CICS® Transaction Server for VSE/ESA™

Performance Guide

Release 1

SC33-1667-02

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Note!

Before using this information and the product it supports, be sure to read the general information under “Notices” on page 393.

Third Edition (April 2006)

This edition applies to Release 1 of CICS Transaction Server for VSE/ESA, program number 5648-054, and to all subsequent versions, releases, and modifications until otherwise indicated in new editions. Make sure you are using the correct edition for the level of the product.

The CICS for VSE/ESA Version 2.3 edition remains applicable and current for users of CICS for VSE/ESA Version 2.3.

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At the back of this publication is a page entitled “Sending your comments to IBM”. If you want to make any comments, please use one of the methods described there.

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Preface

What this book is about

This book is intended to help you to:

- Establish performance objectives and monitor them.
- Identify performance constraints, and make adjustments to the operational CICS system and its application programs.

This book does not discuss the performance aspects of the CICS Front End Programming Interface. See the *CICS Front End Programming Interface User's Guide* for more information. This book does not contain Front End Programming Interface dump statistics.

Who this book is for

This book is for a person who is involved in:

- System design
- Monitoring and tuning CICS performance

What you need to know to understand this book

You need to have a good understanding of how CICS works. This assumes familiarity with most, if not all, of the books in the CICS library, together with adequate practical experience of installing and maintaining a CICS system.

How to use this book

If you want to establish performance objectives, monitor the performance of a CICS system, and occasionally make adjustments to the system to keep it within objectives, you should read through this book in its entirety.

If you have a performance problem and want to correct it, read Parts 3 and 4 of this book. You may need to refer to various sections in Part 2.

Notes on terminology

The following abbreviations are used throughout this book:

- CICS refers to CICS Transaction Server for VSE/ESA.
- VSE refers to VSE/ESA.
- VTAM refers to ACF/VTAM.

Notes on terminology

The terms listed in Table 1 are commonly used in the CICS Transaction Server for VSE/ESA Release 1 library. See the *CICS Glossary* for a comprehensive definition of terminology.

Table 1 (Page 1 of 2). Commonly used words and abbreviations in CICS Transaction Server for VSE/ESA Release 1

Term	**Definition (and abbreviation if appropriate)**
$(the dollar symbol)	In the character sets and programming examples given in this book, the dollar symbol ($) is used as a national currency symbol and is assumed to be assigned the EBCDIC code point X'5B'. In some countries a different currency symbol, for example the pound symbol (£), or the yen symbol (¥), is assigned the same EBCDIC code point. In these countries, the appropriate currency symbol should be used instead of the dollar symbol.
BSM	BSM is used to indicate the basic security management supplied as part of the VSE/ESA product. It is RACROUTE-compliant, and provides the following functions: • Signon security • Transaction attach security
C	The C programming language
CICSplex	A CICSplex consists of two or more regions that are linked using CICS intercommunication facilities. Typically, a CICSplex has at least one terminal-owning region (TOR), more than one application-owning region (AOR), and may have one or more regions that own the resources accessed by the AORs
CICS Data Management Facility	The new CICS Transaction Server for VSE/ESA Release 1 facility to which all statistics and monitoring data is written, generally referred to as “DMF”
CICS/VSE	The CICS product running under the VSE/ESA operating system, frequently referred to as simply “CICS”
COBOL	The COBOL programming language
DB2 for VSE/ESA	Database 2 for VSE/ESA which was previously known as “SQL/DS”.

Table 1 (Page 2 of 2). Commonly used words and abbreviations in CICS Transaction Server for VSE/ESA Release 1

Term	Definition (and abbreviation if appropriate)
ESM	ESM is used to indicate a RACROUTE-compliant external security manager that supports some or all of the following functions: • Signon security • Transaction attach security • Resource security • Command security • Non-terminal security • Surrogate user security • MRO/ISC security (MRO, LU6.1 or LU6.2) • FEPI security.
FOR (file-owning region)—also known as a DOR (data-owning region)	A CICS region whose primary purpose is to manage VSAM and DAM files, and VSAM data tables, through function provided by the CICS file control program.
IBM C for VSE/ESA	The Language Environment version of the C programming language compiler. Generally referred to as “C/VSE”.
IBM COBOL for VSE/ESA	The Language Environment version of the COBOL programming language compiler. Generally referred to as “COBOL/VSE”.
IBM PL/I for VSE/ESA	The Language Environment version of the PL/I programming language compiler. Generally referred to as “PL/I VSE”.
IBM Language Environment for VSE/ESA	The common runtime interface for all LE-conforming languages. Generally referred to as “LE/VSE”.
PL/I	The PL/I programming language
VSE/POWER	Priority Output Writers Execution processors and input Readers. The VSE/ESA spooling subsystem which is exploited by the report controller.
VSE/ESA System Authorization Facility	The new VSE facility which enables the new security mechanisms in CICS TS for VSE/ESA R1, generally referred to as “SAF”
VSE/ESA Central Functions component	The new name for the VSE Advanced Function (AF) component
VSE/VTAM	“VTAM”

Determining if a publication is current

IBM regularly updates its publications with new and changed information. When first published, both the printed hardcopy and the BookManager softcopy versions of a publication are in step, but subsequent updates are normally made available in softcopy before they appear in hardcopy.

For CICS Transaction Server for VSE/ESA Release 1 books, softcopy updates appear regularly on the *Transaction Processing and Data Collection Kit* CD-ROM, SK2T-0730-xx and on the *VSE/ESA Collection Kit* CD-ROM, SK2T-0060-xx. Each reissue of the collection kit is indicated by an updated order number suffix (the -xx part). For example, collection kit SK2T-0730-20 is more up-to-date than SK2T-0730-19. The collection kit is also clearly dated on the front cover.

For individual books, the suffix number is incremented each time it is updated, so a publication with order number SC33-0667-02 is more recent than one with order number SC33-0667-01. Updates in the softcopy are clearly marked by revision codes (usually a “#” character) to the left of the changes.

Note that book suffix numbers are updated as a product moves from release to release, as well as for updates within a given release. Also, the date in the edition notice is not changed until the hardcopy is reissued.

Part 1. Setting performance objectives

This book describes how CICS® performance might be improved. It also provides reference information to help you achieve such improvement.

Good performance is the achievement of agreed service levels. This means that system availability and response times meet user's expectations using resources available within the budget.

The performance of a CICS system should be considered:

- When you plan to install a new system
- When you want to review an existing system
- When you contemplate major changes to a system.

There are several basic steps in tuning a system, some of which may be just iterative until performance is acceptable. These are:

1. Agree what good performance is.
2. Set up performance objectives (described in Chapter 1, "Establishing performance objectives").
3. Decide on measurement criteria (described in Chapter 3, "Performance monitoring and review").
4. Measure the performance of the production system.
5. Adjust the system as necessary.
6. Continue to monitor the performance of the system and anticipate future constraints (see "Monitoring for the future" on page 16).

Parts 1 and 2 of this book describe how to monitor and assess performance.

Parts 3 and 4 suggest ways to improve performance.

This part contains the following chapters:

Recommendations given in this book, based on current knowledge of CICS, are general in nature, and cannot be guaranteed to improve the performance of any particular system.

Chapter 1. Establishing performance objectives

Performance objectives often consist of a list of transactions and expected timings for each. Ideally, through them, good performance can be easily recognized and you know when to stop further tuning. They must, therefore, be:

- Practically measurable
- Based on a realistic workload
- Within the budget

Such objectives may be defined in terms such as:

- Desired or acceptable response times, for example, within which 90% of all responses occur
- Average or peak number of transactions through the system
- System availability, including mean time to failure, and downtime after a failure

After you have defined the workload and estimated the resources required, you must reconcile the desired response with what you consider attainable. These objectives must then be agreed and regularly reviewed with users.

Establishing performance objectives is an iterative process involving the activities described in the rest of this chapter.

Defining some terms

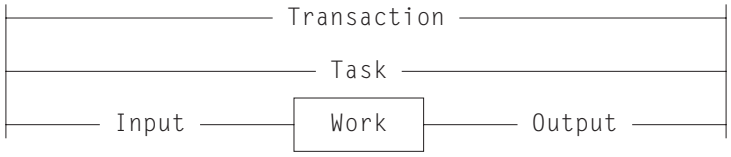
For performance measurements we need to be very specific about what we are measuring. Therefore, it is necessary to define a few terms.

The word **user** here means the terminal operator. A user, so defined, sees CICS performance as the **response time**, that is, the time between the last input action (for example, a keystroke) and the expected response (for example, a message on the screen). Several such responses might be required to complete a user **function**, and the amount of work that a user perceives as a function can vary enormously. So, the number of functions per period of time is not a good measure of performance, unless, of course, there exists an agreed set of benchmark functions.

A more specific unit of measure is therefore needed. The words **transaction** and **task** are used to describe units of work within CICS. Even these can lead to ambiguities, because it would be possible to define transactions and tasks of varying size. However, within a particular system, a series of transactions can be well defined and understood so that it becomes possible to talk about relative performance in terms of transactions per second (or minute, or hour).

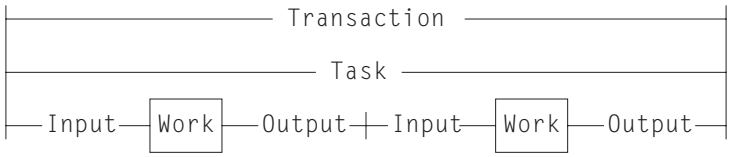
In this context there are three modes of CICS operation.

Nonconversational



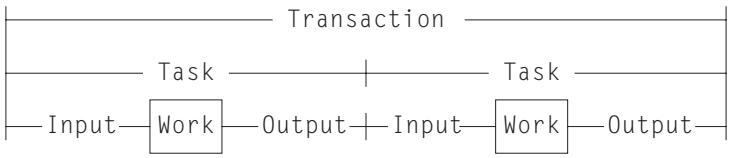
Nonconversational mode is of the nature of one question, one answer; resources are allocated, used, and released immediately on completion of the task. In this mode the words transaction and task are more or less synonymous.

Conversational



Conversational mode is potentially wasteful in a system that does not have abundant resources. There are further questions and answers during which resources are not released. Resources are, therefore, tied up unnecessarily waiting for users to respond, and performance may suffer accordingly. Transaction and task are, once again, more or less synonymous.

Pseudoconversational



Pseudoconversational mode allows for slow response from the user. Transactions are broken up into more than one task, yet the user need not know this. The resources in demand are released at the end of each task, giving a potential for improved performance.

The input/output surrounding a task may be known as the **dialog**.

Defining performance objectives and priorities

Performance objectives and priorities depend on the user's expectations. From the point of view of CICS, these objectives state response times to be seen by the terminal user, and the total throughput per day, hour, or minute.

The first step in defining performance objectives is to specify what is required of the system. In doing this, you must consider the available hardware and software resources so that reasonable performance objectives can be agreed. Alternatively you should ascertain what additional resource is necessary to attain users' expectations, and what that resource would cost. This cost might be important in negotiations with users to reach an acceptable compromise between response time and required resource.

An agreement on acceptable performance criteria between the data processing and user groups in an organization is often formalized and called a **service level agreement**.

Common examples in these agreements are, on a network with remote terminals, that 90% of all response times sampled are under six seconds in the prime shift, or that the average response time does not exceed 12 seconds even during peak periods. (These response times could be substantially lower in a network consisting only of local terminals.)

You should consider whether to define your criteria in terms of the average, the 90th percentile, or even the worst-case response time. Your choice may depend on the audit controls of your installation and the nature of the transactions in question.

Analyzing the current workload

Break down the work to be done into transactions. Develop a profile for each transaction that includes:

- The **workload**, that is, the amount of work done by CICS to complete this transaction. In an ideal CICS system (with optimum resources), most transactions perform a single function with an identifiable workload.
- The **volume**, that is, the number of times this transaction is expected to be executed during a given period. For an active system, you can get this from the CICS statistics.

Later, transactions with common profiles can be merged, for convenience, into **transaction categories**.

Establish the priority of each transaction category, and note the periods during which the priorities change.

Determine the resources required to do the work, that is:

- Physical resources managed by the operating system (real storage, DASD I/O, terminal I/O)
- Logical resources managed by the subsystem, such as control blocks and buffers.

To determine transaction resource demands, you can make sample measurements on a dedicated machine using the CICS monitoring facility. Use these results to suggest possible changes that could have the greatest effect if applied before system-wide contention arises. You can also compare your test results with those in the production environment.

See Chapter 2, “Gathering data for performance objectives” on page 7 for more detailed recommendations on this step.

Translating resource requirements into system objectives

You have to translate the information you have gathered into system-oriented objectives for each transaction category. Such objectives include statements about the transaction volumes to be supported (including any peak periods) and the response times to be achieved.

Any assumptions that you make about your installation must be used consistently in future monitoring. These assumptions include **computing-system factors** and **business factors**.

Computing-system factors include the following:

- **System response time**: this depends on the design and implementation of the code, and the power of the processor.
- **Network response time**: this can amount to seconds, while responses in the processor are likely to be in fractions of seconds. This means that a system can never deliver good responses through an overloaded network, however good the processor.
- **DASD response time**: this is generally responsible for most of the internal processing time required for a transaction. You must consider all I/O operations that affect a transaction.
- **Existing workload**: this may affect the performance of new transactions, and vice versa. In planning the capacity of the system, consider the total load on each major resource, not just the load for the new application.

  Response times can vary for a number of reasons, and the targets should, therefore, specify an acceptable degree of tolerance. Allow for transactions that are known to make heavy demands on the processor and database I/O.

  To reconcile expectations with performance, it may be necessary to change the expectations or to vary the mix or volume of transactions.

Business factors are concerned with work fluctuations. Allow for daily peaks (for example, after receipt of mail), weekly peaks (for example, Monday peak after weekend mail), and seasonal peaks as appropriate to the business. Also allow for the peaks of work after planned interruptions, such as preventive maintenance and public holidays.

Chapter 2. Gathering data for performance objectives

During the design, development, and test of a total system, information is gathered about the complexity of processing with particular emphasis on I/O activity. This information is used for establishing performance objectives.

Four phases of installation planning are suggested:

1. Requirements definition phase
2. External design phase
3. Internal design phase
4. Coding/testing phase

Requirements definition phase

In this phase, careful estimates like the following are your only input:

- Number of transactions for each user function
- Number of I/O operations per user function (DASD and terminals)
- Time required to key in user data (including user “thinking time”)
- Line speeds (number of characters per second) for remote terminals
- Number of terminals and operators required to achieve the required rate of input
- Maximum rate of transactions per minute/hour/day/week
- Average and maximum workloads (that is, processing per transaction)
- Average and maximum volumes (that is, total number of transactions)
- Likely effects of performance objectives on operations and system programming

External design phase

During the external design phase, you should:

1. Estimate the network, processor, and DASD loading based on the dialog between users and tasks (that is, the input to each transaction, and consequent output).
2. Revise your disk access estimates. After external design, only the logical data accesses are defined (for example, EXEC CICS READ).

Remember that, after the system has been brought into service, no amount of tuning can compensate for poor initial design.

Internal design phase

More detailed information is available to help:

- Refine your estimate of loading against the work required for each transaction dialog. Include screen control characters for field formatting.
- Refine disk access estimates against database design. After internal design, the physical data accesses can at least be defined for the application-oriented accesses.
- Add the accesses for CICS temporary storage (scratchpad) data, CICS log, program library, and CICS transient data to the database disk accesses.
- Consider if additional loads could cause a significant constraint.
- Refine estimates on processor use.
- Estimate the internal response time as the sum of I/O times and processor times plus wait times for resources. Allow for paging. For example, if you assume a paging rate of four pages a second, you must allow for as many page faults (typically 25 to 50 milliseconds each) as occur during the time that your transaction is in the system. A page fault in CICS stops all current tasks for the duration of the page fault.

Coding and testing phase

During the coding and testing phase, you should:

1. Refine the internal design estimates of disk and processing resources.
2. Refine the network loading estimates.
3. Run the monitoring tools and compare results with estimates. See Chapter 4, “An overview of performance-measurement tools” on page 23 for information on the CICS monitoring tools.

Post-development review

Review the performance of the complete system in detail. The main purposes are to:

- Validate performance against objectives
- Identify resources whose use requires regular monitoring
- Feed the observed figures back into future estimates.

To achieve this, you should:

1. Identify discrepancies from the estimated resource use
2. Identify the categories of transactions that have caused these discrepancies
3. Assign priorities to remedial actions
4. Identify resources that are consistently heavily used
5. Provide utilities for graphic representation of these resources
6. Project the loadings against the planned future system growth to ensure that adequate capacity is available
7. Update the design document with the observed performance figures

8. Modify the estimating procedures for future systems.

Information supplied by end users

Comments from users are a necessary part of the data for performance analysis and improvement. Reporting procedures must be established, and their use encouraged.

Log exceptional incidents. These incidents should include system, line, or transaction failure, and response times that are outside specified limits. In addition, you should log incidents that threaten performance, such as:

- deadlocks
- deadlock abends
- stalls
- indications of going short-on-storage (SOS)
- maximum number of multiregion operation (MRO) sessions used

Also log situations such as recoveries, including recovery from DL/I deadlock abend and restart, which mean that additional system resources are being used.

The data logged should include the date and time, location, duration, cause (if known), and the action taken to resolve the problem.

Chapter 3. Performance monitoring and review

Once you have established performance objectives, the objectives should be monitored using appropriate methods. This chapter describes some monitoring techniques; Chapter 4, "An overview of performance-measurement tools" on page 23 describes how to use them.

Deciding on monitoring activities and techniques

In this book, **monitoring** is specifically used to describe the regular checking of the performance of a CICS production system, against objectives, by the collection and interpretation of data. Subsequently, **analysis** describes the techniques used to investigate the reasons for performance deterioration. **Tuning** may be used for any actions that result from this analysis.

Monitoring should be ongoing because it:

- Establishes transaction profiles (that is, workload and volumes) and statistical data for predicting system capacities
- Gives early warning through comparative data to avoid performance problems
- Measures and validates any tuning you may have done in response to an earlier performance problem.

A performance history database is a valuable source from which to answer questions on system performance, and to plan further tuning.

Monitoring may be described in terms of strategies, procedures, and tasks.

Strategies may include:

- Continuous or periodic summaries of the workload. You can track all transactions or selected representatives.
- Snapshots at normal or peak loads. Peak loads should be monitored for two reasons:
  1. Constraints and slow responses are more pronounced at peak volumes.
  2. The current peak load is a good indicator of the future average load.

Procedures, such as good documentation practices, should provide a management link between monitoring strategies and tasks. The following should be noted:

- The growth of transaction rates and changes in the use of applications
- Consequent extrapolation to show possible future trends
- The effects of nonperformance system problems such as application abends, frequent signon problems, and excessive retries

Tasks (not to be confused with the task component of a CICS transaction) include:

- Running one or more of the tools described in Chapter 4, "An overview of performance-measurement tools" on page 23
- Collating the output
- Examining it for trends.

You should allocate responsibility for these tasks between operations personnel, programming personnel, and analysts. You must identify the resources that are to be regarded as critical, and set up a procedure to highlight any trends in the use of these resources.

Because the tools require resources, they may disturb the performance of a production system.

Give emphasis to peak periods of activity, for both the new application and the system as a whole. It may be necessary to run the tools more frequently at first to confirm that the expected peaks correspond with the actual ones.

It is not normally practical to keep all the detailed output. Arrange for summarized reports to be filed with the corresponding CICS statistics, and for the output from the tools to be held for an agreed period, with customary safeguards for its protection.

Conclusions on performance should not be based on one or two snapshots of system performance, but rather on data collected at different times over a prolonged period. Emphasis should be placed on peak loading. Because different tools use different measurement criteria, early measurements may give apparently discrepant results.

Your monitoring procedures should be planned ahead of time. These procedures should explain the tools to be used, the analysis techniques to be used, the operational extent of those activities, and how often they are to be performed.

Developing monitoring activities and techniques

When you are developing a master plan for monitoring and performance analysis, you should establish:

- A master schedule of monitoring activity. You should coordinate monitoring with operations procedures to allow for feedback of online events as well as instructions for daily or periodic data gathering.
- The tools to be used for monitoring. The tools used for data gathering should provide for dynamic monitoring, daily collection of statistics, and more detailed monitoring. (See “When to review?” on page 13.)
- The kinds of analysis to be performed. This must take into account any controls you have already established for managing the installation. You should document what data is to be extracted from the monitoring output, identifying the source and usage of the data. Although the formatted reports provided by the monitoring tools help to organize the volume of data, you may need to design worksheets to assist in data extraction and reduction.
- A list of the personnel who are to be included in any review of the findings. The results and conclusions from analyzing monitor data should be made known to the user liaison group and to system performance specialists.

- A strategy for implementing changes to the CICS system design resulting from tuning recommendations. This has to be incorporated into installation management procedures, and should include items such as standards for testing and the permitted frequency of changes to the production environment.

Planning the review process

Establish a schedule for monitoring procedures. This schedule should be as simple as possible. The activities done as part of the planning should include the following:

- Listing the CICS requests made by each type of task. This helps you decide which requests or which resources (the high-frequency or high-cost ones) need to be looked at in statistics and CICS monitoring facility reports.
- Drawing up checklists of review questions.
- Estimating resource usage and system loading for new applications. This is to enable you to set an initial basis from which to start comparisons.

When to review?

You should plan for the following broad levels of monitoring activity:

- Dynamic (online) monitoring
- Daily monitoring
- Periodic (weekly and monthly) monitoring
- Keeping sample reports as historical data

Dynamic monitoring

By dynamic monitoring, we mean “on-the-spot” monitoring that you can, and should, carry out at all times. This type of monitoring generally includes the following:

- Observing the system’s operation continuously to discover any serious short-term deviation from performance objectives.

  Use the CEMT transaction (CEMT INQ|SET MONITOR), together with end-user feedback.
- Obtaining feedback from operators. The control operator is an important source of information about the behavior of the CICS system. An important part of the feedback from the master terminal operator concerns the conditions observed during a CICS monitoring facility run. This information can help validate the data received from the run.
- Obtaining status information. Together with status information obtained by using the CEMT transaction, you can get status information on system processing during online execution. This information could include the queue levels, active regions, active terminals, and the number and type of conversational transactions. You can get this information with the aid of an automated program invoked by the master terminal operator. At prearranged times in the production cycle (such as before scheduling a message, at shutdown of part of the network, or at peak loading), the program can capture the transaction processing status and measurements of system resource levels.

Daily monitoring

The overall objective here is to daily measure and record key system parameters. The daily monitoring data usually consists of counts of events and gross level timings. In some cases, the timings are averaged for the entire CICS system.

- Record both the daily average and the peak period (usually one hour) average of, for example, messages, tasks, processor usage, I/O events, and storage used. Compare these against your major performance objectives and look for adverse trends.
- List the CICS-provided statistics at the end of every CICS run. You should date and time-stamp the data that is provided, and file it for later review. For example, in an installation that has settled down, you might review daily data at the end of the week. Generally, you can carry out reviews less frequently than collection, for any one type of monitoring data. If you know there is a problem, you might increase the frequency; for example, reviewing daily data immediately it becomes available.

  You should be familiar with all the facilities in CICS for providing statistics at times other than at shutdown. The main facilities, using the CEMT transaction, are invocation from a terminal (with or without reset of the counters) and automatic time-initiated requests.
- File an informal note of any incidents reported during the run. These may include a shutdown of CICS that causes a gap in the statistics, a complaint from your end users of poor response times, a terminal going out of service, or any other item of significance. This makes it useful when reconciling disparities in detailed performance figures that may be discovered later.
- Print the system console log for the period when CICS was active, and file a copy of the console log in case it becomes necessary to review the CICS system performance in the light of the concurrent batch activity.
- Run one of the performance analysis tools described in Chapter 4, “An overview of performance-measurement tools” on page 23 for at least part of the day if there is any variation in load from day to day. File the summaries of the reports produced by the tools you use.
- Transcribe onto a graph any items identified as being consistently heavily used in the post-development review phase (described in Chapter 2, “Gathering data for performance objectives” on page 7).

Weekly monitoring

Here, the objective is to periodically collect detailed statistics on the operation of your system for comparison with your system-oriented objectives and workload profiles.

- Run the CICS monitoring facility with performance class active, and process it. It may not be necessary to do this every day, but it is important to do it regularly and to keep the sorted summary output as well as the detailed reports.

  Whether you do this on the same day of the week depends on the nature of the system load. If there is an identifiable heavy day of the week, this is the one that you should monitor. (Bear in mind, however, that the use of the monitoring facility causes additional load, particularly with performance class active.)

  If the load is apparently the same each day, run the CICS monitoring facility daily for a period sufficient to confirm this. If there really is little difference from day to day in the CICS load, check the concurrent batch loads in the same way from the logs. This helps you identify any obscure problems because of peak volumes or unusual transaction mixes on specific days of the week. The first few weeks' output from the CICS statistics also give guidance for this.

  It may not be necessary to review the detailed monitor report output every time, but you should always keep this output in case the summary data is insufficient to answer questions raised by the statistics or by user comments. Label the CICS monitoring facility output tape (or a dump of the DASD data set) and keep it for an agreed period in case further investigations are required.
- Run VMMAP because this shows I/O usage, channel usage, and so on. File the summary reports and archive the output tapes for some agreed period.
- Review the CICS statistics, and any incident reports.
- Review the graph of critical parameters. If any of the items are approaching a critical level, check the performance analysis outputs for more detail and follow any previously agreed procedures (for example, notify your management).
- Tabulate or produce a graph of values as a summary for future reference.

Monthly monitoring

- Run VMMAP.
- Review the VMMAP and performance analysis listings. If there is any indication of excessive resource usage, follow any previously agreed procedures (for example, notify your management), and do further monitoring.
- Date- and time-stamp the VMMAP output and keep it for use in case performance problems start to arise. You can also use the output in making estimates, when detailed knowledge of component usage may be important. These aids provide detailed data on the usage of resources within the system, including processor usage, use of DASD, and paging rates.

Monitoring for the future

When performance is acceptable, you should establish procedures to monitor system performance measurements and anticipate performance constraints before they become response-time problems. Exception-reporting procedures are a key to an effective monitoring approach.

In a complex production system there is usually too much performance data for it to be comprehensively reviewed every day. Key components of performance degradation can be identified with experience, and those components are the ones to monitor most closely. You should identify trends of usage and other factors (such as batch schedules) to aid in this process.

Consistency of monitoring is also important. Just because performance is good for six months after a system is tuned is no guarantee that it will be good in the seventh month.

Reviewing performance data

The aims of the review procedure are to provide continuous monitoring, and to have constantly available a good level of detailed data, so that there is minimal delay in problem analysis.

Generally, there should be a progressive review of data. You should review daily data weekly, and weekly data monthly, unless any incident report or review raises questions that require an immediate check of the next level of detail. This should be enough to detect out-of-line situations with the minimum of effort.

The review procedure also ensures that additional data is available for problem determination, should it be needed. The weekly review should take approximately one hour, particularly after experience has been gained in the process and after you are able to highlight the items that require special consideration. The monthly review will probably take half a day at first. After the procedure has been in force for a period, it will probably be completed more quickly. However, when new applications are installed or when the transaction volumes or numbers of terminals are increased, the process is likely to take longer.

Review the data from the VMMAP listings only if there is evidence of a problem from the gross-level data, or if there is an end-user problem that can't be solved by the review process. Thus, the only time that needs to be allocated regularly to the detailed data is the time required to ensure that the measurements were correctly made and reported.

When reviewing performance data, try to:

- Establish the basic pattern in the workload of the installation
- Identify variations from the pattern.

Do not discard ***all*** the data you collect, after a certain period. Discard most, but leave a representative sample. For example, do not throw away ***all*** weekly reports after three months; it is better to save those dealing with the last week of each month. At the end of the year, you can discard all except the last week of each quarter. At the end of the following year, you can discard all the previous year's

data except for the midsummer week. Similarly, you should keep a representative selection of daily figures and monthly figures.

The intention is that you can compare any report for a ***current*** day, week, or month with an ***equivalent*** sample, however far back you want to go. The samples become more widely spaced but do not cease.

Confirming that the system-oriented objectives are reasonable

After the system is initialized and monitoring is operational, you need to find out if the objectives themselves are reasonable (that is, achievable, given the hardware available), based upon actual measurements of the workload.

When you measure performance against objectives and report the results to users, you have to identify any systematic differences between the measured data and what the user sees. This means an investigation of the differences between internal (as seen by CICS) and external (as seen by the end user) measures of response time.

If the measurements differ greatly from the estimates, you must revise application response-time objectives, plan a reduced application workload, or upgrade your system. If the difference is not too large, however, you can embark on tuning the total system. Parts 3 and 4 of this book tell you how to do this tuning activity.

Typical review questions

Use the following questions as a basis for your own checklist.

Some of the questions are not strictly to do with performance. For instance, if the transaction statistics show a high frequency of transaction abends with usage of the abnormal condition program, this could perhaps indicate signon errors and, therefore, a lack of terminal operator training. This, in itself, is not a performance problem, but is an example of the additional information that can be provided by monitoring.

1. How frequently is each available function used?

    a. Has the usage of transaction identifiers altered?
    b. Does the mix vary from one time of the day to another?
    c. Should statistics be requested more frequently during the day to verify this?

    A different approach must be taken:

    - In systems where all messages are channeled through the same initial task and program (for user security routines, initial editing or formatting, statistical analysis, and so on)
    - For conversational transactions, where a long series of message pairs is reflected by a single transaction
    - In transactions where the amount of work done relies heavily on the input data.

    In these cases, you have to identify the function by program or data set usage, with appropriate reference to the CICS program statistics, file statistics, or other statistics. In addition, you may be able to put user tags into the monitoring

data (for example, a user character field in the case of the CICS monitoring facility), which can be used as a basis for analysis by products such as SLR.

These questions should be directed at the appropriate set of statistics.

2. What is the usage of the telecommunication lines?
   a. Do the CICS terminal statistics indicate any increase in the number of messages on the terminals on each of the lines?
   b. Does the average message length on the CICS performance class monitor reports vary for any transaction type? This can easily happen with an application where the number of lines or fields output depends on the input data.
   c. Is the number of terminal errors acceptable? If you are using a terminal error program or node error program, does this indicate any line problems? If not, this may be a pointer to terminal operator difficulties in using the system.
3. What is the DASD usage?
   a. Is the number of requests to file control increasing? Remember that CICS records the number of logical requests made. The number of physical I/Os depends on the configuration of indexes, and on the data records per control interval and the buffer allocations.
   b. Is intrapartition transient data usage increasing? Transient data involves a number of I/Os depending on the queue mix. You should at least review the number of requests made to see how it compares with previous runs.
   c. Is auxiliary temporary storage usage increasing? Temporary storage uses control interval access, but writes the control interval out only at syncpoint or when the buffer is full.
4. What is the virtual storage usage?
   a. How large are the dynamic storage areas?
   b. Is the short-on-storage (SOS) condition being reached often?
   c. Have any incidents been reported of tasks being purged after deadlock timeout interval (DTIMOUT) expiry?
   d. How much program loading activity is there?
   e. From the monitor report data, is the use of dynamic storage by task type as expected?
   f. Is storage usage similar at each execution of CICS?
   g. Are there any incident reports showing that the first invocation of a function takes a lot longer than subsequent ones? This may arise when programs are loaded that then have to open data sets. Can this be reconciled with application design?
5. What is the processor usage?
   a. Is the processor usage as measured by the monitor report consistent with previous observations?
   b. Are batch jobs that are planned to run, able to run successfully?
   c. Is there any increase in usage of functions running at a higher priority than CICS? Include in this VSE readers and writers, VSE POWER, and VTAM®

if running above CICS, and overall I/O, because of the lower-priority partitions.

6. What is the usage of the CICS log?
   a. What is the average output block size written? If it is far below the allocated buffer size, is it possible to reduce the buffer allocation, or does it have to be that large to handle an occasional large item?
   b. What is the I/O rate in requests and physical blocks on the log?
   c. If the log is on tape, is the tape drive fast enough to cope with the traffic required?
   d. If the log is on DASD, is it subject to undue contention from other data sets? In particular, are any of the resources whose updates are logged, resident on the same drive?

      Note: It is bad practice to put a recoverable (updated) resource and a log on the same drive. If that drive fails, you lose both the resource and the log, and you are unable to carry out any forward recovery procedures that you may have.

7. Do any figures indicate design, coding, or operational errors?
   a. Are any of the resources mentioned above heavily used? If so, was this expected at design time? If not, can the heavy use be explained in terms of heavier use of transactions?
   b. Is the heavy usage associated with a particular application? If so, is there evidence of planned growth or peak periods?
   c. Are browse transactions issuing more than the expected number of requests? In other words, is the count of browse requests issued by a transaction greater than what you expected users to cause?
   d. Is the CICS CSAC transaction (provided by the DFHACP abnormal condition program) being used frequently? Is this because invalid transaction identifiers are being entered? For example, errors are signaled if transaction identifiers are entered in lowercase on IBM® 3270 terminals but automatic translation of input to uppercase has not been specified.

      A high use of the DFHACP program without a corresponding count of CSAC may indicate that transactions are being entered without proper operator signon. This may, in turn, indicate that some terminal operators need more training in using the system.

In addition to the above, you should regularly review certain items in the CICS statistics, such as:

- Times the MAXTASK limit reached (transaction manager statistics)
- Peak tasks (transaction class statistics)
- Times cushion released (storage manager statistics)
- Storage violations (storage manager statistics)
- Maximum RPLs posted (VTAM statistics)
- Short-on-storage count (storage manager statistics)
- Wait on string total (file control statistics)
- Journal buffers full (journal statistics).

You should also satisfy yourself that large numbers of dumps are not being produced.

Furthermore, you should review the effects of and reasons for system outages and their duration. If there is a series of outages, you may be able to detect a common cause of them.

Anticipating and monitoring system changes and growth

No production system is static. Each system is constantly changing because of new function being added, increased transaction volumes because of a growth in the number of terminal users, addition of new applications or software components, and changes to other aspects of the data processing complex, such as batch. As much as possible, the effects of these changes need to be anticipated, planned for, and monitored.

To find out what application changes are planned, an interviewing system or application development managers can be useful to determine the effect of new function or applications and the timing of those changes. Associated with this is the effect of new software to be installed, as well as the known hardware plans for installing new equipment.

When a major change to the system is planned, increase the monitoring frequency before and after the change. A major change includes the addition of:

- A new application or new transactions
- New terminals
- New software releases.

You should look at individual single-thread transactions as well as the overall behavior of the production system.

If the system performance has altered as a result of a major change to the system, data for before-and-after comparison of the appropriate statistics provides the best way of identifying the reasons for the alteration.

Consider having extra tools installed to make it easier to project and test future usage of the system. Tools such as the Teleprocessing Network Simulator (TPNS) program can be used to test new functions under volume conditions before they actually encounter production volumes. Procedures such as these can provide you with insight as to the likely performance of the production system when the changes are implemented, and enable you to plan option changes, equipment changes, scheduling changes, and other methods for stopping a performance problem from arising.

Part 2. Tools that measure the performance of CICS

This part gives an overview of the various tools that can be used to find out which resources are in contention. The first section, Chapter 4, “An overview of performance-measurement tools” on page 23, gives an overview of the tools available. The remaining sections describe the following tools:

- Chapter 5, “Using CICS statistics” on page 33
- Chapter 6, “The CICS monitoring facility” on page 57

Chapter 4. An overview of performance-measurement tools

After reasonable performance objectives have been agreed, you have to set up methods to determine whether the production system is meeting those objectives.

Performance of a production system depends on a variety of factors imcluding the following:

- Amount of usage
- Paging rates
- Virtual storage requirements placed on the main processor
- Traffic to and from the disk devices
- Ttraffic of messages throughout the network

You have to monitor all of these factors to determine when constraints in the system may develop. A variety of programs could be written to monitor all these resources. Many of these programs are currently supplied as part of IBM® products such as CICS or are supplied as separate products. This chapter describes some of the products that can give performance information on different components of a production system.

The list of products in this chapter is far from being an exhaustive summary of performance monitoring tools, yet the data provided from these sources comprises a large amount of information. To monitor all this data is an extensive task. Furthermore, only a small subset of the information provided is important for identifying constraints and determining necessary tuning actions, and you have to identify this specific subset for your particular CICS system.

You also have to bear in mind that there are two different types of tools:

1. Tools that directly measure whether you are meeting your objectives
2. Additional tools to look into internal reasons why you might not be meeting objectives.

None of the tools can directly measure whether you are meeting end-user response time objectives. The lifetime of a task within CICS is comparable, that is, usually related to response time and bad response time is usually correlated with long lifetime within CICS, but this correlation is not exact because of other contributors to response time.

Obviously, you want tools that help you to measure your objectives. In some cases, you may choose a tool that looks at an internal function that contributes towards your performance objectives (such as task lifetime). You may do this rather than directly measuring the actual objective, because of the difficulty of measuring it.

When you have gained experience of the system, you should have a good idea of the particular things that are most significant in that particular system and, therefore, what things might be used as the basis for exception reporting. Then, one way of simply monitoring the important data might be to set up exception-reporting procedures that filter out the data that is not essential to the tuning process. This involves setting standards for performance criteria that identify

constraints, so that the exceptions can be distinguished and reported while normal performance data is filtered out. These standards vary according to individual system requirements and service level agreements.

You often have to gather a considerable amount of data before you can fully understand the behavior of your own system and determine where a tuning effort can provide the best overall performance improvement. Familiarity with the analysis tools and the data they provide is basic to any successful tuning effort.

Remember, however, that all monitoring tools cost processing effort to use. Typical costs are 5 to 10% additional processor cycles for the CICS monitoring facility (performance class), and up to 1% for the exception class. The CICS trace facility overhead is highly dependent on the workload used. The overhead can be in excess of 25%.

In general, then, we recommend that you use the following tools in the sequence of priorities shown below:

1. CICS statistics
2. CICS monitoring data
3. CICS internal and auxiliary trace.

CICS performance data

- "CICS statistics"
- "The CICS monitoring facility"
- "The sample statistics program (DFH0STAT)" on page 25
- "CICS trace facilities" on page 25.

CICS statistics

CICS statistics are the simplest and the most important tool for permanently monitoring a CICS system. They collect information on the CICS system as a whole, without regard to tasks.

The CICS statistics domain writes the following five types of statistics to data management facility (DMF):

- Interval
- End-of-day
- Requested
- Requested reset
- Unsolicited

Each of these sets of data is described and a more general description of CICS statistics is given in Appendix A, "CICS statistics tables" on page 221.

The CICS monitoring facility

The CICS monitoring facility collects information about CICS tasks, and is described more completely in Chapter 6, "The CICS monitoring facility" on page 57.

The *CICS Customization Guide* contains programming information on the data set formats and the *CICS Operations and Utilities Guide* describes the monitoring utility programs, DFHMNDUP and DFH$MOLS.

The sample statistics program (DFH0STAT)

You can use the statistics sample program, DFH0STAT, to help you determine and adjust the values needed for CICS storage parameters, for example, using DSALIM and EDSALIM. The program produces a report showing critical system parameters from the CICS dispatcher, an analysis of the CICS for VSE/ESA™ storage manager and loader statistics. The program demonstrates the use of the EXEC CICS INQUIRE and EXEC CICS COLLECT STATISTICS commands to produce an analysis of a CICS for VSE/ESA system. You can use the sample program as provided or modify it to suit your needs. It can be used to provide data about the following:

- System status, monitoring and statistics
- Transaction manager and dispatcher
- Storage
- Loader
- Transactions
- Transaction totals including subspace usage information
- Programs
- Program totals
- Temporary storage
- Transient data
- LSR pools
- Files
- Data tables

See Appendix B, “The sample statistics program, DFH0STAT” on page 319 for the details and interpretation of the report.

CICS trace facilities

For the more complex problems that involve system interactions, you can use the CICS trace to record the progress of CICS transactions through the CICS management modules. Whereas a dump gives a “snapshot” of conditions at a particular moment, CICS trace provides a history of events leading up to a specific situation. CICS includes facilities for selective activation or deactivation of some groups of traces.

The CICS trace facilities can also be useful for analyzing performance problems such as excessive waiting on events in the system, or constraints resulting from inefficient system setup or application program design.

Several types of tracing are provided by CICS, and are described in the *CICS Problem Determination Guide*. Trace is controlled by:

- The system initialization parameters (see the *CICS System Definition Guide*).
- CETR transaction (see the *CICS-Supplied Transactions* manual). CETR also provides for trace selectivity by, for instance, transaction type or terminal name.
- CEMT SET INTRACE, or CEMT SET AUXTRACE (see the *CICS-Supplied Transactions* manual).

- EXEC CICS SET TRACEDEST, EXEC CICS SET TRACEFLAG, or EXEC CICS SET TRACETYPE (see the *CICS System Programming Reference* for programming information).

Two destinations are available for trace data:

1. The internal trace table, in main storage above the 16MB line
2. Auxiliary trace data sets, defined as SAM data sets on tape or disk.

Other CICS data

The measurement tools previously described do not provide all the data necessary for a complete evaluation of current system performance. They do not provide information on how and under what conditions each resource is being used, nor do they provide information about the existing system configuration while the data is being collected. It is therefore extremely important to use as many techniques as possible to get information about the system. Additional sources of information include the following:

- Hardware configuration
- VTOC listings
- CICS table listings, especially:
  - SIT (and overrides in the CICS startup procedure)
  - FCT (file control table)
  - VSAM file specifications
- Load module cross-reference of the CICS nucleus
- Dump of the CICS partition. See the *CICS Operations and Utilities Guide* for information on how to get a partition dump for CICS when the CICS partition abends.

This data, used with the data produced by the measurement tools, provides the basic information that you should have for evaluating your system's performance.

Tools for monitoring operating system performance data

This section introduces the tools you can use to monitor performance data from the VSE/ESA operating system.

Virtual machine monitor analysis program (VMMAP)

This program product is designed to aid in performance management and capacity planning through the use of the VM/Monitor facility on a VM®/SP™ system.

VMMAP provides the capability for:

- Processing VM/Monitor data
- Creating reports and graphs on VM/370 performance and utilization
- Adding analysis routines.

By processing data collected by the VM/Monitor facility, VMMAP enables the installation to:

- Monitor system utilization
- Identify performance bottlenecks
- Discover trends in performance
- Plot system demand against capacity.

Performance reports can be created from VM/Monitor data collected on VM/370, VM/SP, and the VM/SP High Performance Option (VM/SP HPO).

For further information, see the *VMMAP General Information* manual.

VSE/ESA system status

The **display system activity** panel available with VSE/ESA provides a variety of information about system and CICS activity. For system activity, it shows:

- Processor utilization
- The start I/O (SIO) rate for the whole system
- Number and frequency of page-ins (for non-VM systems)
- Number and frequency of page-outs (for non-VM systems).

For activity on the CICS system that forms part of the VSE/Interactive Computing and Control Facility (VSE/ICCF), it shows:

- Number of CICS tasks that have been attached after system startup
- Number of CICS tasks attached during the current interval (per second)–the task rate
- Numbers of CICS active and suspended tasks
- Maximum length of the active chain for the day–peak activity.

The *VSE/ESA System Utilities* book describes the display system activity facility and the information it produces.

VSE GETVIS display

The GETVIS **partition** ID command, issued for the partition in which CICS/VSE is operating, gives details of partition GETVIS. The details provided include the size of GETVIS, the current usage, and high water mark. The latter is particularly important for monitoring 31-bit GETVIS usage.

VSE/ICCF display Activity function

The display system activity function is provided in the program product, VSE/ICCF, for job monitoring. You can also use this function to ascertain the number of start I/Os for a single transaction. Before and during a transaction, the number of start I/Os is shown on a second display (under VSE/ICCF). While this function is running, no activity other than the test transaction should take place in the CICS system, and there should be no remote connection.

A report that is displayed on the screen lists for each partition the job name that is used, the name of the phase that is executing, and the number of start I/Os. The screen refreshes every 15 seconds. This refers to display activity and not to the display channel and device activity screen. 4 must be subtracted from the difference of the start I/Os displayed in the “before” and “after” reports for each test transaction, because the inputs/outputs of the two screens are included.

In order to change the timer interval of the display activity functions to zero, which means an update of the screen(s) only on pressing ENTER, a new user NAME is defined as having:

- An initial screen selection panel called (for example) WKLADM and
- New application profile: WKLA.

All other users remain with the standard value provided by VSE/ESA.

You must do the following:

1. Select “Maintain Application Profiles” (path 213)
    - Go to the line with IESLA.
    - Specify ‘1’ (ADD) in the line for IESLA.
    - Specify NAME=WKLA (for example) as a new application name, and DATA=00 as a new value.
    - Press PF5 (==> Application profile WKLA has been successfully added).
    - Press PF6 (==> System application profile records have been successfully built)
    - Press PF3 (END).

2. Select “Maintain Selection Panels” (path 212).
   - Add ‘1’ to (for example) the IESEADM line to obtain the next screen as a skeleton.
   - Change this screen to:

     ```
     Selection panel name = WKLADM (for example)
     1  IESEADM          2  Normal Menu
     2  WKLA             1  System Utilizations
     3  IESDS            1  DASD Utilizations
     ```

     (Erase the residual lines by inserting blanks. TYPE 1 means Application Profile; TYPE 2 means Selection Panel.)
   - Press ENTER to see the changes you have made.
   - Press PF5 (==>Selection panel WKLADM has been added).
   - Press PF6 (==> System selection panel records have been successfully built)
   - Press PF3 (END).
3. Select “Maintain User Profiles” (path 211).
   - Specify ‘1’ (ADD) in the line for SYSA.
   - Specify:
     - USERID (the new userid)
     - USER TYPE as 1
     - PASSWORD as PSWD (the user password)
     - DAYS as 000
     - INITIAL NAME as WKLADM (the name of the first selection panel)
     - NAMETYPE as 2.
   - Press PF5.
   - Press ENTER to accept proposed primary library. (==> User profile information has been updated).
   - Press PF3 (END).

When tape operations also occur (for example, for logging), the usability of this function is limited because the start I/Os on the different units are not separately displayed. For more information about VSE/ICCF see the *VSE/ICCF Administration and Operation* manual.

SDAID (System Debugging AID)

SDAID is a standard VSE system component intended primarily for examining error situations. For performance analysis, the following can be useful:

- Trace output facilities on tape
- Fetch/load trace for the recording of load transactions — for example, for the tuning of the system directory list (SDL)
- Start I/O and I/O interrupt trace
- Instruction trace — secure only for special cases
- SVC trace for special system analysis — for example, is rotational position sensing (RPS) active?

For further information about SDAID, see the *VSE/ESA Diagnosis Tools* manual.

Monitoring performance data for other products

This section gives an overview of the tools that you can use to monitor information about various access methods and other programs used with CICS and the operating system.

Virtual telecommunications access method (VTAM)

VSE VTAM provides information about buffer usage to the system console through the DISPLAY N, BFRUSE command. Other tuning statistics can also be recorded on the system console through the MODIFY procname,TNSTAT command. (This command is described in the *VTAM Operation* manual.)

VTAM trace

The VTAM trace facility is provided as part of VTAM, and tracks messages through different points to and from CICS. The time-stamps that are included can be particularly useful in determining where a transaction spends large amounts of time.

VTAM storage management (SMS) trace

The VTAM storage management (SMS) trace facility collects information about VTAM's usage of its buffers, including which buffers are used in the various buffer pools, and the number of buffer expansions and depletions.

VTAM tuning statistics

Information provided in the VTAM tuning statistics includes data on the performance between VTAM and the network control program (NCP), the number of reads and writes and what caused that activity, and message counts.

Network logical data manager (NLDM)

The Network Logical Data Manager (NLDM) program product (program number 5668-971) runs on VSE under the Network Communications Control Facility (NCCF), collects SNA session-related information, and makes it available for display at an NCCF operator station. By collecting relevant activity during and just prior to failure, NLDM assists in timely network problem determination.

For further information, see the *NLDM General Information* manual.

Network problem determination application (NPDA)

The Network Problem Determination Application (NPDA) (program number 5666-295 for VSE) records information about errors in devices and lines in an SNA network. Cumulative error counts at the different points in a network can point out performance problems arising from error processing.

Further information about NPDA is given in the *Network Problem Determination Application (NPDA) General Information* manual.

VSE/Network management productivity facility (VSE/NMPF)

The VSE/Network Management Productivity Facility (VSE/NMPF) is a set of job streams, programs, and data sets that can help network systems and operations personnel become acquainted with, install, and productively use many IBM® systems and network management products such as NPDA and the VSE/Operator Communication Control Facility (VSE/OCCF).

VSE/NMPF can be used in an environment with VSE, VTAM, and the Network Communications Control Facility (NCCF).

Virtual storage access method (VSAM)

Information kept in the VSAM catalog includes items on record sizes, data set activity, and data set organization.

LISTCAT (VSAM)

VSAM LISTCAT provides information that interprets the actual situation of VSAM data sets. This information includes counts of the following:

- Whether and how often control interval (CI) or control area (CA) splits occur.
- Physical accesses to the data set.
- Extents for a data set (secondary allocation). Avoid this secondary allocation, if possible, by making the primary allocation sufficiently large.
- Index levels.

Teleprocessing network simulator (TPNS)

The Teleprocessing Network Simulator (TPNS) (program number 5662-262) is a program that simulates terminal activity coming through the NCP. TPNS, which requires VM or MVS as a base, can be used to operate an online system at different transaction rates, and is able to monitor system performance at those rates. TPNS also keeps information about response times, which can be analyzed after a simulation.

Further information about TPNS is given in the *Teleprocessing Network Simulator (TPNS) General Information* manual.

Chapter 5. Using CICS statistics

This chapter introduces and describes CICS statistics. It describes the methods for collecting statistics and discusses those statistics that can be used for tuning your CICS system.

Introduction to CICS statistics

CICS management modules control how events are managed by CICS. As events occur, CICS produces information that is available to you as system and resource statistics.

The resources controlled by CICS include files, databases, journals, transactions, programs, and tasks. Resources that CICS manage, and values that CICS use in its record-keeping role, are defined in one of the following ways:

- Online, by the CICS CEDA transaction
- Online, by EXEC CICS CREATE commands
- Offline, by the CICS system definition (CSD) utility program, DFHCSDUP. See the *CICS Customization Guide* for programming information about DFHCSDUP
- Offline, by CICS control table macros

Statistics are collected during CICS online processing for later offline analysis. The statistics domain writes statistics records to a Data Management Facilities (DMF) data set. The records are of SMF type 110, sub-type 002. Monitoring records and some journaling records are also written to the DMF data set as type 110 records. You might find it useful to process statistics and monitoring records together. For programming information about DMF, see the *CICS Customization Guide*, and for DMF data set considerations, see the *CICS Operations and Utilities Guide*,

Types of statistics data

CICS produces five types of statistics:

Interval statistics
are gathered by CICS during a specified interval. CICS writes the interval statistics to the DMF data set automatically at the expiry of the interval if:

- Statistics recording status was set ON by the STATRCD system initialization parameter (and has not subsequently been set OFF by a CEMT or EXEC CICS SET STATISTICS RECORDING command). The default is STATRCD=OFF.
- ON is specified in CEMT SET STATISTICS.
- The RECORDING option of the EXEC CICS SET STATISTICS command is set to ON.

End-of-day statistics
are a special case of interval statistics where all statistics counters are collected and reset. There are three ways to reset the statistics counters:

- The end-of-day expiry time

- When CICS quiesces (normal shutdown)
- When CICS terminates (immediate shutdown).

The end of day value defines a logical point in the 24 hour operation of CICS. You can change the end of day value using CEMT SET STATISTICS or the EXEC CICS SET STATISTICS command.
End-of-day statistics are always written to the DMF data set, regardless of the setting of the RECORDING option set by:

- The system initialization parameter, STATRCD.
- The CEMT SET STATISTICS ON/OFF command.
- The option of EXEC CICS SET STATISTICS.

The statistics that are written to the DMF data set are those collected since the last event which involved a reset. The following are examples of resets:

- At CICS startup
- Issue of RESETNOW RECORDNOW in CEMT or EXEC CICS STATISTICS commands.

The default end-of-day value is 000000 (midnight).

Requested statistics
are statistics that the user has asked for by using one of the following commands:

- CEMT PERFORM STATISTICS RECORD
- EXEC CICS PERFORM STATISTICS RECORD
- EXEC CICS SET STATISTICS ON|OFF RECORDNOW

These commands cause the statistics to be written to the DMF data set immediately, instead of waiting for the current interval to expire. The PERFORM STATISTICS command can be issued with any combination of resource types or you can ask for all resource types with the ALL option. For more details about CEMT commands see the *CICS-Supplied Transactions*; for programming information about the equivalent EXEC CICS commands, see the *CICS System Programming Reference*.

Requested statistics are always written to the DMF data set, regardless of the setting of the RECORDING option set by:

- The system initialization parameter, STATRCD.
- The CEMT SET STATISTICS ON/OFF command.
- The option of EXEC CICS SET STATISTICS.

Requested reset statistics
differ from requested statistics in that all statistics are collected and statistics counters are reset. There are three ways to reset the statistics counters:

- CEMT PERFORM STATISTICS RECORD ALL RESETNOW
- EXEC CICS PERFORM STATISTICS RECORD ALL RESETNOW
- EXEC CICS SET STATISTICS ON|OFF RESETNOW RECORDNOW

You can also invoke requested reset statistics when changing the recording status from ON to OFF, or vice versa, using the following commands:

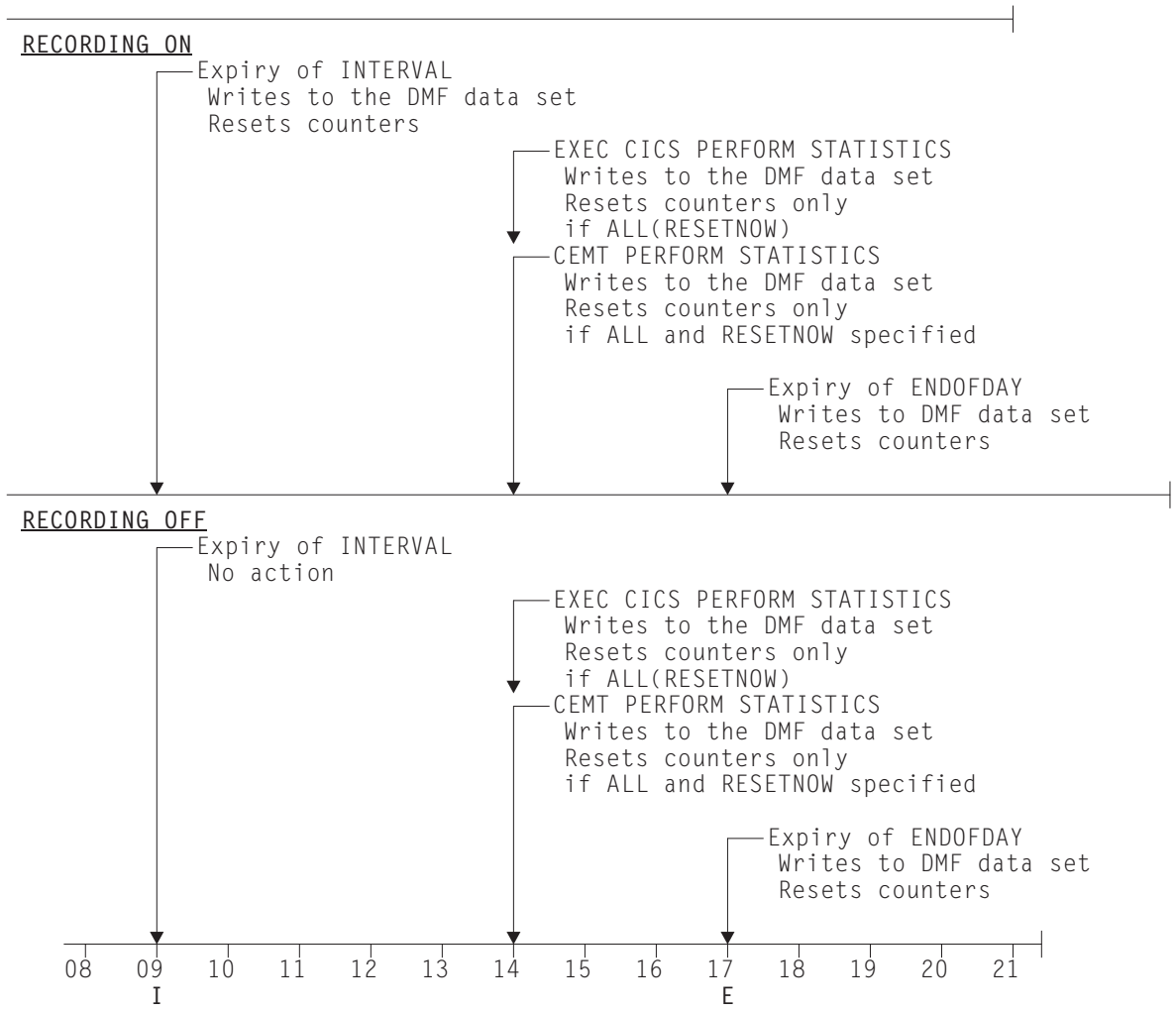


Figure 1. Summary of statistics reset functions

- CEMT SET STATISTICS ON|OFF RECORDNOW RESETNOW
- EXEC CICS SET STATISTICS ON|OFF RECORDNOW RESETNOW

Note: It is valid to specify RECORDNOW RESETNOW options only when there is a genuine change of status from STATISTICS ON to OFF, or vice versa. In other words, coding EXEC CICS SET STATISTICS ON RECORDNOW RESETNOW when statistics is already ON will cause an error response.

The PERFORM STATISTICS command must be issued with the ALL option if RESETNOW is present.

RESETNOW RECORDNOW on the SET STATISTICS command can only be invoked if the RECORDING option is changed. See also Figure 1.

Note: Issuing the RESETNOW command by itself in the SET STATISTICS command causes the loss of the statistics data that has been collected since the last interval. Interval collections take place only if you set the RECORDING status ON. To set the statistics recording status ON or OFF, use either the RECORDING option on this command or the system initialization parameter STATRCD. Statistics are always

written, and counts reset, at the end of day. See Figure 1 for further information.

Unsolicited statistics
are automatically gathered by CICS for dynamically allocated and deallocated resources.

Unsolicited statistics are always written to the DMF data set, regardless of the setting of the RECORDING option set by:

- The system initialization parameter, STATRCD.
- The CEMT SET STATISTICS ON/OFF command.
- The option of EXEC CICS SET STATISTICS.

Unsolicited statistics are produced for:

autoinstalled terminals
Whenever an autoinstalled terminal entry in the TCT is deleted (after the terminal logs off), CICS collects statistics covering the autoinstalled period since the last interval. The period covers any delay interval specified by the system initialization parameter, AILDELAY.

If an autoinstall terminal logs on again before the expiry of the delay interval, then the accumulation of statistics continues until the next interval. At that interval, the accumulation of statistics is restarted.

files Whenever CICS closes a file, CICS collects statistics covering the period from the last interval.

LSRpools
When CICS closes the last file in an LSRPOOL, CICS collects the statistics for the LSRPOOL. The following peak values are reset to the current value at each interval collection:

- Peak number of requests waiting for a string
- Maximum number of concurrent active file control strings.

The other statistics, which are not reset at an interval collection, cover the entire period from the time the LSRPOOL is created (when the first file is opened) until the LSRPOOL is deleted (when the last file is closed).

Note: To ensure that accurate statistics are recorded USS statistics must be collected.

In particular, during a normal CICS shutdown, files are closed before the end of day statistics are gathered. This means that file and LSRPOOL end of day statistics will be zero, while the correct values will be recorded as unsolicited statistics.

Resetting statistics counters

When statistics are written to the DMF data set, the counters are reset in one of the following ways:

- Reset to zero
- Reset to 1
- Reset to current values (this applies to peak values)
- Are not reset

- Exceptions to the above.

For detailed information about the reset characteristics, see Appendix A, “CICS statistics tables” on page 221.

The arrival of the end-of-day time, as set by the ENDOFDAY parameters, always causes the current interval to be ended (possibly prematurely) and a new interval to be started. Only end-of-day statistics are collected at the end-of-day time, even if it coincides exactly with the expiry of an interval.

Changing the end-of-day value changes the times at which INTERVAL statistics are recorded immediately. In Figure 2, when the end-of-day is changed from midnight to 1700 just after 1400, the effect is for the interval times to be calculated from the new end-of-day time. Hence the new interval at 1500 as well as for the times after new end-of-day time.

When you change any of the INTERVAL values (and also when CICS is initialized), the length of the current (or first) interval is adjusted so that it expires after an integral number of intervals from the end-of-day time.

These rules are illustrated by the following example. **I** indicates an interval recording and **E** indicates an end-of-day recording.

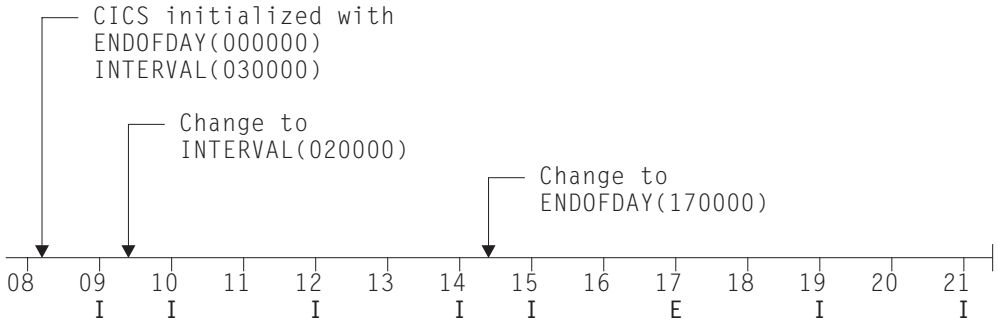


Figure 2. Resetting statistics counters

If you want your end-of-day recordings to cover 24 hours, set INTERVAL to 240000.

Note: Interval statistics are taken precisely on a minute boundary. Thus users with many CICS regions could have every region writing statistics at the same time, if you have both the same interval and the same end of day period specified. This could cost up to several seconds of the entire CPU. If the cost becomes too noticeable, in terms of user response time around the interval expiry, you should consider staggering the intervals. One way of doing this while still maintaining very close correlation of intervals for all regions is to use a PLT program like the supplied sample DFH$STED which changes the end-of-day, and thus each interval expiry boundary, by a few seconds. See *CICS Operations and Utilities Guide* for further information about DFH$STED.

Setting the system initialization parameter STATRCD=OFF reduces the number of times that statistics are written to the DMF data set and the counters are reset, to the end-of-day only.

Processing CICS statistics

There are four ways of processing CICS statistics:

1. Use the CICS DFHSTUP offline utility. For guidance about retrieving CICS statistics from DMF, and about running DFHSTUP, see the *CICS Operations and Utilities Guide*.
2. Write your own program to report and analyze the statistics. For details about the statistics record types, see the assembler DSECTs named in each set of statistics. For programming information about the formats of CICS statistics DMF records, see the *CICS Customization Guide*.
3. Use the sample statistics program (DFH0STAT).

   You can use the statistics sample program (DFH0STAT) to help you determine and adjust the values needed for CICS storage parameters, for example, using DSALIM and EDSALIM. The program produces a report showing critical system parameters from the CICS dispatcher, an analysis of the CICS storage manager and loader statistics, and an overview of the storage in use. The program demonstrates the use of the EXEC CICS INQUIRE and EXEC CICS COLLECT STATISTICS commands to produce an analysis of a CICS system. You can use the sample program as provided or modify it to suit your needs. For more details, see Appendix B, “The sample statistics program, DFH0STAT” on page 319.

Interpreting CICS statistics

In the following sections, as indicated in Table 2 on page 39, guidance is given to help with the interpretation of the statistics report. Information is presented in the order that it appears in the DFHSTUP report. Some headings have been omitted where they have little or no performance impact. Detailed information about the statistics tables is given in Appendix A, “CICS statistics tables” on page 221.

Table 2. Performance statistics types	
Statistic type	**page**
Dispatcher statistics	40
Dump statistics	44
Dynamic transaction backout statistics	44
Front end programming interface statistics	44
Files	45
ISC/IRC attach time statistics	53
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LSRPOOLS	46
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Statistics domain statistics	39
Storage manager statistics	40
Task control	39
Temporary storage	41
Terminal autoinstall statistics	43
Terminals	46
Transaction class statistics	40
Transaction manager statistics	39
Transactions	44
Transient data (global)	42
Transient data (resource)	42
VTAM statistics	43

Statistics domain statistics

Statistics recording on to a DMF data set can be a very CPU-intensive activity. The amount of activity depends more on the number of resources defined than the extent of their use. This may be another reason to maintain CICS definitions by removing redundant or over-allocated resources.

For more information about the statistics domain statistics, see page 284.

Transaction manager statistics

The “Times the MAXTASK limit reached” indicates whether MXT is constraining your system. The only time that you may need to constrain your system in this way is to reduce virtual storage usage. As most CICS virtual storage is above the 16MB line you may be able to run your system without MXT constraints, but note that CICS does preallocate storage, above and below the 16MB line, for each MXT whether or not it is used. Changing MXT affects your calculations for the dynamic

storage areas. See “Maximum task specification (MXT)” on page 162 for more information.

For more information about transaction manager statistics, see page 310.

Transaction class (TRANCLASS) statistics

If you are never at the limit of your transaction class setting then you might consider resetting its value, or review whether there is any need to continue specifying any transaction types with that class.

For more information, see the transaction class statistics on page 307.

Dispatcher statistics

CICS TCB statistics

If the SIT parameter MNPER is set ON, “Accum CPU time/TCB” is the amount of CPU time which each CICS TCB consumed since the last time statistics were reset. Totalling the values of “Accum time in VSE wait” and “Accum time dispatched” gives you the approximate time since the last time CICS statistics were reset. The ratio of the “Accum CPU time /TCB” to this time shows the percentage usage of each CICS TCB. The “Accum CPU time/TCB” does not include uncaptured time, thus even a totally busy CICS TCB would be noticeably less than 100% busy from this calculation. If a CICS region is more than 70% busy by this calculation then you are approaching that region’s capacity.

Note: “Accum time dispatched” is NOT a measurement of CPU time because VSE can run higher priority work. For example, all I/O activity and higher priority partitions, without CICS being aware.

For more information about dispatcher statistics, see page 230.

Monitoring statistics

Recording monitoring data on to a DMF data set can be a very CPU-intensive activity. The amount of activity depends on the number of transactions run. For information about using monitoring, see Chapter 6, “The CICS monitoring facility” on page 57.

Storage manager statistics

Dynamic program compression releases programs which are not being used progressively as storage becomes shorter. However, short-on-storage conditions can still occur and are reported as “Times went short on storage.” If this value is not zero you might consider increasing the size of the dynamic storage area. Otherwise you should consider the use of MXT and transaction classes to constrain your system’s virtual storage.

The storage manager requests “Times request suspended,” and “Times cushion released,” indicate that storage stress situations have occurred. Some of these situations may not have produced a short-on-storage condition. For example, a GETMAIN request may cause the storage cushion to be released. However, loader

can compress some programs, obtain the cushion storage, and avoid the short-on-storage condition.

Note: In the task subpools section, the “Current elem stg” is the number of bytes actually used while “Current page stg” is the number of pages containing one or more of these bytes.

For more information, see the CICS statistics tables on pages 285, 287, and 292.

Loader statistics

“Average loading time” = “Total loading time” / “Number of library load requests.” This indicates the response time overhead suffered by tasks when accessing a program which has to be brought into storage. “Not-in-use” program storage is freed progressively so that the “Amount of the dynamic storage area occupied by not in use programs,” and the free storage in the dynamic storage area are optimized for performance. Loader attempts to keep not-in-use programs in storage long enough to reduce the performance overhead of reloading the program. As the amount of free storage in the dynamic storage decreases, the not-in-use programs are freemained in order of those least frequently used to avoid a potential short-on-storage condition.

Note: The values reported are for the instant at which the statistics are gathered and vary since the last report.

“Average Not-In-Use queue membership time” = “Total Not-In-Use queue membership time” / “Number of programs removed by compression.” This is an indication of how long a program is left in storage when not in use before being removed by the dynamic program storage compression (DPSC) mechanism. If the interval between uses of a program (interval time divided by the number of times used in the interval) is less than this value, the program is probably already in storage when it is next required.

Note: This factor is meaningful only if there has been a substantial degree of loader domain activity during the interval and may be distorted by startup usage patterns.

“Average suspend time” = “Total waiting time” / “Number of waited loader requests.”

This is an indication of the response time impact which may be suffered by a task due to contention for loader domain resources.

Note: This calculation is not performed on requests that are currently waiting.

For more information, see the CICS statistics tables on page 262.

Temporary storage statistics

If a data item is written to temporary storage (using WRITEQ TS), a temporary storage queue is built. The temporary storage queue items are grouped into temporary storage groups (TSGIDs). The number of items per group that are allowed is controlled by the system initialization parameter, TSMGSET. The default is four. If the number of entries in the queue exceeds the limit specified by TSMGSET then a further TSGID will be allocated. This will be registered in TS statistics by “Queue extensions created.”

The value of queue extensions created should be low compared with “times queues created.” If it is high, consider increasing the TSMGSET system initialization parameter.

The “Writes more than control interval” is the number of writes of records whose length was greater than the control interval (CI) size of the TS data set. This value should be used to adjust the CI size. If the reported value is large, increase the CI size. If the value is zero, consider reducing the CI size until a small value is reported.

The number of “times aux. storage exhausted” is the number of situations where one or more transactions may have been suspended because of a NOSPACE condition, or (using a HANDLE CONDITION NOSPACE command, the use of RESP on the WRITEQ TS command, or WRITEQ TS NOSUSPEND command) may have been forced to abend. If this item appears in the statistics, increase the size of the temporary storage data set. “Buffer writes” is the number of WRITEs to the temporary storage data set. This includes both WRITEs necessitated by recovery requirements and WRITEs forced by the buffer being needed to accommodate another CI. I/O activity caused by the latter reason can be minimized by increasing buffer allocation using the system initialization parameter, TS=(b,s), where b is the number of buffers and s is the number of strings.

The “Peak number of strings in use” item is the peak number of concurrent I/O operations to the data set. If this is significantly less than the number of strings specified in the TS system initialization parameter, consider reducing the system initialization parameter to approach this number.

If the “Times string wait occurred” is not zero, then consider increasing the number of strings. For details about adjusting the size of the TS data set, the number of strings and buffers see the *CICS System Definition Guide*.

For more information, see the CICS statistics tables on page 296.

Transient data statistics

You should monitor the data provided by CICS on the amount of I/O activity for transient data, in the form of the number of READs and WRITEs to the transient data intrapartition data set. If there is a large amount of READ activity, this indicates that the buffer allocation may be insufficient, even though the “peak concurrent string access” may be fewer than the number allocated.

You should aim to minimize the “intrapartition buffer waits” and “string waits” by increasing the number of buffers and the number of strings (if you can afford any associated increase in your use of real storage).

For more information, see the CICS statistics tables on pages 312 and 315.

VTAM statistics

The “peak RPLs posted” includes only the receive-any RPLs defined by the RAPOOL system initialization parameter. The value shown can be larger than the value specified for RAPOOL, because CICS reissues each receive-any request as soon as the input message associated with the posted RPL has been disposed of. VTAM may well cause this reissued receive-any RPL to be posted during the current dispatch of terminal control. While this does not necessarily indicate a performance problem, a number much higher than the number of receive-any requests specified via RAPOOL may indicate, for VSE, that VTAM was required to queue incoming messages when no receive-any was available to accept the input. You should limit this VTAM queueing activity by providing a sufficient number of receive-any requests to handle all but the input message rate peaks.

In addition to indicating whether the value for the RAPOOL initialization parameter is large enough, you can also use the “maximum number of RPLs posted” statistics (A03RPLX) to determine other information.

VTAM SOS simply means that a CICS request for service from VTAM was rejected with a VTAM sense code indicating that VTAM was unable to acquire the storage required to service the request. VTAM does not give any further information to CICS, such as what storage it was unable to acquire.

This situation most commonly arises at network startup or shutdown when CICS is trying to schedule requests concurrently, to a larger number of terminals than during normal execution. If the count is not very high, it is probably not worth tracking down. In any case, CICS automatically retries the failing requests later on.

If your network is growing, however, you should monitor this statistic and, if the count is starting to increase, you should take action. Use D NET,BFRUSE to check if VTAM is short on storage in its own region and increase VTAM allocations accordingly if this is required.

The maximum value for this statistic is 99, at which time a message is sent to the console and the counter is reset to zero. However, VTAM controls its own buffers and gives you a facility to monitor buffer usage.

If you feel that D NET,BFRUSE is insufficient, you can activate SMS tracing in VTAM to sample buffer activity at regular intervals. If you have installed NetView, you can also have dynamic displays of the data that is obtained with D NET, BFRUSE.

For more information, see the CICS statistics tables on page 317.

Terminal autoinstall statistics

If “times SETLOGON HOLD issued” is not zero, your region is reaching your AIQMAX limit. If this statistic increases over a period of time, you may need to review whether you can afford to increase AIQMAX.

For more information, see the CICS statistics tables on page 224.

Dump statistics

Both transaction and system dumps are very expensive and should be thoroughly investigated and eliminated.

For more information, see the CICS statistics tables on page 233.

Dynamic transaction backout statistics

Normally, dynamic log records are simply added to a main storage dynamic log buffer. If this proves to be too small, records are spilled to a main storage chain. There is a performance cost in spilling records, so the dynamic log buffer size is automatically tuned to keep this number low compared with the number of records written.

If the ratio of records spilled to records logged is too high, it may be that the value of the system initialization parameter DBUFSZ is too low. The DBUFSZ value imposes an upper limit on the dynamic log buffer size that may be allocated by the self-tuning mechanism.

Because the initial allocations are half the maximum, the dynamic self-tuning mechanism may take some time to settle down.

If the “number of records spilled” is consistently over 2% of the “number of records logged,” you should increase the buffer size.

For more information, see the CICS statistics tables on page 237.

Transaction statistics

Use these statistics to find out which transactions (if any) had storage violations.

It is also possible to use these statistics for capacity planning purposes. But remember, many systems experience both increasing cost per transaction as well as increasing transaction rate.

For more information, see the CICS statistics tables on page 305.

Program statistics

“Average fetch time” is an indication of how long it actually takes VSE to perform a load from the VSE sublibrary in the LIBDEF search chain concatenation into CICS managed storage.

For more information, see the CICS statistics tables on page 281.

Front end programming interface (FEPI) statistics

CICS monitoring and statistics data can be used to help tune FEPI applications, and to control the resources that they use. FEPI statistics contain data about the use of each FEPI pool, a particular target in a pool, and each FEPI connection.

For more information, see the CICS statistics tables on page 237.

File statistics

File statistics collect data about the number of application requests against your data sets. They indicate the number of requests for each type of service that are processed against each file. If the number of requests is totaled daily or for every CICS execution, the activity for each file can be monitored for any changes that occur. Note that these file statistics may have been reset during the day; to obtain a figure of total activity against a particular file during the day, refer to the DFHSTUP summary report. Other data pertaining to file statistics and special processing conditions are also collected.

The wait-on-string number is only significant for files related to VSAM data sets. VSAM, STRNO=5 in the file definition means, for example, that CICS permits five concurrent requests to this file. If a transaction issues a sixth request for the same file, this request must wait until one of the other five requests has completed ("wait-on-string").

String number setting is important for performance. Too low a value causes excessive waiting for strings by tasks and long response times. Too high a value increases VSAM virtual storage requirements and therefore real storage usage. However, as both virtual storage and real storage are above the 16MB line, this may not be a problem. In general, the number of strings should be chosen to give near zero "wait on string" count.

Note: Increasing the number of strings can increase the risk of deadlocks because of greater transaction concurrency. To minimize the risk you should ensure that applications follow the standards set in the *CICS Application Programming Guide*.

A file can also "wait-on-string" for an LSRPOOL string. This type of wait is reflected in the local shared resource pool statistics section (see "LSRPOOL statistics" on page 46) and not in the file wait-on-string statistics.

If you are using data tables, an extra line appears in the DFHSTUP report for those files defined as data tables. "Read requests", "Source reads", and "Storage alloc(K)" are usually the numbers of most significance. For a CICS-maintained table a comparison of the difference between "read requests" and "source reads" with the total request activity reported in the preceding line shows how the request traffic divides between using the table and using VSAM and thus indicates the effectiveness of converting the file to a CMT. "Storage alloc(K)" is the total storage allocated for the table and provides guidance to the cost of the table in storage resource, bearing in mind the possibility of reducing LSRPOOL sizes in the light of reduced VSAM accesses.

For more information, see the CICS statistics tables on page 241.

Journal statistics

Each journal employs two buffers for efficiency; CICS can thus use one buffer for output, while concurrently receiving records from transactions in the other buffer. If the receiving buffer becomes full before output to the other buffer has completed, the "buffer full" count is incremented by one. This situation causes significant increase in internal response time as every transaction attempting to put a record into the journal has to wait. The buffer size should be increased to reduce this problem.

For more information, see the CICS statistics tables on page 260.

LSRPOOL statistics

CICS supports the use of up to fifteen LSRPOOLS. CICS produces two sets of statistics for LSRPOOL activity: one set detailing the activity for each LSRpool, and one set giving details for each file associated with an LSRPOOL. Statistics are printed for all pools that have been built (a pool is built when at least one file using the pool has been opened).

You should usually aim to have no requests that waited for a string. If you do then the use of MXT may be more effective.

When the last open file in an LSRPOOL is closed, the pool is deleted. The subsequent unsolicited statistics (USS) LSRPOOL record written to DMF can be mapped by the DFHA08DS DSECT.

The fields relating to the size and characteristics of the pool (maximum key length, number of strings, number and size of buffers) may be those which you have specified for the pool, through resource definition online command DEFINE LSRPOOL. Alternatively, if some, or all, of the fields were not specified, the values of the unspecified fields are those calculated by CICS when the pool is built.

It is possible to change the LSRPOOL specification of a file when it is closed. You must then consider the characteristics of the pool that the file is to share (if the pool is already built), or the file open may fail. If the pool is not built and the pool characteristics are specified by you, take care that these are adequate for the file. If the pool is not built and CICS calculates all or some of the operands, it may build the pool creations of that pool. The statistics show all creations of the pool, so any changed characteristics are visible.

You should consider specifying separate data and index buffers if you have not already done so. This is especially true if index CI sizes are the same as data CI sizes.

For more information, see the CICS statistics tables on page 272.

Terminal statistics

There are a number of ways in which terminal statistics are important for performance analysis. From them, you can get the number of inputs and outputs, that is, the loading of the system by end users. Line-transmission faults and transaction faults are shown (these both have a negative influence on performance behavior).

For more information, see the CICS statistics tables on page 302.

ISC/IRC system and mode entry statistics

You can use the ISC/IRC system and mode entry statistics to detect some problems in a CICS intersystem environment.

The following section attempts to identify the kind of questions you may have in connection with system performance, and describes how answers to those questions can be derived from the statistics report. It also describes what actions, if any, you can take to resolve ISC/IRC performance problems.

Some of the questions you may be seeking an answer to when looking at these statistics are these:

- Are there enough sessions defined?
- Is the balance of **contention winners** to **contention losers** correct?
- Is there conflicting usage of APPC modegroups?
- What can be done if there are unusually high numbers, compared with normal or expected numbers, in the statistics report?

Summary connection type for statistics fields

The following two tables show the connection type that is relevant for each statistics field:

Table 3 (Page 1 of 2). ISC/IRC system entries

System entry	Field	IRC	LU6.1	APPC
Connection name	A14CNTN	X	X	X
AIDS in chain	A14EALL	X	X	X
Generic AIDS in chain	A14ESALL	X	X	X
ATIs satisfied by contention losers	A14ES1		X	
ATIs satisfied by contention winners	A14ES2	X	X	
Peak contention losers	A14E1HWM	X	X	
Peak contention winners	A14E2HWM	X	X	
Peak outstanding allocates	A14ESTAM	X	X	X
Total number of allocates	A14ESTAS	X	X	X
Queued allocates	A14ESTAQ	X	X	X
Failed link allocates	A14ESTAF	X	X	X
Failed allocates due to sessions in use	A14ESTAO	X	X	X
Total bids sent	A14ESBID		X	
Current bids in progress	A14EBID		X	
Peak bids in progress	A14EBHWM		X	
File control function shipping requests	A14ESTFC	X	X	X
Interval control function shipping requests	A14ESTIC	X	X	X
TD function shipping requests	A14ESTTD	X	X	X

Table 3 (Page 2 of 2). ISC/IRC system entries				
System entry	**Field**	**IRC**	**LU6.1**	**APPC**
TS function shipping requests	A14ESTTS	X	X	X
DLI function shipping requests	A14ESTDL	X	X	X
Terminal sharing requests	A14ESTTC	X		X

All the fields below are specific to the mode group of the mode name given.

Table 4. ISC/IRC mode entries				
Mode entry	**Field**	**IRC**	**LU6.1**	**APPC**
Mode name	A20MODE			X
ATIs satisfied by contention losers	A20ES1			X
ATIs satisfied by contention winners	A20ES2			X
Peak contention losers	A20E1HWM			X
Peak contention winners	A20E2HWM			X
Peak outstanding allocates	A20ESTAM			X
Total specific allocate requests	A20ESTAS			X
Total specific allocates satisfied	A20ESTAP			X
Total generic allocates satisfied	A20ESTAG			X
Queued allocates	A20ESTAQ			X
Failed link allocates	A20ESTAF			X
Failed allocates due to sessions in use	A20ESTAO			X
Total bids sent	A20ESBID			X
Current bids in progress	A20EBID			X
Peak bids in progress	A20EBHWM			X

For more information about the usage of individual fields, see the CICS statistics described under “ISC/IRC system and mode entries” on page 250.

General guidance for interpreting ISC/IRC statistics

You should read the following notes on how the information about interpreting the ISC/IRC statistics is presented:

1. Usage of A14xxx and A20xxx fields:
   - In most cases, the guidance given in the following section relates to all connection types, that is, IRC, LU6.1, and APPC. Where the guidance is different for a particular connection type, the text indicates the relevant type of connection.
   - The statistics fields which relate to IRC and LU6.1 are always prefixed A14, whereas the APPC fields can be prefixed by A14 or A20. For more information on which field relates to which connection type, see Table 3 on page 47 and Table 4.
2. Use of the terms “Contention Winner” and “Contention Loser”:

- APPC sessions are referred to as either **contention winners** or **contention losers**. These are equivalent to secondaries (SEND sessions) and primaries (RECEIVE sessions) when referring to LU6.1 and IRC.

3. Tuning the number of sessions defined:
   - In the following sections it is sometimes stated that if certain counts are too high then you should consider making more sessions available. In these cases, be aware that as the number of sessions defined in the system is increased, it may have the following effects:
     - Increased use of real and virtual storage.
     - Increased use of storage on GATEWAY NCPs in network.
     - Increased use of storage by VTAM.
     - Increased line loading in the network.
     - The back-end CICS system (AOR) may not be able to cope with the increased workload from the TOR.
     - Possible performance degradation due to increased control block scanning by CICS.
   - The recommendation is to set the number of sessions available to the highest value you think you may need, and then through monitoring the statistics (both ISC/IRC and terminal statistics) over a number of CICS runs, reduce the number of sessions available to just above the number required to avoid problems.
4. Tuning the number of contention winner and contention loser sessions available:
   - Look at both sides of the connection when carrying out any tuning, as changing the loading on one side could inversely affect the other. Any change made to the number of contention winner sessions available in the TOR has an effect on the number of contention loser sessions in the AOR.
5. Establish a connection profile for comparison and measurement.

   One of the objectives of a tuning exercise should be to establish a profile of the usage of CICS connections during both normal and peak periods. Such usage profiles can then be used as a reference point when analyzing statistics to help you:
   - Determine changed usage patterns over a period of time
   - To anticipate potential performance problems before they become critical.

Are there enough sessions defined?

To help you determine whether you have enough sessions defined, you can check a number of peak fields that CICS provides in the statistics report.
These are:

1. **"Peak outstanding allocates"** (fields A14ESTAM and A20ESTAM)
   "Total number of allocates" (field A14ESTAS)
   "Total specific allocate requests" (field A20ESTAS).

   When reviewing the number of sessions for APPC modegroups, and the number of "Peak outstanding allocates" appears high in relation to the "Total number of allocates," or the "Total specific allocate requests" within a statistics reporting period, it could indicate that the total number of sessions defined is too low.

2. **"Peak contention winners"** (fields A14E2HWM and A20E2HWM)
   "Peak contention losers" (fields A14E1HWM and A20E1HWM)

   If the number of ("Peak contention winners" + "Peak contention losers") equals the maximum number of sessions available (as defined in the SESSIONS definition), this indicates that, at some point in the statistics reporting period, all the sessions available were, potentially, in use. While these facts alone may not indicate a problem, if CICS also queued or rejected some allocate requests during the same period, then the total number of sessions defined is too low.

Action: Consider making more sessions available with which to satisfy the allocate requests. Enabling CICS to satisfy allocate requests without the need for queueing may lead to improved performance.

However, be aware that increasing the number of sessions available on the front-end potentially increases the workload to the back-end, and you should investigate whether this is likely to cause a problem.

Is the balance of contention winners to contention losers correct?

There are several ways to determine the answer to this, as CICS provides a number of fields which show contention winner and contention loser usage.

The following fields should give some guidance as to whether you need to increase the number of contention winner sessions defined:

1. **"Current bids in progress"** (fields A14EBID and A20EBID)
   "Peak bids in progress" (fields A14EBHWM and A20EBHWM)

   The value "Peak bids in progress" records the maximum number of bids in progress at any one time during the statistics reporting period. "Current bids in progress" is always less than or equal to the "Peak bids in progress."

   Ideally, these fields should be kept to zero. If either of these fields is high, it indicates that CICS is having to perform a large number of bids for contention loser sessions.

2. **"Failed allocates due to sessions in use"** (fields A14ESTAO and A20ESTAO)

   This value is incremented for allocates that are rejected with a SYSBUSY response because no sessions are immediately available (that is, for allocate requests with the NOSUSPEND or NOQUEUE option specified). This value is also incremented for allocates that are queued and then rejected with an AAL1 abend code; the AAL1 code indicates that the allocate is rejected because no session became available within the specified deadlock timeout (DTIMOUT) time limit.

   If the number of "Failed allocates due to sessions in use" is high within a statistics reporting period, it indicates that not enough sessions were immediately available, or available within a reasonable time limit.

3. **"Peak contention losers"** (fields A14E1HWM and A20E1HWM).

   If the number of "Peak contention losers" is equal to the number of contention loser sessions available, then the number of contention loser sessions defined may be too low. Alternatively, for APPC/LU6.1, CICS could be using the contention loser sessions to satisfy allocates due to a lack of contention winner sessions. This should be tuned at the front-end in conjunction with winners at

the back-end. For information on how to specify the maximum number of sessions, and the number of contention winners, see the *CICS Resource Definition Guide*.

Actions:

For APPC, consider making more contention winner sessions available, which should reduce the need to use contention loser sessions to satisfy allocate requests and, as a result, should also make more contention loser sessions available.

For LU6.1, consider making more SEND sessions available, which decreases the need for LU6.1 to use primaries (RECEIVE sessions) to satisfy allocate requests.

For IRC, there is no bidding involved, as MRO can never use RECEIVE sessions to satisfy allocate requests. If "Peak contention losers (RECEIVE)" is equal to the number of contention loser (RECEIVE) sessions on an IRC link, the number of allocates from the remote system is possibly higher than the receiving system can cope with. In this situation, consider increasing the number of RECEIVE sessions available.

Note: The usage of sessions depends on the direction of flow of work. Any tuning which increases the number of winners available at the front-end should also take into account whether this is appropriate for the direction of flow of work over a whole period, such as a day, week, or month.

Is there conflicting usage of APPC modegroups?

There is a possibility of conflicting APPC modegroup usage, where a mixture of generic and specific allocate requests is used within a CICS region.

A specific allocate is an allocate request that specifies a particular (specific) mode group of sessions to allocate from, whereas a generic allocate does not specify any particular mode group only the system to which an allocate is required. In the latter case CICS determines the session and mode group to allocate.

The fields you need to investigate to answer this question, are:

"Total generic allocates satisfied" (field A20ESTAG)
"Total specific allocate requests" (field A20ESTAS)
"Peak outstanding allocates" (field A20ESTAM)
"Total specific allocates satisfied" (field A20ESTAP).

If the "Total generic allocates satisfied" is much greater than "Total specific allocate requests," and "Peak outstanding allocates" is not zero, it could indicate that generic allocates are being made only, or mainly, to the first modegroup for a connection.

This could cause a problem for any specific allocate, because CICS initially tries to satisfy a generic allocate from the first modegroup before trying other modegroups in sequence.

Action: Consider changing the order of the installed modegroup entries. Modegroups for a connection are represented by TCT mode entries (TCTMEs), with the modegroup name being taken from the MODENAME specified on the SESSIONS definition. The order of the TCTMEs is determined by the order in which CICS installs the SESSIONS definitions, which is in the order of the SESSIONS name as stored on the CSD (ascending alphanumeric key sequence).

See Figure 3 on page 52 for an illustration of this. To change the order of the TCTMEs, you must change the names of the SESSIONS definitions. You can use the CEDA RENAME command with the AS option to rename the definition with a different SESSIONS name within the CSD group. By managing the order in which the TCTMEs are created you can ensure that specific allocates reference modegroups lower down the TCTME chain, and avoid conflict with the generic ALLOCATEs. **Alternatively, make all allocates specific allocates**.

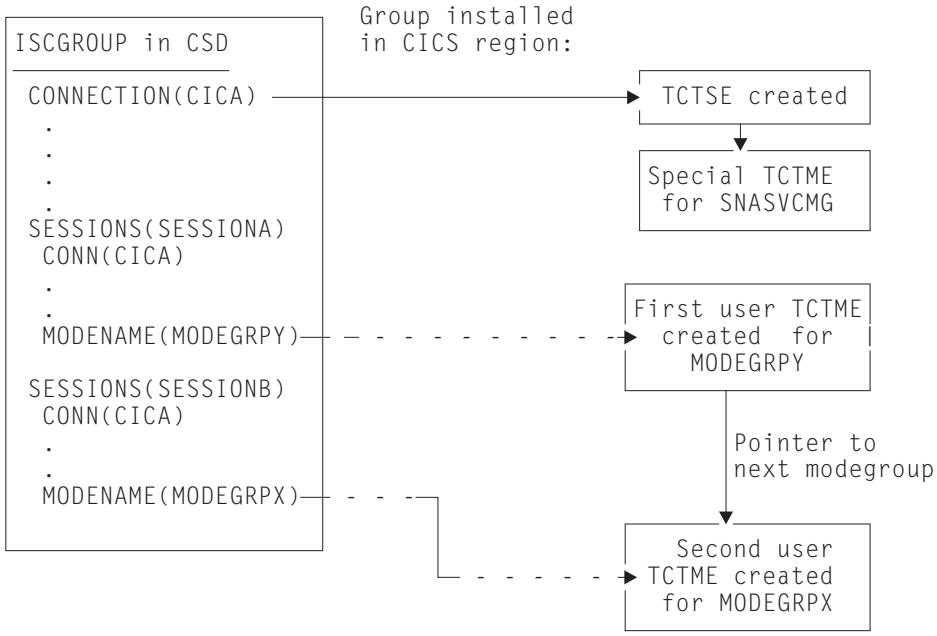

Figure 3. How the sequence of TCT mode entries is determined

What if there are unusually high numbers in the statistics report?

When looking down the **ISC/IRC system and mode entries** statistics report, you may notice a number of fields that appear to be unusually high in relation to all others. This section lists some of those fields, and what action you can take to reduce their numbers:

1. **"Peak contention losers"** (fields A14E1HWM and A20E1HWM).

   If the number of "Peak contention losers" is equal to the number of contention loser sessions available, then the number of contention loser sessions defined may be too low, or, if your links are APPC/LU6.1, CICS could be using the contention loser sessions to satisfy allocates due to a lack of contention winner sessions.

   Action: Consider making more contention winner sessions available with which to satisfy the allocate requests.

2. **"Peak outstanding allocates"** (fields A14ESTAM and A20ESTAM)

   If the number of "Peak outstanding allocates" appears high, in relation to the "Total number of allocates," or the "Total specific allocate requests" for APPC modegroups within a statistics reporting period, it could indicate that the total number of sessions defined is too low, or that the remote system cannot cope with the amount of work being sent to it.

Action: Consider making more sessions available with which to satisfy the allocate requests, or reduce the number of allocates being made.

3. **"Failed link allocates"** (fields A14ESTAF and A20ESTAF)

   If this value is high within a statistics reporting period, it indicates something was wrong with the state of the connection. The most likely cause is either that the connection is released, out of service, or it has a closed mode group.

   Action: Examine the state of the connection that CICS is trying to allocate a session on, and resolve any problem that is causing the allocates to fail.

   To help you to resolve a connection failure, check the CSMT log for the same period covered by the statistics for any indication of problems with the connection that the statistics relate to.

   It may also be worth considering writing a connection status monitoring program, which can run in the background and regularly check connection status and take remedial action to re-acquire a released connection. This may help to minimize outage time caused by connections being unavailable for use. See the *CICS System Programming Reference* manual for programming information about the EXEC CICS INQUIRE|SET CONNECTION and the EXEC CICS INQUIRE|SET MODENAME commands that you would use in such a program.

4. **"Failed allocates due to sessions in use"** (fields A14ESTAO and A20ESTAO)

   This value is incremented for allocates that have been rejected with a SYSBUSY response because no sessions were immediately available, and the allocate requests were made with the NOSUSPEND or NOQUEUE option specified. This value is also incremented for allocates that have been queued and then rejected with an AAL1 abend code; the AAL1 code indicates the allocate was rejected because no session was available within the specified deadlock timeout (DTIMOUT) time limit.

   If the number of "Failed allocates due to sessions in use" is high, within a statistics reporting period, it indicates that not enough sessions were immediately available, or available within a reasonable time limit.

   Action: The action is to consider making more contention winner sessions available. This action would result in a reduction in the amount of bidding being carried out, and the subsequent usage of contention loser sessions.

5. **"Peak bids in progress"** (fields A14EBHWM and A20EBHWM)

   Ideally, these fields should be kept to zero. If either of these fields are high, it indicates that CICS is having to perform a large amount of bidding for sessions.

   Action: Consider making more contention winner sessions available, to satisfy allocate requests.

ISC/IRC attach time entries

ISC/IRC Signon activity. If the number of "entries reused" in signon activity is low, and the "entries timed out" value for signon activity is high, then the value of the USRDELAY system initialization parameter should be increased. The "average reuse time between entries" gives some indication of the time that could be used for the USRDELAY system initialization parameter.

ISC Persistent verification (PV) activity. If the number of "entries reused" in the PV activity is low, and the "entries timed out" value is high, then the PVDELAY system initialization parameter should be increased. The "average reuse time between entries" gives some indication of the time that could be used for the PVDELAY system initialization parameter.

Note: If there are a lot of either signed-on or PV-entries timed out, and not many reused, your performance may be degraded because of the need to make calls to an external security manager, for security checking.

For more information, see the CICS statistics tables on page 259.

Recovery utility program statistics

On completion of the CICS recovery utility program (initiated only when an emergency restart occurs), the following statistics are provided at destination CSSL. This can be defined as the system console or control terminal in your destination control table.

Activity statistical data:

The following information is given for each task:

- Task ID shows the CICS generated task identifier.
- Trans ID shows the transaction identifier as specified in the CICS CEDA transaction or in the program control table.
- Term ID shows the terminal identifier.
- Data collected is the total count of records recovered and written to the restart data set for the user-journaled records.

Transient data statistical data:

The following information is given for each destination:

- Dest ID shows the destination identifier.
- Q count is the total number of records for the destination.
- Recovered indicates whether the destination was successfully recovered. Error conditions that cause unsuccessful recovery are:
  - I/O: error occurred during reading or writing of chain record.
  - Record count: record count on the track was invalid.
  - Chaining: break in chaining of tracks before last track could be read.

File backout statistics:

The following information is given for each entry:

- File ID shows the file name.
- RD/WR are records collected because of journaling and written to the restart data set.
- RD UPDT are records collected because of READ UPDATE, written to the restart data set, and subsequently backed out.

- WR ADD are records collected because of WRITE ADD, written to the restart data set, and subsequently backed out.

DL/I backout statistics:

The following backout information is given for each entry:

- DL/I ID gives the DL/I task identifier.
- Task ID gives the CICS-generated task identifier.
- Trans ID is the primary transaction identifier as specified in CEDA or in the program control table.
- PSB name is the DL/I program specification block name.

The entries for DL/I backout need not have a corresponding task entry on the active task's statistics. This is because the DL/I log entries are not counted with the other log entries that comprise the active task list. Note those DL/I entries that show zero data records. These are tasks that had issued a DL/I terminate call before the system failed, or had written no records to the DL/I database before the system failed.

Chapter 6. The CICS monitoring facility

The CICS monitoring facility is discussed in the following topics:

Introduction to CICS monitoring

CICS monitoring collects data about the performance of all user- and CICS-supplied transactions during online processing for later offline analysis. The records produced by CICS monitoring are in SMF 110 record format, and are written to a data management facility (DMF) data set.

Note: Statistics records and some journaling records are also written to the DMF data set as type 110 records. You might find it particularly useful to process the statistics records and the monitoring records together, because statistics provide resource and system information that is complementary to the transaction data produced by CICS monitoring. The contents of the statistics fields, and the procedure for processing them, are described in Appendix A, "CICS statistics tables" on page 221.

Monitoring data is useful both for performance tuning and for charging your users for the resources they use.

The classes of monitoring data

Two types, or "classes", of monitoring data may be collected. These are **performance** class data, and **exception** class data.

Performance class data

Performance class data is detailed transaction-level information, such as the processor and elapsed time for a transaction, or the time spent waiting for I/O. At least one performance record is written for each transaction that is being monitored.

Performance class data provides detailed, resource-level data that can be used for accounting, performance analysis, and capacity planning. This data contains information relating to individual task resource usage, and is completed for each task when the task terminates.

You can enable performance-class monitoring by coding MNPER=ON (together with MN=ON) in the system initialization table (SIT). Alternatively you can use either the (CEMT SET MONITOR ON PERF) or EXEC CICS SET MONITOR STATUS(ON) PERFCLASS(PERF) commands.

This information could be used periodically to calculate the charges applicable to different tasks. If you want to set up algorithms for charging users for resources used by them, you could use this class of data collection to update the charging information in your organization's accounting programs. (For previous versions of CICS, we did not recommend charging primarily on exact resource usage, because of the overheads involved in getting these figures.)

Exception class data

Exception class data is information on exceptional conditions suffered by a transaction. This data highlights possible problems in system operation. There is one exception record for each exception condition. Exception records are produced after each of the following conditions encountered by a transaction has been resolved:

- Wait for storage in the CDSA
- Wait for storage in the UDSA
- Wait for storage in the SDSA
- Wait for storage in the RDSA
- Wait for storage in the ECDSA
- Wait for storage in the EUDSA
- Wait for storage in the ESDSA
- Wait for storage in the ERDSA
- Wait for auxiliary temporary storage
- Wait for auxiliary temporary storage string
- Wait for auxiliary temporary storage buffer
- Wait for file string
- Wait for file buffer
- Wait for LSRPOOL string.

An exception record is created each time any of the resources covered by exception class monitoring becomes constrained by system bottlenecks. If performance data is also being recorded, it keeps a count of the number of exception records generated for each task. The exception records can be linked to the performance data by the transaction identifier in both records.

This data is intended to help you identify constraints that affect the performance of your transaction. The information is written to a DMF data set as soon as the task that was originally constrained has been released.

You can enable exception-class monitoring by coding MNEXC=ON (together with MN=ON) in the SIT. Alternatively you can use, either the CEMT command (CEMT SET MONITOR ON EXCEPT) or EXEC CICS SET MONITOR STATUS(ON) EXCEPTCLASS(EXCEPT).

Event monitoring points

Product-Sensitive programming interface

CICS monitoring data is collected at system-defined event monitoring points (EMPs) in the CICS code. Although you cannot relocate these monitoring points, you can choose which **classes** of monitoring data you want to be collected. Programming information about CICS monitoring is in the *CICS Customization Guide*.

If you want to gather more performance class data than is provided at the system-defined event monitoring points, you can code additional EMPs in your application programs. At these points, you can add or change up to 16384 bytes of user data in each performance record. Up to this maximum of 16384 bytes you can have, for each ENTRYNAME qualifier, any combination of the following:

- Between 0 and 256 counters
- Between 0 and 256 clocks
- A single 8192-byte character string.

You could use these additional EMPs to count the number of times a certain event occurs, or to time the interval between two events. If the performance class was active when a transaction was started, but was not active when a user EMP was issued, the operations defined in that user EMP would still execute on that transaction's monitoring area. The DELIVER option would result in a loss of data at this point, because the generated performance record cannot be output while the performance class is not active. If the performance class was not active when a transaction was started, then the user EMP would have no effect.

User EMPs can use the EXEC CICS MONITOR command. For programming information about this command, refer to the *CICS Application Programming Reference* manual.

Additional EMPs are provided in some IBM program products, such as DL/I. From CICS's point of view, these are like any other user-defined EMP. EMPs in user applications and in IBM program products are identified by a decimal number. The numbers 1 through 199 are available for EMPs in user applications, and the numbers from 200 through 255 are for use in IBM program products. The numbers can be qualified with an 'entryname', so that you can use each number more than once. For example, PROGA.1, PROGB.1, and PROGC.1 identify three different EMPs because they have different entrynames.

For each user-defined EMP there must be a corresponding monitoring control table (MCT) entry, which has the same identification number and entryname as the EMP that it describes.

You do not have to assign entrynames and numbers to system-defined EMPs, and you do not have to code MCT entries for them.

Here are some ideas about how you might make use of the CICS system fields and user fields provided with the CICS monitoring facility:

- If you want to time how long it takes to do a table lookup routine within an application, then you code an EMP with, say, ID=50 just before the table lookup routine and an EMP with ID=51 just after the routine. The system programmer codes a TYPE=EMP operand in the MCT for ID=50 to start user clock 1. You also code a TYPE=EMP operand for ID=51 to stop user clock 1. The application executes. When EMP 50 is processed, user clock 1 is started. When EMP 51 is processed, the clock is stopped.
- One user field could be used to accumulate an installation accounting unit. For example, you might count different amounts for different types of transaction. Or, in a browsing application, you might count 1 unit for each record scanned and not selected, and 3 for each record selected.

  You can also treat the fullword count fields as 32-bit flag fields to indicate special situations, for example, out-of-line situations in the applications,

operator errors, and so on. CICS includes facilities to turn individual bits or groups of bits on or off in these counts.

- The performance clocks can be used for accumulating the time taken for I/O, DL/I scheduling, and so on. It usually includes any waiting for the transaction to regain control after the requested operation has completed. Because the periods are counted as well as added, you can get the average time waiting for I/O as well as the total. If you want to highlight an unusually long individual case, set a flag on in a user count as explained above.
- One use of the performance character string is for systems in which one transaction ID is used for widely differing functions. The application can enter a subsidiary ID into the string to indicate which particular variant of the transaction applies in each case.

  Some users have a single transaction ID so that all user input is routed through a common prologue program (for security checking, for example). In this case, it is very easy to record the subtransaction identifier during this prologue. (However, it is equally possible to route transactions with different identifiers to the same program, in which case this technique is not necessary.)

Note: Accounting data for a single combination of either transaction, terminal, or operator identifiers may represent multiple transactions. In an SNA network using pipeline sessions, one operator may work with different terminal identifiers at different times, so each accounting record may have contributions from several operators.

The monitoring control table (MCT)

You use the monitoring control table (MCT):

- To tell CICS about the EMPs that you have coded in your application programs and about the data that is to be collected at these points
- To tell CICS that you want certain system-defined performance data not to be recorded during a particular CICS run.

DFHMCT TYPE=EMP

There must be a DFHMCT TYPE=EMP macro definition for every user-coded EMP. This macro has an ID operand, whose value must be made up of the ENTRYNAME and POINT values specified on the EXEC CICS MONITOR command. The PERFORM operand of the DFHMCT TYPE=EMP macro tells CICS which user count fields, user clocks, and character values to expect at the identified user EMP, and what operations to perform on them.

DFHMCT TYPE=RECORD

The DFHMCT TYPE=RECORD macro allows you to *exclude* specific system-defined performance data from a CICS run. (Each performance monitoring record is approximately 572 bytes long, without taking into account any user data that may be added, or any excluded fields.)

Each field of the performance data that is gathered at the system-defined EMPs belongs to a group of fields that has a group identifier. Each performance data field also has its own numeric identifier that is unique within the group identifier. For example, the transaction sequence number field in a performance record belongs to the group DFHTASK, and has the numeric identifier ‘031’. Using these

identifiers, you can exclude specific fields or groups of fields, and reduce the size of the performance records.

Full details of the MCT are provided in the *CICS Resource Definition Guide*, and examples of MCT coding are included with the programming information in the *CICS Customization Guide*.

Three sample monitoring control tables are also provided in the VSE/ESA sublibrary PRD1.BASE

- For terminal-owning regions (TORs) - DFHMCTT$
- For application-owning regions (AORs) - DFHMCTA$
- For file-owning regions (FORs) - DFHMCTF$.

These samples show how to use the EXCLUDE and INCLUDE operands to reduce the size of the performance class record in order to reduce the volume of data written by CICS to DMF.

Controlling CICS monitoring

When CICS is initialized, you switch the monitoring facility on by specifying the system initialization parameter MN=ON. MN=OFF is the default setting. You can select the classes of monitoring data you want to be collected using the MNPER, and MNEXC system initialization parameters. You can request the collection of any combination of performance class data, and exception class data. The class settings can be changed whether monitoring itself is ON or OFF. For guidance about system initialization parameters, refer to the *CICS System Definition Guide*.

When CICS is running, you can control the monitoring facility dynamically. Just as at CICS initialization, you can switch monitoring on or off, and you can change the classes of monitoring data that are being collected. There are two ways of doing this:

1. You can use the master terminal CEMT INQ|SET MONITOR command, which is described in the *CICS-Supplied Transactions* manual.
2. You can use the EXEC CICS INQUIRE and SET MONITOR commands; programming information about these is in the *CICS System Programming Reference*.

If you activate a class of monitoring data in the middle of a run, the data for that class becomes available only for transactions that are started thereafter. You cannot change the classes of monitoring data collected for a transaction after it has started. It is often preferable, particularly for long-running transactions, to start all classes of monitoring data at CICS initialization.

Processing of CICS monitoring facility output

You may want to write your own application program to process output from the CICS monitoring facility. The *CICS Customization Guide* gives programming information about the format of this output.

CICS provides a sample program, DFH$MOLS, which reads, formats, and prints monitoring data. It is intended as a sample program that you can use as a skeleton if you need to write your own program to analyze the data set. Comments

within the program may help you if you want to do your own processing of CICS monitoring facility output. See the *CICS Operations and Utilities Guide* for further information on the DFH$MOLS program.

Performance implications

For information on the performance implications of using the CICS monitoring facility, see “CICS monitoring facility” on page 200.

Interpreting CICS monitoring

All of the exception class data and all of the system-defined performance class data that can be produced by CICS monitoring is listed below. Each of the data fields is presented as a field description, followed by an explanation of the contents. The field description has the format shown in Figure 4, which is taken from the performance data group DFHTASK.

```
001 (TYPE-C, 'TRAN', 4 BYTES)
 |       |       |       |
 |       |       |       Length of the field (as re-
 |       |       |       presented by CMODLENG in the
 |       |       |       dictionary entry).
 |       |       |
 |       |       Informal name for the field, as used,
 |       |       perhaps, in column headings when the
 |       |       monitoring output is postprocessed
 |       |       (CMODHEAD of the dictionary entry).
 |       |
 |      Data type, which may be one of the following:
 |        A - a 32-bit count
 |        C - a byte string
 |        P - a packed decimal value
 |        S - a clock comprising a 32-bit accumulation
 |            of 16-microsecond units followed by an
 |            8-bit flag followed by a 24-bit count
 |            (modulo-16 777 216) of the number of
 |            intervals included in the accumulation.
 |        T - a time stamp derived directly from the
 |            output of an STCK instruction.
 |       (CMODTYPE of the dictionary entry)
 |
Field identifier by which the field may be individually
excluded or included during MCT preparation (CMODIDNT of
the dictionary entry).
```

Figure 4. Format of the descriptions of the data fields

Note: In Figure 4 references to the associated dictionary entries apply only to the performance class data descriptions. Exception class data is not defined in the dictionary record.

Clocks and time stamps

In the descriptions that follow, the term **clock** is distinguished from the term **time stamp**.

A **clock** is a 32-bit value, expressed in units of 16 microseconds, accumulated during one or more measurement periods. The 32-bit value is followed by 8 reserved bits, which are in turn followed by a 24-bit value indicating the number of such periods.

Neither the 32-bit timer component of a clock nor its 24-bit period count are protected against wraparound. The timer capacity is about 18 hours, and the period count runs modulo 16 777 216.

The 8 reserved bits have the following significance:

Bits 0, 1, 2 and 3	Used for online control of the clock when it is running, and should always be zeros on output.
Bits 4 and 7	Not used.
Bits 5 and 6	Used to indicate, when set to 1, that the clock has suffered at least one out-of-phase start (bit 5) or stop (bit 6).

A **time stamp** is an 8-byte copy of the output of an STCK instruction.

Note: All times produced in the offline reports are in GMT (Greenwich Mean Time) not local time. Times produced by online reporting can be expressed in either GMT or local time.

Performance class data

The performance class data is described below in order of group name. The group name is always in field CMODNAME of the dictionary entry.

A user task can be represented by one or more performance class monitoring records, depending on whether the MCT event monitoring option DELIVER or the system initialization parameters MNCONV=YES or MNSYNC=YES have been selected. In the descriptions that follow, the term “user task” means “that part or whole of a transaction that is represented by a performance class record”, unless the description states otherwise.

A note about response time

You can calculate the internal CICS response time by subtracting performance data field 005 (start time) from performance data field 006 (stop time).

Figure 5 shows the relationship of dispatch time, suspend time, and CPU time with the response time.

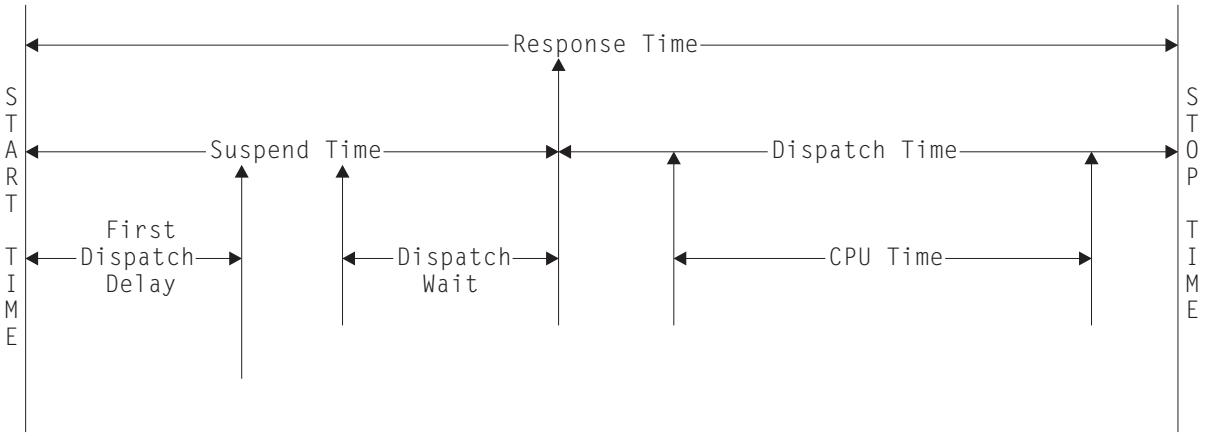

Figure 5. Response time relationships

A note about wait times

The performance data fields 009, 010, 011, 063, 100, 101, 129, 133, 134, 156, and 171. all record the elapsed time spent waiting for a particular type of I/O operation. For example, field 009 records the elapsed time waiting for terminal I/O. The elapsed time includes not only that time during which the I/O operation is actually taking place, but also the time during which the access method is completing the outstanding event control block, and the time subsequent to that until the waiting CICS transaction is redispatched.

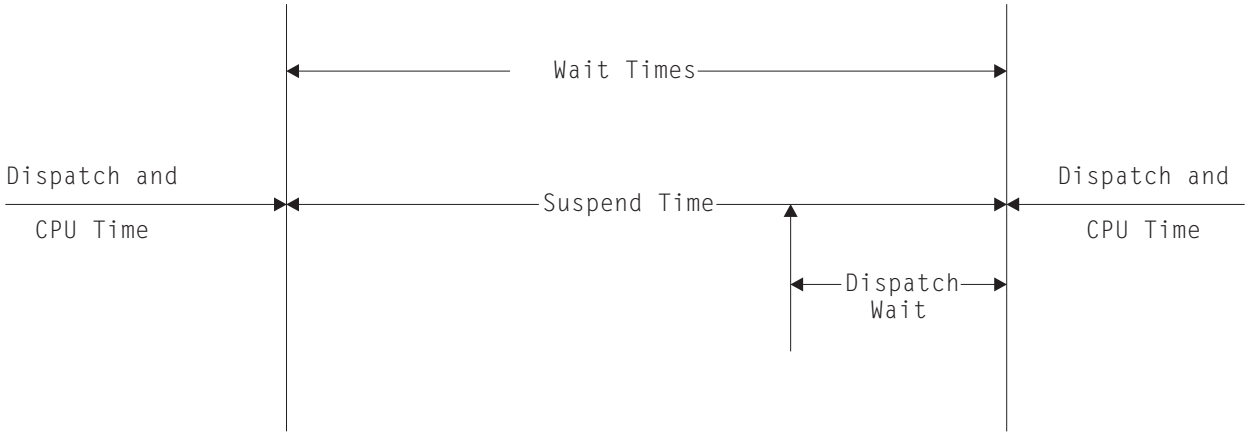

Figure 6. Wait time relationships

A note about program load time

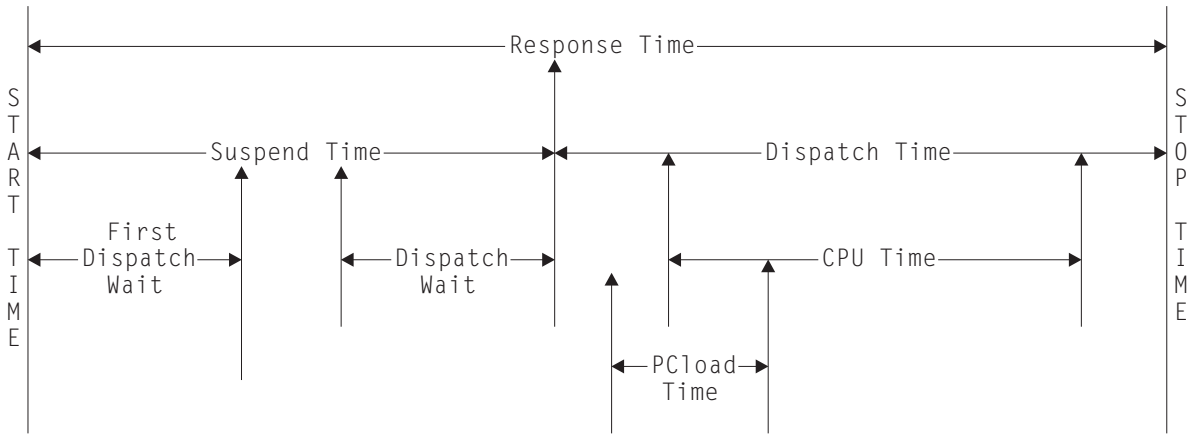

Figure 7. Program load time

Figure 7 shows the relationship between the program load time (field 115) and the dispatch time and the suspend time (fields 7 and 14).

A note about exception wait time

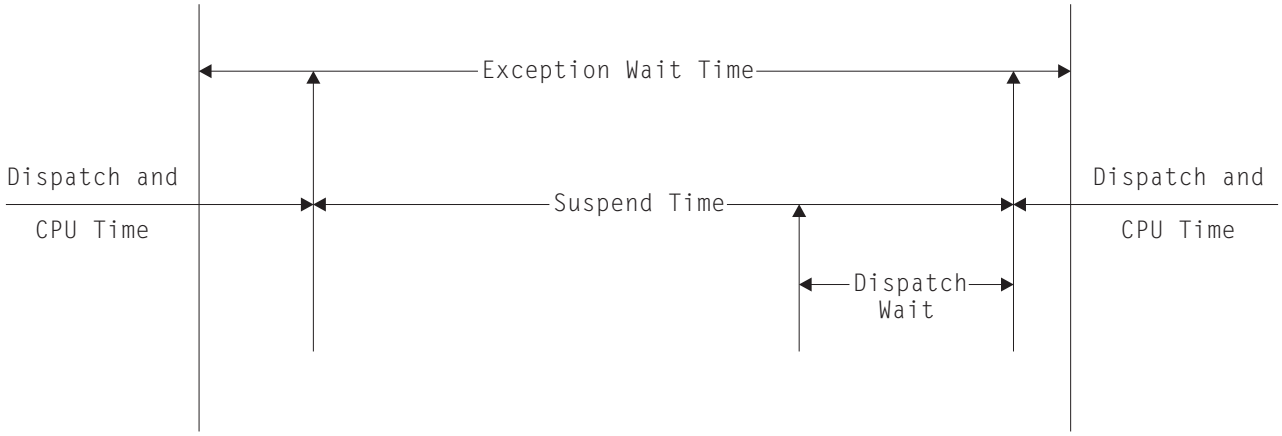

Figure 8. Exception wait time

Figure 8 shows the relationship between the exception wait time (field 103), and the dispatch time and suspend time (fields 7 and 14).

A note about RMI elapsed and suspend time

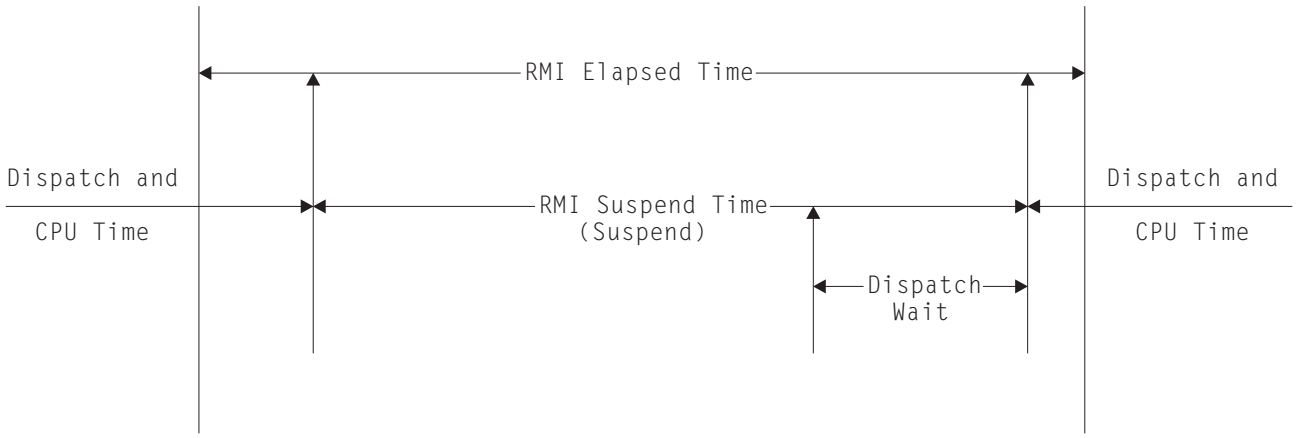

Figure 9. RMI elapsed and suspend time

Figure 9 shows the relationship between the RMI elapsed time and the suspend time (fields 170 and 171).

A note about storage occupancy counts

An occupancy count measures the area under the curve of user-task storage in use against elapsed time. The unit of measure is the "byte-unit", where the "unit" is equal to 1024 microseconds, or 1.024 milliseconds. Where *ms* is milliseconds, a user task occupying, for example, 256 bytes for 125 milliseconds, is measured as follows:

125 / 1.024 *ms* = 122 units * 256 = 31 232 byte-units.

Note: All references to "Start time" and "Stop time" in the calculations below refer to the middle 4 bytes of each 8 byte start/stop time field. Bit 51 of Start time or Stop time represents a unit of 16 microseconds.

To calculate response time and convert into microsecond units:
Response = ((Stop time − Start time) * 16)
To calculate the number of 1024 microsecond "units":
Units = (Response / 1024)
or
Units = ((Stop time − Start time) / 64)
To calculate the average user-task storage used from the storage occupancy count:
Average user-task = storage used (Storage Occupancy / Units)

To calculate units per second:
Units Per Second = (1 000 000 / 1024) = 976.5625
To calculate the response time in seconds:
Response time = (((Stop time − Start time) * 16) / 1 000 000)

During the life of a user task CICS measures, calculates, and accumulates the storage occupancy at the following points:

- Before GETMAIN increases current user-storage values
- Before FREEMAIN reduces current user-storage values
- Just before the performance record is moved to the buffer.

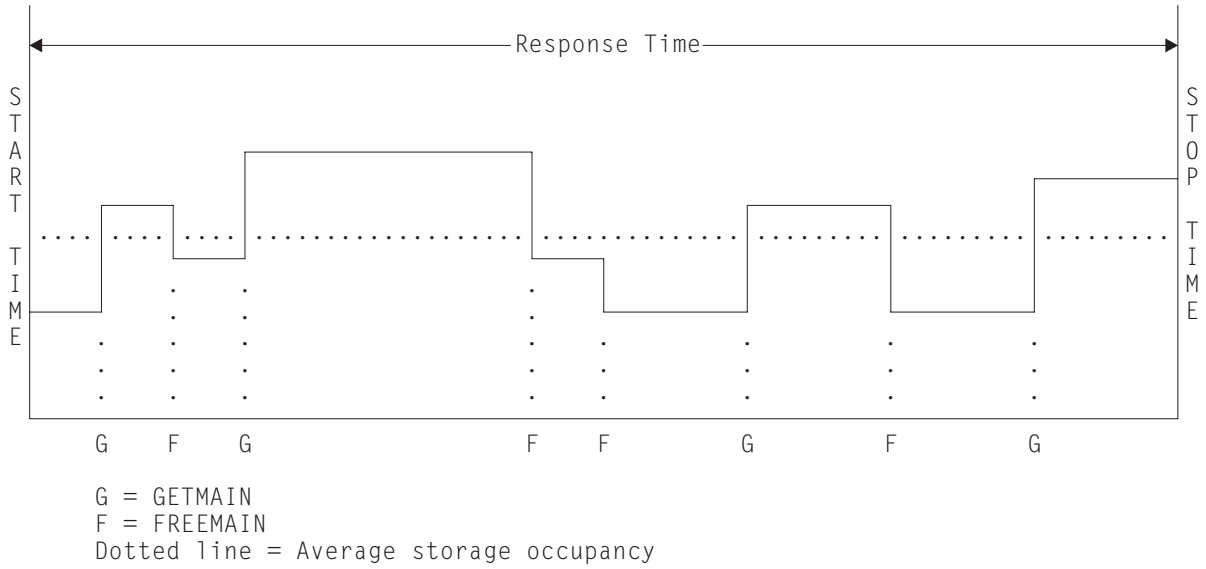

Figure 10. Storage occupancy

A note about program storage

The level of program storage currently in use is incremented at LOAD, LINK, and XCTL events by the size (in bytes) of the referenced program, and is decremented at RELEASE or RETURN events.

Note: On an XCTL event, the program storage currently in use is also decremented by the size of the program issuing the XCTL, because the program is no longer required.

Figure 11 on page 68 shows the relationships between the “high-water mark” data fields that contain the maximum amounts of program storage in use by the user task. Field PCSTGHWM (field ID 087) contains the maximum amount of program storage in use by the task both above **and** below the 16MB line. Fields PC31AHWM (139) and PC24BHWM (108) are subsets of PCSTGHWM, containing the maximum amounts in use above and below the 16MB line, respectively. Further subset-fields contain the maximum amounts of storage in use by the task in each of the CICS dynamic storage areas (DSAs).

Note: The totaled values of all the subsets in a superset may not necessarily equate to the value of the superset; for example, the value of PC31AHWM plus the value of PC24BHWM may not equal the value of PCSTGHWM. This is because the peaks in the different types of program storage acquired by the user task do not necessarily occur simultaneously.

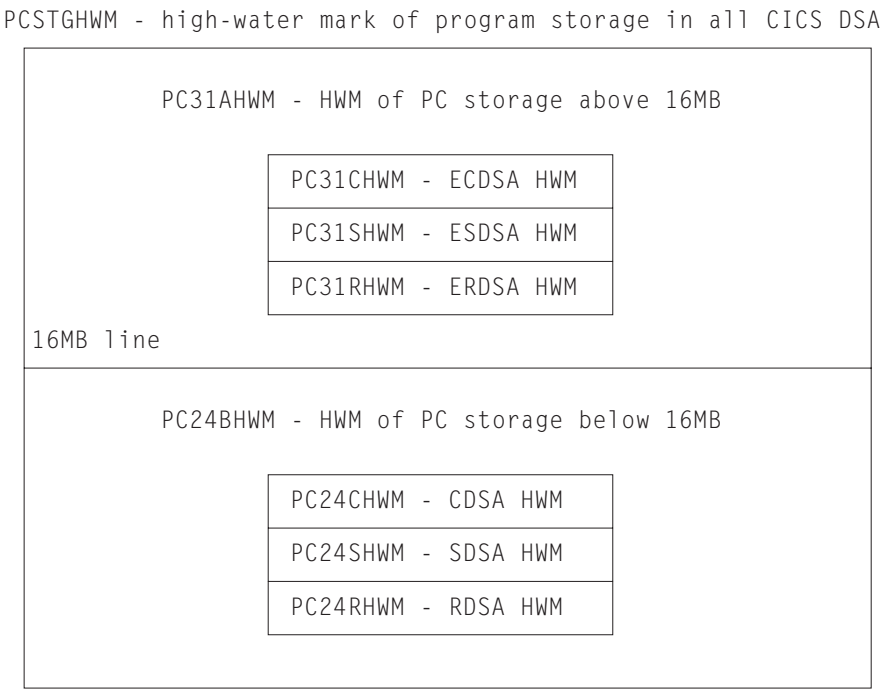

Figure 11. Relationships between the "high-water mark" program storage data fields

Part 3. Analyzing the performance of a CICS system

This part gives an overview of performance analysis, identifies performance constraints, and describes various techniques for performance analysis.

Chapter 7. Overview of performance analysis

There are four main uses for performance analysis:

1. You currently have no performance problems, but you simply want to adjust the system to give better performance, and you are not sure where to start.
2. You want to characterize and calibrate individual stand-alone transactions as part of the documentation of those transactions, and for comparison with some future time when, perhaps, they start behaving differently.
3. A system is departing from previously identified objectives, and you want to find out precisely where and why this is so. Although an online system may be operating efficiently when it is installed, the characteristics of the system usage may change and the system may not run so efficiently. This inefficiency can usually be corrected by adjusting various controls. At least some small adjustments usually have to be made to any new system as it goes live.
4. A system may or may not have performance objectives, but it appears to be suffering severe performance problems.

If you are in one of the first two categories, you can skip this chapter and the next and go straight to Chapter 9, " CICS performance analysis" on page 91.

If the current performance does ***not*** meet your needs, you should consider tuning the system. The basic rules of tuning are:

1. Identify the major constraints in the system.
2. Understand what changes could reduce the constraints, possibly at the expense of other resources. (Tuning is usually a trade-off of one resource for another.)
3. Decide which resources could be used more heavily.
4. Adjust the parameters to relieve the constrained resources.
5. Review the performance of the resulting system in the light of:
   - Your existing performance objectives
   - Progress so far
   - Tuning effort so far.
6. Stop if performance is acceptable; otherwise do one of the following:
   - Continue tuning
   - Add suitable hardware capacity
   - Lower your system performance objectives.

The tuning rules can be expressed in flowchart form as follows:

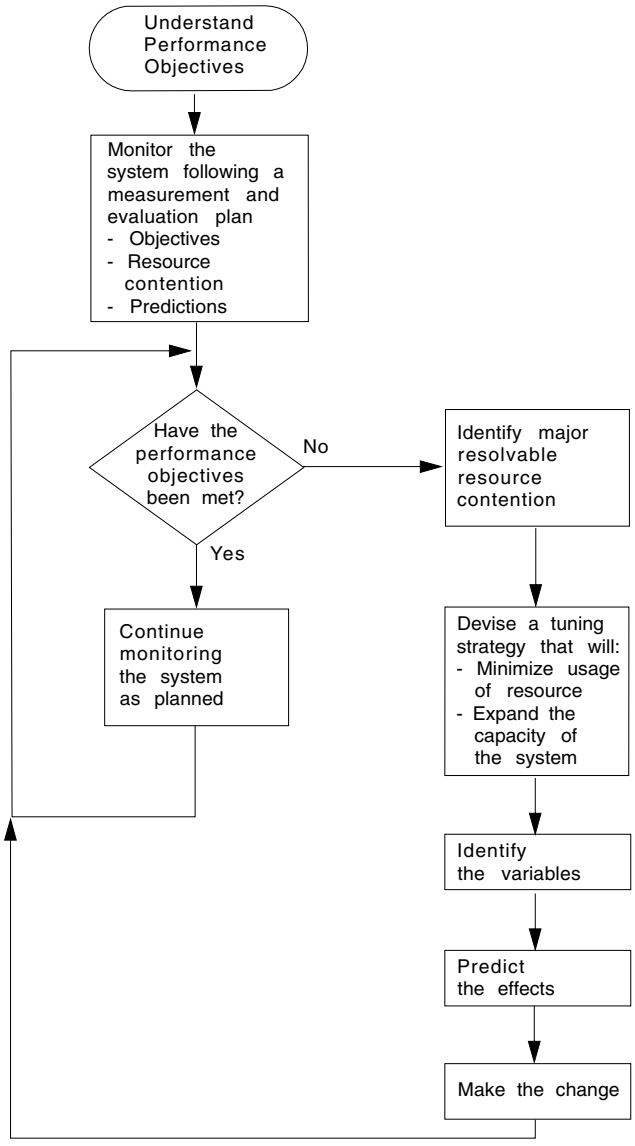

Figure 12. Flowchart to show rules for tuning performance

Establishing a measurement and evaluation plan

For some installations, a measurement and evaluation plan might be suitable. A measurement and evaluation plan is a structured way to measure, evaluate, and monitor the system's performance. By taking part in setting up this plan, the users, user management, and your own management will know how the system's performance is to be measured. In addition, you will be able to incorporate some of their ideas and tools, and they will be able to understand and concur with the plan, support you and help you to feel part of the process, and provide you with feedback.

The implementation steps for this plan are:

1. Devise the plan
2. Review the plan
3. Implement the plan
4. Revise and upgrade the plan as necessary.

Major activities in using the plan are:

- Collecting information periodically to determine:
  - Whether objectives have been met
  - Transaction activity
  - Resource utilization.
- Summarizing and analyzing the information. For this activity:
  - Plot volumes and averages on a chart at a specified frequency
  - Plot resource utilization on a chart at a specified frequency
  - Log unusual conditions on a daily log
  - Review the logs and charts weekly.
- Making or recommending changes if objectives have not been met.
- Relating past, current, and projected:
  - Transaction activity
  - Resource utilization

  to determine:
  - If objectives continue to be met
  - When resources are being used beyond an efficient capacity.
- Keeping interested parties informed by means of informal reports, written reports, and monthly meetings.

A typical measurement and evaluation plan might include the following items as objectives, with statements of recording frequency and the measurement tool to be used:

- Volume and response time for each department
- Network activity:
  - Total transactions
  - Tasks per second
  - Total by transaction type
  - Hourly transaction volume (total, and by transaction).

- Resource utilization examples:
  - DSA utilization
  - Processor utilization with CICS
  - Paging rate for CICS and for the system
  - Channel utilization
  - Device utilization
  - Data set utilization
  - Line utilization.
- Unusual conditions:
  - Network problems
  - Application problems
  - Operator problems
  - Transaction count for entry to transaction classes
  - SOS occurrences
  - Storage violations
  - Device problems (not associated with the communications network)
  - System outage
  - CICS outage time.

Investigating the overall system

Always start by looking at the overall system before you decide that you have a specific CICS problem. The behavior of the system as a whole is usually just as important. You should check such things as total processor usage, DASD activity, and paging.

Performance degradation is often due to application growth that has not been matched by corresponding increases in hardware resources. If this is the case, solve the hardware resource problem first. You may still need to follow on with a plan for multiple regions.

Information from at least three levels is required:

1. **CICS**: Examine the CICS interval or end-of-day statistics for exceptions, queues, and other symptoms which suggest overloads on specific resources. A shorter reporting period can isolate a problem. Consider software as well as hardware resources: for example, utilization of VSAM strings or database threads as well as files and TP lines. Check run time messages sent to the console and to transient data destinations, such as CSMT and CSTL, for persistent application problems and network errors.

   Use tools such as CEMT to monitor the online system and identify activity which correlates to periods of bad performance. Collect CICS monitoring facility history and analyze it to identify performance and resource usage exceptions and trends. For example, processor-intensive transactions which do little or no I/O should be noted. After they get control, they can monopolize the processor. This can cause an erratic response in other transactions with more normally balanced activity profiles. They may be candidates for isolation in another CICS region.
2. **VSE**: Use DMF data to discover any relationships between periods of bad CICS performance and other concurrent activity in the VSE system. Monitor CICS region paging rates to make sure that there is sufficient real storage to support the configuration.

3. **Network**: The proportion of response time spent in the system is usually small compared with transmission delays and queuing in the network. Identify problems and overloads in the network with an automatic tool such as Netview. Without automatic tools you are dependent on the application users' subjective opinions that performance has deteriorated. This makes it more difficult to know how much worse performance has become and to identify the underlying reasons.

Within CICS, the performance problem is either a poor response time or an unexpected and unexplained high use of resources. In general, you need to look at the system in some detail to see why tasks are progressing slowly through the system, or why a given resource is being used heavily. The best way of looking at detailed CICS behavior is by using CICS auxiliary trace. But note that switching on auxiliary trace, though the best approach, may actually worsen existing poor performance while it is in use (see page 201).

The approach is to get a picture of task activity first, listing only the task traces, and then to focus on particular activities: specific tasks, or a very specific time interval. For example, for a response time problem, you might want to look at the detailed traces of one task that is observed to be slow. There may be a number of possible reasons.

The tasks may simply be trying to do too much work for the system. You are asking it to do too many things, which takes time. The users are trying to put too much through a system that cannot do all the work that they want done.

Another possibility is that the system is real-storage constrained, and therefore the tasks progress more slowly than expected because of paging interrupts. These would show as delays between successive requests recorded in the CICS trace.

Yet another possibility is that many of the CICS tasks are waiting because there is contention for a particular function. There is a wait on strings on a particular data set, for example, or there is an application enqueue such that all the tasks issue an enqueue for a particular item, and most of them have to wait while one task actually does the work. Auxiliary trace enables you to distinguish most of these cases.

Other ways to analyze performance

Potentially, any performance measurement tool, including statistics and the CICS monitoring facility, may tell you something about your system that help in diagnosing problems. You should regard each performance tool as usable to some degree for each purpose: monitoring, single-transaction measurement, and problem determination.

Again, CICS statistics may reveal heavy use of some resource. For example, you may find a very large allocation of temporary storage in main storage, a very high number of storage control requests per task (perhaps 50 or 100), or high program use counts that may imply heavy use of program control LINK.

Both statistics and CICS monitoring may show exceptional conditions arising in the CICS run. Statistics can show waits on strings, waits for VSAM shared resources, waits for storage in EXEC CICS GETMAIN requests, and so on. These also generate CICS monitoring facility exception class records.

While these conditions are also evident in CICS auxiliary trace, they may not appear so obviously, and the other information sources are useful in directing the investigation of the trace data.

In addition, you may gain useful data from the investigation of CICS outages. If there is a series of outages, common links between the outages should be investigated.

Chapter 8, “Identifying CICS constraints” on page 77 tells you how to identify the various forms of CICS constraints, and Chapter 9, “ CICS performance analysis” on page 91 gives you more information on performance analysis techniques.

Chapter 8. Identifying CICS constraints

If current performance has been determined to be unacceptable, you need to identify the performance constraints (that is, the causes of the symptoms) so that they can be tuned.

Constraints on a CICS system are discussed in the following topics:

Major CICS constraints

Major constraints on a CICS system show themselves in the form of external symptoms: stress conditions and paging being the chief forms. This chapter describes these symptoms in some detail so that you can recognize them when your system has a performance problem, and know the ways in which CICS itself attempts to resolve various conditions.

The fundamental thing that has to be understood is that practically every symptom of poor performance arises in a system that is congested. You can get task constraints, your MXT or transaction class limit is exceeded (adding to the processor overhead because of retries) for some of the following reasons:

- If there is a slowdown in DASD
- If transactions doing data set activity pile up:
- If there are waits on strings
- If there are more transactions in the system
- If there is a greater virtual storage demand
- If there is a greater real storage demand
- If there is paging
- If there are more transactions in the system, the task dispatcher uses more processor power scanning the task chains.

The result is that the system shows heavy use of ***all*** its resources, and this is the typical system stress. It does not mean that there is a problem with all of them; it means that there is a constraint that has yet to be found. To find the constraint, you have to find what is really affecting task life.

Response times

The basic criterion of performance in a production system is response time, but what is good response time? In straightforward data-entry systems, good response time implies subsecond response time. In normal production systems, good response time is measured in the five to ten second range. In scientific, compute-bound systems or in print systems, good response time can be one or two minutes.

Good performance, then, depends on a variety of factors including user requirements, available capacity, system reliability, and application design. Good performance for one system can be poor performance for another.

When checking whether the performance of a CICS system is in line with the system's expected or required capability, you should base this investigation on the hardware, software, and applications that are present in the installation.

If, for example, an application requires 100 accesses to a database, a response time of three to six seconds may be considered to be quite good. If an application requires only one access, however, a response time of three to six seconds for disk accesses would need to be investigated. Response times, however, depend on the speed of the processor, and on the nature of the application being run on the production system.

You should also observe how consistent the response times are. Sharp variations indicate erratic system behavior.

The typical way in which the response time in the system may vary with increasing transaction rate is gradual at first, then deteriorates rapidly and suddenly. The typical curve shows a sharp change when, suddenly, the response time increases dramatically for a relatively small increase in the transaction rate.

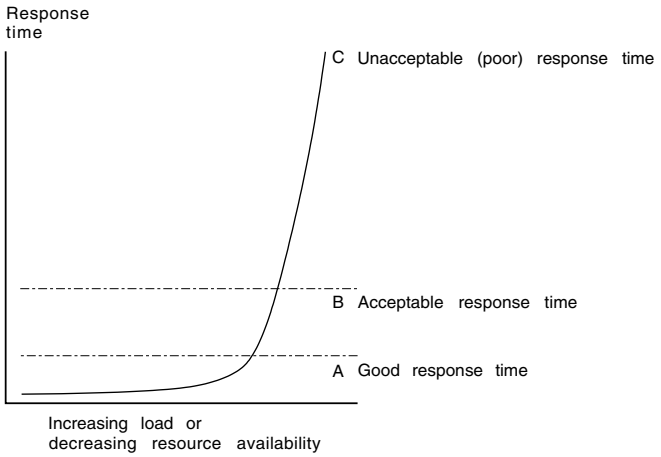

Figure 13. Graph to show the effect of response time against increasing load

For stable performance, it is necessary to keep the system operating below this point where the response time dramatically increases. In these circumstances, the user community is less likely to be seriously affected by the tuning activities being undertaken by the DP department, and these changes can be done in an unhurried and controlled manner.

Response time can be considered as being made up of queue time and service time. Service time is generally independent of usage, but queue time is not. For example, 50% usage implies a queue time approximately equal to service time, and 80% usage implies a queue time approximately four times the service time. If service time for a particular system is only a small component of the system response (for example, in the processor) 80% usage may be acceptable. If it is a greater portion of the system response time, for example, in a communication line, 50% usage may be considered high.

If you are trying to find the response time from a terminal to a terminal, you should be aware that the most common “response time” obtainable from any aid or tool that runs in the host is the “internal response time”. Trace can identify only when the software in the host, that is, CICS and its attendant software, first “sees” the message on the inbound side, and when it last “sees” the message on the outbound side.

Internal response time gives no indication of how long a message took to get from the terminal, through its control unit, across a line of whatever speed, through the communication controller (whatever it is), through the communication access method (whatever it is), and any delays before the channel program that initiated the read is finally posted to CICS. Nor does it account for the time it might take for CICS to start processing this input message. There may have been lots of work for CICS to do before terminal control regained control and before terminal control even found this posted event.

The same is true on the outbound side. CICS auxiliary trace knows when the application issued its request, but that has little to do with when terminal control found the request, when the access method ships it out, when the controllers can get to the device, and so on.

While the outward symptom of poor performance is overall bad response, there are progressive sets of early warning conditions which, if correctly interpreted, can ease the problem of locating the constraint and removing it.

In the advice given so far, we have assumed that CICS is the only major program running in your system. If batch programs or other online programs are running simultaneously with CICS, you must ensure that CICS receives its fair share of the system resources and that interference from other regions does not seriously degrade CICS performance.

Storage stress

Stress is the term used in CICS for a shortage of free space in one of the dynamic storage areas.

Storage stress can be a symptom of other resource constraints that cause CICS tasks to occupy storage for longer than is normally necessary, or of a flood of tasks which simply overwhelms available free storage, or of badly designed applications that require unreasonably large amounts of storage.

Controlling storage stress

Control of storage stress is necessary to avoid the major disturbance to transaction throughput and response time that could result from dynamic program storage compression. (The removal of ***all*** nonresident, not-in-use programs which previous versions implemented when a GETMAIN request could not be satisfied.)

Nonresident, not-in-use programs may be deleted progressively with decreasing free storage availability as CICS determines appropriate, on a least-recently-used basis. The dispatching of new tasks is also progressively slowed as free storage approaches a critically small amount. This self-tuned activity tends to spread the cost of managing storage. There may be less or more program loading overall, but the heavy overhead of a full program compression is not incurred at the critical time.

The loading or reloading of programs is handled by CICS with a VSE subtask. This allows other user tasks to proceed in parallel with the program load.

User runtime control of storage usage is achieved through appropriate use of MXT and transaction class limits, (which may alter XDSALIMIT dynamically). This is necessary to avoid the short-on-storage condition that can result from unconstrained demand for storage.

Short-on-storage condition

CICS reserves a minimum number of free storage pages for use only when there is not enough free storage to satisfy an unconditional GETMAIN request even when all not-in-use nonresident programs have been deleted, called a cushion.

Whenever a request for storage results in the number of free pages in one of the dynamic storage areas falling below its respective cushion size, or failing to be satisfied even with the storage cushion, a cushion stress condition exists. Details are given in the storage manager statistics (“Times request suspended,” “Times cushion released”). CICS attempts to alleviate the storage stress situation by releasing programs with no current user and slowing the attachment of new tasks. If these actions fail to alleviate the situation or if the stress condition is caused by a task that is suspended for SOS, a short-on-storage condition is signaled. This is accompanied by message DFHSM0131 or DFHSM0133.

Purging of tasks

If a CICS task is suspended for longer than its DTIMOUT value, it may be purged. That is, the task is abended and its resources freed, thus allowing other tasks to use those resources. In this way, CICS attempts to resolve what is effectively a deadlock on storage.

CICS abend

If purging tasks is not possible or not sufficient to solve the problem, CICS ceases processing. You must then either cancel and restart the CICS system, or initiate or allow an XRF takeover.

What is paging?

The virtual storage of a processor may far exceed the size of the central storage available in the configuration. Any excess must be maintained in auxiliary storage (DASD), or in expanded storage. This virtual storage occurs in blocks of addresses called “pages”. Only the most recently referenced pages of virtual storage are assigned to occupy blocks of physical central storage. When reference is made to a page of virtual storage that does not appear in central storage, the page is brought in from DASD or expanded storage to replace a page in central storage that is not in use and least recently used.

The newly referenced page is said to have been “paged in”. The displaced page may need to be “paged out” if it has been changed.

Paging problems

It is the **page-in** rate that is of primary concern, because page-in activity occurs synchronously Page-out activity is overlapped with CICS processing, so it does not appreciably affect CICS throughput.

A page-in from expanded storage incurs only a small processor usage cost, but a page-in from DASD incurs a time cost for the physical I/O and a more significant increase in processor usage.

Thus, extra DASD page-in activity slows down the rate at which transactions flow through the CICS system. Transactions take longer to get through CICS, you get more overlap of transactions in CICS, and so you need more virtual and real storage.

If you suspect that a performance problem is related to excessive paging, you can use system activity tools for more information, such as VMPRF or RTM/ESA if you run VSE/ESA as a VM guest. If you have ICCF, you can use the Display Activity screen to view system paging information.

Consider controlling CICS throughput by using MXT and transaction class limits in CICS, or the DL/I MAXTASK specification in the DLZACT, on the basis that a smaller number of concurrent transactions require less real storage, cause less paging, and can be processed faster than a larger number of transactions.

What is an ideal CICS paging rate from DASD? Less than one page-in per second is best to maximize the throughput capacity of the CICS region. Anything less than five page-ins per second is probably acceptable; up to ten may be tolerable. Ten per second is marginal, more is probably a major problem. Because CICS performance can be affected by the waits associated with paging, you should not allow paging to exceed more than five to ten pages per second.

Note: The degree of sensitivity of CICS systems to paging from DASD depends on the transaction rate, the processor loading, and the average internal lifetime of the CICS tasks. An ongoing, hour-on-hour rate of even five page-faults per second may be excessive for some systems, particularly when you realize that peak paging rates over periods of ten seconds or so could easily be four times that figure.

What paging rates are excessive on various processors and are these rates operating-system dependent? Excessive paging rates should be defined as those which cause excessive delays to applications. The contribution caused by the

high-priority paging supervisor executing instructions and causing applications to wait for the processor is probably a minor consideration as far as overall delays to applications are concerned. Waiting on a DASD device is the dominant part of the overall delays. This means that the penalty of “high” paging rates has almost nothing to do with the processor type.

CICS systems are usually able to deliver much better response times with somewhat better processor utilization when the potential of large amounts of central and expanded storage is exploited by keeping more data and programs in memory.

Recovery from storage violation

CICS can detect storage violations when:

- The duplicate storage accounting area (SAA) or the initial SAA of a TIOA storage element has become corrupted.
- The leading storage check zone or the trailing storage check zone of a user task storage has become corrupted.

A storage violation can occur in two basic situations:

1. When CICS detects an error during its normal processing of a FREEMAIN request for an individual element of a TIOA storage, and finds that the two storage check zones of the duplicate SAA and the initial SAA are not identical
2. CICS also detects user violations involving user task storage by checking the storage check zones of an element of user task storage following a FREEMAIN command.

When a storage violation is detected, an exception trace entry is made in the internal trace table. A message (DFHSM0102) is issued and a CICS system dump follows if the dump option is switched on.

Storage violations can be reduced considerably if CICS has storage protection, and command protection (CMDPROT) enabled.

See the *CICS Problem Determination Guide*. for further information about diagnosing and dealing with storage violations.

Dealing with limit conditions

The main limit conditions or constraints that can occur in a CICS system include those listed at the beginning of this chapter. Stress conditions generally tell you that certain limiting conditions have been reached. If these conditions occur, additional processing is required, and the transactions involved have to wait until resources are released.

To summarize, limit conditions can be indicated by the following:

- Virtual storage conditions (“short-on-storage”: SOS). This item in the CICS storage manager statistics shows a deficiency in the allocation of virtual storage space to the CICS region.

  In most circumstances, allocation of more virtual storage does not in itself cause a degradation of performance. You should determine the reason for the condition in case it is caused by some form of error. This could include failure

of applications to free storage (including temporary storage), unwanted multiple copies of programs or maps, storage violations, and high activity of nonresident exception routines caused by program or hardware errors.

All new applications should be written to run above the 16MB line. The dynamic storage areas above the 16MB line can be expanded up to the 2GB limit of 31-bit addressing. The dynamic storage areas below the 16MB line are limited to less than 16MB.

- Number of simultaneous tasks (MXT and transaction class limit) reached (shown in the transaction manager statistics).
- Maximum number of VTAM receive-any RPLs in use (shown in the VTAM statistics).
- 'Wait-on-string' and associated conditions for VSAM data sets (shown in the file control statistics).

Check how frequently the limit conditions occur. In general:

- If **no** limit conditions occur, this implies that too many resources have been allocated. This is quite acceptable if the resource is inexpensive, but not if the resource is both overallocated and of more use elsewhere.
- **Infrequent** occurrence of a limit condition is an indication of good usage of the particular resource. This usually implies a healthy system.
- **Frequent** occurrence (greater than 5% of transactions) usually reveals a problem, either directly or indirectly, that needs action to prevent more obvious signs of poor performance. If the frequency is greater than about 10%, you may have to take some action quickly because the actions taken by CICS itself (dynamic program storage compression, release of storage cushion, and so on) can have a perceptible effect on performance.

  Your own actions should include:

  – Checking for errors

  – Raising the limit, provided that it does not have a degrading effect on other areas

  – Allocating more resources to remove contention

  – Checking recovery usage for contention.

Identifying performance constraints

When you are dealing with limit conditions, you may find it helpful to check the various points where performance constraints can exist in a system. These points are summarized below under hardware and software constraints.

Hardware constraints

1. **Processor cycles**. It is not uncommon for transactions to execute more than one million instructions. To execute these instructions, they must contend with other tasks and jobs in the system. At different times, these tasks must wait for such activities as file I/O. Transactions give up their use of the processor at these points and must contend for use of the processor again when the activity has completed. Dispatching priorities affect which transactions or jobs get use of the processor, and batch or other online systems may affect response time

through receiving preferential access to the processor. Batch programs accessing online databases also tie up those databases for longer periods of time if their dispatching priority is low. At higher usages, the wait time for access to the processor can be significant.

2. **Real storage (working set)**. Just as transactions must contend for the processor, they also must be given a certain amount of real storage. A real storage shortage can be particularly significant in CICS performance because a normal page fault to acquire real storage results in synchronous I/O. The basic design of CICS is asynchronous, which means that CICS processes requests from multiple tasks concurrently to make maximum use of the processor. Most paging I/O is synchronous and causes the VSE task that CICS is using to wait, and that part of CICS cannot do any further processing until the page operation completes. Most, but not all, of CICS processing uses a single VSE task (called 'QUASI' in the dispatcher statistics).
3. **Database-associated hardware (I/O) contention**. When data is being accessed to provide information that is required in a transaction, an I/O operation passes through the processor, the processor channel, a disk control unit, the head of string on a string of disks, and the actual disk device where the data resides. If any of these devices are overused, the time taken to access the data can increase significantly. This overuse can be the result of activity on one data set, or on a combination of active data sets. Error rates also affect the usage and performance of the device. In shared DASD environments, contention between processors also affects performance. This, in turn, increases the time that the transaction ties up real and virtual storage and other resources.

   The use of large amounts of central and expanded storage by using very large data buffers, and by keeping programs in storage, can significantly reduce DB I/O contention and somewhat reduce processor utilization while delivering significant internal response time benefits.
4. **Network-associated hardware contention**. The input and output messages of a transaction must pass from the terminal to a control unit, a communications link, a network controller, a processor channel, and finally the processor. Just as overuse of devices to access data can affect response time, so excessive use of network resources can cause performance degradation. Error rates affect performance as well. In some cases, the delivery of the output message is a prerequisite to freeing the processor resources that are accessed, and contention can cause these resources to be tied up for longer periods.

Software constraints

1. **Database design**. A data set or database needs to be designed to the needs of the application it is supporting. Such factors as the pattern of access to the data set (especially whether it is random or sequential), access methods chosen, and the frequency of access determine the best database design. Such data set characteristics as physical record size, blocking factors, the use of alternate or secondary indexes, the hierarchical or relational structure of database segments, database organization (HDAM, HIDAM, and so on), and pointer arrangements are all factors in database performance.

   The length of time between data set reorganizations can also affect performance. The efficiency of accesses decreases as the data set becomes more and more fragmented. This fragmentation can be kept to the minimum by reducing the length of time between data set reorganizations.

2. **Network design**. This item can often be a major factor in response time because the network links are much slower than most components of an online system. Processor operations are measured in nanoseconds, line speeds in seconds. Screen design can also have a significant effect on overall response time. A 1200-byte message takes one second to be transmitted on a relatively high-speed 9600 bits-per-second link. If 600 bytes of the message are not needed, half a second of response time is wasted. Besides screen design and size, such factors as how many terminals are on a line, the protocols used (SNA, bisynchronous), and full-or half-duplex capabilities can affect performance.
3. **Use of specific software interfaces or serial functions**. The operating system, terminal access method, database manager, data set access method, and CICS must all communicate in the processing of a transaction. Only a given level of concurrent processing can occur at these points, and this can also cause a performance constraint. Examples of this include the VTAM receive any pool (RAPOOL), VSAM data set access (strings), CICS temporary storage, CICS transient data, and CICS intercommunication sessions. Each of these can have a single or multiserver queueing effect on a transaction's response time, and can tie up other resources by slowing task throughput.

One useful technique for isolating a performance constraint in a CICS system with VTAM is to use the IBMTEST command issued from a user's terminal. This terminal must not be in session with CICS, but must be connected to VTAM.

You enter at a VTAM terminal:

```
IBMTEST (n)(,data)
```

where *n* is the number of times you want the data echoed, and *data* may consist of any character string. If you enter no data, the alphabet and the numbers zero through nine are returned to the terminal. This command is responded to by VTAM.

IBMTEST is an echo test designed to give the user a rough idea of the VTAM component of terminal response time. If the response time is fast in a slow-response system, the constraint is not likely to be any component from VTAM onward. If this response is slow, VTAM or the network may be the reason. This sort of deductive process in general can be useful in isolating constraints.

To avoid going into session with CICS, you may have to remove APPLID= from the LU statement or specify AUTOCONNECT(NO) in the RDO TYPETERM definition for the terminal.

Resource contention

The major resources used or managed by CICS consist of the following:

- Processor
- Real storage
- Virtual storage
- Software (specification limits)
- Channels
- Control units
- Lines
- Devices

- Sessions to connected CICS systems.

Contention at lower levels prevents full use of higher-level resources. To avoid or reduce resource contention, you can:

- Minimize or eliminate the use of a resource by:
  - Reordering, relocating, or reducing its size
  - Redesigning, rewriting, rescheduling, or reducing processing time
  - Educating, eliminating a function, or controlling its usage.
- Give the resource more capacity
- Exchange one resource with another:
  - Processor with virtual storage
  - Real storage with paging I/O
  - Paging I/O with program library I/O
  - Priorities of various end-users with each other
  - CICS response times with batch throughput
  - Batch throughput with more DP operators.

Two sets of “Symptoms and Solutions” are provided in this chapter. The first set provides suggested solutions for poor response, and the second set provides suggested solutions for a variety of resource contention problems.

Solutions for poor response time

Table 5 shows four levels of response time, in decreasing order of severity. The major causes are shown for each level together with a range of suggested solutions. Your first step is to check the causes by following the advice given in Chapter 9, “ CICS performance analysis” on page 91. When you have identified the precise causes, the relevant checklist in Chapter 11, “ Performance checklists” on page 105 tells you what solutions are available and where to find information in Part 4 of this book on how to implement the solutions.

Table 5 (Page 1 of 2). CICS response time checklist

Level	Symptom	Major Causes	Overall Solution
1	Poor response at all loads for all transactions	High level of paging	Reduce working set, or allocate more real storage
		Very high usage of major resources	Reconsider system resource requirements and redesign system Check for application errors and resource contention

Table 5 (Page 2 of 2). CICS response time checklist

Level	Symptom	Major Causes	Overall Solution
2	Poor response at medium and high loads	High level of paging	Reduce working set, or allocate more real storage
		High processor usage	Reduce pathlength, or increase processor power
		High DB or data set usage	Reorganize data sets, reduce data transfer, or increase capacity
		High communication network usage	Reduce data transfer, or increase capacity
		TP or I/O access-method constraint	Increase buffer availability
		CICS limit values exceeded	Change operands, provide more resources, or check if errors in application
3	Poor response for certain transactions only	Identify common characteristics	As for level 2
		Lines or terminal usage	Increase capacity, reduce data transfer, or change transaction logic or data set design
		Data set usage	Change data set placement buffer allocations or change enqueue logic or data set design
		High storage usage	Redesign or tune applications
		Same subprograms as affected transaction	Redesign or tune application subprograms
		Same access method or CICS features as used by transaction	Reallocate resource or change application. Reevaluate use of feature in question
		Limit conditions	Reallocate resource or change application
4	Poor response for certain terminals	Check network loading as appropriate	Increase capacity of that part of network
		Check operator techniques	Revise terminal procedures
		Check CEDA or TCT generation	Redefine CEDA or TCT entries

Symptoms and solutions for resource contention problems

This section presents a general range of solutions for each type of constraint. You should:

1. Confirm that your diagnosis of the type of constraint is correct, by means of detailed performance analysis. Chapter 9, " CICS performance analysis" on page 91 describes various techniques.
2. Read Chapter 10, " Tuning the system" on page 99 for general advice on performance tuning.
3. See the relevant sections in Part 4 of this book for detailed information on applying the various solutions.
4. Improve virtual storage exploitation. This requires:
   - Large data buffers above the 16MB line
   - Programs that run above the 16MB line
   - Large amounts of central and expanded storage to support the virtual storage exploitation.

   Such a system can deliver better internal response times, while minimizing DASD I/O constraint and reducing processor utilization.

DASD constraint

Symptoms

- Slow response times (the length of the response time depends on the number of I/O operations, with a longer response time when batch mode is active)
- High DSA utilization
- High paging rates
- MXT limit frequently reached
- SOS condition often occurs.

Solutions

- Reduce the number of I/O operations.
- Tune the remaining I/O operations.
- Balance the I/O operations load.

See "DASD tuning" on page 116 for suggested solutions.

Communications network constraint

Symptoms

- Slow response times
- Good response when few terminals are active on a line, but poor response when many terminals are active on that line
- Big difference between internal response time and terminal response time.

Solutions

- Reduce the line utilization.
- Reduce delays in data transmission.
- Alter the network.

Remote systems constraints

Symptoms

- SOS condition or MXT occur when there is a problem with a connected region.
- CICS takes time to recover when the problem is fixed.

Solutions

- Control the amount of queuing which takes place for the use of the connections to the remote systems.
- Improve the response time of the remote system.

Virtual storage constraint

Symptoms

- Slow response times
- Multiple loads of the same program
- Increased I/O operations against program libraries
- High paging rates
- SOS condition often occurs.

Solutions

- Tune the VSE system to obtain more virtual storage for CICS (increase the partition size).
- Expand or make more efficient use of the dynamic storage area.

See the “Virtual storage above and below 16MB line checklist” on page 107 for a detailed list of suggested solutions.

Real storage constraint

Symptoms

- High paging rates
- Slow response times
- MXT limit frequently reached
- SOS condition often occurs.

Solutions

- Reduce the demands on real storage
- Tune the VSE system to obtain more real storage for CICS
- Obtain more central and expanded storage.

See the “Real storage checklist” on page 108 for a detailed list of suggested solutions.

Processor cycles constraint

Symptoms

- Slow response times
- Low-priority transactions respond very slowly
- Low-priority work gets done very slowly.

Solutions

- Increase the dispatching priority of CICS.
- Reevaluate the relative priorities of operating system jobs.
- Reduce the number of VSE partitions.
- Reduce the processor utilization for productive work.
- Use only the CICS facilities that you really require.
- Turn off any trace that is not being used.
- Minimize the data being traced by reducing the:
  - Scope of the trace
  - Frequency of running trace.
- Obtain a faster processor.

See the “Processor cycles checklist” on page 109 for a detailed list of suggested solutions.

Chapter 9. CICS performance analysis

Performance analysis, as compared with monitoring, is the use of certain performance tools described in Part 2 to:

- Investigate a deviation from performance objectives that is resulting in performance deterioration, and identify performance problems
- Identify where a system can be adjusted to give a required level of performance
- Characterize and calibrate individual stand-alone transactions as part of the documentation of those transactions, and for comparison with some future time when, perhaps, they start behaving differently.

Assessing the performance of a DB/DC system

You may find the following performance measurements helpful in determining the performance of a system:

1. **Processor usage**: This item reflects how active the processor is. Although the central processor is of primary concern, 37X5 communications controllers and terminal control units (these can include an intelligent cluster controller such as the 3601 and also the 3270 cluster control units) can also increase response time if they are used heavily.
2. **I/O rates**: These rates measure the amount of access to a disk device or data set over a given period of time. Again, acceptable rates vary depending on the speed of the hardware and response time requirements.
3. **Terminal message or data set record block sizes**: These factors, when combined with I/O rates, provide information on the current load on the network or DASD subsystem.
4. **Indications of internal virtual storage limits**: These vary by software component, including storage or buffer expansion counts, system messages, and program abends because of system stalls. In CICS, program fetches on nonresident programs and system short-on-storage or stress messages reflect this condition.
5. **Paging rates**: CICS can be sensitive to a real storage shortage, and paging rates reflect this shortage. Acceptable paging to DASD rates vary with the speed of the DASD and response time criteria. Paging rates to expanded storage are only as important as its effect on processor usage.
6. **Error rates**: Errors can occur at any point in an online system. If the errors are recoverable, they can go unnoticed, but they put an additional load on the resource on which they are occurring.

You should investigate both system conditions and application conditions.

System conditions

A knowledge of these conditions enables you evaluate the performance of the system as a whole as follows:

- System transaction rate (average and peak)
- Internal response time and terminal response time, preferably compared with transaction rate
- Working set, at average and peak transaction rates
- Average number of disk accesses per unit time (total, per channel, and per device)
- Processor usage, compared with transaction rate
- Number of page faults per second, compared with transaction rate and real storage
- Communication line usage (net and actual)
- Average number of active CICS tasks
- Number and duration of outages.

Application conditions

These conditions, measured both for individual transaction types and for the total system, give you an estimate of the behavior of individual application programs.

You should gather data for each main transaction and for the average values for the total system. This data includes:

- Program calls per transaction
- CICS storage GETMAINs and FREEMAINs (number and amount)
- Application program and transaction usage
- File control (data set, type of request)
- Terminal control (terminal, number of inputs and outputs)
- Other CICS requests.

Methods of performance analysis

You can use two methods for performance analysis:

1. Measuring a system under full production load (**full-load** measurement), to get all information that is measurable only under high system-loading.
2. Measuring single-application transactions (**single-transaction** measurement) during which the system should not carry out any other activities. This gives an insight into the behavior of single transactions under optimum system conditions.

Because a system can have a variety of problems, we cannot recommend which option you should use to investigate the behavior of a system. When in doubt about the extent of a problem, you should always use both methods.

Rapid performance degradation often occurs after a threshold is exceeded and the system approaches its ultimate load. You can see various indications only when the system is fully loaded (for example, paging, short-on-storage condition in CICS, and so on), and you should usually plan for a full-load measurement.

Bear in mind that the performance constraints might possibly vary at different times of the day. You might want to run a particular option that puts a particular pressure on the system only at a certain time in the afternoon.

If a full-load measurement reveals no serious problems, or if a system is not reaching its expected performance capability under normal operating conditions, you can then use single-transaction measurement to reveal how individual system transactions behave and to identify the areas for possible improvement.

Often, because you have no reliable information at the beginning of an investigation into the probable causes of performance problems, you have to examine and analyze the whole system.

Before carrying out this analysis, you must have a clear picture of the functions and the interactions of the following components:

- Operating system supervisor with the appropriate access methods
- CICS management modules and control tables
- VSAM data sets
- DL/I VSE databases
- DB2 for VSE/ESA databases
- External security managers
- Performance monitors
- CICS application programs
- Influence of other regions
- Hardware peripherals (disks and tapes).

In addition, you should collect the following information:

- Does performance fluctuate or is it uniformly bad?
- Are performance problems related to a specific hour, day, week, or month?
- Has anything in the system been changed recently?
- Have all such changes been fully documented?

Full-load measurement

A full-load measurement highlights latent problems in the system. It is important that full-load measurement lives up to its name, that is, you should make the measurement when, from production experience, the peak load is reached. Many installations have a peak load for about one hour in the morning and again in the afternoon. CICS statistics and various performance tools can provide valuable information for full-load measurement. In addition to the overall results of these tools, it may be useful to have the CICS auxiliary trace active for about one minute.

CICS auxiliary trace

CICS auxiliary trace can be used to find situations that occur under full load. For example, all ENQUEUEs that cannot immediately be honored in application programs result in a suspension of the issuing task. If this frequently happens, attempts to control the system by using the CEMT master transaction, are not effective.

Trace is a very heavy overhead. Use trace selectivity options to minimize this overhead.

Comparison charts

You might wish to consider using a comparison chart to measure key aspects of your system's performance before and after tuning changes have been made. A suggested chart is as follows:

Table 6. Comparison chart 1

Run	DL/I transactions	VSAM transactions	Response times	Most heavily used transaction	Average-use transaction
	No./response	No./response	DL/I VSAM	No./response	No./response

Table 7. Comparison chart 2

Run	Average-use transaction	Paging rate	DSA virtual storage	Tasks	Most heavily used DASD
	No./response	System/CICS	Max./Average	Peak/at MXT	Resp./Util

Table 8. Comparison chart 3

Run	Average-use DASD	CPU utilization			
	Resp./Util				

The use of this type of comparison chart requires the use of TPNS (if running under VM), CICS interval statistics and an OEM performance monitor, and interval statistics running together for about 20 minutes, at a peak time for your system. It also requires you to identify the following:

- A representative selection of terminal-oriented DL/I transactions accessing DL/I databases
- A representative selection of terminal-oriented transactions processing VSAM files
- The most heavily used transaction
- Two average-use nonterminal-oriented transactions writing data to intrapartition transient data destinations
- The most heavily used volume in your system
- A representative average-use volume in your system.

To complete the comparison chart for each CICS run before and after a tuning change, you can obtain the figures from the following sources:

- **DL/I transactions**: you should first identify a selection of terminal-oriented DL/I transactions accessing DL/I databases.
- **VSAM transactions**: similarly, you should first identify a selection of terminal-oriented transactions processing VSAM files.
- **Response times**: external response times are available from the TPNS terminal response time analysis report; internal response times are available from your OEM performance monitor. The “DL/I” subheading is the average response time calculated at the 99th percentile for the terminal-oriented DL/I transactions you have previously selected. The “VSAM” subheading is the average response time calculated at the 99th percentile for the terminal-oriented VSAM transactions you have previously selected.
- **Paging rate (system)**: This is the total paging rate per second for the entire system.
- **Tasks**: this is from the transaction manager statistics (part of the CICS interval, end-of-day, and requested statistics). The “Peak” subheading is the figure shown for “Peak Number of Tasks” in the statistics. The “At MXT” subheading is the figure shown for “Number of Times at Max. Task” in the statistics.
- **Most heavily used DASD**: this is the most heavily used volume in your system, as indicated by your OEM performance monitor. The “Resp.” subheading is the figure shown in the “Avg. Resp. Time” column for the volume you have selected. The “Util.” subheading is the figure shown in the “% Dev. Util.” column for that volume.
- **Average-use DASD**: this is a representative average-use volume in your system, as indicated by your OEM performance monitor. The “Resp.” subheading is the figure shown in the “Avg. Resp. Time” column for the volume you have selected. The “Util.” subheading is the figure shown in the “% Dev. Util.” column for that volume.
- **Processor utilization**: this is from your OEM performance monitor processor activity report.

This chart is most useful when comparing before-and-after changes in performance while you are tuning your CICS system.

Single-transaction measurement

You can use full-load measurement to evaluate the average loading of the system per transaction. However, this type of measurement cannot provide you with information on the behavior of a single transaction and its possible excessive loading of the system. If, for example, nine different transaction types issue five start I/Os (SIOs) each, but the tenth issues 55 SIOs, this results in an average of ten SIOs per transaction type. This should not cause concern if they are executed simultaneously. However, an increase in the transaction rate of the tenth transaction type could possibly lead to poor performance overall.

Sometimes, response times are quite good with existing terminals, but adding a few more terminals leads to unacceptable degradation of performance. In this case, the performance problem may be present with the existing terminals, and has simply been highlighted by the additional load.

To investigate this type of problem, do a full-load measurement as well as a single-transaction measurement. To be of any use, the single-transaction measurement must be done when no batch region is running, and there must be no activity in CICS apart from the test screen. Even the polling of remote terminals should be halted.

You should measure each existing transaction that is used in a production system or in a final test system. Test each transaction two or three times with different data values, to exclude an especially unfavorable combination of data. Document the sequence of transactions and the values entered for each test as a prerequisite for subsequent analysis or interpretation.

Between the tests of each single transaction there should be a pause of several seconds, to make the trace easier to read. A copy of the production database or data set should be used for the test, because a test data set containing 100 records can very often result in completely different behavior when compared with a production data set containing 100 000 records.

The condition of data sets has often been the main reason for performance degradation, especially when many segments or records have been added to a database or data set. Do not do the measurements directly after a reorganization, because the database or data set is only in this condition for a short time. On the other hand, if the measurement reveals an unusually large number of disk accesses, you should reorganize the data and do a further measurement to evaluate the effect of the data reorganization.

You may feel that single-transaction measurement with only one terminal under these conditions is not an efficient tool for revealing a performance degradation that might occur when, perhaps 40 or 50 terminals are in use. Practical experience has shown, however, that this is usually the only means for revealing and rectifying, with justifiable expense, performance degradation under full load. The main reason for this is that it is sometimes a single transaction that throws the system behavior out of balance. Single-transaction measurement can be used to detect this.

Ideally, single-transaction measurement should be carried out during the final test phase of the transactions. This gives the following advantages:

- Any errors in the behavior of transactions may be revealed before production starts, and these can be put right during validation, without loading the production system unnecessarily.
- The application is documented during the measurement phase. This helps to identify the effects of later changes.

CICS auxiliary trace

Auxiliary trace is a standard feature of CICS, and gives an overview of transaction flows so that you can quickly and effectively analyze them.

From this trace, you can find out whether a specified application is running as it is expected to run. In many cases, it may be necessary for the application programmer responsible to be called in for the analysis, to explain what the transaction should actually be doing.

If you have a very large number of transactions to analyze, you can select, in a first pass, the transactions whose behavior does not comply with what is expected.

If all transactions last much longer than expected, this almost always indicates a system-wide error in application programming or in system implementation. The analysis of a few transactions is then sufficient to determine the error.

If, on the other hand, only a few transactions remain in this category, these transactions should be analyzed next, because it is highly probable that most performance problems to date arise from these.

Chapter 10. Tuning the system

When you have identified specific constraints, you will have identified the system resources that need to be tuned. The major steps in tuning a system are as follows:

- "Determining acceptable tuning trade-offs"
- "Making the change to the system"
- "Reviewing the results of tuning" on page 101

Determining acceptable tuning trade-offs

The art of tuning can be summarized as finding and removing constraints. In most systems, the performance is limited by a single constraint. However, removing that constraint, while improving performance, inevitably reveals a different constraint, and you might often have to remove a series of constraints. Because tuning generally involves decreasing the load on one resource at the expense of increasing the load on a different resource, relieving one constraint always creates another.

A system is always constrained. You do not simply remove a constraint; you can only choose the most satisfactory constraint. Consider which resources can accept an additional load in the system without themselves becoming worse constraints.

Tuning usually involves a variety of actions that can be taken, each with its own trade-off. For example, if you have determined virtual storage to be a constraint, your tuning options may include reducing buffer allocations for data sets, or reducing terminal scan delay (ICVTSD) to shorten the task life in the processor.

The first option increases data set I/O activity, and the second option increases processor usage. If one or more of these resources are also constrained, tuning could actually cause a performance degradation by causing the other resource to be a greater constraint than the present constraint on virtual storage.

Making the change to the system

The next step in the tuning process is to make the actual system modifications that are intended to improve performance. You should consider several points when adjusting the system:

- Tuning is the technique of making small changes to the system's resource allocation and availability to achieve relatively large improvements in response time.
- Tuning is not always effective. If the system response is too long and all the system resources are lightly used, you see very little change in the CICS response times. (This is also true if the wrong resources are tuned.) In addition, if the constraint resource, for example, line capacity, is being fully used, the only solution is to provide more capacity or to redesign the application (to transmit less data, in the case of line capacity).
- Do not tune just for the sake of tuning. Tune to relieve identified constraints. If you tune resources that are not the primary cause of performance problems, this has little or no effect on response time until you have relieved the major

constraints. It may actually make subsequent tuning work more difficult. If there is any significant improvement potential, it lies in improving the performance of the resources that ***are*** major factors in the response time.

- In general, tune major constraints first, particularly those that have a significant effect on response time. Arrange the tuning actions so that items having the greatest effect are done first. In many cases, one tuning change can solve the performance problem if it addresses the cause of the degradation. Other actions may then be unnecessary. Further, improving performance in a major way can alleviate many user complaints and allow you to work in a more thorough way. The 80/20 rule applies here; a small number of system changes normally improves response time by most of the amount by which it can be improved, assuming that those changes address the main causes of performance problems.
- Make one tuning change at a time. If two changes are made at the same time, their effects may work in opposite directions and it may be difficult to tell which of them had a significant effect.
- Change allocations or definitions gradually. For example, when reducing the number of resident programs in a system, do not change all your RDO PROGRAM resource definitions in a system from RESIDENT=YES to RESIDENT=NO at once. This could cause an unexpected lengthening of response times by increasing storage usage because of fragmentation, and increasing processor usage because of higher program loading activity. If you change a few programs at a time, starting with the lesser-used programs, this can give you a better idea of the overall results.

  The same rule holds true for buffer and string settings and other data set operands, transaction and program operands, and all resources where the operand can be specified individually for each resource. For the same reason, do not make large increases or decreases in the values assigned to task limits such as MXT.
- Continue to monitor constraints during the tuning process. Because each adjustment changes the constraints in a system, these constraints vary over time. If the constraint changes, tuning must be done on the new constraint because the old one is no longer the restricting influence on performance. In addition, constraints may vary at different times during the day.
- Put fallback procedures in place before starting the tuning process. As noted earlier, some tuning can cause unexpected performance results. If this leads to poorer performance, it should be reversed and something else tried. If previous definitions or path designs were not saved, they have to be redefined to put the system back the way it was, and the system continues to perform at a poorer level until these restorations are made. If the former setup is saved in such a way that it can be recalled, back out of the incorrect change becomes much simpler.

Reviewing the results of tuning

After each adjustment has been done, review the performance measurements that have been identified as factors of response time to verify that the desired performance changes have occurred and to quantify that change. If performance has improved to the point that service level agreements are being met, no more tuning is required. If performance is better, but not yet acceptable, investigation is required to determine the next action to be taken, and to verify that the resource that was tuned is still a constraint. If it is not still a constraint, new constraints need to be identified and tuned. This is a return to the first step of the tuning process, and you should repeat the next steps in that process until an acceptable performance level is reached.

Part 4. Improving the performance of a CICS system

Important

Always tune DASD, the network, and the overall VSE system ***before*** tuning any individual CICS subsystem through CICS parameters.

Also review your application code before any further tuning

Chapter 11, " Performance checklists" on page 105 itemizes the actions you can take to tune the performance of an operational CICS system.

The other chapters in this part contain the relevant performance tuning guidelines for the following aspects of CICS:

- Chapter 12, "VSE/ESA and DASD" on page 111
- Chapter 13, " Networking and VTAM" on page 119
- Chapter 14, " VSAM and file control" on page 135
- Chapter 15, " Journaling" on page 153
- Chapter 16, "Virtual and real storage" on page 159
- Chapter 17, " MRO and ISC/IRC" on page 179
- Chapter 18, " Programming considerations" on page 189
- Chapter 19, " CICS facilities" on page 191
- Chapter 20, " Tuning XRF" on page 205
- Chapter 21, "Improving CICS startup and normal shutdown time" on page 215.

Chapter 11. Performance checklists

The following checklists provide a quick reference to options that you can adjust to relieve different constraints. They assume that you have identified the exact cause of an existing constraint; they should ***not*** be used for random tuning exercises.

There are four checklists, corresponding to four of the main contention areas described in Chapter 8, “Identifying CICS constraints” on page 77.

1. I/O contention (this applies to data set and database subsystems, as well as to the data communications network)
2. Virtual storage above and below the 16MB line
3. Real storage
4. Processor cycles.

The checklists are in the sequence of low-level to high-level resources, and the items are ordered from those that probably have the greatest effect on performance to those that have a lesser effect, from the highest likelihood of being a factor in a normal system to the lowest, and from the easiest to the most difficult to implement.

Before taking action on a particular item, you should review the item to:

- Determine whether the item is applicable in your particular environment
- Understand the nature of the change
- Identify the trade-offs involved in the change.

Input/output contention checklist

Note:

Ideally, I/O contention should be reduced by using very large data buffers and keeping programs in storage. This would require adequate central and expanded storage, and programs that can be loaded above the 16MB line

Virtual storage above and below 16MB line checklist

Note:

The lower the number of concurrent transactions in the system, the lower the usage of virtual storage. Therefore, improving transaction internal response time decreases virtual storage usage. Keeping programs in storage above the 16MB line, and minimizing physical I/Os makes the largest contribution to well-designed transaction internal response time improvement.

Real storage checklist

Note:

Increasing use of virtual storage may cause increased paging, if insufficient real sorage is available.

Defining and referencing very large areas of data (for example, CICS-maintained data tables or large LSR pools) increases the demands for real storage. If there is insufficient real storage available, a significant increase in page-in rate occurs. This can cause large response time increases, and short-on-storage conditions as all CICS functions are stopped for the duration of the page-in I/O.

Processor cycles checklist

Note:

Minimizing physical I/Os by employing large data buffers and keeping programs in storage reduces processor use, if adequate central and expanded storage is available.

Chapter 12. VSE/ESA and DASD

This chapter includes the following topics:

Tuning CICS and VSE/ESA

Tuning CICS for virtual storage under VSE/ESA depends on the following main elements:

- VSE/ESA systems tuning
- VTAM tuning
- CICS tuning
- VSAM tuning.

Because tuning is a top-down activity, you should already have made a vigorous effort to tune VSE/ESA before tuning CICS. Your main effort to reduce virtual storage constraint and to get relief should be concentrated on reducing the life of the various individual transactions: in other words, shortening task life.

This section describes some of the techniques that can contribute significantly to shorter task life, and therefore, a reduction in virtual storage constraint.

The installation of a faster processor can cause the current instructions to be executed faster and, therefore, reduce task life (internal response time), because more transactions can be processed in the same period of time. Installing faster DASD can reduce the time spent waiting for I/O completion, and this shorter wait time for paging operations, data set index retrieval, or data set buffer retrieval can also reduce task life in the processor.

Additional real storage, if page-ins are frequently occurring (if there are more than 5 to 10 page-ins per second, CICS performance is affected), can reduce waits for the paging subsystem.

You can isolate CICS data on DASD drives, strings, and channels to minimize the I/O contention suffered by CICS from other DASD activity in the system. Few CICS online systems generate enough I/O activity to affect the performance of CICS seriously if DASD is isolated in this manner.

So far we have concentrated on CICS systems that run a stand-alone single CICS address space. If you want to combine the workload from two or more processors onto a VSE image, you must be aware of the virtual storage requirements of each of the subsystems that are to execute on the single-image ESA processor.

By its nature, CICS requires a large private partition that may not be available when the large system's common requirements of these other subsystems are satisfied. If, after tuning the operating system, VTAM, VSAM, and CICS, you find that your

address space requirements still exceed that available, you can split CICS using one of three options:

1. Multiregion option (MRO)
2. Intersystem communication (ISC)
3. Multiple independent address spaces.

Adding large new applications or making major increases in the size of your VTAM network places large demands on virtual storage, and you must analyze them before implementing them in a production system. Careful analysis and system specification can avoid performance problems arising from the addition of new applications in a virtual-storage-constrained environment.

If you have not made the necessary preparations, you usually become aware of problems associated with severe stress only after you have attempted to implement the large application or major change in your production system. Some of these symptoms are:

- Poor response times
- Short-on-storage
- Program compression
- Heavy paging activity
- Many well-tested applications suddenly abending with new symptoms
- Dramatic increase in I/O activity on CICS program libraries.

Various chapters in the rest of this book deal with specific, individual operands and techniques to overcome these problems. They tell you how to minimize the use of virtual storage in the CICS address space, and how to split it into multiple address spaces if your situation requires it.

For an overall description of ESA virtual storage, see Appendix C, “VSE/ESA and CICS virtual storage” on page 365.

Splitting online systems: availability

Splitting the CICS system into two or more separate address spaces may lead to improved availability. If CICS failures are being caused by application program errors, for example, separating out the failing application can improve overall availability. This can also give virtual storage gains and, in addition, can allow you to use multiprocessors and VSE images more efficiently. See “Splitting online systems: virtual storage” on page 160 for more details.

The availability of the overall system may be improved by splitting the system because the effects of a failure can be limited or the time to recover from the failure can be reduced.

The main ways of splitting a system for availability are to have:

- **Terminal owning regions**. With one or more terminal owning regions (TORs) using transaction routing, availability can be improved because a TOR is less likely to fail because it contains no application code. The time taken to restart the failed part of the system is reduced because the terminal sessions are maintained at failure if the TOR continues to operate.
- **Multiple application owning regions**. Using multiple application owning regions (AORs), you can separate unstable or new applications from the rest of

the system. If these applications cause a failure of that AOR, all other AORs are still available. If the region susceptible to failure contains no terminals or files and databases, it also tends to restart quickly.

Applications under test in AORs can use function shipping to access 'live' data, which adds to the realism of the test environment.

- **File owning regions**. File requests from many CICS regions can be function-shipped to file owning regions (FORs). The FORs contain no application code and so are unlikely to fail, so that access to files can be maintained even if other regions fail. Removing the files and databases from these other regions speeds up their recovery by removing file allocation and opening time.

Having only one FOR in a system, or logical subset of a system, can reduce the operational difficulties of restarting a system. It is possible to split the regions in different ways to those described so far, by having many regions all of which own some terminals, some applications, and some files and databases. This type of splitting is very complex to maintain and operate, and also needs careful monitoring to ensure that the performance of the overall system is optimal. For these reasons, a structured approach with each of the regions having a clearly defined set of one type of resource is recommended.

Limitations

Splitting a CICS system requires increased real storage, increased processor cycles, and extensive planning. These overheads are described in more detail in "Splitting online systems: virtual storage" on page 160.

Recommendations

If availability of your system is an important requirement, both splitting systems and the use of XRF should be considered. The use of XRF can complement the splitting of systems by automating the recovery of the components.

When splitting your system, you should try to separate the sources of failure so that as much of the rest of the system as possible is protected against their failure, and remains available for use. Critical components should be backed up, or configured so that service can be restored with minimum delay. Since the advantages of splitting regions for availability can be compromised if the queueing of requests for remote regions is not controlled, you should also review "Intersystems Session Queue Management" on page 181.

Increasing the CICS partition size

If all other factors in a CICS system are kept constant, increasing the partition size available to CICS allows an increase in the dynamic storage areas.

Changes to VSE and other subsystems over time generally reduce the amount of storage required below the 16MB line. Thus the CICS partition size may be able to be increased when a new release of VSE or non-CICS subsystem is installed.

If you specify a larger partition the value of the relevant DSA size system initialization parameter must be increased or the extra space is not used.

How implemented

Partition size is defined by the VSE ALLOC statement. See the *VSE/ESA System Control Statements* manual for more information.

How monitored

Use the VSE GETVIS command to display information about the current size, allocation, and usage of the GETVIS area of a partition, or of the system GETVIS area. For more information see the *VSE/ESA System Control Statements* manual

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Giving the CICS partition a high dispatching priority

Giving the CICS partition high dispatching priority causes the processor to be accessible more often when it is needed.

The relative order of priority can be:

- VTAM
- Performance monitor
- Database
- CICS

How implemented

Use the VSE PRTY attention routine (AR) command to set the relative priority of the CICS partition. See the *VSE/ESA System Control Statements* manual for more information.

How monitored

Use the VSE PRTY AR command to display the priority sequence of the static partitions or dynamic partition classes in the system.

Partition exit interval (ICV)

When CICS cannot dispatch a task, either because there are no tasks in the system at that time, or because all tasks are waiting for data set or terminal I/O to finish, CICS issues an operating-system WAIT. The ICV, system initialization parameter (see also "Terminal scan delay (ICVTSD)" on page 127) controls the length of this wait (but bear in mind that any interrupt, for example, data set I/O or terminal I/O, before any of these expires, causes CICS to be dispatched).

The ICV system initialization parameter specifies the maximum time in milliseconds that CICS releases control to the operating system when there are no transactions ready to resume processing. CICS issues a region wait in this case for the time specified in the ICV, system initialization parameter. If activity in the system causes CICS to be dispatched sooner, this parameter has no effect.

In general, ICV can be used in low-volume systems to keep part of the CICS management code paged in. Expiration of this interval results in a full terminal control table (TCT) scan in non-VTAM environments, and controls the dispatching of terminal control in VTAM systems with low activity. Redispatch of CICS by VSE/ESA after the wait may be delayed because of activity in the supervisor or in higher-priority partitions, for example, VTAM. The ICV delay can affect the shutdown time if no other activity is taking place.

The value of ICV acts as a backstop for MROBTCH (see “Batching requests (MROBTCH)” on page 184).

Main effect

The partition exit interval determines the maximum period between terminal control full scans. However, the interval between full scans in very active systems may be less than this, being controlled by the normally shorter terminal scan delay interval (see “Terminal scan delay (ICVTSD)” on page 127). In such systems, ICV becomes largely irrelevant unless ICVTSD has been set to zero.

Secondary effects

Whenever control returns to the task dispatcher from terminal control after a full scan, ICV is added to the current time of day to give the provisional due time for the next full scan. In idle systems, CICS then goes into an operating-system wait state, setting the timer to expire at this time. If there are application tasks to dispatch, however, CICS passes control to these and, if the due time arrives before CICS has issued an operating-system WAIT, the scan is done as soon as the task dispatcher next regains control.

In active systems, after the due time has been calculated by adding ICV, the scan may be performed at an earlier time by application activity (see “Terminal scan delay (ICVTSD)” on page 127).

Operating-system waits are not always for the duration of one ICV. They last only until some event ends. One possible event is the expiry of a time interval, but often CICS regains control because of the completion of an I/O operation. Before issuing the operating-system WAIT macro, CICS sets an operating-system timer, specifying the interval as the time remaining until the next time-dependent activity becomes due for processing. This is usually the next terminal control scan, controlled by either ICV or ICVTSD, but it can be the earliest ICE expiry time, or even less.

In high-activity systems, where CICS is contending for processor time with very active higher-priority subsystems (VTAM, other CICS systems) control may be seized from CICS so often that CICS always has work to do and never issues an operating-system WAIT.

Where useful

The region exit interval is useful in environments where batch or other CICS systems are running concurrently.

Limitations

Too low a value can impair concurrent batch performance by causing frequent and unnecessary dispatches of CICS. Too high a value can lead to an appreciable delay before the system handles time-dependent events (such as abends for terminal read or deadlock timeouts) after the due time.

A low ICV value does not prevent all CICS modules from being paged out. When the ICV time interval expires, the operating system dispatches CICS task control which, in turn, dispatches terminal control. CICS references only task control, terminal control, TCT, and the CSA. No other modules in CICS are referenced. If there is storage constraint they do not stay in real storage.

After the operating-system WAIT, redispatch of CICS may be delayed because of activity in the supervisor or in higher-priority regions such as VTAM, and so on.

The ICV delay can affect the shutdown time if no other activity is taking place.

Recommendations

The time interval can be any decimal value in the range from 100 through 3600000 milliseconds.

In normal systems, set ICV to 1000–10000 milliseconds, or more.

A low interval value can enable much of the CICS nucleus to be retained, and not be paged out at times of low terminal activity. This reduces the amount of paging necessary for CICS to process terminal transactions (thus representing a potential reduction in response time), sometimes at the expense of concurrent batch region throughput. Large networks with high terminal activity tend to drive CICS without a need for this value, except to handle the occasional, but unpredictable, period of inactivity. These networks can usually function with a large interval (10000 to 30000 milliseconds). After a task has been initiated, the system recognizes its requests for terminal services and the completion of the services, and overrides this maximum delay interval.

Small systems or those with low terminal activity are subject to paging introduced by other jobs running in competition with CICS. If you specify a low interval value, key portions of the CICS nucleus are referenced more frequently, thus reducing the probability of these pages being paged-out. However, the execution of the logic, such as terminal polling activity, without performing productive work might be considered wasteful.

You must weigh the need to increase the probability of residency by frequent but unproductive referencing, against the extra overhead and longer response times incurred by allowing the paging to occur. If you increase the interval size, more productive work is performed at the expense of performance if paging occurs during the periods of CICS activity.

How implemented

ICV is specified in the SIT or at startup, and can be changed using either the CEMT or EXEC CICS SET SYSTEM (time) command. It is defined in units of milliseconds, rounded down to the nearest multiple of ten. The default is 1000 (that is, one second; usually too low).

How monitored

The region exit interval can be monitored by the frequency of CICS operating-system WAITs that are counted in “Dispatcher statistics” on page 230.

DASD tuning

The main solutions to DASD problems are to:

- Reduce the number of I/O operations
- Tune the remaining I/O operations
- Balance the I/O operations load
- Consider using virtual disks

Reducing the number of I/O operations

The principal ways of reducing the number of I/O operations are to:

- Allocate additional address space buffers
- Use data tables when appropriate
- Use or increase the use of main temporary storage
- Eliminate or minimize program compression
- Review and improve the design of applications run on CICS
- Make use of a DASD controller cache, but only if data set placement tuning has been done
- Minimize CI/CA splits by:
  - Allocating ample free space (free space can be altered by key range during load)
  - Timely reorganizations of disk storage

Tuning the I/O operations

This can reduce service time. The principal ways of tuning the I/O operations are to:

- Specify the correct CI size. This has an effect on:
  - The space used on the volume
  - Transfer time
  - Storage requirements for buffers
  - The type of processing (direct or sequential)
- Use imbeds or replication for VSAM data sets
- Specify the location of the VTOC correctly.
- Take care over data set placement within the volume.
- Use an appropriately-fast device type and, if necessary, use a cache memory (but only if data set placement tuning has been done and if there are sufficient channels to handle the device speed)

Balancing I/O operations

This can reduce queue time. The principal ways of balancing I/O operations are to:

- Spread a high-use data set across multiple volumes.
- Minimize the use of shared DASD volumes between multiple processors.
- Place batch files and online files on separate volumes, especially:
  - Spool files
  - Sort files
  - Assembler or compiler work files
  - Page data sets
- Place index and data on separate volumes (for VSAM KSDS files).
- Place concurrently-used files on separate volumes. For example, a CICS journal should be the only data set in use on its volume.

Take the following figures as guidelines for best DASD response times for online systems:

- Channel busy: less than 30% (with CHP ids this can be higher)
- Device busy: less than 35% for randomly accessed files
- Average response time: less than 20 milliseconds

Aim for multiple paths to disk controllers because this allows dynamic path selection to work.

Consider using virtual disks

Virtual disks make it possible to allocate (temporary) data in virtual storage rather than on a real disk device. Doing so allows data access to be performed at memory speeds, reducing the number of I/Os to disk devices, although at the cost of real storage. For more information, see the *VSE/ESA Planning* manual.

Chapter 13. Networking and VTAM

This chapter includes the following topics:

Terminal input/output area (TYPETERM IOAREALEN or TCT TIOAL)

If you are using VTAM, the IOAREALEN keyword of an RDO TYPETERM resource definition determines the initial size of the terminal input/output area (TIOA) to be passed onto a transaction for each terminal. The syntax for IOAREALEN is ({0|value1},{0|value2}). This operand is used only for the first input message for all transactions.

One value defining the minimum size is used for non-SNA devices, while two values specifying both the minimum and maximum size are used for SNA devices.

This book does not discuss the performance aspects of the CICS Front End Programming Interface. See the *CICS Front End Programming Interface User's Guide* for more information.

Effects

When value1,0 is specified for IOAREALEN, value1 is the minimum size of the terminal input/output area that is passed to an application program when a RECEIVE command is issued. If the size of the input message exceeds value1, the area passed to the application program is the size of the input message.

When value1, value2 is specified, value1 is the minimum size of the terminal input/output area that is passed to an application program when a RECEIVE command is issued. Whenever the size of the input message exceeds value1, CICS will use value2. If the input message size exceeds value2, the node abnormal condition program sends an exception response to the terminal.

If you specify ATI(YES), you must specify an IOAREALEN of at least one byte.

Limitations

Real storage can be wasted if the IOAREALEN (value1) is too large for most terminal inputs in the network. If IOAREALEN (value1) is smaller than most initial terminal inputs, excessive GETMAIN requests can occur, resulting in additional processor requirements, unless IOAREALEN(value1) is zero.

Recommendations

IOAREALEN(value1) should be set to a value that is slightly larger than the average input message length for the terminal. The maximum value that may be specified for IOAREALEN is 32767 bytes.

If a value of nonzero is required, the best size to specify is the most commonly encountered input message size. A multiple of 64 bytes minus 21 allows for SAA requirements and ensures good use of operating system pages.

For VTAM, you can specify two values if inbound chaining is used. The first value should be the length of the normal chain size for the terminal, and the second value should be the maximum size of the chain. The length of the TIOA presented to the task depends on the message length and the size specified for the TIOA. (See the example in Figure 14.)

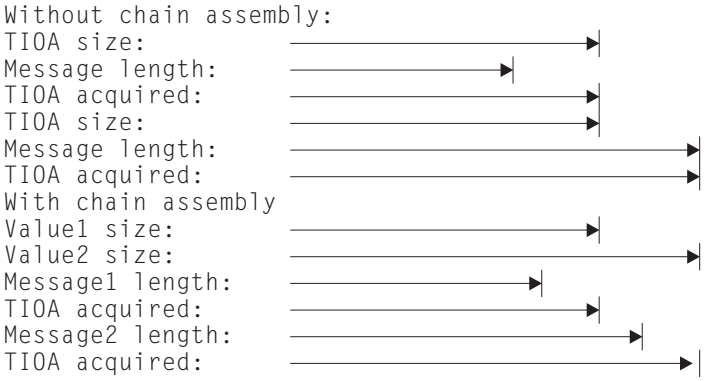


Figure 14. Message length and terminal input/output area length

Avoid specifying too large a value1, for example, by matching it to the size of the terminal display screen. This area is used only as input. If READ with SET is specified, the same pointer is used by applications for an output area.

If too small a value is specified for value1, extra processing time is required for chain assembly, or data is lost if inbound chaining is not used.

In general, a value of zero is best because it causes the optimum use of storage and eliminates the second GETMAIN request. If automatic transaction initiation (ATI) is used for that terminal, a minimum size of one byte is required.

The second value for SNA devices is used to prevent terminal streaming, and so should be slightly larger than the largest possible terminal input in the network. If a message larger than this second value is encountered, a negative response is returned to the terminal, and the terminal message is discarded.

How implemented

For VTAM, the TIOA value is specified by the IOAREALEN keyword of the RDO TYPETERM resource definition.

How monitored

The NetView Performance Monitor (NPM) can be used to show storage usage and message size characteristics in the network.

Receive-any input areas (RAMAX)

The system initialization parameter, RAMAX, specifies the size in bytes of the I/O area that is to be allocated for each VTAM receive-any operation. These storage areas are called receive-any input areas (RAIAs), and are used to receive the first terminal input for a transaction from VTAM. All input from VTAM comes in request/response units (RUs).

Storage for the RAIAs, which is above the 16MB line, is allocated by the CICS terminal control program during CICS initialization, and remains allocated for the entire execution of the CICS job step. The size of this storage is the product of the RAPOOL and RAMAX system initialization parameters.

Effects

VTAM attempts to put any incoming RU into the initial receive-any input area, which has the size of RAMAX. If this is not large enough, VTAM indicates that and also states how many extra bytes are waiting that cannot be accommodated.

RAMAX is the largest size of any RU that CICS can take directly in the receive-any command, and is a limit against which CICS compares VTAM's indication of the overall size of the RU. If there is more, VTAM saves it, and CICS gets the rest in a second request.

With a small RAMAX, you reduce the virtual storage taken up in RAIAs but risk more processor usage in VTAM retries to get any data that could not fit into the RAIA.

For many purposes, the default RAMAX value of 256 bytes is adequate. If you know that many incoming RUs are larger than this, you can always increase RAMAX to suit your system.

For individual terminals, there are separate parameters that determine how large an RU is going to be from that device. It makes sense for RAMAX to be at least as large as the largest CEDA SENDSIZE for any frequently-used terminals.

Where useful

You can use the RAMAX system initialization parameter in any networks that use the VTAM access method for terminals.

Limitations

Real storage can be wasted with a high RAMAX value, and additional processor time can be required with a low RAMAX value. If the RAMAX value is set too low, extra processor time is needed to acquire additional buffers to receive the remaining data. Because most inputs are 256 bytes, this should normally be specified.

Recommendations

Code RAMAX with the size in bytes of the I/O area allocated for each receive-any request issued by CICS. The maximum value is 32767.

Set RAMAX to be slightly larger than your CICS system input messages. If you know the message length distribution for your system, set the value to accommodate the majority of your input messages.

In any case, the size required for RAMAX need only take into account the first (or only) RU of a message. Thus, messages sent using SNA chaining do not require RAMAX based on their overall chain length, but only on the size of the constituent RUs.

Receive-any input areas are taken from a fixed length subpool of storage. A size of 2048 may appear to be adequate for two such areas to fit on one 4KB page, but only 4048 bytes are available in each page, so only one area fits on one page. A size of 2024 should be defined to ensure that two areas, including page headers, fit on one page.

How implemented

RAMAX is a system initialization parameter.

How monitored

The size of RUs or chains in a network can be identified with a VTAM line or buffer trace. The maximum size RUs are defined in the SENDSIZE keyword on the RDO TYPETERM resource definition..

Receive-any pool (RAPOOL)

The RAPOOL system initialization parameter specifies the number of concurrent receive-any requests that CICS is to process from VTAM. RAPOOL determines how many receive-any buffers there are at any time and, therefore, if VTAM has a lot of input simultaneously, it enables VTAM to put all the messages directly into CICS buffers rather than possibly having to store them itself elsewhere.

Effects

Initially, task input from a terminal or session is received by the VTAM access method and is passed to CICS if CICS has a receive-any request outstanding.

For each receive-any request, a VTAM request parameter list (RPL), a receive-any control element (RACE), and a receive-any input area (RAIA)—the value specified by RAMAX (see “Receive-any input areas (RAMAX)” on page 121) are set aside. The total area set aside for VTAM receive-any operations is:

(maximum RAIA size + RACE size + RPL size) * RAPOOL

See page 121 for RAIA considerations.

In general, input messages up to the value specified in RAPOOL are all processed in one dispatch of the terminal control task. Because the processing of a receive-any request is a short operation, at times more messages than the RAPOOL value may be processed in one dispatch of terminal control. This

happens when a receive-any request completes before the terminal control program has finished processing and there are additional messages from VTAM.

VTAM receive-any processing is for the first terminal message in a transaction, so RAPOOL has no effect on further inputs for conversational tasks. Those additional inputs are processed with VTAM receive-specific requests.

The pool is used only for the first input to start a task; it is not used for output or conversational input. VTAM posts the event control block (ECB) associated with the receive any input area. CICS then moves the data to the terminal I/O area (TIOA) ready for task processing. The RAIA is then available for reuse.

Where useful

Use the RAPOOL system initialization parameter in networks that use the VTAM access method for terminals.

Limitations

If the RAPOOL value is set too low, this can result in terminal messages not being processed in the earliest dispatch of the terminal control program, thereby inducing transaction delays during high-activity periods. For example, if you use the default and five terminal entries want to start up tasks, three tasks may be delayed for at least the time required to complete the VTAM receive-any request and copy the data and RPL. In general, no more than 5 to 10% of all receive-any processing should be at the RAPOOL ceiling, with none being at the RAPOOL ceiling if there is sufficient storage.

If the RAPOOL value is set too high, this can use excessive virtual storage, but does not affect real storage because the storage is not page-fixed and is therefore paged out.

Recommendations

Whether RAPOOL is significant or not depends on the environment of the CICS system.

In some cases, it may sometimes be more economical for VTAM to store the occasional peak of messages in its own areas rather than for CICS itself to have a large number of RAIAs, many of which are unused most of the time.

Furthermore, there are situations where CICS reissues a receive-any as soon as it finds one satisfied. It thereby uses the same element over and over again in order to bring in any extra messages that are in VTAM.

CICS maintains a VTAM RECEIVE ANY for n of the RPLs, where n is either the RAPOOL value, or the MXT value minus the number of currently active tasks, whichever is the smaller. See the *CICS System Definition Guide* for more information about these system initialization parameters.

A general recommendation is to code RAPOOL with the number of fixed request parameter lists (RPLs) that you require. When it is not at MXT, CICS maintains a receive-any request for each of these RPLs. The number of RPLs that you require depends on the expected activity of the system, the average transaction lifetime, and the MXT specified.

The RAPOOL value you set depends on the number of sessions, the number of terminals, and the ICVTSD value (see page 127) in the system initialization table (SIT). Initially you should set RAPOOL to 1.5 times your peak ***local*** [1] transaction rate per second plus the autoinstall rate. This can then be adjusted by analyzing the CICS VTAM statistics and by resetting the value to the maximum RPLs reached.

How implemented

RAPOOL is a system initialization parameter.

How monitored

The CICS VTAM statistics contain values for the maximum number of RPLs posted on any one dispatch of the terminal control program, and the number of times the RPL maximum was reached. This maximum value may be greater than the RAPOOL value if the terminal control program is able to reuse an RPL during one dispatch. See “VTAM statistics” on page 43 for more information.

SNA transaction flows (MSGINTEG and PROTECT)

Within CICS, the RDO PROFILE MSGINTEG and PROTECT options can be used to control the communication requests and responses that are exchanged between the terminals in a network and the VTAM and NCP communications programs.

Effects

One of the options in Systems Network Architecture (SNA) is whether the messages exchanged between CICS and a terminal are to be in definite or exception response mode. Definite response mode requires both the terminal and CICS to provide acknowledgment of receipt of messages from each other on a one-to-one basis.

SNA also ensures message delivery through synchronous data link control (SDLC), so definite response is not normally required. Specifying either message integrity (MSGINTEG) or message protection (PROTECT) causes the sessions for which it is specified to operate in definite response mode.

In other cases, the session between CICS and a terminal operates in exception response mode, and this is the normal case. Specifying PROTECT adds the overhead of writing the messages to the CICS system log as well.

In SNA, transactions are defined within brackets. A begin bracket (BB) command defines the start of a transaction, and an end bracket (EB) command defines the end of that transaction. Unless CICS knows ahead of time that a message is the last of a transaction, it must send an EB separate from the last message if a transaction terminates. The EB is an SNA command, and can be sent with the message, eliminating one required transmission to the terminal.

Specifying the ONEWTE option for a transaction implies that only one output message is to be sent to the terminal by that transaction, and allows CICS to send

[1] The RAPOOL figure does not include MRO sessions, so you should set RAPOOL to a low value in application- or file-owning regions (AORs or FORs).

the EB along with that message. Only one output message is allowed if ONEWTE is specified and, if a second message is sent, the transaction is abended.

The second way to allow CICS to send the EB with a terminal message is to code the LAST option on the last terminal control or basic mapping support SEND command in a program. Multiple SEND commands can be used, but the LAST option must be coded for the final SEND in a program.

The third (and most common) way is to issue SEND without WAIT as the final terminal communication. The message is then sent as part of task termination.

You have the following options:

- Specifying neither MSGINTEG nor PROTECT
- Specifying MSGINTEG only (which simply asks for definite response to be forced)
- Specifying PROTECT only (which not only forces MSGINTEG but also causes logging of sequence numbers before and after, and therefore causes more overhead in the processing of messages).

Where useful

The above options can be used in all CICS systems that use VTAM.

Limitations

The MSGINTEG option causes additional transmissions to the terminal. Transactions remain in CICS for a longer period, and tie up virtual storage and access to resources (primarily enqueues). MSGINTEG is required if the transaction must know that the message was delivered.

The PROTECT option incurs the overhead of MSGINTEG and adds the overhead of logging, but is required for message resynchronization and re-presentation on emergency restart in the case of transactions using CICS as an intelligent programmed SNA controller.

When MSGINTEG is specified, the TIOA remains in storage until the response is received from the terminal. If PROTECT is specified, the task is delayed until the response is received. Either option can increase the virtual storage requirements for the CICS partition because of the longer duration of the storage needs.

How implemented

Protection can be specified in the RDO PROFILE definition by means of the MSGINTEG, ONEWTE, and PROTECT options. MSGINTEG and PROTECT options are used with SNA LUs only. See the *CICS Resource Definition Guide* for more information about the profile definition.

How monitored

You can monitor the use of the above options from a VTAM trace by examining the exchanges between terminals and CICS and, in particular, by examining the contents of the request/response header (RH).

SNA chaining (RECEIVESIZE, BUILDCHAIN, and SENDSIZE)

Systems Network Architecture (SNA) allows terminal messages to be chained, and lets large messages be split into smaller parts while still logically treating the multiple message as a single message.

Input chain size and characteristics are normally dictated by the hardware requirements of the terminal in question, and so the RDO TYPETERM BUILDCHAIN and RECEIVESIZE keywords have no default values. The size of an output chain is specified by the RDO TYPETERM SENDSIZE keyword.

Effects

Because the network control program (NCP) also segments messages into 256-byte blocks for normal LU Type 0, 1, 2, and 3 devices, a SENDSIZE value of zero eliminates the overhead of output chaining. A value of 1536 is required for local devices of this type.

If you specify the RDO TYPETERM SENDSIZE keyword for intersystem communication (ISC) sessions, this must match the RDO TYPETERM RECEIVESIZE keyword in the other system. The RDO TYPETERM SENDSIZE keyword controls the size of the SNA element that is to be sent, and the RDO TYPETERM RECEIVESIZEs need to match so that there is a corresponding buffer of the same size able to receive the element.

If you specify BUILDCHAIN(YES), CICS assembles a complete chain of elements before passing them to an application. If you do not specify BUILDCHAIN(YES), each individual RU is passed to an individual receive-any in the application. With SNA/3270, BMS does not work correctly if you do not specify BUILDCHAIN(YES).

If you are dealing with very large inbound elements that exceed a maximum of 32KB, you cannot use the BUILDCHAIN keyword. You must use multiple individual RUs, and this extends the transaction life in the system.

Where useful

Chaining can be used in systems that use VTAM and SNA terminals of types that tolerate chaining.

Limitations

If you specify a low RDO TYPETERM SENDSIZE value, this causes additional processing and real and virtual storage to be used to break the single logical message into multiple parts.

Chaining may be required for some terminal devices. Output chaining can cause flickering on display screens, which can annoy users. Chaining also causes additional I/O overhead between VTAM and the NCP by requiring additional VTAM subtasks and STARTIO operations. This additional overhead is eliminated by making use of the VTAM large message performance enhancement option (LMPEO).

Recommendations

The RDO TYPETERM RECEIVESIZE value for IBM 3274-connected display terminals should be 1024; for IBM 3276-connected display terminals it should be 2048. These values give the best line characteristics while keeping processor usage to a minimum.

How implemented

Chaining characteristics are specified in the RDO TYPETERM resource definition with the SENDSIZE, BUILDCHAIN, and RECEIVESIZE keywords.

How monitored

Use of chaining and chain size can be determined by examining a VTAM trace. You can also use the CICS internal and auxiliary trace facilities, in which the VIO ZCP trace shows the chain elements. Some of the network monitor tools such as NetView Performance Monitor (NPM) give this data.

Terminal scan delay (ICVTSD)

The terminal scan delay (ICVTSD) system initialization parameter determines the frequency with which CICS attempts to process terminal output requests.

In general, this value defines the time that the terminal control program must wait to process:

- Non-VTAM terminal I/O requests with WAIT specified
- Non-VTAM output deferred until task termination
- Automatic transaction initiation (ATI) requests
- VTAM terminal management, including output request handling, in busy CICS systems with significant application task activity.

This last case arises from the way that CICS scans active tasks.

On CICS non-VTAM systems, the delay value specifies how long the terminal control program must wait after an application terminal request, before it carries out a TCT scan. The value thus controls batching and delay in the associated processing of terminal control requests. In a low-activity system, it controls the dispatching of the terminal control program.

The batching of requests reduces processor time at the expense of longer response times. On CICS VTAM systems, it influences how quickly the terminal control program completes VTAM request processing.

Effects

VTAM

In VTAM networks, a low ICVTSD value does not cause full TCT scans because the output from VTAM terminals is processed from the activate queue chain, and only those terminal entries are scanned.

With VTAM terminals, CICS uses bracket protocol to indicate that the terminal is currently connected to a transaction. The bracket is started when the transaction is

initiated, and ended when the transaction is terminated. This means that there could be two outputs to the terminal per transaction: one for the data sent and one when the transaction terminates containing the end bracket. In fact, only one output is sent (except for WRITE/SEND with WAIT and definite response). CICS holds the output data until the next terminal control request or termination. In this way it saves processor cycles and line utilization by sending the message and end bracket or change direction (if the next request was a READ/RECEIVE) together in the same output message (PIU). When the system gets very busy, terminal control is dispatched less frequently and becomes more dependent upon the value specified in ICVTSD. Because CICS may not send the end bracket to VTAM for an extended period of time, the life of a transaction can be extended. This keeps storage allocated for that task for longer periods and potentially increases the amount of virtual storage required for the total CICS dynamic storage areas.

Setting ICVTSD to zero can overcome this effect.

Non-VTAM

ICVTSD is the major control on the frequency of full terminal control table (TCT) scanning of non-VTAM terminals. In active systems, a full scan is done approximately once every ICVTSD. The average extra delay before sending an output message should be about half this period.

In non-VTAM networks, partial scans occur for other reasons, such as an input arriving from a terminal, and any outputs for that line are processed at the same time. For that reason, a value of between 0.5 and one second is normally a reasonable setting for non-VTAM networks.

CICS scans application tasks first, unless there is an ICVTSD-driven scan. In a highly utilized system, input and output messages may be unreasonably delayed if too large a ICVTSD value is specified.

All networks

In reasonably active systems, a nonzero ICVTSD virtually replaces ICV (see page 114) because the time to the next TCT full scan (non-VTAM) or sending of output requests (VTAM) is the principal influence on operating system wait duration.

The ICVTSD parameter can be changed in the system initialization table (SIT) or through JCL parameter overrides. If you are having virtual storage constraint problems, it is highly recommended that you reduce the value specified in ICVTSD. A value of zero causes the terminal control task to be dispatched most frequently. If you also have a large number of non-VTAM terminals, this may increase the amount of nonproductive processor cycles. A value of 100—300 milliseconds may be more appropriate for that situation. In a pure VTAM environment, however, the overhead is not significant, unless the average transaction has a very short pathlength, and ICVTSD should be set to zero for a better response time and best virtual storage usage.

Where useful

The ICVTSD system initialization parameter can be used in all except very low-activity CICS systems.

Limitations

In VTAM systems, a low value adds the overhead of scanning the activate queue TCTTE chain, which is normally a minor consideration. A high value in high-volume systems can increase task life and tie up resources owned by that task for a longer period of time; this can be a significant consideration.

A low, nonzero value of ICVTSD can cause CICS to be dispatched more frequently, which increases the overhead of performance monitoring.

Recommendations

Set ICVTSD to a value less than the region exit time interval (ICV), which is also in the system initialization table (see page 114). Use the value of zero in an environment that contains only VTAM terminals and consoles, unless your workload consists of many short transactions. For non-VTAM systems, specify the value of zero only for small networks (1 through 30 terminals).

For almost all systems that are not “pure” VTAM, the range should be somewhere in the region of 100 milliseconds to 1000 milliseconds. ICVTSD can be varied between, say, 300 and 1000 milliseconds without a very significant effect on the response time, but increasing the value decreases the processor overhead. An ICVTSD larger than 1000 milliseconds may not give any further improvement in processor usage, at a cost of longer response times.

If ICVTSD is reduced, and, if there is ample processor resource, a small reduction in response time can be achieved. If you go below 250 milliseconds, any improvement in response time is likely to seem negligible to the end user and would have an increased effect on processor usage.

The recommended absolute minimum level, for systems that are not “pure” VTAM, is approximately 250 milliseconds or, in really high-performance, high-power systems that are “pure” VTAM, 100 milliseconds.

How implemented

The ICVTSD system initialization parameter is defined in units of milliseconds. Use the commands CEMT or EXEC CICS SET SYSTEM SCANDELAY (nnnn) to reset the value of ICVTSD.

How monitored

Monitor task duration and processor requirements. The dispatcher domain statistics reports the value of ICVTSD.

Compression of output terminal data streams

For output messages, CICS provides user exits with access to the entire output data stream. User code can be written to remove redundant characters from the data stream before the data stream is sent to the terminal. This technique can produce a dramatic improvement in response times if the proportion of characters not needed is large, because telecommunication links are usually the slowest paths in the network.

Limitations

Some additional processor cycles are required to process the exit code, and the coding of the exit logic also requires some effort. Use of a compression exit reduces the storage requirements of VTAM or TCAM and NCP, and reduces line transmission time.

Recommendations

The simplest operation is to replace redundant characters, especially blanks, with a repeat-to-address sequence in the data stream for 3270-type devices.

Note: The repeat-to-address sequence is not handled very quickly on some types of 3270 cluster controller. In some cases, alternatives may give superior performance. For example, instead of sending a repeat-to-address sequence for a series of blanks, you should consider sending an ERASE and then set-buffer-address sequences to skip over the blank areas. This is satisfactory if nulls are acceptable in the buffer as an alternative to blanks.

Another technique for reducing the amount of data transmitted is to turn off any modified data tags on protected fields in an output data stream. This eliminates the need for those characters to be transmitted back to the processor on the next input message, but you should review application dependencies on those fields before you try this.

There may be other opportunities for data compression in individual systems, but you may need to investigate the design of those systems thoroughly before you can implement them.

How implemented

The global user exits used to compress terminal messages are the XZCOUT1 exit for VTAM devices, and the XTCTOUT exit for TCAM-supported devices. See the *CICS Customization Guide* for programming information.

How monitored

The contents of output terminal data streams can be examined in either a VTAM or TCAM trace.

Automatic installation of terminals

During autoinstall processing, CICS obtains storage from the control subpool in the extended CICS dynamic storage area (ECDSA), to handle each autoinstall request. The amount of virtual storage obtained is mainly determined by the length of the CINIT request unit, which varies for different LU types. For a typical autoinstall request from an LU6.2 terminal, the amount of dynamic virtual storage obtained is between 120 to 250 bytes.

Overall, the principal consumer of CICS resource in autoinstall processing is the autoinstall task (CATA) itself. If, for some reason, the autoinstall process is not proceeding at the rate expected during normal operations, there is a risk that the system could be filled with CATA transaction storage.

Maximum concurrent autoinstalls (AIQMAX)

This system initialization parameter codes the maximum number of devices that can be queued concurrently for autoinstall.

The AIQMAX value does not limit the total number of devices that can be autoinstalled.

The restart delay parameter (AIRDELAY)

This system initialization parameter specifies whether you want autoinstalled terminal definitions to be retained by CICS across a restart. The value of the restart delay is specified as “hhmmss” and the default is “000700”, which is seven minutes. This means that if a terminal does not log on to CICS within seven minutes after an emergency restart, its terminal entry is scheduled for deletion.

Setting the restart delay to zero means that you do not want CICS to re-install the autoinstalled terminal entries from the global catalog after restart. In this case, CICS does not write the terminal entries to the catalog while the terminal is being autoinstalled. This can have positive performance effects on the following processes:

Autoinstall: By eliminating the I/O activity, autoinstall has a shorter pathlength and becomes more processor-intensive. So, in general, the time taken to autoinstall a terminal is reduced. However, the response time of other tasks may increase slightly because CATA has a high priority and does not have to wait for as much I/O activity.

Emergency and warm restart: When no autoinstalled terminal entries are cataloged, CICS has to restore fewer entries from the restart data set during warm or emergency restart, which can reduce the restart time. Thus, if you have a large number of autoinstalled terminals, the restart time can be significantly improved when restart delay is set to zero.

Normal shutdown: CICS deletes autoinstalled terminal entries during normal shutdown unless AIRDELAY ≠0 and the terminal has not been deleted. If the restart delay is set to zero, CICS has not cataloged terminal entries when they were autoinstalled, so they are not deleted. This can reduce normal shutdown time.

XRF takeover: The system initialization parameter, AIRDELAY, should not affect XRF takeover. The tracking process still functions as before regardless of the value of the restart delay. Thus, after a takeover, the alternate system still has all the autoinstalled terminal entries. However, if a takeover occurs before the catchup process completes, some of the autoinstalled terminals have to log on to CICS again. The alternate CICS system has to rely on the catalog to complete the catchup process and, if the restart delay is set to zero in the active system, the alternate system is not able to restore the autoinstalled terminal entries that have not been tracked. Those terminals have to log on to the new CICS system, rather than being switched or rebound after takeover.

You have to weigh the risk of having some terminal users log on again because tracking has not completed, against the benefits introduced by setting the restart delay to zero. Because catchup takes only a few minutes, the chance of such a takeover occurring is usually small.

The delete delay parameter (AILDELAY)

The delete delay system initialization parameter lets you control how long an autoinstalled terminal entry remains available after the terminal has logged off. The default value of zero means that the terminal entry is scheduled for deletion as soon as the terminal is logged off. Otherwise, CICS schedules the deletion of the TCTTE as a timer task.

In general, setting the delete delay to a nonzero value can improve the performance of CICS when many autoinstalled terminals are logging on and off during the day. However, this does mean that unused autoinstalled terminal entry storage is not freed for use by other tasks until the delete delay interval has expired. This parameter provides an effective way of defining a terminal whose storage lifetime is somewhere between that of an autoinstalled terminal and a statically defined terminal.

The effect of setting the delete delay to a nonzero value can have different effects depending on the value of the restart delay:

Nonzero restart delay: When the restart delay is nonzero, CICS catalogs autoinstalled terminal entries in the global catalog.

If the delete delay is nonzero as well, CICS retains the terminal entry so that it is re-used when the terminal logs back on. This can eliminate the overhead of:

- Deleting the terminal entry in virtual storage
- An I/O to the catalog and recovery log
- Re-building the terminal entry when the terminal logs on again.

Zero restart delay: When the restart delay is zero, CICS does not catalog autoinstalled terminal entries in the global catalog whatever value is specified for the delete delay.

If the delete delay is nonzero, CICS retains the terminal entry so that it is re-used when the terminal logs back on. This can save the overhead of deleting the terminal entry in virtual storage and the rebuilding of the terminal entry when the terminal logs on again.

Effects

You can control the use of resource by autoinstall processing in three ways:

1. By using the transaction class limit to restrict the number of autoinstall tasks that can concurrently exist (see page 164).
2. By using the CATA and CATD transactions to install and delete autoinstall terminals dynamically. If you have a large number of devices autoinstalled, shutdown can fail due to the MXT system initialization parameter being reached or CICS becoming short on storage. To prevent this possible cause of shutdown failure, you should consider putting the CATD transaction in a class of its own to limit the number of concurrent CATD transactions.
3. By specifying AIQMAX to limit the number of devices that can be queued for autoinstall. This protects against abnormal consumption of virtual storage by the autoinstall process, caused as a result of some other abnormal event.

   If this limit is reached, the AIQMAX system initialization parameter affects the LOGON and BIND processing by CICS. CICS requests VTAM to stop passing

LOGON and BIND requests to CICS. VTAM holds such requests until CICS indicates that it can accept further LOGONs and BINDs (this occurs when CICS has processed a queued autoinstall request).

Recommendations

If the autoinstall process is noticeably slowed down by the AIQMAX limit, raise it. If the CICS system shows signs of running out of storage, reduce the AIQMAX limit. If possible, set the AIQMAX system initialization parameter to a value higher than that reached during normal operations.

In a **non-XRF** environment, settings of (restart delay=0) and (delete delay= hhmmss>0) are the most efficient for processor and DASD utilization. However, this efficiency is gained at a cost of virtual storage, because the TCT entries are not deleted until the delay period expires.

A value of zero for both restart delay and delete delay is the best overall setting for many systems from an overall performance and virtual-storage usage point of view.

If restart delay is greater than zero (cataloging active), the performance of autoinstall is significantly affected by the definition of the global catalog (DFHGCD) and the output data set for transient data. The default buffer specifications used by VSAM for the restart data set may not be sufficient in a high activity system.

Because a considerable number of messages are sent to transient data during logon and logoff, the performance of these output destinations should also be taken into consideration.

In an **XRF** environment, a restart delay value of greater than zero should give better performance when catchup of a large number of autoinstalled terminals is necessary.

How monitored

Monitor the autoinstall rate during normal operations by inspecting the autoinstall statistics regularly.

Chapter 14. VSAM and file control

This chapter includes the following topics:

VSAM considerations: general objectives

Tuning consists of providing a satisfactory level of service from a system at an acceptable cost. A satisfactory service, in the case of VSAM, is likely to be obtained by providing adequate buffers to minimize physical I/O and, at the same time, allowing several operations concurrently on the data sets.

The costs of assigning additional buffers and providing for concurrent operations on data sets are the additional virtual and real storage that is required for the buffers and control blocks.

Several factors influence the performance of VSAM data sets. The rest of this section reviews these and the following sections summarize the various related operands of file control.

Note that, in this section, a distinction is made between “files” and “data sets”:

A “file” means a view of a data set as defined by an FCT file entry and a VSAM ACB.

A “data set” means a VSAM “sphere”, including the base cluster with any associated AIX® paths.

Note: If you wish to use existing VSAM file definitions remote FCT entries must be migrated to the CICS definition data set (CSD). For more information about migrating macro-defined tables to the CSD, see the *CICS Resource Definition Guide*

Local shared resources (LSR) or Nonshared resources (NSR)

The first decision to make for each file is whether to use LSR or NSR for its VSAM buffers and strings. It is possible to use up to fifteen separate LSR pools for file control files. There is also a decision to make on how to distribute the data sets across the LSR pools.

CICS provides separate LSR buffer pools for data and index records. If only data buffers are specified, only one set of buffers are built and used for both data and index records.

Note that all FCT files opened for access to a particular VSAM data set normally must use the same resource type: see “Data set name sharing” on page 142.

LSR files share a common pool of buffers and a common pool of strings (that is, control blocks supporting the I/O operations). Other control blocks define the file and are unique to each file or data set. NSR files or data sets have their own set of buffers and control blocks.

Some important differences exist between NSR and LSR in the way that VSAM allocates and shares the buffers.

In NSR, the minimum number of data buffers is STRNO + 1, and the minimum index buffers (for KSDSs and AIX paths) is STRNO. One data and one index buffer are preallocated to each string, and one data buffer is kept in reserve for CI splits. If there are extra data buffers, these are assigned to the first sequential operation; they may also be used to speed VSAM CA splits by permitting chained I/O operations. If there are extra index buffers, they are shared between the strings and are used to hold high-level index records, thus providing an opportunity for saving physical I/O.

In LSR, there is no preallocation of buffers to strings, or to particular files or data sets. When VSAM needs to reuse a buffer, it picks the buffer that has been referenced least recently. Strings are always shared across all data sets.

Before issuing a read to disk when using LSR, VSAM first scans the buffers to check if the control interval it requires is already in storage. If so, it may not have to issue the read. This buffer “lookaside” can reduce I/O significantly.

Another important difference between LSR and NSR is in concurrent access to VSAM CIs. NSR allows multiple copies of a CI in storage; you can have one (but only one) string updating a CI and other strings reading different copies of the same CI. In LSR, there is only one copy of a CI in storage; the second of the requests must queue until the first operation completes. LSR permits several read operations to share access to the same buffer, but updates require exclusive use of the buffer and must queue until a previous update or previous reads have completed; reads must wait for any update to finish. It is possible, therefore, that transactions with concurrent browse and update operations that run successfully with NSR may, with LSR, hit a deadlock as the second operation waits unsuccessfully for the first to complete.

Transactions should always be designed and programmed to avoid deadlocks. For further discussions, see the *CICS Application Programming Guide*.

LSR has significant advantages, by providing:

- More efficient use of virtual storage because buffers and strings are shared.
- Better performance because of better buffer lookaside, which can reduce I/O operations.
- Self-tuning because more buffers are allocated to busy files and frequently referenced index control intervals are kept in its buffers.

- Better read integrity because there is only one copy of a CI in storage.
- Use of synchronous file requests and an EXCPAD taken for all requests.

  File control requests for NSR files are done asynchronously, however, and still cause the CICS main task or subtask to stop during a split.

NSR, on the other hand:

- Allows for specific tuning in favor of a particular data set
- Can provide better performance for sequential operations.

The general recommendation is to use LSR for all VSAM data sets except where you have one of the following situations:

- A file is very active but there is no opportunity for lookaside because, for instance, the file is very large.
- High performance is required by the allocation of extra index buffers.
- Fast sequential browse or mass insert is required by the allocation of extra data buffers.
- Control area (CA) splits are expected for a file, and extra data buffers are to be allocated to speed up the CA splits.

If you have only one LSR pool, a particular data set cannot be isolated from others using the same pool when it is competing for strings, and it can only be isolated when it is competing for buffers by specifying unique CI sizes. In general, you get more self-tuning effects by running with one large pool, but it is possible to isolate busy files from the remainder or give additional buffers to a group of high performance files by using several pools. It is possible that a highly active file has more successful buffer lookaside and less I/O if it is set up as the only file in an LSR subpool rather than using NSR. Also the use of multiple pools eases the restriction of 255 strings for each pool.

Number of strings

The next decision to be made is the number of concurrent accesses to be supported for each file and for each LSR pool.

This is achieved by specifying VSAM “strings”. A string is a request to a VSAM data set requiring “positioning” within the data set. Each string specified results in a number of VSAM control blocks (including a “placeholder”) being built.

VSAM requires one or more strings for each concurrent file operation. For nonupdate requests (for example, a READ or BROWSE), an access using a base needs one string, and an access using an AIX needs two strings (one to hold position on the AIX and one to hold position on the base data set). For update requests where no upgrade set is involved, a base still needs one string, and a path two strings. For update requests where an upgrade set is involved, a base needs 1+n strings and a path needs 2+n strings, where ‘n’ is the number of members in the upgrade set (VSAM needs one string per upgrade set member to hold position). Note that, for each concurrent request, VSAM can reuse the n strings required for upgrade set processing because the upgrade set is updated serially. See “CICS calculation of LSR pool operands” on page 141.

A simple operation such as read direct frees the string or strings immediately, but a read for update, mass insert, or browse retains them until a corresponding release, update, or end browse is performed.

The interpretation of the STRNO operand by CICS and by VSAM differs depending upon the context:

- The equivalent STRINGS operand of the RDO FILE resource definition has the same meaning as the STRNO in the VSAM ACB for NSR files: that is, the actual number of concurrent outstanding VSAM requests that can be handled. When AIX paths or upgrade sets are used, the actual number of strings which VSAM allocates to support this may be greater than the STRNO value specified.
- The equivalent STRINGS operand of the RDO LSRPOOL resource definition has the same meaning as the STRNO in the VSAM BLDVRP macro: that is, the absolute number of strings to be allocated to the resource pool. Unless an LSR pool contains only base data sets, the number of concurrent requests that can be handled is less than the STRNO value specified.

For LSR, it is possible to specify the precise numbers of strings, or to have CICS calculate the numbers. The number specified in the SHRCTL macro is the actual number of strings in the pool. If CICS is left to calculate the number of strings, it derives the pool STRNO from the FCT file entries and interpret this, as with NSR, as the actual number of concurrent requests. (For an explanation of CICS calculation of LSR pool operands, see “CICS calculation of LSR pool operands” on page 141.)

You must decide how many concurrent read, browse, updates, mass inserts, and so on you need to support.

If access to a file is read only with no browsing, there is no need to have a large number of strings; just one may be sufficient. Note that, while a read operation only holds the VSAM string for the duration of the request, it may have to wait for the completion of an update operation on the same CI.

In general, where some browsing or updates are used, STRNO should be set to 2 or 3 initially and CICS file statistics should be checked regularly to see the proportion of wait-on-strings encountered. Wait-on-strings of up to 5% of file accesses would usually be considered quite acceptable. You should not try, with NSR files, to keep wait-on-strings permanently zero.

CICS manages string usage for both files and LSR pools. For each file, whether it uses LSR or NSR, CICS limits the number of concurrent VSAM requests to the STRNO= specified in the FCT file entry. For each LSR pool, CICS also prevents more requests being concurrently made to VSAM than can be handled by the strings in the pool. Note that, if additional strings are required for upgrade-set processing at update time, CICS anticipates this requirement by reserving the additional strings at read-for-update time. If there are not enough file or LSR pool strings available, the requesting task waits until they are freed. The CICS statistics give details of the string waits.

When deciding the number of strings for a particular file, consider the maximum number of concurrent tasks. Because CICS command level does not allow more

than one request to be outstanding against a particular data set from a particular task, there is no point in allowing strings for more concurrent requests.

If you want to distribute your strings across tasks of different types, the transaction classes may also be useful. You can use transaction class limits to control the transactions issuing the separate types of VSAM request, and for limiting the number of task types that can use VSAM strings, thereby leaving a subset of strings available for other uses.

All placeholder control blocks must contain a field long enough for the largest key associated with any of the data sets sharing the pool. Assigning one inactive file that has a very large key (primary or alternate) into an LSR pool with many strings may use excessive storage.

Size of control intervals

The size of the data set control intervals is not an operand specified to CICS; it is defined through VSAM Access Method Services (AMS). However, it can have a significant performance effect on a CICS system that provides access to the control interval.

In general, direct I/O runs slightly more quickly when data CIs are small, whereas sequential I/O is quicker when data CIs are large. However, with NSR files, it is possible to get a good compromise by using small data CIs but also assigning extra buffers, which leads to chained and overlapped sequential I/O. However, all the extra data buffers get assigned to the first string doing sequential I/O.

VSAM functions most efficiently when its control areas are the maximum size, and it is generally best to have data CIs larger than index CIs. Thus, typical CI sizes for data are 4KB to 12KB and, for index, 1KB to 2KB.

In general, you should specify the size of the data CI for a file, but allow VSAM to select the appropriate index CI to match. An exception to this is if key compression turns out to be less efficient than VSAM expects it to be. In this case, VSAM may select too small an index CI size. You may find an unusually high rate of CA splits occurring with poor use of DASD space. If this is suspected, specify a larger index CI.

In the case of LSR, there may be a benefit in standardizing on the CI sizes, because this allows more sharing of buffers between files and thereby allow a lower total number of buffers. Conversely, there may be a benefit in giving a file unique CI sizes to prevent it from competing for buffers with other files using the same pool.

Try to keep CI sizes at 512, 1KB, 2KB, or any multiple of 4KB. Unusual CI sizes like 26KB or 30KB should be avoided. A CI size of 26KB does not mean that physical block size will be 26KB; the physical block size will most likely be 2KB in this case (it is device-dependent).

Number of buffers (NSR)

The next decision is the number of buffers to be provided for each file. Enough buffers must be provided to support the concurrent accesses specified in the STRNO operand for the file (in fact VSAM enforces this for NSR).

Specify the number of data and index buffers for NSR using the DATABUFFERS and INDEXBUFFERS keywords of the RDO FILE resource definition. It is important to specify sufficient index buffers. If a KSDS consists of just one control area (and, therefore, just one index CI), the minimum index buffers equal to STRNO is sufficient. But when a KSDS is larger than this, at least one extra index buffer needs to be specified so that at least the top level index buffer is shared by all strings. Further index buffers reduces index I/O to some extent.

BUFND should generally be the minimum at STRNO + 1, unless the aim is to enable overlapped and chained I/O in sequential operations or it is necessary to provide the extra buffers to speed up CA splits.

Note that when the file is an AIX path to a base, the same INDEXBUFFERS (if the base is a KSDS) and DATABUFFERS are used for AIX and base buffers (but see “Data set name sharing” on page 142).

Number of buffers (LSR)

The set of buffers of one size in an LSR pool is called a “subpool.” The number of buffers for each subpool is controlled by the DATAxxx and INDEXxxx keywords of the RDO LSRPOOL resource definition. It is possible to specify precise numbers or to have CICS calculate the numbers. (The method used by CICS to calculate the number of buffers is described below.)

Allowing CICS to calculate the LSR operands is easy but it requires additional overhead (at startup) to build the pool because CICS must read the VSAM catalog for every file that is specified to use the pool. Also it cannot be fine-tuned by specifying actual quantities of each buffer size. When making changes to the size of an LSR pool, refer to the CICS shutdown statistics before and after the change is made. These statistics show whether the proportion of VSAM reads satisfied by buffer lookaside is significantly changed or not.

In general, you would expect to benefit more by having extra index buffers for lookaside, and less by having extra data buffers. This is a further reason for standardizing on LSR data and index CI sizes, so that one subpool does not have a mix of index and data CIs in it.

Note: Data and index buffers are specified separately with the LSRPOOL definition. Thus, there is not a requirement to use CI size to differentiate between data and index values.

Take care to include buffers of the right size. If no buffers of the required size are present, VSAM uses the next larger buffer size.

CICS calculation of LSR pool operands

If you have not specified LSR operands for a pool, CICS calculates for you the buffers and strings required. To do this, it scans the FCT for all file entries for files specified to use the pool. For each, it uses:

- From the FCT file entries:
  - The number of strings, STRINGS on an RDO LSRPOOL resource definition
- From the VSAM catalog:
  - The levels of index for each of these files
  - The CI sizes
  - The keylengths for the base, the path (if it is accessed through an AIX path), and upgrade set AIXs.

Note: If you have specified only buffers or only strings, CICS performs the calculation for what you have not specified.

The following information helps you calculate the buffers required. A particular file may require more than one buffer size. For each file, CICS determines the buffer sizes required for:

- The data component
- The index component (if a KSDS)
- The data and index components for the AIX (if it is an AIX path)
- The data and index components for each AIX in the upgrade set (if any).

The number of buffers for each is calculated as follows:

- For data components (base and AIX) = (STRINGS in the RDO FILE resource definition +1
- For index components (base and AIX) = (STRINGS in the RDO FILE resource definition) + (the number of levels in the index) – 1
- For data and index components for each AIX in the upgrade set, one buffer each.

When this has been done for all the files to use the pool, the total number of buffers for each size is:

- Reduced to either 50% or the percentage specified in the SHARELIMIT keyword or the RDO LSRPOOL resource definition. The SHARELIMIT keyword takes precedence.
- If necessary, increased to a minimum of three buffers.
- Rounded up to the nearest 4KB boundary.

To calculate the number of strings, CICS determines the number of strings to handle concurrent requests for each file as the sum of:

- STRINGS= strings for the base
- STRINGS= strings for the AIX (if it is an AIX path)
- n strings if there is an upgrade set (where ‘n’ is the number of members in the upgrade set).

When the strings have been accumulated for all files, the total is:

- Reduced to either 50% or the percentage specified in the SHARELIMIT keyword of the RDO LSRPOOL resource definition. The SHARELIMIT keyword takes precedence.
- Reduced to 255 (the maximum number of strings allowed for a pool by VSAM).
- Increased to the largest specified STRINGS= for a particular file.

The operands calculated by CICS are shown in the CICS statistics.

Data set name sharing

Data set name (DSN) sharing (MACRF=DSN specified in the VSAM ACB) is available for all VSAM data sets. It causes VSAM to create a single control block structure for the strings and buffers required by all the files that relate to the same base data set cluster, whether as a path or direct to the base. VSAM makes the connection at open time of the second and subsequent files. Only if DSN sharing is specified does VSAM realize that it is processing the same data set.

Data set name sharing is available for VSAM files using both local shared resources (LSR) and nonshared resources (NSR)

This single structure:

- Provides VSAM update integrity for multiple ACBs (FCT file entries) updating one VSAM data set
- Allows the use of VSAM share options 1 or 2, while still permitting multiple update ACBs within the CICS region
- Saves virtual storage.

The NSRGROUP keyword of the RDO FILE resource definition is associated with DSN sharing. It is used to group together FCT entries that are to refer to the same VSAM base data set. NSRGROUP=name has no effect for data sets that use LSR.

When the first member of a group of DSN-sharing NSR files is opened, CICS must specify to VSAM the total number of strings to be allocated for all file entries in the group, by means of the BSTRNO value in the ACB. VSAM builds its control block structure at this time regardless of whether the first data set to be opened is a path or a base. CICS calculates the value of BSTRNO used at the time of the open by adding the STRINGS values in all the FCT entries that share the same NSRGROUP.

If you do not provide the BASE= operand, the VSAM control block structure may be built with insufficient strings for later processing. This should be avoided for performance reasons. In such a case, VSAM invokes the dynamic string addition feature to provide the extra control blocks for the strings as they are required, and the extra storage is not released until the end of the CICS run.

AIX considerations

For each AIX defined with the UPGRADE attribute, VSAM upgrades the AIX automatically when the base cluster is updated.

For NSR, VSAM uses a special set of buffers associated with the base cluster to do this. This set consists of two data buffers and one index buffer, which are used

serially for each AIX associated with a base cluster. It is not possible to tune this part of the VSAM operation.

For LSR, VSAM uses buffers from the appropriate subpool.

Care should be taken when specifying to VSAM that an AIX should be in the upgrade set. Whenever a new record is added, an existing record deleted, or a record updated with a changed attribute key, VSAM updates the AIXs in the upgrade set. This involves extra processing and extra I/O operations.

Effect of data set name sharing on data set SHAREOPTIONS

The SHAREOPTIONS attribute of a VSAM data set defines the access that VSAM allows to that data set by files (ACBs). VSAM regards as a single file (ACB) all those files accessing the same data set with data set name sharing active. However, CICS always opens files using data set name sharing for output. Not all the files relating to the data set need have data set name sharing specified in the file control table. Files outside the data set name sharing structure can still be opened provided that the limits set by the SHAREOPTIONS attribute are not exceeded. If the data set has SHAREOPTIONS 1 or 2 (specifying that one ACB only can be open for update at any one time), all files using data set name sharing for that data set must be closed before a file outside the data set name sharing structure can open for output, even if their SERVREQ options restrict access to read-only requests.

Situations that cause extra physical I/O

Listed below are some situations that can lead to a lot of physical I/O operations, thus affecting both response times and associated processor pathlengths:

- When a KSDS is defined with SHROPT of 4, all direct reads cause a refresh of both index and data buffers (to ensure latest copy).
- Any sequence leading to CICS issuing ENDREQ invalidates all data buffers associated with the operation. This may occur when you end a get-update (without the following update), a browse (even a start browse with a no-record-found response), a mass-insert or any get-locate from a program. If the operation is not explicitly ended by the program, CICS ends the operation at syncpoint or end of task.
- If there are more data buffers than strings, a start browse causes at least half the buffers to participate immediately in chained I/O. If the browse is short, the additional I/O is unnecessary.

Empty data sets

An empty data set is a data set that has not yet had any records written to it. VSAM imposes several restrictions on an empty data set such as not allowing you to have an alternate index in the upgrade set. CICS allows you to use an empty data set in the same way as you use a normal data set. You should, however, only attempt to write records to an empty data set.

If the file is read while it is still empty, CICS will CLOSE and OPEN the file every time it is referenced. This can cause serious performance degradation. For more information about empty data sets, see the *CICS System Definition Guide*.

VSAM resource usage (LSRPOOL)

The default for all VSAM data sets is LSR. The LSRPOOLID keyword of the RDO FILE resource definition allows the use of up to fifteen separate LSR pools. The default is LSRPOOL=1.

Effects

The LSRPOOLID keyword specifies whether a file is to use LSR or NSR and, if LSR, which pool.

Where useful

The LSRPOOLID keyword can be used in CICS systems with VSAM data sets.

Limitations

All files in a data set name sharing group must use either the same LSR pool, or they must all use NSR.

If you continue to use the DFHFCT macro to define your VSAM files, SERVREQ=REUSE files cannot use LSR. RDO has no equivalent to the SERVREQ=REUSE operand.

Recommendations

See “VSAM considerations: general objectives” on page 135. Consider removing files from an LSR pool.

How implemented

The resource usage is defined by the LSRPOOL definition or the DFHFCT TYPE=SHRCTL macro. If DFHFCT is currently being used to define VSAM files, data tables, or LSR pools, they should be migrated to the CICS system definition data set (CSD). For details on migrating DFHFCT defined resources to the CSD, see the *CICS Resource Definition Guide*.

VSAM buffer allocations for NSR (INDEXBUFFERS and DATA BUFFERS)

For files using non shared resources (NSR), the INDEXBUFFERS and DATABUFFERS keywords on an RDO FILE resource definition define the VSAM index buffers and data buffers respectively.

Effects

INDEXBUFFERS and DATABUFFERS specify the number of index and data buffers for an NSR file.

The number of buffers can have a significant effect on performance. The use of many buffers can permit multiple concurrent operations (if there are the corresponding number of VSAM strings) and efficient sequential operations and CA splits. Providing extra buffers for high-level index records can reduce physical I/O operations.

Buffer allocations above the 16MB line represent a significant part of the virtual storage requirement of most CICS systems.

Further information on VSAM buffer allocations is given in the VSAM publications, for example, the *VSE/VSAM Users Guide*.

INDEXBUFFERS and DATABUFFERS have no effect if they are specified for files using LSR.

Where useful

INDEXBUFFERS and DATABUFFERS should be specified in CICS systems that use VSAM NSR files in CICS file control.

Limitations

These operands can be overridden by VSAM if they are insufficient for the strings specified for the VSAM data set. The maximum specification is 255. A specification greater than this will automatically be reduced to 255. Overriding of VSAM buffers should never be done by specifying the BUFND and BUFNI operands on the DLBL statement.

Recommendations

See “VSAM considerations: general objectives” on page 135.

How implemented

The VSAM buffer allocations are defined either via INDEXBUFFERS and DATA BUFFERS operands on a RDO FILE resource definition, or the BUFNI and BUFND operands of a DFHFCT TYPE=FILE macro.

For LSR files, they are ignored.

How monitored

The effects of these operands can be monitored through transaction response times and data set and paging I/O rates. The CICS file statistics show data set activity to VSAM data sets. The VSAM catalog shows data set activity, space usage, and CI size.

CICS monitoring exception records are produced when a wait for string is necessary, and can be very useful in identifying files that may need more strings allocated.

VSAM buffer allocations for LSR (DATAxxx and INDEXxxx)

For files using shared resources (LSR), the number of buffers to be used is not specified explicitly by file. The files share the buffers of the appropriate sizes in the LSR pool. The number of buffers in the pool may either be specified explicitly using the DATAxxx and INDEXxxx keywords of an RDO LSRPOOL resource definition (or the BUFFERS operand in the DFHFCT TYPE=SHRCTL macro). If DFHFCT is currently being used to define VSAM files, data tables, or LSR pools, they should be migrated to the CICS system definition data set (CSD). For more information about migrating macro-defined tables to the CSD, see the *CICS Resource Definition Guide*.

Effects

The DATAxxx and INDEXxxx keywords allow for exact definition of specific buffers for the LSR pool.

The number of buffers can have a significant effect on performance. The use of many buffers can permit multiple concurrent operations (if there are the corresponding number of VSAM strings). It can also increase the chance of successful buffer lookaside with the resulting reduction in physical I/O operations.

The number of buffers should achieve an optimum between increasing the I/O saving due to lookaside and increasing the real storage requirement. This optimum is different for buffers used for indexes and buffers used for data. Note that the optimum buffer allocation for LSR is likely to be significantly less than the buffer allocation for the same files using NSR.

Where useful

The DATAxxx and INDEXxxx keywords should be used in CICS systems that use VSAM LSR files in CICS file control.

Recommendations

See “VSAM considerations: general objectives” on page 135.

How implemented

VSAM buffer allocations are defined using the DATAxxx and INDEXxxx keywords of an RDO FILE resource definition command (or BUFFERS operand on a DFHFCT TYPE=SHRCTL macro.

How monitored

The effects of these operands can be monitored through transaction response times and data set and paging I/O rates. The effectiveness affects both file and lsrpool statistics. The CICS file statistics show data set activity to VSAM data sets. The VSAM catalog can show data set activity, space usage, and CI size.

VSAM string settings for NSR (STRINGS)

The STRINGS keyword on an RDO FILE resource definition is used to determine the number of concurrent operations possible against the file and against the VSAM base cluster to which the file relates.

Effects

The STRINGS operand for files using NSR has the following effects:

- It specifies the number of concurrent asynchronous requests that can be made against that specific file.
- It is used as the STRINGS in the VSAM ACB.
- It is used, in conjunction with the BASE operand, to calculate the VSAM BSTRINGS.

Strings represent a significant part of the virtual storage requirement of most CICS systems. With CICS this storage is above the 16MB line.

Where useful

The STRINGS keyword should be specified in CICS systems that use VSAM NSR files in CICS file control.

Limitations

A maximum of 255 strings can be used as the STRINGS or BSTRINGS in the ACB.

Recommendations

See “VSAM considerations: general objectives” on page 135.

How implemented

The number of strings is defined by the STRINGS keyword of an RDO FILE resource definition (or the STRINGS operand on a DFHDCT TYPE=FILE macro). It corresponds to the VSAM operand in the ACB except where a base file is opened as the first for a VSAM data set; in this case, the CICS-accumulated BSTRNO value is used as the STRNO for the ACB.

How monitored

The effects of the STRINGS keyword can be seen in increased response times and monitored by the string queueing statistics for each FCT entry.

VSAM string settings for LSR (STRINGS)

STRINGS is used to determine the number of strings and thereby the number of concurrent operations possible against the LSR pool (assuming that there are buffers available).

Effects

The STRINGS operand relating to files using LSR has the following effects:

- It specifies the number of concurrent requests that can be made against that specific file.
- It is used by CICS to calculate the number of strings and buffers for the LSR pool.
- It is used as the STRNO for the VSAM LSR pool.
- It is used by CICS to limit requests to the pools to prevent a VSAM short-on-strings condition (note that CICS calculates the number of strings required per request).

Where useful

The STRINGS keyword can be specified in CICS systems with VSAM data sets.

Limitations

A maximum of 255 strings is allowed per pool.

Recommendations

See “VSAM considerations: general objectives” on page 135.

How implemented

The number of strings is defined by the STRINGS keyword on an RDO FILE resource definition (or the STRINGS operand on a DFHFCT TYPE=FILE macro) which limits the concurrent activity for that particular file.

How monitored

The effects of the STRINGS keyword can be seen in increased response times for each file entry. The CICS LSRPOOL statistics give information on the number of data set accesses and the highest number of requests for a string.

Examination of the string numbers in the CICS statistics shows that there is a two-level check on string numbers available: one at the data set level (see “File statistics” on page 241), and one at the shared resource pool level (see “LSRPOOL statistics” on page 272).

Maximum keylength for LSR (MAXKEYLENGTH)

The MAXKEYLENGTH of an RDO LSRPOOL resource definition (or KEYLEN operand of a DFHFCT TYPE=FILE macro) specifies the size of the largest key to be used in an LSR pool.

The maximum keylength may be specified explicitly using the MAXKEYLENGTH keyword of an RDO LSRPOOL resource definition or it may be left to CICS to determine from the VSAM catalog.

Effects

The MAXKEYLENGTH operand causes the “placeholder” control blocks to be built with space for the largest key that can be used with the LSR pool. If the MAXKEYLENGTH specified is too small, it prevents requests for files that have a longer key length.

Where useful

The MAXKEYLENGTH operand can be used in CICS systems with VSAM data sets.

Recommendations

See “VSAM considerations: general objectives” on page 135.

The key length should always be as large as, or larger than, the largest key for files using the LSR pool.

How implemented

The size of the maximum keylength is defined in the MAXKEYLENGTH keyword of an RDO LSRPOOL resource definition (or the KEYLEN operand on a DFHFCT TYPE=LSRPOOL macro).

Resource percentile for LSR (SHARELIMIT)

The SHARELIMIT keyword on an RDO LSRPOOL resource definition (or the RSCLMT operand on a DFHFCT TYPE=SHRCTL macro) specifies the percentage of the buffers and strings that CICS should apply to the value that it calculates.

Effects

The method used by CICS to calculate LSR pool operands and the use of the SHARELIMIT value is described in “VSAM considerations: general objectives” on page 135.

This operand has no effect if both the VSAM buffers (DATAxxx and INDEXxxx) and the STRINGS keywords are specified on the RDO LSRPOOL resource definition.

Where useful

The SHARELIMIT operand can be used in CICS systems with VSAM data sets.

Recommendations

See “VSAM considerations: general objectives” on page 135.

Because SHARELIMIT can be applied only to files that are allocated at initialization of the LSR pool (when the first file in the pool is opened), it is always wise to specify the decimal STRINGS and buffer size parameters (LSRPOOL DATAxxx and INDEXxxx) for an LSR pool.

How implemented

The SHARELIMIT operand is specified in the LSRPOOL. definition on the CSD (or the RSCLMT operand on a DFHFCT TYPE=SHRCTL macro).

VSAM local shared resources (LSR)

Effects

CICS always builds a control block for LSR pool 1. CICS builds control blocks for other pools if either an RDO LSRPOOL resource definition is installed or an installed RDO FILE resource definition specifies LSRPOOLID(nn).

Where useful

VSAM shared resources can be used in CICS systems that use VSAM.

Recommendations

See “VSAM considerations: general objectives” on page 135.

How implemented

CICS uses the operands to build the LSR pool provided in either:

- a DFHFCT TYPE=SHRCTL macro
- an RDO LSRPOOL resource definition

How monitored

VSAM LSR can be monitored by means of response times, paging rates, and CICS LSRPOOL statistics. The CICS LSRPOOL statistics show string usage, data set activity, and buffer lookasides (see “LSRPOOL statistics” on page 272).

Data tables

Data tables enable you to build, maintain and have rapid access to data records contained in tables held in a data space. Therefore, they can provide a substantial performance benefit by reducing DASD I/O and pathlength resources. The pathlength to retrieve a record from a data table is significantly shorter than that to retrieve a record already in a VSAM buffer.

Effects

- After the initial data table load operation, DASD I/O can be eliminated for all user-maintained and for read-only CICS-maintained data tables.
- Reductions in DASD I/O for CICS-maintained data tables are dependent on the READ/WRITE ratio. This is a ratio of the number of READs to WRITEs that was experienced on the source data set, prior to the data table implementation. They also depend on the data table READ-hit ratio, that is, the number of READs that are satisfied by the table, compared with the number of requests that go against the source data set.
- CICS file control processor consumption can be reduced by up to 70%. This is dependent on the file design and activity, and is given here as a general guideline only. Actual results vary from installation to installation.

For CICS-maintained data tables, CICS ensures the synchronization of source data set and data table changes. When a file is recoverable, the necessary synchronization is already effected by the existing record locking. When the file is nonrecoverable, there is no CICS record locking and the note string position (NSP) mechanism is used instead for all update requests. This may have a small performance impact of additional VSAM ENDREQ requests in some instances.

Recommendations

- Remember that data tables are defined by two RDO FILE operands, TABLE and MAXNUMRECS of the file definition. No other changes are required.
- Start off gradually by selecting only one or two candidates. You may want to start with a CICS-maintained data table because this simplifies recovery considerations.

- Select a CICS-maintained data table with a high READ to WRITE ratio. This information can be found in the CICS LSRPOOL statistics (see page 272) by running a VSAM LISTCAT job.
- READ INTO is recommended, because READ SET incurs slightly more internal overhead.
- Monitor your real storage consumption. If your system is already real-storage constrained, having large data tables could increase your page-in rates. This in turn could adversely effect CICS system performance.
- Files that have a large proportion of update activity that does not require to be recovered across a restart would be better suited for user-maintained data tables.
- User-maintained data tables can use the global user exit XDTRD to modify as well as select records. This could allow the user-maintained data table to contain only the information relevant to the application.

How implemented

Data tables can be defined by an RDO FILE resource definition or a DFHFCT TYPE=CICSTABLE or USERTABLE macros. See the *CICS Resource Definition Guide*, and the *CICS Shared Data Tables Guide* manuals for further information.

How monitored

Performance statistics are gathered to assess the effectiveness of the data table. They are in addition to those available through the standard CICS file statistics.

The following information is recorded:

- The number of attempts to read from the table
- The number of unsuccessful read attempts
- The number of bytes allocated to the data table
- The number of records loaded into the data table
- The number of attempts to add to the table
- The number of records rejected by a user exit when being added to the table either during loading or via the API
- The number of attempts to add a record which failed due to the table being full (already at its maximum number of records)
- The number of attempts to update table records via rewrite requests.
- The number of attempts to delete records from the table
- The highest value which the number of records in the table has reached since it was last opened.

There are circumstances in which apparent discrepancies in the statistics may be seen, caused, for example, by the existence of inflight updates.

DL/I buffers

DL/I can locate DL/I VSAM buffers above the 16MB line. Only those buffers which are defined in the HSBFR statement—that is, for which buffer management is performed by VSAM—are eligible. Buffers which are defined in the HDBFR statement and DL/I itself are located below the line.

Effects

The main effect of using storage above the line is to free the space needed in CICS DSA, allowing transactions to have a faster throughput rate.

DL/I applications benefit from the following CICS functions being moved above the 16MB line:

- Main temporary storage
- Dynamic transaction buffers
- Non-DL/I resources, where these benefit from 31-bit implementation. The corresponding DL/I application also benefits.

DL/I applications also benefit from changes which exploit distributed program link (DPL). This reduces the processing overhead when compared with function shipping

Tuning considerations

DL/I support is limited to DL/I KSDS and some ESDS type files for which VSAM I/O buffering is used. See Table 9.

Table 9. VSAM buffers above 16MB

Type of file or data set	**Eligibility**
HDAM ESDS	NO
HIDAM ESDS	NO
HIDAM KSDS (index)	YES
Secondary index both HDAM and HIDAM	YES
HISAM ESDS (data)	YES
HISAM KSDS (index)	YES
SHISAM KSDS (index and data)	YES

Recommendations

Putting as many of your DL/I buffers and applications above the line as possible frees space in the CICS DSA so that the transaction rate can be increased.

Implementing and monitoring DL/I buffers

DL/I 31-bit support must be explicitly invoked. The default is to locate all buffers below the 16MB line. You should set HSMODE=ANY in the DL/I control statement for batch DL/I or HSMODE=ANY in the DLZACT TYPE=CONFIG macro for both online and MPS access.

Compare the size of your GETVIS before and after all the DL/I databases are open. The difference will give you some idea of the potential benefit.

Chapter 15. Journaling

This chapter includes the following topics:

Activity keypoint frequency (AKPFREQ)

The activity keypoint frequency value (AKPFREQ) system initialization parameter specifies the number of physical outputs to the CICS system log before an activity keypoint is to be taken. A keypoint is a snapshot of in-flight tasks and tables (such as the destination control table (DCT), and temporary storage table (TST)) in the system at that time. During emergency restart, CICS only needs to read back for records for those tasks identified in a keypoint. CICS reads the system log backward until the first activity keypoint is encountered. This activity keypoint is analyzed to determine if the system log should be read backward further to gather data for in-flight tasks.

In summary, the AKPFREQ value determines the amount of writing on the journal between keypoint frequencies and, therefore, the amount that may need to be read back on an emergency restart. It also determines the extent to which the journal data is interspersed with additional data for keypoints.

Limitations

Increasing the AKPFREQ value has the following effects:

- Restart and XRF takeover times tend to increase.
- The size requirements of the restart data set (DFHRSD) may be increased.
- The amount of data that is written to the log is reduced.

Decreasing the AKPFREQ value has the following effects:

- Restart time may be reduced. This is particularly important in high-availability systems such as those running with XRF=YES (see “Using extended recovery facility (XRF)” on page 205).
- Task wait time and processor cycles tend to increase.
- Paging may increase.
- More data is written to the log.

Taking a keypoint imposes an overhead on the running system. Paging increases at keypoint time because many control blocks are scanned.

Setting AKPFREQ to zero makes emergency restart impossible.

Recommendations

If you set AKPFREQ too high and thus make your keypoint frequency too low, the writing of the keypoints causes the system to slow down for a short time. If you set AKPFREQ too low and make your keypoint frequency too high, you may get a short emergency restart time but you also increase the amount of data on the log because a higher proportion of it is keypoint data.

Having a low AKPFREQ value does not help in reducing the log read time if the system contains long-running tasks which do not take regular syncpoints when they update recoverable resources. If the system contains this sort of task, it has to read back the LOG all the way to the last syncpoint (or transaction start) for that task.

Set AKPFREQ to a value that allows activity keypoints no more often than once every 15 minutes. If your system takes keypoints more frequently, increase AKPFREQ.

How implemented

Activity keypoint frequency is determined by the AKPFREQ system initialization parameter. The CSKP transaction and the DFHAKP program must also be installed (IBM-supplied group DFHAKP). AKPFREQ can be altered with the CEMT SET SYSTEMAKP(value) command while CICS is running.

How monitored

A message, DFHJC5801, is written to the CSMT transient data destination each time a keypoint is taken. Use CICS transaction statistics (see page 305) to see the frequency of execution of the CSKP transaction.

CICS journaling (BUFSIZE, SYSWAIT=STARTIO|ASIS)

The buffer size (BUFSIZE) operand in the journal control table indicates the size of each buffer used in journal output. The size for the buffers ranges from 256 through 32760 bytes. Both buffers of each journal are of equal size and are created and acquired at CICS initialization.

BUFSIZE limits the maximum size of a journal block. Thus, it also implies a limit on the maximum size of any single record written to that journal. Journal control builds a label record at the front of the buffer and the remaining space in the buffer constitutes the maximum size of any single record.

Note: If no change is made to the value you specified for BUFSIZE in releases before CICS Transaction Server for VSE/ESA Release 1, a GETMAIN will result in twice the former amount of storage being acquired.

Effects

Journal records are blocked, variable-length records. They are passed to the buffers in the following way:

1. Records are added to the first (current) buffer until such time that output is required. This could be because:
   - An immediate (STARTIO) write has been requested for a record.
   - A synchronous (WAIT) request was received and one second has elapsed.

- The current buffer is full.

2. The two buffers are swapped, the current buffer becoming the alternate, and the alternate becoming the current.
3. Output is performed on the alternate buffer, containing the records just added.
4. While output is in progress, new records may also be added to the current buffer.
5. If the current buffer becomes full before output has completed on the alternate buffer, the 'buffer full' statistic is incremented by one, and any task attempting to put a record into that journal is held until the output is completed.

If SYSWAIT=STARTIO (the default) has been coded in the JCT, all synchronizing requests from CICS management modules will force immediate output. In general, this will only affect the system log, as most requests from CICS management modules are directed to the system log. However, CICS management modules also write to user journals when they have been specified as forward recovery logs.

Normally, SYSWAIT=STARTIO should be chosen to minimize transaction response times. However, if the frequency of output to the journal becomes so high that the device becomes overloaded, code SYSWAIT=ASIS in the JCT. Output is then performed as necessary according to the criteria in the the list in point 1 on page 154 above.

If SYSWAIT=ASIS is preferred, it is recommended that you code it only for user journals. Use of this option may reduce any contention on a busy device and provide very small CPU savings. Response times for transactions using journals with this option are likely to be longer than when using the default.

Limitations

BUFSIZE must not exceed the physical capacity of the journal device that is going to receive the data. There is a maximum limit of 32760 bytes and, on DASD devices, the limit may be smaller because of a smaller track capacity.

On the other hand, BUFSIZE must be at least large enough to hold the maximum sized single journal record (together with the label) that may be written to the journal.

Recommendations

In most systems it is preferable to use the default (SYSWAIT=STARTIO) thus minimizing response time. For the system log, use a BUFSIZE such that 'buffer full' does not occur. If possible, all user journals should also have a BUFSIZE such that 'buffer full' does not occur.

The number of 'buffer full', as reported in CICS statistics, should be as near to zero as possible for the CICS system log. The BUFSIZE should be made large enough to ensure this. The virtual storage cost of the buffer is likely to be much less than the virtual storage cost of increased transaction response times incurred when ‘buffer full’ occurs.

For programming information on the format of journal records, see the *CICS Customization Guide*.

A busy CICS journal, particularly the system log, has typically a very high device utilization rate and should, therefore, be the only high-activity data set on a DASD volume.

How implemented

Journal output characteristics are defined with the BUFSIZE, and SYSWAIT=STARTIO|ASIS options in the DFHJCT TYPE=ENTRY macro.

How monitored

The CICS journal control statistics show activity and blocking of records to the defined journals. The following information is given in these statistics (see page 260):

- The number of output requests made
- The number of blocks written
- The average length of blocks written
- The number of times the buffer was full (that is, the current buffer had filled before output has completed on the alternate buffer).

Small journal size and long running transactions that update protected resources and do not syncpoint, may cause the start of a long running transaction to become 'lost' from the currently accessible system log. This makes transaction backout impossible.

Journal volume switches (JOUROPT=AUTOARCH|PAUSE)

To allow you to continue writing to journals while archiving is in progress, two disk data sets are required for every journal. CICS archives the filled data set while writing to the second data set.

When a journal data set is filled, it is closed and CICS automatically archives the data set to either tape or disk. The journal data set is not reused until archiving is complete.

The only need for operator intervention should be to mount a new tape.

Effects

If the journal was specified with the PAUSE option in its journal control table (JCT) entry, at the switch to the second data set, CICS sends either message DFHJC4583 or DFHJC4586. This message indicates that the specified journal disk is about to be overwritten by output. The operator has to respond to this message before the next switch can take place. If the operator has not responded before the second extent becomes full, the JCT PAUSE option causes logging to cease until the operator has responded.

Recommendations

If AUTOARCH is used, two journal data sets are required.

Automatic journal archiving (JOUROPT=AUTOARCH in the JCT) minimizes operator intervention and the possibility of the second data set filling before the first has been archived.

Forcing a journal volume switch during non-peak periods can minimize the effect of the wait. Use two tape drives, with maximum tape reel data capacity, to minimize the effect with tape journaling. Using two tape drives eliminates the rewind and remount time.

How implemented

A switch can be forced on a data set by using EXEC CICS SET JOURNALNUM ADVANCE, or with CEMT SET JOURNALNUM ADVANCE. See the *CICS Recovery and Restart Guide* and the *CICS Resource Definition Guide* for further information on the JCT specifications, and the *CICS-Supplied Transactions* manual for further information on the CEMT transaction.

How monitored

Journal archiving information is part of journal statistics (see page 260).

Chapter 16. Virtual and real storage

This chapter includes the following topics:

This chapter discusses performance tuning issues related to virtual and real storage.

CICS storage management works in units of pages that are normally identical to the operating system page size. Think about choosing area sizes so that they fit properly onto pages.

Allocations that specify a number of storage areas should be set to fill all pages used. Storage size allocations should be defined at a size that optimizes page usage. Allocation of storage areas that are exactly divisible by the page size completely fill the pages.

Tuning CICS virtual storage

The CICS virtual storage tuning process consists of several steps that you should take in the following order:

1. Understand the contents of the CICS address space. To determine what is good or bad in your system, you must first fully understand the contents of the CICS address space and what components of the system affect the size of each of the areas. See Appendix C, “VSE/ESA and CICS virtual storage” on page 365 for a description of the CICS address space.
2. Measure the CICS address space using one of the following tools to determine the approximate sizes of each of the areas:
   - CICS formatted dump (loader domain and storage domain only) to look at the CICS region
   - CICS storage statistics
   - The sample statistics program (DFH0STAT) to provide selected statistical information for estimating the size of your DSAs.
3. Using the results of the above measurements, determine if each of the areas of the CICS address space is within the expected sizes and select the areas that

seem to be the most out of line from your expectations. Concentrate on these items; do not waste time on areas that represent only a small amount of storage improvement.

4. Evaluate the guidance given in the following chapter to see whether it is applicable to your installation.

Splitting online systems: virtual storage

A method of increasing the virtual storage available to a CICS system is to split the system into two or more separate address spaces. Splitting a system can also allow you to use multiprocessor complexes to the best advantage because a system can then operate on each processor concurrently. Splitting systems can also provide higher availability; see "Splitting online systems: availability" on page 112. See page 179 for information on using intercommunication facilities.

If data, programs, or terminals must be shared between the systems, CICS provides intercommunication facilities for this sharing. Two types of intercommunication are possible:

1. **Intersystem communication (ISC)**. ISC is implemented through the VTAM LU6.1 or LU6.2. These give program-to-program communication with System Network Architecture (SNA) protocols. ISC includes facilities for function shipping, distributed transaction processing, and transaction routing.
2. **Multiregion operation (MRO)**. MRO is implemented through VSE cross-memory facilities. It includes function shipping, distributed transaction processing, and transaction routing.

The definition of too many MRO sessions can unduly increase the processor time used to test their associated ECBs. Use the CICS-produced statistics (see "ISC/IRC system and mode entries" on page 250) to determine the number of MRO sessions defined and used. For more detailed information on ISC and MRO, see the *CICS Intercommunication Guide*.

MRO also allows you to use multiprocessors more fully, and the multiple address spaces can be dispatched concurrently. MRO is implemented primarily through changes to CICS resource definitions and job control statements for the various regions. To relieve constraints on virtual storage, it may be effective to split the CICS address space in this manner.

Function shipping allows you to define data sets, transient data, temporary storage, DL/I databases, or interval control functions as being remote. This facility allows applications to request data set services from a remote region (that is, the other CICS address space where the data sets are physically defined). Heavy use of VSAM and DL/I resources requires large amounts of virtual storage. If, for example, 500 VSAM KSDS data sets are removed to a remote region from the region where the application is being run, this can potentially save more than one megabyte.

The DL/I call and EXEC interfaces are supported for function shipping. CICS handles the access to remote resources and returns the requested items to a program without the need for recoding the program.

Distributed transaction processing allows direct communication between one application program and another application program, on a "send/receive" basis,

much as a program communicates with a terminal. See the *CICS Distributed Transaction Programming Guide* for information about DTP.

Transaction routing allows a terminal owned by one CICS region to run a transaction that resides in another region, as if that transaction resided in the terminal-owning region.

Where useful

Most CICS systems can be split.

Limitations

Splitting a CICS region requires increased real storage, increased processor cycles, and extensive planning.

If you only want transaction routing with MRO, the processor overhead is relatively small. The figure is release- and system-dependent but for safety, assume a total cost somewhere in the range of 15–30KB instructions per message-pair. This is a small proportion of most transactions: commonly 10% or less.

The cost of MRO function shipping can be very much greater, because there are normally many more inter-CICS flows per transaction. It depends greatly on the disposition of resources across the separate CICS systems.

MRO can affect response time as well as processor time. There are delays in getting requests from one CICS to the next. These arise because CICS terminal control in either CICS system has to detect any request sent from the other, and then has to process it; and also because, if you have a uniprocessor, VSE has to arrange dispatching of two CICS systems and that must imply extra WAIT/DISPATCH overheads and delays.

The system initialization parameter ICVTSD (see page 127) can influence the frequency with which the terminal control program is dispatched. Another system initialization parameter is MROLRM, which should be coded yes if you want to establish a long-running mirror task. This saves re-establishing communications with the mirror transaction if the application makes many function shipping requests in a unit of work. A value in the range 300–1000 milliseconds is typical in non-MRO systems, and a value in the range 150–300 is typical for MRO systems (and even lower if you are using function-shipping).

You also have to ensure that you have enough MRO sessions defined between the CICS systems to take your expected traffic load. They do not cost much in storage and you certainly do not want to queue. Examine the ISC/IRC statistics to ensure that no allocates have been queued, also ensure that all sessions are being used.

Other parameters, such as MXT, may need to be adjusted when CICS systems are split. In an MRO system with function shipping, tasks of longer duration might also require further adjustment of MXT together with other parameters (for example, file string numbers, virtual storage allocation). Finally, if you plan to use MRO, you may want to consider whether it would be advantageous to share CICS code or application code using the VSE shared virtual area (SVA). Note that this is to save real storage, not virtual storage, and other non-CICS address spaces. Use of SVA for the eligible modules in CICS is controlled by the system initialization parameter, SVA=YES; this tells CICS to search for the modules in the SVA. For further

information on use of SVA, see “Using modules in the shared virtual area (SVA)” on page 172.

Recommendations

To tune CICS to get more virtual storage, you must first tune VSE and then CICS. If, after you have tuned VSE common virtual storage, you still cannot execute CICS in a single address space, you must then consider splitting the CICS workload into multiple address spaces. Many installations find it convenient to split their CICS workload into multiple independent address spaces, where their workload is easily definable and no resource sharing is required. If it is easy to isolate application subsystems and their associated terminals, programs, and data sets, it is reasonable to split a single CICS address space into two or more independent address spaces. They become autonomous regions with no interactions.

A system can be split by application function, by CICS function (such as a data set owning or terminal owning CICS), or by a combination of the two functions. Ideally, you should split the system completely, with no communication required between the two parts. This can reduce overheads and planning. If this is not possible, you must use one of the intercommunication facilities.

You can provide transaction routing between multiple copies of CICS. If additional virtual storage is needed, it would be reasonable, for example, to split the AOR into two or more additional CICS copies. When you have split the system either partially or completely, you can reduce the amount of virtual storage needed for each region by removing any unused resident programs. One consequence of this is reduce the size of the relevant DSA.

Admittedly, MRO uses additional processor cycles and requires more real storage for the new address spaces. Many installations have several megabytes of program storage, however, so the potential virtual storage savings are significant.

You should also remember that only a local or remote PSB can be scheduled at one time with function shipping, affecting the integrity of the combined databases. Distributed transaction processing can allow for transactions in both systems to concurrently schedule the PSBs.

MRO generally involves less overhead because the processing of the telecommunications access method is avoided. VTAM logons and logoffs can provide an alternative to transaction routing if the logons and logoffs are infrequent.

How implemented

You must define resources in the CSD (CICS system definition) data set, such as program files and terminal definitions. You must also check links to other systems, together with the connection and session definitions that substantiate such links.

Maximum task specification (MXT)

The MXT system initialization parameter limits the total number of concurrent user tasks in the CICS system. It also affects the amount of storage allocated to the kernel stack segment.

Effects

MXT primarily controls virtual storage usage, particularly to avoid short-on-storage (SOS) conditions. It also controls contention for resources, the length of queues (this can avoid excessive processor usage), and real storage usage.

MXT controls the number of user tasks that are eligible for dispatch. When MXT is set (either at startup, when an EXEC CICS SET SYSTEM command is processed, or when using a CEMT transaction) the kernel and dispatcher attempt to preallocate sufficient control blocks to guarantee that MXT user tasks can be created concurrently. The majority of the storage used in this preallocation is obtained from the CDSA or ECDSA, although a small amount of VSE storage is required for each task (approximately 256 bytes above the 16MB line, and 32 bytes below the 16MB line for each user task). It is interrelated with the DSA size limits that you set (DSALIM, EDSALIM).

Limitations

If you set MXT too low, throughput and response time can suffer when system resources (processor, real storage, and virtual storage) are not constrained.

If you set MXT too high at startup, CICS forces a smaller maximum number of tasks consistent with available storage.

If you set MXT too high while running, you get the error message: “CEILING REACHED.”

For MRO considerations, read about the secondary effects of the region exit interval (ICV) on page “Partition exit interval (ICV)” on page 114.

Recommendations

Initially, set MXT to the number of user tasks you require concurrently in your system by totaling the following:

- The number of concurrent long-running tasks
- Each terminal running conversational tasks
- An estimate of the number of concurrent tasks from terminals running nonconversational tasks
- An estimate of the number of concurrent nonterminal tasks.

How implemented

The MXT system initialization parameter has a default value of 5, and a minimum setting of 1. It can be altered with either CEMT or EXEC CICS SET SYSTEM MAXTASKS commands while CICS is running.

How monitored

The CICS transaction manager statistics show the number of times the MXT ceiling has been reached.

Transaction class (MAXACTIVE)

Transaction classes give you a mechanism to limit the number of CICS tasks within your system. By spreading your tasks across a number of transaction classes and controlling the maximum number of tasks that can be dispatched within each transaction class, you can control resource contention between tasks and limit the number of tasks that CICS considers eligible for dispatching at task attach.

Effects

Together with MXT, transaction classes control the transaction "mix", that is, it ensures that one type of transaction does not monopolize CICS.

When the number of tasks within a class is at the specified ceiling, no additional tasks within that class are attached until one of them terminates.

Transaction classes can be used to force single-threading of a few tasks, either to avoid ENQ interlocks or because of the excessive effect of several such tasks on the rest of the system.

Limitations

Transaction classes are unsuitable in normal use for conversational transactions, because the (n+1) user may be locked out for a long time.

If TRANCLASS is specified with transaction CATD, the MAXACTIVE attribute of the transaction class must have a value of at least two in the corresponding field to prevent all the CATD transactions stacking up behind the one in the ECB wait during an emergency restart. See the *CICS Resource Definition Guide* for more details of TRANCLASS.

Recommendations

The MAXACTIVE attribute of the transaction class definition can be used to control a specific set of tasks that may be heavy resource users, tasks of lesser importance (for example, "Good morning" broadcast messages), and so on, allowing processor time or storage for other tasks.

By selecting transaction classes and their MAXACTIVE values, you can control the mix of transactions; that is, you can ensure that one type of transaction does not monopolize CICS. In particular, you can restrict the number of "heavyweight" tasks, the load on particular data sets or disk volumes, and the printer load on lines. For example, you can use transaction classes to isolate "difficult" tasks, or put all user tasks into separate classes. Suggested classes are simple enquiries, complex enquiries or short browses, long browses, short updates, long updates. Separate nonconversational tasks from conversational tasks. If you need to single-thread non-reentrant code, use ENQ for preference.

Using transaction classes can be useful for particularly high-resource-consuming tasks that do not exceed MAXACTIVE ceiling frequently, but should not be implemented for normal tasks or for design reasons such as serializing a function within a particular task. Application design should be reviewed as an alternative in these cases.

How implemented

You specify the maximum number of tasks in each transaction class using the MAXACTIVE attribute. You specify the value of the class associated with a particular task using the TRANCLASS keyword of an RDO TRANSACTION resource definition. Most CICS Cxxx transaction identifiers are not eligible.

MAXACTIVE values can be changed using the CEMT SET TRANCLASS(classname) MAXACTIVE(value) or EXEC CICS SET TRANCLASS() MAXACTIVE() commands.

How monitored

If you have divided your tasks into classes, you can use the CEMT INQUIRE TCLASS command to provide an online report. The CICS transaction class statistics show the number of times that the number of active transactions in the transaction class reached the MAXACTIVE value ("Times MaxAct").

Transaction class purge threshold (PURGETHRESH)

The PURGETHRESH attribute of an RDO TRANCLASS resource definition limits the number of tasks which are newly created, but cannot be started because the MAXACTIVE limit has been reached for the associated transaction class. These tasks are queued by the transaction manager domain in priority order until they obtain class membership.

They occupy small amounts of storage, but if the queue becomes very long CICS can become short-on-storage and take a considerable time to recover. Systems where a heavy transaction load is controlled by the TRANCLASS mechanism are most prone to being overwhelmed by the queue.

The tasks on the queue are not counted by the MXT mechanism. MXT limits the total number of tasks that have already been admitted to the system within TRANCLASS constraints.

Effects

The length of the queue of tasks waiting to be started in a TRANCLASS is limited by the PURGETHRESH attribute of that class. Any new transaction which would cause the limit to be reached is abended with the abend code AKCC. Tasks that were queued before the limit was reached are allowed to continue waiting until they can be executed.

Where useful

The PURGETHRESH attribute should be specified only where the transaction load in a TRANCLASS is heavy. This is the case in a system which uses a terminal-owning region (TOR) and multiple application-owning regions (AORs) and where the TRANCLASSes are associated with the AORs and are used to control the numbers of transactions attempting to use the respective AORs. In this configuration, an AOR can slow down or stall and the associated TRANCLASS fills (up to the value defined by MAXACTIVE) with tasks that are unable to complete their work in the AOR. New transaction are then queued and the queue can grow to occupy all the available storage in the CICS DSA within a few minutes, depending on the transaction volume.

Recommendations

The size of each entry in the queue is the size of a transaction (256 bytes) plus the size of the TIOA holding any terminal input to the transaction. There can be any number of queues, one for each TRANCLASS that is installed in the TOR.

You can estimate a reasonable size for the queue by multiplying the maximum length of time you are prepared for users to wait before a transaction is started by the maximum arrival rate of transactions in the TRANCLASS.

Make sure that the queues cannot occupy excessive amounts of storage at their maximum lengths.

The queuing limit should not be set so low that CICS abends transactions unnecessarily, for example when an AOR slows down due to a variation in the load on the CPU.

How implemented

The PURGETHRESH attribute of a TRANCLASS is used to set the limit of the queue for that transaction classes. The default action is not to limit the length of the queue.

Note that the CEMT SET TRANCLASS(name) PURGETHRESH(p) command can be used to change the purge threshold of a transaction class online.

How monitored

To monitor the lengths of the queues for each transaction class you should use CICS transaction class statistics. Many statistics are kept for each transaction class. Those that are particularly relevant here are:

XMCPI
Number of transactions abended AKCC because the size of the queue reached the PURGETHRESH limit.

XMCPQT
The peak number of transactions in the queue.

XMCTAPT
The number of times the size of the queue reached the PURGETHRESH limit.

You can also tell how many tasks are queued and active in a transaction class at any one time by using the CEMT INQUIRE TRANCLASS command.

You can monitor the number of AKCC abends in the CSMT log. These abends indicate the periods when the queue limit was reached. You must correlate the transaction codes in the abend messages with the transaction classes to determine which limit was being reached. The tasks on the queue are not counted by the MXT mechanism. MXT limits the total number of tasks that have already been admitted to the system within TRANCLASS constraints.

Task prioritization

Prioritization is a method of giving specific tasks preference in being dispatched.

Priority is specified by terminal in an RDO TERMINAL resource definition (TERMPRIORITY) or by transaction in a CEDA TRANSACTION definition (PRIORITY) and by operator in the (OPPRTY) external resource manager (ESM) database.

The overall priority is determined by summing the priorities in all three definitions for any given task, with the maximum priority being 255.

```
TERMPRIORITY+PRIORITY+OPPRTY => 255
```

The value of the system initialization parameter, PRTYAGE also influences the dispatching order, for example, PRTYAGE=1000 causes the task's priority to increase by 1 every 1000ms it spends on the ready queue.

Effects

The dispatching priority of a task is reassessed each time it becomes ready for dispatch, based on clock time as well as defined priority.

A task of priority n+1 that has just become ready for dispatch is usually dispatched ahead of a task of priority n, but only if PRTYAGE milliseconds have not elapsed since the latter last became ready for dispatch.

Thus, a low priority task may be overtaken by many higher priority tasks in a busy system, but eventually arrives at the top of the ready queue for a single dispatch.

The lower the value of PRTYAGE, the sooner this occurs.

Where useful

Prioritization is useful for browsing tasks, and tasks that use a lot of processor time. Input/Output bound tasks can take the required amount of CPU, and move on to the next read/write wait. CPU-intensive tasks take higher priority over the less intensive tasks.

Prioritization can be implemented in all CICS systems. It is more important in a high-activity system than in a low-activity system. With careful priority selection, an improvement in overall throughput and response time may be possible.

Input/Output bound tasks can take the required amount of CPU, and move on to the next read/write wait. CPU-intensive tasks take higher priority over the less intensive tasks.

Prioritization can minimize resource usage of certain resource-bound transactions.

Limitations

Prioritization increases the response time for lower-priority tasks, and can distort the regulating effects of MXT and the MAXACTIVE attribute of the transaction class definition.

Priorities do not affect the order of servicing terminal input messages and, therefore, the time they wait to be attached to the transaction manager.

Because prioritization is determined in three sets of definitions (terminal, transaction, and operator), it can be a time-consuming process for you to track many transactions within a system.

CICS prioritization is not interrupt-driven as is the case with operating system prioritization, but simply determines the position on a ready queue. This means that, after a task is given control of the processor, the task does not relinquish that control until it issues a CICS command that calls the CICS dispatcher. After the dispatch of a processor-bound task, CICS can be tied up for long periods if CICS requests are infrequent. For that reason, prioritization should be implemented only if MXT and the MAXACTIVE attribute of the transaction class definition adjustments have proved to be insufficient.

Recommendations

Use prioritization sparingly, if at all, and only after you have already adjusted task levels using MXT and the MAXACTIVE attribute of the transaction class definition.

It is probably best to set all tasks to the same priority, and then prioritize some transactions either higher or lower on an exception basis, and according to the specific constraints within a system.

Do not prioritize against slow tasks unless you can accept the longer task life and greater dispatch overhead; these tasks are slow, in any case, and give up control each time they have to wait for I/O.

Use small priority values and differences. Concentrate on transaction priority. Give priority to control operator tasks rather than the person, or at least to the control operator's signon ID rather than to a specific physical terminal (the control operator may move around).

Consider for **high** priority a task that uses large resources. However, the effects of this on the overall system need careful monitoring to ensure that loading a large transaction of this type does not lock out other transactions.

Also consider for **high** priority those transactions that cause enqueues to system resources, thus locking out other transactions. As a result, these can process quickly and then release resources. Examples of these are:

- Using intrapartition transient data with logical recovery
- Updating frequently used records
- Automatic logging
- Tasks needing fast application response time, for example, data entry.

Lower priority should be considered for tasks that:

- Have long browsing activity
- Are process-intensive with minimal I/O activity
- Do not require terminal interaction, for example:
  - Auto-initiate tasks (except when you are using transient data intrapartition destinations or queues with a destination facility of "terminal" (DESTFAC=TERMINAL) in the destination control table (DCT), and the TRIGGER level is greater than zero)
  - Batch update controlling tasks

PRTYAGE should usually be left to its default value, unless certain transactions get stuck behind higher priority transactions during very busy periods.

How implemented

You specify the priority of a **transaction** in the CEDA TRANSACTION definition with the PRIORITY keyword. You specify the priority for a **terminal** in the CEDA terminal definition with the TERMPRIORITY keyword or in the TCT with the TRMPRTY operand. You specify the priority for an **operator** in the external resource manager (ESM) database.

PRTYAGE is a system initialization parameter.

How monitored

There is no direct measurement of transaction priority. Indirect measurement can be made from:

- Task priorities
- Observed transaction responses
- Overall processor, storage, and data set I/O usage.

Simplifying the definition of CICS dynamic storage areas

CICS allocates dynamic storage areas automatically. This removes the need to specify the size of each individual dynamic storage area. You need specify only the overall limits within which CICS can allocate storage for these areas.

CICS uses eight separate dynamic storage areas:

CDSA
RDSA
SDSA
UDSA

ECDSA
ERDSA
ESDSA
EUDSA

To facilitate continuous operations, and to simplify CICS system management, the individual DSA sizes are determined by CICS, and can be varied dynamically by CICS as the need arises. You simply specify how much storage that CICS is to use for the DSAs in two amounts—one for the four DSAs above the 16MB boundary, and the other for the four DSAs below. Automatic sizing within the specified limits removes the need for restarts to change DSA sizes. You can also vary the overall limits dynamically, using either the CEMT master terminal command, or an EXEC CICS SET command. See “The dynamic storage areas” on page 367 for more information about considerations regarding the size you should set for the DSALIM and EDSALIM parameters.

Extended Dynamic Storage Areas

Conceptually, you should view the system initialization parameter, EDSALIMIT, as limiting the size of one large storage pool where each of the DSAs above the line (ECDSA, ESDSA, EUDSA, ERDSA) acquire space. The unit of allocation is 1MB extents. An allocated extent can be used by only the owning EDSA (EDSAs cannot share a given extent). If there is not enough space within the allocated extents to satisfy a request, additional extents are acquired as necessary unless the EDSALIMIT has been reached.

In situations where one of the EDSAs attempts to acquire an additional extent and there are no free extents, empty extents belonging to other EDSAs are used. Program compression may be triggered when the EDSALIMIT is approached and there are few free or empty extents available. The EUDSA no longer contains programs, and so program compression does not occur in it. The other EDSAs are evaluated individually to determine if program compression is required.

Estimating the EDSALIMIT

Specify the EDSALIMIT so that there is sufficient space to accommodate all the EDSAs.

- The EDSAs (ECDSA, ESDSA, EUDSA and ERDSA) are managed by CICS as part of the EDSALIMIT. Because the EDSAs are managed in 1 megabyte increments (extents), it is important to allow for fragmentation and partially used extents by rounding up the value of the EDSALIMIT accordingly. Because there are 4 extended DSAs, consider rounding up each EDSA's requirement to a megabyte boundary.
- You must allow 64K per concurrent active task for the EUDSA. The safest estimate is to assume MXT as the number of concurrent active tasks. If your applications use more than 64K per task, you must adjust the formulas accordingly (use multiples of 64K increments if adjusting the formula).

Kernel stack storage is allocated out of EDSA, and for more information about kernel storage see "CICS kernel storage" on page 379.

The minimum EDSALIMIT is 10MB and the default value is 20MB. The maximum EDSALIMIT size is (2 gigabytes - 1 megabyte).

The EDSALIMIT can be dynamically adjusted using the CEMT command without having to stop and restart your CICS system. The safest approach is to:

- Slightly over-specify the EDSALIMIT initially.
- Monitor each EDSA's usage while your system is running near peak loads.
- Tune your EDSALIMIT size using CEMT SET SYSTEM commands.

If you under-specify the EDSALIMIT, your system can go short on storage and it you may not be able to issue CEMT commands to increase the limit.

Dynamic Storage Areas (below the line)

If your installation is constrained for virtual storage below the line, the simplest approach is to set the DSALIMIT equivalent to the sum of the CDSA and UDSA. You will have to consider adjusting these figures so that they use the 256KB limit, see "DSA details" on page 171.

You may find that there is slightly more storage available below the line for DSA storage. CICS pre-allocates approximately 3KB or less of kernel stack storage below the line per task. The majority of kernel stack storage is allocated out of CICS DSAs instead of VSE storage.

DSA details

The DSAs below the line are managed in a similar manner to the EDSAs. The differences in DSA and EDSA management are:

- The extent size for the CDSA, RDSA, and SDSA is in 256KB increments rather than the 1MB size used for the EDSAs.
- Allocation is in 256KB extents. It is important to keep this in mind because you must allow for some fragmentation between the 256KB extents of the CDSA, RDSA and SDSA compared with the 1 megabyte extents of the UDSA.
- Task storage is 4KB per active task in the UDSA compared with the 1 megabyte or 64KB size for the EUDSA.
- If your applications use more than 4KB per task, you must adjust the formula accordingly (use multiples of 4KB increments if adjusting the formula).
- If your system uses the SDSA and the RDSA, you must allow for these DSAs to be allocated in 256KB increments.

Estimating the DSALIMIT

If you have sufficient virtual storage to adjust your DSALIMIT to a value greater than the sum of your current CDSA + UDSA, the following formulas may be used

Note: In each of the components of the calculations that follow remember to round their values up to a 256KB boundary.

1. If you can afford to specify a generous DSALIMIT:

   CDSA + UDSA + 256K (if both RDSA and SDSA used)

2. If your current installation DSAs and MXT values are set to values larger than necessary:

   Peak CDSA Used + Peak UDSA Used + 256K (if both RDSA and SDSA used)

The minimum DSALIMIT is 2MB and the default value is 5MB. (The maximum DSALIMIT size is 16MB).

As discussed in the EDSALIMIT section, it is safer to slightly over-specify the DSALIMIT than to under-specify it. The DSALIMIT can be tuned to a smaller value after you have obtained data from your running system.

Dynamically altering a DSALIMIT value

Accurate sizing of the DSALIMIT and EDSALIMIT parameters is no longer critical. It is not necessary to recycle your CICS system to make a change to the DSA sizes. CEMT SET SYSTEM, EXEC CICS SET SYSTEM, or CEMT SET DSAS, a CEMT panel which groups all the storage-related parameters together, can be used to make a change. Care should always be taken, however, when increasing DSALIMIT or EDSALIMIT, as other subsystem problems may occur. For example, a VSE GETVIS could fail. It is necessary to understand the storage requirement outside the DSAs.

A reduction of DSALIMIT or EDSALIMIT cannot take place if there are no DSA extents free to release. The storage manager will release extents as they become available until the new DSALIMIT or EDSALIMIT value is reached. A short-on-storage condition may occur when reducing DSALIMIT or EDSALIMIT. A new parameter, SOSSTATUS, has been added to CEMT INQUIRE SYSTEM, EXEC CICS INQUIRE SYSTEM, and CEMT INQUIRE DSAS commands to give you some indication of short-on-storage conditions.

Removing redundant table entries

Unused table entries increase the cycle requirements because of the additional entries that have to be searched in a table, and thus they tie up real and virtual storage. Elimination of these entries can save some processor resources.

Effects

Entries made in CICS tables, such as unused terminals in the terminal control table (TCT), or unused files in the file control table (FCT), tie up storage just as if they were used, and can increase the time needed to search through the tables. They can increase CICS startup or restart time as well.

How implemented

Unused entries are most common in the TCT. but can exist in any CICS table.

How monitored

Use CICS table manager statistics and review those entries with zero counts.

Using modules in the shared virtual area (SVA)

Some CICS management and user modules can be moved into the 24-bit or 31-bit shared virtual area (SVA). For systems running multiple copies of CICS, this can allow those multiple copies to share the same set of CICS management code.

Effects

The benefits of placing code in either of the SVAs are:

- The code is protected from possible corruption by user applications. Because the SVAs are in protected storage, it is virtually impossible to modify the contents of these programs.
- Performance can be improved and the demand for real storage reduced if you use the SVAs for program modules. If more than one copy of the same release of CICS is running in multiple address spaces of the same processor, each address space requires access to the CICS nucleus modules. These modules may either be loaded into each of the address spaces or shared in either of the SVAs. If they are shared in an SVA, this can reduce the working set and therefore, the demand for real storage (paging).
- You can decrease the storage requirement in the private area by judicious allocation of the unused storage in the SVAs created by rounding to the next segment.

Limitations

Maintenance requirements should be considered. If test and production systems are sharing SVA modules it may be desirable to run the test system without the SVA modules when new maintenance is being tested.

The disadvantage of placing too many modules in the 24-bit SVA (but not the 31-bit SVA) is that it may become excessively large. The size of the 31-bit SVA is not usually a problem.

Recommendations

The objective is to use the SVAs wisely to derive the maximum benefit from placing modules in the SVA.

All users with multiple CICS address spaces should put all eligible modules in the 31-bit SVA.

How implemented

SVA=YES must be specified in the system initialization table (SIT). Specifying SVA=NO allows you to test a system with new versions of CICS programs (for example, a new release) before moving the code to the production system. The production system can then continue to use modules from the SVA while you are testing the new versions.

An additional control, the PRVMOD system initialization parameter, enables you to exclude particular modules explicitly from use in the SVA.

For information on installing modules in the SVA, see the *CICS System Definition Guide*.

Map alignment

CICS maps that are used by basic mapping support (BMS) can be defined as aligned or unaligned. In aligned maps, the length field associated with a BMS data field in the BMS DSECT is always aligned on a halfword boundary. In unaligned maps, the length field follows on immediately from the preceding data field in the map DSECT.

A combination of aligned and unaligned maps can be used.

Effects

In unaligned maps, there is no guarantee that the length fields in the BMS DSECT are halfword-aligned. Some COBOL and PL/I compilers, in this case, generate extra code in the program, copying the contents of any such length field to, or from, a halfword-aligned work area when its contents are referenced or changed.

Specifying map alignment removes this overhead in the application program but increases the size of the BMS DSECT, at worst by one padding byte per map data field, and marginally increases the internal pathlength of BMS in processing the map. The best approach, therefore, is to use unaligned maps, except where the compiler being used would generate inefficient application program code.

In COBOL, an unaligned map generates an unsynchronized structure. In PL/I, an unaligned map generates a map DSECT definition as an unaligned structure. Correspondingly, aligned maps produce synchronized structures in COBOL and aligned structures in PL/I.

Limitations

In CICS, BMS maps are always generated in groups ("map sets"). An entire map set must be defined as aligned or unaligned. Also, maps may be used by application programs written in a variety of languages. In these cases, it is important to choose the option that best suits the combination of programs and, if there is any requirement for both aligned and unaligned maps, the ALIGNED option should be taken.

Conversion of maps from aligned to unaligned or conversely should be avoided if possible, because changing the map DSECT also requires reassembly or recompilation of all application programs that reference it.

How implemented

Map alignment is defined when maps are assembled. Aligned maps use the SYSPARM(A) option. The BMS=ALIGN/UNALIGN system initialization parameter defines which type of map is being used.

The map and map set alignment option can also be specified when maps and map sets are defined using the screen definition facility (SDF II) licensed program product. For more information, see the *Screen Definition Facility II Primer for CICS/BMS Programs*.

How monitored

The importance of map alignment may be found by inspecting programs that handle screens with a large number of fields. Try recompiling the program when the BMS DSECT is generated first without, and then with, the map alignment option. If the program size, as indicated in the linkage edit map, drops significantly in the second case, it is reasonable to assume there is high overhead for the unaligned maps, and aligned maps should be used if possible.

Resident, nonresident, and transient programs

Programs, map sets, and partitions can be defined as RESIDENT(NO|YES) and USAGE(NORMAL|TRANSIENT). Programs can be defined as RELOAD(NO|YES).

Effects

Any program defined in the CSD is loaded into the CDSA, RDSA, SDSA, ECDSA, ERDSA, or ESDSA on first usage. RELOAD(YES) programs cannot be shared or reused. A program with RELOAD(YES) defined is only removed following an explicit EXEC CICS FREEMAIN. USAGE(TRANSIENT) programs can be shared, but are deleted when the use count falls to zero. RESIDENT(NO) programs become eligible for deletion when the use count falls to zero. The CICS loader domain progressively deletes these programs as DSA storage becomes shorter, on a least-recently-used basis.

RESIDENT(YES) programs are not normally deleted. If NEWCOPY is executed for any program, a new copy is loaded and used on the next reference and the old copy becomes eligible for deletion when its use count falls to zero.

Recommendations

Because programs that are not in use are deleted on a least-recently-used (LRU) basis, they should be defined as RESIDENT(NO) unless there are particular reasons to favor particular programs by keeping them permanently resident. Variations in program usage over time are automatically taken account of by the LRU algorithm.

Thus, a much-used nonresident program is likely to remain resident anyway, whereas–during periods of light usage–a resident program could be wasting the virtual storage it permanently occupies.

For programs written to run above the 16MB line, you should be able to specify EDSALIM large enough such that virtual storage is not a constraint.

The reasons for defining a program as RESIDENT might be:

- Possible avoidance of storage fragmentation, because all such programs are in a single block of storage (but not new copies of programs).
- Programs are needed to deal with potential crises (for example, CEMT).
- Heavy contention on the VSE LIBDEF search program libraries. However, this should usually be dealt with by data set placement or other DASD tuning.

How monitored

The tuning objective is to optimize throughput at an acceptable response time by minimizing virtual storage constraint. There are specific loader domain statistics for each program.

Putting application programs above the 16MB line

RMODE(ANY) application programs are kept in the EDSA, which is in VSE extended virtual storage above the 16MB line. Work areas associated with the programs may also reside above the 16MB line.

Effects

It is possible to LINK or XCTL between 31-bit mode programs and 24-bit mode programs. You can convert programs to 31-bit mode programs and move them above the 16MB line to the extended private area. Moving programs above the 16MB line frees that amount of virtual storage below the 16MB line for other use.

See the *CICS Operations and Utilities Guide* for information on using programs from the 24-bit or 31-bit shared virtual area (SVA).

Using the 31-bit SVA is usually better than using the extended DSAs when multiple address spaces are employed, because the program is already loaded when CICS needs it, and real-storage usage is minimized.

Where useful

This facility is useful where there is demand for virtual storage up to the 16MB line and there is sufficient real storage.

Limitations

Some compilers do not support programs that run above the 16MB line. Assembler H Version 2 DOS/VS COBOL 1.3.1 and VS COBOL II 1.3.2 are examples of languages that do provide the necessary support.

Because the purpose of using virtual storage above the 16MB line is to make the space below this available for other purposes, there is an overall increase in the demand for real storage when programs are moved above the 16MB line.

There is a restriction on the use of COMMAREAs being passed between programs running in 31-bit addressing mode and programs running in 24-bit addressing mode. COMMAREAs passed from a 31-bit program to a 24-bit program must be capable of being processed by the 24-bit program, therefore they must not contain 31-bit addresses: addresses of areas that are themselves above the 16MB line.

How implemented

Programs that are to reside above the 16MB line must be link-edited with the AMODE(31),RMODE(ANY) options on the MODE statement of the link-edit. See the *CICS Operations and Utilities Guide* for further information.

VTAM pacing (PACING, VPACING)

VTAM® storage may be exhausted if batch type terminals send data faster than a CICS transaction can process that data. The use of secondary to primary pacing, sometimes called inbound pacing, limits the amount of data queued for any given batch terminal.

PACING controls the flow of traffic from the network control program (NCP) to the terminal and does not affect the processor activity as such. VPACING on the other hand controls the flow of traffic between the host and the NCP.

The VPACING parameter of the CICS APPL statement determines how many messages can be sent in a session to the VTAM application program by another VTAM logical unit without requiring that an acknowledgment (called a “pacing response”) be returned. The host sends data path information units (PIUs) according to the definition of VPACING. The first PIU in a group carries a pacing indicator in the RH. When this PIU is processed by the NCP, the NCP sends a response to the host with the same pacing indicator set to request a new pacing group. This means that, for every **x** PIUs to a terminal and every **y** PIUs to a printer, the pacing response traffic must flow from the NCP to the host which, based on the volume of traffic, could cause a significant increase in host activity.

Normally, VPACING is implemented when a shortage of NCP buffers requires controlling the volume of flow between the host and the NCP. You may be able to lessen the effect on the processor by increasing the VPACING value to what the NCP can actually tolerate.

The PACING parameter is required for most printers, to match the buffer capacity with the speed of printing the received data. Terminals do not normally require pacing unless there is a requirement to limit huge amounts of data to one LU, as is the case with some graphics applications. Use of pacing to terminals causes response time degradation. The combination of PACING and VPACING causes both response time degradation and increased processor activity, and increased network traffic.

Recommendations

PACING and VPACING should be specified for all terminals to prevent a “runaway” transaction from flooding the VTAM network with messages and requiring large amounts of buffer storage. If a transaction loops while issuing SENDs to a terminal, IOBUF and NCP buffers may fill up causing slowdowns and VTAM storage shortage conditions.

PACING and VPACING should always be specified high enough so that normal data traffic may flow without being regulated, but excessive amounts of data are prevented from entering the network and impairing normal data flow.

How implemented

For secondary to primary pacing, you must code:

- SSNDPAC=nonzero value in the LOGMODE entry pointed to by the secondary application program
- VPACING=nonzero value on the APPL definition for the secondary application.

The value used is coded on the VPACING parameter. If either of these values are zero, no pacing occurs.

Specify VPACING on the APPL statement defining the CICS region, and any nonzero value for the SSNDPAC parameter on the LU statement defining the batch device. You should ensure that the device supports this form of pacing by referring to the component description manual for that device.

For further information on the selection criteria for values for the PACING and VPACING parameters, see the *VTAM Network Implementation Guide*.

Dynamic log buffer size (DBUFSZ)

The dynamic log buffer stores backout information in the dynamic log for dynamic transaction backout purposes. Dynamic transaction backout is used to reverse changes made to recoverable resources in CICS if a transaction abend or syncpoint rollback occurs.

The dynamic log is allocated in the dynamic storage area above the 16MB line (EDSA). The minimum allocation is 2KB.

The dynamic log buffer is not acquired until a recoverable resource has been modified and the first dynamic log record for the buffer is to be written.

The actual buffer size allocated is not the same for all transactions, but is dynamically self-tuned for each transaction to a value that is just large enough to accommodate the log almost all of the time. The (occasional) requirements

exceeding the allocation are satisfied by spilling to a chain of main storage allocations in the EDSA.

Effects

The system initialization parameter, DBUFSZ, influences the self-tuning algorithm by constraining the dynamic log buffer size to not more than DBUFSZ, and defining the initial allocation for each transaction as half of DBUFSZ.

Where useful

Dynamic transaction backout is used by any transaction that updates recoverable resources. DBUFSZ applies to any such transaction.

Dynamic transaction backout is automatically provided, but it has no effect (that is, no dynamic log is acquired) for a task unless it issues a request to update recoverable resources.

Limitations

Because the initial allocation of space for the dynamic log buffer is half the maximum specified in the DBUFSZ system initialization parameter, the dynamic self-tuning mechanism may take some time to settle down. Statistics collected over short periods could be misleading.

Recommendations

Normally, little use of overflow storage is required, and this should be achieved automatically if the DBUFSZ system initialization parameter is large enough.

Look at the dynamic transaction backout statistics. If the ratio of the number of records logged and the number of records spilled is higher than 2%, consider increasing the DBUFSZ value in the SIT.

How implemented

Dynamic transaction backout is automatically available in CICS with resource definition online (RDO). The maximum size of the dynamic log buffer is defined by the system initialization parameter, DBUFSZ.

How monitored

The CICS dynamic transaction backout statistics give information on dynamic buffer activity, and the number of records spilled.

Chapter 17. MRO and ISC/IRC

This chapter includes the following topics:

CICS intercommunication facilities

CICS intercommunication facilities allow different CICS systems to communicate and share resources with each other. These facilities consist of the following components:

- Function shipping
- Distributed transaction processing
- Asynchronous processing
- Transaction routing.
- Distributed program link.

For details of the CICS intercommunication facilities, see the *CICS Intercommunication Guide*. See also “Splitting online systems: availability” on page 112, and “Splitting online systems: virtual storage” on page 160.

If there are a number of intercommunication requests for each transaction, function shipping generally incurs the most overhead. The number of requests per transaction that constitutes the break-even point depends on the nature of the requests.

Both distributed transaction processing (DTP) and asynchronous processing are, in many cases, the most efficient method of intercommunication because a variety of requests can be batched in one exchange. DTP, however, requires an application program specifically designed to use this facility. For information about designing and developing DTP, see the *CICS Distributed Transaction Programming Guide*.

Transaction routing, in most cases, involves one input and one output between systems, and the overhead is minimal.

Multiregion operation (MRO), in general, causes less processor overhead than intersystem communication (ISC) because the SVC pathlength is shorter than that through the multisystem networking facilities of VTAM. This is particularly true with CICS MRO, which provides a long-running mirror transaction and fastpath transformer program.

Some SVC-processing overhead can be eliminated from MRO in CICS with the use of MVS cross-memory services. Cross-memory services use the MVS common system area (CSA) storage for control blocks, not for data transfer. This can also be of benefit. Note, however, that MVS requires that an address space using cross-memory services be non-swappable.

For situations where ISC is used across MVS images, consider using XCF/MRO. XCF/MRO consumes less processor overhead than ISC.

ISC mirror transactions can be prioritized. The CSMI transaction is for data set requests, CSM1 is for communication with IMS/ESA systems, CSM2 is for interval control, CSM3 is for transient data and temporary storage, and CSM5 is for IMS/ESA DB requests. If one of these functions is particularly important, it can be prioritized above the rest. This prioritization is not effective with MRO because any attached mirror transaction services any MRO request while it is attached.

If ISC facilities tend to flood a system, this can be controlled with the VTAM VPACING facility. Specifying multiple sessions (VTAM parallel sessions) increases throughput by allowing multiple paths between the systems.

CICS also allows you to specify a VTAM class of service (COS) table with LU6.2 sessions, which can prioritize ISC traffic in a network. Compare the performance of CICS function shipping with that of IMS/ESA data sharing.

Limitations

- Use of intercommunication entails trade-offs as described in “Splitting online systems: virtual storage” on page 160 and “Splitting online systems: availability” on page 112.
- Increased numbers of sessions can minimally increase real and virtual storage but reduce task life. The probable overall effect is to save storage.
- MVS cross-memory services reduce CSA and cycle requirements.
- MRO high performance facilities reduce processing requirements.
- IMS/ESA data sharing usually reduces processor requirements.
- Accessing DL/I databases via the IMS DBCTL facility reduces processor requirements relative to function shipping.
- For MRO considerations, read about the secondary effects of the partition exit interval (ICV) in “Partition exit interval (ICV)” on page 114.

How implemented

See the &dfha100l. for information about resetting the system for MRO or ISC. See also “Splitting online systems: virtual storage” on page 160.

How monitored

CICS ICS/IRC statistics (see page 250) show the frequency of use of intercommunication sessions and mirror transactions. The VTAM trace, an SVC trace, and RMF give additional information.

Intersystems Session Queue Management

When intersystems links are added to the system there is the possibility that they cannot respond adequately to transaction requests because the remote system is performing badly. The poor performance can be due either to a long-term condition such as lack of resource or overloading, or a temporary situation such as a dump being taken. In any case there is the danger that the problem can cause a long queue to form in the requesting system.

Mechanisms are provided in CICS for:

- Protection of the requesting system from using too many resources whilst transactions queue for the use of the intersystems sessions.
- Detection of problems in remote systems. CICS can issue messages to indicate a problem on an intersystems connection and the parameters control the criteria that are used to determine when a problem exits, or has gone away.

The two mechanisms are:

1. The QUEUELIMIT and MAXQTIME parameters on the connection resource definition.

   The QUEUELIMIT parameter limits the number of transactions which can be queued in allocate processing waiting for a session to become free. Any transactions which try to join a queue already at its limit are rejected.

   The MAXQTIME parameter is a control on the wait time of queued allocate requests that are waiting for free sessions on a connection that appears to be unresponsive. If the rate of processing of the queue indicates that a new allocate will take longer than the specified time to reach the head of the queue, the whole queue is purged.
2. The XZIQUE user exit, which is given control when an allocate request is about to be queued, or the first time it succeeds after a suspected problem. The XZIQUE exit can control the queue in the same way as the CEDA parameters, or you can use it to add more sophisticated controls of your own.

Both mechanisms produce the same effect on the application program which issued the allocate; a SYSIDERR condition is returned. Return codes are also provided to the dynamic routing program to indicate the state of the queue of allocate requests.

CICS Resource Definition Guide contains more description of the CEDA commands; and the *CICS Customization Guide* gives programming information about the XZIQUE exit and its relationship with the rest of CICS, including application programs and the dynamic routing program.

Relevant statistics

For each connection CICS records the following:

- The number of allocates queued for the connection, and the peak value of this number. (`Peak outstanding allocates` in the Connection statistics.)

  You can use this statistic to see how much queuing normally takes place on connections in your system. If there is occasionally a large queue you should consider controlling it. “Are there enough sessions defined?” on page 49 has more advice on setting the right number of sessions for your connections.

For each of the queue control mechanisms CICS records the following statistics for each connection:

- The number of allocates which were rejected due to the queue becoming too large
- The number of times the queue was purged because the throughput was too slow
- The number of allocates purged due to slow throughput.

"ISC/IRC system and mode entry statistics" on page 47 also contains an explanation of these, and other connection statistics.

Ways of approaching the problem and recommendations

The queue limit mechanism should be used to control the number of tasks waiting for the use of an intersystems link. You should use the control to ensure that even at its maximum length the queue does not use too many, and certainly not all, of the MXT slots in the system. You can also use the MAXACTIVE setting of a TRANCLASS definition to do this if you can segregate your transactions into classes which correspond to the remote regions they require.

You should allow sufficient intersystems sessions to enable their free availability during normal running. Session definitions do not occupy excessive storage, and the occupancy of transaction storage probably outweighs the extra storage for the session. The number of sessions should correspond to the peak number of transactions in the system which are likely to use the connection - you can see the maximum number of sessions being used from the terminal statistics for the connection. If all sessions were used the connections statistics show the number of times allocates were queued compared with the total number of requests.

Even in a system which has no problems there are significant variations in the numbers of transactions which are active at any time, and the actual peak number may be larger than the average over a few minutes at the peak time for your system. You should use the average rather than the actual peak; the queueing mechanism is intended to cope with short term variations, and the existence of a queue for a short time is not a cause for concern.

The start of a queue is used by the queue limiting mechanism as a signal to start monitoring the response rate of the connection. If queues never form until there is a big problem the detection mechanism is insensitive. If there are always queues in the system it will be prone to false diagnosis.

You should set the queue limit to a number which is roughly the same size as the number of sessions - within the limits imposed by MXT if there are many connections whose cumulative queue capacity would reach MXT. In this latter case you might need to design your own method - using ZXIQUE - of controlling queue lengths so that the allocation of queue slots to connections was more dynamic.

You should set the MAXQTIME parameter with regard to the time you think the users of the system should be prepared to wait for a response in the case of a potential problem, but bear in mind that you should not set it to be short in combination with a queue limit that is low, since this leads to a very sensitive detection criterion.

Monitoring the settings

The number of allocates rejected by the queue control mechanism should be monitored. If there are too many it may indicate a lack of resources to satisfy the demands on the system - or poor tuning.

The number of times the queue is purged should indicate the number of times a serious problem occurred on the remote system. If the purges do not happen when the remote system fails to respond then examine the setting of the MAXQTIME parameter - it may be too high, and insensitive. If the indication of a problem is too frequent and causes false alarms simply due to variations in response time of the remote system then the parameter may be too low, or the QUEUELIMIT value too low.

Terminal input/output area (SESSIONS IOAREALEN) for MRO sessions

For MRO function shipping, the SESSIONS definition keyword, IOAREALEN, is used. This keyword regulates the length of the terminal input/output area (TIOA) to be used for processing messages transmitted on the MRO link. These TIOAs are located above the 16MB line.

Effects

The IOAREALEN value controls the length of the TIOA which is used to build a message transmitted to the other CICS system (that is, an outgoing message).

Two values (value1 and value2) can be specified. Value1 specifies the initial size of the TIOA to be used in each session defined for the MRO connection. If the size of the message exceeds value1, CICS acquires a larger TIOA to accommodate the message.

Only one value is required, however if value2 is specified CICS will use value2 whenever the message cannot be accommodated by the value1.

A value of zero causes CICS to get a storage area exactly the size of the outgoing message, plus 24 bytes for CICS requirements.

If the IOAREALEN value is not specified, it defaults to 4KB.

Where useful

The IOAREALEN keyword can be used in the definition of sessions for either MRO transaction routing or function shipping. In the case of MRO transaction routing, the value determines the initial size of the TIOA, whereas the value presents some tuning opportunities in the MRO function shipping environment.

Limitations

Real and virtual storage can be wasted if the IOAREALEN value is too large for most messages transmitted on your MRO link. If IOAREALEN is smaller than most messages, or zero, excessive FREEMAIN and GETMAIN requests can occur, resulting in additional processor requirements.

Recommendations

For optimum storage and processor utilization, IOAREALEN should be made slightly larger than the length of the most commonly encountered formatted application data transmitted across the MRO link for which the sessions are defined. For efficient operating system paging, add 24 bytes for CICS requirements and round the total up to a multiple of 64 bytes. A multiple of 64 bytes (or less) minus 24 bytes for CICS requirements ensures a good use of operating system pages.

How implemented

The TIOA size can be specified in the IOAREALEN keyword of the SESSIONS definition.

Batching requests (MROBTCH)

Certain events in a region can be accumulated in a batch prior to posting, until the number specified in the MROBTCH system initialization parameter is reached (or ICV times out). Then, the region is started so that it can process the requests. The batching of MRO requests includes some non-MRO events such as:

- VSAM physical I/O completion
- Subtasked (mostly VSAM) request completion (if SUBTSKS=1 is specified)
- DL/I request completion implemented through DBCTL.

Strictly speaking, batching is applicable to a TCB rather than the region. MROBTCH is applied only to the 'quasi-reentrant' mode TCB.

Effects

Compared to no batching (MROBTCH=1, that is, the default), setting MROBTCH=n has the following effects:

- Up to [(n–1)*100/n]% saving in the processor usage for waiting and posting of that TCB. Thus, for n=2, 50% savings may be achieved, for n=3, 66% savings, for n=6, 83% savings, and so on.
- An average cost of (n+1)/2 times the average arrival time for each request actually batched.
- Increased response time may cause an increase in overall virtual storage usage as the average number of concurrent transactions increases.
- In heavily loaded systems at peak usage, some batching can happen as a natural consequence of queueing for a busy resource. Using a low MROBTCH value greater than one may then decrease any difference between peak and off-peak response times.

Setting MROBTCH higher than 6 is not recommended as the decreasing additional processor saving is unlikely to be worth the further increased response time.

You require a relatively low value of MROBTCH for ICV to maintain reasonable response time during periods of low utilization.

Recommendations

Depending on the amount of response time degradation you can afford, you can set MROBTCH to different values using either CEMT or EXEC CICS SET SYSTEM MROBATCH(value).

The recommendation is to use CEMT or EXEC CICS INQUIRE SYSTEM MROBATCH(value) to arrive at a suitable batch value for a given workload. Then use CEMT or EXEC CICS SET SYSTEM MROBATCH(value) to reset the figure appropriately. See the *CICS-Supplied Transactions* manual for more information about CEMT; for programming information about the EXEC CICS system programming commands, see the *CICS System Programming Reference*.

During slow periods the ICV unconditionally dispatches the partition, even if the batch is not complete and provides a minimum delay. In this case, set ICV to 500 milliseconds in each partition.

Extending the life of mirror transactions (MROLRM and MROFSE)

This MROLRM system initialization parameter can have a significant effect on the performance of a workload in an MRO function shipping environment.

Setting **MROLRM=NO** causes the mirror to be attached and detached for each function-shipped request until the first request for a recoverable resource or a file control start browse is received. After such a request is received, the mirror remains attached to the session until the calling transaction reaches syncpoint.

Setting **MROLRM=YES** in a partition receiving function shipping requests causes a mirror transaction to remain attached to the MRO session from first request until the calling transaction reaches syncpoint. This option causes system-dependent effects, as follows:

- Some systems show significant improvements in processor utilization per transaction. They are likely to be systems with a significant percentage of inquiry transactions, each with multiple VSAM calls, or transactions with many reads followed by a few updates.
- Some systems show no performance difference. Workloads using IMS/ESA, or transactions that make a lot of use of VSAM-update or browse-activity, may fall into this category.
- Some systems could be degraded because there is an extra flow at syncpoint. An example of this would be a system with a very simple inquiry transaction workload.

In general, setting MROLRM=YES is recommended.

Setting MROFSE=YES in a region issuing function shipping requests causes the mirror to remain attached to the MRO session from the first request until the calling transaction reaches end of task. (A DPL flow will cause the session to be freed at the following syncpoint.) This parameter should be used in conjunction with MROLRM=YES on the system receiving the function shipping requests.

- Some systems show significant improvements in processor utilization for each transaction. They are likely to be systems that benefit from MROLRM=YES

and have multiple syncpoints with function shipping requests issued between each syncpoint.

- Some systems could be degraded because:
  - the session may be held until the end of the task rather than to the user syncpoint.
  - there may be redundant syncpoint flows if a significant number of the units of work have no function shipping.

It may be necessary to increase system initialization parameter MXT because of the extended life of the mirror task.

It may also be necessary to increase the number of SEND sessions defined to the front end system with a consequential change to the number of RECEIVE sessions defined on the back end. MROLRM=YES implies an increase in the number of RECEIVE sessions defined to the back end system.

Deletion of shipped terminal definitions (DSHIPINT and DSHIPIDL)

In a transaction routing environment, terminal definitions can be "shipped" from a terminal-owning region (TOR) to an application-owning region (AOR). A shipped terminal definition in an AOR becomes redundant when:

- The terminal user logs off.
- The terminal user stops using transactions which route to the AOR.
- The TOR on which the user is signed on is shut down.
- The TOR is restarted without recovering autoinstalled terminal definitions, and the autoinstall user program DFHZATDX assigns a new set of terminal ids to the same set of terminals.

Shipped terminal definitions which have become redundant may need to be deleted. Long-lasting shipped terminal definitions do not generally cause storage problems because of the relatively small amounts of storage which they occupy. However, there are other considerations, such as security, which may require that redundant shipped terminal definitions are not allowed to persist in an AOR.

The CICS-supplied transaction CRMF periodically scans the shipped terminal definitions in the AOR and flags those which it has determined to be redundant. If any redundant definitions have been identified, then the CICS-supplied transaction CRMD is invoked to delete them. This processing is referred to as the CICS timeout delete mechanism.

The system initialization parameters DSHIPINT and DSHIPIDL control the amount of time for which a redundant shipped terminal definition is allowed to survive and the frequency at which shipped terminal definitions are tested for redundancy.

Effects

The DSHIPIDL system initialization parameter determines the period of time for which a shipped terminal definition is allowed to remain inactive before it may be flagged for deletion. The DSHIPINT system initialization parameter determines the time interval between invocations of the CRMF transaction. CRMF will examine all shipped terminal definitions to determine which of them have been idle for longer

than the time interval specified by DSHIPIDL. If CRMF identifies any redundant terminal definitions, it will invoke CRMD to delete them.

Where useful

The CRMF/CRMD processing will be most effective in a transaction routing environment in which there may be shipped terminal definitions in an AOR which remain idle for considerable lengths of time.

Limitations

Once CRMF/CRMD processing has deleted a shipped terminal definition, the terminal definition will need to be re-shipped when the terminal user next routes a transaction from the TOR to the AOR. Care should therefore be taken not to set DSHIPIDL to a value which is low enough to cause shipped terminal definitions to be frequently deleted between transactions. Such processing could incur CPU processing costs, not just for the deletion of the shipped terminal definition, but also for the subsequent re-installation when the next transaction is routed.

Bear in mind that if a large value is chosen for DSHIPINT, it will influence the length of time that a shipped terminal definition will survive. The period of time for which a shipped terminal definition will remain idle before being deleted will be extended by an average of half of the DSHIPINT value. This is because once the terminal has exceeded the limit for idle terminals set by the DSHIPIDL parameter, it will have to wait (for an average of half of the DSHIPINT interval) before CRMF is scheduled to identify the terminal definition as idle and flag it for CRMD to delete. When the DSHIPINT interval is significantly longer than the DSHIPIDL interval (which will be the case if the default values of 120000 for DSHIPINT and 020000 for DSHIPIDL are accepted), DSHIPINT becomes the dominant factor in determining how long an idle shipped terminal definition will survive before being deleted.

Recommendations

Ensure that unnecessary processing is not being generated by too low a value being assigned to DSHIPIDL. The storage occupied by the shipped terminal definitions is not normally a concern, so the default value which specifies a maximum idle time of 2 hours is reasonable, unless other concerns (such as security) suggest that it should be shorter.

Decide whether you wish to delete idle shipped terminal definitions incrementally or en masse. CRMF processing in itself causes negligible CPU overhead, so a low value for DSHIPINT may therefore be specified at little cost, providing that a sensible value for DSHIPIDL has been chosen. Specifying a low value for DSHIPINT so that CRMF runs relatively frequently could mean that idle terminal definitions are identified in smaller batches, so that CRMD processing required to delete them is spread out over time.

A higher value for DSHIPINT, especially if the default value of 12 hours is accepted, may mean that when CRMF runs it identifies a considerable number of idle terminal definitions, so that a larger burst of CPU is required for the CRMD processing. You may wish to ensure that this type of processing occurs during periods of low activity in the CICS region. To this end, the CEMT INQUIRE/SET/PERFORM DELETSHIPPED commands (and their equivalent

CICS/ESA SPI commands) are available to help you schedule when the CRMF transaction will be invoked.

How implemented

The maximum length of time for which a shipped terminal definition is allowed to remain idle before it may be flagged for deletion is specified by the CICS system initialization parameter DSHIPIDL. The interval between scans to test for idle definitions is specified by the CICS system initialization parameter DSHIPINT.

Both these parameters may be adjusted by the CEMT INQUIRE/SET DELETSHIPPED commands. Note that the revised interval to the next invocation of the timeout delete mechanism starts from the time the command is issued, not from the time of the last invocation, nor from the time of CICS startup.

The timeout delete mechanism may be invoked immediately by the CEMT PERFORM DELETSHIPPED command or its CICS/ESA SPI equivalent.

How monitored

The CICS terminal autoinstall statistics provide information on the current setting of the DSHIPINT and DSHIPIDL parameters, the number of shipped terminal definitions built and deleted, and the idle time of the shipped terminal definitions.

Chapter 18. Programming considerations

This chapter discusses programming considerations in the following topic:

BMS map suffixing and the device-dependent suffix option

CICS BMS allows you to use different versions of a map set for different device types by specifying a one-letter suffix for each different device type. Use of this facility requires the BMS device-dependent suffix (DDS) option. For further information on map set suffixes, see the *CICS Application Programming Guide*.

Where only one version of a map is involved, it is optional whether the device type suffix is coded. If the DDS option is being used, it is more efficient to use the device suffixes than to leave the suffix blank. This is because, if the DDS option applies, CICS first looks for a map set with a suffix name and then searches again for a map with a blank suffix. Processor cycle requirements are reduced by eliminating the second table lookup.

Effects

If only one device type is used with all maps in a CICS system and all devices have the same screen size, CICS can be initialized to look for a blank suffix, thus eliminating the second lookup.

If the map is to be used with multiple devices, multiple maps with the same basic source are needed because the device type needs to be specified, and suffixing is required in this case.

Recommendation

If you decide that you need device-dependent suffixing, you should suffix all your map sets. If you do not need it, use blank suffixes (no suffix at all) and specify the NODDS option in BMS.

How implemented

Maps are named in the link-edit process. These names are defined in the MAPSET definition. Specifying NODDS in the BMS= system initialization parameter determines that map suffixing is not used in CICS.

How monitored

No direct measurement of map suffixing is given.

Language Environment®/VSE

LE-conforming CICS applications issuing EXEC CICS LINK requests cause an increase in system pathlength. Repeated EXEC CICS LINK calls to the same LE-conforming program result in multiple GETMAIN/FREEMAIN requests for run time work areas (RUWAs).

The DFHSIT parameter RUWAPOOL (YES) results in the creation of a run unit work area pool during task initialization. This pool is used to allocate RUWAs required by LE-conforming programs. This reduces the number of GETMAINs and FREEMAINs in tasks which perform many EXEC CICS LINKS to LE-conforming programs.

For more information about the RUWAPOOL system initialization parameter, see the *CICS System Definition Guide*. For more general information about LE/VSE performance under CICS, see the *Language Environment for ESA/VSE Installation and Customization Guide*.

Chapter 19. CICS facilities

This chapter includes the following topics:

CICS temporary storage (TS)

CICS temporary storage is a scratchpad facility that is heavily used in many systems. Data in temporary storage tends to be short-lived, emphasis being placed on ease of storage and retrieval. Temporary storage exists in two forms:

- Main temporary storage, which is in the dynamic storage area above the 16MB line (ECDSA)
- Auxiliary temporary storage is stored in VSAM-managed data set while the storage for the buffers is allocated from the ECDSA.

Temporary storage is used in many circumstances within CICS, as well as for requests from application tasks. The uses of temporary storage include:

- Basic mapping support (BMS) paging
- Message switching (CMSG transaction) or BMS routing
- Interval control: EXEC CICS START FROM (...) to hold data until it is retrieved
- Execution diagnostic facility (EDF) to review prior pages of diagnostic information
- MRO/ISC local queueing while the target system is unavailable
- Your applications for:
  - Scratchpad
  - Queueing facility
  - Data transfer.
- Other products or application packages.

Effects

If main temporary storage is used, requests to a TS queue are serialized with the storage being allocated from the ECDSA.

The performance of auxiliary temporary storage is affected by the characteristics of the data set where it resides. The VSAM control interval (CI) size affects transfer efficiency, with a smaller size being desirable if access to CIs is random, and a larger size if use of CIs is more sequential. In general, the larger the queues and write/read ratio, the more sequential the usage tends to be. Records which span control intervals are possible. Up to 32767 buffers and 255 strings can be

specified, and overlap processing can be achieved, although a specific queue is still processed serially. The maximum control interval (CI) size is 64KB.

For both auxiliary and main TS queues CICS allocates a given number of entries for pointers to records in a queue (see the system initialization parameter, TSMGSET). If the number of entries is insufficient, additional storage for more pointers is acquired. This is known as TS queue extension. The number of queue extensions should normally be in the 10 to 20% range. See “Temporary storage” on page 296.

Auxiliary temporary storage queues can be made recoverable by providing a temporary storage table recovery entry. Main temporary storage can never be recoverable.

Limitations

Increasing the use of main temporary storage, using a larger CI size, increasing the number of buffers, or increasing the TSMGSET allocation increases the virtual storage needs of the ECDSA and real storage needs.

If you use auxiliary temporary storage, a smaller CI size, and a smaller TSMGSET setting if extensions are infrequent, can reduce the real storage requirements.

Recommendations

Main temporary storage

Temporary storage items are stored in the ECDSA above the 16MB line. No recovery is available. No CICS locking or enqueues are used, because there is no protection support. Queues are locked for the duration of the TS request.

The fact that temporary storage items are stored in main storage also means that there is no associated I/O, so we recommend main temporary storage for short-duration tasks with small amounts of data.

Auxiliary temporary storage

Auxiliary temporary storage occupies less address space than main temporary storage, and should be used for large amounts of temporary storage data, or for data that is to be held for long periods.

Temporary storage I/O occurs only when a record is not in the buffer, or when a new buffer is required, or if dictated by recovery requirements.

Secondary extents for temporary storage

During temporary storage initialization, the temporary storage data set is dynamically formatted. On a cold start on temporary storage (TS=(COLD,n,n), system initialization parameter) when the data set is empty, the data set is formatted to the end of the primary extent. Any secondary extents are not formatted. On a cold start of temporary storage when the data set is not empty or when temporary storage is not cold started, no further formatting of the data set takes place.

The use of secondary extents allows more efficient use of DASD space. You can define a temporary storage data set with a primary extent large enough for normal

activity, and with secondary extents for exceptional circumstances, such as unexpected peaks in activity.

It follows that you can reduce or eliminate the channel and arm contention that is likely to occur because of heavy use of temporary storage data.

Multiple buffers

The use of multiple VSAM buffers allows multiple VSAM control intervals to be available in storage at the same time. This makes it possible for the CICS temporary storage programs to service several requests concurrently, using different buffers.

If requests have to be queued, they are queued serially by temporary storage queue name. Typically, a request has to be queued if the control interval it requires is in use, or if one or more previous requests for the same queue are already waiting. Under these conditions, the servicing of requests for other queues can continue.

The use of multiple buffers also increases the likelihood that the control interval required by a particular request is already available in a buffer. This can lead to a significant reduction in the number of real input/output requests (VSAM requests) that have to be performed. (However, VSAM requests are always executed whenever their use is dictated by the requirements of physical and logical recovery.) Note that although the use of a large number of buffers may greatly improve performance for non-recoverable temporary storage queues, the associated buffers still have to be flushed sequentially at CICS shutdown, and that might take a long time.

The number of buffers that CICS allocates for temporary storage is specified by the TS system initialization parameter.

The benefits of multiple buffers depend on the way an installation's auxiliary temporary storage is used. In most cases, the default TS specification in the SIT (three buffers) should be sufficient. Where the usage of temporary storage is high or where the lifetime of temporary storage data items is long, it may be worthwhile to experiment with larger numbers of buffers. The buffer statistics in the CICS temporary storage statistics give sufficient information to help you determine a suitable allocation.

In general, you should aim to minimize the number of times that a task has to wait either because no space in buffers is available to hold the required data or because no string is available to accomplish the required I/O. The trade-off here is between improvement of temporary storage performance and increased storage requirements. Specifying a large number of buffers may decrease temporary storage I/O but lead to inefficient usage of real storage and increased paging.

Concurrent input/output operations (multiple strings)

Temporary storage programs issue VSAM requests whenever real input/output is required between the buffers and the VSAM temporary storage data sets. The use of multiple VSAM strings enables multiple VSAM requests to be executed concurrently, which, in turn, leads to faster servicing of the buffers.

VSAM requests are queued whenever the number of concurrent requests exceeds the number of available strings. Constraints caused by this can thus be relieved by

increasing the number of available strings, up to a maximum equal to the number of buffers.

The number of VSAM strings that CICS allocates for temporary storage is specified by system initialization parameter, TS.

Multiple strings allow more I/O operations to be performed concurrently. Several I/O requests can be outstanding at any time, up to the number of strings specified. Allowing the number of strings to default to the number of buffers ensures that no tasks are waiting for a string. Not all strings may be used in this case, however, and this causes inefficient use of storage. You should adjust the number of strings by using the peak number in use given in the statistics.

If the device containing the temporary storage data set is heavily used, the TS system initialization parameter can be used to regulate the activity, but this leads to an increase in internal CICS waits.

Control interval (CI) sizes

You should first consider whether the control interval (CI) size for the data set is suitable for your overall system requirements.

BMS paging may be on a large-screen device. Check whether it exceeds your temporary storage CI size.

Because temporary storage can use records larger than the control interval size, the size of the control intervals is not a major concern, but there is a performance overhead in using temporary storage records that are larger than the CI size.

The parameter, CONTROLINTERVALSIZE, of the VSAM CLUSTER definition is specified when you allocate your data sets.

The control interval size should be large enough to hold at least one (rounded up) temporary storage record, including 64 bytes of VSAM control information for control interval sizes less than, or equal to, 16 384, or 128 bytes of control information for larger control interval sizes. For further information about the effect of the control interval size for CICS temporary storage, see the *CICS System Definition Guide*.

How implemented

Temporary storage items can be stored either in main storage or in auxiliary storage on DASD. Main-only support can be forced by specifying TS=(,0) (zero temporary storage buffers) in the SIT.

A choice of MAIN or AUXILIARY is available for the application programmer in the WRITEQ TS command for each queue. See the *CICS Application Programming Reference* manual for programming information about the WRITEQ command.

How monitored

The CICS temporary storage statistics show TSMGSET extensions and records used in main and auxiliary temporary storage. These statistics also give buffer and string information and data on I/O activity.

If recovery is used for auxiliary temporary storage, the DATA identifier (called QUEUE name by the application programmer) is enqueued for DELETEQ TS and WRITEQ TS requests but not READQ TS. In a high-activity system, DATA identifiers should be monitored to ensure that a given DATA identifier is not a resource that is constraining your transaction throughput.

You should monitor the following:

TS buffer size
This is determined by the CI size.

TS group identifier
This is controlled by the TSMGSET system initialization parameter.

TS data (QUEUE) identifiers
You should minimize their number and their duration in the system.

TS space
Make the data set allocation large enough to avoid task suspension.

Note: If the NOSPACE condition is not handled, the task is suspended until temporary storage becomes available. If the NOSPACE condition is handled (through the use of the HANDLE CONDITION NOSPACE command or the use of RESP on the WRITEQ TS command) or the WRITEQ TS NOSUSPEND command, the user application receives control when the condition occurs, and can then decide whether to end the transaction normally, abend, or wait.

TS unit table (TSUT)
This is controlled by the number of different DATA identifiers created and in use concurrently in temporary storage.

Number of TS buffers
This is controlled by the second parameter of the TS system initialization parameter.

Number of TS strings
This is controlled by the third parameter of the TS system initialization parameter.

CICS transient data (TD)

Transient data is used in many circumstances within CICS, including:

- Servicing requests made by user tasks, for example, a request to build a queue of data for later processing.
- Servicing requests from CICS, primarily to write messages to system queues for printing. Transient data should, therefore, be set up at your installation to capture these CICS messages.
- Managing the DASD space holding the intrapartition data.
- Initiating tasks based on queue trigger level specification and on records written to an intrapartition destination.
- Requesting logging for recovery as specified in your CICS destination control table (DCT).
- Passing extrapartition requests to the operating system access method for processing.

Various options can affect the performance of this facility.

Recovery options

Recovery can affect the length of time for which a transient data record is enqueued. You can specify one of three options:

1. **No recovery**. If you specify no recovery, there is no logging, no enqueuing for protecting resources, and no deferred work element (DWE) processing.
2. **Physical recovery**. Specify physical recovery when you need to restore the intrapartition queue to the status that it had immediately before a system failure. The main performance consideration is that there is no deferred transient data processing, which means that automatic task initiation may occur instantaneously. Records that have been written may be read by another task immediately. CIs are released for reusable queues on the first read of a new CI. For every WRITEQ TD request, the CI buffer is written to the VSAM data set.

   Note: All other resources offering recovery within CICS provide only logical recovery. Using backout in an abend situation would exclude your physically recoverable and non-recoverable transient data from the backout.
3. **Logical recovery**. Specify logical recovery when you want to restore the queues and restore trigger levels to the status that they had before execution of the failing task (when the system failed or when the task ended abnormally). Thus, logical recovery works in the same way as recovery defined for other recoverable resources such as file control, and temporary storage.

In summary, physical recovery ensures that records are restored in the case of a system failure, while logical recovery also ensures integrity of records in the case of a task failure, and ties up the applicable transient data records for the length of a task that enqueues on them.

Up to 32767 buffers and 255 strings can be specified for a transient data set, with serial processing only through a destination.

Specifying a higher trigger level on a destination causes a smaller number of tasks to be initiated from that destination.

Intrapartition transient data considerations

Multiple VSAM buffers

When you use multiple buffers and strings for intrapartition transient data support, this can remove the possible constraint in transient data caused by the use of a single system-wide buffer (and string). Statistics allow you to tune the system with regard to transient data usage.

If requests have to be queued, they are queued serially by transient data destination. Typically, a request has to be queued if the control interval it requires is in use, or if one or more previous requests for the same queue or destination are already waiting. Under these conditions, the servicing of requests for other queues or destinations can continue.

The use of multiple buffers also increases the likelihood that the control interval required by a particular request is already available in a buffer. This can lead to a

significant reduction in the number of real input/output requests (VSAM requests) that have to be performed. (However, VSAM requests are always executed whenever their use is dictated by the requirements of physical and logical recovery.)

The number of buffers that CICS allocates for transient data is specified by the TD system initialization parameter. The default is three.

The provision of multiple buffers allows CICS to retain copies (or potential copies) of several VSAM CIs in storage. Several transient data requests to different queues can then be serviced concurrently using different buffers. Requests are serialized by queue name, not globally. Multiple buffers also allow the number of VSAM requests to the transient data data set to be reduced by increasing the likelihood that the CI required is already in storage and making it less likely that a buffer must be flushed to accommodate new data. VSAM requests are still issued when required by recovery considerations.

The benefits of multiple buffers depend on the pattern and extent of usage of intrapartition transient data in an installation. For most installations, the default specification (three buffers) should be sufficient. Where the usage of transient data is extensive, it is worthwhile to experiment with larger numbers of buffers. The buffer statistics give sufficient information to help determination of a suitable allocation. In general, the aim of the tuning should be to minimize the number of times a task must wait because no buffers are available to hold the required data.

In this exercise, there is a trade-off between improving transient data performance and increased storage requirements. Specifying a large number of buffers may decrease transient data I/O and improve concurrency but lead to inefficient usage of real storage. Also, if there is a large number of buffers and a small number of queues, internal buffer searches per queue may take longer.

The buffers are obtained in the CICS ECDSA during initialization.

Multiple VSAM strings

As far as concurrent input/output operations with CICS are concerned, the transient data programs issue VSAM requests whenever real input/output is required between the buffers and the VSAM transient data data sets. The use of multiple VSAM strings enables multiple VSAM requests to be executed concurrently, which in turn leads to faster servicing of the buffers.

VSAM requests are queued whenever the number of concurrent requests exceeds the number of available strings. Constraints from this cause can thus be relieved by increasing the number of available strings, up to a maximum of 255. The limit of 255 on the number of strings should be taken into consideration when choosing the number of buffers. If the number of buffers is more than the number of strings, the potential for string waits increases.

The number of VSAM strings that CICS allocates for transient data is specified by the TD system initialization parameter. The CICS default is three.

Logical recovery

Logging, enqueuing, and DWE processing occur with logical recovery transactions, including dynamic backout of the failing task's activity on the transient data queue. Logical recovery would generally be used when a group of records have to be processed together for any reason, or when other recoverable resources are to be processed in the same task.

During processing of the transient data request, the destination queue DCT entry is enqueued from the first request, for either input or output, or both (if the queue is to be deleted), until the end of the unit of work (UOW). This means that none of the other tasks can access the queue for the same purpose during that period of time, thus maintaining the integrity of the queue's status.

At the end of the UOW (syncpoint or task completion), syncpoint processing takes place and the DCT entry is logged. Any purge requests are processed (during the UOW, a purge only marks the queue ready for purging). The empty CIs for reusable queues are released for general transient data use. Any trigger levels reached during the UOW cause automatic task initiation to take place for those queues with the TRIGLEV DCT operand specified as greater than zero. The buffer is written out to the VSAM data set as necessary.

The DEQueue on the DCT entry occurs, releasing the queue for either input or output processing by other tasks. Records written by a task can then be read by another task.

Logging activity

With **physical** recovery, the DCT entry is logged before each READQ, after the first WRITEQ for a destination, at a PURGE request, and at an activity keypoint time.

With **logical** recovery, the DCT entry is logged at syncpoint and at activity keypoint time.

Secondary extents for intrapartition transient data

During initialization of intrapartition transient data, CICS initializes a VSAM empty intrapartition data set by formatting control intervals until the first extent of the data set is filled. Additional control intervals are formatted as required if the data set has been defined with multiple extents.

The use of secondary extents allows more efficient use of DASD space. You can define an intrapartition data set with primary extents large enough for normal activity, and with secondary extents for exceptional circumstances, such as unexpected peaks in activity.

It follows that you can reduce or eliminate the channel and arm contention that is likely to occur because of heavy use of intrapartition transient data.

Extrapartition transient data considerations

Extrapartition destinations are, in practice, sequential data sets to which CICS uses SAM PUT commands. The main performance factor to note is the possibility of operating system waits; that is, the complete CICS partition waits for the I/O completion. The wait (of long duration) can occur for one of the following reasons:

- No buffer space available.

- Secondary space allocation.
- Volume (extent) switching.
- Dynamic open or close of the data set.
- A force end of volume caused by the application.
- The data set is defined on a physical printer (1403 or 3211) and the printer has run out of paper.
- A LOCK has been issued for another data set on the same volume.

Therefore, you should try to eliminate or minimize the occurrences of CICS region waits by:

- Having sufficient buffering and blocking of the output data set
- Avoiding volume switching by initially allocating sufficient space
- Avoiding dynamic OPEN/CLOSE during peak periods.

An alternative method of implementing sequential data sets is to employ a CICS user journal. Table 10 summarizes the differences between these two methods.

Table 10. Extrapartition transient data versus user journal

Extrapartition TD	**User Journal**
Region (CICS) may wait	Task waits
Buffer location: In VSE storage	Buffer location: In DSA
Number of buffers: 1—32767	Two buffers
Input ***or*** output	***Both*** input ***and*** output, but tasks may wait
Accessible by multiple tasks	• Accessible for output by multiple tasks • Accessible for input by single task under exclusive control

Indirect destinations

To avoid specifying extrapartition data sets for the CICS-required entries (such as CSMT and CSSL) in the DCT, you are recommended to use indirect destinations for combining the output of several destinations to a single destination. This saves storage space and internal management overheads.

Long indirect chains can, however, cause significant paging to occur.

Limitations

Application requirements may dictate a lower trigger level, or physical or logical recovery, but these facilities increase processor requirements. Real and virtual storage requirements may be increased, particularly if several buffers are specified.

How implemented

Transient data performance is affected by the REUSE, TRIGLEV, and DESTRCV operands in the TYPE=INTRA macro in the destination control table (DCT).

Recommendations

Suggestions for reducing WAITS during SAM processing are to:

- Avoid specifying a physical printer.
- Use single extent data sets whenever possible to eliminate WAITs resulting from the end of extent processing.
- Avoid placing data sets on volumes subject to frequent or long duration LOCK activity.
- Avoid placing many heavily-used data sets on the same volume.
- Choose BUFNO and BLKSIZE such that the rate at which CICS writes or reads data is less than the rate at which data can be transferred to or from the volume, for example, avoid BUFNO=1 for unblocked records whenever possible.
- Choose an efficient BLKSIZE for the device employed such that at least 3 blocks can be accommodated on each track.

How monitored

The CICS statistics show transient data performance. CICS transient data statistics can be used to determine the number of records written or read. Application knowledge is required to determine the way in which the lengths of variable length records are distributed.

CICS monitoring facility

The CICS monitoring facility (CMF) collects data about the performance of all user- and CICS-supplied transactions during online processing for later offline analysis. The records produced by CICS monitoring are in SMF 110 record format, and are written to a DMF data set.

Monitoring data is useful for performance, tuning, and for charging your users for the resources they use. See Chapter 6, “The CICS monitoring facility” on page 57 for further information.

Limitations

Performance class monitoring can be a significant overhead. The overhead is likely to be about 5 to 10%, but is dependent on the workload.

Recommendations

If you do not need accounting information because other billing processes exist and you have other means of gathering any performance data required, the CICS monitoring facility should not be used. The same is true for the exception component.

Recording of the above information incurs overhead, but, to tune a system, both performance and exception information may be required. If this is not a daily process, the CICS monitoring facility may not need to be run all the time. When tuning, it is necessary to run the CICS monitoring facility during peak volume times because this is when performance problems occur.

Consider excluding fields from monitoring records if overuse of the DMF data set is a potential problem.

How implemented

To implement CICS monitoring, you can reset the system initialization table parameters (MNPER, MNEXC, and MN) see the *CICS System Definition Guide*.

You can change the settings dynamically using either CEMT INQUIRE|SET MONITOR or EXEC CICS INQUIRE|SET MONITOR. See "Controlling CICS monitoring" on page 61 for more information. Alternatively see the *CICS-Supplied Transactions* manual for details of CEMT; see the *CICS System Programming Reference* for programming information about INQUIRE and SET commands.

How monitored

CICS Monitoring Domain statistics show the number of records produced of each type. These statistics monitor CMF activity.

CICS trace

CICS trace is used to record requests made by application programs to CICS for various services. Because this involves the recording of these requests each time they occur, the overhead depends on the frequency of the requests.

The CICS internal trace table resides in VSE virtual storage above the 16MB line (but not in the EDSAs).

A trace table always exists and is used for recording exception conditions useful for any first failure data capture. Other levels of trace are under the control of the user. There are a large number of parameters and the CEMT commands which allow dynamic control over the system and transaction dumps.

Effects

Buffers for the CICS auxiliary trace data set are allocated dynamically from VSE free storage below the 16MB line. Auxiliary trace is activated when the system initialization parameter AUXTR, or a startup override, is set on.

Buffer allocation may also take place at execution time in response to a CETR or CEMT transaction request to set auxiliary trace to START (CEMT SET AUXTRACE START) or simply to open the auxiliary trace data set. See the *CICS-Supplied Transactions* manual for further information.

Deallocation or freeing of the buffer space occurs in response to CEMT SET AUXTRACE STOP command. Note that the buffer space is ***not*** freed on PAUSE and SWITCH requests, the former not implying CLOSE and the latter having been optimized.

Limitations

Running trace increases processing requirements considerably. Not running trace, however, reduces the amount of problem determination information that is available.

The additional cost of auxiliary trace is very largely due to the I/O operations. Auxiliary trace entries vary in size, and they are written out in blocks of 4KB. Twin buffers are used but, even if the I/O can be overlapped, the I/O rate is quite large for a busy system.

When you use CICS auxiliary trace, you may need to decrease the relevant DSASZE system initialization parameter by 8KB to ensure that adequate address space is given up to the operating system to allow for the allocation of the two 4KB auxiliary trace buffers.

Recommendations

The trace table should be large enough to contain the entries needed for debugging purposes.

With first failure data capture, CICS produces some trace entries regardless of the settings produced. Because of this most of the tracing overhead can be reduced by running with the following options:

- Internal tracing off
- Auxiliary tracing on
- Print auxiliary trace data only when required.

CICS allows tracing on a transaction basis rather than a system basis, so the trace table requirements can be reduced.

How implemented

Trace activation is specified with the INTTR system initialization parameter or as a startup override.

The size of the trace table is specified by the TRTABSZ system initialization parameter or as a startup override. The minimum size is 16KB.

Trace can be defined at the transaction level with the TRACE keyword on in the TRANSACTION definition.

Auxiliary trace activation is specified with the AUXTR system initialization parameter.

With CICS initialized and running, internal trace and auxiliary trace can be turned on or off, independently and in either order, with one of the following: CETR, CEMT SET INTRACE START or CEMT SET AUXTRACE START commands. Auxiliary trace entries are recorded only when internal trace is active.

How monitored

No direct measurement of trace is given.

CICS recovery

Some types of recoverable resources, when they are accessed for update, cause logging. Do not define more resources as recoverable than you need for application programming requirements, because the extra logging incurs extra I/O and processor overheads. If the resource in question does not require recovery, these overheads are unproductive.

Limitations

Specifying recovery increases processor time, real and virtual storage, and I/O requirements. It also increases task waits arising from enqueues on recoverable resources and system log I/O, and increases restart time.

Recommendation

Do not specify recovery if you do not need it. If the overhead is acceptable, logging can be useful for auditing, or if a data set has to be rebuilt.

For information on specific recoverable resources, see “CICS temporary storage (TS)” on page 191, and “CICS transient data (TD)” on page 195.

How implemented

See the *CICS Recovery and Restart Guide* for information on each resource to be specified as recoverable.

How monitored

CICS auxiliary trace shows task wait time due to enqueues.

CICS security

CICS provides an interface for an external security manager (ESM) for three types of security: transaction, resource, and command security.

Effects

Transaction security verifies an operator’s authorization to access a transaction. Resource security limits access to data sets, transactions, transient data destinations, programs, temporary storage records, and journals. Command security is used to limit access to specific commands and applies to special system programming commands. For example, EXEC CICS INQUIRE, SET, PERFORM, DISCARD, and COLLECT. Transactions that are defined with CMDSEC=YES must have an associated user.

Limitations

Protecting transactions, resources, or commands unnecessarily both increases processor cycles, and real and virtual storage requirements.

Recommendations

Because transaction security is enforced by CICS, it is suggested that the use of both resource security and command security should be kept to the minimum. The assumption is that, if operators have access to a particular transaction they therefore have access to the appropriate resources.

Unless it is vital, do not use the PERFORM SECURITY REBUILD command. It severely slows down your system. This is, because, while it is being processed, all transactions doing a security check must wait until it has completed.

How implemented

Resource security is defined with:

- The RESSEC(YES) keyword in the TRANSACTION definition.

Command security is defined with:

- The CMDSSEC(YES) keyword in the TRANSACTION definition.

How monitored

No direct measurement of the overhead of CICS security is given.

CICS storage protection facilities

There are three facilities available that are related to storage protection:

- Storage protect
- Command protection.

Each offers protection as follows:

Storage protect

Protects CICS code and control blocks from being accidentally overwritten by user applications.

Command protection

Ensures that an application program does not pass storage to CICS using the EXEC CICS interface, which requires updating by CICS, although the application itself cannot update the storage.

Recommendation

Storage protection, and command protection protect storage from user application code. They add no benefit to a region where no user code is executed, a pure TOR or a pure FOR (where no DPL requests are function shipped).

Chapter 20. Tuning XRF

This chapter includes the following topics:

Using extended recovery facility (XRF)

The extended recovery facility (XRF) is a related set of programs that allows an installation to achieve a higher level of availability to end users.

Availability of a system is a function of the number of outages and the duration of each outage. Even if all unplanned outages caused by hardware and software failures could be eliminated, there would still be planned outages for maintenance, configuration changes, or migration.

CICS with XRF aims to reduce the duration of unplanned outages by having an **alternate system** that monitors the well-being of the **active system** that is running the CICS workload. (The alternate and active systems can be on the same or separate MVS images.) The alternate system reacts automatically to a failure of the active system, and then starts to **take over** from the failing system. Because a takeover is faster than the restart of a CICS system, planned outages are also speeded up by having the alternate system take over from the active system.

Note that XRF itself does not eliminate outages. Because XRF reduces the effects of planned and unplanned outages on the end user, it is able to provide a higher level of availability than a non-XRF CICS system, but it does not provide continuous availability.

The main source of information on CICS with XRF is the *CICS XRF Guide*. This section provides a summary of performance and tuning considerations for XRF.

Recovery time

The length of outage perceived by the end user in an XRF environment depends on many factors, most of which are common to the non-XRF environment as well. A takeover has much in common with an emergency restart, so factors such as the number of backouts and the amount of log to be read back are as important to takeover times as emergency restart times. The main differences in a takeover are due to the way that a failure is detected, the way that terminal sessions are handled during the takeover, and the semi-initialized state of the alternate system.

Failure detection

The alternate CICS continuously monitors the 'health' of the active CICS system and, if it detects that it has failed, it initiates a takeover. In a typical non-XRF environment an operator detects the failure of the CICS system and starts procedures to cancel the system (if necessary) and then starts a new system. Many users find that this automation of failure detection and recovery initiation causes the biggest reduction in outage time.

Session switching

On VSE/ESA sessions are divided into two classes. Class 2 (tracked) sessions are rebound automatically at takeover and Class 3 (untracked) sessions require operator intervention before they can be used again. VSE/ESA does not support Class 1 (XRF-capable) sessions.

The time taken to restore service to the end user in an XRF system depends on the class of terminal being used:

- **Tracked sessions (Class 2)**: For Class 2 sessions, the network size has the same effect as in a non-XRF environment. All the terminals that are in session at takeover time have to be rebound, which is a time-consuming process. The users of these terminals gain from the automatic detection of failure, however.
- **Untracked sessions (Class 3)**: Class 3 terminals have to wait for the operator to switch them to the new active, and this is probably the major factor in the time taken to restore service to them.

Semi-initialized alternate system

A takeover by an alternate system is faster than restarting a CICS system because, in addition to the factors pointed out earlier in this section, the alternate system is partially initialized and has already completed some of the necessary steps, including data set allocation and loading of the nucleus.

Performance of XRF phases

Takeover is only one of a series of phases that an XRF system goes through. The phases are initialization, synchronization, surveillance and tracking, takeover, and termination. The functional aspects of these phases are described in the *CICS XRF Guide*. In this section we examine the performance aspects of these phases.

Initialization and termination phases

These phases are almost identical to their non-XRF counterparts and are not discussed at further length here.

Synchronization phase

In the synchronization phase, the active sends an image of the trackable resources (TCT and session states) to the alternate system. With this information the alternate system builds a TCT.

A system transaction (CXCU) runs on the active system to send the image of the TCT and sessions to the alternate system. This transaction has a measurable effect on processor utilization and throughput, which is greater on a small processor. The effects can be mitigated to some extent by changing the priority of CXCU; for details, see the *CICS XRF Guide*.

For the alternate system, the processor cost of synchronization is the cost of building the TCT, which can be relatively significant on a small processor

These costs affect the active system if the alternate system is on the same VSE image.

The real storage demands of the active and alternate systems also increase during synchronization, the latter particularly.

Because this phase is relatively short (a few minutes) and normally happens only once before takeover, you may consider scheduling the synchronization phase to a period of lower activity, when its effect is less. A catchup for a system with few sessions, and especially one with few or no terminals (such as a FOR), has limited effect. The full benefits of XRF are available only when an alternate system has synchronized with the active system.

Surveillance and tracking phase

The active/alternate pair spends most of its time in the surveillance and tracking phase. The alternate system monitors the active system to detect any failure. Changes to the TCT and session states that occur on the active system are reflected on the alternate system.

The cost of surveillance is a small, constant processor overhead and an increase in real storage working set size. This cost is present on an active system that has XRF=YES coded, whether or not an alternate system is running. The cost of running an alternate system that is carrying out surveillance is comparable with the overhead of having XRF=YES on an active system. External throughput and response time on the active system are not significantly affected.

The cost of tracking is determined by the rate of change to the TCT (RDO and autoinstall) and session states (autoinstall and logon/logoff). On an active system, the extra cost of passing information to the alternate system is not much more than the cost of surveillance. For the alternate system, the cost of tracking and the cost of installation and binding sessions are almost the same as the cost of these processes on the active system.

Takeover phase

The *CICS XRF Guide* discusses takeover.

Active CICS, VTAM session close: When the active CICS ends, its VTAM APPL is closed. The VTAM processing (closing all the active sessions) can delay the termination of the CICS address space. The alternate CICS system waits until the active system has terminated before proceeding, and so takeover time can be lengthened.

Clock synchronization: In a two-VSE image environment, when the active CICS system has terminated, the alternate CICS system can continue to take over its resources, but only if the time-of-day clock reading on the alternate system's VSE image is later than that on the active system's VSE image at termination. If it is not, the alternate system waits until it is. This is necessary because CICS often relies on time-of-day (TOD) clock values to provide the correct sequence of events; for example, when system log records are used for backout or recovery.

This means that, for best takeover time, the alternate system's clock time must be equal to or ahead of the active system's time. Ideally, the clocks should be exactly synchronized. If the alternate system is ahead of the active system at one takeover, on a reverse takeover it is behind and has to wait.

In practice, however, exact synchronization is impossible to achieve because individual TOD clocks drift at different rates. As long as the clocks are within a few seconds of each other, takeovers is not seriously delayed.

Emergency restart: The emergency restart-like part of a takeover has many of the same considerations as a normal emergency restart. In an XRF environment, some considerations are given added emphasis:

- Effect of data backout. Because XRF is a means of automating the detection of a failure and the subsequent emergency restart, it follows that data backout with XRF during the takeover process is the same as it is in any other emergency restart. The backout process is the same, and the time it requires (as with any emergency restart) is a function of the uncommitted updates to protected resources of in-flight tasks at the time of failure, completely independent of XRF. However, these updates do have to be backed out as part of the takeover process.

  Data backout is usually a greater portion of overall takeover time on a larger processor, because:

  - Although the same random behavior of in-flight transactions exists for any processor, a larger processor running at the same processor utilization is likely to have more transactions in flight at the time of failure. Therefore, the potential for, and the probability of, data backout increases with the size of the processor at a given utilization.
  - A faster processor completes the processor-bound portions of takeover faster than a smaller processor with the same terminal network size. These activities are primarily VTAM activities, such as session cleanup on the alternate system and closing the sessions on the active system. Because the faster processor tends to make the overall takeover time less, the I/O-bound activities such as data backout becomes a more significant portion of the total.

  In order to reduce the number of backouts, it is important to design long-running transactions so that they reach syncpoint as soon as possible when recoverable resources can be committed.
- Activity keypointing. It is a good idea to have a low AKPFREQ value because this may reduce the LOG read time. CICS needs to read back at least as far as the last activity keypoint to ensure that it knows about all the tasks to be backed out. For details, see "Activity keypoint frequency (AKPFREQ)" on page 153.
- Other jobs on the VSE image. Other activity on the VSE image can affect emergency restart time by reducing the resources available to CICS. It is wise to consider real-storage isolation (fencing).

LU clean-up and recovery: Tracked and untracked terminals have to be rebound after takeover. This is a time-consuming process and is also resource intensive. The AUTCONN parameter in the SIT gives a means of delaying the re-bind of tracked terminals, to allow time for manual switching.

Post-takeover stabilization: After takeover completes, there is a period in which the new active system adjusts to running the CICS workload. This period is similar to just after an emergency restart.

Defining files with RDO FILE operands STATUS=ENABLED and OPENTIME=FIRSTREF (FILSTAT=(ENABLED,CLOSED) operand on a DFHFCT TYPE=FILE macro) may help to reduce the effect of file opening on the system, at the expense of response time for the transaction that accesses the file. However, in a system where all the files are needed almost immediately, this has little overall effect.

The definition of the alternate system to VSE must ensure that the CICS workload can be supported after takeover. Commands can be imbedded in the CLT to change the alternate system's dispatching priority or change the priority of other work at takeover time.

Cost of XRF

Processor utilization

In an environment where CICS is running and the processor workload is low enough to give satisfactory throughput and response times, the addition of XRF should not place a significant additional demand on the processor. This statement applies to systems other than those which have a large autoinstall or logon/logoff rate. In such cases, because the alternate system duplicates the actions of the active system, the total demand of the active/alternate pair for processor resource for these activities is double that of a non-XRF system.

Processor utilization is most likely to be a factor for short periods when specific events occur:

- When the alternate system signs on to the CICS availability manager (CAVM), the active system is notified and starts sending over session information and status to it. This can cause a large increase in processor utilization on the alternate system and a smaller increase on the active system for this catchup phase.
- At takeover time, the sessions have to be ended on the active VSE image. VTAM activity causes a noticeable effect on processor utilization during this time.
- At takeover time there is a noticeable increase in processor utilization while VTAM goes through session cleanup for sessions that were established at the time of failure.

  This becomes a bigger factor if the VSE image on which the alternate system is running is also the network owner in a dual-VSE image environment. The VTAM network owner has to terminate the old sessions. This subject is discussed in the *CICS XRF Guide*.

Real storage

Using the XRF function of CICS increases the real storage demands of your system. This cost is in two parts:

1. **The active system**: Using XRF=YES on an active system increases the real storage requirements of that CICS address space mainly because of the CAVM code and associated data.

2. **The alternate system**: Each alternate CICS is a separate address space which has its own CAVM data. You can economize on the real storage to some extent by placing the CAVM code in the 31-bit SVA if you have more than one CICS system with XRF=YES running on the same copy of VSE. The real storage requirement during the surveillance phase, if there is no tracking, is much lower than that of an active CICS system; this is typical of alternate AORs and FORs because there is hardly any tracking for them to do. When the system is in the synchronization phase, or when session state and TCT changes are being tracked by the alternate system, the real storage requirements increase to be closer to those of an active CICS system at a low transaction rate.

Virtual storage

Most of the new code for XRF and its control blocks is located above the 16MB line. Some additional storage is used below the line for:

- VSAM control blocks for the CAVM data sets
- Storage for an extra CICS system task
- VSE storage for the XRF subtask.

Tuning XRF performance

Control and message data sets

The active and alternate pair of CICS systems communicates using a pair of shared data sets. These data sets are called the control and message data sets. The flow of data to and from these data sets is managed by the CICS availability manager (CAVM). The CAVM exists on both the alternate and the active CICS system. Each CAVM writes a surveillance record every two seconds and reads the data set to determine the "health" of the other CICS. In addition, when the alternate CICS system is initialized, the active CICS system sends messages to the alternate system (via the CAVM) about its TCT and session states using the message data set.

These data sets are important for each XRF pair, and they should be placed on DASD with reasonable response time. In addition, the control and message data sets for any given pair of active and alternate systems should be placed on separate actuators, controllers, and channel paths. If I/O to the control data set becomes impossible, the CAVMs attempts to exchange status information by means of the message data set.

The method of space calculation, more precise recommendations on data set placement, and the appropriate definition parameters and JCL for the CAVM data sets are given in the *CICS System Definition Guide*.

Alternate CICS system initialization

Unless your system contains non-VTAM terminals, specify TCT=NO in the SIT for the alternate system. If you do not, takeover can be delayed due to merging with RDO defined VTAM terminal definitions.

Clock synchronization between active and alternate CICS systems

As mentioned under “Takeover phase” on page 207, to ensure optimum takeover times, you should try to keep the system clocks as nearly synchronized as possible.

Backout processing time

The time for the recovery utility program (DFHRUP) to complete backout processing is important both to fast emergency restarts and to fast takeovers. One factor in this time is how far back the utility must read on the system log before it finds a keypoint record. Read the discussions of AKPFREQ values in “Activity keypoint frequency (AKPFREQ)” on page 153 to see how this log read time can be minimized.

Another factor that affects this time is the number of backouts to be done, which is a function of the application design of the inflight tasks. Frequent syncpoints should be designed into long running tasks that update protected resources.

Dispatching priority for the alternate CICS system

It is essential to the proper functioning of the surveillance mechanism that an alternate CICS system has a dispatching priority, relative to other address spaces, which means it is dispatched when it needs to be, and does not have to wait for a lull in other work. Otherwise the alternate system may take longer to detect a failure of the active system. Also, the active CICS system may conclude that the alternate system has failed because its surveillance signals are absent.

Alternate delay interval (ADI)

The ADI=(**30** | *decimal-value*) system initialization parameter is used on an XRF system to define the alternate delay interval, in seconds. This is the interval that must elapse between the (apparent) loss of surveillance signal from the active system and any reaction by the alternate system.

An installation can use a low ADI and TAKEOVER=MANUAL, in which case the operator can make the decision as to whether a takeover is really required.

You can set surveillance off with the CEBT command before undertaking a procedure that would otherwise result in an unwanted takeover, such as taking an MVS dump of the active system. After the procedure has completed, you can set surveillance on again with the CEBT command.

Limitations

Low ADI provides early warning of the failure of the active system but causes no extra overhead. If set too short, it increases the likelihood of an unwanted takeover. This is particularly true if TAKEOVER=AUTO is being used. It should be set long enough so that expected events in the system are not detected as failures of the active system. If events such as system dumps that cause the active system not to be dispatched for 30 seconds occur regularly, for example, ADI should be set to a value of more than 30. If this value is set too high, it increases takeover time and, therefore, decrease availability.

Recommendation

Set ADI to a large enough value so that common events which cause the active system to be delayed are not detected as failures, resulting in an unwanted takeover.

POWER delay interval (XRFTODI)

The XRFTODI=(**30**|*decimal-value*) system initialization parameter is used to define the POWER delay interval, in seconds. The alternate system waits for this period of time before involving the system operator if the active system does not terminate.

Limitations

In a two-VSE image configuration, a small XRFTODI an provide early warning of VSE image failures. If it is set small enough, the message asking the operator to confirm job termination or VSE image failure always appears. This does not hinder smooth operation of the XRF function, but installations may not wish the message to appear except under unusual circumstances. One reason is that an incorrect reply to this message can destroy the integrity of the system's data.

Recommendation

The main factor affecting the choice of XRFTODI is the time taken for the SDUMP of the active system (if any). To avoid the operator message appearing except in cases where operator intervention is probably needed, XRFTODI must be set larger than the expected SDUMP time.

Primary delay interval (PDI)

The PDI=(**30**|*decimal-value*) system initialization parameter is used to define the primary delay interval, in seconds. This is the interval that must elapse between the (apparent) loss of surveillance signal from the alternate system and any reaction by the active system.

Recommendation

Set PDI to a large enough value so that common events which cause the alternate system to be delayed are not detected as possible failures.

Initial data set status (OPENTIME)

Specifying the RDO FILE operand OPENTIME (or the FILSTAT operand on a DFHFCT TYPE=FILE macro) can affect the speed at which the system recovers after takeover.

If OPENTIME(FIRSTREF) or FILSTAT=(ENABLED,CLOSED) is coded, it leaves the data sets closed until the first transaction references them, unless they are needed for backout of inflight tasks. The first transaction to refer to a data set, and any others that access it while it is being opened, suffers increased response time, however. In a system with a large number of data sets that are referenced infrequently, this option spreads the effect of data set opening at the cost of increased individual transaction time.

If OPENTIME(STARTUP) or FILSTAT=(ENABLED,OPENED) is coded instead, all data sets are opened immediately after takeover. On systems where all the data sets are referenced soon after takeover, transaction response time is affected while the data sets are being opened initially, but the period for the average transaction response time to recover to the level prior to takeover may be shortened.

AUTCONN

AUTCONN=(0|*hhmmss*) is used to define an additional delay between the completion of takeover and the first attempt to re-bind tracked (class 2) sessions.

Note: This additional delay also applies to terminals with CONNECT=AUTO specified in the TCT on cold, warm, and emergency restarts.

Chapter 21. Improving CICS startup and normal shutdown time

This chapter tells you how to try to reduce the amount of time for CICS startup. Because various configurations are possible with CICS, different areas of the startup may require attention. Shutdown is discussed in the section on Buffer Considerations.

1. Start by defining your GCD, LCD, CSD and RSD, as shown in the *CICS System Definition Guide*.
2. When defining your terminals, pay attention to the position of group names within the GRPLIST. If the group containing the TYPETERMs is last, all the storage used for building the terminal definitions is held until the TYPETERMs are known and this could cause your system to go short-on-storage.

   Groups in the GRPLIST in the SIT are processed sequentially. Place the groups containing the model TERMINAL definitions followed by their TYPETERMs in the GRPLIST before the user transactions and programs. This minimizes the virtual storage tied up while processing the installation of the terminals.

   Note: All terminals are installed, even surrogate TCT entries for MRO.

   You must ensure that the DFHVTAM group precedes any TERMINAL or TYPETERM definition in your GRPLIST. It is contained in the DFHLIST GRPLIST, so adding DFHLIST first to your GRPLIST ensures this. If you do not do this, the programs used to build the TCT are loaded for each terminal, thus slowing cold start.
3. You should not have more than about 100 entries in any group defined in the CSD. This may cause unnecessary overhead during processing, as well as making maintenance of the group more difficult.
4. Make sure that changing the START= parameter does not change the default for any facilities that your users do not want to have AUTO-started. Any facility that you may want to override may be specifically coded in the PARM= on the EXEC statement, or all of them may be overridden by specifying START=(...,ALL).
5. Tune the VSAM parameters of the local and global catalogs to suit your installation.
   a. CI sizes should be changed for optimum data and DASD sizes (see “Size of control intervals” on page 139 for more information). 4KB index CI, and 8KB or 16KB data CI can be recommended; 32KB data has been found to slow down the COLD start.
   b. You should specify the BUFNI and BUFND DLBL parameters in JCL for the GCD rather than using the BUFSPACE DLBL parameter.
   c. Allocate not more than ten data buffers. CICS opens the GCD with 32 strings, so allocate one per string, plus one more.

d. Alter the number of index buffers by coding the number of strings plus the number of index set records in the index. The number of records in the index set can be calculated from IDCAMS LISTCAT information as follows:

- T = total number of index records (index REC-TOTAL)
- D = data control interval size (data CISIZE)
- C = data control intervals per control area (data CI/CA)
- H = data high-used relative byte address (data HURBA)
- The number of index set records can then be computed:

  The number of sequence set records: S = H / (D X C)

- This calculation is really the number of used control areas. The number of sequence set records must be the same as the number of used CAs.

  The number of index set records: I = T - S

Free space has no effect, so do not spend time trying to tune this.

Imbed and replicate can be specified, but these only help on reads later.

6. On a COLD start, try deleting the GCD data set and re-allocating and initializing it using JCL prior to the CICS job. This may be faster than allowing CICS to clean up the GCD at COLD start. CICS deletes all entries it finds in the GCD, resulting in a lot of processing.

   Note: If you do reinitialize the GCD data set (for any reason), you must also do the same for the LCD data set. The reverse also applies. See the *CICS System Definition Guide* for more information.

7. Allocate your DATA and INDEX data sets on different units, if possible.
8. Consider the use of autoinstalled terminals as a way of improving cold start, even if you do not expect any storage savings. On startup, fewer terminals are installed, thereby reducing the startup time.
9. The RAPOOL system initialization parameter should be set to a value that allows faster autoinstall rates. For a discussion of this, see “Receive-any pool (RAPOOL)” on page 122.
10. Specify the buffer, string, and key length parameters in the RDO LSRPOOL definition (or the DFHFCT TYPE=SHRCTL macro). This reduces the time taken to build the LSR pool, and also reduces the open time for the first file to use the pool.
11. If you have defined performance groups for the CICS system, ensure that all steps preceding the CICS step are also in the same performance group or, at least, have a high enough dispatching priority so as not to delay their execution.
12. If possible, have one VSAM user catalog with all of the CICS VSAM data sets to reduce the catalog search time.
13. Keep the number of libraries defined by the LIBDEF search to a minimum.
14. Use of the shared modules in the shared virtual area (SVA) can help to reduce the time to load the CICS nucleus modules. See the *CICS System Definition Guide* for advice on how to install CICS modules in the SVA.
15. CICS does not load programs at startup time for resident programs. The storage area is reserved, but the program is actually loaded on the first access through program control for that program. This speeds startup. The correct way to find a particular program or table in storage is to use the

program-control LOAD facility to find the address of the program or table. The use of the LOAD facility physically loads the program into its predefined storage location if it is the first access.

The use of a PLTPI task to load these programs is one possible technique, but you must bear in mind that the CICS system is not operational until the PLTPI processing is complete, so you should not load every program. Load only what is necessary, or the startup time will appear to increase.

16. Use automatic journal archiving or allow the definitions of the system log and other journals in the JCT to default to the LRU (least recently used) option. This enables CICS to write to the less recently used data set while you archive the more recently used data set. This avoids a delay in CICS online operation.

CI size of data and index components of the GCD

General VSAM tuning guidelines for the NSR environment apply to tuning for the GCD. 4KB or 8KB for the data CI, and 2KB for the index CI, should be appropriate in most cases. Consult the VSAM manuals for special considerations such as different DASD device types.

Buffer considerations

To achieve a balance between virtual storage usage and the time for a CICS warm shutdown, a specification of BUFND=4 and BUFNI=3 plus ((level of indexes) – 1) is recommended.

For example, if the GCD has a two-level index, the JCL statement should be as follows:

```
//DLBL DFHGCD, 'CICS410.DFHGCD',BUFNI=4,BUFND=4
```

The number of index levels can be obtained by using the IDCAMS LISTCAT command against a GCD after CICS has been shut down. Because cold start mainly uses sequential processing, it should not require any extra buffers over those automatically allocated when CICS opens the file.

You may wish to increase the number of buffers to improve autoinstall performance. The minimum you should specify is the number suggested above for warm shutdown. This should stop the high-level index being read for each autoinstall.

Note that if you have a large number of devices autoinstalled, shutdown can fail due to the MXT system initialization parameter being reached or CICS becoming short on storage. To prevent this possible cause of shutdown failure, you should consider putting the CATD transaction in a class of its own to limit the number of concurrent CATD transactions. Also, AIQMAX can be specified to limit the number of devices that can be queued for autoinstall. This protects against abnormal consumption of virtual storage by the autoinstall/delete process, caused as a result of some other abnormal event.

If this limit is reached, the AIQMAX system initialization parameter affects the LOGON, LOGOFF and BIND processing by CICS. CICS requests VTAM to stop passing such requests to CICS. VTAM holds the requests until CICS indicates that it can accept further commands (this occurs when CICS has processed a queued autoinstall request).

Part 5. Appendixes

The four appendixes are:

Appendix A. CICS statistics tables

This appendix provides reference information about CICS statistics. For information about the interpretation of CICS statistics see Chapter 5, “Using CICS statistics” on page 33.

Interpreting CICS statistics

All five types of CICS statistics record (interval, end-of-day, requested, requested reset, and unsolicited) present information as DMF records. The numbers used to identify each DMF statistics record are given in the copybook DFHSTIDS. Programming information about the formats of CICS statistics records are given in the *CICS Customization Guide*.

Each area of CICS statistics is listed below in the following format:

Statistics area: Statistics type

Brief description, if appropriate.

Name of the assembler DSECT mapping this data.

DFHSTUP name	Field name	Description
DFHSTUP name is the name as it appears on the DFHSTUP report.	**Field name** is the name as it appears in the DSECT referred to above.	**Description** is a brief description of the statistics field. Reset characteristic: Reset characteristic of the statistics field at a statistics interval collection. The values can be: • Not reset • Reset to zero • Reset to 1 • Reset to current values (this applies to peak values only) • An exception to the above (these will be documented).

Statistics areas are listed alphabetically.

Summary report: The Statistics Utility Program (STUP) provides a summary report facility that can be selected using a DFHSTUP control parameter. Information on how to run DFHSTUP is given in the *CICS Operations and Utilities Guide*. When selected, the summary report is placed after all other reports. The DFHSTUP summary report facility summarizes (totals, peaks, and averages) the interval, unsolicited, requested reset and end-of-day statistics on an “applid” by “applid” basis. Requested statistics are not involved in the production of the summary report.

The summary report feature uses all of the appropriate statistic collections contained on the DMF data set. Therefore, depending on when the summary report feature is executed and when the DMF data set was last cleared, summary reports may be produced covering an hour, a week, or any desired period of time. Note that due to the potential magnitude of the summary data, it is not recommended that a summary period extend beyond one year.

Within each of the following sections, the meaning of the summary statistics is given. Because the summary statistics are computed offline by the DFHSTUP utility, the summary statistics are not available to online users. Due to the potential magnitude of the summary data, and due to limited page width, summary data may be represented as a scaled value. For example, if the total number of terminal input messages is 1234567890, this value is shown as 1234M, where 'M' represents millions. Other scaling factors used are 'B' for billions and 'T' for trillions. Scaling is only performed when the value exceeds 99999999, and only then when page width is limited, for example in terminal statistics.

Table 11. Statistics listed in this appendix

Statistic type	DSECT	Page
Autoinstall (global) statistics	DFHA04DS	224
Autoinstall (resource) statistics	DFHA04DS	228
Dispatcher statistics	DFHDSGDS	230
Dump statistics	DFHSDGDS	232
Dynamic transaction backout statistics	DFHA05DS	237
FEPI: Pool statistics	DFHA22DS	237
FEPI: Connection statistics	DFHA23DS	238
FEPI: Target statistics	DFHA24DS	239
File control statistics	DFHA17DS	241
ISC/IRC system and mode entries	DFHA14DS	250
ISC/IRC attach time statistics	DFHA21DS	259
Journals	DFHA13DS	260
Loader statistics	DFHLDGDS	262
LSR pools	DFHA08DS	272
Monitoring statistics	DFHMNGDS	280
Programs	DFHLDRDS	281
Program autoinstall	DFHPGGDS	283
Statistics domain statistics	DFHSTGDS	284
Storage manager statistics	DFHSMDDS	285
	DFHSMSDS	287
	DFHSMTDS	292
Table manager	DFHA16DS	295
Temporary storage	DFHA12DS	296
Terminals	DFHA06DS	302
Transactions	DFHA02DS	305
Transaction class statistics	DFHA15DS	307
Transaction manager statistics	DFHA15DS	310
Transient data (global) statistics	DFHA11DS	312
Transient data (resource) statistics	DFHA10DS	315
User domain statistics	DFHUSGDS	316
VTAM statistics	DFHA03DS	317

Autoinstall global statistics

This is the DFHSTUP listing for terminals that are connected, while the system is running, by means of the autoinstall facility. These statistics are obtained as **interval**, **end-of-day**, or **requested** statistics. CICS also records **unsolicited** autoinstall statistics, which DFHSTUP prints in a separate report; see "Autoinstalled terminals" on page 228.

Autoinstall: Local definition statistics

These statistics are available online, and are mapped by the DFHA04DS DSECT.

DFHSTUP name	Field name	Description
Autoinstall attempts	A04VADAT	is the number of eligible autoinstall attempts made during the current session of CICS to create terminal entries as users logged on. For an attempt to be considered eligible, CICS and VTAM must not be terminating, autoinstall must be enabled, and the terminal type must be valid for autoinstall (not pipeline, LU6.1).
		Reset characteristic: reset to zero
Rejected attempts	A04VADRJ	is the number of eligible autoinstall attempts that were subsequently rejected during the current session of CICS. Reasons for rejection can be maximum concurrency value exceeded, invalid bind, the user program has rejected the logon, and so on. If this number is unduly high, check the reasons for rejection.
		Reset characteristic: reset to zero
Deleted attempts	A04VADLO	is the number of deletions of terminal entries as users logged off during the current session.
		Reset characteristic: reset to zero
Peak concurrent attempts	A04VADPK	is the highest number of attempts made during the current session to create terminal entries as users logged on at the same time.
		Reset characteristic: reset to current value
Times the peak was reached	A04VADPX	is the number of times when the highest number of attempts were made during the current session to create terminal entries as users logged on at the same time.
		Reset characteristic: reset to 1
Times SETLOGON HOLD issued	A04VADSH	is the number of times that the SETLOGON HOLD command was issued during this run of CICS. CICS issues the VTAM SETLOGON HOLD command when the maximum number of concurrent autoinstall requests allowed (the AIQMAX= system initialization parameter) is exceeded.
		Reset characteristic: reset to zero
Queued logons	A04VADQT	is the number of attempts that were queued for logon due to delete in progress of the TCTTE for the previous session with the same LU.
		Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Peak of queued logons	A04VADQK	is the highest number of logons that were queued waiting for TCTTE deletion at any one time. If this is unduly high, consider increasing the delete delay interval parameter of the AILDELAY system initialization parameter. Reset characteristic: reset to current value
Times queued peak reached	A04VADQX	is the number of times this peak was reached. Reset characteristic: reset to 1

Autoinstall: remote definitions - shipped terminal statistics

DFHSTUP name	Field name	Description
Delete shipped interval	A04RDINT	is the currently-specified time delay, in the form **hhmmss**, between invocations of the timeout delete transaction that removes redundant shipped terminal definitions. The value is set either by the DSHIPINT system initialization parameter, or by a subsequent SET DELETSHIPPED command. Reset characteristic: not reset
Delete shipped idle time	A04RDIDL	is the currently-specified minimum time, in the form **hhmmss**, that an inactive shipped terminal definition must remain installed in this region, before it becomes eligible for removal by the CICS timeout delete transaction. The value is set either by the DSHIPIDL system initialization parameter, or by a subsequent SET DELETSHIPPED command. Reset characteristic: not reset
Shipped terminals built	A04SKBLT	is the number of shipped remote terminal definitions installed at the start of the recording period, plus the number built during the recording period. This value equates to the sum of “Shipped terminals installed” and “Shipped terminals deleted”. Reset characteristic: reset to number of skeletons installed
Shipped terminals installed	A04SKINS	is the number of shipped remote terminal definitions currently installed in this region. Reset characteristic: not reset
Shipped terminals timed out	A04SKDEL	is the number of shipped remote terminal definitions deleted during the recording period by the TIMEOUT transaction. Reset characteristic: reset to zero
Times interval expired	A04TIEXP	is the number of times the remote delete interval (A04RDINT) expired since the start of the recording period. Reset characteristic: reset to zero
Remote deletes received	A04RDREC	is the number of old-style (pre-CICS Transaction Server for VSE/ESA Version 1) remote delete instructions received by this region since the start of the recording period. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Remote deletes issued	A04RDISS	is the number of old-style (pre-CICS Transaction Server for VSE/ESA Version 1) remote delete instructions issued by this region since the start of the recording period. Reset characteristic: reset to zero
Successful remote deletes	A04RDDEL	is the number of shipped terminal definitions deleted from this region because of old-style remote delete instructions, since the start of the recording period. Reset characteristic: reset to zero
Total idle count	A04TIDCT	is the total number of times that all previously used remote terminal definitions (whether deleted from the system or currently in the system) had been idle awaiting reuse. This number does not include the remote terminal definitions currently idle awaiting reuse (see A04CIDCT). Reset characteristic: reset to zero
NOT IN THE DFHSTUP REPORT	A04TIDLE	is the total time (expressed in STCK units) that all previously used remote terminal definitions (whether deleted from the system or currently in the system) had been idle awaiting reuse. This number does not include the remote terminal definitions currently idle awaiting reuse (see A04CIDLE). Reset characteristic: reset to zero
Average idle time		is the average idle time (expressed in STCK units) that all previously used remote terminal definitions (whether deleted from the system or currently in the system) had been idle awaiting reuse. This number does not include the remote terminal definitions currently idle awaiting reuse. This value is calculated offline by DFHSTUP and is, therefore, not accessible through the EXEC CICS COLLECT STATISTICS command. Reset characteristic: not reset
Maximum idle time	A04TMAXI	is the maximum time (expressed in STCK units) for which a previously idle shipped terminal definition had been idle during the recording period. This number does not include the remote terminal definitions currently idle awaiting reuse (A04CMAXI). Reset characteristic: reset to current value
NOT IN THE DFHSTUP REPORT	A04CIDCT	Reset characteristic: Not reset
NOT IN THE DFHSTUP REPORT	A04CIDLE	Reset characteristic: Not reset
NOT IN THE DFHSTUP REPORT	A04CMAXI	Reset characteristic: Not reset

Autoinstall: Summary global statistics

Summary statistics are not available online.

DFHSTUP name	Description
Autoinstall attempts	is the total number of eligible autoinstall attempts made during the entire CICS session to create terminal entries as users logged on. For an attempt to be considered eligible, CICS and VTAM must not be terminating, autoinstall must be enabled, and the terminal type must be valid for autoinstall (not pipeline, LU6.1, or LU6.2 parallel sessions).
Rejected attempts	is the total number of eligible autoinstall attempts that were subsequently rejected during the entire CICS session. Reasons for rejection can be, for example, maximum concurrency value exceeded, invalid bind, or the user program has rejected the logon. If this number is unduly high, check the reasons for rejection.
Deleted attempts	is the total number of deletions of terminal entries as users logged off during the entire session.
Peak concurrent attempts	is the highest number of attempts made during the entire CICS session to create terminal entries as users logged on at the same time.
Times the peak was reached	is the number of times that the “peak concurrent attempts” value was reached during the entire CICS session.
Times SETLOGON HOLD issued	is the number of times that the SETLOGON HOLD command was issued during the entire run of CICS. CICS issues the VTAM SETLOGON HOLD command when the maximum number of concurrent autoinstall requests allowed (the AIQMAX= system initialization parameter) is exceeded.
Queued logons	is the total number of attempts that had to be queued for logon because delete of the TCTTE for the previous session with the same LU was in progress.
Peak of queued logons	is the highest number of logons that were queued waiting for TCTTE deletion at any one time. If this is unduly high, consider increasing the delete delay interval parameter of the AILDELAY system initialization parameter.
Times queued peak reached	is the number of times that the “peak of queued logons” value was reached.
Delete shipped interval	is the currently-specified time delay, in the form **hhmmss**, between invocations of the timeout delete transaction that removes redundant shipped terminal definitions. The value is set either by the DSHIPINT system initialization parameter, or by a subsequent SET DELETSHIPPED command.
Delete shipped idle time	is the currently-specified minimum time, in the form **hhmmss**, that an inactive shipped terminal definition must remain installed in this region, before it becomes eligible for removal by the CICS timeout delete transaction. The value is set either by the DSHIPIDL system initialization parameter, or by a subsequent SET DELETSHIPPED command.
Shipped terminals built	is the number of shipped remote terminal definitions installed at the start of the recording period, plus the number built during the recording period. This value equates to the sum of “Shipped terminals installed” and “Shipped terminals deleted”.
Shipped terminals timed out	is the number of shipped remote terminal definitions deleted during the recording period by the TIMEOUT transaction.
Times interval expired	is the number of times the remote delete interval (A04RDINT) expired since the start of the recording period.
Remote deletes received	is the number of old-style (pre-CICS Transaction Server for VSE/ESA Version 1) remote delete instructions received by this region since the start of the recording period.
Remote deletes issued	is the number of old-style (pre-CICS Transaction Server for VSE/ESA Version 1) remote delete instructions issued by this region since the start of the recording period.

DFHSTUP name	Description
Successful remote deletes	is the number of shipped terminal definitions deleted from this region because of old-style remote delete instructions, since the start of the recording period.
Total idle count	is the total number of times that all previously used remote terminal definitions (whether deleted from the system or currently in the system) had been idle awaiting reuse. This number does not include the remote terminal definitions currently idle awaiting reuse (see A04CIDCT).
Average idle time	is the average idle time (expressed in STCK units) that all previously used remote terminal definitions (whether deleted from the system or currently in the system) had been idle awaiting reuse. This number does not include the remote terminal definitions currently idle awaiting reuse.
Maximum idle time	is the maximum time (expressed in STCK units) for which a previously idle shipped terminal definition had been idle during the recording period. This number does not include the remote terminal definitions currently idle awaiting reuse (A04CMAXI).

Autoinstalled terminals

The autoinstalled terminal statistics are of the **unsolicited** type only. These unsolicited statistics are produced when an autoinstalled terminal is about to be deleted due to the terminal being logged off. It contains the history of the activity on that terminal since the last interval. On a statistics interval, currently logged-on autoinstalled terminals are reported under **Terminal control: Resource statistics**, mapped by DSECT DFHA06DS. The statistics for an autoinstalled terminal are reset at that time. For total activity from logon to logoff, consult the summary report for this terminal.

This category of statistics is not related directly to autoinstall global statistics, which are described on page 224.

Autoinstalled terminal statistics: Unsolicited

These statistics are available online, and are mapped by the DFHAUSDS DSECT.

DFHSTUP name	Field name	Description
Term ID	AUSTETI	is a unique identifier for the terminal. Reset characteristic: not reset
Input messages	AUSTENI	is the number of input messages received from the terminal. Reset characteristic: reset to zero
Output messages	AUSTENO	is the number of output messages sent to the terminal. Reset characteristic: reset to zero
Transactions	AUSTEOT	is the number of transactions that the terminal ran during the time it was logged on. Reset characteristic: reset to zero
Transmission errors	AUSTETE	is the number of transmission errors which occurred during the time that the terminal was logged on. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Transaction errors	AUSTEOE	is the number of transaction errors which occurred during the time that the terminal was logged on. Reset characteristic: reset to zero.
Luname	AUSLUNAM	is the terminal Luname. Reset characteristic: not reset
Logon Time	AUSONTM	is the time at which this terminal was autoinstalled. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*. The DSECT field contains the value as a store clock (STCK) value in local time. Reset characteristic: not reset
Logoff Time	AUSOFFTM	is the time at which this terminal was logged-off. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*. The DSECT field contains the value as a store clock (STCK) value in local time. Reset characteristic: not reset
Logon Duration	n/a	is the logged on duration for this terminal. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*. This field does not appear in the Dsect; it is calculated as the difference between AUSOFFTM and AUSONTM. Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	AUSGONTM	is the time at which this terminal was autoinstalled. This time is expressed as *hours:minutes:seconds.decimals*. The DSECT field contains the value as a store clock (STCK) value in GMT. Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	AUSGOFTM	is the time at which this terminal was logged-off. This time is expressed as *hours:minutes:seconds.decimals*. The DSECT field contains the value as a store clock (STCK) value in GMT. Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	AUSPRTY	is the terminal priority. Reset characteristic: not reset

Autoinstalled: Summary terminal statistics: Unsolicited

Summary statistics are not available online.

DFHSTUP name	Description
Term ID	is a unique identifier for the terminal.
Luname	is the terminal Luname.
Input msgs	is the total number of input messages received from the terminal.
Output msgs	is the total number of output messages sent to the terminal.
Transactions	is the total number of transactions that the terminal ran during the time it was logged on.
Xmission Errors	is the total number of transmission errors which occurred during the time that the terminal was logged on.
Xaction Errors	is the total number of transaction errors which occurred during the time that the terminal was logged on.
Ave Logged On Time	is the average time that the terminal was logged on.

Dispatcher statistics

Dispatcher domain: Global statistics

These statistics are available online, and are mapped by the DFHDSGDS DSECT.

DFHSTUP name	Field name	Description
Start time	DSGLSTRT	is the time at which the dispatcher started. This value can be used as an approximate time at which CICS started. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value in local time. Reset characteristic: not reset
NOT IN DFHSTUP REPORT	DSGSTART	is the time at which the dispatcher started. This value can be used as an approximate time at which CICS started. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value in GMT. Reset characteristic: not reset
Current number of tasks	DSGCNT	is the current number of tasks in the system. This figure includes all system tasks and all user tasks. Reset characteristic: not reset
Peak number of tasks	DSGPNT	is the peak value of the number of tasks concurrently in the system. Reset characteristic: reset to current value
Current ICV time (msec)	DSGICVT	is the ICV time value (expressed in *milliseconds*) specified in the SIT, or as an override, or changed dynamically using CEMT SET SYSTEM TIME(value) or EXEC CICS SET SYSTEM TIME(fullword binary data-value) commands. Reset characteristic: not reset
Current ICVTSD time (msec)	DSGICVSD	is the ICVTSD time value (expressed in *milliseconds*) specified in the SIT, or as an override, or changed dynamically using CEMT SET SYSTEM SCANDELAY(value) or EXEC CICS SET SYSTEM SCANDELAY(fullword binary data-value) commands. Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	DSGASIZE	records the current number of VSE subtasks in the system under which the CICS dispatcher runs. Reset characteristic: not reset

Dispatcher domain: Subtask statistics

The following fields are mapped by the DSGTCB DSECT within the DFHDSGDS DSECT. The DSGTCB DSECT is repeated for each mode of dispatcher subtasks in CICS (DSGASIZE). The subtask statistics only have meaning if the VSE subtask is active (DSGTCBF1). There are three modes of VSE subtask:

1. The quasi-reentrant VSE subtask.
2. The resource-owning VSE subtask.

3. The FEPI VSE subtask.

DFHSTUP name	Field name	Description
Mode	NOT IN THE DSECT	contains, in the DFHSTUP report, either QUASI, RESOURCE, or SZ (FEPI subtask), depending upon which subtask it refers to. Reset characteristic: none
NOT IN THE DFHSTUP REPORT	DSGTCBF1	Subtask flag byte X'80' means the subtask is active. If the subtask is not active there are no statistics in the following fields. Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	DSGTCBNM	name of the subtask that the following statistics refer to. The names can be 'QR_SUBD', 'RO_SUBD', and 'SZ_SUBD'. Reset characteristic: not reset
VSE Waits	DSGSYSW	is the number of VSE waits which occurred on this VSE subtask. Reset characteristic: reset to zero
NOT IN THE DFHSTUP REPORT	DSGPERCT	is percentage use of the processor for this VSE subtask. This value is continuously recalculated and does not represent the percentage processor time for the current statistics interval. Reset characteristic: not reset
Accum Time in VSE wait	DSGTWT	is the accumulated real time that the CICS region was in a VSE wait, that is, the total time used between a VSE wait issued by the dispatcher and the return from the VSE wait. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: reset to zero
Accum Time Dispatched	DSGTDT	is the accumulated real time that this VSE subtask has been dispatched by VSE, that is, the total time used between a VSE wait issued by the dispatcher and the subsequent wait issued by the dispatcher. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: reset to zero
NOT IN THE DFHSTUP REPORT	DSGTCT	is the accumulated CPU time taken for this DS task, that is, the processor time used by this VSE subtask while executing the default dispatcher task (DSTCB). The DSECT field contains the time as a store clock (STCK) value. Reset characteristic: reset to zero
Accum CPU Time / VSE subtask	DSGACT	is the accumulated CPU time taken for this VSE subtask. that is, the total time that this VSE subtask has been in execution. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: reset to zero

Dispatcher domain: Summary global statistics

Summary statistics are not available online.

DFHSTUP name	Description
Start time	is the time at which the dispatcher started. This value can be used as an approximate time at which CICS started. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals* at the local time; however, the DSECT field contains the time as a local store clock (STCK) value.
Average number of tasks	is the average number of tasks in the system. This figure is calculated by averaging the "current number of tasks" statistic as reported in the interval report. Hence, the larger the statistics interval the more accurate this figure will be.
Peak number of tasks	is the peak number of tasks concurrently in the system.
Peak ICV time (msec)	is the peak ICV time value (expressed in *milliseconds*) specified in the SIT, or as an override, or changed dynamically using CEMT SET SYSTEM TIME(value) or EXEC CICS SET SYSTEM TIME(fullword binary data-value) commands.
Peak ICVTSD time (msec)	is the peak ICVTSD time value (expressed in *milliseconds*) specified in the SIT, or as an override, or changed dynamically using CEMT SET SYSTEM SCANDELAY(value) or EXEC CICS SET SYSTEM SCANDELAY(fullword binary data-value) commands.

Dispatcher domain: Summary VSE subtask statistics

The following statistics are repeated for each of the three modes of VSE subtask:

1. The quasi-reentrant VSE subtask.
2. The resource-owning VSE subtask.
3. The FEPI VSE subtask. (Optional because it is controlled by the system initialization parameter, FEPI) and is the secondary LU mode.

DFHSTUP name	Description
Mode	Contains in the DFHSTUP report either QUASI, or RESOURCE, or SZ depending upon which VSE subtask it refers to.
VSE Waits	is the total number of VSE waits which occurred on this VSE subtask.
Total Time in VSE wait	is the total real time that this VSE subtask was in a VSE wait. The DFHSTUP report expresses this time as *days–hours:minutes:seconds.decimals*.
Total Time Dispatched	is the total real time that this VSE subtask has been dispatched by VSE. The DFHSTUP report expresses this time as *days–hours:minutes:seconds.decimals*.
Total CPU Time / VSE subtask	is the total CPU time taken for this VSE subtask. The DFHSTUP report expresses this time as *days–hours:minutes:seconds.decimals*. There is only a non-zero value if performance class monitoring is active when using an MCT with CPU=YES specified.

Dump statistics

The dump domain collects global and resource statistics for both system and transaction dumps which occur during the CICS run.

System dumps

Dump domain: System dump global statistics

These statistics fields contain the global data collected by the dump domain for system dumps. They are available online, and are mapped by the DFHSDGDS DSECT.

DFHSTUP name	Field name	Description
Dumps taken	SYS_DUMPS_TAKEN	is the number of system dumps taken by the whole system during the present run of CICS. This number does not include suppressed dumps. Reset characteristic: reset to zero
Dumps suppressed	SYS_DUMPS_SUPPR	is the number of system dumps, requested from the dump domain by CICS or by a user, which were suppressed by one of: • A user exit • The dump table • A global system dump suppression. Reset characteristic: reset to zero

Dump domain: System dump resource statistics

These statistics fields contain the data collected by the dump domain for system dumps. They are available online, and are mapped by the DFHSDRDS DSECT.

DFHSTUP name	Field name	Description
Dumpcode	SDRCODE	is the system dump code. This code is a CICS message number with the DFH prefix and the action code suffix (if any) removed. For guidance information about CICS messages, see the *VSE/ESA Messages and Codes Volume 3* manual. Reset characteristic: not reset
Dumps	SDRSTKN	is the number of system dumps taken for the dump code identified in the Dumpcode (SDRCODE) field. Reset characteristic: reset to zero
Dumps suppressed	SDRSSUPR	is the number of system dumps, for the dump code identified in the Dumpcode (SDRCODE) field, which were suppressed by one of the following: • A user exit • The dump table • A global system dump suppression. Reset characteristic: reset to zero
NOT IN THE DFHSTUP REPORT	SDRTTKN & SDRTSUPR	These fields are always zero. They exist here only for compatibility with the transaction dump statistics record format. A transaction dump can force a system dump to be taken as well (it is an option in the transaction dump table), but a system dump cannot force a transaction dump to be taken. Reset characteristic: not applicable

Dump domain: Summary system dump global statistics

Summary statistics are not available online.

DFHSTUP name	Description
Dumps taken	is the total number of system dumps taken by the whole system during the entire run of CICS. This number does not include suppressed dumps.
Dumps suppressed	is the total number of system dumps, requested from the dump domain by CICS or by a user, which were suppressed by one of: • A user exit • The dump table • A global system dump suppression.

Dump domain: Summary system dump resource statistics

Summary statistics are not available online.

DFHSTUP name	Description
Dumpcode	is the system dump code. This code is a CICS message number with the DFH prefix and the action code suffix (if any) removed. For guidance information about CICS messages, see the *VSE/ESA Messages and Codes Volume 3* manual.
Dumps	is the total number of system dumps taken for the dump code identified in the Dumpcode field.
Dumps suppressed	is the total number of system dumps, for the dump code identified in the Dumpcode field, which were suppressed by one of: • A user exit • The dump table • A global system dump suppression.

Transaction dumps

Dump domain: Transaction dump global statistics

These statistics fields contain the global data collected by the dump domain for transaction dumps. They are available online, and are mapped by the DFHTDGDS DSECT.

DFHSTUP name	Field name	Description
Dumps taken	TRANS_DUMP_TAKEN	is the number of transaction dumps taken by the whole system during the present run of CICS. This number does not include suppressed dumps. Reset characteristic: reset to zero
Dumps suppressed	TRANS_DUMP_SUPP	is the number of transaction dumps, requested from the dump domain by CICS or by a user, which were suppressed by one of: • A user exit • The dump table. Reset characteristic: reset to zero

Dump domain: Transaction dump resource statistics

These statistics fields contain the data collected by the dump domain for transaction dumps, by dump code. They are available online, and are mapped by the DFHTDRDS DSECT.

DFHSTUP name	Field name	Description
Dumpcode	TDRCODE	is the transaction dump code. For guidance information about transaction abend codes, see the *VSE/ESA Messages and Codes Volume 3* manual. Reset characteristic: not reset
Dumps	TDRTTKN	is the number of transaction dumps taken for the dump code identified in the Dumpcode (TDRCODE) field. Reset characteristic: reset to zero
Dumps suppressed	TDRTSUPR	is the number of transaction dumps suppressed for the dump code identified in the Dumpcode (TDRCODE) field. Reset characteristic: reset to zero
System dumps	TDRSTKN	is the number of system dumps forced by the transaction dump identified in the Dumpcode (TDRCODE) field. Reset characteristic: reset to zero
System dumps suppressed	TDRSSUPR	is the number of system dumps, forced by the transaction dump identified in the Dumpcode (TDRCODE) field, which were suppressed by one of: • A user exit • The transaction dump table • A global system dump suppression. Reset characteristic: reset to zero

Dump domain: Summary transaction dump global statistics

Summary statistics are not available online.

DFHSTUP name	Description
Dumps taken	is the total number of transaction dumps taken by the whole system during the entire run of CICS. This number does not include suppressed dumps.
Dumps suppressed	is the total number of transaction dumps, requested from the dump domain by CICS or by a user, which were suppressed by one of: • A user exit • The dump table.

Dump domain: Summary transaction dump resource statistics

Summary statistics are not available online.

DFHSTUP name	Description
Dumpcode	is the transaction dump code. For guidance information about transaction abend codes, see the *VSE/ESA Messages and Codes Volume 3* manual.
Dumps	is the total number of transaction dumps taken for the dump code identified in the Dumpcode field.
Dumps suppressed	is the total number of transaction dumps suppressed for the dump code identified in the Dumpcode field.
System dumps	is the total number of system dumps forced by the transaction dump identified in the Dumpcode field.
System dumps suppressed	is the total number of system dumps, forced by the transaction dump identified in the Dumpcode field, which were suppressed by one of: • A user exit • The transaction dump table • A global system dump suppression.

Dynamic transaction backout statistics

These statistics are available online, and are mapped by the DFHA05DS DSECT.

DFHSTUP name	Field name	Description
Number of records logged	A05DBLA	is the number of records written to the dynamic log, so that they are available for transaction backout. Reset characteristic: reset to zero
Number of records spilled	A05DBSA	is the number of times the dynamic log overflow mechanism had to be used. Reset characteristic: reset to zero

Dynamic transaction backout: Summary statistics

Summary statistics are not available online.

DFHSTUP name	Description
Number of records logged	is the number of records written to the dynamic log, so that they are available for transaction backout.
Number of records spilled	is the number of times the dynamic log overflow mechanism had to be used.

Front end programming interface (FEPI) statistics

FEPI statistics contain data about the use of each FEPI pool, a target in any pool, and FEPI connection.

FEPI: Pool statistics

These statistics give information about each FEPI pool. The statistics are available online, and are mapped by the DFHA22DS DSECT.

DFHSTUP name	Field name	Description
Pool Name	A22POOL	is the FEPI pool name. Reset characteristic: not reset
Targets	A22TRGCT	is the current number of targets in the pool. Reset characteristic: not reset
Nodes	A22NDCT	is the current number of nodes in the pool. Reset characteristic: not reset
Available Connections		
–Current	A22CONCT	is the number of connections in the pool. Reset characteristic: not reset
–Peak	A22CONPK	is the peak number of connections in the pool. This field is needed because targets and nodes may be deleted between intervals. Reset characteristic: reset to current value (A22CONCT)
Allocates		
–Total	A22ALLOC	is the number of conversations that have been allocated from this pool. Reset characteristic: reset to zero
–Peak	A22PKALL	is the peak number of concurrent conversations allocated from this pool. Reset characteristic: reset to current value

DFHSTUP name	Field name	Description
Allocate Waits		
NOT IN THE DFHSTUP REPORT	A22WAIT	is the current number of conversations waiting to be allocated.
		Reset characteristic: not reset
–Total	A22TOTWT	is the number of conversations that had to wait to be allocated.
		Reset characteristic: reset to zero
–Peak	A22PKWT	is the peak number of conversations that had to wait to be allocated.
		Reset characteristic: reset to current value (A22WAIT)
Allocate Timeouts	A22TIOUT	is the number of conversation allocates that timed out.
		Reset characteristic: reset to zero

FEPI: Connection statistics

These statistics give information about each FEPI connection. The statistics are available online, and are mapped by the DFHA23DS DSECT.

DFHSTUP name	Field name	Description
Pool Name	A23POOL	is the FEPI pool name.
		Reset characteristic: not reset
Target Name	A23TARG	is the FEPI target name.
		Reset characteristic: not reset
Node Name	A23NODE	is the FEPI node.
		Reset characteristic: not reset
Acquires	A23ACQ	is the number of times the connection was acquired.
		Reset characteristic: reset to zero
Conversations	A23CNV	is the number of conversations that have used this connection.
		Reset characteristic: reset to zero
Unsolicited Inputs	A23USI	is the number of times unsolicited input was received on this connection.
		Reset characteristic: reset to zero
Characters		
–Sent	A23CHOUT	is the number of characters of data sent on this connection.
		Reset characteristic: reset to zero
–Received	A23CHIN	is the number of characters of data received on this connection.
		Reset characteristic: reset to zero
Receive Timeouts	A23RTOUT	is the number of times a FEPI RECEIVE timed-out on this connection.
		Reset characteristic: reset to zero
Error Conditions	A23ERROR	is the number of VTAM error conditions raised for this connection.
		Reset characteristic: reset to zero

FEPI: Target Statistics

These statistics give information about a particular target in a pool. The statistics are available online, and are mapped by the DFHA24DS DSECT.

DFHSTUP name	Field name	Description
Target Name	A24TARG	is the FEPI target name.
		Reset characteristic: not reset
Pool Name	A24POOL	is the FEPI pool name.
		Reset characteristic: not reset
Applid	A24APPL	is the VTAM applid of the target.
		Reset characteristic: not reset
Nodes	A24NDCT	is the number of nodes connected to this target.
		Reset characteristic: not reset
Allocates	A24ALLOC	is the number of conversations **specifically** allocated to this target in this pool.
		Reset characteristic: reset to zero
Allocate Waits		
–Total	A24TOTWT	is the number of conversations that had to wait to be allocated to this target in this pool.
		Reset characteristic: reset to zero
–Wait	A24WAIT	is the number of current conversations waiting to be allocated to this target in this pool
		Reset characteristic: reset to zero
–Peak	A24PKWT	is the peak number of conversations that had to wait to be allocated to this target in this pool.
		Reset characteristic: reset to current value (A24WAIT)
Allocate Timeouts	A24TIOUT	is the number of conversation allocates to this target in this pool that timed out.
		Reset characteristic: reset to zero

FEPI: Unsolicited pool statistics

Unsolicited pool statistics are produced when a pool is discarded. The statistics are mapped by the DFHA22DS DSECT. They contain the same information as the interval statistics.

FEPI: Unsolicited connection statistics

Unsolicited connection statistics are produced when a connection is destroyed. This occurs when a DELETE POOL, DISCARD NODELIST, DISCARD POOL or DISCARD TARGETLIST command is used. The statistics are mapped by the DFHA23DS DSECT. They contain the same information as the interval statistics.

FEPI: Unsolicited target statistics

Unsolicited target statistics are produced when a target is destroyed or removed from a pool. This occurs when a DELETE POOL, DISCARD POOL or DISCARD TARGETLIST command is used. The statistics are mapped by the DFHA24DS DSECT. They contain the same information as the interval statistics.

FEPI: Pool summary statistics

Summary statistics are not available online.

DFHSTUP name	Description
Pool Name	is the FEPI pool name.
Targets	is the number of targets in the pool.
Nodes	is the number of nodes in the pool.
Available Connections	
–Current	is the number of connections in the pool.
–Peak	is the highest peak number of connections in the pool.
Allocates	
–Totals	is the total number of conversations allocated from this pool.
–Peak	is the highest peak number of concurrent conversations allocated from this pool.
Allocate Waits	
–Total	is the total number of conversations that had to wait to be allocated.
–Peak	is the highest peak number of conversations that had to wait to be allocated.
Allocate Timeouts	is the total number of conversation allocates that timed out.

FEPI: Connection summary statistics

Summary statistics are not available online.

DFHSTUP name	Description
Pool Name	is the FEPI pool name.
Target Name	is the FEPI target name.
Node Name	is the FEPI node.
Acquires	is the total number of times the connection was acquired.
Conversations	is the total number of conversations that have used this connection.
Unsolicited Inputs	is the total number of times unsolicited input was received on this connection.
Characters	
–Sent	is the total number of characters of data sent on this connection.
–Received	is the total number of characters of data received on this connection.
Receive Timeouts	is the total number of times a FEPI RECEIVE timed-out on this connection.
Error Conditions	is the total number of VTAM error conditions raised for this connection.

FEPI: Target summary statistics

Summary statistics are not available online.

DFHSTUP name	Description
Target Name	is the FEPI target name.
Pool Name	is the FEPI pool name.
Applid	is the VTAM applid of the target.
Nodes	is the number of nodes in the pool.
Allocates	is the total number of conversations **specifically** allocated to this target in this pool.
Allocate Waits	

DFHSTUP name	Description
–Total	is the total number of conversations that had to wait to be allocated to this target in this pool.
–Peak	is the highest peak number of conversations that had to wait to be allocated to this target in this pool.
Allocate Timeouts	is the total number of conversations allocated to this target in this pool that timed out.

File statistics

There are four sections in the DFHSTUP report for file statistics:

- Files: Resource Information ("Files: Resource information statistics").
- Files: Requests Information ("Files: Requests information statistics" on page 244).
- Files: Data table requests information ("Files: Data table requests information statistics" on page 246).
- Files: Performance information ("Files: Performance information statistics" on page 248).

Unsolicited file statistics are printed in a statistics report separate from other types of CICS statistics.

These statistics can be accessed online using the EXEC CICS COLLECT STATISTICS command and are mapped by the DFHA17DS DSECT. For programming information about the EXEC CICS COLLECT STATISTICS command, see the *CICS System Programming Reference*.

Files: Resource information statistics

DFHSTUP name	Field name	Description
File Name	A17FNAM	is the name you specified in: • The RDO DEFINE FILE command of resource definition online • The EXEC CICS CREATE command • The TYPE=FILE,FILE= operand of the DFHFCT macro. Reset characteristic: not reset

DFHSTUP name	Field name	Description
Dataset Name	A17DSNAM	is the 44-character name defining the physical data set to the system. You may have specified this in: • The DSNAME operand specified in the DEFINE FILE command of resource definition online • The operand specified in the DLBL file-id operand of the CICS JCL • By dynamic allocation of a data set to a file through the use of CEMT SET FILE DSNAME or EXEC CICS SET FILE DSNAME commands. If no data set is currently allocated to the file, this field is blank. If the file is remote, no data set name is printed but the word "**remote**" is substituted for the data set name. Reset characteristic: not reset
Base Dataset Name (If Applicable)	A17BDSNM	In the instance that the file is a VSAM PATH, this field gives the base data set name. Reset characteristic: not reset.
Dataset Type	A17DSTYP	is the data set type. • B = DAM • E = VSAM ESDS • K = VSAM KSDS • R = VSAM RRDS • P = VSAM PATH Reset characteristic: not reset.
DT Indicator	A17DT	is a one-byte field that contains the value "R", or "S" or "T", or "X", if data table statistics fields are present in the record. "R" indicates that this is a remote file for which table read and source read statistics are present. "S" indicates that the resource was not opened as a table but was able to access data from a table associated with the same data set. "T" indicates that the resource is a data table. "X" indicates that the resource has been opened with a source data set which has an associated CICS maintained data table. Reset characteristic: not reset
Time Opened	A17LOPNT	is the time at which this file was opened. If this field is not set, A17LOPNT contains the hexadecimal value X'00000000 00000000', shown in the report as "CLOSED". If the field is set, it contains a time expressed as a store clock (STCK) value in local time. This field contains a valid time if: • The file was open at the time the statistics were taken. • This is an unsolicited statistics request due to the file being closed. Reset characteristic: not reset

DFHSTUP name	Field name	Description
Time Closed	A17LCLST	is the time at which this file was closed. If this field is not set, A17LCLST contains the hexadecimal value X'00000000 00000000', shown in the report as “OPEN”. If the field is set, it contains a time expressed as a store clock (STCK) value in local time. Reset characteristic: not reset
Remote Name	A17RNAME	The name by which this file is known in the system or region in which it is resident. Reset characteristic: not reset.
Remote Sysid	A17RSYS	When operating in an ISC or MRO environment, and the file is held by a remote system, this field specifies the system upon which the file is resident. Reset characteristic: not reset.
Lsrpool ID	A17POOL	The identity of the local shared resource pool. This value is that specified by: • The LSRPOOLID operand of the resource definition online RDO DEFINE FILE command. • The LSRPOOLID keyword on an EXEC CICS CREATE FILE command. • The TYPE=FILE, LSRPOOL= operand of the DFHFCT macro. 'N' means that it is not defined in an LSR pool. Reset characteristic: not reset.
NOT IN THE DFHSTUP REPORT	A17FLOC	states whether the file is defined as being local to this CICS system, or resides on a remote CICS system. The field is one byte long, and is set to “R” if remote. Reset characteristic: not reset

Note: When the source data set of a user-maintained table is closed, the “time opened” is reset to the time at which the source was closed.

Files: Summary resource information statistics

Summary statistics are not available online.

DFHSTUP name	Description
File Name	is the name you specified in: • The RDO DEFINE FILE command of resource definition online • The EXEC CICS CREATE FILE command • The TYPE=FILE,FILE= operand of the DFHFCT macro.
Dataset Name	is the 44-character name defining the physical data set to the system.
Base Dataset Name (If applicable)	In the instance that the file is a VSAM PATH, this field gives the base data set name.
Dataset Type	is the data set type. • B = DAM • E = VSAM ESDS • K = VSAM KSDS • R = VSAM RRDS • P = VSAM PATH

DFHSTUP name	Description
DT Indicator	is a one-byte field that contains the value “R”, or “S” or “T”, or “X”, if data table statistics fields are present in the record. “R” indicates that this is a remote file for which table read and source read statistics are present. “S” indicates that the resource was not opened as a table but was able to access data from a table associated with the same data set. “T” indicates that the resource is a data table. “X” indicates that the resource has been opened with a source data set which has an associated CICS maintained data table.
Remote Name	The name by which this file is known in the system or region in which it is resident.
Remote Sysid	When operating in an ISC or MRO environment, and the file is held by a remote system, this field specifies the system upon which the file is resident.
Lsrpool ID	The identity of the local shared resource pool. This value is that specified via: • The LSRPOOLID operand of the resource definition online RDO DEFINE FILE command. • The LSRPOOLID keyword on an EXEC CICS CREATE FILE command. • The TYPE=FILE, LSRPOOL operand of the DFHFCT macro. 'N' means that it is not defined in an LSR pool.

Files: Requests information statistics

The following eight items are service request statistics. They do not tell you directly how many I/O accesses are being carried out for each transaction (a single-transaction measurement is required for this). Nevertheless, by regularly totaling the service requests against individual data sets, they can enable you to anticipate data set problems when I/O activity increases.

They list the number of service requests processed against the data set. These are dependent on the type of requests that are allowed on the data set.

DFHSTUP name	Field name	Description
File Name	A17FNAM	is the name you specified in: • The RDO DEFINE FILE command of resource definition online • The EXEC CICS CREATE FILE command • The TYPE=FILE, FILE operand of the DFHFCT macro. Reset characteristic: not reset
Get Requests	A17DSRD	is the number of GET requests attempted against this file. Reset characteristic: reset to zero
Get Upd Requests	A17DSGU	is the number of GET UPDATE requests attempted against this file. Reset characteristic: reset to zero
Browse Requests	A17DSBR	is the number of GETNEXT and GETPREV requests attempted against this file. Reset characteristic: reset to zero
Update Requests	A17DSWRU	is the number of PUT UPDATE requests attempted against this file. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Add Requests	A17DSWRA	is the number of PUT requests attempted against this file.
		Reset characteristic: reset to zero
Delete requests		A17DSDEL or A17RMDEL is printed here
	A17DSDEL	is the number of DELETE requests attempted against this local file, or
		Reset characteristic: reset to zero
	A17RMDEL	is the number of DELETE requests for a VSAM file in a remote system. In systems connected by a CICS intercommunication (MRO or ISC) link, the statistics recorded for the remote files are a subset of those recorded for the files on the local system.
		Reset characteristic: reset to zero
VSAM EXCP Requests		
–Data	A17DSXCP	A value is printed if the FCT entry has been opened and used as a VSAM KSDS during the CICS run, even if the FCT entry is not being used as a KSDS at the time of taking statistics. See notes 1 and 2.
–Index	A17DSIXP	See notes 1 and 2.
		Reset characteristic: reset to zero

Notes: The "VSAM EXCP requests" fields indicate the number of I/O operations on the file for data and index records respectively. Also, note the following points:

1. The values printed for both items relate to the FCT entry. If dynamic allocation has been used to change the physical data sets associated with an FCT entry, the value shown is an accumulation for all the data sets.
2. Take care when using these values for files participating in data set name sharing, because VSAM maintains only one count of EXCPs for all access method control blocks (ACBs) thus connected. In this situation, the value reported against each file represents the total accesses for all sharing ACBs during the period for which the file was open. (Therefore, if all files in the data set name sharing group were open for the same period, each file would have the same EXCP values reported against it, which would be the total for all the files in the group.)

Files: Summary requests information statistics

Summary statistics are not available online.

DFHSTUP name	Description
File Name	is the name you specified in: • The RDO DEFINE FILE command of resource definition online • The EXEC CICS CREATE FILE command • The TYPE=FILE, FILE operand of the DFHFCT macro.
Get Requests	is the total number of GET requests issued against this file.
Get Upd Requests	is the total number of GET UPDATE requests issued against this file.
Browse Requests	is the total number of GETNEXT and GETPREV requests issued against this file.
Update Requests	is the total number of PUT UPDATE requests issued against this file.
Add Requests	is the total number of PUT requests issued against this file.
Delete Requests	is the total number of DELETE requests issued against this file.
VSAM EXCP Request	
–Data	A value is printed if the FCT entry has been opened and used as a VSAM KSDS during the CICS run. See notes 1 and 2.

DFHSTUP name	Description
–Index	See notes 1 and 2.

Notes: The previous two fields indicate the number of I/O operations on the file for data and index records respectively. Also, note the following points:

1. The values printed for both items relate to the FCT entry. If dynamic allocation has been used to change the physical data sets associated with an FCT entry, the value shown is an accumulation for all the data sets.
2. Take care when using these values for files participating in data set name sharing, because VSAM maintains only one count of EXCPs for all ACBs connected in the same way. In this situation, the value reported against each file represents the total accesses for all sharing ACBs during the period for which the file was open. (Therefore, if all files in the data set name sharing group were open for the same period, each file would have the same EXCP values reported against it, which would be the total for all the files in the group.)

Files: Data table requests information statistics

If the file is a data table, further fields are present in the statistics record. The presence of these additional fields is indicated by the value “R”, or “S”, or “T”, or “X” in the field A17DT. Their names and meanings are as follows:

DFHSTUP name	Field name	Description
File Name	A17FNAM	is the name you specified in: • The RDO DEFINE FILE command of resource definition online • The EXEC CICS CREATE FILE command • The TYPE=FILE, FILE operand of the DFHFCT macro. Reset characteristic: not reset
Close Type	A17DTTYP	This one-byte field is set to: “C” when a CICS maintained table is closed. “P” when a file which has been accessing a CICS-maintained table is closed but the table remains open because there are other files still open which are using the table, “S” when the source data set for a user table is being closed, “U” when a user maintained table is closed. Reset characteristic: not reset
Read Requests	A17DTRDS	is the number of attempts to retrieve records from the table. Reset characteristic: reset to zero
Recs¬in Table	A17DTRNF	is the number of records placed in the table by the loading process or as a result of API READ requests issued while loading was in progress. Reset characteristic: reset to zero
Adds from Reads	A17DTAVR	is the number of records placed in the table by the loading process or as a result of API READ requests issued while loading was in progress. Reset characteristic: reset to zero
Add Requests	A17DTADS	is the number of attempts to add records to the table as a result of WRITE requests. Reset characteristic: reset to zero
Adds rejected – Exit	A17DTARJ	is the number of records CICS attempted to add to the table which were rejected by the global user exit. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Adds rejected – Table Full	A17DTATF	is the number of records CICS attempted to add to the table but was unable to do so because the table already contained the maximum number of records specified.
		Reset characteristic: reset to zero
Rewrite Requests	A17DTRWS	is the number of attempts to update records in the table as a result of REWRITE requests.
		Reset characteristic: reset to zero
Delete Requests	A17DTDLS	is the number of attempts to delete records from the table as a result of DELETE requests.
		Reset characteristic: reset to zero
Highest Table Size	A17DTSHI	is the peak number of records present in the table.
		Reset characteristic: reset at close
Storage Alloc(K)	A17DTALT	is the total amount of storage allocated to the data table. The DFHSTUP report expresses the storage in kilobytes. DFHSTUP does not total the storage allocated for all data tables because multiple files may share the same data table.
		Reset characteristic: not reset

Note: The request information statistics output for a data table represents the activity of the source data set, and the data table request information represents the activity of the data table. Therefore, for a CICS-maintained table, you would expect to find similar counts in both sections of the statistics output for requests which modify the table, because both the source data set and the table must be updated. For a user-maintained table, there should be no updating activity shown in the data table resource information.

DFHSTUP name	Field name	Description
When using the shared data tables feature the statistics records will contain the additional information as follows:		
NOT IN THE DFHSTUP REPORT	A17DTSIZ	is the current number of records in the data table.
		Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	A17DTUST	is the total amount of storage (kilobytes) in use for the data table.
		Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	A17DTALE	is the total amount of storage (kilobytes) allocated for the record entry blocks.
		Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	A17DTUSE	is the total amount of storage (kilobytes) in use for the record entry blocks.
		Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	A17DTALI	is the total amount of storage (kilobytes) allocated for the index.
		Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	A17DTUSI	is the total amount of storage (kilobytes) in use for the index.
		Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	A17DTALD	is the total amount of storage (kilobytes) allocated for the record data.
		Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	A17DTUSD	is the total amount of storage (kilobytes) in use for the record data.
		Reset characteristic: not reset

DFHSTUP name	Field name	Description
NOT IN THE DFHSTUP REPORT	A17DTRRS	is the total number of read retries, that is the number of times reads in an AOR had to be retried because the FOR changed the table during the read. A17DTRRS is **not** a count of accesses which failed because a file owning region (FOR) was updating the specific record that the AOR wished to read. In such cases, the request is function shipped and is counted in the "source reads." Reset characteristic: not reset

Note: Data table fields are present in the statistics records but contain zeros if shared data tables are not installed or the resource is not a data table.

Files: Summary data table requests statistics

Summary statistics are not available online.

DFHSTUP name	Description
File Name	is the name you specified in: • The RDO DEFINE FILE command of resource definition online • The EXEC CICS CREATE FILE command • The TYPE=FILE, FILE operand of the DFHFCT macro.
Table Type	This one-byte field is set to: "C" when a CICS maintained table is closed. "P" when a file which has been accessing a CICS maintained table is closed but the table remains open because there are other files still open which are using the table, "S" when the source data set for a user table is being closed, "U" when a user maintained table is closed.
Successful Reads	is the total number of reads from the data table.
Recs - in Table	is the total number of records in the data table.
Adds from Reads	is the total number of records placed in the table by the loading process or as a result of API READ requests issued while loading was in progress.
Add Requests	is the total number of attempts to add records to the table as a result of WRITE requests.
Adds Rejected	
–Exit	is the total number of records CICS attempted to add to the table which were rejected by the global user exit.
–Table Full	is the total number of records CICS attempted to add to the table but was unable to do so because the table already contained the maximum number of records specified.
Rewrite Requests	is the total number of attempts to update records in the table as a result of REWRITE requests.
Delete Requests	is the total number of attempts to delete records from the table as a result of DELETE requests.
Highest Table Size	is the peak number of records present in the table.

Files: Performance information statistics

These statistics are available online, and are mapped by the DFHA17DS DSECT.

DFHSTUP name	Field name	Description
File Name	A17FNAM	is the name you specified in: • The RDO DEFINE FILE command of resource definition online • The EXEC CICS CREATE FILE command • The TYPE=FILE, FILE operand of the DFHFCT macro. Reset characteristic: not reset
Strings	A17STRNO	The maximum permissible number of concurrent updates. Reset characteristic: not reset.
Active Strings	A17DSASC	The current number of updates against the file. Reset characteristic: not reset.
Wait On Strings		
–Current	A17DSCWC	The current number of 'waits' for strings against the file. Reset characteristic: not reset
–Total	A17DSTSW	The total number of 'waits' for strings against the file. Reset characteristic: reset to zero
–Highest	A17DSHSW	The highest number of 'waits' for strings against the file. Reset characteristic: reset to current value
Buffers		
–Data	A17DSDNB	The number of buffers to be used for data. Reset characteristic: not reset.
–Index	A17DSINB	The number of buffers to be used for index. Reset characteristic: not reset.

Files: Summary performance information statistics

Summary statistics are not available online.

DFHSTUP name	Description
File Name	is the name you specified in: • The RDO DEFINE FILE command of resource definition online • The EXEC CICS CREATE FILE command • The TYPE=FILE, FILE operand of the DFHFCT macro.
Strings	The maximum permissible number of concurrent updates.
Wait On Strings	
–Total	The total number of ‘waits’ for strings against the file.
–HWM	The highest number of 'waits' for strings against the file.
Buffers	
–Data	The number of buffers to be used for data.
–Index	The number of buffers to be used for index.

ISC/IRC system and mode entries

The ISC/IRC system and mode entry statistics area of the DFHSTUP listing is for a CICS system using intersystem communication. This provides summary statistics for the CICS intercommunication facility.

System entry

ISC/IRC system entry: Resource statistics

The system entry statistics record both ISC and IRC statistics. Some entries are unique to one or the other, and show zero activity if that function is not used. Statistics are provided for each system entry in the terminal definition.

These statistics are available online, and are mapped by the DFHA14DS DSECT. This DSECT is to be used:

- For processing data returned for an online enquiry for a connection (EXEC CICS COLLECT STATISTICS)
- For processing connection statistics offline (DMF)
- For processing the connection totals (the summation of all defined connections in this CICS region).

CICS always allocates a SEND session when sending an IRC request to another region. Either a SEND or RECEIVE session can be allocated when sending requests using LU6.1 ISC, and either a contention loser or a contention winner session can be allocated when sending requests using APPC.

In LU6.1, SEND sessions are identified as secondaries, and RECEIVE sessions are identified as primaries.

DFHSTUP name	Field name	Description
Connection name	A14CNTN	corresponds to each system entry defined by a CONNECTION definition in the CSD. Reset characteristic: not reset
Aids in chain	A14EALL	is the current number of automatic initiate descriptors (AIDs) in the AID chain. Reset characteristic: not reset
Generic aids in chain	A14ESALL	is the current number of automatic initiate descriptors (AIDs) that are waiting for a session to become available to satisfy an allocate request. Reset characteristic: not reset
ATIs satisfied by contention losers	A14ES1	is the number of ATI requests (queued allocates) that have been satisfied by contention loser sessions (primaries for LU6.1). This is always zero for IRC system entries. For APPC, this field is zero when written to DMF, but if accessed online using the EXEC CICS COLLECT STATISTICS command, this field is the summation of the equivalent mode entry statistics. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
ATIs satisfied by contention winners	A14ES2	is the number of ATI requests (queued allocates) that have been satisfied by contention winner sessions (secondaries for LU6.1). This field is the total ATIs when the system entry is for IRC. For APPC, this field is zero when written to DMF, but if accessed online using the EXEC CICS COLLECT STATISTICS command, this field is the summation of the equivalent mode entry statistics. Reset characteristic: reset to zero
Peak contention losers	A14E1HWM	is the peak number of contention loser sessions (primaries for LU6.1) that were in use at any one time. For APPC, this field is zero. Reset characteristic: reset to current value
Peak contention winners	A14E2HWM	is the peak number of contention winner sessions (secondaries for LU6.1) that were in use at any one time. For APPC, this field is zero. Reset characteristic: reset to current value
Note for the following five fields: For APPC only, if an allocate request does not specify a mode group, CICS takes the first mode group within the sessions available, and the statistics for these allocates are reported against the system entry. If an allocate specifically requests a mode entry, the statistics for these allocates go into that mode entry.		
Peak outstanding allocates	A14ESTAM	is the peak number of allocate requests that were queued for this system. For APPC this field is incremented only for generic allocate requests. Reset characteristic: reset to current value
Total number of allocates	A14ESTAS	is the number of allocate requests against this system. For APPC: • This field is incremented only for generic allocate requests • If accessed online using the EXEC CICS COLLECT STATISTICS command, this field also contains the summation of the equivalent mode entry statistics. Reset characteristic: reset to zero
Queued allocates	A14ESTAQ	is the current number of queued allocate requests against this system. An allocate is queued due to a session not being available at this moment. This includes waiting for a bind, a bid, or all sessions are currently in use. For APPC: • This field is incremented only for generic allocate requests • If accessed online using the EXEC CICS COLLECT STATISTICS command, this field also contains the summation of the equivalent mode entry statistics. Reset characteristic: not reset

DFHSTUP name	Field name	Description
Failed link allocates	A14ESTAF	is the number of allocate requests that failed due to the connection being released, out of service, or with a closed mode group. For APPC: • This field is incremented only for generic allocate requests • If accessed online using the EXEC CICS COLLECT STATISTICS command, this field also contains the summation of the equivalent mode entry statistics. Reset characteristic: reset to zero
Failed allocates due to sessions in use	A14ESTAO	is the number of allocate requests that failed due to a session not being currently available for use. These requests get SYSBUSY responses to the allocate. This field is incremented for allocates failing with an AAL1 abend code. For APPC only: • This field is only incremented for generic allocate requests • If accessed online using the EXEC CICS COLLECT STATISTICS command, this field also contains the summation of the equivalent mode entry statistics. Reset characteristic: reset to zero
Maximum queue time (seconds)	A14EMXQT	is the MAXQTIME specified on the CONNECTION definition. This value represents the maximum time you require to process an allocate queue on this connection. If the allocate queue would take greater than this time to process then the entire queue would be purged. This value only takes effect if the QUEUELIMIT value (A14EALIM) has been reached. Reset characteristic: not reset
Allocate queue limit	A14EALIM	is the QUEUELIMIT parameter specified on the CONNECTION definition. If this value is reached then allocates are rejected. Reset characteristic: not reset
Number of QUEUELIMIT allocates rejected	A14EALRJ	the total number of allocates rejected due to the QUEUELIMIT value (A14EALIM) being reached. Reset characteristic: reset to zero
Number of MAXQTIME allocate queue purges	A14EQPCT	is the total number of times an allocate queue has been purged due to the MAXQTIME value (A14EMXQT). A queue is purged when the total time it would take to process a queue exceeds the MAXQTIME value. Reset characteristic: reset to zero
Number of MAXQTIME allocates purged	A14EMQPC	is the total number of allocates purged due to the queue processing time exceeding the MAXQTIME value (A14EMXQT). If sessions have not been freed after this mechanism has been invoked then any subsequent allocate requests are purged and included in this statistic as the MAXQTIME purging mechanism is still in operation. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Number of XZIQUE allocates rejected	A14EZQRJ	is the total number of allocates rejected by the XZIQUE exit. Reset characteristic: reset to zero
Number of XZIQUE allocate queue purges	A14EZQPU	is the total number of allocate queue purges that have occurred at XZIQUE request for this connection. If accessed online using the EXEC CICS COLLECT STATISTICS command, this field additionally contains the summation of the equivalent mode entry statistics. Reset characteristic: reset to zero
Number of XZIQUE allocates purged	A14EZQPC	is the total number of allocates purged due to XZIQUE requesting that queues should be purged (A14EZQPU) for this connection. If XZIQUE has not overridden this mechanism (by response) then any subsequent allocate requests are purged and included in this statistic as the XZIQUE purging mechanism is still in operation. If accessed online using the EXEC CICS COLLECT STATISTICS command, this field additionally contains the summation of the equivalent mode entry statistics. Reset characteristic: reset to zero
Total bids sent	A14ESBID	is the total number of bids that were sent. A bid is sent on an LU6.1 RECEIVE session only. This field is always zero for IRC entries. For APPC, this field is zero when written to DMF, but if accessed online using the EXEC CICS COLLECT STATISTICS command, this field is the summation of the equivalent mode entry statistics. Reset characteristic: reset to zero
Current bids in progress	A14EBID	is the number of bids currently in progress. A bid is sent on an LU6.1 RECEIVE session only. This field is always zero for IRC system entries. For APPC, this field is zero when written to DMF, but if accessed online using the EXEC CICS COLLECT STATISTICS command, this field is the summation of the equivalent mode entry statistics. Reset characteristic: not reset
Peak bids in progress	A14EBHWM	is the peak number of bids that were in progress at any one time. A bid is sent on an LU6.1 RECEIVE session only. Reset characteristic: reset to current value
File control function shipping requests	A14ESTFC	is the number of file control requests for function shipping. Reset characteristic: reset to zero
Interval control function shipping requests	A14ESTIC	is the number of interval control requests for function shipping. Reset characteristic: reset to zero
TD function shipping requests	A14ESTTD	is the number of transient data requests for function shipping. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
TS function shipping requests	A14ESTTS	is the number of temporary storage requests for function shipping. Reset characteristic: reset to zero
DL/I function shipping requests	A14ESTDL	is the number of DL/I requests for function shipping. Reset characteristic: reset to zero
Terminal sharing requests	A14ESTTC	is the number of transaction routing commands. This number is incremented on both regions when the transaction is routed, and when the terminal I/O request is routed between regions. This field is not supported for LU6.1. Reset characteristic: reset to zero

ISC/IRC system entry: Summary resource statistics

Summary statistics are not available online.

DFHSTUP name	Description
Average number of AIDs in chain	is the average number of automatic initiate descriptors (AIDs) in the AID chain.
Average number of generic AIDs in chain	is the average number of AIDs waiting for a session to become available to satisfy an allocate request.
ATIs satisfied by contention losers	is the total number of ATI requests (queued allocates) that have been satisfied by contention loser sessions (primaries for LU6.1). This is always zero for IRC system entries.
ATIs satisfied by contention winners	is the total number of ATI requests (queued allocates) that have been satisfied by contention winner sessions (secondaries for LU6.1). This field is the total ATIs when the system entry is for IRC.
Peak contention losers	is the peak number of contention loser sessions (primaries for LU6.1). that were in use at any one time. For APPC, this field is zero.
Peak contention winners	is the peak number of contention winner sessions (secondaries for LU6.1) that were in use at any one time. For APPC, this field is zero.

Note for the following five fields: For APPC only, if an allocate request does not specify a mode group, CICS takes the first mode group within the sessions available, and the statistics for these allocates are reported against the system entry. If an allocate specifically requests a mode entry, the statistics for these allocates go into that mode entry.

Peak outstanding allocates	is the peak number of allocation requests that were queued for this system. For APPC this field contains only generic allocate requests.
Total number of allocates	is the total number of allocate requests against this system. For APPC this field contains only generic allocate requests.
Average number of queued allocates	is the average number of queued allocate requests against this system. For APPC this field is incremented only for generic allocate requests.
Failed link allocates	is the total number of allocate requests that failed due to the connection being released, out of service, or with a closed mode group. For APPC this field is incremented only for generic allocate requests.
Failed allocates due to sessions in use	is the total number of allocate requests that failed due to a session not being currently available for use. These requests get SYSBUSY responses to the allocate. This field is incremented for allocates failing with an AAL1 abend code. For APPC this field is incremented only for generic allocate requests.
Maximum queue time (seconds)	is the last non-zero value encountered for the MAXQTIME specified on the CONNECTION definition. This value represents the maximum time you require to process an allocate queue on this connection. If the allocate queue requires more than this time to process the entire queue would be purged. This value only takes effect if the QUEUELIMIT value has been reached.

DFHSTUP name	Description
Allocate queue limit	is the last non-zero value encountered for the QUEUELIMIT parameter specified on the CONNECTION definition. If this value is reached then allocates are rejected.
Number of QUEUELIMIT allocates rejected	is the is the total number of allocates rejected due to the QUEUELIMIT value being reached.
Number of MAXQTIME allocate queue purges	is the total number of times an allocate queue has been purged due to the MAXQTIME value. A queue is purged when the total time it would take to process a queue exceeds the MAXQTIME value.
Number of MAXQTIME allocates purged	is the total number of allocates purged due to the queue processing time exceeding the MAXQTIME value. If sessions have not been freed after this mechanism has been invoked then any subsequent allocate requests are purged and included in this statistic as the MAXQTIME purging mechanism is still in operation.
Number of XZIQUE allocates rejected	is the total number of allocates rejected by the XZIQUE exit
Number of XZIQUE allocate queue purges	is the total number of allocate queue purges that have occurred at XZIQUE request for this connection.
Number of XZIQUE allocates purged	is the total number of allocates purged due to XZIQUE requesting that queues should be purged for this connection. If XZIQUE has not overridden this mechanism (by response) then any subsequent allocate requests are purged and included in this statistic as the XZIQUE purging mechanism is still in operation.
Total bids sent	is the total number of bids that were sent. A bid is sent on an LU6.1 RECEIVE session only. This field is always zero for IRC and APPC system entries.
Average bids in progress	is the average number of bids in progress. A bid is sent on an LU6.1 RECEIVE session only. This field is always zero for IRC and APPC system entries.
Peak bids in progress	is the peak number of bids that were in progress at any one time. A bid is sent on an LU6.1 RECEIVE session only. This field is always zero for IRC and APPC system entries.
File control function shipping requests	is the total number of file control requests for function shipping.
Interval control function shipping requests	is the total number of interval control requests for function shipping.
TD function shipping requests	is the total number of transient data requests for function shipping.
TS function shipping requests	is the total number of temporary storage requests for function shipping.
DL/I function shipping requests	is the total number of DL/I requests for function shipping.
Terminal sharing requests	is the total number of transaction routing commands. This number is incremented on both regions when the transaction is routed, and when the terminal I/O request is routed between regions. This field is not supported for LU6.1.

Mode entry

The ISC/IRC system and mode entry statistics area of the DFHSTUP listing is for a CICS system using intersystem communication. This provides summary statistics for the CICS intercommunication facility.

ISC/IRC mode entry: Resource statistics

These statistics are collected only if you have an APPC connection defined in your CICS region, and they are then produced for each mode group defined in that connection. These statistics cannot be accessed online using the EXEC CICS COLLECT STATISTICS command. They are only produced for offline processing (written to DMF).

These statistics are mapped by the DFHA20DS DSECT. This DSECT is also used to map the mode entry totals records.

DFHSTUP name	Field name	Description
NOT IN THE DFHSTUP REPORT	A20SYSN	is the name of the APPC connection/system that owns this mode entry. It corresponds to the system entry, defined by an RDO CONNECTION resource definition. Reset characteristic: not reset
Mode name	A20MODE	is the mode group name related to the the intersystem connection name above (A20SYSN). This corresponds to modename in the sessions definition. Reset characteristic: not reset
ATIs satisfied by contention losers	A20ES1	is the number of ATI requests (queued allocates) that have been satisfied by “contention loser” sessions belonging to this mode group. Reset characteristic: reset to zero
ATIs satisfied by contention winners	A20ES2	is the number of ATI requests (queued allocates) that have been satisfied by “contention winner” sessions belonging to this mode group. Reset characteristic: reset to zero
Peak contention losers	A20E1HWM	is the peak number of “contention loser” sessions belonging to this mode group that were in use at any one time. There can be sessions not defined (by the MAXIMUM parameter of the RDO SESSIONS resource definition) as “contention winners” or “contention losers”, and their states are dynamically decided at bind time. Reset characteristic: reset to current value
Peak contention winners	A20E2HWM	is the peak number of “contention winner” sessions belonging to this mode group that were in use at any one time. There can be sessions not defined (by the MAXIMUM= parameter of the RDO SESSIONS resource definition) as “contention winners” or “contention losers”, and their states are dynamically decided at bind time. Reset characteristic: reset to current value
The following three fields are incremented when an allocate is issued against a specific mode group. If a generic allocate request is made, the equivalent system entry statistics ***only*** are incremented.		
Peak outstanding allocates	A20ESTAM	is the peak number of allocation requests that were queued for this mode group. Reset characteristic: reset to current value

DFHSTUP name	Field name	Description
Total specific allocate requests	A20ESTAS	is the number of specific allocate requests against this mode group. Reset characteristic: reset to zero
Total specific allocates satisfied	A20ESTAP	is the number of specific allocates satisfied by this mode group. Reset characteristic: reset to zero
Total generic allocates satisfied	A20ESTAG	is the number of generic allocates satisfied from this mode group. The allocates are made for APPC without the mode group being specified. Reset characteristic: reset to zero
The following three fields are incremented when an allocate is issued against a specific mode group. If a generic allocate request is made, the equivalent system entry statistics ***only*** are incremented.		
Queued allocates	A20ESTAQ	is the current number of queued specific allocate requests against this mode group. An allocate is queued due to a session in this mode group not being available at this moment. This includes waiting for a bind, a bid, or all sessions currently in use. Reset characteristic: not reset
Failed link allocates	A20ESTAF	is the number of specific allocate requests that failed due to the connection being released, out of service, or with a closed mode group. Reset characteristic: reset to zero
Failed allocates due to sessions in use	A20ESTAO	is the number of specific allocate requests that failed due to a session not being currently available for use in this mode group. These requests get SYSBUSY responses to the allocate. This field is incremented for allocates failing with an AAL1 abend code. Reset characteristic: reset to zero
Number of XZIQUE allocate queue purges	A20EQPCT	is the total number of allocate queue purges that have occurred at XZIQUE request for this mode entry. Reset characteristic: reset to zero
Number of XZIQUE allocates purged	A20EZQPC	is the total number of allocates purged due to XZIQUE requesting that queues should be purged (A20EQPCT) for this mode entry. If XZIQUE has not overridden this mechanism (by response) then any subsequent allocate requests are purged and included in this statistic as the XZIQUE purging mechanism is still in operation. Reset characteristic: reset to zero
Total bids sent	A20ESBID	is the number of bids that were sent on the sessions defined to this mode group. A bid is sent on an APPC “contention loser” session when there are no “contention winner” sessions available to allocate. Reset characteristic: reset to zero
Current bids in progress	A20EBID	is the number of bids that are in progress on the sessions defined to this mode group. A bid is sent on an APPC “contention loser” session when there are no “contention winner” sessions available to allocate. Reset characteristic: not reset

DFHSTUP name	Field name	Description
Peak bids in progress	A20EBHWM	is the peak number of bids that were in progress at any one time, on the sessions defined to this mode group. A bid is sent on an APPC “contention loser” session when there are no “contention winner” sessions available to allocate. Reset characteristic: reset to current value

ISC/IRC mode entry: Summary resource statistics

Summary statistics are not available online.

These statistics are collected only if you have an APPC connection defined in your CICS region, and they are then produced for each mode group defined in that connection.

DFHSTUP name	Description
Connection name	is the name of the APPC connection/system that owns this mode entry. It corresponds to the system entry in the terminal definition.
Mode name	is the mode group name related to the intersystem connection name above (A20SYSN). It corresponds to the modename in the sessions definition.
ATIs satisfied by contention losers	is the total number of ATI requests (queued allocates) that have been satisfied by “contention loser” sessions belonging to this mode group.
ATIs satisfied by contention winners	is the total number of ATI requests (queued allocates) that have been satisfied by “contention winner” sessions belonging to this mode group.
Peak contention losers	is the peak number of “contention loser” sessions belonging to this mode group that were in use at any one time. There can be sessions not defined (by the MAXIMUM= parameter of the RDO SESSIONS resource definition) as “contention winners” or “contention losers”, and their states are dynamically decided at bind time.
Peak contention winners	is the peak number of “contention winner” sessions belonging to this mode group that were in use at any one time. There can be sessions not defined (by the MAXIMUM= parameter of the RDO SESSIONS resource definition) as “contention winners” or “contention losers”, and their states are dynamically decided at bind time.
The next three fields only contain allocates against specific mode groups. Generic allocate requests are contained in the equivalent system entry statistics.	
Peak outstanding allocates	is the peak number of allocation requests that were queued for this mode group.
Total specific allocate requests	is the total number of specific allocate requests against this mode group.
Total specific allocates satisfied	is the total number of specific allocates satisfied by this mode group.
Total generic allocates satisfied	is the total number of generic allocates satisfied from this mode group.
The next three fields only contain allocates against specific mode groups. Generic allocate requests are contained in the equivalent system entry statistics.	
Average number of queued allocates	is the average number of queued specific allocate requests against this mode group. An allocate is queued due to a session in this mode group not being available at this moment. This includes waiting for a bind, a bid, or all sessions currently in use.
Failed link allocates	is the total number of specific allocate requests that failed due to the connection being either released, or out of service, or with a closed mode group.
Failed allocates due to sessions in use	is the total number of specific allocate requests that failed due to a session not being currently available for use in this mode group. These requests get SYSBUSY responses to the allocate. This field is incremented for allocates failing with an AAL1 abend code.

DFHSTUP name	Description
Number of XZIQUE allocate queue purges	is the total number of allocate queue purges that have occurred at XZIQUE request for this mode entry.
Number of XZIQUE allocates purged	is the total number of allocates purged due to XZIQUE requesting that queues should be purged (A20EQPCT) for this mode entry. If XZIQUE has not overridden this mechanism (by response) then any subsequent allocate requests are purged and included in this statistic as the XZIQUE purging mechanism is still in operation.
Total bids sent	is the total number of bids that were sent on the sessions defined to this mode group. A bid is sent on an APPC “contention loser” session when there are no “contention winner” sessions available to allocate.
Average bids in progress	is the average number of bids in progress.
Peak bids in progress	is the peak number of bids that were in progress at any one time, on the sessions defined to this mode group. A bid is sent on an APPC “contention loser” session when there are no “contention winner” sessions available to allocate.

ISC/IRC attach time entries

The ISC/IRC attach time statistics of the DFHSTUP listing is for a CICS system using intersystem communication or interregion communication. It provides summary statistics for the number of times that the entries on the PV 'signed on from' list are either reused or timed out. Using this data you can adjust the PVDELAY system initialization parameters.

ISC/IRC attach time: Resource statistics

These statistics are collected if you have either an LU6.2 connection or IRC defined in your CICS region, and they are then produced globally, one per system. These statistics cannot be accessed online using the EXEC CICS COLLECT STATISTICS command; they are only produced for offline processing (written to DMF).

These statistics are mapped by the DFHA21DS DSECT.

DFHSTUP name	Field name	Description
Persistent Verification refresh time	A21_SIT_LUIT_TIME	is the time in minutes set by the PVDELAY parameter of the SIT. It specifies how long entries are allowed to remain unused in the PV 'signed on from' list of a remote system. The range is from zero through 10080 minutes (seven days) and the default is 30 minutes. If a value of zero is specified, then entries are deleted immediately after use. Reset characteristic: not reset
ISC Persistent Verification Activity		
Entries reused	A21_LUIT_TOTAL_REUSES	refers to the number of entries in the PV 'signed on from' list of a remote system that were reused without reference to an external security manager (ESM). Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Entries timed out	A21_LUIT_TOTAL_TIMEOUT	refers to the number of entries in the PV 'signed on from' list of a remote system that were timed out. Reset characteristic: reset to zero
Average reuse time between entries	A21_LUIT_AV_REUSE_TIME	refers to the average time that has elapsed between each reuse of an entry in the PV 'signed on from' list of a remote system. Reset characteristic: reset to zero

ISC/IRC attach time: Summary resource statistics

Summary statistics are not available online.

These statistics are collected only if you have either an LU6.2 connection or IRC defined in your CICS region, and they are then produced globally, one per system.

DFHSTUP name	Description
Persistent verification refresh time	is the time in minutes set by the PVDELAY system initialization parameter It specifies how long entries are allowed to remain unused in the PV 'signed on from' list of a remote system. that were timed out.
Entries reused	refers to the number of times that user's entries in the PV 'signed on from' list were reused without referencing the ESM of the remote system.
Entries timed out	refers to the number of user's entries in the PV 'signed on from' list that were timed out after a period of inactivity.
Average reuse time between entries	refers to the average amount of time that has elapsed between each reuse of a user's entry in the PV 'signed on from' list.

Journal statistics

Each journal employs two buffers. CICS uses one buffer for output while receiving records from transactions in the other buffer.

Journal control: Resource statistics

The information in this section is produced for every journal defined in the CICS region.

In addition to the number of records written, the journal control statistics indicates the frequency of the buffer full situation. This means that the receiving buffer has filled before I/O on the alternate buffer has had time to complete. The BUFSIZE operand for the journal should be increased to reduce this problem. These statistics are available online, and are mapped by the DFHA13DS DSECT.

DFHSTUP name	Field name	Description
Journal ID	A13JFID	is the identifier of the journal as specified in the JFILEID operand of DFHJCT. CICS itself use the first journal (JFILEID=01), called the system log. CICS users are allowed to have 98 other journals numbered 2 through 99, and can also write data on the system log. Journal identifiers appear in the same sequence as defined in the JCT. Reset characteristic: not reset

DFHSTUP name	Field name	Description
Journal Type	A13TYPE	is the journal type as defined in the TYPE=ENTRY JTYPE of the DFHJCT macro. JTYPE defines the type of journal being used. It can be one of the following: tapes, disks, or DMF. See the *CICS Resource Definition Guide* for the definition of JTYPE.
		Reset characteristic: not reset
Records Written	A13LRC	is the number of records written to the journal.
		Reset characteristic: reset to zero
Blocks Written	A13PBC	is the number of physical I/Os written to the journal.
		Reset characteristic: reset to zero
Buffer Full	A13BFC	is the number of times the receiving buffer filled before I/O on the alternate buffer has had a chance to complete. Increase the BUFSIZE value.
		Reset characteristic: reset to zero
Ave. O/P Blk size	A13ABS	is an approximate average of the output block size, expressed in bytes.
		Reset characteristic: reset to zero
Tapes Opened	A13VOOC	is the quantity of tapes that were opened for use.
		Reset characteristic: reset to zero
The following three statistics only have any meaning when automatic archiving has been specified in the JCT entry; the values are initialized to zero at CICS startup.		
Waits on Archive	A13WAC	is the number of times CICS has had to wait for this journal because the archive job has not completed at the time it was needed.
		Reset characteristic: reset to zero
Archives Submit.	A13ASUB	is the number of times an archive job has been sent to the POWER queue for this journal.
		Reset characteristic: reset to zero
Data sets Opened	A13JDO	is the number of times an OPEN has been issued for this job.
		Reset characteristic: reset to zero

Journal control: Summary resource statistics

Summary statistics are not available online.

DFHSTUP name	Description
Journal Id	is the identifier of the journal as specified in the JCT JFILEID operand. CICS itself uses the first journal (JFILEID=01), called the system log.
	CICS users are allowed to have 98 other journals numbered 2 through 99, and can also write data on the system log. Journal identifiers appear in the same sequence as defined in the JCT.
Journal Type	indicates which volume the journal has been written to (DISK1 or DISK2, TAPE1 or TAPE2) or whether the journal was written to a DMF data set.
Records written	is the total number of records written to the journal.
Blocks Written	is the total number of physical I/Os written to the journal.
Buffer Full	is the number of times the receiving buffer filled before I/O on the alternate buffer has had a chance to complete. Increase the BUFSIZE value.
Ave. O/P Blk size	is an approximate average of the output block size, expressed in bytes.
Tapes Opened	is the total number of tapes that were opened for use.

DFHSTUP name	Description
The following three statistics only have any meaning when automatic archiving has been specified in the JCT entry; the values are initialized to zero at CICS startup.	
Waits on Archive	is the total number of times CICS has had to wait for this journal because the archive job has not completed at the time it was needed.
Archives Submit.	is the total number of times an archive job has been sent to the POWER queue for this journal.
Data sets Opened	is the total number of times an OPEN has been issued for this job.

Loader statistics

The loader maintains global statistics to assist the user in tuning and accounting.

Loader domain: global statistics

These statistics fields contain the global data collected by the loader.

These statistics can be accessed online using the EXEC CICS COLLECT STATISTICS command and are mapped by the DFHLDGDS DSECT. For programming information about the EXEC CICS COLLECT STATISTICS command, see the *CICS System Programming Reference*.

DFHSTUP name	Field name	Description
Library load requests	LDGLLR	is the number of times the loader has issued a VSE LOAD request to load programs from a sublibrary of the LIBDEF search chain concatenation into CICS managed storage. Modules in the SVA are not included in this figure. Reset characteristic: reset to zero
Total loading time	LDGLLT	is the time taken for the number of library loads as indicated by LDGLLR. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*. However, the DSECT field contains a 4-byte field which expresses the time in 16-microsecond units. Reset characteristic: reset to zero
Average loading time		is the average time taken to load a program. This value is calculated offline by DFHSTUP and hence is not available to online users. DFHSTUP expresses this time as *hours:minutes:seconds.decimals*. Reset characteristic: none
Program uses	LDGPUSES	is the number of uses of any program by the CICS system. Reset characteristic: not reset
Waiting requests	LDGWLR	is the number of loader domain requests that ***are currently*** forced to suspend due to the loader domain performing an operation on that program on behalf of another task. These operations could be: • A NEWCOPY request • Searching the SVA • A physical load in progress. Reset characteristic: not reset

DFHSTUP name	Field name	Description
Requests that waited	LDGWTDLR	is the number of loader domain requests that ***were*** forced to suspend due to the loader domain performing an operation on that program on behalf of another task. These operations could be: • A NEWCOPY request • Searching the SVA • A physical load in progress. This figure is the total number of tasks that have waited, and does not include those that are currently waiting (LDGWLR). Reset characteristic: reset to zero
Peak waiting Loader requests	LDGWLRHW	is the maximum number of tasks suspended at any one time. Reset characteristic: reset to current value (LDGWLR)
Times at peak	LDGHWMT	is the number of times the high watermark level indicated by LDGWLRHW was reached. This, along with the fields LDGWTDLR and LDGWLRHW, is an indication of the level of contention for loader resource. Reset characteristic: reset to 1
Total waiting time	LDGTTW	is the suspended time for the number of tasks indicated by LDGWTDLR. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*. However, the DSECT field contains a 4-byte field which expresses the time in 16-microsecond units. Reset characteristic: reset to zero
CDSA		
Programs removed by compression	LDGDPSCR	is the number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism. Reset characteristic: reset to zero
Total Not In Use queue membership time	LDGDPSCT	is the program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*. However, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Average Not In Use queue membership time		is the average length of time that a program is eligible for removal from storage by the DPSC mechanism. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*. However, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: none
Reclaims from Not In Use queue	LDGRNIU	is the number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC). Reset characteristic: reset to zero
Programs loaded but Not In Use	LDGPNIU	is the number of programs on the Not-In-Use (NIU) queue. Reset characteristic: not reset
Amount of DSA occupied by Not In Use programs	LDGCNIU	is the current amount of CDSA storage which is occupied by Not-In-Use (NIU) programs. Reset characteristic: not reset
ECDSA		
Programs removed by compression	LDGDPSCR	is the number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism. Reset characteristic: reset to zero
Total Not In Use queue membership time	LDGDPSCT	is the program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: reset to zero
Average Not In Use queue membership time		is the average length of time that a program is eligible for removal from storage by the DPSC mechanism. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: none
Reclaims from Not In Use queue	LDGRNIU	is the number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC). Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Programs loaded but Not In Use	LDGPNIU	is the number of programs on the Not-In-Use (NIU) queue. Reset characteristic: not reset
Amount of DSA occupied by Not In Use programs	LDGCNIU	is the current amount of ECDSA storage which is occupied by Not-In-Use (NIU) programs. Reset characteristic: not reset
SDSA		
Programs removed by compression	LDGDPSCR	is the number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism. Reset characteristic: reset to zero
Total Not In Use queue membership time	LDGDPSCT	is the program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: reset to zero
Average Not In Use queue membership time		is the average length of time that a program is eligible for removal from storage by the DPSC mechanism. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: none
Reclaims from Not In Use queue	LDGRNIU	is the number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC). Reset characteristic: reset to zero
Programs loaded but Not In Use	LDGPNIU	is the number of programs on the Not-In-Use (NIU) queue. Reset characteristic: not reset
Amount of DSA occupied by Not In Use programs	LDGCNIU	is the current amount of SDSA storage which is occupied by Not-In-Use (NIU) programs. Reset characteristic: not reset
ESDSA		
Programs removed by compression	LDGDPSCR	is the number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Total Not In Use queue membership time	LDGDPSCT	is the program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: reset to zero
Average Not In Use queue membership time		is the average length of time that a program is eligible for removal from storage by the DPSC mechanism. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: none
Reclaims from Not In Use queue	LDGRNIU	is the number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC). Reset characteristic: reset to zero
Programs loaded but Not In Use	LDGPNIU	is the number of programs on the Not-In-Use (NIU) queue. Reset characteristic: not reset
Amount of DSA occupied by Not In Use programs	LDGCNIU	is the current amount of ESDSA storage which is occupied by Not-In-Use (NIU) programs. Reset characteristic: not reset
RDSA		
Programs removed by compression	LDGDPSCR	is the number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Total Not In Use queue membership time	LDGDPSCT	is the program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: reset to zero
Average Not In Use queue membership time		is the average length of time that a program is eligible for removal from storage by the DPSC mechanism. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: none
Reclaims from Not In Use queue	LDGRNIU	is the number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC). Reset characteristic: reset to zero
Programs loaded but Not In Use	LDGPNIU	is the number of programs on the Not-In-Use (NIU) queue. Reset characteristic: not reset
Amount of DSA occupied by Not In Use programs	LDGCNIU	is the current amount of RDSA storage which is occupied by Not-In-Use (NIU) programs. Reset characteristic: not reset
ERDSA		
Programs removed by compression	LDGDPSCR	is the number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Total Not In Use queue membership time	LDGDPSCT	is the program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: reset to zero
Average Not In Use queue membership time		is the average length of time that a program is eligible for removal from storage by the DPSC mechanism. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: none
Reclaims from Not In Use queue	LDGRNIU	is the number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC). Reset characteristic: reset to zero
Programs loaded but Not In Use	LDGPNIU	is the number of programs on the Not-In-Use (NIU) queue. Reset characteristic: not reset
Amount of DSA occupied by Not In Use programs	LDGCNIU	is the current amount of ERDSA storage which is occupied by Not-In-Use (NIU) programs. Reset characteristic: not reset

Loader domain: Summary global statistics

Summary statistics are not available online.

These statistics fields contain the summary global data for the loader.

DFHSTUP name	Description
Library load requests	is the total number of times the loader has issued a VSE LOAD request to load programs from a sublibrary of the LIBDEF search chain for the CICS job into CICS managed storage. Modules in the SVA are not included in this figure.
Total loading time	is the total time taken for the number of library loads indicated by LDGLLR. The DFHSTUP report expresses this time as *days–hours:minutes:seconds.decimals*.
Average loading time	is the average time to load a program from a sublibrary of the LIBDEF search chain for the CICS job into CICS managed storage. This value is expressed as *minutes:seconds.decimals*.
Program uses	is the total number of uses of any program by the CICS system.

DFHSTUP name	Description
Requests that waited	is the total number of loader domain requests that were forced to suspend due to the loader domain performing an operation on that program on behalf of another task. These operations could be: • A NEWCOPY request • Searching the SVA • A physical load in progress.
Peak waiting Loader requests	is the peak number of tasks suspended at one time.
Times at peak	is the total number of times the peak level indicated by the previous statistic was reached. This, along with the previous 2 values, is an indication of the level of contention for loader resource.
Total waiting time	is the total suspended time for the number of tasks indicated by the "Requests that waited" statistic. The DFHSTUP report expresses this time as *days–hours:minutes:seconds.decimals*.
CDSA	
Programs removed by compression	is the total number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism.
Total Not In Use queue membership time	is the total program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *days–hours:minutes:seconds.decimals*.
Average Not In Use queue membership time	is the average time between a program becoming eligible for removal from storage by the DPSC and the actual time of its removal from storage. This statistic is expressed in *minutes:seconds.decimals*.
Reclaims from Not In Use queue	is the total number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC).
Programs loaded but Not In Use	is the total number of programs on the Not-In-Use (NIU) queue.
ECDSA	
Programs removed by compression	is the total number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism.
Total Not In Use queue membership time	is the total program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *days–hours:minutes:seconds.decimals*.
Average Not In Use queue membership time	is the average time between a program becoming eligible for removal from storage by the DPSC and the actual time of its removal from storage. This statistic is expressed in *minutes:seconds.decimals*.
Reclaims from Not In Use queue	is the total number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC).

DFHSTUP name	Description
Programs loaded but Not In Use	is the total number of programs on the Not-In-Use (NIU) queue.
SDSA	
Programs removed by compression	is the total number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism.
Total Not In Use queue membership time	is the total program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *days–hours:minutes:seconds.decimals*.
Average Not In Use queue membership time	is the average time between a program becoming eligible for removal from storage by the DPSC and the actual time of its removal from storage. This statistic is expressed in *minutes:seconds.decimals*.
Reclaims from Not In Use queue	is the total number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC).
Programs loaded but Not In Use	is the total number of programs on the Not-In-Use (NIU) queue.
ESDSA	
Programs removed by compression	is the total number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism.
Total Not In Use queue membership time	is the total program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *days–hours:minutes:seconds.decimals*.
Average Not In Use queue membership time	is the average time between a program becoming eligible for removal from storage by the DPSC and the actual time of its removal from storage. This statistic is expressed in *minutes:seconds.decimals*.
Reclaims from Not In Use queue	is the total number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC).
Programs loaded but Not In Use	is the total number of programs on the Not-In-Use (NIU) queue.
ESDSA	
Programs removed by compression	is the total number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism.

DFHSTUP name	Description
Total Not In Use queue membership time	is the total program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *days–hours:minutes:seconds.decimals*.
Average Not In Use queue membership time	is the average time between a program becoming eligible for removal from storage by the DPSC and the actual time of its removal from storage. This statistic is expressed in *minutes:seconds.decimals*.
Reclaims from Not In Use queue	is the total number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC).
Programs loaded but Not In Use	is the total number of programs on the Not-In-Use (NIU) queue.
RDSA	
Programs removed by compression	is the total number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism.
Total Not In Use queue membership time	is the total program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *days–hours:minutes:seconds.decimals*.
Average Not In Use queue membership time	is the average time between a program becoming eligible for removal from storage by the DPSC and the actual time of its removal from storage. This statistic is expressed in *minutes:seconds.decimals*.
Reclaims from Not In Use queue	is the total number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC).
Programs loaded but Not In Use	is the total number of programs on the Not-In-Use (NIU) queue.
ERDSA	
Programs removed by compression	is the total number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism.
Total Not In Use queue membership time	is the total program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. The DFHSTUP report expresses this time as *days–hours:minutes:seconds.decimals*.
Average Not In Use queue membership time	is the average time between a program becoming eligible for removal from storage by the DPSC and the actual time of its removal from storage. This statistic is expressed in *minutes:seconds.decimals*.

DFHSTUP name	Description
Reclaims from Not In Use queue	is the total number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC).
Programs loaded but Not In Use	is the total number of programs on the Not-In-Use (NIU) queue.

LSRPOOL statistics

CICS supports the use of up to 15 LSRpools, and produces two sets of statistics for LSRpool activity.

LSRpool: resource statistics for each LSR pool

The following information describes the size and characteristics of the pool, and shows the data collected for the use of strings and buffers.

These statistics are available online, and are mapped by the DFHA08DS DSECT.

DFHSTUP name	Field name	Description
Pool Number	A08SRPID	is the identifying number of the pool. This value may be in the range 1 through 15. Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	A08FLAGS	is a flag set to value X'80' if separate data and index pools are used, or set to value X'00' if data and index buffers share the same pool. Reset characteristic: not reset
Time Created	A08LKCTD	is the time when this LSR pool was created. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals* in local time. Reset characteristic: not reset
Time Deleted	A08LKDTD	is the local time (STCK) when this LSR pool was deleted. This field is printed only if the pool has been deleted (that is, if all the files using the pool have been closed). If no value is set, the DSECT field contains the packed hexadecimal value X'00000000 00000000' This field is only printed for unsolicited statistics when the pool is deleted. The process of deleting an LSR pool results in the output of unsolicited statistics for the pool. Information for the deleted pool is not printed in subsequent statistics output. For this reason, the “time pool deleted” field is normally printed only in this unsolicited statistics output. Reset characteristic: not reset
NOT IN DFHSTUP REPORT	A08GBKCD	is the time when this LSR pool was created. Reset characteristic: not reset

DFHSTUP name	Field name	Description
NOT IN DFHSTUP REPORT	A08GBKDD	is the time when this LSR pool was deleted expressed in GMT. This field is printed only if the pool has been deleted (that is, if all the files using the pool have been closed). If no value is set, the DSECT field contains the packed hexadecimal value X'00000000 00000000' This field is only printed for unsolicited statistics when the pool is deleted. The process of deleting an LSR pool results in the output of unsolicited statistics for the pool. Information for the deleted pool is not printed in subsequent statistics output. For this reason, the "time pool deleted" field is normally printed only in this unsolicited statistics output. Reset characteristic: not reset
Maximum key length	A08BKKYL	is the length of the largest key of a VSAM data set which may use the LSR pool. The value is obtained from one of: • The MAXKEYLENGTH option of the RDO DEFINE or EXEC CICS CREATE LSRPOOL command, if it has been coded • The TYPE=SHRCTL,KEYLEN= operand of the DFHFCT macro. • A CICS calculation at the time the LSR pool is built. Reset characteristic: not reset
Total number of strings	A08BKSTN	is the value obtained from one of: • The STRINGS option of the RDO DEFINE or EXEC CICS CREATE LSRPOOL command, if it has been coded • The TYPE=SHRCTL,STRNO= operand of the DFHFCT macro. • A CICS calculation at the time the LSR pool is built. Reset characteristic: not reset
Peak requests that waited for string	A08BKHSW	is the highest number of requests that were queued at one time because all the strings in the pool were in use. Reset characteristic: reset to current value
Total requests that waited for string	A08BKTSW	is the number of requests that were queued because all the strings in the pool were in use. This number reflects the number of requests that were delayed during CICS execution due to a restriction in LSR pool string resources. Reset characteristic: reset to zero
Peak concurrently active strings	A08BKHAS	is the maximum number of strings that were active during CICS execution. If you have coded a value for the number of strings the pool is to use, this statistic is always less than or equal to the value you have coded. If your coded value for string numbers is consistently lower than this value in the statistics, you could consider reducing it so that your pool of VSAM strings is not bigger than you need. Reset characteristic: reset to current value

DFHSTUP name	Field name	Description

Note that if separate data and index pools are not being used, all the statistics for the totals are obtained from the A08TO*xxx*_DATA variables, the index totals being unused.

LSRpool: data buffer statistics

DFHSTUP name	Field name	Description
NOT IN THE DFHSTUP REPORT	A08BKBSZ	is the size of the buffers that are available to CICS. Buffers may be specified through: • The DATAxxx and INDEXxxx operands of the RDO DEFINE or EXEC CICS CREATE LSRPOOL command. • The TYPE=SHRCTL,BUFFERS= operand of the DFHFCT macro • A CICS calculation at the time the LSRPOOL is built, of the buffers to use. Reset characteristic: not reset
Number	A08TOBFN_DATA	is the number of data buffers used by the pool. Reset characteristic: not reset
Lookasides	A08TOBFF_DATA	is the number of successful lookasides to data buffers for the pool. Reset characteristic: not reset
Reads	A08TOFRD_DATA	is the number of read I/Os to the data buffers for the pool. Reset characteristic: not reset
User writes	A08TOUIW_DATA	is the number of user-initiated buffer WRITEs from data buffers for the pool. Reset characteristic: not reset
Non-user writes	A08TONUW_DATA	is the number of non-user-initiated buffer WRITEs from data buffers for the pool. Reset characteristic: not reset

LSRpool: index buffer statistics

DFHSTUP name	Field name	Description
NOT IN THE DFHSTUP REPORT	A08BKBSZ	is the size of the buffers that are available to CICS. Buffers may be specified through: • The DATAxxx and INDEXxxx operands of the RDO DEFINE or EXEC CICS CREATE LSRPOOL command. • The TYPE= SHRCTL,BUFFERS= operand of the DFHFCT macro • A CICS calculation at the time the LSRPOOL is built, of the buffers to use. Reset characteristic: not reset
Number	A08TOBFN_INDX	is the number of index buffers used by the pool. Reset characteristic: not reset
Lookasides	A08TOBFF_INDX	is the number of successful lookasides to index buffers for the pool. Reset characteristic: not reset
Reads	A08TOFRD_INDX	is the number of read I/Os to the index buffers for the pool. Reset characteristic: not reset
User writes	A08TOUIW_INDX	is the number of user-initiated buffer WRITEs from index buffers for the pool. Reset characteristic: not reset

DFHSTUP name	Field name	Description
Non-user writes	A08TONUW_INDX	is the number of non-user-initiated buffer WRITEs from index buffers for the pool. Reset characteristic: not reset

LSRpool: Buffer statistics

DFHSTUP name	Field name	Description
Buffer Size	A08BKBSZ	is the size of the buffers that are available to CICS. Buffers may be specified through: • The DATAxxx and INDEXxxx operands of the RDO DEFINE or EXEC CICS CREATE LSRPOOL command. • The TYPE= SHRCTL,BUFFERS= operand of the DFHFCT macro • A CICS calculation at the time the LSRPOOL is built buffers to use. Reset characteristic: not reset
Number	A08BKBFN	lists the number of buffers of each size available to CICS: Reset characteristic: not reset
Lookasides	A08BKBFF	is the number of read requests that VSAM was able to satisfy without initiating an I/O operation; that is, the requested record, whether index or data, was already present in one of the buffer resident CIs. This means that no physical I/O had to be done to put the control interval in the buffer. The tuning methodology usually employed involves either increasing the number of buffers of a particular CI size until the ratio of lookasides to READs stops increasing significantly or, conversely, reducing the number of buffers until the ratio of lookasides to READs begins to drop significantly. For most data sets, successful lookaside hits on indexes are more likely. These statistics are obtained from VSAM and represent the activity after the pool was created. Note that these statistics are ***not*** reset by CICS under any circumstances. Reset characteristic: not reset
Reads	A08BKFRD	is the number of I/O operations to the buffers that VSAM was required to initiate to satisfy the CICS application's activity. This figure represents failures to find the control interval in the buffers. These statistics are obtained from VSAM and represent the activity after the pool was created. Note that these statistics are ***not*** reset by CICS under any circumstances. Reset characteristic: not reset
User writes	A08BKUIW	is the number of user-initiated I/O WRITE operations from the buffers that VSAM was required to initiate to satisfy the CICS application's activity. These statistics are obtained from VSAM and represent the activity after the pool was created. Note that these statistics are ***not*** reset by CICS under any circumstances. Reset characteristic: not reset

DFHSTUP name	Field name	Description
Non-user writes	A08BKNUW	is the number of non-user initiated I/O WRITE operations from the buffers that VSAM was forced to initiate due to no buffers being available for reading the contents of a CI. These statistics are obtained from VSAM and represent the activity after the pool was created. Note that these statistics are ***not*** reset by CICS under any circumstances. Reset characteristic: not reset

LSRpool: Summary resource statistics for each LSR pool

Summary statistics are not available online.

DFHSTUP name	Description
Total number of pools built	is the total number of LSRPOOLS that were built during the entire CICS run.
Peak requests that waited for string	is the highest number of requests that were queued at one time because all the strings in the pool were in use.
Total requests that waited for string	is the total number of requests that were queued because all the strings in the pool were in use. This number reflects the number of requests that were delayed during CICS execution due to a restriction in LSR pool string resources.
Peak concurrently active strings	is the peak number of strings that were active during CICS execution. If you have coded a value for the number of strings the pool is to use, this statistic is always less than or equal to the value you have coded. If your coded value for string numbers is consistently lower than this value in the statistics, you could consider reducing it so that your pool of VSAM strings is not bigger than you need.

LSRpool: Summary data buffer statistics

Summary statistics are not available online.

The group of statistics fields below summarizes the usage of each of the eight LSRPOOLS during the entire CICS run.

DFHSTUP name	Description
Pool Number	is the identifying number of the pool. This value may be in the range 1 through 15.
Lookasides	is the total number of successful lookasides to data buffers for the pool.
Reads	is the total number of read I/Os to the data buffers for the pool.
User writes	is the total number of user-initiated buffer WRITEs from data buffers for the pool.
Non-user writes	is the total number of non-user-initiated buffer WRITEs from data buffers for the pool.

LSRpool: summary index buffer statistics

Summary statistics are not available online.

DFHSTUP name	Description
Pool Number	is the identifying number of the pool. This value may be in the range 1 through 15.

DFHSTUP name	Description
Lookasides	is the total number of read requests that VSAM was able to satisfy without initiating an I/O operation; that is, the requested record, whether index or data, was already present in one of the buffer resident CIs. This means that no physical I/O had to be done to put the control interval in the buffer. The tuning methodology usually employed involves either increasing the number of buffers of a particular CI size until the ratio of lookasides to READs stops increasing significantly or, conversely, reducing the number of buffers until the ratio of lookasides to READs begins to drop significantly. For most data sets, successful lookaside hits on indexes are more likely. These statistics are obtained from VSAM and represent the activity after the pool was created. Note that these statistics are ***not*** reset by CICS under any circumstances.
Reads	is the total number of I/O operations to the buffers that VSAM was required to initiate to satisfy the CICS application's activity. This figure represents failures to find the control interval in the buffers. These statistics are obtained from VSAM and represent the activity after the pool was created. Note that these statistics are ***not*** reset by CICS under any circumstances.
User writes	is the total number of user-initiated I/O WRITE operations from the buffers that VSAM was required to initiate to satisfy the CICS application's activity. These statistics are obtained from VSAM and represent the activity after the pool was created. Note that these statistics are ***not*** reset by CICS under any circumstances.
Non-user writes	is the total number of non-user initiated I/O WRITE operations from the buffers that VSAM was forced to initiate due to no buffers being available for reading the contents of a CI. These statistics are obtained from VSAM and represent the activity after the pool was created. Note that these statistics are ***not*** reset by CICS under any circumstances.

The following information describes the buffer usage for each file that was specified to use the LSR pool at the time the statistics were printed. Note that this section is not printed for unsolicited statistics output.

If the allocation of files to the LSR pool is changed during the period that the statistics cover, no history of this is available and only the current list of files sharing the pool are printed in this section. The activity of all files that have used the pool are, however, included in all the preceding sections of these statistics.

LSRpool Files: Resource statistics for each file specified to use the pool

DFHSTUP name	Field name	Description
Pool Number	A09SRPID	is the LSR pool number, in the range 1 through 15, associated with this file. Reset characteristic: not reset
File Name	A09DSID	is the CICS file identifier you specified through resource definition online. Reset characteristic: not reset
Data Buff Size	A09DBN	is the buffer size used for the file's data records. This value is one of the eleven possible VSAM buffer sizes ranging from 512 bytes to 32 KB. The value is zero if the file has not been opened yet. Reset characteristic: not reset

DFHSTUP name	Field name	Description
Index Buff Size	A09IBN	is the buffer size used for the file's index records. This is printed, even if the file has subsequently been dynamically allocated to a VSAM ESDS or RRDS. The values this field may take are the same as for the data buffer size statistic. Reset characteristic: not reset
Total Buff Waits	A09TBW	is the number of requests that had to wait because all buffers of the size used by the data set for data (or index) in the LSR pool were in use. Reset characteristic: reset to zero
Peak Buff Waits	A09HBW	is the peak number of requests that had to wait because all buffers of the size used by the data set for data (or index) in the LSR pool were in use. If the data sets are waiting for buffers you should examine the numbers of buffers defined for the data and index buffer sizes used by the data set. The buffer size used by VSAM depends on the control interval size in the VSAM definition of the data set. If no buffer size exists for the specified control interval size, the next largest buffer size available is used. Reset characteristic: reset to current value

LSRpool files: Summary resource statistics

Summary statistics are not available online.

DFHSTUP name	Description
Pool Number	is the LSR pool number, in the range 1 through 15, associated with this file.
File Name	is the CICS file identifier you specified through resource definition online.
Data Buff Size	is the last non-zero value encountered for the buffer size used for the file's data records. This value is one of the eleven possible VSAM buffer sizes ranging from 512 bytes to 32 KB. The value is zero if the file has not been opened yet. The last non-zero value is produced only if it has been opened.
Index Buff Size	is the last non-zero value encountered for the buffer size used for the file's index records. This is printed, even if the file has subsequently been dynamically allocated to a VSAM ESDS or RRDS. The values this field may take are the same as for the data buffer size statistic.
Total Buff Waits	is the total number of requests that had to wait because all buffers of the size used by the data set for data (or index) in the LSR pool were in use.
Peak Buff Waits	is the peak number of requests that had to wait because all buffers of the size used by the data set for data (or index) in the LSR pool were in use. If the data sets are waiting for buffers you should examine the numbers of buffers defined for the data and index buffer sizes used by the data set. The buffer size used by VSAM depends on the control interval size in the VSAM definition of the data set. If no buffer size exists for the specified control interval size, the next largest buffer size available is used.

Monitoring statistics

Monitoring data is made up of a combination of performance class data, exception class data.

Monitoring domain: Global statistics

These statistics fields are collected from the monitoring domain. They are available online, and are mapped by the DFHMNGDS DSECT.

DFHSTUP name	Field name	Description
Exception records	MNGER	is the number of exception records written to DMF. Reset characteristic: reset to zero
Exception records suppressed	MNGERS	is the number of exception records suppressed by the global user exit (XMNOUT). Reset characteristic: reset to zero
Performance records	MNGPR	is the number of performance records scheduled for output to DMF. Because the monitoring domain buffers performance class records, there is still a possibility that monitoring can be deactivated, thus preventing the output of the performance class records that have been buffered. Reset characteristic: reset to zero
Performance records suppressed	MNGPRS	is the number of performance records suppressed by the global user exit (XMNOUT). Reset characteristic: reset to zero
DMF records	MNGSMFR	is the number of SMF records written to the DMF data set. CICS writes exception class SMF records as soon as the monitor domain is notified of the exception completion, so there is one exception record per SMF record. The performance class, however, has many performance class records per SMF record. The SMF record for the performance class is written when the buffer is full, performance class has been deactivated, or CICS is quiescing. Reset characteristic: reset to zero
DMF errors	MNGSMFE	is the number of non-OK responses from the request to write a record to DMF. This count is incremented when a DMF write fails for any reason, for example, when DMF is inactive. Reset characteristic: reset to zero

Monitoring domain: Summary global statistics

Summary statistics are not available online.

DFHSTUP name	Description
Exception records	is the total number of exception records written to DMF.
Exception records suppressed	is the total number of exception records suppressed by the global user exit (XMNOUT).
Performance records	is the total number of performance records scheduled for output to DMF. Because the monitor domain buffers performance class records, there is still a possibility that monitoring can be deactivated, thus preventing the output of the performance class records that have been buffered.
Performance records suppressed	is the total number of performance records suppressed by the global user exit (XMNOUT).
DMF records	is the total number of SMF records written to the DMF data set. CICS writes exception class SMF records as soon as the monitor domain is notified of the exception completion, so there is one exception record per SMF record. The performance class, however, has many performance class records per SMF record. The SMF record for the performance class is written when the buffer is full, performance class has been deactivated, or CICS is quiescing.
DMF errors	is the total number of non-OK responses from the request to write a record to DMF. This count is incremented when a DMF write fails for any reason, for example, when DMF is inactive.

Program statistics

The program statistics assist the user in tuning and accounting.

Programs: Resource statistics

These statistics fields contain the resource data collected by the loader for each program. They are available online, and are mapped by the DFHLDRDS DSECT.

DFHSTUP name	Field name	Description
Program name	LDRPNAME	is the name of the program. Reset characteristic: not reset
Times used	LDRTU	is the number of times CICS tasks within the system have issued load requests to the loader domain to obtain access to a usable instance of this program. These load requests may cause the loader domain to issue a VSE LOAD. Reset characteristic: reset to zero
Fetch count	LDRFC	is the number of times the loader domain has issued a VSE LOAD request to load a copy of the program from a sublibrary of the LIBDEF search chain for the CICS job into CICS managed storage. Reset characteristic: reset to zero
NOT IN THE DFHSTUP REPORT	LDRFT	is the time taken to perform all fetches. The DSECT field contains a four-byte value that expresses the time in 16-microsecond units. Reset characteristic: reset to zero
Average fetch time	Calculated by DFHSTUP	is the average time taken to perform a fetch of the program. The DFHSTUP report expresses this time as *minutes:seconds.decimals*. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
NEWCOPY count	LDRTN	is the number of times a NEWCOPY has been requested against this program. Reset characteristic: reset to zero
Program size	LDRPSIZE	is the size of the program in bytes, if known (otherwise zero). Reset characteristic: not reset
Times removed	LDRRPC	is the number of times an instance of this program has been removed from CICS managed storage due to the actions of the Dynamic Program Storage Compression (DPSC) mechanism. Reset characteristic: reset to zero
Location	LDRLOCN	is the location of the current storage resident instance of the program, if any. It has one of the following values: **DFHSTUP value:** NONE **DSECT value:** LDRNOCO (X'00') **Meaning:** No current copy **DFHSTUP value:** CDSA **DSECT value:** LDRCDCO (X'01') **Meaning:** Current copy in the CDSA **DFHSTUP value:** SDSA **DSECT value:** LDRSDCO (X'08') **Meaning:** Current copy in the SDSA **DFHSTUP value:** LPA **DSECT value:** LDRLPACO (X'03') **Meaning:** Current copy in the LPA **DFHSTUP value:** ECDSA **DSECT value:** LDRECDCO (X'04') **Meaning:** Current copy in the ECDSA **DFHSTUP value:** ESDSA **DSECT value:** LDRESDCO (X'09') **Meaning:** Current copy in the ESDSA **DFHSTUP value:** ERDSA **DSECT value:** LDRERDCO (X'06') **Meaning:** Current copy in the ERDSA **DFHSTUP value:** RDSA **DSECT value:** LDRRDCO (X'0A') **Meaning:** Current copy in the RDSA Reset characteristic: not reset

Programs: Summary resource statistics

Summary statistics are not available online.

These statistics fields contain the summary resource data statistics for the loader for each program.

DFHSTUP name	Description
Program name	is the name of the program.
Times used	is the total number of times CICS tasks within the system have issued load requests to the loader domain to obtain access to a usable instance of this program. These load requests may cause the loader domain to issue VSE LOAD requests to obtain access to usable instances of this program.

DFHSTUP name	Description
Fetch count	is the total number of times the loader domain has issued a VSE LOAD request to load a copy of the program from a sublibrary of the LIBDEF search chain for the CICS job into CICS managed storage.
Average fetch time	is the average time taken to perform a fetch of the program. The DFHSTUP report expresses this time as *minutes:seconds.decimals*.
NEWCOPY count	is the total number of times a NEWCOPY has been requested against this program.
Times removed	is the total number of times an instance of this program has been removed from CICS managed storage due to the actions of the Dynamic Program Storage Compression (DPSC) mechanism.

Program autoinstall statistics

Program autoinstall: Global statistics

These statistics can be accessed online using the EXEC CICS COLLECT STATISTICS command and are mapped by the DFHPGGDS DSECT. For programming information about the EXEC CICS COLLECT STATISTICS command, see the *CICS System Programming Reference*.

DFHSTUP name	Field name	Description
Program autoinstall attempts	PGGATT	is the number of times that a program autoinstall was attempted. Reset characteristic: reset to zero
Rejected by autoinstall exit	PGGREJ	is the number of times that a program autoinstall request was rejected by the program autoinstall URM program. Reset characteristic: reset to zero
Failed autoinstall attempts	PGGFAIL	is the number of times that a program autoinstall failed due to a number of reasons other than rejects (as counted by PGGREJ). For example the autoinstall URM program did not provide valid attributes; the model name specified by the URM was not defined; the exit tried to recurse, and disabled the URM. Reset characteristic: reset to zero

Program autoinstall: Summary global statistics

Summary statistics are not available online.

DFHSTUP name	Description
Program autoinstall attempts	is the number of times that a program was autoinstalled.
Rejected by autoinstall exit	is the number of times that a program is rejected by the autoinstall exit.
Failed autoinstall attempts	is the number of times that a program failed to autoinstall.

Statistics domain statistics

Statistics domain: Global statistics

These statistics are available online, and are mapped by the DFHSTGDS DSECT.

DFHSTUP name	Field name	Description
Interval collections so far	STGNC	is the number of interval collections made during the CICS run, or from one end-of-day to the following end-of-day. Reset characteristic: This field is reset to zero only at every end-of-day collection.
DMF writes	STGSMFW	is the number of DMF writes since the last reset time. This figure includes records written for all types of statistics collections. Reset characteristic: reset to zero
NOT IN THE DFHSTUP REPORT	STGLDW	is the length of data written to DMF during an interval, expressed as bytes. This figure includes length of data written during an interval for unsolicited, requested, and interval/end-of-day collections. Reset characteristic: reset to zero **Note:** This field contains the accumulated length of statistics records excluding the DMF headers.

Interval, end-of-day, and requested statistics all contain the same items.

Statistics domain: Summary global statistics

Summary statistics are not available online.

DFHSTUP name	Description
Total number of interval collections	is the total number of interval collections made during the entire CICS run.
Total number of DMF writes	is the total number of DMF writes during the entire CICS run. This figure includes records written during an interval for unsolicited, requested, and interval/end-of-day collections.

Storage manager statistics

These statistics are produced to aid all aspects of storage management.

Storage manager statistics: Domain subpools

These statistics can be accessed online using the EXEC CICS COLLECT STATISTICS command and are mapped by the DFHSMDDS DSECT. For programming information about the EXEC CICS COLLECT STATISTICS command, see the *CICS System Programming Reference*.

DFHSTUP name	Field name	Description
Subpool Name	SMDSPN	is the unique 8-character name of the domain subpool. The values of the domain subpool field are described in Appendix C, "VSE/ESA and CICS virtual storage" on page 365 . Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	SMDETYPE	The assembler DSECT field name has the value X'01' or X'02', indicating whether all the elements in the subpool are fixed length or variable length. For further information about subpool elements, see Appendix C, "VSE/ESA and CICS virtual storage" on page 365 . Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	SMDFLEN	is the length of each subpool element (applicable to FIXED length subpools only). For further information about subpool elements, see Appendix C, "VSE/ESA and CICS virtual storage" on page 365 . Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	SMDELCHN	The assembler DSECT field name has the value X'01' or X'02', indicating whether or not SM maintains an element chain for the subpool with the addresses and lengths of each element. For further information about element chains, see Appendix C, "VSE/ESA and CICS virtual storage" on page 365 . Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	SMDBNDRY	is the boundary on which each element is aligned. This is a power of 2 in the range 8 through 4096 bytes. For further information about boundaries, see Appendix C, "VSE/ESA and CICS virtual storage" on page 365 . Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	SMDLOCN	The storage location of this domain subpool. The assembler DSECT field name has the following values: • SMDBELOW (X'01') below the 16MB line. • SMDABOVE (X'02') above the 16MB line. Reset characteristic: not reset
Location	SMDDSANAME	Name of the DSA that the domain subpool is allocated from. Values can be 'CDSA', 'SDSA', 'RDSA', 'ECDSA', 'ESDSA', and 'ERDSA'. Reset characteristic: not reset

DFHSTUP name	Field name	Description
NOT IN THE DFHSTUP REPORT	SMDDSAINDEX	A unique identifier for the dynamic storage area that this subpool is allocated from. Values can be • SMDCDSA (X'01') indicating that the subpool storage is obtained from the CDSA. • SMDSDSA (X'03') indicating that the subpool storage is obtained from the UDSA. • SMDRDSA (X'04') indicating that the subpool storage is obtained from the UDSA. • SMDECDSA (X'05') indicating that the subpool storage is obtained from the ECDSA. • SMDESDSA (X'07') indicating that the subpool storage is obtained from the EUDSA. • SMDERDSA (X'08') indicating that the subpool storage is obtained from the ERDSA. Reset characteristic: not reset
Access	SMDACCESS	is the type of access of the subpool. It will be either CICS, USER, or READONLY. If storage protection not active, all storage areas will revert to CICS except those in the ERDSA. • SMDCICS (X'01') access is CICS key. • SMDUSER (X'02') access is USER key. • SMDREADONLY (X'03') is read-only protection. Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	SMDIFREE	is the size of the initial free area for the subpool (which may be zero), expressed in bytes. For further information about the initial free area, see Appendix C, “VSE/ESA and CICS virtual storage” on page 365 . Reset characteristic: not reset
Getmain Requests	SMDGMREQ	is the number of GETMAIN requests for the subpool. Reset characteristic: reset to zero
Freemain Requests	SMDFMREQ	is the number of FREEMAIN requests for the subpool. Reset characteristic: reset to zero
Current Elements	SMDCELEM	is the current number of storage elements in the subpool. Reset characteristic: not reset
Current Elem Stg	SMDCES	is the sum of the lengths of all the elements in the subpool, expressed in bytes. Reset characteristic: not reset
Current Page Stg	SMDCPS	is the space taken by all the pages allocated to the subpool, expressed in bytes. Reset characteristic: not reset
Peak Page Stg	SMDHWMPS	is the peak page storage allocated to support the storage requirements of this subpool. Reset characteristic: reset to current value

Summary domain subpools statistics

Summary statistics are not available online.

DFHSTUP name	Description
Subpool Name	is the unique 8-character name of the domain subpool. The values of the domain subpool field are described in Appendix C, “VSE/ESA and CICS virtual storage” on page 365 .
Location	is the indicator of the subpool location (CDSA, SDSA, RDSA, ECDSA, ESDSA, or ERDSA).
Access	is the type of access of the subpool. It will be either CICS, USER, or READONLY. If storage protection not active, all storage areas will revert to CICS except those in the ERDSA.
Getmain Requests	is the total number of GETMAIN requests for the subpool.
Freemain Requests	is the total number of FREEMAIN requests for the subpool.
Peak Elements	is the peak number of storage elements in the subpool.
Peak Elem Stg	is the peak amount of element storage in the subpool, expressed in bytes.
Peak Page Stg	is the peak amount of page storage in the subpool, expressed in bytes.

Storage manager: global statistics

These statistics ***can*** be accessed online using the EXEC CICS COLLECT STATISTICS command. For programming information about the EXEC CICS COLLECT STATISTICS command, see the *CICS System Programming Reference*.

These statistics are collected for each pagepool. They are available online, and are mapped by the DFHSMSDS DSECT.

DFHSTUP name	Field name	Description
Storage protection	SMSSTGPROT	X'01' active
		X'00' not active
Reentrant programs	SMSRENTPGM	X'01' protect. RDSA and ERDSA obtained from key 0 storage.
		X'00' no protect. RDSA and ERDSA obtained from key 8 storage.
Current DSA limit	SMSDSALIMIT	Current DSA limit value
Current DSA total	SMSDSATOTAL	Total amount of storage currently allocated to the DSAs below the line. This value may be smaller or larger than SMSDSALIMIT.
Peak DSA total	SMSHWMDSATOTAL	The total amount of storage allocated to the DSAs below the line. This value may be smaller or larger than SMSDSALIMIT.
Current EDSDA limit	SMSEDSALIMIT	Current EDSA limit
Current EDSA total	SMSEDSATOTAL	Total amount of storage currently allocated to the DSAs above the line. This value may be smaller or larger than EDSALIMIT.
Peak EDSA total	SMSHWMESDATOTAL	The total amount of storage allocated to the DSAs above the line. This value may be smaller or larger than SMSESDALIMIT.

Storage manager statistics: dynamic storage areas

These statistics ***can*** be accessed online using the EXEC CICS COLLECT STATISTICS command. For programming information about the EXEC CICS COLLECT STATISTICS command, see the *CICS System Programming Reference*.

These statistics are collected for each pagepool. They are available online, and are mapped by the DFHSMSDS DSECT.

DFHSTUP name	Field name	Description
NOT IN THE DFHSTUP REPORT	SMSNPAGP	is the number of pagepools in the CICS region. There are eight pagepools: the CDSA (CICS dynamic storage area), the UDSA (user dynamic storage area), the SDSA (shared dynamic storage area), the RDSA (read-only dynamic storage area), the ECDSA (extended CICS dynamic storage area), the ESDSA (extended shared dynamic storage area), the EUDSA (extended user dynamic storage area), and the ERDSA (extended read-only dynamic storage area). Reset characteristic: not reset
Note: The following fields are mapped by the SMSBODY DSECT within the DFHSMSDS DSECT. The SMSBODY DSECT is repeated for each pagepool in the CICS region (SMSNPAGP).		
Header in DFHSTUP report	SMSDSANAME	Name of the DSA that this record represents. Values can be 'CDSA', 'UDSA', 'SDSA', 'RDSA', 'ECDSA', 'EUDSA', 'ESDSA', and 'ERDSA'. Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	SMSDSAINDEX	A unique identifier for the dynamic storage area that this subpool is allocated from. Values can be: • SMSCDSA (X'01') The page pool is the CDSA. • SMSUDSA (X'02') The page pool is the UDSA. • SMSSDSA (X'03') The page pool is the SDSA. • SMSRDSA (X'04') The page pool is the RDSA. • SMSECDSA (X'05') The page pool is the ECDSA. • SMSEUDSA (X'06') The page pool is the EUDSA. • SMSESDSA (X'07') The page pool is the ESDSA. • SMSERDSA (X'08') The page pool is the ERDSA. Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	SMSLOCN	is the location of this pagepool. The assembler DSECT field name has the following values: • SMSBELOW (X'01') below the 16MB line. • SMSABOVE (X'02') above the 16MB line.

DFHSTUP name	Field name	Description
Current DSA Size	SMSDSASZ	is the current size of the CDSA, UDSA, SDSA, RDSA, ECDSA, EUDSA, ESDSA, or ERDSA, expressed in bytes.
		Reset characteristic: not reset
Peak DSA Size	SMSHWMDSASZ	is the peak size of the CDSA, UDSA, SDSA, RDSA, ECDSA, EUDSA, ESDSA, or ERDSA, expressed in bytes sinces that last time that statistics were recorded.
		Reset characteristic: not reset
Cushion Size	SMSCSIZE	is the size of the cushion, expressed in bytes. The cushion forms part of the CDSA, UDSA, ECDSA, EUDSA, or the ERDSA, and is the amount of storage below which CICS goes SOS.
		Reset characteristic: not reset
Free storage (inc. cushion)	SMSFSTG	is the amount of free storage in this pagepool, that is the number of free pages multiplied by the page size (4K), expressed in bytes.
		Reset characteristic: not reset
Percentage free storage		is the percentage of the storage that is free. This value is calculated offline by DFHSTUP and is, therefore, not accessible via the EXEC CICS COLLECT STATISTICS command.
		Reset characteristic: not reset
Peak free storage	SMSHWMFSTG	is the largest amount of storage that is free since the last time that statistics were recorded.
		Reset characteristic: not reset
Lowest free storage	SMSLWMFSTG	is the smallest amount of storage that is free since the last time that statistics were recorded.
		Reset characteristic: not reset
Largest free area	SMSLFA	is the length of the largest contiguous free area in the CDSA RDSA, SDSA, EDSA, UDSA, ECDSA, EUDSA, or ERDSA, expressed in bytes. To get an indication of the storage fragmentation in this pagepool, compare this value with “Free storage” (SMSFSTG) in the pagepool. If the ratio is large, then this pagepool is fragmented.
		Reset characteristic: not reset
Getmain Requests	SMSGMREQ	is the number of GETMAIN requests from the CDSA, RDSA, SDSA, EDSA, UDSA, or ECDSA, EUDSA, or ERDSA.
		Reset characteristic: reset to zero
Freemain Requests	SMSFMREQ	is the number of FREEMAIN requests from the CDSA, UDSA, ECDSA, EUDSA, RDSA, SDSA, EDSA, or ERDSA.
		Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
NOT IN THE DFHSTUP REPORT	SMSASR	is the number of ADD_SUBPOOL requests to create a subpool (domain or task) from the CDSA, UDSA, ECDSA, EUDSA, ERDSA, RDSA, SDSA, or ESDSA. Reset characteristic: reset to zero
NOT IN THE DFHSTUP REPORT	SMSDSR	is the number of DELETE_SUBPOOL requests (domain or task) from the CDSA, UDSA, ECDSA, EUDSA, ERDSA, RDSA, SDSA, or ESDSA. Reset characteristic: reset to zero
NOT IN THE DFHSTUP REPORT	SMSCSUBP	is the current number of subpools (domain and task) in the CDSA, UDSA, ECDSA, EUDSA, ERDSA, RDSA, SDSA, or ESDSA. Reset characteristic: not reset
Times no storage returned	SMSCRISS	is the number of times a GETMAIN request with SUSPEND(NO) returned the condition INSUFFICIENT_STORAGE. Reset characteristic: reset to zero
Times request suspended	SMSUCSS	is the number of times a GETMAIN request with SUSPEND(YES) was suspended because of insufficient storage to satisfy the request at the moment. Reset characteristic: reset to zero
Current suspended	SMSCSS	is the number of GETMAIN requests currently suspended for storage. Reset characteristic: not reset
Peak requests suspended	SMSHWMSS	is the peak number of GETMAIN requests suspended for storage. Reset characteristic: reset to current value
Purged while waiting	SMSPWWS	is the number of requests which were purged while suspended for storage. Reset characteristic: reset to zero
Times cushion released	SMSCREL	is the number of times a GETMAIN request caused the storage cushion to be released. The cushion is said to be released when the number of free pages drops below the number of pages in the cushion Reset characteristic: reset to zero
Times went short on storage	SMSSOS	is the number of times CICS went SOS in this pagepool (CDSA, UDSA, ECDSA, EUDSA, RDSA, SDSA, ESDSA or ERDSA), where SOS means either that the cushion is currently in use and/or there is at least one task suspended for storage. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Total time SOS	SMSTSOS	is the accumulated time that CICS has been SOS in this DSA. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value. Reset characteristic: reset to zero
Storage violations	SMSSV	is the number of storage violations recorded in the CDSA, UDSA, ECDSA, EUDSA, RDSA, SDSA, ESDSA, and the ERDSA.
Access	SMSACCESS	is the type of access of the page subpool. It will be either CICS, USER, or READONLY. If storage protection not active, all storage areas will revert to CICS except those in the ERDSA. • SMSCICS (X'01') access is CICS key. • SMSUSER (X'02') access is USER key. • SMSREADONLY (X'03') is read-only protection. Reset characteristic: not reset
Current extents	SMSEXTS	is the number of extents currently allocated to a specified dynamic storage area. Reset characteristic: not reset
Extents added	SMSEXTSA	is the number of extents added to a dynamic storage area since the last time statistics were recorded. Reset characteristic: not reset
Extents released	SMSEXTSR	is the number of extents which have been released from a dynamic storage area since the last time statistics were recorded. Reset characteristic: not reset

Storage manager: Summary global statistics

Summary statistics are not available online.

DFHSTUP name	Description
Storage protection	is the total storage protection defined to the storage manager.
Reentrant programs	is the number of reentrant programs.
Current DSA limit	this is the limit of CICS dynamic storage area that can be defined by the storage manager
Current DSA total	this is the number of CICS dynamic storage areas currently in use by the storage manager
Peak DSA total	is the highest number of CICS dynamic storage areas used by the storage manager since the last recorded statistics
Current EDSA limit	this is the number of extended dynamic storage areas currently defined by the storage manager
Current EDSA total	this is the number of extended dynamic storage areas currently in use by the storage manager
Peak EDSA total	is the highest number of extended dynamic storage area defined by the storage manager since the last recorded statistics

Summary dynamic storage areas statistics

Summary statistics are not available online.

DFHSTUP name	Description
DSA size	is the total size of the CDSA, UDSA, SDSA, RDSA, ECDSA, EUDSA, ESDSA, or ERDSA, expressed in bytes.
Cushion size	is the size of the cushion, expressed in bytes. The cushion forms part of the DSA or the EDSA, and is the amount of storage below which CICS goes SOS.
Getmain requests	is the total number of GETMAIN requests from the CDSA, UDSA, SDSA, RDSA, ECDSA, EUDSA, ESDSA, or ERDSA.
Freemain requests	is the total number of FREEMAIN requests from the CDSA, UDSA, SDSA, RDSA, ECDSA, EUDSA, ESDSA, or ERDSA.
Times no storage returned	is the total number of times a GETMAIN request with SUSPEND(NO) returned the condition INSUFFICIENT_STORAGE.
Times request suspended	is the total number of times a GETMAIN request with SUSPEND(YES) was suspended because of insufficient storage to satisfy the request at the moment.
Peak requests suspended	is the peak number of GETMAIN requests suspended for storage.
Purged while waiting	is the total number of requests which were purged while suspended for storage.
Times cushion released	is the total number of times a GETMAIN request caused the storage cushion to be released. The cushion is said to be released when the number of free pages drops below the number of pages in the cushion
Times went short on storage	is the total number of times CICS went SOS in this pagepool (CDSA, UDSA, ECDSA, EUDSA, or ERDSA), where SOS means either that the cushion is currently in use and/or there is at least one task suspended for storage.
Total time SOS	is the accumulated time that CICS has been SOS in this DSA. The DFHSTUP report expresses this time as *hours:minutes:seconds.decimals*; however, the DSECT field contains the time as a store clock (STCK) value.
Storage violations	is the total number of storage violations recorded in the CDSA, UDSA, ECDSA, EUDSA, and the ERDSA.
Access	is the type of access of the page subpool. It will be either CICS, USER, or READONLY. If storage protection not active, all storage areas will revert to CICS except those in the ERDSA.

Storage manager statistics: Task subpools

These statistics cannot be accessed online using the EXEC CICS COLLECT STATISTICS command. They are produced only for offline processing (written to DMF).

These statistics are collected for each pagepool. They are mapped by the DFHSMTDS DSECT.

Although task subpools are dynamically created and deleted for each task in the system, these statistics are the sum of all task subpool figures for the task related pagepools (CDSA, UDSA, ECDSA, and EUDSA). If further granularity of task storage usage is required, use the performance class data of the CICS/ESA monitoring facility.

DFHSTUP name	Field name	Description
NOT IN THE DFHSTUP REPORT	SMTNTASK	is the number of task subpools in the CICS region. Reset characteristic: not reset

Note: The following fields are mapped by the SMTBODY DSECT within the DFHSMTDS DSECT. The SMTBODY DSECT is repeated for each task subpool in the CICS region (SMTNTASK).

DSA Name	SMTDSANAME	Name of the dynamic storage area from which this task storage has been allocated. Values can be 'CDSA', 'UDSA', 'ECDSA',and 'EUDSA'. Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	SMTDSAINDEX	A unique identifier for the dynamic storage area that these statistics refer to. Values can be: • SMTCDSA (X'01') indicating that the task storage is obtained from the CDSA • SMTUDSA (X'02') indicating that the task storage is obtained from the UDSA • SMTECDSA (X'05') indicating that the task storage is obtained from the ECDSA • SMTEUDSA (X'06') indicating that the task storage is obtained from the EUDSA Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	SMTLOCN	tells you whether the dynamic storage area is above or below the line. • SMTBELOW (X'01') below the 16MB line. • SMTABOVE (X'02') above the 16MB line. Reset characteristic: not reset
Access	SMTACCESS	is the type of access of the subpool. It will be either CICS or USER. • SMTCICS (X'01') access is CICS key. • SMTUSER (X'02') access is USER key. Reset characteristic: not reset
Getmain Requests	SMTGMREQ	is the number of task subpool GETMAIN requests from this dynamic storage area. Reset characteristic: reset to zero
Freemain Requests	SMTFMREQ	is the number of task subpool FREEMAIN requests from this dynamic storage area. Reset characteristic: reset to zero
Current Elements	SMTCNE	is the number of elements in all the task subpools in this dynamic storage area. Reset characteristic: not reset
Current Elem Stg	SMTCES	is the sum of the storage occupied by all elements in task subpools within this dynamic storage area, expressed in bytes. Reset characteristic: not reset
Current Page Stg	SMTCPS	is the sum of the storage in all pages allocated to task subpools within this dynamic storage area, expressed in bytes. Reset characteristic: not reset
Peak Page Stg	SMTHWMPS	is the peak page storage allocated to support task storage activity in that dynamic storage area. Reset characteristic: reset to current value

Summary task subpools statistics

Summary statistics are not available online.

The following fields are mapped by the SMTBODY DSECT within the DFHSMTDS DSECT. The SMTBODY DSECT is repeated for each task subpool in the CICS region (SMTNTASK).

DFHSTUP name	Description
DSA Name	tells you whether the dynamic storage area is in the CDSA, UDSA, ECDSA, or EUDSA.
Access	is the type of access of the subpool. It will be either CICS, or USER.
Getmain Requests	is the total number of task subpool GETMAIN requests from this dynamic storage area.
Freemain Requests	is the total number of task subpool FREEMAIN requests from this dynamic storage area.
Peak Elements	is the peak number of elements in all the task subpools in this dynamic storage area.
Peak Elem Storage	is the peak amount of storage occupied by all elements in task subpools within this dynamic storage area, expressed in bytes.
Peak Page Storage	is the peak amount of storage in all pages allocated to task subpools within this dynamic storage area, expressed in bytes.

Table manager

Table manager: Global statistics

These statistics are available online, and are mapped by the DFHA16DS DSECT.

DFHSTUP name	Field name	Description
NOT IN THE DFHSTUP REPORT	A16NTAB	is the number of tables defined to the table manager. Reset characteristic: not reset
The following fields are mapped by the A16STATS DSECT, which is repeated for each table (A16NTAB).		
Table Name	A16TNAM	is the name of a CICS table supported by the table manager. Reset characteristic: not reset
Total Size of Table Manager Storage (bytes)	A16TSIZE	is the amount of storage, expressed in bytes, used by the table manager to support the table named in the field above (for example, for scatter tables and directory segments). This does not include storage used by the tables themselves. Reset characteristic: not reset

Table manager: Summary global statistics

Summary statistics are not available online.

DFHSTUP name	Description
Table Name	is the name of a CICS table supported by the table manager.
Average Table Size (bytes)	is the average amount of storage, expressed in bytes, used by the table manager to support the table named in the field above (for example, for scatter tables and directory segments). This does not include storage used by the tables themselves.
Peak Table Size (bytes)	is the peak amount of storage, expressed in bytes, used by the table manager to support the table named in the field above (for example, for scatter tables and directory segments). This does not include storage used by the tables themselves.

Temporary storage

Temporary storage statistics are produced for the data that is written into a temporary storage queue.

This is the DFHSTUP listing for temporary storage statistics.

Temporary storage: Global statistics

These statistics are available online, and are mapped by the DFHA12DS DSECT.

DFHSTUP name	Field name	Description
Put/Putq main storage requests	A12STA5F	is the number of records that application programs wrote to main temporary storage.
		Reset characteristic: reset to zero
Get/Getq main storage requests	A12NMG	is the number of records that application programs obtained from main temporary storage.
		Reset characteristic: reset to zero
Peak storage for temp. storage (main)	A12STA6F	is the peak value, expressed in bytes, of the amount of virtual storage used for temporary storage records.
		Reset characteristic: reset to current value
Current storage for temp. storage (main)	A12STA6A	is the current value, expressed in bytes, of the amount of virtual storage used for temporary storage records.
		Reset characteristic: not reset
Put/Putq auxiliary storage requests	A12STA7F	is the number of records that application programs wrote to auxiliary temporary storage.
		Reset characteristic: reset to zero
Get/Getq auxiliary storage requests	A12NAG	is the number of records that application programs obtained from auxiliary temporary storage.
		Reset characteristic: reset to zero
Peak temporary storage names in use	A12QNUMH	is the peak number of temporary storage queue names in use at any one time.
		Reset characteristic: reset to current value
Current temporary storage names in use	A12QNUM	is the current number of temporary storage queue names in use.
		Reset characteristic: not reset
Number of entries in longest queue	A12QINH	is the peak number of items in any one queue.
		Reset characteristic: reset to zero
Queue extensions threshold	A12GIDNE	is the number of records that are held in a single temporary storage group identifier (TSGID). This value is controlled by the system initialization parameter, TSMGSET.
		Reset characteristic: not reset

Note: The next two items are indications of whether the value chosen for TSMGSET is working as planned.

Times queues created	A12STA3F	is the number of times that CICS created individual temporary storage queues.
		Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Queue extensions created	A12STA4F	is the number of times it was necessary to create a TSGID extension. The capacity of a single TSGID is determined by the TSMGSET system initialization parameter, and indirectly controls how many additional extension blocks have to be built.
		Reset characteristic: reset to zero
Control interval size	A12CSZ	is the size of VSAM's unit of transmission between DASD and main storage, specified in the CONTROLINTERVALSIZE parameter in the VSAM CLUSTER definition for the temporary storage data set (for guidance information about this, see the *CICS Operations and Utilities Guide*). In general, using large CIs permits more data to be transferred at one time, resulting in less system overhead.
		Reset characteristic: not reset
Available bytes per control interval	A12NAVB	is the number of bytes available for use in the TS data set control interval.
		Reset characteristic: not reset
Segments per control interval	A12SPCI	is the number of segments available in the TS control interval.
		Reset characteristic: not reset
Bytes per segment	A12BPSEG	is the number of bytes per segment of the TS data set.
		Reset characteristic: not reset
Writes more than control interval	A12STABF	is the number of writes of records whose length was greater than the control interval (CI) size.
		Reset characteristic: reset to zero
Longest auxiliary temporary storage record	A12LAR	is the size, expressed in bytes, of the longest record written to the temporary storage data set.
		Reset characteristic: not reset
Number of control intervals available	A12NCI	is the number of control intervals (CIs) available for auxiliary storage. This is the total available space on the temporary storage data set expressed as a number of control intervals. This is not the space remaining at termination.
		Reset characteristic: not reset
Peak control intervals in use	A12NCIAH	is the peak number of CIs containing active data.
		Reset characteristic: reset to current value
Current control intervals in use	A12NCIA	is the current number of CIs containing active data.
		Reset characteristic: not reset
Times aux. storage exhausted	A12STA8F	is the number of situations where one or more transactions may have been suspended because of a NOSPACE condition, or (using a HANDLE CONDITION NOSPACE command) may have been forced to abend.
		Reset characteristic: reset to zero
Number of temp. storage compressions	A12STA9F	is the number of times that the temporary storage buffers were compressed.
		Reset characteristic: reset to zero

Note: The following statistics are produced for buffer usage:

DFHSTUP name	Field name	Description
Temporary storage buffers	A12NBCA	is the number of temporary storage buffers specified by the TS= system initialization parameter. The number of buffers allocated may exceed the number requested.
		Reset characteristic: not reset
Buffer waits	A12BWTN	is the number of times a request was queued because all buffers were allocated to other tasks. A buffer wait occurs if the required control interval is already in a locked buffer, and therefore unavailable, even if there are other buffers available.
		Reset characteristic: reset to zero
Peak users waiting on buffer	A12BUWTH	is the peak number of requests queued because no buffers were available.
		Reset characteristic: reset to current value
Current users waiting on buffer	A12BUWT	is the current number of requests queued because no buffers were available.
		Reset characteristic: not reset
Buffer writes	A12TWTN	is the number of WRITEs to the temporary storage data set. This includes both WRITEs necessitated by recovery requirements (see next item) and WRITEs forced by the buffer being needed to accommodate another CI.
		Reset characteristic: reset to zero
Forced writes for recovery	A12TWTNR	is the subset of the total number of WRITEs caused by recovery being specified for queues. This I/O activity is not affected by buffer allocation.
		Reset characteristic: reset to zero
Buffer reads	A12TRDN	is the number of times a CI has to be read from disk. Increasing the buffer allocation decreases this activity.
		Reset characteristic: reset to zero
Format writes	A12TWTNF	is the number of times a new CI was successfully written at the end of the data set to increase the amount of available space in the data set. A formatted write is attempted only if the current number of CIs available in the auxiliary data set have all been used.
		Reset characteristic: reset to zero
Note: The following statistics are produced for string usage:		
Temporary storage strings	A12NVCA	is the number of temporary storage strings specified by the TS= system initialization parameter. The number of strings allocated may exceed the number requested.
		Reset characteristic: not reset
Peak number of strings in use	A12NVCAH	is the peak number of concurrent I/O operations. If this is significantly less than the number specified by the TS= system initialization parameter, consider reducing the TS= value to approach this number.
		Reset characteristic: reset to current value

DFHSTUP name	Field name	Description
Times string wait occurred	A12VWTN	is the number of I/O requests that were queued because no strings were available. This is zero if the number of strings is the same as the number of buffers. If this is a high percentage (over 30%) of the number of I/O requests, consider increasing the number of strings initially allocated. Reset characteristic: reset to zero
Peak number of users waiting on string	A12VUWTH	is the peak number of I/O requests that were queued at any one time because all strings were in use. Reset characteristic: reset to current value
Current users waiting on string	A12VUWT	is the current number of I/O requests that are queued because all strings are in use. Reset characteristic: not reset
I/O errors on TS data set	A12STAAF	is the number of input/output errors which occurred on the temporary storage data set. This should normally be zero. If it is not, inspect the CICS and VSAM messages to determine the cause. Reset characteristic: reset to zero

Temporary storage: Summary global statistics

Summary statistics are not available online.

DFHSTUP name	Description
Put/Putq main storage requests	is the total number of records that application programs wrote to main temporary storage.
Get/Getq main storage requests	is the total number of records that application programs obtained from main temporary storage.
Peak storage for temp. storage (main)	is the peak value, expressed in bytes, of the amount of virtual storage used for temporary storage records.
Put/Putq auxiliary storage requests	is the total number of records that application programs wrote to auxiliary temporary storage.
Get/Getq auxiliary storage requests	is the total number of records that application programs obtained from auxiliary temporary storage.
Peak temporary storage names in use	is the peak number of temporary storage queue names at any one time.
Number of entries in longest queue	is the peak number of items in any one queue, up to a maximum of 32KB.
Queue extensions threshold	is the total number of records that are held in a single temporary storage group identifier (TSGID). This value is controlled by the system initialization parameter, TSMGSET.

Note: The next two items are indications of whether the value chosen for TSMGSET is working as planned.

Times queues created	is the total number of times that CICS created individual temporary storage queues.
Queue extensions created	is the total number of times it was necessary to create a TSGID extension. The capacity of a single TSGID is determined by the TSMGSET option in the SIT, and indirectly controls how many additional extension blocks have to be built.

DFHSTUP name	Description
Control interval size	is the size of VSAM's unit of transmission between DASD and main storage, specified in the CONTROLINTERVALSIZE parameter in the VSAM CLUSTER definition for the temporary storage data set (for guidance information about this, see the *CICS Operations and Utilities Guide*). In general, using large CIs permits more data to be transferred at one time, resulting in less system overhead.
Available bytes per control interval	is the number of bytes available for use in the last TS data set control interval.
Segments per control interval	is the number of segments in last TS data set control interval.
Bytes per segment	is the number of bytes per segment of the last TS data set control interval.
Writes more than control interval	is the total number of writes of records whose length was greater than the control interval (CI) size. If the reported value is large, increase the CI size. If the value is zero, consider reducing the CI size until a small value is reported.
Longest auxiliary temporary storage record	is the size, expressed in bytes, of the longest record written to the temporary storage data set.
Number of control intervals available	is the number of control intervals (CIs) available for auxiliary storage. This is the total available space on the temporary storage data set expressed as a number of control intervals. This is not the space remaining at termination.
Peak control intervals available	is the peak number of CIs containing active data.
Times aux. storage exhausted	is the total number of situations where one or more transactions may have been suspended because of a NOSPACE condition, or (using a HANDLE CONDITION NOSPACE command) may have been forced to abend. If this item appears in the statistics, increase the size of the temporary storage data set.
Number of temp. storage compressions	is the total number of times that temporary storage buffers were compressed.

Note: The following statistics are produced for buffer usage:

Temporary storage buffers	is the total number of temporary storage buffers specified by the TS= system initialization parameter. The number of buffers allocated may exceed the number requested.
Buffer waits	is the total number of times a request was queued because all buffers were allocated to other tasks. A buffer wait occurs if the required control interval is already in a locked buffer, and therefore unavailable, even if there are other buffers available.
Peak users waiting on buffers	is the peak number of requests queued because no buffers were available.
Buffer writes	is the total number of WRITEs to the temporary storage data set. This includes both WRITEs necessitated by recovery requirements (see next item) and WRITEs forced by the buffer being needed to accommodate another CI. I/O activity caused by the latter reason can be minimized by increasing buffer allocation.
Forced writes for recovery	is the subset of the total number of WRITEs caused by recovery being specified for queues. This I/O activity is not affected by buffer allocation.
Buffer reads	is the total number of times a CI has to be read from disk. Increasing the buffer allocation decreases this activity.
Format writes	is the total number of times a new CI was successfully written at the end of the data set to increase the amount of available space in the data set. A formatted write is attempted only if the current number of CIs available in the auxiliary data set have all been used.

Note: The following statistics are produced for string usage:

DFHSTUP name	Description
Temporary storage strings	is the total number of temporary storage strings specified by the TS= system initialization parameter. The number of strings allocated may exceed the number requested.
Peak number of strings in use	is the peak number of concurrent I/O operations. If this is significantly less than the number specified by the TS= system initialization parameter, consider reducing the TS= value to approach this number.
Times string wait occurred	is the total number of I/O requests that were queued because no strings were available. This is zero if the number of strings is the same as the number of buffers. If this is a high percentage (over 30%) of the number of I/O requests, consider increasing the number of strings initially allocated.
Peak number of users waiting on string	is the peak number of I/O requests that were queued at any one time because all strings were in use.
I/O errors on TS data set	is the total number of input/output errors which occurred on the temporary storage data set. This should normally be zero. If it is not, inspect the CICS and VSAM messages to determine the cause.

Terminal statistics

This is the DFHSTUP listing for terminal statistics.

There are a number of ways in which terminal statistics are important for performance analysis. From them, you can get the number of inputs and outputs, that is, the loading of the system by end users. Line-transmission faults and transaction faults are shown (these both have a negative influence on performance behavior).

Terminal control: Resource statistics

These statistics are gathered for each terminal, including ISC, IRC and MRO sessions. They are available online, and are mapped by the DFHA06DS DSECT. In addition to this, this DSECT should be used to map the terminal totals record.

DFHSTUP name	Field name	Description
Line Id	A06TETI	is the line number for SAM (sequential device support) lines. The line ID is blank for all other access methods.
		Reset characteristic: not reset
Term Id	A06TETI	is the identifier of each terminal as stated in the TERMINAL keyword of the RDO DEFINE or EXEC CICS CREATE TERMINAL command, or in the TRMIDNT= operand in the DFHTCT macro.
		Reset characteristic: not reset
Luname	A06LUNAM	is the terminal LU name
		Reset characteristic: not reset
The remainder of the information should be used for tracking terminal activity.		
Polls	A06LENP	is the number of polls that have been sent to the terminal. This field is for SAM.
		Reset characteristic: reset to zero
Terminal Type	A06TETT	is the terminal type as defined in the TCT. For information about terminal types and their codes, see the DFHTCTTE DSECT.
		Reset characteristic: not reset
Acc Meth	A06EAMIB	is the terminal access method as defined in the TCT. For information about access methods and their codes, see the DFHTCTTE DSECT.
		Reset characteristic: not reset
Input Messages	A06TENI	See note.
		Reset characteristic: reset to zero
Output Messages	A06TENO	See note.
		Reset characteristic: reset to zero

Note: Input messages (A06TENI) and output messages (A06TENO) are the amount of message activity per terminal. Input and output messages should represent the message traffic between CICS and the terminal. Input traffic should be the result of operator initiated input: that is, initial transaction input or input as a result of a conversational read to the terminal. Output messages should be output written by the application program or messages sent by CICS.

Input and output messages can vary because of differences in the application program being used on different terminals. ATI-initiated transactions would typically not have terminal input but could result in one or many output messages. A batch oriented terminal could initiate a single transaction that did multiple reads to the terminal resulting in multiple input messages. The differences between the remote and local terminal counts may be a result of different applications that run on them. Otherwise, they should be similar.

DFHSTUP name	Field name	Description
Transactions	A06TEOT	is the number of transactions, both nonconversational and pseudoconversational, that were started at this terminal. The transaction count is less than input messages if conversational transactions are being used. Reset characteristic: reset to zero When the operator signs off, the transaction count is not reset. At this time, message DFHSN1200 is issued containing the transaction count for that operator.
Storage Viols.	A06CSVC	is the number of storage violations that have occurred on this terminal. Reset characteristic: reset to zero
Transmission Errors	A06TETE	is the number of errors for this terminal, or the number of disconnects for this session. Reset characteristic: reset to zero
Transaction Errors	A06TEOE	is the number of transactions associated with this particular terminal that could not be started. This could mean that a transaction identifier has not been defined in the CSD data set, or that the operator does not have the proper security to enter the transaction, or that the transaction has been disabled. Reset characteristic: reset to zero When the operator signs off, the transaction error count is not reset. At this time, message DFHSN1200 is issued containing the transaction error count for that operator.
Pipeline messages—Totals	A06TCNT	is the total throwaway count. Reset characteristic: reset to zero
Pipeline messages—Groups	A06SCNT	is the number of consecutive throwaways. Reset characteristic: reset to zero
Pipeline messages—Max Csec	A06MCNT	is the maximum throwaway count. Reset characteristic: reset to zero
NOT IN THE DFHSTUP REPORT	A0GPRTY	is the terminal priority Reset characteristic: not reset
TIOA Storage	A06STG	is the TIOA storage allowed at this terminal. Reset characteristic: reset to zero

Terminal control: Summary resource statistics

Summary statistics are not available online.

DFHSTUP name	Description
Line Id	is the line number for SAM (sequential device support) lines. The line ID is blank for all other access methods.
Term Id	is the identifier of each terminal as stated in the TERMINAL keyword of the RDO DEFINE or EXEC CICS CREATE TERMINAL command, or in the TRMIDNT= operand in the DFHTCT macro.
Luname	is the terminal LU name
The remainder of the information should be used for tracking terminal activity.	
Polls	is the total number of polls that have been sent to the terminal. This field is for SAM only.
Terminal Type	is the terminal type as defined in the TCT. For information about terminal types and their codes, see the DFHTCTTE DSECT.
Acc Meth	is the terminal access method as defined in the TCT. For information about access methods and their codes, see the DFHTCTTE DSECT.
Input Messages	See note below.
Output Messages	See note below.

Note: Input and output messages are the amount of message activity per terminal. Input and output messages should represent the message traffic between CICS and the terminal. Input traffic should be the result of operator initiated input: that is, initial transaction input or input as a result of a conversational read to the terminal. Output messages should be output written by the application program or messages sent by CICS.

Input and output messages can vary because of differences in the application program being used on different terminals. ATI-initiated transactions would typically not have terminal input but could result in one or many output messages. A batch oriented terminal could initiate a single transaction that did multiple reads to the terminal resulting in multiple input messages. The differences between the remote and local terminal counts may be a result of different applications that run on them. Otherwise, they should be similar.

Transactions	is the total number of transactions, both nonconversational and pseudoconversational, that were started at this terminal. The transaction count is less than input messages if conversational transactions are being used. When the operator signs off, the transaction count is not reset. At this time, message DFHSN1200 is issued containing the transaction count for that operator.
Storage Viols.	is the total number of storage violations that have occurred on this terminal.
Transmission Errors	is the total number of errors recorded for this terminal.
Transaction Errors	is the total number of transactions associated with this particular terminal, that could not be started. This could mean that a transaction identifier has not been defined in the CSD data set, or that the operator does not have the proper security to enter the transaction, or that the transaction has been disabled. When the operator signs off, the transaction error count is not reset. At this time, message DFHSN1200 is issued containing the transaction error count for that operator.
Pipeline messages—Totals	is the total throwaway count.
Pipeline messages—Groups	is the total number of consecutive throwaways.
Pipeline messages—Max Csec	is the maximum throwaway count.
Average TIOA Storage	is the average TIOA storage allowed at this terminal.

Transaction statistics

This is the DFHSTUP listing for transaction statistics.

Transaction statistics: Resource statistics

The transaction statistics show how often each transaction is called.

These statistics can be accessed online using the EXEC CICS COLLECT STATISTICS command and are mapped by the DFHXMRDS DSECT. For programming information about the EXEC CICS COLLECT STATISTICS command, see the *CICS System Programming Reference*. In addition to this, this DSECT should be used to map the transaction totals record.

DFHSTUP name	Field name	Description
Trans ID	XMRTI	is the transaction identifier associated with the transaction definition.
		Reset characteristic: not reset
Program Name	XMRPN	is the name of the initial program to which the transaction linked.
		Reset characteristic: not reset
Tclass Name	XMRTCL	is the name of the transaction class in which the transaction is defined.
		Reset characteristic: not reset
Prty	XMRPRTY	is the priority of the transaction, from 0–255.
		Reset characteristic: not reset
Remote Name	XMRRNAM	is the name of the transaction on the remote system.
		Reset characteristic: not reset
Remote Sysid	XMRRSYS	is the name of the remote system where the transaction resides.
		Reset characteristic: not reset
Dynamic	XMRDYN	indicates whether the transaction has been defined as DYNAMIC=YES (Y) or DYNAMIC=NO (N).
		Reset characteristic: not reset
Attach Count	XMRAC	is the number of times that this transaction has been attached,
		Reset characteristic: reset to zero
Retry Count	XMRRC	is the number of times that this transaction definition has been used to retry a transaction.
		Reset characteristic: reset to zero
Dynamic Local	XMRDLC	is the number of times the dynamic transaction routing exit has chosen to run this transaction on the local system. This field is zero if the transaction was not defined as DYNAMIC=YES. For further information about dynamic transaction routing, see the programming information in the *CICS Customization Guide*.
		Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Dynamic Remote	XMRDRC	is the number of times the dynamic transaction routing exit has chosen to run this transaction on a remote system. This field is zero if the transaction was not defined as DYNAMIC=YES. For further guidance about dynamic transaction routing, see the programming information in the *CICS Customization Guide*. Reset characteristic: reset to zero
Remote Starts	XMRRSC	is the number of attempts to start this transaction on a remote system. This may not necessarily be the same as the number of successful starts. Reset characteristic: reset to zero
Storage Violations	XMRSVC	is the number of storage violations for this transaction that have been detected by CICS storage management. This is a serious concern if it occurs in a production system. You should act immediately to identify the cause of the problem because it can lead to data corruption, and therefore should not be allowed to continue in an operational system. Reset characteristic: reset to zero

Transactions: Summary resource statistics

Summary statistics are not available online.

DFHSTUP name	Description
Trans ID	is the transaction identifier associated with the transaction definition.
Program Name	is the name of the initial program to which the transaction was linked.
Tclass Name	is the name of the transaction class in which the transaction is defined.
Prty	is the priority of the transaction, from 1–255.
Remote Name	is the name of the transaction on the remote system.
Remote Sysid	is the name of the remote system where the transaction resides.
Dynamic	indicates whether the transaction has been defined as DYNAMIC=YES (Y) or DYNAMIC=NO (NO).
Attach Count	is the total number of times this transaction has been attached.
Retry Count	is the total number of times that this transaction definition has been used to retry a transaction.
Dynamic Local	is the total number of times the dynamic transaction routing exit has chosen to run this transaction on the local system. This field is zero if the transaction was not defined as DYNAMIC=YES. For further guidance information about dynamic transaction routing. For programming information about dynamic transaction routing, see the *CICS Customization Guide*.
Dynamic Remote	is the total number of times the dynamic transaction routing exit has chosen to run this transaction on a remote system. This field is zero if the transaction was not defined as DYNAMIC=YES. For further information about dynamic transaction routing, see the *CICS Customization Guide*.
Remote Starts	is the total number of times this transaction definition has been used to start a transaction remotely.

DFHSTUP name	Description
Storage Violations	is the total number of storage violations for this transaction that have been detected by CICS storage management. This is a serious concern if it occurs in a production system. You should act immediately to identify the cause of the problem because it can lead to data corruption, and therefore should not be allowed to continue in an operational system.

Transaction class (TCLASS) statistics

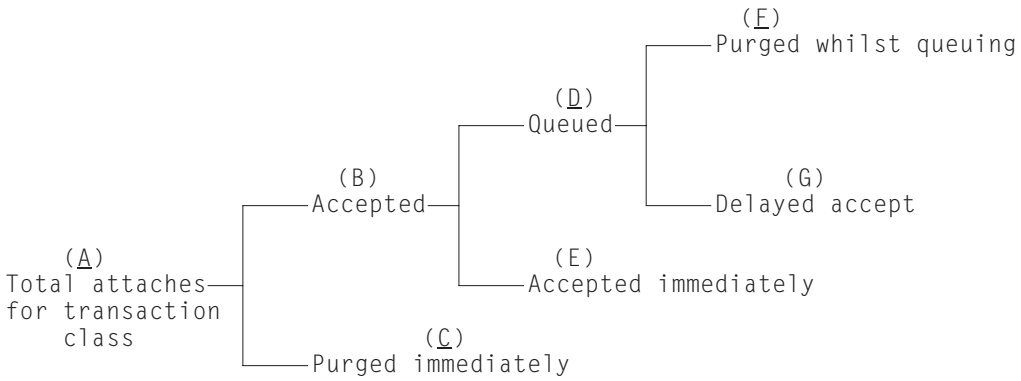
Transaction class: Resource statistics

These statistics can be accessed online using the EXEC CICS COLLECT STATISTICS command and are mapped by the DFHXMCDS DSECT. For programming information about the EXEC CICS COLLECT STATISTICS command, see the *CICS System Programming Reference*.

DFHSTUP name	Field name	Description
Tclass Name	XMCTCL	is the 8–character name of the transaction class. Reset characteristic: not reset
Number Trandfs	XMCITD	is the number of installed transaction definitions that are defined to belong to this transaction class. **Note:** This will be a reference count from the latest version of the transaction definition table. This statistic is useful to identify redundant tclasses. Reset characteristic: not reset
Max Act	XMCMXT	is the maximum number of transactions in the named transaction class that may be active concurrently. Reset characteristic: not reset
Purge Thresh	XMCTH	is the queue limit of the purge threshold at which transactions in the named transaction class is purged instead of being added to the queue of transactions that are waiting for membership of the transaction class. Reset characteristic: not reset
TOTAL		
–Attaches	XMCTAT	is the total number of attach requests made for transactions in this transaction class. Reset characteristic: reset to zero
–AcptImm	XMCAI	is the number of transactions that did not have to queue to become active in this transaction class. They are accepted immediately. Reset characteristic: reset to zero
–PrgImm	XMCPI	is the number of transactions that were purged immediately because the queue reached the purge threshold for this transaction class. Reset characteristic: reset to zero
–Queued	XMCAAQ	is the number of transactions that have become active in this transaction class but queued first. Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
–PrgQ'd	XMCPWQ	is the number of transactions that have been purged whilst queuing for acceptance into the transaction class. This includes those transactions purged explicitly through Master Terminal, or implicitly through the purge threshold of the transaction class being lowered.
		Reset characteristic: reset to zero
–Q-Time	XMCTQTME	is the total time in STCK units spent waiting by those transactions that were queued in the transaction class.
		Note: This time only includes the time spent by those that have finished queuing. In order to calculate the average queuing time, current queue must be subtracted from the 'queued' count.
		Reset characteristic: reset to zero
Peak Act	XMCPAT	is the highest number of active transactions reached in the transaction class.
		Reset characteristic: reset to current value
Peak Queued	XMCPQT	is the highest number of transactions queued waiting for admittance to the transaction class.
		Reset characteristic: reset to current value
Times MaxAct	XMCTAMA	is the number of separate times that the number of active transactions in the transaction class was equal to the maximum value (XMCMXT). Also registers times when maxactive setting of the tclass is zero and there are no active transactions in the tclass.
		Reset characteristic: reset to zero or one if transaction class is currently at its maxactive limit.
Times PrgThr	XMCTAPT	is the number of separate times that the purge threshold of the transaction class has been reached (times at purge threshold).
		Reset characteristic: reset to zero or one if transaction class is currently at its purge threshold limit.
CURRENT		
–Act	XMCCAT	is the current number of transactions currently active in this transaction class.
		Reset characteristic: not reset
–Queued	XMCCQT	is the number of transactions that are currently queuing in this transaction class.
		Reset characteristic: not reset
–Queue Time	XMCCQTME	is the total time in STCK units spent waiting by those transactions that are currently queuing in this transaction class.
		Reset characteristic: not reset

The following diagram illustrates the transaction class statistics.




```
Attaches for Transaction class  = A                    (XMCTAT)
Accepted                        = B       (A - C)
Purged immediately              = C                    (XMCPI)
Queued                          = D       (B - E)
Accepted immediately            = E       (B - D)      (XMCAI)
Purged whilst queuing           = F                    (XMCPWQ)
Accepted after queuing          = G       (D - F)      (XMCAAQ)
```

Transaction class: Summary resource statistics

Summary statistics are not available online.

DFHSTUP name	Description
Tclass Name	is the 8 character name of the transaction class.
Max Act	The maximum number of transactions in the named tclass that may be active concurrently.
Purge Thresh	The queue limit at which transactions in the named tclass will be purged instead of being added to the queue of transactions that are waiting for membership of the transaction class.
Total	
–Attaches	is the total number of attach requests made for transactions in this transaction class.
–AccptImm	The total number of transactions that did not have to queue to become active in this transaction class.
–PurgdImm	The total number of transactions that were purged immediately because they made the queue reach the purge threshold for this transaction class.
–Queued	The total number of transactions that have been made to queue in this transaction class.
–PurgQ'd	The total number of transactions that have been purged whilst queuing for acceptance into the transaction class. This includes those transactions purged explicitly via Master Terminal, or implicitly via the purge threshold of the transaction class being lowered.
–Queuing-Time	The total time spent waiting by those transactions that were queued. Note this time only includes the time spent by those have finished queuing. In order to calculate the average queuing time, current queue must be subtracted from the 'queued' count.
Peak Act	The total highest number of active transactions reached in the transaction class.
Peak Queued	The total highest number of transactions queued waiting for admittance to the transaction class.
Times Max Act	The total number of separate times that the number of active transactions in the transaction class was equal to the maximum value.

DFHSTUP name	Description
Times PurgeThr	The total number of separate times that the purge threshold has been reached.
Average Queuing-Time	The average time spent waiting by those transactions that were queued.

Transaction Manager

Transaction manager: Global statistics

These statistics can be accessed online using the EXEC CICS COLLECT STATISTICS command and are mapped by the DFHXMGDS DSECT. For programming information about the EXEC CICS COLLECT STATISTICS command, see the *CICS System Programming Reference*.

DFHSTUP name	Field name	Description
Total number of transactions (user + system)	XMGNUM	is the number of transactions (user + system) that have run in the system.
		Reset characteristic: reset to zero
Current MAXTASKS limit	XMGMXT	is the latest MXT value (expressed as a number of tasks) specified in the SIT, or as an override, or changed dynamically using CEMT SET SYSTEM MAXTASKS(value) or EXEC CICS SET SYSTEM MAXTASKS(fullword binary data-value) commands.
		Reset characteristic: not reset
Current number of active user transactions	XMGCAT	is the current number of active user transactions in the system.
		Reset characteristic: not reset
Current number of MAXTASK queued user transactions	XMGCQT	Current number of queued user transactions in the system. Note that this does not include transactions queueing for tclass membership.
		Reset characteristic: not reset
Times the MAXTASKS limit reached	XMGTAMXT	is the number of times the MXT limit has been reached
		Reset characteristic: reset to zero (or one if at MXT)
Peak number of MAXTASK queued user transactions	XMGPQT	is the peak number of queued user transactions in the system.
		Reset characteristic: reset to current value (XMGCQT)
Peak number of active user transactions	XMGPAT	is the peak number of active user transactions reached in the system.
		Reset characteristic: reset to current value (XMGCAT)
Total number of active user transactions	XMGTAT	is the number of user transactions that have become active.
		Reset characteristic: reset to zero
Total number of MAXTASK delayed user transactions	XMGTDT	is the number of user transactions that had to queue for MXT reasons.
		Reset characteristic: reset to zero
Total MAXTASK queuing time	XMGTQTME	is the total time spent waiting by those user transactions that had to queue for MXT reasons.
		Reset characteristic: reset to zero

DFHSTUP name	Field name	Description
Total MAXTASK queuing time of currently queued user transactions	XMGCQTME	is the total time spent waiting so far by those user transactions currently queuing for MXT reasons. Reset characteristic: not reset
NOT IN THE DFHSTUP REPORT	XMGTNUM	is the total of user and system transactions attached to date, up to the time of the last statistics reset. **Note:** The total of XMGNUM and XMGTNUM represents the total number of transactions attached so far. Reset characteristic: reset to XMGNUM + XMGTNUM at the time of the last reset.

Transaction manager: Summary global statistics

Summary statistics are not available online.

DFHSTUP name	Description
Total number of transactions (user and system)	is the total number of tasks that have run in the system.
MAXTASK limit	is the MXT value (expressed as a number of tasks) specified in the SIT, or as an override, or changed dynamically using CEMT SET SYSTEM MAXTASKS(value) or EXEC CICS SET SYSTEM MAXTASKS(fullword binary data-value) commands.
Times the MAXTASK limit reached	is the total number of times MXT has been reached.
Peak number of MAXTASK queued user transactions.	is the peak number of queued user transactions reached in the system.
Peak number of active user transactions	is the peak number of active user transactions reached in the system.
Total number of active user transactions	is the total number of user transactions that have become active.
Total number of MAXTASK delayed user transactions	is the total number of transactions that had to queue for MXT reasons.
Total MAXTASK queuing time	is the total time spent waiting by those user transactions that had to queue for MXT reasons.
Average MAXTASK queuing time of queued transactions	is the average time spent waiting by those user transactions that had to queue for MXT reasons.

Transient data (global)

Transient data: Global statistics

These statistics are available online, and are mapped by the DFHA11DS DSECT.

DFHSTUP name	Field name	Description
In the statistics produced for the intrapartition data set:		
Control interval size	A11ACISZ	is the size of the control interval, expressed in bytes.
		Reset characteristic: not reset
Control intervals	A11ANCIS	is the current number of control intervals active within the CICS system.
		Reset characteristic: not reset
Peak control intervals used	A11AMXCI	is the peak value of the number of control intervals concurrently in the system.
		Reset characteristic: reset to current value
Times NOSPACE occurred	A11ANOSP	is the number of times that a NOSPACE condition has occurred.
		Reset characteristic: reset to zero
Writes to dataset	A11ACTPT	is the number of WRITEs to the transient data data set. This includes both WRITEs needed for recovery (see below) and WRITEs forced by the buffer being needed to accommodate another CI. I/O activity caused by the latter reason can be minimized by increasing the buffer allocation.
		Reset characteristic: reset to zero
Reads from dataset	A11ACTGT	is the number of times a CI has to be read from disk. Increasing the buffer allocation decreases this activity.
		Reset characteristic: reset to zero
Formatting write	A11ACTFT	is the number of times a new CI was written at the end of the data set in order to increase the amount of available space.
		Reset characteristic: reset to zero
I/O errors	A11ACTIO	is the number of input/output errors that have occurred during this run of CICS.
		Reset characteristic: reset to zero
In the statistics produced for buffer usage:		
Intrapartition buffers	A11ANBFA	is the number of transient data buffers specified by the TD= system initialization parameter. The number of buffers allocated may exceed the number requested.
		Reset characteristic: not reset
Peak intra. buffers containing valid data	A11AMXIU	is the peak number of intrapartition buffers which contain valid data.
		Reset characteristic: reset to current value
Intrapartition accesses	A11ATNAL	is the number of times intrapartition buffers have been accessed.
		Reset characteristic: reset to current value
Peak concurrent intrapartition accesses	A11AMXAL	is the peak value of the number of concurrent intrapartition buffer accesses.
		Reset characteristic: reset to current value

DFHSTUP name	Field name	Description
Intrapartition buffer waits	A11ATNWT	is the number of times a request was queued because all buffers were allocated to other tasks. A buffer wait occurs if the required control interval is already in a locked buffer, and therefore unavailable, even if there are other buffers available.
		Reset characteristic: reset to current value
Peak intrapartition buffer waits	A11AMXWT	is the peak number of requests queued because no buffers were available.
		Reset characteristic: reset to current value
All of the intrapartition data set statistics above are printed, even if the values reported are zero.		
CICS produces the following statistics for multiple strings:		
Number of strings	A11SNSTA	is the number of strings currently active.
		Reset characteristic: not reset
Times string accessed	A11STNAL	is the number of times a string was accessed.
		Reset characteristic: reset to current value
Peak concurrent string accesses	A11SMXAL	is the peak number of strings concurrently accessed in the system.
		Reset characteristic: reset to current value
String waits	A11STNWT	is the number of times that tasks had to wait due to no strings being available.
		Reset characteristic: reset to current value
Peak string waits	A11SMXWT	is the peak number of concurrent string waits in the system.
		Reset characteristic: reset to current value

Transient data: Summary global statistics

Summary statistics are not available online.

DFHSTUP name	Description
In the statistics produced for the intrapartition data set:	
Control interval size	is the last value encountered for the size of the control interval, expressed in bytes.
Peak control intervals used	is the peak number of control intervals concurrently in the system.
Times NOSPACE occurred	is a total number of times that a NOSPACE condition has occurred.
Writes to dataset	is the total number of WRITEs to the temporary storage data set. This includes both WRITEs needed for recovery (see below) and WRITEs forced by the buffer being needed to accommodate another CI. I/O activity caused by the latter reason can be minimized by increasing the buffer allocation.
Reads from dataset	is the total number of times a CI has to be read from disk. Increasing the buffer allocation decreases this activity.
Formatting write	is the total number of times a new CI was written at the end of the data set in order to increase the amount of available space.
I/O errors	is the total number of input/output errors that have occurred during this run of CICS.
In the statistics produced for buffer usage:	
Intrapartition buffers	is the last value encountered for the number of transient data buffers specified by the TD system initialization parameter. The number of buffers allocated may exceed the number requested.
Peak intra. buffers containing valid data	is the peak number of intrapartition data sets which contain valid data.
Intrapartition accesses	is the total number of times that intrapartition data sets have been accessed.
Peak concurrent intrapartition accesses	is the peak number of concurrent intrapartition data set accesses.
Intrapartition buffer waits	is the total number of times a request was queued because all buffers were allocated to other tasks. A buffer wait occurs if the required control interval is already in a locked buffer, and therefore unavailable, even if there are other buffers available.
Peak intrapartition buffer waits	is the peak number of requests queued because no buffers were available.
In the statistics produced for the intrapartition data set:	
All of the intrapartition data set statistics above are printed, even if the values reported are zero.	
CICS produces the following statistics for multiple strings:	
Times strings accessed	is the total number of times a string was accessed.
Peak concurrent string accesses	is the peak number of strings concurrently accessed in the system.
String waits	is the total number of times that tasks had to wait due to no strings being available.
Peak string waits	is the peak number of concurrent string waits in the system.

Transient data: Resource statistics

These statistics are collected for each destination. You can use the information from the statistics for each destination to calculate the average number of transient data accesses per transaction. The items in this listing reflect the information you placed in the destination control table (DCT). The statistics are available online, and are mapped by the DFHA10DS DSECT. In addition, this DSECT should be used to map the transient data totals record.

DFHSTUP name	Field name	Description
Dest Id	A10DEST	is the destination identifier (called a "queue" by the application programmer) that you specified in the DESTID operand of the DFHDCT macro. Reset characteristic: not reset
Remote Name	A10RQID	The remote queue name (for a TYPE=REMOTE queue), as specified via the TYPE=REMOTE, RMTNAME operand of the DFHDCT macro. Reset characteristic: not reset.
Remote Sysid	A10RSID	The remote system name (for a TYPE=REMOTE queue), as specified via the TYPE=REMOTE, SYSIDNT operand of the DFHDCT macro. Reset characteristic: not reset.
Indirect Name	A10IDQN	The indirect destination queue name (for a TYPE=INDIRECT queue), as specified via the TYPE=INDIRECT, DESTID operand of the DFHDCT macro. Reset characteristic: not reset.
Only one of the following four fields contains valid data, depending on the class of destination.		
Extra. Outputs	A10EO	is the number of WRITEs to the output data set or READs from the input data set. Reset characteristic: reset to zero
Intra. Outputs	A10IO	is the number of WRITEs to an intrapartition data set. This includes queues defined with a trigger level. Reset characteristic: reset to zero
Indirect Requests	A10IR	is the number of WRITEs to or READs from an indirect destination. Reset characteristic: reset to zero
Remote Requests	A10RR	is the number of READs and WRITEs made to a remote destination identifier. The remote destination can be defined to be across LU6.2, LU6.1, and MRO connections. Reset characteristic: reset to zero
NOT IN DFHSTUP REPORT	A10TYPE	is the destination type. • X'01' Extrapartition queues • X'02' Intrapartition queues • X'03' Indirect queues • X'04' Remote queues Reset characteristic: reset to zero

Note: The above statistics are also totalled for all destinations.

Transient data: Summary resource statistics

Summary statistics are not available online.

DFHSTUP name	Description
Dest Id	is the destination identifier (called a "queue" by the application programmer) that you specified in the DESTID operand of the DFHDCT macro.
Remote Name	The remote queue name (for a TYPE=REMOTE queue), as specified via the TYPE=REMOTE, RMTNAME operand of the DFHDCT macro.
Remote Sysid	The remote system name (for a TYPE=REMOTE queue), as specified via the TYPE=REMOTE, SYSIDNT operand of the DFHDCT macro.
Indirect Name	The indirect destination queue name (for a TYPE=INDIRECT queue), as specified via the TYPE=INDIRECT, DESTID operand of the DFHDCT macro.
Only one of the following five fields contains valid data, depending on the class of destination.	
Extra. Outputs	is the total number of WRITEs to the output data set or READs from the input data set.
Intra. Outputs	is the total number of WRITEs to an intrapartition data set. This includes queues defined with a trigger level.
Indirect Requests	is the total number of WRITEs to or READs from an indirect destination.
Remote Requests	is the total number of READs and WRITES made to a remote destination identifier. The remote destination can be defined to be across LU6.2, LU6.1, and MRO connections.

Note: The above statistics are also totalled for all destinations.

User domain statistics: Global statistics

These statistics are not available online, and are mapped by the DFHUSGDS DSECT.

DFHSTUP name	Field name	Description
Average Timeout Reuse Time	USGTOMRT	the mean time that timeout entries are on the timeout queue before they are reused
		Reset characteristic: reset to zero
Timeout Reuse Count	USGTORC	the number of times that timeout entries are recovered from the queue before they timeout.
		Reset characteristic: reset to zero
Timeout Expiry Count	USGTOEC	the number of times a timeout entry was deleted because it was timed out.
		Reset characteristic: reset to zero
Directory Reuse Count	USGDRRC	the number of times a timeout entry was reused.
		Reset characteristic: reset to zero
Directory not found count	USGDRNFC	the number of times a userid was not found in the directory, but was later successfully added.
		Reset characteristic: reset to zero

VTAM statistics: Global statistics

These statistics are available online, and are mapped by the DFHA03DS DSECT.

DFHSTUP name	Field name	Description
Times at RPL maximum	A03RPLXT	is the number of times the peak RPL posted value (A03RPLX) was reached. Reset characteristic: reset to zero
Peak RPLs posted	A03RPLX	is the maximum number of receive-any request parameter lists (RPLs) that are posted by VTAM on any one dispatch of terminal control. Reset characteristic: reset to zero
Short on storage count	A03VTSOS	is a counter that is incremented in the VTAM SYNAD exit in the CICS terminal control program each time VTAM indicates that there is a temporary VTAM storage problem. Reset characteristic: reset to zero
Dynamic opens count	A03DOC	is the number of times the VTAM access method control block (ACB) was opened through the control terminal. If VTAM is started before CICS and stays active for the whole CICS run, this value is zero. Reset characteristic: reset to zero
Average LUs in session	A03LUNUM	is the current number of LUs in session. The types of LU that are included are: • LU6.1 primaries and secondaries in session (bound) • LU6.2 primaries and secondaries in session (bound) • VTAM terminals. Reset characteristic: not reset.
HWM LUs in session	A03LUHWM	is the current highest number of LUs logged on. The types of LU that are included are: • LU6.1 primaries and secondaries in session (bound) • LU6.2 primaries and secondaries in session (bound) • VTAM terminals. Reset characteristic: reset to current value.
PS inquire count	A03PSIC	is the number of times CICS issued INQUIRE OPTCD=PERSESS. Reset characteristic: reset to current value.
PS nib count	A03PSNC	is the number of VTAM sessions that persisted. Reset characteristic: reset to current value.
PS opndst count	A03PSOC	is the number of persisting sessions that were successfully restored. Reset characteristic: reset to current value.
PS unbind count	A03PSUC	is the number of persisting sessions that were terminated. Reset characteristic: reset to current value.
PS error count	A03PSEC	is the number of persisting sessions that were already unbound when CICS tried to restore them. Reset characteristic: reset to current value.

VTAM Summary global statistics

Summary statistics are not available online.

DFHSTUP name	Description
Times at RPL maximum	is the total number of times the maximum RPL posted value (A03RPLX) was reached.
Peak RPLs posted	is the peak number of receive-any request parameter lists (RPLs) that are posted by VTAM on any one dispatch of terminal control.
Short on storage count	is a counter that is incremented in the VTAM SYNAD exit in the CICS terminal control program each time VTAM indicates that there is a temporary VTAM storage problem.
Dynamic opens count	is the total number of times that the VTAM access method control block (ACB) was opened through the control terminal. If VTAM is started before CICS and stays active for the whole CICS run, this value is 0.
Current LUs in session	is the average value for the number of LUs logged on.
HWM LUs in session	is the highest value of the number of LUs logged on.
PS inquire count	is the total number of times CICS issued INQUIRE OPTCD=PERSESS.
PS nib count	is the total number of VTAM sessions that persisted.
PS opndst count	is the total number of persisting sessions that were successfully restored.
PS unbind count	is the total number of persisting sessions that were terminated.
PS error count	is the total number of persisting sessions that were already unbound when CICS tried to restore them.

End of Product-Sensitive programming interface

Appendix B. The sample statistics program, DFH0STAT

You can use the statistics sample program, DFH0STAT, to help you determine and adjust the values needed for VSE/ESA storage parameters, for example, using DSALIMIT and EDSALIMIT. The program produces a report showing critical system parameters from the VSE/ESA dispatcher, an analysis of the VSE/ESA storage manager and loader statistics, and an overview of the VSE storage in use. The program demonstrates the use of the EXEC CICS INQUIRE and EXEC CICS COLLECT STATISTICS commands to produce an analysis of a VSE/ESA system. You can use the sample program as provided or modify it to suit your needs.

The sample statistics program consists of the following resources:

DFH0STAT
Statistics sample program.

DFH$STAS
Assembler language program called by DFH0STAT.

DFH$STCN
Assembler language program called by DFH0STAT.

DFH$STRP
Assembler language program called by DFH0STAT.

DFH0STM
Mapset used by the STAT transaction.

STAT
Transaction used to invoke the program, DFH0STAT.

All programs are command level and run above the 16MB line.

DFH0STAT can be invoked from the PLT at PLTPI (second phase) or PLTSD (first phase) or as a CICS transaction (either from a console or as a conversational transaction from a terminal).[2] The output is sent via the CICS SPOOL interface for which a number of default parameters can be changed by the user to specify the distribution of the report(s). These defaults are defined in the working-storage section of this program under the 01 level “OUTPUT-DEFAULTS”.

If DFH0STAT is invoked from a terminal, you may choose to direct the output to a temporary storage queue, instead of to the POWER list queue.

If an EXEC CICS SPOOL .. command fails when the program is run as a transaction, an error message is displayed on the users screen and the transaction will continue. If the program is not being run from a terminal, a message will be sent to the console using EXEC CICS WRITE OPERATOR commands and the transaction will be terminated normally.

To enable you to use the sample program, you must:

[2] If you want to run DFH0STAT while in PLT processing, ensure that all the sample statistics programs are defined with RDO keyword EXECkey set to CICS.

1. Assemble and link-edit the BMS mapset DFH0STM. Include the physical mapset in a sublibrary of the LIBDEF search chain for the CICS job. You can either include the symbolic mapset in a user copy library or insert it directly into the source of DFH0STAT.
2. Translate the DFH0STAT program source code, turning CICS commands into code understood by the compiler. The program source code is provided in the VSE/ESA sublibrary PRD1.BASE.

   Note: You must use the translator option SP™ when translating DFH0STAT.
3. Compile the translator output for DFH0STAT to produce object code.
4. Link-edit the object module to produce a load module, which you store in an application load library that is concatenated to the LIBDEF search chain for the CICS job.
5. Create resource definition entries, in the CSD, for the programs, mapset, and the STAT transaction.
6. Define the system initialization parameter SPOOL=YES. This specifies that you need support for the system spooling interface.

Analyzing CICS Transaction Server for VSE/ESA Version 1 DFH0STAT Reports

DFH0STAT can produce reports about:

- System Status, Monitoring and Statistics
- Transaction Manager and Dispatcher
- Storage
- Loader
- Transactions
- Transaction Totals
- Programs
- Program Totals
- Temporary Storage
- Transient Data
- LSR Pools
- Files
- Data Tables.

The heading of each report includes the generic applid, sysid, jobname, date and time, and the CICS Transaction Server for VSE/ESA version and release information.

System Status Report

Figure 15 shows the format of the System Status Report. The field headings and contents are described in Table 12 on page 322.

```
Applid CICSA3    Sysid CICS  Jobname F3CICS41    Date 11/10/98    Time 14:34:54                  CICS 01.01.00         PAGE 1


System Status

   VSE Release . . . . . :  VSE/AF6.4.0

   CICS Startup. . . . . :  COLD
   CICS Status . . . . . :  ACTIVE
   Storage Protection. . :  INACTIVE

   Reentrant Programs. . :  PROTECT


Monitoring

   Monitoring . . . . . :  ON
   Exception Class. . . :  ON
   Performance Class. . :  ON

   Exception Class Records . . . . . :          0
   Exception Records Suppressed. . . :          0
   Performance Class Records . . . . :         21
   Performance Records Suppressed. . :          0
   DMF Records . . . . . :          0
   DMF Errors. . . . . :          0


Statistics

   Statistics End-of-Day Time . . :  00:00:00
   Statistics Interval. . . . . :  03:00:00
   Next Statistics Collection . . :  15:00:00
   Statistics Recording . . . . . :  ON
```

Figure 15. The System Status Report

Table 12 (Page 1 of 2). Fields in the System Status Report	
Field Heading	**Description**
System Status	
VSE Release	identifies the level of VSE. Source field: CVTPRODN
CICS Startup	indicates the type of CICS startup. Source field: EXEC CICS INQUIRE SYSTEM STARTUP(cvda)
CICS Status	indicates the current status of the local CICS system. Source field: EXEC CICS INQUIRE SYSTEM CICSSTATUS(cvda)
Storage Protection	indicates the status of storage protection. Source field: EXEC CICS INQUIRE SYSTEM STOREPROTECT(cvda)
Reentrant Programs	indicates if read-only programs reside in key-0 protected storage. Source field: SMSRENTPGM
Monitoring	
Monitoring	indicates whether CICS monitoring is active in the system. Source field: EXEC CICS INQUIRE MONITOR STATUS(cvda)
Exception Class	indicates whether the exception class of CICS monitoring data is being collected. Source field: EXEC CICS INQUIRE MONITOR EXCEPTCLASS(cvda)
Performance Class	indicates whether the performance class of CICS monitoring data is being collected. Source field: EXEC CICS INQUIRE MONITOR PERFCLASS(cvda)
Exception Class Records	is the number of exception records written to SMF. Source field: MNGER
Exception Class Suppressed	is the number of exception records suppressed by a global user exit program at exit point XMNOUT. Source field: MNGERS
Performance Class Records	is the number of performance records scheduled for output to SMF. Because the monitoring domain buffers performance class records, there is still a possibility that monitoring can be deactivated, thus preventing the output of the performance class records that have been buffered. Source field: MNGPR
Performance Class Suppressed	is the number of performance records suppressed by a global user exit program at exit point XMNOUT. Source field: MNGPRS
DMF Records	is the number of SMF records written to the SMF data set. CICS writes exception class SMF records as soon as the monitor domain is notified of the exception completion, so there is one exception record per SMF record. The performance class, however, has many performance class records per SMF record. The SMF record for the performance class is written when the buffer is full, performance class has been deactivated, or CICS is quiescing. Source field: MNGSMFR

Table 12 (Page 2 of 2). Fields in the System Status Report

Field Heading	Description
DMF Errors	is the number of non-OK responses from the request to write a record to DMF. This count is incremented when a DMF write fails for any reason. For example, when DMF is inactive. Source field: MNGSMFE
Statistics	
Statistics End-of-Day Time	is the current end-of-day time for recording statistics. Source field: EXEC CICS INQUIRE STATISTICS ENDOFDAY
Statistics Interval	is the current statistics recording interval. Source field: EXEC CICS INQUIRE STATISTICS INTERVAL
Next Statistics Collection	is the next statistics recording time. Source field: EXEC CICS INQUIRE STATISTICS NEXTTIME
Statistics Recording	is the current status of statistics recording. Source field: EXEC CICS INQUIRE STATISTICS RECORDING(cvda)

Transaction Manager and Dispatcher Report

Figure 16 shows the format of the Transaction Manager and Dispatcher Report. The field headings and contents are described in Table 13 on page 325.

```
Applid CICSA3    Sysid CICS  Jobname F3CICS41    Date 11/10/98    Time 14:34:54              CICS 01.01.00         PAGE 2

Transaction Manager

   Total Accumulated transactions so far. . :              30

   Accumulated transactions (since reset) . :              30

   Maximum transactions allowed (MXT) . . . :               5
   Times at MXT . . . . . . . . . . . . . . :               0
   Current Active User transactions . . . . :               2
   Peak Active User transactions. . . . . . :               4
   Total Active User transactions . . . . . :               9

   Current Running transactions . . . . . . :               1
   Current Dispatchable transactions. . . . :               0
   Current Suspended transactions . . . . . :               1
   Current System transactions. . . . . . . :               0

   Transactions Delayed by MXT. . . . . . . :               0
   Total MXT queueing time. . . . . . . . . :  00:00:00.00000
   Average MXT queueing time. . . . . . . . :  00:00:00.00000

   Current Queued User transactions . . . . :               0
   Total Queueing time for current queued . :  00:00:00.00000
   Average Queueing time for current queued :  00:00:00.00000
Dispatcher

   Dispatcher start time. . . :  14:32:33.91055

   Peak tasks . . . . . . . . :      22
   Current tasks. . . . . . . :      11

   Current ICV time . . . . . :       1,000ms
   Current ICVR time. . . . . :       5,000ms
   Current ICVTSD time. . . . :         500ms
   Current PRTYAGING time . . :      32,768ms

   Number of active CICS TCBs :       2

     TCB       TCB          TCB        Op. System    Op. System         TCB             TCB             DS TCB
     Name      Status     Start Time       Waits       Wait Time     Dispatch Time     CPU Time        CPU Time

   QR_SUBD     Active   14:32:33.91055         613  00:01:39.94765  00:00:40.71213  00:00:00.00000  00:00:00.00000
   RO_SUBD     Active   14:32:35.71575          87  00:01:48.09525  00:00:30.75973  00:00:00.00000  00:00:00.00000
   Totals                                                           00:01:11.47186  00:00:00.00000  00:00:00.00000
```

Figure 16. The Transaction Manager and Dispatcher Report

Table 13 (Page 1 of 3). Fields in the Transaction Manager and Dispatcher Report	
Field Heading	**Description**
Transaction Manager	
Accumulated transactions so far	is the number of tasks that have accumulated. Source field: XMGNUM
Maximum transactions allowed (MXT)	is the specified maximum number of user transactions as specified in the SIT, or as an override, or changed dynamically using CEMT SET SYSTEM MAXTASKS(value) or EXEC CICS SET SYSTEM MAXTASKS(fullword binary data-value) commands. Source field: XMGMXT
Times at MXT	is the number of times that the number of active user transactions equalled the specified maximum number of user transactions (MXT). Source field: XMGTAMXT
Current Active User transactions	is the current number of active user transactions. Source field: XMGCAT
Peak Active User transactions	is the peak number of active user transactions reached. Source field: XMGPAT
Total Active User transactions	is the total number of user transactions that have become active. Source field: XMGTAT
Current Running transactions	is the current number of Running transactions. Source field: EXEC CICS INQUIRE TASKLIST RUNNING
Current Dispatchable transactions	is the current number of Dispatchable transactions. Source field: EXEC CICS INQUIRE TASKLIST DISPATCHABLE
Current Suspended transactions	is the current number of Suspended transactions. Source field: EXEC CICS INQUIRE TASKLIST SUSPENDED
Current System transactions	is the current number of system transactions. Source field: ((Running + Dispatchable + Suspended) - XMGCAT)
Transactions Delayed by MXT	is the number of user transactions that had to queue for MXT reasons before becoming active, excluding those still waiting. Source field: XMGTDT
Total MXT Queueing Time	is the total time spent waiting by those user transactions that had to wait for MXT reasons. **Note:** This does not include those transactions still waiting. Source field: XMGTQTME
Average MXT Queueing Time	is the average time spent waiting by those user transactions that had to wait for MXT reasons. Source field: (XMGTQTME / XMGTDT)
Current Queued User transactions	is the current number of user transactions currently queuing for MXT reasons. **Note:** That this does not include transactions currently queued for Transaction Class. Source field: XMGCQT

Table 13 (Page 2 of 3). Fields in the Transaction Manager and Dispatcher Report	
Field Heading	**Description**
Total Queueing Time for current queued	is the total time spent waiting by those user transactions currently queued for MXT reasons. **Note:** This does not include the time spent waiting by those transactions that have finished queuing. Source field: XMGCQTME
Average Queueing Time for current queued	is the average time spent waiting by those user transactions currently queued for MXT reasons. Source field: (XMGCQTME / XMGCQT)
Dispatcher	
Dispatcher Start Time	is the time at which the dispatcher started. Source field: DSGSTART
Peak Tasks	is the peak number of tasks concurrently in the system. Source field: DSGPNT
Current tasks	is the current number of tasks in the system. This figure includes all system tasks and all user tasks. Source field: DSGCNT
Current ICV Time	is the ICV time value (expressed in *milliseconds*) specified in the SIT, or as an override, or changed dynamically using CEMT SET SYSTEM TIME(value) or EXEC CICS SET SYSTEM TIME(fullword binary data-value) commands. Source field: DSGICVT
Current ICVR Time	is the current task runaway time interval. Source field: EXEC CICS INQUIRE SYSTEM RUNAWAY
Current ICVTSD Time	is the ICVTSD time value (expressed in *milliseconds*) specified in the SIT, or as an override, or changed dynamically using CEMT SET SYSTEM SCANDELAY(value) or EXEC CICS SET SYSTEM SCANDELAY(fullword binary data-value) commands. Source field: DSGICVSD
Current PRTYAGING Time	is the current task priority aging factor. Source field: EXEC CICS INQUIRE SYSTEM PRTYAGING
Number of active CICS TCBs	is the number of active CICS VSE subtasks. Source field: DSGTCBF1 -> DSGTCBAC
TCB Name	is the name of the VSE subtask that the statistics refer to. The names are:- • 'QR_SUBD' • 'RO_SUBD' • 'SZ ' Source field: DSGTCBNM
TCB Status	is the current status of this CICS dispatcher VSE subtask. **Note:** If the VSE subtask is inactive there are no statistics in the following fields. Source field: DSGTCBAC

Table 13 (Page 3 of 3). Fields in the Transaction Manager and Dispatcher Report	
Field Heading	**Description**
TCB Start Time	is the time at which the dispatcher started this VSE subtask. Source field: DSGSTART
Op. System Waits	is the number of MVS waits which occurred on this VSE subtask. Source field: DSGSYSW
Op. System Wait Time	is the accumulated real time that this VSE subtask was in a VSE wait, that is, the total time used between a VSE wait issued by the dispatcher and the return from the VSE wait. Source field: DSGTWT
TCB Dispatch Time	is the accumulated real time that this VSE subtask has been dispatched by VSE, that is, the total time used between a VSE wait issued by the dispatcher and the subsequent wait issued by the dispatcher. Source field: DSGTDT
Totals	
VSE subtask Dispatch Time	is the total accumulated real time that the active VSE subtasks have been dispatched. Source field: DSGTDT for each active VSE subtask

Storage Reports

The Storage Below 16Mb Report provides information on the use of MVS and CICS VSE/ESA virtual storage. It contains the information you need to understand your current use of virtual storage below 16Mb and helps you to verify the size values used for the CDSA, UDSA, SDSA and RDSA and the value set for the DSA limit. Figure 17 shows the format of the Storage Below 16Mb Report. The field headings and contents are described in Table 14 on page 329.

```
Applid CICSA3    Sysid CICS  Jobname F3CICS41    Date 11/10/98    Time 1 4:34:54                CICS 01.01.00          PAGE 3

   Partition size established from ALLOC parameter . . :      26,111K

Storage BELOW 16MB

   Partition GETVIS area size under 16 Mb  . . . . . :       8,704K

     Partition GETVIS used area below 16 Mb  . . . . . :       4,568K
     Partition GETVIS free area below 16 Mb  . . . . . :       4,136K
     Partition GETVIS maximum used below 16 Mb . . . . :       8,704K
Partition GETVIS largest free area  below 16 Mb . :       4,096K

   Current DSA Limit . . . . . :       4,096K
   Current Allocation for DSAs . :       1,792K
   Peak Allocation for DSAs. . . :       1,792K
                                  CDSA            UDSA            SDSA            RDSA                  Totals

   Current DSA Size. . . . . :            512K            256K            256K            768K           1,792K
   Current DSA Used. . . . . :            188K              4K             88K            660K             940K
   Current DSA Used as % of DSA. :         36%              1%             34%             85%          52% of DSA Size
 * Peak DSA Used . . . . . :            264K              4K             88K            660K
   Peak DSA Size . . . . . :            512K            256K            256K            768K
   Cushion Size. . . . . :             64K             64K             64K             64K
   Free Storage (inc. Cushion) . :      324K            252K            168K            108K
 * Peak Free Storage . . . . . :       340K            256K            256K            560K
 * Lowest Free Storage . . . . . :     248K            252K            168K            108K
   Largest Free Area . . . . . :        248K            252K            168K             96K
   Largest Free Area as % of DSA :       48%              98%             65%             12%
   Largest Free/Free Storage . . :     0.76            1.00            1.00            0.88

   Current number of extents . . :        2               1               1               2               6
   Number of extents added . . . :        2               1               1               2
   Number of extents released. . :        0               0               0               0

   Getmain Requests. . . . . :          213              27               8              18
   Freemain Requests . . . . . :        155              25               2               0

   Current number of Subpools. . :       32               9               6               4              51

   Add Subpool Requests. . . . . :       55              32               6               4
   Delete Subpool Requests . . . :       23              23               0               0

   Times no storage returned . . :        0               0               0               0
   Times request suspended . . . :        0               0               0               0
   Current requests suspended. . :        0               0               0               0
   Peak requests suspended . . . :        0               0               0               0
   Requests purged while waiting :        0               0               0               0

   Times Cushion released. . . . :        0               0               0               0
   Times Short-On-Storage. . . . :        0               0               0               0
   Total time Short-On-Storage . :  00:00:00.00000  00:00:00.00000  00:00:00.00000  00:00:00.00000
   Average Short-On-Storage time :  00:00:00.00000  00:00:00.00000  00:00:00.00000  00:00:00.00000

   Storage Violations. . . . . :        0               0               0               0               0

   Access. . . . . :          CICS            CICS            CICS         READONLY

 '*' indicates values reset on last DSA Size change
```

Figure 17. The Storage Report Below 16Mb

Table 14 (Page 1 of 4). Fields in the Storage Below 16Mb Report	
Field Heading	**Description**
Partition size established from ALLOC parameter	is the partition size established by calculating the partition ending address - the partition start address.
Storage BELOW 16MB	
Partition GETVIS area size under 16Mb.	is the total partition GETVIS area available for this partition below 16Mb, expressed in Kbytes.
Partition GETVIS used area below 16Mb.	is the currently used amount of partition GETVIS area available below 16Mb, expressed in Kbytes.
Partition GETVIS maximum used below 16Mb.	is the maximum amount of the partition GETVIS area below 16Mb that has been used, expressed in Kbytes.
Partion GETVIS largest free area below 16Mb.	is the size of the largest area in partition GETVIS below 16Mb that is free, expressed in Kbytes.
Current DSA Limit	is the current DSA Limit, expressed in Kbytes. Source field: (SMSDSALIMIT / 1024)
Current Allocation for DSAs	is the current amount of storage allocated to the DSAs below 16MB, expressed in Kbytes. This value may be smaller or larger than the current DSA limit. Source field: (SMSDSATOTAL / 1024)
Peak Allocation for DSAs	is the peak amount of storage allocated to the DSAs below 16MB, expressed in Kbytes. This value may be smaller or larger than the current DSA limit. Source field: (SMSHWMDSATOTAL / 1024)
Current DSA Size	is the current size of the CDSA, UDSA, SDSA, or the RDSA, expressed in Kbytes. Source field: (SMSDSASZ / 1024)
Current DSA Used	is the current amount of storage used in this DSA expressed in Kbytes. Source field: ((SMSDSASZ - SMSFSTG) / 1024)
Current DSA Used as % of DSA	is the current amount of storage used in this DSA expressed as a percentage of the current DSA size. Source field: (((SMSDSASZ - SMSFSTG) / SMSDSASZ) * 100)
Peak DSA Used	is the peak amount of storage used in this DSA expressed in Kbytes. Source field: (SMSHWMPS / 1024)
Peak DSA Size	is the peak size of the CDSA, UDSA, SDSA, or the RDSA, expressed in Kbytes. Source field: (SMSHWMDSASZ / 1024)
Cushion Size	is the size of the cushion, expressed in bytes. The cushion forms part of the CDSA, UDSA, SDSA, or the RDSA, and is the amount of storage below which CICS goes SOS. Source field: (SMSCSIZE / 1024)

Table 14 (Page 2 of 4). Fields in the Storage Below 16Mb Report	
Field Heading	**Description**
Free Storage (inc. Cushion)	is the current amount of free storage in this pagepool, expressed in Kbytes. Source field: (SMSFSTG / 1024)
Peak Free Storage	is the peak amount of free storage in this pagepool, expressed in Kbytes. Source field: (SMSHWMFSTG / 1024)
Lowest Free Storage	is the lowest amount of free storage in this pagepool, expressed in Kbytes. Source field: (SMSLWMFSTG / 1024)
Largest Free Area	is the length of the largest contiguous free area in the CDSA, UDSA, SDSA, or RDSA, expressed in bytes. Source field: (SMSLFA / 1024)
Largest Frea Area as % of DSA	is the largest contiguous free area in the CDSA, UDSA, SDSA, or RDSA, expressed as a precentage of the current DSA Size. Source field: ((SMSLFA / SMSDSASZ) * 100)
Largest Frea/Free Storage	is an indication of the storage fragmentation in this pagepool. This value is calculated by dividing the “Largest Free Area” (SMSLFA) by the “Free storage” (SMSFSTG). If the ratio is large, then this pagepool is fragmented. Source field: (SMSLFA / SMSFSTG)
Current number of extents	is the current number of extents allocated to this DSA. Source field: SMSEXTS
Number of extents added	is the number of extents added to this DSA. Source field: SMSEXTSA
Number of extents released	is the number of extents released from this DSA. Source field: SMSEXTSR
Getmain Requests	is the number of GETMAIN requests from the CDSA, UDSA, SDSA, or RDSA. Source field: SMSGMREQ
Freemain Requests	is the number of FREEMAIN requests from the CDSA, UDSA, SDSA, or RDSA. Source field: SMSFMREQ
Current number of Subpools	is the current number of subpools (domain and task) in the CDSA, UDSA, SDSA, or RDSA. Source field: SMSCSUBP
Add Subpool Requests	is the number of ADD_SUBPOOL requests to create a subpool (domain or task) from the CDSA, UDSA, SDSA, or RDSA. Source field: SMSASR

Table 14 (Page 3 of 4). Fields in the Storage Below 16Mb Report	
Field Heading	**Description**
Delete Subpool Requests	is the number of DELETE_SUBPOOL requests (domain or task) from the CDSA, UDSA, SDSA, or RDSA. Source field: SMSDSR
Times no storage returned	is the number of times a GETMAIN request with SUSPEND(NO) returned the condition INSUFFICIENT_STORAGE. Source field: SMSCRISS
Times request suspended	is the number of times a GETMAIN request with SUSPEND(YES) was suspended because of insufficient storage to satisfy the request at the moment. Source field: SMSUCSS
Current requests suspended	is the number of GETMAIN requests currently suspended for storage. Source field: SMSCSS
Peak requests suspended	is the peak number of GETMAIN requests suspended for storage. Source field: SMSHWMSS
Requests purged while waiting	is the number of requests which were purged while suspended for storage. Source field: SMSPWWS
Times cushion released	is the number of times a GETMAIN request caused the storage cushion to be released. The cushion is said to be released when the number of free pages drops below the number of pages in the cushion. Source field: SMSCREL
Times Short-On-Storage	is the number of times CICS went SOS in this pagepool (CDSA, UDSA, SDSA, or RDSA), where SOS means either that the cushion is currently in use and/or there is at least one task suspended for storage. Source field: SMSSOS
Total Short-On-Storage time	is the accumulated time that CICS has been SOS in this DSA. Source field: SMSTSOS
Average Short-On-Storage time	is the average time that CICS has been SOS in this DSA. Source field: (SMSTSOS / SMSSOS)
Storage Violations	is the number of storage violations recorded in the CDSA, UDSA, SDSA, or the RDSA. Source field: SMSSV

Table 14 (Page 4 of 4). Fields in the Storage Below 16Mb Report	
Field Heading	**Description**
Access	is the type of access of the page pool. It will either be CICS, USER, or READONLY. If storage protection is not active, all storage areas will revert to CICS except those in the RDSA. • CICS - access is CICS key • USER - access is USER key • READONLY - access is read-only protection Source field: SMSACCESS

The Storage Above 16Mb Report provides information on the use of MVS and CICS VSE/ESA virtual storage. It contains the information you need to understand your current use of virtual storage above 16Mb and helps you to verify the size values used for the ECDSA, EUDSA, ESDSA and ERDSA and the value set for the EDSA limit. Figure 18 shows the format of the Storage Above 16Mb Report. The field headings and contents are described in Table 15 on page 334.

```
Applid CICSA3    Sysid CICS  Jobname F3CICS41    Date 11/10/98    Time 1 4:34:54                CICS 01.01.00         PAGE 4

Storage ABOVE 16MB

   Partition GETVIS area size above 16 Mb  . . . . . . :      16,384K

     Partition GETVIS used area above 16 Mb  . . . . . :      12,500K
     Partition GETVIS free area above 16Mb . . . . . . :       3,884K
     Partition GETVIS maximum used above 16 Mb . . . . :      16,384K
Partition GETVIS largest free area above 16 Mb  . :           7,876K

   Current EDSA Limit. . . . . . :      10,240K
   CICS Trace table size . . . . . . . . . . . . . . . . :          64K
   Current Allocation for EDSAs. :      10,240K
   Peak Allocation for EDSAs . . :      10,240K

                                  ECDSA            EUDSA            ESDSA            ERDSA           Totals

   Current DSA Size. . . . . . . :           2,048K           1,024K           1,024K           6,144K          10,240K
   Current DSA Used. . . . . . . :           1,400K              64K             100K           5,012K           6,576K
   Current DSA Used as % of DSA. :              68%               6%               9%              81%              64% of EDSA Size
 * Peak DSA Used . . . . . . . . :           1,404K              64K             100K           5,012K
   Peak DSA Size . . . . . . . . :           2,048K           1,024K           1,024K           6,144K
   Cushion Size. . . . . . . . . :             128K               0K             128K             256K
   Free Storage (inc. Cushion) . :             648K             960K             924K           1,132K
 * Peak Free Storage . . . . . . :           1,024K           1,024K           1,024K           2,792K
 * Lowest Free Storage . . . . . :             644K             960K             924K           1,132K
   Largest Free Area . . . . . . :             644K             960K             924K             880K
   Largest Free Area as % of DSA :              31%              93%              90%              14%
   Largest Free/Free Storage . . :            0.99             1.00             1.00             0.77

   Current number of extents . . :               2                1                1                5               9
   Number of extents added . . . :               2                1                1                5
   Number of extents released. . :               0                0                0                0

   Getmain Requests. . . . . . . :           8,304                9                3              245
   Freemain Requests . . . . . . :           3,924                7                0                9

   Current number of Subpools. . :             133                9                3                4             149
   Add Subpool Requests. . . . . :             156               32                3                4
   Delete Subpool Requests . . . :              23               23                0                0

   Times no storage returned . . :               0                0                0                0
   Times request suspended . . . :               0                0                0                0
   Current requests suspended. . :               0                0                0                0
   Peak requests suspended . . . :               0                0                0                0
   Requests purged while waiting :               0                0                0                0

   Times Cushion released. . . . :               0                0                0                0
   Times Short-On-Storage. . . . :               0                0                0                0
   Total time Short-On-Storage . :  00:00:00.00000   00:00:00.00000   00:00:00.00000   00:00:00.00000
   Average Short-On-Storage time :  00:00:00.00000   00:00:00.00000   00:00:00.00000   00:00:00.00000

   Storage Violations. . . . . . :               0                0                0                0               0

   Access. . . . . . . . . . . . :            CICS             CICS             CICS         READONLY

  '*' indicates values reset on last DSA Size change
```

Figure 18. The Storage Report Above 16Mb

Table 15 (Page 1 of 4). Fields in the Storage Above 16Mb Report	
Field Heading	**Description**
Storage ABOVE 16MB	
Partition GETVIS area size above 16Mb.	is the total partition GETVIS area available for this partition below 16Mb, expressed in Kbytes.
Partition GETVIS used area above 16Mb.	is the currently used amount of partition GETVIS allocated above 16Mb, expressed in Kbytes.
Partition GETVIS free area above 16Mb.	is the currently available amount of partition GETVIS area above 16Mb, expressed in Kbytes.
Partion GETVIS maximum used above 16Mb.	is the maximum amount of the partition GETVIS area above 16Mb that has been used, expressed in Kbytes.
Partion GETVIS largest free area above 16Mb.	is the size of the largest area in partition GETVIS above 16Mb that is free, expressed in Kbytes.
Current EDSA Limit	is the current EDSA Limit, expressed in Kbytes. Source field: (SMSEDSALIMIT / 1024)
CICS Trace table size	is the current size of the CICS trace table. Source field: EXEC CICS INQUIRE TRACEDEST TABLESIZE
Current Allocation for EDSAs	is the peak amount of storage allocated to the DSAs above 16MB, expressed in Kbytes. This value may be smaller or larger than the current EDSA limit. Source field: (SMSEDSATOTAL / 1024)
Peak Allocation for EDSAs	is the peak amount of storage allocated to the DSAs above 16MB, expressed in Kbytes. This value may be smaller or larger than the current EDSA limit. Source field: (SMSHWMEDSATOTAL / 1024)
Current DSA Size	is the current size of the ECDSA, EUDSA, ESDSA, or the ERDSA, expressed in Kbytes. Source field: (SMSDSASZ / 1024)
Current DSA Used	is the current amount of storage used in this DSA expressed in Kbytes. Source field: ((SMSDSASZ - SMSFSTG) / 1024)
Current DSA Used as % of DSA	is the current amount of storage used in this DSA expressed as a percentage of the current DSA size. Source field: (((SMSDSASZ - SMSFSTG) / SMSDSASZ) * 100)
Peak DSA Used	is the peak amount of storage used in this DSA expressed in Kbytes. Source field: (SMSHWMPS / 1024)
Peak DSA Size	is the peak size of the ECDSA, EUDSA, ESDSA, or the ERDSA, expressed in Kbytes. Source field: (SMSHWMDSASZ / 1024)

Table 15 (Page 2 of 4). Fields in the Storage Above 16Mb Report	
Field Heading	**Description**
Cushion Size	is the size of the cushion, expressed in bytes. The cushion forms part of the ECDSA, EUDSA, ESDSA, or the ERDSA, and is the amount of storage below which CICS goes SOS. Source field: (SMSCSIZE / 1024)
Free Storage (inc. Cushion)	is the current amount of free storage in this pagepool, expressed in Kbytes. Source field: (SMSFSTG / 1024)
Peak Free Storage	is the peak amount of free storage in this pagepool, expressed in Kbytes. Source field: (SMSHWMFSTG / 1024)
Lowest Free Storage	is the lowest amount of free storage in this pagepool, expressed in Kbytes. Source field: (SMSLWMFSTG / 1024)
Largest Free Area	is the length of the largest contiguous free area in the ECDSA, EUDSA, ESDSA, or ERDSA, expressed in Kbytes. Source field: SMSLFA
Largest Frea Area as % of DSA	is the largest contiguous free area in the ECDSA, EUDSA, ESDSA, or ERDSA, expressed as a precentage of the current DSA Size. Source field: ((SMSLFA / SMSDSASZ) * 100)
Largest Frea/Free Storage	is an indication of the storage fragmentation in this pagepool. This value is calculated by dividing the “Largest Free Area” (SMSLFA) by the “Free storage” (SMSFSTG). If the ratio is large, then this pagepool is fragmented. Source field: (SMSLFA / SMSFSTG)
Current number of extents	is the current number of extents allocated to this DSA. Source field: SMSEXTS
Number of extents added	is the number of extents added to this DSA. Source field: SMSEXTSA
Number of extents released	is the number of extents released from this DSA. Source field: SMSEXTSR
Getmain Requests	is the number of GETMAIN requests from the ECDSA, EUDSA, ESDSA, or ERDSA. Source field: SMSGMREQ
Freemain Requests	is the number of FREEMAIN requests from the ECDSA, EUDSA, ESDSA, or ERDSA. Source field: SMSFMREQ
Current number of Subpools	is the current number of subpools (domain and task) in the ECDSA, EUDSA, ESDSA, or ERDSA. Source field: SMSCSUBP

Table 15 (Page 3 of 4). Fields in the Storage Above 16Mb Report	
Field Heading	**Description**
Add Subpool Requests	is the number of ADD_SUBPOOL requests to create a subpool (domain or task) from the ECDSA, EUDSA, ESDSA, or ERDSA. Source field: SMSASR
Delete Subpool Requests	is the number of DELETE_SUBPOOL requests (domain or task) from the ECDSA, EUDSA, ESDSA, or ERDSA. Source field: SMSDSR
Times no storage returned	is the number of times a GETMAIN request with SUSPEND(NO) returned the condition INSUFFICIENT_STORAGE. Source field: SMSCRISS
Times request suspended	is the number of times a GETMAIN request with SUSPEND(YES) was suspended because of insufficient storage to satisfy the request at the moment. Source field: SMSUCSS
Current requests suspended	is the number of GETMAIN requests currently suspended for storage. Source field: SMSCSS
Peak requests suspended	is the peak number of GETMAIN requests suspended for storage. Source field: SMSHWMSS
Requests purged while waiting	is the number of requests which were purged while suspended for storage. Source field: SMSPWWS
Times cushion released	is the number of times a GETMAIN request caused the storage cushion to be released. The cushion is said to be released when the number of free pages drops below the number of pages in the cushion. Source field: SMSCREL
Times Short-On-Storage	is the number of times CICS went SOS in this pagepool (ECDSA, EUDSA, ESDSA, or ERDSA), where SOS means either that the cushion is currently in use and/or there is at least one task suspended for storage. Source field: SMSSOS
Total Short-On-Storage time	is the accumulated time that CICS has been SOS in this DSA. Source field: SMSTSOS
Average Short-On-Storage time	is the average time that CICS has been SOS in this DSA. Source field: (SMSTSOS / SMSSOS)

Table 15 (Page 4 of 4). Fields in the Storage Above 16Mb Report	
Field Heading	**Description**
Storage Violations	is the number of storage violations recorded in the ECDSA, EUDSA, ESDSA, or the ERDSA. Source field: SMSSV
Access	is the type of access of the page pool. It will either be CICS, USER, or READONLY. If storage protection is not active, all storage areas will revert to CICS except those in the ERDSA. • CICS - access is CICS key • USER - access is USER key • READONLY - access is read-only protection Source field: SMSACCESS

Loader and Program Storage Report

Figure 19 shows the format of the Loader and Program Storage Report. The field headings and contents are described in Table 16 on page 339.

```
Applid CICSA3    Sysid CICS  Jobname F3CICS41    Date 11/10/98    Time 1 4:34:54                CICS 01.01.00         PAGE 5

Loader

   Library Load requests. . . . . . . . . . . . . :           293  Total Program Uses . . . . . . . . . . . . . . :           269
   Total Library Load time. . . . . . . . . . . . :  00:00:14.26742 Program Use to Load Ratio. . . . . . . . . . . :           9.1
   Average Library Load time. . . . . . . . . . . :  00:00:00.04868
   Library Load requests that waited. . . . . . . :             2
   Total Library Load request wait time . . . . . :  00:00:00.10822
   Average Library Load request wait time . . . . :  00:00:00.05411
   Current Waiting Library Load requests. . . . . :             0
   Peak Waiting Library Load requests . . . . . . :             1
   Times at Peak. . . . . . . . . . . . . . . . . :             2  Average Not-In-Use program size. . . . . . . . . :           17K

CDSA                                              ECDSA

   Programs Removed by compression. . . . . . . . :             0  Programs Removed by compression. . . . . . . . :             0
   Time on the Not-In-Use Queue . . . . . . . . . :  00:00:00.00000  Time on the Not-In-Use Queue . . . . . . . . . : 00:00:00.00000
   Average Time on the Not-In-Use Queue . . . . . :  00:00:00.00000  Average Time on the Not-In-Use Queue . . . . . : 00:00:00.00000
   Programs Reclaimed from the Not-In-Use Queue . :             0  Programs Reclaimed from the Not-In-Use Queue . :             0
   Programs Loaded - now on the Not-In-Use Queue. :             1  Programs Loaded - now on the Not-In-Use Queue. :             2

SDSA                                              ESDSA

   Programs Removed by compression. . . . . . . . :             0  Programs Removed by compression. . . . . . . . :             0
   Time on the Not-In-Use Queue . . . . . . . . . :  00:00:00.00000  Time on the Not-In-Use Queue . . . . . . . . . : 00:00:00.00000
   Average Time on the Not-In-Use Queue . . . . . :  00:00:00.00000  Average Time on the Not-In-Use Queue . . . . . : 00:00:00.00000
   Programs Reclaimed from the Not-In-Use Queue . :             0  Programs Reclaimed from the Not-In-Use Queue . :            33
   Programs Loaded - now on the Not-In-Use Queue. :             0  Programs Loaded - now on the Not-In-Use Queue. :             2

RDSA                                              ERDSA

   Programs Removed by compression. . . . . . . . :             0  Programs Removed by compression. . . . . . . . :             0
   Time on the Not-In-Use Queue . . . . . . . . . :  00:00:00.00000  Time on the Not-In-Use Queue . . . . . . . . . : 00:00:00.00000
   Average Time on the Not-In-Use Queue . . . . . :  00:00:00.00000  Average Time on the Not-In-Use Queue . . . . . : 00:00:00.00000
   Programs Reclaimed from the Not-In-Use Queue . :             0  Programs Reclaimed from the Not-In-Use Queue . :         2,149
   Programs Loaded - now on the Not-In-Use Queue. :             4  Programs Loaded - now on the Not-In-Use Queue. :            20

Program Storage

   Nucleus Program Storage (CDSA) . . . . . . . . :           20K  Nucleus Program Storage (ECDSA). . . . . . . . :            8K

   Program Storage (SDSA) . . . . . . . . . . . . :            0K  Program Storage (ESDSA). . . . . . . . . . . . :          100K
   Resident Program Storage (SDSA). . . . . . . . :            0K  Resident Program Storage (ESDSA) . . . . . . . :            0K

   Read-Only Nucleus Program Storage (RDSA) . . . :           64K  Read-Only Nucleus Program Storage (ERDSA). . . :        1,048K
   Read-Only Program Storage (RDSA) . . . . . . . :          112K  Read-Only Program Storage (ERDSA). . . . . . . :        2,052K
   Read-Only Resident Program Storage (RDSA). . . :          292K  Read-Only Resident Program Storage (ERDSA) . . :            0K

   CDSA used by Not-In-Use programs. :        17K   3.28% of CDSA   ECDSA used by Not-In-Use programs :         5K   0.22% of ECDSA
   SDSA used by Not-In-Use programs. :         0K   0.00% of SDSA   ESDSA used by Not-In-Use programs :         2K   0.15% of ESDSA
   RDSA used by Not-In-Use programs. :        56K   7.26% of RDSA   ERDSA used by Not-In-Use programs :       437K   7.11% of ERDSA
```

Figure 19. The Loader and Program Storage Report

Table 16 (Page 1 of 4). Fields in the Loader and Program Storage Report	
Field Heading	**Description**
Loader	
Library Load requests	is the number of times the loader has issued an VSE LOAD request to load programs from the DFHRPL library concatenation into CICS managed storage. Modules in the LPA are not included in this figure. Source field: LDGLLR
Total Program Uses	is the number of uses of any program by the CICS system. Source field: LDGPUSES
Total Library Load time	is the time taken for the number of library loads indicated by LDGLLR. Source field: LDGLLT
Program Use to Load Ratio	is the ratio of program uses to programs loads. Source field: (LDGPUSES / LDGLLR)
Average Library Load time	is the average time to load a program. Source field: (LDGLLT / LDGLLR)
Library Load requests that waited	is the number of loader domain requests that ***were*** forced to suspend due to the loader domain performing an operation on that program on behalf of another task. These operations could be: • A NEWCOPY request • Searching the SVA • A physical load in progress. This figure is the total number of tasks that have waited, and does not include those that are currently waiting (LDGWLR). Source field: LDGWTDLR
Total Library Load request wait time	is the suspended time for the number of tasks indicated by LDGWTDLR. Source field: LDGTTW
Average Library Load request wait time	is the average loader domain request suspend time. Source field: (LDGTTW / LDGWTDLR)
Current Waiting Library Load requests	is the number of loader domain requests that ***are currently*** forced to suspend due to the loader domain currently performing an operation on that program on behalf of another task. These operations could be: • A NEWCOPY request • Searching the SVA • A physical load in progress. Source field: LDGWLR
Peak Waiting Library Load requests	is the maximum number of tasks suspended at one time. Source field: LDGWLRHW

Table 16 (Page 2 of 4). Fields in the Loader and Program Storage Report	
Field Heading	**Description**
Times at Peak	is the number of times the high watermark level indicated by LDGWLRHW was reached. This, along with the previous two values, is an indication of the level of contention for loader resource. Source field: LDGHWMT
Average Not-In-Use program size	is the average size of a program currently on the Not-In-Use queue. Source field: ((LDGCNIU + LDGSNIU + LDGRNIUS + LDGECNIU + LDGESNIU + LDGERNIU) / 1024) / LDGPROGNIU)
Programs Removed by compression	is the number of program instances removed from storage by the Dynamic Program Storage Compression (DPSC) mechanism. Source field: LDGDPSCR
Time on the Not-In-Use Queue	is the program Not-In-Use (NIU) queue membership time. For each program that becomes eligible for removal from storage by the DPSC mechanism, the time between the program becoming eligible and the actual time of its being removed from storage is calculated. This field is the sum of these times for all programs removed by the DPSC mechanism and as such can be greater than the elapsed time CICS run time. This field does not include the wait time for those programs reclaimed from the Not-In-Use queue. Source field: LDGDPSCT
Average Time on the Not-In-Use Queue	is the average length of time that a program is eligible for removal from storage by the DPSC mechanism. Source field: (LDGDPSCT / LDGDPSCR)
Programs Reclaimed from the Not-In-Use Queue	is the number of reclaims that CICS has made from the Not-In-Use (NIU) queue. Reclaims occur when a request is issued for programs currently in the Not-In-Use queue. The reclaimed instance of a program is no longer eligible for program compression (DPSC). Source field: LDGRECNIU
Programs Loaded - on the Not-In-Use Queue	is the number of programs on the Not-In-Use (NIU) queue. Source field: LDGPROGNIU
Program Storage	
Nucleus Program Storage (CDSA)	is the current amount of storage allocated to nucleus programs in the CDSA. Source field: (SMDCPS for subpool 'LDNUC ' / 1024)
Nucleus Program Storage (ECDSA)	is the current amount of storage allocated to nucleus programs in the ECDSA. Source field: (SMDCPS for subpool 'LDENUC ' / 1024)

Table 16 (Page 3 of 4). Fields in the Loader and Program Storage Report

Field Heading	Description
Program Storage (SDSA)	is the current amount of storage allocated to programs in the SDSA. Source field: (SMDCPS for subpool 'LDPGM ' / 1024)
Program Storage (ESDSA)	is the current amount of storage allocated to programs in the ESDSA. Source field: (SMDCPS for subpool 'LDEPGM ' / 1024)
Resident Program Storage (SDSA)	is the current amount of storage allocated to resident programs in the SDSA. Source field: (SMDCPS for subpool 'LDRES ' / 1024)
Resident Program Storage (ESDSA)	is the current amount of storage allocated to resident programs in the ESDSA. Source field: (SMDCPS for subpool 'LDERES ' / 1024)
Read-Only Nucleus Program Storage (RDSA)	is the current amount of storage allocated to nucleus programs in the RDSA. Source field: (SMDCPS for subpool 'LDNUCRO ' / 1024)
Read-Only Nucleus Program Storage (ERDSA)	is the current amount of storage allocated to nucleus programs in the ERDSA. Source field: (SMDCPS for subpool 'LDENUCRO' / 1024)
Read-Only Program Storage (RDSA)	is the current amount of storage allocated to programs in the RDSA. Source field: (SMDCPS for subpool 'LDPGMRO ' / 1024)
Read-Only Program Storage (ERDSA)	is the current amount of storage allocated to programs in the ERDSA. Source field: (SMDCPS for subpool 'LDEPGMRO' / 1024)
Read-Only Resident Program Storage (RDSA)	is the current amount of storage allocated to resident programs in the RDSA. Source field: (SMDCPS for subpool 'LDRESRO ' / 1024)
Read-Only Resident Program Storage (ERDSA)	is the current amount of storage allocated to resident programs in the ERDSA. Source field: (SMDCPS for subpool 'LDERESRO' / 1024)
CDSA used by Not-In-Use programs	is the current amount of CDSA storage which is occupied by Not-In-Use (NIU) programs. Source field: (LDGSTGNIU(1) / 1024)

Table 16 (Page 4 of 4). Fields in the Loader and Program Storage Report	
Field Heading	**Description**
ECDSA used by Not-In-Use programs	is the current amount of ECDSA storage which is occupied by Not-In-Use (NIU) programs. Source field: (LDGSTGNIU(2) / 1024)
SDSA used by Not-In-Use programs	is the current amount of UDSA storage which is occupied by Not-In-Use (NIU) programs. Source field: (LDGSTGNIU(3) / 1024)
ESDSA used by Not-In-Use programs	is the current amount of EUDSA storage which is occupied by Not-In-Use (NIU) programs. Source field: (LDGSTGNIU(4) / 1024)
RDSA used by Not-In-Use programs	is the current amount of UDSA storage which is occupied by Not-In-Use (NIU) programs. Source field: (LDGSTGNIU(5) / 1024)
ERDSA used by Not-In-Use programs	is the current amount of ERDSA storage which is occupied by Not-In-Use (NIU) programs. Source field: (LDGSTGNIU(6) / 1024)

Transactions Report

Figure 20 shows the format of the Transactions Report. The field headings and contents are described in Table 17 on page 344.

```
Applid CICSA3    Sysid CICS  Jobname F3CICS41    Date 11/10/98    Time 1 4:34:54                CICS 01.01.00         PAGE 6

Transactions

   Tran    Tran      Program                Task Data      Attach      Restart     Dynamic  -  Counts      Remote
     id    Class     Name       Dynamic   Location/Key      Count        Count       Local       Remote      Starts

   ARPS              DFH$ARPS   Static       Any/USER            0            0           0            0           0
   CATA              DFHZATA    Static       Any/CICS            1            0           0            0           0
   CATD              DFHZATD    Static       Any/CICS            0            0           0            0           0
   CATR              DFHZATR    Static       Any/CICS            0            0           0            0           0
   CCIN   DFHCOMCL   DFHZCN1    Static       Any/CICS            0            0           0            0           0
   CDTS              DFHZATS    Static       Any/CICS            0            0           0            0           0
   CEBR              DFHEDFBR   Static       Any/CICS            0            0           0            0           0
   CECI              DFHECIP    Static     Below/USER            1            0           0            0           0
   CECS              DFHECSP    Static       Any/CICS            0            0           0            0           0
   CEDA              DFHEDAP    Static       Any/CICS            0            0           0            0           0
   CEDB              DFHEDAP    Static       Any/CICS            0            0           0            0           0
   CEDC              DFHEDAP    Static       Any/CICS            0            0           0            0           0
   CEDF              DFHEDFP    Static       Any/CICS            0            0           0            0           0
   CEGN              DFHCEGN    Static       Any/CICS            0            0           0            0           0
   CEHP              DFHCHS     Static     Below/CICS            0            0           0            0           0
   CEHS              DFHCHS     Static     Below/CICS            0            0           0            0           0
   CEMS              DFHEMSP    Static       Any/CICS            0            0           0            0           0
   CEMT              DFHEMTP    Static     Below/CICS            0            0           0            0           0
   CEOS              DFHEMSP    Static       Any/CICS            0            0           0            0           0
   CEOT              DFHEOTP    Static     Below/CICS            0            0           0            0           0
   CEPW              DFHPSOP    Static       Any/CICS            0            0           0            0           0
   CESC              DFHCESC    Static       Any/CICS            0            0           0            0           0
   CESF              DFHSFP     Static     Below/CICS            0            0           0            0           0
   CESN              DFHSNP     Static     Below/CICS            0            0           0            0           0
   CEST              DFHESTP    Static     Below/CICS            0            0           0            0           0
   CETR              DFHCETRA   Static     Below/CICS            0            0           0            0           0
   CFTS              DFHZATS    Static       Any/CICS            0            0           0            0           0
   CGRP              DFHZCGRP   Static       Any/CICS            1            0           0            0           0
   CITS              DFHZATS    Static       Any/CICS            0            0           0            0           0
   CLS1              DFHZLS1    Static       Any/CICS            0            0           0            0           0
   CLS2              DFHLUP     Static     Below/CICS            0            0           0            0           0
   CLS3              DFHCLS3    Static     Below/CICS            0            0           0            0           0
   CLS4              DFHCLS4    Static     Below/CICS            0            0           0            0           0
   CMPX              DFHMXP     Static     Below/CICS            0            0           0            0           0
   CMSG              DFHMSP     Static     Below/CICS            0            0           0            0           0
   CMTS              DFHZATS    Static       Any/CICS            0            0           0            0           0
   COVR              DFHZCOVR   Static       Any/CICS            0            0           0            0           0
   CPLT              DFHSIPLT   Static     Below/CICS            1            0           0            0           0
   CPMI              DFHMIRS    Static     Below/USER            0            0           0            0           0
   CQRY              DFHQRY     Static       Any/CICS            0            0           0            0           0
   CRMD              DFHZATMD   Static       Any/CICS            0            0           0            0           0
   CRMF              DFHZATMF   Static       Any/CICS            0            0           0            0           0
   CRSQ              DFHCRQ     Static     Below/CICS            1            0           0            0           0
   CRSR              DFHCRS     Static     Below/CICS            0            0           0            0           0
   CRSY              DFHRMSY    Static     Below/CICS            0            0           0            0           0
   CRTE              DFHRTE     Static     Below/CICS            0            0           0            0           0
   CRTX              ########   Dynamic      Any/CICS            0            0           0            0           0
   CSAC              DFHACP     Static     Below/CICS            1            0           0            0           0
   CSCY              DFHCPY     Static       Any/CICS            0            0           0            0           0
   CSFE              DFHFEP     Static       Any/CICS            0            0           0            0           0
   CSFU              DFHFCU     Static     Below/CICS            1            0           0            0           0
```

Figure 20. The Transactions Report

Table 17. Fields in the Transactions Report	
Field Heading	**Description**
Transactions	
Tran id	is the name of the transaction. Source field: EXEC CICS INQUIRE TRANSACTION
Tran Class	is the name of the transaction class in which the transaction is defined. Source field: XMRTCL
Program Name	is the name of the program when the transaction was defined, or spaces if a program name was not supplied. Source field: XMMRPN
Dynamic	indicates whether the transaction was defined as dynamic. Source field: XMRDYN
Task Data Location	is where certain CICS control blocks will be located for the transaction. Source field: EXEC CICS INQUIRE TRANSACTION TASKDATALOC
Task Data Key	is the storage key in which CICS will obtain all storage for use by the transaction. Source field: EXEC CICS INQUIRE TRANSACTION TASKDATAKEY
Attach Count	is the number of times this transaction definition has been used to attach a transaction. Source field: XMRAC
Restart Count	is the number of times this transaction was restarted after an abend. This field is zero if the transaction was not defined as RESTART=YES. Source field: XMRRC
Dynamic Counts - Local	is the total number of times the dynamic transaction routing exit has chosen to run this transaction on the local system. This field is zero if the transaction was not defined as DYNAMIC=YES. Source field: XMRDLC
Dynamic Counts - Remote	is the total number of times the dynamic transaction routing exit has chosen to run this transaction on a remote system. This field is zero if the transaction was not defined as DYNAMIC=YES. Source field: XMRDRC
Remote Starts	is the total number of times this transaction definition has been used to start a transaction remotely. Source field: XMRRSC

Transaction Totals Report

Figure 21 shows the format of the Transactions Totals Report. The field headings and contents are described in Table 18.

```
Applid CICSA3    Sysid CICS  Jobname F3CICS41    Date 11/10/98    Time 1 4:34:54                CICS 01.01.00         PAGE 8

Transaction Totals

      Task Data       Transaction    Attach
     Location/Key     Count          Count


     Below/CICS           29           21
       Any/CICS           43            7
     Below/USER           25            2
      Any/USER             5            0


   Totals                102           30
```

Figure 21. The Transaction Totals Report

Table 18. Fields in the Transaction Totals Report

Field Heading	Description
Transaction Totals	
Task Data Location/Key	is the number of transactions defined with this combination of task data location and task data key.
Transaction Count	is the number of transaction definitions for this combination of task data location, and task data key.
Attach Count	is the number of times these transaction definitions have been used to attach a transaction.

Programs Report

Figure 22 shows the format of the Programs Report. The field headings and contents are described in Table 19 on page 347.i

```
Applid CICSA3    Sysid CICS  Jobname F3CICS41    Date 11/10/98    Time 1 4:34:54                CICS 01.01.00         PAGE 9

Programs

   Program   Data   Exec                  Times          Total          Average          Times       Times      Program     Program
    Name     Loc    Key    Times Used     Fetched      Fetch Time     Fetch Time        Newcopy     Removed      Size      Location

   $EDCTCPV  Below  USER           0                                                        0           0                  None
   CEECBLDY  Below  USER           0                                                        0           0                  None
   CEECCICS  Below  USER           1            1    00:00:00.29580    00:00:00.29580      0           0       295,192    RDSA
   CEECDATX  Below  USER           0                                                        0           0                  None
   CEECMI    Below  USER           0                                                        0           0                  None
   CEECRHP   Below  USER           0                                                        0           0                  None
   CEECZST   Below  USER           0                                                        0           0                  None
   CEEDATE   Below  USER           0                                                        0           0                  None
   CEEDATM   Below  USER           0                                                        0           0                  None
   CEEDAYS   Below  USER           0                                                        0           0                  None
   CEEDCOD   Below  USER           0                                                        0           0                  None
   CEEDSHP   Below  USER           0                                                        0           0                  None
   CEEDYWK   Below  USER           0                                                        0           0                  None
   CEEEV000  Below  USER           0                                                        0           0                  None
   CEEEV001  Below  USER           0                                                        0           0                  None
   CEEEV002  Below  USER           0                                                        0           0                  None
   CEEEV003  Below  USER           1            1    00:00:01.22705    00:00:0  1.22705     0           0     1,195,866    ERDSA
   CEEEV004  Below  USER           0                                                        0           0                  None
   CEEEV005  Below  USER           1            1    00:00:00.04660    00:00:0  0.04660     0           0        15,288    ERDSA
   CEEEV006  Below  USER           0                                                        0           0                  None
   CEEEV007  Below  USER           0                                                        0           0                  None
   CEEEV008  Below  USER           0                                                        0           0                  None
   CEEEV009  Below  USER           0                                                        0           0                  None
   CEEEV010  Below  USER           1            1    00:00:00.48985    00:00:0  0.48985     0           0       196,094    ERDSA
   CEEEV011  Below  USER           0                                                        0           0                  None
   CEEEV012  Below  USER           0                                                        0           0                  None
   CEEEV013  Below  USER           0                                                        0           0                  None
   CEEEV014  Below  USER           0                                                        0           0                  None
   CEEEV015  Below  USER           0                                                        0           0                  None
   CEEEV016  Below  USER           0                                                        0           0                  None
   CEEEV017  Below  USER           0                                                        0           0                  None
   CEEFMDA   Below  USER           0                                                        0           0                  None
   CEEFMDT   Below  USER           0                                                        0           0                  None
   CEEFMTM   Below  USER           0                                                        0           0                  None
   CEEFRST   Below  USER           0                                                        0           0                  None
   CEEGMT    Below  USER           0                                                        0           0                  None
   CEEGMTO   Below  USER           0                                                        0           0                  None
   CEEGPID   Below  USER           0                                                        0           0                  None
   CEEGQDT   Below  USER           0                                                        0           0                  None
   CEEGTST   Below  USER           0                                                        0           0                  None
   CEEHDLR   Below  USER           0                                                        0           0                  None
   CEEHDLU   Below  USER           0                                                        0           0                  None
   CEEISEC   Below  USER           0                                                        0           0                  None
   CEEITOK   Below  USER           0                                                        0           0                  None
   CEEKDS    Below  USER           1            1  0 00:00:00.11022    00:00:0  0.11022     0           0        77,896    ERDSA
   CEELCLE   Below  USER           1            1  0 00:00:00.02768    00:00:0  0.02768     0           0        10,704    ERDSA
   CEELOCT   Below  USER           0                                                        0           0                  None
   CEEMENU0  Below  USER           0                                                        0           0                  None
   CEEMENU2  Below  USER           0                                                        0           0                  None
   CEEMENU3  Below  USER           0                                                        0           0                  None
   CEEMENU4  Below  USER           0                                                        0           0                  None
```

Figure 22. The Programs Report

Table 19. Fields in the Programs Report	
Field Heading	**Description**
Programs	
Program Name	is the name of the program. Source field: EXEC CICS INQUIRE PROGRAM
Data Loc	is the storage location which the program is able to accept. Source field: EXEC CICS INQUIRE PROGRAM DATALOCATION
EXEC Key	is the access key in which the program will execute. Source field: EXEC CICS INQUIRE PROGRAM EXECKEY
Times Used	is the number of times CICS tasks within the system have issued load requests to the loader domain to obtain access to a usable instance of this program. These load requests may cause the loader domain to issue an MVS LOAD. Source field: LDRTU
Times Fetched	is the number of times the loader domain has issued an MVS LOAD request to load a copy of the program from the DFHRPL library concatenation into CICS managed storage. Source field: LDRFC
Total Fetch Time	is the time taken to perform all fetches for this program. Source field: LDRFT
Average Fetch Time	is the average time taken to perform a fetch of the program. Source field: (LDRFT / LDRFC)
Times Newcopy	is the number of times a NEWCOPY has been requested against this program. Source field: LDRTN
Times Removed	is the number of times an instance of this program has been removed from CICS managed storage due to the actions of the Dynamic Program Storage Compression (DPSC) mechanism. Source field: LDRRPC
Program Size	is the size of the program in bytes, if known (otherwise zero). Source field: LDRPSIZE
Program Location	is the location of the current storage resident instance of the program, if any. It has one of the following values: • None - No current copy • CDSA - Current copy is in the CDSA • SDSA - Current copy is in the SDSA • RDSA - Current copy is in the RDSA • ECDSA - Current copy is in the ECDSA • ESDSA - Current copy is in the ESDSA • ERDSA - Current copy is in the ERDSA • SVA - Current copy is in the SVA • ESVA - Current copy is in the ESVA Source field: LDRLOCN

Program Totals Report

Figure 23 shows the format of the Program Totals Report. The field headings and contents are described in Table 20 on page 349.

```
Applid CICSA3    Sysid CICS  Jobname F3CICS41    Date 11/10/98    Time 1 4:34:54                CICS 01.01.00         PAGE 10

Program Totals

   Programs. . . . . :         749
     Assembler . . . . :         719
     C . . . . . :             3
     COBOL . . . . . :           5
     LE/VSE. . . . . :           0
     PL1 . . . . . :             4
     Other . . . . . :          18
   Maps. . . . . :             33
   Partitionsets . . . . :        1

   Total . . . . . :         783

   CDSA Programs . . . . :       2
   SDSA Programs . . . . :       0
   RDSA Programs . . . . :       7

   ECDSA Programs. . . . :       4
   ESDSA Programs. . . . :       3
   ERDSA Programs. . . . :      43

   SVA Programs. . . . . :       0
   ESva Programs . . . . :       0

   Unused Programs . . . :       1
   Not Located Programs. :     723

   Total . . . . . :         783
```

Figure 23. The Program Totals Report

Table 20. Fields in the Program Totals Report	
Field Heading	**Description**
Program Totals	
Programs - Assembler	is the current total number of programs defined to CICS as Assembler programs.
Programs - C	is the current total number of programs defined to CICS as C programs.
Programs - COBOL	is the current total number of programs defined to CICS as COBOL programs.
Programs - LE/VSE	is the current total number of programs defined to CICS as LE/VSE programs.
Programs - PL1	is the current total number of programs defined to CICS as PL/1 programs.
Programs - Other	is the current total number of programs defined to CICS that are not Assembler, C, COBOL, LE/VSE or PL/1.
Maps	is the current number of maps defined to CICS.
Partitionsets	is the current number of partitionsets defined to CICS.
Total	is the total number of programs, maps, and partitionsets defined to CICS.
CDSA Programs	is the current number of programs, maps, and partitionsets defined to CICS residing in the CDSA.
SDSA Programs	is the current number of programs, maps, and partitionsets defined to CICS residing in the SDSA.
RDSA Programs	is the current number of programs, maps, and partitionsets defined to CICS residing in the RDSA.
ECDSA Programs	is the current number of programs, maps, and partitionsets defined to CICS residing in the ECDSA.
ESDSA Programs	is the current number of programs, maps, and partitionsets defined to CICS residing in the ESDSA.
ERDSA Programs	is the current number of programs, maps, and partitionsets defined to CICS residing in the ERDSA.
SVA Programs	is the current number of programs, maps, and partitionsets defined to CICS residing in the SVA.
ESVA Programs	is the current number of programs, maps, and partitionsets defined to CICS residing in the ESVA.
Unused Programs	is the current number of programs, maps, and partitionsets defined to CICS and which have been sublibrary of the LIBDEF search chain for the CICS job library but which have not been used by any CICS task.
Not Found Programs	is the current number of programs, maps, and partitionsets defined to CICS but which have not been located in any sublibrary.
Total	is the total number of programs, maps, and partitionsets defined to CICS.

Temporary Storage Report

Figure 24 shows the format of the Temporary Storage Report. The field headings and contents are described in Table 21.

```
Applid CICSA3    Sysid CICS  Jobname F3CICS41    Date 11/10/98    Time 1 4:34:54                CICS 01.01.00         PAGE 25

Temporary Storage

   Put/Putq main storage requests . . . . . :           0
   Get/Getq main storage requests . . . . . :           0
   Peak storage used for TS Main. . . . . . :           0K
   Current storage used for TS Main . . . . :           0K

   Put/Putq auxiliary storage requests. . . :           0
   Get/Getq auxiliary storage requests. . . :           0

   Times temporary storage queue created. . :           0
   Peak temporary storage queues in use . . :           0
   Current temporary storage queues in use. :           0
   Items in longest queue . . . . . :           0
   Queue extension threshold. . . . . :           4
   Queue extensions created . . . . . :           0

   Control interval size. . . . . :       4,096
   Control intervals in the DFHTEMP dataset :         108
   Peak control intervals used. . . . . :           1
   Current control intervals in use . . . . :           1
   Available bytes per control interval . . :       4,032
   Segments per control interval. . . . . :          63
   Bytes per segment. . . . . :          64
   Writes bigger than control interval size :           0
   Largest record length written. . . . . :           0
   Times auxiliary storage exhausted. . . . :           0
   Number Temporary storage compressions. . :           0

   Temporary storage strings. . . . . :           3
   Peak Temporary storage strings in use. . :           0
   Temporary storage string waits . . . . . :           0
   Peak users waiting on string . . . . . :           0
   Current users waiting on string. . . . . :           0

   Temporary storage buffers. . . . . :           3
   Temporary storage buffer waits . . . . . :           0
   Peak users waiting on buffer . . . . . :           0
   Current users waiting on buffer. . . . . :           0
   Temporary storage buffer reads . . . . . :           0
   Temporary storage buffer writes. . . . . :           0
   Forced buffer writes for recovery. . . . :           0
   Format writes. . . . . :           0

   I/O errors on the DFHTEMP dataset. . . . :           0
```

Figure 24. The Temporary Storage Report

Table 21 (Page 1 of 4). Fields in the Temporary Storage Report

Field Heading	Description
Temporary Storage	
Put/Putq main storage requests	is the number of records that application programs wrote to main temporary storage. Source field: A12STA5F
Get/Getq main storage requests	is the number of records that application programs obtained from main temporary storage. Source field: A12NMG

Table 21 (Page 2 of 4). Fields in the Temporary Storage Report	
Field Heading	**Description**
Peak storage used for TS Main	is the peak value, expressed in Kbytes, of the amount of virtual storage used for temporary storage records. Source field: (A12STA6F / 1024)
Current storage used for TS Main	is the current value, expressed in Kbytes, of the amount of virtual storage used for temporary storage records. Source field: (A12STA6A / 1024)
Put/Putq auxiliary storage requests	is the number of records that application programs wrote to auxiliary temporary storage. Source field: A12STA7F
Get/Getq auxiliary storage requests	is the number of records that application programs obtained from auxiliary temporary storage. Source field: A12NAG
Times temporary storage queue created	is the number of times that CICS created individual temporary storage queues. Source field: A12STA3F
Peak temporary storage queues in use	is the peak number of temporary storage queue names in use at any one time. Source field: A12QNUMH
Current temporary storage queues in use	is the current number of temporary storage queue names in use. Source field: A12QNUM
Items in longest queue	is the peak number of items in any one temporary storage queue. Source field: A12QINH
Queue extension threshold	is the number of records that are held in a single temporary storage group identifier (TSGID). This value is controlled by the system initialization parameter, TSMSGSET. Source field: A12GIDNE
Queue extensions created	is the number of times it was necessary to create a TSGID extension. The capacity of a single TSGID is determined by the TSMGSET option in the SIT, and indirectly controls how many additional extension blocks have to be built. Source field: A12STA4F
Control interval size	is the size of VSAM's unit of transmission between DASD and main storage, specified in the CONTROLINTERVALSIZE parameter in the VSAM CLUSTER definition for the temporary storage data set. In general, using large CIs permits more data to be transferred at one time, resulting in less system overhead. Source field: A12CSZ
Control intervals in the DFHTEMP dataset	is the number of control intervals (CIs) available for auxiliary storage. This is the total available space on the temporary storage data set expressed as a number of control intervals. This is not the space remaining at termination. Source field: A12NCI

Table 21 (Page 3 of 4). Fields in the Temporary Storage Report	
Field Heading	**Description**
Peak control intervals in use	is the peak number of control intervals (CIs) containing active data. Source field: A12NCIAH
Current control intervals in use	is the current number of control intervals (CIs) containing active data. Source field: A12NCIA
Available bytes per control interval	is the number of bytes available for use in a DFHTEMP data set control interval (CI). Source field: A12NAVB
Segments per control interval	is the number of segments available in a DFHTEMP data set control interval (CI). Source field: A12SPCI
Bytes per segment	is the number of bytes per segment of the DFHTEMP data set. Source field: A12BPSEG
Writes bigger than control interval size	is the number of writes of records whose length was greater than the control interval (CI) size. Source field: A12STABF
Largest record length written	is the size, expressed in bytes, of the longest record written to the temporary storage data set. Source field: A12LAR
Times auxiliary storage exhausted	is the number of situations where one or more transactions may have been suspended because of a NOSPACE condition, or (using a HANDLE CONDITION NOSPACE command) may have been forced to abend. Source field: A12STA8F
Number Temporary Storage compressions	is the number of times that the temporary storage buffers were compressed. Source field: A12STA9F
Temporary storage strings	is the number of temporary storage strings specified in the TS= system initialization parameter or in the overrides. The number of strings allocated may exceed the number requested. Source field: A12NVCA
Peak Temporary storage strings in use	is the peak number of concurrent I/O operations. If this is significantly less than the number specified in the SIT, consider reducing the SIT value to approach this number. Source field: A12NVCAH
Temporary storage string waits	is the number of I/O requests that were queued because no strings were available. This is zero if the number of strings is the same as the number of buffers. If this is a high percentage (over 30%) of the number of I/O requests, consider increasing the number of strings initially allocated. Source field: A12VWTN

Table 21 (Page 4 of 4). Fields in the Temporary Storage Report	
Field Heading	**Description**
Peak users waiting on string	is the peak number of I/O requests that were queued at any one time because all strings were in use. Source field: A12VUWTH
Current users waiting on string	is the current number of I/O requests that are queued because all strings are in use. Source field: A12VUWT
Temporary storage buffers	is the number of temporary storage buffers specified in the TS= system initialization parameter or in the overrides. The number of buffers allocated may exceed the number requested. Source field: A12NBCA
Temporary storage buffer waits	is the number of times a request was queued because all buffers were allocated to other tasks. A buffer wait occurs if the required control interval is already in a locked buffer, and therefore unavailable, even if there are other buffers available. Source field: A12BWTN
Peak users waiting on buffer	is the peak number of requests queued because no buffers were available. Source field: A12BUWTH
Current users waiting on buffer	is the current number of requests queued because no buffers are available. Source field: A12BUWT
Temporary storage buffer reads	is the number of times a CI has to be read from disk. Increasing the buffer allocation decreases this activity. Source field: A12TRDN
Temporary storage buffer writes	is the number of WRITEs to the temporary storage data set. This includes both WRITEs necessitated by recovery requirements (see next item) and WRITEs forced by the buffer being needed to accommodate another CI. Source field: A12TWTN
Forced buffer writes for recovery	is the subset of the total number of WRITEs caused by recovery being specified for queues. This I/O activity is not affected by buffer allocation. Source field: A12TWTNR
Format writes	is the number of times a new control interval (CI) was successfully written at the end of the data set to increase the amount of available space in the temporary storage data set. A formatted write is attempted only if the current number of control intervals (CIs) available in the auxiliary data set have all been used. Source field: A12TWTNF
I/O errors on the DFHTEMP dataset	is the number of input/output errors which occurred on the temporary storage data set. This should normally be zero. If it is not, inspect the CICS and VSAM messages to determine the cause. Source field: A12STAAF

Transient Data Report

Figure 25 shows the format of the Transient Data Report. The field headings and contents are described in Table 22.

```
Applid CICSA3    Sysid CICS  Jobname F3CICS41    Date 11/10/98    Time 14:34:54                CICS 01.01.00         PAGE 26

Transient Data

   Transient data reads . . . . . :           0
   Transient data writes. . . . . :           0
   Transient data formatting writes . . . . :           0

   Control interval size. . . . . :       1,536
   Control intervals in the DFHNTRA dataset :         156
   Peak control intervals used. . . . . :           1
   Times NOSPACE on DFHNTRA occurred. . . . :           0

   Transient data strings . . . . . :           3
   Times Transient data string in use . . . :           0
   Peak Transient data strings in use . . . :           0
   Times string wait occurred . . . . . :           0
   Peak users waiting on string . . . . . :           0

   Transient data buffers . . . . . :           5
   Times Transient data buffer in use . . . :           0
   Peak Transient data buffers in use . . . :           0
   Peak buffers containing valid data . . . :           0
   Times buffer wait occurred . . . . . :           0
   Peak users waiting on buffer . . . . . :           0

   I/O errors on the DFHNTRA dataset. . . . :           0
```

Figure 25. The Transient Data Report

Table 22 (Page 1 of 2). Fields in the Transient Data Report

Field Heading	Description
Transient Data	
Transient data reads	is the number of times a CI has to be read from disk. Increasing the buffer allocation decreases this activity. Source field: A11ACTGT
Transient data writes	is the number of WRITEs to the transient data data set. This includes both WRITEs needed for recovery (see below) and WRITEs forced by the buffer being needed to accommodate another CI. I/O activity caused by the latter reason can be minimized by increasing the buffer allocation. Source field: A11ACTPT
Transient data formatting writes	is the number of times a new CI was written at the end of the data set in order to increase the amount of available space. Source field: A11ACTFT
Control interval size	is the size of the control interval, expressed in bytes. Source field: A11ACISZ
Control intervals in the DFHNTRA dataset	is the current number of control intervals active within the CICS system. Source field: A11ANCIS
Peak control intervals used	is the peak value of the number of control intervals concurrently in the system. Source field: A11AMXCI

Table 22 (Page 2 of 2). Fields in the Transient Data Report	
Field Heading	**Description**
Times NOSPACE on DFHNTRA occurred	is the number of times that a NOSPACE condition has occurred. Source field: A11ANOSP
Transient data strings	is the number of strings currently active. Source field: A11STSTA
Times Transient data string in use	is the number of times a string was accessed. Source field: A11STNAL
Peak Transient data strings in use	is the peak number of strings concurrently accessed in the system. Source field: A11SMXAL
Times string wait occurred	is the number of times that tasks had to wait due to no strings being available. Source field: A11STNWT
Peak users waiting on string	is the peak number of concurrent string waits in the system. Source field: A11SMXWT
Transient data buffers	is the number of transient data buffers specified in the system initialization table (SIT) or in the SIT overrides. The number of buffers allocated may exceed the number requested. Source field: A11ANBFA
Times Transient data buffer in use	is the number of times intrapartition buffers have been accessed. Source field: A11ATNAL
Peak Transient data buffers in use	is the peak value of the number of concurrent intrapartition buffer accesses. Source field: A11AMXAL
Peak buffers containing valid data	is the peak number of intrapartition buffers which contain valid data. Source field: A11AMXIU
Times buffer wait occurred	is the number of times a request was queued because all buffers were allocated to other tasks. A buffer wait occurs if the required control interval is already in a locked buffer, and therefore unavailable, even if there are other buffers available. Source field: A11ATNWT
Peak users waiting on buffer	is the peak number of requests queued because no buffers were available. Source field: A11AMXWT
I/O errors on the DFHNTRA dataset	is the number of input/output errors that have occurred on the DFHNTRA dataset during this run of CICS. Source field: A11ACTIO

LSR Pools Report

Figure 26 shows the format of the LSR Pools Report. The field headings and contents are described in Table 23 on page 357.

```
Applid CICSA2    Sysid CICS  Jobname CICS41      Date 11/10/98    Time 14:35:03                CICS 01.01.00         PAGE 27

LSR Pools

Pool Number :   1      Time Created :   14:33:51.67492

      Maximum key length . . . . . . . :          22
      Total number of strings  . . . . :           2
      Peak concurrently active strings :           1
      Total requests waited for string :           0
      Peak requests waited for string. :           0

Buffer Totals

        Data Buffers . . . . . . . . . :          19                 Index Buffers. . . . . . . . . :           0
        Successful look asides . . . . :          39                 Successful look asides . . . . :           0
        Buffer reads . . . . . . . . . :           4                 Buffer reads . . . . . . . . . :           0
        User initiated writes. . . . . :           0                 User initiated writes. . . . . :           0
        Non-user initiated writes. . . :           0                 Non-user initiated writes. . . :           0

Data and Index Buffer Statistics

                          Look                    User
      Size    Buffers     Asides       Reads      Writes      Writes

        512       8         0           1          0           0
       1024       4         0           0          0           0
       2048       4        39           3          0           0
       8192       3         0           0          0           0
```

Figure 26. The LSR Pools Report

Table 23 (Page 1 of 2). Fields in the LSR Pools Report	
Field Heading	**Description**
LSR Pools	
Pool Number	is the identifying number of the LSR pool. This value may be in the range 1 through 15.
Time Created	is the time when this LSR pool was created. Source field: A08LBKCD
Maximum key length	is the length of the largest key of a VSAM data set which may use this LSR pool. Source field: A08BKKYL
Total number of strings	is the total number of VSAM strings defined for this LSR pool. Source field: A08BKSTN
Peak concurrently active strings	is the maximum number of strings that were active during CICS execution. If you have coded a value for the number of strings the pool is to use, this statistic is always less than or equal to the value you have coded. If your coded value for string numbers is consistently lower than this value in the statistics, you could consider reducing it so that your pool of VSAM strings is not bigger than you need. Source field: A08BKHAS
Total requests waited for strings	is the number of requests that were queued because all the strings in the pool were in use. This number reflects the number of requests that were delayed during CICS execution due to a restriction in LSR pool string resources. Source field: A08BKTSW
Peak requests waited for strings	is the highest number of requests that were queued at one time because all the strings in the pool were in use. Source field: A08BKHSW
Buffer Totals	
Data Buffers	is the number of data buffers specified for the LSR pool. Source field: A08TDBFN
Successful look asides	is the number of successful lookasides to data buffers for this LSR pool. Source field: A08TDBFF
Buffer reads	is the number of read I/Os to the data buffers for this LSR pool. Source field: A08TDFRD
User initiated writes	is the number of user-initiated buffer writes from the data buffers for this LSR pool. Source field: A08TDUIW
Non-user initiated writes	is the number of non-user-initiated buffer writes from the data buffers for this LSR pool. Source field: A08TDNUW
Index Buffers	is the number of index buffers specified for the LSR pool. Source field: A08TIBFN
Successful look asides	is the number of successful lookasides to index buffers for this LSR pool. Source field: A08TIBFF

Table 23 (Page 2 of 2). Fields in the LSR Pools Report	
Field Heading	**Description**
Buffer reads	is the number of read I/Os to the index buffers for this LSR pool. Source field: A08TIFRD
User initiated writes	is the number of user-initiated buffer writes from the index buffers for this LSR pool. Source field: A08TIUIW
Non-user initiated writes	is the number of non-user-initiated buffer writes from the index buffers for this LSR pool. Source field: A08TINUW
Data Buffer Statistics	
Size	is the size of the data buffers that are available to CICS. Source field: A08BKBSZ
Buffers	is the number of buffers of each size available to CICS. Source field: A08BKBFN
Look Asides	is the number of read requests that VSAM was able to satisfy without initiating an I/O operation; that is, the requested record, whether index or data, was already present in one of the buffer resident CIs. This means that no physical I/O had to be done to put the control interval in the buffer. The tuning methodology usually employed involves either increasing the number of buffers of a particular CI size until the ratio of lookasides to READs stops increasing significantly or, conversely, reducing the number of buffers until the ratio of lookasides to READs begins to drop significantly. For most data sets, successful lookaside hits on indexes are more likely. These statistics are obtained from VSAM and represent the activity after the pool was created. Source field: A08BKBFF
Reads	is the number of I/O operations to the buffers that VSAM was required to initiate to satisfy the CICS application's activity. This figure represents failures to find the control interval in the buffers. These statistics are obtained from VSAM and represent the activity after the pool was created. Source field: A08BKFRD
User Writes	is the number of user-initiated I/O WRITE operations from the buffers that VSAM was required to initiate to satisfy the CICS application's activity. These statistics are obtained from VSAM and represent the activity after the pool was created. Source field: A08BKUIW
Non-User Writes	is the number of non-user initiated I/O WRITE operations from the buffers that VSAM was forced to initiate due to no buffers being available for reading the contents of a CI. These statistics are obtained from VSAM and represent the activity after the pool was created. Source field: A08BKNUW

Files report

Figure 27 shows the format of the Files Report. The field headings and contents are described in Table 24.

```
Applid CICSA3    Sysid CICS  Jobname F3CICS41    Date 11/10/98    Time 14:34:54                CICS 01.01.00         PAGE 27

Files

           Access          LSR  Str Waits    Read    Get Update   Browse       Add        Update      Delete     Data    Index
Filename   Method   Type   Pool Max Total    Requests   Requests  Requests    Requests    Requests    Requests    EXCPs    EXCPs


   DFHCSD    VSAM           1     0    0          0         0         0          0           0           0          0        0
   RFILEA    REMOTE                0    0          0         0         0          0           0           0          0        0
   RTFILEA REMOTE                  0    0          5         0         0          0           0           0          0        0

   Totals                                          5         0         0          0           0           0          0        0
```

Figure 27. The Files Report

Table 24 (Page 1 of 2). Fields in the Files Report

Field Heading	Description
Files	
Filename	is the name of the file. Source field: EXEC CICS INQUIRE FILE
Access Method	indicates the access method for this file. Source field: EXEC CICS INQUIRE FILE ACCESSMETHOD
Type	indicates how the records are organized in the data set that corresponds to this file. Source field: EXEC CICS INQUIRE FILE TYPE
LSR Pool	The identity of the LSR pool defined for this file. '0' means that it is not defined in an LSR pool. Source field: EXEC CICS INQUIRE FILE LSRPOOLID
Str Waits Max	is the maximum number of string waits for the file. Source field: A17DSHSW
Str Waits Total	is the total number of string waits for the file. Source field: A17DSTSW
Read Requests	is the number of GET requests attempted against this file. Source field: A17DSRD
Get Update Requests	is the number of GET UPDATE requests attempted against this file. Source field: A17DSGU
Browse Requests	is the number of GETNEXT and GETPREV requests attempted against this file. Source field: A17DSBR
Add Requests	is the number of PUT requests attempted against this file. Source field: A17DSWRA
Update Requests	is the number of PUT UPDATE requests attempted against this file. Source field: A17DSWRU

Table 24 (Page 2 of 2). Fields in the Files Report	
Field Heading	**Description**
Delete Requests	is the number of DELETE requests attempted against this local file. Source field: A17DSDEL
Data EXCPs	is the number of EXCPs requested against the data portion of the file. Source field: A17DSXCP
Index EXCPs	is the number of EXCPs requested against the index portion of the file. Source field: A17DSIXP

Data Tables Reports

Figure 28 shows the format of the Data Tables Requests Report. The field headings and contents are described in Table 25.

```
Applid CICSA2    Sysid CICS  Jobname CICS41      Date 11/10/98    Time 14:35:03                CICS 01.01.00         PAGE 29

Data Tables - Requests

                 Data          Max      Successful    Records     Adds via     Adds via      Adds       Rewrite     Delete      Read
Filename     Table Type      Num recs      Reads     Not found      Read         API        Rejected    Requests    Requests    Retries

TFILEA       CICS/TABLE          200          0             0         42           0             0           0           0          0
UFILEA       USER/               200          0             0          0           0             0           0           0          0
```

Figure 28. The Data Tables Requests Report

Table 25 (Page 1 of 2). Fields in the Data Tables Requests Report

Field Heading	Description
Data Tables - Requests	
Filename	is the name of the file. Source field: EXEC CICS INQUIRE FILE
Data Table Type	indicates whether this file represents a data table. Source field: EXEC CICS INQUIRE FILE TABLE
Max Num Rec	is the maximum number of records that the data table can hold. Source field: EXEC CICS INQUIRE FILE MAXNUMRECS
Successful Reads	is the number of attempts to retrieve records from the table. Source field: A17DTRDS
Records Not Found	is the number of times API READ requests were directed to the source data set because the record was not found in the table. Source field: A17DTRNF
Adds via Read	is the number of records placed in the table by the loading process or as a result of API READ requests issued while loading was in progress. Source field: A17DTAVR
Adds via API	is the number of attempts to add records to the table as a result of WRITE requests. Source field: A17DTADS
Adds Rejected	is the number of records CICS attempted to add to the table which were rejected by the global user exit. Source field: A17DTARJ
Rewrite Requests	is the number of attempts to update records in the table as a result of REWRITE requests. Source field: A17DTRWS
Delete Requests	is the number of attempts to delete records from the table as a result of DELETE requests. Source field: A17DTDLS

Table 25 (Page 2 of 2). Fields in the Data Tables Requests Report	
Field Heading	**Description**
Read Retries	is the total number of read retries, that is the number of times reads in an AOR had to be retried because the FOR changed the table during the read. Source field: A17DTRRS

Figure 29 shows the format of the Data Tables Storage Report. The field headings and contents are described in Table 26.

```
Applid CICSA2    Sysid CICS  Jobname CICS41      Date 11/10/98    Time 14:35:03                CICS 01.01.00         PAGE 30

Data Tables - Storage

                                    <------- Total ------>  <------ Entries ----->  <------- Index ------>  <------- Data------->

                  Current      Peak     Storage    Storage      Storage    Storage     Storage    Storage     Storage    Storage
Filename   Type   Records     Records   Allocated  In-use     Allocated  In-Use     Allocated  In-Use     Allocated  In-Use

  TFILEA   CICS       42          42         192         7          32         1          32         2         128         4
  UFILEA   USER        0           0           0         0           0         0           0         0           0         0
```

Figure 29. The Data Tables Storage Report

Table 26 (Page 1 of 2). Fields in the Data Tables Storage Report	
Field Heading	**Description**
Data Tables - Storage	
Filename	is the name of the file. Source field: EXEC CICS INQUIRE FILE
Type	is the type of data table, CICS-maintened or user-maintained. Source field: EXEC CICS INQUIRE FILE TABLE
Current Records	is the current number of records in the data table. Source field: A17DTSIZ
Peak Records	is the peak number of records in the data table. Source field: A17DTSHI
Total - Storage Allocated	is the total amount of storage (kilobytes) in allocated for the data table. Source field: A17DTALT
Total - Storage In-Use	is the total amount of storage (kilobytes) in use for the data table. Source field: A17DTUST
Entries - Storage Allocated	is the total amount of storage (kilobytes) allocated for the record entry blocks. Source field: A17DTALE
Entries - Storage In-Use	is the total amount of storage (kilobytes) in use for the record entry blocks. Source field: A17DTUSE
Index - Storage Allocated	is the total amount of storage (kilobytes) allocated for the index. Source field: A17DTALI
Index - Storage In-Use	is the total amount of storage (kilobytes) in use for the index. Source field: A17DTUSI

Table 26 (Page 2 of 2). Fields in the Data Tables Storage Report	
Field Heading	**Description**
Data - Storage Allocated	is the total amount of storage (kilobytes) allocated for the record data. Source field: A17DTALD
Data - Storage In-Use	is the total amount of storage (kilobytes) in use for the record data. Source field: A17DTUSD

Appendix C. VSE/ESA and CICS virtual storage

Diagnosis, Modification or Tuning Information

Important note

This appendix provides some data relating to other products installed with CICS. This information was valid when this book was written, but no guarantee can be given that the information will stay unchanged, either for other products or for CICS itself. You should always check the information with your local IBM Systems Center.

This appendix describes:

- Major elements of "The CICS partition"
- Contents of "The dynamic storage areas" on page 367.

Most of the CICS storage areas are moved above the line, and it is necessary to have some detailed knowledge of the components that make up the total address space in order to determine what is really required.

Furthermore, it is important to understand the implications of the value of MXT (maximum tasks) on the storage use within the CICS address space. The value chosen for MXT and the size specified for the DSA limit and the EDSA limit. For a given region size, a high MXT value reduces the storage available for other users in the dynamic storage areas.

The CICS partition

The CICS partition has both static and dynamic storage requirements. The static areas are set at initialization time and do not vary over the execution of that address space. The dynamic areas increase or decrease their allocations as the needs of the address space vary, such as when data sets are opened and closed, and VTAM inbound messages being queued.

This section describes the major components of the CICS address space. In CICS Transaction Server for VSE/ESA Release 1 there are eight dynamic storage areas. They are:

The user DSA (UDSA)
The user-key storage area for all user-key task-lifetime storage below the 16MB boundary.

The read-only DSA (RDSA)
The key-0 storage area for all reentrant programs and tables below the 16MB boundary.

The shared DSA (SDSA)
The user-key storage area for any non-reentrant user-key RMODE(24) programs, and also for any storage obtained by programs issuing CICS GETMAIN commands for storage below the 16MB boundary with the SHARED option.

The CICS DSA (CDSA)
The CICS-key storage area for all non-reentrant CICS-key RMODE(24) programs, all CICS-key task-lifetime storage below the 16MB boundary, and for CICS control control blocks that reside below the 16MB boundary.

The extended user DSA (EUDSA)
The user-key storage area for all user-key task-lifetime storage above the 16MB boundary.

The extended read-only DSA (ERDSA)
The key-0 storage area for all reentrant programs and tables above the 16MB boundary.

The extended shared DSA (ESDSA)
The user-key storage area for any non-reentrant user-key RMODE(ANY) programs, and also for any storage obtained by programs issuing CICS GETMAIN commands for storage above the 16MB boundary with the SHARED option.

The extended CICS DSA (ECDSA).
The CICS-key storage area for all non-reentrant CICS-key RMODE(ANY) programs, all CICS-key task-lifetime storage above the 16MB boundary, and CICS control blocks that reside above the 16MB boundary.

Figure 30 on page 367 shows an outline of the areas involved in the partition area. The three main areas are the shared area, VSE storage, and the CICS region. The exact location of the free and allocated storage may vary depending on the activity and the sequence of the GETMAIN/FREEMAIN requests.

Additional VSE storage may be required by CICS for kernel stack segments for CICS system tasks, this is the CICS kernel.

VSAM storage

The VSAM buffers and most of the VSAM file control blocks reside above the 16MB line.

The VSAM buffers may be for CICS data sets defined as using local shared resources (LSR) (the default) or nonshared resources (NSR). If DL/I data sets are used, the buffers for these data sets always use an LSR pool.

The VSAM LSR pool is built dynamically above the 16MB line when the first file specified as using it is opened, and deleted when the last file using it is closed.

Other file storage

Every opened data set requires some amount of storage in this area for such items as input/output blocks (IOBs) and channel programs.

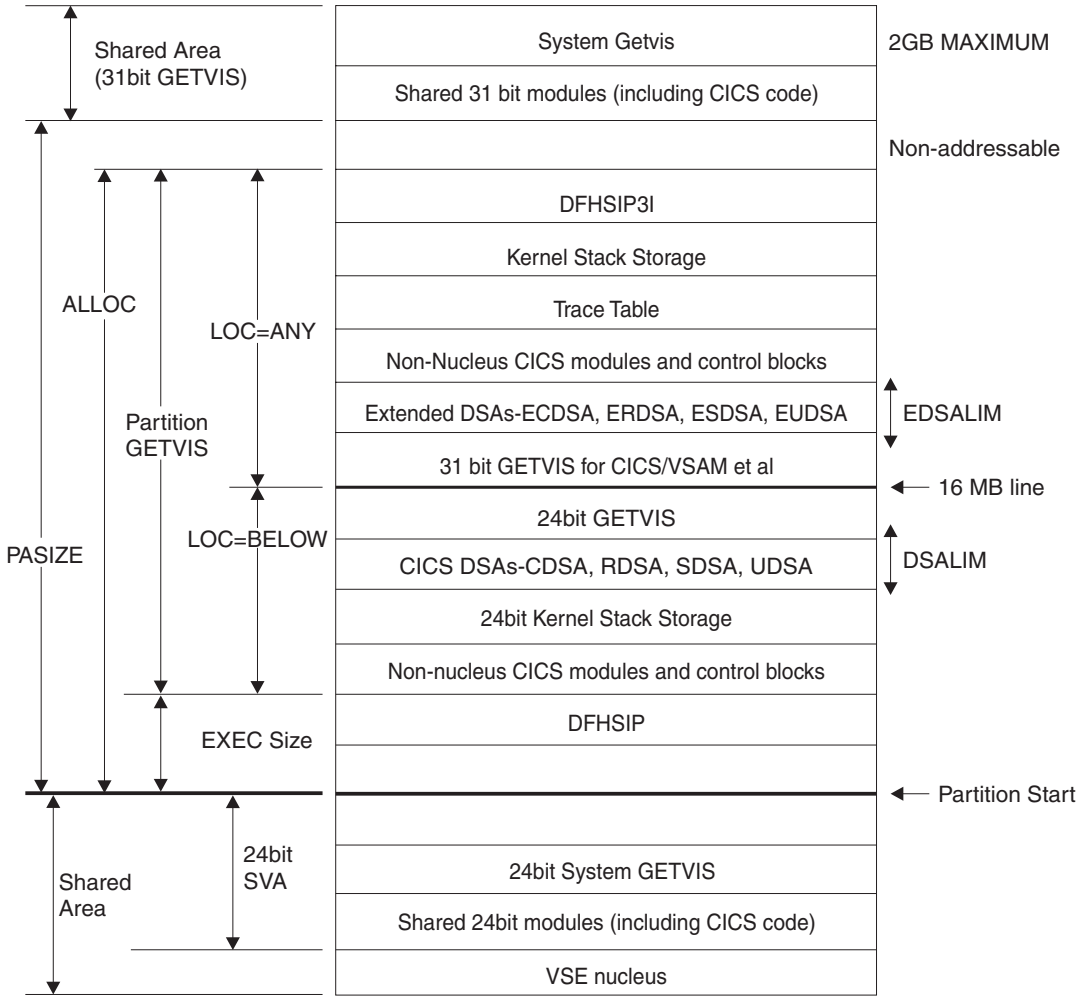


Figure 30. CICS partition immediately after system initialization

The dynamic storage areas

The dynamic storage areas are used to supply CICS tasks with the storage needed to execute your transactions. From the storage size that you specify on the DSALIM and the EDSALIM parameters, CICS allocates the dynamic storage areas above and below the line respectively.

Too small a dynamic storage area results in increased program compression or, more seriously, SOS (short on storage) conditions, or even storage deadlock abends when program compression is not sufficient.

DSAs consist of one or more extents. An extent below the line is 256KB and above the line, 1MB (except UDSA with TRANISO active, when the extent is 1M).

CICS GETMAIN requests for dynamic storage are satisfied from one of the following: the CDSA, RDSA, SDSA, ESDSA, UDSA, ECDSA or the ERDSA during normal execution. The sizes of the dynamic storage areas are defined at CICS initialization, but the use of storage within them is very dynamic.

The dynamic storage areas consist of a whole number of virtual storage pages allocated from a number of VSE storage subpools. CICS uses about 180 storage subpools, which are located in the dynamic storage areas. For a list of the

subpools see the tables on pages 369 through 379. Each dynamic storage area has it own “storage cushion.” These subpools (including the cushion) are dynamically acquired, as needed, a page at a time, from within the dynamic storage area.

The dynamic storage areas are essential for CICS operation. Their requirements depend on many variables, because of the number of subpools. The major contributors to the requirements are program working storage and the type and number of program and terminal definitions. The storage used by individual subpools can be determined by examining the CICS domain subpool statistics (storage manager statistics).

If you have exhausted the tuning possibilities of VSE/ESA and other tuning possibilities outside CICS, and the dynamic storage areas limits have been set as large as possible within CICS, and you are still encountering virtual storage constraint below 16MB, you may have to revise the use of options such as MXT and making programs resident, to keep down the overall storage requirement. This may limit task throughput. If you foresee this problem on a VSE/ESA system, you should consider ways of dividing your CICS system, possibly by use of facilities such as CICS multiregion operation (MRO), described in the *CICS Intercommunication Guide*. You can also reduce storage constraint below 16MB by using programs which run above 16MB.

In systems with a moderate proportion of loadable programs, program compression is an indicator of pressure on virtual storage. This can be determined by examining the CICS storage manager statistics which report the number of times that CICS went short on storage.

If the dynamic storage areas limits are too small, CICS performance is degraded. The system may periodically enter a short-on-storage condition, during which it curtails system activity until it can recover enough storage to resume normal operations.

However, resist the temptation to make the dynamic storage area limit as large as possible (which you could do by specifying the maximum allowable partition size). If you do this, it can remove any warning of a shortage of virtual storage until the problem becomes intractable.

The dynamic storage areas limits should be as large as possible after due consideration of other areas, especially the VSE storage area above 16MB.

CICS subpools

This section describes briefly the main features of the subpools. They are found in each of the dynamic storage areas. Most of the subpools are placed above the 16MB line. Those subpools that are found below the 16MB line, in the CDSA, SDSA, RDSA, and UDSA, need to be more carefully monitored due to the limited space available.

Individual subpools may be static or dynamic. Some contain static CICS storage which cannot be tuned. All the subpools are rounded up to a multiple of 4KB in storage size and this rounding factor should be included in any subpool sizing or evaluation of storage size changes due to tuning or other changes. CICS statistics contain useful information about the size and use of the dynamic storage area

subpools. The CICS subpools in the dynamic storage areas may be grouped and described according to the major factor affecting their use.

Application design
The use of CICS facilities such as program LINK, SHARED storage GETMAINs, the type of file requests, use of temporary storage, application program attributes (resident or dynamic), or the number of concurrent DBCTL, or DB2®, requests affect storage requirements.

Number of files definitions
These subpools may only be tuned by reducing the number of file definitions, or by using MRO.

The use of DL/I, or DB2
These subpools are only present if local DL/I, or DB2, are used. The subpools may be tuned by reducing the number of threads, reducing the DMB and PSB pools in the case of local DL/I or by using maximum tasks (MXT) or transaction classes.

Nucleus and macro table storage
It may be possible to reduce the macro table storage by reducing the number of macro definitions or by migrating selected macro-defined tables to RDO.

Number and type of terminal definitions
The OPNDLIM system initialization parameter may also be tuned to limit storage use.

The following tables list the subpools according to their dynamic storage areas and their use. These tables do not include the storage subpools used by the Front End Programming Feature. See *CICS Front End Programming Interface User's Guide* for more information.

CICS subpools in the CDSA

Table 27 (Page 1 of 2). CICS subpools in the CDSA

Subpool name	Description
AP_TCA24	24 bit TCA subpool
BBSSP1	closely coupled interface use.
BBSSP2	closely coupled interface use.
DFHAPD24	is a general subpool for application domain storage below the line.
DFHTDG24	contains variable length transient data general storage and control blocks that reside below the line.
DFHTDSDS	contains real transient data SDCIs, each of which contains a DCB which resides below the line.
FC_ACB	contains the ACBs for VSAM files.
FC_DTF	contains the DCBs for DAM files. Each file that is defined requires 104 bytes.
FC_BELOW	contains real VSWA and data buffers for pre-reads. Each VSWA requires 120 bytes of storage. The maximum number of data buffers for pre-reads is given by: (number of strings) x (maximum record length) x (number of files)

Table 27 (Page 2 of 2). CICS subpools in the CDSA	
Subpool name	**Description**
FCCBELOW	file control general storage below the line - storage used for SET storage for CICS key applications.
KESTK24	2KB below the line kernel stack. One per MXT plus one for every dynamic system task that is running.
KESTK24E	4KB below the line kernel stack extension. At least one of these for every ten tasks specified in the MXT limit.
LDNRS	contains 24-bit resident programs linked as not SVA eligible, and loaded with EXECUTION-KEY(CICS).
LDNUC	contains the CICS nucleus and macro tables. The CICS nucleus is approximately 192KB and the size of the tables can be calculated. The FCT may be migrated to RDO if it is currently a macro table. See the *CICS Resource Definition Guide* for more information. Programs defined EXECKEY(CICS) and link edited RMODE(24) without the reentrant open.
SMCONTRL	satisfies GETMAINs for control class storage.
SMSHARED	contains shared storage below the 16MB line, for example RMI global work areas, EDF blocks for the life of the transaction being monitored, and other control blocks.
SMSHRC24	is used for many control blocks of SHARED_CICS24 class storage.
SMTCA24	stores the TCA when the task data location option is set to BELOW.
SMTP24	holds line and terminal I/O areas which cannot be located above the 16MB line. The storage requirements depend on the amount of terminal and line traffic in the system. The subpool may be tuned by reducing the RAPOOL, RAMAX, TIOAL size, and number of MRO sessions.
SZSPFCAC	contains the FEPI VTAM ACB work areas.
TRUBELOW	TRUE parameters are copied here for 24-bit TRUEs.
TSVSWAS	temporary storage VSWAS are placed here.
XMGEN24	transaction manager 24-bit general subpool.
ZCSETB24	contains application control buffers below the line.

CICS subpools in the SDSA

Table 28 (Page 1 of 2). CICS subpools in the SDSA	
Subpool name	**Description**
APECA	contains the event control areas
BBSSP3	closely coupled interface - contains storage for use by applications.
DFHAPU24	is a general subpool for application domain storage below the line.
LDPGM	contains dynamically loaded application programs (RMODE (24)). The expected size of this subpool may be predicted from previous releases, and by taking LDPGMRO into account. The subpool size may be reduced by using 31-bit programs. Not reentrant.

Table 28 (Page 2 of 2). CICS subpools in the SDSA	
Subpool name	**Description**
LDRES	contains resident application programs (RMODE (24). The expected size of this subpool may be predicted from previous releases, and by taking LDRESRO into account. The subpool size may be reduced by using 31-bit programs. Not reentrant.
SMSHRU24	is used for many control blocks of SHARED_USER24 class storage.
ZCTCTUA	contains the TCTTE user area. It can be located in of the following DSAs: CDSA, SDSA, ECDSA, or ESDSA. Its location is controlled by the system initialization parameter, TCTUALOC=ANY|BELOW and the system initialization parameter, TCTUAKEY=CICS|USER. The maximum size can be specified in USERAREALEN operand of the terminal definition. See the *CICS Resource Definition Guide* for more information about the terminal definition.

CICS subpools in the RDSA

Table 29. CICS subpools in the RDSA	
Subpool name	**Description**
LDNUCRO	contains programs defined EXECKEY(CICS) that were link edited REENTRANT and RMODE(24).
LDPGMRO	contains programs defined EXECKEY(USER) which are not RESIDENT, that were link edited RMODE(24) and REENTRANT.
LDRESRO	contains programs defined EXECKEY(USER) and RESIDENT and were link edited REENTRANT and were link edited REENTRANT and RMODE.

CICS subpools in the ECDSA

Table 30 (Page 1 of 7). CICS subpools in the ECDSA	
Subpool name	**Description**
AITM_TAB	is the autoinstall terminal model (AITM) table entry subpool (DFHAITDS).
AP_AFCTE	contains the application part of the File Control Table (FCT) for all local and remote files that are defined. Each VSAM file requires 48 bytes of storage and each remote file requires 64 bytes.
APAID31	contains storage for AIDs above the line.
AP_TCA31	contains the application part of the TCA table
AP_TXDEX	contains the application part of the TXD table
APBMS	contains storage use by BMS.
APCOMM31	contains COMMAREAs. The storage requirement depends on the size of COMMAREA specified and the number of concurrent users of the application.
APEISTAC	contains storage used by the EXEC CICS interface.
APICE31	contains storage for ICEs above the line.
APURD	subpool contains URDs and nontask DWEs.

Table 30 (Page 2 of 7). CICS subpools in the ECDSA	
Subpool name	**Description**
DDBROWSE	contains storage for Directory Manager browse request tokens.
DDGENRAL	contains Directory Manager control blocks general information.
DDS_PPT	contains storage for Directory Manager directory elements for the PPT table.
DDS_RTXD	contains storage for Directory Manager directory elements for the RTXD table.
DDS_TCL	contains storage for Directory Manager directory elements for the TCL table.
DDS_TPNM	contains storage for Directory Manager directory elements for the TPNM table.
DDS_TXD	contains storage for Directory Manager directory elements for the TXD table.
DDS_USD1	contains storage for Directory Manager directory elements for the USD1 table.
DDS_USD2	contains storage for Directory Manager directory elements for the USD2.
DFHAPDAN	is a general subpool for application domain storage above the line.
DFHTDDCT	contains the dynamically created DCTs used for XRF.
DFHTDG31	contains transient data general storage and control blocks. The storage requirement depends on the number of buffers and strings, and on the control interval size specified.
DFHTDIOB	contains transient data input/output buffers. The storage requirement is given by the control interval size of the intrapartition transient data set multiplied by the number of buffers.
DFHTDWCB	contains the quick called wait control block used by transient data.
DMSUBPOL	is the domain manager subpool for general usage.
DSBROWSE	contains storage for dispatcher browse request tokens.
FC_ABOVE	contains real VSWA and data buffers for pre-reads. Each VSWA requires 120 bytes of storage. The maximum number of data buffers for pre-reads is given by: (number of strings) x (maximum record length) x (number of files)
FC_ACB	contains ACBs for VSAM files. There is one ACB, of 80 bytes, per VSAM file.
FC_DAM	DAM file control blocks. Each DAM file requires 96 bytes of storage.
FC_DLI	contains storage for DL/I file control blocks.
FC_DSNAM	contains data set name blocks. Each file requires a data set name block which uses 120 bytes of storage.
FC_FFLE	contains the fast file elements (FFLEs). A FFLE is built each time a transaction references a file name that has not previously been referenced by that transaction. The FFLE is retained until the end of the task. There is a free chain of FFLEs not currently in use.

Table 30 (Page 3 of 7). CICS subpools in the ECDSA	
Subpool name	**Description**
FC_FRAB	contains file request anchor blocks (FRABs). There is one FRAB for each transaction that has issued a file control request. The FRAB is retained until the end of the task. There is a free chain of FRABs not currently in use.
FC_FRTE	contains file request thread elements (FRTE). There is one FRTE for each active file control request per task. A file control request has a FRTE if: • It has not yet terminated its VSAM thread. For example, a browse that has not yet issued an ENDBR. • It has updated a recoverable file and there has not yet been a syncpoint. • It is holding READ-SET storage that must be freed in future. There is a free chain of FRTEs not currently in use.
FC_SHRCT	contains file control SHRCTL blocks. There are fifteen of these and each describes a VSAM LSR pool.
FC_VSAM	contains the file control table (FCT) entries for VSAM files.
FCB_C1K	contains file control buffers of length 1KB. They are used by file control requests that are made against files whose maximum record length is between 512 bytes+1 byte up to 1KB.
FCB_C12K	contains file control buffers of length 12KB. They are used by file control requests that are made against files whose maximum record length is between 8KB+1 byte up to 12KB.
FCB_C16K	contains file control buffers of length 16KB. They are used by file control requests that are made against files whose maximum record length is between 12KB+1 byte up to 16KB.
FCB_C2K	contains file control buffers of length 2KB. They are used by file control requests that are made against files whose maximum record length is between 1KB+ 1 byte up to 2KB.
FCB_C20K	contains file control buffers of length 20KB. They are used by file control requests that are made against files whose maximum record length is between 16KB+1 byte up to 20KB.
FCB_C24K	contains file control buffers of length 24KB. They are used by file control requests that are made against files whose maximum record length is between 20KB+1 byte up to 24KB.
FCB_C256	contains file control buffers of length 256 bytes. They are used by file control requests that are made against files whose maximum record length is less than or equal to 256 bytes.
FCB_C28K	contains file control buffers of length 28KB. They are used by file control requests that are made against files whose maximum record length is between 24KB+1 byte up to 28KB.
FCB_C32K	contains file control buffers of length 32KB. They are used by file control requests that are made against files whose maximum record length is between 28KB+1 byte up to 32KB.
FCB_C4K	contains file control buffers of length 4KB. They are used by file control requests that are made against files whose maximum record length is between 2KB+1 byte up to 4KB.

Table 30 (Page 4 of 7). CICS subpools in the ECDSA	
Subpool name	**Description**
FCB_C512	contains file control buffers of length 512 bytes. They are used by file control requests that are made against files whose maximum record length is between 256 bytes+1 byte up to 512 bytes.
FCB_C8K	contains file control buffers of length 8KB. They are used by file control requests that are made against files whose maximum record length is between 4KB+1 byte up to 8KB.
JAGLOBAL	is used for automatic journal archiving.
JCDYNLOG	is used for the dynamic log.
JCFWDREC	is used by journal control's forward recovery mechanism.
KESTK31	12KB above the line kernel stack. One per MXT plus one for every dynamic system task that is running.
KESTK31E	4KB above the line kernel stack extensions. At least one for every ten tasks specified in the MXT limit.
KETASK	kernel task entries.
LD_APES	loader domain - active program elements.
LD_CNTRL	loader domain - general control information.
LD_CPES	loader domain - current program elements.
LD_CSECT	loader domain - CSECT list storage.
LDENRS	contains 31-bit resident programs linked as not SVA eligible, and loaded with EXECUTION_KEY(CICS).
LDENUC	contains the extended CICS nucleus, and 31-bit macro tables. The extended CICS nucleus is approximately 50KB. Programs defined EXECKEY(CICS) and link edited RMODE(ANY) without the REENTRANT option.
LI_PLB	language interface - program language block. One is allocated for each program when control is first passed to it.
MN_CNTRL	contains monitoring control blocks - general information.
MN_MAES	contains monitoring control blocks. The storage requirement is 48 bytes per active task.
MN_TMAS	contains monitoring control blocks. The storage requirement is 472 bytes per active task.
MRO_QUEU	is used by the MRO work queue manager.
MROWORKE	is used by the MRO work queue manager elements.
PGGENRAL	general purpose program manager domain subpools.
PGHMRSA	program handle manager cobol register save areas.
PGHTB	program manager handle table block.
PGLLE	program manager load list elements.
PGPGWE	program manager wait elements.
PGPPTE	program manager program definitions (PPTs).
PGPTA	program manager transaction-related information.
PR_TABLE	contains storage for PTEs from the PRT.
RM_TABLE	is used to quickcall the recovery manager lifetime control block.

Table 30 (Page 5 of 7). CICS subpools in the ECDSA	
Subpool name	**Description**
RCF_PFX	report controller - contains storage for conversion buffers.
RCF_PSC	report controller - contains storage for DFHPSCPS control blocks.
RCF_PSR	report controller - contains storage for DFHPSRPS control blocks.
RCF_PSU	report controller - contains storage for DFHPSUPS control blocks.
RCF_PSW	report controller - contains storage for DFHPSWPS control blocks.
SMSHRC31	is used for many control blocks of SHARED_CICS31 class storage.
SMTP	holds line and terminal I/O areas. The storage requirements depend on the amount of terminal and line traffic in the system. The subpool may be tuned by reducing the RAPOOL, RAMAX, TIOAL size, and number of MRO sessions.
STSUBPOL	is a statistics domain manager subpool.
SZSPFCCD	is the FEPI connection control subpool.
SZSPFCCM	is the FEPI common area subpool.
SZSPFCCV	is the FEPI conversation control subpool.
SZSPFCDS	is the FEPI device support subpool.
SZSPFCNB	is the FEPI node initialization block subpool.
SZSPFCND	is the FEPI node definition subpool.
SZSPFCPD	is the FEPI pool descriptor subpool.
SZSPFCPS	is the FEPI property descriptor subpool.
SZSPFCRP	is the FEPI request parameter list subpool.
SZSPFCRQ	is the FEPI requests subpool.
SZSPFCSR	is the FEPI surrogate subpool.
SZSPFCTD	is the FEPI target descriptor subpool.
SZSPFCWE	is the FEPI work element subpool.
SZSPVUDA	is the FEPI data areas subpool.
TIA_POOL	is the timer domain anchor subpool.
TIQCPOOL	is the timer domain quickcell subpool.
TSBUFFRS	contains the temporary storage I/O buffers. The storage requirement is given by: (TS control interval size) x (number of TS buffers). The use of temporary storage by application programs affects the size of a number of subpools associated with temporary storage control blocks:
TSGENRAL	The amount of storage used by the TSGENRAL subpool depends on the number of buffers and strings and the control interval size defined for the temporary storage data set.
TSGIDS	The storage used by the TSGIDS subpool increases relative to the number of names in use and the number of records in each temporary storage queue.
TSMAIN	contains storage for temporary storage main storage. The subpool could be reduced by using auxiliary temporary storage.

Table 30 (Page 6 of 7). CICS subpools in the ECDSA	
Subpool name	**Description**
TSQERES	The storage used by the TSQERES subpool increases relative to the number of temporary storage queues in use.
TSUTCTRL	The storage used by the TSUTCTRL subpool contains a TSUT anchor block and any browse elements that are in use. It is a relatively small subpool.
TSUTNODE	The storage used by the TSUTNODE subpool increases relative to the number of temporary storage queue in use.
UE_EPBPL	is the subpool for the user exit program block (EPB).
USGENRAL	is the general-purpose subpool for the user domain.
USIDTBL	contains the attach security userid table entries (LUITs). See “ISC/IRC attach time entries” on page 259 for more information.
USRTMQUE	contains queue elements for users waiting for USRDELAY. Each queue element is 16 bytes.
USUDB	contains user data blocks. The storage requirement is 128 bytes per unique user.
USXDPOOL	contains user domain transaction-related data. Each executing transaction requires 32 bytes.
XMGENRAL	is the general-purpose subpool for the transaction manager
XMLQEA	contains storage for large QEAs. The storage requirement depends on the number of concurrent ENQs for resources.
XMSQEA	contains storage for small QEAs. The storage requirement depends on the number of concurrent ENQs for resources.
XMTCLASS	contains the transaction manager tranclass definition.
XMTRANSN	transaction manager transactions. One for every transaction in the system.
XMTXDINS	transaction manager transaction definition.
XMTXDSTA	transaction manager transaction definition.
XMTXDTPN	contains the transaction manager transaction definition TPNAME storage.
XSGENRAL	is the general-purpose subpool for the security domain.
XSXMPOOL	contains security domain transaction-related data. Each executing transaction requires 56 bytes.
ZCBIMG	contains BIND images.
ZCBMSEXT	contains the BMS extensions for terminals. Subpool storage requirements are 48 bytes for each terminal, surrogate, ISC session, and console.
ZCBUF	contains the non-LU6.2 buffer list.
ZCCCE	contains the console control elements. Each console requires 48 bytes.
ZCGENERL	is the general-purpose subpool for terminal control.
ZCLUCBUF	contains the LU6.2 SEND and RECEIVE buffer list .
ZCLUCEXT	contains the LU6.2 extensions. The storage requirement is 224 bytes for each LU6.2 session.

Table 30 (Page 7 of 7). CICS subpools in the ECDSA	
Subpool name	**Description**
ZCNIBD	contains the NIB descriptors. Each terminal, surrogate, ISC session, and system definition requires 96 bytes of storage.
ZCNIBISC	contains the expanded NIB and response during OPNDST/CLSDST for ISC. Each concurrent logon/logoff requires 448 bytes of storage.
ZCNIBTRM	contains the expanded NIB during OPNDST/CLSDST for terminals. Each concurrent logon/logoff requires 192 bytes of storage.
ZCRAIA	contains the RECEIVE ANY I/O areas.
ZCRPL	contains the RPLs for active tasks. Each active task associated with a VTAM terminal requires 152 bytes.
ZCSETB	contains application control buffers above the line.
ZCSKEL	contains the remote terminal entries. Each remote terminal definition requires 32 bytes of storage.
ZCSNEX	contain the TCTTE sign-on extensions. The storage requirement is 48 bytes for each terminal, surrogate, session, and console.
ZCTCME	contains the mode entries. Each mode entry requires 128 bytes of storage.
ZCTCSE	contains the system entries. Each system entry requires 192 bytes of storage.
ZCTCTTEL	contains the large terminal entries. 504 bytes of storage are required for every terminal, surrogate model, and ISC session defined.
ZCTCTTEM	contains the medium terminal entries. 400 bytes of storage are required for every IRC batch terminal.
ZCTCTTES	contains the small terminal entries. 368 bytes of storage are required for every MRO session and console.
ZCTPEXT	the TPE extension.
ZC2RPL	contains the duplicate RPLs for active tasks. Each active task associated with a VTAM terminal requires 304 bytes.
ZCTCTUA	contains the TCTTE user area. It can be located in of the following DSAs: CDSA, UDSA, ECDSA, or EUDSA. Its location is controlled by the system initialization parameter, TCTUALOC=ANY|BELOW and the system initialization parameter, TCTUAKEY=CICS|USER. The maximum size can be specified in USERAREALEN operand of the terminal definition. See the *CICS Resource Definition Guide* manual for more information.

CICS subpools in the ESDSA

Table 31 (Page 1 of 2). CICS subpools in the ESDSA	
Subpool name	**Description**
LDEPGM	contains extended (31) bit dynamically loaded application programs and programs defined EXECKEY(USER).
LDERES	contains extended (31) bit resident application programs.
SMSHRU31	is used for many control blocks of SHARED_USER24 class storage, RMI global work areas, EDF blocks for the life of the transaction being monitored, and other control blocks.

Table 31 (Page 2 of 2). CICS subpools in the ESDSA	
Subpool name	**Description**
ZCTCTUA	contains the TCTTE user area. It can be located in of the following DSAs: CDSA, UDSA, ECDSA, or EUDSA. Its location is controlled by the system initialization parameter, TCTUALOC=ANY|BELOW and the system initialization parameter, TCTUAKEY=CICS|USER. The maximum size can be specified in USERAREALEN operand of the terminal definition. See the *CICS Resource Definition Guide* for more information.

CICS subpools in the ERDSA

Table 32. CICS subpools in the ERDSA

Subpool name	Description
LDENRSRO	contains extended (31) bit resident reentrant programs loaded with EXECUTION_KEY(CICS).
LDENUCRO	contains the extended CICS nucleus and 31-bit macro tables. The extended CICS nucleus is approximately 1850KB. The contents of this subpool has to linked reentrant.
LDEPGMRO	contains extended (31) bit dynamically loaded application programs. The contents of this subpool has to linked reentrant.
LDERESRO	contains extended (31) bit resident application programs. The contents of this subpool has to linked reentrant.

CICS kernel storage

CICS kernel storage consists of control blocks and data areas that CICS requires to manage system and user tasks throughout CICS execution. The majority of this storage is allocated from the CICS DSAs. A small amount of this storage is allocated from VSE storage.

The kernel recognises two types of task: static tasks, and dynamic tasks. The kernel storage for static tasks is pre-allocated and is used for tasks controlled by the MXT mechanism. The storage for dynamic tasks is not pre-allocated and is used for tasks such as system tasks which are not controlled by the MXT value. Because the storage for dynamic tasks is not pre-allocated, the kernel may need to GETMAIN the storage required to attach a dynamic task when the task is attached.

The number of static tasks is dependant upon the current MXT value (there are MXT+1 static tasks). The storage for static tasks is always GETMAINed from the CICS DSAs. If MXT is lowered the storage for an excess number of static tasks is freed again.

During early CICS initialisation the kernel allocates storage for 8 dynamic tasks. This storage is GETMAINed from VSE and is always available for use by internal CICS tasks. All other storage for dynamic tasks is then allocated, as needed, from the CICS DSAs. Typically when a dynamic task ends, its associated storage is freed.

The storage required by a single task is the same for both types of task and can be divided into storage required above and below the 16MB line:

- Above the line the following storage is required per task:
  - A 896-byte kernel task entry
  - A 12K 31-bit stack.
- Below the line the following storage is required per task:
  - A 2K 24-bit stack.

In addition to this storage, the kernel also allocates a number of 4K extension stacks both above and below the 16MB line. These are for use by any task, if it overflows the stack storage allocated to it. The number of 24-bit and 31-bit stack

extensions pre-allocated by the kernel is determined by dividing the current MXT value by 10.

When the kernel GETMAINs storage from the CICS DSAs, the following subpools are used:

- In the CDSA:

```
KESTK24             2K stack segments
KESTK24E            4K extension stack segments
```

- In the ECDSA:

```
KESTK31             12K stack segments
KESTK31E            4K extension stack segments
KETASK              896 byte task entries
```

End of Diagnosis, Modification or Tuning Information

Appendix D. Performance data

This appendix contains:

- Timings for various CICS functions
- Timings for MRO and ISC
- Sizes of CICS tables located below the 16MB line.

Estimated processor timings for CICS functions

This section contains the following tables:

These tables allow you to make comparisons between the various CICS functions and some of the factors that affect the processing time of particular CICS functions. These tables can also help you to make decisions concerning application design when you are considering performance. To calculate a time for a function, find the entries appropriate to your installation and application, and add their values together.

Notes on the tables

1. All the processing times are estimates based on measurements of similar functions, and are in **milliseconds** for a hypothetical processor that would be equivalent in power to a System/370™ Model 4341-11. These timings are for execution of CICS functions within the CICS region.
2. The processing times will increase when you use CICS monitoring or trace facilities. The increases due to the CICS monitoring facility vary with the transaction mix, system definition, and system configuration. Measurements of CICS workloads under laboratory conditions have shown that the overhead of performance class monitoring is in the range of 7 to 11%.
3. Similarly, for internal trace, the processing increase varies on different transaction mixes. Trace selectivity allows a wide range of tracing activity to be specified. The associated overhead will clearly also have a wide range. Estimates included here are for level 1 tracing for all CICS components which is the functional equivalent of CICS for VSE/ESA Version 2.3 internal trace.
4. All these timings assume no paging. However, if a reference is made to a virtual storage page that does not reside in real storage, operating-system time will be used to retrieve the required page.
5. NE. No estimate is available.
6. N/A. Not applicable.
7. Recoverability assumes journal on DASD using files with RECOV set to BACKOUTONLY (FCT with LOG=YES).

Transaction initialization

Table 33. Transaction initialization

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
	Via VTAM
Read in and attach task search for transaction	13.28
Initialize Assembler COBOL II	 1.21 4.60
Internal Trace	6.87

Transaction termination

Table 34. Transaction termination

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
	Via VTAM
Return EXEC/CICS clean-up Assembler COBOL II	 1.54 4.00
LUW syncpoint	9.74
Internal Trace	4.49
Terminate transaction Deferred transaction (per request unit(RU))	 9.25
Note: These timings are for when NOWAIT parameter is used on any previous EXEC SEND commands (see "Send to 3270").	

Send to 3270

Table 35. Send to 3270

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
	Via VTAM
EXEC SENDMAP map fields Assumes NOWAIT	2.90 See note 1. See note 2.
Internal trace	2.44.

Notes:

1. The time taken to map the fields depends on the number of fields and the number of maps.

   The map fields timing is:

   ```
   (0.70 x nm) + (0.08 x nf)
   ```

   where

   - "nm" is the number of floating maps.
   - "nf" is the number of fields in the map. This number should include application data fields, constant fields, and null fields (that is, the spaces between visible fields).

2. See Table 34 for timings for NOWAIT parameter

RECEIVE from 3270

Table 36. RECEIVE from 3270

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
	Via VTAM
EXEC RECEIVEMAP locate map unmap fields	1.48 0.79 See note 1.
Internal trace	2.78
Flush pending sends Terminal Control (per RU). See note 2.	10.80 11.42

Notes:

Performance timings are for receive map with one input field against a map with 80 fields (3 RUs).

1. The time to unmap the fields depends upon the number of fields and the number of maps. The timing to unmap the screen input fields is:

   ```
   (0.56 x nm) + (rf x 0.02mf) + (0.08rf)
   ```

   where:

   - "nm" is the number of maps.
   - "mf" is the number of fields to be checked (left to right, top to bottom) before the correct field position in the map is found; repeated for each received field.
   - "rf" is the number of received fields.

2. These timings vary depending on the length of the transmitted message. Terminal control timing is:

   ```
   INTEGER(message/RU) (7.62)
   ```

WRITEQ transient data (VSAM)

Table 37. WRITEQ transient data (VSAM)

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
	Intrapartition
WRITEQ TD (see notes 1 and 2) With I/O Buffering only	 10.6 4.4
Internal trace	1.3
Recoverability no trace With internal trace	 7.49 8.90

Notes:

1. **Single Buffer Support**: These times vary depending on the sequence of writes to a particular queue or to a different queue. If the writes are to the same queue, the time is the sum of one WRITEQ TD with I/O plus (n–1) without I/O, where *n* is the number of records that can fit the transient data CI size.

   If the WRITEQ TD is to a different queue (worst case), the time is the sum of one WRITEQ TD to flush out the previous queue buffer, plus a READQ TD if the QUEUE already exists, plus a further WRITEQ TD without I/O.

2. **Multiple Buffer Support**: The aim of multiple buffer support is to:

   - Reduce the amount of I/O to service requests, excluding recoverability
   - Allow a degree of concurrency of I/O operations.

   If you specify only a single string and buffer, execution will be as described in Note 1. If you specify more than one buffer, this increases the probability of a buffer being available for the WRITEQ TD data and, therefore, minimizes the output operation. If recovery is specified, the output operations always occur.

   If all buffers are full, output operations take place to free up buffers for the current request.

READQ transient data (VSAM)

Table 38. READQ transient data (VSAM)

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
	Intrapartition
READQ TD	
With I/O	6.53
From buffer only (see note 1)	1.80
Internal trace	1.3
Recoverability	
no trace	7.49
With internal trace	8.90

Notes:

The aim of multiple buffer support is to:

1. Reduce the amount of I/O to service requests, excluding recoverability
2. Allow a degree of concurrency of I/O operations.

If you specify more than one buffer, this increases the probability of the required data existing in one of the buffers.

If the data cannot be found in the buffers, one or more I/O operations are necessary. If the data buffers are not “mirrored” on the output device, a buffer is written to free the buffer for the read operation. The read operation is then performed.

WRITEQ temporary storage

Table 39. WRITEQ temporary storage

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)	
	Main Storage	**Aux. Storage**
WRITEQ TS		
With I/O	N/A	7.19
Without I/O	2.29	2.56
Recoverability	N/A	7.49
no trace	N/A	8.90
With internal trace		
Internal trace	1.03	1.03

READQ temporary storage

Table 40. READQ temporary storage

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)	
	Main Storage	Aux. Storage
READQ TS		
With I/O	N/A	8.59
Without I/O	1.78	1.99
Recoverability		
no trace	N/A	7.49
With internal trace	N/A	8.90
Internal trace	1.03	1.03

START BROWSE (VSAM)

Table 41. START BROWSE (VSAM)

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
START BROWSE	2.89
Index I/O	7.40
Sequence set I/O	7.40
Data buffer I/O	7.40
Internal trace	0.73

READ NEXT BROWSE (VSAM)

Table 42. READ NEXT BROWSE (VSAM)

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
READ NEXT	
Read with I/O	6.63
From buffer only	1.42
Internal trace	0.37

END BROWSE (VSAM)

Table 43. END BROWSE (VSAM)

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
END BROWSE	1.26
Internal trace	0.37

READ (VSAM)

Table 44. READ (VSAM)

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)	
	K S D S	E S D S
READ		
Index with I/O	7.40	N/A
Sequence set I/O	7.40	N/A
Read data with I/O	9.86	9.31
From Buffer only	3.09	2.21
Recovery (see note)	1.03	NE
Internal trace from buffers only	0.38	0.38

Note: When RECOV is set to BACKOUTONLY (AUTOLOG=YES in FCT), the before image is placed in the journal buffer by the READ for UPDATE. It is not forced out to DASD until the REWRITE, by which time it may have been forced out by other journal activity.

WRITE (VSAM)

Table 45. WRITE (VSAM)

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)	
	K S D S	E S D S
WRITE		
Index with I/O	NE	
Sequence set I/O	NE	
Data with I/O	11.74	
Recoverability		
no trace	11.42	
with internal trace	13.14	
Internal trace	0.59	

Note: CICS file integrity includes a READ operation prior to the WRITE to check whether the record exists.

REWRITE (VSAM)

Table 46. REWRITE (VSAM)

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)	
	K S D S	E S D S
WRITE		
Index with I/O	7.83	N/A
Sequence set I/O	7.83	N/A
Data with I/O	9.24	9.18
Data only	NE	NE
Recoverability		
no trace	7.49	7.49
With internal trace	8.90	8.90
Internal trace	0.58	0.58

DELETE (VSAM)

Table 47. DELETE (VSAM)

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
	KSDS
DELETE	11.46
Recoverability	
no trace	7.49
With internal trace	8.90
Internal trace	0.59

Storage control

Table 48. Storage control

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
GETMAIN	0.80
FREEMAIN	0.78
Internal trace	
GETMAIN	0.41
FREEMAIN	0.46

Program control

Table 49. Program control

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
LINK Assembler COBOL II	 1.41 4.07
Internal trace	1.60
RETURN Assembler COBOL II	 1.11 3.44
Internal trace	0.87

User journaling

Table 50. User journaling

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
EXEC interface (STARTIO=YES) Write to log	 4.59
Internal trace	1.12

ENQ/DEQ resource

Table 51. ENQ/DEQ resource

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
ENQ DEQ	0.23 0.22
Internal trace	0.59

Interval control

Table 52. Interval control

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
SUSPEND ASKTIME	0.66 0.12
Internal trace SUSPEND ASKTIME	 0.64 0.41

EXEC conditions

Table 53. EXEC conditions

CICS INTERNAL FUNCTION	APPROXIMATE TIMINGS (ms)
EXEC functions	
HANDLE AID	0.43
HANDLE CONDITION	0.38
IGNORE	0.32
ASSIGN ABCODE	0.16
ADDRESS CWA	0.16
Internal trace	
Internal storage (aid)	0.38
(cond)	0.40
(ign)	0.40
(abc)	0.20
(cwa)	0.20

MRO

Estimated processor timings for function shipping on MRO

Table 54. Estimated timings for function shipping on MRO

CICS INTERNAL FUNCTION	Application-owning region	Resource-owing region
First function ship	7.7	12.0
Subsequent function ship	5.20	5.75
Last function ship including syncpoint	15.50	14.50
Low utilization effect	1.40	1.40

Notes:

1. The timings were obtained from an investigation of shipped file requests. Other types of requests may show slightly different characteristics.
2. These times should be added to the processing times of the CICS commands that are function shipped.
3. The low utilization effect is a consequence of the extra work involved in task communication and management when the system is not busy. The timings given here are an estimate of this effect. They should be added for the percentage of function shipped flows which arrive at either region and find it in a VSE WAIT.
4. The syncpoint flow is for a two region MRO case where the file owning region (FOR) has a logical unit of work to commit.

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