CICS Family:

GC33-0155-05

General Information

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GC33-0155-05

General Information

Note!

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

Sixth Edition (January 1995)

This edition applies to the following releases of the IBM licensed program Customer Information Control System (CICS):

- CICS/ESA Version 4 Release 1, program number 5655-018
- CICS/ESA Version 3 Release 3, program number 5685-083
- CICS/ESA Version 3 Release 2, program number 5685-083
- CICS/MVS Version 2 Release 1 Modification Level 2, program number 5665-403
- CICS/VSE Version 2 Release 3, program number 5686-026
- CICS/VSE Version 2 Release 2, program number 5686-026
- CICS/VSE Version 2 Release 1, program number 5686-026
- CICS/400 Version 3, program number 5763-DFH
- CICS/400 Version 2, program number 5738-DFH
- CICS/6000 Version 1, program number 5621-063
- CICS for OS/2 Version 2 Release 0 Modification Level 1, program number 5648-036
- CICS Clients, Version 1, program number 5622-543

It applies to all subsequent releases and modifications until otherwise indicated in new editions. Consult the latest edition of the applicable IBM system bibliography for current information on these products.

This edition is a major revision of, and obsoletes, GC33-0155-4.

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About this book

What does this book describe?

This book describes the IBM CICS family of products.

CICS licensed programs are application servers for business applications. They are also application platforms for running a variety of transactional applications from a wide range of devices. They offer shared access to a variety of data sources.

Who should read this book

This book is for:

- Key software decision makers and their staffs
- System designers
- Application designers.

Anyone who is new to Information Systems departments and who needs a high-level overview of the CICS range of products would also benefit from reading this book.

What's in this book

What is CICS?
Introduces transaction processing systems and client/server computing in general and CICS in particular. It explains the advantages of using CICS in these environments and describes some typical applications.

What CICS can do for you
Briefly describes internal CICS facilities.

The CICS family
Introduces the members of the CICS family.

Glossary

Index

What you need to know to understand this book

This book assumes you have some experience of computer applications, but that you don't necessarily know anything about CICS.

The terms we use

Throughout this book, the term *CICS* means any of the CICS family of products: CICS/ESA, CICS/MVS, CICS/VSE, CICS for OS/2, CICS/400, CICS/6000, CICS for DEC OSF/1 AXP, and CICS for HP 9000. Where we mean specific products, we use their full names.

In this book, *CICS on Open Systems* is used to refer to CICS/6000, CICS for DEC OSF/1 AXP, and CICS for HP 9000, subject to their availability.

We normally abbreviate CICS release levels — *4.1*, for example, means Version 4 Release 1.

We also use *MVS* to mean MVS/ESA and MVS/XA, and *VSE* to mean VSE/ESA and VSE/SP.

Bibliography

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CICS/VSE 2.3: Release Guide, GC33-0700
CICS Clients: Administration, SC33-1436
CICSPlex SM: Concepts and Planning, GC33-0786
CICS VSAM Recovery MVS/ESA Version 2 Guide, SH19-6709
MQSeries Planning Guide GC33-1349

For information about other IBM products, ask your IBM representative for a list of publications about those products. For information about non-IBM products, see the publications available from the manufacturers of those products.

CICS maintains a worldwide web (WWW) server on the Internet. The universal resource locator (URL) for the CICS “home page” is:

```
http://www.hursley.ibm.com/cics/
```

The server makes various resources available from this “page”, including an online version of this book in hypertext markup language (HTML) format.

Part 1. What is CICS?

CICS is IBM's general-purpose online transaction processing (OLTP) software. It is a powerful application server that runs on a range of operating systems from the smallest desktop to the largest mainframe.

It is flexible enough to meet your transaction-processing needs, whether you have thousands of terminals or a client/server environment with workstations and LANs exploiting modern technology such as graphical interfaces or multimedia.

It takes care of the security and integrity of your data while looking after resource scheduling, thus making the most effective use of your resources. CICS seamlessly integrates all the basic software services required by OLTP applications, and provides a business application server to meet your information-processing needs of today and the future.

Typical transaction processing applications include:

- Retail distribution systems
- Finance—banking, insurance, and stockbroking systems
- Order entry and processing systems
- General ledger systems
- Payroll systems
- Automatic teller machines
- Airline reservation systems
- Process control systems

and many, many others.

Chapter 1. An introduction to CICS

CICS is a software product that is used by many thousands of organizations (large and small) all over the world to take care of their transaction processing needs.

Each product in the CICS family is designed to run on a particular operating system and hardware platform, and each product has powerful functions to allow interproduct communication with other members of the CICS family. CICS provides a cost-effective and manageable transaction processing system, allowing you to write your own applications or to choose from many existing vendor-written business products.

Transactions

Transactions are familiar to us in everyday life when we exchange money for goods and services, such as buying a train ticket or paying for medicine. Such transactions involve a short conversation (for example, requesting availability and cost), and then making the payment. The processing of any one of these items is a business transaction, of the kind that is handled by CICS.

Viewed simply, a typical OLTP transaction consists of many computing and data-access tasks to be executed in one or more machines; the tasks may include handling the user interface, data retrieval and modification, and communications. In CICS terms, these operations are grouped together as a unit of work or a **transaction**.

A transaction management system (sometimes called a transaction monitor) such as CICS:

- Handles the start, running, and completion of units of work for many concurrent users
- Enables the application (when started by an end-user) to run efficiently, to access a number of protected resources in a database or file system, and then to terminate—normally returning an output screen to the user
- Isolates many concurrent users from each other so that two users cannot update the same resource at the same time.

CICS is a layer of middleware that shields applications from the need to take account of exactly what terminals and printers are being used, while providing a rich set of resources and management services for those applications.

In particular, CICS provides an easy-to-use application programming interface (API)—EXECUTE CICS (or EXEC CICS)—which allows a rich set of services (including file access, scratchpad, and presentation services) to be used in the application and to be ported to and from a wide variety of hardware and software platforms where CICS is available.

In addition to the application services, CICS provides support for clients to run on workstations and other devices, and to interoperate with CICS. These support services can be used in conjunction with a wide range of screen interface tools, and allow the client's part of an application to access business logic and transactions from the client's workstation.

Transaction processing

CICS facilitates your business transactions by:

- Handling small to very large numbers of users
- Letting many users share the same information and applications simultaneously or concurrently
- Being comprehensive—offering a wide variety of services and functions
- Making transaction systems affordable
- Protecting the shared information (data integrity)
- Providing portable interfaces for applications
- Being reliable—high-quality software
- Maximizing availability—having extensive backup and recovery facilities
- Not being tied to a single database technology
- Enabling workstation applications to access network applications and resources with integrity and security.

Why have CICS?

CICS has played a key role in evolving OLTP. It now provides such comprehensive client/server support and application services that it can truly be considered as being more than a transaction monitor. It is a highly efficient **application server**.

In a business environment, there are certain key requirements that an efficient application server can provide:

- An application server must be able to support a wide range of terminals, printers, personal workstation interfaces, and industry-specific devices such as point-of-sale and banking terminals. It must be able to service a high number of these devices interacting simultaneously.
- An application server must be available to employees and customers when they need it. For some businesses this means 24 hours a day, seven days a week. If the system fails, it must be up and running again quickly, and the data must be consistently restored with no loss of integrity.
- The transaction data must provide a true picture of the state of the business. If a transaction has to be abandoned for some reason, the application server must undo the effects of that transaction. If a transaction competes directly with another, the application server must ensure that one transaction completes its (logical) unit of work (either normally or abnormally) before other transactions that are contending to update the same data are allowed to access that data.
- A good response time is essential. This translates into high productivity for employees and efficient service for customers. Transactions must be prioritized to ensure that the most important ones get processed first.
- Transaction processing should cost only a small fraction of the resulting value of each transaction.
- The application server needs easy-to-use ways of writing applications with different screens and printers.

The wide-ranging family of CICS products supports the needs of the extended enterprise, and its intersystem communication functions offer powerful, easy-to-use application extensions for distributed computing.

CICS—whether on a local area network (LAN) or wide area network (WAN), and on a wide variety of hardware platforms—offers all of these benefits, and more. It takes care of terminal input and output, scheduling, and the execution of multiple-use requests, as well as transaction management. CICS is a system-level program that deals with complex transaction integrity problems, leaving application programmers to concentrate on the solutions to business problems.

CICS provides efficient algorithms for handling many short-running units of work for many users concurrently. The rich application programming interface provided by CICS is:

- High-level (by means of EXEC CICS commands).
- Usable from a variety of programming languages, on different operating systems and hardware environments, with a variety of networks and value-added services.
- Portable from one CICS platform to another.

With all its interfaces, CICS allows transactional applications to run and interoperate on a wide variety of systems.

Why have CICS on a LAN or WAN?

Many customers are now moving beyond simple data-oriented or decision-support applications on the LAN toward mission-critical and/or process-oriented tasks—and this requires additional software beyond the database that those customers may already have.

CICS on a LAN or WAN:

- Complements a relational database by providing coordination of recovery between multiple and heterogeneous resource managers (for example, VSAM, SQL, and Message Queues).
- Provides powerful, easy-to-use interconnectivity between the LAN or WAN and CICS on other platforms.
- Enables CICS applications to be run on the LAN. The client/server architecture of CICS ensures that you need to maintain only one programming skill for business logic—CICS application programming. You can develop applications for a range of application servers, from LAN to mainframe, using the CICS API.

Client programming interfaces provide access to CICS from a broad spectrum of personal computers and systems.

Desktop client systems bring additional flexibility and ease-of-use, and availability to the powerful applications provided by server systems.

CICS solutions for business problems:

- **Integrity**. Many transactions may be accessing the same data at the same time. It is important that all transactions are able to complete successfully, without interfering with any other transaction. Changed data must be available immediately to all other transactions.

  An online transaction processing system can become quite complex, with a large number of concurrent users and a high volume of transactions. Despite this complexity, a transaction processing system must still allow users to share data and resources with full integrity.

- **Security**. Users must have security of access to the **CICS system**, with no-one being able to sign on and run programs unless they are authorized to do so. Supervisors can assign authority for a user to run specific **transactions** and can restrict access to specific **resources**.

- **Recoverability**. In the event of an application or system failure (for example, if there is a power loss and the computer system shuts down), when the system restarts, any uncompleted work that was in progress at the time of shutdown, including changes to data, must be **backed out** to a point where the system was last in a consistent state.

- **Connectivity**. Transactions are generally invoked by online input and generate online output. To be online, the end user needs a terminal or workstation connected to a computer system. That system configuration could be:

  - A standalone workstation.
  - A local area network (LAN)—a communication network offering a physical, hardwired connection to a group of users across a limited area. Separate LANs can be interconnected.
  - A wide area network (WAN) consisting of several LANs connected by telecommunication links.

- **Scalability and affordability**. Client/server technologies enable applications to be split and distributed to meet diverse business needs. The CICS family is growing all the time.

  Using members of the CICS family, you can execute transactions anywhere in the network. CICS programs can communicate with other programs on the same CICS system or on a remote system. They can also access data held remotely, elsewhere in the network. CICS gives you the opportunity to have the resources you need where you need them; you have the choice.

- **Portability**. With the CICS family, programming skills and programs are portable across the different platforms. The CICS application programming interface means that applications using a range of EXEC CICS commands can run on hardware ranging from workstations up to mainframes without needing major change. It also means that existing programming skills can be used across multiple CICS platforms. CICS client APIs also allow applications to be ported across different client platforms.

For a cost-effective solution, you can use CICS as your application server, either by writing your own applications or by purchasing vendor products. The CICS family of application servers is available across all of IBM's strategic hardware and operating system platforms, and on those of other computer vendors. CICS can provide all these solutions, and more...

CICS—the application server

Nearly all OLTP applications fall into one or other of the following types:

- **Enquiry**—accessing information held on centralized files
- **Enquiry and update**—accessing the information and altering it
- **Data entry**—updating and creating centralized information
- **Message switching**—transferring messages across the network.

Different applications can access the same data set or database, and can also access programs (business logic), data sets, and databases on other systems. All the types of application just mentioned are available across the CICS family of products although, in some cases, the type of terminal that can be used may be limited to programmable workstations, 3270 terminals, and printers. In many cases, the application can be enhanced and the user interface improved by having part of the application run on the programmable workstation.

Power

As an application server, CICS provides:

- A means of enabling and disabling access to system resources such as data, applications, queues, and terminals
- An operator interface for a human or a computer program to be able to handle most common operational tasks, including seeing and responding to messages and other system conditions
- A range of methods of interprocessor communication
- Useful application services such as queuing, context management, unit-of-work management, program management, and scratchpad areas.

Choice

CICS servers are available in a number of different versions, each one designed to provide transaction processing services in a different environment. These include MVS/ESA, VSE/ESA, MVS/370, OS/400, AIX on RISC System/6000, OS/2, DEC OSF/1 AXP, and HP-UX.

CICS clients include those for OS/2, AIX, Macintosh, Windows, DOS, LANDP, HP, Digital, and Sun.

CICS also supports a very wide range of terminals: printers, monochrome and color displays, badge readers, banking devices, and so on.

Value

The wide variety of CICS systems gives the following advantages:

- **Application rightsizing (scalability)**. You can:
  - Migrate applications to the best platform
  - Develop applications on the best platform
  - Leverage your programming investment.
- **Distributed client/server-based systems**. You can:
  - Put applications and data where business dictates
  - Utilize platform strengths for client/server processing
  - Enhance applications and the portability and integrity of your data.
- **Enterprise-wide communications**. This gives you:
  - Good connectivity for non-homogenous systems
  - An industry-standard API
  - Data integrity (industrial-strength OLTP).

One CICS system can talk to others, both within the same host and at the other side of the globe. So you can base a worldwide data communication system around CICS. You don't have to, though. CICS is equally at home with small clusters of local devices.

The CICS API gives access to many CICS services. It allows application development in a consistent style, independent of the programming language used and the functionality of the underlying system.

You can select the CICS facilities that you want, and build whatever kind of user interface best suits your end users. You provide the application programs that the end users actually run; CICS makes them much easier to write by providing a wide selection of simple, high-level commands.

You can also use application generators such as VisualGen to develop CICS applications.

Large number of applications

CICS has gained wide customer acceptance over the years; one result being the large number of software products (both IBM and non-IBM) that will run with, or under, CICS. These range from application generators to performance-monitoring tools, and from simple utilities to complete off-the-shelf applications that you can buy and put more or less straight into production on your system.

Interoperability, extensibility, and evolution

As you will see later, and as shown in Figure 1 on page 9, every CICS product can be connected to any other, either directly or indirectly. In this way, CICS systems can cooperate to share information or workload, and to provide administrative and control capabilities.

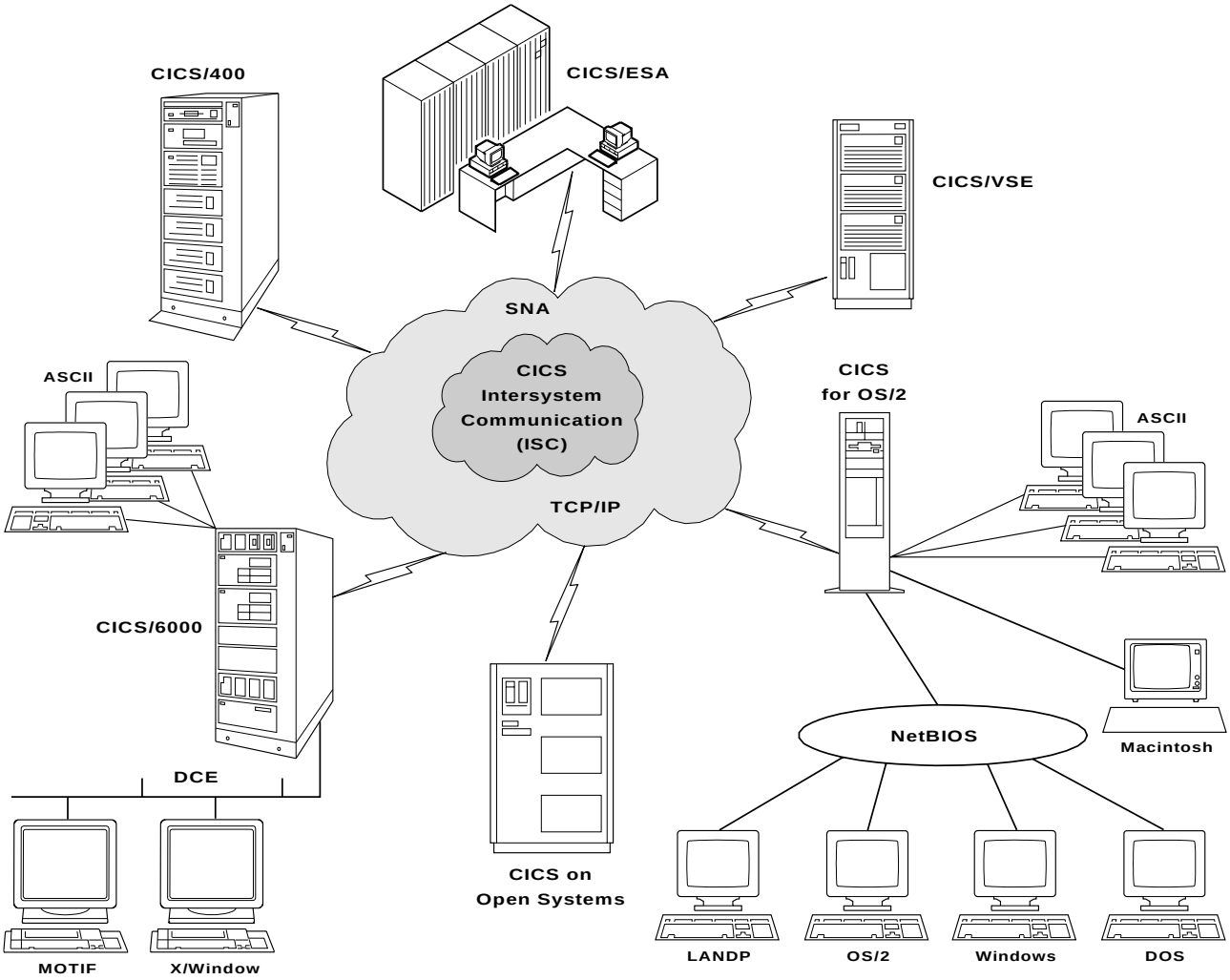

Figure 1. The CICS family—a range of choices

CICS products have evolved in parallel with the growth of online terminal networks and database technologies. CICS is continuously changing, to keep pace with changes in those technologies and with customers' needs.

Reliability

Reliability and data integrity are attributes of all CICS family members. In addition, powerful intersystem communications facilities make it easy to link your CICS installations together. CICS aids programmer productivity in a complex world—whether the environment is stand-alone, client/server, or distributed.

Performance optimization

A network's end users make all kinds of demands on many different sets of data. The things they want to do individually (for example, add a new employee to the payroll file) are usually simple and do not take very long. However, their jobs are often interrelated and share the same programs and data. Furthermore, they all want short response times. For these reasons, the users' work can be done more efficiently within a single operating system job, rather than as separate jobs.

To handle all the work within the same job in this way calls for a controller, just as a computer needs an operating system to control its various jobs. As an application server, CICS carries out this controlling function.

A properly planned extended enterprise solution can provide significant benefits. The CICS systems can match the needs of the enterprise not only as it appears today, but as it might appear tomorrow. Consider using client/server solutions for your business needs. Current investments in technology can complement past investments, providing a base for the future and a continued return on investments in applications and skills.

CICS—the application server

CICS is far-reaching...

- All major IBM and many non-IBM platforms supported
- Dependable, high-integrity platform interoperability
- Transparent use of applications across LANs and WANs
- Multiple network protocols supported, including SNA and TCP/IP.

CICS is powerful...

- Wide-ranging client/server application support
- Scalable application environments from tens to thousands of users
- Comprehensive business transaction management
- Integration of modern solutions such as voice and image processing.

CICS is reassuring...

- Software fault-tolerance ensuring availablity and recoverability
- Consistent, dependable performance
- Optimum usage of system resources
- Concurrent sharing of data with complete integrity.

CICS is all-embracing...

- Multiple relational database management systems (RDBMSs) and data systems supported
- Broad range of industry-specific terminals and devices supported
- Common application programming interface (API) for many programming languages
- Productive programming environment and application portability.

Part 2. What CICS can do for you

This part of the book describes the kinds of things CICS does for the user—what it is that people need when they are doing business transaction processing.

CICS acts as an application server within the operating system of your choice. It handles transaction processing work on behalf of the application, to save the application itself from having to do specialized task scheduling and control, and data routing and locking, that transaction-handling requires.

The operating system can continue to process its normal, nontransaction workload. On mainframe platforms, the operating system treats CICS as a single program, even though CICS itself may be handling tens or hundreds of other programs.

The CICS family provides a very rich and comprehensive set of services that are available on all family members. These services include:

- **Transaction management**. Applications can control the disposition of transactions through commit/abort processing. CICS also provides implied support for starting transactions (that is, transactions can be started as a result of direct terminal input, receipt of a network communication message, or scheduling of a batch job. In addition, a unit of work can be started by the application issuing a “start transaction” command).
- **Extensive data management support for both flat files and databases**. CICS file control provides access and/or update of fixed- or variable-length structured files. File organizations can be sequential, relative-record, or indexed with multiple indexes. Databases are supported through integration interfaces, depending on the platform. They can be supplied by IBM or other vendors, depending on the type of database.
- **Terminal and screen handling**. CICS applications can access a variety of terminals. Screen mapping services provide a method of building screen format management into CICS applications, and additional tools facilitate the development of such applications. Graphical user interfaces (GUIs) can be used on platforms where they are available.
- **Queue management**. Extensive queuing facilities are provided. These facilities provide scratchpad support, asynchronous communication between applications, transaction batching, general data storage, and many other capabilities that offer flexibility in application construction.
- **Interval control**. This allows application-related events to be triggered by some time interval or by time of day—an essential aspect of any real-time system.
- **Abnormal and exceptional condition handling**. Extensive support is provided for applications to handle abnormal and exception situations in a consistent, high-level way. This includes support for application recovery and restart; also for orderly termination with diagnostics.
- **Storage management**. CICS functions allow applications to manage storage for their own use. CICS tracks storage allocation to protect against “leakage” (storage that the system loses track of, which could cause a system crash).
- **Serialization**. The CICS enqueue/dequeue function enables serialization of applications that need to share application-related objects.

- **Workstation client connectivity**. Client APIs (ECI and EPI) enable workstation applications to access applications or data on CICS servers.
- **Logging/journaling**. CICS logging and journaling functions provide reliable storage and retrieval of information for use during application or system restart and recovery.
- **Work area management**. CICS manages various transaction- or application-related work areas for applications, automatically providing them and freeing them as transactions start and finish, or maintaining them across transactions.
- **Distributed applications**. CICS provides extensive support for constructing distributed applications.
- **Recovery and restart**. CICS has facilities that allow the recovery and restart of applications, the system, and its resources. These do not require any application involvement, but application-specific processing can optionally be included as part of the recovery/restart processing for your CICS system.
- **Application development tools**. Many tools supplied by IBM and non-IBM vendors support the development of CICS applications, including screen-design aids, graphical user interface (GUI) tools, fourth-generation languages (4GLs), CASE tools, debugging facilities, and various utilities for data management.
- **System management**. Extensive management facilities include the definition and management of system and application resources, security at varying levels of granularity (user access to the system, resources, and communication links), workload management, diagnostic and serviceability aids, and operator controls.
- **Debugging facilities**. These help with problem determination in both applications and the system.

The rest of this part describes how CICS works for you under the following headings:

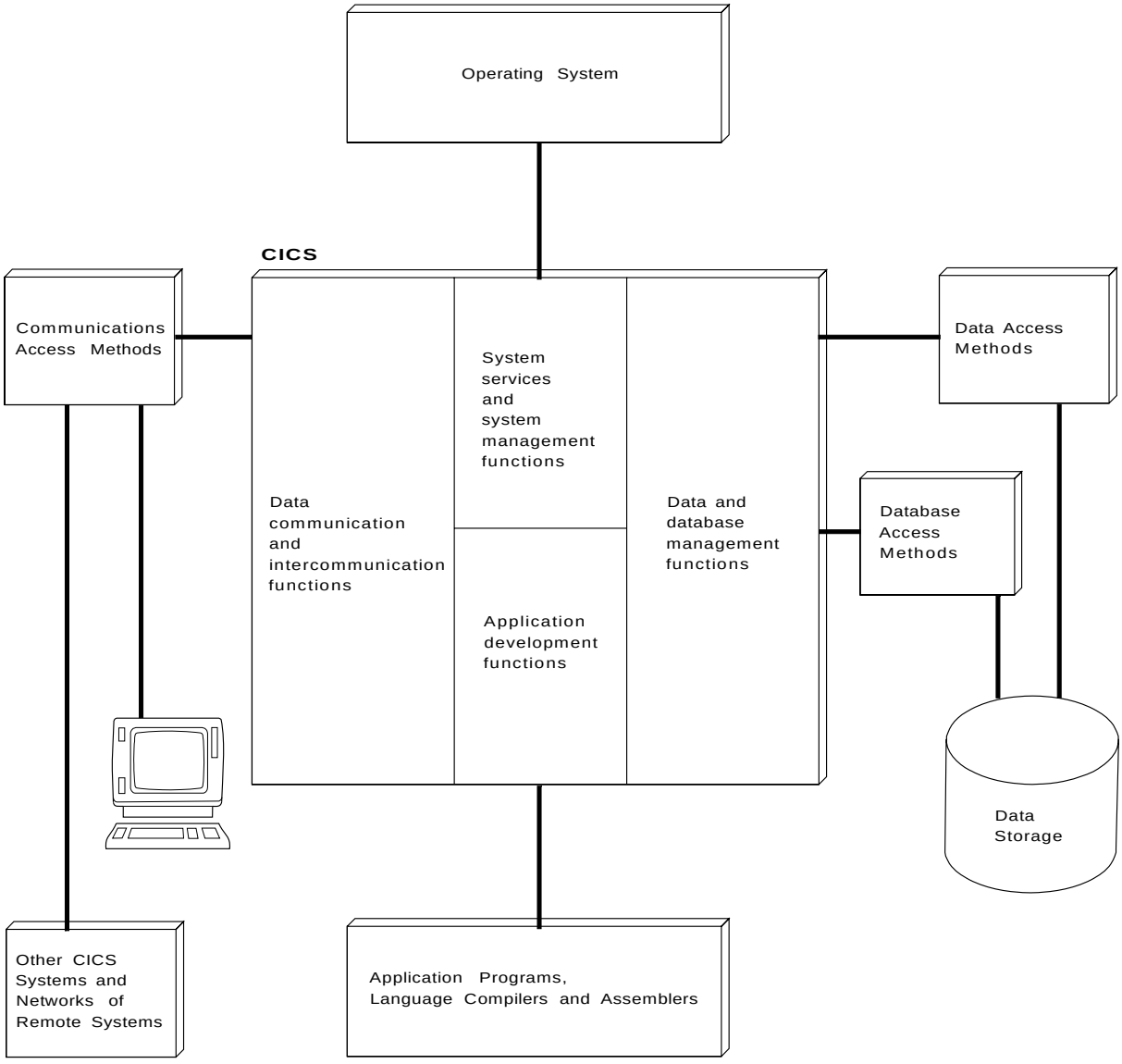

Figure 2. CICS and its software environment

Chapter 2. Management of data and databases

The most important thing about transaction processing is the data. This is true of most systems but, with transaction processing, the concerns about data are more varied. In other systems, your concern is that you don't lose or corrupt the data. In a transaction processing system, you need to make sure that different applications do not clash over use of the data, and that you do not jeopardize its integrity by losing track of its update, either.

The implications and consequences of the loss of data, or of its integrity, are so much greater in a real-time system. If things go wrong in a complex system, multiple, simultaneous changes to data can be heavily intertwined, so recovering from failure of machinery or software, or from human error, can be difficult.

The CICS family provides the services to handle data reliably, but also to reinstate it if anything does go wrong.

This chapter discusses the CICS family interfaces to **data storage** you can use, including **databases**, **data sharing**, and **file control**.

It also describes the features of CICS that help to preserve **data and system integrity** both in normal operation and under error conditions.

Databases

Databases give the greatest degree of data independence. You can share them between batch programs as well as CICS transactions, with equal freedom for both access and update, and with full database integrity.

Currently, **relational** database managers for use with CICS include:

- The DB2 family (DB2 for ESA, DB2 for VSE, DB2 for VM, DB2 for AS/400, DB2 for RISC System/6000, DB2 for OS/2, and DB2 for UNIX)
- Other relational databases such as Oracle, Sybase, Ingres, and Informix.

CICS gives attachment interfaces for these database managers, and provides monitoring and control services. The database manager products supply interfaces and utilities that enable programmers to write data access commands that are similar to CICS commands (the EXEC SQL commands). Programs can therefore be created or modified by programmers with a knowledge of CICS commands—even though the structure of EXEC CICS commands and EXEC SQL commands is different, the style is similar.

CICS applications can access the appropriate DB2 family member. CICS applications that process DB2 tables can also access any SQL database manager and file control. CICS applications can call SQL, and any SQL database manager can access CICS applications. So you can access DB2 data from a CICS/ESA or CICS/MVS environment, and you can access both DL/I and DB2 data in a coexistent environment. For information about DB2, see the *IBM DATABASE 2 General Information* manual (GC26-4073).

Similarly, CICS/VSE supports the SQL/DS relational database manager. CICS/VSE application programs can contain both EXEC DLI and EXEC SQL commands.

Sharing DL/I data

CICS on mainframe platforms also supports hierarchical database managers such as IMS and DL/I DOS/VS. These are of more traditional designs, but remain very popular because of their high performance and because they continue to hold huge amounts of the world's commercial data.

IMS Datasharing allows more than one system to have concurrent access to a DL/I database. This means that concurrently active batch regions can share DL/I databases with CICS transactions.

A DL/I database can, of course, be remote from a CICS system.

CICS file control

Indexed and sequential data sets offer a limited form of database facility within CICS, with information organized in individual files. These are processed by CICS file control interfacing with the appropriate access method depending on the operating system. The main access method used is the Virtual Storage Access Method (VSAM).

Using indexed or sequential data sets gives adequate function for many applications, and offers simplicity, ease of use, and economy.

For CICS/6000 and CICS/400, file control is provided by emulating VSAM.

Among other things, file control provides command-level access to browsing facilities. It also looks after buffer and block management, and deals with access method dependencies. This gives the application programmer a degree of access-method independence.

File control reads from, and writes to, user-defined data sets and data tables, gathers statistics, and acquires dynamic storage for I/O operations. Furthermore, CICS file control allows updates, additions, deletions, random retrieval, and sequential retrieval (browsing) of logical data in the data sets.

In general, CICS provides optional automatic journaling and logging facilities for records that are updated, deleted from, or added to a file control data set. You can specify **automatic journaling** in the file control table for each data set affected. For a specified data set, a record read for update, a new record added, or an existing record deleted is automatically written to the specified journal.

In addition to automatic journaling, file control may perform **automatic logging** of certain file operations on recoverable files. This logging is written on the CICS system log and on the dynamic log. In the event of either a system or a transaction failure, the information can subsequently be used to restore the recoverable data set as though the current transaction had never run.

CICS storage areas

Two other forms of CICS storage used by all members of the CICS family are **transient data** and **temporary storage**. Transient data consists of queues of data to be sent to a terminal, such as a printer, and sequential files. With CICS/VSE, the CICS report controller facility enables you to create reports from data held in transient data queues.

Temporary storage provides an internal scratchpad facility for CICS's own use and for passing parameters between transactions. A CICS-supplied transaction allows you to browse these queues.

Data and system integrity

Users want to protect data from accidental loss or corruption. In other words, the **integrity** of your data must be maintained:

- During updating
- If transactions are canceled
- Following a system failure.

The system must ensure data integrity through:

- **Atomicity**—each unit of work is a separate entity or integral unit, and it either succeeds or fails. Each unit of work must be capable of being committed (completed) on successful termination, or rolled-back (backed-out) on failure. If a unit of work fails to complete, there is no danger of it partially executing and corrupting data in a database; if a unit of work is completed, any changes to the database data are made permanent.
- **Consistency**—units of work obey legal protocols defined within the application context, and are repeatable in a specific sequence (with reproducible and predictable results). The unit of work maintains the same relationship with all the data used to execute the unit of work; this helps to prevent any corruption of data that is used in different databases.
- **Isolation**—complete independence of tasks. This makes sure that two units of work cannot occur at the same time while operating on the same data; one unit of work must either be delayed until the other one completes its task, or it must be canceled. At the point of commitment, no state change made is dependent on uncommitted changes made in other concurrent object units of work. A locking mechanism must be available to prevent simultaneous updates of the same information.
- **Durability**—permanence of processing results. This ensures that, in the case of a failure of any part of the system, a successful unit of work will be reflected as a permanent change to a database. The resulting object state changes survive termination of units of work in the presence of hardware and software errors.

Maintaining the integrity of data during updating

Where many users have access to the same data, there is always a chance that several of them will try to change the same record at the same time. Rather than allow this to happen, all members of the CICS family ensure that one operator's updating of data is complete before another's may start.

Maintaining the integrity of data if transactions are canceled

During normal execution of a task, CICS logs information about all protected data that is being changed. This protected data is called a **recoverable resource**. The term applies to any resource for which recovery information is recorded (and which can therefore be recovered by reversing or "backing out" the changes made to it). It covers, among other things, any files you nominate, certain transient data and temporary storage queues, and DL/I databases.

Dynamic logs

CICS puts the information about this protected data in the **dynamic log** (a separate area of storage allocated as required). The log information is deleted after the successful completion of the task. However, if for any reason the task is not completed, the data changes can be reversed, restoring the protected data to its original state.

Dynamic transaction backout

CICS carries out **dynamic transaction backout** (DTB) to manage this recovery. If a transaction fails, due perhaps to application program error, data access error, transmission error, or because an operator decides to cancel a transaction, DTB reverses the updates that have been carried out by the transaction involved.

The process of canceling changes in data works backward from the last change before the failure, hence the name dynamic transaction backout. The backout occurs within the same task. This safeguards other tasks from the possibility of using corrupted data, because modified data is not released for use by them ("committed") until the current task has finished with it.

Synchronization points

Application programs can specify intermediate **synchronization points** (sync points). A sync point is a logical point in the execution of an application program where the changes made to the databases by the program are consistent and complete and can be committed to the database. The output, which has been held up to that point, is sent to its destination(s), the input is removed from the message queues, and the database updates are made available to other applications. When a program terminates abnormally, CICS recovery and restart facilities do not back out updates before the last completed syncpoint. Sync points delimit a logical unit of work (LUW).

Logical units of work

An LUW is a sequence of processing actions (database changes, for example) that must be completed before any of the individual actions can be regarded as committed. When changes are committed (by successful completion of the LUW and recording of the sync point on the system log), they do not need to be backed out after a subsequent failure of the task or system. The end of an LUW is marked in a transaction by a sync point, issued either by the user program or by CICS at the end of task. In the absence of user sync points, the entire task is an LUW.

If there's a failure, a sync point tells CICS that changes made before that point (that is, during a preceding LUW) do not need to be backed out. Sync points help to speed up and simplify recovery from failure in a long-running task. LUW integrity is maintained even when a unit of work is split between a number of CICS family members.

The subsequent recovery

If you use DTB, it can be followed by a **restart** function, which allows the transaction to be retried immediately.

Transaction restart is an optional facility on many platforms which allows a canceled transaction to be restarted automatically without intervention by the terminal operator, provided that certain conditions are met (these are documented in the books for each member of the CICS family). The facility allows the application program to perform additional recovery functions written by the programmer.

If an application program runs into problems, it can choose to call the **rollback** facility to cancel the changes it has made in all recoverable resources during the current transaction. These are then restored to the state prevailing at the previous sync point.

The terminal user is usually unaware of these transaction recovery functions.

Maintaining the integrity of data following system failure

In addition to the dynamic log mentioned above, CICS keeps track of the activities of programs in the system through system logging and automatic journaling. A journal is a sequential data set (on tape or a direct access storage device) which can be used to provide, for example, a record of operator and system actions, or a means of recovering superseded data. You can specify the extent of this journaling in control tables set up when the CICS system is generated.

If the system fails, CICS provides recovery programs to rebuild the system, using the system log.

CICS tries to keep running even though a fault has occurred. However, drastic faults (such as a loss of power or an operating system failure) can cause CICS to stop. The logging and journaling facilities enable you to restart the system without losing all the previous work.

Chapter 3. Data communication and interproduct communication

With CICS, there are two aspects of communication:

- **Data communication**: communication with devices (terminals), including printers, workstations, and point-of-sale and banking automatic teller machines (ATMs)
- **Interproduct communication**: communication with other CICS or non-CICS (for example, IMS) systems.

Data communication

CICS uses a variety of communication subsystems to talk to the “outside world”. These include:

- IBM’s SNA LU6.2 communication access method for mainframes
- TCP/IP
- ICF (OS/400)
- NetBIOS.

The simplest form of CICS communication is between CICS and a nonprogrammable terminal. Next is between CICS and programmable workstation clients. Later, we will look at CICS-to-CICS communications.

CICS provides:

- The API to send and receive data from the terminal without knowing about data streams
- The mapping services for handling input and output from nonprogrammable terminals
- Client/server services that permit cooperative processing between programmable workstation clients and the application server.

End users remain unaware of how communication takes place, which is driven by applications using EXEC CICS API commands to send and receive data. System programming shields the application programmer from the details of networks and data formats. This allows the business application to be isolated from the technicalities of the communications themselves.

Interproduct communication

As well as communicating with terminals (including workstations in terminal emulator mode), CICS systems can communicate with other data-processing systems. In doing so, they can share workloads. Table 1 on page 22 summarizes the protocols for communicating from one member of the CICS family to another.

Table 1. Communication protocols among CICS systems

"From" CICS system	"To" CICS system(s)	Communication protocols
CICS/ESA, CICS/VSE	CICS/ESA, CICS/VSE, CICS/6000, CICS for OS/2, CICS/400	SNA LU6.2*
CICS for OS/2	All CICS platforms	SNA LU6.2
CICS for OS/2	CICS for OS/2	NetBIOS or TCP/IP
CICS/400	All CICS platforms	SNA LU6.2
CICS/6000	All CICS platforms	SNA LU6.2
CICS/6000	Other CICS/6000 systems	TCP/IP
CICS Clients	CICS/ESA and CICS/VSE (via ECI), and CICS/400	SNA LU6.2
CICS Clients	CICS for OS/2 and CICS on Open Systems	TCP/IP
CICS Clients	CICS for OS/2 (not Macintosh)	NetBIOS

Note: * CICS systems have been successfully tested with both open systems interconnection (OSI) networks and transmission control protocol/internet protocol (TCP/IP) networks, as well as MQSeries.

Depending on the nature of the communicating systems, the applications, and the workloads, the model of communication between CICS systems will vary from simple client/server through to full-scale cooperative processing.

In every case, the CICS systems will use the same underlying communication subsystems and protocols to achieve their ends.

The interproduct communication functions that can be used on all CICS platforms are:

- Function shipping (remote data access)
- Transaction routing (remote application invocation)
- Distributed program link (remote procedure call)
- Asynchronous processing (remote message or queue)
- Distributed transaction processing (peer-to-peer cooperative processing).

The CICS name for each facility is followed in parentheses by the generic industry term.

The first four facilities are transparent to the transaction. However, distributed transaction processing requires a pair of transactions to be written, and one of these need **not** be a CICS transaction.

Function shipping

Function shipping enables an application program running in one CICS system to access resources owned by another CICS system.

In the resource-owning system, a transaction is initiated to perform the necessary operation; for example, to access CICS files or temporary storage, and to reply to the requester.

The user is unaware of these “behind-the-scenes” activities, and need not know where the resource actually exists.

Transaction routing

Transaction routing enables a terminal connected to one CICS system to run a transaction in another CICS system.

It is common for CICS/ESA, CICS/VSE, and CICS/MVS users to have a terminal-owning region (TOR) that “owns” end-user network resources, an application-owning region (AOR) that owns user transactions and programs, and a resource-owning region (ROR) that owns data resources. These resources can include files, temporary storage queues, and transient data queues, and may have access to database managers such as DBCTL or DB2.

Distributed program link

Distributed program link (DPL) enables an application program executing in one CICS system to link (pass control) to a program in a different CICS system. The linked-to program executes and returns a result to the linking program.

This process is equivalent to remote procedure calls (RPCs). You can write applications that issue RPCs that can be received by members of the CICS family.

Asynchronous processing

Asynchronous processing enables a transaction executing in one CICS system to start a transaction in a different system. The two transactions then execute independently of each other.

Asynchronous processing is actually the function shipping of the command to start a remote transaction, in which the processing is independent of the sessions on which requests are sent and replies are received. Asynchronous processing can also be done using distributed transaction processing.

Distributed transaction processing

Distributed transaction processing enables a transaction running in one CICS system to communicate synchronously with transactions running in other systems. The transactions are designed and coded specifically to communicate with each other. This method is typically used by banks, for example, or for “just-in-time” stock replacement.

CICS clients

For CICS clients using CICS systems as servers, there are two APIs called the external call interface (ECI) and the external presentation interface (EPI).

External call interface

ECI enables a non-CICS application running on a workstation to call a CICS program located on the CICS server. To the called program, an ECI call is indistinguishable from a distributed program link call issued by a remote CICS application program.

ECI is a flexible model for designing new client/server applications. The client logic that manages the presentation—graphical user interface (GUI), for example—is cleanly separated from the CICS server business logic.

External presentation interface

EPI allows a non-CICS application running on a workstation to appear to the CICS server as one or more standard 3270 terminals. The application can thereby start CICS transactions and send and receive standard 3270 data streams to and from the transactions.

EPI allows a workstation interface to be added to an existing CICS application, and appears as transaction routing at the server. The application can present the 3270 data to the user by emulating a 3270 terminal, or by using a graphical user interface such as Presentation Manager.

Both ECI and EPI are described in the *CICS Family: Client/Server Programming* manual (SC33-1435).

Terminal emulation

CICS clients can run 3270 terminal emulators. A client terminal emulator transmits or receives standard CICS transaction routing flows to or from a CICS server. This allows a user to interact with the server, and run transactions, as if the client were a locally-attached 3270 terminal.

Multiple terminal emulators can be run on a single client. The emulators can be connected to the same CICS server, or to different servers.

Non-CICS clients

IBM provides two ways in which you can call CICS programs on MVS/ESA from non-CICS environments:

- The IBM OpenEdition DCE Base Services MVS/ESA (program number 5655-064) and IBM OpenEdition DCE Application Support MVS/ESA Feature for CICS/ESA provides access to existing data and application logic in CICS and IMS from any DCE client via DCE Remote Procedure Call (RPC).
- The CICS Open Network Computing Remote Procedure Call (ONC RPC) Feature for ESA (program number 5655-018) allows remote users to access CICS/ESA applications by calling them as remote procedures using the ONC RPC format.

  ONC software developed by Sun Microsystems provides RPC and eXternal Data Representation (XDR) interfaces, which are available on many platforms. Client platforms supporting ONC RPC include Sun Solaris, HP-UX, and DEC OSF/1, as well as IBM OS/2, VM, MVS, and AS/400, and other systems including DOS, VMS, and MacOS.

  The CICS ONC RPC Feature allows these interfaces to be associated with one or more CICS transactions acting as a server to ONC RPC clients anywhere on an attached TCP/IP network. TCP/IP for MVS is a prerequisite for this Feature.

What interproduct communication brings you

Interproduct communication can help you in several ways:

- You can split or duplicate transactions on different systems to minimize the effects of a failure in any one system.
- You can keep data at a central point in the network and make it easier to protect that data and gain additional security.
- You can test new CICS application programs away from your production work in a separate CICS test region. This leaves your production system unaffected by any failure of the test system.
- You can divide a CICS installation on a departmental basis, providing independent operation for one department while allowing controlled access to resources belonging to another.

  Transactions need not be allocated to departments because, with transaction routing, any terminal can run a transaction on any system.
- Interproduct communication can help balance the load on the total system.

  In large CICS systems, interproduct communication allows the system to be split into two or more separate systems with shared resources.

  You can allocate CICS applications to different regions according to their response time needs. For example, you could run a data entry application, needing very rapid responses, in the highest-priority region and have an online data inquiry and update application running in a lower-priority region. Taking into account the longer periods of operator thinking time needed between terminal transactions, the inquiry and update users should still maintain satisfactory response times.

  You can move any non-CICS applications that need a great deal of processor time and few terminal interactions into a third region where they do not degrade the response times of the higher-priority transactions.

For further information on CICS interproduct communication, see the *CICS Family: Interproduct Communication* manual (SC33-0824).

Chapter 4. Application development

You may choose to use one or more complete application system packages that can be tailored to your particular requirements. Many packages of that kind are available from IBM or from other sources. Additionally, or instead, your organization can develop its own application programs, using facilities provided by CICS, or tools and services available from IBM or other sources.

The traditional CICS application development cycle is to design and code a program, translate and compile it, and then test it. The approach taken may vary from rapid application development (RAD) to fully integrated computer-aided software engineering (I-CASE).

Because CICS is usually in daily use helping you run your business, it is important not to install new applications on your production CICS system until you are sure they are reliable and bug-free.

Mainframe testing can be done in a separate test CICS system or in an MRO environment separate from your key applications. (It is worth noting that some of our customers have installed CICS systems solely for application development purposes.)

Workstation CICS testing can be done with source-level debugging tools and functional development environments such as IBM Workframe and Micro Focus Workbench.

Figure 3 gives an overall view of the traditional application development life cycle.

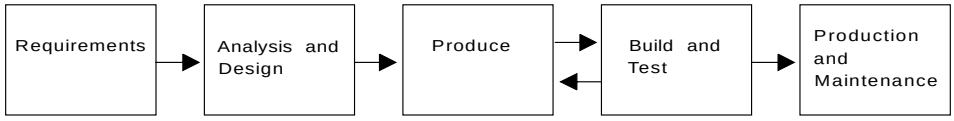

Figure 3. The application development life cycle

This chapter describes the **application development tools and facilities** that you can use for developing your own applications.

Application development tools

CICS users have a number of possible approaches to application development, and they usually find that they need to combine two or more of these. These approaches include:

- Procedural programming languages (COBOL, PL/I, C, C++, or Assembler)
- Fourth generation languages (4GLs)
- Database management languages (such as SQL and DL/I)
- Computer-aided software engineering (CASE)
- User interface development
- Object oriented programming environments.

Your application programs can be written in C, COBOL, PL/I, assembler, or C++ language. For each of these languages, programmers can include CICS commands within the program to use the particular CICS facility required. In

addition, a wide variety of higher level tools, such as VisualGen and 4GLs, allow generation of the CICS application.

Object-oriented (OO) programming, such as with C++, allows one application to build on the code written for the previous one, thereby reducing application development costs.

CICS client APIs (ECI and EPI) enable any workstation application to access CICS. This can include multimedia applications.

The facilities that must be provided for the application programs will vary according to the environment within which CICS is running. For instance, CICS itself provides simple data-handling functions. However, operations on complex data structures can be handled more easily through the use of database products such as SQL and DL/I.

Programmers who are developing CICS applications have a rich collection of facilities and tools available to them. This section outlines some of the main ones.

CICS itself provides the following facilities:

- A command language translator that preprocesses source code CICS commands into the form that the relevant language compiler or assembler requires
- The execution diagnostic facility (EDF) to enable the programmer to test and debug application programs online
- A command-level interpreter for online syntax checking and, optionally, command execution
- A browsing facility for browsing through CICS temporary storage or transient data queues (described on page 17)
- Extensive tracing and formatted dump facilities.

Various associated tools include:

- A program that permits easy interactive development of terminal screen formats (Screen Definition Facility II)
- Object-oriented, GUI, and client development tools such as VisualAge
- Application program generators such as Cross System Product (CSP) and VisualGen
- Integrated CASE tools such as CGI's PACBASE.

The sections that follow describe these facilities and tools in more detail. In addition, various tools are available from other vendors.

Command language translator

The command language translator runs as an offline batch process. It accepts as its input your source CICS application program which will, of course, contain CICS commands. The translator's output is an equivalent source program, but with the original CICS commands commented out, and replaced by subroutine calls and parameters in the language of the source program. It also provides diagnostic information for any syntax errors it finds.

The translator also processes commands to access DL/I databases on appropriate CICS platforms.

Execution diagnostic facility (EDF)

The execution diagnostic facility (a powerful CICS-supplied transaction) is designed to help you test and debug an application program online.

With EDF generated and the terminal in DEBUG mode, you can have every CICS command intercepted and interpreted, before its execution. Each command is displayed in source form along with keywords, keyword arguments, and specified options.

Command interpreter

The command interpreter (a CICS-supplied transaction) gives you an online interactive system for setting up and executing CICS commands on a “try it and see” basis. The interpreter helps you with the syntax, the required operands, defaults, and various options for the selected command, allowing you to build that command. You can validate the command, and (if you wish) in most cases proceed to execute it.

Trace and dump facilities

For the more complex problems that involve system interactions, CICS provides the **trace control** program. This is an optional CICS debugging aid that you can use to trace the path of an application program.

Trace control consists of the trace control program itself (which is invoked before and after each CICS command) and a trace table. CICS programs can generate requests that:

- Select which CICS functions are recorded
- Start and stop the recording of trace information about the application program in the trace table, on a CICS-wide basis
- Enter user information in the trace table.

Dump control is the CICS management module that writes out the contents of selected areas of storage to a sequential data set for printing. Dump control is automatically invoked when a transaction terminates abnormally.

The areas selected to be dumped can include main storage areas related to the requesting task; CICS control tables; and, particularly, the trace table itself for help in debugging.

There’s a **formatted dump program** whose output contains a dump of the CICS partition or region. Each control block is printed separately in the dump, and is preceded by a heading; for some of the blocks the important fields are printed by name. CICS also produces a full range of diagnostics to describe execution-time errors.

Character-based user interface development

Part of the Common User Access (CUA) architecture defines a standard format for terminal screens. You can use CICS Basic Mapping Services (BMS) to create maps that conform to CUA.

In CICS, BMS is the 3270 screen interface. The user can navigate around the CICS system using one of the following techniques:

- A system of menus (in which the user is asked to move the cursor to the required item and press Enter)
- Fast-path commands (generally identified in a menu)
- Accessing a CICS transaction directly from the command line
- A combination of the above.

BMS allows the user to select fields on a screen by moving the cursor to them or, alternatively, to select the required option by typing in a fast-path command or code. More experienced users use the fast-path commands to bypass intermediate screens. (3270 screen interfaces can be emulated on other CICS platforms, as well as on mainframe platforms.)

In an enquiry system, the user is asked to enter one or more details (search criteria) and press Enter. The CICS system then searches the database and, if the search is successful, the remainder of the data is presented to the user.

Screen Definition Facility II (SDF II) for CICS/ESA and CICS/VSE

If you use BMS on CICS/ESA or CICS/VSE, you can either use the BMS macros (a batch process) or work online with a separate licensed program called Screen Definition Facility II (SDF II), program number 5664-366. This not only enables you to define BMS maps online, but also helps you convert your existing map definitions into SDF II format.

Using SDF II, you can build a screen layout online and automatically create and save the corresponding map and map set definitions in a map specification library. You can display these maps, edit them, and save them.

Here's a list of the main features and functions of SDF II:

- Throughout an online session, you always have reference information available for both normal operation and error situations.
- You can assemble a collection of maps to form a page (or screen) that you can define, inspect, and test online.
- You can define a set of default values to apply for a given online session.
- Your map specification library and the associated library management functions give you a complete inventory of all your maps and map sets, with status information. You can delete, rename, or copy objects, and get map details printed out.

Screen Design Aid (SDA) for CICS/6000

CICS/6000 has the Screen Design Aid (SDA) family of products for developing BMS maps.

SDA uses a Window-Icon-Mouse-Pointer (WIMP) interface and emulates the IBM 3270 Information Display System. SDA runs in the AIXwindows environment and conforms to the style of other AIXwindows applications.

The SDA interface is used to create and modify BMS source files using an AIXwindows interface. You can use the work area in the main SDA window to create (or modify) panel fields by positioning the cursor and typing the field text. Options allow you to specify field attributes, such as highlighting and field outlining. Creating and modifying screens in this way is referred to as *edit mode*.

All visible field attributes (for example color, highlight, and intensity) emulated in edit mode provide a good indication of the panel appearance on a 3270 type terminal. Another mode, *test mode*, lets you test the effect of protected and input fields using 3270 terminal emulation keyboard handling. The test mode also removes the editing guides to give a more accurate emulation of a 3270 screen. Note that CICS emulates 3270-type terminal functionality and does not handle 3270 terminals directly.

To run the SDA, you must have access to a system with AIX Base Operating System and AIXwindows installed. The SDA uses the MOTIF toolkit, and is therefore usable only from terminals that support the X interface, such as X-Terminals and IBM RISC System/6000 graphics workstations.

Graphical user interfaces (GUI) development

If you are designing screens for a programmable workstation, graphical CUA can be used by integrating the screen-painting interfaces of, for example, OS/2 Presentation Manager into the CICS application via ECI or EPI.

The CUA architecture lays down guidelines for application presentation using:

- Action bars and pull-down menus
- Scroll bars
- Push buttons
- Entry fields
- Dialog boxes
- Help messages.

The main advantage of the GUI type of system is that, with minimal effort, the end-user perception of the application can be substantially improved.

Pseudo-GUI

The pseudo-GUI technique allows part or all of a CICS application to be front-ended with a program running on a workstation. The existing (character-based) data stream is intercepted and replaced with GUI-type controls.

A pseudo-GUI application has a close resemblance to its character-based forerunner in that the end user participates in a predefined and predictable dialog, and may do only one thing at a time.

Simple changes like taking an over-complicated character-based screen and splitting it into several windows, or allowing data to be pasted from other applications, can provide a marked improvement in end-user productivity.

EASEL is an example of a pseudo-GUI product.

"True" GUI

An application that has been designed so that separate modules contain screen-handling, business logic, and data logic will be less difficult to port to a GUI interface than one that has been designed as a monolithic module.

A true GUI application tends to be event-driven, allowing multiple windows into the application.

The use of icons, graphics, cut-and-paste operations, and GUI techniques can lead to productivity gains for end-users and application development. However, building truly GUI-conforming applications is not simple in any language, and often requires the use of GUI tools such as IBM's VisualAge.

GUI applications for IBM OS/2 Presentation Manager

Pseudo-GUI applications can be written for OS/2 using the Presentation Manager interface of the OS/2 operating system directly to control the information on the screen. This allows you to develop applications with end-user interfaces that conform to the graphical CUA standards.

Alternatively, a large number of GUI tools allow you to prototype and develop CUA-conforming user interfaces for OS/2 application programs, including IBM's VisualAge, which support Presentation Manager and which interface via the ECI.

GUI applications for other GUI environments

Programs can also be written to use the X-Windows or OSF/Motif environments, or the Apple Macintosh.

VisualAge

VisualAge provides a series of OS/2-based tools for the development of GUI applications for OS/2 execution systems; and database and communications support products, including support for the CICS ECI.

VisualAge enables you to develop client/server database and transaction processing (OLTP) applications for OS/2.

VisualAge uses object-oriented technology to simplify the development of applications in a graphical environment using construction from components. Additionally, more experienced developers can use the underlying IBM Smalltalk language, which includes an integrated suite of productivity tools for editing, browsing, debugging, and inspecting the applications that are generated.

Application program generators

Application program generators that can be used with CICS include VisualGen, the Cross System Product (CSP), and PACBASE.

VisualGen

VisualGen is a 4GL, OS/2-based application development generator for applications that run in a variety of workstation and host environments. VisualGen can define, test, and generate GUI client applications (OS/2 and Microsoft Windows), server applications, and single-system applications in the same development environment.

VisualGen application definition and test facilities share information through the definition and test phases of application development. In addition, developers can test an application in interactive mode, without having to generate, compile, and link-edit the application. Feedback received during definition and test allows problems to be solved faster.

GUI client applications generated by VisualGen can interface with CICS-based, full-function servers on MVS/ESA, VSE, or OS/2 systems.

Cross System Product (CSP)

CSP simplifies the development of applications that use the 3270 series of terminals. With this one interactive tool, programmers can build applications, define screens and logic, test the application, and put it into production.

Cross System Product/Application Development (CSP/AD) uses prompts, menus, “fill-in-the-blanks”, and HELP screens to guide programmers through the development steps. By using the prototyping and interactive testing capabilities, you can place the eventual application into production earlier.

CSP/AD supports sequential files, VSAM data sets, and SQL and DL/I databases. Data definitions are entered using menus and prompts, thus speeding up the process and increasing the accuracy. So the whole application development cycle is speeded up.

CSP/AD’s output is a file that defines the application. Cross System Product/Application Execution (CSP/AE) then processes this file to execute the application.

PACBASE

CGI’s PACBASE is an integrated CASE tool for both standalone and client/server development. It uses a repository of shared specifications that can be implemented on mainframes, OS/2, AS/400, or UNIX network servers.

From functional application specifications, PACBASE produces complete applications; online, batch, client/server applications can be ported to a wide range of environments from a single set of specifications.

PACBASE consists of:

- PACDESIGN for the analysis and design of an information system
- PACBENCH for the construction of server elements
- PAC/CS for the construction of GUI-based client/server systems.

Chapter 5. System services

This chapter is about the control functions provided by CICS. Three of these control functions in particular supervise and control the allocation of resources within the system. These functions are **task control, program control**, and **storage control**.

Another control function (**interval control**) offers timer services.

Task control

Task control looks after the status of all CICS tasks. Many of them are processed concurrently with task control allocating processor time among them. In CICS terms, this is called **multitasking**.

When an operator requests a transaction, normally by logging on and keying in a transaction code, CICS checks the status of the operator and the terminal. This ensures that the operator is known to the system and that the transaction is valid for that user and that terminal. Task control then creates a task for the transaction.

CICS tries to give the best response times to the most important or urgent work. Usually, several tasks are competing for resources, so a transaction, an operator, and a terminal are each assigned a priority related to the importance of the functions they carry out. CICS sums these priorities to give the overall priority of the task, and uses this priority to decide the order in which to process competing tasks.

Because transactions are not normally processed through to completion in a single, uninterrupted operation, CICS makes such decisions (about priorities) many times during the execution of a task. For example, a transaction might be processed until it reaches an instruction involving input from a file or a terminal. Then, while the transaction waits for its input, another waiting task begins or resumes execution.

Program control

As soon as task control has started a task for the transaction, it becomes program control's job to associate the task with the appropriate application program.

Although many tasks may need to use the same application program, program control loads only one copy of the code into memory. Each task threads its way through this code independently, so many users can all be running transactions that are concurrently using the same physical copy of an application program.

Storage control

On the mainframe, CICS maintains full control over virtual storage. Storage control acquires, controls, and frees dynamic storage—this being the space left within a region after CICS itself is loaded. Dynamic storage is used for programs, input/output areas, work spaces, and so on.

Other members of the CICS family use operating system services to manage storage control.

Timer services

Interval control functions allow applications to start and control a range of time-dependent actions (such as starting a particular transaction at a certain time of day, signaling when a specified period has elapsed, and so on).

Chapter 6. System management

This chapter tells you about a variety of mechanisms that allow you to manage your CICS system: **transactions, utility programs, and resources**.

Transaction management

CICS supplies a number of transactions that you can use to control the system and its resources. CICS-supplied transactions have identification codes that start with the letter *C* and are four characters in length.

The most significant CICS-supplied transactions for system management are the master terminal transaction and the resource definition online transaction.

Master terminal transaction

The master terminal transaction can be used to make changes and adjustments to your system while it is running. It can help you to get round a problem without taking down your CICS system. Sometimes you can use it to defer a problem until you can handle it properly at the next scheduled outage. You can also use the master terminal transaction to manage databases, in particular for the dynamic allocation and deallocation of data sets.

With the master terminal transaction, you can:

- Control the number of tasks, or the number of certain types of task, running at any given time
- Purge a particular task from the system
- Enable or disable a particular transaction
- Enable or disable a file; for example, to allow controlled access to it by application programs
- Start or stop tracing, monitoring, or statistics activities
- Switch dump data sets when one is full
- Open and close interregion communication connections
- Install a newly link-edited copy of an application program without taking down the system
- Specify some messages (usually urgent ones) to be routed to the master terminal.

Note: The master termination transaction is not available on CICS OS/2.

Resource definition online transaction

You can use the resource definition online transaction to define resources to CICS while your CICS region is running.

SMIT interface (CICS/6000)

CICS/6000 uses the AIX System Management Interface Tool (SMIT), which has a menu system for selecting the command you wish to run. You can reach the SMIT menu for CICS either by following the "Applications" menu or by using fastpath commands. Further information about the SMIT is given in the *AIX Version 3.2: Installation Guide* (SC23-2341).

Utility programs with CICS/ESA and CICS/VSE

CICS/ESA and CICS/VSE supply a number of utility programs to help you manage your system.

In particular, you can use one of the utility programs to define, initialize, and review resource definitions in the CSD, either while CICS is running or while it is inactive. You can also use the same utility to help migrate resource definitions from control tables to the CSD.

Other CICS-supplied utility programs allow you to:

- Examine or display data from CICS journal data sets. This utility can:
  - Print or copy an entire journal data set
  - Print or copy from multiple journal data sets based upon control statement input
  - Select and print journal records on the basis of sequential position in the data set
  - Select and print journal records based upon data contained within the record itself, such as the contents of a time, date, or identification field
  - Allow EXIT routines to process any selected journal records.
- Check, update, and list the journal archive control data set
- Format output from dumps, monitoring, statistics, and trace
- Identify macro-level programs on regions running earlier releases of CICS
- Identify in-doubt resource manager records
- Preformat tapes or disk data sets used for system logs or journals
- Reposition and correctly close a journal tape after an uncontrolled system shutdown
- Migrate the CICS signon table to the external security manager for CICS.

In addition to the utility programs listed here, CICS provides sample utility programs, including one for printing messages on a local 3270 printer as the messages arise.

CICS also provides a sample program that reads, formats, and prints monitoring data. You can use this as a skeleton if you need to write your own program to analyze the SMF data set that contains the monitoring data.

The report controller—part of CICS/VSE—is a set of programs and transactions that interface with VSE/POWER to help your end users create reports and print them at distributed locations.

CICS resources

CICS is modular. You can select options appropriate to your applications to help you achieve the best balance for your applications between system function and performance.

CICS is astonishingly flexible—you can define resources in an array of system tables, or by automatic installation while the system is running.

To run your system, CICS needs information about your other system resources. These are the information processing resources of your business: the programs and data you use; and the terminals, printers, and telecommunications links. Many of the properties of these resources can be altered, so you can customize your CICS system in accordance with the functions and resources you need for your business.

The role of the system programmer

System programmers debug CICS system problems and write CICS user exit routines and error management programs. They define the resources in the CICS control tables, and set up the master terminal operator's procedures. They must work with application designers and programmers to ensure that each new application is supported by any necessary system features and resources.

Part 3. The CICS family

The CICS family consists of a number of products that run on a variety of operating system and hardware platforms. These currently consist of:

ESA (see page 42) for mid- to high-range System/390 users

VSE (see page 45) for mid-range System/390 users

AIX/6000 (see page 47) for mid-range RISC System/6000 users

OS/400 (see page 49) for mid-range AS/400 users

OS/2 (see page 51) for entry systems users.

In addition, a range of CICS clients (see page 54) can be connected to CICS application servers. The CICS family is further extended by CICS on Open Systems (see page 57).

There is a CICS system to suit your needs.

CICS/ESA

CICS/ESA is the most powerful of the CICS application servers. It runs on the latest System/390 processors, including the new generation of CMOS-based parallel transaction servers (PTSs).

Highlights of CICS/ESA Version 4

Here's a summary of the main features introduced during 1994 in Version 4 of CICS/ESA:

- Transaction isolation
- Fast restart using persistent sessions
- Stress containment by session queue manager
- Simplified session initiation
- MRO links between MVS images
- Improved facilities for dynamic transaction routing
- More flexibility with temporary storage exit
- Coordination with CICSPlex SM
- Easier migration with an affinities tool
- External CICS interface
- Security for nonterminal transactions
- Better access to CICS state data
- Support for CICS client
- Security, monitoring, and statistics for FEPI
- Autoinstall for programs and map sets
- Autoinstall for LU6.2 parallel sessions
- Improved monitoring and statistics
- Goal-oriented workload management.

CICS/ESA brings a variety of improvements and functions for making CICS more than ever the system of choice for enterprise computing:

- Configuration management is simple and straightforward; you can automatically connect your client/server workstations with the extension of autoinstall to LU6.2 parallel sessions.
- Your non-CICS application programs can seamlessly invoke CICS service programs, through an external CICS interface that can be called from any local MVS image. As well as invoking local services in CICS, the non-CICS application can also use CICS ISC to call services in CICS family members on connected workstations and servers throughout the enterprise.
- If you are an application developer, you have more control over CICS internals through the addition of more exits and API extensions.
- The integration of the front end programming interface (FEPI) means even greater security and enhanced monitoring for resources managed by FEPI, giving improved integration of CICS and IMS applications, as well as making CICS easier to install and maintain.
- Security for server transactions is improved all the way through. Nonterminal transactions have the same level of security as terminal transactions. This improvement is particularly valuable for transactions started by the MQSeries for MVS/ESA product.
- Language support is enhanced by the support of IBM SAA AD/Cycle Language Environment/370 Version 1 Releases 1 and 2 run-time environment (program

number 5688-198), with the following COBOL, C/370, and PL/I SAA AD/Cycle compilers:

- SAA AD/Cycle COBOL/370 (5688-197)
- SAA AD/Cycle C/370 (5688-216)
- SAA AD/Cycle PL/I (5688-235).

Parallel computing

CICS/ESA takes advantage of and exploits parallel transaction servers. Without the need for any changes to your applications, you can extend even further the well-known CICS advantages of:

- High availability—through cloned systems, dynamic workload management, shared data and generic resource
- Good price/performance—using leading-edge technology hardware
- Formidable capacity—by transactions being run in parallel
- All-round scalability—by incrementing a PTS system with plug-in processors.

Availability and performance

CICS/ESA enhances availability through a number of significant changes:

- Your user application data is protected between transactions by extensions to storage protection, giving transaction isolation.
- Your CICS-DB2 applications realize improved performance through an integrated DB2 adaptor.
- Cross-system multiregion operation (XCF/MRO) exploits the cross-system coupling facility (XCF) of MVS/ESA 5.1 to enable MRO to operate across MVS images within a sysplex. The enhanced MRO support also permits new connections to be added while interregion communication (IRC) is open. In addition, it uses an external security manager (such as RACF) instead of CICS internal security mechanisms for MRO security authorization.
- Your users will be back to work sooner after unplanned outages through CICS making use of VTAM's persistent session support. It provides a fast restart-in-place for terminals, with no need to log on again.
- You will see improved availability between connected CICS systems with the intersystem session queue management facility, which recognizes and responds to bottlenecks.

System management

CICS/ESA provides improved system management, which is further enhanced by the use of the CICSPlex SM product.

- Within multiple CICS address spaces, you can:
  - Minimize the effect of unplanned outages of application-owning regions (AORs) by routing work to other AORs
  - Protect users from interruption while dynamically removing an AOR from service
  - Improve system throughput for a varying workload.

- You no longer need to define your programs and map sets to a CICS/ESA system, because autoinstall extends to these objects as well.
- You can manage your service level agreements and business goals by using CICS/ESA in conjunction with CICSPlex SM, to achieve goal-driven workload management for service class and resource utilization.
- You can shield your end users from system specifics with the ability to log on using a single name to a set of CICS/ESA regions within local MVS images without having to know which regions are available. This facility uses the VTAM generic resource function, which improves availability and makes the CICS regions appear to be a single CICS system—especially important in a parallel system.
- You can tailor or translate your CICS messages yourself by using the message editing facility to create alternate message tables.
- You have improved CICS system management capability with:
  - Dynamic addition of MRO links without stopping all MRO activity
  - Movement of CICS regions from one MVS image to another with no link definition changes
  - An external security manager for MRO bind security.

To complete the package

There are numerous other enhancements:

- Even greater quality and reliability, through additional product restructuring.
- Easier problem determination, with additional trace facilities.

What to do next

Consult the *CICS/ESA 4.1 Release Guide* (GC33-1161) for information on the software products and software levels required for each function.

Consult the *CICS/ESA 4.1 Migration Guide* (GC33-1162) for help in migrating from CICS/ESA 3.3.

Consider these products for use with CICS/ESA:

- CICSPlex System Manager (see “CICSPlex SM” on page 59 for further information)
- CICS Transaction Affinities Utility (program number 5696-582)
- MQSeries (see “MQSeries” on page 60 for further information).

CICS/VSE

CICS for the VSE/ESA environment provides transaction processing for the intermediate-size central site as well as for distributed user locations requiring volume transaction processing.

As the full-function CICS system for the VSE/ESA environment, CICS/VSE has a close affinity with CICS/ESA, allowing easier connectivity between different CICS systems and improved programmer productivity.

Highlights of CICS/VSE Version 2

Many user requirements have been included to increase the affinity of CICS/VSE with CICS/ESA, mainly in the API area.

Here's a summary of the main features of CICS/VSE Version 2:

- Virtual storage constraint relief
- Data tables
- Distributed program link
- Dynamic transaction routing
- Extended recovery facility (XRF).

Virtual storage constraint relief

Virtual storage constraint relief is provided by 31-bit virtual addressing for system growth. This means that, in comparison with previous releases of CICS/VSE, more terminals, applications, and files are supported on a single CICS/VSE platform, with improved performance because the systems are less constrained.

Data tables

CICS/VSE also supports data tables, which provide significantly enhanced performance for certain applications accessing VSAM data.

Distributed program link

Distributed program link offers an easy-to-use way for a CICS/VSE application to act as a client or server in a distributed environment. Because a CICS program can call another CICS program in a remote CICS system, parts of an application can be transferred easily between host systems, as well as from host to workstation. This gives performance benefits by running applications closer to the resources they access.

Distributed program link also simplifies the process of writing distributed transaction programming applications. It is an addition to the other CICS intersystem communication facilities such as function shipping and transaction routing.

Dynamic transaction routing

CICS/VSE also includes dynamic transaction routing, which allows your local CICS system to choose where to run a CICS application, in accordance with the resources that are available.

With the growth capabilities of CICS/VSE, you no longer have to fine-tune your systems to manage small amounts of storage. Indeed, with the increased capacity of a single CICS partition, you may wish to consolidate several CICS images into one.

CICS application programmers no longer have to be so concerned with the efficient use of virtual storage or with program size, thereby improving their productivity.

Language support

As well as the familiar CICS language support (Assembler, COBOL, and PL/I), C/370, VS COBOL II, High-Level Assembler (HLASM), and Language Environment for VSE/ESA are supported in CICS/VSE.

What to do next

Consult the *CICS/VSE Release Guide* (GC33-0700) for detailed information about the latest release of CICS/VSE.

CICS/6000

CICS/6000 and other open systems run on commercial-strength AIX (as IBM AIX CICS/6000) and on other UNIX-based operating systems, and maintain the industry-standard CICS application programming interface that makes CICS truly an open system with the power and dependability to run mission-critical applications.

CICS/6000 is a client/server system that connects to other CICS systems in Local and Wide Area Networks, allowing workloads to be balanced by distributing and sharing resources. CICS/6000 combines the application server-power of CICS with the open distributed standards of X/Open, TCP/IP, and the Distributed Computing Environment (DCE) so that it fits naturally into any open system and has a high degree of integrity and longevity.

CICS/6000 comprises both server and client code for IBM RISC System/6000 workstations, full client code for Sun workstations, and PC and Macintosh client workstations that can be connected to a CICS/6000 server. A growing number of products based on CICS/6000 have also been announced by IBM licensees for non-IBM server systems.

Server support

CICS/6000 provides all the function and services necessary to provide powerful server support on IBM RISC System/6000, and on a growing number of non-IBM UNIX-based workstations. Workload management is built in to help maintain a consistent and predictable response to client workstations.

Support is provided for DB2/6000 and many other relational database management systems (RDBMSs), so that applications developed on mainframes can be easily ported to CICS/6000 with the application function distributed in any way that best meets your business needs.

Client support

CICS/6000 clients make provision for a client to contain varying amounts of function, from a simple GUI front end to a full application, making use of the server only for DB calls.

There is a client component in CICS/6000 and CICS for non-IBM servers. Client support is also provided by CICS Client for Sun workstations. CICS on Open Systems can also be accessed by the CICS Client family.

Delivers everywhere

With CICS/6000, your client/server applications can reach across LANs and WANs to all of your users and customers, and can connect to mainframes and PCs if your business demands it, using TCP/IP or SNA protocols.

CICS clients can be mixed and matched to suit your business, ensuring software compatibility throughout the enterprise.

And CICS can connect to all well-known DB systems as well, giving the ability to run multiple databases from a single application, or simultaneously run applications on different databases, regardless of the location of resources across the network.

These abilities to configure your CICS system in any way that you need, combined with access to a huge portfolio of proven CICS applications from IBM and software vendors makes CICS a complete systems environment, the universal client/server solution, and truly the system for an open future.

What you need to run CICS/6000

Hardware requirements

Any POWERstation and POWERserver model configured with a minimum of one supported display with keyboard and mouse, or one supported ASCII terminal.

Memory requirements

- Minimum of 32MB for AIX/6000
- Minimum of 16MB for AIX Client for CICS/6000.

Operating system

AIX/6000 Version 3.2.3, 3.2.4, or 3.2.5.

Programming requirements

- AIX DCE Base/6000 is required for both AIX CICS/6000 and AIX Client for CICS/6000
- Encina Peer-to-Peer Executive for AIX/6000 and Encina Server for AIX/6000 are required for AIX CICS/6000
- The following programs are required within a DCE cell accessible from AIX CICS/6000:
  - Encina Structured File Service for AIX/6000 and its prerequisites
  - AIX DCE Cell Directory Server/6000
  - AIX DCE Security Server/6000.
- Encina Peer-to-Peer Gateway for AIX/6000 and AIX SNA Services Version 1 are required for SNA connectivity.

Language requirements

- Application programs written in COBOL must have been compiled with Micro Focus COBOL Version 1.3 for AIX.
- Micro Focus COBOL Run Time Environment Release 1.3 or later is required for successful execution of COBOL application programs.
- Application programs written in C must have been compiled with the AIX XL/C Compiler, included in AIX/6000.

CICS/400

You can mix CICS applications and existing AS/400 packages to give you access to a vast range of business solutions.

The AS/400 computer system's ease of use and cost-effectiveness are due to the integration of important services into the OS/400 operating system. CICS/400 is designed in a similar way to this software and, by exploiting the integrated services, is able to offer a very low cost per transaction.

Like CICS and other important software, DB2/400 is also integrated in the AS/400, allowing complete portability of applications, and full interoperability with other systems. CICS/400 allows you to integrate your AS/400s with your other computers as part of an enterprise-wide solution.

Client/server

CICS on an AS/400 provides a strong client/server platform. It can either act as front end to a mainframe, or serve LAN-connected CICS client workstations.

CICS clients make provision for a workstation to contain varying amounts of function, from simply providing a GUI front end to an AS/400 application to having the client run the application and use the AS/400 only as a data server.

An AS/400 with CICS/400 allows users to run applications on any connected CICS system as if they were running on the local AS/400. This means that resources and data can be close to the users, allowing them to be processed as the business requires, with seamless access to remote data servers.

CICS COBOL command-level applications can be easily migrated, with some modifications. Migration is even simpler using the cooperative software that IBM offers, IBS/MIGRATOR.

Data integrity is provided by the AS/400 security and database facilities, with CICS/400 adding the emulation of VSAM file control.

With the announcement of DB2/400 building on improvements to the AS/400 database, migration of host CICS-DB2 applications will become easy.

CICS/400 reduces the risk in migration: your applications will work as before, with full functionality, no disruption to end users, and minimum application redevelopment costs.

What's new in CICS/400 3.1

- Support for modern client/server computing through the direct connection of CICS Clients.
- Support for applications written in the C programming language.
- Even greater integrity for multiple database updates across systems, with two-phase-commit technology.

What you need to run CICS/400

Hardware requirements

CICS/400 is designed to run on all models of the AS/400 system.

Operating system

CICS/400 will run under the Operating System/400 Versions 2.2, 2.3, and 3.1.

Language requirements

Currently, the following languages are supported:

- IBM COBOL/400
- IBM Integrated Language Environment C/400.

CICS for OS/2

CICS for OS/2 Version 2 is licensed as multi-user or single-user. CICS for OS/2 multi-user operates as a high-performance server for clients, supports cooperative processing with other CICS family members including other CICS for OS/2s, and provides powerful application server capabilities to support business-critical applications and distributed data access in a client/server environment.

In addition, CICS for OS/2 provides enhanced CICS support for the single user. CICS for OS/2 single-user can be host-attached, LAN-attached, stand-alone, or used in portable workstations that have only occasional host or LAN connectivity.

CICS for OS/2 provides the features that have made CICS so important for enterprise computing:

- CICS family application programming interface (API) means that your existing CICS applications and programming skills can be transferred straight to the workstation. This not only makes the workstation an important part of your distributed computing environment, but also means that it is an ideal platform for developing host applications in C++, C, and COBOL, allowing faster product development.
- CICS for OS/2 data facilities provide complete integrity in accessing both CICS VSAM files and RDBMSs such as DB2/2, so that corporate data held on host machines can be made available and secure on the workstation.
- Intersystem communication (ISC) facilities connect all the different parts of your enterprise so that they can share information and processing power, bringing even greater efficiency and consistency to your business. ISC makes available everything needed for full client/server support, sharing of CICS resources, and cooperative processing with other CICS systems.

Server support

CICS for OS/2 provides all the function and services necessary to provide powerful application server support on the workstation, making it easier to control and manage the application logic associated with commercial data.

In turn, the CICS for OS/2 server can act as a client to other CICS systems, giving total flexibility in designing client/server applications.

Support is provided for DB2 and many other relational database management systems (RDBMSs), so that applications developed on mainframes can be easily ported to CICS for OS/2 with the application function distributed in the way that best meets your business needs.

Client support

With CICS, your client/server applications can reach across LANs and WANs to your users and customers, connecting to mainframes and other business systems such as AS/400 or RISC System/6000, should your business demand it. And CICS for OS/2 clients can be mixed and matched to suit your business, ensuring software compatibility throughout the enterprise.

CICS clients that will connect to CICS for OS/2, as well as other principal platforms, are available separately in the IBM CICS Clients product, which includes clients for OS/2, DOS, Windows, and Macintosh environments. See the information on CICS

Clients on page 54 for ways in which you can implement client applications with CICS for OS/2 multi-user.

CICS can integrate all the LANs within your business, and can connect to your enterprise computing systems, providing state-of-the-art client/server computing. And this can all be done with the resources you have within your organization: employing the CICS skills that you already have, capitalizing on the workstations within departments, and reusing application code on new platforms or through object oriented methods—by using the C++ compiler support to increase programming productivity and quality.

CICS for OS/2 is a cost-effective way of making your business even more competitive. Your users can work with familiar easy-to-use applications and can access CICS data in their favorite workstation tools, like Lotus 1-2-3. Your systems and applications programmers can use their existing skills without retraining. And you will be able to plan for the future with a guaranteed growth path for applications and technology.

Language support

A wealth of application development products can be used with CICS for OS/2, including:

- IBM VisualAge for OS/2, for client/server application development
- IBM VisualGen Developer, for a 4GL application development environment.

Other application development products include Digitalk's PARTS Wrapper for CICS, Easel Corp's Easel Workbench, KASE System's KASE:VIP for OS/2 with ECI Designer, Micro Focus COBOL Workbench, Microsoft Visual Basic with Network Software Associates' Visual Basic Connection for CICS.

What's new in CICS for OS/2 Version 2.0.1

Enhancements since CICS OS/2 Version 2.0 are:

- EBCDIC support for CICS COBOL applications. This allows application data to be passed to and received from CICS for OS/2 in EBCDIC format, removing the need for user-conversion tables, and considerably simplifying the moving of applications to and from a mainframe CICS.
- Support for the C++ language, bringing the productivity and quality benefits of code reuse and function encapsulation to CICS applications and application development on the PS/2.
- Support for the PL/I language, benefiting customers who use PL/I as a key language in their business. They can use the workstation as a host development platform for CICS applications, reusing their existing PL/I host programming skills, and distribute/migrate existing CICS PL/I applications to the workstation.
- Support for CICS Clients.
- Support for TCP/IP communication with CICS Clients.
- Support for NetBIOS communications over IPX/SPX using the NetBIOS emulator in the Novell NetWare Requester.

What to do next

Ordering information for CICS for OS/2 Version 2.0.1

CICS for OS/2 is shipped with both CD-ROM and diskettes

- Single-User, part number 17H7172
- Multi-User, part number 17H7196

There is an option for upgrading from single-user to multi-user.

Customers who already have CICS OS/2 Version 2.0 can obtain the functions of CICS for OS/2 Version 2.0.1 by applying the latest service level.

Complementary products

- IBM DATABASE 2 OS/2 (DB2/2)
- IBM CICS Clients, for multi-platform client access to CICS for OS/2:
  - IBM CICS Client for DOS, part number 17H7605
  - IBM CICS Client for Windows, part number 17H7616
  - IBM CICS Client for OS/2, part number 17H7627
  - IBM CICS Client for Macintosh, part number 17H7638.
- Application development tools—see “Language support” on page 52.

CICS Clients

CICS Clients are available for:

- OS/2
- Windows
- DOS
- Macintosh.

The family of client products for a range of different desktop platforms makes it easy for you to connect OS/2, DOS, Windows, and Macintosh client machines to a wide range of CICS application servers, from host computers to workstations.

CICS Clients support widely-used communications protocols:

- NetBIOS and IPX/SPX via Novell NetWare
- TCP/IP
- APPC (also via Novell NetWare for SAA).

and three different ways of implementing client/server applications, offering different degrees of client functionality and speed of implementation. This means that you can choose the rate at which you progress to client/server solutions. You do not need CICS for OS/2 installed as a server.

CICS Clients are the easy and cost-effective route to client/server. They make best use of your existing hardware, software and skills. They offer three simple stages to full client/server implementation. And you can use your favorite PC graphical user interface to enhance productivity and present both local and remote data, simultaneously.

CICS Clients allow you to capitalize on your PC investment immediately by using your 3270 applications on the desktop. You can then use widely-available rapid application development (RAD) tools from IBM and other vendors to gain the presentation and distribution benefits at a pace that suits the needs of your business.

You can implement your client/server applications progressively in these three simple and low-risk stages, all offering concurrent access to many different applications and servers:

- Emulating a 3270 display, allowing the CICS client to access your CICS applications and data from anywhere in your enterprise network, with no programming effort.
- Modernizing your existing CICS 3270 applications. Add a GUI front end, with no programming change to the CICS application, by using the external presentation interface (EPI).
- Developing new distributed client/server applications, using the external call interface (ECI). The presentation logic runs in the client, and the CICS application and data can run on a CICS server anywhere in your network.

CICS Clients functions and connectivity

- Industry standard communications protocols supported (see Table 2)
- Three ways of connecting to applications (see Table 2)
- Auto-install of clients at most server systems (see Table 2)
- Easy data exchange with desktop productivity tools
- Client printer support
- Customization of client emulator's colors and keyboard mappings
- Convenient interfacing of devices such as bar-code readers or scanners.

Table 2. CICS client/server functions and protocols

CICS Servers	Workstation clients				Function				Protocol		
	OS/2	DOS	Win-dows	Mac	ECI	EPI	Term Emul	Auto-install	LU6.2	Net-BIOS	TCP/IP
OS/2 V.2.0.1	Y	Y	Y	Y	Y	Y	Y	Y		Y[1]	Y
OS/2 V.2.0 multi-user	Y	Y	Y	Y	Y					Y[1]	
CICS on Open Systems	Y	Y	Y	Y	Y	Y	Y	Y			Y
400 V.3.1	Y	Y	Y	Y	Y	Y	Y	Y	Y		
ESA V.4.1	Y	Y	Y	Y	Y			Y	Y		
ESA V.3.3	Y	Y	Y	Y	Y			Y[2]	Y		
MVS V.2.1.2	Y	Y	Y	Y	Y			Y[2]	Y		
VSE V.2.3	Y	Y	Y	Y	Y			Y[2]	Y		
VSE V.2.2	Y	Y	Y	Y	Y			Y[2]	Y		

Key:

Y	Function or protocol is supported
ECI	External Call Interface
EPI	External Presentation Interface
Term Emul	Terminal Emulation
Autoinstall	The user does not need to predefine the client connection to the server

1) NetBIOS is not supported by the Macintosh client. You can use IBM NetBIOS, or a third-party NetBIOS emulator. For example, Novell's NetBIOS emulator provides NetBIOS flows over its Internetwork Packet eXchange (IPX) protocol.
2) Only single-session LU6.2 connections can be autoinstalled.

What you need to run CICS Clients

To connect CICS Clients, you need:

- IBM OS/2 Version 2.0 or later
- Microsoft Windows 3.1
- DOS 3.3 or later
- Apple Macintosh System 7.1 or later.

Ordering information

Program part numbers of CICS Clients are:

- OS/2—17H7627
- Windows—17H7616
- DOS—17H7605
- Macintosh—17H7638.

A helpful guide is *CICS Clients: Administration* (SC33-1436). This manual is shipped with CICS Clients products.

A complementary product is IBM LAN Distance, which allows you to dial into a LAN using a modem and telephone lines. Using advanced remote node technology, it supports a wide range of LAN protocols and commonly used LAN-based applications.

CICS on Open Systems

There is a client for CICS on Open Systems for each of the following operating systems:

Operating system	Client name
AIX	IBM AIX Client for CICS/6000
DEC OSF/1 AXP	CICS for DEC OSF/1 AXP Client
HP-UX	CICS for HP 9000 Client
SunOS	IBM CICS Client for Sun Systems

Each client for CICS on Open Systems can attach to any or all of the following CICS servers:

- CICS/6000 Version 1 Release 2
- CICS for DEC OSF/1 AXP
- CICS for HP 9000.

Note: Clients for CICS on Open Systems cannot attach to any other CICS servers.

Chapter 7. Extended family and partner systems

Because CICS has gained worldwide acceptance as the leading application server, a large number of software products (both IBM and non-IBM) have been produced to run with, or under, CICS. This chapter describes some of these products.

CICSPlex SM

Because CICS saves end users from having to know where an application is being run, many CICS regions can be linked into a collection known as a **CICSplex**, spread over many address spaces, in multiple MVS instances, processors, and data centers.

CICSPlex System Manager for MVS/ESA (CICSPlex SM) lets you view and manage your CICSplex, however large or complex, as if it were a single CICS region. With CICSPlex SM, you benefit from a range of powerful functions including a real-time single-system image, a single point of control, automated workload management, and real-time analysis functions that automatically alert you to potential problems.

CICSPlex SM can provide you with the following business benefits:

- More effective and efficient management of multiple CICS regions across the entire enterprise
- Improved availabilty and stability for business-critical applications
- Improved service to end users
- Transactions automatically routed away from problem regions
- Early detection and notification of potential problems
- Smooth handling of varying and unexpected workloads
- Better utilization of existing capacity by workload balancing
- Reduced effort and risk when making system upgrades and changes
- Support for growing business demands without increased staff
- Unique software technology to let you view and control all CICS regions as if they are one.

Many IBM mainframe accounts use CICS to provide their online transaction processing systems, including business-critical systems for handling customer service and taking orders. CICSPlex SM meets the need of CICS customers to simplify the business of controlling their systems.

CICSPlex SM cuts down the work by allowing an enterprise to group many CICS regions into a CICSPlex, and then to manage it as if it were a single region. This is achieved through a unique feature of the product—a “single-system image” of the entire CICSPlex.

There is no need to know where a particular piece of an application is located—the command is sent to CICSPlex SM, which uses its single-system image technology to send it on to the correct regions.

But cutting complexity is not just about making existing operations easier—it also involves a completely new approach to detecting problems before they become severe. CICSPlex SM lets you define:

- Those aspects of CICS status that are to be monitored
- A policy stating what a healthy system should look like.

When the real state deviates from policy, real-time analysis (RTA) acts by notifying the operator, or by invoking automation programs such as NetView to fix the problem. This can avoid CICS failures and improve service to end users.

Workload management is especially important for CICS running on the Parallel 390 hardware. This is the part of CICSPlex SM that automatically balances work by routing transactions to the region best able to handle them. Using knowledge of region health and load, it spreads the work over the CICSPlex, avoiding regions where it would run slowly or fail. The result is better throughput and availability—even if a region crashes, most end users will not notice because their work will be routed to the survivors.

Together, these features significantly ease the task of running even the largest CICSplex, letting you put your business needs first.

CICSPlex SM manages the entire CICSplex from CICS/ESA (3.3 or later), CICS/MVS (2.1.2), and CICS/VSE (2.2 or later), and IBM has issued a statement of direction for support of CICS for OS/2.

The *CICSPlex SM: Concepts and Planning* manual (GC33-0786) gives more information about this product.

CICS VSAM Recovery (CICSVR)

CICS VSAM Recovery for MVS/ESA Version 2 Release 1 provides forward recovery of VSAM data sets used by CICS/MVS and CICS/ESA.

CICSVR applies information saved in CICS journals to restored copies of the most recent backup of VSAM data sets before their loss or damage.

CICSVR works in batch mode, independently from CICS. Depending upon your application characteristics, you can even recover your data sets and return them to CICS without bringing your entire CICS system to a halt.

For detailed information about CICSVR, see the *CICS VSAM Recovery MVS/ESA Version 2 Guide* (SH19-6709).

MQSeries

The IBM MQSeries (Messaging and Queuing Series) products provide an asynchronous messaging and queuing function with assured delivery across platforms such as:

- IBM's OS/2, DOS, OS/400, AIX, VSE, MVS, and S/88
- Digital VMS, Tandem Guardian, SunOS, HP-UX, SCO UNIX, and UNIXWare. Support has also been announced for Sun Solaris, AT&T GIS UNIX, and Tandem Guardian Himalaya.

Business and logic applications, using an application environment such as CICS, access the communication services through a Message Queuing Interface (MQI).

The MQSeries software:

- Protects messages from loss or corruption while they are on a queue
- Ensures that the message is delivered to whichever system the recipient is on once and once only.

MQSeries can allow CICS applications to communicate very easily with non-IBM systems and platforms. It brings to the CICS environment a simple asynchronous communication facility with assured delivery of messages.

For more information, see the *MQSeries Planning Guide* (GC33-1349).

Glossary

A

AIX. Advanced interactive executive (the IBM UNIX-based operating system)

AOR. Application-owning region

API. Application programming interface

APPC. Advanced program-to-program communication

ASCII. American National Standard Code for Information Interchange

ATM. Automatic teller machine

B

BMS. Basic mapping support

C

CASE. Computer aided software engineering

CICS. Customer Information Control System

CICSplex. A collection of related and connected CICS regions

CICSPlex SM. CICSPlex System Manager/ESA (CICSPlex SM)

CICSVR. CICS VSAM/Recovery/MVS

COBOL. Common Business Oriented Language

CSD. CICS system definition

CSP/AD. Cross-system product/application development

CSP/AE. Cross-system product/application execution

CUA. Common user access

D

DB. Database

DBCTL. Database control subsystem

DCE. Distributed Computing Environment (OSF)

DLI. Data Language/I

DOS. Disk operating system

DPL. Distributed program link

DTB. Dynamic transaction backout

DTP. Distributed transaction processing

E

EASEL. A PC-based development tool for building graphical applications (EASEL Inc.)

EBCDIC. Extended binary coded decimal interchange code

ECI. External call interface

EDF. Execution diagnostic indicator

Encina. ENterprise Communication In a New Age (Transarc transaction monitor for RISC System/6000)

EPI. External presentation interface

ESA. Enterprise systems architecture

F

FCT. File control table

FEPI. Front end programming interface

G

GUI. Graphical user interface

H

HLASM. High-level assembler

HP. Hewlett-Packard

HP-UX. A Hewlett-Packard UNIX-based operating system

I

I-CASE. Integrated computer aided software engineering

IPX/SPX. Internetwork packet exchange/sequenced packet exchange

IRC. Interregion communication

ISC. Intersystem communication

L

LAN. Local area network

LANDP. IBM LAN distributed platform

LUW. Logical unit of work

LU6.2. Logical unit type 6.2—an SNA protocol for communication between processors

M

MQI. Message queue interface

MRO. Multiregion operation

MVS. Multiple virtual storage

N

NetBIOS. Network basic input/output system

O

OLTP. Online transaction processing

ONC. Open network computing (developed by Sun Microsystems, Inc.)

OO. Object-oriented

OS. Operating system

OSF Inc. Open Software Foundation, Inc.

OSI. Open systems interconnection

P

PTS. Parallel transaction system

R

RACF. Resource access control facility

RAD. Rapid application development

RDBMS. Relational database management system

RDO. Resource definition online

RISC. Reduced instruction set computer

ROR. Resource-owning region

RPC. Remote procedure call

S

SCO. Santa Cruz Operation, Inc.

SDA. Screen design aid

SDF. Screen definition facility

SMF. System management facility

SMIT. System management interface tool

SNA. Systems network architecture

SQL. Structured query language

T

TCP/IP. Transmission control protocol/Internet protocol

TOR. Terminal-owning region

U

UNIX. An operating system, the trade mark of which is licensed exclusively by X/Open Company Limited

V

VM. Virtual machine

VS. Virtual storage

VSAM. Virtual storage access method

VSE. Virtual storage extended

VTAM. Virtual telecommunications access method

W

WAN. Wide area network

WIMP. Window-Icon-Mouse-Pointer

X

XA. Extended architecture

XCF. Cross-system coupling facility

XDR. External data representation

XRF. Extended recovery facility

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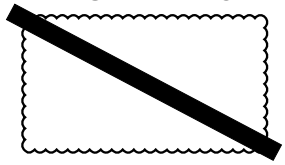

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