Chapter 1: Introduction to the AS/400

Chapter Overview

This chapter introduces you to the basics of the AS/400, including

- single-level storage (memory)

- the function of licensed internal code

- the differences among versions, releases, and modification levels of OS/400

- the difference between batch and interactive jobs

- the function of system values

- the purpose of Control Language (CL)

- the function of the Integrated File System (IFS)

- AS/400 objects, libraries, folders, and queues

AS/400 Architecture

The AS/400 has a highly complex architecture that includes hardware, software, security, and other components. To effectively manage this complex system and the daily tasks it performs, as a system operator, you must understand the AS/400's basic architectural concepts and related terminology. The AS/400 supports a great variety of hardware devices and software, but in this book we discuss only the most commonly used components and those that a system operator typically needs to know about or work with.

Storage Management

One of the unique characteristics of the AS/400 is its use of the **single-level storage** concept. Other hardware manufacturers separate storage management into two separate hardware components: main memory, which is also called RAM (random access memory), and disk (more correctly called DASD, for direct access storage devices). With single-level storage, these two hardware devices are combined into a logical unit because they are inseparable. To help you understand this concept, consider your car. The transmission and the engine are two separate, physical pieces of hardware; but if either one is not functioning, the car doesn't run. Single-level storage (or storage management) applies the same principle. Both components of memory must be functioning and be properly integrated, or users can't access the data they need.

The AS/400 also uses a nontraditional method of storing data on the disk drives and disk platters. Traditionally, systems store files contiguously. If a part of the disk is unused but too small for a particular file, the operating system bypasses the small space and uses a larger space. This approach causes gaps on the disk platter that the system must later "compress."

On the AS/400, a single database object is usually spread over several disk drives and multiple disk platters. This approach allows for several users' data to be retrieved (seemingly) simultaneously and quickly displayed on multiple workstation screens. The disk drives actually retrieve data at the same speed as before; but data retrieval appears faster to the user. This method not only improves performance but also eliminates the need to compress unused disk space. Distributing data in this way does, however, make comprehensive backup mandatory.

Licensed Internal Code
Licensed internal code (LIC), also called system licensed internal code, is software that interacts directly with the AS/400 hardware. LIC typically performs the following functions:

- storage management

- pointer and address management

- program management

- expectation and event management

- data management

- I/O management

- security management

To support specific hardware models and processors of the AS/400, IBM also issues Model Unique Licensed Internal Code (MULIC) or, for some models, Feature Unique Licensed Internal Code (FULIC). MULIC/FULIC programs are model or processor dependent and change as more models are added and others are upgraded. As the system operator, you may be required to install **Program Temporary Fixes (PTFs)** for licensed internal code. A new release of LIC may be required when a new machine is being installed, if the IPL disk crashes, or if you are restoring your system after a complete system loss. We discuss installing LIC PTFs in the next section and in greater depth in Chapter 7.

Versions, Releases, Modifications, and PTFs

The AS/400 is not a static combination of hardware and software. IBM continuously improves OS/400 and repairs reported problems so the system remains at top efficiency for its users. These improvements and repairs take the form of versions, releases, modifications, and PTFs. A new **version** of OS/400 contains significant new code or functions for the OS/400. A new **release** represents a major improvement to the operating system (see the Preface for the version and release being used for this edition). A release can be a new product, or it can incorporate new functions or PTFs into an existing version of the operating system. A release can be a smaller upgrade than a version. A **modification level** is frequently a collection of PTFs issued since the previous modification, release, or version; this collection of PTFs may be shipped as a single package. A change in modification level doesn't add new functions to the release. IBM may ship a new release with a modification level of zero. When the release is shipped with one or more additional changes incorporated, the modification level is incremented accordingly (i.e., for Version 4, you might receive Release 1, Modification level 2).

PTFs generally correct problems or potential problems found within a particular IBM licensed software product (e.g., RPG IV, COBOL/400, or AS/400 Client Access). PTF lists are updated daily and are available through IBM's Electronic Customer Support, which gives online access to IBM service facilities, technical information, and marketing support information. You should review PTF lists regularly for applicability to your hardware and software.

Subsystems

The AS/400 hardware and software join to make a secure and efficient platform for jobs performed on the system and the work management concepts associated with these jobs. To help manage jobs, you can divide the system into separate work groups called **subsystems**. All work on the AS/400 is done within subsystems. The AS/400 can be divided into myriad subsystems for more efficient processing of different types of jobs. The subsystem description (*SBSD) is an object that describes a subsystem and controls the tasks the subsystem performs. The subsystem and subsystem description allocate resources and manipulate system objects for

the most efficient use of the different hardware and tasks the system has been designed to perform.

Interactive vs. Batch Subsystems

Subsystems may run either **interactive** jobs or **batch** jobs. Interactive jobs begin when a person signs on to the terminal, and they usually have a higher priority than other tasks. Generally, interactive jobs require the user to type a command, wait for the machine to display the requested material, type another command, and so on. While waiting for the user to enter the next instruction, the operating system is either checking (polling) to see whether other users have completed a command or executing tasks for another user.

Batch jobs generally run with minimal or no interaction with the user. They usually have a lower priority than interactive jobs; consequently, they usually run when the AS/400 has time available. For example, a batch job might post all the detail journals to the general ledger. Batch jobs may also be held until a certain time of day. For example, a given batch job may automatically run each night at 11 o'clock. An example of such a batch job would be the nightly deletion of work files before a system backup.

System Values

System values (ˇSYSVAL) are AS/400 attributes that let each installation customize the machine to the organization's needs and specifications. Consider, for example, the differing needs of an AS/400 installed in China and one installed in Holland. Each machine needs different alphabet characters, different displays of the time and date, and possibly different security levels and hardware.

Some system values control system performance; others define security levels; yet others simply provide defaults to command options that are unspecified. System values can be divided into eight categories:

- date/time

- editing

- system control

- library list

- allocations

- message logging

- storage values

- security values

A user must have proper authority to change a system value; in many installations only the security officer has sufficient authority to make these changes. However, as a system operator, you must be aware of many of the nearly 100 system values because these values are a convenient way to modify small portions of the operating system - they control how a given command, or even the entire system, performs.

Consider the system value QDATE, which may be either a 5-digit or a 6-digit field. A 6-digit field could hold a date such as 11-28-00, while a 5-digit field would be used for a Julian date. Julian dates have no months; instead, they contain a single value for the day of the year. For example, the first day of January expressed as a Julian date is 1, while December 31 is 365 (or 366 in a leap year). The system value QYEAR holds only the year value - in this example, 00. (QCENTURY is the system value for the century.) QDATFMT (an editing system value) defines

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how your machine displays the system date value. Several options are available, including *mm-dd-yy*, used for most reports; *yy/mm/dd*, convenient for sorting; or *dd:mm:yy*, used in military format and in many European countries. You can also customize the type of separators; the previous examples show three such options - the hyphen, the dash, and the colon.

The system value QTIME contains the system time of day. It comprises three other system values, QHOUR (based on a 24-hour clock), QMINUTE, and QSECOND.

The system value QCURSYM determines the currency symbol, which is country dependent; for example, the yen, lira, franc, and dollar use different symbols.
Other system values of interest are shown in

Table 1.1: Commonly Used AS/400 System Values

System Value	Description
System Control	
QABNORMSW	Indicates how the system last ended (0=normal and 1=abnormal).
QATNPGM	Contains the name of the attention program.
QAUTOCFG	Turns the autoconfiguration feature on (1) or off (0).
QCTLSBSD	Specifies which subsystem is in control when the system starts, usually QCTL or QBASE.
QDEVNAMING	Defines how to name devices, using either S/36 or AS/400 standards.
QDSCJOBITV	Contains the time interval that an interactive job can remain disconnected before it is ended.
QINACTITV	Contains the time interval that an interactive job can remain inactive before the system disconnects it, ends it, or takes some other action.
QIPLDATTIM	Contains the date and time to automatically IPL.
QIPLSTS	Contains the IPL status indicator, which indicates the form of IPL that last occurred.
QPWRRSTIPL	Specifies whether an automatic IPL should be started when power is restored following a power failure.
QIPLTYPE	Specifies the type of IPL to perform when the system is powered on manually, with the key in the normal position. A value of 0 indicates unattended IPL, 1 indicates attended IPL, and 2 is for problem resolution.
QKBDTYPE	Specifies a language character set for the keyboard.
QKBDBUF	Indicates whether keyboard buffering is allowed. Keyboard buffering lets you type into a storage buffer before the key strokes are requested.
QMODEL	Holds the system model number and can't be modified.
QPRTDEV	Specifies the name of the system's default printer, usually PRT01.

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System Value	Description
System Control	
QRMTSIGN	Specifies whether a remote sign-on is allowed, and how to handle the remote sign-on.
QSFWERRLOG	Turns software error logging on or off.
QSTRPRTWTR	Specifies how print writers are started. A 1 means that all print writers start automatically after IPL; a 0 requires the operator to manually start print writers.
QSRLNBR	Contains the preloaded serial number.
QTOTJOB	Indicates the total number of jobs that can be started. Affects performance.
QUPSDYTIM	If the system has an uninterruptible power supply, specifies how long the batteries are designed to supply power to the system in the event of a power failure.
QUPSMSGQ	Designates the message queue the UPS will send messages to.
QASTLVL	Contains the user assistance level.
Library List	
QUSRLIBL	A default list of up to 25 libraries for the user portion of the library list.
QSYSLIBL	A default list of up to 15 libraries for the system portion of the library list.
Allocation	
QACTJOB	Specifies the initial number of active jobs that will have space allocated.
QADLACTJ	When the number of jobs in QACTJOB is exceeded, specifies the additional number of active jobs that will have space allocated.
QJOBSPLA	Specifies how large to allocate a spooling area for a job.
QRCLSPLSTG	Specifies how many days to keep empty spooled database members.
Message Logging	
QACGLVL	Indicates the job accounting level in use; *NONE is the default.
QHSTLOGSIZ	Specifies how many records are stored in each version of the history log.
QPRBHLDITV	Specifies how many days a problem in the problem log should be retained.
Storage	

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Storage	
QBASACTLVL	Specifies how many jobs can compete concurrently for the memory in the base storage pool.
QBASPOOL	Defines the minimum for the base storage pool size (in kilobytes).
QMAXACTLVL	Specifies the maximum number of active jobs allowed on the system.
QMCHPOOL	Specifies the machine storage pool size (in kilobytes).
Security	
QALWOBJRST	Provides multiple choices to restore security-sensitive objects.
QALWUSRDMN	Specifies which libraries allow user domain objects to be located in them.
QAUDCLT	Provides choices to control how security auditing is performed.
QAUDENDACN	Specifies action to take when security auditing can't be performed.
QAUDFRCLVL	Specifies how often to write the security auditing journal to disk.
QAUDLVL	Lists which security-related actions to journal.
QAUTORMT	Turns on (1) or off (0) automatic configuration of remote controllers.
QAUTOVRT	Indicates how many (0 – 9999) virtual devices to allow to be automatically configured in a remote communications environment.
QCRTAUT	Sets the systemwide default public authority for new objects created on the system. This value can be overridden by the create command.
QCRTOBJAUD	Defines the default auditing level for a newly created object.
QDSPSGNINF	Controls the display of sign-on information.
QINACTMSGQ	Specifies the action to take when a job is inactive for the time specified in the QINACTITV system value.
QLMTSECOFR	Specifies whether to prevent the security officer from accessing certain devices.
QMAXSIGN	Specifies how many invalid sign-on attempts are allowed.
QMAXSGNACN	Specifies the action to take when the QMAXSIGN limit is reached.
QPWDEXPITV	Defines the number of days a password is valid before it expires. *NOMAX is a valid option.

Storage	
QPWDMINLEN	Defines the minimum number of characters required in a password.
QPWDRQDDIF	Controls duplicate passwords and limits how often a user can reuse a password.
QSECURITY	Indicates the security level; valid levels are 10, 20, 30, 40, and 50.

Control Language

Control Language (CL), an integral part of OS/400, is a set of commands by which users control operations and request system-related functions on the AS/400. A CL command usually is made up of three-character words; up to 10 characters (usually three words) can be merged to form commands. For example, in CL, work is abbreviated as WRK, system is abbreviated as SYS, and status is abbreviated as STS. The command WRKSYSSTS, therefore, is translated as Work with System Status. CL commands can be entered on the command line or executed from within a program. When commands are entered from a program or menu, the user selects options that are displayed in more friendly, English-type format. The program then translates the selected option into the appropriate CL command or commands. We discuss CL commands further in Chapter 3.

Files and File Systems

A company's data isn't useful unless it can be accessed in an organized and efficient manner to create useful information. A **database** is a collection of data organized to provide easy access to the information. For example, personnel records are stored together in a database to allow payroll to be processed easily. Each employee's payroll information is held in a **record** within the database. Each record contains the same type of information (e.g., name, address, hours worked). OS/400 includes a built-in, fully integrated database management system - DB2.

A **stream file** is a stream of data that is not divided into records. Documents, images, text, video, and audio files are all forms of stream files.

Integrated File System

With the growth of communications and connectivity among many different types of computers, IBM developed the **Integrated File System (IFS)** to allow for open connectivity. With a variety of file systems, the IFS provides multiple ways of accessing AS/400 objects. The two most common file systems included in the IFS structure are the library file system, QSYS.LIB, and the document library services file system, QDLS.

The QSYS.LIB file system supports the AS/400 library structure by providing access to AS/400 database files and all other object types that a library supports or manages. Because the AS/400 identifies objects by their qualified name (i.e., *library/ object*), QSYS.LIB accesses an AS/400 object using the name of the library and the name of the object. For example, to reference the EMPMASTER file in the PAYROLL library, you'd refer to PAYROLL/EMPMASTER.

The QDLS file system provides access to documents and folders on the AS/400 and supports access to stream files. The QDLS file system includes the files stored in AS/400 folders that are usually accessed by OfficeVision for AS/400, AS/400 Client Access, or a personal computer application.

> **Note**   **OfficeVision for AS/400 is a IBM-supplied program that includes word processing and e-mail features and may be used from a personal computer or an IBM display terminal. AS/400 Client Access is an IBM program that provides connectivity and communication between an AS/400 and a personal computer running Windows 95/98, Windows NT, DOS, or IBM OS/2.**

Additional file systems are included in the IFS for specific purposes and for compatibility among different types of operating systems and application software. For example, the Network File System (NFS) provides access to data and objects stored on a remote NFS server; the QNTC file system provides access to data and objects stored on a server running NT 4.0 or higher, including access to data on an NT Server running on an Integrated Netfinity Server; and the optical file system (QOPT) provides access to stream data stored on optical media.

Objects

As you've probably noticed by now, every item stored on the AS/400 is an **object**. Because every stored item is an object, backup and restore procedures become more manageable. Objects are categorized by type, which lets the user specify the types of objects required for a given task or backup procedure. Objects include data files, user profiles, job queues, message queues, print queues, compiled programs, word-processing documents, and menus. Some file objects may contain other objects, called **members**, depending on the characteristics of the main file object.

Each object is assigned an owner when it is created. The owner is either the user profile or the group profile that created the object.

> **Note**   The *user profile* **is an object that defines system access for a user: the objects the user can access, the libraries the user can use, the user's authorities, and the special groups to which the user belongs. We discuss user profiles in Chapter 2.**

When an object is created, the owner is given all the object and data authorities to that object. When giving ownership of the object to another user profile, the original owner can keep all the object and data authorities the same or remove all authority to the object. If the creating user has specified that a group profile owns an object, all members of the group profile have authority to the object; any user assigned to the group may add, modify, or delete records in the object, assuming all data authorities are provided. This feature is helpful when data sharing is necessary. Consider a company that takes orders by telephone. Each clerk taking orders needs access to all the customer records, so each clerk should be a member of a group profile that includes authority to the object containing customer records. (We present additional information about group profiles in Chapter 2.)

Libraries and Folders

Objects on the AS/400 may exist within a **folder** or a **library**. Folders and libraries act as holding areas for related objects. The type of object determines the location in which an object is stored.

Folders (object type *FLR) are objects similar to paper folders in that they can contain other folders and stream files (e.g., word processing letters, memos, and other types of text files, including files in PC formats). OfficeVision for AS/400 and AS/400 Client Access process folders.

The AS/400 uses a library in much the same way that personal computers use directories. Libraries and directories are holding areas for related material. For example, one library might hold payroll programs, while another holds inventory control programs. Libraries generally contain many other objects. Unlike directories or folders, however, libraries can't contain other libraries (with one exception - library QSYS, discussed below). Database files are stored in libraries.

IBM supplies several libraries with the AS/400. Some of these libraries contain the objects that make up the operating system; others hold the programs, data files, and other objects that make up licensed program products (e.g., language compilers, OfficeVision for AS/400). Most AS/400s contain the QSYS, QSYS2, QGPL, QHLPSYS, QSPL, QTEMP, and QUSRSYS libraries because these libraries are usually required to run the system and to support common user needs.

- QSYS is the system library. It contains the programs and other objects that make up the operating system. QSYS must exist on an AS/400 for the system to work. Other libraries on the AS/400 exist within the context of the QSYS library; as we mentioned above, it's the only library that can contain other libraries. A few special objects, such

as user profiles and I/O configurations, can exist only within QSYS. You should never modify or delete any object in the QSYS library because the operating system might stop working if you do. Only in unusual circumstances would you ever add an object to QSYS; you would normally create objects only within a user-defined library.

- QSYS2 is a additional system library for system objects that don't begin with the letter Q.

- QGPL is the general-purpose library that contains IBM-provided objects. The system places newly created objects that are not specifically placed in a library in QGPL. User objects inadvertently placed in QGPL should be moved to the appropriate user library.

- QHLPSYS contains the online help information that is displayed when the Help key or the extended help function keys are pressed.

- QSPL holds the spooled output pages that have not yet been printed. As system operator, you shouldn't manipulate the QSPL program or command files.

- QTEMP is a library that is created for each job. Each time a user signs on, the system creates a QTEMP library for the interactive job. If the user submits a job to the batch queue, another QTEMP library is created for the batch job. The QTEMP library is deleted when the job ends. QTEMP stores temporary objects, such as work files, that a job might need. Because each job's QTEMP library is deleted at the end of a job, any objects in QTEMP are also deleted. QTEMP objects are private to a job. A job can access only those QTEMP objects in its own QTEMP library, not those in any other job's QTEMP library.

- QUSRSYS is a library where user objects can exist and also be available to the system. QUSRSYS frequently holds message queues for individual users and a common message file for an application's error messages.

Table 1.2 summarizes the common AS/400 libraries.

Table 1.2: Common AS/400 Libraries	
Library Name	**Typical Contents**
QSYS	System library
	- Operating-system code
	- User profiles
	- I/O configuration objects
	- References to other libraries
QSYS2	Additional system library for system objects that don't begin with the letter Q
QDCT	Language dictionaries for OfficeVision
QDOC	Documents, shared folders
QGPL	General-purpose library
	- Job queue descriptions
	- Printer output queue descriptions

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Table 1.2: Common AS/400 Libraries	
Library Name	**Typical Contents**
	▪ Miscellaneous installation-specific descriptions
QHLPSYS	System help screens
QOFC	OfficeVision for AS/400 library
QPDA	Application Development Toolset
	▪ Program Development Manager (PDM)
	▪ Source Entry Utility (SEU)
	▪ Screen Design Aid (SDA)
QPFR	Performance measurement tools
QPWXALIB	Client Access base programs
QPWXCLIB	Client Access for Windows 3.1
QRPG	RPG/400 compiler
QRPGLE	ILE RPG/400 compiler
QSPL	Spool library for printed reports, etc.
QSQL	DB2/400 Query Manager and SQL Development Kit
QTEMP	Library to hold temporary objects
	▪ Work files
	▪ Temporary data areas
QUSRSYS	System library for installation-specific information
	▪ System journals, journal receivers
	▪ Database cross references
	▪ Files used by system commands
	▪ Message queues
	▪ Character translation tables

Your AS/400 may also have other IBM libraries, depending on the IBM products your organization purchases. Product libraries contain IBM licensed program products that are self-contained software packages. Each product resides in a separate library. For example, the RPG/400 compiler and RPG/400 support programs are loaded into the QRPG library.

Independent software vendors supply their own libraries with the objects that make up their applications. You can also create libraries to hold your organization's programs and data files.

Note   **Most IBM-supplied library names begin with the letter Q. Therefore, you generally should avoid creating libraries with a first letter of Q.**

In most installations, the system administrator creates user libraries. User libraries are commonly created to hold an individual's work; for example, each programmer should have his/her own user

library. The administrator can create as many user libraries as are convenient; the only limit is the amount of disk space available in DASD.

Queues

Objects of special importance to operators are **queues**. Queues are holding areas for messages, printed reports, batch jobs, and other work that is waiting to be received, released to the CPU, or accessed by a specific user. For example, when a message is generated and sent, it is then retained in the user's message queue.

A **message queue** (object type *MSGQ) is an area for holding messages. Users may choose to delete unneeded messages after they have read them. The system automatically creates message queues when the user profile is created.

An **output queue** (object type *OUTQ) is a holding area for reports that are waiting to be printed. We discuss output handling in detail in Chapter 5.

Other Objects

A message file (object type *MSGF) holds predefined message texts and their corresponding message numbers. When a program detects an error, rather than display a message number, the system shows predefined message text to the user. The text may suggest actions to correct the error or it may direct the user to contact the computer center. The system message files include QCPFMSG and many more in the QSYS library. Some program products have their own message files; for example, the RPG compiler holds messages in the QRPGMSG message file in library QRPG. All together, there are more than 26,000 predefined messages. A common example of a predefined message is "Device STAT1 is no longer communicating."

The journal and journal receiver objects (object types *JRN and *JRNRCV, respectively) are objects that record events that have happened in the system. Any file may use journaling; but database file operations such as adding, deleting, or changing records are tracked automatically whenever the journaling system is active. Changes are recorded in a journal object to provide an audit trail of modifications.

Menus (object type *MENU) are objects that list a choice of predefined or related activities. Each activity is displayed on the screen and the user chooses an option. The menu program then runs the user's choices by calling the appropriate CL commands and other programs. Generally, menus have message files associated with them to explain any errors or problems to the users.

Programs (object type *PGM) are objects stored in machine language for faster execution. The *PGM object is not a displayable file but has a displayable source file object linked to it. The source is written in a language such as RPG/400, COBOL/400, or CL.

AS/400 Sign On

The information in the upper right corner of an AS/400 Sign On screen describes the connection of the workstation to an AS/400 (see Figure 1.1).

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                    Sign On

                              System  . . . . . :  S1029512
                              Subsystem . . . . :  QINTER
                              Display . . . . . :  LCOMPAQA


    User . . . . . . . . . . . . . .   _____
    Password . . . . . . . . . . . .   _____
    Program/procedure  . . . . . . .   _____
    Menu . . . . . . . . . . . . . .   _____
    Current Library  . . . . . . . .   _____





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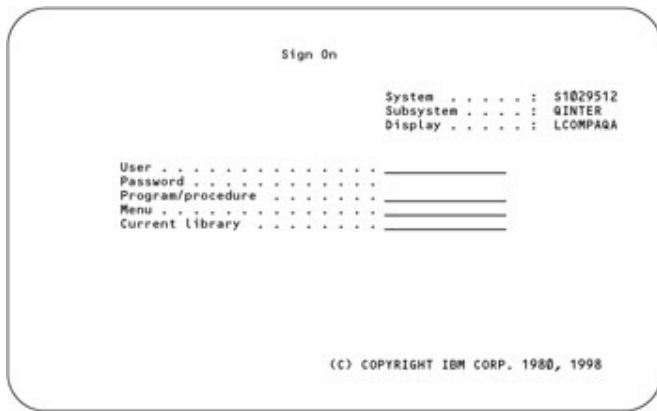
Figure 1.1: AS/400 Sign On Screen

The System number represents the AS/400 that the workstation is connected to. This is an IBM serial number (each AS/400 has a unique system number) or an installation name.

The Subsystem name refers to the main storage area that this workstation connection will use to execute and process jobs.

The Display name is the unique name assigned to the individual workstation. A unique name for each workstation provides a means for operators or users to identify a station connected to an AS/400.

The main section of the Sign On screen contains user-specific information. The user ID and password fields help protect the information on the AS/400.

Note   **The AS/400 security officer creates the user ID and password before a new user first signs on. Your instructor will provide you with a user ID and password.**

The Program/procedure, Menu, and Current library entries on the Sign On screen are optional. The Program/procedure entry lets the user specify a program or procedure to execute immediately during sign on. This option may be used to bypass the menus or commands necessary to open an application. The Menu entry lets the user go directly to a specific menu when signing on. The Current library entry may be used to specify the library in which newly created objects will be stored.

To sign on to an AS/400 that requires a user ID and password, perform the following steps:
1. Type *your user ID*.
2. Type *your password*.
3. Press Enter.

Unless you specify a different menu on the sign-on screen, the AS/400 Main Menu or the General Systems Tasks panel will be displayed.

Note   **Whether the AS/400 Main Menu or the General Systems Tasks panel is displayed is specified in the user profile and is based on the user ID of the user signing on to the AS/400. A system operator's user ID invokes the General Systems Tasks panel. Most other user IDs invoke the AS/400 Main Menu. Both panels feature multiple menu items and a selection or command line for command entry. CL commands may be typed and executed from the command line.**

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When you finish your work, it's important to sign off the AS/400. System operators generally have more authority over and access to AS/400 objects than the average user. Leaving your workstation unattended and signed on with a system operator's authority may be dangerous for an organization's valuable information. To sign off the AS/400 and return to the AS/400 Sign On screen, perform the following steps:

1. Type **Signoff** on the command line.

2. Press Enter.

Chapter Summary

The AS/400 architecture and design apply a unique method of storage and information access. One of a system operator's responsibilities is maintaining the security of the data stored on an AS/400. Thus, understanding the structure and terminology involved in the storage and retrieval of data is important when developing procedures for safeguarding an organization's information.

End user help is also a system operator's responsibility. If an end user can't find a file needed to perform a task, as system operator you may be called upon to locate it. Knowing the types of objects and their storage locations is, thus, very important to a system operator. Maintaining the system is also part of a system operator's job. Cleaning up old unwanted files and monitoring performance is important.

Key Terms

batch job

Control Language (CL)

database

folder

Integrated File System (IFS)

interactive job

library

Licensed internal code (LIC)

member

menu

message queue

modification level

object

output queue

program

Program Temporary Fix (PTF)

queue

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record

release

single-level storage

stream file

subsystem

system value

user profile

version

Review Questions

1. What is single-level storage?
2. What is licensed internal code? What functions does it perform?
3. What is the difference between a release and a modification level?
4. What is the purpose of Program Temporary Fixes (PTFs)? Why are they important?
5. Think about interactive and batch jobs. Which has a higher priority? Why?
6. What functions do the system values perform?
7. What is the Integrated File System (IFS)?
8. What is the difference between a data file and a stream file? Where is each type of file stored?
9. What types of information can be stored in an object? List several types of objects.
10. How are libraries different from folders? Which library is the exception to this difference? Why?
11. Which library is required for the AS/400 to operate?
12. What is the purpose of a queue? List several types of queues.
13. How do you sign on to an AS/400?
14. How do you sign off of an AS/400?

Exercises

1. Sign on to the AS/400 and access your user profile by typing **DSPUSRPRF** on the command line. A screen showing the fields User Profile, Type of Information, and Output will be displayed. Type *your user profile name* on the User Profile line and press Enter. Press the Print Screen key to copy the user profile to your queue. Print the user profile, write your name on the printed list, and turn the results in to your instructor.
2. Access the system values by typing **DSPSYSVAL** on any command line. A screen that includes the options of System Value and Output will be displayed. Place the cursor on the System Value field and press function key F4 to get a list of system values that can be displayed. (The functions keys appear along the top of your keyboard.) Type **QACTJOB** and press Enter. Press the Print Screen key to copy the QACTJOB screen to your queue. Press Enter to return to the command line. Print the screen, write your name on the printed screen, and turn the results in to your instructor.

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3. Press function key F9 (Retrieve) to display the last command that was executed. Use the appropriate arrow to move the cursor to QACTJOB and change this to **QBASPOOL**. Press Enter to display the system values. Press the Print Screen key to copy the QBASPOOL screen to your queue. Press Enter to return to the command line. Print the screen, write your name on the printed screen, and turn the results in to your instructor. Sign off the AS/400.

Chapter 2: Security

Chapter Overview

This chapter introduces you to several very important system concepts, including

- uses of system values

- AS/400 security levels

- assistance levels

- user profiles

- user profile classes

- group profiles

- job descriptions

- library lists

- authorization lists

- object authority

- data authority

- the DSPOBJAUT (Display Object Authority) command

- the authority search path

Information is one of a company's most valuable assets. Imagine attempting to process an order with only the customer's credit card slip, when the file with the customer's name, address, and product order numbers is lost. What if the company's inventory was in multiple warehouses throughout the country and the inventory file was destroyed? Imagine trying to pay suppliers if the accounts payable file has been corrupted. Realistically, losing the corporate database can cause a business to fail. Security isn't just a matter of proper backups; rather, it requires comprehensive thinking.

Envision a jeweler putting the gold and diamonds into a vault at night. The next morning, the jeweler can open the vault, look around, and determine whether any items have been stolen. Now picture the computer center manager looking at the disk drives. Unlike the jeweler, the manager can't be sure that the data files haven't copied and sold to a competitor or that individual records haven't been changed. Keeping the corporate data confidential and accurate is of utmost concern in maintaining a successful business.

Security has three separate aspects: physical security of the hardware, backup of the data files, and prevention of unauthorized access to the data files. Physical security of the system unit, workstations, and printers must be part of any security considerations. The AS/400 includes a key

lock to help prevent unauthorized access to the functions on the control panel of the system unit. Backup and restore are such important topics that we devote Chapter 7 to the subject. Security violations within the corporation are often unintentional incursions by employees; nonetheless, such violations can cause many problems. In today's world of connectivity, however, the paramount risk is unauthorized outside users accessing corporate data.

The AS/400 security system allows a wide range of configurations to control and monitor authorized user access, both onsite and through outside connectivity. The AS/400 security system is built into the operating system, allowing for consistent security between the operating system and other licensed programs. This configuration ensures that an application program can't easily bypass security because the security features are integrated into the operating system.

The AS/400's operating system provides several methods, which use many different tools, to create a secure environment. System values, security levels, assistance levels, user profiles, group profiles, and authorization lists work together to allow the manipulation and control of data on the AS/400.

System Values

As we discussed in Chapter 1, **system values** are attributes that can change how the entire computer system functions. Some system values can be used within other commands if ˙SYSVAL is specified as a parameter's value. The operating system uses the contents of the corresponding system value to execute the command.

The security audit journal, QAUDJRN, is provided with the operating system. The system value that determines what is logged in the audit journal is QAUDLVL. Some of the values that can be specified for QAUDLVL are ˙NONE to disable the auditing function; ˙AUTFAIL to log authority failure events; ˙CREATE to log when objects are created; ˙DELETE to log when objects are deleted; ˙JOBDTA to log job start, stop, and disposition information; ˙OBJMGT to log when objects are moved or renamed; ˙PGMFAIL to log system integrity violations; ˙SAVRST to track restore operations; and ˙SECURITY to log security changes and related functions. A number of other options also provide a full range of security auditing.

The QCRTAUT (System Default Create Authority) system value determines the public authority of a new object.

| Note | The "public" is considered any valid AS/400 user who didn't create an object. |

The QCRTAUT system value usually works with the CRTAUT (Create Authority) parameter of the library description where the new object is being placed. The public authority values are ˙CHANGE, ˙USE, ˙EXCLUDE, and ˙ALL. Those users with public authority can change newly created objects if the authority value is ˙CHANGE, but they can only view objects if they have been granted only ˙USE authority. Public users aren't allowed to view or change an object with the ˙EXCLUDE value. Public users have complete control of the object when you specify ˙ALL as the value. ˙CHANGE is the recommended value for the QCRTAUT system value because several IBM-supplied libraries' CRTAUT parameter value is ˙SYSVAL, and ˙CHANGE is required for some operations. In addition, some objects located in the IBM-supplied libraries must be accessed before users are allowed to sign on.

To monitor a user's profile and password, you can use the QDSPSGNINF (Display Sign-on Information) system value, which lets you show the user additional sign-on information each time (s)he signs on to the system. The sign-on information includes the date of last sign-on, the number of invalid sign-on attempts, and (if fewer than seven days remain) the number of days until the password expires. A value of 0 for this parameter specifies that the sign-on information won't be displayed. A value of 1 specifies that the sign-on information will be displayed when the user signs on to the system.

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To foil unauthorized users from attempting to sign on to the system, you can specify the maximum number of consecutive invalid sign-on attempts allowed in the QMAXSIGN system value. Valid entries for QMAXSIGN are 1-25 and *NOMAX. Three sign-on attempts are recommended to allow authorized users enough attempts to correct typing errors before the system disables the device. When the value specified in QMAXSIGN is reached, an action specified in the QMAZSGNACN system value is executed. The possible actions are to disable the device, disable the user profile, or disable both the device and the user profile. See the Appendix for information about how to reactivate the device.

Limiting users to signing on to a single workstation at a time promotes security awareness and limits the possibility of users leaving a device available to unauthorized people. The QLMTDEVSSN (Limit Device Sessions) system value, set to 1, limits users to one device session at a time. Setting the value to 0 allows an unlimited number of sessions.

System values also determine the action the system should take if a user forgets to sign off a workstation. The QINACTITV (Inactive Job Time-Out Interval) system value specifies how long an interactive job can be inactive before the system should intervene. The QINACTMSGQ (Inactive Job Message Queue) system value dictates the action the system should take when the QINACTITV parameter's value has been reached. If the QINACTMSGQ value is *ENDJOB, the job is terminated. If the QINACTMSGQ system value is *DSCJOB, the job is suspended and the workstation returns to the sign-on screen. The suspended job can be resumed if the same user signs on to the same workstation. The QDSCJOBITV (Disconnected Job Time-out Interval) system value determines how long a job can remain suspended before the system ends it.

System values also control how the system reacts during a power failure. The system value QUPSMSGQ (Uninterruptible Power Source Message Queue) determines the queue to which power-related messages should be sent. The system value QUPSDLYTIM (Uninterruptable Power Source Delay Time) specifies how long to wait on standby power before powering down the system. The system value QPWRRSTIPL (Power Restart Initial Program Load) determines whether the system should begin an automatic IPL when power returns.

Note	**To better understand the QUPSMSGQ and QUPSDLYTIM system values, you need to realize that the Uninterruptible Power Supply (UPS) referenced in each value is a battery pack. You can purchase a UPS with enough batteries to keep your system running for 30 minutes and longer. For example, a hospital or police dispatch that runs on an AS/400 may require a UPS with battery packs for 48 hours. Therefore, the UPS-related system values must be defined according to the UPS your company has purchased. Let's assume that your company's UPS has 12 hours' worth of power and that shutting down the machine takes 90 minutes. In this case, it might be wise to set the QUPSDLYTIM system value to begin the shut-down after 10 hours on the UPS battery packs.**

When you change a system value, certain changes are effective immediately; more frequently, however, the change becomes effective only after the next system IPL.

Security Levels

OS/400 supports five **security levels.** Each level has varying degrees of security support (see Table 2.1). Each increase in the security level increases the safety of objects, but it also makes sharing objects more difficult. The system value that activates the security level on the AS/400 is QSECURITY.

Table 2.1: Security Levels

Security Level	Security Activities

Table 2.1: Security Levels

Security Level	Security Activities
10	No pre-existing user profile or password is required to sign on, and there is no resource security. Anyone who signs on can use any file, library, or device if special authorities specified in the user profile use the default values. The system creates a user profile for anyone who signs on. Before OS/400 V3R7, the system shipped from IBM with a default setting of level 10.
20	A user profile and a password are required to sign on, but there is no resource security. When there is no resource security, any user who can sign on has authority to all objects on the system and can therefore modify or delete any object.
30	Password and resource security are enforced. When a user requests an object, multiple levels of object authority go into effect.
40	Additional security checking occurs during program execution. For example, users submitting jobs using a job description containing a user profile name must have *USE authority. Since OS/400 V3R7, all new AS/400 systems are shipped from IBM with a default QSECURITY value of 40.
50	Levels 40 and 50 are similar. Level 50 provides the additional function of the C2 federal government standard for audit trails.

You can find out the security level of the system you are working on by using the DSPSYSVAL (Display System Value) command. For example, to display the screen shown in Figure 2.1, perform the following steps:

1. Type **DSPSYSVAL** on the command line.

2. Press function key F4 to prompt. (The functions keys appear along the top of your keyboard.)

3. Type **QSECURITY**.

4. Press Enter.

```
                          Display System Value

System value . . . . . . . : QSECURITY

Description. . . . . . . . : System security level

System security level  . . :    30        10-Physical security only (no longer
                                              supported)
                                           20-Password security only
                                           30-Password and object security
                                           40-Password, object, and operating
                                              system integrity
                                           50-Password, object, and enhanced
                                              operating system integrity




Press Enter to continue.

F3-Exit    F12-Cancel
```

Figure 2.1: Display System Value Screen

As you can see, the system in Figure 2.1 is operating at security level 30, meaning passwords and object authority are verified for each request. Level 10 (physical security only) isn't supported for the version of OS400 (V4R1M0) running on this system.

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To exit the Display System Value screen, press function key F3.

Assistance Levels

You can minimize user mistakes by eliminating menu items and function key options that don't relate to the user's job. The system's **assistance levels** (specified in system value QASTLVL) customize the user's view of the displays with additional information or with information in less technical terms. Three assistance levels are supported on the AS/400:

- *BASIC - The basic assistance level provides an Operational Assistant interface for beginners; it uses friendly, nontechnical language.

- *INTERMED - The intermediate assistance level uses the system interface with more functions available; it's for users more accustomed to technical computer terms.

- *ADVANCED - The advanced assistance level uses the expert system interface. Frequently, it doesn't display the option numbers and the function keys. The advanced assistance level is for sophisticated users familiar with commands and function key activities.

You can change the assistance level on any display that allows the use of function key F21 or with the commands that have the assistance-level parameter. Not all displays have more than one assistance level. The Operational Assistant interface retains different assistance level values for the following groups of displays: Printer Output, Printers, Jobs, Handling Messages, Device Status, User Enrollment, and System Status. When a user signs off the system, the current assistance level for each display remains stored until the user signs on and changes it. If the assistance level's system value isn't suitable for a user's needs, you can modify the user profile to override the system value.

User Profiles and User-Specific Objects

The **user profile** is an object that defines system access for the user: the objects that the user can access, the libraries that the user can use, the assigned authorities, and the special groups to which the user belongs. A user profile must be generated for each user before a user can access the system.

On those systems that still support security level 10, a user profile is automatically generated before a new user finishes the sign-on process.

| **Caution** | **There is a problem with how security level 10 generates the user profile. The new user profile will be generated even if the user misspells his/her sign-on name.** |

On systems using security levels 20, 30, 40, and 50, the security officer or system administrator must create the user profile before the user's first sign-on. The user profile's **user ID** value can be up to 10 characters long, but it can't begin with a number. OS/400 isn't case sensitive, and it displays user profile listings in alphabetical order, whether the entries are uppercase or lowercase. Several IBM licensed programs, including Client Access for OS/400, suggest limiting the user ID to eight characters. This limitation is mandatory when you are linking to certain communications networks.

The user ID and **password** are combined to complete the sign-on process. User IDs and passwords should be kept private. The password length is determined by two system values, QPWDMAXLEN (Password Maximum Length) and QPWDMINLEN (Password Minimum Length). A value from 1 to 10 is allowed, but a minimum of five characters is recommended (the longer the password, the harder it is to guess). Like the user ID, the password may not begin with a number. A user's password can't be displayed on the AS/400. If a user forgets his/her password, the security officer or system administrator can modify the user ID, giving it a new password. For convenience, the password is generally changed to the same characters as the user ID value; users should then choose a new password when they next sign on. See the Appendix for more information about how to modify a user's password.

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You can display user profile information with the DSPUSRPRF (Display User Profile) command. For example, to display your system operator user profile information, perform the following steps:

1. Type **DSPUSRPRF** on a command line.

2. Press function key F4 to prompt.
3. Type *your user ID.*
4. Press Enter to display the user profile information, as shown in Figure 2.2.

```
                        Display User Profile - Basic

User profile . . . . . . . . . . . . . . . . . :     QSYSOPR

Previous sign-on . . . . . . . . . . . . . . :     03/09/99 17:59:07
Sign on attempts not valid . . . . . . . . . :     0
Status . . . . . . . . . . . . . . . . . . . :     *ENABLED
Date password last changed . . . . . . . . . :     06/21/92
Password expiration interval . . . . . . . . :     *SYSVAL
Set password to expired  . . . . . . . . . . :     *NO
User Class . . . . . . . . . . . . . . . . . :     *SYSOPR
Special authority  . . . . . . . . . . . . . :     *JOBCTL
                                                    *SAVSYS
Group profile  . . . . . . . . . . . . . . . :     *NONE
Owner  . . . . . . . . . . . . . . . . . . . :     *USRPRF
Group authority  . . . . . . . . . . . . . . :     *NONE
Group authority type . . . . . . . . . . . . :     *PRIVATE
Supplemental groups  . . . . . . . . . . . . :     *NONE
Assistance level  . . . . . . . . . . . . . . :     *SYSVAL
                                                                More..

Press Enter to continue.

F3=Exit    F12=Cancel
```

Figure 2.2: Display User Profile Screen at the Basic Assistance Level

Figure 2.2 is the first page of the Display User Profile screen generated by the DSPUSRPRF command. We discuss only the entries on this screen that are of concern to the system operator.

The DSPUSRPF command provides such information as the date and time of the previous sign-on, and sign-on attempts that weren't valid. This information could assist in verifying unauthorized access. For example, this latter field may show sign-on attempts during a time when a user was on vacation or otherwise not available to use the system.

The Status field determines whether the user profile is valid for sign-on. Possible parameter values are *ENABLED and *DISABLED. The profile must be enabled to allow the user to sign on. To enhance security, a user's profile may be disabled while (s)he is on vacation or for whatever reason isn't using the system for a period of time.

The Date password last changed field and the Password expiration interval field help determine whether users should change their passwords. If the password isn't modified before the preset interval, the operating system displays the Change Password screen. The Password expiration interval field can use *NOMAX if no change is required, *SYSVAL to use the predefined value from the QPWDEXPITV system value, or any number from 1 to 366 to denote the number of days a password remains valid.

The Set password to expired field can be defined as *YES to force users to change their passwords. You use this field with the Set password to expired parameter of the CRTUSRPRF (Create User Profile) command when you are creating a new user profile. When the Set password to expired system value is *NO, users aren't prompted to change their passwords and may continue to use their current passwords indefinitely.

User Profile Classes and Object Authorities
Assuming that the system security is at level 30 or higher, five **user profile classes** are available: security officer (*SECOFR), security administrator (*SECADM), programmers (*PGMR), system operator (*SYSOPR), and system users (*USER). Each user profile class has special default authorities based on the security level. Unless users specifically need to use other system

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functions, their user class should be set to *USER. The *USER class results in a modified view of the menu and limits the use of certain commands.

Note   **Reducing options and commands for most users shouldn't be considered detrimental or punitive; rather, such system management lets users focus on their actual job functions.**

Within the *SYSOPR user class, the system operator can perform tasks such as backing up libraries and objects, restoring objects from tape, or powering down the system. Usually, a system operator monitors a special message queue, QSYSOPR. The QSYSOPR message queue receives the system error messages and informational messages about the batch jobs that are running or about jobs that have special needs. For example, a job may request that invoice forms be loaded into the printer. This type of message is sent to the QSYSOPR message queue. Because batch jobs are disconnected from the interactive user who started the job, the system operator also handles batch jobs. If a batch job requires additional information or has special instructions, the request is sent to the QSYSOPR message queue.

Each object, whether it is a library, a menu, or a queue, has authorities attached to it. These authorities are the normal authorities and can be *ALL, *CHANGE, *USE, or *EXCLUDE. *ALL authority gives the user the ability to create, delete, or modify the object. *CHANGE authority lets the user modify the object but doesn't let the user delete the object. *USE authority gives the user the right to view the object, but nothing more. *EXCLUDE authority removes all rights to the object, including the authority to view the object.

The Special authority field in Figure 2.2 extends the actions a user can be authorized to perform on the system resources or on groups of objects. These authorities include saving the system, controlling other users' jobs, using the system service tools, controlling spooled output files, and creating user profiles.

It is possible to specify more than one value for the Special authority field. The system value *USRCLS (user class) can be used to grant a user the authorities that correspond to that individual's user profile class. The *SECADM special authority can also be used in this parameter. If the user needs no special authority, you can use the value of *NONE. (*NONE is normally used with a group profile to define the group's authorities.)

You can also assign specific authority values in the Special authority field. The various authorities and their associated actions are shown in Table 2.2. The User Class column lists the user classes that include a special authority by default (at security level 30).

Table 2.2: Special Authorities and Associated Actions

Authorities	Actions	User Class
*ALLOBJ	Lets a user access all system resources.	*SECOFR
*AUDIT	Lets the user change the auditing attributes with the commands CHGOBJAUD, CHGDLOAUD, and CHGUSRAUD. Use of the *AUDIT special authority can cause considerable risk to the system and should be allowed infrequently.	*SECOFR
*IOSYSCFG	Lets the user change the system's configuration. The *IOSYSCFG authority is required for setting up TCP/IP, OSI commands, and other communications requirements.	*SECOFR

Table 2.2: Special Authorities and Associated Actions

Authorities	Actions	User Class
*JOBCTL	Lets a user change, cancel, hold, and release all files on output queues; hold, release, and clear job queues; hold, release, change, and cancel other users' jobs; start print writers; change the attributes of a job, such as the printer forms; stop/start subsystems; and perform an IPL.	All except *USER
*NONE	Special authorities are not granted for this user.	As needed
*SAVSYS	Lets a user perform save and restore operations for all resources.	All except *USER
*SECADM	Lets a user add user IDs; change, delete, and display authority for OfficeVision for AS/400 users; add and remove access codes; give and remove a user's access code authority; change security items for a user; and modify certain system values.	*SECADMIN, *SECOFR
*SERVICE	Lets a user perform the display and alter service functions.	*SECOFR
*SPLCTL	Lets a user control spool functions, such as cancel, delete, display, and hold and release other users' spooled output files.	*SECOFR

As we discussed earlier in the chapter, the Assistance level field defines the assistance level for the user profile, and it can be *SYSVAL (as shown in Figure 2.2), basic, intermediate, or advanced. The ASTLVL parameter initiates control at sign-on and functions for all commands executed from the command line. The *SYSVAL entry refers the user profile back to the QASTLVL system value. If the QASTLVL value contains the basic assistance level, the user profile will be set at the basic assistance level. A menu may have a separate assistance level value. Operational Assistant has a predetermined value, but the user can override the initial value by requesting a different assistance level.

Group Profile Concerns
A **group profile** is similar to a user profile except that it gives the same set of authorities to multiple users. A user whose user profile is a member of a group profile generally has the same authorities as the group. In rare instances, a user profile may be defined to override the authority of the group profile. Group profiles are frequently created to provide every user in a department with the same authority to the same objects. When a group profile is connected to a user profile, the user is automatically granted object management - *OBJMGT and *CHANGE - authorities to the group profile's objects.

When an individual user creates an object, ownership of the object is clearly defined. However, when a member of a group creates an object, the ownership can be confusing. The Owner field in the user profile (see Figure 2.2) helps define ownership of any objects the user creates.

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Ownership values can be *USRPRF (when the individual user owns any newly created objects) or *GRPPRF (when the group profile is considered to be the owner of all newly created objects). The Group authority field in the user profile works with the Owner field in the group profile to further define ownership of newly created objects. See Table 2.3 for further explanation.

Table 2.3: Group Authority and Owner Consideration

User Profile's Group Authority Field	Group Profile's Owner Field	Results
*ALL, *USE, *CHANGE, or *EXCLUDE	*USRPRF	The user profile gains the authority over the new object. The authority may be one of these four choices: *ALL, *USE, *CHANGE, or *EXCLUDE.
*NONE	*GRPPRF	The group profile gains the authority over a newly created object. Because the group has all the authority, the user profile must be specified as *NONE.

As Table 2.3 suggests, using the group profile allows for more flexibility in the security scheme and is less complicated for the security officer or system administrator responsible for managing a large number of profiles.

To view the next page of the Display User Profile screen (Figure 2.3), press Page down.

```
                  Display User Profile - Basic

User profile . . . . . . . . . . . . . . . :    QSYSOPR

Current library  . . . . . . . . . . . . :    QSYSOPR
Initial program  . . . . . . . . . . . . :    *NONE
   Library  . . . . . . . . . . . . . . . :
Initial menu . . . . . . . . . . . . . . :    SYSTEM
   Library  . . . . . . . . . . . . . . . :      *LIBL
Limit capabilities . . . . . . . . . . . :    *NO
Text . . . . . . . . . . . . . . . . . . :    System Operator
Display sign on information  . . . . . . :    *SYSVAL
Limit device sessions. . . . . . . . . . :    *SYSVAL
Keyboard buffering . . . . . . . . . . . :    *SYSVAL
Maximum storage allowed  . . . . . . . . :    *NOMAX
   Storage used  . . . . . . . . . . . . :      0
Highest scheduling priority  . . . . . . :    0
                                                      More...

Press Enter to continue.

F3=Exit    F12=Cancel
```

Figure 2.3: Display User Profile Screen at the Basic Assistance Level

The Current library field specifies the name of the current library for the user. By default, any objects this user creates reside in the current library. The system searches the current library before it looks for information in any other user libraries. The *CURLIB value is used in many other commands. *CURLIB is accessed from the user profile's Current library value. The *CRTDFT (Create default) value specifies that the user has no current library. If the Current library value is *CRTDFT, library QGPL becomes the current library. As we discussed in Chapter 1, QGPL should be reserved for IBM needs. Therefore, you should avoid using *CRTDFT.

Specifying a library name for this parameter helps users save new objects in the proper library. Any library can be specified as the current library. You can use this field to enhance system organization; however, a user can place new objects into any library to which (s)he is authorized. Before you can specify a current library for a user, you must have already created the library.

Note   **In Figure 2.3, the current library is listed as QSYSOPR. This library is not shipped with the AS/400, but we've found that creating a common library for the operators on various shifts can be quite helpful. The**

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shared library also provides a single location for custom-built programs or menus that make the system operator's functions easier.

The Initial program field determines the program to be executed immediately after sign-on. Any valid program name can be used. The Library field is the library that contains the program. For example, consider the accounting staff at a hospital. The bookkeepers may prefer that when they complete sign-on, the billing program is displayed automatically.

The Initial menu field determines the menu displayed after sign-on. The available options include MAIN, the AS/400's main menu; SYSTEM, the menu for operational tasks; or any valid menu name. If the value of *SIGNOFF is entered, the user is automatically signed off the system after the initial program completes. *SIGNOFF can be used to lock a user into only one program, thus enhancing security. OfficeVision/400 users can use this field to go directly to OfficeVision/400 and bypass the initial menus.

As you can see in Figures 2.2 and 2.3, the Display User Profile screen includes many other fields; the few fields we've discussed here only introduce you to the power of the AS/400's security system and the user profile's place in that system.

To exit the Display User Profile screen, press function key F3.

Job Descriptions

A user's **job description** is another aspect of security. A job description can be attached to a single user, or it can be assigned to a group of users sharing the same authorities and job requirements. Job descriptions should be set up for batch jobs to control how those jobs enter the operating system.

A job description includes such attributes as where the job is executed, the priority of the job, the printer to be used (if printer output is part of the job), and how message logging is to be handled. Using job descriptions provides flexibility and control over the job's execution. IBM supplies some job descriptions, such as QBATCH and QPGMR; you can also create your own job descriptions.

> **Tip**   **A job description should be created for any user who can submit a batch job. The job description prevents future problems with batch jobs.**

Two CL commands relate to batch jobs: The BCHJOB (Batch Job) and SBMJOB (Submit Job) commands can override the values in the job description. A user profile name, usually that of an interactive user, is required to start a batch job. However, the user who schedules or starts a batch job is disconnected from the job once the job is submitted.

To display your job description information (Figure 2.4), perform the following steps:

1. Type **DSPJOBD** on any command line.

2. Press function key F4 to prompt.
3. Type *your user ID*.

4. Press Enter.

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```
                    Display Job Description
                                            System XXXXXXX
Job description:   QSYSOPR     Library:  QSYSOPR

User profile . . . . . . . . . . . . . . :    *RQD
CL syntax check. . . . . . . . . . . . . :    *NOCHK
Hold on job queue  . . . . . . . . . . . :    *NO
End severity . . . . . . . . . . . . . . :    30
Job date . . . . . . . . . . . . . . . . :    *SYSVAL
Job switches . . . . . . . . . . . . . . :    00000000
Inquiry message reply. . . . . . . . . . :    *RQD
Job priority (on job queue). . . . . . . :    5
Job queue. . . . . . . . . . . . . . . . :    QBATCH
  Library. . . . . . . . . . . . . . . . :    QGPL
Output priority (on output queue)  . . . :    5
Printer device . . . . . . . . . . . . . :    *USRPRF
Output queue . . . . . . . . . . . . . . :    *USRPRF
  Library. . . . . . . . . . . . . . . . :


                                            More...

Press Enter to continue

F3=Exit   F12=Cancel
```
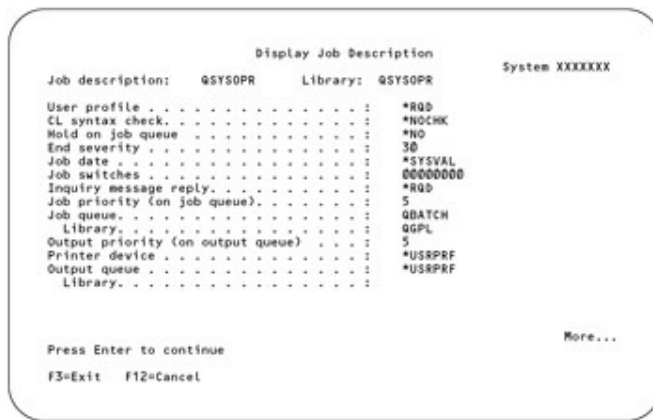
Figure 2.4: Display Job Description Screen

(If no job description is named after your user ID, you may use an IBM-supplied job description, such as QBATCH.)

As with the user profile discussion above, the following discussion covers only the entries on the Display Job Description screen that concern the system operator.

Notice that the name of the job description and its associated library are displayed. In this case, the User profile field has a value *RQD, indicating that a valid user ID must be associated with the job description.

The CL syntax check field lets you check the syntax of CL commands as you submit the job, rather than when the job actually runs. (In the job description in Figure 2.4, no checking occurs until the job runs because *NOCHK is specified.) By specifying syntax checking in this field, a job description can help users diagnose syntax errors earlier. The CL syntax check program assigns numeric values to an error based on the severity of the error. Values of 0 - 99 are possible, with 0 indicating the least serious error. By specifying a value in the End severity field, you can control how serious a syntax error must be before it ends the processing of the job. In most instances, an End severity value of 30 is appropriate.

A job is automatically held on the job queue if the value of the Hold on job queue field is *YES. If a job is held on the job queue, the job doesn't run until an authorized user or system operator who has *JOBCTL authority releases it. This option is valuable when you are submitting large batch jobs and holding them until a later (and probably less busy) time. The default for this value is *NO; the operating system processes the job when the job reaches the top of the job queue.

The Job date field is the date on which the job was started. If *SYSVAL is the value of this parameter, the date stored in the QDATE system value is used.

The Job switches field specifies the initial settings for a group of eight job switches. You can use these switches to control the flow of programs. The initial setting for the Job switches field is all zeros (or all off). Programmers can modify these switches to call CL or other high-level language (HLL) programs, depending on the circumstances.

Note   **Job switches are a remnant of the punch-card era of computing and are rarely used in today's processing.**

An inquiry message requires a response from the user or operator. The Inquiry message reply field determines how inquiry messages are answered. The options for this field are
- *RQD - require a reply. If *RQD is specified, the messages must be answered before the job continues running.

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- *DFT - reply with the message's predefined default reply.

- *SYSRPYL - reply with a message stored in the system reply list. The operating system checks the system reply list for an answer. If an answer is located, the system uses the reply just as if an operator had entered it.

Normally, *RQD is used so that the inquiry messages are displayed with the various answer choices. *SYSRPYL commonly is used when the system is retrying a failing device or restarting a communications line that has gone down. These conditions don't necessarily require an operator to input the answer.

When a job is submitted to batch, the Job priority (on job queue) field determines the scheduling priority for this job on the job queue (i.e., its relative position in the line of jobs waiting to execute). The highest job priority is 1, the lowest priority, 9. If two batch jobs are submitted to the job queue at the same time, the Job priority value determines which job is executed first. If the two batch jobs have the same job priority, the job received on the queue first is processed first, assuming that no higher priority job is in the queue.

The Output priority (on output queue) field determines the priority for spooled files to be printed. As with job priorities, the highest priority is 1, the lowest priority, 9. If a spooled output file with priority 3 is received at the same time as a spooled output file with priority 6, the spooled output file with priority 3 is sent to the printer first. If two job descriptions have the same priority specified, the first job on the queue is printed first.

Most computer centers use different printers for different reports so that no one needs to change forms between print jobs. The Printer device field in the job description specifies which printer receives the spooled output from the job. If the *USRPRF value is used, the printer specified in the user's user profile receives the output. This field lets a user change printers as needs and conditions vary.

The Output queue and its associated Library fields determine where the spooled output files are stored until the files are sent to a printer. Allowing multiple output queues to hold spooled files helps keep both the user and the system operator organized. If *USRPRF is specified for the value, the value specified in the user's user profile determines the output queue that receives the spooled files.

To exit the Display Job Description screen, press function key F3.

Library List

The **library list** helps programs locate objects on the system. If a program or a user doesn't specify an object by qualified name (i.e., *library/object*), the system searches the library list to locate the object. Standardized library lists can be specified by name, or the QUSRLIBL and QSYSLIBL system values can be used. The system searches only the libraries included in the library list on the Display Library List screen to locate objects the user has requested.

To display the Display Library List screen (Figure 2.5), perform the following steps:

1. Type **DSPLIBL** on the command line.

2. Press Enter.

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```
                    Display Library List
                                        System:  XXXXXXX
     Type options, press Enter.
       5=Display objects in library

     Opt    Library     Type      Text
       _    USRSYS      SYS       User changes to IBM supplied objects
       _    QSYS        SYS       System Library
       _    QSYS2       SYS       System Library for CPI's
       _    QUSRSYS     SYS       SYSTEM LIBRARY FOR USERS
       _    QHLDSYS     SYS
       _    QSYSOPR     CUR       QSYSOPR production library
       _    QTEMP       USR
       _    QGPL        USR       General Purpose Library




                                                          Bottom
     F3=Exit    F12=Cancel    F17=Top    F18=Bottom
```

Figure 2.5: Display Library List Screen

The Display Library List screen lists the library search path. The library name, type, and text description are displayed. The operating system uses standard abbreviations for library types. A system library is identified by SYS. A production library is identified by PRD. A user's current library is identified by CUR, and other user libraries are identified by USR.

Note	**The libraries are searched in the sequence in which they are listed. If two objects have the same name but are located in different libraries (and both libraries are included in the library list), the search ends when the first object with the specified name is located in the library placed highest in the library list.**

Option 5 offers an easy way to determine whether an object is located in a library. When you specify this option for a particular library, a list of all the objects in the library and the library name are displayed. This display is functionally similar to the DOS directory list.

Using the library list doesn't prevent users from accessing objects in libraries not included in their library lists. If a user has authorization and specifies the correct name of any library, the operating system searches the library for the listed object. To prevent unauthorized use of a library or other objects, object authority must be limited for each object that requires protection.

To exit the Display Library List screen, press function key F3.

Authorization Lists

OS/400 offers great flexibility in creating an environment where users can access the same library but have individual limitations to the objects within that library. For example, the payroll administrator should have access to all payroll information, yet another user with the same group profile as the payroll administrator might need access to only monthly totals for reports. The payroll administrator should have all rights to the objects within the payroll library. On the other hand, the other user should have read-only authority to payroll objects and perhaps no authority to salary items. **Authorization lists** make it possible to establish different levels of access for multiple users to the same object. Authorization list authority can be granted to the public, to a group of users, or to an individual user. An authorization list must exist in QSYS and can be attached to any number of objects.

For example, consider a group of users - in this case, all members of the same department. The security administrator can create an authorization list so that the members of the department have access to their department's data. By generating one authorization list, the security administrator can more easily add and delete authorized employees to and from this list.

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Authorization lists also are helpful when objects need to be set at different levels of authority for a specific group of users. Consider the following situation: The company president has approved a new procedure for the accounts receivable department. This object needs to have *PUBLIC access, but other departments shouldn't be bothered with the new procedure. In this case, the authorization list can provide the *PUBLIC authority to the group profile of the users in the accounts receivable department. The authorization list provides access to the accounts receivable department - but only this department, thus solving many issues with one authorization list.

To access the Display Authorization List screen (Figure 2.6), perform the following steps:

1. Type **DSPAUTL** on any command line.

2. Press function key F4 to prompt.
3. Type *the name of a valid authorization list.* (Ask your instructor to provide the name of a valid authorization list.)

4. Press Enter.

```
                    Display Authorization List

Object . . . . . :    CL            Owner . . . . . . . . :   QSECOFR
  Library. . . . :  QSYS            Primary group . . . . :   *NONE

              Object         List
User          Authority      Mgt
QSECOFR       *ALL            X
*PUBLIC       *USE

                                                          Bottom

F3=Exit   F11=Display detail object authorities      F12=Cancel
F15=Display authorization list objects    F17=Top    F18=Bottom
```
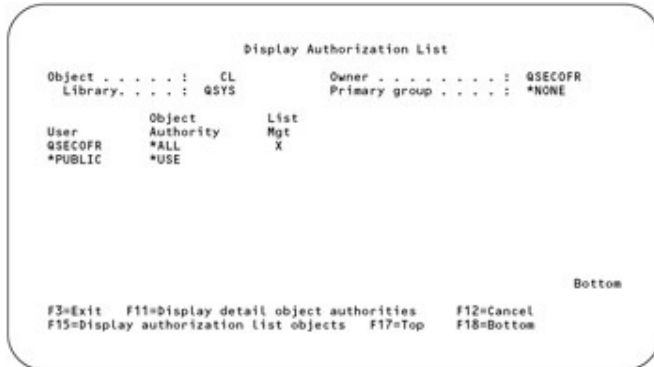
Figure 2.6: Display Authorization List Screen

The authority listed for a user in the Object Authority column indicates a user's authority to an object secured by this authorization list. An X in the List Mgt column denotes that the user has been granted authority to manage the authorization list. Management includes adding and deleting users authorized to the list.

To see more details from this screen, press function key F11 (Display detail object authorities) to bring up a screen similar to the one in Figure 2.7.

```
                    Display Authorization List

Object . . . . . . . :  QOPTSEC          Owner . . . . . . . :   QSYS
  Library  . . . . . :    QSYS           Primary group . . . :   *NONE
              Object       List ----------- Object-----------
User          Authority    Mgt  Opr  Mgt  Exist  Alter  Ref
QSYS          *ALL          X    X    X     X      X      X
*PUBLIC       *CHANGE            X

                                                          Bottom

Press Enter to continue.

F3-Exit    F11-Display data authorities   F12-Cancel
F15-Display authorization list objects  F17-Top  F18-Bottom
```

Figure 2.7: Display Authorization List Screen, Detailed

In Figure 2.7, the right side of the screen relates specifically to the objects controlled by the authorization list. There are five types of authorities:

▪ Opr - Object operational authority lets users access the object as specified by the object's data authorities; we discuss these authorities below.

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- Mgt - Object management authority lets the object be moved and renamed, and it lets members be added to the object.

- Exist - Object existence authority lets the object be deleted.

- Alter - Alter authority allows changes to the attributes of an object, such as adding or removing triggers for a database file.

- Ref - Object reference authority allows for modification of how the object is related to other objects.

OS/400 supplies predefined object authority values to use for individuals or for groups. *ALL authority allows users full authority to operations on an object. *CHANGE authority lets the user change, modify, or view an object. *USE authority lets the user only view information in the object or execute a program object. The *EXCLUDE value grants no authority to or use of the object. Authority to an object is divided into two categories: **object authority** and **data authority**. Object authority determines the specific functions that can be applied to the *object*. Data authority usually applies to the operations allowed on the *contents* of an object that contains data. Table 2.4 lists the five data authority classifications.

Table 2.4: Data Authority Classifications

Data Authorities	Description
*READ	Lets the user view the contents of an object.
*ADD	Lets the user add entries to an object. A user must have *ADD authority to add records to a file or jobs to a queue.
*UPD	Lets the user change the items in an object.
*DLT	Lets the user delete items contained in an object.
*EXECUTE	Lets the user run a program or locate an object in a library.

A user's authority can be custom defined with object and data authority classifications.

To exit the Display Authorization List screen, press function key F3.

Display Object Authority Command

The DSPOBJAUT (Display Object Authority) command lets the operator view the authorized users for an object. This approach is the reverse of that for viewing the user profile, group profile, or authorization list. In the previous material, the operator always viewed access from the user at the top to the data object at the bottom. With the DSPOBJAUT command, the operator is looking from the bottom upward. Assume that a user receives an error message saying that the user doesn't have access to or is unauthorized to use an object. As system operator, you would likely find it helpful to review the object's authorities. To do so, you must have authority to use the DSPOBJAUT command.

To view the Display Object Authority screen for a library (Figure 2.8), perform the following steps:

1. Type **DSPOBJAUT** on the command line.

2. Press function key F4 to prompt.
3. Type *the name of a valid library* for name of the object. (Ask your instructor for the name of a valid library, or you may use QGPL.)
4. Type *LIBL for the name of library.
5. Type *LIB for the type of object.
6. Press Enter.

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```
                    Display Object Authority

Object . . . . . . . :   QGPL        Owner . . . . . . . . :   QSYS
   Library . . . . . :    QSYS       Primary group . . . :  *NONE
Object type . . . . :   *LIB

Object secured by authorization list . . . . . . . . . . :  *NONE
                          Object ------------ Object -----------
User          Group       Authority  Opr  Mgt  Exist  Alter  Ref
QSYS                      *ALL        x    x    x      x      x
QSYSOPR                   USER DEF    x    x
QPGMR                     USER DEF    x    x
QSECOFR                   *ALL        x    x    x      x      x
QSRV                      USER DEF    x    x
*PUBLIC                   *CHANGE     x

                                                            Bottom
Press Enter to continue.

F3=Exit   F11=Display data authorities   F12=Cancel   F17=Top   F18=Bottom
```

Figure 2.8: Display Object Authority Screen, Detailed

Tip   **Position the cursor on a field you may have questions about, then press function key F4 to display a list of the available options.**

As you can see in Figure 2.8, the Display Object Authority screen displays the authorities allowed for the users. If a user owns an object, the user should have all authorities to that object. As system operator, if you want to see all users and their authorities to an object, you must have object management authority. The security administrator can use the DSPOBJAUT command to list all users and their authorities to an existing object.

Tip   **Press function key F11 to view details of the screen (similar to the detail shown in Figure 2.7).**

Authority Search Path

Any time access to an object is requested, the operating system examines authorities in a specific sequence. It's important to understand this sequence because the system will discontinue the search if sufficient authority is given at any level of examination. The **authority search path** is as follows:

1. Ownership of the object
   A. The owner's special authority, specified in the owner's user profile
   B. The owner's specific authority attached to the object
   C. Authorization lists attached to the object

2. User profile
   A. The user's special authority, specified in the user profile
   B. The user's specific authority attached to the object
   C. Authorization lists attached to the object

3. Group profile
   A. The group's special authority, specified in the group profile
   B. The group's specific authority attached to the object
   C. Authorization lists attached to the object

4. Public authority to the object

Your AS/400's security should be configured according to the search path, or a security risk may be involved. For example, if a user's special authority (item 2A) to an object is *EXCLUDE, but the user is also included in an authorization list (item 1C) with authority of *CHANGE, the user will have change authority.

To exit the Display Object Authority screen, press function key F3.

Chapter Summary

Security on the AS/400 supports many different needs for diverse organizations. The AS/400 operating system provides the tools to administer AS/400 security through CL commands and a menu-driven system user interface. Because of the AS/400's provisions for assistance levels, library lists, and the user profile's first menu option, unauthorized users can be limited to a narrow view of the system, should they gain access. Using group profiles and authorization lists makes security easier to maintain. The user profile and job description combine to control both interactive and batch jobs by enforcing the security of the object authorities. A major advantage of the AS/400 is its ability to let you combine various objects to create customized security configurations to meet the differing needs of users.

AS/400 security is an immense topic. In this chapter, we've merely touched on some security issues to introduce some very important system concepts. When you have completed this course, you may want to return to this chapter to review the security issues. For an in-depth discussion of AS/400 security, see Wayne Madden and Carol Woodbury's book *Implementing AS/400 Security, Third Edition* (29th Street Press).

Key Terms

assistance level

authority search path

authorization list

data authority

group profile

job description

library list

object authority

password

security level

system value

user ID

user profile

user profile class

Review Questions

1. Which system value determines the default public authority of a new object?
2. A user profile must exist and a password is required at what security level(s)?
3. Which parameter in the user profile works with the user class to limit users' access?
4. Explain the difference between a group profile and an authorization list.
5. How does a job description affect security?
6. If a program or a user doesn't specify an object by qualified name, how does the system find the object?
7. What is the difference between object authority and data authority?

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8. When the system checks for sufficient authority to an object, where does it check first? Where does it check last?

Exercises

1. Display the system values that determine how the system reacts during a power failure.
2. Display your user profile and determine whether you are attached to a group profile.
3. Display object authority for your library and determine the public's authority for it.

Chapter 3: The User Interface

Chapter Overview

The AS/400 user interface presents all levels of users with multiple ways to accomplish their tasks. This chapter provides an introduction to the interface methods, including

- menus, entry screens, and function keys

- the command line

- the AS/400 General System Tasks menu

- Operational Assistant

- the purpose and use of Control Language (CL)

- AS/400 help and extended help

- AS/400 InfoSeeker

Menus, Entry Screens, and Function Keys

The AS/400 operating system, OS/400, provides the user access to the system through easy-to-use menus, entry screens, and function keys. (For the more advanced user, a command line supports typed commands to accomplish the same tasks.)

OS/400 **menus** display a list of options for the user to choose from, each preceded by a number. The user makes a choice by typing the associated number on the selection or command line. AS/400 menus are labeled in the upper left corner of the display. Users can go directly to a menu by typing on the command line the CL command GO and the menu label (e.g., GO SYSTEM to access the General System Tasks menu). Menus are linked or chained to other menus or entry screens.

Entry screens prompt the user for additional information to accomplish a task, such as entering a user ID and password on the AS/400 Sign-on screen. Entry screens aren't labeled in the upper left corner, and they can't be accessed with the GO command. In addition, a selection or command line isn't normally displayed on a entry screen.

A list of **function keys** is displayed at the bottom of menus and entry screens. On a workstation keyboard, all the function keys are in two rows on the top of the keyboard.

Note   **A PC keyboard provides only twelve function keys. To use functions associated with function keys F13-F24 on a PC keyboard, hold down the Shift key and press one of the existing function keys. The Shift key adds 12 to the function key pressed. Thus, F13 is Shift + the F1 key, F14 is Shift + the F2 key, F15 is Shift + the F3 key, and so on from left to right.**

Function keys provide a "shortcut" to frequently used functions. Recall that in earlier chapters, you've used function key F4 to prompt and function key F3 to exit various screens. The purpose of a function key, which can vary from one menu or entry screen to another, is listed on each

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menu or screen next to the function key number. In Figure 3.1, for example, function key F3 exits the menu, and function key F16 brings up the AS/400 Main menu.

```
SYSTEM                          General System Tasks
                                             System:   xxxxxxx

Select one of the following:

        1. Jobs
        2. Status
        3. Display system operator messages
        4. Messages
        5. Files, libraries, and folders
        6. Save
        7. Restore
        8. Device operations
        9. Communications

       60. More system task options




Selection or command
===>_____
F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel   F13=Information Assistant
F16=AS/400 Main menu
```

Figure 3.1: General System Tasks Menu

General System Tasks
The AS/400's General System Tasks menu (Figure 3.1) doesn't apply to most users; however, it's commonly displayed as the first screen to those with a user class of SYSOPR. It usually appears as soon as a system operator signs on.

Note   **Other users on the system are generally shown the AS/400 Main menu (Figure 3.2). To access the AS/400 Main menu from the General System Tasks menu, press F16.**

Because you, as system operator, frequently are the initial contact point for resolving user problems, you also need to be familiar with the AS/400 Main menu. After a careful review of the various menu options, however, you might be concerned that the average user may have access to areas that don't seem appropriate. If user profiles and object authorities are set up correctly on your system, any option the user selects activates the security system, and unauthorized users are denied further access. To return to the General System Tasks menu, press F3.

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```
Main                    AS/400 Main Menu
                                              System:    XXXXXXXX
Select one of the following:

     1.  User tasks
     2.  Office tasks
     3.  General system tasks
     4.  Files, libraries, and folders

     6.  Communications
     7.  Define or change the system
     8.  Problem handling
     9.  Display a menu
    10.  Information Assistant options
    11.  Client Access tasks

    90.  Sign off




Selection or command
===>
F3=Exit   F4= Prompt  F9=Retrieve   F12=Cancel   F13=Information Assistant
F23=Set Initial menu
```

Figure 3.2: AS/400 Main Menu

As you can see in Figure 3.1, the General System Tasks menu lets you perform system tasks relating to jobs; system operator messages and other messages; files, libraries, and folders; save and restore operations; device operations; and communications. Because many of these tasks are also available through the Operational Assistant menu, we concentrate on the more "friendly" Operational Assistant.

Operational Assistant

Operational Assistant consists of a series of user-friendly menus that help the system operator perform routine tasks: controlling jobs and printer output, message handling, power on/off tasks, and system backups. You can access the **Operational Assistant** menu (Figure 3.3) by pressing the Attention key (if the system value QATNPGM is set to ˚ASSIST), or by performing the following steps:

1. Type **GO ASSIST** on the command line.

2. Press Enter.

```
ASSIST              AS/400 Operational Assistant(TM) Menu
                                              System:    XXXXXXXX
To select one of the following, type its number below and press Enter:

     1. Work with printer output
     2. Work with jobs
     3. Work with messages
     4. Send messages
     5. Change your password

    10. Manage your system, users, and devices
    11. Customize your system, users, and devices

    75. Information and problem handling

    80. Temporary sign-off




  Type a menu option below
        __
F1=Help    F3=Exit    F9=Command line    F12=Cancel
```

Figure 3.3: AS/400 Operational Assistant Menu

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Option 1 gives you access to the Work with Printer Output screen where you can view and control all the printer files spooled for output (i.e., those that haven't been printed). The printing options are covered in greater detail in Chapter 5.

Option 2 lets you hold, delete, release, and display messages, or work with printer output from the jobs that are running within the system. Chapter 4 covers these topics in greater detail.

Option 3 displays all the messages in the system operator message queue (if your user profile has been assigned the QSYSOPR message queue). As the system operator, you receive all messages concerning batch jobs and jobs requiring special attention. Chapter 4 also covers these topics in greater detail.

Option 4 lets you send a message to any single user or group of users, even if they are not currently signed on to the system.

Option 5 lets you change your password. This option is limited to changing the password for the user ID that is currently signed on.

Option 10 lets you manage your system, users, and devices. You can display the system status; run a backup; work with system operator messages, printer output, jobs, signed-on users, and device status tasks; and customize the system, users, and devices. Chapter 6 covers this topic in more detail.

Option 11 lets you customize the AS/400 configuration. The security officer can create new user IDs or edit existing functions. From this option, you can also access menus to create new devices or to change configurations for existing devices.

Option 75 provides tools for accessing valuable information about procedures to assist in problem resolution.

Option 80 provides a temporary sign-off. This option is valuable when a user must leave his/her workstation unattended for a period of time when (s)he is in the middle of an activity or program. A temporary sign-off lets the user suspend the application, thus saving the user's time because (s)he doesn't have to pass through all the menus to return to his/her activity, and maintains system security. When the user returns to the system, the AS/400 automatically returns to the application screen that was displayed at the time of temporary sign-off.

If you are in the middle of an application and want to temporarily sign off the system, you must access the AS/400 Operational Assistant menu. From this menu, type **80**, then press Enter. The sign-on screen in Figure 3.4 is displayed.
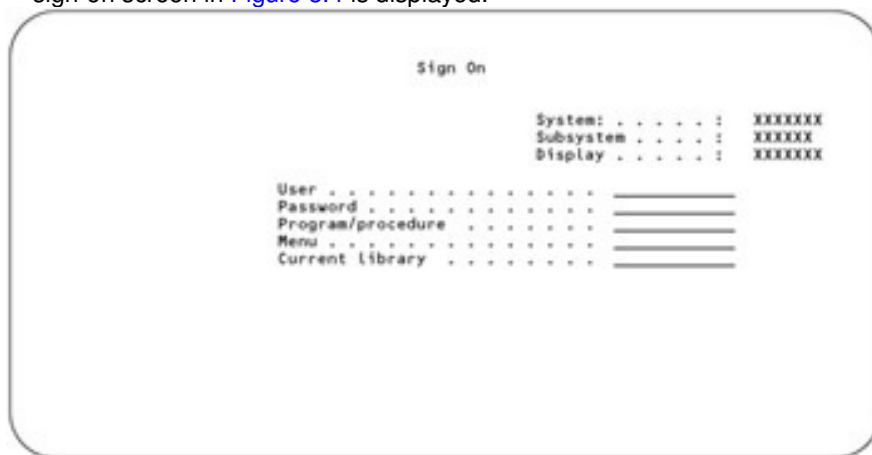
Figure 3.4: Sign-On Screen

To sign back on to the system, perform the following steps:

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1. Type *your user ID*.
2. Type *your password*.
3. Press Enter.

To return to the application that was in use before you accessed the AS/400 Operational Assistant menu, press F3.

CL Commands

The first five Operational Assistant menu options have corresponding AS/400 **CL commands** that execute the same programs. Table 3.1 lists the commands that correspond to the menu items.

Table 3.1: Operational Assistant Menu Options and Associated CL Commands

Menu Option	CL Command
Work with printer output	WRKSPLF
Work with jobs	WRKUSRJOB
Work with messages	WRKMSG
Send messages	SNDMSG - The Operational Assistant menu doesn't actually use a CL command to perform this task, but the SNDMSG command performs a similar function.
Change your password	CHGPWD

CL consists of more than 1,000 commands that execute OS/400 functions. The naming structure IBM uses to create CL commands is English-like in nature, which makes the commands easy to comprehend. CL commands can consist of a verb and a noun, or a verb, an adjective, and a noun. Table 3.2 shows an example of the CL command WRKSPLF (Work with Spooled File), which consists of a verb, an adjective, and a noun.

Table 3.2: Sample CL Command Structure

CL Abbreviation	English Word
WRK	work
SPL	spooled
F	file

As you can see, abbreviations are used to construct CL commands. Vowels are rarely used in a CL command. Table 3.3 lists the most frequently used command abbreviations.

Table 3.3: Most Frequently Used CL Command Abbreviations

CL Abbreviation	English Word
CHG	change
CPY	copy
CRT	create
DLT	delete
DSP	display

Table 3.3: Most Frequently Used CL Command Abbreviations

CL Abbreviation	English Word
STR	start
WRK	work
OBJ	object
STS	status
SYS	system
PRT	printer
WTR	writer

Many experienced AS/400 users prefer to use commands rather than menus because commands let them access the tasks directly without moving through the menu layers. In this book we attempt to provide both the menu options and the CL commands as appropriate. You enter CL commands at a **command line**. If a command line isn't visible when you are displaying the Operational Assistant menu, press F9 to get a command line.

When you enter a CL command, at least three function keys are available to you: F4=Prompt, F9=Retrieve, and F12=Cancel. F4 provides prompting help to view the CL command groups. To access the Major Command Groups menu (Figure 3.5), press F4.


```
MAJOR                Major Command Groups
                                              System: xxxxxxx
Select one of the following:

        1.  Select Command by Name        SLTCMD
        2.  Verb Commands                 VERB
        3.  Subject Commands              SUBJECT
        4.  Object Management Commands     CMDOBJMGT
        5.  File Commands                 CMDFILE
        6.  Save and Restore Commands     CMDSAVRST
        7.  Work Management Commands       CMDWRKMGT
        8.  Data Management Commands       CMDDTAMGT
        9.  Security Commands             CMDSEC
       10.  Print Commands                CMDPRT
       11.  Spooling Commands             CMDSPL
       12.  System Control Commands        CMDSYSCTL
       13.  Program Commands              CMDPGM

                                              More...
Selection or command
===>
F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel   F13=Informational Assistant
F16=AS/400 Main Menu
```

Figure 3.5: Major CL Command Groups

By choosing a certain command group, you can narrow the search for a specific command. For example, operators are frequently interested in verb commands because of all the actions they need to perform on the system. To access the first screen of a list of verb commands from the Major Command Groups menu, type **2** for Verb Commands, then press Enter to display the Verb Commands menu (Figure 3.6).

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```
VERB                    Verb Commands

Select one of the following:

    1. Add Commands                         CMDADD
    2. Allocate Commands                    CMDALC
    3. Answer Commands                      CMDANS
    4. Analyze Commands                     CMDANZ
    5. Apply Commands                       CMDAPY
    6. Ask Commands                         CMDASK
    7. Auditing Commands                    CMDAUD
    8. Call Commands                        CMDCALL
    9. Configuration Commands               CMDCFG
   10. Change Commands                      CMDCHG
   11. Chain Commands                       CMDCHK
   12. Close Commands                       CMDCLO
   13. Clear Commands                       CMDCLR
   14. Compare Commands                     CMDCMP
                                            More . . .

Selection or command
==>
```

Figure 3.6: Verb Command Menu

This menu displays all possible subcategories for verb commands and requires you to further narrow the search for the appropriate command. Notice that "More . . ." is displayed after option 14. You can view more verb commands by pressing Page down. When you reach the end of the list, "Bottom" will be displayed instead of "More . . .".

> **Note**   On a workstation (dumb terminal) keyboard, Page down is the Shift key plus the Roll up key. Page up is the Shift key plus the Roll down key.

To get a feel for this function, let's work through an example using the display commands that operators use quite frequently. To do so, perform the following steps:
1. Press Page down twice or until option 30, Display Commands, appears.
2. Type **30** to select Display Commands.
3. Press Enter to display the Display Commands menu (Figure 3.7).

```
CMDDSP                  Display Commands

Select one of the following:

Commands
    1. Change Device Desc  (Display)        CHGDEVDSP
    2. Create Device Desc  (Display)        CRTDEVDSP
    3. Display Access Code                  DSPACC
    4. Display Access Code Authority        DSPACCAUT

    6. Display Active Prestart Jobs         DSPACTPJ
    7. Display Active Profile List          DSPACTPRFL
    8. Display Activation Schedule          DSPACTSCD
    9. Display APPN Information             DSPAPPNINF
   10. Display Audit Journal Entries        DSPAUDJRNE
   11. Display Authority                    DSPAUT
   12. Display Authority Holder             DSPAUTHLR
   13. Display Authorization List           DSPAUTL
                                            More . . .

Selection or command
==>

F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel   F16=Major menu
```

Figure 3.7: Display Commands Menu

You can choose a particular display command by selecting the corresponding number from this menu.

When you are ready to exit the command-prompting menus, press F3 to cancel the display.

> **Tip**   CL commands can be incorporated into a CL program, and programmers can actually create new CL commands. CL programs are similar to batch files on a PC, but CL programs are much more flexible and sophisticated. For a detailed look at creating your own CL commands, see *Creating CL Commands by Example* **(29th Street Press, 1999).**

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Most CL commands have additional parameters that can be specified if the default values aren't applicable to the job at hand. In fact, some CL commands require that additional parameters be specified. The Display Command screen (Figure 3.8) lets you view optional and required parameters for any CL command. To access this screen and see these additional parameters, type **DSPCMD** on the command line, then press Enter.

```
                          Display Command  (DSPCMD)

  Type choices, press Enter.

  Command . . . . . . . . . . . . :                        Name
    Library . . . . . . . . . . . :        *LIBL           Name, *LIBL, *CURLIB
  Output . . . . . . . . . . . . .:        *               *, *PRINT




                                                                        Bottom
  F3=Exit    F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
  F24=More keys
  Parameter CMD required.
```
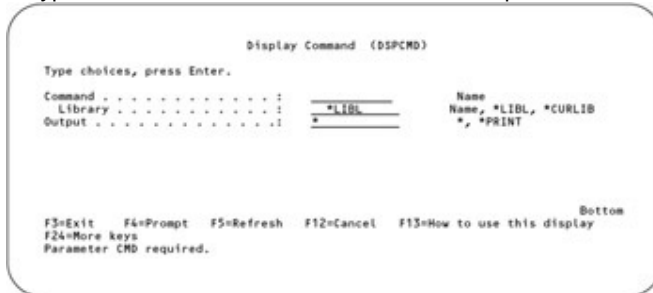
Figure 3.8: Display Command (DSPCMD) Screen

The Display Command screen requires that you enter the name of the command you want to view. Optional parameters are the library name and the output device. The library name is required if the library isn't contained in the library list. The default output device option (*) lets you view the information on your workstation screen. If you want a printed copy, you can change the output option to *PRINT.

Prompted CL Commands

The parameter values listed on the Display Command Information screen are defaults or assigned values. When you type a command on the command line and press Enter, the command is executed according to the command parameter default values, assuming the command has required parameters associated with it.

Many times, however, the defaults aren't suitable for the task at hand. Pressing F4 when the cursor is located on a parameter provides more parameter options. The parameters listed depend on which CL command is displayed. Some CL commands have pages of required parameters, and others have none (e.g., the SIGNOFF command needs no parameters).

To exit the Display Command Information screen, press F3.
Now let's use a value other than the default message queue value on the Work with Messages (WRKMSG) screen (Figure 3.9). To access this screen, type **WRKMSG** on the command line, then press F4 to prompt the command.

```
                         Work with Messages (WRKMSG)

  Type choices, press Enter.

  Message queue  . . . . . . . . .      *WRKUSR        Name, *WRKUSR, *SYSOPR...
    Library  . . . . . . . . . . .                     Name, *LIBL, *CURLIB
  Output . . . . . . . . . . . . .      *              *, *PRINT




  F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters  F12=Cancel
  F13=How to use this display       F24=More keys
```
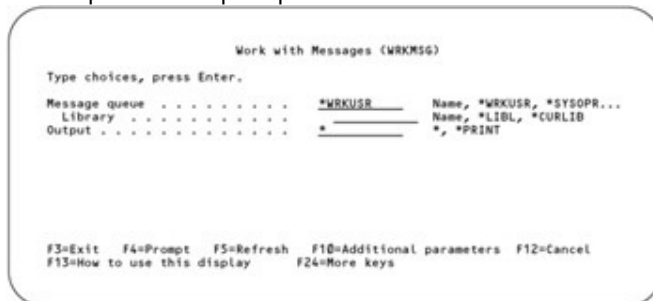
Figure 3.9: Work with Messages (WRKMSG) Screen

Tip   **Typing a question mark before the command name on the command line has the same effect as pressing F4 after the command is entered. This alternative is helpful when you are accessing a system with a modified keyboard mapping program and function key F4 has another**

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purpose.

In place of the *WRKUSR default for the Message queue parameter,
1. Type *your user ID* for the Message queue parameter.
2. Type *your library name* for the associated Library parameter.
3. Type an asterisk (*) for the output parameter. (Although the default is to view the output on screen, you can still specify a value of * for the OUTPUT parameter.)

Press F3 to return to the Operational Assistant menu.

CL Keyword Notation

A CL command can be broken down into parts (Figure 3.10). In simplified form, the command name is followed by the parameters. Each parameter has two parts: the keyword and the value.
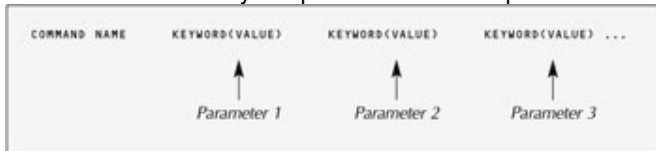
Figure 3.10: General Structure of a CL Command

Any CL command that has parameters is structured this way. For example, each parameter shown on the Work with Messages screen in Figure 3.9 has a keyword associated with it. To see the associated keywords, from the Work with Messages screen in Figure 3.9, press F24 for more function keys, then press F11 for keywords.

> **Tip** **You can press the F11 key even when it isn't one of the keys shown at the bottom of the screen. You may press any valid key, even if it is not shown. As you become more familiar with the keys, you can skip pressing F24.**

In Figure 3.11, the corresponding keyword for each parameter of the WRKMSG command is listed in the center column, with the default value in the right column.
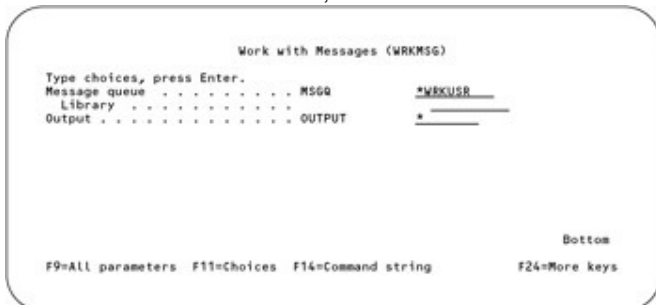
Figure 3.11: Work with Messages (WRKMSG) Screen with Keywords Displayed

In this example, the message queue keyword is MSGQ. The library doesn't show an associated keyword and is indented two spaces under the message queue name because it is part of the MSGQ keyword (i.e., the message queue is a qualified name).

Advanced users frequently want to type commands on the command line and specify the values for the parameters, rather than prompting the command. One method of doing this is to use **keyword notation**. To get a taste of entering a CL command using keyword notation, type the previous CL command on the command line:
1. Press F9 from the Operational Assistant menu to get a command line if one isn't displayed.
2. Type **WRKMSG MSGQ** (*userlib/userid*) **OUTPUT(*)**.
3. Press Enter.

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Note	The value for the MSGQ parameter is listed as the library name, then the message queue name. When you type rather than prompt a command, for technical reasons the order of the values within a qualified name is the reverse of the order for the same qualified name on the command prompting screen.

When you use keyword notation as we did above, the parameters can actually be in any order. Therefore, you could type the WRKMSG command above as
WRKMSG OUTPUT([*]) MSGQ (*userlib/userid*)

To cancel the command line, press F12.

CL Positional Notation
We've covered two methods of executing CL commands. The easiest approach is to use the command line and the F4 prompt function. A second method is to type the commands on the command line using keyword notation. However, as you become more familiar with the CL command parameters, you might want to type the commands on the command line using **positional notation**. When parameter values are entered by position, they must be entered in the order in which they are specified within the command syntax. (The F4 prompt function lists the parameters in sequence.)

Note	Positional notation saves typing, but entries must be accurate. Also, most commands limit the number of parameters that you can enter using positional notation. You should reserve this method for commands with brief parameter lists until you have more experience using CL commands.

To enter the WRKMSG command using positional notation, you simply type
WRKMSG *userlib/userid* [*]

You can also use a combination of keyword notation and positional notation. However, when you use a combination of keyword and positional notation, the positional parameters must occur first; once keyword notation is used, positional notation is no longer valid, and any additional parameters must be specified in keyword notation. Using a combination of keyword and positional notation, you can type the WRKMSG command as
WRKMSG *userlib/userid* **OUTPUT([*])**

To cancel the command line in the above examples, press F12.

The F9 Retrieval Function

As we've worked through this chapter, you've seen how CL commands insert keywords and the appropriate values to complete a CL command. You've probably also noted that when you are viewing a command that has been prompted, the keyword and the values are shown on the prompt screen in an English-like format. However, when the command is sent to the operating system for execution, it is restructured into CL syntax.

If you must perform the same task more than once, you can redisplay the CL command syntax by pressing function key F9 to retrieve the previous CL command, along with the related keywords. Using F9 minimizes the typing that would otherwise be required. Because previous commands are saved in a buffer for the user's current session, each time you press F9, the system backs up an additional command, so you can browse through previous commands until you find the one you want to repeat. During sign-off, the buffer is cleared.

Let's say the keyword notation version of the WRKMSG command is the last CL command we've used. In this case, pressing F9 should return

WRKMSG MSGQ(your library/your message queue) OUTPUT(*)

AS/400 Help

AS/400 Help provides users with several levels of Help functions. The AS/400 supports **online help** for menus, entry screens, and prompt functions. For example, if you press the Help key while the cursor is located on a menu (or a menu option), the system retrieves a description and instructions about how to use the menu (or option). Users also can search the Help database for information while they are using an index.

       Tip   **If the cursor is still located on the command line when you press the Help key, you receive help information for the command line instead of the Help menu.**

To display the Operational Assistant help, you may have to first type **GO ASSIST** on any command line and press Enter. Then

1. Move the cursor to the title line.

2. Press Help to display the Operational Assistant's help information.

The Help screen (Figure 3.12) overlays the Operational Assistant menu with information about the Operational Assistant. This is general information relating to the menu. The information included in the Help function varies depending upon the current AS/400 display and the position of the cursor on that display. The online help lets you and other users successfully use the appropriate parameters to accomplish your tasks without having to refer to a manual printed on paper.
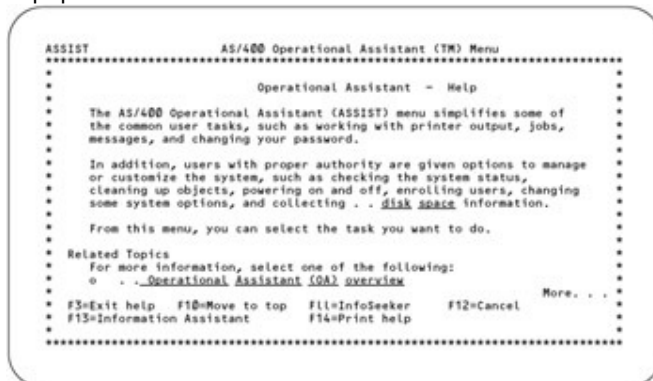
Figure 3.12: AS/400 Operational Assistant Menu with Help Screen Overlay

To further explore the online help capabilities, let's experiment with the help information covering the GO command. First, cancel the information on the Operational Assistant help screen. Then we can start the online help functions.

1. Press F12 to cancel the Help screen overlay.

2. Press F9 to access a command line.
3. Type **GO** on the command line.
4. Press F4 to prompt to bring up the Go to Menu (GO) screen (Figure 3.13).

```
                         Go to Menu (GO)

  Type choices, press Enter.

  Menu . . . . . . . . . . . . . .   _____    Name, generic*, *ALL
    Library . . . . . . . . . . .    *LIBL       Name, *LIBL, *CURLIB...
  Return point. . . . . . . . . .    *YES        *YES, *NO




                                                           Bottom

  F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
  F24=More keys
```
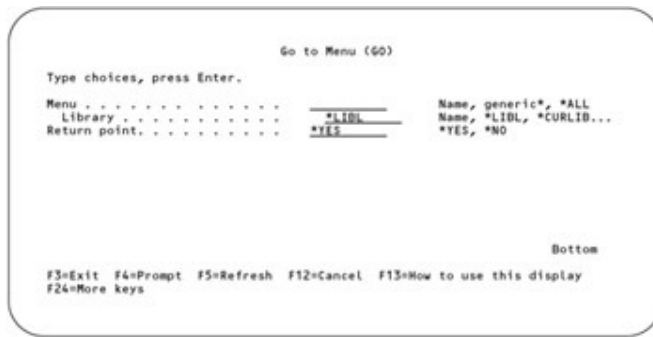
Figure 3.13: Go to Menu (GO) Screen

To gain further information about a parameter, position the cursor somewhere within the parameter, then press the Help key. Information specific to the parameter will overlay the existing display.

To access the screen shown in ,

1. Press the arrow keys to position the cursor somewhere on the Return point parameter line.

2. Press Help to activate the overlay.

```
                         Go to Menu (GO)

  Type choices, press Enter.

  Menu . . . . . . . . . . . . . .   _____    Name, generic*, *ALL
    Library  . . . . . . . . . . .   *LIBL       Name, *LIBL, *CURLIB...
  Return point . . . . . . . . . .   *YES        *YES, *NO
       :..........................................................:
       :               Return point (RTNPNT) - help                :
       :                                                            :
       :   Specifies whether to return to the display where the     :
       :   command is entered when the Exit key is pressed.         :
       :                                                            :
       :   The possible values are:                                 :
       :                                                            :
       :   *YES  The display where the command is entered is        :
       :         returned to when the Exit key is pressed.          :
       :                                                            :
       :   *NO   The display where the command is entered is        :
       :         not returned to when the Exit key is pressed.      :
       :                                                            :
       :   F2=Extended help  F10=Move to top  F11=InfoSeeker        :
  F3=Exit F4=P: F12=Cancel        F20=Enlarge      F24=More keys    :
  F24=More key:..........................................................:
```

Figure 3.14: Go to Menu (GO) Screen with Return Point Help Overlay

As shown in , the F2=Extended help option is located within the help area so users can access the information relating to the entire screen. When parameters are listed for an entry, the cursor must be positioned on an entry field. To access the **extended help**, a user must first access the Help function.

To retrieve extended help, press F2. is a sample of an extended help screen for the GO command.

```
                              Go to Menu (GO)
*****************************************************************************
*                         Go to Menu  (GO) - Help                          *
*                                                                          *
*                                                                          *
*    The Go to Menu (GO) command shows the menu requested. This command    *
*    allows you to specify either a particular menu or a generic menu      *
*    name. You can optionally specify whether or not to return to the      *
*    menu from which the command is entered after showing the menu         *
*    specified.                                                            *
*                                                                          *
*    Using the Previous and Exit Keys                                      *
*                                                                          *
*    A menu is placed on an internal menu stack before it is run. If a     *
*    stack is not available for the menu, one is created. When the         *
*    Cancel key is pressed for a menu, the previous menu in the stack is   *
*    shown.  Each menu stack is ten elements (menus) deep.  When the       *
*    eleventh menu is placed on the menu stack, the first, or oldest,      *
*    menu is removed from the stack. This menu cannot be returned to by    *
*    using the Cancel key.                                                 *
*                                                              More ...     *
*    F3=Exit help   F10=Move to top     F11=InfoSeeker        F12=Cancel    *
*    F13=Information Assistant       F14=Print help                         *
*                                                                          *
*****************************************************************************
```

Figure 3.15: Extended Help Screen for the Go to Menu (GO) Command

To return to the General System Tasks screen in preparation for the exercises at the end of this chapter, press F3 repeatedly to exit the help screens and the other menus.

AS/400 InfoSeeker
AS/400 **InfoSeeker** lets you obtain information by searching online documentation stored on the AS/400. InfoSeeker is the access to the AS/400 Soft Copy Library - all the manuals related to the operating system and licensed program products - online. This soft copy library can be installed on the AS/400, PCs, or a PC network and accessed through IBM's Book Manager Library Reader program. When InfoSeeker is active, you can press F11 to show the InfoSeeker display, which contains a list of online bookshelves and books. You can open a book or type keywords to begin a search to look for specific information. To use InfoSeeker, your machine must have the documentation stored online. Otherwise, the function isn't available.

Chapter Summary

The AS/400 user interface gives all levels of users multiple ways to accomplish their tasks. All techniques for interacting with the system are interchangeable, letting advanced users fall back to the easy-to-use menus and beginners progress as their needs dictate. It's important to remember to always read the screen for options, function keys, and other information. The online help available on the AS/400 is a valuable, time-saving tool that lets you obtain information quickly.

Key Terms

CL commands

command line

entry screen

extended help

function key

InfoSeeker

keyword notation

menu

online help

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positional notation

Review Questions

1. How do you access the Operational Assistant?

2. Why should a user sign off his/her terminal when going to lunch?

3. How would a user access a list of commands related to jobs?

4. Is the following a valid command?
   5.   WRKMSG MSGQ(userid) *PRINT

6. What help function lets the user browse online documentation?

Exercises

1. Display the system operator's messages using Operational Assistant.

2. Display the system operator's messages using the appropriate CL command and the keyword method.

3. Display the system operator's messages using the appropriate CL command and the positional method.

4. Use the proper Help function to find out how to temporarily sign off the system from within an application.

5. Temporarily sign off the system.

Chapter 4: Working with Jobs and Handling Messages

Chapter Overview

OS/400 provides many tools to manage jobs. In this chapter, you learn
- how jobs are submitted

- how to schedule jobs

- how to work with batch jobs

- how to work with jobs by status

- how to change job attributes

- how to work with job queues

- how to work with interactive users

- how to answer messages

- where messages are derived from

- how to get message details

- how to change a message queue

- how to work with job logs

Submitting and Scheduling Jobs

AS/400 users and operators perform their tasks by executing **jobs**. A job can be one short, simple function, or it can be a series of programs working together to complete a complex task. Recall from Chapter 1 that the two basic types of jobs are interactive and batch. During an interactive session, the user types a request (and presses Enter or a function key), and the system responds to the request. These sessions, interactive jobs, begin when a user signs on to a workstation and end when the user signs off.

When constant system interaction with the user isn't required, the job can run as a batch job. Once submitted, a batch job disconnects from the workstation, allowing the workstation to be available for further interactive tasks or for additional batch jobs. Two common examples of jobs that are run in batch mode are printed Query reports and month-end data posting. Jobs that require a large amount of processing should always be run in batch mode and shouldn't require an operator's response during processing.

A batch job is submitted to a **job queue**, as shown in Figure 4.1.
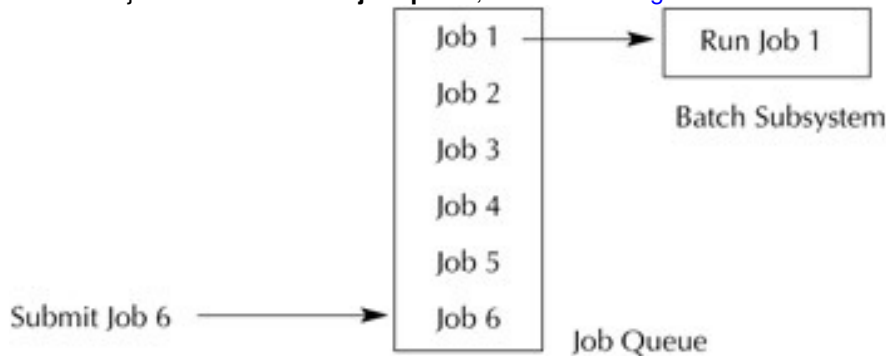
Figure 4.1: Submitting a Batch Job to a Job Queue

A job queue is a waiting area for pending batch jobs. Assuming that the job priorities are the same among batch jobs, each new batch job enters at the bottom of the job queue. The batch subsystem retrieves and executes these jobs in arrival order. Jobs can be held; or if the subsystem is inactive, the batch jobs can be postponed indefinitely. Jobs may be intentionally submitted to an inactive job queue to control scheduling for an unattended night shift. The system operator can then start the subsystem at the end of the work day and job processing will begin automatically.

Submit Job Command

Another way to control scheduling on a one-time basis is to use the SBMJOB (Submit Job) command. To access the Submit Job (SBMJOB) screen (Figure 4.2),

1. Type **SBMJOB** on any command line.

2. Press F4 to prompt.

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Figure 4.2: Submit Job (SBMJOB) Screen

Tip **Recall that to access additional information, you can position the cursor and press Help to view the possible parameter values.**

If the job to be submitted is a program, you can type **CALL** and the name of the program on the Command to run line (e.g., **CALL PAYROLL**). You can execute a CL command in the same way by typing the command as you would enter it on a command line.

The Submit Job screen has many options and parameters available. In the following sections, we cover those of interest to the system operator.

Job Name

Each job on the AS/400 has a unique, qualified job name that consists of job name, user name, and job number. When a user submits a job to batch, (s)he can either specify his/her own job name or accept the system default value. The system default value, *JOBD, uses the name of the job description indicated on the Job description parameter. The user name included in the qualified job name is the name of the user profile for the executing job. The system assigns the job number. Examples of valid qualified job names are 000667/QSYSOPR/PAYROLL for a submitted batch job and 135792/QSYSOPR/DSP01 for an interactive workstation session.

Schedule Date and Schedule Time

The next parameters on the Submit Job (SBMJOB) screen of interest to the system operator are Schedule date (SCDDATE) and Schedule time (SCDTIME); but these parameters aren't displayed on the initial screen. To display these and other additional parameters,

1. Press F10.
2. Press Page down twice to bring up the screen in Figure 4.3.

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```
                            Submit Job (SBMJOB)

   Type choices, press Enter.

   System library list . . . .  *CURRENT    *CURRENT, *SYSVAL
   Current library . . . . . .  *CURRENT    Name, *CURRENT, *USRPRF...
   Initial library list. . . .  *CURRENT    Name, *CURRENT, *JOBD...
            + for more values    _____
   Message logging:
     Level . . . . . . . . . .  *JOBD       0-4, *JOBD
      Severity . . . . . . . .  *JOBD       0-99, *JOBD
      Text. . . . . . . . . .   *JOBD       *JOBD, *MSG, *SECLVL, *NOLIST
   Log CL program commands      *JOBD       *JOBD, *NO, *YES
   Inquiry message reply . . .  *JOBD       *JOBD, *RQD, *DFT, *SYSRPYL
   Hold on job queue . . . . .  *JOBD       *JOBD, *NO, *YES
   Schedule date . . . . . . .  *CURRENT    Date, *CURRENT, *MONTHSTR...
   Schedule time  . . . . . .   *CURRENT    Time, *CURRENT
   Job date . . . . . . . . .   *JOBD       Date, *JOBD, *SYSVAL
   Job switches  . . . . . . .  *JOBD       Character value, *JOBD
   Allow display by WRKSBMJOB   *YES        *YES, *NO


                                                              More...
   F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel F13=How to use this display
   F24=More keys
```

Figure 4.3: Submit Job (SBMJOB) Screen, Additional Parameters

The SBMJOB command lets you submit many types of jobs, including programs and CL commands, at a convenient time and delay the execution. The Schedule date parameter specifies the day the job will be released to the job queue. The Schedule time parameter specifies the time of day the job will be released to the job queue. To release the job to the job queue immediately, you can use the *CURRENT value for both the Schedule date and Schedule time parameters.

To experiment with the SBMJOB command, perform the following steps to send a message to yourself with a three-minute delay.
1. Press Page up twice to return to the first Submit Job screen (Figure 4.2).
2. Type **SNDMSG** for the Command to run parameter.

3. Press F4 to prompt and fill in the message command.
4. Type *your user ID* as the receiving user ID.
5. Press Page down twice to bring up the screen with the Schedule time parameter (Figure 4.3).

6. Type a time value that is three minutes later than the current time of day for the Schedule time parameter.

7. Press Enter to send the message to yourself.

Working with Job Schedule Entries

Another job scheduling tool available on the AS/400 is the WRKJOBSCDE (Work with Job Schedule Entries) command. This command contains the information you need to submit a batch job at regular intervals. This tool also has an easy-to-use interface that lets you submit any type of job or command at specified times. Adding a job schedule entry causes a job to be submitted at the specified time. Removing a job schedule entry stops the job from being submitted. Other types of changes in job schedule entries are allowed, such as holding and releasing entries in the job scheduler. Each job schedule entry has a unique job name and entry number.
To access the WRKJOBSCDE command screen (Figure 4.4),
1. Type **WRKJOBSCDE** on any command line.

2. Press Enter.

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```
                      Work with Job Schedule Entries
                                              System: xxxxxxxx
                                              04/16/99  15:03:26

   Type options, press Enter.
     2=Change   3=Hold   4=Remove   5=Display details   6=Release
     8=Work with last submission    10=Submit immediately

                                                          Next
                  =====Schedule=====              Recovery  Submit
   Opt  Job    Status  Date       Time      Frequency  Action   Date
    _   QSYSOPR SCD    *MONTHSTR  13:22:30   *MONTHLY   *SBMRLS  01/07/00




                                                          Bottom
      Parameters or command ===>_____
   F3=Exit   F4=Prompt       F5=Refresh   F6=Add    F9=Retrieve
   F11=Display job queue data  F12=Cancel   F17=Top   F18=Bottom
```

Figure 4.4: Work with Job Schedule Entries Screen

To schedule a job once, weekly, or monthly, press F6 to add a job schedule entry. The job scheduler submits the job automatically at the specified time.

Commonly used options on the Work with Job Schedule Entries screen are shown in Table 4.1.

Table 4.1: Commonly Used WRKJOBSCDE Command Options	
Work with Job Options	**Description**
2=Change	Modifies the job schedule entry for the selected job but doesn't affect any jobs already submitted.
3=Hold	Results in the job entry being bypassed if the scheduled time occurs while the job is held.
4=Remove	Permanently deletes a job schedule entry so that the job isn't executed.
6=Release	Releases a held job schedule entry. If the scheduled time hasn't passed, the job is submitted for execution. If the scheduled time has passed, a warning message is displayed indicating the job was missed. As system operator, you can submit the job manually or use option 10.
10=Submit immediately	Submits a job for execution immediately. Can be used when a held job's scheduled time has passed. Also helpful for clean-up activities; occasionally you need to run these functions immediately, usually because of problems.

Working with Batch Jobs

The Work with Jobs screen is a useful tool for working with batch jobs. You can access this screen (Figure 4.5) through Operational Assistant by performing the following steps:

1. Type **GO ASSIST** on any command line.

2. Press Enter to bring up the Operational Assistant menu.
3. Type **2** for the Work with Jobs option.
4. Press Enter.

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```
                        Work with Jobs
                                              System   S1029512
User . . . . . . .  QSYSOPR    Name, *ALL, F4 for list

Type options below, then press Enter.
3=Hold    4=Delete (End)    6=Release    7=Display message
8=Work with printer output

      Job Queue/
Opt   Job          Status
      QBATCH
_       BONUS2     Message waiting (use opt 7)
_       BONUS      Running
_       NOBONUS    Running job held (use opt 6)
_       PAYCODE    Ending
_       PAYROLL    Waiting to run (2 of 4)
_       OVERTIME   Scheduled MM/DD/YR 12:00:00
_       TIMECARD   Held (use opt 6)


                                               Bottom
F1=Help   F3=Exit  F5=Refresh  F9=Command line  F11=Display dates/times
F12=Cancel F14=Select other jobs  F22=Work with job queues   F24=More keys
```

Figure 4.5: Work with Jobs Screen

Tips
- **Job Schedule Entry jobs don't appear on the Work with Jobs display until they are submitted to the batch job queue.**
- **To view or manage the jobs of other users, including batch jobs, you must have job control (*JOBCTL) authority.**
- **To display the status of a single user, you can type the user's ID in the User parameter. If you forget the user ID, you can press F4 to prompt for a list of all user IDs.**
- **You can enter a generic name for the User parameter; for example, D* shows all the jobs for all users whose names start with a D, such as David, Diana, or Duke. To enter a generic name, press F14 (Select other jobs), then enter the generic name on the Select Other Jobs screen.**

The default on the Work with Jobs screen is to sort by job queue and within each job queue by status. To see all batch jobs (you must have *JOBCTL authority), type ***ALL** in the User parameter on the Work with Jobs screen and press Enter (Figure 4.6).

```
                        Work with Jobs
                                             System: XXXXXXX
User . . . . . . .  *ALL_____   Name, *ALL, F4 for list

Type options below, then press Enter.
  3=Hold   4=Delete (End)   6=Release   7=Display message
  8=Work with printer output

      Job Queue/
Opt   Job          User       Status
      QBATCH
_       BONUS      SMITH      Message waiting (use opt 7)
_       MYJOB      HARRY      Running
_       BONUS2     SHEMP      Ending
      QS36EVOKE
_       PAYROLL    DUNNJ2     Waiting to run (1 of 4)
_       INVOICES   MAHONEY    Waiting to run (2 of 4)
_       INVOICES2  MONTEY     Waiting to run (3 of 4)
_       INVOICES3  GEORGE     Scheduled 12/15/96 22:00:00


                                               Bottom
F1=Help  F3=Exit  F5=Refresh   F9=Command line  F11=Display dates/times
F12=Cancel F14=Select other jobs F22=Work with job queues F24=More keys
```

Figure 4.6: Work with Jobs Screen with the User Parameter

Notice the User column. Accessing this screen lets you conveniently determine which user submitted each job.

Working with Jobs by Status
Most AS/400s have a large number of jobs in the batch queue. Generally, the system operator is responsible for ensuring that the queued jobs are processing quickly and efficiently. To help facilitate jobs, you may find it useful to obtain the status of jobs by category. For example, you may be concerned with jobs that have a status of Hold because of an unanswered message. To

view the available choices (Figure 4.7), press F14 (Select other jobs) on the Work with Jobs screen.

```
                         Work with Jobs

                        Select Other Jobs

     Select the following jobs for the list.

     Type choices below, then press Enter.

       User . . . . . . . . . . . .   *ALL_____    Name, *ALL, F4 for list
     Status:
       Message waiting. . . . . . . . .  Y           Y=Yes, N=No
       Running. . . . . . . . . . . . .  Y           Y=Yes, N=No
       Running job held . . . . . . . .  Y           Y=Yes, N=No
       Ending . . . . . . . . . . . . .  Y           Y=Yes, N=No
       Waiting to run/Scheduled . . . .  Y           Y=Yes, N=No
       Held . . . . . . . . . . . . . .  Y           Y=Yes, N=No
       Job queue held . . . . . . . . .  Y           Y=Yes, N=No
       Queue not assigned . . . . . . .  Y           Y=Yes, N=No
       Printer output . . . . . . . . .  N           Y=Yes, N=No




     F1=Help   F5=Refresh   F12=Cancel
```

Figure 4.7: Work with Jobs Screen, Select Other Jobs Option

The default display uses *ALL for the User parameter and includes all jobs in any status except Printer output. (Excluding the finished jobs with printer output waiting helps reduce the number of jobs on the display.) To clear specific job types from this display, type N next to each job status you're not interested in. After you press Enter, only the selected jobs will be displayed. To return jobs to the display, change the status column to Y.

To see when jobs were submitted, press F11 (Display dates/times) on the Work with Jobs screen. Knowing how long the lag time on the job queue is, you can try to predict the waiting time before a job begins to execute.

Changing Job Sequence

Occasionally, a batch job is submitted that must run immediately. To expedite the critical job, you as system operator must hold all currently running jobs, all batch jobs that have a higher priority, and any jobs in the queue ahead of the critical job. To hold executing jobs, use option 3 from the Work with Jobs screen. The status of the job(s) will be changed to Running job held or to Held. Press F5 to refresh the screen and ensure the job status has changed.

After the critical job has completed, all the held jobs must be released. To release a batch job on the Work with Jobs screen, select option 6 for the job or jobs you want released. The status of the jobs should be changed to Released. Again, press F5 to refresh the screen and ensure the job status has changed. The status of the released jobs should be changed to Running, Waiting to run, or Scheduled.

Occasionally, a job is submitted at an inappropriate time or by accident. To remove a batch job, use option 4 on the Work with Jobs screen to delete (end) the job. You will receive a Confirm Delete message. Press Enter to confirm the end of the job, or press F12 to cancel and keep the job.

When you delete a batch job, it no longer appears on the display. However, the deleted job will still be displayed if the job had printer output waiting and you've specified a status of Yes for the Printer output parameter on the Select Other Jobs display.

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Changing Job Attributes

Thus far in this chapter, the displays have used the Basic Assistance level. Recall from Chapter 2 that you can view and access additional functions and options by changing the assistance level on these screens. To do so on the Work with Jobs screen,

1. Press F24 until F21=Select assistance level is listed at the bottom of your screen.

2. Press F21.
3. Type **2** to change to the intermediate assistance level.
4. Press Enter to return to the Work with Jobs screen (Figure 4.8).

```
                       Work with User Jobs                  SYSTEM01
                                           04/10/99          14:29:40
     Type options, press Enter.
       2=Change   3=Hold   4=End    5=Work with  6=Release  7=Display message
       8=Work with spooled files    13=Disconnect

     Opt  Job         User       Type   =====Status=====  Function
       _  QDFTJOBD    QSYSOPR    BATCH    SCD
       _  QPWROFFPGM  QSYSOPR    BATCH    OUTQ



                                                          Bottom
     Parameter, or command
       = >
     F3=Exit    F4=Prompt   F5=Refresh  F9=Retrieve    F11=Display schedule data
     F12=Cancel  F21=Select assistance level
```

Figure 4.8: Work with User Jobs Screen

Changing the assistance level has changed the Work with Jobs screen to the Work with User Jobs screen. Three additional options are available for managing jobs: option 2=Change, option 5=Work with, and option 13=Disconnect.

Option 2 is used to change job attributes, including the job priority, output priority and output queue, and job queue. Before you change any job attributes, you should hold the job. After you change the desired attributes, you can release the job to run. Perform the following steps to change the job queue for the QDFTJOBD job in Figure 4.8:

1. Type **3** in the option column of the QDFTJOBD job to hold the job.
2. When the job status changes to HLD, type **2** in the option column.

3. Press Enter to bring up the Change Job (CHGJOB) screen.
4. Press F10 to display additional parameters as shown in Figure 4.9. (Under Additional Parameters, the job queue is the first parameter.)

```
                        Change Job (CHGJOB)

     Type choices, press Enter.
     Job name . . . . . . . . . . . . . > QDFTJOBD     Name, *
       User . . . . . . . . . . . . . . >   QSYSOPR    Name
       Number . . . . . . . . . . . . . >   075731     000000 999999
     Job priority (on JOBQ) . . . . .     5            0-9, *SAME
     Output priority (on OUTQ) . . .      5            1-9, *SAME
     Print device . . . . . . . . . .     PRT01        Name, *SAME, *USRPRF
     Output queue . . . . . . . . . .     *DEV         Name, *SAME, *USRPRF, *DEV ...
     Library  . . . . . . . . . . .                    Name, *LIBL, *CURLIB
     Run priority . . . . . . . . . .     *SAME        1 99, *SAME

                        Additional Parameters

     Job queue  . . . . . . . . . . .     QBATCH       Name, *SAME
     Library  . . . . . . . . . . . .       QGPL       Name, *LIBL, *CURLIB
     Print text . . . . . . . . . . .     *BLANK
                                                               More ...
     F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
     F24=More keys
```

Figure 4.9: Change Job (CHGJOB) Screen

> **Tip**   **You can also access the Change Job (CHGJOB) screen typing the CHGJOB command on any command line and specifying the name of the job to be changed.**

To return to the Work with Jobs screen after you change the job queue,

1. Press F12 to cancel.

2. Press F21 to change assistance level.

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3. Type **1** for Basic assistance level.

4. Press Enter.

Working with Job Queues

Most system operators monitor other job queues in addition to the batch job queue. You can accomplish this easily using the Work with Job Queues screen:

1. Press F9 to get a command line.
2. Type **WRKJOBQ** on the command line.
3. Press Enter to view job queue activity information (Figure 4.10).

Figure 4.10: Work with Job Queues Screen

On the Work with Job Queues screen, you can hold or release any job queue. Individually holding every job submitted to the job queue prevents those jobs from running, but it doesn't prevent newly submitted jobs from running. Using this display to inactivate the entire queue at once is faster and more error-free because no jobs in the queue will run.

To hold a job queue using the Work with Job Queues screen, type **3** in the option column for the job queue that must be held. The status of the job queue will change to "Job queue held."

Tip	**The Work with Job Queues screen shows only job queues that have waiting or running jobs. If no active jobs are associated with a job queue, the Work with Job Queues screen appears empty. Always use the F5 function key to refresh your display to ensure that you are viewing the most current display.**

Option 6 releases a held job queue. The status of the job queue will change to "Job queue released." To return to the Operational Assistant menu, press F12 twice.

Working with Signed-On Users

Another system operator function is to monitor the QINTER subsystem that runs interactive user jobs. Interactive users may not use the largest share of AS/400 resources, but these users frequently have the highest priority for system use. Therefore, smooth functioning of interactive users' jobs is paramount. To display all currently signed on users and what they are working on,

1. On the Operational Assistant menu, type **10** (Manage your system, users, and devices).

2. Press Enter.
3. Type **12** (Work with signed-on users).
4. Press Enter to display the Work with Signed-On Users screen (Figure 4.11).

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```
                        Work with Signed-On Users
                                             System: XXXXXXX
    Find user . . . . . . . . . . . .  _____    Starting characters

    Type options below, then press Enter.
      3=Send message  4=Sign off 5=Display details  7=Display message

                       Display
    Opt  User          Station    Activity
    _    BRUNS         BRUNSS3    ASSIST menu
    _    EVERLY        EVERLYS2   INVENTORY program
    _    GOETZ         QPADEV0004 Command entry
    _    JACK          JACKS4     Message waiting (use Opt 7)
    _    SMITH         SMITHS1    WRKUSRJOB command
    _    TELLY         QPADEV0008 MAIN menu
    _    TUBER         QPADEV0002 WRKSPLF command





                                                     Bottom
    F1=Help    F3=Exit    F5=Refresh    F10=Send message to all
    F11=Display additional information  F13=Sort list  F24=More keys
```

Figure 4.11: Worked with Signed-On Users Screen

From this screen, you can send messages to all the users currently signed on, sign off users who have forgotten to sign off, and display information about the interactive jobs.

> **Tip**   **By signing off, a user stops his or her interactive job regardless of any processing that may be active. Therefore, it's important to be careful when signing a user off the system lest you inadvertently cause problems. For example, ending a user's interactive job that is updating a file can cause the file to be updated incorrectly.**
>
> **If you are sure that a user must be signed off the system, use option 4 on the Work with Signed-On Users screen. Press Enter to confirm the sign-off, or press F12 to leave the user signed on. The Work with Signed-On Users screen will no longer show the User ID(s) of the user(s) who have been signed off the system.**

The list of users on the Work with Signed-On Users screen is initially sorted by user name and shows each user's display station and activities. To find a specific user signed on to the system, type the first few characters of the user's name in the Find user field and press Enter. The list is positioned to the first user matching the characters you typed.

You can sort the list by display station or user name. To do so,
1. Press F13 (Sort list).
2. Type **2** to sort by display station name or **1** to sort by user name.
3. Press Enter.
4. To include on the screen users who are temporary signed off, press F24 to view more function key options.
5. Press F14 to display the Select Other Users and Display Stations screen.
6. To include signed-off users, type **Y** in the "Include temporarily signed off users…" field.

There are two ways to display additional information about the users currently signed on to the system. For a single user listed on the Work with Signed-On Users screen, select option 5 (Display details). The Display Details screen presents the user, the workstation description, and the current activities.
To get additional information for all users shown on the Work with Signed-On Users screen, press F11 (Display additional information) to bring up a pop-up window (Figure 4.12) where you can select the type of information you want.
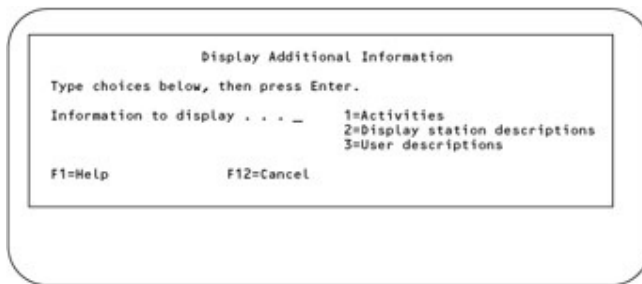
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```
                    Display Additional Information
  Type choices below, then press Enter.

  Information to display . . . _     1=Activities
                                     2=Display station descriptions
                                     3=User descriptions

  F1=Help             F12=Cancel
```

Figure 4.12: Display Additional Information Pop-Up Screen

Working with All Active Jobs

For the most part, you should use the Work with Jobs and Work with Signed-on Users screens to manage batch and interactive jobs. However, if you're trying to troubleshoot performance problems, you may find the WRKACTJOB (Work with Active Jobs) command useful because it lets you view all the active jobs running on the system. To display the Work with Active Jobs screen (Figure 4.13),

1. Type **WRKACTJOB** on any command line.

2. Press Enter.

```
                        Work with Active Jobs               SYSTEM01
                                              01/21/00   08:26:38
  CPU %:   25.2     Elapsed time:   00:10:58    Active jobs:   77

  Type options, press Enter.
    2=Change   3=Hold   4=End   5=Work with   6=Release   7=Display message
    8=Work with spooled files   13=Disconnect ...

  Opt  Subsystem/Job   User      Type  CPU %  Function       Status
   _     QCTL          QSYS      SBS    .0                   DEQW
   _       QSYSSCD     QPGMR     BCH    .0    PGM-QEZSCNEP    EVTW
   _     QINTER        QSYS      SBS    .0                   DEQW
   _       CEMADDENS2  CEMADDEN  INT    .0    *  -CMDENT      DSPW
   _       DSP010201   USER      INT   1.5    CMD=STRED       DSPW
   _       DSP020605   LKC       INT   3.7    *  -CMDENT      DSPW
   _       DSP020704   JSMITH    INT    .0    MNU-MAIN        DSPW
   _       DSMOTHERS1  DSMOTHER  INT    .0    MNU-ASSIST      DSPW
   _       FALKELS1    FALKEL    INT    .0    *  -CMDENT      DSPW
                                                             More ...
  Parameters or command
  ===>
  F3=Exit      F5=Refresh   F10=Restart statistics   F11=Display elapsed data
  F12=Cancel   F23=More options   F24=More keys
```

Figure 4.13: Work with Active Jobs Screen

Caution   **Because WRKACTJOB uses a large amount of system resources to retrieve the information for the screen, you shouldn't use it heavily.**

You can use the Work with Active Jobs screen to find a job that is slowing down performance on the system. You should first look at the Work with Jobs screen to see whether any jobs have messages waiting and to view the jobs status. If the status of a job on the Work with Jobs screen is Running (with no messages), you can bring up the Work with Active Jobs screen to determine whether the job is affecting the system response time by using a large amount of system resources.

If you find a job on the Work with Active Jobs screen with a high utilization number under the CPU % column, perhaps the job is in an infinite loop or creating other problems. If this high utilization continues to grow, you might need to disconnect or end the job. In Chapter 8, we discuss the Work with Active Jobs screen in more detail.
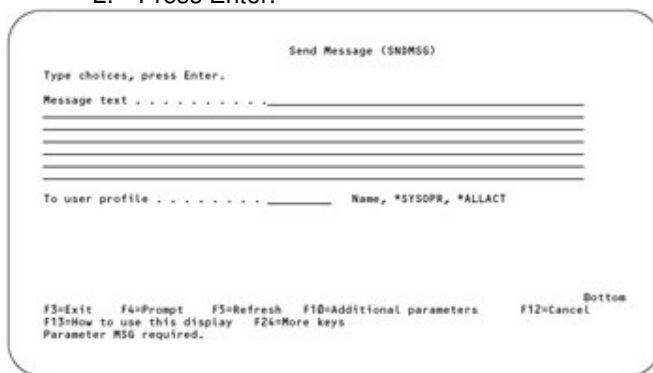
Message Handling

Messages provide the means for you to communicate with the system and with the system users. When you ask the system to do something, the system may respond with messages indicating the status of that request. In addition, you can communicate with other users through messages that are sent via the system.

As the system operator, users and programs send you messages that communicate conditions you must respond to and indicate actions you need to take. As a user, you receive messages in response to your actions at a workstation. These messages are placed in **message queues**. You can send messages to signed on users using option 3 on the Work with Signed-On Users screen, the SNDMSG (Send Message) command, or the SNDBRKMSG (Send Break Message) command. The SNDMSG command sends a message to the user ID specified even if the user is not signed on to the system. The SNDBRKMSG command interrupts the user and displays the message on the workstation. You should use a break message only when it is imperative that the user be notified immediately, such when you need to announce a system shutdown. You can send a message as an **informational message** or an **inquiry message**. An informational message doesn't require an answer from the user(s); an inquiry message does.

To bring up the Send Message (SNDMSG) screen (Figure 4.14),

1. Type **SNDMSG** on any command line.

2. Press Enter.

```
                          Send Message (SNDMSG)

 Type choices, press Enter.

 Message text . . . . . . . . . . ._____
 _____
 _____
 _____
 _____
 _____

 To user profile . . . . . . . . _____    Name, *SYSOPR, *ALLACT




                                                              Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display   F24=More keys
 Parameter MSG required.
```

Figure 4.14: Send Message (SNDMSG) Screen

The To user profile parameter lets you specify a user ID, the system operator (*SYSOPR), or all active users (*ALLACT). (You can't use *ALLACT with an inquiry message.) Pressing F4 on the To user profile entry blank line displays additional options allowed for entry. Pressing F10 brings up additional parameters (Figure 4.15).

```
                          Send Message (SNDMSG)

 Type choices, press Enter.

 Message text . . . . . . . . . ._____
 _____
 _____
 _____
 _____
 _____

 To user profile . . . . . . . .   _____    Name, *SYSOPR, *ALLACT

                      Additional Parameters

 To message queue  . . . . . . .              Name, *SYSOPR
    Library . . . . . . . . . . .   *LIBL     Name, *LIBL, *CURLIB
              + for more values
                                    *LIBL
 Message type . . . . . . . . . .   *INFO     *INFO, *INQ
                                                              More ...
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```
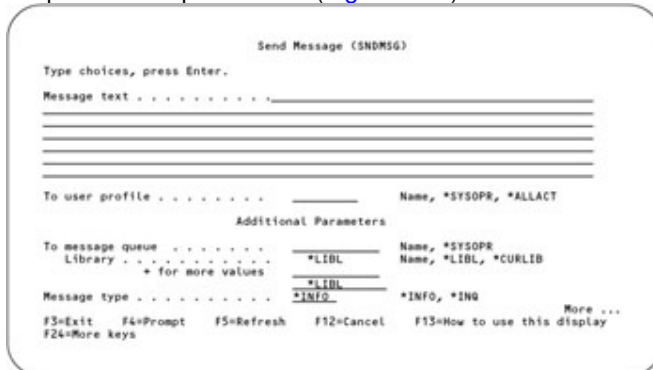
Figure 4.15: Send Message (SNDMSG) Screen with Additional Parameters

Under Additional parameters, the To message queue parameter lets you send the message to a specific message queue found in either the library list or the library you specify. For example, you can send the message to the user profile message queue for interactive jobs. The Message type

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parameter lets you indicate whether the message is an informational (*INFO) or inquiry (*INQ) message. Paging down on this screen lets you view more parameters, including one that lets you specify the message queue that will receive the reply to an inquiry message. You can specify a message queue name or *WRKSTN to direct the reply to the message queue associated with the workstation the sender is using.
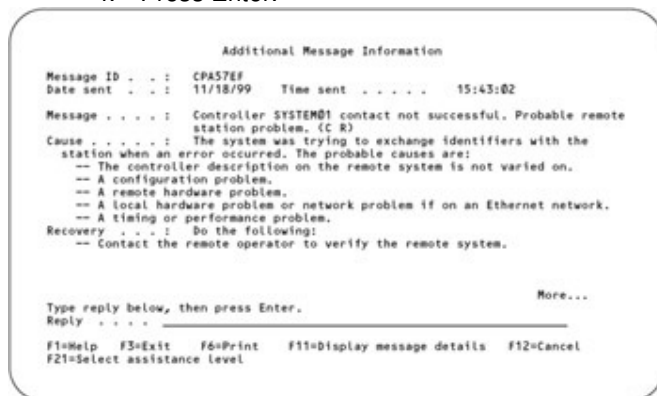
The default for the SNDMSG command is to interrupt users who are working. If you don't want to disturb them, find the Interrupt user parameter under Additional Parameters and change the value to N.

The system itself sends informational or inquiry messages for certain system events. System-generated informational messages give a status report about what the system is doing. System-generated inquiry messages often include answer choices to select from. These messages are sent to the system operator's message queue (QSYSOPR), a user's message queue, or to the workstation's message queue.

Note   **When you receive a system-generated inquiry message, it's important to display the description of the choices before typing a selection to answer the inquiry. The same choice doesn't necessarily provide the same answer for different inquiry messages. For example, C could mean Continue for one question and Cancel for another. Pressing F1 on the inquiry line displays the associated meanings for the letter choices.**

You can find out more about messages on the Work with Messages screen from the Operational Assistant menu. To access the Additional Information screen (Figure 4.16), perform the following steps:

1. If necessary, type **GO ASSIST** to bring up the Operational Assistant menu.
2. Type **3** for the Work with Messages option.
3. Type **5** next to a message that needs a reply.
4. Press Enter.


```
                    Additional Message Information

Message ID . . :   CPA57EF
Date sent . . :    11/18/99    Time sent . . . . .    15:43:02

Message . . . . . :    Controller SYSTEM01 contact not successful. Probable remote
                       station problem. (C R)
Cause . . . . . :      The system was trying to exchange identifiers with the
     station when an error occurred. The probable causes are:
       -- The controller description on the remote system is not varied on.
       -- A configuration problem.
       -- A remote hardware problem.
       -- A local hardware problem or network problem if on an Ethernet network.
       -- A timing or performance problem.
Recovery . . . :      Do the following:
       -- Contact the remote operator to verify the remote system.


                                                         More...
Type reply below, then press Enter.
Reply . . . .  _____

F1=Help   F3=Exit    F6=Print    F11=Display message details   F12=Cancel
F21=Select assistance level
```

Figure 4.16: Additional Message Information Screen

Usually, one of the causes listed on this screen will help you identify the problem. Occasionally, however, these message explanations may be misleading and the suggested solutions might not correct the problem; the listed causes are only probable explanations for what might be causing an error.

You can press Page down to see any remaining information about the message. When you have read the information, you can type an answer in the Reply field and press Enter.
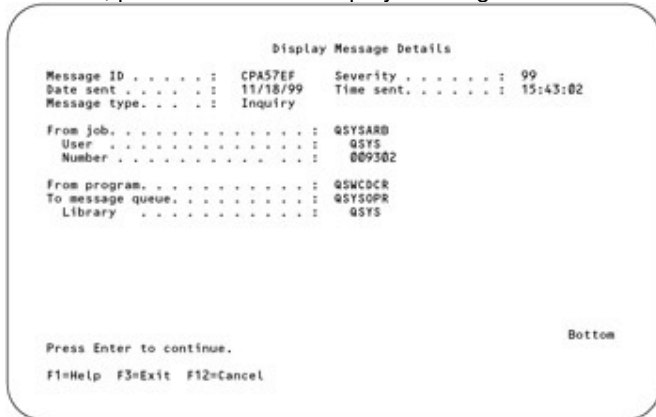
Tip   **If you select option 5 (Display details and reply) for a message that doesn't need a reply, the additional information is about the message. If**

the message requires a reply, type the answer in the field provided at the bottom of the Additional Message Information screen you see when your system is set at the Basic Assistance level.

The Additional Message Information screen includes the **message ID**. All error messages have a message ID. The system uses the message ID to keep track of its messages. Programmers use these identifiers to handle error messages within their programs. The first three letters of the message ID indicate the message category. Some typical message categories are shown in Table 4.2.

Table 4.2: Typical AS/400 Message Categories

Category	Explanation
CPA - CPZ	Messages from the operating system
CBE - CBX	Cobol messages
CSC	Cobol syntax checker messages
LBE- LSC	Cobol messages
MCH	Licensed internal code messages
QRG	RPG messages
RPG - RXT	RPG messages
SBX - SSC	Cobol messages
SQL	Structured Query Language (SQL) messages

The remaining four digits in an error message (which may include hexadecimal values) indicate the sequence number of the message. In Figure 4.16, for example, the message ID indicates that the message is from the operating system (CPA); the message is numbered 57EF. A message ID is shown when you use the Help key to request the Display Additional Message screen.

In Figure 4.16, the lower right corner of the screen includes the "More…" notation, and a second page includes details about the message, as shown in Figure 4.17. To view these additional details, press F11 on the Display Message Details screen.

```
                        Display Message Details

Message ID . . . . . :   CPA57EF      Severity . . . . . . :  99
Date sent . . . . . :   11/18/99     Time sent. . . . . . :  15:43:02
Message type. . . . :   Inquiry

From job. . . . . . . . . . . . :   QSYSARB
  User  . . . . . . . . . . . . :     QSYS
  Number  . . . . . . . . . . . :     009302

From program. . . . . . . . . . :   QSWCDCR
To message queue. . . . . . . . :   QSYSOPR
  Library  . . . . . . . . . . . :     QSYS




                                                              Bottom
Press Enter to continue.

F1=Help  F3=Exit  F12=Cancel
```

Figure 4.17: Display Message Details Screen

Tip   **To see all the information about a message on one display, switch to the Intermediate Assistance level using the F21 function key while you are on the Additional Message Information screen.**

To return to the Additional Message Information screen, press Enter.

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To print an individual message, use the F6 function key on the Additional Message Information screen; both screens of the display print. The output is sent to the QSYSPRT spooled file and can be viewed or printed from the output queue.

Occasionally, a problem seems to grow as you try to correct it. When problem resolution becomes lengthy, printing out the sequence of error messages is one of the best things you can do to help resolve the problem. Rather than print each individual message, you may find it is easier to print the entire message queue by performing the following steps.

1. Press F12 until the Operation Assistant menu is shown.

2. Press F9 to get a command line.
3. Type **WRKMSG** on any command line.

4. Press F4 to prompt the command.
5. Type *your message queue name.*
6. Type ***PRINT** for the output parameter value.

7. Press Enter.

When you specify the *PRINT parameter on the WRKMSG (Work with Messages) command, the output is placed in your output queue, where you can display it or send it to a printer.

Message Queues
The QBATCH subsystem usually sends all system-generated operator messages to the QSYSOPR message queue. The system operator using the user profile **QSYSOPR** is assigned the message queue QSYSOPR. During an interactive session, messages sent from other users and messages sent by the system are typically placed in the interactive user's message queue. A message queue is like a mail box. Each workstation has a message queue with the same name as the workstation ID, and each user has a message queue with the same name as the user ID. To view the setup of your message queue, press F24 (More keys) on the Work with Messages screen, then press F22 (Display list details) to bring up a screen similar to the one in Figure 4.18.

```
                    Display List Details

Message queue . . . . . . . . :    SMITHS1
    Library . . . . . . . . . :      QSYS
Delivery  . . . . . . . . . . :    *NOTIFY
Program . . . . . . . . . . . :    *DSPMSG
Severity  . . . . . . . . . . :    0
Description . . . . . . . . . :    Work Station Message Queue

Message queue . . . . . . . . :    SMITH
    Library . . . . . . . . . :      QUSRSYS
Delivery  . . . . . . . . . . :    *NOTIFY
Program . . . . . . . . . . . :    *DSPMSG
Severity  . . . . . . . . . . :    0
Description . . . . . . . . . :    Jim Smith's message queue




    Press Enter to continue.

    F1=Help  F3=Exit  F12=Cancel
```

Figure 4.18: Display List Details Screen

This display shows details about both the workstation message queue and the user message queue. The following discussion applies to the most commonly used parameters for both message queues.

The Message queue parameter specifies the name of the message queue that contains the messages. This is generally the same name as the workstation name or the user ID.

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The Library parameter is the library that stores the message queue. This library should be included in the user's library list.

The Delivery parameter specifies the method by which messages are delivered - the message either interrupts the user at the time of delivery, sounds an alarm, holds until answered, or automatically sends a default reply. When an interactive user signs on to the system, his/her message queue is put into the delivery mode specified in the user profile.

The Program parameter is more appropriately called the "break message handling program." This parameter specifies a program that the system will call if a message of sufficient severity arrives at a message queue that is in *BREAK (interrupt) mode. The program may activate an error-correction sequence, stop the job stream, or call a message program. A programmer usually defines the severity value that triggers the program. The default value is *DSPMSG, to use the system-supplied message display program.

The Severity parameter determines whether a message has a level equal to or greater than the severity value that has been established. If so, the operating system either interrupts the user or turns on the message-waiting light, depending upon the designated Delivery value.

The Description entry is the description of the message queue; this information is commonly entered when the message queue is created.

You can customize the values of the parameters listed on the Display List Details screen. To do so, you use the CHGMSGQ (Change Message Queue) command:

1. Press F12 until you return to the Operational Assistant menu.

2. Press F9 to display a command line.
3. Type **CHGMSGQ**.
4. Press F4 to prompt for parameters (Figure 4.19).

```
                    Change Message Queue (CHGMSGQ)

 Type choices, press Enter.

 Message queue  . . . . . . . .                Name, *USRPRF, *WRKSTN
   Library  . . . . . . . . . .    *LIBL      Name, *LIBL, *CURLIB
 Delivery . . . . . . . . . . .   *SAME       *SAME, *HOLD, *BREAK...
 Severity code filter . . . .    59           0-99, *SAME
 Text 'description' . . . . .    Sandra Smith at Ext 485



                                                          Bottom
 F3=Exit  F4=Prompt  F5=Refresh  F10=Additional Parameters  F12=Cancel
 F13=How to use this display      F24=More keys
```

Figure 4.19: Change Message Queue (CHGMSGQ) Screen

As the operator, you will frequently select and modify the Delivery parameter. You can select one of four values: *BREAK, *NOTIFY, *HOLD, and *DFT. *BREAK specifies that when a message is received, the user's work is interrupted and a message is displayed on the screen. This value can be overridden if a program was specified to handle the message condition. For example, when you as the system operator need to shut down the system, you can select the *BREAK value. The shut-down message interrupts all interactive users and gives them time to close their jobs and sign off their workstations.

*NOTIFY specifies that when a message is received, the user's work isn't interrupted. The message turns on the workstation attention light (or message-waiting symbol), and an alarm may

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sound, although not all workstations are equipped with an alarm. To display the message, the user can use either the DSPMSG (Display Messages) or the WRKMSG command.

*HOLD acts as a silencer. The user isn't notified in any way when a new message arrives. The message queue retains the messages until the user requests his/her messages, using the DSPMSG or the WRKMSG command.
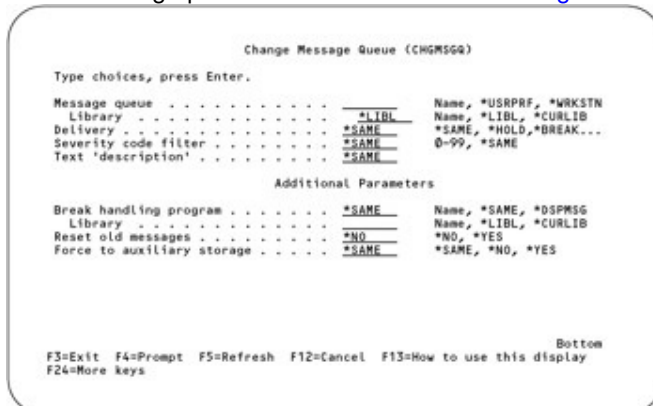
*DFT can potentially cause problems, and you should use it with caution. When you use *DFT, all informational messages are ignored. Messages requiring a reply are sent a system-supplied default reply. Messages may be sent to other users or workstation message queues, but none of the messages are kept in the receiving queue if the receiving queue is in *DFT delivery mode. The system operator's message queue, QSYSOPR, is treated differently - these messages are kept in the queue and logged in the history log, QHST. For unattended operations, you can use the *DFT value.

The next parameter of interest is the severity code filter. You can use the severity code filter in *BREAK mode to filter out messages that interrupt the user's work. For example, if a message severity code of 59 is defined, the system breaks into the user's work only if messages with codes of 59 or greater are detected. Any message with a severity code of less than 59 is sent to the message queue and the message-waiting symbol is turned on. (This scenario assumes that the Program value is *DSPMSG).

Now, assume we have the same message severity code filter of 59 but that the message queue is in *NOTIFY mode. In this case, the system notifies the user of any messages received that have a severity code of 59 or greater by turning on the message-waiting symbol and/or sounding the alarm, if the workstation has one. Any message with a severity code of less than 59 is sent to the message queue, but the message-waiting symbol isn't turned on. The message is saved until the user reads and deletes it.

As we mentioned above, the Text 'description' parameter should provide a description of the message queue. As an aid in troubleshooting, we recommend that for message queues assigned to users, the description contain the user's name and phone extension, as shown in Figure 4.19. (When message queues become overly full, it's very helpful to have both the name and phone extension of the message queue owner.)

To access additional parameters from the Change Message Queue (CHGMSGQ) screen, press F10 to bring up a screen similar to the one in Figure 4.20.

```
                    Change Message Queue (CHGMSGQ)

     Type choices, press Enter.

     Message queue . . . . . . . . . . . .            Name, *USRPRF, *WRKSTN
       Library . . . . . . . . . . . . . .  *LIBL     Name, *LIBL, *CURLIB
     Delivery . . . . . . . . . . . . . . .  *SAME    *SAME, *HOLD,*BREAK...
     Severity code filter . . . . . . . .  *SAME     0-99, *SAME
     Text 'description' . . . . . . . . .  *SAME

                         Additional Parameters

     Break handling program . . . . . . . .  *SAME    Name, *SAME, *DSPMSG
       Library . . . . . . . . . . . . . .            Name, *LIBL, *CURLIB
     Reset old messages . . . . . . . . . .  *NO      *NO, *YES
     Force to auxiliary storage . . . . . .  *SAME    *SAME, *NO, *YES




                                                              Bottom
     F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
     F24=More keys
```

Figure 4.20: Change Message Queue (CHGMSGQ) Screen, Additional Parameters

Notice in Figure 4.20 that what was the Program parameter on the Display List Details screen is more descriptively the "Break handling program" parameter. As we mentioned above, this program specifies the program name and library location for a program to be executed if the normal default, *DSPMSG, isn't desired.

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Specify *NO for the Reset old messages parameter to prevent a message you have already read and viewed from being redisplayed in your message queue. Specifying *YES to this parameter makes you review the messages again and again until you delete them.

The Force to auxiliary storage parameter is usually specified as *SAME, to use the value specified in the message queue. The message queue usually has this parameter specified as *NO to indicate that changes made to the message queue, including its messages, aren't immediately forced into auxiliary storage. When *YES is specified, all changes made to the message queue description and each new message in the queue are immediately forced to auxiliary storage and duplicated in DASD. The *YES option is an important message-queue recovery tool that provides communications between programs, but it slows down system performance and uses additional disk space.

Working with Job Logs

A job's activities are tracked and documented in a **job log**. Viewing a job log may be valuable in determining problems encountered within a job. Both batch and interactive jobs create job logs. While an interactive job is running, its job log is being created. If the interactive job ends with problems, the job log is sent to an output queue. If the interactive job ends normally, the job log isn't sent to an output queue. To display your interactive job log from within the interactive session, you use the DSPJOBLOG (Display Job Log) command:

1. Type **DSPJOBLOG** on any command line.

2. Press Enter.
3. Press F10 to display detailed messages (Figure 4.21).


```
                        Display All Messages
                                                     System: SYSTEM01
 Job . . :   DISPLAY003    User . . :    QSYSOPR    Number . . . :  075727




 Job 075727/QSYSOPR/DISPLAY003 started on 04/10/99 at 14:04:37 in subsystem
 QINTER in QSYS. Job entered system on 04/10/99 at 14:04:36.

 3 > go assist
 4 > SNDMSG MSG(TESTING)
                                                            More ...
 Press Enter to Continue.

 F3=Exit    F5=Refresh   F12=Cancel   F17=Top    F16=Bottom
```

Figure 4.21: Display All Messages Screen

Note   **The title of the Display Job Log screen changes to Display All Messages when you press F10 on the Display Job Log screen.**

At the beginning of the job log, the job name and the date and time the job started are listed. Then, the Display All Messages screen lists all the commands entered during your interactive session as well as any problems or errors that occurred during the execution of the job. The job log is always in sequence.

You can also use the DSPJOBLOG command to view other jobs by typing the command on the command line and prompting the command with the F4 function key. On the prompt screen, you can specify the job number, user, name of the specific job you want to view, and whether to print the job log (as opposed to viewing it on your display).

You can also display job logs from the Work with Jobs screen (Figure 4.5) by typing **8** in the option column of the job for which you want to display the job log. On the Work with Printer Output screen, you then specify option 5 to display the spooled file of the associated job log, QPJOBLOG.

You can also print the job log for your interactive job when you sign off by including the *LIST option with the SIGNOFF command:

1. Type **SIGNOFF *LIST** on any command line.
2. Press Enter.

Chapter Summary

The AS/400 operating system provides many menus and commands to manage and handle jobs. This chapter focused on the tools provided through the Operational Assistant. There are other methods of performing the same tasks using commands or other options from other menus. Changing your assistance level can provide you with more parameters for managing jobs. Not all screens let the user change assistance levels. It's important to read your screen carefully and note the function keys and options available to you. Pressing F1 (the Help key) provides further information about any screen.

Key Terms

informational message

inquiry message

job

job log

job queue

message ID

message queue

QSYSOPR

Review Questions

1. What are the two basic types of jobs that an AS/400 system operator commonly deals with?
2. What is the purpose of the SBMJOB (Submit Job) command?
3. What is the purpose of the WRKJOBSCDE (Work with Job Scheduling Entries) command?
4. What happens to a Job Scheduling entry that has a Held status when it is released to the job queue?
5. What are the three parts of the qualified job name?
6. What is a job queue?
7. How can the system operator change the sequence of the jobs on the job queue?
8. How do you find a specific user signed on to the system?
9. What command allows changes to message queues?
10. What do the first three letters of the message ID indicate?
11. What is tracked in the job log?

Exercises

1. Change your message queue to interrupt you whenever you receive a message.
2. Print a message that you have received.
3. Schedule a batch job to send a message to your instructor at a certain time.

4. Using the Work with Jobs screen from the Operational Assistant menu, display all the jobs that are running and all the running jobs that are held. Use the Print Screen key to capture the results; print these results and turn them in.

5. Send a message.

6. Print your interactive job log when you sign off the system.

Chapter 5: Managing Print Functions

Chapter Overview

OS/400 provides many tools to manipulate and control printer output. In this chapter, you learn

- how to work with queued printer output

- how to access the Operational Assistant's printer output screens at the Basic assistance level

- how to modify the status of the various spooled output files

- how to work with spooled output files at the Intermediate assistance level

- the function of printer writers

- how to change printer output quickly

- how to work with printer messages

- how to work with printers

- the default output queues and default message queues

- the function of completed printer output

Printing

AS/400 programs generally don't send data directly to printers. While the AS/400 supports direct printing, which may be suitable for PCs with one workstation and one printer, this approach is generally unacceptable in a multitasking environment. Consider that interactive jobs aren't completed until the user signs off, possibly at the end of the work day. When direct printing is used, the printer is dedicated to that one interactive job and is unavailable to any other jobs until that one job is completed.

Printers may be physically attached to an AS400 in many different ways, including an attachment directly to the AS400 or a connection to a workstation using a printer emulation package. Whatever the printer's physical connection, you can still control printer output with the methods we describe in this chapter.

Figure 5.1 illustrates how printer output moves from an interactive or batch job to a final printed report.
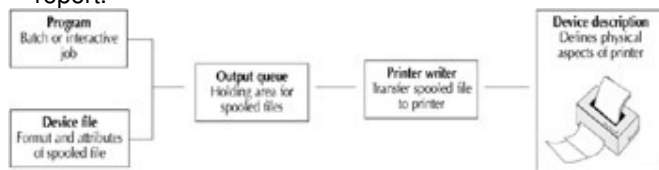

Figure 5.1: Creating and Printing a Spooled File

A program running a batch or interactive job creates an image, called a **spooled file member** (**spooled file**, for short), of printer output. Instructions from an application program or a system-supplied program combine with data to create the spooled file. The program opens a **device file** to define the format of the output and how the system should process the spooled file.

The program and the device file place the spooled file on an **output queue** until a printer is available to print it. Like other queues, an output queue is a holding area. A single output queue may have spooled files from many different jobs and many different users. In some cases, a single job might place spooled files on more than one output queue. An administrator may also create an output queue for each department. For example, the accounting department may have a separate output queue for its jobs while the production department has an output queue for its jobs.
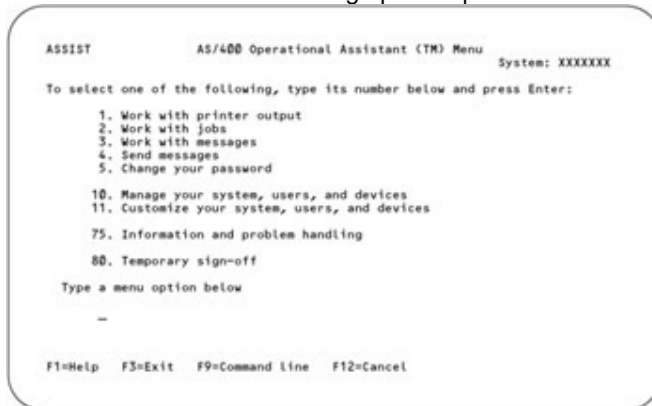
After the spooled file is created and sent to an output queue, a **printer writer** transfers the spooled file from the output queue to a **printer**. Each printer has an associated **device description** that defines the physical aspects of the printer, including the device type, model, number of trays, and location of printer on the network.

> **Tip**   **Printer formatting capabilities are stored in a printer device file. Before you switch a spooled print file to another printer, you need to know the formatting capabilities of the printers. For further information about printer formatting, see the Appendix.**

As a system operator in a multitasking, multiple-printer environment, much of your job often involves directing and controlling the printing process. You should encourage users to review their reports at the terminal before they print. Then, if an error occurs, they can delete the spooled file, correct the input that caused the error, and rerun the job - without requiring that you be involved in the process at all.

However, when you do need to be involved in the printing process, the Operational Assistant lets you work with queued printer output in many different ways (e.g., by user, printer, job, job status, or output name). A series of menus helps you perform these routine tasks of controlling jobs and printer output. To access the Operational Assistant menu,

1. Type **GO ASSIST** on any command line.
2. Press Enter to bring up the Operational Assistant menu (Figure 5.2).

```
ASSIST            AS/400 Operational Assistant (TM) Menu
                                          System: XXXXXXX

To select one of the following, type its number below and press Enter:

      1. Work with printer output
      2. Work with jobs
      3. Work with messages
      4. Send messages
      5. Change your password

     10. Manage your system, users, and devices
     11. Customize your system, users, and devices

     75. Information and problem handling

     80. Temporary sign-off

   Type a menu option below

      _


  F1=Help   F3=Exit   F9=Command line   F12=Cancel
```

Figure 5.2: AS/400 Operational Assistant Menu

When you select Operational Assistant's option 1 (Work with printer output), you are shown the Work with Printer Output screen (Figure 5.3), which offers you a user-friendly interface where you can work with all types of printer output. As the system operator (with QSYSOPR authority), you can view and control all the printer output files for all users who have unprinted reports.

```
                         Work with Printer Output
                                                  System    S0000000
  User . . . . . . . QSYSOPR     Name, *ALL, F4 for list

  Type options below, then press Enter. To work with printers, press F22.
    2=Change   3=Hold   4=Delete   5=Display        6=Release   7=Message
    9=Work with printing status    10=Start printing   11=Restart printing

         Printer/
  Opt    Output        Status
         PRTMFG
    _      INVENTORY    Printer stopped (use opt 10)
    _      ORDENTRY     Printer stopped (use opt 10)
         PRTACT
    _      PAYROLL      Printing page 3 of 154
         Not Assigned
    _      TIMECARD     Not assigned to printer (use opt 10)

                                                            Bottom
  F1=Help     F3=Exit     F5=Refresh      F11=Dates/pages/forms    F12=Cancel
  F14=Select other printer output         F20=Include system output  F24=More keys
```

Figure 5.3: Work with Printer Output Screen

Tip   **You can substitute the CL command WRKSPLF (Work with Spooled Files) for the GO ASSIST command and option 1. At the Basic assistance level, both methods show the same display.**

Working with Printer Output at the Basic Assistance Level

The assistance level at which a user is operating causes different screens to be displayed from Option 1 on the Operational Assistant menu. To ensure that your work and the text in this section agree, check to be sure you're working at the **Basic assistance level:**

1. Press F21 (Select assistance level).
2. Type **1** for Basic assistance level.

As the system operator, you will use the Work with Printer Output screen shown in Figure 5.3 to inspect the flow of spooled print jobs as they proceed to the printer. Spooled output reports assigned to a printer (assuming that everything else is prepared) will be printed according to their output priority. A programmer or system administrator assigns jobs an output priority before the jobs are run. The default priority for spooled output is set to the same priority level, and output is printed on a first in/first out (FIFO) basis unless otherwise changed by a programmer or administrator.

Let's assume that all the jobs in a queue have the same output priority level. When another job adds a spooled file with the same priority to the queue, OS/400 places the new spooled file at the bottom of the queue. However, if the new job has the highest output priority, the spooled file is placed in the queue above all the other jobs' files and will be printed next. The operating system won't stop a lower priority file in the middle of the printing process to let a higher priority file access the printer. If it's necessary to interrupt the spooling program to print a higher priority report, you as the system operator must hold the spooled output. We discuss how to do so in the next section.

Typing the user profile ID in the User field near the top of the Work with Printer Output screen displays only one individual's spooled output. The screen will be displayed as shown in Figure 5.3, with the name of the user (in this case, QSYSOPR) to limit the number of queued reports on the display. The Work with Printer Output screen divides the spooled output by printer name. (The queued printer output in Figure 5.3 is sorted by printer name.) Spooled output with a status of "Not assigned to a printer" appears last on the display. To view all the printer output, type *ALL in the User field.

Tips
- **If you don't know the user ID, place the cursor on the User field and press F4 to display a complete list of users.**
- **You can enter a partial name in the User field together with the asterisk (*) wildcard character. For example, if you want to see all output that starts with AR, you would type AR* in the User field.**

Working with Printer Output Options and Function Keys

In this section, we discuss the options and commonly used function keys you will be working with as you direct and control the printing process via the Work with Printer Output screen in a multiple-printer environment. Several of the options display additional screens for review or for modification.
Use option 2 (Change) to modify the **print attributes**. To practice with this option,
    1.   Type **2** in the option column of a spooled file.
    2.   Press Enter to bring up the Change Printer Output screen (Figure 5.4).

```
                      Change Printer Output
User . . . . . . . . : JCHARLES        Date . . . . . . . . : 18/21/99
Printer output . . . : ACCTPAY         Time. . . . . . . . . : 13:40:01

Pages . . . . . . . : 10
Status . . . . . . . : Waiting to print
Type choices below, then press Enter.
Printer to use . . . .      PRTACT        Name, F4 for list

          Copies and pages:
            Number of copies . . . . 1         1-255
            First page to print  . . 1         Number
            Last page to print . . . *LAST     Number, *LAST
            Type of forms  . . . . . *STD      Form type, *STD

          Print this output next      N        Y=Yes, N=No
          Save printer output  . . .  N        Y=Yes, N=No




    F1=Help   F3=Exit   F5=Refresh   F12=Cancel
```

Figure 5.4: Change Printer Output Screen

Among other items, the attributes of a spooled print job include the printer device, the number of copies to be printed, and the type of forms to be placed in the printer. You may specify the device name of a printer to use to print a report. Use this field to assign a printer to a report that has not been assigned or to move a report from one printer to another.
    Tip   **If you don't know which printer to use, place the cursor on the Printer to use line and press F4 to see the Select printer list.**

To change the number of copies to be printed, type the desired number in the Number of copies field. To specify the page number that this printer output should begin printing on, type the page number in the First page to print field. If you don't need to print the entire report, type a page number in the Last page to print field. You can use these two fields together if, for example, a paper jam damaged part of the report or you want to print only a portion of a report.

To change the form type, type the desired name of the form in the Type of forms field. This option can be useful during application testing - for example, to verify check or invoice alignment by printing the spooled output on plain paper.
To change when printer output prints and to move printer output to the front of the queue for printing, type **Y** in the Print this output next field. The user who owns the spooled printer output has authority to make this change. As system operator, you can also make this change if you have been granted *SPLCTL authority. The printer output is placed with other reports with the same priority and forms type. Higher priority print jobs will be printed first.
To save the printer output after printing, type **Y** in the Save printer output field. Normally, you would delete printer output to avoid cluttering up the system. However, for output that prints on special forms, it may be helpful to save the spooled output. If you discover alignment problems after the output has printed, you can reprint without having to rerun the program (which may be impossible to do without a great amount of effort).

If the printer output is currently printing, you can still change the Number of copies and Save printer output fields. If you need to modify other options, first hold the printer output, make the change, and then release the printer output.

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To return to the Work with Printer Output screen, press F3.

Use option 3 (Hold) on the Work with Printer Output screen to specify the spooled output to be held. When spooled output is held, the status changes to Held and the spooled file won't be printed until an operator releases it. Once released, the job will be sequenced according to its priority.

Use option 6 (Release) to release the spooled output. The status of the spooled output changes to Released.

Use option 4 (Delete) to permanently remove spooled output from the Work with Printer Output screen. Press Enter a second time to confirm the deletion. The deleted spooled output should no longer appear on the Work with Printer Output screen. If the spooled output remains visible, press F5 to refresh the screen.

As system operator, you should be extremely careful when you delete jobs from the output queue because it may not be possible to regenerate the spooled output. For example, some print jobs simply report on the contents of the user's database files. These jobs can be deleted and rerun with no long-term consequences. However, you shouldn't delete any reports that serve as an audit trail for a database file update. These output reports frequently can't be regenerated without restoring a previous version of the file and re-entering the file updates. In rare cases, a user who deletes audit trail reports may actually be committing fraud or embezzlement. You can protect yourself by asking for approval from a supervisor to delete the output report or by moving the report to an unassigned output queue. Moving the report to a different output queue provides several advantages. First, the report won't show up on the user's output queue; second, the job won't inadvertently move up to the printing position in the job queue; and third, if the report is indeed necessary, the output can be moved back to an active queue for printing.

Tip   **Before deleting printer output that another user created, consider whether your user profile contains *SPLCTL authority.**

Use option 5 (Display) to display the contents of a spooled report (Figure 5.5).

Figure 5.5: Display Spooled File Screen

The ruled line marks the beginning of the actual data in the printer output, as shown in the example in Figure 5.5. You can use the Control and Find fields at the top of the screen to locate information within the spooled output. Two entries for the Control field are T for top and B for bottom. The Find field locates any text typed in the variable area with an exact match in the spooled file. For more information about either of these fields, place the cursor on the appropriate line and press Help.

Use option 7 (Message) on the Work with Printer Output screen to display any messages relating to the spooled output. We discuss printer messages in greater detail later in this chapter.

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Use option 10 (Start printing) to assign spooled output to a printer. Type the name of the printer to be used in the Printer field, or press F4 to select from a list of all the printers on the system. If the printer is not started, the Start Printing message will be shown. The spooled output now appears under the name of the printer.

Use option 11 (Restart printing) when a job has been stopped in the middle of printing - or more likely, when there has been a paper jam.

Commonly Used Function Keys

Occasionally, printed output is misplaced, or a spooled file is inadvertently placed in a held output queue. One method that can help you locate the report is to verify that the spooled file was actually printed. To display the completed printer output screen, press F6 from the Work with Printer Output screen.

Because the completed output lists are generally lengthy, your may find it helpful to sort the information using the F10=Sort list function key. The Sort list option is useful for locating a specific report when numerous spooled output jobs are on a queue.

Note **F6 and F10 are available on your AS/400 only if the system's job accounting function is active and is collecting printer completion information.**

To see another view of the same display, press F11(Dates/pages/forms). The Date/pages/forms view shows when the spooled output was created, the total number of pages, the types of forms being used, and the number of copies to be printed. The date/time columns can help you to calculate how long a job has been on the output queue and predict approximately how long it will be before the job begins printing.

Occasionally, you may make an error while you are typing the printer name, or you might belatedly realize that a lengthy job has started printing. Fortunately, function key F22 lets you control the printers on your system. From the resulting Work with Printers screen, you can start, stop, or restart a printer, or you can respond to messages that may indicate printer problems.

Working with Printer Output at the Intermediate Assistance Level
Recall from Chapter 2 that the AS/400 assistance level is designed to meet the changing needs of both users and computer center staff members. The WRKSPLF command provides an interesting example of the versatility of assistance levels because the basic and intermediate assistance levels display two different screens. You may find it helpful to set the assistance level to Intermediate when you are working with spooled files and printer writers.

Tip **Pressing the F9 function key displays a command line on screens that don't provide one automatically.**

To work with spooled files at the **Intermediate assistance level,**

1. Press F9 to display a command line.
2. Type **WRKSPLF ASTLVL(*INTERMED)**.
3. Press Enter to bring up the Work with All Spooled Files screen (Figure 5.6).

```
                         Work with All Spooled Files

     Type options below, press Enter.
       1=Send   2=Change   3=Hold   4=Delete   5=Display   6=Release   7=Message
       8=Attributes         9=Work with printing status

                          Device or                                Total    Cur
     Opt    File          User      Queue     User Data  Sts       Pages   Page  Copy

       _    QSYSPRT       QSYSOPR   PRTACT               WTR          1       1     1
       _    QPJOBLOG      QSYSOPR   QSYSOPR              RDY          1             1
       _    QPJOBLOG      QSYSOPR   QSYSOPR              RDY          1             1
       _    QSYSPRT       QSYSOPR   QSYSOPR              RDY          1             1
       _    QSYSPRT       QSYSOPR   QSYSOPR              RDY          1             1
       _    QPDCDEVA      QSYSOPR   QSYSOPR              RDY          1             1
       _    QSYSPRT       QSYSOPR   QSYSOPR              HLD          1             1




                                                                 Bottom
     Parameters for options 1, 2, 3 or command
     ===>
     F3=Exit   F10=View 3   F11=View 2   F12=Cancel   F22=Printers   F24=More keys
```

Figure 5.6: Work with All Spooled Files Screen, View 1

Compare Figure 5.3, Work with Printer Output, with the system set at the Basic assistance level, and Figure 5.6, Work with All Spooled Files, with the system set at the Intermediate assistance level. Note that the Intermediate assistance level displays a completely different screen of the same data.

The Work with All Spooled Files screen has three different views, each providing you with slightly different information. View 1, the default view - shown in Figure 5.6 - lists the name of the job (under File), the user or program that submitted the job, and the output queue where the spooled output is located. View 1 lists the spooled files in the order they are to be printed, assuming that all the spooled files have the same priority.

The status column, Sts, reveals the condition of the job. Notice the first spooled file on the figure has a status of writer, WTR, while other spooled files are ready to print, RDY, or are held, HLD. For more information about status codes, see Table 5.1.

Table 5.1: Spooled File Status Codes and Meanings

Status Code	Description
*CHG, CHG	Some change has been initiated on this spooled file. *CHG is displayed temporarily, until you press F5 to refresh the screen.
CLO	This printed report is finished (closed) but the entire job hasn't been completed.
DFR	The job is deferred (similar to HLD).
*HLD, HLD	An operator has held the job. *HLD is displayed temporarily, until you press F5 to refresh the screen.
MSGW	The spooled output has a message waiting and won't print until the message is answered.
OPN	The job is unfinished or open.
PND	The spooled output status is pending.
PRT	The job is currently being printed.
*RLS, RLS	An operator has released the job. *RLS is displayed temporarily, until you press F5 to refresh the screen.
SAV	The job has been printed with the save status. All copies of the spooled output were printed, but the report file will be saved on the output queue until it's released or deleted.

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Table 5.1: Spooled File Status Codes and Meanings	
Status Code	**Description**
SND	The spooled output has been sent to another system.
WTR	The printer writer is formatting the job or the job is printing.

The Spooled output schedule (SCHEDULE) parameter of the CHGPRTF (Change Printer File) or CHGSPLFA (Change Spooled File Attributes) command controls whether a spooled file is available to print as soon as the individual report is closed, or whether the report must wait until the entire job that created it has finished. This parameter is particularly important for any spooled file that an interactive job creates. Remember that an interactive job doesn't end until the user signs off. Any spooled file created with *JOBEND specified for the SCHEDULE parameter waits in an output queue with a status of CLO until the user signs off, possibly at the end of the day. If the operator notices a job that is on the output queue for an extended period of time, it may be appropriate to contact an administrator or programmer to request a change to *FILEEND, to print the job as soon as the spooled file is closed. This change can be helpful if one program creates multiple reports. If the report must wait until the entire job has finished, use *JOBEND for this parameter.

Work with All Spooled Files, View 1

Many of the option and function keys perform the same function at both the Basic and the Intermediate assistance levels. Therefore, this section covers only the options or functions that are new or have a modified function at the different assistance levels.

Use option 1 (Send) on the Work with All Spooled Files screen to send a spooled file to another system or to another user's output queue on the same system. Type the user ID and network address for the user who will receive the file on the Send Network Spooled File (SNDNETSPLF) screen. This option is helpful because most users don't have access to or authority to view or work with another user's output queue. If a user needs to view or work with a spooled file that is located in another user's output queue or system, it may be easier for you as the system operator to copy the output to the current user's output queue. This function is not the same as changing the output queue for a printed report (option 2). When you use option 1, you send a copy of the printed output to another output queue, but the original remains in its original queue.

If the user receiving the spooled file is a user on another AS/400, the name of that system must be in the system directory. (The system directory is a listing that identifies all users and systems allowed to communicate with your AS/400 and its users.)

Tips
- **Use the DSPDIRE (Display Directory Entry) command to view the list of users and systems in your communications network.**
- **To ensure that all the attributes of the spooled file are sent, press F4 and type *ALLDATA in the Data format field.**

Use option 2 (Change) on the Work with All Spooled Files screen to assign a spooled output report to a printer and to change other attributes of the printed output. Before the printer writer accepts the report for formatting, you or the user must designate the printer to be used. Type the name of the printer to be used in the Printer field.

Use option 7 (Message) to display any messages relating to the spooled output - in general, messages relate to a printer request. We discuss printer messages in greater detail later in this chapter.

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Use option 8 (Attributes) to display the attributes that are listed when the program, the data, and the printer device files are combined. You can modify certain attributes (using option 2), such as the number of copies to be printed. However, you can't alter other attributes, such as the number of lines on a page.

Work with All Spooled Files, View 2

Press F11 to bring up View 2 of the Work with All Spooled Files screen (Figure 5.7). This view has several new pieces of information that are of interest to the system operator.

```
                    Work with All Spooled Files

   Type options below, press Enter.
     1=Send   2=Change   3=Hold   4=Delete   5=Display   6=Release   7=Message
     8=Attributes      9=Work with printing status

   Opt    File      User      Form Type   Pty   Date       Time
     _     QSYSPRT   QSYSOPR   *STD         5    08/15/99   14:53:33
     _     QPJOBLOG  QSYSOPR   *STD         5    08/15/99   14:54:33
     _     QPJOBLOG  QSYSOPR   *STD         5    08/15/99   14:54:56
     _     QSYSPRT   QSYSOPR   *STD         5    08/15/99   14:55:01
     _     QSYSPRT   QSYSOPR   *STD         5    08/15/99   14:55:22
     _     QSYSPRT   QSYSOPR   *STD         5    08/15/99   14:55:46
     _     QPDCDEVA  QSYSOPR   *STD         5    08/15/99   14:56:12




                                                         Bottom
   Parameters for options 1, 2, 3 or command
   ===>
   F3=Exit  F10=View 1  F11=View 3  F12=Cancel  F22=Printers  F24=More keys
```

Figure 5.7: Work with All Spooled Files Screen, View 2

The Form Type column specifies the kind of paper to be used for the printing process. In Figure 5.7, all the spooled files are requesting standard forms. In the early days of computers, most documents for internal use were printed on greenbar (green-and-white striped paper). Nonstandard forms were typically preprinted documents, such as invoices or pay checks. Today the corporate standard is set partially by the printer hardware available and partially by individual preference. A chain printer with a wide carriage may still use greenbar, while a laser printer may be unable to use any paper wider than 8 ½ inches. Your computer center should have a list of the abbreviations and the forms that you are to use.

The priority of the spooled file is also shown in View 2. Priorities may be assigned from a high of 1 to a low of 9. Notice in Figure 5.7 that all the jobs have the same priority; therefore, the spooled files will print in the order displayed.

Work with All Spooled Files, View 3

The third view of the Work with All Spooled Files screen (Figure 5.8) lists the File name, the User name, and the Job number. You can combine these three pieces of information to construct the **qualified job name**. (We discussed the qualified job name and its importance in Chapter 4.) To display View 3 from View 2, press F11.

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```
                       Work with All Spooled Files

 Type options below, press Enter.
   1=Send   2=Change   3=Hold   4=Delete   5=Display   6=Release   7=Message
   8=Attributes        9=Work with printing status

                    File
 Opt   File         Nbr   Job      User      Number   Queue      Library
   _   QSYSPRT       18    STAT1    QSYSOPR   075883   QSYSOPR    QSYSOPR
   _   QPJOBLOG      19    STAT1    QSYSOPR   075884   QEZJOBLOG  QUSRSYS
   _   QPJOBLOG      19    STAT1    QSYSOPR   075890   QEZJOBLOG  QUSRSYS
   _   QSYSPRT       20    STAT1    QSYSOPR   075892   QSYSOPR    QSYSOPR
   _   QSYSPRT       21    STAT1    QSYSOPR   075903   QSYSOPR    QSYSOPR
   _   QSYSPRT       22    STAT1    QSYSOPR   075908   QSYSOPR    QSYSOPR
   _   QPDCDEVA      23    STAT1    QSYSOPR   075014   QSYSOPR    QSYSOPR



                                                          Bottom
 Parameters for options 1, 2, 3 or command
 ===>
 F3=Exit  F10=View 2  F11=View 1  F12=Cancel  F22=Printers  F24=More keys
```

Figure 5.8: Work with All Spooled Files Screen, View 3

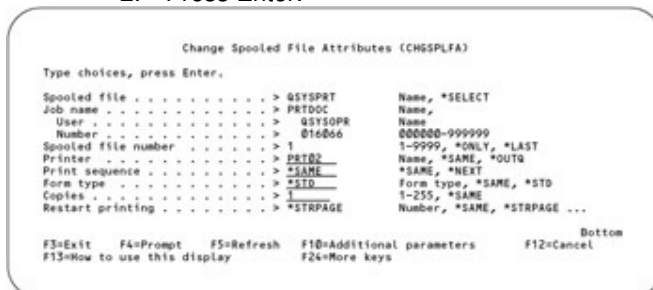To return to View 1 from View 3, press F11.

Printer Writers

The printer writer is an AS/400 system program that sends spooled output from an output queue to a physical printer. Any spooled files on an output queue remain in the queue until a printer writer has sent the report to a printer. For more information about print formatting, see the Appendix.
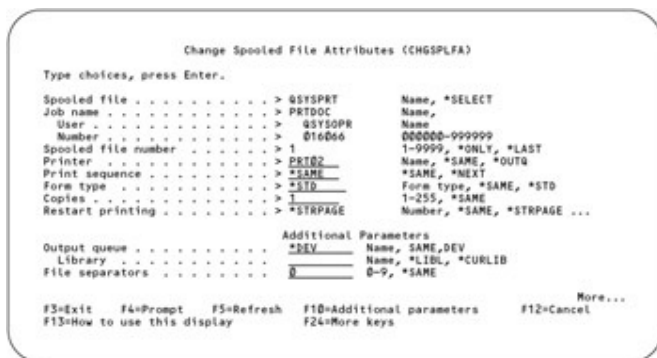
Changing Printer Output

At the Intermediate assistance level, option 2 (Change) on the Work with All Spooled Files screen lets you change and manipulate spooled files. To bring up the Change Spooled File Attributes (CHGSPLFA) screen (Figure 5.9),

      1.   From any view of the Work with All Spooled Files screen, type **2** in the option column of the spooled file for which you want to change attributes.

      2.   Press Enter.

```
                   Change Spooled File Attributes (CHGSPLFA)

 Type choices, press Enter.

 Spooled file . . . . . . . . . . > QSYSPRT        Name, *SELECT
 Job name . . . . . . . . . . . . > PRTDOC         Name,
   User . . . . . . . . . . . . . >   QSYSOPR      Name
   Number . . . . . . . . . . . . >   016066       000000-999999
 Spooled file number  . . . . . . > 1              1-9999, *ONLY, *LAST
 Printer  . . . . . . . . . . . . > PRT02          Name, *SAME, *OUTQ
 Print sequence . . . . . . . . . > *SAME          *SAME, *NEXT
 Form type  . . . . . . . . . . . > *STD           Form type, *SAME, *STD
 Copies . . . . . . . . . . . . . > 1              1-255, *SAME
 Restart printing . . . . . . . . > *STRPAGE       Number, *SAME, *STRPAGE ...

                                                                  Bottom
 F3=Exit    F4=Prompt    F5=Refresh    F10=Additional parameters    F12=Cancel
 F13=How to use this display         F24=More keys
```
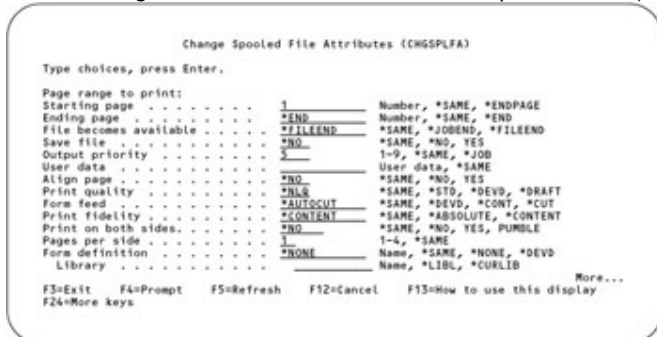
Figure 5.9: Change Spooled File Attributes (CHGSPLFA) Screen

Compare the title of the screen in Figure 5.4, Change Printer Output, with the system set at the Basic assistance level, and the title of the screen in Figure 5.9, Change Spooled File Attributes (CHGSPLFA), with the system set at the Intermediate assistance level. The parameters are described in different wording also. To access additional parameters (Figure 5.10), press F10.

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Change Spooled File Attributes (CHGSPLFA)

Type choices, press Enter.

```
Spooled file . . . . . . . . . . > QSYSPRT       Name, *SELECT
Job name . . . . . . . . . . . . > PRTDOC        Name,
  User . . . . . . . . . . . . . >   QSYSOPR     Name
  Number . . . . . . . . . . . . >   016066      000000-999999
Spooled file number . . . . . . > 1             1-9999, *ONLY, *LAST
Printer . . . . . . . . . . . . > PRT02          Name, *SAME, *OUTQ
Print sequence . . . . . . . . . > *SAME         *SAME, *NEXT
Form type . . . . . . . . . . . > *STD           Form type, *SAME, *STD
Copies . . . . . . . . . . . . . > 1             1-255, *SAME
Restart printing . . . . . . . . > *STRPAGE      Number, *SAME, *STRPAGE ...

                    Additional Parameters
Output queue . . . . . . . . . .   *DEV          Name, SAME,DEV
  Library . . . . . . . . . . .                  Name, *LIBL, *CURLIB
File separators . . . . . . . .    0             0-9, *SAME

                                                        More...
F3=Exit    F4=Prompt    F5=Refresh    F10=Additional parameters    F12=Cancel
F13=How to use this display          F24=More keys
```

Figure 5.10: Change Spooled File Attributes (CHGSPLFA) Screen with Additional Parameters

The Change Spooled File Attributes screen displays additional parameters for changing the output queue for the printer output. You may need to send the output to a different output queue than originally specified. The option to change the printer is available on this screen also. Specifying *DEV for the Output queue parameter instructs the system to send the spooled file to the output queue assigned to the printer listed in the Printer parameter on this screen. Press Page down to view more additional parameters (Figure 5.11).

```
                    Change Spooled File Attributes (CHGSPLFA)

Type choices, press Enter.

Page range to print:
  Starting page . . . . . . . .    1             Number, *SAME, *ENDPAGE
  Ending page . . . . . . . . .    *END          Number, *SAME, *END
File becomes available . . . . .   *FILEEND      *SAME, *JOBEND, *FILEEND
Save file . . . . . . . . . . . .  *NO           *SAME, *NO, YES
Output priority . . . . . . . . .  5             1-9, *SAME, *JOB
User data . . . . . . . . . . . .                User data, *SAME
Align page . . . . . . . . . . .   *NO           *SAME, *NO, YES
Print quality . . . . . . . . . .  *NLQ          *SAME, *STD, *DEVD, *DRAFT
Form feed . . . . . . . . . . . .  *AUTOCUT      *SAME, *DEVD, *CONT, *CUT
Print fidelity . . . . . . . . .   *CONTENT      *SAME, *ABSOLUTE, *CONTENT
Print on both sides . . . . . . .  *NO           *SAME, *NO, YES, PUMBLE
Pages per side . . . . . . . . .   1             1-4, *SAME
Form definition . . . . . . . . .  *NONE         Name, *SAME, *NONE, *DEVD
  Library . . . . . . . . . . .                  Name, *LIBL, *CURLIB
                                                        More...
F3=Exit    F4=Prompt    F5=Refresh    F12=Cancel    F13=How to use this display
F24=More keys
```

Figure 5.11: Change Spooled File Attributes (CHGSPLFA) with Additional Parameters (Page 2)

This second page of additional parameters lists more parameters for controlling spooled files, including options to control printing such as double-sided printing, aligning the page, and form feed options. The "File becomes available" parameter lets you specify whether the file is available to print at the end of the job or at the end of the spooling of the file. The Page range to print parameters are useful when you don't want to print the entire file at this time or when you want to print part of a long spooled file that didn't print correctly the first time.

During a work shift, you may send hundreds of jobs to the printer writer and, therefore, to the printer. To send the output to be printed, you must type in the name of the appropriate printer. Let's assume that 100 jobs are ready to be moved to the printer named PRTMFG. From one of the Work with All Spooled Files views, you would need to type **2** in the option column of the first job to be changed, press Enter, and type **PRTMFG**. You would then need to repeat this process 99 additional times. As you can see, this is a time-consuming and potentially error-prone process. An easier and more error-free method is to type **2** in the option column for all 100 jobs, then type a single CL command parameter - **OUTQ(PRTMFG)** - on the command line as shown in Figure 5.12. When the system processes this change, all the jobs are transferred to the PRTMFG printer writer.

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```
                  Work with All Spooled Files
Type options below, press Enter.
  1=Send   2=Change   3=Hold   4=Delete   5=Display   6=Release   7=Message
  8=Attributes         9=Work with printing status

                     Device or                          Total   Cur
  Opt   File         User      Queue    User Data  Sts  Pages   Page  Copy

   2    QSYSPRT      QSYSOPR   PRTACT              WTR    1       1     1
   2    QPJOBLOG     QSYSOPR   QSYSOPR             RDY    1             1
   2    QPJOBLOG     QSYSOPR   QSYSOPR             RDY    1             1
   2    QSYSPRT      QSYSOPR   QSYSOPR             RDY    1             1
   2    QSYSPRT      QSYSOPR   QSYSOPR             HLD    1             1
   2    QSYSPRT      QSYSOPR   QSYSOPR             RDY    1             1
   2    QPDCDEVA     QSYSOPR   QSYSOPR             RDY    1             1




                                                          Bottom
Parameters for options 1, 2, 3 or command
===>OUTQ(PRTMFG)
F3=Exit  F10=View 3  F11=View 2  F12=Cancel   F22=Printers   F24=More keys
```

Figure 5.12: Work with All Spooled Files Screen with OUTQ CL Command

Note   **This technique requires the assistance level to be set to Intermediate for your user ID.**

To understand why this technique works, you need to first understand that option 2 invokes the CHGSPLFA (Change Spooled File Attributes) command; OUTQ is a valid parameter for this command. When you type option 2 in front of one or more reports and include a value for the OUTQ parameter on the command line, the CHGSPLFA command executes for each report, using the specified parameter value.

Working with Printer Messages

As system operator, you will find myriad messages associated with the printer. In this section, we discuss the technique for answering messages in general, rather than discussing specific messages.

The AS/400 supports many types of messages. All messages provide a communications channel from the system to a system operator or user. You should encourage users to view their **message queue** and delete their messages as soon as it's practical. This method helps ensure that messages are actually read and that disk space usage is kept to a minimum.

In Figure 5.13, the operator has a message relating to forms alignment. The forms alignment message gives you five choices for the proper reply: I, C, G, N, and R. Because the AS/400 has many messages with multiple choices, as a novice system operator you may want to display the details before trying to answer the message. Typing a 5 in the option column for the message displays additional details about the message. Specific information about how to answer the message will be provided, as shown in Figures 5.14 and 5.15. You should type the appropriate response and press Enter.

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```
                        Work with Messages

User . . . . . . . . : JCHARLES              System . . . . . . XXXXXXX
Type options below, then press Enter.
  4=Remove   5=Display detail and reply

Opt   Message
                           Messages needing a reply
  __   Verify Alignment on Device PRTACT.  (I C G N R)

                           Messages not needing a reply

  __   Controller ETHLINET can not be varied on or off.
  __   SMTP job QTSMTPSRVR ended abnormally
  __   Device PCUSER1 no longer communicating.
  __   Device STAT05 no longer communicating.
  __   Verify alignment on printer PRTMFG. (I G N R E C)
  __     Reply . . :  I
  __   Device STAT09 no longer communicating.
  __   Device QPADEV0017 no longer communicating


F1=Help   F3=Exit   F5=Refresh   F6=Display system operator messages
F16=Remove messages not needing a reply      F17=Top    F24=More keys
```

Figure 5.13: Work with Messages Screen

```
                  Additional Message Information

Message ID . . . . . : CPA4002          Severity . . . . : 99
Message type . . . . : INQUIRY
Job . . : XXXXX       User . . . XXXXXXX     Number . . . : 96584
Date sent . . . . . : 02/10/00          Times sent . . . : 10:03:35
From Program . . . . : WRTYIP           Instruction  . . : 0000

Message  . . . . . . : Verify Alignment on Device PRTACT.  (I C G N R)
Cause  . . . . . . . : The forms may not be aligned correctly.  The first
  line for the file is 1.
Recovery . . . . . . : Do one of the following and try the request again.
Possible choices for replying to message . . . . . . . . . . . . :
  I  -- To continue printing aligned forms starting with the next line of
     file, type an I.
  C  -- To cancel processing, type a C.
  G  -- To continue printing aligned forms skipping to the next form and
     printing the first line again, type a G.

                                                           More...

Type reply, press Enter.
  Reply . . : _____
Press Enter to continue.
F3=Exit           F12=Cancel
```

Figure 5.14: Additional Message Information Screen

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```
                    Additional Message Information

Message ID . . . . . : CPA4002              Severity . . . . : 99
Message type . . . . : INQUIRY
   N  -- To print the first line again on the next form and to verify the
      alignment,
      1. Press Stop only if Start and Stop are two keys, or press Reset.
      2. Advance the paper to the next form by pressing Form Feed/New Page
      3. Adjust the alignment with the forms adjust control
      4. Press Ready, Start, or Start/Stop.
      5. Type an N.
   R  -- To print the first line again on the current form and to verify the
      alignment if the forms are not aligned,
      1. Press Stop only if Start and Stop are two keys, or press Reset.
      2. Adjust the alignment with the forms adjust control.
      4. Press Read, Start or Start/Stop.
      5. Type an R.


                                                              Bottom

Type reply, press Enter.
   Reply . . : _____
Press Enter to continue.
F3=Exit              F12=Cancel
```

Figure 5.15: Additional Message Information Screen, Continued

Caution — **We recommend that you (as system operator) *not* use option 4 (Remove) or the F16 function key on the Work with Messages screen (Figure 5.14) to remove messages that don't require a reply. These messages provide an audit trail for system activity (as does the job log). These messages provide copious information about system actions, and they let you review actions taken earlier that may have caused a current problem.**

Working with Printers

Most AS/400 installations have multiple printers connected to the system, and the status of each printer may be different. To look at printer status and to work with printers at the Intermediate assistance level,

1. From the Work with All Spooled Files screen, press F22 (Printers).
2. Press Enter to display the Work with All Printers screen (Figure 5.16).

```
                     Work with All Printers

Type options, press Enter.
  1=Start   2=Change   3=Hold   4=End   5=Work with   6=Release
  7=Display messages   8=Work with output queue


Opt  Device      Sts   Sep   Form Type   File     User      User Data
  _  PCUSER2S2   END
  _  PC19S2      END
  _  PRTMFG      STR   *FILE  *ALL




                                                              Bottom
Parameters for options 1, 2, 3, 4, 6 or command
===>_____
F3=Exit   F11=View 2   F12=Cancel   F17=Top   F18=Bottom   F24=More keys
```

Figure 5.16: Work with All Printers Screen

In the figure, two printer writers have a status of END. A printer writer may have a status of END for many reasons: The printer may need repairs; the printer could be stopped after regular hours for security reasons; or there could be an after-hours paper jam that no one was available to correct. To end a printer writer, use option 4 (End) on the Work with All Printers screen. Press

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Enter on the Confirm End of Writer screen. After a printer is stopped, it must be restarted before any output can be generated. Use option 1 (Start) to begin the process of activating the printer. Press F5 to refresh the screen. When the printer's status is changed to start, STR, the system is in the process of activating the printer.

A forms-alignment message may appear when the printing restarts. If the status changes to Message waiting, a forms-alignment message may require a response. Use option 7 (Display messages) to view the message and provide the appropriate response. Once the response has been accepted, the STR status will be shown.

Use option 3 (Hold) to hold the printer. All print jobs assigned to this printer are held. Printers that have been held have a status of *HLD or HLD.

To release the printers, use option 6 (Release) on the Work with All Printers screen. The status of the printer changes to RLS. Press F5 to refresh the screen, and the status changes to started, STR.

Use option 8 (Work with output queue) to change, hold, or release files on the output queue instead of having to work directly with the associated printer device.

Output Queues and Message Queues

Normally, an output queue exists for each printer on the system. Often, output queues have the same name as the printers on the system. These output queues are called default output queues. A system may have special output queues that don't have a printer name associated with them. For example, an output queue may be set aside for all printer output requiring special forms. As the system operator, you should check this queue periodically to decide when to assign reports to a printer and which forms are needed. Another output queue may be reserved for job logs.
To start a printer and assign it to a different output queue, type the STRPRTWTR (Start Printer Writer) command on a command line and press F4 to prompt. In the printer parameter, specify the name of the printer to start. In the Output queue parameter, specify the output queue name to use. If the output queue is not in the QGPL library or a library from your library list, type the name of the library and the output queue before the name of the output queue. For example, type **lib/xxxxxxxx** where *lib* is the name of the library and *xxxxxxxx* is the name of the output queue.

> **Tip**   **To change the characteristics of an output queue, use the CHGOUTQ (Change Output Queue) command.**

Output queue descriptions can affect how output prints. The Job separators parameter in the output queue description controls whether separator pages are printed between spooled files. Job separator pages provide identifying information about a spooled file. These pages are useful to help users locate their printed reports when many different people use a printer or when a printer generates a large volume of output.

The order of the spooled output files on a queue controls the sequence in which output prints. The Sequence parameter controls the sequencing of the output. New spooled files are put after others on the queue (first in, first out), or they may be put in order according to the time the job creating the output entered the system.

You may find that the volume of messages in the QSYSOPR message queue is quite large. If so, it may be helpful to separate the messages for each printer to a different message queue, especially if the printers are in remote locations. To temporarily change the message queue, start the printer using the STRPRTWTR (Start Printer Writer) command, press F4, and change the Message queue name parameter to a valid message queue on the system.

> **Tip**   **To permanently change where printer messages are located, use the WRKDEVD (Work with Device Description) command to specify the**

name of the printer whose message queue is to be changed and the new message queue/library name, as appropriate.

Troubleshooting Report Problems

The Work with All Spooled Files screen is very helpful in determining why a report isn't printing. Once you have located the spooled printer output on one of the displays, examine the Sts column to determine why that information isn't printing. For more information, use option 9 (Work with printing status) to view a more detailed status description than is available on other screens. The Work with Printing Status screen might also have more than one status message for the printer output. Use option 5 (Detailed description) on the Work with Printing Status screen for an explanation of the status and a list of alternative actions. This information can be helpful in solving any printer problems you might encounter.

A report may have already printed but have been distributed to the wrong person. In this case, you will want to display completed printer output. (The system must be configured to save information about completed printer output.) To display completed printer output from the Work with Printer Output screen, press F6 (Completed printer output). On the Display Completed Printer Output screen, sort the information using function key F10.

To further investigate why spooled output isn't printing, gather information about the job and the output, such as the job name. If the output was created interactively, the job name is the name of the workstation the person was using. If the output was created by a batch job, the job name is assigned on the SBMJOB (Submit Job) command. Other questions to consider include the following:

- What user ID was used to create the output?

- On which printer does the output usually print?

- Does it print on special forms?

- How many pages is it?

- What is the output name?

- When was the job run?

Based on the information you gather, where the report has been queued usually becomes obvious.

Chapter Summary

The AS400 operating system supplies the user with many tools to manipulate and control printer output. The Basic assistance level provides the beginner with easy-to-use screens to handle the simpler tasks. The Intermediate assistance level provides the more advanced user with additional information and options to manipulate and control printer output. A system operator's assistance level is determined by the amount of control that (s)he needs to perform assigned duties.

Key Terms

Basic assistance level

device description

device file

Intermediate assistance level

message queue

output queue

printer

print attributes

printer writer

qualified job name

spooled file member (spooled file)

Review Questions

1. How do you access the Operational Assistant at the Basic assistance level?
2. What criteria does the operating system use to select the next spooled output file for printing?
3. Why would you hold or release a spooled output file?
4. What is the difference between releasing a spooled output file and using option 10 to start printing?
5. If a user signs off his/her terminal when (s)he goes to lunch, how would this affect the printing of the user's spooled output files?
6. What is a printer writer? Why is it important?
7. In what situations would an operator need to change spooled output files to a different printer?
8. How do you stop a printer? Why would it be necessary to stop a printer?
9. Get two examples of common printer messages. Why do these messages occur?
10. What is the default output queue? Why does it exist?

Exercises

1. Hold and release a print job.
2. Stop a printer.
3. Restart a printer.
4. Change the output queue assigned to a spooled file.
5. Print more than one copy of a spooled file.

Chapter 6: Device Configuration

Chapter Overview

In this chapter, we explore the connectivity tasks that the system operator commonly performs, including setting up controllers, display devices, printers, tape drives, and optical drives. Then we walk you through

- working with line descriptions

- working with controller descriptions

- displaying device descriptions for existing hardware

- copying a device description

- creating device descriptions for new hardware

Network Topologies

All **devices** on the AS/400, whether physical or logical, must connect in some orderly fashion to ensure that all data and requests are passed to the CPU and processed in sequence. The arrangement for passing data between the CPU and the user is referred to as the system's topology. Communications are passed via lines, line controllers, and device addresses; finally, a connection to the device is established. Because communications and connectivity is a complex subject, we discuss only the three most common network topologies in this chapter.

A computer network is a collection of computer nodes physically connected by a suitable communications medium. A computer node can be a PC, a computer workstation, a minicomputer (such as the AS/400), or a larger computer system (e.g., a mainframe). The arrangement and connection of these network nodes is referred to as the network topology. The three common network topologies are bus, ring, and star (Figure 6.1).
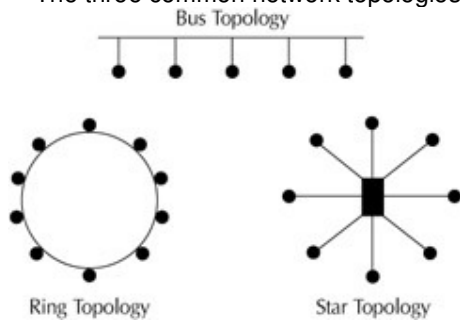
Figure 6.1: Common Network Topologies

In a **bus topology**, one network node is connected to another by a single cable until the last node is reached; a bus network has two distinct ends. The original method for attaching PC workstations or display stations to an AS/400 was a direct connection using twinaxial cable in a bus topology that is attached to a port. The port, in turn, attaches to a line extending out of the AS/400 (see Figure 6.2).
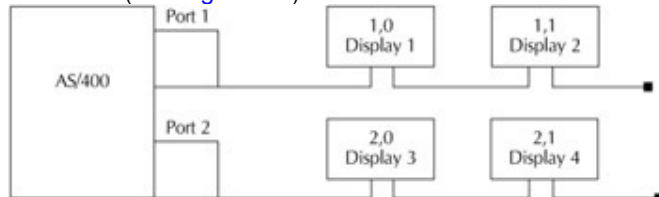
Figure 6.2: Relationship Among the CPU, Ports, and Devices

Each display terminal or PC workstation is attached to an adapter that physically attaches to the twinaxial cable. The number of ports available depends on the AS/400 model and the hardware purchased. Many installations still use this method; it is the most common approach to connecting display terminals to an AS/400.

Twinaxial data link control (TDLC) is a direct link to an AS/400 using twinaxial cable. The TDLC link is configured with a bus topology. Other types of bus topology are available. Synchronous data link control (SDLC) is generally used for communications between two remotely connected computers. The sending and receiving stations are commonly connected with each other, usually through telephone lines.

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In a **ring topology**, the connections come full circle; in other words, the last node is connected to the first node to form a complete ring. Token-Ring networks send data in one direction throughout the ring by using a symbol of authority (a specialized transmission frame, consisting of starting, ending, and controlling bit sequences) called a token. The token controls the transmission - stations in the network send or receive data only when they hold the token. The flow of the token is a logical ring, so the token always ends up at the originating system. Think of the token as a person who delivers the mail to your house and returns to the post office when all the mail has been delivered. When the mail carrier comes to your mail box, you can send and/or receive mail. If you place a letter in your mail box after the mail carrier has passed your house, your letter must wait until the next day. Token-Ring topology uses this same concept; of course, Token-Ring is much faster.

In a **star topology**, the most commonly used setup, a main server or hub handles the communications, and all the nodes are attached to the main server or hub. Each workstation connects directly to a port, providing exceptionally fast access. The AS/400 "listens" for the user to press the Enter key. When the AS/400 "hears" the request, it responds almost immediately.

Ethernet networks frequently use the star topology or a combination of topologies in a PC LAN. An Ethernet network remains inactive until a response is requested from the server or workstation.

Once the particular topology has been selected, you need lines, controllers, and device addresses before a device can be connected and communications established with users.

Note	**The type of cable used determines the type of adapter installed on a PC workstation. Display terminals are connected with twinaxial cable. PC workstations may be connected using other media. Telephone wires, coaxial cable, and twisted pair cable are all commonly used in a network environment. Telephone lines are generally used to connect computers not physically located in the same geographic location. Satellites and optical fiber may be used also for Wide Area Networks (WANs). Coaxial cable and twisted pair cable are used for Local Area Networks (LANs) where computers are located in the same building or complex. In many large organizations, a combination of media is used to service multiple offices within a company.**

Lines, Controllers, and Addresses

Before a device will function on an AS/400, there must be a description of the line, controller, and device; and a unique address must be provided for each workstation and printer. To use a line, controller, or device on an AS/400, the line, controller, or device must be made available for use (**varied on**). If a line is **varied off**, it isn't available to any of the other controllers or devices that use that line. Figure 6.3 displays the hierarchy of the relationship among lines, controllers, and devices.
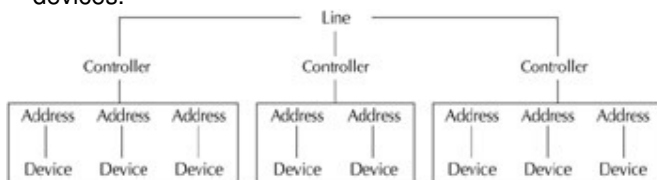
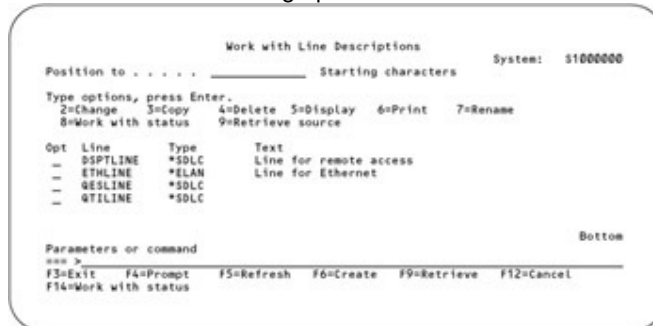**Figure 6.3:** Relationship Among Lines, Controllers, and Devices

Lines

Lines are the first level of connection from the AS/400. Most systems have multiple lines linking the AS/400 to its devices. Lines can be actual cables, phone lines, or other types of lines. Because lines come in a variety of types, each line must have a line description, an object that describes the attributes of a communications line for another system, controller, or network. An individual line may have more than one line description, but only one line description can be

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varied on at a time. There are different categories of lines for different types of communications; for example a Token-Ring line is type *TRLAN and an Ethernet line description is *ELAN.

To work with line descriptions,
1. Type **WRKLIND** on a command line if you aren't on the Operational Assistant menu.
2. Press Enter to bring up a screen similar to the one in Figure 6.4.


```
                        Work with Line Descriptions
                                                    System:   S1000000
        Position to . . . . .  _____  Starting characters

        Type options, press Enter.
          2=Change    3=Copy   4=Delete  5=Display   6=Print    7=Rename
          8=Work with status   9=Retrieve source

        Opt  Line       Type     Text
          _  DSPTLINE   *SDLC    Line for remote access
          _  ETHLINE    *ELAN    Line for Ethernet
          _  GESLINE    *SDLC
          _  GTILINE    *SDLC


                                                             Bottom
        Parameters or command
        === >
        F3=Exit    F4=Prompt    F5=Refresh   F6=Create   F9=Retrieve   F12=Cancel
        F14=Work with status
```

Figure 6.4: Work with Line Descriptions Screen

As you can see in Figure 6.4, the Work with Line Descriptions screen lists the lines attached to an AS/400. Several options are available to work with and control these lines. You use option 5 (Display) to display the line description attributes. The attributes listed will vary according to line category or type. To work with the status of a line, you use option 8 (Work with status) or press F14.

Controllers

Controllers are a combination of a hardware card and software programs designed to handle a certain level of device transmission traffic. Think of controllers as traffic cops. A traffic cop lets a certain number of cars pass though an intersection then stops the traffic, giving the converging cars their turn at crossing through the intersection. Controllers have a similar function - they monitor traffic to allow all the devices access to the CPU. A controller handles the hardware devices unique to a particular line, whether the devices are remote or local. Because controllers can support a variety of devices, a controller description is required to define the type of physical devices that the controller will be handling.

Line and controller descriptions are created as part of your AS/400 installation; the descriptions vary depending on the type of communications hardware installed for connectivity. Display terminals, sometimes referred to as dumb terminals, may share a controller if attached on a twinaxial bus. PC workstations using Advanced Program to Program Communications (APPC) use a controller assigned specifically to that workstation. System operators aren't generally responsible for maintaining and creating these descriptions. On the other hand, devices are added or removed frequently, for many reasons, such as maintenance. And often it is the system operator's job to maintain and control the changing of these devices.

Addresses

An AS/400 **address** is a means of uniquely identifying each device attached to the system. (In Figures 6.2 and 6.3, note that each device has a unique address.) The method used in identifying the appropriate address again is determined by the connection method.

An AS/400 twinaxial connection address consists of two parts: a port and a switch setting. The **port** is the place where the line is physically attached to the AS/400. The switch setting uniquely identifies each device along the line.

        Tip   **The twinaxial address is much like a street address, which includes a house number and a street name, such as 1000 College Drive. In computer terms, addresses are reversed, with the street name (port**

**number) first and the house number (switch setting) last, such as
College Drive, 1000.**

Two devices on the same line can't have the same switch setting. As long as a switch setting isn't duplicated on a line, devices may be attached in any order. The address for a display terminal connected through a twinaxial bus topology is listed in the device description for that display terminal.

An AS/400 Ethernet or Token-Ring connection address is the address associated or assigned to the network adapter installed on each workstation. The address isn't determined by the same means as a twinaxial connection address. Organizations use different addressing schemes to create or assign network addresses to network adapters. The address of a computer attached to an AS/400 using APPC is included in the controller associated with that workstation or computer. To view a Display Controller Description screen similar to the one in Figure 6.5,

1. Type **WRKCTLD** on any command line.

2. Press Enter to bring up the Work with Controller Descriptions screen.
3. Type **5** in the option column of an *APPC type controller description.

4. Press Enter, then Page down to view additional parameters.

```
                    Display Controller Description          S00000000
                                              02/05/00  17:01:00
Controller description . . . . . :    PC01
Option . . . . . . . . . . . . . :    *BASIC
Category of controller . . . . . :    *APPC

Link type  . . . . . . . . . . . :    *LAN
Online at IPL  . . . . . . . . . :    *YES
Character code . . . . . . . . . :    *EBCDIC
Maximum frame size . . . . . . . :    16393
Current maximum frame size . . . :    521
Remote network identifier. . . . :    ASIA
Remote control point . . . . . . :    AMEBA
Initial connection . . . . . . . :    *DIAL
Dial initiation  . . . . . . . . :    *LINKTYPE
Switched disconnect  . . . . . . :    *NO
Data link role . . . . . . . . . :    *NEG
LAN remote adapter address . . . :    0060069B7442
                                                           More...

Press Enter to continue.

F3=Exit   F11=Display keywords   F12=Cancel
```

Figure 6.5: Display Controller Description, Additional Parameters

Figure 6.5 displays the description for PC01, an APPC category of controller, with the LAN remote adapter address of 0060069B7442. The LAN remote adapter address parameter is unique within a LAN.

| Note | **APPC lets a program on one AS/400 execute actions, such as run applications or access databases, on a remote computer system. APPC provides peer-to-peer communications in a Systems Network Architecture (SNA) environment. Programs on separate computers on a network can work together to accomplish a single task, such as sending and receiving e-mail or running a query on a database using a Windows 95/NT workstation to process data located on an AS/400.** |

Devices

A **device description** contains the attributes and characteristics of the device it describes. Because the AS/400 is capable of supporting a variety of devices (e.g., workstations, printers, or tape drives), each device requires a device description. The device description provides a connection between a physical (or logical) device and the AS/400 with which it is communicating. The device description includes the type of device, the name of the controller to attach with, and additional attributes associated with the category or type of device described.
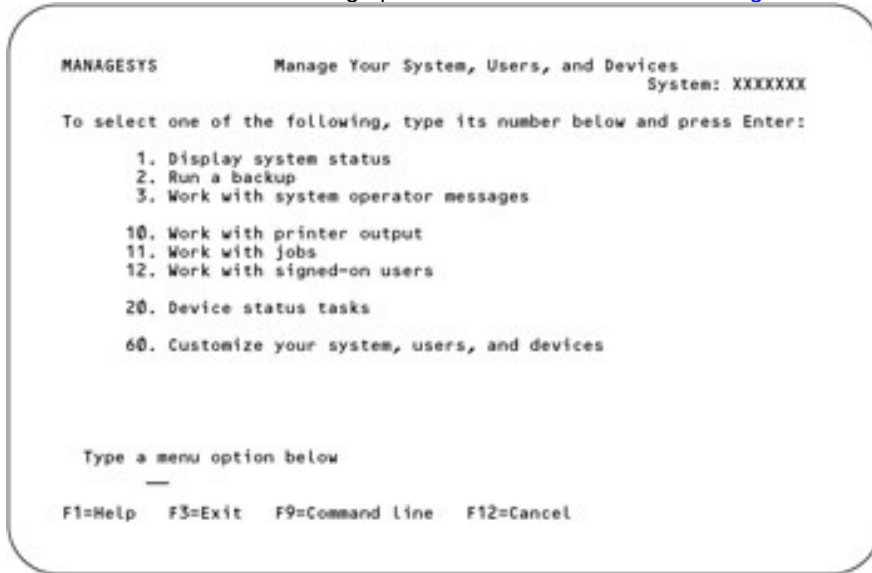
| Note | **Virtual devices are automatically created to form a connection between a user and a physical workstation attached on a LAN or remote system. A** virtual device **is a logical device description that isn't associated with a piece of hardware. Unlike other devices, a virtual device isn't automatically varied on and ready for use after an IPL. A** |

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virtual device is automatically varied on when a user accesses it for the first time after an IPL. PC workstations use virtual device descriptions. A PC device description lists the type and model of the physical device that the PC emulates.

Operational Assistant offers an easy menu-driven way to manage and view the various devices:
1. Type **GO ASSIST** if you aren't on the Operational Assistant menu.

2. Press Enter.
3. Type **10** for the Manage your system, users, and devices option.
4. Press Enter to bring up a screen similar to the one in Figure 6.6.

```
MANAGESYS           Manage Your System, Users, and Devices
                                          System: XXXXXXX

To select one of the following, type its number below and press Enter:

      1. Display system status
      2. Run a backup
      3. Work with system operator messages

      10. Work with printer output
      11. Work with jobs
      12. Work with signed-on users

      20. Device status tasks

      60. Customize your system, users, and devices




   Type a menu option below

      __

 F1=Help   F3=Exit   F9=Command Line   F12=Cancel
```

Figure 6.6: Manage Your System, Users, and Devices Screen
Table 6.1 describes the options available on the Manage Your System, Users, and Devices screen in Figure 6.6.

Table 6.1: Options on the Manage Your System, Users, and Devices Screen	
Option	**Description**
1=Display system status	Lets you look at the system status, displaying such things as disk space, users, and batch jobs.
2=Run a backup	Lets you run a daily, weekly, or monthly backup with other IBM backup options. We discuss backup and restore in Chapter 7.
3=Work with system operator messages	Lets you display and work with the system operator messages (see Chapter 4).
10=Work with printer output	Lets you send, change, hold, delete, display, release, or modify attributes related to printing status with the spooled files (see Chapter 5).
11=Work with jobs	Lets you hold, delete, release, display messages, and work with printer output on all jobs in the system (see Chapter 4).
12=Work with signed-on users	Lets you send messages, sign off users, display details, and display messages of all users who are signed on at the time (see Chapter 4).

Table 6.1: Options on the Manage Your System, Users, and Devices Screen	
Option	**Description**
20=Device status tasks	Lets you work with the devices in the system, such as display devices, printers, tape devices, and optical devices.

Device Status

Devices can be turned on or off and disconnected from the system to be repaired or upgraded. Generally, the system operator is responsible for controlling the various states of these hardware devices.

To access the Device Status Task menu (Figure 6.7) from the Operational Assistant menu, type **20** and press Enter.

```
DEVICESTS                    Device Status Task
                                          System: XXXXXXX

To select one of the following, type its number below and press Enter:

        1. Work with display devices
        2. Work with printer devices
        3. Work with tape devices
        4. Work with diskette devices

       10. Print local device addresses




    Type a menu option below
       __

    F1=Help   F3=Exit   F9=Command Line   F12=Cancel
```
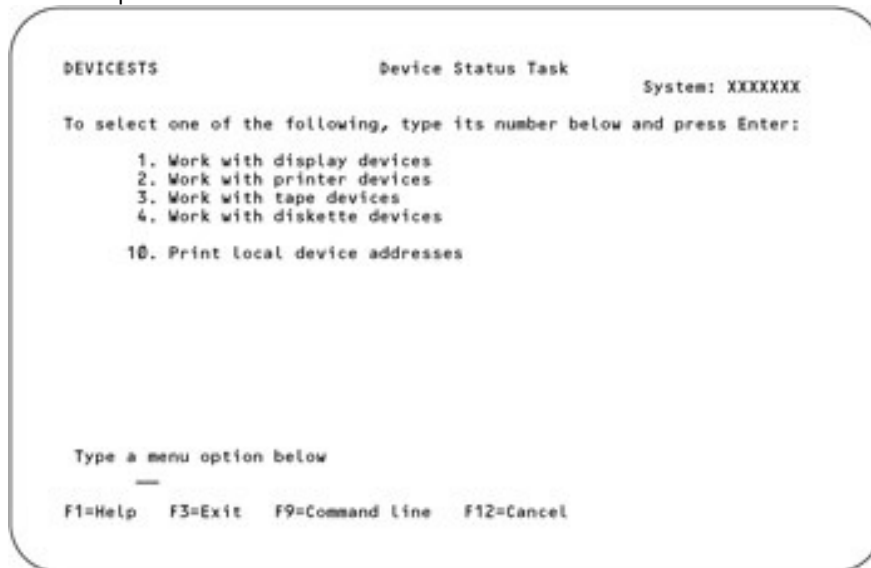
Figure 6.7: Device Status Task Menu

As you can see in Figure 6.7, the Device Status Task menu subdivides hardware devices into display devices, printer devices, tape devices, and diskette devices.

Note   **Diskette drives aren't common on the newer models of AS/400s. Because PCs are increasingly used as workstations, it is easiest to copy files to a diskette through the workstation diskette drive.**

Tip   **In the following discussion, to view the screens with more specific information, you must be at the Intermediate assistance level. While you are displaying one of the screens, you can change your assistance level by pressing F21 and choosing option 2.**

Device Status for Display Devices

To access the Work with Configuration Status screen for display devices (Figure 6.8), on the Device Status Task screen, type **1** and press Enter. As you can see in Figure 6.8, the Work with Configuration Status screen for display devices contains the status of each display device on the system. You can make a display device available (varied on) or unavailable (varied off) by typing a 1 or a 2 in the option column of the display device. You can use these options to enhance security. For example, at the end of the work day, you can vary off display devices in a public place to make them unavailable during the evening and night hours. Of course, you'll need to vary on the devices in the morning, making them available for the first shift. Varying a device on

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or off takes some time to complete; the system displays the VARY ON PENDING or VARY OFF PENDING message until the device status has changed.

```
                     Work with Configuration Status          S0000000
                                              02/05/00   15:51:03
    Position to . . . . . _____     Starting characters

    Type options, press Enter.
      1=Vary on   2=Vary off      5=Work with job     8=Work with description
      9=Display mode status      13=Work with APPN status

    Opt  Description          Status           -------------- Job --------------
      _    DSP01              ACTIVE           OPERATOR    QSYSOPR      567833
      _    DSP02              ACTIVE
      _    PC01               RCYPND
      _    PC02               SIGNON DISPLAY
      _    PC15               VARY ON PENDING
      _    PC05               ACTIVE
      _      QPCSUPP          ACTIVE/TARGET    QXFSERV     USERID       567835
      _      QPCSUPP          ACTIVE/TARGET    PC05        USERID       567836



                                                             More ...
    Parameters or command
    ===>  _____
    F3=Exit  F4=Prompt  F12=Cancel  F23=More options  F24=More keys
```

Figure 6.8: Work with Configuration Status Screen (Displays)

You should encourage your users to sign off their workstations whenever they will be gone for any length of time, such as to lunch or to a meeting. Again, this technique enhances system security. When a user has signed off but has left the workstation powered on, the workstation status is SIGNON DISPLAY.

Note in Figure 6.8 that the status of ACTIVE may be further defined (e.g., ACTIVE/TARGET). The variations for ACTIVE include ACTIVE/TARGET, ACTIVE/ALLOCATE, ACTIVE/DETACHED, ACTIVE/READER, ACTIVE/SOURCE, and ACTIVE/WRITER. The jobs that have ACTIVE further defined are generally jobs that are called automatically and are required for support or as a supplement to another job that is running.

The recovery pending (RCYPND) status indicator is generated when the system has noted an error and has automatically started an error-recovery task. Generally, these error-recovery tasks are for network interfaces, lines, and controllers. The system frequently can correct the problem and the RCYPND status indicator will be replaced with VARY ON PENDING.

The three columns on the right in Figure 6.8, under the Job heading, show three items of information. These three items are the same ones that make up the qualified job name. For interactive jobs, the first column contains the terminal or station number. For batch jobs, the job name will be the name of the batch job. The second column contains the user ID or user sign-on name. The last column contains the job number - a six-digit numeric number assigned automatically by the system.

Device Descriptions for Displays

Display device descriptions fall into several broad categories: terminals, PCs with terminal emulation, remote devices, and the system console. A system operator typically spends a large portion of time working with display devices. Because these devices provide the user with input and output capabilities to the system, the *IOSYSCFG special authority is required to work with devices.

To work with a display device description,
1. On the Work with Configuration Status screen, type **8** on the option line for the device to be displayed (in this example, OPERATOR).

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2. Press Enter to bring up the Work with Device Description screen.
3. Type **5** to display the description.
4. Press Enter to bring up the first page of the Display Device Description screen (Figure 6.9).

```
                    Display Device Description
                                                        XXXXXXX
                                               04/06/00  10:05:34

        Device description . . . . . . . . . :   OPERATOR
        Option . . . . . . . . . . . . . . . :   *BASIC
        Category of device . . . . . . . . . :   *DSP
        Device class . . . . . . . . . . . . :   *LCL
        Device type  . . . . . . . . . . . . :   3476
        Device model . . . . . . . . . . . . :   EA
        Port number. . . . . . . . . . . . . :   0
        Switch setting . . . . . . . . . . . :   0
        Online at IPL  . . . . . . . . . . . :   *YES
        Attached controller. . . . . . . . . :   CTL01
        Keyboard language type . . . . . . . :   USB
        Character identifier . . . . . . . . :   *KBDTYPE
        Allow blinking cursor  . . . . . . . :   *YES
        Print device . . . . . . . . . . . . :   *SYSVAL
        Output queue . . . . . . . . . . . . :   *DEV

                                                        More...
        Press Enter to continue

        F3=Exit   F11=Display keywords   F12=Cancel
```

Figure 6.9: Display Device Description Screen for OPERATOR, Page 1

The name of the device is OPERATOR, and the category of the device is a standard 3476 terminal (*DSP) that is directly cabled to the CPU as a local device (*LCL). The next several parameters give the device type and model number.

The second page of the Display Device Description screen (Figure 6.10) repeats the first three lines of the device name, option, and device category for clarification. The new data on this screen describes the default printer and any customizing performed on this device.

```
                    Display Device Description
                                                        XXXXXXX
                                               04/06/00  10:05:34

        Device description . . . . . . . . . :   OPERATOR
        Option . . . . . . . . . . . . . . . :   *BASIC
        Category of device . . . . . . . . . :   *DSP
        Printer file . . . . . . . . . . . . :   QSYSPRT
          Library . . . . . . . . . . . . . :     *LIBL
        Workstation customizing object . . . :   *NONE
        Text . . . . . . . . . . . . . . . . :   CREATED BY AUTO-CONFIGURATION

                                                        Bottom
        Press Enter to continue

        F3=Exit   F11=Display keywords   F12=Cancel
```

Figure 6.10: Display Device Description Screen for OPERATOR, Page 2

Each display device has a unique device description. Figure 6.11 shows the device description for STAT14, another local terminal device. Local terminal devices are those devices that have a port and switch address - in this example, port 5, switch 3. Local devices are generally connected to the AS/400 via a twinaxial cable. These devices have a device class of local (*LCL). This particular display device is attached to the CTL02 controller.

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```
                   Display Device Description
                                            xxxxxxx
                              04/06/00  10:06:45

  Device description . . . . . . . . :   STAT14
  Option . . . . . . . . . . . . . . :   *BASIC
  Category of device. . . . . . . . :    *DSP
  Device class . . . . . . . . . . . :   *LCL
  Device type  . . . . . . . . . . . :   3476
  Device model  . . . . . . . . . . :    EA
  Port number . . . . . . . . . . . :    5
  Switch setting  . . . . . . . . . :    3
  Online at IPL . . . . . . . . . . :    *YES
  Attached controller . . . . . . . :    CTL02
  Keyboard language type . . . . . . :   USB
  Character identifier . . . . . . . :   *KBDTYPE
  Allow blinking cursor  . . . . . . :   *YES
  Print device . . . . . . . . . . . :   *SYSVAL
  Output queue . . . . . . . . . . . :   *DEV


                                            More...

  Press Enter to continue

  F3=Exit   F11=Display keywords   F12=Cancel
```

Figure 6.11: Display Device Description Screen for STAT14

Device Status for Printers

Generally, the AS/400 has a variety of printers connected to it. To bring up the Work with Configuration Status screen for printers (Figure 6.12),

> 1. From the Display Device Description screen, press F12 repeatedly until the Device Status Tasks menu is again displayed.
>
> 2. Type **2** for the Work with printer devices option.
>
> 3. Press Enter.

```
                Work with Configuration Status
                                            xxxxxxx
                              04/06/00  10:07:16

  Position to  . . . . . _____      Starting characters

  Type options, press Enter.
    1=Vary on   2=Vary off   5=Work with job   8=Work with description
    9=Display mode status ...

  Opt  Description      Status         --------------Job--------------
  __   LASER            VARIED OFF
  __   PRTACT           ACTIVE/WRITER     PRTACT    QSPLJOB    049041
  __   PRTMFG           VARY ON PENDING


                                            Bottom
  Parameters or command
  ===>
  F3=Exit   F4=Prompt   F12=Cancel   F23=More options   F24=More keys
```

Figure 6.12: Work with Configuration Status Screen (Printers)

Figure 6.12 shows three printers. We recommend that your printer names be descriptive to help differentiate among similar printers at different locations. In Figure 6.12, two of the printers are named by location, with one in the accounting department and the other on the manufacturing floor.

Device Description for Printers

A printer, like every other device attached to the AS/400, must have a device description to identify its attributes to the AS/400. To work with a printer device description,

> 1. On the Work with Configuration Status screen, type **8** on the option line for the printer (in this case PRTACT).
>
> 2. Press Enter to bring up the Work with Device Description screen.
> 3. Type **5** to display the device description.

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4. Press Enter to bring up the first page of the Display Device Description screen for PRTACT (Figure 6.13).

```
                        Display Device Description
                                                    XXXXXXX
                                           04/06/00  10:07:43
        Device description  . . . . . . . . :   PRTACT
        Option  . . . . . . . . . . . . . . :   *BASIC
        Category of device. . . . . . . . . :   *PRT
        Device class  . . . . . . . . . . . :   *LCL
        Device type . . . . . . . . . . . . :   *IPDS
        Device model. . . . . . . . . . . . :   0
        Advanced function printing. . . . . :   *NO
        Port number . . . . . . . . . . . . :   1
        Switch setting  . . . . . . . . . . :   0
        Online at IPL . . . . . . . . . . . :   *YES
        Attached controller. . .  . . . . . :   CTL01
        Font:
           Identifier . . . . . . . . . . . :   011
           Point size. . . . . . . . . . . . :   *NONE
        Form feed . . . . . . . . . . . . . :   *CONT



                                                    More...

        Press Enter to continue

        F3=Exit   F11=Display keywords   F12=Cancel
```

Figure 6.13: Display Device Description Screen for Printer PRTACT, Page 1

As you can see in Figure 6.13, printer PRTACT is locally attached (*LCL). It communicates through the CTL01 controller. Note the Port number and Switch setting parameters. Unlike tape units and optical drives, printers attached locally must have an address, like a workstation.

On page 2 of the Display Device Description screen for PRTACT (Figure 6.14), notice the Text parameter. It indicates that the system used auto-configuration to generate the device description.

```
                        Display Device Description
                                                    XXXXXXX
                                           04/06/00  10:07:43
        Device description . . . . . . . . . :   PRTACT
        Option . . . . . . . . . . . . . . . :   *BASIC
        Category of device . . . . . . . . . :   *PRT
        Separator drawer . . . . . . . . . . :   *FILE
        Printer error message. . . . . . . . :   *INQ
        Message queue  . . . . . . . . . . . :   QSYSOPR
           Library  . . . . . . . . . . . . . :   *LIBL
        Text . . . . . . . . . . . . . . . . :   CREATED BY AUTO-CONFIGURATION



                                                    Bottom

        Press Enter to continue

        F3=Exit   F11=Display keywords   F12=Cancel
```

Figure 6.14: Display Device Description Screen for Printer PRTACT, Page 2

Device Status for Tape Devices

For most standalone PCs, backup consists of copying files to a floppy drive. While this approach to backup may be inconvenient for the PC user, it is manageable. However, with the AS/400's single-level approach to memory storage and the large volume of objects stored on the CPU, tape backup becomes a more efficient option so, as system operator, you may find yourself working with tape devices.

To display the device description screen for a tape device,
1. From the Display Device Description screen for printer PRTACT, press F12 repeatedly until the Device Status Tasks menu is again displayed.
2. Type **3** for the Work with tape devices option.
3. Press Enter to bring up the Configuration Status screen in Figure 6.15.

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```
                    Work with Configuration Status
                                              XXXXXXX
                                     04/06/00  10:08:15

    Position to  . . . . . _____    Starting characters

    Type options, press Enter.
      1=Vary on   2=Vary off   5=Work with job   8=Work with description
      9=Display mode status ...

    Opt  Description     Status          --------------Job--------------
     __   TAP01          VARIED ON


                                                Bottom
    Parameters or command
    ===>
    F3=Exit   F4=Prompt   F12=Cancel   F23=More options   F24=More keys
```

Figure 6.15: Work with Configuration Status Screen (Tape Devices)

    4. Type **8** on the option line of the device to be displayed (in this example, TAP01).

    5. Press Enter to bring up the Work with Device Description screen.
    6. Type **5** to display the device description.
    7. Press Enter to bring up the bring up the Display Device Description screen for TAP01 (Figure 6.16).

```
                    Display Device Description
                                              XXXXXXX
                                     04/06/00  10:08:24
    Device description . . . . . . . . . :   TAP01
    Option . . . . . . . . . . . . . . . :   *BASIC
    Category of device . . . . . . . . . :   *TAP
    Device type  . . . . . . . . . . . . :   6341
    Device model . . . . . . . . . . . . :   0001
    Resource name  . . . . . . . . . . . :   TAP01
    Online at IPL  . . . . . . . . . . . :   *YES
    Message queue. . . . . . . . . . . . :   QSYSOPR
      Library  . . . . . . . . . . . . . :     *LIBL
    Text . . . . . . . . . . . . . . . . :   *BLANK




                                                Bottom

    Press Enter to continue

    F3=Exit   F11=Display keywords   F12=Cancel
```
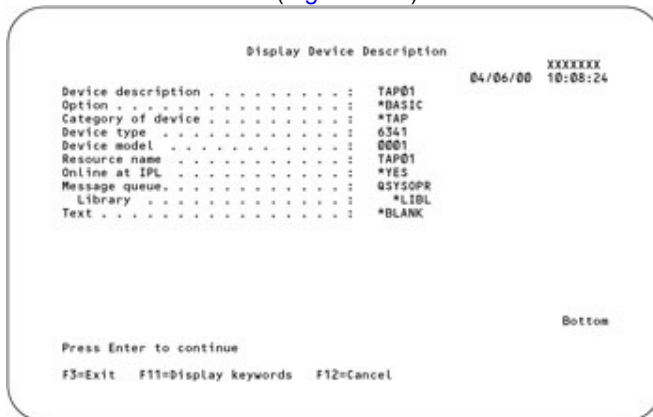
Figure 6.16: Display Device Description Screen (Tape Devices)

Tape devices must be varied on like other devices on the AS/400. You can modify the status of the device from the Work with Configuration Status screen (Figure 6.15).

In Figure 6.16, you can see that the name of the device is TAP01, and it's a 6341 tape device that comes online at IPL. The device description doesn't display or require a local address because tape drives are directly connected via a controller card, through a special address called a resource name.

Note that the Text parameter is blank. Unlike the printer device description above, this tape device description wasn't generated by auto-configuration. However, you can enter text when you create the tape device description.

Device Status for Optical Drives

The AS/400 supports three categories of optical media, CD-ROM, WORM, and erasable optical cartridge. Optical storage is a practical way of upgrading OS/400 and applying program temporary fixes (PTFs). It's faster than most tape drives and may be used efficiently to archive data. Like all other devices connected to an AS/400, the device description for the optical device

must be varied on before it may be accessed. The optical device may be managed from the Work with Configuration Status screen in the same manner as other devices.

1. Type **WRKDEVD** on any command line.

2. Press F4 to prompt the Work with Device Descriptions command.
3. Type ***OPT** as the device description.

4. Press Enter to bring up the Work with Device Description screen.
5. Type **5** in the option column next to the optical device description.
6. Press Enter to bring up the Display Device Description screen for the optical device (Figure 6.17).
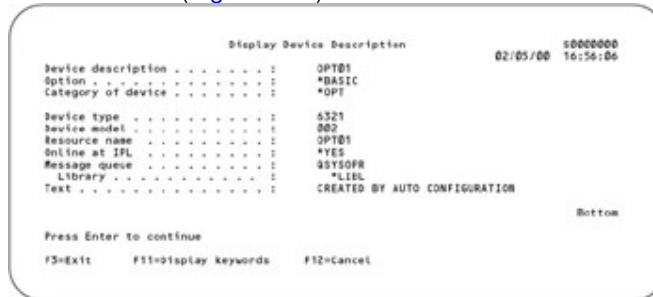
Figure 6.17: Display Device Description Screen (Optical Devices)

Figure 6.17 displays the information for an optical drive named OPT01 of category *OPT. The Online at IPL parameter is set to *YES, indicating that the optical drive is varied on during IPL. The Text parameter indicates that the device description was created by the auto-configuration feature of OS/400.

Adding New Devices

Before you add new devices to the AS/400, you should first document your system hardware. Draw a layout of the physical location of your local devices. Include in your documentation the type of devices attached to your network and the device addresses. You can use various forms located in your AS/400 Device Configuration Guide to document your hardware information. You will find these forms to be exceptionally helpful, but you need to be sure to keep them up-to-date. If devices are moved or replaced, update all related forms.

Now that you are comfortable with the concept of device descriptions and how to access existing descriptions, the next question is, "How are descriptions created?" Several methods are available to configure devices. As you've seen above, the AS/400 can configure devices automatically. For automatic configuration, the system value QAUTOCFG must be set to 1 (on). As the system operator, you will plug in a new device and ensure the device is turned on; the AS/400 will then configure the device and vary it on during the next IPL.

Automatic configuration has several disadvantages. If you leave the QAUTOCFG system value on, each IPL sequence may create extraneous device descriptions for devices that are powered on. This understandably creates confusion for system operators and system staff. We recommend that you turn off auto-configuration immediately after a device description has been created. To turn auto-configuration off, change the QAUTOCFG system value to 0.

Another disadvantage of automatic configuration is that you have no control over the name assigned to the device. The system assigns a name that probably means nothing to you. You will usually find it more convenient to have device names that are easy to identify for later problem resolution. The AS/400 lets you change object names with the RNMOBJ (Rename Object) command, but renaming is an extra step.

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Copying Device Descriptions for Display Stations

Configuring devices manually is frequently faster than auto-configuration, and manual configuration also lets you provide meaningful names for the new devices. If you need to configure a display station that is the same type as one that already exists, you can copy the description of the existing display station and change the old address to the appropriate address for the new device.

To display the Work with Device Descriptions screen in Figure 6.18, type **WRKDEVD** on a command line and press F4 to prompt.

Figure 6.18: Work with Device Descriptions Screen

In large AS/400 shops, the Work with Device Descriptions screen may be many pages long. Prompting the WRKDEVD command lets you choose the specific types of device descriptions to work with, filtering out the others. This gives you a more user-friendly working environment.

To select a specific device type, on the Work with Device Descriptions screen, press F4 again to prompt the Device description parameter (Figure 6.19).

Figure 6.19: Specifying a Value for the Device Description Parameter

As Figure 6.19 shows, many different types of devices can be attached to the AS/400. As you might expect, the device descriptions are either three-or six-character words. To specify a device description for a display station,

1. Type **DSP** as the value for the Device description parameter.

2. Press Enter to bring up the Work with Device Description screen for display devices.

Let's say you want to copy the device description for a display device named TEST. You would type 3(Copy) in the option column of device description TEST and press Enter.

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When you copy the device description, you must provide a new name and new address for the new device, as shown in Figure 6.20.

```
                  Create Device Desc (Display) (CRTDEVDSP)

   Type choices, press Enter.

      Device description . . . . . . .              Name
      Device class . . . . . . . . . . >  *LCL      *LCL, *RMT, *VRT, *SNPT
      Device type . . . . . . . . . . >  5476      3101, 3151, 3161, 3162...
      Device model . . . . . . . . . . >  EA       0, 1, 2, 4, 11, 12, 23...
      Port number . . . . . . . . . . >  5         0-17
      Switch setting . . . . . . . . . >  6         0, 1, 2, 3, 4, 5, 6
      Online at IPL . . . . . . . . . >  *YES      *YES, *NO
      Attached controller . . . . . . >  CTL02     Name
      Keyboard language type . . . . . >  USB       *SYSVAL, AGB, AGI, BLI...
      Allow blinking cursor . . . . . >  *YES      *YES, *NO
      Text 'description' . . . . . . . >  *BLANK


                                                          More...

   F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
   F13=How to use this display        F24=More keys
```

Figure 6.20: Copying a Device Description

You must name the new device and change the Port number and Switch setting parameters to the correct address of the new device. Device addresses must be unique. To name the new device TEST2 and change its port number to 5 and its switch setting to 6,

1. Type **TEST2** for the Device description parameter.
2. Type **5** for the Port number parameter.
3. Type **6** for the Switch setting parameter.

4. Press Enter.

Manually Creating a Device Description
If you choose to, or need to, create a display station description because one doesn't exist to copy, you can type **CRTDEVDSP** (Create Device Description Display) on the command line and press Enter to bring up a screen similar to Figure 6.21. After you have completed entering the parameters, press Enter.

```
                  Create Device Desc (Display) (CRTDEVDSP)

   Type choices, press Enter.

      Device description . . . . . . .   _____   Name
      Device class . . . . . . . . . .   _____   *LCL, *RMT, *VRT, *SNPT
      Device type . . . . . . . . . .   _____   3101, 3151, 3161, 3162...
      Device model . . . . . . . . . .   _____   0, 1, 2, 4, 11, 12, 23...








                                                          Bottom

   F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
   F13=How to use this display        F24=More keys
```
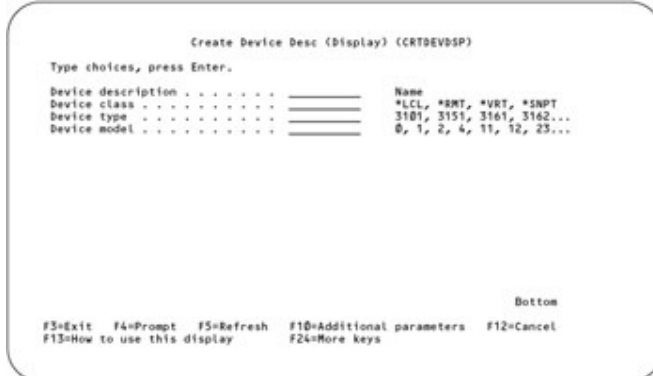
Figure 6.21: Create Device Desc (Display) (CRTDEVDSP) Screen

Now that OS/400 is prepared for a new display station, the display station itself must be programmed. Locate the documentation that accompanied the hardware to find out how to access the address screen. Some of the newer IBM models require that you hold the space bar down while the device is powering on. Other older IBM display stations or System/36 display stations require you to adjust actual physical switches on the device. When the address screen is available, enter the same port and switch setting that you defined on the Create Device Description screen.

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After configuring the display station and setting the address, turn off the power and then turn it on again. Go to an operator's console and vary the new device on. Use the Work with Device Description display to verify that the new device has varied on. Type **8** on the Work with Device Descriptions screen next to the device you varied on (or type **WRKCFGSTS** on the command line if you aren't on the Work with Device Descriptions display), then press Enter.

Troubleshooting

If the newly installed display station won't vary on, ensure that the following steps have been successfully completed:

1. Create the device description, including selecting a unique port and switch address.

2. Assign the same port and switch address to the display station address screen.

3. Vary on the device.

If the display station still won't vary on, it is possible that the controller isn't active. The controller for the port must be active for the devices attached to it to function. In Figure 6.22, CTL02 is the description for the controller that handles display station TEST2.

```
                    Work with Configuration Status          XXXXXXX
                                                            03/06/00
     Position to . . . . . _____    Starting characters _____

     Type options, press Enter.
       1=Vary on   2=Vary off   5=Work with job   8=Work with description
       9=Display mode status ...

     Opt  Description      Status            --------------Job--------------
          CTL02            ACTIVE
          TEST2            VARY OFF PENDING




                                                            Bottom
     Parameters or command
     ===> _____
     F3=Exit  F4=Prompt  F12=Cancel   F23=More options   F24=More keys
```

Figure 6.22: Work with Configuration Status Screen

Type a **1** (Vary on) next to the controller name. When the controller is shown as ACTIVE, type **1** next to the display device to vary it on. The new display station should now be ready for use.

Adding a PC Workstation

Adding a PC workstation connection to an AS/400 involves different connectivity steps from those for adding a display station because PC workstations may connect using several different types of connectivity solutions. These solutions determine the connectivity steps involved in establishing communications with the AS/400. In Chapter 9, we discuss the various choices and methods.

When you install a PC workstation of the same type as an already existing APPC workstation, you can copy the controller description of the existing APPC workstation. When you copy a PC APPC controller description, you must change the LAN adapter address for the PC for the new controller description created. Then you must vary on the newly created controller before it is available for use. The operating system will create virtual devices as needed for emulation sessions.

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Creating Device Descriptions for Printers and Tape Drives

You can create device descriptions for printers and tape drives the same way you create display device descriptions - by copying one that already exists or by creating one manually.
For example, if you want to create a new printer device description manually, use the CRTDEV-PRT (Create Device Printer) command, as shown in Figure 6.23.

Figure 6.23: Create Device Desc (Printer) (CRTDEVPRT) Screen, Page 1

After you supply the parameters with the correct information from your printer documentation, a screen similar to Figure 6.24 will be displayed.

Figure 6.24: Create Device Desc (Printer) (CRTDEVPRT) Screen, Page 2

The type and model information you enter on the first Create Device Description screen determine the parameters displayed in Figure 6.24. Models of printers have different features and each model is configured differently.
To create a new tape drive description manually instead of copying an existing one, use the CRTDEVTAP (Create Device Tape) command, as shown in Figure 6.25.

Figure 6.25: Create Device Desc (Tape) (CRTDEVTAP) Screen

Chapter Summary

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The AS/400 supports a number of peripheral devices, including display devices, PC workstations, printers, and tape and optical drives. Meaningful device names and mapping locations of devices are helpful for troubleshooting purposes. This level of organization is invaluable when hardware device problems arise and users need a replacement device immediately. When working with line descriptions, controllers, and devices on an AS/400, the system operator must be aware of the status and configuration of his/her system. The types of devices, communications methods, and hardware determine how a system is organized and arranged. The varying on and off of a device can be helpful in securing your AS/400.

Key Terms

address

bus topology

controller

device

device description

line

port

ring topology

star topology

vary off

vary on

virtual device

Review Questions

1. How do the bus, ring, and star topologies differ?

2. The physical address of a device consists of two parts. What are they?

3. How do you determine whether automatic configuration for devices is turned on?

4. What status is required for a controller to allow a device attached to it to function?

5. Are physical addresses required for printers attached to the AS/400 using a twinaxial connection?

Exercises

1. Print a copy of the device description of your workstation.

2. Print a copy of the controller description that is used by your device.

3. Print a copy of the line description that is associated with your workstation.

Chapter 7: Backup, Restore, and PTFs

Chapter Overview

Backing up, restoring, and loading program temporary fixes on your system are primary responsibilities of an AS/400 system operator. In this chapter, you learn

- the concept behind save/restore commands

- the importance of quarterly, monthly, weekly, and daily backup procedures

- how to set up a backup procedure

- how to restore different object types

- how to order program temporary fixes (PTFs)

- how to load PTFs

- how to verify a PTF installation

Creating a Backup Plan

Backing up your system is a time-consuming, but necessary, task. If your system crashes and the information it contained was not backed up, the loss to your company, both in time spent trying to recreate the data lost and in the dollars lost for data that can't be replaced, can be critical. Many "disaster" scenarios can be fixed when backed-up information is restored. For example, someone could accidentally or intentionally delete an object, a disk drive could be damaged, or a virus could enter your system. Whatever the scenario, backing up your system regularly is critical, and your backup plan should always be documented.

In all backup plans, you need to balance the time required to back up an object with the time constraints for restoring the object. Because restoring data generally occurs during an emergency, most backup plans emphasize the time required to restore an object. The backup guidelines we use in this text represent a balance between the time spent recovering from a potential disaster and the time required to back up all data as required for a potential disaster recovery. So a primary question becomes "When and how often should a given object be backed up?"

One good rule of thumb is to back up objects whenever there is a significant change to the data. For example, a payroll system may need to be backed up weekly, while a customer order-entry system probably requires daily backups.

Save Commands

To prevent data loss, a dependable backup plan must ensure that every object and every category of object is saved regularly. OS/400 offers seven separate save commands to back up different classes of objects. The following material discusses the various save commands and then ties these commands into a comprehensive quarterly, weekly, and daily procedure.

The simplest save method uses the SAVSTG (Save Storage) command. SAVSTG saves every object on the system. The disadvantage of this command is that it saves a sector-by-sector copy of the total contents of DASD storage. A SAVSTG is a disk-image save and isn't very flexible. With SAVSTG, you can't restore individual libraries or objects. But a SAVSTG backup is the quickest way to restore an exact copy of all data to the same hardware configuration when a complete restore is required. Because SAVSTG isn't very flexible for restoring objects to a system, most installations opt for an organized strategy of full system backup using other backup commands.

The SAVSYS (Save System) command saves the AS/400 Licensed Internal Code (LIC), the operating system, and all security data. This save command requires the system to be in a restricted state, which means users can't be signed on to the system during the SAVSYS

procedure. To place your system into a restricted state, you must end all subsystems except the controlling subsystem. (We discuss subsystems in detail in Chapter 8.)

The SAVLIB (Save Library) command saves libraries that contain IBM licensed programs, such as RPG/400, COBOL/400, and OfficeVision/400. SAVLIB also saves IBM-defined libraries such as QGPL, QUSRSYS, QRCL, and most other libraries that begin with Q but that are not related to a specific licensed program. More importantly, SAVLIB saves user libraries. User libraries usually contain corporate data and represent the largest volume of variable information that requires backup.

The SAVSECDTA (Save Security Data) command saves all security data, including user profiles and authorization lists that allow access to your system. This information is also saved by the SAVSYS command.

The SAVCFG (Save Configuration) command saves configuration objects such as lines, controllers, devices, and other communications objects defined to support the AS/400. These objects are also saved by the SAVSYS command.

The SAVDLO (Save Documents Library Object) command saves documents stored in folders for OfficeVision objects.

The SAVCHGOBJ (Save Changed Objects) command saves objects only if they have been changed since the last backup. IBM-supplied libraries such as QGPL, QUSRSYS, QRCL, and all other Q* libraries may not have changes. The SAVCHGOBJ backup command saves time and is commonly used in the daily backup cycle.

The SAV (Save) command can save the entire system. We recommend, however, that you use existing backup commands, as discussed above, and that you use the SAV command for the Integrated File System (IFS) objects.

Sample Backup Plan
Now that we have briefly discussed the save commands, let's look at a reasonable way to implement a backup plan. Tables 7.1a, 7.1b, and 7.1c show a suggested schedule for backing up all objects on the system.

Table 7.1a: Quarterly Backup Procedures

Backup Procedure		Restore Command
SAVSYS		RSTUSRPRF,
SAVSECDTA		RSTCFG,
SAVDLO DLO(*ALL) FLR(*ANY)		RSTAUT
SAVLIB LIB(*IBM) ACCPTH(*YES)		RSTUSRPRF,
SAVLIB LIB(*ALLUSR) ACCPTH(*YES)		RSTAUT
SAV DEV('QSYS.LIB/TAP01.DEVD')	+	RSTDLO
OBJ(('/*') ('QSYS.LIB' *OMIT)	+	RSTLIB
('/QDLS' *OMIT)) UPDHST(*YES)		RSTLIB
		RST

Table 7.1b: Weekly (or Monthly) Backup Procedures

Backup Procedure	Restore Commands
SAVDLO DLO(*ALL) FLR(*ANY)	RSTDLO
SAVLIB LIB(*ALLUSR) ACCPTH(*YES)	RSTLIB
SAV DEV('QSYS.LIB/TAP01.DEVD') +	RST
OBJ(('/*') ('QSYS.LIB' *OMIT) +	
('QDLS' *OMIT)) UPDHST(*YES)	

Table 7.1c: Daily Backup Procedures

Backup Procedure	Restore Commands
SAVSECDTA	RSTUSRPRF,
SAVCFG	RSTAUT
SAVDLO DLO(*CHG)	RSTCFG
SAV DEV('QSYS.LIB/TAP01.DEVD') +	RSTDLO
OBJ(('/*') ('QSYS.LIB' *OMIT) +	RST
('QDLS' *OMIT)) +	RSTOBJ
CHGPERIOD(*LASTSAVE) UPDHST(*NO)	
SAVCHGOBJ OBJ(*ALL) LIB(*ALLUSR) +	
OBJJRN(*YES) ACCPTH(*YES)	
DSPOBJD OBJ(QSYS/QSAV*) OBJTYPE(*DTAARA) +	
DETAIL(*FULL) OUTPUT(*PRINT)	

The various save commands combine to save all the system objects at a minimum of every three months. This comprehensive backup plan incorporates the various save commands to isolate data in relatively small blocks. The small size of the objects balances the varying needs of changing objects and keeps restore time to a minimum. Note that different save commands require different restore commands.

Note **The SAVLIB and SAVCHGOBJ commands in Tables 7.1a, 7.1b, and 7.1c include the access path parameter (ACCPTH (*YES)). This parameter specifies that the access paths are to be included in the save. Saving the access paths increases backup time, but doing so greatly reduces restore time when you are restoring during a full-system recovery. However, each organization should evaluate the savings balanced with the additional time required to save these access paths. Saving access paths can take at least 20 percent to 50 percent longer for production data libraries. Those same libraries may see as little as a 10 percent reduction in restore time. Also, you need more tapes when you save access paths. With all of this in mind, ask yourself how often your MIS department has had to do a full recovery. Some businesses won't see an advantage in saving access paths**.

You should implement the quarterly save procedure every three months and after PTFs have been applied.

You should follow the monthly save procedure every month on the same relative day (e.g., the last day of the month). You should perform a general monthly backup after month-end processing.

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You should also perform the weekly save procedure the same day every week, after any required weekly processing is completed.

You should conduct the daily save procedure each day at the end of the day (e.g., 5:00 p.m.), after the day's processing is completed.

Tip   **You can run the procedures in Tables 7.1a, 7.1b, and 7.1c from your command line or your security officer can set them up in Operational Assistant, which provides customized menus to execute your saves**.

The media options for saving data from an AS/400 are tape, diskettes, optical media, or save files. Because diskette drives are not commonly installed with AS/400 hardware, we don't discuss them here. Optical media is normally used for archiving information, not to provide backup and recovery capability. Optical media may be used only with the SAVLIB, SAVCHGOBJ, SAVDLO, and SAV commands. Tape may be used with all save commands available with OS/400.

Tape Considerations

The most common medium for backing up your system is tape, and the AS/400 supports numerous types of backup tape devices. For a successful backup and restore plan, you need to ensure that tape drives are cleaned regularly. You must initialize tapes before use, and you should use more than one set of backup tapes and rotate the sets. If a set of backup tapes is destroyed or damaged, you can use a previous backup set to restore the system to a previous state of usability. Label and date all tapes appropriately, and store backup tapes in a safe but accessible area. With extended use, tapes wear out like any other type of medium. When errors begin to occur with a tape, you should replace it with a new one.

To access the Tape menu (Figure 7.1), type **GO TAPE** on any command line and press Enter.

```
 TAPE                         Tape
                                               System   SXXXXXXX
 Select one of the following:
       1. Display tape information
       2. Initialize a tape
       3. Print contents of a tape
       4. Save
       5. Restore
       6. Work with tape device status
       7. Verify tape


       70. Related commands

 Selection or command
 ==>_____

 F3=Exit    F4=Prompt    F9=Retrieve    F12=Cancel    F13=Information Assistant
 F16=AS/400 Main menu
```

Figure 7.1: Tape Menu

As you can see, the Tape menu provides nearly all the commands you need for tape functions or to resolve a tape problem. The stored header information (option 1, Display tape information) provides a summary of data concerning the tape currently in the drive. To access this information from the Tape menu, type **1** and press Enter to bring up the Display Tape (DSPTAP) screen (Figure 7.2).

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```
                           Display Tape (DSPTAP)

    Type choices, press Enter.

    Device . . . . . . . . . . . . .                    Name
    Volume identifier . . . . . . .      *MOUNTED        Character value, *MOUNTED
    File label . . . . . . . . . .       *ALL
    Sequence number . . . . . . . .      1               1-16777215
    Data type . . . . . . . . . . .      *LABELS         *LABELS, *SAVRST
    Output . . . . . . . . . . . .       *               *, *PRINT, *OUTFILE
    End of tape option . . . . . . .     *REWIND         *REWIND, *UNLOAD




                                                                     Bottom
    F3=Exit    F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
    F24=More keys
```
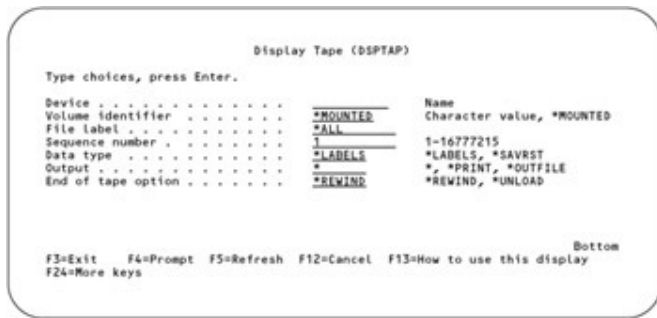
Figure 7.2: Display Tape (DSPTAP) Screen

The Device parameter requires a valid tape drive name to identify the tape drive containing the tape for display. The Volume identifier's default value is *MOUNTED, referring to the tape that is physically inserted in the tape drive. A character value may be specified here if the tape has been initialized with a volume label. The File label parameter defaults to the value of *ALL; this value displays information for all the files located on the tape. A character value name may be used for the File label if you choose to view or print information for one file. The Sequence number parameter is used, for volumes that contain multiple files, to view or print information about specific files or groups of files located on the tape. You can use the Sequence number and File label parameters together to specify the files included in the DSPTAP command. If the value of the File label parameter is *ALL and the sequence number is 10, all files located on the tape including and following the tenth file are included in the display tape processing.

The Data type parameter value may be specified as *LABELS or *SAVRST. The *LABELS value displays the labels of the files located on the tape. When the *SAVRST value is used for this parameter, additional information about the files on the tape is displayed - including a description of each object saved and summary information about the saved objects.

The Output parameter may be either *PRINT (printer spooled file to be generated) or * (information to display on the screen).

> **Tip** If your AS/400 has multiple tape drives and you are a new system operator, you may want to print the Display Tape screen to help you remember the correct spelling of the tape device name.

Initializing Tapes

Initializing a tape is similar to formatting a diskette on a DOS system, and you must complete the initialization before information can be stored on a tape. The initialization process sets up the tape label and other required parameters. You can also use the INZTAP (Initialize Tape) command to erase data from a tape before you reuse the tape.

To bring up the Initialize Tape (INZTAP) screen (Figure 7.3),
1. Press F3 from the Display Tape screen to return to the TAPE menu.
2. Type **2**.
3. Press Enter.

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```
                    Initialize Tape (INZTAP)

 Type choices, press Enter.

 Tape device . . . . . . . .                Name
 New volume identifier  . . .   *NONE       Character value, *NONE
 New owner identifier . . . .   *BLANK
 Volume identifier  . . . . .   *MOUNTED    Character value, *MOUNTED
 Check for active files . . .   *YES        *YES, *NO, *FIRST
 Tape density. . . . . . . .    *DEVTYPE    *DEVTYPE, *FMT3480...
 Code . . . . . . . . . .       *EBCDIC     *EBCDIC, *ASCII
 End of tape option . . . .     *REWIND     *REWIND, *UNLOAD
 Clear . . . . . . . . . . .    *NO         *NO, *YES




                                                        Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 7.3: Initialize Tape (INZTAP) Screen

To begin the initialization process, you must enter a value for the Tape device parameter. This is the name of your tape drive defined on the Display Tape screen. A maximum of 10 characters is allowed.

The New volume identifier parameter attaches an internal volume ID name to the tape. Volume IDs help keep multiple tapes for the same application separate and confirm when a tape is approved for reuse. Volume IDs can have a maximum of six characters.

The New owner identifier parameter writes an owner's name to the tape. You will probably use an application name here because it's more effective than an owner's name. A maximum of 14 characters is allowed.

The Volume identifier parameter is the volume name that was attached to this tape the last time it was initialized. To change the volume ID, enter a maximum of six characters. Each tape should have a unique volume ID to avoid unintentionally overwriting data. This parameter value can also be *MOUNTED. If the value is entered as *MOUNTED, the initialization continues for any tape regardless of the previous name.

The Check for active files parameter specifies whether OS/400 should check for active files on the tape before initialization. If *YES is specified and the system finds active data on the tape, the system won't initialize the tape.

The Tape density parameter should always be specified as *DEVTYPE so that the tape is initialized to the density supported by the tape drive.

The Code parameter refers to the collating sequence of the backup. For continued use on an AS/400, this parameter value should be *EBCDIC. Use the value *ASCII to restore this tape to an ASCII computer system.

The End of tape option indicates whether the tape should be rewound (*REWIND) or rewound and ejected (*UNLOAD) after initialization is complete. Generally, *UNLOAD is preferred only for unattended backups.

The Clear parameter specifies whether the tape's data is to be deleted before initialization. Clearing the data takes more time, and the initialization process duplicates this step. Therefore, this parameter value is generally *NO.

Reclaiming Storage

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Periodically **reclaiming storage** is important to maintaining single-level storage on the AS/400. Remember that single-level storage allows main memory and DASD to be treated as a single accessible unit. As a result of power or equipment failures, an object may be lost (an object that can't be found in a library or that has no ownership connection is considered lost) or damaged. A damaged item isn't usable. The RCLSTG (Reclaim Storage) command may correct damaged or lost data. The RCLSTG command searches for all objects not in a library, all objects without an owner, and all damaged or destroyed objects. When the Reclaim Storage process finds objects that meet these requirements, the system creates a library named QRCL. The RCLSTG command copies these reclaimed objects to the QRCL library, then deletes them from the inappropriate locations. You must run the RCLSTG command interactively from the system console; it can't be submitted to batch. You must first be sure the system is in a restricted state with all subsystems ended. Finally, it's important to know that reclaiming storage may be a lengthy process, so you should schedule it accordingly.

Objects in the QRCL library should be moved to proper locations or deleted if they are unusable.

Cleaning Tasks

After the tapes are prepared and storage has been reclaimed, it's important to clean up old files and objects that are no longer useful and shouldn't be saved via backup. For example, each time a program is compiled, a backup object is created in library QRPLOBJ. The system gives the backup object a name that starts with Q and ends with a number. In companies that employ programmers, the QRPLOBJ library typically becomes very full. You should routinely clear out these objects with the CLRLIB (Clear Library) command. Using positional notation, you can enter this command as

CLRLIB QRPLOBJ

and press Enter.

OS/400 keeps journals, journal receivers, and logs for tracking system activity. These objects accumulate information daily and use DASD storage. Cleaning up old journals and journal receivers helps keep your system running smoothly. You can automatically clean up objects that are no longer needed by scheduling clean-up activities using the Operational Assistant's Cleanup Tasks menu. To access the Cleanup Tasks menu (Figure 7.4), type **GO CLEANUP** on any command line and press Enter.

```
CLEANUP                    Cleanup Tasks
                                              System: XXXXXXX

To select one of the following, type its number below and press Enter:
  1. Change cleanup options
  2. Start cleanup at scheduled time
  3. Start cleanup immediately
  4. End cleanup




Type a menu option below
  __

F1=Help   F3=Exit   F9=Command Line   F12=Cancel
```

Figure 7.4: Cleanup Tasks Menu

Tips ▪ **To use the CLEANUP command or menu option, you must be signed on as the security officer or have been given authority to use this command.**
      ▪ **You can also access the Cleanup Tasks menu from the Operational Assistant menu. To do so, choose option 11 (Customize your system, users, and devices) on the Operational**

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Option 1 allows customization of the cleanup activities, such as when to automatically start cleanup, which objects to delete, and how many days to wait before cleaning up. (You can also use the CHGCLNUP (Change Cleanup) command to modify the options.)

Option 2 schedules the cleanup activities to be run automatically. These cleanup tasks are often scheduled daily on second or third shift. The CL command to start cleanup at the scheduled time is

STRCLNUP OPTION(*SCHED)

The cleanup starts automatically at the time specified in option 1.

Option 3 starts the cleanup job immediately. This allows the cleanup job to run on demand instead of waiting for its scheduled time. You can also use the CL command

STRCLNUP OPTION(*IMMED)

Option 4 lets you end the cleanup tasks immediately. This option terminates the cleanup job if it's waiting on the job queue, or you can use the ENDCLNUP command to terminate cleanup activities.

For practice, let's start cleanup at the scheduled time. From the Cleanup Tasks menu, type **2** on the option line, then press Enter. When the cleanup tasks are completed, you can start the actual system backup.

Running a Backup

Now that the backup plan has been completed, the tapes have been initialized, storage has been reclaimed, and the cleanup tasks are finished, you can start the system backup. As with all AS/400 commands, you can complete this task in many ways. Here we use the Operational Assistant's customization feature.

To access the AS/400 Operational Assistant menu, type **GO ASSIST** on the command line, then press Enter to bring up the AS/400 Operational Assistant menu (Figure 7.5). From this menu, type **11** as your menu option choice, then press Enter to bring up the customization menu (Figure 7.6).

```
ASSIST              AS/400 Operational Assistant Menu
                                        System: XXXXXXX
  To select one of the following, type its number below and press Enter:

        1. Work with printer output
        2. Work with jobs
        3. Work with messages
        4. Send messages
        5. Change your password

        10. Manage your system, users, and devices
        11. Customize your system, users, and devices

        75. Information and problem handling

        80. Temporary sign-off


   Type a menu option below
        __

   F1=Help   F3=Exit   F9=Command line   F12=Cancel
```

Figure 7.5: AS/400 Operational Assistant Menu

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```
SETUP            Customize Your System, Users, and Devices
                                                          System: XXXXXXX

To select an option, type its number below and press Enter:

      1. Change system options
      2. Cleanup tasks
      3. Power on and off tasks
      4. Disk space tasks
      5. Backup tasks

     11. Change passwords for IBM-supplied users

     20. Communications configuration tasks




Type a menu option below


    _
 F1=Help   F3=Exit   F9=Command line   F12=Cancel
```

Figure 7.6: Customize Your System, Users, and Devices Menu

Tip   **You can access the customization menu directly by typing GO SETUP on any command line**.

To begin the backup tasks from the Customize Your System, Users, and Devices menu, type **5** as your menu choice, then press Enter to bring up the Backup Tasks menu (Figure 7.7).

```
BACKUP                    Backup Tasks
                                                System: XXXXXXX
To select one of the following, type its number below and press Enter:

      1. Run backup
      2. Display backup status

     10. Set up backup

     20. Initialize a tape
     21. Initialize a tape set




Type a menu option below


    _
 F1=Help   F3=Exit   F9=Command line   F12=Cancel
```

Figure 7.7: Backup Tasks Menu

If your security officer has created a backup procedure for your system, choose option 1 from the Backup Tasks menu. Otherwise, you can use option 10 (Set up backup) only if you either are signed on with security officer authority or have been granted authority to use this menu. For practice purposes, assume you have this authority and choose the Set up backup option - type **10**, then press Enter to bring up the Set Up Backup menu (Figure 7.8).

```
SETUPBCKUP                Set Up Backup
                                                System: XXXXXXX
To select one of the following, type its number below and press Enter:

      1. Change daily backup options
      2. Change weekly backup options
      3. Change monthly backup options

     10. Change library backup list
     11. Change folder backup list

     20. Change backup schedule




Type a menu option below


    _
 F1=Help   F3=Exit   F9=Command line   F12=Cancel
```

Figure 7.8: Set Up Backup Menu

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This menu lets you change the daily, weekly, or monthly backup procedures. In addition, you can change the library backup list, the folders backup list, or the backup schedule from this menu. After you have defined the backup procedures, press F3 to return to the Backup Tasks menu (Figure 7.7). The backup procedures should be run under a user profile with *SAVSYS (Save System) authority. *SAVSYS authority speeds up the backup because the system doesn't have to perform authority checking on each object.

Restricting access to the system when you are performing saves is a good practice. Many save commands don't require restricted access, but that is the only way to ensure that the save contains the most current object a user may be using. If any user has an update or exclusive lock on a file while you run your backups, the object can't be saved.

Before you do a restricted backup, send all users a message telling them to sign off the system. Use the SNDMSG (Send Message) command or the SNDBRKMSG (Send Break Message) command. For either command, always specify the time the system will be taken down and when the users can expect the system to be available.

As we mentioned earlier, you must end all subsystems except the controlling subsystem (QCTL) for a complete system save. Use the ENDSBS (End Subsystem) command for each subsystem. The ENDSBS command lets you end a subsystem either in a controlled manner or immediately. A controlled ending of a subsystem is preferred because it allows active jobs to end themselves. You should use an immediate end to a subsystem only when there are no active jobs running on the system. As an alternative to the ENDSBS command, you can use the ENDSYS (End System) command, which ends all subsystems and brings the system to a restricted state.

Now you are ready to do the system backup. Choose option 1 on the Backup Tasks menu to begin copying data to the tapes. Follow the displayed instructions until the backup is complete.

Using Save Files
If your backup strategy requires that you occasionally do an unattended backup (meaning that you don't have a system operator available to change tapes), you can consider the option of saving objects to a **save file**. A save file is an object you as the system operator must create to hold a compressed version of backed up objects. All the objects you have requested for backup are compressed and placed into this save file. The save file can be transferred to a tape later.

> **Tip** **You can't do a save operation on a file that is being updated or that is allocated exclusively to another job, with the exception of a journal receiver**.

It's important to use caution in this process because saving to a save file requires a great deal of DASD. Make sure that, when the amount of memory required by the files you are saving is added to existing DASD storage, you won't be creating a total DASD usage in excess of 80 percent. DASD usage in excess of 90 percent seriously degrades system performance. And if you make an error in your calculations and DASD is over-committed (more than 100 percent), it will be necessary to do a total reload of the system.

To create a save file,
1. Press F9 to display a command line.
2. Type **CRTSAVF** on the command line.
3. Press F4 to bring up the Create Save File screen (Figure 7.9).

```
                    Create Save File (CRTSAVF)

  Type choices, press Enter.

  Save file  . . . . . . . . . . .                Name
    Library  . . . . . . . . . . .   *CURLIB      Name, *CURLIB
  Text 'description'  . . . . . . .  *BLANK




                                                              Bottom

  F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
  F13=How to use this display        F24=More keys
```
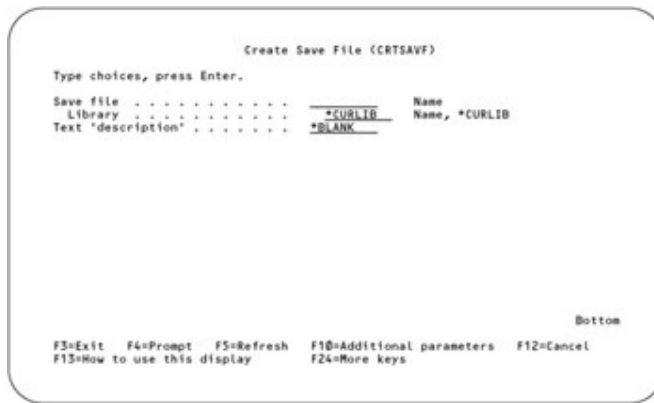
Figure 7.9: Create Save File (CRTSAVF) Screen

To practice creating a save file, on the Create Save File (CRTSAVF) screen,
   1. Type *your name* as the Save file name. (A descriptive name usually is preferred.)
   2. Type **Practice** as the text description of the file.

   3. Press Enter.
After you have created a save file to store information, save your library to the save file using the SAVLIB command. Type **SAVLIB** on the command line, and press F4 to bring up the Save Library screen (Figure 7.10).

```
                    Save Library (SAVLIB)

  Type choices, press Enter.

  Library  . . . . . . . . . . . .   _____   Name, *NONSYS, *ALLUSR, *IBM
              + for more values      _____
  Device . . . . . . . . . . . . .   _____   Name, *SAVF
              + for more values      _____
  Volume identifier  . . . . . . .   *MOUNTED    Character value, *MOUNTED
              + for more values
  Sequence number  . . . . . . . .   *END        1-9999, *END
  Label  . . . . . . . . . . . . .   *LIB
  File expiration date . . . . . .   *PERM       Date, *PERM
  End of tape option . . . . . . .   *REWIND     *REWIND, *LEAVE, *UNLOAD




  F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
  F13=How to use this display        F24=More keys
```

Figure 7.10: Save Library (SAVLIB) Screen

To execute the SAVLIB command,
   1. Type *your name* for Library name (must be a valid library name).
   2. Type *SAVF for Device.

   3. Press Enter.
This command saves your entire library to a save file on disk. After a save file exists on disk, you can copy it to tape with the SAVSAVFDTA command (Figure 7.11).

```
                     Save Save File Data (SAVSAVFDTA)

  Type choices, press Enter.

  Save file  . . . . . . . . . . .               Name
    Library  . . . . . . . . . . .   *LIBL       Name, *LIBL, *CURLIB
  Device . . . . . . . . . . . . .               Name
                 + for more values
  Volume identifier  . . . . . . .   *MOUNTED    Character value, *MOUNTED
                 + for more values
  Sequence number  . . . . . . . .   *END        1-9999, *END
  End of Tape option . . . . . . .   *REWIND     *REWIND, *LEAVE, *UNLOAD
  Clear  . . . . . . . . . . . . .   *NONE       *NONE, *ALL, *AFTER

                        Additional Parameters

  File expiration date . . . . . .   *PERM       Date, *PERM
  Data compaction  . . . . . . . .   *DEV        *DEV, *NO
  Output . . . . . . . . . . . . .   *NONE       *NONE, *PRINT, *OUTFILE


                                                              More...
  F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
  F24=More keys
```

Figure 7.11: Save Save File Data (SAVSAVFDTA) Screen

Restoring Objects

Hopefully, the ultimate disaster won't strike your system, but it's important to be organized and prepared if the worst should happen. You use the restore commands to replace damaged or deleted objects. At first glance, our sample backup plan in Tables 7.1a, 7.1b, and 7.1c may appear to be overkill. However, you can restore objects only in a certain way. In other words, how the objects were saved determines how the restore can be executed. Our sample backup plan provides flexibility for restoring quickly.

Before any backup plan is complete, you must be sure that full system backups are done on the Alternate Load IPL device. An initial program load (IPL) requires that the tape device be specified as the Alternate Load IPL device. Check with your system administrator to see which device is your Alternate Load IPL device.

To completely restore your system, take the following steps:
1. Restore the LIC from your most recent SAVSYS tapes. IBM's *Backup: Recovery - Basic Guide* explains how to restore the LIC.
    You must sign on as the security officer, QSECOFR. If the security officer's password has changed since the last system save, you must use the old password to ensure a password match.
2. Type **GO RESTORE** and press Enter to go to the Restore menu.
3. Choose Option 21 (System and user data) to restore all the IBM Licensed Program Products, user libraries, document library objects, and IFS objects, all with full prompting.
4. At the End Subsystem command prompt, press Enter.
5. Press Enter to respond to informational messages.
6. At the User Profile command prompt screen,
    A. Press F10 for additional parameters.
    B. Change the Allow object differences parameter value to *ALL.
    C. Change the "Output member options replace or add records" parameter value to *ADD.
    D. Press Enter.
7. At the Configuration command prompt screen,
    A. Change the System resource management parameter value to *NONE.
    B. Press F10 for additional parameters.
    C. Change the Allow object differences parameter value to *ALL.

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D. Change the "Output member options replace or add records" parameter value to *ADD.

E. Press Enter.

8. At the Restore Library command prompt,
A. Press F10 for additional parameters.

B. Change the Database member option parameter value to *ALL.

C. Change the Allow object differences parameter value to *ALL.

D. Change the "Output member options replace or add records" parameter value to *ADD.

E. Press Enter.

9. At the Restore Document Library Objects command,
A. Press F10 for additional parameters.

B. Change the Allow object differences parameter value to *ALL.

C. Change the "Output member options replace or add records" parameter value to *ADD.

D. Press Enter.

10. At the Restore Authority command, press Enter.

11. At the Start Subsystems command, press F3 to exit.
12. Type **SIGNOFF *LIST** to send the JOBLOG to an output queue and press Enter.

13. Sign on.

14. Turn the keylock to the normal position.
15. Type **PWRDWNSYS *IMMED** and press Enter.

16. When the IPL is complete, use the DSPTAP command to inventory the latest SAVCHGOBJ tapes so you know which libraries and objects are represented.

17. Using the DSPTAP lists, use the RSTOBJ command to restore changed objects.
When a complete system restore isn't required, you may find it more convenient to type **GO RESTORE** on the command line and press Enter to bring up the Restore menu (Figure 7.12).

```
RESTORE                         Restore
                                        System    SXXXXXXX

Select one of the following:
  Restore Data
    1. Files
    2. Libraries
    3. Documents and folders
    4. Programs
    5. Other objects
    6. Licensed programs
    7. Configuration
    8. User profiles
    9. Objects in directories

  Restore System and User Data
    21. System and user data

                                        More ...
Selection or command
==> _____


F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel   F13=Information Assistant
F16=AS/400 Main Menu
```

Figure 7.12: Restore Menu

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The Restore menu includes all the restore commands explained earlier. Use the prompt screen for additional options.

As we've said, you may never need to restore an object or to recover from a disaster; however, good planning and documentation provide an organized process to correct any unforeseen problems. Regular system backups are a necessary prerequisite for peace of mind.

Program Temporary Fixes (PTFs)

As we explained in Chapter 1, when IBM becomes aware of a problem in its software (problems are either discovered by IBM staff or reported to IBM by AS/400 users), IBM first generates an **authorized program analysis report (APAR)** to study the problem. If necessary, IBM creates a **program temporary fix (PTF)** to correct the problem. A PTF is labeled temporary because IBM documents the problem and incorporates the correction into the next release or modification of the software, which makes the fix permanent. When a PTF is generated, it usually corrects one problem and is called an **individual PTF**. However, IBM also puts together **cumulative (CUM) PTF** packages, which are aggregates of the individual PTFs. A convenient way for you to manage PTFs is through the cumulative PTF packages. Before loading or applying PTFs, we recommend a full system backup so that if any of the applied PTFs creates a problem on the system, you can return the system to its previous operating status.

Individual PTFs include a cover letter (Figure 7.13) that explains which device or software required the correction, as well as other pertinent information. Always read the cover letter because you may find important information there about how the PTF will correct a problem your system may be experiencing. Follow the instructions exactly.

The cover letter provides a description of the problem and the corrective measure taken to solve the problem. It also includes any activation instructions or special instructions involved in applying the PTF. It's important to be aware of the version, release, and modification level of your OS/400 before ordering or loading and applying PTFs. Note in the cover letter in Figure 7.13 the Release is listed as 410, indicating that this PTF is intended for OS/400 at Version 4, Release 1, modification level 0.

```
            PTF#:  SF53260 - OPERATING SYSTEM/400
Licensed Program:  5769SS1
      APAR Fixed:  SA77561, SA78061
         Release:  410

Abstract
OSP-MSGMCH0601-F/QSRSVPRE DURING SAVLIB SAVACT

Pre/Co-Requisite PTF / Fix List
REQ LICENSED PTF/FIX
TYPE PROGRAM REL NUMBER LICENSED PROGRAM DESCRIPTION
---------------------------------------------------------
PRE 5769SS1 410 SI39044 OPERATING SYSTEM/400 (LEVEL INDICATOR)

APAR Error Description / Circumvention
DESCRIPTION OF PROBLEM FIXED FOR APAR SA77561 :
-----------------------------------------------
When saving a library with a large network of database files,
using the SAVLIB command and specifying a value other than *NO
for the SAVACT parameter, resulted in the following error:

MSGMCH0601 F/QSRSVPRE T/QSRSVPRE

Space offset X'00FFFF00' is outside current limit for object
QSR.ADDITIONAL_INFO.001

CORRECTION FOR APAR SA77561 :
-----------------------------
Internal processing has been corrected to avoid this particular
MCH0601 error, which could occur when saving a library with
a large network of database files.

CIRCUMVENTION FOR APAR SA77561 :
--------------------------------
None.

DESCRIPTION OF PROBLEM FIXED FOR APAR SA78061 :
-----------------------------------------------
SAVSECDTA results in MSGMCH0601 F/QSRSVPRE T/QSRSVPRE

CORRECTION FOR APAR SA78061 :
-----------------------------
Internal save processing has been corrected to prevent this
particular MCH0601 error during SAVSECDTA.

CIRCUMVENTION FOR APAR SA78061 :
--------------------------------
None.

Activation Instructions
None.

Special Instructions
None.

Default Instructions
THIS PTF CAN BE APPLIED IMMEDIATE OR DELAYED.

Supersedes
PTF/FIX NO(S).  APAR TITLE LINE
SF40840 OSP-INCORROUT SAVING MESSAGE QUEUES IN BREAK MODE
SF49160 OSP-9R200C-MSGMCH1210-F/QSRSVPRE-T/QSRSIPPE DURING SAVLIB
SF48061 OSP-MSGCPF3797 0003 NOT IDENTIFY AN OBJECT

Summary Information
System.................. AS/400
Models.................. *ALL
Release................. V4R1M0
Recompile............... N
Library................. QSYS
MRI Feature............. NONE

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```

Figure 7.13: Sample PTF Cover Letter

You can order PTFs through IBM's Electronic Customer Support (ECS) system. When you use ECS, the cover letter is stored in a file named QAPZCOVER in the QGPL library.

Note   **Version 2 users should note that the QAPZCOVER file contains a member name starting with a P followed by the PTF number. Version 3 users should note that the member name starts with a Q**.

To display the cover letter, use the DSPPFM (Display Physical File Member) command or print the cover letter with the CPYF (Copy File) command, specifying QSYSPRT for the To file parameter.

High-impact and pervasive (HIPER) PTFs are critical PTFs because they fix problems that can crash the computer or severely degrade performance, or they correct a multitude of machine problems. HIPER PTFs are usually in a separate classification from other PTFs and should be loaded onto the system as soon as possible.

To order individual PTFs, you need the PTF number. IBM has created some reserved PTF numbers that you can use to order particular types of PTFs (Table 7.2).

Table 7.2: PTF Numbers and Descriptions

Number	Description
MF98vrm	Preventive service planning information report for licensed internal code.

Table 7.2: PTF Numbers and Descriptions

Number	Description
SF97vrm	PTF summary listing.
SF98vrm	Preventive service planning information report for licensed programs. Includes the date of the latest CUM PTF package.
SF99vrm	CUM PTF package.
SHnnnnn	Individual PTF for MAPICS or CMAS. Each n represents a numeral of a 5-digit sequence number.

In Table 7.2, *v* is the OS/400 version number, *r* is the release number, and *m* is the modification level. Therefore, for V4R1M0, *vrm* would be replaced by 410. Note that some of the PTFs are informational reports, not program objects.

To order PTFs through ECS, use the SNDPTFORD (Send Program Temporary Fix Order) command (Figure 7.14).

Figure 7.14: Send PTF Order (SNDPTFORD) Screen

The PTF parts parameter offers a choice of receiving the cover letter and the PTF code (*ALL) or just the cover letter (*CVRLTR). Because your particular AS/400 may not have the hardware or the software associated with the PTF, it may be helpful initially to download only the cover letters.

The Delivery method parameter with the *ANY value indicates that if the PTF is small enough, it should be transmitted electronically through the ECS modem line. Most PTF listings and reports are delivered electronically. The delivery method parameter of *ANY is replaced with the *LINKONLY value, and the PTF is sent through the ECS line. The ECS program downloads the PTF save file to DASD. If the PTF exceeds the *LINKONLY size, such as with a CUM PTF, IBM mails a tape within 48 hours of when you placed the order.

The Order parameter with the *REQUIRED value performs additional PTF verification. If the needed PTF has a prerequisite, both PTFs are sent. You can request the *PTFID value, which lists the prerequisite PTF IDs, to help you determine whether the earlier PTF has previously been installed.

The Reorder parameter value can be either *YES or *NO. Specifying *NO causes the system to check whether the PTF is already loaded and/or applied on your system. If the PTF is loaded, the SNDPTFORD command ends with an error. The system attempts to avoid a duplicate order.

To reorder the cover letter only, specify *CVRLTR for the value of the PTF parts parameter and change the Reorder parameter value to *YES.

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shows a sample of an order for an individual PTF. To order a cumulative PTF package, you would type **SNDPTFORD SF99***vrm*. The *vrm* is the version, release, and modification level of your system. For example, to order a CUM tape for Version 4 Release 1 Modification level 0, type **SNDPTFORD SF99410**.

Loading Individual PTFs
From time to time, you may need to apply individual PTFs. You can order them in small groups of up to 20 at a time via the ECS modem. If your ECS modem is a 2400 bps modem, or if the quantity of PTFs is more than just a few, you can change the Delivery method to *ANY and receive the PTFs on tape. Custom **Preventive Service Packages (PSPs)** are usually mailed within 48 hours after order placement.

PTFs are of two general types: Microcode Fixes (PTFs that begin with MF) and System Fixes (PTFs that begin with SF). All PTFs can be applied permanently or temporarily, and some may be applied immediately. Most fixes are best applied temporarily, but occasionally they must be applied permanently right away. Consult the cover letter that comes with the PTF. Look for special instructions, and follow them. You can usually remove temporarily applied PTFs if they cause a problem. You can't remove permanently applied PTFs.

PTFs usually require an IPL before they are applied. Even PTFs that are "Immediate" usually carry special instructions to become active, and they may be more conveniently applied with the next unattended IPL.

Any and all PTFs can be loaded and applied during regular hours and marked "Apply at the next IPL." Because you can normally do an IPL after a weekly unattended full-system save, the PTFs will be applied without any additional effort. You should be aware that applying PTFs during an IPL can greatly increase how long it takes to perform the IPL.

Microcode Fixes (MFs) carry special importance because they affect basic machine functions (those basic services that are below the machine interface - MI). Because of their importance, there are actually two copies of these fixes: One group contains all the permanently applied MFs and is called the A side; the other group contains all of the MFs, including the latest temporarily applied MF PTFs. Because of the importance of the microcode to the entire computing environment, if a new temporarily applied MF PTF causes a problem, the system can be IPLed to the A side and, in essence, restored immediately.
The front panel of the AS/400 can show an A or a B, but that isn't the best place to look to see on which side of the Microcode the system is running. Often, during the automatic install process of a CUM tape, the front panel can show A but the system is actually running on the B side. The system is just looking ahead. To make sure, type **DSPPTF** and press Enter. The first group of PTFs displayed will be the MFs, and the top of the screen is the last IPL source. Most systems in a normal production environment should run on the B side. Most temporary PTFs are running on the B side. When the PTFs are made permanent, they are, essentially, copied to the A side; the machine will then IPL from side A.
To access the Program Temporary Fix (PTF) menu (Figure 7.15), type **GO PTF** on any command line and press Enter.

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```
PTF                          Program Temporary Fix
                                               System   SXXXXXX
   Select one of the following:

      1. Load a program temporary fix
      2. Apply a program temporary fix
      3. Copy a program temporary fix
      4. Remove a program temporary fix
      5. Display a program temporary fix
      6. Order a program temporary fix
      7. Install a program temporary fix from a list
      8. Install program temporary fix package

     70. Related commands

   Selection or command
   ==>_____


   F3=Exit    F4=Prompt   F9=Retrieve   F12=Cancel   F13=Information Assistant
   F16=AS/400 Main menu
```

Figure 7.15: Program Temporary Fix (PTF) Menu

All the options needed to manage PTFs are located on this menu. Temporary fixes that aren't transferred electronically from ECS are mailed either on tape or diskette, and they need to be loaded onto the system.
Option 1 menu loads individual PTFs from tape, diskette, or a save file (*SAVF). To load a PTF, type **1** and press Enter to bring up the Load Program Temporary Fix (LODPTF) screen (Figure 7.16).

```
                    Load Program Temporary Fix (LODPTF)

   Type choices, press Enter.

   Product  . . . . . . . .               F4 for list
   Device . . . . . . . . .   *SERVICE    Name, *SERVICE, *SAVF
   PTF numbers to select  .   *ALL        Character value, *ALL
        + for more values
   PTF numbers to omit. . .   _____    Character value
        + for more values
   Superseded PTFs  . . . .   *APYPERM    *APYPERM, *NOAPY
   Release  . . . . . . . .   *ONLY       *ONLY, VxRxMx




                                                              Bottom
   F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel  F13=How to use this display
   F24=More keys
```
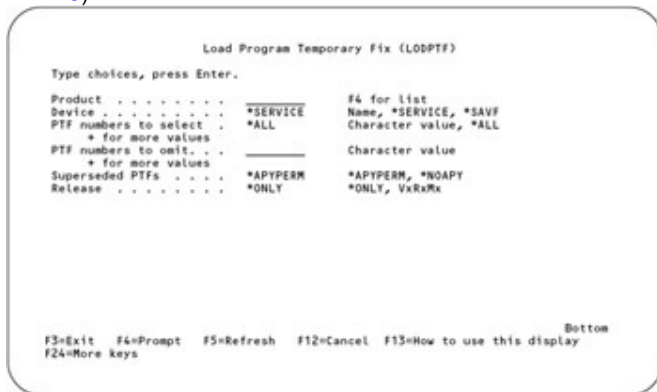
Figure 7.16: Load Program Temporary Fix (LODPTF) Screen

The "PTF numbers to select" and the "PTF numbers to omit" parameters refer to the PTF numbers that identify the PTFs. All PTFs are identified by a unique number, to connect the PTF with the hardware device or application software problem that necessitates the correction.

Loading Cumulative PTFs
PTF CUM tapes should be installed using the instructions sent with the tape. Usually, those instructions lead you through many preparatory steps that are necessary to ensure the successful installation of the CUM PTFs. After you've followed the instructions with the tape, on the Program Temporary Fix (PTF) menu, type 8 and press Enter to bring up the Install Options for Program Temporary Fixes screen (Figure 7.17)

```
                    Install Options for Program Temporary Fixes
                                                       System: XXXXXXX
        Type choices, press Enter.

          Device . . . . . . . . _____    Name, *SERVICE

          Automatic IPL . . . .   Y          Y=Yes
                                             N=No

          PTF type . . . . . .    1          1=ALL PTFs
                                             2=HIPER PTFs and HIPER LIC fixes only
                                             3=HIPER LIC fixes only




        F3=Exit   F12=Cancel
```
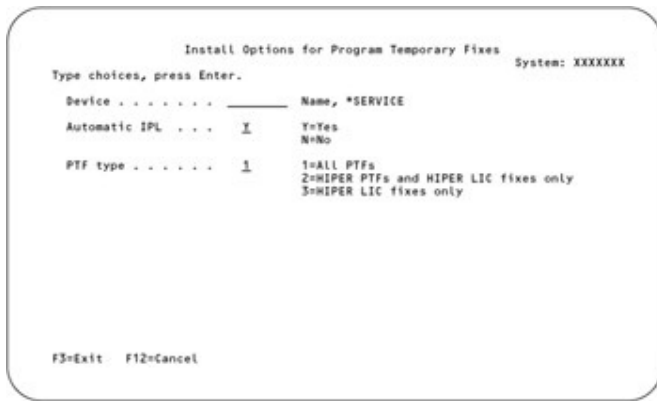
Figure 7.17: Install Options for Program Temporary Fixes Screen

The CUM tape can be installed during normal business hours. Just remember to change the Automatic IPL parameter value to N.

Additional PTFs may also be applied and marked for IPL action. Then let the next unattended IPL, after the dedicated system save, apply them all.

Verifying PTF Installation

Use the Manage Licensed Programs menu to verify that the PTFs were successfully installed. To access this menu,

1. Type **GO LICPGM** on a command line to display the Manage Licensed Programs menu.

2. Press Enter.
3. Type **50** to review PTF installations.

4. Press Enter.

5. Press Enter again to view PTF installation messages.

The system presents a series of messages that inform you whether the PTF was installed successfully. Look for the word "failed" anywhere in the messages (e.g., "Loading of PTFs failed," "Application failed," or "Applying PTFs failed"). Occasionally, IBM issues PTFs that do more damage than good; these PTFs are reported in the HIPER PTF packages as PTFs in error. Anytime before a PTF is applied permanently, you can remove it with option 4 on your Program Temporary Fix menu (see Figure 7.15). Ensure that the PTFs are, in fact, working properly before you apply them permanently.

Anytime after you load and/or apply PTFs, and before you apply PTFs permanently, you should display them. The DSPPTF (Display PTF) command, in its simplest form, provides a list of all PTFs currently on the system and their status. The status can be applied temporarily, permanently, loaded, or superseded. To display the PTF status, use option 5 on the Program Temporary Fix menu to bring up the Display Program Temporary Fix (DSPPTF) screen (Figure 7.18).

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```
                    Display Program Temporary Fix (DSPPTF)

  Type choices, press Enter.

  Product . . . . . . . . . . . . .   *ALL        F4 for list
  PTF numbers to select . . . . . .   *ALL        Character value, *ALL...
  Release . . . . . . . . . . . .     *ALL        *ALL, VxRxMx
  Cover letter only . . . . . . . .   *NO         *NO, *YES
  Output . . . . . . . . . . . . .    *           *, *PRINT, *OUTFILE




                                                                        Bottom
  F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
  F24=More keys
```
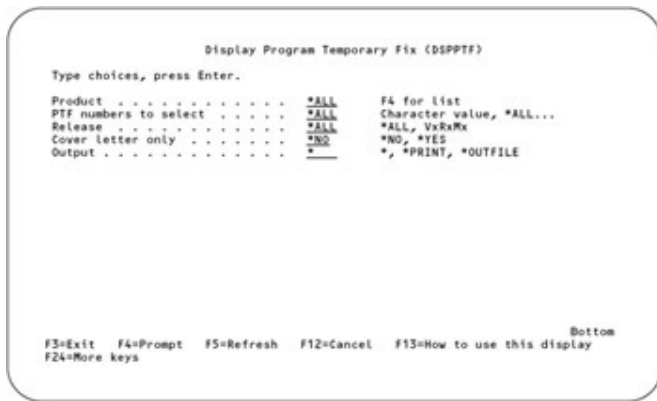
Figure 7.18: Display Program Temporary Fix (DSPPTF) Screen

This additional information is brief (and sometimes confusing), but it can be helpful. The DSPPTF (Display Program Temporary Fix) command accepts several parameters to help you narrow the list of PTFs. For example, prompt the Product parameter to select just the PTFs for a particular application package. Request that the list be sent to *PRINT to generate a spooled output file, then place the report with other system documentation.

PTFs are a necessary part of AS/400 maintenance. We recommend that you load and apply a CUM PTF package every three or four months. If your system has problems that you can't seem to pinpoint, the solution may already be waiting in a PTF. To further avoid problems, you should keep a printed list of all PTFs near the CPU. If your computer experiences problems and can't IPL, this list can be very beneficial to the IBM support group as they help you resolve the problems.
The AS400 Web site (www.as400service.ibm.com/) is a useful tool to find which PTFs are available for your system. It provides a means to find an individual PTF or to determine which PTF you need to solve specific problems on your system.

Preventive Service Planning (PSP) information is available for viewing on the site. You can access it by specifying your version, release, and modification level. (A Preventive Service Planning - PSP-document lists all the PTFs that apply to a version, release, and modification level of OS/400.) The Search Preventive Service Planning option on the AS/400 site displays a page that lets you search the cover letters for the OS/400 version. The cover letters that apply to the search words typed will be retrieved and listed.

Chapter Summary

Performing backups and applying program temporary fixes are primary responsibilities of an AS/400 system operator. To keep your system functioning smoothly and productively, OS/400 provides multiple commands to allow flexibility in securing your organization's information. IBM provides PTFs to help keep your system running without errors. Many of the backup, restore, and PTF load procedures are lengthy and tie up system resources. It's important not to interfere with daily business, and these procedures should be scheduled accordingly.

Key Terms

authorized program analysis report (APAR)

cumulative PTF

high-impact and pervasive (HIPER) PTF

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individual PTF

preventive service package (PSP)

program temporary fix (PTF)

reclaim storage

save file

Review Questions

1. Why should you have an AS/400 system backup plan?

2. Why does the system require several different save commands?

3. Why does the system require several different restore commands?

4. Why does the AS/400 accumulate files that need to be deleted by the system operator or the automatic clean-up process?

5. Why is it necessary to initialize tapes? What other purpose does initialization serve?

6. The Delivery method parameter with the SNDPTFORD command defines what? What is the difference between the value choices? Why choose either one?

7. PTFs should be loaded and installed on what area displayed on the CPU panel?

8. Individual PTF cover letters include what information?

9. When is an AS/400 in a restricted state?

10. Why is reclaiming storage important?

Exercises

1. Create a sample backup plan.

2. Print a PTF list for the OS/400.

3. Create a save file of your library.

4. Print a cover letter from the AS/400 Web site of an individual PTF that applies to your operating system.

Chapter 8: Subsystems and Performance

Chapter Overview

AS/400 performance is affected by many factors including the hardware system configuration, the applications used, and the system workload. This chapter addresses subsystem and storage pool configurations that affect system performance. In this chapter you learn

- the function of subsystems

- the concept of time slices, run priorities, and job states

- the concept of machine pool paging

- how to use the WRKSYSSTS (Work with System Status), WRKACTJOB (Work with Active Jobs), and WRKDSKSTS (Work with Disk Status) commands to monitor and measure system performance

- how to power down the system

Subsystems

As we mentioned in Chapter 1, all user jobs are processed within a **subsystem** on the AS/400. Subsystems provide an organized way of allocating resources. Subsystems are started when the AS/400 powers up and loads the operating system and other necessary objects into main memory. The AS/400 provides two subsystem configurations. The basic configuration includes three subsystems: QBASE, QSPL, and QSYSWRK. **QBASE** is the controlling subsystem and handles the interactive, batch, and communications jobs. QSPL coordinates spooling and printing, and QSYSWRK supports the system functions. This simple arrangement is convenient for installation but doesn't take advantage of the system's capabilities. Separating the work load into additional subsystems can improve performance; in fact, some individual software applications available on the AS/400 are designed to run in their own subsystems. Many administrators have found that placing each specific type of job into its own subsystem provides maximum AS/400 efficiency. For example, establishing separate subsystems for batch, interactive, and communications jobs provides much more consistent system performance. The second subsystem configuration supplied with the AS/400 consists of subsystems to be used in a multiple-subsystem configuration: QCTL, QINTER, QSPL, QCMN, QBATCH, and QSYSWRK. **QCTL** is the controlling subsystem and handles interactive jobs executed from the system console.QINTER supports interactive jobs from attached user workstations. QSPL handles spooled file jobs, including placing files or jobs into disk storage for later processing or printing. QCMN supports communications jobs. QBATCH supports batch jobs, and QSYSWRK coordinates system functions. Each subsystem has a job queue with the same name assigned to it. Although the AS/400 allows for virtually any combination of jobs within subsystems, your installation's workload and communication methods will determine the configuration needed for top performance.

The system console is attached to the QCTL subsystem. This configuration is important for many reasons, but the most important concerns IPL. When the AS/400 performs an IPL, the system console is the only display station capable of carrying out functions until the IPL is complete. Specifically, QCTL begins an important autostart job at IPL. The autostart job starts the system-supplied subsystems QINTER, QSPL, QCMN, QBATCH, and QSYSWRK.

Each time a subsystem is created, a subsystem description is created. A subsystem description is an object that describes the subsystem's attributes, including the amount of main memory used and any autostart job entries assigned to the subsystem.

Changing the IBM-provided subsystem configuration is a very simple task. The system value QCTLSBSD (Controlling Subsystem Description) holds the name of the initial subsystem. If you change the name of the controlling subsystem to QCTL, the AS/400 understands to start using the second configuration.

| Tip | **Changing the controlling subsystem requires security officer authority. If you have the appropriate authority, you could use the CHGSYSVAL (Change System Value) command to change your controlling subsystem.** |

To check whether the controlling subsystem on your AS/400 is QCTL, use the DSPSYSVAL (Display System Value) command:

1. Type **DSPSYSVAL** on any command line.
2. Press F4 to prompt for DSPSYSVAL command parameters.
3. Type **QCTLSBSD** for the "System value" parameter.
4. Press Enter to bring up the Display System Value screen (Figure 8.1).

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```
                       Display System Value

System value . . . . . :   QCTLSBSD
Description  . . . . . :   Controlling subsystem


Controlling subsystem  . . . :    QCTL
  Library  . . . . . . . . . :    QSYS







Press Enter to continue.

F3=Exit   F12=Cancel
```

Figure 8.1: Display System Value Screen

The Display System Value screen displays the value for the controlling subsystem. In this
example, QCTL is the controlling subsystem, and it's located in library QSYS.
To work with a subsystem on the AS/400, use the WRKSBS (Work with Subsystems) command.
To designate a particular subsystem using positional notation, type **WRKSBS *subsystem_name***.
The default for the name of the subsystem parameter is *ALL. To access the Work with
Subsystems screen (Figure 8.2),

1. Press Enter to exit the DSPSYSVAL screen.
2. Type **WRKSBS** on the command line.

3. Press Enter.

```
                       Work with Subsystems
                                              System:    XXXXXXXX
Type options, press Enter.
  4=End subsystem 5=Display subsystem description
  8=Work with subsystem jobs

                   Total      -----------Subsystem Pools-----------
Opt Subsystem   Storage (K)   1  2  3  4  5  6  7  8  9  10
  _ QBATCH          0         2
  _ QCMN            0         2
  _ QCTL            0         2
  _ QINTER          0         2  4
  _ QSERVER         0         2
  _ QSPL            0         2  3
  _ QSYSWRK         0         2
  _ QTCP            0         2

                                                      More ...
Parameters or command
===>
F3=Exit  F5=Refresh  F11=Display system data  F12=Cancel
F14=Work with system status
```

Figure 8.2: Work with Subsystems Screen

The Work with Subsystems screen shows all the currently active subsystems. If a subsystem isn't
active, it won't be displayed and isn't available for use.

Tip   **To start a subsystem, use the STRSBS (Start Subsystem) command on
                 any command line.**

The WRKSBS screen lets you, as the system operator, work with subsystem jobs by typing **8** in
the option column next to the name of a subsystem. This is a convenient way to verify whether,
and how many, jobs are running in a subsystem.

System Pools
As we have discussed, subsystems are generally created to improve system performance for
different departments or for different users' needs. Each subsystem is defined to run in a system
pool based on how many resources the job is likely to require. A **system pool**, also called a

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storage pool, is a logical division of main memory reserved for processing a job or group of jobs. The operating system preassigns subsystems to main memory pools.

We can compare system pools to multiple swimming pools. A reasonable approach to sharing the swimming pools would be to dedicate each swimming pool to a particular type of swimmer. One pool might be dedicated to lap swimming, one to diving practice, and one to children for splashing and playing. System pools work in the same way, with work divided into types of jobs.
Each system pool has a predefined size and **activity level.** Activity levels are the maximum number of jobs that can run simultaneously in the particular system pool. We can also relate activity levels to the swimming pools example. The lap pool might have eight lanes, while the diving pool may be able to efficiently handle a dozen divers, and the children's pool may have a maximum limit of 75 children.

Because the number of jobs sharing a system pool is limited, each job secures just enough resources to run efficiently. Specifying a large number for the activity level lets many more jobs enter main storage. These jobs compete for system resources, ultimately slowing the completion of all the jobs.
When the AS/400 is shipped, all of main storage resides in two system pools: the **machine pool** (*MACHINE) and the **base pool** (*BASE). The machine pool must be defined to support your system hardware; the amount of main storage allocated to the machine pool is hardware-dependent and varies with each AS/400.

The base pool is the main storage that remains after the machine pool is reserved. *BASE can be designated as a shared pool for all subsystems to use to process work, or *BASE can be divided into smaller pools of shared and private main storage. Other shared system pools may include *INTERACT (for interactive jobs), *SPOOL (for printers), and *SHRPOOL 1 through *SHRPOOL 10 (for pools that you can define for your own purposes). If a job uses all the resources available in the pool it's assigned to, the job may then access additional resources in the *BASE pool.
Shared pool sizes are controlled via the CHGSHRPOOL (Change Shared Pool) or WRSHRPOOL (Work with Shared Pools) commands. Figure 8.3 shows a WRKSHRPOOL screen, on which you can modify the pool size or activity level simply by changing the entries of the Defined Size (K) and Max Active columns.

```
                      Work with Shared Pools
                                        System:    XXXXXXXX
  Main storage size  (K) . :     65536

  Type changes (if allowed), press Enter.

            Defined    Max    Allocated    Pool     -Paging Option-
  Pool      Size (K)  Active  Size (K)     ID       Defined Current
  *MACHINE    26166   *****     26166       1       *FIXED  *FIXED
  *BASE       23324      66     23324       2       *FIXED  *FIXED
  *INTERACT    9372      79      9372       4       *CALC   *CALC
  *SPOOL        652       5       652       3       *FIXED  *FIXED
  *SHRPOOL1       0       0                         *FIXED
  *SHRPOOL2       0       0                         *FIXED
  *SHRPOOL3       0       0                         *FIXED
  *SHRPOOL4       0       0                         *FIXED
  *SHRPOOL5       0       0                         *FIXED
  *SHRPOOL6       0       0                         *FIXED
                                                           More ...
  Command
  ===>
  F3=Exit   F4=Prompt F5=Refresh F9=Retrieve F11=Display tuning data
  F12=Cancel
```

Figure 8.3: Work with Shared Pools Screen

To see which pools a subsystem is using, use the DSPSBSD (Display Subsystem Description) command:
1. Type **DSPSBSD QBASE** on any command line.
2. Press Enter.
3. Type **2** to choose Pool definitions from the Display Subsystem Description menu.
4. Press Enter to bring up a screen similar to the one in Figure 8.4.

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```
                        Display Pool Definitions
                                              System:   XXXXXXXX
Subsystem description:   QBASE          Status:   INACTIVE

Pool     Storage      Activity
 ID      Size (K)     Level
  1        *BASE
  2      *INTERACT




                                               Bottom


Press Enter to continue.

F3=Exit   F12=Cancel
```
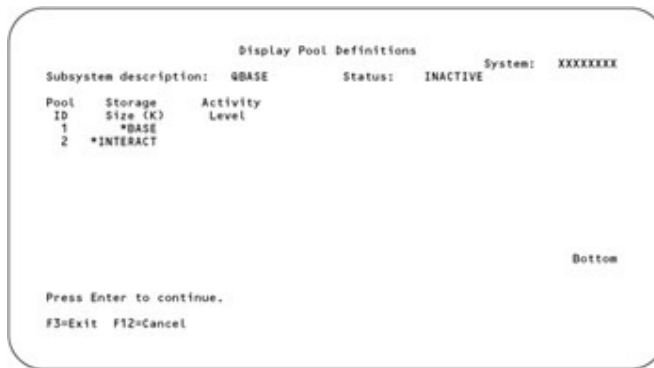
Figure 8.4: Display Pool Definitions Screen

The pool definitions for QBASE in Figure 8.4 show that the second IBM subsystem configuration is in effect. In this example, Figure 8.4 shows that the QBASE subsystem is inactive. If QBASE were active, the screen indicates that the *BASE and *INTERACT system pools would be used for this subsystem. A pool ID number is assigned to each subsystem listed.

Don't confuse subsystem pool numbering with system pool numbering. The AS/400's two predefined system pools, *MACHINE and *BASE, are defined as system pool number 1 and system pool number 2, respectively. (*MACHINE is reserved for hardware needs. *BASE is shared and drawn from as needed for batch jobs or other jobs not able to acquire enough memory from other pools.)

Pool numbering within a subsystem is unique to that subsystem, and only the routing entries in that subsystem use it to determine which pool jobs will use, based on the routing data associated with each job. As subsystems define new storage pools (shared or private) in addition to the two predefined system pools, the system simply assigns the next available system pool number to use as a reference on the WRKSYSSTS display.

For example, with the above pools for QBASE and the following pools for QSPL,

QSPL ((1 *BASE) (2 *SPOOL))

the system pool numbering might correspond to the subsystem pool numbering shown in Table 8.1.

Table 8.1: System and Subsystem Pool Numbering

System Pool Number	QBASE Pool Number	QSPL Pool Number
1. *MACHINE pool		
2. *BASE pool	1	1
3. *INTERACT shared pool	2	
4. *SPOOL shared pool		2

A private pool is a specific allocation of main storage reserved for one subsystem. It's common to use a private pool when QCTL is the controlling subsystem instead of QBASE. Although using QBASE as the controlling subsystem lets you divide main storage into separate pools, using QCTL is inherently easier to manage and administer in terms of controlling the number of jobs and performance tuning.

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Now let's look again at Figure 8.2. In this example, the Subsystem Pools area (numbered 1-10) identifies which system storage pools are used by each subsystem storage identifier. The numbers below the Subsystem Pools heading correspond to the subsystem name. The numbers below subsystem 1 and subsystem 2 identify the system pools. To attach a name to the system pool number in use, you need to access the WRKSYSSTS (Work with System Status) screen (Figure 8.5). To do so, type **WRKSYSSTS** on a command line, then press Enter.

```
                    Work with System Status
                                        02/06/00  16:22:12        XXXXXXXX
    % CPU used . . . . . . :        53.1    Auxiliary storage:
    Elapsed time . . . . . :    00:37:37      System ASP . . . . . :    8.12 G
    Jobs in system . . . . :         827    % system ASP used . . :   60.888
    % addresses used:                         Total  . . . . . . . :    6.12 G
    Permanent . . . . . . :        .007      Current unprotect used :    242 M
    Temporary . . . . . . :        .010      Maximum unprotect  . . :    262 M

    Type changes (if allowed), press Enter.

    System    Pool     Reserved    Max
     Pool   Size (K)   Size (K)   Active   Pool        Subsystem    Library
       1      26166      16264     +++++   *MACHINE
       2      23324          0        88   *BASE
       3        652          0         5   *SPOOL
       4       9372          0        79   *INTERACT

                                                               More ...
    Command
    ===>
    F3=Exit   F4=Prompt   F5=Refresh   F9=Retrieve   F10=Restart
    F11=Display paging option
```

Figure 8.5: Work with System Status Screen

The System Pool column in Figure 8.5 displays the number that corresponds to the system pool numbers displayed vertically under Subsystem Pools in Figure 8.2. In Figure 8.2, the jobs in subsystem 1 are using the *BASE pool.

Ending Subsystems

You can use the ENDSBS (End Subsystem) command to end any subsystem. For example, you might want to end a remote subsystem at the end of the day so it is unavailable at night. But be careful not to end subsystems while users are running valid jobs within them.

When you need to end a subsystem with the ENDSBS command (Figure 8.6), the system prompts you for the name of the subsystem you want to end; the prompt is for either a controlled end (*CNTRLD) or an immediate end (*IMMED).

```
                      End Subsystem (ENDSBS)

    Type choices, press Enter.

    Subsystem . . . . . . . . . . . .              Name, *ALL
    How to end  . . . . . . . . . .    *CNTRLD     *CNTRLD, *IMMED
    Delay time, if *CNTRLD  . . . . .  *NOLIMIT    Seconds, *NOLIMIT




                                                                 Bottom
    F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
    F13=How to use this display        F24=More keys
```

Figure 8.6: End Subsystem (ENDSBS) Screen

A controlled end allows all active jobs to continue for as long as the Delay time parameter specifies. You can change the value of the Delay time parameter to a given number of seconds, or you can specify no maximum (*NOLIMIT) so that all active jobs continue indefinitely.

An immediate end forces the system to take drastic measures to end the jobs; if users are updating files (especially keyed files), OS/400 may have to repair the files the next time you IPL, which could cause the IPL to take much longer.

System Performance

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Everyone who has worked on an AS/400 has experienced days when the system seems especially slow. Interactive processing needs usually are high between 8:00 a.m. and 5:00 p.m.; at midnight of the same day, processing needs are generally quite different. Disk storage (DASD), main memory (storage pools), central processing unit (CPU) time slices, run priorities, and job states combine to execute the system duties and user tasks with various degrees of efficiency.

The AS/400 automatically adjusts pool sizes and activity levels with the QPFRADJ (Automatic Performance Adjustment) system value. The QPFRADJ value indicates whether and when the system should adjust resources. If 0 is specified for the QPFRADJ system value, no adjustments are made. If 1 is specified, the system calculates the activity level and pool sizes and changes them during IPL. If 2 is specified, the system calculates and changes pool sizes and activity levels at regular intervals and at IPL. If 3 is specified, the system calculates and changes resources at regular intervals but not at IPL.

However, many systems can benefit from additional minor tuning changes to improve their performance. The AS/400 MIS staff can monitor system performance and tune the AS/400 for maximum efficiency. Security officers are generally the only people who can actually modify the system. However, system operators often monitor AS/400 performance and inform the security officer when changes may be needed. The following discussion demonstrates how to monitor and calculate the best performance balance for your system and how to prevent bottlenecks from occurring.

The MIS staff should first define the organization's preference for system performance goals. One possible definition might be that programmers should have system priority for compiles and testing. Another definition might be that the customer-support department has the highest system priority. By pinpointing the areas within the organization where performance is most important, the MIS staff can more easily balance DASD, main memory, and the CPU. Any one of these areas can become a bottleneck. Main memory and DASD are finite resources with room for only a certain number of jobs. OS/400 effectively manages the efficient use of the AS/400's disk drives. But it's necessary to monitor disk usage to ensure that total disk usage doesn't exceed 80 percent of the available disk space. If disk usage exceeds 80 percent, performance may become very poor and the likelihood of a system crash is high. If disk usage exceeds 80 percent often, removing seldom-used applications or purchasing more DASD may be necessary.

CPU Issues and Considerations
CPU considerations are varied and are considerably different from those related to main memory and DASD. The CPU uses **time slices**, **run priorities**, and **job states** to effectively manage the jobs submitted for processing.

Time Slices and Run Priorities

A time slice is the amount of processor time a job has before the CPU moves to other jobs of equal or higher priority. The run priority indicates the importance of the job. Within a single storage pool, the job that has been given higher priority will acquire system resources first. On the AS/400, the run priority number is a ranking from 1 through 99, with 1 being the highest priority. Don't confuse the run priority (which determines the priority of the job while it's executing) with the job priority (which determines the relative order of a job waiting on the job queue).

As an example of how the system prioritizes jobs, AS/400 print writers have higher priority than interactive jobs because printers use so little processor time that they don't significantly delay other jobs. Giving print writers high priority makes better use of the printer and speeds system throughput. In addition, the default system values usually give higher priority to interactive work than to batch jobs, just as you would give higher priority to people who are waiting on the phone

than to requests you have received in the mail. Batch jobs generally have the lowest priority and access system resources only when jobs with higher priority are inactive.

Job States

Another concept related to jobs is the job state. Jobs running on the AS/400 are in one of three states: active, waiting, or ineligible. A job is considered active when it's occupying storage, using the processor, and not exceeding the activity level of the storage pool. We can relate the active status to a swimmer actually swimming in the lap pool and using one of the lanes.

A waiting job is generally inactive until the next user request is initiated. For example, an interactive user may be discussing a problem with a customer and not currently entering any data into the computer. This job takes one of the activity level slots because the user may press a function key or the Enter key at any time.

An ineligible job can't occupy storage or use the processor because the activity level has reached its maximum limit.

Jobs shift between job states automatically, depending on the system's work load. For example, when a user presses Enter at the workstation and there is room within the activity level range, the user's interactive job passes from the wait to the active mode. If, however, the activity level limit has been reached for that storage pool, the job changes from wait to ineligible and remains ineligible until some other job leaves the active state. The ineligible job then makes the job transition from ineligible to active. If an active job request reaches the end of the time slice without conclusion, the system checks to determine whether some other job of equal or higher priority in the same storage pool is in the ineligible state. If a job is ineligible, the active job transfers from an active to an ineligible state to let the other jobs run. Thus, if another job of equal or higher priority in the same storage pool is ineligible, the current job becomes ineligible when it reaches the end of its time slice. This approach lets other jobs move into the active or wait states to be executed or wait their turn. When a job is completed or an interactive user signs off, the job is removed from the system.

Now that you have the information you need to understand the basic concepts underlying system performance, let's look at how you can specifically measure that performance.

Measuring System Performance

You can identify system performance values by monitoring the Work with System Status (WRKSYSSTS), the Work with Active Jobs (WRKACTJOB), and the Work with Disk Status (WRKDSKSTS) screens and then completing some minimal calculations. For a one-week period, run these three commands several times a day, trying to do so at approximately the same time each day. Take your measurements during a busy time. Take five "snapshots" of each screen about one minute apart to record average response times for interactive jobs. An easy way to do this is to use the Print Screen key and the F5 (Refresh) key.

Work with System Status
To access the Work with System Status screen again, type **WRKSYSSTS** on any command line, and press Enter to bring up a screen similar to the one in Figure 8.7.

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```
                    Work with System Status              XXXXXXXX
                                          12/06/99  16:33:22
  % CPU used . . . . . . . :      4.6  Auxiliary storage:
  Elapsed time . . . . . . :  00:00:01    System ASP . . . . . . :   8.12 G
  Jobs in system . . . . . :      833    % system ASP used . . :  60.6816
  % addresses used:                      Total . . . . . . . . :   6.12 G
  Permanent  . . . . . . . :     .007    Current unprotect used :    242 M
  Temporary  . . . . . . . :     .010    Maximum unprotect     :     262 M

  Type change, (if allowed), press Enter.

  System    Pool    Reserved     Max   -----DB-----  ---Non-DB---
  Pool    Size (K)  Size (K)   Active  Fault  Pages  Fault  Pages
    1       28188     16256    +++++    .0     .0     .0     .0
    2       23324         0       88    .0     .0     .0     .0
    3         652         0        5    .0     .0     .0     .0
    4        9372         0       79    .0     .0    1.6    4.0
    5        2000         0        2    .0     .0     .0     .0
                   More...
  Command
  ===>
  F3=Exit    F4=Prompt         F5=Refresh    F9=Retrieve      F10=Restart
  F11=Display transition data  F12=Cancel    F24=More keys
```

Figure 8.7: Portion of the Work with System Status (WRKSYSSTS) Screen

The machine shown in Figure 8.7 has five system pools. The Pool Size is the amount of main memory storage available, expressed in **pages**. Pages are blocks of information set aside to hold information required for the jobs that are running. If a pool isn't large enough to hold all the information needed for the job, the information must be retrieved from DASD. This retrieval time slows job completion and may cause other jobs to be placed in an ineligible job state.

The machine pool's Reserved Size shows the amount of memory reserved for each pool. The system calculates the reserved size using storage pool sizes and activity levels. You can't directly change it.

The maximum number of jobs that can be in main storage simultaneously is shown in the Max Active column. This number isn't the same as the maximum number of currently active jobs.

The DB (database) Faults column indicates the number of times per second that database information was requested but wasn't available in main storage. This data must then be retrieved from disk and placed into main storage, ultimately slowing down the system. DB Pages is the rate per second that database pages (512-byte blocks of information) are being retrieved from disk into main storage. The Non-DB Faults and Pages columns indicate the same information for data that doesn't fall into the database category, such as program code.

The machine pool (system pool 1), which contains low-level system code and OS/400 licensed programs, can significantly affect system performance. The size of the machine pool is held in system value QMCHPOOL. You won't usually change this system value because setting the storage pool too small adversely affects performance. You can monitor general system performance by observing the machine pool faulting and paging rates on the WRKSYSSTS display. The chart in Figure 8.8a illustrates typical faulting ranges and how they usually affect performance.

```
System    Pool      Reserved    Max    DB      DB    | Non-DB | Non-DB
Pool    Size (K)   Size (K)   Active  Faults  Pages  | Faults | Pages
  1       28188      16256    +++++    .0      .0    |   .0   |   .0
```

MAIN STORAGE CONFIGURED	GOOD	ACCEPTABLE	POOR
12 MB OR LESS	2	2–4	>4
MORE THAN 12 MB	1	1–2.5	>2.5
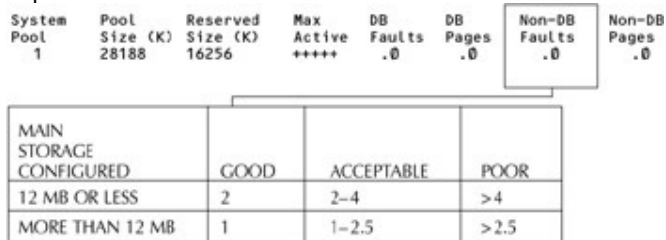
Figure 8.8a: Sample from Work with System Status (WRKSYSSTS) Screen

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If monitoring reveals that the machine pool performance is poor, you should make your security officer aware of the actual values.

Other Pools

The guidelines for system pools 2, 3, and 4 aren't as simple as those for the machine pool (see Figure 8.8b).

```
System   Pool       Reserved   Max     DB       DB      Non-DB    Non-DB
Pool     Size (K)   Size (K)   Active  Faults   Pages   Faults    Pages

 2       23324         0        88      .0       .0       .0        .0
 3         652         0         5      .2       .0       .0        .0
 4       19372         0        79      .0       .0      1.6       4.0
```

Add these two values for each pool
and compare them to the guidelines
in Table 8.2.

Figure 8.8b: Sample from Work with System Status (WRKSYSSTS) Screen

You must consider each pool individually. For each pool, add the database faults and the non-database faults. Then, find the figure from Table 8.2 that applies to your system's hardware model type. You can use the appropriate figure and the result calculated above to evaluate your system's performance.

Table 8.2: Model Performance Guidelines			
Model	**Good**	**Acceptable**	**Poor**
9402/400 2130, 2131, 2132, 2133	<50	50-100	>100
9406/500 2140, 2141	<50	50-100	>100
9406/500 2142, 2143, 40S, 2110, 50S, 2120	<100	100-175	>175
9406/510 2144	<150	150-300	>300
9406/530 2150, 50S, 2121	<150	150-300	>300
9406/530 2151, 2152, 2153, 53S, 2154, 2155, 2156	<200	200-325	>325
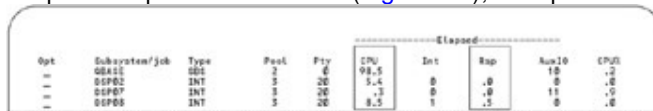
If monitoring reveals that a pool performance is poor, you should inform your security officer of the actual values.

In summary, find the system memory pools that have the highest page-faulting rates, and look for any unusual causes for faulting - compiles in the wrong pool, large queries running simultaneously, and/or interactive save/restore operations. Determine whether the causes of high faulting rates are likely to occur regularly; if so, scheduling changes may be in order. If your system needs a more permanent solution, purchasing additional memory or disk drives may be necessary.

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Work with Active Jobs

Signs of a possible bottleneck include variations in job priority within the same storage pool, unusually high CPU usage, and slow response time. Jobs in the same memory pool with different priority may cause problems because jobs with low priorities can't compete with jobs of higher priority. Because programmers tend to have higher system priority and use more resources when they are compiling or testing applications, other users could become locked out. One way to prevent this problem is to separate programming jobs from other interactive users by giving programmers a separate subsystem.

To monitor the CPU usage of individual jobs, access the Work with Active Jobs screen by typing **WRKACTJOB** on a command line and pressing Enter. From the initial display, press F11 to bring up the Elapsed Time screen (Figure 8.9), then print the screen.

Figure 8.9: Sample from Work with Active Jobs (WRKACTJOB) Screen

Caution		**You should rarely use the WRKACTJOB screen because displaying the information for each job requires considerable system overhead. In this book, we specifically don't have all the students perform the WRKACTJOB command during the class period because when everyone in a large class requests this screen, the system response time degrades dramatically.**
		If you don't need to see all active jobs during your normal daily work, consider using the WRKUSRJOB (Work with User Jobs) command, which displays jobs by user profile name, or the WRKSBSJOB (Work with Subsystem Jobs) command, which displays jobs by subsystem name.

Using the same measuring techniques as you did for the WRKSYSSTS screens, collect the new data. If CPU usage is high since a particular job has begun, it might be wise to submit this job as a batch job instead of an interactive job. For example, query jobs use great quantities of CPU time, effectively locking out other interactive users; such jobs are generally better if they are submitted as batch jobs.

Another area that can point out problems in performance is the Rsp column of the Work with Active Jobs, Elapsed Time screen. This column represents the average interactive response time for a job, expressed in seconds. Response is generally expressed numerically. However, if the response is noted as a series of pluses (+++),this particular job or workstation isn't getting its share of time slices. Many factors could contribute to this situation. It's possible that the job isn't getting its time slice because it's sharing a pool with jobs that have a higher priority. Another reason might be that all the system resources are being used by a large job that might better be submitted at night. Another reason might be that a large number of interactive users are active, requesting the same resource at the same time. Sometimes, the +++ appears for only a few seconds until the system processes the requests - the +++ shouldn't occur for long periods. If the situation persists, notify your security officer. For more information about items on the Work with Active Jobs screen, press Help on the item you want to learn more about.

Work with Disk Status

One disk unit is always used more because this unit contains the system programs. The operating system also loads from this disk unit. All other nonsystem unit usage should be relatively balanced. As we previously mentioned, the total disk storage used shouldn't exceed 80

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percent total of the available space. If any nonsystem disk unit becomes exceedingly full, poor performance - and possibly a disk crash - may result.

To obtain disk storage information, type **WRKDSKSTS** on any command line, then press Enter to bring up the Work with Disk Status screen (Figure 8.10). Again, note that the figure is only a portion of this screen.

```
              Size    %    I/O   Request  Read Write Read Write %
  Unit  Type  (M)   Used   Rqs   Size (k)  Rqs  Rqs  (K)  (K)  Busy
   1    9332  200   99.9    .0      .0      .0   .0   .0   .0    0
   2    9332  200   76.8    .0      .0      .0   .0   .0   .0    0
   3    9332  200   77.0    .0      .0      .0   .0   .0   .0    0
```

Figure 8.10: Portion of Work with Disk Status (WRKDSKSTS) Screen

The Unit column in Figure 8.10 lists the number assigned to each individual disk drive. The % Busy value shouldn't exceed 40 percent. When the busy percentage is high, the AS/400 will have long queues of waiting jobs and all the time slices will be used as the system attempts to access the data required for the jobs in the queues. Users will see system performance degradation and longer turn-around times. Scheduling jobs at nonpeak periods may be one way to relieve the daytime load on the system. If rescheduling jobs doesn't correct the problem, your organization may have to purchase additional DASD for the system.

If system performance has degraded because of excessive disk usage, you should delete unnecessary files from the disk. Occasionally, you may be able to back up seldom-used application packages and programs and remove them from the system. You can place these programs back in DASD when they are needed. One such example might be a budget package that is used only one or two months of the year.

Note   **An AS/400 Performance Tools program is available from IBM. The Performance Tools program supplies tools to measure performance, interprets the results, and recommends changes. Often, the Performance Tools program recommends running batch jobs when the system isn't so busy.**

A Performance Monitor is also available on the AS/400. The Performance Monitor collects performance data and generates reports so you can analyze performance for the period of time the monitor is running. To start the Performance Monitor, use the STRPFRMON command on any command line. This monitor uses system resources when activated and should be used only when troubleshooting performance problems. The Performance Monitor should track performance during a time that includes high and low workloads.

Powering Down the AS/400

Powering down a computer system as sophisticated as the AS/400 isn't like turning the power switch off on a personal computer. Often, the system is running jobs that you might not be aware of, and you must be careful not to interrupt those jobs by powering down the system. For example, the AS/400 may be running batch jobs that communicate with remote systems or that are printing reports.

You can check system activity with the WRKACTJOB command. Type **WRKACTJOB** on a command line and press Enter to bring up the Work with Active Jobs screen (Figure 8.11). The Work with Active Jobs screen shows which jobs are currently active - that is, which jobs are actually running. Some jobs are system jobs that you'll see all the time, even when you're the only user on the system.

```
                          Work with Active Jobs
                                          02/10/00  19:52:04    xxxxxxxx
    CPU %:    .0    Elapsed time:  00:00:00    Active jobs:   30
  Type options, press Enter.
     2=Change 3=Hold 4=End 5=Work with 6=Release  7=Display message
     8=Work with spooled files   13=Disconnect ...

  Opt  Subsystem/Job  User      Type  CPU %  Function       Status
    _    QBATCH        QSYS      SBS    .0                    DEQW
    _    QCMN          QSYS      SBS    .0                    DEQW
    _    QCTL          QSYS      SBS    .0                    DEQW
    _      QSYSSCD     QPGMR     BCH    .0   PGM-QEZSCNEP     EVTW
    _    QINTER        QSYS      SBS    .0                    DEQW
    _      QPADEV0011  QSYSOPR   INT    .0   CMD-WRKACTJOB    RUN
    _    QSPL          QSYS      SBS    .0                    DEQW
    _      PRT01       QSPLJOB   WTR    .0                    PRTW
    _    QSYSWRK       QSYS      SBS    .0                    DEQW


                                                         More...
   Parameters or command
   ===>
   F3=Exit F5=Refresh F10=Restart statistics 11=Display elapsed data F12=Cancel
   F23=More options   F24=More keys
```

Figure 8.11: Work with Active Jobs Screen

You should send a message to all your users before you power down. This message should be friendly yet authoritative. Allow users plenty of time to end the tasks they're performing. The best way to announce an anticipated power down is to send everyone a break message using the SNDBRKMSG (Send Break Message) command (Figure 8.12).

```
                     Send Break Message (SNDBRKMSG)

    Type choices, press Enter.

    Message text . . . . . . Shutting down the system in 30 minutes.
    Please sign off as quickly as possible. 02/10/00




    To work station message queue  .  *ALLWS      Name, *ALLWS
      Library . . . . . . . . . . .  *LIBL       Name, *LIBL
                   + for more values

    Message type . . . . . . . . . .  *INFO      *INFO, *INQ
    Message queue to get reply . . .  QSYSOPR    Name
      Library . . . . . . . . . . .  *LIBL      Name, *LIBL



                                                      Bottom

    F3=Exit    F4=Prompt    F5=Refresh      F12=Cancel
    F13=How to use this display             F24=More keys
```

Figure 8.12: Send Break Message (SNDBRKMSG) Screen

This command sends a message that is immediately displayed at the users' screens, interrupting whatever they are doing. The users will be forced to press Enter to return to whatever they were doing.

In the example shown in Figure 8.12, the same message is sent to all display stations. Unfortunately, for any display stations that aren't active at the time the message is sent, the message will be displayed to the next user who signs on at that station, possibly the next day. The PWRDWNSYS command actually turns off the system. As shown in Figure 8.13, the screen is similar to that displayed with the ENDSBS command in that this screen also has a How to end parameter that accepts either *CNTRLD or *IMMED. This parameter is of value only if you haven't ended the subsystems beforehand. If all subsystems are ended, the value you select in this parameter is irrelevant.

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```
                    Power Down System (PWRDWNSYS)

  Type choices, press Enter.

  How to end . . . . . . . . . . .    *CNTRLD     *CNTRLD, *IMMED
  Delay time, if *CNTRLD . . . . .    3600        Seconds, *NOLIMIT
  Restart after power down . . . .    *NO         *NO, *YES
  IPL source . . . . . . . . . . .    *B          *PANEL, A, B, D





                                                          Bottom
  F3=Exit    F4=Prompt    F5=Refresh     F12=Cancel
  F13=How to use this display            F24=More keys
```
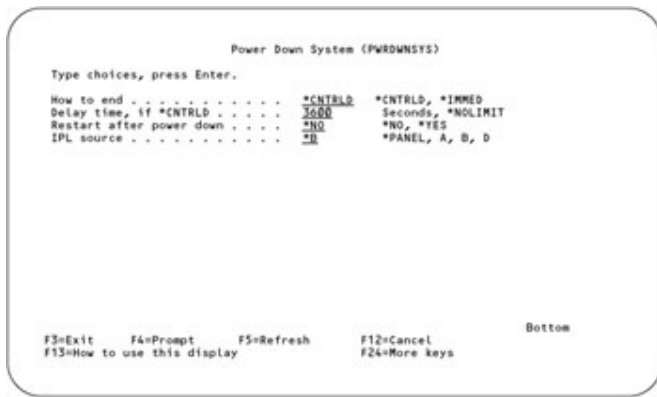
Figure 8.13: Power Down System (PWRDWNSYS) Screen

Shutting down the system with the PWRDWNSYS command doesn't cut electrical power from peripheral devices such as display stations and printers; these devices must be shut off individually.

The Restart after power down parameter of this command is very important. Specifying *NO for this parameter causes the system to actually shut itself down, removing electrical power from all CPU components. If you choose *YES for this parameter, the system goes through the motions of powering down; but before the power is shut off, it starts again. This is how you can perform an IPL without shutting down the system entirely.

Chapter Summary

AS/400 users must decide what is acceptable performance. If users report long waits for system attention, you can do some simple monitoring to determine whether configuration changes should be discussed or new hardware needs to be purchased. For more detailed information about performance, you can use the Performance Monitor to generate detailed reports of the use of system resources. If poor performance is noted in only one application or communication method, program temporary fixes or service packs may alleviate the problem area.

Key Terms

activity level

base pool

job state

machine pool

page

QBASE

QCTL

run priority

subsystem

system pool (storage pool)

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time slice

Review Questions

1. When you are running the AS/400 in multiple-subsystem configuration, what is the controlling subsystem?

2. Subsystems are created for what purpose?

3. Define the difference between a controlled subsystem end and an immediate subsystem end.

4. What is the disadvantage of using the WRKACTJOB command during your normal daily activities?

5. Looking at Figure 8.14, what is the +++? Why is this happening?

Opt	Subsystem/job	User	Type	CPU%	Function	Status
_	QBASE	QSYS	SBS	.0		DEQW
_	DSP02	TMPROKOP	INT	.0	*-CMDENT	DSPW
_	DSP07	MHUFFAR	INT	.0	*-CMDENT	DSPW
_	DSP08	BDSNYDER	INT	.0	*-CMDENT	DSPW

					------Elapsed--------			
Opt	Subsystem/job	Type	Pool	Pty	CPU	Int	Rsp	AuxIO	CPU%
_	QBASE	SBS	2	0	98.5			10	.2
_	DSP02	INT	3	20	5.4	0	+++	0	.0
_	DSP07	INT	3	5	.3	0	.0	11	.9
_	DSP08	INT	3	5	308.5	1	.5	0	.0

Figure 8.14: Sample Work with Active Jobs Screen

6. Looking at Figure 8.14, is this acceptable performance for an AS/400 Model 9402/400?

Exercise

1. Using the WRKSBS display, print the pool definitions for the QINTER subsystem.

Chapter 9: Client Access for Windows 95/NT and Operations Navigator

Chapter Overview

The most commonly used operating system on a PC attached to an AS/400 is Windows 95/98. Client Access for Windows 95/NT is IBM's method of integrating the AS/400 and PCs running Windows. Client Access for Win95/NT provides a graphical interface and numerous desktop features. AS/400 Operations Navigator, a component of Client Access for Win95/NT, provides many tools to help AS/400 system operators perform their tasks. In this chapter, you learn

- the basic Client Access and Operations Navigator features

- how to handle messages with Operations Navigator

- how to manage printer output and printers with Operations Navigator

- how to manage jobs with Operations Navigator

- how to schedule backups with Operations Navigator

Client Access for Windows 95/NT

The AS/400 Client Access Family for Windows is a group of IBM licensed software products that provides desktop connectivity and communications between an AS/400 and a PC operating in a Windows environment. IBM created and developed of the AS/400 Client Access family to meet the need for PCs integrated with AS/400 host systems. PCs provide users with easy-to-use programs, while the AS/400 provides strong database capabilities and a central data storage system.

Client/Server Computing

Client/server computing lets computer users within a network share information and computer resources - such as programs, data, and printers - with other intelligent computers within their network. Sharing software and peripherals reduces the cost of purchases and gives end users the flexibility to choose the appropriate resource for the job at hand from their own workstations.

Client Access implements client/server technology. The client application resides on the PC, and the server application resides on the AS/400. The philosophy behind client/server technology is that certain tasks can be performed better on one computer platform than on another. Tasks are distributed to the appropriate platform to achieve optimal performance, reliability, and usability. For example, the AS/400 is an excellent database server, while the PC uses a graphical user interface (GUI) to enhance the appeal and usability of applications. The AS/400 provides the data while the PC is responsible for formatting and displaying the data.

AS/400 Integrated File System

The **Integrated File System (IFS)** is part of the AS/400's operating system that supports storage management capabilities that are similar to those on a PC. It provides a file system and directory structure like a PC operating system. The IFS allows the AS/400 to perform as a PC file server. Through Client Access, PC users can access the IFS using the Win95/NT Network Neighborhood and Explorer interface. All Win95/NT features (e.g., drag-and-drop, rename, delete) are fully operational when a user accesses the AS/400 IFS. Network drive letters may be mapped using the Win95/NT map network drive utility. The IFS also supports long file names.

The Directory Update component included with Client Access for Win95/NT provides users with the capability to select directories on a PC and update these directories from a configured network server or from multiple networked servers. These servers can be AS/400s or Local Area Network (LAN) servers. The Directory Update function provides the means to load non-Client Access software products on a server attached to the network and keep those product program files updated on the attached PCs. The files in the selected directory on the PC are compared to the files in a server directory and if the files are different, the Directory Update feature copies the files from the server to the PC's selected directory.

Connectivity

Client Access for Win95/NT supports a large group of communications providers that may connect a Win95/NT client and an AS/400. These communications providers can be used with different connectivity options over LANs, Wide Area Networks (WANs), twinaxial connections, and remote connections using modems. Client Access for Win95/NT connections can coexist with Novell network connections, providing great flexibility for a company's network configurations.

Emulators

Client Access for Win95/NT's Personal Communications 5250 (PC5250) feature provides 5250 emulation sessions to the AS/400, allowing users' PCs to imitate AS/400 display stations. PC5250 supports up to 26 display sessions on the AS/400. Hot spots, macros, and pop-up key pads are supported functions for the 5250 emulation. A PC workstation can also act as the AS/400 system console through the built-in PC Console function in the PC5250 emulator. The

AS/400 Graphical Access emulator gives AS/400 displays a PC look and feel with an easy point-and-click interface. All of the original function keys used on an AS/400 terminal are still available to the user. The Graphical Access screen includes push buttons, pull-down menus, radio buttons, and dialog boxes.

Data Transfer

The Data Transfer feature included in Client Access for Win95/NT lets users transfer data to and from a library/file (member) format on the AS/400. The Data Transfer utility is fully integrated with Win95/NT operating-system platforms. Data Transfer options provide the choice of transferring a file, a record, or a field between a PC and an AS/400 in a variety of different file formats. For example, an end user might need to use data from an AS/400 database member in a Lotus spreadsheet. A Lotus spreadsheet program can't directly access the file format of an AS/400 database member; therefore, the database member must be converted into a format Lotus can understand. Data transfers may be completed interactively or in batch mode.

Printing with Client Access for Windows 95/NT

With the Client Access for Win95/NT network printing function, network printers attached to the AS/400 may be configured for PC programs. To access the complete functions, such as overlays and page segments available on AS/400 printers, an advanced function printing (AFP) printer driver is needed. AFP drivers are optional and may be installed to the Windows system directory. The Advanced Function Printing Workbench Viewer included with Client Access for Win95/NT lets the user view and browse spooled files located on the AS/400. Other PC users may also share a printer attached to a PC through the use of the PC5250 emulator.

Open Database Connectivity (ODBC)
Client Access for Win95/NT provides a 32-bit **Open Database Connectivity (ODBC)** driver that provides high performance data access to AS/400 databases. ODBC is an industry-standard interface (defined by Microsoft) for database connectivity between an application using Structured Query Language (SQL) and a database. An application that uses ODBC can access any database that has an ODBC driver available, giving different application programs access to the same database and letting users retrieve information with their choice of application programs. For example, a user can open an AS/400 database using Microsoft Access and work with database records in the Microsoft Access format.

Object Linking and Embedding (OLE)
Client Access for Win95/NT includes integrated **Object Linking and Embedding (OLE)** support that enables users to share data with other applications that support OLE. A user can create an OLE object that may contain multiple data types and still browse or change that data within the object. This feature enables users to link and view spreadsheet data with word processing data in one object. Linking is performed through the Windows copy and paste features. If the word processing data is updated in the original file link, the OLE object is updated automatically also. Embedding also uses the Windows copy and paste features.

AS/400 Operations Navigator

From a system operator's point of view, the most useful component of Client Access is AS/400 Operations Navigator (OpNav), a graphical interface used from a PC to manage AS/400 operations and administrative tasks. With basic OpNav features installed, a system operator can manage messages, printer output, and printers. OpNav also lets a system operator manage jobs, schedule regular backups, view software and hardware inventory, and - with proper authority - perform some security-related tasks. In the following sections, we discuss the OpNav functions of most interest to a system operator.

When Client Access for Win95/NT is installed with OpNav using the installation defaults, only the Basic Operations are installed (Figure 9.1). In the right pane of the OpNav window in Figure 9.1, you can see that Basic Operations include handling messages, printer output, and printers. When additional features are installed, the right pane of the OpNav window displays the additional features.
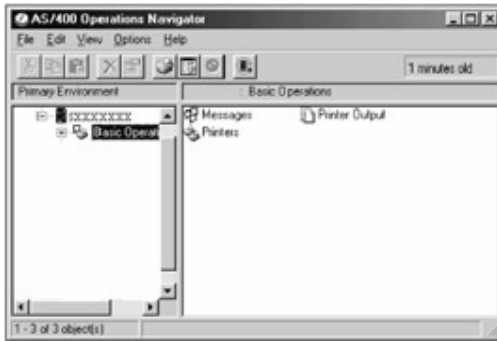
Figure 9.1: AS/400 Operations Navigator Window

For quick access to commonly used functions, the OpNav user interface includes icons on the toolbar at the top of each window. You can use menus (accessed by right-clicking an item or using the menu bar) to perform the same tasks, but using the icons minimizes the number of mouse clicks or key strokes required to perform a task. Figure 9.1 displays icons for cutting, copying, pasting, deleting, displaying properties, and printing.

Tips
- **To view the function assigned to a icon, move your mouse pointer over the icon and descriptive text will pop up.**
- **In the upper right corner of Figure 9.1, "1 minutes old" is displayed. To view the latest information, click View on the menu bar and select Refresh.**

Operations Navigator Message Handling

OpNav lets you work with AS/400 messages using a graphical interface. Click Messages in the left pane to open your list of messages in the right pane of the OpNav window (Figure 9.2).

Figure 9.2: AS/400 Operations Navigator - Messages Window

The messages listed in the right pane default to the signed-on or current user. The system operator messages are listed in Figure 9.2.

Tip
- **To change the view of the messages listed and define which details are displayed, click Options on the menu bar, select Include from the menu, and specify alternative choices. You can use Options, Include on other OpNav lists as well (e.g., printer output, printers).**

As you can see in Figure 9.2, OpNav includes graphics to help you identify the type of message listed. A bubble with a question mark identifies an inquiry message while a bubble with text identifies an informational message. Messages are listed in order with unanswered inquiry

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messages first, the sender's copy of messages that require a reply second, and messages requiring no reply third.

To view an individual message, click the message to open the Detailed Message Information window. Figure 9.3 displays the message details for an informational message to alert users that the system will be powered down at a specific time.
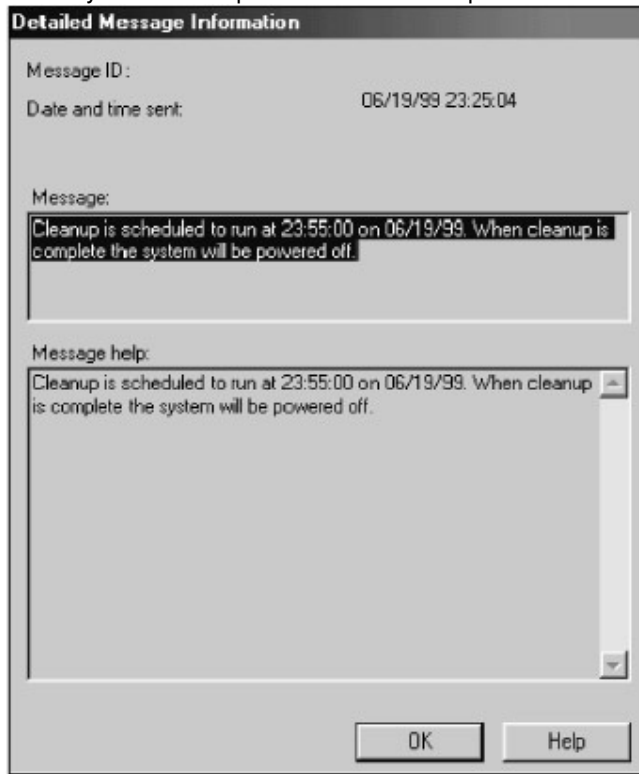
Figure 9.3: Detailed Message Information Window

The date and time the message was sent is included. If the message is an inquiry message, additional options to answer the message are available.

Tip	**You can also use the properties icon, fourth from the left in Figure 9.2, to view details of a selected (highlighted) message. The properties of a message lists additional information including the severity or importance of the message and where the message was created.**

In the OpNav window in Figure 9.2, if the reply-to-message icon (second from the left) is high-lighted for the selected message, the message requires a reply. You can click the reply-to-message icon or use the context menu accessed by right-clicking the message. To delete a message, you can use the delete icon (third from the left in Figure 9.2) or the Delete option on the message's context menu.

To display the context menu for Messages (Figure 9.4), in the left pane of Figure 9.2, right-click Messages.

Figure 9.4: Context Menu for Messages

The options available include exploring the messages for the user logged on, opening the right pane to list the messages, creating a Windows shortcut for Messages to be viewed and accessed from another window on your desktop, and sending a message.

To send a message, click Send Message on the context menu to bring up the Send Message dialog box (Figure 9.5).
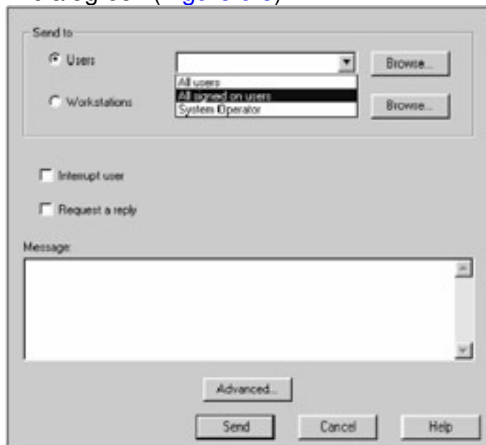
Figure 9.5: Send Message Dialog Box

As you can see in Figure 9.5, the Send Message dialog box provides all the send message options associated with the SNDMSG (Send Message) command. Messages may be sent to users or workstations. A message may be sent to all users, all signed-on users, or the system operator. If you want to send a message to an individual user, you can type the user ID or click Browse to find the user ID. By checking the appropriate box, you can send an important message that interrupts a user or request a reply from a user or workstation.

Handling Printer Output

All features available with the WRKSPLF (Work with Spooled Files) command are accessible through OpNav's graphical interface. With a click of your mouse, you can view, hold, and delete printer output. You work with printer output through the Printer Output option (Figure 9.6) or - if the output is associated with a printer - through the Printers option.
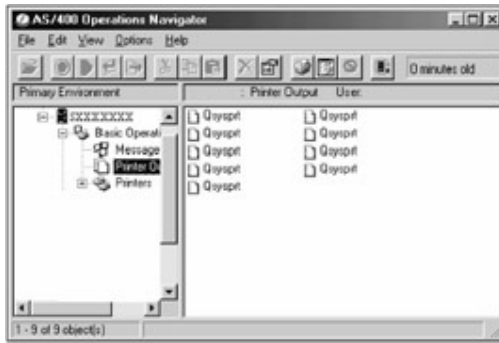
Figure 9.6: AS/400 Operations Navigator - Printer Output Window

As with the Messages feature, icons are available for quick access to functions associated with printer output. When a function is available, its associated icon is highlighted. Context menus also provide access to functions.

To list the printer output associated with your user ID, open the Printer Output folder in the left pane of the OpNav window. The printer output is listed in the right pane. As we mentioned earlier, to change the view of the listing, use the Include option from the Options menu (Figure 9.7). You can choose to list printer output by user, printer, output queue, form type, user-specified data, status, and/or job name.
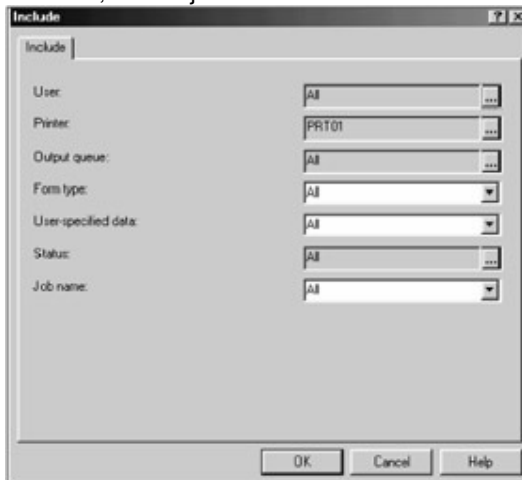
Figure 9.7: Include Dialog Box for Printer Output

To view your printer output, in the right pane of the Printer Output window (Figure 9.6), click the printer output that you want to view.

As system operator, you can use the Printers folder to handle printers and the output assigned to them. To access printer output assigned to a specific printer, open the Printers folder and click the printer name assigned to your output. Figure 9.8 displays the printer output assigned to the printer PRT01.

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Figure 9.8: Printer Output for PRT01

You control a printer from OpNav by right-clicking the printer to display its context menu. From the context menu, you can perform all the tasks that are included on the Work with Printers screen: You can hold, stop, start, and restart the printer, as well as make it available or unavailable.

To control printer output assigned to a specific printer, right-click the spooled file you want to work with to bring up its associated context menu (Figure 9.9).
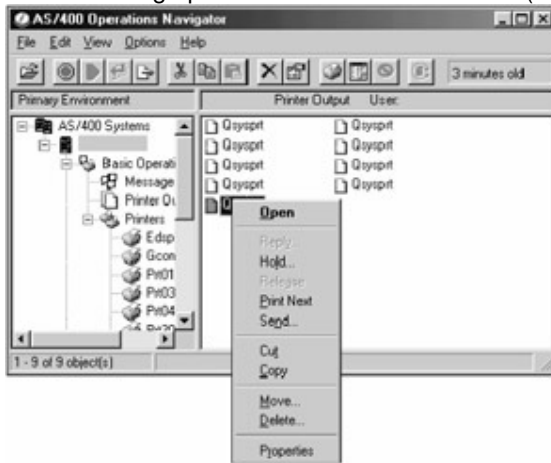
Figure 9.9: Context Menu for Printer Output

The Open option displays the spooled file. The Hold option holds the spooled file for printing later. The Release option (available only when the spooled file has been held) releases the spooled file from its held status. The Print Next option lets you move the spooled file to print ahead of all other spooled files in the queue. You can also cut, copy, move, and delete a spooled file from this menu.

Job Management with Operations Navigator

The tools for managing jobs are available through OpNav's Job Management feature. To view a list of jobs, open the Job Management folder in the left pane of the OpNav window, and click the Jobs item. A list of jobs is displayed in the right pane (Figure 9.10).

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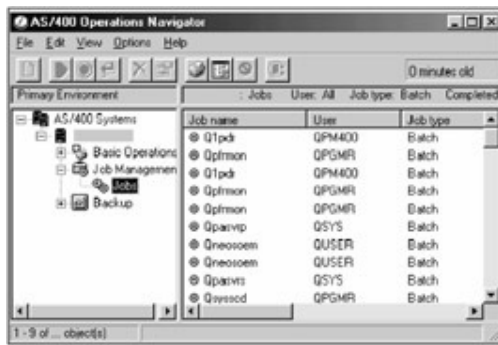
Figure 9.10: AS/400 Operation Navigator - Jobs Window

The list of jobs provides information about each job, including its status, the type of job, and the date and time it was created. (As with the other OpNav features we've discussed, you can use the Include option from the Options menu to customize the view of the items in the Jobs window.) Icons are available for job management and are highlighted when they are available for the selected job. You can hold, delete, and control a job using its context menu. You can view additional information for each job by displaying the job properties (Figure 9.11).

Figure 9.11: Job Properties Dialog Box - General 1 Tab

As you can see in Figure 9.11, a job's properties include detailed information about the job, including the job type, the date it entered the system, the job description, and the library. In Figure 9.11, the job has a job type of Batch, its status is Printer output, and it's using the QNORMAL job description in library QTEMP. You can change the priority on the printer output queue from the Printer Output tab.

The Job queue tab (Figure 9.12) displays the job queue and library used, the priority of the job on the job queue, and the time and date that the job entered the queue.

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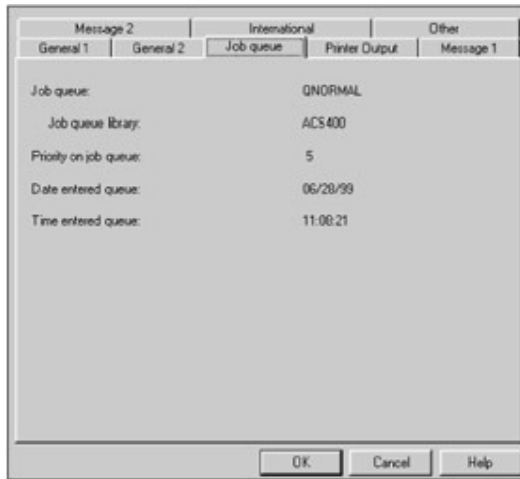
Figure 9.12: Job Properties Dialog Box - Job Queue Tab

The Message 1 and Message 2 tabs include information about messages associated with the job. These messages may also be in the operator's or user's job queue, depending on the message queue assigned to the job.

Backing up with Operations Navigator

Backing up your system's data is one of the most important activities for an AS/400 system operator. OpNav provides easy-to-use policies to control and implement AS/400 backups. IBM supplies three **backup policies**: Daily, Weekly, and Monthly. You can alter these policies to fit your needs through the OpNav Backup feature.

Click Backup to open the Backup feature. Click Policies to list the supplied policies (Figure 9.13).

Figure 9.13: AS/400 Operations Navigator - Backup Policies Window

Figure 9.13 lists the IBM-supplied policies. The Scheduled column lists the times the backups will be run. The Tape Set column lists the tape sets already defined for each policy.

Click Daily to open the properties of the Daily backup policy and switch to the What tab (Figure 9.14).

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Figure 9.14: Daily Backup Policy Properties - What Tab

In the Data to save portion of the What tab, you can choose to back up user libraries, folders, user directories (which includes the IFS), and/or additional data. (Recall from Chapter 7 that security data and configuration data aren't usually saved daily but instead are saved after changes or additions to the security or configuration - or perhaps monthly. The OfficeVision (OV) mail and calendars should be saved daily because new mail is sent every day and calendars are updated daily.) You can click Browse to browse the system and select and customize what should be backed up (Figure 9.15).
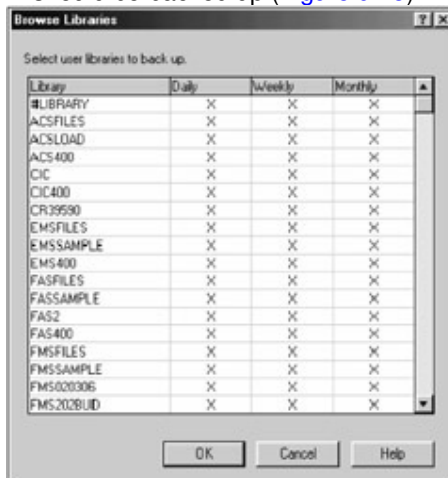
Figure 9.15: Browse User Libraries

The X displayed in the Daily, Weekly, and Monthly columns indicates that these libraries are included in the three backup polices. To omit a library from the one of the backups, delete the X in the appropriate column.

In the Save portion of the What tab (Figure 9.14), you can choose to save all of the data that has been selected in the Data to save portion or to save only the data that has changed since the last backup. You can also print a detailed report after the backup.

The When tab of the Backup properties dialog box (Figure 9.16) displays the scheduling times and days for the three backup policies.

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Figure 9.16: Daily Backup Policy Properties - When Tab

The options for scheduling a backup include the day of the week. In the time column, you specify the time of day to run the associated backup. Obviously you wouldn't run a daily backup on the same day that you run your weekly or monthly backup. Monthly backup scheduling includes the "Occurrence of day in month to run monthly backup" option, which lets you choose among five days to run the monthly backup.

On the Where tab of the Backup Policies dialog box (Figure 9.17), you specify the device to be used for backup. In addition to the tape drive to use and the target tape information, you can specify whether to erase the tape before backup and which tape set to rotate.
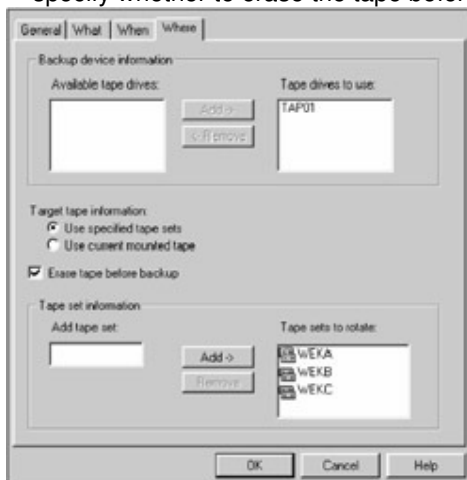
Figure 9.17: Daily Backup Policy Properties - Where Tab

Chapter Summary

Client/server computing provides the design for intelligent computers to share information. Easy-to-use interfaces were developed to facilitate information sharing. Client Access for Win95/NT is IBM's way to integrate Microsoft Windows 95/NT and the AS/400. Through Client Access for Win95/NT, users can access information on an AS/400 using the Win95/NT graphical interface and desktop features.

OpNav is the Client Access for Win95/NT feature that helps system operators perform their tasks with a user-friendly interface. Through the use of Client Access and OpNav, a system operator is no longer limited to a system console to manage the system.

Key Terms

backup policies

client/server computing

Integrated File System (IFS)

Object Linking and Embedding (OLE)

Open Database Connectivity (ODBC)

Review Questions

1. What is the purpose of Client Access?
2. When sending a message to a user with OpNav, how do you request a reply?
3. What is the Include selection on the Options menu used for?
4. How do you identify the purpose of an icon?
5. How do you display a job's properties?
6. How do you end a job?
7. What are backup policies?
8. What do user directories include?

Exercises

1. Print your job log from OpNav.
2. Identify the highlighted icons associated with a spooled file.
3. Change the columns listed when the messages folder is open.

Appendix A: Commonly Used Commands

Appendix Overview

This appendix contains a summary of commands that the novice system operator may be asked to use. We have found these generally helpful, and they may solve problems that initially aren't obvious. We've noted when the commands require security officer or system administrator authority.

User-Related Activities

Activity: Delete all objects from a library.
To delete all objects from a library, use the CLRLIB (Clear Library) command. This command doesn't delete the library itself. If there is no current library or if no current library is specified, the library list in QGPL is cleared. Therefore, we suggest that you *always* enter the library name when you use this command. You need security officer or system administrator authority to use the CLRLIB command.

1. Type **CLRLIB**.
2. Press F4 to prompt.
3. Type the *library name* as the value for the Library parameter.

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Activity: Change an individual's object authority.

To change an individual's object authority, use the EDTOBJAUT (Edit Object Authority), GRTOBJAUT (Grant Object Authority), or RVKOBJAUT (Revoke Object Authority) command.

Activity: Change a password that has been forgotten or has expired.

To change a password, use the CHGUSRPRF (Change User Profile) command.
1. Type **CHGUSRPRF**.
2. Press Enter.
3. Type the *user ID* for the User ID parameter.
4. Press Enter.
5. Change the Password parameter value to the same value as the User ID parameter.
6. Change the Set password to expired parameter value to *YES.
7. Press Enter.
8. Have the user sign on with the password that is now the same as his/her user ID.
9. Have the user type **CHGPWD**, press Enter, and follow the instructions on the Change Password screen.

Activity: Print a data file without having to do a screen dump.

To print a data file without having to do a screen dump, use the CPYF (Copy File) command. The spooled file will be placed in the output queue to which you are signed on.
1. Type **CPYF**.
2. Press F4 to prompt.
3. Type the *name of the file to print* as the value for the From file parameter.
4. Type ***PRINT** as the value for the To file parameter.
5. Press Enter.

Programmer-Related Activities

Activity: Look for backup objects from compiled programs.

Any users, but generally programmers, sometimes receive an error message indicating that they have exceeded the maximum storage for their user profiles. Each time a source member is compiled, a new object is created in the current library and in a library called QRPLOBJ. The system assigns the backup object a name that starts with Q and ends with a number. To look for these backup objects from compiled programs, use the WRKOBJOWN (Work with Object Owner) command. You need security officer or system administrator authority to use the WRKOBJOWN command.
1. Type **WRKOBJOWN**.
2. Press Enter.
3. Look through the objects on the screen. If this particular area has multiple Q… files, the backup objects could be causing the "exceeded maximum storage" error message. You can delete these objects without concern.

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Activity: Delete all backup objects from the QRPLOBJ library.

To delete all backup objects from the QRPLOBJ library (generally created from source member compiles), use the CLRLIB (Clear Library) command to delete all the Q… files. You need security officer or system administrator authority to use the CLRLIB command.

1. Type **CLRLIB**.
2. Press F4 to prompt.
3. Type **QRPLOBJ** as the value for the Library parameter.
4. Press Enter.
5. Have the user sign off and then sign back on.

Activity: End a program loop from a workstation.

A program generally loops during the development stage. When a program loops, the Input Inhibit indicator stays lit on the workstation and the keyboard is locked. To end the program, you need to end the request to the system. Ensure that the programmer is notified of the program name and that the program was ended.

1. Hold down the SHIFT key.
2. Press the SYSREQ key. An input line will appear across the bottom of the screen.
3. Press Enter.
4. Choose option 2 (end the previous request).

Software or Hardware Activities

Activity: Load an IBM licensed program.

If no version number for a licensed program is listed in the right column of the Installed Licensed Programs screen, the program hasn't yet been loaded. To load an IBM licensed program,

1. Type **GO LICPGM** to access the Licensed Programs Options screen.
2. Type **11** to access the Installed Licensed Programs screen.
3. Press Enter.

Activity: Change the device address.

After you move a device from one location to another, the device must be assigned a new address. Because no two devices can have the same address at any time (whether they are varied on or off), as system operator, you must assign a nonexistent address to the old device (possibly the matching port number with a switch setting of 99), then change the new device to the appropriate port and switch settings.

1. VARY OFF the old device.
2. Type **WRKCFGSTS**.
3. Press F4 to prompt.
4. Type ***DEV** as the value for the Type parameter.
5. Press Enter to accept other parameter defaults.
6. Change the port and switch settings for the old device:
   A. Select option 8 (Work with device description).
   B. Select option 2 (Change) on the Work with Device Description screen.
   C. Change the Port Number and Switch Setting parameters.
7. Press Enter.

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8. Repeat the previous steps to change the port and switch setting for the new device.

9. VARY ON the new device.

Activity: Test whether the modem is working before you use ECS for the Electronic Customer Support.

1. Type **SNDSRVRQS** on any command line.

2. Press F4 to prompt.
3. Type ***TEST** for the appropriate parameter.

4. Press Enter.

Activity: Access and change information about the printer.

The AS/400 stores pieces of information concerning printing in five different objects. The system moves through the list until it has gathered enough information to print a given report. The following list shows the location and the order the AS/400 uses to find the information for printing output:

- Printer device file

- Job description

- User profile

- Workstation description

- Printer device description system value (QPRTDEV)

Some values for devices and output queues can cause this sequence to change. IBM's *Guide to Programming for Printing* (SC41-37133) has more specific information about these exceptions. Table A.1 summarizes your change options.

Table A.1: Change Options for Printer Information	
To change the printer device file	Change the DEV (Device) parameter value on the CHGPRTF (Change Printer File) command or on the OVRPRTF (Override Printer File) command.
To change the job description	Change the PRTDEV (Print device) and OUTQ (Output Queue) parameters on the CHGJOBD (Change Job Description) command.
To change the workstation description	Use the WRKDEVD (Work with Device Description) command; use option 2 (Change) for the device to change. Then change the PRTDEV (Print Device) and OUTQ (Output Queue) parameters.
To change the user profile	Use the PRTDEV (Print Device) and OUTQ (Output Queue) parameters on the CHGUSRPRF (Change User Profile) command.
To change the default printer for the entire system	Use the Default system printer field on the Change System Options display. To find this display, type **GO SETUP** on any command line and press Enter. Then select option 1 (Change system options).

Power Off/On Considerations

Activity: Implement a semiemergency AS/400 power-down.

The option to power off the system from the console can be used only if at least 40 minutes are available to complete the power down.

1. Type **GO POWER**.

2. Press Enter.

3. Select option 3 (Power off immediately).

Activity: Power on the AS/400 after an emergency shutdown.

To power on the AS/400 after an emergency shutdown,

1. Turn on the operator's console.

2. Turn the Key Lock switch to the Manual position.

3. Turn the Unit Emergency switch to On.

4. When the Sign-On screen appears, sign on as the system operator. You can answer most of the screens that appear after sign-on by pressing Enter.