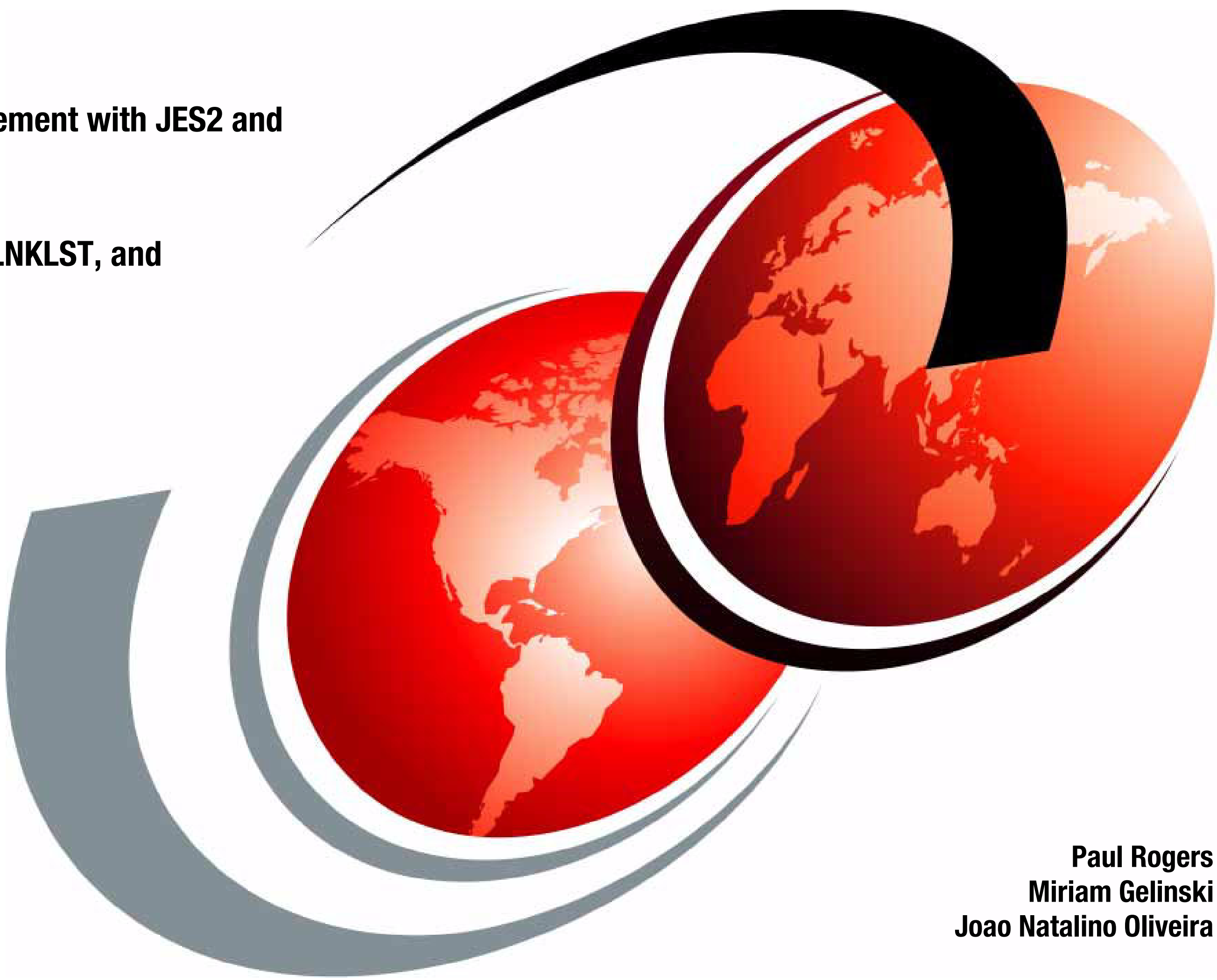
IBM

ABCs of z/OS System Programming Volume 2

z/OS implementation and maintenance

Job mangement with JES2 and JES3

SSI, LPA, LNKLST, and catalogs



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ABCs of z/OS System Programming Volume 2

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Note: Before using this information and the product it supports, read the information in “Notices” on page ix.

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Contents

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Preface

The ABCs of z/OS® System Programming is a ten volume collection that provides an introduction to the z/OS operating system and the hardware architecture. Whether you are a beginner or an experienced system programmer, the ABCs collection provides the information that you need to start your research into z/OS and related subjects. If you would like to become more familiar with z/OS in your current environment, or if you are evaluating platforms to consolidate your e-business applications, the ABCs collection will serve as a powerful technical tool.

This volume describes the basic system programming activities related to implementing and maintaining the z/OS installation, and provides details about the modules used to manage jobs and data. The topics covered are:

- Overview of the parmlib definitions and the IPL process. The parameters and system data sets necessary to IPL and run a z/OS operating system are described, along with the main daily tasks for maximizing performance of the z/OS system.
- Basic concepts related to subsystems, how to use the subsystem services provided by IBM® subsystems, and planning considerations for setting up and writing your own subsystem.
- Job management in the z/OS system using the job entry subsystems JES2 and JES3. Details about how JES2 and JES3 are used to receive jobs into the operating system, schedule them for processing by z/OS, and control their output processing.
- The link pack area (LPA), LNKLST, authorized libraries, and the role of VLF and LLA components.
- Catalogs and data set attributes.

The contents of the other volumes are as follows:

Volume 1: Introduction to z/OS and storage concepts, TSO/E, ISPF, JCL, SDSF, MVS™ delivery and installation

Volume 3: Introduction to DFSMS, storage management

Volume 4: Communication Server, TCP/IP, and VTAM®

Volume 5: Base and Parallel Sysplex®, system logger, global resource serialization, z/OS system operations, automatic restart management, hardware management console, performance management

Volume 6: RACF®, PKI, LDAP, cryptography, Kerberos, and firewall technologies

Volume 7: Infoprint® Server, Language Environment®, and SMP/E

Volume 8: z/OS problem diagnosis

Volume 9: z/OS UNIX System Services

Volume 10: Introduction to z/Architecture™, zSeries® processor design, zSeries connectivity, LPAR concepts, and HCD

The team that wrote this redbook

This redbook was produced by a team of specialists from around the world working at the International Technical Support Organization, Poughkeepsie Center.

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z/OS implementation and daily maintenance

Regardless of which method you use to install the z/OS operating system (ServerPac or CBPDO), it is highly recommended that you understand the basic aspects of the z/OS implementation, from installation to preparing for daily activities after IPL.

This chapter gives you an overview of the basics as well as the IPL process. It describes the main parameters and system data sets necessary to IPL and run a z/OS operating system, and the main daily tasks that a system programmer performs to maximize the advantages that a well-implemented operating system can offer to your IT structure.

1.1 Basic aspects of z/OS implementation

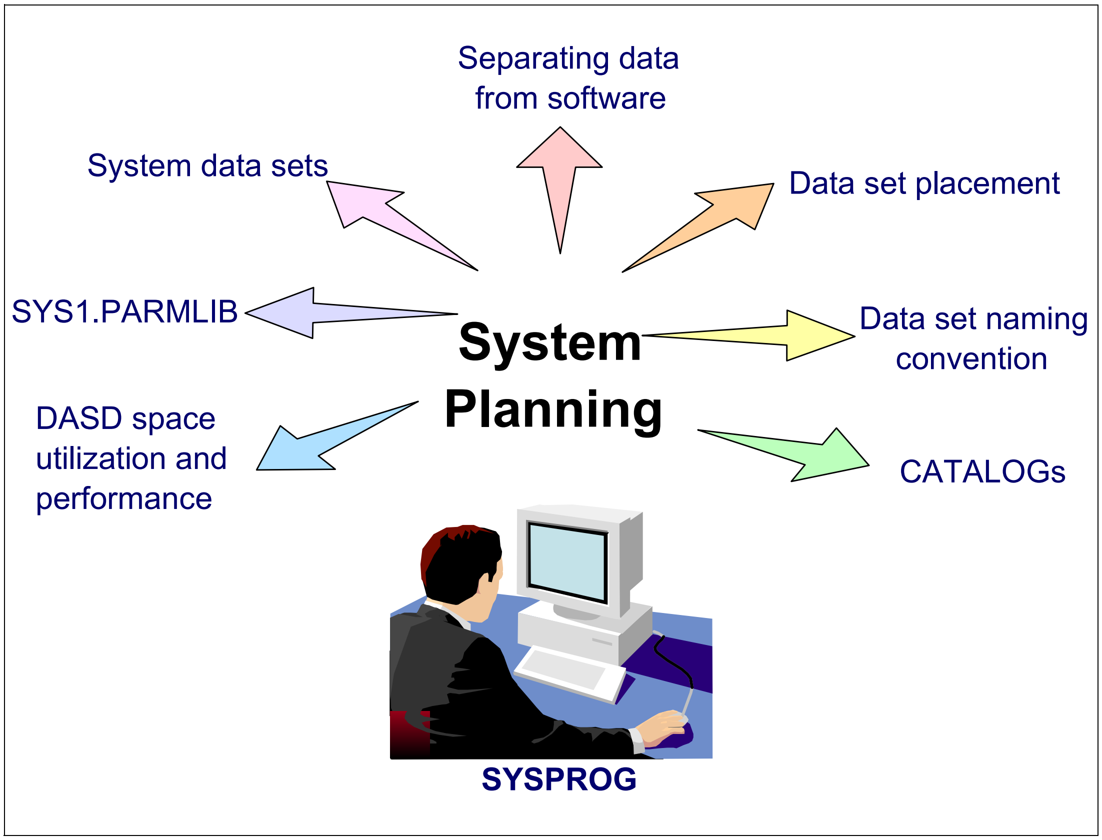


Figure 1-1 Basic aspects of z/OS implementation

Basic aspects of z/OS implementation

When you build a z/OS system, you must balance the needs of your installation to build one that meets its needs well. While this will sometimes mean compromise, it more often means finding ways to build a flexible system that is easy to install, easy to migrate, easy to extend, and most important, easy to manage. When applied well, using a well-planned structure, this flexibility can be used to control the time it takes to install and migrate new systems or new software levels throughout an installation.

A phased approach will often prove most feasible and can begin to control the installation and migration workload in the least time. This provides you benefits, starting with the next installation and migration cycle, while controlling the work involved in implementation.

Some aspects you might have to consider in adopting a structured approach to installation are:

- SYS1.PARMLIB and parmlib concatenation (logical parmlib)
- Catalogs and indirect catalog entries
- Separating data from software
- Placing data sets on specific volumes
- Choosing a naming convention for data sets
- DASD space utilization and performance
- System and installation requirements

1.2 SYS1.PARMLIB

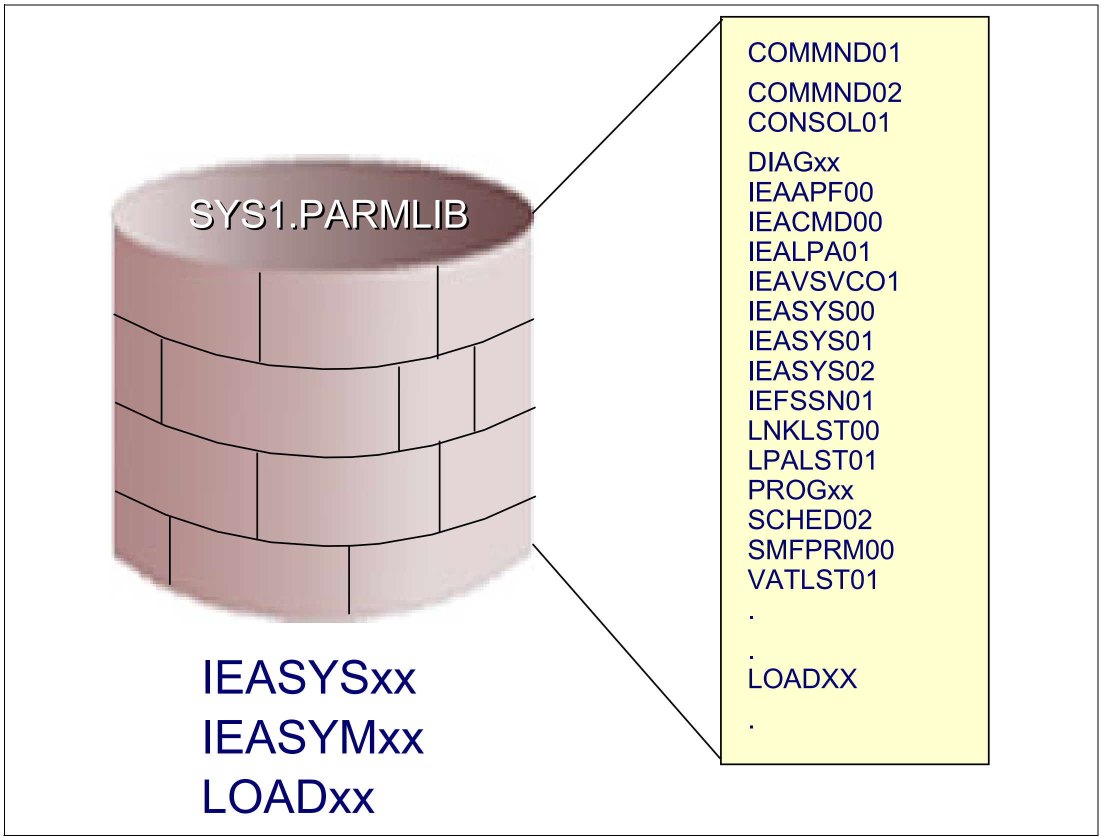


Figure 1-2 Defining the members of SYS1.PARMLIB

Overview of parmlib members

SYS1.PARMLIB is a required partitioned data set that contains IBM-supplied and installation-created members, which contain lists of system parameter values. You can include user-written system parameter members in SYS1.PARMLIB before installing a product.

SYS1.PARMLIB is read by the system at IPL, and later by such components as the system resource manager, the TIOC, and GTF, which are invoked by operator commands. The purpose of parmlib is to provide many initialization parameters in a pre-specified form in a single data set, and thus minimize the need for the operator to enter parameters. The SYS1.PARMLIB data set can be blocked and can have multiple extents, but it must reside on a single volume.

Note: This is the most important data set in a z/OS operating system.

All parameters of the SYS1.PARMLIB data set are described in *z/OS MVS Initialization and Tuning Reference*, SA22-7592. Three of the most important parmlib members are discussed in this chapter. They are as follows:

IEASYSxx This parmlib member allows the specification of system parameters that are valid responses to the IEA101A SPECIFY SYSTEM PARAMETERS message, as shown in Figure 1-17 on page 28. Multiple system parameter lists are valid.

The list is chosen by the operator SYSP parameter or through the SYSPARM statement of the LOADxx parmlib member.

IEASYMxx Specifies, for one or more systems in a multisystem environment, the static system symbols and suffixes of IEASYSxx members that the system is to use. One or more IEASYMxx members are selected using the IEASYM parameter in the LOADxx parmlib member.

LOADxx Contains information about the name of the IODF data set, which master catalog to use, and which IEASYSxx members of SYS1.PARMLIB to use.

1.3 Rules for parmlib member definitions

- Use columns 1 through 71 to specify parameters, 72-80 ignored
- Do not use blank lines
- Leading blanks in records are acceptable, start in any column
- Enter data in uppercase characters only
- Use commas to separate multiple parameters in a record
- Enclose multiple subparameters in parentheses
- Indicate record continuation with a comma followed by a blank
- The system ignores anything after a comma followed by a blank
- End of a member is the first record that does not end in a comma

```
CON=01,MLPA=(00,01,02,03,L), USE CONSOL01, USE IEALPA(00-03)
    COUPLE=&SYSCLONE,           XCF SERIAL CTCS ARE DEFINED
  PLEXCFG=MULTISYSTEM,          TURN SYSPLEX ON
   DIAG=01              USE DIAG01-LAST STMT; LIST ENDS HERE
/* CLOCK=SA     */         (this line is commented out)
```

Figure 1-3 Specifying the rules when defining parmlib members

Syntax rules for parmlib members

The following rules apply to the creation of parmlib members:

- Use columns 1 through 71 to specify parameters. The system ignores columns 72 through 80.
- Do not use blank lines.
- Leading blanks in records are acceptable. Therefore, a parameter need not start at column 1.
- Enter data in *uppercase* characters only; the system does not recognize lowercase characters.
- Use commas to separate multiple parameters in a record, but do not leave blanks between commas and subsequent parameters.
- Enclose multiple subparameters in parentheses. The number of subparameters is not limited.
- Indicate record continuation with a comma followed by at least one blank.
- The system ignores anything after a comma followed by one or more blanks. You can use the remainder of the line for comments.
- The system considers the first record that does not end in a comma to be the end of the member and ignores subsequent lines. You can use the remainder of the record, which contains the last parameter, for comments, providing there is at least one blank between the last parameter and the comments. You can also use additional lines after the last parameter for comments.

Figure 1-3 shows an example of the syntax used in creating a parmlib member.

1.4 System symbols

- ❑ Dynamic system symbols
  - ➢ Substitution text changes often
- ❑ Static system symbols
  - ➢ Substitution text is fixed at system initialization
  - ➢ Two types of static symbols
    - – System-defined
    - ➢ &SYSCLONE - &SYSNAME - &SYSPLEX - &SYSR1
    - – Installation-defined

Figure 1-4 Defining system symbols

System symbols are elements that allow systems to share parmlib definitions while retaining unique values in those definitions. System symbols act like variables in a program; they can take on different values, based on the input to the program. When you specify a system symbol in a shared parmlib definition, the system symbol acts as a “place holder.” Each system that shares the definition replaces the system symbol with a unique value during initialization.

The following terms describe the elements of system symbols:

Symbol Name The name that is assigned to a symbol. It begins with an ampersand (&) and optionally ends with a period (.).

Substitution Text The character string that the system substitutes for a symbol each time it appears. Substitution text can identify characteristics of resources, such as the system on which a resource is located, or the date and time of processing. When you define static system symbols in the IEASYMxx parmlib member (see Figure 1-8 on page 13), the substitution text can contain other static system symbols; the resolved substitution text refers to the character string that is produced after all symbols in the substitution text are resolved.

Types of system symbols

The following terms describe the types of system symbols:

Dynamic A system symbol whose substitution text can change at any point in an IPL. Dynamic system symbols represent values that can change often, such as dates and times. A set of dynamic system symbols is defined to the system; your installation cannot provide additional dynamic system symbols.

Static A symbol whose substitution text is defined at system initialization and remains fixed for the life of an IPL. One exception, &SYSPLEX, has a substitution text that can change at one point in an IPL. Static system symbols are used to represent fixed values such as system names and sysplex names.

There are two types of static system symbols:

- **System-defined:** System-defined static system symbols already have their names defined to the system. Your installation defines substitution texts or accepts system default texts for the static system symbols, which are:
  - &SYSCLONE
  - &SYSNAME
  - &SYSPLEX
  - &SYSR1
- **Installation-defined:** Installation-defined static system symbols are defined by your installation. The system programmer specifies their names and substitution texts in the SYS1.PARMLIB data set.

1.5 System symbols: Types

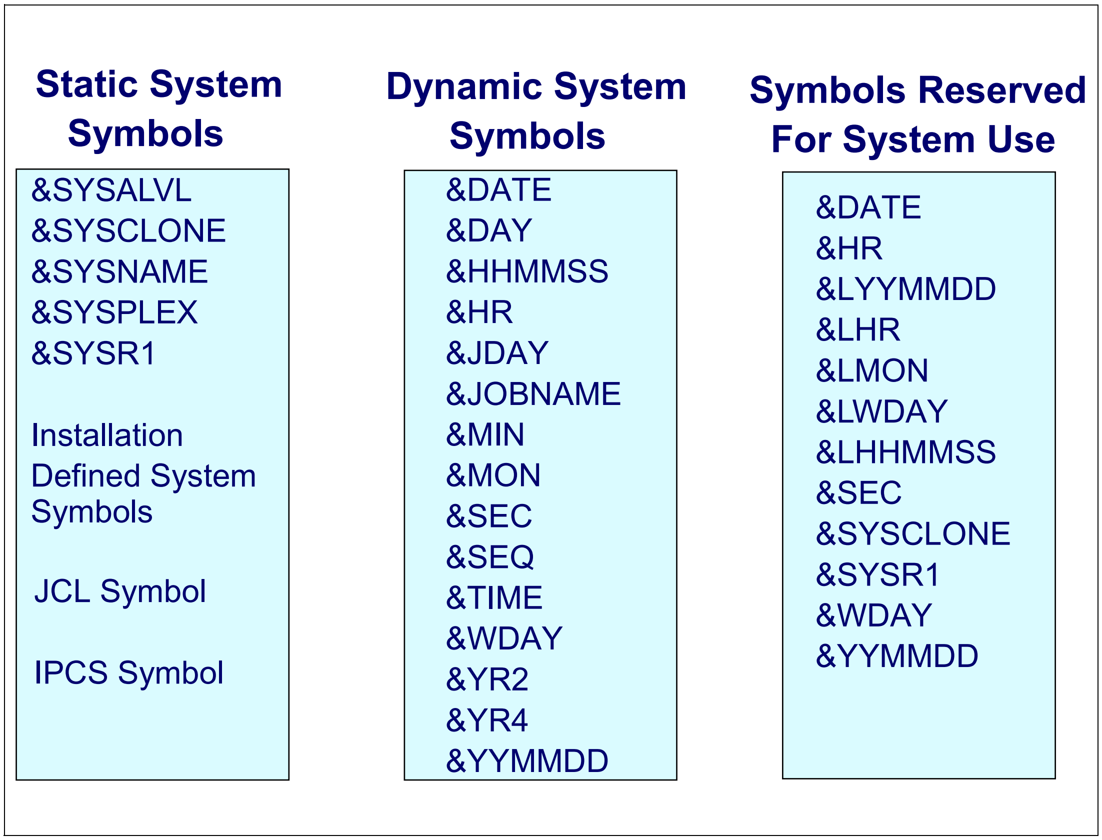


Figure 1-5 Types of system symbols that can be specified

Static system symbols

The system substitutes text for static system symbols when it processes parmlib members. For static system symbols that the system provides, you can define substitution texts in parmlib or accept the default substitution texts. You can also define up to 99 additional static system symbols. You can enter the `DISPLAY SYMBOLS` operator command to display the static texts that are in effect for a system. See *z/OS MVS System Commands*, SA22-7627, for information about how to enter **DISPLAY SYMBOLS**. You can use the **SYMDEF** interactive problem control system (IPCS) subcommand to display an entry in the system symbol table. See *z/OS MVS Interactive Problem Control System (IPCS) Commands*, SA22-7594, for information about the **SYMDEF** subcommand.

In addition to the system symbols listed in Figure 1-5, the system allows you to define and use symbols in:

JCL symbol Symbols can be used in JCL. You can define JCL symbols on EXEC, PROC, and SET statements in JCL, and use them only in:

- JCL statements in the job stream
- Statements in cataloged or in-stream procedures
- DD statements that are added to a procedure

For more information about using JCL symbols, see *z/OS MVS JCL Reference*, SA22-7597.

IPCS symbol Symbols can be use by IPCS to represent data areas in dumps that are processed with IPCS subcommands.

For more information about using IPCS symbols, see *z/OS MVS Interactive Problem Control System (IPCS) User's Guide*, SA22-7596.

Note: Although IBM recommends the use of ending periods on system symbols, the text of this chapter does not specify them, except in examples, out of consideration for readability.

Dynamic system symbols

You can specify dynamic system symbols in parmlib. However, be aware that the system substitutes text for dynamic system symbols when it processes parmlib members. For example, if you specify &HHMMSS in a parmlib member, its substitution text reflects the time when the member is processed.

This situation can also occur in other processing. For example, if you specify the &JOBNAME dynamic system symbol in a `START` command for a started task, the resolved substitution text for &JOBNAME is the name of the job assigned to the address space that calls the symbolic substitution service, not the address space of the started task.

Symbols reserved for system use

When you define additional system symbols in the IEASYMxx parmlib member, ensure that you do not specify the names reserved for system use.

If you try to define a system symbol that is reserved for system use, the system might generate unpredictable results when performing symbolic substitution.

In addition to the symbols reserved for system use that are shown in Figure 1-5, the following symbols are also reserved for system use:

&JDAY, &JOBNAME, &LDAY, &LHHMMSS, &LJDAY, &LMIN, &LSEC, &LTIME, &LYR2, LYR4, &MIN, &MON, &SEQ, &SID, &SYSNAME, &SYSPLEX, &SYSUID, &TIME, &YR2, &YR4, &SYSALVL

1.6 Logical parmlib

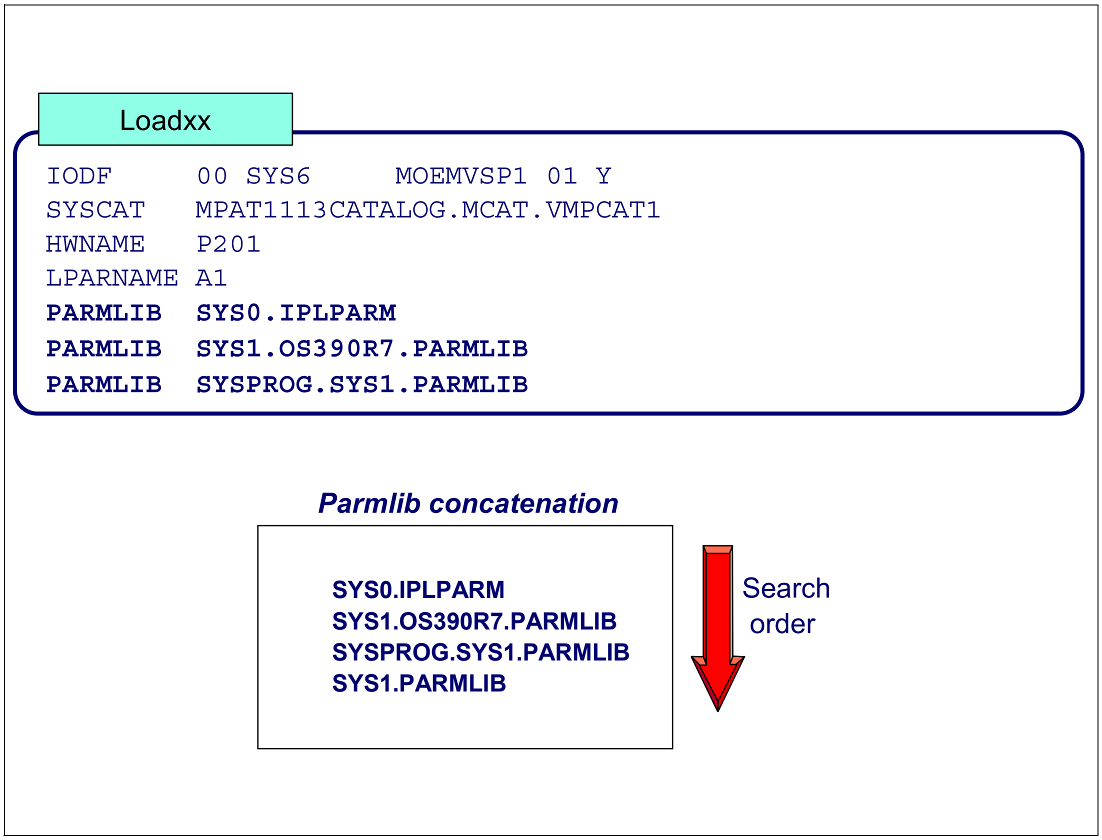


Figure 1-6 Creating a logical parmlib

Using parmlib concatenation

Beginning with OS/390 V2R2, you can concatenate up to 10 data sets to SYS1.PARMLIB, in effect creating a *logical parmlib*. You define the concatenation in the LOADxx member of SYS1.PARMLIB or SYSn.IPLPARM. When there is more than one PARMLIB statement, the statements are concatenated and SYS1.PARMLIB, as cataloged in the Master Catalog, is added at the end of the concatenation. You can also use the **SETLOAD** operator command to switch from one logical parmlib to another without an IPL.

The benefit of using parmlib concatenation is that it gives you greater flexibility in managing parmlib and changes to parmlib members.

Note: If you do not specify at least one PARMLIB statement in the LOADxx, the parmlib concatenation will consist of only SYS1.PARMLIB and Master Scheduler processing will use the IEFPARM DD statement, if there is one in the Master JCL. However, if there is no PARMLIB statement in the parmlib concatenation and there is no IEFPARM DD statement, Master Scheduler processing will use only SYS1.PARMLIB.

For more information on logical parmlib, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

1.7 Parmlib concatenation

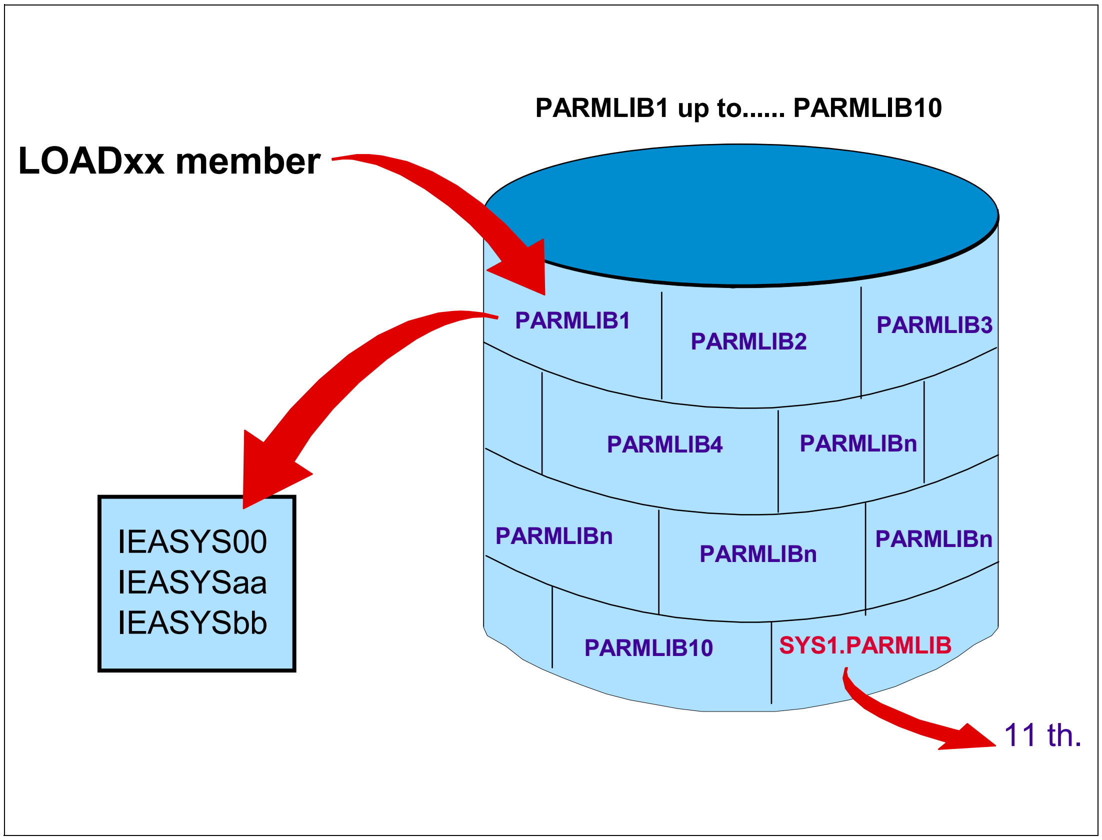


Figure 1-7 LOADxx member pointing to the parmlib concatenation

Description and use of the parmlib concatenation

This section discusses the parmlib concatenation, its purpose, ways to control the parmlib data sets, and general syntax rules for creating most members of the data sets.

The parmlib concatenation is a set of up to 10 partitioned data sets defined through PARMLIB statements in the LOADxx member of either SYSn.IPLPARM or SYS1.PARMLIB. These members contain many initialization parameters in a pre-specified form in a single logical data set, thus minimizing the need for the operator to enter parameters. SYS1.PARMLIB makes the eleventh or last data set in the concatenation and is the default parmlib concatenation if no PARMLIB statements exist in LOADxx. For specific information on how to define a logical parmlib concatenation, see "LOADxx (system configuration data sets)" on page 22. The SYS1.PARMLIB data set itself can be blocked and can have multiple extents, but it must reside on a single volume. The parmlib concatenation used at IPL must be a PDS. However, after an IPL you can issue a **SETLOAD** command to switch to a different parmlib concatenation that contains PDSEs. For information on processing of concatenated data sets see *z/OS DFSMS: Using Data Sets*, SC26-7410.

Parmlib contains both a basic or default general parameter list IEASYS00 and possible alternate general parameter lists, called IEASYSaa, IEASYSbb, and so forth. Parmlib also contains specialized members, such as COMMNDxx, and IEALPAxx. Any general parameter list can contain both parameter values and "directors." The directors (such as MLPA=01) point or direct the system to one or more specialized members, such as IEALPA01.

The parmlib concatenation is read by the system at IPL, and later by other components such as the system resource manager (SRM), the TIOC, and SMF, which are invoked by operator commands. The TIOC is the terminal I/O coordinator, whose parameters are described under member IKJPRM00. SMF is the System Management Facility, whose parameters are described under member SMFPRMxx.

The system always reads member IEASYS00, the default parameter list. Your installation can override or augment the contents of IEASYS00 with one or more alternate general parameter lists. You can further supplement or partially override IEASYS00 with parameters in other IEASYSxx members or operator-entered parameters. You can specify the IEASYSxx members that the system is to use in:

- The IEASYMxx parmlib member
- The LOADxx parmlib member

The operator selects the IEASYSxx member using the SYSP parameter at IPL. The parameter values in IEASYS00 remain in effect for the life of an IPL unless they are overridden by parameters specified in alternate IEASYSxx members or by the operator.

1.8 Using system symbols in parmlib

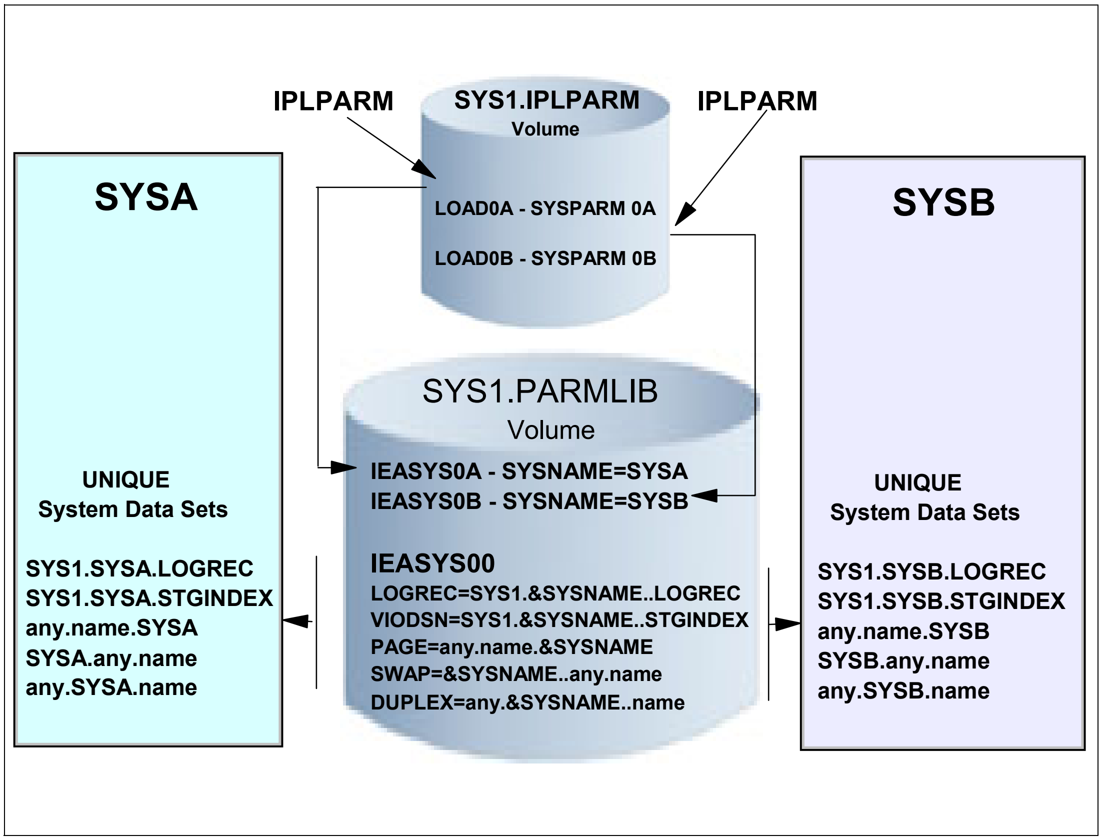


Figure 1-8 Defining parmlib members using system symbols

Using system symbols in parmlib

After you set up parmlib for sharing, do the following to specify system symbols in parmlib definitions:

1. Know the rules for using system symbols in parmlib.
2. Determine where to use system symbols in parmlib.
3. Verify system symbols in parmlib.

Know the rules for using system symbols in parmlib

Follow these rules and recommendations when using system symbols in parmlib:

1. Specify system symbols that:
   - Begin with an ampersand (&)
   - Optionally end with a period (.)
   - Contain 1 to 8 characters between the ampersand and the period (or the next character, if you do not specify a period)

   If the system finds a system symbol that does not end with a period, it substitutes text for the system symbol when the next character is one of the following:

   - Null (the end of the text is reached)
   - A character that is not alphabetic, numeric, or special (@,#, or $)

Recommendation: End all system symbols with a period. Omitting the period that ends a system symbol could produce unwanted results under certain circumstances. For example, if the character string (2) follows a system symbol that does not have an ending period, the system processes the (2) as substring syntax for the system symbol, regardless of how you intended to use the string in the command.

2. Use a small set of system symbols so they are easy to manage and remember.
3. Code two consecutive periods (..) if a period follows a system symbol. For example, code &DEPT..POK when the desired value is D58.POK and the substitution text D58 is defined to the system symbol &DEPT.
4. When using system symbols in data set name qualifiers, keep the rules for data set naming in mind. For example, if you use SC68 as a data set qualifier, ensure that the substitution text begins with an alphabetic character.
5. Ensure that resolved substitution texts do not extend parameter values beyond their maximum lengths. For example, suppose the following command is to start CICS®:

   S CICS,JOBNAME=CICSSC68,...

   The resolved substitution text for SC68 cannot exceed four characters because jobnames are limited to eight characters (the four characters in CICS plus up to four character in SC68). A substitution text of SYS1 is valid because it resolves to the jobname CICSSYS1. However, a substitution text of SYSTEM2 is not valid because it resolves to the jobname of CICSSYSTEM2, which exceeds the allowable maximum of eight characters.
6. If you use &SYSCLONE, ensure that the LOADxx parmlib member indicates that the system is to check for a unique &SYSCLONE substitution text on each system.
7. If you use SC68, ensure that its substitution text is unique on each system.
8. Do not specify system symbols in the values on the OPI and SYSP parameters in the IEASYSxx parmlib member.
9. Do not specify system symbols that were introduced in MVS/ESA™ SP 5.2 in parmlib members that are processed by pre-MVS/ESA SP 5.2 systems.
10. Do not specify any system symbols in parmlib members that do not support system symbol substitution.

1.9 Where to use system symbols in parmlib

- Symbols in data set names
  - SMFPRMxx parmlib member
    - SY&SYSCLONE..SMF.DATA
- Symbols when systems share the same parmlib member
  - IEASYSxx parmlib member
    - CLOCK=&SYSCLONE.
- Started task commands
  - S CICS,JOBNAME=CICS&SYSCLONE.
    - CICSSYS1 on SYS1
    - CICSSYS2 on SYS2

Figure 1-9 Examples of using system symbols in parmlib

System symbols offer the greatest advantage when two or more systems require different data sets, jobs, procedures, or entire parmlib members. This section provides examples of how to specify system symbols when naming certain resources in parmlib.

Data sets

A good example of using system symbols in data set names is the DSNAME parameter in the SMFPRMxx parmlib member, which specifies data sets to be used for SMF recording. Assume that each system in your sysplex requires one unique data set for SMF recording. If all systems in the sysplex use the same SMFPRMxx parmlib member, you could specify the following naming pattern to create different SMF recording data sets on each system:

```
SY&SYSCLONE..SMF.DATA
```

When you IPL each system in the sysplex, the &SYSCLONE system symbol resolves to the substitution text that is defined on the current system. For example, if a sysplex consists of two systems named SYS1 and SYS2, accepting the default value for &SYSCLONE produces the following data sets:

```
SYS1.SMF.DATA on system SYS1
SYS2.SMF.DATA on system SYS2
```

> **Note:** The use of &SYSCLONE provides unique data set names while establishing a consistent naming convention for SMF recording data sets.

Parmlib members

You can apply the same logic to system images that require different parmlib members. For example, assume that system images SYS1 and SYS2 require different CLOCKxx parmlib members. If both systems share the same IEASYSxx parmlib member, you could specify &SYSCLONE in the value on the CLOCK parameter:

```
CLOCK=&SYSCLONE;
```

When each system in the sysplex initializes with the same IEASYSxx member, &SYSCLONE resolves to the substitution text that is defined on each system. Accepting the default value for &SYSCLONE produces the following:

```
CLOCK=S1    (Specifies CLOCKS1 on system SYS1)
CLOCK=S2    (Specifies CLOCKS2 on system SYS2)
```

Started task JCL

If JCL is for a started task, you can specify system symbols in the source JCL or in the **START** command for the task. You cannot specify system symbols in JCL for batch jobs, so you might want to change those jobs to run as started tasks.

If a started task is to have multiple instances, determine if you want the started task to have a different name for each instance. Started tasks that can be restarted at later times are good candidates. The different names allow you to easily identify and restart only those instances that require a restart. For example, you might assign different names to instances of CICS because those instances might be restarted at later points in time. However, instances of VTAM, which are generally not restarted, might have the same name on different systems.

When you start a task in the COMMNDxx parmlib member, you can specify system symbols as part of the job name. Assume that system images SYS1 and SYS2 both need to start customer information control system (CICS). If both system images share the same COMMNDxx parmlib member, you could specify the SC68 system symbol on a **START** command in COMMNDxx to start unique instances of CICS:

```
S CICS,JOBNAME=CICSSC68,...
```

When each system in the sysplex initializes with the same COMMNDxx member, SC68 resolves to the substitution text that is defined on each system. If SC68 is defined to SYS1 and SYS2 on the respective systems, the systems start CICS with the following jobnames:

```
CICSSYS1 on system SYS1
CICSSYS2 on system SYS2
```

Verify system symbols in parmlib

IBM provides you with tools to verify symbol usage in parmlib. The parmlib symbolic preprocessor tool allows you to test symbol definitions before you IPL the system to use them. This tool shows how a parmlib member will appear after the system performs symbolic substitution.

If you only need to verify a new parmlib member's use of the current system symbols, you can run the IEASYMCK sample program to see how the contents of the parmlib member will appear after symbolic substitution occurs.

The IEASYMCK program is located in SYS1.SAMPLIB. See the program prolog for details.

1.10 Member IEASYSxx

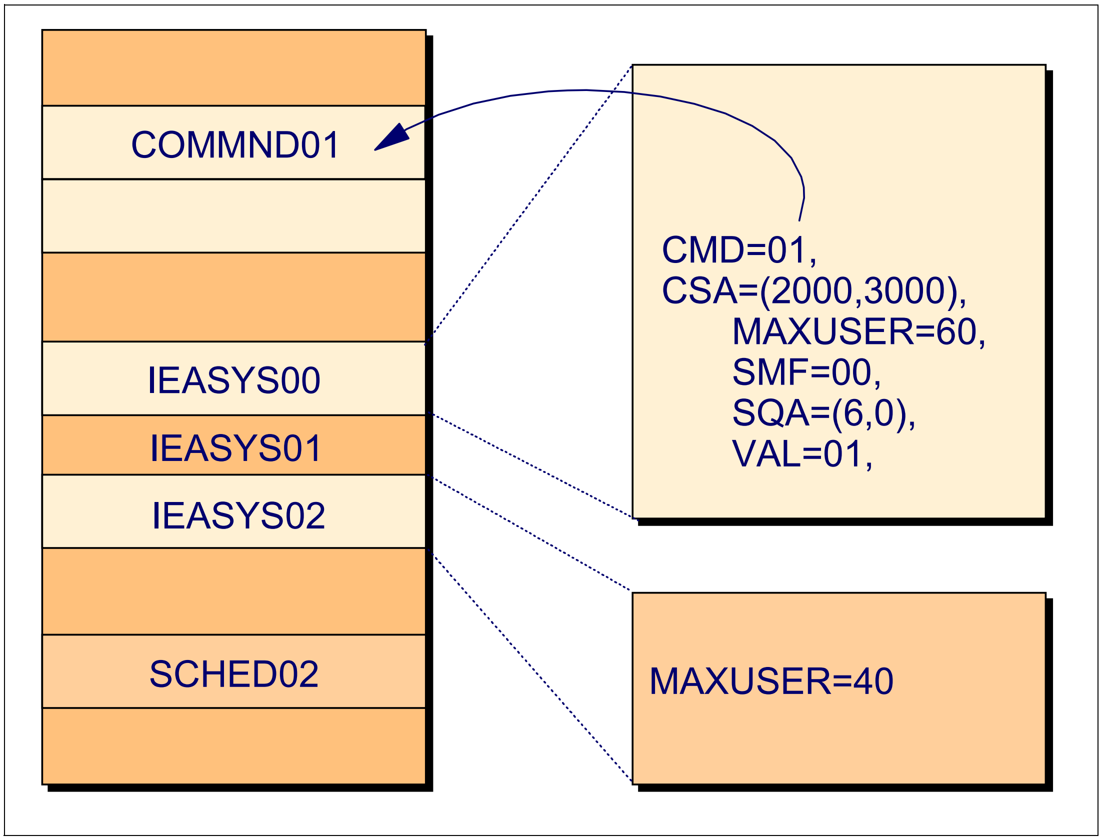


Figure 1-10 Parmlib member IEASYSxx

IEASYSxx (system parameter list)

You can specify system parameters using a combination of IEASYSxx parmlib members and operator responses to the SPECIFY SYSTEM PARAMETERS message. You can place system parameters in the IEASYS00 member or in one or more alternate system parameter lists (IEASYSxx) to provide a fast initialization that requires little or no operator intervention.

IEASYS00 is the most likely place to put installation defaults or parameters that will not change from IPL to IPL. The system programmer can add to or modify parameters in IEASYS00. The alternate IEASYSxx members, in contrast, should contain parameters that are subject to change, possibly from one work shift to another.

Use of the IEASYS00 or IEASYSxx members can minimize operator intervention at IPL. Because IEASYS00 is read automatically, the operator can respond to SPECIFY SYSTEM PARAMETERS with ENTER or U and need not enter parameters unless an error occurs and prompting ensues.

The use of system parameter lists in parmlib offers two main advantages:

- The parameter lists shorten and simplify the IPL process by allowing the installation to preselect system parameters.
- The parameter lists provide flexibility in the choice of system parameters.

You can do one of the following to specify a parameter list other than IEASYS00 for an IPL:

- Have the operator specify the suffix of an alternate IEASYSxx member by replying SYSP=xx in response to the SPECIFY SYSTEM PARAMETERS message.

  ```
  R 00,SYSP=xx
  ```

  The operator specifies this parameter to specify an alternate system parameter list in addition to IEASYS00.

- Specify one or more suffixes of alternate IEASYSxx members on the SYSPARM parameter in the LOADxx or in the IEASYMxx parmlib member.

Overview of IEASYSxx parameters

See *z/OS MVS Initialization and Tuning Reference*, SA22-7592 for a list of all the system parameters that can be placed in an IEASYSxx or IEASYS00 member (or specified by the operator). Detailed discussions of these parameters are provided in other sections of the IEASYSxx topic.

> **Note:** PAGE and GRS are the only mandatory parameters that have no default. They must be specified.

The GRSRNL parameter is mandatory when the GRS= parameter is specified as JOIN, TRYJOIN, START, or STAR. The GRSRNL parameter is ignored when GRS=NONE.

Specifying the list option for IEASYSxx parameters

Certain parameters in IEASYSxx (such as CLOCK, CON, and MLPA) allow you to specify the list option (L). If you specify the L option, and message suppression is not active, the system writes all of the statements read from the associated parmlib member to the operator's console during system initialization. If message suppression is active (the default), the system writes the list to the console log only.

To ensure that messages are not suppressed, specify an appropriate initialization message suppression indicator (IMSI character) on the LOAD parameter. The IMSI characters that do not suppress messages are A, C, D, M, and T.

For more information on the LOAD parameter, see the section on loading the system software in *z/OS MVS System Commands*, SA22-7627.

Statements/parameters for IEASYSxx

For detailed information about statements/parameters, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

1.11 IEASYSxx and system symbols

- Understand the rules

```
IEASYMxx                          IEASYSxx

SYMDEF(&PAGTOTL='(10,5)')         PAGTOTL=&PAGTOTL.,
```

- Can be specified in IEASYSxx

```
              &SYSNAME = SYSA
              &SYSCLONE = SA
              &SYSPLEX = PX01

LNK=(&SYSPLEX(-2:2).,03,00,L),     LNK=(01,03,00,L),
CLOCK=&SYSCLONE.,                  CLOCK=SA,
PROG=&SYSNAME(1:2),                PROG=SY,
LOGREC=&SYSNAME..LOGREC            LOGREC=SYSA.LOGREC
```

Figure 1-11 Specifying system symbols in IEASYSxx

IEASYSxx and system symbols

You can specify system symbols in all parameter values in IEASYSxx except in the values for the SYSP and OPI parameters and in specifying CLPA and OPI.

If you intend to use system symbols to represent parmlib member suffixes in IEASYSxx, be careful when defining, in the IEASYMxx parmlib member, parentheses (such as in the case of list notation) or commas as part of the substitution text:

- Specify system symbols only to the right of the equals sign and before the comma in the IEASYSxx notation.
- Specify only *balanced* parentheses in either the defined substitution text or the hard-coded values.

For example, the following notation for IEASYMxx and IEASYSxx is valid because the left and right parentheses both appear in the system symbol definition:

```
        IEASYMxx                     IEASYSxx
        --------                     --------
  SYMDEF(&PAGTOTL='(10,5)')      PAGTOTL=&PAGTOTL.,
```

The following notation is not valid because the parentheses are split between the system symbol definition and the hard-coded definition in IEASYSxx:

```
        IEASYMxx                     IEASYSxx
        --------                     --------
    SYMDEF(&PAGTOTL='10,5)')     PAGTOTL=(&PAGTOTL.,
```

Example of using system symbols in IEASYSxx

Suppose the following system symbols have the values indicated:

```
SC68 = SYSA
&SYSCLONE = SA
&SYSPLEX = PX01
```

Then assume that you want to do the following in IEASYSxx:

1. Specify the LNKLSTxx member identified by the last two letters in the sysplex name and also LNKLSTxx members 03 and 00.
2. Specify the CLOCKxx member identified by &SYSCLONE.
3. Specify the PROGxx member identified by the first two letters in the system name.
4. Specify a data set name for error recording that has the system name as a high-level qualifier.

Code IEASYSxx as follows:

```
LNK=(&SYSPLEX(-2:2).,03,00,L),
CLOCK=&SYSCLONE.,
PROG=SC68(1:2),
LOGREC=SC68.LOGREC
```

The values of the parameters resolve to:

```
LNK=(01,03,00,L),
CLOCK=SA,
PROG=SY,
LOGREC=SYSA.LOGREC
```

1.12 IEASYMxx

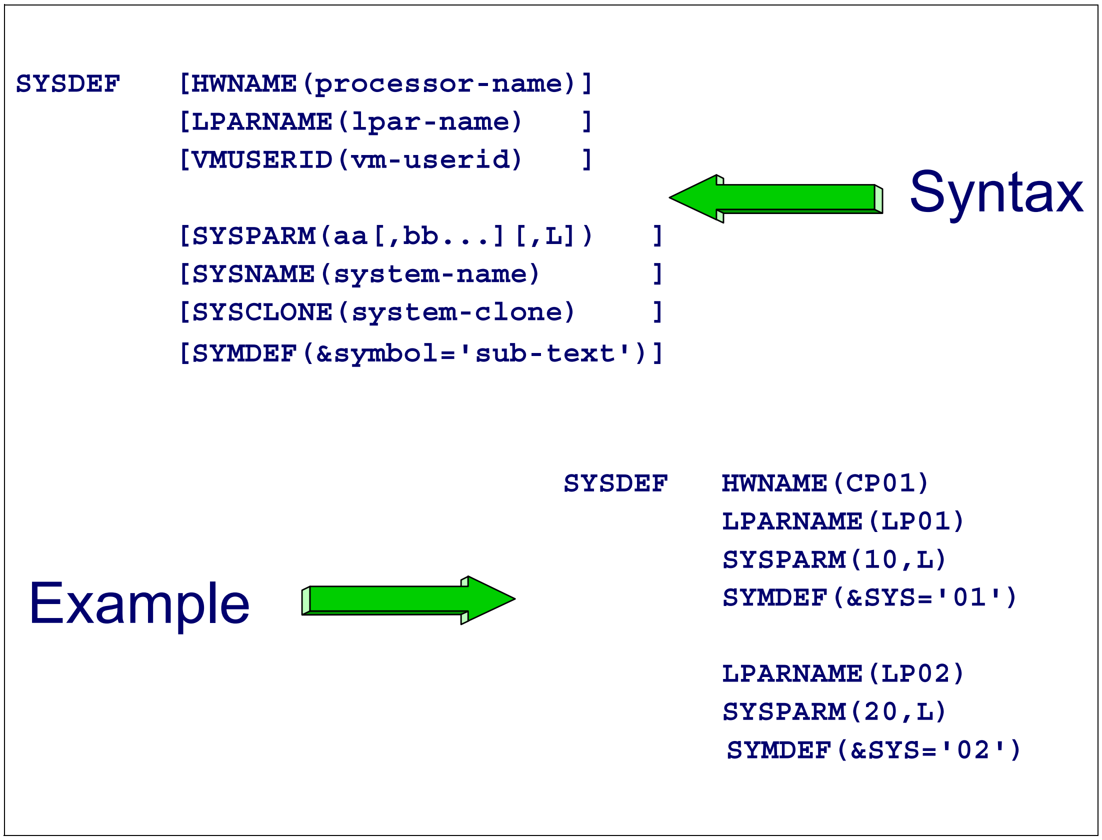


Figure 1-12 Specifying an IEASYMxx parmlib member

Create an IEASYMxx parmlib member

The main purpose of IEASYMxx is to provide a single place to specify system parameters for each system in a multisystem environment. The IEASYMxx parmlib member contains statements that do the following:

- Define static system symbols
- Specify IEASYSxx parmlib members that contain system parameters

You can apply the statements in IEASYMxx to any system in your environment. Therefore, only one IEASYMxx member is required to define static system symbols and specify system parameters for all systems.

In IEASYMxx, you can define up to 99 additional static system symbols for each system in a multisystem environment. In other words, you can define as many additional static system symbols in IEASYMxx as you like, so long as no more than 99 of those system symbols apply to a particular system at any time during an IPL.

The LOADxx parmlib member specifies the IEASYMxx member that the system is to use. For information about how to specify the suffix of the IEASYMxx member in LOADxx, see the next figure.

1.13 LOADxx parmlib member

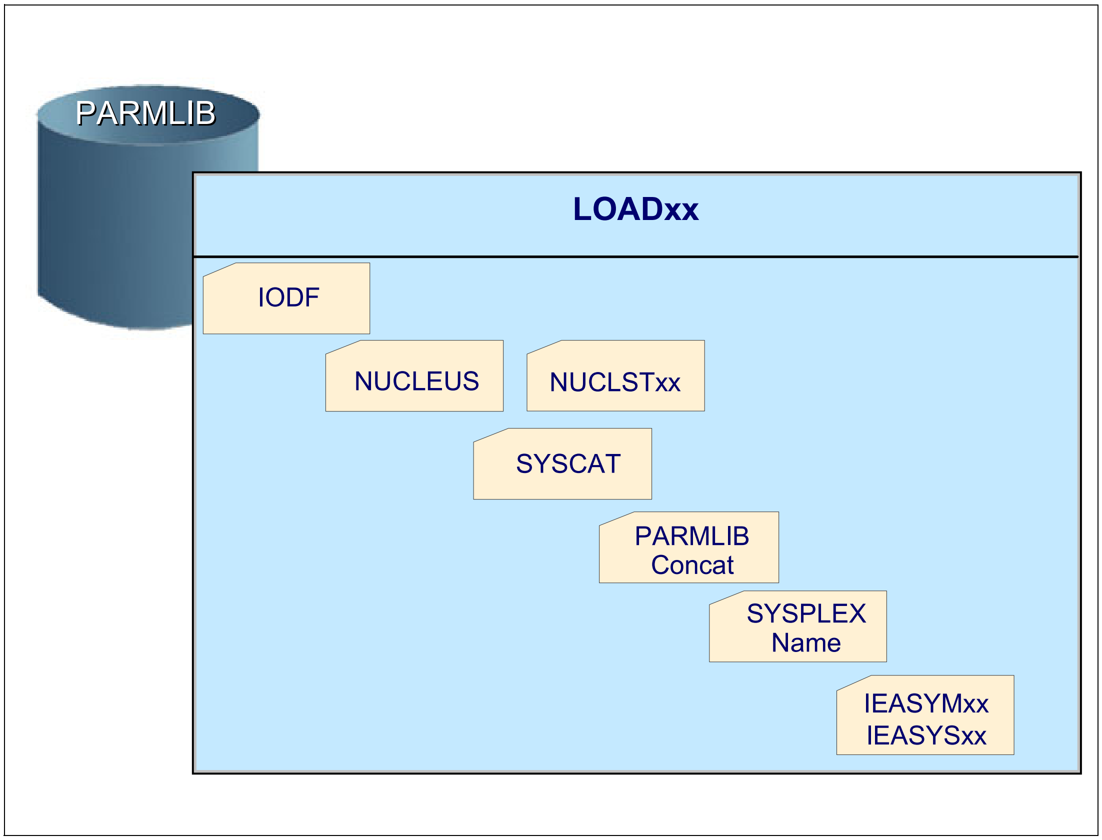


Figure 1-13 Specifying the LOADxx parmlib member data sets

LOADxx (system configuration data sets)

The system must have access to a LOADxx member which specifies:

- Information about your I/O configuration as specified by the IODFxx suffix to be used.
- An alternate nucleus ID.
- The NUCLSTxx member that you use to add and delete modules from the nucleus region at IPL-time.
- The name of the master catalog.
- Information about the parmlib concatenation.
- The name of the sysplex (systems complex) that a system is participating in; it is also the substitution text for the &SYSPLEX system symbol.
- The IEASYMxx and IEASYSxx parmlib members that the system is to use.
- Additional parmlib data sets that the system will use to IPL. These data sets are concatenated ahead of SYS1.PARMLIB to make up the parmlib concatenation.
- Filtering keywords so you can use a single LOADxx member to define IPL parameters for multiple systems. The initial values of the filter keywords (HWNAME, LPARNAME, and VMUSERID) are set at IPL to match the actual values of the system that is being IPLed. The LOADxx member can be segmented by these keywords.

The LOADxx member is selected through the use of the LOAD parameter on the *system control* (SYSCTL) frame of the system console. For information about specifying the LOAD parameter, see *z/OS MVS System Commands*, SA22-7627. If the operator does not select a LOADxx member on the system console, the system uses LOAD00.

1.14 Placement of LOADxx member

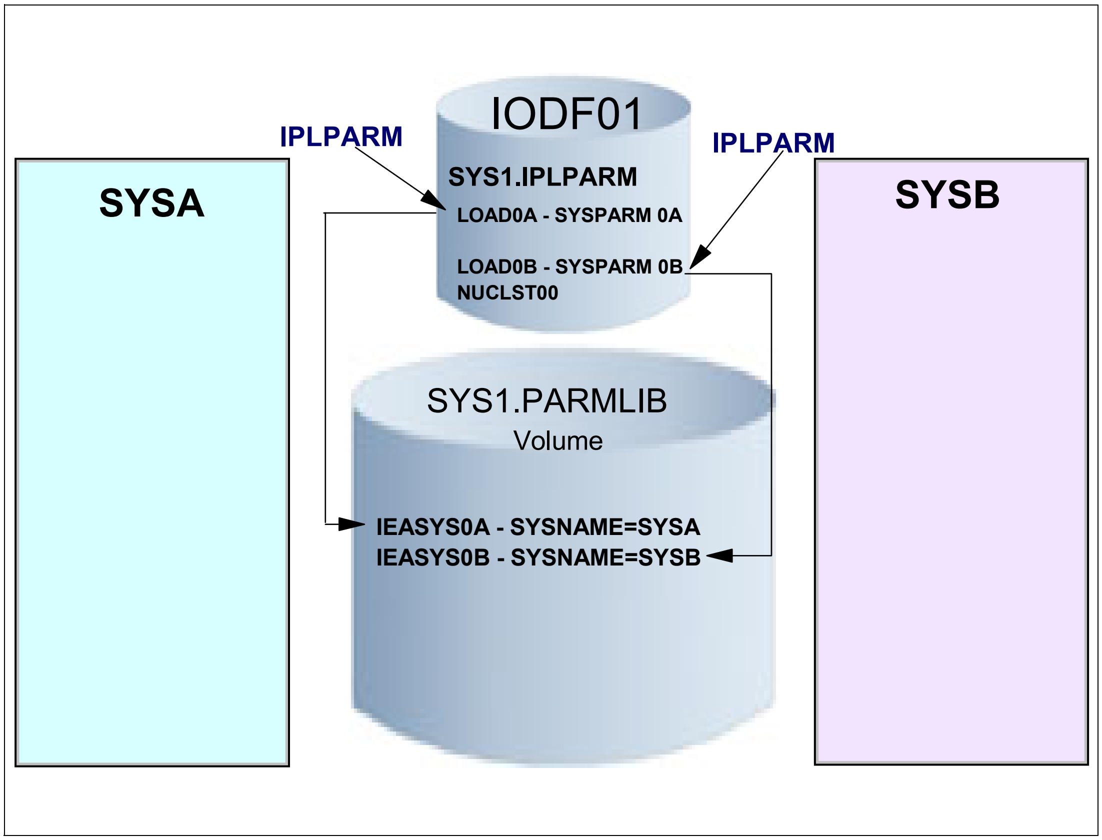


Figure 1-14 Placing the LOADxx member into a data set

Placement of LOADxx

You can place the LOADxx member in one of the system data sets:

SYSn.IPLPARM SYSn.IPLPARM is an optional partitioned data set that contains LOADxx members that point to I/O definition files (IODFs) that reside on the same volume as SYSn.IPLPARM. SYSn.IPLPARM is particularly useful in a multisystem environment, as shown in Figure 1-14.

You can use one SYSn.IPLPARM data set for each system. On each system, the SYSn.IPLPARM data set must be on the volume where the production IODF for that system resides.

For more information about the relationships between a SYSn.IPLPARM data set and its associated IODFs, see *z/OS MVS System Data Set Definition*, SA22-7629.

Note: This system data set must reside on a direct access volume. This volume should contain only one SYSn.IPLPARM data set and its associated IODFs. (The character *n* is a single numeral, 0 through 9.)

SYS1.PARMLIB

Consider placing LOADxx in the SYSn.IPLPARM data set. During IPL, the system looks for LOADxx in the following order:

1. SYS0.IPLPARM through SYS9.IPLPARM on the IODF volume
2. SYS1.PARMLIB on the IODF volume
3. SYS1.PARMLIB on the SYSRES volume

Do not create a SYSn.IPLPARM data set unless it contains the LOADxx member that is used to configure your system. When the system finds either SYSn.IPLPARM or SYS1.PARMLIB, it expects to find a LOADxx member in the data set. If the LOADxx member specified on the LOAD parameter is not in the data set, the system loads a wait state.

The NUCLSTxx member must reside in the same data set as the LOADxx member. This member can reside in either SYS1.PARMLIB or SYSn.IPLPARM, depending on how the installation defined its I/O configuration.

Member SYSCATLG of SYS1.NUCLEUS can contain a pointer to the master catalog. However, IBM recommends that you use the SYSCAT statement of the LOADxx member of SYS1.PARMLIB or SYSn.IPLPARM to identify the master catalog.

1.15 Controlling parmlib

- Make full use of up to 10 installation-defined parmlib
- Include changed members in one of the 10 parmlib
- Use installation-defined parmlib for testing
- Delete unsupported parameters and members
- Use parmlib members for appropriate functions
- Update parmlib for changes
- Keep track of parameters in parmlib members
- Allocate sufficient space for parmlib
- Ensure EXITxx and GTFPARM reside in SYS1.PARMLIB
- Decide where parmlib resides
- Protect the parmlib

Figure 1-15 Ways to control parmlib members

A parmlib concatenation allows you to have more flexibility in managing parmlib members and changes to parmlib members. To control parmlib and ensure that it is manageable, you should consider the following:

- Use the ability to have up to 10 installation-defined parmlib data sets to separate your parmlib members along organization or function lines and use appropriate RACF security for each data set.
- Include members with installation changes in one of the 10 installation-defined parmlib data sets to avoid having the member overlaid by IBM maintenance on SYS1.PARMLIB.
- Use an installation-defined parmlib data set to contain any parmlib members to be used on test systems. They can be included in front of your *standard* parmlib concatenation without forcing changes to the *standard* parmlib concatenation.
- Delete unsupported parameters and members. Because most components treat unsupported parameters from previous releases as syntax errors, you should probably remove the old parameters or build parmlib from scratch. This action will minimize the need for operator responses during an IPL. Then, you can save space by removing unsupported members.
- Use the parmlib members for the appropriate functions. For example, use COMMNDxx to contain commands useful at system initialization. Use IEACMDxx for IBM-supplied commands. Use IEASLPxx for SLIP commands. See each member for further information.
- Update parmlib with new or replacement members as you increase your experience with new releases.

- Keep track of which parameters are included in particular parmlib members. This bookkeeping is necessary for two reasons:
  a. The system doesn't keep track of parmlib members and their parameters.
  b. The default general parameter list IEASYS00 is always read by the system and master scheduler initialization.

  The parameters in IEASYS00 can be overridden by the same parameters when they are specified in alternate general lists, such as IEASYS01, or IEASYS02. Then, certain parameters, such as FIX, APF, and MLPA, direct the system to particular specialized members (in this example, IEAFIXxx, and IEALPAxx).

  The installation should keep records of which parameters and which values are in particular members, and which general members point to which particular specialized members (COMMNDxx, IEALPAxx, and so forth). A grid or matrix for such bookkeeping is very helpful.

- Allocate sufficient space for parmlib. One way to estimate space is to count the number of 80-character records in all members that are to be included in one parmlib data set and factor in the blocksize of the data set. Then add a suitable growth factor (for example, 100 to 300 percent) to allow for future growth of alternate members. To recapture space occupied by deleted members, use the **compress** function of IEBCOPY. However, should the data set run out of space, you may copy the members to a larger data set, create a new LOADxx member in which you replace the PARMLIB statement for the full data set with a PARMLIB statement for the new larger data set, and then issue a **SETLOAD** command to switch to the concatenation with the new data set.
- Ensure EXITxx and GTFPARM reside in SYS1.PARMLIB since they can only be accessed from SYS1.PARMLIB.
- Decide which volume(s) and device(s) should hold the parmlib concatenation. The data set must be cataloged, unless it resides on SYSRES or its volume serial number is included on the PARMLIB statement in LOADxx. The data set could be placed on a slow or moderate speed device. For information about the placement of parmlib data sets and the IODF data set, see *z/OS MVS System Data Set Definition*, SA22-7629.
- Use a security product (like RACF) to protect the data sets. The purpose is to preserve system integrity by protecting the appendage member (IEAAPP00) and the authorized program facility members (IEAAPFxx and PROGxx) from user tampering.

General syntax rules for the creation of members

The following general syntax rules apply to the creation of most parmlib members. Exceptions to these rules are described under specific members. The general rules are:

- Logical record size is 80 bytes.
- Blocksize must be a multiple of 80.
- Any columns between 1 and 71 may contain data.
- Statements are entered in uppercase characters.
- Suffix member identifiers can be any combination of A to Z and 0 to 9, though some member identifiers may allow other characters.
- Columns 72 through 80 are ignored.
- Continuation is indicated by a comma followed by one or more blanks after the last entry on a record.
- Leading blanks are suppressed. A record therefore need not start at a particular column.
- Suffix member identifiers (such as LNK=A2) can be any alphanumeric combination.
- Comments are most often indicated by using /* and */ as the delimiters in columns 1–71, for example:

  ```
  /*comment*/
  ```

  However, some parmlib members require other methods. Check specific parmlib members for information about specifying comments.

1.16 Initialization of z/OS

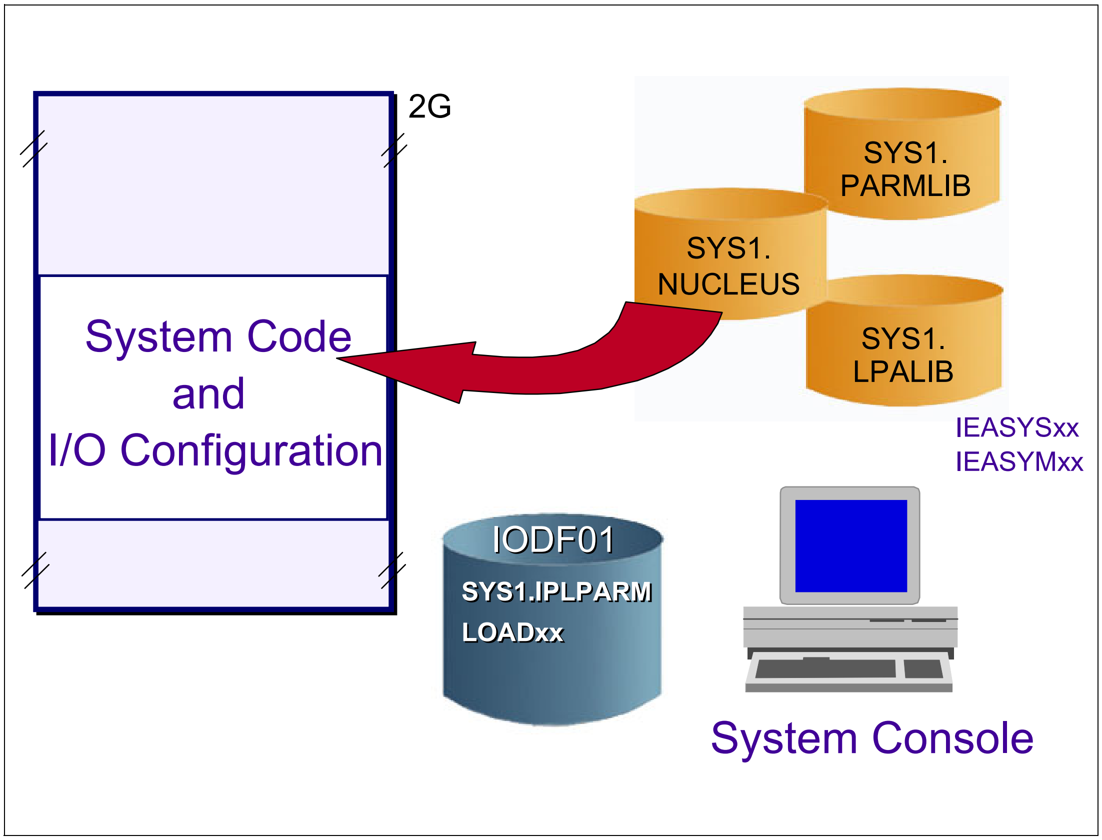


Figure 1-16 Initialization process for z/OS

IPL of z/OS

Initial program loading (IPL) provides a manual means for causing a program to be read from a designated device and for initiating execution of that program. When the system hardware is ready, you can use the system console to load the system software.

During initialization of a z/OS system, the operator uses the system console, which is connected to the processor controller or support element. From the system console, the operator initializes the system control program during the nucleus initialization program (NIP) stage.

During the NIP stage, the system might prompt the operator to provide system parameters that control the operation of MVS. The system also issues informational messages that inform the operator about the stages of the initialization process.

The LOADxx parmlib member allows your installation to control the initialization process. For example, in LOADxx, you specify IEASYSxx or IEASYMxx members that the system is to use; the system does not prompt the operator for system parameters that are specified in those members. Instead, it uses the values in those members.

The definition of these parameters are discussed later in this chapter.

1.17 Types of IPLs

- Cold start
  - Loads PLPA - (CLPA)
- Quick start
  - No reload of PLPA - (CVIO)
- Warm start
  - No reload of PLPA

Message to operator and a possible response

IEA101A SPECIFY SYSTEM PARAMETERS

R 00,SYSP=xx,CLPA

R 00,SYSP=xx,CVIO

Figure 1-17 The three types of IPLs and the operator response

Types of IPL

It is possible that in this discussion we will use terms that are unfamiliar to you (like LPA, SQA, VIO, and so forth). The objective is to condense the IPL types and process (shown in the next figure) in order to give you an overview of the IPL and its interactions with the operator. Further, we discuss the main aspects of the architecture as well as the mechanisms of z/OS mentioned here.

Depending on the level of customization, a system IPL can bring up many different configurations, but there are only three basic types of IPL:

Cold Start Any IPL that loads or reloads the Pageable Link Pack Area (PLPA) and does not preserve VIO data sets. The first IPL after system installation is always a cold start because the PLPA must be initially loaded. At the first IPL after system installation the PLPA will automatically be loaded from the LPALST concatenation. The page data sets for this IPL will be those specified in IEASYSxx, plus any additional ones specified by the operator. Subsequent IPLs need only be cold starts if the PLPA has to be reloaded either to alter its contents or to restore it when it has been destroyed. The PLPA needs to be reloaded:

- At the first IPL after system initialization, when the system loads it automatically.
- After modifying one or more modules in the LPALST concatenation.
- After the PLPA page data set has been damaged and is therefore unusable, so its contents must be restored. The PLPA can be reloaded by

responding `CLPA` (Create Link Pack Area) to the `SPECIFY SYSTEM PARAMETERS` prompt.

Quick Start Any IPL that does not reload the PLPA and does not preserve VIO data sets. The system re-creates page and segment tables to match the in-use PLPA. You would normally perform a Quick Start IPL after a power up. The PLPA from the previous session can be used without reloading it from the LPALST concatenation. A Quick Start can be initiated by replying `CVIO` (Clear VIO) to the `SPECIFY SYSTEM PARAMETERS` prompt.

Warm Start Any IPL that does not reload the PLPA and preserves journaled VIO data sets. The operator does not enter `CLPA` or `CVIO` at the `SPECIFY SYSTEM PARAMETERS` prompt. Any definitions of existing page data sets as non-VIO local page data sets are preserved.

System parameters prompt

If the LOADPARM, shown in Figure 1-18 on page 30, has been set to indicate the operator should be prompted for system parameters (A, P, S or T), NIP issues the following prompt on the NIP console:

```
IEA101A  SPECIFY SYSTEM PARAMETERS
```

At this point, the operator can respond in one of a number of ways:

- Pressing Enter will cause the system to use the parameters coded in SYS1.PARMLIB(IEASYS00).
- Entering **`SYSP=xx`** will cause the parameters in SYS1.PARMLIB(IEASYS*xx*) to be used.
- Entering multiple IEASYSxx members, **`SYSP=(xx,yy,..)`**, for multiple concatenations to be used.

Specifying any of the individual parameters that appear in IEASYSxx will cause these parameters to be used instead of the ones coded in IEASYSxx except PAGE parameters. If multiple IEASYSxx members are searched, the system *always* reads IEASYS00 first, followed by the additional ones you specify. If the same parameters are found in one or more IEASYSxx members, the latest overriding parameter is used.

PAGE parameters

The PAGE parameter allows the installation to name page data sets as additions to existing page data sets. The maximum number of page data sets is 256, which includes the optional page data set specified by the DUPLEX parameter. The system determines which page data sets to use by merging information from three sources: IEASYS00, IEASYSxx, and the PAGE parameter.

During system initialization, the system first uses the list of page data sets specified on the PAGE parameter of the IEASYS00 parmlib member. It then uses any other IEASYSxx parmlib member (identified via the SYSP=xx parameter). The IEASYSxx PAGE data set name list overrides the one in IEASYS00.

1.18 Initial Program Load (IPL)

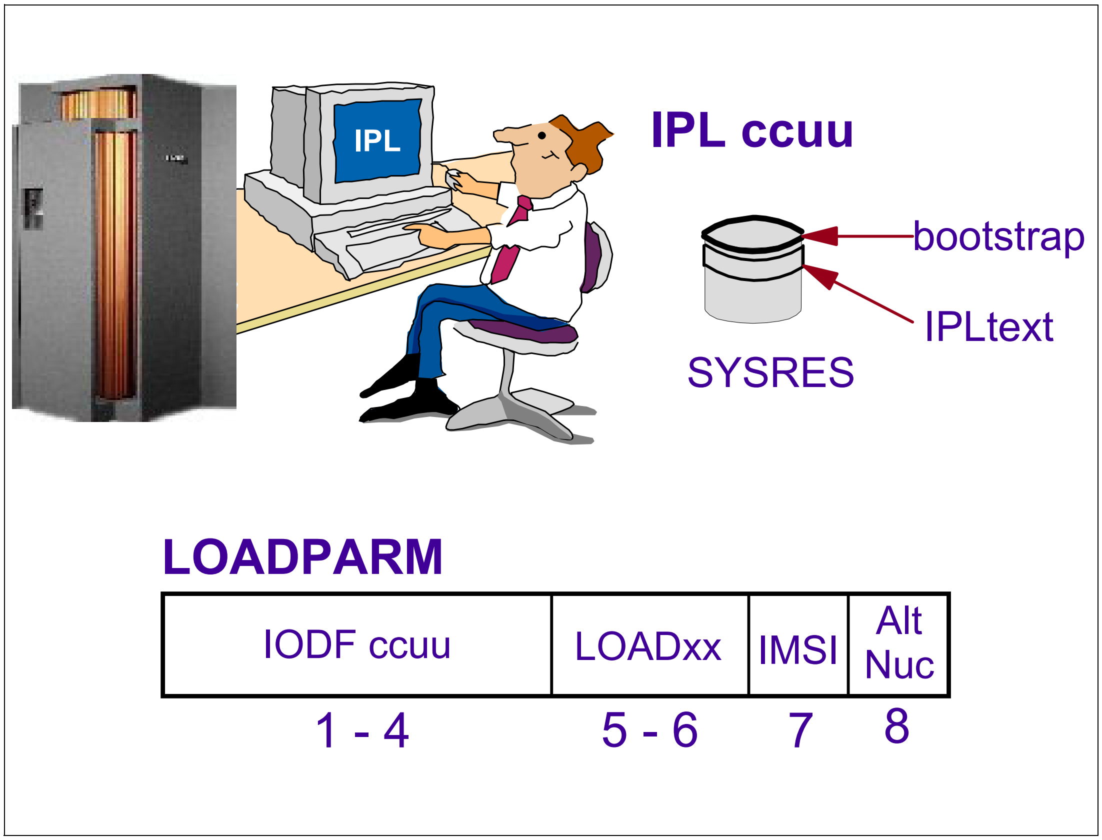


Figure 1-18 IPLing the system

The IPL process

An Initial Program Load (IPL) is the act of loading a copy of the operating system from disk into the CPU's central storage and executing it. Not all disks attached to a CPU will have loadable code on them. A disk that does is generally referred to as an "IPLable" disk, and more specifically as the SYSRES volume.

IPLable disks will contain a bootstrap module at cylinder 0 track 0. At IPL, this bootstrap is loaded into storage at real address zero and control is passed to it. The bootstrap then reads the IPL control program IEAIPL00 (also known as IPL text) and passes control to it. This in turn starts the more complex task of loading the operating system and executing it.

Attempts to IPL from a disk that does not contain IPL text results in an error condition.

IEAIPL00 prepares an environment suitable for starting the programs and modules that make up the operating system. First, it clears central storage to zeros before defining storage areas for the master scheduler. It then locates the SYS1.NUCLEUS data set on the SYSRES volume and loads a series of programs from it known as IPL Resource Initialization Modules (IRIMs). These IRIMs will then start to construct the normal operating system environment of control blocks and subsystems that make up a z/OS system. Some of the more significant tasks performed by the IRIMs are to:

- Read the LOADPARM information entered on the hardware console at the time the IPL command was executed. LOADPARM is discussed in "The Load Parameter (LOADPARM)" on page 31.

- Search the volume specified in the LOADPARM as containing the IODF data set for the LOADxx member–the value of *xx* is also taken from the LOADPARM. IRIM will first attempt to locate LOADxx in SYS0.IPLPARM. If this is unsuccessful, it will look for SYS1.IPLPARM, and so on, up to and including SYS9.IPLPARM. If, at this point, it still has not been located, the search will continue in SYS1.PARMLIB.

  When a LOADxx member has been successfully located, it will be opened and information including the nucleus suffix (unless overridden in LOADPARM), the master catalog name, and the suffix of the IEASYSxx member to be used, will be read from it.
- Load the MVS nucleus.
- Initialize virtual storage in the master scheduler address space for the System Queue Area (SQA), the Extended SQA (ESQA), the Local SQA (LSQA), and the Prefixed Save Area (PSA). At the end of the IPL sequence, the PSA will replace IEAIPL00 at real storage location zero, where it will then stay.
- Initialize real storage management, including the segment table for the master scheduler, segment table entries for common storage areas, and the page frame table.

The last of the IRIMs then loads the first part of the Nucleus Initialization Program (NIP), which then invokes the Resource Initialization Modules (RIMs), one of the earliest of which starts up communications with the NIP console defined in SYS1.NUCLEUS.

The Load Parameter (LOADPARM)

The most basic level of control is through the Load Parameter (LOADPARM). This is an eight-character value made up of four fields that the operating system will refer to as it IPLs, causing it to take the specified actions. The LOADPARM is made up of the following components:

IODF ccuu The IODF device address. This is also the device on which the search for the LOADxx member of SYSn.IPLPARM or SYS1.PARMLIB begins. The first four characters of the LOADPARM specify the hexadecimal device address for the device that contains the I/O Definition File (IODF) VSAM data set. This is also the device on which the search for the LOADxx member of SYSn.IPLPARM or SYS1.PARMLIB begins. This device address can be in the range X'0000' to X'FFFF'. If the address is less than four digits, pad it with leading zeros–for example, a device address of *c1* should be entered as *00c1*. If you do not specify the device address, the system uses the device address of the system residence (SYSRES) volume.

LOADxx The xx suffix of the LOADxx parmlib member. The LOADxx member contains information about the name of the IODF data set, which master catalog to use, and which IEASYSxx members of SYS1.PARMLIB to use.

The default for the LOADxx suffix is zeroes. The system reads the LOADxx and NUCLSTxx members from SYSn.IPLPARM or SYS1.PARMLIB on the volume specified on the LOAD parameter (or the SYSRES volume, if no volume is specified). After the system opens the master catalog, the system reads all other members from the SYS1.PARMLIB data set that is pointed to by the master catalog. This SYS1.PARMLIB might be different from the SYS1.PARMLIB to which the LOAD parameter points.

IMSI x The prompt feature character specifies the prompting and message suppression characteristics that the system is to use at IPL. This character is commonly known as an initialization message suppression indicator (IMSI).

Some IMSI characters suppress informational messages from the system console, which can speed up the initialization process and reduce message traffic to the console. It can also cause you to miss some critical messages, so you should always review the hardcopy log after initialization is complete.

Alt Nuc x The last character specifies the alternate nucleus identifier (0–9). Use this character at the system programmer's direction. If you do not specify an alternate nucleus identifier, the system loads the standard (or primary) nucleus (IEANUC01), unless the NUCLEUS statement is specified in the LOADxx member.

1.19 PARMLIB commands

```
❑ D PARMLIB
    IEE251I 09.32.31 PARMLIB DISPLAY 452
     PARMLIB DATA SETS SPECIFIED
     AT IPL
     ENTRY  FLAGS  VOLUME  DATA SET
       1      D    TOTSY1  SYS1.PARMLIB
     MASTER PROCESSING USING THE FOLLOWING PARMLIBS
     ENTRY  FLAGS  VOLUME  DATA SET
       1      S    TOTSY1  SYS1.PARMLIB
❑ D IPLINFO
    IEE254I  13.06.10 IPLINFO DISPLAY 025
     SYSTEM IPLED AT 08.25.41 ON 08/05/1996
     RELEASE SP6.0.2
     USED LOADR2 IN SYS0.IPLPARM ON 0CD0
     IEASYM LIST = XX
     IEASYS LIST = (R2,XX) (OP)
```

Figure 1-19 Commands to display parmlib information after IPL

Parmlib commands

The use of commands enables installations to display the current logical parmlib, display general IPL information, and change the current logical parmlib settings.

The commands are:

- **DISPLAY PARMLIB**

  This command displays the logical parmlib setup for the IPLed system. The output of this command includes the parmlib data set name(s) and volser(s) that were defined by LOADxx PARMLIB statement(s), and if used, MASTER JCL IEFPARM DD statements. When the errors option on the command is used, the display shows any parmlibs that were defined in LOADxx but were not found. This command is only valid before a **SETLOAD** command is issued. A sample output is shown in the visual.

- **DISPLAY IPLINFO**

  This command displays the general IPL information used by the system. The output includes the date and time of the IPL, release level, LOADxx information, and what IEASYSxx and IEASYMxx parmlib members were used. A sample output of the command is shown in Figure 1-19.

1.20 Parmlib commands (continued)

❑ SETLOAD xx,PARMLIB

```
SETLOAD R2,PARMLIB,DSN=SYS0.IPLPARM
IEF196I IEF237I 0CD0 ALLOCATED TO SYS00006
IEE252I MEMBER   LOADR2 FOUND IN SYS0.IPLPARM
IEF196I IEF237I 0CD0 ALLOCATED TO SYS00007
IEF196I IEF237I 0FC1 ALLOCATED TO SYS00008
IEF196I IEF237I 0FC1 ALLOCATED TO SYS00009
IEF196I IEF285I   SYS1.PARMLIB                                 KEPT
IEF196I IEF285I   VOL SER NOS= TOTSY1.
IEF196I IEF285I   SYS0.IPLPARM                                 KEPT
IEF196I IEF285I   VOL SER NOS= IODFPK.
IEF107I PARMLIB CONCATENATION WAS UPDATED FROM LOADR2
```

Figure 1-20 Changing parmlib concatenations with the setload command

Parmlib commands

The following command (which is also shown in the figure) allows the installation to dynamically change a parmlib concatenation without having to IPL. The **SETLOAD** command specifies the LOADxx member that contains the PARMLIB statements to use for the switch. The syntax of the command is as follows:

```
SETLOAD xx,PARMLIB[,{DSNAME|DSN}=dsn][,{VOLUME|VOL|VOLSER}=vol]
```

Where:

- **xx** - Specifies the one or two character suffix used to identify the LOADxx member that you want to process.
- **PARMLIB** - Specifies that the system is to process the PARMLIB statements in the LOADxx member according to the filter parameters (HWNAME, LPARNAME, VMUSERID). For more information on filter parameters, see the LOADxx member in *z/OS MVS Initialization and Tuning Reference*, SA22-7592.
- **DSNAME** or **DSN =dsn** - Specifies the 1 to 44 character name of the data set where the LOADxx member resides. The default is to locate the LOADxx member specified in a data set within the existing parmlib concatenation.
- **VOLUME** or **VOL** or **VOLSER =vol** - Specifies the 1 to 6 character serial number identifier of the volume where the specified data set resides.

A sample output of the **SETLOAD** command is shown in Figure 1-20.

```
SETLOAD R2,PARMLIB,DSN=SYS0.IPLPARM
```

1.21 Use of SETLOAD command

❑ After SETLOAD issued

```
D PARMLIB
IEE251I 09.36.52 PARMLIB DISPLAY 470
 PARMLIB DATA SETS SPECIFIED
 AT 09.34.11 ON 08/03/1996
 LOADR2 DATA SET=SYS0.IPLPARM
        VOLUME=CATALOG
 ENTRY  FLAGS  VOLUME  DATA SET
   1      S    CATALOG SYS0.IPLPARM
   2      S    CATALOG SYS1.OS390R2.PARMLIB
   3      S    CATALOG SYS1.PARMLIB
```

❑ After SETLOAD issued and an IPL

```
D PARMLIB
IEE251I 13.10.57 PARMLIB DISPLAY 027
 PARMLIB DATA SETS SPECIFIED
 AT IPL
 ENTRY  FLAGS  VOLUME  DATA SET
   1      S    IODFPK  SYS0.IPLPARM
   2      S    TOTSY1  SYS1.OS390R2.PARMLIB
   3      D    TOTSY1  SYS1.PARMLIB
```

Figure 1-21 DIsplaying the parmlib members in use after a setload command

Use of SETLOAD command

The sample output shown in Figure 1-21 is a result after the **SETLOAD** command was issued.

The second display shows the output of a **DISPLAY PARMLIB** command after an IPL had taken place using **LOADR2**. PARMLIB statements were specified in **LOADR2**. Note the difference in the FLAGS column shown in the figure.

The FLAGS describe how the parmlibs were specified:

- S denotes the LOADxx PARMLIB statement.
- D denotes the default (SYS1.PARMLIB).

1.22 Catalogs

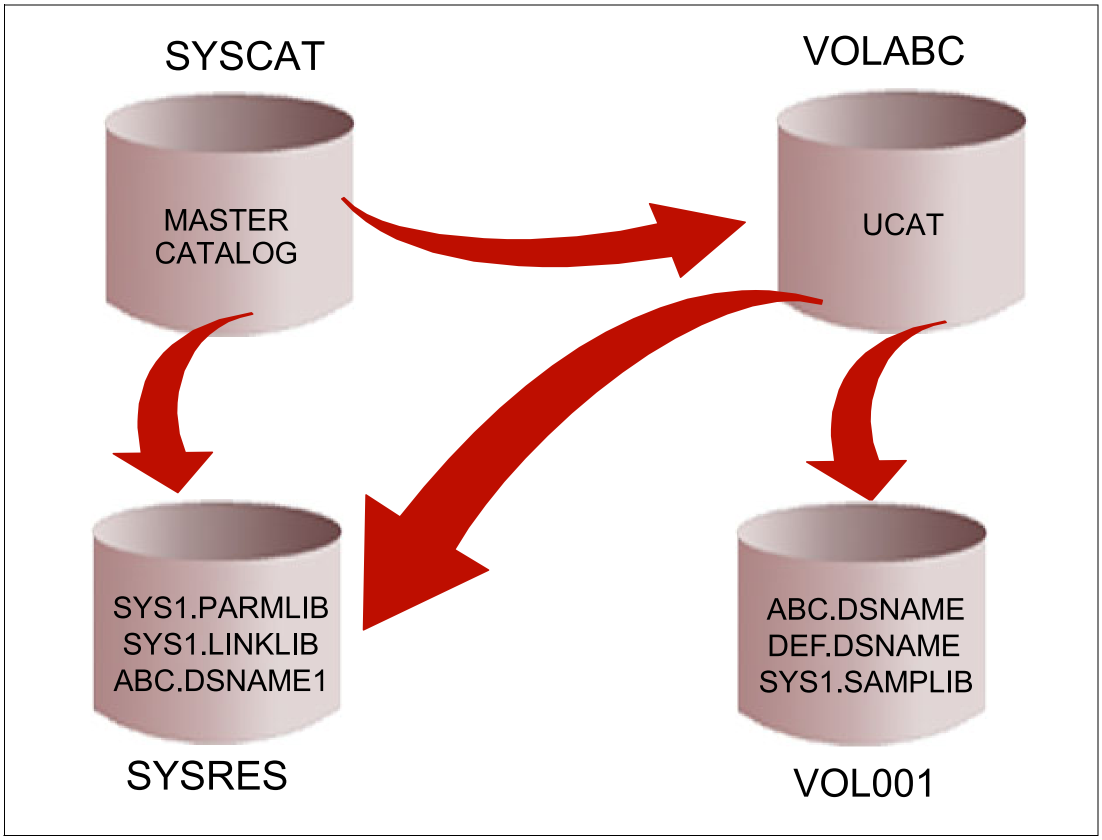


Figure 1-22 Defining catalog data sets

Catalogs

A catalog is a data set that contains information about other data sets. It provides users with the ability to locate a data set by name, without knowing where the data set resides. By cataloging data sets, your users will need to know less about your storage setup. Thus, data can be moved from one device to another, without requiring a change in JCL DD statements which refer to an existing data set.

Cataloging data sets also simplifies backup and recovery procedures. Catalogs are the central information point for VSAM data sets; all VSAM data sets must be cataloged. In addition, all SMS-managed data sets must be cataloged.

Using indirect catalog entries

Indirect cataloging, also known as indirect volume serial support, allows the system to dynamically resolve volume and device type information for non-VSAM, non-SMS managed data sets that reside on the system residence (IPL) volume when accessed through the catalog. This allows you to change the volume serial number or the device type of the system residence volume without also having to recatalog the non-VSAM data sets on that volume.

The extended indirect volume serial support that was introduced in OS/390 V2R3 allows catalog entries to be resolved using system symbols defined in the IEASYMxx parmlib member, so that indirect references can be made to one or more logical extensions to the system residence volume. Therefore, you can have multiple levels of z/OS data sets residing on multiple sets of volumes with different names and device types, and use them with the same master catalog.

Using indirect catalog entries, together with the indirect volume serial enhancements, allows you to share the master catalog among multiple images that use different volumes with different names for the system residence volumes and their extensions.

For more information on indirect volume serial support, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

Catalog management

Ensuring that your catalogs are effectively managed is therefore a crucial aspect of DASD management. Some of the most common catalog management tasks that a system programmer may have are:

- Defining and maintaining the master catalog
- Defining the alias and user catalog
- Protecting the catalogs
- Cleaning up catalogs
- Backing up catalogs and performing catalog recovery

1.23 Separating data from software

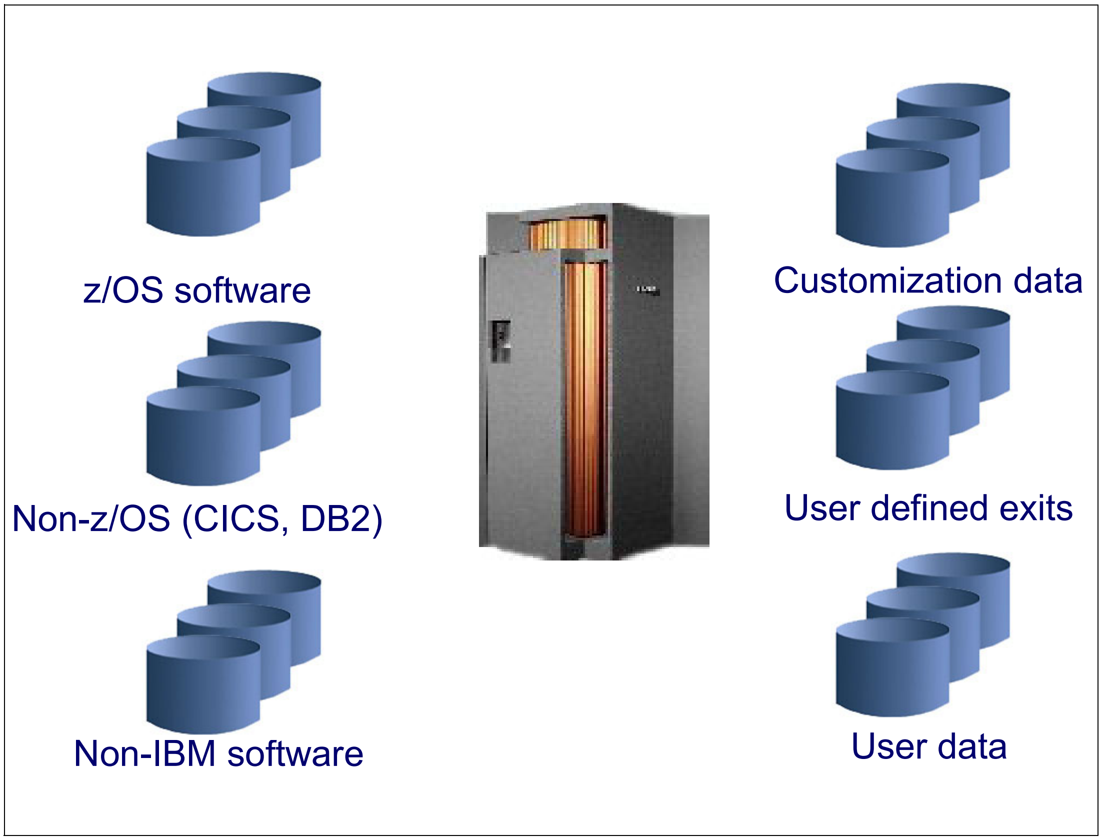


Figure 1-23 Placing the software on separate volumes from user data

Separating data from software

When you separate your data from your system software, you eliminate many tasks that would otherwise need to be performed each time you upgrade or replace your system software. One effective way to achieve this is to use dedicated pools of DASD volumes for each.

The kinds of data you should separate from z/OS software are:

- Customization data, including most system control files
- Non-IBM software
- IBM non-z/OS products, for example CICS and DB2®
- User-defined exits
- User data

Your goal is to make it easier to replace the volumes that contain z/OS software, which allows you to keep the other software and data you will need to use with z/OS across migrations.

1.24 Placing data sets on specific volumes

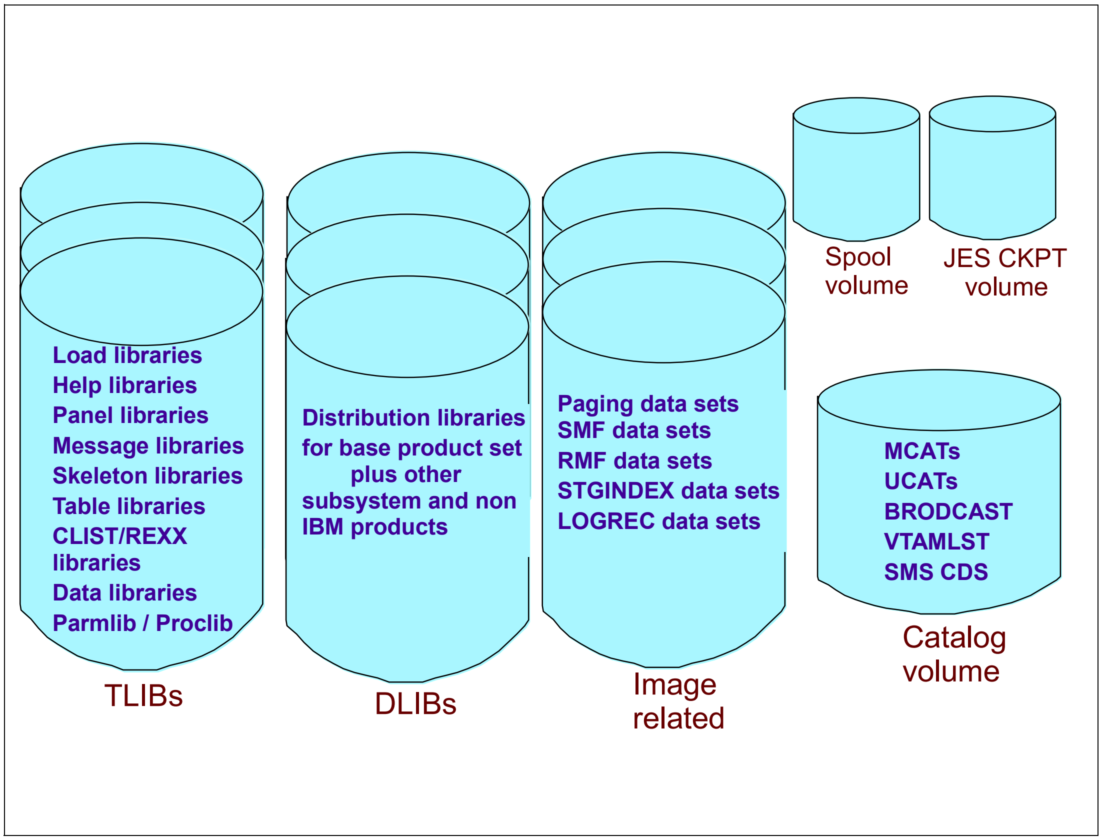


Figure 1-24 Where to place data sets

Placing data sets on specific volumes

Some SYSRES volume types, such as the 3390-3, are not big enough to hold all the target libraries for a z/OS system. Therefore, you have to move some data sets to SYSRES logical extension volumes (or overflow volumes). The considerations you should take into account for placing data sets on specific volumes are:

- Your ability to use a system (or subsystem) replacement
- Data set and system availability
- System performance
- System cloning and servicing techniques
- Sysplex/multisystem operations
- Sharing data sets
- Backup and recovery
- Disaster recovery

With these considerations in mind, you should determine which data sets to place on each volume based on data set type, not based on element, feature, or product. There are basically five types of data sets, each of which can be placed on a separate (logical) volume:

- SMP/E global-shared data sets
- Target libraries (TLIBs) for product sets

- Distribution libraries (DLIBs) for product sets
- Image-related data sets
- Cluster-related data sets

SMP/E global-shared data sets

These data sets should be placed on a volume shared by all systems in the complex that need SMP/E global information. Sharing these data sets will provide for easy backup and recovery. The recommended types of data sets for this volume are:

- SMP/E global CSI
- SMPPTS
- SMP/E global logs (SMPLOG and SMPLOGA)

1.25 The TLIBs volumes

- TVOL1
- TVOL2 - n
- HFS Target Volume
- Licensed Product Target Volume
- Vendor Product Target Volume
- Subsystem Target Volume

Figure 1-25 Target libraries

Target libraries (TLIBs) for product sets

These target libraries spread across several volumes, from primary to secondary volumes:

- **Primary target volume (TVOL1)** - The TVOL1 is the first target library volume and the system residence (IPL) volume; it contains many of the z/OS target libraries. Make sure you leave enough free space to allow for future growth. The recommended types of TVOL1 data sets are:
  - *Load libraries* - data sets containing load modules.
  - *Change migration libraries* - used during migration from one level of software to another.
  - *Help libraries* - data sets that contain help information.
  - *Panel libraries* - data sets that contain ISPF panels.
  - *Message libraries* - z/OS libraries that contain ISPF messages and MMS source messages.
  - *Skeleton libraries* - z/OS libraries that contain ISPF skeletons.
  - *Table libraries* - z/OS libraries that contain ISPF tables.
  - *Fixed-block CLIST and EXEC libraries* - data sets that contain CLIST and REXX EXECs.
  - *Data libraries* - z/OS libraries that contains data parts which include workstation information, header files, or other various types of data.
  - *SMP/E-managed PARMLIB* - the data set that is pointed to by the PARMLIB DDDEF, which will be used to store parmlib members supplied by products you install.

  - *SMP/E-managed PROCLIB* - the data set that is pointed to by the PROCLIB DDDEF, which will be used to store JCL procedures supplied by products you install.

- **Secondary target volumes (TVOL2–TVOLn)** - The TVOL2 through TVOLn are volumes used for data sets that do not fit on TVOL1. They are for the z/OS product set and the recommended types of TVOL2 through TVOLn data sets are:
  - *Fixed-block CLIST and EXEC libraries* - used only if variable-block CLIST and EXEC libraries were used on TVOL1.
  - *Sample and JCL libraries* - z/OS libraries that contain samples, header files, and JCL jobs.
  - *Source libraries* - z/OS libraries that contain source code.
  - *Macro libraries* - z/OS libraries that contain assembler macros, header files, and other information identified in SMP/E as the element type MACRO.
  - *Workstation libraries* - can be combined with the data libraries.
  - *Softcopy libraries into which SMP/E installs* - z/OS libraries that contain books, bookshelves, and bookindexes.
  - *Font and printing libraries* - z/OS libraries that contain fonts and data sets required for printing.
  - *Flat files that SMP/E cannot manage* - interface repositories and so forth, excluding books.
  - SMP/E target CSI
  - *SMP/E target data sets* - including SMPLTS, SMPMTS, SMPSTS, and SMPSCDS.
  - User catalog for the SMP/E target CSI and MVS-supplied data sets

- **HFS target volume** - Recommended types of data sets (filesystems) for this volume are:
  - HFS data sets for z/OS elements or features that install into an HFS.
  - Any non-z/OS HFS data set, except those containing customization data.

- **Licensed product target volume** - The libraries on this volume consist of the licensed product set that you might not have in a system-replacement order and you want to keep separate. The recommended types of data sets for this volume are:
  - Licensed program target libraries.
  - SMP/E target CSI.
  - SMP/E target data sets: SMPLTS, SMPMTS, SMPSTS, and SMPSCDS.
  - User catalog where all the licensed program libraries and the SMP/E target CSI are cataloged.

- **Vendor product target volume** - The libraries on this volume consist of the vendor product set that you might not have in a system-replacement order and you want to keep separate. The recommended types of data sets for this volume are:
  - Vendor target libraries.
  - SMP/E target CSI.
  - SMP/E target data sets: SMPLTS, SMPMTS, SMPSTS, and SMPSCDS,
  - User catalog where all the vendor product target libraries including the SMP/E target CSI are cataloged.

- **Subsystem target volume** - The libraries on this volume consist of the subsystem product sets (for example, CISCS, DB2, IMS™, or NCP). The recommended types of data sets for this volume are:
  - Subsystem target libraries.
  - Alternate subsystem SMP/E global CSI, if applicable.
  - SMP/E target CSI.
  - SMP/E target data sets: SMPLTS, SMPMTS, SMPSTS, and SMPSCDS.
  - User catalog where the subsystem targets libraries including SMP/E CSIs are cataloged.

1.26 The DLIB volumes

- DLIB Vol for TVOL1, TVOL2 - TVOLn, HFS
- DLIB Vol for Licensed Products
- DLIB Vol for Vendor Products
- DLIB Vol for Subsystems

Figure 1-26 The distribution library volumes

Distribution libraries (DLIBs) for product sets

You should place data sets on the DLIB volumes wherever they fit. However, keep in mind how other systems will use the distribution libraries when you are deciding where to place them. There are cases where you don't want or need a set of distribution libraries available on certain packs, for example having multiple target zones connect to a DLIB zone. The DLIB volumes, like the target volumes, can be divided into primary and secondary volumes:

- DLIB volumes for TVOL1, TVOL2 through TVOLn, and HFS

  These distribution libraries are the ones that are placed by ServerPac for your z/OS product sets. By keeping the distribution libraries on the same volumes it will be easier to avoid overlaying data sets.

- DLIB volumes for licensed products

  These are the distribution libraries that correspond to the target libraries for the licensed product set. These are data sets that would not be overlaid in a system replacement.

- DLIB volume for vendor products

  These are the distribution libraries that correspond to the target libraries for the vendor product set. These are data sets that would not be overlaid in a system replacement.

- DLIB volumes for subsystems

  These distribution libraries are the ones that are placed by ServerPac for subsystem product sets. Keeping the distribution libraries on the same volumes makes it easier to avoid overlaying data sets.

1.27 The image-related volumes

- Page data set volume 1
- Page data set volume 2 through n
- HFS customization volume

Figure 1-27 Volumes containing non-shareable system information

Image-related data sets

These data sets contain non-shareable system image information. Although the recommendation is that they be put on separate volumes, if DASD space is scarce you can combine them at the expense of performance or availability, or both. The image-related data sets are placed in the following recommended volumes:

- **Page data sets volume 1** - The recommended types of data sets for this volume are:
  - PLPA (one-cylinder allocation)
  - COMMON

Note: Unless your system is central-storage constrained, and has significant PLPA paging activity, there is little or no performance impact to combining the PLPA and COMMON page data sets. The PLPA data set should be allocated first, as a one-cylinder data set, with the COMMON data set allocated second, immediately following the PLPA data set on the same volume. The size of the COMMON data set should be large enough to contain both PLPA and COMMOND pages.

This causes the vast majority of PLPA pages to be written to the COMMOND page data set during IPL. This allows the operating system to use the chained CCWs within a single data set and improves performance when both data sets are on the same volume.

The message (`ILR005E PLPA PAGE DATA SET FULL, OVERFLOWING TO COMMON DATA SET`) during IPL can be ignored when the PLPA and COMMON page data sets are on the same volume.

- **Page data set volumes 2 to n** - The recommended types of data sets for these volumes are:
  - Local
  - SMF
  - RMF™ reporting
  - STGINDEX data set (if used)
  - Image-related LOGREC data set (if used)
- **HFS customization volume** - This is an installation-maintained volume that contains data sets that will not be overlaid by system replacement. This volume is separate from the HFS target volume because it contains unshareable HFS files that will generally need to be mounted MODE(RDWR). The recommended types of data sets for this volume are:
  - HFS data sets that must be in write mode (for instance, /tmp, /etc, /dev, /u) and that contain customized information.
  - User catalog where the HFS data sets are cataloged.

1.28 The cluster-related volumes

- ❑ Master catalog volume
- ❑ JES Checkpoint volume
- ❑ JES Spool volume
- ❑ Sysplex volume 1
- ❑ Sysplex volume 2
- ❑ Softcopy volumes

Figure 1-28 Volumes containing shareable data sets

Cluster-related data sets

These are shareable data sets used in a multisystem environment. Cluster-related data sets should use system symbolics in their names for easier maintainability. While all cluster-related data sets can be combined on the same volume, it is usually preferable to separate certain data sets from others for performance or availability reasons. You can group the cluster-related data sets into the following volumes:

- **Master catalog volume** - The recommended types of data sets for this volume are:
  - Master Catalog
  - BROADCAST data set
  - Customer parmlib concatenation (not the SMP/E DDDEFed PARMLIB)
  - Customer proclib concatenation (not the SMP/E DDDEFed PROCLIB)
  - UADS data set (if used)
  - VTAMLST data set
  - SMS control data sets (ACDS, SCDS, and COMMDS), HSM, RMM, and so forth
  - APPC VSAM data set
  - System control files (TCPI/P configuration and so forth)
  - Primary RACF database
  - IODF data set
  - SYS0.IPLPARM
  - UCATs
  - SYS1.DDIR sysplex dump directory data set
  - DAE data set

- **JES checkpoint volume** - For maximum performance and reduced contention, place the primary JES checkpoint data set on its own dedicated volume. The JES checkpoint primary data set may be on a Coupling Facility.
- **JES spool volume** - You can place the JES duplex checkpoint data set together with the JES spool to reduce I/O and improve performance. Having the duplex data set on the same volume as one of the JES spool data sets will take advantage of the fact that JES checks, during every write to the JES spool, whether a checkpoint data set resides on the same volume.
- **Sysplex-related volume 1** - The recommended types of data sets for this volume are:
  - SYSPLEX primary
  - CFRM alternate
  - ARM primary
  - WLM primary
  - LOGR primary
  - OMVS primary

  Note: The CFRM primary and SYSPLEX primary should be on different volumes attached to different control units. All other primary couple data sets can reside on the same volume, and all other alternate couple data sets can reside on a different volume.

- **Sysplex-related volume 2** - The recommended types of data sets for this volume are:
  - Sysplex alternate
  - CFRM alternate
  - ARM alternate
  - WLM alternate
  - LOGR alternate
  - OMVS alternate
  - Secondary RACF database
- **Softcopy volume** - This volume holds softcopy books and related data sets. The recommended types of data sets for this volume are:
  - Books
  - Bookshelves
  - Bookindexes

Many volumes on your system will contain data sets that are not supplied by ServerPac. Keeping such volumes separate from those that ServerPac will replace, or that you will replace when migrating the new system to other system images, makes it easier to prevent overlaying data sets that you want to keep.

For more information on data set placement, see *z/OS and z/OS.e Planning for Installation*, GA22-7504.

1.29 Naming conventions for data sets

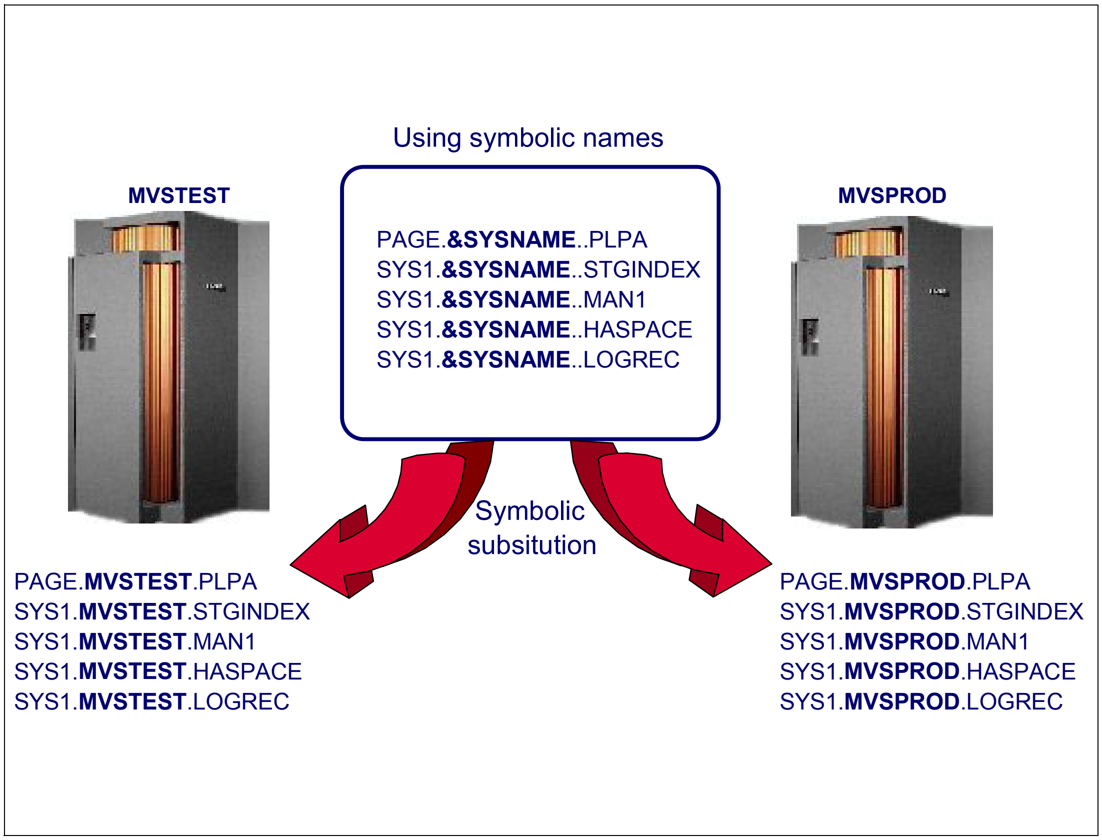


Figure 1-29 Choosing names for z/OS data sets

Choosing a naming convention for data sets

Choosing the right naming conventions for system software data sets can save you considerable time during installation and migration.

Some data sets are associated with only one system in a multisystem environment. Choose names for these data sets that reflect the name of the specific system. Names of system operational data sets, such as page and swap data sets, should include the system name. You can accomplish this using the IBM-supplied system symbol *SC68*.

Using symbolic substitution involves carefully establishing naming conventions for data sets such as parmlib and proclib members, system images, HCD definition, and so forth. Remember that once your system goes into production with a set of naming conventions, you cannot easily change them.

IBM has been removing the level-dependent qualifier (such as V1R1M0) from default data set names for z/OS elements in order to ease your migration to a new z/OS release. This preserves much of your existing JCL, system procedures, parmlib and other system control file contents, and security system definitions across upgrades, saving you time and reducing the opportunity for error because updates will be limited to just the data sets in which the low-level qualifiers were changed.

1.30 DASD space utilization and performance

- Non-RECFM U Data Sets
  - Use System Determine Block Size, BLKSIZE=0
- RECFM U Data Sets
  - Use BLOCKSIZE=32760
- UADS Data Sets
  - Same block size as the currently used
- Font Libraries
  - Use BLOCKSIZE=12288

Figure 1-30 Determining space utilization for data sets

DASD space utilization and performance

The space required by system software data sets, except for PDSE data sets, is affected by the block sizes you choose for those data sets. Generally, data sets with larger block sizes use less space to store the same data than those with smaller block sizes.

The exception to this general rule is fixed block (FB) record format data sets. They should not be allocated with block sizes larger than half the track length of the DASD they are allocated on. Doing so will cause considerable DASD space to be wasted because current DASD track lengths are less than twice the maximum block size of 32760 bytes.

Generally, system-determined block sizes (SDB) are the best choice for block size for fixed block (FB), variable blocked (VB), and variable block spanned (VBS) record format data sets. You should use SDB for all system software data sets with these record formats except those for which IBM specifically recommends other block sizes. One way to do this is by specifying BLKSIZE=0 in the DCB parameter of a DD statement when allocating new data sets using JCL. For more information, see *z/OS MVS JCL Reference*, SA22-7597.

Data sets with undefined (U) record formats do not follow the same rules as those with other record formats. In particular, most load libraries in partitioned data sets (not PDSEs) will require less space and offer better performance at increasing block sizes right up to the block size limit of 32760 bytes. This is because the program management binder, linkage editor, and IEBCOPY's `COPYMOD` command use the data set block size only to set the maximum block length they will use.

Allocate all load libraries using a block size of 32760 bytes unless you plan to move your system software data sets from the device types on which they were originally allocated to device types with shorter track lengths, or plan to move them between device types having different track lengths without using IEBCOPY `COPYMOD`.

For most efficient use of DASD, it is recommended that you allocate z/OS data sets using the following block sizes:

- Use the SDB for most non-RECFM U data sets.
- For RECFM U data sets, use BLKSIZE=32760.
- For UADS data sets for TSO/E, use the same block size you currently use to allocate a new one. Do not use SDB, as this will result in very poor DASD space utilization.
- You should not use the SDB for font libraries too. The correct block size for the font libraries is 12288.

For more information on the usage of SDB, see *z/OS DFSMS: Using Data Sets*, SC26-7410.

1.31 System data sets

- Master Catalog
- IODF
- SYSn.IPLPARM
- SYS1.BRODCAST
- SYS1.CMDLIB
- SYS1.CSSLIB
- SYS1.DUMPnn
- SYS1.HELP
- SYS1.IMAGELIB
- SYS1.LINKLIB
- LOGREC
- SYS1.LPALIB
- SYS1.MACLIB
- SYS1.MIGLIB
- SYS1.MODGEN
- SYS1.NUCLEUS
- SYS1.PARMLIB
- SYS1.PROCLIB
- SYS1.SAMPLIB
- SYS1.SVCLIB
- SYS1.UADS
- SYS1.STGINDEX
- SYS1.VTAMLIB

Figure 1-31 System data sets

System data sets

Before you install z/OS, you must select and define the system data sets that you need.

Before you include components from the distribution libraries (DLIBs) and user-defined data sets in the system, use JCL and access method services to define the system data sets.

Figure 1-31 lists some of the common system data sets. For a complete list of system data sets, see *z/OS MVS System Data Set Definition*, SA22-7629.

1.32 System administration

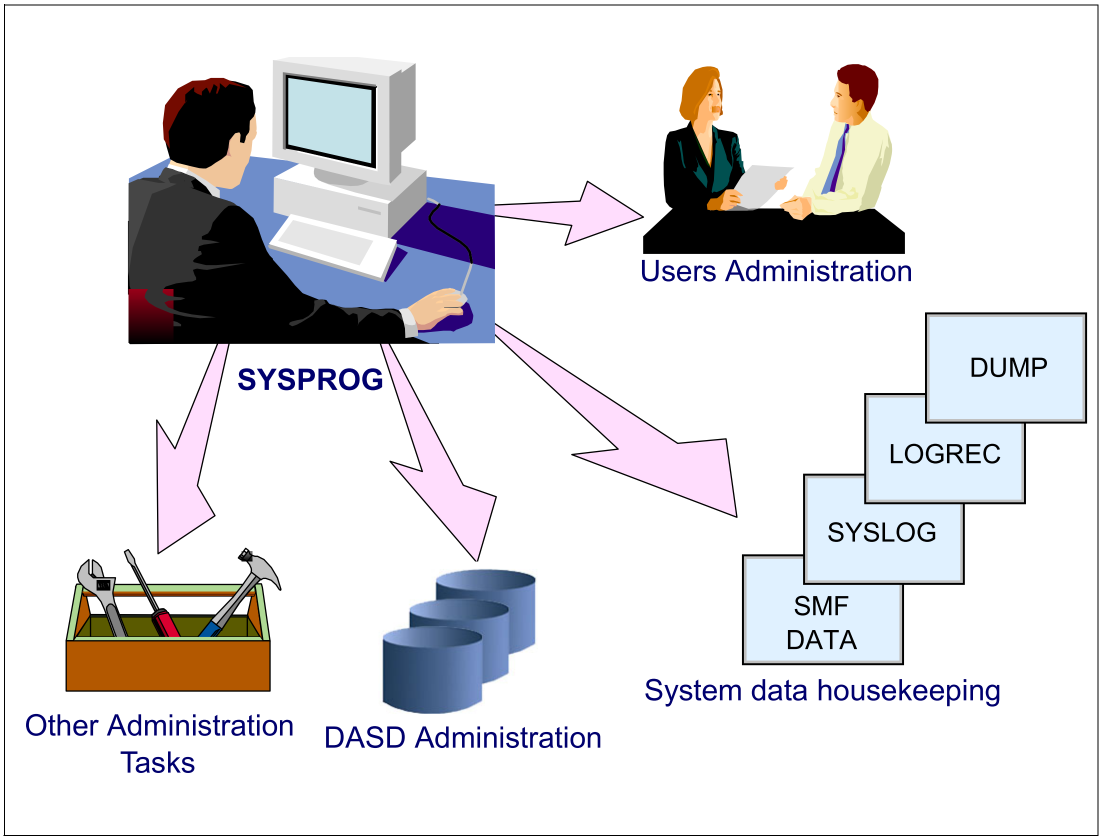


Figure 1-32 System administration tasks

System administration tasks

Once you have the system up and running, most of your time is spent maintaining the system and providing technical support to the users. The remainder of this chapter describes some of the administrative tasks performed by a system programmer, specifically:

- User administration
- DASD administration
  - Adding a new DASD volume
  - Implementing DFSMS
  - Handling DASD problems
- System data housekeeping
  - SMF recording
    - SMFPRMxx parmlib member - Dumping SMF data
  - LOGREC data - SYSLOG data
- Other administration tasks
  - Working with MIH
  - Adding page data sets
  - Changing TSO timeout
  - Adding spool volumes
  - Deleting spool volumes
  - Verifing system configuration
  - Viewing SYSOUT using ISPF
  - Changing your TSO profile
  - Backing up and restoring z/OS

1.33 User administration

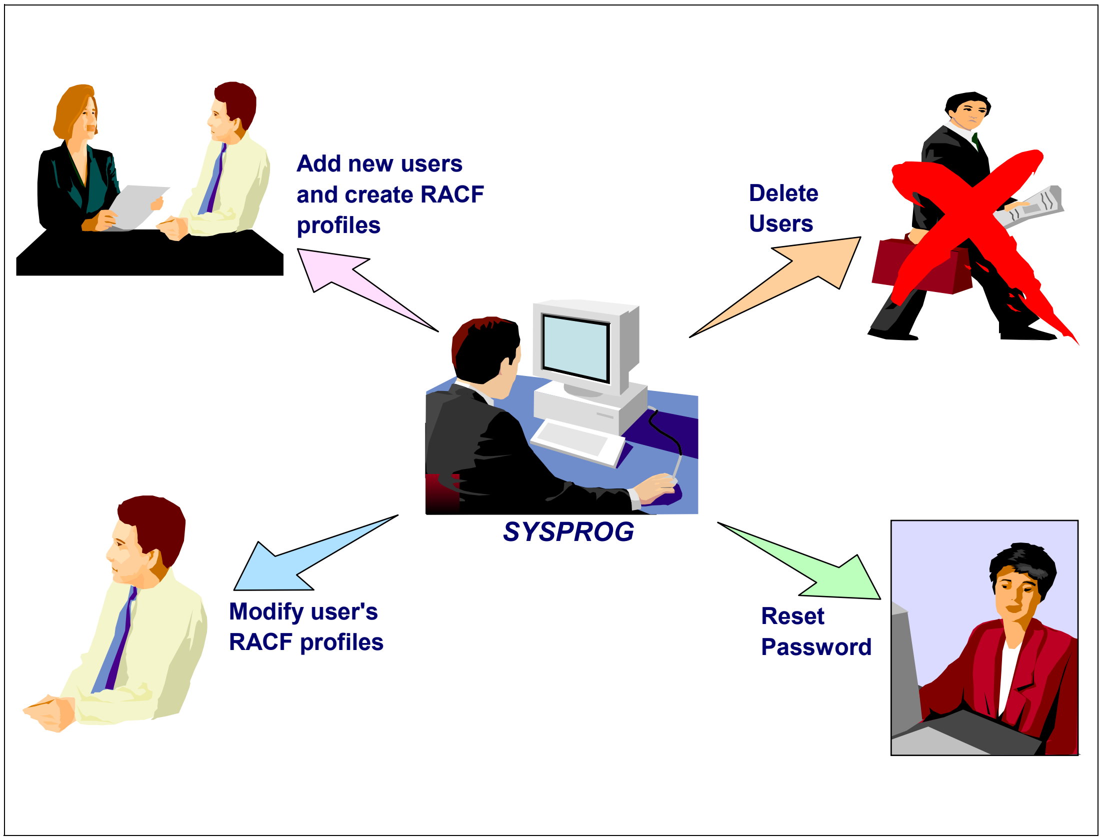


Figure 1-33 User administration tasks

User administration

A system is never complete without users using it. Most of the time, you will find yourself having to perform certain user administration tasks. The next few sections provide examples of typical processes used when adding, deleting, or administering users.

Some of the common user administrative tasks are:

- Adding new users
- Creating RACF profiles for new users
- Modifying RACF profiles for existing users
- Resetting passwords
- Deleting users and their RACF profiles

1.34 DASD administration

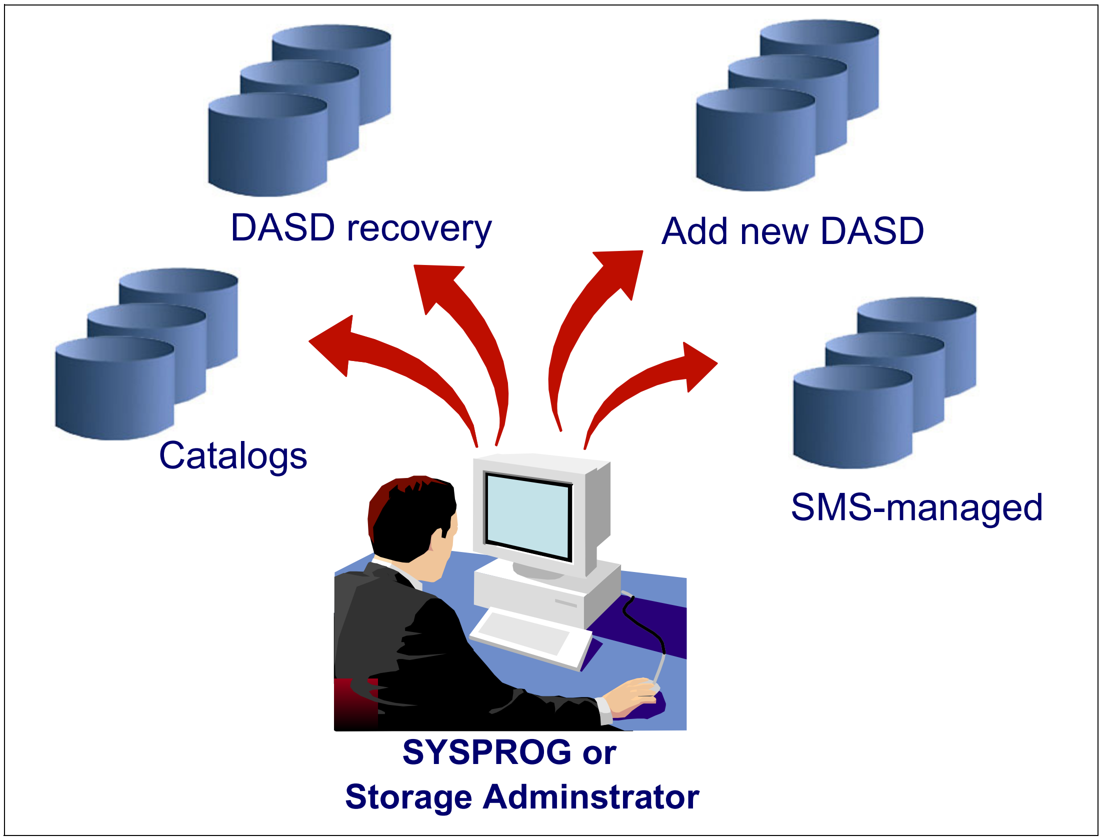


Figure 1-34 DASD administration tasks

DASD administration

On a large installation, you might have a team of storage administrators to take care of all DASD administration tasks, and you as a system programmer may only be required to help with obscure problems and exit routines. In that environment, you may never have to deal with the hardware side of DASD management, other than modifying IODF and IOCDS using HCD. On the other hand, your installation may be of a smaller scale that doesn't warrant having a dedicated team of storage administrators, so you may have to take on far more of these roles.

DASD management

As a system programmer taking on the additional responsibility of a storage administrator, you might have to handle these aspects of DASD management:

- Adding new DASD devices and volumes to your system
- Implementing SMS
- Effectively managing catalogs
- Dealing with DASD problems

1.35 Adding a new DASD volume

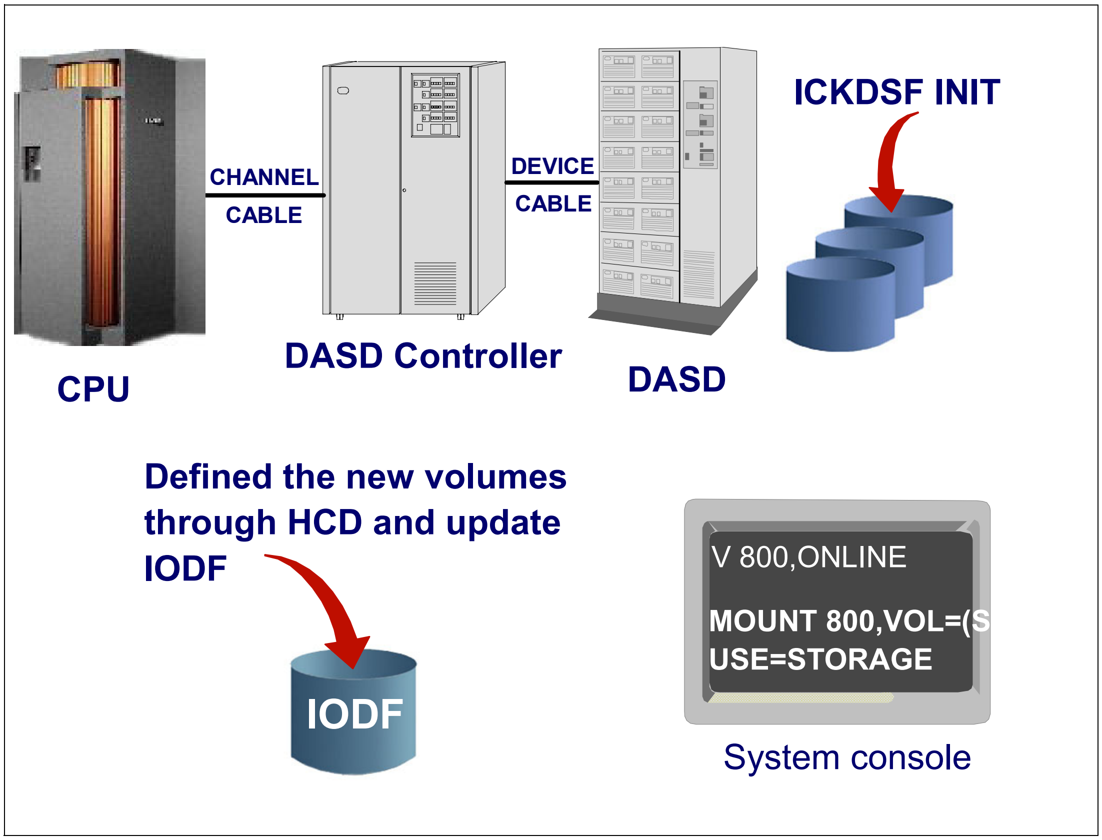


Figure 1-35 Adding a new DASD volume

How to add additional DASD volumes

The following list outlines the steps for making a new DASD volume available to your system:

1. Physically connect the new device to the storage controller, which is connected to the system through an available channel. Normally, this task is performed by an IBM Customer Engineer who takes care of all the hardware installation.
2. Using HCD, update the IODF and IOCDS to include the new devices. You might want to define the device as belonging to one or more eligible device tables defined in your current IODF, so that data sets can be allocated on it using the UNIT parameter with the associated esoteric device name. For more information on how to use HCD, see *z/OS Hardware Configuration Definition User's Guide*, SC33-7988.
3. Using ICKDSF, initialize the new volume with a volume serial label, a volume table of contents (VTOC), and a VTOC index. For more information on ICKDSF, see *Device Support Facilities User's Guide and Reference Release 17*, GC35-0033.
4. Vary the device online, and issue an appropriate `MOUNT` command, or re-IPL MVS to cause the new volume to be mounted according to the VATLST entries.

A disk volume (except a DFSMS-managed volume) is mounted with one of the following use attributes:

- PRIVATE

  New data sets will be created on this volume only if the user (by using JCL or the TSO **ALLOCATE** command or an ISPF menu specification) specifies the volume serial number of this disk volume.

- PUBLIC

  MVS may place a temporary data set on this volume if the user (by using JCL or otherwise) did not specify a volume serial number for the temporary data set. Data sets may also be placed on this volume by specifying the volume serial number, as with the PRIVATE volumes. A temporary data set is one with a DSNAME beginning with an ampersand or with a disposition equivalent to NEW,DELETE. For more information about the DSNAME parameter in JCL, see *z/OS MVS JCL Reference*, SA22-7597.

- STORAGE

  MVS places permanent data sets on this volume if the user did not supply a volume serial number for the data sets. In addition, temporary data sets, and data sets placed by volume serial number, may also be placed on this volume.

  You can set the volume use attributes by:

  - Using the **MOUNT** operator command
  - Using the VATLSTxx parmlib member

  For more information on the **MOUNT** command, see *z/OS MVS System Commands*, SA22-7627.

  The VATLSTxx parmlib member defines the default mount and use attributes for disk volumes found during IPL. The mount attribute determines the conditions under which a volume can be unmounted, while the use attribute controls the type of request for which a volume can be allocated.

  Example of VATLSTxx: VATDEF IPLUSE(PRIVATE),SYSUSE(PRIVATE)

  MPCAT1,1,0,3390,Y

  MPRES1,1,2,3390,Y

  MPRES2,1,2,3390,Y

This example specifies the use attribute. STORAGE is denoted by 0, PUBLIC by 1, and PRIVATE by 2.

For more information on the VATLSTxx parmlib member, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

1.36 Implementing DFSMS

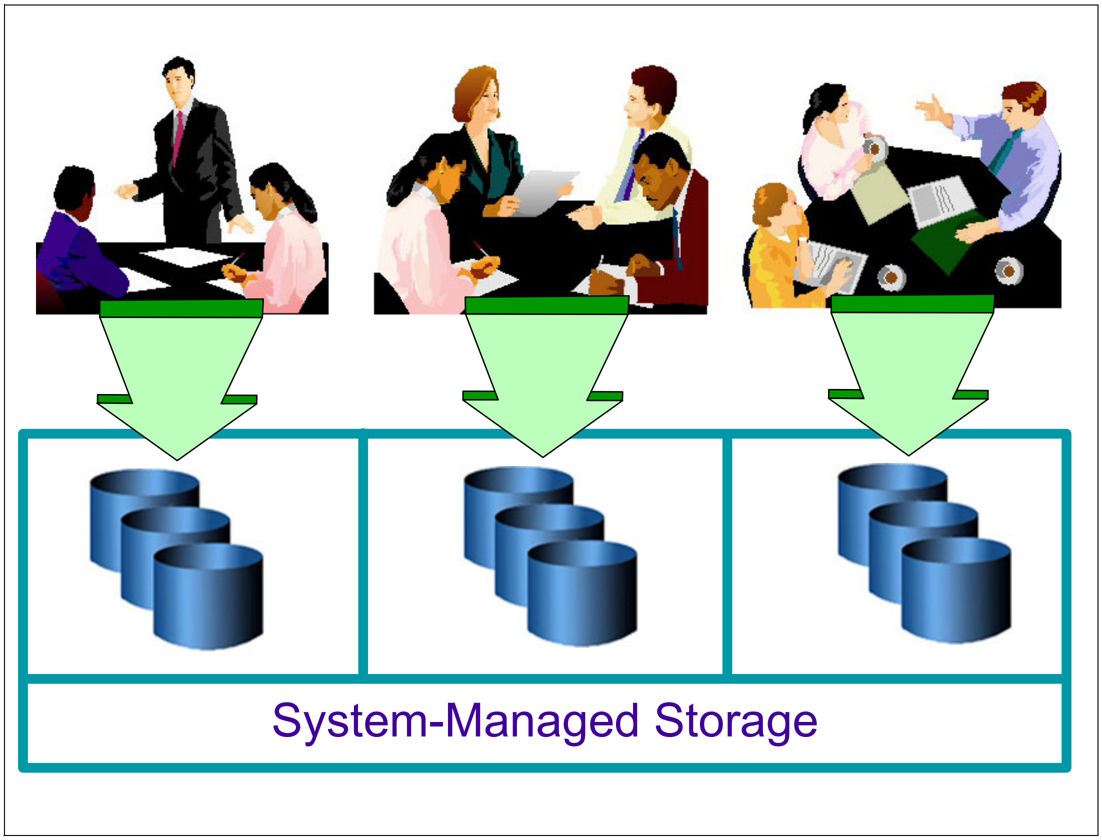


Figure 1-36 Implementing DFSMS - system-managed storage

Implementing System Managed Storage (SMS)

After you have added the new volumes to the system, you should not make all the volumes available to the users and allow them to use them as they wish. With no restriction on which volumes they can use or how much space they can allocate, your new disk volumes will be filled up fairly quickly. You could spend most of your time providing a new supply of disk volumes for other essential data, tracking down the owner of each data set to establish their importance, and trying to negotiate for space reduction. One way to solve this problem is to allocate individual volumes to each application, usage type, or group of users. Each of these volumes are mounted PRIVATE and allocation can be done by specifying the volume serial number. However, this method of control has some disadvantages:

- The requirement of specifying a volume serial number in JCL during allocation can lead to inflexibility; for example, a space allocation on one volume might fail even though there is a lot of space on other volumes available to the user.
- It is time-consuming and difficult to change the volumes available to the user because this requires changing the hard-coded volume serial number in the JCL.

To avoid these problems, implement DFSMS. It uses software to help automate the management of storage, data security, data set placement, data set migration and recall, data set backup, and data set recovery and deletion. This ensures that current data is available when needed and obsolete data is removed from storage, providing the following benefits:

- Simplified data allocation
- Ensured data integrity on new allocation
- Improved allocation control

1.37 Handling DASD problems

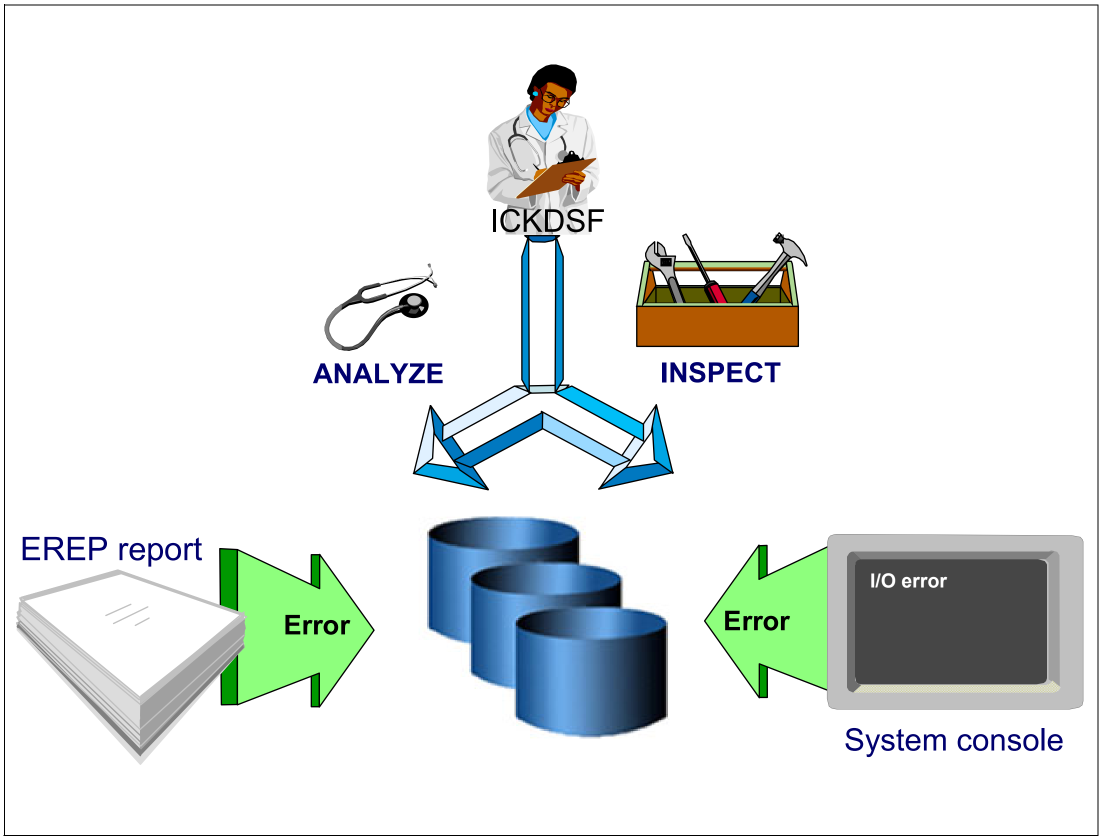


Figure 1-37 Handling DASD problems

How to deal with DASD problems

The most common DASD problem you will encounter in your role as a system programmer is an I/O error.

The normal error handling processing by the storage subsystem (that is, the storage control and its attached storage devices) and by the operating system, z/OS, includes various functions that recognize errors and recover from them whenever possible. The storage subsystem performs the following functions:

- Adds ECC (error checking and correction) information to each field of a record when written.
- Detects errors in reading data, in performing control operations, in functioning of the hardware, and in programming.
- Retries I/O operations for certain error conditions.
- Assembles usage and error information in the form of sense information.
- Maintains counts of disk storage errors.
- Does ECC correction activity or sends the ECC data to the operating system for correction.

The operating system, MVS provides standard error recovery procedures to handle errors detected by the storage subsystem. For example, MVS:

- **Implements recovery actions** - The specific recovery actions depend on the particular error condition that was defined in the sense information sent from the storage subsystem;

for example, retrying an operation when an equipment check is reported in the sense information.

- **Logs usage and error information records** - The error data that is sent to the system is stored in the Error Recording Data set (ERDS), that is SYS1.LOGREC. The system processes the sense information to produce and supplement data records describing the conditions under which the error occurred. The EREP program formats error reports and may also perform error analysis based on information it obtains from the SYS1.LOGREC.
- **Issues system messages at the operator console** - System console messages may be the initial notification of hardware or media problem. Most information messages contain data on the type and location of an error, and give sense information in hexadecimal format.

The errors shown on the EREP report should be followed up, particularly as temporary errors tend to lead to permanent errors. Normally, you will call an IBM Customer Engineer to look into the problem, or your hardware engineer if it turns out to be a hardware error. However, when the problem is caused by a disk media failure, you may have to perform some form of media recovery actions using ICKDSF.

You can use the **ANALYZE** command to detect and differentiate recording surface and drive-related problems on a volume. It can also scan data to help detect possible media problems. Sample JCL for the **ANALYZE** command follows:

```
//ICKDSF1 JOB (),'MVSSP',NOTIFY=&SYSUID,CLASS=A,MSGLEVEL=(1,1),
//          MSGCLASS=X
//ANALYZE  EXEC PGM=ICKDSF
//VOLUME   DD UNIT=3390,VOL=SER=MPDLB2,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSIN    DD *
   ANALYZE DDNAME(VOLUME) SCAN DRIVETEST
```

Note: When diagnosing media problems, you should always use the **ANALYZE** command with the DRIVETEST operand. This will ensure that the device hardware can perform basic operations, such as seek, reads, and writes.

When the ANALYZE report shows that there are potential media errors, you can use the **INSPECT** command to check the surface of a track to determine if there is a defect, than flag the defective track and assign an alternate track. The PRESERVE operand allows you to save the data on the inspected tracks to the assigned alternate tracks. Sample JCL for the **INSPECT** command follows:

```
//ICKDSF2 JOB (),'MVSSP',NOTIFY=&SYSUID,CLASS=A,MSGLEVEL=(1,1),
//          MSGCLASS=X
//INSPECT  EXEC PGM=ICKDSF
//VOLUME   DD UNIT=3390,VOL=SER=MPDLB2,DISP=SHR
/SYSPRINT DD SYSOUT=*
//SYSIN    DD *
   INSPECT DDNAME(VOLUME) ASSIGN CHECK PRESERVE
```

For more information on **ANALYZE** and **INSPECT**, and other ICKDSF commands, see *Device Support Facilities User's Guide and Reference Release 17*, GC35-0033.

1.38 System data housekeeping

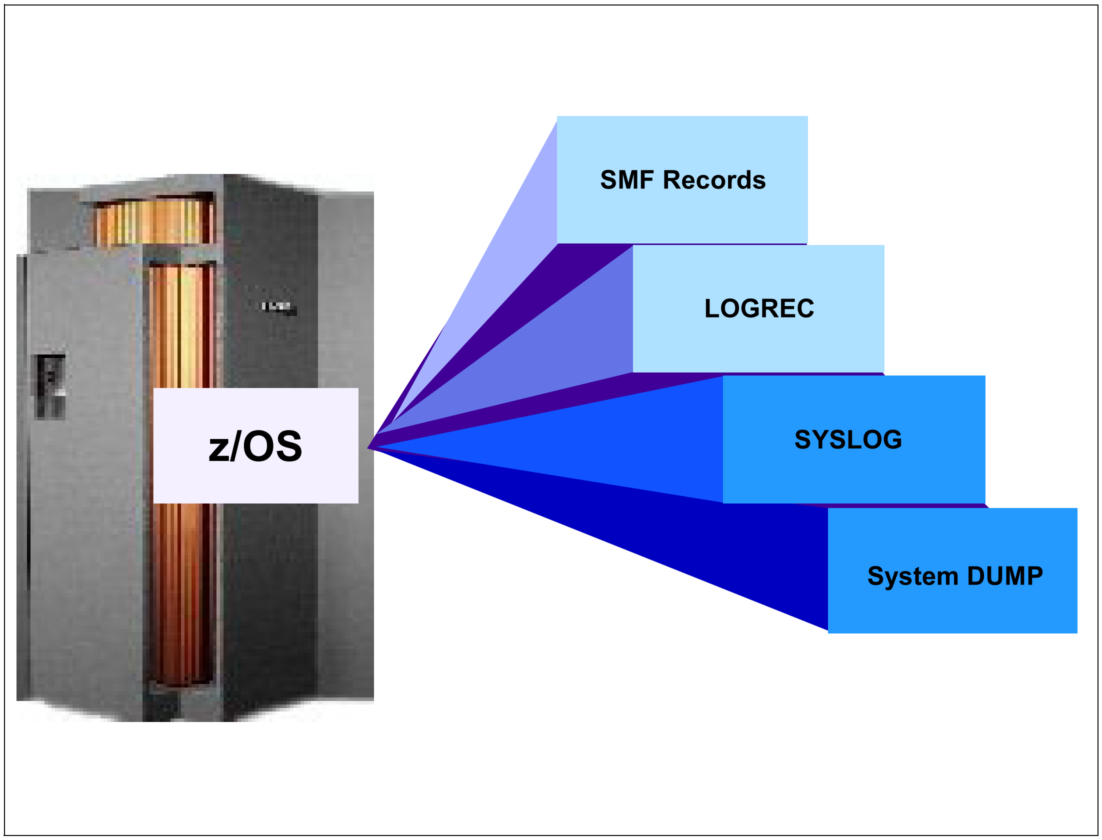


Figure 1-38 System data housekeeping

System data housekeeping

To help you manage your system properly, MVS generates lots of useful data of various types and stores them in system data sets. There are four types of system data which you will have to deal with:

- **SMF records** - The SMF records contain a variety of information that enables you to produce many types of analysis reports and summary reports so that you can evaluate changes in configuration, workload, or job scheduling procedures by studying the trends in the data.

  You can also use SMF data to determine system resources wasted because of problems such as inefficient operational procedures or programming conventions.

- **LOGREC data** - The LOGREC data set contains statistical data about machine failures (processor failures, I/O device errors, channel errors). It also contains records for program error recording, missing interrupt information, and dynamic device reconfiguration (DDR) routines.
- **SYSLOG data** - This data set resides in JES2's spool space. It can be used by application and system programmers to record communications about problem programs and system functions. It also contains a record of console messages and operator commands for audit and diagnosis purposes.
- **System DUMP data sets** - These are sequential data sets which contain system dumps that record areas of virtual storage in case of system task failures.

1.39 SMF data

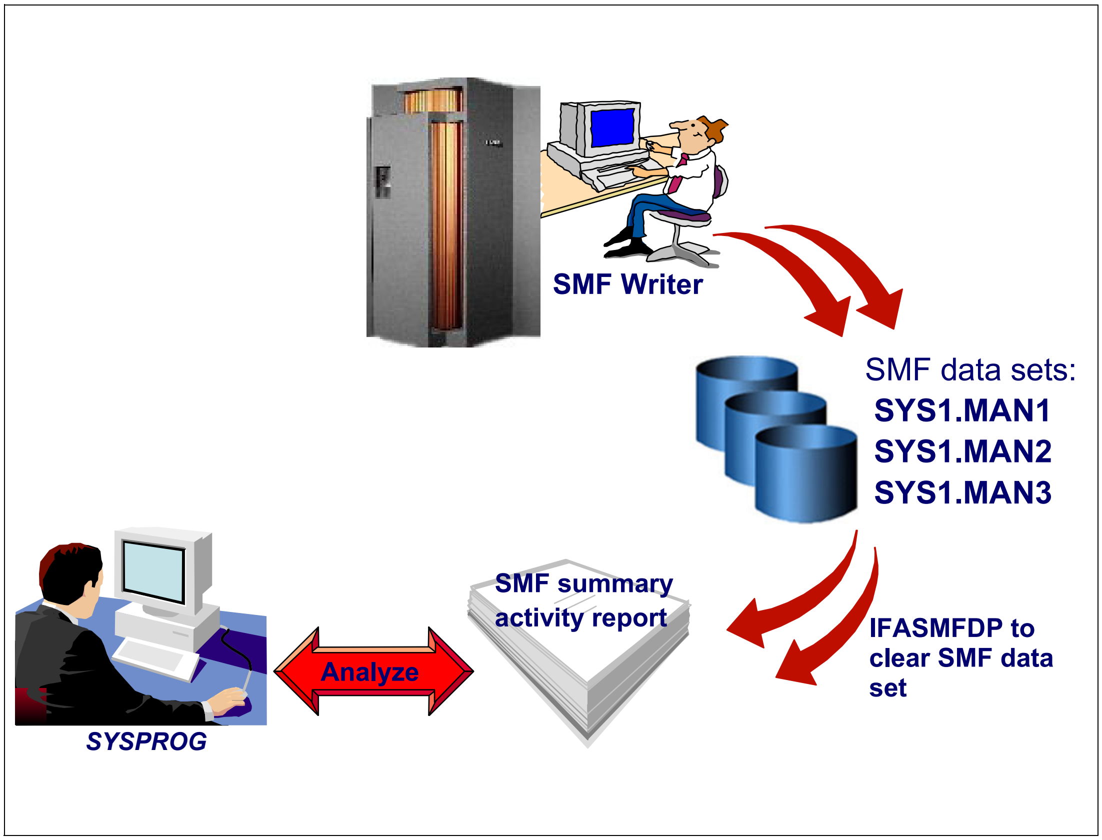


Figure 1-39 Collecting SMF data

How to collect SMF data

To record SMF data, you have to allocate direct access space and catalog the SMF data sets. You should allocate at least two data sets for SMF use (with at least one on a high-performance device), as follows:

1. A high-performance device is needed because, if the I/O rate is too slow, data will have to be buffered. The buffers will eventually fill up, which could result in lost data.
2. Consider the following factors when determining which device type to specify when allocating SMF data sets:
   - Your system configuration
   - The amount of SMF data to be written
   - The size of SMF buffers (the control interval size)
   - Your installation's report program requirement

The naming convention used for SMF data sets is SYS1.MANx, such as SYS1.MAN1, SYS1.MAN2, SYS1.MAN3, and so forth. You can use the sample JCL, as follows, to allocate new SMF data sets.

```
//DEFINE  JOB (),'MVSSP',NOTIFY=&SYSUID,CLASS=A,MSGLEVEL=(1,1),
//          MSGCLASS=X
//STEP1    EXEC  PGM=IDCAMS
//SYSPRINT DD SYSOUT=*
//SYSIN    DD *
DEFINE CLUSTER( -
    CONTROLINTERVALSIZE(4096) -
    CYLINDERS(40) -
    NAME(SYS1.MAN1) -
    NONINDEXED -
    RECORDSIZE(4086,32767) -
    REUSE -
    SHAREOPTIONS(2) -
    SPANNED -
    SPEED -
    VOLUME(MTCAT1) ) -
  DATA( -
    NAME(SYS1.MAN1.DATA) )
/*
```

1.40 SMFPRMxx parmlib member

```
ACTIVE                         /*ACTIVE SMF RECORDING*/
 DSNAME(SYS1.MAN1,             /*SMF DATA SET NAMES*/
        SYS1.MAN2,             /*SMF DATA SET NAMES*/
        SYS1.MAN3)             /*SMF DATA SET NAMES*/
 NOPROMPT                      /*DON'T PROMPT THE OPERATOR*/
 REC(PERM)                     /*TYPE 17 PERM RECORDS ONLY*/
 INTVAL(10)                   /* INTERVAL RECORDING EVERY 10 MIN */
 MAXDORM(3000)                /* WRITE AN IDLE BUFFER AFTER 30 MIN*/
 STATUS(010000)               /* WRITE SMF STATS AFTER 1 HOUR*/
 JWT(2400)                    /* 522 AFTER 24 HOURS   */
 SID(&SYSNAME(1:4))           /* SYSTEM ID IS &SYSNAME  */
 LISTDSN                      /* LIST DATA SET STATUS AT IPL*/
 LASTDS(MSG)                  /*DEFAULT TO MESSAGE          */
 NOBUFFS(MSG)                 /*DEFAULT TO MESSAGE          */
 SYS(TYPE(0,6,7,15,17,21,26,30,43,45,61,64,65,66,70:79,80,81,110),
     EXITS(IEFU83,IEFU84,IEFACTRT,IEFUJV,
           IEFUSI,IEFUJI,IEFUTL,IEFU29),NOINTERVAL,NODETAIL)
```

Figure 1-40 Example of an SMFPRMxx parmlib member

SMFPRMxx parmlib member

Once you have allocated all the required SMF data sets, you have to update the SMFPRMxx in SYS1.PARMLIB to reflect the new SMF data sets. In order to enable SMF recording, make sure that the first parameter in SMFPRMxx is set to ACTIVE, as shown in Figure 1-40.

To activate the new changes to SMF parameters, you can use the **SET** command to make them effective (assuming that you have added SYS1.MAN3 to SMFPRM00) as shown in the following example of issuing the **SET** command. (The notes referenced in this code are found on the following page.)

```
SET SMF=00
IEF196I IEF237I 0800 ALLOCATED TO IEFPARM
IEE252I MEMBER SMFPRM00 FOUND IN SYS1.PARMLIB
IEF196I IEF237I 0802 ALLOCATED TO SYS00004
IEE966I SYS1.MAN3 IS BEING FORMATTED 1
IEF196I IEF285I   SYS1.PARMLIB                               KEPT
IEF196I IEF285I   VOL SER NOS= MPRES1.
IEE949I 03.01.03 SMF DATA SETS 097
            NAME      VOLSER SIZE(BLKS) %FULL  STATUS
 2  P-SYS1.MAN1 MPCAT1      7200      9  ACTIVE
          S-SYS1.MAN2 MPCAT1      1800      0  ALTERNATE
          S-SYS1.MAN3 MPCAT1      1800      0  ALTERNATE
IEE536I SMF      VALUE 00 NOW IN EFFECT
```

1 SMF found that SYS1.MAN3 has not been formatted. The formatting is now taking place.

2 The name of the SMF data set preceded by a *P* indicates that it is the primary SMF data set. If the name is preceded by an *S*, the data set is a secondary SMF data set.

Types of SMF records

You can control which SMF record types are recorded by using the SYS parameter in the SMFPRMxx parmlib member. You can specify SYS(TYPE(0:255)) to record all SMF records. However, this can create considerable overhead and fill up the SMF data sets very quickly. The default SYS parameter is *SYS(NOTYPE(14:19,62:69,99)*. This collects all SMF records except the following:

- Record type 14 is written for input non-VSAM direct access, tape data sets, or VIO data sets.
- Record type 15 is written for output non-VSAM direct access, or VIO data sets.
- Record type 16 is written to record information about events and operations of the sorting program.
- Record type 17 is written when a non-temporary data set or temporary data set is scratch.
- Record type 18 is written when a non-VSAM data set is renamed.
- Record type 19 is written for a list of online devices with specific IPL time frame.
- Record types 62 to 69 are written for various VSAM data sets and catalog activities.
- Record type 99 is written by the System Resource Manager (SRM) component when running in goal mode.

For more information about the rest of SMF record types, see *z/OS MVS System Management Facilities (SMF)*, SA22-7630.

1.41 Dumping SMF data

```
//SMFCLR  JOB (),'MVSSP',NOTIFY=&SYSUID,CLASS=A,MSGLEVEL=(1,1),
//          MSGCLASS=X
//STEP1   EXEC PGM=IFASMFDP,REGION=4M
//DUMPIN   DD  DSN=SYS1.MAN1,DISP=SHR
//DUMPOUT  DD  DISP=(NEW,CATLG),DSN=SMF.ALLRECS,
//             UNIT=SYSALLDA,VOL=SER=MPDLB2,SPACE=(CYL,(30,10),RLSE),
//             DCB=(RECFM=VBS,LRECL=32760,BLKSIZE=4096)
//SYSPRINT DD  SYSOUT=*
//SYSIN    DD  *
     INDD(DUMPIN,OPTIONS(ALL))
/*
```

Figure 1-41 Dumping SMF data JCL

Dumping SMF data

When the current recording data set cannot accommodate any more records, the SMF writer routine automatically switches recording from the active SMF data set to an empty SMF data set and issues the following message regarding the full data set:

```
*IEE362A SMF ENTER DUMP FOR SYS1.MAN1 ON MPCAT1
```

You can use the sample JCL shown in the visual to dump the SMF data to a user data set and clear the SMF data set for reuse.

OPTIONS(ALL) indicates that the input data set specified in the DUMPIN DD statement is to be copied, then reset and preformatted.

Note: The output data set in the DUMPOUT DD statement should be large enough to hold one SMF data set; the minimum requirement is 30 cylinders.

Alternatively, you may code an IEFU29 exit to submit the job. The IEFU29 exit is invoked (if activated in SMFPRMxx) whenever an SMF data set switch occurs. For more information about the IEFU29 dump exit, see *z/OS MVS Installation Exits*, SA22-7593.

1.42 LOGREC data

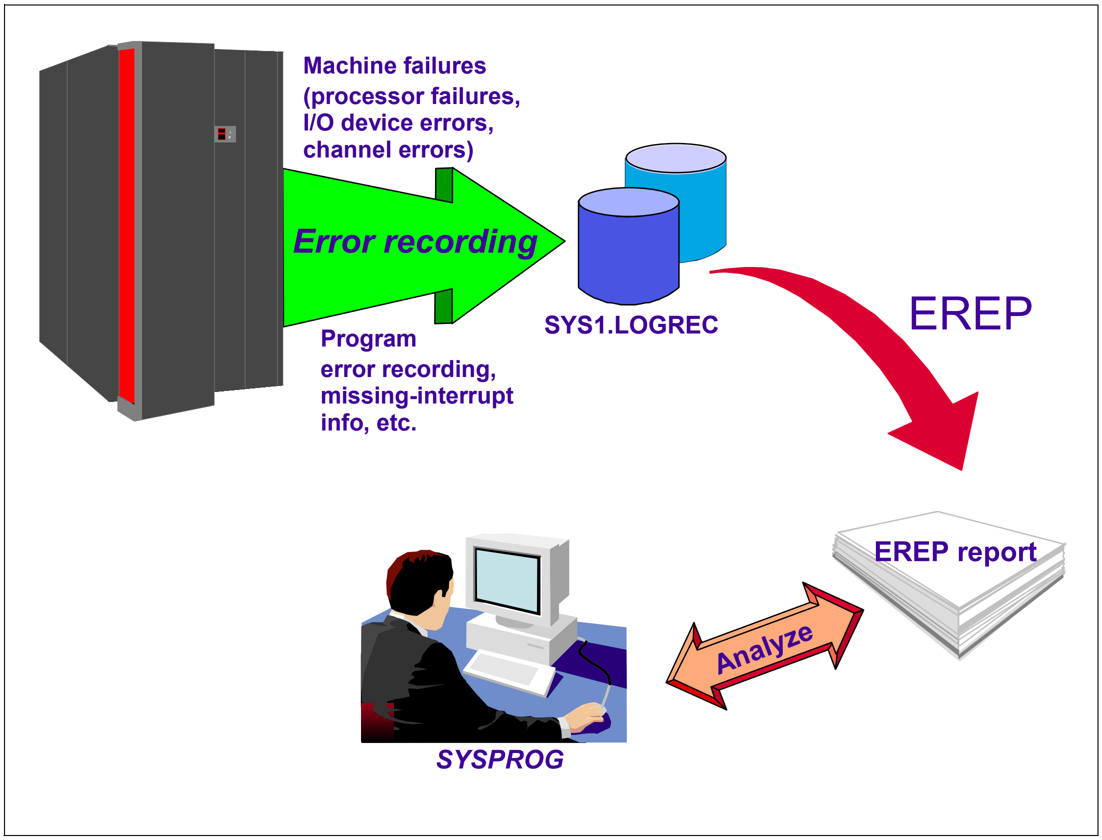


Figure 1-42 Overview of logrec processing

How to create SYS1.LOGREC

When an error occurs, the system records information about the error in the LOGREC data set. The information provides you with a history of all hardware failures, selected software errors, and selected system conditions. You can use the Environment Record, Editing, and Printing (EREP) program to:

- Print reports about the system records
- Determine the history of the system
- Learn about a particular error

Before the system can record all this information, you must first allocate the logrec data set and initialize it.

> **Note:** Whenever you allocate or reallocate the logrec data set, the newly allocated data set will not be used until you initialize it and IPL the system on which it is to be used

You can use the following sample JCL to create and initialize a new logrec data set:

```
//LOGREC  JOB (),'MVSSP',NOTIFY=&SYSUID,CLASS=A,MSGLEVEL=(1,1),
//          MSGCLASS=X
//*********************************************
//* CREATE A NEW LOGREC DATASET AND INITIALIZE IT
//*********************************************
//STEP1   EXEC PGM=IFCDIP00,COND=(4000,LT)
//SERERDS  DD UNIT=SYSDA,VOL=SER=MPRES1,SPACE=(CYL,3,,CONTIG),
//            DSN=SYS1.LOGREC,DISP=(,CATLG)
```

Note: The IBM-supplied default name for the logrec data set is SYS1.LOGREC. To change the logrec data set name known to the system, use the LOGREC parameter of the IEASYSxx parmlib member.

If you use the default name SYS1.LOGREC in a multisystem environment, take care to ensure that the logrec data set is uniquely specified with the volume-serial. This will prevent the initialization of another system's logrec data set in the event that IFCDIP00 is run on a different system.

How to clear SYS1.LOGREC

The logrec data set will eventually become full, the same as the SMF data set, and console messages appear requesting the operator to take action. Therefore, this data set needs to be cleared so that it can be reused. The process is a little different because there is only one logrec data set.

As a system programmer, you have to set up a process to clear the logrec data set when the following message appears:

```
IFB080E LOGREC DATA SET NEW FULL, DSN=SYS1.LOGREC
```

This is issued when the logrec data set becomes 90 percent full; if action is not taken and logrec fills up completely, the following message, which requires prompt action, is issued:

```
IFB081I LOGREC DATA SET IS FULL, hh.mm.ss, DSN=SYS1.LOGREC
```

At this stage, if you do not take any action, the system continues processing, but further error records will be lost. You can use the following sample JCL to clear the logrec data set:

```
//CLRLOG  JOB (),'MVSSP',NOTIFY=&SYSUID,CLASS=A,MSGLEVEL=(1,1),
//          MSGCLASS=X
//STEP    EXEC   PGM=IFCEREP1,PARM='CARD'
//SERLOG  DD  DSN=SYS1.LOGREC,DISP=OLD
//ACCDEV  DD  DSN=SYS1.LOGREC.TEMPSTOR,DISP=MOD
//TOURIST DD  SYSOUT=*
//EREPPT  DD  SYSOUT=*
//SYSIN   DD  DUMMY
     SYSUM
     ACC=Y
     ZERO=Y
```

The job will copy the logrec data set to the data set specified in the DDNAME ACCDEV, print a brief summary of logrec data, and then clear the data set. For more information about the rest of the parameters, see *Environmental Record Editing and Printing Program (EREP) Reference*, GC35-0152.

1.43 SYSLOG data

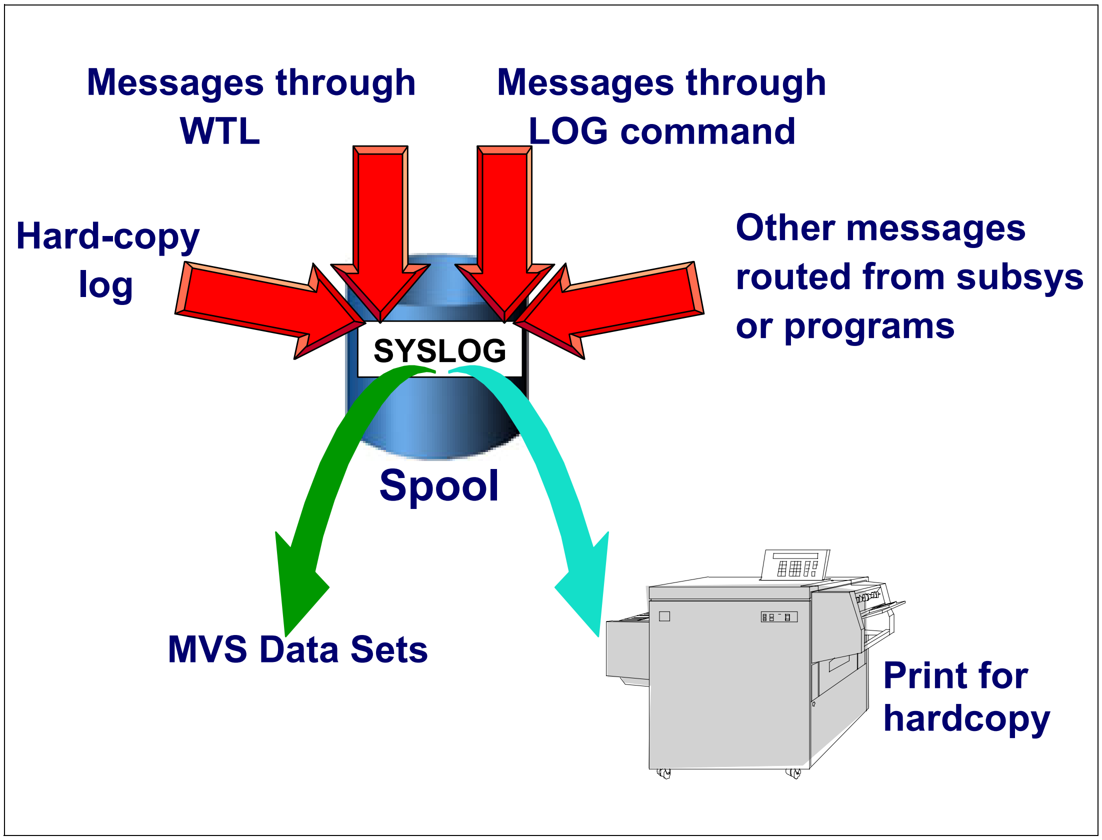


Figure 1-43 SYSLOG data

The SYSLOG

The SYSLOG on the MVS system actually consists of two separate logs: the system log and the hardcopy log. The hardcopy log is a record of all system message traffic, specifically:

- Messages to and from all consoles
- Commands and replies entered by the operator

In a JES3 system, the hardcopy log is always written to the SYSLOG. While in a JES2 system, you can choose to have the hardcopy log written to the SYSLOG or to a console printer. You can do this by specifying the HARDCOPY statement in the CONSOLxx parmlib member as shown in the HARDCOPY statement in the CONSOLxx member of parmlib in the following example:

```
HARDCOPY DEVNUM(SYSLOG,OPERLOG) 1
         ROUTCODE(ALL)
         CMDLEVEL(CMDS)
         UD(Y)
```

1 SYSLOG indicates that the system log is to be the hardcopy medium, while OPERLOG indicates that the operations log will be activated and will receive the hardcopy message set.

For more information on the HARDCOPY statement, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

Note: The system defaults to SYSLOG as the hardcopy medium in any of the following cases:

- You do not code a HARDCOPY statement.
- You specify an unusable hardcopy console.
- You specify OPERLOG alone but the operations log is unusable.

The SYSLOG is a SYSOUT data set provided by the job entry subsystem (either JES2 or JES3). SYSOUT data sets are output spool data sets on direct access storage devices (DASD). An installation should print the SYSLOG periodically to check for problems. The SYSLOG consists of the following:

- All messages issued through Write To Log (WTL) macros.
- All messages entered by the LOG operator commands.
- Usually, the hardcopy log.
- Any messages routed to the SYSLOG from any system component or program.

You can limit the maximum number of WTLs (messages) allowed for the SYSLOG at IPL time by using the LOGLMT parameter in the IEASYSxx parmlib member. The value is used by log processing to determine when the SYSLOG should be scheduled for SYSOUT processing by JES. When this value is reached, the log processing:

- Issues a simulated WRITELOG command to close and free the current SYSLOG.
- Releases the closed SYSLOG to the printer queue whose output class is specified by the LOGCLS parameter of the IEASYSxx parmlib member.
- Allocates and opens a new SYSLOG.

Example of LOGLMT and LOGCLS in IEASYSxx: LOGCLS=L, LOGLMT=99999,

In the example, the SYSLOG is scheduled for SYSOUT processing on output class L when 99,999 WTLs have been issued. For more information on LOGLMT and LOGCLS, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

Remember that the SYSLOG provides a permanent, consolidated record of all console messages and commands, that is, the event log of the system. Thus, you might want to review the SYSLOG at a later date when you are doing problem diagnosis. Instead of having the SYSLOG written to the output queue after a certain number of WTLs, you should set up a procedure to organize the SYSLOG data set depending on your installation's requirement.

You can perform your housekeeping as follows:

1. Set up a procedure to have the system operator issue the `WRITELOG` command to close and allocate a new SYSLOG at the end of each processing day. For example, `WRITELOG H`.

   Note: Class H is not a default printer class, so the SYSLOG data set is kept in the spool.

2. At the end of the week, you will have seven SYSLOG data sets in the spool. You can now decide to offload the SYSLOG to an MVS data set or route it to a printer for a hardcopy printout.
3. It's really not necessary to keep SYSLOG data sets for more than a week, so if you keep a week's worth of SYSLOG data sets, you should not have a problem.

1.44 Other administration tasks

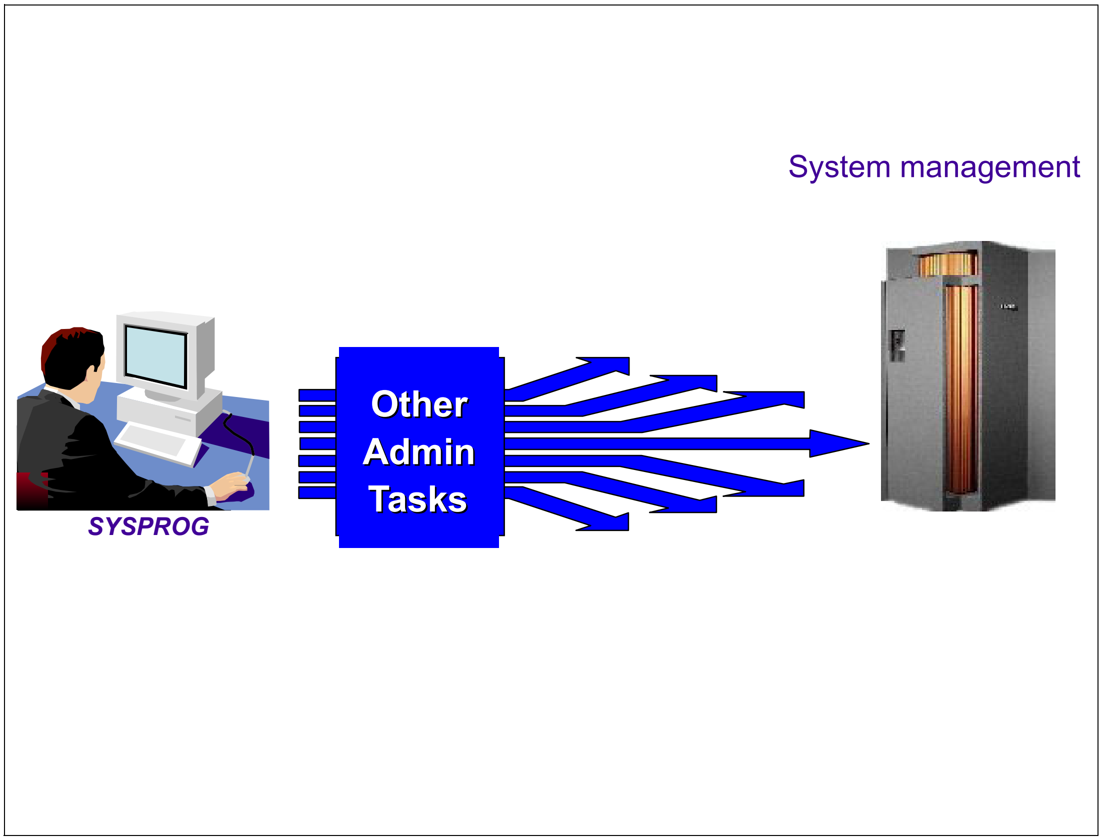


Figure 1-44 Other administration tasks for the sysprog

Other administration tasks

In the remainder of this chapter we discuss some other administrative tasks and techniques. Specifically, we show you how to:

- Work with MIH
- Add page data sets
- Change TSO timeout
- Add spool volumes
- Delete spool volumes
- Verify system configuration
- View SYSOUT using ISPF
- Change your TSO profile
- Back up and restore z/OS

1.45 Working with missing interrupt handler

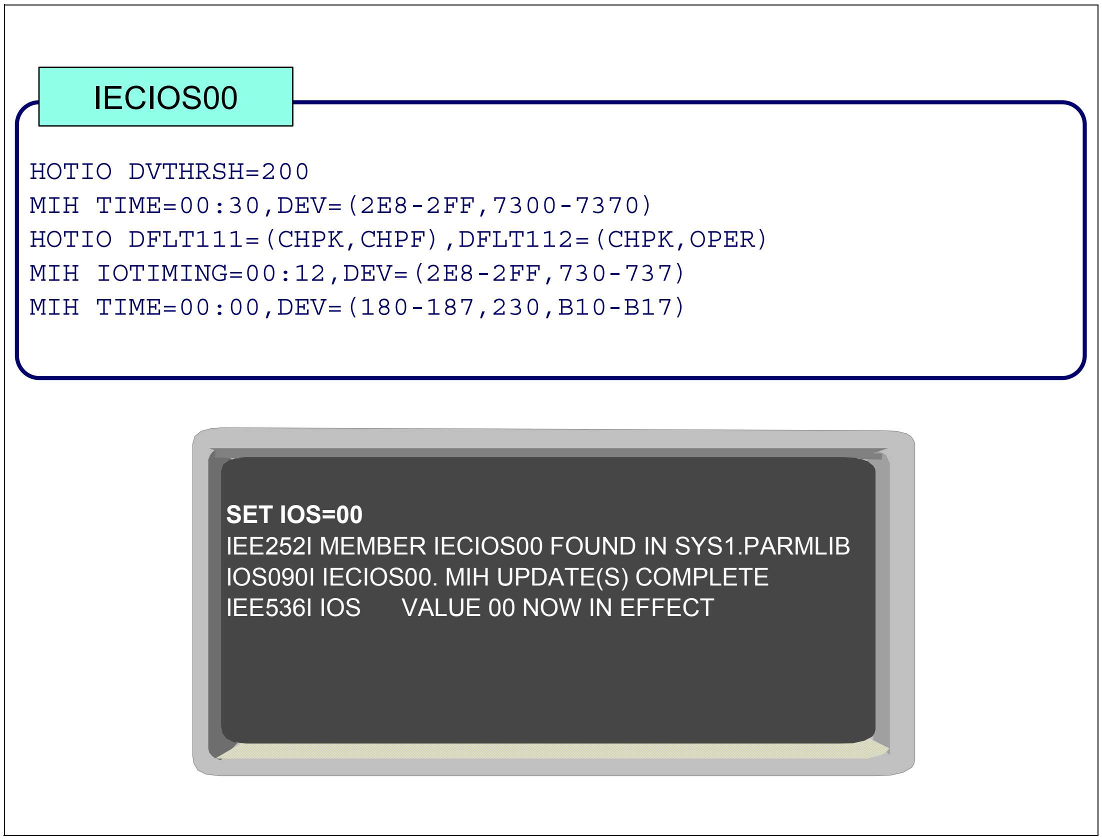


Figure 1-45 Specifying MIH parameters in parmlib

How to work with missing interrupt handler (MIH)

When z/OS sends channel commands to a control unit, it waits for a response. If no response is received after a certain amount of time, a missing interrupt situation exists. The following conditions qualify as missing interrupts if the specified time interval has elapsed:

- Primary status interrupt pending
- Secondary status interrupt pending
- Start pending condition
- Idle with work queued
- Mount pending

You can use the IECIOSxx parmlib member to specify the timing limits for devices in your system. When the value that you specify for the I/O timing limit is greater than the value that you specify for MIH, normal MIH recovery will be in effect until the I/O timing limit is reached. Once this limit is reached, the system abnormally ends the I/O request.

Hot I/O refers to a hardware malfunction that causes repeated, unsolicited I/O interrupts. If those I/O interrupts are not deleted, the system can loop or the System Queue Area (SQA) can be depleted. The I/O subsystem (IOS) tries to detect the hot I/O condition and performs recovery actions before the system requires an IPL. Recovery actions taken for a hot device depend on the type of device and its reserve status. You can use the HOTIO statement in IECIOSxx, as shown in the following example, to modify the Hot I/O Detection Table (HIDT), and to eliminate operator intervention where recovery actions defined in HIDT (by default) require the operator to respond to a message.

```
HOTIO DVTHRSH=200
MIH TIME=00:30,DEV=(2E8-2FF,7300-7370)
HOTIO DFLT111=(CHPK,CHPF),DFLT112=(CHPK,OPER)
MIH IOTIMING=00:12,DEV=(2E8-2FF,730-737)
MIH TIME=00:00,DEV=(180-187,230,B10-B17)
```

Once you have updated the IECIOSxx parmlib member, you can activate the changes using the **SET** command, as shown in the following example:

```
SET IOS=00
IEE252I MEMBER IECIOS00 FOUND IN SYS1.PARMLIB
IOS090I IECIOS00. MIH UPDATE(S) COMPLETE
IEE536I IOS      VALUE 00 NOW IN EFFECT
```

For more information on the IECIOSxx parmlib member, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

1.46 Adding a page data set

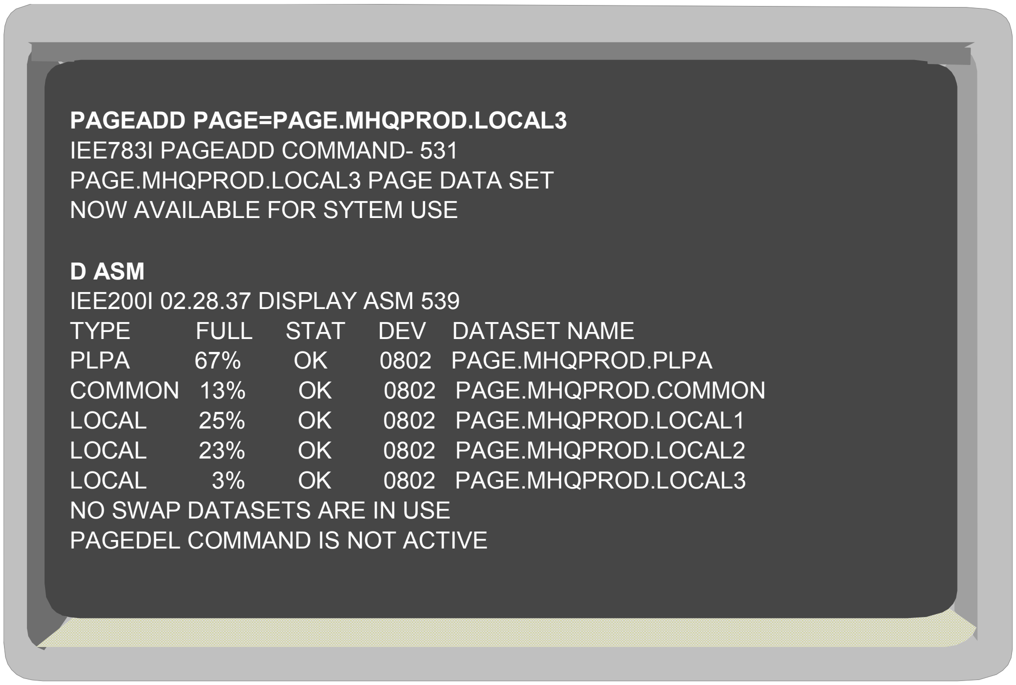


Figure 1-46 Command to add a page data set

How to add additional page data sets

z/OS can support a large amount of virtual storage by using paging data sets. Data sets named page spaces are used to contain this virtual storage. Another term often used to collectively describe these page spaces is auxiliary storage, which is managed by Auxiliary Storage Manager (ASM).

As your workload increases, you may run out of available auxiliary storage. When the system detects a shortage of available slots in the auxiliary storage paging space, meaning that 70 percent of available slots are already in use, it issues the following message:

```
IRA200E AUXILIARY STORAGE SHORTAGE
```

The system rejects **LOGON**, **MOUNT**, and **START** commands until the shortage is relieved.

If no action is taken, the system issues the following message when 90 percent of all available auxiliary storage is in use:

```
IRA201E CRITICAL AUXILIARY STORAGE SHORTAGE
```

The solution to this problem is to increase the auxiliary storage available for z/OS use by defining more page space. You can use the sample JCL that follows to define a new page data set.

```
//DEFPAGE  JOB (),'MVSSP',NOTIFY=&SYSUID,CLASS=A,MSGLEVEL=(1,1),
//          MSGCLASS=X
//STEP1    EXEC PGM=IDCAMS,COND=(4000,LT)
//SYSPRINT DD SYSOUT=*
//PAGELOC  DD UNIT=3390,VOL=SER=MPCAT1,DISP=OLD
//SYSIN    DD *
  DEFINE PAGESPACE(  -
      FILE(PAGELOC) -
      NAME(PAGE.MHQPROD.LOCAL3) -
      CYLINDERS(200) -
      VOLUME(MPCAT1) )
```

After you have successfully defined a new page data set, you can relieve the auxiliary shortage by adding the new page data set to the system as shown in the following example:

```
PAGEADD PAGE=PAGE.MHQPROD.LOCAL3
IEE783I PAGEADD COMMAND- 531
PAGE.MHQPROD.LOCAL3 PAGE DATA SET
NOW AVAILABLE FOR SYSTEM USE
```

After you have added the new page data set to the system, the system issues the following message:

```
IRA202I AUXILIARY STORAGE SHORTAGE RELIEVED
```

You can check the status of the auxiliary storage by issuing the **D ASM** command as follows:

```
D ASM
IEE200I 02.28.37 DISPLAY ASM 539
TYPE     FULL STAT   DEV  DATASET NAME
PLPA      67%   OK  0802  PAGE.MHQPROD.PLPA
COMMON    13%   OK  0802  PAGE.MHQPROD.COMMON
LOCAL     25%   OK  0802  PAGE.MHQPROD.LOCAL1
LOCAL     23%   OK  0802  PAGE.MHQPROD.LOCAL2
LOCAL      3%   OK  0802  PAGE.MHQPROD.LOCAL3
NO SWAP DATASETS ARE IN USE
```

To ensure this new page data set remains a permanent part of your z/OS system, you should update the PAGE= parameter in your IEASYSxx parmlib member to include the new page data set, as shown in the following example:

```
PAGE=(PAGE.MHQPROD.PLPA,
      PAGE.MHQPROD.COMMON,
      PAGE.MHQPROD.LOCAL1,
      PAGE.MHQPROD.LOCAL2,
      PAGE.MHQPROD.LOCAL3,L),
```

1.47 Changing TSO timeout

SMFPRMxx

```
ACTIVE                                   /* ACTIVE SMF RECORDING */
DSNAME(SYS1.MAN1,SYS1.MAN2,SYS3.MAN3)   /* SMF DATA SET NAMES   */
NOPROMPT                                 /* NO PROMPTING         */
JWT(0030)                                /* 522 AFTER 30 MINS    */
```

TSO logon proc

```
000100 //TSPROC PROC
000200 //*------This is a comment line -----------------------
000300 //TSPROC EXEC PGM=IKJEFT01,DYNAMNBR,TIME=1440
```

Figure 1-47 Changing the TSO timeout value

How to change the TSO timeout value

After a period of inactivity, TSO will automatically log a user off. This elapsed time is set in the SMFPRMxx parmlib member using the parameter JWT(hhmm), as shown in the following example where *hh* is the amount of real time in hours and *mm* is in minutes.

```
ACTIVE                          /*ACTIVE SMF RECORDING*/
  DSNAME(SYS1.MAN1,              /*SMF DATA SET NAMES*/
         SYS1.MAN2,              /*SMF DATA SET NAMES*/
         SYS1.MAN3)              /*SMF DATA SET NAMES*/
  NOPROMPT                       /*DON'T PROMPT THE OPERATOR*/
  REC(PERM)                      /*TYPE 17 PERM RECORDS ONLY*/
  INTVAL(10)                    /* INTERVAL RECORDING EVERY 10 MIN */
  MAXDORM(3000)                 /* WRITE AN IDLE BUFFER AFTER 30 MIN*/
  STATUS(010000)                /* WRITE SMF STATS AFTER 1 HOUR*/
  JWT(0030)                     /* 522 AFTER 24 HOURS   */
  SID(SC68(1:4))            /* SYSTEM ID IS SC68  */
  LISTDSN                       /* LIST DATA SET STATUS AT IPL*/
  LASTDS(MSG)                   /*DEFAULT TO MESSAGE          */
  NOBUFFS(MSG)                  /*DEFAULT TO MESSAGE          */
  SYS(TYPE(0,6,7,15,17,21,26,30,43,45,61,64,65,66,70:79,80,81,110),
      EXITS(IEFU83,IEFU84,IEFACTRT,IEFUJV,
            IEFUSI,IEFUJI,IEFUTL,IEFU29),NOINTERVAL,NODETAIL)
```

In the example, a user is forced off after 30 minutes of no activity. You can edit this PARMLIB member and change this value. You can set this new value by using the **SET** operator command:

```
SET SMF=00
```

Note: There is a possibility that TSO users are not being timed out when the value specified in the JWT parameter has expired. This usually happens when TIME=1440 is specified in the TSO logon procedure that the users used to log on to the system.

```
//TSPROC PROC
//TSPROC EXEC PGM=IKJEFT01,DYNAMNBR=256,TIME=1440
```

The TIME=1440 is a special value that will:

- Allow the particular job to run for an unlimited amount of time
- Ignore the JWT parameter in SMFPRMxx parmlib member for the job

1.48 Adding spool volumes in JES2

JES2 PARM

```
SPOOLDEF BUFSIZE=3856,
         DSNAME=SYS1.MHQPROD.HASPACE,
         FENCE=NO,
         SPOOLNUM=32,
         TGBPERVL=5,
         TGSIZE=33,
         TGSPACE=(MAX=16288,
                  WARN=80),
         TRKCELL=3,
         VOLUME=MPSPL
```

$S SPL

```
$S SPL(MPCAT2)
$HASP893 VOLUME(MPCAT2)  STATUS=INACTIVE,COMMAND=(START)
$HASP646 16.9066 PERCENT SPOOL UTILIZATION
IEF196I IEF237I 0805 ALLOCATED TO $MPCAT2
IEF196I $HASP423 MPCAT2 IS BEING FORMATTED
```

Figure 1-48 Adding spool volumes in a JES2 system

How to add spool volumes

The spool is the repository for all input jobs and most system out (SYSOUT) that JES2 manages. Due to fluctuating workload requirements, such as I/O errors, hardware failures, or utilization needs, you might need to add spool packs.

Spool volumes are added either at cold start or dynamically through the use of the operator command **$S SPL**. You can define a maximum of 253 spool volumes to JES2 at any one time.

To define the spool volumes during JES2 startup, use the SPOOLDEF statement in the JES2 PARM. The SPOOLDEF statement that follows is an example of SPOOLDEF statement in the JES2 PARM. (Notes® referenced in the code are on the following page.)

```
SPOOLDEF BUFSIZE=3856,       /* MAXIMUM BUFFER SIZE     &BUFSIZE     c*/
         DSNAME=SYS1.MHQPROD.HASPACE, 1
         FENCE=NO,           /* Don't Force to Min.Vol. &FENCE      oc*/
         SPOOLNUM=32 2, /* Max. Num. Spool Vols     c*/
         TGBPERVL=5,         /* Track Groups per volume in BLOB   ownc*/
         TGSIZE=33,          /* 30 BUFFERS/TRACK GROUP  &TGSIZE    wnc*/
         TGSPACE=(MAX=16288, /* Fits TGMs into 4K Page  &NUMTG=(,    c*/
                  WARN=80),  /*                       &NUMTG=(,%   onc*/
         TRKCELL=3,          /* 3 Buffers/Track-cell    &TCELSIZ     c*/
         VOLUME=MPSPL 3      /* SPOOL VOLUME SERIAL   &SPOOL     c*/
```

1 The JES2 spool data set name.

2 This specifies the maximum number of spool volumes which can be defined at any one time.

3 Specifies the four- to five-character prefix assigned to JES2's spool volumes. The first four to five characters of the volume serial must be identical to the character specified by this parameter. Those volumes beginning with this prefix and a data set named the same as the DSNAME specification are considered JES2 volumes.

> **Note:** If the maximum of 253 spool volumes is exceeded during a cold start, JES2 issues a message informing the operator that more spool volumes were found than expected from the SPOOLNUM parameter on the SPOOLDEF initialization statement.

As mentioned, you can also add spool volumes dynamically by using operator command, **$S SPL** as shown in the following example:

```
$S SPL(MPCAT2)
$HASP893 VOLUME(MPCAT2)  STATUS=INACTIVE,COMMAND=(START)
$HASP646 16.9066 PERCENT SPOOL UTILIZATION
IEF196I IEF237I 0805 ALLOCATED TO $MPCAT2
IEF196I $HASP423 MPCAT2 IS BEING FORMATTED
$HASP423 MPCAT2 IS BEING FORMATTED
$HASP850 3750 TRACK GROUPS ON MPCAT1
$HASP850 586 TRACK GROUPS ON MPCAT2
$HASP851    28232 TOTAL TRACK GROUPS MAY BE ADDED
$HASP630 VOLUME MPCAT2 ACTIVE     0 PERCENT UTILIZATION
```

> **Note:** If the dynamic addition of another spool volume is attempted (thereby exceeding the maximum of 253 spool volumes), the command will be ignored, the volume will not be added, and the message $HASP411 will be issued to the operator.

You can now display the status and the percentage utilization of all spool volumes using the operator command, **$D SPL** as shown in the following example:

```
$DSPL
$HASP893 VOLUME(MPCAT1)  STATUS=ACTIVE,PERCENT=16
$HASP893 VOLUME(MPCAT2)  STATUS=ACTIVE,PERCENT=0
$HASP646 14.7370 PERCENT SPOOL UTILIZATION
```

1.49 Deletion of spool volumes in JES2

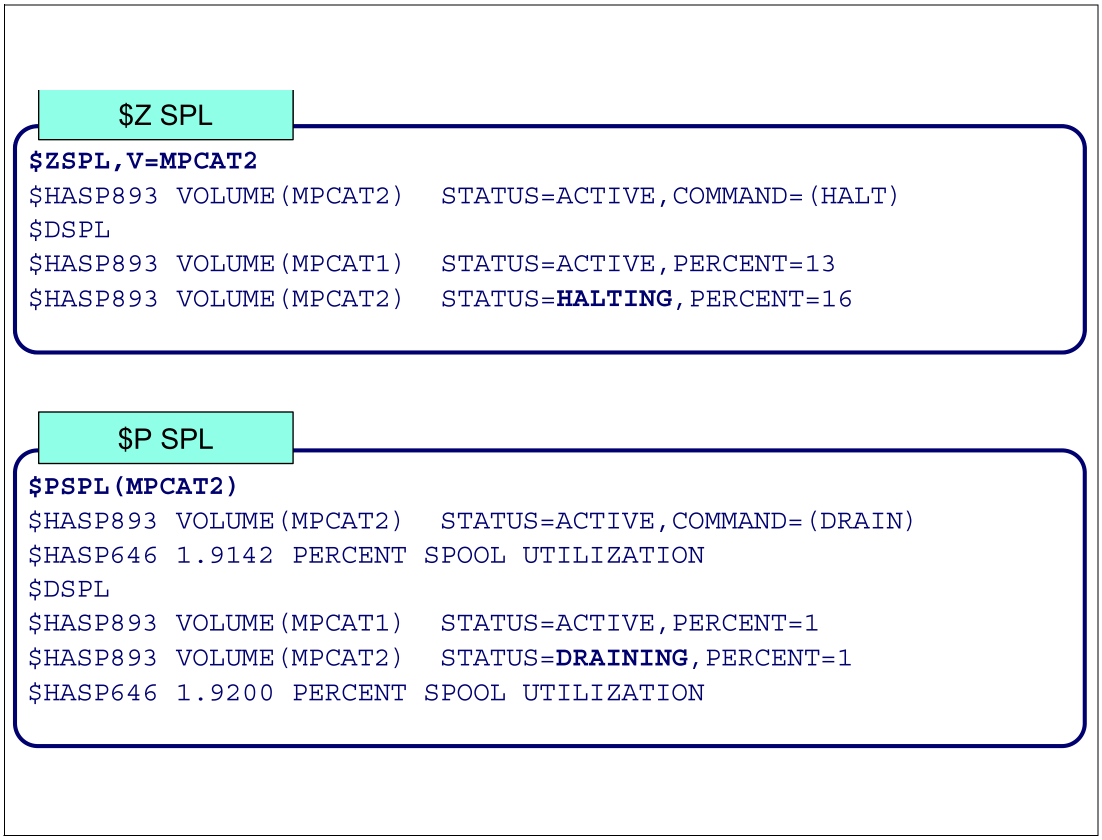


Figure 1-49 Deleting spool volumes in a JES2 system

How to delete spool volumes

Spool volumes can be deleted dynamically as needed to meet your installation's requirements, using the operator commands:

- `$Z SPL`
- `$P SPL`

Some considerations must be recognized and precautions must be taken to prevent improper usage of the spool volume deletion commands, specifically:

- If the volume being deleted (halted or drained) contains spooled or remote messages or the JESNEWS data set, these items are automatically moved to another volume.

> **Note:** This process may take some time because spooled remote messages and SYSOUT are only moved from the draining volume when they become the lowest-numbered job on the volume.

- If there are no active volumes available for these data sets, the deletion process will not complete until an active volume is available to accept them.

You use the `$Z SPL` command to halt an active spool volume. When you issue the `$Z` command, no new work is allowed to start and no new space on the volume is allocated. Any currently allocated space remains intact and the volume can be removed without the loss of work.

The volume status is HALTING until all currently active jobs which have space allocated on the volume are completed. After that the status of the volume changes to INACTIVE. System response to the **$Z** command is shown in the following example:

```
$ZSPL,V=MPCAT2
$HASP893 VOLUME(MPCAT2)  STATUS=ACTIVE 1,COMMAND=(HALT)
$DSPL 2
$HASP893 VOLUME(MPCAT1)  STATUS=ACTIVE,PERCENT=13
$HASP893 VOLUME(MPCAT2)  STATUS=HALTING 3,PERCENT=16
$HASP646 13.7066 PERCENT SPOOL UTILIZATION
        .
        .
        .
$HASP395 LSTDDF   ENDED
$HASP309 INIT B    INACTIVE ******** C=GA
IEF196I IEF285I   SYS1.MHQPROD.HASPACE                         KEPT
IEF196I IEF285I   VOL SER NOS= MPCAT2.
$HASP630 VOLUME MPCAT2 INACTIVE 4  16 PERCENT UTILIZATION
```

1 The initial status of the spool volume, MPCAT2 was ACTIVE.

2 To display the status of spool volumes, you used the **$DSPL** command.

3 After the **$Z** command was issued, the status changed to HALTING.

4 When the job (LSTDDF) ends, the status of the spool volume (MPCAT2) changed to INACTIVE.

To drain and delete an entire spool volume, you can use the **$P SPL** operator command. The command prevents any available tracks on the draining spool volume from being selected for allocation. Until all jobs currently allocated to the volume have completed all phases of job processing, the volume is considered to have a status of draining. The spool volume is drained when no allocated spool space remains on that volume, and the volume is unallocated to all systems in the multi-access spool complex.

Note: Once the spool volume is drained, JES2 does not retain any information concerning that volume. Therefore, you cannot display any information about the volume.

The following example shows the system response when you issue the **$P SPL** command when an active job is running:

```
$PSPL(MPCAT2)
$HASP893 VOLUME(MPCAT2)  STATUS=ACTIVE 1,COMMAND=(DRAIN)
$HASP646 1.9142 PERCENT SPOOL UTILIZATION
$DSPL
$HASP893 VOLUME(MPCAT1)  STATUS=ACTIVE,PERCENT=1
$HASP893 VOLUME(MPCAT2)  STATUS=DRAINING 2,PERCENT=1
$HASP646 1.9200 PERCENT SPOOL UTILIZATION
```

1 The initial status of the spool volume to be drained.

2 After the **$PSPL(MPCAT2)** command was issued, the status of the spool volume (MPCAT2) changed to DRAINING.

If you want to cancel and deallocate all cancellable jobs on the drained spool volume, you can use the CANCEL operand together with the **$P SPL** command. All jobs and SYSOUT will be deleted from the volume; any spooled remote messages and the JESNEWS data set (if present) are automatically moved to another active spool volume.

Note: The **$P SPL,CANCEL** command can also be used to drain an inactive volume, purging all jobs allocated to it. However, this can result in lost track groups on other volumes. You can recover any lost space by doing an all-member warm start, or the JES2 automatic spool reclamation function will also recover them within one week, whichever occurs first. You can prevent the loss of spool space by using the **$S SPL,P,CANCEL** command only if the spool volume can be remounted.

An example of the **$ SPL,P,CANCEL** command is shown, as follows:

```
$SSPL(MPCAT2),P,CANCEL 1
$HASP893 VOLUME(MPCAT2)  STATUS=DRAINING,COMMAND=(START,DRAIN)
$HASP646 7.1200 PERCENT SPOOL UTILIZATION
        .
        .
        .
IEF196I IEF285I   SYS1.MHQPROD.HASPACE                         KEPT
IEF196I IEF285I   VOL SER NOS= MPCAT2.
$HASP806 VOLUME MPCAT2 DRAINED 2
```

1 The command will fail with the message: `REQUEST INVALID DUE TO ACTIVE STATUS` if the spool volume is not in the DRAINING status.

2 At the successful completion of the command the status of the spool changed to DRAINED, which indicates you can no longer display any information about the volume.

Note: If all the spool volumes are deleted, JES2 will not be capable of performing any work. Hence, be very careful when you delete any spool volumes.

For more information on the use and syntax of the spool configuration commands, see *z/OS JES2 Commands*, SA22-7526.

1.50 Verifying the system configuration

CONFIGxx

```
* CHP AND DEV STATEMENTS GENERATED BY
* BUILD CONFIGXX REPLACE REQUEST
* 2002-08-10  07:31:54    IODF: SYS6.IODF6F
* PROCESSOR: SCZP801   PARTITION: A9        OS CONFIGURATION ID:
L06RMVS1
CHP (08,09,0A,0B,0C,0D,0E,0F,10,11,12,13,14),ONLINE
CHP (15,16,17,18,19,1B,1C,1D,1E,20,21,22,23),ONLINE
CHP (24),OFFLINE
CHP (25,27,28,29,2A,2B,2C,2D,2E,2F,31,32,33),ONLINE
CHP (34,35,36,37,38,39,3A,3D,3E,3F,40,41,42),ONLINE
CHP (43,44,46,48,49,4A,4B,4C,4D,4E,4F,50,51),ONLINE
CHP (52,53,54,55,56,57,58,59,5A,5B,5C,5D,5E),ONLINE
CHP (5F,60,61,EC,ED,EE,EF,FC,FD,FE,FF),ONLINE
DEVICE (001A),(1E,54),ONLINE
DEVICE (001B),(34,35),ONLINE
DEVICE (001C),(29,39),ONLINE
DEVICE (001D),(21,2C),ONLINE
DEVICE (001E),(20,4A),ONLINE
DEVICE (001F),(2B,33,4B),ONLINE
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

Figure 1-50 Verifying the system configuration

How to verify the system configuration

When you start an HCD session, you need to specify the IODF that HCD is to use. Before you can activate your configuration, you must build a production IODF. The IODF data sets must be cataloged so that you can use them with HCD.

The CONFIGxx parmlib member is a list of records that an installation can use to define a standard configuration of system elements. The system elements include the processors, the expanded storage, vector facilities, storage, channel paths, devices, and volumes. You can use the configuration defined in CONFIGxx in two ways:

- To compare the differences between the current configuration and the standard configuration as defined in a CONFIGxx member. To do that, use the **DISPLAY M=CONFIG(xx)** operator command.
- To reconfigure some of the system elements by using the **CONFIG** operator command with the MEMBER option.

You can create a CONFIGxx parmlib member manually, as described in the *z/OS MVS Initialization and Tuning Reference*, SA22-7592; or through the *Build CONFIGxx member* option using Hardware Configuration Definition (HCD).

1.51 HCD primary panel

```
                                 z/OS V1.4 HCD
 Command ===> ______________________________________________________
 (C) Copyright IBM Corp. 1990, 2003. All rights reserved.
                             Hardware Configuration

 Select one of the following.

 2_   1.  Define, modify, or view configuration data
      2.  Activate or process configuration data
      3.  Print or compare configuration data
      4.  Create or view graphical configuration report
      5.  Migrate configuration data
      6.  Maintain I/O definition files
      7.  Query supported hardware and installed UIMs
      8.  Getting started with this dialog
      9.  What's new in this release

 For options 1 to 5, specify the name of the IODF to be used.

 I/O definition file . . . 'SYS1.IODF00.WORK'                     +
```

Figure 1-51 Select Option 2 to activate or process configuration data

To build the CONFIGxx using HCD, follow these steps:

1. From the Hardware Configuration panel, select Option 2, Activate or process configuration data, as shown in Figure 1-51.

   Remember to specify your production I/O definition file (IODF).

1.52 HCD activate or process configuration data

```
                         z/OS V1.4 HCD
 ┌───── Activate or Process Configuration Data ─────┐
 │                                                     │
 │                                                     │
 │ Select one of the following tasks.                  │
 │                                                     │
 │ 6_  1.  Build production I/O definition file        │
 │     2.  Build IOCDS                                 │
 │     3.  Build IOCP input data set                   │
 │     4.  Create JES3 initialization stream data      │
 │     5.  View active configuration                   │
 │     6.  Activate or verify configuration            │
 │         dynamically                                 │
 │     7.  Activate configuration sysplex-wide         │
 │     8.  Activate switch configuration               │
 │     9.  Save switch configuration                   │
 │     10. Build I/O configuration statements          │
 │     11. Build and manage S/390 microprocessor       │
 │         IOCDSs and IPL attributes                   │
 │     12. Build validated work I/O definition file    │
 │                                                     │
 │  F1=Help     F2=Split     F3=Exit     F9=Swap       │
 │ F12=Cancel                                          │
 └─────────────────────────────────────────────────────┘
```

Figure 1-52 Select Option 6 to activate or verify configuration dynamically

2. Select Option 6, Activate or verify configuration dynamically.

   For the verify function on the Activate or Verify Configuration panel to be available, the processor configuration from which the active IOCDS was built must match the configuration in the IODF used for IPL (token match).

   The system programmer (or other authorized persons) can use the option Activate or verify configuration dynamically, or the `ACTIVATE` operator command, to make changes to a running configuration. That is, the possibility is offered to change from a currently active configuration to some other configuration that is to be made active without the need to POR or IPL the system again.

   When activating a configuration dynamically, HCD compares the currently active IODF with the IODF that is to be activated and then processes the difference.

   For the IODF that is to be activated, HCD uses the production IODF that is currently in use with the dialog. Use the same high-level qualifier for the currently active IODF and the IODF to be activated.

   z/OS Hardware Configuration Definition Planning, GA22-7525 gives a detailed description of how to dynamically activate a configuration. It describes the prerequisites for a dynamic activation, explains when hardware and software changes or software-only changes are allowed, and describes the actions necessary to change your I/O configuration dynamically.

1.53 Activate or verify configuration

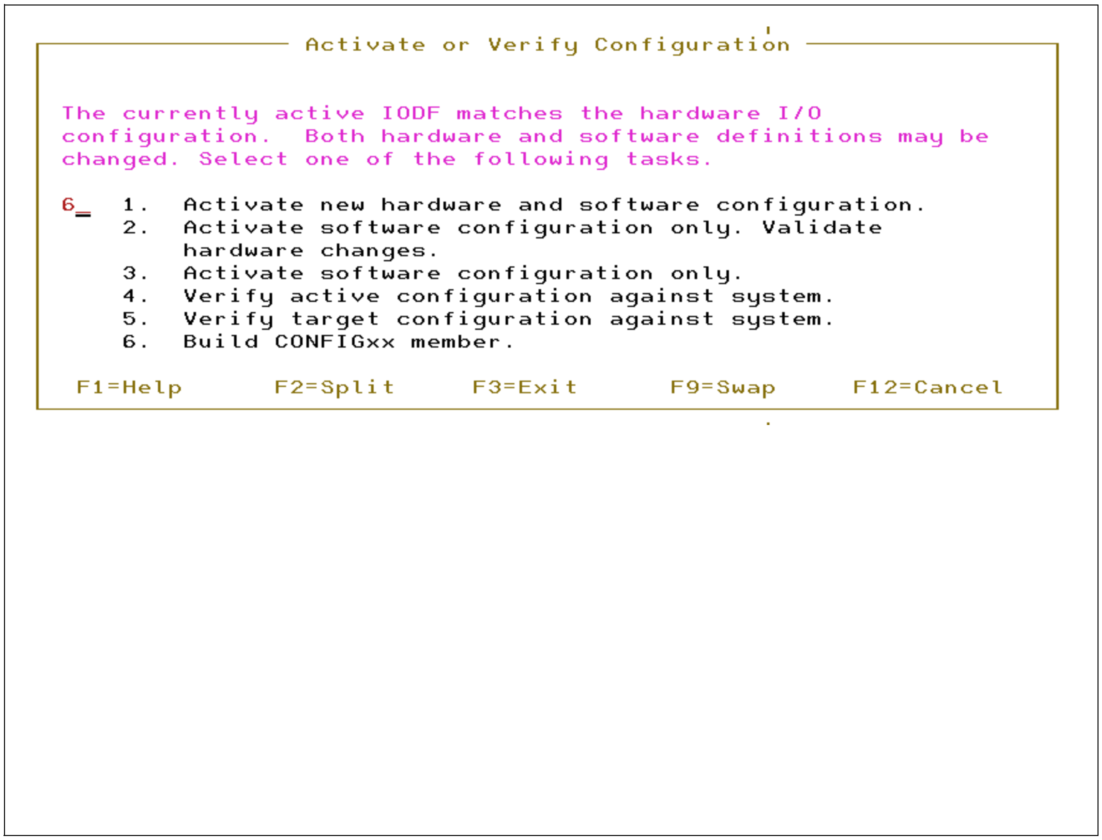


Figure 1-53 Activate or verify configuration panel

3. Specify the system that you want your CONFIGxx member to build from. A CONFIGxx member can be built by:
   a. Selecting the Build CONFIGxx member action from the Activate or Verify Configuration panel (for the local system)
   b. Selecting the Build CONFIGxx member action from the Active Sysplex Member panel (for a system in a sysplex)
   c. Using a batch utility

1.54 Identify system I/O configuration

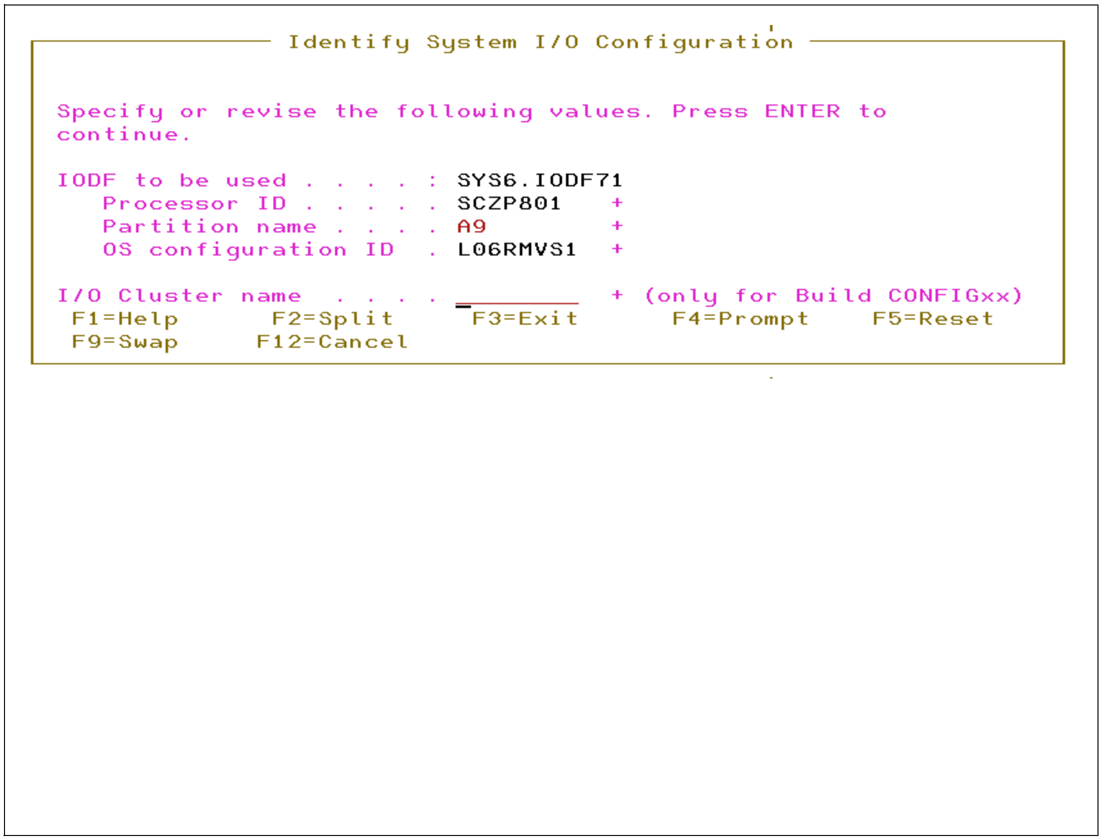


Figure 1-54 Identify system I/O configuration panel

After selecting Build CONFIG member, the Identify System I/O Configuration panel is displayed (Figure 1-54). After selecting a system, and an I/O cluster name for managed channel paths, the Restrict Ports Eligible for Dynamic CHPID Management panel is displayed if the configuration contains managed channel paths for the selected I/O cluster. This panel shows all control units known by the selected system and manageable by DCM, and their switch ports set to eligible for DCM (indicated by a `Y`). You can specify ports as ineligible for DCM by overtyping `Y` with `N`.

4. Complete the process by specifying the partitioned data set that will contain CONFIGxx and the suffix of the CONFIGxx.

1.55 Build CONFIGxx Member panel

```
                          Build CONFIGxx Member

 Specify or revise the values for the CONFIGxx member. Press ENTER to
 continue.

 Partitioned data set name . _______________________________________________
 Suffix of CONFIGxx member . __

 Volume serial number  . . . ______  + (if data set not cataloged)
  F1=Help     F2=Split    F3=Exit     F4=Prompt   F5=Reset    F9=Swap
 F12=Cancel
```

Figure 1-55 Build CONFIGxx Member panel

The initial value for the partitioned data set name is SYS1.PARMLIB.

- Specify the CONFIGxx member suffix.

If the specified CONFIGxx member already exists, the Confirm Update CONFIGxx Member panel is displayed.

> **Note:** It is recommended that you update the corresponding CONFIGxx member to reflect changes that you have made, especially after any dynamic changes to the system elements.

1.56 Creating CONFIGxx member in batch

```
//BCONFG    JOB (),'MVSSP', NOTIFY=&SYSUID,CLASS=A,
//                    MSGLEVEL=(1,1), MSGCLASS=X
//BUILD         EXEC  PGM=CBDMGHCP,
//               PARM='CONFIG,XX,00,SCZP601,A1,L06RMVS1,R,BACK00'   1
//HCDIODFS  DD  DSN=SYS6.IODF71,DISP=OLD                        2
//HCDDECK   DD  DSN=SYS1.PARMLIB,DISP=SHR                      3
//HCDMLOG   DD  DSN=TAYYF.HCD.MSGLOG,DISP=SHR
//HCDTRACE DD  DSN=TAYFF.HCD.TRACE,DISP=SHR
```

```
D M=CONFIG
```

Figure 1-56 Creating a CONFIGxx member using a batch job

Creating CONFIGxx member in batch

You can also use a batch job to create the CONFIGxx member. The JCL in Figure 1-56 is a sample to accomplish the task. The following notes apply to this code:

1. This parameter creates a CONFIG00 member with the Processor ID (SCZP601), Partition ID (A1) and OS configuration ID (L06RMVS1).
2. This specifies the Source IODF.
3. This specifies the output partitioned data set for CONFIGxx.

For more information, see *z/OS Hardware Configuration Definition User's Guide*, SC33-7988.

When you issue the **`DISPLAY M=CONFIG(xx)`** operator command, the system displays the differences between the current configuration and the configuration described in the CONFIGxx parmlib member. The default suffix of the CONFIGxx is 00.

If the existing configuration matches the one specified in the CONFIGxx, the following message is shown:

```
D M=CONFIG
IEF196I IEF237I OFC0 ALLOCATED TO SYS00118
IEE252I MEMBER CONFIG00 FOUND IN SYS1.PARMLIB
IEE097I 11.07.34 DEVIATION STATUS 633
               FROM MEMBER CONFIG00
        NO DEVIATION FROM REQUESTED CONFIGURATION
```

On the other hand, if there is any mismatch between the existing configuration and that defined in the CONFIGxx, the following message is shown (note that this is only an example, you might receive something different depending on what is deviated from in the configuration):

```
D M=CONFIG
IEE252I MEMBER CONFIG00 FOUND IN SYS1.PARMLIB
IEE097I 23.15.15 DEVIATION STATUS 663
               FROM MEMBER CONFIG00
CHP          DESIRED  ACTUAL
20           ONLINE   NOT AVAILABLE
DEVICE      DESIRED  ACTUAL
0790,95      ONLINE   OFFLINE
```

1.57 View sysout using ISPF

```
  Menu  Utilities  Help
--------------------------------------------------------------------
                               Outlist Utility
Option ===>  L

    L List job names/id(s) via the TSO STATUS command
    D Delete job output from SYSOUT hold queue
    P Print job output and delete from SYSOUT hold queue
    R Requeue job output to a new output class
blank Display job output

For Job to be selected:
   Jobname  . .
   Class  . . .
   JobID  . . .

For Job to be requeued:
   New Output class  . .
```

Figure 1-57 View the sysout using ISPF

How to view sysout using ISPF

You can use Option 3.8 from the ISPF Primary Option Menu to view the SYSOUT of your jobs, instead of SDSF.

The list jobs function is used to obtain status information on jobs in your system. To list job status, fill in the following fields of the Outlist Utility panel:

- Enter *L* in the option field.
- Optionally, enter the jobname parameter as follows:
  - If jobname is blank or consists of your user ID plus one character, status is listed for all jobs having jobnames consisting of your user ID followed by one character.

    Note: The jobname must be your user ID or start with your user ID.

  - If jobname is anything else, status is listed for the specified jobname only.

The job status information will be displayed on the lower part of the screen, as shown in Job status information in the following display. If the list is too long to fit on the screen, *** will be written as the last line. Press Enter to display the next page of data.

```
For Job to be requeued:
   New Output class  . .

JOB TAYYFB(JOB20684) ON OUTPUT QUEUE
JOB TAYYFA(JOB20683) ON OUTPUT QUEUE
JOB TAYYFC(JOB20685) ON OUTPUT QUEUE
***
```

After you have the list of your jobs in the output queue, you can display the output for a particular job by entering the Jobname or the Job ID in the appropriate place and pressing Enter. The next panel displayed will be similar to that shown in Status display for a particular job. The Job ID is useful if there are several jobs with the same job name, as follows:

```
BROWSE    TAYYF.SPF103.OUTLIST                Line 00000000 Col 001 080
Command ===>                                          Scroll ===> CSR
******************************** Top of Data ***************************
                   J E S 2  J O B  L O G  --  S Y S T E M  S C 5 2  --

13.54.38 JOB20683 ---- THURSDAY,  06 MAY 1999 ----
13.54.38 JOB20683  IRR010I  USERID TAYYF    IS ASSIGNED TO THIS JOB.
13.54.38 JOB20683  ICH70001I TAYYF    LAST ACCESS AT 13:38:05 ON THURSDA
13.54.38 JOB20683  $HASP373 TAYYFA   STARTED - INIT A    - CLASS A - SYS
13.54.38 JOB20683  IEF403I TAYYFA - STARTED - TIME=13.54.38
13.54.45 JOB20683  -                                         --TIMINGS (
13.54.45 JOB20683  -JOBNAME  STEPNAME PROCSTEP    RC   EXCP    CPU    SR
13.54.45 JOB20683  -TAYYFA            APPRSU      00   3047    .02    .0
13.54.45 JOB20683  IEF404I TAYYFA - ENDED - TIME=13.54.45
13.54.45 JOB20683  -TAYYFA   ENDED.  NAME-MVSSP               TOTAL CPU
13.54.45 JOB20683  $HASP395 TAYYFA   ENDED
```

You can also use the requeue job output function to change output from a held SYSOUT queue to some other output class. It is typically used to print the output by directing it to a non-held output class. (Use the list job option if you wish to obtain the names and IDs of currently held jobs.) To requeue job output, fill in the following fields of the Outlist Utility panel:

- Enter R in the option field.
- Enter the job name.
- Enter the class to specify the held SYSOUT queue (which currently contains the job output).
- Enter the job ID if duplicate jobnames exist in the held SYSOUT queue (otherwise, omit).
- Enter the new output class to specify the output class into which the held output will be requeued.

1.58 Changing your TSO profile

```
 READY
profile
 CHAR(0)  LINE(0)    PROMPT   INTERCOM   NOPAUSE NOMSGID MODE    WTPMSG
NORECOVER PREFIX(TAYYF)   PLANGUAGE(ENU) SLANGUAGE(ENU)
 DEFAULT LINE/CHARACTER DELETE CHARACTERS IN EFFECT FOR THIS TERMINAL
 READY
profile noprefix
 READY
profile
 CHAR(0)  LINE(0)    PROMPT   INTERCOM   NOPAUSE NOMSGID MODE    WTPMSG
NORECOVER NOPREFIX        PLANGUAGE(ENU) SLANGUAGE(ENU)
 DEFAULT LINE/CHARACTER DELETE CHARACTERS IN EFFECT FOR THIS TERMINAL
 READY
```

Figure 1-58 Changing your TSO profile

How to change your TSO user profile

Your user profile defines how you want the system to respond to information sent to or from your terminal. The typical user profile is defined by default values of the **PROFILE** command's operands. You can use the **PROFILE** command to display or change your user profile

You can enter the **PROFILE** command from a TSO prompt (either a READY prompt, or Option 6, ISPF Command Shell in ISPF). You can also enter the **PROFILE** command in the command line of any ISPF panel by prefixing the command with TSO:

```
TSO PROFILE
```

An example of the profile is:

```
CHAR(0) LINE(0) PROMPT INTERCOM NOPAUSE NOMSGID MODE WTPMSG NORECOVER
PREFIX(TAYYF) PLANGUAGE(ENU) SLANGUAGE(ENU)
DEFAULT LINE/CHARACTER DELETE CHARACTERS IN EFFECT FOR THIS TERMINAL
```

Using the **PROFILE** command, you can specify:

- On terminals without delete keys, the characters that delete a single character or the remainder of a line (CHAR operand, LIST operand).
- Whether you want the system to prompt you for information (PROMPT/NOPROMPT operand).
- Whether you want to receive messages from other users (INTERCOM/NOINTERCOM operand).

- Whether you want to be able to obtain information about messages issued to your terminal while you execute a CLIST (PAUSE/NOPAUSE operand).
- Whether you want to see the message numbers of messages displayed at your terminal (MSGID/NOMSGID operand).
- Whether you want to receive mode messages at your terminal (MODE/NOMODE operand).
- Whether you want to see at your terminal messages issued to you by a program (write-to-programmer messages) (WTPMSG/NOWTPMSG operand).
- Whether you want the EDIT recovery function in effect (RECOVER/NORECOVER operand).
- A user ID or character string to be used as the first qualifier of all non-fully-qualified data set names (PREFIX operand).
- Primary and secondary languages (PLANGUAGE and SLANGUAGE operands) to be used in displaying translated messages, help information, and the TRANSMIT full-screen panel.

One of the most common settings in your profile that you will change is the TSO PREFIX. The TSO PREFIX determines the first qualifier to be added to all data sets that are not fully qualified.

Note: To specify a fully qualified name for a data set, enclose it in quotes. For example, 'SYS1.PARMLIB'.

To change the TSO PREFIX to, for example, TAYYF; enter the following command:

```
PROFILE PREFIX(TAYYF)
```

When you specify a data set without quotes, such as TEST.JCLLIB, the system recognizes it as *TAYYF.TEST.JCLLIB*. You can set the prefix to any value you want, but normally it is your user ID.

If you do not want to append a prefix to non-fully-qualified data sets, enter:

```
PROFILE NOPREFIX
```

For more information on the rest of the profile settings, see *z/OS TSO/E User's Guide*, SA22-77942.

1.59 Backup and restore of z/OS

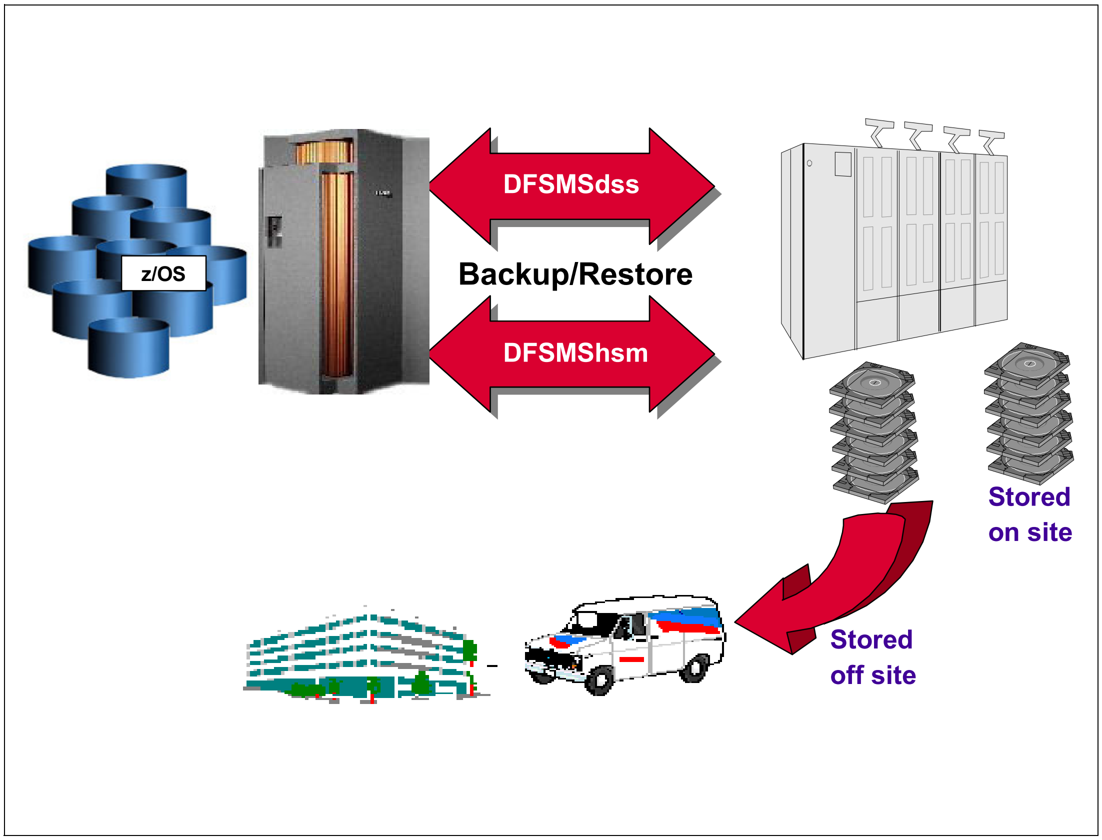


Figure 1-59 Backup and restore of z/OS

How to back up and restore z/OS

There are times when you have made a change to some system parameters and at the next scheduled IPL, the system simply refuses to start up. You realize that you have made a mistake in the change, and try to go back to the way things were before the change. That's why you need to back up the system.

There are several other situations in which you need to perform recovery actions, for instance:

- When a hardware error occurs; for example, a DASD crash that took out a critical DASD volume.
- An I/O error during IPL due to a change to a system library, for example SYS1.NUCLEUS, or perhaps the master catalog, or any one of the critical system data sets that you need for a successful IPL.
- A corrupted system data set.

Before you start backing up your system, you have to set up a backup/restore strategy if one is not in place in your environment. There are a number of aspects you should consider in establishing your policy, including:

- The frequency of the backup

  Normally, a full system backup is done weekly. This is sufficient if you do not have frequent system changes. For any minor changes before the scheduled backup, you might want to consider backup by data sets instead of a full system backup.

- The resource needed for backup

  The tape or cartridge drive (for example, IBM or compatible 3420, 3480, or 3490) is considered one of the most commonly used backup/restore devices. The disadvantage of using these devices is that they are relatively slow as compared to a direct access device, like the IBM 3390.

- How many backup sets you should keep

  You probably want to keep two sets of backup, if your resource permits. One set is kept at your installation, and the other is kept offsite.

You can use the DFSMSdss™ program ADRDSSU to back up your system. Using ADRASSU, you can plan to have the following typical backup:

- Full or complete

  All data in the system is backed up regardless of type, content, or access pattern. Sample JCL for a full volume dump show is shown in the following:

```
//DSSDUMP JOB (),'MVSSP',NOTIFY=&SYSUID,CLASS=A,MSGLEVEL=(1,1),
//          MSGCLASS=X
//STEP1    EXEC  PGM=ADRDSSU
//SYSPRINT DD    SYSOUT=A
//DASD     DD    UNIT=3390,VOL=SER=MPDLB1,DISP=OLD
//TAPE     DD    UNIT=(3480,2),VOL=SER=(TAPE01,TAPE02),
//  LABEL=(1,SL),DISP=(NEW,CATLG),DSNAME=MPDLB1.BACKUP
//SYSIN    DD    *
    DUMP  INDDNAME(DASD1) -
          OUTDDNAME(BACKUP) -
          FULL OPTIMIZE(4) -
          COMPRESS
/*
```

- Incremental

  An incremental backup only backs up data that has been changed since a previous backup. Managing data this way requires the operating system to maintain some form of change control for individual data sets. Sample JCL for an incremental dump shows Sample JCL for doing an incremental dump, on only data sets changed since the last backup, is as follows:

```
//DSSDUMP JOB (),'MVSSP',NOTIFY=&SYSUID,CLASS=A,MSGLEVEL=(1,1),
//          MSGCLASS=X
//STEP1    EXEC  PGM=ADRDSSU
//SYSPRINT DD    SYSOUT=A
//TAPE     DD    UNIT=(3480,2),VOL=SER=(TAPE01,TAPE02),
//  LABEL=(1,SL),DISP=(NEW,CATLG),DSNAME=MPDLB1.BACKUP
//SYSIN    DD    *
    DUMP OUTDD(TAPE) -
         DS(INCL(**) -
            BY((DSCHA EQ 1)))
/*
```

- Selective

  Data backed up under control of the user. Specific volumes and data sets are selected for backup based on importance or access pattern. Sample JCL for backing up selective data sets, specifically data sets that have a high level qualifier of ISP, is shown in the following:

```
//DSSDUMP JOB (),'MVSSP',NOTIFY=&SYSUID,CLASS=A,MSGLEVEL=(1,1),
//          MSGCLASS=X
//STEP1    EXEC  PGM=ADRDSSU
//SYSPRINT DD    SYSOUT=A
//TAPE     DD    UNIT=(3480,2),VOL=SER=(TAPE01,TAPE02),
//  LABEL=(1,SL),DISP=(NEW,CATLG),DSNAME=MPRES2.BACKUP
//SYSIN    DD    *
    DUMP OUTDD(TAPE) -
         DS(INCL(ISP.**)) -
         TOL(ENQF) OPTIMIZE(4) COMPRESS
/*
```

For more information on the use of ADRDSSU, see *z/OS DFSMSdss Storage Administration Reference*, SC35-0424.

2

Subsystems and subsystem interface (SSI)

This chapter describes basic concepts that you need to understand if you want to write your own subsystem or want to use services provided by IBM subsystems. It also describes planning considerations for setting up and writing your own subsystem.

When you want to write your own subsystem, you must:

- Provide the routines to support the request for a function. These function routines get control from the SSI. They may actually perform the function or may pass control to other routines that you provide.
- Provide a subsystem address space (if required).
- Let MVS know that the subsystem exists (define the subsystem).
- Provide the information to the SSI that it will need to find your function routines (initialize the subsystem).
- Provide accounting information parameters to your subsystem (if required).

Note: When writing your own subsystem you must also provide any control blocks or resources that the subsystem requires for its own operation, which MVS does not provide.

2.1 Defining subsystems and subsystem interface

- What is a subsystem?
- Types of subsystems
  - Master
  - Job entry or primary
  - Secondary
  - Functional
- What is the SSI
- Unique attributes of the SSI

Figure 2-1 Defining subsystems and subsystem interface

A subsystem is a service provider that performs one function or many functions, but does nothing until it is requested. Although the term "subsystem" is used in other ways, in this book a subsystem must be the master subsystem or be defined to MVS in one of the following ways:

- Processing the IEFSSNxx parmlib member during IPL

  You can use either the keyword format or positional format of the IEFSSNxx parmlib member. We recommend that you use the keyword format, which allows you to define and dynamically manage your subsystems.
- Issuing the IEFSSI macro
- Issuing the SETSSI system command

> **Note:** The master subsystem (MSTR) is a part of MVS and is not defined in any of these ways.

Some examples of IBM-supplied subsystems that use these interfaces are the following:

- JES2
- JES3
- IMS
- NetView®

- OPC

There are four types of subsystems:

- The *master scheduler subsystem* is used to establish communication between the operating system and the primary job entry subsystem, which can be JES2 or JES3. It is also used to initialize system services such as the system log and communications task.
- The *primary subsystem* is the job entry subsystem that MVS uses to do work. It can be either JES2 or JES3.
- *Secondary subsystems* provide functions as needed by IBM products, vendor products, or the installation.
- *Functional subsystems*: JES2/JES3 allows certain functions to operate outside the JES2/JES3 address space. JES3 does this using:
  - The functional subsystem address space (FSS)
  - The functional subsystem interface (FSI)
  - The functional subsystem application (FSA)

  The JES3 FSS that deals with output services is one type of FSS. This particular FSS address space may be created automatically or established by a CALL command for a printer device which is capable of running under the control of an FSS address space. The operator CALL command designates a printer as a "hot writer," while a writer invoked automatically when output is queued is a "dynamic writer."

MVS communicates with subsystems through the SSI.

Subsystem interface (SSI)

The SSI is the interface used by routines (IBM, vendor, or installation-written) to request services of, or to pass information to, subsystems. An installation can design its own subsystem and use the SSI to monitor subsystem requests. An installation can also use the SSI to request services from IBM-supplied subsystems. The SSI acts only as a mechanism for transferring control and data between a requestor and the subsystem; it does not perform any subsystem functions itself.

Unique attributes of the SSI

The SSI is a way for one routine to call another routine. There are a number of other ways that a routine can call another routine, such as:

- Branch and link register (BALR) 14,15
- LINK or LINKX macro
- Program call (PC)
- SVC

The SSI is different from these linkage interfaces, however, in that:

- The called routine does not have to be there. That is, when a routine calls the subsystem, the SSI checks to see if the subsystem either is not interested in the request or does not exist. The caller then receives an appropriate return code.
- A caller's request can be routed to multiple subsystem routines.

2.2 Subsystem initialization

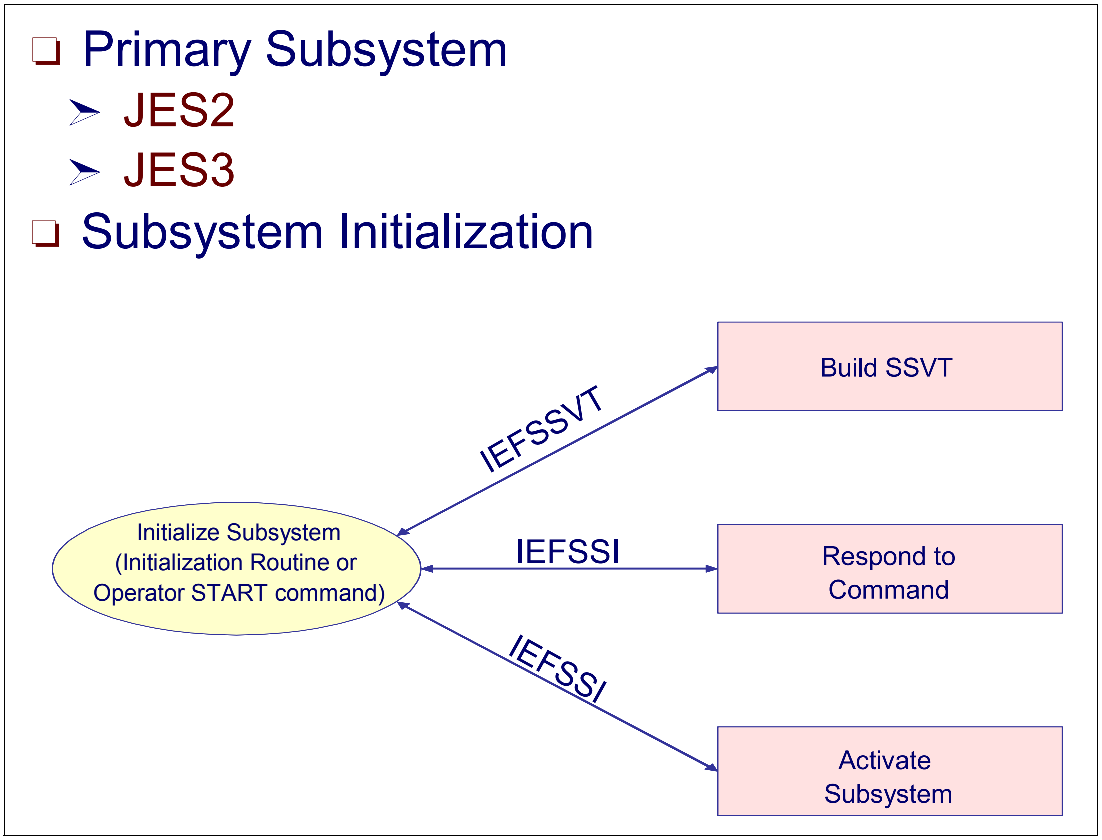


Figure 2-2 Subsystem initialization

The primary subsystem

For work to be done, MVS requires that at least one subsystem be defined as a job entry subsystem (JES) to bring jobs into the system. The JES, in fact, is called the primary subsystem. You can select either JES2 or JES3. If you do not specify an IEFSSNxx member in SYS1.PARMLIB, MVS attempts to use the system default member, IEFSSN00. IEFSSN00, as supplied by IBM, contains the definition for the default primary job entry subsystem, JES2.

If you attempt to IPL without specifying an IEFSSNxx member, and IEFSSN00 is not present or does not identify the primary subsystem, the system issues message IEFJ005I and prompts the operator for the primary subsystem.

For an IPL, do not define a subsystem more than once in a combination of IEFSSNxx members that can be used together or within a single member. The same subsystem can appear in two different IEFSSNxx members when the members will not be used together. In general, if MVS detects a duplicate name, both of the following are true:

- MVS does not define the duplicate subsystem
- MVS does not give control to the initialization routine.

The system issues the following message:

```
IEFJ003I: DUPLICATE SUBSYSTEM subname NOT INITIALIZED
```

How to initialize your subsystem

There are two ways to initialize your subsystem:

- Specifying an initialization routine
- Using the START command

You can also combine these methods, doing part of the setup through an initialization routine, then completing initialization through a START command.

Specifying an initialization routine

You can optionally specify the name of your subsystem initialization routine when you define your subsystem. If the functions the subsystem supplies might be needed during the IPL process, define your initialization routine in IEFSSNxx. In this case, the initialization routine handles all the preparation to ensure the subsystem is active.

Using the START command

If the subsystem functions are not needed until a later time, you can use the START command to initialize your subsystem. See *z/OS MVS System Commands*, SA22-7627-04 and *z/OS MVS JCL Reference*, SA22-7597-04 for more information on the START command.

Figure 2-2 on page 100 shows how you can initialize your subsystem either by specifying an initialization routine or by using the START command.

2.3 Types of subsystem requests

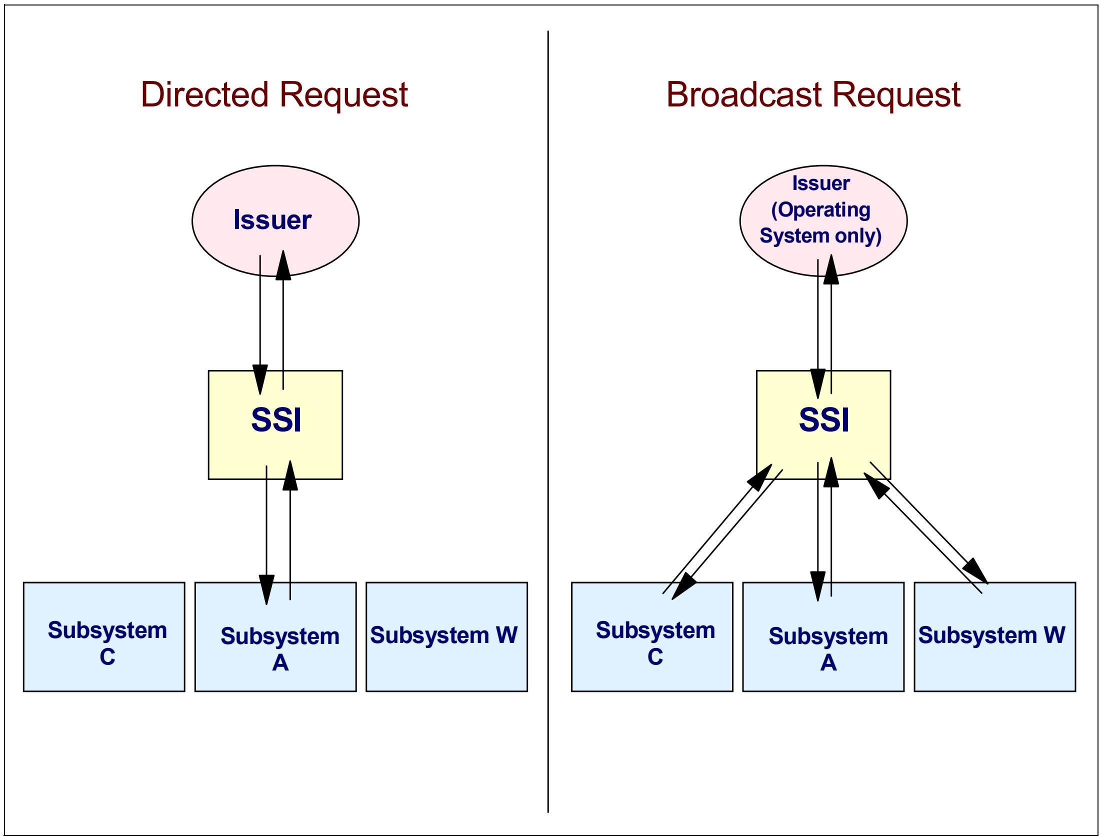


Figure 2-3 Types of subsystem request

The SSI handles two types of requests: directed requests and broadcast requests. Directed requests, which can be defined by the installation, are made to one named subsystem. For a directed request, the caller informs the named subsystem of an event, or asks the named subsystem for information. For example, you can access JES SYSOUT data sets with a directed request.

The left side of Figure 2-3 shows the processing for a directed request.

Broadcast requests, which are defined by MVS, provide the ability for subsystems to be informed when certain events occur in the system. Broadcast requests differ from directed requests in that the system allows multiple subsystems to be informed when an event occurs. The SSI gives control to each subsystem that is active and that has expressed an interest in being informed of the event. For example, your subsystem can be informed when a WTOR message is issued in order to automate a response to the WTOR. The right side of Figure 2-3 shows the processing for a broadcast request.

The IEFJFRQ installation exit provides a way to examine and modify subsystem function requests. See *z/OS MVS Installation Exits*, SA22-7593-04 for more information on the capabilities and use of the IEFJFRQ exit.

2.4 IEFSSNxx parmlib member

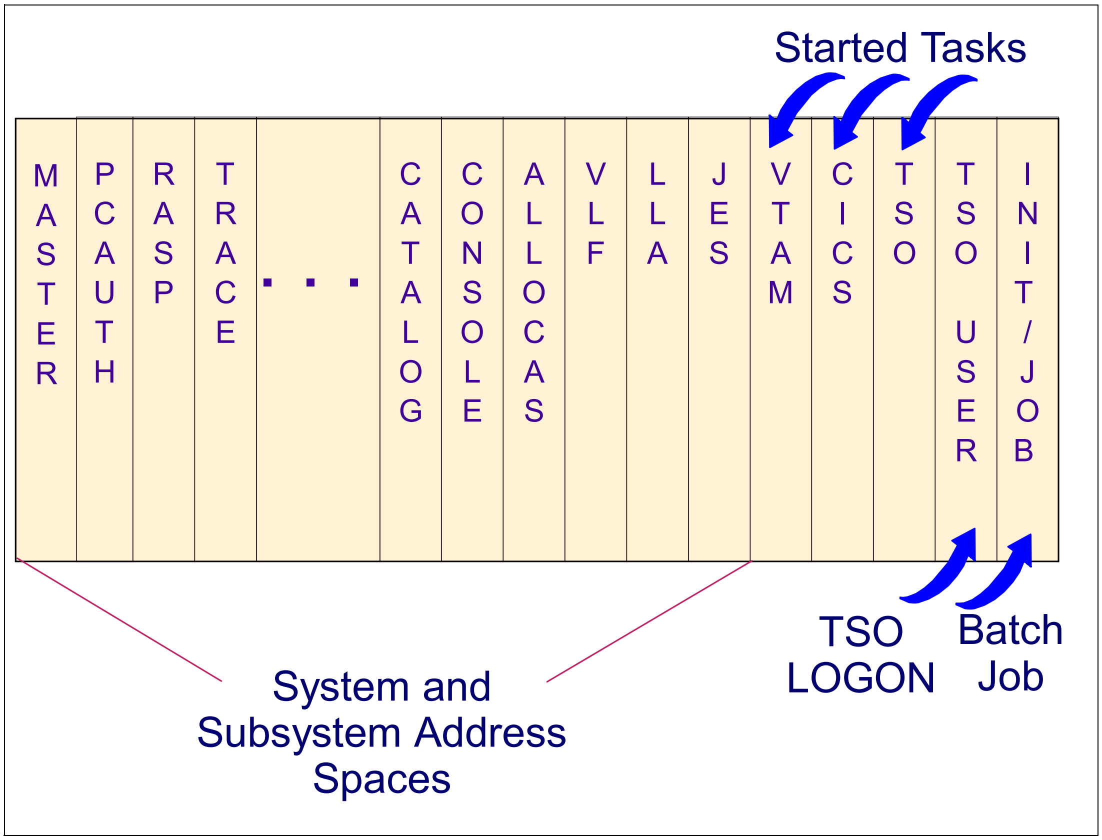


Figure 2-4 IEFSSNxx parmlib member

IEFSSNxx (subsystem definitions) - keyword parameter form

A subsystem is a service provider that performs one or many functions, but does nothing until it is requested. Subsystems are defined to MVS by the processing of the IEFSSNxx parmlib member during IPL. You can use either the keyword format or positional format of the IEFSSNxx parmlib member. We recommend that you use the keyword format, which allows you to define and dynamically manage your subsystems. You do this by:

- Issuing the IEFSSI macro
- Issuing the **SETSSI** system command

IEFSSNxx contains parameters that define the primary subsystem and the various secondary subsystems that are to be initialized during system initialization.

IEFSSNxx allows you to:

- Name the subsystem initialization routine to be given control during master scheduler initialization.
- Specify the input parameter string to be passed to the subsystem initialization routine.
- Specify a primary subsystem name and whether you want it started automatically.

For information about writing subsystems, see *z/OS MVS Using the Subsystem Interface*, SA22-7642-01.

The order in which the subsystems are initialized depends on the order in which they are defined in the IEFSSNxx parmlib member on the SSN parameter. Unless you are starting the Storage Management Subsystem (SMS), start the primary subsystem (JES) first. Some subsystems require the services of the primary subsystem in their initialization routines. Problems can occur if subsystems that use the subsystem affinity service in their initialization routines are initialized before the primary subsystem. If you are starting SMS, specify its record before you specify the primary subsystem record.

Note: In general, it is a good idea to make the subsystem name the same as the name of the member of the SYS1.PROCLIB used to start the subsystem. If the name does not match, you may receive error messages when you start the subsystem.

Restrictions for IEFSSNxx

The following restrictions apply for IEFSSNxx:

- All subsystem definitions in a single IEFSSNxx member must use the same format. A single member cannot contain both positional and keyword definitions.
  - If a member begins with the positional format and switches to the keyword format, processing of the member stops, and the IEFJ002I message is issued. The last subsystem definition processed for the member is the last positional format definition before the switch. The system does not process another definition of either format from the member, but continues processing with the next member, if any.
  - If a member begins with the keyword format and a positional format definition is found, the system issues a syntax error message, and processing continues with the next definition of the keyword format.

Only subsystems that have been defined using the keyword format IEFSSNxx parmlib member, the IEFSSI REQUEST=ADD macro, or the **SETSSI ADD** system command can use the following dynamic SSI services:

- Macros

  IEFSSI REQUEST=ACTIVATE

  IEFSSI REQUEST=DEACTIVATE

  IEFSSI REQUEST=OPTIONS

  IEFSSI REQUEST=SWAP

  IEFSSI REQUEST=GET

  IEFSSI REQUEST=PUT

  IEFSSVT

- System commands

  `SETSSI ACTIVATE`

  `SETSSI DEACTIVATE`

You cannot use dynamic SSI services for subsystems defined with the positional form of this member.

2.5 Subsystem definitions

SYS1.PARMLIB: IEFSSNxx

```
SUBSYS     SUBNAME(subname)
          [CONSNAME(consname)]
          [INITRTN(initrtn)
          [INITPARM(initparm)]]
          [PRIMARY({NO|YES})
          [START({YES|NO})]]
```

SUBSYS SUBNAME(SMS) INITRTN(IGDSSIIN)
INITPARM('ID=60,PROMPT=YES')
SUBSYS SUBNAME(JES2) PRIMARY(YES)

SYS1.PARMLIB: IEASYSxx SSN=xx

Figure 2-5 Subsystem definitions

Statements and parameters for IEFSSNxx

The storage management subsystem (SMS) is the only subsystem that can be defined before the primary subsystem. Refer to the description of parmlib member IEFSSNxx in *z/OS V1R4.0 MVS Initialization and Tuning Reference*, SA22-7592-03, for SMS considerations. The statements and parameters for IEFSSNxx are:

SUBSYS The statement that defines a subsystem that is to be added to the system. If more than one SUBSYS statement appears for the same subsystem name, the first statement will be the one used to define the subsystem. The duplicate statements will be rejected with a failure message that is sent to the console.

SUBNAME(subname) The subsystem name. The name can be up to four characters long; it must begin with an alphabetic or special character (#, @, or $), and the remaining characters (if any) can be alphanumeric or special.

CONSNAME(consname) The name of the console to which any messages that the SSI issues as part of initialization processing are to be routed. This name is optional and can be two to eight characters long. This console name is also passed to the routine named on the INITRTN keyword if it is specified. The default is to issue messages to the master console.

INITRTN(initrtn) The name of the subsystem initialization routine. This name is optional and can be one to eight characters long. The first character can be either alphabetic or special. The remaining characters can be either alphanumeric or special. The routine receives control in supervisor state key 0. It must be the name of a program accessible through LINKLIB.

INITPARM(initparm) Input parameters to be passed to the subsystem initialization routine. The input parameters are optional and are variable in length for a maximum of 60 characters. If blanks, commas, single quotes, or parentheses are included in the input parameters, the entire parm field must be enclosed in single quotes. If the parm field is enclosed in single quotes, a single quote within the field must be specified as two single quotes. The INITPARM keyword can only be specified if the INITRTN keyword is specified.

PRIMARY({NO|YES}) This parameter indicates whether this is the primary subsystem. The primary subsystem is typically a job entry subsystem (either JES2 or JES3).

This parameter is optional. Initialize the primary subsystem before any secondary subsystem(s) except SMS. If you specify PRIMARY on more than one statement, the system issues message IEFJ008I and defines the second subsystem but ignores the PRIMARY specification.

The IEFSSNxx parmlib member is the only place you can define the primary subsystem. It cannot be defined using the dynamic SSI services IEFSSI REQUEST=ADD macro or the **SETSSI ADD** command. The default is NO.

START({YES|NO}) This parameter indicates whether an automatic **START** command should be issued for the primary subsystem.

If the parmlib entry for the primary subsystem is START(NO), the operator must start it later with a **START** command. If the parmlib entry for the primary subsystem does not specify the START parameter, it defaults to START(YES).

The START parameter cannot be specified for a secondary subsystem. If you specify the PRIMARY(NO) parameter, there is no default for the START parameter.

Example

Define subsystem *JES2* as a primary subsystem and the **START** command to be issued by the system. No initialization routine is required because subsystem JES2 builds the SSVT when the **START** command is issued.

```
SUBSYS SUBNAME(JES2) PRIMARY(YES)
```

Parameter in IEASYSxx (or specified by the operator)

The SSN parameter in IEASYSxx identifies the IEFSSNxx member that the system is to use to initialize the subsystems, as follows:

```
SSN=        {aa           }
            {(aa,bb,...)  }
```

The two-character identifier, represented by aa (or bb, and so forth) is appended to IEFSSN to identify IEFSSNxx members of parmlib. If the SSN parameter is not specified, the system uses the IEFSSN00 parmlib member.

The order in which the subsystems are defined on the SSN parameter is the order in which they are initialized. For example, a specification of SSN=(13,Z5) would cause those subsystems defined in the IEFSSN13 parmlib member to be initialized first, followed by those subsystems defined in the IEFSSNZ5 parmlib member. If you specify duplicate subsystem names in IEFSSNxx parmlib members, the system issues message IEFJ003I to the SYSLOG, the master console, and consoles that monitor routing code 10 messages.

Some exits that use system services may run before other system address spaces are active. You must ensure that any address spaces required by the system services are available prior to invoking the service.

For more information, see the section on handling errors in defining your subsystem in *OS/390 MVS Using the Subsystem Interface*, SC28-1502.

Syntax rules for IEFSSNxx

The following rules apply to the creation of IEFSSNxx:

- Each SUBSYS statement in IEFSSNxx defines one subsystem to be initialized.
- Use columns 1 through 71. Do not use columns 72 through 80 because the system ignores these columns.
- Comments may appear in columns 1 through 71 and must begin with */** and end with **/*.
- A statement must begin with a valid statement type followed by at least one blank or end-of-line.
- A statement ends with the beginning of the next valid statement type or end-of-file.
- A statement can be continued even though there is no explicit continuation character.
- Operands must be separated by valid delimiters. Valid delimiters are a blank, or column 71. If the operand contains parentheses, then the right parenthesis is accepted as a valid delimiter.
- Multiple occurrences of a delimiter (except for parentheses) are accepted, but treated as one.

IBM-supplied default for IEFSSNxx

If you do not specify the SSN system parameter, the system uses the IEFSSN00 parmlib member. IEFSSN00 specifies JES2 as the primary subsystem.

If you specify a set of IEFSSNxx members that do not identify a primary subsystem, the system issues a message that prompts the operator to specify the primary subsystem.

2.6 Subsystem interface (SSI)

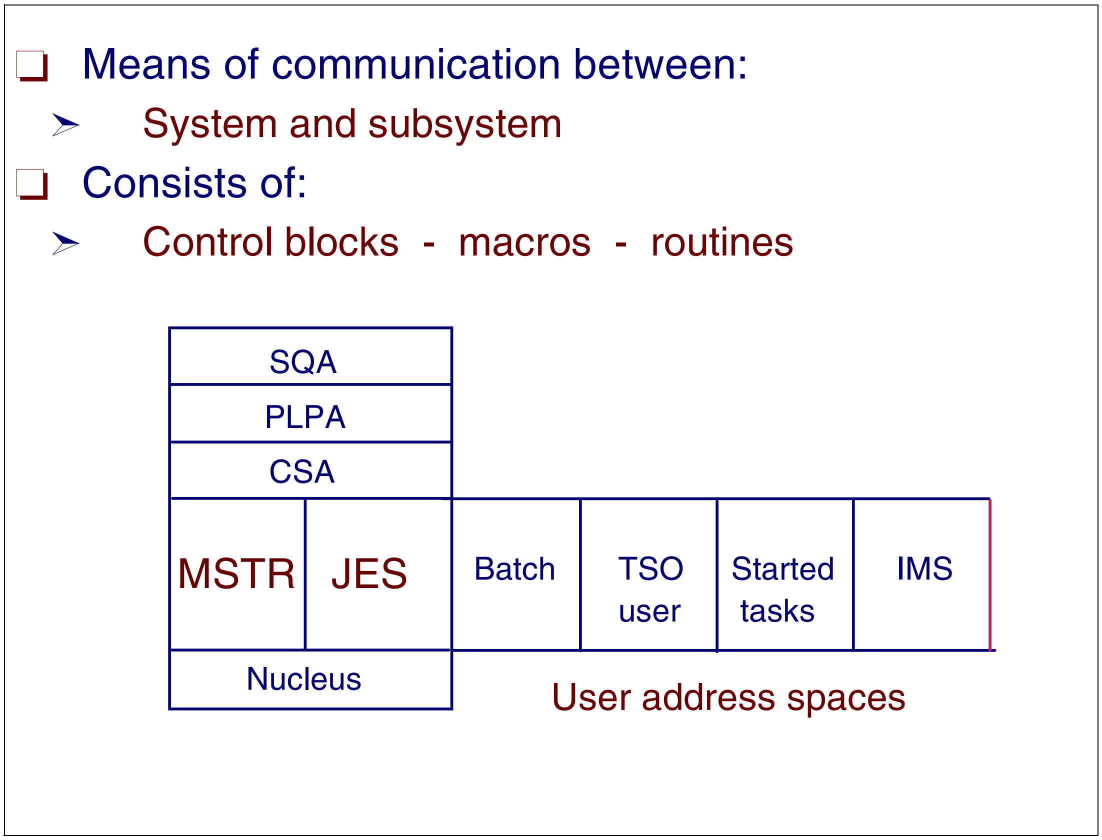


Figure 2-6 Subsystem interface - SSI

The SSI is an interface that provides communication between MVS and JES through the IEFSSREQ macro. The SSI is the interface used by routines (IBM, vendor, or installation-written) to request services of, or to pass information to, subsystems. An installation can design its own subsystem and use the SSI to monitor subsystem requests. An installation can also use the SSI to request services from IBM-supplied subsystems. The SSI acts only as a mechanism for transferring control and data between a requestor and the subsystem; it does not perform any subsystem functions itself.

MVS functions issue the IEFSSREQ macro to invoke JES. The calling routine uses the subsystem option block (SSOB) and subsystem identification block (SSIB) to identify the required processing to JES. The calling routine uses the IEFSSREQ macro to pass the SSIB and SSOB to JES.

2.7 SSI control blocks and routines

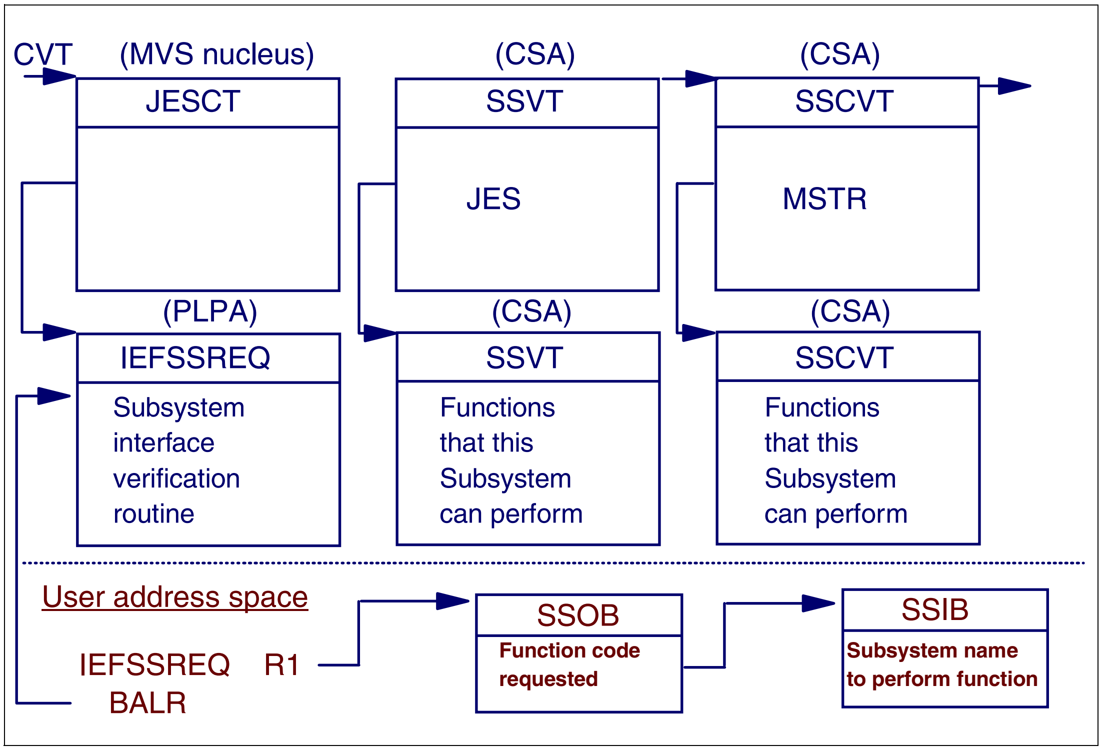


Figure 2-7 SSI control blocks and routines

The MVS nucleus contains a control block named the JES control table (JESCT). This block contains a pointer to the primary subsystem (JES2/JES3) communication vector table (SSCVT), which is located in CSA. There will always be at least two SSCVTs, one of which represents the MVS master subsystem.

The macro that provides communication between MVS and JES2/JES3 is the IEFSSREQ macro. MVS functions issue this macro to invoke JES3. The calling routine uses the subsystem option block (SSOB) and subsystem identification block (SSIB) to identify the required processing to JES3. The calling routine uses the IEFSSREQ macro to pass the SSIB and SSOB to JES. The control blocks involved are:

JESCT JES control table (JESCT). A control block in the MVS nucleus that contains information used by subsystem interface routines.

SSCVT Primary subsystem communication vector table (SSCVT). This control block is the common storage area that contains information used by the subsystem interface routines.

SSVT The subsystem vector table (SSVT). The SSVT resides in the JES common service area (CSA) and contains the following information:

- **SSOB** Subsystem options block (SSOB). The control block into which MVS places a function code when communicating with JES over the subsystem interface. The function code identifies a requested service.
- **SSIB** Subsystem identification block (SSIB). The control block into which MVS places the name of the subsystem to which it is directing a request over the subsystem interface.

2.8 SSI request to master subsystem

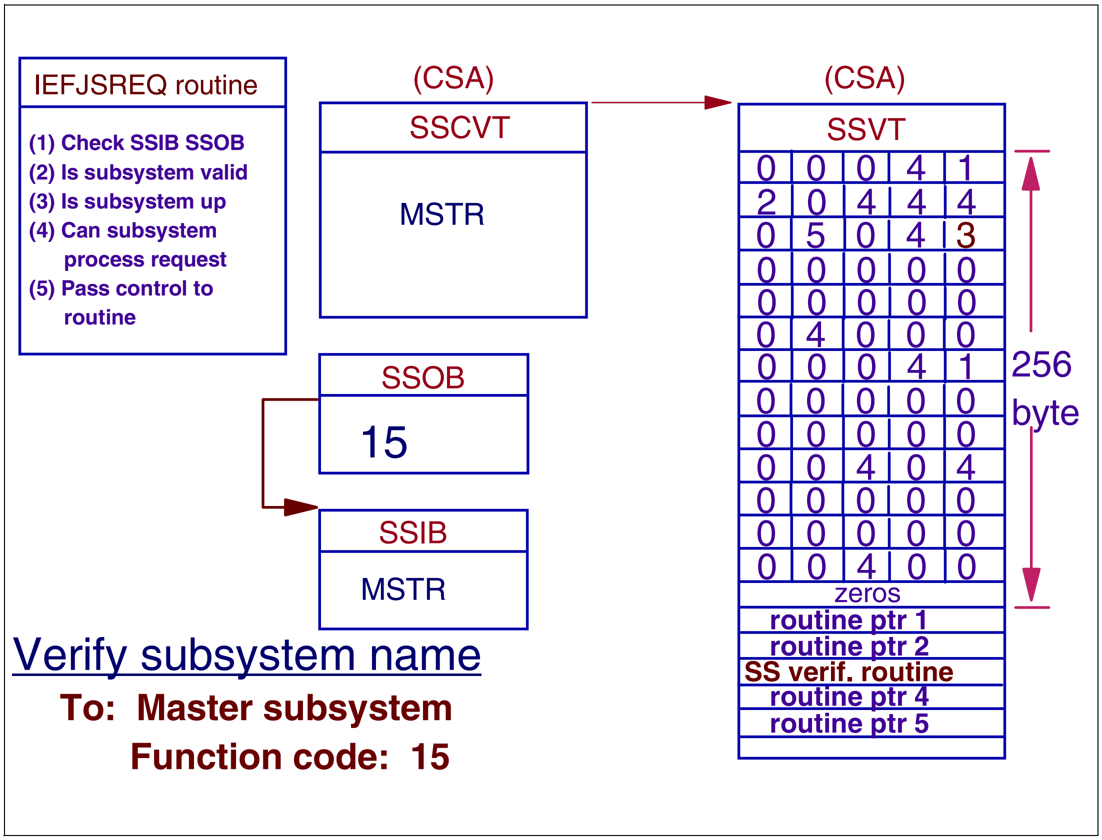


Figure 2-8 SSI request to master subsystem

The IEFJSREQ routine checks the validity of the SSOB and SSIB; the request routine determines that the target subsystem exists and is started. It next uses the function code to determine if the subsystem performs the requested function and to derive the address of a routine to which the request is be passed. The SSOB contains the function code requested by the caller and the SSIB contains the name of the subsystem to perform the function requested.

There are 15 SSI functions supported by the master subsystem, but several of the routines perform more than one function.

The SSVT contains a matrix of the function codes and in the visual the first function code supported by the MSTR subsystem is function code 4. The number 4 shown in the fourth position indicates that the routine that gets control is the fourth routine pointer (ptr) shown after the function code matrix in the SSVT.

Function code 15 is used by the master subsystem (MSTR) to verify the subsystem (JES) name when JES initializes, and is the third routine pointer, as function code 15 has a 3 in the matrix.

2.9 JES2 supported SSI functions

1	SYSOUT	53	FSS/FSA CONNECT/DISCON
2	CANCEL	54	SUBSYSTEM VERSION
3	JOB STATUS	64	TRANSACTION PROCESSING
4	EOT	70	SJF SPOOL SERVICES
5	JOB SELECTION	71	JOB INFORMATION
6	ALLOCATION	75	NOTIFY-USER MSG ROUTER
7	UNALLOCATION	77	PERSISTENT JCL
8	EOM	79	SYSOUT API
9	WTO/WTOR	80	ENHANCED STATUS
10	CMD PROCESSING (SVC34)		
11	REMOT DEST VALIDITY CK		
12	JOB DELETION		
13	JOB RE-ENQUEUE		
16	OPEN		
17	CLOSE		
18	CHECKPOINT		
19	RESTART		
20	REQUEST JOB ID		
21	RETURN JOB ID		

Figure 2-9 JES2 supported SSI functions

Figure 2-9 lists the functions supported by JES2 as a subsystem.

Following is a list of directed function codes a user program can request. IBM subsystems provide these function codes.

Code	Requested Function	Subsystem*	Type of Request
1	Process SYSOUT data	JES2/JES3	Directed sets
15	Verify subsystem	Master	Directed function
20	Request job ID	JES2/JES3	Directed
21	Return job ID	JES2/JES3	Directed
54	Request subsystem	JES2/JES3/Master	Directed version information
71	JES JOB information	JES2	Directed
75	Notify user message	JES2/JES3	Directed service
79	SYSOUT Application	JES2/JES3	Directed Program Interface (SAPI)

2.10 JES3 supported SSI functions

1	SYSOUT	24	COMMON ALLOCATION
2	CANCEL	25	COMMON UNALLOCATION
3	JOB STATUS	26	CHANGE DDNAME
4	EOT	27	CHANGE ENQ USE ATTRIBUTE
5	JOB SELECTION	28	DDR CANDIDATE SELECT
6	ALLOCATION	29	DDR CANDIDATE VERIFY
7	UNALLOCATION	30	DDR SWAP NOTIFICATION
8	EOM	31	DDR SWAP COMPLETE
9	WTO/WTOR	32	SVC34 COMMAND FAIL
10	CMD PROCESSING (SVC34)	34	WRITE TO LOG
11	REMOT DEST VALIDITY CK	40	EARLY VOLUME RELEASE
12	JOB DELETION	53	FSS/FSA CONNECT/DISCON
13	JOB RE-ENQUEUE	54	SUBSYSTEM VERSION
16	OPEN	56	SMS TO JES3 COMMUNICATION
17	CLOSE	62	BDT SUBSYSTEM
18	CHECKPOINT	64	TRANSACTION PROCESSING
19	RESTART	72	VARY PATH CALL
20	REQUEST JOB ID	75	NOTIFY-USER MSG ROUTER
21	RETURN JOB ID	77	PERSISTENT JCL
22	STEP INITIATION	79	SYSOUT API
23	DYNAMIC ALLOCATION	80	ENHANCED STATUS

Figure 2-10 JES3 supported SSI functions

Figure 2-10 lists the function codes supported by JES3 as a subsystem.

Following is a list of directed function codes, along with their purposes, that a user program can request. IBM subsystems provide these function codes.

Code	Requested Function	Subsystem*	Type of Request
1	Process SYSOUT data	JES2/JES3	Directed sets
15	Verify subsystem	Master	Directed function
20	Request job ID	JES2/JES3	Directed
21	Return job ID	JES2/JES3	Directed
54	Request subsystem	JES2/JES3/Master	Directed version information
71	JES JOB information	JES2	Directed
75	Notify user message	JES2/JES3	Directed service
79	SYSOUT Application	JES2/JES3	Directed Program Interface (SAPI)

3

Job management

z/OS job management in a z/OS system uses a job entry subsystem (JES) to receive jobs into the operating system, schedule them for processing by z/OS, and control their output processing. JES provides supplementary job management, data management, and task management functions such as: scheduling, control of job flow, and spooling. JES is designed to provide efficient spooling, scheduling, and management facilities for the z/OS system.

For a program to execute on the computer and perform the work it is designed to do, the program must be processed by the operating system. The operating system consists of a base control program (BCP) with a job entry subsystem (JES2 or JES3) and DFSMSdfp™ installed with it.

For the operating system to process a program, programmers must perform certain job control tasks. These tasks are performed through the job control statements (JCL). The job control tasks are performed by the JES and are:

- Entering jobs
- Processing jobs
- Requesting resources

3.1 z/OS and job management

- ❑ Understanding JCL
- ❑ Job control statements
- ❑ Required JCL statements
- ❑ Why JES?

Figure 3-1 z/OS and job management

A major goal of an operating system is to process jobs while making the best use of system resources. To achieve that goal, the operating system does *resource management*, which consists of the following:

- Before job processing, reserve input and output resources for jobs
- During job processing, manage resources such as processors and storage
- After job processing, free all resources used by the completed jobs, making the resources available to other jobs

At any instant, a number of jobs can be in various stages of preparation, processing, and post-processing activity. To use resources efficiently, the operating system distributes jobs into queues to wait for needed resources according to their stages, such as: conversion queue, waiting execution queue, processing queue, output queue, and so forth. The function of keeping track of which job is in which queue is called *workflow management*.

The MVS system divides the management of jobs and resources with a JES. JES does job management and resource management before and after job execution, while MVS does it during job execution. The JES receives jobs into MVS, schedules them for processing by MVS, and controls their output processing.

3.2 Job management

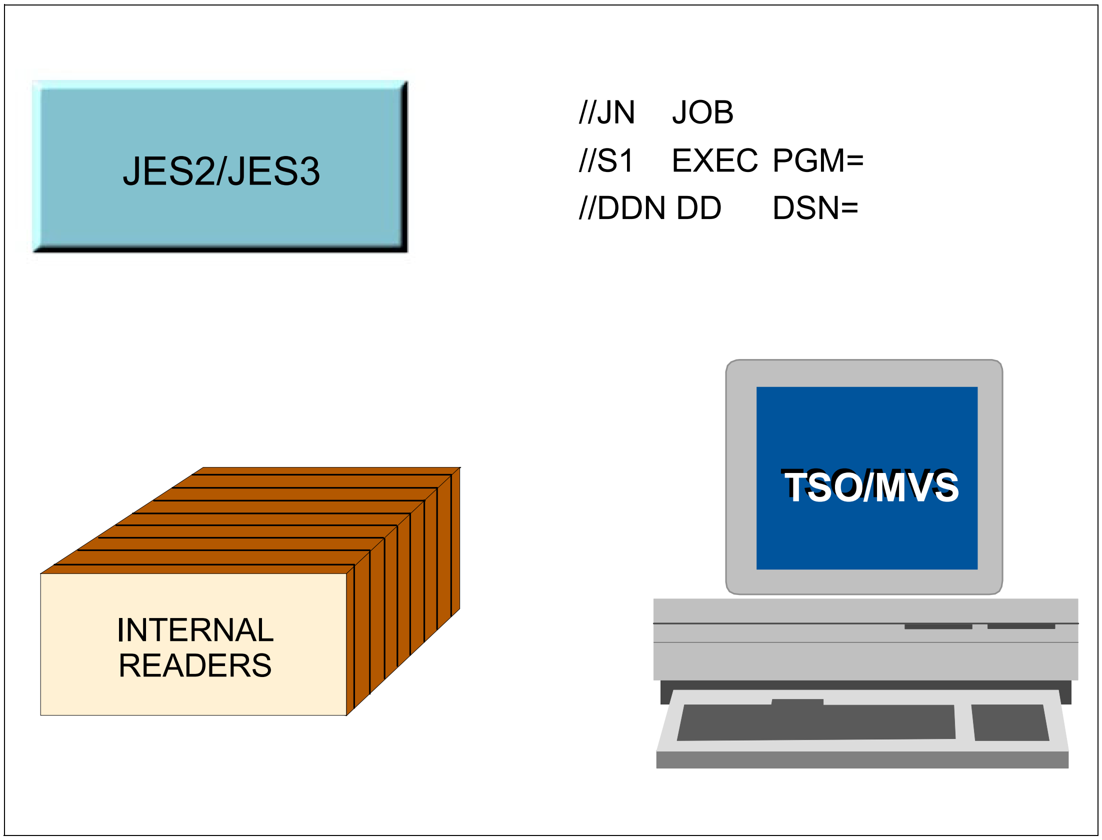


Figure 3-2 Job management

Understanding JCL

To get your MVS system to do work for you, you must describe to the system the work you want done and the resources you will need. You use JCL to provide this information to MVS. Refer to volume one, chapter three for a description of JCL and how it works.

As shown in Figure 3-2 and described in volume 1, you can submit a job from a TSO/E terminal to JES2 or JES3 using internal readers. Jobs are submitted to different classes of execution according to the CLASS parameter.

Figure 3-2 shows an overview of the job-submission process. The user performs the parts on the left side of the figure, and the system performs the parts on the right. In this figure, z/OS and JES comprise the “system.”

3.3 JCL-related actions

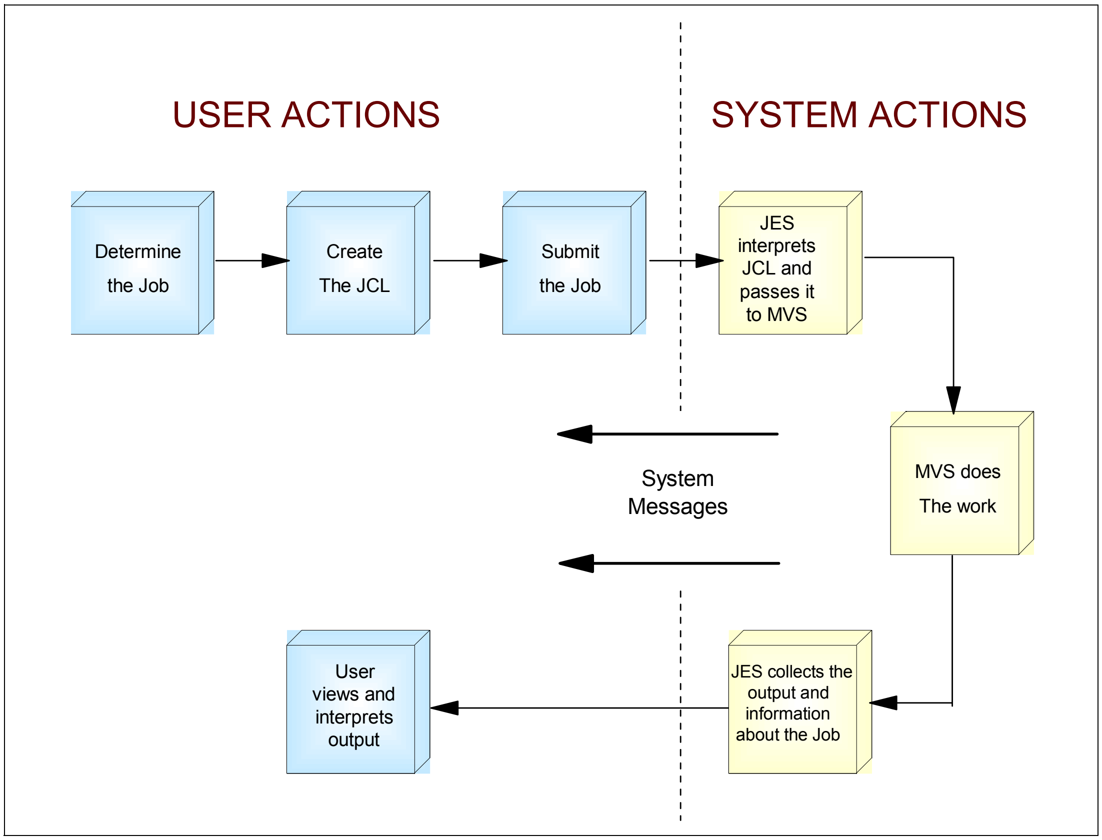


Figure 3-3 JCL-related actions

Job control statements

This flow was described in volume one, chapter four. There you can find a description of JCL and its usage. In this chapter we describe the role of the JES, the difference between JES2 and JES3, and how they can be tailored to your installation.

3.4 JES2 and JES3 main differences

- JES2
  - Each JES2 is independent
  - Device allocation by MVS
- JES3
  - Global JES3 and Local JES3
  - Global JES3 controls all:
    - Job selecting
    - Job scheduling
    - Job output
  - Installation can choose device allocation
    - Global JES3 or MVS
  - Workload balancing according to resource requirements of jobs

Figure 3-4 JES2 and JES3 main differences

You can choose between two options for your primary JES: JES2 and JES3.

If your installation has only one MVS image, then both JES2 and JES3 perform similar functions, with JES3 providing additional functions related to job scheduling. The common functions executed by both JESes are reading jobs into the system, converting them to internal machine-readable form, select them for processing, processing their output, and purging them from the system.

If your installation has more than one MVS image in a configuration, then the scheduling functions of JES3 are a big advantage. If you have more than one MVS image and you are running JES2, then JES2 in each MVS image exercises independent control over its job processing functions. That is, within the configuration, each JES2 processor controls its own job input, job scheduling, and job output processing.

In a JES3 environment, however, one MVS image hosts a JES3 that performs centralized control over its and the other MVS images' functions. This JES3 is called *JES3 global processor*; the JES3 instances in the other MVS images are called *JES3 local processors*.

It is from the global processor that JES3 manages jobs and resources for the entire complex, matching jobs with available resources. JES3 ensures that they are available before selecting the job for processing.

To better understand the functional differences between JES2 and JES3, refer to *z/OS JES2 Initialization and Tuning Guide*, SA22-7532, and *z/OS JES3 Initialization and Tuning Guide*, SA22-7549.

3.5 JES2 primary job entry subsystem

- JES2 functions
- JES2 job flow
- JES2 spool data set
- JES2 checkpointing
- JES2 configuration
- JES2 customization
- JES2 exits
- How to start JES2
- How to stop JES2
- JES2 operation

Figure 3-5 JES2 primary job entry subsystem

What is JES2?

MVS uses a JES to receive jobs into the operating system, schedule them for processing by MVS, and control their output processing. JES2 is descended from HASP (Houston automatic spooling priority). HASP is defined as a computer program that provides supplementary job management, data management, and task management functions such as scheduling, control of job flow, and spooling. HASP remains within JES2 as the prefix of most module names and the prefix of all messages sent by JES2 to the operator.

JES2 is a functional extension of the HASP II program that receives jobs into the system and processes all output data produced by the job. So, what does all that mean? Simply stated, JES2 is that component of MVS that provides the necessary functions to get jobs into, and output out of, the MVS system. It is designed to provide efficient spooling, scheduling, and management facilities for the MVS operating system.

But, none of this explains why MVS needs a JES. Basically, by separating job processing into a number of tasks, MVS operates more efficiently. At any point in time, the computer system resources are busy processing the tasks for individual jobs, while other tasks are waiting for those resources to become available. In its most simple view, MVS divides the management of jobs and resources between the JES and the base control program of MVS. In this manner, JES2 manages jobs before and after running the program; the base control program manages them during processing.

The following sections describe each JES2 function identified in Figure 3-5.

3.6 JES2 functions

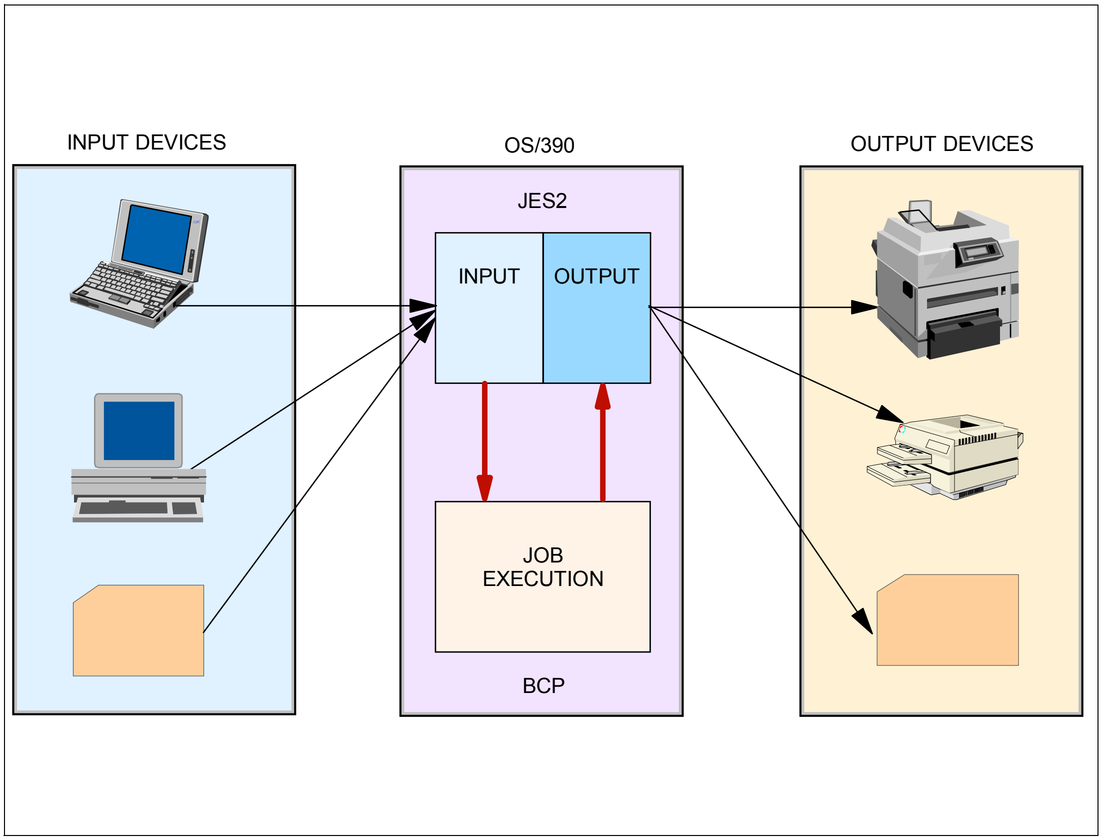


Figure 3-6 JES2 functions

During the life of a job, both JES2 and the base control program of MVS control different phases of the overall processing. Generally speaking, a job goes through the following phases:

- Input
- Conversion
- Processing
- Output
- Print/punch (hard copy)
- Purge

Except for processing, all the job phases are controlled by JES2.

To manage job input/output, JES2 controls a number of functional areas, all of which you can customize according to your installation's need. Some of the major functional areas and processing capabilities are:

- Getting work into and out of MVS (input/output control):

  JES2 controls output and input devices such as local and remote printers, punches, and card readers. You define each device to JES2 using JES2 initialization statements. All are directly under JES2's control with the exception of those printers that operate under the Print Services Facility™ (PSF). Printed and punched output can be routed to a variety of devices in multiple locations. The control JES2 exercises over its printers ranges from the job output classes and job names from which the printer can select work, to specifications such as the forms on which the output is printed. This control allows the system programmer to establish the job output environment most efficiently without causing unnecessary printer backlog or operator intervention. Through JES2, the installation defines the job input classes, reader specifications, and output device specifications. As a result, JES2 is the central point of control over both the job entry and job exit phases of data processing. As shown in Figure 3-6, you can also enter jobs to JES2 using TSO/E or any other product that can read jobs from a data set and pass them to JES2 via internal reader.

- Maximizing efficiency through job selection and scheduling:

  JES2 allows the installation to define work selection criteria. It can be specific for each output device (local and remote printers and punches and offload devices). The work selection criteria are defined in the device initialization statements and can be changed dynamically using JES2 commands. You can define:

  – Specification of job and output characteristics that JES2 considers when selecting work for an output device

  – Priority of the selection characteristics

  – Characteristics of the printer and job that must match exactly

  A job's output is grouped based on the data set's output requirements. The requirements may be defined in the job's JCL or by JES2-supplied defaults.

  When selecting work to be processed on a device, JES2 compares the device characteristics with the output requirements. If they match, JES2 sends the output to the device. If they do not match, JES2 does not select the work for output until the operator changes the device characteristics or the output requirements.

- Offloading work and backing up system workload:

  JES2 gives your installation the capability to offload data from the spool and later reload data to the spool. This is useful if you need to:

  – Preserve jobs and SYSOUT across a cold start

  – Migrate your installation to another release of JES2

  – Convert to another DASD type for spool

  – Archive system jobs and SYSOUT

  – Relieve a full-spool condition during high-use periods

  – Provide a backup for spool data sets

  – Back up network connections

  JES2 offers many selection criteria to limit the spool offload operation. These selection criteria can be changed by operator command, according to initial specification in the JES2 initialization statements.

- System security:

  JES2 provides a basic level of security for resources through initialization statements. That control can be broadened by implementing several JES2 exits available for this purpose. A more complete security policy can be implemented with System Security Facility (SAF) and a security product such as RACF.

- Supporting advanced function printers (AFPs)

JES2 is responsible for all phases of job processing and monitors the processing phase. The base control program (BCP) and JES2 share responsibility in the z/OS system. JES2 is responsible for job entry (input), the base control program for device allocation and actual job running, and finally JES2 for job exit (output).

Figure 3-7 on page 122 presents an overview of the job phases.

3.7 JES2 job flow

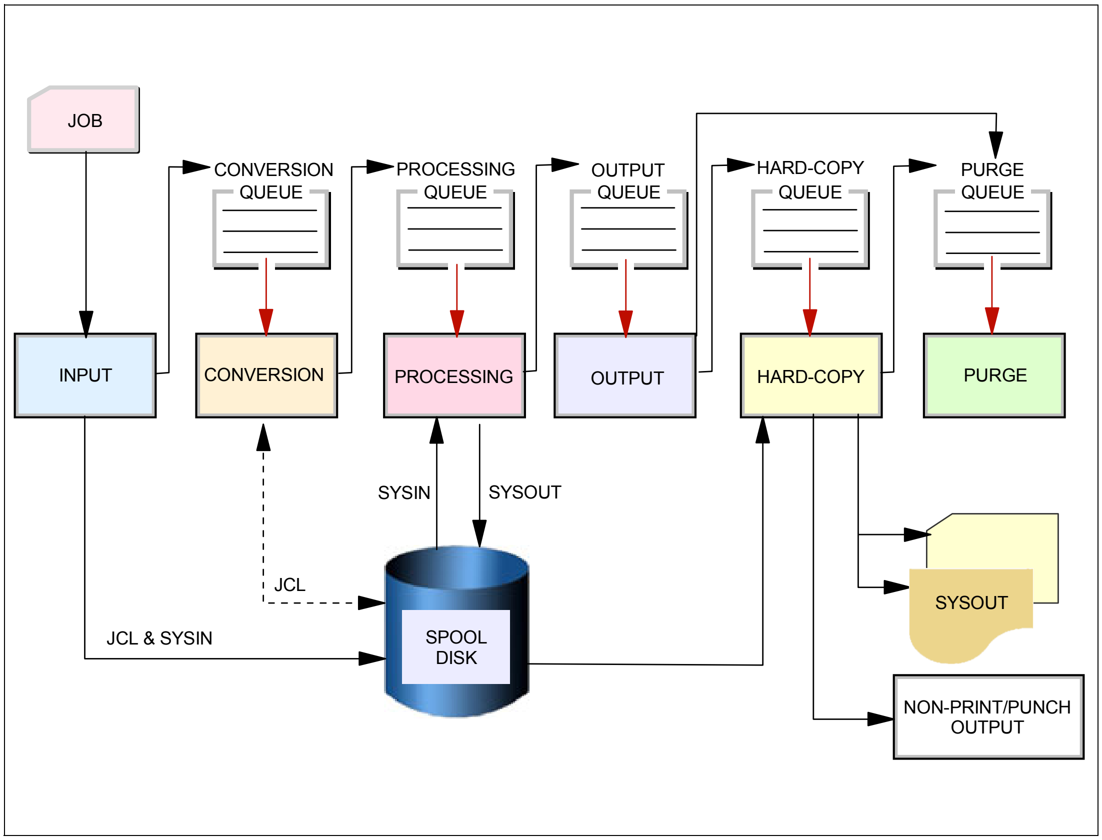


Figure 3-7 JES2 job flow

The job queues contain jobs that are:

- Waiting to run - conversion queue
- Currently running - execution queue
- Waiting for their output to be produced - output queue
- Having their output produced - hard-copy (print/punch) queue
- Waiting to be purged from the system - purge queue

The six phases of job processing are as follows:

1. Input phase

   JES2 accepts jobs, in the form of an input stream, from input devices, internal readers, other nodes in a job entry network, and from other programs.

   The internal reader is a program that other programs can use to submit jobs, control statements, and commands to JES2. Any job running in MVS can use an internal reader to pass an input stream to JES2. JES2 can receive multiple jobs simultaneously through multiple internal readers. MVS uses internal readers, allocated during system initialization, to pass to JES2 the JCL for started tasks, START and MOUNT commands, and TSO LOGON requests.

   The system programmer defines internal readers to be used to process all batch jobs other than STCs and TSO requests. These internal readers are defined in JES2 initialization statements and JES2 allocates them during JES2 initialization processing.

The internal readers for batch jobs can be used for STCs and TSO requests, if not processing jobs.

JES2 reads the input stream and assigns a job identifier to each JOB JCL statement. JES2 places the job's JCL, optional JES2 control statements, and SYSIN data onto DASD data sets called spool data sets. JES2 then selects jobs from the spool data sets for processing and subsequent running.

2. Conversion phase

   JES2 uses a converter program to analyze each job's JCL statements. The converter takes the job's JCL and merges it with JCL from a procedure library. The procedure library can be defined in the JCLLIB JCL statement, or system/user procedure libraries can be defined in the PROCxx DD statement of the JES2 startup procedure. Then, JES2 converts the composite JCL into converter/interpreter text that both JES2 and the job scheduler functions of MVS can recognize. Next, JES2 stores the converter/interpreter text on the spool data set. If JES2 detects any JCL errors, it issues messages, and the job is queued for output processing rather than run. If there are no errors, JES2 queues the job for execution.

3. Processing phase

   In the processing phase, JES2 responds to requests for jobs from the MVS initiators. An initiator is a system program that is controlled by JES or by WLM (in goal mode, with WLM Batch Initiator Management).

   JES2 initiators are defined to JES2 through JES2 initialization statements. JES2 initiators are started by the operator or by JES2 automatically when the system initializes. The installation associates each initiator with one or more job classes in order to obtain an efficient use of available system resources. Initiators select jobs whose classes match the initiator assigned class, obeying the priority of the queued jobs.

   WLM initiators are started by the system automatically based on the performance goals, relative importance of the batch workload, and the capacity of the system to do more work. The initiators select jobs based on their service class and the order they were made available for execution. Jobs are routed to WLM initiators via a JOBCLASS JES2 initialization statement.

   In goal mode, with WLM Batch Management, a system can have WLM initiators and JES2 initiators.

   After a job is selected, the initiator invokes the interpreter to build control blocks from the converter/interpreter text that the converter created for the job. The initiator then allocates the resources specified in the JCL for the first step of the job. This allocation ensures that the devices are available before the job step starts running. The initiator then starts the program requested in the JCL EXEC statement.

   JES2 and the MVS Basic Control Program (BCP) communicate constantly to control system processing. The communication mechanism, known as the subsystem interface, allows MVS to request services of JES2. For example, a requestor can ask JES2 to find a job, message or command processing, or open (access) a SYSIN or SYSOUT data set. Further, the base control program notifies JES2 of events such as messages, operator commands, the end of a job, or the end of a task.

   By recognizing the current processing phase of all jobs on the job queue, JES2 can manage the flow of jobs through the system.

4. Output phase

   JES2 controls all SYSOUT processing. SYSOUT is a data set in a printer device format, that is, it is ready to be printed. Intermediately, a sysout file is stored in the spool data set. There are many advantages in spooling a sysout to JES, such as faster processing (DASD is faster than a printer), optimization of the printer devices, and spool backup and archive. MVS directs to sysout system messages related to job execution.

After a job finishes, JES2 analyzes the characteristics of the job's output in terms of its output class and device setup requirements; then JES2 groups data sets with similar characteristics. JES2 queues the output for print processing.

5. Hardcopy phase

   JES2 selects output for processing from the output queues by output class, route code, priority, and other criteria. The output queue can have output to be processed locally or output to be processed at a remote location (either an RJE workstation or another node). After processing all the output for a particular job, JES2 puts the job on the purge queue.

6. Purge phase

   When all processing for a job completes, JES2 releases the spool space assigned to the job, making the space available for allocation to subsequent jobs. JES2 then issues a message to the operator indicating that the job has been purged from the system.

3.8 JES2 spool data set

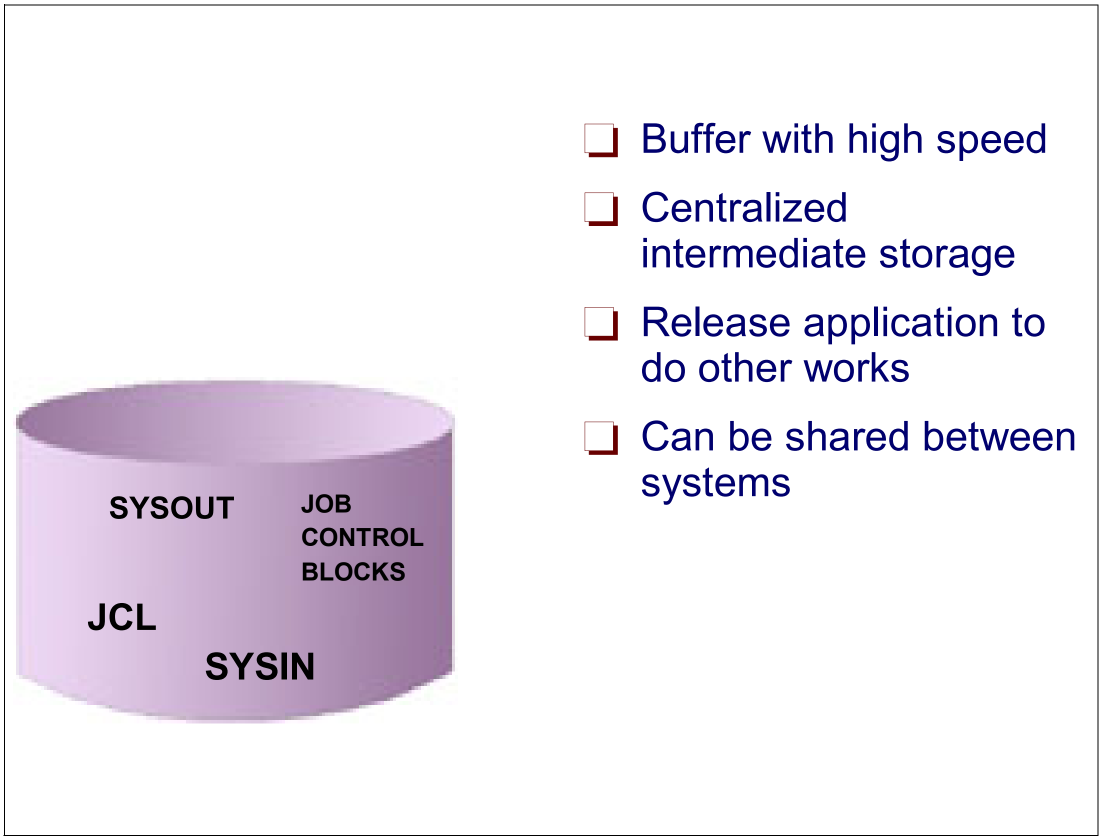


Figure 3-8 JES2 spool data set

JES2 maintains copies of its data sets that contain job and output queues (that is, lists of jobs to be processed by MVS) on direct access storage devices (DASD). Future work is added to these queues and JES2 selects work for processing from them. These data sets and queues must remain current and accurate to maintain system integrity and performance. The following is a discussion of the JES2 spool and checkpoint data sets and the processing JES2 uses to maintain them.

Spool data sets and spooling

Simultaneous peripheral operations online (spool) has several meanings as used in this book and throughout JES2 documentation. Spooling is a process by which the system manipulates its work. This includes:

- Using storage on direct access storage devices (DASD) as a buffer storage to reduce processing delays when transferring data between peripheral equipment and a program to be run.
- Reading and writing input and output streams on an intermediate device for later processing or output.
- Performing an operation such as printing while the computer is busy with other work.

Spool also refers to the direct access device that contains the spool data sets. This definition is generally apparent from the context of its use and should not cause any misunderstanding in the following sections of this book or other JES2 documentation.

Spooling is critical to maintain performance in the MVS-JES2 environment. JES2 attempts to maximize the performance of spooling operations, which ultimately benefits the throughput of work through the JES2 installation.

As noted previously, spooling provides simultaneous processing and a temporary storage area for work that is not yet completed. Once JES2 reads a job into the system, JES2 writes the job, its JCL, its control statements, and its data to a spool data set until further processing can occur.

For these reasons, spooling is critical to maintain performance in the MVS-JES2 environment.

3.9 JES2 checkpoint data set

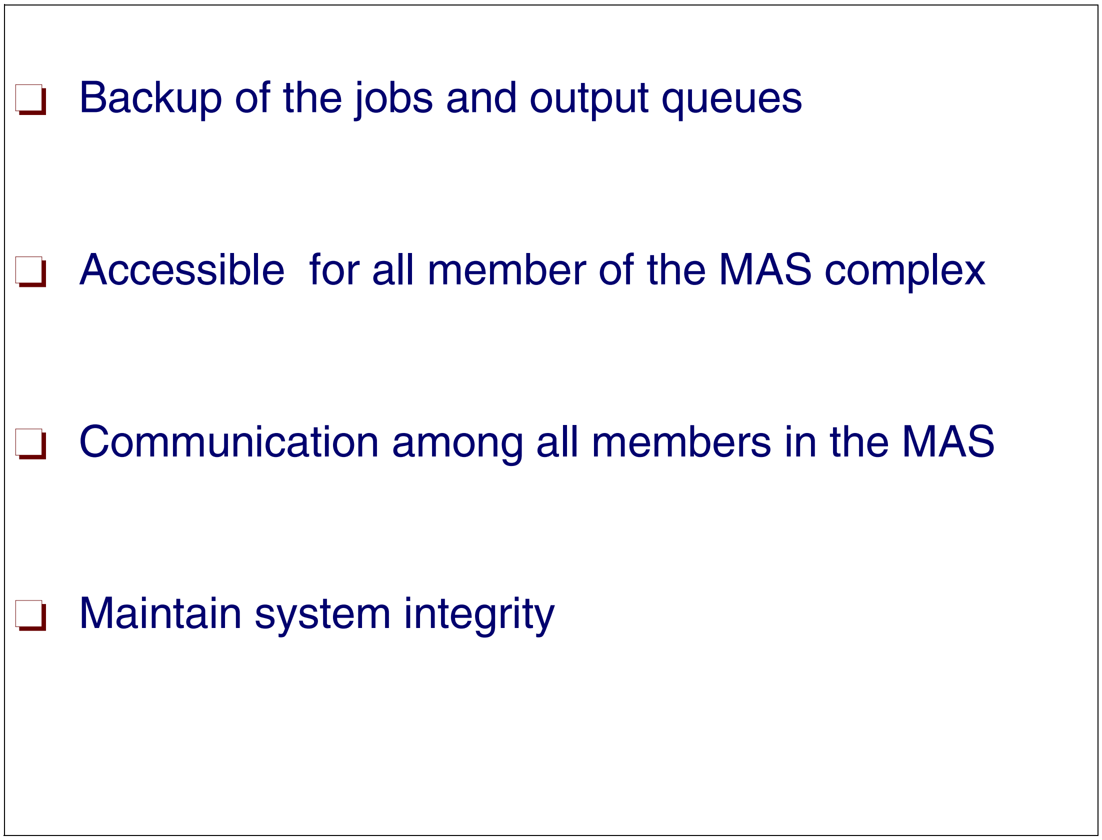


Figure 3-9 JES2 checkpoint data set

JES2 checkpointing

Errors can occur while processing jobs and data. Some of these errors can result in the halting of all system activity. Other errors can result in the loss of jobs or the invalidation of jobs and data. If such errors occur, it is preferable to stop JES2 in a way that allows processing to be restarted with minimal loss of jobs and data. The checkpoint data set, checkpointing, and the checkpoint reconfiguration dialog all help to make this possible.

The *checkpoint* is the data set that JES2 maintains on either DASD or a Coupling Facility that permits JES2 to perform two separate functions:

1. Job and output queue backup to ensure ease of JES2 restart, since it contains information about what work is yet to be processed and how far along that work has progressed.
2. In a multi-access spool (MAS) environment, member-to-member workload communication to ensure efficient independent JES2 operation.

JES2 periodically updates the checkpoint data set by copying the changed information from the in-storage copy to the checkpoint data set copy. Information in the checkpoint data set is critical to JES2 for normal processing as well as in the event that a JES2 or system failure occurs.

Checkpointing is the periodic copying of a member's in-storage job and output queues to the checkpoint data set. In a MAS environment, checkpointing ensures that information about a member's in-storage job and output queues is not lost if the member loses access to these queues as the result of either hardware or software errors. Because all members in a JES2

MAS configuration operate in a loosely-coupled manner, each capable of selecting work from the same job and output queues, checkpointing allows all members to be aware of current queue status. Within the single-member environment, the checkpoint function operates solely as a backup to the “in-storage” job and output (SYSOUT) queues maintained by JES2.

There are three ways of specifying the checkpoint configuration mode. The type of mode you select depends upon your JES2 configuration:

- DUPLEX-mode processing with backup:

  JES2 can operate its checkpoint configuration in DUPLEX mode if you have defined two checkpoint data sets, a primary and a duplex. They can be either in DASD or a Coupling Facility. The duplex data set is updated once for every write to the primary. If the primary data set suffers an error, the duplex can provide either an exact duplicate of the primary or a very similar, almost current (depending on when it was last updated) copy of the checkpoint data.

  It is recommended that all members in the JES2 configuration operate, if possible, with DUPLEX=ON in the CKPTDEF. This provides the greatest protection from checkpoint error.

- DUPLEX-mode processing without backup:

  Processing with a single checkpoint data set is not recommended in most cases. If that data set becomes damaged, lost, or suffers an I/O error, and your member experiences a concurrent failure, you will not have a checkpoint data set available to restart JES2. But you have the benefit that JES2 will not need to read/write to two data sets. However, depending on your specific volume or structure use and configuration, it might not be practical for particular members of your JES2 configuration to maintain a backup checkpoint (for example, in systems that manage basically online transactions).

- DUAL-mode processing:

  This configuration also uses two data sets, but in a “flip-flop” scheme; that is, individual members do not always read and write to the same CKPTn data set. However, the member performing a read always uses the checkpoint data set last updated. This is not required in a single-member environment. However, it is recommended in a MAS environment, if the installation is suffering from degraded system performance due to high checkpoint data set I/O. The use of the change provides reduced I/O to the checkpoint data set during most, if not all, update accesses by a member of the multi-access spool configuration.

  Note: This mode cannot be used if any checkpoint data set resides on a Coupling Facility structure.

JES2 provides a dynamic means by which the current checkpoint configuration can be changed. It is the checkpoint reconfiguration dialog, which can be initiated by the operator system or by JES2. JES2 will enter a checkpoint reconfiguration for any of these reasons:

- To complete initialization processing:
  - Either JES2 could not determine the checkpoint data set specifications, or JES2 requires operator verification of the data set specifications
  - JES2 startup option
  - Checkpoint statement definition
- To correct an I/O error to the checkpoint data set
- To move the checkpoint off a volatile Coupling Facility structure

3.10 JES2 configurations

- ❑ Single-processor
- ❑ Multiple-system (multi-access spool)
- ❑ Poly-JES
- ❑ Remote job entry (RJE)
- ❑ Network job entry (NJE)

Figure 3-10 JES2 configurations

The following are possible JES2 configurations:

- Single-system configuration

  A JES2 configuration can contain as few as one processor (one MVS and JES2 system) or as many as 32 processors linked together. A single processor is referred to as a single-system configuration. Such a system is suitable for an installation that has a relatively small work load, or possibly an installation that requires a single processor to be isolated from the remainder of the data processing complex (for example, to maintain a high degree of security).

- Multiple-system configuration (MAS)

  Many installations take advantage of JES2's ability to link processors together to form a multiple-processor complex, which is generally referred to as a multi-access spool (MAS) configuration. A multi-access spool configuration consists of two or more JES2 (MAS) processors at the same physical location, all sharing the same spool and checkpoint data sets. There is no direct connection between the processors; the shared direct access data sets provide the communication link. Each JES2 processor can read jobs from local and remote card readers, select jobs for processing, print and punch results on local and remote output devices, and communicate with the operator. Each JES2 processor in a multiple processor complex operates independently of the other JES2 processors in the configuration.

  The JES2 processors share a common job queue and a common output queue, which reside on the checkpoint data sets. These common queues enable each JES2 processor to share in processing the installation's workload; jobs can run on whatever processor is available and print or punch output on whatever processor has an available device with the proper requirements. Users can also specifically request jobs to run on a particular processor and output to print or punch on a specific device. If one processor in the configuration fails, the others can continue processing by selecting work from the shared queues and optionally take over for the failed processor. Only work in process on the failed processor is interrupted; the other JES2 systems continue processing.

- Running multiple copies of JES2 (Poly-JES)

  MVS allows more than one JES2 subsystem to operate concurrently, if one subsystem is designated as the primary subsystem and all others are defined as secondary subsystems. A secondary JES2 does not have the same capabilities as the primary JES2, and some restrictions apply to its use. Most notably, TSO/E users can only access the primary subsystem. The restrictions are necessary to maintain the isolation from the MVS-JES2 production system, but the convenience for testing is a valuable function. Operation of multiple copies of JES2 is referred to as poly-JES. Secondary JES2s can be useful in testing a new release or installation-written exit routines. This isolation prevents potential disruption to the primary JES2 and base control program necessary for normal installation production work.

- JES2 remote job entry (RJE)

  An RJE workstation is a workstation that is connected to a member by means of data transmission facilities. The workstation can be a single I/O device or group of I/O devices or can include a processor such as a z/Series machine. Generally, RJE workstations include a programmable workstation (such as a personal computer) connected to the MVS system through a telecommunication link. Such a link utilizes synchronous data link control (SDLC) or binary synchronous communication (BSC) protocols for communicating between JES2 and remote devices. The remote device will be either a system network architecture (SNA) remote, which uses SDLC, or a BSC remote, which uses BSC. Figure 3-11 on page 131 shows a simple RJE configuration.

- JES2 network job entry (NJE)

  The JES2 network job entry facility is similar to remote job entry (RJE) in that both provide extensions to a computer system. In its simplest terms, NJE is “networking” between systems that interact as peers, whereas RJE is networking between JES2 and workstations. The main difference between them is one of overall computing power and processor location. Remember, RJE is an extension of a single computer system (that is, either a single-processor or multi-access spool complex) that allows jobs to be submitted from, and output routed back to, sites that are remote to the location of that system. NJE provides a capability to link many such single-processor systems or multi-access spool complexes into a processing network. Each system can be located on the same physical processor, side-by-side in a single room, or across the world in a network of thousands of nodes. The important difference is that a processor and its local and remote devices make up a node. Two or more attached nodes make up an NJE network.

3.11 JES2 example of an RJE configuration

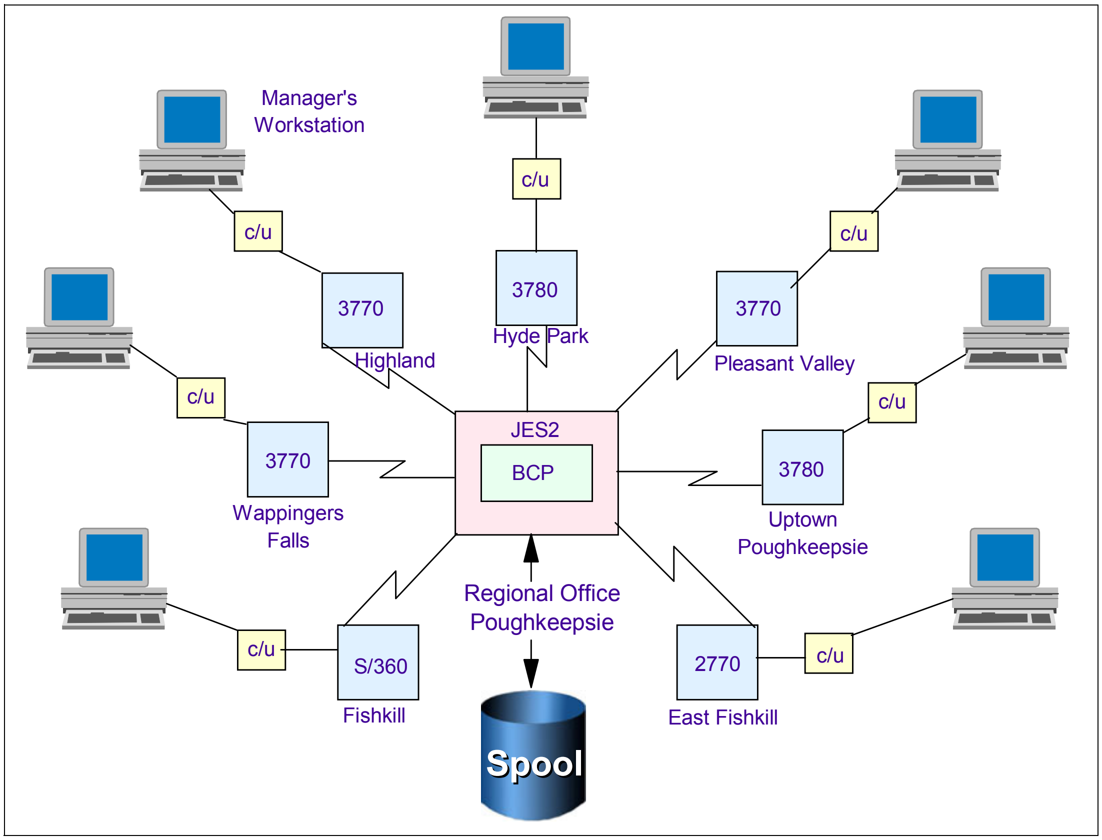


Figure 3-11 JES2 example of a RJE configuration

An RJE workstation is an extension of the local processing facility, except that work is sent across teleprocessing lines. Sending work across teleprocessing lines is convenient for an installation that needs to provide many data entry points at remote locations or route output to many diverse locations. The following examples illustrate the use of RJE in two familiar daily business scenarios:

- In a large department store, many sales clerks need to print output on printers located at the many customer check-out desks throughout the store. Because the location of the building prevents direct connection to the MVS system located in the central office located several hundred miles away, each printer can be defined to JES2 as a remote printer.
- Consider a clothing store chain in which the store managers at seven different stores all need to place orders, access inventory, and provide billing information, all the information for which is maintained on storage devices located in the computer center at the main office. An individual store's workstation is defined to JES2 as an SNA-attached remote to which the individual terminals are defined and as such become an extension of the JES2 configuration located at the main office.

As depicted in Figure 3-11, each of the clothing stores within a localized region of New York (the Hudson Valley towns of Highland, Hyde Park, Pleasant Valley, and so forth) is connected to the single processor located at the regional office in Poughkeepsie. One MVS/JES2 system conducts the business of inventory control, shipping, and billing for all of the stores in the region.

JES2 processes remote jobs in the same manner as those received from a local reader. (Local devices are printers, punches, card readers, and lines directly attached to the system without the need of transmission facilities.) The terminals and printers located in the Poughkeepsie office are locally attached; all other I/O devices (terminals and printers) in all the other branch stores are defined to JES2 as remote terminals and printers.

To provide RJE processing, the RJE workstation must be defined to the local processor. There are two protocols available by which JES2 can communicate with the RJE workstations: synchronous data link control (SDLC) and binary synchronous communication (BSC).

An RJE workstation can have a processor, like the System/370™, that runs a JES2-generated program. The JES2-generated program allows the processor to send jobs to, and receive data from, JES2. Such RJE workstations have generally been replaced by either a programmable workstation (such as a personal computer) or a network job entry configuration, and they are rarely used in today's processing environment. Some RJE workstations do not have a processor. These workstations use a remote terminal, for example, a 2780 or 2770, to enter jobs into, and receive data from, JES2.

Refer to *z/OS JES2 Initialization and Tuning Guide*, SA22-7532-02 for a more complete discussion of RJE concepts.

3.12 JES2 example of an NJE configuration

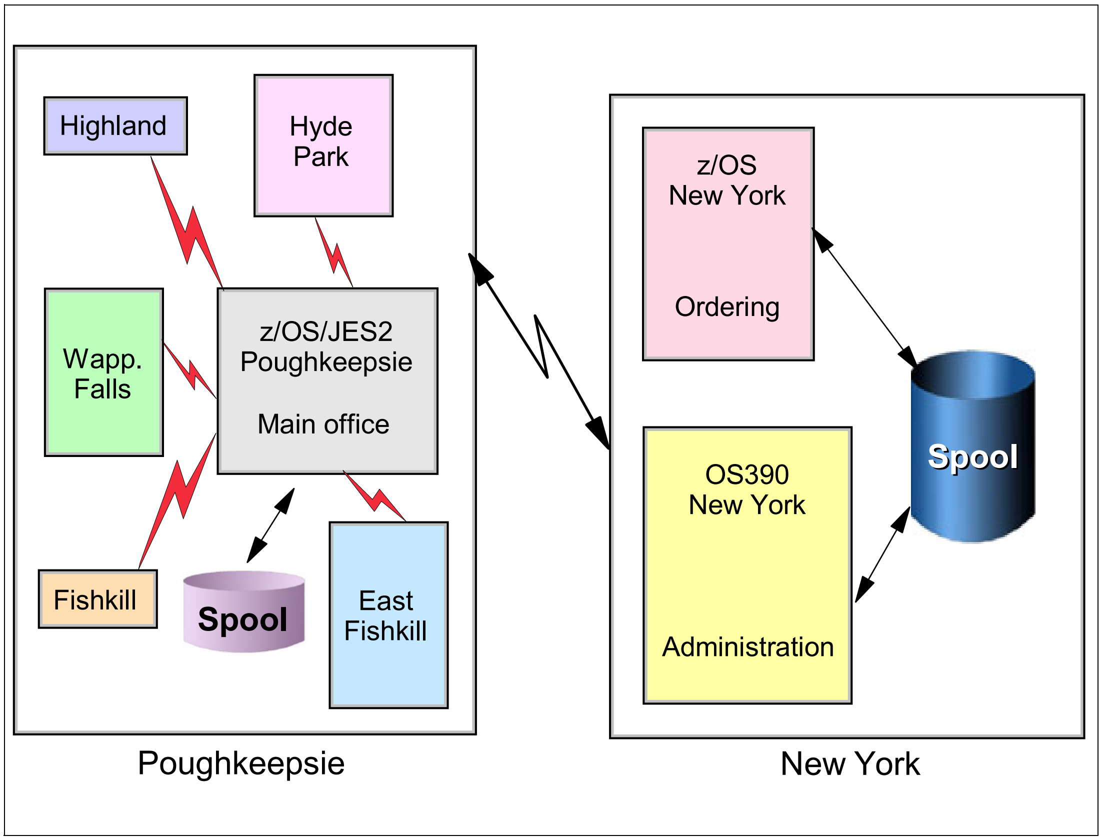


Figure 3-12 JES2 example of an NJE configuration

The JES2 network job entry (NJE) facility is similar to remote job entry (RJE) in that they both provide extensions to a computer system.

NJE network nodes communicate (send and receive data) using various teleprocessing facilities. Nodes on the same physical processor use the Virtual Telecommunications Access Method (ACF/VTAM) program product to communicate; no hardware is required. Nodes located in the same room or building can utilize channel-to-channel adapters (CTCA) or telecommunication links. Nodes that are geographically dispersed utilize SNA or BSC telecommunication links. The following example further explains this concept.

If we return to the previous example of the clothing store chain, the Poughkeepsie regional office is the location of the processor (MVS and JES2); each of the sites (Highland, Hyde Park, Pleasant Valley, Fishkill, and so forth) is attached to the Poughkeepsie office as a remote site. Together, all the locations shown in Figure 3-11 comprise the Poughkeepsie node. For a locally owned, relatively small clothing store chain such as the one depicted, this complex may suffice. However, for a national clothier or one dealing in the import/export business, one processor would likely prove to be inadequate. Such a company would likely elect to establish many nodes throughout the world, each connected to all others in an NJE complex. Refer to Figure 3-12 for a diagrammatic view of such a network. Note that the different groups of the ordering/billing department and the business administration/payroll department can be separate members of a MAS making up the New York node.

Also note that the New York node is a multi-access spool configuration; Poughkeepsie is the configuration illustrated in Figure 3-11 on page 131, and all the other nodes located around the world (which are not depicted) are simple single-system configurations. In the network, a store manager in Pleasant Valley can order an item, the Poughkeepsie office (the main office for the Hudson Valley region) tallies the orders from this store and its other six stores and submits its order to the clothier chain headquarters located in New York City. The request and subsequent confirmation of the order is not instantaneous due to the distance and the traffic in the system but is a faster and a more efficient method of doing business than a telephone conversation, particularly if you further consider time zone differences. *Traffic* refers to the number of users, requests, jobs, and data currently being routed across available teleprocessing lines.

3.13 JES2 customization

Figure 3-13 JES2 customization

JES2 is designed to be tailored to meet an installation's particular processing needs. You can address your basic customization needs when you create the JES2 initialization data set. If you find this control over JES2 processing to be insufficient, JES2 also provides exits and table pairs to change many JES2 functions or processes.

If you need to modify JES2 processing beyond the capability provided by initialization statements, and elect to do so through installation-written code, such code should be isolated from the IBM-shipped source code. Changes to JES2 processing implemented through direct source code modification are error prone, counter-productive during migration to future releases, and can prove to be very time-consuming when debugging, diagnosing, and applying IBM-written fixes (program temporary fixes (PTFs) and authorized program analysis report (APARs) fixes) to code. Further, alteration of JES2 processing in this manner complicates IBM service assistance. Therefore, JES2 provides several means of allowing you to tailor its processing without direct source code modification.

Recommended methods for tailoring JES2 processing include JES2 table pairs, IBM-defined exits, and installation-defined exits. A general discussion of each is provided later in this chapter. Refer to *z/OS JES2 Installation Exits*, SA22-7534-03 for a complete description of each IBM-defined exit.

JES2 initialization data set

Because every installation that uses JES2 to manage its work input and output is unique, so too are the requirements each installation has on JES2. To meet these needs, JES2 is highly tailorable, and with minimal effort, a system programmer can customize most JES2 functions by changing and using the JES2 initialization data set that is provided with the product in the HASIPARM member of the SYS1.VnRnMn.SHASSAMP data set. Although this data set will not run as shipped without some installation additions, it is a valuable model that can save hours of system programmer input time.

With a set of approximately 70 initialization statements, you can control all JES2 functions. The JES2 initialization data set provides all the specifications that are required to define output devices (printers and punches), job classes, the JES2 spool environment, the checkpoint data sets, the trace facility, and virtually every other JES2 facility and function.

Each initialization statement groups initialization parameters that define a function. The use of most JES2 initialization statements is optional. That is, you need not define them unless you need to implement or tailor a particular function. Further, many of the parameters provide default specifications that allow your installation to perform basic JES2 processing with no explicit definition on your part. JES2 requires only a minimal set of initialization statements (and/or parameters) that you define when first installing JES2.

The JES2 initialization data set provides all the specifications that are required to define:

- Output devices (printers and punches)
- Job classes
- The JES2 spool environment
- The checkpoint data sets
- The trace facility
- Every other JES2 facility and function

In the IBM-provided sample data set, SYS1.VnRnMn.SHASSAMP, the HASI* members are samples you can tailor to meet your installation's needs.

JES2 initialization statements give the system programmer a single point of control to define an installation's policies regarding the degree of control users have over their jobs. For example, consider the confusion an installation would experience if users were allowed to define their own job classes and priorities. Very likely, all users would define all their jobs as top priority, resulting in no effective priority classifications at all.

JES2 provides an assortment of commands you can use to dynamically alter JES2 customization whenever your processing needs change. Table 3-1 identifies the available JES2 initialization statements.

Table 3-1 JES2 initialization statements

Initialization statement	Function
APPL(avvvvvvv)	Defines an SNA NJE application to JES2.
BADTRACK	Specifies an address or range of addresses of defective spool volume tracks JES2 is not to use.
BUFDEF	Defines the local JES2 buffers to be created.
CKPTDEF	Defines the JES2 checkpoint data set(s) and the checkpointing mode.
COMPACT	Defines a compaction table for use in remote terminal communications.
CONDEF	Defines the JES2 console communication environment.
CONNECT	Specifies a static connection between the nodes identified.
DEBUG	Specifies whether debugging information is to be gathered by JES2 during its operation for use in testing.
DESTDEF	Defines how JES2 processing interprets and displays both job and SYSOUT destinations.

Initialization statement	Function
DESTID(jxxxxxxx)	Defines a destination name (mostly for end-user use, as on a JCL statement) for a remote terminal, another NJE node, or a local device.
D MODULE(jxxxxxxx)	Displays diagnostic information for specified JES2 assembly modules and installation exit assembly modules.
ESTBYTE	Specifies, in thousands of bytes, the default estimated output (SYSOUT) for a job at which the "BYTES EXCEEDED" message is issued, and the subsequent action taken.
ESTIME	Specifies, in minutes, the default elapsed estimated execution time for a job, the interval at which the "TIME EXCEEDED" message is issued, and whether the elapsed time job monitor feature is supported.
ESTLNCT	Specifies, in thousands of lines, the default estimated print line output for a job, the interval at which the "LINES EXCEEDED" message is issued, and the subsequent action taken.
ESTPAGE	Specifies the default estimated page output (in logical pages) for a job, the interval at which the "PAGES EXCEEDED" message is issued, and the subsequent action taken.
EXIT(nnn)	Associates the exit points defined in JES2 with installation exit routines.
FSS(accccccc)	Specifies the functional subsystem for printers that are supported by an FSS (for example Print Services Facility).
INCLUDE	Allows new initialization data sets to be processed.
INIT(nnn)	Specifies the characteristics of a JES2 logical initiator.
INITDEF	Specifies the number of JES2 logical initiators to be defined.
INTRDR	Specifies the characteristics of all JES2 internal readers.
JOBCLASS(v)	Specifies the characteristics associated with job classes, started tasks, and time sharing users.
JOBDEF	Specifies the characteristics that are assigned to jobs that enter the JES2 member.
JOBPRTY(n)	Specifies the relationship between job scheduling priorities and job execution time.
LINE(nnnn)	Specifies the characteristics of one teleprocessing line or logical line (for SNA) to be used during remote job entry or network job entry.
L(nnnn).JT(m)	Specifies the characteristics for a job transmitter on an NJE line.
L(nnnn).ST(m)	Specifies the characteristics for a SYSOUT transmitter on a line defined for network job entry.
LOADMOD(jxxxxxxx)	Specifies the name of a load module of installation exit routines to be loaded.
LOGON(n)	Identifies JES2 as an application program to VTAM.
MASDEF	Defines the JES2 multi-access spool configuration.
MEMBER(n)	Defines the members of a JES2 multi-access spool configuration.
NAME	Specifies the module or control section to be modified through subsequent VER and REP initialization statements.

Initialization statement	Function
NETACCT	Specifies a network account number and an associated local account number.
NJEDEF	Defines the network job entry characteristics of this JES2 node.
NODE(nnnn)	Specifies the characteristics of the node to be defined.
OFF(n).JR	Specifies the characteristics of the offload job receiver associated with an individual offload device.
OFF(n).JT	Specifies the characteristics of the offload job transmitter associated with an individual offload device.
OFF(n).SR	Specifies the characteristics of the offload SYSOUT receiver associated with an individual offload device.
OFF(n).ST	Specifies the characteristics of the offload SYSOUT transmitter associated with an individual offload device.
OFFLOAD(n)	Specifies the characteristics of the logical offload device.
OPTSDEF	Defines the options that are currently in effect.
OUTCLASS(v)	Specifies the SYSOUT class characteristics for one or all output classes.
OUTDEF	Defines the job output characteristics of the JES2 member.
OUTPRTY(n)	Defines the association between the job output scheduling priorities and the quantity (records or pages) of output.
PCEDEF	Specifies the definition for various JES2 processes.
PRINTDEF	Defines the JES2 print environment.
PROCLIB	Ensures that data sets specified can be allocated.
PRT(nnnn)	Specifies the characteristics of a local printer.
PUNCHDEF	Defines the JES2 punch environment.
PUN(nn)	Specifies the characteristics of a local card punch.
R(nnnn).PR(m)	Specifies the characteristics of a remote printer.
R(nnnn).PU(m)	Specifies the characteristics of a remote punch.
R(nnnn).RD(m)	Specifies the characteristics of a remote card reader.
RDR(nn)	Specifies the characteristics of a local card reader.
RECVOPTS(type)	Specifies the error rate below which the operator will not be involved in the recovery process.
REDIRect(vvvvvvvv)	Specifies where JES2 directs the response to certain display commands entered at a console.
REP	Specifies replacement patches for JES2 modules during initialization.
REQJOBID	Describes attributes to be assigned to Request Jobid address spaces.
RMT(nnnn)	Specifies the characteristics of a BSC or SNA remote terminal.
SMFDEF	Specifies the system management facilities (SMF) buffers to JES2.
SPOOLDEF	Defines the JES2 spool environment.

Initialization statement	Function
SSI(nnn)	Specifies the characteristics associated with individual subsystem interface definitions.
SUBTDEF	Specifies the number of general purpose subtasks you wish JES2 to attach during initialization.
TPDEF	Defines the JES2 teleprocessing environment.
TRACE(n)	Specifies whether a specific trace ID(s) is to be started.
TRACEDEF	Defines the JES2 trace environment.
VER	Specifies verification of replacement patches for JES2 modules during initialization.

For more information, refer to *z/OS JES2 Initialization and Tuning Reference*, SA22-7533-03 and *z/OS JES2 Initialization and Tuning Guide*, SA22-7532.

When you are first getting started, you need not define or even be concerned about some of the more sophisticated processing environments such as a multi-access spool complex, nodes, or remote workstations. You are simply building a base on which your installation can grow. There is no need to be overwhelmed with the potential complexity of your JES2 system.

As your installation grows, you will likely use more and more of JES2's available functions. The sample data set shipped in SYS1.PARMLIB contains all default values and requires only the addition of installation-defined devices and installation-specific values. It contains all the JES2 initialization statements and the defaults for all parameters for which they are provided.

JES2 table pairs

Table pairs provide a facility to change, delete, or add to JES2 processing and/or function. Changes made to JES2 processing using table pairs are generally less prone to error than are changes made through installation exits. This is true because JES2 macros generate the tables and generally require you to write less code to be run.

A number of JES2 functions (such as initialization statement processing, command processing, and message building) use tables. You can customize these JES2 functions, and others, by extending their associated tables. JES2 examines two tables, known as a table pair. The first table (the JES2 table) provides the default processing specifications; the second table (the user table) is used to extend, change, or delete the default processing specifications. For example, you can add your own JES2 commands and messages, add a new initialization statement or parameter, abbreviate the length of a JES2 command, or delete an unnecessary command to prevent its accidental misuse.

To simplify the use of this facility you can use the JES2 default tables as templates for construction of installation-written tables. Depending on the table(s) from which you choose to add, change, or delete, using table pairs generally takes less detailed knowledge of JES2 internal structure than does writing an exit.

Table pairs do not replace the need for exits. Table pairs and exit points can provide added capability either independently or in conjunction with one another.

3.14 JES2 exits

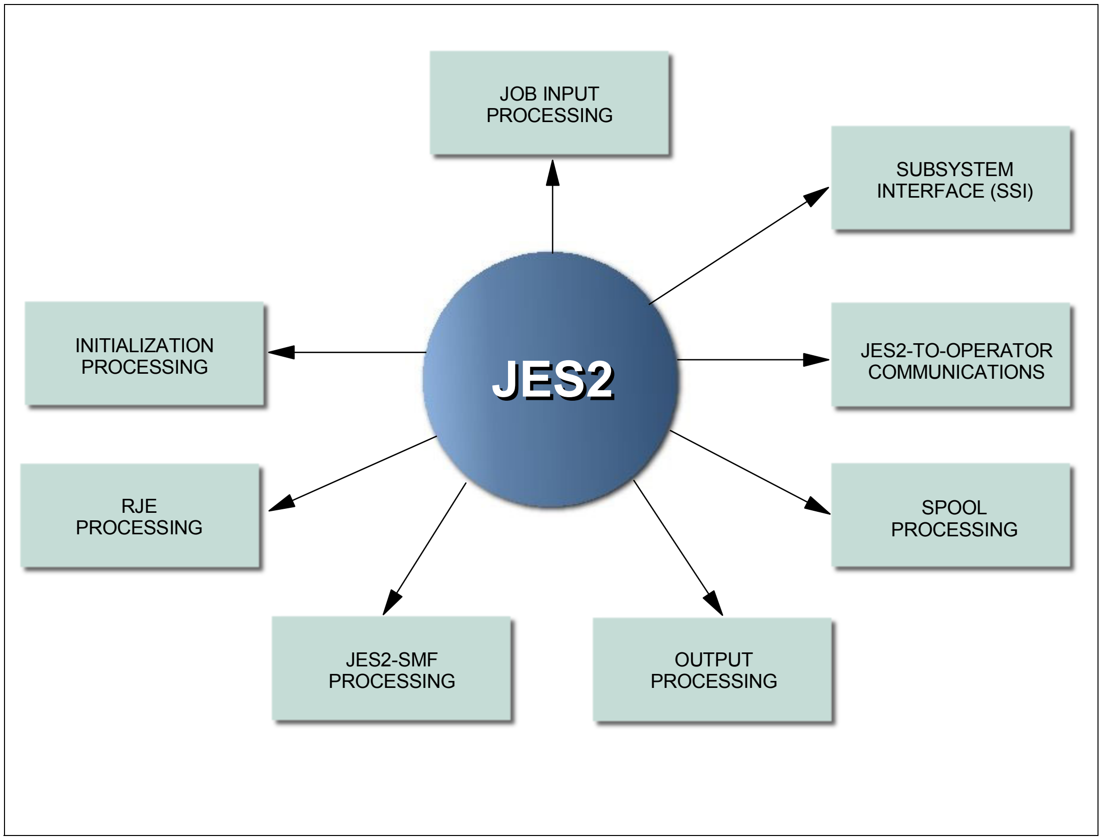


Figure 3-14 JES2 - exits

JES2 may not satisfy all installation-specific needs at a given installation. When you modify JES2 code to accomplish your specific functions, you are susceptible to the migration and maintenance implications that result from installing new versions of JES2. JES2 exits allow you to modify JES2 processing without directly affecting JES2 code. In this way, you keep your modifications independent of JES2 code, making migration to new JES2 versions easier and making maintenance less troublesome.

- Initialization processing

  You can modify the JES2 initialization process and incorporate your own installation-defined initialization statements in the initialization process. Also, you can change JES2 control blocks prior to the end of JES2 initialization.

- Job input processing

  You can modify how JES2 scans and interprets a job's JCL and JES2 control statements. Also, you can establish a job's affinity, execution node, and priority assignments before the job actually runs.

- Subsystem interface (SSI) processing

  You can control how JES2 performs SSI processing in the following areas: job selection and termination, subsystem data set OPEN, RESTART, allocation, CLOSE, unallocation, end-of-task, and end-of-memory.

- JES2-to-operator communications

  You can tailor how JES2 communicates with the operator and implement additional operator communications for various installation-specific conditions. Also, you can preprocess operator commands and alter, if necessary, subsequent processing.

- Spool processing

  You can alter how JES2 allocates spool space for jobs.

- Output processing

  You can selectively create your own unique print and punch separator pages for your installation output on a job, copy, or data set basis.

- JES2-SMF processing

  You can supply to SMF added information in SMF records.

- RJE processing

  You can implement additional security checks to control your RJE processing and gather statistics about signons and signoffs.

JES2 provides various strategic locations, called exit points, from where an installation-written exit routine can be invoked. JES2 can have up to 256 exits, each identified by a number from 0 to 255. JES2 code includes a number of *IBM-defined exits*, which have already been strategically placed in the code. For these IBM-defined exits you need only write your own exit routines and incorporate them via the EXIT(nnn) and LOAD(xxxxxx) initialization statements, where *nnn* is the exit point number and *xxxxxx* is the load module name.

If the IBM-defined exits are not sufficient, you can define your own exit points. However, exits established by you are modifications to JES2 code, and you must remember that you run a greater risk of disruption when installing a new version of JES2 code. The new JES2 code into which you have placed your exits may have significantly changed since the insertion of your exit point.

The IBM-defined exits can be classified into two categories:

- Not job-related exits:

  These are exits taken during functions not necessarily related to individual jobs (for example, JES2 initialization, JES2 termination, RJE, and JES2 command processing).

- Job-related exits:

  These exits are described in further detail in the following section.

3.15 JES2 input-related exits

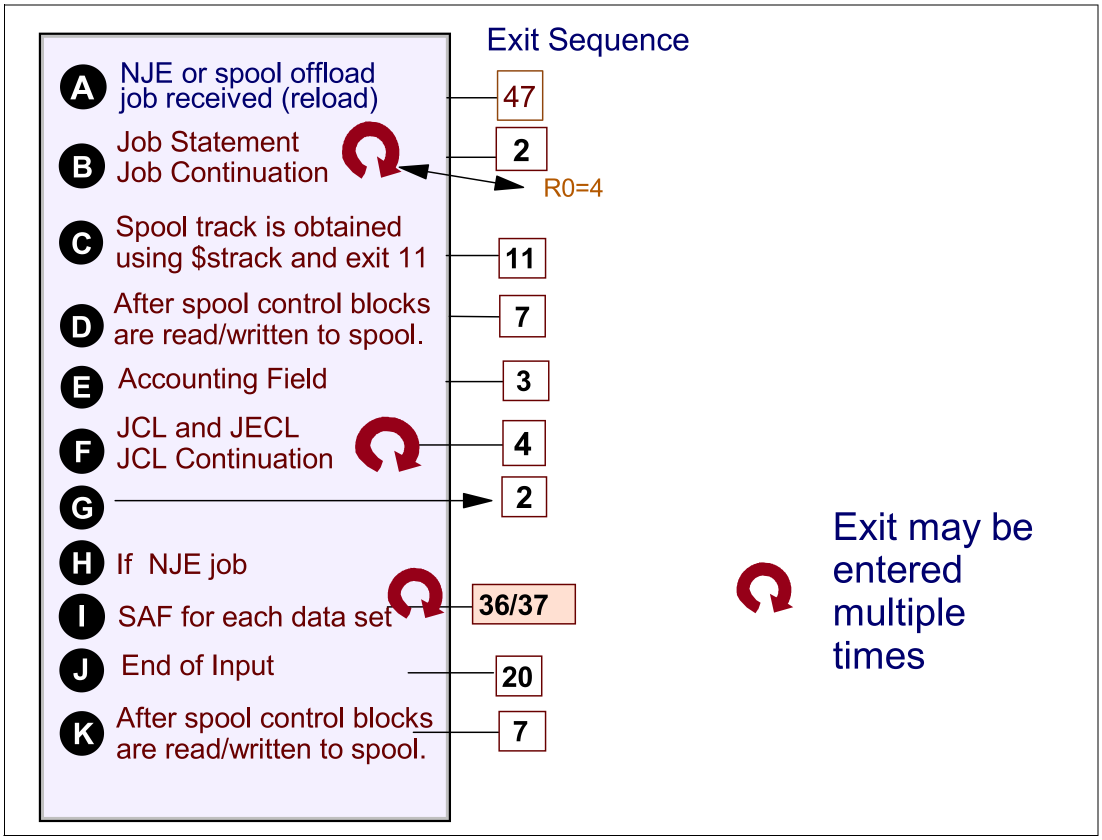


Figure 3-15 JES2 input-related exits

Jobs that come in through the input phase go through the following exits:

- **Specific purpose exits** provide specific functions. These exits do not occur at predictable intervals during the life of a job. For that reason, they are not appropriate for general-purpose use. Examples of specific purpose exits are job output overflow (Exit 9) and spool partitioning exits (Exits 11 and 12).
- **General purpose exits** are usually considered when there is a user requirement to control installation standards, job resources, security, output processing, and other job-related functions.

There are two major considerations when selecting an exit to satisfy user requirements:

1. The environment of the exit

   This determines the addressable data areas, the facilities available when the exit is taken, and so forth.

2. The sequence of the exits

   Which exits precede and which exits follow each exit? What processing has preceded and followed the exit? It is very important to avoid some exit processing in order to avoid being overridden by another exit's processing.

Often the use of more than one exit is required, and sometimes a combination of JES2 and other exits (such as Systems Management Facilities (SMF) exits) must be used. Table 3-2 on page 143 and Table 3-3 on page 144 list the job-related exits in order to help you decide which exits to choose to control certain processes or functions during the life of a job.

Many installations use input service exits to control installation standards, tailor accounting information, and provide additional controls. When choosing an exit to act in this phase, it is important to consider all sources of jobs, especially if you want to select jobs from some sources to follow standards. For more details, refer to *JES2 Installations Exits*, SC28-1793

Table 3-2 JES2 job-related exits

Exit	Exit title	Comments and some specific uses
1	Print/punch job separator	Taken when a job's data sets have been selected for printing or punching, prior to the check for the standard separator page.
2	JOB statement scan	The first exit taken for a job and before the statement is processed.
3	JOB statement accounting field scan	Taken after JOB statement has been processed. Normally used to replace or supplement JES2's accounting field scanning routine (HASPRSCN), but also used as a post job card exit.
4	JCL and JES2 control statement scan	Taken for each JCL and JECL statement submitted but not for PROCLIB JCL statements.
6	Converter/Interpreter Text scan	A good exit for scanning JCL because of structured text and single record for each statement (no continuation).
7	$JCT Read/Write (JES2 environment)	Receives control when JES2 main task reads or writes the $JCT.
8	Control Block Read/Write (user or Subtask environment)	Taken from the user address space or a JES2 subtask each time a spool resident control block ($JCT, $IOT, $SWBIT, $OCR) is read from or written to spool.
15	Output Data Set/Copy Select	Taken once for each data set where the data set's $PDDB matches the selected Job Output Element ($JOE) and once for each copy of these data sets.
20	End of Job Input	Taken at the end of input processing and before $JCT is written. This is usually a good place to make final alterations to the job before conversion.
28	SSI Job Termination	Taken at the end of job execution before the $JCT is written to spool.
30	SSI Data Set Open/Restart	Taken for SYSIN, SYSOUT, or internal reader Open or Restart processing.
31	SSI Data set Allocation	Taken for SYSIN, SYSOUT, or internal reader Allocation processing. Uses: Fail an allocation. Affect how JES2 processes data set characteristics.
32	SSI Job Selection	Taken after all job selection processing is complete. Uses: Suppress job selection-related messages. Perform job-related processing such as allocation of resources and I/O for installation-defined control blocks.
33	SSI Data Set Close	Taken for SYSIN, SYSOUT, or internal reader Close processing. Uses: Free resources obtained at OPEN.

Exit	Exit title	Comments and some specific uses
34	SSI Data Set Unallocation - Early	Taken for SYSIN, SYSOUT, or internal reader early in allocate processing. Uses: Free resources obtained by Exit 30.
35	SSI End-of-Task	Taken at end of each task during job execution. Uses: Free task-related resources.
36	Pre-SAF	Taken just prior to JES2 call to SAF. Uses: Provide/change additional information to SAF. Eliminate call to SAF.
37	Post-SAF	Taken just after the return from the JES call to SAF. Uses: Change the result of SAF verification. Perform additional security authorization checking above what SAF provides.
40	Modifying SYSOUT	Taken during OUTPUT processing for each SYSOUT data set before JES2 gathers data sets with like attributes into a $JOE. Uses: Change the destination of a SYSOUT data set. Change the class of a SYSOUT data set to affect grouping.
44	Post Conversion (JES2 environment)	Taken after job conversion processing and before the $JCT and $JQE are checkpointed. Uses: Change fields in the $JQE and $JCT.
46	NJE Transmission	Taken for NJE header, trailer, and data set header during NJE job transmission. Uses: Remove/add/change installation-defined sections to an NJE data area before transmission.
47	NJE Reception	Taken for NJE header, trailer, and data set header during NJE job reception. Uses: Remove/change installation-defined sections that were previously added to an NJE data area.
48	Sysout unallocation - Late	More suitable then exit 34 when modifying SYSOUT characteristics or affecting SPIN processing.
49	Job Queue Work Select	Taken whenever JES2 has located a pre-execution job for a device. Uses: Provide an algorithm to accept or not accept a JES2-selected job. Control WLM initiator job selection.

Table 3-3 Some SMF job-related exits

Exit	Exit Title	Comments and some specific uses
IEFUJV	SMF Job Validation	Receives control: Before each JCL statement is interpreted, and After all the JCL is converted, and again After all the JCL is interpreted.

Exit	Exit Title	Comments and some specific uses
IEFUJI	SMF Job Initiation	Receives control before a job on the input queue is selected for initiation. Uses: Selectively cancel the job.
IEFUSI	SMF Step Initiation	Receives control before each job step is started (before allocation). Uses: Limit the user region size.
IEFACTRT	SMF Job Termination	Receives control on the termination of each step or job. Uses: Decide whether the system is to continue the job (for step job). Decide whether SMF termination records are to be written to SMF data set.
IEFUJP	SMF Purge	Receives control when a job is ready to be purged from the system, after the job has terminated and all its sysouts have been written. Uses: Selectively decide whether the SMF job purge record (type 26) is to be written to the SMF data set.

3.16 JES2 exits in conversion phase

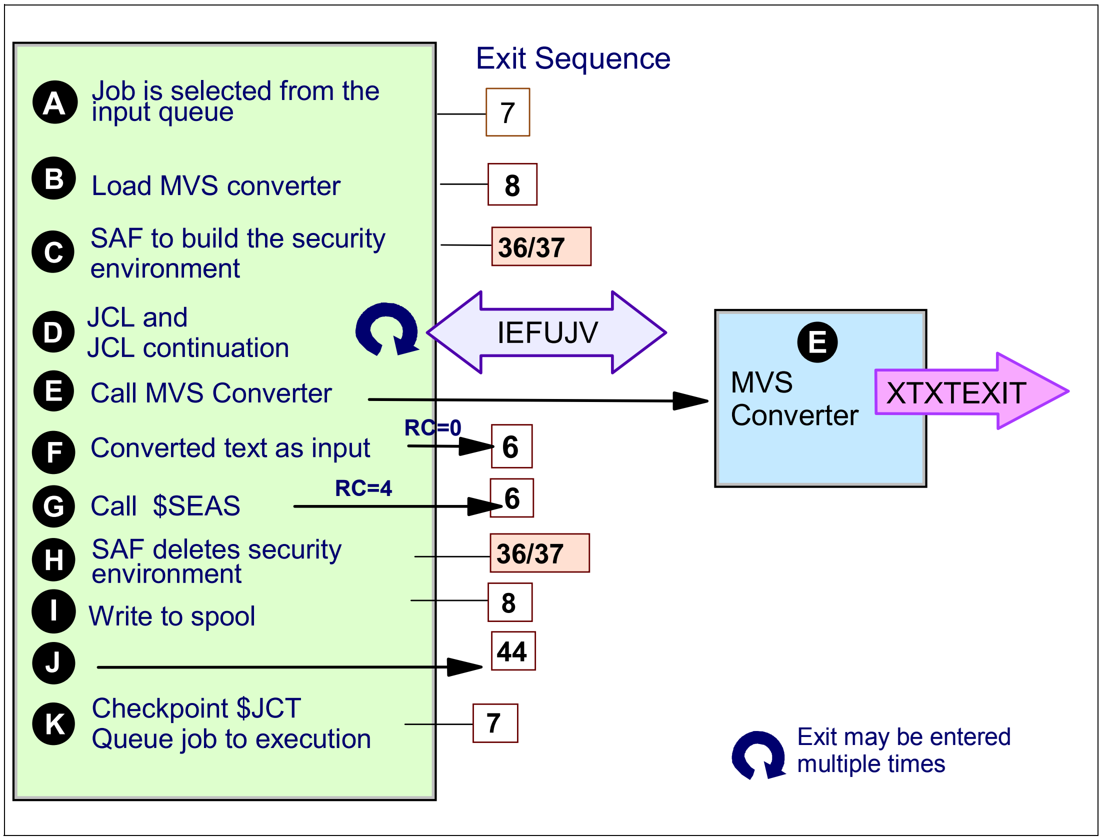


Figure 3-16 JES2 exits in conversion phase

The conversion phase of JES2 processing is accomplished in two environments. First the Converter Processor Control Element ($PCE) is dispatched in the JES2 maintask environment to select a job from the input queue. Secondly, the Converter subtask, after being posted by the Converter maintask, calls the MVS Converter to do the actual conversion (JCL to C/I text). The reason for the subtask environment is that the conversion process requires the reading of the JCL data set from spool, reading JCL from PROCLIB, writing JCL images to spool, and the writing of C/I text to spool. These I/O operations cannot be accomplished in the maintask environment.

It's important to understand the difference in these two environments when considering exit usage. Exit 7 executes in the maintask environment, and Exit 6, and the SMF IEFUJV exit, execute in the subtask environment. If maintask functions are needed for a subtask exit, it may be necessary to use two exits, for example Exits 6 and 44 in conjunction, to provide a specific function.

Another important consideration is that there can be (and usually are) more than one converter processor (and subtask) and therefore, any exits taken in the subtask (Exits 6 and exit, IEFUJV) must be MVS reentrant. The scenario illustrated in Figure 3-16 is described by the conversion processing presented in Table 3-4.

Table 3-4 Conversion Phase Processing

Step	Processing	Exit used
A	A job is selected from the input queue, and the job's $JCT is read from spool. Exit 7 is invoked with a value of zero in general register zero (R0=0). The Daughter Task Element (DTE) is initialized and the Converter subtask is POSTed.	7
B	The JES2 conversion subtask locates the job's $PDDBs (JES2 Peripheral Data Definition Blocks) and Fake Opens the ACBs (Access Control Blocks) for internal text, job log, system messages, JCL, and JCL images data sets. The Converter subtask LOADs the MVS Converter, if the Converter has not already been loaded. Exit 8 is taken for reading the $IOTs from spool.	8
C	The Security Access Service ($SEAS) macro calls the Security Authorization Facility (SAF) to build the security environment in case the job stream contains MVS commands which if present, would be issued by the Converter using the Command SVC. The user ID associated with the command would be the user's, not JES2. As a result of the $SEAS call, Exits 36 and 37 are called.	36 37
D	For each JCL image, SMF exit IEFUJV (entry codes 0, 4, 8, and 64) is taken. This includes continuation statements. IEFUJV is called once more with an entry code of 16.	SMF exit IEFUJV
E	After the statement and all continuation statements have been converted into C/I text, the Converter exit, XTXTEXIT is called to provide spool data set names for SYSIN and SYSOUT JCL statements. If the statement represents a SYSIN data set, a $SEAS call is made to audit the creation.	XTXTEXIT
F	After the spool data set names have been generated (if SYSIN or SYSOUT), Exit 6 is invoked (R0=0) with the completed C/I text statement as input to the exit.	6
G	At the completion of conversion and after the Converter returns to the JES2 converter processor module, a $SEAS call is issued to delete the security environment. Exit 6 (R0=4) is taken again to allow final processing.	6
H	As a result of the $SEAS call, Exits 36 and 37 are called.	36 37
I	Exit 8 is taken to write the $IOTs. The JES2 converter processor module subtask POSTs its maintask and WAITs for the next job.	8
J	Exit 44 is taken to allow user modifications that require the maintask environment. Using the $DOGJQE macro you can access and optionally update fields in the JQE.	44
K	The JES2 converter processor module maintask checkpoints the $JCT, invokes Exit 7, and queues the $JQE to the execution job queue.	7

The conversion phase offers the only chance to have exit control over all of a job's JCL. Although SMF exit, IEFUJV is taken for each JCL and JCL continuation statement, JES2 Exit 6 offers some advantages.

First, the format of the C/I text is more structured. It is in parsed form and all major syntax errors have been removed. This has all been done by the converter before the exit gets control.

Another advantage of Exit 6 over IEFUJV is that once JCL statements have been converted into C/I text, there are no continuation statements. That is, the entire JCL statement, along with all continuation statements, are represented by a single C/I text statement.

A SAF security environment exists within the subtask and can be used with the RACF FACILITY class to control the specification of options within JCL. Exit 6 messages can be returned to the Converter to be issued by the Converter.

3.17 JES2 exits in execution phase

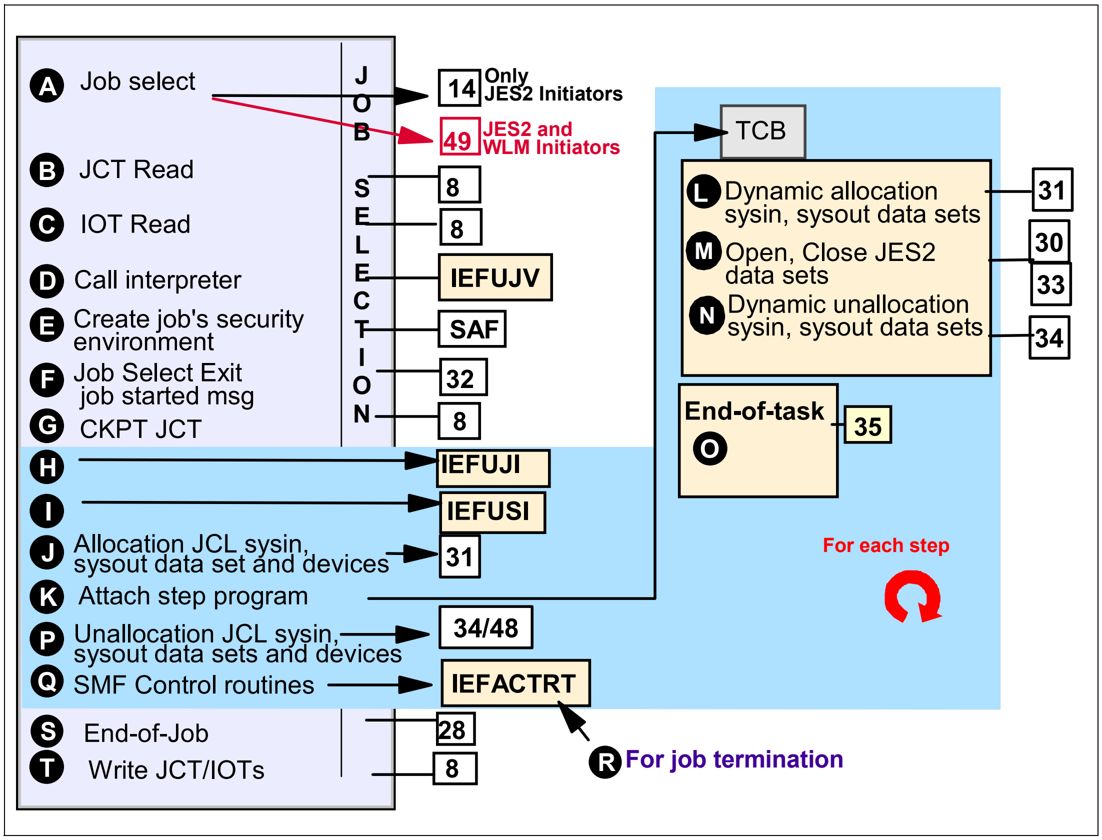


Figure 3-17 JES2 exits in execution phase

This section attempts to merge those functions provided by a section of JES2 code in the JES2 Job Select/Termination module known as “Job Selection” and the pieces of MVS code known in the broad sense as the “Initiator.” The MVS Initiator consists of many modules which perform job selection, allocation, and initiator attach services (and others). JES2 Job Select also includes end-of-job functions.

For the purpose of this discussion, job selection is defined as the period, starting with the initiator’s Subsystem Interface (SSI) call for job selection by class and ending with the JES2 message, `$HASP373 JOB STARTED`. Table 3-5 describes the processing that occurs during the Execution Phase, as depicted in Table 3-17.

Table 3-5 Execution phase exits

Step	Processing	Exit used
A	The MVS Job Selection module issues an SSI call specifying function code 5, which identifies the call to JES2 as a request to select a job by class. SSI calls with a function code of 5 are processed by the JES2 Job Select/Termination module. JBSELECT POSTs JES2 execution processing and WAITs for a job to be selected. If a JES2 initiator is selecting work, JES2 calls Exit 14 to allow the your installation to provide its own queue selection routine or to tailor the selection request. Exit 14 is not a job-related exit, that is, JES2 has not selected a job at this time. Exit 14 can select a job or it can tell JES2 to select a job. If a WLM initiator is selecting work, JES2 does not call Exit 14. After JES2 selects a job from the execution queue, it calls Exit 49, which can accept or reject the job. If Exit 49 rejects the job, JES2 searches for another job. JES2 does not call Exit 49 if Exit 14 selects a job. If JES2 execution processing finds a job that matches the Initiator's defined job classes, it POSTs the waiting initiator and provides the job's $JCT spool address in the $SJB. If a job has been found, control is given to the JBFOUND routine.	14 49
B	The JBFOUND routine reads the job's JES2 $JCT using the spool address passed in the $SJB. Exit 8 is the first exit taken out of the user's (or job's) address space after a job is selected. This first entry to Exit 8 is taken after the job's $JCT has been read. The job name and job-id are available as well as all other information in the $JCT. If later SMF exits for this job need addressability to the JES2 $JCT, store the JES2 $JCT address (as contained in Exit 8 parameter list) into the JCTUCOM field that later becomes the JMRUCOM.	8
C	Exit 8 is again taken to read the primary allocation $IOT. There also may be additional calls to Exit 8 to read secondary allocation $IOTs and/or $PDDB-only $IOTs based on the job's JCL. Exit 8 is called for all spool control block reads and writes. JES2 allows installations to create extensions to the $JCT where job-related accounting data can be stored and transmitted through the network. Using the $JCTX macro extension service, you can add, expand, locate, and delete these extensions.	8
D	The JBFOUND routine calls the MVS SWA Create Control module to obtains storage for and initialize the Interpreter Entry List. The Interpreter Entry List contains information from JES2, such as user ID and security information, and is used for linking to the MVS Interpreter. Both JES2 and MVS have a data area named JCT. The two JCTs are not similar and one is not a copy, or partial copy, of the other. The Interpreter Entry List contains a pointer to the in-storage copy of the beginning of the $JCT JMR area which is used to create the CEPA/JMR. The MVS Interpreter Initialization routine calls the MVS Interpreter Router routine and after the internal text has been interpreted, the MVS Enqueue routine issues the call to SMF exit IEFUJV (entry code of 32). This is the first SMF exit for a job during the execution phase. The Scheduler Work Area (SWA) job and step tables have been created. The JMR pointer, called the CEPA in SMF documentation, is provided in the exit parameter list.	IEFUJV

Step	Processing	Exit used
E	After the Interpreter returns control to the MVS SWA Create Control module, a RACROUTE REQUEST=VERIFY,ENV=CREATE is then issued to create the job's security environment. The SAF Router exit is invoked if it exists and Message ICH70001I is issued by RACF identifying the user. If an error occurred during Job Select processing, for example a JCL error, then the job's security environment is not created.	SAF Router exit
F	Exit 32 is called. The $JCT, all $IOTs, the JMR, and the ACEE have been created and are available. The JBSELECT routine then issues the $HASP373 JOB STARTED message.	32
G	Before job select processing is complete and control returns to the Initiator, JES2 checkpoints (writes to spool) the $JCT. Exit 8 is called.	8
H	Job initiation calls SMF exit, IEFUJI. MVS job initiation is a series of calls to step initiation based on the number of steps in a job.	IEFUJI
I	MVS step initiation consists of a call to SMF exit, IEFUSI, step allocation for those data sets and devices defined in the job's JCL, and a call to the MVS Initiator Attach routine.	IEFUSI
J	Allocation of JCL defined SYSIN, SYSOUT, and internal readers initiates a call to Exit 31.	31
K/L	The MVS Initiator Attach routine attaches a subtask with an entry point of the program name specified on the EXEC JCL statement for the job step. The job step could dynamically allocate JES2 SYSIN, SYSOUT, or internal readers and therefore Exit 31 can be called.	31
M	The OPEN and CLOSE of JES2 data sets and internal readers call Exits 30 and 33.	30 33
N	Dynamic Unallocation of JES2 data sets and internal readers initiate a call to Exit 34. Exit 48 can be used in preference to Exit 34. Exit 34 may be too early to affect some fields in the $PDDB because unallocation processing takes place after Exit 34. Use Exit 48 when altering fields in the $PDDB, this exit can also be used to control Spin processing.	34 48
O	At End-of-Task (EOT) processing an SSI call is made to JES2 and Exit 35 is called.	35
P	Control is passed (return from Attach) to the MVS Initiator Attach routine and subsequently MVS Step Delete calls Step Unallocation which unallocates those data sets and devices defined in the job's JCL on a step basis. Exit 34 is called for JCL defined SYSIN, SYSOUT, and internal readers. Exit 48 is also taken, as mentioned previously.	34 48
Q	The MVS Unallocation routine calls the MVS SMF Control routine which calls SMF exit IEFACTRT with entry codes 20 and 12. If additional job steps are to be processed, control is passed back to step 8. Otherwise, control is passed to Job Termination at step 17.	SMF exit IEFACTRT
R	Job Termination (actually this is Step Termination for the last step) again calls SMF exit IEFACTRT with entry codes 20 and 16. Control is then passed to MVS Step Delete where an SSI call (12) is made for Job Termination.	IEFACTRT
S	End-of-job processing calls Exit 28. This exit can clean up resources obtained over the life of job execution.	28
T	Spool control blocks are checkpointed. Exit 8 is taken for the $JCT write. The $JQE is placed on the OUTPUT queue to await output processing.	8

3.18 JES2 start procedure

```
//JES2      PROC M=JES2PARM
//IEFPROC   EXEC PGM=HASJES20,TIME=1440,
//HASPPARM DD DSN=SYS1.PARMLIB(MEMBER1)
//          DD DSN=SYS1.PARMLIB(COMMON)
//          DD DSN=SYS1.PARMLIB(NJEDEFS)
//          DD DSN=SYS1.PARMLIB(PRINTERS)
//PROC00    DD DISP=SHR,DSN=SYS1.PROCLIB
//PROC01    DD DISP=SHR,DSN=SYS1.PROCLIB
```

Figure 3-18 JES2 start procedure

How to start JES2

JES2 can be started after the z/OS system has been initialized. The z/OS system automatically starts JES2 if your installation provides this capability. Otherwise, you must issue the START command to invoke a JCL procedure in SYS1.PROCLIB that starts JES2. JES2 initialization is performed after JES2 has been started. Initiators will not accept work (process jobs) until JES2 initialization is complete.

JES2 start procedure

To start the JES2 component, an installation must provide a subsystem cataloged JCL procedure (PROC). The PROC name can be a maximum of four characters. The PROC must be defined in the IEFSSNxx member of SYS1.PARMLIB.

The basic JCL procedure is shown in Figure 3-18. It contains an EXEC statement and five DD statements. The EXEC statement could specify the following parameters:

PGM= Specify the name of the JES2 load module that resides in an authorized library.

TIME= Specify 'NOLIMIT' or 1440 to prevent system ABEND code 322.

PARM= Specify JES2 start options. It is suggested that you specify *NOREQ* for the start parameters. *WARM* is the default. Table 3-6 on page 158 lists the JES2 start options available.

It is recommended that you do not specify the REGION parameter to prevent any virtual storage limitations in the JES2 address space. The DD statement parameters specify as follows:

PROC00 Defines a default procedure library to be used for converting the JCL of batch jobs, time-sharing logons, and system tasks.

PROCxx (01-99) Can be used to define other user-cataloged procedure libraries that are associated with job classes by the JOBCLASS initialization statement or by the /*JOBPARM JES2 control statement.

HASPPARM Specifies the data set containing the initialization statements that will be used for JES2 initialization. With this statement, you can control all JES2 functions. The majority of them can be changed dynamically using JES2 commands.

3.19 HASPPARM using INCLUDE statement

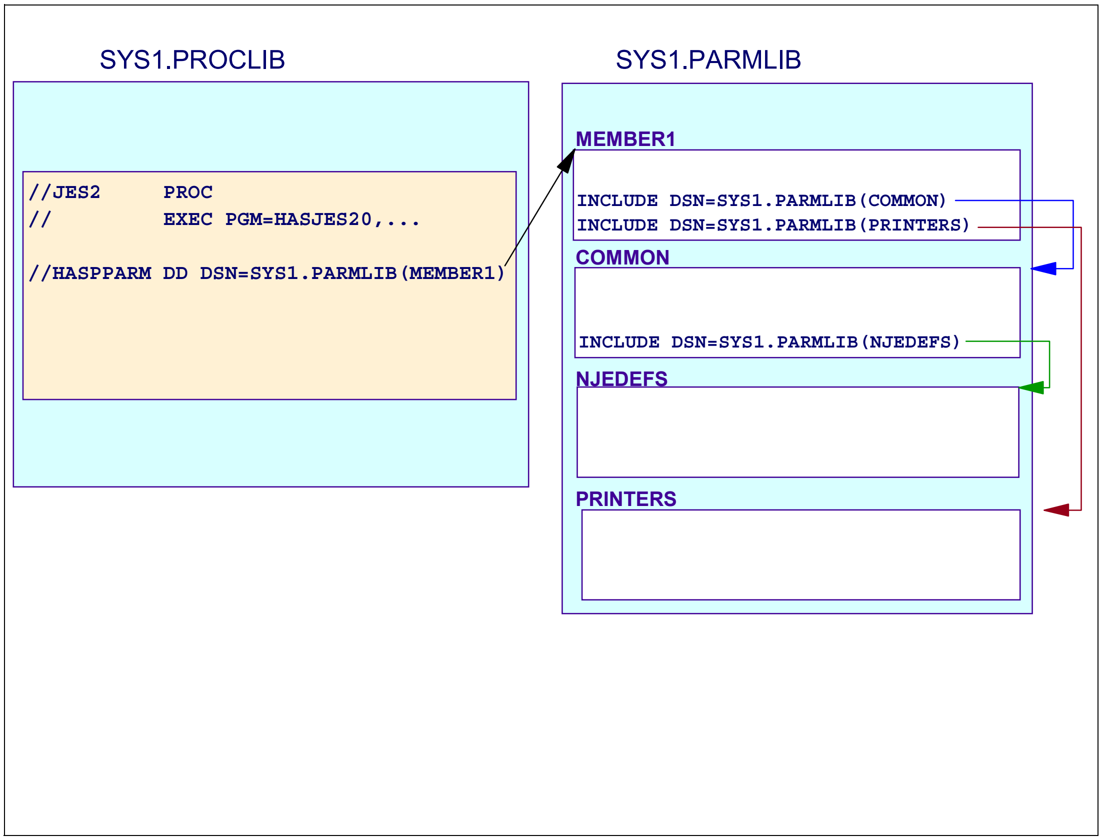


Figure 3-19 HASPPARM using the INCLUDE statement

With JES2 V1R2, the syntax of the INCLUDE initialization statement specifies a required data set name, and a volser and unit (required only if needed for allocation). The data set name can have a member name. The statements in the included data set are processed immediately. When the end of the included data set is reached, processing continues with the statement after the include of the original data set. Includes can be nested. There is loop detection to prevent a nesting loop.

The INCLUDE statement has the following considerations:

- DSNAME can include a member name.
- VOLSER and UNIT are optional (if data set is cataloged).
- Statements in the data sets are processed immediately.
- An INCLUDE data set can have INCLUDE statements.

The following example shows four members that make up the JES2 initialization definitions in the JES2 procedure. Using the INCLUDE statement, the JES2 procedure is simplified, as shown in Figure 3-19.

```
//JES2     PROC
//         EXEC PGM=HASJES20,...
//HASPPARM DD DSN=SYS1.PARMLIB(MEMBER1)
//         DD DSN=SYS1.PARMLIB(COMMON)
//         DD DSN=SYS1.PARMLIB(NJEDEFS)
//         DD DSN=SYS1.PARMLIB(PRINTERS)
```

3.20 Simplified procedure using the default parmlib member

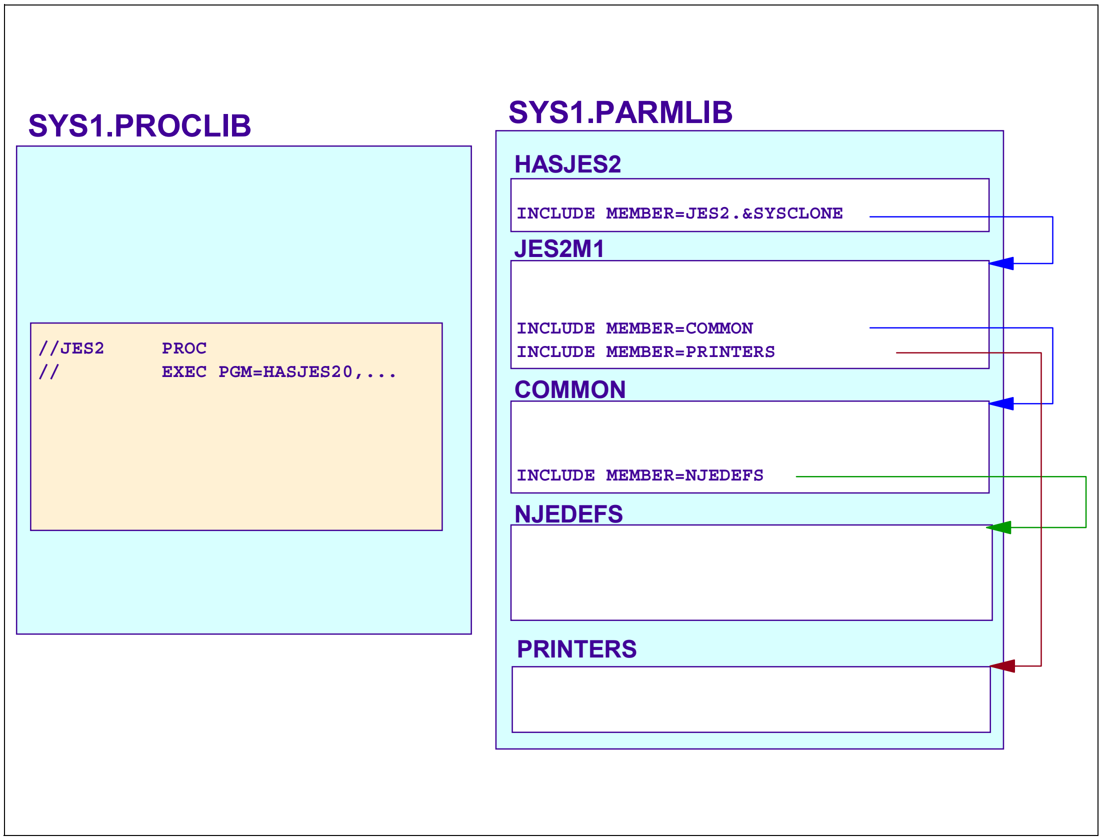


Figure 3-20 Simplified JES2 procedure using the default parmlib member

Enhancement to INCLUDE statement

Improvements to the INCLUDE initialization statement enable the reading of an additional member from the current data sets for the initialization statements. The new syntax added to the INCLUDE statement in JES2 V1R4 is as follows:

- INCLUDE MEMBER=member

  member_a should be in the current parmlib data set being processed.

- INCLUDE PARMLIB_MEMBER=member

  member_b should be in the default logical parmlib.

> **Note:** The new keywords MEMBER and PARMLIB_MEMBER are mutually exclusive with the keywords DSNAME or VOLSER or UNIT.

Default parmlib member

This JES2 V1R4 support allows for a default PARMLIB member. This member is used only if there is no HASPPARM DD and the operator does not use a HASPPARM= start option. The default is HASJES2 where JES2 is the actual subsystem name. The default member comes from the logical PARMLIB concatenation.

There is also the ability to specify the "default" member as a start option, (MEMBER=). If MEMBER= is specified, it will be used. HASPPARM = and MEMBER= are mutually exclusive and can be specified as follows:

MEMBER= If specified by the operator as a start option, then use that member as the default PARMLIB.

HASPPARM= If specified by the operator as a start option, then use that DD name for the PARMLIB.

HASPPARM DD If this DD exists in the JES2 procedure, then use that DD name as the PARMLIB.

Note: If none of the above are specified, then use HASJES2 as the default PARMLIB concatenation.

If there is any problems with any of these, message HASP450 is issued and then the operator can respond if JES2 should continue, just as is done previously if the OPEN of the DD for PARMLIB fails. If the operator replies 'Y', JES2 initialization continues and console mode is entered, which again is the same as previously.

PARMLIB search order

Following is the search order to determine which PARMLIB to use:

1. If HASPPARM=ddname parameter is specified, use that DD.
2. If MEMBER=PARMLIB_MEMBER= parameter is specified, use that member from logical PARMLIB.
3. If neither is specified, try to open DD with ddname of HASPPARM.
4. If no HASPPARM DD is found, use HASjesx member from the logical parmlib, which is the default PARMLIB concatenation. This is HASJES2 in the examples.

Using default PARMLIB

With the new enhancements to the INCLUDE processing, it is now possible to remove the HASPPARM DD from the JES2 procedure, as shown in Figure 3-20. In this example, all the members must be in the logical PARMLIB concatenation and they are in SYS1.PARMLIB.

The HASJES2 member contains an INCLUDE statement that points to PARMLIB member JES2M1, as the value of &SYSCLONE is M1.

3.21 JES2 start parameters

- COLD/WARM
- CKPT1/CKPT2
- NOREQ/REQ
- NOLIST/LIST
- NOLOG/LOG
- FORMAT/NOFMT
- HASPPARM=ddname
- SPOOL=VALIDATE/NOVALIDATE
- CONSOLE
- REC ONFIG
- NONE / U / N

Figure 3-21 JES2 start parameters

JES2 start options

JES2 uses start options to determine how it will perform the current initialization. You can specify start options in either of two ways:

- As parameters on the EXEC statement in the JES2 procedure
- As options specified at the console

If you do not specify the options on the EXEC statement, JES2 requests them from the operator by issuing the $HASP426 (SPECIFY OPTIONS) message.

The operator then enters the options using the standard reply format as described in z/OS JES2 Commands. The operator can enter options in upper or lower case; they must be separated by commas. If the operator enters conflicting options (for example, WARM,COLD), the last option specified is the one JES2 uses.

If the options are specified on the EXEC statement, JES2 suppresses the $HASP426 (SPECIFY OPTIONS) message and completes initialization without operator intervention unless CONSOLE control statements have been added to the JES2 initialization data set or an initialization statement is in error.

If you let JES2 prompt for the options, JES2 issues message $HASP426:

```
*id $HASP426 SPECIFY OPTIONS - jesname
```

You should respond using the z/OS **REPLY** command to specify the JES2 options determined by your installation procedures.

```
REPLY id,options
```

Table 3-6 explains the JES2 start options.

If you respond to message $HASP426 with the **$PJES2** command, JES2 will terminate.

Note: If you specify the `NOREQ` option, JES2 will automatically start processing following initialization. Otherwise, you must enter the **$S** command in response to the `$HASP400 ENTER REQUESTS` message to start JES2 processing.

Table 3-6 JES2 start parameters

Option	Explanation
FORMAT NOFMT	FORMAT specifies that JES2 is to format all existing spool volumes. If you add unformatted spool volumes, JES2 automatically formats them whether FORMAT is specified or not. With FORMAT, JES2 automatically performs a cold start. Default: NOFMT specifies that JES2 is not to format existing spool volumes unless JES2 determines that formatting is required.
COLD WARM	COLD specifies that JES2 is to be cold-started. All jobs in the system will be purged and all job data on the spool volumes will be scratched. Default: WARM specifies that JES2 is to continue processing jobs from where they were stopped. If the FORMAT option was also coded, then JES2 will ignore the WARM specification and perform a cold start.
SPOOL = VALIDATE NOVALIDATE	VALIDATE specifies that the track group map is validated on a JES2 all-member warm start. Default: SPOOL=NOVALIDATE specifies that the track group map is not validated when JES2 restarts.
NOREQ REQ	NOREQ specifies that the $HASP400 (ENTER REQUESTS) message is to be suppressed and JES2 is to automatically start processing when initialization is complete. Default: REQ specifies that the $HASP400 (ENTER REQUESTS) message is to be written at the console. This message allows you to start JES2 processing with the $S command.
NOLIST LIST	NOLIST specifies that JES2 is not to print the contents of the initialization data set or any error flags that occur during initialization. If you specify NOLIST, JES2 ignores any LIST control statements in the initialization data set. *z/OS JES2 Initialization and Tuning Reference* presents an example of an initialization data set listing produced by using the list option. Default: LIST specifies that JES2 is to print all the statements in the initialization data set and any error flags that occur during initialization. (JES2 prints these statements if a printer is defined for that purpose when JES2 is started.) LIST will not print any statements that follow a NOLIST control statement in the initialization data set.
NOLOG LOG	NOLOG specifies that JES2 is not to copy initialization statements or initialization errors to the HARDCPY console. If you specify NOLOG, JES2 ignores LOG control statements in the initialization data set. Default: LOG specifies that JES2 is to honor any LOG statements in the initialization data set.

Option	Explanation
CKPT1 CKPT2	Specifies what checkpoint data set JES2 must use for building the JES2 work queues. Default: If you do not specify, JES2 automatically determines which checkpoint data set to use.
RECONFIG	RECONFIG specifies that JES2 will use the checkpoint data set definitions as specified on the CKPTDEF statement in the initialization data set. JES2 overrides any modifications to the checkpoint data set definitions previously made either by the $T CKPTDEF command or through the use of the checkpoint reconfiguration dialog. Specifying RECONFIG will also cause JES2 to enter the reconfiguration dialog during initialization and issue message $HASP289 CKPT1 AND/OR CKPT2 SPECIFICATIONS ARE REQUIRED. If you previously reconfigured your checkpoint configuration through the checkpoint reconfiguration dialog, the CKPTDEF statement definition may not contain the most current checkpoint definition. Changes made through the checkpoint reconfiguration dialog are not saved in the input stream data set.
HASPPARM=ddname	HASPPARM=ddname specifies the name of the data definition (DD) statement that defines the data set containing the initialization statements that JES2 is to use for this initialization. Default: HASPPARM=HASPPARM specifies that JES2 is to be initialized using the initialization statements in the data set defined by the HASPPARM DD statement in the JES2 procedure.
CONSOLE	Causes JES2 to simulate receiving a CONSOLE initialization statement after all initialization statements are processed. That is, if CONSOLE is specified, JES2 will divert to the operator console for further parameter information after the input stream data set has been exhausted.
NONE U N	NONE, U, or N character specifies that JES2 is to use all of the default start options. There is no difference between these three options; they are equivalent. When NONE, U, or N is specified, JES2 uses the default start options, which are: NOFMT WARM REQ LIST LOG

New start option with default PARMLIB

You can now start JES2 with the new start option of reading the initialization stream from the default PARMLIB specification, as follows:

- S JES2,PARM=('MEMBER=member')
- S JES2,PARM=('PARMLIB_MEMBER=member')

The operator should reply to the $HASP467 message as follows:

```
r xx,MEMBER=member
```

where `member` is the member of logical parmlib in each of the above specifications.

The following conditions should be considered:

- HASPPARM=ddname and MEMBER= are mutually exclusive.

- If neither HASPPARM= nor MEMBER= is specified, then it will process from the default HASjesx member of logical parmlib (where jesx is the JES2 subsystem name).
- IBM does not ship a default parmlib member.

Starting JES2 without a JES2 PROC

In an emergency, you can start JES2 without a JES2 procedure because of the elimination of the need to specify the HASPPARM data set and the PROCLIB data sets, a change that was introduced in JES2 V1R2. Start JES2 as follows:

- **`S IEESYSAS,PROG=HASJES20,JOBNAME=JES2`**

  This start command assumes that HASJES20 is in the LINKLIST (no STEPLIB). During JES2 initialization when the OPEN of HASPPARM fails, the logical parmlib member HASJES2 will be used. If HASJES2 is not found, message $HASP469 is issued.

- **`S IEESYSAS,PROG=HASJES20,JOBNAME=JES2,PARM='MEMBER=MEMBER2'`**

  This start command uses the logical parmlib member MEMBER2 and no OPEN of the HASPPARM DD is attempted. This option is new with JES2 V1R4 because of the new MEMBER= capabilities. If MEMBER2 is not found, message $HASP469 is issued.

3.22 Restarting JES2

- Cold start
  - All job data in spool is lost
- Warm start
  - All-member warm start
  - Single-member warm start
  - Quick start
  - Hot start

Figure 3-22 Restarting JES2

Restarting JES2 with cold start option

Very few definitions, or redefinitions, of some JES2 facilities and resources require that the JES2 system be totally shut down. JES2 must be restarted with a cold start to allow all component systems to be aware of the changed facilities and resources. The time to restart JES2 in this manner is based on the work in the system and, if not scheduled, causes a disruption in data processing services. All job data previously on the spool volumes is lost with cold start. You can avoid data loss by scheduling a spool offload of the JES2 queues. In a MAS configuration, no other member can be active during a cold start. Use of the FORMAT option causes a cold start.

An IPL must precede a JES2 cold start, unless JES2 was stopped with a $P JES2 operator command.

Warm start

During a warm-start initialization, JES2 reads through its job queues and handles each job according to its status:

- Jobs in input readers are lost and must be reentered.
- Jobs in output (print/punch) are requeued and later restarted. The checkpoint for jobs on the 3800 printer points to the end of the page being stacked at the time of the checkpoint. Jobs that were sent to the 3800 printer but that did not reach the stacker are reprinted from the checkpoint. If no checkpoint exists, then it is reprinted from the beginning.

- Jobs in execution are either requeued for execution processing or are queued for output processing.
- All other jobs remain on their current queues.

There are four ways in which a warm start can be performed in a multi-access spool configuration, as follows:

1. All-member warm start

   An all-member warm start is performed if a warm start is specified by the operator and JES2 determines that no other members of the configuration are active or there is only one member in the configuration. All in-process work in the MAS will be recovered. After an all-member warm start, other members entering the configuration for the first time will perform a quick start.

2. Single-member warm start

   This is performed when WARM is specified and others members of the configuration are active. The warm-starting member joins the active configuration and recovers only work in process on that member when it failed or was stopped.

3. Quick start

   This is performed when you specified a warm start and JES2 determined that the job queue and job output table do not need to be updated. In this case, the member being started is not the first member being started in the MAS. This occurs:

   – After **`$P JES2`** has been issued to quiesce the member. Because all work is quiesced, there is no need to update the job queue or job output table before restarting.

   – After an all-member warm start has been performed and no work is waiting to be processed; therefore, the job and output queues are empty.

   – When a **`$E MEM`** command was entered at a processor within the MAS configuration other than the member being started.

4. Hot start

   This is a warm start of an abnormally terminated JES2 member without an intervening IPL. When it happens, all address spaces continue to execute as if JES2 had never terminated. JES 2 validates (and rebuilds, when necessary) the job and output queues and the job queue index. Damaged or corrupted job output elements (JOEs) and job queue elements (JQEs) are placed on the rebuild queue.

3.23 Stopping JES2

- $P command to stop all JES2 processing
- Log off all TSO/E users
- $HASP099
- Stop all started tasks
- $P JES2
  - $P JES2,QUICK (poly-JES environment)
  - $P JES2,ABEND
  - $P JES2 ABEND,FORCE
- HALT EOD

Figure 3-23 Stopping JES2

There are instances when JES2 must be stopped and restarted either by a warm or cold start. For example, redefining the number of systems in a network job environment requires a warm start. You can stop and restart JES2 in a system at any time by using operator commands. This allows you to:

- Quiesce job processing in preparation for an orderly system shutdown.
- Restart JES2 to perform an initialization with different initialization parameter specifications.

You can dynamically change JES2 initialization statements by using the $T operator for most parameters. Before stopping JES2 for the purpose of changing initialization statement parameters, refer to *z/OS JES2 Initialization and Tuning Reference*, SA22-7533-03.

To stop JES2, do the following:

1. Issue the $P command to stop all JES2 processing. System initiators, printers, punches, job transmitters, and SYSOUT transmitters will not accept any new work and will become inactive after completing their current activity. However, new jobs will be accepted through input devices. When all TSO users log off, and all JES2 started tasks, logical initiators, printers, and punches complete their current activities and become inactive, JES2 notifies you with the following message:

   ```
   $HASP099 ALL AVAILABLE FUNCTIONS COMPLETE
   ```

2. Stop all started tasks.

3. Enter the $P JES2 command to withdraw JES2 from the system. If any jobs are being processed or any devices are active, the $P JES2 command is processed as a $P command and drains JES2 work from the system.

   If it is not possible or reasonable to drain the JES2 member (for example, due to large numbers of lines, jobs, and remote; or, if you plan to restart JES2 using a hot start) you can specify:

   ```
   $P JES2,ABEND
   ```

   The ABEND parameter forces JES2 termination regardless of any JES2 or system activity. If the checkpoint resides on a Coupling Facility structure and the member is processing a write request, JES2 issues the `$HASP552` message and delays the $P command until the checkpoint write has completed.

   If the $P JES2,ABEND command does not successfully terminate JES2, you can also specify the FORCE parameter. The $PJES2,ABEND,FORCE command results in a call to the recovery termination manager (RTM) to terminate the JES2 address space. Because the FORCE parameter can cause unpredictable results, always attempt to enter the $P JES2,ABEND command first.

   To withdraw JES2 from a system involved in cross-system activity, you can issue the $P JES2,QUICK command. Cross-system activity occurs when a user on one JES2 subsystem requests a cross-system function from another JES2 subsystem within the same poly-JES2 environment. This option deletes the control blocks for the request submitted by the user who requested cross-system function. Before using the QUICK keyword on the $P JES2 command, you should send a message to the user asking them to end their cross-system activity.

4. Issue the `HALT EOD` command. It ensures that important statistics and data records in storage are not permanently lost.

3.24 JES2 operations

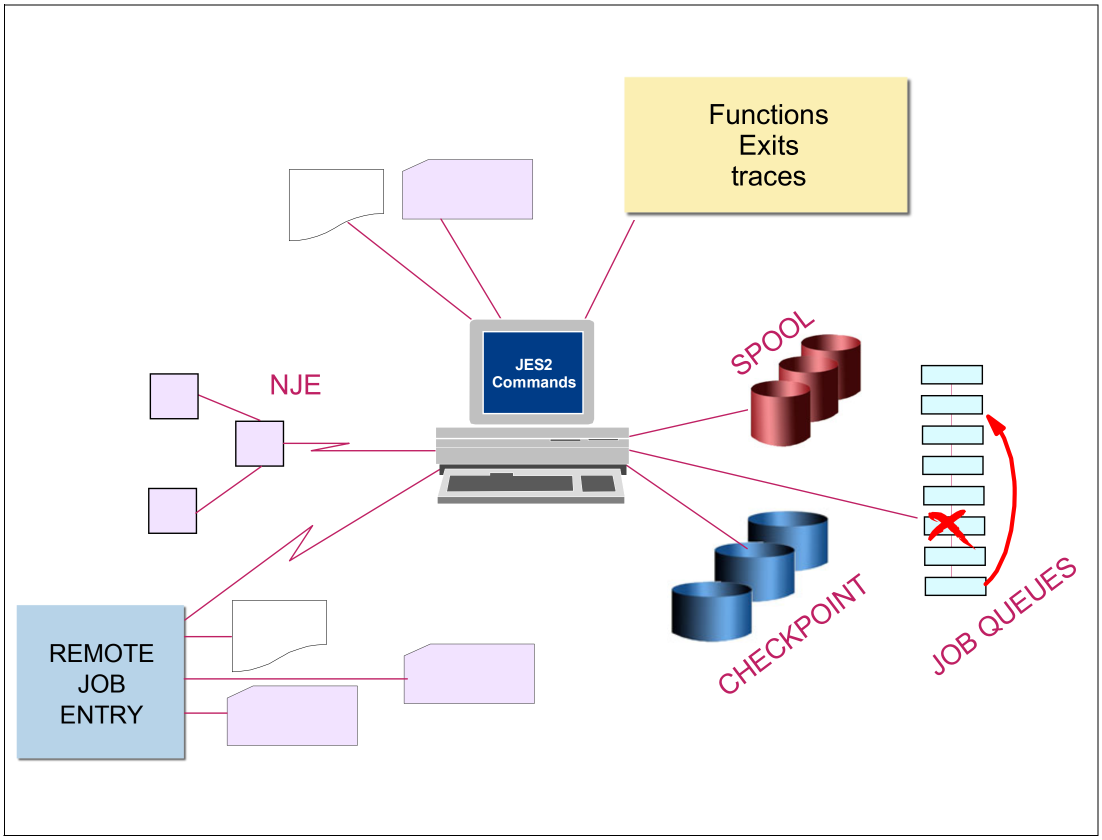


Figure 3-24 JES2 operations

No large data processing system or subsystem can continuously operate independently of system programmer or operator intervention. To help you maintain your overall work environment, JES2 provides a set of commands that permits you to control most of the JES2 functions and devices under its control.

As your JES2 complex becomes more sophisticated, you might connect your system to others to form a network of systems. You can use operator commands to control the lines that connect the separate systems, as well as to define the separate systems to yours. This is typically a very dynamic environment since different systems are added or deleted from the network due to maintenance, hardware reconfiguration requirements, workload balancing, or the need to access a database at a different location. JES2 commands permit you to alter most of your original network definition, as required. Almost all JES2 initialization statements can be changed dynamically by JES2 operator commands.

Operator commands can be used to:

- Display status information and device definition
- Start, stop, and halt devices under JES2's control
- Assign units to local printers, punches, card readers, and lines, or reassign units to these devices
- Modify processing, such as: output definition, the dynamic alteration of the checkpoint definition, enabling installation-defined exits, offload devices, printer and punch characteristics, and job characteristics

- Add function and functional subsystems
- Delete function, network systems, exits, and diagnostic traces

Your installation can require that only certain operators can issue certain JES2 commands and/or restrict commands coming in from RJE workstations, NJE nodes, or any other device. You can use RACF and customization techniques to limit the degree of control an individual or group can have over JES2 resources.

All JES2 commands are entered using standard z/OS command interfaces such as a z/OS console, or within the JES2 initialization data set. As the default, JES2 prefixes its commands and messages with a dollar sign ($). For commands, the prefix character defines the scope of the command as being JES2 only; for messages, the prefix character is informational in that it designates that the message was issued by the JES2 component. You can change this symbol through the CONDEF initialization statement.

3.25 Controlling the JES2 environment

- $S
- $P
- $P JES2
- $T BUFDEF
- $T SMFDEF

Figure 3-25 Controlling the JES2 environment

The following commands are useful to control the JES2 environment:

- Start JES2 processing, **$S**

  To start system activity.

- Stop JES2 processing, **$P**

  To stop all system initiators, printers, punches, job transmitters, and SYSOUT transmitters after they complete their current activity.

- Withdraw JES2 from the system, **$P JES2**

  To withdraw JES2 from the system to which the entering console is attached.

- Monitor local buffers, **$T BUFDEF**

  To specify the percentage of local buffers use at which JES2 alerts the operator of a local buffer shortage. Local buffers can reside below 16 megabytes of virtual storage or above 16 megabytes of virtual storage.

- Monitor SMF buffers, **$T SMFDEF**

  To set the SMF buffer warning level.

3.26 Controlling a MAS environment

- $D MASDEF
- $D MEMBER
- $T MASDEF
- $D CKPTDEF
- $T CKPTDEF

Figure 3-26 Controlling a MAS environment

The following commands are useful to control your multi-access spool (MAS) environment:

- Display characteristics of the MAS, **`$D MASDEF`**

  To display multi-access spool definition and tuning parameters.

- Display the status of MAS members, **`$D MEMBER`**

  The information displayed for each member includes the member name and any of the following information:

  - The date and time the member was started.
  - The member that is restarting this member's work.
  - The status of the member.
  - The name of the MVS system image of the member.
  - The time the member last accessed the checkpoint.
  - The version of JES2 running on the member.

  This command has parameters you can use as a filtering technique to limit the type of information to search, or the amount of information to display.

- Control the MAS environment, **`$T MASDEF`**

  To specify multi-access spool definition and tuning parameters.

- Display the checkpoint definition, **`$D CKPTDEF`**

  This command has parameters you can use as a filtering technique to limit the type of information to search, or the amount of information to display.

- Control the checkpoint definition, **`$T CKPTDEF`**

  - To modify the checkpoint definition
  - To initiate a checkpoint reconfiguration dialog with JES2

3.27 Controlling JES2 spooling

- $D SPOOL
- $S SPOOL
- $T SPOOLDEF
- $P SPOOL
- $Z SPOOL

Figure 3-27 Controlling JES2 spooling

The following commands are useful to control the JES2 spool:

- Display spool volume usage, **$D SPOOL**

  To display the status and percent utilization of a specified spool volume or all spool volumes

- Start a spool volume, **$S SPOOL**

  To add or reactivate a spool volume to the spool configuration

- Control the JES2 spooling environment, **$T SPOOLDEF**

  To specify the JES2 spooling environment characteristics

- Drain a spool volume, **$P SPOOL**

  To drain and delete an entire spool volume by processing all work on the volume and preventing any available space on the volume from being allocated

- Halt a spool volume, **$Z SPOOL**

  To deallocate a spool volume after active work completes its current phase of processing (executing, printing, punching)

3.28 Controlling JES2 jobs

- $A Job
- $C Job
- $CO Job
- $D Job
- $H Job
- $L Job
- $O Job
- $P Job
- $PO Job
- $T Job
- $T O

Figure 3-28 Controlling JES2 jobs

The following commands are useful to control JES2 jobs:

- Release specified jobs, **`$A Job`**
- Cancel a job, **`$C Job`**
- Cancel output groups, **`$CO Job`**
- Display information about a specified job, **`$D Job`**
- Hold a specified job, **`$H Job`**
- List job output information, **`$L Job`**
- Release or cancel held output groups, **`$O Job`**
- Purge a job, **`$P Job`**
- Purge an output job, **`$PO Job`**
- Change a job's class, scheduling priority, or member affinity, **`$T Job`**
- Set output characteristics, **`$T O`**

3.29 Controlling JES2 printers

- $D PRT
- $E PRTnnnn
- $P PRTnnnn
- $S PRTnnnn
- $Z PRTnnnn

Figure 3-29 Controlling JES2 printers

The following commands are useful to control JES2 printers:

- Display printers, **`$D PRT`**

  To display printer work selection and processing characteristics. This command has parameters you can use as a filtering technique to limit the type of information to search, or the amount of information to display.

- Restart printer activity, **`$E PRTnnnn`**

  To stop the printing of the current output group and requeue the output according to its job priority for later processing.

- Stop a printer, **`$P PRTnnnn`**

  To stop a printer after it completes processing the current output group and then free the associated system resources.

- Start a printer, **`$S PRTnnnn`**

  To start printer activity. The $HASP190 message asks whether the requested setup has been completed for the specified device. Either verify that the setup is complete or issue the **`$T PRTnnnn`** command to override specific setup specifications. Then reissue the **`$S`** command to physically start the printer.

- Halt printer activity, **`$Z PRTnnnn`**

  To temporarily halt local or remote printer activity.

JES2 diagnosis communication mechanisms

The following diagnostic tools are available for detecting and diagnosing problems occurring in the JES2 environment:

- Messages

  JES2 provides a set of messages to alert the JES2 operator and system programmer of processing errors.

- Traces

  Optionally, your installation can use the JES2 tracing facility, a function that records events associated with specific functions, such as each time JES2 is initialized or terminated or each time an exit routine is taken.

- IPCS

  JES2 exploits the interactive problem control system (IPCS) facility to allow you to view the formatted contents of JES2 control blocks and dumps of system data necessary when diagnosing and recovering from processing errors.

3.30 JES3

- JES3 configuration
- JES3 complex
- JES3 single-system image
- JES3 multi-system image
- Availability
- Workload balancing
- Spooling
- Control flexibility
- JES3 phases of job processing
- JES3 operator control
- How to start and stop JES3

Figure 3-30 JES3

With the z/OS MVS JES3 system, resource management and workflow management are shared between MVS and its JES3 component. Generally speaking, JES3 does resource management and workflow management *before* and *after* job execution, while MVS does resource and workflow management *during* job execution.

JES3 considers job priorities, device and processor alternatives, and installation-specified preferences in preparing jobs for processing job output. The features of the JES3 design include:

- Single-system image
- Workload balancing
- Availability
- Control flexibility
- Physical planning flexibility

Figure 3-30 shows the JES3 topics discussed in this section.

3.31 JES3 configuration

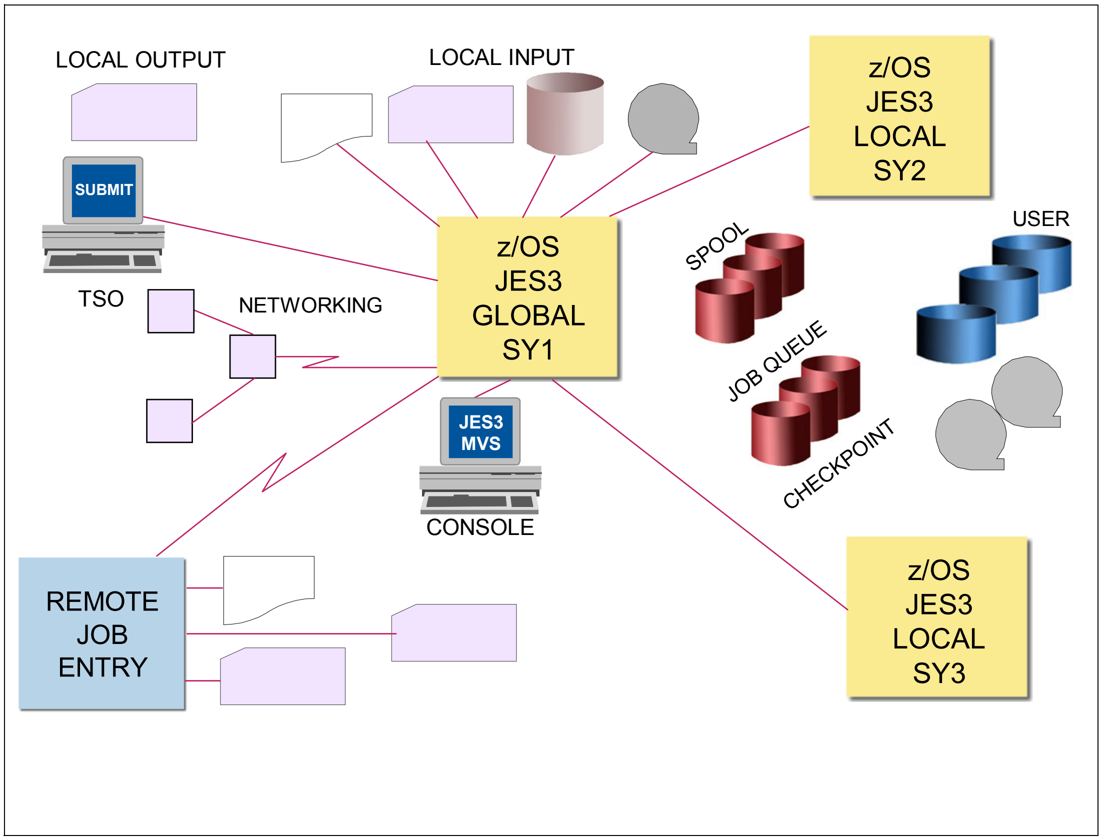


Figure 3-31 JES3 configuration

JES3 can run on a single processor, or on multiple processors, up to thirty-two processors in a sysplex. A *sysplex* is a set of MVS systems communicating and cooperating with each other through certain multisystem hardware components and software services to process customer workloads.

The hardware components used for connecting the systems are:

- A sysplex timer to synchronize the TOD clocks of the processors of a sysplex (not required if a sysplex is located on only one processor).
- Channel-to-channel connections to connect the members of a sysplex to house a coupling data set.

In a sysplex, your installation must designate one processor as the focal point for the entry and distribution of jobs and for the control of resources needed by the jobs. That processor, called the *global processor*, distributes work to the processors, called local processors.

It is from the global processor that JES3 manages jobs and resources for the entire complex, matching jobs with available resources. JES3 manages processors, I/O devices, volumes, and data. To avoid delays that result when these resources are not available, JES3 ensures that they are available before selecting the job for processing.

JES3 keeps track of I/O resources, and manages workflow in conjunction with the workload management component of MVS by scheduling jobs for processing on the processors where the jobs can run most efficiently. At the same time, JES3 maintains data integrity. JES3 will not schedule two jobs to run simultaneously anywhere in the complex if they are going to update the same data.

JES3 may be operated from any console that is attached to any system in the sysplex. From any console, an operator can direct a command to any system and receive the response to that command. In addition, any console can be set up to receive messages from all systems, or a subset of the systems in the sysplex. Thus, there is no need to station operators at consoles attached to each processor in the sysplex.

If you want to share input/output (I/O) devices among processors, JES3 manages the sharing. Operators do not have to manually switch devices to keep up with changing processor needs for the devices.

The JES3 architecture of a global processor, centralized resource and workflow management, and centralized operator control is meant to convey a single-system image, rather than one of separate and independently-operated computers.

JES3 runs in the following environments:

- Single-processor environment
- Multiprocessor environment
- Remote job processing environment
- JES3 networking environment
- APPC environment

A JES3 complex can involve any combination of these environments.

3.32 JES3 complex

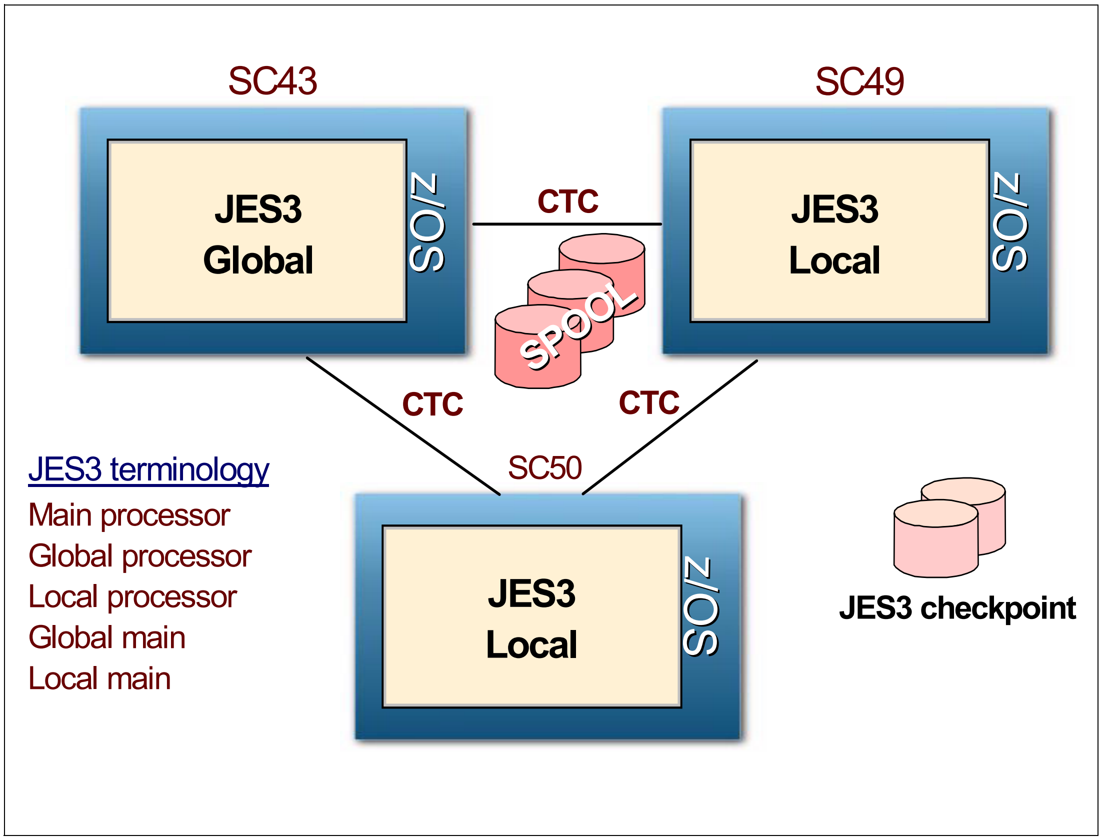


Figure 3-32 JES3 complex

z/OS uses JES3 to control the input, processing, and output of jobs. JES3 services the job processing requirements of from 1 to 32 physically connected z/OS processors called *mains*. Viewed as a whole, the 1- to 32-main environment serviced by JES3 is called a *complex*.

JES3 has its own private address space in each of the mains in the complex. One main, the JES3 global main, is in control of the entire complex. There must be a *global main*; if there is only one main in the complex, that main is the global. In a complex with more than one main, the other mains in which JES3 resides are called *local mains*. There can be as many as 31 local mains.

JES3 is designed so that if the global fails, any properly-configured local within the complex can assume the function of the global through a process called dynamic system interchange (DSI). Figure 3-32 illustrates the basic structure of a JES3 complex.

3.33 MVS subsystems in JES3 environment

- Primary subsystem - JES3
  - System input and output - (JES3 Global)
  - Manage jobs and spool - (JES3 Global)
- Functional subsystems - FSS
  - Offload function to locals and global address space
    - Converter/Interpreter and printers
  - JES3 global controls
    - FSS start and stop
    - Selection of work
    - Operator communication

Figure 3-33 MVS subsystems in JES3 environment

As the primary subsystem, the global JES3 plays as important role, and the following functions provided by JES3 indicate why communication is needed between MVS and JES3. The global JES3:

- Introduces all jobs into the system, no matter what the source.
- Handles scheduling of conversion and interpretation of JCL.
- Performs pre-execution setup of devices.
- Schedules MVS jobs to all main processors.
- Maintains awareness of all jobs in execution.
- Handles the scheduling of all SYSOUT data sets.
- Manages the allocation and deallocation of space on the shared-spool devices.

When carrying out some of these responsibilities, global JES3 needs the assistance of local JES3. This is true during the scheduling of work on the local processor.

Functional subsystem

JES3 allows certain functions to operate outside the JES3 address space. JES3 does this using:

- The functional subsystem address space (FSS)
- The functional subsystem interface (FSI)

- The functional subsystem application (FSA)

The JES3 FSS that deals with output services is one type of FSS. This particular FSS address space may be created automatically or established by a **CALL** command for a printer device which is capable of running under the control of an FSS address space. The operator **CALL** command designates a printer as a “hot writer,” while a writer invoked automatically when output is queued is called a “dynamic writer.”

Another FSS deals with converter/interpreter services similar to those that occur in the JES3 global.

3.34 JES3 global

- Global processor manages jobs and resources
  - For the entire complex
  - Matches jobs with available resources
- JES3 global manages
  - Processors - I/O devices - Volumes - Data sets
- When resources are not available
  - JES3 ensures that they are before selecting the job for processing to an initiator
- Operations aid
  - Operator commands
  - Diagnostic tools

Figure 3-34 JES3 global

Figure 3-34 is a restatment of the key functions of JES3 global processor, whether that processor is the only one in the configuration, or the designated global in a sysplex containing up to 32 processors. For details, review the previous three topics.

3.35 JES3 sysplex components

- Sysplex - 1 to 32 coupled systems
  - Using hardware and software elements
- XCF - Cross-system coupling facility
  - Provides communication services for a sysplex
- CTC - Channel to channel adapter
  - Provides direct connection between MVS systems
- GRS - Global resource serialization
  - Used to serialize resources - Uses XCF

Figure 3-35 JES3 sysplex components

The sysplex components and terminology are as follows:

Sysplex
: Up to 32 systems or MVS images may be defined in a sysplex coupled together by hardware and software elements.

XCF
: The cross-system coupling facility (XCF) is the operating system component that controls members and groups, provides inter-member communications (exchange data, programs, and so on), and monitoring services for members.

CTC
: A CTC is used for channel-to-channel connectivity. It is a form of direct connection between processors or between channels of the same processor. In the context of this document, this type of connection refers to an ESCON® channel operating in CTC mode. CTC links may be used when a sysplex is made up of two or more systems.

GRS
: Whenever one or more systems in a GRS complex are not in a sysplex, GRS uses its own dedicated CTCs to communicate between systems not in the sysplex, and uses XCF services between systems in the sysplex.

3.36 JES3 multisystem sysplex

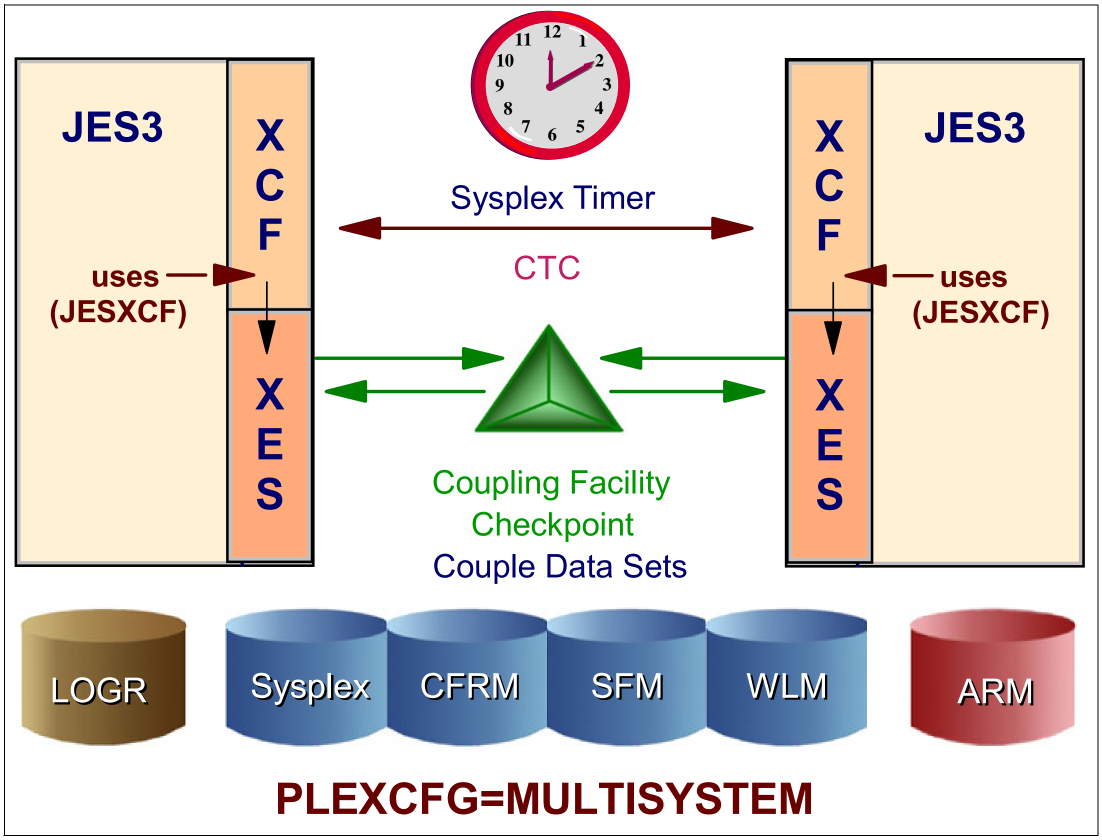


Figure 3-36 JES3 multisystem sysplex

With multiple MVS images in multiple CPCs, PLEXCFG=MULTISYSTEM is the XCF mode required. A Sysplex Timer® is required, as shown in the Figure 3-36. The two JES3 systems communicate using XCF, and the signalling services can be through either CTCs or the coupling facility.

Multiprocessing is a way of doing work with two or more connected processors.

Some of the advantages of running JES3 in this environment are:

- Elimination of much of the overhead of scheduling work for and operating separate processors
- Sharing devices by processors, which means that the devices can be used more efficiently
- Movement of work to other processors, should one processor become overworked, need maintenance, or need to be removed from the complex for any reason

The global processor and the local processors communicate using the MVS cross-system coupling facility (XCF). JES3 devices (the devices from which JES3 reads jobs, and on which JES3 stores jobs awaiting processing, stores job output, and writes job output) are connected to the global processor. Some JES3 devices that write job output can also be connected to the local processors.

The global processor runs most of JES3, for it is from the global processor that JES3 allocates resources to jobs and sends jobs to local processors for processing. In addition, JES3 can also pass jobs to MVS in the global processor for processing.

Each local processor has a complete MVS system and JES3 routines for spooling and for communication with the global processor. When MVS in a local processor needs a job, JES3 in that local processor sends the job request to JES3 in the global processor via XCF signalling. JES3 in the global processor returns identifying information about a job, and JES3 in the local processor uses that information to retrieve the job from the spool device.

If a problem arises on the global processor while JES3 is running, you can transfer global functions to a local processor. This transfer is called dynamic system interchange (DSI). The processor you choose must be capable of assuming the same workload as the previous global.

3.37 JES3 global functions

- JES3 Global functions
  - Workflow manager
    - Schedule jobs
    - Manage job queue
    - System coupler
  - Resource manager
    - Processors - Devices - Volumes - Data sets
  - Operations aid
    - Operator commands
    - Diagnostic tools

Figure 3-37 JES3 global functions

- **Workflow manager:** JES3 provides installation benefits from the distribution of work among processors as a workflow manager. The entry of all jobs through a central point means that control of the actions needed to prepare jobs for execution can be centralized. The distribution and publication of job management functions becomes unnecessary, and an awareness of the status of all jobs entering or leaving the system can be easily maintained. This awareness is particularly useful in recovery situations, where the scope of recovery is largely a function of the quality of the tracking performed prior to the failure.
- **Resource manager:** Another benefit is resource management. All jobs, all input required for the jobs, and all output produced by the jobs enters or leaves the system at a single point. This single point, JES3, can coordinate the subsystem, the allocation of devices, volumes, and data sets. Centralized resource control expands the opportunity for full resource utilization. If you are using the storage management subsystem (SMS), you can allow SMS to coordinate the allocation of permanently resident catalog volumes and cataloged data sets. When SMS is activated, JES3 will not manage units and volumes for SMS-managed data sets.
- **Operations aid:** Operator control also benefits from improved resource utilization and centralized job management. With all system resources known to JES3 and with one job management mechanism, it is relatively simple to provide control over the entire system. And yet, the need for operator control can be minimized because JES3 is aware of job mix and resource availability and can coordinate them with little need for operator intervention and decision-making.

3.38 JES3 terminology

- JES3 naming conventions
  - Module names: IAT ff xx
    - FF: functional area
    - XX: function performed
  - Module examples
    - IATISDV - IATOSDR - IATSICA
    - IATISDR - IATOSSC - IATSI34
  - Coding macros - IATX...
  - Data macros - IATY...
  - JES3 nucleus - IATNUC

Figure 3-38 JES3 terminology

JES3 terminology and naming conventions

Most JES3 module names are seven characters long and begin with the characters IAT. The fourth and fifth characters are a mnemonic that represents a specific function. The sixth and seventh characters indicate a service preformed by that module within the function. For example IATISDV:

- IAT signifies that this is a JES3 module.
- IS signifies that this is an input service module.
- DV signifies that this is the device driver module.

The mnemonic in the fourth and fifth character indicates any of the following module functions:

AB	abnormal termination
BD	MVS/Bulk Data Transfer
CN	console services
DC	dependent job control
DJ	dump job
DL	deadline scheduling
DM	spool data management
DS	dynamic system interchange
DY	dynamic allocation fastpath
FC/FP	functional subsystem interface
FS	failsoft

GR	general routines
GS	general service
II	converter/interpreter service
IN	initialization
IP	interactive problem control system
IQ	operator inquiry commands
IS	input service
JV	job validation
LV	locate/verify
MD	main device scheduler
MF	JES3 monitoring facility
MO	operator modify commands
MS	main service and generalized main scheduling
NT	JES3 networking
OS	output service
PU	purge
RJ	binary synchronous communication remote job processing
SA	mass storage system table create
SN	systems network architecture remote job processing
SS/SI	subsystem interface
UT	operator utilities
UX	user exit

The sixth and seventh characters restrict any of the above mnemonics to further classification of a specific task, and indicate (but are not limited to) any of the following:

XM	cross memory processing
DV or DR	driver module for a particular DSP
DT or DA	data CSECT for a particular DSP
CR	card reader processing
MN	monitor

Due to the limited number of combinations provided by 2 characters, there are exceptions to these conventions.

Additional conventions are:

- The fourth character of most JES3 executable macros is an X (but there are executable macros that do not follow this convention):

  `IATX`

- The fourth character of a JES3 data area mapping macro is a Y:

  `IATY`

- The fourth character of a JES3 macro that expands within other JES3 macros is a Z:

  `IATZ`

The JES3 nucleus load modules are named:

IATNUC - JES3 address space

IATNUCF - C/I FSS address space

AITNUCI - Initialization stream checker

3.39 JES3 single processor

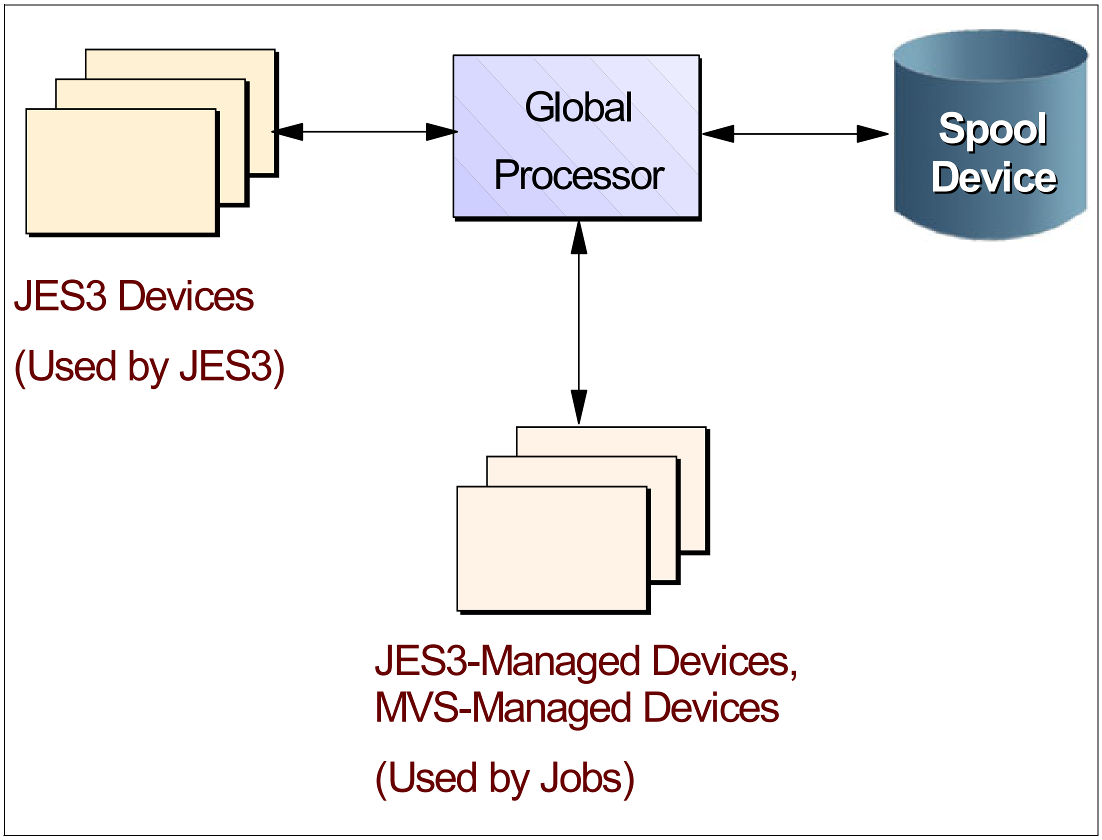


Figure 3-39 JES3 single processor

Figure 3-39 shows JES3 in a single-processor environment, also known as a single-system sysplex. Besides the processor, two categories of I/O devices are shown:

- JES3 devices (those used by JES3)
- JES3- and MVS-managed devices (those used by jobs).

The spool device is a direct-access storage device (DASD) that is treated in a special way by JES3, so it is shown and explained separately.

In installations with one processor, the global processor, JES3 coexists in that processor with MVS and with running jobs. In many respects, JES3 is treated like a job by MVS. (That is, MVS handles JES3 in much the same way it handles the jobs it receives from JES3 for processing.) JES3 becomes a processable “job” during initialization, while jobs submitted to the system become processable by the actions of JES3.

3.40 JES3 multiprocessing

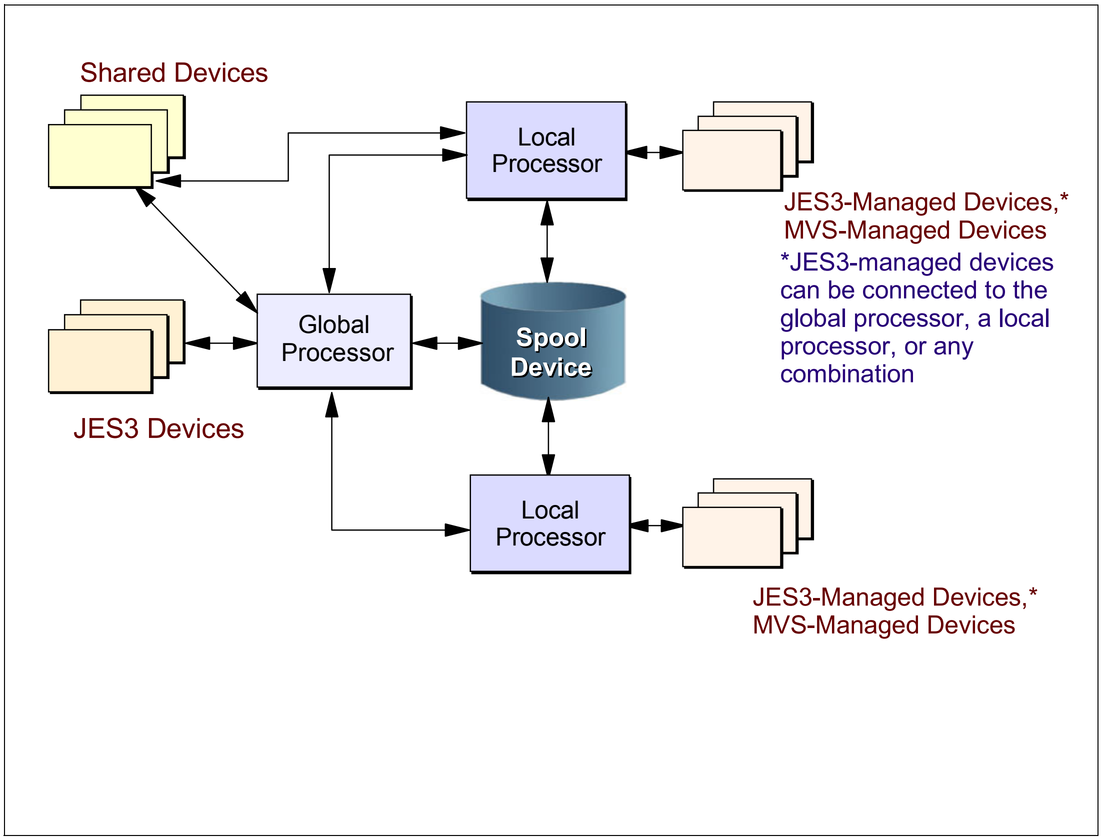


Figure 3-40 JES multiprocessing

Multi-system image

As previously discussed, *multiprocessing* is a way of doing work with two or more connected processors. In a multiprocessing environment, also known as a multisystem sysplex, JES3 allows up to 32 processors, also known as mains, to be configured into the complex. JES3 uses one processor (called the global) to do work and also to distribute work to up to 31 other processors (called locals).

Figure 3-40 shows a JES3 multiprocessing system that has three processors, that communicate via XCF signalling. The global processor runs most of JES3, for it is from the global processor that JES3 allocates resources to jobs and sends jobs to local processors for processing. In addition, JES3 can also pass jobs to z/OS in the global processor for processing.

Each local processor has a complete z/OS system and JES3 routines for spooling and for communication with the global processor. When z/OS in a local processor needs a job, JES3 in that local processor sends the job request to JES3 in the global processor via XCF signalling. JES3 in the global processor returns identifying information about a job, and JES3 in the local processor uses that information to retrieve the job from the spool device.

If a problem arises on the global processor while JES3 is running, you can transfer global functions to a local processor. This transfer is called dynamic system interchange (DSI). The processor you choose must be capable of assuming the same workload as the previous global.

Availability

If a problem develops with the global processor, you can have one of the other processors assume the global functions (operators have JES3 commands to cause the switch). Jobs running on other processors, including the one to become the new global processor, will usually be unaffected (except for a waiting period until global activities are resumed).

If part of JES3 fails, JES3 collects failure symptoms, records error data, and attempts recovery. All major JES3 components are protected by at least one special JES3 recovery routine. If recovery is unsuccessful, the failing component gets insulated from the rest of JES3, resources are freed, and the failing component will not be used again. If the component is not critical to overall JES3 processing, complete JES3 failure may be avoided.

Workload balancing

JES3 balances workload among processors by considering the resource requirements of jobs. The method JES3 uses is the same whether one or several processors make up the configuration. Thus, addition of another processor does not mean a new operational and scheduling environment.

3.41 JES3 spooling

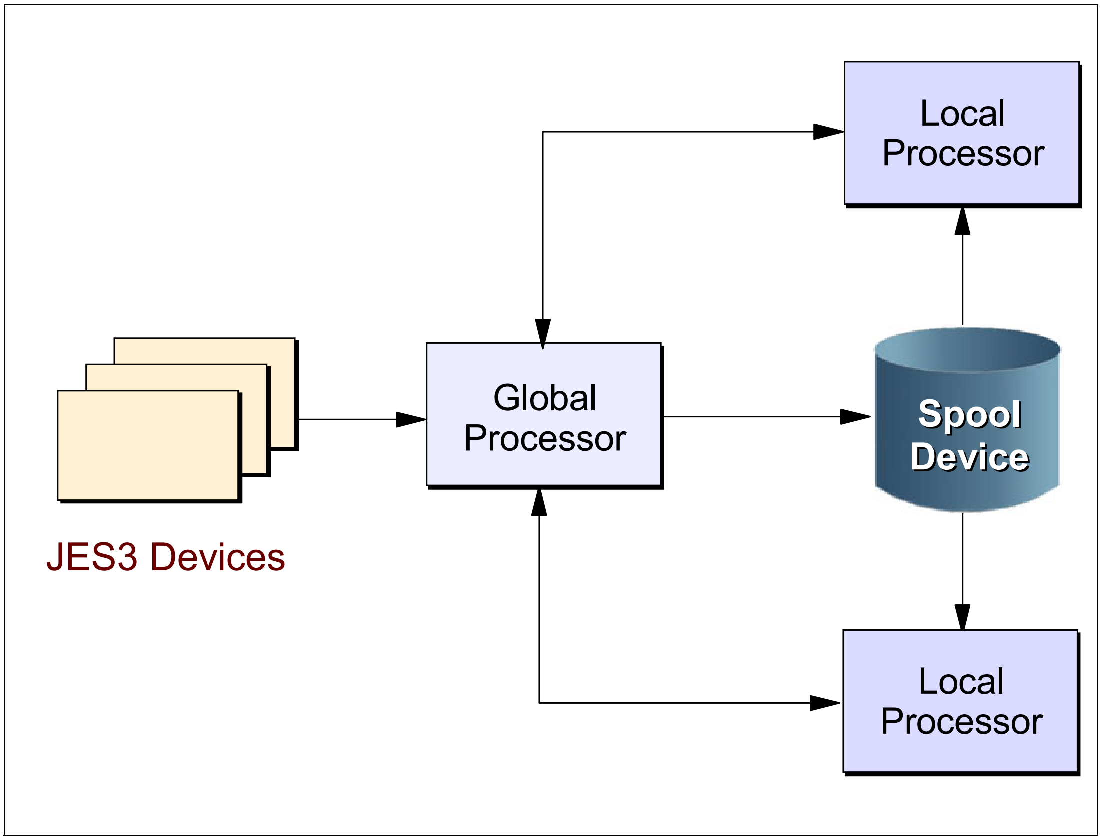


Figure 3-41 JES3 spooling

Spool devices

Most multiprocessing systems use shared data storage. In JES3 the spool device becomes the shared data storage. Thus, besides being a buffer (as for single-processor systems), in multiprocessing systems the spool device becomes a collection point for data to be distributed to individual processors. Also, the spool device becomes a collection point for data coming from local processors routed to JES3 output devices connected to the global processor.

Control flexibility

Operating systems must be easy to control. Internal complexity must be offset by features that make the systems easy to operate, to monitor, and to change. JES3 has designed-in features for operators, application programmers, and system programmers, including:

- Operators have special JES3 commands. Some commands activate programs to handle I/O devices, while others obtain or change the status of jobs being processed. With multiple processing-unit systems, JES3 operators have less to do than for an equal number of individual systems because they can control the entire complex from a central point, and because JES3 decides where and when jobs will be processed.

  JES3 applies installation policies, as defined in the JES3 initialization stream, to perform job scheduling, thus freeing the operator from this task.

  Even though JES3 handles job flow control, there are operational controls in JES3 for the operator to use at his or her discretion to override JES3 decisions, and to take control in unusual situations.

- Application programmers have special JES3 control statements (similar to JCL statements). There are control statements to make some jobs run only after successful (or unsuccessful) processing of other jobs, and for specifying the time of day, week, month, or even the year when jobs should run.
- System programmers have special JES3 initialization statements to define the way JES3 is to manage devices and jobs. Operators or application programmers can override many of these initialization options on a job-by-job basis. JES3 gives system programmers a unique way of setting installation policy for device and job management. They define separate groups of processing rules. Application programmers select and apply the groups of rules in various ways to individual jobs.

Where JES3 does not provide the exact function that your complex requires, such as special printing requirements, the system programmers can write their own routines and make them part of the JES3 program. This is done through installation exits provided with JES3 and through dynamic support programs that can be added to JES3. For diagnostic purposes, JES3 provides traces and dumps. Traces are copies of data made during normal processing to help monitor activity in the system, and dumps are copies of data made at times of failure.

3.42 JES3 job flow

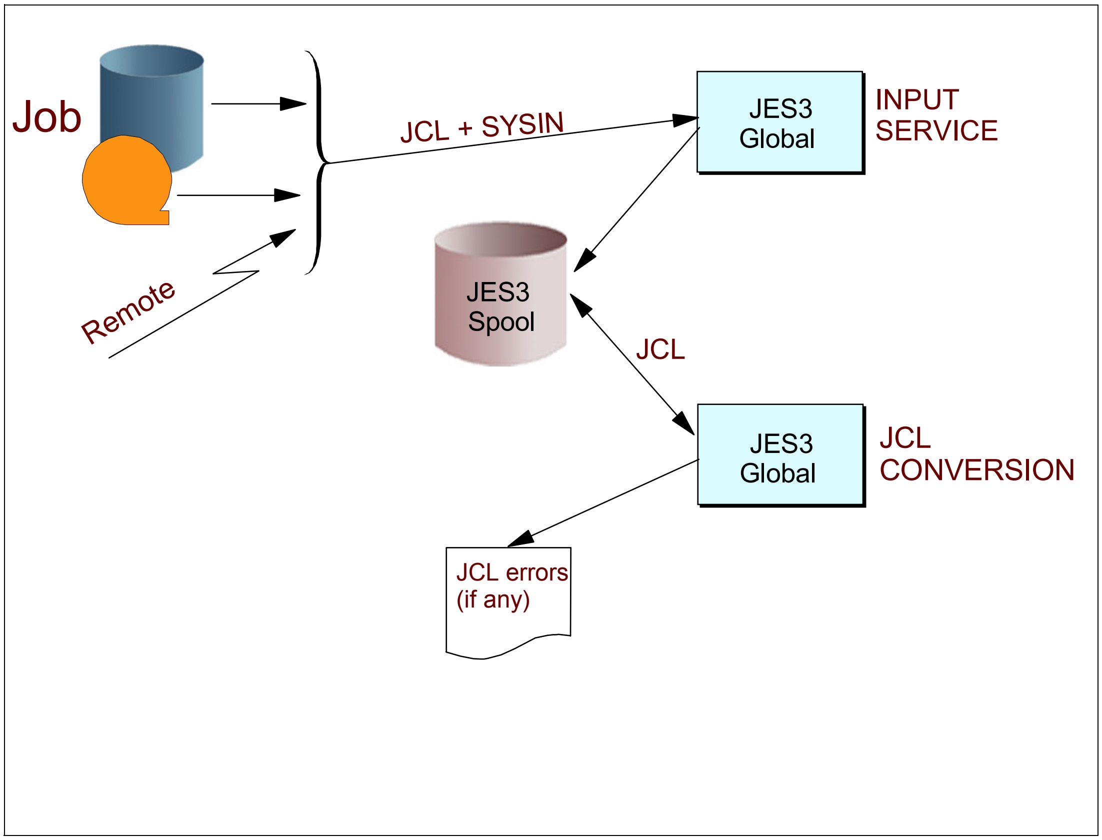


Figure 3-42 JES3 job flow

JES3 phases of job processing

Following are the first two phases of processing for a job in a JES3 system:

- Input service

  JES3 initially reads all jobs into the global and assigns to each job a unique JES3 job number from the available job number pool. Jobs can be submitted from a locally-attached tape, disk, or card reader. In addition, jobs can be submitted from remote job processing (RJP) workstations, time-sharing option (TSO/E) terminals, other systems in a job entry network, or by the internal reader.

  START and MOUNT commands and TSO/E LOGONs cause jobs to be started from predefined procedures. Input service processes the JCL created for these jobs in the same manner as any other standard job.

  Jobs initially placed on direct-access storage devices (DASD) and subsequently analyzed by JES3 input service are placed on the JES3 spool.

- Converter/interpreter processing (JCL conversion)

  JES3 chooses the address space where it converts the job's JCL. The selected address space then reads the job's JCL from spool and converts and interprets the JCL. During this processing, JES3 flushes any job with JCL errors and determines the job-referenced data sets that require volume mounting. JES3 passes the information about the required resources to the JES3 main device scheduler (MDS) if a job requires devices, volumes, or data sets.

3.43 JES3 job flow (2)

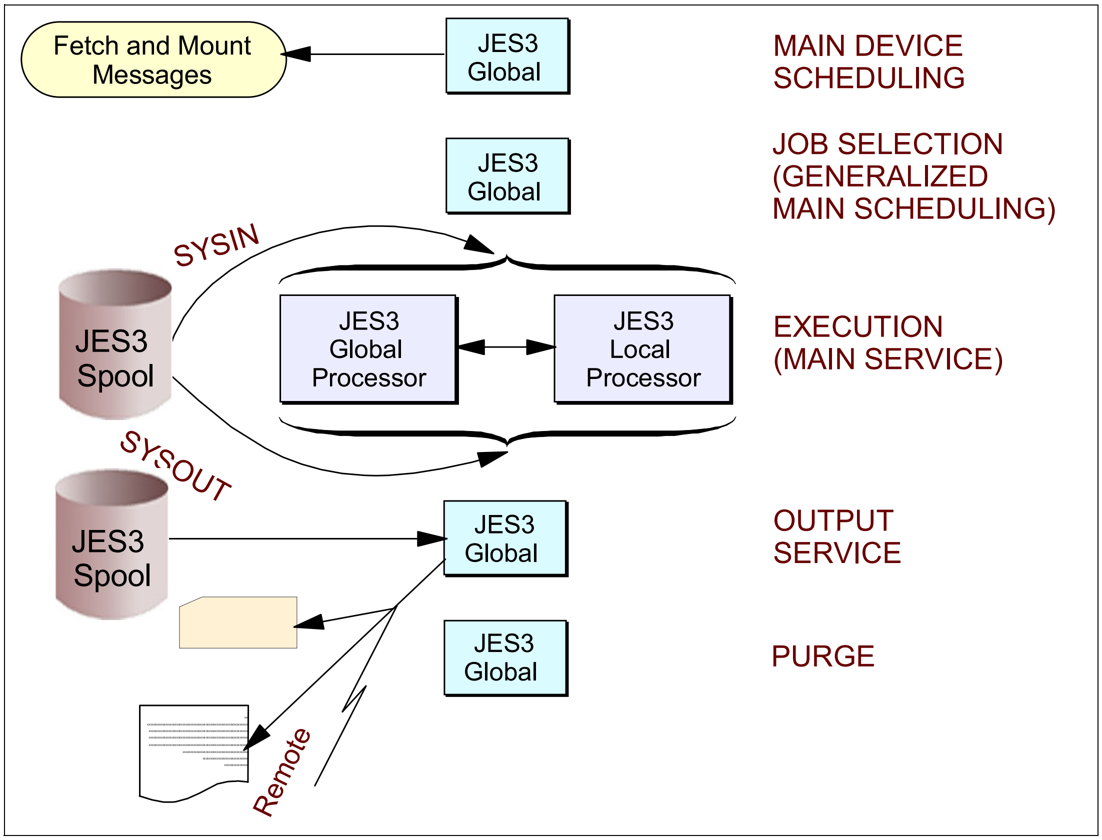


Figure 3-43 JES3 job flow (2)

After the first two phases, during which jobs are entered into the system and then passed through the converter and interpreter, the next phases are:

- Main device scheduling (job resource management)

  MDS ensures that resources (devices, volumes, and data sets) needed by the job are allocated before the job processes. MDS sends fetch messages to the tape and disk libraries, and mount messages to the setup operators to mount the volumes needed.

- Generalized main scheduling (job selection)

  JES3 schedules the job for processing based on specifications determined by the installation.

- Processing (main service - job execution)

  Jobs can run on the global or a local. z/OS controls the job during this phase. During processing, output generated by the job is usually written to the JES3 spool.

- Output processing

  Once processing is complete, JES3 processes the job's output data from the JES3 spool. Output data sets are printed and punched by JES3 output service when an available device matches the data set's requirements, such as forms, carriage forms control buffer (FCB), and train. JES3 output service informs the operator of any setup requirements of the data sets. The devices involved can be either local or remote, as defined by the job.

- Purge processing

  After output processing is complete, the purge function releases all spool space associated with the completed job.

JES3 from a system programmer's point of view

One way of visualizing JES3 is as a control program that performs job entry and job exit services. Another way of visualizing JES3 is as a language. Saying that JES3 is a control program is analogous to saying FORTRAN is a compiler. In reality, there is a FORTRAN language and a FORTRAN compiler. Similarly, there is a JES3 language and there is a JES3 program. Just as a FORTRAN programmer uses the FORTRAN language to define work the compiler is to do, JES3 system programmers use the JES3 language to define the work that JES3 is to do.

The JES3 language is made up of initialization statements, control statements, and commands. Operators and application programmers use parts of the language, but it is system programmers who define the total JES3 environment. Often, what is specified on JES3 initialization statements can be overridden with JES3 commands or control statements. While system programmers may not themselves use commands or control statements, they may have to instruct operators or application programmers on when and how they should be used.

A further level of defining how JES3 should do its work comes in the form of installation exits supplied with JES3. For example, in the area of controlling the print output from jobs, a system programmer can:

- Define initial values in the initialization stream
- Allow the operator to make certain modifications to the initial values
- Write an installation exit routine to further modify or control what should happen to the output

3.44 JES3 job flow review

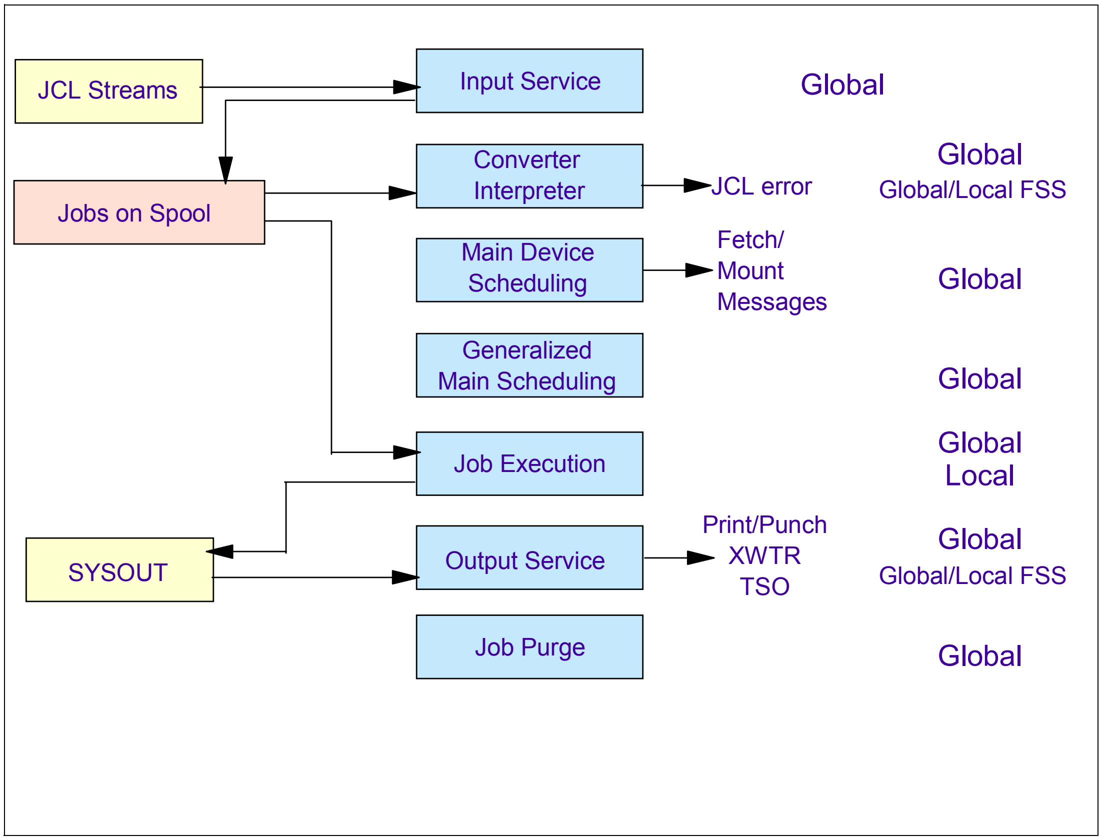


Figure 3-44 JES3 job flow review

Whatever the source of the input, JES3 is signalled that an input stream is to be read. This begins a chain of events that includes:

- Creation and scheduling of a card reader job.
- Reading of the input stream by a DSP.
- Building of JCT entries for each job in the input stream.
- Execution of DSPs represented by scheduler elements in the JCT entries for each job.

The modules that provide this service control the processing at the beginning of a typical MVS job. Input routines create scheduler elements that represent jobs to JES3, process control statements, and group jobs into batches.

Input service accepts and queues all jobs entering the JES3 system. The global processor reads the job into the system from:

- A TSO SUBMIT command
- A local card reader (CR DSP)
- A local tape reader (TR DSP)
- A disk reader (DR DSP)
- A remote work station (RJP/SNARJP DSPs)
- Another node in a job entry network (NJE DSPs)

- The internal reader (INTRDR DSP)

This service reads from the input source and adds jobs to the job queue.

The converter/interpreter (C/I) is the first scheduler element for every standard job. After a job passes through this first segment of processing, JES3 knows what resources the job will require during execution. C/I routines provide input to main device scheduling (MDS) routines by determining available devices, volumes, and data sets. These service routines process the job's JCL to create control blocks for setup and also prevent jobs with JCL errors from continuing in the system. Main device scheduling provides for the effective use of system resources. JES3 MDS, commonly referred to as "setup," ensures the operative use of non-sharable mountable volumes, eliminates operator intervention during job execution, and performs data set serialization. It oversees specific types of pre-execution job setup and generally prepares all necessary resources to process the job. The main device scheduler routines use resource tables and allocation algorithms to satisfy a job's requirements through the allocation of volumes and devices, and, if necessary, the serialization of data sets.

JES3 generalized main scheduling (GMS) is the group of routines that govern where and when MVS execution of a JES3 job occurs. Job scheduling controls the order and execution of jobs running within the JES3 complex.

Job execution is under the control of JES3 main service, which selects jobs to be processed by MVS initiators. Main service selects a job for execution using the job selection algorithms established at JES3 initialization. MAINPROC, SELECT, CLASS and GROUP initialization statements control the key variables in the job scheduling and job execution process.

Output service routines operate in various phases to process sysout data sets destined for print or punch devices, TSO users, internal readers, external writers, and writer functional subsystems.

Purge processing represents the last scheduler element for any JES3 job (that is, the last processing step for any job). It releases the resources used during the job and uses the System Management Facility (SMF) to record statistics.

3.45 JES3 job flow: Scheduler elements

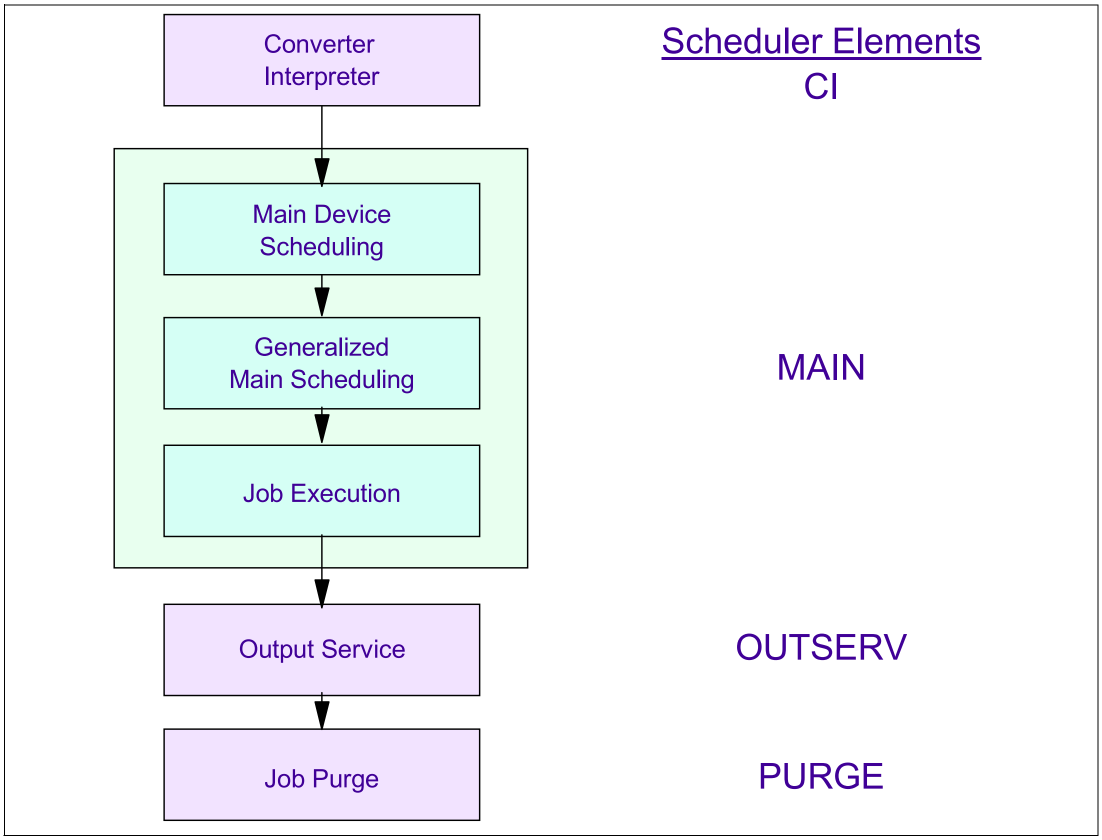


Figure 3-45 JES3 job flow: Scheduler elements

JES3 processing performed on behalf of jobs consists of distinct phases. A typical job originating in the input stream requires the following phases:

- Converting the job's JCL to a form usable by MVS.
- Insuring I/O resources needed by the job are available, and passing the job to MVS.
- Handling the job's SYSOUT data.
- Removing the job from the system.

Each of the four phases of a job is represented by a scheduler element (SE) in the JCT entry for the job shown in the Figure 3-45. Every scheduler element denotes a unit of work JES3 must perform to process the job. Each is represented on the FCT chain by one or more DSPs that performs the work required for that type of SE. Scheduler elements needed for job A are listed here (the actual DSP name is shown in capital letters).

There are two types of jobs in the JES3 complex:

- – The standard job
- – The non-standard job

Every job containing JCL, but containing no special JES3 control statements, is considered a standard job. JES3 places into the JCT entries of all standard jobs the same four scheduler elements in the same order:

- Converter/Interpreter (CI)

- Main service (MAIN)
- Output service (OUTSERV)
- Purge (PURGE)

Each JCT entry contains information about the job and an entry for each SE. Each SE entry contains flags indicating that SE's status: inactive, active, or complete. JSS uses these flags to determine which SE is next for scheduling/ending functions. The first SE that is not marked complete is selected, and is marked either complete or active.

3.46 JES3 standard job

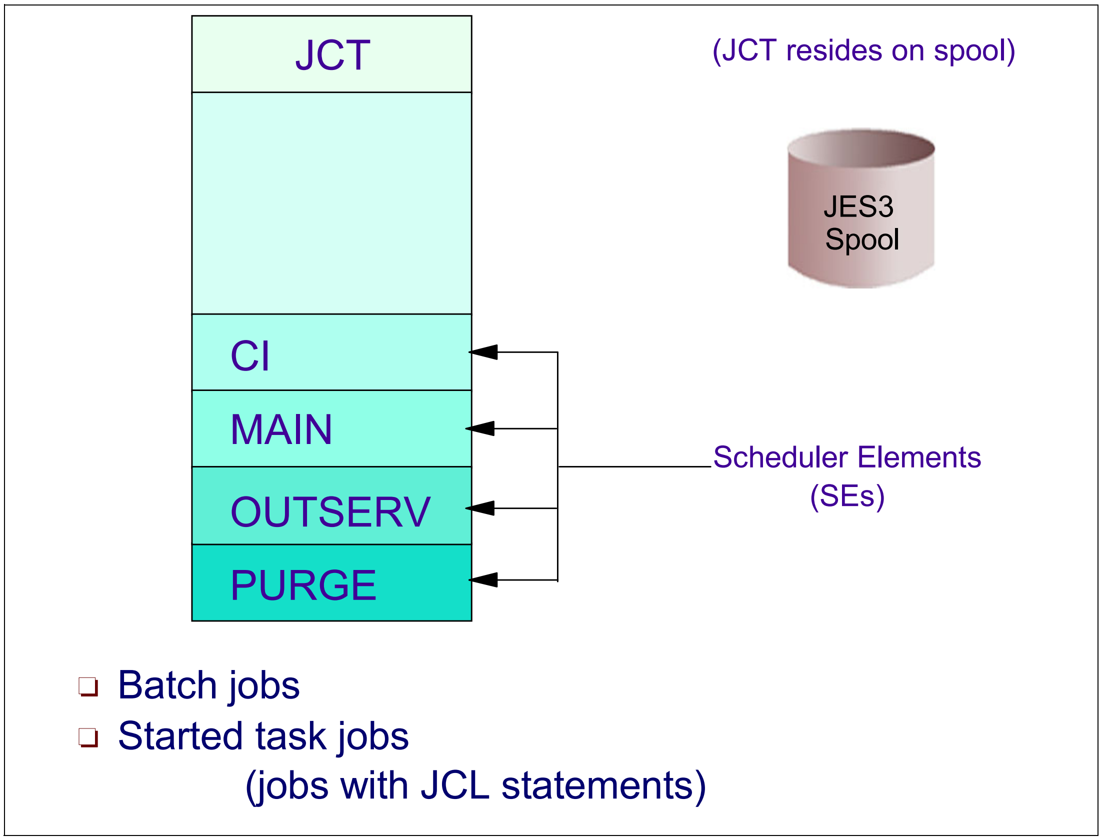


Figure 3-46 JES3 standard job

The names in parentheses are formal names of the DSPs that are executed to perform the work. The number or type of scheduler elements to be used for standard jobs can be changed by means of a user exit routine; such a change would apply to all standard jobs.

JES3 job management consists of the following phases:

- Input service (when the jobs is read in to the system).
- Converter/interpreter service
- Resource allocation
- Job selection and scheduling
- Output service
- Purge

Note: Resource allocation and JOB selection and scheduling is performed by the MAIN scheduler element.

3.47 JES3 non-standard job

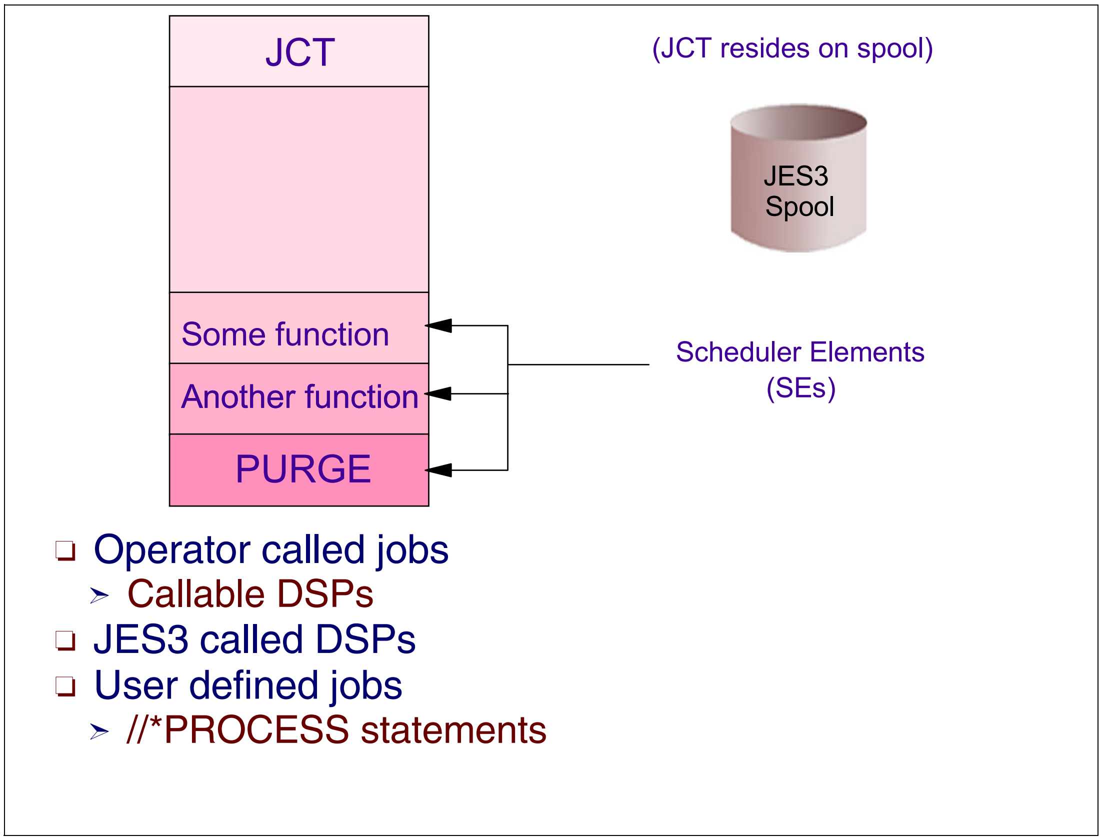


Figure 3-47 JES3 non-standard job

A non-standard job is a job for which the user determines the number of segments and their order of execution. To specify a different set of scheduler elements on a job-by-job basis, code special JES3 control statements and include them with JCL statements for the jobs.

Called jobs, which are non-standard, are created by operator request. The operator uses JES3 `*CALL` commands to make the requests. Called jobs are unique because they are not defined by JCL; there is, in fact, no JCT involved at all. These jobs are internally generated by JES3 in response to the `*CALL` command, and their JCT entries always contain two scheduler elements:

- One to represent the DSP needed for the request
- One to remove the called job from the system (PURGE)

3.48 Creating a batch job

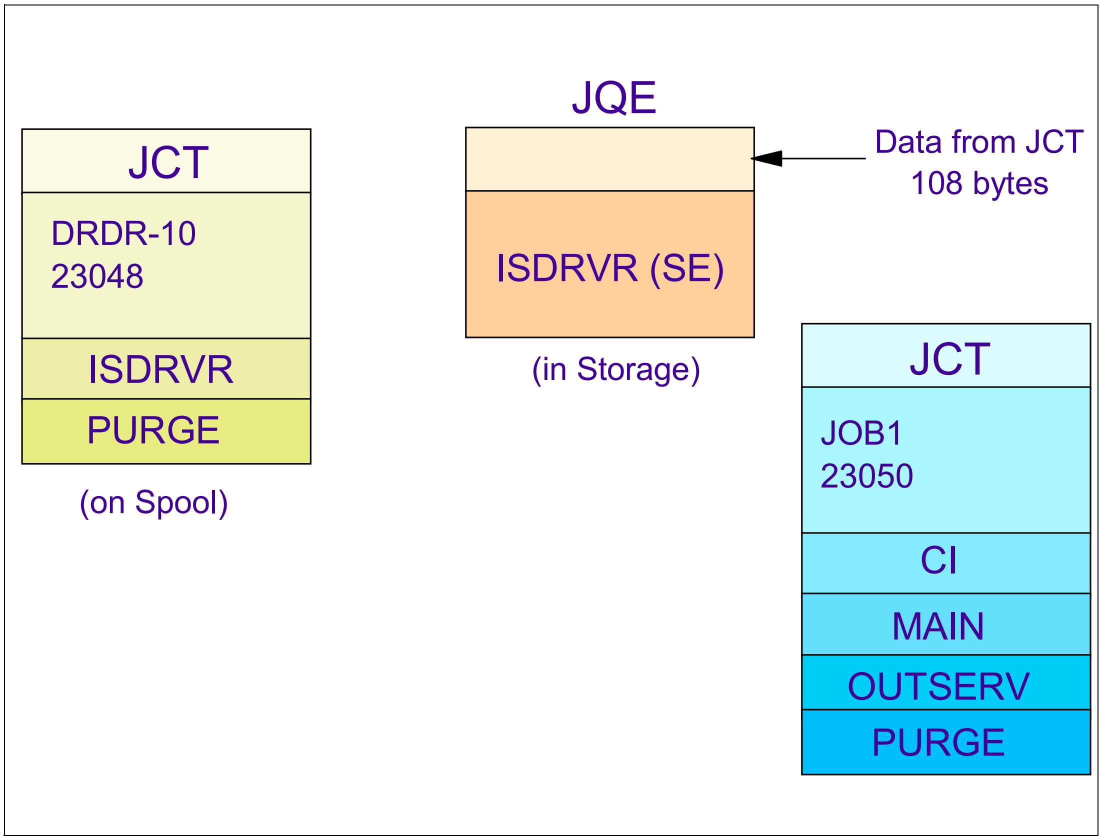


Figure 3-48 Creating a batch job

For each job in the input stream, ISDRVR creates a JCT entry for each MVS job in the batch.

Information placed into the JCT entry for a job includes:

- A JES3 job number
- The jobname from the JOB statement
- The job priority and class
- A symbolic origin for the job (for returning job output to the origin)
- Information from JES3 control statements
- Scheduler elements representing the DSPs needed to process the job

Since the sample job is a standard job, the scheduler elements will be CI, MAIN, OUTSERV, and PURGE

3.49 Converter/interpreter processing

- First scheduler element for standard job
- Interface to MVS converter/interpreter
- Construct SWA - write to spool
- Flush jobs with JCL errors
- Determine devices required
- Determine volumes required
- Establish data set awareness
- 13 user exits
- Uses subtasks - number is user defined
  - Controllable by operator

Figure 3-49 Converter/interpreter processing

The CI DSP serves as an interface between JES3 and the JES3 CI subtasks that invoke the MVS converter/interpreter subtasks. The interface responsibilities of the CI DSP are:

- To fail the job if JCL errors are detected by the MVS converter/interpreter
- To fail any job that contains more JCL statements than the limit allows
- To delay processing of any job that would temporarily cause the C/I subtasks to process more JCL statements than the system limit allows
- To copy the SWA control blocks that are produced by the MVS converter/interpreter onto spool

The CI DSP stores I/O requirements in job-related control blocks called the job summary table (JST) and job volume table (JVT). It writes these control blocks to spool along with others for the job. These control blocks and some that are kept in main storage allow JES3 to maintain a complex-wide awareness of the status of volumes and data sets.

During JES3 initialization, JES3 attaches an installation-defined number of converter/interpreter (C/I) tasks. These C/I tasks are subtasks to the JES3 primary task. When a C/I subtask processes a job, the scheduler work area (SWA) in the address space in which the service is invoked (global functional subsystem) provides temporary storage for the job's JCL statements. These statements remain in the SWA until the C/I subtask finishes processing the job. When several C/I subtasks run concurrently, the SWA contains the JCL statements for all the jobs these subtasks are processing.

3.50 Main scheduler element

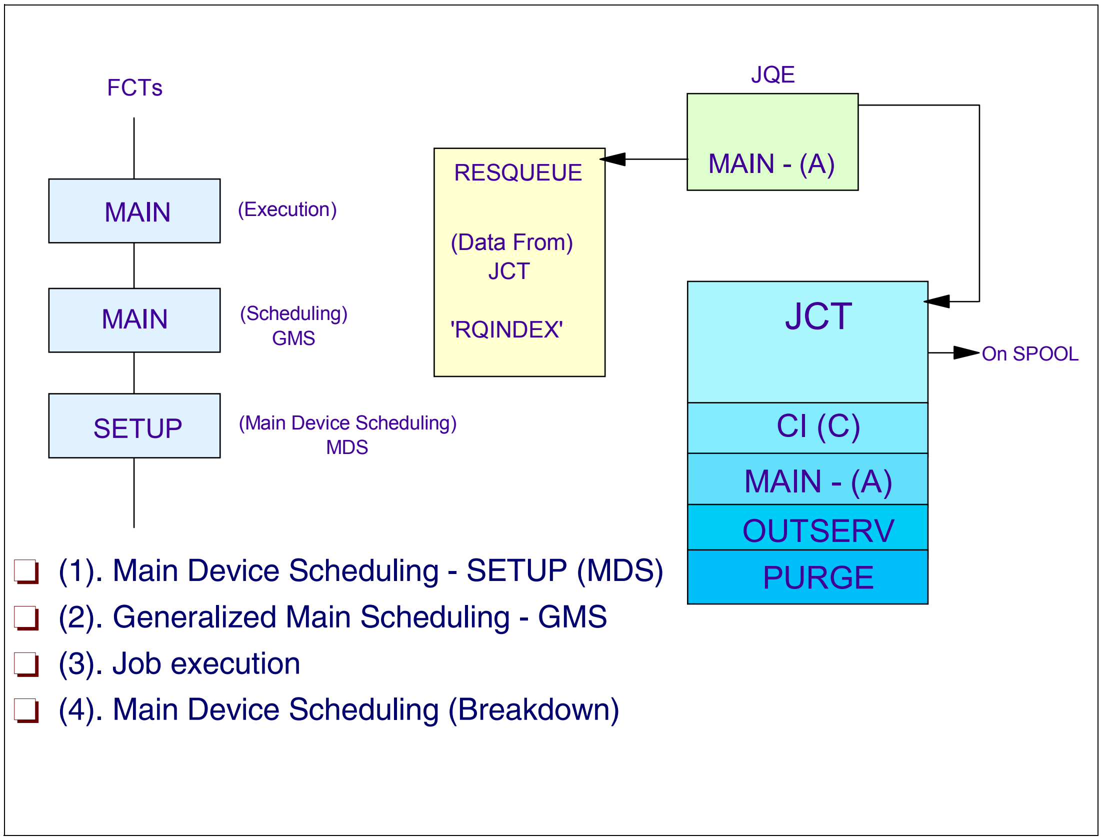


Figure 3-50 Main scheduler element

Main scheduler element processing

When the MAIN scheduler element is scheduled, the following functions occur under the FCTs, as illustrated in Figure 3-50. Main device scheduling is the allocation of device, volume, and data set resources to jobs, the selection of jobs to be passed to MVS initiators for execution, and the freeing of allocated resources after the jobs are executed.

For standard jobs, main service processing begins when the job segment scheduler reaches the MAIN scheduler element in the job's JCT entry. The MAIN scheduler element represents two DSPs: setup (SETUP) and generalized main scheduling (MAIN). Both of these DSPs are resident and each has a permanent entry in the FCT chain, so the job segment scheduler need not construct the FCT entries.

The work performed by the SETUP and MAIN DSPs is crucial to JES3 processing. The goals of the SETUP and MAIN DSPs are effective resource utilization and maximum job throughput. The processing sequence is:

- Initial setup processing to prepare I/O resources
- Generalized main scheduling to select and pass a job to an initiator
- Job execution
- Breakdown processing to relinquish I/O resources

3.51 Main device scheduling (MDS)

- MDS processing options
  - Volume fetch
  - Job setup
  - High watermark setup (HWS)
  - Explicit setup - //*MAIN SETUP=
  - NONE - (makes MDS optional)
- Schedules resources to jobs
  - Devices - volumes - data sets
- Objectives
  - Satisfy resource requirements before execution

Figure 3-51 Main device scheduling - MDS

Main device scheduling (MDS) represents the second phase of setup processing. Converter/interpreter is the first phase. The converter/interpreter routines construct a job summary table (JST) that lists required data sets and devices, and a job volume table (JVT) that describes the volumes the main's device scheduling routines will fetch and allocate. Volumes that are mounted will be verified.

Main device scheduling functions are optional and may be bypassed for a job as well as a complex. The purpose of MDS is to allocate I/O resources among competing jobs and release resources after they have been used. JES3 setup processing is defined by JES3 initialization statement parameters, JCL control statements, and JES3 operator commands. JES3 setup is available through the following options:

- Volume fetch
- Job setup
- High-watermark setup
- Explicit setup

3.52 Main scheduler element processing

- Generalized Main Scheduling - GMS
  - User defined algorithms - jobs to initiators
- Job execution
  - Monitor jobs during execution
  - Operator communication
- Main device scheduling - Breakdown
  - Return resources - devices, volumes, data sets

Figure 3-52 Main scheduler element processing

JES3 job scheduling is the group of routines that govern where and when MVS execution of a JES3 job occurs. Job scheduling controls the order and execution of jobs running within the JES3 complex.

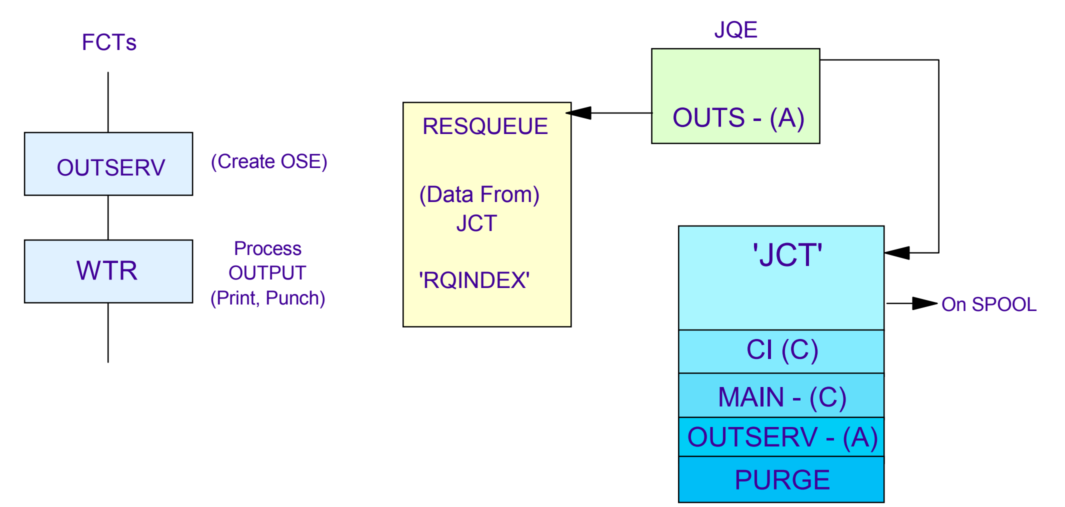
Job scheduling involves the routines invoked by the MAIN DSPs, which are represented by the MAIN scheduler elements on the job control table entry.

GMS selects jobs to be processed by MVS initiators. GMS selects a job for execution using the job selection algorithms established at JES3 initialization. MAINPROC, SELECT, CLASS, and GROUP initialization statements control the key variables in the job scheduling and job execution process.

During execution, the operator can monitor and cancel jobs.

When a step completes or the job ends, MDS breakdown occurs, which allows the freeing of resources, devices, volumes, and data sets.

3.53 OUTSERV scheduler element processing



- OSE creation
  - Characteristics for processing output
- Scheduling output
  - Writer selection parameters - WS

Figure 3-53 OUTSERV scheduler element processing

OUTSERV scheduler element processing phases

- Phase 1 - queuing of output
- Phase 2 - scheduling of output
- Phase 3 - printing and punching of output

Phases 1 and 2 occur in the JES3 global address space on the global processor. Phase 3 can run in the global address space under the global primary task, the global auxiliary task, or the functional subsystem.

- The OUTSERV DSP summarizes output data sets at two points of processing:
  - For normal jobs, when a job completes main service processing
  - For spin-off data sets, when a job or a DSP moves a data set directly to output service for processing before the job ends
- JES3 creates output service elements (OSEs) to summarize the output data set characteristics for scheduling. An OSE represents all of a job's output data sets with similar scheduling characteristics. One job can have several OSEs. OSEs are later used to schedule output to specific devices.
- The JES3 WTR DSP handles printing and punching of output. The WTR DSP reads from spool and writes to the specific output device, thereby performing device dependent functions. Output can be sent to a variety of devices. For locally attached devices that are driven by JES3 in the global address space, the WTR DSP writes directly to the device. For non-locally attached devices that are not driven by the JES3 global address space, the WTR DSP passes output to the appropriate interface. This can be RJP, SNARJP, NJE services, the internal writer, or a functional subsystem (FSS).

3.54 OUTPUT service processing

- Output writers
  - Hot writers - *X WTR,........
  - Dynamic writers
- Output types processed
  - Print and punch
  - External writer - PSO
  - TSO users via OUTPUT command - PSO
- 10 user exits
- SMF type 6 records

Figure 3-54 OUTPUT service processing

Hot writers give operations personnel total control of output handling. Operators enter commands to call and control hot writers. Hot writers remain available, even when there is nothing to print.

Dynamic writers are often used for volume printing on stock paper. These writers allow JES3 to control changing the setup characteristics for devices, thereby reducing the amount of control operators have over when and how writing is performed.

The output types processed are by device type. This characteristic indicates which type of device is to receive the output. Data sets that were defined as “print type” will be sent to printers, “punch type” will be routed to punches, and “sys type” will be routed to TSO or to external writers.

3.55 Purge processing

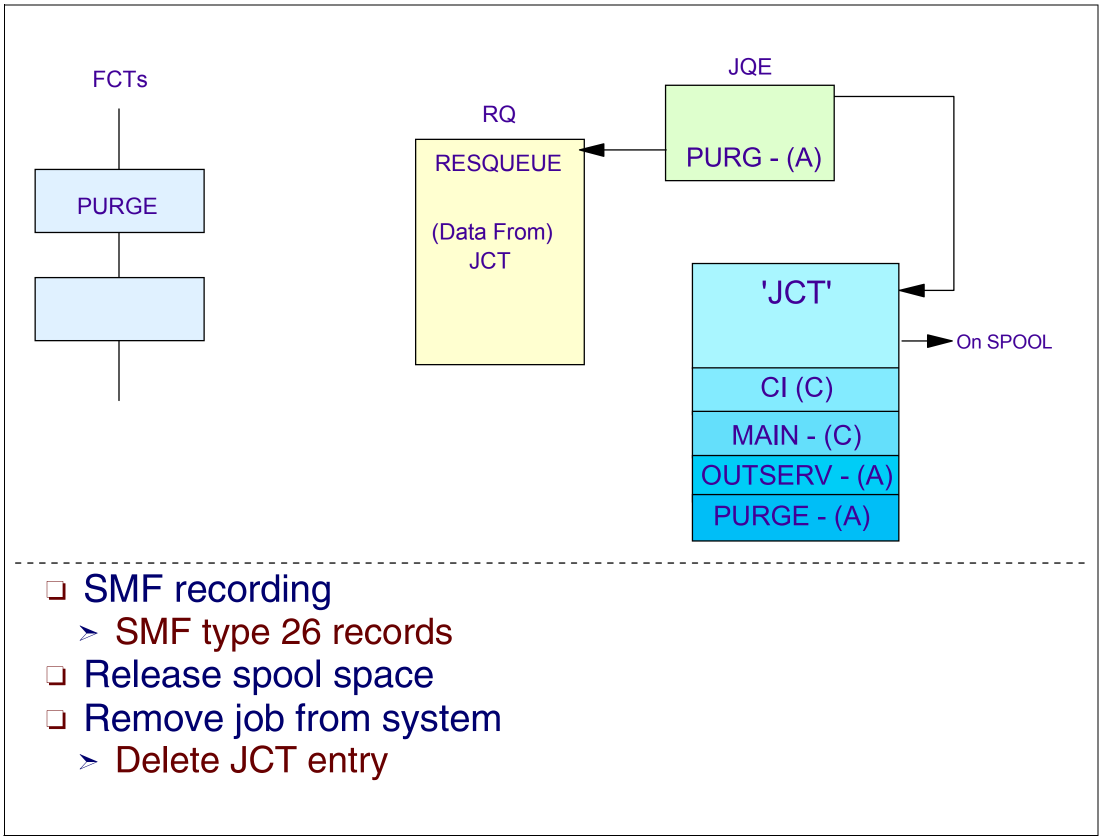


Figure 3-55 Purge processing

Purge processing represents the last scheduler element for any JES3 job (that is, the last processing step for any job). It releases the resources used during the job and uses the System Management Facility (SMF) to record statistics. Purge processing consists of the following steps:

- JES3 releases all spool space assigned to the job and updates resident control blocks.
- JES3 writes SMF record type 25, which contains device allocation information.
- JES3 writes SMF record type 26, which contains final job accounting information.
- JES3 informs the operator that the job has been purged.
- The JCT entry is deleted.

3.56 JES3 functions not in JES2

- Main Device Scheduling (MDS)
- Generalized Main Scheduling (GMS)
- Dependent Job Control (DJC)
- Deadline scheduling
- Interpreter processing
- Priority aging

Figure 3-56 JES3 functions not in JES2

Main device scheduling

JES3 provides a device management facility called the main device scheduler (MDS) that can wholly or partially support the MVS allocation process. The purpose of MDS is to satisfy job resource requirements (the devices, volumes, and data sets needed) before and during job execution, thus allowing execution to proceed without allocation delays. MDS also allows controlled multisystem access to commonly accessible data sets in the loosely coupled environment.

Generalized main scheduling

Each time an MVS initiator requests work, generalized main scheduling (GMS) selects and schedules a job for execution. The job that GMS selects depends primarily upon initialization parameters that you have specified. Deadline scheduling and dependent job control (DJC), additional GMS functions, enable you to control when jobs execute. With deadline scheduling, you specify a deadline by which you want the job to run. JES3 periodically increases the job's selection priority in an attempt to run the job by the specified deadline. DJC allows you to create a network of related jobs.

Dependent job control

Dependent job control (DJC) is a means of coordinating the processing of jobs. With DJC, one job will not run unless some other job has run first. (DJC has an MVS counterpart for conditional execution of job steps.) DJC requires no advance preparation with JES3 initialization statements. Application programmers can specify all relationships between jobs on JES3 control statements they submit with the affected jobs.

Deadline scheduling

Deadline scheduling is a way of scheduling jobs by time of day or by week, month, or year. Job priorities remain in force, but as deadlines approach, JES3 increases the priorities, thereby increasing the likelihood the jobs will be processed before a certain deadline. System programmers must prepare for deadline scheduling with JES3 initialization statements that tell when a priority is to be increased, and by how much. Then application programmers can put deadlines on JES3 control statements they include with the jobs.

Interpreter processing

Converter/Interpreter (C/I) service controls the conversion of JCL statements to Converter/Interpreter text and then into control blocks. This service comprises primarily the JES3 CI and POSTSCAN dynamic support programs, the C/I subtasks under which the MVS C/I routines run, and the initiator support routines. C/I service controls the conversion and interpretation of a job's JCL. The three principal phases of C/I service are:

- Converter/Interpreter phase: Uses the MVS C/I routines to convert and interpret JCL into scheduler control blocks. At this time, the scheduler control blocks are created in the scheduler work area (SWA).
- Prescan phase: Extracts job requirements from the scheduler control blocks for use in the postscan phase. At the end of the prescan phase, the scheduler control blocks are moved from the SWA to JES3 spool.
- Postscan phase: Locates data sets and gathers information for use in JES3 device setup.

Priority aging

When all initiators are busy, throughput of certain jobs might fall below normal expectations. To help in these situations, JES3 uses the additional scheduling function of priority aging. Priority aging can help ensure that jobs that have been waiting to run have a chance of being selected to run before those jobs that just entered the system. By using priority aging, an installation can increase the priority of a waiting job. The longer the job waits, the higher its priority becomes, up to a limit, and the greater its chances of being selected to run.

3.57 Dynamic support program (DSP)

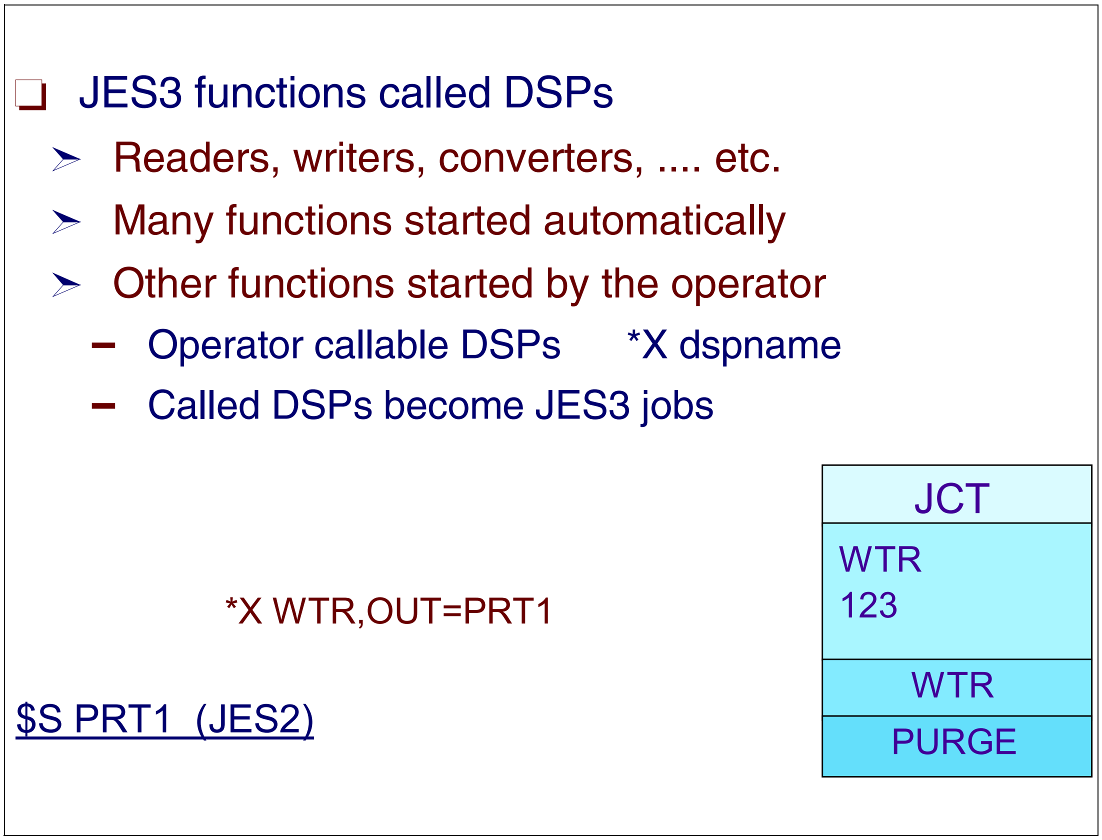


Figure 3-57 Dynamic support program (DSP)

Each small piece of work that JES3 performs when processing a job is accomplished with a JES3 program called a dynamic support program, or DSP. Each DSP is presented on the FCT chain by one or more FCT entries or elements. The elements on the FCT chain are executed according to their priority, and are placed on the FCT chain with the high priority element first. The higher priority elements are executed before the lower priority elements.

JES3 dynamic support programs (DSPs) control JES3 processing. Some primary DSPs (such as MAIN) directly relate to a job's execution. Other DSPs (such as Dump Job and Disk Reader DSPs) provide functions or services that can be called by a system operator.

In addition to the JES3 DSPs, you can create your own DSPs and add them to the system. Such DSPs run enabled in supervisor state, and under protection key 1. They become part of JES3, and JES3 expects them to use the same programming conventions as JES3 DSPs supplied by IBM. Examples of DSPs provide by JES3 are readers, writes, converts, and so on.

To execute a DSP:

1. Issue the *`CALL` command to make the DSP available to the system (that is, added to the FCT chain).
2. Issue the *`START` command to start processing the DSP.

To stop a DSP, issue the *`CANCEL` command.

3.58 JES3 and consoles

- JES3 may be operated from any console attached to any system
- From any console, an operator can
  - Direct a command to any system
  - Receive the response to that command
- Any console can be set up to receive messages
  - From all systems
  - Specific systems

Figure 3-58 JES3 and consoles

JES3 may be operated from any console that is attached to any system in the sysplex. From any console, an operator can direct a command to any system and receive the response to that command. In addition, any console can be set up to receive messages from all systems, or a subset of the systems in the sysplex. Thus, there is no need to station operators at consoles attached to each processor in the sysplex.

3.59 Issuing commands

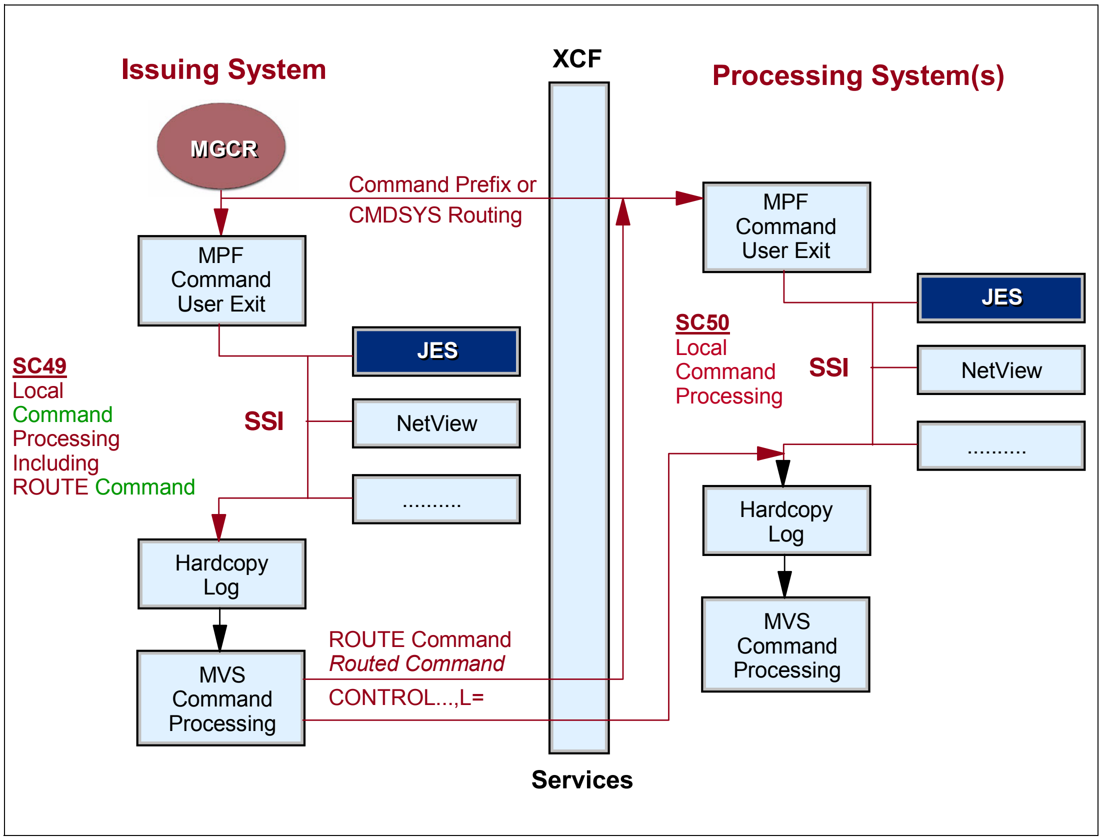


Figure 3-59 Issuing commands

You must establish a command prefix for each JES3 system since commands are routed also by the prefix. The routing of commands occurs as follows:

- Command prefix and CMDSYS routing

  If the command contains a prefix or the console has a CMDSYS specification that directs the command to another system, the command is immediately transmitted using XCF services to the processing system.

  > **Note:** For command prefix and CMDSYS routing, the command is first transported to the receiving system before any system symbol substitution takes place.

  A REPLAY command is sent to the system where the WTOR was issued. If the REPLAY command text contains system symbols, substitution occurs on the receiving system.

- MPF command user exit

  If the command is not transmitted to another processing system, it is processed on the issuing system by the installation MPF command exit routines. The exits are specified using the .CMD statement in the MPFLSTxx parmlib member. These exits can perform authority checking, modify the command text, or the command processing.

  > **Note:** For commands containing system symbols, substitution has occurred before the exit is entered.

- SSI processing

  The command is broadcast on the subsystem interface (SSI) to all active subsystems. Each subsystem inspects the command and decides whether to process it. The subsystems base the decision on the command prefix characters of the command string. For example, by default, NetView looks for a percent sign (%) and process the commands starting with the % sign.

  When a subsystem decides to process the command, the command is passed to subsystem processing, and a return code is set to indicate that the command was processed by a subsystem.

  Note: At this point in processing, all system symbol substitution has occurred. The original command text is also available.

- Hardcopy log

  Once the command has been examined by all active subsystems, it is logged to the &hc.log (usually SYSLOG or OPERLOG).

  Note: The hardcopy log contains the command before any system symbols contained in the command have been substituted, and it also contains the command after substitution has occurred.

- MVS command processing

  If none of the subsystems has marked the command as having been processed, it is assumed to be an MVS command and is passed to the appropriate MVS command processor. If a command processor does not exist, an error message is issued stating that the command is invalid.

3.60 Consoles on each system

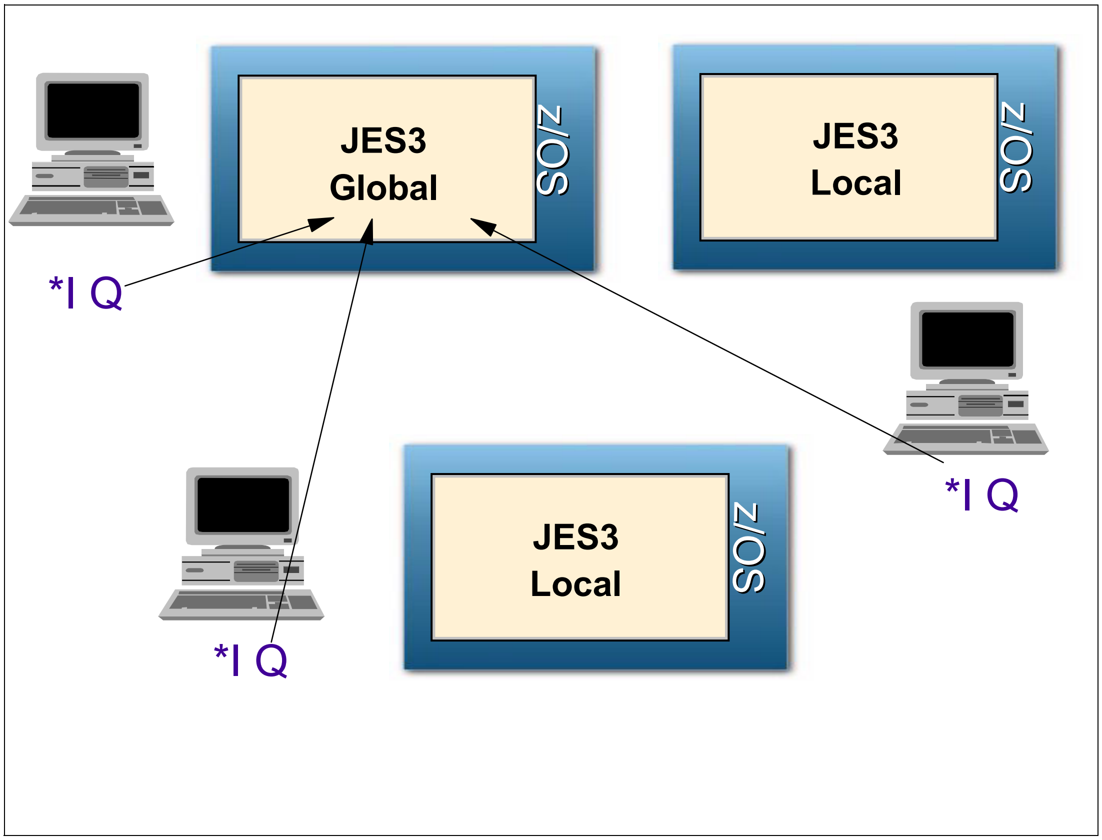


Figure 3-60 Consoles on each system

Consoles are devices that you use to enter commands and receive messages from JES3, MVS, and application programs. Consoles fall into one of the following classes:

- Multiple console support (MCS) consoles
- Remote job processing (RJP) consoles

MCS consoles are devices that you can physically attach to global or local processors. These consoles allow you to control the sysplex. Refer to *z/OS MVS Planning: Operations*, SA22-7601 for information about MCS consoles in a sysplex environment.

RJP consoles are devices that you attach to the JES3 global as part of a remote workstation using telecommunications lines. RJP permits you to submit jobs and receive output at workstations that can reside at some distance from your installation.

See *z/OS JES3 Initialization and Tuning Reference*, SA22-7550 for more information about defining RJP consoles.

3.61 JES3 commands

- *INQUIRY commands are used to request information - (*I)
- *MODIFY commands used to change specifications in jobs - (*F)
- *CALL (*X), *START (*S), *RESTART (*R), *CANCEL (*C), and *FAIL commands used to control dynamic support programs (DSPs)
- *VARY (*V) commands and the *MODIFY,V (*F V) command are used to control devices and other JES3 resources
- *SWITCH and *FREE commands used to control RJP consoles
- *MESSAGE commands are used to communicate with other consoles and with remote nodes
- *SEND (*T) commands route commands to a remote node
- *DUMP and *RETURN are used to terminate JES3

Figure 3-61 JES3 commands

JES3 operator control

Commands are requests you make to the system. You can use commands to control devices, to change specifications previously made to the system, or to display information about the operator's console. The first element of a command is a prefix that informs JES3 that a command is being entered. The default JES3 command prefix is the asterisk character (*).

These are the basic JES3 commands and their purposes:

- *INQUIRY commands are used to request information. No action will be taken except that the requested information will be displayed.
- *MODIFY commands are used to change specifications given in jobs or previous commands, or during initialization.
- *CALL, *START, *RESTART, *CANCEL, and *FAIL commands are used to control dynamic support programs (DSPs), such as utilities.
- *VARY commands and the *MODIFY,V command are used to control devices and other JES3 resources.
- *SWITCH and *FREE commands are used exclusively to control RJP consoles.
- *MESSAGE commands are used to communicate with other consoles and with remote nodes.
- *SEND commands are used to route commands to a remote node.
- *DUMP and *RETURN commands are used to end JES3.
- *TRACE command is used to trace certain JES3 events.

3.62 Controlling JES3 jobs

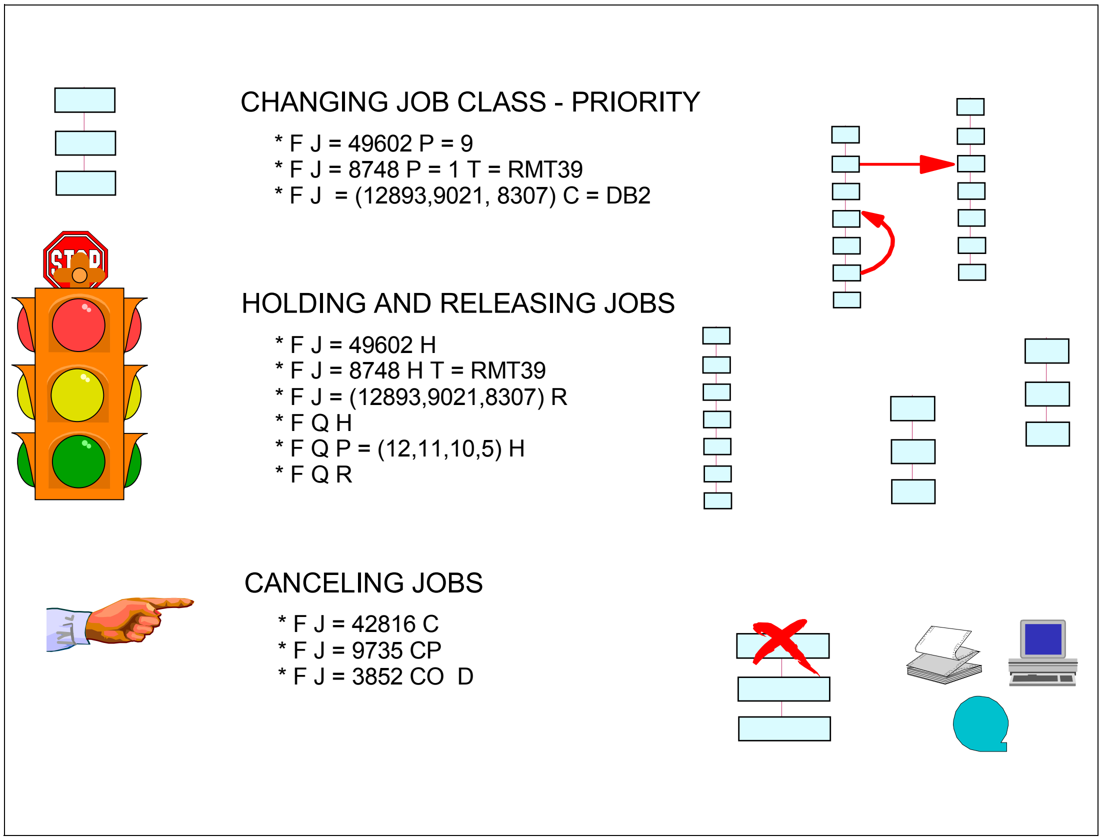


Figure 3-62 Controlling JES3 jobs

Use the **`*MODIFY,J=`** or the **`*F,J=`** command to:

- Hold a job, **`*F,J=nnnn H`**
- Release a job, **`*F,J=nnnn R`**
- Cancel a job, **`*F,J=nnnn C`** or **`CP`** or **`CO`**
- Change a job's priority, **`*F,J=nnnn P=nn`**
- Change a job's job class, **`*F,J=nnnn C=class`**
- Change a job's JESMSGLG logging status, **`*F,J=nnnn LOG`** or **`NOLOG`**

Use the **`*MODIFY,Q`** or *__`F,Q`__ command to:

- Hold or release all the jobs in the JES3 job queue, **`*F Q H`** or **`R`**
- Hold or release jobs of a designated priority, **`*F Q P=nnn H`** or **`R`**

3.63 Controlling job input

- DSP dictionary entry for ISDRVR

```
ISDRVR    IATYDSD    PRTY = 4,PABLE = YES,              *
                     CSECT = IATISDT,REENT = YES,       *
                     DRVR = IATISDV,MAXCT = 2
```

- Inquiry DSP entry ISDRVR

```
*I X,D=ISDRVR
IAT8475 (IQDX) - ISDRVR   MXCT=000002 USE=000000 MOD=YES
IAT8472 (IQDX) - ISDRVR   IS NOT IN HOLD
```

- Modify DSP entry ISDRVR

```
*F X,D=ISDRVR,MC=5
IAT8484 (MODX) - ISDRVR   OLDMXCT=000002 NEWMXCT=5
```

Figure 3-63 Controlling job input

Each small piece of work that JES3 performs when processing a job is accomplished with a JES3 program called a dynamic support program, or DSP. Each DSP is represented on the FCT chain by one or more FCT entries or elements. The elements on the FCT chain are executed according to their priority, and are placed on the FCT chain with the high priority element first. The higher priority elements are executed before the lower priority elements.

The IATYDSD macro generates an entry for a dynamic support program (DSP) in the DSP dictionary (module IATGRPT or, in a C/I FSS address space, module IATGRPTF). An entry in the table is required for each DSP in order for it to be recognized as part of JES3. The following are considerations:

ISDRVR: The 1 to 8 character name of the DSP whose entry is being created by this macro. If the DSP is to be callable, this name will appear as the argument of an ***X,dspname** command. If the DSP is to be processable, this name will appear in the //*PROCESS dspname JCL statements. The label is required.

PRTY: The priority to be assigned to the DSP, in the range from 1 through 255. This priority becomes the FCT priority when the DSP is activated.

REENT: Specifies that the DSP is reenterable.

DRVR: The name of the DSP driver module to be loaded, if necessary, for each use of the DSP.

CSECT: The name of the data CSECT to be loaded by the job segment scheduler driver (module IATGRJR) for each use of the DSP.

MAXCT The maximum number of copies of this DSP that may be concurrently active. The number must be within the range 1 through 65535. If this parameter is not specified for a DSP specifying REENT=YES, no MAXCT limit is imposed. This parameter is dynamically alterable by using the **`*MODIFY`** command unless you specify MUCC=NO.

JSS schedules all DSPs into execution by building an FCT and adding the FCT to the FCT chain in priority sequence.

3.64 Commands for job queue status

❑ *I Q - *I Q,N=ALL - *I Q,N=25

```
*I Q
IAT8674 JOB NJECONS  (JOB02539) P=15 NJECONS(ACTIVE)
IAT8674 JOB NJERDR   (JOB02540) P=15 NJERDR(ACTIVE)
IAT8674 JOB NJERDR   (JOB13925) P=15 NJERDR(ACTIVE)
IAT8674 JOB DEADLINE (JOB19683) P=15 DEADLINE(ACTIVE)
IAT8674 JOB SNARJP   (JOB13067) P=15 SNARJP(ACTIVE)
IAT8674 JOB MONITOR  (JOB13361) P=15 MONITOR(ACTIVE)
IAT8674 JOB SDSF     (JOB17432) P=15 CL=A        OUTSERV(PENDING WTR)
IAT8674 JOB DFSMSHSM (JOB17433) P=15 CL=A        OUTSERV(PENDING WTR)
IAT8674 JOB OAM      (JOB17434) P=15 CL=A        OUTSERV(PENDING WTR)
IAT8674 JOB OPTSO    (JOB17436) P=15 CL=A        OUTSERV(PENDING WTR)
IAT8595 INQUIRY ON JOB QUEUE STATUS COMPLETE,      10 JOBS DISPLAYED
```

Figure 3-64 Commands for job queue status

Use the **`*INQUIRY,Q`** command to display:

- A list of jobs waiting for a DSP.
- The names of the spool data sets assigned to a spool partition and whether the partition is defined as the default partition, the initialization partition, or an overflow partition.
- The size of the partition and the amount of space currently available.
- The status of a partition, and users of the largest spool space.
- The status of a spool data set and the name of the spool partition the data set belongs to.
- All the defective tracks currently known to JES3.
- The amount of space available on all the JES3 spool data sets in the complex.
- A list of jobs of a particular category in the JES3 job queue.
- The amount of space remaining in the JES3 job queue.
- The status of the spool integrity function.
- A list of jobs that use the specified scheduling environment that are either waiting to be scheduled or have been scheduled for main service. Information about why the job is waiting can also be displayed.
- A list of jobs with the specified service class that are either waiting to be scheduled for main service or have been scheduled for main service. Information about why the job is waiting can also be displayed.
- Whether or not multiple batch jobs with the same name may be scheduled for the MAIN SE at the same time.

You might want to use this command to help determine if a performance problem is the result of JES3 using a high percentage of the available spool space in one or more spool partitions.

3.65 Jobs in operator hold

```
*I Q,H,OP
IAT8674 JOB A        (JOB09773) P=01 CL=A        HOLD=(OP) CI
IAT8674 JOB B        (JOB09774) P=01 CL=A        HOLD=(OP,N) CI
IAT8674 JOB C        (JOB09775) P=01 CL=A        HOLD=(OP,N) CI
IAT8674 JOB D        (JOB09777) P=01 CL=A        HOLD=(OP,N) CI
IAT8674 JOB E        (JOB09779) P=01 CL=A        HOLD=(OP,N) CI
IAT8698 HELD JOB SUMMARY:
IAT8696     5 JOBS IN OPERATOR HOLD
IAT8595 INQUIRY ON JOB QUEUE STATUS COMPLETE,       5 JOBS DISPLAYED
```

Dependent Job Control (DJC)
(DJC Network)

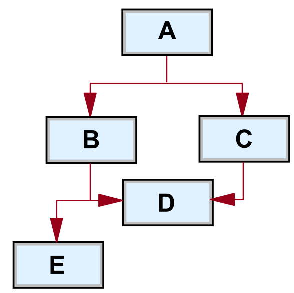


Figure 3-65 Jobs in operator hold

You can use the command **`*I Q,H. OP`** to display the status of all jobs in operator hold, with the total summary count.

You can use the option **`H`** to display the status of jobs held with:

- Operator hold
- DJC operator hold
- Error hold
- Spool hold
- Priority hold
- DJC net hold
- Automatic restart management hold

3.66 Jobs in hold

```
*I Q H
IAT8674 JOB A        (JOB09773) P=01 CL=A        HOLD=(OP) CI
IAT8674 JOB B        (JOB09774) P=01 CL=A        HOLD=(OP,N) CI
IAT8674 JOB C        (JOB09775) P=01 CL=A        HOLD=(OP,N) CI
IAT8674 JOB D        (JOB09777) P=01 CL=A        HOLD=(OP,N) CI
IAT8674 JOB E        (JOB09779) P=01 CL=A        HOLD=(OP,N) CI
IAT8696     4 JOBS IN DJC NET HOLD
IAT8595 INQUIRY ON JOB QUEUE STATUS COMPLETE,       5 JOBS DISPLAYED

*I Q,H,SUMM
IAT8698 HELD JOB SUMMARY:
IAT8696     5 JOBS IN OPERATOR HOLD
IAT8696     0 JOBS IN DJC OP HOLD
IAT8696     4 JOBS IN DJC NET HOLD
IAT8696     0 JOBS IN ERROR HOLD
IAT8696     0 JOBS IN SPOOL HOLD
IAT8696     0 JOBS IN ARM HOLD
IAT8696     0 JOBS IN PRIORITY HOLD
IAT8595 INQUIRY ON JOB QUEUE STATUS COMPLETE,       0 JOBS DISPLAYED
```

Figure 3-66 Jobs in hold

The output of the **`*I Q,H`** command is shown in Figure 3-66.

If you use the **`SUMM`** option you will display the summary of jobs for each hold type.

3.67 Managing output service jobs

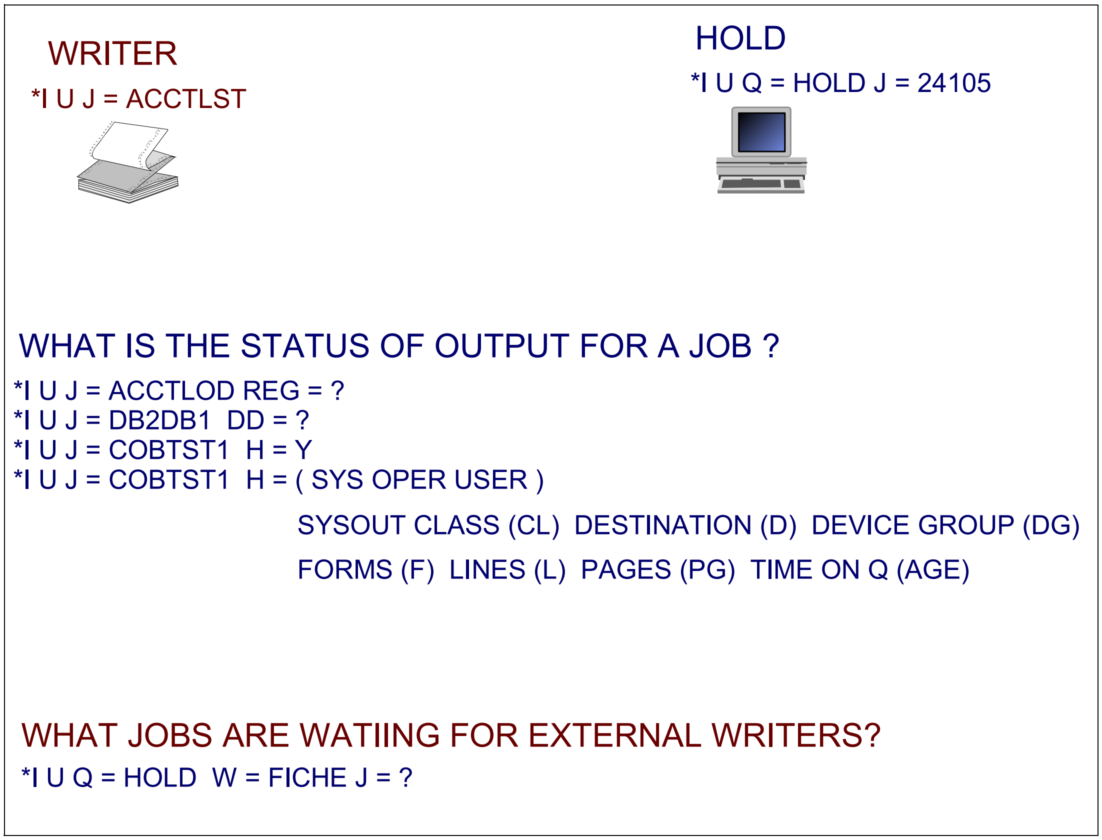


Figure 3-67 Managing output service jobs

Use the **`*INQUIRY,U`** or the **`*I,U`** command to display job output in a JES3 system. The job output can be at various places within the system and your selection of the proper **`Q=`** keyword value on the **`*INQUIRY,U`** command dictates what output you want.

The choices are generally the following:

- **`*INQUIRY,U,Q=BDT`**

  To display SNA/NJE job output.

- **`*INQUIRY,U,Q=HOLD`**

  To display job output on the HOLD queue.

- **`*INQUIRY,U,Q=WTR`**

  To display job output on the WTR service queue.

- **`*INQUIRY,U`**

  To display job output on the WTR service queue. (`Q=WTR` is the default.)

A command can have a length of up to 126 characters if the command is issued from an input device that permits that command length.

3.68 Start JES3 with a hot start

- ❑ After an orderly shutdown
- ❑ After a JES3 failure on the global from which JES3 cannot automatically recover
- ❑ After an MVS failure that terminates all functions in the global
- ❑ To replace one of your checkpoint data sets
- ❑ Warm start requires IPL of all systems

Figure 3-68 Start JES3 with a hot start

Use a hot start to start JES3 on the global:

- After an orderly shutdown
- After a JES3 failure on the global from which JES3 cannot automatically recover
- After an MVS failure that terminates all functions in the global
- To replace one of your checkpoint data sets

JES3 does not read the initialization stream during a hot start. Instead, JES3 initializes itself by using the parameter values established during the previous cold or warm start. In addition, certain changes made by the operator after the previous restart remain in effect. For a list of these changes, see *z/OS JES3 Commands*, SA22-7540-03.

If you perform an IPL of MVS before the hot start, JES3 restarts jobs that were running on the global and are eligible for restart. If a job is not eligible for restart, JES3 processes it based on the job's failure options. For an explanation of the failure options, see the FAILURE parameter on the CLASS initialization statement. JES3 also restarts all FSSs that were running on the global and reschedules all jobs that were active in the FSS at the time of the IPL. If you do not perform an IPL of MVS before the hot start, all jobs and FSSs that were running before the hot start continue to run after the hot start. During a hot start, JES3:

- Examines the job queue to verify that it can restart each job
- Prompts the operator if it locates a job that contains invalid control information
- Removes jobs that contain invalid control information

- Records the job control information associated with the removed jobs (they are recorded in the data set defined by the //JES3SNAP DD statement)
- Continues to process valid jobs that were in the job queue before the hot start. Internal job numbering resumes with the next available job number.

Jobs and FSSs running on locals before the hot start continue to execute after the hot start. Any changes to the definition of an FSS brought about by using the ***MODIFY** operator command before the hot start remain in effect across a hot start with or without an IPL of MVS. Overflow partition relationships, including any changes brought about by using the ***MODIFY** operator command before the hot start, also remain in effect across a hot start.

Warm start

Use a warm start to restart JES3 on the global:

- After either type of hot start or hot start with refresh fails.
- After a failure of the global because of a software/hardware failure.
- When you want to change the initialization stream and the changes cannot be performed with a hot start with refresh.
- Following the construction of the MVS Base Control Program.

During a warm start, JES3 reads and processes the initialization stream, saves jobs that are in the job queue, and terminates active jobs according to the job's failure options.

After a warm start, you must IPL and then restart all local processors. All FSS address spaces terminate at IPL time and are restarted by JES3 after IPL. JES3 then reschedules all jobs that were active in the FSS address space at the time of warm start. Any changes to the definition of an FSS address space brought about by using the ***MODIFY** operator command before the warm start are lost. JES3 continues to process jobs that were in the job queue at the time of the warm start.

3.69 JES3 DLOG function

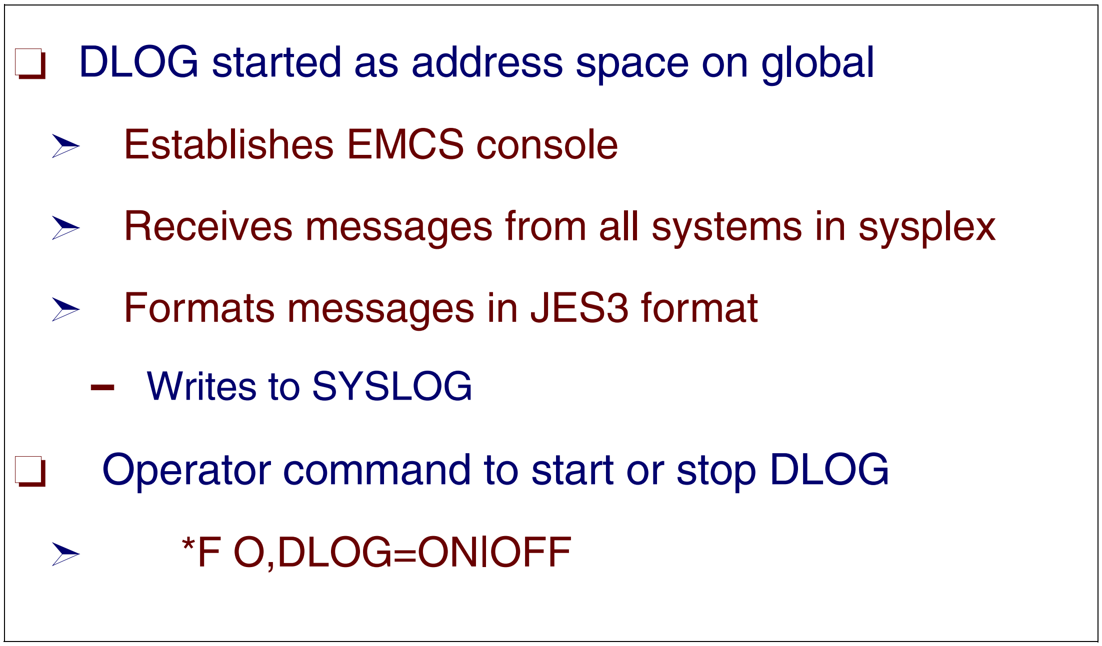


Figure 3-69 JES3 DLOG

JES3 provides an option to activate a DLOG, where records are written in the JES3 format rather than the MVS format.

The DLOG message traffic is managed by MCS. On the global, JES3 activates an extended MCS console with the HARDCOPY=YES attribute to receive the hardcopy message set. The messages received by the DLOG EMCS console are in the MDB format and are converted to the JES3 DLOG format and then written using the WTL macro service to the global JES3 system's SYSLOG (alias DLOG).

JES3 initialization assigns SYSLOG unconditionally to be the MVS hardcopy medium (VARY SYSLOG, HARDCPY) on all systems. If a hardcopy log to a device is required (MLOG is requested in the initialization stream), it is written by JES3 to a JES3-managed device. In addition, if DLOG is specified in the initialization stream, and the JES3 global is restarting without IPL, JES ensures that the log is active on the global processor (WRITELOG START). During local connect processing, JES3 causes the accumulated log data on each local to be written to spool (WRITELOG).

When JES3 is installed, you have the option to use the OPERLOG as the only hardcopy media. Because JES3 can no longer unconditionally assign SYSLOG to the MVS hardcopy media (VARY SYSLOG, HARDCPY) on all systems, this processing is removed. However, if DLOG is requested in the initialization stream, JES3 global initialization continues to ensure that SYSLOG is assigned the hardcopy media and that a SYSLOG task in the console address space is active.

The initial state for DLOG is defined on the CONSTD initialization statement with the parameter DLOG=ON or DLOG=OFF, as shown in Figure 3-69 on page 225. The old CONSTD keyword HARDCOPY= is deleted.

The operator can turn the DLOG on or off with a command.

3.70 JES3 start procedure

```
//JES3      PROC
//IEFPROC   EXEC PGM=IATINTK,DPRTY=(15,15)
//STEPLIB   DD DISP=SHR,DSN=SYS1.VnRnMn.SIATLIB
//CHKPNT    DD DISP=SHR,DSN=SYS1.JES3CKPT
//CHKPNT2   DD DISP=SHR,DSN=SYS1.JS3CKPT2
//JES3JCT   DD DISP=SHR,DSN=dsn
//SPOOl1    DD DISP=SHR,DSN=dsn
    .
    .
//SPOOLnn   DD DISP=SHR,DSN=dsn
//JES3OUT   DD DISP=SHR,DSN=dsn
//JES3SNAP DD UNIT=AFF=JES3OUT
//JESABEND DD UNIT=AFF=JES3OUT
//SYSABEND DD UNIT=AFF=JES3OUT
//JES3DRDS DD DISP=SHR,DSN=dsn
//IATPLBST DD DISP=SHR,DSN=SYS1.PROCLIB
                        .
                        .
//IATPLBnn              .
//JES3IN    DD DISP=SHR,DSN=SYS1.PARMLIB(JES3IN00)
```

Figure 3-70 JES3 start procedure

How to start JES3

JES3 runs as a started task in the z/OS environment. Therefore, z/OS must be active before you can start JES3. Moreover, JES3 must be active on the global before you can start JES3 on the local mains.

The required JES3 procedure DD statements are explained as follows:

IEFPROC Specifies the name of the JES3 job step task, load module IATINTK.

CHKPNT and **CHKPNT2** Define the JES3 checkpoint data set(s). At least one of the two checkpoint data sets must be allocated and cataloged prior to JES3 operation. Each checkpoint data set must be allocated as a single extent which begins and ends on a cylinder boundary. The size of each data set should be at least 2 cylinders on a 3380, 3390, or 9345 spool volume.

JES3JCT Defines the JES3 job control table (JCT) data set. This data set must be allocated and cataloged prior to JES3 operation. The data set must be large enough to accommodate the maximum number of JCT records to be allocated concurrently during normal system operation.

Spool1 and **Spoolnn** Define the spool data sets. The installation selects the ddnames and data set names for these statements. The ddname for this statement must be the same ddname specified on the BADTRACK, FORMAT, or TRACK initialization statements. Spool data sets must be allocated and cataloged prior to JES3 operation.

JES3OUT Defines the data set upon which the JES3 initialization stream and initialization error messages are printed. This data set is de-allocated after initialization completes. You can tailor the block size (BLKSIZE) and logical record length (LRECL) values to improve performance. The values you can specify are device-dependent.

IATPLBST Defines the installation's standard procedure library.

JES3IN Defines the data set containing the JES3 initialization stream. This data set must be a blocked or unblocked partitioned data set. In our example, the initialization stream is read from SYS1.PARMLIB(member JES3IN00).

3.71 JES3 initialization stream

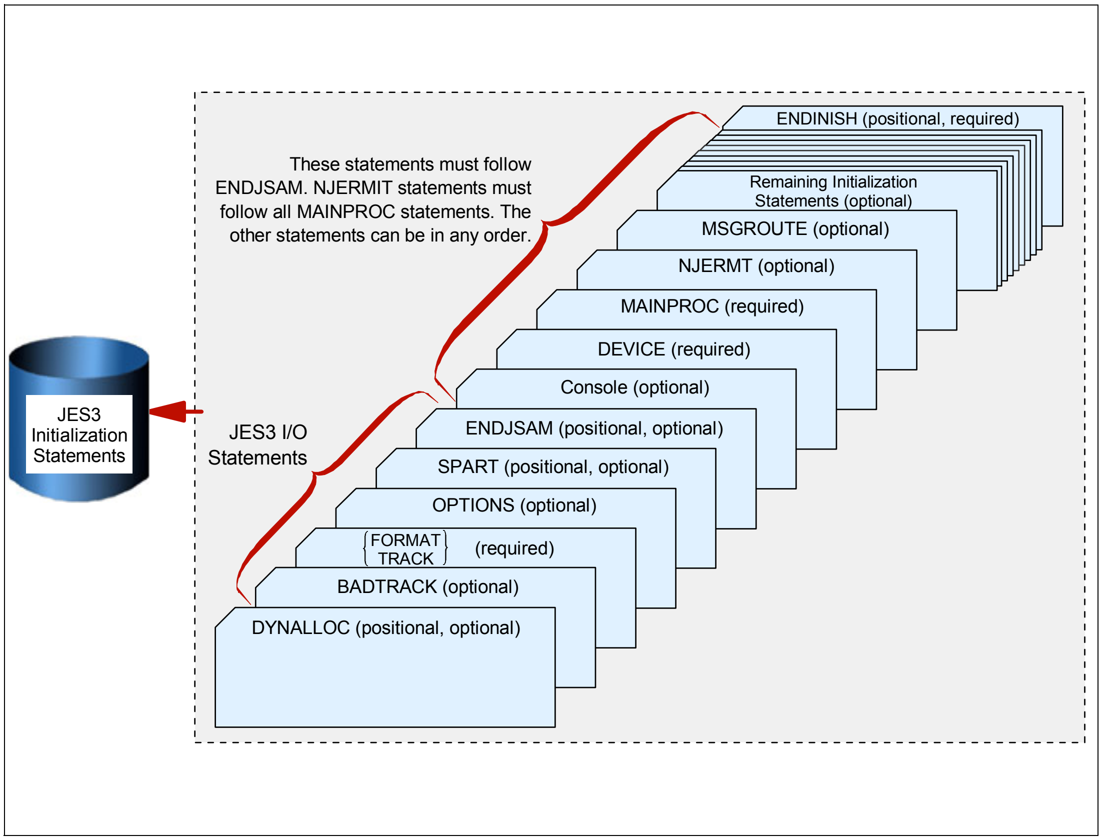


Figure 3-71 JES3 initialization stream

JES3 initialization deck

Here are the required JES3 initialization statements:

- DEVICE,DTYPE=SYSMAIN,JNAME=main1,JUNIT=(,main2,,~OFFlONÀ,...)

  Use this form of the DEVICE statement (there are two other forms of the DEVICE statement) to define the initial status of mains in a JES3 complex. You must code one of these DEVICE statements for each main on every processor in the complex, as follows:

  ```
  DEVICE,DTYPE=SYSMAIN,JNAME=SY1,JUNIT=(,SY1,,ON,)
  ```

- ENDINISH

  Use the ENDINISH statement to identify the end of the initialization statements in the initialization stream.

- ENDJSAM

  Use the ENDJSAM initialization statement to indicate the end of the JES3 spool initialization statements.

- FORMAT,DDNAME=ddname,SPART=partitionname {,STT=(cylnum,cylnum)} {,STTL=(cylnum,numtrkgps)}

  Use the FORMAT statement to specify formatting for a data set residing on a direct-access spool volume during initialization. Specify this statement only when introducing an unformatted volume into a JES3 system or when you change the BUFSIZE parameter on the JES3 BUFFER initialization statement as follows:

```
FORMAT,DDNAME=SPOOL1,STT=(30,31),SPART=PART1
```

The corresponding DD statement in the JES3 start procedure is:

```
//SPOOL1 DD DSN=dsn,DISP=OLD,UNIT=SYSDA,VOL=SER=xxxxxx
```

- MAINPROC,NAME=main,SYSTEM=JES3,FIXPAGE=,ID=msgprefix,MDEST=, PRTPAGE=,RID=,SELECT=,SID=,SPART=partitionname,TRKGRPS=,USRPAGE=

  Use the MAINPROC initialization statement to define a uniprocessor or a multiprocessor as a JES3 main. The initialization stream must include one MAINPROC statement for each main that you wish to define to JES3. Each MAINPROC statement must have a DEVICE statement that specifies DTYPE=SYSMAIN associated with it.

  The NAME=main specifies the name of a JES3 main. The name should match the purpose of the main, or at least the hardware it is using. You also use this name in operator commands and in the JES3 CLASS, DEVICE, GROUP, MSGROUTE, and SETACC initialization statements to refer to the main. It must be the first or second parameter on the statement.

  The SPART=partitionname specifies the spool partition that JES3 is to use for jobs that execute on the main defined by this statement. To specify the default spool partition, omit the SPART parameter.

- TRACK,DDNAME=ddname,SPART=partitionname {,STT=(cylnum,cylnum)} {,STTL=(cylnum,numtrkgps)}

  Use the TRACK initialization statement to replace a corresponding FORMAT statement in an initialization stream after the spool data set specified by the FORMAT statement has been formatted. The TRACK statement indicates that the corresponding data set has been formatted.

```
TRACK,DDNAME=SPOOL1
TRACK,DDNAME=SPOOL2
```

  Associated DD statements in the JES3 procedure:

```
//SPOOL1 DD DSN=dsn,DISP=OLD,UNIT=3330,VOL=SER=xxxxxx
//SPOOL2 DD DSN=dsn,DISP=OLD,UNIT=3330,VOL=SER=MVSRW2
```

Depending on how your z/OS initial program load (IPL) procedures are set up, JES3 can be started automatically or you can start JES3 manually by entering a z/OS **START** command from the master console. The manual method allows you to determine if the IPL and system configuration conditions are acceptable before starting JES3. If the JES3 subsystem definition in the IEFSSNxx parmlib member specifies the NOSTART subparameter, JES3 must be started manually. Otherwise JES3 will start automatically.

3.72 JES3 startup messages

```
S JES3


IAT3040 STATUS OF JES3 PROCESSORS IN COMPLEX
IAT3040 SC50   ( ), SC49   ( ), SC43   <UP>


IAT3011 SPECIFY JES3 START TYPE
*175 IAT3011 (C, L, H, HA, HR, HAR, W, WA, WR, WAR, OR CANCEL)

r 175,h

IAT4030 0001 SPOOL DATA SET  IN USE
IAT4075 MAXIMUM NUMBER OF JOBS IS LIMITED TO 0012236 BY JCT DATA SET
SIZE
IXZ0001I CONNECTION TO JESXCF COMPONENT ESTABLISHED, 638
          GROUP WTSCPLX9 MEMBER SC43
```

Figure 3-72 JES3 startup messages

Figure 3-72 shows the messages that are displayed when you start JES3. The first message shows the status of JES3 processors in the complex; after that, JES3 sends a request to the operator asking him the type of start.

Here are the ways to start JES3:

- Hot start
- Hot start with analysis
- Hot start with refresh
- Hot start with refresh and analysis
- Warm start
- Warm start with analysis
- Warm start to replace a spool data set
- Warm start with analysis to replace a spool data set
- Cold start
- Local start (used to start local mains only)

The type of start you select depends on why you need to start or restart JES3. In our example the operator chose hot start (h). During hot start JES3 displays information about the spool configuration as well as other information, as shown in Figure 3-72.

3.73 JES3 startup

IXZ0001I CONNECTION TO JESXCF COMPONENT ESTABLISHED, 697
GROUP WTSCPLX9 MEMBER JES3DLOG
IAT7114 DLOG INITIALIZATION SUCCESSFUL

*IAT3100 JES3 OS2.10.0 SYSTEM HOTSTART ON 2002.013 AS SC43

Start scheduling jobs

- Job segment scheduler (JSS) - issue following command

  *S JSS

Figure 3-73 JES3 startup

After a successful system hot start, the messages in Figure 3-73 are displayed. To start scheduling jobs the operator has to issue the following command.

```
*S JSS
```

Before starting job scheduling, you can use JES3 commands to cancel jobs, change the status of jobs, and change the status of devices. During a hot start with analysis, you can release jobs in spool hold status after reinstating a spool data set that contains data for the jobs, and you can vary devices online or offline. You can make adjustments for any system data that might have been lost during the restart.

You can also make any changes to the system that were made before a hot start or a warm start, but did not remain in effect after the restart. When you are satisfied that the system is ready to begin processing, enter a ***START,JSS** command to start job scheduling.

3.74 JES3 messages following *S JSS

```
IAT6394 MONITOR FUNCTION ACTIVE
IAT7131 NJECONS NOW ACTIVE
IAT9225 NJERDR IS ACTIVE
IAT9225 NJERDR IS ACTIVE
IAT5919   100 INITIAL VERIFY RESPONSES RECEIVED FROM SC43
 . . . . . . . . . . . . . . . . . . . . . . . . . .

IAT2006 PREMATURE JOB TERM - JOB  ASCHINT  (JOB19360) - CANCEL
- SC43
IAT7450 JOB INITJES3 (INT19367) PURGED


IAT2645 ****** SC43     CONNECT COMPLETE ******
S INIT.A        IATMSMS
S INIT.A        IATMSMS
S INIT.A        IATMSMS
S INIT.A        IATMSMS
S JES9CI.CI9,,,(JES3,8,IATINFC)
```

*Figure 3-74 JES3 messages following *S JSS*

The messages shown in Figure 3-74 are displayed by JES3 to indicate which functions are active and other actions that JES3 took during job scheduling initialization.

It also shows that the system is connected to the complex and which initiators are available (started) for job processing.

3.75 JES3 start types

```
H      -  Hot Start
HA     -  Hot Start with Analysis
HR     -  Hot Start with Refresh
HAR    -  Hot Start with Refresh and Analysis
W      -  Warm Start
WA     -  Warm Start with Analysis
WR     -  Warm Start to Replace a Spool Data Set
WAR    -  Warm Start with Analysis to Replace a
          Spool Data Set
C      -  Cold Start
L      -  Local Start
```

Figure 3-75 JES3 start types

The types of starts and restarts for the JES3 global processor are shown in Figure 3-75. You must use a cold start when starting JES3 for the first time. For subsequent starts (restarts), you can use any one of the start types, depending on the circumstances at the time. Thus, the other types of starts are actually restarts.

JES3 initialization statements are read as part of cold start, warm start, and hot start with refresh processing. If JES3 detects any error in the initialization statements, it prints an appropriate diagnostic message on the console or in the JES3OUT data set. JES3 ends processing if it cannot recover from the error. In this case, you must notify the system programmer to ensure that the error is corrected before restarting JES3.

JES3 configuration and processing options are specified with the initialization statements. Because many options affect the overall performance of the system, initialization statements must be provided by your system programmer. After starting JES3 on a local main, you can use the ROUTE command to start JES3 on all the local processors once JES3 global initialization is complete. For example:

```
ROUTE *OTHER,S JES3
```

Use a local start to restart JES3 on a local main after a normal shutdown on the local, after JES3 ends due to a failure in either the local JES3 address space or z/OS, or after partitioning a multiprocessor. You must also start each local main after you perform a cold start or any type of warm start on the global, or after you use a hot start to remove or reinstate a spool data set on the global processor. You can perform a local start any time the global is active. Local start processing uses the initialization stream placed on the spool data sets during global main initialization.

Note: Do not start a main if another main having the same name is active in the complex.

Before you begin, be sure that all spool data sets available to the global are also available to this local.

If you are performing an IPL of the local main and the MSTRJCL contains the automatic START command, the command is displayed on your console immediately after the z/OS master scheduler is initialized. You can enter the z/OS command:

```
START JES3
```

The first message from JES3 is:

```
IAT3040     STATUS OF JES3 PROCESSORS IN COMPLEX
               main(status) (,main(status)...)
```

A series of entries on the following lines of the message contain the name of each main followed by a code for that main's status as recorded in the complex status record (CSR). During a start for the system, this entry (the status of the global) is:

```
main< >
```

On subsequent starts, this entry could be:

```
main<IN>
```

This indicates that the previous start ended abnormally during initialization; this main is still recorded in the CSR as being in initialization as follows:

```
main<UP>
```

This main is recorded in the CSR as currently being active (up). Consult with the system programmer before continuing with a cold start.

Next, JES3 issues the following message:

```
nn IAT3011 SPECIFY JES3 START TYPE:(C, L, H, HA, HR, HAR, W, WA, WR, WAR
OR CANCEL)
```

To continue the start, enter the appropriate letters shown in the message, as follows:

```
R nn,C
```

To cancel the start, enter:

```
R nn,CANCEL
```

Note: Because cold start processing involves reinitializing the spool and losing all jobs, JES3 issues the following message requiring you to confirm your request for a cold start before JES3 takes irreversible action:

```
nn IAT3033     CONFIRM JES3 COLD START REQUEST (U) OR CANCEL
```

To continue the cold start, enter:

```
R nn,U
```

To cancel the cold start, enter:

```
R nn,CANCEL
```

Any other reply restarts the sequence, beginning with message IAT3011.

After JES3 initialization has finished, you should start the job segment scheduler (JSS). You start job scheduling after JES3 issues message IAT3100 notifying you that initialization processing is complete on the global:

```
IAT3100  JES3 xxxxx SYSTEM type START ON yyyy.ddd AS main
```

where xxxxx is the release level of JES3; type is COLD, WARM, or HOT; yyyy.ddd is the Julian date; and main is the JES3 name of the main.

Before starting job scheduling, you can use JES3 commands to cancel jobs, change the status of jobs, and change the status of devices. During a hot start with analysis, you can release jobs in spool hold status after reinstating a spool data set that contains data for the jobs, and you can vary devices online or offline. You can make adjustments for any system data that might have been lost during the restart. You can also make any changes to the system that were made before a hot start or a warm start but did not remain in effect after the restart.

When you are satisfied that the system is ready to begin processing, enter the following command to start job scheduling:

```
*START,JSS
```

After you enter the *START,JSS command, ensure that the global is varied online to JES3. If it is not, enter the **`*MODIFY,V,main,ON`** command to vary the processor online, ensuring that the subsystem interface, the z/OS system commands, and the system log are initialized. JES3 then issues the following message:

```
IAT2645     ***** main CONNECT COMPLETE *****
```

If you do not want the global to run jobs, you can now vary the main offline to JES3 scheduling with the **`*MODIFY,V,main,OFF`** command. At this point, you can resubmit any jobs that were canceled or whose processing was altered as a result of the restart.

How to stop JES3

Stopping local processors

Before you remove a local main for maintenance or other reasons, allow processing jobs to complete normally. Use the following steps:

1. Enter a **`*F, V,main,OFF`** command for the local main to prevent JES3 from scheduling any further jobs on the processor.
2. Enter the **`*RETURN`** command with the proper password to end JES3 after all jobs on the local main have completed processing.

3. Enter the **HALT EOD** command on the local main to ensure that important statistics and data records in storage are not permanently lost.

Your installation may not want to wait for all jobs to complete normally, for example:

- Jobs will not end due to system problems (hardware and software)
- An IPL or JES3 restart is scheduled to take place at a predetermined time and jobs will not be able to complete. In this case, you must make the decision to delay the IPL or to cancel the jobs.

Note: Enter the **HALT EOD** command only if you are performing an IPL or SYSTEM RESET, not to restart JES3.

Stopping the global processor

Before stopping the global, you should stop the local mains as described previously. You should stop all JES3 processing by entering the ***F,Q,H** command, which puts all jobs in hold status before stopping JES3. System initiators, printers, and punches do not begin any new work, and become inactive after completing their current activity. Jobs in JES3 queues remain in their current position.

You should also queue the system log for printing by entering the **WRITELOG** command. This prevents log messages from being lost if you later restart JES3 with a hot start.

Once all system activity has completed, enter the ***RETURN** command to end JES3.

***RETURN,password,FSS=fssname** or

***RETURN,password,FSS=ALL** or

***RETURN,password,FSS=NONE**

After you enter the ***RETURN** command, enter the **HALT EOD** command to ensure that important statistics and data records in storage are not permanently lost. As a result of this command, the internal I/O device error counts are stored in the SYS1.LOGREC data set; the SMF buffers are emptied onto one of the SYS1.MANx data sets; and the system log, if still active, is closed and put on the print queue. When these actions are complete, the system issues message IEE334I, stating that the HALT EOD operation was successful.

3.76 TME 10 OPC

- Understanding TME 10 OPC
- What is TME 10 OPC
- What is an OPC Tracker
- What is an OPC Controller
- Workload Management Tool
- Users of TME 10 OPC

Figure 3-76 TME 10 OPC

Operations planning and control

The TME® 10 Operations Planning and Control (TME 10™ OPC) Licensed Program is the IBM foundation for enterprise workload management. TME 10 OPC provides a comprehensive set of services for managing and automating the workload. Whether you manage a single-image z/OS system or multi-vendor networks and systems from a single point of control, TME 10 OPC helps you manage and automate the production workload.

TME 10 OPC builds operating plans from your descriptions of the production workload.

TME 10 OPC consists of a base product, the tracker, and a number of features. All the systems in your complex require the base product. The *tracker* is the link between the system that it runs on and the TME 10 OPC controller.

One z/OS system in your complex is designated the controlling system and runs the controller feature. From this system, you can automatically plan, control, and monitor your entire production workload. Only one controller feature is required, even when you want to start standby controllers on other z/OS systems in a sysplex.

- **Tivoli® OPC** makes it possible for the scheduling manager to maintain current and future production processing across your enterprise. Tivoli OPC benefits the scheduling manager by:
  - Automatically schedule all production workload activities.

- Automatically resolve the complexity of production workload dependencies and drive the work in the most efficient way.
- Supporting the simulation of future workloads on the system. The scheduler can evaluate, in advance, the effect of changes in production workload volumes or processing resources.
- Giving a real-time view of the status of work as it flows through the system so that the scheduler can quickly:
  - Respond to customer queries about the status of their work.
  - Identify problems in the workload processing.
- Providing facilities for manual intervention.
- Managing many workload problems automatically. The TME 10 OPC production-workload-restart facilities, hot standby, automatic recovery of jobs and started tasks, and data set cleanup provide the scheduler with comprehensive error- and disaster-management facilities.
- Providing a log of changes to the TME 10 OPC production workload data through the audit-trail facility. This assists the scheduler in resolving problems caused by user errors.
- Managing unplannable work.

- The **operations manager** uses the reporting, planning, and control functions to:
  - Improve the efficiency of the operation.
  - Improve control of service levels and quality.
  - Set service level agreements for end-user applications and for services provided.
  - Improve relationships with end-user departments.
  - Increase the return on your IT investment.
  - Develop staff potential.
- The **Shift Supervisor** uses TME 10 OPC, especially in multisystem complexes, where local and remote systems are controlled from a central site. Also it can help the shift supervisor to:
  - Monitor and controll the flow of production work through multisystem complexes.
  - Controll the use of mountable devices.
  - Separate information about work status from system and other information.
  - Provide end users with status information directly.
  - Manage the workload if a system failure occurs.
  - Make changes to the current plan in response to unplanned events, such as equipment failures, personnel absences, and rush jobs.
- The **application programmer**. The TME 10 OPC user-authority checking enables application development groups to use all the planning and control functions of TME 10 OPC in parallel with—but in isolation from—production systems and services. For the application programmer, it can be a valuable tool for application development staff, anabling them to:
  - Package new applications for regular running
  - Test new JCL in final packaged form
  - Test new applications and changes to existing ones
  - Restart or rerun unsuccessful jobs.

- The **console operators** can be freed from these time-consuming tasks:
  - Starting and stopping started tasks.
  - Preparing JCL before job submission.
  - Submitting jobs.
  - Verifying the sequence of work.
  - Reporting job status.
  - Performing data set cleanup in recovery and rerun situations.
  - Responding to workload failure.
  - Preparing the JCL for step-level restarts.
- The **workstation operators** gets help in:
  - Providing complete and timely status information.
  - Providing up-to-date ready lists that prioritize the work flow.
  - Providing online assistance in operator instructions.
- The **end users** and **help desks** can be informed about the status of workload processing. They can use the ISPF dialogs or the Workload Monitor/2 to check the status of the processing of their applications themselves, from a personal workstation. End users can make queries using the Workload Monitor/2 without having to be familiar with TME 10 OPC, ISPF, or TSO, and without having to be logged on to a local system. The Workload Monitor/2 also provides alerts that can automatically advise end users when their work has completed or ended in error. The help desk can use the Workload Monitor/2 in the same way to answer queries from end users about the progress of their workload processing.

3.77 TME 10 OPC platforms

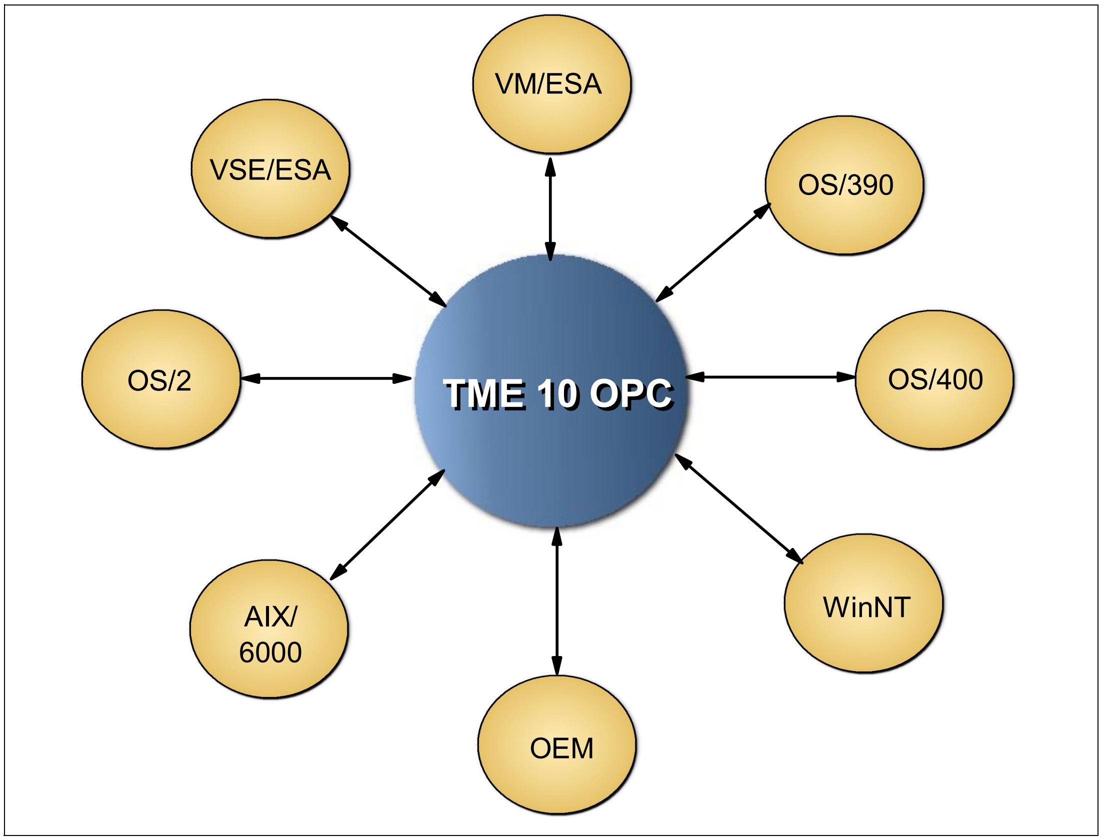


Figure 3-77 TME 10 OPC platforms

TME 10 OPC is a state-of-the-art production workload manager, designed to help you meet your present and future data processing challenges. Its scope encompasses your entire enterprise information system, including heterogeneous environments.

Pressures in today's DP environment are making it increasingly difficult to maintain the same level of services to customers. Many installations find that their batch window is shrinking. More critical jobs must be finished before the morning online work begins. Conversely, requirements for the integrated availability of online services during the traditional batch window put pressure on the resources available for processing the production workload. More and more, 7/24 (7 days a week, 24 hours a day) is not only a DP objective but a requirement.

Users and owners of DP services are also making more use of batch services than ever before. The batch workload tends to increase each year at a rate slightly below the increase in the online workload. Combine this with the increase in data usage by batch jobs, and the end result is a significant increase in the volume of work.

Furthermore, there is a shortage of people with the required skills to operate and manage increasingly complex DP environments. The complex interrelationships between production activities—between manual and machine tasks—have become unmanageable without a workload management tool.

TME 10 OPC provides leading-edge solutions to problems in production workload management. It can automate, plan, and control the processing of your enterprise's entire production workload, not just the batch subset. TME 10 OPC functions as an “automatic driver” for your production workload, to maximize the throughput of work and optimize your resources, but it also allows you to intervene manually as required.

When TME 10 OPC interfaces with other system management products, it forms part of an integrated automation and systems management platform for your DP operation.

TME 10 OPC forms operating plans based on user descriptions of the operations department and its production workload. These plans provide the basis for your service level agreements and give you a picture of the production workload at any point in time. You can simulate the effects of changes in your production workload and in resource availability by generating trial plans.

Good planning is the cornerstone of any successful management technique. Effective planning also helps you maximize return on your investments in information technology.

TME 10 OPC automates, monitors, and controls the flow of work through your enterprise's entire DP operation, on both local and remote systems. From a single point of control, TME 10 OPC analyzes the status of the production work and drives the processing of the workload according to installation business policies. It supports a multiple end-user environment, enabling distributed processing and control across sites and departments within your enterprise.

3.78 z/OS OPC configuration

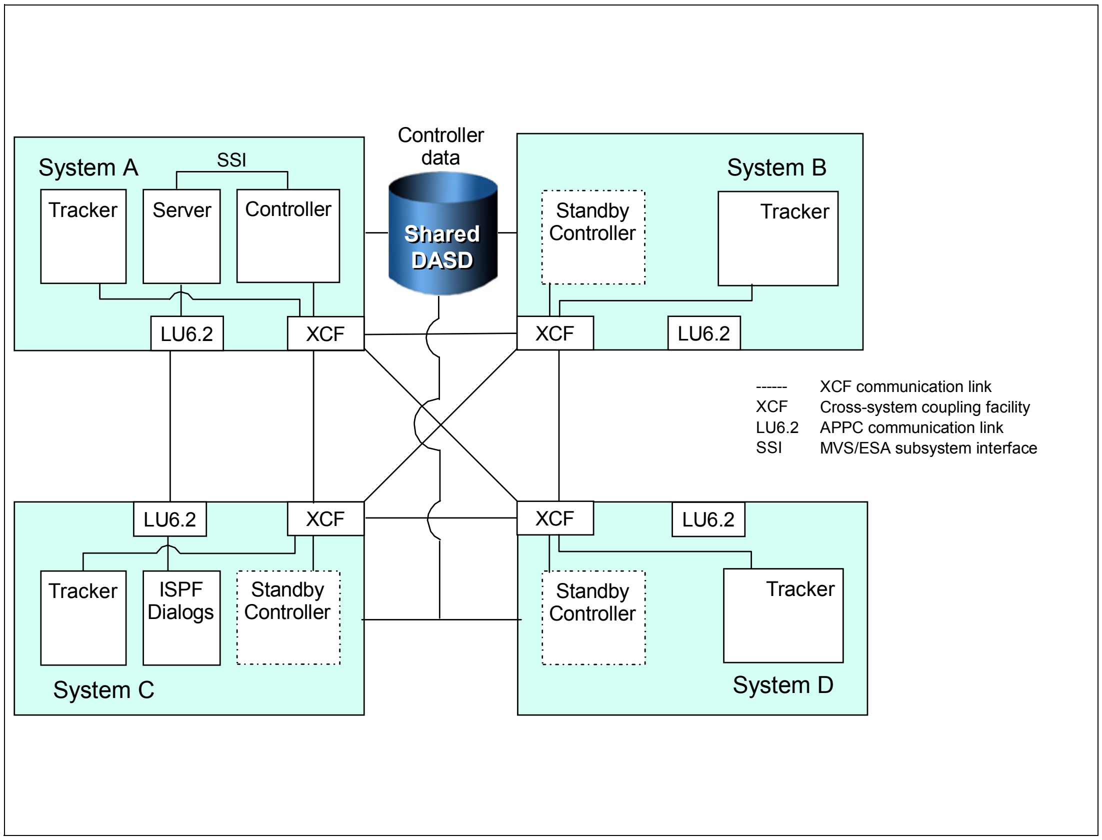


Figure 3-78 z/OS OPC configuration

What is a TME 10 OPC Tracker

A tracker is required for every controlled z/OS system in a TME 10 OPC configuration. This includes, for example, local controlled systems within shared DASD or sysplex configurations.

The tracker runs as a z/OS subsystem and interfaces with the operating system (through JES2 or JES3, and SMF), using the subsystem interface and the operating system exits. The tracker monitors and logs the status of work, and passes the status information to the controller via shared DASD, XCF, or ACF/VTAM.

You can exploit the z/OS cross-system Coupling Facility (XCF) to connect your local z/OS systems. Rather than being passed to the controlling system via shared DASD, work status information is passed directly via XCF connections. XCF lets you exploit all of TME 10 OPC's production-workload-restart facilities and its hot standby function.

The tracker on a remote z/OS system passes status information about the production work in progress to the controller on the TME 10 OPC controlling system. All communication between TME 10 OPC subsystems on controlling and remote systems is done via ACF/VTAM.

TME 10 OPC lets you link remote systems using ACF/VTAM networks. Remote systems are frequently used locally “on premises” to reduce the complexity of the DP installation.

Every controlled AS/400® system needs the Tracker Agent for OS/400® feature installed. When this feature is used, status information and job logs for the production workload are passed back to the controlling z/OS system using APPC services. The TME 10 OPC controller submits jobs and commands to one system in an AS/400 cluster; from there the work is directed to the target AS/400 system.

Controlled UNIX systems require the OPC Tracker Agent feature for the appropriate implementation of UNIX, including the z/OS Open Edition environment. When one of these features is used, status information and job logs for the production workload are passed back to the controlling z/OS system using TCP/IP services. The TME 10 OPC controller submits jobs and commands directly to the target UNIX system.

If you use Load Leveler to manage workload distribution in your heterogeneous workstation environment, the OPC Tracker Agents for AIX® and the other UNIX implementations can integrate with Load Leveler 1.2.

To control the workgroup workload on OS/2® workstations and servers, you need the Tracker Agent for OS/2 feature. When this feature is used, status information and job logs for the production workload are passed back to the controlling z/OS system using TCP/IP services. The TME 10 OPC controller submits jobs and commands directly to the target workstation system. To control the workgroup workload on Windows NT workstations and servers, you need the Tracker Agent for Windows NT feature. When this feature is used, status information and job logs for the production workload are passed back to the controlling z/OS system using TCP/IP services. The TME 10 OPC controller submits jobs and commands directly to the target workstation system.

Remote systems controlled by other operating environments can also communicate with the TME 10 OPC controller using supplied programs. Although not a full-function tracker agent today, these routines provide you with the opportunity to centralize control and automate the workload on these operating environments. The supplied sample programs demonstrate communication using a variety of methods. The programs can be tailored for a specific environment.

TME 10 OPC Tracker Agents are functionally equivalent to the base z/OS tracker, with the exception that automatic data set cleanup and the job-completion checker (JCC) functions are not provided for non-z/OS platforms. This means you can use TME 10 OPC functions like automatic recovery and automatic job tailoring for your non-z/OS workload. Many installations run business applications on a variety of UNIX platforms. TME 10 OPC provides tracker agents that can manage your workload in several operating system environments. At the time of this writing, tracker agents for OS/400, AIX/6000, HP-UX, SunOS, Sun Solaris, Pyramid MIPS ABI, Digital OpenVMS, Digital UNIX, AIX, and System/390® Open Edition operating systems are available, as well as the tracker agents for OS/2 and Windows NT platforms, and the base tracker for z/OS.

What is a TME 10 OPC controller

The controller is the focal point of your TME 10 OPC configuration. It uses the information in the database to determine which jobs to run, when they should run, and where they should run. It contains the controlling functions, the dialogs, and TME 10 OPC's own batch programs. Only one TME 10 OPC controller is required to control the entire TME 10 OPC installation, including local and remote systems.

The system that the controller is started on is called the TME 10 OPC controlling system. TME 10 OPC systems that communicate with the controlling system are called controlled systems. You need to install in your z/OS system at least one controller for your production systems. It can control the entire TME 10 OPC configuration, both local and remote. You can use the TME 10 OPC controller to provide a single, consistent control point for submitting and tracking the workload on any operating environment.

TME 10 OPC provides open interfaces to let you integrate the planning, scheduling, and control of work units such as online transactions, file transfers, or batch processing in any operating environment that can communicate with z/OS.

TME 10 OPC as a workload management tool

TME 10 OPC allows you to:

- Manage your workload on a variety of platforms from a single point of control.
- Run jobs on the right day at the right time.
- Start jobs in the correct order.
- Resolve complex dependencies between jobs.
- Take into account business days and holidays across divisions, states, and countries.
- Provide plans for the future workload to help you manage peak processing (year-end work, for example).
- Optimize hardware resources by allocating work to specific machines.
- Initiate automatic recovery actions in the event of hardware or software failure.
- Maintain logs of work that has run and that is available for viewing or post-processing.

4

LPA, LNKLST, and authorized libraries

In order to maximize the retrieving modules performance, the MVS operating system, and now z/OS, has been designed to maintain in memory those modules that are needed for fast response to the operating system as well as for the critical applications. Link pack area (LPA), LNKLST, and authorized libraries described here are the cornerstone of the fetching process. The role of VLF and LLA components are described at the appropriate level.

Modules (programs), whether stored as load modules or program objects, must be loaded into both virtual storage and central storage before they can be run. When one module calls another module, either directly by asking for it to be run or indirectly by requesting a system service that uses it, it does not begin to run instantly. How long it takes before a requested module begins to run depends on where in its search order the system finds a usable copy, and on how long it takes the system to make the copy it finds available.

You should consider these factors when deciding where to place individual modules or libraries containing multiple modules in the system-wide search order for modules:

- The search order the system uses for modules
- How placement affects virtual storage boundaries
- How placement affects system performance
- How placement affects application performance

4.1 Link pack area (LPA)

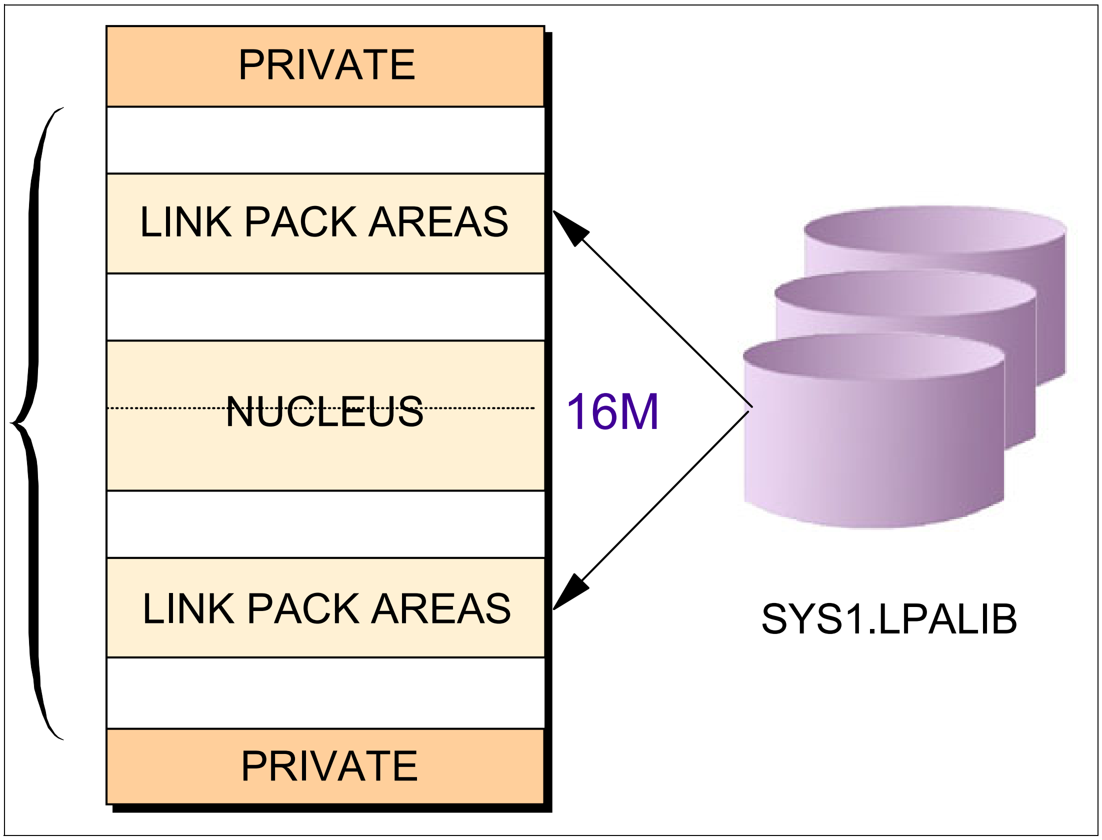


Figure 4-1 Link pack area (LPA)

Link pack area (LPA) modules are loaded in common storage, shared by all address spaces in the system. Because these modules are reentrant and are not self-modifying, each can be used by any number of tasks in any number of address spaces at the same time. Modules found in LPA do not need to be brought into virtual storage because they are already in virtual storage.

Modules placed anywhere in LPA are always in virtual storage, and modules placed in FLPA are also always in central storage. Whether modules in LPA, but outside FLPA, are in central storage depends on how often they are used by all the users of the system, and on how much central storage is available. The more often an LPA module is used, and the more central storage is available on the system, the more likely it is that the pages containing the copy of the module will be in central storage at any given time.

LPA pages are only stolen, and never paged out, because there are copies of all LPA pages in the LPA page data set. But the results of paging out and page stealing are usually the same; unless stolen pages are reclaimed before being used for something else, they will not be in central storage when the module they contain is called.

LPA modules must be referenced very often to prevent their pages from being stolen. When a page in LPA (other than in FLPA) is not continually referenced by multiple address spaces, it tends to be stolen. One reason these pages might be stolen is that address spaces often get swapped out (without the PLPA pages to which they refer), and a swapped-out address space cannot refer to a page in LPA.

When all the pages containing an LPA module (or its first page) are not in central storage when the module is called, the module will begin to run only after its first page has been brought into central storage.

Modules can also be loaded into CSA by authorized programs. When modules are loaded into CSA and shared by multiple address spaces, the performance considerations are similar to those for modules placed in LPA. (However, unlike LPA pages, CSA pages must be paged out when the system reclaims them.)

4.2 LPA subareas

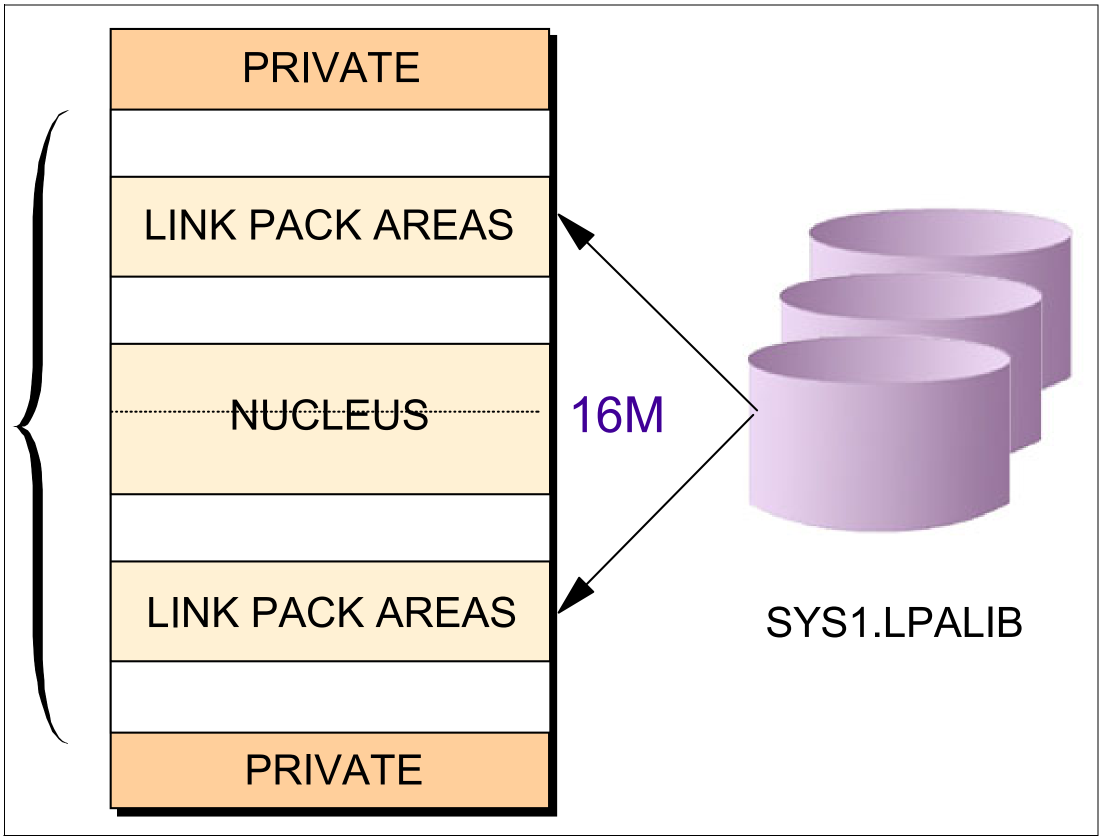


Figure 4-2 LPA subareas

The link pack area (LPA) is a section of the common area of an address space. It exists below the system queue area (SQA) and consists of the pageable link pack area (PLPA), then the fixed link pack area (FLPA) if one exists, and finally the modified link pack area (MLPA).

For more information, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

Each component of the LPA has a counterpart in the extended common area (that is above the 16 megabyte line) as follows:

FLPA The FLPA exists only for the duration of an IPL. Therefore, if an FLPA is desired, the modules in the FLPA must be specified for each IPL (including quick-start and warm-start IPLs).

An installation can elect to have some modules that are normally loaded in the pageable link pack area (PLPA) loaded into the fixed link pack area (FLPA). This area should be used only for modules that significantly increase performance when they are fixed rather than pageable. Modules placed in the FLPA must be reentrant and refreshable.

It is the responsibility of the installation to determine which modules, if any, to place in the FLPA. Note that if a module is heavily used and is in the PLPA, the system's paging algorithms will tend to keep that module in central storage. The best candidates for the FLPA are modules that are infrequently used but are needed for fast response to some terminal-oriented action.

PLPA During initialization, both primary and secondary (or duplexed) PLPAs are established. The PLPA is established initially from the LPALST concatenation.

On the PLPA page data set, ASM maintains records that have pointers to the PLPA and extended PLPA pages. During quick start and warm start IPLs, the system uses the pointers to locate the PLPA and extended PLPA pages. The system then rebuilds the PLPA and extended PLPA page and segment tables, and uses them for the current IPL.

If CLPA is specified at the operator's console, indicating a cold start is to be performed, the PLPA storage is deleted and made available for system paging use. A new PLPA and extended PLPA are then loaded, and pointers to the PLPA and extended PLPA pages are recorded on the PLPA page data set.

The secondary PLPA is saved on the optional duplex paging data set for recovery purposes. If any uncorrectable I/O error occurs on a page-in request from the PLPA, the duplexed PLPA is used.

MLPA This area may be used to contain reenterable routines from APF-authorized libraries that are to be part of the pageable extension to the link pack area during the current IPL. The MLPA exists only for the duration of an IPL. Therefore, if an MLPA is desired, the modules in the MLPA must be specified for each IPL (including quick start and warm start IPLs). The MLPA is allocated just below the FLPA (or the PLPA, if there is no FLPA); the extended MLPA is allocated above the extended FLPA (or the extended PLPA if there is no extended FLPA). When the system searches for a routine, the MLPA is searched before the PLPA.

> **Note:** Loading a large number of modules in the MLPA can increase fetch time for modules that are not loaded in the LPA. This could affect system performance.
>
> The MLPA can be used at IPL time to temporarily modify or update the PLPA with new or replacement modules. No actual modification is made to the quick start PLPA stored in the system's paging data sets. The MLPA is read-only, unless NOPROT is specified on the MLPA system parameter.

4.3 Pageable link pack area

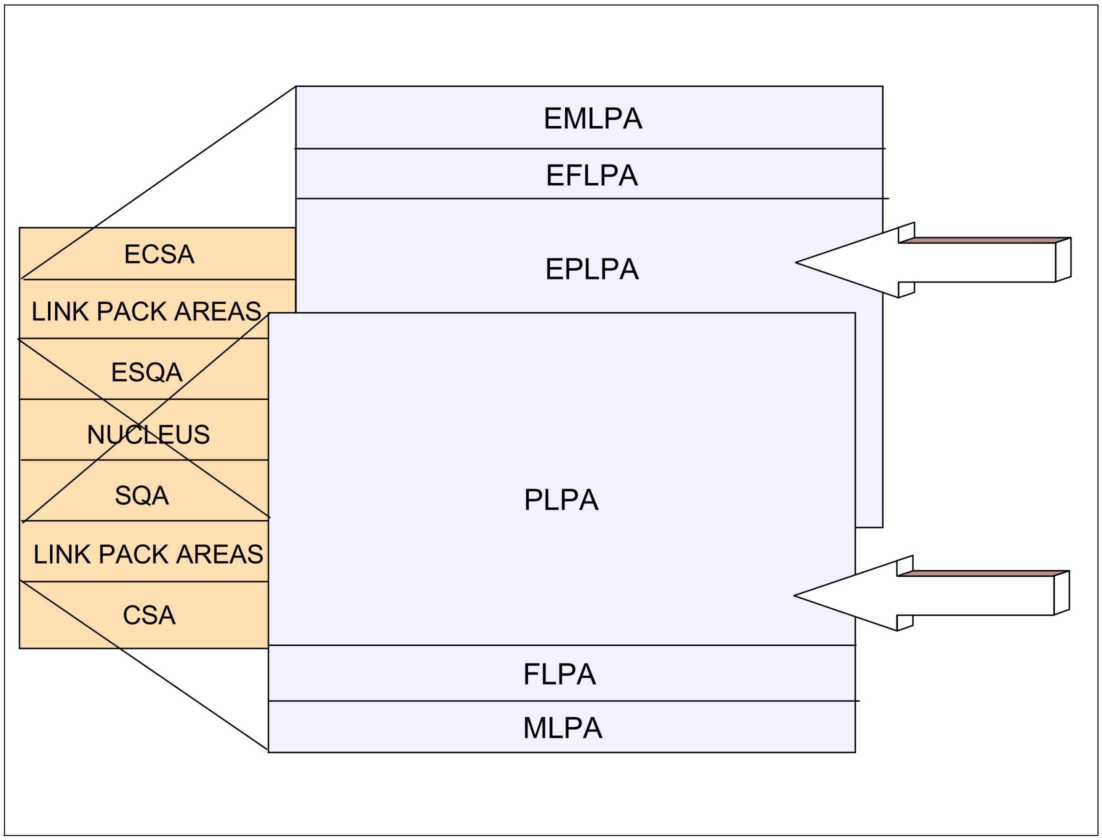


Figure 4-3 Pageable link pack area

Pageable link pack area (PLPA/extended PLPA)

The PLPA is an area of common storage which is loaded at IPL time (when you do a cold start, specify CLPA in your IPL).

This area contains SVC routines, access methods, and other read-only system programs, along with any read-only reenterable user programs selected by an installation that can be shared among users of the system. It is also desirable to place all frequently used refreshable SYS1.LINKLIB and SYS1.CMDLIB modules in the PLPA.

Contents of the PLPA or extended PLPA

The PLPA and extended PLPA contain all members of SYS1.LPALIB and any other libraries that are specified in the active LPALSTxx through the LPA parameter in the IEASYSxx or from the operator's console at system initialization. The modules in the PLPA or extended PLPA must be reentrant and executable.

4.4 LPA parmlib definitions

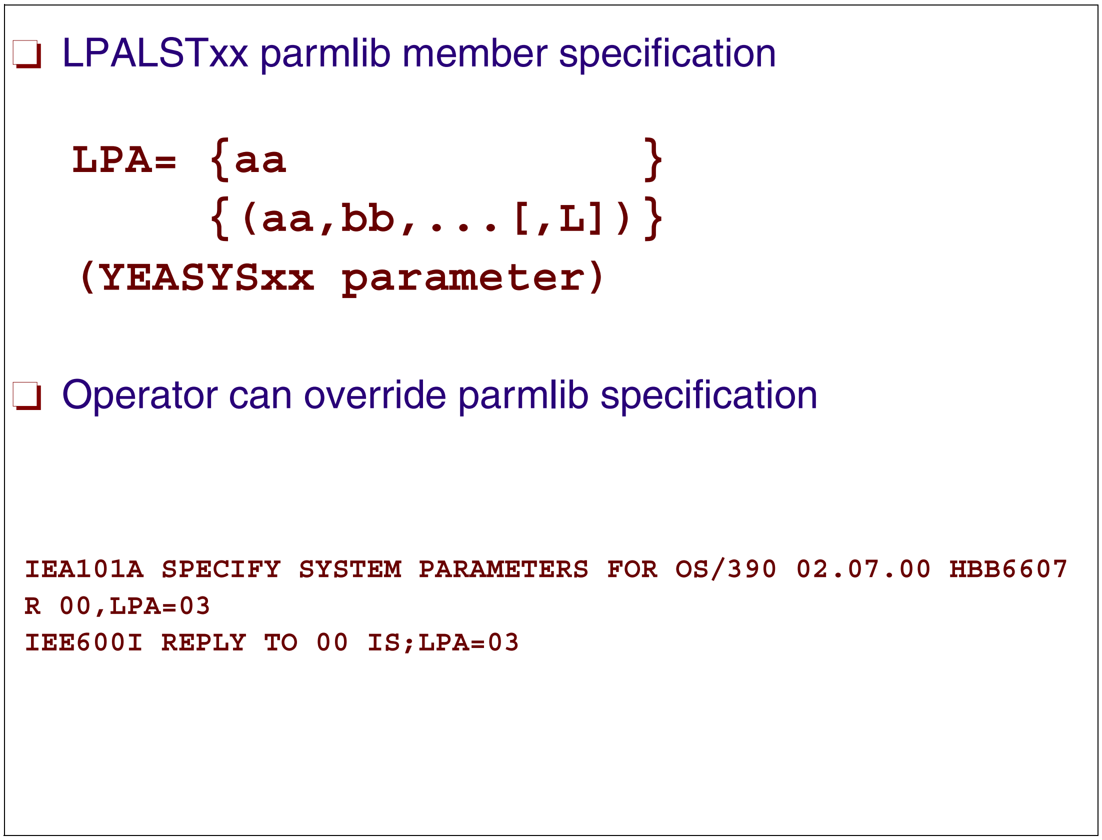


Figure 4-4 LPA parmlib definitions

Specifying LPA parameters in parmlib

The two characters (A through Z, 0 through 9, @, #, or $) represented by aa (or bb and so forth) in Figure 4-4, are appended to LPALST to form the name of the LPALSTxx parmlib members.

If the L option is specified, the system displays the contents of the LPALSTxx parmlib members at the operator's console as the system processes the members.

The LPA parameter is only effective during cold starts, or during IPLs in which you specify the CLPA option. The LPA parameter does not apply to modules requested through the MLPA option.

An example of overriding the value of the LPA parameter in the IEASYSxx during system initialization is as follows:

```
IEA101A SPECIFY SYSTEM PARAMETERS FOR z/OS 02.05.00 HBB6605
r 00,LPA=03
IEE600I REPLY TO 00 IS;LPA=03
```

LPALST03 was selected during system initialization.

How to specify modules in the PLPA or extended PLPA

Use one or more LPALSTxx members in the SYS1.PARMLIB to concatenate your installation's program library data sets to SYS1.LPALIB. You can also use the LPALSTxx member to add your installation's read-only reenterable user programs to the pageable link pack area (PLPA). The system uses this concatenation, which is referred to as the LPALST concatenation, to build PLPA.

Note: The system does not check user catalogs when it searches for data sets to be added to the LPALST concatenation. Therefore, the data sets in the concatenation must be cataloged in the system master catalog.

During nucleus initializing process (NIP), the system opens and concatenates each data set specified in LPALSTxx in the order in which the data set names are listed, starting with the first-specified LPALSTxx member.

If one or more LPALSTxx members exist, and the system can open the specified data sets successfully, the system uses the LPALST concatenation to build the PLPA (during cold starts and IPLs that included the CLPA option). Otherwise, the system builds the PLPA from only those modules named in the SYS1.LPALIB.

Note: The LPALST concatenation can have up 255 extents. If you specify more data sets than the concatenation can contain, the system truncates the LPALST concatenation and issues messages that indicate which data sets are excluded in the concatenation.

4.5 Coding a LPALSTxx parmlib member

```
   Menu  Utilities  Compilers  Help
-------------------------------------------------------------------------
EDIT    SYS1.PARMLIB(LPALST05) - 01.01         Line 00000000 Col 001 080
Command ===>                                                Scroll ===> PAGE
*************************** Top of Data ********************************
SYS2.LPALIB,
SYS1.LPALIB,
SYS1.SICELPA,
SYS1.SORTLPA,
NETVIEW.V3R1M0.SCNMLPA1,
ISF.SISFLPA,
ISP.SISPLPA,
EOY.SEOYLPA,
SYS1.ISAMLPA,
REXX.V1R3M0.SEAGLPA,
TCPIP.SEZALPA,
EJES.V2R3M0.SEJELMD1,
CICSTS12.CICS.SDFHLPA(TOTCI2)
*************************** Bottom of Data *****************************
```

Figure 4-5 LPALSTxx parmlib member example

Some important syntax rules for the creation of LPALSTxx are:

- On each record, place a string of data set names separated by commas.
- If a data set is not cataloged in the system master catalog, but is cataloged in a user catalog, specify in parentheses immediately following the data set name the one to six character VOLSER of the pack on which the data set resides.
- Indicate continuation by placing a comma followed by at least one blank after the last data set name on a record.

Figure 4-5 displays an example of LPALSTxx. The last member, CICSTS12.CICS.SDFHLPA(TOTCI2), is a user-cataloged data set on VOLSER TOTCI2.

4.6 Fixed link pack area

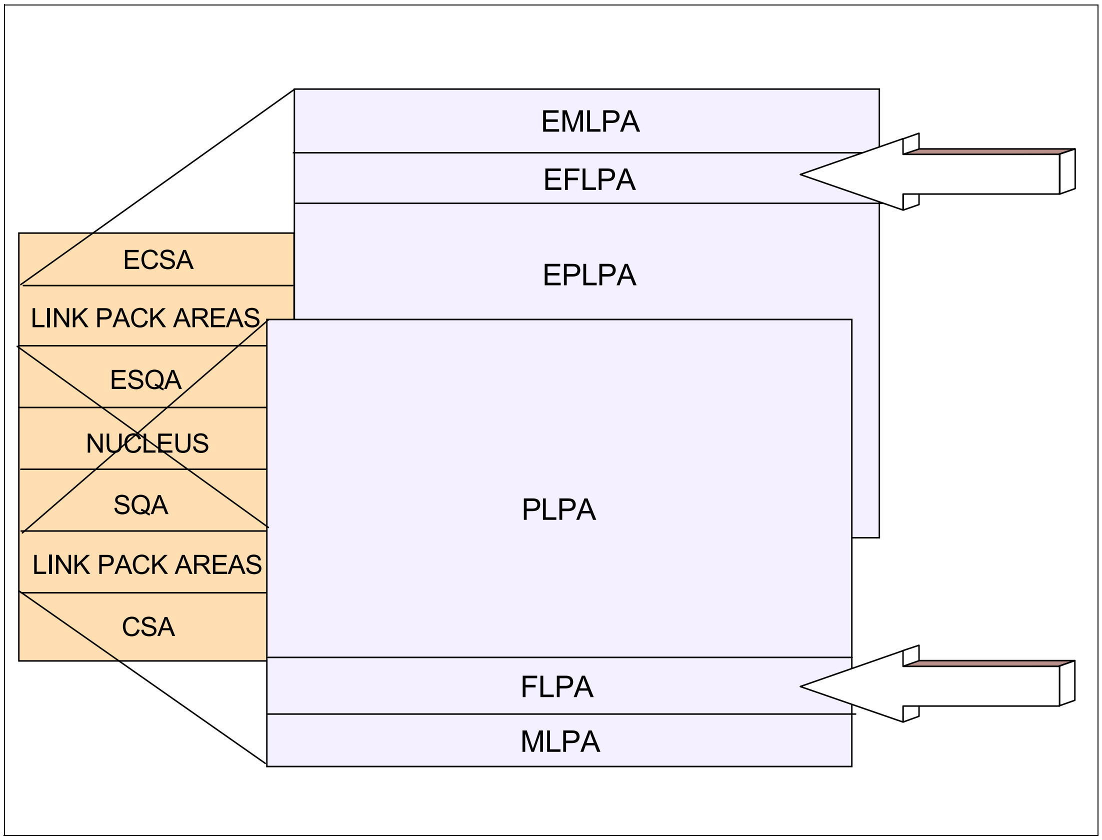


Figure 4-6 Fixed link pack area

Fixed link pack area (FLPA or extended FLPA)

The FLPA is loaded at IPL time, with those modules listed in the active IEAFIXxx member of SYS1.PARMLIB, and also contains modules which must be kept in fixed storage frames (that is, they cannot be paged out).

This area should be used only for modules that significantly increase performance when they are fixed rather than pageable. Modules placed in the FLPA must be reentrant and refreshable. The best candidate for the FLPA are modules that are infrequently used but are needed for fast response.

Contents of the FLPA or extended FLPA

Modules from the LPALST concatenation, the LNKLST concatenation, SYS1.MIGLIB, and SYS1.SVCLIB can be included in the FLPA. FLPA is selected through specification of the FIX parameter in IEASYSxx, which is appended to IEAFIX to form the IEAFIXxx parmlib member, or from the operator's console at system initialization.

Modules specified in IEAFIXxx are placed in the FLPA or extended FLPA, depending on the RMODE of the modules. Modules with RMODE of 24 are placed in the FLPA, while those with an RMODE of ANY are placed in the extended FLPA.

4.7 Coding the IEAFIXxx member

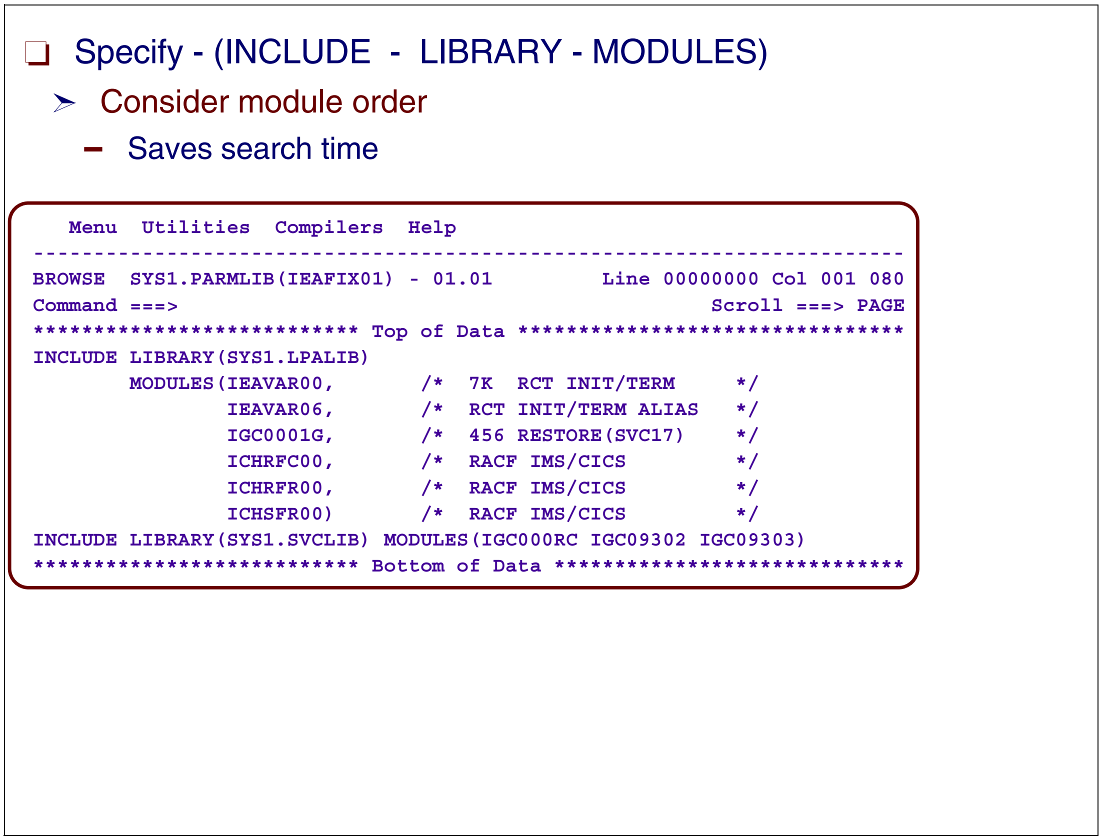


Figure 4-7 The IEAFIXxx parmlib member

Specifying modules in the FLPA or extended FLPA

Use the IEAFIXxx member in the SYS1.PARMLIB to specify the names of the modules that are to be fixed in central storage for the duration of an IPL.

Note: These libraries should be cataloged in the system master catalog.

Modules specified in IEAFIXxx are loaded and fixed in the order which they are specified in the member. To keep search time within reasonable limits, do not allow the FLPA to become excessively large.

Coding IEAFIXxx in SYS1.PARMLIB

The statements or parameters used in IEAFIXxx are:

INCLUDE Specifies modules to be loaded as temporary extensions to the existing pageable link pack area (PLPA).

LIBRARY Specifies a qualified data set name. The specified library must be cataloged in the system master catalog.

MODULES Specifies a list of 1 to 8 character module names.

Rules for specification of IEAFIXxx

- Each statement must begin with the INCLUDE keyword.

- The library name follows the LIBRARY keyword and is enclosed in parentheses.
- The list of modules follows the MODULES keyword and is enclosed in parentheses. Any number of modules' names can be specified.
- The statement is assumed to be all information from one INCLUDE keyword to the next INCLUDE keyword or until end-of-file.
- Use all columns except 72 through 80.

The visual shows an example of IEAFIXxx

Advantages of FLPA or extended FLPA

Because fixed modules are not paged, you save I/O time and paging overhead by placing moderately used modules into the FLPA. This can shorten the LPALST concatenation. When a module is requested, the program manager searches the list of fixed routines before it examines the pageable LPA directory.

Note: The price for this performance improvement is the reduction in the central storage available for paging old jobs and starting new jobs. Remember that pages referenced frequently tend to remain in central storage even when they are not fixed.

For more information, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

4.8 Specifying the IEAFIXxx member

- Operator response to IEA101A - system parameters
  - R 00,FIX=aa - (overrides IEASYSxx FIX=)
- Display contents of IEAFIXxx on console
  - Use L option
- Override the page protection default
  - Use NOPROT option

```
FIX= {aa                          }
     {(aa,[,L][,NOPROT])          }
     {(aa,bb,...[,L][,NOPROT])}
```

Figure 4-8 Specifying the IEAFIXxx parmlib member

How to specify FIX parameter during system initialization

The two characters (A through Z, 0 through 9, @, #, or $) represented by aa (or bb and so forth), are appended to IEAFIX to form the name of the IEAFIXxx parmlib members. The options are:

L If the L option is specified, the system displays the contents of the IEAFIXxx parmlib members at the operator's console as the system processes the members.

NOPROT By default, the LPA modules in the IEAFIXxx parmlib members are page-protected in storage. However, the NOPROT option allows an installation to override the page protection default.

Syntax format for FIX parameter: FIX= {aa} {(aa,[,L][,NOPROT]) } {(aa,bb,...[,L][,NOPROT])}

An example of overriding the value of the FIX parameter that was specified in the IEASYSxx during system initialization follows; member 01 is selected during system initialization:

```
IEA101A SPECIFY SYSTEM PARAMETERS FOR z/OS 02.05.00 HBB6605
R 00,FIX=01
IEE600I REPLY TO 00 IS;FIX=01
```

4.9 Modified link pack area

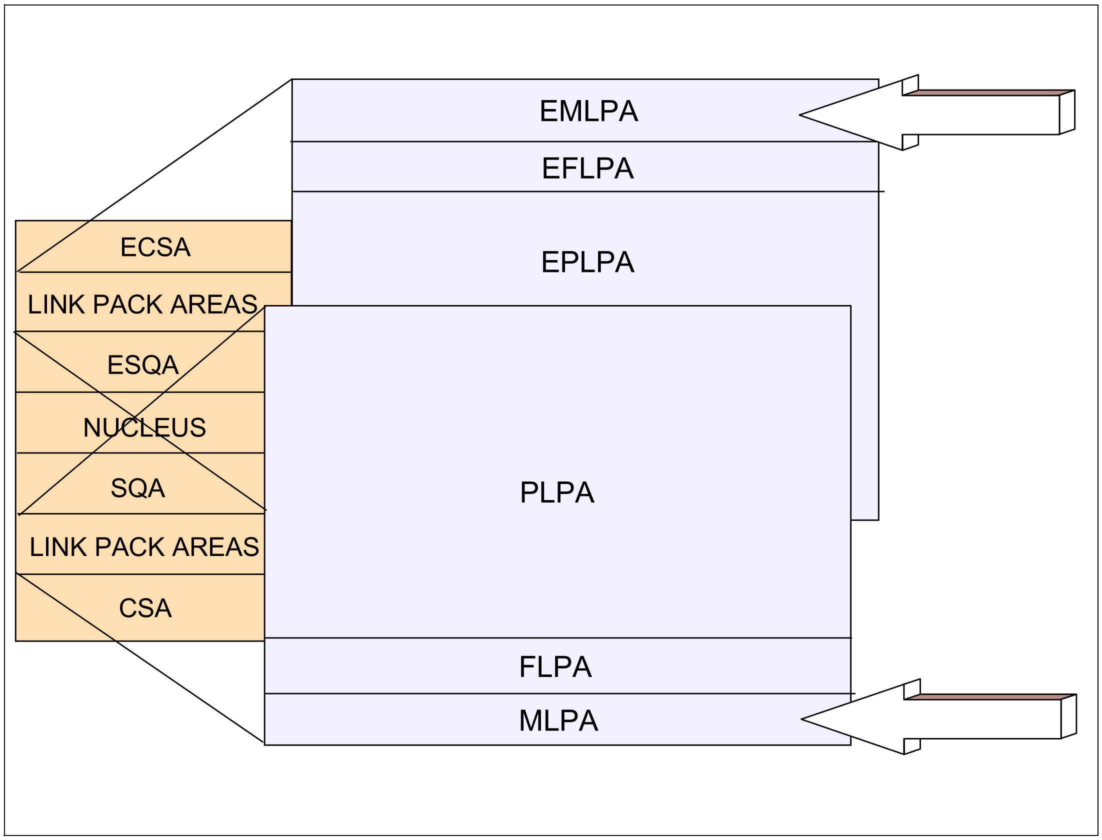


Figure 4-9 Modified Link Pack Area

Modified link pack area (MLPA/extended MLPA)

This area may be used to contain reenterable routines from APF-authorized libraries that are to be part of the pageable extension to the link pack area during the current IPL.

The MLPA exists only for the duration of the IPL. Therefore, if an MLPA is desired, the modules in the MLPA must be specified for each IPL (including quick start and warm start IPLs).

Contents of the MLPA or extended MLPA

MLPA contains modules listed in the active IEALPAxx member of SYS1.PARMLIB, through the specification of the MLPA parameter in the IEASYSxx or from the operator's console at system initialization.

LPA modules specified in the IEALPAxx are placed in the MLPA or the extended MLPA, depending on the RMODE of the modules. Modules with an RMODE of 24 are placed in the MLPA, while those with an RMODE of ANY are placed in the extended MLPA.

4.10 Coding the IEALPAxx member

❑ Specify - (INCLUDE - LIBRARY - MODULES)

```
   Menu  Utilities  Compilers  Help
------------------------------------------------------------------------
BROWSE   SYS1.PARMLIB(LEALPA02) - 01.01         Line 00000000 Col 001 080
Command ===>                                                Scroll ===> PAGE
*************************** Top of Data ********************************
INCLUDE LIBRARY(ISP.SISPLOAD)
        MODULES(ISPASUBS,ISPEX,ISPEXEC,
                ISPLINK,ISPLNK,
                ISPQRY)
INCLUDE LIBRARY(SYS1.LINKLIB)
        MODULES(IFBSEXIT)
*************************** Bottom of Data *****************************
```

Figure 4-10 Coding the IEALPAxx parmlib member

How to code IEALPAxx of the SYS1.PARMLIB

Figure 4-10 is an example of the IEALPAxx member.

The important syntax rules for IEALPAxx are:

- Each statement must begin with the INCLUDE keyword.
- The library name follows the LIBRARY keyword and is enclosed in parentheses.
- The list of modules follows the MODULES keyword and is enclosed in parentheses. Any number of module names can be specified.
- The statement is assumed to be all information from one INCLUDE keyword to the next INCLUDE keyword or until end-of-file.
- Use all columns except 72 through 80.

4.11 Specifying the IEALPAxx member

- ❑ Operator response to IEA101A - system parameters
  - ➢ R 00,MLPA=02 - (overrides IEASYSxx MLPA=)
- ❑ Display contents of IEALPAxx on console
  - ➢ Use L option
- ❑ Override the page protection default
  - ➢ Use NOPROT option

```
MLPA= {aa                              }
      {(aa,[,L][,NOPROT])              }
      {(aa,bb,...[,L][,NOPROT])}
```

Figure 4-11 Specifying the IEALPAxx member

Specifying the MLPA member at system initialization

The two characters (A through Z, 0 through 9, @, #, or $) represented by aa (or bb and so forth), are appended to IEALPA to form the name of the IEALPAxx parmlib members. The options are:

L If the L option is specified, the system displays the contents of the IEALPAxx parmlib members at the operator's console as the system processes the members.

NOPROT By default, the LPA modules in the IEALPAxx parmlib members are page-protected in storage. However, the NOPROT option allows an installation to override the page protection default.

Syntax format for MLPA parameter: MLPA= {aa} {(aa[,L][,NOPROT]) } {(aa,bb,...[,L][,NOPROT])}

An example of overriding the value of the MLPA parameter in the IEASYSxx during system initialization follows; IEALPA02 was selected during system initialization:

```
IEA101A SPECIFY SYSTEM PARAMETERS FOR z/OS 02.05.00 HBB6605
R 00,MLPA=02
IEE600I REPLY TO 00 IS;MLPA=02
```

4.12 Dynamic LPA functions

- LPA statement in PROGxx parmlib member
  - LPA ADD
  - LPA DELETE
  - LPA CSAMIN
- SETPROG LPA operator command
- D PROG,LPA operator command
- CSVDYLPA macro

Figure 4-12 Dynamic LPA functions

Managing dynamic LPA content

Dynamic link pack area (DLPA) was introduced in OS/390 Release 4, which has the ability to dynamically add or delete modules from the link pack area (LPA) after the IPL. This facility allows optional and new products to be loaded into the system without an IPL. It also enables you to display modules residing in LPA.

A module added dynamically will be found before one of the same name added during the IPL. This allows you to test new modules before you put them into production. Modules added dynamically to the LPA will be loaded into the common area (CSA) or extended common area (ECSA).

How to perform dynamic LPA functions

The dynamic LPA functions may be invoked in one of the following ways:

- The PROGxx parmlib member includes the LPA statements, which are used to define what modules can be added to or deleted from LPA after the IPL. You use the **`SET`** command to validate the PROGxx parmlib member; for example, **`SET PROG=xx`**.
- The **`SETPROG LPA`** command may be used to initiate a change (add or delete) to the LPA.
- The **`DISPLAY PROG,LPA`** command may be used to display information about modules that have been added to LPA.
- The CSVDYLPA macro allows an authorized program to initiate dynamic LPA services.

For more information, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

4.13 The LNKLST

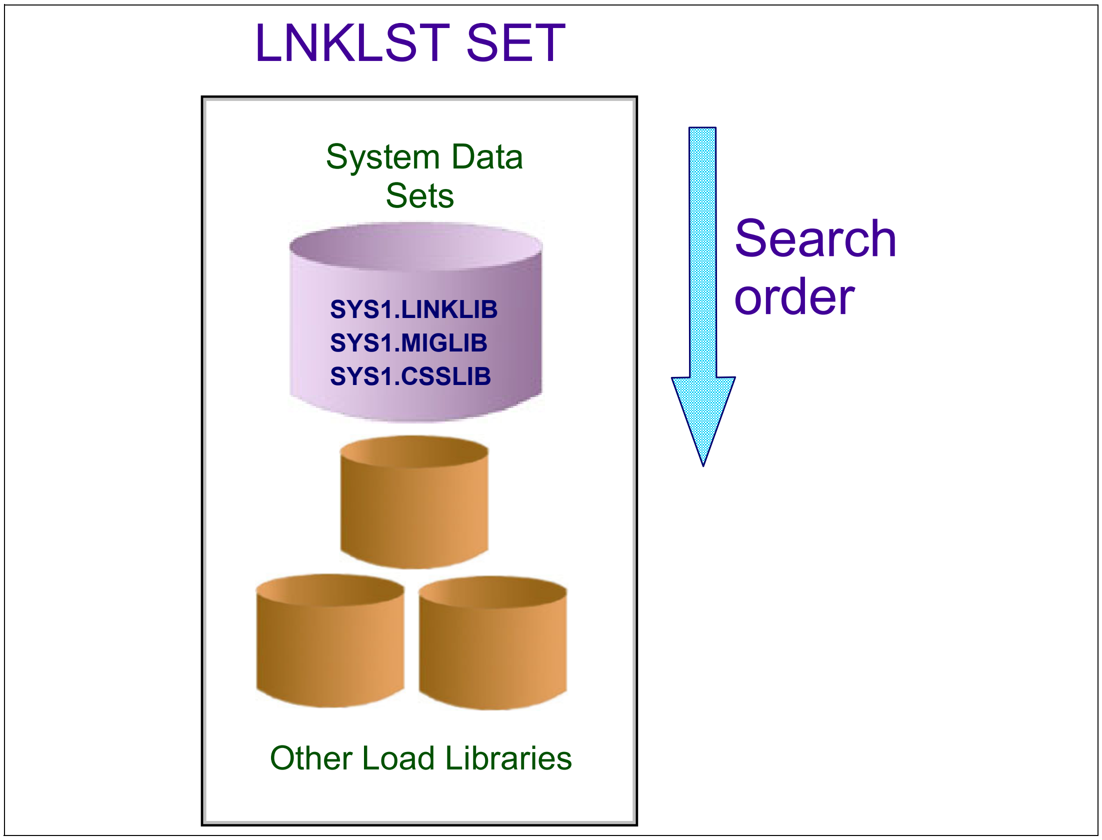


Figure 4-13 Overview of the LNKLST

Overview of the LNKLST

This section explains the LNKLST and the related mechanisms utilized to improve the performance of locating and fetching modules. It is important to understand the relationship between the LNKLST and LLA/VLF.

When determining which data sets LLA is to manage, try to limit these choices to production load libraries that are rarely changed. Because LLA manages LNKLST libraries by default, you need only determine which non-LNKLST libraries LLA is to manage. If, for some reason, you do not want LLA to manage particular LNKLST libraries, you must explicitly remove such libraries from LLA management.

Because you obtain the most benefit from LLA when you have both LLA and VLF functioning, you should plan to use both. When used with VLF, LLA reduces the I/O required to fetch modules from DASD by causing selected modules to be staged in VLF data spaces. LLA does not use VLF to manage library directories. When used without VLF, LLA eliminates only the I/O the system would use in searching library directories on DASD.

All LLA-managed libraries must be cataloged. This includes LNKLST libraries. A library must remain cataloged for the entire time it is managed by LLA. The benefits of LLA apply only to modules that are retrieved through the following macros: LINK, LINKX, LOAD, ATTACH, ATTACHX, XCTL, and XCTLX.

LLA does not stage load modules in overlay format. LLA manages the directory entries of overlay format modules, but the modules themselves are provided through program fetch. If you want to make overlay format modules eligible for staging, you must re-linkedit the modules as non-overlay format. These reformatted modules might occupy more storage when they execute and, if LLA does not stage them, might take longer to be fetched.

The LNKLST is a group of system and user-defined load libraries which form part of the search order the system uses for programs.

Modules (programs), whether stored as load modules or programs objects, must be loaded into both virtual storage and central storage before they can be run.

By default, the LNKLST begins with these system data sets:

- SYS1.LINKLIB
- SYS1.MIGLIB
- SYS1.CSSLIB

You can change this order and add other load libraries to the LNKLST concatenation.

The LNKLST concatenation

The LNKLST concatenation is established at IPL time. It consists of SYS1.LINKLIB, followed by the libraries specified in the LNKLSTxx member(s) of SYS1.PARMLIB. The LNKLSTxx member is selected through the LNK parameter in the IEASYSxx member of the SYS1.PARMLIB. In addition, the system also automatically concatenates data sets SYS1.MIGLIB and SYS1.CSSLIB to SYS1.LINKLIB.

The building of the LNKLST concatenation happens during an early stage in the IPL process, before any user catalogs are accessible, so only those data sets whose catalog entries are in the system master catalog may be included in the linklist. However, to include a user cataloged data set in the LNKLST concatenation, you have to specify both the name of the data set and the volume serial number (VOLSER) of the DASD volume on which the data set resides.

Note: The number of data sets that you can concatenate to form the LNKLST concatenation is limited by the total number of DASD extents the data sets will occupy. The total number of extents must not exceed 255. When the limit has been exceeded, the system writes error message IEA328E to the operator's console.

These data sets are concatenated in the order in which they appear in the LNKLSTxx member(s), and the system creates a data extent block (DEB) that describes the data sets concatenated to SYS1.LINKLIB and their extents. This contains details of each physical extent allocated to the linklist. These extents remains in effect for the duration of the IPL. After this processing completes, the library lookaside (LLA) is started and manages the LNKLST data sets and can be used to control updates to them.

Specifying the LNK parameter

An example of overriding the value of the LNK parameter in the IEASYSxx during system initialization is as follows:

```
IEA101A SPECIFY SYSTEM PARAMETERS FOR z/OS 02.05.00 HBB6605
R 00,LNK=03
IEE600I REPLY TO 00 IS;LNK=03
```

For more information, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592, and *z/OS MVS System Commands*, SA22-7627.

4.14 Dynamic LNKLST functions

- LNKLST statement in PROGxx parmlib member
  - SET PROG=xx command
- SETPROG LNKLST operator command
- D PROG,LNKLST operator command
- CSVDYNL macro

Figure 4-14 Dynamic LNKLST commands

Managing dynamic LNKLST content

You can change the current LNKLST set dynamically through the **SET PROG=xx** and **SETPROG LNKLST** commands.

A LNKLST set remains allocated until there are no longer any jobs or address spaces associated with it. If the current LNKLST set is dynamically changed, any job or address space associated with the previous LNKLST set continues to use the data sets until the job or address space finishes processing. Thus, a previously current LNKLST set might be active or in use by a job or address space even though a new current LNKLST set has been activated. Jobs or address spaces that are started after the new current LNKLST set is activated use the new current LNKLST set.

An active LNKLST set cannot be modified. Once the last job or address space associated with a LNKLST set terminates, the LNKLST set is no longer active. The only other way to deactivate a LNKLST set is with LNKLST UPDATE.

Through SET PROG=xx and SETPROG LNKLST, you can also remove the definition of a LNKLST set from the system, associate a job or address space with the current LNKLST set, or locate a specific module associated with a data set in the LNKLST set.

You can update the LNKLST content dynamically using the following methods:

- You can create a PROGxx parmlib member with the new changes to the LNKLST set, then issue the **SET PROG=xx** operator command to activate the changes.

- You can simply use the **SETPROG LNKLST** operator command to update the LNKLST directly.
- You can also use the **D PROG,LNKLST** command to display information about the LNKLST set.
- Finally, you can use CSVDYNL macro programming service in an authorized program to change the LNKLST concatenation for associated jobs and address spaces.

For more information, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592, and *z/OS MVS System Commands*, SA22-7627.

4.15 Library lookaside (LLA)

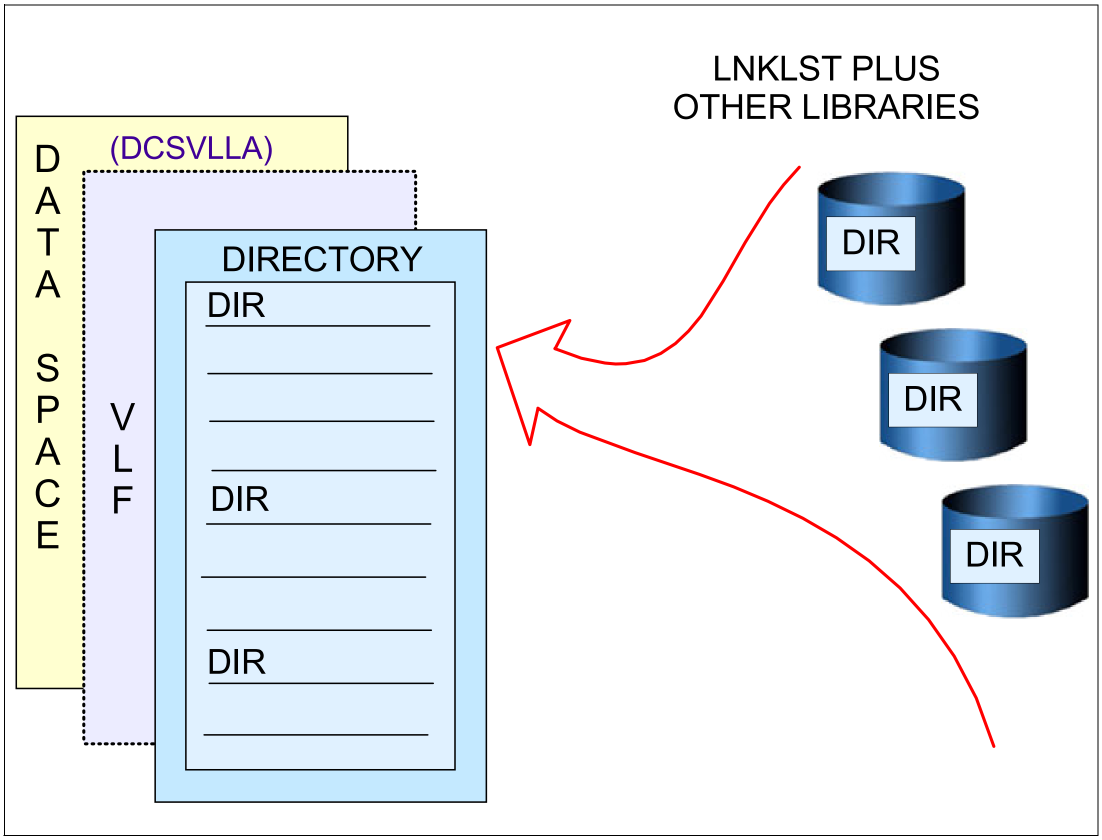


Figure 4-15 Library lookaside (LLA)

The library lookaside (LLA) overview

Library lookaside (LLA) is an address space that maintain a copy of the directory entries of the libraries that it manages. Since the entries are cached, the system does not need to read the data set directory entries to find out where a module is stored before fetching it from DASD. This greatly reduces I/O operations.

The main purpose of using LLA is to improve the performance of module fetching on your system.

How LLA improves performance

LLA improves module fetch performance in the following ways:

1. By maintaining (in the LLA address space) copies of the library directories the system uses to locate load modules. The system can quickly search the LLA copy of a directory in virtual storage instead of using costly I/O to search the directories on DASD.
2. By placing (or staging) copies of selected modules in a virtual lookaside facility (VLF) data space DCSVLLA when you define the LLA class to VLF, and start VLF. The system can quickly fetch modules from virtual storage, rather than using slower I/O to fetch the modules from the DASD.
3. By determining which modules, if staged, would provide the most benefit to module fetch performance. LLA evaluates modules as candidates for staging based on statistics it collects about the members of the libraries it manages (such as module size, frequency of fetches per module (fetch count), and the time required to fetch a particular module). If

necessary, you can directly influence LLA staging decisions through installation exit routines (CSVLLIX1 and CSVLLIX2).

Planning LLA use

Before you can use LLA, you have to do the following:

1. Determine which libraries should be LLA-managed libraries.
2. Code the CSVLLAxx parmlib member to include, modify, and remove the LLA-managed libraries as well as to optimize the performance of the search processing and selectively refresh LLA directory entries.
3. Learn how to control the LLA through the operator commands **`Start`**, **`Stop`**, and **`Modify LLA`**. LLA directory entries may be selectively refreshed via the operator command **`F LLA,REFRESH`**.

LLA-managed libraries

By default, LLA address space caches directory entries for all the modules in the data sets included in the linklist concatenation (defined in LNKLSTxx or PROGxx parmlib member).

You can also identify other user-defined load libraries that contain frequently used modules to be managed by LLA.

4.16 CSVLLAxx SYS1.PARMLIB member

```
LIBRARIES(libname1,libname2,...[-LNKLST-],...)
            MEMBERS(mmbr1,mmbr2,..)
LNKMEMBERS(mmbr1,mmbr2,...)
REMOVE(libname1,libname2,...[-LNKLST-],...)
GET_LIB_ENQ(YES|NO)
PARMLIB(dsn) SUFFIX(xx)
FREEZE(libname1,libname2,...[-LNKLST-],...)
NOFREEZE(libname1,libname2,...[-LNKLST-],...)
EXIT1(ON|OFF)
EXIT2(ON|OFF)
PARMSUFFIX(xx)
```

```
START LLA,LLA=xx
MODIFY LLA,UPDATE=xx
MODIFY LLA,REFRESH
```

Figure 4-16 CSVLLAxx parmlib member

You use the CSVLLAxx parmlib member to specify which libraries (in addition to the LNKLST concatenation) library lookaside is to manage.

> **Note:** If you do not supply a CSVLLAxx member, LLA will by default manage only those libraries defined in the LNKLST concatenation.

You can also use CSVLLAxx to specify:

- Libraries to be added or removed from LLA management while LLA is active.
- Whether LLA is to hold an enqueue for the libraries it manages.
- Libraries for which LLA is to use the performance-enhancing FREEZE|NOFREEZE option.
- Members of libraries, or whole libraries, to be selectively refreshed in the LLA directory.
- Additional CSVLLAxx members to be used to control LLA processing. These members can reside in data sets other than SYS1.PARMLIB.
- Whether exit routines are to be called during LLA processing.

For more information, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

How to start and stop LLA

To start LLA, use the `START LLA,LLA=xx` command. This command identifies the CSVLLAxx parmlib member to build the LLA directory. This command is issued during system initialization by the IBM-supplied IEACMD00 parmlib member; the command can also be entered by the operator.

The parameters for the **S LLA** command are:

LLA Invokes the LLA procedure and creates the LLA address space.

LLA=xx Indicates which CSVLLAnn parmlib member LLA is to use. If you omit **LLA=xx**, LLA will build its directory using only the LNKLST libraries.

SUB=MSTR Indicates that the name of the subsystem that will process the task is the master subsystem. If you omit this parameter, the JES subsystem starts LLA. The resulting dependency on JES requires LLA to be stopped when stopping JES.

Note: We recommend that you specify **SUB=MSTR** on the **START LLA** command to prevent LLA from failing if JES fails.

Syntax format for S LLA command: `S LLA[,SUB=MSTR][,LLA=xx]`

To stop LLA, use the **P LLA** operator command.

The parameter for the **P LLA** command is:

LLA The job name assigned to the LLA address space.

Syntax for P LLA command: `P LLA`

For more information, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592, and *z/OS MVS System Commands*, SA22-7627.

How to modify LLA

You can use the **MODIFY LLA** command to change LLA dynamically, in one of the following ways:

- **MODIFY LLA,REFRESH**

  This command rebuilds LLA's directory for the entire set of libraries managed by LLA. This action is often called the complete refresh of LLA.

- **MODIFY LLA,UPDATE=xx**

  This command rebuilds LLA's directory only for specified libraries or modules. xx identifies the CSVLLAxx member that contains the names of the libraries for which directory information is to be refreshed. This action is often called a selective refresh of LLA.

Note: There are several situations where you need to refresh the LLA with the latest version of the directory information from the DASD; whenever you update a load module in a library that LLA manages, make sure you follow the update by issuing the appropriate form of the MODIFY LLA command to refresh LLA's cache with the latest version of the directory information from the DASD. Otherwise, the system will continue to use an older version of a load module.If you accidentally delete a data set from the current LNKLST set, the system will continue working, and continue finding modules in the deleted library! This is because the physical addresses of the members are still held by LLA even though it is no longer possible to open the directory. This only works, of course, until the physical space on the DASD is reused by something else.You will also find yourself in the situation where you need to compress a data set from the LNKLST set. You should refresh LLA's cache after the compress; otherwise, the directory entries in the LLA for every module moved during the compress process would be invalid, leading to abends whenever a user attempted to load one of these, until a refresh is done.

Use the following to do a complete update of the LLA:

```
F LLA,REFRESH
CSV210I LIBRARY LOOKASIDE REFRESHED
```

4.17 Compressing LLA-managed libraries

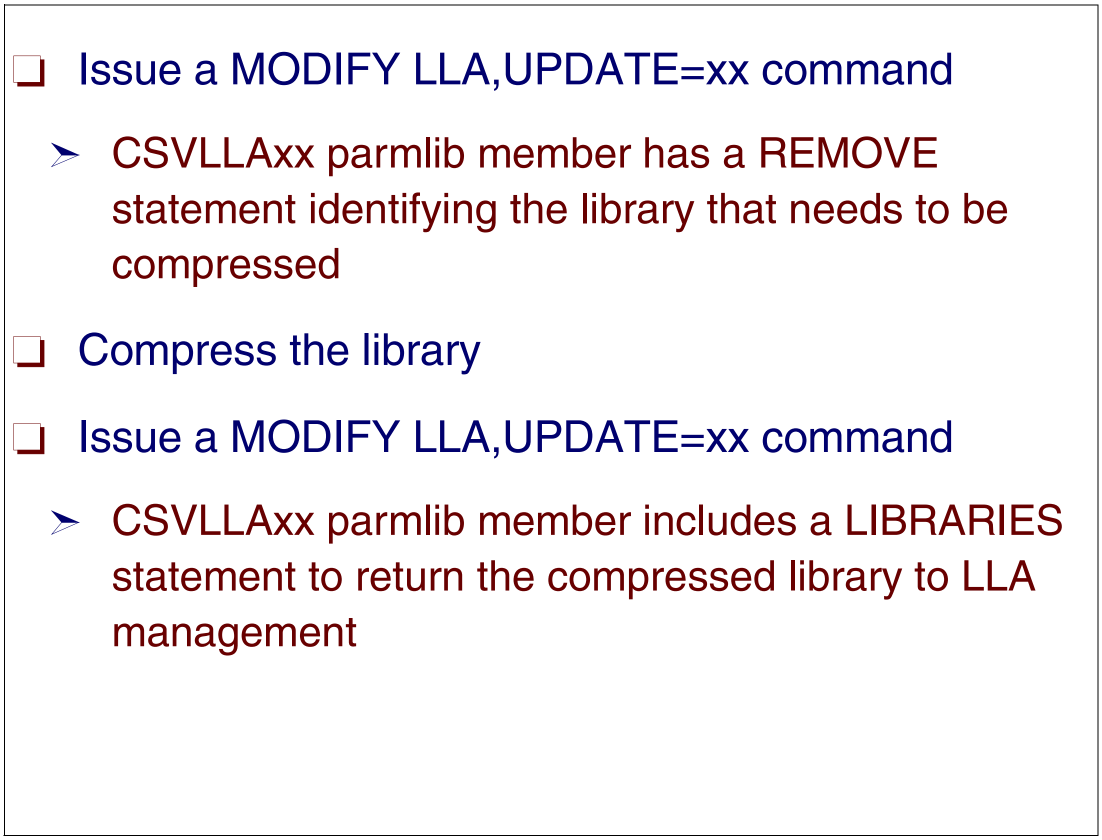


Figure 4-17 Compressing LLA-managed libraries

How to compress LLA-managed libraries

The procedure for compressing an LLA-managed library is:

1. Create a new CSVLLAxx member that includes a REMOVE statement identifying the library that needs to be compressed.

```
    Menu  Utilities  Compilers  Help
------------------------------------------------------------------------
BROWSE  SYS1.PARMLIB(CSVLLA02)  - 01.01       Line 00000000 Col 001 080
*************************** Top of Data ********************************
REMOVE(SYS1.LINKLIB)
*************************** Bottom of Data *****************************
```

Then issue the **F LLA,UPDATE=xx** command, as follows:

```
F LLA,UPDATE=02
IEE252I MEMBER CSVLLA02 FOUND IN SYS1.PARMLIB
CSV210I LIBRARY LOOKASIDE UPDATED
```

2. Compress the library.

   There are two ways of compressing a data set:

   – You can issue the line command **Z** against the data set you want to compress from the ISPF panel.

```
Menu  Options  View  Utilities  Compilers  Help
------------------------------------------------------------------------
DSLIST - Data Sets Matching SYS1.LINKLIB                      Row 1 of 1
Command ===>                                            Scroll ===> PAGE

Command - Enter "/" to select action            Message          Volume
------------------------------------------------------------------------
Z        SYS1.LINKLIB                                            MPRES1
********************* End of Data Set list *****************************
```

– Or you can submit a job to compress the data set using the utility IEBCOPY as shown in the following sample JCL.

```
//COMPRES JOB (),'MVSSP',NOTIFY=&SYSUID,CLASS=A,MSGLEVEL=(1,1),
//          MSGCLASS=X
//*********************************************
//*                                           *
//*    COMPRESSING DATA SETS USING IEBCOPY  *
//*                                           *
//*********************************************
//STEP1  EXEC PGM=IEBCOPY
//SYSPRINT DD SYSOUT=*
//INPUT    DD DSNAME=SYS1.LINKLIB,DISP=SHR
//OUTPUT   DD DSNAME=SYS1.LINKLIB,DISP=SHR
//SYSIN    DD *
    COPY INDD=INPUT,OUTDD=OUTPUT
/*
```

3. Create a new CSVLLAxx member that includes a LIBRARIES statement to return the compressed library to LLA management.

```
   Menu  Utilities  Compilers  Help
------------------------------------------------------------------------
BROWSE  SYS1.PARMLIB(CSVLLA03)  - 01.01        Line 00000000 Col 001 080
*************************** Top of Data ********************************
LIBRARIES(SYS1.LINKLIB)
*************************** Bottom of Data *****************************
```

Then issue the **F LLA,UPDATE=xx** command, as follows:

```
F LLA,UPDATE=03
IEE252I MEMBER CSVLLA03 FOUND IN SYS1.PARMLIB
CSV210I LIBRARY LOOKASIDE UPDATED
```

4.18 Virtual lookaside facility (VLF)

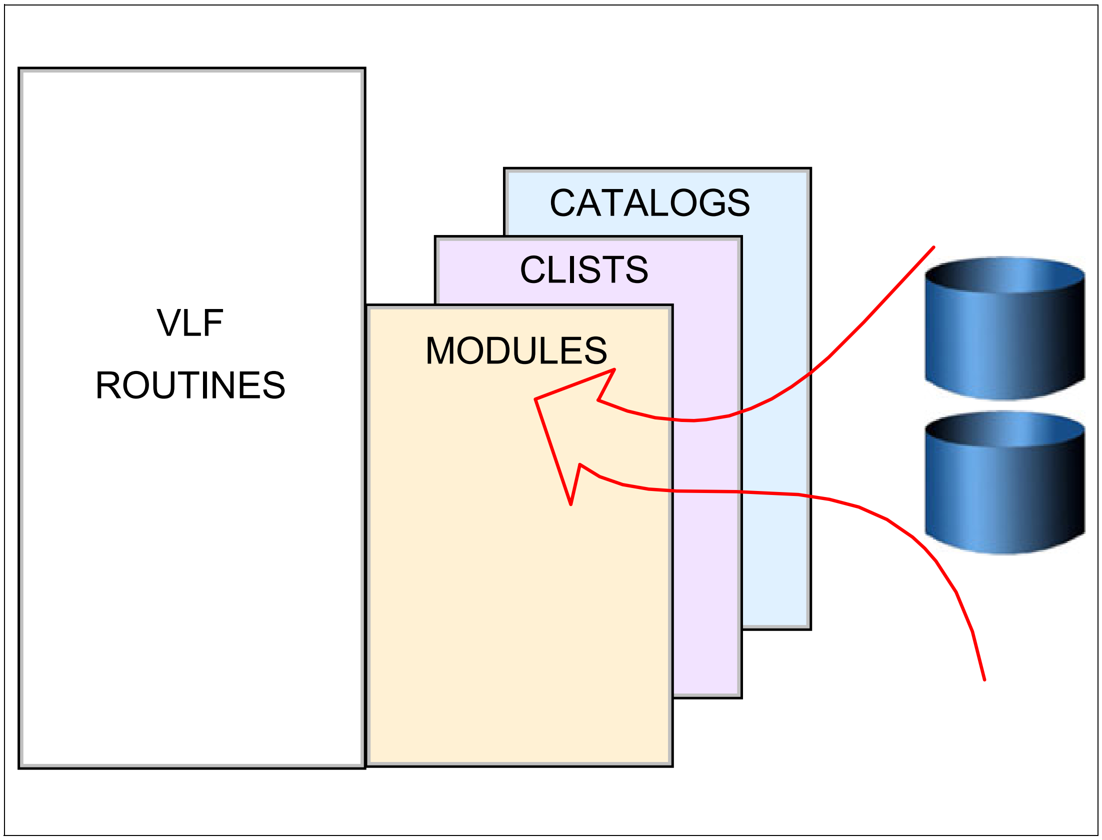


Figure 4-18 Virtual lookaside facility (VLF) overview

Virtual lookaside facility (VLF) overview

The virtual lookaside facility (VLF) is a set of services that can improve the response time of applications that must retrieve a set of data for many users. VLF creates and manages data spaces to store an application's most frequently used data. When the application makes a request for data, VLF checks its data space to see if the data is there. If the data is present, VLF can rapidly retrieve it without requesting I/O to DASD.

To take advantage of VLF, an application must identify the data it needs to perform its task. The data is known as a data object. Data objects should be small-to-moderate in size, named according to the VLF naming convention discussed later in this section, and associated with an installation-defined class of data objects.

Certain IBM products or components such as LLA, TSO/E, CAS, and RACF use VLF as an alternate way to access data. Since VLF uses virtual storage for its data spaces, there are performance considerations that each installation must weigh when planning for the resources required by VLF.

Note: VLF is intended for use with major applications. Because VLF runs as a started task that the operator can stop or cancel, it cannot take the place of any existing means of accessing data on DASD. Any application that uses VLF must also be able to run without it.

Using VLF with LLA

You will obtain the most benefit from LLA when you have both LLA and VLF functioning; you should plan to use both. When used with VLF, LLA reduces the I/O required to fetch modules from the DASD by causing selected modules to be staged in VLF data spaces.

LLA does not use VLF to manage library directories. When using without VLF, LLA eliminates only the I/O that the system would use in searching for library directories on DASD.

VLF considerations

Before you can take full advantage of implementing VLF to improve your system performance, there are several factors you have to consider. Some of these factors are:

- VLF works best with two kinds of data:
  - Data objects that are members of partitioned data sets, located through a partitioned data set (PDS) concatenation.
  - Data objects that, while not PDS members, could be easily described as a collection of named objects that are repeatedly retrieved by many users.

  If neither description fits your data objects, it is likely that you would not obtain any performance benefit from VLF. Remember, there are storage overhead costs associated with using VLF.
- Like data in private storage, data stored through VLF is subject to page stealing. That is, VLF works best when a significant portion of the data is likely to remain in processor storage and not be paged out to auxiliary storage.
- VLF works best with relatively small objects because less virtual storage is expended to reduce the number of I/O operations.
- VLF is designed to improve performance by increasing the use of virtual storage to reduce the number of I/O operations. For a system that is already experiencing a central, expanded, or auxiliary storage constraint, this strategy is probably not a good choice.

VLF planning

Before you can use VLF, you have to:

1. Start VLF using the IBM-supplied default COFVLFxx parmlib member.
2. Update COFVLFxx to include the VLF classes associated with the applications or products.

4.19 COFVLFxx parmlib member

```
CLASS    NAME(classname)
         {EDSN(dsn1) [VOL(vol)] EDSN(dsn2)...}
         {EMAJ(majname1) EMAJ(majname2)...}

         [MAXVIRT(nnn)]
```

```
S VLF,SUB=MSTR[,NN=xx]

P VLF
```

Figure 4-19 Defining the COFVLFxx parmlib member

You use the COFVLFxx of the SYS1.PARMLIB to define classes of VLF objects. To activate a class of VLF objects, VLF requires that a CLASS statement describing that group of objects be present in the active COFVLFxx parmlib member (the member named on the **START** command used for VLF).

A VLF class is a group of related objects made available to users of an application or component. To get the most benefit from using VLF, consider its use for objects that are:

- Used frequently
- Changed infrequently
- Used by multiple end users concurrently

Some of the more important statement and parameters for COFVLFxx are:

CLASS Each group of objects that VLF processes must have a CLASS statement defining it. The CLASS statement indicates that the following parameters define that particular group of objects to VLF.

NAME(classname) NAME(classname) specifies the name of the VLF class. The classname may be 1 to 7 alphanumeric characters including @, #, and $. IBM-supplied VLF class names begin with the letters A through I, for example, NAME(CSVLLA).

EDSN(dsn)]VOL(vol)] For a PDS class, EDSN(dsn) identifies a partitioned data set name whose members are eligible to be the source for VLF objects in the class. The dsn can be 1 to 44 alphanumeric characters, including

@, #, and periods (.). You do not need to specify the volume if the cataloged data set is the desired one. If the data set is not cataloged, or if you have multiple data sets with the same name on different volumes, you must specify VOL(vol). Without the volume serial number, an uncataloged data set is not included in the eligible data set name list. The system issues an informational message to the operator to identify any data set where the system cannot find the catalog entry to extract the volume. Multiple occurrences of the same data set name with a different volume are acceptable. However, if duplicate entries of the same data set name and the same volume occur, the system issues an informational message and ignores the redundant information.

EMAJ(majname) EMAJ identifies an eligible major name (majname) for a non-PDS class, a class that does not have a major name and minor name related to partitioned data sets and their members. The majname can be 1 to 64 alphanumeric characters except comma(,), blank, or right parenthesis ()), for example EMAJ(LLA).

> **Note:** Do not use the EMAJ and the EDSN parameter on the same CLASS statement.

For more information, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

:The following shows an example of a COFVLFxx parmlib member:

```
   Menu  Utilities  Compilers  Help
------------------------------------------------------------------------
BROWSE  SYS1.PARMLIB(COFVLF04)  - 01.01       Line 00000000 Col 001 080
*************************** Top of Data ********************************
CLASS NAME(CSVLLA)              /* CLASS NAME FOR LIBRARY LOOKASIDE  */
      EMAJ(LLA)                 /* MAJOR NAME FOR LIBRARY LOOKASIDE  */
                                /* Default MAXVIRT = 4096 4K blocks  */
                                /*                 = 16Mb            */
/*                                                                   */
CLASS NAME(IKJEXEC)         /* TSO/E VERSION 2 CLIST/REXX INTERFACE  */
      EDSN(SYS1.OS390.CLIST)
      EDSN(MVSTOOLS.SHARED.CLIST)
      MAXVIRT(1024)         /* MAXVIRT = 512 4K blocks               */
                            /*         = 4Mb                         */
/*                                                                   */
CLASS NAME(IGGCAS)          /* MVS/DFP 3.1 CATALOG in Data space     */
      EMAJ(CATALOG.SC54.MCAT)
      EMAJ(CATALOG.TOTICF1.VITSO01)
      MAXVIRT(1024)         /* MAXVIRT = 512 4K blocks               */
/*        = 2Mb (minimum value)        */
*************************** Bottom of Data *****************************
```

Starting and stopping VLF

To start VLF, you use the **START VLF,SUB=MSTR,N=xx** command. This command identifies the COFVLFxx parmlib member to build VLF. This command is issued by the IBM-supplied COMMND00 parmlib member during system initialization; the command can also be entered by the operator.

The parameters for the **S VLF** command are: **S VLF,SUB=MSTR[,NN=xx]**. This invokes the VLF procedure that starts the virtual lookaside facility (VLF), where:

NN=xx Indicates that the system is to start VLF using the COFVLFxx member of the SYS1.PARMLIB (default COFVLF00).

Syntax for S VLF command: `S VLF,SUB=MSTR[,NN=xx]`

To stop VLF use the **`P VLF`** command.

The parameter for the **`P VLF`** command is:

VLF The jobname assigned to the virtual lookaside facility. Using this parameter stops VLF with the message COF033I.

Note: Stopping VLF can degrade your system performance.

4.20 Authorized libraries

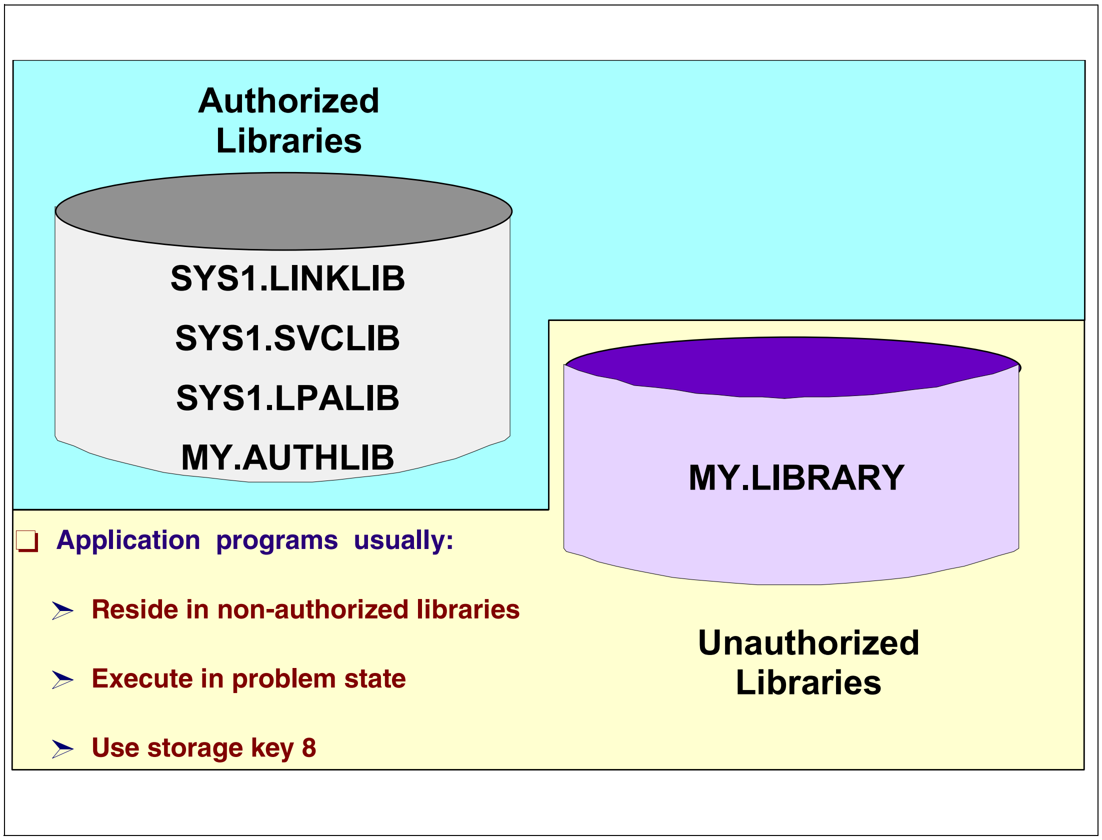


Figure 4-20 Authorized libraries overview

z/OS offers a mechanism called the authorized program facility (APF) to restrict the access to sensitive system functions or user programs. APF was designed to avoid integrity exposures. The installation identifies what libraries contain those special functions or programs. Those libraries are then called APF (authorized program facility) libraries.

The modified link pack area (MLPA) may be used to contain reenterable routines from APF-authorized libraries that are to be part of the pageable extension to the link pack area during the current IPL. The MLPA exists only for the duration of an IPL. Therefore, if an MLPA is desired, the modules in the MLPA must be specified for each IPL (including quick start and warm start IPLs).

The MLPA is allocated just below the FLPA (or the PLPA, if there is no FLPA); the extended MLPA is allocated above the extended FLPA (or the extended PLPA if there is no extended FLPA). When the system searches for a routine, the MLPA is searched before the PLPA.

Note: Loading a large number of modules in the MLPA can increase fetch time for modules that are not loaded in the LPA. This could affect system performance.

The MLPA can be used at IPL time to temporarily modify or update the PLPA with new or replacement modules. No actual modification is made to the quick start PLPA stored in the system's paging data sets. The MLPA is read-only, unless NOPROT is specified on the MLPA system parameter.

Authorized libraries overview

Many system functions, such as entire supervisor calls (SVC) or special paths through SVCs, are sensitive. Access to these functions must be restricted to only authorized programs to avoid compromising the security and integrity of the system.

The system considers a program authorized if the program has one or more of the following characteristics:

- Runs in supervisor state (bit 15 of the PSW is zero).
- Runs with PSW key 0 to 7 (bits 8 through 11 of the PSW are in the range 0 to 7).
- Runs under an APF-authorized job step task.

The authorized program facility allows your installation to identify system or user programs that can use sensitive system functions.

Libraries that contain authorized programs are known as authorized libraries. APF-authorized programs must reside in one of the following authorized libraries:

- SYS1.LINKLIB
- SYS1.SVCLIB
- SYS1.LPALIB
- An authorized library specified by your installation

Note: By default, the libraries in the LNKLST concatenation are considered authorized unless you specified LNKAUTH=APFTAB in the IEASYSxx parameter list. However, if the system accesses the libraries in the LNKLST concatenation through JOBLIB or STEPLIB DD statements, the system does not consider those libraries authorized unless you specified the library name in the APF list by using either the IEAAPFxx or the PROGxx parmlib member. If a JCL DD statement concatenates an authorized library in any order with an unauthorized library, the entire set of concatenated libraries is treated as unauthorized. SYS1.LPALIB is treated as an authorized library only while the system builds the pageable link pack area (PLPA) using the LPALSTxx parmlib member. All modules in PLPA are marked as coming from an authorized library. When accessed through a STEPLIB, JOBLIB, or TASKLIB DD statement, SYS1.LPALIB is considered an authorized library only if you have included it in the APF list.

Authorized program facility

You can use the authorized program facility (APF) to identify system or user programs that can use sensitive system functions. For example, APF:

- Restricts the use of sensitive system SVC routines (and sensitive user SVC routines, if you need them) to APF-authorized programs
- Allows the system to fetch all modules in an authorized job step task only from authorized libraries, to prevent programs from counterfeiting a module in the module flow of an authorized job step task

Authorizing a program

To authorize a program, you must first assign the authorized code to the first load module of the program. APF prevents authorized programs from accessing any load module that is not in an authorized library. When the system attaches the first load module of a program, the system considers the program APF-authorized if the module meets both the following criteria:

1. The module is contained in an authorized library.

2. The module is link-edited with authorized code, AC=1 (to indicate that you want to authorize the job step task). This code is contained in a bit setting in the partitioned data set (PDS) directory entry for the module.

Link-editing modules with AC=1

You can use the PARM field on the link-edit step to assign the APF-authorization code to a load module. To assign an authorization code using JCL, code AC=1 in the operand field of the PARM parameter of the EXEC statement.

```
//LKED   EXEC  PGM=HEWL,PARM='AC=1',...
```

This method causes the system to consider every load module created by the step to be authorized.

The authorization code of a load module has meaning only when it resides on an APF-authorized data set and when the load module executes as the first program of a job-step attach. If no authorization code is assigned in the linkage editor step, the system assigns the default of authorized. Thus, if a load module tries to execute functions or SVCs that require authorization, the system abnormally ends the program and issues abend code X'306' reason code X'04'.

Guidelines for using APF

When you use APF authorization, you must control which programs are stored in the authorized libraries. If the first module in a program sequence is authorized, the system assumes that the flow of control to all subsequent modules is known and secure as long as these subsequent modules come from authorized libraries. To ensure that this assumption is valid you should:

- Ensure that all programs that run as authorized programs adhere to your installation's integrity guidelines.
- Ensure that no two load modules with the same name exist across the set of authorized libraries. Two modules with the same name could lead to accidental or deliberate mix-up in module flow, possibly introducing an integrity exposure.
- Link edit with the authorization code (AC=1) only the first load module in a program sequence. Do not use the authorization code for subsequent load modules, thus ensuring that a user cannot call modules out of sequence, or bypass validity checking or critical-logic flow.

It is recommended that you protect the libraries in the APF list with generic security product profiles so only selected users can store programs in those libraries.

4.21 Authorizing libraries

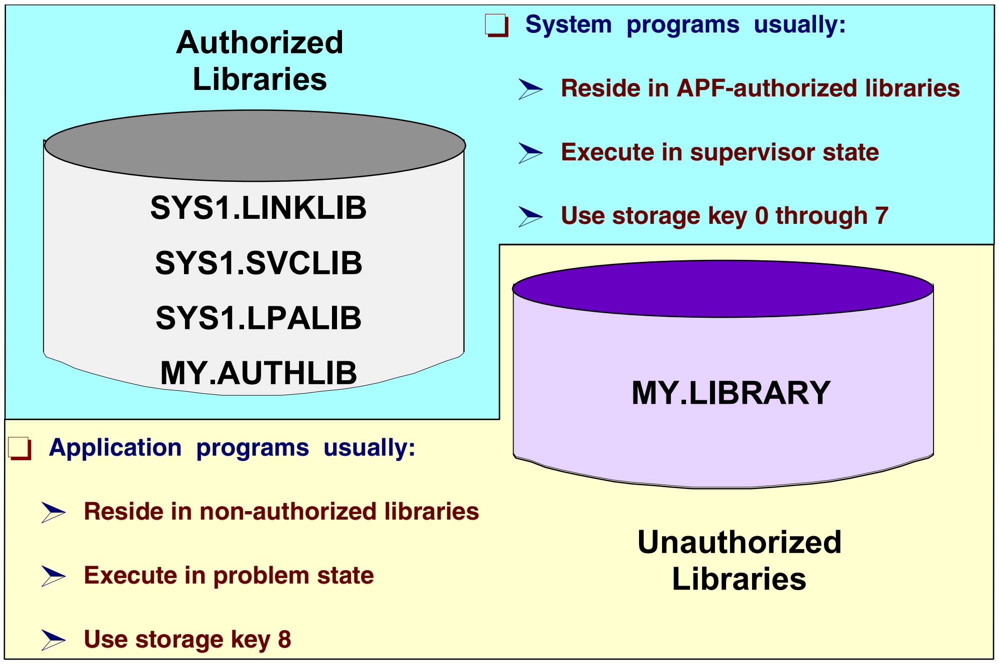


Figure 4-21 Authorizing libraries

Specifying program libraries to be APF authorized

The APF list is built during IPL using those libraries specified in the IEAAPFxx or PROGxx parmlib members, indicated by the APF and PROG parameters in IEASYSxx, or from the operator's console at system initialization.

Note: You can also dynamically modify the APF list after IPL, but only when you have used the dynamic APF format in the PROGxx.

IEAAPFxx parmlib member coding

Use the IEAAPFxx member in the SYS1.PARMLIB to specify program libraries that are to receive APF authorization. List the data set names of the libraries, along with the volume where the library resides.

To specify the volume where the library resides, use one of the following:

- The volume serial number of the volume on which the library resides.
- Six asterisks (******) to indicate that the library resides on the current SYSRES volume.
- *MCAT* to indicate the library resides on the volume on which the system master catalog resides.
- Nothing after the library name, to indicate that the library is managed by the storage management system (SMS).

:Following is an example of the IEAAPFxx:

```
 Menu  Utilities  Compilers  Help
-------------------------------------------------------------------------
BROWSE  SYS1.PARMLIB(PROGTT)   - 01.01        Line 00000000 Col 001 080
Command ===>                                           Scroll ===> PAGE
*************************** Top of Data ********************************
SYS1.VTAMLIB        ******,
SYS1.SICELINK       ******,
SYS1.LOCAL.VTAMLIB  TOTCAT,
ISP.SISPLOAD        *MCAT*
```

PROGxx parmlib member coding

You can use the APF statement to specify:

- The format of the APF-authorized library list, whether it is dynamic or static.
- Program libraries to be added to the APF list.
- Program libraries to be deleted from the APF list.

Note:

1. The system automatically adds SYS1.LINKLIB and SYS1.SVCLIB to the APF list at IPL.
2. If you specify a dynamic APF list format in PROGxx, you can update the APF list at any time during normal processing or at IPL. You can also enter an unlimited number of libraries in the APF list.
3. If you specify a static APF list format in PROGxx, you can define the list only at IPL, and are limited to defining a maximum of 255 library names (SYS1.LINKLIB and SYS1.SVCLIB, which are automatically placed in the list at IPL, and up to 253 libraries specified by your installation).

The statements and parameters for the APF statement are:

FORMAT(DYNAMIC|STATIC) Specifies that the format of the APF list is dynamic or static.

ADD|DELETE Indicates whether you want to add or delete a library from the APF list.

DSNAME(dsname) The 44-character name of a library that you want to add or delete from the APF list.

SMS|VOLUME(volume) The identifier for the volume containing the library specified on the DSNAME parameter, which is one of the following:

- SMS, which indicates that the library is SMS-managed.
- A six character identifier for the volume.
- ******, which indicates that the library is located on the current SYSRES volume.
- *MCAT*, which indicates that the library is located on the volume containing the master catalog.

Syntax format for APF statement: `APF FORMAT(DYNAMIC|STATIC) APF ADD | DELETE DSNAME(dsname) SMS | VOLUME(volname)`

The following shows an example of PROGxx definition:

```
 Menu  Utilities  Compilers  Help
-------------------------------------------------------------------------
BROWSE  SYS1.PARMLIB(PROGTT)   - 01.01        Line 00000000 Col 001 080
Command ===>                                          Scroll ===> PAGE
*************************** Top of Data ********************************
APF FORMAT(DYNAMIC)
APF ADD
    DSNAME(SYS1.VTAMLIB)
    VOLUME(******)
APF ADD
    DSNAME(SYS1.SICELINK)
    VOLUME(******)
APF ADD
    DSNAME(SYS1.LOCAL.VTAMLIB)
    VOLUME(TOTCAT)
APF ADD
    DSNAME(ISP.SISPLOAD)
    VOLUME(*MCAT*)
*************************** Bottom of Data *****************************
```

Note: It is recommended that you use the PROGxx instead of IEAAPFxx parmlib member to define the APF list, regardless of whether you plan to take advantage of the dynamic update capability. If you specify both the PROG=xx and the APF=xx parameters, the system places into the APF list those libraries listed in the IEAAFPxx, followed by those libraries in the PROGxx. If you are currently using the IEAAPFxx parmlib member to define the APF list, you can convert the format of IEAAPFxx to a PROGxx format using an IEAAPFPR REXX exec provided by IBM. For more information, see *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

4.22 Dynamic APF functions

- APF statement in PROGxx parmlib member
- SETPROG APF operator command
- D PROG,APF operator command

Figure 4-22 Dynamic APF functions

Managing dynamic APF

You can use the following ways to update the content of the APF table dynamically:

- Use PROGxx parmlib member which includes the appropriate APF statement to define the change.
- The **SETPROG AFP™** operator can also initiate a change to the APF table.
- The **DISPLAY AFP** command can be used to display the list of libraries authorized by APF.

Using the PROGxx parmlib member

As mentioned in the previous section, you can use the APF statement to add or delete libraries from the APF list. To delete a library from the APF list use the following command:

Example of the APF DELETE: `APF DELETE DSNAME(SCRIPT.R40.DCFLOAD) VOLUME(MPRES2)`

Activate the change by using a **SET PROG=xx** command as follows:

```
SET PROG=T4
IEE252I MEMBER PROGT4   FOUND IN SYS1.PARMLIB
CSV410I DATA SET SCRIPT.R40.DCFLOAD ON VOLUME MPRES2 DELETED FROM APF
LIST
IEE536I PROG     VALUE T4 NOW IN EFFECT
```

To add a library to the APF list use the following command:

Example of the APF ADD: `APF ADD DSNAME(MYPROG.LOADLIB)  VOLUME(MPRES3)`

Activate the change by using a **`SET PROG=xx`** command as follows:

```
SET PROG=T5
IEE252I MEMBER PROGT5   FOUND IN SYS1.PARMLIB
CSV410I DATA SET MYPROG.LOADLIB ON VOLUME MPRES2 ADDED TO APF LIST
IEE536I PROG     VALUE T5 NOW IN EFFECT
```

Using the SETPROG APF command

Use the **`SETPROG APF`** operator command to perform the following functions:

- Change the format of the authorized program facility (APF) list from static to dynamic, or static to dynamic.
- Add a library to a dynamic APF list.
- Delete a library from a dynamic APF list.

Syntax for SETPROG APF command: `SETPROG APF{,FORMAT={DYNAMIC|STATIC}} {,{ADD|DELETE},DSNAME|LIBRARY=libname,{SMS|VOLUME=volume}}`

To change the format of the APF list to dynamic:

```
SETPROG APF,FORMAT=DYNAMIC
CSV410I APF FORMAT IS NOW DYNAMIC
```

To add a library to the APF list:

```
SETPROG APF,ADD,DSNAME=SCRIPT.R40.DCFLOAD,VOLUME=MPRES2
CSV410I DATA SET SCRIPT.R40.DCFLOAD ON VOLUME MPRES2 ADDED TO APF LIST
```

To delete a library from the APF list:

```
SETPROG APF,DELETE,DSNAME=SCRIPT.R40.DCFLOAD,VOLUME=MPRES2
CSV410I DATA SET SCRIPT.R40.DCFLOAD ON VOLUME MPRES2 DELETED FROM APF
```

Note: If you try to add or delete from na APF list that is in a static format, the system responds with a CSV411I message, as follows:

```
SETPROG APF,DELETE,DSNAME=SCRIPT.R40.DCFLOAD,VOLUME=MPRES2
CSV411I ADD/DELETE IS NOT ALLOWED BECAUSE APF FORMAT IS STATIC
```

Using the DISPLAY APF command

You can use the **`DISPLAY APF`** command to display one or more entries in the list of APF-authorized libraries. Each entry in the APF list display contains:

- An entry number
- The name of an authorized library
- An identifier for the volume on which the authorized library resides (or *SMS*, if the library is SMS-managed)

Syntax for DISPLAY APF command: `D PROG,APF[,ALL ]  |,DSNAME=libname |,ENTRY=xxx  |,ENTRY=(xxx-yyy)  ],L={a|cc|cca|name|name-a} ]`

To display the whole APF list:

```
D PROG,APF
CSV450I 05.18.16 PROG,APF DISPLAY 971
FORMAT=DYNAMIC
ENTRY VOLUME DSNAME
   1  MPRES1 SYS1.LINKLIB
   2  MPRES1 SYS1.SVCLIB
   3  MPRES1 CPAC.LINKLIB
               .
               .
               .
  36  MPRES2 NETVIEW.V2R4M0.USERLNK
  37  MPRES2 NPM.V2R3M0.SFNMLMD1
  38  MPRES2 EMS.V2R1M0.SEMSLMD0
```

This number is the decimal entry number for each of the libraries defined in the APF list. To display the specific library at entry number 1:

```
D PROG,APF,ENTRY=1
CSV450I 05.24.55 PROG,APF DISPLAY 979
FORMAT=DYNAMIC
ENTRY VOLUME DSNAME
1  MPRES1 SYS1.LINKLIB
```

To display all the libraries in the range from 1 to 5:

```
D PROG,APF,ENTRY=(1-5)
CSV450I 05.26.27 PROG,APF DISPLAY 981
FORMAT=DYNAMIC
ENTRY VOLUME DSNAME
   1  MPRES1 SYS1.LINKLIB
   2  MPRES1 SYS1.SVCLIB
   3  MPRES1 CPAC.LINKLIB
   4  MPRES1 ISF.SISFLOAD
   5  MPRES1 ISF.SISFLPA
```

5

Catalogs

A catalog describes data set attributes and records the location of a data set so that the data set can be retrieved without requiring the user to specify its location. Multiple user catalogs contain information about user data sets, and a single master catalog contains entries for system data sets and user catalogs.

In z/OS the component controlling catalogs, Catalog Manager is embedded in DFSMSdfp. It supports three types of catalogs, which can coexist on the same operating system:

- ICF catalogs
- VSAM catalogs
- CVOLs

All data sets managed by the storage management subsystem (SMS) must be cataloged in an ICF catalog.

Most installations depend on the availability of catalog facilities to run production job streams and to support online users. For maximum reliability and efficiency, all permanent data sets should be cataloged, and all catalogs should be integrated catalog facility catalogs. See *z/OS DFSMS: Managing Catalogs*, SC26-7409 for information on VSAM catalogs and CVOLS and how to convert to integrated catalogs.

5.1 Catalogs

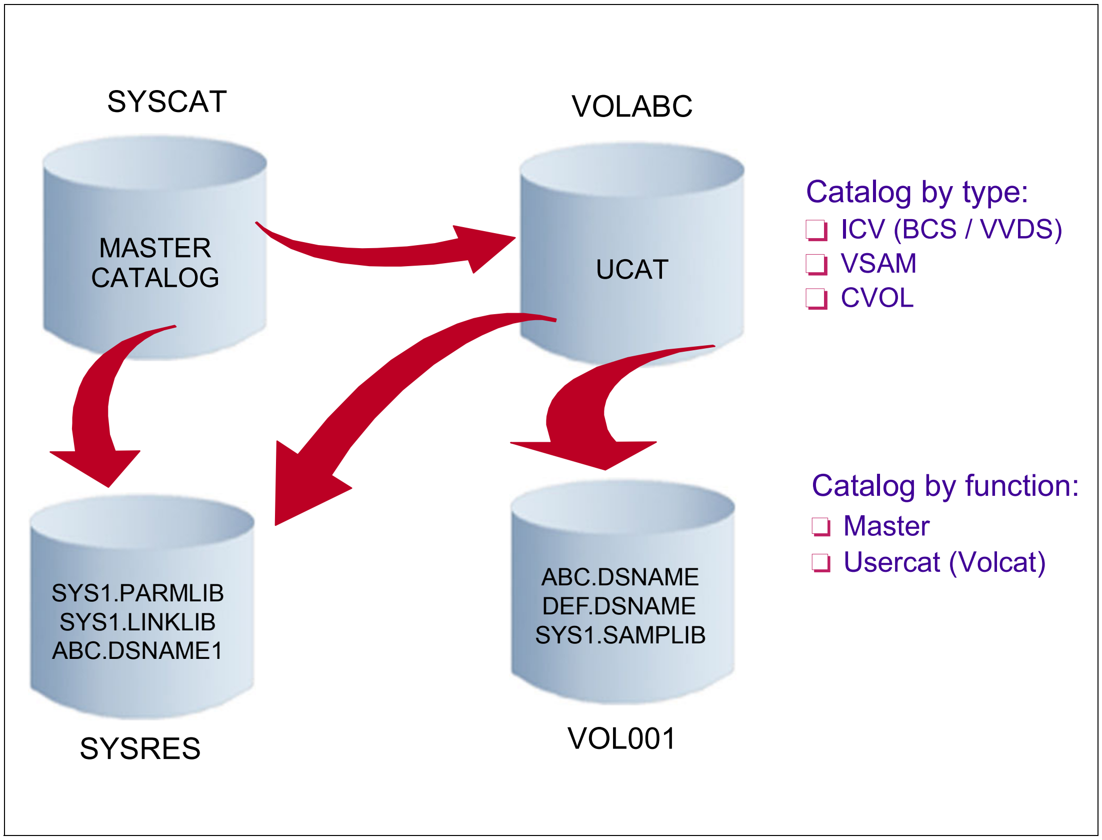


Figure 5-1 Catalogs

Catalogs

A catalog is a data set that contains information about other data sets. It provides users with the ability to locate a data set by name, without knowing where the data set resides. By cataloging data sets, your users need to know less about your storage setup. Thus, data sets can be moved from one device to another, without requiring a change in JCL DD statements that refer to an existing data set.

Cataloging data sets also simplifies backup and recovery procedures. Catalogs are the central information point for VSAM data sets; all VSAM data sets must be cataloged. In addition, all SMS-managed data sets must be cataloged.

DFSMS provides three types of catalogs: integrated catalog facility catalogs (ICV), VSAM catalogs, and operating system control volumes (OS CVOLs).

The integrated catalog facility should satisfy all your cataloging needs. Any type of data set or object can be cataloged in an integrated catalog facility catalog. Functions provided for VSAM catalogs and OS CVOLs are for compatibility only. Many advanced MVS/DFP™ functions require the use of integrated catalog facility catalogs (for example, the storage management subsystem).

This chapter provides information only about ICF Catalogs. For further information about VSAM catalogs and OS CVOLs catalogs, refer to *z/OS DFSMS: Managing Catalogs*, SC26-7409.

5.2 Introduction to ICF

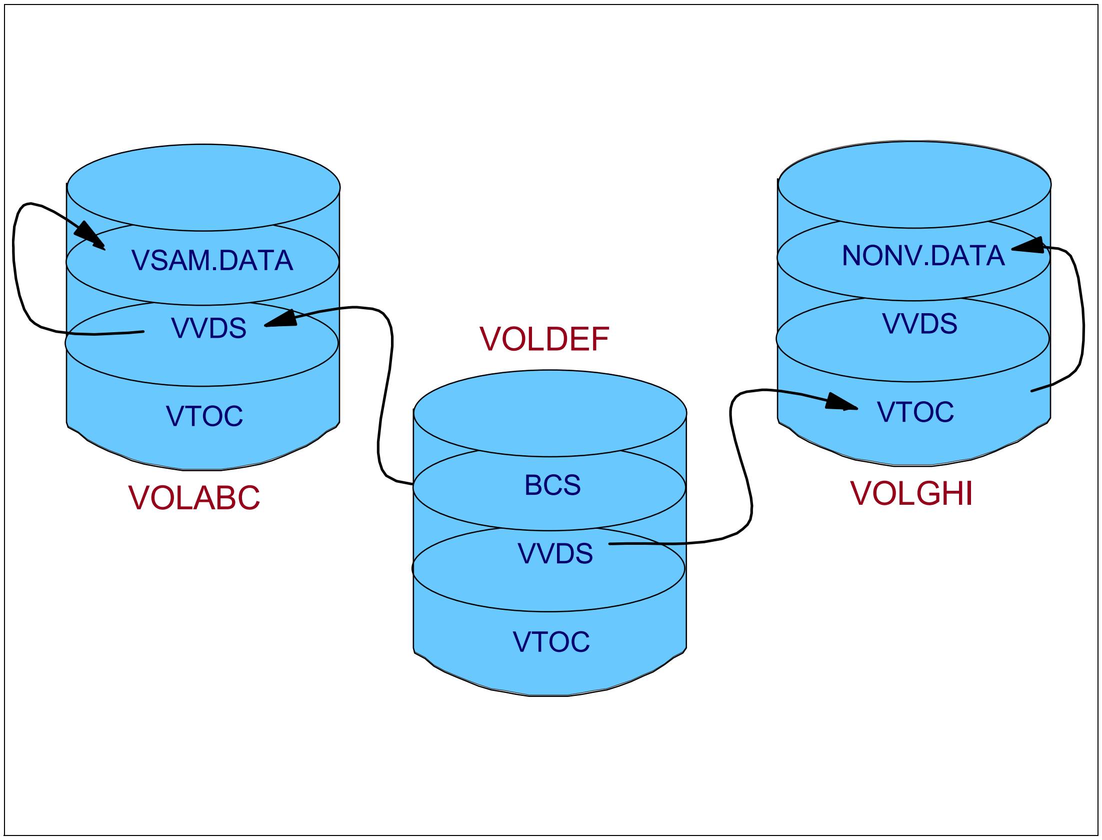


Figure 5-2 Introduction to ICF

Introduction to ICF

An integrated catalog facility has two components, a VSAM volume data set (VVDS) and a basic catalog structure (BCS). These components are described in the following paragraphs.

Basic catalog structure (BCS)

The basic catalog structure is a VSAM key-sequenced data set. It uses the data set name as a key to store and retrieve data set information. For VSAM data sets, the BCS contains volume, security, ownership, and association information. For non-VSAM data sets, the BCS contains volume ownership and association information. In other words, the BCS portion of the ICF catalog contains the *static* information about the data set, the information that changes very seldom.

For non-VSAM data sets that are not SMS-managed, all catalog information is contained within the BCS. For the other types of data sets, there is other information available in the VVDS.

Related information in the BCS is grouped into logical, variable-length, spanned records related by key. The BCS uses keys that are the data set names (plus one character for extensions). A control interval can contain multiple BCS records. To reduce the number of I/Os necessary for catalog processing, logically-related data is consolidated in the BCS.

VSAM volume data set (VVDS)

The VVDS is a VSAM entry-sequenced data set (ESDS) that has a 4 KB control interval size. It contains additional catalog information (not contained in the BCS) about the VSAM and SMS-managed non-VSAM data sets residing on the volume where the VVDS is located. Every volume containing any VSAM or any SMS-managed data sets *must* have a VVDS in it. In a sense, we can say that the VVDS is a sort for VTOC extension for certain types of data sets. A VVDS may have data set information about data sets cataloged in distinct BCSs.

A VVDS contains the data set characteristics, extent information, and the volume-related information for the VSAM data sets cataloged in the BCS. If you are using the storage management subsystem (SMS), the VVDS also contains data set characteristics and volume-related information for the non-VSAM, SMS-managed data sets on the volume. As you can see, the type of information retained in VVDS is more frequently modified or more *volatile* than that in the BCS.

A VVDS is recognized by the restricted data set name SYS1.VVDS.V*volser*, where *volser* is the volume serial number of the volume on which the VVDS resides.

You can explicitly (via IDCAMS) define the VVDS, or it is implicitly created after you define the first VSAM data set in the volume or the first non-VSAM SMS-managed data set.

An explicitly defined VVDS is not related to any BCS until a data set or VSAM object is defined on the volume. As data sets are allocated on the VVDS volume, each BCS with VSAM or SMS-managed data sets residing on that volume is related to the VVDS. An explicit definition of a VVDS does not update any BCS and, therefore, can be performed before the first BCS in the installation is defined. Explicitly defining a VVDS is usually appropriate when you are initializing a new volume. If you are not running SMS, and a volume already contains some non-VSAM data sets, it is appropriate to allow the VVDS to be defined implicitly with the default space allocation of TRACKS(10 10).

The VVDS is composed of a minimum of two records:

- A VSAM volume control record (VVCR)
- A VVDS self-describing volume record

The first logical record in a VVDS is the VSAM volume control record (VVCR). It contains information for management of DASD space and the BCS names which currently have cataloged VSAM or SMS-managed non-VSAM data sets on the volume. It might have a pointer to an overflow VVCR.

The second logical record in the VVDS is the VVDS self-describing VVR (VSAM volume record). This self-describing VVR contains information that describes the VVDS.

The remaining logical records in the VVDS are VVRs for VSAM objects or non-VSAM volume records (NVRs) for SMS-managed non-VSAM data sets. The hexadecimal RBA of the record is used as its key or identifier.

VSAM volume records (VVR)

VSAM volume records contain information about the VSAM data sets residing on the volume with the VVDS. The number of VVRs for VSAM data sets varies according to the type of data set and the options specified for the data set.

Non-VSAM volume record (NVR)

The non-VSAM volume record (NVR) is equivalent to a VVR record, but the NVR record is for SMS-managed non-VSAM data sets. The NVR contains SMS-related information.

5.3 The master catalog

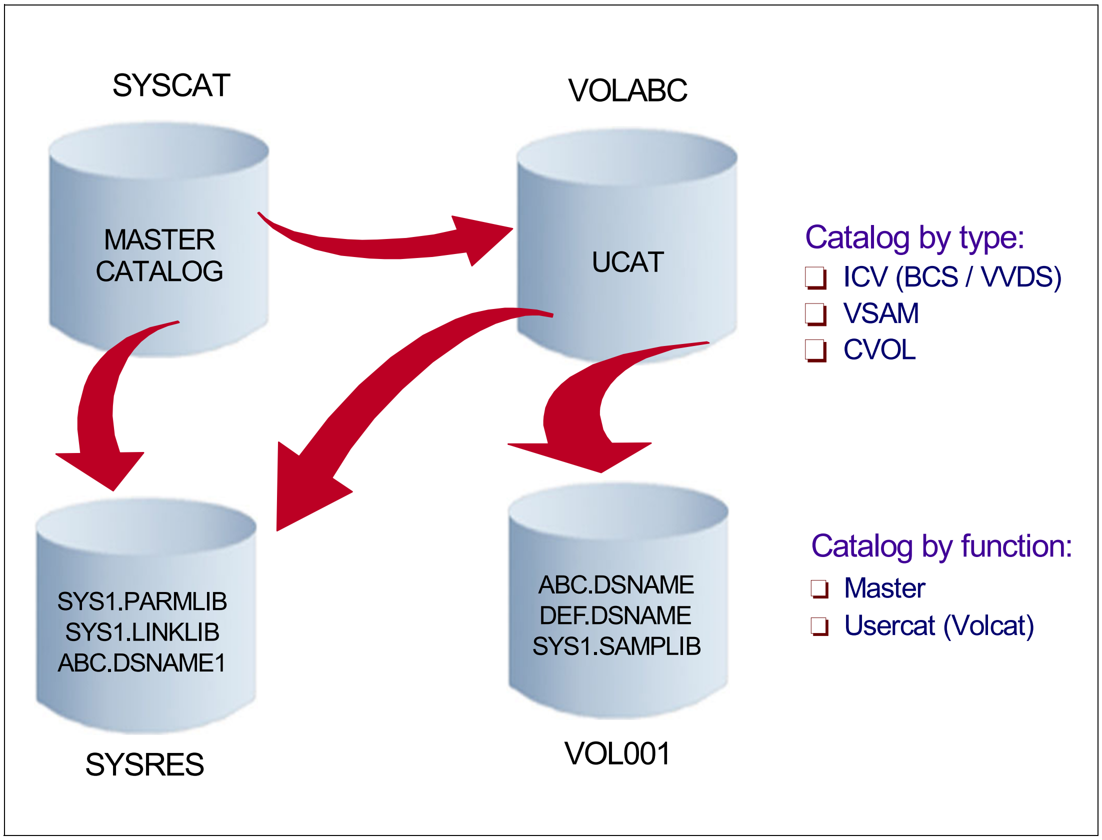


Figure 5-3 The master catalog

Catalogs by function

By function, the catalogs can be classified as Mastercat (master catalog) and Usercats (user catalogs). A particular case of Usercat is the Volcat, which is a Usercat containing only tape library and tape volume entries.

There is no structural difference between a Mastercat and a Usercat. What makes a Mastercat different is how it is used, and what data sets are cataloged in it.

Master catalog

Each system has one active Mastercat. The Mastercat does not have to reside on the system residence volume. For performance, recovery, and reliability, we recommend that you only use integrated catalog facility catalogs. Also, a Mastercat can be shared between different MVS images.

The Mastercat for a system must contain entries for all Usercats (and their aliases) that the system uses. The only other data sets you should catalog in the Mastercat are the system, or *SYS1* data sets. These data sets must be cataloged in the Mastercat for proper system initialization.

The Mastercat at system initialization

During a system initialization, the Mastercat is read so that system data sets and Usercats can be located. Their catalog entries are placed in the in-storage catalog cache as they are read.

Catalog aliases are also read during system initialization, but they are placed in an alias table separate from the in-storage catalog. The concept of aliases is covered in “Using aliases” on page 294.

Thus, if the Mastercat only contains entries for system data sets, catalogs, and catalog aliases, the entire Mastercat is in main storage by the completion of the system initialization.

Identifying the Mastercat

At IPL, you must indicate the location (Volser and data set name) of the Mastercat. This can be done by:

- SYSCATxx member of SYS1.NUCLEUS data set or the default member name that is SYSCATLG (also in SYS1.NUCLEUS).
- LOADxx member of SYS1.PARMLIB / SYS1.IPLPARM. We recommend this method.

5.4 Identifying the Mastercat

```
  Menu  Options  View  Utilities  Compilers  Help
------------------------------------------------------------------
DSLIST - Data Sets Matching SYS1.PARMLIB
Command ===>

Command - Enter "/" to select action                     Message
------------------------------------------------------------------
listc ent(/)1.PARMLIB                                   LISTC RC=00
         SYS1.PARMLIB.AOC
         SYS1.PARMLIB.BACKUP
         SYS1.PARMLIB.CB
         SYS1.PARMLIB.INSTALL
         SYS1.PARMLIB.NEW
         SYS1.PARMLIB.OLD
         SYS1.PARMLIB.PD
         SYS1.PARMLIB.POK
         SYS1.PARMLIB.SAPRES
***************************** End of Data Set list ***************

NONVSAM ------- SYS1.PARMLIB
     IN-CAT --- MCAT.OS3R5V01.VTOTCAT
***
```

Figure 5-4 Identifying the Mastercat

Identifying the Mastercat

The **LISTCAT** command lists each catalog entry with the generic name GENERIC.*.BAKER, where * is any 1- to 8-character simple name. The parameters are:

ENTRIES Specifies the entryname of the object to be listed. Because GENERIC.*.BAKER is a generic name, more than one entry can be listed.

An easy way to identify the Mastercat (after definition) is via ISPF 3.4. Type `SYS1.PARMLIB` and when the SYS1.PARMLIB data sets are listed, beside the SYS1.PARMLIB name type `LISTC ENT(/)`, as shown in Figure 5-4.

Note: The / specifies to use the data set name on the line where the command is entered.

The response to the command is shown at the bottom of the figure, as follows:

```
NONVSAM ------- SYS1.PARMLIB
     IN-CAT --- MCAT.OS3R5V01.VTOTCAT
```

5.5 Using aliases

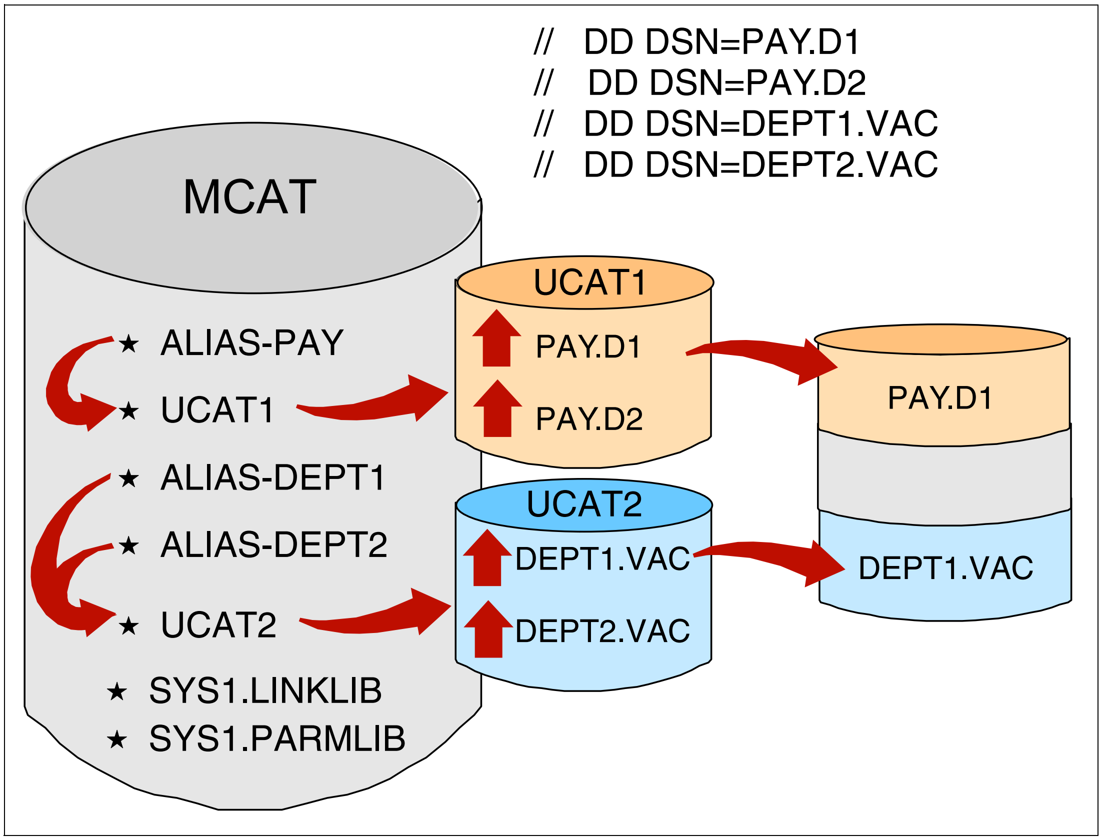


Figure 5-5 The ICF Usercat

Usercats

An ICF Usercat has the same structure as an ICF Mastercat. The difference is in the Usercat *function*. Mastercat should be used to contain information about system data sets (SYS1.) and pointers to Usercats. Usercats should be used to contain information about your installation cataloged data sets. This is implemented through the alias concept.

Using aliases

Aliases are used to tell catalog management which Usercat your data set is cataloged in. You define an appropriate alias name for a Usercat in the Mastercat. Next, match the highest-level qualifier (HLQ) of your data set with the alias. This identifies the appropriate Usercat to be used to satisfy the request.

In Figure 5-5, all data sets with an HLQ of PAY have their information in the Usercat UCAT1 because in the Mastercat there is an alias PAY pointing to UCAT1. The ones with DEPT1 and DEPT2 have their information in the Usercat UCAT2 because in the Mastercat there are aliases DEPT1 and DEPT2 pointing to UCAT2.

Note that aliases can also be used with non-VSAM data sets in order to create alternate names to the same data set.

5.6 Catalog search order

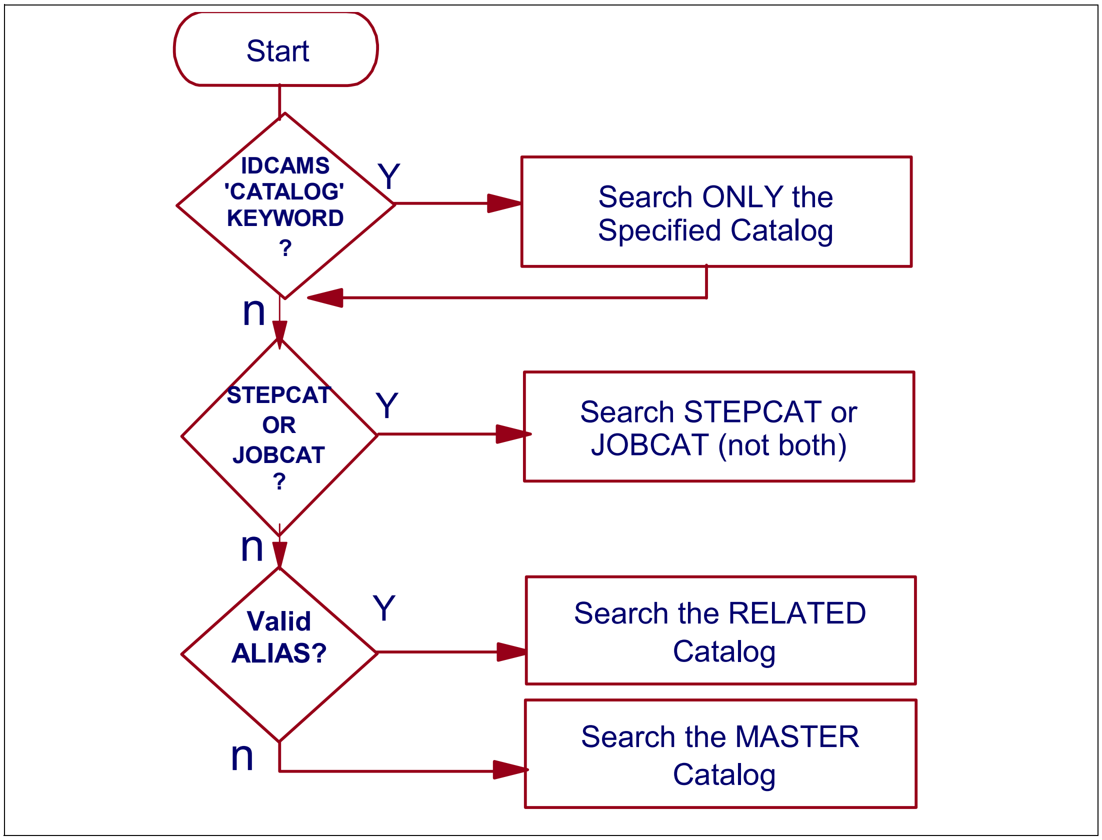


Figure 5-6 Catalog search order

Catalog search order

Most catalog searches should be based on catalog aliases. Some alternatives to catalog aliases are available for directing a catalog request, specifically the JOBCAT and STEPCAT DD statements, the CATALOG parameter of access method services, and the name of the catalog.

Search order for catalogs

For the system to determine where a data set is to be cataloged, the following search order is used to find the catalog:

1. If the IDCAMS Define (creation and cataloging) statement is used and the CATALOG parameter "Direct the search to a specific catalog" is indicated, then use this catalog that is referred to.
2. Otherwise, use the catalog named in the STEPCAT DD statement.
3. If no STEPCAT, use the catalog named in the JOBCAT DD statement.
4. If no JOBCAT, and the HLQ is a catalog alias, use the catalog identified by the alias or the catalog whose name is the same as the HLQ of the data set.
5. If no catalog has been identified yet, use the Mastercat.

Search order for locating

The following search order is used to locate the catalog for an already-cataloged data set:

1. If at any IDCAMS invocation there is a need to locate a data set and the CATALOG parameter “Direct the search to an specific catalog” is indicated, use the catalog that is referred to. If the data set is not found, fail the job.
2. Otherwise, search all catalogs specified in a STEPCAT DD statement in order.
3. If not found, search all catalogs specified in a JOBCAT DD statement in order.
4. If not found, and the HLQ is an alias for a catalog, search the catalog; or if the HLQ is the name of a catalog, search the catalog. If the data set is not found, fail the job.
5. Otherwise, search the Mastercat

Note: For SMS-managed data sets, JOBCAT and STEPCAT DD statements are not allowed and cause a job failure. Also, they are not recommended even for non-SMS data sets. So, do not use them.

To use an alias to identify the catalog to be searched, the data set or object name, or the generation data group base name, must be a qualified name.

When you specify a catalog in the IDCAMS CATALOG parameter, and you have appropriate RACF authority to the FACILITY class profile STGADMIN.IGG.DIRCAT, the catalog you specify is used. For instance:

```
DEFINE CLUSTER (NAME(PROD.PAYROLL) CATALOG(SYS1.MASTER.ICFCAT))
```

defines a data set PROD.PAYROLL to be cataloged in SYS1.MASTER.ICFCAT.

You can use RACF to prevent the use of the CATALOG parameter and restrict the ability to define data sets in the Mastercat.

5.7 Access Method Services

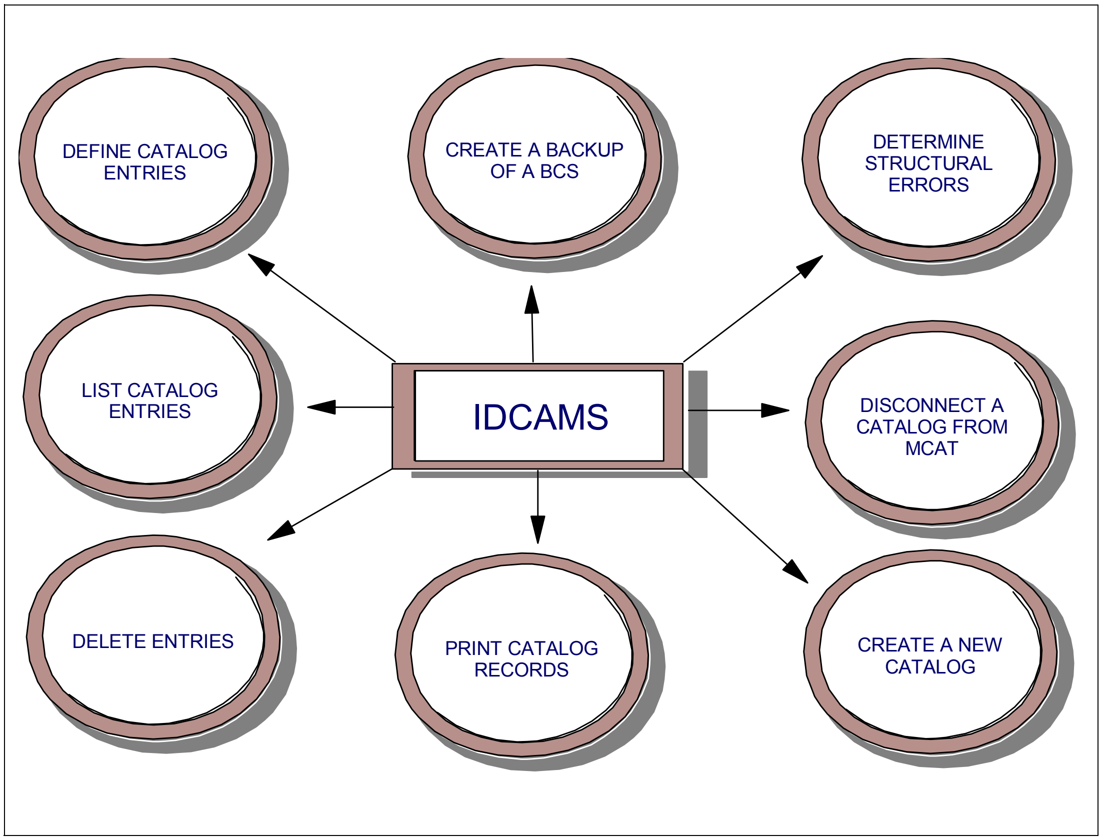


Figure 5-7 Access Method Services

Access Method Services (AMS)

You use Access Method Services to define and maintain catalogs. Access Method Services commands can also be used to define and maintain VSAM and non-VSAM data sets. For a complete explanation of the usage of access method services, the required JCL, and examples, see *z/OS DFSMS Access Method Services for Catalogs*, SC26-7394.

The following note lists some Access Method Services commands that can be used with catalogs.

Note:

1. The access method services **ALTER**, **CREATE**, and **DELETE** commands should only be used to recover from tape volume catalog errors. Since access method services cannot change the library manager inventory in an automated tape library, ISMF should be used for normal tape library **ALTER**, **CREATE**, and **DELETE** functions.
2. **DIAGNOSE** recognizes tape library and tape volume record types. It checks the cell structure of the volume catalog.

5.8 Creating a basic catalog structure (BCS)

```
//DEFCAT JOB....
//DEFCAT EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=A
//SYSIN DD *
     DEFINE USERCATALOG          -
      (NAME(SYS1.ICFCAT)         -
     MEGABYTES( 15 15)           -
     VOLUME(FERNAN)              -
     ICFCATALOG                  -
     FREESPACE(10 10)            -
     STRNO(3)                    -
     IMBED                       -
     REPLICATE  )                -
     DATA( CISIZE(4096)          -
     BUFND(4)   )                -
     INDEX( BUFNI(4)    )
```

Figure 5-8 JCL to create a basic catalog structure

Use the access method services `DEFINE USERCATALOG ICFCATALOG` command to define the basic catalog structure of an ICF catalog. Figure 5-8 shows an example of using this command.

Use the access method services `DEFINE USERCATALOG VOLCATALOG` to define a catalog that only contains tape library and tape volume entries. See *z/OS DFSMS Access Method Services for Catalogs*, SC26-7394, for more detail.

5.9 Defining a BCS with a model

```
//DEFCAT4   JOB     ...
//STEP1     EXEC    PGM=IDCAMS
//SYSPRINT DD       SYSOUT=A
//SYSIN     DD      *
     DEFINE USERCATALOG( -
            NAME(RSTUCAT2)  -
            VOLUME(VSER03)  -
            MODEL(USERCAT4  -
              USERCAT4)   ) -
          CATALOG(AMAST1)
/*
```

Figure 5-9 Defining a basic catalog structure with a model

When you define a BCS or VVDS, you can use an existing BCS or VVDS as a model for the new one. The attributes of the existing data set are copied to the newly defined data set unless you explicitly specify a different value for an attribute. You can override any of a model's attributes.

If you do not want to change or add any attributes, you need only supply the entry name of the object being defined and the MODEL parameter. When you define a BCS, you must also specify the volume and space information for the BCS.

There is an example of that in Figure 5-9, where:

NAME Specifies the name of the catalog to be defined as RSTUCAT2.

VOLUME Specifies that the catalog is to reside on volume VSER03. Volume VSER03 is dynamically allocated.

MODEL Identifies USERCAT4 as the catalog to use as a model for RSTUCAT2. The attributes and specifications of USERCAT4 that are not otherwise specified with the shown parameters are used to define the attributes and specifications of RSTUCAT2. The master catalog, AMAST1, contains a user-catalog connector entry that points to USERCAT4. This is why USERCAT4 is specified as MODEL's catname subparameter. Values and attributes that apply to RSTUCAT2 as a result of using USERCAT4 as a model are:

- FOR = 365 days (retention period)
- CYLINDERS = 3 (primary) and 2 (secondary) are allocated to the catalog

- BUFFERSPACE = 3072 bytes
- ATTEMPTS = 2
- NOWRITECHECK
- CODE is null
- AUTHORIZATION is null
- OWNER is null

Because catalogs contain their own entries, you must specify the name of the catalog twice in the MODEL parameter.

5.10 Defining aliases

```
//DEFALIAS JOB MSGCLASS=X,NOTIFY=FPITA
//ALIAS     EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=A
//SYSIN     DD *
       DEFINE ALIAS -
              (NAME(FPITA)      -
              RELATE(SYS1.ICFCAT.UCAT))

       DEFINE ALIAS -
              (NAME(VERA)      -
              RELATE(SYS1.ICFCAT.UCAT))
   /*
```

Figure 5-10 JCL to define aliases

To use a catalog, the system must be able to determine which data sets should be defined in that catalog. The simplest way to accomplish this is to define aliases in Mastercat for the catalog–if it is a Usercat. Before defining an alias, carefully consider the effect the new alias has on old data sets. A poorly chosen alias could make some data sets inaccessible.

You can define aliases for the Usercat in the same job in which you define the catalog by including **DEFINE ALIAS** commands after the `DEFINE USERCATALOG` command. You can use conditional operators to ensure the aliases are only defined if the catalog is successfully defined. After the catalog is defined, you can add new aliases or delete old aliases.

Catalog aliases are defined only in the Mastercat, which contains an entry for the user catalog. The number of aliases a catalog can have is limited by the maximum record size for the Mastercat. If the Mastercat is defined with the default record sizes, there is a practical maximum of 3000 aliases per catalog, assuming the aliases are only for HLQs. If you use multilevel aliases, fewer aliases per catalog can be defined.

You cannot define an alias if a data set cataloged in the Mastercat has the same high-level qualifier as the alias. The **DEFINE ALIAS** command fails with a `"Duplicate data set name"` error. For example, if a catalog is named TESTE.TESTSYS.ICFCAT, you cannot define the alias TESTE for any catalog.

Figure 5-10 shows a DEFINE ALIAS job.

5.11 Deleting a data set

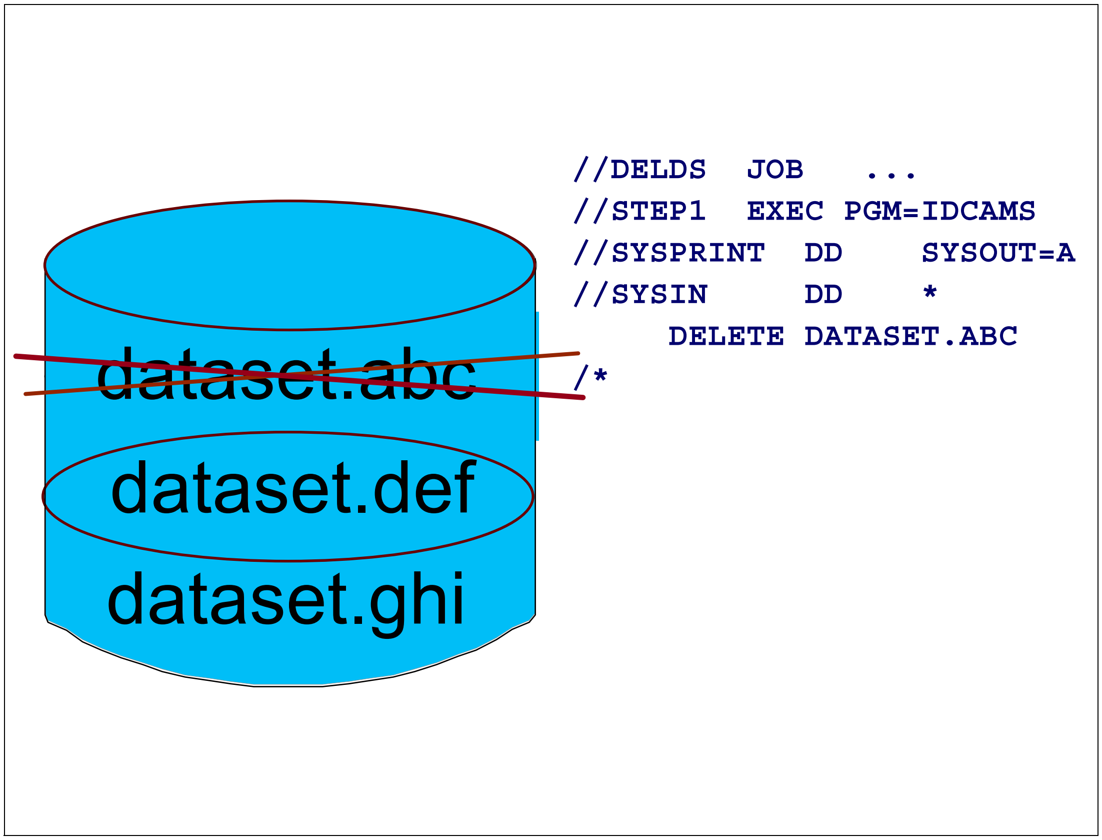


Figure 5-11 Deleting a data set

Deleting data entities

Sometimes in your installation you need to delete an alias, delete only a catalog entry, or you may have garbage in your DASD and need to delete a VSAM/non-VSAM data set that is not cataloged anymore. The next few topics will describe some of these situations and show you how to handle them.

To delete a data set (uncatalog and scratch from VTOC) that is cataloged and is in DASD, you can simply issue a command **DELETE** in ISPF 3.4 in front of its name, issue the **DELETE dsname** in ISPF option 6 (commands), or submit a batch IDCAMS job to delete it, as shown in Figure 5-11.

Aliases

To simply delete an alias, use the IDCAMS **DELETE ALIAS** command, specifying the alias you are deleting.

To delete all the aliases for a catalog, use **EXPORT DISCONNECT** to disconnect the catalog. The aliases are deleted when the catalog is disconnected. When you again connect the catalog (using **IMPORT CONNECT**) the aliases remain deleted.

Deleting the catalog entry

To only delete a catalog entry you can the use the **DELETE NOSCRATCH** command; the VVDS and VTOC entry are not deleted. The entry deleted can be reinstated with the **DEFINE RECATALOG** command as follows:

```
 //DELNOSCR  JOB   ...
    //STEP1     EXEC  PGM=IDCAMS
    //SYSPRINT  DD    SYSOUT=A
    //SYSIN     DD    *
         DELETE VERA.DATASET NOSCR
/*
```

VVR and NVR records

When the catalog entry is missing, and the data set remains in the DASD, you can use the **DELETE VVR** for VSAM data sets and **DELETE NVR** for non-VSAM SMS-managed data sets as follows:

```
//DELGDG   JOB   ...
     //STEP1     EXEC  PGM=IDCAMS
     //DD1       UNIT=3390,VOL=SER=FERNAN
     //SYSPRINT  DD  SYSOUT=A
                DELETE  -
                VERA.LUZ.VSAM.INDEX -
                FILDE(DD1) -
                VVR
```

Caution: When deleting VSAM KSDS, you must issue a `DELETE VVR` for each of the components, the DATA, and the INDEX.

Generation data group (GDG)

In this example, a generation data group base catalog entry, GDGBASE is deleted from the catalog. The generation data sets associated with GDGBASE remain unaffected in the VTOC, as shown in the following JCL:

```
//DELGDG   JOB   ...
//STEP1     EXEC  PGM=IDCAMS
//SYSPRINT  DD    SYSOUT=A
           DELETE -
               GDGBASE -
               GENERATIONDATAGROUP -
               RECOVERY
```

The **DELETE** command removes the GDG base catalog entry from the catalog. Its parameters are:

GDGBASE GDGBASE is the name of the GDG base entry.

GENERATIONDATAGROUP GENERATIONDATAGROUP specifies the type of entry being deleted. VSAM verifies that GDGBSE is a GDG entry, then deletes it. If GDGBASE is not a GDG entry, VSAM issues a message and does not delete it.

RECOVERY RECOVERY specifies that only the GDG base entry name in the catalog is to be deleted. Its associated generation data sets remain intact in the VTOC.

Delete an ICF

When deleting an ICF, you must take care to specify whether you want to delete only the catalog, or if you want to delete all associated data. The following examples show how to delete a catalog.

Delete with recovery

In this example, a user catalog is deleted in preparation for replacing it with an imported backup copy. The VVDS and VTOC entries for objects defined in the catalog are not deleted and the data sets are not scratched, as shown in the following JCL:

```
//DELICF     JOB   ...
//STEP1     EXEC  PGM=IDCAMS
//DD1       DD    VOL=SER=CACSW3,UNIT=3380,DISP=OLD
//SYSPRINT  DD    SYSOUT=A
//SYSIN     DD    *
         DELETE -
                USERCAT -
                FILE(DD1) -
                RECOVERY -
                USERCATALOG
/*
```

RECOVERY: Specifies that only the catalog data set is deleted, without deleting the objects defined in the catalog.

Delete an empty user catalog

In the following example, a user catalog is deleted. A user catalog can be deleted when it is empty; that is, when there are no objects cataloged in it other than the catalog's volume. If the catalog is not empty, it cannot be deleted unless the FORCE parameter is specified.

```
//DELICF   JOB   ...
//STEP1    EXEC  PGM=IDCAMS
//SYSPRINT DD    SYSOUT=A
//SYSIN    DD    *
           DELETE -
                 CATALOG.ICF.UCAT -
                 PURGE -
                 USERCATALOG
/*
```

Attention: The FORCE parameter deletes all clusters in the catalog.The `DELETE` command deletes both the catalog and the catalog's user catalog connector entry in the Mastercat.

For more information about the `DELETE` command, refer to *z/OS DFSMS Access Method Services for Catalogs*, SC26-7394.

Delete a migrated data set

A migrated data set is a data set moved by DFSMShsm™ to a cheaper storage device to make room in your primary DASD farm. MVS recognizes that a data set is migrated by the MIGRAT word in its catalog entry.

When you need to delete a data set with MIGRAT status in the catalog, but the data set is not referenced in the HSM control data sets, you should execute a **DELETE NOSCRATCH** command again for this data set.

To execute the **DELETE** command against a migrated data set, you must have a RACF group ARCCATGP defined, and logon in TSO using this group.

For further information about ARCCATGP group, refer to *z/OS DFSMShsm Implementation and Customization Guide*, SC35-0418.

5.12 Listing a catalog

```
 LISTC CAT(CATALOG.O36ICFM.VO36CAT)
IDCAMS  SYSTEM SERVICES
TIME: 16:00:25
                             LISTING FROM CATALOG --
CATALOG.O36ICFM.VO36CAT
CLUSTER ------- 0000000000000000000000000000000000000000000
   DATA ------- CATALOG.O36ICFM.VO36CAT
   INDEX ------ CATALOG.O36ICFM.VO36CAT.CATINDEX
ALIAS --------- ADSM
ALIAS --------- AFP
NONVSAM ------- ANF.AANFEXEC
NONVSAM ------- ANF.AANFLOAD
NONVSAM ------- ANF.AANFMAC
NONVSAM ------- ANF.AANFMLIB
NONVSAM ------- ANF.AANFPLIB
NONVSAM ------- ANF.SANFPLIB
....
ALIAS --------- VSAPL
ALIAS --------- VSF2
ALIAS --------- VSPASCAL
         THE NUMBER OF ENTRIES PROCESSED WAS:
                   AIX -------------------0
                   ALIAS --------------1589
                   CLUSTER ---------------2
                   DATA ------------------2
                   GDG -------------------0
                   INDEX -----------------1
                      NONVSAM ------------1539
                   PAGESPACE -------------0
                   PATH ------------------0
                   SPACE -----------------0
                   USERCATALOG -----------1
                   TAPELIBRARY -----------0
                   TAPEVOLUME ------------0
                   TOTAL --------------3134
         THE NUMBER OF PROTECTED ENTRIES SUPPRESSED WAS 0
IDC0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
IDCAMS  SYSTEM SERVICES
TIME: 16:00:25
```

Figure 5-12 Listing a catalog

Requesting information from a catalog

You can list catalog records using the access method services **LISTCAT** command, or the ISMF line operator command **CATLIST**. **CATLIST** produces the same output as **LISTCAT**.

You can use the **LISTCAT** output to monitor VSAM data sets. The statistics and attributes listed can be used to help determine if you should reorganize, recreate, or otherwise alter a VSAM data set to improve performance or avoid problems.

Figure 5-12 shows one example of such a listing.

LISTCAT examples

You can use **LISTCAT** to list the aliases associated with a catalog. Specify ALL with the catalog name in the ENTRIES parameter as shown in the following JCL:

```
//ALIAS    EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=A
//SYSIN    DD *
        LISTCAT ALL ENTRIES(SYS1.UCAT.VVOLUME)
/*
```

You can use **LISTCAT** to list all USERCATALOGs connected to a Master catalog, as shown in the following JCL:

```
//LISTUCAT EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=A
//SYSIN    DD *
        LISTCAT CAT(MCAT.SYSCATLG) USERCATALOG)
/*
```

The following JCL shows an example of listing all information from a catalog:

```
//LISTCAT  EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=A
//SYSIN    DD *
       LISTCAT CAT(CATALOG.ICF.VERALS)
/*
```

For more information about **LISTCAT**, see *z/OS DFSMS Access Method Services for Catalogs*, SC26-7394; for details on using **CATLIST** see *z/OS DFSMS: Using the Interactive Storage Management Facility*, SC26-7411.

Printing contents of a CATALOG and VVDS

You can print the contents of a BCS or VVDS with the **PRINT** command, but the only circumstance where it might be useful is when you need to determine which catalogs are connected to a VVDS. This might be necessary to determine which BCSs to specify in a **DIAGNOSE** command, or when you are recovering a volume.

The following JCL shows an example of a VVDS print:

```
//PRNTVVDS EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=A
//VVDS     DD DSN=SYS1.VVDS.VSPOOL1,DISP=SHR,
//            UNIT=SYSDA,VOL=SER=SPOOL1,AMP=AMORG
//SYSIN    DD *
         PRINT INFILE(VVDS) COUNT(1)
/*
```

5.13 Catalog address space (CAS)

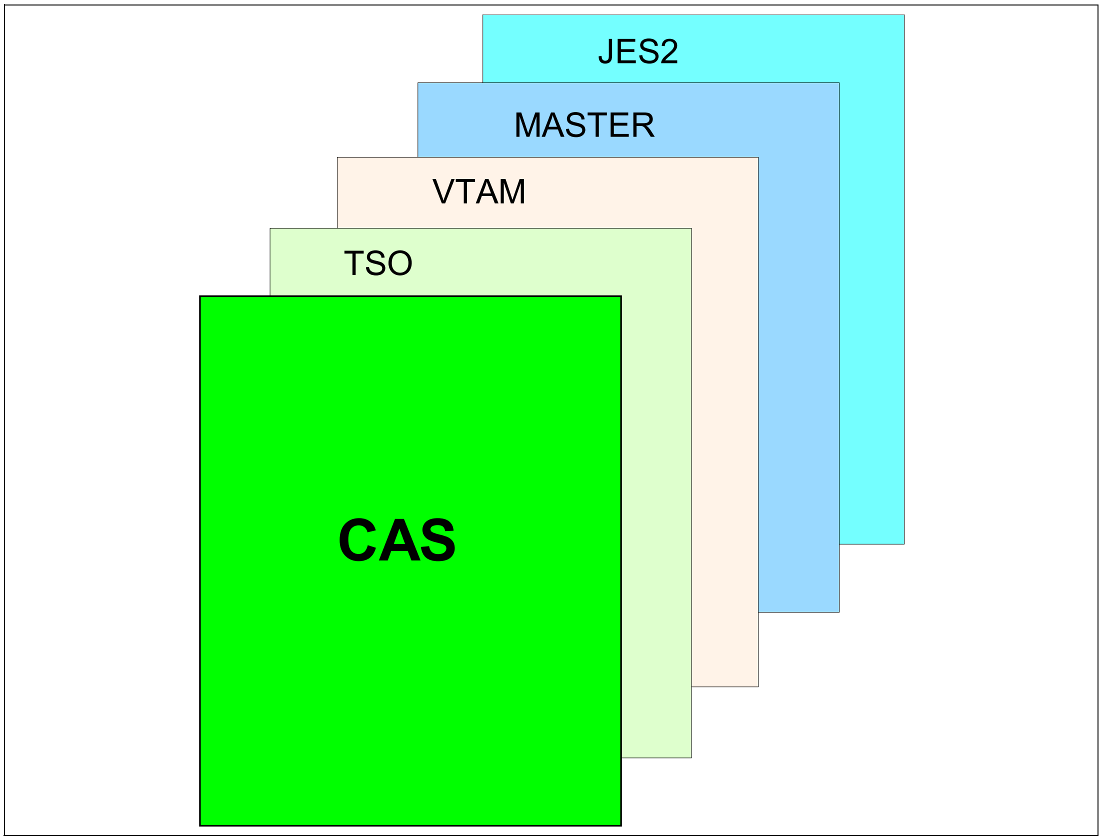


Figure 5-13 Catalog address space (CAS)

The catalog address space

Catalog functions are performed in the *catalog address space* (CAS). Most catalog modules and control blocks are located in the catalog address space above the 16 MB virtual line. This reduces the required virtual storage in a user's private area needed to perform catalog functions.

During the initialization of an MVS system, all user catalog names identified in the Mastercat, their aliases, and their associated volume serial numbers are placed in tables in CAS. The number of lower limit CAS service tasks specified in the SYSCATxx member of SYS1.NUCLEUS (or the LOADxx member of SYS1.PARMLIB) is also created, and a table called the CRT keeps track of these service tasks. This number controls the multitask level within the CAS. The default value is X'3C'.

If you intend to use VLF as a cache for catalog records, the general recommendation is to use VLF for Usercats and CAS for Mastercat.

Changes to the Mastercat are automatically reflected in the CAS tables. The information in the Mastercat is normally the same as the information in CAS. For shared catalogs, the CASs on all the sharing systems are updated, maintaining data integrity for your systems.

Restarting the catalog address space

Restarting the CAS should be considered only as a final option before IPLing a system. Never try restarting CAS unless an IPL is your only other option. A system failure caused by catalogs, or a CAS storage shortage due to FREEMAIN failures, might require you to use `MODIFY CATALOG,RESTART` to restart CAS in a new address space.

Never use `RESTART` to refresh catalog or VVDS control blocks or to change catalog characteristics. Restarting CAS is a drastic procedure, and if CAS cannot restart, you will have to IPL the system.

Note: It is possible that a catalog request, currently being processed, cannot be properly retried after being interrupted by these commands. Use these commands when all other means of correcting an ongoing catalog error have failed.

When you issue `MODIFY CATALOG,RESTART`, the CAS mother task is ABENDed with ABEND code 81A, and any catalog requests in process at the time are redriven.

The restart of CAS in a new address space should be transparent to all users. However, even when all requests are redriven successfully and receive a return code of zero, the system might produce indicative dumps on the console, the system log, and on user job logs. There is no way to suppress these indicative dumps.

5.14 Backup procedures

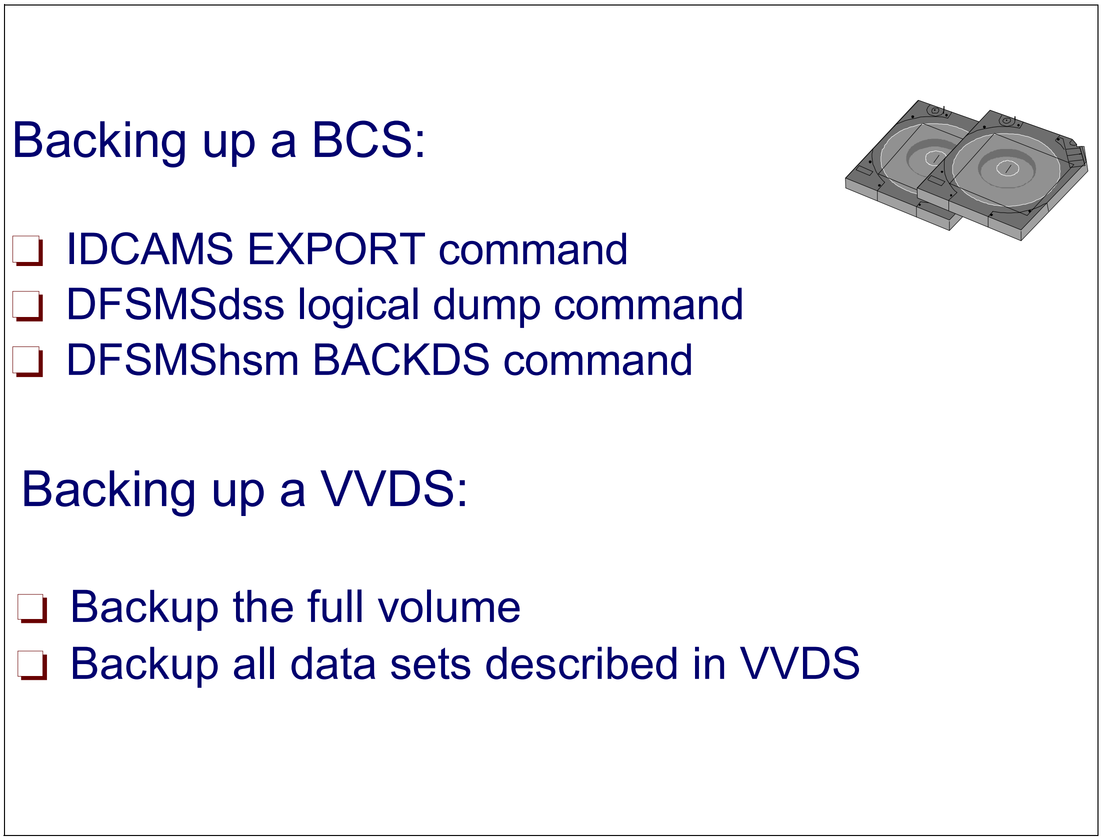


Figure 5-14 Backup procedures for catalogs

The two parts of an ICF catalog, the BCS and the VVDS, require different backup techniques: the BCS can be backed up like any other data set, whereas the VVDS can only be backed up as part of a volume dump. The entries in the VVDS and VTOC are backed up when the data sets they describe are exported with access method services, logically dumped with DFSMSdss, or backed up with DFSMShsm.

Backing up a BCS (Mastercat or Usercat)

You can use the access method services **EXPORT** command, the DFSMSdss logical **DUMP** command, or the DFSMShsm **BACKDS** command to back up a BCS. You can later recover the backup copies using the same utility used to create the backup; the access method services **IMPORT** command for exported copies; the DFSMSdss **RESTORE** command for logical dump copies; and the DFSMShsm **RECOVER** command for DFSMShsm backups.

The copy created by these utilities is a *portable* sequential data set that can be stored on a tape or direct access device, which can be of a different device type than the one containing the source catalog.

When these commands are used to back up a BCS, the aliases of the catalog are saved in the backup copy. The source catalog is not deleted, and remains as a fully functional catalog. The relationships between the BCS and VVDSs are unchanged.

You cannot permanently export a catalog by using the PERMANENT parameter of **EXPORT**. The TEMPORARY option is used even if you specify PERMANENT or allow it to default. PERMANENT specifies that the cluster or alternate index is to be deleted from the original system and its storage space is freed. If its retention period has not yet expired, you must also code PURGE.

Note: You cannot use `IDCAMS REPRO` or other copying commands to create and recover BCS backups.

Backing up a VVDS

The VVDS should not be backed up as a data set to provide for recovery. To back up the VVDS, back up the volume containing the VVDS, or back up all data sets described in the VVDS (all VSAM and SMS-managed data sets). If the VVDS ever needs to be recovered, recover the entire volume, or all the data sets described in the VVDS.

You can use either DFSMSdss or DFSMShsm to back up and recover a volume or individual data sets on the volume.

Backing up a Mastercat

A Mastercat can be backed up like any other BCS. You should use `EXPORT`, DFSMSdss, or DFSMShsm for the backup. Another way to provide a backup for the Mastercat is to create an alternate Mastercat. For information on defining and using an alternate Mastercat, see *z/OS DFSMS: Managing Catalogs*, SC26-7409.

You should also make periodic volume dumps of the Mastercat's volume. This dump can later be used by the stand-alone version of DFSMSdss to restore the Mastercat if you cannot access the volume from another system.

5.15 Recovery procedures

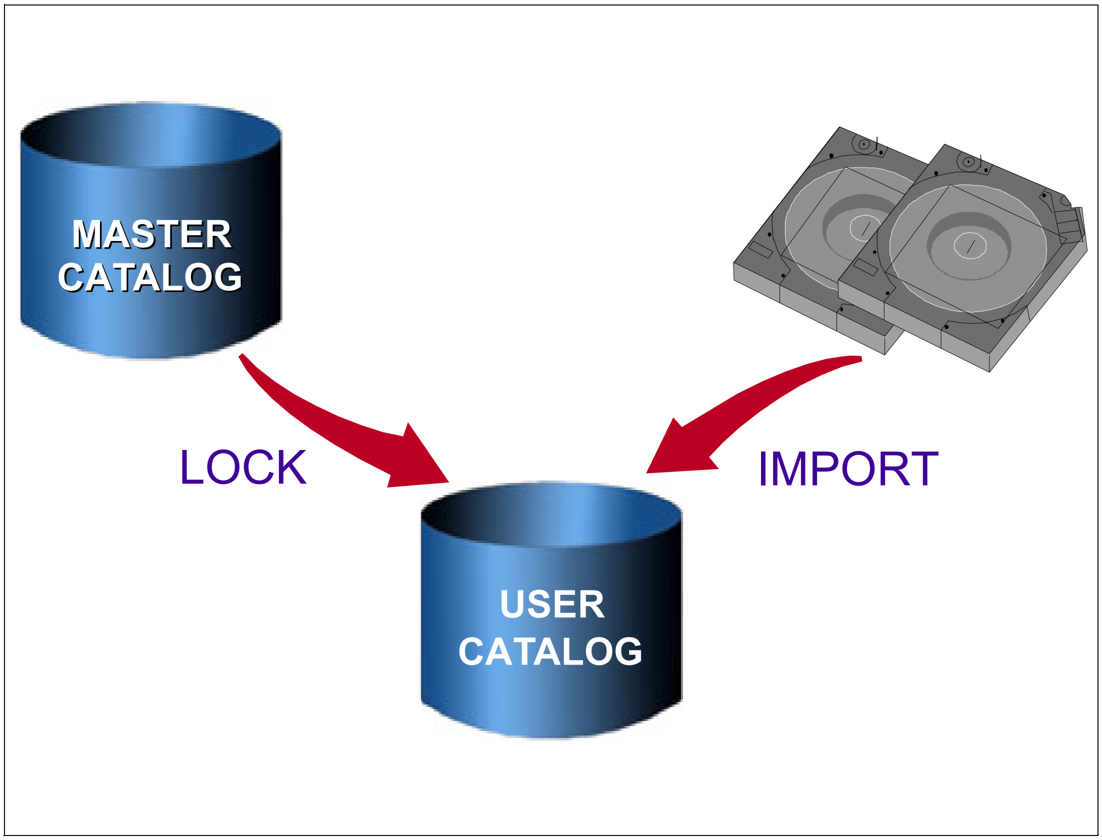


Figure 5-15 Recovery procedures

Normally, a BCS is recovered separately from a VVDS. A VVDS usually does not need to be recovered, even if an associated BCS is recovered. However, if you need to recover a VVDS, and a BCS resides on the VVDS's volume, you must recover the BCS as well. If possible, you should export the BCS before recovering the volume, and then recover the BCS from the exported copy. This ensures a current BCS.

Before recovering a BCS or VVDS, try to recover damaged records. If damaged records can be rebuilt, you can avoid a full recovery. BCS records can be recovered using the access method services **DELETE** and **DEFINE** commands with appropriate parameters. VVDS and VTOC records can be recovered using the **DELETE** command and by recovering the data sets on the volume.

You can recover a BCS that was backed up with the access method services **EXPORT** command, the DFSMSdss logical **DUMP** command, or the DFSMShsm **BACKDS** command or automatic backup. To recover the BCS, use the **IDCAMS IMPORT** command, the DFSMSdss **RESTORE** command, or the DFSMShsm **RECOVER** command.

When you recover a BCS using these commands, you do not need to delete and redefine the target catalog unless you want to change the catalog's size or other characteristics, or unless the BCS is damaged in such a way as to prevent the usual recovery. The recovered catalog is reorganized when you use **IMPORT** or **RECOVER**, but not when you use **RESTORE**.

Aliases to the catalog can be defined if you use DFSMSdss, DFSMShsm, or if you specify ALIAS on the **IMPORT** command. If you have not deleted and redefined the catalog, all existing aliases are maintained, and any aliases defined in the backup copy are redefined if they are not already defined.

Lock the BCS before you try to recover a BCS. After you recover the catalog, update the BCS with any changes which have occurred since the last backup You can use the access method services **DIAGNOSE** command to identify certain unsynchronized entries.

We recommend that you restrict access to a catalog when you are recovering it or when you are performing other maintenance procedures which involve redefining the catalog. If you do not restrict access to the catalog (by locking it, by terminating user sessions, or by another method), users might be able to update the catalog during recovery or maintenance and create a data integrity exposure. Locking the catalog eliminates the need to terminate user sessions during catalog recovery or maintenance.

In addition, you can only lock integrated user catalogs. You cannot lock a master catalog. While the catalog is locked, unauthorized requests to access the catalog fail with a return code indicating that the catalog is temporarily unavailable. Jobs entered with JCL fail with a JCL error. You cannot make JCL jobs wait until the catalog is unlocked. The catalog is also unavailable to any system that shares the catalog.

You can also use the Integrated Catalog Forward Recovery Utility (ICFRU) to recover a damaged catalog to a correct and current status. This utility uses system management facilities (SMF) records that record changes to the catalog, updating the catalog with changes made since the BCS was backed up. ICFRU can also be used with shared catalogs or master catalogs, if the master catalog is not being used as a master at the time. We recommend the use of ICFRU to avoid the loss of some catalog data even after the recovery.

For further information about recovery procedures, see *z/OS DFSMS: Managing Catalogs*, SC26-7409.

5.16 Protecting catalogs

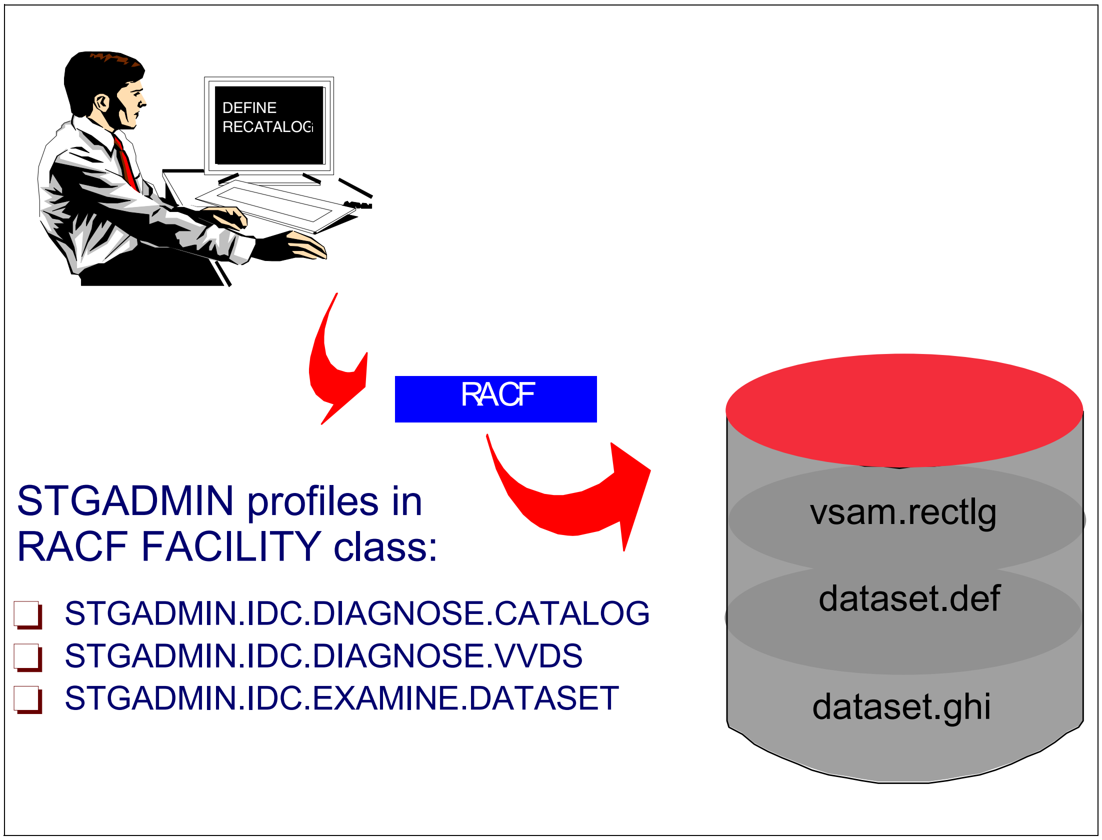


Figure 5-16 Protecting catalogs with RACF

The protection of data includes:

- Data security: the safety of data from theft or intentional destruction
- Data integrity: the safety of data from accidental loss or destruction

Data can be protected either indirectly, by preventing access to programs which can be used to modify data, or directly, by preventing access to the data itself. Catalogs and cataloged data sets can be protected in both ways.

To protect your catalogs and cataloged data, use the Resource Access Control Facility (RACF) or similar product.

RACF authorization checking

RACF provides a software access control measure you can use in addition to or instead of VSAM passwords. RACF protection and password protection can coexist for the same data set.

To open a catalog as a data set, you must have ALTER authority and APF authorization. When defining an SMS-managed data set, the system only checks to make sure the user has authority to the data set name and SMS classes and groups. The system selects the appropriate catalog, without checking the user's authority to the catalog. You can define a data set if you have ALTER or OPERATIONS authority to the applicable data set profile.

Deleting any type of RACF-protected entry from a RACF-protected catalog requires ALTER authorization to the catalog or to the data set profile protecting the entry being deleted. If a non-VSAM data set is SMS-managed, RACF does not check for DASDVOL authority. If a non-VSAM, non-SMS-managed data set is being scratched, DASDVOL authority is also checked.

For ALTER RENAME, the user is required to have the following two types of authority:

- ALTER authority to either the data set or the catalog
- ALTER authority to the new name (generic profile) or CREATE authority to the group

Be sure that RACF profiles are correct after you use REPRO MERGECAT or CNVTCAT on a catalog that uses RACF profiles. If the target and source catalogs are on the same volume, the RACF profiles remain unchanged.

Non-VSAM tape data sets defined in an integrated catalog facility catalog can be protected by:

- Controlling access to the tape volumes
- Controlling access to the individual data sets on the tape volumes

Profiles

To control the ability to perform functions associated with storage management, define profiles in the FACILITY class whose profile names begin with STGADMIN (storage administration). For a complete list of STGADMIN profiles, see *z/OS DFSMSdfp Storage Administration Reference*, SC26-7402. Examples of some profiles are:

```
STGADMIN.IDC.DIAGNOSE.CATALOG
STGADMIN.IDC.DIAGNOSE.VVDS
STGADMIN.IDC.EXAMINE.DATASET
```

5.17 Merging catalogs

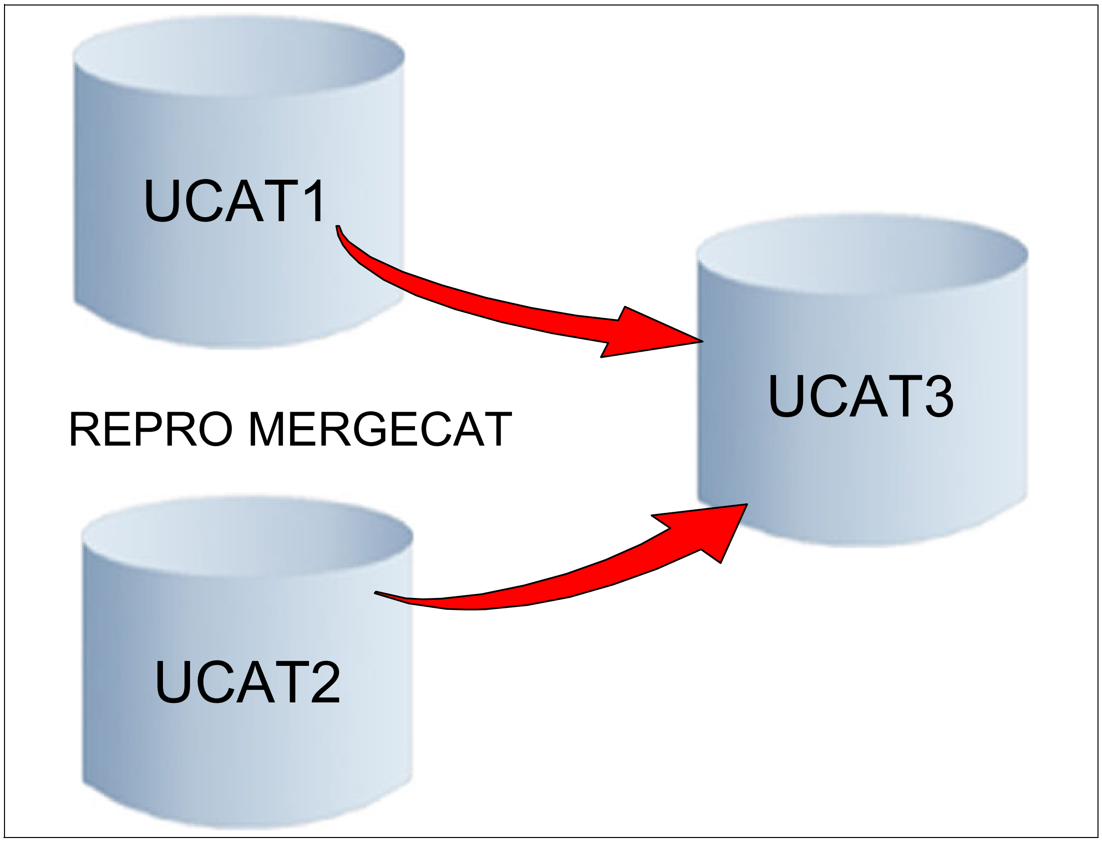


Figure 5-17 Merging catalogs

You might find it beneficial to merge catalogs if you have many small or seldom-used catalogs. An excessive number of catalogs can complicate recovery procedures and waste resources such as CAS storage, tape mounts for backups, and system time performing backups.

Merging catalogs is accomplished in much the same way as splitting catalogs. The only difference between splitting catalogs and merging them is that in merging, you want all the entries in a catalog to be moved to a different catalog, so that you can delete the obsolete catalog.

Use the following steps to merge two integrated catalog facility catalogs:

1. Use **ALTER LOCK** to lock both catalogs.
2. Use **LISTCAT** to list the aliases for the catalog you intend to delete after the merger, as in the following example.

```
//LISTCAT    JOB    ...
//STEP1      EXEC   PGM=IDCAMS
//OUTDD      DD     DSN=LISTCAT.OUTPUT,UNIT=3480,
//           VOL=SER=TAPE10,LABEL=(1,NL),DISP=(NEW,KEEP),
//           DCB=(RECFM=VBA,LRECL=125,BLKSIZE=629)
//SYSPRINT   DD     SYSOUT=A
//SYSIN      DD     *
     LISTCAT -
          CATALOG(YOURCAT) -
          OUTFILE (OUTDD) -
          ...
/*
```

`OUTDD` specifies an alternate output file so that the `LISTCAT` output can be written onto an auxiliary storage device. The `LISTCAT` command's `OUTFILE` parameter points to the `OUTDD DD` statement. Only the `LISTCAT` output is written to the alternate output device. JCL statements , system messages, and job statistics are written to the SYSPRINT output device.

3. Use **EXAMINE** and **DIAGNOSE** to ensure that the catalogs are error-free. Fix any errors indicated.
4. Use **REPRO MERGECAT** without specifying the ENTRIES or LEVEL parameter. The OUTDATASET parameter specifies the catalog that you are keeping after the two catalogs are merged. This step can take a long time to complete.
5. Use the listing created in step 2 to create a sequence of **DELETE ALIAS** and **DEFINE ALIAS** commands to delete the aliases of the obsolete catalog, and to redefine the aliases as aliases of the catalog you are keeping. If this step fails for any reason, see "Recovering from a REPRO MERGECAT Failure" in *z/OS DFSMS: Managing Catalogs*, SC26-7409.
6. Use **DELETE USERCATALOG** to delete the obsolete catalog. Specify RECOVERY on the **DELETE** command.
7. If your catalog is shared, run the **EXPORT DISCONNECT** command on each shared system to remove unwanted user catalog connector entries.
8. Use **ALTER UNLOCK** to unlock the remaining catalog.

You can also merge entries from one tape volume catalog to another using **REPRO MERGECAT**. **REPRO** retrieves tape library or tape volume entries and redefines them in a target tape volume catalog. In this case, VOLUMEENTRIES needs to be used to correctly filter the appropriate entries. The LEVEL parameter is not allowed when merging tape volume catalogs.

5.18 Splitting a catalog

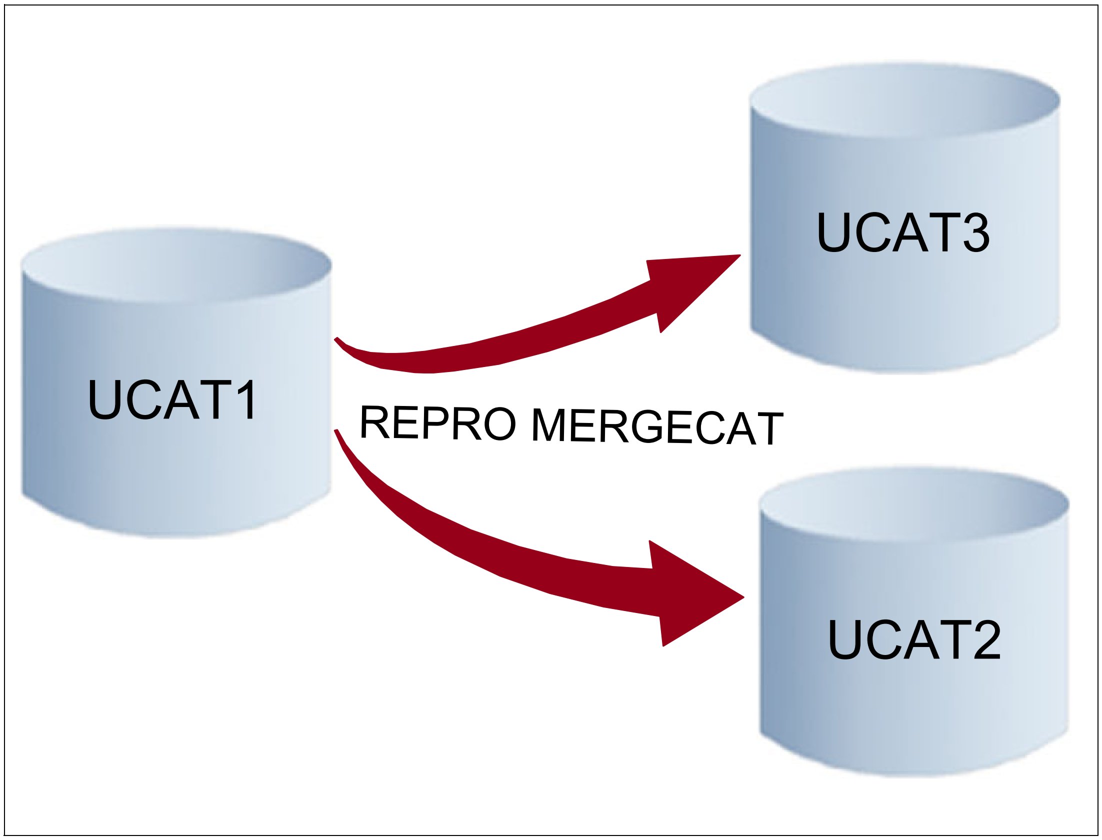


Figure 5-18 Splitting a catalog

You can split a catalog to create two catalogs or to move a group of catalog entries, if you determine that a catalog is either unacceptably large or that it contains too many entries for critical data sets.

If the catalog is unacceptably large (a catalog failure would leave too many entries inaccessible), then you can split the catalog into two catalogs. If the catalog is of an acceptable size but contains entries for too many critical data sets, then you can simply move entries from one catalog to another.

To split a catalog or move a group of entries, use the access method services **REPRO MERGECAT** command. Use the following steps to split a catalog or to move a group of entries:

1. Use **ALTER LOCK** to lock the catalog. If you are moving entries to an existing catalog, lock it as well.
2. If you are splitting a catalog, define a new catalog with **DEFINE USERCATALOG LOCK**.
3. Use **LISTCAT** to obtain a listing of the catalog aliases which you are moving to the new catalog. Use the OUTFILE parameter to define a data set to contain the output listing.
4. Use **EXAMINE** and **DIAGNOSE** to ensure that the catalogs are error-free. Fix any errors indicated.
5. Use **REPRO MERGECAT** to split the catalog or move the group of entries. When splitting a catalog, the OUTDATASET parameter specifies the catalog created in step 2. When moving a group of entries, the OUTDATASET parameter specifies the catalog which is to receive the entries. This step can take a long time to complete.

Use the ENTRIES or LEVEL parameters to specify which catalog entries are to be removed from the source catalog and placed in the catalog specified in OUTDATASET.

If this step fails for any reason, see "Recovering from a MERGECAT Failure" in *z/OS DFSMS: Managing Catalogs*, SC26-7409.

6. Use the listing created in step 3 to create a sequence of **`DELETE ALIAS`** and **`DEFINE ALIAS`** commands for each alias. These commands delete the alias from the original catalog, and redefine them as aliases for the catalog which now contains entries belonging to that alias name.

   The **`DELETE ALIAS/DEFINE ALIAS`** sequence must be run on each system that shares the changed catalogs.

7. Unlock both catalogs using **`ALTER UNLOCK`**.

5.19 Catalog performance

- Define Alias
- Do not catalog user data sets in the Master
- Avoid JOBCAT/STEPCAT
- Cache the Usercat in VLF
- Cache the Mastercat in CAS
- Do not place the most accessed data sets in the same catalog

Figure 5-19 Catalog performance

Performance should not be your main consideration when you define catalogs. It is more important to create a catalog configuration which allows easy recovery of damaged catalogs with the least amount of system disruption. However, there are several options you can choose to improve catalog performance without affecting the recoverability of a catalog.

Factors affecting catalog performance

The main factors affecting catalog performance are the amount of I/O required for the catalog and the subsequent amount of time it takes to perform the I/O. These factors can be reduced by caching catalogs in special caches used only by catalogs. If a catalog is cached, the reduced I/O to the catalog reduces the effect of other factors on catalog performance.

If the Mastercat only contains entries for catalogs, catalog aliases, and system data sets, the entire Mastercat is read into CAS virtual storage during system initialization. Because the Mastercat, if properly used, is rarely updated, the performance of the Mastercat is not appreciably affected by I/O requirements.

Eliminating JOBCAT and STEPCAT DD

Another good reason for not using STEPCAT and JOBCAT is because they have poor performance.

Caching catalogs

The simplest method of improving catalog performance is to use cache to maintain catalog records within CAS private area address space or VLF data space.

Two types of cache are available exclusively for catalogs. The in-storage catalog (ISC) cache is contained within the catalog address space (CAS). The catalog data space cache (CDSC) is separate from CAS and uses the MVS VLF component which stores the cached records in a data space. Both types of cache are optional, and each can be cancelled and restarted without an IPL.

Although you can use both types of catalog cache, you cannot cache a single catalog in both types of cache simultaneously. You must decide which catalogs benefit the most from each type of cache.

Catalog records are cached in the ISC or CDSC under the following conditions:

- For Mastercat, all records accessed sequentially or by key are cached except for alias records. Alias records are kept in a separate table in main storage.
- For Usercats, only records accessed by key are cached, that is by data set name–which is the normal type of access.
- For each catalog, the records are cached in the CDSC if you have indicated the catalog is to use CDSC. Otherwise, the records are cached in the ISC (Usercat included) unless you have stopped the ISC for the catalog. If you stop both the CDSC and the ISC for a catalog, then records are not cached.

In-storage cache (ISC)

The in-storage catalog cache resides in the private area of the CAS. It is the default catalog cache. Each Usercat cached in ISC is given a fixed amount of space for cached records. When a Usercat reaches its allotted space in the ISC, the least recently used record is removed from the ISC to make room for the new entry.

Catalogs which are not frequently updated use the ISC most effectively. The Mastercat is ideally suited for ISC because master catalog records are infrequently updated. The performance of the ISC is affected if the catalog is shared with another system.

Mastercat, unlike Usercats, is not limited to a set amount of CAS virtual storage. All eligible records in the Mastercat are cached in the ISC as they are read.

Thus, you should keep the number of entries in the master catalog to a minimum, so that the ISC for the master does not use an excessive amount of main storage.

Since ISC is the default catalog cache, catalogs are cached in the ISC unless you specify that the catalog is to use CDSC, or unless you use the **MODIFY CATALOG** operator command to remove the catalog from the ISC.

Catalog data space cache (CDSC)

CDSC resides in a data space which you define with the COFVLFxx member of SYS1.PARMLIB. The CDSC uses the virtual look-aside facility (VLF), which can be started by using the **START VLF** operator command. In the COFVLFxx you should declare:

- NAME(IGGCAS)
- EMAJ(catname): The names of the catalogs to be cached
- MAXVIRT({ 4096|size}): The maximum virtual storage that VLF can use to cache catalog records

You can add catalogs to the CDSC only by changing the COFVLFxx member to specify the catalogs, stopping VLF, then starting VLF. Because this interrupts servicing on the existing CDSC, catalog performance might be degraded for a while.

The CDSC can concurrently be used for any catalog which is not using the ISC. A single catalog cannot use both the CDSC and the ISC. Unlike the ISC, catalogs cached in the CDSC are not limited to a specific amount of data space virtual storage. A catalog caches records until no space is left in the data space cache. Once the data space cache is full, the space occupied by the record least used is removed to make room for new records.

5.20 Monitoring the CAS

```
**CAS*******************************************************************
**CAS**  CATALOG ADDRESS SPACE REPORT OUTPUT                          **
**CAS*******************************************************************
**CAS**  CATALOG COMPONENT LEVEL       = HDZ11C0                      **
**CAS**  CATALOG ADDRESS SPACE ASN     = 0012                         **
**CAS**  SERVICE TASK UPPER LIMIT      = 00C8                         **
**CAS**  SERVICE TASK LOWER LIMIT      = 003C                         **
**CAS**  HIGHEST # SERVICE TASKS       = 0006                         **
**CAS**  CURRENT # SERVICE TASKS       = 0006                         **
**CAS**  MAXIMUM # OPEN CATALOGS       = 0032                         **
**CAS**  ALIAS TABLE AVAILABLE         = YES                          **
**CAS**  ALIAS LEVELS SPECIFIED        = 1                            **
**CAS**  CRT TABLE SLOT ROTATION       = OFF                          **
**CAS**  SYS% TO SYS1 CONVERSION       = OFF                          **
**CAS**  CAS MOTHER TASK               = 00A5BE88                     **
**CAS**  CAS MODIFY TASK               = 00A5B5B0                     **
**CAS**  CAS ANALYSIS TASK             = 00A5B950                     **
**CAS**  CAS ALLOCATION TASK           = 00A5BCF0                     **
**CAS**  VOLCAT HI-LEVEL QUALIFIER     = SYS1                         **
**CAS**  DELETE UCAT/VVDS WARNING      = ON                           **
**CAS*******************************************************************
```

Figure 5-20 Monitoring the CAS

Using the **MODIFY CATALOG,REPORT** command, you can obtain general information about the catalog address space. This information can be used to evaluate your current catalog environment setup. If you determine that your current setup is inadequate, you can change it with another **MODIFY CATALOG** command, or by changing the SYSCATxx member of SYS1.NUCLEUS.

Figure 5-20 shows an example of the output of an unqualified **MODIFY CATALOG,REPORT** command.

There is information about the service tasks available to process catalog requests. In this example, you can see that the service task lower limit is adequate for the current number of tasks. The service task upper limit defaults to X'B4', and can be changed by the **MODIFY CATALOG,TASKMAX** command. The highest number of service tasks is equal to the highest value the current number of tasks field has reached.

Catalog management creates tasks as necessary, as the current number of tasks exceeds the service task lower limit. As catalog requests subside, the number of tasks attached and available for processing requests is reduced until the lower limit is reached.

The maximum number of open catalogs is the value set by the **MODIFY CATALOG,CATMAX** command. This is the maximum number of catalogs, in hexadecimal, which might be open to CAS simultaneously. If the maximum is reached, catalog management closes the least recently used catalog before opening another catalog. Normally, a catalog remains open once it has be opened.

The alias table available entry indicates whether there is a problem with the catalog alias table. This field should always say YES. If it says NO, try restarting the catalog address space. Performance is affected when catalog management does not have catalog aliases in the catalog alias table.

For more details on the `F CATALOG,REPORT` output, refer to *z/OS DFSMS: Managing Catalogs*, SC26-7409.

5.21 Monitoring the CAS performance

```
IEC359I CATALOG PERFORMANCE REPORT
*CAS***************************************************
*  -----CATALOG EVENT----    --COUNT--   ---AVERAGE---  *
*  Entries to Catalog             409     18.617  SEC   *
*  BCS ENQ Shr                    413      0.458 MSEC   *
*  BCS ENQ Excl                     9      0.341 MSEC   *
*  BCS DEQ                        442      0.459 MSEC   *
*  VVDS RESERVE CI                 24    132.823 MSEC   *
*  VVDS DEQ CI                     24      1.141 MSEC   *
*  VVDS RESERVE Shr                93    310.896 MSEC   *
*  VVDS RESERVE Excl                8      0.970 MSEC   *
*  VVDS DEQ                       101      1.193 MSEC   *
*  SPHERE ENQ Excl                 16      0.304 MSEC   *
*  SPHERE DEQ                      16      0.303 MSEC   *
*  RPL ENQ                          3      0.210 MSEC   *
*  RPL DEQ                          3      0.244 MSEC   *
*  BCS Get                      2,074      2.468 MSEC   *
*  BCS Put                          5     21.764 MSEC   *
*  BCS Erase                        3     34.630 MSEC   *
*  VVDS I/O                       130     13.194 MSEC   *
*  VLF Define Major                 1     13.861 MSEC   *
```

Figure 5-21 Monitoring the CAS performance

Figure 5-21 shows part of the report obtained by the execution of the MVS command:

```
MODIFY CATALOG,REPORT,PERFORMANCE
```

This command can be useful in identifying performance problems that you suspect are related to catalog processing. For example, if the average time for ENQs that is shown in the report seems excessive, it might indicate some problems in the GRS configuration, or parameter specifications. High I/O times might indicate problems with:

- Channel or device load
- Volumes that are suffering a high number of I/O errors
- Volumes that have excessively high RESERVE rates or long RESERVE durations

5.22 Monitoring the CDSC performance

```
IEC359I CATALOG CACHE REPORT
*CAS*************************************************************
*   HIT% -RECORDS- -SEARCHES --FOUND-- -DELETES- -SHR UPD- --PURGE
*
* SYS1.MVSRES.MASTCAT                              (ISC)
*    42%    1,578        679     291         13         0        3
* SYS1.PROD.UCAT                                   (VLF)
*    37%    2,304      1,014     372         27        42        0
*
*CAS*************************************************************
```

Figure 5-22 Monitoring the CDSC performance

In order to evaluate the catalog data space cache, use the command:

```
MODIFY CATALOG,REPORT,CACHE
```

You can use this command to evaluate the cache performance for a specified catalog, or for all catalogs that are currently being cached. The numbers shown in this report are in decimal.

When you evaluate the cache performance for a catalog, you need to consider how long the catalog has been using the cache. If the cache has only been available for a catalog for an hour, the hit ratio will likely be low. However, if the catalog has been using the cache for a week, expect a good hit ratio. The hit ratio is an indication of cache usage while the cache is available. The values do not accumulate between performing IPLs, stopping and starting VLF, or restarting the catalog address space.

5.23 Using multiple catalogs

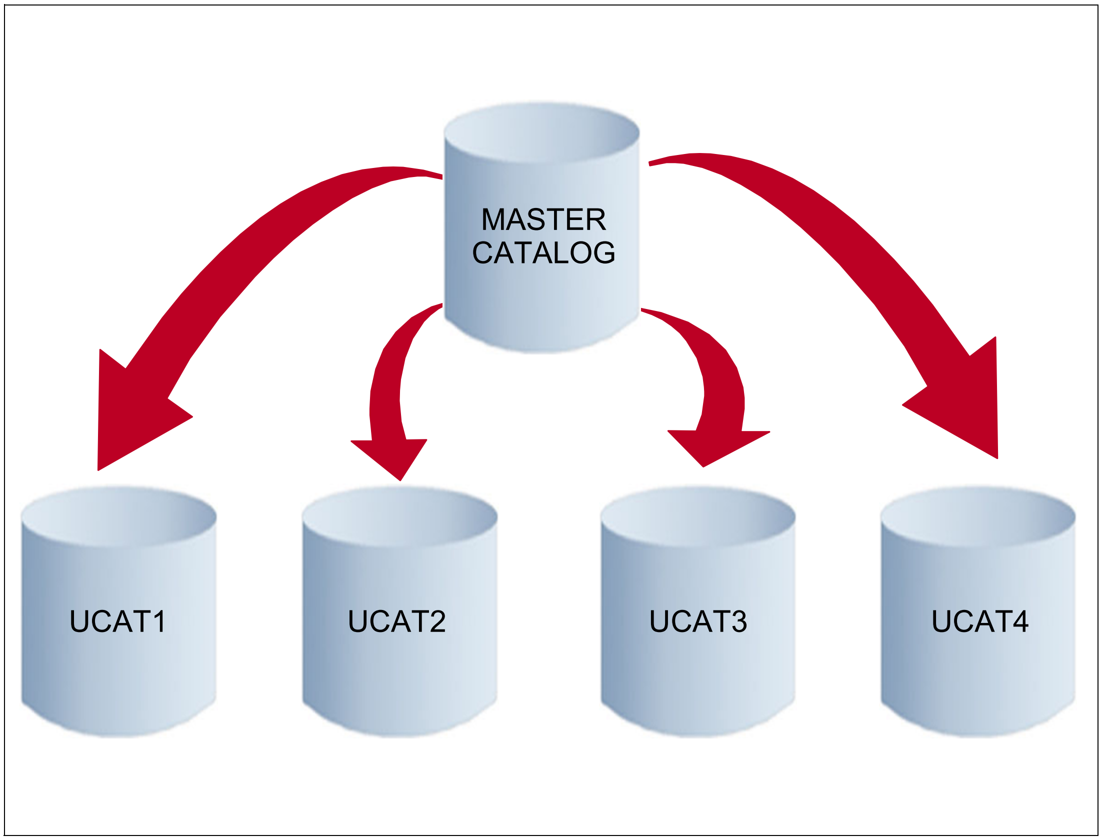


Figure 5-23 Using multiple catalogs

Multiple catalogs on multiple volumes may perform better than fewer catalogs on fewer volumes. This is because of the interference between requests to the same catalog; for example, a single shared catalog being locked out by another system in the sysplex. This situation can occur if some other application issues a **RESERVE** against the volume that has nothing to do with catalog processing. Another reason can be that there is more competition to use the available volumes, and thus more I/O can be in progress concurrently.

If you are not using VLF for caching, there is a limited amount of cache storage assigned to each catalog in CAS. Large catalogs may suffer from this fixed limit and receive less benefit from non-VLF caching than an environment with more, smaller catalogs.

Multiple catalogs may reduce the impact of the loss of a catalog by:

- Reducing the time necessary to recreate any given catalog
- Allowing multiple catalog recovery jobs to be in process at the same time

Recovery from a pack failure is dependent on the total amount of catalog information on a volume–regardless of whether this information is stored in one or many catalogs.

5.24 Sharing catalogs

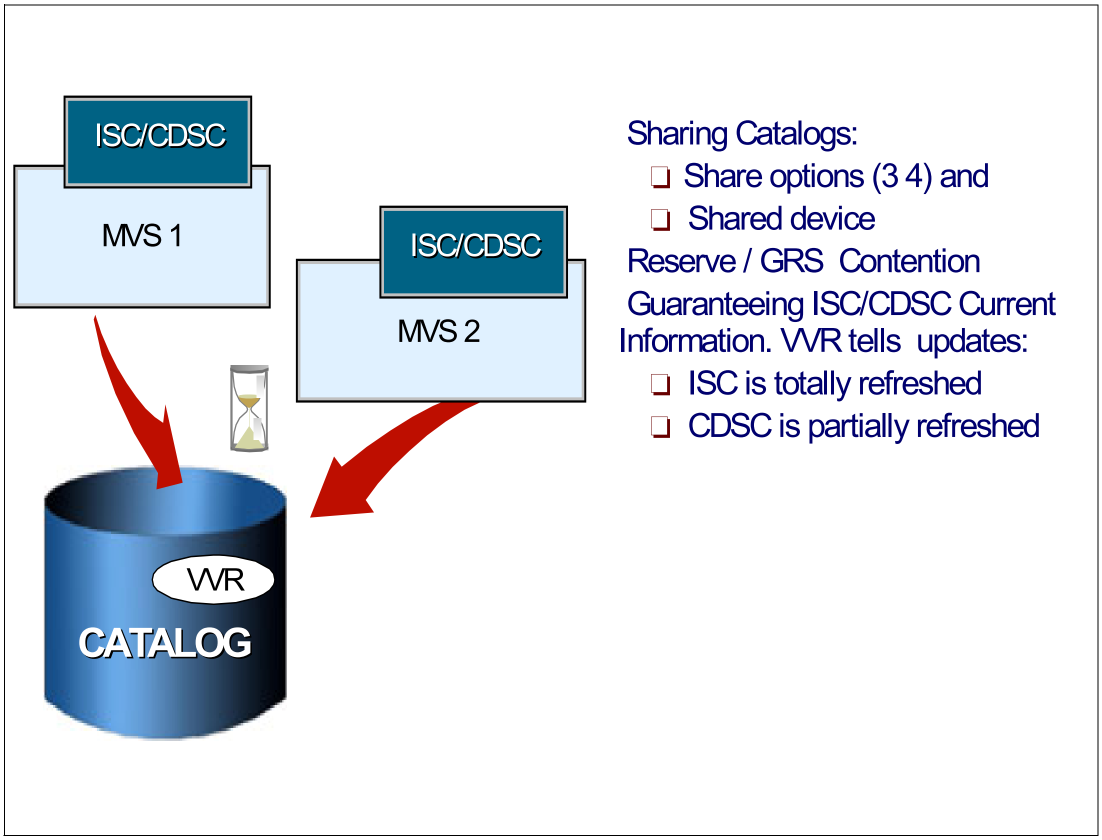


Figure 5-24 Sharing catalogs

If a BCS catalog is defined with share options (3 4), and if it resides on a shared device, catalog management considers the catalog a shared catalog, including the corresponding VVDSs.

If a catalog is not really shared with another system, move the catalog to an unshared device or alter its share options to (3 3). To prevent potential catalog damage, never place a catalog with share options (3 3) on a shared device.

The volume containing the VVDS is reserved before the I/O is performed.

Guaranteeing the ISC/CDSC current information

Before each physical access to a shared catalog, special I/O checking is performed to ensure that the ISC or CDSC contains current information. Checking also ensures that the access method control blocks for the catalog are updated in the event the catalog has been extended, or otherwise altered from another system. This checking maintains data integrity. It also affects performance because in order to keep this integrity, for every catalog access, a special VVR in the shared catalog must be read before using the ISC or CDSC version of the BCS record. This access implies a DASD reserve and I/O operations.

Changes to shared catalogs are handled differently depending on whether the catalog uses the ISC or the CDSC:

- If a catalog uses the ISC and a sharing system updates a record as indicated by the special VVR (any record, even if the record is not cached in this system's ISC), catalog management releases the entire ISC for the catalog and creates a new ISC for the catalog. Individual records changed by a sharing system are not identified and updated for ISC catalogs.

- The CDSC, however, can identify individual records which a sharing system has updated by executing I/O operations. The special VVR contains a wrap table with the keys of the 90 most recent records updated/added/deleted. For every catalog record read, the catalog VVR must be read. If the BCS records cached in CDSC on that system are not changed, they are still valid. If the table of updated records in the VVR has wrapped since the last time the catalog was accessed by this system, the complete CDSC cache is purged for this catalog. If not, only those records indicated in VVR are discarded from CDSC cache. This requires I/O to VVDS for each BCS I/O. It also generates Reserves or GRS traffic.

  Thus, when a sharing system updates a record, the CDSC space used by the catalog is not necessarily totally released.

5.25 DFSMS enhanced catalog sharing

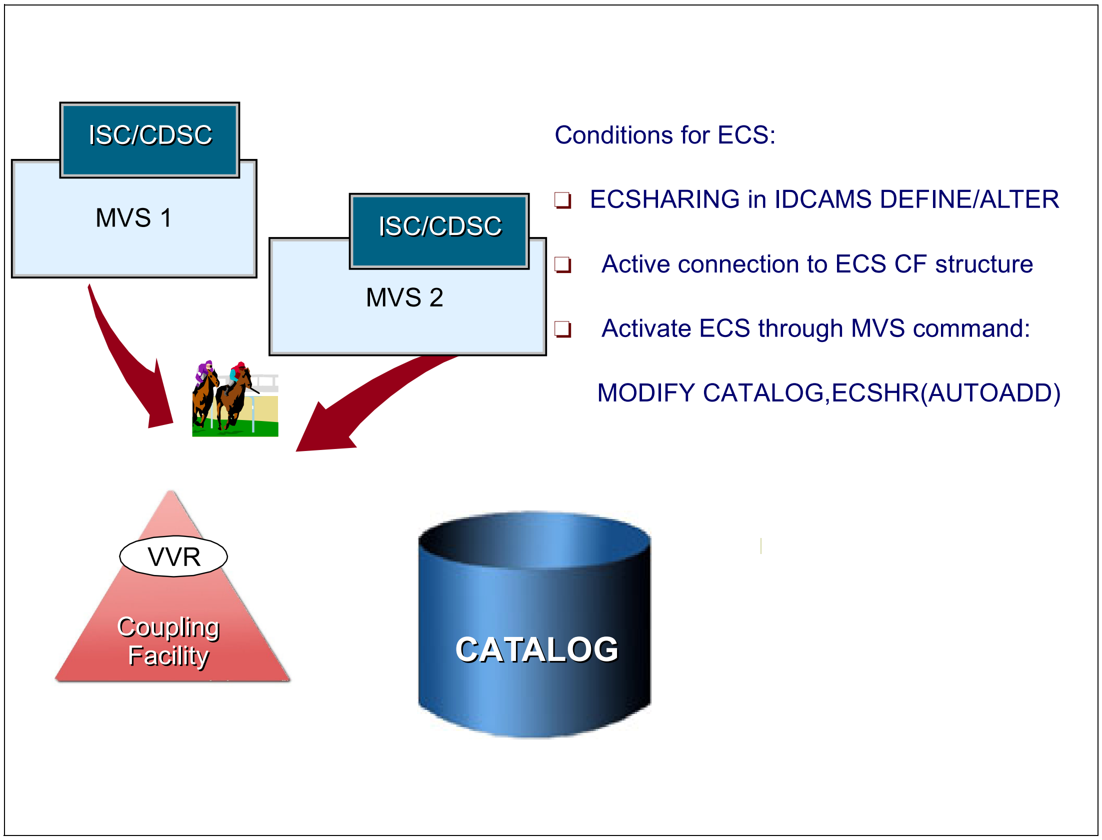


Figure 5-25 DFSMS enhanced catalog sharing

If the catalog has been defined to support DFSMS Enhanced Catalog Sharing (ECS) by the ECSHARING attribute, most of the overhead associated with shared catalog is eliminated.

ECS uses a cache Coupling Facility structure to keep the special VVR. Also the Coupling Facility structure (as defined in CFRM) keeps a copy of the updated records. A new ENQ is used to indicate that a catalog is being used in ECS mode. As you can see, there is no more I/O to read the catalog VVR in order to verify the updates. In addition, the eventual modifications are also kept in the Coupling Facility structure, thus avoiding more I/O.

A new attribute, ECSHARING, is available on the **IDCAMS DEFINE** and **ALTER** commands. Setting this attribute ON makes a catalog eligible for sharing using the ECS protocol, as opposed to the VVDS/VVR protocol. However, catalog management does not actually use the ECS protocol unless:

- There is an active connection to the ECS cache structure, and
- ECS mode has been activated by either the **MODIFY CATALOG,ECSHR(AUTOADD)** command or the **MODIFY CATALOG,ECSHR(ADD...)** command.

ECS saves about 50 percent in elapsed time and provides an enormous reduction in ENQ/Reserves.

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

IBM Redbooks

For information on ordering these publications, see "How to get IBM Redbooks" on page 332. Note that some of the documents referenced here may be available in softcopy only.

- *z/OS Version 1 Release 3 and 4 Implementation*, SG24-6581
- *z/OS Version 1 Release 2 Implementation*, SG24-6235
- *z/OS V1R3 DFSMS Technical Guide*, SG24-6569
- *OS/390 Version 2 Release 10 Implementation*, SG24-5976
- *JES3 in a Parallel Sysplex*, SG24-4776
- *MVS/ESA SP-JES3 Version 5 Implementation Guide Release 5.1.1, 5.2.1*, SG24-4582
- *MVS/ESA SP-JES2 Version 5 Implementation Guide Release 5.1.0, 5.2.0*, SG24-4583

Other publications

These publications are also relevant as further information sources:

- *z/OS MVS JCL Reference*, SA22-7597
- *z/OS MVS Interactive Problem Control System (IPCS) User's Guide*, SA22-7596
- *z/OS MVS Initialization and Tuning Reference*, SA22-7592
- *z/OS MVS Interactive Problem Control System (IPCS) Commands*, SA22-7594
- *z/OS MVS Planning: Operations*, SA22-7601
- *z/OS DFSMS: Using Data Sets*, SC26-7410
- *z/OS MVS System Data Set Definition*, SA22-7629
- *z/OS and z/OS.e Planning for Installation*, GA22-7504
- *z/OS MVS System Data Set Definition*, SA22-7629
- *z/OS Hardware Configuration Definition User's Guide*, SC33-7988
- *z/OS Hardware Configuration Definition Planning*, GA22-7525
- *Device Support Facilities User's Guide and Reference Release 17*, GC35-0033
- *z/OS MVS System Commands*, SA22-7627
- *z/OS MVS System Management Facilities (SMF)*, SA22-7630
- *z/OS MVS Installation Exits*, SA22-7593
- *Environmental Record Editing and Printing Program (EREP) Reference*, GC35-0152
- *z/OS JES2 Commands*, SA22-7526
- *z/OS TSO/E User's Guide*, SA22-77942
- *z/OS DFSMSdss Storage Administration Reference*, SC35-0424

- *z/OS DFSMS Access Method Services for Catalogs*, SC26-7394
- *z/OS DFSMS: Managing Catalogs*, SC26-7409
- *z/OS DFSMSdfp Storage Administration Reference*, SC26-7402
- *z/OS DFSMShsm Implementation and Customization Guide*, SC35-0418
- *z/OS DFSMS: Using the Interactive Storage Management Facility*, SC26-7411

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Job mangement with JES2 and JES3

SSI, LPA, LNKLST, and catalogs

The ABCs of z/OS System Programming is a ten volume collection that provides an introduction to the z/OS operating system and the hardware architecture. Whether you are a beginner or an experienced system programmer, the ABCs collection provides the information that you need to start your research into z/OS and related subjects. If you would like to become more familiar with z/OS in your current environment, or if you are evaluating platforms to consolidate your e-business applications, the ABCs collection will serve as a powerful technical tool.

This volume describes the basic system programming activities related to implementing and maintaining the z/OS installation, and provides details about the modules used to manage jobs and data. The topics covered are:

- Overview of the parmlib definitions and the IPL process. The parameters and system data sets necessary to IPL and run a z/OS operating system are described, along with the main daily tasks for maximizing performance of the z/OS system.
- Basic concepts related to subsystems, how to use the subsystem services provided by IBM subsystems, and planning considerations for setting up and writing your own subsystem.
- Job management in the z/OS system using the job entry subsystems JES2 and JES3. Details about how JES2 and JES3 are used to receive jobs into the operating system, schedule them for processing by z/OS, and control their output processing.
- The link pack area (LPA), LNKLST, authorized libraries, and the role of VLF and LLA components.
- Catalogs and data set attributes.

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