IBM

Migration Guide to the Air-Cooled ES/9000 Processors

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Abstract

The purpose of this document is to provide information and guidance which should be useful in a successful migration to an air-cooled ES/9000 processor.

Who Should Use This Guide

This document should be used by IBM Systems Engineers and customers when planning a migration to an air-cooled ES/9000 processor.

How To Use This Guide

This document should be used in conjunction with other air-cooled ES/9000 processor publications, DASD publications, and operating system manuals. The guide is structured in the following manner:

Chapter 1, "Introducing the Air-Cooled ES/9000 Processors' gives an overview of the air-cooled ES/9000 processors and I/O devices.

Chapter 2, "Software Requirements" describes the necessary levels of operating system software required to support the air-cooled ES/9000 processors and associated I/O.

Chapter 3, "I/O Considerations" provides information about which devices are supported for attachment to the air-cooled ES/9000 processors. Additional considerations pertaining to I/O attachment capabilities are also discussed.

Chapter 4, "Input/Output Configuration Program (IOCP)" presents an overview of the use and implementation of IOCP.

Chapter 5, "Processor Resource/Systems Manager (PR/SM) Overview" discusses how PR/SM is implemented on an air-cooled ES/9000 processor. Information on implementing both LPAR and MPG is provided.

Chapter 6, "Sample Migration Scenarios" discusses specific considerations for various environments migrating to an air-cooled ES/9000 processor.

Chapter 1. Introducing the Air-Cooled ES/9000 Processors

The ES/9000 family consists of two lines of air-cooled processors and a single line of water-cooled processors. The purpose of this chapter is to present information concerning the two lines of air-cooled processors.

The IBM 9221 processors are a rack-mounted system with integrated attachments as well as channel-attach capability. These processors are a successor to the ES/9370 family and will be an excellent replacement for small to intermediate S/370 architecture processors such as the IBM 4341, 4361, and smaller 4381s.

In a very general sense, the IBM 9121 processors are a follow-on to the S/370 channel-architected systems like the IBM 4381. They are also a suitable replacement for the IBM 3081 and the IBM 3083. This line consists of six models: four uni-processors and two dyadic processors.

The IBM 9221

Models

The IBM 9221 processor models are the 120, 130, 150 and the 170. All four models are uni-processors. Three operating modes will be available: Native S/370 mode, Native ESA/390, and LPAR mode using PR/SM. For easier migration, the S/370 Base Option Feature (#9370) for models 120, 130, and 150 allows the use of a broader selection of integrated I/O subsystem features than the ESA Option Feature (#9390).

The modes of operation, the integrated I/O, and the new channel capabilities are designed to allow an orderly migration from predecessor systems.

Main Storage (Memory)

The memory available on the IBM 9221 models is dependent on the mode of operation. The minimum size is 16 MB and the maximum is 256 MB. Following is a table of the minimum and maximum memory sizes for each model:

MAIN STORAGE CAPACITIES (in MB)

Model	120		130		150		170	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Operating Mode								
Native S/370	16	64	16	64	16	64	32	64
ESA/390	16	256	16	256	16	256	32	256
ESA/390 LPAR	16	256	16	256	16	256	32	256

Channel Configurations

Attachment of I/O devices may be made either via an Integrated I/O Subsystem, a parallel channel, or an ESCON channel. The Integrated I/O Subsystems are supported in both S/370 mode and ESA/390 mode. The parallel channels are supported in either mode, but the ESCON channels will run only in ESA/390 mode. **Parallel channels and S/370 BMPX channels are mutually exclusive on a system.**

A wide variety of devices may be attached via the Integrated I/O Subsystems, including the S/370 BMPX channel (feature #3000). This feature is supported only in Native S/370 mode and can be used as a migration vehicle in moving to ESA/390 mode. All of the integrated devices are attached to the Integrated I/O Subsystem on the IBM 9221.

Parallel and ESCON channels attach differently to the IBM 9221 than do the Integrated I/O Subsystems. These channels are available on either one per card or in groups of three per card. Feature code 6101 provides a single parallel channel, while feature code 6103 provides three parallel channels. In the same manner, feature code 6111 provides a single ESCON channel, while feature code 6113 provides three ESCON channels. There can be both parallel and ESCON cards on a system.

The parallel channels can be configured to run in either byte or block mode. It is recommended that no more than eight of these parallel channels be configured as byte mode channels on a system. Only two channels may be configured as byte channels unless logical partitions under PR/SM are defined. In this case, two byte channels per partition are allowed.

S/370 BMPX channels operate at speeds up to 3 megabytes/sec, while the parallel channels operate at speeds up to 4.5 megabytes/sec. ESCON channels operate at speeds up to 10 megabytes/sec.

The following chart outlines the total I/O bus and channel capacity of the system:

IBM 9221 CHANNEL AND I/O BUS CONFIGURATIONS

Model	Minimum Channels (T/P/E)	Maximum Channels (T/P/E)	I/O Buses (Min/Max)
IBM 9221 - 120	0/0/0	12/12/12	0/4
IBM 9221 - 130	0/0/0	12/12/12	0/4
IBM 9221 - 150	0/0/0	12/12/12	0/6
IBM 9221 - 170	0/0/0	24/24/24	0/6

Note: T = Total Channels
P = Parallel Channels
E = ESCON Channels

Consoles

Processor Console: The Processor Console on the IBM 9221 provides many of the same functions as the Processor Console (IOSP) on the IBM 9121. In dealing with hardware type functions it is used to perform system configurations, to do problem analysis, to do service runs, and to display the status of the system. It is also used to download microcode from the fixed-disk to the processor and integrated I/O subsystems. It is used for the time-of-day clock setting and for application of code fixes. It is a PS/2 model 70 and has a special interface for attachment to the IBM 9221 processor.

With optional feature code #2000 the PS/2 processor console can also serve as an SCP operator console.

System Control Program Console In addition to the processor console, there must be at least one SCP console on each system. It must be a 3270-type, non-SNA terminal, attached to a work station controller, a LAN controller or to a channel via a controller such as a 3x74. **In LPAR mode on the IBM 9221, each partition must have it's own SCP operator console and either workstation controller, LAN controller, or channel attached non-SNA 3X74.**

Feature Highlights

Following are some of the more significant features available on the IBM 9221:

Integrated I/O Subsystems: The IBM 9221 has many optional I/O subsystems which allow an extremely wide variety of configurations. Among these are the DASD/Tape Subsystem, the Work Station Subsystem, the Telecommunication Subsystem and the ASCII Subsystem. For details on these and additional subsystem features, see Chapter 3, "I/O Considerations."

The Multi-system Channel Communication Unit Feature: The MCCU, feature code 6200, is available on the IBM 9221 as an optional feature. It permits processor-to-processor interchange of data between the IBM 9221 and up to three other processors attached via parallel channels. All four channels can be active simultaneously. It is equivalent to and identifies itself as an IBM 3088-1.

The rack-mounted MCCU provides bus and tag cable connectors for four channels and offers a total of 63 links (addresses) whereby one channel may use up to 21 addresses. All four channels can be active simultaneously. It operates in either S/370 or ESA/390 mode and appears to an attached channel as an external I/O device control unit.

To load the functional control code (licensed internal code), the MCCU needs a connection to the processor console via a token ring interface.

PR/SM Feature (Processor Resource/System Manager feature): This feature is standard on all models of the IBM 9221. With PR/SM it is possible for the processor to be run in LPAR (logical partitioned) mode with up to four logical partitions being supported. Each partition runs as a separate system and must have it's own dedicated set of channels and SCP console.

PR/SM also provides the capability to run Multiple Preferred Guests (MPG). See Chapter 5, "PR/SM Overview", for additional information.

Upgrades

Upgrades within the IBM 9221 processors can be made as follows:

From Model	To Model
120	130
130	150
150	170

In the case of the models 120, 130 and 150, the System/370 Base Option (feature #9370) can be converted to the ESA/390 Option (feature #9390). All upgrades can be made at the installation site.

Upgrades from ES/9370 models to the IBM 9221 can be made as follows:

From ES/9370 Model	To IBM 9221 Model
50	130
50	150
60	130
60	150
80	150
90	150
90	170

The IBM 9121

Models

The six models of the IBM 9121 are the 190, 210, 260, 320, 440, and the 480. Models 190, 210, 260 and 320 are uni-processors, while models 440 and 480 are dyadics. All models may be run in either native ESA/390 mode or in LPAR mode. In native mode, ESA versions of IBM operating systems are supported. ESA versions of IBM operating systems can also be run in LPAR mode. However, S/370 operating systems **must** be run in LPAR mode.

Main Storage (Memory)

Each uni-processor model has 64 MB of real storage as standard. The dyadic models have 128 MB as standard. The maximum real storage available on all models is 1024 MB except for the model 190, where the maximum real storage is 512 MB. Each model of the IBM 9121 allows storage to be defined as expanded storage and central storage. The amount of real storage of each type is defined at IML in 1 MB increments.

The following table shows the various memory combinations for each of the models:

MAIN STORAGE CAPACITIES (in MB)

Model	190	210	260	320	440	480
INSTALLED						
Minimum	64	64	64	64	128	128
Maximum	512	1024	1024	1024	1024	1024
CENTRAL						
Minimum	32	32	32	32	32	32
Maximum	128	256	256	256	256	256
EXPANDED						
Minimum	0	0	0	0	0	0
Maximum	480	992	992	992	992	992

Channel Configurations

The IBM 9121 can be configured either with parallel channels only or with a combination of both parallel and ESCON channels. The parallel channels can be defined as either byte-multiplexor or block-multiplexor mode. Only the first eight parallel channels (channels X'00' - X'07') can be defined to run as byte multiplexor channels.

The parallel channels can transfer data at speeds up to 4.5 million bytes/sec. The ESCON channels can operate at a sustained rate of 10 million bytes/sec. In addition, the ESCON channels permit cable lengths of up to 3 kilometers. With the use of the ESCON Directors, the length can be further extended to 9 kilometers.

The channels can be added in groups of four. The following chart shows the minimum and maximum channel capabilities for all models of the IBM 9121.

MINIMUM/MAXIMUM CHANNEL CONFIGURATIONS

Model	190	210	260	320	440	480
Minimum						
Parallel ESCON	8 0	8 0	12 0	12 0	12 0	12 0
Maximum						
Parallel ESCON	24 20	48 36	48 36	48 36	48 36	48 36
TOTAL Parallel and ESCON Channels						
	32	48	48	48	48	48

Consoles

Processor Console: The processor console on the IBM 9121 is called the IOSP (I/O Support Processor). It serves as an interface to the hardware and is used for hardware control and monitoring functions such as modifying or setting up configurations, service operations and problem analysis. **It is only used in this hardware capacity and cannot function as an SCP operator control terminal.**

The IOSP that comes with the system has a Multi-port Adapter Card to which is attached the IBM 8503 Processor Console. The IBM 5853-1 Modem, used for RSF, is also attached to the adapter card. Up to 4 optional IBM 3151 Display Stations and up to 2 optional printers such as the IBM 4201 or 4202 Proprinters can be attached to the other six positions. These devices can be used as additional interfaces to the hardware functions indicated above. **Neither the 8503 nor the 3151s may be used as SCP consoles.**

System Control Program Console: At least one SCP operator control terminal is required for operating system control. When running in LPAR mode each LPAR partition must have it's own **dedicated** SCP operator console. This terminal must be attached to a non-SNA 3x74 controller. **Since the SCP consoles and non-SNA controllers are not shipped with the IBM 9121, you must provide them separately.**

Feature Highlights

Following are some of the most significant features available on the IBM 9121:

PR/SM Feature (Processor Resource/System Manager feature): This feature is standard on all models of the IBM 9121. With PR/SM it is possible for the processor to be run in LPAR (logical partitioned) mode with up to seven logical partitions being supported. However, a maximum of four partitions is recommended for the Model 190 to ensure balanced performance. Each partition runs as a separate system and must have it's own dedicated set of channels and SCP console.

PR/SM also provides the capability to run Multiple Preferred Guests (MPG) under VM/XA 2.1 and VM/ESA 1.1.1. See Chapter 5, "PR/SM Overview", for additional information.

Expanded Storage: Expanded Storage is available for all models of the IBM 9121. Expanded storage is physically a piece of real storage and is allocated above the control storage. It appears to the system as a separate piece of equipment and is addressable by some operating systems in 4k-page increments.

RSF and IBM 5853 Modem: The Remote Support Facility (RSF) is standard on all models. **An IBM 5853-1 modem (or equivalent) is required for RSF and is not included with the system; The 5853 must be ordered separately.**

Vector Facility Feature: The vector facility is optional and is available on all models of the IBM 9121. With this feature, significantly higher levels of performance may be achieved for many numerically-intensive engineering and scientific applications.

Upgrades

Upgrades within the IBM 9121 processors can be made as follows:

From Model	To Model
190	210
190	260
210	260
210	320
260	320
260	440
260	480
320	440
320	480
440	480

Upgrades can be performed at the site location. In cases where additional channels and the Vector facility are added, the Expansion Frame may be required.

A migration from the IBM 9221 to the IBM 9121 is permissible. In this upgrade, the channel attached devices may be moved and attached to the IBM 9121. The IBM 2440 tape drive and controller can be moved. **However, the integrated rack mounted adapters and I/O devices may NOT be moved from the IBM 9221 to the IBM 9121.**

Chapter 2. Software Requirements

Prior to migrating to an air-cooled ES/9000 processor, it's important to understand the necessary software requirements for air-cooled ES/9000 support. The software planning phase of the air-cooled ES/9000 migration effort should identify not only the appropriate software support levels, but also any support issues regarding I/O devices. The following sections identify this information for several S/370 operating systems supported on the air-cooled ES/9000 processors. Certain operating systems that are supported on the air-cooled ES/9000 processors (AIX/370 1.2 and TPF 3.1) will not be covered in this manual.

MVS Support

The following are the minimum levels of MVS required to support the air-cooled ES/9000 processors. While MVS is supported on all models of the IBM 9121 and IBM 9221 processors, MVS does not provide support for any of the integrated I/O adapters on the IBM 9221.

MVS/SP 1.3.5 & 1.3.6

PTF UY90636 is required to support the IBM 9221, while PTF UY90632 is required to support the IBM 9121. This release of MVS can be IPLed in S/370 mode on the IBM 9221 and under LPAR on both the IBM 9221 and IBM 9121.

MVS/SP 2.2.0

PTF UY90628 is required to support the IBM 9221, while PTFs UY90628 and UY90633 are required to support the IBM 9121. This release of MVS can be IPLed in ESA/390 mode and under LPAR on both the IBM 9221 and IBM 9121.

MVS/SP 3.1.0E

PTF UY90629 is required to support the IBM 9221, while PTFs UY90629 and UY90634 are required to support the IBM 9121. This release of MVS can be IPLed in ESA/390 mode and under LPAR on both the IBM 9221 and IBM 9121.

MVS/SP 3.1.3

PTF UY90630 is required to support the IBM 9221, while PTFs UY90630 and UY90635 are required to support the IBM 9121. This release of MVS can be IPLed in ESA/390 mode and under LPAR on both the IBM 9221 and IBM 9121.

MVS/ESA SP 4.1.0

PTF UY90631 is required to support both the IBM 9221 and IBM 9121. This release of MVS can IPLed in ESA/390 mode and under LPAR on both the IBM 9221 and IBM 9121.

MVS/ESA SP 4.2.0

MVS/ESA SP 4.2.0 contains full support for both the IBM 9221 and IBM 9121. No additional service is required. This release of MVS can be IPLed in ESA/390 mode and under LPAR on both the IBM 9221 and IBM 9121.

VSE Support

The following are the minimum levels of VSE required to support the air-cooled ES/9000 processors.

VSE/SP 3.2.2

VSE/SP 3.2.2 provides support for the air-cooled ES/9000 processor only. It does NOT support the 9336 DASD or the MCCU (feature #6200) on the IBM 9221. There is also no support for ESCON channels on the air-cooled ES/9000 processors. Only 16 MB of real storage and 16 parallel channels are supported by this level of VSE. VSE/SP 3.2.2 can be IPLed in S/370 mode on the IBM 9221 and under LPAR on both the IBM 9221 and IBM 9121.

VSE/SP 4.1.2

Full support for the air-cooled ES/9000 processors is provided by VSE/SP 4.1.2 with APAR DY39560. This release of VSE provides support for the 9336 DASD and the MCCU feature on the IBM 9221. However, there is NO support for the ESCON channels. Only 16 MB of real storage and 16 parallel channels are supported by this level of VSE. VSE/SP 4.1.2 can be IPLed in S/370 mode on the IBM 9221 and under LPAR on both the IBM 9221 and IBM 9121.

VSE/ESA 1.1.0

This level of VSE provides full support for the air-cooled ES/9000 processors. It also provides ES Conversion channel support, as well as support for the 9336 DASD and the MCCU feature on the IBM 9221. This level of VSE supports up to 384 MB of real storage. Also, support for 256 channels is provided. VSE/ESA 1.1.0 can be IPLed in S/370 mode on the IBM 9221, and in ESA/390 mode and under LPAR on both the IBM 9221 and IBM 9121.

VM Support

Full support for the IBM 9221 and IBM 9121 is provided in the following VM releases by PUT 9002 and 9003 with the appropriate service applied.

VM/SP 1.5.0

IBM 9221 and IBM 9121 support is provided at PUT 9002 and 9003 with APAR VM42832 in PTF UV90584. This release of VM can be IPLed in S/370 mode and under LPAR on both the IBM 9221 and IBM 9121.

VM/SP 1.6.0

IBM 9221 and IBM 9121 support is provided at PUT 9002 and 9003 with APAR VM42832 in PTF UV90586. This release of VM can be IPLed in S/370 mode and under LPAR on both the IBM 9221 and IBM 9121.

VM/HPO 1.5.0

IBM 9221 and IBM 9121 support is provided at PUT 9002 and 9003 with APAR VM42832 in PTF UV90585. This release of VM can be IPLed under LPAR on both the IBM 9221 and IBM 9121.

VM/HPO 1.6.0

IBM 9221 and IBM 9121 support is provided at PUT 9002 and 9003 with APAR VM42832 in PTF UV90587. This release of VM can be IPLed under LPAR on both the IBM 9221 and IBM 9121.

VM/XA 2.1

IBM 9221 and IBM 9121 support is provided at PUT 9002 and 9003 with APAR VM42913. This release of VM can be IPLed in ESA/390 mode and under LPAR on both the IBM 9221 and IBM 9121.

VM/ESA 1.1.0 (370 Feature)

IBM 9221 and IBM 9121 support is provided for this release of VM with APAR VM42848 in PTF UV90074. Up to 64 MB of central storage and up to 32 channels are supported. This release of VM can be IPLed in S/370 mode and under LPAR on the IBM 9221 and under LPAR on the IBM 9121.

VM/ESA 1.1.0 (ESA Feature)

Full support for the IBM 9221 and IBM 9121 is provided in this version of VM. No additional maintenance is required. ESCON channels will be supported in this release. This release of VM can be IPLed in ESA/390 mode and under LPAR on both the IBM 9221 and IBM 9121.

VSE under VM Support

A version or release of VSE is "supported" under VM on an air-cooled ES/9000 processor if all the following pre-requisites are met:

- the release of VSE is currently supported
- VSE is running under a level of VM which is currently supported
- the level of VM has announced support for the particular air-cooled ES/9000 processor.

The following scenario illustrates this support:

- VSE/SP V2.1.7 is supported on the IBM 9221 under VM/SP 6 UNTIL THE END OF SERVICE for either VSE/SP V2.1.7 or VM/SP 6, whichever comes first. In this case, VSE/SP V2.1.7 service ends first (3/91 in the U.S. and 12/90 elsewhere). Therefore, VSE/SP V2.1.7 would no longer be supported under VM/SP 6 on the IBM 9221 after 3/91.

DPPX/370 Support

DPPX/370 provides a migration path on System/370 architecture for current users of DPPX/SP (8100 hardware). Extensive migration aids are available to assist the conversion of DPPX/SP on the 8100 to DPPX/370 on the ES/9000 rack-mounted processors. A migration from 8100 to ES/9000 distributed nodes will typically be done in stages, where individual nodes are gradually replaced in stages over a period of time. In these cases, DPPX/SP and DPPX/370 can coexist and be centrally managed from the MVS/XA host, with no changes to the existing 8100 software or host procedures.

The facilities for migrating from DPPX/SP to DPPX/370 on the ES/9000 include:

- Peer Data Transfer, which allows transfer of data sets, catalogs, and CLISTs between DPPX/SP and DPPX/370 systems.
- System Configuration Manager (SCM), which is used to customize both hardware and software components of the system.
- A Migration Aid package for use with DPPX/SP, to prepare many of the system and application components for migration.
- Support of the existing 8100 system as a control unit for the ES/9000, to enable continued support for any incompatible 8100 devices such as the loop controller.

The 8100 system must be at DPPX/SP release 3 or 4 to take full advantage of these migration aids.

An excellent, comprehensive migration guide is available which details all the steps necessary to convert the 8100 hardware and user applications to ES/9000. The publication is "DPPX/SP to DPPX/370 Migration" (GC23-0641) and is part of the system library for DPPX/370. This manual should be referenced in detail for any migration of DPPX to the ES/9000 processors.

DPPX/370 Processor Support

DPPX/370 supports the IBM 9221 models 120, 130, 150, and 170.

DPPX/370 Release 2: Requires APAR DF19421 for support of the ES/9000. This release operates in S/370 mode ONLY on the ES/9000.

DPPX/370 Release 3: Available September, 1991. This release supports the ES/9000 processors in both System/370 and ESA/370 modes of of operation. DPPX/370 release 3 will run as a logical partition under PR/SM. LPAR support under PR/SM will be available November, 1991.

With ESA/390 mode, DPPX/370 Release 3 will support 128 megabytes of main storage and up to 2 gigabytes of logical storage. With extended logical addressing, larger user address spaces can be defined allowing for growth in size of applications. The extended addressability does not require any change to existing program or user interfaces. Applications currently running under DPPX/370 can take advantage of the larger address space sizes without modifications.

DPPX/370 Device Support

DPPX/370 supports the ESCON Channel for attachment of the IBM 3174-21L. Since the ESCON Channel is only available in ESA/390 mode, it is not supported by DPPX/370 Release 2, which only runs in S/370 mode. Likewise, the Parallel Channel also is not supported by DPPX/370 Release 2.

Devices which are supported by DPPX/370 Release 3 on either the S/370 channel feature #6003 or the Parallel channel are:

- IBM 3174 establishment controller
- IBM/TELEX 1589 tape drive
- IBM 2440 magnetic tape subsystem, models A01, B01, J01
- IBM 3422 magnetic tape subsystem.

DPPX/370 supports the following ES/9000 rack-mounted storage devices:

- 9332, all models
- 9335 DASD
- 9336, all models
- 9347 tape drive
- 9348 tape drive

Please note that any channel-attached DASD such as the 3380 and 3390, as well as any CKD DASD, are not supported by DPPX/370.

Software Requirements Summary

System Control Program	IBM 9221			IBM 9121	
	S/370	*ESA/390*	*LPAR*	*ESA/390*	*LPAR*
VM					
VM/SP 1.5[1]	X	-	X	-	X
VM/SP 1.6[2]	X	-	X	-	X
VM/HPO 1.5[3]	-	-	X	-	X
VM/HPO 1.6[4]	-	-	X	-	X
VM/XA 2.1[5]	-	-	X	X	X
VM/ESA 1.1.0 (370 Feature)[6]	X	-	X	-	X
VM/ESA 1.1.0 (ESA Feature)	-	X	X	X	X
MVS					
MVS/370 1.3.5 and 1.3.6[7]	X	-	X	-	X
MVS/SP 2.2.0[8]	-	X	X	X	X
MVS/SP 3.1.0E[9]	-	X	X	X	X
MVS/SP 3.1.3[10]	-	X	X	X	X
MVS/ESA SP 4.1.0[11]	-	X	X	X	X
MVS/ESA SP 4.2.0	-	X	X	X	X
VSE					
VSE/SP 3.2.2	X	-	X	-	X
VSE/SP 4.1.2[12]	X	-	X	-	X
VSE/ESA 1.1.0	X	X	X	X	X
DPPX					
DPPX/370 1.2[13]	X	-	-	-	-
DPPX/370 1.3	X	X	X	-	-

LEGEND:

X = Supported
- = Not Supported

NOTES:

1. PUT level 9002 or PUT Level 9003 With APAR VM42832 in PTF UV90584
2. PUT level 9002 or PUT Level 9003 With APAR VM42832 in PTF UV90586
3. PUT level 9002 or PUT Level 9003 With APAR VM42832 in PTF UV90585
4. PUT level 9002 or PUT Level 9003 With APAR VM42832 in PTF UV90587
5. PUT level 9002 or PUT Level 9003 With APAR VM42913
6. With APAR VM42848 in PTF UV90074
7. PTF UY90636 required for IBM 9221
   PTF UY90632 required for IBM 9121
8. PTF UY90628 required for IBM 9221
   PTF UY90628 and UY90633 required for IBM 9121
9. PTF UY90629 required for IBM 9221
   PTF UY90629 and UY90634 required for IBM 9121
10. PTF UY90630 required for IBM 9221
    PTF UY90630 and UY90635 required for IBM 9121
11. PTF UY90631 required for IBM 9221
    PTF UY90631 required for IBM 9121
12. With APAR DY39560
13. With APAR DF19421

Chapter 3. I/O Considerations

When migrating to an air-cooled ES/9000 processor, it's important to consider not only which devices will attach to the new processor, but how that attachment may differ from previously installed processors. The purpose of this chapter is to identify areas where special consideration should be given when planning for the migration of I/O devices to an air-cooled ES/9000 processor.

Operating Systems Console Considerations

The ES/9000 processors use an outboard workstation as a service processor and, in the case of the IBM 9221, as a console device. The service processor is based on a PS/2 microprocessor, with special attachments to provide the processor connection and support. This device is used for the installation and maintenance of Licensed Internal Code, system configuration, system control, and problem analysis functions.

All system console hardware and attachment cables are provided with the ES/9000 processor. The customer must provide additional 110v power for the display, microprocessor, and modem, as well as a table or other suitable work area.

IBM 9221 Processor Console

The IBM 9221 system console device is known as the Processor Console. The processor console connects to the processor unit using two separate attachments: a system connection, and an optional 3270 device connection.

The system connection is made to the IBM 9221 processor unit itself, for use as a system control device. The system interface cable connects the parallel port on the PS/2 microprocessor unit to a native attachment on the IBM 9221 processor. This connection is used for system control functions such as IML, IPL, Configuration, and Problem Analysis. The cable length for the system connection is 6 meters (20 feet). For an extended distance, a LAN-attached Remote Console and Remote Console Facility are offered.

The IBM 9221 processor console implements a Common User Access (CUA) interface under Systems Application Architecture. SAA provides ease of use and consistency with other IBM processor and operating systems.

The processor console attachments include:

- PS/2 Model 70-121
- 8513 12-inch color display
- Internal tape backup unit
- 60mb fixed disk
- Multiprotocol adapter for remote facilities
- Mouse for console operations
- Optional attachments:
  - Feature #2000--3270 Operator Console attachment

- Feature #1133--Token Ring connection for LAN attached Remote Console support, and as the prerequisite connection of the Processor Console to the MCCU (feature #6200)

Use of the processor console as a personal system is not supported.

The processor console can connect in 3270 mode by using a coaxial cable from the Feature #2000 card to the work station control unit. Feature Code #2000 consists of the 3270 connection card and operating software. The device simulates a non-SNA 3270 display in DFT (distributed function terminal) mode. In this manner, the device can function as an operating system console as well as the system control console. Although OS/2 Extended Edition is used as the base for 3270 communications, only one DFT session is supported by FC#2000.

For the FC#2000 3270 connection, cable length is limited only to the standard imposed by the cabling system that is used. The coax connection can be made to a #6120 Workstation Subsystem feature on the IBM 9221 processor, or to any non-SNA 3x74 control unit.

IBM 9221 LAN Attached Remote Console and Remote Console

An optional LAN attached Remote Console can be provided for users who require a connection distance greater than 25 feet. This console is attached through the Token-Ring feature, #1133, using local-area network cabling and an 8228 (multi-station access unit) or equivalent device. The device used as the LAN attached remote console must also have a token-ring connection card.

The distance limitation for the LAN attached remote console connection is 200 meters. In addition, the connection must be made with a private local-area network. The IBM 9221 LAN attached remote console cannot participate with other users in an 802.5 LAN. However, multiple IBM 9221 systems and LAN attached remote consoles MAY share the private LAN.

The remote console support can be used to control the IBM 9221 from a switched SDLC connection. The remote device must be a standalone console; IBM 9221 processor consoles cannot function as a remote operator console. This is a departure from the previous ES/9370 support, which permitted a ES/9370 processor console to dial and control a second system.

In either implementation, the connection is made between the LAN attached remote console or the remote console, and the IBM 9221 processor console. Direct connection between the LAN attached device and the processor itself is not provided. Therefore, the primary processor console must be operational to use the LAN attached remote console or remote support.

The device used for the LAN attached remote console or the remote console the following minimum configuration:

- PS/2 model 55SX or above (80386 or 80386SX)
- 60mb fixed disk
- 6 meg storage or greater
- 1.44 mb diskette drive
- OS/2 Extended Edition 1.2 or higher

- Connection for Token-ring or SDLC dial
- 5853 modem (or equivalent) for SDLC connection

Devices that were used as remote consoles for the ES/9370 may not support the IBM 9221 remote console software. The minimum configuration for an ES/9370 operating the ROF console was a PS/2 model 30 or PC/AT, running DOS software. The CUA implementation on the ES/9000 requires OS/2, which does not run on these devices.

IBM 9121 Frame I/O Support Processor Configuration

The IOSP component of the IBM 9121 frame models is an externally-attached, specially configured version of the PS/2 microprocessor. The operator interface is very similar to the existing ES/3090 IOSP consoles.

Following is the basic configuration of the I/O Support Processor:

- PS/2 microprocessor unit
- 8503 monochrome display
- Internal tape drive
- Two internal disk drives
- Multiport adapter for remote IOSP displays
- Up to two Proprinter attachments
- Optional token ring attachment

The IOSP provides the following console functions:

- System console
- Service console
- System monitor console
- Service monitor console
- Program mode console

The IOSP on the IBM 9121 does not provide an operating system console session. A 3270-type device attached via a channel-attached non-SNA control unit is required for use as an operating system console. In the case of multiple systems executing under an LPAR configuration, each logical partition must have its own operating system console attached through a separate 3x74.

For customers requiring console functions remote from the processor, IOSP remote displays (features #1001 - #1004) are available. Each feature provides a 3151 display with 1920 character support and a unique keyboard. The attachment to the IOSP uses a standard RS-422-A interface. The maximum distance from the IOSP is 2000 feet. A 100 foot cable is provided. If a distance greater than 100 feet is required, the customer must provide that cable.

The IBM 9121 does not provide ROCF support, which was a feature on many 43xx processors. Most of the functions performed by ROCF are now provided by network management software.

The following table summarizes the similarities and differences between selected S/370 and ES/9000 family console arrangements.

Table 1. S/370 Processors--System Console Differences

Feature	4361	4381	9370	IBM 9221 (RACK)	IBM 9121 (FRAME)
Base unit	3279	3279	PS/2-30	PS/2-70	IOSP
Program base	N/A	N/A	DOS 3.0	OS/2 EE 1.2	3090 Console
SAA Presentation Mgmt	No	No	No	Yes	No
Tape backup	No	No	No	Yes	Yes
3270 Console connection	Standard	Standard	Standard	Use FC #2000	No
Remote device type	3275	3275	PC/AT, PS/2	PS/2-55X, or above	Alternate IOSP feature

Attachment/Compatibility Considerations

IBM 9221 Device Attachment

I/O devices attach to the IBM 9221 processor using the following methods:

- Internal processor bus
- S/370 block multiplexer channel through the internal bus
- Parallel channel #6101 or #6103
- ESCON channel #6111 or #6113

The internal bus attaches the integrated adapters that are common to the ES/9370 system. Because of the differences in architecture between 370 and ESA modes, these attachment methods are only supported in specific processor modes:

- The S/370 BMPX channel #6003 only functions with the S/370 Base Option Feature (#9370).
- The Parallel Channel #6101/#6103 can function in either Native S/370 or ESA/390 mode.
- The ESCON Channel #6111/#6113 only functions in ESA/390 mode.
- The S/370 BMPX channel feature #6003 cannot coexist with either the Parallel (#6101/6103) or ESCON channels (#6111/6113).

In addition, some of the ES/9370 integrated attachments are not supported, or only operate in S/370 mode. The following features are NOT supported in any manner on the ES/9000:

- #6030 Communications Processor: Replaced by #6130
- #6032 4-line Async Adapter: Replaced by #6033

- #6001 Power Sequence Control: Replaced by #6201
- #5000 I/O Card Unit Adapter: Replaced by #5100
- #5030 I/O Expansion Unit: Replaced by #5010/#5020

The following features are supported only in S/370 mode:

- #6003 S/370 Block Multiplexer channel. For ESA/390 mode, use #6101/#6103, the Parallel Channel.
- #6010 DASD/TAPE adapter. For ESA/390 mode, use feature #6310.
- #6020/#6021 Workstation Subsystem. For ESA/390 mode, use feature #6120.

The following ES/9370 features are supported on the IBM 9221 in all modes:

- #6130 Communications processor
- #6120 Workstation subsystem
- #6310 DASD/TAPE subsystem
- #6034 4mbs Token Ring adapter
- #6134 4mbs/16mbs Token Ring adapter
- #6035 IEEE 802.3 LAN adapter.

43xx Device Attachment to the IBM 9221

The 4341 and 4381 processors attached devices through external block multiplexer and byte channels. In addition, the 4321, 4331 and 4361 processors used integrated adapters as well as S/370 channels for device attachments. Consider the following restrictions when migrating 43xx devices to the IBM 9221 rack models:

- S/370 channel device attachment: The S/370 BMPX channel #6003 does not operate in byte mode. Some byte-mode devices such as the 2701 and 37x5 controller running Emulation Program will not run on this version of S/370 channel. The Parallel Channel, #6101/#6103, can be configured to run in byte mode to support these devices.
- DASD/TAPE Adapter: The 43xx used this adapter to natively attach 3310, 3370, and 8809 devices to the processor. These devices will not work with the IBM 9221 DASD/TAPE subsystem, FC #6310. The 3310 devices will not work with any other processor. To use the 3370, a 3880 control unit must be added to place the devices on a S/370 channel. Otherwise, consider migrating the data to 933x FBA devices on the IBM 9221. For integrated tape support, consider the 9347 or 9348 tape drives, based on customer requirements. Otherwise, a S/370 channel-attached tape unit such as the 2440 is required to replace the 8809.
- Display/Printer Adapter (DPA): This feature was used to support system printers with a coaxial cable connection. Certain line printer models could be placed on this adapter to interpret non-3270 character streams and function in S/370 channel mode. These devices will not migrate to the workstation subsystem of the IBM 9221 unless the following alterations are made:
  - 3262 Model 1: Convert to Model 3 with RPQ XG3247
  - 3262 Model 11: Convert to Model 13 with RPQ S01498
  - 4245 Model D12: Remove feature #9160.

These changes will enable the above devices to be used on the #6020/#6021 or #6120 Work Station subsystem of the IBM 9221.

- Communications Adapter: The IBM 9221 #6130 Communications Subsystem has its own unique cable connectors and the existing 43xx CA cables will not fit. New cables can be provided with the IBM 9221 at an additional expense, or the customer can provide their own cables. See 'IBM 9221 Planning for System Installation' GA24-4187 for information on the cable layouts.

Device Attachment to the IBM 9121 Frame Systems

External devices are attached to the IBM 9121 through either the 4.5MB parallel channel or the 10MB ESCON channel. The parallel channel can function in byte, block multiplexer, or selector mode. Almost all devices that were supported on the 43xx and ES/9370 S/370 channels are supported on this channel. One exception is the 3410, which is not supported on the parallel channel because it does not support shared selector channels.

Note the following when migrating from a ES/9370 system to the IBM 9121:

- None of the integrated adapters of the ES/9370 are supported on the IBM 9121. Also, none of the bus-attached hardware such as the 933x DASD can be converted to run on the Parallel channel.
- The IBM 9121 supports only the following rack-mounted devices:
  - 2440 Tape drive attached to parallel channel
  - 3174-12L, 22L attached to ESCON channel

The following tables summarize the current listed device support for channel and bus-connected devices on the air-cooled processors. These are devices that have been formally tested or verified by development as able to operate with the processor as shown below. The absence of support for a particular device is not an indication that the connection will not work if tested. For a formal statement of support from IBM for any device not listed below, an RPQ is necessary.

Table 2 (Page 1 of 2). Supported device attachments to ES/9000 air-cooled processors.						
DEVICE/MODEL	**IBM 9221 RACK**				**IBM 9121 FRAME**	
	Internal Bus Adapter	**#6003 BMPX**	**#6101/ #6103 (Parallel)**	**#6111/ #6113 (ESCON)**	**4.5 MB (Parallel)**	**10 MB (ESCON)**
DASD and Controllers						
3330/3333	N	Y	Y	N	Y	N
3340/3344	N	Y	Y	N	N	N
3350	N	Y	Y	N	Y	N
3370	N	Y	Y	N	N	N
3375	N	Y	Y	N	Y	N
3380	N	Y	Y	N	Y	Y
3390	N	N	Y	Y	Y	Y
9332	FC#6310	N	N	N	N	N
9335	FC#6310	N	N	N	N	N
9336	FC#6310	N	N	N	N	N
3830	N	N	Y	N	N	N
3850	N	N	Y	N	N	N
3880	N	Y	Y	N	Y	N
3990	N	Y	Y	Y	Y	Y
Tape Units and Controllers						
1589 (TELEX)	N	Y	Y	N	N	N
2440	N	Y	Y	N	Y	N
3410/3411	N	Y	N	N	N	N
3420/3803	N	Y	Y	N	Y	N
3422	N	Y	Y	N	Y	N
3430	N	Y	Y	N	Y	N
3480	N	Y	Y	N	Y	N
3490	N	Y	Y	Y	Y	Y
9347	FC#6310	N	N	N	N	N
9348	FC#6311	N	N	N	N	N
Display/Printer Control Units						
3174	N	Y	Y	N	Y	N
3174-12L,22L	N	N	N	Y	N	Y
3272	N	Y	Y	N	Y	N
3274	N	Y	Y	N	Y	N
7170	N	Y	Y	N	Y	N
7171	N	Y	Y	N	Y	N
Graphics Systems and Controllers						
3250	N	Y	Y	N	N	N
5080/6080	N	Y	Y	N	Y	N
5088	N	Y	Y	N	Y	N
6090	N	Y	Y	N	Y	N
6098	N	Y	Y	N	Y	N
Communications Controllers						
2701	N	N	Y	N	N	N
3705 NCP	N	Y	Y	N	Y	N
3720 NCP	N	Y	Y	N	Y	N
3725-1,2 NCP	N	Y	Y	N	Y	N
3745 NCP	N	Y	Y	N	Y	N
37xx EP/PEP (All)	N	N	Y	N	Y	N

Table 2 (Page 2 of 2). Supported device attachments to ES/9000 air-cooled processors.

DEVICE/MODEL	IBM 9221 RACK				IBM 9121 FRAME	
	Internal Bus Adapter	#6003 BMPX	#6101/ #6103 (Parallel)	#6111/ #6113 (ESCON)	4.5 MB (Parallel)	10 MB (ESCON)
Printers						
1403/2821	N	Y	Y	N	N	N
3203-5	N	Y	Y	N	Y	N
3211/3811	N	Y	Y	N	Y	N
3262-5	N	Y	Y	N	Y	N
3800-1	N	N	N	N	Y	N
3800-3,6	N	Y	Y	N	Y	N
3820	N	Y	Y	N	Y	N
3825	N	Y	Y	N	Y	N
3827	N	Y	Y	N	Y	N
3835	N	Y	Y	N	Y	N
4245-1	N	Y	Y	N	N	N
4245-12,20	N	Y	Y	N	Y	N
4248	N	Y	Y	N	Y	N
6262	N	Y	Y	N	Y	N
Channel Connections						
3044-C01	N	Y	Y	N	Y	N
3044 C02,D01,D02	N	N	Y	N	Y	N
308X CTCA	N	Y	Y	N	N	N
3088-A1,1,2	N	Y	Y	N	Y	N
3172-001	N	Y	Y	Y	Y	Y
3172-002	N	Y	Y	N	Y	N
3737	N	Y	Y	N	Y	N
3814	N	Y	Y	N	Y	N
4341 CTCA	N	Y	Y	N	N	N
4381 CTCA	N	Y	Y	N	N	N
8232	N	Y	Y	N	Y	N
MCCU (FC #6200)	N	Y	Y	N	N	N
9032-2	N	N	N	Y	N	Y
9033-1	N	N	N	Y	N	Y
9034-1	N	N	N	Y	N	Y
9035-2	N	N	N	Y	N	Y
Other Products						
2501	N	Y	Y	N	Y	N
2540/2821	N	Y	Y	N	N	N
3505	N	Y	Y	N	Y	N
3525	N	Y	Y	N	Y	N
3540	N	Y	Y	N	Y	N
3838	N	N	N	N	Y	N
3848-1	N	N	N	N	Y	N
3890/3890XP	N	Y	Y	N	Y	N
3897/3898	N	N	Y	N	N	N
495X	N	Y	Y	N	Y	N
9770	N	Y	Y	N	N	N
9775	N	Y	Y	N	N	N

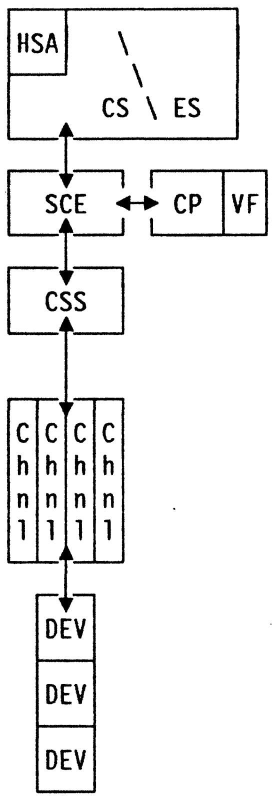
Chapter 4. IOCP

The purpose of this chapter is to provide information and materials which will assist with the understanding, implementation and usage of the IOCP process.

To accomplish these ends a brief overview of the hardware components that provide the functions required to support the Input / Output subsystem will be covered. Terminology and familiarity with the components and their functions are included. There are explanations of the IOCP process, mechanics and flow of the steps, samples of the creation and implementation of the functions and various related activities and associated features.

ES/9000 Hardware Components

Fundamental to the entire I/O subsystem concept of a ES/9000 complex is an understanding of the relationship of the hardware components of the system. Figure 1 on page 22 shows a very general block diagram which relates the various components of the complex. A key factor to be noted is the intent to relate the storage of data on external (I/O) devices to the access of the data by central storage and the central processor(s). The text accompanying the diagram notes the relationships and naming of the components.



It is important to associate the hardware components of the ES/9000 system, including central storage (CS), expanded storage (ES), and the vector facility (VF).

A key element is the System Control Element (SCE). The SCE provides the communication function between the components.

The SCE coordinates the activities between the Central Processor(s) (CP), the Main Storage subsystem (CS/ES) and the Channel Subsystem (CSS).

To identify and provide for communications with the Input/ Output devices, an area of Central Storage, called the Hardware System Area (HSA), contains control information defining the I/O subsystem.

The control information is loaded in the system (HSA) as shown in a later diagram.

Figure 1. ES/9000 Hardware Components

The bottom portion of the figure represents the physical components of a processor complex which are familiar to most. The 'Chnl' label refers to the physical channel interfaces to which 'channel' interface cables connect. These cables then attach to I/O control units and I/O devices which are represented by the 'DEV' labels in the figure.

Channel Subsystem (CSS)

The channel facility required to perform an I/O operation is called a subchannel. The control and implementation of I/O operations depend on the following:

- Architectural mode of operation
  - S/370
  - ESA/390

- Data mode of operation
  - Byte multiplex
  - Block multiplex
  - ESCON

- I/O interface protocol
  - Inter locked
  - Data streaming
  - Non synchronous

SUBCHANNELS

One unit control word (UCW) is assigned to each subchannel. UCWs are stored in the hardware system area (HSA) of central storage and are moved to a channel subsystem during execution of an I/O operation.

The **architectural mode of operation** is determined by the central processor (CP) instruction set (S/370 or ESA/390) selected during initialization of the processor complex or of a logical partition. The IBM 9121 offers only ESA/390 mode of operation, unless in logical partitioned (LPAR) mode. The IBM 9221 offers both S/370 and ESA/390 modes of operation.

The **data mode of operation** is determined by the multiplex (byte or block) or ESCON[1] mode selected for specific channels during initialization the processor complex.

The **I/O interface protocol** is determined by the interface sequencing operations selected for specific control units and their associated devices that are attached to the channel.

Information is required to facilitate the activities of the channel subsystem (CSS). The installation specific I/O configuration information is created by the installation and stored on magnetic media which is associated with the Processor Controller Element (PCE) of the complex. The data is stored on the integrated DASD of the PCE I/O Support Processor (IOSP). The information is saved in data sets named Input Output Configuration Data Sets (IOCDS). Six of these data sets are provided on the IBM 9121 (A0 - A5), while four (A0 - A3) are available on the IBM 9221.

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1 This chapter does not attempt to cover the functions or features introduced by the addition of ESCON capability. This material is found in other IBM publications such as *Enterprise Systems Connection: Planning and Migration, GG66-3181*.

Hardware System Initialization

At hardware system initialization the I/O specific configuration information previously created and stored in an IOCDS is loaded into the Hardware System Area (HSA) of central storage. The initialization process also uses the information to load the appropriate Licensed Internal Code into the channel subsystem for each defined channel. For the channels that have more than one possible mode the decision process uses this information to decide on the appropriate action. On an IBM 9121, the first eight (8) parallel channels have the capability to operate in block or byte multiplexer mode. On the IBM 9221, any eight of the parallel channels X'20' - X'37' can be byte multiplexor. The option chosen at this point in the hardware initialization process is also reflected in the information loaded into the HSA.

The following schematic represents the selection of an IOCDS and its subsequent loading into the HSA during hardware initialization.

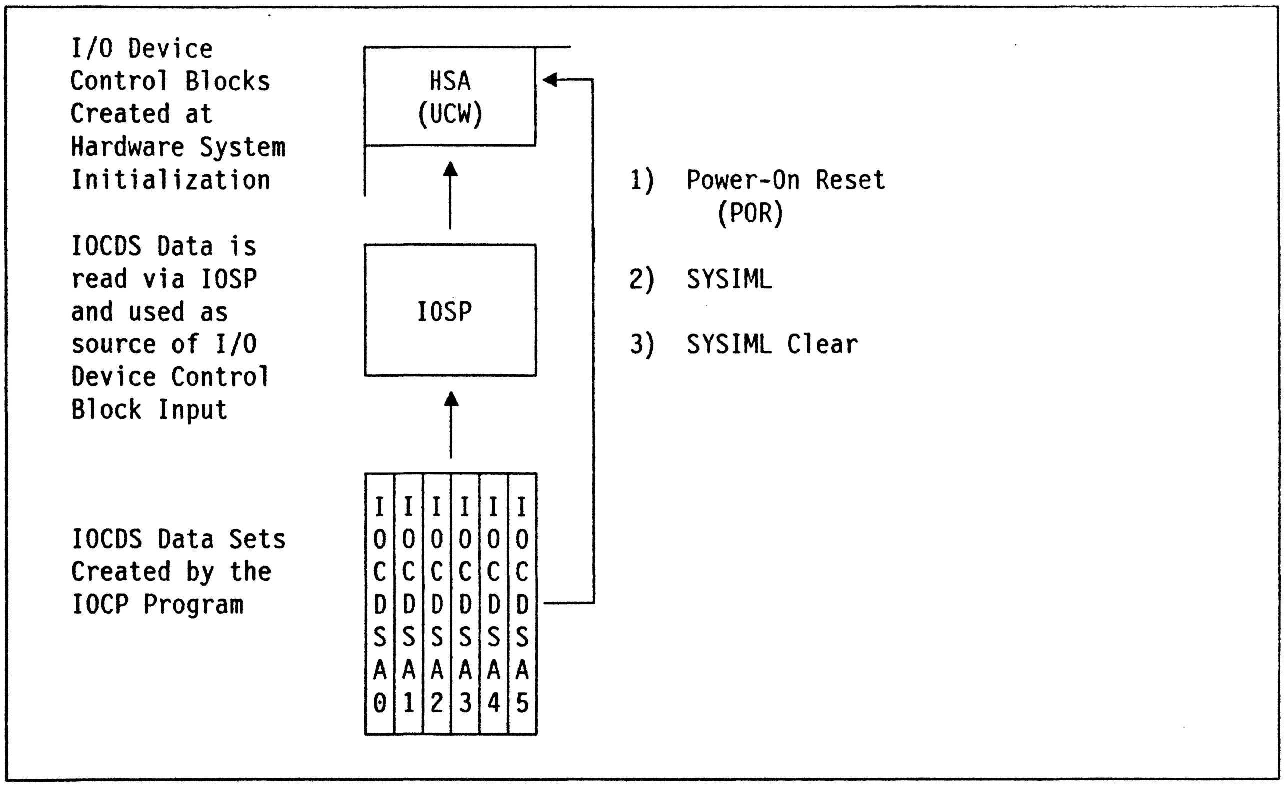


Figure 2. I/O Control Block Creation in HSA on IBM 9121

Any of the three actions noted on the diagram will create a newly loaded HSA. A decision is made by the installation operational function as to which I/O Control Data Set (IOCDS) is to be selected. As shown, there are six data sets available (IOCDSA0 - IOCDSA5). Selection of a valid choice will be installation dependent and determined by the selected configuration.

The three options listed are disruptive and require the System Control Program (SCP) and application programs to be reinitialized.

Requirements for the Process

The Channel Subsystem (CSS) requires specific information about the hardware I/O configuration. (Where is the data? How is it retrieved?) The following three components provide the physical connectivity of a specific I/O device with main storage and the processor(s).

- Channel Paths
- Control Units
- I/O Devices

The channel subsystem handles all I/O operations for each central processor. The CSS controls communication between a configured channel, the control unit and the I/O device. The I/O configuration data set (IOCDS) that is selected at system initialization defines the channel paths on the processor complex, the control units attached to the channel paths, and the I/O devices attached to the control units. The IOCDS is created by the I/O Configuration Program (IOCP) and is stored on the IOSP integrated disk storage device. At hardware system initialization, the IOCDS information is used to build the necessary control blocks in the hardware system area of central storage (which is not available for program use).

The channels in the channel subsystem provide transfer of data between central storage and I/O devices, under control of a channel program. The channels operate independently of other operations being performed by a central processor. A central processor is therefore free to resume other operations after initiating an I/O operation.

The air-cooled ES/9000 channel subsystem is not like the 4300 channel implementation. The 4300 systems utilized central processor 'cycle stealing' to provide channel service. That implementation limited the maximum aggregate data rate of the system to a value less than the aggregate sum of the data rates for the channels. ES/9000 complexes have an aggregate rate which is equal to the sum of the maximum data rates for the channels. This is the result of each ES/9000 channel being a separate entity as stated above.

Hardware I/O Control Block Creation

Control Blocks are created in the Hardware System Area (HSA) of Central Storage (CS) during Hardware Initialization. These control blocks are named Unit Control Words (UCW). For those familiar with operations on the 4300 family of processors in S/370 mode, it is noted that these UCW control blocks were created and updated from the hardware system console utilizing a manual data entry process. Other prior S/370 models also provided for a manual entry process to establish the correct definitions. In many cases these steps were accomplished through the services of a hardware service representative.

Software I/O Control Block Creation

The IPL (Initial Program Load) process validates the System Control Program (SCP) I/O definitions with the HSA I/O information and enables the Channel Subsystem for I/O activity.

Introduction to the IOCP Process

The IOCP process was introduced with the announcement of the 3081 on November 12, 1980. The new IOCP process provided additional flexibility and function to the I/O configuration management function.

- Now the USER can define the I/O subsystem with:
  - Multiple definition capability
  - Storage on magnetic media (DASD)
  - Validity checking at creation
  - Viewing during normal operations
  - Batch and stand alone update capability
  - Hardcopy reporting
- No Longer Dependent on Hardware Service Representative for Changes

The above capabilities made it possible to provide more flexibility within an installation. Backup configurations could be predefined, tested, and documented. Changes to the I/O configuration could be documented and the implementation expedited through prior planning and checking. A new IOCDS reflecting the changes to the I/O subsystem could be planned and created before the actual physical changes to the configuration occurred. Upon completion of the hardware changes the new IOCDS could be selected and loaded into the HSA. The process no longer requires the involvement of hardware service personnel to update the UCWs.

The basic steps of the IOCP process have not changed over the years. As new functions and features of the I/O subsystems have evolved there have been modifications to the IOCP process to accommodate the changes.

- On systems with channels having either Byte or Block multiplexing capability it is a simple coding change to specify the option chosen.
- I/O Controller features on the IBM 9221 are assigned a unique channel type (IOC).
- When data steaming was introduced, a parameter was added to indicate this feature.
- When the channel data rate increased to 4.5 MB this function was included via a parameter change.

  With the advent of Logical Partition mode (LPAR) naming of the logical partitions and the assignment of the physical channel paths was implemented through the IOCP process.
- ESCON implementation is defined by additions to IOCP input statements.
- Future enhancement and expansion of the I/O subsystem capabilities will be defined and implemented through the IOCP process.

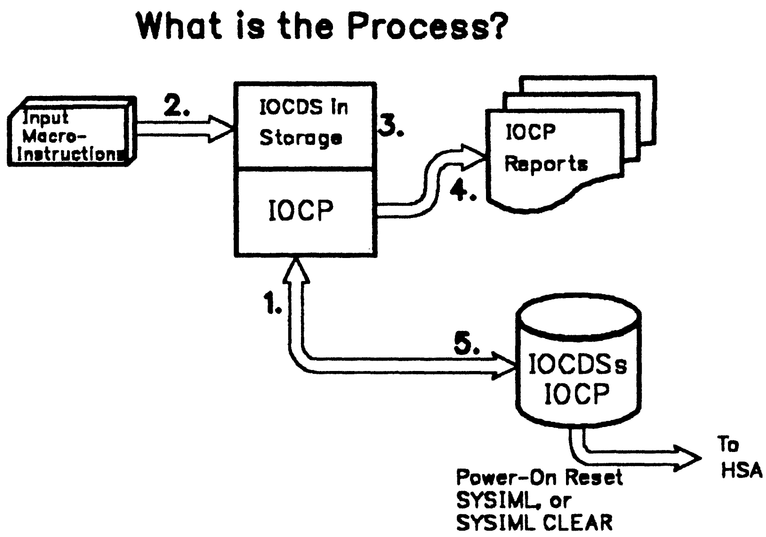


Figure 3. IOCP Process

How Does the Process work?

Figure 3 shows the steps needed to initially install a new system requiring a customized IOCDS that matches the installed I/O configuration.

1. The stand alone version of the IOCP program is initiated from the hardware system console and is read from the IOSP DASD storage media associated with the Processor Control Element (PCE).
2. An input device is defined to the IOCP program as the designated input source for previously created IOCP input statements. A tape drive is valid for both the IBM 9221 and IBM 9121, while the IBM 9121 also supports a card reader for IOCP input. An optional printer is also defined at this time.
3. The IOCP program reads the input statements, builds an IOCDS in storage and communicates via the IOSP system console. If the input is syntactically correct a message indicating this status is displayed on the console.
4. If the input is correct, an option is presented allowing the stand alone IOCP reports to be printed.
5. Another option is presented to allow the writing of the new IOCDS to an installation selected data set (A0-A5 for the IBM 9121 and A0-A3 for the IBM 9221).
6. When the writing of the new IOCDS is completed a Power-On Reset (POR) can be initiated, with the new IOCDS as the target data set. The new installation defined I/O configuration will be loaded into the HSA.

Stand Alone IOCP Steps

The stand alone IOCP process is represented by Figure 4 with the following notes:

- The processor complex must be in ESA/390 mode to initiate the stand alone IOCP process.
- The subsequent POR will initialize the system in ESA/390 or LPAR mode depending on installation options selected.

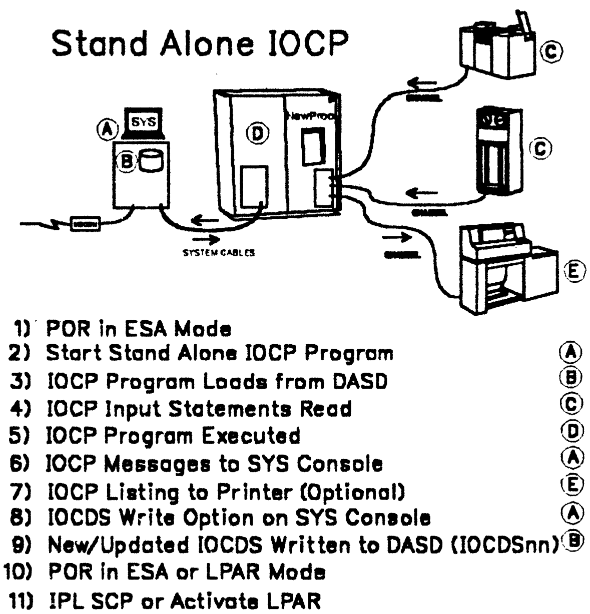
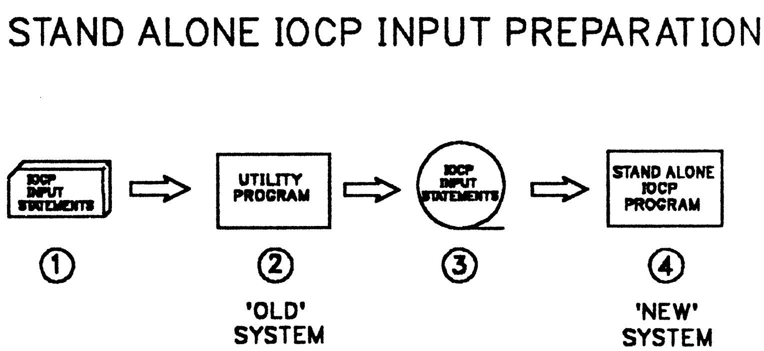


Figure 4. Stand Alone IOCP Steps



1. Using any existing installation method, the IOCP input statements are coded on the desired media (cards, tape, DASD).
2. Using an existing system the input statements could be syntax checked (recommended) and reports generated by a batch IOCP program implementation.

3. When the desired results are achieved the data is written to the selected stand alone IOCP input media.
4. The input is read into the stand alone IOCP as described in Figure 4 on page 28.

It is important to note that all efforts should be made to insure that the IOCP input is syntactically as well as installation specifically correct. If this is not the case, especially in 'push-pull' situations, there exists the potential for disruption and dissatisfaction with the install process. A simple safeguard example is to create a duplicate copy of the stand alone IOCP input statements. Unnecessary delays can be generated by 'missing' card decks, snapped input tapes or syntax errors.

Enhanced Stand Alone IOCP Process

Enhancements have been added to aid with the IOCDS generation process in the stand alone environment. These enhancements include a full screen editor and associated functions. With the new functions it is now possible to create a new IOCDS using skeleton statements, or load an existing IOCDS into processor storage. This input can then be modified, syntax-checked and validated, then written back to the same or a different IOCDS. Reports of existing IOCDSs can also be printed. These new functions are initiated from menu selections on the system console supported by stand alone IOCP.

Figure 5 illustrates steps from the enhanced process.

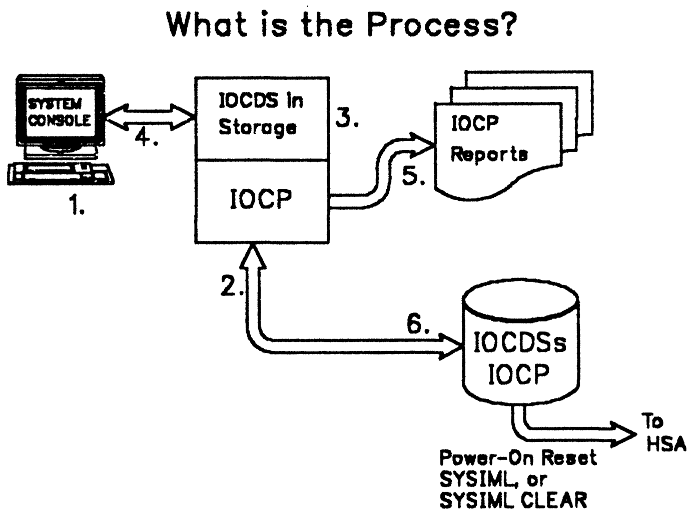


Figure 5. Enhanced Stand Alone IOCP Process

1. The stand alone IOCP process is initiated from the hardware system console and the 'update' of an existing IOCDS is selected.
2. The selected IOCDS is read from the PCE DASD storage device.
3. The IOCDS is loaded into processor storage.
4. Changes are made to the IOCP statements displayed on the screen.
5. If desired, reports will be printed.
6. The IOCDS is updated or a new data set is created on the DASD.
7. The new IOCDS is used as input to the POR process and the new I/O configuration is loaded into the HSA.

The full screen editor facility of the stand alone IOCP will be especially useful for those accounts not having a system control program that supports the batch update version of the IOCP.

An important use for the editor is during initial install of an ES/9000 system. Mismatches between addresses of the physically connected I/O devices (tape drive, card reader, printer) utilized by the stand alone IOCP process and those defined in the IOCDS shipped with the system will make it necessary to change the specifications in the existing IOCDS to match the characteristics of the physical I/O devices installed.

Necessary changes can be made, a second IOCDS created and a POR done to implement the changes in the HSA. The stand alone IOCP will then be able to read and write to the selected devices and the installation defined IOCDS can be created. The ensuing POR will then create the I/O configuration control blocks (UCWs) in the HSA as defined by the installation.

Batch IOCP Process

The capability to create and/or update IOCDSs is provided by certain SCPs. As opposed to the stand alone process the batch process allows update activity while the system is running in a normal production environment.

While support levels of SCPs and the IOCP vary throughout the product line the following SCPs have batch IOCP processing support capabilities:

- MVS
- VM/ESA
- VM/XA
- VM/SP HPO

All other SCPs require use of the stand alone process to create IOCDSs on the ES/9000 system. Support for the ES/9000 processors is provided by a new version of IOCP.

While new processor and other support has been added, existing IOCP definition statements are upward compatible and may be used as input to the IOCP process. Coding for the 4381 while similar, does have differences and should be checked against the *IBM 4381 Input Output Configuration Program User's Guide and Reference, Appendix D, (GC24-3964)* for possible coding differences from the other IOCP programs.

Syntax Checking and Validation is provided by the batch process, thus allowing verification of a designated I/O configuration before the actual IOCDS is written. This validation may be run on any system type, but only the target system can write the physical IOCDS for that system.

As with the stand alone IOCP process, the batch process provides the capability to update existing IOCDSs or to create new data sets.

Although the product supported versions of VM/SP, VSE/SP, and VSE/ESA do not support the reading and writing of IOCDSs, they do provide syntax checking of the IOCP input statements and printing of the associated reports. Utilizing this capability will allow an installation to define and syntax check the input statements before the new system is installed. At installation time the necessary IOCP input statements will already have been prepared, checked and validated against the I/O configuration by the customer installation support function, and the input statements will be available and ready for the required stand alone IOCP process.

The VSE version of IOCP will become available soon after the availability of VSE/ESA 1.1.0. It will be used on both VSE/ESA and VSE/SP systems.

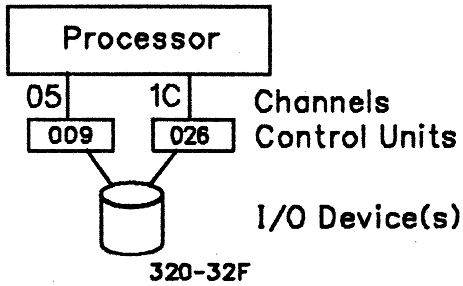
IOCP Input Statements

The coding format for IOCP input statement uses Assembler language coding rules (start in column 10, continuation in column 16, non-blank character in column 72 to signify continuation, etc.). Statements are in 80-byte card image format. Because the IOCP process evolved with MVS, the statement format aligns with the MVS SYSGEN statement structure. Following are some highlights of the implementation points:

- MVS provides a 'Combined Deck' option
  (MVS & IOCP 'tolerate' parameters used exclusively by the other)
- VM usage requires the IOCP format
  (Not compatible with VM DMKRIO statements)
- MVS Supports Card, Tape, and DASD
- VM Supports DASD
- VSE Supports Card, Tape, and DASD
- Stand Alone Supports:
  - Card, Tape
  - Console, DASD (IOCDS) added with this version of IOCP
- All Support Printer Output

To illustrate the format and structure of the IOCP statements the following example is shown. The physical configuration consists of one string of 3390 DASD (16 devices) at address X'320-32F' in S/370 addressing terms (IODEVICE); two 3990 storage directors (control units) which are connected to the 3390s (CNTLUNIT; and two channel paths (CHPID) which are identified as X'05' and X'1C'.

This definition will provide two paths through two control units to the I/O devices.



- CHAN05 CHPID PATH=(05,3),TYPE=BL
- CHAN1C CHPID PATH=(1C,4),TYPE=BL

- CU09 CNTLUNIT CUNUMBR=009,PATH=(05),PROTOCL=S4,UNIT=3990,
  UNITADD=(20,16)

- CU26 CNTLUNIT CUNUMBR=026,PATH=(1C),PROTOCL=S4,UNIT=3990,
  UNITADD=(20,16)

- DASD IODEVICE CUNUMBR=(009,026),UNIT=3390,
  ADDRESS=(320,16)

Figure 6. IOCP Input Statement Coding Example

The CHPID macro statement defines the physical address of the channel PATH (05 or 1C) while the second parameter defines the desired S/370 'channel' address as specified in the associated SCP. The TYPE parameter defines the type of physical channel that is selected (BYTE or BLOCK multiplexer). On an IBM 9121, channels X'00-07' have the capability of being defined and initialized as either BLOCK or BYTE. On an IBM 9221, channels X'20-37' can be assigned as BYTE channels, with a maximum of eight defined as BYTE. This parameter implements this option.

The CNTLUNIT macro provides a 'CUNUMBR' or 'tag' for each control unit, a referral to a PATH as defined in an associated CHPID macro, a PROTOCL parameter which defines this control unit as having 4.5 MB data streaming capability, a physical control unit address and number of devices (UNITADD), and a device type identifier (UNIT).

The IODEVICE macro relates the I/O device to its associated control unit(s) (CUNUMBR), a device number (or address in S/370 terminology) (ADDRESS) and a device type (UNIT).

While other parameters exist, this example shows the basic coding required for the definition of I/O devices on a system utilizing the IOCP process.

IOCP Statement Coding

Figure 7 on page 36 illustrates a system having display devices, DASD and unit record equipment. The devices and the address are:

- `3278  model  3 at 'addresses' 100-103`
- `3380           at 'addresses' 250-257`
- `3505  model P3 at 'addresses' 00C`
- `3525  model B2 at 'addresses' 00D`
- `4248  model B2 at 'addresses' 00E`
- `4248  model B2 at 'addresses' 01E`
- `3480           at 'addresses' 480-487`

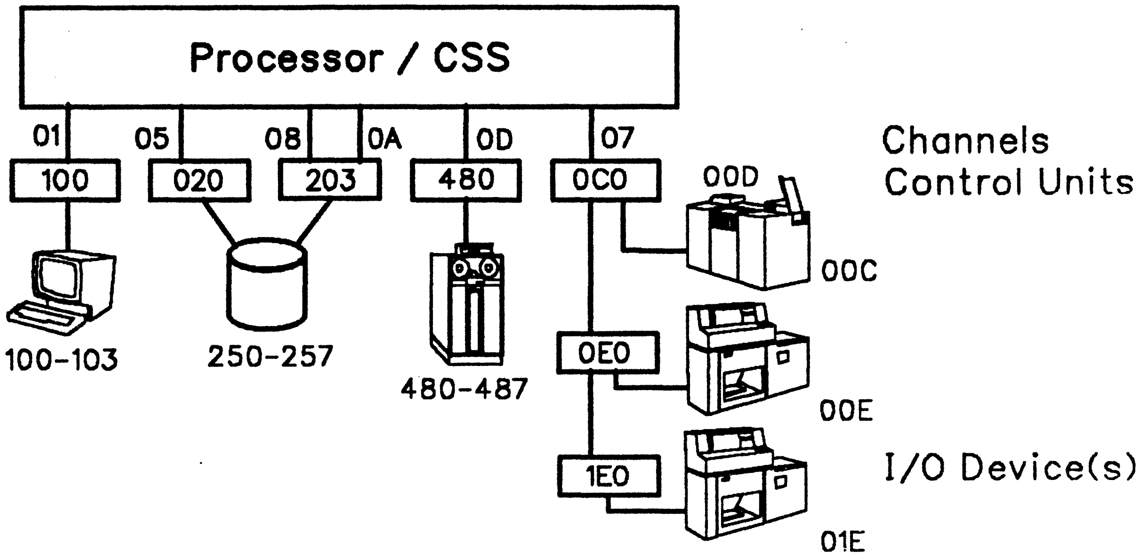
This example has additional coding which shows three channel paths available to the DASD. Also shown are three separate control units on the same channel path for the unit record devices.

Note the ID statement (see figure 7) which is a label providing a high level identifier for the file. It will also print on reports for this IOCP code.

The following examples are not complete, as parameters have not been included such as 'PROTOCL'. Specific parameters and values for each device type are listed in Appendix D of *Input/Output Configuration Program User's Guide SC38-0097.*

When planning for the IOCP generation, it is important to involve the IBM Hardware Service Representative to ensure the proper addresses of the control units and devices.

ESA/390 IOCP Example



- ID MSG1='ESA/390 MODE IOCP FILE'

- CHPID PATH=(01),TYPE=BL
- CHPID PATH=(05),TYPE=BL
- CHPID PATH=(07),TYPE=BY
- CHPID PATH=(08),TYPE=BL
- CHPID PATH=(0A),TYPE=BL
- CHPID PATH=(0D),TYPE=BL

- CNTLUNIT CUNUMBR=100,PATH=01,SHARED=YB,UNIT=3274,UNITADD=(00,32)
- CNTLUNIT CUNUMBR=020,PATH=05,SHARED=N,UNIT=3880,UNITADD=(50,16)
- CNTLUNIT CUNUMBR=203,PATH=(08,0A),SHARED=N,UNIT=3880,UNITADD=(50,16)
- CNTLUNIT CUNUMBR=0C0,PATH=07,SHARED=N,UNIT=3505,UNITADD=(0C,2)
- CNTLUNIT CUNUMBR=0E0,PATH=07,SHARED=N,UNIT=4248,UNITADD=(0E,1)
- CNTLUNIT CUNUMBR=1E0,PATH=07,SHARED=N,UNIT=4248,UNITADD=(1E,1)
- CNTLUNIT CUNUMBR=480,PATH=0D,SHARED=N,UNIT=3480,UNITADD=(80,8)

- IODEVICE CUNUMBR=100,ADDRESS=(100,4),UNIT=3278,MODEL=3,
- IODEVICE CUNUMBR=(020,203),ADDRESS=(250,8),UNIT=3380
- IODEVICE CUNUMBR=0C0,ADDRESS=00C,UNIT=3505,MODEL=P3,
- IODEVICE CUNUMBR=0C0,ADDRESS=00D,UNIT=3525,MODEL=B2,
- IODEVICE CUNUMBR=0E0,ADDRESS=00E,UNIT=4248
- IODEVICE CUNUMBR=1E0,ADDRESS=01E,UNIT=4248
- IODEVICE CUNUMBR=480,ADDRESS=(480,8),UNIT=3480

Figure 7. ESA/390 IOCP Coding Example

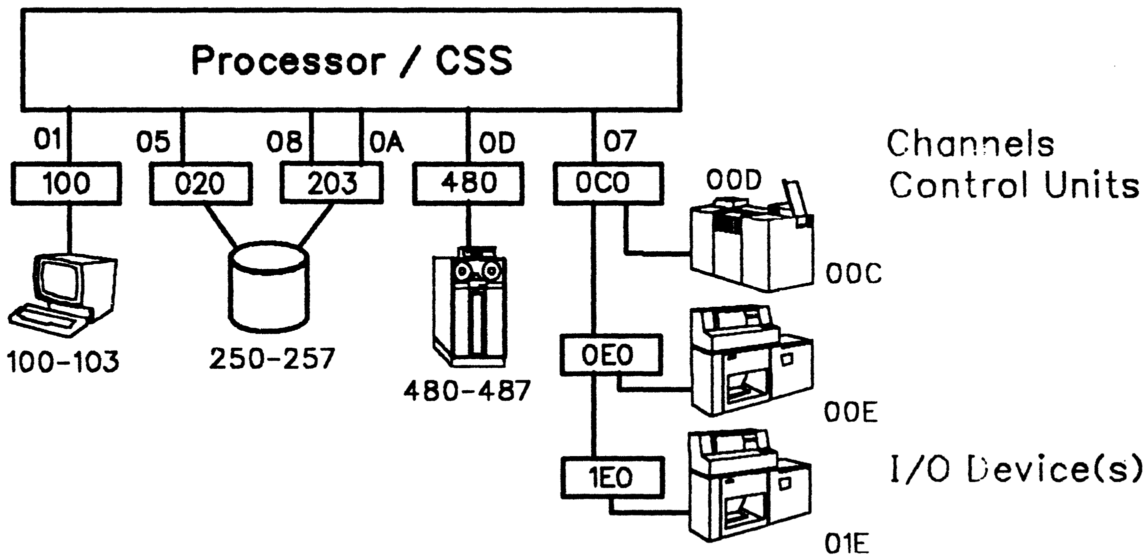
LPAR IOCP Example

Having seen a sample of the coding required for various device types in ESA/390 mode, the sample will now change to add the required parameters for the creation of an LPAR capable IOCDS.

Note that the ONLY required changes that have occurred are the inclusion of the 'PARTITION' parameter on the CHPID macro statements. In this example all of the CHPIDs are assigned to logical partition 'LP1' except CHPID X'08' which is assigned to 'LP2'. Note that the 'REC' parameter MUST be coded on S/370 CHPIDs. **REC** indicates the CHPID is reconfigurable.

For documentation purposes the 'PATH' parameter has the S/370 channel number and channel set designated as the second and third values for each CHPID definition. The relationship of the CHPIDs and S/370 channel 'addresses' will be discussed later in this chapter.

The remainder of the statements are unchanged.



- ID MSG1='LPAR MODE IOCP FILE'

- CHPID PATH=(01,1,0),TYPE=BL,PARTITION=(LP1,REC)
- CHPID PATH=(05,2,0),TYPE=BL,PARTITION=(LP1,REC)
- CHPID PATH=(07,0,0),TYPE=BY,PARTITION=(LP1,REC)
- CHPID PATH=(08,2,0),TYPE=BL,PARTITION=(LP2,REC)
- CHPID PATH=(0A,3,0),TYPE=BL,PARTITION=(LP1,REC)
- CHPID PATH=(0D,4,0),TYPE=BL,PARTITION=(LP1,REC)

- CNTLUNIT CUNUMBR=100,PATH=01,SHARED=YB,UNIT=3274,UNITADD=(00,32)
- CNTLUNIT CUNUMBR=020,PATH=05,SHARED=N,UNIT=3880,UNITADD=(50,16)
- CNTLUNIT CUNUMBR=203,PATH=(08,0A),SHARED=N,UNIT=3880, X
  UNITADD=(50,16)
- CNTLUNIT CUNUMBR=0C0,PATH=07,SHARED=N,UNIT=3505,UNITADD=(0C,2)
- CNTLUNIT CUNUMBR=0E0,PATH=07,SHARED=N,UNIT=4248,UNITADD=(0E,1)
- CNTLUNIT CUNUMBR=1E0,PATH=07,SHARED=N,UNIT=4248,UNITADD=(1E,1)
- CNTLUNIT CUNUMBR=480,PATH=0D,SHARED=N,UNIT=3480,UNITADD=(80,8)

- IODEVICE CUNUMBR=100,ADDRESS=(100,4),UNIT=3278,MODEL=3,
- IODEVICE CUNUMBR=(020,203),ADDRESS=(250,8),UNIT=3380
- IODEVICE CUNUMBR=0C0,ADDRESS=00C,UNIT=3505,MODEL=P3,
- IODEVICE CUNUMBR=0C0,ADDRESS=00D,UNIT=3525,MODEL=B2,

- IODEVICE CUNUMBR=0E0,ADDRESS=00E,UNIT=4248
- IODEVICE CUNUMBR=1E0,ADDRESS=01E,UNIT=4248
- IODEVICE CUNUMBR=480,ADDRESS=(480,8),UNIT=3480

Logical Partition S/370 Channel Definition (LPCHND Frame)

The IBM 9121 operates in either ESA/390 mode or LPAR mode. The support of a S/370 mode SCP is through the use of LPAR or as a guest of VM/XA SP2.1 or VM/ESA on the IBM 9121. The IBM 9221 operates in Native S/370 mode, Native ESA/390 mode, and LPAR mode using PR/SM. The following information deals with the LPAR mode implementation and its requirements for S/370 SCP channel definition.

On the IBM 9221, modifications of the CHPID to logical channel number assignment are done via an Image profile that can be saved across IMLs.

On the IBM 9121, the CHPID to logical channel number assignment is done with the **LPCHND** frame. This frame displays all 32 logical channels that can be defined in channel set 0. Only VM/SP HPO supports greater than 16 channels in a channel set.

While S/370 channel number and channel set information is ignored if included in a ES/9000 IOCDS definition, it can be beneficial to include the information for reference as shown in the preceding coding example. Use the IOCP output for a reference when updating the **LPCHND** frame on the IBM 9121.

In addition to updating S/370 channel definitions, the **LPCHND** frame can be used to display the CHPIDs defined as RECơnfigurable in any logical partition.

Only when the CHPID to channel definition is complete are S/370 mode logical partitions eligible to be activated.

The following three figures show the initial state of the **LPCHND** frame; the entry of the CHPID values that match the desired S/370 logical channel values; and finally, an example of the frame after the updates have been completed.

Upon completion of this process the logical partition (LP1) may be activated. A S/370 mode SCP that has the designated S/370 addresses defined may then be IPLed. The channel subsystem will provide the interface to the appropriate I/O devices as defined by the IOCP and the SCP.

In summary, the SCP will request I/O to channel X'00' and the channel subsystem will access the devices on CHPID (path) X'07'. Each of the defined S/370 channels will be mapped to the appropriate channel subsystem CHPID as defined in this example.

```
                                              dd mmm yy   hh:mm:ss

             Logical Partition S/370 Channel Definition     (LPCHND)


IOCDS: A0/LPARPROD          ----------------------CS0---------------------


                 Channel      00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F

                 CHPID(hex):

                              __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __


                 Channel      10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F

                 CHPID(hex):

                              __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
                 CHPIDs not assigned to selected Partition are highlighted



A= Partition                B= Action
 1. LP1                      1. Update S/370 Channel Definition
 2. LP2                      2. Display Reconfigurable CHPIDS
 3. LP3                      3. Select Channel set 1
 4. LP4
 5.
 6.
 7.


COMMAND==>
```

Figure 8. Initial LPCHND Frame

Figure 8 shows the format of the LPCHND frame. In the upper left corner are the IOCDS number and name (A0/LPARPROD). The two lines of channel values reflect the 32 possible channels available in a S/370 channel set. The column headed 'A=Partition' shows the logical partition names as defined in the IOCDS. The 'B=Action' column displays the potential actions possible from this frame.

Selection of options 'A1 B1' takes us to Figure 9 on page 41.

```
                                                   dd mmm yy  hh:mm:ss

               Logical Partition S/370 Channel Definition     (LPCHND)

   IOCDS: A0/LPARPROD            ----------------------CS0---------------------

                   Channel     00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F

                   CHPID(hex):

                               07 01 05 0A 0D __ __ __ __ __ __ __ __ __ __ __

                   Channel     10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F

                   CHPID(hex):

                               __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
                   CHPIDs not assigned to selected Partition are highlighted


   A= Partition                  B= Action
   →1. LP1                       →1. Update S/370 Channel  Definition
    2. LP2                        2. Display Reconfigurable CHPIDS
    3. LP3                        3. Select Channel set 1
    4. LP4
    5.
    6.
    7.

   COMMAND==>
```

Figure 9. LPCHND Frame Update for LPAR LP1

Figure 9 now shows the actions that were selected. The cursor was placed on the input line for the 'CHPID(hex):' values. The corresponding 'CHPID' values have been entered under the desired S/370 channel values.

When the enter key is pressed, Figure 10 on page 42 will be presented.

```
                                                    dd mmm yy  hh:mm:ss

            Logical Partition S/370 Channel Definition     (LPCHND)

IOCDS: A0/LPARPROD            ----------------------CS0---------------------

               Channel      00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F

               CHPID(hex):  07 01 05 0A 0D
                            __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

               Channel      10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F

               CHPID(hex):
                            __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __
               CHPIDs not assigned to selected Partition are highlighted


A= Partition                  B= Action
→1. LP1                        1. Update S/370 Channel Definition
 2. LP2                        2. Display Reconfigurable CHPIDS
 3. LP3                        3. Select Channel set 1
 4. LP4
 5.
 6.
 7.

COMMAND==>
```

Figure 10. Updated LPCHND Frame

The above figure shows the display values for the updated S/370 channel values that correspond to our example. Note that selection 'A1' is indicated. Displayed are the logical channel definitions for our defined logical partition 'LP1'.

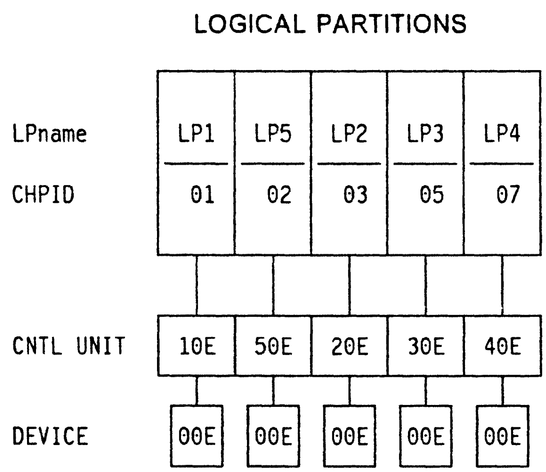
Note: Remember that S/370 mode LPARs must have the S/370 channels defined via the LPCHND frame BEFORE the S/370 mode LPAR can be activated.

Logical partition 'LP1' may now be activated in S/370 mode and a S/370 SCP IPLed.

LPAR IOCP Coding Example

The following diagram and coding example illustrates a common configuration possibility. In this case there are five logical partitions defined with each of the LPARs having a printer at S/370 address X'00E'. Another approach is to view this as a combination of five separate physical systems (five 43xxs), each having an identical I/O configuration. Assume that all five have exactly the same SCP I/O definitions and the logical partition names are 'LP1 - LP5'.

At installation time the channel cables from the existing systems will be moved to the new ES/9000 system. Each of CHPIDs X'01' through X'07' have BYte or BLock capability. ('TYPE=' parameter on the CHPID macro.) The channel cables from byte multiplexer channel X'0' on the 43xx systems will be moved to the corresponding CHPIDs on the new system. For example, the channel X'0' cable from 43xx system '1' would be moved to CHPID X'01'. The channel X'0' cable from 43xx system '2' will move to CHPID '03' and so forth. Note that the IOCP 'address' parameters are the same in all combinations.



- ID MSG1='LPAR MODE IOCP FILE'

- CHPID PATH=(01,0),TYPE=BY,PARTITION=(LP1,REC)
- CHPID PATH=(02,0),TYPE=BY,PARTITION=(LP5,REC)
- CHPID PATH=(03,0),TYPE=BY,PARTITION=(LP2,REC)
- CHPID PATH=(05,0),TYPE=BY,PARTITION=(LP3,REC)
- CHPID PATH=(07,0),TYPE=BY,PARTITION=(LP4,REC)

- CNTLUNIT CUNUMBR=10E,PATH=01,SHARED=N,UNIT=4248,UNITADD=(**0E,1**)
- IODEVICE CUNUMBR=10E,ADDRESS=**00E**,UNIT=4248

- CNTLUNIT CUNUMBR=20E,PATH=03,SHARED=N,UNIT=4248,UNITADD=(**0E,1**)
- IODEVICE CUNUMBR=20E,ADDRESS=**00E**,UNIT=4248

- CNTLUNIT CUNUMBR=30E,PATH=05,SHARED=N,UNIT=4248,UNITADD=(**0E,1**)
- IODEVICE CUNUMBR=30E,ADDRESS=**00E**,UNIT=4248

- CNTLUNIT
  CUNUMBR=40E,PATH=07,SHARED=N,UNIT=4248,UNITADD=(0E,1)
- IODEVICE CUNUMBR=40E,ADDRESS=00E,UNIT=4248

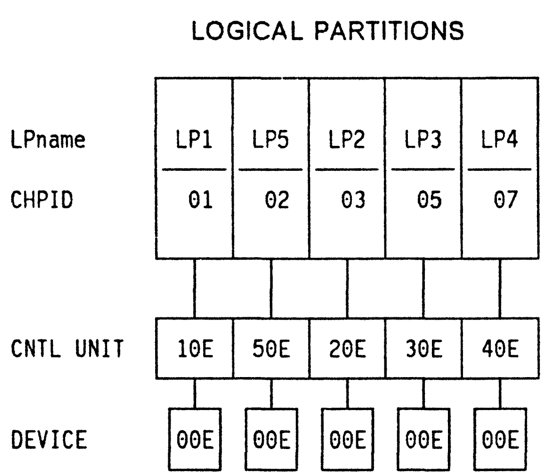
- CNTLUNIT
  CUNUMBR=50E,PATH=02,SHARED=N,UNIT=4248,UNITADD=(0E,1)
- IODEVICE CUNUMBR=50E,ADDRESS=00E,UNIT=4248

LPAR Coding Example 2-B

The following example has the same coding specifications. It has been included to highlight the requirement that the IODEVICE macro MUST follow its corresponding CNTLUNIT macro which MUST follow its CHPID macro. However the grouping of macro statements beyond that requirement is an installation option. There is a logical grouping advantage for example 2.

Example 2-B is the format that is presented by the IOCDS update facility of the stand alone IOCP process.

The first IODEVICE macro is coded twice to show that the default quantity of devices, if not coded, is one.



- ID MSG1='LPAR MODE IOCP FILE'

- CHPID PATH=(01,0),TYPE=BY,PARTITION=(LP1,REC)
- CHPID PATH=(02,0),TYPE=BY,PARTITION=(LP5,REC)
- CHPID PATH=(03,0),TYPE=BY,PARTITION=(LP2,REC)
- CHPID PATH=(05,0),TYPE=BY,PARTITION=(LP3,REC)
- CHPID PATH=(07,0),TYPE=BY,PARTITION=(LP4,REC)

- CNTLUNIT
  CUNUMBR=10E,PATH=01,SHARED=N,UNIT=4248,UNITADD=(0E,1)
- CNTLUNIT
  CUNUMBR=20E,PATH=03,SHARED=N,UNIT=4248,UNITADD=(0E,1)
- CNTLUNIT
  CUNUMBR=30E,PATH=05,SHARED=N,UNIT=4248,UNITADD=(0E,1)
- CNTLUNIT
  CUNUMBR=40E,PATH=07,SHARED=N,UNIT=4248,UNITADD=(0E,1)

- CNTLUNIT CUNUMBR=50E,PATH=02,SHARED=N,UNIT=4248,UNITADD=(**0E,1**)

- IODEVICE CUNUMBR=10E,ADDRESS=**00E**,UNIT=4248
- ** IODEVICE CUNUMBR=10E,ADDRESS=(**00E,1**),UNIT=4248 **
- IODEVICE CUNUMBR=20E,ADDRESS=**00E**,UNIT=4248
- IODEVICE CUNUMBR=30E,ADDRESS=**00E**,UNIT=4248
- IODEVICE CUNUMBR=40E,ADDRESS=**00E**,UNIT=4248
- IODEVICE CUNUMBR=50E,ADDRESS=**00E**,UNIT=4248

IOCP Points to Ponder

- Process evolved from MVS SYSGEN process
- Replaces Static Hardware UCW Definition Process on Prior Systems
- Provides Additional I/O Configuration Definition Capability
  - Old to New Configuration Changes
  - LPAR Flexibility
  - Back Up Configurations
  - Vehicle for Implementing New and Additional Features and Functions
    - Build on Existing Configuration
    - Validate Definition Before Physical Changes Made
    - Provide Backup Capability
- For installed control units, it is important that IOCP statements be coded to reflect the same range of addresses to which the control unit is capable of responding. Failure to code IOCP statements for installed control units in this manner can cause unpredictable results; many of these conditions are difficult to diagnose.
- Always code a multi-device control unit for the number of devices it is configured for even if less than the maximum I/O devices are installed.
- IODEVICE macros may reflect the actual devices installed even if less than the control unit configuration amount is installed.
- 'Plan ahead' for additional devices on a control unit as appropriate. If not done, the addition of devices will require an IOCDS update. I/O devices coded but not installed are recognized as not being installed. Devices installed but not coded can cause difficulties.
- Use physical I/O configuration documentation to plan, code and implement the I/O configuration.

IOCP Statements Format

- CHPID (Channel Path ID)
  - PATH = (CHPID{,370 channel**,370 channel set**})
  - TYPE = {BLock|BYte|S|FX|CTC|IOC}
  - PARTITION = (Partition Name{,REC})

  ** - Ignored by IOCP in ESA/390 mode
- CNTLUNIT
  - CUNUMBR=nnnn (0-FFFF)
  - PATH = (CHPID{,chpid,chpid,chpid})
  - PROTOCL={D|S|S4}
  - SHARED={Y|YB|N} (See Appendix D of *Input/Output Configuration Program User's Guide SC38-0097*.)
  - UNIT=type (<= 5 alphameric characters)
  - UNITADD=(Address{nn},Quantity*)
- IODEVICE
  - CUNUMBR=nnnn (0-FFFF)
  - ADDRESS=(Address{nnn},Quantity*)
  - UNIT=type (<= 5 alphameric characters)

* Quantity is Optional : Default = 1

Chapter 5. PR/SM Overview

This section provides an overview of the Processor Resource/System Manager (LPAR mode) feature. The purpose of the overview is provide a general base of knowledge about LPAR[2].

Processor Resource/Systems Manager (PR/SM)

- What is PR/SM?
  - Hardware Feature For ES/9000 Processors
  - Introduces New Power-On-Reset Mode (LPAR)
  - Provides Support For
    - Flexible Partitioning of Processor Resources Across Multiple Logical Partitions in LPAR Mode
      - Processors
      - Central Storage
      - Expanded Storage
      - Channel Paths
      - Vector Elements
    - VM/ESA and VM/XA System Product Facility for Multiple Preferred Guests (MPG) When Operating in ESA/390 Mode

The Processor Resource/Systems Manager (PR/SM) feature is a standard hardware feature on ES/9000 processors. It provides support for the functions which allow an ES/9000 processor complex to be logically partitioned. Logically partitioned operation is accomplished through a power-on-reset mode named *LPAR*.

When the ES/9000 processor complex is operating in ESA/390 mode, up to six preferred guests are supported by VM/ESA or VM/XA SP 2.1 facility for Multiple Preferred Guests.

[2] For more information refer to *Processor Resource/Systems Manager Planning Guide, GA22-7123* and *Operating Guide, GA23-0375.*

What is a Logical Partition?

- Collection of Processor Complex Resources That, When Combined, Are Capable of Running an Operating System
- Logical Partitions
  - Can be S/370 or ESA/390 Mode[3]
  - Run Isolated From One Another
  - Operate Independently
  - Can be Viewed as a Processor Complex Within a Processor Complex

A logical partition is a collection of processor complex resources, that when combined, are capable of running an operating system. Certain processor resources (central processors (CPs) and vector elements) can be shared among the logical partitions while other processor resources (central storage (CS), expanded storage (ES), and channel paths (CHP)) must be dedicated to the logical partition.

Logical partitions can be defined to support S/370 mode operation or ESA/390[3] mode operation. This allows S/370 mode SCPs, 370-XA mode SCPs, or ESA/390 mode SCPs to run in a logical partition. Specific SCPs and their corresponding support levels will be discussed later.

Logical partitions operate independently and are isolated from one another. Different System Control Programs (SCPs) can operate concurrently in separate logical partitions. An SCP program operating in one partition does not have access to information in another logical partition. All storage addresses used in the instructions or channel program addresses of a partition are relocated by the processors and channels and checked to ensure that they are in the range of physical storage allocated to the logical partition. Isolation of I/O activity is achieved by giving each partition its own logical I/O subsystem. Channel paths, subchannels, and logical control units are dedicated to a partition.

For all practical purposes, a logical partition can be viewed as a processor complex within a processor complex. In essence, a logical partition is a logical machine consisting of a subset of the resources of the physical processor complex that is isolated from all other partitions by the PR/SM hardware feature and Licensed Internal Code.

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3 370-XA mode is a subset of ESA/390 mode.

SCPs Supported in a Logical Partition

- MVS/SP V3.1.0E(+)
- MVS/SP V2.2.0 (+)
- MVS/SP V1.3.5 and V1.3.6
- VM/ESA(+)
- VM/XA System Product Release 2.1
- VM/SP HPO R5(+)
- VM/SP R5 (+)
- VSE/ESA(+)
- VSE/SP V4.1.2
- VSE/SP V3.2.2
- DPPX/370 1.2(*)
- DPPX/370 1.3(*)(+)

Note: (+) and Subsequent Release(s)

(*) Supported only on IBM 9221

Potential Environments and Uses

The following lists a number of potential environments and uses for logical partition mode operation. Based on the author's experience, the following have been the most prevalent to date.

- S/370 SCP Support on ES/9000 Air-Cooled Frame Models
- Workload Consolidation
- Migration to New Software Releases
- Production and Test
- Development, Test & Maintenance
- Constrained Systems
  - Permit Horizontal Growth Within Same System Image
    - i.e... Virtual Storage Constrained Environments
- MVS/XA Extended Recovery Facility (XRF) Environments
- Departmental Systems (Workload Separation)
- Mergers and Acquisitions

S/370 SCP Support on ES/9000 Air-Cooled Frame Models: S/370 mode is not provided on these models. LPAR provides a facility to use the new hardware and its enhancements and retain the ability to operate with previously installed S/370 SCPs.

Workload Consolidation: With the constant pressure to reduce operating costs, many users have taken advantage of logical partitioning to consolidate workloads on larger IBM processor complex images and reduce the number of separate system footprints on the floor. This not only offers a reduction in environmental costs (space, power, cooling) but may also result in reduced licensing costs for software products since fewer physical images are involved.

With the introduction of LPAR on the ES/9000 processor complexes the workload consolidation will take many forms. A common choice will be similar to the above example of multiple systems being combined on one ES/9000 complex. Another example that has been seen is that of the multi-VSE guest environment under VM. In some cases VM is used only as a host for the guests. In other cases VM is used for other functions as well as for guest support. Installations may elect to separate key production guests and run them stand alone in unique LPARs. Other guests can still run under VM. In this case VM will also be running in a logical partition.

For customers desiring support for multiple guest operating systems, VM/XA System Product Release 2.1 or VM/ESA with Multiple Preferred Guest support may also be considered for operation in ESA/390 mode. Up to six preferred guests are supported by VM/XA System Product 2.1 and VM/ESA Multiple Preferred Guest facility under PR/SM. Additionally, CMS and V=V machines are also supported.

Migration To New Software Releases: This is a another popular use for logical partitioning. A number of users have made use of logical partitioning during the migration to a new level of system control program or to a completely new SCP. The ability to run current SCP production and SCP testing and migration in different partitions on the same physical ES/9000 processor complex may reduce a migration cycle.

Production and Test: This is another popular use of logical partitioning. It is a system programmer's delight come true. The ability to have an available test system at times other than on weekends and off shift can contribute to faster problem resolution as well as faster application implementation.

Constrained Systems: Another use of logical partitioning is to address virtual storage constrained systems. Take as an example a system running a combination IMS and TSO workload. The physical system on which the combined workload is running may not be fully utilized. Full utilization of the system requires that both the IMS and TSO workloads grow. However, neither can grow because of a virtual storage constraint. By using logical partitioning, the IMS and TSO workloads can be put in separate logical partitions, thereby reducing the virtual storage constraint in each system. The end result is that both workloads can continue to grow and the physical processor can be more effectively utilized.

LPAR Mode

- Selected at Power-on-Reset Time (IML)
- Maximum # of LPs per Operating Configuration
  - 4 - ES/9000 Air Cooled Rack Mounted Models
  - 7 - ES/9000 Air Cooled Frame Models
- Resource Assignment To Logical Partition

Resource	Dedicated	Shared	Granularity
Central Processor	Y	Y	1 CP
Vector Element	Y	Y	1 VE
Central Storage	Y	*	1 MB
Expanded Storage	Y	*	1 MB
Channel Path	Y	*	1 CHP

(*) Can be dynamically reconfigured between Logical Partitions

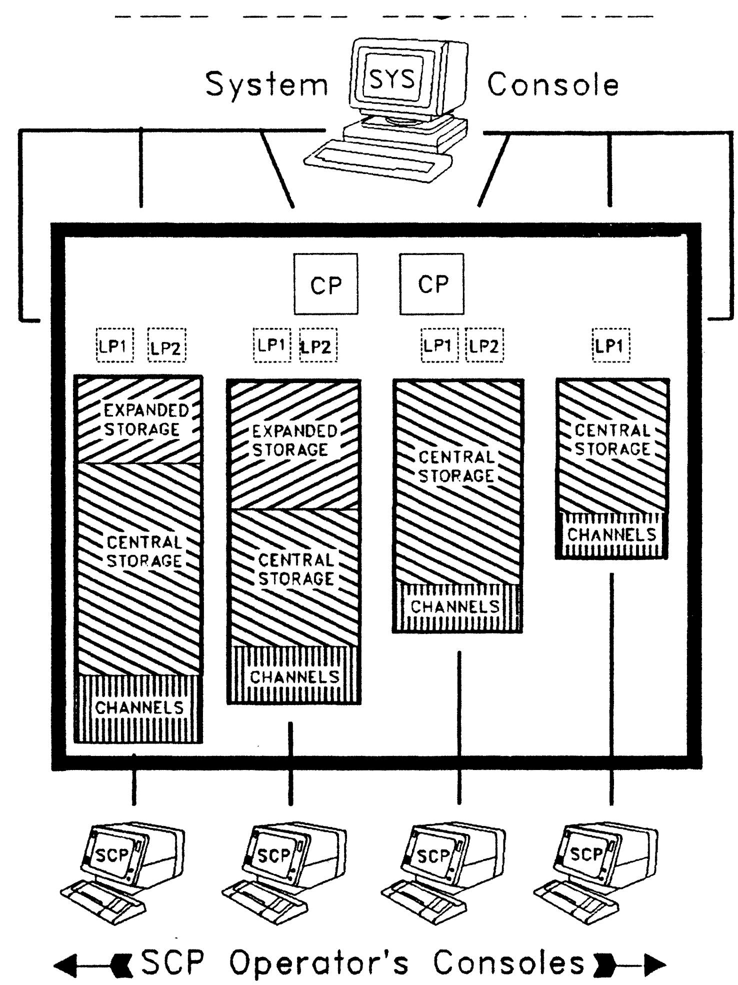
LPAR mode of operation on a ES/9000 processor complex is selected at power-on-reset time as is ESA/390 mode. The maximum number of logical partitions supported per operating configuration is model dependent.

ES/9000 Air-Cooled Rack Mounted Models support a maximum of four (4) logical partitions. ES/9000 Air-Cooled Frame Models support a maximum of seven (7) logical partitions.

The assignment of resources to the logical partitions, as well as the level of granularity, is as follows:

- CPs - The CP resource can either be dedicated to a logical partition or shared between logical partitions. While it is permissible to have a mixture of logical partitions, some using dedicated CP resources while others share the CP resource, no single logical partition can be assigned a combination of dedicated and shared CP resources. The requirement to share or dedicate CPs in a logical partition is not like the VM guest environment where a guest may have both shared and dedicated CPs defined at the same time. The assignment of a dedicated CP reduces the shared CP pool by the number of dedicated CPs. Therefore dedicating a CP to any LPAR on a uniprocessor model removes the ability to have any other LPAR active when the LPAR with the dedicated CP is active since the shared CP pool has been reduced to zero. The level of granularity is a single CP.
- Vector Elements - The vector element resource is either dedicated to the logical partition or shared between logical partitions. Since vector elements operate in conjunction with the physical CPs (each physical CP can have a vector element installed), dedication or sharing of the vector element is accomplished indirectly through the assignment of CPs. It is not possible for a logical partition to have dedicated CPs while sharing one or more vector elements, or to have dedicated vector elements while sharing one or more CPs.

- Central and expanded storage are dedicated to the logical partition. The PR/SM feature presents each logical partition with elements of CS and ES (if defined) which have an addressing range starting at X'00' for the size of the definition. Each logical partition must have central storage assigned but expanded storage is SCP and installation dependent. The level of granularity for allocation is 1 MB.
- Channel paths are dedicated to the logical partition. The level of granularity is one channel path. Although channel paths are dedicated to a logical partition, they can be dynamically or statically reconfigured between logical partitions. SCPs supporting dynamic path reconfiguration provide the function for the movement of the channel paths between logical partitions while the SCP is active. Those SCPs not supporting dynamic reconfiguration can also benefit from this feature although the reconfiguration is made possible by using PR/SM functions when the SCP is not active in the logical partition involved in the reconfiguration.



This diagram presents a visual concept of LPAR mode operation on an ES/9000 processor complex. The underlying hardware configuration used in the picture is a ES/9000 Model 440 or 480 processor complex (as indicated by the two physical CPs shown). Four logical partitions are also shown.

The darker lines around the perimeter of the logical partitions indicate that each partition is isolated from the others and operates independently. Each partition has its own set of dedicated resources (i.e.. channel paths, central storage, and optionally, expanded storage). The CP resource may either be dedicated to a logical partition or shared between logical partitions.

Logical partition 1 (numbering left to right) has been defined as a logical 2-way (indicated by the dotted logical CPs above the partition) The other three partitions which also share the two physical CPs comprising the shared pool of CP resources are defined as a logical 2-way, a logical 2-way, and logical 1-way (indicated by the dotted logical CPs above the partition). The logical CP makeup of the four partitions using shared CP resources in the example was arbitrarily chosen to indicate the flexibility of defining partitions with differing logical CP requirements. The logical CP definition for each of the four partitions sharing the four physical processors could have been a logical 1-way or a logical 2-way (the maximum number of CPs in the shared pool). If the installation had chosen to dedicate a CP to one of the logical partitions, there would then have been one CP remaining in the shared pool. Under these circumstances the number of shared CPs assigned to any of the remaining LPARs can only be one. One CP is dedicated to one LPAR, one CP is shared by three LPARs.

The assignment of physical CPs to a logical partition using dedicated CP resources is done by LPAR. During partition definition only the number of logical CPs needed by the partition is specified. No control is provided for specifying which specific physical CP(s) is/are to be assigned to the partition. The installation has no control nor is there any benefit to the control of the assignment of dedicated CPs.

The single hardware system console shown at the top supports both ESA/390 mode and LPAR mode operation. In ESA/390 mode the primary role of the system console is operational control of the physical complex. In LPAR mode the system console also performs this role in addition to other roles, as follows:

- Operational control of the physical complex
- Operational control of the logical partition
- LPAR definition/control

Operational Control Of The Physical Complex: The console role in LPAR mode is the same as in ESA/390 mode. It provides selection of POR (Power-On-Reset) mode for the operating configuration (ESA/390, LPAR), configuration of functional elements (CPs, central or expanded storage elements, and CHPIDs), and selection of the IOCDS dataset (hardware I/O configuration) to be used during the POR process.

Operational Control Of The Logical Partition: In this role the single 'physical' system console functions as the 'logical' system console for each partition. The functions associated with the OPRCTL and SYSCTL operator frames are extended to the logical partition. These functions include **system reset, load, restart, store status, alter/display**, among others. The use of the **START, STOP, RESTART,** and **INTERRUPT** function keys are also extended to the logical partition.

Actions taken from the OPRCTL or SYSCTL frames or the previously mentioned functions keys will affect the global operating configuration in ESA/390 mode. In LPAR mode, these actions affect only the logical partition on whose behalf the system console is functioning at the time the action was requested. Operator commands are provided to switch the 'logical' assignment of the system console between the partitions.

LPAR Definition/Control: The system console is also used for logical partition definition and control. Activities include defining resources for the partitions, activation and deactivation of the partitions, identifying dedicated and shared use of the CP resource by the partitions, establishing partition dispatching weights, displaying storage maps for central and expanded storage, and establishing a correspondence between S/370 channel numbers and physical channel paths for S/370 mode partitions.

PR/SM Goals

- Maximize Throughput By Allocating All Available Cycles
- Ensure Responsiveness

Implementation

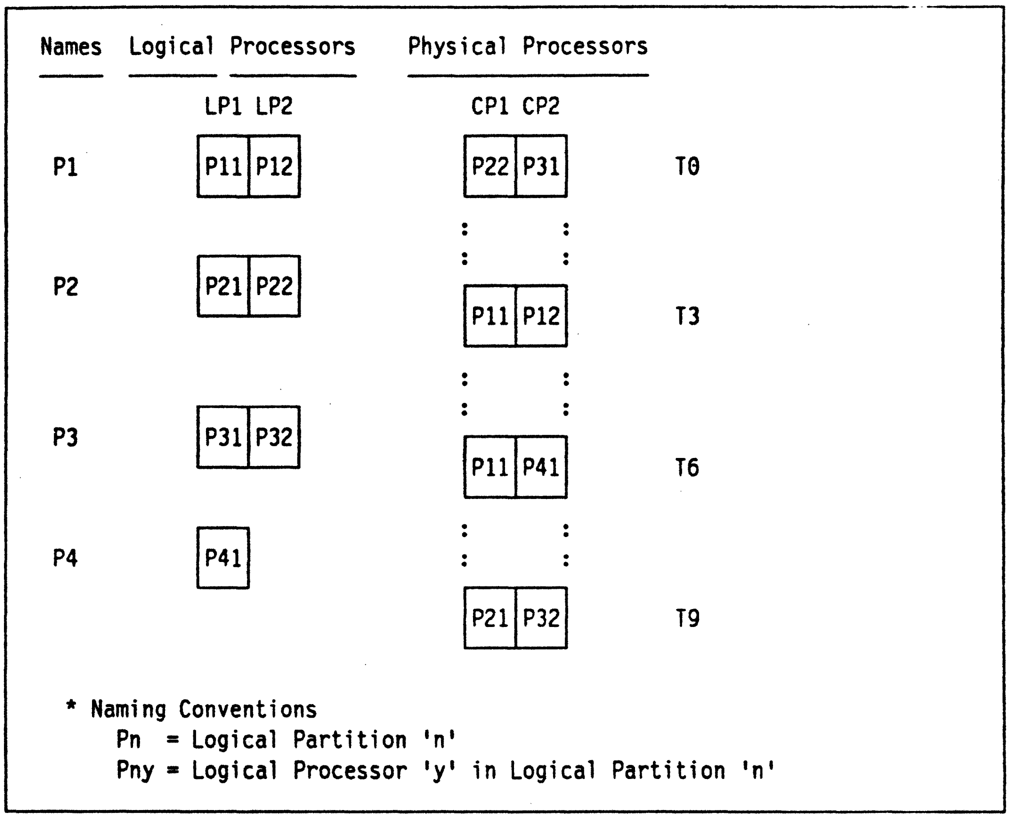
- Logical Processor Is Dispatchable Unit
  - Able To Mix Dedicated and Shared LPs
  - Able To Mix Shared Uni,...N-way LPs
- Dynamic Dispatch Interval
- Event Driven Dispatching
  - Wait Detection
  - I/O Interrupt
  - Dispatch Interval End
  - SIGP Awareness

The LPAR dispatcher was designed with the objective of allocating all available physical CPU cycles to logical processors that are ready to execute instructions while maintaining good I/O response times.

To achieve these objectives, LPAR makes each individual logical shared processor of every partition a separately dispatchable unit of work. It is important to understand this distinction: ***LPAR dispatches logical processors*, not logical partitions**. This is an important concept to understand when more than one physical CP exists.

Many ES/9000 Air-Cooled Frame Models installations will have only one physical CP and subsequently only one logical CP per logical partition. While the number of CPs will be only one, the dispatching and management of the CP resource does not change. There will be more than one logical partition vying for the CP resource in any environment where more than one logical partition is activated and there is work to be done.

Event Dispatching



The preceding figure is a graphic illustration of possible snapshots of the logical processor dispatching on the physical processors. At any given point in time any of the logical CPs can be dispatched on any of the physical CPs. The dispatching mechanism manages the use of the physical CP resource in an efficient and productive manner which maximizes throughput and ensures responsiveness of the LPARs.

The logical processor labels do not have any significance beyond the diagram. They are intended to identify the logical processors in the diagram.

The diagram is a representation of some possible combinations of physical CP utilization. One example not shown is the case where there are no logical CPs to be dispatched and the physical CPs would be idle.

Logical Partitioning Mechanics

```
Partition Definition

    Partition Activation

        Partition Control

            Partition Deactivation
```

Partition Definition

- Name and Number of Partitions
- Validate Resource Definitions
- Apportion Physical Resources
- Two-Phase Process
  - IOCP
  - System Console Frames

This list of functions notes the steps required to define an LPAR environment. Each of the functions are explained below.

- IOCP
  - Define Number of Partitions
  - Assign Partition Names
  - Assign CHPID to Partition
    - Dedicated to a Partition
    - Can be Configured Between Partitions

The IOCP process provides two definition functions for the process. First and foremost, the names of the logical partitions are defined in the IOCP process. Secondly, the channel paths are identified and assigned to their respective logical partitions. This is done with the ***'PARTITION=(name,REC)'*** parameter on the 'CHPID' IOCP input statement macro. The 'REC' parameter is required for S/370 mode SCPs and also for any channel paths which are to be capable of reconfiguration. As indicated, the channel paths are ***dedicated*** to the partition to which they are assigned. If the logical partition is thought of as a separate physical entity from an I/O subsystem viewpoint then the channel path assignment relates to the physical attachment of channel cables to that processor complex. Any channel cable can only be directly attached to one processor complex; any channel path in an LPAR environment can only be assigned to one LPAR.

- System Console Frame(**LPDEF**)
  - Assign / Indicate
    - Main Storage in 1MB Granularity
    - Expanded Storage in 1MB Granularity
    - % of CPs (& Vector)
    - S/370 or ESA/390 Mode
    - CPUID
    - Partition Auto-IPL Parameters

The **LPDEF** frame is on the IOSP (hardware) system console and provides the remaining resource identification and definition. A menu is presented that lists the defined LPARs by name and provides input areas for each of the listed resources. This is the mechanism that defines whether the LPAR will operate in S/370 or ESA/390 mode. Note that these are definitions only. The CPUID value will be discussed at a later point in this section. The partition auto-IPL parameters are described and explained in Processor Resource/Systems Manager Planning Guide, GA22-7123.

- System Console Frame(**LPCHND**)
  - Assign S/370 Channel Number to CHPID Correspondence

The ***LPCHND*** frame is the means by which the relationship is established between the physical channel path (CHPID) and corresponding logical channel, control unit and device as defined in the SCP. Examples of this frame are shown in the IOCP section of this manual. ***LPARs that are to be activated in S/370***

mode MUST have the definitions for channel paths completed BEFORE the LPAR can be activated.

Partition Activation

- System Console Interface(**LPDEF**)
- Validates Resource Assignments
- Allocates Physical Resources to Partition
  - CPs & Vector
  - Central Storage (Cleared)
  - Expanded Storage (Cleared)
- Reset Channel Paths Assigned to Partition

```
On Completion
The SCP Can be IPLed
Into the Partition
```

When LPAR definition has been completed the logical partition may then be activated. This function is accomplished via the LPDEF frame on the IOSP system console.

The resource assignments are checked for validity. An example is a situation where the installation has defined an LPAR with more shared CPs than are available in the shared CP pool. An example could be as simple as having defined an LPAR with one dedicated CP on a ES/9000 model 440 or 480. Subsequent attempts to activate an LPAR with two shared CPs will fail based on the lack of resource.

Allocation of the defined resources is done assuming the validity checking was positive. The storage allocated to the LPAR is cleared at allocation time, insuring that there is no unwanted carry over of memory contents from a prior LPAR that may have previously been allocated this storage.

The channel paths have been previously defined in the IOCDS and have been defined to S/370 channels on the LPCHND frame. At allocation a reset is issued to all of the channel paths assigned to this LPAR. This will reset outstanding conditions which may have resulted from prior activities on these channel paths.

Upon completion of the activation of an LPAR, the designated SCP can be IPLed into the logical partition.

Partition Control

- System Console Frame Interface(**LPCTL**)
  - Indicate Partitions Use Of CPU Resource
    - Dedicated
      or
      Shared
  - Assign Processing Weights to Partitions
    - Indicate CPU Resource To Be Capped At Weight Or Not
    - Weights and Capping Indicator Can be Changed While Partition is Active
  - Assign Target CPU Time For Dispatch Interval
    - Optional
    - Global Assignment
    - Partitions With Non-dedicated CP Resources

The definition and activation of LPARs enable the partition for use. The **LPCTL** frame provides the control functions for logical partition mode. This frame defines the CPs as shared or dedicated. It is also the source of the **WEIGHT** assignment. These values define the CPU utilization controls and dispatching of logical processors in the LPAR environment. The weight value for a shared processor (1 - 999) is relative to the total of all LPAR weight values and has no affect on the processor resources consumed as long as there is excess processor capacity.

As an example, if there were three active LPARs and they all had weight values of 10, the relative value of each would be 10/30 or 1/3. In simple terms this means that each logical partition would receive 1/3 of the processor resource if the system was 100% busy. If two LPARs were idle the remaining active LPAR could receive up to 100% of the resource. This implementation assures that each LPAR will receive its allocated share of the processor resource when needed. The dispatching of the logical CPs is also monitored and controlled in a manner that prevents an LPAR from monopolizing the CP resource to the detriment of other LPARs.

In addition to the CP resource distribution function the ability exists to limit an LPAR to the specified CP resource. There are situations where an installation does not want an LPAR to receive more than its defined allocation of CP resource. This is implemented on the LPCTL frame for each LPAR through the use of the capping function.

The menu on the LPCTL frame requires a 'YES' or 'NO' for the 'Capped' column. A yes for an LPAR will prevent that LPAR from ever receiving more than the allocated proportion of CP resource, regardless of other LPAR CP activity. The LPAR is guaranteed up to the CP resource defined but never any greater amount. This is different than our previous example with three LPARs and two idle. In that case the active LPAR could receive 100% of the CP resource. With capping the active LPAR can only receive 33% as its WEIGHT value was 10/30 or

1/3. Another example would be a situation where the weight value for an LPAR was derived to be 10% of the total weight. In that case the LPAR would never get more than 10% of the resource even when the remaining 90% was idle. Additional information on capping and weights can be found in the Operating Guide, GA23-0375

Partition Deactivation

- System Console Frame Interface(**LPDEF**)
- Resets Partition and Releases Physical Resources
  - CPs & Vector
  - Central Storage
  - Expanded Storage
- Dedicated CHPID Resource is Reset But Left Configured to Partition

Partition deactivation is the reverse process of activation. When a logical partition is deactivated all components are reset and released for use by the system. Storage is cleared and the processor elements and CHPIDs are reset. The CHPIDs are reset but are still associated with the logical partition to which they are defined.

Operational Interfaces

- Physical Processor Complex

  System Console

- LPAR Controls

  System Console

- Logical Processor Complex

  System Console

- Each Operating System

  SCP Operators Console

The following section will differentiate this list of four operational interfaces and control points[4]. The first and fourth bullets are common to LPAR and ESA/390 modes. The second and third items are unique to LPAR.

[4] All references to specific frames are covered in detail in: *Operating Guide, GA23-0375.*

'hysical Processor Complex

- System Console
  - Configuration
  - Power-on-Reset
  - IOCDS Selection/Control
  - Problem Analysis Facility
  - Remote Service Facility
  - System Activity Display

The items listed are all related to the physical aspects of system operation. The configuration options refer to the physical segments of the processor complex that can be affected by the installation. The remaining items apply to LPAR or ESA/390 mode and are defined and explained in Operating Guide, GA23-0375.

LPAR Control

- System Console
  - Resource Definition(**LPDEF**)
  - Partition Activation(**LPDEF**)
  - Partition Controls(**LPCTL**)
  - Partition Deactivation(**LPDEF**)
  - Channel Path Assignment Map(**LPCHNA**)
  - S/370 Channel Number to CHPID Correspondence(**LPCHND**)
  - Storage Map(**LPSMAP**)
    - Central Storage
    - Expanded Storage
  - Partition Security Controls(**LPSEC**)

The LPAR control functions have been discussed previously and are noted in the list. Two additional frames are for display purposes and provide information. Channel assignment status for the LPAR environment (LPCHNA) and mapping of LPAR storage allocation to physical storage (LPSMAP) can be displayed.. The last item refers to security functions within LPAR. The access to LPAR control information for one LPAR by another LPAR can be restricted. This frame and its contents are described in Operating Guide, GA23-0375

Logical Processor Complex

- System Console Frames (IOSP)
- Functions(**OPRCTL,SYSCTL**)
  - System Reset
  - Load
  - Restart
  - Store Status
  - PC Stall Detect
  - Alter/Display
  - I/O Problem Determination
  - SCP/System Console Communication(**SCPMSG Frame**)
- Function Keys (Partition Sensitive)
  - Start / Stop
  - Restart / Interrupt

A logical processor complex utilizes the same frames used in ESA/390 mode. While all the items are described in the Operations manual, a familiar process will be noted. To IPL an SCP on a ES/9000 system in a logical partition in LPAR mode, the **OPRCTL** or **SYSCTL** frames can be used. Both have the same basic capabilities with each having unique functions. A key point to understand is that the presentation of the frames in LPAR mode are for the particular LPAR being worked with. If functions for another LPAR are desired, that LPAR must be targeted for the action. This process will be defined later.

The same is true for the function keys that are listed. When the keys are used they will work with the targeted LPAR only.

Operator Access to Logical Partition

- **SETLP** Service Language Command
  - This Service Language Command (SLC) is used to select the partition that the system console is to interface with. The command targets the LPAR to be communicated with by means of the frames previously listed.

Controlling Operator Access to the Logical Partition

- **LOCKLP** and **UNLOCKLP** Service Language Commands
  - LOCKLP
    The LOCKLP SLC blocks partition sensitive commands and prevents inadvertent operator action against a wrong partition i.e., IPL/RESET. A well written procedure will explicitly define the logical partition to be acted upon. If the LPAR is 'locked' the action to carry out the procedure can specifically note the proper steps and prevent unwanted events. To access a locked partition the following SLC is issued.

- UNLOCKLP
  UNLOCKLP provides a defined action for gaining access to the control functions of an LPAR and allows partition sensitive commands to be issued.

It is recommended that ALL partitions be locked at all times. If this option is used the probability of an accidental action against a partition will be reduced by requiring one more step to ensure that the correct LPAR is being targeted for the action.

Each Operating System

- SCP Operators Console
  - Any Device Supported by ES/9000 and the SCP Active in the Partition
  - Channel Attached
  - Operations Consoles Configuration Guidelines Unchanged

As previously stated, each logical partition can be thought of as a completely separate entity. The channel paths are dedicated to the LPARs. SCP operators consoles are channel attached to the processor complex. Therefore each LPAR must have at least one SCP operators console provided. Additional importance is given to this statement when the installation is merging 4300 type environments onto the LPAR mode processor complex.

The 4300 console implementation provided for System/SCP sharing of the hardware console. This is not the case on the air-cooled ES/9000 procesors. Each logical partition must have a minimum of one separate console for SCP operator use. Other guidelines for SCP console usage or configurations are unchanged.

Note: The displays and content seen on the SCP operator consoles will be no different in LPAR mode than they were on the previous system.

Compatibility Considerations

CPUID

- Each Logical Partition Must be Uniquely Identified
- CPUID Presented To Logical Partition Not Same As In ESA/390 Mode

VERSION CODE	C S S S S S	XXXX	0000	ESA/390 MODE

```
    C = CP Number (1-2)
    S = 5 DIGIT SERIAL NUMBER
 XXXX = 9121 or 9221
```

VERSION CODE	C I S S S S	XXXX	0000	LPAR MODE

```
    C = LOGICAL CP Number (1-2)
    I = LP ID (0-F) - USER SPECIFIED AND UNIQUE FOR EACH PARTITION
 SSSS = LOW ORDER 4 DIGITS OF SERIAL NUMBER
 XXXX = 9121 or 9221
```

Possible Impact to Licensed Software Products

LPAR mode changes the information returned from the Store CPU ID (STIDP) instruction. The installation must assign **each** logical partition a unique identifier in the range of X'0 to F'. This unique value is then returned when an LPAR issues the STIDP instruction. For example, the LPAR defined as LP1 could have the 'I' value set to '1'. The physical serial number of the system may be '20021' but the value returned to LP1 by STIDP would be '10021'. If a software product was licensed by the physical serial number and checked for it, a message, warning or other communication could be triggered indicating the mismatch. If a critical situation exists, it can be circumvented by assigning to one and only one LPAR, the actual value of the physical serial number, '2' in this case.

LPAR Planning

Processor Resource

- Estimate Requirements For Each LP Separately
- Combine Workload Requirements
- Plan For Contingency (Simultaneous Peak Loads,...)

When planning for processor resources keep in mind the basic premise that each LPAR is a separate entity. Each LPAR workload must be analyzed and its requirements determined. Each of the LPAR processor requirements are then combined to determine the total requirements and the relative capacity of the processor complex required. There are no new guidelines or techniques to be employed when running in LPAR mode. Similarly, measurement of an installed LPAR complex should be done on a logical partition by logical partition basis.

Number of Logical Processors

- Considerations
  - Physical Configuration
  - SCP Capabilities
  - RAS Flexibility
  - Peak Demand Requirements
  - Subsystem Use of Multi-engines
    - IMS, CICS, DB2, TSO, CMS
- Recommendation
  - Define Only The Required Number of Logical CPs To Handle The Workload

This topic will not apply to those planning for a uniprocessor model of the ES/9000. For those using the dyadic models the considerations listed above have meaning. A simple example of SCP capabilities would be the assignment of two logical CPs to a VSE logical partition. VSE supports one and only one CP. On the other hand it is entirely valid to define several VSE LPARs with one shared logical CP on a dyadic processing complex. Assume that six LPARs were defined. This would mean that six logical CPs would be dispatched on the two physical CPs. There is no mapping of logical to physical CPs. A logical CP that has work to be done will be dispatched on a physical CP that is available. It may be dispatched on either physical CP during subsequent processing.

Central and Expanded Storage

- Understand Storage Requirement of Workloads To Be Run In The Partitions
- Plan Each Logical Partition Separately
- Understand SCP Limitations
- Combine Workload Requirements
- Flexibility Through
  - Variety Of Storage Options on ES/9000 Models
  - Allocation In 1 MB Granularity
  - Dynamic Storage Reconfiguration

The same guidelines exist for storage planning. The whole is equal to the sum of the individual LPARs. One consideration is the fact that storage can now be allocated in 1 Mb increments. This means that allocations can be varied to meet changing LPAR workloads or to favor LPARs that have more business reasons for having additional storage.

Dynamic storage reconfiguration is supported by the levels of MVS/XA and MVS/ESA that support the ES/9000. The function provides reconfiguration of central storage between LPARs while the LPARs are active.

PAR Documentation

- PR/SM Planning Guide (GA22-7123)
- Input/Output Configuration Program User's Guide SC38-0097
- Planning for Recovery, GA23-0376

nternational Technical Support Center Documentation

- MVS/XA in Multi-Image Environments, GG24-3274
- VSE/SP In A Logical Partition, GG24-3318

Related IBM Documentation

- IBM Systems Journal (Vol. 28, No. 1, 1989)
  - 'Multiple Operating Systems On One Processor Complex' Article
- ES/9000 PR/SM Introduction And Operations (PC Based Operator Training Course For LPAR) (ES/3090 based)
  - SRA Order Number 32048

Summary

PR/SM (Logical Partition Mode)

- Standard Hardware Feature
- Extends Operational Capability of ES/9000 Models
- Flexible Support of Different Sized Partitions
- Wide Range of Operating System Support
- No Additional Software Skills
- No Impact on SCP Operator Console Training

Chapter 6. Sample Migration Scenarios

Migrating to an air-cooled ES/9000 processor could be as simple as MESing a currently installed ES/9370 Model 90, or as involved as replacing a 4361 processor, 3370 DASD, and migrating to VSE/SP 4.1.2, all at the same time. This chapter will discuss the migration considerations for these two scenarios, as well as for other scenarios whose migration efforts fall somewhere in between these.

General Approach to Migration

The goal in any migration is to minimize the amount of changes being made at one time. When migrating to an air-cooled ES/9000, there are four primary areas where these changes can occur: processor, non-DASD I/O, DASD, and operating system software. Where possible, changes should be made in only one of these areas at a time. This reduces the potential for error while improving the opportunity for quicker resolution of migration problems should they occur.

In order to reduce exposure to problems during the migration process, it is important to migrate the four areas of change in the proper sequence. In general, the operating system software should be brought up to the supported level first. Obviously this is not possible if you're going to be installing on "new" DASD during the migration process. However, if your operating system software will remain installed on existing DASD, this software should be upgraded prior to installing the air-cooled ES/9000 processor.

The next step in the migration process is replacing the current CPU with the new air-cooled ES/9000 processor. The CPU migration may be an MES to a current ES/9370, or a CPU replacement. The type of CPU migration will affect the type of backup plan you have in place should the CPU migration not be on schedule.

The non-DASD I/O portion of the migration addresses making necessary changes to I/O devices such as printers, terminal control units, and telecommunication controllers. These changes should occur simultaneously with the CPU migration. This will ensure these devices are properly configured and can be used when the CPU migration is complete.

As part of many air-cooled ES/9000 migrations, new DASD will be installed. Some customers will choose to replace all their older DASD with new, while others will simply use the new DASD in addition to that currently installed. Those users replacing DASD should plan their DASD migration carefully in order to optimize the use of the new DASD on their system.

The following section provides different environments from which customers will migrate to air-cooled ES/9000 processors. Each scenario will attempt to address the tasks and issues involved in that migration effort.

Disclaimer: The migration scenarios presented here are meant to be examples only and are not intended to be used as recommendations for specific processors. The specific air-cooled ES/9000 processor your customer migrates to will depend on many factors, including current workload, growth rate, etc. Also, the list of migration issues for each scenario is not meant to be all inclusive. It is, however, intended to present the major issues involved in the specific migration scenario.

4361-5 to IBM 9221 Model 130

Current Environment

CPU:	4361-5
DASD:	3370-2 attached via 4361 DASD Adapter
Tape:	8809
SCP Console:	Attached to 4361 Display/Printer Adapter
Terminals:	Attached via non-SNA 3274 control units
Printers:	4245-D12 with feature #9160
SCP:	VSE/SP 1.3.5

Proposed Environment

CPU:	IBM 9221 Model 130
DASD:	3370-2, attached via 3880-1 Control Unit
Tape:	2440
SCP Console:	Attached to local non-SNA 3274 control unit
Terminals:	Attached via non-SNA 3274 control units
Printers:	4245-012
SCP:	VSE/SP 4.1.2

Migration Issues

SCP: The first step in the migration process for this customer is to upgrade his VSE operating system. After installing VSE/SP 4.1.2, APAR DY39560 will need to be installed to provide support for the IBM 9221 processor by VSE/SP 4.1.2.

Due to physical space limitations in his computer room, this customer will first have to remove his 4361-5 prior to installing his IBM 9221. He'll, therefore, need to perform his operating system migration on the 4361 prior to installing the IBM 9221 processor.

3880-1 Control Unit: Because this customer wants to attach his 3370s to the ES/9000 Model 130, he will have to install a 3880-1 control unit. 3370 DASD do not attach directly to an air-cooled ES/9000 processor. The 3880 should be installed at the same time the IBM 9221 is installed.

2440 Tape Drive: The replacement of the 8809 tape drive is required because it does not attach to an air-cooled ES/9000 processor. This customer has chosen to replace it with a 2440, which attaches to the S/370 channel subsystem (feature #6101 or #6103).

SCP Console: The customer will have the option of using either the IBM 9221 Service Processor or a 327x terminal as his VSE systems console. Because he already has a local non-SNA 3274 installed, this customer has chosen to attach both his operating system console and his local terminals to the 3274 control unit.

Printers: With feature #9160 on the 4245-D12 printer, this printer appears to VSE as a 'channel-attached' systems printer, even though it is coax- attached. This feature must be removed in order to attach this printer to the IBM 9221 Model 130. RPQ S01562 is required to remove this feature. In order for this printer to continue to be used as a systems printer, RPQ S01566 must be ordered. This RPQ converts the model D12 to model 012, which is a channel-attached printer. Feature #6101 or #6103 is required for attachment of the 4245-012 to the IBM 9221 Model 130.

9377-90 to IBM 9221 Model 150

Current Environment

CPU:	9377-90
DASD:	9335 (DASD subsystem feature #6310)
Tape:	3422 (S/370 Channel subsystem #6003)
Communications:	2 BSC lines (Communications subsystem feature #6030)
SCP Console:	Attached to WSC features #6020/#6021
Terminals:	Attached to WSC features #6020/#6021
Printers:	4245-D12 attached to WSC feature (#6020/#6021))
SCP:	VM/SP 1.6 (PUT 9002)

Proposed Environment

CPU:	IBM 9221 Model 150
DASD:	9335 (DASD subsystem feature #6310)
Tape:	3422 (S/370 Channel subsystem #6003)
Communications:	2 BSC lines (Communications subsystem feature #6251)
SCP Console:	Attached to WSC features #6020/#6021
Terminals:	Attached to WSC features #6020/#6021
Printers:	4245-D12 attached to WSC feature (#6020/#6021))
SCP:	VM/SP 1.6 (PUT 9002)

Migration Issues

SCP: Because the customer is already running a supported level of VM/SP for the IBM 9221 processor, he'll need only to apply APAR VM42832 to his VM/SP 1.6 system to have full support for the IBM 9221 processor.

Processor subsystem changes: Because this customer is upgrading his current ES/9370 to an IBM 9221, all I/O subsystems currently on his ES/9370 can be migrated to the IBM 9221 without change except the communications subsystem feature #6030. Feature #6030 is replaced with feature #6251, which is the telecommunications subsystem package consisting of one telecommunications processor (#6130) and one multi-protocol 2-line adapter (#6031). Feature #6030 is replaced at no charge as part of the upgrade to the IBM 9221.

SCP Console: Because the IBM 9221 service processor will also be used as the VM systems console, feature #2000 must be ordered for the IBM 9221 to allow the service processor to have 3270 capability. This console, as well as the user's other terminals, will then attach to the IBM 9221 workstation subsystem.

4381-23 to IBM 9121 Model 210

Current Environment

CPU:	4381-23
DASD:	3375
Tape:	3803/3420
Communications:	3720 Communications Controller
SCP Console:	Attached to 4381 Display Console Adapter
Terminals:	Attached via non-SNA 3174 control units
Printers:	6262-14
SCP:	VSE/SP 2.1.7

Proposed Environment

CPU:	IBM 9121 Model 210
DASD:	3390
Tape:	3803/3420
Communications:	3720 Communications Controller
SCP Console:	Attached to non-SNA 3174 control unit
Terminals:	Attached via non-SNA 3174 control units
Printers:	6262-14
SCP:	VSE/SP 4.1.2

Migration Issues

SCP: This customer should migrate to VSE/SP 4.1.2 prior to installing the IBM 9121 processor. APAR DY39560 must be installed on top of VSE/SP 4.1.2 to provide full support for the IBM 9121 processor. It's also important to note that the 4.1.2 level of VSE provides support for the 3390s in 3380- track compatibility mode. If native support for the 3390s is desired, the customer will need to migrate to VSE/ESA.

LPAR: Because he is running a S/370 operating system, this customer will have to configure a logical partition (LPAR) on the IBM 9121 for VSE to run.

IOCP: It will be necessary for this customer to perform an IOCP generation prior to IPLing VSE on his IBM 9121.

DASD: Although this customer plans to replace all his currently installed DASD with 3390s when he installs the new processor, he must use a "phased" approach. Having VSE/SP 4.1.2 installed provides him support for the IBM 9121. He can then install the new processor and 3390 DASD. Since his goal is to replace all his 3375 DASD, he'll need to begin migrating his system to the 3390s.

The least disruptive approach to this migration would be to implement a second LPAR for installing VSE/SP 4.1.2 on the 3390 DASD. Once that effort is complete, he can migrate his user files and data to the 3390s at his convenience, thereby causing the least disruption to his production environment.

SCP Console: Because the IBM 9121 processor does not come with an operating system console, a 327x terminal attached to a local non-SNA control unit is required. Additionally, when this customer implements a second LPAR, a second local non-SNA control unit and 327x terminal will be needed.

4381-2 to IBM 9221 Model 170

Current Environment

CPU:	4381-2
DASD:	3370
Tape:	3803/3420
Communications:	4 SDLC lines on a 3705 Communications Controller
SCP Console:	Attached to 4381 Display Console Adapter
Terminals:	Attached via non-SNA 3174 control units
Printers:	6262-14
SCP:	VSE/SP 3.1.1 under VM/SP 1.6

Proposed Environment

CPU:	IBM 9221 Model 170
DASD:	9336
Tape:	3803/3420
Communications:	4 SDLC lines (Communications subsystem feature #6252)
SCP Console:	Attached to non-SNA 3174 control unit
Terminals:	Attached via non-SNA 3174 control units
Printers:	6262-14
SCP:	VSE/ESA 1.1.0 under VM/SP 1.6

Migration Issues

SCP: Although the customer's goal is to install VSE/ESA, he should first bring his currently installed operating systems to a supported level for the IBM 9221 processor. On his VM system, he'll simply need to install APAR VM42832 to get IBM 9221 support. For his VSE system, he should 'refresh' his current system to VSE/SP 3.2.2 via the VSE/SP Fast Service Upgrade (FSU) process. When VSE/ESA 1.1.0 becomes available, the customer will then be able to begin a migration to that version of VSE.

DASD: This customer will need to retain his 3370 DASD until he's migrated his VM system and installed VSE/ESA on the 9336 DASD. The recommend approach would be to first migrate VM/SP to the 9336s, leaving VSE/SP installed on the 3370s. After the VM/SP migration to 9336s is complete, the customer can begin his VSE/ESA migration. With VM installed, the customer can generate a 'guest' VSE/ESA machine.

He should first install VSE/ESA on the 9336s. His next step will involved migrating his user libraries and data to the 9336s. Once his VSE/ESA system is completely migrated to the 9336s, this 'guest' machine can become the production VSE. The 3370 DASD can then be removed from the system.

SCP Console: The customer will have the option of using either the IBM 9221 Service Processor or a 327x terminal as his VSE or VM systems console. Because he already has a local non-SNA 3174 installed, this customer has chosen to attach both operating system consoles and his local terminals to the 3174 control unit.

Communications: This customer has chosen to use the telecommunications subsystem package feature #6252 on the IBM 9221 and, therefore, will discontinue his 3705.

4341-11 to IBM 9221 Model 120

Current Environment

CPU:	4341-11
DASD:	3380
Tape:	3803/3420
Communications:	3720 Communications Controller
SCP Console:	Attached to 4341 Display Console Adapter
Terminals:	Attached via non-SNA 3174 control units
Printers:	3211
SCP:	VSE/SP 4.1.1 under VM/SP 1.5

Proposed Environment

CPU:	IBM 9221 Model 120
DASD:	3380
Tape:	3803/3420
Communications:	3720 Communications Controller
SCP Console:	Attached to non-SNA 3174 control unit
Terminals:	Attached via non-SNA 3174 control units
Printers:	6262-14
SCP:	VSE/SP 4.1.1 under VM/SP 1.5

Migration Issues

SCP: This customer is currently running a supported level of VM/SP for the IBM 9221 processor. He'll need only install APARs VM42832, VM42649, and VM42652 to get full IBM 9221 support. He will, however, need to 'refresh' his VSE/SP to the 4.1.2 level via the Fast Service Upgrade (FSU) process, then apply APAR DY39560 to support the IBM 9221 processor.

SCP Console: This customer currently uses the 4341 processor console as his VSE systems console. He uses a 3179 attached to a local non-SNA 3174 as his VM console. On the IBM 9221 processor, he'll have to provide another 327x terminal attached to a local non-SNA control unit for his VSE system console.

3083-JX to IBM 9121 Model 260

Current Environment

CPU:	3083-JX
DASD:	3380
Tape:	3480
Communications:	3720 Communications Controller
SCP Console:	Attached to non-SNA 3174 control unit
Terminals:	Attached via non-SNA 3174 control units
Printers:	4248
SCP:	MVS/SP 2.2.3

Proposed Environment

CPU:	IBM 9121 Model 260
DASD:	3380
Tape:	3480
Communications:	3720 Communications Controller
SCP Console:	Attached to non-SNA 3174 control unit
Terminals:	Attached via non-SNA 3174 control units
Printers:	4248
SCP:	MVS/SP 2.2.3

Migration Issues

SCP: This customer is currently running a supported level of software for the IBM 9121 processor. He'll need only install PTFs UY90628 and UY90633 for full IBM 9121 support.

IOCP: It will be necessary for this customer to perform an IOCP generation prior to IPLing MVS/SP 2.2.3 on his IBM 9121.

Appendix A. Glossary

This glossary includes definitions from:

- The *American National Dictionary for Information Processing Systems*, copyright 1982 by the Computer and Business Equipment Manufacturers Association (CBEMA). Copies may be purchased from the American National Standards Institute, 1430 Broadway, New York, New York 10018. Definitions are identified by the symbol (A) after definition.
- The *Information Technology Vocabulary*, developed by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Organization for Electrotechnical Committee (ISO/IEC JTC1/SC1). Definitions of published sections of the vocabularies are identified by the symbol (I) after definition; definitions from draft international standards, draft proposals, and working papers in development by the ISO/IEC JTC1/SC1 vocabulary subcommittee are identified by the symbol (T) after definition, indicating final agreement has not yet been reached among participating members.

The following cross-references are used in this glossary:

Compare with. This refers to a term that has an opposed or substantively different meaning.

Deprecated term for. This indicates that the term should not be used. It refers to a preferred term, which is defined in the glossary.

See. This refers the reader to multiple-word terms in which this term appears.

See also. This refers the reader to terms that have a related, but not synonymous, meaning.

Synonym for. This indicates that the term has the same meaning as a preferred term, which is defined in the glossary.

Synonymous with. This is a backward reference from a defined term to all other terms that have the same meaning.

A

absolute address. (1) An address after translation and prefixing, but before configuration. See also *logical address, physical address, real address*, and *virtual address*. (2) An address that, without the need for further evaluation, identifies a storage location or a device. (T) (3) An address that is permanently assigned by the machine designer to a storage location. (A)

active configuration. In an Enterprise Systems Connection Director (ESCD), the configuration determined by the status of the currently active set of connectivity attributes. Contrast with *saved configuration*.

adapter. (1) A general term for a device that provides some transitional function between two or more devices. (2) In an Enterprise Systems Connection link environment, hardware used to join different connector types.

address. (1) A value that identifies a register, a particular part of storage, a data source, or a data sink. The value is represented by one or more characters. (2) To refer to a device or an item of data by its address. (3) The location in the storage of a computer where data is stored. (4) In data communication, the unique code assigned to each device or workstation connected to a network. (5) The identifier of a location, source, or destination.

AID. Attention identifier.

AIX. Advanced Interactive Executive

APAR. Authorized program analysis report.

application. (1) The use to which an information processing system is put; for example, a payroll application, an airline reservation application, a network application. (2) A collection of software components used to perform specific types of work on a computer.

ASCII. American National Standard Code for Information Interchange.

async. Asynchronous.

attention identifier (AID). A character in a data stream indicating that the user has pressed a key, such as the Enter key, that requests an action by the system.

authorized program analysis report (APAR). A report of a problem caused by a suspected defect in a current unaltered release of a program.

B

batch. Pertaining to a program or operation that is performed with little or no interaction between the user and the system. Contrast with *interactive*.

binary synchronous communication (BSC). A form of telecommunication line control that uses a standard set of transmission control characters and control character sequences, for binary synchronous transmission of binary-coded data between stations. Compare with *Synchronous Data Link Control*.

block. A string of data elements recorded or transmitted as a unit. The element may be characters, words, or physical records. (T)

BMPX. Block multiplexer.

BSC. Binary synchronous communication.

bus. In a processor, a physical facility on which data is transferred to all destinations, but from which only addressed destinations may read in accordance with appropriate conventions. (I)

byte. (1) A binary character operated on as a unit and usually shorter than a computer word. (A) (2) A string consisting of a specific number of bits, usually eight, treated as a unit, and representing a character. (3) A group of eight adjacent binary digits representing one EBCDIC character.

C

CA. (1) Channel address. (2) Communication adapter. (3) Common adapter.

CDS. Configuration data set.

cable. In fiber optics, see *jumper cable, multifiber cable, optical cable, optical cable assembly,* and *trunk cable*.

central processor. A processor that contains the sequencing and processing facilities for instruction execution, interruption action, timing functions, initial program loading, and other machine-related functions.

central storage. Storage that is an integral part of the processor unit. Central storage includes both main storage and the hardware system area.

channel (CHN). (1) A path along which signals can be sent, for example, data channel, output channel. (A) (2) In the channel subsystem, each channel controls an I/O interface between the channel control element and the attached control units.

channel path. A single interface attaching one or more control units.

channel path identifier (CHPID). (1) A system-unique value assigned to each installed channel path of the system. A CHPID identifies a physical channel path. (2) A two-digit hexadecimal number that identifies a channel path.

channel subsystem (CSS). A collection of subchannels that directs the flow of information between I/O devices and main storage, relieves the processor of communication tasks, and does path management functions.

channel subsystem (CSS) Licensed Internal Code. The IOP Licensed Internal Code and the CHN Licensed Internal Code. See also *IOP Licensed Internal Code* and *CHN Licensed Internal Code*.

channel-attached. Pertaining to attachment of devices directly by data channels (I/O channels) to a computer. Synonym for *local*. Contrast with *telecommunication-attached*.

CHN Licensed Internal Code. The Licensed Internal Code to start, to maintain, and to end all I/O operations on the I/O interface.

CHPID. Channel path identifier.

CICS. Customer Information Control System.

CMS. Conversational monitor system.

coax. Coaxial.

coaxial cable. A cable consisting of one conductor, usually a small copper tube or wire, within and insulated from another conductor of larger diameter, usually copper tubing or copper braid.

column. A vertical arrangement of data. Contrast with *row*.

command. (1) A request for system action. (2) A request from a terminal for the performance of an operation or the execution of a particular program. (3) A value sent on an I/O interface from a channel to a control unit that specifies the operation to be performed.

component. (1) Hardware or software that is part of a functional unit. (2) A functional part of an operating system; for example, the scheduler or supervisor.

config. (1) Configuration. (2) Configurator. (3) Configure.

configuration. (1) The arrangement of a computer system or network as defined by the nature, number, and the chief characteristics of its functional units. More specifically, the term configuration may refer to a hardware configuration or a software configuration. (I) (A) (2) In an Enterprise Systems Connection Director (ESCD), the physical interconnection capability determined by a set of attributes. The attribute values specify the connectivity control status and identifiers associated with the ESCD and its ports. See also *active configuration, configuration matrix, connectivity attributes*, and *saved configuration*.

configuration matrix. In an Enterprise Systems Connection Director (ESCD), an array of connectivity attributes, displayed in rows and columns, that can be used to alter both active and saved configurations.

connected. In an Enterprise Systems Connection Director (ESCD), the attribute that, when set, establishes a dedicated connection. Contrast with *disconnected*.

connection. In an Enterprise Systems Connection Director (ESCD), an association established between two ports that provides a physical communication path between them.

console. A logical device that is used for communication between the user and the system. See *system console* and *service console*.

control block. A storage area used by a computer program to hold control information. (I)

control program. A computer program designed to schedule and to supervise the execution of programs of a computer system.

control unit. A general term for any device that provides common functions for other devices or mechanisms. Synonym for *controller*.

controller. A unit that controls input/output operations for one or more devices.

conversational monitor system (CMS). A virtual machine operating system that provides general interactive time sharing, problem solving, and program development capabilities, and operates only under control of the VM/370 VM control program.

conversion. (1) In programming languages, the transformation between values that represent the same data item but belong to different data types. Information can be lost through conversion because accuracy of data representation varies among different data types. (2) The process of changing from one method of data processing to another or from one data processing system to another. (3) The process of changing from one form of representation to another; for example, to change from decimal representation to binary representation.

CP. (1) Control program. (2) Central processor.

cps. Characters per second.

CS. (1) Central storage. (2) Cycle steal.

CSS. Channel subsystem.

CUA. Control unit address (channel, control unit, and device address).

cursor. (1) A movable, visible mark used to indicate the position at which the next operation will occur on a display screen. (2) A unique symbol that identifies a character position on a display screen, usually the character position at which the next character to be entered from the keyboard will be displayed.

Customer Information Control System (CICS). An IBM licensed program that enables transactions entered at remote terminals to be processed concurrently by user-written application programs. It includes facilities for building, using, and maintaining data bases.

D

DASD. Direct access storage device.

data streaming. A protocol for transmitting data on a channel. In this protocol, the sender continues to transmit data without waiting for acknowledgement of receipt of the data.

data transfer. (1) The result of the transmission of data signals from any data source to a data receiver. (2) The movement, or copying, of data from one location and the storage of the data at another location.

dedication. Pertaining to the assignment of a system resource; for example, an I/O device, a program, or an entire system to one application or purpose.

default. Pertaining to an attribute, value, or option that is assumed when none is explicitly specified.

device. A mechanical, electrical, or electronic contrivance with a specific purpose.

direct access storage device (DASD). A device in which access time is effectively independent of the location of the data.

disconnected. In an Enterprise Systems Connection Director (ESCD), the attribute that, when set, removes a dedicated connection. Contrast with *connected*.

diskette. A flexible magnetic disk enclosed in a protective container.

diskette drive. The mechanism used to seek, read, and write data on diskettes.

display. See *display device, display image*, and *display screen*.

display device. A device that presents information on a screen. See also *display screen*.

display image. Information, pictures, or illustrations that appear on a display screen. See also *display device*.

display screen. The surface of a display device on which information is presented to a user. See also *display image*.

DOS/VS (Disk Operating System/Virtual Storage). A predecessor system of DOS/VSE, VSE, and VSE/ESA.

duplex. Pertaining to communication in which data can be sent and received at the same time. Synonymous with *full duplex*.

E

EE. Execution element.

element. A major part of a component (for example, the buffer control element) or a major part of the system (for example, the system control element).

emulation. (1) The imitation of all or part of one system by another, primarily by hardware, so that the imitating system accepts the same data, executes the same programs, and achieves the same results as the imitated computer system. (2) The use of programming techniques and special machine features to allow a computing system to execute programs written for another system. (3) Imitation; for example, imitation of a computer or device. (4) Contrast with *simulation*.

ESA. Enterprise Systems Architecture.

ESCD console. The ESCD input/output device used to perform connectivity tasks at the ESCD.

ESCD console adapter. The adapter in the ESCD console that provides the hardware attachment between the ESCD and the ESCD console.

ESCON. Enterprise Systems Connection.

event. (1) An occurrence or happening. (2) An occurrence of significance to a task; for example, the completion of an asynchronous operation, such as an input/output operation.

execution element (EE). An element in a central processor that performs all floating-point, fixed-point multiply, fixed-point divide, and convert operations.

expanded storage. (1) Optional integrated high-speed storage that transfers 4K-byte pages to and from central storage. (2) Additional (optional) storage that is addressable by the system control program. Expanded storage improves system response and system performance. (3) All storage above 256MB. Storage between 64MB and 256MB can be partitioned between central storage and expanded storage.

F

F. Farad.

FC. Feature code.

feature. A part of an IBM product that can be ordered separately by the customer.

feature code. A code used by IBM to process hardware and software orders.

fixed disk. A rigid magnetic disk used in a fixed disk drive.

frame. (1) A housing for machine elements. (2) The hardware support structure, covers, and all electrical parts mounted therein that are packaged as one entity for shipping. (3) A formatted display.

full duplex. Synonym for *duplex*.

G

G. Giga.

giga (G). Ten to the ninth power; 1 000 000 000 in decimal notation. When referring to storage size, 2 to the thirtieth power, 1 073 741 824 in decimal notation.

H

hardware system area (HSA). A logical area of central storage that is used to store Licensed Internal Code and control information (not addressable by application programs).

hex. Hexadecimal.

hexadecimal (hex). Pertaining to a numbering system with base of 16; valid numbers use the digits 0 through 9 and characters A through F, where *A* represents 10 and *F* represents 15.

host (computer). (1) In a computer network, a computer that provides end users with services such as computation and data bases and that usually performs network control functions. (2) The primary or controlling computer in a multiple-computer installation.

HSA. Hardware system area.

I

I. Instruction (as in I-address, I-buffer, I-bus, I-cache, I-counter, I-element, I-execution, I-fetch, I-queue, I-register, I-step, I-time).

I/O. Input/output.

I/O configuration. The collection of channel paths, control units, and I/O devices that attaches to the processor unit.

I/O configuration data set (IOCDS). The data set, located in the diskette drive files that are associated with the I/O support processor (IOSP), that contains the I/O configuration definition.

I/O configuration program (IOCP). A program that defines to a system all available I/O devices and channel paths.

Note: The configuration program is available in three versions: stand-alone, VM/370, and MVS.

I/O interface. The interface that connects channels and control units for the exchange of signals and data.

I/O support processor. The hardware unit that provides I/O support functions for the primary support processor and maintenance support functions for the processor controller element.

ID. Identifier.

identifier (ID). (1) One or more characters used to identify or name a data element and possibly to show certain properties of that data element. (2) In an Enterprise Systems Connection Director (ESCD), a user-defined symbolic name of 24 characters or less that identifies a particular ESCD. See also *password identifier* and *port address name*.

IML. Initial machine load.

in. Inch.

initial machine load (IML). A procedure that prepares a device for use.

initial program load (IPL). The initialization procedure that causes an operating system to start operation.

initialization. Preparation of a system, device, or program for operation.

initialize. To set counters, switches, addresses, or storage contents to zero or other starting values at the beginning of, or at prescribed points in, the operation of a computer routine. (A)

input device. A device in a data processing system by which data can be entered into the system.

input/output. (1) Pertaining to a device whose parts can perform an input process and an output process at the same time. (I) (2) Pertaining to a functional unit or channel involved in an input process, output process, or both, concurrently or not, and to the data involved in such a process.

input/output configuration data set (IOCDS). A configuration definition built by the I/O Configuration Program (IOCP) and stored on disk files associated with the processor controller.

input/output configuration program (IOCP). The program that defines the I/O configuration data required by the processor complex to control I/O requests.

input/output support processor (IOSP). The hardware unit that provides I/O support functions for the primary support processor (PSP). It also provides maintenance support function for the processor controller element (PCE).

input/output support processor (IOSP) display station. The display station and keyboard that function with the system unit to provide support for the primary support processor (PSP).

input/output support processor (IOSP) system board. The logic board that provides basic processor and I/O functions for the IOSP.

input/output support processor (IOSP) system board memory. The card that plugs into the system board for the IOSP processor function.

input/output support processor (IOSP) tape drive. The tape drive inside the IOSP.

interactive. Pertaining to a program or system that alternately accepts input and then responds. An interactive system is conversational; that is, a continuous dialog exists between user and system. Contrast with *batch*.

interface. (1) A shared boundary between two functional units, defined by functional characteristics, common physical interconnection characteristics, signal characteristics, and other characteristics as appropriate. (2) A shared boundary. An interface can be a hardware component to link two devices or a portion of storage or registers accessed by two or more computer programs. (3) Hardware, software, or both, that links systems, programs, or devices.

interrupt. (1) A suspension of a process, such as execution of a computer program caused by an external event, and performed in such a way that the process can be resumed. (A) (2) To stop a process in such a way that it can be resumed. (3) In data communication, to take an action at a receiving station that causes the sending station to end a transmission. (4) To temporarily stop a process. (5) Synonymous with *interruption*.

interruption. Synonym for *interrupt*.

IOCDS. I/O configuration data set.

IOCP. I/O configuration program.

IOP Licensed Internal Code. The Licensed Internal Code used by the I/O processor to start and to end (normally or abnormally) all I/O operations for the central processor.

IOSP. Input/output support processor.

IPL. Initial program load.

J

jumper cable. In an Enterprise Systems Connection environment, a duplex fiber optic cable that provides physical attachment between two devices or between a device and a distribution panel. Contrast with *trunk cable*.

K

K. When referring to storage capacity, two to the tenth power, 1024 in decimal notation. (A)

L

LAN. Local area network.

local. Pertaining to a device accessed directly without use of a telecommunication line. Synonym for *channel-attached*. Contrast with *remote*.

local area network (LAN). A data network located on the user's premises in which serial transmission is used for direct data communication among data stations. (T)

logical address. The address found in the instruction address portion of the program status word (PSW). If translation is off, the logical address is the real address. If translation is on, the logical address is the virtual address. See also *absolute address, physical address, real address*, and *virtual address*.

logical partition (LPAR). In LPAR mode, a subset of the processor unit resources that is defined to support the operation of a system control program (SCP).

loop. (1) A sequence of instructions processed repeatedly while a certain condition prevails. (2) A closed unidirectional signal path connecting input/output devices to a network.

LPAR. Logical partition.

LPAR mode. A central processor mode that is available on the Configuration (CONFIG) frame. LPAR mode allows the operator to allocate the hardware resources of the processor unit among several logical partitions.

M

main storage. A logical entity that represents the program addressable portion of central storage. See also *central storage*.

maintenance analysis procedure (MAP). A step-by-step procedure for tracing a symptom to the cause of a failure.

MAP. Maintenance analysis procedure.

Mb. Megabit.

MB. Megabyte; 1 048 576 bytes.

medium. A physical carrier of electrical or optical energy.

megabit (Mb). A unit of measure for throughput. 1 megabit = 1 048 576 bits.

megabyte (MB). (1) A unit of measure for storage size. One megabyte equals 1 048 576 bytes. (2) Loosely, one million bytes.

MES. Miscellaneous equipment specification.

mm. Millimeter.

mode. In any cavity or transmission line, one of those electromagnetic field distributions that satisfies Maxwell's equations and the boundary conditions. The field pattern of a mode depends on wavelength, refractive index, and cavity or waveguide geometry. (A)

modem (modulator/demodulator). A device that converts digital data from a computer to an analog signal that can be transmitted on a telecommunication line, and converts the analog signal received to data for the computer.

MPG. Multiple Preferred Guests.

multidrop (network). A network configuration in which there are one or more intermediate nodes on the path between a central node and an endpoint node.

multifiber cable. An optical cable that contains two or more fibers. (A) See also *jumper cable, optical cable assembly,* and *trunk cable*.

multiple preferred guests. A VM/XA facility that, with the Processor Resource/Systems Manager (PR/SM), supports up to six preferred virtual machines. See also *preferred virtual machine*.

multiplexing. In data transmission, a function that permits two or more data sources to share a common transmission medium so that each data source has its own channel.

MVS. Multiple Virtual Storage, consisting of MVS/System Product Version 1 and the MVS/370 Data Facility Product operating on a System/370 processor. See also *MVS/XA*.

MVS/SP. Multiple Virtual Storage/System Product.

MVS/XA. Multiple Virtual Storage/Extended Architecture, consisting of MVS/System Product Version 2 and the MVS/XA Data Facility Product, operating on a System/370 processor in the System/370 extended architecture mode. MVS/XA allows virtual storage addressing to 2 gigabytes. See also *MVS*.

N

network. An arrangement of programs and devices connected for sending and receiving information.

no. Number.

NO. Normally open.

O

operating system (OS). Software that controls the execution of programs. An operating system may provide services such as resource allocation, scheduling, input/output control, and data management. (I) (A)

Note: Although operating systems are predominantly software, partial or complete hardware implementations are possible.

optical cable. A fiber, multiple fibers, or a fiber bundle in a structure built to meet optical, mechanical, and environmental specifications. (A) See also *jumper cable, optical cable assembly,* and *trunk cable*.

optical cable assembly. An optical cable that is connector-terminated. Generally, an optical cable that has been terminated by a manufacturer and is ready for installation. (A) See also *jumper cable* and *optical cable*.

optical power. Synonym for *radiant power*.

option. (1) A specification in a statement, a selection from a menu, or a setting of a switch, that can be used to influence the execution of a program. (2) A hardware or software function that can be selected or enabled as part of a configuration process. (3) A piece of hardware (such as a network adapter) that can be installed in a device to modify or enhance device function.

OS. Operating system.

P

PA. Problem analysis.

page. In a virtual storage system, a fixed-length block that has a virtual address and is transferred as a unit between real storage and auxiliary storage. (I) (A)

parallel channel. A channel having a System/360 and System/370 channel-to-control-unit I/O interface, that uses bus-and-tag cables as a transmission medium.

parameter. (1) A variable that is given a constant value for a specified application and that can denote the application. (2) An item in a menu for which the user specifies a value or for which the system provides a value when the menu is interpreted. (3) Data passed between programs or procedures.

password identifier. In an Enterprise Systems Connection Director (ESCD), a user-defined symbolic name of 24 characters or less that identifies the password user.

path. In a network, a route between any two nodes.

PCE. Processor controller element.

physical address. The absolute address after configuration (the final address). See also *absolute address*, *logical address, real address*, and *virtual address*.

POR. Power-on reset.

port. (1) An access point for data entry or exit. (2) A connector on a device to which cables for other devices such as display stations and printers are attached.

port address name. In an Enterprise Systems Connection Director (ESCD), a user-defined symbolic name of 24 characters or less that identifies a particular port.

power. In fiber optics, synonym for *radiant power*.

power-on reset. The state of the machine after a logical power-on before the control program is IPLed.

PR/SM. Processor Resource/Systems Manager.

preferred virtual machine. A virtual machine that runs in the V = R area. The control program gives this virtual machine preferred treatment in the areas of performance, processor assignment, and I/O interrupt handling. See also *multiple preferred guests*.

primary Enterprise Systems Connection Manager (ESCM). In multiple ESCM environments, the source of ESCM commands.

problem determination (PD). The process of determining the source of a problem; for example, a program component, machine failure, telecommunication facilities, user or contractor-installed programs or equipment, environmental failure such as a power loss, or user error.

processor controller element (PCE). Hardware that provides support and diagnostic functions for the processor unit. The processor controller communicates with the processor unit through the logic service adapter and the logic support stations, and with the power supplies through the power thermal controller. It includes: primary support processor (PSP), initial power controller (IPC), input/output support processor (IOSP), and the control panel assembly.

Processor Resource/Systems Manager (PR/SM). A function that allows the processor unit to operate several system control programs (SCPs) simultaneously in LPAR mode. It provides for logical partitioning of the real machine and support of multiple preferred guests. See also *multiple preferred guests*.

processor unit. The boundaries of a system, exclusive of I/O control units and devices, that can be controlled by a single operating system. A processor unit consists of main storage, one or more central processing units, time-of-day clocks, and channels, which are, or can be, placed in a single configuration. A processor unit also includes channel subsystems, service processors, and expanded storage where installed.

profile. Data that describes the significant characteristics of a user, a group of users, or one or more computer resources.

program function (PF) key. On a display device keyboard, a key that passes a signal to a program to call for a particular display operation.

program temporary fix (PTF). A temporary solution or by-pass of a problem diagnosed by IBM as resulting from an error in a current unaltered release of the program.

program version. A separate IBM licensed program, based on an existing IBM licensed program, that usually has significant new code or new function.

protocol. (1) A set of semantic and syntactic rules that determines the behavior of functional units in achieving communication. (2) In SNA, the meanings of and the sequencing rules for requests and responses used for managing the network, transferring data, and synchronizing the states of network components. (3) A specification for the format and relative timing of information exchanged between communicating parties.

ps. Picosecond.

PS/2. IBM Personal System/2.

PTF. Program temporary fix.

R

radiant power. In fiber optics, the time rate of flow of radiant energy, expressed in watts. The prefix is often dropped and the term power is used. (A) Synonymous with *optical power*.

RAS. Reliability, availability, serviceability.

real address. (1) An address before prefixing, such as found in the instruction address portion of the channel status word (CSW). If translation is off, the logical address is the real address. See also *absolute address, logical address, physical address*, and *virtual address*. (2) The address of a storage location in real storage. (I)(A) (3) In VM, the address of a location in real storage or the address of a real I/O device.

remote. Pertaining to a system, program, or device that is accessed through a telecommunication line.

replace. To substitute an item for another; for example, to substitute an existing field-replaceable unit (FRU) with another of the same type.

request for price quotation (RPQ). A custom feature for a product.

RETAIN. Remote technical assistance and information network.

row. A horizontal arrangement of data. Contrast with *column*.

RPQ. Request for price quotation.

RSF. Remote support facility.

S

S/370. System/370 mode.

SAA. Systems Application Architecture.

saved configuration. In an Enterprise Systems Connection Director (ESCD), a stored set of connectivity attributes whose values determine a ESCD configuration that can be used to replace all or part of the configuration currently active. Contrast with *active configuration*.

scalar. (1) A quantity characterized by a single value. (I)(A) (2) A type of program object that contains either string or numeric data. It provides representation and operational characteristics to the byte string to which it is mapped. (3) Pertaining to a single data item as opposed to an array of data items. (4) Compare with *vector*.

SCE. System control element.

SCP. System control programming.

screen. See *display screen*.

SEC. System engineering change.

service console. A logical device used by service representatives to maintain the processor unit and to isolate failing field replaceable units. The service console can be assigned to any of the physical displays attached to the input/output support processor.

session. In SNA, a logical connection between two network addressable units (NAUs) that can be activated, tailored to provide various protocols, and deactivated as requested.

simulation. (1) The representation of selected characteristics of the behavior of one physical or abstract system by another system. In a digital computer system, simulation is done by software; for example, (a) the representation of physical phenomena by means of operations performed by a computer system, and (b) the representation of operations of a computer system by those of another computer system. (2) Contrast with *emulation*.

SLC. Service language command.

SNA. Systems Network Architecture.

standard. Something established by authority, custom, or general consent as a model or example.

station. (1) An input or output point of a system that uses telecommunication facilities; for example, one or more systems, computers, terminals, devices, and associated programs at a particular location that can send or receive data over a telecommunication line. (2) A location in a device at which an operation is performed; for example, a read station. (3) In SNA, a link station.

storage. A unit into which recorded text can be entered, in which it can be retained and processed, and from which it can be retrieved.

subchannel. The channel facility required for sustaining a single I/O operation.

subchannel (SCH). In ESA/370 mode, a group of contiguous words in the hardware system area that provides all of the information necessary to initiate, control, and complete an I/O operation.

subsystem. A secondary or subordinate system, or programming support, usually capable of operating independently of or asynchronously with a controlling system.

synchronous. (1) Pertaining to two or more processes that depend on the occurrences of a specific event, such as common timing signal. (2) Occurring with a regular or predictable time relationship.

Synchronous Data Link Control (SDLC). A discipline conforming to subsets of the Advanced Data Communication Control Procedures (ADCCP) of the American National Standards Institute (ANSI) and High-level Data Link Control (HDLC) of the International Organization for Standardization, for managing synchronous, code-transparent, serial-by-bit information transfer over a link connection. Transmission exchanges may be duplex or half-duplex over switched or nonswitched links. The configuration of the link connection may be point-to-point, multipoint, or loop. (I) See also *binary synchronous communications.*

SYSGEN. System generation.

SYSIML. System initial machine load.

system. (1) The processor unit and all attached and configured I/O and communication devices. (2) In information processing, a collection of machines, programs, and methods organized to accomplish a set of specific functions.

system configuration. A process that specifies the devices and programs that form a particular data processing system.

system console. A logical device used for the operation and control of hardware functions (for example, IPL, alter/display, and reconfiguration). The system console can be assigned to any of the physical displays attached to the processor controller.

system control element (SCE). The hardware that handles the transfer of data and control information associated with storage requests between the elements of the processor unit.

system control programming (SCP). IBM-supplied programming that is fundamental to the operation and maintenance of the system. It serves as an interface with licensed programs.

system generation (SYSGEN). The process of selecting optional parts of an operating system and of creating a particular operating system tailored to the requirements of a data processing installation. (I)(A)

system reset (SYSRESET). To reinitialize the execution of a program by repeating the initial program load (IPL) operation.

Systems Application Architecture (SAA). An architecture developed by IBM that consists of a set of selected software interfaces, conventions, and protocols, and that serves as a common framework for application development, portability, and use across different IBM hardware systems.

Systems Network Architecture (SNA). The description of the logical structure, formats, protocols, and operational sequences for transmitting information units through, and controlling the configuration and operation of, networks.

T

table. Information presented in rows and columns.

telecommunication-attached. Pertaining to the attachment of devices by teleprocessing lines to a host processor. Synonym for *remote*. Contrast with *channel-attached*.

terminal. In data communication, a device, usually equipped with a keyboard and display device, that can send and receive information.

time-of-day (TOD) clock. A System/370 hardware feature with a clock that is incremented once every microsecond to provide a consistent measure of elapsed time suitable for indicating the date and time. The TOD clock runs regardless of whether the processing unit is in a running, wait, or stopped state.

token. A sequence of bits passed from one device to another on the token-ring network that signifies permission to transmit over the network. It consists of a starting delimiter, an access control field, and an end delimiter. The access control field contains a bit that indicates to a receiving device that the token is ready to accept information. If a device has data to send along the network, it appends the data to the token. When data is appended, the token then becomes a frame.

token ring. A network with a ring topology that passes tokens from one attaching device (node) to another. A node that is ready to send can capture a token and insert data for transmission.

trunk cable. In an Enterprise Systems Connection environment, a cable consisting of one or, usually, more link segments that do not directly attach to an active device. These segments usually exist between distribution panels and can be located within, or external to, a building. Contrast with *jumper cable*.

U

UCW. Unit control word.

unit control word. An identifier that contains the control information necessary for a channel to perform input/output operations to an attached device.

V

V. (1) Virtual (as in V = R). (2) Volt.

V = R. Virtual equals real.

vector. (1) A quantity usually characterized by an ordered set of numbers. (I)(A) (2) A one-dimensional array. Compare with *scalar*.

version. See *program version*.

virtual address. (1) A symbolic address naming the relative location of data. See also *absolute address, logical address, physical address*, and *real address*. (2) The address of a location in virtual storage. A virtual address must be translated into a real address to process the data in processor storage.

virtual machine (VM). (1) A functional simulation of a computer and its associated devices. Each virtual machine is controlled by a suitable operating system. VM/370 controls concurrent execution of multiple virtual machines on a single System/370. (2) In VM, a functional simulation of either a System/370 computing system or a System/370-Extended Architecture computing system. Each virtual machine is controlled by an operating system. VM controls concurrent execution of multiple virtual machines on a single system.

Virtual Machine/System Product (VM/SP). An IBM-licensed program that manages the resources of a single computer so that multiple computing systems appear to exist. Each virtual machine is functionally equal to a "real" machine.

virtual storage (VS). (1) The storage space that can be regarded as addressable main storage by the user of a computer system in which virtual addresses are mapped into real addresses. The size of virtual storage is limited by the addressing scheme of the computer system and by the amount of auxiliary storage available, not by the actual number of main storage locations. (2) Addressable space that is apparent to the user as the processor storage space, from which the instructions and the data are mapped into the processor storage locations.

VM. Virtual machine.

VM/SP. Virtual Machine/System Product.

VM/XA. Virtual Machine/Extended Architecture.

vol. Volume.

VSE (Virtual Storage Extended). An operating system that is an extension of DOS/VS. A VSE system consists of a) a licensed VSE/Advanced Functions support and b) any IBM-supplied and user-written programs required to meet the data processing needs of a user. VSE and the hardware it controls form a complete data processing system. Its current version is called VSE/ESA.

VSE/Advanced Functions. The basic operating system support needed for a VSE-controlled installation.

VSE/ESA (Virtual Storage Extended/Enterprise Systems Architecture). The most advanced VSE system currently available.

W

wait. The condition of a processing unit when all operations are suspended.

work area. An area reserved for temporary storage of data that are to be operated on.

workstation. (1) An I/O device that allows either transmission of data or the reception of data (or both) from a host system, as needed to perform a job; for example, a display station or printer. (2) A configuration of I/O equipment at which an operator works. (3) A terminal or microcomputer, usually one connected to a mainframe or network, at which a user can perform tasks.

write. To make a permanent or transient recording of data in a storage device or on a data medium.

X

x. (1) Symbol for an unknown value or character. (2) Symbol for a variable alphanumeric character.

X. Hexadecimal (as in X'5F').

XA. Extended architecture.

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Runtime values:

Document fileid	3196MSTR SCRIPT
Document type	USERDOC
Document style	IBMXAGD
Profile	EDFPRF20
Service Level	0017
SCRIPT/VS Release	3.2.1
Date	90.11.13
Time	15:33:49
Device	3820A
Number of Passes	2
Index	NO
SYSVAR G	INLINE
SYSVAR S	OFF

Formatting values used:

Annotation	NO
Cross reference listing	YES
Cross reference head prefix only	NO
Dialog	LABEL
Duplex	YES
DVCF conditions file	(none)
DVCF value 1	(none)
DVCF value 2	(none)
DVCF value 3	(none)
DVCF value 4	(none)
DVCF value 5	(none)
DVCF value 6	(none)
DVCF value 7	(none)
DVCF value 8	(none)
DVCF value 9	(none)
Explode	NO
Figure list on new page	YES
Figure/table number separation	YES
Folio-by-chapter	NO
Head 0 body text	(none)
Head 1 body text	Chapter
Hyphenation	YES
Justification	YES
Language	ENGL
Layout	OFF
Leader dots	YES
Master index	(none)
Partial TOC (maximum level)	4
Partial TOC (new page after)	INLINE
Print example id's	NO
Print cross reference page numbers	YES
Process value	(none)
Punctuation move characters	.,
Read cross-reference file	(none)
Running heading/footing rule	NONE
Show index entries	NO
Table of Contents (maximum level)	3
Table list on new page	YES
Title page (draft) alignment	RIGHT
Write cross-reference file	(none)

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