IBM RS/6000 and System/390
Server-on-Board Model F50
Is It Right for You?

IBM

Technical Application Brief

GC28-1619-03

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Fourth Edition (May 1998)

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Preface

The purpose of this document is to help you determine whether the IBM RS/6000 and System/390 Server-on Board Model F50 (Enhanced R/390) is right for your enterprise. A brief description tells how the Enhanced R/390 can be used in various environments. After understanding its capabilities, you will have an opportunity to determine if the Enhanced R/390 fits your business needs by completing a questionnaire and a worksheet. Further planning information is provided to assist you in understanding some of the alternatives and choices when configuring the Enhanced R/390.

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Summary of Changes

Revision of GC28-1619-00

Performance data has been added to the appendix of this document.

Revision of GC28-1619-01

This document has been updated to describe the IBM RS/6000 and System/390 Server-on Board Model 591.

GC28-1619-02

This document has been updated to describe the IBM RS/6000 and System/390 Server-on Board 7025-Model F50

GC28-1619-03

This document has been updated to reflect the use of the new "Enhanced P/390 Microprocessor Adapter" and the support of the SMP (Symmetric Multi-Processor) mode of operation.

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Chapter 1. Description

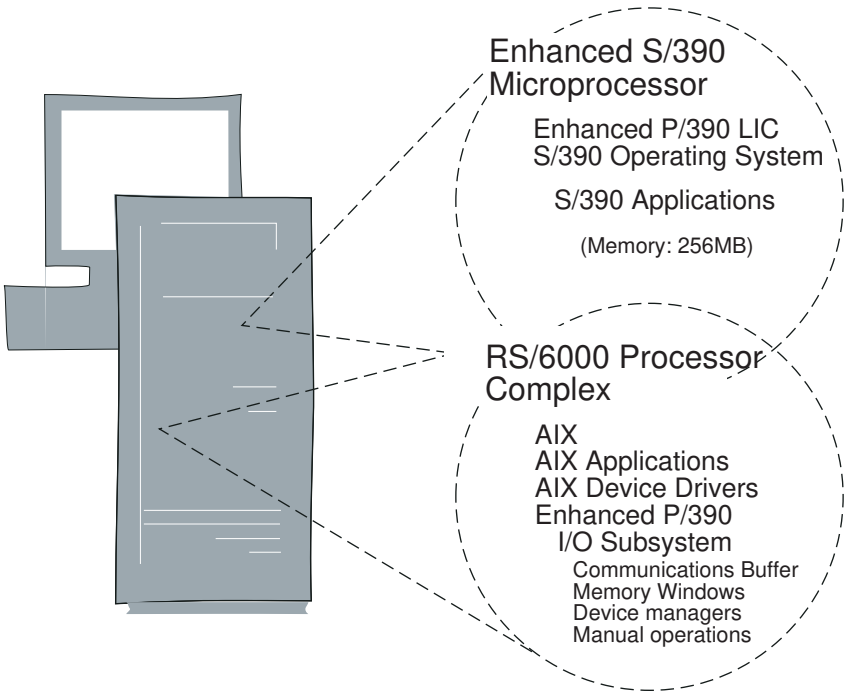

Figure 1. IBM RS/6000 and System/390 Server-on Board

Continuing the drive to provide flexibility and cost-effective computing with the latest technology to meet our customers requirements, IBM announced the availability of the Enhanced System/390 Microprocessor Adapter (Enhanced P/390) to function as a coprocessor in the powerful and expandable RS/6000 Server 7025-Model F50. The combined features of the RS/6000 and S/390 produce a computer system capable of executing both RS/6000-based and S/390-based applications concurrently. The integrated product is called the IBM RS/6000 and System/390 Server-on Board. (Throughout this book, the IBM RS/6000 and System/390 Server-on Board is called the Enhanced R/390.)

The new "IBM Enhanced System/390 Microprocessor Adapter" (referred to in this document as the Enhanced P/390) is now provided as part of the IBM RS/6000 and System/390 Server-on Board. Enhanced P/390 includes a number of significant improvements to provide even better flexibility and capability than the previous versions of the system. The Enhanced P/390 provides 256MB of S/390 memory (double the P/390 memory), up to a 40% increase in processor speed, and significantly better I/O capacity.

The Enhanced R/390 also introduces support of the S/390 components running in Symmetric MultiProcessor (SMP) mode on the RS/6000 F50. By using multiple RS/6000 processors (the F50 supports up to four 332MHz processors), the Enhanced R/390 can multi-thread key Device Managers and other support functions, providing significantly improved I/O throughput. The use of multiple processors and SMP capability can also provide better configuration flexibility and

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performance when supporting significant non-S/390 (AIX) workloads on the Enhanced R/390 system.

The Enhanced R/390 offers a wide variety of possibilities and creative uses for your business needs. The Enhanced R/390 is a low-cost single platform that combines the strengths of the S/390 and AIX operating systems with the large portfolio of S/390 and UNIX applications. Here are some of the possibilities:

Application Development. The Enhanced R/390 is a cost-effective platform to develop UNIX client/server applications for both the S/390 environment and the RS/6000 environment. Figure 2 shows an Enhanced R/390 being used for application development. As a development workstation that is ideal for small development teams, the Enhanced R/390 exploits the productivity of S/390 and UNIX development tools while having immediate access to a S/390 and AIX system for testing and debugging applications. UNIX-based system design and re-engineering CASE tools plus S/390 3GL and 4GL tools, such as object-oriented SOM and DSOM, can help shorten the development cycle for S/390 and UNIX environments. As a dedicated resource for development and test, the Enhanced R/390 increases the availability of the host production system in the following ways:

- Using the same tool set as the host
- Eliminating the dependencies on the host
- Reducing risk on the production system

As the **year 2000** rapidly approaches, an urgent business requirement arises to verify customer-developed applications with year-2000-compliant hardware and software. For S/370 and S/390 customers, the Enhanced R/390 is the ideal platform to test these applications and develop necessary changes without impacting the host system. Using the Enhanced R/390, the time-of-day (TOD) clock can be changed to reflect the year 2000 for testing date-reliant applications.

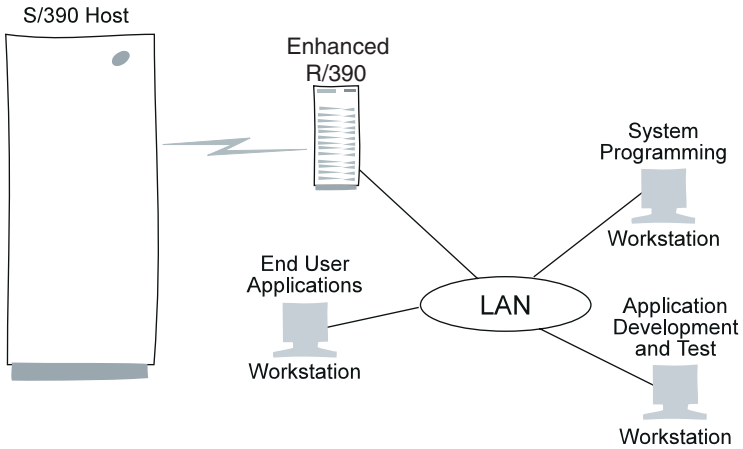

Figure 2. Enhanced R/390 as an Application Development Workbench

The Enhanced R/390 is also targeted for solution providers to develop or port UNIX applications to the OS/390 UNIX Services environment. OS/390 provides the XPG5 base, which allows easy porting of UNIX applications. The goal is to make it easy for customers and solution providers to develop, maintain, and test applications. The Enhanced R/390 is designed to provide an ideal environment for immediate and isolated test of new applications with access to problem determination tools and resources during critical shifts.

Old Iron Replacement Market. Figure 3 on page 3 shows how you can replace outdated S/370 and S/390 systems. Customers with general purpose processors can now upgrade to new technologies and gain substantial savings with the Enhanced R/390. In addition, for those customers participating in the LAN environment, the Enhanced R/390 addresses the customers' LAN needs by providing them with the opportunity to replace their existing system and to continue using their existing applications. In terms of porting S/370 applications to a new technology, the Enhanced R/390 facilitates easy upgrades in comparison to moving to an entirely new platform. The Enhanced R/390 allows the upgraded S/390 customer to also use the vast portfolio of UNIX applications and to port UNIX applications to OS/390 UNIX Services.

With the Enhanced R/390, the customer can use the same skill set and same applications on new technology. Some of this customer set will continue to run back-level non-ESA software. Today this works well for the customer; however, it will not work for them at the turn of the century. The Enhanced R/390 system is **year-2000**-capable with S/390 ESA software and CMOS hardware. At the customer's pace, UNIX skills can be developed to take advantage of the large UNIX portfolio set.

Substantial savings can be achieved through lower maintenance costs, lower energy costs, lower connectivity costs, and environmental savings. These potential benefits are derived from CMOS technologies with higher reliability, lower power requirements, LAN connectivity, and reduced space requirements.

Note: Enhanced R/390 is a possible replacement for models 4341, 4361, 4381, 9221-120, 9221-130, 9221-150, 9221-170, 9371, 9373, 9375, and 9377, 9371, 9373, 9377, and 9375 depending on machine configurations and workload characteristics.

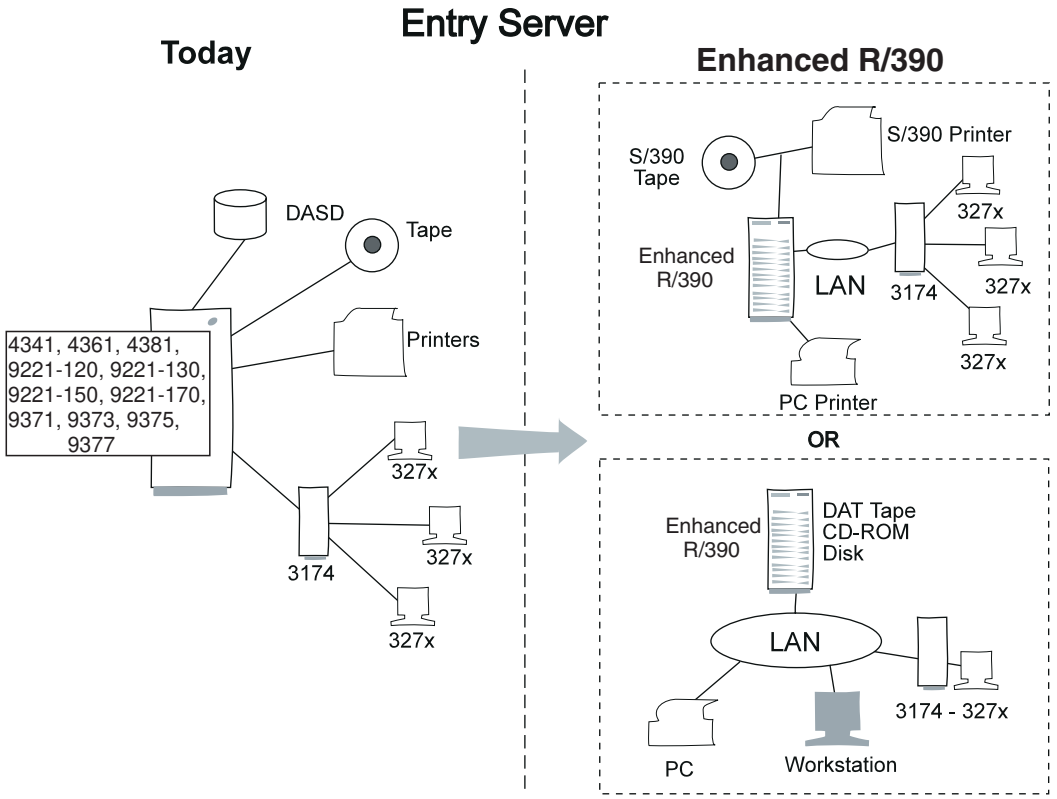

Figure 3. Enhanced R/390 as a Replacement

Application Server. Figure 4 on page 4 shows the Enhanced R/390 participating in a distributed environment as an application server. Application servers have a variety of client/server usages, such as a distributed server with additional or legacy applications, a distributed server with a single function of file serving or print serving, or a server packaged with a Solution Provider S/390 or UNIX application, to name a few. Ideal for a department or small business, the Enhanced R/390 is an application server that runs both AIX and S/390 applications unchanged. The Enhanced R/390 allows remote locations to run, some unattended, while serving the remote users with consistent business application and data across the enterprise. Solution providers can incorporate their applications on the Enhanced R/390 and widen their customer base by targeting previously unobtainable markets. The Enhanced R/390 application server brings specific workloads into LAN environments, solving business needs, resulting in improved productivity, local control, and reduced telecommunication costs.

The Enhanced R/390 enables the S/390 to be a server or client in an existing LAN with access to host data. As a client, the Enhanced R/390 can seamlessly participate in any LAN environments. As a server, the Enhanced R/390 is a fully integrated S/390 or RS/6000 server. This choice of implementation provides the customer with flexibility and duality while satisfying the customers' requirement to participate in local area networks.

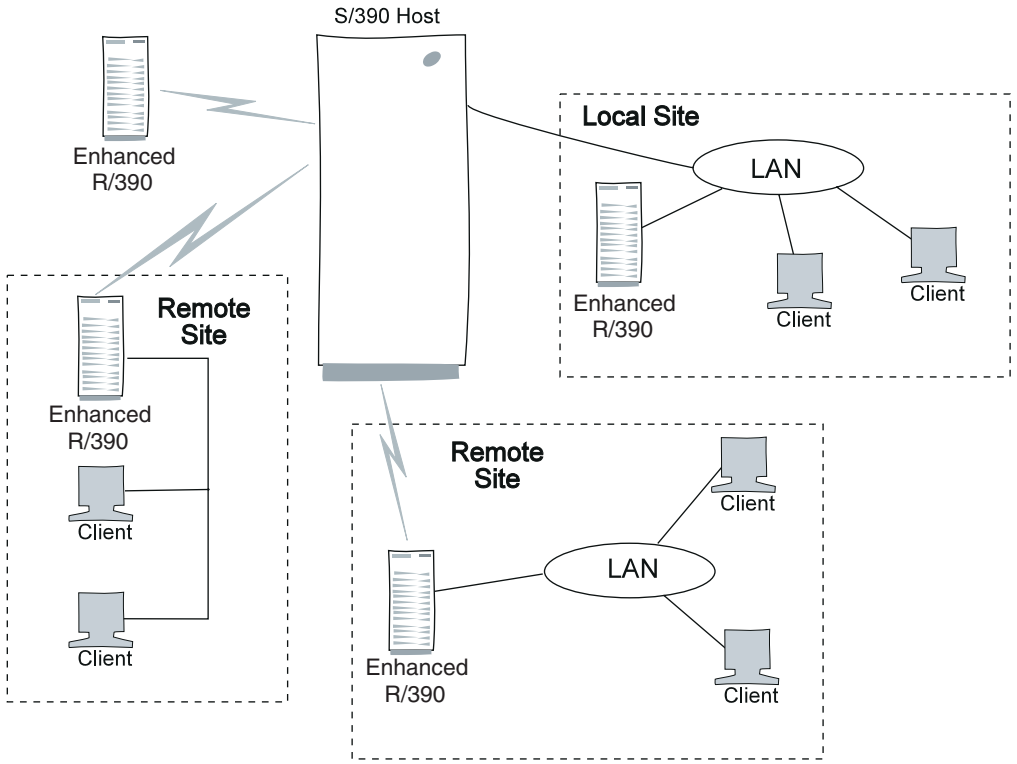

Figure 4. Enhanced R/390 in Distributed Environments

New Entry Server. The possibilities of the Enhanced R/390 are numerous and varied, depending on the customer's need and creativity. As network-centric computing grows in intensity, the Enhanced R/390 will find new uses, such as a webserver and router server. With the low-cost single platform for a dual environment, the Enhanced R/390 can enter markets that were previously limited by price or by function.

Is It Right for You? Chapter 3, “Performance Overview” on page 13 and Chapter 4, “Planning for a New Environment” on page 15 can help you determine whether the Enhanced R/390 is right for you. You should analyze your capacity and configuration requirements carefully to see whether it will suit your business needs.

Chapter 2. Highlights

The Enhanced R/390 is a dual architecture system consisting of a S/390 processor and one or more RISC processors. The Enhanced R/390 features the industry-common Peripheral Component Interface (PCI) and Industry Standard Architecture (ISA) bus technology. The Enhanced System/390 Microprocessor Adapter provides the S/390 ESA instruction set necessary to run the VM/ESA, VSE/ESA, and OS/390 operating systems.

The RS/6000 PowerPC architecture supports AIX applications, advanced local area network applications, and teleprocessing. The RS/6000 also provides support for the S/390 Processor Complex I/O using device managers, device drivers, and S/390 channel emulation. Selected S/390 devices are either channel-attached using the S/390 Parallel Channel adapter or emulated using RS/6000 devices in a manner that is transparent to the S/390.

Enhanced System/390 Microprocessor Adapter (Enhanced P/390)

The Enhanced System/390 Microprocessor Adapter or Enhanced P/390 is presently supported in the RS/6000-7025 Model F50. It has the following features:

- IBM Enhanced System/390 Microprocessor Adapter with 256MB ECC standard S/390 memory
- 64-bit internal data flow
- Integrated floating point unit
- Support for S/390 ESA architecture (included licensed internal code)
- Uses RS/6000 resources to emulate S/390 I/O devices
- Includes diskettes with AIX device managers

RS/6000 Model F50 System

Here are the highlights of the RS/6000 Model F50.

- 1,2,3, or 4-way 604e X5 166 MHz PowerPC processors, upgradable to 1,2,3, or 4-way 604e X5 332 MHz PowerPC processors.
- 256KB of L2 cache
- 128MB base ECC synchronous DRAM memory expandable to 3GB (addressable)
- Nine PCI slots: two are shared ISA slots
  - Seven PCI slots at 32 bit/33MHz
  - Two PCI slots at 64 bit/33MHz (switchable to 50 MHz)
- Two integrated SCSI-2 Fast/Wide controllers
- Bays, maximum of 22 total media and disk bays
  - 10 base bays: four media, six hot-swap disk
  - 12 optional hot-swappable disk drive bays
- 4GB/8GB 4mm digital audio tape (DAT) drive, required for Enhanced P/390
- 8X-speed CD-ROM drive
- 4.5GB Ultra-SCSI-enabled disk drive
- 1.44MB diskette drive
- Integrated Ethernet with thick (10Base5) and twisted pair (10BaseT) output connectors
- Three serial and one parallel port
- 930-watt base power supply

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Internal RAID support—SCSI, Ultra-SCSI, or SSA
Service processor for enhanced reliability and serviceability
Enhanced 101-keyboard
Three-button mouse
One-year warranty

Connectivity

There are many ways to provide connectivity to the S/390 operating systems running on the Enhanced R/390 With appropriate software installed, the Enhanced R/390 can operate under the IBM Systems Network Architecture (SNA), IBM non-SNA networks, and some non-IBM networks. The device managers identified in this section are described in Chapter 6, “Planning Guide” on page 21.

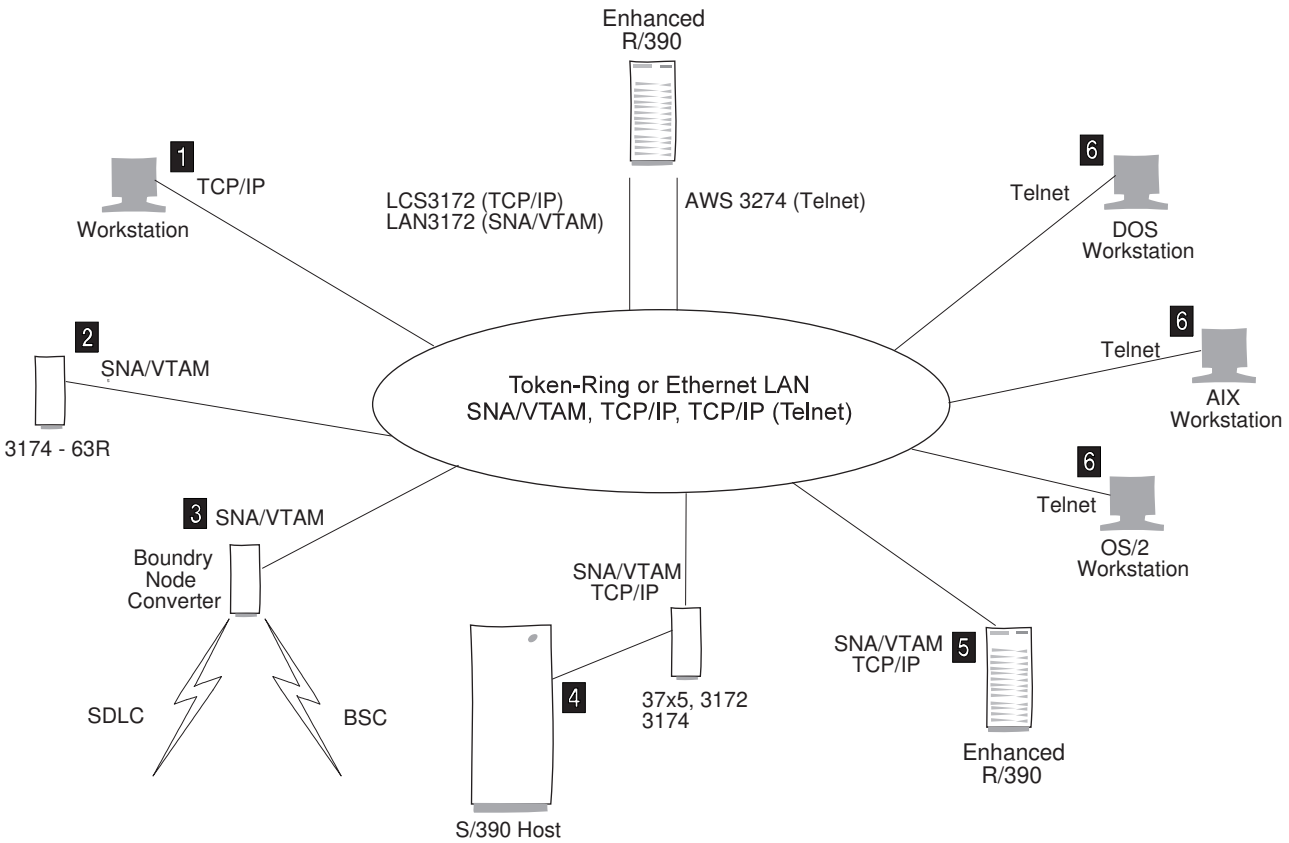

Figure 5. The Enhanced R/390 in a Local Area Network

Figure 5 shows the possibilities of using either a token ring or an Ethernet LAN using the Enhanced P/390-provided device managers LCS3172, LAN3172, and AWS3274.

TCP/IP clients 1 connected to the LAN can access the S/390 operating system running on the Enhanced R/390.

3270-type terminals and printers can gain connectivity to the S/390 operating systems through a LAN-attached 3174-63R display controller 2 using SNA/VTAM.

A LAN-attached boundary node converter 3 using SNA/VTAM can be used to provide connectivity for SDLC- and BSC-attached devices.

LAN-attached S/390 host mainframes 4 can establish connectivity to the S/390 operating systems using either SNA/VTAM or TCP/IP. A S/390 host connection to the LAN would be through a 3172, 3174, 37X5, controller.

The S/390 operating systems on the Enhanced R/390 can communicate across the LAN peer-to-peer to another Enhanced R/390 5 as if they were connected using a 3172-001 controller. Either SNA/VTAM or TCP/IP can be used.

LAN-attached workstations 6 using any TCP/IP-attachable 3270 emulator can communicate with the S/390 operating systems using a local DFT non-SNA Telnet session. Typical workstation emulators would be XANT, X3270, HCON, TN3270 for AIX, PMANT, TN3270, and PC/3270 for OS/2, TN3270, and PC/3270 for DOS.

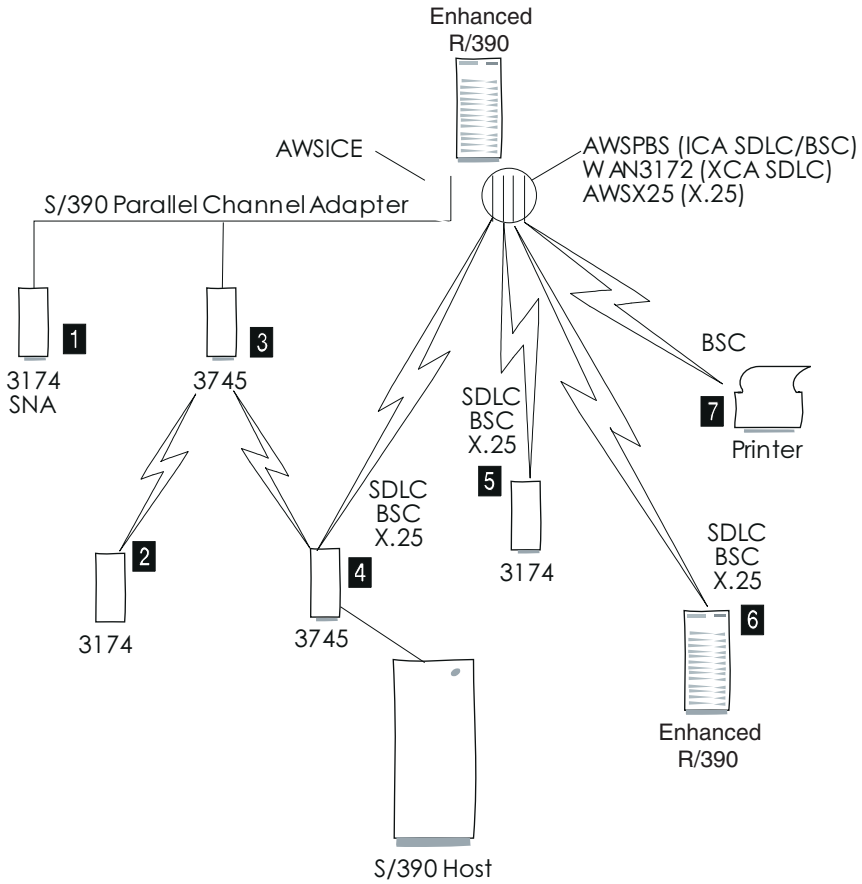

Figure 6. The Enhanced R/390 with Communication Lines

Figure 6 describes connectivity options using conventional communication lines and Enhanced P/390 device managers AWSPBS and WAN3172. Also provided is an attachment capability using the S/390 Parallel Channel adapter, which supports the 370 OEMI (Original Equipment Manufacturers Information) specification.

3174 display controllers 1 can be connected to the S/390 Parallel Channel adapter, thus providing local attachment of 3270-type terminals and printers.

Applications requiring an expanded communication capability can attach a 3745 3 to the S/390 Parallel Channel adapter. The 3745 can provide alternate connections to the S/390 host 4 or 3174 display controllers 2 as well as increased connectivity options.

Connectivity to a remote S/390 host 4 can be established using a directly connected SDLC, BSC, or X.25 communication link.

Remote 3270-type terminals and printers can be attached using a 3174 display control unit 5 with a directly connected communication link.

A peer-to-peer Enhanced R/390 connection 6 can be established using a communication link and either SDLC, BSC, or X.25 protocols.

Remote printers 7 can be attached using BSC protcols.

S/390 I/O Device Mapping

In addition to the connectivity options described, the Enhanced P/390 uses the I/O resources of the RS/6000 to map S/390 devices to RS/6000 devices. For example, an S/390 DASD device is mapped into an AIX file.

The following table shows some of the device mapping that is used:

Figure 7. Device Mapping

Host S/390 Device	**Enhanced R/390 Device**
FBA,CKD,ECKD DASD	AIX file
2540 card reader	AIX file
1403/3211 printer	AIX file or printer
3420/3422/3480 tape drive	4mm digital audio tape (DAT) drives
3215 typewriter keyboard emulator	X-Window session
3270 information display	Telnet session (HCON)
3172	LAN VTAM or TCP/IP connection

System/390 Software

The Enhanced P/390 supports all currently marketed versions of OS/390, VM/ESA, VSE/ESA and most associated software products. To find out the current release level for the operating system that is supported, contact your IBM marketing representative, or IBM authorized dealer, or call 800-IBM-CALL in the U.S. and Canada.

A fully functional S/390 software system is available on a CD-ROM. The CD-ROM contains a preconfigured system that can be used to become operational and to provide a base for additional software products.

As part of the Enhanced R/390 order, the customer can specify the appropriate S/390 preconfigured CD-ROM. This CD-ROM contains preconfigured S/390 system images that provide a S/390 operating system ready for IPL. Also included are, I/O device maps to help the customer get started and a set of unique tools to take advantage of the dual operating system environment.

All System/390 software orders are also distributed on currently supported media, as well as the new tape media, 4mm DAT (digital audio tape) cartridge for the most current products. (Base VM/ESA is available on OMA CD-ROM media.) To support service updates, a 4GB/8GB 4mm DAT drive is required.

Enhanced P/390 Licensed Internal Code and Licensed Program Product

The Enhanced P/390 licensed internal code is responsible for implementation of the ESA/390 architecture on the Enhanced P/390 microprocessor. To support the I/O requirements of the ESA/390 operating systems and its programs, device emulators, and device drivers are also provided for the AIX environment. The Enhanced P/390 licensed internal code and licensed program product is provided on diskettes and is already preloaded on the Enhanced R/390 when it is delivered.

AIX Operating System

The following version of AIX and supporting programs is required:

AIX Version 4.2.1 for Servers and AIX Version 4.2.1 for Client. The Server Version supports all of the function of the Client Version and more.

IBM 3270 Host Connection Program (HCON) or equivalent.

The Enhanced R/390 uses AIX facilities to control pieces of the RS/6000 system, including standard I/O devices, such as the display, keyboard, mouse, disks, and printer. The multitasking capabilities of AIX allow concurrent execution of AIX applications and the device managers and programs that support the Enhanced P/390. Installation and operation of the S/390 environment are also integrated into the AIX environment. Enhanced R/390s are delivered preloaded with AIX.

Chapter 3. Performance Overview

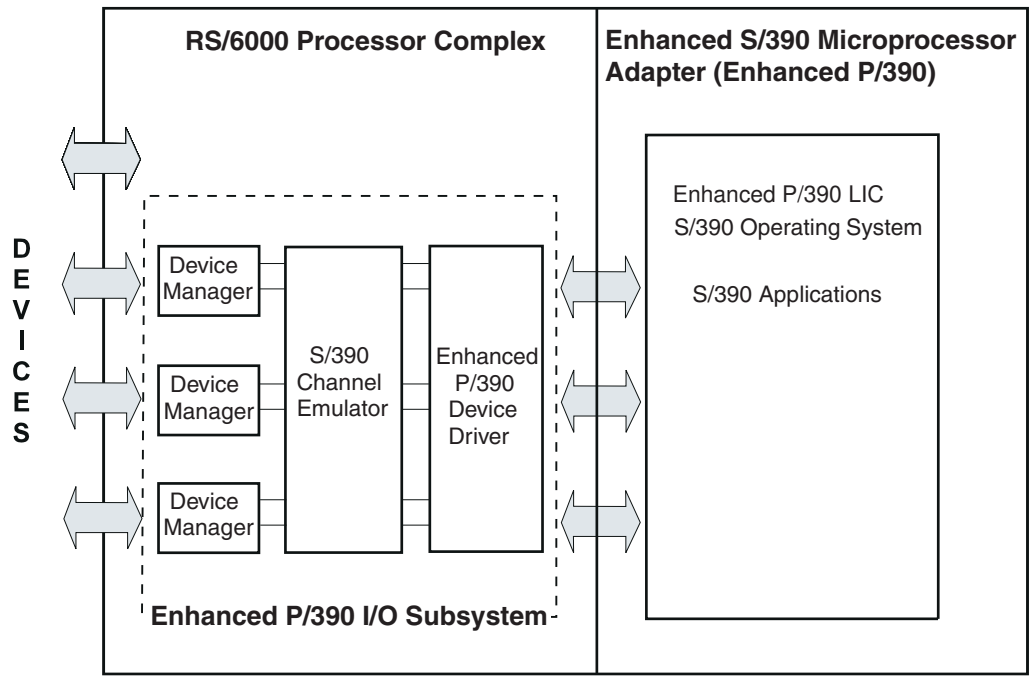

Figure 8. System/390 I/O Handled by Device Managers and Drivers

The Enhanced R/390 is a combination of the System/390 and RS/6000 architectures that provides access and use of both in a single package. While the S/390 instructions execute natively on a dedicated CMOS chip on the Enhanced P/390, as shown in Figure 8, the execution of the S/390's I/O is handled by device managers, device drivers, and S/390 channel emulation executing on the RS/6000 processor complex. The S/390 design in the Enhanced R/390 is unique when compared to other S/390 processors. In this implementation, selected S/390 devices (tapes and printers) are either channel-attached (via the S/390 Parallel Channel adapter) or emulated on RS/6000 devices in a manner that is transparent to the S/390.

While this mix creates an environment with many exciting options for I/O attachment and support, some S/390 capabilities are not available with this technique. For example, the I/O design for the Enhanced R/390 does not support multiple channels attached to the same physical device, a capability that is exploited in other S/390 systems.

Use of the Enhanced R/390 for your business requires workload planning to achieve good results. Environments with concurrent work being run on both the AIX and S/390 platforms may see some increase in end-user response times. The degree of interaction between the two platforms is a function of the specific workload being run on each. However, exploitation of SMP capability now provides a means to minimize the interaction of concurrent AIX and S/390 work.

Chapter 5, “Planning Worksheet” on page 19, Chapter 6, “Planning Guide” on page 21, and Appendix A, “Performance” on page 31, are designed to help you

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determine whether your planned S/390 workload for the Enhanced R/390 is feasible.

Chapter 4. Planning for a New Environment

The following questionnaire outlines the S/370 or S/390 environment that you want to move to the Enhanced R/390. This information guides you through the worksheet analysis and planning guide in the next sections. In addition, this information is important if you need to call for further help with analysis. Answer the questions based on the workload you plan to run on the Enhanced R/390. Complete a separate sheet for each machine type you plan to replace or application you plan to move.

1. **Current system, if applicable.**:

Machine Type	Model	Memory	CPU Utilization	S/37 Mode S/39 Mode
_____	_____	_____	_____	_____

2. **Type of DASD installed or connected:**

Type	Quantity	GB
671 331 337 9332 9335 9336 (FBA)	_____	_____
333 335 3375 338 339 9345 (CKD/ECKD)	_____	_____
Other _____	_____	_____
	TOTAL	_____

3. **What operating system are you currently running and planning to run?**

| Current:
| VM/HPO VM/SP VM/XA VM/ESA DOS/VSE VSE/SP VSE/ESA MVS/SP MVS/XA

| Planned: VM/ESA VSE/ESA S/39

4. **What type of workload are you planning on running?**

Planned: CMS CICS DB2 IMS BATCH TSO

For workload performance information:
MVS/TSO ==> See “MVS/TSO Performance” on page 31
VM/CMS ==> See “VM/CMS Performance” on page 34
VSE/CICS ==> See “VSE/CICS Performance” on page 36

For approximate performance of other workloads, refer to:
MVS/CICS ==> VSE/CICS Light I/O (See “VSE/CICS Performance” on page 36)
MVS/DB2 ==> DB2 Performance (See “Other MVS Workloads” on page 32)
MVS/IMS ==> IMS Performance (See “Other MVS Workloads” on page 32)

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5. **Performance**:

   You can find disk I/O information by using the following programs:

   VM: VM PRF or VM RTM
   VSE: Explore[1]
   MVS: RMF

   Current number of disk I/Os per second _____

   Projected number of disk I/O per second _____
   (based on adding/removing workloads)

6. **Types of I/O devices that are currently attached on the system.** The Host Attachment column defines attachment method currently used to connect the devices to your system.

I/O Device	Machine Type	Host Attachment (Chn/LAN/Coax/TP)	Performance	Other		
Printers:			Lines/Minute			
	_____	_____	_____			
	_____	_____	_____			
	_____	_____	_____			
	_____	_____	_____			
Tapes:			Tape Performance (KB/sec)		Block Size	
	_____	_____	_____		_____	
	_____	_____	_____		_____	
	_____	_____	_____		_____	
	_____	_____	_____		_____	
Display Controllers:			# of Users			
	_____	_____	_____			
	_____	_____	_____			
	_____	_____	_____			
	_____	_____	_____			
Communication Controllers:			Speed (bps)	# of Lines	Devices/Line	
	_____	_____	_____	_____		_____
	_____	_____	_____	_____		_____
	_____	_____	_____	_____		_____
	_____	_____	_____	_____		_____

[1] Explore is a product of Goal Systems International, Inc.

7. **User Network Information:**

	Local	Remote	No. Users
HARDWARE:			
Token Ring Network (16MB/4MB)	_____	_____	_____
Ethernet 8 2.3	_____	_____	_____
Channel Attach (VTAM/BTAM)	_____	_____	_____
SOFTWARE:			
HP/UX	_____	_____	_____
UNIXWARE	_____	_____	_____
Banyan Vines	_____	_____	_____
via SNA/VTAM	_____	_____	_____
via TCP/IP (host/LAN)	_____	_____	_____
OS/2 LAN Server	_____	_____	_____
Novell	_____	_____	_____
AIX	_____	_____	_____
Others:	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

Chapter 5. Planning Worksheet

The following questions are preliminary, pending completion of the latest performance calculations. They will help you determine whether the Enhanced R/390 is right for your business. You will need to refer to other sections of this document to complete some of your answers. At the end of the worksheet, you will know (1) if it is right for you, (2) if it is not right for you, or (3) if you need to contact your industry authorized Business Partner for further analysis.

1. Specify the amount of disk storage (GB) you need for your planned environment?

   (a) Up to 145GB
   (b) Between 145GB and 1TB (See "DASD/Disk Storage" on page 23)
   (c) Between 1TB and 2TB (See "DASD/Disk Storage" on page 23)
   (d) Greater than 2TB

2. What is the total number of lines per minute required for printing?

   (a) Fewer than 2
   (b) Between 2 and 5 (See "S/37 or S/39 Printers" on page 29)
   (c) Between 5 and 25
   (d) More than 25

3. MVS: How many MVS/TSO application development users are supported?

   (a) Fewer than 5 (See "MVS/TSO Performance" on page 31)
   (b) Between 5 and 9
   (c) More than 9
   (d) Not applicable

4. VM: How many VM application development users are supported?

   (a) Fewer than 25
   (b) Between 25 and 35 (See "VM/CMS Performance" on page 34)
   (c) More than 35
   (d) Not applicable

5. VSE: If you are running an interactive, database workload, what is the expected number of disk I/O operations per second?

   (a) Fewer than 1
   (b) Between 1 and 15 (See "VSE/CICS Performance" on page 36)
   (c) Between 15 and 4
   (d) More than 4

6. How many communication lines do you require?

   (a) Fewer than 16 (38.5 Kps) for VM or VSE; or fewer than 4 (19.2 Kps) for OS/39
   (b) Greater than (a), but can use Boundry Node Converter or similar technology
   (c) Greater than (a), but can use S/39 channel attached 3745
   (d) Greater than (a), and cannot use BNC technology or 3745

7. If you plan to replace an existing 43xx or 937x machine, what are you replacing (assumption: light I/O, see "VSE/CICS Performance" on page 36)?

   (a) A 4331, 4341, 4361, 4381-11, 4381-21, 4381-23, 4381-91E, 9373, 9375, 9377, 9221-12 , 9221-13 , or 9221-15
   (b) A 4381-24 9221-18 , 9121-18 , or larger capacity models that are under-utilized (See Appendix B, " Conversion Example" on page 39)
   (c) A 4381-24, 9221-19 , 9121-18 , or larger capacity models that are near or fully utilized
   (d) Not applicable

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8. Do you have a critical time requirement for your batch window?

   (a) No
   (b) Not applicable
   (c) Yes

9. Does your planned workload fit with anticipated growth over your investment period? Refer to Appendix A, “Performance” on page 31 for more information.

   (a) Yes
   (b) Not applicable
   (c) No
   (d) Not applicable

10. What Enhanced P/390 memory size is required for your workload to run on the IBM RS/6000 and System/390 Server-on Board?

    (a) Up to 256MB
    (b) Not applicable
    (c) Not applicable
    (d) Requires more than 256MB S/39 Storage

11. Do you require more than 255 channel addresses for your system?

    (a) No
    (b) Yes, but some are local non-SNA terminals
        (See “S/39 Connectivity Options” on page 25.)
    (c) Not applicable
    (d) Yes

If you answered (a) to all the above questions after reading all the pertinent information, a single Enhanced R/390 looks like a good fit for your business. Call your distributor or solution provider who source from IBM distributors. These distributors and solution providers are exclusive channel for Enhanced R/390 offerings.

If you answered (b) to any of the above questions, please refer to the specified section to determine if your workload can be run on the Enhanced R/390. If the workload can run, consider it an (a) answer, if not consider it a (d) answer. If you are still not able to determine the feasibility of your workload with the additional information provided, consider it a (c) answer.

If you answered (c) to any of the above questions, further analysis is required to determine if workloads and data can be logically divided between two Enhanced R/390s or between an existing machine and a Enhanced R/390. For more information contact the appropriate solution provider.

If you answered (d) to any of the above questions, the Enhanced R/390 is not a fit due to the complexity involved in managing the required number of systems and maintenance of the platform. You should consider other S/390 processors. Contact your IBM client representative.

Chapter 6. Planning Guide

The matrix in Figure 9 on page 22 is a tool to help you understand the I/O alternatives involved in migrating your current system or workload to the Enhanced R/390. Following the matrix are the Enhanced R/390 characteristics and guidelines to assist you with your planning.

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Figure 9. Planning Guide for Enhanced R/390

Today's Configuration	**Enhanced R/390 Alternative**	
Existing Device	**Direct Connect via Enhanced R/390 adapter**	**Emulated Using Enhanced R/390 Devices**
DASD:		
FBA DASD: 0671, 3310, 3370, 9332, 9335, 9336	N/S	AIX file [1]
CKD DASD: 3330, 3350, 3375, 3380, 3390, 9345	N/S	AIX file [1]
Tapes:		
3420, 3422 ([2, 3])	S/390 Parallel Channel adapter	4mm DAT
3480 ([3])	S/390 Parallel Channel adapter	4mm DAT
3490E ([3])	S/390 Parallel Channel adapter SCSI	N/A N/A
Printers:		
1403, 3211(*)	S/390 Parallel Channel adapter	AIX file, printer
3203(*), 3800, 4245, 4248	S/390 Parallel Channel adapter	N/A
3820	S/390 Parallel Channel adapter LAN ([4])	N/A N/A
Card readers:		
2540	N/S	AIX file
Controllers:		
2703 (*)	S/390 Parallel Channel adapter	N/A
3720, 3725, 3745	S/390 Parallel Channel adapter Multiport Model 2 LAN ([4])	N/A N/A N/A
3174 non-SNA ([5])	S/390 Parallel Channel adapter Multiport Model 2 LAN ([4])	N/A N/A N/A
3172	S/390 Parallel Channel adapter LAN ([4])	N/A N/A
ICA-SDLC, BSC	N/A	Multiport Model 2 (VM and VSE)
ICA-X.25	N/A	X.25 coprocessor (VM and VSE)
XCA-SDLC	N/A	Multiport Model 2 (MVS and OS/390)

Note:

N/A = not applicable; N/S = not supported

[1]The AIX files reside only on direct access storage devices. Local LANs can be used if you have network-attached, shared, read-only devices.

[2]Emulated 3420s must be defined in the configuration (DEVMAP) as 3420 or 3422.

[3]Only certain models are supported using the S/390 Parallel Channel adapter adapter.

[4]Any LAN adapter that is supported can be used such as Token Ring or Ethernet.

[5]The 3174-63R is the LAN-attached model and the 3174-95R is the SDLC/BSC model.

*Although technically feasible based on interface definitions, these devices have not been run on the Enhanced R/390.

Enhanced R/390 Characteristics

This section provides Enhanced R/390 characteristics and guidelines to help assess the capabilities of the system: The following topics are covered:

DASD and disk storage
Connectivity
Display controllers
S/390 functions
Migration to ESA
Warranty information

DASD/Disk Storage

There are several methods of attaching DASD to an Enhanced R/390.

S/370, S/390 DASD migration to internal storage

The Enhanced R/390 does not directly attach to existing S/370 or S/390 DASD devices. To use existing disk images, the S/370 and S/390 DASD needs to be dumped to tape and restored to the appropriate emulated DASD type on hard disk.

Internal DASD

Enhanced R/390 disk subsystem has been designed to provide exceptional expandability with easy installation and service. The Enhanced R/390 disk offerings allow internal hot-swappable disk capacities ranging from 4.5GB to 145GB in either 4.5GB or 9.1GB increments. The design feature that provides the ability to upgrade is the 6-pack backplane into which up to six disk drives can be installed. Individual drives are mounted in the 6-pack via carriers.

Enhanced R/390 can accommodate up to three hot-swappable 6-packs. The hot-swap capability is enabled via the backplane associated with each 6-pack. Enhanced R/390 comes standard with one hot-swappable backplane.

Enhanced R/390 supports three types of DASD connectivity; Serial Storage Architecture Architecture (SSA), SCSI, and Ultra-SCSI.

The SCSI RAID-5 and SSA configuration requires the standard 16-bit 4.5GB Ultra-SCSI-enabled hard disk to be moved into a media bay for use as a boot drive by selecting feature code 3006 instead of standard feature code 9394.

SCSI RAID. A PCI SCSI RAID adapter that enables SCSI RAID-5 internally. A single PCI SCSI RAID adapter can drive up to three 6-packs.

SSA RAID. A PCI SSA RAID adapter that enables SSA RAID-5 internally or externally. A single PCI SSA RAID adapter can drive up to three 6-packs as well as SSA external disks. SSA can only be implemented on an Enhanced R/390 containing a maximum of 2GB of memory.

Ultra-SCSI. One dedicated PCI Ultra-SCSI SE adapter is required to drive a SCSI 6-pack at Ultra-SCSI speed. A PCI Ultra-SCSI Differential adapter can be used to support an external Ultra-SCSI RAID subsystem.

External DASD

If additional DASD capacity is required, a broad range of external DASD subsystems can be used. Depending on your requirements for capacity,

performance and reliability, one or more of the following disk subsystems can be used for your application:

7131 SSA Multi-Storage Tower model 405 with up to 45.5GB per tower
7131 SCSI Multi-Storage Tower model 105 with up to 31.GB per tower
7133 Rack-mountable model 010 and model 020 with up to 145.6GB per subsystem
7133 Disk Subsystem model 600 with up to 145.6GB per tower

Based on the availability of the RS/6000 adapter sockets and the disk subsystem selected, total DASD capacity can be extended into the tera-byte range.

DASD Subsystem Considerations

The various types of DASD connectivity for the Enhanced R/390 provide you with a means of optimizing your configuration for initial cost, performance, or data protection. The following set of guidelines can be used to configure a DASD subsystem that will meet your needs.

Use Ultra-SCSI if your concern is primarily cost. Ultra-SCSI provides good performance because of its high SCSI bus transfer rate. Data protection for your critical data can be obtained through mirroring (RAID-1).

Use SSA if performance is your concern. Best performance is obtained when using mirroring (RAID-1) for data protection.

Consider SCSI RAID if you are working with large databases requiring protection. To determine the best alternative for your particular database size, compare the cost of SCSI RAID-5 for a system configured with several RAID-5 arrays to the cost of SSA and Ultra-SCSI mirroring (RAID-1).

Critical data protection should address all modes of possible failure such as power, adapter cards, and so on, in addition to disk configuration failures.

For Enhanced R/390 systems that also support significant non-S/390 workloads, especially when utilizing SMP mode, care should be taken to separate the S/390 disk storage from the non-S/390 disk storage. The best way to do this is to define separate RAID arrays for each environment. Isolating each array on a separate SCSI channel or SSA loop, or on separate SSA or SCSI RAID adapters gives more isolation.

DASD Requirements for S/390

For any DASD configuration, a minimum of 700MB must be allocated for AIX 4.2.1. For the S/390 preconfigured operating systems (without applications), the following minimum additional DASD allocations are recommended:

VSE/ESA - 2GB
VM/ESA - 3GB
OS/39 - 7GB

Device Managers

Selected S/390 devices are either channel-attached via the S/390 Parallel Channel adapter or they are emulated using RS/6000 devices. This device manager function is provided with the Enhanced P/390 licensed program product. Figure 10 on page 25 summarizes the S/390 operating system device type codes used for the S/390 devices emulated by the Enhanced R/390 device managers.

Device Type Codes Summary

Figure 10. Device Managers Available on S/390 Operating Systems

Device Manager	Function	DEVTYPE	S/390 Operating Systems Supported
AWS2540	2540 card reader emulator	2540	OS/390, MVS/ESA, VM/ESA, VSE/ESA
AWS2821	Print manager	1403, 3211	OS/390, MVS/ESA, VM/ESA, VSE/ESA
AWS3215	3215 consoles emulated in X windows	3215	OS/390, MVS/ESA, VM/ESA, VSE/ESA
AWS3274	3274 Control unit emulator (non-SNA)	3277, 3278, 3279	OS/390, MVS/ESA, VM/ESA, VSE/ESA
AWS34xx	SCSI-attached tape drive	3420, 3422, 3480, 3490, 3490F00/F01	OS/390, MVS/ESA, VM/ESA, VSE/ESA
AWSCKD	CKD and ECKD DASD emulator	3330, 3350, 3375, 3380, 3390, 9345	OS/390, MVS/ESA, VM/ESA, VSE/ESA
AWSFBA	FBA DASD emulator	0671, 3310, 3370, 9332, 9335, 9336	VM/ESA and VSE/ESA
AWSICE	S/390 Parallel Channel adapter device manager	See “AWSICE: S/390 Parallel Channel Interface” on page 26	OS/390, MVS/ESA, VM/ESA, VSE/ESA
AWSPBS	SDLC/BSC support	ICA	VM/ESA and VSE/ESA
AWSPCSRV	CMS commands	PCSE	VM/ESA
AWSOMA	Optical media attachment	3422, 3423	OS/390, MVS/ESA, VM/ESA, VSE/ESA
AWSTAPE	3420 or 3422 tape emulator	3420, 3422	OS/390, MVS/ESA, VM/ESA, VSE/ESA
AWSX25	X.25 support	ICA	VM/ESA and VSE/ESA
LAN3172	3172 LAN gateway (SNA)	3088	OS/390, MVS/ESA, VM/ESA, VSE/ESA
LCS3172	3172 LAN channel station for TCP/IP	3088 (even/odd address pair)	MVS/ESA, VM/ESA, and OS/390
WAN3172	3172 SDLC gateway	3088	MVS/ESA and OS/390

S/390 Connectivity Options

This section provides an overview of the various connectivity options that are available for the Enhanced R/390. Connectivity options are provided by the various Enhanced R/390 adapters and the device managers provided with the Enhanced P/390 package.

AWS3215: 3215 Emulation–X Windows

The AWS3215 device manager emulates an IBM 3215 display unit in a X/Motif window. Utilities such as DDR and ICKDSF can be run from this window.

AWS3274: 3274 Emulation–Telnet

The AWS3274 device manager allows the Enhanced R/390 to emulate a 3274 non-SNA control unit. The emulator uses a Telnet session to connect LAN-attached workstations that use a TCP/IP-attachable 3270 emulator. Through this emulator, any TCP/IP client on a LAN can be connected to the S/390 processor. A Token Ring or Ethernet adapter is required.

AWSICE: S/390 Parallel Channel Interface

The AWSICE device manager allows most real S/370 and S/390 I/O control units to be attached to the Enhanced R/390 using the ARTIC960 PCI Co-Processor Platform with the S/390 Parallel Channel adapter (application interface board or AIB) attached.

Some typical attachments are:

Line and page printers, such as the IBM 3800 Model 1 and the IBM 4248
Tape drives [2], such as the IBM 3420, 3480, and 3490
Communication controllers, such as the IBM 3720 and 37X5
Display controllers, such as the 3174 non-SNA

The AWSICE device manager does not support 3274 or DASD attachment. Some usage considerations are:

A maximum of two adapters is supported and each occupies one PCI slot. Unlike S/390 channels, you can intermix modes and speeds (byte, block, or data streaming at DCI, 3 or 4.5MB/sec) for different devices attached to the same S/390 Parallel Channel adapter simultaneously.

Only certain IBM devices have been tested. Some non-IBM devices may not function properly.

The AWSICE device manager requires a dedicated S/390 Parallel Channel adapter. It cannot be shared with any AIX applications.

To optimize performance, using more than two control units is not recommended.

One S/390 Parallel Channel adapter can support both S/370 and S/390 printers and tape drives. You can intermix modes and speeds for different devices attached to the same adapter simultaneously.

AWSPBS: SDLC/BSC ICA–ARTIC Multiport Model 2 Support

The AWSPBS device manager provides enhanced synchronous data link control (SDLC) and binary synchronous communications (BSC) integrated communications adapter (ICA) support for the S/390 VM/ESA and VSE/ESA operating systems. The device manager emulates a 9221 SDLC or BSC ICA to VTAM and provides connectivity to such devices as the 3174 or 3274 terminal control unit, and the 3275 communication controller. SDLC is used primarily to transmit EBCDIC in a

[2] SCSI-attached tape drives improve performance.

SNA network. BSC can transmit EBCDIC or ASCII code. With BSC, the device manager can act as a control or tributary station.

The 1MB ARTIC Multiport Model 2 ISA adapter is required for this support. A maximum of two adapters is supported. The adapter provides up to eight ports with any mix of SDLC or BSC protocols at speeds up to 38.4Kbs for each line running concurrently. The EIA-232D interface is used with point-to-point switched or point-to-point nonswitched lines operating in half-duplex mode. Dial capability using V.25bis protocol is also available for SDLC switched lines.

AWSX25: X.25 ICA

The AWSX25 device manager provides leased-line connectivity to an X.25 Packet Switched network for the S/390 VM/ESA and VSE/ESA operating systems. Support for switched-line connectivity is available as an RPQ. The device manager is defined to the operating systems as a 9221 SDLC ICA. The device manager requires the X.25 Interface Co-processor/2 ISA bus that provides a single port and accommodates one of three selectable interfaces: X.21, EIA-232D, and V.35. A maximum of two adapters is supported.

LAN3172: 3172 Emulation–DLC

The LAN3172 device manager emulates a real channel-attached 3172 with the interconnect control program (ICP). This emulation provides connectivity between VTAM XCA running in the Enhanced R/390 and the LAN. The emulator provides APPN node support and dependent LU support (3270) emulation for LAN-attached workstations. To establish a connection to a host, a path to a host-attached 3172, 3174, or 3745 controller can be used. A high-performance token-ring adapter or Ethernet adapter is required.

LCS3172: 3172 Emulation–TCP/IP

The LCS3172 device manager emulates a real channel-attached 3172 with the interconnect control program (ICP). This emulation provides connectivity between TCP/IP running under VM/ESA, or OS/390 in the Enhanced R/390. TCP/IP for VSE/ESA is provided by a third party. Using this emulator, connectivity can be established to any TCP/IP-enabled host or workstation. To establish a connection to a mainframe host, a path to a host-attached 3172, 3174, or 3745 can be used.

This device manager requires the use of the direct interface of a token-ring or Ethernet adapter. The adapter used cannot be shared with any other AIX application.

WAN3172: 3172 Emulation–SDLC

The WAN3172 device manager emulates a channel-attached 3172 and provides SDLC support for VTAM as a separate XCA PORT. This device manager is provided specifically for OS/390 operating systems, which do not support ICA connections. The emulator converts the DLC protocol from VTAM to SDLC.

The IBM 4-Port Multiprotocol Communication Controller ISA adapter is required. A maximum of two adapters is supported. The adapter provides up to four ports at speeds up to 19.2Kbs for each line running concurrently. The EIA-232D interface is used with point-to-point nonswitched lines, or point-to-point switched lines.

S/390 I/O Device Mapping

The Enhanced P/390 package provides the following additional device managers to complement its connectivity capability. In general, these device managers can map a standard RS/6000 device to a S/390 device.

AWS2540: Card Reader Emulation

The AWS2540 device manager allows the S/390 operating system to read in AIX files placed in a designated directory. Files in the directory appear to the S/390 operating system as card decks placed in a card stacker. Only one 2540 is allowed. ASCII-to-EBCDIC translation is done if required.

AWS2821: Printer Emulation

The AWS2821 device manager provides emulation for one or more 1403 or 3211 printers. The printed output can be directed to an AIX file or standard IBM Proprinter (parallel port printer). Printers that use the following control and escape sequences can be used:

Line feed = 0x0A
Form feed = 0x0C
Carriage return = 0x0D
ESC 3 n (where n is the lines per inch)
ESC C n (where n is the lines per page)

AWS34XX: 34XX Tape Drive Emulation

The AWS34XX device manager emulates 3420, 3422, 3480, and 3490 tape drives using RS/6000 SCSI-attached tape drives. The following device types are emulated:

Emulated Type	RS/6000 Tape Drive
3420, 3422, 3480	4mm DAT drive
3490	3490F00/F01

AWSCKD: CKD/ECKD DASD Emulation

The AWSCKD device manager emulates count key data (CKD) and extended count key data (ECKD) DASD by mapping a complete S/390 operating system volume to a single AIX file. DASD types emulated are 3330, 3350, 3375, 3380, 3390 and 9345. The AIX file can reside on any AIX direct storage device that uses a file system, such as DASD or CD-ROM. A local LAN can also be used if shared, read-only devices that are network-attached are available.

AWSFBA: FBA DASD Emulation

The AWSFBA device manager emulates fixed block architecture (FBA) DASD by mapping a complete S/390 operating system volume to a single AIX file. DASD types emulated are 0671, 3310, 3370-1, 9332-600/602, 9335, and 9336-10/20. The AIX file can reside on any AIX direct storage device that uses a file system. This includes DASD or CD-ROM. A local LAN can also be used if network-attached shared, read-only devices are available.

AWSPCSRV

The AWSPCSRV device manager allows the Enhanced P/390 to directly communicate with the AIX environment. It does this by supporting special Enhanced P/390 specific commands issued from the host Enhanced P/390 system such as the PCOPY command under VM/CMS. PCOPY allows a user to import or export files between the host Enhanced P/390 and the AIX systems.

AWSOMA

The AWSOMA device manager reads a CDROM in optical media attach (OMA) format. IBM uses this format to deliver program products, fixes, and publications. AWSOMA reads a tape descriptor file (TDF), which describes the format and location of files on the CDROM and the logical organization of those files on the tape. This device manager is useful for allowing S/390 applications to have direct access to LAN files.

AWSTAPE: 3420/3422 Tape Drive Emulation

The AWSTAPE device manager emulates one or more 3420 or 3422 tape drives using an AIX file. The AIX file can reside on any AIX direct storage device that uses a file system, such as DASD or CD-ROM. Read, write, and repositioning commands are supported.

S/370 or S/390 Printers

Printing to a channel-attached page printer in line printer emulation mode on the Enhanced R/390 is slow when compared to using an ES/9000 channel. Printing to a page printer in page printer mode is as fast as using an ES/9000 channel.

Daisy-chaining three channel-attached page printers off of a single S/390 Parallel Channel adapter provides better printer performance than attaching three printers between two S/390 Parallel Channel adapters. The Enhanced R/390 supports two S/390 Parallel Channel adapters.

S/370 or S/390 Tape Drives

If you exchange tapes from a Enhanced R/390 with tapes from other S/370 or S/390 systems, ensure that the tape media is compatible between the systems. S/370 or S/390 systems typically use 3420, 3480, or 3490 tape drives. You may need to use tape drives that are compatible with these formats attached to the Enhanced R/390 using the S/390 Parallel Channel adapter or via a SCSI interface. The 9346 tape drive cannot be attached to the Enhanced R/390. For optimum performance, IBM recommends using SCSI-attached tape drives rather than S/390 channel-attached tape drives.

The various models of these drives support varying levels of media formats and densities. It is important to verify the compatibility between the drives.

Display Controllers

To utilize existing coax terminals and printers, 3174 non-SNA display controllers can be attached to the Enhanced R/390. For those configurations without this requirement, the Enhanced R/390 provides 3270-type capability using LAN-attached workstations and emulated 3274 SNA Telnet sessions, or 3172 emulation through VTAM or TCP/IP (SNA).

Enhanced P/390 Processor

The Enhanced P/390 provides the standard S/390 architecture described in the *ESA/390 Principles of Operations*, SA22-7201. In addition, the following facilities are supported: Compression, Data Spaces, Expanded Storage, Expanded Sorting, Move Page (Facility 2), Access-List-Controlled Protection, Address-Limit Checking, Broadcasted Purging, Cancel I/O, Subspace Group, Compare Until Substring Equal, Incorrect-Length-Indication Suppression, Interpretive Execution, Move Inverse, MVS Assists (Add Functional Recovery Routine, SVC Assist, Obtain Local Lock, Release Local Lock, Obtain CMS Lock, Release CMS Lock), Program-Event Recording 2, PER Extensions, Private Space, Set Address Space Control Fast, Square Root, Storage-Protection Override, String Instructions, Suppression on Protection, SIE I/O Assist, Called-space identification facility, Checksum facility and Compare-and-move-extended facility.

Unsupported S/390 functions are: ESCON, PR/SM, Parallel Sysplex, Coupling Links, Integrated Coupling Migration Facility, Sysplex, Sysplex Timer (ETR), Concurrent PR/SM Maintenance, Dynamic Reconfiguration Management, Vector Facility, Expanded VF Instructions, Asynchronous Pageout Facility, ICRF, Asynchronous Data Mover Facility.

Migration to ESA

When migrating to ESA, you can run your current software levels until the production systems and applications are up and running (license agreement allows up to one year). If this software is unsupported, you will be running at your own risk.

It is important to note that VTAM Version 3.4 or higher is required to support a 3172 direct-attach or the emulation support on the Enhanced R/390. VTAM 3.4 is the first version to support 3172s.

Enhanced P/390 Warranty

The warranty period for the Enhanced R/390 is one year from the date of purchase and the warranty service is IBM On-Site Repair (IOR).

Post-warranty service is IOR and is provided under an IBM Maintenance Agreement with coverage 24-hours a day 7-days a week with same-day response (average 4-hour response time).

The Enhanced R/390 is an eligible machine for the following options of the Maintenance Services Financial Options category:

Corporate Service Option
Extended Maintenance Option
Mid-Range Systems Option

IOR Hourly Service is also available at the IBM hourly service rate under Classification 1 (one) with one hour minimum.

Appendix A. Performance

This section will be updated at a later time to reflect the performance of the S/390 Server-on-Board. It has been included here as a reference. It reflects only the performance for the previous implementations. The new section will have comparisons between the S/390 Server-on-Board and the Enhanced S/390 Server-on-Board for comparable system configurations. Preliminary analysis indicates that the Enhanced S/390 Server-on-Board will provide up to 60% more throughput or users than that shown in this appendix for the 128MB S/390 adapter. The performance increase can be attributed to a faster S/390 adapter with double the "on-board" memory, a faster F50 processor, and an improvement in the PCI-to-S/390 interface. It should also be noted that the S/390 adapter code has been improved to allow utilization of SMP on both the previous and current RS/6000 Model F50 systems. This will provide a general performance improvement potential for all F50-based S/390 Server-on-Board systems. The actual performance improvement achieved will be a function of the characteristics of your actual workload and results may differ.

The following sections describe the performance that can be achieved with dedicated S/390 workloads. The performance that can be achieved on the Enhanced R/390 depends on the characteristics of the planned workload. If work is being run concurrently on the AIX processor and the P/390, there may be an increase in system response time. However, exploitation of SMP capability now provides a means to minimize the interaction of concurrent AIX and S/390 work.

MVS/TSO Performance

The P/390 provides 32MB and 128MB of storage. At 128MB, up to 50 users can be supported, based on an internal IBM MVS/TSO workload, using emulated CKD DASD. This TSO workload is designed to represent the work done by a TSO end-user community developing and testing programs interactively using ISPF/PDF. Workload activities include editing and browsing source data, compilation, execution, program testing, graphics, and information management transactions. There are 25 different scripts, each consisting of a related set of activities in the form of TSO commands. CLISTs are implicitly and explicitly invoked. The think time is exponentially distributed with an average of 15 seconds between scripts and the internal response time limit is 2 seconds. Compile and assembly operations comprise about five percent of the IBM TSO workload. When workloads with a higher percentage of these operations are encountered, fewer users can be supported.

While the internal response times achieved by the R/390 are within the specified limits, other S/390 processors, due to their standard I/O design point, typically yield lower response times. Since internal response time is one of several factors that contribute to end-user response time, there may be some instances where end-user times are longer than those achieved by other S/390 processors. There are many instances, particularly in remote applications, where use of the R/390 can eliminate or reduce other time components to yield net improvement in overall response time.

The capacity of the R/390 is determined by the characteristics of the work that is run on the processor. One of the key parameters of the work is the I/O content.

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For the MVS/TSO workload, paging can become a significant component of I/O as the number of users is increased for a given storage size. When significant paging occurs, the total I/O demand can exceed the capability of the R/390 and cause the response time to exceed the specified limit. The maximum number of users supported for a given storage size and think time is related to the working set size for the average user, which is approximately 1MB. Larger working set sizes will generally support fewer users, and a smaller working set size will allow a greater number of users.

The number of users supported is based on a configuration that has a P/390 with 128MB of storage, a RS/6000 Model F50 with 256MB of storage, and a mirrored data arrangement on a 7133 disk array. A customer's actual performance will vary depending on many factors, such as I/O content, system configuration, available storage, and the specific workload being processed.

Other MVS Workloads

The performance data in Figure 11 provides guidance to help you determine if your dedicated MVS production on-line workloads will fit on the R/390. It includes several on-line environments and their key characteristics. Due to the inherent I/O content of these workloads, the disk I/O rate becomes a key factor to consider as you evaluate the potential use of the R/390 in your business.

The data in Figure 11 is based on a RS/6000 Model F50 system that has 256MB of storage, and one mirrored 7133 disk array. Each mirrored copy contains ten 3380 (various densities) equivalents loaded with the workload components that are driven in parallel.

Figure 11. Other MVS Workloads

Workload Type	Users/Terminals	Think Time (seconds)	Response Time (seconds)	I/O per Second
IMS/DL1	160	11	1	67
IMS/DB2	40	4	1	67
CICS	182	12	1	53

While the internal response times typically achieved by the R/390 are within the specified limits, other S/390 processors, due to their standard I/O design point, typically yield lower response times. Since internal response time is one of several factors that contribute to end-user response time. There may be some instances where end-user times are longer than those achieved by other S/390 processors. There are many instances, particularly in remote applications, where use of the R/390 can eliminate or reduce other time components to yield net improvement in overall response time.

The IBM internal IMS workload consists of light to moderate transactions covering diverse business functions, including order entry, stock control, inventory tracking, production specification, hotel reservations, banking, and teller systems. These applications are similar to the CICS applications but contain IMS functions, such as logging and recovery. The IMS workload contains sets of 17 unique transactions, each using a different database. The workload uses both VSAM and OSAM databases with VSAM primary and secondary indexes.

The DB2 workload consists of light to moderate transactions from two defined and well-structured applications, inventory tracking and stock control. IMS/DC is used as the transaction manager. The applications are functionally similar, but not identical to, two of the IMS/DL1 and CICS applications. The DB2 work contains seven unique transactions. Conversational and wait-for-input transactions are not included in the DB2 workload.

CICS work consists of light to moderate transactions from many of the same applications mentioned for the IMS work. The CICS applications are written in COBOL or assembler and are functionally similar, but not identical, to the applications used in the IMS workload and uses VSAM data sets only. There are six sets of 17 unique transactions, and five of these are run above the 16 megabyte line.

The data shown here is based on a configuration that has a P/390 with 128MB of storage, a RS/6000 Model F50 with 256MB of storage, and a 7133 disk array. Actual performance a customer will experience will vary depending on many factors, such as I/O content, system configuration, available storage, and the specific workload being processed.

Note: When estimating MVS/DB2 or MVS/IMS for the a 43xx or 937x replacement, use the following approximations:

MVS/DB2: .75 x VSE/CICS Light I/O (See “VSE/CICS Performance” on page 36)

MVS/IMS: .75 x VSE/CICS Light I/O (See “VSE/CICS Performance” on page 36)

VM/CMS Performance

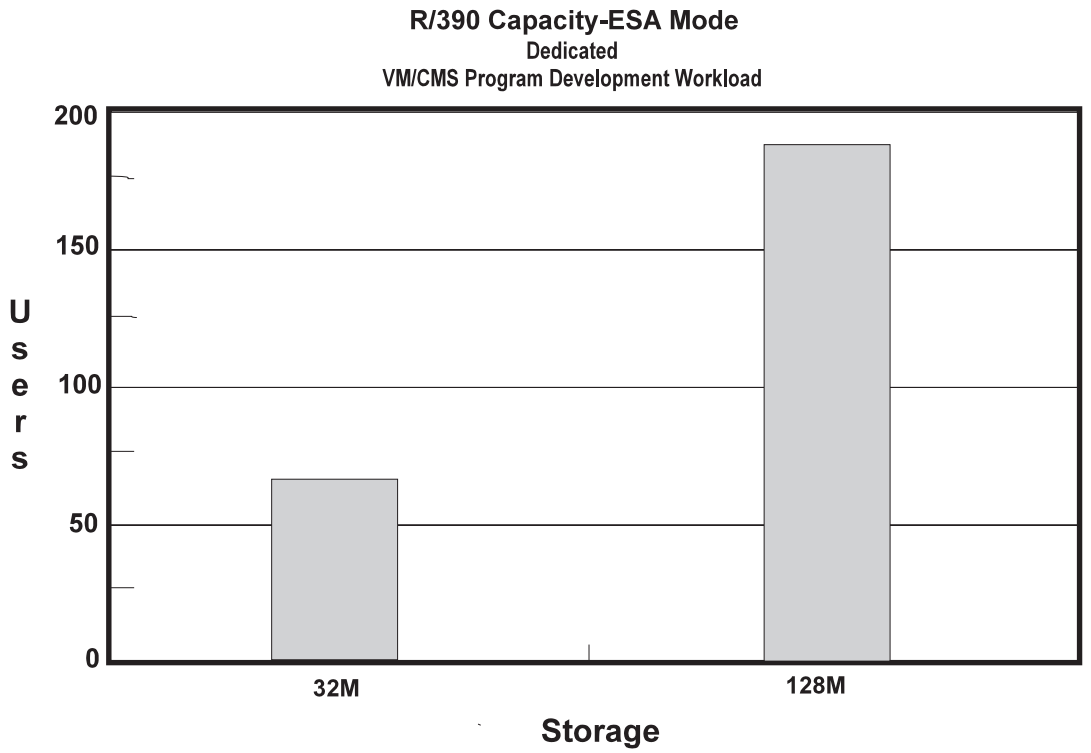

Figure 12. R/390 Capacity—ESA Mode

Figure 12 shows the number of users that can be handled for the two possible memory sizes based on an internal IBM VM/CMS program development workload. This workload is designed to represent the VM/CMS end-user community. Workload activities include program input and editing, compilation, execution, and program test. Each user runs in a separate virtual machine and enters a variety of CMS and CP commands related to the activities called scripts. There are 17 such scripts containing these command sets. The number of users is based on an average think time of approximately 26 seconds between commands and an end-user average response time of one second or less.

While the internal response times achieved by the R/390 are within the specified limits, other S/390 processors, due to their standard I/O design point, typically yield lower response times. Since internal response time is one of several factors that contribute to end-user response time, there may be some instances where end-user times are longer than those achieved by other S/390 processors. There are many instances, particularly in remote applications, where use of the R/390 can eliminate or reduce other time components to yield net improvement in overall response time.

The capacity of the R/390 is determined by the characteristics of the work that is being run on the processor and one of the key parameters of the work is the I/O content. For the VM/CMS program development workload, paging can become a significant component of I/O as the number of users is increased for a given storage size. When significant paging occurs, the total I/O demand can exceed the capability of the R/390 and can cause the response time to exceed the specified limit. The maximum number of users supported for a given storage size and think

time is related to the working set size for the average user, which is approximately 90 pages for the VM program development workload. Larger working set sizes will generally support fewer users, and a smaller working set size will allow a greater number of users.

The data shown here is based on a configuration that has a P/390 with 32MB or 128MB of storage, a RS/6000 Model F50 with 256MB of storage, and one 7133 array. A customer's actual performance will vary depending on many factors, such as I/O content, system configuration, available storage, and the specific workload being processed.

VM Guests Performance

VM/ESA supports guests. When running VM guests on the R/390, multiple high performance guest support is not provided. Only one guest can run as V=R. Additional guests must run as V=V (the default), with possible performance degradation. V=F is not supported. This does not affect CMS guests.

VSE/CICS Performance

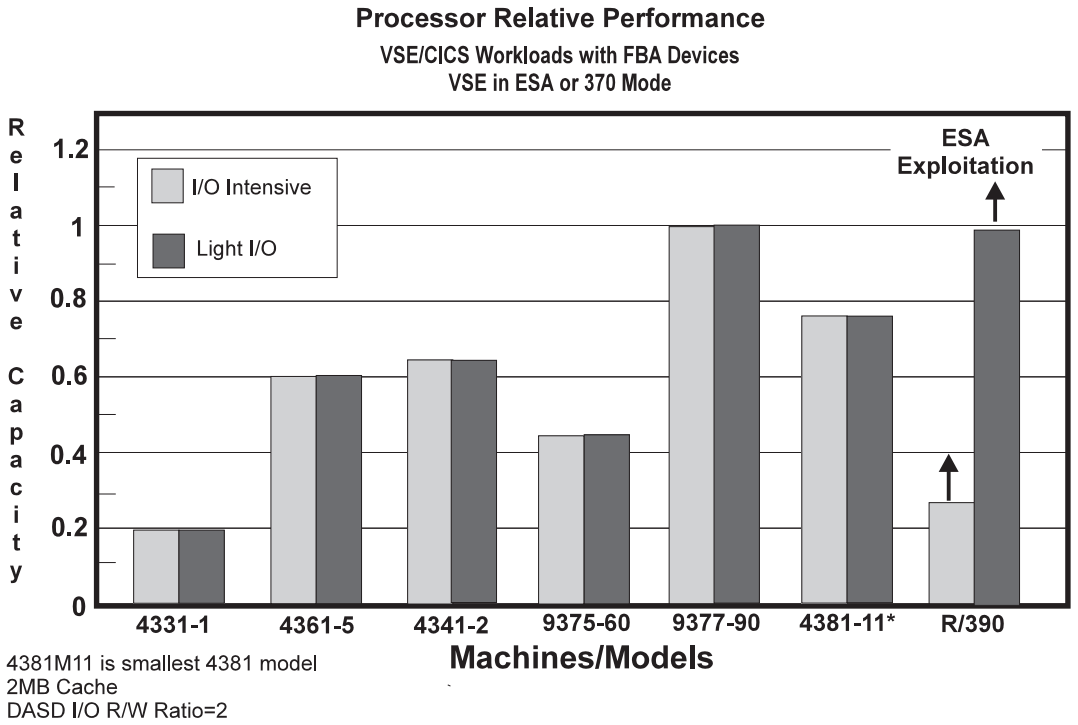

Figure 13. Processor Relative Performance

Figure 13 shows the relative capacity of the processors of interest for dedicated VSE/CICS workloads without ESA exploitation. Relative capacity in this bar graph is based on the external transaction rate for the systems being compared. External transaction rate is the metric typically used for comparisons of systems that may have system resources limiting the processor's ability to do work.

The VSE/CICS workload, designated *light I/O* in the graph, consists of light to moderate transactions from diverse business applications including order entry, stock control, inventory tracking, production specifications, banking, hotel reservations, and teller systems. There are 17 unique transactions using various combinations of CICS functions. This workload issues about three I/O requests per transaction.

The *I/O intensive* work reflects the I/O rate of the RAMP-C workload. RAMP-C is a synthetic interactive workload consisting of four transaction classes differing in complexity. Programs are written in COBOL and are designed to access indexed and sequential files. This workload is characterized by 17 I/O requests per transaction.

The two Enhanced R/390 bars in the chart show that relative performance decreases when I/O rate is increased. The I/O content of the work determines the external transaction rate that can be sustained by the R/390 before I/O contention causes the response time to exceed the one second internal response time limit.

Migrations from older S/370 and S/390 systems that may be constrained by poor tuning, storage limits, or I/O device response times can see performance improvements significantly higher than what is shown in the Figure 13. Analysis of

constraints must be done on a specific workload, environment, and configuration; no single performance number will apply.

I/O elimination through the use of VSE/ESA exploitation can also improve response time, throughput, and relative performance. Since the value of exploitation can be determined only for specific well understood workloads and environments, its benefit is not included in the relative performance bar chart. The capacities shown in the R/390 set of bars applies to either 370 or ESA modes as these two modes offer comparable performance when ESA exploitation is not included. To investigate and clarify the value of VSE/ESA exploitation, contact the appropriate Solution Provider.

VM/VSE guest environments will see *guest to native* ratios comparable to those seen on ES/9000 processors (approximately 0.9 for V=R guests and around 0.7 to 0.8 for V=V guests). V=R guests with dedicated I/O migrating from 370 mode to ESA mode will have a slightly better capacity than those shown in Figure 13 on page 36. V=R guests with non-dedicated I/O (for example, sharing DASD) will show lower ratios than the native case shown in the charts. V=V guest migration typically yields a lower capacity ratio since the Mode=VMESA guest performance is not as good as the 370 environment's Mode=VM guest performance.

The data shown here is based on a configuration that has a P/390 with 32MB of storage, a RS/6000 Model F50 with 256MB of storage, and one 7133 disk array. A customer's actual performance will vary depending on many factors, such as I/O content, system configuration, available storage, and the specific workload being processed.

Appendix B. Conversion Example

This example shows how an outdated system can be replaced by the IBM RS/6000 and System/390 Server-on Board.

9375 Model 60 Replacement

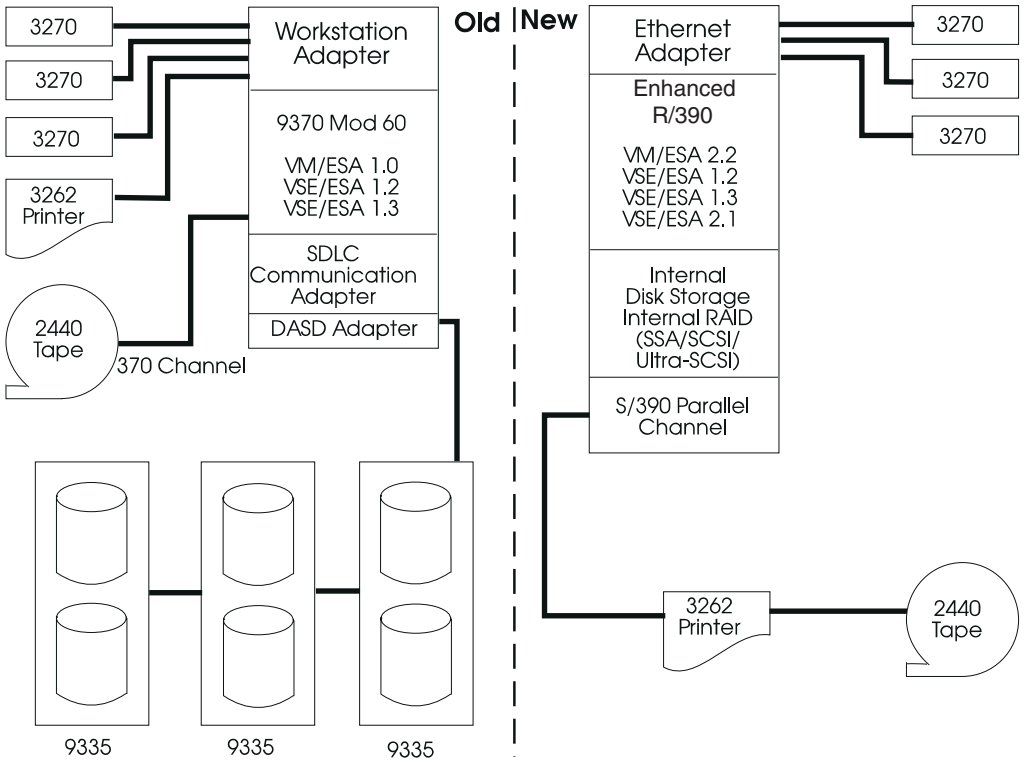

Figure 14. Configuration Example

A software vendor developing applications that run in a VSE/ESA environment might have a system similar to Figure 14. There are numerous options available for a conversion to Enhanced R/390. The conversion described is one example.

9370 System	Enhanced R/390
9335 DASD	Internal SCSI or SSA
3270 terminals	Ethernet-attached non-SNA 3270 emulation using Personal Communication 3270
3262 printer 2440 tape	Retained and attached to the S/390 Parallel Channel adapter
VSE/ESA	Multiple VSE/ESA operating systems running under VM/ESA

Converting to a Enhanced R/390 environment is a relatively straight-forward operation. This conversion can usually be completed in one or two days.

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Planning a conversion requires that you determine how to ensure that the Enhanced R/390 accommodates the original configuration. You must resolve connectivity issues and determine how best to map the existing DASD volumes to the SSA DASD.

The Enhanced R/390 is usually preloaded with AIX, the P/390 licensed internal code, the necessary device drivers or managers, and the S/390 operating system. If the code was not preloaded, it can be loaded in about one day. For the configuration described in this example, the DEVMAP can be configured and the original systems workload can be copied from tape to the Enhanced R/390 in less than one day. The conversion would be complete at this point and production could resume.

Converting to a Enhanced R/390 provides the following benefits:

ESA capability
Reduced power consumption
Improved performance
Reduced maintenance costs
Reduced space requirements
Dual environments–AIX and S/390
Reduced conversion costs

Appendix C. Payback

Figure 15. Payback

Budget Items	Current Monthly Budget	Enhanced R/390 3-Year Cost	
Environmentals			
– Power	_____	_____	$.10/kw in US
– Cooling	_____	_____0_____	n/a
– Floor Space	_____	_____0_____	small!
Maintenance			
– DASD	_____	_____0_____	internal
– Processor	_____	_____0_____	1-year warranty
S/390 Software	_____ MLC	_____	OTC
Hardware Cost	_____0_____ paid	_____	Enhanced R/390 hardware
TOTALS	_____	_____	

Note: If you have monthly connectivity costs, such as dedicated or switched lines cost that you are eliminating or reducing by using the Enhanced R/390, add those to your current monthly costs before doing the following calculation.

Return on Investment

$$\frac{\text{Total Cost of Enhanced R/390}}{\text{Total Current Monthly Budget}} = \text{----------} = \text{_____}$$ Break Even Period (months)

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List of Abbreviations

AIX advanced interactive executive

APPN Advanced Peer-to-Peer Networking

BSC Bisynchronous Data Link Control

CCU communications control unit

CCW channel command word

CDLC Channel Data Link Control

CD-ROM compact disk read-only memory

CKD count key data

CMOS complementary metal oxide semiconductor

CMS conversational monitor system

CPU central processing unit

CTC channel-to-channel

CUA Common User Access

DASD direct access storage device

DAT digital audio tape

DLC data link control

DLL data link library

DOS disk operating system

ECC error correcting code

ECKD enhanced count key data

EDF extended disk format

EIB electrical interface board

EOF end of file

EOL end of line

ESA extended systems architecture

FBA fixed block architecture

FIFO first in, first out

FRU field replaceable unit

GB gigabyte

GDDM Graphical Data Display Manager

GPR general purpose register

HACMP high availability cluster multi-processing (AIX)

HCON 3270 Host Connection program

HPFS high-performance file system

HPOFS High Performance Optical File System

ICA integrated communications adapter

IOCB I/O control blocks

I/O input/output

IOR IBM on-site repair

IP Internet Protocol

IPL initial program load

ISA industry standard architecture

ISFC ISFC Inter-System Facility for Communication

KB kilobyte

LAN local area network

LAPS LAN adapter and protocol support

LIC licensed internal code

LIFO last in, first out

LIPT link IPL port trace

LLC logical link control

LPDA Link Problem Determination Aid

LRECL logical record length

LT logical terminal

LU logical unit

MB megabyte

MHz megahertz

MIH missing interruption handler

OEM original equipment manufacturer

OMA optical-media attach

PC personal computer

PCI peripheral component interconnect (Intel bus standard)

PIU path information unit

PU physical unit

PVM pass-through virtual machine

P/390 System/390 Microprocessor Complex

PSW program status word

R390 RS/6000 and System/390 Server-on-Board

RAID redundant array of independent disks

RECFMS record formatted maintenance statistics

RTS request to send

SAP service access point

SCSI small computer systems interface

SDLC Synchronous Data Link Control

SIE SoftwareXcel Installation Express

SIGP Signal processor

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SIO start I/O

SIT scanner interface trace

SMIT System Management Interface Tool

SMMF SSCP monitor mode function

SNA Systems Network Architecture

SRPI Server-Requester Programming Interface

SSA Serial Storage Architecture

SSCP system services control point

TCPIP transmission control protocol Internet protocol

TDF tape descriptor file

TIC token-ring interface coupler

TOD time of day

TSAF transparent services access facility

UCW unit control word

XGA extended graphics adapter

XID exchange identification

VLSI very large scale integration

VM virtual machine

VTAM virtual telecommunications access method

WAC Wide Area Connector

WAN wide area network

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Server-on-Board Model F50
Is It Right for You?
Technical Application Brief

Publication No. GC28-1619-03

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