

IBM PC Server System/390 Model 330

IBM

Technical Application Brief

Version 6

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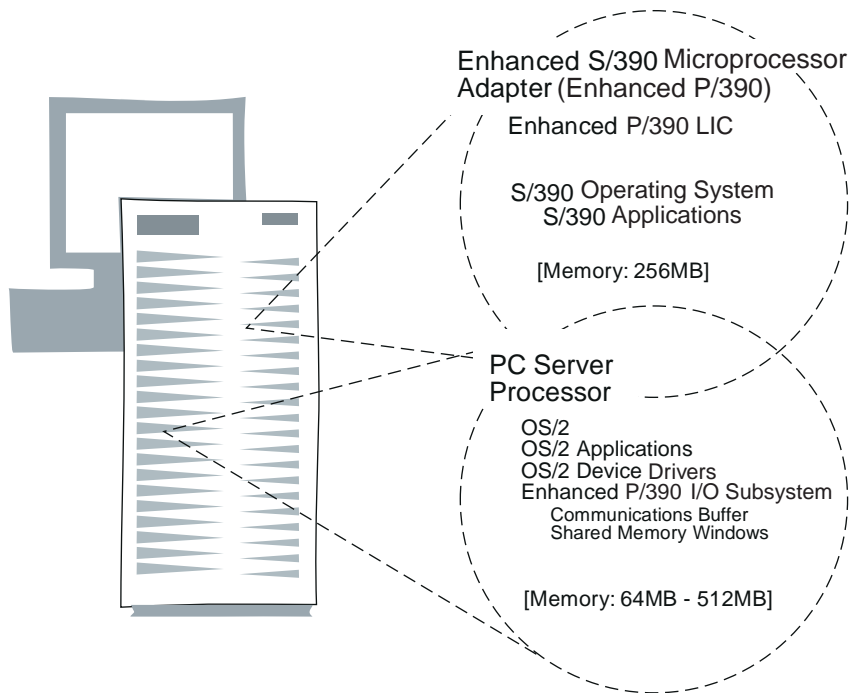
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Preface

The purpose of this document is to help you determine whether the IBM PC Server System/390 Model 330 8460-PB0. (short title, IBM Enhanced PC Server S/390) is right for your enterprise. This document specifically addresses the IBM Enhanced PC Server S/390 with the new "Enhanced S/390 Microprocessor Adapter," which was announced in May 1998. A brief description tells how the IBM Enhanced PC Server S/390 can be used in various environments. After understanding its capabilities, you will have an opportunity to determine if the IBM Enhanced PC Server S/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 a IBM Enhanced PC Server S/390. Upon completion, there are recommended actions.

Chapter 1. Description



| Figure 1. Enhanced PC Server S/390

Continuing the drive to provide flexibility and cost-effective computing with the latest technology to meet your requirements, IBM has announced the **IBM PC Server System/390 Model 330**. The IBM Enhanced PC Server S/390 combines the features of the PC Server and System/390 to produce a computer system capable of executing both PC-based and System/390-based applications concurrently without requiring modifications.

| The new "Enhanced S/390 Microprocessor Adapter" (referred to in this document as the Enhanced P/390) is now provided as part of the IBM Enhanced PC Server S/390. 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 IBM Enhanced PC Server System/390 Model 330 offers a wide variety of possibilities and creative uses for your business needs. Here are examples of these possibilities:

Application Development

IBM PC Server System/390 is a cost-effective platform used to develop client/server applications for the S/390 environment. This workstation is ideal for small application development teams, because it exploits the productivity of S/390 and OS/2 development tools and provides immediate access to the real S/390 architecture for testing and debugging applications. Developers can use UNIX-based or OS/2-based system design and re-engineering tools along with

S/390 3GL and 4GL tools and object-oriented technology to shorten the development cycle for S/390 environments. When the IBM PC Server System/390 is used as a dedicated resource for development and test, it can use the same tools as the host. Therefore, the availability of the host production system is increased, dependencies on the host are eliminated, and risks to the production system are reduced.

The IBM PC Server System/390 is an ideal platform for identifying and developing necessary changes without impacting the host system. The time-of-day (TOD) on the IBM PC Server System/390 is easily changed. The result is a dedicated platform for date-reliant testing of system applications.

Because OS/390 provides the XPG4 base that allows easy porting of UNIX applications, solution providers should consider the IBM PC Server System/390 for developing and porting their customer's applications to the OS/390 environment. The IBM Enhanced PC Server S/390 makes it easy for customers and solution providers to develop, test, and maintain applications. The IBM PC Server System/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.

With the fast approach of the year 2000, it is important that you begin to assess and plan a course of action to address potential challenges during this transition. The IBM PC Server System/390 supports the year 2000 challenge. When it is used in accordance with its associated documentation, the IBM PC Server System/390 correctly processes, supplies, and accepts date information within and between the 20th and 21st centuries.

Replacement Market

Existing S/370 customers with general-purpose processors can gain substantial savings by moving to this new, attractively priced technology now. Many customers with existing S/370 hardware and software are participating in the LAN environment. The IBM PC Server System/390 addresses their business needs by giving them the opportunity to replace these existing systems, while continuing to use their S/370 and S/390 applications and skills. Instead of porting S/370 applications to a new platform, the IBM PC Server System/390 allows for easy upgrades and maintains the classic S/390 strengths. Thus, applications do not have to be moved to an entirely new platform that lack the S/390's advantages.

These systems are possible replacements for S/370 machines, as well as older ESA machines, such as 4341s, 4361s, small 4381s, 9371s, 9373s, 9375s, 9221-120s, and 9221-130s, depending on customer requirements. In many situations, large 4381s, 9377s, 9221-150s, and 9221-170s can be replaced by a PC Server S/390.

Many customers in this group continue to run S/370, XA, or older ESA software. By replacing S/370 systems with the IBM PC Server System/390, these customers can use the latest technology, including S/390 ESA software, yet retain the same skills. The S/390 software provides complete year 2000 support.

Substantial savings may be achieved in lower maintenance costs on both the processor and DASD, lower energy costs, lower connectivity costs, and environmental costs. These potential benefits are derived from the integrated disk characteristics with their high-reliability, low-power requirements, LAN connectivity, and PC Server plus CMOS technologies.

Application Server

Application servers have a variety of client/server uses. Some examples are:

- A distributed server with additional or legacy applications
- A distributed server with a single function; that is, file serving or print serving
- A server packaged with a solution provider's application (S/390, UNIX, or OS/2)

These application servers are ideal for a department or small business, because they can run OS/2 with S/390 applications unchanged. These offerings allow remote locations to run (some unattended), while providing remote users with data and consistent business applications across the enterprise. Solution providers may be able to incorporate their applications on these servers and potentially widen their customer base by targeting markets that were previously unobtainable. In addition, these application servers solve business needs by bringing specific workloads into LAN environments. The results include improved productivity, local control, and reduced telecommunication costs.

The IBM PC Server System/390 can participate as a server or client in an existing local area network with access to host data. As a client, they can seamlessly participate in any LAN environment. As a server, it can run the appropriate LAN functions associated with S/390 or OS/2 depending on customer workload. This choice provides customers with flexibility and availability while satisfying the need to integrate business solutions with consistent applications.

New Entry Server

The possibilities created by the IBM PC Server System/390 are varied and numerous. As network computing grows, these servers will find new uses, for example, as a webserver or router. With the low-cost single platform for a dual environment, the IBM PC Server System/390 is able to enter markets that were previously limited by price and function.

Additional Possibilities

The possibilities for your business are bounded only by your creativity!

Chapter 2. Highlights

The IBM Enhanced PC Server S/390 is a dual-processor system offered in the PC Server 330. The high-performance Pentium processor supports Intel applications and advanced local area network (LAN) functions. A Enhanced S/390 Microprocessor Adapter (Enhanced P/390 adapter) provides the S/390 ESA instruction set and runs the VM/ESA, VSE/ESA, and OS/390 operating systems unmodified. Most S/390 applications run unmodified on the IBM Enhanced PC Server S/390. (Throughout this publication, the Enhanced S/390 Microprocessor Adapter is referred to as the Enhanced P/390.)

Hardware

Here are some of the highlights of the PC Server S/390, using the PC Server Model 330 8460-PB0 as a base:

- 266MHz Intel Pentium II processor –L1 cache is 32KB and L2 cache is 512KB
- Enhanced S/390 Microprocessor Adapter (Enhanced P/390)
 - Enhanced S/390 Microprocessor Adapter with 256MB ECC standard S/390 memory
 - Can use PC Server memory to emulate S/390 expanded storage.
- Integrated single channel Wide Ultra SCSI RAID controller
- Integrated Wide Ultra SCSI controller
- Six hot-swap DASD bays
- Six expansion slots: four 32-bit full-length PCI slots and two full length PCI/ISA combination slots
- Integrated PCI SVGA video with 1MB video memory, standard
- Integrated AMD Family 10/100Mbps PCI Ethernet controller
- Two high-speed serial ports and one parallel port
- Enhanced 101-keyboard
- IBM PS/2 mouse
- 1.44MB diskette drive
- 8X-speed CD-ROM drive
- 4mm digital audio tape (DAT). (Required for IBM Enhanced PC Server S/390 if no other 3420 or 3480 tape drive is present.)
- Flexible disk configuration
 - Standard single-channel, integrated ServeRAID controller
 - Optional, three-channel ServeRAID II SCSI adapter for RAID 0,1, and 5 data storage
 - Six hot-swap bays
 - Flexible expansion capabilities
- Three-year, on-site warranty (may vary outside of US)

| Any features and options supported on a PC Server 330 can be ordered.

Software

| Each IBM Enhanced PC Server S/390 requires:

| IBM OS/2 Warp Server Advanced
| IBM eNetwork Personal Communications for OS/2
| IBM Enhanced PC Server S/390 programs
| S/390 operating system

| All currently marketed VM/ESA, VSE/ESA, and OS/390 operating systems and their associated S/390 products are available for the IBM Enhanced PC Server S/390.

| For all System/390 software orders, the distribution is on currently supported media, including the 4mm DAT tape media (digital audio tape) cartridge for most current products. (Base VM/ESA is available today on OMA CD-ROM media.)

| As part of the S/390 software order, the customer can request the appropriate preconfigured CD-ROM. The preconfigured CD-ROMs contain S/390 system images that provide a "load and go" system. Included on the CD-ROMs 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. The preconfigured CD-ROM consists of the base operating system and one or more utility programs.

Chapter 3. Performance Overview

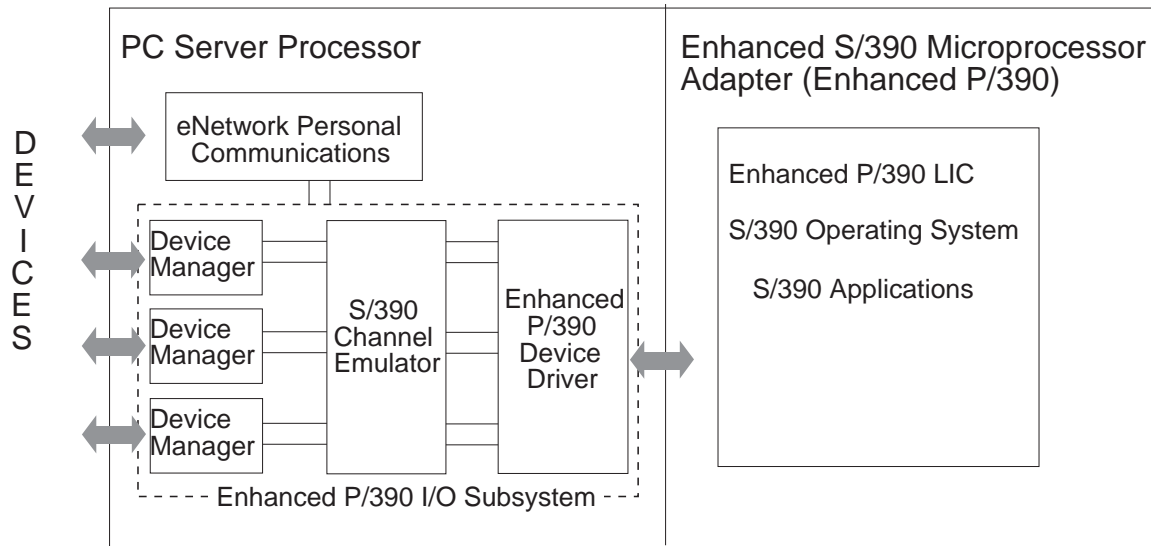


Figure 2. System/390 I/O handled by OS/2 Device Managers/Drivers

The IBM Enhanced PC Server S/390 is a combination of the System/390 and PC Server architectures that provide 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 2, the execution of the S/390's I/O is handled by OS/2 device managers, device drivers and S/390 channel emulation. The S/390 design in the IBM Enhanced PC Server S/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 S/390 Parallel Channel adapter) or emulated utilizing PC 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 IBM Enhanced PC Server S/390 does not support multiple channels if they are attached to the same physical device. This is a capability that is exploited in other S/390 systems.

Use of the IBM Enhanced PC Server S/390 for your business requires workload planning to achieve favorable results. Environments with concurrent work being run on both the OS/2 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.

OS/2 activity is affected by S/390 I/O operations. Depending on usage, the Enhanced P/390 I/O subsystem can consume most of the IBM Enhanced PC Server S/390 resources. Therefore, you should not assume that you can run other applications, such as file servers or databases, on the IBM Enhanced PC Server S/390 at the same time that the S/390 operating system is running on the IBM Enhanced PC Server S/390. Depending on the particular circumstances or applications, this can work fine for you, or it can cause problems. If problems do occur, you may have to remove the other OS/2 applications from the IBM Enhanced PC Server S/390 for the system to work properly.

The performance section, Appendix A, "Performance" on page 29, along with the worksheet, Chapter 6, "Planning Worksheet" on page 15, and the planning information, Chapter 7, "Planning Guide" on page 17, are designed to help you determine if your planned S/390 workload for the IBM Enhanced PC Server S/390 is feasible.

Chapter 4. System Availability

The IBM Enhanced PC Server S/390 offers improved system reliability when compared to an average 43x1 or 937x. When compared to the older machine's system configuration, including attached DASD and DASD controllers, the PC Server S/390 hardware reliability of mean time between failure can be 2 to 5 times better. Using RAID configurations yields even better results when you look at overall availability.

DASD/Disk Storage

The IBM Enhanced PC Server S/390 has integrated up to 44GB of disk capacity, and a high performance Ultra-SCSI RAID controller (ServeRAID) into a single, compact unit. The six internal hot-swappable hard disk drives in a RAID 1 or 5 configuration allows for the replacement of the failing drive without shutting down the system. The unique cooling design promotes maximum airflow over system components and all disk drives for system cooling and reliability. By reducing the hardware complexity and points of failure, and by providing hot-swappable disk drives, the IBM Enhanced PC Server S/390 is designed for superior system availability. Large amounts of additional disk capacity can be obtained by using standard SCSI or SSA attached external enclosures.

RAID

The IBM Enhanced PC Server S/390 model supports RAID 0,1 and 5. RAID 0 offers the best capacity but without disk redundancy. RAID 0 is not recommended. RAID 1 offers total disk redundancy by keeping a complete mirror of each active disk on a dedicated hot-standby backup disk. With RAID 5, sectors that comprise a logical drive are striped across each of the hard drives in the array intermixed with parity data. In the case of disk failure, the system uses the encoded data from the surviving disks to reconstruct the lost data "on the fly." The failed disk can be replaced and automatically reconstructed during background processing on a standby disk. The ServeRAID and ServeRAID II adapters, with current available firmware, automatically performs "data scrubbing" or "synchronization" to ensure complete data redundancy. Anyone choosing to not use this automatic function must ensure that the data is synchronized on a regular basis, preferably weekly. RAID 5 also provides ease of configuration since data is spread across every disk. The RAID drives therefore appear to be one or a small number of large disk drives, rather than many small drives, making the configuration easier to manage.

Uninterruptible Power Supply (UPS)

To improve the system availability, an optional uninterruptible power supply (UPS) is available. The UPS protects the system from utility outages, which may be prevalent in certain geographic regions. By providing the UPS, the system remains powered up during the outage, thus allowing for an orderly shutdown in the event of extended outages, and ensuring data integrity for both the S/390 and the OS/2 applications.

Additional Availability Features

The IBM Enhanced PC Server S/390 also includes ECC memory, I/O bus parity protection, and PCI/ISA technology to ensure system availability and reliability.

Chapter 5. Planning for a New Environment

The following questionnaire helps you outline the environment that you want to move to the IBM Enhanced PC Server S/390. This information is useful to guiding you through the worksheet analysis and planning guide in the next sections. In addition, this information is important if calling for further help with analysis. Answer the questions based on the workload you plan to run on the IBM Enhanced PC Server S/390. A separate questionnaire should be completed 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 (ECKD)	_____	_____
Other _____	_____	_____
TOTAL		_____

3. 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		OS/39	

4. 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 3
 VM/CMS ==> See "VM/CMS Performance" on page 33
 VSE/CICS ==> See "VSE/CICS Performance" on page 35

For approximate performance of other workloads, refer to:

MVS/DB2 ==> DB2 Performance (See "Other MVS Workloads" on page 31)
 MVS/IMS ==> IMS Performance (See "Other MVS Workloads" on page 31)
 MVS/CICS ==> VSE/CICS Light I/O (See "VSE/CICS Performance" on page 35)

5. Performance

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

- VM: VM PRF or VM RTM
- VSE: Explore¹
- MVS: RMF

Current number of disk I/O's 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:			
OS/2 LAN Server	_____	_____	_____
Novell	_____	_____	_____
Banyan Vines	_____	_____	_____
via SNA/VTAM	_____	_____	_____
via TCP/IP (host/LAN)	_____	_____	_____
others	_____	_____	_____

Chapter 6. Planning Worksheet

The following list of questions can help you determine whether the IBM Enhanced PC Server S/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

If it is right for you

If it is not right for you or

If you need to contact your authorized Business Partner for further analysis

1. Specify the amount of disk storage (GB) you need for your planned environment. Assume the use of 9.1GB slim-high disk drives.
 - a. Up to 44GB
 - b. Between 45GB and 160GB (See "DASD/Disk Storage" on page 23.)
 - c. Between 160GB and 900GB (See "DASD/Disk Storage" on page 23.)
 - d. Greater than 900 GB
2. Specify the total number of lines per minute required for printing.
 - a. Fewer than 3000
 - b. Between 3000 and 25000 (See "Data Movement" on on page 22.)
 - c. Between 25000 and 50000 (See "Data Movement" on on page 22.)
 - d. Greater than 50000
3. MVS: How many MVS/TSO application development users are supported?
 - a. Fewer than 50
 - b. Between 50 and 90 (See "MVS/TSO Performance" on page 30.)
 - c. More than 90
 - d. Not applicable
4. VM: How many VM application development users are supported?
 - a. Fewer than 250
 - b. Between 250 and 350 (See "VM/CMS Performance" on page 33.)
 - c. More than 350
 - d. Not applicable
5. If you are running an interactive, database workload what is the expected average disk I/O rate (I/O operations per second)?
 - a. Fewer than 100
 - b. Between 100 and 150 (See "VSE/CICS Performance" on page 35.)
 - c. Between 150 and 400 (see "Disk I/O Performance and Caching" on page 24.)
 - d. More than 400
6. How many communication lines do you require?
 - a. 16 or fewer (VM and VSE), 4 or fewer (MVS)
 - b. More than 16 (VM or VSE), more than 4 (MVS) (See "Communication Controllers" on page 27.)

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 35.)?
 - a. A 4331, 4341, 4361, 4381-11, 4381-21, 4381-23, 4381-90E, 4381-91E, 9373, 9375, 9377, 9221-120, 9221-130, or 9221-150
 - b. A 4381-24, 9221-180, 9121-180 or larger capacity models which are under-utilized
(See Appendix B, "Customer Examples" on page 39)
 - c. A 4381-24, 9221-190, 9121-180, or larger capacity model which are near or fully utilized
 - d. Not applicable
8. Do you have a critical time requirement for your batch window?
 - a. No
 - b. Yes (See "Recommendations and Guidelines" on page 21.)
9. What Enhanced P/390 memory size is required for your workload to run on the IBM Enhanced PC Server S/390?
 - a. Up to 256MB
 - b. Greater than 256MB and can use S/390 Expanded Storage to satisfy the requirement
(See "System Memory Size" on page 22.)
 - c. Not Applicable
 - d. Requires more than 256MB and S/390 Expanded Storage cannot satisfy the requirement
10. Does your planned workload fit with anticipated growth over your investment period? Refer to Appendix A, "Performance" on page 29 for more information.
 - a. Yes
 - b. Not applicable
 - c. Not applicable
 - d. No
11. Do you require more than 255 channel addresses for your system?
 - a. No
 - b. Yes, but some are local non-SNA terminals (See "Alternatives" on page 22)
 - c. Not applicable
 - d. Yes

If you answered (a) to all of the above questions after reading all the pertinent information, a single PC Server System/390 looks like a good fit for you business. Call your authorized Business Partner to place an order. Authorized Business Partners are the exclusive channel for these offerings.

If you answered (b) to any of the above questions, please refer to the specified section to determine if your workload can run on the IBM Enhanced PC Server S/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. Your workload may need to be split across multiple servers. Use the appropriate contact in Appendix E, "For More Information" on page 47.

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

Chapter 7. Planning Guide

The following matrix is a tool to help you understand the I/O alternatives involved in migrating your current system or workload to the IBM Enhanced PC Server S/390. Following the matrix are recommendations and guidelines to assist you.

Figure 3 (Page 1 of 2). PLANNING GUIDE for IBM Enhanced PC Server S/390

TODAY'S CONFIGURATION	ALTERNATIVES				
	N/A=Not Applicable N/S= Not Supported				
	Direct Attach via Adapter Cards			Emulated	
S/370 or S/390 Devices	S/390 Parallel Channel adapter Max: 2/system	SCSI Adapter/ RAID Controller	Other	via OS/2 file (Hard disk, CD-ROM, Diskette, LAN) ¹	via PC Ports (LAN, Parallel Port, Serial Port)
DASD:					
FBA: 0671, 3310, 3370, 9332, 9335, 9336	N/S	N/S	N/A	Read/Write	N/A
CKD/ECKD: 3330, 3350, 9345, 3375, 3380, 3390					
TAPES:					
3420	Yes	- SCSI 9 track - 4 mm DAT cartridge	N/A	Read/Write ²	N/S
3422	Yes	N/S	N/A	Read/Write	N/S
OPTICAL MEDIA ATTACH/2 (3422)	Yes	N/A	N/A	Read Only ¹¹	N/S
3480	Yes	- SCSI cartridge - 4mm DAT cartridge ⁸	N/A	N/S	N/S
3490, 3490E	Yes	SCSI cartridge ⁸	N/A	N/S	N/S
PRINTERS:					
1403*	Yes	N/A	N/A	Yes	Yes
3203*, 3211*, 4248	Yes	N/A	N/A	N/S	N/S
3820, 3812*, 3816*	Yes	N/A	Coax ⁴	N/S	N/S
3287	Yes	N/A	N/A	N/S	Yes ⁵
3800*, 3900	Yes	N/A	N/A	N/S	N/S
COMMUNICATION CONTROLLERS:					
2703*	Yes	N/A	N/A	N/A	Asynchronous (serial)

Figure 3 (Page 2 of 2). PLANNING GUIDE for IBM Enhanced PC Server S/390

TODAY'S CONFIGURATION	ALTERNATIVES				
	N/A=Not Applicable N/S= Not Supported				
	Direct Attach via Adapter Cards			Emulated	
S/370 or S/390 Devices	S/390 Parallel Channel adapter Max: 2/system	SCSI Adapter/ RAID Controller	Other	via OS/2 file (Hard disk, CD-ROM, Diskette, LAN) ¹	via PC Ports (LAN, Parallel Port, Serial Port)
ICA (VM, VSE only)	N/A	N/A	N/A	N/A	WAC adapter (SDLC/BSC) ⁹
XCA (OS/390, MVS, VM, VSE)	N/A	N/A	N/A	N/A	WAC or Portmaster Model 2 adapter (SDLC)
3720*, 3725*	Yes ¹⁰	N/A	N/A	N/A	N/A
DISPLAY CONTROLLERS:					
3174	Yes	N/A	- LAN Adapter ⁷ - SDLC	N/A	LAN Adapter ⁶
INTERCONNECT CONTROLLER:					
3172	Yes	N/A	N/A	N/A	LAN Adapter ⁶
2540 CARD READER	Yes	N/A	N/A	Yes	N/S
3088	Yes	N/A	N/S	N/A	LAN Adapter

Figure 3 (Page 1 of 2). PLANNING GUIDE for IBM Enhanced PC Server S/390

TODAY'S CONFIGURATION	ALTERNATIVES				
	N/A=Not Applicable		N/S= Not Supported		
	Direct Attach via Adapter Cards			Emulated	
	S/390 Parallel Channel adapter	SCSI Adapter/ RAID Controller	Other	via OS/2 file (Hard disk, CD-ROM, Diskette, LAN) ¹	via PC Ports (LAN, Parallel Port, Serial Port)
S/370 or S/390 Devices	Max: 2/system				

Note:

¹The OS/2 files reside only on direct access storage devices and have file systems - hard drive, CD-ROM drive, and diskette drive. Local LANs are also included if you have network attached shared devices.

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

³This emulation is only for connecting IBM Enhanced PC Server S/390 systems on the same LAN.

⁴Available through COAX attach using 3174-95R/91R which also requires a Multiport Model 2 adapter or a Wide Area Connector (WAC) adapter.

⁵Available through CM/2 Version 1.11 on CD-ROM as LP3820.

⁶Any adapter that is supported by LAPs can be used, such as Token Ring, Ethernet, FDDI, ATM or any other NDIS supported adapter. TR and Ethernet have been tested in the IBM Enhanced PC Server S/390 environment. This emulation is only for connecting IBM Enhanced PC Server S/390 systems on the same LAN.

⁷The 3174-63R is the LAN attached model and the 3174-95R is the SDLC/bisynchronous model.

⁸The only supported SCSI-attached 3490 tape drive is the IBM 3490-F00 or F01. This drive must be attached to a differential SCSI adapter (for example, Adaptec AHA2944UW) *not* the PC Server S/390 integrated SCSI port or RAID controller. Contact your IBM authorized Business Partner for more information.

⁹There is a limit of 15 active channel programs. If polling is a concern, consider using a boundry node converter.

¹⁰There is a limit of 16 active channel programs for each S/390 Parallel Channel Adapter.

¹¹The OMA driver is also useful for giving S/390 applications direct access to PC or LAN files.

*Although technically feasible based on interface definitions, these devices have not been run on the IBM Enhanced PC Server S/390. All other devices stated here have been run on the IBM Enhanced PC Server S/390.

Recommendations and Guidelines

This section recommends ways to configure the IBM Enhanced PC Server S/390 and provides guidelines in accessing the capabilities of the system:

- S/390 Parallel Channel adapter
- System memory size
- DASD/Disk storage
- Printers
- Tape drives
- Host mainframe data access
- Communication controllers
- Display controllers
- S/390 functions supported
- Migration to ESA
- Enhanced P/390 Warranty

Overall System

A maximum of 255 devices can be defined on the Enhanced P/390 system, this includes both emulated and channel attached devices. For emulated devices, a maximum of 15 active channel programs are supported. For channel attached devices, a maximum of 16 active channel programs per S/390 Parallel Channel adapter card at one time is supported. (A maximum of 2 S/390 Parallel Channel adapter cards per system is supported.)

S/390 Parallel Channel Adapter

General statement

The S/390 Parallel Channel adapter provides channel-attach capability of most channel-attached (bus and tag) tape drives, printers, display controllers, and communication controllers to the IBM Enhanced PC Server S/390. The IBM Enhanced PC Server S/390 supports a maximum of two S/390 Parallel Channel adapters. Each card occupies one PCI slot.

Some typical attachments are:

- Line and page printers, such as the IBM 4248 and the IBM 3800 Model 1
- Tape drives such as the IBM 3420, 3480, and 3490
- Communication controllers, such as the IBM 3720 and 3745
- SNA and non-SNA display controllers such as the 3174

Restrictions when using a S/390 Parallel Channel adapter

- Only specific IBM devices have been tested. Because of timing considerations, non-IBM implementations of these devices may not function.
- DASD attachment is not supported
- 3274, 3725, 5088, and 6098 are not supported
- A maximum of two adapters is supported.
- For best performance, connect a maximum of four control units to an adapter
- A dedicated S/390 Parallel Channel adapter is required. It cannot be shared with any other OS/2 applications.

- A maximum of 16 active channel programs per card is supported.

Data movement

Minimizing the number of channel control words (CCWs) required to move data is key to maximizing performance for a channel-attached device. The larger the amount of data per CCW, the better the performance.

Printing in page mode is equivalent to using a larger block size on tapes. The number of CCWs per page is less, and the number of data bytes per CCW is greater, so in general, the system can print faster on page printers in page mode than on printers in line mode.

Number of devices supported

The IBM Enhanced PC Server S/390 supports up to two S/390 Parallel Channel adapter cards. One S/390 Parallel Channel adapter can support 1-255 devices. However, there cannot be more than 16 active channel programs at the same time per card.

Note: The IBM Enhanced PC Server S/390 has a system limit of 255 total devices both emulated and channel attached.

Byte mode or block mode

One S/390 Parallel Channel adapter can support both S/370 and S/390 printers and tape drives. Unlike S/390 channels, you can intermix modes and speeds (byte, block or data streaming at DCI, 3 or 4.5 mb/s) for different devices attached to same S/390 Parallel Channel adapter simultaneously.

Alternatives

If the expected data movement or number of I/O operations exceeds the preceding guidelines, consider using PC devices rather than S/390 channel attached devices. Here are two examples:

- Use a PC laser printer connected to a parallel printer port or to a LAN to reduce the workload on a channel attached impact line printer.
- Replace coax-attached terminals (on a 3174) with workstations on a LAN, or replace the channel-attached 3174 with a token ring attached 3174.

System Memory Size

There are two types of system memory, S/390 memory and PC Server memory.

1. The Enhanced P/390 Adapter is only available with 256MB memory. This should be sufficient for any VM/ESA, VSE/ESA, and most OS/390 systems. Memory-intensive systems should consider using PC Server memory to emulate S/390 Expanded Storage (described below).
2. Although the supporting OS/2 system can usually run within 48MB of PC memory, PC memory above the standard 64MB should be added for the following reasons:

Data Caching: When using the Warp Server Advanced system, a large OS/2 cache can be defined which may improve I/O performance. Use of a large OS/2 cache with the HPFS386 option is **not supported** by the Enhanced PC Server S/390. In most systems, use of additional PC Server memory as S/390 Expanded Storage generally provides better performance than the use of large OS/2 data caches.

S/390 Expanded Storage: The Enhanced P/390 code now includes the emulation of S/390 Expanded Storage by using PC Server memory. For S/390 operating systems that support expanded storage (such as VM/ESA and OS/390) this may provide a significant response time improvement.

Note: Ensure that OS/2 always has sufficient memory for itself. For systems with small cache or expanded storage sizes (less than 16MB), 48MB for OS/2 should be sufficient. For systems with larger cache or expanded storage sizes, 128MB should be a safe minimum.

DASD/Disk Storage

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

Direct (channel) connection of the IBM Enhanced PC Server S/390 to S/370 or S/390 DASD devices is not supported. While the connection to standard 'mainframe' disk devices is not supported nor recommended for production use, it will frequently be possible to use this kind of connection for initial data migration from an existing system. Whether the data is copied in this manner (disk to disk copy) or via a dump to tape and restore, all data must be transferred to the internal server disks prior to actual S/390 use. (When transferring data from 'mainframe' disk devices, use an XA or ESA mode utility. For example, on VM systems use DDRXA instead of DDR.)

When less than 44GB is required

The IBM Enhanced PC Server S/390 has six internal Hot/Swap drive bays, each of which can accommodate either a 4.51GB or a 9.1GB disk drive. The normal configuration will include up to six 9.1GB disk drives providing approximately 44GB of useable disk capacity in a RAID 5 configuration. To provide enough read/write access mechanisms to maintain good performance, **at least** five active drives are recommended to be configured for each IBM Enhanced PC Server S/390. Using less than five active drives may seriously limit the disk I/O performance of the system.

When greater than 44GB is required

With external units, the storage capacity of the IBM Enhanced PC Server S/390 can be increased. A variety of external units are available, both SCSI and SSA.

SCSI External Expansion Units

Two external SCSI expansion units are available from IBM: the 3517 and the 3518.

- The 3517 can accommodate up to five 9.1GB or 18GB drives. Therefore, up to 72GB of RAID 5 storage is available in one 3517. You can attach multiple 3517 towers to the PC Server. Two additional non-hot/swap bays are also available in the 3517, providing space for tape drives or non-hot/swap disk drives.
- The 3518 has three banks of hot/swap bays that can each accommodate six 4.5GB or 9.1GB drives. Using a combination of two SCSI/RAID channels and 18 9.1GB drives, a total of 135GB of usable RAID 5 capacity is available within the 3518, or a total of approximately 180GB between the fully configured IBM Enhanced PC Server S/390 and a 3518.

Remember, the base 8640-PB0 has only a single integrated RAID channel for the support of the internal disk drives only, and no battery backup for the cache

memory. To connect any external SCSI enclosures will require the addition of a ServeRAID II adapter. The ServeRAID II adapter can provide up to three external SCSI/RAID channels and allows the use of a battery backed-up cache for improved data integrity.

The combination of a 8640-PB0 and a fully configured 3518 can provide approximately 180GB of useable (RAID-5) disk capacity. Systems which require more disk capacity than this should consider using SSA based configurations. Also, systems with large disk configurations should install the enhanced OS/2 CHKDSK utility to be able to properly support large OS/2 partitions (greater than 12GB).

SSA External Expansion Units

There are also SSA external disk enclosures available. To connect either of these external units would require the use of the PC Server RAID SSA adapter.

- The 3527 is very similar to the 3517, but provides for SSA connection of the hot/swap drives, rather than SCSI. Like the 3517 it can provide up to five 18GB hot/swap disks, for a RAID-5 capacity of 72GB.
- The 7133 is a member of the RS/6000 family of disk storage devices which has been certified for use on PC Servers. There are several models and types (floor standing and rack mounted) which can be configured to over 800GB of total disk space.

The IBM RAID SSA adapter allows for two SSA loops attaching up to 48 drives to each loop, and up to 32 RAID arrays. If you intend to deploy systems with large data configurations, you should understand the advantages of SSA technology and the IBM SSA RAID adapter for PC Servers. See your IBM Business Partner for more information on the SSA RAID adapter.

Accessing Disk Storage Across a LAN

Additionally, you may be able to split your workload across multiple IBM Enhanced PC Server S/390s. Analysis is needed to determine if workloads and data can be logically divided between an existing system and the IBM Enhanced PC Server S/390 or between two IBM Enhanced PC Server S/390s. The main reason for splitting workload is to achieve better performance when accessing data. By using OS/2 LAN Server, one of the IBM Enhanced PC Server S/390s can be used as a file server, thus providing access to shared data for other IBM Enhanced PC Server S/390 systems. However, there is no hardware support for reserve/release function (for example, no lock outs). A software reserve/release program or sharing data only for read operations is recommended.

Disk I/O Performance and Caching

The disk I/O rate (measured in S/390 I/O operations per second) which the IBM Enhanced PC Server S/390 is able to sustain will vary greatly from system to system, depending on workload characteristics and system configuration. Some workloads may saturate the I/O subsystem at an average of 100 I/Os per second, while other workloads can successfully run with peaks up to 400 I/Os per second. If the expected S/390 disk I/O rate falls between 100 and 400 I/Os per second, check with your certified reseller for additional guidance.

In general, the more I/O intensive the workload, the higher potential for bottlenecks. By using data caching techniques, I/O bottlenecks can be reduced.

There are several ways to cache I/Os in the IBM Enhanced PC Server S/390 environment to improve throughput. Two of the methods are software caching in OS/2 and hardware caching for array systems with the SCSI RAID controller. Caching writes in either of these cases may improve the ability to drive higher I/O rates through the IBM Enhanced PC Server S/390 depending on the read/write ratio. However, because the standard integrated controller's cache is not backed up with a battery, certain system failures can cause data integrity exposures that can be minimized by using an optional UPS. See "Uninterruptible Power Supply (UPS)" on page 9.

Software caching using PC memory to store I/Os before writing to the hard disk is enabled using the LAZY WRITE option of OS/2. A specific amount of memory is reserved for caching use. This value is defined in the CONFIG.SYS file. For a High Performance File System (HPFS), use the CACHE command to enable and disable lazy-writes. (The default is on.) For a FAT file system use the DISKCACHE command.

When a write operation is issued from a program, the I/O is written to the cache and the issuing program is informed that the write I/O is complete *before* the data is actually written to the hard disk. Data integrity exposure exists if there is a power failure (without a UPS), an OS/2 failure that cannot be recovered with a soft boot (ALT-CNTL-DEL), or some hardware caused failure.

Hardware caching uses the same concept as software caching, except that the data is stored in the RAID controller adapter card rather than the PC memory. There is 4MB of memory in the integrated (single channel) ServeRAID controller with approximately 3MB available for user data caching. (The current SSA RAID adapter for the PC Server has a total of 8MB of memory and does not have a battery backup function.) The data integrity exposure here exists when a power failure occurs (without a UPS) or with a failure of the RAID controller. If an OS/2 failure occurs, the adapter will flush its cache after approximately six seconds. The high reliability of the RAID controller when combined with a UPS creates an environment with minimal data integrity exposure. However, customers must make their own judgment as to the appropriate risk tolerance in their installation.

For customers with severe data integrity and/or I/O performance requirements, use of the ServeRAID II adapter in addition to or in place of the standard integrated ServeRAID controller should be considered. The ServeRAID II adapter provides an option for 8MB of *battery backed-up* cache memory. The additional memory provides improved performance (especially in a RAID 5 environment) and the battery backup of the cache provides full data integrity, even in the unlikely case of adapter failure.

Another form of caching is to make use of S/390 Expanded Storage to allow the S/390 operating system to keep more data in storage and avoid doing I/O operations. Since the availability of P390 support level 2.4, PC Server memory can be used to emulate S/390 Expanded Storage. This may offer a significant overall performance improvement for systems and applications which can take advantage of Expanded Storage.

As with all systems, the performance benefits and applicability of caching is dependent on the operating system and its workload characteristics.

S/370 or S/390 Tape Drives

Compatibility

If you exchange S/390 tapes with other S/370 and/or S/390, you need to ensure the tape media that you choose is usable by those machines. Most likely you will need to use 3420 or 3480 tape drives attached via the SCSI adapter or S/390 Parallel Channel adapter.

Tape size and compression

Figure 4 shows tape sizes with and without compression.

Figure 4. Tape Size with and without Compression

Tape	Size Without Compression	Size With Compression
3420	120MB	N/A
3422	120MB	N/A
3480	200MB	400MB
3490E	N/A	2.3GB
DAT DDS2	4GB	10GB
DAT DDS3	12GB	24GB

Restrictions

- The Enhanced P/390 I/O subsystem does not support the READ BACKWARDS CCW unless the SKIP bit is on. This may affect certain tape utility programs. It applies to all tapes, whether emulated or SCSI-attached.
- When you are purchasing a SCSI-attached 3420 or 3480 tape drive, make sure the drive you purchase has been tested by the dealer with the Enhanced P/390 SCSI tape device drivers. There are different levels of hardware and firmware, usually found in older or refurbished drives, that will not operate correctly or at all with the IBM Enhanced PC Server S/390.
- The only supported SCSI-attached 3490 tape drive is the IBM 3490-F00 or F01. (The use of a differential SCSI controller such as Adeptec AHA2944UW is required for these drives.)

Host Mainframe Access

Remote (TP) or XCA

Using ICA emulation, the IBM Enhanced PC Server S/390 can be VTAM/peer-connected to a host system using SDLC to share host applications. A Wide Area Connector (WAC) is required in the IBM Enhanced PC Server S/390.

LAN3172/LCS3172

Using a local and remote LAN attachment with LAN3172 emulation, the IBM Enhanced PC Server S/390 can be VTAM peer-to-peer connected to a host system (37x5, 3172, 3174 or ICA) to share host applications. Using a bridge or router between the local and remote LANs allows the systems to appear to be LAN-attached.

Using a local or remote LAN attachment with LCS3172 emulation, the IBM Enhanced PC Server S/390 can be TCP/IP peer-to-peer connected to a host system (37x5, ICA, 3172) to share host applications. The TCP/IP connection is for OS/390, VM/ESA, and VSE/ESA.

VM file access

Using LAN or coax attached 3270 sessions, CMS files on a VM host can be shared using IBM Enhanced PC Server S/390 transparent file access (TFA). The IBM Enhanced PC Server S/390 can also participate in TSAF and AVS clusters. This allows direct file access to VM's shared file system.

Communication Controllers

To get communication function there are several alternatives:

Channel-attached S/390 communication controllers (2703, 3720, 3745) using a S/390 Parallel Channel adapter.

Emulated 2703s using either the asynchronous ports of the PC Server or an adapter providing multiple asynchronous ports

Emulated ICA devices by using a Portmaster Model 2 for SDLC lines with RS232 interfaces, up to 38 Kbps

Emulated XCA devices by using a WAC adapter for SDLC

Emulated XCA device by using a boundary node converter for SDLC and BSC for speeds up to 56 Kbps

Emulated ICA devices using a wide area connector (WAC) for SDLC or BSC line interface using RS232, V.35, or X.21

The number of lines possible for each device, whether emulated or channel attached differ and depends on how the device is configured. If you need greater than eight lines, please contact your Business Partner for configuration assistance.

Display Controllers

The only reason to natively attach a 3174 control unit via a S/390 Parallel Channel adapter or LAN attach a 3174-63R is to be able to utilize existing coax terminals and printers. The easier method is to use the IBM Enhanced PC Server S/390's 3172 emulation through VTAM or TCP/IP to any LAN-attached workstation (SNA).

S/390 Functions

The IBM Enhanced PC Server S/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 (license agreement allows up to 1 year with the purchase of a new license) until the production systems and applications are up and running. If this software is unsupported, you will be running at your own risk.

It is important to note that VTAM Version 3.4.1 or higher is required to support a 3172 direct-attach or the emulation support on the IBM Enhanced PC Server S/390. VTAM 3.4.1 is the first version to support 3172s.

Enhanced P/390 Warranty

The warranty period for the P/390 is three years from the date of purchase and the warranty service is IBM On-Site Repair (IOR). Standard coverage is eight hours a day, 5 days a week. Optional coverage of 24 hours a day, seven days a week is available and recommended for most IBM Enhanced PC Server S/390 customers.

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 P/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

Note: The information in this section is based on preliminary data.

The following sections describe the performance that can be achieved with dedicated S/390 workloads. The performance of the IBM Enhanced PC Server S/390 depends on the type of workload and its characteristics. If non-S/390 related work is run on the Pentium processor during S/390 operations, there may be an increase in system response time for either or both workloads.

Comparison to IBM Enhanced PC Server S/390 Model 330

Performance for the PC Server Enhanced S/390 is a function of two key components: the Enhanced P/390 P/390 processor and the PC Server processor. (See Figure 1 on page 1) the performance of the Enhanced P/390 adapter has been improved compared to the previous P/390 adapter. These improvements are due to an increase in clock speed, individual instruction execution time improvements, and improvements in the S/390 PCI interface. The following sections show the benefit of these improvements for various workloads and provide comparisons with the previous P/390 adapter for equivalent system configurations.

MVS/TSO Performance

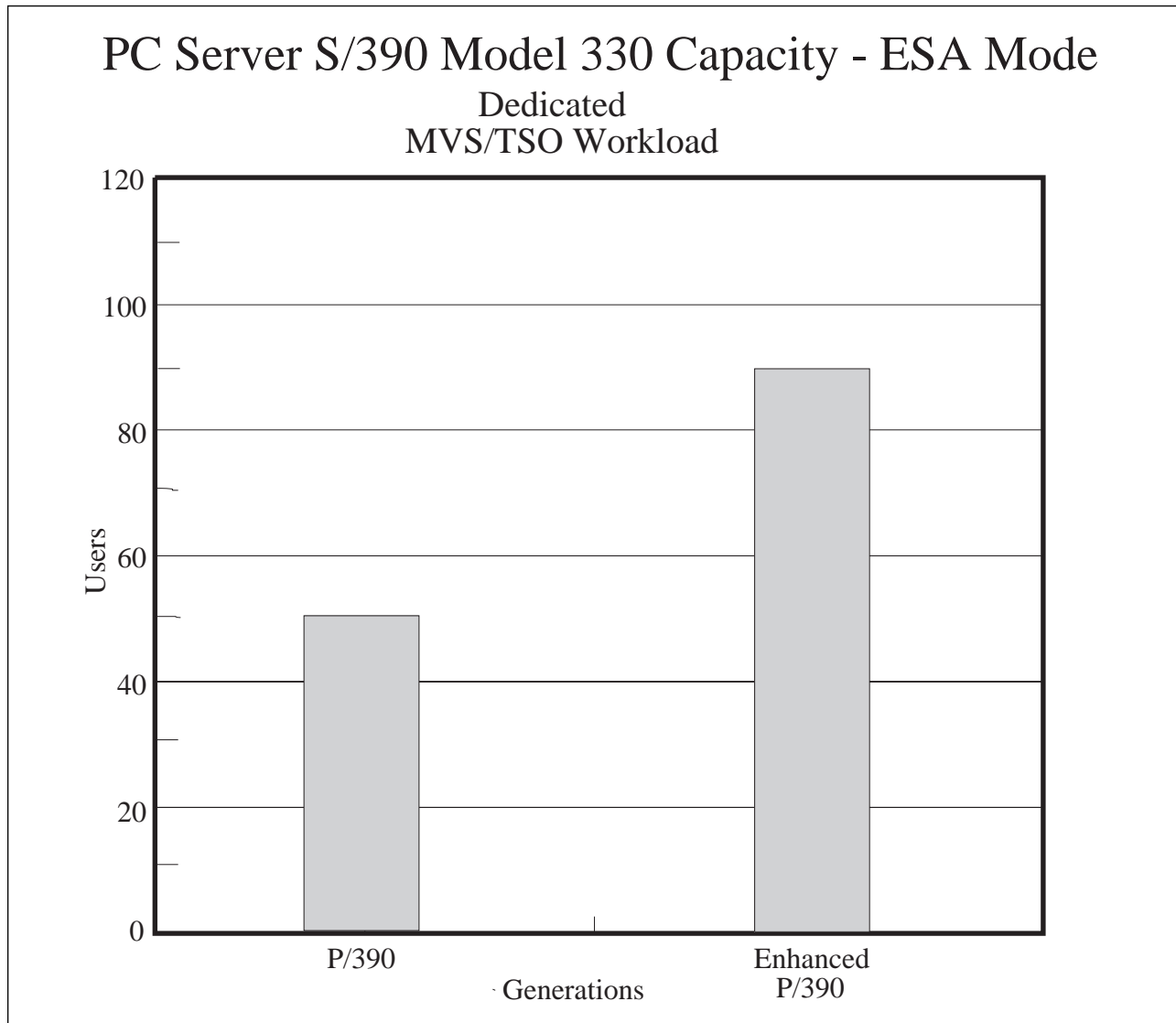


Figure 5.

The Enhanced P/390 P/390 has 256MB of "on-board" storage and will support up to 90 users based on an internal 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 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 IBM Enhanced PC Server S/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 IBM Enhanced PC Server S/390 can eliminate or reduce other time components to yield net improvement in overall response time.

The capacity of the IBM Enhanced PC Server S/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. 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 IBM Enhanced PC Server S/390 and cause the response time to exceed the specified limit. Although comparable performance is seen by specifying either LAZY=ON for the OS/2 HPFS/HPFS386 cache or WRITEBACK for the cache on the disk adapter card, use of WRITEBACK with LAZY=off is recommended. 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 for the specified 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 in this section is based on measurements and projections for a IBM Enhanced PC Server S/390 with 256MB of S/390 storage, 128MB of PC Server storage and two 10GB SSA RAID 5 arrays of 4.5GB devices. A 48MB HPFS386 cache was specified. The arrays were set up with 64K stripe, WB, and READ AHEAD off. 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 6 provides guidance to help you determine if your dedicated MVS production on-line workloads will fit on the IBM Enhanced PC Server S/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 IBM Enhanced PC Server S/390 in your business.

The data in Figure 6 is based on measurements and projections for a IBM Enhanced PC Server S/390 with 256MB of S/390 storage, 128MB of PC Server storage and two 10GB SSA RAID 5 arrays of 4.5GB devices. A 48MB HPFS386 cache was specified. The arrays were set up with 64K stripe, WB, and READ AHEAD off. Each RAID array contained a logical drive with ten 3380 (various densities) equivalents loaded with the workload components arranged so that the I/O rates to either logical drive was no more than 60 percent of the total average I/O rate. A system with a single array will handle approximately 85 percent of I/O's and users shown. All workloads have LAZY set to off for the HPFS386 cache and CICS also has the RAID adapter cache set to WRITETHRU. IMS and DB2 have the RAID adapter cache set to WRITEBACK thus allowing disk WRITES to be cached for these two workloads. 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.

Figure 6. Other MVS Workloads

Workload Type	Users/Terminals	Think Time (seconds)	Response Time (seconds)	I/O per Second	Number of Disk Arrays
IMS/DL1	190	11	1	100	2
IMS/DB2	50	4	1	100	2
CICS	225	12	1	80	2

While the internal response times achieved by the IBM Enhanced PC Server S/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 IBM Enhanced PC Server S/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 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 datasets only. There are six sets of 17 unique transactions, and five of these are run above the 16Meg line.

Note: When estimating MVS/DB2 or MVS/IMS for the a 43xx, 937x, or 9221 replacement, use the following approximations:

MVS/DB2 ==> .8 x VSE/CICS Light I/O (See "VSE/CICS Performance" on page 35)

MVS/IMS ==> .8 x VSE/CICS Light I/O (See "VSE/CICS Performance" on page 35)

VM/CMS Performance

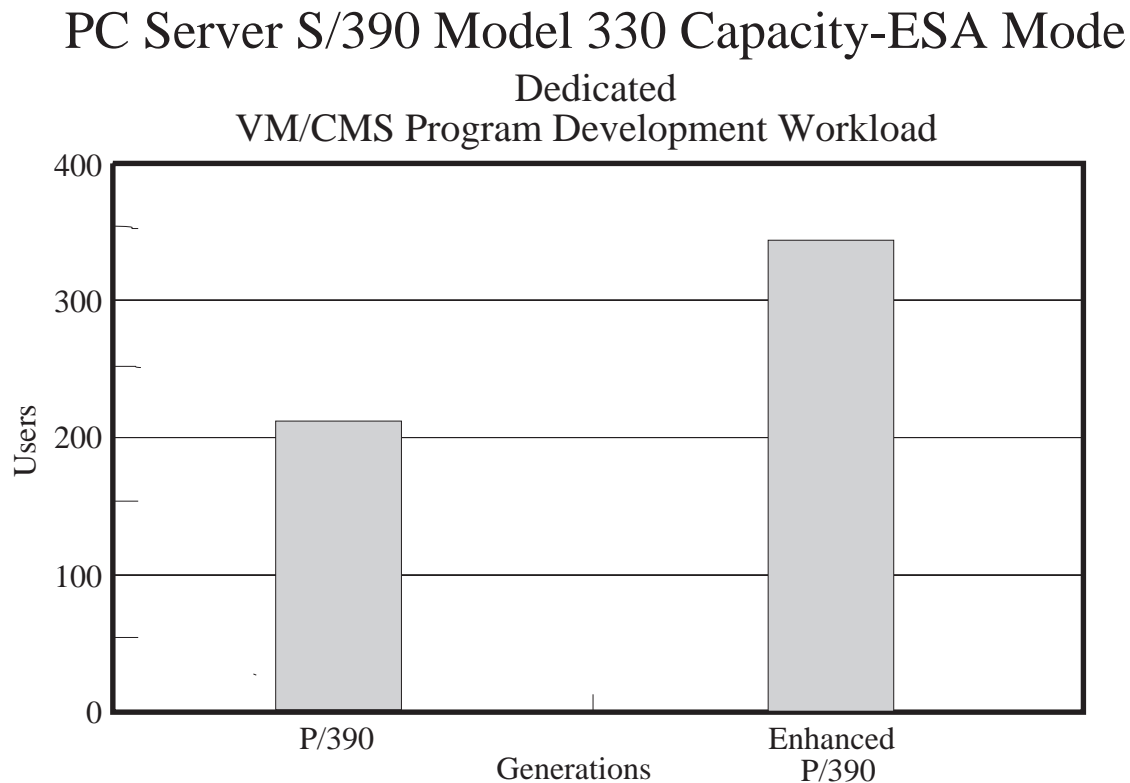


Figure 7.

Figure 7 shows a comparison between the Enhanced P/390 P/390 and the P/390 in the same PC Server 330 for a dedicated 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 1 second or less.

While the internal response times achieved by the IBM Enhanced PC Server S/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 IBM Enhanced PC Server S/390 can eliminate or reduce other time components to yield net improvement in overall response time.

The capacity of the IBM Enhanced PC Server S/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 IBM Enhanced PC Server S/390

and can cause the response time to exceed the specified limit. Although the data in the graph reflects cached I/O writes by specifying either LAZY=ON for the 2MB OS/2 HPFS cache or WRITEBACK for the cache adapter card, use of WRITEBACK with LAZY=off is recommended. 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 in Figure 7 on page 33 is based on measurements and projections for a basic IBM Enhanced PC Server S/390 containing a single (RAID5) 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.

VM Guests Performance

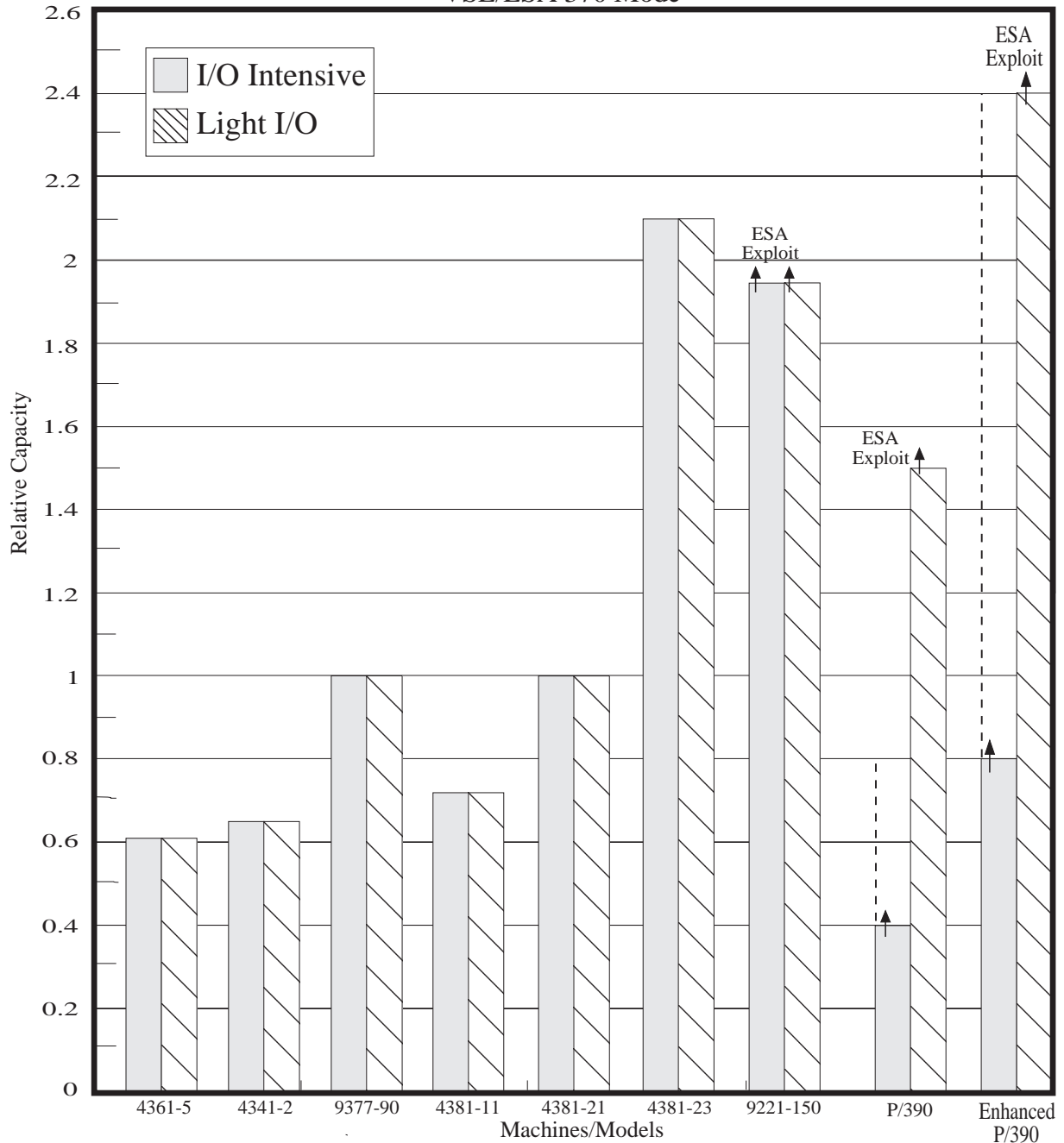
VM/ESA supports guests. When running VM guests on the IBM Enhanced PC Server S/390, be aware of the following:

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.

The licensed internal code (LIC) does not include SIE IOASSIST for the V=R guest when the VM/ESA ESA Feature is running natively on it. The absence of the assist does not change the behavior of the guest, but it effects the overall performance offered when compared with other S/390 processors. IOASSIST can also be turned off by the customer on an ES/9000 or other VM/ESA supported processors.

VSE/CICS Performance

Processor Relative Performance VSE/CICS Workloads with FBA Devices VSE/ESA 370 Mode



2MB OS/2 HPFS Cache
DASD I/O R/W Ratio=2

Figure 8.

Figure 8 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 (ETR) 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 pair of PC Server bars in the chart show that relative performance decreases when I/O rate is increased. The I/O content of the work determines the throughput rate (TCR) that can be sustained by the IBM Enhanced PC Server S/390 before I/O contention causes the response time to exceed the one second internal response time limit.

Since the initial untuned capacity of the IBM Enhanced PC Server S/390 is limited by the I/O intensity of the work being done and not by processor capacity or paging caused by adding users, I/O elimination/speedup techniques can play a role in improving throughput. I/O response times on the IBM Enhanced PC Server S/390 benefit from use of the latest hard disk technology and the flexibility of using several different methods to cache data. A cache can be specified in the IBM Enhanced PC Server S/390 memory (HPFS) or the cache on the disk controller card can be setup. When using either method, handling of write requests (write policy) becomes a performance - data integrity trade-off. Although best response time and throughput may be achieved when the cache control policy allows write completion status to be given before data is actually written to the disk storage device (cached disk WRITES), a data integrity exposure exists. The integrity exposure is reduced by allowing disk WRITES to be cached only on the disk controller card and then minimized by using an uninterruptable power source (UPS) to eliminate the power outage component of the exposure. Environments requiring maximum data integrity must not allow disk WRITES to be cached and accept the associated response time and throughput. For these environments, the relative number of READ and WRITE requests per unit of time and the effectiveness of the READ caching are key performance parameters. The data in Figure 8 on page 35 based on use of a HPFS cache and a cached disk controller each with forced-write-through policy and a READ to WRITE ratio of two.

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 only be determined for specific well understood workloads and environments, its benefit is not included in Figure 8 on page 35. The capacities shown in the IBM Enhanced PC Server S/390 set of bars applies to either 370 or ESA modes as these two modes offer comparable performance when ESA exploitation is not included. S/390 storage caches, larger OS/2 caches, and higher read-to-write ratios increase the relative performance of the IBM Enhanced PC Server S/390 processor while lower read-to-write ratios and smaller caches reduce relative performance.

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 8 on page 35. V=R guests with non-dedicated I/O (eg. 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 environments Mode=VM guest performance.

The data shown in this section is based on measurements and projections for a basic IBM Enhanced PC Server S/390 with an enhanced P/390 adapter card and containing a single (RAID5) disk array for light I/O work and a 64M PC Server with a 2MB HPFS cache for I/O intensive work. 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 Performance Reference Data

A *FLASH* is available in the PCSVR390 Package on MKTTOOLS and on HONE and IBMLINK (WSC Flash 9522, Document id G023542) with more detailed performance information, including:

- CACHE setup and tuning
- Workload detail

Although written for the IBM Enhanced PC Server S/390 in the model 500, much of this information is still pertinent.

Appendix B. Customer Examples

The following examples show how outdated systems can be replaced by IBM PC Server System/390.

Customer #1: 9375 Model 60 Replacement

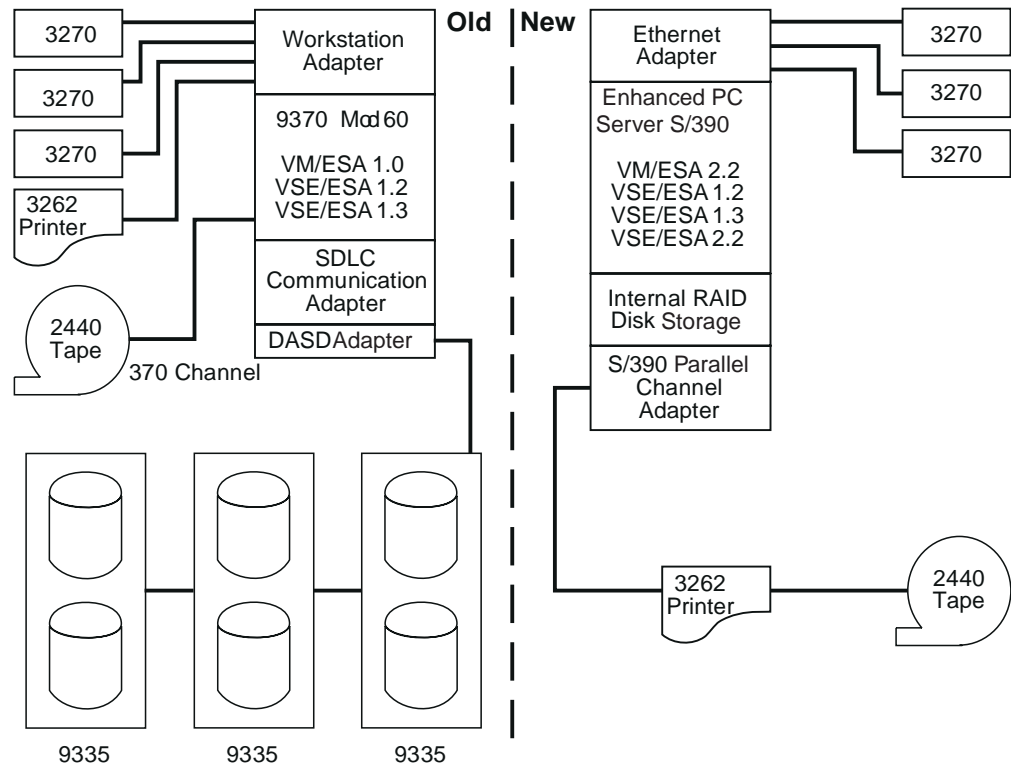


Figure 9. Example of a Replacement of a 9375 Model 60

One example is a software vendor who develops applications that run in a VSE/ESA environment. This customer replaced a 9375 Model 60 and 9335 DASD with the IBM Enhanced PC Server S/390 with internal disk storage utilizing RAID 5 technology. Multiple VSE/ESA operating systems were run as guests under VM/ESA. The customer placed the IBM Enhanced PC Server S/390 onto an Ethernet environment attaching non-SNA 3270 terminals via Personal Communications 3270 to the LAN. In addition, the customer kept the existing 3262 printer and two 2440 tape drives and attached the devices via the S/390 Parallel Channel adapter.

1. Planning

The planning session took about one and a half days. The first day was used to determine what was needed to move to the new environment and resolve connectivity issues. One half day was spent mapping their volumes to the RAID DASD to best utilize their resources.

2. Installation

Day 1: Installed and configured OS/2, CM/2, MPTS, P390 code (licensed internal code and device drives/managers) and RAID disk storage.

Day 2: Installed VM/ESA and VSE/ESA operating system. Configured DEVMAP and copied customers workload from tape to the IBM Enhanced PC Server S/390. The customer was in production on Day 2.

3. Benefits

ESA capability

Power consumption reduction

Performance improvements

Maintenance cost reduction

Space reduction

Dual environments—OS/2 and S/390

No conversion costs

Customer #2: 4381 Model 13 Replacement

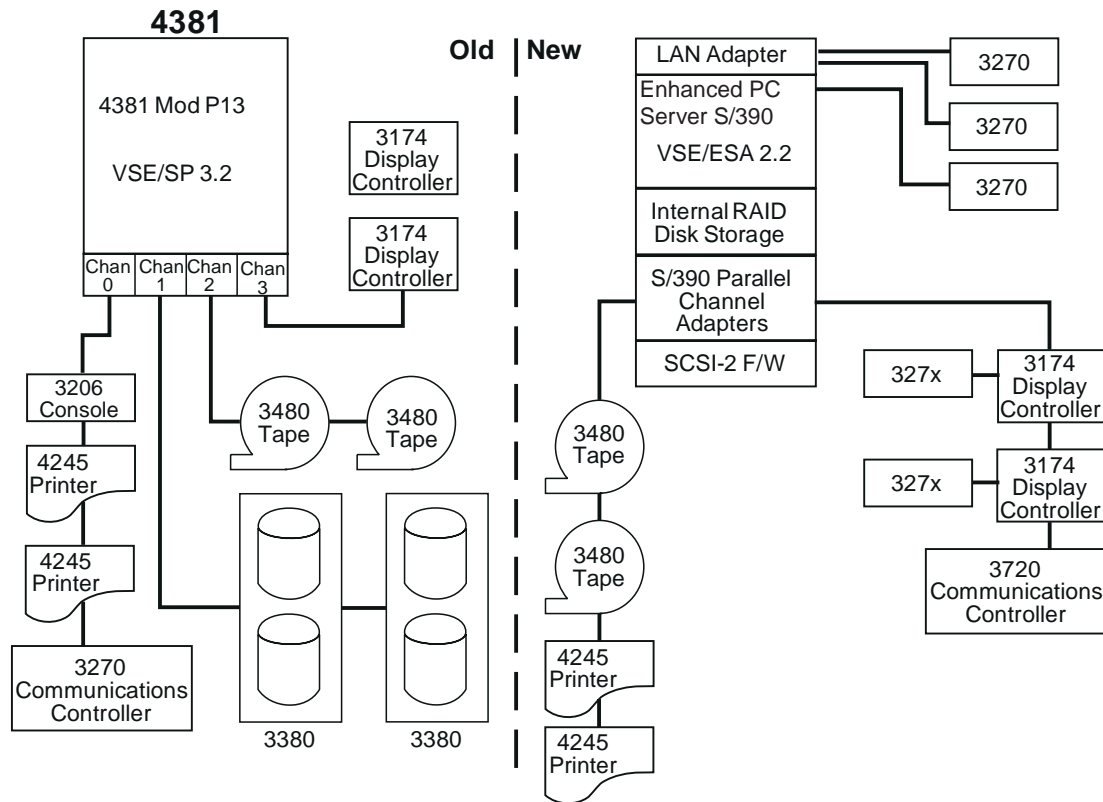


Figure 10. Example of a Replacement of a 4381 Model 13

Another example is a large manufacturing/distribution center who replaced a 4381 Model P13 and its 3380 DASD with a IBM Enhanced PC Server S/390 and RAID 5 DASD. The customer is a VSE/CICS user with many batch applications. The IBM Enhanced PC Server S/390 is connected to the existing printers, tapes, communication and display controllers supporting over 100 users.

1. Planning

The planning session took about two days. The first day was used to determine what was needed to move to the new environment and resolve connectivity issues. Another day was spent mapping their volumes to the RAID DASD to configure their new system.²

2. Installation

Day 1: Installed and configured OS/2, CM/2, MPTS, P/390 code (licensed internal code and device drives/managers) and RAID disk storage.

Day 2: Installed VSE/ESA operating system. Configured DEVMAP and copied customers workload from tape to the IBM Enhanced PC Server S/390.

3. Benefits

² The scenario depicted here is a real customer migration and does not represent optimal migration for all customers. Customers and authorized Business Partner must develop appropriate migration path for their workload.

ESA capability
Power consumption reduction
Performance improvements
Maintenance cost reduction
Space reduction
Dual environments—OS/2 and S/390
No conversion costs

Appendix C. Payback

Figure 11. Payback

Budget Items	Current Monthly Budget	PC Server System/390 3 Year Cost
Environmentals		
– Power	_____	_____ \$.10/kw in US
– Cooling	_____	_____ 0 n/a
– Floor Space	_____	_____ 0 small!
Maintenance		
– DASD	_____	_____ 0 internal
– Processor	_____	_____ 0 3 year warranty
S/390 Software	_____ MLC	_____ OTC
Hardware Cost	_____ 0 paid	_____ PC Server 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 IBM Enhanced PC Server S/390, add those to your current monthly costs, before doing the following calculation.

Return on Investment

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

Appendix D. Ordering Information

To Order

Call your authorized Business Partner to obtain configuration and pricing information and to place an order. The authorized Business Partners are the exclusive channel for these offerings.

Figure 12. Order Checklist

Component	8640-PB0
Monitor	
Additional PC memory	
	32, 64, 128, 256MB increments
Enhanced P/390 Card	
	Enhanced P/390 adapter with 256MB of ECC S/390 memory
Additional internal disk drives	
	3 to 6 internal disk drives (At least 5 drives recommended for performance.)
External DASD enclosures/disk drives	
S/390 Parallel Channel adapter	
LAN adapter card	
	TR, Ethernet, other
Adapters	
	WAC, Multiport Model 2 adapter
UPS	
Printers	
SCSI Tape Drives	
OS/2 software	
S/390 software	

Appendix E. For More Information

For more information contact:

Your authorized Business Partner

PC500390 CFORUM on IBMPC

IBM Enhanced PC Server S/390 Competency Center

- PCSVR390 on RHQVM15
- E-mail: PCSVR390@vnet.ibm.com
- World Wide Web: <http://www.s390.ibm.com/products/p390/p390hp.html>
- FTP: <ftp://p390.ibm.com/doc>

Related Publications

If you need further details on operations and configurations of the IBM Enhanced PC Server S/390, you can order the following document:

IBM PC Server System/390 User's Guide and Reference, SA22-7249.

Communicating Your Comments to IBM

IBM PC Server System/390 Model 330
Technical Application Brief
Version 6

Publication No. GK20-2763-05

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