

IBM S/390® Integrated Server 3006



Technical Application Brief

Model B01

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Preface

The purpose of this document is to help you determine whether the IBM S/390 Integrated Server Model B01 (short title, IBM S/390 Integrated Server) is right for your enterprise. This document specifically addresses the IBM S/390 Integrated Server with the "Enhanced S/390 Microprocessor," which was reviewed in May 1998. A brief description tells how the IBM S/390 Integrated Server can be used in various environments. After understanding its capabilities, you will have an opportunity to determine if the IBM S/390 Integrated Server 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 S/390 Integrated Server. Upon completion, there are recommended actions.

Chapter 1. Description

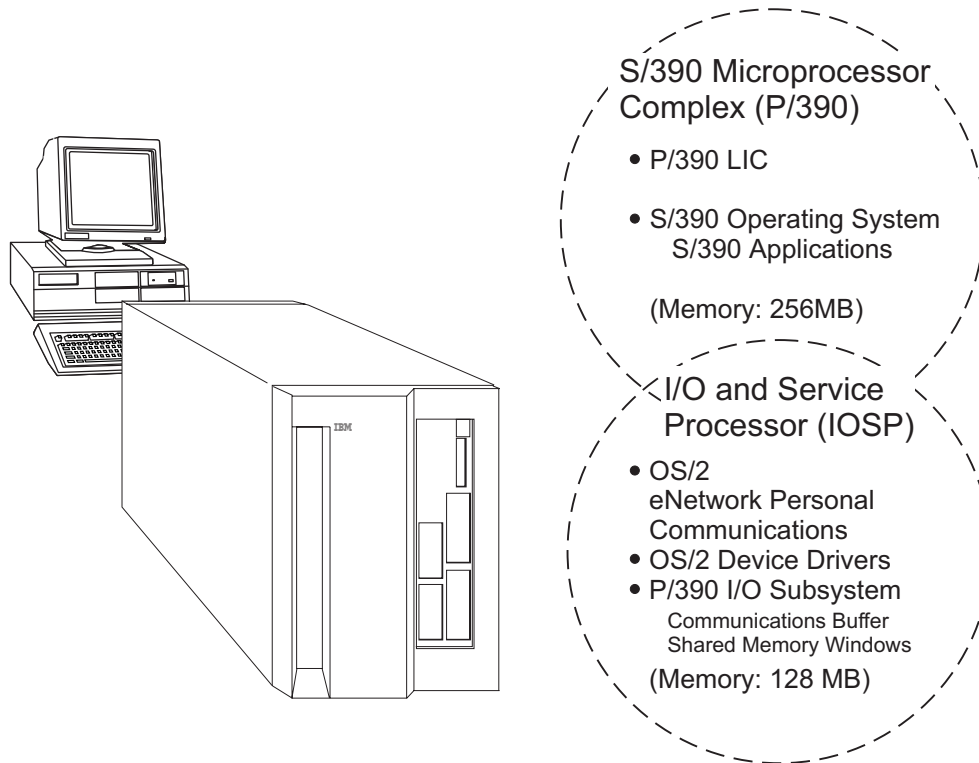


Figure 1. S/390 Integrated Server

Continuing the drive to provide flexibility and cost-effective computing with the latest technology to meet your requirements, IBM has announced the **System/390 Integrated Server Model B01**.

The IBM S/390 Integrated Server Model B01 is a S/390 processor capable of taking advantage of the full range of the ESA architecture. It is capable of attaching to ESCON or Parallel S/390 devices natively through adapters or it can emulate S/390 devices including DASD, tape, communication and display controllers.

The IBM S/390 Integrated Server includes the Enhanced P/390 adapter (generally referred to in this document as the P/390) which provides a CMOS processor and 256MB of S/390 memory which provides S/390 functionality. All supported OS/390, VM, and VSE operating systems as well as S/390 applications run on the IBM S/390 Integrated Server. The IBM S/390 Integrated Server makes use of an I/O and Service Processor (IOSP) providing an environment for running device managers and emulating S/390 I/O.

In 1999, IBM will announce and deliver a processor with 2X performance of the processor shipped in 1998. For those customers who are considering upgrading to that capability in 1999, the software price will be at the then prevailing terms.

Note: All statements regarding IBM's future direction or intent are subject to change and/or withdrawal without notice and represent goals and objectives only.

The IBM S/390 Integrated Server Model B01 offers a wide variety of possibilities and creative uses for your business needs. Here are examples of these possibilities:

- **Application Development**

IBM S/390 Integrated Server 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 provides immediate access to the real S/390 architecture for testing and debugging applications. Developers can use S/390 3GL and 4GL tools and object-oriented technology to shorten the development cycle for S/390 environments. When the IBM S/390 Integrated Server 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 System/390 Integrated Server is an ideal platform for identifying and developing necessary changes without impacting the host system. The time-of-day (TOD) on the IBM System/390 Integrated Server 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 System/390 Integrated Server for developing and porting their customer's applications to the OS/390 environment. The IBM S/390 Integrated Server makes it easy for customers and solution providers to develop, test, and maintain applications. The IBM System/390 Integrated Server 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 System/390 Integrated Server is fully year 2000 compliant and can be used as an independent and flexible year 2000 test system. When it is used in accordance with its associated documentation, the IBM System/390 Integrated Server 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 System/390 Integrated Server 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 System/390 Integrated Server 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 IBM S/390 Integrated Server.

Many customers in this group continue to run S/370, XA, or older ESA software. By replacing S/370 systems with the IBM System/390 Integrated Server, 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 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 S/390 application

These application servers are ideal for a department or small business, because they can run 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 System/390 Integrated Server 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 S/390 file or print server, it can serve clients with print services or data access, 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 System/390 Integrated Server 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 System/390 Integrated Server 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 S/390 Integrated Server is made up of two key processing components. An Enhanced S/390 Microprocessor complex (P/390) 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 S/390 Integrated Server. The second component is an I/O and Service Processor (IOSP) utilizing a high-performance Pentium II processor. This IOSP provides an execution environment for the programs which provide the S/390 I/O emulation. (Throughout most of this publication, the Enhanced S/390 Microprocessor is referred to as simply the P/390).

Hardware

Here are some of the highlights of the IBM S/390 Integrated Server:

- Enhanced S/390 Microprocessor (P/390)
 - Enhanced S/390 Microprocessor with 256MB ECC standard S/390 memory
 - Can use IOSP memory to emulate S/390 expanded storage.
- I/O and Service Processor (IOSP) with an on board high performance Intel Pentium II processor –L1 cache is 32KB and L2 cache is 512KB, memory of 128MB.
- Internal Serial Storage Architecture (SSA) RAID-5 DASD controller
- Sixteen hot-swap DASD bays
- Expansion slots: Sixteen 32 bit Peripheral Component Interconnect (PCI) I/O slots and three Industry Standard (ISA) slots
- AGP On-Board Video with 2MB memory
- Integrated 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
- CD-ROM drive
- 4mm DDS/3 digital audio tape (DAT).
- Flexible disk configuration
- N+1 Power Redundancy

Software

Each IBM S/390 Integrated Server requires:

- IBM OS/2 Warp Server
- IBM eNetwork Personal Communications for OS/2

Note: The above two need not be ordered separately as they are pre-configured with the P/390 support.

- 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 S/390 Integrated Server.

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.

Internet access will be required for service and support, therefore an additional LAN adapter card or modem will be necessary. The internet connection itself can be provided by an Internet Service Provider (ISP).

Environmentals

Physical Box Specifications

- Width: 533mm (20.5 in.)
- Depth: 1038mm (40.0 in.)
- Height: 819mm (31.5 in.)
- Weight: 155kg maximum, 100 kg base (340 lb. max, 220 lb base)

Note: At 340 pounds, the system unit is fully configured with 16 DASD, integrated battery backup, CD-ROM, floppy drive, N+1 power, DAT tape drive, and all PCI slots filled.

Operating Environment

- Temperature: 10 to 40C (50 to 104 F)
- Relative Humidity: 8% to 80%
- Wet Bulb: 27C (80.6 F) (Class C)
- Electrical Power: 1.32 kVA

Chapter 3. Performance Overview

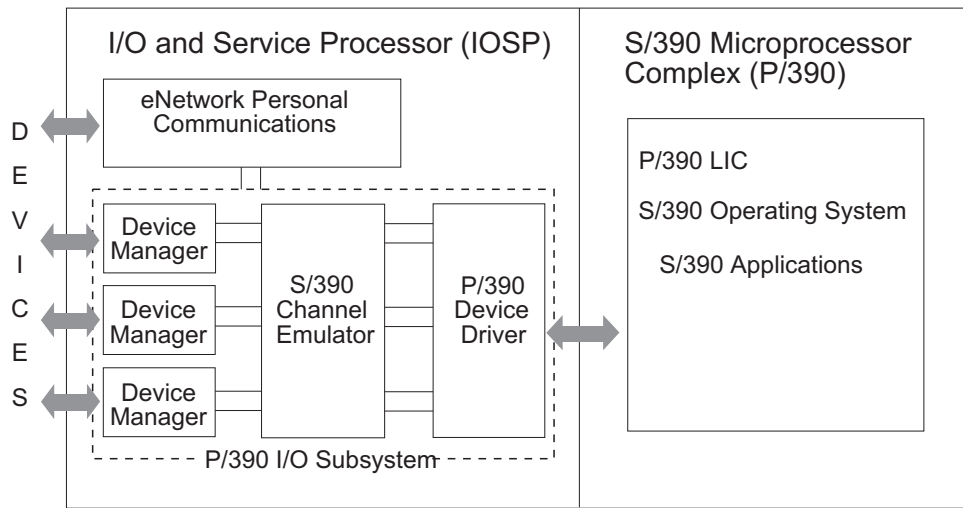


Figure 2. System/390 I/O handled by I/O and Service Processor (IOSP) Device Managers/Drivers

The IBM S/390 Integrated Server is a combination of a System/390 processor and an I/O and Service Processor (IOSP). While the S/390 instructions execute natively on a dedicated CMOS chip on the P/390, as shown in Figure 2, the execution of the S/390's I/O is handled by I/O and Service Processor (IOSP) device managers, device drivers and S/390 channel emulation. The S/390 design in the IBM S/390 Integrated Server 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 S/390 Serial Channel adapter) or emulated utilizing I/O and Service Processor (IOSP) devices in a manner that is transparent to the S/390. DASD devices can be attached via the S/390 Serial Channel Adapter or emulated using 18GB HDDs in a manner that is transparent to the S/390 operating system or application.

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 S/390 Integrated Server does not support multiple paths to the same physical device. This is a capability that is exploited in other S/390 systems.

Use of the IBM S/390 Integrated Server for your business requires workload planning to achieve favorable results.

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 S/390 Integrated Server is feasible.

Chapter 4. System Availability

The IBM S/390 Integrated Server offers improved system reliability when compared to an average 43x1, 937x, or 922x. When compared to the older machine's system configuration, including attached DASD and DASD controllers, the S/390 Integrated Server 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 S/390 Integrated Server has up to 255GB of usable DASD internal to the system. The sixteen internal hot-swappable hard disk drives in a RAID 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 S/390 Integrated Server is designed for superior system availability.

RAID

The IBM S/390 Integrated Server model supports a RAID 5 configuration. 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. RAID 5 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.

Power Management

To improve the system availability, an optional Internal Battery Feature (IBF) is available. The IBF protects the system from utility outages, which may be prevalent in certain geographic regions. By providing the IBF, 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 S/390 applications.

The power subsystem is designed with N+1 redundancy. Failure of a power thermal component does not cause a system outage. This allows for concurrent replacement of a failed power subsystem component. The power system offers dual primary (AC) power feeds. Each feed is electrically isolated to enable redundant power paths.

Additional Availability Features

The IBM S/390 Integrated Server 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 S/390 Integrated Server. 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 S/390 Integrated Server. 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/370 Mode S/390 Mode
-----	-----	-----	-----	-----
_____	_____	_____	_____	_____

2. Type of DASD installed or connected:

Type	Quantity	GB
-----	-----	-----
0671 3310 3370 9332 9335 9336 (FBA)	_____	_____
3330 3350 3375 3380 3390 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/390

4. Type of workload are you planning on running?

Planned: CMS CICS DB2 IMS BATCH TSO

For workload performance information:

MVS/TSO ==> See "MVS and OS/390 Performance" on page 29
 VM/CMS ==> See "VM/CMS Performance" on page 32
 VSE/CICS ==> See "VSE/CICS Performance" on page 34

For approximate performance of other workloads, refer to:

MVS/DB2 ==> DB2 Performance (See "Other Workloads" on page 30)
 MVS/IMS ==> IMS Performance (See "Other Workloads" on page 30)
 MVS/CICS ==> VSE/CICS Light I/O (See "VSE/CICS Performance" on page 34)

5. Performance

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

- 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
	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
DASD:			DASD Performance (Disk IO/sec)	CKD/FBA
	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
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 802.3	_____	_____	_____
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 S/390 Integrated Server 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 18GB disk drives.
 - a. Up to 255GB (See "DASD/Disk Storage" on page 23.)
 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 and OS/390 Performance" on page 29.)
 - 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 32.)
 - 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 34.)
 - 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 26.)

7. If you plan to replace an machine, what are you replacing (assumption: light I/O, see "VSE/CICS Performance" on page 34.)?
 - 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, 9221-170, 9121-180 or larger capacity models which are under-utilized
(See Appendix B, "Customer Examples" on page 37)
 - c. A 4381-24, 9221-170, 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 S/390 Integrated Server?
 - 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 25.)
 - 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 IBM S/390 Integrated Server 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 S/390 Integrated Server. 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 S/390 Integrated Servers. Use the appropriate contact in Appendix E, "For More Information" on page 45.

If you answered (d) to any of the above questions, the IBM S/390 Integrated Server 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 S/390 Integrated Server. Following the matrix are recommendations and guidelines to assist you.

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

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 and ESCON Channel adapter ¹²	SCSI Adapter	Other	via OS/2 file (Hard disk, CD-ROM, Diskette, LAN) ¹	via PC Ports (LAN, Parallel Port, Serial Port)
Max: 4/system					
DASD:					
FBA: 0671, 3310, 3370, 9332, 9335, 9336 CKD/ECKD: 3330, 3350, 9345, 3375, 3380, 3390	Note ¹²	N/S	N/A	Read/Write	N/A
TAPES:					
3420	Yes	- 4 mm DAT cartridge ^{4,13}	N/A	Read/Write ^{2,4}	N/S
3422	Yes	N/S	N/A	Read/Write	N/S
OPTICAL MEDIA ATTACH/2 (3422)	Yes	N/A	N/A	Read Only ¹⁰	N/S
3480	Yes	- SCSI cartridge ⁷ - 4mm DAT cartridge ¹³	N/A	N/S	N/S
3490, 3490E	Yes	SCSI cartridge ⁷	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 ³	N/S	N/S
3287	Yes	N/A	N/A	N/S	N/S
3800*, 3900	Yes	N/A	N/A	N/S	N/S
COMMUNICATION CONTROLLERS:					
2703*	Yes	N/A	N/A	N/A	N/A

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

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 and ESCON Channel adapter ¹²	SCSI Adapter	Other	via OS/2 file (Hard disk, CD-ROM, Diskette, LAN) ¹	via PC Ports (LAN, Parallel Port, Serial Port)
	Max: 4/system				
XCA (OS/390, MVS VM, VSE)	N/A	N/A	N/A	N/A	WAC or Multiport Model 2 adapter (SDLC) ⁸
ICA (VM,VSE)	N/A	N/A	N/A	N/A	WAC and Bisync (SDLC) ⁸
3720*, 3745	Yes ⁹	N/A	N/A	N/A	N/A
DISPLAY CONTROLLERS:					
3174	Yes	N/A	- LAN Adapter ⁶ - SDLC	N/A	LAN Adapter
3274,5088,6098	N/S	N/S	N/S	N/S	N/S
INTERCONNECT CONTROLLER:					
3172	Yes	N/A	N/A	N/A	LAN Adapter ⁵
2540 CARD READER	Yes	N/A	N/A	Yes	N/S
3088	Yes ¹¹ .	N/A	N/S	N/A	N/A

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

TODAY'S CONFIGURATION	ALTERNATIVES				
	N/A=Not Applicable			N/S= Not Supported	
	Direct Attach via Adapter Cards			Emulated	
	S/390 Parallel and ESCON Channel adapter ¹²	SCSI Adapter	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: 4/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.

³Available through COAX attach using 3174-95R/91R which also requires a Multiport Model 2 adapter or a Wide Area Connector (WAC) adapter.

⁴See limitation on Read Backwards in associated Doc file.

⁵Any adapter that is supported by MPTS 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 S/390 Integrated Server environment. This emulation can be used for connecting IBM S/390 Integrated Server systems on the same LAN.

⁶The 3174-63R is the LAN attached model and the 3174-95R is the SDLC/bisynchronous model.

⁷The only supported SCSI-attached 3490 tape drive is the IBM 3490-F01. This drive must be attached to a differential SCSI adapter (for example, Adaptec AHA2944UW) *not* the I/O and Service Processor (IOSP) integrated SCSI port. Contact your IBM authorized Business Partner for more information.

⁸There is a limit of 15 active channel programs. If polling is a concern, consider using a boundary node converter.

⁹There is a limit of 16 active channel programs for each S/390 Parallel or ESCON Channel Adapter.

¹⁰The OMA driver is also useful for giving S/390 applications direct access to PC or LAN files.

¹¹The S/390 ESCON Channel Adapter can communicate with a S/390 host providing it's ESCON Adapter is defined as a CTC. The S/390 ESCON Channel Adapter itself, however, cannot be configured as a CTC.

¹²If the device has an ESCON interface then it is supported with the ESCON Channel adapter. No DASD at all are supported with the Parallel Channel adapter.

¹³The 4mm Dat Tape drive is only provided for loading software and service. It is not recommended to be used for backup procedures.

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

Recommendations and Guidelines

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

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

Overall System

A maximum of 255 devices can be defined on the IBM S/390 Integrated Server 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 or S/390 Serial Channel adapter card at one time is supported.

Up to four S/390 Channel Adapter cards are supported with the IBM S/390 Integrated Server Model B01 of which a maximum of two can be ESCON.

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 S/390 Integrated Server. The IBM S/390 Integrated Server supports a maximum of four Parallel adapters in any combination.

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 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 only supported on ESCON Serial Channel adapters.
- 3274, 5088, 3725, and 6098 controllers are not supported
- A maximum of four 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.
 - Multi-path is not supported (two channels to the same device controller).
- **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 S/390 Integrated Server supports up to four 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 S/390 Integrated Server 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.

S/390 ESCON Channel Adapter

- **General statement**

The S/390 ESCON Channel Adapter provides channel-attach capability of all ESCON Channel attached devices to the IBM S/390 Integrated Server. The IBM S/390 Integrated Server supports a maximum of two Serial Channel adapters in any combination.

The primary purpose for attaching ESCON devices to the S/390 Integrated Server is for connectivity. The performance of integrated I/O devices will probably be better, in most cases, than ESCON-attached devices. Because of the PCI bus structure in the IOSP, S/390 Integrated Server ESCON performance will not match that of traditional mainframe ESCON channels.

Some typical attachments are:

- DASD controllers, such as the IBM 3990 and 3880's.
 - Line printers, such as the IBM 3900
 - Tape drives such as the IBM 3480, and 3490
 - Communication controllers, such as the IBM 3745 unit
 - SNA display controllers such as the 3174
 - ESCON director
- **S/390 DASD Attachment**

Direct channel connection of the IBM S/390 Integrated Server to S/390 ESCON DASD devices is supported. The S/390 Serial Channel Adapter must be used for this function.
 - **Restrictions when using the S/390 ESCON 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 only supported on ESCON Serial Channel adapters.
 - A maximum of two ESCON adapters is supported.
 - Only ESCON channel functions are supported. ESCON to Parallel converter and CTC function is not supported, however a S/390 Serial Channel adapter can connect to another S/390 system where the CTC “load” is in that system's channel.
 - Multi-path is not supported (two channels to same device controller).

DASD/Disk Storage

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

In some cases, migration of existing S/370 or S/390 DASD to the S/390 Integrated Server's internal emulated DASD is favorable. Standard Dump/Restore programs should be used to accomplish this.

If the source DASD is ESCON attached to the IBM S/390 Integrated Server then a program such as DFDSS can be used to copy the data from the ESCON attached DASD to the emulated DASD on the IBM S/390 Integrated Server without the intermediate step of dumping the DASD volume to tape.

If the source DASD has a parallel attachment to another S/370 or S/390 system, then the DASD must be first dumped to tape, then restored to the emulated DASD on the IBM S/390 Integrated Server using standard dump/restore programs.

- **DASD Capacities**

The IBM S/390 Integrated Server has sixteen internal Hot/Swap drive bays, each of which can accommodate an 18GB disk drive. The normal configuration will include up to sixteen 18GB disk drives providing approximately 255GB 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 S/390 Integrated Server. Using less than five active drives may seriously limit the disk I/O performance of the system.

Additionally, you may be able to split your workload across multiple IBM S/390 Integrated Servers. Analysis is needed to determine if workloads and data can be logically divided between an existing system and the IBM S/390 Integrated

Server or between two IBM S/390 Integrated Servers. The main reason for splitting workload is to achieve better performance when accessing data.

Disk I/O Performance and Caching

The disk I/O rate (measured in S/390 I/O operations per second) which the IBM S/390 Integrated Server 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.

The IBM S/390 Integrated Server environment throughput can be improved through I/O caching. Caching writes in either of the methods described below may improve the ability to drive higher I/O rates through the IBM S/390 Integrated Server 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 IBF. See "Power Management" on page 9.

Software caching using the IOSP 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 an IBF), an OS/2 failure that cannot be recovered with a soft boot, or some hardware caused 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. IOSP 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. This is available only on the VM/ESA and OS/390 operating systems. If your VSE/ESA operating system is executing natively, third party software (Opti-Cache) from Barnard Software Inc. is available to provide the advantages of S/390 expanded storage.

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

System Memory Size

There are two types of system memory, S/390 memory and the I/O and Service Processor (IOSP) memory.

1. The P/390 has 256MB of ECC memory for use by the S/390 operating system and S/390 applications. This should be sufficient for any VM/ESA, VSE/ESA, and most OS/390 systems. Memory-intensive systems should consider using I/O and Service Processor (IOSP) memory (also referred to as PC memory) to emulate S/390 Expanded Storage (described below).
2. The P/390 code includes the emulation of S/390 Expanded Storage by using the I/O and Service Processor (IOSP) memory. The I/O and Service Processor (IOSP) memory consists of 128MB. This 128MB is standard and is the only supported configuration.

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.

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. Standard IBM 3420, 3480, or 3490 tape drives can be channel attached via the S/390 Parallel Channel adapter or S/390 ESCON adapter. There is also a 3490E tape drive that may be SCSI-attached using a differential SCSI 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

- **Restrictions**

- The 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.
- The only supported SCSI-attached 3490 tape drive is the IBM 3490-F01. (The use of the Adaptec AHA2944UW differential SCSI controller is required for these drives.)
- The 4mm DAT tape drive is only provided for loading software and service. It is not recommended to be used for backup procedures.

Host Mainframe Access

- **ICA**

Using ICA emulation, the IBM S/390 Integrated Server can be VTAM peer-connected to a host system using SDLC to share host applications. An ISA Wide Area Connector (WAC) is required in the IBM S/390 Integrated Server and up to six ICA lines are supported.

- **XCA**

Using XCA emulation, communication lines appear to VTAM as Lan adapters. Current versions of VTAM on VM/ESA, VSE/ESA, and OS/390 ESA support XCA. A Multiport Model 2 or ISA Wide Area Connector (WAC) is required in the IBM S/390 Integrated Server and up to sixteen XCA lines are supported.

- **LAN3172/LCS3172**

Using a local and remote LAN attachment with LAN3172 emulation, the IBM S/390 Integrated Server 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 S/390 Integrated Server 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.

- **ESCON Serial Channel adapter**

Only ESCON channel functions are supported. ESCON to Parallel converter and CTC function is not supported, however a S/390 Serial Channel adapter can connect to another S/390 system where the CTC "load" is in that system's channel.

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 or S/390 Serial Channel adapter
- Emulated XCA devices by using an ISA WAC or Multiport Model 2 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 (ISA 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 six 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, S/390 ESCON adapter or LAN attached 3174-63R is to be able to utilize existing coax terminals and printers. The easier method is to use the IBM S/390 Integrated Server's 3172 emulation through VTAM or TCP/IP to any LAN-attached workstation.

S/390 Functions

The IBM S/390 Integrated Server 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, Branch-and-set-Authority Facility, Immediate-and-relative-instruction facility, Perform-Locked-Operation Facility, Checksum facility and Compare-and-move-extended facility.

Unsupported S/390 functions are: 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 S/390 Integrated Server. VTAM 3.4.1 is the first version to support 3172s.

Appendix A. Performance

The following sections describe the performance that can be achieved with several S/390 workloads. Since performance of the IBM S/390 Integrated Server depends on the type of work being run on the machine, you should focus on the performance for a workload that is most representative of your actual work. The information supplied in the following paragraphs will assist you in determining the performance you can expect.

MVS and OS/390 Performance

TSO Performance

The TSO workload can be considered a storage intensive workload and with the 256MB of “on-board” storage for the P/390 adapter up to 90 users can be supported.

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 S/390 Integrated Server 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 S/390 Integrated Server can eliminate or reduce other time components to yield net improvement in overall response time.

As mentioned previously, the capacity of the IBM S/390 Integrated Server is determined by the type of work being run. One of the key characteristics of “work” is I/O content. While the TSO workload described here contains a relatively light I/O content when adequate amounts of storage per user are present, paging I/O can become significant when the number of users is increased beyond a certain threshold. When paging I/O becomes significant, total I/O can exceed the I/O capability of the machine and response times will increase. The supported number of users is determined by the number of users at which either excessive paging occurs or the processor becomes saturated. However, with 256MB's of storage for the P/390 processor, the processor will generally become saturated before excessive paging occurs.

The maximum number of users supported for a 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 S/390 Integrated Server with 256MB of S/390 storage, 128MB of I/O and Service Processor (IOSP) storage, a single SSA RAID5 array configured across 7 devices respectively, and 1 SSA loop. A 2MB HPFS read cache (LAZY=OFF) was also specified. 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 Workloads

The performance data shown in Figure 5 provides guidance to help you determine if your dedicated MVS production on-line workloads will fit on the IBM S/390 Integrated Server. 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 S/390 Integrated Server in your business.

The data shown in this section is based on measurements and projections for a IBM S/390 Integrated Server with 256MB of S/390 storage, 128MB of I/O and Service Processor (IOSP) storage, a single SSA RAID5 array configured across 7 devices, and 1 SSA loop. A 2MB HPFS read cache (LAZY=OFF) was also specified. The RAID5 array contained 14 emulated 3380 (various densities) equivalents loaded with the workload components. All workloads have LAZY set to OFF for the HPFS cache. 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 5. Other Workloads

Workload Type	Users/ Terminals	Think Time (seconds)	Response Time (seconds)	I/O per Second
IMS/DL1	260	11	1	110
IMS/DB2	65	4	1	110
CICS	295	12	1	90

While the internal response times achieved by the IBM S/390 Integrated Server 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. However, there are many instances, particularly in remote applications, where use of the IBM S/390 Integrated Server 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 34)
- MVS/IMS ==> .8 x VSE/CICS Light I/O (See "VSE/CICS Performance" on page 34)

VM/CMS Performance

The IBM S/390 Integrated Server Model B01 will support up to 340 users for a 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 S/390 Integrated Server 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 S/390 Integrated Server can eliminate or reduce other time components to yield net improvement in overall response time.

Again, the capacity of the IBM S/390 Integrated Server is determined by the type of work being run. One of the key characteristics of the work is I/O content. While the VM/CMS workload described here contains a relatively light I/O content when adequate amounts of storage per user are present, paging I/O can become significant when the number of users is increased beyond a certain threshold. When paging I/O becomes significant, total I/O can exceed the I/O capability of the machine and response times will increase. The supported number of users is determined by the number of users at which either excessive paging occurs or the S/390 processor becomes saturated. However, with 256MB's of storage for the P/390 processor, the processor will generally become saturated before excessive paging occurs.

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 development workload. Larger working set sizes will generally support fewer users, and a smaller working set size will allow for a greater number of users.

The performance data is based on measurements and projections for a basic IBM S/390 Integrated Server containing a single (RAID5) disk array configured across 4 devices and 1 SSA loop. 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 S/390 Integrated Server, 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

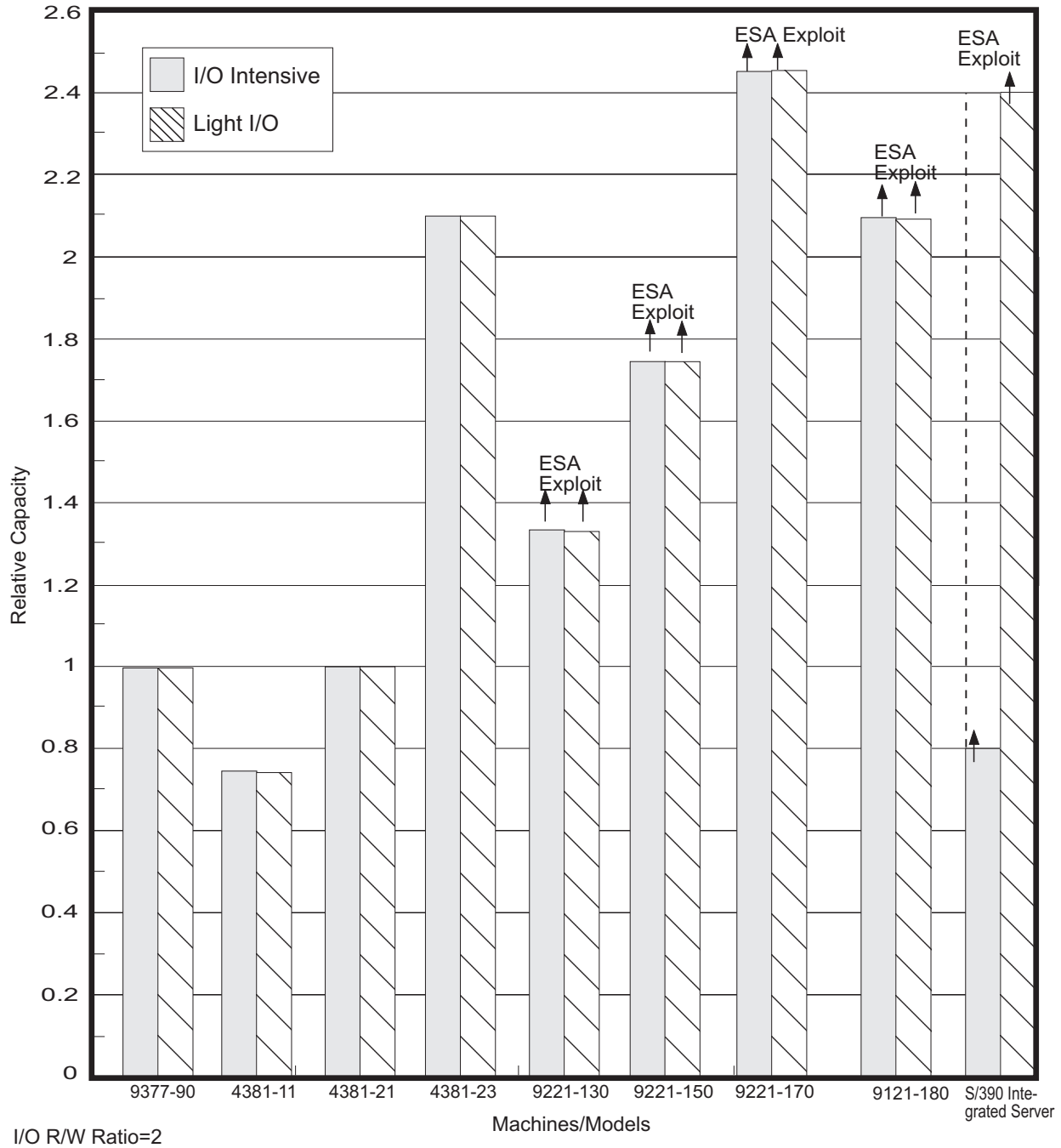


Figure 6.

Figure 6 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 Integrated 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 (ETR) that can be sustained by the IBM S/390 Integrated Server before I/O contention causes the response time to exceed the one second internal response time limit.

Since the initial un-tuned capacity of the IBM S/390 Integrated Server 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 S/390 Integrated Server benefit from use of the latest hard disk technology and by using a READ cache in S/390 storage or a HPFS cache in IOSP storage. When using HPFS, handling of write requests (write policy) may become a performance - data integrity trade-off. Although best response time and throughput may be achieved when the cache control policy allows Fast Write (write completion status to be given before data is actually written to the disk storage device), this benefit is achieved while creating an increased data integrity exposure. Environments requiring maximum data integrity must not allow disk WRITES to be cached and accept the associated response time and throughput performance. 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 6 on page 34 is based on use of a 2MB HPFS cache with forced write-through policy, a non-cached SSA disk controller, and an I/O 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 6 on page 34. The capacities shown in the IBM S/390 Integrated Server 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 and higher read-to-write ratios increase the relative performance of the IBM S/390 Integrated Server 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 6 on

page 34. 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 IBM S/390 Integrated Server with 256MB of S/390 storage, 128MB of I/O and Service Processor (IOSP) storage, one SSA RAID5 array containing the workload components, and 1 SSA loop. A 2MB HPFS read cache was (LAZY=OFF) was also specified. 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. Customer Examples

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

Customer #1: 9375 Model 60 Replacement

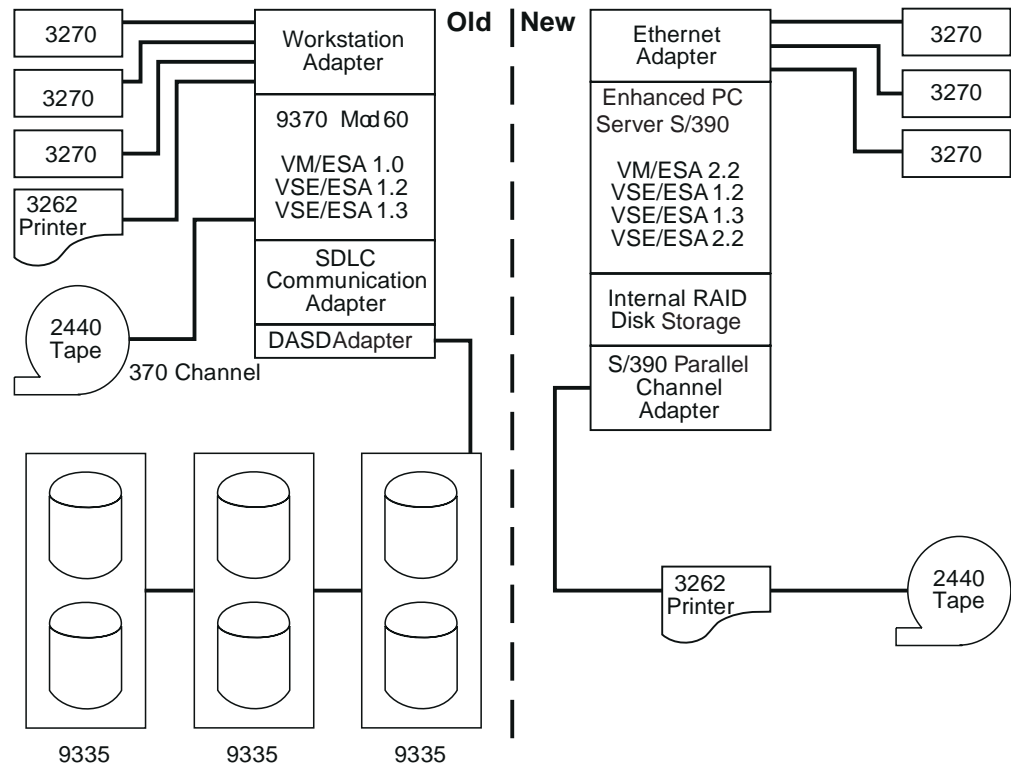


Figure 7. Example of a Replacement of a 9375 Model 60

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 S/390 Integrated Server 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 S/390 Integrated Server onto an Ethernet environment attaching users via TCT/IP 3270 sessions. 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 IOSEP, (P/390 licensed internal code and device drivers/managers) and RAID 5 disk storage.

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

3. **Benefits**

- ESA capability
- Power consumption reduction
- Performance improvements
- Maintenance cost reduction
- Space reduction
- No conversion costs

Customer #2: 4381 Model 13 Replacement

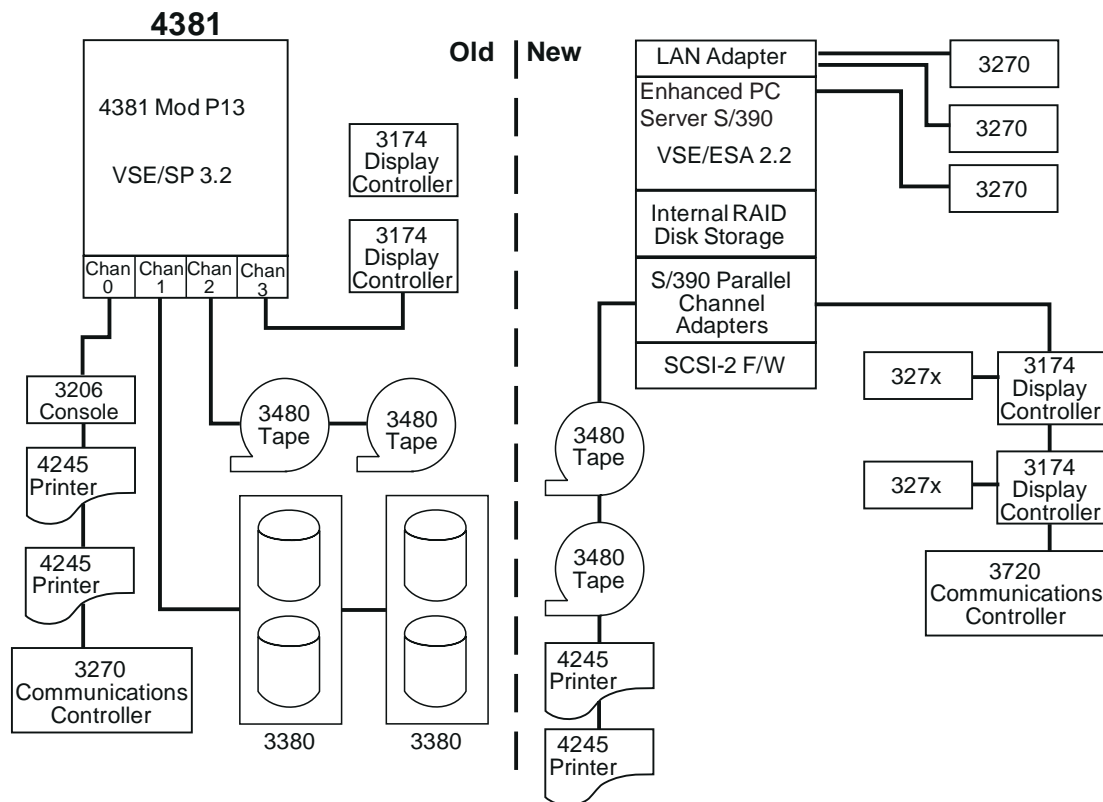


Figure 8. Example of a Replacement of a 4381 Model 13

Another example is a large manufacturing/distribution center who replaced a 4381 Model P13 and its 3380 DASD with a IBM S/390 Integrated Server and RAID 5 DASD. The customer is a VSE/CICS user with many batch applications. The IBM S/390 Integrated Server 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 IOSP, (P/390 licensed internal code and device drives/managers) and RAID 5 disk storage.
- Day 2: Installed VSE/ESA operating system. Configured DEVMAP and copied customers workload from tape to the IBM S/390 Integrated Server.

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
- No conversion costs

Appendix C. Payback

Figure 9. Payback

Budget Items	Current Monthly Budget	S/390 Integrated Server 3 Year Cost
• Environmentals		
– Power	• _____	• _____ \$.10/kw in US
– Cooling	• _____	• _____ 0 n/a
– Floor Space	• _____	• _____ 0 small!
• Maintenance		
– DASD	• _____	• _____ 0 internal
– Processor	• _____	• _____ 0 1 yr. warranty monthly maint. (2 yrs.)
• S/390 Software	• _____ MLC	• _____ ESL (Entry System License)
• Hardware Cost	• _____ 0 paid	• _____ Integrated 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 S/390 Integrated Server, add those to your current monthly costs, before doing the following calculation.

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

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 10. Order Checklist

Component	S/390 Integrated Server Model B01
Monitor	
IOSP memory	
<ul style="list-style-type: none"> 128MB standard 	
Enhanced P/390 Card	
<ul style="list-style-type: none"> Enhanced P/390 adapter with 256MB of ECC S/390 memory 	
Additional internal disk drives	
<ul style="list-style-type: none"> 3 to 16 internal disk drives (At least 5 drives recommended for performance.) 	
S/390 Parallel Channel adapter	
S/390 Serial Channel adapter	
LAN adapter card	
<ul style="list-style-type: none"> TR, Ethernet 	
Adapters	
<ul style="list-style-type: none"> ISA WAC, Multiport Model 2 adapter, Adaptec AHA2944UW, other 	
IBF (Integrated Battery Facility)	
UPS (Uninterruptable Power Supply)	
Printers	
SCSI Tape Drives	
<ul style="list-style-type: none"> 36-track:IBM 3490-F01 	
S/390 software	

Appendix E. For More Information

For more information contact:

- Your authorized Business Partner
- S390IS CFORUM on IBMPC
- IBM S/390 Integrated Server Competency Center
 - PCSVR390 on RHQVM15
 - E-mail: PCSVR390@vnet.ibm.com
 - World Wide Web: <http://www.s390.ibm.com/is>
 - FTP: <ftp://p390.ibm.com/doc>

Related Publications

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

- *IBM S/390 Integrated Server User's Guide and Reference*, GC38-0403-00.

Readers' Comments — We'd Like to Hear from You

**IBM S/390® Integrated Server 3006
Technical Application Brief
Model B01**

Publication No. GK21-0291-00

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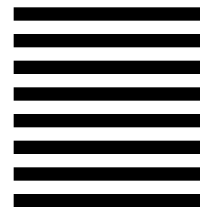
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