IBM S/390 Parallel Enterprise Servers — G5 Models, Plan-Ahead for 1999

Overview

- Capacity Upgrades on Demand, enabling non-disruptive adding of CPs or ICFs to most G5 models.
- A new feature for 1999, Concurrent Conditioning, enables the G5 server to have I/O hot plugging and non-disruptive capacity upgrades on demand.
- Recent Specweb achievements establish the G5 as the premier server for e-commerce by demonstrating the most scalable Internet access throughput on the most secure server in the industry for business transactions.
- Significant technology improvements to the world’s fastest, most powerful S/390 server — IBM’s Generation 5, and how these new capabilities complement the business of Information Technology.
- Important planning insight — how Generation 5 will evolve with the next generation of S/390 CMOS servers.
- Significant new S/390 architecture instructions
- Year 2000 updates from OS/390®, VM, and VSE.
- New S/390 Parallel Enterprise Coupling Facility model upgrade paths are being provided to assist you in upgrading from prior 9674 Coupling Facilities to the S/390 Generation 5 family. Additional granularity makes the path into the G5 family much easier. These additional G5 upgrade options enable you to take advantage of a modest performance and capacity boost from the 9674 C04 and C05 models, to S/390 Parallel Enterprise Server™ Generation 5 model R06.

- S/390’s Cryptographic Coprocessor Chip receives the highest rating level of Security from the National Institute of Standards and Technology (NIST) and the Communication Security Establishment (CSE) of Canada.

Key Prerequisites


Planned Availability Dates

New Features

- Concurrent Conditioning — February 26, 1999
- Processor Unit Optimizer — June 30, 1999
- Alternate Support Element — June 30, 1999

Upgrades from 9674 C04 & C05

- Upgrades to R06 Models — February 26, 1999

At a Glance

IBM S/390 Parallel Enterprise Servers Generation 5 new news:

- Capacity Upgrades on Demand, enabling non-disruptive CP and ICF adds to most G5 servers.
- A new Concurrent Conditioning Feature to enable planning for I/O, memory, and ICFs for non-disruptive growth.
- Proof point that the G5 is the Industry’s most scalable Web Server.
- Significant additional S/390 architecture.
- New technology updates to the S/390 Generation 5 server.
- Updates to IBM S/390’s platform support for Y2K challenges.
- Additional upgrades from 9674 Coupling Facility models C04 and C05 to the G5 model R06
- IBM’s S/390 Cryptographic Coprocessor receives FIPS 140-1 Level 4 certification.

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Unprecedented growth in areas such as e-business overlays 1999 — the year when Information Technology executives must focus on non-disruptive growth. Assistance to IBM's customers for minimal server disruption to commerce opportunities later in 1999 is addressed by today’s announcement of IBM’s Plan-Ahead process. Today's announcement also highlights the ongoing updates to S/390 Generation 5 — new functions, features, instructions and future direction by IBM’s flagship server model.

IBM is announcing Plan-Ahead and Capacity Upgrade on Demand and Concurrent Conditioning on S/390 Generation 5 servers. With this announcement, a S/390 G5 Server may be upgraded from a Uni to 10-way server non-disruptively. This capability exploits new architecture that allows one or more Processing Unit(s) (PUs) to be added non-disruptively. Therefore, the G5 server installed to meet current workload will also accommodate non-disruptive PU upgrades to meet new demands that might have otherwise fallen victim to Y2K planning concerns. Associated with this is the planning process to allow for growth of the memory and channel subsystems; the S/390 G5 server can avoid future outages due to hardware changes.

S/390’s Plan-Ahead Process: Plan-Ahead links the use of the Capacity Upgrades on Demand and the Concurrent Conditioning Feature with planning performed between IBM’s account team and IBM’s customer. IBM’s commitment to a planning partnership is underscored by today’s announcement. Planning ahead with the use of feature #1999 enables customers to accurately determine a future server configuration. IBM will also support its customers planning effort via capacity planning tools, IBM's order processing configurator and team sessions, with the objective of non-disruptive growth to satisfy essential capacity demand.

IBM is continuing its technology leadership in the area of Parallel Sysplex® clustering, in cryptography with the FIPS 140-1 certification, with Open Systems Adapter improvements, and FICON. FICON again demonstrates S/390 technology leadership of data bandwidth through the entire system. From the OSA connection, to the user, to the FICON connections, to the data, the S/390 G5 Server has end-to-end bandwidth capability.

Customer Value of Generation 5 Servers Cryptographic Coprocessor: According to a leading Business Intelligence consulting firm, the average data warehouse application will increase in size 36X over the next 3 years; windows for system and data maintenance are all but closed. Demand for constant access to intelligence data has become the norm in our global economy. As business relies more on data warehouse to drive decisions and operations, access control to the data becomes even more critical. Web-enabling data warehouses are the latest trend for the ever-increasingly mobile workforce. A secure server that protects corporate intellectual assets from tampering and unauthorized access is vital to competitiveness and economic survival. G5’s integrated cryptographic coprocessor meet the most stringent security requirements, as proven by the latest FIPS 140-1 level 4 certification.

In summary, today’s announcement provides IT business its necessary tools and options to enable secure, non-disruptive growth in an environment posing multiple unknown factors.

System 390 has recently shattered by over 50% the industry record for Specweb throughput on a single server, an incredible 21,591 hits per second using a Turbo 10-way processor G5 and OS/390 Version 2 Release 7. In the industry today, the most explosive growth has come from the movement to the Internet, providing access and most recently real commerce over the Internet. This growth is unprecedented and defies most customer’s ability to plan for this phenomena. G5, with this recent achievement, has demonstrated enough capacity to handle any customer’s needs, even with this explosive trend. Customers can rest assured that as they enable e-business including real transaction processing over the internet, that their growth can be handled non-disruptively and with no change to their business processes.

G5 Technology Excellence: Capacity Upgrades on Demand

Capacity Upgrades on Demand: Available on most G5 servers June 30, 1999, Capacity Upgrade on Demand function provides the ability to add one or more Central Processors (CPs) or shared Internal Coupling Facilities (ICFs) non-disruptively. CP(s) can be added to the G5 Server with no system power down and no associated re-IML/IPLs. Initially Capacity Upgrades on Demand will non-disruptively add processing capacity to OS/390 and VM/ESA® native configurations and shared CP PR/SM™ partitions only. With Capacity Upgrades on Demand it is possible to only add Processor Unit(s) (PUs). Removing a PU is disruptive today and will continue to be disruptive.

The Capacity Upgrades on Demand function is based on new S/390 Configuration Reporting Architecture. Configuration Reporting architecture provides detailed information on system wide changes to the number of configured CPs, system serial number, plant of manufacture, CPU address, and other information. Key to the functioning of Capacity Upgrades on Demand is a new instruction. The Store System Information (STSI) instruction provides the ability for the operating system and the application software to dynamically determine the processing capacity of the S/390 server. The powerful Store System Information instruction can provide reporting of information on the general system, on all CPs, on a single CP, System serial numbers, functional characteristics, quantity and multiprocessor related data, information on LPAR and VM guest support. Disclosure of the STSI Instruction to Independent Software Vendors (ISVs) will commence in 1H 1999.

If a second CRYPTO coprocessor is required, such as models RA6 and R16 (which utilize one CRYPTO coprocessor), an IML is necessary to enable the second CRYPTO coprocessor (if the RA6 has upgraded to a RB6 or an R16 has upgraded to a R26).

Groundrules: Capacity Upgrades on Demand will not be applicable:

- If the model is not running OS/390 Release 1 or higher, with APAR OW37091 or VM/ESA Version 2 Release 2 or higher with required APAR VM62075. **Note:** OS/390 with APAR OW27091 does not support Capacity Upgrades on Demand as a VM guest unless the VM APAR VM62075 is applied to VM.
If a model requires an engine size or cycle time change from the existing model: For example an RA6 can not upgrade to an R16, nor can an R16 upgrade to a RB6. Examples of nondisruptive, valid upgrades are: RA6 to RB6, R16 to R26, RC6 to RD6, T16 to T26, T36, R46, R56, R66, R76, R86, R96, RX6; R46 to R56, R66; R76 to R86, R86, RX6; Y16 to Y26, Y36, Y46, Y56, Y66, Y76, Y86, Y96, YX6. Refer to the Plan-Ahead Planning Guide for more paths.

If a new MCM is required: MCM boundaries are:
1. RD6 (top of the 6 PU module)
2. R66 (top of the 8 PU module); Note this exclusion can be lifted by use of feature 7990, 12 PU “super-sizer”, or feature 1998.
3. RX6 (top of 12 PU)
4. YX6 (top of G5 family)

Upgrades that cross MCM boundaries will still be available after the Capacity Upgrades on Demand function is enabled; an MCM change will continue to be disruptive.

If a second CRYPTO coprocessor is added; this applies to models RA6 and R16. An IML is necessary to enable the second CRYPTO coprocessor.

If an additional SAP must be added: This only affects the R36, R46, R56 and R66 when upgrading to a R76, R86, R96 or RX6. If a second SAP has been added prior to upgrading, the upgrade can be concurrent. Also, feature 7990 and feature 1998 allow models R36, R46, R56, and R66 to be upgraded to models R76, R86, R96 and RX6 using Capacity Upgrades on Demand.

If a logical processing unit is added to an LPAR partition: LPAR partitions must be deactivated and the partition redefined to add a logical processor. Then the partition must be reactivated and the applications re-IPL’ed without affecting other partitions.

Installations must also understand that memory and I/O must be planned in advance to avoid outages associated with installing new memory cards or disruptive-type I/O card installation. The Concurrent Conditioning Feature, #1999, mitigates disruptions caused by memory and I/O, if followed.

Activation of Capacity Upgrades on Demand function is controlled by IBM. IBM software changes that are based on the capacity of the processor(s), on which the software is installed will be adjusted to the maximum capacity of the processor(s) made available to the installation, after activation of the Capacity Upgrades on Demand function.

PR/SM™ configurations supporting multiple partitions that share a pool of CPs support concurrent CP upgrades. PR/SM code, once signalled that one or more CPs has been made available to the configuration will vary them online, automatically, into the “shared pool” of CPs, and begin full utilization of the added capacity. For example, a pool of 8 physical CPs are shared between 2 LPARs — one LPAR is defined to have 6 logical CPs and the other is defined to have 3 logical CPs (for a total of 9 logical CPs). A physical CP can be added to the active pool of 8 CPs to effectively increase the available sharable pool capacity among the partitions, to 9 CPs.

More G5 Excellence: New Features for 1999

The following features are being announced to support Capacity Upgrade on Demand.

Processor Unit Optimizer (PUO) (Feature 1998): The Processor Unit Optimizer enables a Generation 5 server with spare PUs to be upgraded nondisruptively. The PUO feature includes Licensed Internal Code (LIC) to enable:

- Capacity Upgrade on Demand
- Assignment of a second SAP if the server has feature 7990 installed

Concurrent Conditioning Feature (Feature 1999): Concurrent Conditioning, can also be thought of as the “Plan-Ahead Feature.” This feature, together with input of a future target or “TO-BE” configuration, allows G5 upgrades to exploit the “expert systems” decision tree logic of S/390’s Order Process Configurator and identify PU’s, coupling or I/O option positioning for non-disruptive upgrades at some future time. Feature 1999 may add I/O cages with a full compliment of I/O support cards (FIBB and CHA), as well as memory, ISC-M (adapter) cards, the 12 PU MCM (feature 7990) or ICFs.

The feature identifies content of the TO-BE configuration which can not be hot installed or uninstalled, therefore allowing the proper planning and appropriate installation of the features to eliminate or minimize any down time associated with feature installation besides adding CPs. IBM announced its intent May 7, 1998, to enable nondisruptive I/O removal and/or replacement, beginning second quarter 1999, a new level of Licensed Internal Code (LIC) will be available to allow Parallel, ESCON®, OSA-2, and FICON channel cards to be added or removed from the G5 without causing an outage. Installations at or near the 256 CHPID limit will find this new capability a valuable enabler to maximize their configurations.

Alternate Support Element Feature (Feature 0071): This feature enables a second Support Element (SE) to be installed in the G5 Server frame, as a backup to the primary SE. In the event of a hardware malfunction, the mirrored alternate will take over for the failing SE when a switch located on the server’s Emergency Power Off (EPO) panel is manually set. The G5 will continually verify that the alternate SE is functional during use of the primary SE, with status displayed at the primary SE. Hardware maintenance can be performed on the Primary SE (in Service Mode).

Additional New Functions for G5:

Non-disruptive I/O Removal and/or Replacement: Identified as a Statement of Direction in May 1998, new LIC available by second quarter 1999, will enable G5s to allow Parallel, ESCON, OSA-2, and FICON channel cards to be added or removed non-disruptively. Installations near the 256 CHPID limit may maximize configuration. While this enhancement is not presently extended to CHA, FIBB, or ISC adapter (mother) cards, with the proper use of feature 1999, installations may minimize disruption due to I/O addition.

Family Upgrade Preparation: I/O Configuration Definitions (IOCDS): In preparation for upgrading to a G5, IOC can write a G5 IOCDS to the G4 or earlier CMOS system with the new CHECKCPC IOC execution parameter. This function is available on MVS™, OS/390, VM and VSE versions of IOC. It eliminates the running of a stand-alone IOC during the upgrade, thereby reducing the install time. The IOCDS is unusable until the CPC has been upgraded. This parameter is unnecessary when upgrading from a G5 (except the R66) to the next generation of CMOS processor.

Use of Last Processing Unit (PU) Spare: Beginning March 31, 1999, G5 will allow use of the last spare PU.
For most models, this capability increases the quantity of ICF features or additional SAP features. CPs, ICFs and SAPs use a common PU. Ten way processors (RX6 and YX6) will continue to have no spare, ICF or additional SAPS as all PUs are used for 10 CPs and 2 standard SAPs. Models that can now have an ICF or an additional SAP that could not previously are the RD6, R96 and Y96.

**NOTE:** As of June 30, 1999, all models that can be ordered with feature 1998 and feature 7990 will be configured with 2 SAPs as standard, to assist non-disruptive upgrades from models R36, R46, R56, R66, to models R76, R86, R96, or RX6.

**Special Configuration Fast Activation (CBU Fast Activate):** For customers with a valid attachment for S/390 Emergency Backup Upgrade in place and the appropriate Capacity Backup features identified (engines are identified by features 7994, 7995 or 7996 depending on model) starting March 31, 1999, an option to electronically activate their Capacity Backup Configuration will continue to be available. **Note:** Activation of CBU by a test diskette or by a CE with a diskette from IBM Poughkeepsie Product Engineering will continue to be a valid activation option.

**Note:** Secure accounts will require an IBM service representative on site for activation of the CBU function.

**Remote Control of the G5 via the Web Server:** Occasional monitoring and control of supporting elements connected to a single G5 Hardware Management Console has been enabled by a Web Server that is now integral with current G5 Hardware Management Consoles (HMCs). A systems programmer or operator may monitor and/or control defined CPCs, CPC images, or groups from a remote site with a subset of task lists and tasks that are available on the HMC. For more information, refer to S/390 Hardware Management Console Operations Guide (GC38-0470).

**S/390 Generation 5: The Significance of End-to-End Bandwidth**

- The G5 server, with its integration of new architecture, hardware, and software, delivers the high-performance I/O channel connectivity and capacity necessary for leading edge S/390 Generation 5 installations. It is also the cornerstone of an I/O infrastructure that will soon be the new reference standard of the IT industry. Each FICON channel, for example, is designed to support more than 4000 I/O operations per second, allowing each channel to provide capacity equivalent up to 8 ESCON channels. Compared to ESCON's 17 MB/sec. simplex link capability, FICON's use of 100 MB/sec. full duplex links, substantially improves data transmission speed with native attached control units. Link distances up to 10 Km are standard, 10-20 Km via RPQ, and up to 100 Km with repeaters. To effectively utilize the data transfer capability of fiber over long distances, frame buffers have been increased to allow transmission links, with repeaters, for distances up to 100 Km without data droop. By comparison, the maximum link distance of ESCON without data droop is 9 Km. FICON's distance capability is becoming increasingly important as more customers are implementing remote I/O and vaulting for disaster recovery and Geographically Dispersed Parallel Sysplexes for availability.

- e-business, business intelligence, server consolidation, and an overall growth of databases in traditional business segment has stressed ESCON to the limits of its architecture. ESCON was introduced in 1990, and has served well for the 1990s decade. However, ESCON has become a limiting factor for leading edge data centers to manage and partition their data. By contrast, FICON implementation has extended the number of unit addresses supported on a single channel to 16 K (the ESCON limit is 1 K). Data centers will now be able to partition datasets more effectively and reduce queuing constraints as well as improve performance. Increased link speeds and I/O rates supported by FICON also facilitate more control units to be attached per link. FICON architecture will support up to 255 control unit addresses per link—a 15X increase over ESCON architecture.

While other S/390 plug-compatible vendors have the hardware capability of physically attaching greater than 256 channels, S/390’s flagship operating systems support 256 channels. The combination of 12 FICON channels on a G5 server, in conjunction with a single image of OS/390, yields an effective equivalent of up to 304 ESCON channels worth of data within 256 channel constraints. IBM’s October 20, 1998, Statement of Direction for 24 FICON channels will increase the effective equivalence up to 360 ESCON channels. Even less demanding environments, including multiple OS/390 images in LPAR mode, can utilize the same FICON efficiencies to reduce overall hardware configurations through channel consolidation.

FICON’s high I/O rate and bandwidth allows installations the option to reduce channel requirements, increase total system I/O capacity for a single operating system image, or a blend of both for optimum I/O availability, and price.

Hewitt Associates, one of FICON’s beta test customers, intends to create one geographically dispersed Parallel Sysplex across two campuses which are 3.6 miles (6 km) apart. Each facility will have one-half of the production servers, one-half of the tape resources and either the primary or remote mirror of all DASD. After installing dedicated single mode fiber between the facilities, FICON is anticipated to enable the configuration with much less fiber media, much less ESCON director capacity and overall much less cost than any earlier technologies (such as Extended Distance Facility (XDF) links and Wave Division Multiplexers).

- Networking with S/390’s Open Systems Adapter:
  - S/390 Generation 5 has been announced with five different OSA-2 connectivity options: Ethernet/Token-Ring (ENTR) FDDI, ATM 155 and Fast Ethernet.
    - OSA has been standard on CMOS servers since September 1996.
  - A Statement of Direction to announce Gigabit Ethernet (GbE) was also included in the S/390 announcement on May 7, 1998.

**Connectivity Enabler: SAP Capacity:** G5 Systems have been designed to provide enough SAP capacity for TPF and non TPF workloads. The SAP capacity of G5s will vary with workload environments and the model of G5. It is possible to have up to 3 additional SAPs for a total of 5 SAPs on some G5 models. The SAP performance on G5 is characterized in the following ways.

- In an ideal laboratory capacity benchmarking environment where there is no contention for channels, ESCON directors, control units or devices a G5 SAP has the capacity to process 37,000 start subchannels/second (ssch/sec). G5 models with 2 SAPs standard have a capacity of 74, 000 ssch/sec.
- TPF environments where requests may get queued at the channel instead of the SAP have a capacity of...
CMOS Cryptographic Feature: On January 19, 1998, IBM announced that a key product for enabling secure e-business transactions earned the highest certification for commercial security ever awarded by the U.S. government. The product, an IBM CMOS coprocessor chip, is the second of two IBM Cryptographic products to ever achieve this level of certification, known the Federal Information Processing Standard (FIPS) 140-1 Level 4. The first being the IBM 4758 PCI Cryptographic Coprocessor Card which was developed using the same design philosophy as the IBM CMOS Cryptographic Coprocessor Chip. This achievement is the proof point that S/390 is the leader in Enterprise security from both functional and throughput perspectives.

The G5’s CMOS Cryptographic Coprocessor is physically secure. The IBM CMOS Cryptographic Coprocessor Chip provides a tamper-sensing and tamper-responding environment in which to run sensitive applications. Upon detection of physical attack, including penetration, radiation, voltage, excessive cold or heat, the device is “zeroized” and the sensitive information erased.

The type of data that the IBM CMOS CRYPTO chips protect is often priceless to IBM’s customers; the highest level of security is absolutely imperative for these sensitive processes. Two Cryptographic Coprocessors are standard on most G5 models.

The coprocessor, a highly secure CMOS chip, offloads computationally-intensive cryptographic processes from the main CPU that make up the hosting server and performs sensitive tasks unsuitable for less secure general purpose computers. Each chip contains multiple hardware cryptographic engines for cryptographic operations that are driven by cryptographic APIs. The supporting software API, ICSF, is imbedded into IBM’s OS/390 Operating System, all releases. G5 has dual twin-tailed (for availability) CRYPTO Coprocessors. United States Government FIPS 140-1 standard is used to qualify cryptographic module security. FIPS certification is recognized and supported by both the U.S. National Institute of Standards and Technology (NIST) and the Canadian Communications Security Establishment (CSE).

For more information refer to: http://www.ibm.com/security

**G5 Functional Enhancements for Parallel Sysplex**

**Internal Coupling Channel (IC):** The G5 Server introduces support for the Internal Coupling channel (IC), which is a micro coded “linkless” coupling channel between CF LPARs and OS/390 LPARs on the same CEC. This enhancement eliminates the overhead associated with LPAR-simulation of CF coupling links previously supported via the Internal Coupling Migration Facility (ICMF) enabling a potential performance benefit. Additionally, the IC has significant value beyond the performance characteristics. That is, LPARs using ICs to communicate internally within a CEC (either CF LPARs or OS/390 partitions) can simultaneously use HiPerLinks or ICBs to communicate with CFs or OS/390 systems external to the CEC. This flexibility eliminates the need to “wrap” a coupling link to the same CEC to communicate internally if external communication from the same partition is also required. Hence, the restrictions associated with ICMF are eliminated and internal communication performance to the CFCC LPAR ICF is greatly improved. The IC offers a performance benefit over the use of ICBs when OS/390 and the CF partition that it communicates with reside within the same CEC (and is therefore the channel of choice for this type of configuration). OS/390 support for this function was delivered via APAR OW28460 (and above).

**Enhanced Parallel Sysplex Clock Function:** A 128 bit TIME OF DAY (TOD) clock, to enable sufficient clock resolution for future servers; without this facility, future S/390 servers would be constrained in how fast they are allowed to process instructions which return a unique TOD clock value. Another benefit of the 128-bit TOD is that it returns a Sysplex unique store clock, useful to applications requiring a unique value, such as a time stamp, across the sysplex.

**Note:** 64 bit TOD continues to be supported (existing applications will not be impacted by this improvement).

**Dynamic ICF Expansion Across ICFs (1 Partition with Dedicated and Shared ICFs):** This new function, available June 30, 1999, is an enhancement to the Dynamic ICF Expansion item available on G4/G5 processors. With this enhancement, customers will be able to both dedicate ICF(s) to a partition and share ICF(s) across this and other CF partitions in order to more efficiently utilize ICF resources across production, test and backup CF partitions. Changes are required in LPAR and the service element to support the ability to define shared and dedicated ICFs to the same partition. Enhanced Dynamic ICF expansion builds on the support required for 2 shared pools (CPs and ICFs): Shared ICF Processors on a 9672-Rn6 or Yn6. As the uni- and single system performance have increased, it is more desirable for customers to run more workloads from additional images on the same server. IBM has already provided this capability with shared CPs; customer feedback has driven the requirement for like function with shared ICFs.

**Shared ICF Processors on a 9672-Rn6, Yn6:** This new function allows ICFs to be defined as shared processors in an LPAR partition on the same server that has the potential for an OS/390 partition. Currently, CPs may be shared between any partitions, and ICFs may be shared in 9672-R06 partitions, but ICFs may not be shared when an OS/390 partition may also be defined. Given IBM’s strategy towards all CF partitions using ICFs, it is...
necessary to support shared ICFs in this configuration to allow the same functions as when CPs are defined.

A significant number of installations define both a production and a test CF partition on the same machine, with processors shared between the two (with the production CF having a higher weight). As more workloads are enabled for full availability using ICF partitions on a CPC (with one or more OS/390 partitions) more installations may be constrained to one CF partition.

RMF supports multiple CP types, reported via Diagnose 204 and 224; SPEs will be available June 1999. An upcoming architecture will define 1-byte codes for CP types (general purpose and ICF) so that the partition data report can separate out the two shared pools of processors (physical and logical).

Shared ICFs on G5 servers will be available starting March 31, 1999. Shared ICFs are required in order to nondisruptively add ICFs to future configurations with Capacity Upgrades on Demand. Adding ICFs nondisruptively to a shared pool of ICFs is enabled with code beginning June 30, 1999.

Using the Concurrent Conditioning Feature 1999 — Available on new build or upgrades to models R6, T6, or Y6; not applicable to model R06:

The Concurrent Conditioning Feature assists customers wishing to exploit the Capacity Upgrade on Demand function by conditioning a G5 for concurrent I/O installation and planning in advance the installation of disruptive additions (for example memory) that would prevent a concurrent upgrade. This involves:

- Determining the correct MCM from which higher models can be upgraded to.
- Determining the memory required for additional capacity. MEMORY UPGRADES are disruptive and will continue to be disruptive. Memory requirements must be analyzed. Once the future memory requirement is known the appropriate memory can be ordered and either pre-installed or else identified to the site that installation of additional memory will be disruptive.

The following table summarizes the minimum and maximum G5 memory offerings by model:

- Models RA6 through RD6: Min 1 GB — Max 12 GB
- Models T16, T26, R36 through RX6: Min 2 GB — Max 24 GB
- Models Y16 through Y66: Min 5 GB — Max 24 GB
- Models Y76 through YX6: Min 8 GB — Max 24 GB

- Analyzing software releases and LIC release schedule. As migration to new releases are disruptive, migrations must be addressed.

The Concurrent Conditioning Feature allows the S/390 order process to code a server configuration so that it is properly configured for a future concurrent capacity upgrade. The general rules for this feature follow:

1. Using the order process configurator to define a future ("TO-BE") configuration.
2. The TO-BE configuration will be specified to include up to 3 I/O cages.
3. The TO-BE configuration will be determined by first executing the configurator then adding any features that are desired in the TO-BE configuration.
4. The configurator will then allow the user to process a CURRENT configuration for the server order that is the initial, or starting server configuration.
5. The features and cables plugged and placed in the CURRENT server configuration, in preparation for the TO-BE configuration will be indicated as: hot-pluggable, not hot-pluggable, or not installed, but necessary.
6. Any feature or cable that is not hot-pluggable must be installed in the CURRENT server configuration, in order to condition the system for the nondisruptive addition of future features.
7. The CURRENT configuration is determined by subtracting the results of the TO-BE server configuration, and the results of the CURRENT server configuration, then adding the features that are NOT hot-pluggable/unpluggable.
8. Features in the CURRENT configuration will be balanced across the I/O cages that are installed.
9. All cables will be installed, STI to FIBB ans so on.
10. The configurator will allow ICFs, SAPs and Memory Features to be over-ridden, if the user opts to install fewer features in the CURRENT configuration, than identified in the TO-BE configuration. If necessary, feature counts are overridden, a warning message advises that the upgrade is disruptive when the TO-BE configuration is activated.
11. Two reports will be provided: a CHPID report for the CURRENT configuration and a PLANNING report for the TO-BE configuration.
12. TO-BE configurations are available for both New Build and MESs.
13. MES orders will not rebalance the base configuration.
14. If the user configures an MES using the Plan-Ahead upgrade feature, and does not add any new features to the base system, the only cards or cables moved, added or deleted will be to satisfy the TO-BE configuration.
15. Certain I/O feature exchanges or feature conversions may apply to the TO-BE configuration. Refer to the Order Configurator for specific situations.

Additional Upgrade Paths to Model R06: The following are the upgrade paths from 9674 models C04 and C05 S/390 Parallel Enterprise Coupling Facilities to Generation 5 Model R06.

Planned Availability: February 26, 1999

- C04 to R06 2-way to 1 ICF
- C04 to R06 3-way to 1 ICF
- C04 to R06 5-way to 2 ICFs
- C04 to R06 4-way to 2 ICFs
- C04 to R06 4-way to 3 ICFs
- C04 to R06 5-way to 2 ICFs
- C04 to R06 5-way to 3 ICFs
- C04 to R06 5-way to 4 ICFs
- C04 to R06 6-way to 3 ICFs
- C04 to R06 6-way to 4 ICFs
- C04 to R06 7-way to 4 ICFs
- C04 to R06 8-way to 4 ICFs
- C04 to R06 8-way to 5 ICFs
- C04 to R06 9-way to 4 ICFs
- C04 to R06 9-way to 5 ICFs
- C04 to R06 9-way to 6 ICFs
- C04 to R06 10-way to 4 ICFs
Significant New S/390 Architecture Instructions

- Architecture for Capacity Upgrade on Demand

Capacity Upgrade on Demand is based on new S/390 Configuration Reporting Architecture. The Configuration Reporting Architecture provides system level information such as the system serial number and the number of configured CPUs, as well as information on a single CPU. A new instruction, Store System Information is introduced to allow streamlined reporting of information critical to effective system management of changes in system capacity. It will also serve as a single point of focus for reporting static, unchanged configuration data. Store System Information provides multiple levels of granularity. Information, is reported on the general system, on all CPUs, or on a single CPU. The types of information reported are system and CPU serial numbers, functional characteristics, quantity and multiprocessor-related data. Also reported are plant of manufacture and CPU address.

The architecture of the Store System Information instruction provides for information on the programming environment created by the PR/SM and VM/ESA hypervisors. System information can be requested at the machine level (non-hypervised), at the PR/SM level (if the system is logically partitioned), or at the VM hypervisor level (if a program is running in a virtual machine, whether VM/ESA is running in basic mode or in a logical partition). The Store System Information instruction allows information to be reported on each of these levels of operation. Initial VM support, in VM/ESA Version 2 Releases 2 and 3, is via APAR VM62075 and does not include the information described above for the VM-hypervisor level of operation. Information on other applicable VM support in individual VM releases will follow in future announcements.

OS/390 APAR OW37091 is required for this instruction use.

Notice to ISVs: IBM plans to discontinue its use of the version code field of the “Store CPU ID” instruction (STIDP) to identify the processor model for processors which have the Capacity Upgrade on Demand capability. With this announcement, ISVs are advised to use the new instruction, “Store System Information” (STSI) to obtain processor model and other related information for those processors.

- Architecture for Extended Translation

The Unicode character encoding standard is an international character code for information processing that includes all the major scripts of the world. Unicode transformation formats allow a certain number of ASCII values to be transmitted as-is. UTF-8 is a transformation format that is commonly used, that is, in X/Open environments Unicode is enhanced with the Extended Translation Architecture. This improves performance of translations between Unicode and UTF-8. The Extended Translation Facility consists of three new instructions: Translate Extended, Convert Unicode to UTF-8, and Convert UTF-8 to Unicode.

Translate Extended enhances performance by collapsing two serial sequences into one. Currently a Translate and Test instruction must be run against a character string to locate an escape character, followed by a Translate instruction that translates the bytes preceding the escape character. The Translate Extended instruction performs escape character location and character translation one pass through the character string.

Year 2000

This product is Year 2000 ready. When used in accordance with its associated documentation, it is capable of correctly processing, providing, and/or receiving date data within and between the twentieth and twenty-first centuries, provided that all products (for example, hardware, software, and firmware) used with the product properly exchange accurate date data with it.

Product Positioning

S/390 Platform Update: Positioning for the Future

Euro Support: IBM’s S/390 Division has successfully enabled all its affected S/390 software products to handle the euro currency — this milestone was achieved on January 1, 1999. None of the current range of S/390 servers are affected by the euro currency. S/390 is ideally positioned to help your business meet the challenge of 1999 and the introduction of the euro:

- S/390 is the server of choice for large scale enterprise-wide applications. Where the euro is the catalyst for firms to consolidate and rationalize country-based operations, the IBM S/390 has the scalability and capacity to support the business requirements.

- Solutions for large scale e-business: S/390 is uniquely placed to handle the largest Europe-wide or global e-commerce applications enabling organizations to reach the nearly 300 million consumers of the Eurozone who will find the single currency encourages a greater level of cross-border buying.

- A platform for the major ERP applications: Major ERP solutions such as SAP R/3 run on S/390 allowing integrated enterprise-wide business management, and can facilitate business restructuring/reengineering, which may be triggered by the euro.

- Migration Assistance: The complex changes to applications and systems demand extensive testing and parallel operations; IBM’s SNAPCAP storage offering provides a cost effective way of satisfying the additional temporary storage capacity which may be needed.

Progress Update: OS/390, VM/ESA, VSE/ESA

OS/390: Supplementary Information to the Latest Preview


The upcoming OS/390 announcement will also include support for FICON.
Planning Guide for Multisystem Customers is now Available: Customers running OS/390 in a multisystem configuration (both Parallel Sysplex and non-Parallel Sysplex) need to ensure they are appropriately positioned for supported software migrations. IBM is aware that some customers may have elected to freeze their software due to Year 2000 considerations. Since each OS/390 release, with few exceptions, is available to order for a six month window only, it is very important that OS/390 users be positioned for a supported migration path in the Year 2000 and beyond.

The Planning Guide for Multisystem Customers: Migrating Considerations Through the Year 2000 is available on the Internet to help customers make informed decisions about their software levels with complete understanding of IBM’s supported coexistence and migration scenarios. The URL is:


This planning guide contains information that is vitally important for every OS/390 customer, whether freezing systems for Year 2000 or not.

OS/390 Year 2000 Support: The Runtime Analyzer for MVS and OS/390 (RAMO) is a runtime tool, presently being well received by installations to both “find” and “fix” applications suspected of Y2K exposure. RAMO operates on a load module rather than source code, and will create a new Year 2000 ready load module without any need for recompilation. RAMO is also a recognized valuable tool for use in the integrated testing process.

OS/390 V2R7 is Euro Ready and includes support for the euro sign. Where applicable, this support is now available via PTFs. This support is provided for MVS/ESA™ SP™ 5.2 and 5.2.2 and all OS/390 releases. The euro support is now available via maintenance from the Euro PSP buckets.

VM/ESA

VM/ESA supports Capacity Upgrades on Demand. VM/ESA Version 2 Releases 2 and 3 will provide initial support for the new Store System Information instruction via APAR VM62075, to be generally available when the new instruction is generally available on the S/390 servers. This support will not include the return of the archived VM-hypervisor information at this time, but will provide basic-machine and PR/SM-hypervisor information to guests.

Family Upgrade Preparation: I/O Configuration Definition (IOCDS)

VM/ESA support for this function was delivered via APAR VM61752.

Euro Support: VM/ESA Version 2 Releases 2 and 3 are now Euro Ready with the application of euro support PTFs. Customers should refer to Euro Ready information on the VM/ESA home page for a complete list of required PTFs. The URL address for this site is:

http://www.VM.ibm.com/euro


Links to other important euro Web sites will also be found at this site.

VM/ESA Version 2 Release 2 support for the Year 2000 transition focused on ensuring that the VM/ESA system operates correctly in the Year 2000 and beyond. VM/ESA Version 2 Release 3 enhancements provide services that will help ease the transition to the Year 2000 and improve the usability of the system. VM/ESA Year 2000 support:

• Enables 4-digit year dates in the operating system.
• Enables identification and conversion of applications to Year 2000 readiness.
• Enables the end user to view and use 4-digit years.
• Provides migration utilities to help ease the Year 2000 transition. In addition, customers who are setting up Year 2000 test systems for S/390 platforms should consider VM/ESA. VM guest support provides a unique environment for Year 2000 testing of OS/390, MVS, TPF, VSE, and VM systems. Guest systems running under VM/ESA may run with their system clocks set to a different date and time than the host VM/ESA system without affecting the date and time of the host system. Multiple guests may be run simultaneously, each with a different date and time setting.

e-business: The network computing paradigm is not new to VM. Facilities such as Web serving, Web browsers for CMS, TCP/IP, and Distributed Relational Database Architecture™ (DRDA®) have been available for years. VM/ESA Version 2 Release 3 includes an integrated TCP/IP product suite as a priced optional feature. This provides the communication and key enablers required to access the Internet and build a functionally rich network computing environment that exploits the strengths of S/390 architecture. In addition, IBM Business Partners provide secure Web servers for enabling e-business with VM/ESA. The Message Queuing (MQ™) Interface is a popular network computing technology that enables applications on different systems and architectures to work together. VM/ESA support for MQ enables client or server applications in the network to connect to applications on VM that have implemented the MQ communication protocol. Deploying key enterprise applications is now easier in VM/ESA with support for the Sun Microsystems Inc. Java™ Development Kit (JDK), Version 1.1.4. Also, IBM has implemented the code changes necessary to fix the “February 29, 2000”, date format bug found in Sun’s Java Development Kit version 1.1.4 and 1.1.5 and is, therefore, able to confirm that the IBM Java Port for VM/ESA is Year 2000 ready.

Server Consolidation: IBM continues to enable the capability to consolidate workloads on VM/ESA. ADSM provides the capability to utilize S/390 resources for the storage/retrieval of data. On September 1, 1998, IBM announced the intent to provide a new ADSM for VM/ESA product that will provide ADSM Version 3 function, including powerful new enterprise management enhancements. The Network File System (NFS) server support on VM enables access to files stored on S/390 DASD including VM minidisks and the VM Shared File System from any platform with an NFS Client. The most recent enhancement to NFS in Version 2 Release 3 allows access to files stored in VM’s native UNIX® file system (the Byte File System).

Business Intelligence: A new version of DB2® Server for VSE & VM, Version 6 Release 1 was made generally available on December 11, 1998, with key new functions. With this new release of DB2, VM customers can:
• Extend e-business capabilities and improve ease of configuration and maintainability through the use of DRDA RUOW over a CP/IP network to connect databases in a distributed database solution. You can also choose to secure TCP/IP connections using any external security manager that supports the RACROUTE interface.

• Reduce network costs associated with distributed statements by using a single network send and receive operation to execute a series of SQL statements contained in the stored and provide faster access to your distributed data.

• Protect their database investment and provide the support needed to address changing business requirements while making systems ready for Year 2000 and euro currency.

• Improve database availability and decrease archive time with a new incremental archive capability; only data changed since the last archive was taken will need to be archived.

• Increase system availability and response time and make better, faster business decisions with QMF™ and QMF for Windows™ as optional features providing powerful and reliable query and reporting tools.

Technology Leadership: VM/ESA supports OS/390 running as a guest operating system. This guest environment supports OS/390 exploitation of new hardware function not supported by VM natively. These functions include:

• Testing of a Parallel Sysplex system environment: VM/ESA provides a Parallel Sysplex testing environment for MVS or OS/390 guests with VM/ESA Version 2 Release 3 on S/390 Parallel Enterprise Server Generations 3, 4, and 5 and on S/390 Multiprise™ 2000 servers. This support simulates one or more completely coupled Parallel Sysplex environments within a single VM image. VM supports MVS and OS/390 testing as an aid for customers’ deployment of coupled Parallel Sysplex clusters. Real hardware coupling facilities and coupling links are not required nor supported. One or more virtual machines are the Coupled Guests (MVS or OS/390) and one or more are the Coupling Facility (CF) Servers running on the S/390 server’s licensed Coupling Facility Control Code (CFCC).

S/390 Parallel Enterprise Server — Generation 5 (G5): VM/ESA supports the G5 natively, however, some recent G5 features are only supported for the guest environment. They are:

• IEEE Floating Point — This support enables OS/390 and other guest operating systems to use basic floating-point extensions, floating-point-support extensions, hexadecimal floating-point extensions, and binary floating-point, which are provided with the IEEE Floating-Point hardware. In addition, the VM/ESA Control Program DISPLAY, STORE, and TRACE commands are enhanced to aid in the development, testing, and diagnosis of programs that exploit the new floating-point architecture. This support is available via a PTF for APAR VM61762.

• Integrated Cluster Bus (ICB) — The ICB is the core of the Parallel Sysplex Integrated Cluster, offering both improved CF interconnect bandwidth and dramatically reduced command latency to/from the CF. With the ICB technology, IBM S/390 clustered systems will be able to scale in capacity without incurring additional overhead as the individual processors increase in engine speed with each successive processor generation. The VM/ESA guest support for the ICB is provided via a PTF for APAR VM61760 and is needed if a G5 customer is running VM/ESA and OS/390 in different logical partitions on the same CEC and has the new cluster-bus coupling channels installed for OS/390. If VM/ESA is used to control dynamic I/O configuration changes on the CEC, this APAR will provide such support for cluster-bus channels.

VSE/ESA

VSE/ESA Version 2 Release 4: The next release of VSE/ESA, VSE/ESA Version 2 Release 4, will be available on June 25, 1999. This new release of VSE/ESA is an important step forward in the growing affinity between VSE and OS/390. Application portability between VSE and OS/390 is greatly increased with the introduction of the CICS® Transaction Server for VSE/ESA (CICS TS VSE/ESA).

CICS TS VSE/ESA provides fundamental new growth opportunities for VSE customers by providing many new functions which result in advantages like:

• Less downtime: CICS TS VSE/ESA exploits the Subsystem Storage Protection feature of the S/390 servers. Resource Definition Online (RDO) now supports online definition of a wide range of different resources.

• New Opportunities for Growth: CICS TS VSE/ESA provides extensive Virtual Storage Constraint Relief Shared Data Tables to enhance the CICS performance. Many enhancements in the area of Application Programming Interfaces (APIs), for example, the new external CICS interface (EXCI) allows VSE batch programs to invoke CICS applications.

• New e-business Capabilities: CICS TS VSE/ESA will deliver new functions to support the implementation of an e-business environment. The CICS Web Interface allows you to directly access CICS applications and data from any Web browser. Together with the 3270 bridge, the CICS Web Interface will make all CICS applications accessible from a Web browser. (Note: The availability of the Web Interface and the 3270 bridge will be announced at a later date). The CICS Universal Client Version 3.0 and the CICS Transaction Gateway Version 3.0 are both part of the CICS Transaction Server for VSE/ESA. Those two products can be used to implement a robust 3-tier e-business solution with easy access to your existing CICS applications and data.

Doing e-business with VSE/ESA V2.4: TCP/IP for VSE/ESA (available with VSE/ESA 2.3 and VSE/ESA 2.4) extends the connectivity and interoperability of VSE/ESA. It provides the foundation for VSE’s participation in new exciting e-business solutions. The TCP/IP for VSE/ESA “Application Pak” feature includes a basic Web server that will allow you to use your VSE system as a server providing applications and data to a Web browser client. This allows you to leverage your investment in S/390 data, applications, skills, and hardware.

Together with the CICS Transaction Server for VSE/ESA, VSE/ESA Version 2 Release 4 is perfectly positioned to help you with the implementation of your e-business.

Euro Support: Euro support for VSE/ESA is available for VSE/ESA 1.4 and VSE/ESA 2. The latest information concerning euro readiness of VSE/ESA and related products is available on the VSE home page at:

Year 2000 Readiness: VSE/ESA Version 1 Release 4.3 and later releases, and VSE/ESA Version 2 and later releases are Year 2000 ready. For more details on VSE/ESA Year 2000 support, refer to the VSE home page at:

http://www.s390.ibm.com/vse/

In addition, IBM offers a selection of tools and services to help address Year 2000 issues in your own applications.

Special Year 2000 News

Support for S/390 Customers: As we enter the last lap in our efforts to achieve readiness for the Year 2000 challenge, S/390 leads the industry with ready hardware and software offerings. The Parallel Enterprise Server — Generation 5 has been enhanced this year to optionally provide Capacity Upgrades on Demand to non-disruptively add capacity to an installed processor. This process enables installations to increase server capacity for the requirements such as Year 2000 testing, new application workloads and increased transaction workloads. Also offered in the S/390 tool bag is the S/390 Integrated Server, which is available with any of the Year 2000 ready IBM Operating Systems. Additionally, a wide array of application remediation tools are also available to our customers.

S/390’s Year 2000 Test Laboratory Commitment

IBM’s S/390 Hardware Lab has assembled a state-of-art Year 2000 test floor. This installation contains every S/390 hardware product certified by IBM as “Year 2000 ready”. Our objective is to enable immediate access to any S/390 hardware configuration in response to any Year 2000 incident. Lab experts have hands-on equipment to reproduce any reported anomalies real time.

IBM Global Services: Update for 1999

The following new services are offered in support of S/390. Contact your IBM representative for details:

IBM Installation Services for Geographically Dispersed Parallel Sysplex

A Geographically Dispersed Parallel Sysplex is a multi-site management facility spread across two or more sites, up to 20 kilometers apart or up to 40 kilometers apart, via an RPQ. This system uses automation technology to help manage databases, processors, network resources and storage subsystem mirroring; it automatically mirrors critical data and efficiently balances workload between the sites.

Geographically Dispersed Parallel Sysplex offers you flexibility and supports all transaction and database managers, such as:

- CICS
- IMS™
- DB2
- IMS DB
- VSAM

With this technology, IBM offers you continuous availability, efficient workload management, system resource management and prompt data recovery for your business-critical S/390 applications and data.

This service can offer you the solution that best fits your business needs. You can choose from the following:

Full Geographically Dispersed Parallel Sysplex, which includes:

- Remote Copy Configuration
- Automation of planned reconfigurations
- Automation of unplanned reconfigurations
- Remote Copy Management Facility (RCMF)
- This utility manages the remote copy configuration and the storage subsystems. It does not manage system workload.

A White Paper, “Geographically Dispersed Parallel Sysplex: The S/390 Multi-site Application Availability Solution” details IBM’s approach to satisfy continuous availability solutions. This document is available from your IBM representative, or can be downloaded from the Internet URL:


Installation Services for S/390 Cryptographic Coprocessor

This service provides a services specialist at the customer’s site to plan, configure, customize, and activate the cryptographic components (called CRYPTO) associated with a single IBM CMOS machine. These components include

- Up to two Cryptographic Coprocessors and their associated enablement diskettes
- The OS/390 Integrated Cryptographic Services Facility (ICSF) component software
- If present, the hardware and software components of a single Trusted Key Entry (TKE) Workstation

This service also provides basic skills transfer for up to two of the customer’s personnel.

Statement of General Direction

- IBM intends to make S/390 Generation 5 and the next generation of S/390 CMOS servers functionally equivalent.
- IBM intends to provide VM/ESA support for FICON and the IBM Cryptographic Coprocessor.
- For valid orders, IBM intends to shorten turnaround time and delivery of LIC-only upgrades.

Trademarks

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Other company, product, and service names may be trademarks or service marks of others.
Publications

The following publications are available to be ordered prior to shipment of a G5 model:

<table>
<thead>
<tr>
<th>Title</th>
<th>Order Number</th>
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</thead>
<tbody>
<tr>
<td>S/390 Parallel Enterprise Server™ and OS/390® Reference Guide</td>
<td>G326-3070</td>
</tr>
<tr>
<td>S/390 Parallel Enterprise Server — Generation 5</td>
<td>GA22-7158</td>
</tr>
<tr>
<td>Pre-Installation Configuration Workbook (G5 models)</td>
<td>GC38-3120</td>
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<tr>
<td>IBM Parallel Enterprise Server — Generation 5 SAPR Guide</td>
<td>SA98-0062</td>
</tr>
<tr>
<td>Learning to Use the S/390® CMOS Console</td>
<td>SK2T-2512</td>
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<tr>
<td>Introduction to IBM S/390 FICON</td>
<td>SG24-5176</td>
</tr>
<tr>
<td>IBM S/390 FICON Migration Guide</td>
<td>SG24-5169</td>
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The following publications reflect the announced product and are shipped with the product:

<table>
<thead>
<tr>
<th>Title</th>
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<tbody>
<tr>
<td>PR/SM™ Planning Guide</td>
<td>GA22-7236</td>
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<tr>
<td>IOCP User’s Guide</td>
<td>GC38-0401</td>
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<tr>
<td>Managing Your Processors</td>
<td>GC38-0460</td>
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<td>Hardware Management Console Guide</td>
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<td>Operations Guide</td>
<td>GC38-3119</td>
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<tr>
<td>Standalone IOCP User’s Guide</td>
<td>GC38-0458</td>
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<tr>
<td>Pre-Installation Configuration Workbook (G5 Models)</td>
<td>GC38-3120</td>
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<tr>
<td>HWMCA Programming Interfaces</td>
<td>SC28-8143</td>
</tr>
<tr>
<td>Problem Analysis (PA) Guide</td>
<td>SY22-9876</td>
</tr>
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</table>

Security, Auditability, and Control

The customer is responsible for evaluation, selection, and implementation of security features, administrative procedures, and appropriate controls in application systems and communications facilities.

Terms and Conditions

This product is available for purchase under the terms of the IBM Customer Agreement.

IBM hardware products are manufactured from new parts, or new and used parts. In some cases, the hardware product may have been previously installed.

Regardless, IBM warranty terms apply.

IBM Credit Corporation Financing: Yes

Warranty Period: One year.

Warranty Service: IBM On-Site Repair (IOR)

Maintenance Service: IOR

Usage Plan Machine: No

IBM Hourly Service Rate Classification: Three

Mid-Range System Option: The announced product is an eligible machine for the Mid-Range System Option of the IBM Customer Agreement. A revised exhibit will be available at a later date.

<table>
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<tr>
<th>Eligible Type</th>
<th>Three-Year Discount</th>
<th>Five-Year Discount</th>
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<tr>
<td>9672</td>
<td>12%</td>
<td>17%</td>
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</table>

Corporate Service Option: The announced product is an eligible machine for the Corporate Service Option of the IBM Customer Agreement. A revised exhibit will be available at a later date.

<table>
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<th>System</th>
<th>Three-Year Discount</th>
<th>Five-Year Discount</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>14%</td>
<td>19%</td>
</tr>
</tbody>
</table>

Central Facility Maintenance Service (CFMS) Option: No

When a type of service involves the exchange of a machine part, the replacement may not be new, but will be in good working order.

Rental Offering: No

Product Available: Yes

This announcement is provided for your information only. For additional information, contact your IBM representative, call 800-IBM-4YOU, or visit the IBM home page at: http://www.ibm.com.
**Field-Installable Features:** Yes

**Model Conversions:** Yes

**Customer Setup:** No

**Graduated Charges:** No

**Licensed Internal Code:** The IBM Machine or Feature/MES is provided with Licensed Internal Code for use by a customer on a specific machine, designated by serial number. The Licensed Internal Code is an integral part of the machine. It is licensed only under the terms and conditions of the IBM Customer Agreement and the IBM Agreement for Licensed Internal Code. It is a valuable intellectual property of the IBM Corporation.

Section 3 of the IBM Customer Agreement authorizes the customer to execute the Licensed Internal Code to enable the specific machine to function according to its specifications. The customer is authorized to execute the Licensed Internal Code only for the model listed in the Purchase Supplement (or other Transaction Document) relating to the IBM Customer Agreement.

**Educational Allowance:** A reduced charge is available to qualified education customers. The educational allowance may not be added to any other discount or allowance.

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**Call Now to Order**

To order, contact the IBM North America Sales Centers, your local IBM representative, or your IBM Business Partner.

IBM North America Sales Centers, our national direct marketing organization, can add your name to the mailing list for catalogs of IBM products.

Phone: 800-IBM-CALL
Fax: 800-2IBM-FAX
Internet: ibm-direct@vnet.ibm.com
Mail: IBM North America Sales Centers
Dept. YE010
P.O. Box 2690
Atlanta, GA 30301-2690
Reference: YE010

To identify your local IBM Business Partner or IBM representative, call 800-IBM-4YOU.

**Note:** Shipment will begin after the planned availability date.

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