

Intelligent systems management, rock-solid reliability
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Systems Management for IBM @server xSeries Servers

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Executive Summary

Three critical elements make up the IBM vision for the future of e-business:

- *Application flexibility* — Choices in selecting, building and deploying applications
- *New tools for managing e-business* — New ways to manage end-to-end growth, risks and costs
- *Innovative technology* — Extreme performance and scalability with IBM reliability and security

Inherent in managing risks and costs, while maximizing server reliability and availability, is the need for the right systems management tools. Effective systems management can be a complex undertaking and difficult to achieve without the right tools. It requires specialized hardware, software and firmware working together to form a comprehensive solution. Servers, professional workstations, desktop and mobile computers, network adapters, network operating systems, and other network computing components all have to be designed to cooperate in this regard. Few server vendors have the technical skills needed to develop and integrate all aspects of systems management.

IBM is an industry leader in this area because it provides systems management features that give the administrator the tools needed to effectively plan for, deploy, manage, support and retire networked clients and servers. The threefold IBM systems management strategy is fundamental to our efforts to help you reduce your total cost of ownership. Our strategy is to:

- *Provide manageability solutions based on industry standards for system management.* IBM systems management tools have been designed and developed to help streamline and automate management and support tasks such as asset deployment and tracking through leading-edge, standards-based tools.
- *Provide products with proven, reliable technology while helping you reduce the total cost of ownership.* Our commitment to server leadership is expressed in IBM X-Architecture™ technology¹, which takes the best capabilities from larger IBM systems and adapts them into a framework that will integrate with a wide range of industry-standard, systems management products and operating systems.
- *Provide smooth integration with leading enterprise and workgroup managers.* Our goal is to create a comprehensive solution built on a management foundation that fits with your existing assets and grows with your business.

IBM @server xSeries™ systems support Project eLiza™—an IBM initiative to advance the goal of self-managing systems. This support is achieved on xSeries™ servers by incorporating advanced technologies and intelligent management tools for real hands-off reliability.

IBM management tools work together like no others to give you the ability to manage your systems easily and efficiently. This paper describes the IBM tools and how they help you to solve your systems management concerns.

¹ See the white paper entitled "IBM X-Architecture Technology" at <http://ibm.com/eserver/xseries> for more information. From the xSeries home page, select **Library** for links to the different types of documentation available.

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Management Challenges and Requirements

The complex IT environment is evolving at a rate that, just a few years ago, would have been unimaginable. And the rate will undoubtedly increase in the future, as new technologies appear. In this environment, IT professionals are faced with a variety of management problems.

Businesses today continue to decentralize their IT assets and consolidate their skills. They are doing this with new tools and technology that can offer more, and better, functionality, but often at the cost of increased complexity. The solution to this problem is not simply “systems management” but *smart* systems management—the efficient, productive and *proactive* administration of IT assets within the business. Smart systems management enables early warning of impending problems and allows quick solutions to those problems remotely. IBM @server xSeries servers, with advanced local and remote management capabilities, provide that level of systems management, no matter the size of your networked business.

Many models provide features such as built-in systems management processors or adapters, Automatic Server Restart (ASR) to restart your servers when there is no one present to do so, Chipkill™ memory and Memory ProteXion™ to automatically correct most memory errors, Predictive Failure Analysis® (PFA) for rapid identification of a failing component within the server, Light Path Diagnostics™ to quickly and simply direct you to the location of a failed component, C2T Interconnect™ cabling to simplify the cable management of rack-optimized servers—and many other features, plus IBM Director management software to fully exploit the hardware and provide a consistent user interface.

One challenge is to give administrators more control with less complexity. Another is to provide solutions that help significantly reduce the total costs associated with systems over their entire life cycle—from planning to deployment, to managing and servicing, and finally to repurposing or disposal. A third is integrating your systems management software into higher levels of workgroup or enterprise management tools such as Microsoft® System Management Server (SMS), Intel® LANDesk® Management Suite, Tivoli® management software, Computer Associates Unicenter TNG Framework, HP OpenView, BMC Patrol and NetIQ. xSeries servers meet these challenges.

IBM understands the consequences of not having your networked systems operating reliably and efficiently when you need them. If your network administration tools fail, that can significantly impact the operation of your business. Because of this, you spend more time managing existing IT resources than you should, rather than working on important business-related problems. Our goal is to provide a systems management solution that will provide you with comprehensive control of your xSeries systems in this complex environment and enable you to spend more time managing your business and not your IT infrastructure.

The following topics explain what standard and optional IBM systems management tools are available for your use with xSeries servers.

IBM Hardware and Firmware that Enable Superior Systems Management

Certain administrative functions must be performed while servers are shut down or before the operating system has loaded—for example, remotely starting a desktop system and updating system software. In order to be able to perform these functions, the servers and some options (such as network interface cards—NICs) must be designed with features that enable these capabilities.

Some solutions can be implemented entirely in hardware or software. Others require an assist from firmware as well. Firmware (programming imbedded in hardware) includes such things as system BIOS, diagnostics and offline adapter functions stored in nonvolatile memory (NVRAM).

IBM uses a three-tiered approach to systems management hardware and firmware: core, enhanced and advanced capabilities.

Tier 1, core integrated systems management, include such features as:

- Wake on LAN®
- Preboot eXecution Environment (PXE)
- Automatic Server Restart
- Alternate Boot Sequence
- Support for the optional IBM Remote Supervisor Adapter

The second tier, enhanced integrated systems management, comprises technologies such as:

- Predictive Failure Analysis
- Light Path Diagnostics
- Temperature, voltage and fan environmental monitoring and alerting
- IBM Integrated Systems Management processor and IBM Advanced System Management (ASM) processor
- IBM Interconnect Cable Kit
- Error logging
- Remote power control
- Redundant fans and power supplies

Tier 3, the pinnacle of systems management technology, includes:

- IBM Remote Supervisor Adapter
- Web browser interface
- Console redirection (text and graphics)
- Windows “blue screen” redirection
- Independent Ethernet controller and A/C power
- Independent serial port

These and other capabilities are described in the following sections.

Restarting Offline Clients and Servers

Wake on LAN is a feature built into client systems. It permits a server to remotely power on the client if it has been shut off. Once powered up the server can be controlled across the network, using the **Preboot eXecution Environment (PXE)**.

Like Wake on LAN, PXE is firmware built into a client PC. It allows software such as **IBM Remote Deployment Manager** (formerly called LCCM) to take control of a system before the BIOS, operating system or applications are loaded and lets an administrator perform many low-level tasks remotely that would otherwise require a visit to each system. These tasks may include such things as formatting a hard disk drive, flashing the system BIOS, updating CMOS settings, or updating an operating system.

One possible obstacle to Wake on LAN working correctly is a diskette left in the floppy drive. Ordinarily the system would try to load an operating system from the diskette, rather than starting from the hard disk drive. This would prevent the system from connecting to the network and being available for remote administration. However, IBM includes another feature called **Alternate Boot Sequence**, which allows PCs awakened by Wake on LAN to start up normally, even when a diskette is in the drive.

These features save your administrator the time and effort of traveling to each of the PCs (some of which may be in other cities) and turning them on individually. More than that, the administrator can perform all sorts of offline maintenance on them after they are restarted—upgrading BIOS, operating systems and applications or changing CMOS configuration options, for example. Plus, using tools such as IBM Remote Deployment Manager and **Software Delivery Assistant**, entire system software images or individual applications can be “broadcast” during downtime to many different PCs on the network for automated installation.

Wake on LAN is great for starting a PC remotely from a server, but what if it's the server that's down, and what if there is no one onsite to restart it?

When a server locks up due to an operating system crash or a transitory hardware event—such as a power flicker—often all that is needed to rectify the problem is to restart the server. Typically, if there is no one physically present to flip the power switch or press the reset button, the server remains offline until someone is able to get there to restart it. In an e-commerce environment, even a minute of downtime can result in the loss of hundreds of thousands of dollars in revenues². The obvious solution is to design a way for the server to restart itself without human intervention, but until recently this type of technology was reserved for mainframes and other high-end servers.

IBM developed a solution to this problem, called **Automatic Server Restart (ASR)**. ASR technology is a combination of hardware circuitry tied into the server's system reset function and a device driver that is intelligent enough to know the difference between an actual problem and a normal startup or shutdown process.

Simply put, the ASR software works as a watchdog timer. Periodically, the ASR driver resets the ASR hardware timer to zero. As long as the server continues running, the ASR hardware timer will keep being reset, but if the operating system locks up or the hardware freezes somehow the ASR software will be unable to reset the hardware timer. If the timer is not reset within five minutes, it automatically triggers the ASR hardware, which immediately restarts the server (and logs an ASR event for later viewing by the administrator). This means the software is designed so that *no more than five minutes can pass before the server is restarted*.

If your server doesn't have ASR capability, how sure are you that someone can get to and restart any of your servers in less than five minutes, every time, day or night?

Failure Prevention and Maintenance

In order to avoid expensive downtime you need high availability from your servers. Some types of system failures are unpredictable, such as a power surge from a lightning strike, damage due to improper handling, and the like. However, many types of failures are gradual and can be predicted with a high degree of accuracy. Statistical analyses of similar devices that have failed in the past reveal patterns, which IBM has used to develop failure detection methodologies for various devices and even software.

² According to *Sm@rtPartner* magazine (September 18, 2000), for an e-commerce company like Amazon.com every second of downtime costs \$4,000; for a Wall Street brokerage firm the cost is \$108,000 per minute or *\$6.5 million per hour*.

Using advanced heuristic techniques and periodic self-diagnostics, IBM **Predictive Failure Analysis** can detect when components are operating outside of normal specifications and approaching historical failure thresholds. This enables PFA to predict the failure of supported components often as much as 24 to 48 hours before failure occurs, affording administrators the time to locate replacement parts and hot swap the failing components prior to actual failure—and at a time that’s convenient to the administrator. In conjunction with **IBM Director Software Rejuvenation**, PFA can detect impending software problems and restart the application (or perform a controlled shutdown of the operating system), before the software locks up or manifests performance problems.

When PFA-enabled devices exceed a designated error threshold (for example, a fan is running either too fast or too slow, or a hard drive is producing an unacceptable number of soft errors), the server (via IBM Director) can automatically initiate an e-mail message or page the administrator with an alert regarding an impending hardware or software failure. As illustrated in *Table 1*, IBM @server xSeries servers offer a wide array of PFA-enabled features:

<i>PFA-enabled Components</i>	<i>IBM @server xSeries Servers</i>
Hardware³:	
Hard disk drives	Yes
Memory	Yes
Processors	Yes
Fans	Yes
Voltage Regulator Modules (VRMs)	Yes
Power supplies	Yes
Software (via IBM Director Software Rejuvenation)	Yes

Table 1. PFA usage in xSeries servers

The unique IBM **Light Path Diagnostics** feature used in select servers sets a new standard for Intel processor-based server maintenance and repair. Light Path Diagnostics contributes to enhanced manageability. xSeries servers are designed with fast, accurate problem isolation as a goal, and Light Path Diagnostics meets that goal. Light Path Diagnostics works hand in hand with Predictive Failure Analysis and environmental self-monitoring features that IBM embeds in vital components.

Heat and mechanical wear are significant contributors to computer part failures over the course of thousands or tens of thousands of hours of continuous operation. It is essential that these components be easy to locate and simple to replace in your server. For this reason, IBM has PFA-enabled not only the mechanical parts (hard disk drives, cooling fans and power supplies—which also have fans), but also those subject to damage from power surges (power supplies and voltage regulator modules—VRMs), plus the two most critical parts in any computer: the processor and memory, as well as software (via IBM Director Software Rejuvenation).

All xSeries servers include LED status indicators on the front panel. When the Predictive Failure Analysis of a component indicates impending problems the service processor alerts the system manager, illuminates the front-panel status indicator and turns on an indicator light on the Light Path Diagnostics service panel in servers that include the Light Path Diagnostics feature. (*Figure 1* shows the Light Path Diagnostics service panel from an xSeries 250 server.)

³ PFA-enabled components vary by xSeries server model.

Servers with Light Path Diagnostics also include LEDs attached to specific components within each server to guide service personnel to those parts. These tools work together to simplify and speed the repair of failing or failed parts without even requiring the running of system diagnostics.



Figure 1. Light Path Diagnostics panel

Symptoms of impending failure can be subtle or intermittent, normally requiring that technicians painstakingly test to identify the specific device that is failing. Light Path Diagnostics simplifies server maintenance by eliminating this time-consuming step.

LEDs on the processor board can help you quickly and easily locate an individual memory DIMM (if one begins acting erratically) or a failing processor. (How would you know which of multiple processors is the failing one, otherwise?)

A technology new to industry-standard servers that helps prevent or minimize server downtime is IBM **Real Time Diagnostics**. Based on the Distributed Management Task Force (DMTF) Common Information Model (CIM), Real Time Diagnostics allows an administrator to run diagnostics on system resources *while users are still working*, thereby increasing system uptime and taking IBM customers closer to OnForever™ levels of high availability. This is a feature that has been available for some time on larger servers but was lacking in the industry-standard server market, until now. Real Time Diagnostics is available on selected xSeries servers, including the x360 and x440.

IBM, working with Intel and PC-Doctor, introduced industry-standard extensions to CIM to support concurrent diagnostics in 1999. This Common Diagnostic Model (CDM) standardizes how to interface concurrent diagnostics with the operating system, making the diagnostic routines available to all CIM-aware diagnostic applications. With the diagnostic extensions to CIM now defined, IBM is working with independent hardware vendors to define methods and create concurrent diagnostic tools and utilities to keep xSeries servers up and running.

IBM Real Time Diagnostics is our implementation of CDM. The combination of IBM Predictive Failure Analysis (system health monitoring), Real Time Diagnostics and hot-swap components means that you might never again have to shut down your xSeries server to run diagnostics or replace hot-swappable components.

Real Time Diagnostics can be operated through the IBM Director management software to provide a consistent, easy to use management interface for controlling many system functions. (For more information on Real Time Diagnostics, see the IBM Director topic later in this paper.)

IBM systems management adapters and processors

The IBM family of system management adapters and processors helps provide you with virtual onsite management designed to maximize system control. Even with the server powered off, or when the server has failed, the Advanced System Management solutions enable extensive remote management of your xSeries servers.

Automated Server Restart and orderly operating system shutdown are supported by the entire family of systems management products for the following operating systems: Microsoft® Windows® NT® Server 4.0 and V4.0 SMP Feature, Windows 2000, Novell NetWare 3.2, 4, 5 and intraNetWare, SCO UnixWare⁴ 7.1, IBM OS/2® Warp Server 3 and 4 and Linux®. The family of systems management products is hardware and software independent for all other functions.

⁴ SCO UnixWare support is limited to ANSI terminal, telnet and Web management.

Control is provided remotely from any network client using a standard Web browser interface or a telnet or ANSI terminal, from the IBM Director management software or locally.

An IBM systems management *processor* is integrated onto the system board of most xSeries servers. Higher-function systems management *adapters* are standard in selected models and are available as options in various other xSeries models. With these systems management adapters and processors, if the operating system is unavailable you can still determine faults and restart the server.

The **Advanced System Management (ASM) processor** (sometimes referred to as the service processor or ASM processor) is an integrated subsystem solution that runs independently of the server's hardware and operating system. Each ASM processor contains a microprocessor, nonvolatile memory and a dedicated serial port for systems management.

The ASM processor receives Predictive Failure Analysis notifications, sends alerts to IBM Director or a pager via modem and controls the server's Light Path Diagnostics functions. Other functions provided by the ASM processor include:

- Remote flash update of system and ASM processor BIOS via modem.
- Remote diagnostics using ROM-based utilities.
- Remote power cycling of the server (power-on and -off).
- Remost POST.
- Remote access to RAID and SCSI configurations through a Remote POST Console.
- A shared serial port, allowing connection to the ASM processor and the operating system through a single modem. The operating system owns the shared serial port while the system is up and running; however, during POST and during a critical event, the ASM processor owns the port.
- Access to vital product data with serial numbers of key components through IBM Director.
- Alerts for voltage threshold exceeded, critical and noncritical temperature threshold exceeded, single and multiple fan failures, power supply failures, hard disk failures, power on/off, operating system hang and other conditions.
- Dial-in management support.
- Support for the IBM Interconnect Cable Kit (described following).

With all these powerful remote management functions, security is essential. The ASM processor includes security features such as password protection, user profiles (up to 12 profiles with the ability to define the level of access rights), a time stamp in the event log of the last logon, and configurable dial-back security to protect the server from unauthorized access.

The **Integrated Systems Management (ISM) processor** is an integrated processor included in some newer xSeries models. It offers capabilities similar to that of the ASM processor, with some exceptions:

- The ISM processor doesn't include a shared serial port, so it can't provide IBM Director alerts or remote text console support via serial port (including ANSI and Telnet-based management). Instead, the ISM processor offers alerts sent to IBM Director via LAN. It also can't offer remote POST and diagnostics.
- While the ASM processor allows remote updates of both system BIOS and the ASM processor firmware, the ISM processor supports updating only the ISM processor firmware.

The top-of-the-line, half-length 32-bit PCI **Remote Supervisor Adapter** (standard in some xSeries models, optional in others) adds a redundant Ethernet controller to the one (or two in the case of the x330) included with the server, for situations where the operating system is not available—the ASM Ethernet connection, when combined with the optional external power

source) will function even while the server is unplugged. This is a level of service and support typically found only on larger IBM systems. System alerts can be sent via LAN, pager, serial port (across a modem or null modem) or e-mail (with the event log attached) to designated IT personnel; the SNMP, DNS, PPP and DHCP standards are supported.

The enhanced Web client for the Remote Supervisor Adapter includes a new Web interface and an HTML server and allows the administrator to remotely view redirected text and graphics from the server to see exactly what is happening on the remote systems. It provides full keyboard support (with all operating systems) and mouse access and video control of the server (for Microsoft Windows NT and Windows 2000). Support includes observing POST startup and shutdown sequences as well as all system and operating system error messages—including Windows NT/2000 “blue screen” errors. This degree of control over a remote system allows an administrator to better assess the scope of the problem before taking remedial action.

The Remote Supervisor Adapter also includes new functions to support static partitioning on the x440. These functions include the ability to read and write persistent partition information on each chassis (node) with a partition software management component prior to server start-up. The partition information (a Partition Descriptor) describes the interconnectivity and role (for example, boot node) of each chassis in the partition as defined by the user. The partition information is then read by the server POST (power-on self-test) on each chassis to initialize the hardware in preparation for loading and executing the operating system. Once the OS is running, it will support more than one Remote Supervisor Adapter controlled by a single OS image (needed in the case of multichassis partitions).

In the future, the partition management infrastructure that includes external management software, the management network, the Remote Supervisor Adapter and the platform firmware will be used to support autodiscovery of hardware components for enhanced usability, autopartitioning for enhanced availability and dynamic partitioning for enhanced serviceability across the xSeries product line.

Table 2 compares the features of the various IBM systems management solutions:

Systems Management Features	ASM Processor	ISM Processor	Remote Supervisor Adapter
Monitoring			
Automatic server restart	Yes	Yes	Yes
Capture Windows blue screen errors	No	No	Yes
Environmental monitors (temperature/voltage/fans)	Yes	Yes	Yes
Interfaces with Light Path Diagnostics	Yes	Yes	Yes (Note 1)
Optional power source	No	No	Yes
PFA on system components (fans, power supplies, memory etc.)	Yes	Yes	Yes
POST, loader, operating system time-outs	Yes	Yes	Yes
Redirection of text	Yes	No	Yes
Redirection of graphics	No	No	Yes

Systems Management Features	ASM Processor	ISM Processor	Remote Supervisor Adapter
Alerting			
Alert to IBM Director via network	Yes (Note 2)	Yes (Note 2)	Yes
Alert to IBM Director via serial port	Yes (Note 3)	Yes (Note 2)	Yes (Note 3)
Alert to pager (numeric or alphanumeric)	Yes (Note 3)	Yes (In-band only)	Yes (Note 3)
SMTP alert via e-mail	No	No	Yes
SNMP traps	Supported (Note 4)	Yes (In-band only)	Yes
SNMP via PPP	No	No	Yes
Management/configuration			
ANSI-based management	Yes (Note 3)	No	Yes (Note 3)
IBM Director-based management	Yes	Yes	Yes
Remote BIOS and adapter / processor firmware updates	Yes (Note 6)	ISM firmware only	Yes (Note 6)
Remote control (GUI)	No	No	Yes (Note 1)
Remote POST & diagnostics	Yes (Note 6)	No	Yes (Note 6)
Remote power control	Yes	Yes	Yes
Telnet-based management	Supported (Note 4)	No (Note 5)	Yes
View status logs	Yes	Yes	Yes
Vital Product Data support	Yes	Yes	Yes
Web-based management	Supported (Note 4)	Supported (Note 7)	Yes
Connectivity			
10/100 Ethernet controller included	No	No	Yes
DHCP support	N/A	N/A	Yes
DNS support	N/A	N/A	Yes
PPP support	No	N/A	Yes
Shared serial port included	Yes	No	Yes
IBM Interconnect Cable Kit supported	Yes	Yes	Yes

Table 2. IBM systems management processor and adapter features

Notes to Table 2

1. The Remote Supervisor Adapter is currently available as an option only on the x220, x232 and x342. When the Remote Supervisor Adapter is installed in these systems the ISM processor is automatically disabled. The Remote Supervisor Adapter will take over all management and monitoring of the server, including Light Path Diagnostics and remote control.

When the Remote Supervisor Adapter is installed in the x330, the ASM processor performs all management and monitoring and the Remote Supervisor Adapter acts as a gateway to the interconnect and Ethernet networks. The advanced capabilities of the Remote Supervisor Adapter are not available—you are limited to the functionality of the ASM processor, except for the gateway capability.

2. In-band via the IBM Director Agent.
3. Requires an external modem or null-modem cable.
4. This feature is enabled when the ASM processor is connected, using the IBM Interconnect Cable Kit, to an ASM PCI Adapter (withdrawn) in another server. This feature is provided through the other server's ASM adapter.
5. This feature requires a serial port.
6. Support requires an out-of-band (offline) connection such as serial, Ethernet or the ASM Interconnect Cable Kit. Out-of-band connections can be made even when the operating system is not functioning.
7. This function is enabled via the IBM Director Agent or by using a Remote Supervisor Adapter with the IBM Interconnect Cable Kit.

Using xSeries servers that contain the *ASM* processor (except the x330—see below) or the ASM PCI Adapter, up to **12** servers can be remotely managed from one system, using the peer-to-peer systems management interconnect capability that is available using the RS485 interconnect port provided with each ASM processor or ASM PCI Adapter. This interconnect capability is standard on the x130/x135 Performance Line, x240, x250, x330 and x350 servers and is optional on the x370. One of these interconnect networks can include any combination of ASM processors, ASM PCI adapters and Remote Supervisor Adapters totaling 12.

Alternatively, by using x330 servers (with the interconnect cabling standard) or servers that include either the *ISM* processor (such as the x232 and x342) or the IBM Remote Supervisor Adapter (the x360 and x440), up to **24** servers can be connected using the *optional IBM Interconnect Cable Kit*. (The kit is *included* with the Remote Supervisor Adapter when the adapter is purchased as an option.) It is also possible to combine ASM processors, ASM PCI adapters, ISM processors and Remote Supervisor Adapters into a 24-server interconnect network, but there are limitations imposed by the BIOS in the older ASM PCI adapter and the ASM processor.

In order to achieve a systems management interconnect network of more than 12 individual RS485 connections that include one or more ASM PCI adapters and/or ASM processors, certain rules must be followed:

- You must update the firmware of all service processors and adapters to the latest level
- The interconnect network **must** include *at least* one server with a **Remote Supervisor Adapter** (either installed as a server option or preinstalled in the server), **unless** *all* the servers on the interconnect network are **x330** servers (which means they have an integrated ASM *processor*). The ASM processors in the x330 *can* communicate with one another (via Telnet) without a Remote Supervisor Adapter on the interconnect network, however to take advantage of the Web interface a Remote Supervisor Adapter is required.
- If the interconnect network includes even *one* server with an **ASM processor** that's *not* in an x330 server, or an **ASM PCI Adapter**, then the maximum number of RS485 connections between the ASM PCI Adapters, ASM processors, and Remote Supervisor Adapters is limited to **12**. To go beyond 12, you can add up to **12** *ISM* processor-based (but no Remote Supervisor Adapter-based) servers to this interconnect network, as long as there is at least one Remote Supervisor Adapter (and no more than 12 total ASM processors, ASM PCI Adapters and Remote Supervisor Adapters) among the 24. The ASM PCI Adapters and the ASM processors cannot communicate with the *ISM* processor-based servers, so a Remote Supervisor Adapter, which can communicate with all **24** servers, should be used to manage the interconnect network.

Here are some examples for clarity:

- **10 ASM processors, 1 ASM PCI Adapter, 1 Remote Supervisor Adapter and 12 ISM processors** — Valid
- **10 ASM processors, 1 ASM PCI Adapter, 2 Remote Supervisor Adapters and 11 ISM processors** — **Invalid due to second Remote Supervisor Adapter** (With ASM processors and ASM PCI Adapters on the interconnect network, all Remote Supervisor Adapters must be among the first 12.)
- **24 x330 systems (all ASM processors)** — Valid
- **23 x330 systems and 1 Remote Supervisor Adapter** — Valid
- **23 x330 systems and 1 ASM PCI Adapter** — **Invalid due to ASM adapter** (You would need a Remote Supervisor Adapter to manage the others.)
- **14 x330 systems, 1 Remote Supervisor Adapter and 9 ISM processors** — Valid
- **23 ISM processors and 1 Remote Supervisor Adapter** — Valid
- **24 Remote Supervisor Adapters** — Valid
- **23 Remote Supervisor Adapters and 1 ISM processor** — Valid
- **23 Remote Supervisor Adapters and 1 ASM PCI adapter** — **Invalid due to ASM adapter**

Due to the complexity of interconnecting the older ASM PCI Adapters and ASM processors with the newer ISM processors and Remote Supervisor adapters, it may be advisable to separate them into individual interconnect networks: up to 12 of the older adapters/processors on one network and up to 24 of the newer adapters/processors on another interconnect network. This means administering two separate networks, but greatly simplifies configuring the individual networks. Besides, if there are more than 24 servers in your organization that you wish to manage, they will have to be divided into groups of 12 or 24 anyway.

Servers may also be controlled via direct LAN connection, dial-up access or a serial link. A modem or network adapter on any one of the systems can be shared by all 12 or 24 servers and be used as a “gateway,” both outbound to allow any of those systems to send alerts, or inbound to permit an administrator to control any of the servers remotely. The maximum distance between the first and last processors or adapters is 91.4m (300 ft.).

Table 3 shows which xSeries servers use which IBM systems management solutions:

<i>xSeries Server Model</i>	<i>ASM Processor</i>	<i>ISM Processor</i>	<i>Remote Supervisor Adapter</i>	<i>Interconnect Cable Kit ⁵</i>
x130 / x135 Value Line (Note 1)	N/A	N/A	N/A	N/A
x130 / x135 Performance	Standard (Note 2)	No	Optional	(Note 3)
x200 (Note 1)	N/A	N/A	N/A	N/A
x220	No	No	Optional	No
x232	No	Standard	Optional	Optional (Note 4)
x240	Standard	No	No	Optional
x250	Standard	No	No	(Note 3)

⁵ The IBM Interconnect Cable Kit (P/N 03K9309) is an option for systems using the ASM processor or the ASM PCI Adapter. The kit includes an internal interconnect knockout cable and an interconnect single pigtail cable with two external RS485 ports. The Remote Supervisor Adapter *option* also provides the cabling. The x360 and x440 ship with the Remote Supervisor Adapter installed—but not the interconnect cabling, which is why they require the cable kit.

<i>xSeries Server Model</i>	<i>ASM Processor</i>	<i>ISM Processor</i>	<i>Remote Supervisor Adapter</i>	<i>Interconnect Cable Kit ⁵</i>
x300 (Note 1)	N/A	N/A	N/A	N/A
x330	Standard	No	Optional	(Note 3)
x342	No	Standard	Optional	Optional (Note 4)
x343 (Note 5)	No	No	No	No
x350	Standard	No	No	(Note 3)
x360	No	No	Standard	Optional
x370 (Note 6)	No	No	No	Optional
x380 (Note 5)	No	No	No	No
x440	No	No	Standard	Optional

Table 3. System compatibility for IBM systems management processors and adapters

Notes to Table 3

1. The x200, x300 and the x130/x135 Value Line (which are based on the x300 hardware) do not support systems management processors or adapters. (The x130/x135 Performance Line models are based on the x330 hardware.)
2. As of November 2001, the ASM processor is supported in the x135 Performance Line for out-of band (unplugged) management (i.e., serial or IBM Interconnect), but not in-band (online) management (via the operating system) because the Linux preload doesn't have the device driver installed.
3. The IBM Interconnect Cable Kit is unnecessary on x130/135 Performance Line, x250, x330 and x350 servers, because they include RS485 ports as standard features.
4. Requires a no-charge BIOS update.
5. The Intel Server Control (ISC) processor is included in this server and supported by Intel for systems management functions.
6. The x370 includes an ASM PCI Adapter, which has been withdrawn as an optional feature for other server models.

All of these systems management capabilities work together to help reduce downtime and increase your ability to maximize server productivity and availability.

Hot-Swap / Redundant Components

Many xSeries server components, such as hard disk drives, Active™ PCI and Active™ PCI-X adapters, power supplies, voltage regulator modules (VRMs) and cooling fans are **redundant** and/or **hot swappable**, allowing your system to operate normally despite a component failure. This minimizes maintenance downtime. Combining this hot-swap technology with IBM Director and PFA technology, administrators can be notified of an impending failure and—if redundant components are involved—replace the failing component with no server interruption. Often components can be replaced prior to an actual failure. This prevents downtime and helps facilitate onsite troubleshooting and maintenance.

Active PCI, available in many xSeries servers, helps to increase total server availability by letting you add or replace PCI cards while the system is running. Building upon the success of IBM Active PCI, **Active PCI-X** supports both PCI and the new PCI-X adapters in selected xSeries servers. Active PCI/PCI-X features can be categorized as follows:

- **Hot swap** — Allows you to replace adapters without having to shut down and restart the server.
- **Hot add** — Provides easy upgradeability, by allowing you to add new adapters to the server while it's running. (IBM was the first in the industry to offer this capability.)
- **Failover** — Allows a second—backup—adapter to pick up the workload automatically if the primary adapter fails.

IBM Active PCI for Microsoft Windows 2000, Windows NT and Novell NetWare promotes high availability for xSeries servers. IBM also plans Active PCI support for Linux sometime in 2002. The Windows NT solution includes IBM PCI Hot Plug wizard and IBM PCI Hot Swap wizard. The two wizards provide clear, step-by-step guidance for adding or swapping adapters. Using IBM Active PCI, you can upgrade your server, replace adapters and make other changes without having to shut down your xSeries servers.

IBM Systems Management Software

Systems management software works in conjunction with the hardware. Although the hardware may enable the management capabilities, it is the software that determines what you can do with those features by logging and displaying alerts and other management information and taking appropriate action in response. Tools such as IBM Director, Remote Deployment Manager, ServerGuide™, Software Delivery Assistant, System Migration Assistant and UpdateXpress enable you to take control of your servers and networked client systems to an unprecedented degree.

Using this software, you can remotely deploy new systems, upgrade software, migrate users from old systems to new ones without losing all the system configurations, Web browser bookmark files and other customizations the user spent so much time on, and perform many other management tasks quickly and efficiently. In many cases the tasks can be predefined and automated to run during off-hours when systems are unattended and network usage is low.

IBM Director

In January 2002, IBM strengthened IBM Director's industry-leading systems management capabilities by adding Linux support for many of its previously Windows-only features, as well as many other enhancements. IBM Director 3.1, built upon industry standards, is a powerful suite of tools and utilities included with xSeries servers and designed to manage servers in the Intel environment. IBM Director automates many of the processes required to run your networks productively, including capacity planning, rack management, preventative maintenance, diagnostic monitoring, trouble shooting and others. It supports a variety of operating systems, including Microsoft Windows NT, Windows 2000, Windows XP, Windows 98 and Millennium Edition, IBM OS/2®, Novell NetWare, Linux and SCO UnixWare. IBM Director supports a veritable alphabet soup of industry standards such as DMI, CIM, WMI, SNMP, TCP/IP, IPX, SNA, NetBIOS, SLIP, XML and HTTP, among others.

IBM Director offers a graphical user interface for easy local and remote access and control and smooth integration into higher levels of workgroup or enterprise management tools, including:

- BMC Patrol (new in Director 3.1)
- Computer Associates Unicenter
- HP OpenView
- Intel LANDesk Management Suite
- Microsoft System Management Server (SMS)
- NetIQ (new in Director 3.1)

- Tivoli management software
- TNG Framework

By letting IT administrators view the hardware configuration of remote systems in detail and monitor the usage and performance of critical components, such as processors, disks and memory, IBM Director can help you manage your server with ease and efficiency. More importantly, it can help you control many of the hidden costs of operation.

IBM Director 3.1 was updated to support IBM Enterprise X-Architecture⁶ capabilities, including remote I/O via the IBM RXE-100 Remote Expansion Enclosure and the new Real Time Diagnostics feature of the x360 and x440 servers. Several CIM (Common Information Model)-related enhancements include:

- CIM instrumentation for Linux
- Mass configuration of client CIM properties. — Saves time by setting up and configuring multiple remote systems as a group, rather than having to touch each system individually
- Hardware instrumentation via CIM — Enables RAID and systems management hardware information and alerts to be passed up to higher-level management packages as part of the IBM Director upward integration modules (UIMs)

Another enhancement is automated, color-coded system health checking. (See the *Management console and agent* section for more information.) And, of course, IBM Director 3.1 adds support for the latest xSeries, IntelliStation[®], NetVista[™] and ThinkPad[®] hardware.

Director consists of a management server, the management console and agent and a portfolio of tools for advanced server management:

Management server

The management server is the heart of IBM Director, providing the application logic and current system-related management information stored in an integrated, centralized relational database for easy access, even when the system in question is not available. The management server provides discovery of remote systems, presence checking, security and authentication, management console support and a persistent store of inventory information in its built-in relational database. If preferred, the management server can be configured to use one of the following database products:

- IBM DB2[®] Universal Database[™] 5.2 (or later)
- Microsoft SQL Server 6.5 or 7.0, SQL Server 2000, Access 2000 or Microsoft Data Engine (MSDE) 1.0
- Oracle 7.3.4 through 8.1.7

The management server runs on Windows NT or Windows 2000.

Management console and agent

The management console is a Java[™]-based graphical user interface for performing administrative tasks. It provides comprehensive hardware management via drag-and-drop or a single click. A scrolling “ticker tape” status bar on the bottom of the console window allows the monitoring of system attributes without the user having to open a separate console. (If desired, multiple management consoles can be opened simultaneously.) IBM Director 3.1 added a color-coded system health status monitor. This provides rapid, at-a-glance management information that lets administrators easily and quickly ascertain the health status of managed systems. Director 3.1 also added agents for Linux distributions that are based on the V2.4 kernel. This allows you to

⁶ Go to http://ibm.com/eserver/enterprise_xarchitecture for the “Introducing Enterprise X-Architecture Technology” white paper.

manage, monitor and receive alerts from systems running Caldera, Red Hat, SuSE or TurboLinux.

Figure 2 shows the IBM Director 3.1 console, including the new color-coded health status feature, just above the status bar at the bottom.

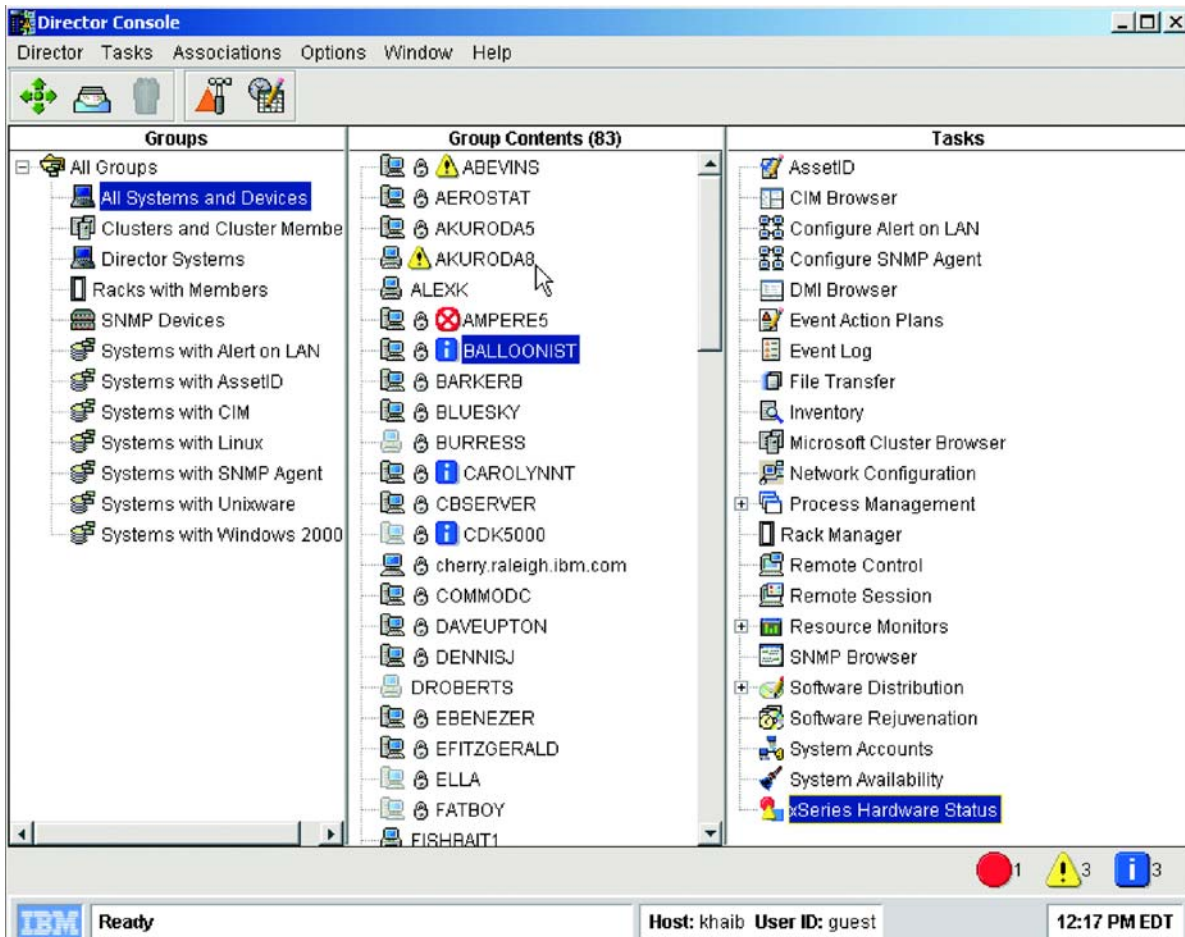


Figure 2. IBM Director 3.1 console

All system-specific data gathered by the management console is stored in the management server relational database. The management console runs on Windows NT/2000, Windows 98 and Windows XP Professional.

IBM Director Extensions

IBM Director extensions expand the manageability of your server hardware to help administrators configure, deploy, manage and maintain IBM @server xSeries servers easily and effectively. IBM Director Extensions include Capacity Manager, Cluster Manager, Management Processor Assistant, Rack Manager, RAID Manager, Real Time Diagnostics, Software Rejuvenation and System Availability. IBM Director 3.1 added Linux support for all extensions except Cluster Manager and the new Real Time Diagnostics.

- **Capacity Manager** — Capacity Manager monitors critical server resources such as processor utilization, disk capacity, memory usage and network traffic. Using advanced artificial intelligence, it identifies bottlenecks for an individual system, a group of systems (new in Director 3.1) or a cluster and recommends upgrades to prevent diminished performance or downtime.

Capacity Manager can even identify latent bottlenecks and make recommendations for preventive action.

For example, Capacity Manager can *help* predict hard disk drive and memory shortages that might cause problems for your systems. Because Capacity Manager features can help you predict problems *before* they occur, the administrator can perform proactive planning and—if necessary—schedule service and upgrades before potential problems degrade performance.

- **Cluster Manager** — Cluster Manager allows an administrator to easily identify, configure and manage clustered servers using one graphical tool. Administrators can be alerted via pager or e-mail about cluster events (in hardware, the operating system and Microsoft Cluster Service [MSCS]). Alternatively, Cluster Manager can trigger recovery programs or others automatically.
- **Management Processor Assistant** — The Management Processor Assistant (MPA) tool, formerly called Advanced System Management, offers exceptional control of systems by letting you monitor critical subsystems as well as restart and troubleshoot servers, even if a server has suffered a fatal error or is powered off. This utility works in concert with the IBM family of systems management processors and adapters described previously. IBM Director 3.1 added management support for the RXE-100 remote I/O unit.
- **Rack Manager** — Rack Manager offers a drag-and-drop interface for easily configuring and monitoring rack components using a realistic visual representation of the rack and its components. It also provides detailed health status information for the rack and its elements. IBM Director 3.1 added the ability to drag-and-drop objects *between* racks.
- **RAID Manager** — RAID Manager lets an administrator configure, monitor and manage local and remote SCSI and IDE RAID subsystems without taking the server(s) offline, and thus avoiding costly downtime. IBM Director 3.1 added FRU (field replaceable unit) number reporting in alerts for RAID components and hard disk drives. This reduces labor and service costs by providing replacement part information in the alert message so that the correct part is sent with the service call.
- **Real Time Diagnostics** — Real Time Diagnostics helps maintain server availability by performing diagnostics on system and subsystem components while the server is still running, without interrupting the users. This IBM Director-based tool analyzes all system and subsystem components, including processors, hard disk drives, RAID controllers and attached drives, tape drives and memory then proactively alerts the administrator of suspected component problems. Because Real Time Diagnostics is designed to identify and analyze server issues *before* they become critical, the server can stay up and running longer. Currently, Real Time Diagnostics runs on Windows 2000. Support for Windows .NET and Linux are planned for the future.
- **Software Rejuvenation** — In networked servers, software often exhibits an increasing failure rate over time, due to programming errors, data corruption, numerical error accumulation, etc. These errors can spawn threads or processes that are never terminated, or they can result in memory leaks or file systems that fill up over time. These effects constitute a phenomenon known as "software aging," which can lead to unplanned server outages.

Advanced IBM analytical techniques allow IBM Director Software Rejuvenation to monitor trends and *predict* system outages based on the experience of system outages on a given server. Alerts of this sort act as Predictive Failure Analysis for software, giving an administrator the opportunity to schedule servicing (rejuvenation) at a convenient time in advance of an actual failure and *avoid* costly downtime. Software Rejuvenation can be scheduled to reset all or part of the software system with no need for operator intervention. When software rejuvenation reinitializes a server, the server's software failure rate often returns to its initial lower level because resources have been freed up and the cumulative effects of numerical errors have been removed.

When Software Rejuvenation is invoked within a clustered environment, cluster management failover services (such as Microsoft Cluster Services and Microsoft Datacenter Server) may be used to gracefully stop the offending subsystem and restart it on the same or another node in the cluster in a controlled manner. In a clustered environment, xSeries servers can be set to failover to another server, then be reset by IBM Director without downtime.

IBM Director 3.1 added a Trend Viewer feature to graphically monitor the software aging process and an “application culprit” list that identifies the applications most likely to be causing the aging.

- **System Availability** — System Availability accurately measures uptime/downtime for individual servers or groups of servers, and provides a variety of graphical views of this information. This enables you to track the improvements in your server availability in order to validate the benefits of the systems management processes and tools. IBM Director 3.1 added the ability to distinguish between planned vs. unplanned outages.

A future release of IBM Director will gain the ability to distinguish between chassis and partitions⁷, so that systems management hardware alerts can be pinpointed by both partition and chassis. (Figure 3 shows how the new IBM Director console may look with the Enterprise X-Architecture System Partition Manager. Note the system partitioning tasks.)

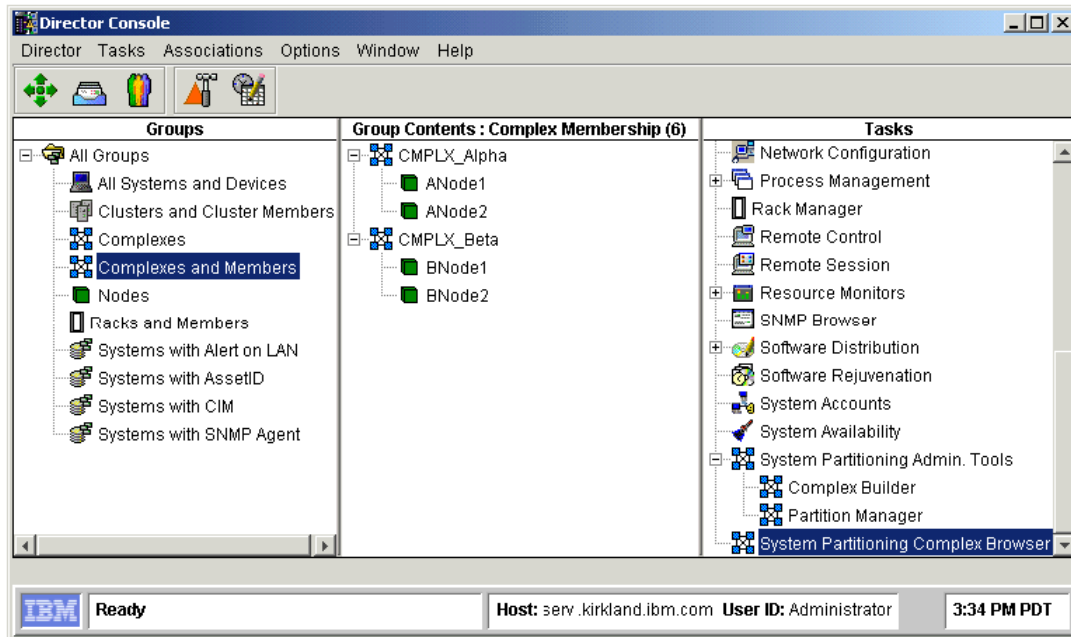


Figure 3. Future IBM Director console that includes partitioning support

Future versions of IBM Director also plan to add two new IBM Director Extensions—*System Partition Manager* and *Active PCI Manager*:

- **System Partition Manager** — System Partition Manager provides a graphical interface for x440 users to create hardware partitions (initially static partitions, with other types to come in time). It allows an administrator to configure a specific server (while it is offline) from a remote system, prior to starting the OS. (Figure 4 shows an early version of System Partition Manager.) System Partition Manager uses the network link to the onboard systems management processor or adapter to establish the relationships among nodes. These relationships are maintained in a persistent database and can be recalled and activated at any time using the graphical interface. Because System Partition Manager integrates with IBM Director, it is part of a common management infrastructure that is used to manage a running partition.

⁷ Go to <http://ibm.com/eserver/xseries> for the white paper entitled “System Partitioning on IBM @server xSeries Servers” for more information. From the xSeries home page, select **Library** for links to the different types of documentation available.

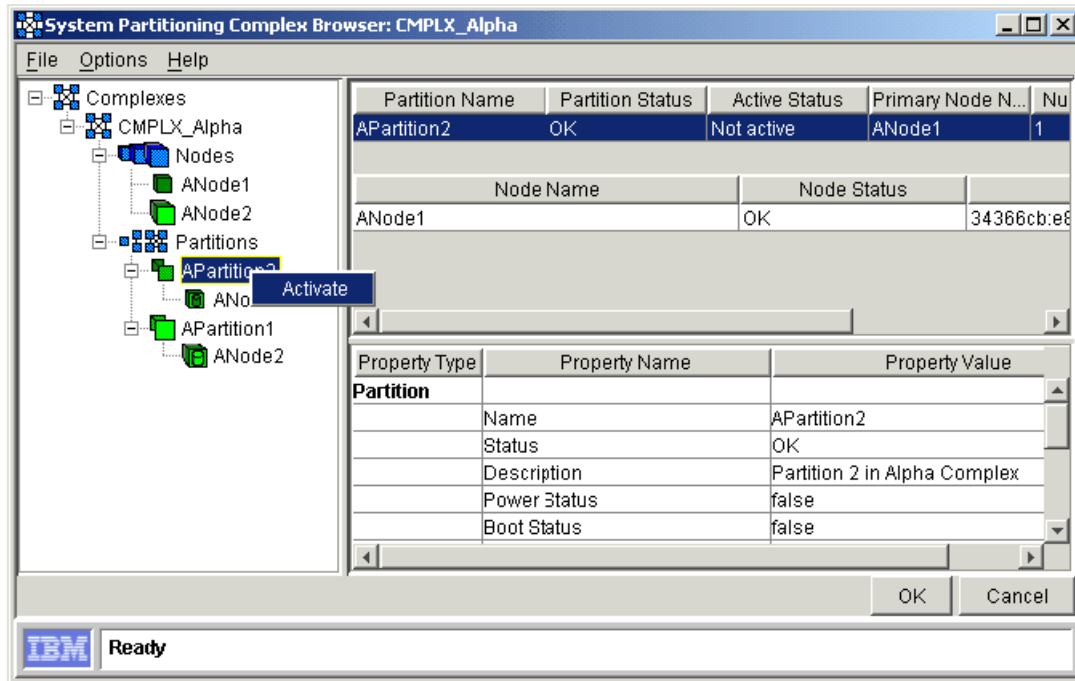


Figure 4. System Partition Manager

- Active PCI Manager** — Active PCI Manager helps x360 and x440 users optimize I/O performance by matching card characteristics to the PCI-X bus and offering guidance as to the best slots in which to install PCI and PCI-X adapters. It also suggests whether adapters should go in the server or in an RXE-100 Remote Expansion Enclosure containing an additional 6 or 12 PCI-X slots. Active PCI Manager helps optimize the allocation of slots to the bus speeds, in order to maximize throughput. Currently, Active PCI Manager supports only Windows 2000. Support for Microsoft Windows .NET is planned for a future version of Active PCI Manager. (Figure 5 shows how this tool—still in development—might look in the final version.)

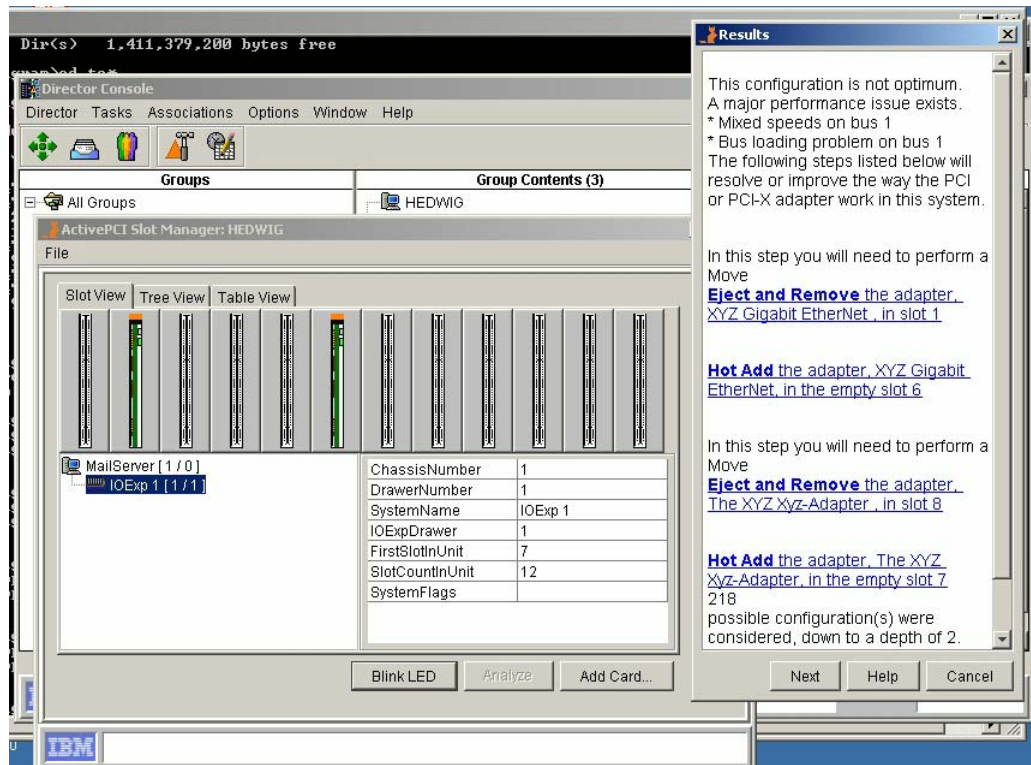


Figure 5. Active PCI Manager

IBM Process Control

Developed by IBM, Process Control enables an administrator to control how multiple applications access a server's resources. (Process Control was provided to Microsoft for inclusion in Windows 2000 Datacenter Server, however it is *available only from IBM* for the Windows 2000 Server and Advanced Server products.) Rather than letting applications demand as much memory and processor cycles as they want, administrators can set specific limitations on these and other system resources.

By preventing greedy applications from dominating server resources, IBM Process Control can help improve performance both for the server overall and for application users in general. Application vendors have no incentive to impose restrictions on their software. One application may have its priority set unnecessarily high, to the detriment of all other applications. Or two applications may each try to use all available memory, causing contention. These types of ill-behaved applications make it virtually impossible to run many applications concurrently on a conventional server.

Process control allows administrators to apply fairness rules, based on business needs, to programs running on a server by:

- Assigning affinities to achieve server partitioning
- Assigning priorities to rank applications relative to one another
- Assigning scheduling classes to differentiate within priorities
- Enforcing processor time limits to kill runaway processes
- Enforcing memory commitments to limit real and virtual memory consumption
- Limiting the number of processes running concurrently

Process Control is a snap-in for Microsoft Management Console (MMC) that offers both command line and graphical interfaces. (Figure 6 shows the graphical interface.) It complements the Windows 2000 Task Manager and System Monitor without trying to replace either.

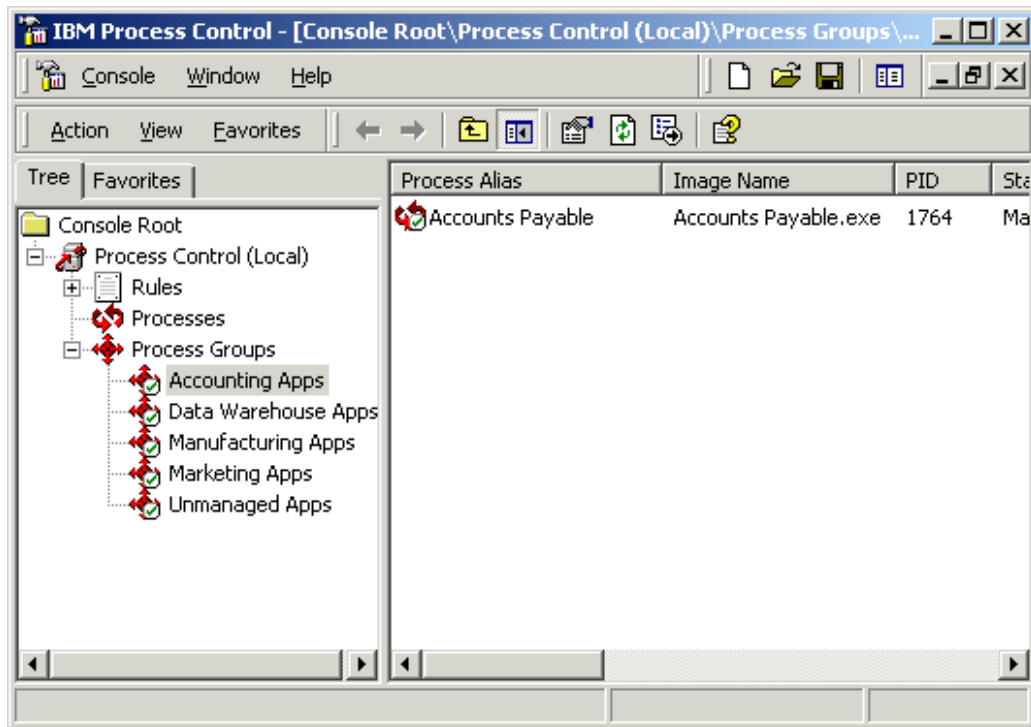


Figure 6. IBM Process Control

Here are some sample uses for Process Control:

- Consolidate two applications on a 4-way server and set up Process Control so that each program is assigned to two processors.
- Assign a higher priority to the current production version of an application, while a newer version runs at a lower priority during limited testing prior to deployment. This allows you to test the new version without hurting the performance of the server for the production users.
- Limit the execution time of a buggy application so that it can't get stuck in a loop and tie up processor cycles. (At the same time, you can configure Process Control to automatically send an alert to IBM Director that the process has terminated and set up an IBM Director event action plan to automatically restart the application.)
- Limit the number of concurrent copies of an application to two, where more instances of that program results in excessive paging and disk thrashing.

Figure 7 illustrates the simplicity of assigning application-to-processor affinity:

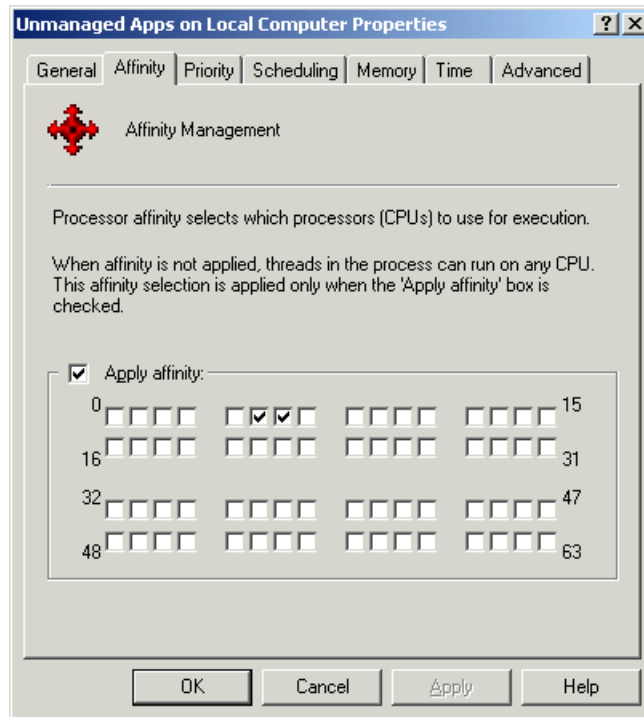


Figure 7. IBM Process Control affinity management

System Deployment

So you finally got the go-ahead to replace 1,000 old PCs and a dozen servers with brand new state of the art models. Now all you have to do is figure out how you will install your corporate-standard software suite on all of them as quickly as possible, and do it without major disruption to either your IT staff or the recipients of the new PCs. If you chose IBM as your computer supplier you just made your job infinitely easier, because IBM servers include software specifically designed to simplify the installation, configuration and deployment of both servers and client systems. These tools include IBM ServerGuide, IBM Remote Deployment Manager, IBM Software Delivery Assistant, IBM System Migration Assistant and UpdateXpress.

IBM ServerGuide is a server installation assistant that simplifies the process of installing and configuring xSeries servers. ServerGuide goes beyond mere hardware configuration by assisting with the installation of your operating system, system device drivers and other system components with minimal user intervention. The goal of ServerGuide is to simplify and shorten installation. This focus on deployment helps you reduce both your total cost of ownership and the complexity that administrators and technical personnel face.

ServerGuide, an important part of xSeries systems management, is shipped with most xSeries servers at no additional charge. It has been expanded and updated to help you install Microsoft Windows NT, Windows 2000, Windows 2000 Advanced Server, Red Hat and SuSE Linux faster than ever before. It addresses most configuration and onsite requirements during deployment, setup and configuration. The built-in intelligence of ServerGuide recognizes machine types and models as well as firmware versions and other hardware criteria. As a result, ServerGuide offers installation and configuration choices for your system.

IBM Remote Deployment Manager is a tool that runs on your xSeries server to simplify and automate the deployment, redeployment, lower-level management and disposal of other xSeries servers, IBM IntelliStation workstations, IBM ThinkPad notebooks, IBM NetVista desktops and IBM Point-of-Sale computers. Remote Deployment Manager (RDM) incorporates imaging technology

from industry leader PowerQuest to provide high performance cloning, recovery, and reprovisioning solutions.

RDM gains control of a system by downloading an operating system from the network. This provides two key capabilities:

- Perform via the network many of the lower-level tasks that previously required a visit to each computer
- Deploy and manage many systems concurrently

Using RDM, a network administrator can perform the following kinds of tasks remotely:

- Configure a RAID adapter
- Configure a service processor/adaptor
- Flash BIOS and other system firmware
- Modify CMOS settings
- Perform automated installation of operating systems and applications
- Backup and recover the primary partition
- Erase all data on the system's hard drives, making the data nonrecoverable (to protect sensitive information when a system is redeployed or retired)

RDM supports the deployment of the following operating systems:

- Microsoft Windows 2000 Professional, Server and Advanced Server
- Microsoft Windows 98
- Microsoft Windows NT 4.0 Workstation and Server
- Microsoft Windows XP Professional
- Microsoft Windows .NET (future release of RDM)
- Linux (future release of RDM)

RDM can be installed on Windows 2000, Windows XP and Windows NT.)

RDM is licensed to deploy IBM supported systems at no additional charge, and it may be downloaded from http://ibm.com/pc/us/eserver/xseries/systems_management/dwnl.html. Customers may also purchase Remote Deployment Manager licenses to deploy non-IBM systems (as part of the IBM Software Installation Toolkit⁸).

Rapid Restore, which is part of Remote Deployment Manager, partitions the hard drive and loads software applications and an extra copy of the operating system during the initial loading of the operating system. If the OS should fail, Rapid Restore allows the user to restart the PC using the extra copy of the operating system. The user can be up and running again quickly, without waiting for problem diagnosis or for a technical support person to be dispatched.

IBM Software Delivery Assistant (SDA) helps virtually eliminates delays caused by waiting for the IT staff to find time to update each user's system. It eliminates the cost of user downtime caused by the absence of necessary software on their systems. It also reduces disk storage costs, because the company needs to maintain only a single server image of all its applications. SDA accomplishes this by installing all applications required by a user's job description, including core applications (such as personal productivity tools) and others (including enterprise resource planning, customer care, financials, human resources, programming languages, etc.). SDA recognizes the user's profile and therefore knows who that user is, what his or her job is, and which software is needed for that person to accomplish the job.

⁸ Go to http://commerce.www.ibm.com/cgi-bin/ncommerce/ProductDisplay?prfnbr=1888008&cntrfnbr=1&prmenbr=1&cntry=840&lang=en_US for more information about the IBM Software Installation Toolkit for Non-IBM Servers.

IBM System Migration Assistant (SMA) enables custom settings, e-mail and data to be migrated from a user's former PC to a new PC accurately and efficiently. When older computers are refreshed or new computers are distributed, moving user data and system settings to the new system can be expensive and time-consuming. Users who can't find the spreadsheets their bosses sent them or who lose the valuable bookmarks they have been saving in their browser over the years are not only frustrated, they are unproductive. SMA can help resolve these issues.

IBM UpdateXpress can help reduce your cost of computing by providing a simple yet effective way to update server firmware and the firmware of supported options within most xSeries servers. With UpdateXpress, administrators no longer have to spend hours visiting each individual server that they want to update. Now they can update the server or client system firmware from anywhere on the network.

UpdateXpress detects the server and subsystem components and firmware levels and presents this information to the system administrator. It then provides the administrator the option of selecting specific upgrades manually or allowing UpdateXpress to automatically upgrade the system unattended. This allows administrators to better utilize their time and skills performing other urgent or high-level tasks while the server firmware is being upgraded.

Through an HTML index page (new in V1.0.5), the administrator can easily view and select self-extracting BIOS and diagnostic update packages, with or without system restart capabilities. The administrator can also deploy these update packages via the software distribution function of existing workgroup management software, such as Tivoli, Microsoft SMS, CA Unicenter or HP OpenView. This makes it easier for system administrators to keep all systems operating at peak efficiency, automatically—even remotely.

UpdateXpress benefits include:

- Detecting and presenting the level of current system and subsystem firmware and enabling the upgrade of firmware (BIOS, diagnostics, tape drives and hard drives) and device drivers (system board, SCSI controllers, Ethernet controllers, systems management processors and ServeRAID™ controllers).
- Allowing the system administrator to manually select components for upgrading. UpdateXpress performs an automatic and unattended upgrade of the system and subsystem components.
- Performs an automatic and unattended upgrade of the system and subsystem components.

Storage Management

When considering systems management, don't forget about storage management to help protect your critical data and reduce server downtime. Overall systems management is incomplete without effective storage management. IBM storage management tools include IBM Director RAID Manager (described in the IBM Director section, previously), IBM ServeRAID Manager and FlashCopy.

For simpler deployment and integration of SCSI and fibre-based storage on the latest generation of SCSI RAID controllers, IBM ServeRAID products provide a cost-effective, reliable foundation for your business-critical storage. ServeRAID adapters support nine levels of RAID, including enhanced RAID 1E, 1E0 and 5E, to enhance integrity and availability. **IBM ServeRAID Manager** is a combination of software and firmware that supports the enhanced functions of the ServeRAID adapters, including clustering, Active PCI and Active PCI-X, as well as adapter failover capabilities. ServeRAID Manager integrates with IBM Director to provide management and control of the RAID array using a common interface.

In addition, the **FlashCopy™** high-availability software, included with ServeRAID Manager, provides an almost instantaneous copy of a logical volume. By supporting fast duplication, FlashCopy helps minimize application downtime associated with performing backups and restores. FlashCopy makes it possible for you to access both the source and destination copies. This enables applications that use either the source or destination copy to operate almost without interruption. In addition,

FlashCopy can improve system performance by offloading host resources. This tool takes a snapshot of the source drive and places it on the target drive, which can then be extracted and used in another server or placed on tape. Previously, this type of technology was available only on high-end enterprise storage platforms.

Tape Drive Management Assistant

Cleaning the read/write heads of tape backup units is a commonly overlooked preventive maintenance task. Lack of periodic cleaning is one of the primary causes of premature failure of the drives. Even worse, a seriously dirty drive can produce corrupted backup tapes, resulting in the loss of critical data when retrieval is necessary.

This situation is easily preventable through a regimen of periodic cleaning. In the past it was up to busy administrators to keep track of the cleaning schedule, which often was overlooked. This is why IBM is developing a tape drive management tool to automate the scheduling process for the administrator. When it is released in the second half of 2002, it will be designed to generate reminders according to the predefined factory schedule and sends an e-mail reminder to the administrator. Tape Drive Management Assistant then logs the sending of the message and later logs when the cleaning is performed. The Tape Drive Management Assistant tool will integrate with IBM Director so that all server management functions can be performed via one unified front-end program. The logs can be reviewed by the administrator and by service personnel to verify that the cleanings were performed as scheduled. More frequent cleanings contribute to longer-lasting tape drives and can help ensure that your backed up data will be available when you need it.

Service and Support Options

IBM servers are designed to be easy to install, extremely reliable and simple to maintain. Yet sooner or later there will come a time when you need help. You may simply have a configuration question or need a firmware upgrade. Any vendor can supply this level of support via the Web. But if you need assistance with something more complicated, and especially if you need help quickly or in the wee hours of the morning, it is important that you have access to sophisticated self-help tools available around the clock and experienced support personnel. IBM offerings in this area include IBM Access Support, IBM Electronic Service Agent™, and the IBM HelpCenter® support centers.

Online Support

IBM offers extensive technical support via the Web at <http://ibm.com/support>. Support options include links to forums/newsgroups, problem submission, online shopping support, service offerings, device drivers for all IBM product lines, software downloads and even upcoming technical seminar worldwide schedules and registration. (The direct URL for IBM @server support is <http://ibm.com/server/support>.)

In addition, IBM recently introduced a new support tool called **IBM Access Support** for desktop, mobile and xSeries server customers. Access Support is a customizable HTML-based application portal that provides tools, support, and services in a common interface to help diagnose and resolve common user problems. It provides information and functions that include automated solutions to common system problems, a display of key system configuration, automated self-service, as well as links to system update tools and icons to support applications. System information can be saved to an XML file and sent to another system, or accessed remotely from an authorized client or server.

The initial release is a stand-alone application that does not require connectivity to the Internet. Key functions of this initial release of Access Support include:

- **Viewing system details** — This feature provides detailed information about a computer. It displays a snapshot of the basics (machine type, model, serial number, etc.) plus an extensive

breakdown arranged in an easy-to-navigate tree structure that include BIOS information, SCSI/IDE devices, device drivers, and much more.

- **Using automated solutions** — Use automated solutions to identify, diagnose and fix common issues that previously required the user to follow manual, time consuming instructions in the user guide or a problem determination check list on the Web.
- **Starting help applications and getting software updates** — These interfaces serve as a launch pad and contain short cuts and links to other software support tools, such as UpdateXpress, Real Time Diagnostics, IBM Director, and the IBM Electronic Service Agent.
- **Updating Access Support** — When new versions of Access Support are available, this feature will enable users to easily download the new versions.

The IBM Access Support client may be downloaded using a new automated Web install and content update process from the IBM customer support Web site. The initial release introduces the application and configuration protections feature which allow customers to restore selected system settings to a previously known working condition. Customers can also expect enhancements to the systems details interface as well as a dynamic display of content relevant to their machine configuration while connected to the Internet. Automated solutions can also be executed from the IBM customer support Web site without having the client application.

IBM Access Support offers a unique solution for customers who need fast, accurate, and easily understandable answers to questions about their computing environment. It also serves as a self-help tool that provides customers with the knowledge they need to solve common problems on their own. This promotes user productivity and significantly reduces computer problem-solving time. Access Support can be used as a stand-alone application or in conjunction with many other tools that can provide additional help and support.

IBM Access Support is supported on specific ThinkPad, NetVista, IntelliStation and xSeries models. Access Support is available to xSeries Server customers via the ServerGuide application CD. Go to <http://ibm.com/pc/qtechinfo/MIGR-4WLSC7.html> for more information on Access Support.

IBM Access Support helps you resolve usage questions and obtain software updates, but what about hardware issues? IBM offers an innovative “call home” feature that allows xSeries servers to immediately and automatically place a service call to IBM support, which can dispatch onsite service if necessary. The **IBM Electronic Service Agent (eSA)** is a no-charge software tool that resides on a server and provides electronic support and problem management capabilities through a secure electronic dialogue between your systems and IBM. eSA monitors your networked servers for hardware errors and has an integrated performance monitor function that automatically collects system utilization information. eSA can also perform hardware and software inventories and reports inventory changes to IBM. All information sent to IBM is stored in a secure database and used for improved problem determination.

eSA allows IBM to quickly and proactively respond to customers and to assist in maintaining higher availability and performance. eSA takes advantage of the IBM Director remote management capabilities and allows remote monitoring of the customer environment from IBM for advanced problem determination. It is supported on most xSeries servers and is available as long as the server is under warranty or is covered by an IBM maintenance agreement. Additional fee services are available, including:

- System health check
- Capacity planning
- Inventory management

For more information, or to download, go to <http://ibm.com/support/electronic> (click on *Electronic Service Agent Information*).

IBM HelpCenter Support Centers

More than 1,700 support specialists staff the award-winning IBM HelpCenter support centers. These specialists can answer your questions about IBM servers, network equipment, storage options and other IBM products—in 22 languages. The IBM HelpCenter also handles OEM operating systems and applications supported on IBM systems. You can reach IBM experts by phone and the Internet, including interactive Web-based forums monitored by IBM specialists. The HelpCenter is available 24 hours a day, seven days a week, 365 days a year, and spans nine facilities around the world⁹ that provide backup and overflow support for one another as needed. A single, centralized database helps IBM technicians share customer information and solutions worldwide to provide fast, accurate responses to customers. We're here when you need us.

How X-Architecture Technologies Fit into Project eLiza

Real Time Diagnostics and IBM Director are just two of the technologies that go into the IBM Project eLiza initiative. Project eLiza is an ongoing “autonomic computing” initiative aimed at creating self-managing servers that require little or no human interaction, with the goal of making computing networks as easy to manage as today’s kitchen appliances. Autonomic computing takes its name from the autonomic nervous system in the human body, which monitors and regulates functions such as breathing and digestion. The objective of eLiza is to use autonomic computing to reduce the amount of human input needed to run large networks and server farms and, in doing so, reduce operating costs to businesses. Four major categories serve as the foundation for Project eLiza technologies: self-optimizing, self-healing, self-configuring and self-protecting.

Project eLiza incorporates many IBM X-Architecture and Enterprise X-Architecture features (shown in *Table 4*), including the other high-availability aspects of the IBM OnForever initiative. Utilizing IBM @server xSeries servers, businesses now have access to a number of critical self-managing capabilities that help predict, identify and repair problems before availability is affected.

Self-Configuring	Self-Optimizing	Self-Protecting	Self-Healing
<ul style="list-style-type: none"> • C2T Interconnect cabling • Hot-add components • IBM Director automatic mass configuration of hardware • Remote I/O (RXE-100) • ServerGuide • System Partitioning • UpdateXpress • XpandOnDemand scalability 	<ul style="list-style-type: none"> • Hot-add memory • IBM Director Active PCI Manager • IBM Director Automated Event Action Plans • IBM Director Capacity Manager • IBM Director System Partitioning Manager • Memory eXpansion Technology (MXT) • Real Time Diagnostics • Remote Deployment Manager 	<ul style="list-style-type: none"> • Electronic Solution Assurance Review (eSAR) • Fibre Array Storage Technology (FAST) • Memory mirroring • Memory ProteXion • ServeRAID FlashCopy • Systems management processors 	<ul style="list-style-type: none"> • Active PCI / PCI-X • Automated System Health • Automatic Server Restart • Chipkill memory • Electronic Service Agent • Hot-swap/hot-add and/or redundant processors, memory, hard disk drives, fans, power supplies and adapters • IBM Director Software Rejuvenation • Light Path Diagnostics • Predictive Failure Analysis (PFA)

Table 4. eLiza technologies

Note: Bold text indicates Enterprise X-Architecture technologies.

⁹ HelpCenter response times vary and support hours may vary by geography.

Visit <http://ibm.com/servers/eserver/introducing/eliza> for more information about Project eLiza.

Conclusion

The IBM system management solution for xSeries servers provides administrators with a complete set of tools to help reduce the total cost of ownership through the effective management, maintenance and optimization of LAN-attached xSeries servers and clients. These tools, which include hardware, software and firmware, as well as online and consulting services, work in concert, for the most effective manageability of server systems in the industry today. As a result, the factors that contribute to most network business system failures can be anticipated, assessed and dealt with well before they can become a problem.

It is estimated that most organizations spend as much as six times the purchase price of their systems to install, support and maintain those systems. Reducing this total cost of ownership is exactly what the IBM systems management tools were designed to do.

IBM systems management adapters and processors complement the server hardware instrumentation and management software to provide system administrators with total remote management of a system independent of the server status. The management processor can automatically restart the system and proactively alert the administrator in case of problems.

IBM Director, the centerpiece of IBM systems management software tools, is based on industry standards and designed for ease of use. The intuitive Java-based GUI helps administrators manage single or large groups of IBM and non-IBM Wired for Management (WfM) 2.0 servers, mobile computers and workstations. Because of its industry-standard foundation, IBM Director can be easily adopted into heterogeneous environments and help reduce total cost of ownership through reduced downtime, increased productivity and reduced service and support costs. It can also integrate into robust enterprise and workgroup management systems from such vendors as Tivoli, Computer Associates, HP, Microsoft and Intel. Tools like IBM Director Software Rejuvenation—which can predict upcoming software failures and automatically correct them before they become a problem, and IBM Process Control—which allows you to better utilize your system's resources—are examples of innovative IBM software technologies put to good use for systems management.

Add to this the excellent service and support for which IBM is famous—including IBM Access Support, Electronic Service Agent and the IBM HelpCenter support centers located around the world—and you have a complete solution for your xSeries servers.

The result is that the xSeries systems management features allow you to run your business-critical applications with the confidence that they will be available when your end users and customers need them. This means that you can spend less time managing your IT assets and more time managing your business. After all, wasn't the reason you bought the servers in the first place to *reduce* your workload?

Additional Information

Visit our Web site at <http://ibm.com/eserver/xseries> (or call 1-888-SHOPIBM) for more information on IBM @server xSeries server direction, products and services, including part numbers and prices for the hardware and software products described in this paper. From the xSeries home page, select **Library** for a list of the types of documentation available.



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