Intelligent systems management, rock-solid reliability
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Systems Management for IBM @server xSeries Servers 2003

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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 we provide 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 systems 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, via 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™ technology, which takes the best capabilities of 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 *autonomic computing*—an IBM vision for advancing the goal of self-managing systems by incorporating multiple layers of self-healing tools designed to allow the server to continue operating, despite system errors or failures. This support is achieved on xSeries servers via 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 can help you solve your systems management concerns.

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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 and evolve in turn. In this environment, IT professionals are faced with a variety of management concerns.

Businesses today continue to decentralize their IT assets. They are doing this with new tools and technology that can offer more, and better, functionality, but often at the cost of increased complexity. In a recent survey[1] conducted by CIO Insights, 42% of the almost 500 IT executives polled said their systems were more complex than necessary, and that *maintaining and managing the excess complexity cost them an average of 29% of their IT budgets*. 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, as a facet of autonomic computing, corrects some problems automatically, enables early warning of impending problems and allows quick solutions to problems remotely. IBM @server xSeries servers, with advanced local and remote management capabilities, offer that level of systems management, no matter the size of your networked business.

Many models offer features such as:

- Integrated **systems management processors** or **adapters**
- **Automatic Server Restart** to automatically 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**® to enable rapid identification of a failing component within the server as much as 48 hours *before* actual failure occurs
- **Light Path Diagnostics**™ to quickly and simply direct a servicer to the location of a failed or failing component via a central operator panel and component LEDs
- **Real Time Diagnostics** that allow an administrator to run hardware diagnostics *without* taking the server offline
- **C2T Interconnect**™ cabling and **Advanced Connectivity Technology** cabling to simplify the cable management of rack-optimized servers
- **IBM Director** and IBM **Tivoli**® systems management software to provide a consistent user interface for many systems management tools

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 systems management software into higher levels of workgroup or enterprise management tools such as Tivoli Enterprise Framework and NetView®, Microsoft® System Management Server (SMS), 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.

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[1] CIO Insights, February 2003.

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 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, includes such features as:

- Wake on LAN®
- Preboot Execution Environment (PXE)
- Automatic Server Restart (ASR)
- Alert Standard Format (ASF)
- Wake on LAN Startup Sequence
- Support for the optional IBM Remote Supervisor Adapter I or Remote Supervisor Adapter II

The second level, **Tier 2**, enhanced integrated systems management (which includes Tier 1 functionality), comprises technologies such as:

- Predictive Failure Analysis
- Light Path Diagnostics
- Temperature, voltage, fan and other environmental monitoring and alerting
- IBM Integrated Systems Management Processor (ISMP)
- Remote systems management capability
- Error logging
- Remote power control
- Redundant fans, power supplies and other components

The pinnacle of IBM systems management technology, **Tier 3** (which includes Tier 1 and Tier 2 functionality), adds:

- Built-in IBM Remote Supervisor Adapter
- The ability to manage a rack of up to 24 servers from a *single* Ethernet connection using a Remote Supervisor Adapter (I or II), or via serial connection (Remote Supervisor Adapter I only)
- Web-based out-of-band control
- Remote redirection of video, keyboard and mouse
- Microsoft Windows® “blue screen” capture
- Independent Ethernet controller and A/C power

- Independent serial port
- Virtual floppy drive
- Virtual CD-ROM drive — Remote Supervisor Adapter II only
- SSL security support — Remote Supervisor Adapter II only
- Lightweight Directory Access Protocol (LDAP) support — Remote Supervisor Adapter II only (Q3/03)

These and other capabilities are described in the following sections.

Restarting Offline Clients and Servers

xSeries servers employ a number of technologies, both manual and automatic, local and remote, that work to restart offline systems.

Wake on LAN permits a server to be remotely powered on if it has been shut down. Once restarted, the server can be started from across the network using the **Preboot Execution Environment** (PXE).

Like Wake on LAN, PXE is system firmware. It allows software such as the optional **IBM Remote Deployment Manager** 4.1 to take control of a system before the operating system or applications are loaded (using Wake on LAN and PXE) 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, updating the system firmware, changing CMOS configuration options or deploying a Windows or Linux 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 **Wake on LAN Startup Sequence**, which allows servers awakened by Wake on LAN to start up using that startup order, rather than the normal sequence.

These features can save your administrator the time and effort of traveling to each of the servers (some of which may be in other locations) and turning them on individually. More than that, the administrator can perform offline maintenance on them after they are restarted. Plus, using IBM Remote Deployment Manager, entire system software images or individual applications can be “broadcast” or “pushed” during downtime from a server to many different systems on the network for automated installation.

Wake on LAN is great for starting a client system remotely from a server, but what if it’s the push 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 press the power button or 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 revenues[2]. 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.

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[2] According to *Sm@rtPartner* magazine (September 18, 2000), for an e-commerce company like Amazon.com every *minute* of downtime costs $240,000 (**$14.4 million** *per hour*); for a Wall Street brokerage firm the cost is $108,000 per minute (**$6.5 million** *per hour*). This amount is likely to increase over time.

Several years ago, IBM developed a solution to this problem: **Automatic Server Restart** (ASR). ASR technology is a combination of hardware circuitry tied into the server's system reset function and a device driver.

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[3] 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 two 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 two 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 two 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.

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 48 hours before failure occurs. This can provide administrators the time to locate replacement parts and replace the failing components prior to actual failure—and at a time that's convenient to the administrator. In conjunction with **IBM Director Software Rejuvenation** (described later), PFA can also 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 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 it can 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[4]:

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[3] ASR includes support for the following operating systems: Microsoft Windows NT® Server 4.0 and Server 4.0 Enterprise Edition; Windows 2000 Server, Advanced Server and Datacenter Server; Windows Server 2003 Standard Edition, Enterprise Edition, Enterprise Edition for 64-bit Itanium 2 Systems, Datacenter Edition and Datacenter Edition for 64-bit Itanium 2 Systems; Novell NetWare 4.11/4.12/5.x/6.x; SCO UnixWare[1] 7.1.1/7.1.3; IBM OS/2® Warp Server for e-Business and Warp Server Advanced V4; Red Hat Linux (for Uniprocessor and SMP) 6.2/7.1/7.2/7.3/8.0 and Advanced Server 2.1; SuSE Linux (for Uniprocessor and SMP) 7.2/7.3/8.0/8.1 and SuSE Linux Enterprise Server (SLES) 7.0/8.0.

[4] PFA-enabled components vary by xSeries server model. Not all of these PFA-enabled features are found in all xSeries models.

PFA-enabled Components	*IBM @server xSeries Servers*
Hardware: Hard disk drives	Yes
Memory	Yes
Processors	Yes
Fans[5]	Yes
Voltage Regulator Modules (VRMs)	Yes
Power supplies	Yes
XceL4™ Server Accelerator Cache	Yes
Software (via IBM Director Software Rejuvenation)	Yes

Table 1. *PFA usage in xSeries servers*

The unique IBM **Light Path Diagnostics** feature incorporated in most xSeries servers sets a new standard for Intel processor-based server maintenance and repair. Light Path Diagnostics contributes to enhanced manageability by identifying the exact failed or failing component and quickly leading the servicer directly to it. 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 systems management processor alerts IBM Director, 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 335 server.)

Servers with Light Path Diagnostics also include LEDs associated with specific components (DIMMs, HDDs, etc.) 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.

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.

Figure 1. *Light Path Diagnostics panel*

[5] PFA support for fans requires an optional IBM Remote Supervisor Adapter I or II.

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

Alert Standard Format (ASF) server firmware alerts IBM Director to anomalous environmental factors, such as voltage and thermal conditions—even if the server has failed.

A relatively new technology in 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. This is a feature that has been available for some time on larger servers but was lacking in the industry-standard server market, until recently. Real Time Diagnostics is available on all xSeries servers.

Real Time Diagnostics can be operated through IBM Director on Windows 2000-based xSeries systems to provide a consistent, easy to use management interface for controlling many system functions. Linux support is planned for a future version. (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, IBM systems management technologies[6] enable extensive *remote* management of your xSeries servers using the following technologies:

An IBM systems management processor or adapter is included in all currently marketed xSeries servers except models x205, x225 and x305 which ship with ASR only. The adapters, which have enhanced systems management capabilities, 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 **Integrated Systems Management Processor** (ISMP) is an integrated processor included in most xSeries models to monitor the system. It is an integrated subsystem solution that runs independently of the server's hardware and operating system. Each ISMP contains a microcontroller and nonvolatile memory.

The ISMP generates Predictive Failure Analysis notifications, sends alerts to IBM Director if the IBM Director Agent is installed an running (otherwise via ASF or a Remote Supervisor Adapter), and controls the server's Light Path Diagnostics functions. Other functions provided by the ISMP include:

- Remote flash update of ISMP processor firmware
- Remote server power control (power on and off) and reset
- Sending alerts to IBM Director via LAN
- Access to embedded Vital Product Data with serial numbers of key components, through IBM Director or a Remote Supervisor Adapter
- Generating alerts for voltage threshold exceeded, critical and noncritical temperature threshold exceeded, single and multiple fan failures, power supply failures, hard disk failures, operating system hangs and other conditions
- Support for the IBM Interconnect Cable Kit (described below)

[6] Each system management product does not support every operating system listed.

Given all of these powerful remote management functions, security is essential. The Remote Supervisor Adapter 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 half-length 32-bit PCI **Remote Supervisor Adapter I** (standard in some xSeries models, optional in others) adds a dedicated Ethernet controller to the one or two (depending on the model) included with the server, for situations where the operating system is not available—the Remote Supervisor Adapter I Ethernet connection, when combined with the optional external power source will provide limited 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 (optionally with the event log attached) to designated IT personnel; industry SNMP, DNS, PPP and DHCP standards are supported.

The enhanced Web client for the Remote Supervisor Adapter I or II 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), and much more. The Remote Supervisor Adapter I provides full keyboard and mouse support and video control of the server (with supported Microsoft Windows and Linux operating systems). Support includes observing POST (power-on self-test) 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 I also supports static physical partitioning on the x440. This includes 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 during the server POST on each chassis to initialize the hardware in preparation for loading and running the operating system. Once the OS is running, it will support more than one Remote Supervisor Adapter I controlled by a single OS image (which is necessary in the case of multichassis partitions).

The newest member of the IBM systems management adapter family is the **Remote Supervisor Adapter II**. It offers (or soon will offer) all of the capabilities of the Remote Supervisor Adapter I and adds the following new features:

- Remote text redirection over LAN
- Remote flashing of diagnostic firmware
- Significantly faster remote flashing performance than the Remote Supervisor Adapter I, via hardware-based graphic console redirection
- Both PCI and AGP video redirection
- Significantly faster console redirection performance than the Remote Supervisor Adapter I
- Virtual CD support (remote start from CD)
- LDAP support (server dependent) — Q3/2003
- SSL support — (server dependent)

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

Systems Management Features	*Integrated Systems Management Processor*	*Remote Supervisor Adapter I*	*Remote Supervisor Adapter II*
Monitoring			
Automatic Server Restart	**Yes**	**Yes**	**Yes**
Capture Windows blue screen errors	No	**Yes**	**Yes**
Environmental monitors (temperature/voltage/fans)	**Yes**	**Yes**	**Yes**
Interfaces with Light Path Diagnostics	**Yes**	**Yes** (Note 1)	**Yes** (Note 1)
Optional power source	No	**Yes**	**Yes**
PFA for power supplies, memory, processors, HDDs and VRMs	**Yes**	**Yes**	**Yes**
PFA for system fans/blowers	**No**	**Yes** (Note 2)	**Yes** (Note 2)
PFA for XceL4 Server Accelerator Cache	**No**	**Yes** (Note 3)	No (Note 3)
POST, loader, operating system time-outs	**Yes**	**Yes**	**Yes**
Redirection of text	No	**Yes**	**Yes**
Redirection of graphics	No	**Yes** (PCI video only)	**Yes** (PCI and AGP video)
Windows NT/2000 CIM device driver instrumentation	No	**Yes**	**Yes**
Alerting			
Alert to IBM Director via network	**Yes** (Notes 4, 9)	**Yes**	**Yes**
Alert to IBM Director via serial port	**Yes** (Notes 4, 9)	**Yes** (Note 5)	**Yes** (Q3/2003)
Alert to pager (numeric or alphanumeric)	**Yes** (Note 4)	**Yes** (Note 5)	**Yes** (Note 5)
e-mail via SMPT	No (Notes 4, 9)	**Yes**	**Yes**
SNMP traps	**Yes** (Note 9)	**Yes**	**Yes**
SNMP via PPP	No (Notes 4, 9)	**Yes**	**Yes**
Management/configuration			
ANSI-based terminal management	No	**Yes**	**Yes** (Q3/2003)
IBM Director-based management	**Yes**	**Yes**	**Yes**

Systems Management Features	*Integrated Systems Management Processor*	*Remote Supervisor Adapter I*	*Remote Supervisor Adapter II*
Independent Ethernet and AC power	No	**Yes**	**Yes**
Remote BIOS and adapter / processor firmware updates	ISMP firmware only	**Yes** (Note 6)	**Yes** (Note 6)
Remote diagnostics firmware updates	No	**Yes**	**Yes**
Remote control (GUI)	No	**Yes**	**Yes**
Remote POST & diagnostics	No	**Yes** (Note 6)	**Yes** (Note 6)
Remote power control	**Yes**	**Yes**	**Yes**
Telnet-based management	No	**Yes**	**Yes** (Q3/2003)
View status logs	**Yes**	**Yes**	**Yes**
Virtual CD support (remote start from CD)	No	No	**Yes**
Virtual floppy support (remote start from floppy)	No	**Yes**	**Yes**
Vital Product Data support	**Yes**	**Yes**	**Yes**
Web-based management	**Supported** (Note 8)	**Yes**	**Yes**
Connectivity			
10/100 Ethernet controller included	No	**Yes**	**Yes**
DHCP support	N/A	**Yes**	**Yes**
DNS support	N/A	**Yes**	**Yes**
IBM Interconnect cable feature supported	**Yes**	**Yes**	**Yes**
LDAP support	No	Limited	**Yes** (Q3/2003)
PPP support	N/A	**Yes**	**Yes**
Shared serial port support	No	**Yes**	**Yes** (Q3/2003)
SSL support	No	Limited	**Yes**

Table 2. *xSeries systems management processor and adapter features*

Notes to Table 2

1. The Remote Supervisor Adapter I and/or Remote Supervisor Adapter II are available as options on servers incorporating the ISMP.
2. A Remote Supervisor Adapter I or II adds PFA support for fans to the PFA support already provided by the ISMP.
3. PFA support is provided by the Remote Supervisor Adapter I for the XceL4 Server Accelerator Cache used in x440/x450 servers. At present, no xSeries servers that include the XceL4 Server Accelerator Cache support the Remote Supervisor Adapter II.

4. In-band via the IBM Director Agent.
5. This capability requires an external modem or null-modem cable.
6. Support requires an out-of-band (offline) connection such as serial, Ethernet or the IBM Interconnect cable feature. Out-of-band connections can be made even when the operating system is not functioning.
7. This feature requires a serial port.
8. This function is enabled via the IBM Director Agent or by using a Remote Supervisor Adapter I with the IBM Interconnect cable feature.
9. Via RS485 connection to a Remote Supervisor Adapter I or II.

By using servers that include either the ISMP or an IBM Remote Supervisor Adapter, up to **24** servers can be connected using the **IBM Interconnect** cabling feature. Up to 23 servers can be daisy-chained together this way using standard Category 5 (CAT5) cabling and the built-in RS485 ports in xSeries servers. The 23rd server in the chain then daisy-chains to a 24th server, containing a Remote Supervisor Adapter[7] I or II. The maximum distance between the first and last processors or adapters is 91.4m (300 ft).

Servers may also be controlled via direct LAN connection, a serial connection via dial-up or null modem. A modem or network adapter on any one of the systems can be shared by all 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.

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

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

xSeries Server Model	*Integrated Systems Management Processor*	*Remote Supervisor Adapter I*	*Remote Supervisor Adapter II*	Interconnect Cable Kit
x205	No	**Optional**	**Optional** (Q3/2003)	No
x220	No	**Optional**	No	No
x225	No	**Optional**	**Optional** (Q3/2003)	No
x232	**Standard**	**Optional**	No	No
x235	**Standard**	**Optional**	**Optional**	No
x255	**Standard**	**Optional**	**Optional** (Q3/2003)	No
x305	No	**Optional**	**Optional** (Q3/2003)	No
x335	**Standard**	**Optional**	**Optional** (Q3/2003)	No
x342	**Standard**	**Optional**	No (Note 1)	No
x345	**Standard**	**Optional**	**Optional**	No

[7] When the Remote Supervisor Adapter I and II are purchased separately as *option*s they include an IBM Interconnect "dongle" that the other servers in the chain plug into. The **x360**, **x440** and **x450** ship with the Remote Supervisor Adapter I already installed, but do *not* include the interconnect dongle. The IBM Interconnect Cable Kit (P/N 03K9309) is available as an option for those systems. The kit includes an internal knockout cable and a single-pigtail interconnect dongle with two external RS485 ports.

xSeries Server Model	*Integrated Systems Management Processor*	*Remote Supervisor Adapter I*	*Remote Supervisor Adapter II*	Interconnect Cable Kit
x360	**Standard**	**Standard**	No	**Optional**
x440	**Standard**	**Standard**	No	**Optional**
x450	**Standard**	**Standard**	No	**Optional**

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

Note to Table 3

1. Power control and alerting are available remotely on the x342 from the Remote Supervisor Adapter II, via the IBM Interconnect feature.

Hot-Swap / Redundant Components

Many xSeries server components, such as hard disk drives, adapters in Active™ PCI-X slots, power supplies, voltage regulator modules (VRMs) and cooling fans are **redundant** and/or **hot swappable**, allowing your system to continue operating normally despite a component failure. This minimizes maintenance downtime. Combining this hot-swap technology with IBM Director, Alert Standard Format and PFA technology, administrators can be notified of an impending failure and—if redundant components are involved—replace the failing component without server interruption. Often components can be replaced prior to an actual failure. This prevents downtime and helps facilitate onsite troubleshooting and maintenance.

Active PCI-X, available in many xSeries servers, helps to increase total server availability by letting you add or replace PCI and PCI-X adapters while the system is running. Active 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 upgradability, 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 for Intel-architecture servers, on the IBM Netfinity® 5500 in 1998.)
- **Failover** — Allows a second—backup—adapter to pick up the workload automatically if the primary adapter fails.

IBM Active PCI-X support for Microsoft Windows 2000**,** Windows Server 2003, Windows NT, Linux and Novell NetWare promotes high availability for xSeries servers. Using IBM Active PCI-X, 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 hand-in-hand with system hardware and firmware. Although the hardware and firmware 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*, *IBM Director Server Plus Pack*, *Application Workload Manager*, *ServerGuide*™, *Remote Deployment Manager*, *Software Distribution Premium Edition*, *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 and firmware; 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

IBM Director provides a comprehensive and extremely powerful set of workgroup systems management tools that are included with each xSeries system. The award-winning[8] IBM Director suite allows you to centrally configure and manage individual systems and groups of computers throughout the enterprise. IBM Director offers a graphical user interface for easy local and remote access and control. (*Figure* 2 shows an example of the IBM Director 4.1 management console.) IBM Director can be extended for more advanced management of blade server with the optional *IBM Director Server Plus Pack*.

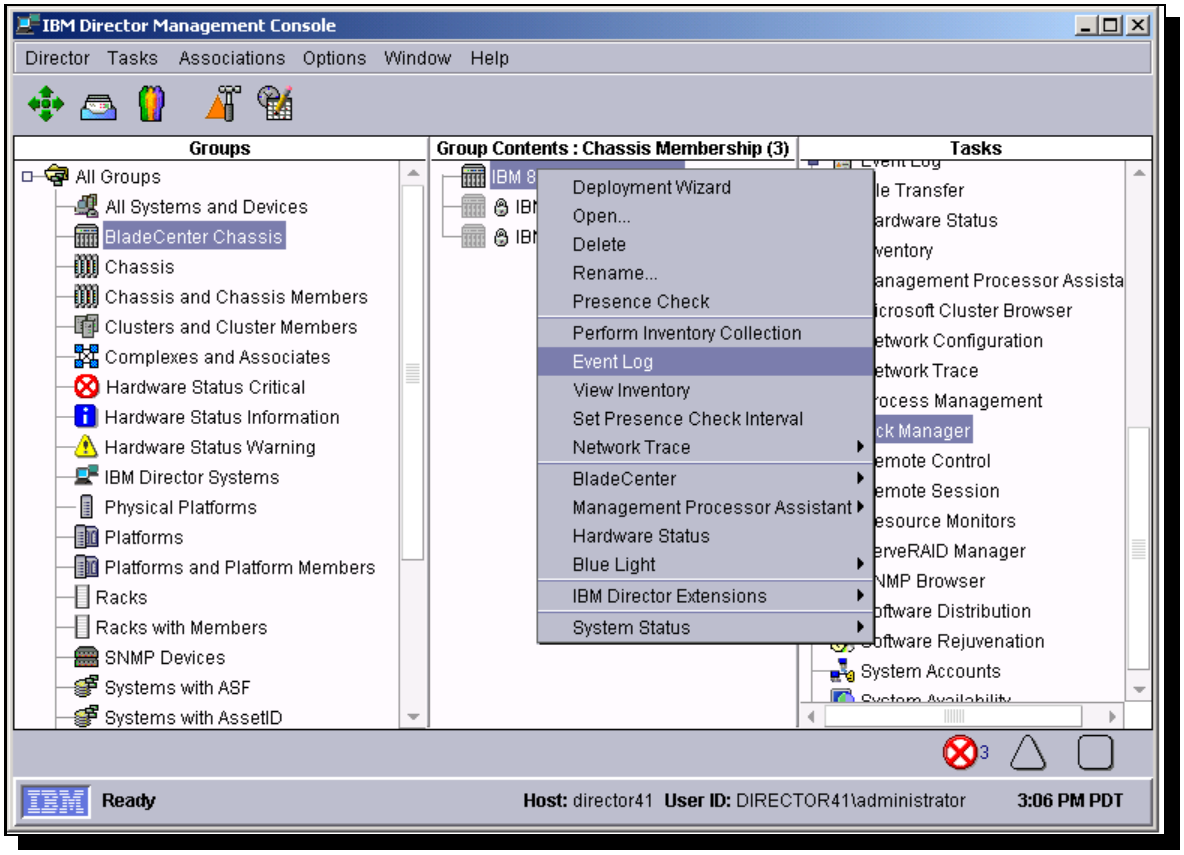

Figure 2. *IBM Director management console*

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, hard disk drives, power supplies, cooling fans, voltage regulator modules (VRMs) 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.

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[8] Most recently, *PC Magazine* bestowed upon IBM Director 3.1 its Editors' Choice award for mid-tier systems management suites, saying "IBM Director, the best proprietary product we reviewed, earns our Editors' Choice. We are most impressed by how easy it is to manage this suite. .... In short, IBM strikes the best balance by offering capabilities native to IBM products along with compatibility with non-IBM equipment." (*PC Magazine*, October 1, 2002.)

IBM Director features

IBM Director offers tremendous customer value thanks to some key capabilities:

- **Multiaction, event-based, action planning** — IBM Director supports the creation of event action plans (EAPs), which allow you to establish alerts and tailor actions (such as displaying a ticker tape console message or posting a message to an intranet newsgroup) to be executed automatically in response to specific events identified in the event logs. An event action plan enables an administrator to designate either the appropriate person to be alerted or the corrective action to be automated, based on the rules set up in the action plan. IBM Director 4.1 uses both the Event Action Plan Builder task and the new EAP Configuration Wizard to simplify the act of creating and modifying EAPs.
- **Calendar-based event scheduler** — The scheduler enables administrators to execute any noninteractive IBM Director function at a desired time. This includes running a capacity management report, performing an inventory scan or powering a system on/off, to name a few.
- **Secure management of groups of systems** — User profiles can be set up in IBM Director to allow access to specific management tasks and groups on a per user basis. For example, an account could be set up to permit a help desk staffer to view only system monitors, whereas a system administrator account could have full access to all tasks. Additionally, an account can be granted rights to access only systems belonging to certain groups.
- ***Robust monitoring and alert handling*** — IBM Director includes advanced monitoring capabilities. It can generate alerts based on the event log and monitor many system performance parameters, using sophisticated threshold settings. For example, a warning could be sent to the administrator when the percentage of disk space used reaches 50%, and then a critical warning could be sent when the utilization reaches 80%.
- **Heterogeneous hardware support** — IBM Director manages both IBM and non-IBM systems. It is based on industry standards and will perform basic configuration and management tasks on all Intel-compatible platforms. This means that you can use IBM Director to manage your entire inventory of Intel-based servers, as well as your desktop and notebook PCs. IBM Director also offers smooth integration into higher levels of workgroup or enterprise management tools, including:
  - Tivoli Enterprise Framework and NetView NT
  - BMC Patrol
  - Computer Associates Unicenter TNG Framework
  - HP OpenView Network Node Manager
  - Microsoft Systems Management Server (SMS)
  - NetIQ

IBM Director 4.1 operating system support includes:

- **IBM Director Management Server** — Microsoft Windows 2000 Server and Advanced Server; Red Hat Linux 7.3 and SuSE Linux 8.0.
- **IBM Director Console** — Windows XP Professional; Windows 2000 Professional, Server, Advanced Server; Red Hat Linux 7.3; SuSE Linux 8.0.
- **IBM Director Agent** — Windows XP Professional; Windows 2000 Professional, Server, Advanced Server and Datacenter Server; Windows Server 2003 Standard, Web and Enterprise Editions; Red Hat Linux 7.1, 7.2, 7.3 and Advanced Server 2.1; SuSE Linux 7.2, 7.3, 8.0, 8.1 and Enterprise Server (SLES) 7.0; SCO Group OpenUnix 8.0 and 8.0.1 and Novell NetWare 6.0. The agent will also run in a VMWare ESX Server 1.5x VM console on xSeries servers that are supported with VMWare.

New in IBM Director 4.1 is IBM @server BladeCenter support, which allows complete BladeCenter management from the IBM Director console. IBM Director supports discovery of newly added chassis and individual blades and provides console objects that allow manipulation

of each BladeCenter entity. The console also monitors hardware status and reports system health.

IBM Director Components

The following tools are included with IBM Director 4.1:

- **Management Processor Assistant** (MPA), formerly called Advanced System Management, works in concert with the IBM family of systems management processors and adapters to offer exceptional control of systems. MPA includes management support for xSeries servers, the RXE-100 Remote Expansion Enclosure and BladeCenter. Using MPA you can:
  - Monitor critical subsystems via IBM Director event action plans and integration with Hardware Status
  - Remotely troubleshoot a system via Light Path Diagnostics and the systems management processor event log
  - Configure groups of systems management processors, including user accounts and how to notify the administrator of event alerts (via pager, e-mail, SNMP traps or through IBM Director, for example)
  - Perform basic hardware management, including power control and restart options
  - View and print component Vital Product Data
- **RAID Manager** lets an administrator configure, monitor and manage local and remote SCSI and IDE RAID subsystems without taking the server(s) offline, and therefore avoiding costly downtime. RAID Manager includes FRU (field replaceable unit) number reporting in alerts for RAID components and hard disk drives. This helps to reduce labor and service costs by providing replacement part information in the alert message so that the correct part is sent along with the servicer.
- **Update Assistant** is a new IBM Director tool that offers an administrator the ability to import UpdateXpress updates and push them to systems with IBM Director Agent (including the type, version and severity of the update), from both graphical and command line interfaces. Specifically, firmware and driver update packages can be imported from the UpdateXpress CD, which is typically released quarterly. Update Assistant gives administrators one place to go for system and subsystem updates. It facilitates the management and distribution of updates from a single point of control, and helps save time and keep systems operating optimally, with the latest updates.
- **Software Distribution Standard Edition** enables administrators to distribute IBM-created software packages remotely to systems running IBM Director Agent. The optional **Software Distribution Premium Edition** is available separately for customers who wish to create their own software packages for distribution.
- **BladeCenter Deployment Wizard** allows an administrator to quickly and easily configure BladeCenter hardware. Configuration settings are saved as profiles on the IBM Director server and can be used to simultaneously deploy multiple BladeCenter chassis or blades. A profile provides a powerful policy-based method of predefining a chassis configuration, including settings for management modules and Ethernet and Fibre Channel switches, as well as the operating system images to be installed on each blade inserted in the chassis.

  Using “detect and deploy” technology, when a new, unconfigured blade is plugged into the chassis BladeCenter Deployment Wizard launches Remote Deployment Manager, which executes the appropriate profile, which in turn automatically deploys an operating system according to the policy defined for that blade bay.

  BladeCenter Deployment Wizard helps to make system deployment easier by providing the following key benefits:

  - *Ease of use* — The wizard provides a simple, powerful interface that configures basic BladeCenter settings (such as IP addresses for the management and Ethernet modules). This allows administrators to be more productive and accomplish more in less time.

- *Mass configuration of chassis and blades* — Once configured, a profile can be applied many times simply by assigning it to new hardware. If you have a large number of blades, this potentially represents a tremendous time savings.
- *Policy-based configuration* — Profiles allow you to establish policies for each blade bay in your BladeCenter, even before acquiring the blades. After this initial configuration, administrators need not be present for each blade installation.
- *Support for autonomic computing* — The combination of profiles and detect-and-deploy technology allows you to deploy a blade simply by inserting it into the chassis. Configuration is automatic, with no human intervention required.

Figure 3 shows how to assign policies to specific blade bays via profiles, using BladeCenter Deployment Wizard.

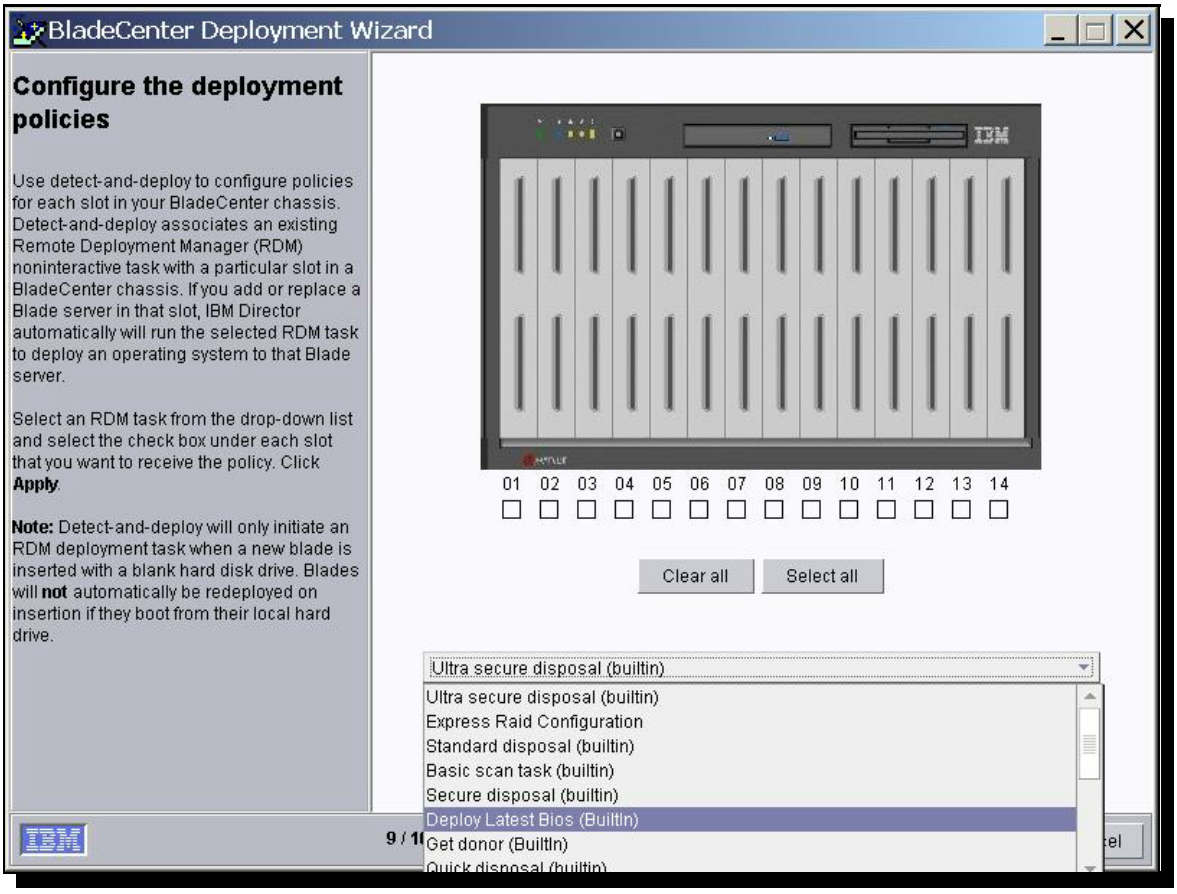


Figure 3. BladeCenter *Deployment Wizard* deployment policies setup

In addition to the modules that ship with IBM Director, the following tools, which *integrate* into IBM Director, may be downloaded from **ibm.com** at no additional charge[9]:

- The **Real Time Diagnostics** tool helps maintain server availability by performing diagnostics on system and subsystem components while the server is still running, without interrupting the users. This tool analyzes system and subsystem components (including processors, hard disk drives, RAID controllers and attached drives, tape drives and memory), then provides information to the administrator about suspected component problems and appropriate corrective actions. On xSeries systems with Light Path Diagnostics, Real Time Diagnostics reports the status of the Light Path Diagnostics. Real Time Diagnostics reduces downtime by

[9] Customers may be charged by their local phone companies and/or their Internet service providers for the cost of downloading. Please check with the local ISP and telephone service provider for more details.

allowing administrators and service personal to identify and analyze server issues while the system is running.

- **Management Processor Command Line Interface** (MPCLI) works in concert with the IBM family of systems management processors and adapters to offer exceptional control of systems. It provides a scriptable command line interface for performing basic hardware management. Supported function includes:
  - Remotely troubleshooting a system via Light Path Diagnostics and the systems management processor event log
  - Configuring groups of systems management processors, including user accounts and how to notify the administrator of event alerts (via pager, e-mail, SNMP traps or through IBM Director, for example)
  - Performing basic hardware management, including power control and restart options
  - Viewing component Vital Product Data
  - Performing updates of the service processor firmware

Go to http://**ibm.com**/servers/eserver/xseries/systems_management/director_4.html for more information or to take the interactive IBM Director 4.1 Web Tour.

IBM Director Server Plus Pack

The basic management functions included in IBM Director provide the ability to get servers up and running quickly and smoothly, and to simplify the ongoing hardware management. Additional powerful tools are available as extensions to IBM Director to further strengthen its management capabilities. The **IBM Director Server Plus Pack** is a fee-based offering of five tools: *Capacity Manager, Active PCI Manager, System Availability, Rack Manager* and *Software Rejuvenation*. They integrate into IBM Director for a consistent look and feel and provided advanced systems management from a single console. These tools are indispensable to the effective management of a data center:

- **Capacity Manager** monitors the utilization of critical server resources such as processors, disk drives, memory and network bandwidth. Using advanced artificial intelligence techniques, Capacity Manager identifies bottlenecks for an individual system, a group of systems, or a cluster and recommends system upgrades to alleviate diminished performance or downtime. Capacity Manager can even identify latent bottlenecks and make recommendations for preventive action.

  Capacity Manager can be configured to continually gather various resource monitor usage data for analysis. It produces reports that span multiple systems, allowing the user to quickly isolate historic problems or to identify trends that indicate impending trouble. The reports can be configured to trigger alerts if bottlenecks are present, and to allow automated responses such as paging the administrator. Capacity Manager eases the burden of managing sets of machines, improves the administrator's understanding of how systems are used over time and provides a proactive approach to help avoid impaired performance and costly failures.
- **Active PCI Manager** helps optimize adapter I/O performance by matching card characteristics to the PCI-X bus provided in most xSeries servers, and offering guidance as to the best slots in which to install PCI and PCI-X adapters in order to maximize adapter throughput. Some adapters, such as next-generation 10Gbps (or higher) InfiniBand, Ethernet and Fibre Channel cards, will benefit from running in 133MHz PCI-X slots, while other adapters will run at top speed in 100MHz, 66MHz or even 33MHz PCI slots. Active PCI Manager also recommends (in the case of an x360 or x440) whether adapters should go in the server chassis or in an RXE-100 Remote Expansion Enclosure containing an additional 6 or 12 PCI-X slots.

  Active PCI Manager provides two user interfaces: Fault Tolerant Management Interface (FTMI) and Slot Manager. Slot Manager offers three different views of the information: A graphical **Slot View**, shown in *Figure* 4 displaying the slots in an x255 server (note the blue tab above Slot 1, to indicate that it is *not* a hot-swap slot), a **Tree View**, showing a tree-structure layout of the slots, and a **Table View**, which is a simple row-and-column layout.

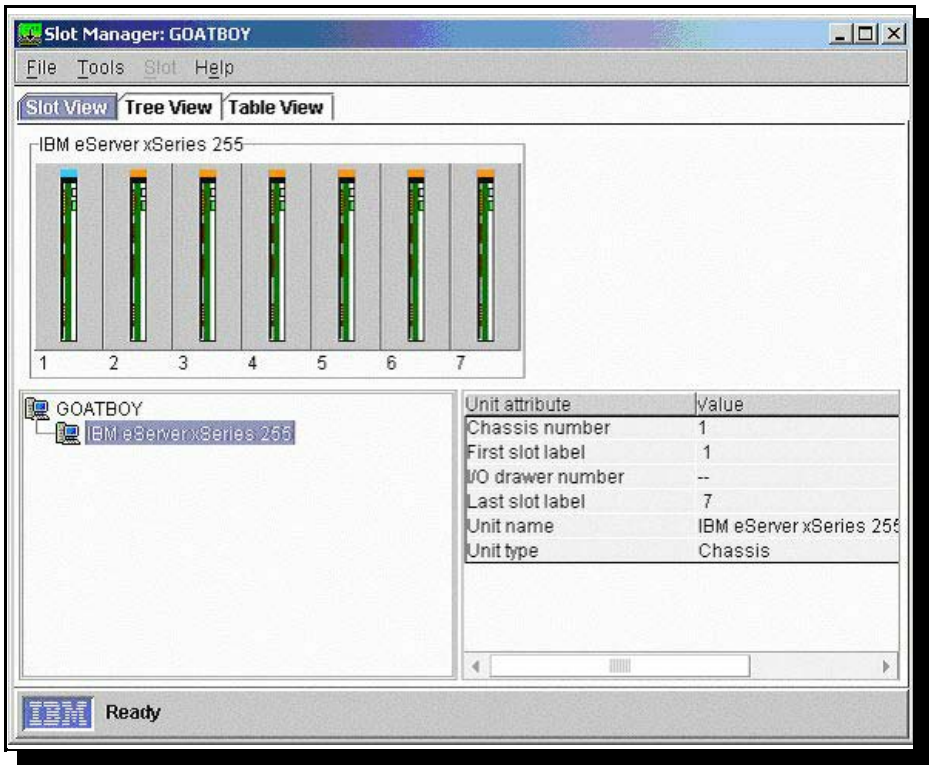


Figure 4. *Slot Manager — Slot View*

Active PCI Manager analyzes the server configuration and makes recommendations for optimizing the slot usage. *Figures 5a and 5*b show part of the optimization text displayed for the user:

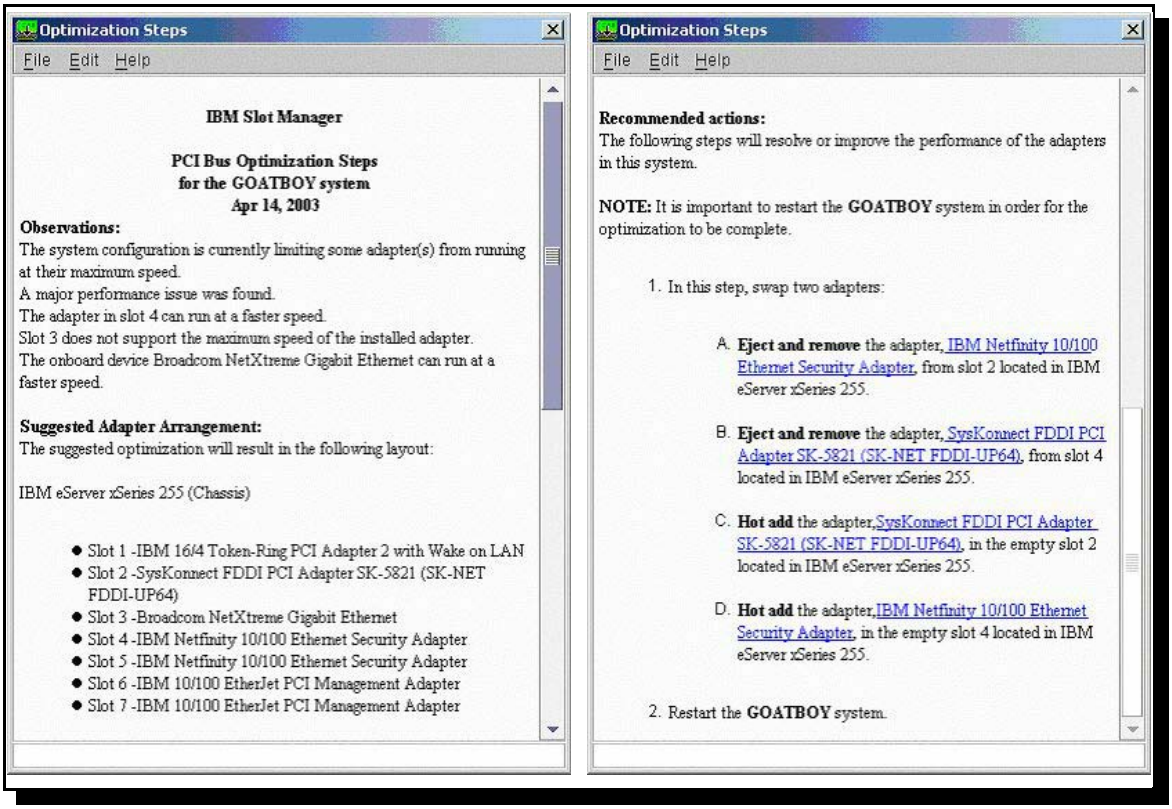


Figure 5a and 5b. *Slot Manager optimization steps*

- **System Availability** measures uptime/downtime for individual servers or groups of servers, and provides a variety of graphical views of this information. Presentation-quality graphs demonstrate the overall system availability, aid in showing availability trends and can be used to compare the impact of performance changes and routine maintenance. This enables you to track the improvements in your server availability to validate the benefits of the systems management processes and tools. System Availability can also distinguish between planned and unplanned outages.

  New in System Availability 4.1 is Problematic System Analysis, a tool that identifies problematic systems (defined as an individual system that has had too many unplanned outages over a given time period, or a system with excessively old availability data that fails to report data to the server). This allows you to focus on the systems that need the most attention. System Availability needs no special out-of-box setup and its simple-to-understand reporting provides the graphic proof that you're getting a cost-effective solution from your servers.
- **Rack Manager** provides a realistic graphical view of the devices in a rack. This view shows information such as rack membership and physical placement of the chassis in the rack. This capability can be useful for planning rack layouts. The intuitive drag-and-drop graphical interface provides a quick, comprehensive view of system topology and status that can be absorbed in a single glance, without the need for complex commands. In addition, Rack Manager provides an updated status of BladeCenter bays as blades are inserted and removed. Rack Manager can even be used as a general-purpose console for IBM Director, allowing an administrator to drop IBM Director tasks onto rack objects for execution. Rack Manager also provides detailed information about the health status of the rack and its contents. (For example, objects change color to indicate issues requiring attention.) *Figure 6* shows the Rack Manager user interface.

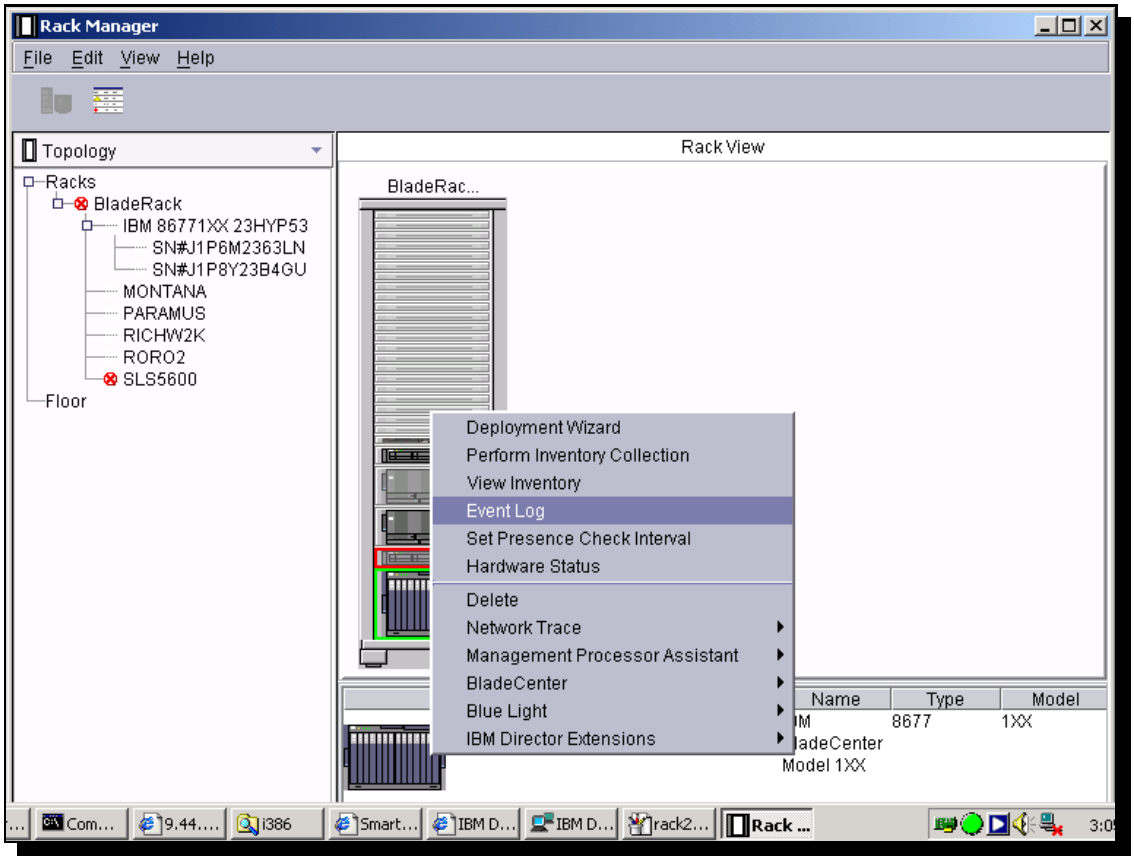


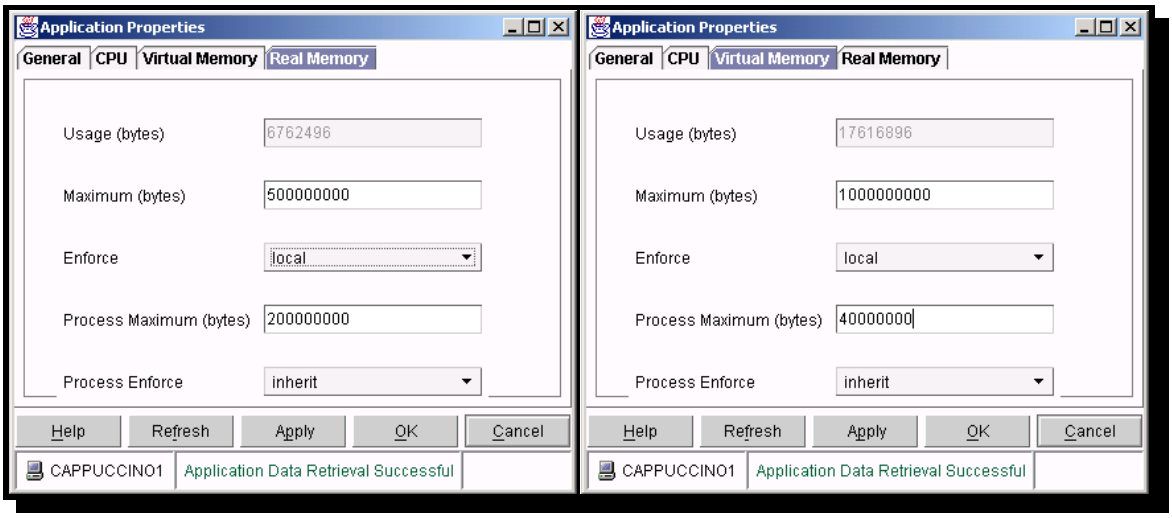
Figure 6. *Rack Manager console*

- **Software Rejuvenation** monitors software trends on the server and predicts possible points of failure. Software often exhibits an increasing failure rate over time when unused resources, such as memory, are not released. This is commonly referred to as software aging. Software Rejuvenation monitors trends in resource utilization and it predicts system outages due to software aging. Notification of a predicted system outage can give administrators the opportunity to take corrective action and avoid a system failure, or to schedule a system restart at a more convenient time. Alternatively, Software Rejuvenation can automatically schedule the system for rejuvenation. After the system restart, resources are reclaimed, and the software failure rate returns to its initial lower level.

  When Software Rejuvenation is used in a clustered environment, high availability can be maintained by checking that failover servers are available before initiating system rejuvenation. In the case of BladeCenter, one blade can be set to fail over to another blade, and then be reset by IBM Director.

Application Workload Manager

Developed for IBM by Aurema, Application Workload Manager (AWM) for IBM Director 4.1 is an optional enterprise-class resource management tool for advanced workload management on IBM xSeries servers. AWM integrates tightly with IBM Director 4.1 to extend the systems management capabilities of Microsoft Windows 2000 by providing a comprehensive, proven solution for allocation, management and control of system resources such as CPU, real memory and virtual memory that allows the administrator to specify how multiple applications use server resources. It maximizes application availability and quality of service by autonomously managing server workloads to protect against unexpected resource contention. And it does all this without compromising application performance. *Figures 7a and 7b* demonstrate how simple it is to apply real and virtual memory limits for an application using AWM.



Figures 7a and 7b. *Applying limits to real and virtual memory*

Specific uses for AWM include:

- **Server Consolidation**
  - Enables multiple applications to be run reliably on a consolidated server
  - Provides required usage data collection, billing & charge-backs for shared services/consolidated servers.
- **Citrix MetaFrame/Terminal Services optimization**
  - Allows more users and more applications on a single server, while maintaining service levels

  - Minimizes runaway processes
  - Offers more reliable and predictable Service Levels
- **Cluster failover protection**
  - Enables successful application sharing on the remaining operational node in the event of a cluster node failover
- **Consistent Quality of Service (QoS) assurance**
  - Helps meet QoS objectives and Services Level Agreements, even with system resources under heavy load

AWM can help dramatically improve application availability on xSeries servers to keep workloads running at maximum efficiency across the enterprise, even during times of peak system loads. As a result, higher server utilization and a potential reduction in the number of servers needed can provide a solid foundation for server consolidation, help reduce IT costs and produce a faster return on investment. (*Figure 8* shows a process-level view of CPU usage.)

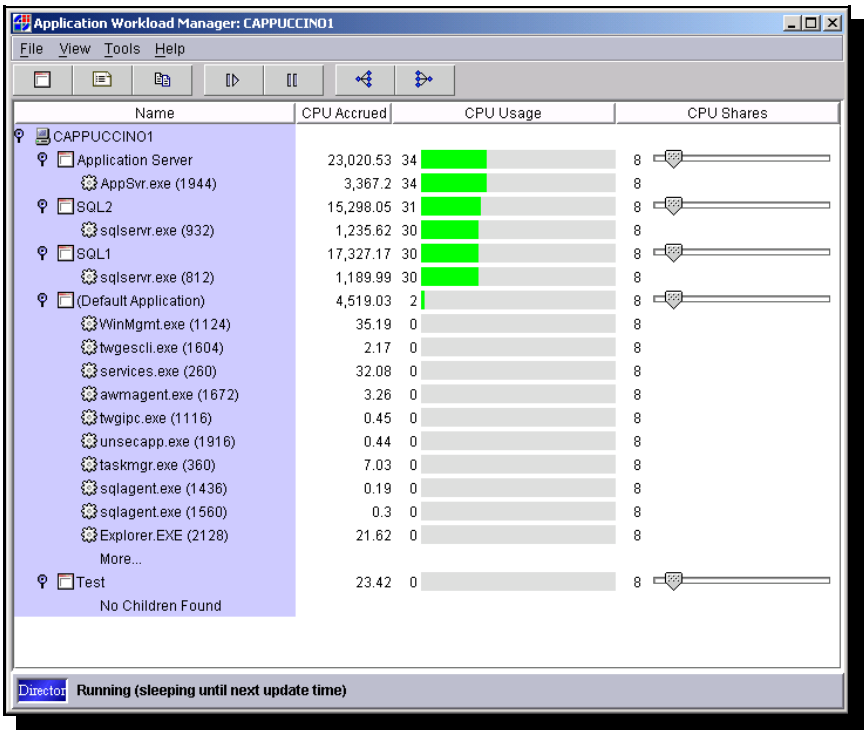


Figure 8. *CPU usage by process within application*

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 to 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 both of servers and client systems. These tools include *IBM ServerGuide*, *IBM Remote Deployment Manager*, *IBM Software Distribution Premium Edition*, *IBM System Migration Assistant* and *IBM UpdateXpress*:

IBM ServerGuide

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 automated installation of the Windows 2000 operating 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. It has been expanded and updated to help you install Microsoft Windows 2000 Server and Advanced Server faster than ever before. (Drivers are also included for support of Novell NetWare, Red Hat Linux and SuSE Linux.) 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 ServeRAID firmware versions and other hardware criteria. As a result, ServerGuide offers installation and configuration choices for your system.

IBM Remote Deployment Manager

Remote Deployment Manager (RDM) 4.1 supports the deployment, update and retirement of servers across the computing environment. Based on industry standards, RDM simplifies and automates the deployment, redeployment, configuration management and disposal of Intel-based computer systems across the entire enterprise. RDM incorporates imaging technology from industry leader PowerQuest to provide high-performance cloning, recovery, and reprovisioning solutions. RDM provides administrators with the ability to download an entire system image or a firmware update remotely to any offline node in the network. RDM also provides scripting capabilities to simplify the configuration of systems with unique requirements. All of this functionality is provided as an IBM Director module. Because of integration with IBM Director, RDM acquires access to all of the tools that IBM Director offers, such as scheduling and event action planning for deployment.

RDM 4.1 provides leadership deployment capabilities and comes loaded with features that make it easier to deploy and redeploy xSeries servers. Benefits include:

- **Infrastructure savings** — RDM automation can help reduce the number of people required for server deployment.
- **Travel and time savings** — RDM reduces the time required to provision servers by deploying ***all***[10] server images all at once. Your IT staff doesn't need to visit each server individually.
- **Single enterprise solution** — RDM can deploy any IBM or non-IBM Intel® processor-based PC or server that supports Preboot Execution Environment (PXE) and Wake on LAN (WOL) technology to support your entire heterogeneous environment.
- **Built-in system restoration support with PowerRestore technology** — Partnership with PowerQuest gives RDM local disk restore via a power-on keyboard sequence. PowerRestore allows the administrator to partition a hard drive and install applications and an extra copy of the operating system during the initial software load. If the OS should fail, PowerRestore 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.
- **All-in-one update process** — RDM offers scripting for all types of updates, including firmware updates. This provides the administrator with the ability to use a single tool to update an entire system at once—including BIOS, the systems management processor or a total system image.
- **Data protection and reduced downtime costs** — RDM provides rapid software image restoration.

[10] The number of servers that can be deployed at once is limited only by the infrastructure resources.

- **Increased business security** — RDM offers clean wiping of confidential data from retired machines, allowing you to choose how many times the drives are overwritten.
- **Security** — RDM stores system images, which are then available for backup and offsite storage.

RDM 4.1 makes provisioning new BladeCenter blade servers an easy task. RDM determines the "personality" of each blade and handles unattended installation—potentially a major cost savings, especially for a decentralized organization.

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

- Configure a RAID adapter
- Flash the system BIOS and other system firmware
- Save and restore CMOS settings
- Perform automated installation of operating systems and applications
- Back up and recover the primary partition
- Erase all data on the system's hard drives, making the data practically unrecoverable (to protect sensitive information when a system is redeployed or retired)

The operating system requirement for *RDM servers* is Microsoft Windows 2000 Server/Advanced Server. RDM *deployment servers* and *consoles* can be installed on Windows 2000 or Windows XP Professional.

RDM 4.1 supports the *deployment* of the following operating systems:

- Microsoft Windows 2000 Professional, Server and Advanced Server
- Microsoft Windows XP Professional
- Microsoft Windows Server 2003 Standard, Enterprise and Web Editions
- Red Hat Linux 7.3/8.0

A number of new features were added to RDM 4.1, including:

- Full integration into IBM Director 4.1, including drag-and-drop functionality
- Unattended, automated installation of Windows XP Professional and Linux
- Performing hardware configuration separately from operating system deployment
- Multicast technology to deploys hundreds of servers concurrently from one RDM server
- Independent scheduling of multiple deployment and updating tasks
- Enhanced support for BladeCenter, with additional functionality
- Active™ PCI/Active PCI-X drivers for Windows
- Creation of custom deployment tasks by an administrator
- Support for x330 Memory eXpansion Technology (MXT) firmware updates (via custom tasks)
- Updating of firmware for network, SCSI and RAID controllers, and systems management processors via custom tasks
- Support for the latest versions of systems management BIOS for BladeCenter and partitionable servers (such as the x440)

Figure 9 shows an example of setting up an unattended operating system installation with RDM 4.1.

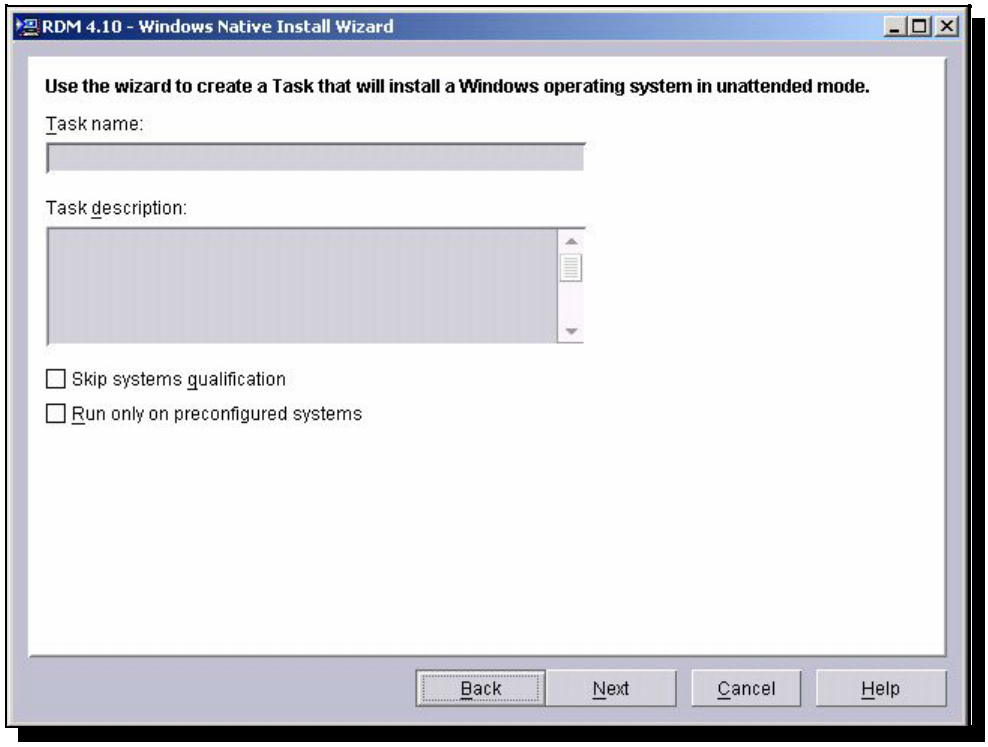


Figure 9. *Setting up an unattended OS installation with RDM 4.1*

To better understand what Remote Deployment Manager can do for a company, you can watch a fictitious business, Best Company, accomplish the types of jobs commonly faced by any IT department. IBM has developed an interactive demonstration called the IBM Remote Deployment Manager Web Tour. It will step you through an example of configuring workstations by creating "donor" software images, launching the template wizard and so on. This tour demonstrates how easy it is to perform all of these tasks from the IBM Director console, and how quickly automating repetitive tasks, such as deploying multiple clones of an image to new servers, can be accomplished through Event Action Plans.

To take the interactive RDM 4.1 Web Tour, or to purchase and download RDM, go to http://**ibm.com**/servers/eserver/xseries/systems_management/sys_migration/rdm41.html.

IBM Software Distribution Premium Edition

Unlike RDM, which allows an administrator to deploy system images in an *offline* environment, the optional Software Distribution Premium Edition allows the creation, packaging and distribution of software applications and updates to individual systems or groups that are up and running with the IBM Director Agent for Windows or Linux. It provides wizards to simplify the creation of packages from Microsoft Windows Installer, InstallShield and Linux RPM Package Manager files. Because your IT staff doesn't have to visit every client or server to install software, Software Distribution Premium Edition helps to reduce labor costs and increase software update efficiency.

IBM System Migration Assistant

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've been saving in their browsers over the years, are not only frustrated, they're unproductive. SMA can help resolve these issues.

IBM UpdateXpress

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 requires updating. 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 by performing other urgent or high-level tasks while the server firmware is being upgraded.

Through an HTML index page, 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 enterprise workgroup management software. This makes it easier for system administrators to keep all systems operating at peak efficiency automatically—even remotely.

UpdateXpress benefits include:

- Detecting and presenting to the administrator the level of current system and subsystem firmware (system BIOS, diagnostics, tape drive and hard drive BIOS), and enabling the upgrade of firmware 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.
- Performing an automatic and unattended upgrade of the system and subsystem components.
- Remote point-to-point administration of updates to any server or IntelliStation on the network—virtually anytime, anywhere.

IBM provides an UpdateXpress CD on a quarterly basis as a self-installable, executable update package. An ISO image of the CD can be downloaded from the xSeries support site at http://**ibm.com**/pc/qtechinfo/MIGR-4JTS2T.html.

Alternatively, you can have the CD shipped to you for a nominal fee from an IBM fulfillment site. Go to http://**ibm.com**/servers/eserver/xseries/systems_management/sys_migration/xpress.html.

Cluster Systems Management (CSM) 1.3.1 (planned for Q2/03), which integrates with IBM Director, can help to reduce the total cost of ownership for cluster environments by streamlining and simplifying the management of large numbers of servers from a single point of control. This is of particular value in large data centers or for customers who are running complex high-performance workloads, where managers are constantly challenged to meet ever-changing business demands and improve service levels at the same time that IT budgets are shrinking. As customers evolve from using clusters for single-purpose workloads to employing cluster technology in grids or utility models, CSM can provide a path for growth and enhanced value.

The key features of CSM can translate into reduced costs, higher availability of the cluster for productive use and improved system utilization. Customers who have existing AIX-based cluster systems can leverage those skills to manage their Linux clusters. System administrators can automate problem determination and recovery, automate repetitive installation and configuration tasks, and monitor and report health information and resource utilization.

CSM is intended primarily for managing clusters of Linux-based xSeries servers or AIX-based pSeries™ servers, or for heterogeneous clusters combining the two, although it also works well with nonclustered Linux servers. Typically, customers would use IBM Director to manage all-Windows or a mix of Windows and Linux-based xSeries systems in a nonclustered environment. CSM would be the preferred choice for Linux-only nonclustered xSeries servers or clustered Linux/AIX systems (both xSeries and pSeries)—especially in a high-performance computing (HPC) environment. In some situations, it may be advantageous to run both IBM Director and CSM in the same BladeCenter chassis.

CSM provides integration with IBM Director for Linux so that both products can be used together to manage systems from a single graphical console, sharing information and events with each other. Features include:

- Recognition of CSM management servers and nodes during system discovery
- Representation of CSM-based cluster nodes in the IBM Director console as manageable entities
- The ability to view CSM node attribute data using the console's inventory browser
- The ability to create dynamic groups of CSM nodes based on CSM node attribute data (as well as any other system inventory data)

The IBM Director integration for CSM also allows the administrator to build event action plans based on CSM conditions (as well as other IBM Director event types), and correspondingly the ability to trigger IBM Director actions based on Resource Monitoring and Control (RMC) events. CSM and other Linux programs can be run on the cluster nodes or management server through the IBM Director console. IBM Director provides additional hardware control features beyond those available in CSM, including RAID configuration and rack manager, and also runs in both Windows and Linux environments.

As a complement to CSM, Enhanced Cluster Tools (ECT) for Linux (available from http://alphaworks.**ibm.com**/tech/ect4linux) enhance the management of Linux clusters. ECT adds to CSM features like an xCAT-to-CSM transition tool to either migrate from xCAT to CSM or to run xCAT and CSM together (sharing data), a script to get the MAC addresses from Cisco switches, as well as support for remotely flashing the BIOS of xSeries servers.

CSM provides the following features to Linux cluster customers:

- Integration with IBM high-availability software for Linux (System Automation Manager, or SAM), General Parallel File System (GPFS) and other autonomic computing solutions, such that CSM can run in the same cluster with SAM and GPFS. The cluster offerings from IBM are designed to work together and are all based on a common event and high-availability infrastructure (Reliable Scalable Cluster Technology—RSCT) with these products. (Plans call for an even greater degree of integration between these tools in the future.)
- Management of configuration files across the cluster.
- Remote access to hardware inventory, vitals and systems management processor logs.
- Software maintenance for all the nodes in the cluster.
- Efficient event monitoring for the cluster and automated responses.
- Basic performance monitoring.
- Software diagnostics and problem determination.
- Common management for AIX and Linux.

CSM supports the x330, x335, x342, x345, x360, x440 and BladeCenter[11] servers, as well as IntelliStation (machine type 6221) workstations, running Red Hat Linux Professional 7.2/7.3/8.0,

[11] CSM 1.3 users will need a service update to CSM 1.3.0.20 for BladeCenter support.

Red Hat Linux Advanced Server 2.1, SuSE Linux Professional 8.0/8.1 or SuSE Linux Enterprise Server (SLES) 7.0/8.0.

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-1 (**1E**), 1+0 (**1E0**) and 5 (**5EE**)—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 RAID arrays 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 the 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, an extremely dirty drive can produce corrupted backup tapes, resulting in the loss of critical data when retrieval is necessary.

This situation is easily preventable by cleaning the tape drive according to the manufacturer's recommendation. In the past it was up to busy administrators to keep track of the cleaning status of the drive, which often was overlooked. This is why IBM has developed a tape drive management tool to monitor the tape drive status for the administrator. It is designed to generate alerts when cleaning is required for xSeries supported tape drives. The cleaning event alerts can be routed however an administrator defines using the IBM Director alerting capabilities.

The Tape Drive Management Assistant tool integrates with IBM Director so that a single administrator can monitor many backup servers, regardless of location, via one unified front-end program. Ensuring that cleaning actions are taken when needed contributes to longer-lasting tape drives and offers the peace of mind that your backed-up data will be available when you need it.

For more information about Tape Drive Management Assistant, or to download it, go to http://**ibm.com**/servers/eserver/xseries/systems_management/xseries_sm.html.

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. However, 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 around-the-clock access to sophisticated self-help tools 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[12]. 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.

IBM 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.

IBM Access Support is supported on specific xSeries, ThinkPad, NetVista and IntelliStation systems. 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 customers resolve usage questions and obtain software updates, but what about hardware issues? IBM offers an innovative “call home” feature that allows xSeries servers to automatically report hardware problems to IBM support, which can even dispatch onsite service[13] if necessary to those customers entitled to onsite support under the terms of their warranty or an IBM Maintenance Agreement. The IBM **Electronic Service Agent** is a downloadable software tool available from the IBM support Web site. It resides on a server and uses rich security to provide electronic support and problem management capabilities through an electronic dialogue between customer systems and IBM. Electronic Service Agent monitors networked servers for hardware errors and it can perform hardware and software inventories and report inventory changes to IBM. All information sent to IBM is stored in a database and used for improved problem determination.

Electronic Service Agent allows IBM to quickly and proactively respond to customers and to assist in maintaining higher availability and performance. Electronic Service Agent takes advantage of the IBM Director remote management capabilities and allows remote monitoring of the customer environment from IBM, for even more sophisticated problem determination. It’s 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

[12] The direct URL for IBM @server support is http://**ibm.com**/server/support.

[13] For onsite labor, IBM will attempt to diagnose and resolve the problem remotely before sending a technician.

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

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 **17** 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 world[14] 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 IBM Director Fits into a Tivoli Systems Management Solution

IBM customers are a very diverse group, with wide variations in company size, IT infrastructure and IT skills. Because of this, customers' systems management needs also vary widely, requiring different degrees of sophistication. IBM fulfills those needs by offering a broad, comprehensive set of products that allows even smaller, less sophisticated customers to grow in a consistent, complementary fashion up to the use of products with greater scope and capabilities.

IBM systems management products offer different levels of functionality and capability to meet the needs of all our customers. IBM Director is a workgroup manager for Intel-based hardware and it includes tools for detailed hardware management. For customers who need only workgroup-level management in an Intel hardware environment, IBM Director alone (or in concert with Remote Deployment Manager and other IBM Director plug-ins) can be a complete solution. IBM Tivoli products provide highly scalable *enterprise-level* systems management solutions for both Intel and non-Intel hardware with broad, sophisticated systems management and monitoring capability, including advanced software distribution, applications management, network management and business systems management.

Tivoli systems management products and IBM Director can be used together for those customers who want to complement Tivoli enterprise capabilities with IBM Director's more granular tools. IBM Director includes modules that enable smooth integration into the Tivoli environment and that provide detailed inventories of Intel-based hardware, alerts and tools to the Tivoli console. Tivoli products can also serve as an upgrade path for customers who have outgrown the capabilities of IBM Director.

Together, Tivoli software and IBM Director provide customers with a comprehensive enterprise-class systems management solution that can encompass everything from PCs up through mainframes.

Go to the IBM Tivoli Web site at http://www.**tivoli.com**/products for more detailed information about the Tivoli product portfolio.

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[14] HelpCenter response times vary and support hours may vary by geography.

How Does Systems Management Apply To IBM e-Business On Demand?

The idea of buying only the IT resources you need, when you need them—much like you would electricity and water—is gaining ground. This concept, which IBM calls *e-business on demand*, refers to the delivery of standardized processes, applications and infrastructure over the network as a service, providing both business and IT functionality. Sometimes referred to as e-sourcing, e-business on demand enables companies to tap into bandwidth, processing power, storage, applications and Web-based services only as needed, thus connecting price and usage with business returns.

An enterprise is an on demand business if its business processes are integrated end-to-end across the company and with key partners, suppliers and customers. It's an enterprise that can respond with flexibility and speed to any customer demand, market opportunity or external threat.

An on demand technology infrastructure has four essential characteristics. The infrastructure is:

- **Integrated.** Systems are easily linked across the enterprise and across its entire range of customers, partners, and suppliers.
- **Open.** Different systems can work together and link with devices and applications across organizational and geographic boundaries.
- **Virtualized.** The infrastructure takes advantage of "computing grids" to make the collective power of grid resources available to anyone in the grid who needs them, and making the best use of technology resources and minimizing complexity.
- **Autonomic.** Self-healing capabilities allow the infrastructure to respond automatically and work around problems, security threats, and system failures.

It is primarily in the area of autonomic computing that IBM @server xSeries systems management technology makes its presence felt. The implications for an autonomic, on demand business approach are immediately evident: A network of organized, "smart" computing components can give customers what they need, when they need it, and without devoting precious IT resources to fixing problems that can be handled automatically. That's one of the promises of e-business on demand.

Read the IBM white paper, *Living in an On Demand World*[15] for more information about IBM On Demand computing.

Conclusion

The IBM system management solution for xSeries servers provides administrators with a comprehensive 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 become a problem.

It is estimated that most organizations spend as much as *six times* the original purchase price of their systems to install, support and maintain those systems. Minimizing the 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

[15] http://**ibm.com**/e-business/doc/content/feature/offers/whitepaper.pdf.

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 xSeries systems management software tools, is based on industry standards and is designed for ease of use. The intuitive Java-based GUI helps administrators manage single or large groups of IBM and non-IBM Intel processor-based 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 Computer Associates, HP, Microsoft, BMC, NetIQ and of course IBM/Tivoli. IBM Director Software Rejuvenation—which can predict upcoming software failures and automatically correct them before they become a problem—is an example 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 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 **Literature** for a list of the types of documentation available.

Go to http://**ibm.com**/servers/eserver/xseries/systems_management/xseries_sm.html for more information about xSeries systems management products.

In addition, the following IBM Redbooks™ publications are available for download from the IBM Web site at http://**ibm.com**/redbooks:

- Implementing Systems Management Solutions using IBM Director (SG24-6188-01)
- IBM Director Security (REDPO417)
- Managing IBM TotalStorage NAS with IBM Director (SG24-6830-00)
- Integrating IBM Director with Enterprise Management Solutions (SG24-5388-01)
- Using Active PCI Manager (REDP0446)
- IBM @server BladeCenter Systems Management (REDP3582)
- The Cutting Edge: IBM @server BladeCenter (REDP3581)
- IBM @server BladeCenter Type 8677 Planning and Installation Guide (SG24-6196-00)
- IBM @server xSeries 440 Planning and Installation Guide (SG24-6196-00)
- Server Consolidation with the IBM @server xSeries 440 and VMware ESX Server (SG24-6852-00)

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