



# 3COM

*Centralized Control Across Distributed Systems*

## Desktop Management



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# **Desktop Management**

## **Centralized Control Across Distributed Systems**

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## Acronyms and Abbreviations

**ACPI**  
Advanced Configuration and Power Interface

**BIOS**  
basic input/output system

**DHCP**  
Dynamic Host Configuration Protocol

**DMI**  
Desktop Management Interface

**DMTF**  
Desktop Management Task Force

**FTP**  
File Transfer Protocol

**GUI**  
graphical user interface

**IPMI**  
Intelligent Platform Management Interface

**MBA**  
Managed PC Boot Agent

**MIF**  
Management Information Format

**NC**  
network computer

**NCP/IPX**  
Network Control Program/Internetwork Packet Exchange

**NIC**  
network interface card

## Desktop Management

### Centralized Control Across Distributed Systems

*Companies looking to reduce the high cost of managing PCs and extend administrative control can do so while retaining the scalability and strategic flexibility of distributed computing. Enhanced NICs are transforming the current and future generations of full-powered, full-featured PCs into manageable PCs.*

*This white paper compares the Managed PC solution to three other possible approaches: network computers (NCs), Net PCs, or strict enforcement of standard desktop configurations. It explains the basic components of Managed PCs and three key applications: Remote Wake Up, Managed PC Boot Agent, and remote inventory in compliance with the DMI 2.0 industry specification. The paper also discusses other emerging management standards and technologies.*

### Gaining Control Without Losing at the Desktop

Managed PCs are full-featured PCs that can communicate intelligently with network management applications, enabling them to be inexpensively administered from a central location. Systems administrators can power up, boot, configure, monitor, inventory, and maintain Managed PCs remotely from a single

console—in most cases automatically after hours.

Organizations are turning to Managed PCs because of the opportunity to regain centralized control over end-user systems while dramatically reducing total cost of ownership (TCO). Unlike other strategies for lowering desktop management costs, such as thin clients, Managed PCs deliver cost savings without requiring organizations to give up the functionality and flexibility of distributed computing.

### Attacking the Biggest Slice of PC Cost

Demand for Managed PC solutions is growing in response to the increasing disparity between the falling cost of desktop hardware and software and the rising cost of supporting these systems and their users. The proliferation of distributed architectures combined with rapid change in PC components and user needs is presenting corporate IS with a massively complex, daunting, and costly task. In fact, industry analysts estimate the total cost of ownership of a networked PC at \$9,000 to \$13,000 annually—three to four times the average purchase price. As shown in Figure 1, nearly 80 percent of this cost is for labor, support, and administration.

By extending network management visibility and control all the way to the desktop, Managed PC solutions can reduce these costs

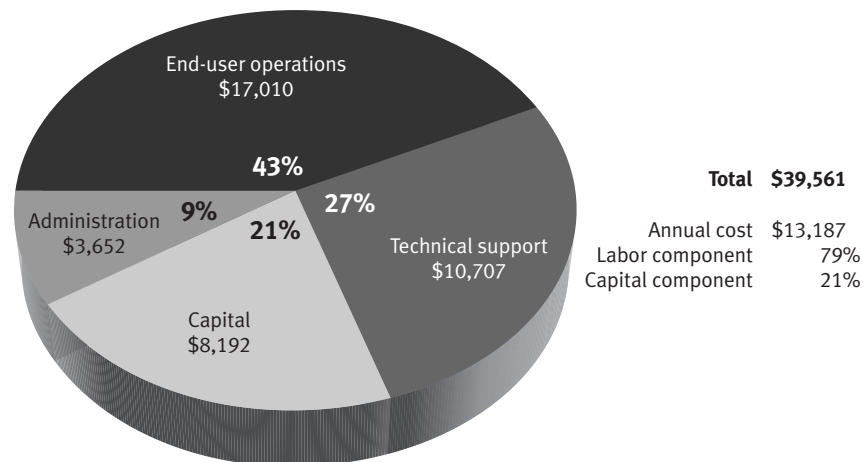


Figure 1. The Total Cost of PC Ownership

## The Managed PC Difference: Time and Money

**Scenario 1:** Karen has corrupted her PC's operating system. You can't use any of your standard troubleshooting tools to look at and repair files because you can't talk to her PC. You don't have anyone you can send on-site right this moment, so Karen, angry and unproductive, has to wait several hours. Elapsed time to solution: 6 hours. Estimated cost: about \$500\* for Karen's lost time plus help desk time fielding Karen's numerous calls and finally going on-site to get her PC back online. Alternatively, if Karen's PC were a Managed PC, you could use Pre-OS capabilities to load a mini-operating system from the network. The mini-OS would enable you to boot Karen's PC and use your troubleshooting tools. Then you could reinstall the OS and applications by downloading the appropriate software image from a network server. Elapsed time to solution: 20 minutes. Estimated cost: about \$25\* in help desk time. Karen doesn't lose any time because you can tell her how long it's going to take and she can do something else while her PC gets fixed.

**Scenario 2:** You need to inventory the BIOS of all the PCs in a department and update those that aren't current before you install new applications. You could run a remote asset tracking routine during the day, but that would

\* Costs are based on an estimated average of \$75 per hour for professional staff salary and benefits. They do not take into account additional costs such as application and script development.

seriously degrade network performance and affect user productivity. So you send an e-mail asking everyone to leave their systems on that night. The next day, two-thirds of the systems have been inventoried and updated, but one-third haven't because users forgot and powered off. Three members of your help desk staff spend the next several days dealing with problems these users are experiencing due to incompatibilities between their outdated BIOS versions and the new applications. Elapsed time to solution: one week. Estimated cost: \$5400\*.

Alternatively, you don't bother with e-mail or rely on end-user conscientiousness because the PCs in the department are Managed PCs. You set the inventory and update for midnight and go home without a worry. At midnight, while you're sleeping soundly, a network server sends out a Remote Wake Up signal and powers on all systems as needed. A DMI 2.0-compliant application performs the inventory and desktop management tools perform the BIOS updates and application installation. The next day everybody is using the same BIOS version. Elapsed time to solution: one night. Estimated cost: next to nothing.

substantially. A 1998 article in *PC Week*, for example, reported that Deutsche Telekom expects to save some 50 million deutsche marks, about \$28 million a year—in large part by configuring new PCs over the network and solving most support calls at the help desk instead of sending a technician (at a cost of about \$800 a day) on-site.

In organizations experiencing rapid market growth or undergoing mergers and acquisitions, Managed PC solutions can be a means of containing IS headcount and costs while supporting increasing numbers of users. They can also contribute to revenue-enhancing pro-

ductivity by compressing new-hire setup, reducing work downtime due to PC problems, and accelerating upgrades to the latest PC technologies and applications.

### Other Strategies—NCs, Net PCs, Standardization

Managed PCs are one of several current approaches to lowering PC support costs. Some organizations are replacing or augmenting existing PCs with either network computers (NCs) or Net PCs, which operate exclusively or partially from a network server. These "thin clients" have less hardware than

### Acronyms and Abbreviations

**OS**  
*operating system*

**PCI**  
*Peripheral Component Interconnect*

**PCMCIA**  
*Personal Computer Memory Card Interface Association*

**PME**  
*Power Management Enable*

**PROM**  
*programmable read-only memory*

**PXE**  
*Preboot eXecution Environment*

**ROM**  
*read-only memory*

**RPL**  
*remote program load*

**RWU**  
*Remote Wake Up*

**SNMP**  
*Simple Network Management Protocol*

**TCO**  
*total cost of ownership*

**WfM**  
*Wired for Management*

traditional PCs, so they cost less to purchase. Companies save even more from centralized administration of all desktops.

But wholesale migration to thin clients has a down side. It means trading off benefits that were the impetus for the move to client/server architectures in the first place—flexibility to meet individual needs, preservation of vendor choice, and the ability to keep pace with changing technology.

Other organizations are trying to simplify desktop management by strictly prescribing standard desktop configurations. Administrative costs go down because help desks need to support only a single platform and set of applications.

While imposing some degree of desktop standardization is generally regarded as a “best practice” for TCO management, organizations that rely solely on uniformity for cost control may find the approach difficult to maintain over time. Success depends on strict enforcement; even slight variations can introduce complexities that eliminate much of the management benefit. But strict adherence can interfere with individual productivity by preventing users with specialized needs from requesting applications that best suit a task and denying everyone the opportunity to take advantage of the wealth of applications and information available on the Internet (for example, via PointCast). Uniformity can also increase risk by committing the company too heavily to a single vendor or technology and

narrowing migration options and internal skill sets.

Managed PCs offer cost savings similar to those achievable with NCs and Net PCs, without trading off the benefits of distributed computing. They offer the control achievable through standardization, without forcing all desktops into a mold that may not fit some users.

In addition, Managed PCs can be used as a complement to other approaches. As seen in Figure 2, Managed PCs, Net PCs, and NCs can all be administered from the same centralized network applications, enabling companies to provision employees with a workstation appropriate for their needs. For companies standardizing on specific desktop configurations, using Managed PCs provides a degree of flexibility that may make upholding such policies over time more feasible. Administrators can allow occasional exceptions since, with the ability to remotely inventory and reconfigure any system, they can efficiently manage variations from the standard.

#### Components of a Managed PC Solution

During the past year abundant efforts have been made by industry associations and individual vendors to respond to demand for Managed PCs. Solutions consist of two basic components: some type of management applications and a PC equipped to communicate intelligently over a network with those applications.

## Glossary

### **network computer (NC)**

*A sealed workstation that has no local disk drive; NC users run applications and access files entirely from servers.*

### **Net PC**

*A sealed workstation with a hard drive but no floppy drive, and with limited expansion possibilities; users can run applications and store files locally, but all configuration, management, and updating is done by a server.*

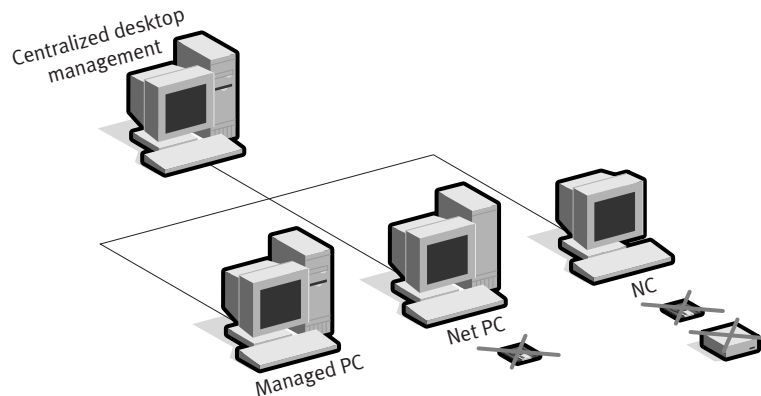


Figure 2. Centralized Administration of Mixed End-User Systems

### **Management Applications**

The Managed PC capabilities on the market today are just the beginning of a wealth of product offerings on the way. Current products fall roughly into three groups: PC utilities, desktop management suites, and enterprise management suites.

**PC Utilities.** PC manufacturers with Managed PC product lines generally provide a kit of proprietary and/or standard management utilities. These can include a variety of capabilities, from remote configuration management to monitors that alert administrators to problems such as temperature, voltage, and fan irregularities and chassis intrusions. New Dell systems, for example, ship with the Dell Inspector 4.1 browser-based tool that enables local or remote PCs to report on their configuration status and is compliant with the Desktop Management Task Force (DMTF) Desktop Management Interface (DMI) 2.0 specification. Other PC manufacturers offer similar packages.

**Desktop Management Suites.** All leading PC vendors also offer their own suites of management tools, and a number of third-party software vendors have competitive or complementary products as well. These application suites, which are generally aimed at small to medium-size companies, offer a collection of applications with a consistent graphical user interface (GUI). Typical features include software distribution, inventory tools, and a variety of system administration and troubleshooting tasks. Some suites include tools for distributing and updating OSs, performing remote BIOS updates, and remotely locking PC components such as floppy disk drives, keyboard, and I/O ports. Many of these suites support Simple Network Management Protocol (SNMP) and DMI 2.0, which means they can perform desktop asset tracking in cooperation with DMI-enabled PCs.

Examples of desktop management suites include Compaq Insight Manager, Dell OpenManage, Digital ClientWORKS, Hewlett-Packard TopTools, and IBM LANClient Control Manager. Third-party offerings include

Platinum's (formerly Intel's) LANDesk Client Manager (LDCM), Tivoli's IT Director, Network Associates' Zero Administration Client (ZAC) Suite, ON Technology's ON Command CCM, and Symantec's Norton Administrator Suite.

**Enterprise Management Solutions.** Enterprise management solutions provide a comprehensive set of management applications that work in heterogeneous environments across multi-vendor platforms. Examples include Computer Associates' Unicenter TNG, Hewlett-Packard's OpenView, IBM's Tivoli TME 10 Enterprise Management Solution, and Microsoft's Systems Management Server (SMS).

These solutions, which have focused primarily on LAN and WAN links, are now reaching all the way to the desktop. Some vendors are extending product functionality and others are offering plug-in capability for desktop management suites. (For example, HP TopTools can plug into not only HP OpenView but Microsoft Systems Management Server and Computer Associate's Unicenter TNG. Dell's OpenManage plugs into the HP suite as well as into IBM's Tivoli TME 10.) Enterprise suites provide a view of PCs in the context of the network as well as centralized management of PC inventory data and extensive reporting features.

### **Manageable PCs**

To take advantage of current and emerging Managed PC applications, companies need PCs that can cooperate in the management process. These PCs have management-ready network interface cards (NICs) with functions implemented in firmware, software, and hardware. While some features are applicable only to newer PCs, many can be implemented on existing PCs through a software download, flash ROM update, or a PROM upgrade.

In selecting management-ready PC NICs, companies can smooth the transition to a centrally managed environment by choosing products that support the widest range of industry-standard protocols, existing network administration services and tools, and management applications. Wise choices will also

help to future-proof investments for what is sure to be a period of emerging technology developments and rapid change.

### 3Com Managed PC Solutions—Key Capabilities

3Com, the world's leading supplier of desktop and workgroup networking solutions, offers a full range of Managed PC features for Ethernet, Fast Ethernet, and Token Ring product lines. These products offer customers a unique advantage: state-of-the-art management intelligence built into industry-leading 3Com NICs, which are known for their performance, reliability, and compatibility.

3Com's Managed PC solutions are compatible with leading management applications, including those from HP, Microsoft, Platinum (formerly Intel), Tivoli, ON Technology Corporation, and Network Associates. 3Com NICs support new and emerging standards, including Preboot eXecution Environment (PXE), DMI 2.0, Wired for Management (WfM), and Advanced Configuration and Power Interface (ACPI). They also support tried-and-true standards such as DHCP, BOOTP, NCP/IPX, RPL, and Magic Packet. No other NICs provide customers with as much flexibility for selecting a path to Managed PCs.

3Com is committed to offering the most advanced Managed PC features. Currently, our product line supports three key capabilities: Remote Wake Up, Managed PC Boot Agent, and Desktop Management Interface 2.0.

### Remote Wake Up

**What It Does.** Remote Wake Up (RWU) enables a central management application to remotely wake up a PC from a sleep or powered-off state, across the network at any time of the day or night. Using this feature, IS can perform system and application updates, inventory tracking and other administrative tasks after-hours, when network traffic is minimal and user productivity is least impacted.

**Benefits.** IS productivity improves because it is no longer necessary to physically go to PCs to turn them on. Because RWU guarantees that all PCs are accessible when scheduled—regardless of whether users have left the machines on or turned them off—it also eliminates the need for IS to solve compatibility problems introduced as a result of inconsistent installations. An additional benefit is support for “green PC” policies: with RWU, PCs never have to be in a fully powered-up state unless they're in use.

**How It Works.** With this technology, PCs are never completely powered down. As shown in Figure 3, even when the system has been shut off, an auxiliary power supply in the PC provides a low-level current to the NIC. When the NIC receives a wake-up packet from the network and recognizes its own address, it sends a signal to the motherboard telling the main power supply to turn on.

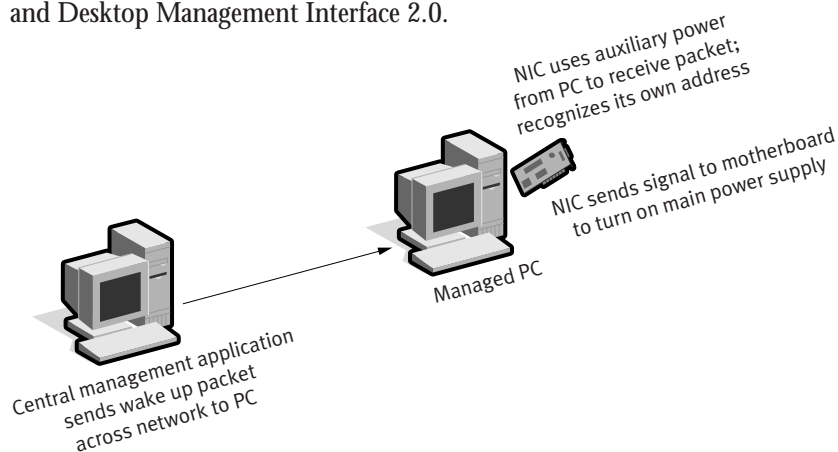


Figure 3. Remote Wake Up

**Standards Supported.** 3Com Remote Wake Up supports both the Advanced Configuration and Power Interface (ACPI) Remote Wake Up and Magic Packet. ACPI is a new industry specification aimed at providing a standard way to integrate power management features throughout a PC system, including hardware, operating system, and application software. It will enable PCs to automatically turn on peripherals, and vice versa. ACPI is associated with the Microsoft-led OnNow industry initiative for “instantly available PCs” and will be standard for Windows 98 and Windows 2000. Magic Packet is a patented technology owned and licensed by Advanced Micro Devices (AMD).

**What You Need to Use RWU.** To incorporate Remote Wake Up, you need:

- Desktop or enterprise management software to send the remote wake up frame to the NIC.
- A PC with a NIC that has the ability to decode a wake up packet. The NIC must also have a way of getting power from the PC’s auxiliary power supply and of sending the wake-up signal to the motherboard.

Currently, this is done over a cable with three-pin connectors to the NIC and motherboard. One of the wires in the cable is for the auxiliary power, another carries a ground signal to keep noise off the line, and the other is for the Power Management Enable (PME) signal, which the NIC sends to the motherboard to tell the PC’s main power supply to turn on. In the near future these auxiliary power and PME interfaces will become a standard part of the PCI bus (version 2.2 and later), eliminating the need for the additional cable.

#### ***Managed PC Boot Agent (MBA)***

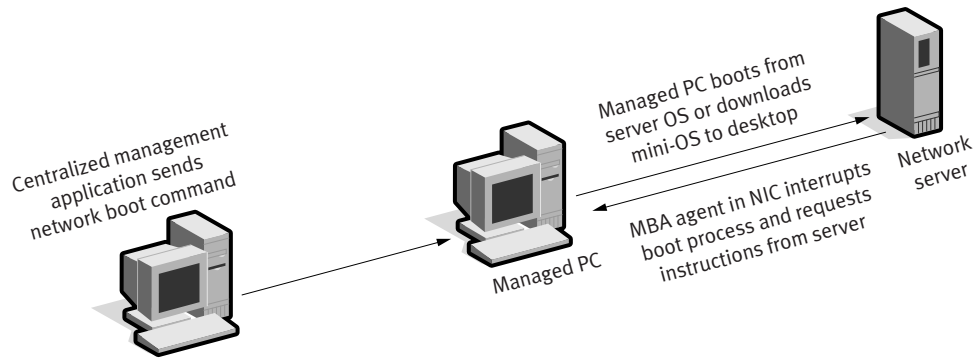
**What It Does.** The Managed PC Boot Agent (MBA) enables a PC to boot from a remote server even if the local operating system (OS) is unable to boot or nonexistent. It enables administrators to perform a wide range of preboot management tasks, such as virus scanning, backups, disaster recovery, reconfigura-

tion, and application and OS installation and updates. MBA can also be used to compare desktop profiles to a centralized software image and to remotely set up a new PC by installing a complete image from a server. MBA can enable a multicast boot, bringing up hundreds of PCs simultaneously. All of these preboot processes are transparent to the user, since the PC behaves as if the boot took place from the local hard drive.

**Benefits.** MBA improves IS productivity and responsiveness as well as end-user satisfaction by eliminating most of the need for on-site troubleshooting and disaster recovery. Instead, the vast majority of problems can be solved remotely and rapidly. Studies show that nearly half of all help desk calls are related to booting problems, which are normally impossible to solve remotely. Because boot failures typically make it impossible for users to properly connect with the network, even the most sophisticated enterprise management tools at the administrator’s disposal are of no use.

MBA guarantees that every PC on the network—even those with damaged operating systems and new PCs with no OS and unformatted hard disks—will connect to the network. The ability to boot under management control also protects PCs when they are most vulnerable to boot sector viruses. In addition, MBA improves IS productivity by enabling administrators to configure or update any number of PCs very efficiently by making changes to a single image on a network server.

**How It Works.** PCs can be configured to respond to a remote command from a central desktop management application. When the Managed PC Boot Agent residing in the 3Com NIC receives the command from the network, it interrupts the normal boot process. The NIC then sends a request for instructions to the server, and the PC boots from the OS residing on the server by initiating Pre-OS software. The server deploys the required tasks to the PC. Once these are successfully completed, the client is given back control and continues to boot locally.



**Figure 4.** Pre-OS Boot Using Managed PC Boot Agent

Alternatively, as shown in Figure 4, MBA can be configured to perform a Pre-OS boot prior to every local boot. Using the complete set of MBA software and utilities, including Pre-OS, a network administrator can make use of diagnostic, configuration, or maintenance tools prior to completing the local boot process.

**Standards Supported.** MBA supports Wired for Management (WfM). It also supports all major boot protocols, including not only the new Preboot eXecution Environment (PXE) protocol defined in the Net PC specification, but also existing protocols such as BOOTP, DHCP, RPL, and NCP/IPX. 3Com customers thus have the flexibility to use NT Server or another specialized server that supports PXE, or to “roll their own” management solutions using the booting support built into other platforms, such as NetWare, LAN Manager, OS/2 Warp, and IBM’s WARP server.

**What You Need to Use MBA.** To implement the Managed PC Boot Agent, you need:

- A NIC with preboot agent firmware (MBA). The agent, which acts as an additional layer of BIOS, can also be installed on an existing NIC as a chip in the Boot ROM socket or through a system BIOS flash upgrade.
- A central boot configuration server.

#### **Desktop Management Interface (DMI) 2.0**

**What It Does.** Desktop Management Interface (DMI) 2.0 enables PCs to provide a detailed self-inventory of hardware and soft-

ware along with status over the network to any DMI-compliant management application. This process, sometimes called “asset tracking,” can be performed automatically after-hours, eliminating the need for administrators to collect information manually at each PC and minimizing impact on the network and user productivity. All DMI 2.0 applications can track major PC components such as processor, BIOS, memory, system files, graphics card, and network card. If the PC vendor has done some extra programming on the PC-side DMI agents, the application may also be able to track hard drives, monitors, sound cards, SCSI cards, and so on.

**Benefits.** DMI improves IS ability to track and control complex computing environments. It also allows companies to depart from standard desktop configurations in order to accommodate exceptional needs, while still maintaining control and orderly processes. Rapid access to up-to-date inventory information speeds planning and streamlines system and application updates.

**How It Works.** Manageable PC components provide information about themselves by means of a Management Information Format (MIF) file. As shown in Figure 5, this information is written to the MIF database and made available to management applications by the service provider. They can also provide status information to the service provider in response to commands received from management applications. DMI includes an event

model, which defines how PC components should generate alerts and indications whenever predefined events occur and how the MIF database should filter and categorize them. The service provider passes these alerts and indications to any management application that has been enabled to receive them.

**Standards Supported.** 3Com NICs support DMI 2.0, a specification of the Desktop Management Task Force (DMTF). DMTF is an industry-wide consortium founded in 1992, and is dedicated to making the PC a manageable, intelligent, self-configuring networked device. DMI Version 1, released in April 1994, provided a standard method of examining a machine's components via software. Version 2.0, released in April 1996, enables remote access of DMI information over a network.

**What You Need to Use DMI.** To implement the Desktop Management Interface, you need:

- A DMI-compliant management application.
- A DMI 2.0-compliant PC. New PCs are DMI-compliant if they have been preloaded with three DMI software agents: (1) a component interface, which is a hardware-independent interface to manageable PC components; (2) a management interface, which is a vendor-independent interface to management applications; and (3) a service provider, which is a desktop-resident program that controls communication between the management interface and the component interface. The service provider also manages access to the MIF, which is an SNMP-compliant text-based repository for information

on the manageable components. These software agents can be downloaded to existing PCs by going to the 3Com FTP server at [ftp.3com.com/pub/desktop\\_management](ftp://ftp.3com.com/pub/desktop_management). There is a link to the ftp server on the 3Com Managed PC Web site at [www.3com.com/managedpc](http://www.3com.com/managedpc). DMI information is also available from the DMTF Web site at [www.dmtf.org](http://www.dmtf.org).

### 3Com Managed PC Solutions in Action

It's 9 a.m. Karen's computer won't boot. She needs to finish a critical report at noon. What now? Figure 6 on page 10 shows how 3Com Managed PC solutions can get Karen's PC back up fast so she can get on with her work.

Before installing new applications, you need to bring all of the department's BIOS up to date. What's the most efficient way? Figure 7 on page 10 shows how 3Com Managed PC solutions can speed updates while minimizing IS time and labor.

### Looking Ahead

Today's Managed PC capabilities are but the first benefits of an ongoing transformation of the PC into a fully manageable networked resource. They're also part of a broader movement toward making all entities within distributed computing architectures more controllable and less costly to manage. Here are some new developments to watch for.

### Managed Mobile PCs

3Com is committed to providing full management support for all types of clients: traditional desktop PCs, mobile PCs, and servers.

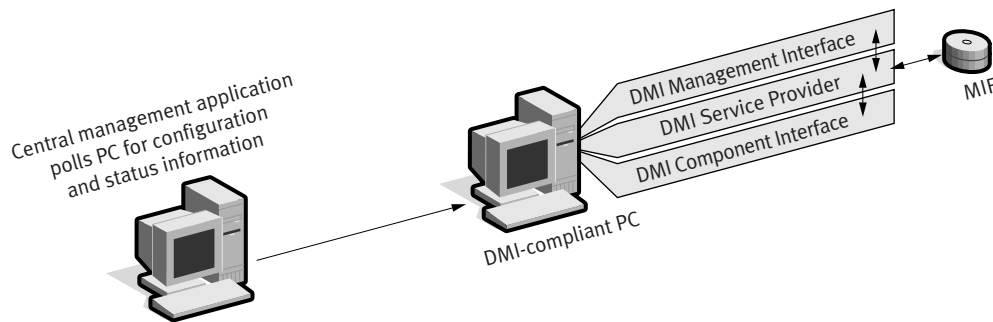
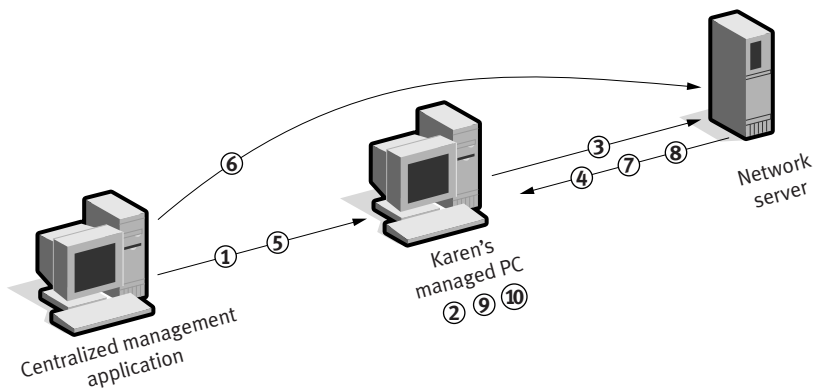


Figure 5. DMI-Compliant Asset Tracking



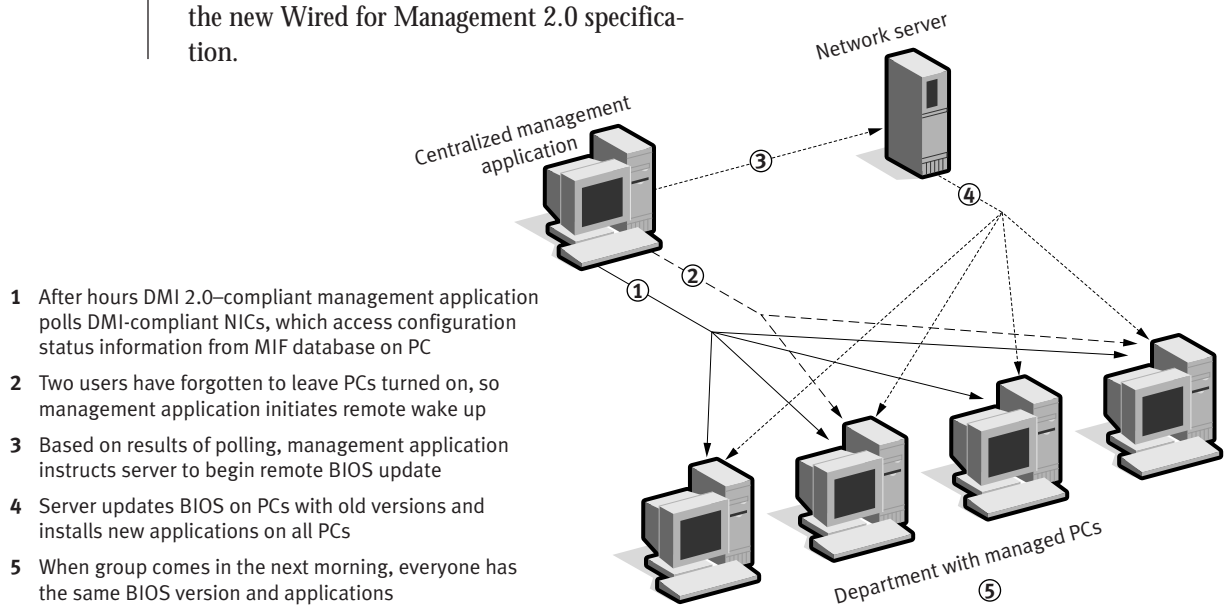
- 1 Administrator sends network boot command
- 2 MBA agent in NIC or system BIOS interrupts boot process
- 3 Requests instructions from server
- 4 Installs mini-OS from server
- 5 Administrator can now use network tools to troubleshoot the problem
- 6 Discovers problem is corrupted registry file, decides to reinstall system from server
- 7 Server reinstalls system from software image
- 8 Server then returns boot control back to local PC
- 9 PC continues booting from local OS
- 10 Karen is up and running in less than an hour

**Figure 6. Troubleshooting a PC That Won't Boot**

All new 3Com NICs and network PC Cards are DMI 2.0-compliant and support ACPI for Remote Wake Up. Full RWU implementation will depend on enhancements to PC Card and bus designs. 3Com is working with other members of the Personal Computer Memory Card Interface Association (PCMCIA) to develop solutions. In addition, at the June 1998 PC Expo, 3Com and its partner SystemSoft demonstrated an industry first—preboot management on a notebook computer. The demonstration showed industry-standard capabilities that will be included in the new Wired for Management 2.0 specification.

### Alerts from Sleeping and Powered-Off PCs

Today's PC software can generate alerts across the network to tell management applications about PC environmental conditions, malfunctions, configuration changes, and tampering. The next generation of PCs and NICs will provide a tighter link to the events going on within a PC and will enable the initiation of alerts even when a PC is powered off or in a nonfunctional state. 3Com is developing this hardware-based capability in cooperation with leading PC manufacturers.



- 1 After hours DMI 2.0-compliant management application polls DMI-compliant NICs, which access configuration status information from MIF database on PC
- 2 Two users have forgotten to leave PCs turned on, so management application initiates remote wake up
- 3 Based on results of polling, management application instructs server to begin remote BIOS update
- 4 Server updates BIOS on PCs with old versions and installs new applications on all PCs
- 5 When group comes in the next morning, everyone has the same BIOS version and applications

**Figure 7. Updating BIOS and Applications After-Hours**

### **More Manageable Servers**

Significant progress is being made in transforming servers into more manageable machines as well. The Intelligent Platform Management Interface (IPMI) is an industry initiative led by Intel, Dell, Hewlett-Packard, and NEC; it will provide a standard interface to hardware used for monitoring a server's physical characteristics, such as temperature, voltage, fans, power supplies, and chassis. The benefits are expected to include increased server availability and cost reduction.

### **Conclusion**

Over the past decade and a half most businesses have moved from centralized mainframes and minicomputers to distributed LANs. They've experienced considerable benefits in the form of increased scalability and strategic flexibility as well as the opportunity to provide users with access to a world of versatile new desktop applications. Yet other

anticipated benefits—most notably productivity gains and cost savings—have remained elusive. They have been offset in large part by the added administrative burden of keeping all those individual PCs configured properly, up to date, and operational.

Managed PCs remove this burden, enabling companies to regain the administrative control that characterized the mainframe era while continuing to take advantage of all the strengths of the LAN era. 3Com, the leader in desktop and workgroup networking solutions, is at the forefront of the movement to manageable distributed computing. Today our NICs offer a wider range of Managed PC solutions that support a broader range of protocols and choices than any other vendor. 3Com will continue to work with industry and standards bodies to be among the first to offer products that incorporate emerging standards and new desktop management technologies. ◻



3Com Corporation enables individuals and organizations worldwide to communicate and share information and resources anytime, anywhere. As one of the world's preeminent suppliers of data, voice, and video communications technology, 3Com has delivered networking solutions to more than 200 million customers worldwide. The company provides large enterprises, small and medium enterprises, carriers and network service providers, and consumers with comprehensive, innovative information access products and system solutions for building intelligent, reliable, and high-performance local and wide area networks.

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