Solutions for Reliable, Cost-effective Printing in Networked Environments

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Introduction

Organizations are discovering that they can reduce computing costs and give users a broader range of printing capabilities by sharing network printers rather than attaching a dedicated printer to each user's PC. The resulting trend toward shared printers, however, is creating a new set of problems.

LAN administrators, who are already overburdened with network management tasks, must take on an additional and time-consuming responsibility: ensuring the availability of print services to the end-user community. Traditional network printing devices and the accompanying management software offer little assistance in trouble-shooting and correcting problems with networked printers. They provide little or no information about their status, the current problem or what action needs to be taken. As a result, administrators spend valuable time assisting end-users with printing tasks—often going to the printer or to the end-user's office to fix the problem. User productivity is hampered because they lose a considerable amount of time trying to get jobs to print.

Organizations are turning to a new generation of print devices that simplify network printing. Today, print servers reduce costs by connecting multiple printers directly to the network instead of to file servers or workstations. These products typically include software that simplifies the job of the LAN administrator and minimizes the cost of managing printers. Print servers address the organization's immediate needs for cost control and easier network printing. At the same time, some of them fit the strategic need for printing devices that participate in an overall framework of end-to-end management of network resources.

This document examines the current state of network printing, including problems, industry trends and solutions. It also presents Intel's hardware and software solutions for reliable, affordable and easy-to-manage network printing.

Printing in a Networked Environment

Studies conducted by International Data Corporation (IDC) report that more and more organizations are buying shared printers and moving away from new printers for dedicated use. Why? Because network printing delivers important advantages to end-users as well as to the organization as a whole.

Most end-users who have dedicated printers attached to their computers also have print spooler software, so they can continue to work while printing occurs in the background. But performance is slowed during printing as CPU resources are used to manage the print job. In addition, while the dedicated printer provides good quality output at acceptable speeds, it may not have special features needed for some jobs, such as higher quality or color output.

Network printing overcomes these problems. Print jobs are directed to a network printer, freeing the PC for other tasks and ensuring high performance of the end-user's PC throughout the printing process. In addition, the network can include a variety of printer types including high-speed, high-quality laser printers, color printers and specialized printers for generating overhead transparencies, posters and drawings. As a result, each user has access to a broad range of printing capabilities. Network printing also reduces the total number of printers required and better utilizes those that are installed. The cost of printers—particularly the more expensive specialty printers—can be shared across a number of users.

Network printing reduces the total number of printers required and spreads the cost of printers across a number of users. It also gives users access to a broader range of printing capabilities.

Yet the heterogeneous nature of today's networked environment makes network printing complex. Networks combine workstations, servers, peripherals, bridges, hubs and routers from many different vendors. And many networks run a variety of network and desktop operating systems. This environment is costly and time consuming to manage. *Forrester Research found that approximately one full-time LAN administrator is required to support every 40 to 50 end-users, costing about $1,500 per user per year. (The Network Strategy Report, 1993.)*

Network printing simply adds to this complexity. LAN administrators must cope with dozens of printer types and models from many different vendors—as well as diverse printer drivers, print spoolers and print servers. Yet administrators have few tools to help them manage the printing environment effectively.

Printing Emerges as a Critical Problem

LAN administrators in some large organizations report spending up to an hour a day managing printers.

As organizations move to network printing, they are incurring hidden costs in the form of productivity losses for both users and administrators. LAN administrators in some large organizations report spending up to an hour a day managing printers.

- Network printing is often slow. One reason for this is that the print driver in the PC doesn't know what fonts are in the printer memory, so it downloads all fonts for every print job.
- Large jobs in the print queue may hold up rush jobs, and the end-user must rely on the LAN administrator to move the job to another queue.
- A print job may fail for a variety of reasons, from a print driver that is configured incorrectly for the target printer to a network problem involving a router or network communications. Again, the user must rely on the LAN administrator for help.
- LAN administrators spend valuable time tracking down problems and restarting print jobs, often having to travel to the printer to fix the problem.
- Trouble-shooting may take considerable time because of the diverse printer types, print servers, print drivers and even different implementations of PostScript* or other page description languages.

In a BIS Strategic Decisions survey, LAN Managers reported speed and contention, and the complexity of network, server and printer driver software as the biggest problems of network printing.

1	Speed/Contention	27.2%
2	Complexity and Use of Network Software, Server, Driver	23.8%
3	Maintenance/Hardware Problems/Consumables	11.9%
4	Communications/Feedback from Printers	8.6%
5	Users-Training/Carelessness	7.3%
6	Cross-platform Compatibility	4.6%
7	Other	4.0%

Figure 1. LAN Managers reported that the issues listed in the above table represent the biggest problems they face in network printing.

LAN administrators need tools to address these problems and to help them support the printing requirements of network users.

Key Industry Trends

Two industry trends promise to help administrators support the increasing number of networked printers: 1) the emergence of industry standards for managing network components and 2) the advent of multi-vendor, end-to-end network management solutions.

Emerging Standards

Since the early 1990s, computer industry leaders have been working together to develop standards that will simplify network management. The Desktop Management Interface (DMI) from the Desktop Management Task Force (DMTF) is such an effort. The goal of DMI is the creation of a common management framework for PCs. DMTF includes such industry leaders as Intel,Digital,Hewlett-Packard, IBM,Microsoft,Novell, SunConnect and Bay Networks, plus over 200 additional participating vendor members.

DMI can be implemented in hardware, software, or a peripheral attached to a desktop computer or network server, enabling that product to become intelligent and manageable. A DMI-enabled component or application can communicate its system resource requirements with a DMI-management application and coexist in a manageable network and PC system.

DMI enhances the management of network printing devices by allowing administrators to control these devices from the same DMI-enabled management console used to manage other network resources. DMI-enabled printing devices can communicate status and other information to the LAN administrator.

DMI-enabled devices communicate status and other information to the administrator to simplify the management of printing resources.

End-to-End Network Management

The enormous costs associated with network management are forcing organizations to seek out an integrated set of services that can control the network from one end to the other. The goal of end-to-end network management is to present a consolidated view of the network, including desktop PCs, servers, peripheral devices and infrastructure. The LAN administrator will operate management tools for all network resources from a single console, monitoring and managing the network infrastructure, backing up and restoring files, monitoring workstations and servers, managing print resources and performing other tasks.

According to Forrester Research, "Everything attached to the network must be conversant with management systems so it can be monitored and controlled from afar."

To achieve this, the network will have to consist of what Forrester Research calls smart components. "Everything attached to the network must be conversant with management systems so it can be monitored and controlled from afar." According to Forrester, no single vendor can provide a comprehensive solution. Vendors must integrate their network management tools and services within a single console. The result will be an end-to-end management architecture that spans the entire network, from the infrastructure, through segments and servers to desktop devices, applications and network peripherals.

Today's Network Printing Solutions

Traditionally, network printers have been connected to a file server or a workstation acting as a dedicated print server (as shown in Figure 2). This configuration offers the advantages of handling large print jobs and supporting many users. When the printer is attached to a file server, however, it must be near that servers. As a result, it may not be readily accessible by end-users. Problem scan also arise when the printer is attached to a workstation. If the workstation must be rebooted, active print jobs are terminated. The administrator may have to reset the printer, PC and print parameters, and end-users must resubmit their print jobs.

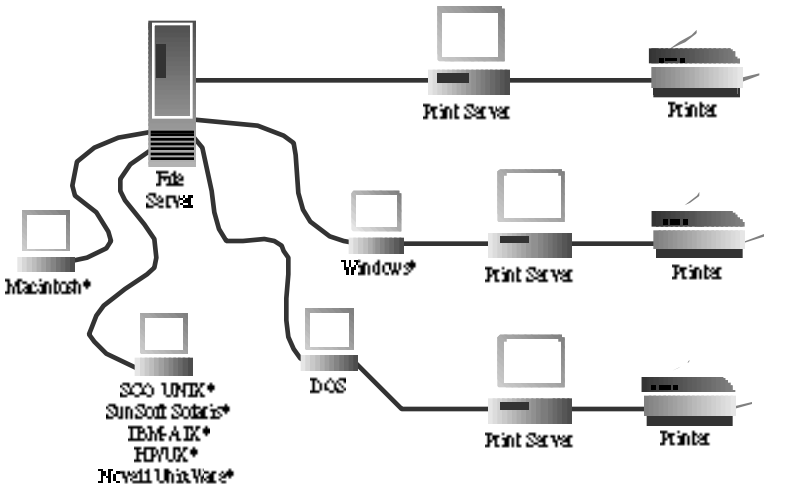

Figure 2. Network printers can connect to a file server or workstation acting as a dedicated print server. Print jobs are directed to the file server or workstation and managed through it.

Today, many organizations are installing print servers which are dedicated devices for attaching a printer (or multiple printers) directly to the network. The print server includes a printer connection, network connection, RAM, ROM and other electronics. As Figure 3 shows, the print server plugs into the network like a workstation, and the printer plugs into the print server.

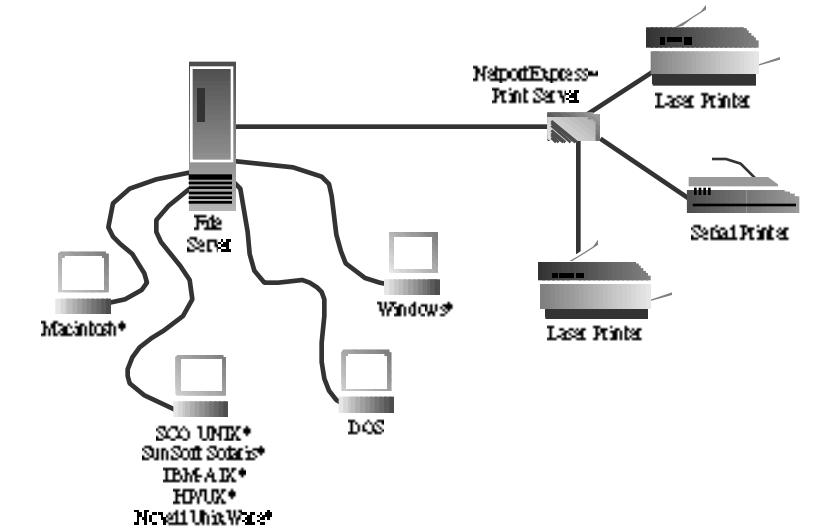

Figure 3. Printers can connect directly to the network using a print server, which communicates with the print service over the network just like workstation-based printers.

Print servers are easy to install and configure, and they can be located anywhere on the network. They cost less and take up little space compared to dedicated workstations.

Print servers offer several important advantages over traditional approaches.

- Easy installation and configuration.
- Flexibility in locating printers.
- Considerably lower cost and space requirements compared to dedicated workstations.
- Software for configuration, management and control.

Internal Print Servers

Some printer manufacturers and third parties provide print server cards that install inside the printer. They offer several advantages:

- They don't take up any additional space.
- They may be optimized for a particular printer model or series.

Some internal cards, however, are proprietary in nature. In environments with printers and management software from multiple vendors, the administrator may have to deal with diverse management approaches. This lack of consistency might hamper productivity during initial set-up and in trouble-shooting and problem-solving. Additionally, internal cards connect only a single printer to the network, so the organization cannot minimize costs by connecting multiple printers to a single print server.

Another drawback of some internal cards is a lack of compatibility. Cards may not work in older printer models from the same manufacturer or with printers from other manufacturers. Cards that work in one series of printers may not work in another. As the organization upgrades printers, it may also have to purchase new internal cards. Finally, internal cards do not address the huge installed base of printers that are not equipped with internal slots.

There is a huge installed base of printers that don't have internal slots. External print servers allow organizations to attach these printers directly to the network.

External Print Servers

An external print server is a small device that plugs into the network and allows a printer to attach to the network. These devices offer several important advantages.

- Lower cost than dedicated workstations. Some print servers support multiple printers, so the organization can spread the cost across several printers to reduce computing costs even further.
- Support for a broad range of printer types from many different vendors. Organizations have a wider choice of printers and can upgrade printers without replacing the print server.
- Support for printers that don't have internal slots.
- Ease of installation and relocation.

One disadvantage of external print servers is that they require extra space.

A wide range of external print servers are available, from low-end, single-port devices to scalable print servers that support up to three or more printers. When selecting a print server, organizations should consider the number of printers they need to connect. If many printers are involved or if several printers will be located in close proximity, print servers that support multiple printers offer a lower price per port and reduced printing costs.

Software Solutions

Several vendors offer software solutions to help organizations manage printers more effectively. These solutions are typically targeted for environments that attach printers to file servers or dedicated workstations. They allow the administrator to control and manage a printer from a file server or workstation, performing such tasks as selecting print queues, moving print jobs from one queue to another, attaching to print queues and specifying the number of copies to print.

Future Trends

Four key trends are affecting the evolution of print server hardware and software. First, according to IDC, the next generation of network print servers will offer increasingly comprehensive management capabilities. The printer MIB (Management Information Base) and MIF (Management Information File) standards expected from DMTF this year "will make such support in the form of vendor supplied utilities a competitive must." (U.S. Network Printer Adapter and Network Laser Printer Markets, IDC, 1994.) With the emergence

of DMI, organizations will expect DMI-enabled devices and that can be managed by industry-standard network management consoles. This will bring printing under the umbrella of end-to-end network management.

Second, IDC expects more and more organizations to attach network printers to print servers rather than to file servers or workstations. Figure 4 shows how IDC anticipates the method of attachment to evolve over the five-year period 1993 to 1998. The number of direct connections will increase from 13.6 percent in 1993 to nearly 45 percent in 1998.

	1993		1994		1998	
	Units	% Share	Units	% Share	Units	% Share
Dedicated to user nodes	309,560	19.2	319,410	18.3	458,920	16.0
Network servers	1,083,891	67.2	1,109,235	63.6	1,128,412	39.3
Direct to network (internal or external network printer adapters)	218,819	13.6	316,765	18.1	1,280,918	44.7
Total	**1,612,270**	**100.0**	**1,745,410**	**100.0**	**2,868,250**	**100.0**

Figure 4. This table shows IDC estimates for the method of attachment for U.S. laser printers shipped to network environments in 1993, 1994 and 1998.

The third trend is a shift toward internal print servers, as manufacturers incorporate internal cards into their printers. Many customers hesitate to move in this direction, however, until industry standards are more clearly defined. External devices will continue to be a strong and viable solution, particularly in light of the large number of printers that don't have internal slots. In addition, many new types of printers, such as the HP DeskJet,don't have internal slots for internal print servers.

The fourth trend affects print management software. In the future, more and more print services will be incorporated into network and desktop operating systems. NetWare* and OS/2* already includes print services, and Windows* 95 will include some print management utilities. In addition, future printers will include embedded technology that allows them to communicate directly with the operating system to facilitate print management. The incorporation of print services into the operating system and the use of embedded systems are still evolving, and the full impact of these trends is yet to be determined.

Intel Network Printing Solutions for Today

Intel's printing solutions provide reliable, cost-effective approach to sharing printers on a network. The primary products in this area are the Intel NetportExpress™ XL and EL print servers, which offer a flexible hardware solution for sharing printers. They include easy-to-use management software for installing, monitoring and controlling the print server, as well as DMI support and Flash memory. Intel also offers LANDesk® Management Suite, an integrated suite of applications for managing tasks on the network. LANDesk Management Suite provides a console for centrally managing a variety of network resources, including NetportExpress print servers.

Intel NetportExpress XL and EL Print Servers

NetportExpress™ print servers offer a low per-printer cost because each device supports multiple printers.

The award-winning NetportExpress print servers help organizations control computing costs by allowing them to attach printers directly to the network. Each unit contains its own microprocessor, memory, LAN interface circuitry and Flash memory. These devices feature a low per-printer cost because each device supports multiple printers.

NetportExpress XL features two standard parallel ports and one serial port, allowing it to support all makes and models of network printers. As a result, organizations have flexibility in choosing the best combination of printers to meet the organization's printing needs. It also simultaneously supports up to four protocols on all connected printers:

- IPX—NetWare* including 4.1 with native NDS support
- TCP/IP—UNIX* (Sun OS, SCO, Solaris,* HP UX and UnixWare*)
- EtherTalk, TokenTalk—AppleTalk*
- Net BIOS—Windows NT*, MS LAN Manager* on MS/OS/2, IBM LAN Server* on IBM OS/2*

The EL is a high-performance print server optimized for NetWare networks. It supports two parallel printers.

NetportExpress print servers are easy to install. Because they are external devices, there's no need to open the printer cover, install a card, or set switches or jumpers. With the high-speed parallel ports, NetportExpress print servers are equal to or faster than internal cards—up to 180 Kbps for the XL and 80 Kbps for the EL.

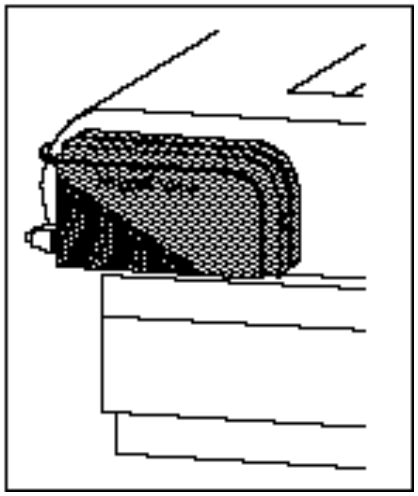

Figure 5. Intel NetportExpress™ print servers let you connect printers anywhere on the network.

DMI-Enabled

Both the XL and EL print servers are DMI-enabled. A static MIF contains critical information on the device as well as telephone numbers for customer support. DMI directs the organization's customer support staff to a central location for finding this essential information regarding network resources. As a result, network administrators have a single source for finding support numbers on any Intel and other DMI-enabled products they manage.

Print Management Software

With Netport Manager software, the administrator can monitor and control the print servers from any PC on the network. This ability to manage printers remotely increases administrator productivity by eliminating the need to go to each printer to control and manage it. Multiple user classifications ensure flexibility in assigning control over NetportExpress units. The ability to assign a password to each unit increases security by allowing the administrator to segment the network print services.

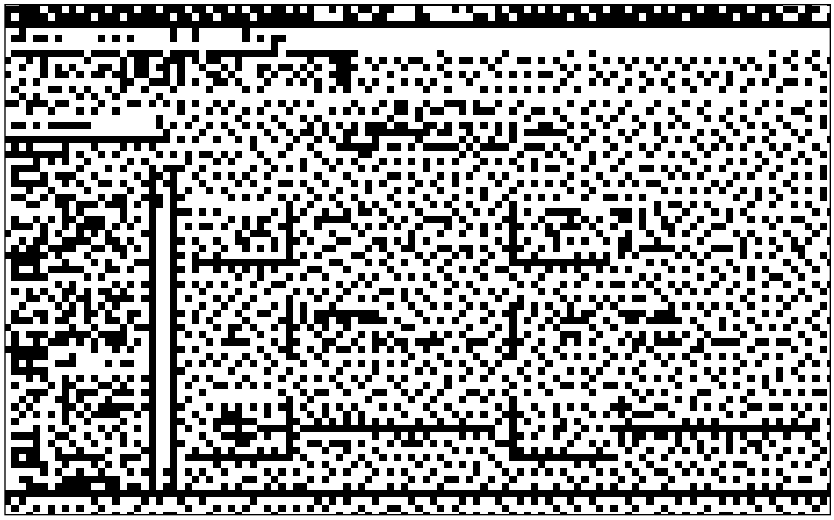

Figure 6. You can set up, configure, monitor and upgrade all Intel print servers in logical domains through the Windows Netport Manager console.

NetportExpress includes two additional print management utilities: LANQView and LANPrint. LANQView is a DOS utility that enables administrators to view and control up to three print queues at once to make the most productive use of print resources. The administrator can move print jobs within a queue or from one queue to another.

LANPrint is a Windows utility that displays a pop-up menu of network printers to simplify printer selection. End-users can switch from one printer to another without worrying about queues, jobs or the inner workings of NetWare. They can also alter such print parameters as banner pages, type styles and the number of copies printed. The administrator can configure the menu to restrict access to a specified list of print job parameters (for example, printer selection only).

Intel Flash Memory Technology

Intel Flash memory is read/write, non-volatile memory that permanently stores the Remote Boot Load (RBL) application code (the software that provides the NetportExpress functions). When NetportExpress boots up, its Flash memory connects with a file server defined in the configuration by the LAN administrator. It then downloads the application file into its RAM. The administrator can configure all NetportExpress units on the network to use the same RBL server and file, which ensures they are running the same version of application code. (Remote Boot Load is a well-established way for diskless workstations to attach to the network.)

Intel Flash memory ensures easy updates across the network, without replacing EEPROMs. Intel provides free software enhancements on an ongoing basis.

Flash memory ensures easy updates when Intel develops new software to provide additional functionality, better performance or compatibility with new network operating system versions. Intel delivers new software releases—free of charge—on a diskette or through our bulletin board system. The administrator simply replaces the application file on the server, and all print servers are automatically upgraded the next time they connect to the server and download the application file. There's no need to replace EEPROMs.

Intel LANDesk® Management Suite

LANDesk® Management Suite is an integrated suite of applications for managing tasks on the LAN, including software distribution and metering, inventory, remote control, server monitoring, print management, traffic monitoring and real-time and historical reporting. It features a common user interface and common data across management applications to enhance administrator productivity. Alert scan be directed to the LANDesk Management Console, via a beeper, or through e-mail or Fax.

Netport Manager plugs into the LANDesk Management Console, so the administrator can manage NetportExpress units from the same console used for managing other LANDesk applications. Through the Alert Management System, Netport Manager can notify the console when a printer is off-line as well as when a problem has occurred with a file server connection, RBL download, print server connection or configuration, or remote printer connection or configuration. This early notification means the LAN administrator can resolve many printing problems before the end-user is impacted.

LANDesk Management Suite incorporates DMI, so network managers can view and configure DMI-enabled components from the LANDesk Management Console. Management information for each desktop or network component is readily accessible from the console.

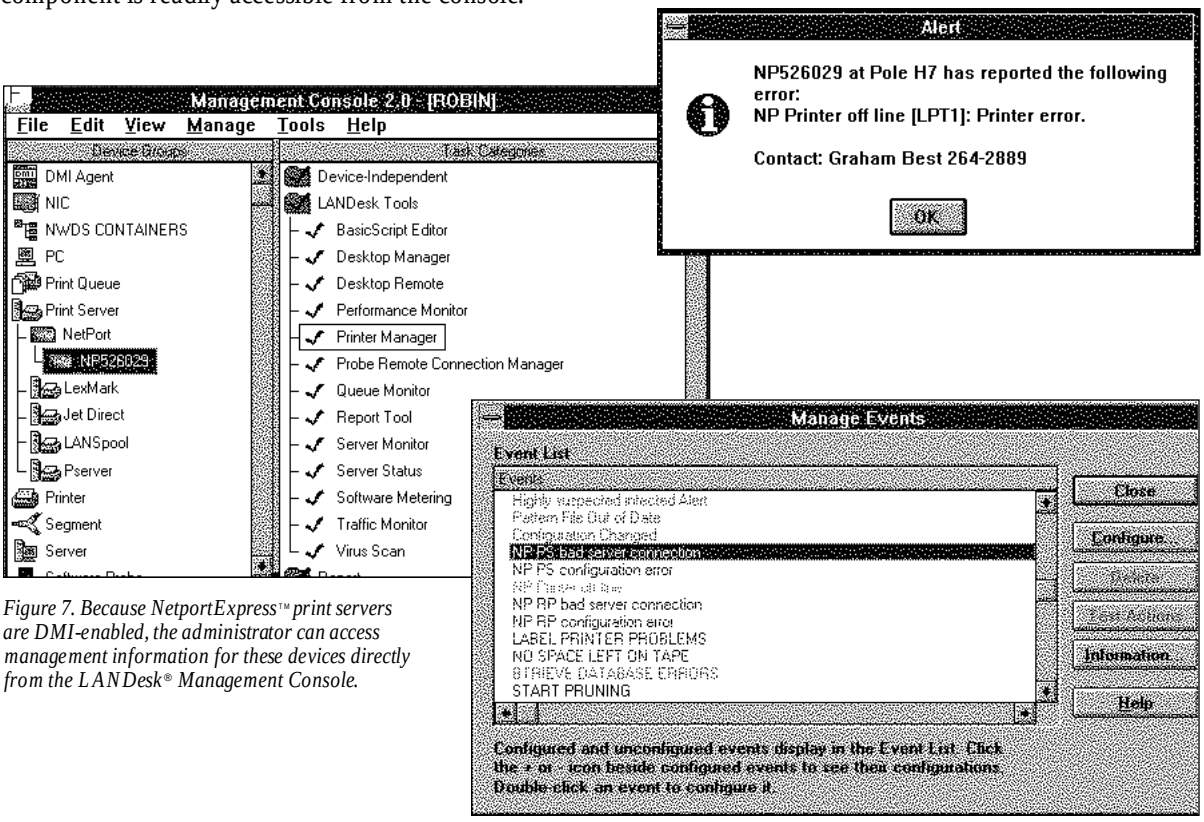

Figure 7. Because NetportExpress™ print servers are DMI-enabled, the administrator can access management information for these devices directly from the LANDesk® Management Console.

Intel Smart Network Services

NetportExpress and LANDesk Management Suite are part of Smart Network Services, Intel's solution for end-to-end network management. Intel is making all its network management tools and network resources smarter. In the case of printing devices, the company is building in intelligence by DMI-enabling NetportExpress print servers, so they can interact with other network management applications.

Intel network management applications will automate tasks where possible, freeing administrators to handle more important tasks. They will also allow administrators to take a proactive role in controlling the network. The applications will monitor the system, take action based on user-defined rules and send alerts to the administrator. The integration of NetportExpress with LANDesk Management Suite is one example of Intel Smart Network Services.

Intel is also joining forces with other industry leaders to engineer their respective management products to enhance end-to-end management. The solution builds upon Novell's ManageWise* console, which centralizes and integrates management of devices and services distributed throughout a multi-vendor network. Network managers running ManageWise can access Intel's desktop management tools, virus protection, network backup and print services directly through the graphical network map.

NetportExpress print servers and the Netport Manager application snap into Novell's ManageWise. Each NetportExpress unit appears as an icon and alias in the ManageWise network map. The administrator clicks on the icon to open the Netport Manager application with the selected NetportExpress unit highlighted.

NetportExpress print servers are also designed to integrate into other industry-standard management consoles as well. They include SNMP (Simple Network Management Protocol) support, so their MIBs can be browsed from any enterprise-wide, SNMP-based management console.

Future Direction

Intel is continuing to enhance functionality and performance of all its network printing solutions. The recent incorporation of DMI is just one example of how Intel print servers are becoming smarter. Over time, Intel will enhance the NetportExpress printer servers' ability to communicate with management consoles to provide additional status information as well as information about printer capabilities. When a problem occurs, alerts will provide more detail on the nature of the problem and how to resolve it.

With smarter print servers, it will be easier to enhance functionality to include such capabilities as redirection of print jobs. Ultimately, redirection of many print jobs could occur automatically to balance the network print load and achieve better utilization of printers. By increasing functionality as well as the level of automation, Intel network printing products will help customers reduce the cost associated with network printing.

Summary

Organizations are under tremendous pressure to provide an increasing level of all types of computing services to their network users. Faced with strict budget constraints, however, they must find a way to provide these services without driving up computing costs. Print servers and their accompanying management software provide a viable solution for satisfying network printing needs while controlling costs.

Intel is the market leader for external print servers. Its NetportExpress XL and EL print servers have won numerous industry awards for excellence, including the Network Computing Editor's Choice Award (1995), Computer Reseller News Editors' Choice Award (1995), LAN Times Readers' Choice Award (1994) and LAN Computing/Internetwork Magazine Standards Achievement Award (1994). These products provide a reliable, cost-effective solution to organizations that have an immediate need for simpler, more affordable network printing. The Netport Manager software ensures easy management of all NetportExpress units on the network.

The NetportExpress products also integrate into the Intel LANDesk Management Suite, enabling administrators to manage NetportExpress units from the same console used for other Intel management applications. NetportExpress and the LANDesk Management Suite support the DMI standard to enhance manageability. In addition, both products plug into industry-standard management consoles such as Novell ManageWise. As a result, they are in line with the industry trend toward end-to-end management of the enterprise network from a single management console.

Network Computing Editor's Choice Award (1995)

Computer Reseller News Eidtors' Choice Award (1995)

What to Look for in a Print Server

✓	Plug-and-play installation
✓	Support for multiple simultaneous printers
✓	Support for all printer makes/models
✓	Upgradability across the network via software—from one location
✓	Easy-to-use management software
✓	Simple printer selection
✓	Easy redirection of print jobs to an alternate printer/queue
✓	Automatic recovery from power outages.
✓	Maximization of network bandwidth.
✓	Integration with industry standard management consoles LANDesk® Management Suite ManageWise* HP OpenView*
✓	Ability to send alerts to management console or via beepers,e-mail and fax
✓	DMI-enabled
✓	Support for multiple protocols IPX/SPX AppleTalk* TCP/IP NET BIOS
✓	Support for all popular network operating systems NetWare* 2.2, 3.11,3.12,4.1,native NDS support Windows NT* UNIX (SCO, SunOS, Solaris 1.x, 2.x,UnixWare,* HP/UX) LAN Manager, LAN Server AppleTalk

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