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Rev 1.1, 970403

Making Networks Work Harder and Smarter

Executive Summary

As more users become more dependent on networks, the focus of networking itself is shifting from infrastructure to peripherals and other devices, and how to provide consistent, manageable access to them. As the number and types of network peripherals grows, the cost and difficulty of connecting those peripherals to networks is coming into sharper focus for users. Network managers are also facing increasingly complex choices over what to connect to their networks, how to connect it effectively and how to manage each connection and keep it running once it has been made.

As a result of all of this, users remain enthusiastic about business networks, but are viewing them more critically. They want consistent, effective, economical and manageable strategies for connecting traditional computing peripherals and other devices to their networks regardless of the types of devices, their manufacturers or the types of computers and protocols used in those networks. As vendors continue and increase innovation in this area, network users and managers can begin to view a future that provides what networks have until now only promised: Access to Everything.

In order to meet the challenges of a new wave of extending the use of networks, Axis Communications developed the ThinServer™ Technology. This comprehensive architecture provides cost-effective plug-and-play network connectivity for any device. Printers, scanners, hard disks, digital cameras, building control systems, and home appliances - they all “deserve” to be networked, delivering more efficient processes by increasing network value and content.

Introduction

Like the popularity of personal computers (PCs) themselves, computing networks are growing prodigiously in size and number in businesses small and large. Accompanying this growth is increasing sophistication among users, which is leading to growing scrutiny of their extensive networking investments, especially in networked peripherals.

This scrutiny is unearthing some interesting facts. One is that the cost of owning and maintaining a networked PC equals multiples of the original purchase price of that PC and its related hardware and software. Another is that connecting needed peripherals like printers and online storage to networks and making those resources easy to access is still not a consistently simple, economical process. Still another is the need to shift networking philosophies away from a focus on PC-based clients and servers and toward generally making networks more useful and productive, and specifically making them more relevant to the daily lives of more people.

This paper will explore the current state of networking and expand on the Access to Everything vision and its ability to increase the value and productivity of users' networks. The paper will then describe the benefits and challenges of delivering Access to Everything, the steps Axis Communications has taken toward this goal, and some glimpses into the future.

A Day of Life with Access to Everything

It's early in the morning, you're snowed in thousands of miles from headquarters, and there's a last-minute problem with the presentation slides you left behind. And the phones are out where you are! You calmly fire up your palmtop with the wireless network modem, and download the latest version of your slides. You make the necessary changes, then print out the slides at a print/fax kiosk in your hotel lobby so you can see exactly how they'll look in the presentation binder. After reviewing the edits over coffee in the lobby coffee shop, you save the corrected file on the headquarter intranet.

Before heading back to your room, you activate your computer's browser and access the video camera outside your ski chalet, about two hours' drive from where you are. Looks like everything's in fine shape, but the on-line thermometer shows that it is a bit chilly, so you turn on the chalet's heat via your browser. A couple of clicks and you're looking at local weather and traffic information. With no emergencies or major delays evident, you confirm receipt of the corrected slides at headquarters, check out of your hotel, jump in your car and head for the slopes, grateful once again for Access to Everything - including time away from the office.

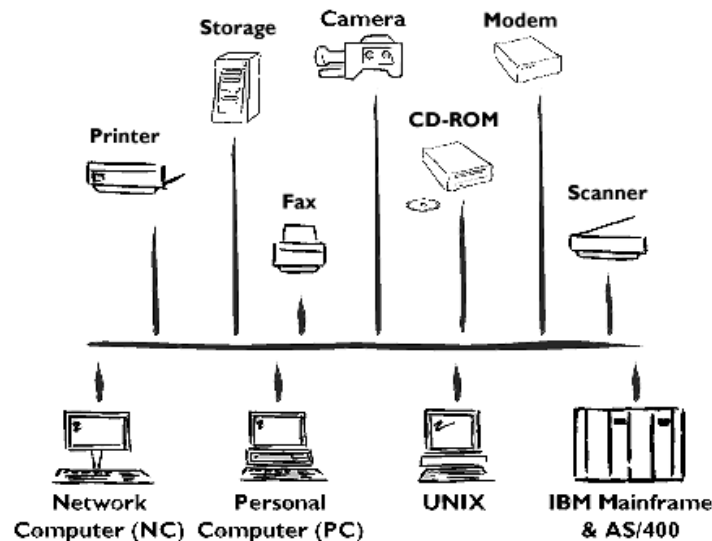


Figure 1. The network is becoming a general resource for providing access to a wide range of devices

Networks to Date: Good, but Not Good Enough

Networking is at a crossroads. Networks are growing in size, number and complexity. Users are increasingly dependent upon and aided by their networks. The web and its technologies are changing networks and how people use them. And the number and type of devices that can potentially increase network value is now taking a great leap forward.

However, the evolution of networking infrastructure is lagging behind the rapid evolution of networking peripherals, appliances and devices and potential connection methods.

Despite the tangible benefits of current networks, it's still expensive and difficult, if not impossible, to attach some devices to some networks. (This becomes an even more difficult problem as networks move into consumer markets and attempt to support connections to traditionally non-electronic, non-networked "peripherals" like coffee-makers and freezers!) There are still no comprehensive, broadly adopted standards for connecting any kind of peripheral, device or appliance to any network (a prime opportunity for Axis Communications, as detailed later in this document). Many connections of peripherals to networks still require a client or server PC as an intermediary, adding to the cost and complexity of such connections. There are numerous competing and sometimes incompatible architectures for managing networks of multiple hardware platforms and software environments, many of which are inconsistent in their ability to support and/or manage a wide range of network peripherals or devices.

None of these impediments has slowed the overall growth of networking. But networking is changing significantly. For example, International Data Corp., a leading market-watcher, expects Internet-related activities to have grown more than 44 percent among server-purchasing companies between 1995 and 1999.

In a recent survey of enterprise users conducted by IDC and its sister publication, "InfoWorld," 43 percent of those responding said browsers and web servers were emerging as the primary interfaces for new applications development. And more than half of the respondents either already have corporate intranets or were planning to implement them within 12 months of the survey.

These intranets will incorporate support for legacy systems, from mainframes to client-server local-area networks (LANs) based on market-leading software offerings like Microsoft Corp.'s Windows NT and Novell Inc.'s NetWare. These intranets will also support new types of "clients" or user computers, in addition to traditional PCs. These new clients will include so-called "network computers," "network appliances" and other electronic devices that combine browser and web-access technologies with the ability to download applications on demand, eliminating the need to store multiple capacity-hungry applications on user PCs.

IDC analysts describe the current state of networking as the beginning of a second phase, especially where corporate networks like intranets are concerned. While business networking's first phase focused on automating "back office" functions, IDC predicts the next area of focus will be on automating "front office" functions and delivering automation to personnel "in the field."

But those in the front office and the field don't use networks - they use client systems, peripherals and networked devices. This implies a shift in focus, away from network infrastructure and plumbing and towards connections between people and the peripherals, devices and network services they actually use. And it's in these important areas that current networks are not good enough anymore.

What Users Want Now: Networking Beyond PCs

Users want networks that give them access to any network resource they might want or need to use, without difficulty or complexity. This means users want more than just connections for their PCs. They want easy access to printers for their reports, scanners for the cards and documents they collect, additional electronic storage for their presentations and multimedia, image-capture for adding visuals to their work. In short, users want "Access to Everything."

In today's networks, connected devices are viewed from a PC-centric or server-centric perspective, rather than from a network-centric focus. This has resulted in devices incapable of network connections except through a PC, a problem compounded by the widely differing approaches for connectivity and manageability adopted by competing peripheral manufacturers.

The challenge facing network users and managers is clear, and daunting. They must grow their networks in managed, secure ways that take full advantage of new opportunities to make those nets work smarter, via infrastructures that are reliable, flexible, scalable and open, and that support connection of diverse peripherals and devices, ultimately, Access to Everything.

Users are clearly realizing real business benefits from today's client-server networks and intranets. However, these benefits can be expensive and harder to quantify than the annual costs of owning and maintaining a PC-based network client or server. And the networks themselves are still not truly easy to manage completely.

Users have also had painful, expensive experiences upgrading and evolving their computing infrastructures to take advantages of significant technical advances. The moves from traditional LANs to the web and intranets is at least as convoluted as the transitions from mainframes to minicomputers, and from minicomputers to PCs, LANs and client-server.

Technologies like Java and HTTP are increasingly becoming de facto industry standards, poised to make flexible, manageable multi-platform networks easier and less expensive to create and maintain. But these technologies are currently not fully available, or available only as specific, sometimes incompatible products from competing vendors.

Thus, today's networks fall short of meeting the true goal of network managers and users: access to anything and everything they might find useful, based on proven, widely used technologies and without extensive, complex changes to core network resources. In other words, Access to Everything.

Clearly, today's PC-focused networking architectures are insufficient to deliver Access to Everything. For evidence, one need only read the industry press today and compare user experiences and complaints regarding intranets with those reported about LANs 10 years ago. In both cases, leading-edge users are reported as cautiously touting successful deployments of advanced applications - while vast numbers of users complain about not being able to print their documents on the network printers they want to use.

This demonstrates that even in a relatively mature network market like that for LANs, the connection of basic peripherals like printers is still potentially problematic. The problem is only compounded when the range of peripherals expands to include storage, scanners, digital cameras and other electronic office equipment. Parallel problems arise in consumer markets with the rise of web-enabled television sets, modem-equipped video-game systems and new network appliances for the home.

Users want solutions to these problems that improve on existing technologies without requiring their wholesale replacement. Access to Everything must include seamless interoperability with current solutions, using the same technological industry and de facto standards wherever possible. It must be flexible enough to allow consistently straightforward connection of current and future peripherals and devices to users' networks. And it must be fully manageable and secure.

Access to Everything: The Challenges and the Solution

The above circumstances describe the major challenge to those seeking Access to Everything. Users and managers must find technologies and tools that help them substantially improve network productivity while keeping costs, changes and other disruptions to a minimum, and keeping and building on the best of what's in place while leaving behind the rest.

The solution for users is, in turn, a challenge to vendors. The solution is an approach based on a common connectivity methodology and architecture flexible enough to support the widest possible variety of electronic devices and networking environments. This is the underlying philosophy of the products and technologies at the core of the Axis architecture.

The vision of Axis Communications is to increase the value of the network by providing:

- users with easier and faster access to more network resources;
- network managers and administrators with easy installation, management, reliability, flexibility and control of network resources; and
- IS/IT managers and organizations with better network utilization and lower overall cost of ownership.

To increase network value, Axis believes connectivity products and technologies must:

- connect all kinds of electronic devices for true Access to Everything;
- provide access to network resources where users are, and not just where PCs and servers are;
- make all network peripherals and devices "smart" by equipping them with their own uniquely addressable, server-independent, high-performance network enabling technology; and
- use the network to install and manage all connected devices.

Axis' ThinServer™ Technology provides a breakthrough in the networking of peripherals. It delivers enabling technologies that make peripherals and other devices "network-ready" without requiring an intermediate PC client or server.

It embraces proven, familiar and widely-adopted technologies so that devices can easily be integrated in existing network environments. It is compatible with all leading network environments, including NetWare, Windows NT, UNIX, IBM OS/2, Apple Macintosh, IBM SNA and intranets based on web-derived technologies such as HTTP, Java and TCP/IP.

Using web technologies as a common ground, it provides consistent, network-wide management of all networked devices, from any point on the network or via Internet-based network connections.

The Axis architecture uses custom-designed, high-performance chip and embedded software technologies to provide "thin" but smart servers for network peripherals and other devices, giving users and managers greater flexibility, performance, manageability and economy than available with competing solutions. In short, regardless of the type of connected device, the Axis architecture makes the device appear to users and their networks as a small, native, low-cost, easy-to-access and easy-to-manage web server. In addition, users can also access and manage the device using native and familiar methods in the standard network operating systems such as Windows (3.x, 95 and NT), NetWare and UNIX.

Conceptually, the Axis architecture resembles that of the "network computer" (NC) concept originally promoted by Sun Microsystems, Oracle and other leading vendors as an alternative to the traditional PC. NCs are designed expressly for connection to a network, and replace complex interface software like Microsoft Windows and IBM's OS/2 with a simple, graphical browser and built-in network connections.

When in use, the NC needs few resident applications. Instead, it gets the applications a user needs from servers on whatever network to which it's connected. This makes the NC more simple, less expensive to buy and to own, and easier and more economical to manage than any PC, which is why the trade press and industry analysts report rapid growth of pilot and production deployment of NCs in corporate environments.

In similar ways, the Axis architecture brings integrated, web-based networking to network-connected devices. Web technologies provide transparent plug-and-play connections between network peripherals and peripheral-server chip hardware and embedded software developed by Axis. Every connected device so equipped "looks and feels" like a file server (Windows NT, NetWare, OS/2, UNIX and web) to the rest of the network, making each network peripheral easy to integrate and manage.

Rather than being based on *computational* technology, such as PCs, the ThinServer Technology is designed from bottom up to provide optimal *communications*. This includes 32-bit RISC-based hardware with chips specifically designed to provide high-bandwidth and low-cost network communications. It has a set of streamlined and compact embedded thin server implementations of major operating systems that provides transparent, plug-and-play, use. And finally, the web server functionality provides platform-independent and powerful access and management of devices from any browser. Through this optimization, miniaturized, high-performing and cost-effective connectivity solutions can be designed for any device.

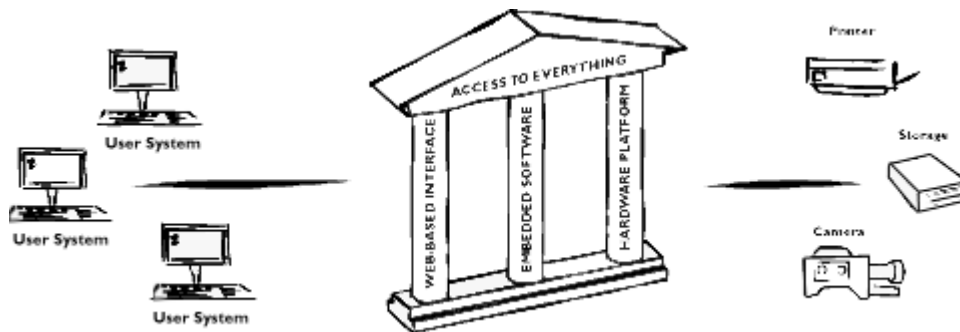


Figure 2. The ThinServer Technology

Other companies have attempted to deliver connectivity solutions for a broad range of peripherals. Approaches such as Novell's NEST (NetWare Embedded System Technology) and "Microsoft At Work" (standard interfaces between electronic office devices and Microsoft computing environments), have generated momentary press interest but so far not drawn strong support from manufacturers of peripherals and office equipment.

However, only the Axis architecture combines the strengths of optimized network hardware, embedded thin server software, and interfaces based on Internet/web technologies. These features deliver open, multi-platform, powerful, flexible, manageable and economical connectivity solutions compatible with all types of peripherals, devices and appliances - Access to Everything.

Products

Axis vision includes to provide users with plug-and-play network connectivity for:

- **Office peripherals** – such as printers, scanners, CD-ROM drives, and hard drives – can be connected and shared where needed, reducing file server overhead and network traffic.
- **Industrial equipment** – such as surveillance cameras and building controls – can replace traditional equipment in favor of open network standards, such as using the web.
- **Consumer products** – such as video players, home security systems and heating – can be controlled from anywhere.
- **Networking hardware** – such as hubs and routers – can be managed using the web interface.

Currently Axis is delivering products which mainly address business computing needs. All products adhere to the Axis ThinServer Technology, use the same optimized hardware and software components, support web-based management and can be upgraded over the network as new features become available without being replaced.

- **AXIS NetEye 200 Internet Camera** - allows users to capture live images and makes them available over the Internet or intranets via a standard browser. As the first web appliance product in its category, it plugs directly into Ethernet or a modem, contains a built-in web server and a high-quality digital color video camera with 704x576 resolution. All in a package not larger than the palm of a hand, enabling a large variety of applications ranging from surveillance to web site improvement.
- **AXIS StorPoint CD Network CD-ROM Server** - makes CD-ROM drives, towers and CD "jukeboxes" network-ready and easily accessible to users of any type of network, allowing users to share valuable CD-ROM information. The embedded thin server software makes accessing CD-ROM drives transparent to the users, they access CDs in the same way as they would access a local CD on their workstation. By sharing CD-ROM information users have access
- **AXIS StorPoint HD Network Hard Disk Server** - provides a plug-and-play solution to add storage to the workgroup. Based on the RISC-based ThinServer Technology, it connects SCSI drives providing a more cost effective and easier to install network storage solution than traditional file servers. One application for this product is to provide network connectivity for removable hard disks, Iomega Jaz.
- **AXIS Print Servers** - let users produce output from their documents by supporting efficient, economical connection of printers (including those linked to IBM host computers) to networks. The latest addition, the AXIS PrintPoint 560/100, support 100Mbit Fast Ethernet networks.

This range of products supports users through the entire cycle of capturing, processing and distributing information via networks. Compared to the old model of "print and distribute," the new "distribute and print" model is far more productive and economical. Axis will soon deliver additional products that deliver the benefits of Access to Everything to users of business networks, and in homes, public places and other venues of everyday life.

What ties all these products together is the Axis ThinServer Technology, which uses web-based technologies to equip every network peripheral with its own optimized network server, compatible with legacy resources as well as with all leading industry standards. Every connected device looks the same to every network, every network looks the same to every connected device, and every device can be managed from anywhere one can connect to the network. Access to Everything.

Future

Several coinciding technologies have made network connectivity of non-PC devices practical, affordable and beneficial. But the evolution has just started. The number of devices that could be connected is considerably higher than the number of PCs in the world today. Web technologies, with their open and flexible functionality, have paved the way for a new breed devices called web appliances. Different from server-oriented devices that serve as resources, these web appliances utilize a new principle of communications – the network-centric model.

Axis is packaging components of its architecture and interface technologies separately to OEM partners, in order to give users greater freedom of choice regarding network peripherals. A version of this approach has helped make Axis print and CD-ROM server technologies leading de facto standards in the networking industry, used by numerous manufacturers. Components of the Axis architecture from chip and software modules to turn-key solutions are available to third parties who want to make their appliances and devices network-ready with proven, widely adopted technologies.

Axis will also extend its efforts to expand the reach of its architecture and products, by partnering with leading complementary vendors and by working with key promulgators of industry standards. As examples, Axis recently launched its “Web-on-a-Chip” project, which seeks to miniaturize and radically reduce cost on web server implementations, and during 1997, new versions of ETRAX will become available to increase throughput and support more devices and networks on chip, such as 100Mbit Fast Ethernet.

Axis is also working together with manufacturers of peripherals and electronic devices, including Hewlett-Packard, IBM, Canon and Xerox, and is forging relationships with leading networking infrastructure vendors, including Microsoft, Netscape, Oracle and Sun. Such partnerships will considerably boost the reach of the Axis architecture, bringing Axis technologies and products to a much broader constituency.

Axis is active in the Internet Engineering Task Force (IETF) and the Internet Society (ISOC), an Associate Member of the Desktop Management Task Force (DMTF), and a Core Member of the Salutation Consortium - groups directly involved in development and promulgation of networking industry standards. As standards in areas like web-based network management and peripheral connection appear and are debated, Axis will strive to take a leadership role in such discussions, independently and in concert with its industry partners as appropriate.

Conclusions

Access to Everything is far more than a catchy phrase. It is a description of an ideal, and a commitment. For network users and managers, Access to Everything means easy, economical, high-performance connectivity of and access to network peripherals and devices of every description. From Axis, it is a commitment to continue developing and promoting technologies that make such connectivity possible and practical. Access to Everything, in short, describes the next step in making nets work harder, smarter and better.

Axis has been in the business of networking peripherals for more than 10 years, and has strong internal development resources and expanding industry partnerships. No other company has focused so closely on delivering network connectivity by making peripherals and other devices available to users on any network. Axis is well-prepared to deliver products and technologies that make Access to Everything a reality.