## Intranet Infrastructure Solutions for Small and Medium Enterprises

Intranet Infrastructure Solutions for Small and Medium Enterprises
A Case Study Analysis
Contents
What Is an Intranet? ..... 2
Why Is the Network Infrastructure Important to Your Intranet? ..... 2
Why Is Purchasing from a Single Vendor Important? ..... 3
What Should You Look for in an Intranet Infrastructure Solution Provider? ..... 3
Why Should 3Com Be Your Single-Vendor Infrastructure Solution Provider? ..... 3
A Case Study: CBA Tool \& Die ..... 4
The Original Office Network ..... 4
Simplifying Information Distribution ..... 6
Connecting Remote Employees to the Intranet ..... 8
Reducing Training Costs ..... 10
Providing Secure, Low-Cost Inter-Office Connections ..... 13
Upgrading the Intranet ..... 15
Conclusion ..... 17
Glossary ..... 18

## Intranet Infrastructure Solutions for Small and Medium Enterprises

## A Case Study Analysis

This 3Com paper shows how an intranet improves business efficiency and profitability. It explains why you need an intranet, why the infrastructure on which you run your intranet is as important as the software that makes it up, and how to choose the best vendor to supply that infrastructure. The introduction describes how an intranet will benefit your business. It covers the reasons why an end-to-end, single-vendor infrastructure solution is the ideal way to expand your intranet and explains how to choose the right vendor for your intranet infrastructure.

The case study in this paper describes the evolution of the intranet at CBA Tool \& Die, a small but growing company whose success is enabled by the expanding functionality of its intranet. The evolution of CBA's intranet includes these stages:

- The initial intranet implementation
- The adoption of remote access technology
- The use of distance learning and virtual workgroups
- The implementation of virtual private networks (VPNs)
- The upgrade to a fully switched and managed intranet infrastructure

At each stage, this paper describes the business motivations for, and the benefits of, the proposed intranet infrastructure solution.

## What Is an Intranet?

Think of an intranet as a "private Internet." It is a network that uses Internet applications but is designed for use by company personnel. An intranet enables a business to capitalize on the benefits of Internet technologies; these benefits include:

- A consistent interface throughout the network
- Easy-to-use Web publishing tools and languages
- A rich assortment of presentation options, including multimedia formats
- Centralized maintenance of shared resources

An intranet lets you leverage exciting new Internet technologies in order to achieve cost savings and productivity gains in your business. It allows you to deliver up-to-date information in a variety of formats-from Web pages to streaming video-and to get the message across more effectively at a lower cost. Intranets can easily establish collaborative environments ranging in scale from simple e-mail and shared scheduling to interactive video and white-board sessions. Since an intranet is based on open standards, it also allows you to leverage future Internet technologies as they become available-without the costs frequently associated with developing custom applications.

## Why Is the Network Infrastructure Important to Your Intranet?

An intranet is made up of two parts: the applications (software) and the network infrastructure on which the applications run. Applications-the visible part of an intranet -provide the functionality to improve productivity and lower costs. A wide spectrum of Internet/intranet applications is available from many vendors.

The network infrastructure includes the hardware—network interface cards (NICs), hubs, routers, switches, and servers-over which the applications run. All network hardware is not the same, and an intranet is only as usable, reliable, and cost-effective as the hardware on which it runs. Crucial considerations in choosing appropriate hardware include:

- Bandwidth availability
- Reliability
- Value, in terms of both initial cost and ease of use and management
- Scalability, to ensure that present and future needs can be met


## Why Is Purchasing from a Single Vendor Important?

When selecting the infrastructure for your intranet, a single-vendor solution is the best choice for several reasons:

- Interoperability-Components from a single vendor will work well together. Even with standards-based architectures, there is no guarantee that components from various vendors will always work together. Products from different vendors also tend to have different form factors, making installation more complex.
- Manageability-Choosing a single infrastructure solution vendor simplifies network management and offers additional benefits, such as end-to-end management and Quality of Service (QoS). Products from different vendors tend to have different management interfaces, making management and administration more difficult and raising the cost of administrator training.
- Simplified purchasing-Purchasing your infrastructure solution from a single vendor can lower overall costs and qualify you for volume pricing discounts. It can also simplify planning and acquisition.
- Streamlined technical support-A single point of contact for support reduces the time spent determining which technical support group to call. It also reduces troubleshooting time and complexity and eliminates the finger pointing often associated with cross-vendor support.


## What Should You Look for in an Intranet Infrastructure Solution Provider?

You should choose a vendor that can provide a complete end-to-end solution (everything from NICs to switches and hubs) and can supply all of the equipment-not just a few of the major components-and the support needed to build, maintain, and grow the entire intranet. A vendor with extensive experience in developing and growing all types of networks, including intranets, has the knowledge and expertise to tailor a solution to meet the demands of your intranet applications.

Another important consideration is the products themselves. Each product should
provide good quality, superior ease of use, high reliability, and a feature set that offers all of the functionality you need. Each product should also fit into the overall solution without excessive duplication of functionality; and each product should be scalable to allow the entire solution to grow with your enterprise.

## Why Should 3Com Be Your Single-Vendor Infrastructure Solution Provider?

3Com Corporation brings many benefits to your intranet infrastructure:

- Experience-3Com has more than 19 years of experience as a leading vendor of network equipment. This experience and expertise give 3Com unparalleled insight into the requirements of the small and medium enterprise market.
- Technology leadership-3Com has always been at the forefront of proven technology. Whether you need cutting-edge technology or a mainstream solution, 3Com will recommend and provide the best solution for you.
- End-to-end solutions-3Com's experience, knowledge of your needs, and complete line of world-class network infrastructure products allow it to offer complete, end-toend solutions without compromising functionality or quality.
- Unsurpassed support-At 3Com, we believe that world-class support is an essential part of a world-class solution. 3Com delivers support worldwide, day or night, to customers ranging from small businesses to global enterprises. 3Com support is available by telephone, on site, or over the World Wide Web.
- Scalability—All 3Com products are designed with scalability in mind. Your 3Com product will grow with you and continue to provide return on your investment.
- Reliability—Network outages result not only in service and repair costs, but also in lost business and lowered productivity. 3Com products are engineered to the highest standards to ensure solid, troublefree performance and long equipment life.
- Ease-of-use-All 3Com products are designed to be easy to use. A product is useful only if it can be used to its best advantage.

Acronyms and

## Abbreviations

BRI
Basic Rate Interface
CD-ROM
compact disc-read only memory

## CIR

committed information rate

## DSL

Digital Subscriber Line

## ICSA

International Computer Security Association

IP
Internet protocol

## ISDN

Integrated Services Digital Network

## Kbps

kilobits per second

## LAN

local area network

## Mbps

megabits per second
NAT
network address translation
NIC
network interface card

## PRI

Primary Rate Interface
QoS
Quality of Service
RMON, dRMON
Remote Monitoring,
distributed RMON

## SI

secured Internet/intranet
SNA
Systems Network
Architecture

## VPN

virtual private network

- Manageability—All 3Com products and solutions are designed for optimum manageability. With a 3Com solution, you can get statistics on your entire networkor reboot a single workstation-from across the room or across the globe.


## A Case Study: CBA Tool \& Die

To stay competitive, many small- and medium-size companies seek networking technology solutions that will improve operational efficiency, lower costs, and increase profits. Selecting the right mix of network products from the myriad vendors in the marketplace can be an intimidating and, in some cases, costly exercise. Using a single networking vendor with the experience, technology, and support to meet your current and future business requirements will help you avoid the problems that have plagued many companies: dead-end solutions and technologies, complete network equipment replacement, vendor incompatibility, and support headaches.

The following case study describes how a company successfully grew its business operations from a small office network to a cost-effective, resource-rich enterprise network that connects its remote offices, sales personnel, and vendors. This study illustrates how the selection of 3 Com as the single networking vendor was a critical factor in the success of the network implementation.

## The Original Office Network

CBA Tool \& Die was a small but growing reseller of commercial hardware and manufacturing tools. The company had 25 full-time employees: 5 in the warehouse, 10 in the front office (accounting and order entry), and 10 local field salespeople. CBA's customers included several major local manufacturers as well as local construction supply and hardware retailers.

CBA began with an inventory system running on a midrange computer system using Systems Network Architecture (SNA). This system had several dedicated terminals distributed within the large warehouse, one terminal in the front office, and a high-speed printer. Order entry, processing, and accounting were done on paper. Sales personnel
entered orders and verified stock by telephoning the office. The office terminal for the warehouse computer was used mostly to check inventory.

As CBA grew, management began to consider the benefits that networking could bring to many facets of the company's operation. Many companies in positions similar to CBA's had reaped huge rewards by leveraging the power of computers and networks to streamline operations and increase profitability. The company recognized the opportunity to increase sales volume, lower costs, improve customer satisfaction, and improve the bottom line.

The first benefit from implementing the network would be the improved efficiency of office operations. All accounting could be done much more efficiently and inexpensively using computers. Switching the company's order entry and invoicing to a PC-based system would not only lower costs and improve efficiency, but also provide additional information and control. For instance, a computer-based system could easily show each customer's ordering history or cross-reference orders by customer or productsomething totally impractical using file cabinets. It would also be easy to back up all of the company's records and safely store a copy off-site.

Once CBA had migrated to a PC-based system, it could start adding features. Direct order entry into the system would streamline order entry from roaming sales personnel, reducing the time spent answering phones and manually entering orders. It would allow salespeople to enter orders at any time of day or night, eliminating overtime when a remote sales representative thought he or she might need to place an emergency order. It would also simplify the addition of remote offices, facilitating business growth.

CBA was also considering selling directly to customers from a Web server and running sales training programs by computer. While the company had not needed these features up to this point, many of the successful companies in CBA's own and in similar industries were enjoying success with them. It was plain that, in order to move up to the "big time," CBA would have to embrace the network trend. The only question: What was the best way to go about it?

## Network

CBA started with a single PC and laser printer, but quickly expanded to a small network. The office network originally used two 8-port 10-megabits-per-second (Mbps) hubs, but these had recently been replaced with a single 24-port 10/100 hub, the 3Com SuperStack ${ }^{\circledR}$ II Dual Speed Hub 500.

At this point, CBA had two networks (Figure 1). The computer that ran the inventory tracking system had its own dedicated terminals and directly connected printer. One of these terminals was in the front office, allowing office personnel to view inventory data without walking to the warehouse.

CBA's front-office network consisted of:

- Twelve workstations: six with 3Com EtherLink ${ }^{\oplus}$ XL 10 NICs and six with 3Com Fast EtherLink XL 10/100 NICs
- A 3Com SuperStack II Dual Speed Hub 500 (10/100 Mbps)
- A 3Com OfficeConnect ${ }^{\circledR} 56 \mathrm{~K}$ LAN modem
- A high-speed laser printer with a print server

The Dual Speed Hub 500 allowed both 10 Mbps and 100 Mbps devices to be used on the same network, enabling CBA to use its existing 10 Mbps equipment and workstations, and improving the performance of workstations equipped with the Fast EtherLink XL 10/100 NICs. Most of the newer workstations were purchased with $10 / 100 \mathrm{Mbps}$ NICs in anticipation of the network upgrade.

The OfficeConnect 56K LAN modem provided economical Internet connectivity and sufficient bandwidth using ordinary telephone lines and a low-cost, single-user access account for CBA's office personnel. The company had considered the ISDN version of the LAN Modem, but felt that the slightly better performance of ISDN did not justify the higher ISDN line rates and connect costs.

## Business Benefit

CBA realized several benefits from the new network. The PC-based accounting package could track orders and payments, print invoices, issue checks, and monitor payroll. After setting up the system, office personnel could simply enter the customer number and the order, and the computer would record the transaction, issue the invoice, and update the customer's account. The system could also issue and track payroll checks, balance the corporate accounts, and provide monthly and quarterly expense and earnings reports. Since reports could be sorted by category, CBA could easily see where money was being spent and identify expense and profit trends. As the staff became more computer savvy, the company began to use software to help with strategic planning, such as accurately predicting when to restock each item and tracking seasonal and regional trends in product movement. Accurately anticipating needs allowed the company to use its warehouse space and capital more efficiently, making better purchasing decisions and improving profitability.


Figure 1. Initial Configuration

## Competitors

Since the staff was relatively new to networking, management realized that it would need assistance in implementing and growing the network. The company quickly ruled out buying components from several vendors. Using a single vendor would simplify purchasing and support, and eliminate interoperability problems. Plus, a single vendor would be able to support CBA's entire infrastructure solution.

CBA's present network needs were relatively simple. The company could have purchased hubs and NICs from just about anyone. But, because it planned to add remote access capabilities to the intranet infrastructure in the near future, the company considered only vendors with complete remote access solutions.

CBA researched products from competitive vendors, focusing on the features it considered critical to future growth plans. After careful consideration, CBA chose 3Com and a local reseller to support it.

## Future

CBA planned to add several regional remote offices and increase its sales staff, while maintaining a single warehouse location. The company also anticipated a shift toward just-in-time shipping to cut storage time and cost, and drop-shipping directly to some of its larger customers. With drop-shipping, some large orders would be shipped directly to customers from CBA's suppliers, bypassing warehouse storage entirely and lowering the company's costs proportionately.

CBA's plans hinged on having a network that would evolve with the company's business. For example, as the company opened remote offices, they, too, would be connected to the network. Eventually, CBA hoped to develop a full-scale national presence, with all locations connected, via its network, in a single "virtual organization."

CBA needed a vendor that could provide a complete network solution at each stage of its evolution. It was also imperative that the solutions (and the equipment they were comprised of) would remain in service as the network evolved. CBA was aware that several companies had been forced to completely
replace their network infrastructure when it could no longer be scaled to meet growing demands.

3Com could provide everything CBA needed to meet current requirements, and promised the solutions and support to help CBA grow.

## Simplifying Information Distribution

This section describes how $C B A$ used an intranet Web server to solve information distribution problems, to reduce costs, and to establish a paperless office. It also describes how the company used a host connectivity application (on the same Web server) to connect the legacy inventory computer to the office network.

CBA began looking at ways to further leverage its network. For example, office personnel needed to access the warehouse inventory computer directly. CBA also wanted to establish a paperless office. Large quantities of materials had been printed, disseminated, and stored; but the information changed frequently and needed to be accessible to sales and order entry personnel. Some of the company's vendors already offered product specifications on CDROM, but CBA had to distribute paper copies or keep track of multiple copies of the CD.

## Network

At this point, CBA's two networks were entirely isolated. The computer that ran the inventory tracking system for the warehouse was a midrange system. It had five dedicated terminals-four in the warehouse and one in the front office-and a directly connected printer. It was also equipped with a Token Ring card.

CBA's front-office network consisted of:

- Twelve PC workstations: six with 3Com EtherLink XL 10 (10 Mbps) NICs and six with 3Com Fast EtherLink XL 10/100 (10/100 Mbps) NICs
- A 3Com SuperStack II Dual Speed Hub 500 (10/100 Mbps)
- A 3Com OfficeConnect 56K LAN modem (to provide shared Internet access)
- A high-speed networked laser printer


## Business Requirement

CBA's two objectives were to:

- Enable front-office personnel to access information from the warehouse inventory system
- Eliminate or reduce the volume of printed material in circulation internally

CBA was printing more than 10,000 pages a month. To lower printing and distribution costs, the company sought to distribute inventory lists, product specification sheets, catalog printouts for salespeople, and general company information over the network.

## Solution

The solution to both of CBA's requirements was to install an intranet Web server and a host publishing system (Figure 2). The intranet server was equipped with two 3Com NICs: a Fast EtherLink XL 10/100 Server NIC to connect to the front-office network, and a TokenLink Velocity ${ }^{\circledR}$ XL Token Ring NIC to connect to the warehouse midrange system. The host publishing system was configured to access the warehouse computer using SNA over Token Ring.

Information previously distributed in printed form was transferred to the Web server. Office staff could now access the intranet Web server using their Web browsers. CBA was not concerned with security issues since the Internet connection was dial-out and used a single-user dynamic IP-type account.

This meant that CBA's intranet server could be accessed only by employees in the office. Soon, CBA decided to upgrade its client contact database for Web access as well.

## Business Benefit

The new Web server reduced the complexity and training costs associated with many of CBA's front-office activities; it increased office staff productivity as well. Office personnel could now use a browser to access virtually all the information on CBA's computers, including the Web-based intranet product database, the inventory information on the warehouse computer, and the client contact information in the Microsoft Access database.

Integrating data into a single system allowed CBA to access historical information about vendor pricing and customer demand for products. Experimenting with data mining and statistical applications, CBA found that it could identify trends in customer purchasing patterns, and in pricing and availability from vendors. CBA could now buy strategicallypurchasing product when demand and price were low, and then warehousing product in anticipation of increased demand and price.

The company also began to experiment with targeted marketing, predicting which products each customer was likely to be most interested in, and then passing this information to off-site salespeople.

As anticipated, the Web server enabled CBA to significantly reduce paper data storage.


Figure 2. Initial Intranet Implementation

Product information sheets and catalogs were scanned and placed online on the Web server, drastically reducing printing and binding costs.

Several benefits were unexpected. Since Web-based information is much easier to update, CBA could now ensure that accurate, up-to-date information was immediately available to everyone. Additionally, the company learned that the Web interface generated less network traffic than using Microsoft Access directly. The reduction in network traffic would become significant once the remote access facilities were in place.

## Competitors

CBA's relationship with 3Com and the local reseller had been successful and, as the network increased in complexity, the company's original reasons for choosing a single-vendor solution proved even more compelling. Since interoperability issues had been avoided, CBA was quite pleased with the level of support provided by 3Com.

Of the four other vendors CBA had considered, only one offered a high-performance 100 Mbps Ethernet server NIC and only one offered a Token Ring NIC. While one competitor offered infrastructure hardware that would meet current needs, CBA saw that that vendor did not offer a complete remote access solution. Enabling remote access to the intranet was CBA's next priority in upgrading the network.

## Future

CBA decided to proceed immediately with plans to make the intranet accessible to its remote sales personnel. The company considered how to offer training to remote sales personnel and to create virtual project teams composed of members from various locations.

As the intranet figured more prominently in the company's business plans, it became obvious that CBA's resolve to choose their infrastructure equipment and vendor carefully had been wise. The company determined that any future equipment choices would be based not only on meeting current requirements, but on being reliable and scalable enough to meet future needs as well.

## Connecting Remote Employees to the Intranet

This section describes how CBA implemented remote access technology to allow its remote employees and offices to connect to the intranet.

CBA's sales volume had more than doubled, with much of the new business being conducted by drop-shipping; most large orders were now being shipped directly from CBA's vendors to customers, reducing fulfillment delays and the need for expensive warehouse space and handling. While the volume of sales continued to grow, the number of paper copies in circulation at CBA dropped by more than 85 percent. The company also noticed a reduction in errors since implementing the intranet, which guaranteed that everyone had current price lists and product information.

CBA had also expanded. It now had 66 full-time employees: 8 in the warehouse, 20 in the front office (accounting and order entry), 1 person for computer support and maintenance, and 37 field salespeople. The company had offices in Los Angeles, Detroit, New York, Dallas, and Massachusetts. It had 12 local field sales personnel who worked out of the New Jersey office, and each remote office had 3 to 7 salespeople. This expansion led CBA to look at ways to provide intranet access to the growing remote offices and sales staff.

## Network

CBA's network now consisted of:

- Twenty-nine PC workstations, most with 3Com Fast EtherLink XL 10/100 (10/100 Mbps) NICs
- Three 3Com SuperStack II Dual Speed Hub 500s (the core of the network)
- A 3Com OfficeConnect 56K LAN modem (to provide shared Internet access)
- A high-speed networked laser printer
- A networked fax server (to handle inbound and outbound faxes)
- A separate midrange computer in the warehouse (a legacy system used for inventory)

Intranet capabilities were provided by a high-end Pentium server, which housed the Web server, and the host publishing system,
which provided access to the legacy warehouse inventory computer.

Each existing and new remote office was designed with a network similar to CBA's original network. The remote office networks consisted of:

- Six to 12 workstations equipped with 3Com Fast EtherLink XL 10/100 NICs
- A 3Com OfficeConnect 56K LAN modem or OfficeConnect ISDN LAN modem (depending on local ISDN line charges and availability)
- A high-speed laser printer with a print server
- A 3Com SuperStack II Dual Speed Hub 500

CBA was now buying workstations equipped with 3Com 10/100 Mbps Parallel Tasking ${ }^{\oplus}$ technology (with the NIC on the PC motherboard). Most of the remote field sales personnel had laptop computers.

## Business Requirement

CBA's next objective was to provide intranet access to the remote offices and remote sales
personnel. Optimally, remote users would have full access to the intranet, and security would not be compromised. CBA also planned to make e-mail available to its users, but wanted to avoid the cost and complexity of a firewall at this point.

## Solution

The solution to CBA's requirements was to install a 3Com SuperStack II Remote Access System 1500 server with one Basic Rate Interface (BRI) card (Figure 3). This solution used two ISDN BRI ports to connect to the telco, providing up to four simultaneous dial-in connections. The SuperStack II Remote Access System 1500 could be expanded by adding another ISDN BRI module (to allow up to 8 simultaneous connections) and again by adding an expansion chassis and two additional BRI modules (to allow up to 16 simultaneous connections). Personnel at each remote office and on the road could now dial directly into the SuperStack II Remote Access System 1500 in the office and connect to the intranet.


Figure 3. Remote Access Technology

Standard dial-up password security was used to prevent unauthorized access.

CBA chose a remote access server rather than an Internet-based solution for several reasons. An Internet-based solution would require CBA to upgrade its dial-up Internet connection to a more costly permanent connection. In addition, to maintain security with a permanent connection, the company would have had to install a firewall to protect its network from outside intruders (the current dial-up connection with network address translation [NAT] was safe from outside intrusion). Since most personnel at remote offices needed Internet access only for e-mail, CBA decided to maintain its existing direct dial-in remote access solution. Remote Internet access could still be obtained through the main office intranet connection, when needed.

Each remote office 3Com OfficeConnect 56 K LAN modem was configured to connect to CBA's main office to access the intranet, and each remote salesperson's laptop computer was configured to access the main office when necessary. Since a digital connection to the telco was required to support 56 K modem users, CBA chose an ISDN BRI-connected unit. BRI proved to be the more economical option since a Primary Rate Interface (PRI) connection would incur substantial installation and usage charges on the line, even when using only a fraction of its capacity. With a BRI-connected unit, the company could add lines as needed and, even if full capacity were reached, the cost would still be equal to or lower than the cost of a PRI.

## Business Benefit

The new remote access capability allowed offsite CBA sales personnel to access the company intranet. This access eliminated the need to fax and mail information packets to the remote offices, and ensured that all CBA sales personnel were given the same price lists and product information. Also, all sales personnel could now access the new Web-based contact and sales lead database, which provided centralized management of lead status.

## Competitors

To complete the remote access solution, CBA needed to add a remote access server and purchase 56 K modems for its remote sales personnel, most of whom had laptop computers.

As CBA's network became more complex, it became increasingly apparent that only a single vendor solution would provide the support and product compatibility it needed. Although quite pleased with 3Com as its infrastructure vendor, CBA researched offerings from other vendors and found the competition unable to provide a complete solution. After careful consideration, CBA chose to stay with 3Com as its infrastructure solutions vendor.

## Future

CBA began to look at more ways to leverage its intranet, possibly conducting remote training sessions for sales personnel and more closely integrating its remote offices.

## Reducing Training Costs

This section describes how CBA used distance learning and virtual workgroups to reduce training costs and to allow employees at remote locations to collaborate more effectively.

CBA's remote access initiative extended the benefits of its intranet to all of its remote employees. Manual processing errors had been reduced, and customers were pleased with CBA's ability to render quick and accurate quotes.

CBA currently had more than 100 fulltime employees: 10 in the warehouse, 40 in the front office, 1 person providing computer support and maintenance, and 50 field salespeople. The company now had 35 field sales personnel operating out of seven remote offices, and 15 operating out of the New Jersey office.

Remote employees were being trained at CBA's office in New Jersey, as often as three times per year. As the number of remote employees continued to grow, training costs became an issue. A more efficient and cost-effective training method was needed.

## Network

CBA's network now consisted of:

- Thirty-five PC workstations, most with 3Com Fast EtherLink XL 10/100 (10/100 Mbps) NICs
- Three 3Com SuperStack II Dual Speed Hub 500s (the core of the network)
- A 3Com OfficeConnect 56K LAN modem (to provide shared Internet access)
- A high-speed networked laser printer
- A networked fax server (to handle inbound and outbound faxes)
- A separate midrange computer in the warehouse
- A Pentium server, which acted as a Web server and housed the host publishing system that provided access to the legacy warehouse inventory computer
- A 3Com SuperStack II Remote Access System 1500 with one ISDN BRI module (to provide remote access)

Each existing and new remote office was designed with a network similar to CBA's original network. The remote office networks consisted of:

- Six to 12 workstations equipped with 3Com Fast EtherLink XL 10/100 NICs
- A 3Com SuperStack II Dual Speed Hub 500
- A 3Com OfficeConnect 56K LAN modem or OfficeConnect ISDN LAN modem (depending on local ISDN line charges and availability)
- A high-speed laser printer with a print server


## Business Requirement

CBA had two objectives:

- To provide more effective, lower-cost training to remote personnel
- To use the company intranet to promote greater cooperation and interaction between geographically isolated groups of employees


## Solution

To solve its training objectives, CBA purchased a high-end interactive Web-authoring package that allowed it to create training presentations that included pictures and video clips (Figure 4). In noninteractive mode, the software would simply play the presentation. In interactive mode, the software would present a lesson, request that the viewer complete a short

online test, and advance the viewer to the next lesson only if he or she scored well.

Because of the extensive use intended for the intranet, CBA decided to upgrade its network infrastructure in several areas. The company increased the bandwidth of the LAN itself, separated the Web and host publishing servers, and added a server for the training system.

To accommodate the overall increase in network traffic and to eliminate bottlenecks, CBA added a 3Com SuperStack II Switch 3300 to the network. The switch prevented traffic on individual network segments from appearing on other segments, dramatically reducing overall traffic.

For both bandwidth and reliability reasons, CBA realized it was unwise to have two critical systems housed on the same PC server. The company felt that the capacity of its current combined Web and host publishing system server would be unable to support the increased traffic resulting from the remote training initiative. It decided to add a separate Web server and to use a separate server for its training system.

To address the expected increase in remote access traffic, the company added a second ISDN BRI module to its SuperStack II Remote Access System 1500, and it added two ISDN BRI lines (for a total of eight simultaneous calls supported). CBA also upgraded the Internet connection to a permanent T1 connection using a 3Com SuperStack II NETBuilder ${ }^{\circledR}$ SI (secure Internet/ intranet platform) router to accommodate increasing Internet traffic. The SuperStack II NETBuilder SI router's built-in ICSAcertified firewall provided security between the company's LAN and the Internet.

## Business Benefit

CBA's distance-learning initiative resulted in two main benefits. Training was now available in a more timely fashion and at a lower cost. CBA instituted quarterly two-day intensive training sessions, which were conducted using two-way videoconferencing and moderated by an experienced instructor. Feedback and answers to questions were immediately
available. Additional training sessions could be scheduled as new products and services were added. Personnel who were not at or near remote offices could even take the training over the Internet. Distance learning eliminated the expense of travel and lost productivity and enabled CBA to create a more responsive training program.

Noninteractive training information was continuously available, which helped improve the efficiency and competency of sales personnel while costing the company virtually nothing.

The infrastructure upgrades actually improved the overall bandwidth and performance of CBA's network-even with the additional distance-learning traffic.

## Competitors

Although CBA was pleased with 3Com and the local reseller as its infrastructure vendor, the company once again decided to see what 3Com's competitors were offering. Since CBA's network needs were quite complex, it decided to consider only vendors who could provide complete solutions and support. While competing vendors offered portions of the complete solution, only 3Com offered the entire end-to-end solution that met CBA's needs.

## Future

As the company grew, it relied more and more on its intranet. The network was performing as expected. Thanks to management's foresight in choosing an infrastructure vendor, it could count on the network to grow as the company grew.

As CBA's network traffic continued to expand, many new cost-control measures became available. Fortunately, 3Com had experience with businesses of all sizes and was able to offer guidance at this critical stage of growth.

The company looked for ways to reduce its telephone tariffs. Since its network was getting quite large and complex, it also looked for a network management solution that would monitor performance and plan infrastructure upgrades proactively.

## Providing Secure, Low-Cost Inter-Office Connections

This section describes how CBA used VPNs to provide secure, low-cost connections over the Internet between its main and remote offices.

CBA now had 175 full-time employees, mostly in the main office or part of the remote sales force. Most of its salespeople were operating out of remote offices (the company now had 10), and more than 75 percent of sales were now done "hands-off"-with product being drop-shipped directly from the vendor to the customer. Drop-shipping allowed CBA to increase sales volume without the extra cost of adding and maintaining warehouse space (and personnel). Most order entry with vendors was handled electronically. Almost all the vendors accepted orders electronically in
"batch mode," and most allowed customers to order using the Internet.

With the advent of electronic ordering, CBA even allowed sales personnel at remote offices to place orders directly with vendors via the previously installed permanent Internet connection.

CBA was confronting increased intranet traffic and, consequently, steadily rising telephone charges from remote access traffic. Currently, each remote office accessed the Internet through the main office's T1 line and remote access system. The company was now using the Internet for nonsecure traffic and for traffic that provided its own security. (When CBA connected to one of its vendors over the Internet, the traffic was secured by the vendor.)

CBA needed to connect its remote offices to its intranet without compromising security.


Figure 5. Virtual Private Networks (VPNs)

Management considered adding intranet servers at each remote office, but the cost of equipment and the personnel needed at each location to administer it were prohibitive.

The company needed to leverage its existing permanent Internet connections and reduce its dial-in remote access costs. CBA would maintain its remote access system for sales personnel connecting from the road.

## Network

CBA's network now consisted of:

- Forty-seven PC workstations, most with 3Com Fast EtherLink XL 10/100 (10/100 Mbps) NICs
- A 3Com SuperStack II Switch 3300 and three 3Com SuperStack II Dual Speed Hub 500s (the core of the network)
- A 3Com SuperStack II NETBuilder SI router connected to a T1 line for shared Internet access
- Three high-speed networked laser printers
- A networked fax server
- A separate midrange computer in the warehouse
- A 3Com SuperStack II Remote Access System 1500 with two ISDN BRI modules (to provide remote access)
- Separate Pentium servers that housed the intranet Web server, the host publishing system that provided access to the legacy warehouse inventory computer, and the training system

Each existing and new remote office was designed with a network similar to CBA's original network. The remote office networks consisted of:

- Six to 12 workstations equipped with 3Com Fast EtherLink XL 10/100 NICs
- A 3Com SuperStack II Dual Speed Hub 500
- A 3Com OfficeConnect 56K LAN modem or OfficeConnect ISDN LAN modem (depending on local ISDN line charges and availability)
- A high-speed laser printer with a print server


## Business Requirement

CBA sought a low-cost method of securely connecting its main office with its remote
offices. The current dial-up connections were becoming too costly; between intranet and Internet traffic, the lines were in use for more than 10 hours a day. Leased lines would be secure, but the cost would be prohibitive; using the Internet would be economical, but data security was questionable.

CBA wanted to leverage the permanent Internet connections already in place while avoiding the security risks usually associated with transferring data over the Internet.

## Solution

CBA decided to implement VPN technology (Figure 5). It added a 3Com PathBuilder ${ }^{\circledR}$ S580 tunnel switch to the main office and 3Com SuperStack II NETBuilder SI routers at each of its remote offices. Each remote office was given a 64 kilobits per second (Kbps) or a 128 Kbps Internet connection. Depending on local pricing and availability, each remote office connection was either Frame Relay over fractional T1 or Digital Subscriber Line (DSL). For added reliability, the OfficeConnect LAN modems at the remote offices served as backup connections.

CBA then ran a server-to-server VPN between each remote office and the main office. (Both the PathBuilder S580 tunnel switch and the SuperStack II NETBuilder SI router also allow dial-in clients to use VPNs if they prefer.) Now, each remote office had its own connection to the Internet, which reduced traffic through the main office remote access system and network. Each remote office had a secure connection to the main office intranet over its VPN, and remote sales personnel could also choose to dial in to the main office SuperStack II Remote Access System 1500 remotely using a VPN client.

VPNs provided better security and flexibility than could have been provided with leased lines, and at a considerably lower cost. Each remote office was connected to the Internet by the best method available at its location, avoiding the carrier and compatibility issues often associated with leased lines.

## Business Benefit

VPNs provided secure, low-cost connections between the main office and remote offices. By using VPNs, CBA could provide connections that were more secure than a leased line, but at Internet prices. The cost of upgrading the company's infrastructure hardware and Internet access accounts was quickly paid back in lower remote access costs.

These new high-speed connections allowed a seamless interaction between CBA's various locations, integrating them into a single virtual organization. Access to the office intranet was now almost instantaneous.

## Competitors

Since CBA had already chosen 3Com as its infrastructure vendor, the choice of a PathBuilder S580 tunnel switch was obvious. Still, CBA looked at competitor offerings
but found them missing features, lacking scalability, or excessively priced.

## Future

As CBA's network continued to grow in capacity and complexity, network management became a major concern. CBA needed to monitor network performance, quickly isolate and identify problem areas, and proactively decide on the appropriate corrective measures.

## Upgrading the Intranet

This section describes how $C B A$ upgraded to a fully switched and managed intranet infrastructure in anticipation of increased network use and the implementation of an extranet.

CBA now had more than 250 employees. Sales of the basic product lines continued to increase, as did profits. The company started to bring


Figure 6. Fully Switched and Managed Intranet Infrastructure
several services in-house, services that had previously been outsourced. It now had a separate Marketing and Public Relations department and a Graphic Arts department. The company was moving into the Engineering Consultation field by offering customers design advice about how to use its product lines more effectively.

All of this resulted in increased demands for network capacity. Since CBA's network had become quite complex, increasing capacity was no longer a simple matter of buying a few more hubs. CBA needed to upgrade its current capacity. In addition, it needed to be able to manage and monitor its network. Future upgrades and changes were inevitable; by managing its network, CBA would be able to use the current network capacity more efficiently, and could plan how and when it should be upgraded.

## Network

CBA's network now consisted of:

- Eighty PC workstations, all with 3Com Fast EtherLink XL 10/100 (10/100 Mbps) NICs
- A 3Com SuperStack II Switch 3300 and four 3Com SuperStack II Dual Speed Hub 500s (the core of the network)
- A 3Com PathBuilder S580 tunnel switch connected to two T1 lines (to provide shared Internet access)
- Three high-speed networked laser printers
- A networked fax server (to handle inbound and outbound faxes)
- A separate midrange computer in the warehouse
- Separate Pentium servers that housed the intranet Web server, the host publishing system that provided access to the legacy warehouse inventory computer, and the training system
- A 3Com SuperStack II Remote Access System 1500 with two ISDN BRI modules (to provide remote access); the Remote Access System 1500 provided eight lines for dial-in use by remote offices and remote sales representatives

Each remote office network was based on:

- Six to 12 workstations equipped with 3Com Fast EtherLink XL 10/100 NICs
- A 3Com SuperStack II Dual Speed Hub 500
- A 3Com SuperStack II NETBuilder SI router (to provide shared direct Internet connections)

Most offices had Frame Relay Internet connections with a 128 Kbps port speed and 32 Kbps committed information rate (CIR); two offices had DSL connections (the connection type was chosen based on local pricing and availability). Each remote office also had an OfficeConnect 56K LAN modem as a backup Internet connection.

## Business Requirement

CBA's requirement was to upgrade the capacity of its network and implement end-to-end network management. In the short term, CBA needed additional network capacity to meet the demands of its expanding business. In the long term, the company needed to implement network management to proactively track the performance of every part of its increasingly complex network. Network management would help CBA avoid network congestion, quickly solve the problems that did occur, and decide when and where network infrastructure upgrades were needed.

## Solution

The solution to CBA's network congestion problems was to replace the SuperStack II Switch 3300 at the heart of its network with the higher-end SuperStack II Switch 3900 (Figure 6). The company moved the 3Com SuperStack II Switch 3300 to its busy Graphic Arts department. The Graphic Arts department's separate server and printer, and the large files that were transferred between workstations, justified a separate switch rather than a hub. CBA added a second central file server and equipped both it and the main Web server with 3Com Gigabit EtherLink Server NICs. Each server was assigned a gigabit port on the SuperStack II Switch 3900. CBA also added a second T1 to its Internet connection for added bandwidth and redundancy.

As a network management solution, CBA chose 3Com's Transcend ${ }^{\circledR}$ Enterprise Manager for Windows NT and Transcend dRMON Edge Monitor System 2.0. This combination allowed
network management staff to monitor network performance at any level (from departments to individual devices), to recognize problem areas, and to design solutions before problems occurred. It also greatly simplified day-to-day troubleshooting and the monitoring of network traffic.

## Business Benefit

With this solution, CBA gained control over its network and improved network performance. Moving to an almost entirely switched network increased performance on the entire CBA network. The new 3Com SuperStack II Switch 3900 can easily support the company's network needs well into the future, and the 3Com SuperStack II Switch 3300 was easily redeployed on the highest traffic area of its network.

3Com's Transcend Enterprise Manager for Windows NT and Transcend dRMON Edge Monitor System 2.0 allow CBA to track network usage, providing two benefits:

- Managed networks simplify the detection and elimination of bottlenecks and other network bandwidth problems. With Edge Monitor System 2.0, any network problemfrom an overloaded switch port to a defective NIC-is easily detected and identified.
- Information provided by network management software makes it possible to identify problem spots in the network. CBA can pinpoint when and where infrastructure upgrades are indicated.


## Competitors

As before, CBA was totally satisfied with the performance, reliability, and service provided by 3Com and the local reseller. 3Com came through again, providing a switch upgrade and network management software. When CBA decided to see what the competition had to offer, management looked at each competitor to gauge how completely and effectively the offerings from each vendor met CBA's requirements.

With such a large, complex network, the company had long ago eliminated the multiplevendor, price-shopping approach. The potential for interoperability, reliability, and service problems made this strategy totally untenable.

## Future

As CBA's intranet infrastructure continued to grow, the company again reflected on the importance of its choice of 3 Com as its infrastructure vendor. It had avoided the horrors that had plagued many of its contemporaries: dead-end solutions and technologies, the complete replacement of network equipment, vendor incompatibility, and support headaches. The network grew with CBA's needs, and there was no indication that it would ever fail to do so. With the intranet firmly in place, CBA looked at other ways to leverage its network infrastructure and knowledge.

The next step was to create an extranet, which involved creating a customer Web site to showcase CBA product lines. Customers could check on product pricing and availability and enter orders directly from their Web browsers. This process would allow the company to reach more people more quickly than ever before, offer better pricing and service, and increase its profit margins. The future was looking bright for CBA.

## Conclusion

As the story of CBA Tool \& Die has shown, a properly planned and implemented intranet can help catapult your business to growth and success. To ensure interoperability, manageability, cost-effectiveness, and ease of use, you should choose a vendor that can provide a complete end-to-end solution and can supply all of the equipment and support needed to build, maintain, and grow an intranet. Each product should provide good quality, superior ease of use, high reliability, and a feature set that offers all of the functionality you need. Each product should also fit seamlessly into the overall solution, and be scalable to allow the entire solution to grow with your enterprise.

3Com Corporation brings two decades of technology leadership to its end-to-end intranet solutions. It delivers scalable, manageable, and reliable products backed by unsurpassed technical support. To grow your business and capture the full benefits of the information age, make 3Com your single-source intranet vendor of choice.

## Glossary of Related Terms

BRI. Basic Rate Interface. See ISDN BRI.
CIR. Committed information rate. Data networking service commitments from the carrier (typically Frame Relay); guaranteed minimum data throughput on a connection, irrespective of port speed.

DSL, xDSL. Digital Subscriber Line. Any one of several digital (data) services (usually permanently connected rather than dial-up) that use ordinary telephone lines. Although ISDN BRI is technically a DSL service, it is usually not considered to be a separate service type. DSL services are usually purchased from the local telephone carrier and are popular for Internet connectivity where available.

Drop-shipping. A shipping strategy used by resellers to reduce or eliminate the need to maintain product inventory and warehouse space. With drop-shipping, product is shipped directly from the supplier's warehouse to the customer without passing through the reseller's facilities.

Dynamic IP address. The addressing scheme used by most low-cost Internet access accounts. Users are assigned an IP address from a list (pool) of available addresses each time they connect. Since users get a different address each time they connect, users with dynamic IP accounts generally cannot run Web or other servers that can be accessed from other locations on the Internet.

E1. A permanently connected data service available in many areas of the world (except in the United States, which uses T1) from the local telephone carrier. E1 service typically provides 30 data channels of 64 Kbps each for a total of 2.048 Mbps throughput. E1 service is typified by wiring convenience and high initial and monthly costs. E1 service can often be split with some channels carrying data and some voice.

Ethernet. The most widely used local area network (LAN) architecture.

Fractional T1. A variation of T1 service that allows the purchase of part of the total throughput of full T1 service (in increments of 64 Kbps channels) at a reduced cost. Fractional T 1 service typically has installation costs similar to those for full T 1 service, but monthly costs are lower.

Four channels of fractional T1 supply the same data throughput as two ISDN BRI lines, but installation and monthly costs are typically much higher. As a larger number of the T1's 24 channels are used, cost differences between fractional T1 and ISDN BRI services diminish.

Frame Relay. A type of packet-switched data service available in many areas. Frame Relay connections are usually permanently connected rather than dial-up.

Host publishing system. A hardware and/or software solution that allows users connected to a LAN or WAN to access data stored on midrange and mainframe computers using a Web-based client (typically a Web browser).

ISDN. Integrated Services Digital Network. An international telecommunications standard for transmitting voice and data over standard telephone lines.

ISDN BRI. A dial-up data service available in most areas from the local telephone carrier. ISDN BRI service provides two data channels ("b" channels), each 64 Kbps , which can be combined to provide 128 Kbps connections (about twice as fast as a 56 K modem). A third control channel (" d " channel) with a throughput of 16 Kbps is also provided, but is not usually used for data transfer. ISDN BRI service is typically more costly than telephone voice service.

ISDN PRI. A permanently connected data service available in most areas from the local telephone carrier. ISDN PRI service typically provides 23 data channels ( T 1 in the United States) or 29 data channels (E1 in most of

Europe), each 64 Kbps. ISDN PRI is typified by wiring convenience and high initial and monthly costs. ISDN PRI service can often be split with some channels carrying data and some voice. ISDN PRI pricing and availability are typically similar to those for T1.

Just-in-time inventory. A stock-ordering strategy used by resellers to reduce stock held in the warehouse to a bare minimum. The term refers to the practice of ordering more product "just in time" to ship to a customer or to integrate into an ordered product.

Leased line. A generic term that applies to virtually any permanently connected data connection; the term usually implies that cost is per-month rather than per-call or per-usage unit. ISDN and DSL lines are not typically referred to as leased lines.

NAT. Network address translation. A process in which a router or proxy translates the addresses of packets entering and leaving a network. NAT allows an internal network to use any convenient addressing scheme without fear of conflict with other Internet users. Since NAT prevents users on the Internet from learning addresses inside the network, it prevents unauthorized access from the Internet (acting as a firewall). Most NAT implementations also allow multiple users to attach to the Internet via a single IP address (which can be a low-cost dynamic IP address).

Port speed. Data networking services (typically Frame Relay); maximum physical throughput available from a connection.

PRI. Primary Rate Interface. See ISDN PRI.
QoS. Quality of Service. Data networking services; a guarantee (or means of providing a guarantee) that specific types of data will experience specific levels of service (in terms of minimum connection speed, number of lost packets, and overall delay). Different data networking services are often differentiated by the presence and level of QoS guarantees. Means of measuring and ensuring QoS can be inher-
ent in a certain type of service or provided externally by hardware and/or software.
Static IP address. The addressing scheme used by most businesses for Internet access accounts (and higher-cost individual accounts). Each local network node is assigned a permanent IP address. A static IP address is generally required in order to run a server that is accessible from the Internet.

SNA. Systems Network Architecture. A network architecture originated (and still used by) IBM for midrange and mainframe computer environments.

T1. A permanently connected data service available in most areas of the United States from the local telephone carrier. T1 service typically provides 24 data channels. T1 service is typified by wiring convenience and high monthly and initial costs. T1 service can often be split with some channels carrying data and some voice.

Token Ring. A local area network (LAN) architecture similar to Ethernet. Token Ring is not compatible with Ethernet at the hardware level and requires different infrastructure hardware.

VPN. Virtual private network. A technology that allows secure data transfer over public networks such as the Internet. This is typically accomplished by establishing a "tunnel" through the public (nonsecure) network between secure endpoints (typically routers or tunnel servers). Data is encrypted (scrambled) as it is passed from the secure network at one end onto the nonsecure network and decrypted (unscrambled) as it is passed from the nonsecure network to the secure network at the other end. All data passing over the nonsecure (public) network is protected by the encryption, providing a connection that is "virtually" as "private" as a leased line. In actuality, data secured by a VPN is safer than data passed over a leased line since an encrypted data stream cannot be "tapped" like a physical line.

More connected.'

## About 3Com Corporation

With more than 200 million customers worldwide, 3Com Corporation connects more people in more ways to information than any other networking company. 3Com delivers innovative information access products and network system solutions to large, medium, and small enterprises; carriers and network service providers; PC OEMs; and consumers. 3Com-More connected. ${ }^{\text {™ }}$

## 3Com Corporation

P.O. Box 58145

5400 Bayfront Plaza
Santa Clara, CA
95052-8145
Phone: 1800 NET 3Com or 14083265000
Fax: 14083265001
World Wide Web:
www.3com.com
3Com Americas International
U.S. Headquarters (serving Canada and Latin America)
Phone: 1408326 2093/
14083266075
Fax: 1408326 5730/ 14083268914
Miami
Phone: 13054618400
Fax: 1305461 8401/02

## 3Com Canada

Burlington
Phone: 9053368168
Fax: 9053367380
Calgary
Phone: 4032653266
Fax: 4032653268
Edmonton
Phone: 7804233266
Fax: 7804232368
Montreal
Phone: 5146833266
Fax: 5146835122
Ottawa
Phone: 6135667055
Fax: 6132339527
Toronto
Phone: 4164983266
Fax: 4164981262
Vancouver
Phone: 6044343266
Fax: 6044343264

## 3Com Latin America

Argentina (serving Argentina,
Paraguay, and Uruguay)
Phone: 54143123266
Fax: 5413143329
Brazil
Phone: 55112465001
Fax: 55112463444
Chile (serving Bolivia, Chile, and
Peru)
Phone: 5622406200
Fax: 5622406231

Colombia
Phone: 5716294110
Fax: 5716294503
Mexico
Phone: 5252010000
Fax: 5252010001
Peru
Phone: 5112215399
Fax: 5112215499
Venezuela
Phone: 5822675550
Fax: 5822673373

## Asia Pacific Rim

Melbourne, Australia Phone: 61399348888 Fax: 61399348880
Sydney, Australia
Phone: 61299375000 Fax: 61299566247
Beijing, China
Phone: 861065880568
Fax: 861065880602
Shanghai, China
Phone: 862163501581
Fax: 862163501531
Hong Kong
Phone: 85225011111
Fax: 85225371149
India
Phone: 91116446123
Fax: 91116236509
Indonesia
Phone: 62215722088
Fax: 62215722089
Osaka, Japan
Phone: 81665363303
Fax: 81665363304
Tokyo, Japan
Phone: 0120313266
(toll free from Japan)
Phone: 81359773266
Fax: 81359773370
Korea
Phone: 82234556300
Fax: 8223194710
Malaysia
Phone: 6037151333
Fax: 6037152333

## New Zealand

Phone: 6493669138
Fax: 6493669139
Philippines
Phone: 6328924476
Fax: 6328115493
Singapore
Phone: 655389368
Fax: 655389369
Taiwan
Phone: 886223775850
Fax: 886223775860
Thailand
Phone: 66223181515
Fax: 6622318158

## 3Com Austria

Phone: 431580170
Fax: 4315801720

## 3Com Benelux B.V.

Belgium
Phone: 3227119400
Fax: 3227119411
Netherlands
Phone: 31346586211
Fax: 31346586222

## 3Com Eastern Europe/CIS

Bulgaria
Phone: 35929625222
Fax: 35929624322
Czech Republic
Phone: 420221845800
Fax: 420221845811
Hungary
Phone: 3612508341
Fax: 3612508347
Poland
Phone: 48226451351
Fax: 48226451352
Russia
Phone: 70952580940
Fax: 70952580941
Slovak Republic
Phone: 4217317850
Fax: 4217317849

## 3Com France

Phone: 33169866800
Fax: 33169071154

## 3Com GmbH

Munich, Germany
Phone: 4989627320
Fax: 498962732233

## 3Com Iberia

Portugal
Phone: 35113404505
Fax: 35113404575
Spain
Phone: 3415096900
Fax: 3413077982

## 3Com Italia S.p.A.

Milan, Italy
Phone: 392253011
Fax: 39227304244
Rome, Italy
Phone: 3965279941
Fax: 39652799423

## 3Com Middle East

Phone: 9714319533
Fax: 9714316766

## 3Com Nordic AB

Denmark
Phone: 4548105000
Fax: 4548105050
Finland
Phone: 358943542067
Fax: 35894555166
Norway
Phone: 4722584700
Fax: 4722584701
Sweden
Phone: 46858705600
Fax: 46858705601

## 3Com Southern Africa

Phone: 27118074397
Fax: 27118037405

## 3Com Switzerland

Phone: 41844833933
Fax: 41844833934

## 3Com UK Ltd.

Edinburgh
Phone: 441312402900
Fax: 441312402903
Ireland
Phone: 35318235000
Fax: 35318235001
Manchester
Phone: 441618741700
Fax: 441618738053
Winnersh
Phone: 441189278200
Fax: 441189695555

