INFORMATION MANAGEMENT: STRATEGY, SYSTEMS, AND TECHNOLOGIES

CHALLENGES OF INTRANET IMPLEMENTATION

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INSIDE

INTRODUCTION
An intranet is a private TCP/IP network that usually supports the same protocols and services as the public Internet, including E-mail, news, chat rooms, and Web pages. Companies build intranets for improving internal communication, distributing information, and enabling more employees to access legacy data. With links to the public Internet, intranets have allowed companies to reach more potential customers, enter untapped markets, and engage in electronic commerce. Coupled with such innovations as the Java development language and new zero-administration netcentric computers, intranets can become the base around which businesses can reinvent themselves.

IMPLEMENTATION ISSUES
The decision to implement an intranet is relatively easy for large companies because they typically have the necessary components already in place. For example, they use TCP/IP (transmission control protocol/Internet protocol) on the wide area network in support of E-mail, file transfers, remote database access, and other routine communications needs. They usually have the technical expertise to install and configure the necessary components, including routers, switches and gateways, and manage these and other network elements through the simple network management protocol (SNMP). They also have people who implement

PAYOFF IDEA
Although intranets can provide companies with benefits including improved communications and more effective information management, their implementation can be costly and time-consuming. This article outlines four primary challenges to intranet implementation and suggests ways of overcoming them.
and maintain client/server technology over local area networks (LANs) that also provide connectivity to legacy host systems. For these companies, it is relatively simple to add a graphical front end to this environment in the form of easy-to-use Web browsers and offer extra functionality from Web servers distributed on the TCP/IP network.

Even for companies that do not already have an existing TCP/IP-based infrastructure, it does not take much to learn how to take advantage of Internet technology and adapt it for internal use. These companies, as well as very small companies that lack any kind of technical expertise, can avail themselves of numerous vendors and service providers who are eager to educate potential customers on the benefits of corporate intranets and offer their own ideas concerning intranet implementation. If a company does not want to build and run its own intranet, there are service providers that handle this as well. In fact, every aspect of building and running a corporate intranet can be outsourced to third-party firms — from designing the intranet Web page, hosting one or more intranet Web sites, and procuring and managing the private IP network itself.

Achieving the benefits of an intranet necessitates proper implementation. First, resources must be available to establish the service, to establish or upgrade the TCP/IP network over which it runs, and to train users. Second, the impact on existing systems must be considered. This includes, for example, the capacity of the current network to support an intranet, the future usefulness of existing legacy systems, and the availability of hardware to properly run multimedia applications. More difficult to resolve is the issue of intranet content. It is necessary to decide what information will be presented, where it will come from, how its accuracy will be assured, and how often it will be updated.

Finally, appropriate security must be implemented — both to prevent external users from accessing corporate resources and to prevent employees, workgroups, departments from being able to access each others' sensitive information and applications. Not only must servers and databases must be structured to prevent unauthorized access, but appropriate tools must be available to easily administer passwords and log-on procedures, log all system activity, and trace the source of attempted break-ins.

These issues, particularly the problem of security, can be construed as disadvantages to implementing a corporate intranet. However, these are basically the same issues that confront users of any type of corporate network. From the perspective of security, for example, even corporate PBXs (private branch eXchanges) are susceptible to the problem of toll-fraud by external hackers. And if the PBX supports data communication as well, tenacious hackers can find their way right onto the LAN or mainframe. It is important to understand that all of these potential disadvantages can be overcome by using the right tools, implementing the right procedures, or selecting a reputable third-party firm. In the final analysis,
the advantages of implementing a corporate intranet far outweigh the potential disadvantages.

**RESOURCES**

Costs are an important consideration when developing an intranet. Beyond the list prices for hardware and software components lie the less obvious costs of administration, maintenance, and additional applications development.

The skill sets that are required for developing an intranet are varied and quite specialized. They include technical people with knowledge of system and network architectures, an understanding of the Internet protocol (IP), and experience in developing applications with such tools as Java, ActiveX, and PERL. There is also a need for creative people, particularly graphic artists and HTML coders who excel at making the content visually compelling through the integration of images, text, and animation.

The cumulative efforts of many people can go into the initial development and implementation of a corporate intranet. However, many of these people may be only peripherally involved. For example, the same network managers and technical staff that keep the division’s telecommunications network up and running, by default, keep the intranet up and running, since they both may share much of the same equipment and lines.

The daily maintenance of an intranet may require only the part-time efforts of a few people from the marketing and technical groups. The caliber of skills of the individuals involved in the task, not the number of people, is what makes all the difference. Though it takes people with specialized skills to develop an intranet, it takes a different set of skills to sustain it. Companies usually deal with this situation by recruiting multifunctional people — those who can apply what they normally do on the job to the medium of the intranet.

**INTRANET MANAGEMENT**

Intranets bring together yet another set of technologies that need to be managed. Instead of using different management systems, organizations should strive to monitor and administer intranet applications from the same console used to manage their underlying operating system software and server hardware. This is a distinct advantage when it comes to ensuring end-to-end availability of intranet resources to users.

**Server Performance**

Vendors are scrambling to meet this need. For example, the hierarchical storage management capabilities of the Unicenter platform from Computer Associates can be extended to HTML pages on a Web server. HTML
Some enterprise management vendors are turning to partnerships to provide users of their management platforms with data on intranet server performance. For example, Hewlett-Packard and Cabletron have joined with BMC Software Inc. to provide application management software that monitors Web server performance and use. The software forwards the data it collects to management consoles, such as HP’s OpenView and Cabletron’s Spectrum, in the platforms’ native format or as basic SNMP (simple network management protocol) traps. Instead of looking at their internal Web sites in an isolated way, this integrated method permits full-fledged enterprise-wide applications management.

**IP Administration**
Managing the Web servers and firewalls is only one aspect of keeping an intranet up and running. IP administration also can become unwieldy as intranets lead to a proliferation of devices and addresses. Intranet-driven IP administration can be facilitated by dynamic host configuration protocol (DHCP) software, which streamlines the allocation and distribution of IP addresses. This insulates network operators from the complexity of assigning addresses across multiple subnetworks and platforms. Since intranets depend on the accurate assignment of IP addresses throughout a company, such tools are virtually essential for ensuring the availability of resources.

**OUTSOURCING**
In addition to the several thousand small Internet service providers (ISPs) nationwide, the regional telephone companies and long distance carriers provide one or more pieces of the intranet. Some provide Web page design, system integration, and full-service private IP networks that offer a choice of access methods and are supported by high-speed backbones.

By tapping into CompuServe’s private IP network, for example, mobile professionals and employees at branch office locations not only have remote access to corporate resources, but they can communicate with each other via E-mail, route documents, and share basic business information. In essence, the use of such services provides organizations with what amounts to a virtual private network (VPN).

When a sales rep at a branch office wants to access a corporate database to execute pricing calculations based on a specific product configuration, for example, he or she dials a local number to access the private CompuServe network, which connects to the company’s enterprise hub or a regional communications server. Since all traffic traverses Com-
puServe's private IP network — which is separate from its public network used by its online subscribers — the privacy of corporate information is assured. This option is also cost-effective because users make a local call to one of the many private nodes managed by CompuServe.

Many other Internet service providers have their own flavor of private IP that can be used for remote access, such as IBM's Global Services Network. Another is PSINet's Business Remote Access InterRamp service, which relies on PSINet's proprietary authentication technique to ensure privacy.

These IP-based virtual private networks are becoming increasingly popular for a variety of reasons. Organizations can rid themselves of costly leased lines and avoid long distance charges for dialup access. They also can save on modem banks. Since support is done by the service provider, there is no need for a round-the-clock support staff, which is almost always required for implementing private intranet solutions. Security is implemented by a combination of authentication and filtering techniques, the use of secure protocols, and firewalls — all of which can be difficult for many organizations to set up and maintain by themselves. By outsourcing its intranet, a company can save as much as 50% of its startup costs and free up IT staff to work on core business issues.

In addition to being a secure, cost-effective solution, other reasons to outsource the corporate intranet include:

- Faster intranet development.
- Easier integration of new technologies and capabilities.
- The availability of better equipment and higher-speed lines than a company can otherwise afford.
- The availability of a wider range of expertise.
- Quality-of-service guarantees.
- Continuous network management and faster response to problems.
- One-stop service and support.

**IMPACT ON EXISTING SYSTEMS**

**Network Performance and Standards**

Intranets also have the potential to significantly increase traffic, causing bandwidth problems. This has some technology managers concerned that bandwidth for vital business applications is being consumed by less-than-vital intranet data. Users are now accessing files that may contain huge graphics, and this has created a tremendous bandwidth issue. As Web servers across an enterprise entice users with new content, intranets also can alter the distribution patterns of network traffic as users hop from one business unit's intranet server to another's, and as companies make it easier to access information and applications no matter where they may be located.
Of course, more servers and bandwidth can be added and the network itself can be partitioned into more subnets to help confine bandwidth-intensive applications to various communities of interest. But these are expensive solutions. A policy-based solution can be just as effective, if not more economical. To prevent these applications from wreaking too much havoc on the network infrastructure, companies can issue standards that establish limits to document size and the use of graphics so that bandwidth is not consumed unnecessarily. These policies can even be applied to E-mail servers, where the server can be instructed to reject messages that are too long or which contain attachments that exceed a given file size. An automated reply message can even be sent back to the originator, stating why the message or attachment was refused and inviting him or her to send it again provided that it meets the stated parameters.

The use of TCP/IP-based nets can also save on the cost of leased lines, or eliminate some of them entirely, particularly if they are used mostly for data communications. Most types of routine data — synchronous and asynchronous — are easily handled by TCP/IP. However, owing to its real-time delivery requirement, isochronous data over TCP/IP nets is still problematic.

In a video conference application, for example, the individual packets of voice and video may take different routes to their destinations which causes them to arrive at different times. Often, the network might be congested at various points, causing variable delay. Either way, the result is that the voice component is rarely synchronized properly with the video component, and the video itself looks jerky most of the time. Even if the TCP/IP network is used for an audio-only conference, the inherent delay can be disruptive and significant delay in packet delivery can cause voice to be clipped.

Although quality-of-service (QoS) protocols, such as the resource ReSerVation Protocol, are available that improve the ability of TCP/IP-based nets to handle isochronous data, they are not yet widely implemented on the wider Internet. If a company plans to implement an intranet that uses the Internet as a backbone between far-flung locations, it is best to leave voice and other real-time applications on scaled down leased-line networks or continue using the public switched telephone network (PSTN), where consistently high quality is assured.

However, if a company plans to rely exclusively on its own TCP/IP net, where it is possible to size the bandwidth to application needs, exercise more control over packet delay, and implement the protocols that improve the performance of isochronous applications, it is possible to move voice and video traffic off leased lines entirely and achieve acceptable quality for internal communications. The PSTN can continue to be used for off-net calls or as a backup when the intranet experiences a temporary outage.
DATABASE ACCESS

Of course, giving outsiders limited access to internal databases raises security concerns. Initially, however, the principal challenge is providing a uniform view into a company’s varied systems, which may even be scattered around the world. One solution is to implement a data warehouse with decision-support tools. The decision-support tools are the glue in the middle, a middleware layer that couples the warehouse to the desktop. The tools are run on a server dedicated to the task of querying the warehouse, building intermediate data sets, and then converting the results into reports that can be viewed in various ways.

Together, the tools represent an active middleware that basically moves the processing from the fat client desktop out onto a server. The desktop simply becomes a dumb device, and all the processing occurs out on the network. This makes it possible to pluck information from the warehouse and other resources and deliver it to different types of clients, be they Web browsers, Windows-based machines or even pagers. The use of intelligent agents to explore vast amounts of data means that users do not have to spend hours sifting through voluminous amounts of information. When the agent finds the desired item, it sends out a notification to the user. A user can send out any number of agents to explore the database. These agents can even go out onto the greater Internet to accomplish their mission.

PERFORMANCE ENHANCEMENT

Intranets are becoming pervasive because they allow network users to easily access information through standard Web browsers and other World Wide Web technologies and tools to provide a simple, reliable, universal and low-cost way to exchange information among enterprise network users. However, the resulting changes in network traffic patterns may require upgrading the network infrastructure to improve performance and prevent user frustration due to slow intranet response times.

These changes include the graphical nature of Web-based information, which dramatically increases network traffic and demands greater network bandwidth; the integration of IP throughout the network; easier access to data across the campus or across the globe, leading to increased inter-subnet traffic which must be routed; and new, real-time multimedia feeds requiring intelligent multicast control.

LAN switches traditionally operate at Layer 2, or the data link layer, providing high performance segmentation for workgroup-based client/server networks. Routing operates at Layer 3, or the network layer, providing broadcast controls, WAN access, and bandwidth management vital to intranets. Most networks do not contain sufficient routing resources to handle the new inter-subnet traffic demands of enterprise intranets.
The optimal solution — intranet switching — is to add Layer 3 switching, the portion of routing functionality required to forward intranet information between subnets, to existing Layer 2 switches. This enables network managers to cost-effectively upgrade the Layer 3 performance in their networks. This is the approach being taken by new intranet switches and software upgrades to existing switches.

Intranets are increasingly being used to support real-time information, such as live audio and video feeds, over the network. These multimedia feeds are sent to all subscribers in a subnet, creating increased multicast traffic and impeding network performance by consuming ever greater amounts of bandwidth. Intelligent multicast control provided by intranet switches helps organizations conserve network bandwidth by eliminating the propagation of multicast traffic to all end stations in a subnet. The intranet switches monitor multicast requests and forward multicast frames only to the ports hosting members of a multicast group.

Most enterprise networks use multiple protocols. In contrast, intranets are IP-based, requiring IP on all intranet access systems throughout the network. To ease IP integration, intranet switching supports protocol-sensitive virtual local area network (VLANs). This allows the addition of IP without changing the logical network structure for other protocols.

Combining IP and ATM routing through integrated private network-to-network interface (I-PNNI) signaling, simplifies network management because only one protocol is managed rather than two. Providing this unified view of the network by implementing a single protocol leads to better path selection and improved network performance.

To accommodate intranet traffic demands, increased switching capabilities must be added to both the edge of the network and to the backbone network. Many organizations are using intranets for mission-critical applications, so the backbone technology must deliver superior performance, scalability, and a high degree of resiliency. For these reasons, ATM is the optimal technology for the core technology for intranet switches.

**ENSURING AN EFFECTIVE INTRANET HOME PAGE**

Users access the corporate intranet by logging onto an internal Web server and entering their password. They typically download the company’s home page with an ordinary Web browser and navigate the intranet using menus, directories, and hyperlinks — just as they would do if they were connected to the World Wide Web on the public Internet. Often, the look and feel of the company’s internal Web page is indistinguishable from those found on the public Internet. However, the layout of the company’s home page can determine the success of the intranet. There are at least five areas that, if given careful consideration, can have a significant positive effect on the site’s usability:
1. Graphics. While graphics can have high visual impact, they can also be overused. In addition to taking away valuable space from the more important content, they take time to download and consume an inordinate amount of bandwidth. This approach adds unnecessary costs to creating or updating pages. As a result, pages get updated less frequently and their information value decreases. Simple graphics and HTML-coded background colors can be just as effective in increasing the usability of information without incurring a performance penalty.

2. Navigation. The corporate site should be easy to navigate and require as few clicks as possible to find the desired information. Sometimes this is difficult to achieve, especially when there is no centralized control or funding, as when each business unit pays for the creation of its own home page out of its own budget. The result is a variety of looks and navigation paths. For example, if the corporate telephone directory is published on the intranet, it should be available on one page, instead of on multiple pages buried deep within the various business unit Web sites. Since some companies have tens of thousands of employees, a search engine should also be included on the directory page to enable users to find contact information quickly.

3. Information prominence. Static, or reference, information should not be positioned on the same page or given the same weight as frequently changing and time-sensitive information, especially when there is no indication as to what information has been updated recently and what information has not been changed. For example, it would not be advisable to put employment opportunities on the same page as the company history, which visitors might read once, if at all.

4. Links. Links to internal sections and external sites should not appear to be the same. An intranet user should always be aware of what information is company-sponsored and what information is publicly available. Links to the outside should be relevant to the business objectives of the intranet. While it may be relevant to link to another Web site to review information about a customer or supplier, it is not usually appropriate to provide links to Internet sites that are unrelated to the company’s business. This might even encourage employees to waste time surfing the Web.

5. Prioritization. Care should be taken to avoid burying important content too deep within the site. For example, it is unwise to put detailed product information or a company directory within the FAQ (frequently asked questions) section, since visitors are not likely to look there for this kind of information.

For an intranet to be successful, it must be designed to encourage usage. It is not enough to update content regularly; the site must adequate-
ly convey that new things are being added frequently. If employees get the impression that the site is changing, they will visit it regularly. The best way to give the site this kind of appeal is to create a dynamic front page. Instead of using unchanging, bit-intensive graphics to draw users into the site, the first page should include the latest company headlines with a tightly written paragraph that summarizes the content behind the links. In this way, employees can quickly visit the site to see what has changed, instead of following multiple links before discovering some new announcement. Even a Javascript-generated scrolling banner embedded somewhere in the home page can be used to indicate that the site contains new information. Many intranet sites even have the date of last revision posted at the bottom of the home page.

Because home page development takes talent and creativity that is not always readily available in house, many companies farm out this task to outside firms that specialize in Web page design. In fact, just about all aspects of intranet development can be outsourced to third-party vendors or service providers.

SECURITY

Increasing the number of people who have access to important data or systems makes a company’s information technology infrastructure vulnerable to attack if precautions are not taken to protect it. Integrating security mechanisms into an intranet minimizes exposure to misuse of corporate data and to overall system integrity. A secure intranet solution implies seamless and consistent security function integrated between desktop clients, application servers, and distributed networks. It should include policies and procedures, the ability to monitor and enforce them, as well as robust software security tools that work well together and do not leave any gaps in protection.

The following basic functions are necessary for broad security coverage:

- Access control software allowing varying degrees of access to applications and data.
- Secure transmission mechanisms like encryption to impede outside parties from eavesdropping or changing data sent over a network.
- Authentication software to validate that the information that appears to have been originated and sent by a particular individual was actually sent by that person.
- Repudiation software to prevent people who have bought merchandise or services over the network from claiming they never ordered what they received.
- Disaster recovery software and procedures to assist in recovering data from a server that experiences a major fault.
• Anti-virus software to detect and remove viruses before they cause damage.

Intranets that extend beyond organizational or company boundaries may require integration among various security systems. In addition, special firewall software may be required to prevent attacks from malicious hackers on the Internet.

**Firewalls**

A firewall can be a dedicated device, or its functions can be added as software that runs on an existing server. In addition, there are new routers available that implement the functions of firewalls and which are specifically designed for extranets.

Firewalls come in three types: packet filters, circuit-level gateways, and application gateways. Some firewall products combine all three into one firewall server, offering organizations more flexibility in meeting their security needs.

**Packet Filtering.** With packet filtering, all IP packets traveling between the internal network and the external network must pass through the firewall. User definable rules allow or disallow packets to be passed. The firewall’s graphical user interface gives system administrators the ability to implement packet filter rules easily and accurately.

**Circuit-Level Gateway.** All of the firewall’s incoming and outgoing connections are circuit-level connections that are made automatically and transparently. The firewall can be configured to enable a variety of outgoing connections such as Telnet, FTP, WWW, Gopher, America On Line, and user-defined applications such as Mail and News. Incoming circuit level connections include Telnet and FTP. Incoming connections are only permitted with authenticated inbound access using one-time password tokens.

**Applications Servers.** Some firewalls include support for several standard application servers. These include Mail, News, WWW, FTP, and DNS (Domain Name Service). Security is enhanced by compartmentalizing these applications from other firewall software, so that if an individual server is under attack, other servers/functions are not affected.

To aid security, firewalls offer logging capabilities as well as alarms that are activated when probing is detected. Log files are kept for all connection requests and server activity. The files can be viewed from the management console, displaying the most recent entries first. The log scrolls in real time as new entries come in. The log files include a variety
of information including connection requests, mail and news traffic, server activity, FTP session activity, and error conditions.

An alarm system watches for network probes. The alarm system can be configured to watch for TCP or UDP probes from either the external or internal networks. Alarms can be configured to trigger E-mail, pop-up windows, messages sent to a local printer, and/or halt the system upon detection of a security breach.

Another important function of firewalls is to remap and hide all internal IP addresses. The source IP addresses are written so that outgoing packets originate from the firewall. The result is that all of the organization’s internal IP addresses are hidden from users on the greater Internet. This provides organizations with the important option of being able to use non-registered IP addresses on their internal network. In not having to assign every computer a unique IP address and not having to register them for use over the greater Internet, which would result in conflicts, administrators can save hundreds of hours of work.

COSTS
The cost of developing a corporate intranet varies considerably on a case by case basis. Large companies can often build sophisticated intranets using existing TCP/IP networks, equipment, and management tools. In such cases, the intranet is treated as just another application that is added to meet business needs. For large companies, the startup cost for intranet development can be incremental.

Staffing
For example, the creative aspects of intranet development, especially the design of the corporate home page and the pages of various business units, are often handled by employees temporarily assigned to the effort and others who are eager to demonstrate what they can do with HTML and graphics, even if they have to do the work on their own time. The same is often true of programming tasks involving Java. The programming language is so new and intriguing that many veteran C programmers jump at the chance to put what they have learned to practical use and push the envelope in the process.

However, the spirit of volunteerism that gets a pilot intranet project off to a good start can fade quickly as the work consumes more of an employee’s time. Eventually the time comes when many employees will want to get paid for what they are doing, or they will opt out of the project. This results in a sudden increase in staffing costs for running the intranet, something most companies do not always plan for at the start and which can easily throw a budget off track.

Another hidden cost is for creating and updating content, designing Web presentations, building hyperlinks, and checking for error, duplica-
tion, and outdated information. A corporate intranet almost always requires continual tweaking, which consumes staff time. The result is that companies generally spend much more than they expect on managing and administering the site. Staff also must continually learn new technology, since Web products, applications, and development tools are evolving at a very rapid pace.

Of course, if the objectives and expectations of the intranet are such that they cannot be achieved by leveraging existing assets, the costs can add up quickly, depending on the number of corporate locations that must be tied together and the degree of sophistication desired. While the cost of staff is often difficult to quantify, the cost of hardware, software and services is relatively easy to figure out.

**Hardware, Software, and Services**

Hardware, software, and services generally fall into the following categories:

- Web-specific hardware, such as servers and peripherals.
- Communications hardware, such as routers and modems, and a firewall.
- Carrier-provided facilities and services, such as leased lines and ISDN. Mobile professionals may require wireless connectivity options.
  - If a private high-speed intranet backbone is required, T1 and T3 lines should be considered.
- Software, including Web browsers, database management, utilities, and development tools.

The startup cost for an intranet that supports 400 to 500 people can be as low as $25,000. This includes the Web browser client software, Web server software, development tools, and the communications hardware. The recurring cost of facilities and services can be obtained from the various carriers and compiled into an annual figure. Companies that do not have in-house technical expertise should also plan to spend 10% of the total startup cost for equipment and software on integration services.

Fortune 100 companies with worldwide locations that must be tied into the intranet can expect to pay quite a bit more, especially if they intend to offer a high level of interactivity, engage in electronic commerce, and Web-enable various office operations. Such companies should plan to spend at least $10 million.

**RETURN ON INVESTMENT**

As companies put together budgets for intranet development and management, eventually they will have to address the issue of return on investment (ROI), as they typically do for any other major capital
expenditure. The extent to which this can be done with any degree of accuracy often depends on how the proposed intranet will be used.

For example, if the intranet will be used to publish staff handbooks, telephone directories, forms, office notices, and other administrative documentation, the annual cost of printing, distributing, updating, and storing these materials contributes to the ROI of the intranet. Although harder to quantify, there is also the significant cost of staff time for filing, updating, and referring to paper-based material that would also be eliminated. A publishing application can garner an annual ROI of as much as 30%. Other applications, such as database access and inventory management, may yield 70% and 50% annual returns, respectively.

Reliance on electronic publishing would improve overall productivity, which is a soft-dollar benefit that can be used to cost justify the intranet, especially when the intranet includes a search engine that allows users to key in on desired information quickly.

There are even ways to set up text-based customer help desks on the intranet that allow customers to quickly diagnose and solve problems with the products they have purchased from the company, further enhancing customer loyalty and reducing staff time. Companies like Cisco Systems and Cabletron Systems have Web pages that allow customers to custom configure such products as routers and hubs and submit orders via fill-in E-mail forms that are sent to the vendor. Customers are notified of errors during the configuration process and alternatives are given to correct the errors before the order is submitted. Many computer companies allow customers to custom configure systems and obtain pricing before submitting the order electronically.

If the company plans to use the intranet for transaction processing, ROI can be fairly easy to calculate. For example, the company can post all of its business forms on the intranet, including various health insurance forms, travel authorization and expense reimbursement forms, vacation schedule forms, worker’s compensation forms, 401K plan forms, and purchase order forms — just to name a few. These and other forms can be called up on the intranet with a Web browser, filled in by the employee, and sent to the appropriate department via E-mail. Employees need not waste time tracking down the paper forms they need and, since the employee-supplied information is submitted in electronic form, departments can process it faster and readily integrate it into various databases. The savings in wasted time and improved forms processing constitute another element that can be factored into the intranet’s return on investment.

Companies can also realize substantial savings on software development. This is due in large part to the universal nature of the Web browser. An MIS department, for example, does not have to spend thousands or hundreds of thousands of dollars to have software developed to access legacy systems when there are simple Java-based terminal emulators
available that allow Web browsers to access legacy data through an intranet. Using Java-enabled Web browsers also saves on the cost of administering clients, since program code resides on a central server where it can be easily maintained and secured. Users automatically have access to the most updated versions of various programs, since the client machines do not retain copies of the programs themselves. Since Java is object oriented, programmers can reuse and extend existing code to develop new applications faster.

**THE BOTTOM LINE**

Corporate intranets are becoming as significant to the telecommunications industry as the PC has become to the computer industry. They fundamentally change the way people in large organizations communicate with each other. In the process, intranets can improve employee productivity and customer response. Intranets are also being used to connect companies with their business partners, allowing them to collaborate in such vital areas as research and development, manufacturing, distribution, sales, and service. A variety of tools are used for these purposes, including interactive text, audio and video conferencing, file sharing, and whiteboarding. In fact, anything that can be done on the public Internet can also be done on a private intranet — easily, economically, and securely.

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