Bechtel Well Positioned to Serve Customers by Using Microsoft and Cisco IPv6 Solution

Overview

Country or Region

Global

Industry

Construction

Customer Profile

Headquartered in San Francisco, California, Bechtel Group is a global engineering, construction, and project management firm with more than 40,000 employees and 2006 revenues of U.S.$20.5 billion.

Business Situation

Having developed a strategy to include Internet Protocol version 6 (IPv6) technology in its customer offerings, Bechtel first needed to upgrade its existing infrastructure to IPv6.

Solution

In a pilot project at six corporate sites, Bechtel deployed routers, switches, and other Cisco® hardware as well as Microsoft software, including the Windows Vista® operating system, that support IPv6.

Benefits

- Easier-to-manage network architecture
- Advanced Windows Vista collaboration technologies
- Rapid deployment of field sites
- Competitive advantage in the marketplace
- Big returns from a modest investment

"Implementing IPv6 has consumed less than 1 percent of our IT budget, and the IT budget is only a small part of the overall corporate budget. These costs are modest compared to the expected benefits."

Bechtel is a leading engineering, construction, and project management company. Always exploring opportunities for improvement, Bechtel saw the strategic value of Internet Protocol version 6 (IPv6) to support a new generation of applications and services. The company elected to upgrade its IPv4 infrastructure to develop experience and competence in IPv6, and partnered with Microsoft, Cisco, and Command Information to deploy IPv6 using Windows® software, including Windows Vista®, and Cisco Catalyst® 6500 Series Switches, Cisco Catalyst 3500 XL Series Switches, and Cisco Integrated Services Routers. By drawing on the experience and products of its partners, Bechtel is well-positioned to bring new services to its customers and global project sites by using advanced networking, discovery, and collaboration technologies. Bechtel expects a very positive return on its strategic IPv6 investment.

Situation

Founded in 1898 and headquartered in San Francisco, California, Bechtel Group is one of the world's leading engineering, construction, and project management companies. Bechtel has completed more than 22,000 projects in 140 countries, including Hoover Dam, the Channel Tunnel, Hong Kong International Airport, the San Francisco Bay Area Rapid Transit system, and the reconstruction of Kuwait's oil fields after the Gulf War. The Bechtel National business line is also a leading provider of services to the U.S. government, and specializes in large, complex projects in such areas as defense, space, energy, security, and the environment. Bechtel Group employs 40,000 workers and had 2006 revenues of U.S.$20.5 billion.

Bechtel continually investigates ways to become more efficient and to provide superior services in a highly competitive environment. When the company determines that particular emerging technologies will have a critical impact on the customers it serves, Bechtel researches and deploys these technologies as early as possible. "Each year, we take a look at technology developments, and we plan for what we think will be coming five years ahead," says Fred Wettling, a Bechtel Fellow and the Technology Strategy Manager at Bechtel. "We align technology with business objectives and project demands to create plans for new developments." For example, a few years ago, Bechtel identified Internet Protocol version 6 (IPv6) as a strategic technology for supporting a new generation of IT applications and services and for enabling more-rapid project mobilization at temporary job sites such as construction projects and disaster recovery scenes.

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> *Bechtel Fellow and Technology Strategy Manager,*
> *Bechtel*

Bechtel sees IPv6 opportunities across multiple global business units. The U.S. government is requiring federal agencies to implement IPv6-compliant networks by mid-2008. Bechtel's telecommunications customers are exploring mobility coupled with Worldwide Interoperability for Microwave Access (WiMAX) and IP Multimedia Subsystem (IMS) technology for new content delivery services. Industrial networking is in a transition to Internet Protocol (IP) services. It's important for Bechtel to develop competence in technologies that are important to its customers and to project execution.

Compared with the still-widely-used Internet Protocol version 4 (IPv4), IPv6 supports built-in multicasting (an efficient technique for sending messages simultaneously to multiple network destinations) and offers improved security, better performance, and easier management. It has built-in Internet Protocol security (IPsec) and simpler plug-and-play connectivity. It also supports automatic configuration of hosts, and can help users and devices automatically discover each other when they connect to the network. In this way, IPv6 will play an important part in contributing to efficient Software as a Service (SaaS) business models, and will expand the capabilities of the Internet to support, for example, new types of peer-to-peer and mobile applications. Additionally, the protocol's larger address space resolves concerns about the impending depletion of the current pool of IPv4 Internet addresses.

Wettling also notes, "The IPv6 standards defined by the Internet Engineering Task Force have generally reached a level of maturity that supports broad adoption in commercial products. Industry leaders like Cisco and Microsoft have included IPv6 features in their products for years. As the standards have matured, Bechtel is now seeing more full-featured implementations of IPv6 in new versions of software, like the Windows Vista® operating system, the Windows Server® 2008 operating system, and Cisco IOS® Software. Cisco now includes IPv6 traffic-handling in hardware. The technology evolution trend is clear: IPv6 is part of our computing future."

Customer needs, project execution enhancements, and industry trends—for these reasons, in 2005, Bechtel developed a strategy to become an early adopter of IPv6. "Bechtel always strives to be a leader in innovation, safety, security, and quality of work," adds Wettling. "We do this by using our strategic objectives and values as guides to develop and execute tactical plans, and IPv6 is a very significant development in networking technology."

However, the Bechtel IT environment, like that of any large company, is the product of years of carefully considered hardware and software purchases, expert maintenance, and talented development and management effort—all devoted to supporting IPv4-based systems. To implement its IPv6 strategy, Bechtel needed to cost-effectively upgrade its own IPv4 infrastructure to the new protocol. This meant that the transition plan would have to preserve as many of the company's existing IT investments as possible and could not interfere with critical day-to-day business operations.

Solution

In 2005, Bechtel began a project to transition its infrastructure (network, applications, server computers, and workstations) to IPv6. The company worked with Microsoft for help in defining a migration path. Bechtel had been talking with Microsoft for years to learn about its experience with IPv6 deployment; working together on deployment for Bechtel became a natural continuation of those talks. Bechtel chose additionally to partner with an expert in networking hardware and security—Cisco—and with an experienced IPv6 integrator—Command Information—to implement the project.

"Employee training and assistance in IPv6 planning were critical to getting the initiative properly launched," says Wettling, who counted on Command Information to partner with Bechtel in both key areas. "We have sent dozens of Bechtel IT professionals to in-depth Command Information application and network training classes. The Command Information team worked closely with Bechtel to develop an effective transition plan. They also helped us to implement an addressing plan for our Internet provider, which needed an independent IPv6 address allocation from the American Registry for Internet Numbers. Cisco and Microsoft contributions and insights have also been significant from the beginning. The ongoing partnership and collaboration of all four organizations has made the transition a success."

Headquartered in San Jose, California, Cisco is the worldwide leader in networking for the Internet. Its IP-based solutions are the foundation of the networks that support business, education, government, and home communications. Cisco has been the primary networking hardware vendor for Bechtel for many years.

Headquartered in Herndon, Virginia, Command Information is among the largest IPv6 systems integrators in the United States, and offers strategy, application, network architecture, security services, and IPv6 transition planning to federal and commercial organizations.

Supporting Coexistence of IPv4 and IPv6

Built on Cisco Catalyst switches, Cisco routers, and Cisco PIX® firewalls, the Bechtel IP virtual private network (VPN) connects eight core data centers, 180 sites that use the Active Directory® service, and over 20,000 client computers running Windows Vista and Windows® XP operating systems. The IT environment is standardized on the Microsoft® server product portfolio, including the Windows Server 2003 Enterprise Edition operating system. For testing purposes, the environment also includes Windows Server 2008, a pre-release version of the next-generation Windows Server operating system.

At the outset of the planning process, Bechtel decided to make the transition to IPv6 gradually instead of all at once. The migration was planned so that all global IPv4 and IPv6 network devices and applications could coexist for as long as necessary—a method called the dual-stack approach. "The Bechtel plan was to transition its network first from pure IPv4 to IPv6-capable, then to IPv6-dominant, and finally to pure IPv6," says Stephen Oronte, Senior Director for Network-Centric Solutions at Command Information.

To decide which sites to transition first, Bechtel considered each site's business needs, including whether the staff worked with federal government customers, and whether the staff had already received IPv6 training. When Bechtel transitioned the first sites in 2006, it began by confirming that IPv6 worked in a lab environment. Next it conducted a pilot rollout in the production environment, with the goal of creating documentation for security management that staff in subsequent locations could use. "The phased approach gave us the confidence that IPv6 is stable, manageable, and secure, and helped us roll it out rapidly in other locations," says Wettling.

Transitioning as Part of Regularly Scheduled Upgrades

Bechtel added IPv6 awareness to all of its usual IT lifecycle activities, from procurement to application development. "Rather than establish a separate effort to adopt IPv6, we decided to include IPv6 as part of our regularly scheduled hardware and software upgrades and application certification processes," says Wettling. "The

guiding principles for our transition plan were to develop IPv6 competence through internal deployment experience, minimize security risk, keep management simple, and avoid project outages."

Most Cisco hardware and software has supported IPv6 for several years. Therefore, rather than replacing foundation network devices, Bechtel generally needed only to make sure that the devices had adequate memory and were running a version of the Cisco IOS Software that supports the IPv6 capabilities that are important to Bechtel, such as security features. Bechtel chose the most up-do-date Cisco IOS Software version, at least Release 12.4 11T, to make sure that the latest IPv6 standards and features are fully supported. New sites are deployed with IPv6 turned on, resulting in wide area network (WAN) and local area network (LAN) segments in parallel with IPv4. For existing sites, if memory or Cisco IOS Software needed to be upgraded, Bechtel followed its standard change processes for upgrading equipment, and then performed the IPv6 WAN and LAN configuration.

Similarly, for existing computers running Windows XP at transitioned sites, the company configured the operating system for IPv6. However, unlike Windows XP, Windows Vista is configured to support IPv6 by default in a dual-stack (IPv4/IPv6) mode, and also supports additional important standards that are not available in Windows XP, such as Dynamic Host Configuration Protocol version 6. Windows Vista also contains several IPv6-specific features that are important both individually and as foundations for future innovation, such as Windows Meeting Space for peer-to-peer collaboration and Peer Name Resolution Protocol (PNRP) for peer discovery. There are also IPv6-specific features in the Microsoft .NET Framework version 3.0, which is part of Windows Vista and an optionally installed component of Windows XP.

The Bechtel Infrastructure Engineering (standard configuration) for Windows Vista is complete, and Windows Vista is being rolled out to application developers and to the Bechtel corporate Software Quality Assurance (SQA) environment. After Bechtel completes application testing later in 2007, Windows Vista will replace Windows XP as the company's standard client computer operating system image.

Overall, Bechtel expects that a majority of its Windows-based computers and Cisco routers and switches will be running IPv6 by the end of 2007, and Bechtel will configure the routers to transport external traffic over IPv6

when the company's carriers begin providing IPv6 connectivity. As of June 2007, more than 20 percent of Bechtel client and server computers were running IPv6 in over 50 locations around the globe. Bechtel has fully transitioned six sites to IPv6 in the United States and the United Kingdom, including all major U.S. sites that work with federal government customers.

Validating Applications

The Bechtel SQA organization issued IPv6 configuration instructions and development guidelines to all application developers in early 2006 to help ensure that all new and upgraded applications would work with either Internet Protocol version. As part of the Bechtel Standard Application Program Certification, the company began testing its applications—both commercial and those that were developed internally—for IPv6 compliance in an environment that has end-to-end IPv6 connectivity. "IPv6 is enabled on the network and on more than 200 server computers running Windows XP, Windows Vista, and Windows Server 2003 in the SQA lab. Going forward, all applications in Bechtel must be able to operate in an environment running IPv6 before they can be released into production. With a simple change to the .NET Framework 3.0 configuration and minor changes to testing processes, we have found that applications can be developed and tested for IPv6 compatibility with very little additional developer or SQA effort," says Wettling. Applications are configured to use IPv6 transport if it is available and IPv4 if it is not. Bechtel developers have already configured IPv6 in their development environments, including the Microsoft .NET Framework. Bechtel expects that all of its internal applications will be certified by September 2007. As Bechtel moves into testing applications running on Windows Vista, it will use the Microsoft Application Compatibility Toolkit version 5.0 to verify that internal and third-party applications run correctly in the new IPv6-enabled environment.

While Windows Vista and Windows Server 2008 are clearly on the Bechtel roadmap, initial IPv6 deployment and application testing has been done with Windows XP and Windows Server 2003. The Bechtel Quality Assurance team is testing for compatibility at the same time that it certifies other programs, rather than establishing a separate project to certify that applications on employee computers are IPv6-compatible. For example, when Bechtel tested the 2007 Microsoft Office system in a pilot, that project included IPv6 being enabled on any client computers

running Windows XP and on any server computers running Windows Server 2003 where client-server communications were present. IPv6 has been enabled on Cisco switches and routers for all network segments, to help ensure end-to-end testing. "Bechtel ran our standard tests for the 2007 Office system, both as a stand-alone application and in its interaction with other client and server applications. We changed our standard test templates to include IPv6 verification. The incremental effort to develop IP version-independent applications or verify an application's IPv6-compatibility is trivial, after standard configurations are established and testing templates are updated," says Wettling.

Managing the IPv6 Environment

To manage its dual-stack network, Bechtel uses the same tools it used for its IPv4-only network, including CiscoWorks from Cisco, an internal application that tracks server computers and storage, and internally developed software to manage IP addressing. These tools detect and monitor IPv4 as well as IPv6 devices, and management information for both types of devices is sent over IPv4 transport. "The objective is to integrate both networks into the existing Bechtel management infrastructure instead of managing them separately," says Oronte.

"Our IPv6 sites are in many locations, and they communicate across the Internet," adds Wettling. "We wanted to make sure that when we put together a network that runs IPv6 traffic across the Web, we did it in a way that supports the basic operation of the engineering teams within the organization."

Implementing Policy-Based Security

Having closer electronic ties between Bechtel and its customers, partners, and suppliers is one driver in the company's move from topology-based security to a policy-based security model. IPv6 supports a policy-based security model and roles-based access, which means that the identification and authorization of people, information, devices, and services is centralized within the network. Bechtel and Command Information are planning the transition to IPv6 and a policy-based model in a way that does not introduce security risk. To detect and prevent unauthorized access, the company chose Cisco adaptive security appliances, which provide firewall, intrusion prevention, and VPN access capabilities in a single device. Bechtel is also adopting Cisco Network Admission Control (NAC), supported in Windows Vista and on Cisco network

devices, to identify users and their roles; to confirm that user devices comply with the Bechtel security policy, including running the most recent version of Windows Vista; and to perform automated remediation if necessary.

Migrating Without Disruption

Although much work remains for the IPv6 deployment project, Bechtel and its partners are pleased with the results so far. "Bechtel and Cisco testing indicates that the IPv6 solution is working technically as expected," says Dave West, Director of Field Operations for the Federal Division of Cisco. "The transition process from IPv4 has been transparent to Bechtel end users, which is one of the company's goals."

Benefits

As Bechtel enables IPv6 in different areas of its network, the company can begin deploying peer-to-peer and collaboration applications that will provide a competitive advantage. In addition, the company expects that innovative product offerings that take advantage of IPv6 capabilities will lead to higher efficiency and new revenue streams, producing high returns from a relatively modest investment. When the IPv6 solution is fully deployed, Bechtel will also enjoy an advanced network architecture that is more secure and easier to manage than the previous IPv4 environment.

More Secure, Easier-to-Manage Network Architecture

IPv6 is helping Bechtel implement a policy-based security model that is intended to help protect people, information, devices, and services. When a user with an IPv6 device attempts to connect to a fully implemented IPv6 network, the network, using NAC technologies from Cisco will identify and authorize the user and will confirm that the user's device complies with Bechtel security policies, such as having antivirus software and a current version of Windows Vista installed. "In the past, we protected the candy's hard crunchy shell," explains Wettling. "Now, we're moving toward protecting the soft chocolaty center."

The policy-based security model also contributes to a simpler IT infrastructure that is easier to manage. "By using policy-based security features supported by Cisco and Microsoft products, we have an environment that is very clean, stable, and secure," says Wettling. "For example, with IPv4, connecting my computer to the Bechtel

network from home requires that I use VPN hardware and software. In the future, IPv6 will remove this layer of complexity. In the future, if I connect to a Bechtel IPv6 network from a home computer with IPv6 turned on, all information will be encrypted in transit, and NAC technologies will certify both me and my device. This means we will be able to make security stronger and management easier compared with traditional border protection methods."

Policy-based security will also simplify guest access in Bechtel offices and at job sites. "Before granting wireless access to a guest, our intelligent Cisco network confirms that both the user and the device have certificates issued by Bechtel," says Wettling. "Roles-based access helps ensure that competitors who visit a Bechtel facility, for example, can access the Internet but not the Bechtel intranet."

IPv6 also simplifies IP addressing, avoiding the need for complicated workarounds that the Bechtel IT group has used in the past, such as assigning temporary IP addresses to devices that connect to the Internet and relying on network address translation. "Bechtel is in no danger of running out of IP address numbers anytime soon because we're using private addressing," says Wettling. "However, the simplicity of IPv6 addressing is going to make life a lot easier for us." For example, IPv6 addressing will eliminate the need for Bechtel or one of its partners to renumber its addresses if both companies are using the same private IPv4 address space. It will also mean that employees can connect devices, such as portable computers and IP phones, immediately and with greater security at any job site. No IT involvement will be required.

Of course, not all Bechtel partners and customers have adopted IPv6 yet, and the company will have to maintain its dual-stack environment until the IPv6 migration is complete. "Bechtel has developed superb software to manage IP addressing and IP devices, and it works well with both IPv4 and IPv6," says Oronte. "This helps Bechtel to work effectively with its vendors and partners who have not yet made the transition to IPv6, but the sooner everyone migrates, the better."

Advanced Windows Vista Collaboration Technologies

Bechtel uses IPv6-compliant Cisco network devices and Windows Vista to connect people, devices, information, and services. "The first thing we tell our customers who are embarking on a transition to IPv6 is that they need to view their company in a network-centric context," says Oronte. "As Bechtel understood long ago, the value of IPv6 is that it allows a business to communicate with all its assets wherever they are throughout the network."

"People—and the devices, information, and services that they need to access—may be in different organizations or locations," adds Wettling. "With IPv6, we can connect resources in ways that were not possible with IPv4. What Microsoft has done with Windows Vista is to give us a solid IPv6 technology foundation on which to build flexible, collaborative applications."

As part of this foundation, Windows Vista includes "People Near Me" peer-to-peer technology. An application can use People Near Me to discover the people who are connected to a local subnet and easily invite them into a collaborative activity. (A subnet is a portion of a network in which all IP addresses have the same prefixes.) People Near Me also supports publishing objects (collections of information about the subnetwork's users) and managing contacts in the Windows Address Book by using secure digital certificates. This technology provides an innovative way for people and applications to make their presence known, request data, and identify relevance to a particular task.

For example, Bechtel is currently developing a solution that will help field engineers verify that current construction matches blueprints. "In an IPv6 environment, field engineers can use helmet-mounted cameras and handheld computers that are automatically recognized when the engineer enters the coverage area," says Wettling. "Engineers can easily collaborate with colleagues who are on-site or in any global office."

Collaboration With or Without Server Computers

Bechtel is especially interested in collaboration techniques that do not require a host server computer. Specifically, Windows Vista peer-to-peer technologies support the Peer Name Resolution Protocol (PNRP), a secure, scalable, and dynamic technique for registering and resolving names. PNRP was first developed for Windows XP, and then was upgraded in Windows Vista. More efficient than the

Domain Name System (DNS), PNRP is almost entirely serverless, easily scales to billions of names, updates addresses in real time (making it ideal for finding mobile users and devices), and can apply names to services as well as to computers and devices.

In Windows Vista, peer-to-peer networking applications can access PNRP name publication and resolution functions through a simplified application programming interface (API). With the API, Bechtel developers and administrators do not have to specify the IPv6 clouds with which to register a particular name and IP address. (A cloud is a grouping of computers that can find and identify one another.) Instead, the PNRP component of Windows Vista automatically determines the appropriate clouds to join and the addresses to publish within the clouds.

A related technology in Windows Vista is Windows Meeting Space. With Windows Meeting Space, groups of users can quickly and securely form a shared, common networking session for up to 10 people in the same room. They can make their workstations and applications available to other group participants, or can transmit information to a video projector that is compliant with Windows Vista. Users can share and jointly edit files within a common work area. And they can do all this through either a corporate network or an impromptu connection.

Wettling says, "With PNRP in Windows Vista, employees can work in situations where a DNS or collaboration server computer is not available. Instead, they can automatically discover someone through the network protocol itself. Additionally, in the near future, we'll be able synchronize portable e-mail devices with personal computers when no e-mail server is available. People are so familiar with current client/server architectures that it may be hard to get used to this new paradigm, but the serverless applications that IPv6 will support are very exciting to think about.

"Turning on IPv6 is just the start," Wettling adds. "The longer-term benefit will be looking at Software as a Service in conjunction with IPv6 and peer-to-peer discovery. Those capabilities will enable Bechtel to be more effective and efficient. The plug-and-play aspects of peer discovery, PNRP, and Windows Meeting Space are extremely important features to us. We see great value in using applications that are built on industry standards and that use these technologies to help workers communicate and collaborate."

For example, Bechtel employees who are using Windows Vista will be able to easily collaborate with partners who are using non-Windows operating systems, if the operating systems support IPv6. "We're not 100 percent there yet with products from any particular company, but with Windows Vista software and its certification program, Microsoft has motivated and transformed the industry so that these plug-and-play solutions will soon be a reality," says Wettling.

Rapid Deployment of Field Command Posts

When Bechtel gets a contract, the time can be very short between the contract's signing and the date by which the job is supposed to get under way. However, at a construction site, for example, just setting up the project's communications infrastructure can be extremely complicated and time-consuming because of the additional setup complexities of IPv4.

Today, setting up temporary trailers requires separate provisioning of electricity, telephone lines, and fiber optics. "If we later need to move the trailers to another part of the site, moving the voice and data lines is really a pain," says Wettling. "In contrast, with our IPv6 infrastructure we can rapidly deploy wireless Cisco routers with Power over Ethernet technology in the trailers, to provide voice, data, and video connections." With IPv6 capability, the routers can form self-configuring, self-healing networks that immediately become aware of any compatible devices in the coverage area. Employees who have IP phones, for example, will be able to freely move from one router's coverage range to another without dropping connection. Authorized portable computers running Windows Vista will automatically have full access to the network's resources because IPv6 is supported by default in Windows Vista.

For emergency response projects—natural disasters, hazardous materials spills, and so on—Bechtel needs to set up command posts and to deploy people and devices even more rapidly than it would at a construction site. "With the peer-to-peer and autodiscovery technologies that are built into IPv6, emergency responders can begin accessing information and collaborating with people from other agencies as soon as they arrive at the site," says Wettling. Situational awareness improves when field personnel can use handheld devices to receive real-time video feeds and to monitor data from IPv6 sensors for everything from wind speed and chemical levels to the

pulse and blood pressure of workers in a hazardous environment. "I get very enthusiastic when describing these scenarios because they illustrate how IPv6 provides value in so many different ways," says Wettling.

The same IPv6 technologies that support rapid deployment of field command posts can also be applied to manufacturing environments, including power plants, chemical factories, and oil and gas facilities—all of which have many control points. "IP is going to become a big part of plant and process automation," says Wettling. "Supervisory Control and Data Acquisitions Systems are clearly moving toward IP. For anyone who asks, 'Beyond just office and field operations, can we take advantage of IPv6 to improve industrial processes?' the answer is a resounding 'Yes!'"

Competitive Advantage in the Marketplace

IPv6 is part of a Bechtel strategy to address the needs of its customers by offering new solutions and new ways of doing business that give the company a competitive edge. "IPv6 supports the applications that our customers demand," says Wettling. "It is increasingly a requirement of government contracts, and government contracts account for billions of dollars of Bechtel revenues. Being responsive to our customers is very important to us.

"And IPv6 is essential to more than just our federal customers," he continues. "We are one of the largest engineering and construction companies for wireless carriers, for example. When you place a cell phone call in the U.S., there's a good chance that we built the tower that makes your call possible. Delivering voice and data to your cell phone is based on IP, and the latest standards-based specifications for IP voice and data require using IPv6. Putting it all together, if our customers require it, then Bechtel is also required to have the expertise to innovate and deliver IPv6 solutions."

Wettling enthusiastically advocates rapid and universal acceptance of the new protocol. "The trend is toward more projects that are joint ventures," he says. "We need to get Bechtel people in the field and integrate Bechtel work processes with the processes of our partners and suppliers. IPv6 helps support this goal."

Wettling continues, "In the past, other industry-wide attempts to fundamentally change network architecture have failed, so it's natural for some customers to ask if IPv6 is a passing fad. I think it is not a fad, and the proof is that we're seeing the impact of IPv6 technology

insertion—that is, IPv6 will be in the customer environment because products like Windows Vista, Windows Server 2008, and Cisco network hardware already come with IPv6 turned on by default. I believe that the new protocol is here to stay." In particular, this technology insertion is fully realized in Windows Vista—all components of the operating system are IPv6-capable. As a result, organizations like Bechtel make their transition to IPv6 easier simply by including Windows Vista in their migration plans.

Oronte adds, "When all of your employees are connected, when you have real-time visibility into all your products and assets, what does that mean in terms of business value? Bechtel has thought this through. Soon, Bechtel will be able to monitor 100,000 workers on a job site that's miles wide. This company really understands the opportunities for how to use its IPv6 investment to make itself more competitive and efficient."

Big Returns from a Modest Investment

"Cost is always relative," says Wettling. "Implementing IPv6 has consumed less than 1 percent of our IT budget, and the IT budget is only a small part of the overall corporate budget. These costs are modest compared to the expected benefits. Also, by educating people to understand that just by turning on IPv6 functionality and choosing products that already support it—making IPv6 a part of our everyday work—we can proceed with migration with little additional cost or effort."

In addition to low monetary costs, the IPv6 transition is consuming relatively few IT time and labor resources, now that the IT department has surpassed an initial learning curve. "It's amazing. As we've moved through the revision of existing applications and the development of new ones, transitioning to IPv6 has been really straightforward," says Wettling. "In the first year, we spent a lot of time with Cisco understanding the basics—network hardware and Cisco IOS Software releases and their different levels of IPv6 support. The Cisco engineers were really helpful during this phase. Now, we have the experience, and the process of transitioning a site to IPv6 is pretty simple. After verifying that a site's hardware and software meet IPv6 requirements, only a couple of days are required to configure the components."

Bechtel believes that the new markets, business opportunities, applications, and efficiencies that IPv6 will bring are well worth the investment. Wettling says, "The

ability to take a camera, sensor, or other remote device, drop it into a network, and have the network discover it automatically and provide it with an end-to-end secure connection to the employees and services who need the device's information—that is the way of the future. And those of us who get there first are going to win the prize—market share."

Wettling concludes, "These early days of IPv6 are like the early days of the Internet when IT departments first began talking about creating a foundation of Web servers and Web browsers. Back then, many business managers asked, 'Why pursue this? What can this really do?' The answer—unknown at the time—was everything from instant news and e-commerce to blogging and YouTube. For IPv6, this is only the beginning of big things to come."

Windows Vista

Windows Vista can help your organization use information technology to gain a competitive advantage in today's new world of work. Your people will be able to find and use information more effectively. You will be able to support your mobile work force with better access to shared data and collaboration tools. And your IT staff will have better tools and technologies to enhance corporate IT security, data protection, and more efficient deployment and management.

For more information about Windows Vista, go to http://www.microsoft.com/windowsvista.

Software and Services	Hardware	Partners	
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		• Command Information	CommandInformation leverage the change
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