Tapping the Benefits of IPv6

Implementers around the globe are finding out how the next-generation Internet Protocol can help them build better, more flexible networks and new applications.

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Contents

Introduction

Around the world, IPv6 is catching on, with companies and organizations of various types putting the next-generation Internet Protocol to use in ways that showcase how the protocol enables innovative new applications and useful additions to existing ones.

In countries including Japan, Korea and China, not to mention the U.S., government entities, enterprises and other organizations are embracing IPv6 for projects as diverse as weather monitoring and first-responder communications to setting up next-generation networks more quickly. In the U.S., federal government agencies face a mandate (U.S. Office of Management and Budget Memorandum 05-22) that their networks support IPv6 by the end of June 2008 in order to maintain U.S. leadership in Internet technologies. That deadline is having a trickle-down effect on many other organizations, including government subcontractors and others that do business with government agencies.

Rather than balk at the mandate, leading organizations are embracing it and examining the ways in which IPv6 can help them build better, more flexible and secure networks. "We see IPv6 as a real foundation for innovation and transformation in the company," says Fred Wettling, manager of IT standards and strategies and a fellow with Bechtel Corp., the giant construction, engineering and project management firm.

ROI of 10:1

Bechtel is far from alone in expecting a big return from its IPv6 investment. A study conducted by RTI International for the National Institute of Standards and Technology (NIST) and the National Telecommunications and Information Administration (NTIA) finds that IPv6 is expected to return $10 for each dollar invested. Study participants identify several major categories of IPv6 applications that, in total, they estimate would deliver benefits in excess of $10 billion per year. The cost of migrating to IPv6, meanwhile, is estimated at $25 billion over 25 years, or $1 billion per year. So, a $1 billion annual investment yields a return in excess of $10 billion per year - a hefty return on investment. Benefits of IPv6 cited in the report include cost reductions from improved security, increased efficiency and innovations that lead to new products and services.[1]

[1] "IPv6 Economic Impact Assessment," prepared by Michael P. Gallaher, Ph.D., and Brent Rowe, RTI International, October 2005.

In terms of security, IPv6 includes native support for IPSec. By itself, this is not generally considered a big advantage over IPv4 because IPSec is already widely used, given it is relatively simple to add to an IPv4 network. But when considered in combination with other capabilities, notably IPv6's self-discovery capabilities and peer-to-peer nature, IPSec plays an important role in creating networks that are both simple to set up and inherently secure.

Security also plays a role in another expected benefit of IPv6: remote access capabilities. With its larger address space, IPv6 offers the ability for any device to be globally addressable, making the protocol ideal for applications such as secure remote monitoring and support. This applies not only to monitoring IT infrastructure components, but virtually anything, from automobiles to appliances. Such a capability could allow manufacturers to increase the life expectancy and functionality of their products while decreasing service costs, the RTI report notes.

IPv6 is also expected to give rise to entirely new applications that would either be difficult or impossible to deploy with IPv4. The multicast capabilities of IPv6, allowing one-to-many communications, may give rise to everything from new forms of games to social network applications. Tom Patterson, former CEO of the IPv6-focused consultancy and service provider Command Information Inc., often cites the example of a form of dating service where people with similar interests are alerted when they happen to be near each other. Perhaps such an application could be combined with an advertisement, where if the pair meet at a nearby coffee shop they get a 2-for-1 deal.

Outlining the Need

Of course the movement to IPv6 is driven largely by a more fundamental need: The world is running out of IPv4 addresses. In October 2007, the IPv4 Address Report Web site predicted that the Internet Assigned Numbers Authority (IANA), which manages IPv4 addresses, would run out of addresses on May 12, 2010. The Regional Internet Registries (RIRs), which distribute IP addresses in their respective regions, are slated to run out a bit later: Feb. 11, 2011, according to the site.[2]

Indeed, both the American Registry for Internet Numbers (ARIN) and RIPE, which serves as the RIR for European ISPs, are both warning that depletion of IPv4 addresses is imminent. "The available IPv4 resource pool has now been reduced to the point that ARIN is compelled to advise the Internet community that migration to IPv6 is necessary for any applications that require ongoing availability from ARIN of contiguous IP number resources," ARIN says in a May 2007 statement.[3] RIPE sounds a similar alarm. "We urge those who will need significant new address resources to deploy IPv6," RIPE says in an October 2007 statement. "We urge that the widespread deployment of IPv6 be made a high priority by all stakeholders."[4]

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[2] Source : IPv4 Address Report: http://www.potaroo.net/tools/ipv4/index.html#r4

[3] "ARIN Board Advises Internet Community on Migration to IPv6," May 21, 2007. http://www.arin.net/announcements/archives/20070521.html

[4] "RIPE Community Resolution on IPv4 Depletion and Deployment of IPv6," Oct. 26, 2007. http://www.ripe.net/news/community-statement.html

Solving the Address Quandary

Other predictions vary, but there's no denying that the 4 billion-plus unique addresses that are possible with the 32-bit IPv4 address field will be exhausted within the next few years. IPv6, on the other hand, has a 128-bit address field, "enough to assign trillions of addresses to each person now on earth or even to every square inch of the earth's surface," according to a January 2006 U.S. Department of Commerce report.[5]

> ***"A freight train is coming. Do you want to go with it or stand in front of it and get mowed down?"***
>
> **Fred Wettling**
> Manager of IT standards and strategies and a fellow with Bechtel Corp.

Such an increase in available addresses has a number of important implications. For one, it means organizations no longer have to rely on Network Address Translation (NAT) devices to conserve address space. NAT evolved largely as a way to get around the address limitations of IPv4. With NAT, an organization can advertise its assigned IP address to those outside its corporate walls, but use different addresses inside its own network, with the NAT device translating between the two. That means the organization is free to use any IP addresses inside the NAT device, even those that are technically assigned to a different organization, essentially allowing a single IPv4 address to support many more users.

But NAT can make it difficult for organizations to open up their networks to one another, as they increasingly need to do. NAT also makes it more difficult to create end-to-end applications, where two end devices can communicate freely with each other. Essentially, NAT stands in the way of the original intent of the Internet, which was peer-to-peer communications among devices — an idea that IPv6 restores. (That said, there are features of NAT that some network administrators like to employ, including certain management and security attributes. With that in mind, RFC 4864, Local Network Protection for IPv6, documents how these features can be implemented using IPv6, but without the problems that NAT introduces.)

The availability of more addresses also makes it feasible to tie many different types of devices into IP networks, beyond computers and network infrastructure. Suddenly, it becomes feasible to implement a vast network of sensors to monitor everything from weather conditions to manufacturing floor equipment and warehouse stock. Likewise, the ubiquitous cell phone could be IP-addressable, opening it up to new applications beyond those provided by whatever the owner's service provider offers. Additionally, any device that is IP-addressable can also be managed remotely, enabling simplified network management. Indeed, it's impossible to predict all the applications that may evolve from not just the expanded address field, but the various other benefits that IPv6 provides (see "IPv6 at a Glance," page 6).

[5] "Technical and Economic Assessment of Internet Protocol Version 6 (IPv6)," January 2006, U.S. Department of Commerce, National Institute of Standards and Technology, National Telecommunications and Information Administration.

A Freight Train is Coming

What is clear, however, is that IPv6 is coming, and it probably already exists on your network. Windows Vista ships with an IPv6 stack, and the protocol is supported in Windows XP SP1 and SP2. Windows Mobile 2003 and later editions also ship with IPv6. The Apple OSX operating system has included IPv6 support for about two years, as have many flavors of Unix and Linux, if not longer. Sun Solaris, IBM AIX and HP/Compaq OpenVMS likewise support the protocol. Similarly, network hardware vendors such as Cisco Systems, Inc. and Juniper Networks, Inc. have long offered support for IPv6.

Given all that support in existing products, the U.S. Office of Management and Budget (OMB) Memorandum 05-22, the 2005 edict that says all federal agencies must support IPv6 by June 2008, seems not so onerous.

"A freight train is coming," as Bechtel's Wettling puts it. "Do you want to go with it or stand in front of it and get mowed down?"

Bechtel and IPv6

Bechtel first embarked on the IPv6 trail in 2005, in part because it was starting to see the protocol mentioned in contracts with its many government customers, Wettling says. Some of those contracts included talk of financial penalties if certain things weren't done with IPv6. In short, IPv6 was required to win business and to execute on jobs that the company did win. So it was a business imperative for Bechtel to develop a level of competence with IPv6.

The company has certainly done that. As of September 2007, more than 14,800 Bechtel client computers — about 85% of the total in the company — had IPv6 turned on. Similarly, more than 60% of all Bechtel network ports are running dual IPv4/IPv6 stacks. By the end of 2008,

IPv6 at a Glance

IPv6 is the next-generation Internet Protocol, intended as the follow-on to IPv4 for networks worldwide. IPv6 is now a mature, stable protocol, first defined by the Internet Engineering Task Force RFC 2460 in December 1998.

The main attributes of IPv6 include the following:

- A dramatically increased address space of 128 bits, vs. 32 bits in IPv4. This allows for 340 x 10^{36} unique addresses - or 340 undecillion addresses.
- Mandated security, with support for the IPSec encryption protocol built in.
- Improved host and router discovery, with the ability to auto-configure both clients and servers. By obviating the need for manual intervention to configure a device upon installation, this capability can greatly simplify network deployments and makes it far easier to deploy numerous IP-addressable devices, including in remote, dangerous places.
- Enhanced mobility with Mobile IPv6, which allows for a device to have an address that is reachable on an IP network, no matter where the device is or what network it's on.
- Enhanced multicast capabilities including scope management and resolution to solve traffic congestion problems.
- QoS enhancements, which allow for premium services for critical Internet traffic, with guaranteed delivery and prioritization.
- Support for jumbo datagram packets of 4 GB (and soon 32 GB), up from 64 KB in IPv4.
- The Flow Label specification (RFC 3697), which enables network utilization to triple, from 27% efficiency to 81%.
- Reserved space within the datagram for future developments.
- Restoration of the end-to-end model of the Internet.

the company expects to be entirely IPv6-enabled, Wettling says (with the exception of systems due for imminent retirement).

IPv6 Drivers

In addition to the federal government mandate, another driver for IPv6 at Bechtel is that the company is converging all of its networks to IP — a concept known as XoIP. That includes everything from its voice networks, which are now about two-thirds voice over IP (VoIP), to video and office systems, and even building plant and process automation systems. For example, the company recently finished building a refinery in India that has 51,000 instruments that must be monitored and controlled. Putting all those instruments on a single IP network would enable the devices to work with the same routers and switches Bechtel normally uses in an office network, as opposed to a proprietary control system network. Some control system manufacturers are already migrating to IP — and IPv6 specifically — thus helping the company greatly simplify its network architectures.

Bechtel now sees IPv6 as a fundamental technology transition, akin to the advent of the Internet and the Web. "It's a general industry trend," Wettling says. "It's kind of like asking a company, 'Why did you implement Web servers?' "

A Gradual Migration

For Bechtel, the only question was how it should implement IPv6. One approach is the forklift upgrade, where you migrate everything at once, like upgrading an operating system. But IPv6 lends itself to a more gradual approach.

"It's not a big separate project where we attack everything. We just embed it into the normal work process," Wettling says. For example, when an infrastructure engineer updates documentation on how to build a Web server, IPv6 becomes part of it. As computers get upgraded, IPv6 gets turned on. Indeed, there's now an edict throughout the company. "If you want to implement a brand new something, it will have IPv6 turned on or it won't be implemented," he says.

"Things are occurring that we never thought of before," Wettling says. "We see IPv6 as a real foundation for innovation and transformation in the company."

Mining the Benefits

Much of the benefit in IPv6 lies in its peer discovery capabilities. One practical application for the technology is in assigning IP addresses to new devices. For desktops, the company has long used Dynamic Host Configuration Protocol (DHCP) to automatically assign addresses, but for servers, the process is manual. "We now use the automatic configuration capabilities of IPv6 for everything that can be configured automatically, including servers," he says. "That may not seem like a big change, but if you start nibbling at small things one after another — 'I don't have to do this and that anymore' — it ends up being quite a massive thing."

Another example of the benefits of IPv6 for Bechtel involves setting up networks at new construction sites. A typical Bechtel construction project may involve 20,000 to 50,000 workers. The company brings in numerous trailers to function as offices, tool sheds and the like. Each requires

a generator to supply power, phone lines and network connections. A few months later, it all gets dismantled and the trailers are moved to another location, perhaps on the same job site, where the process starts all over. "We want to get to the point where we can install a trailer, put in an IPv6 wireless router and have that trailer discover other trailers and create, on the fly, a self-configured mesh network that allows communications among them," Wettling says. "You're not going to go there with IPv4, I'll tell you that."

> ***"The real magic happens when those trailers are all configured with IPv6 and the networks and all the first-responders are prepared to talk IPv6. Any device with IPv6 in it can communicate."***
>
> **Geof Lambert**
> Chairman, CAv6TF and vice-chairman, NAv6TF

Brainstorming on New Apps

With the IPv6 infrastructure in place, now the challenge is coming up with ways to use it effectively. Toward that end, Wettling says he had a 90-minute brainstorming session with representatives from Cisco, Microsoft Corp. and Command Information, an IPv6-focused consulting company that has been working with Bechtel on its implementation. "I threw out a bone or two to prime the pot, and the group went wild. At the end, we had 25 new ideas on areas that we can exploit," he says.

Examples include installing sensors to measure wind speed during construction projects, such as during bridge construction. "Throw the sensors up, let them configure themselves quickly and easily, and it makes our lives safer," Wettling says. Another idea was to retrofit power plants with IPv6 so that, as workers walk through with tablet computers, they can pull drawings from a server, take pictures with a camera mounted to their helmet, talk via Bluetooth-enabled phones over a VoIP network and interactively collaborate with other peers adjacent to them. "You can do that with IPv4, but discovering other people is a lot harder than it is with IPv6," he says.

IPv6 Around the U.S.

Command Information has also developed a number of proof-of-concept applications that use IPv6. One is its Advanced Incident Response System (AIRS), which is intended to allow emergency personnel from various government agencies to communicate seamlessly with one another at the response site. The idea is to transport biometric, environmental and other data from sensors along with voice and video traffic over a wireless IP network that is formed on-site. The traffic gets aggregated at a central command station that is safely outside the incident area, enabling effective, centralized management of the response.

MetroNet6: Effective Early Responder Communications

MetroNet6, a planned ad hoc network for first-responders, is an example of the kind of network Command Information envisions with AIRS. The idea is to enable multiple local authorities—such as local and state police, fire and hospital personnel—to quickly establish communications with one another, and with the Office of Homeland Security in Washington, D.C., in the event of an emergency. Here again, the peer discovery capability of IPv6 is crucial to the effort.

A number of groups, including the California IPv6 Task Force (CAv6TF, a sub Task Force of the North American IPv6 Task Force, or NAv6TF) and the IPv6 Forum, are working to build a prototype MetroNet6 network in Sacramento, Calif., says Geof Lambert, chairman of the CAv6TF and vice-chairman of the NAv6TF. Some equipment is up and running, with a link to the University of New Hampshire Interoperability Lab supplied by NTT America supporting IPv6 for testing. Lambert expects a working prototype of the network to be deployed in 2008.

An example of how the network would work is that local police, state police, firefighters, hospital personnel and other local authorities would all have handheld devices that connect to a metropolitan network based on IPv6. The network would be capable of securely transmitting voice, video, data, images and other forms of information over wireless and broadband connections. Additional sub-networks would be added as required, such as for the National Guard or other U.S. agencies that may be needed in an emergency.

One of the crucial elements that IPv6 brings to MetroNet6 is peer discovery capabilities, which allow communications to be established on an ad hoc basis. Lambert uses the analogy of grains of sand. Imagine you have a handful of sand and each grain is a network node. With IPv6, you could throw the sand up in the air and by the time the individual grains reached the ground, they'd have established a network with one another. "If you threw it up in the air and tried to connect using IPv4, nothing would happen; you couldn't do it," he says. That's because some manual intervention would be required to assign IPv4 addresses, especially to get around NAT devices.

Peer discovery capabilities are critical in the case of emergencies, such as earthquakes, during which some network infrastructure is unavailable. "With IPv6, 5 minutes after the earthquake hits, we can make the most efficient use out of the infrastructure that is available," Lambert says. A short time after that, emergency network equipment can be deployed, including communications trailers or even wireless towers placed by helicopter in strategic locations. "The real magic happens when those trailers are all configured with IPv6 and the networks and all the first-responders are prepared to talk IPv6. Any device with IPv6 in it can communicate."

The grand vision is to establish MetroNet6 networks in multiple U.S. cities and to establish links between them, such that emergency personnel will be able to communicate with their counterparts wherever they may be. That's where the global addressing capability of IPv6 comes into play, making it possible for an IPv6-enabled device anywhere in the world to quickly establish communications with any other device. Of course, this kind of network also requires the cooperation of numerous service providers supporting IPv6. NTT America, for example, is involved in the Sacramento prototype of the MetroNet6 network (See Figure 1, page 10).

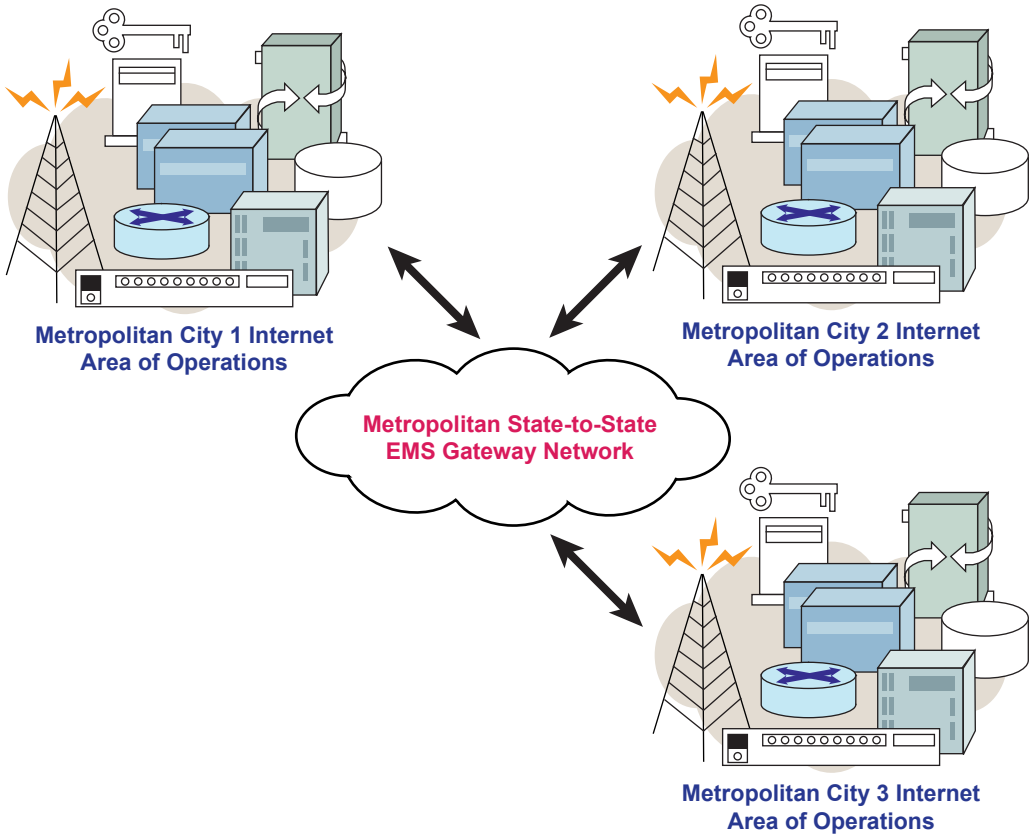
Comcast: Tackling 100M+ IP Addresses

Another service provider, the U.S. cable television and Internet service provider Comcast Corp., is adopting IPv6 to help it manage the vast network of devices installed in its customers' homes. The company previously used private IPv4 addresses to manage the cable modems installed in customer locations, according to Alain Durand, director and IPv6 architect for Comcast. But the company simply could not keep up with the number of addresses it needed. Consider that Com-

cast has some 20 million cable TV customers, with an average of 2.5 set-top boxes each, and that each box requires two IP addresses. That's 100 million addresses right there, and doesn't include additional addresses required for high-speed data and VoIP customers. Customers that get TV, voice and high-speed data service from Comcast need eight or nine IP addresses, assuming an average of 2.5 set-top boxes per household. Acquisitions and new services likewise drive up address requirements.[6]

Using IPv4 is not a viable option because it would require NAT, which would make the task far more difficult. As a result, back in 2005, Comcast began its IPv6 deployment plans. Essentially, the plan is to have multiple subnets at each customer's home or office to provide different services, such as one for video, another for Internet service, a third for maintenance on the set-top box and so on.

Figure 1:
MetroNet6 Grand Vision: City to City Command and Control



Ultimately, the MetroNet6 project is intended to create an emergency response network with communications between cities and states, all built on IPv6.

[6] Source : "IPv6 @ Comcast," a presentation by Alain Durand at the NANOG 37 meeting, June 4-7, 2006, San Jose, Calif. http://www.nanog.org/mtg-0606/durand.html

IPv6 Around the Globe

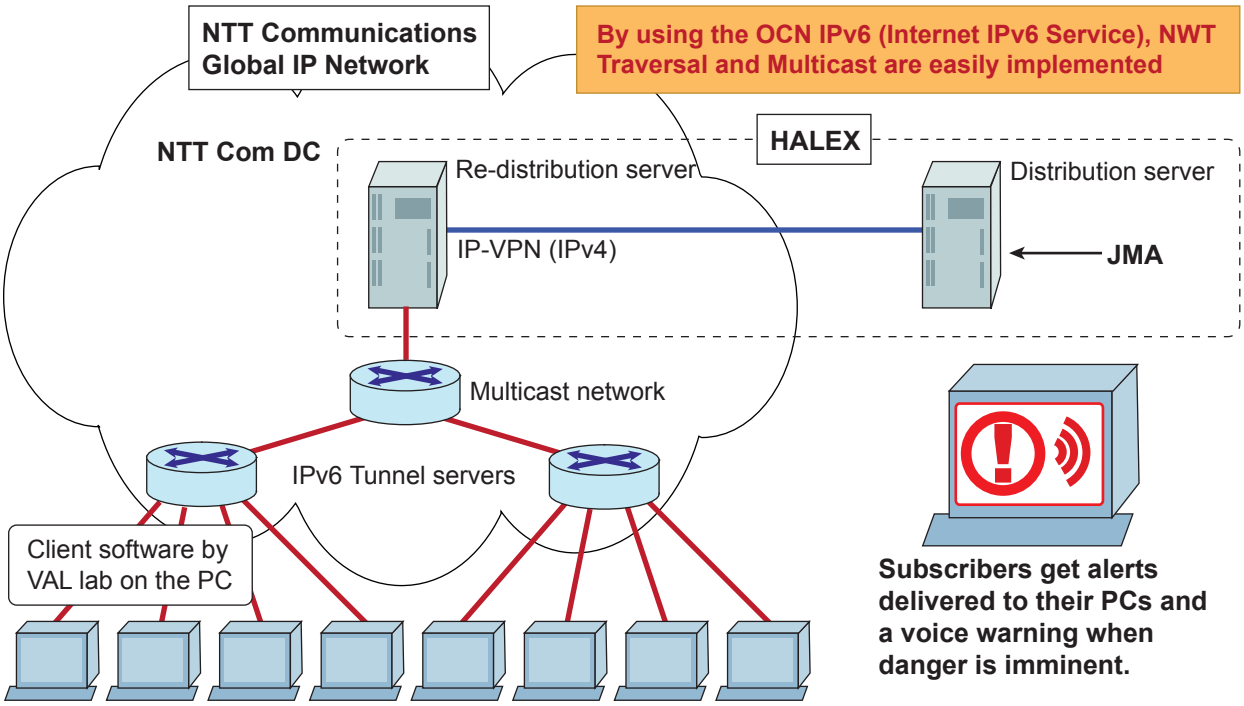
IPv6 is likewise taking hold in other countries around the world, playing a key role in a series of diverse applications, ranging from an innovative earthquake early warning system in Japan to a global communications system for embedded computers within BMW cars.

Earthquake Early Warning System

The Japan Meteorological Agency (JMA) is working with NTT Communications to use IPv6 as part of an earthquake early warning system that is intended to give advance earthquake warnings to factories, railroads and other companies. The system uses some 1,000 sensors that can detect early tremors that signal an earthquake is imminent. The sensors communicate with a JMA server, where the data is analyzed to determine the origin of the tremor, current location and direction of the seismic wave front, and where it may be headed (see Figure 2, below).

The JMA server hands off the resulting data to an NTT IPv6 multicast server, which distributes it via the NTT IPv6 multicast network to consumers and businesses that subscribe to the service. Subscribers get a warning, with an estimated intensity and a countdown in seconds, on their computer screens. The JMA, meanwhile, also issues its own warnings over TV and radio. Even a few seconds of advance warning can be crucial and that's what the system provides, given that warning data travels faster than the earthquake tremor. It could buy enough time to take important countermeasures, such as closing gas valves, alerting first responders and schools, stopping trains and elevators, extinguishing flames and taking cover.

Figure 2:
Architecture of the Japanese Earthquake Warning System



Japanese Agriculture

In another Japanese project, which began in 2002 under the auspices of Japan's Ministry of Public Management, Home Affairs, Posts and Telecommunications, IPv6 plays a role in monitoring the location and health of cattle. Each cow is outfitted with a sensor that can detect its temperature. The sensor, equipped with an IPv6 address and wireless LAN adapter, communicates to wireless LAN access points located at various points around a large ranch. The temperature sensors help monitor for disease, while the location information derived from the access point that the sensor communicates with alerts ranchers to any stray cows. The system is also intended to improve the traceability of beef throughout the growth and distribution process. Such information can help pinpoint the source of any diseases or contamination and improve overall consumer confidence in the industry.

Korea and China: Early Adopters

Since at least 2004, the Republic of Korea has been seeking to make all commercial Internet services IPv6-based by 2010. The KoreaV6 project is well on its way to meeting that goal, with the construction of the KOREAv6 backbone that interconnects domestic IPv6 networks and provides the infrastructure for pilot services aimed at businesses, schools, consumers, hospitals and government agencies. Some 35 organizations offer 11 different IPv6-based services, including a HDTV-quality video streaming service, a digital medical chart system for hospitals, a mobile education service with remote virtual storage and an ecosystem monitoring service, to name a few.[7]

China is in a similar position. In 2003, the Chinese State Department adopted the formation of the China Next Generation Internet (CNGI) as a national project. The four-phase CNGI project includes CERNET2, the Next Generation Education and Research Network in China, which will include native IPv6 support. IPv6 was a requirement in China if for no other reason than to keep up with growth in Internet users. China has an estimated 150 million to 200 million Internet users, yet only about 12% of the population is online, leaving tremendous room for growth — and tremendous demand for new IP addresses.[8]

BMW Eyes IP for Next-Gen Cars

Automaker BMW is looking at IP to network the various control systems in its automobiles. BMW today installs as many as 70 embedded computers to handle tasks ranging from engine and stability control to multimedia functions. A research group at the automaker tested IP as a way to provide real-time communications among the controllers, with promising results, according to a report in *EE Times Europe*.[9] Although the team used IPv4 for its experiments, it evaluated IPv6 as well and found "great potential for IPv6 applications," according to the *EE Times*. The impetus for the project was to keep up with the increasing number of embedded systems that BMW places in its cars

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[7] Source: http://www.vsix.net/english/

[8] "China surpasses U.S. in Internet use," by Natalie Pace, April 3, 2006, Forbes.com. http://www.forbes.com/2006/03/31/china-internet-usage-cx_nwp_0403china.html

[9] "BMW brings Internet Protocol under the hood," by Christoph Hammerschmidt, Nov. 28, 2007, *EETimes Europe*.

and to provide connectivity from those systems to the global Internet, thus creating the potential for real-time communications and device monitoring. Given the sheer number of devices in question, IPv6 would be a natural choice due to its expanded address field.

IPv6 Futures

Looking ahead, there's almost no limit to the possibilities that IPv6 presents in terms of new applications. The peer-to-peer nature of IPv6, with its self-discovery capabilities, presents a multitude of opportunities for device-to-device communications.

For example, when used in combination with a number of other technologies, including the Session Initiation Protocol (SIP) and IP Multimedia Subsystem (IMS), IPv6 has the potential to usher in a new era of peer-to-peer services for mobile communications.

IMS is an architecture for delivering multimedia services over an IP-based mobile network. SIP is a signaling protocol used to set up and tear down telephone calls as well as multimedia sessions in an IP network. When used with the global addressing capabilities of IPv6, IMS enables rich multimedia communications between end devices over a mobile network, without the need for any intermediary servers or devices.

Such a capability could enable new forms of peer-to-peer gaming over mobile networks, with players able to easily find other players and initiate a game that involves multimedia streams. It is also the foundation technology behind the dating service cited earlier, in which two people with similar interests could be alerted when they are near each other.

IPv6 could also create some fundamental changes in the way companies currently do business. One example is home monitoring systems, says Jeffrey Young, senior analyst with the Burton Group consultancy. Think about how a security company typically operates, he says. A technician comes out to a customer's home and installs a monitoring device that costs maybe $50, but the customer is charged $200 to $300 because of the installation expense. With IPv6, the customer could install the device himself and it would be pre-configured to talk to a centralized management station, thus reducing an initial barrier to the sale. The security company still makes money on its monthly monitoring fees.

Young also cites an example of an Army warehouse, full of weapons, food and the like, that may be located somewhere in a desert. Perhaps the Army uses radio frequency identification (RFID) to keep track of inventory in the warehouse. In the IPv4 world, that requires trained technicians to network the warehouse, so that sensors can read the RFID tags on all the inventory and send signals back to the desired server. "With IPv6, you can ship the sensors out there and it's plug and play," Young says. "They come up and negotiate their globally addressable space and establish a secure association with whatever management station you set them up to deal with." The big plus is the Army doesn't have to send trained IT personnel to the desert to configure everything; it can all be done remotely.

Conclusion

As it did with Bechtel, the U.S. federal government mandate is likely to drive additional companies to explore IPv6 — and to come up with their own applications for the protocol. It's impossible to predict all the applications people might devise, but one thing is certain: We will run out of IPv4 addresses in the not-too-distant future.

While existing devices and networks connected to the Internet using IPv4 will continue to function, it will become increasingly more difficult to get contiguous IP addresses from registries such as ARIN, says John Curran, chairman of ARIN. That means organizations that are building new networks, and ISPs or mobile data providers that are adding new customers, will increasingly have no choice but to use IPv6 addresses, he says.

Already, there are organizations attempting to reach your mail and Web servers using IPv6, Curran says. In the near future, he maintains there will be an increasing number of organizations that have no choice but to use IPv6. At that point, you will need to support IPv6 in addition to IPv4 in order to be reachable by "the entire Internet," as Curran puts it.

Burton Group's Young says IPv6 represents an opportunity, at least to those who choose to seize it. His advice is simple: "Go get educated, understand IPv6 and look for ways you can implement it."

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NTT Communications and IPv6

NTT Communications certainly understands IPv6. The company launched its first IPv6 transit services in 2001 and the first IPv6 managed firewall solution in 2005. Its IPv6 network now covers Asia, Australia, the U.S. and Europe. In November 2007, its subsidiary Verio, Inc. became the first North American Web hosting provider to offer IPv6 support when it announced availability of the protocol for the Verio Virtual Private Server (VPS) and Managed Private Server (MPS) hosting solutions.

No provider has a longer history in providing commercial IPv6 than NTT Communications, and the company is involved with some of the most advanced IPv6 projects worldwide.

NTT Communications' IPv6 services enable you to run dual IPv4 and IPv6 stacks for as long as you need to, allowing you to make the transition to IPv6 at your own pace. NTT America offers IPv6 commercial off the shelf (COTS) transit services on the GSA Schedule 70. The company's award winning IPv6 transit service is available in native, tunneled or dual stack modes, and may be procured using GSA Contract No. GS-35F-0322T. The U.S. Federal Aviation Administration, for example, uses IPv4 as well as IPv6 services from NTT Communications in the dual-stack mode.

The NTT Communications network also has a single global ASN worldwide, providing improved performance with no bottlenecks between network segments. As the second-largest telecommunications company by revenue in *Fortune* magazine's 2007 Global 500 survey, NTT Communications also provides the stability you require in a global carrier.

To learn more about NTT Communications and its IPv6 offerings in the U.S., please visit www.us.ntt.net .