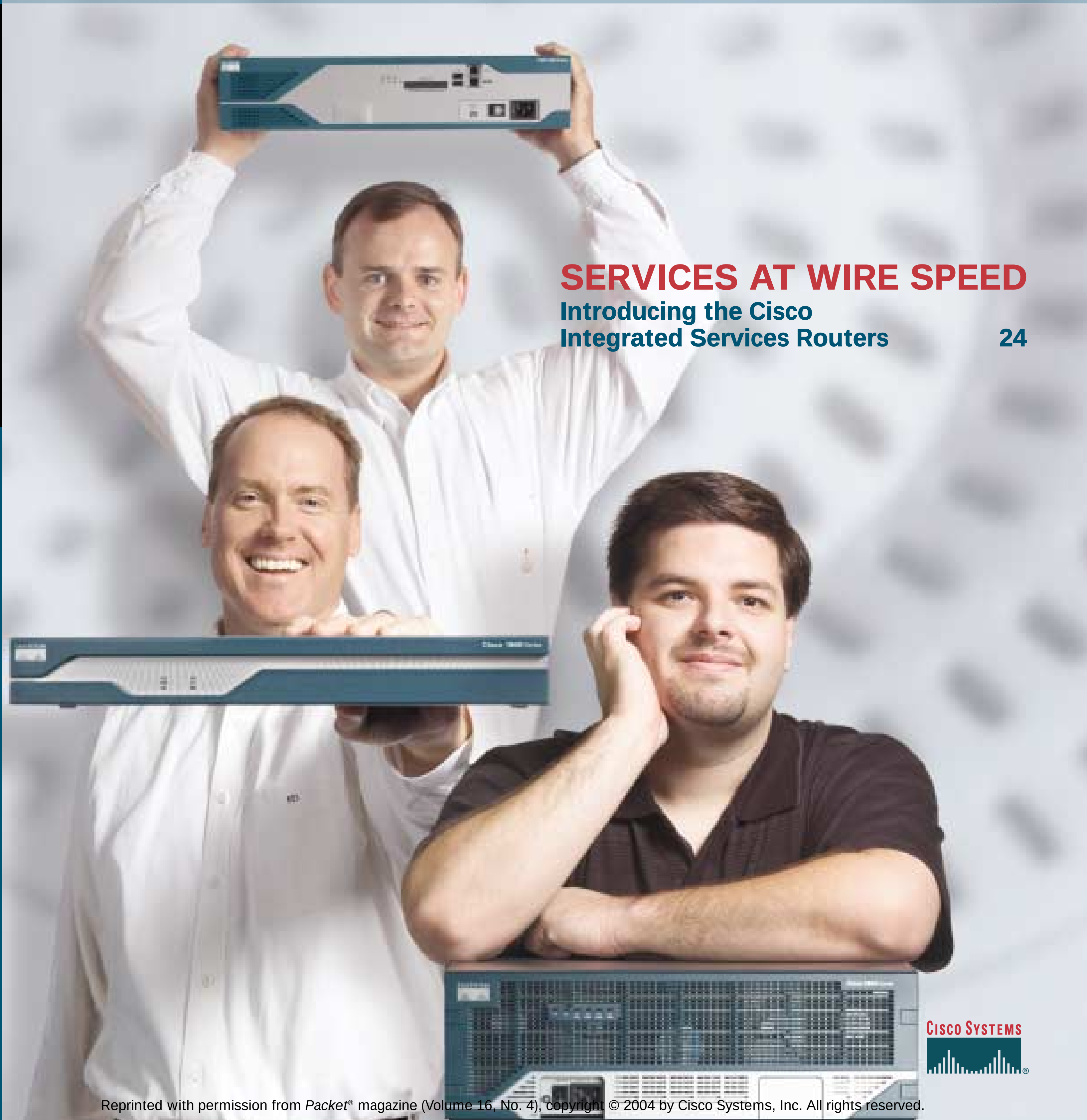
# PACKET

CISCO SYSTEMS USERS MAGAZINE

FOURTH QUARTER 2004



## SERVICES AT WIRE SPEED



Cisco Systems

# Transitioning to IPv6 Now

IPv6 to benefit end-to-end communications can be easily tested today.

**By Leigh Huang**

Of all the benefits that IPv6 promises for next-generation networking—autoconfiguration, limitless addresses, mobility—its ability to recreate end-to-end communications will be among its greatest contributions. By re-enabling direct peer-to-peer communications, IPv6 will be the catalyst for a new generation of shared-experience applications—virtual concerts, video meetings, online video classes, and real-time gaming—using voice, video, and presence-based technology that far transcend today's early-stage applications.

Greg Mably

Contrary to perceptions in the market, IPv6 is not a distant technology, but is now widely available as embedded feature sets in a range of networking products and recent operating system releases. IPv6 stacks are supported in Microsoft operating systems such as Windows Server 2003, Windows XP Service Pack (SP1) and SP2, Windows CE, and PocketPC 2003. Transition mechanisms such as Intrasite Automatic Tunnel Addressing Protocol (ISATAP), Teredo, and 6to4 tunneling provide simple approaches to edge deployment of IPv6 without costly infrastructure upgrades.

IPv6 was facing a typical dilemma: if no mass market existed, developers were hesitant to adopt, hindering the availability of a "killer" application. But IPv6 is gaining momentum worldwide, and enterprises and service providers can easily begin to explore and gain experience with IPv6 through minor infrastructure changes. Developers can begin to write applications that are also IPv6 compliant at minimal extra cost and effort, providing them with a key advantage in an early, but soon to be huge, market.

### The Promise of End-to-End

One of the key issues hindering the growth of rich streaming and real-time collaborative applications is the lack of true end-to-end connectivity. Today's Internet is based on the IPv4 protocol that has not been substantially changed since RFC 791 was published in 1981. Network Address Translators (NATs) have evolved as a makeshift measure to extend the life of the IPv4 public address space. NATs have enabled enterprises, service providers, homes, and Wi-Fi hotspots to hide inside private addresses and share a single public IP address to the outside world.

While NATs provide a useful function by extending the limited range of IPv4 addresses, NATs pose significant problems in an increasingly collaborative and mobile world. NATs break end-to-end connectivity by inserting translation devices that manipulate the data, thereby blocking direct peer-to-peer communications between two devices. While workarounds are available, they increase the complexity of both the development and deployment phases of the project. Finding ways to "traverse" NATs requires developers to divert key resources to address this non-core function during the development cycle. Additionally, many applications and services address the NAT situation by deploying servers in the network. This is an expensive overhead that many smaller organizations cannot afford. The problems created by broken end-to-end connectivity ultimately limit availability of solutions to all customers.

### A Transparent Internet

Beyond the difficulties developers face with NAT workarounds, network administrators must deploy gateways and servers to circumvent the problem. This has led to situations like the AOL MegaPOPs that are proxying millions of people behind gateway devices. All of this activity must be tracked, and it consumes significant bandwidth.

IPv6 eliminates the need for address translation because it restores the network connectivity through its rich IP addressing scheme. This means that each device can have its own IP address, and media streams can be sent directly from peer to peer without going through a translation device. IPv6, therefore, brings back the capability of end-to-end control of communications, making networking applications simpler as the network again becomes transparent.

In addition to enabling peer-to-peer communications and resolving IPv4 address limits, IPv6 presents an opportunity to create a protocol with new and improved features. A simplified header architecture and protocol operation translates into reduced

## Cisco and Microsoft Interoperate with Mobile IPv6

Mobile IPv6 is a technical specification designed to address mobile connectivity in IPv6. Its standardization has been handled by the Mobile IPv6 Working Group (MIP6 WG) in the IETF, and the latest version of Mobile IPv6 is RFC 3775. To date, both Cisco and Microsoft have implemented this to enable market exploration and functional interoperability.

Three elements are specified in Mobile IPv6: the *mobile node* that conducts communication while in transit, the *home agent* that temporarily responds to communication requests on behalf of mobile nodes, and the *correspondent node* that communicates with mobile nodes. Cisco will include support for the home agent on routers running Cisco IOS Software Release 12.3T. The Cisco MIPv6 home agent is interoperable with Microsoft mobile nodes running Windows XP SP1, Windows CE, and PocketPC 2003.

operational expenses. Built-in mobility and security features mean easier and, therefore, more ubiquitous, applications and services that are lacking in IPv4-based networks.

### Gaining Momentum

As with any major technology change, the transition to IPv6 will occur over time. But 2004 has seen a spike in the interest in and deployment of IPv6. In June 2003, the US Department of Defense (DoD) announced a five-year procurement plan stipulating that all future purchases of networking hardware and software would need to be IPv6-capable, or must plan to be before the end of 2007. This doesn't mean that the products need to fully implement IPv6 today, only that they have the necessary IPv6 protocol stacks and ASIC-accelerated hardware to enable the US DoD to successfully deploy IPv6 on the projected turn-on date in 2008.

Cisco and Microsoft are fully committed to supporting these deployment efforts by delivering a complete set of IPv6 solutions to the market and by collaborating with standards bodies such as IETF and other international forums in this area. Both companies are also actively working with US government organizations such as the National IPv6 Task Force, directed by the Secretary of Commerce under the auspices of The President's National Strategy to Secure Cyberspace, to examine the issues around the deployment of IPv6 in the US. Microsoft and Cisco will also work with other industry players.

The electronic consumer industry is also leading the IPv6 effort as demonstrated by Sony Corporation, whose executive vice president, Mario Tokoro, recently stated "All Sony products will be IPv6-enabled in 2005."

### Making the Transition

While IPv6 mass adoption is a few years off, organizations can start today to take small steps and gain familiarity with IPv6. This process has been simplified through the following transition technologies that most equipment manufacturers have built into their products:

- 6to4 for PCs and access routers that have at least one public IPv4 address. 6to4 is typically configured by enterprises and allows tunneling of IPv6 traffic across the open Internet. 6to4 is included with Windows Server 2003, Windows XP SP1 and XP SP2, and Cisco IOS® Software releases.

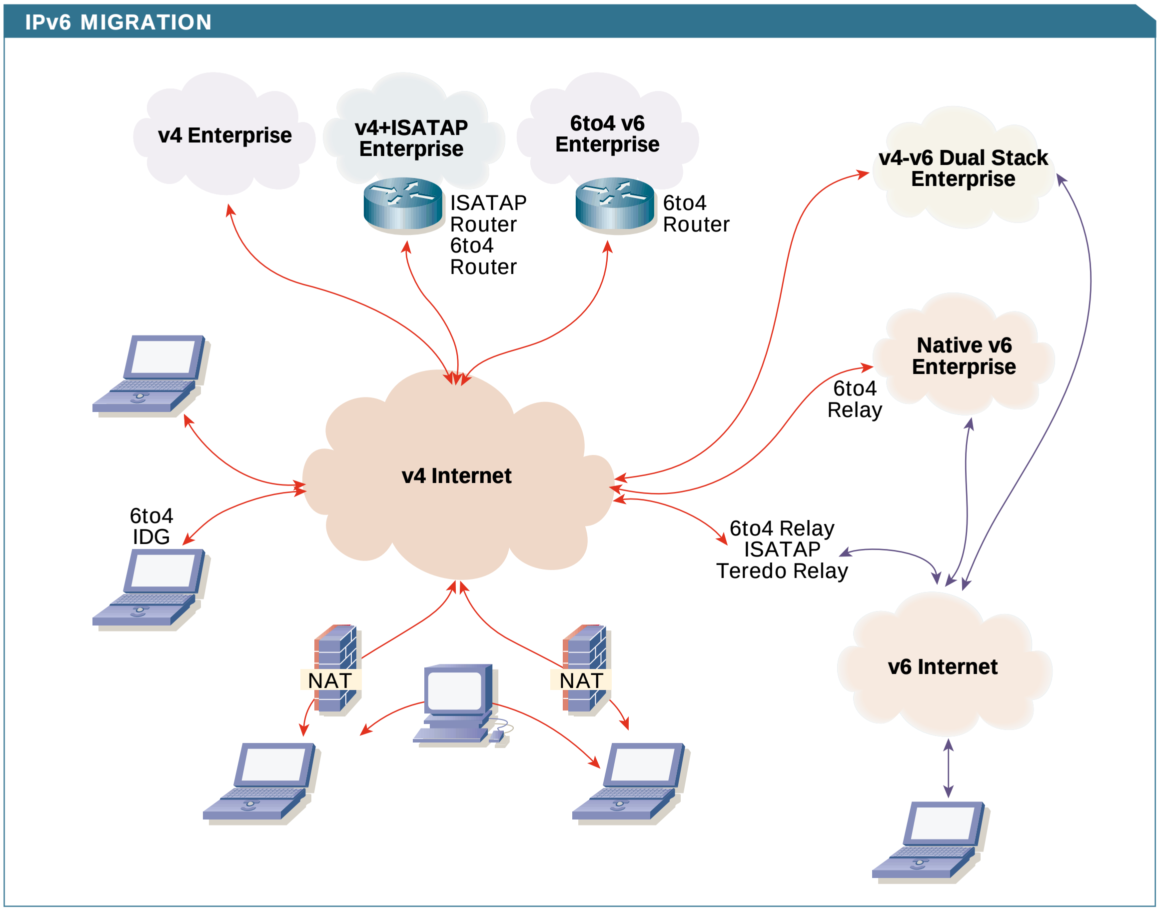
- Teredo for PCs and devices that have private IP addresses, especially in the home. Teredo is a NAT traversal technology that provides tunneling between two hosts when one is behind an IPv4 NAT, and is also used on the open Internet. Microsoft includes Teredo support in The Advanced Networking Pack, a free add-on for Windows XP SP1, and is integrated into Windows XP SP2.

- ISATAP is an enterprise solution for campus networks which tunnels IPv6 packets across an intranet, enabling a smooth deployment of IPv6 devices even when the Layer 3 infrastructure is not yet fully IPv6-ready. Windows .NET server 2003, XP SP1 and XP SP2, and Cisco IOS releases include ISATAP and are fully interoperable.

To enable connectivity across the IPv6 Internet for the above users, many service providers have already deployed 6to4 relays and routers, and Teredo servers and relays into their networks. Deploying transition technologies is an inexpensive and fast way to gain operating experience with IPv6 and enable IPv6 applications with minimal disturbance to the existing network.

For example, a service provider only needs to deploy a Teredo server somewhere on the network to allow consumers who are behind NATs in their homes to begin using IPv6 applications. One example of an IPv6 application is 3Degrees (threedegrees.com), a

**LEIGH HUANG** is an IPv6 Program Manager in Windows Networking and Device Technologies at Microsoft. She holds an MSEE from MIT, and a BSCS from the University of Washington.




**V4/V6 COEXISTENCE STRATEGY** Many transition technologies are now included in vendor's products to enable the migration to IPv6, including ISATAP, Teredo and 6to4. Simple migration can actually begin today at the network edge without requiring costly infrastructure upgrades.

peer-to-peer, collaborative, and file-sharing application. When the 3Degrees application is downloaded to an IPv6-capable Windows XP machine, the application automatically turns on the Windows IPv6 capability—in essence, the machine becomes an island of IPv6. If somebody else also runs the 3Degrees application, these two users can begin to share music files or photos or set up a social group with other 3Degrees users. The main advantage is that the machines are talking peer-to-peer using the unique features of IPv6 to allow real-time control of music sharing between users. And best of all, these users are doing this without requiring any infrastructure upgrade by their service providers.

ISATAP is targeted for enterprise campuses. Hosts running Windows 2003 Server, Windows XP SP1, or XP SP2 with ISATAP can directly communicate using IPv6 even though the overall campus infrastructure is still based on IPv4. Packets from these hosts can then reach the external IPv6 Internet through a Cisco IOS router configured with ISATAP on a tunnel interface.

One of the goals of the Microsoft corporate network is to be an IT showcase for IPv6 deployment. All users have access to IPv6 connectivity. The majority receives IPv6 connectivity through ISATAP servers, while some buildings have routers with dual stack IPv4 and IPv6 capabilities. Microsoft's IT organization is working with industry leaders, such as Cisco, to continue to pilot, deploy, and expand enterprise IPv6 operations.

With these transition technologies, the network does not need to change in order to begin deploying IPv6 applications. In effect, there is not a mutual dependency between network upgrade and application development.

Beyond these transition technologies are more extensive upgrades to the network infrastructure that will come in the near future, including dual stack and native IPv6. Dual IPv4/IPv6 stacks work well with legacy systems and will enable a gradual infrastructure upgrade through normal product lifecycle upgrades.

Native IPv6 offers the highest network capability and end-user benefit, and will provide the most sustainable network over the long term. Though it will require significant upgrades, careful planning will enable a strategic transition of the network and its applications to a viable, long-term infrastructure.

IPv6 stacks are included today in the following Cisco core routers: CRS-1, 12000, and 7600 series, and Layer 3 switches, including the Catalyst 6500, 4500, and 3750 series. Learn more at cisco.com/packet/164_5a2.

### Developer's Perspective

The ease with which users can begin to use IPv6 applications based on transitional technologies mentioned earlier means a market is ready for early developers. As the peer-to-peer model is restored on the Internet, and applications are able to address and identify each device individually, along with the autoconfiguration and mobility features, many new opportunities will become available. Markets such as gaming, mobility, and telematics are only a handful of these potential new opportunities. Telematics, which is the use of a wireless network to support the collection and dissemination of data, will see tremendous growth.

Already, Matsushita Electric Works in Japan is making plans to intelligently control buildings and homes with IPv6. According to Junji Nomura, member of the board and director of new business development at Matsushita, "Toward 2005, Matsushita is developing a new business around device control systems through the network, based on open standards and IPv6. It will be oriented to homes and buildings that have equipment and devices needing ongoing service." In this scenario, customers will plug their IP-addressable refrigerators, washing machines, and other appliances into the network and the service will become available. According to Nomura, this need to address all of these individual devices is why the service will require IPv6.

This scenario suggests that IPv6 will be initially deployed at the edges of the network and will gradually migrate inward toward the core. The combination of deploying transition technologies and migrating applications to be IPv6-capable is the key to getting started. This can be done easily and inexpensively today.

At a minimum, developers should begin by creating IPvX-agnostic applications. As the market and the infrastructure evolve, applications will move into the enterprise space. For those developers wanting to compete in international markets, IPv6 will be a critical capability. ■

**FURTHER READING**

- Cisco IPv6 Website
  cisco.com/ipv6
- Microsoft IPv6 Website
  microsoft.com/ipv6
- IPv6 Transition Technologies white paper
  cisco.com/packet/164_5a1
- IPv6 Style: For people who learn, build, and use IPv6
  www.ipv6style.jp/en/index.shtml