HP & Cisco—Driving Development of Next Generation Internet Protocol focused on enabling IPv6 with Security, Fail Over Features, and Seamless Mobility between Wireless Networks

invent

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The dot-com era may be over, and world economies may be reeling, but the Internet continues to grow by leaps and bounds. One of the most dynamic growth areas is mobile applications. According to an August 2002 report by market researcher IDC, worldwide shipments of mobile telephones and personal digital assistants (PDAs) with digital imaging capabilities will increase to 151 million by 2006.

HP and Cisco Systems, together, are ready to capture these mobility opportunities. The companies formed a strategic global alliance in 1997 to develop end-to-end, network-enabled solutions that leverage both companies' technology leadership in networking, computing, software and services. Continually focused on increasing customer satisfaction and profitability, HP and Cisco are now transforming customers' networks into vital strategic resources by delivering business-critical solutions in network management, IP telephony, wireless & mobility, customer relationship management (CRM) infrastructure and storage.

HP and Cisco are also beginning to collaborate on IPv6, which represents a major advance in the packet messaging protocol of the Internet that integrates the latest IPv4 enhancements such as quality of service (QoS), dynamic fail over features for routers, and security. Mobile computing is greatly optimized in IPv6. Applications that take advantage of these and other advanced IPv6 features run in an IPv6 test environment at HP using Cisco routers and various IPv6 protocols such as mobile IP. The results are a smarter packet for anywhere, anytime, anyway Internet access, high security, and better quality of service. The HP workforce around the world will eventually use IPv6-enabled applications, and the field tests on mobile devices like the iPAQ Pocket PC are laying the groundwork for a new era of always-on mobile connectivity and the end of IP addressing limitations.

Expanded Addressing and Enhanced Mobility

The most talked-about feature in IPv6 is extended address space because the number of addresses in IPv4 (4 billion 32-bit addresses) is running out. Millions of new users in countries such as China and India, and millions of new devices (PDAs, Internet-enabled mobile phones, Internet-connected automobiles) are adding to the address crunch.

IPv6 is a 128-bit addressing system, increasing the address length from 32 bits to 128 bits. With enough IP addresses, every device can have its own permanent address, making network administration and sharing of digital media easier and more widespread.

Another key feature of IPv6 is a more streamlined architecture for mobile IP. Mobile IP is a protocol and network architecture that enables a device to roam on a converged voice/data network like a cell phone.

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The mobile IP network architecture includes a router called a home agent that tunnels datagrams for delivery to the mobile node. The mobile node can discover whether it is on its home network or away from it by using extensions to the Internet Control Message Protocol (ICMP) Router Discovery Protocol. The extensions transmit mobility agent information (for example, network advertisements, solicitations, and responses) that enables this discovery. Routers acting as home agents on the home network tunnel the mobile node's datagrams to it while it is away.

The IPv4 implementation of mobile IP required a router on a remote network to serve as a foreign agent that provided detunneling points for datagrams meant for registered mobile nodes. In mobile IPv6, "there are no foreign agents necessary," explains Yanick Pouffary, Network Technical Directions Leader for OpenVMS at Hewlett-Packard. "The mobile node requires an address while away from home without preexisting infrastructure on the foreign network, so every network is mobile-ready."

When a device on the Internet sends a packet to the mobile node, the home agent redirects it by tunneling to the current location of the mobile node without having to first go through a foreign agent.

EXECUTIVE SUMMARY

BACKGROUND
HP is a leading technology solutions provider for consumers and businesses with market leadership in fault-tolerant servers; UNIX, Linux, and Windows servers; storage solutions; management software; and imaging, printing, and PCs. More than 65,000 professionals worldwide lead the company's IT services team and $4 billion in annual research and development investment fuels the invention of products, solutions, and new technologies to better serve customers and enter new markets.

CHALLENGE
Engineers from HP and the former Compaq have participated in the development of IPv6 since its inception within the IETF in the mid-1990s. A test environment was sought to begin looking at IPv6 features both for HP enterprise users and for customers using HP products.

CISCO SOLUTION
A demonstration of mobile IPv6 features using an iPAQ Pocket PC and an IPv6 test environment looking at various other enterprise applications was created with the help of Cisco Systems. The network infrastructure includes Cisco routers, switches, and wireless access points on campuses running IPv6 protocol extensions to Cisco IOS Software.

RESULTS
The collaborative results have led to a greater appreciation of the features and benefits of IPv6 among Cisco and HP engineers, sales and marketing representatives, and customers worldwide. In 2002, hundreds of users are beta testing the benefits of always-on voice, data, and Web connectivity for iPAQs through mobile IPv6. A corporate test environment at HP is deploying and testing QoS, router failover features, expanded addressing, and other IPv6-enabled features in the company's campuses internationally with great success.

Working Toward Greater IPv6 Adoption

After the merger, teams of network engineers from HP and Compaq aligned their efforts in IPv6 testing and development. Both companies have been working on IPv6 since its inception within the Internet Engineering Task Force (IETF) in the mid-1990s. As a key partner in HP's IPv6 program, Cisco has provided the routers, switches, and support for test networks with the IPv6 features running via existing and expanded versions of Cisco IOS© Software.

An IPv6 mobile demo designed in 2001 features the iPAQ Pocket PC connected to a mobile IP architecture of Cisco routers running the Cisco IOS Software mobile IPv6 home agent extension (currently available for test environments only). Cisco wireless access points provide wireless access to the Internet, e-mail, and other applications running on HP AlphaServers, and more recently, also on HP-UX servers. Attendees at trade shows like Networld+Interop and network architects from Japan's telecommunications giant NTT Do-Co-Mo, France Telecom, and the U.S. Department of Defense have been among those to see the mobile iPAQ demo.

"HP joined Cisco in designing and presenting these demos because we both want to show that IPv6 and mobile IP work extremely well," says Pouffary. "The migration to IPv6 will be gradual and may occur application by application. So we are also demonstrating how enterprises can run IPv4 and IPv6 concurrently."

Hundreds of iPAQs running mobile IPv6 are in use by beta testers worldwide. The applications should be available to consumers by late 2003. "The wireless markets are huge," says Jim Bound. "To do global roaming and roam across networks without needing to reconnect requires IPv6 and mobile IP. IPv4 simply does not have enough address space to scale as forecasted. We need peer-to-peer capabilities without going through a lot of network translation."

Deploying IPv6-Based Applications in the Corporate Enterprise

"I'd been tracking the IPv6 technology since 1998," says Steve Froelich, Network Architect at Hewlett-Packard in Corvallis, Oregon, who wrote a proposal in 2001 to launch a modest test environment for IPv6. "My focus is to explore large-scale deployment in an enterprise setting like HP. We built our test bed outside of the corporate firewall to have an easier engagement with universities and others that are part of the global 6bone network." The 6bone is an experimental IPv6 test network set up by a global consortium of governments, universities, and corporations. It allows testing of IPv6 applications in an environment of various platforms and applications.

The HP IPv6 test environment uses Cisco 7500 and 7200 Series routers in seven offices-five in the United States, one in England, and one in France-with other locations coming online soon. All run experimental IPv6 extensions of Cisco IOS Software protocols. United States WAN connections are T1 lines and the European locations are connected to the test network via IPv4 tunnels. Currently, HP can send IPv6 packets within IPv4 packets through the public Internet, which isn't IPv6 aware. "This is the way most IPv6 traffic is traveling today," says Froelich.

The HP team is looking at infrastructure issues related to IPv6 such as its scalability, management, router failover, QoS support with network prioritization and reservation, and its end-to-end encryption features at the network layer.

"Right now we're in an IPv4 ocean and there are IPv6 islands out here that are getting bigger and bigger," says Froelich. "IPv6 will be built at the edges and will grow from there."

HP has implemented Routing Information Protocol (RIP) in IPv6, which uses hop count as a routing metric, and multiprotocol extensions to Border Gateway Protocol (MP-BGP4), thepredominant interdomain routing protocol used on the Internet that uses route aggregation mechanisms to reduce the size of routing tables, on its IPv6 network. Next is the implementation of IPsec over IPv6 for enhanced end-to-end security features. Dynamic failover routing is another area of interest made possible with IPv6. The team is also going to test applications on the Itanium Processor Family (IPF) servers using HP-UX, Microsoft Windows XP, FreeBSD and Linux operating systems.

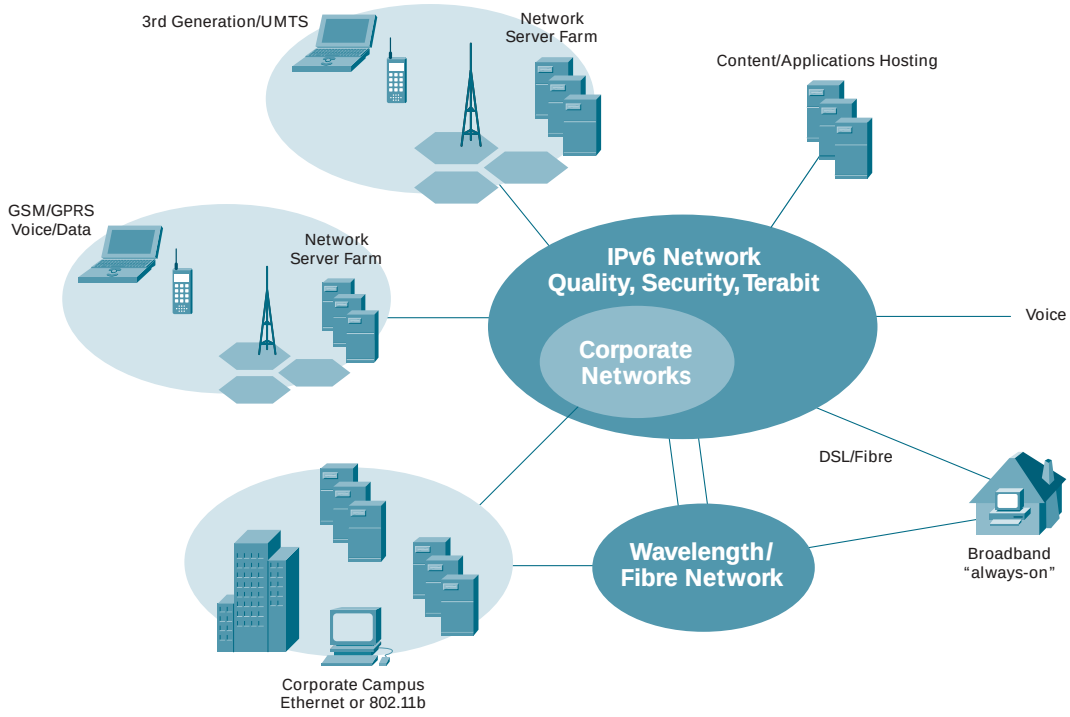
The test network is running Web, e-mail, instant messaging, and short message service applications for mobile devices on campuses. A next step will be to deploy mobile IP, giving HP users always-on connectivity even when off campus.

Common Interests in the Growth of IPv6

"Both of our companies are looking at IPv6 as one of the most important technologies for the development of the Internet," says Patrick Grossetete, Product Manager for IPv6 in Cisco's Internet Technology group. "By working with HP, we can learn what the real customer needs are, how the technology can best be deployed, and see what features might be missing." For example, HP OpenView provides important network management features alongside the Cisco IOS Software for IPv6. "We're doing our best to track IPv6 interest around the world," says Froelich. "Asian-Pacific countries are expressing more interest than anyone else due to the exhaustion of addresses. In Europe mobility is a big driver. There's a thirst for a data-based network rather than a voice-based network to serve these devices."

"We can expect the rollout of IPv6 to occur first in regional IPv6 networks," believes Pouffary. "These networks will be deployed to launch new subscriber services and to gain competitive advantages. They will interoperate with national and international IPv4 networks, assuring global, end-to-end service delivery. In time, the entire national and global IPv4 infrastructure will migrate to the superior features of IPv6."

Figure 1. IPv6—the Transport for Wireless Networks.



IPv6 is key technology for mobility

- Across disparate access networks
- Within IP-based netowrks
- Each user device needs an IP address

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