ISOC MEMBER BRIEFING #4

IPv6 Deployment

September 2001

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BACKGROUND

IPv6 infrastructure can and is being deployed today in the market on Intranets and at the access points on the edge of the Internet. Deployment is in the initial stage, and users can begin to use vendor production IPv6 implementations that began shipping in 2000. IPv6 implementations now exist for router, server, and client products. These can be used to begin the infrastructure deployment and interoperation with IPv4 infrastructure components and on IPv4 Intranets.

What does it mean to deploy an IPv6 infrastructure? This means that today end users can begin to use the IPv6 capabilities from vendors who provide IPv6 within their Internet Protocol stack to create their own products. Users can begin to use IPv6 in conjunction with IPv4 on Local Area Networks (LANs) within their Intranet enterprise. Users can also develop functional IPv6 LANs and can communicate between those LANs using either native IPv6 forwarding or IPv6 tunneled within IPv4 across their Intranet. Most common Internet applications can run over IPv6 (e.g. Telnet, FTP, Web Server/Browser, Mail, DNS) and the common system administration utilities for IPv6 can be used (e.g. Router Configuration, Adapter Configuration) so users can begin using IPv6 on a production basis today.

IPv6 test beds have existed since 1996, and are all interconnected via the 6bone project that provides worldwide IPv6 inter-connectivity among pre- and early production test networks (*http://www.6bone.net/*). Vendors began working on IPv6 implementations in 1995, and in 2000 many vendors began shipping production quality IPv6 within their products and several vendors delivered IPv6 production IP stacks even before 2000.

The first stage of IPv6 deployment is happening now by early adopters and those who have a need for the advantages of IPv6 now. Additional stages will evolve over time.

TECHNICAL ISSUES

IPv6 packets will be tunneled across the IPv4 edge and core using the base transition mechanism (RFC 2893) at first, which are configured IPv6 over IPv4 tunnels. In 2002 more elegant transition mechanisms will begin to appear in the next production releases of IPv6 products. These additional mechanisms will permit more automated procedures for moving packets across the IPv4 edge and core using tunnels to move IPv6 packets end-2-end between enterprise organizations and applications.

This initial IPv6 infrastructure will also be used for markets that will require IPv6 because of the lack of IPv4 address space and that will

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In-depth articles, papers, links and other resources related to this topic are available from the ISOC website at *http://www.isoc.org/briefings/004/.*

Examples in the News

Internet Service Providers Begin IPv6 Implementation
A number of ISPs have begun implementations of IPv6. These include NTTv6Net, IJJ, Skanova - Telia and Zama.

Relevant IETF RFCs/Actions

The base IPv6 specifications supported at this time are as follows:

- RFC 2460: *Internet Protocol, Version 6 (IPv6) Specification*
- RFC 2461: *Neighbor Discovery for IP Version 6 (IPv6)*
- RFC 2462: *IPv6 Stateless Address Configuration*
- RFC 2463: *Internet Control Message Protocol (ICMPv6), for IP Version 6 (IPv6)*
- RFC 1981: *Path MTU Discovery for IP Version 6 (IPv6)*
- RFC 2893: *Transition Mechanisms for IPv6 Hosts and Routers*

In addition to the these base specifications, many other IETF specifications are supported. Consult your vendor to determine what is supported in addition to the base specifications.

The IETF and IEEE have also ratified a *Basic IPv6 API* (RFC 2553), which can be used to begin porting enterprise applications to IPv6 so that they can interoperate with IPv6 and work with the DNS name space for both IPv4 and IPv6. This specification is undergoing final editing and clarifications in 2001, but the base function primitives can be used now to port applications to IPv6. Consult your vendors to obtain porting guides and tools available using the Basic IPv6 API.

About the Background Paper Series

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want end-to-end computing. Wireless and Telephony will be one of the first early adopters of IPv6 for specific parts of their system where the IPv6 address space permits that business model to evolve (e.g. 3GGP, 3GGP2, 802.11 NTT DOCOMO, SS7-to-IP). Other government and enterprise markets will use IPv6 to provide end-to-end transparency (e.g. Military, Internet Cafe's, Banking Services, Distributed Manufacturing) and can begin IPv6 deployment of the essential infrastructure provided by current vendor products today.

As the industry today still works on extending IPv4 in the IETF, IPv6 will continue to evolve and be worked on by the Internet engineering community in the IETF to enhance and add value to the set of base IPv6 specifications and the transition mechanisms to provide the interoperation of IPv4 and IPv6, and in some cases migration to IPv6 completely.

IMPLICATIONS

Different geographies will evolve at different rates. For example, because Europe and Asia have less IPv4 address space than North America, their need to evolve to the abundance of IPv6 address space is more time critical. North America appears to be very slow with their need to deploy IPv6 than those markets. But, the enterprise and telephony markets will require IPv6 for end-to-end transparency even in North America. For example, when the children want to play peer-to- peer games on their Sony PlayStations over the Internet and to use IP layer security end-to-end, they cannot do that on a wide scale in any geography with the current IPv4 address space conservation and limitations. Likewise, if a Telecommunications vendor wants to deploy 2 billion IP addressable phones or gaming devices, IPv4 simply will not work.

The deployment momentum is also adaptable to the IETF evolution working on IPv6. For example, it is imperative that IPv6 resolve the issues concerning multi-homed nodes (node has two ISP connections) to provide prudent aggregation of the Internet routing infrastructure. IPv4 has the same problem, but the problem with the larger IPv6 address space is compounded. The IETF is working on that problem set now.

Even after this first stage of IPv6 infrastructure deployment, when IPv6 could be moved to the edge of the Internet, the IPv4 core will still be used as a tunnel. The rate of IPv6 deployment thus far appears to be in concert with IETF rate of specifications to reach vendor product implementation synchronization for IPv6 deployment.

Users and organizations can begin deployment of an initial IPv6 infrastructure to begin the IPv6 deployment evolution, and the IETF continues to extend, enhance, and evolve the set of IPv6 specifications. Even if a user is not planning to deploy IPv6 immediately, requesting the support of both IPv4 and IPv6 stacks in future products, is a good strategy to be prepared for tomorrow.

For More Information

IPv6 Deployment Research Projects
- 6INIT: *http://www.6init.org*
- 6WINIT: *http://www.6winit.org*

IPv6 Vendor Implementations
- IPv6 Forum: *http://www.ipv6forum.com/*
- Compaq: *http://www.compaq.com/ipv6/*

IPv6 Interoperability Initiatives
- Connectathon: *http://www.connectathon.org/*
- ETSI: *http://www.etsi.org/*
- TAHI: *http://www.tahi.org/*
- IPv6 Stack at Wide Project: *http://www.wide.net*
- IPv6 Tunneling-Viagenie: *http://www.viagenie.ca*

Related Organizations

- Internet Engineering Task Force (IETF)
http://www.ietf.org/
- IPv6 Forum
http://www.ipv6forum.com/
- IPv6 Information Center
http://www.ipv6.org/

About the Author

Jim Bound is a Compaq Fellow and the Network Technical Director within the UNIX Systems Business Unit at Compaq Computer Corporation. Jim was a member of the Internet Protocol Next Generation (IPng) Directorate within the Internet Engineering Task Force (IETF), which selected IPv6, among several proposals, to become the basis of the IETF's work on an IPng in 1994. Jim has been a key designer and implementer of IPv6 and contributor to most core IPv6 specifications. Jim is also a co-author of several Internet specifications and works in progress regarding the interoperation of IPv4 and IPv6 for deployment. Jim founded the ad-hoc IPv6 Deployment Group, which became the IPv6 Forum, where Jim is now Chair of the Technical Directorate. Jim in July 2001 received from the IPv6 Forum the Internet IPv6 Pioneer Award as the IPv6 Forums "Lead Plumber"

Acknowledgements

This paper produced with editorial support from the IPv6 Forum. The ISOC Member Briefing series is made possible through the generous assistance of ISOC's Platinum Program Sponsors: APNIC, ARIN, Cisco Systems, IBM, Microsoft, Nortel Networks, Ripe NCC, and Softcomca.com. For more information: *http://www.isoc.org/isoc/membership/platinum.shtml.*