The Navy's Transition to IPv6

By Mark Evans

One of the more significant evolutions in the history of the Internet is upon us. Internet Protocol version 4 (IPv4), the standard upon which the Internet has operated for the last 20 years, is running out of addresses. Several work-arounds have been implemented in the past few years which enabled the Internet to continue to function. While experts do not agree on the time remaining prior to exhausting the pool of IPv4 addresses, most indications are that it is less than a decade.

The next generation Internet Protocol, IPv6, will solve the address shortage by providing an almost incomprehensible number of IP addresses. Unlike the original implementation; however, there are now millions using the Internet every day. This has prompted some to say that changing protocols now is like changing the engine in a moving airplane. The Department of Defense, a core Internet user, is leading the effort to enable a smooth and timely transition.

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The Assistant Secretary of Defense for Networks and Information Integration (ASD NII) established a Department goal for transitioning all enterprise-wide networks from IPv4 to IPv6 by FY 2008. ASD NII directed that beginning Oct. 1, 2003, all assets developed, procured or acquired shall be IPv6 capable in addition to maintaining interoperability with IPv4 systems/capabilities. In response to the DoD directive, Chief of Naval Operations, Navy Information Office (NIO) designated OPNAV N6F and N61 to lead Navy IPv6 transition plan development. OPNAV in turn delegated the Space and Naval Warfare Systems Command 057A as the designated IPv6 transition technical lead.

Introduction to IPv6

IPv4 uses a 32-bit/4-octet addressing scheme. It's stability and simplicity have been the catalysts of the Internet explosion. IPv4 was originally implemented on ARPANET, a network collaboration of U.S. universities and research centers, funded mainly by the federal government. The designers could not have foreseen the global Internet expansion, and as a result, IPv4 suffers from some serious deficiencies that are driving it to obsolescence.

Available IPv4 address space continues to be depleted and now must be very carefully allocated. These shortages have been partially mitigated through Network Address Translation (NAT) and Classless Interdomain Routing (CIDR). NAT is in widespread use but it is inflexible, often presents a single point of failure and

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prevents, in most cases, the deployment of new peer-to-peer Web-based applications such as gaming and collaboration.

The global demand for more unique IP addresses prompted the Internet Engineering Task Force (IETF) to develop a more robust addressing scheme, IPv6. IPv6 increases addressing availability several orders of magnitude along with other optimizations and improvements. These are summarized below.

Larger Address Space: 128-bit addresses ensure a virtually inexhaustible supply.

Streamlined Routing: The IPv6 header, while larger, is also less complex, which allows route aggregation (simplified hierarchical routing), dramatically reducing the size of routing tables and improving router performance.

Multicast Support: IPv6 inherently supports multicast.

Mobility: Provides an improved version of Mobile IP, which allows mobile nodes to connect to the network at different locations without disrupting communications.

Quality of Service: Although implementation details are yet to be resolved, the IP header includes fields to support real-time and priority traffic.

Auto-configuration: IP addresses and other network-related parameters can be configured automatically.

Native IP Security: All IPv6 implementations must support the IP security features.

The Transition to IPv6

Once the domain of researchers and the government, the Internet is now a well-established commercial entity. Its exact size and configuration are unknown and constantly changing. There is no single controlling authority, and DoD represents only a percentage of the global Internet constituency. Transition to a new underlying protocol will require substantial time, effort, and in some cases, new hardware.

It is predicted that the IPv4 address shortage will become critical by 2010. This presents a reasonable time frame for a gradual

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transition to IPv6. During the transition phase, a hybrid environment comprised of both IPv4 and IPv6 addressing will be fully supported, an approach supported by industry and DoD. Transitional mechanisms, such as tunneling, will exist to ensure connectivity for all programs, although in doing so some of the enhanced features of IPv6 may not be fully utilized.

While some programs may not transition to IPv6, such as those nearing the end of their life cycle, most infrastructures, systems and applications will be affected. To plan adequately for transition, major assessments will need to be made with regard to engineering; procurement; information assurance; test and certification; and deployment.

IPv6 promises a substantial payoff. IPv6 will be an enabling technology of network-centric operations and warfare that will include: mobile platforms; networked sensors; unmanned systems; unmanned aerial vehicles; space systems; and reach-back to logistics bases, facilities, people and information. IPv6 native security will add another layer to the Defense-in-Depth approach to network information assurance. Quality of Service (QoS) features inherent in IPv6 will enhance traffic engineering to an extent not possible with IPv4.

The Navy's IPv6 Transition Plan envisions the evolution of the Navy's institutional and operational networks into one network-centric entity, improving access to the warfighter knowledge base and institutional support systems that will enhance interoperability; mobility; security; reliability; scalability; and assured information integrity.

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For further information on Navy IPv6 transition, please contact navyipv6@navy.mil or visit https://c4isr.spawar.navy.mil/ipv6/.

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