XO Communications

White Paper:

UNDERSTANDING THE TRANSITION TO IPV6

Share:

www.xo.com/follow

connect / communicate / manage / protect / optimize

Understanding the Transition to IPv6

Contents

Our readiness:

XO Communications is ready and able to support the transition from IPv4 to IPv6. XO IPv6 is delivered via standards- based RFC 4798 (6PE) technology. Our network is peered with other major ISPs that have accepted their role in supporting IPv6 and many of our clients presently use IPv6 addressing across the XO network as a dual stack arrangement with IPv4.

IPv6 – A Transition from Existing Network Addressing

The basics of IPv6 are similar to those of IPv4 -- devices can use IPv6 as source and destination addresses to pass packets over a network, and tools like ping work for network testing as they do in IPv4, with some slight variations.

IPv6 Supports source and destination addresses that are 128 bits to provide more address space that can be used more flexibly and effectively.

The general format for a global IPv6 unicast address is comprised of 3 elements:
A Global Routing Prefix + Subnet ID + Interface ID within the 128 bits used for IPv6.
The IPv6 Interface ID is used to identify interfaces on a link, and is required to be unique within a subnet prefix.

The five Regional Internet Registries (ARIN, APNIC, etc) will move toward issuing “titles” to IPv4 and IPv6 address space rather than allocating blocks. ARIN is currently developing an open source package for x.509 certification of resource ownership to facilitate this change.

What IPv6 provides:

1. Reduces time, management & complexity associated with IP Configuration Practices.

- Reduces size and complexity of core Internet Global routing tables with fixed IPv6 header sizes. “Speeds up” Internet processing.
- “Stateless Auto Configuration”- Does not require static IP configuration or the use of DHCP. Combines LAN MAC Address with a prefix provided by the ISP network router.
- When changing ISP’s – ability to change your router configuration to your new global routing prefix and the network renumbering is automated via new feature functionality.
- Uses ICMPv6 Router Solicitation and Router Advertisement messages to determine the IP address of the best default gateway.

2. Re-establish transparency and end to end QoS shaped traffic on the Internet

- Uses Flow Label field to identify packet flow for QoS handling by the router.
- QoS supports DiffServ (like IPv4) but adds a new 20 bit traffic flow field (not yet fully defined for use but is being pursued).

3. Improved Security

- New IPSec Security Protocols inherit to IPv6. ESP (Encapsulating Security Protocol) and AH (Authoritive Header) accommodated.
- NAT is no longer necessary since a public IP is not directly associated with a network device.

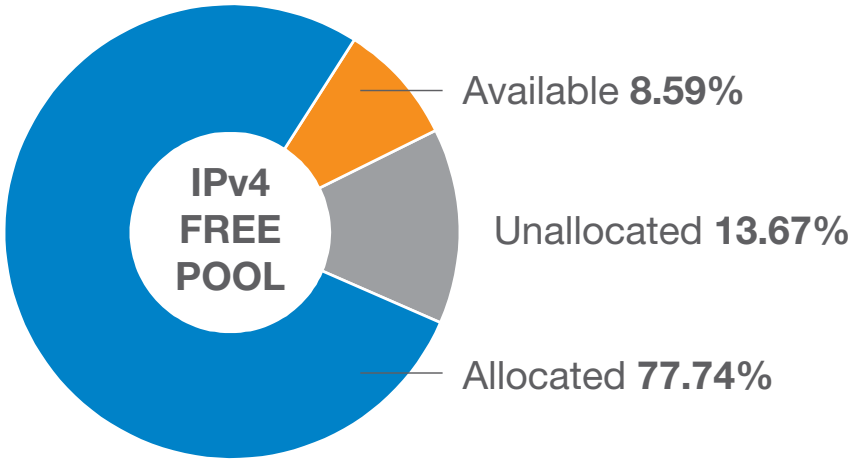
4. Improved Multicasting Functionality on all IPv6 Platforms.

- Uses Multicast Neighbor Solicitation messages to resolve IP addresses to link-layer addresses. IPv6 does not include a checksum in the header.
- Uses Multicast Listener Discovery (MLD) messages to manage membership in local subnet groups.
- “Anycast” – Like multicast, anycast has groups of nodes which both send & receive packets. However, when a packet is sent to an IPv6 Anycast group, it’s only delivered to one of the members. This is helpful for fault tolerant environments like web servers and DNS servers.
- Improve Functionality for Cellular and other mobile nodes. With IPv4, all packets from a mobile device will always go thru its home network regardless of the service it is connected to, creating huge bottlenecks.
    1. MIPv6 - While roaming, a mobile device can now roam without losing TCP connections. The home network holds the device’s TCP connection while roaming on another provider’s network.
    2. An IPv6 mobile node can now connect to a service in a remote network allowing packets to be routed directly by using extension headers. Requires a few initial packets to go to the home agent to optimize the route.

IPv4 Address Depletion

As of February 2010 the available IPv4 addresses were shown as displayed below. With the rate of depletion estimated by ARIN and other authoritive groups, the IPv4 address pool will be exhausted by the end of 2011.

The unallocated space is the IP Address space that will be made available to the 5 Regional Internet Registries (ARIN, APNIC, etc) in 2011. Total depletion from the Internet Assigned Numbers Authority (IANA) is expected in late 2011. The end of ARIN distribution is estimated to occur in early 2012.



- American Registry for Internet Numbers (ARIN) – North America
- Latin American and Caribbean Internet Address Registry (LACNIC) - Latin America and South America
- Réseaux IP Européens (RIPE) – Europe
- Asia Pacific Network Information Centre (APNIC) – Asia Pacific
- The Registry of Internet Number Resources for Africa (AFRINIC) – Africa

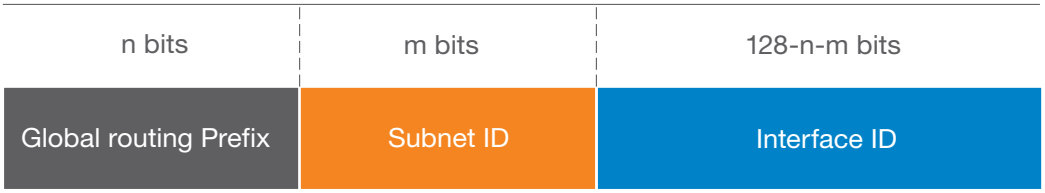
Comparing IPv4 and IPv6

There are approximately 14 billion hosts on the Internet today with IPv4 addresses. Adding this many IPv6 addresses at the individual host level is a daunting task and will take a great deal of time to accomplish. So transitions to IPv6 may go on for years to come.

Adoption of IPv6 by ISPs will need to be completed between 2010 and 2012 as the migration from IPv4 assignments to IPv6 IP assignments by registered authorities is inevitable.

	Internet Protocol version 4 (IPv4)	Internet Protocol version 6 (IPv6)
Address Size	32-bit number	128-bit number
Address Format	Dotted Decimal Notation: 192.149.252.76	Hexadecimal Notation: 3FFE:F200:0234:AB00: 0123:4567:8901:ABCD
Prefix Notation	192.149.0.0/24	3FFE:F200:0234::/48
Number of Addresses	232 = 4,294,967,296	2128 = 340,282,366,920, 938,463,463,374,607,431, 768,211,456

IPv6 Address Format



IPv6 DNS Comment

- Forward (name to address) records are now called AAAA (Quad-A) records in IPv6 versus A records for IPv4
  - » Name Server Address Records in the zone file should list the Top Level Domain* or "TLD" (i.e. google.com) on both the IPv4 "A" record and the IPv6 "AAAA" records. Both records need to be on the same delegated Name Server and "glued" to ensure proper routing between networks. And example is www.google.com to www.googlev6.com and vice versa.
    - – *Domains aren't specific to IPv4/IPv6. Both IPv4 & IPv6 records can exist in the same domain. The domain only acts as a placeholder for records to exist.
  - » The Reverse Record (PTR) has a different format for IPv6. XO caching servers can support IPv6 PTRs today and the IPv6 authoritative name servers will be available in 4Q2011.

Quick Guide – IPv6 Addressing

Some important subnets are:

- CIDR/32 = everything above this has a corresponding IPv4 and IPv6 subnet
- CIDR/64 = /64 is minimum for stateless auto-configuration. Also, some vendors have hard coded routers to only accept a /64.
  - » XO can provide this space allocation for customer LAN (if needed)
- CIDR/48 = Client must provide this or XO will provide (/64 is the standard LAN block assignment.)
- 2000::/3 address space are global unicast addresses
- Loopback Address is 0:0:0:0:0:0:0:1 or ::1

Important Facts for XO Customer Activations

- XO has been assigned an IPv6 block by ARIN: 2610:18::/32, from which XO can delegate customer blocks
- Only one ASN is required for either IPv4 or IPv6, and the same ASN can be used for both. XO requires separate IPv4 and IPv6 BGP sessions.
- ARIN is providing a 4-Byte ASN presently
  - » XO will work with clients on 4-Byte & 2-Byte ASN translations (New_AS_Path) as needed
- IPv6 automation for activations is a work in progress with a solution date of 4Q2011.
- There is no XO IPv6 Transport Network at this time as XO is presently supporting Dual Stack only.
- XO Customer Care Repair is able to receive IPv6 specific traps received via IPv4 transport; additional enhancements are being added to support systems to log IPv6 repair tickets and to track for troubleshooting.

XO Communications

About XO Communications

XO Communications is a leading nationwide provider of advanced broadband communications services and solutions for businesses, enterprises, government, carriers and service providers. Its customers include more than half of the Fortune 500, in addition to leading cable companies, carriers, content providers and mobile network operators. Utilizing its unique combination of high-capacity nationwide and metro networks and broadband wireless capabilities, XO Communications offers customers a broad range of managed voice, data and IP services with proven performance, scalability and value in more than 75 metropolitan markets across the United States. For more information, visit www.xo.com.

For XO updates, follow us on: Twitter | Facebook | Linkedin | SlideShare | YouTube | Flickr