IPv6: Preserve, Prepare, Prosper

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Agenda

Understand Why IPv6 Matters Now
Internet Evolution
IPv6 impact on customers

IPv6 Planning
Make a plan:
Preserve, Prepare, Prosper

Enterprise Designs
Internet Presence
Campus, Wan and Branch
We Finally Ran Out.
Exhaustion continues

http://www.potaroo.net/tools/ipv4/rir.jpg

Registry Exhaustion Dates

April 2011
Implications of pool exhaustion – cascading effect

Despite the wide-scale deployment of NAT, the consumption of the IPv4 pool continues at an accelerating rate.

When IANA runs out, existing IPv4 networks still work.
   The only ones that will be immediately impacted are the RIRs when they come back for more space.

When any RIR runs out, existing IPv4 networks still work.
   The only ones that will be immediately impacted are the LIR/ISP/Enterprise’s when they come back for more space.

When the LIR/ISP runs out, existing IPv4 networks still work.
   The only ones that will be immediately impacted are the people looking for more or new space.

Any specific network will only need IPv6 when they attempt to talk to someone that was unable to acquire enough IPv4 space, or attempt to expand or add new applications and find themselves unable to get enough IPv4 space.
Do we need to move to IPv6

Most common statements

• “I already have enough IPv4 addresses”
• “No content providers are moving to IPv6”
• “We can use NAT/PAT to extend the life of our IPv4 space”
Changing Conversations

With operating systems supporting IPv6 and having it preferred conversations are changing

Used to be:

- “Do we need IPv6? Why worry about it?”
- “But the U.S. isn’t deploying!”

Now I hear:

- “Why is my ping time longer?” …
- … “Because you get different routing with IPv6.”
- … “Actually, mine is shorter.”

ISP perspectives

- “What’s the point?” and “Where’s the money?” have shifted to quiet deployment in trial networks and some backbones.
Current State of IPv6

General perception is that “IPv6 has not yet taken hold”
- IPv4 Address run-out has now made it into “headline news”
- More discussions and run-out plans proposed

Private sector still demanding a business case to “migrate”
- No easy Return on Investment (RoI) computation

But reality is very different from perception!
I have enough IPv4 addresses

Is your OS Dual Stack with Enabled IPv6 by Default?

Your host:
- IPv4 is protected by your favorite personal firewall...
- IPv6 is enabled by default (Vista, Linux, Mac OS/X, ...)

Your network:
- Does not run IPv6

Your assumption:
- I’m safe

Reality
- You are not safe
- Attacker sends Router Advertisements
- Your host configures silently to IPv6
- You are now under IPv6 attack

*Probably time to think about IPv6 in your network*
Some Address Exhaustion Solutions

“Microsoft found that 1 second delay in page loads resulted in a 2.8% drop in revenue per use “ *

“Smartphone” device growth

Mobile device churn rate is high, full turnover in less than 3 years

Opportunity: over 3 Billion IPv6 capable mobile devices by 2014

Key Milestones: 4G is IPv6 by default, 3G (Rel9) enable dual stack

Western Europe
211M 3.5G, 26M 4G

US/Canada
187M 3.5G, 26M 4G

Source: Alain Fiocco, Cisco. IDC
Enterprise Drivers
Failure to Act Will Impact Business

Timing of Globalization and IPv4/IPv6 Co-existence

IPv6 Government Mandate Deadlines

Transition Planning

Early Adopters

Globalization

2010: Low Impact – Buying behavior shift limited to mandated and early adopter sites

2012: Moderate Risk

2014: High Risk

Internet Evolution – Business continuity for customer and employee services

Government Mandates – Must purchase IPv6 capable product and services

Business Advantage – First movers capture new revenue or operational gains

IPv6 Business Impact – The Cost of Waiting Goes Up

Low Risk

Moderate Risk

High Risk
IPv6 Adoption – Customer Momentum
Adoption strategy

Preserve, Prepare, Prosper
IPv6 Motivation

Customer Type or Driver

<table>
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<tr>
<th>Government</th>
<th>Disposition</th>
<th>Reasons For Action</th>
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<tbody>
<tr>
<td>Mandated</td>
<td>Regulations Guide Purchasing</td>
<td>National competitiveness, citizen-facing service availability drives action</td>
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<tr>
<td>Motivated</td>
<td>Customers Need IPv6 Access</td>
<td>Globalization, user-provided devices drives investment, address exhaustion</td>
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<tr>
<td>Early Adopter</td>
<td>IPv4 Address Exhaustion</td>
<td>Address exhaustion, competitive differentiation, opportunistic use of IPv6 to solve challenges</td>
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<tr>
<td>Mainstream</td>
<td>Internet Evolution to IPv6</td>
<td>Investment protection paramount, customer reach and visibility concerns</td>
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Public Sector

IT Consumerization, Service Providers

Smart Grid, Mobile Computing

Many Large Enterprises, Small/Medium Business
Managing an Orderly IPv6 Transition

IPv6 Is Not a Rip-and-Replace Proposition

Preserve

\textit{Preserve the customer’s existing investment}
- Audit and leverage existing IPv6 capabilities

Prepare

\textit{Prepare a migration and deployment plan}
- Identify and enable critical IPv6 functional areas

Prosper

\textit{Prosper through the transition to IPv6 Internet}
- Enable all systems with dual-stack capabilities
- Grow seamlessly as customers transition to IPv6

IPv6 is the foundation of a lifecycle management discussion
Enterprise Design and Deployment
Enterprise Deployment

Planning & Deployment
Summary

Outside First: Internet
Edge Deployment

Inside First: Campus, WAN and Branch
A Phased, Iterative Approach to Successful IPv6 Adoption
Start with a Phased Plan Aligned with Your Business Strategy

1. Identify the highest priority IPv6-critical areas in your network
2. Perform IPv6 Assessment on high priority areas to determine scope
3. Develop a design that enables IPv6 without disrupting your IPv4 network
4. Test and implement in pilot mode, then extend over time into production

Repeat for the Next IPv6-Critical Area in Your Network
## IPv6 Integration Outline

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<th>Pre-Deployment Phases</th>
<th>Deployment Phases</th>
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<td>• Establish the network starting point</td>
<td>• Transport considerations for integration</td>
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<td>• Importance of a network assessment and available tools</td>
<td>• Internet Edge (ISP, Apps)</td>
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<tr>
<td>• Build a pilot or lab environment</td>
<td>• Campus IPv6 integration options</td>
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<tr>
<td>• Obtain addressing or use ULA or documentation prefix (in lab)</td>
<td>• Data Center integration options</td>
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<tr>
<td>• Learn the basics (DNS, routing changes, address assignment)</td>
<td>• WAN IPv6 integration options</td>
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<td>• Execute on gaps found in assessment</td>
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Where do I start?

Based on Timeframe/Use case
Internet Edge – Business continuity
Core-to-Edge – Fewer things to touch
Edge-to-Core – Challenging but doable
IPv6 Co-existence Solutions

Dual Stack
Recommended Enterprise Co-existence strategy

Tunneling Services
Connect Islands of IPv6 or IPv4

Translation Services
Connect to the IPv6 community

Business Partners
Government Agencies
International Sites
Remote Workers
Internet consumers
Internet Edge - to – ISP
Many options

ISP’s that “support IPv6” have varying levels of support
• Many ISP’s that now have dual stack services cannot yet deliver traffic to all IPv6 endpoints
• SLA’s may or may not be equivalent to IPv4

ISP-ISP Filtering Policies for IPv6 not yet consistent
• Still some uncertainty around “safe” prefix length advertisement

See notes for questions to ask your service provider
IPv6

ETR/ ITR CE

LISP encapsulated

SP LISP infrastructure

MR

MS

Internet IPv4

IPv6

ETR/ ITR CE

IPv6

IPv6

Subscribers

Provider

Subscribers

LISP is an alternative to connect islands of IPv6 network over IPv4 network infrastructure.

No change to existing IPv4-based access infrastructure, allow to transport IPv6 over existing IPv4 architecture (Broadband, cable, Mobile …)

Service components:

- Managed CE router at customer premise: performing ITR/ETR function
- SP infrastructure component: hosted Map Resolver, Map Servers
LISP Use Cases
IPv6 Migration Support

Needs:
- Rapid IPv6 Deployment
- Minimal Infrastructure disruption

LISP Solution:
- LISP encapsulation is Address Family agnostic
  - IPv6 interconnected over IPv4 core
  - IPv4 interconnected over IPv6 core

Benefits:
- Accelerated IPv6 adoption
- Minimal added configurations
- No core network changes
- Can be used as a transitional or permanent solution
An enterprise with a critical Internet presence, should perform their own dual-stacking or translation. Others may outsource to a business partner or rely on a downstream provider.
Enterprise Internet Edge transition options

Server Load Balancer

http proxy

IPv6 Internet

IPv6

IPv4

ACE

IPv4-only Host

Stateful NAT64

IPv6 Internet

IPv6

IPv4

ASR1000

IPv4-only Host

Software Proxy

Web Tier

IPv6 Internet

IPv6

IPv4

-Apache
-MSFT
PortProxy

IPv4-only Host

-IPv6

-IPv4

-IPv6
IPv6 Data Center Network Architecture

**Distribution/Core**
- Dual Stack
- Routing protocols (OPSFv3, ISISv6, BGPv6..)
- IPv6 Mcast
- IPv6 security: classification, ACL & policing, CoPP
- BFD
- Flexible Netflow
- 6VPE
- ECMP
- Interface stats
- uRPF

**Towards Access**
- Dual Stack
- HSRPv6/VRRPv3
- BFD
- SVI
- Snooping (MLDv2)
- IGMPv3
- First Hop Security (RA guard)
- PACL/VACL
- IPv6 Management

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**L2/L3 Boundary**
IPv6 in the Enterprise Data Center

Challenges Today

Application support for IPv6 – Know what you don’t know

• If an application is protocol centric (IPv4):
  • Needs to be rewritten
  • Needs to be translated until it is replaced
  • Wait and pressure vendors to move to protocol agnostic framework

Deployment of translation

• NAT64 (Stateful for most enterprises)
• SLB/Proxy
• Apache Reverse Proxy
• Windows Port Proxy
• 3rd party proxy solutions

Network services above L3 (A short-term challenge)

• SLB, SSL-Offload, application monitoring (probes)
• Application Optimization
• High-speed security inspection/perimeter protection
Planning & Deployment

Summary

Outside first: Datacenter/Internet Edge Deployment

Inside first: Dual Stack Campus, WAN and Branch
Campus IPv6 Deployment Options

Dual-Stack IPv4/IPv6

Dual Stack = Two protocols running at the same time (IPv4/IPv6)

#1 requirement—switching/ routing platforms must support hardware based forwarding for IPv6

- 3560/3750, 3560-X/3750-X +
- 4500 Sup6E, Sup7E +
- 6500 Sup32/720, Sup2T +

IPv6 is transparent on L2 switches but consider:

- L2 multicast—MLD snooping
- IPv6 management—Telnet/SSH/HTTP/SNMP
- Intelligent IP services on WLAN

Expect to run the same IGPs as with IPv4

Dual stack where you can, tunnel where you must
Understanding Coexistence Implications

Resources considerations

- Memory (Increase, but storing the same amount of IPv6 routes requires less memory than might be expected)
- CPU (insignificant increase in the case of HW platforms, additive in the case of SW platforms)

Control plane considerations

- Balance between IPv4/IPv6 control plane separation and scalability of the number of sessions

Performance considerations

- Forwarding in the presence of advanced features
- Convergence of IPv4 routing protocols when IPv6 is enabled – don’t optimize too soon
IPv6 First Hop Security

IPv6 Device Tracking
Revoke network access for inactive devices

IPv6 PACL
Filter traffic on Layer 2 ports

IPv6 RA Guard
 Stops false router advertisement threats

IPv6 NDP inspection
Prevents neighbor discovery spoofing attacks

IPv6 uRPF
Blocks spoofed traffic in hardware (16 paths on Sup2T)
IPv6 Traffic Visibility

IPv6 MIBs and host support

IPv6 Traffic Metering with **Flexible Netflow** (export over IPv4)

Response measurement with IP SLA
UDP-Jitter, UDP-Echo, ICMP Echo, TCP Connect

Tunnel detection with **NBAR2**

Tunnel Filtering with **ASA**

IPv6 over IPv4 tunnel

IPv6/IPv4 Dual Stack Hosts

Campus

IPv6 Internet

Release information in speaker notes
Enterprise WAN and Branch Options
Connecting dual stack IPv6 Sites

Using Tunnels
- Manually configured tunnels
- IPv6 over GRE
- LISP
- IPSec Tunnels
- Dynamic Multipoint VPN (DMVPN)

Dual Stack IPv4/IPv6
- Dual Stack CPEs
- Dual Stack Headquarters
- Dual Stack WAN

6VPE Service
- Dual Stack IPv4 / IPv6
- 6VPE VPN Service
June 8 2011 – 00h00-23h59 (UTC)
24-hr IPv6 “Test Flight”
IPv6 access on website’s “front door”
  (DNS AAAA Record on www.company.com)
Note: This is not about turning off IPv4!

Coordinated by:
http://isoc.org/wp/worldipv6day

http://www.worldipv6day.org/participants/
World IPv6 Day Network Design

See: http://www.in.cisco.com/solutions/ipv6/#ext-comp-1097=3 for more
Cisco at Interop Las Vegas 2011
A public implementation of a dual stack IPv4/IPv6 network

See: http://wwwin.cisco.com/solutions/ipv6/#ext-comp-1097=2 for more
Conclusion
Things to consider

The largest cost for most network managers will be training.

- It is packet based, and starts with the letters IP, but other than that it is a different protocol.

Another major cost will be retooling custom apps and scripts.

- Frequent shortcuts assuming an address will always be 32 bits.

Use IPv6 deployment an opportunity to integrate other engineering changes that have not been large enough to justify by themselves.

- What costs will be attributed to IPv6 vs. general evolution?
Call to Action and Resources

- Start now and position for growth
- Next Steps:
  - Assess, Plan, Design Trial, Train, Roll out
- Map out opportunities to be IPv6 ready in planned technology refresh cycles
- Enable your network evolution to IPv6 with Cisco

IPv6 on Cisco.com
http://www.cisco.com/go/ipv6

IPv6 on CEC

Cisco Services for IPv6
Enterprise Readiness Assessment
together we are the human network.

Cisco