



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



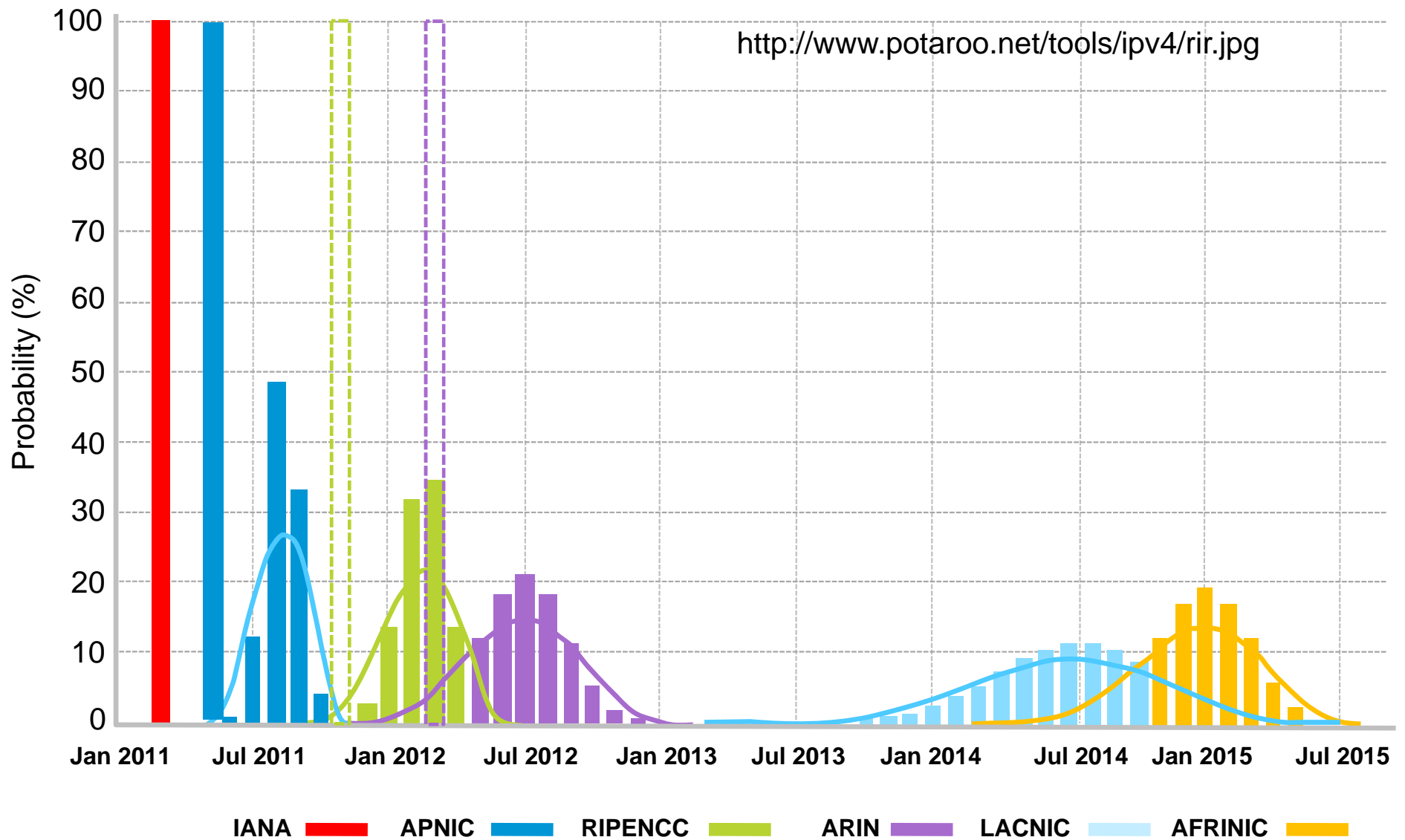
A historical moment

Feb 3, 14:41:24 UTC



We Finally Ran Out.

Exhaustion continues



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:

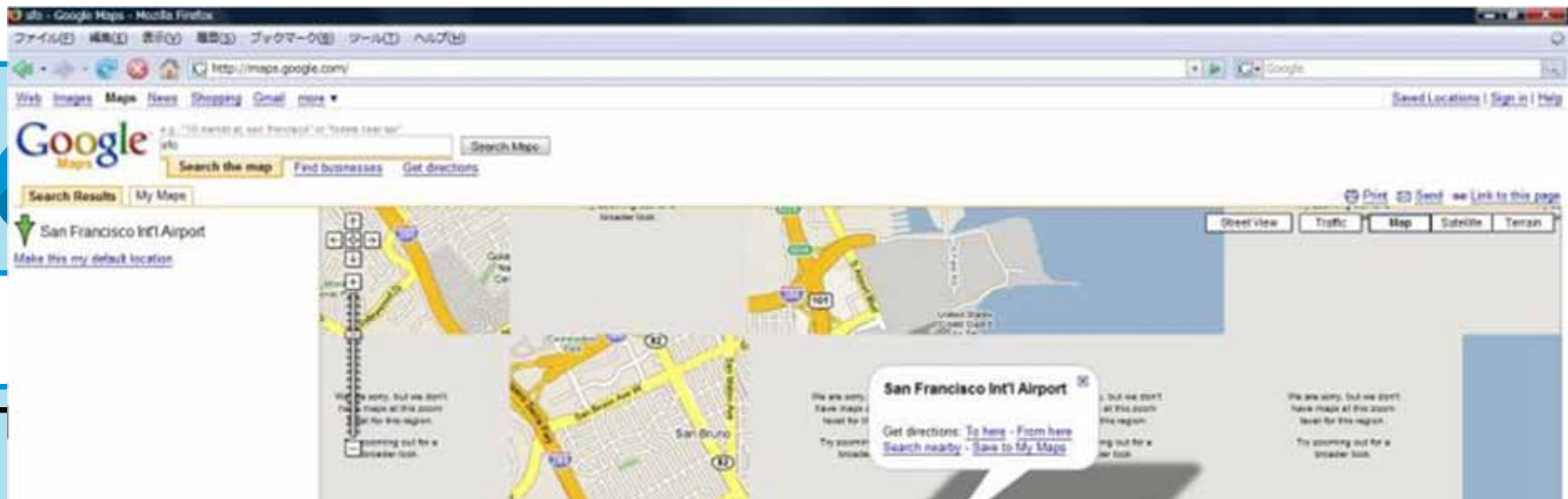
- I'm safe

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 “ *

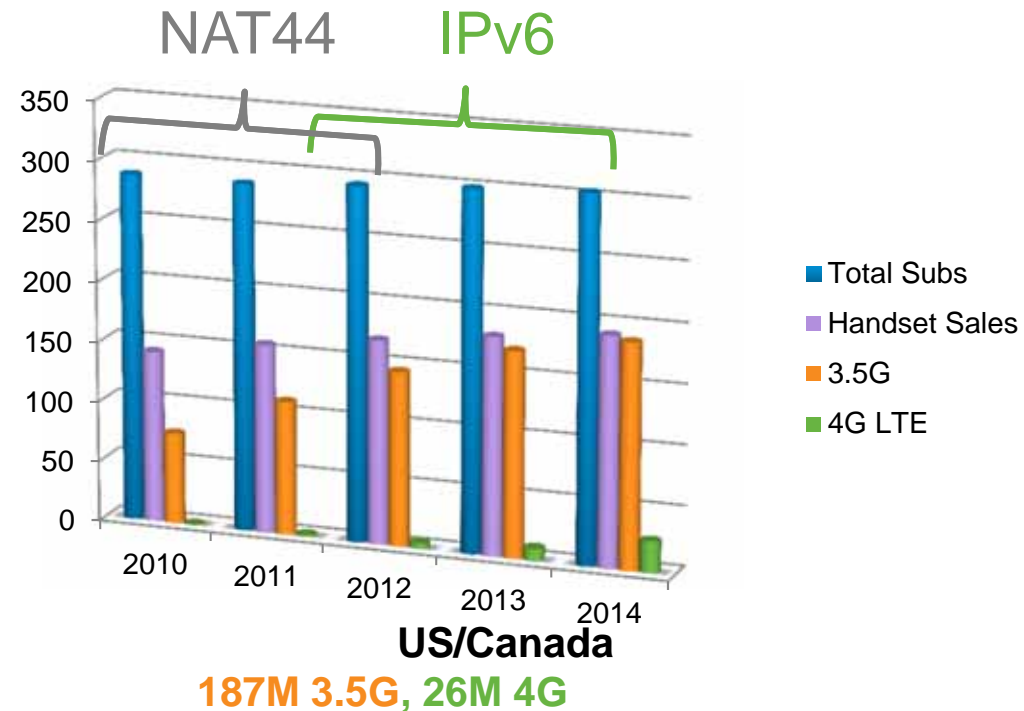
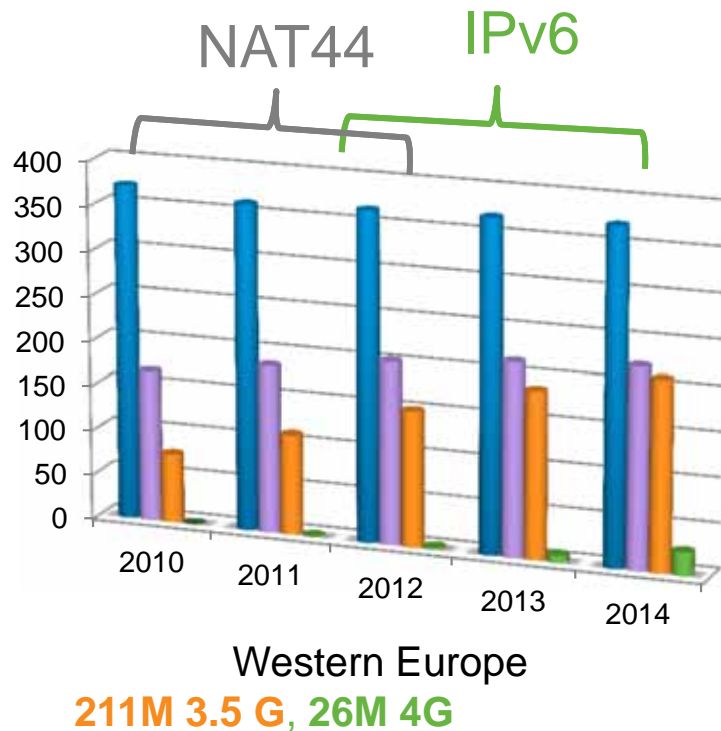
* Source: Robert Kenny “Are traffic charges needed to avert a coming capex catastrophe?

A review of the AT Kearney paper A Viable Future Model for the Internet

14 August 2011, citing: Eric Schurman (bing) & Jake Brutlag (google) Performance related changes and their user impact, 23 June 2009



“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

Enterprise Drivers

Failure to Act Will Impact Business

2010

2012

2014

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

Globalization

IPv6 Government
Mandate Deadlines

IPv4/IPv6
Co-existence

Transition
Planning

Early
Adopters

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

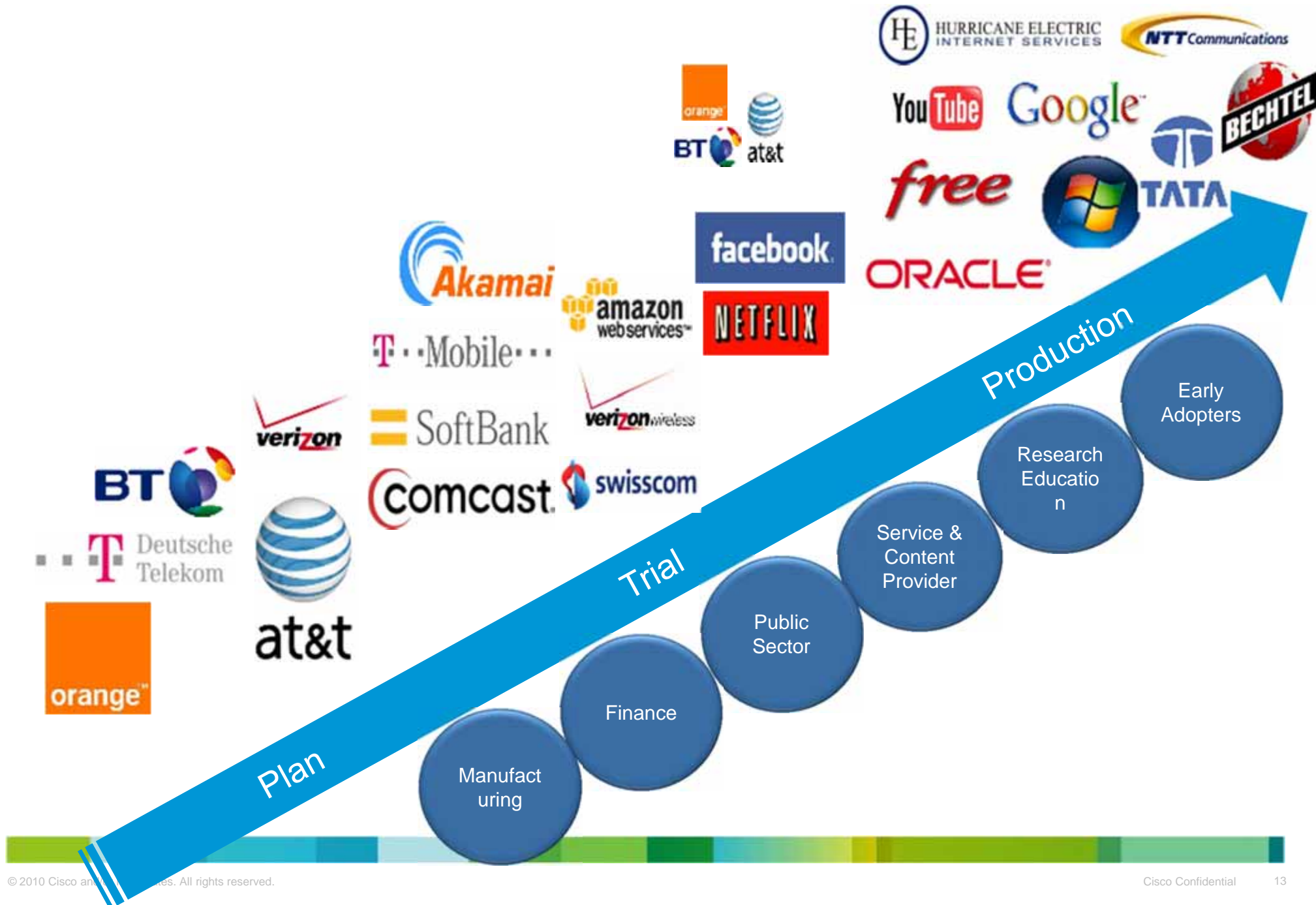
IPv6 Business Impact – The Cost of Waiting Goes Up

Low Risk

Moderate Risk

High Risk

IPv6 Adoption – Customer Momentum





Adoption strategy

Preserve, Prepare, Prosper

IPv6 Motivation

Customer Type or Driver

Disposition

Reasons For Action

Governments
Public Sector

Mandated

Regulations Guide Purchasing

National competitiveness, citizen-facing service availability drives action

IT Consumerization,
Service Providers

Motivated

Customers Need IPv6 Access

Globalization, user-provided devices drives investment, address exhaustion

Smart Grid,
Mobile Computing

Early Adopter

IPv4 Address Exhaustion

Address exhaustion, competitive differentiation, opportunistic use of IPv6 to solve challenges

Many Large Enterprises,
Small/Medium Business

Mainstream

Internet Evolution to IPv6

Investment protection paramount, customer reach and visibility concerns

Managing an Orderly IPv6 Transition

IPv6 Is Not a Rip-and-Replace Proposition

Preserve

Preserve the customer's existing investment

- Audit and leverage existing IPv6 capabilities

Prepare

Prepare a migration and deployment plan

- Identify and enable critical IPv6 functional areas

Prosper

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

Pre-Deployment Phases	Deployment Phases
<ul style="list-style-type: none">• Establish the network starting point• Importance of a network assessment and available tools• Build a pilot or lab environment• Obtain addressing or use ULA or documentation prefix (in lab)• Learn the basics (DNS, routing changes, address assignment)	<ul style="list-style-type: none">• Transport considerations for integration• Internet Edge (ISP, Apps)• Campus IPv6 integration options• Data Center integration options• WAN IPv6 integration options• Execute on gaps found in assessment

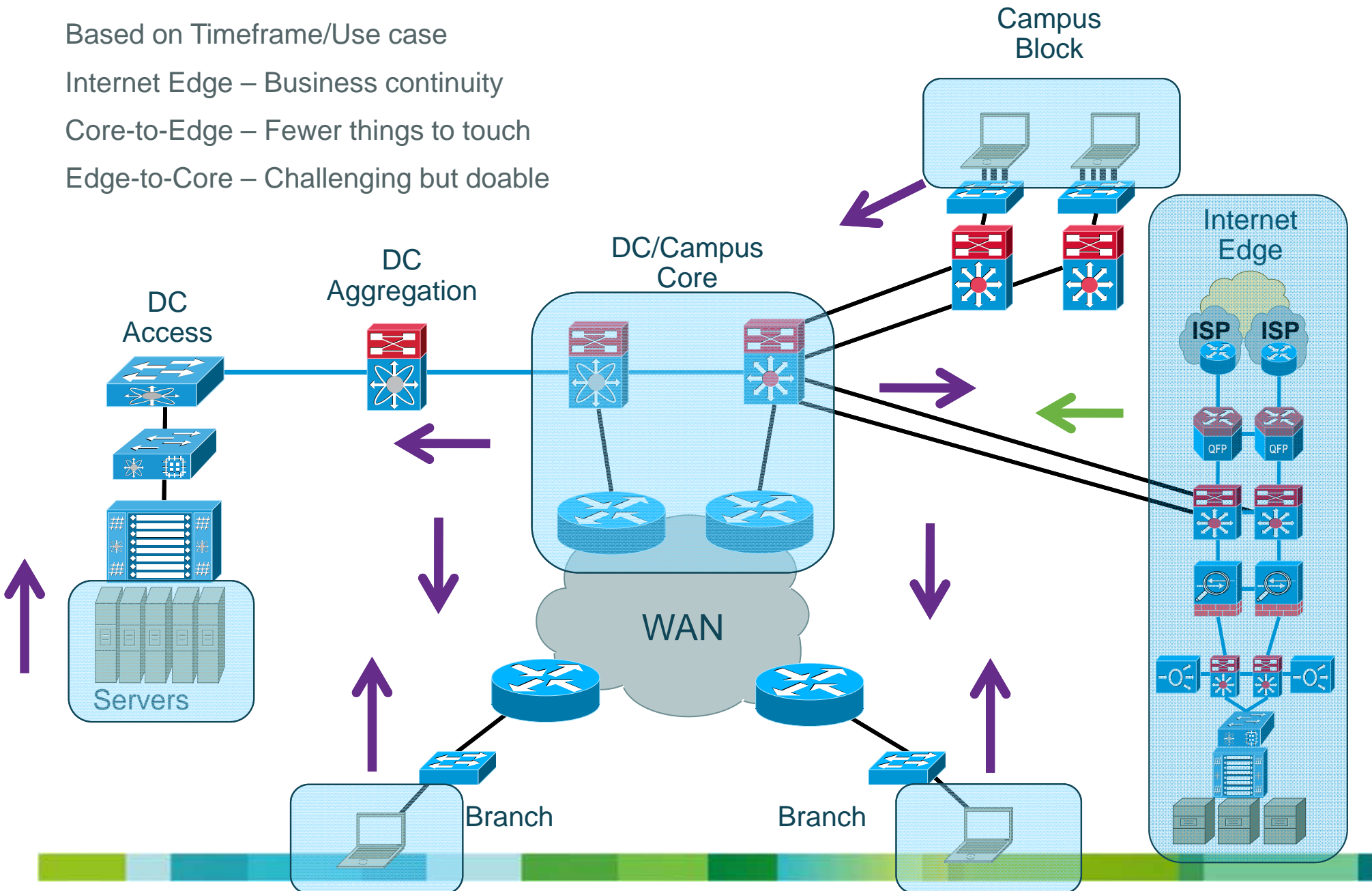
Where do I start?

Based on Timeframe/Use case

Internet Edge – Business continuity

Core-to-Edge – Fewer things to touch

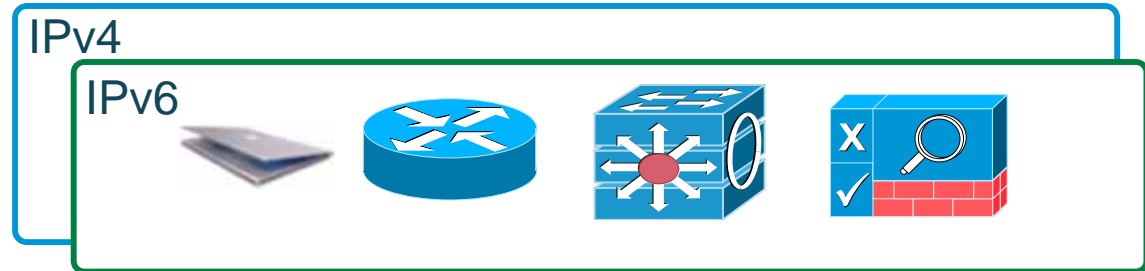
Edge-to-Core – Challenging but doable



IPv6 Co-existence Solutions

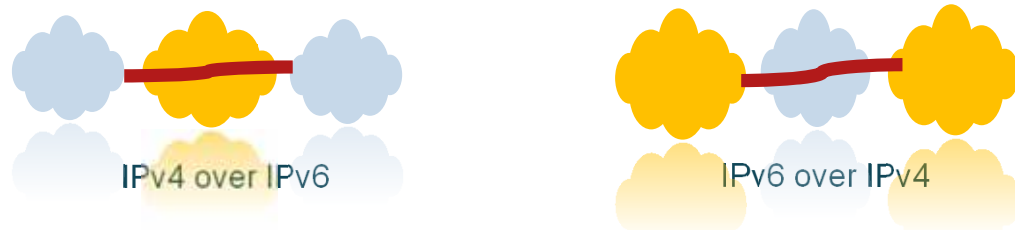
Dual Stack

Recommended Enterprise
Co-existence strategy



Tunneling Services

Connect Islands of IPv6 or
IPv4



Translation Services

Connect to the IPv6
community





Enterprise Deployment

Planning & Deployment
Summary

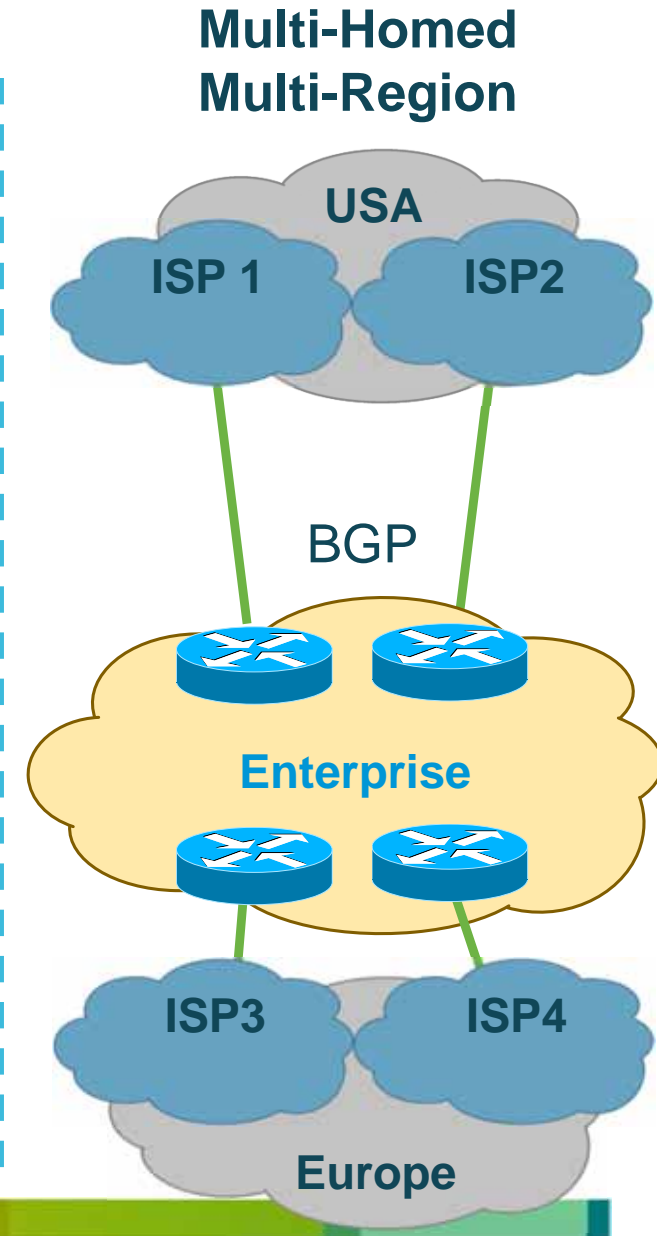
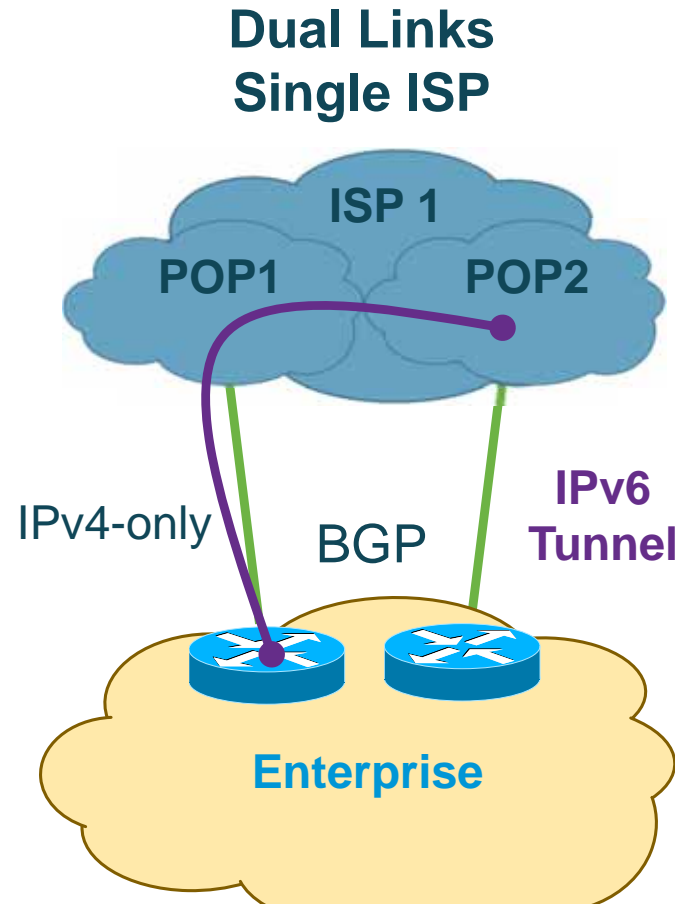
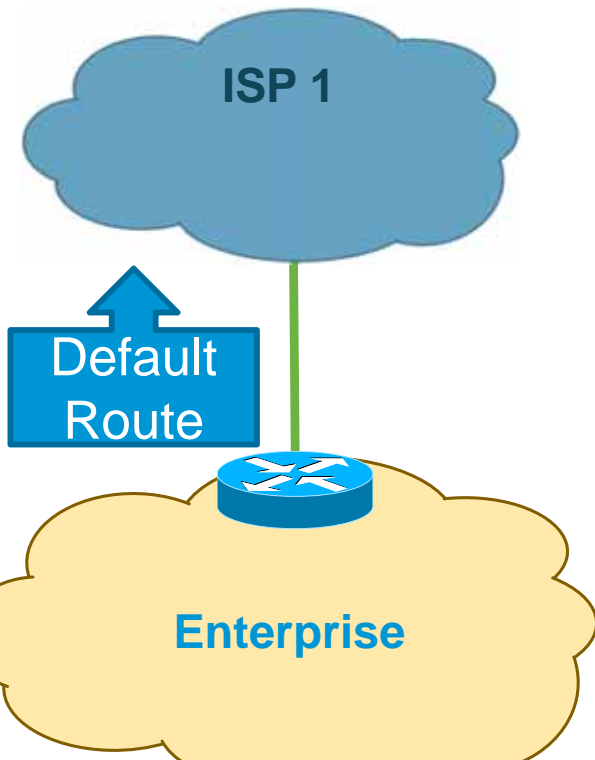
Outside First: Internet
Edge Deployment

Inside First: Campus, WAN
and Branch



Internet Edge - to – ISP

Many options



ISP's that "support IPv6" have varying levels of support

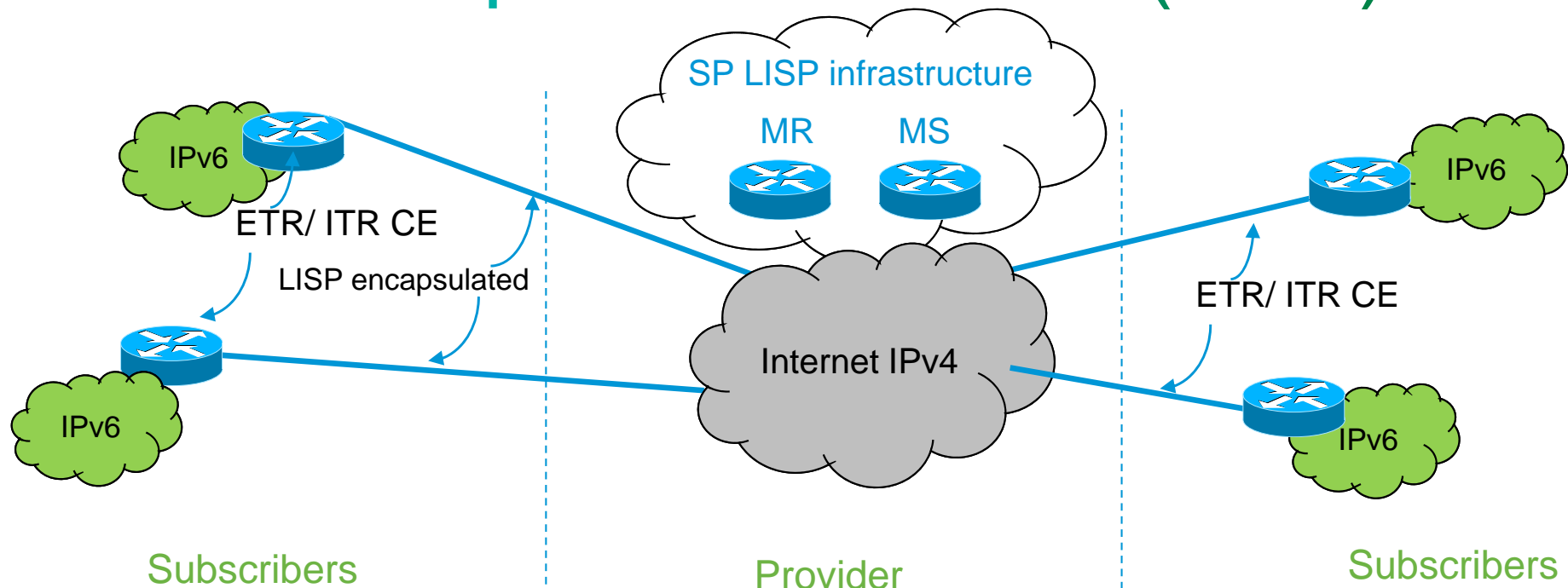
- Many ISP's that now have dual stack services cannot yet deliver traffic to all IPv6 endpoints
- SLA's may or may not be equivalent to IPv4

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

Locator/ID Separation Protocol (LISP)



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:

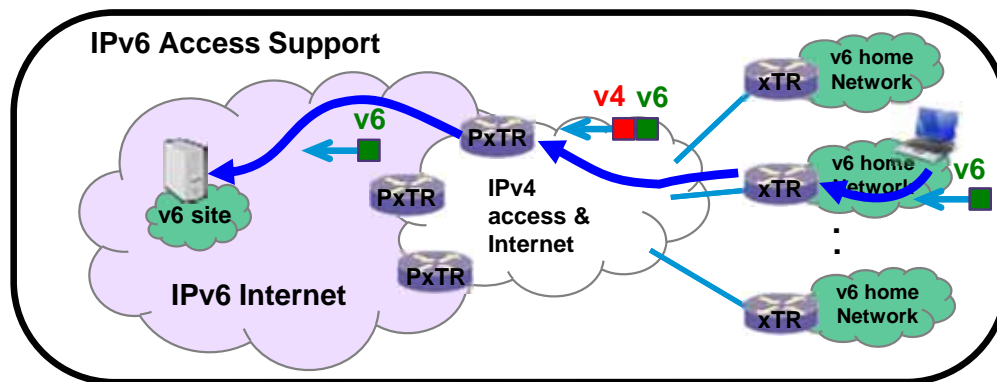
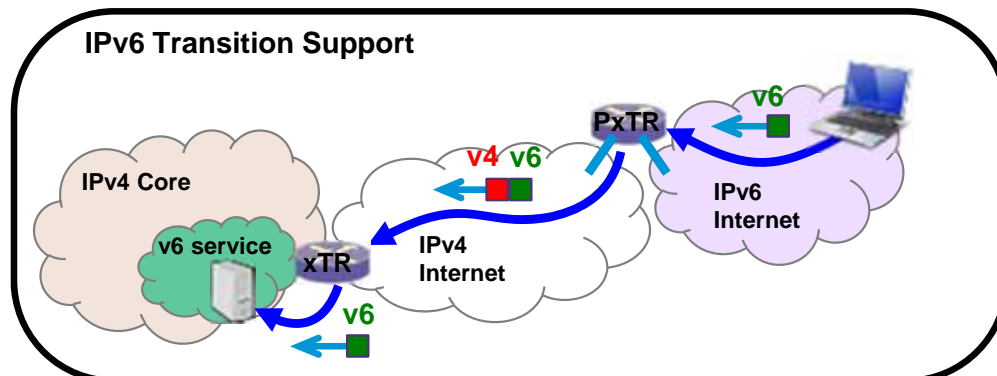
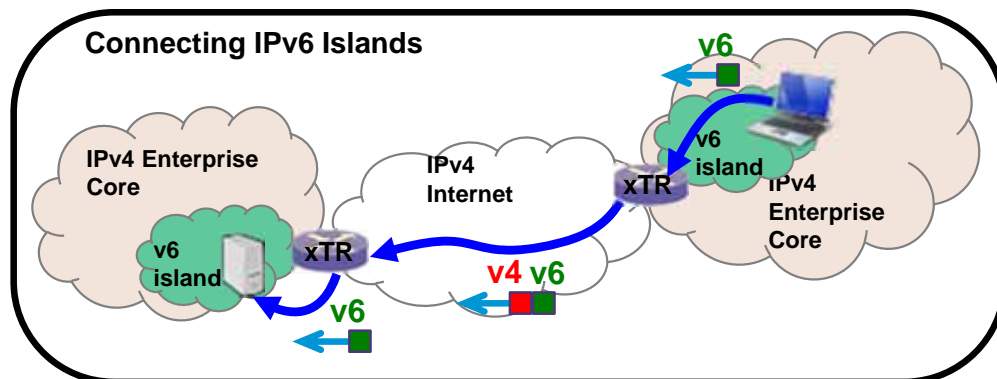
- Rapid IPv6 Deployment
- Minimal Infrastructure disruption

LISP Solution:

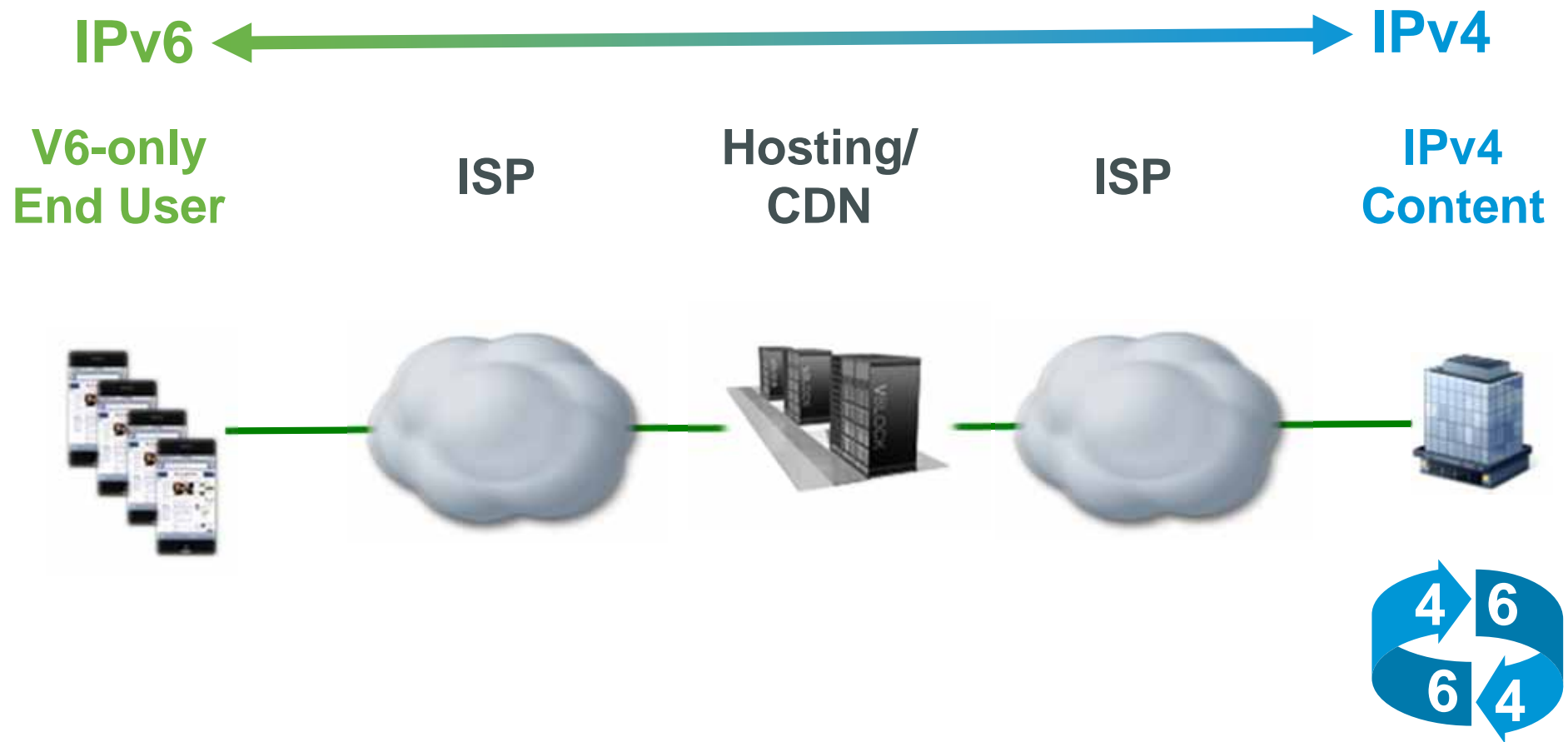
- LISP encapsulation is Address Family agnostic
 - IPv6 interconnected over IPv4 core
 - IPv4 interconnected over IPv6 core

Benefits:

- Accelerated IPv6 adoption
- Minimal added configurations
- No core network changes
- Can be used as a transitional or permanent solution



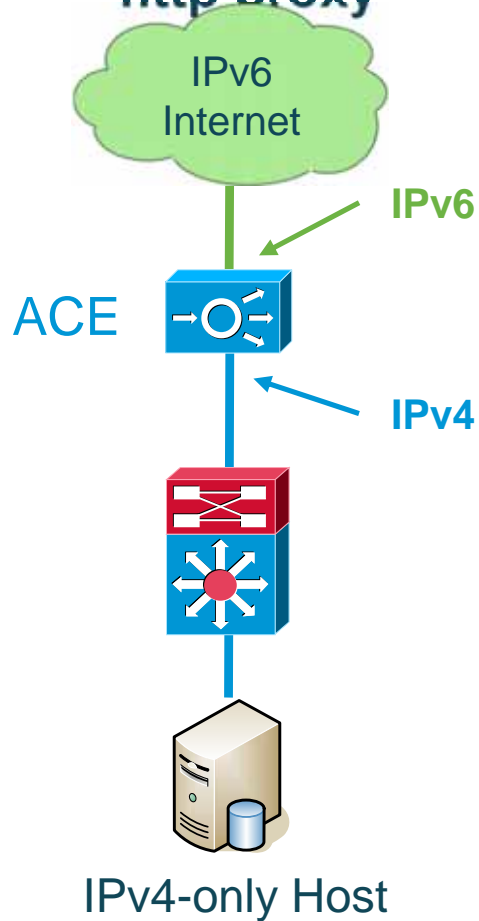
Enterprise IPv4-only service to IPv6 Internet



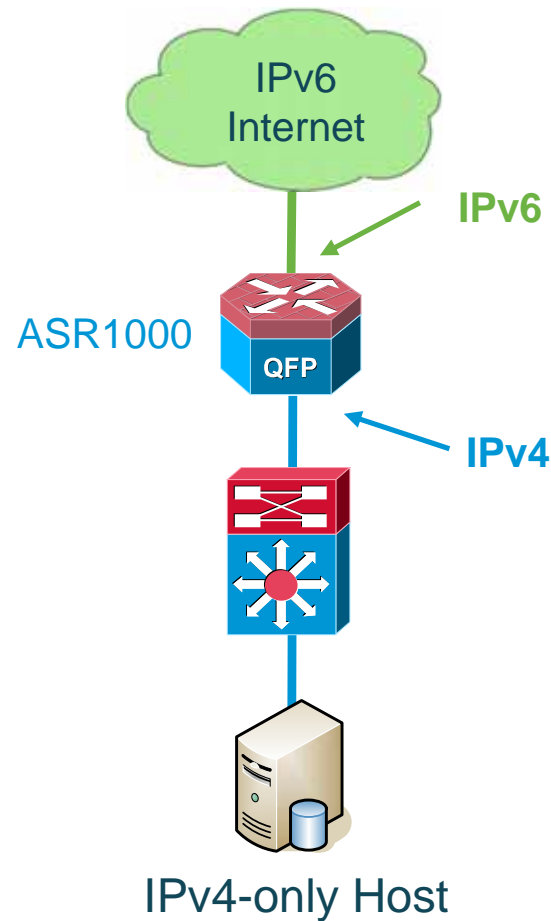
An enterprise with a critical Internet presence, should perform their own dual-stacking or translation. Others may outsource to a business partner or rely on a downstream provider

Enterprise Internet Edge transition options

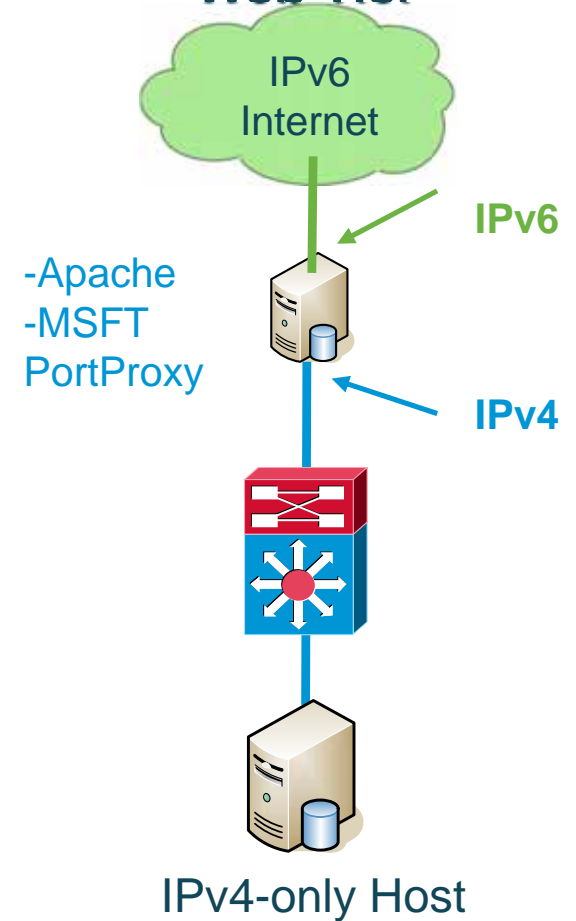
Server Load Balancer http proxy



Stateful NAT64



Software Proxy Web Tier



IPv6 Data Center Network Architecture

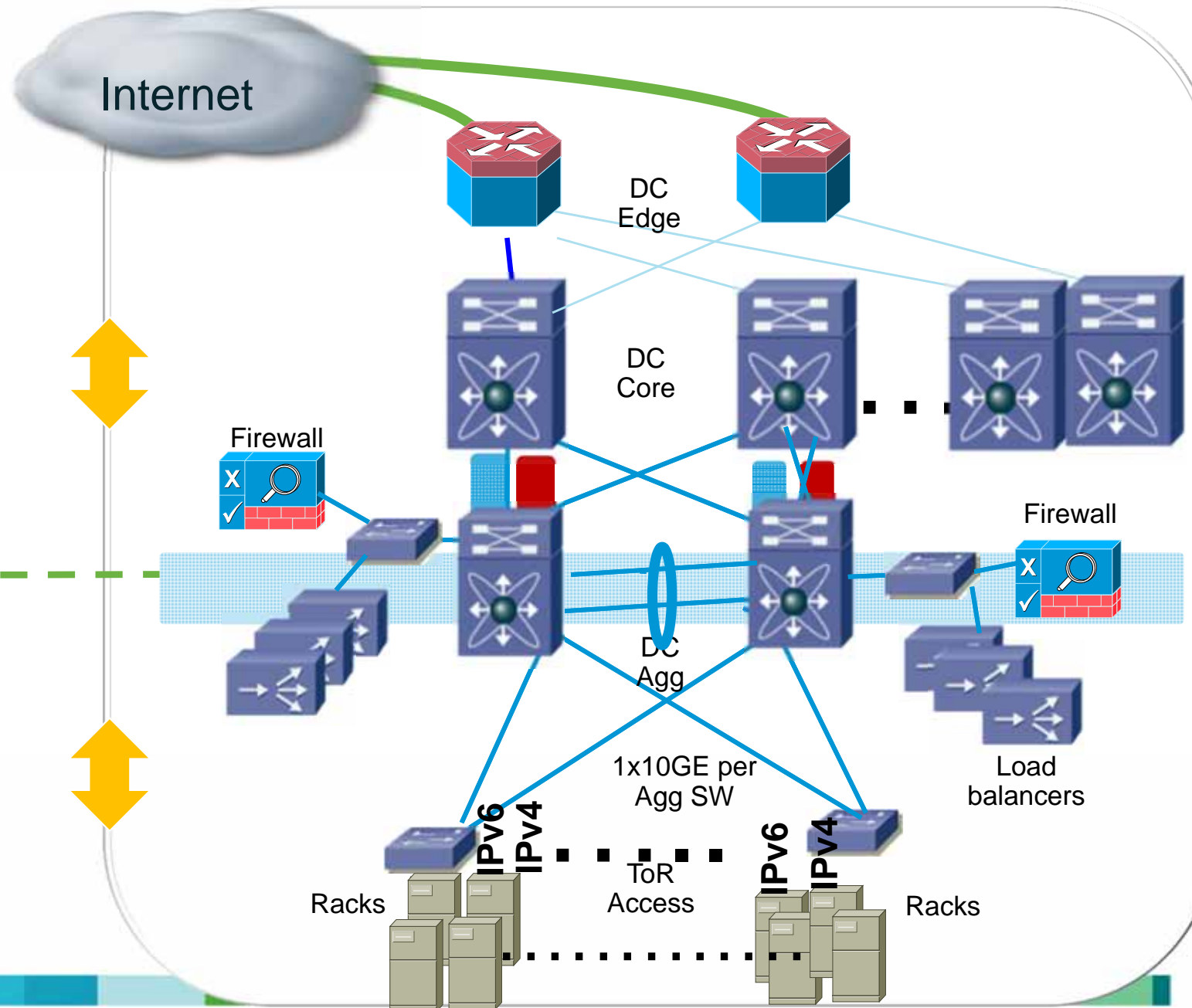
Distribution/Core

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

L2/L3 Boundary

Towards Access

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



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



Enterprise Deployment

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

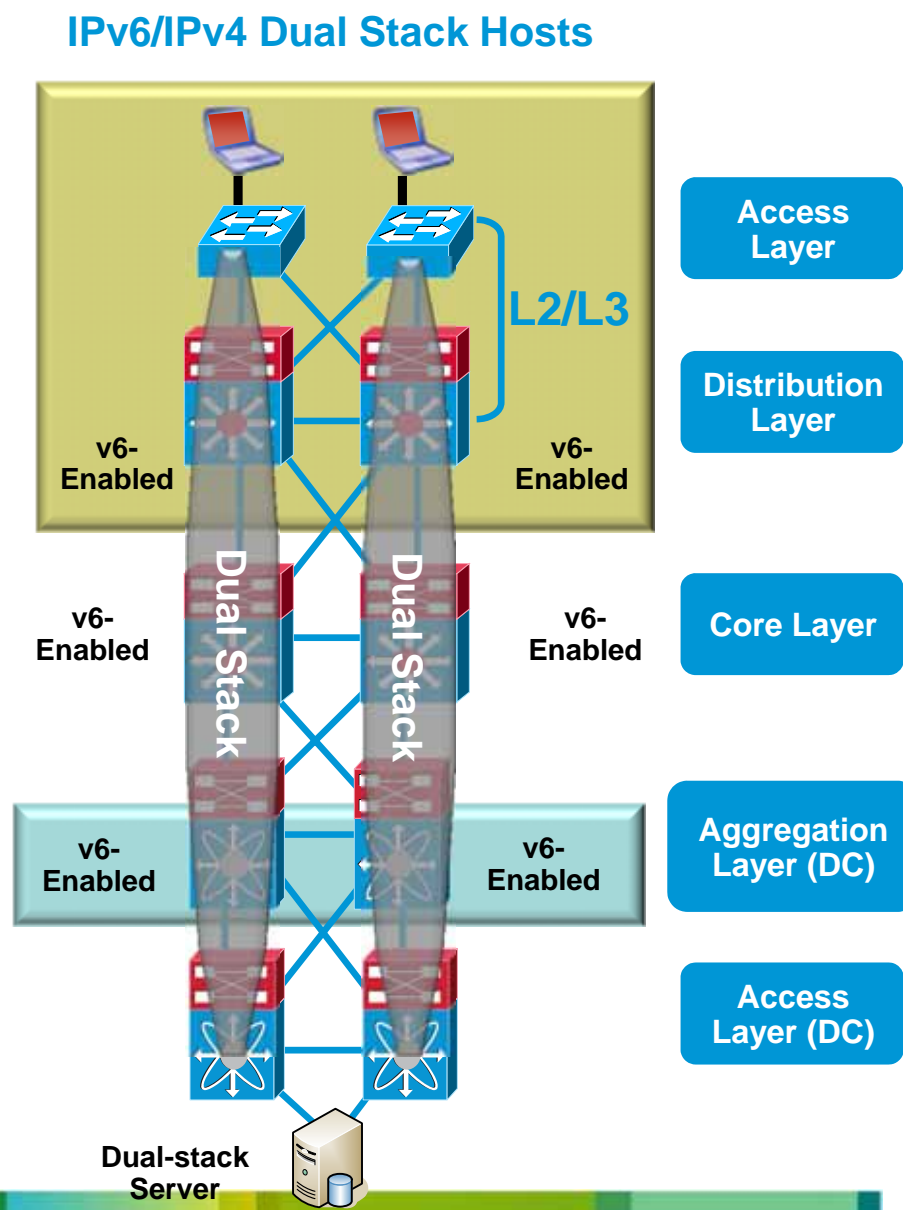
- 3560/3750, 3560-X/3750-X +
- 4500 Sup6E, Sup7E +
- 6500 Sup32/720, Sup2T +

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

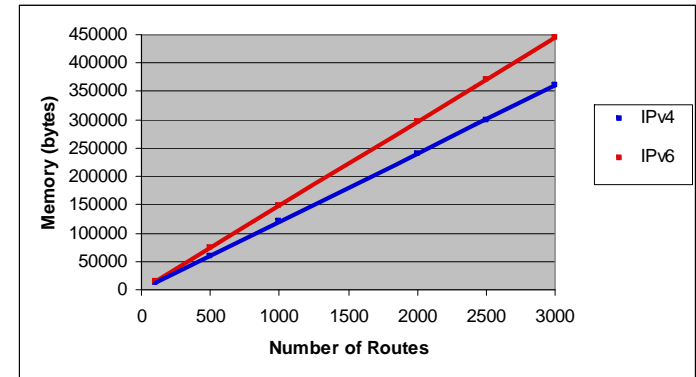
Dual stack where you can, tunnel where you must



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)



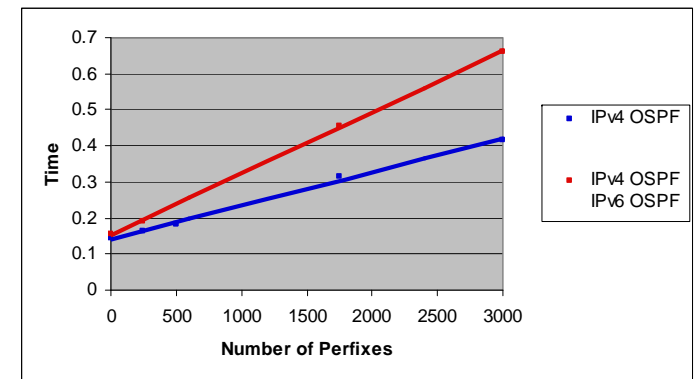
Source: Yenu Gobena, Cisco AS

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



Source: Yenu Gobena, Cisco AS

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

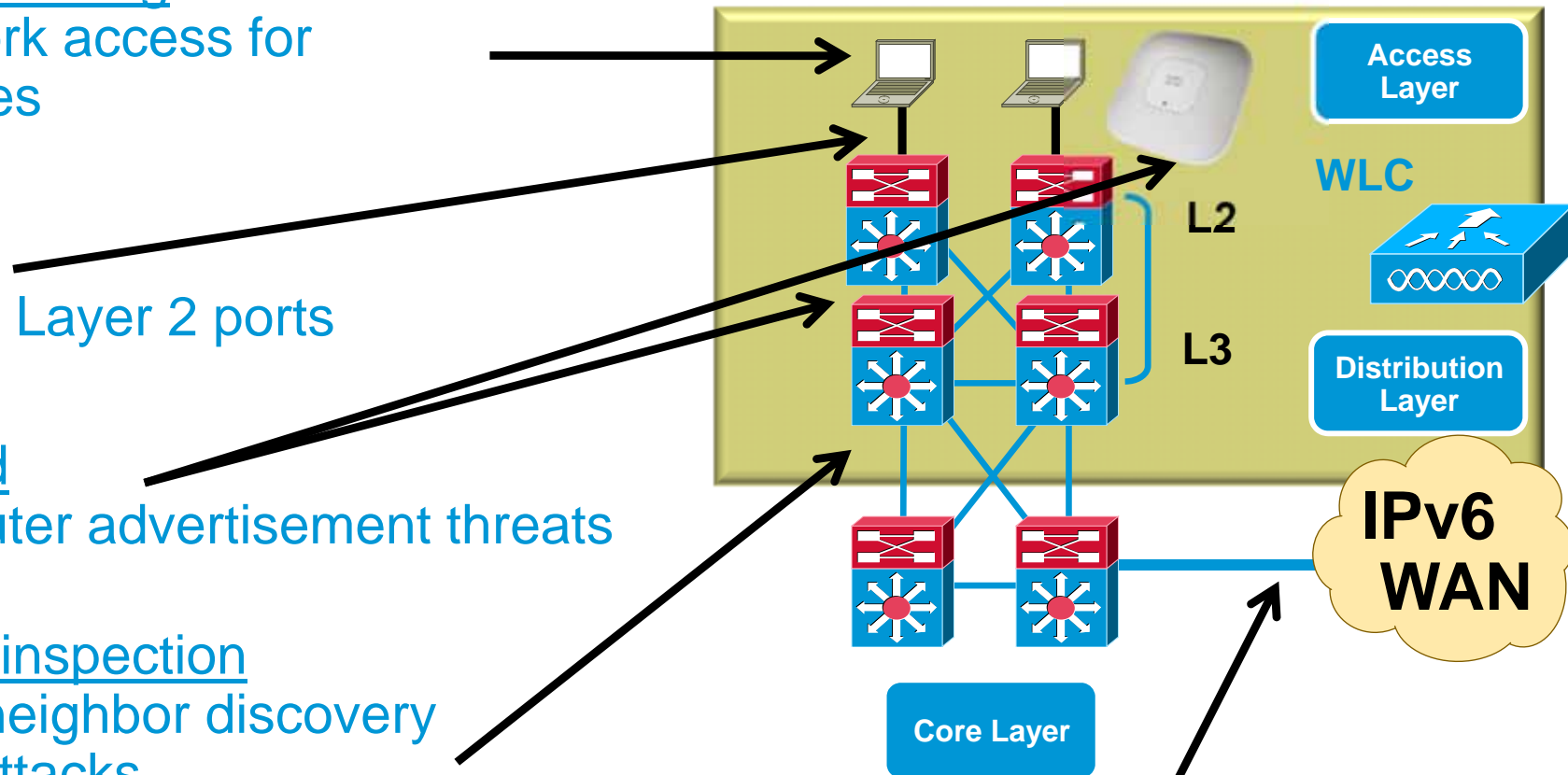
IPv6 NDP inspection

Prevents neighbor discovery spoofing attacks

IPv6 uRPF

Blocks spoofed traffic in hardware (16 paths on Sup2T)

IPv6/IPv4 Dual Stack Hosts



IPv6 Traffic Visibility

IPv6 MIBs and host support

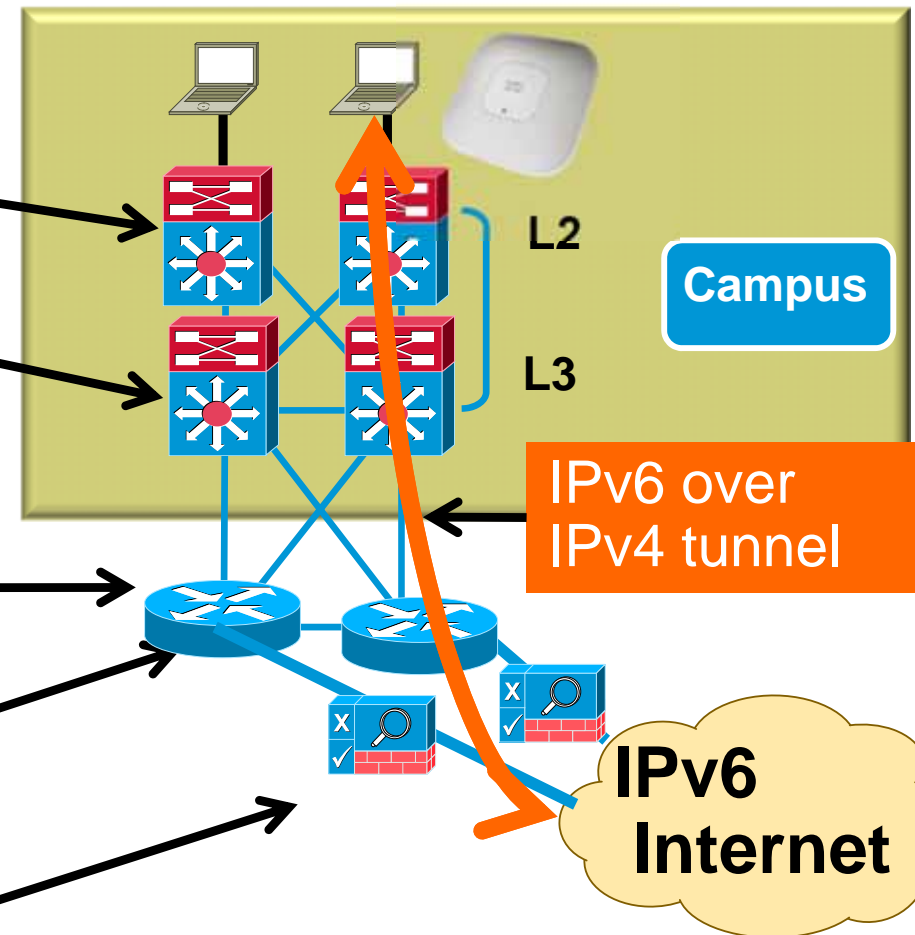
IPv6 Traffic Metering with Flexible Netflow (export over IPv4)

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

Tunnel detection with NBAR2

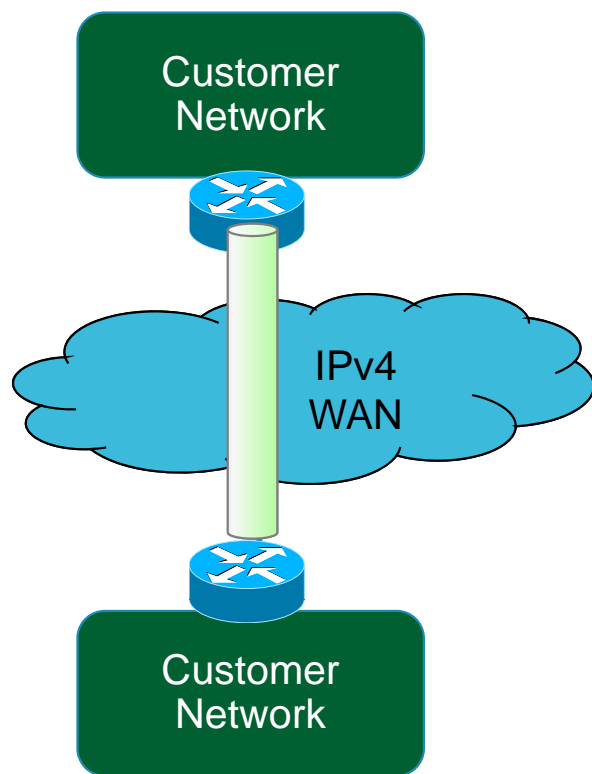
Tunnel Filtering with ASA

IPv6/IPv4 Dual Stack Hosts

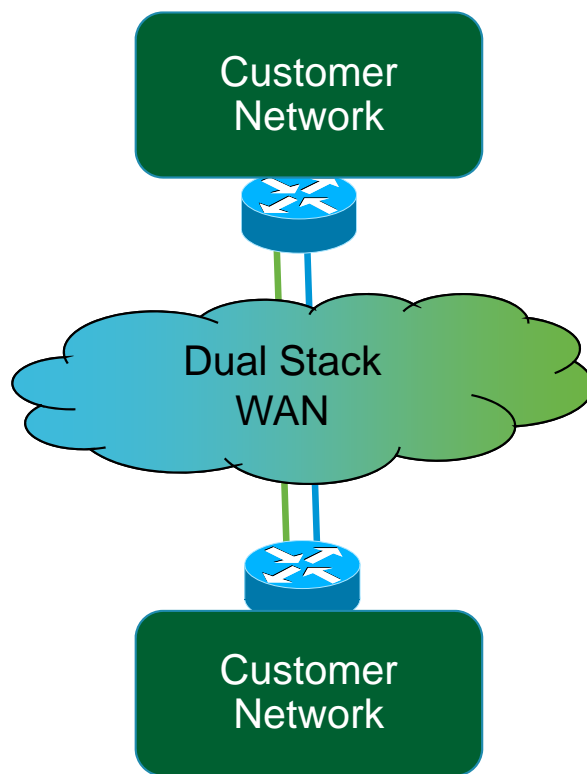


Enterprise WAN and Branch Options

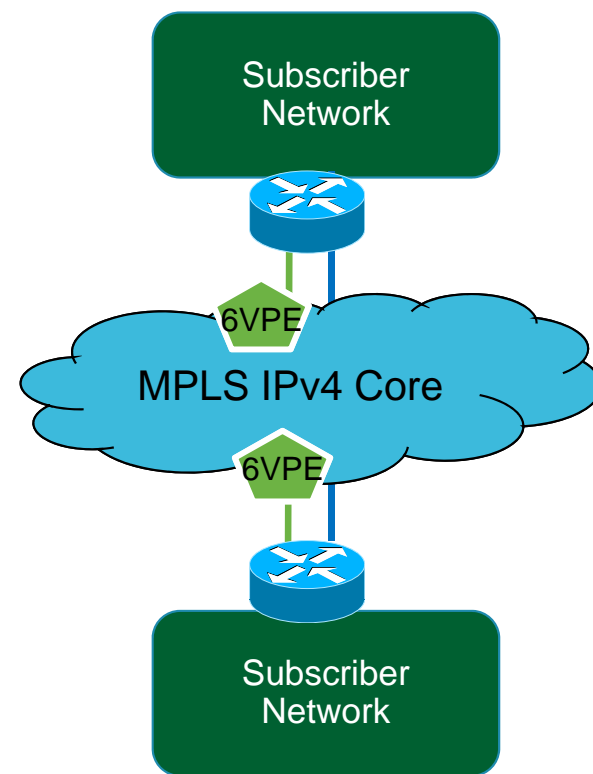
Connecting dual stack IPv6 Sites



Using Tunnels



Dual Stack IPv4/IPv6



6VPE Service

Manually configured tunnels

IPv6 over GRE

LISP

IPSec Tunnels

Dynamic Multipoint VPN (DMVPN)

Dual Stack CPEs

Dual Stack Headquarters

Dual Stack WAN

Dual Stack IPv4 / IPv6

6VPE VPN Service



Cisco on Cisco



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!

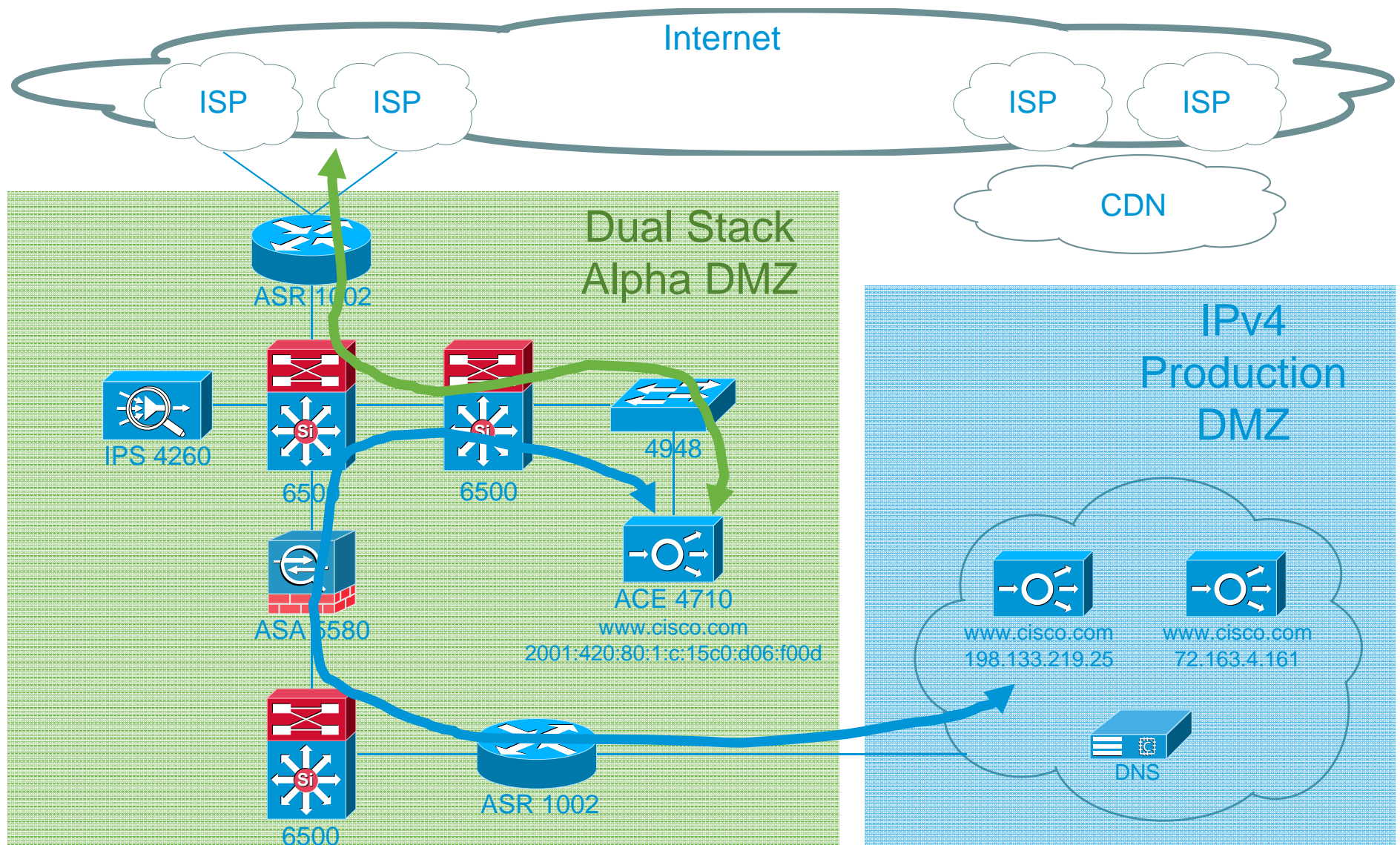
Coordinated by: 
<http://isoc.org/wp/worldipv6day>

Google Facebook Yahoo! Akamai Cisco

<http://www.worldipv6day.org/participants/>

<http://blogs.cisco.com/news/world-ipv6-day-working-together-towards-a-new-internet-protocol/>

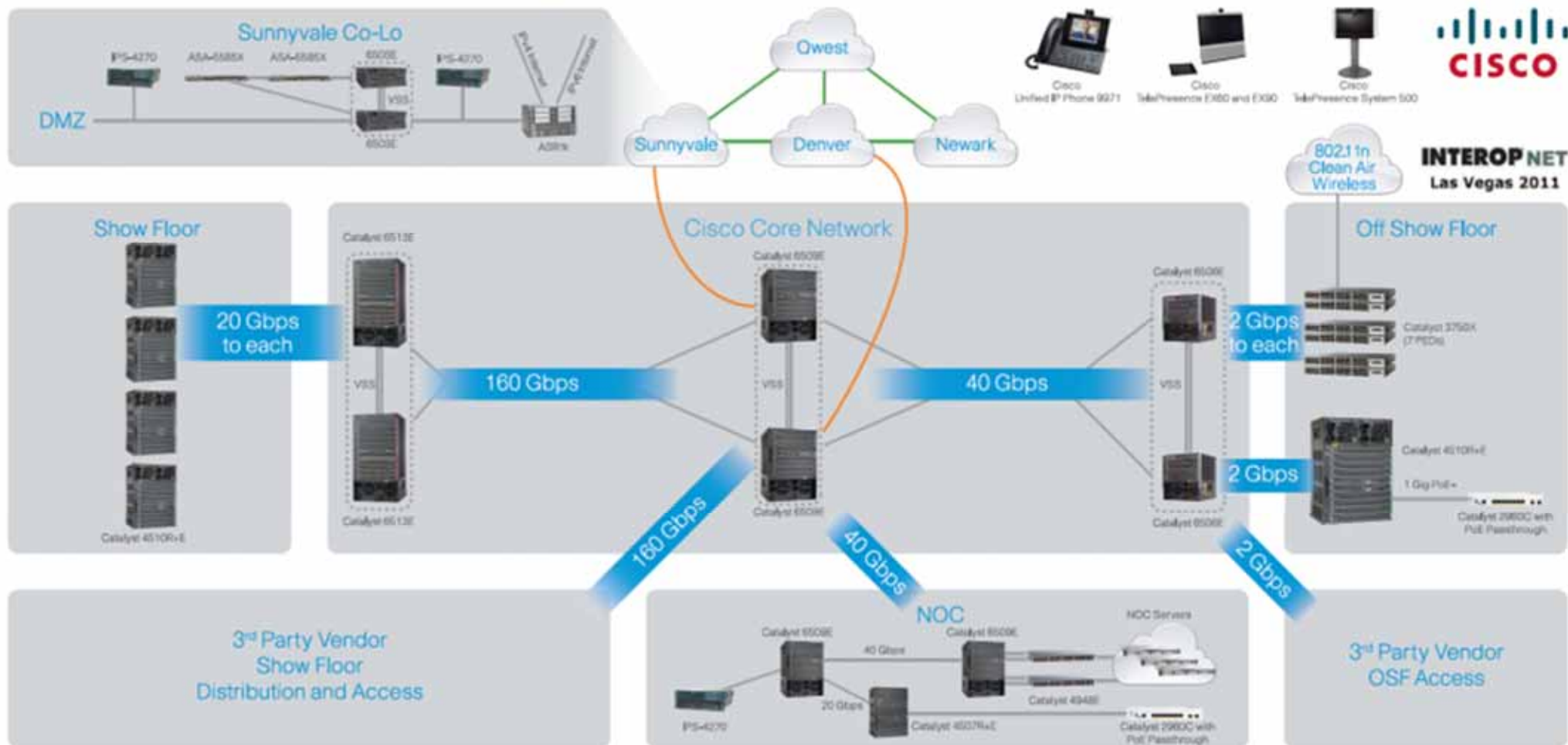
World IPv6 Day Network Design



See: <http://wwwin.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



Routing Switching Wireless Security Video Voice Monitoring

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

<http://wwwin.cisco.com/solutions/ipv6/>

Cisco Services for IPv6

[Enterprise Readiness Assessment](#)

together we are the human network.  cisco.