Cisco IPv6 Integration Best Practices

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Agenda

- The importance of IPv6

- Planning for IPv6

- Designing for IPv6

- IPv6 implementation best practices

- Operating and IPv6 environment

- Cisco IPv6 products

- Questions and answers

IPv6

- Increases the quantity of unique IP addresses available to network devices to an almost infinite number

- Provides the foundation to radically change the way we communicate

IPv6

What Does IPv6 Offer?

Address Space — 128 bits vs. 32 bits (IPv4 addresses predicted to exhaust by 2016)

Quality of Service — IPv6 eliminates the need for network address translation (NAT) and improves communication

Data Security — IP security is an integral part of the base protocol suite in IPv6

Mobility — IPv6 hosts are not restricted by location

Overcoming IPv4 Limitations

Reclaim Original Intent of Global, End-to-End Internet Model

Japan

- Japan has successfully deployed IPv6.

Europe

- European Commission has sponsored several IPv6-focused programs, including 6NET.

U.S.A.

- Department of Defense defined an IPv6 migration process to be completed by 2008.

- Office of Management and Budget mandated that all federal agencies migrate their networks to IPv6 by June 2008.

IPv6 Enables New Innovation

- **Building sensors**
- **Media services**
- **Collaboration**
- **Mobility**

Higher education/research

- **Set-top boxes**
- **Internet gaming**
- **Appliances**
- **Voice/video**
- **Security monitoring**

Consumer

IPv6

- **Embedded devices**
- **Industrial Ethernet**
- **IP-enabled components**

Manufacturing

- **DoD**
- **WIN-T**
- **FCS**
- **JTRS**
- **GIG-BE**

Government (Federal/Public Sector)

- **Telematics**
- **Traffic control**
- **Hotspots**
- **Transit services**

Transportation

- **Animal tags**
- **Imagery**
- **Botanical**
- **Weather**

Agriculture/ wildlife

- **Home care**
- **Imaging**
- **Mobility**

Medical

Survey the Benefits

Innovative capabilities to the desktop

Microsoft's Windows Vista and Apple's Mac OS X v10.3 (and later versions) enable IPv6 by default.

Powerful IP applications

IPv6 enables sophisticated peer-to-peer communication tools that improve interagency collaboration.

Next-generation multicast

Cisco's IPv6 multicast technologies optimize media-streaming applications, allowing timely video feeds and quality-rich information to be easily distributed to millions of citizens worldwide, simultaneously.

Mobility support and wireless access

IPv6's nearly infinite capacity for addresses lends connectivity to myriad electronic devices—mobile phones, laptops, in-vehicle computers, televisions, cameras, etc.

Security

IPv6 is less vulnerable to scanning attacks than IPv4 and possesses capabilities for packet integrity. It mandates that security is provided through information encryption and source authentication.

Plug-and-play

IPv6 auto-configures new equipment to communicate with the network once it is detected, which means devices are ready to use right when needed.

Planning for IPv6

- Everyone must understand the importance of IPv6 to the organization

  Map IPv6 Features/Advantages to areas in your Enterprise Architecture

  Show how IPv6 will aid or transform your organization

- Leadership must buy into the process

- Strong project managers are required to guide the transition

- Organize your plan based on IT environment

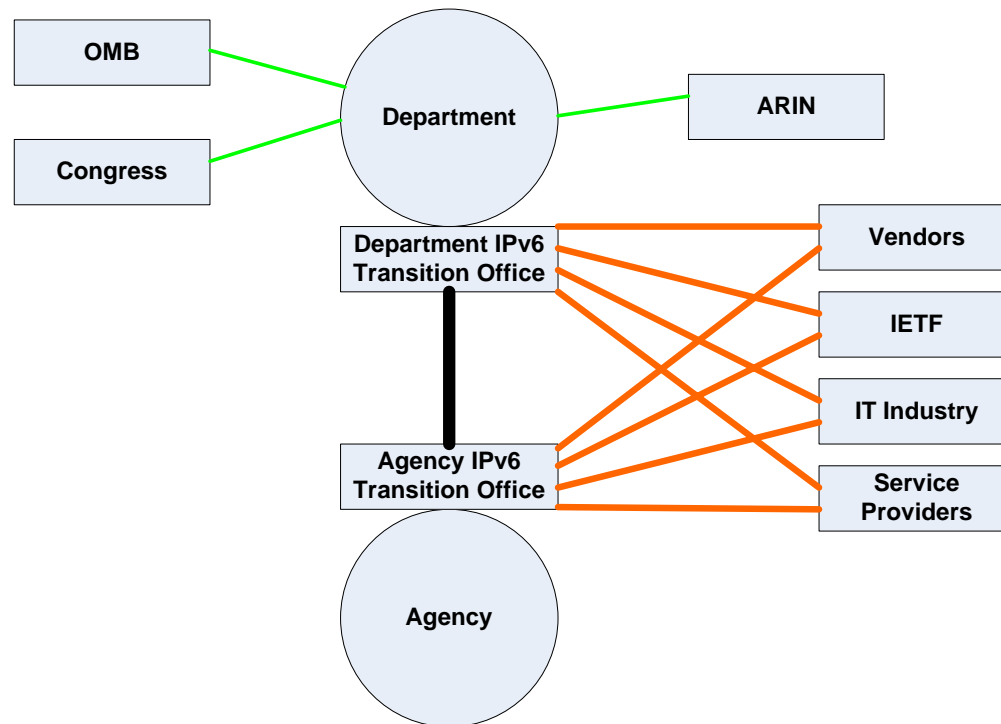 Phases of the transition
  Core/SP interconnect
  Distribution
  Edge

IPv6 Transition Office

- Building a transition office requires a team approach

- Regular/Frequent meetings with IPv6 stakeholders to coordinate IPv6 migration activities

Preparing Your IPv6 Inventory

- Gather information about all your IPv4 devices

    Servers, network equipment, firewalls, desktops

    Look at applications that ride on that equipment

- Determine if devices are capable of running IPv6

- Look at the operating system software they run and then compare to vendor specifications

- There are some tools that can help you gather some of this information

    Cisco IPv6 Scorecard and IPv6 Capability Assessment

    CiscoWorks Network Compliance Manager (NCM) v1.2

- Most of the data will be gathered manually

    This is where project managers will help tremendously

Writing an IPv6 Impact Analysis

- OMB M-05-22 memo to CIOs required impact assessment – risk assessment

- Cost and risk elements as described in OMB Circular A-11

- Cost estimate

  All costs related to IPv6 migration

  Equipment upgrades, lab, training, cost of migration effort, …

- Risk Analysis

  OMB risk analysis methodology

  18 different areas to address the impact of IPv6

Writing an IPv6 Transition Plan

- OMB M-05-22 memo to CIOs required a transition plan
- OMB's Enterprise Architecture Assessment Framework:

    Conduct a requirements analysis to identify current scope of IPv6 within an agency, current challenges using IPv4, and target requirements.

    Develop a sequencing plan for IPv6 implementation, integrated with your agency enterprise architecture.

    Develop IPv6-related policies and enforcement mechanisms.

    Develop training material for stakeholders.

    Develop and implement a test plan for IPv6 compatibility and interoperability.

    Deploy IPv6 using a phased approach.

    Maintain and monitor networks.

    Update IPv6 requirements and target architecture on an ongoing basis.

Building IPv6 Capability

- Training is key to developing IPv6 operational capability

  Scarcity of IPv6-skilled IT staff

  Must train existing employees

- Training for all aspects of IT

  Basic IPv6 training – everyone & operations

  IPv6 advanced networking

  IPv6 for system administrators

  Application developer sessions on IPv6 coding

IPv6 Transition Timeline

IPv6 Multihoming Solutions

Federal IT Technology Refresh Cycle

IPv6 Security Products

DNS/DHCPv6/DDNS Products

IPv6-Capable Vendor Products ⟶

Transition Planning   **HAIPEv3**

IPv6 Constraints

2006	2007	2008	2009	2010	2011

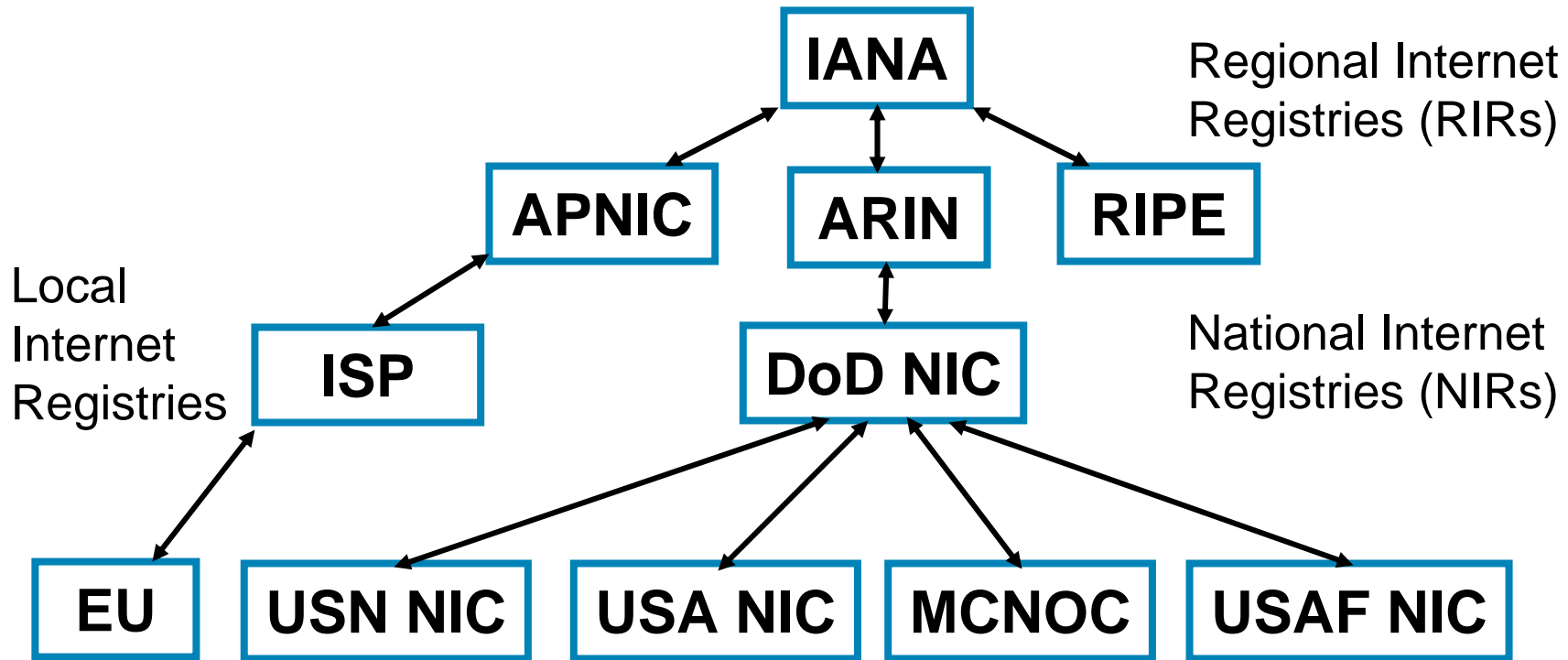**IPv6 Drivers**

IPv4 Address Depletion

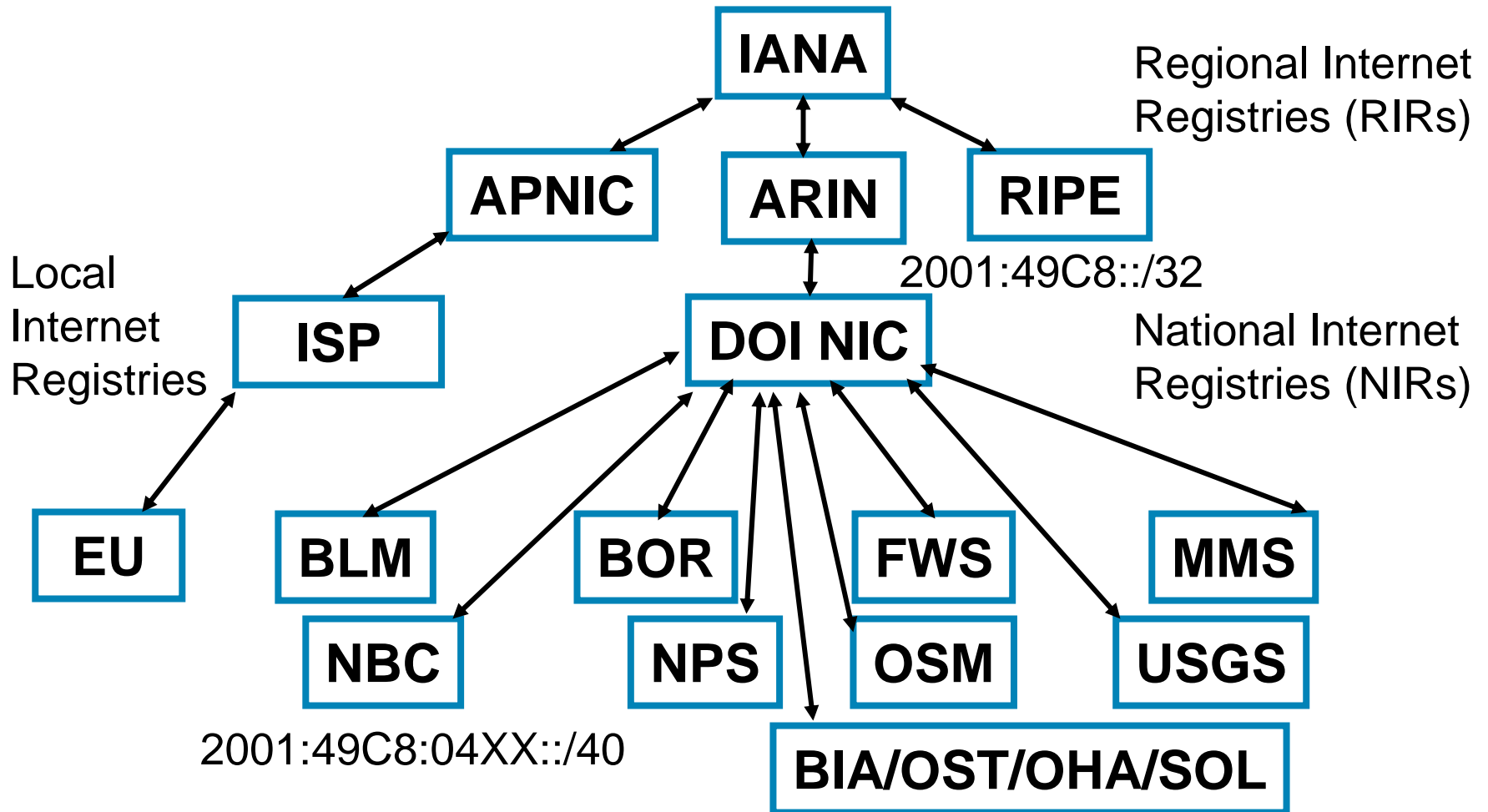**Microsoft Vista Deployment**

Mandated Federal Transition ⟶

IPv6 Design

- Consider your organizational structure and current topology

- IPv6 will use some of the same topology and traffic patterns

    IPv4 made heavy use of Unicast and client/server model

    IPv6 will add more mobile and peer-to-peer traffic flows

- Plan your addressing based on your current topology

    The physical topology won't change with IPv6

- Your IPv6 security architecture will be similar to your current protections
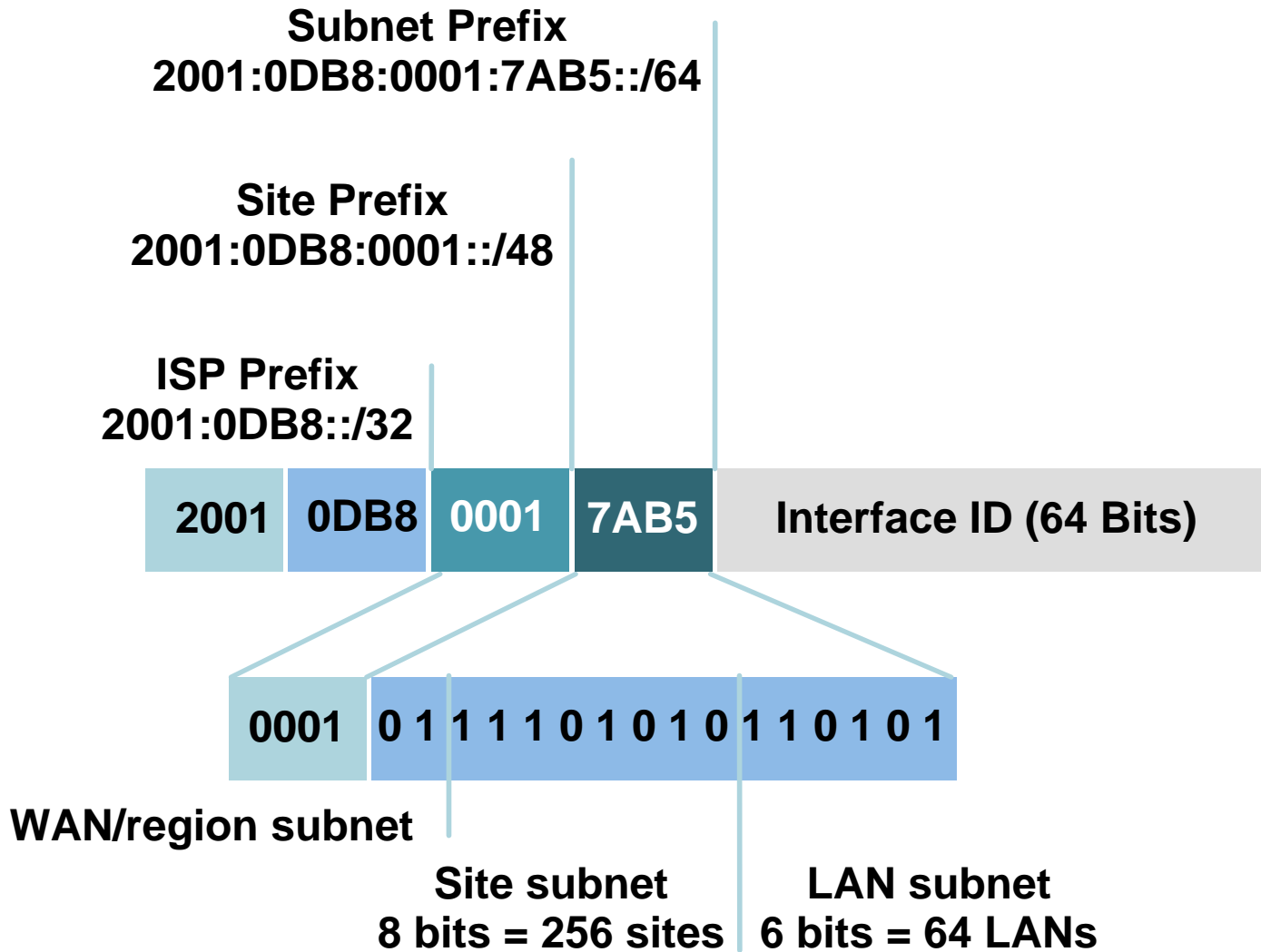
    The perimeter security model is still valid with IPv6

DoD IPv6 Address Management

IANA

APNIC   ARIN   RIPE

Regional Internet Registries (RIRs)

Local Internet Registries

ISP   DoD NIC

National Internet Registries (NIRs)

EU   USN NIC   USA NIC   MCNOC   USAF NIC

DOI IPv6 Address Management

IANA

Regional Internet Registries (RIRs)

APNIC   ARIN   RIPE

Local Internet Registries

ISP   DOI NIC

2001:49C8::/32

National Internet Registries (NIRs)

EU   BLM   BOR   FWS   MMS

NBC   NPS   OSM   USGS

2001:49C8:04XX::/40

BIA/OST/OHA/SOL

IPv6 Addressing Plan

Subnet Prefix
2001:0DB8:0001:7AB5::/64

Site Prefix
2001:0DB8:0001::/48

ISP Prefix
2001:0DB8::/32

| 2001 | 0DB8 | 0001 | 7AB5 | Interface ID (64 Bits) |

| 0001 | 0 1 1 1 1 0 1 0 1 0 1 1 0 1 0 1 |

WAN/region subnet

Site subnet
8 bits = 256 sites

LAN subnet
6 bits = 64 LANs

IPv6 Code Assessment

- Tools for assessing application source code for IPv4/v6 calls.

  Looks for lines in code that may be version-specific

  Similar to Y2K assessment utilities

- For hosts that are written on Microsoft platforms we can use Checkv4.exe to identify if the source code is IPv6-ready.

  http://msdn2.microsoft.com/en-us/library/ms740624.aspx

- For other systems we can use Sun Microsystem's Socket Scrubber.

  It can be compiled on a variety of Unix systems and check the source code for IPv4-only system calls.

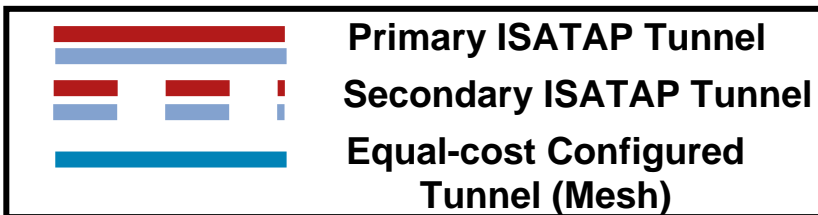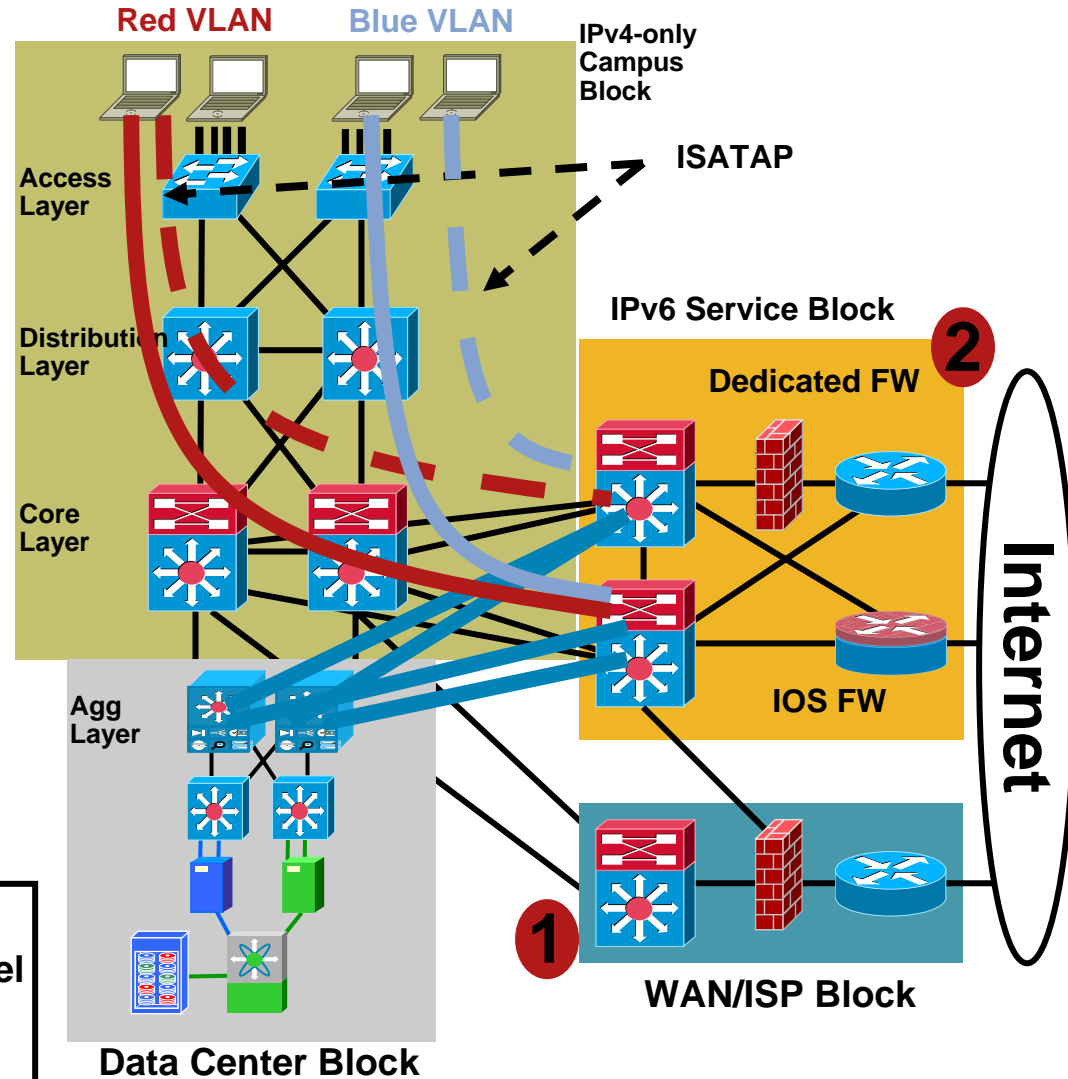- If you have any Tru64 systems there is an IPv6 Porting Assistant

  http://h30097.www3.hp.com/internet/ipv6portingassistant/

IPv6 Implementation

- Planning will prevent issues related to IPv6 from impacting current IPv4 network

- Dual stack where you can, tunnel where you must

    Chose simplicity over complexity

- Security will be key to your strategy

    IPv6 must have the same protections as IPv4

    Purchase new firewalls for IPv6 rather than tunnel IP Protocol 41 through IPv4 firewalls

    Apply best practices for IPv6 filtering and security

    Least privilege, defense in depth, diversity of defense, choke point, weakest link, fail-safe stance, universal participation

IPv6 Service Block

- Provides ability to rapidly deploy IPv6 services without touching existing network

- Provides tight control of where IPv6 is deployed and where the traffic flows (maintain separation of groups/locations)

- Provides basic HA of ISATAP

- ISATAP tunnels from PCs in Access layer to service Block switches

- In this example configured tunnels are used from Data Center to Service Block

- Dependency on ISATAP alienates IPv6 multicast applications

- 1) Leverage existing ISP block for both IPv4 and IPv6 access

- 2) Use dedicated ISP connection just for IPv6 – Can use IOS FW or PIX/ASA appliance

Red VLAN **Blue VLAN** **IPv4-only Campus Block**

ISATAP

Access Layer

Distribution Layer

Core Layer

Agg Layer

IPv6 Service Block

2

Dedicated FW

IOS FW

Internet

1

WAN/ISP Block

Data Center Block

▬▬▬	**Primary ISATAP Tunnel**
▬ ▬ ▬	**Secondary ISATAP Tunnel**
▬▬▬	**Equal-cost Configured Tunnel (Mesh)**

Potential DNS Issues

- Current BIND 9 answers to IPv4 or IPv6 queries

- Old client resolvers may not accurately handle receiving an A and an AAAA

    NXDOMAIN or No Answer

    Client can't reach v4 or v6 site

- Issues with zone transfers between unlike DNS servers

- Consider using a separate dual-stack DNS server for your IPv6 entries
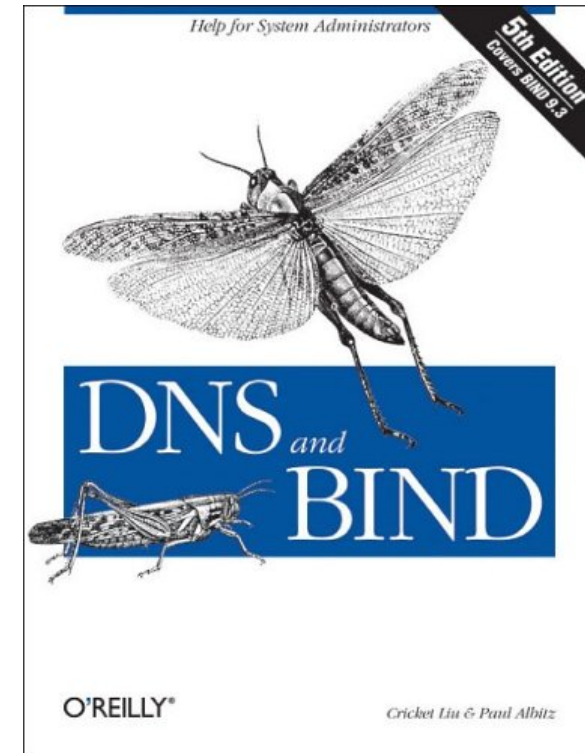
IPv6 Transition Techniques

- No flag day!

- "It's like rebuilding a car engine when the car is traveling 100 mph"

- Upgrade all hosts at one time - not likely/plausible

- Enable host address auto-configuration

    Allows for graceful renumbering

- Dual-stack, tunneling to be used in combination

    Dual-stacking adds complexity and CPU utilization

    Remember to remove tunnels when done (full IPv6)

- Start IPv6 at the edge and then move toward the core

    Less popular because it requires more tunnels

- Start IPv6 at the core and then move toward the edge

    More popular because it uses dual-stack in the core

IPv6 Network Operations

- Increased operational costs due to running dual stack

  Dual stack is not the point of arrival

  Dual-stacking will increase CPU and memory utilization by 15 to 25%

  Performance issues with equipment that is optimized for IPv4 but not IPv6

  Overhead caused by maintaining IPv4 and IPv6 routing tables, firewalls, DNS servers, etc.

- Operational teams need IPv6 troubleshooting skills

  Tunnels are more difficult to troubleshoot than physical links

- Configuration management systems will help monitor the transition

- Regular operational checks needed to insure operations

IPv6 Management

- SNMP via IPv6

    Gather stats on both stacks if system is dual stacked

    IETF RFCs moving to having one MIB for v4/v6

- CiscoWorks Resource Manager Essentials (RME), LMS 2.5

    CiscoView, PathTrace, User Tracking

- CiscoWorks Campus Mgr, Device Fault Mgr

- Cisco NetFlow Collector 5.0

- Service Assurance Agent (SAA) for IPv6

- Network Analysis Module (NAM)

- HP-OV NNM Advanced Edition 7.5

    Smart Plug-in (SPI) for Advanced Routing

IPv6 Challenges

- There is no IPv6 capability or feature of the Internet that you can't do today with IPv4.

- Something new to learn - addresses are difficult to remember

- Larger header – more bits to read in order to get to destination address – requires hardware acceleration

- Effort required to make transition but hopefully operational cost savings with IPv6

- End users won't notice the improvement – users aren't asking for IPv6 services

- Multi-homing is not solved (IETF Multi6 WG)

- May break older IPv4-only applications

- New IPv6 enabled apps will need to be developed

Cisco 7500 Migration Paths to New Platforms

Cisco Catalyst 6500 Series

Cisco 7600 Series

Cisco 7200 Series

Performance and Services Density
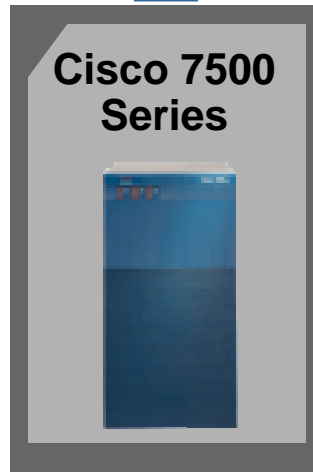
* smaller scale deployments

Cisco 7500 Series

Positioned for:

New technologies

New integrated services

New network architectures

While providing:

Operational consistency

Investment protection

In-kind services and interfaces
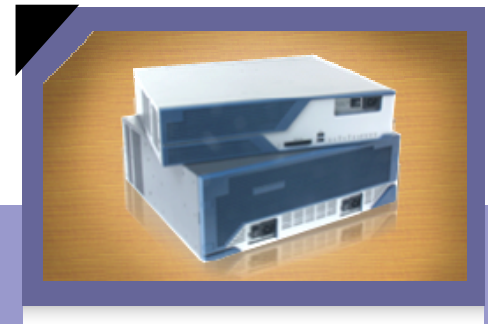
The Routing Evolution: Migrating Legacy Routers to ISRs

Cisco 1800 Series

Cisco 2800 Series

Cisco 3800 Series

Cisco 1600 Series

Cisco 1721

Cisco 1751/1760

Cisco 2500 Series

Cisco 2600 Series

Cisco 3600 Series

Cisco 3700 Series

Other vendors

Performance and Services Density

The Switching Evolution: Migrating Legacy Switches

Performance and Services Density

Summary

- An IPv6 transition is already underway in the federal government and other parts of the world.

- IPv6 infrastructure and host operating systems are ready now!

- Cisco is a leader in IPv6 and has a full-set of IPv6 products

- Much of the infrastructure you have already purchased is IPv6 capable, it's just a matter of enabling (software upgrade)

- GTRI can assist with transition planning

    Perform your assessment

    Create a migration strategy

    Create a test lab or leverage other test labs and start experimenting.

    Dual stack some of your systems

    Test DNS and focus on your other applications

- The sooner we begin the transition, the sooner we will be done.

Q and A

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