Cisco live!

What You Make Possible

TOMORROW starts here.

CISCO

Inside Cisco IT: Making the Leap to IPv6

COCRST-2464

TOMORROW starts here.

IPv6 Sessions

- BRKRST-1069 Understanding IPv6
- BRKRST-2301 Enterprise IPv6 Deployment
- BRKRST-2311 IPv6 Planning, Deployment and Troubleshooting
- BRKSEC-2003 IPv6 Security Threats and Mitigations
- BRKSPG-2604 Deploying Carrier Grade IPv6 using CGSE
- **COCRST-2464 Inside Cisco IT: Making The Leap To IPv6**
- TECRST-2661 Hands on Experience with IPv6

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Agenda

- Overview
  - Introduction to Cisco IT
  - Making the case for IPv6
  - IPv6 Journey
  - Target State
- Preparation
- Implementation Tracks
  - Ubiquitous IPv6 Access
  - IPv6 Internet Presence
- Lessons Learned

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Introducing Cisco

The Global Cisco Family

- 300 locations in 90 countries
- 450+ buildings
- 51 Data Centres and server rooms
- 1500+ labs world wide (500+ in San Jose)

- 66,000+ Employees
- 20,000 Channel Partners
- 110+ Application Service Providers
- 210+ Business and Support Development Partners

Over 180,000 people around the world in the extended Cisco family

Estimated Numbers

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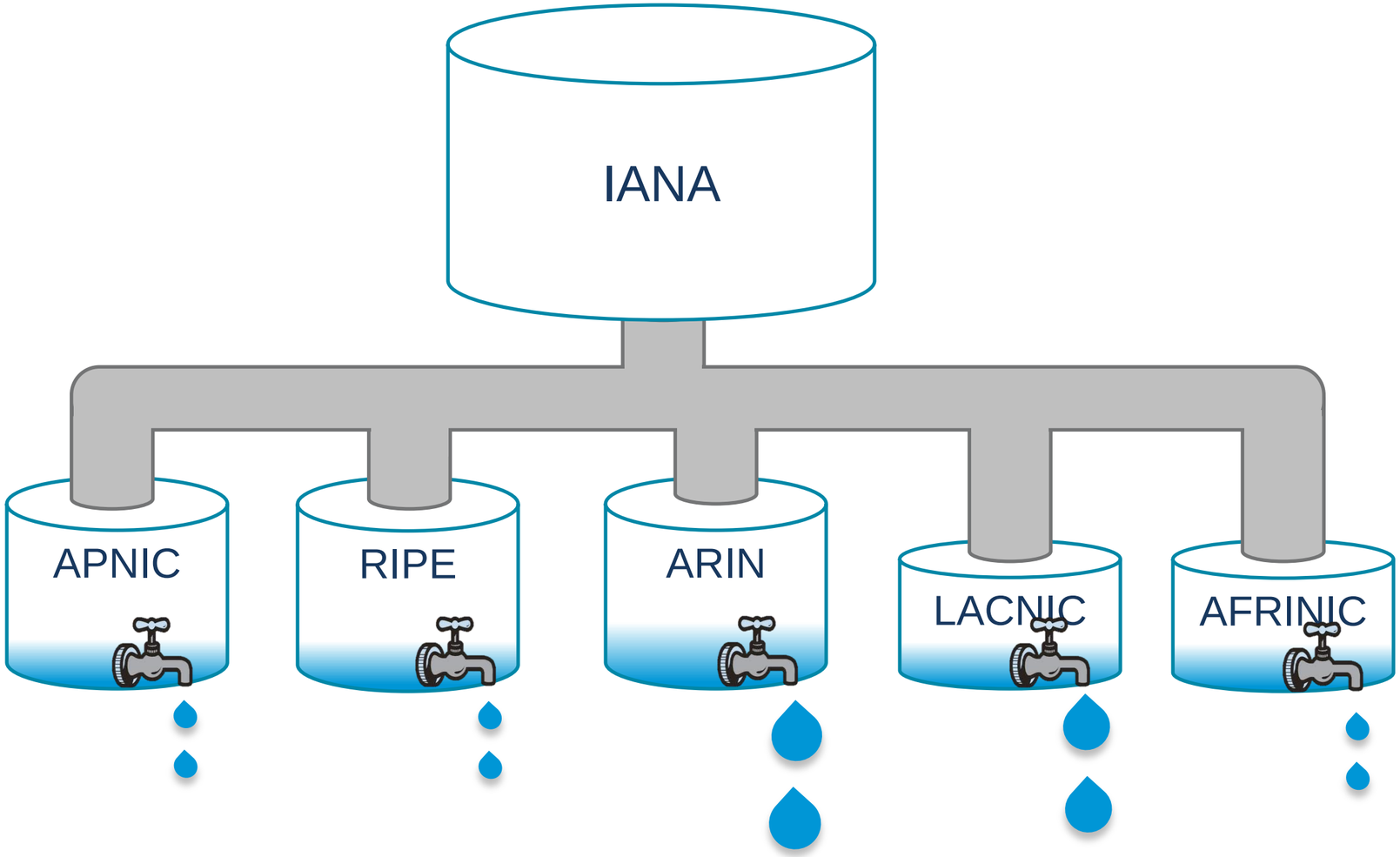
IPv4 Exhaustion



v4 Exhaustion

IPv4 & IPv6 Statistics

RIR v4 IPs Left

AfriNIC	54,253,568
APNIC	18,510,848
ARIN	99,174,144
LACNIC	43,999,744
RIPE	17,272,832

v6 ASNs
15% (6,535/43,120)

v6 Ready TLDs
86% (272/316)

v6 Glues
11,466

v6 Domains
4,162,456

0

days remaining
IANA exhausted

HURRICANE ELECTRIC INTERNET SERVICES

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Making the Case for IPv6

Business Drivers

Leadership and Mindshare
Product Readiness

IT Drivers

Product Development and Testing
Continuity and Growth
Cisco on Cisco

Goals

IPv6 Internet Presence
Ubiquitous IPv6 Access

Constraints

Maintain IPv4 SLA & Security Posture
Funding & Resourcing
Product & Service Gaps

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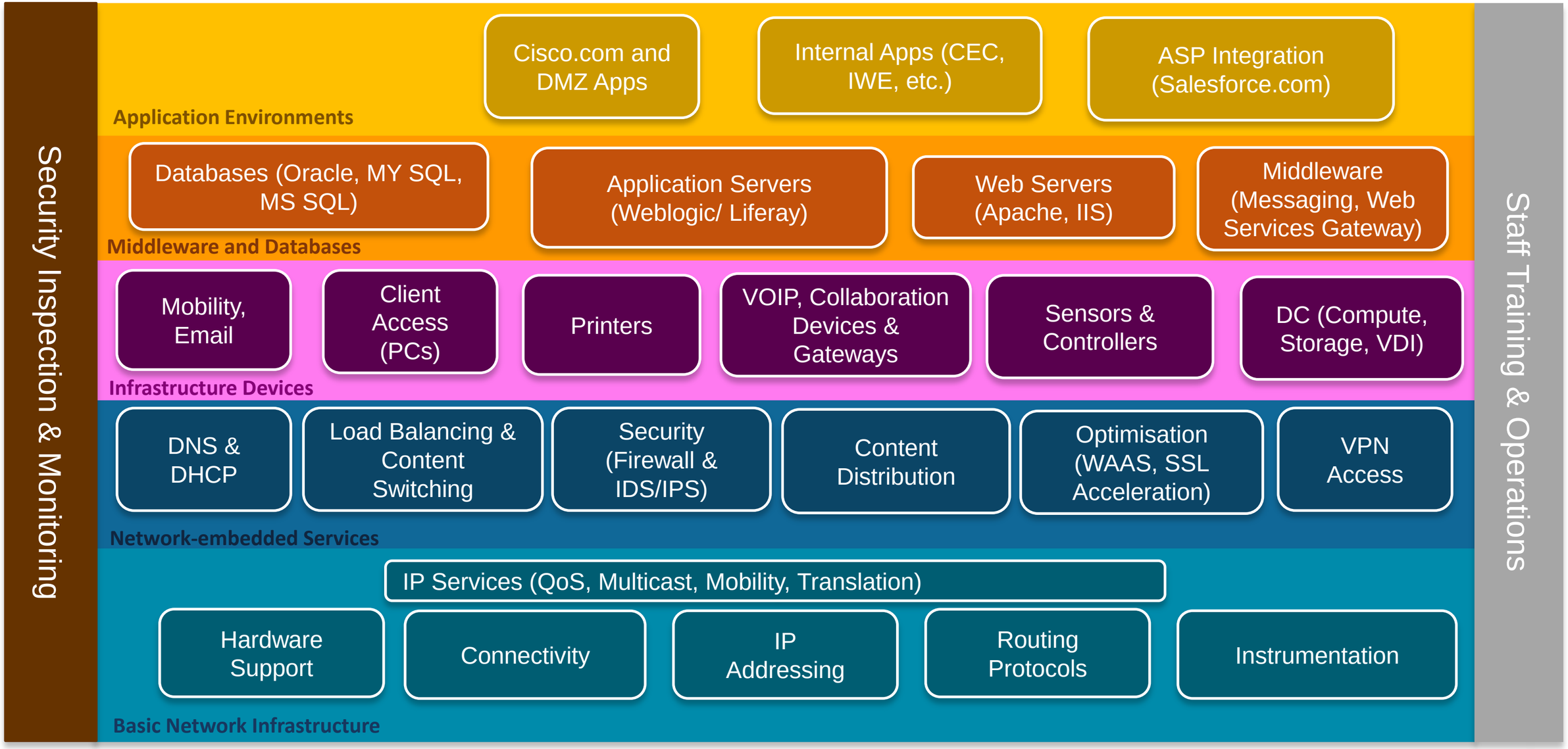
Cisco IT “Stack”



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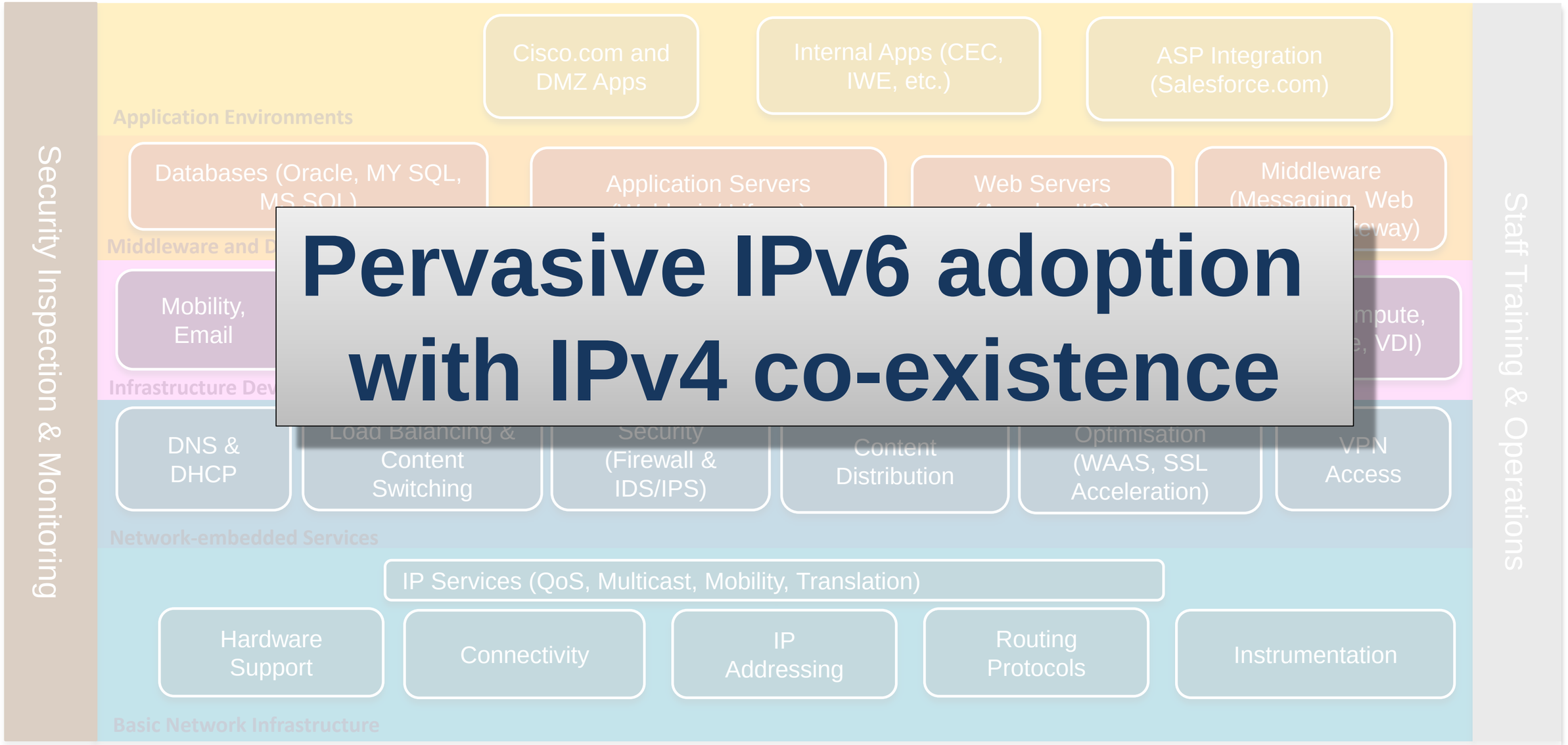
Setting IPv6 Scope



Pervasive IPv6 adoption with IPv4 co-existence

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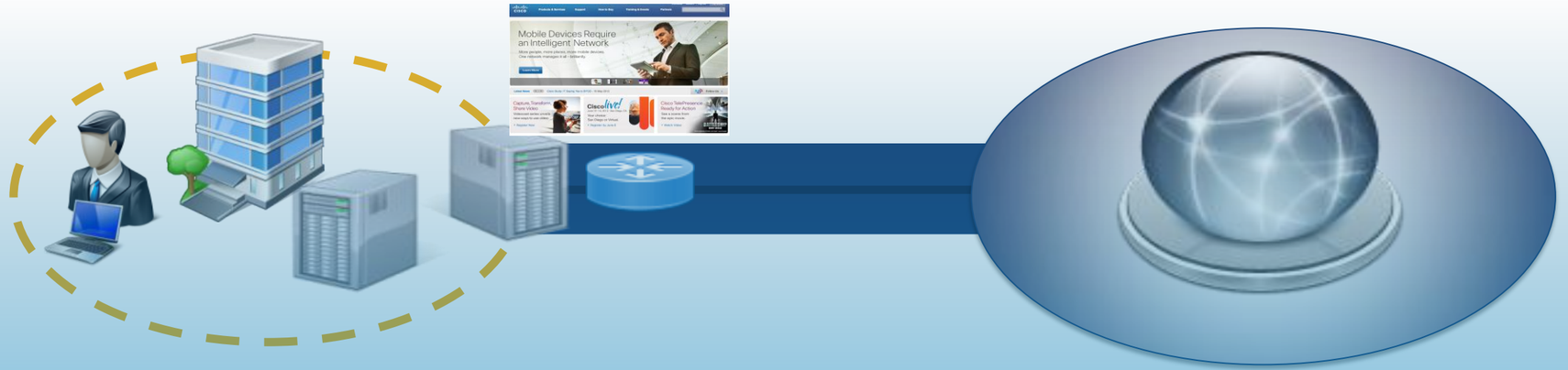
IPv6 Target State

IPv6 Internet Presence

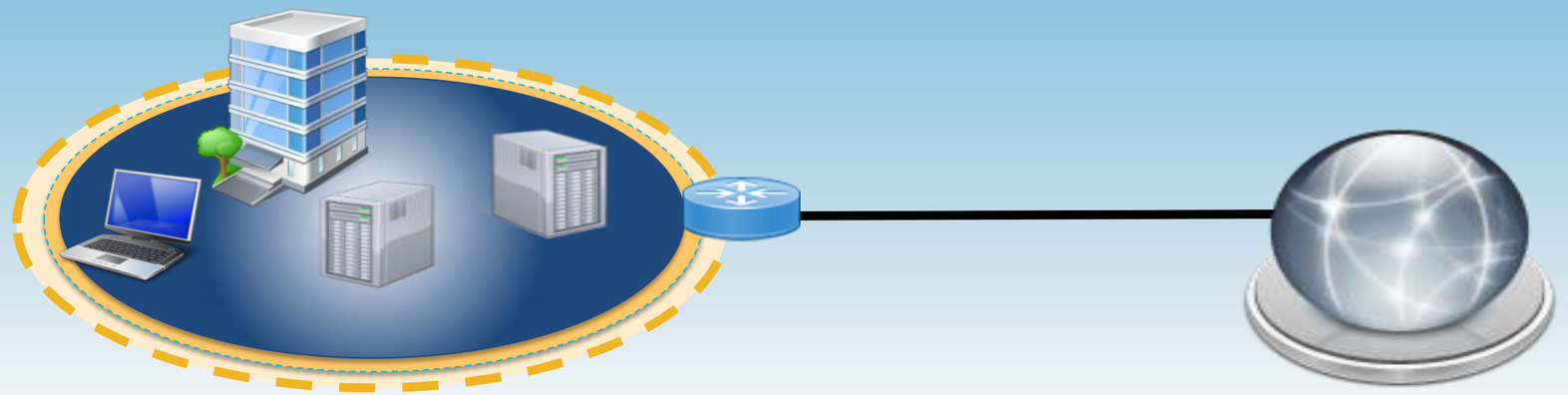
- Internet Evolution
- Business Continuity
- Customers, partners, employees



IPv6 Internet

Ubiquitous IPv6 Access

- Globalisation
- Technology Leadership
- Product Development



Dual-Stack Enterprise

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The IPv6 Journey – A High Level View

IPv4-only → IPv4 and IPv6 co-exist → IPv6-only

2002-2009 | 2010 | 2011 | 2012 | 2013 | 2014

IPv6 Internet Presence (Outside-In)

- www.ipv6.cisco.com
- www.cisco.com accessible over IPv6
- Entire cisco.com platform accessible over IPv6

Ubiquitous IPv6 Access (Inside-Out)

- On-demand tunnel services
  Dual stack "alpha" networks
- Dual stack global core
  Resilient tunnel services
- Dual stack user access (pilot)
- Dual stack user access (prod)
  Dual stack internal DC and apps

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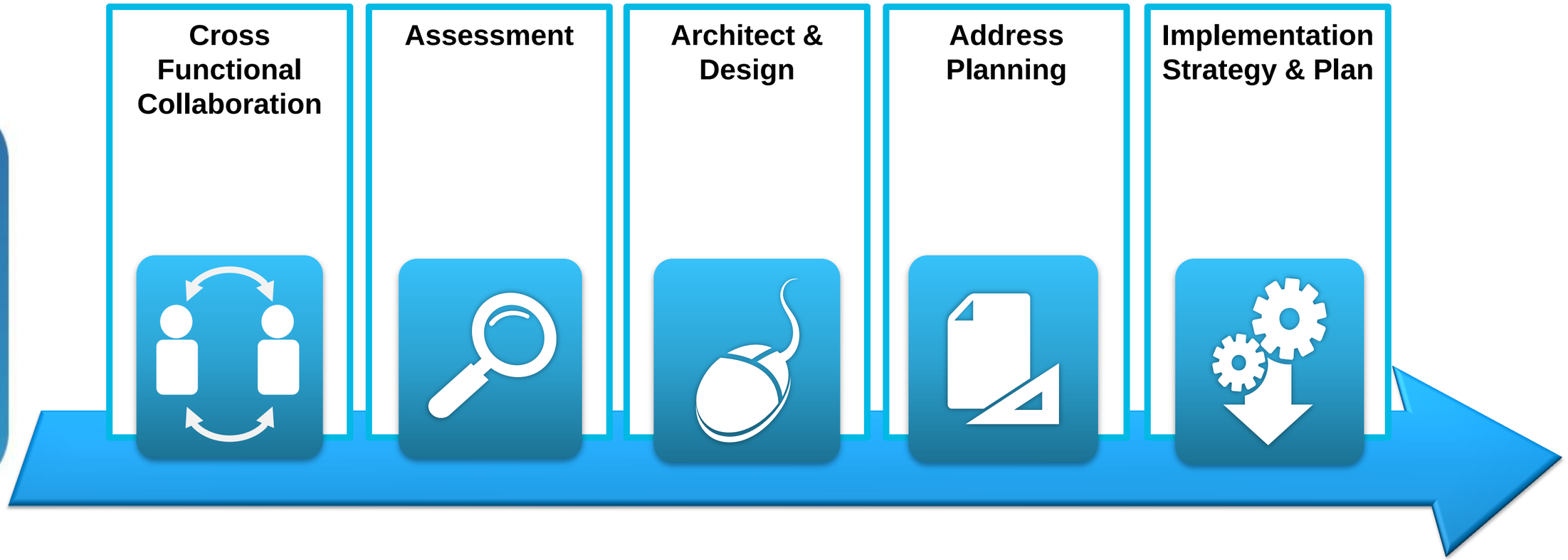
Preparation



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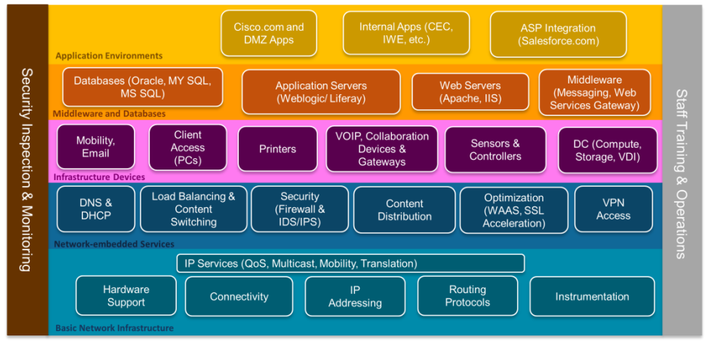
Preparation
Cross Functional Collaboration

- Example of the need for wide cross functional collaboration across IT on IPv6
- Preparation and execution required participation of team members from 7 of 9 of CIO's direct reports



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Preparation

Assessment

- Cisco products, features
  - Engaged Advanced Services for network IPv6 readiness report
- Other vendors
- Tools
  - Security
  - Network management
- Service providers
- Applications behind www.cisco.com

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Preparation
Architect and Design

- Architectural decisions
  - Which routing protocol ?
  - SLAAC vs DHCPv6 ?
  - Code selection and qualification
- Documentation
  - Any new documentation required ?
  - Assess which existing designs are impacted and assign owners
  - Extra review board resources

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Preparation
IPv6 Address Planning

- Established IPv6 Addressing policy
- Address management tool support for IPv6
- Hierarchical Model – Global, Regional, Sub-Regional and Site levels
- Template-based addressing - easy for Implementation and Operations Teams

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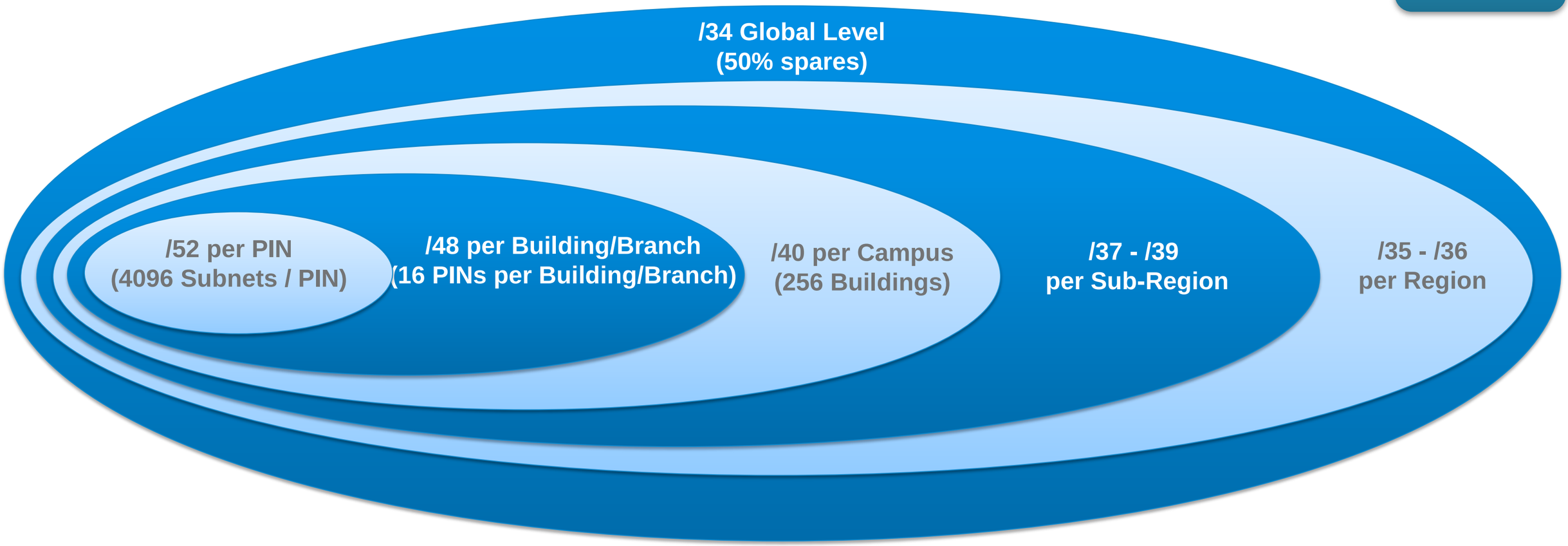
Preparation
IPv6 Address Planning



PIN = Place In the Network

A framework to classify functional areas of the network
eg, Lab, Desktop, DC, DMZ etc

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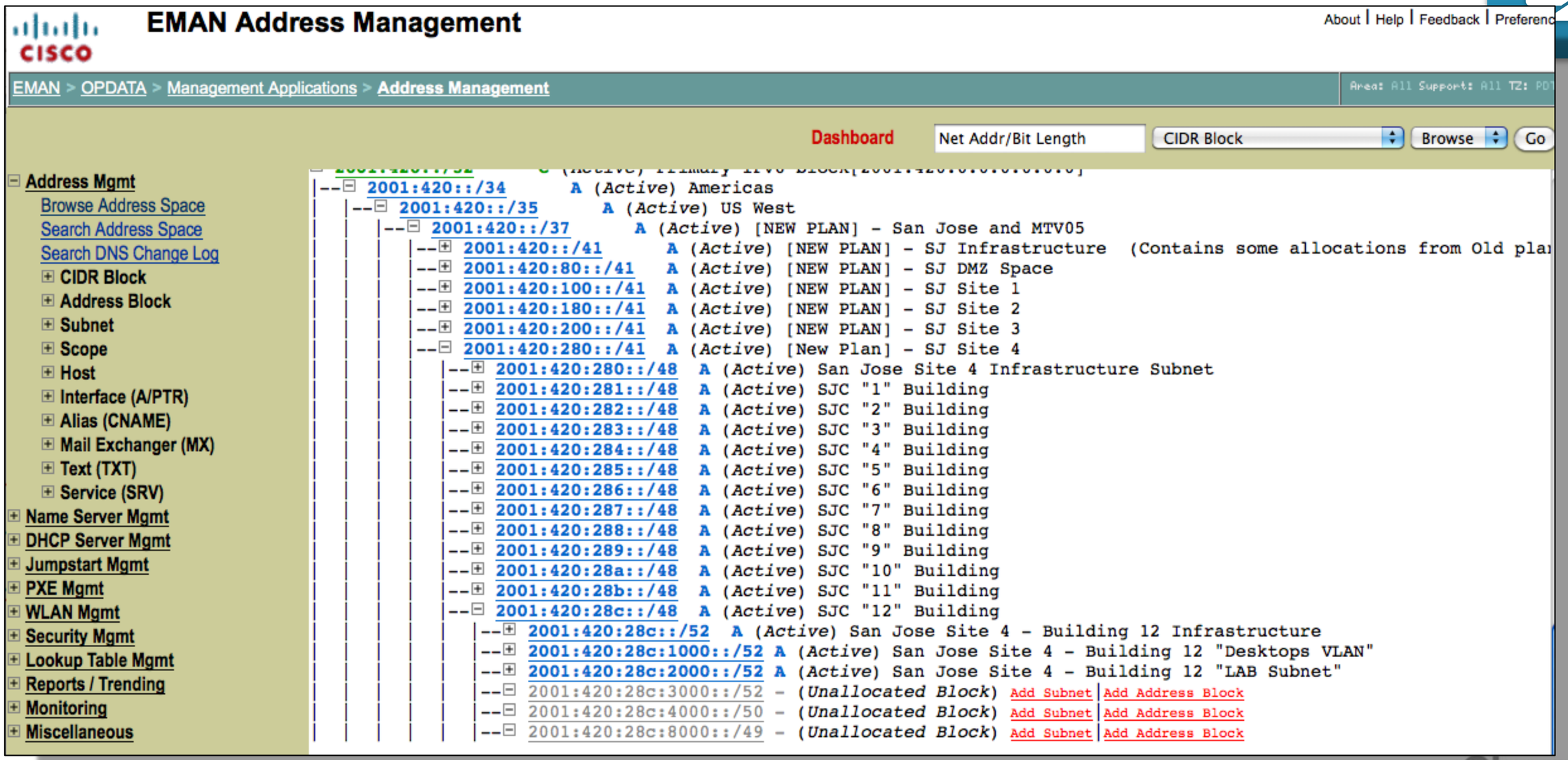
Preparation

IPv6 Address Planning



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Preparation

Implementation Strategy and Plan

"Dual stack where you can, tunnel where you can't and NAT only when have to"

- Long term plan that absorbs cost in established lifecycle process rather than rip and replace
- Have a quick and scalable solution in hand to relieve delivery pressure
- Rip and replace only where necessary (Fast track projects)
- Management via IPv4 with IPv6 service monitoring
- On going training and exposure for I & O teams

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Ubiquitous IPv6 Access

Long Term Plan - Dual Stack the Network

- Core to edge rollout
- Multi-year plan absorbed into existing lifecycle management
  - Simultaneous projects across Desktop, DC, Remote Access, iPoPs
  - Accelerated deployment for select remote sites / services
- Dual stacked services
  - DNS, IP address management, DHCPv6
- Routing protocol same as IPv4 - EIGRP
- SLA same as IPv4

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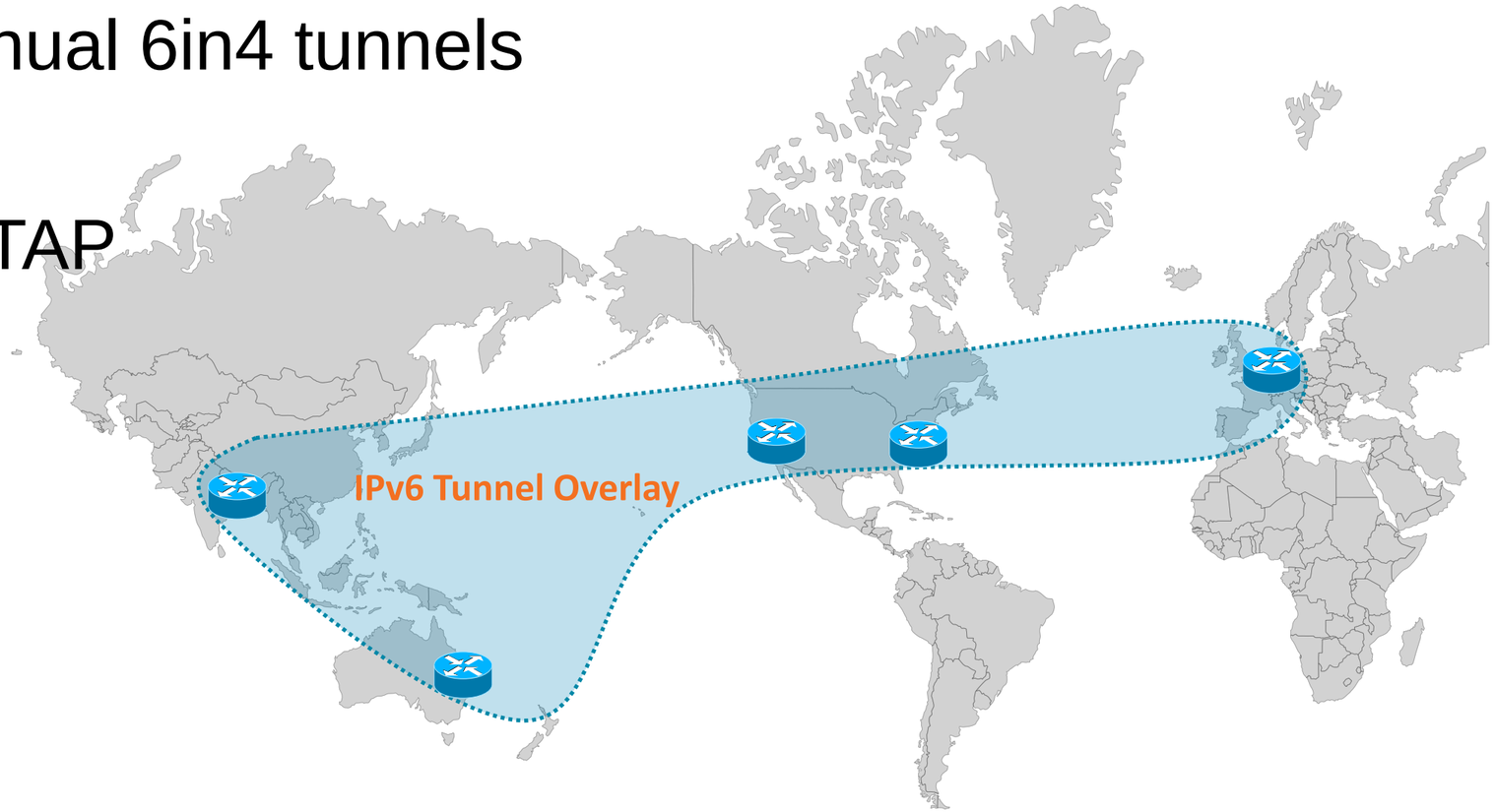
Ubiquitous IPv6 Access

Short Term Plan – Tunnel Infrastructure

- Dual stacked core + Global tunnel infrastructure
- Building / Lab = Manual 6in4 tunnels
  - Evaluating LISP
- User = Anycast ISATAP
- SLA same as IPv4



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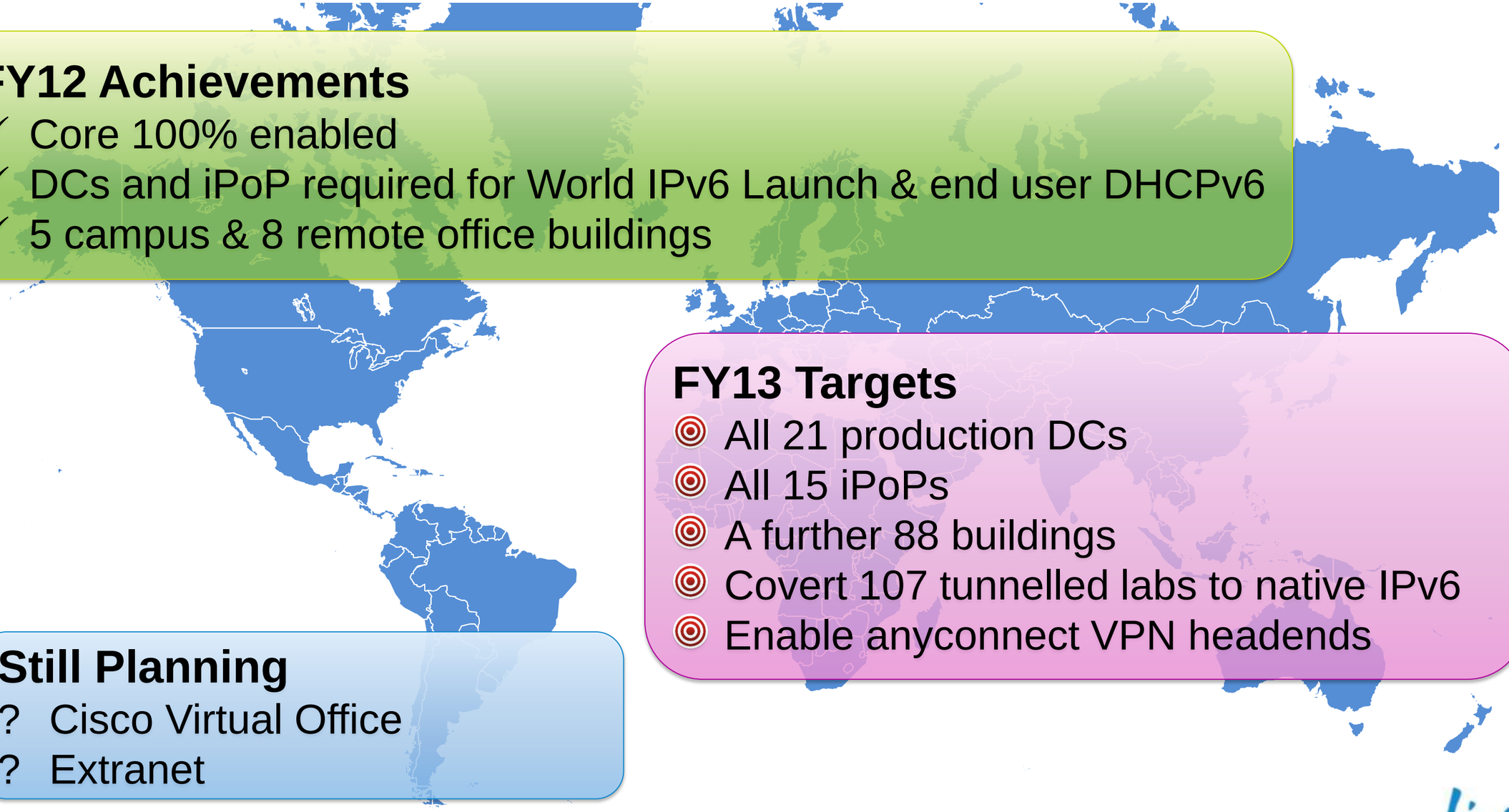
Network: IPv6 Status



FY12 Achievements

- ✓ Core 100% enabled
- ✓ DCs and iPoP required for World IPv6 Launch & end user DHCPv6
- ✓ 5 campus & 8 remote office buildings

FY13 Targets

- All 21 production DCs
- All 15 iPoPs
- A further 88 buildings
- Covert 107 tunnelled labs to native IPv6
- Enable anyconnect VPN headends

Still Planning

- ? Cisco Virtual Office
- ? Extranet

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On-demand tunnel services Dual stack “alpha” networks	Dual stack global core Resilient tunnel services	Dual stack user access (pilot)	Dual stack user access (prod) Dual stack internal DC and apps

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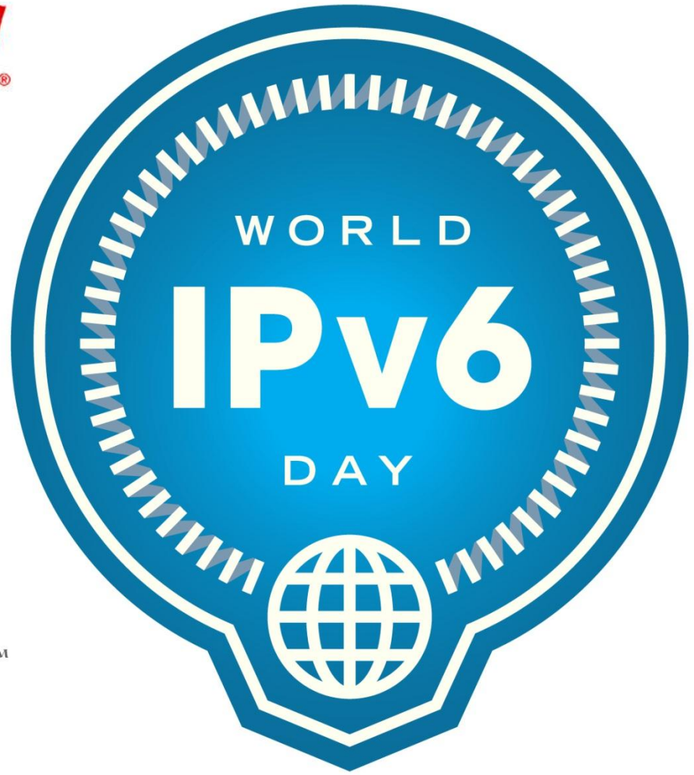

24 hour IPv6 “test flight” 8th June 2011

http://www.internetsociety.org/ipv6/archive-2011-world-ipv6-day

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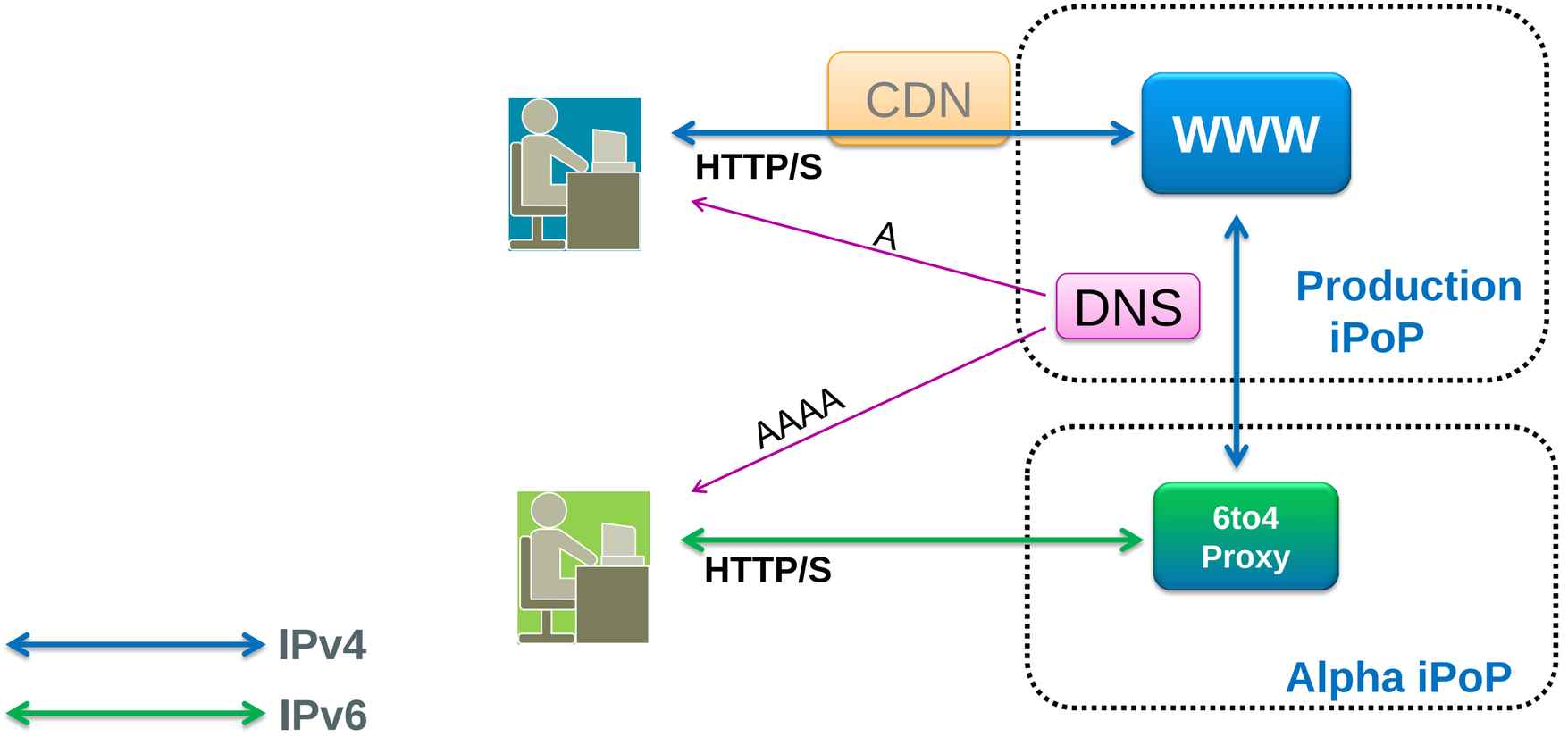
World IPv6 Day

- 6to4 reverse proxy solution
- Returned A and AAAA records for www.cisco.com



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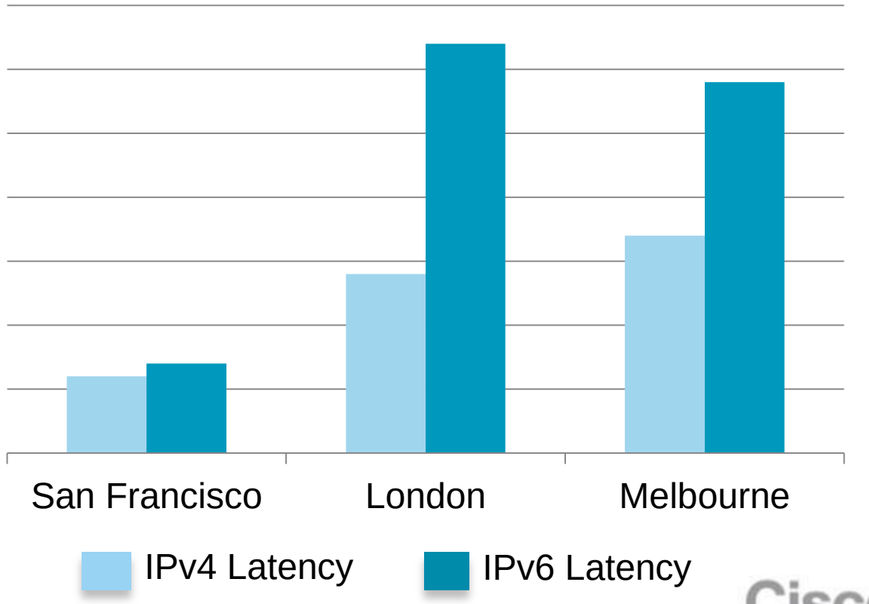
World IPv6 Day

Our Experience

- Network traffic volume based on NetFlow data
  - 1.11% of all traffic to/from www.cisco.com was IPv6
- Support Cases
  - No support cases for www.cisco.com related to World IPv6 Day
- IPv6 performance - Content served over IPv6 was NOT cached/accelerated by CDN. All content was served from a single origin in San Jose.



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www.worldipv6launch.org

3000+ WEB sites, 50+ Operators, 4 RHG vendors

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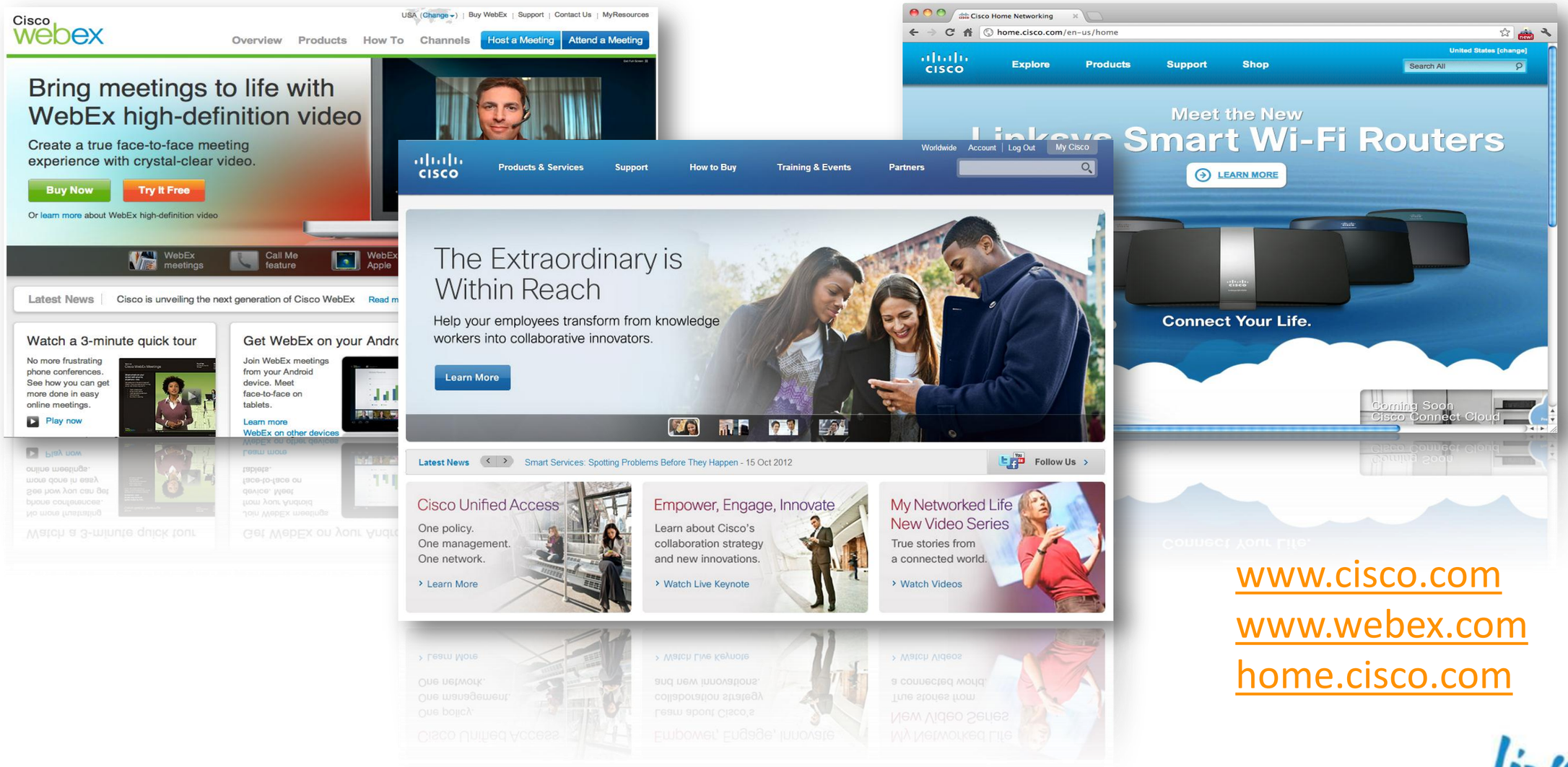
World IPv6 Launch @ Cisco



www.cisco.com
www.webex.com
home.cisco.com

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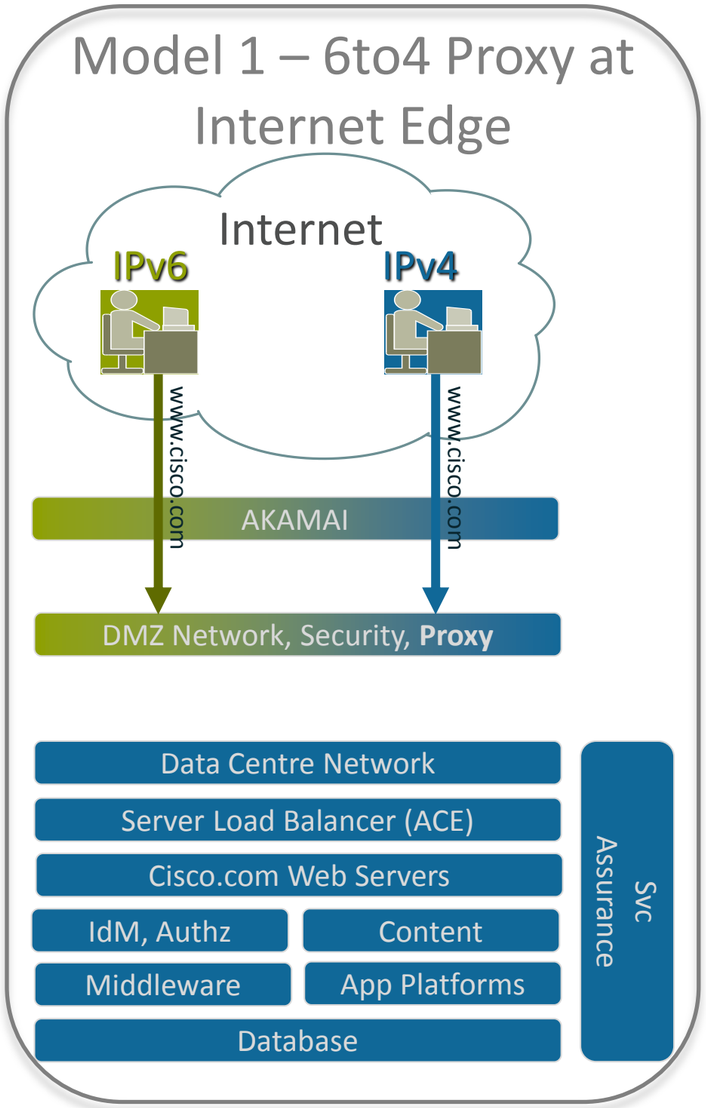
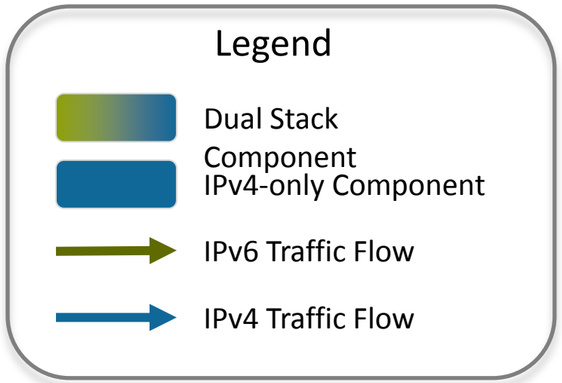
Cisco's IPv6 Web Presence

Architecture for www.cisco.com





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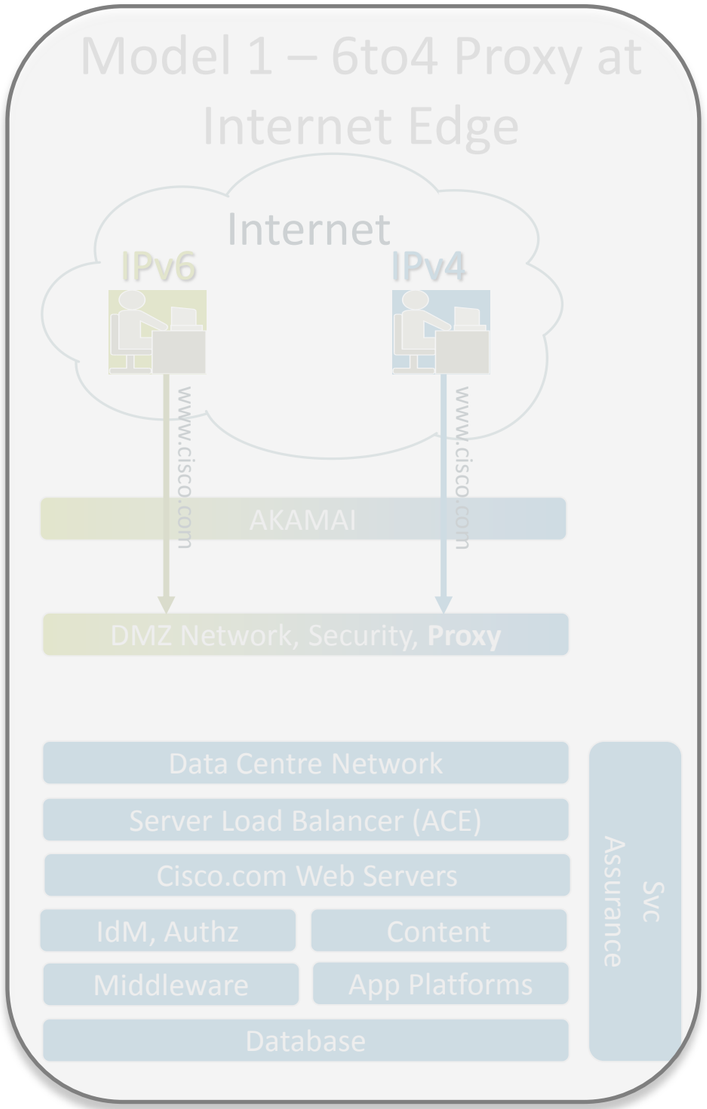
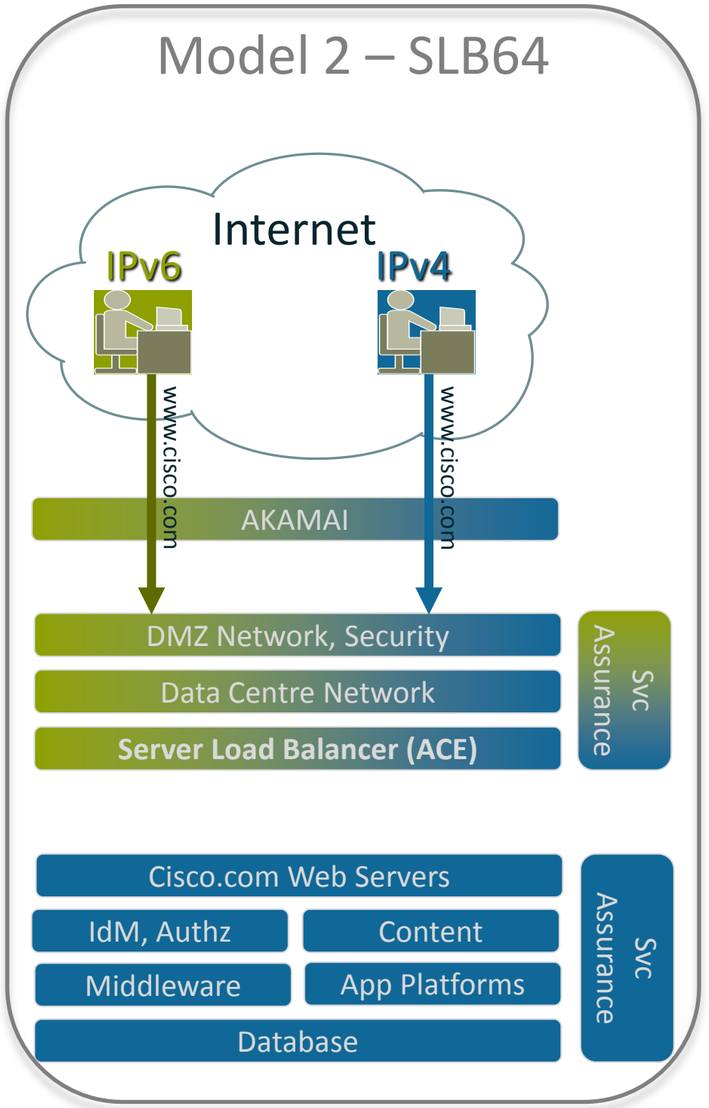
Cisco's IPv6 Web Presence

Architecture for www.cisco.com





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Cisco's IPv6 Web Presence

Architecture for www.cisco.com

Model 1 – 6to4 Proxy at Internet Edge

Model 2 – SLB64

Model 3 – Dual Stack Web Servers

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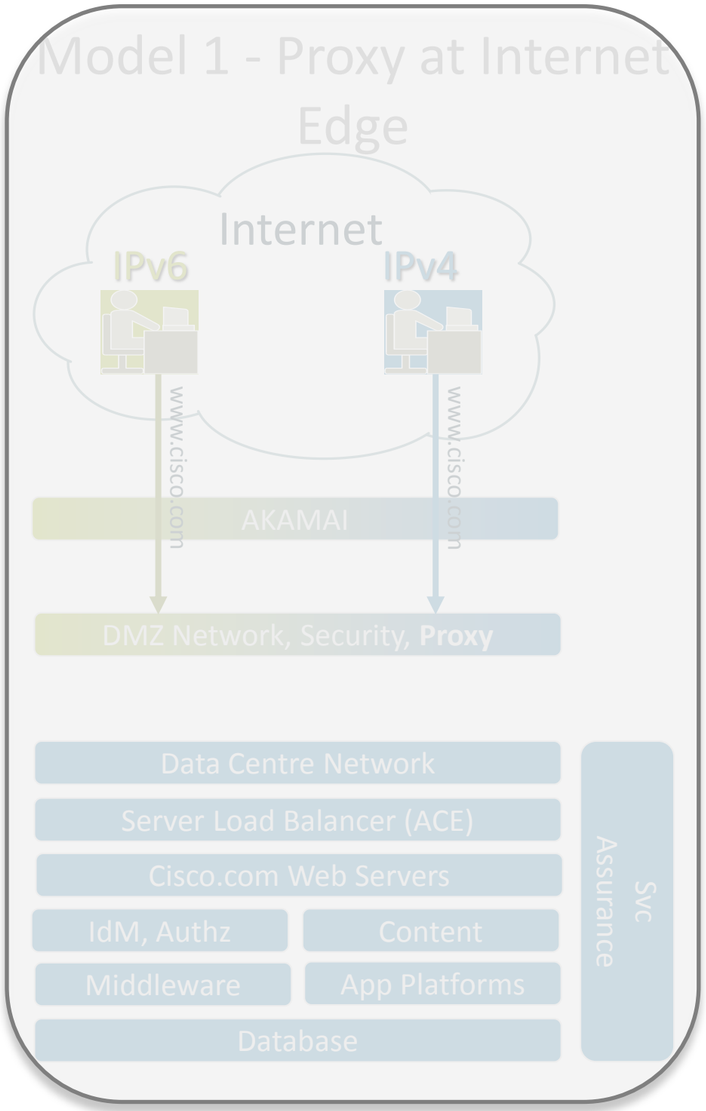
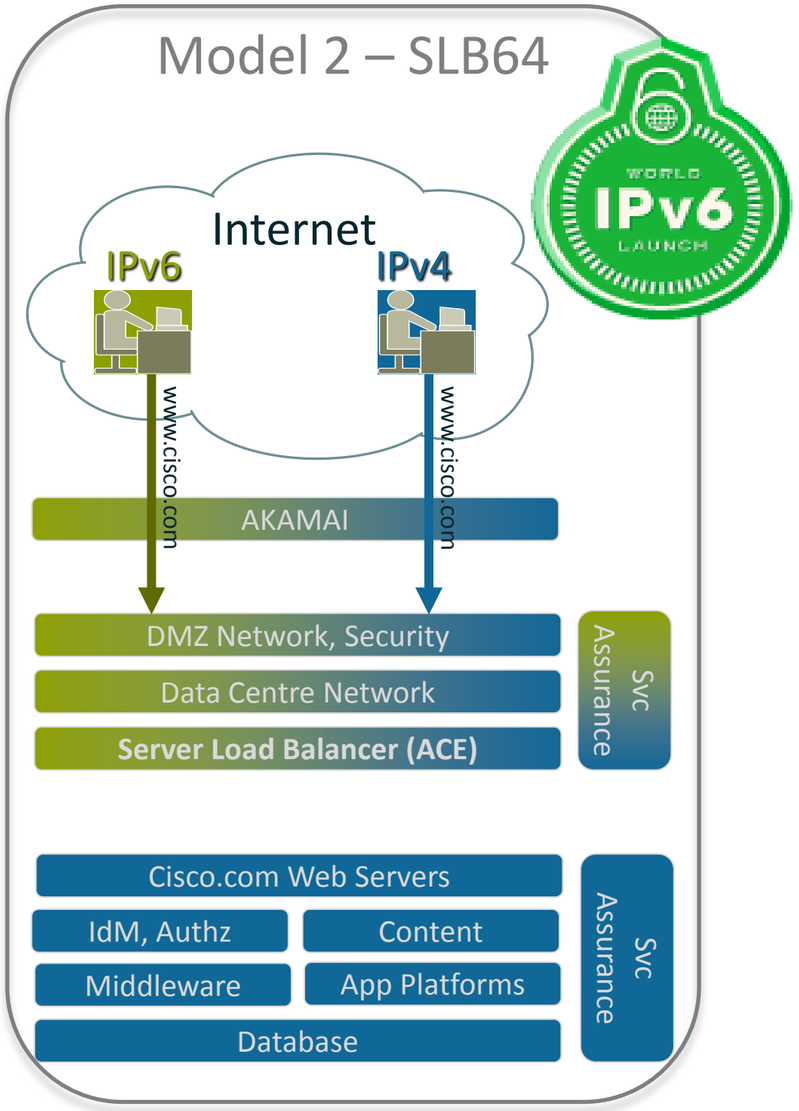
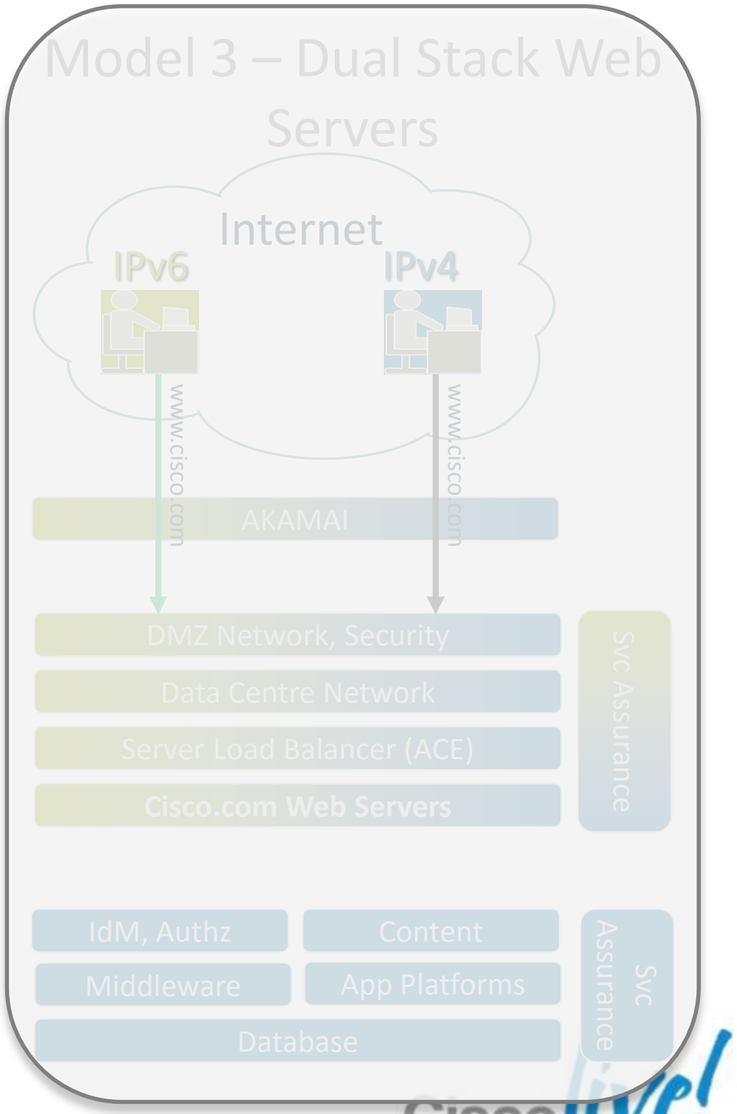
Cisco's IPv6 Web Presence

Architecture Decision for www.cisco.com







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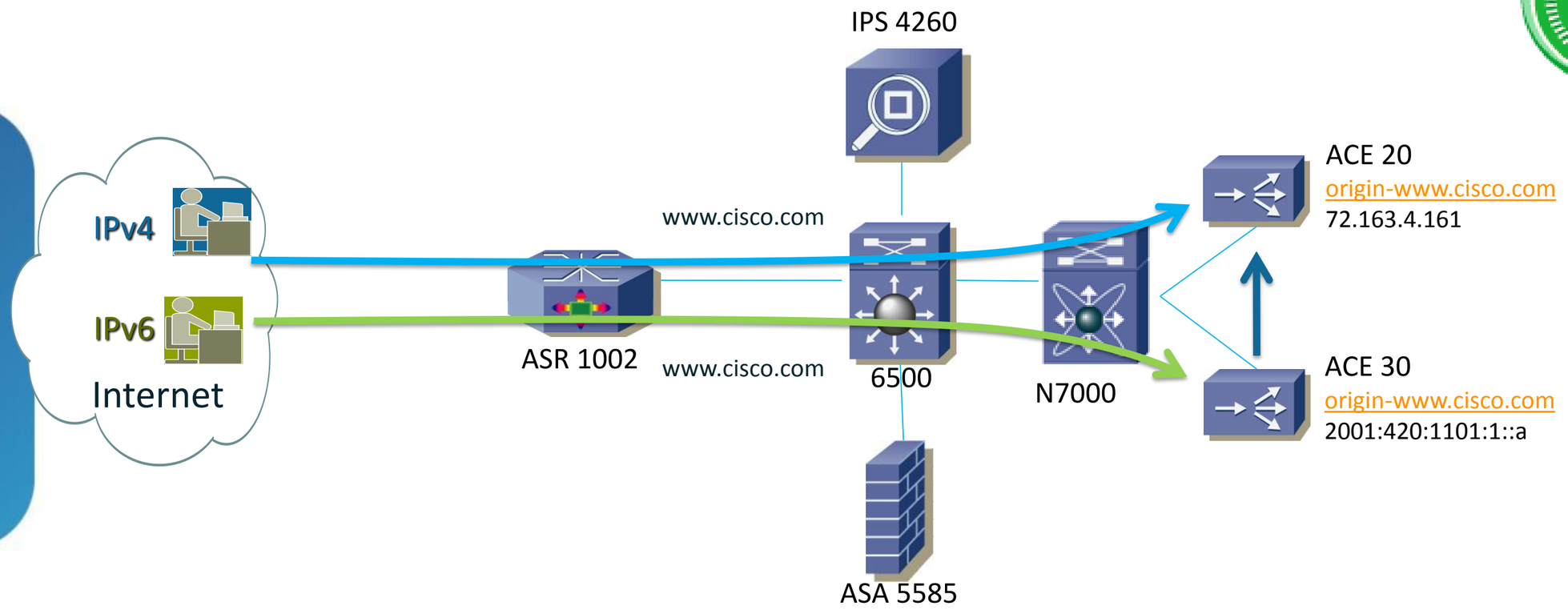
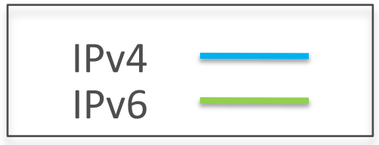
Cisco's IPv6 Web Presence

Design for www.cisco.com





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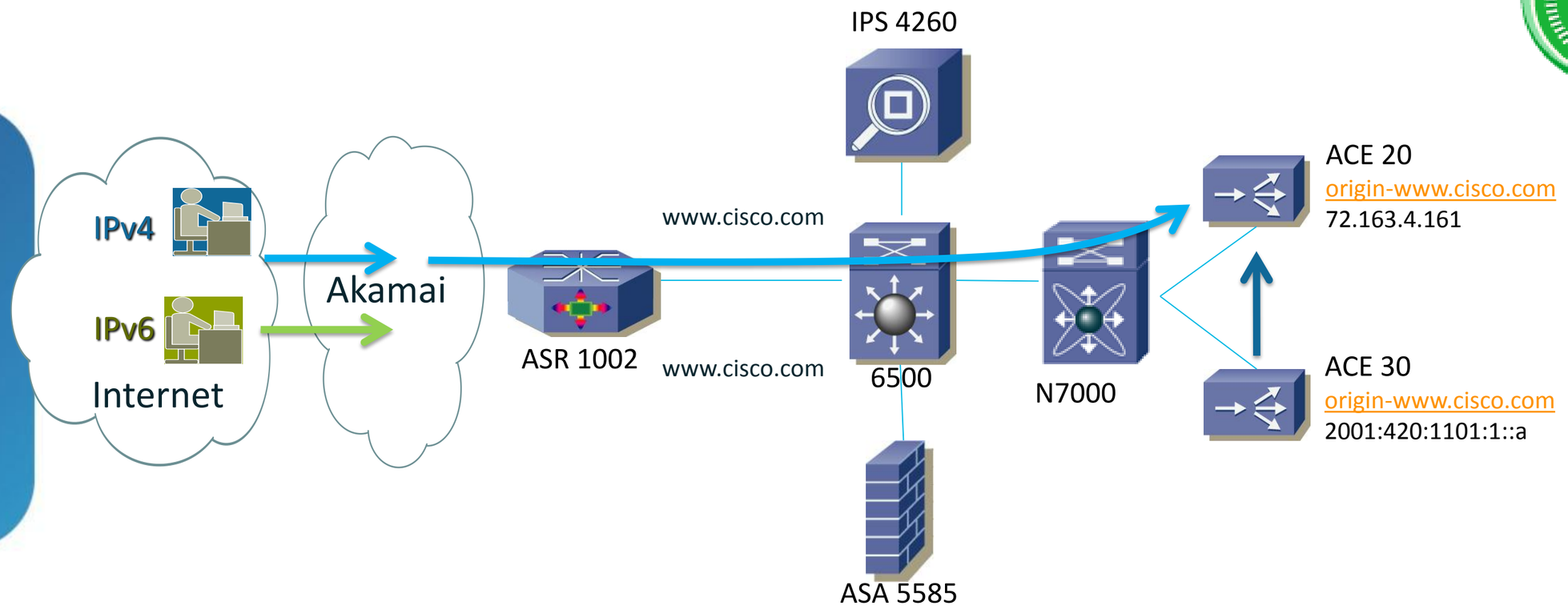

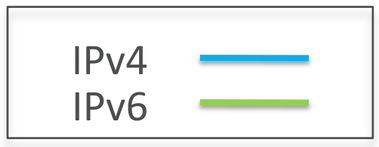

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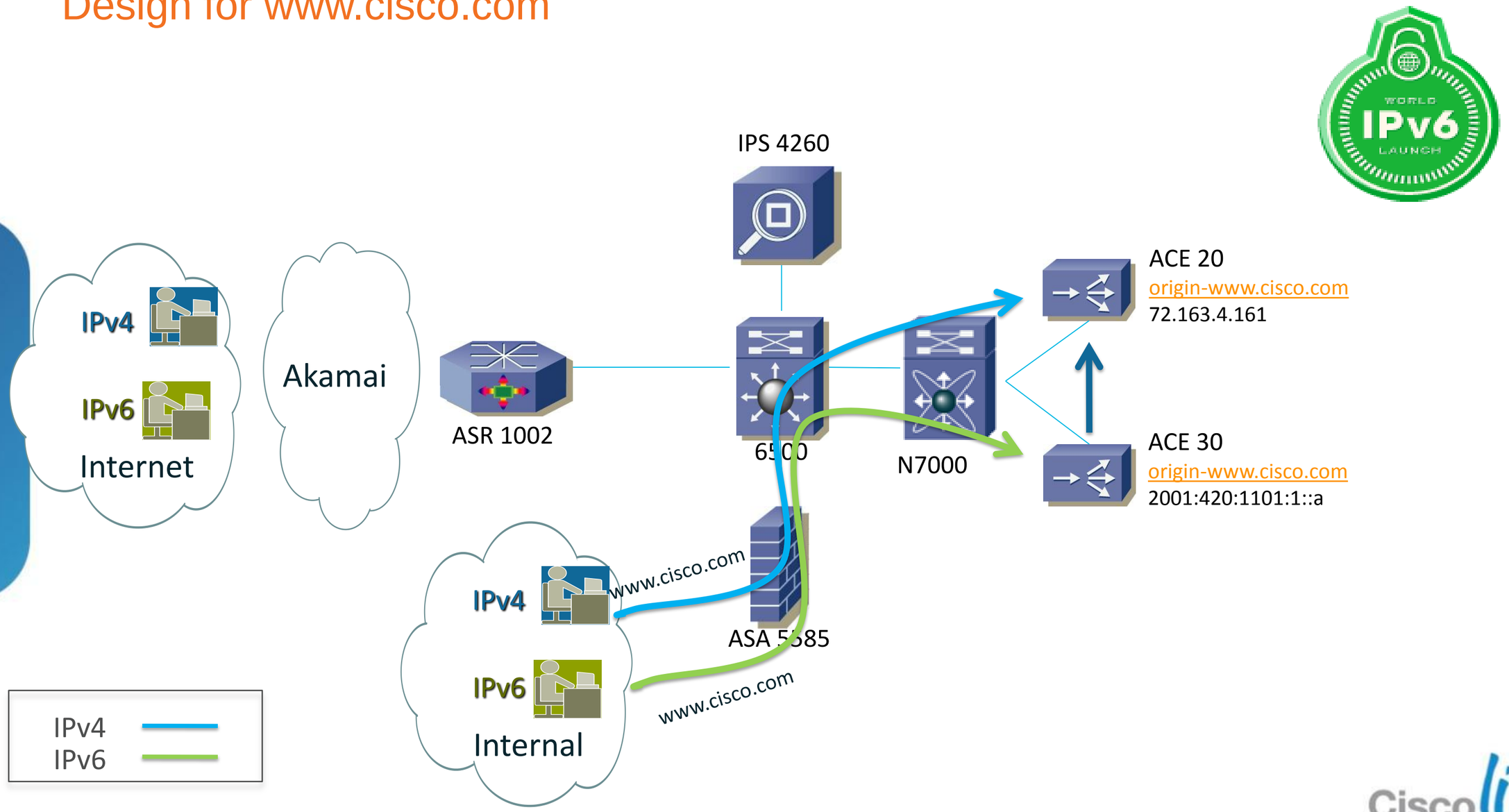

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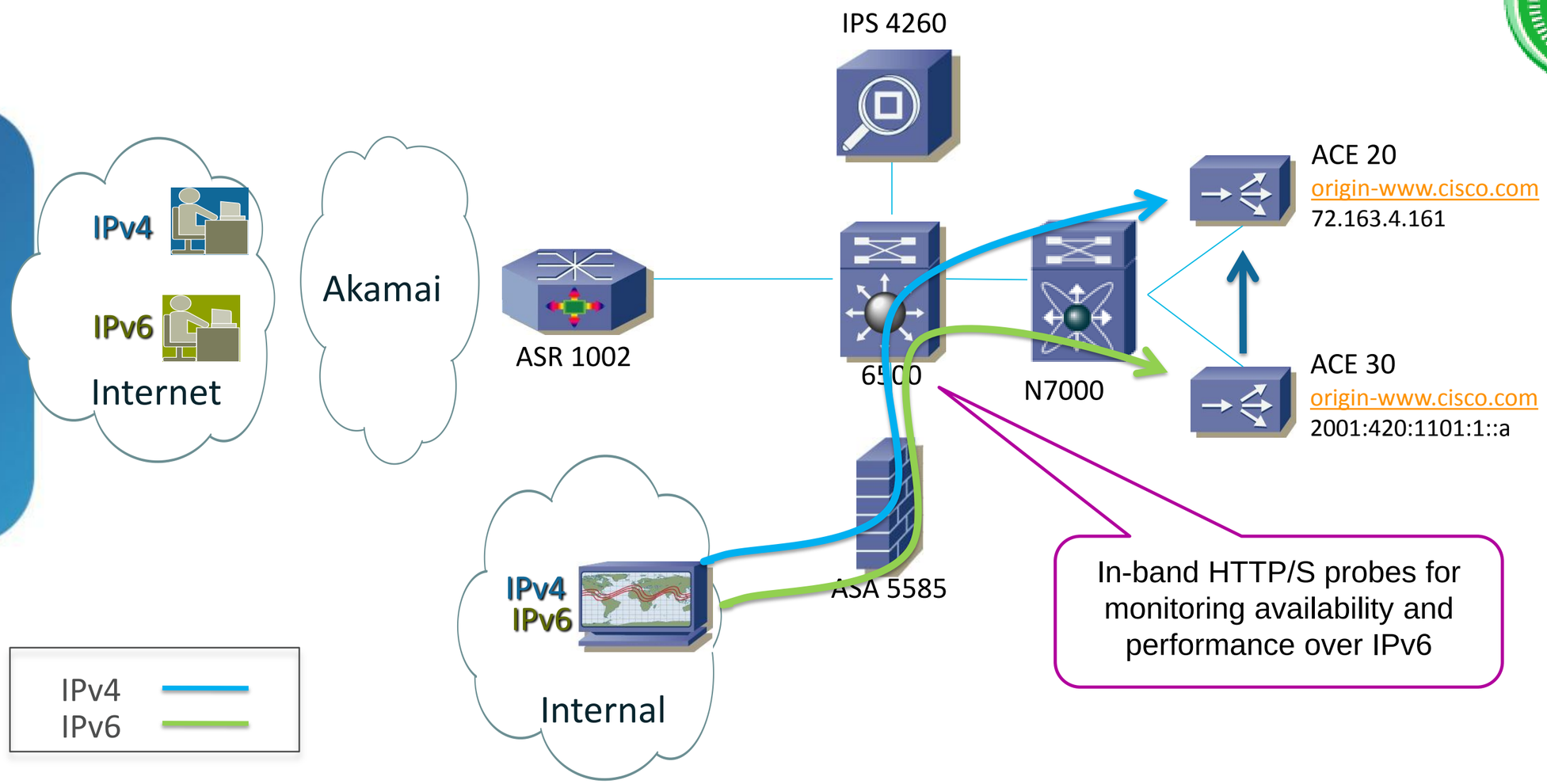

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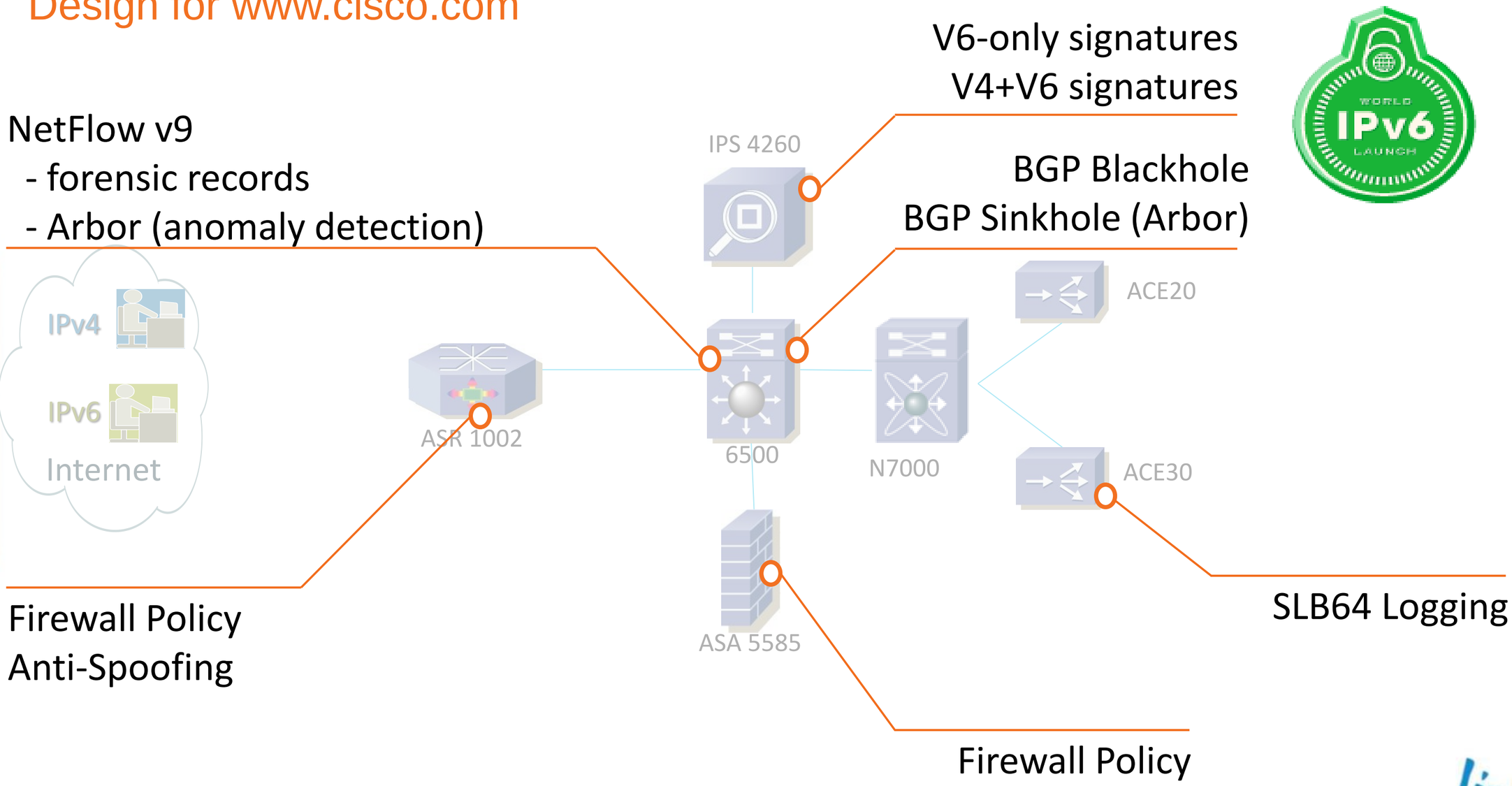

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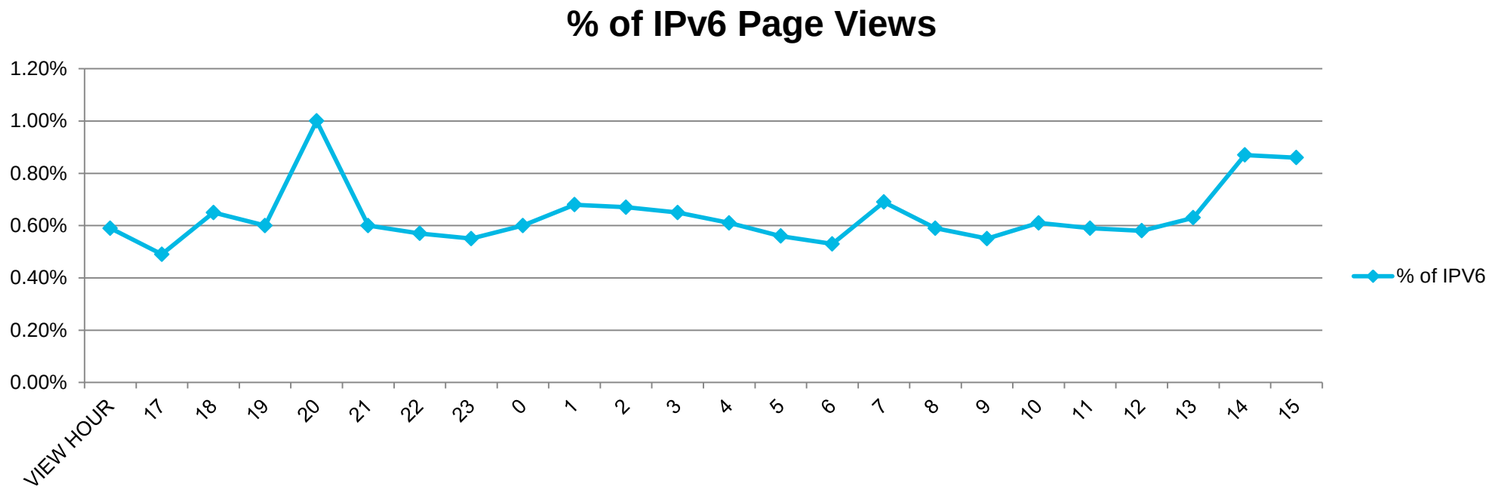
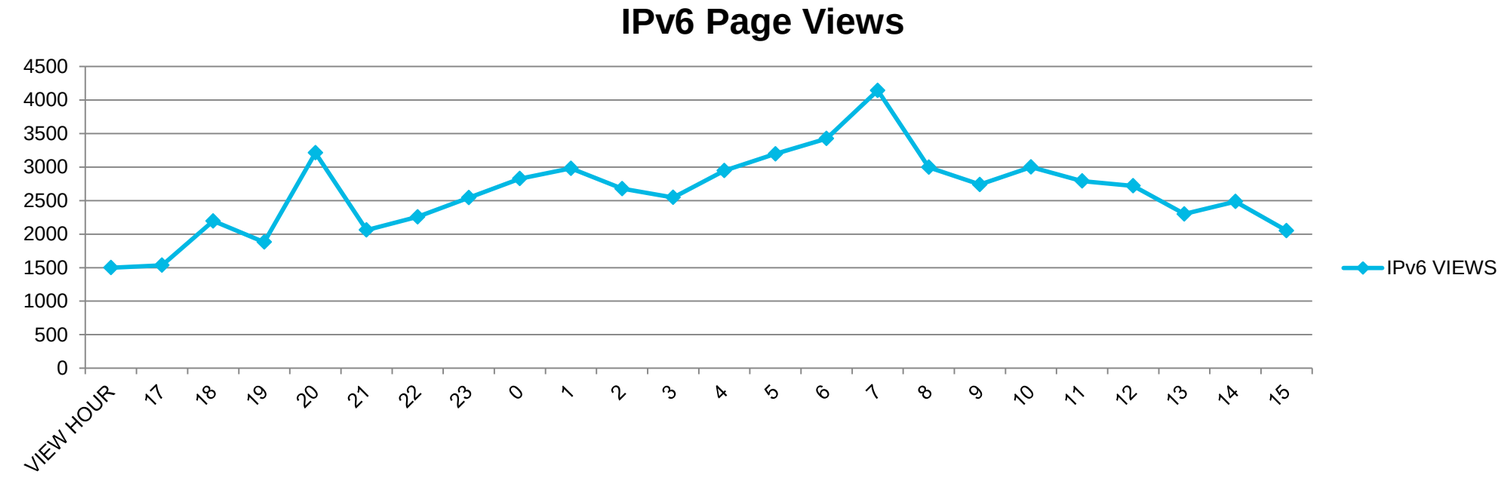
World IPv6 Launch Metrics for www.cisco.com





Source: Cisco IT web analytics

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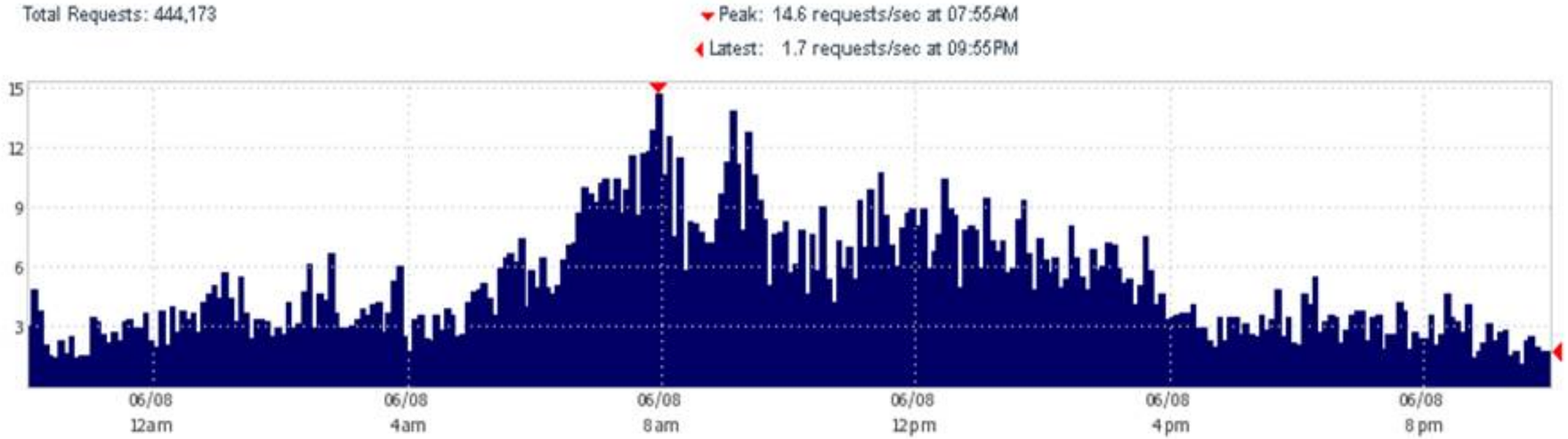
World IPv6 Launch Metrics for www.cisco.com



Data collected for time (24hrs)	IPv4		IPv6		IPv6 % of Total
	Total Requests	Peak Rate /sec	Total Requests	Peak Rate /sec	
06/05/2012 8:00 - 06/06/2012 8:00	160500000	2957.8	275951	15.1	0.17%
06/05/2012 17:00 - 06/06/2012 17:00	153900000	2784.7	494382	16.6	0.32%
06/06/2012 8:00 - 06/07/2012 8:00	157100000	2784.7	561912	16.6	0.36%
06/06/2012 22:00 - 06/07/2012 22:00	147000000	2455	477917	13.8	0.33%
06/07/2012 8:00 - 06/08/2012 8:00	141600000	2455	462781	14.6	0.33%
06/07/2012 22:00 - 06/08/2012 22:00	130900000	2155.9	444173	14.6	0.34%

Source: Akamai

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Lessons Learned

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Lessons Learned

Creating The IPv6 Program

- Cross functional effort across the IT Stack
  - Starts with networking team taking the lead
  - Early engagement of security team, infrastructure and application teams follow
  - Highlighted the importance and urgency around IPv6 from engineers to execs, especially to the application / hosting teams
- Making the case
  - Business case for IPv6 internet presence is simpler to articulate
  - Business case for IPv6 on internal corporate network takes more work
- Early planning is key
- Absorb the IPv6 effort into existing network lifecycle management process

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Lessons Learned

Product Support

- Network hardware, software, functionality
  - Routers, server load balancers
  - Wireless, switches
- Security
  - Firewalls, IDS/IPS, security event management and forensics logging
- Network management and service assurance
  - External and internal availability and performance monitoring

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Lessons Learned

Product Support - Netflow

- IPv6 requires NetFlow v9
  - Some routing platforms don’t support for both NetFlow v5 and NetFlow v9
  - Some routing platforms are constrained to two export destinations
  - Some collectors cannot receive/process Flexible NetFlow
- We had to shift NetFlow collection in our DMZ devices to deal with the constraints above
- Use of NetFlow reflectors can bring some relief

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Lessons Learned

Service Provider Support - ISP

- Will the same SLA apply for IPv6?
- Can the circuit that services the existing IPv4 connection be converted to dual-stack without the physical changes?
- Are full IPv6 global routes available to end customers?
- Is there an IPv6 “looking glass”?
- Are there any restrictions on prefix advertisements?
- What percentage of your IPv4 peers to you currently peer with for IPv6
- Are you partitioned from any other major networks? (i.e. lacking global reach-ability to other major networks)

See http://docwiki.cisco.com/wiki/What_To_Ask_From_Your_Service_Provider_About_IPv6

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Lessons Learned

Service Provider Support

- ISPs
- IP WAN providers
- External monitoring providers
- Content distribution providers

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Lessons Learned

IPv6 Implications for Applications

- Geo-location and web analytics

```
Client_IpAddress := X-forwarded-for address first address;
If null then
   Client_IpAddress := remoteAddress
end if;
use Client_IpAddress for IPCheck
```

- Development, testing, and QA teams require IPv6 access
- How will they get IPv6 access from within the corporate network?
- Supports the business case for an internal corporate network IPv6 deployment

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Lessons Learned

End Devices

- Many of your end devices are already IPv6 enabled
  - From Microsoft Vista and Server 2008
  - From OS X Lion
- "Happy Eyeballs" can mask IPv6 connectivity issues
- Cisco traffic to Facebook, Yahoo! and Google:

Network operator measurements, 16th November 2012 (notes)

Show 10 entries Search: 109

Participating Network	ASN(s)	IPv6 traffic
Cisco	109	4.81%

Source: http://www.worldipv6launch.org/measurements/

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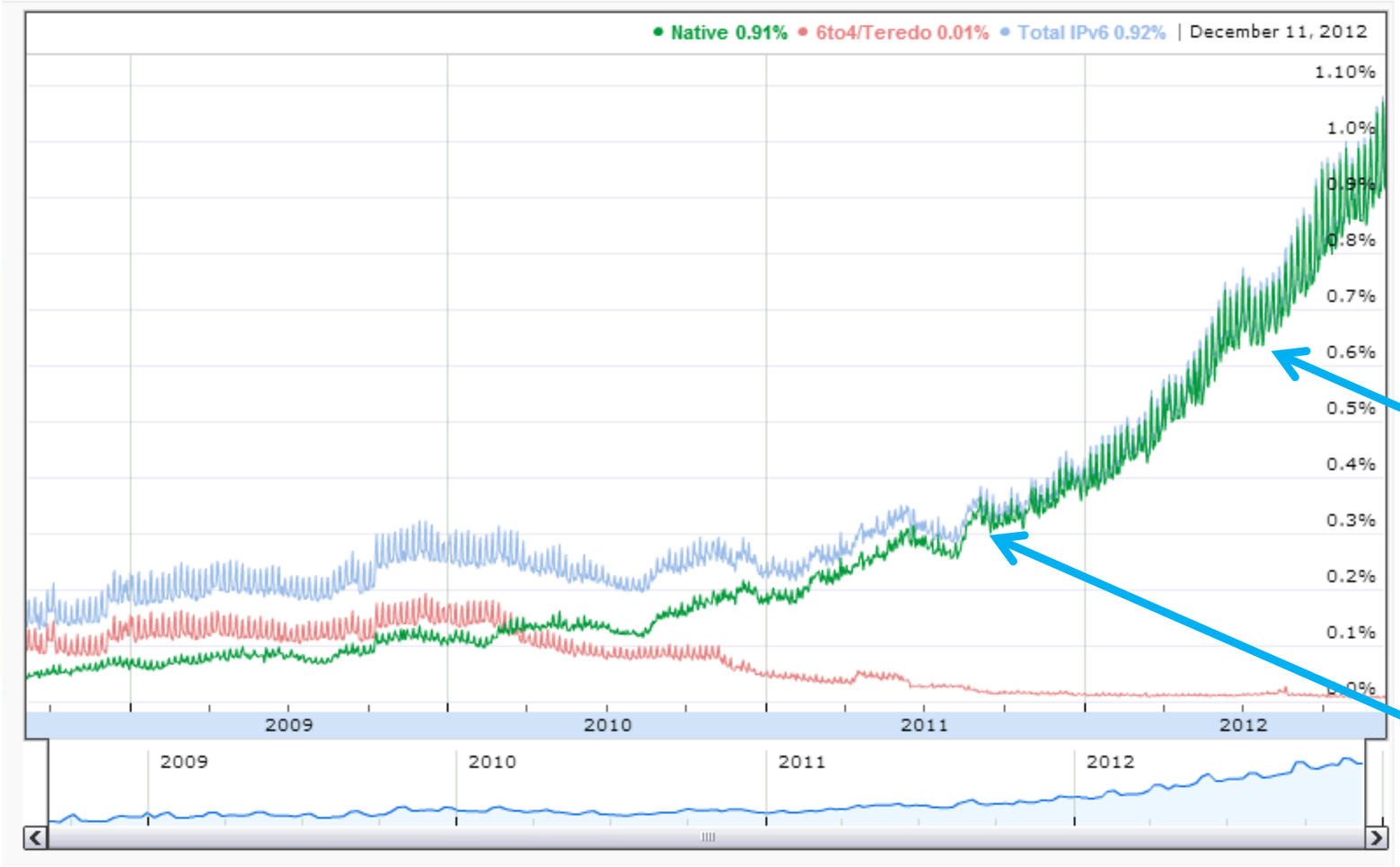
Lessons Learned

IPv6 Growth



World IPv6 Launch

World IPv6 Day

Source: Google

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Q & A

Conclusion

- IPv6 business case is focused around 2 key deployment scenarios
- Dual stack wherever possible, tunnel where not possible
- Take iterative steps on your way to the target state
- Early planning and assessment of product and service gaps
- IPv6 is not a rip and replace effort but an absorbed gradual integration
- IPv6 affects every team across IT, it is NOT a network only problem

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