Présentation IPv6

Fayçal HADJ

Solution Architect IPv6

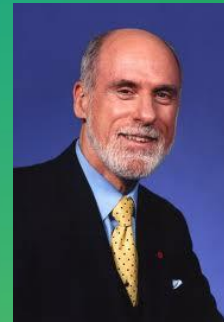**fhadj@cisco.com**

CCIE1135

http://ipv6blog.cisco.fr/

"Be prepared for the new normal"

Vint Cerf
Co-inventeur de TCP/IP

Agenda

Why IPv6

IPv6 Adoption Metrics

Deployment models

Cisco on Cisco

Why Cisco ?

IPv4 run-out is very real

IPv4 & IPv6 Statistics

RIR v4 IPs Left
AfriNIC 54,152,046
APNIC   18,453,324

IANA

RIPE NCC Begins to Allocate IPv4 Address Space From the Last /8

14 Sep 2012

On Friday 14 September, 2012, the RIPE NCC, the Regional Internet Registry (RIR) for Europe, the Middle East and parts of Central Asia, distributed the last blocks of IPv4 address space from the available pool.

This means that we are now distributing IPv4 address space to Local Internet Registries (LIRs) from the last /8 according to section 5.6 of "IPv4 Address Allocation and Assignment Policies for the RIPE NCC Service Region".

This section states that an LIR may receive one /22 allocation (1,024 IPv4 addresses), even if they can justify a larger allocation. This /22 allocation will only be made to LIRs if they have already received an IPv6 allocation from an upstream LIR or the RIPE NCC. No new IPv4 Provider Independent (PI) space will be assigned.
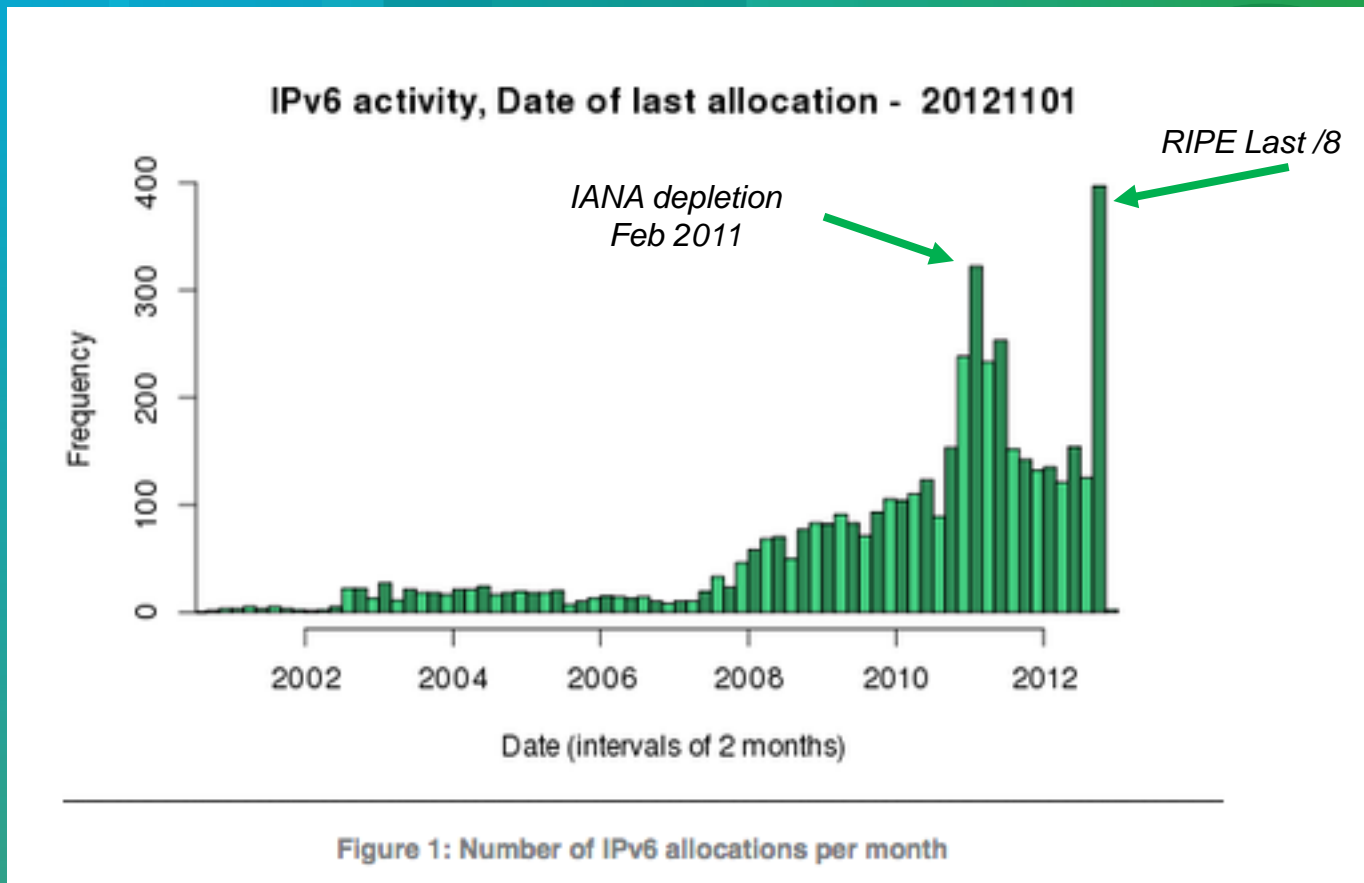
It is now imperative that all stakeholders deploy IPv6 on their networks to ensure the continuity of their online operations and the future growth of the Internet.

days remaining
IANA exhausted

HURRICANE ELECTRIC

Service Providers, Local Registry, Enterprises

http://ipv6.he.net/statistics/

RIPE NCC Membership Statistics - November 2012

IPv6 activity, Date of last allocation - 20121101

Figure 1: Number of IPv6 allocations per month

https://labs.ripe.net/Members/wilhelm/ripe-ncc-membership-statistics-november-2012

Sharing IPv4 public addresses

CGN : Carrier Grade NAT
NAT : Network Address Translation

IPv4

IPv4
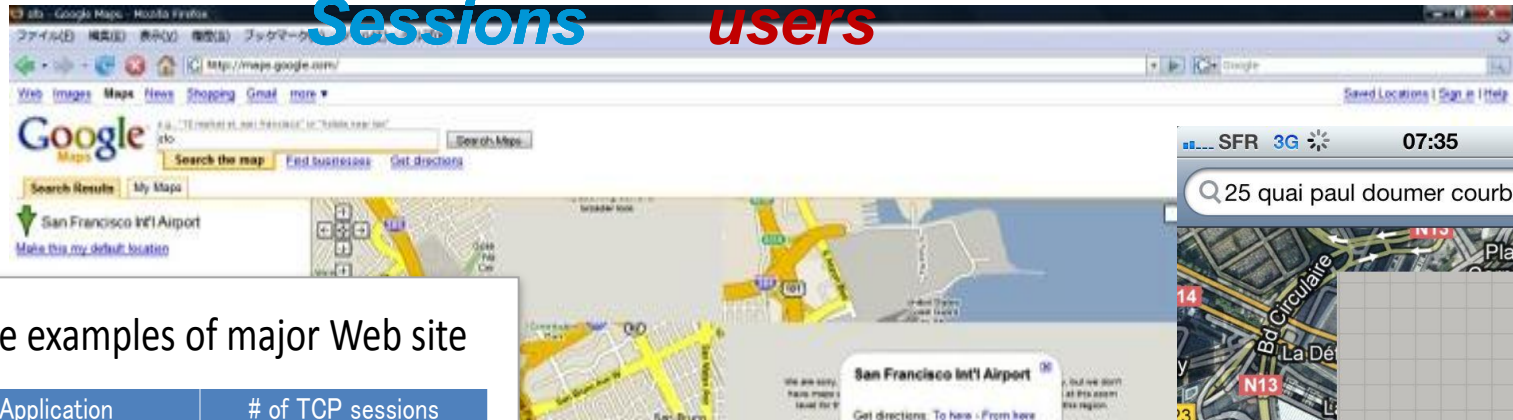
IPv4

CGN

IPv4

Service Provider
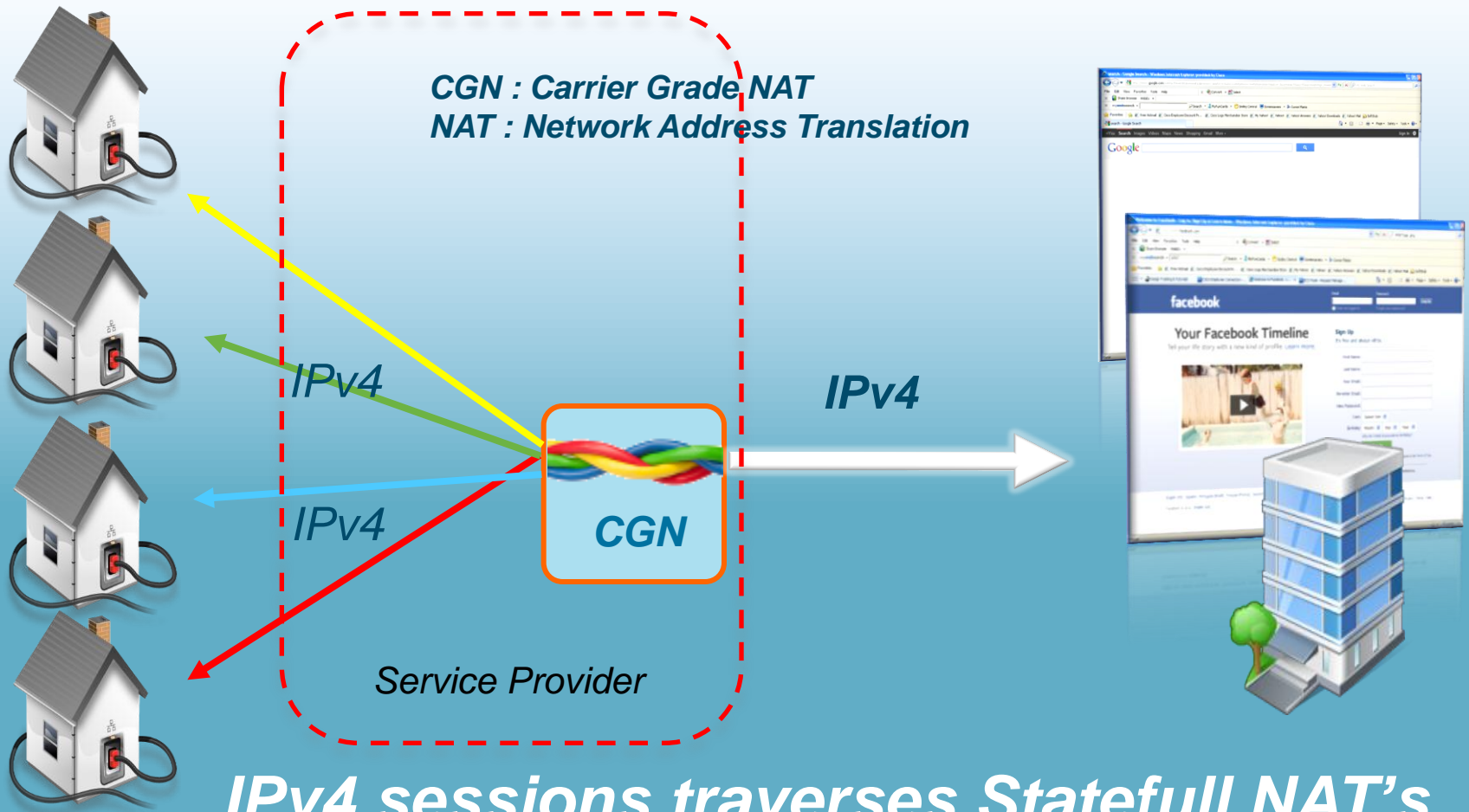
IPv4 sessions traverses Statefull NAT's.
Challenges: Transparency to application, Location, Security

Myth: I Can Run My Business on IPv4
NAT gone Bad !
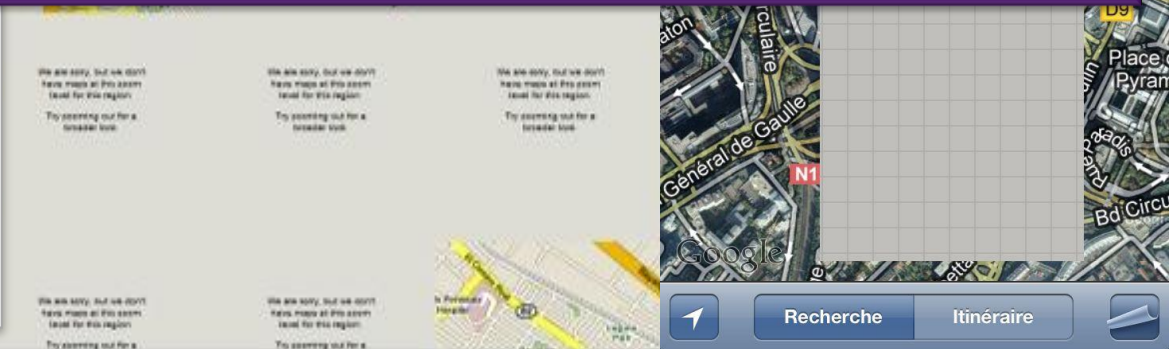
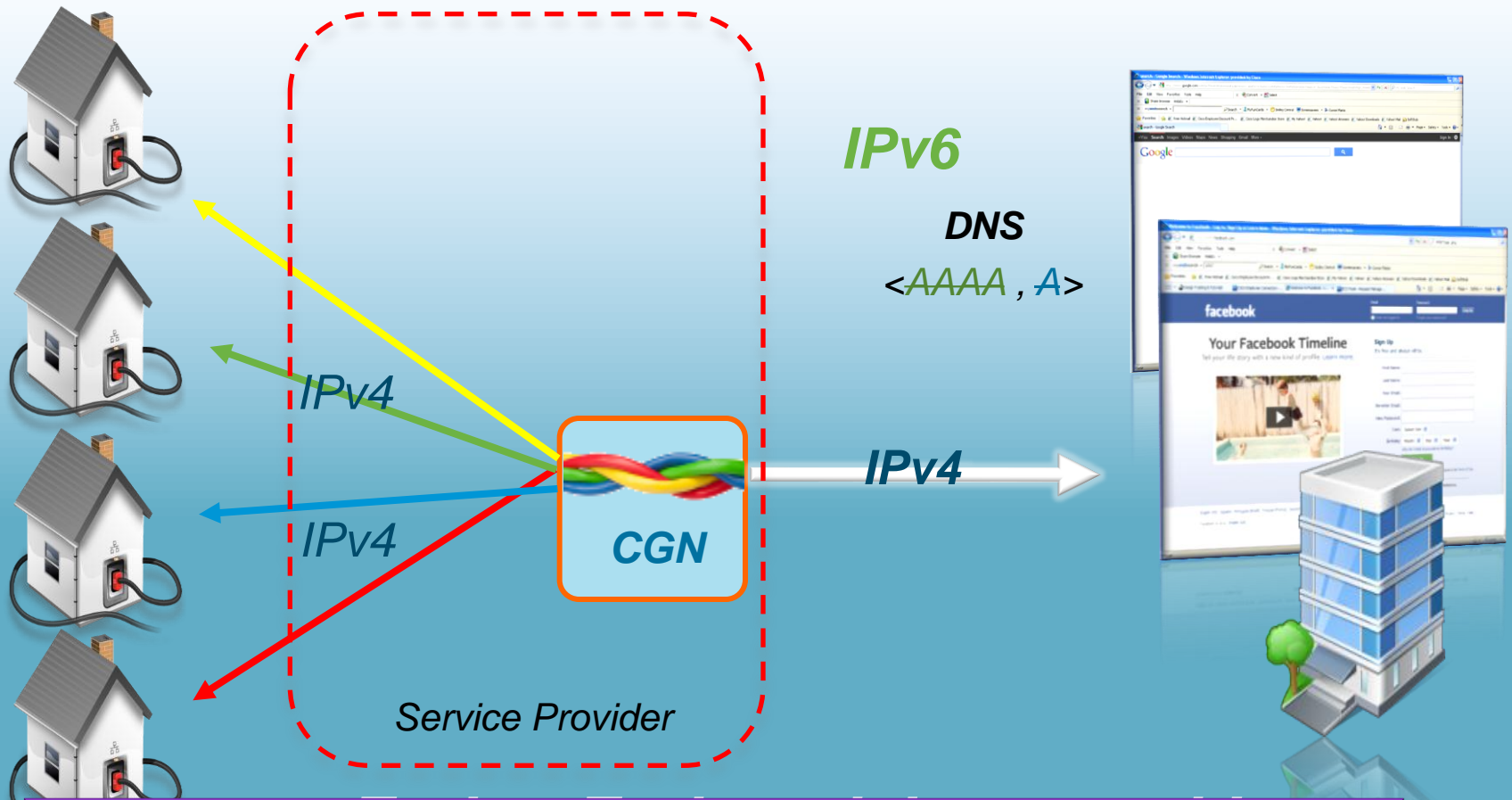*How many concurrent sessions will your business require?*

36 NAT Sessions *times millions of users*

Some examples of major Web site

Application	# of TCP sessions
ニコニコ動画	50〜80
OCN photo friend	170〜200+
iTunes	230〜270
iGoogle	80〜100
楽天(Rakuten)	50〜60
Amazon	90
HMV	100
YouTube	90

What's the cost of a bad user experience ?

Web 2.0 (ex: AJAX) Application Behavior Under Constrained

IPv6 – "Full Spectrum" Internet

IPv6

DNS

<AAAA , A>

IPv4

IPv4

CGN

IPv4

Service Provider

facebook

Your Facebook Timeline

Sign Up

Call to action: Enable IPv6 content
Enable IPv6 users

witch

CGN Bypass, aka 6rd+CGN

Left chart legend: CGN Only — years 2011, 2013, 2015
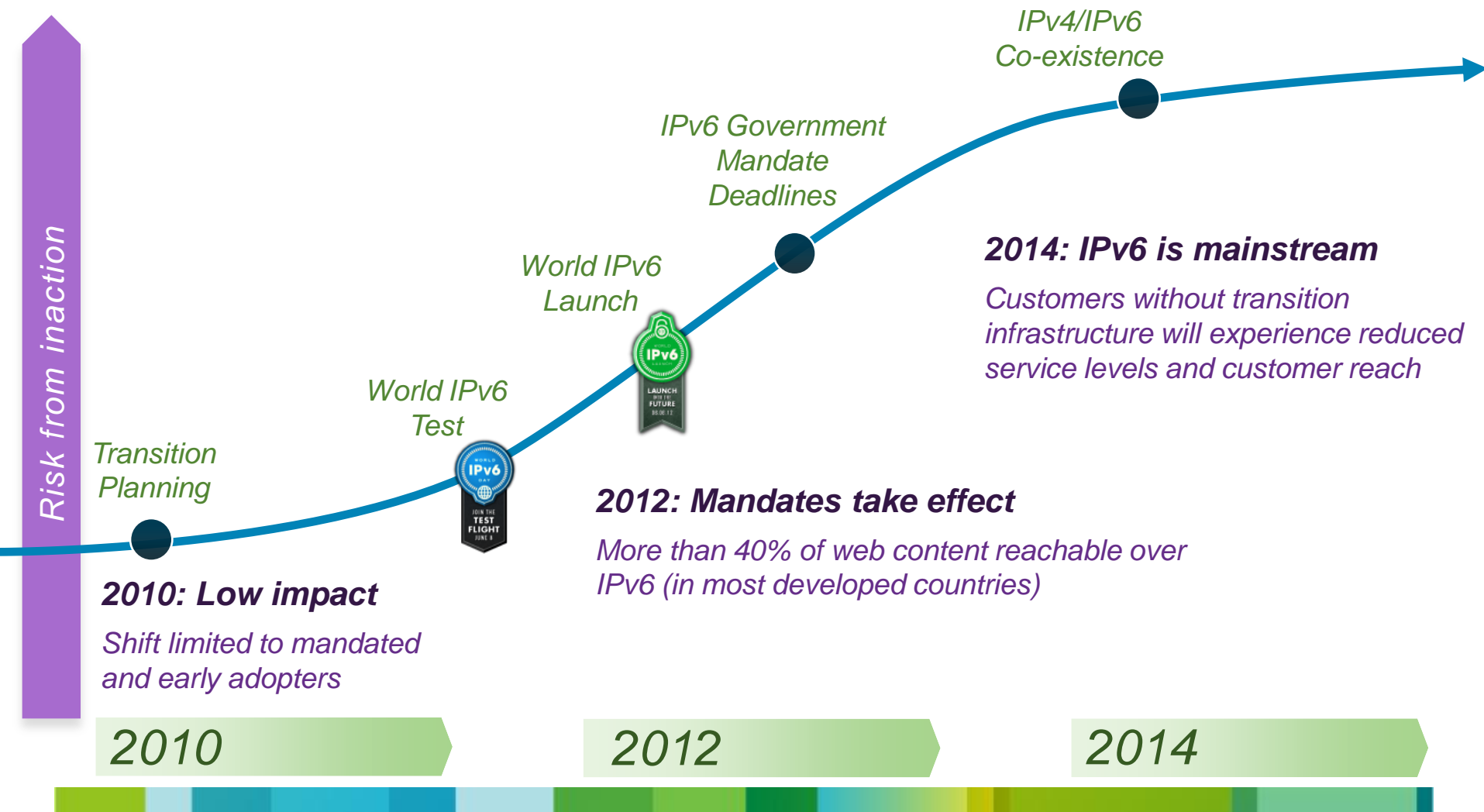
Right chart legend: 6rd + ■ CGN — years 2011, 2013, 2015
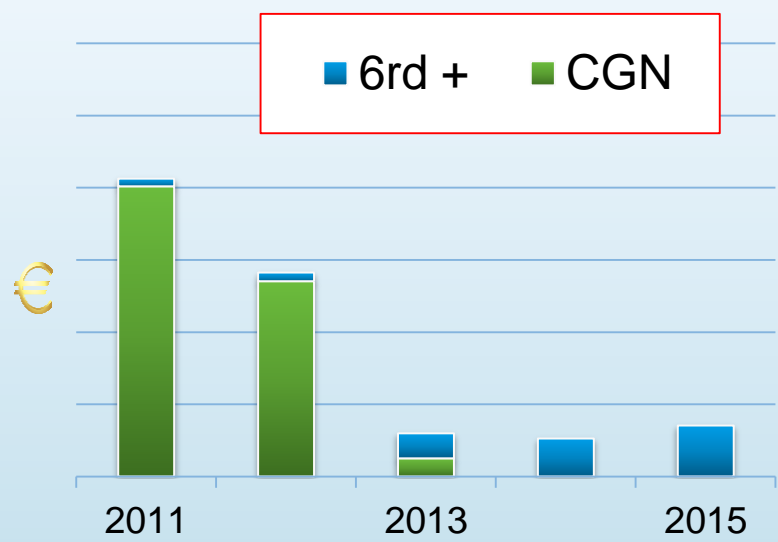
CGN44 Capex and Opex is growing driven by Subcribers growth, AND Application complexity (session per user)

CGN44 cost is capped as Content switches to IPv6.
6rd cost does not increase much as a function of # IPv6 users. AND Application complexity is transparent

. SP with 5M residential subs and a 10% yoy growth *Each home allocated 500 CGN sessions*

Act Now to avoid business impact

Risk from inaction

IPv4/IPv6
Co-existence

IPv6 Government
Mandate
Deadlines

2014: IPv6 is mainstream

Customers without transition infrastructure will experience reduced service levels and customer reach

World IPv6
Launch

World IPv6
Test

Transition
Planning

2012: Mandates take effect

More than 40% of web content reachable over IPv6 (in most developed countries)

2010: Low impact

Shift limited to mandated and early adopters

2010

2012

2014

7.6 Billion IPv6-Capable Devices by 2016
Mobile and Fixed

49% CAGR 2011–2016

Number of Devices (B)

Quid du BYOD ?

- 8
- 7 — 4.03B
- 6
- 5
- 4 — 3.57B
- 3
- 2
- 1 — 662M / 372M
- 0

2011 2012 2013 2014 2015 2016

Source: Cisco VNI Global Forecast, 211–2016

6th June 2012

www.worldipv6launch.org

2948+ WEB sites (91 FR), 50+ Operators, 3 RHG vendors

The Internet Ecosystem
the world has changed on June 6th 2012

http://www.worldipv6launch.org/participants
http://6lab.cisco.com/stats

40%

Content

Cloud

80%

CDN

The Network

Users

1%

AT&T
Verizon Mobile
Comcast, TWC (US)
Free, SFR, Renater(FR)
RCS&RDS (Ro)
XS4ALL (PB)
KDDI (JP)
Softbank (JP)
Many to come in 2013

Amazon
Rackspace
OVH (FR)
Akamai
Limelight

Google
Facebook
Yahoo
Bing
Wikipedia
Netflix
Amazon
Cisco
1000's Enterprises
Public Agencies

IOE : Internet of everythings

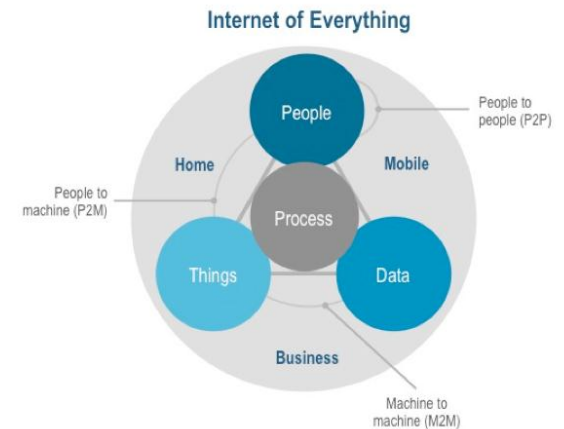How the Internet of Everything will change the world... for the better
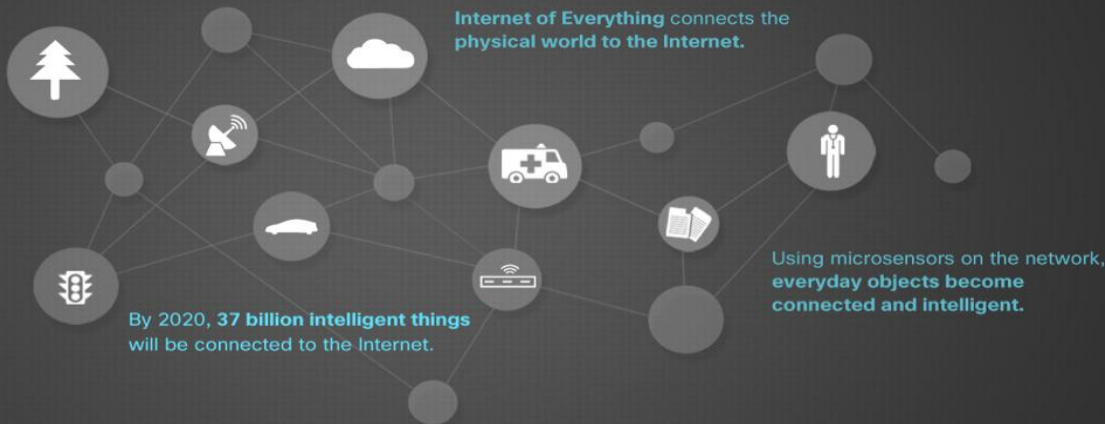
IP won't be limited to PC, tablets or Smartphone Everyday things will have IP addresses.

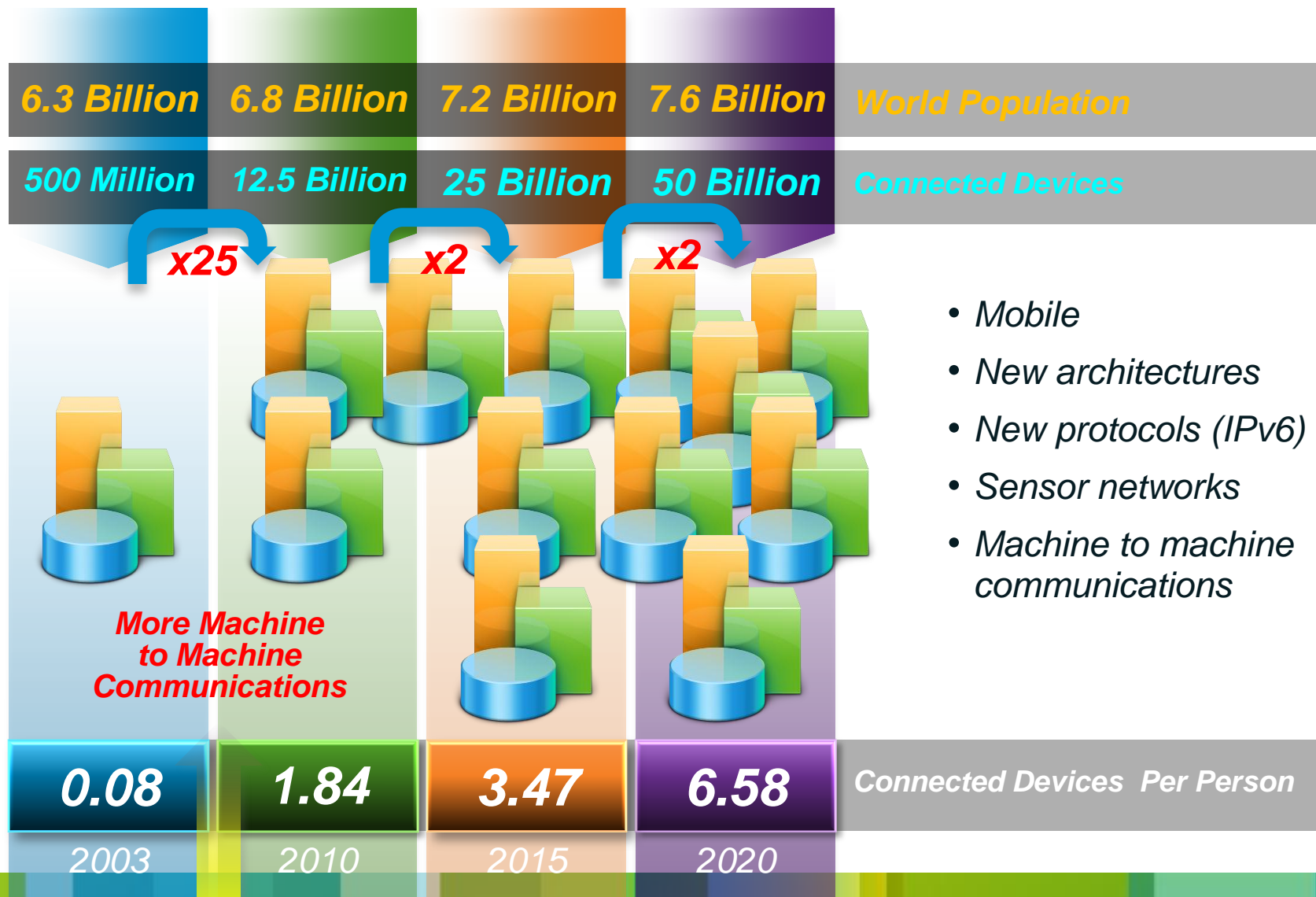*When a vending machine is running out of product, it can automatically schedule its own restock.*

Elderly patients can wear a small wireless device that monitors their heart condition. In an emergency, healthcare providers would automatically be contacted.

Your network enabled car will automatically turn on the air-conditioning in your house, when you're on your way home.

- The widespread deployment of the IPv6 protocol will enable the world's adoption of internet-connected devices and things.
- These applications have very different properties and requirements than today's end users devices

The Internet of Everything Is Already Here

6.3 Billion	**6.8 Billion**	**7.2 Billion**	**7.6 Billion**	*World Population*
500 Million	**12.5 Billion**	**25 Billion**	**50 Billion**	*Connected Devices*

x25   *x2*   *x2*

More Machine to Machine Communications

- *Mobile*
- *New architectures*
- *New protocols (IPv6)*
- *Sensor networks*
- *Machine to machine communications*

0.08	1.84	3.47	6.58	Connected Devices Per Person
2003	2010	2015	2020	

IPv6 Adoption Metrics

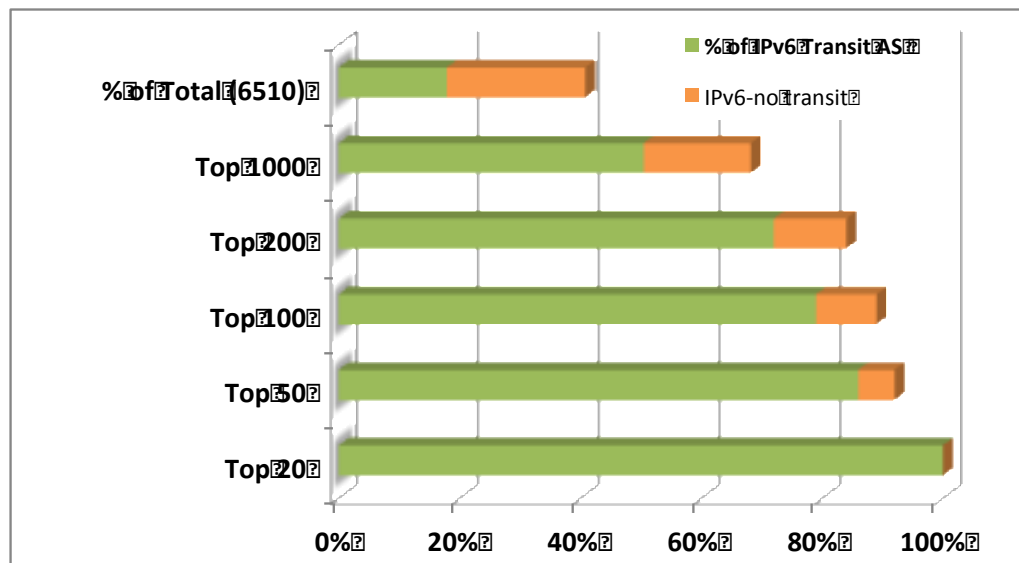# IPv6 Adoption Metrics,
let's measure actual numbers

1. Prefix Allocation /Network Enablement

2. Content

3. Users/Devices
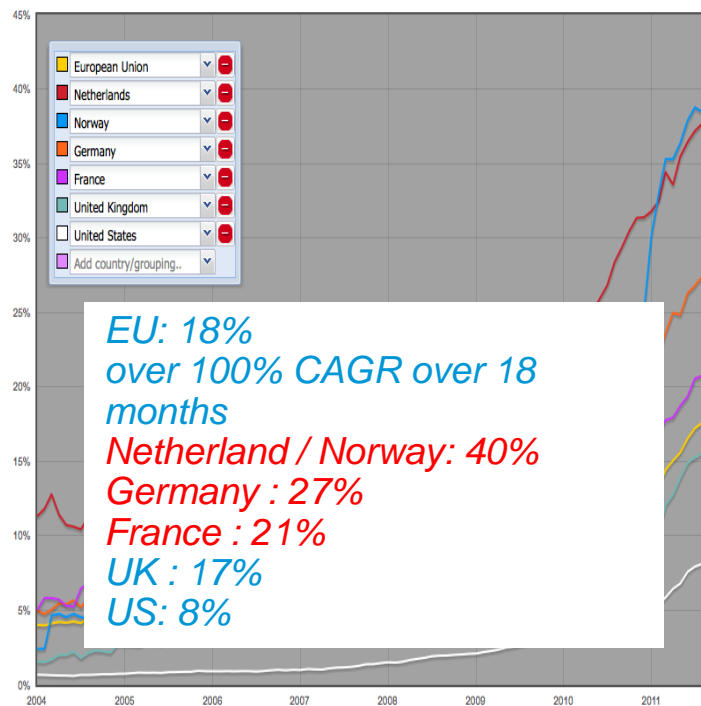
4. Traffic Stats

IPv6 Adoption Metrics: Networks

% of AS's IPV6 enabled

Global IPv6 Transit, Available on a per country basis

permalink: http://v6asns.ripe.net/v/6?s=_EU;s=NL;s=NO;s=DE;s=FR;s=GB;s=US

This graph shows the percentage of networks (ASes) that announce an IPv6 prefix for a specified list of countries or groups of countries

- European Union
- Netherlands
- Norway
- Germany
- France
- United Kingdom
- United States
- Add country/grouping..

EU: 18%
over 100% CAGR over 18 months
Netherland / Norway: 40%
Germany : 27%
France : 21%
UK : 17%
US: 8%

Current growth rate projection put the top three EU economies at over 50% in 12 months

IPv6 Network Enablement: % of Transit AS with IPv6 (source Cisco)

IPv6 Adoption Metrics : TOP 500 Content

IPv6 availability from 6/6/2012

Top Sites
The top 500 sites on the web.

1. **Google**
   google.com
   Enables users to search the world's information, including webpages, images, and videos. Offers...
   More
   ★★★★½   Search Analytics ▶   Audience ▶

2. **Facebook**
   facebook.com
   A social utility that connects people, to keep up with friends, upload photos, share links and ...
   More
   ★★★★☆   Search Analytics ▶   Audience ▶

3. **YouTube**
   youtube.com
   YouTube is a way to get your videos to the people who matter to you. Upload, tag and share your... More
   ★★★★½   Search Analytics ▶   Audience ▶

4. **Yahoo!**
   yahoo.com
   A major internet portal and service provider offering search results, customizable content, cha...
   More
   ★★★★☆   Search Analytics ▶   Audience ▶

5. **Baidu.com**
   baidu.com
   The leading Chinese language search engine, provides "simple and reliable" search exp... More
   ★★★½☆   Search Analytics ▶   Audience ▶

6. **Wikipedia**
   wikipedia.org
   A free encyclopedia built collaboratively using wiki software. (Creative Commons Attribution-Sh...
   More
   ★★★★½   Search Analytics ▶   Audience ▶

7. **Windows Live**
   live.com
   Search engine from Microsoft.
   ★★★★☆   Search Analytics ▶   Audience ▶

8. **Twitter**
   twitter.com
   Social networking and microblogging service utilising instant messaging, SMS or a web interface.
   ★★★★☆   Search Analytics ▶   Audience ▶

9. **QQ.COM**
   qq.com
   China's largest and most used Internet service portal owned by Tencent, Inc founded in Nov...
   More
   ★★★★☆   Search Analytics ▶   Audience ▶

10. **Amazon.com**
    amazon.com
    Amazon.com seeks to be Earth's most customer-centric company, where customers can find and

IPv6 Adoption Metrics : French Content

IPv6 availability from 6/6/2012

Top Sites in France
The top 500 sites in France.

1. **Google France**
   google.fr
   Version française du moteur de recherche. Propose des outils et des services pour les internaut... More
   ★★★★☆ Search Analytics ▶ Audience ▶

2. **Facebook**
   facebook.com
   A social utility that connects people, to keep up with friends, upload photos, share links and ... More
   ★★★★☆ Search Analytics ▶ Audience ▶

3. **Google**
   google.com
   Enables users to search the world's information, including webpages, images, and videos. Offers... More
   ★★★★☆ Search Analytics ▶ Audience ▶

4. **YouTube**
   youtube.com
   YouTube is a way to get your videos to the people who matter to you. Upload, tag and share your... More
   ★★★☆☆ Search Analytics ▶ Audience ▶

5. **Wikipedia**
   wikipedia.org
   A free encyclopedia built collaboratively using wiki software. (Creative Commons Attribution-Sh... More
   ★★★★☆ Search Analytics ▶ Audience ▶

6. **Yahoo!**
   yahoo.com
   A major internet portal and service provider offering search results, customizable content, cha... More
   ★★★★☆ Search Analytics ▶ Audience ▶

7. **Windows Live**
   live.com
   Search engine from Microsoft.
   ★★★★☆ Search Analytics ▶ Audience ▶

8. **leboncoin.fr**
   leboncoin.fr
   site de petites annonces gratuit et sans commission (produits d'occasion, annonces immobilières... More
   ★★★★☆ Search Analytics ▶ Audience ▶

9. **Amazon.fr**
   amazon.fr
   Livres en français et en anglais, neufs ou d'occasion, produits culturels.
   ★★★★☆ Search Analytics ▶ Audience ▶

10. **Orange**
    orange.fr
    Présente les offres de cet opérateur et leurs tarifs, permet de souscrire à certaines d'entre e... More
    ★★★☆☆ Search Analytics ▶ Audience ▶

IPv6 Adoption metrics: WEB Content

3.1%

96.9%
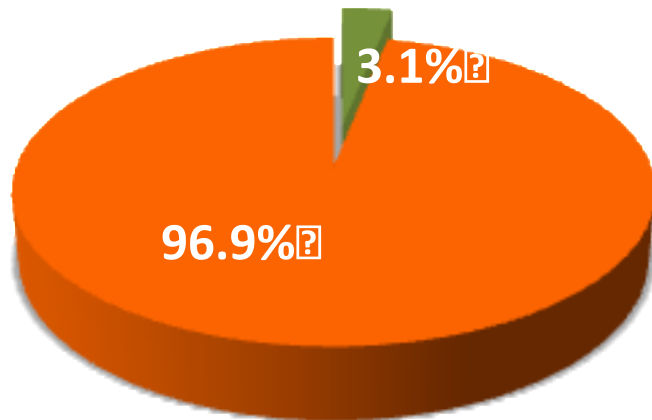
519 sites IPv6 enabled, May20th 2012

27.2%

72.8%
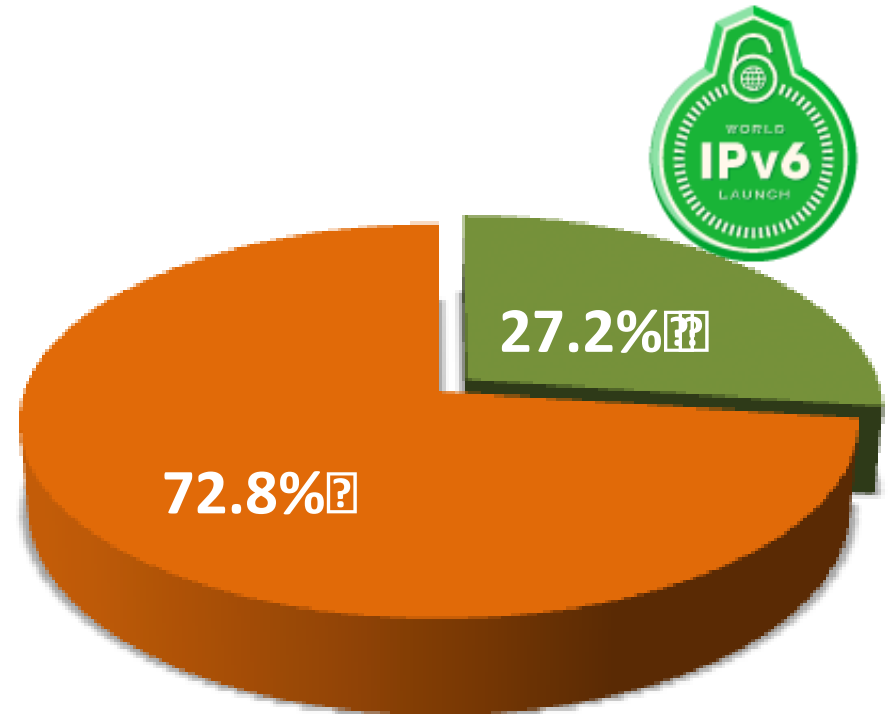
2500+ IPv6 enabled, June6th 2012

Each site that is IPv6 enabled (per *worldIPv6launch.org* list) is represented proportionally to its % of global internet pages viewed (per *www.alexa.co*m ranking)

Source : Cisco (ISOC + alexa.com), Hugo Kaczmarek

IPv6 Adoption Metrics: Users
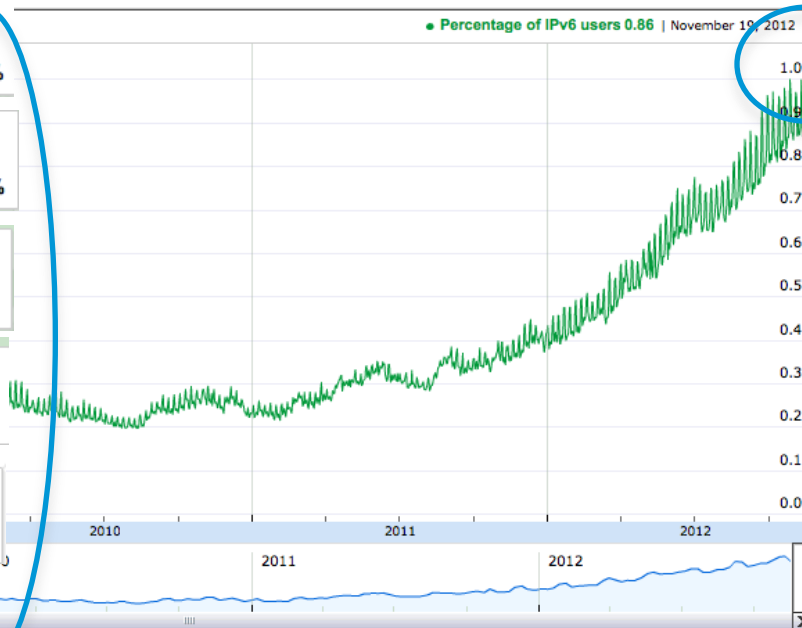## November 17, 2012

Ireland
IPv6 overall deployment: **28.25%**
Detail: **Prefixes : 47.62%** | **Transit AS : 58.9%** | **Content : 37.76%** | **Users : 1.39%**

Czech Republic
IPv6 overall deployment: **33.8%**
Detail: **Prefixes : 68.64%** | **Transit AS : 63.59%** | **Content : 52.87%** | **Users : 1.05%**

Switzerland
IPv6 overall deployment: **28.33%**
Detail: **Prefixes : 57.09%** | **Transit AS : 78.36%** | **Content : 39.43%** | **Users : 1.1%**

Slovenia
IPv6 overall deployment: **31.67%**
Detail: **Prefixes : 62.35%** | **Transit AS : 77.23%** | **Content : 47.37%** | **Users : 1.02%**

Japan
IPv6 overall deployment: **28.43%**
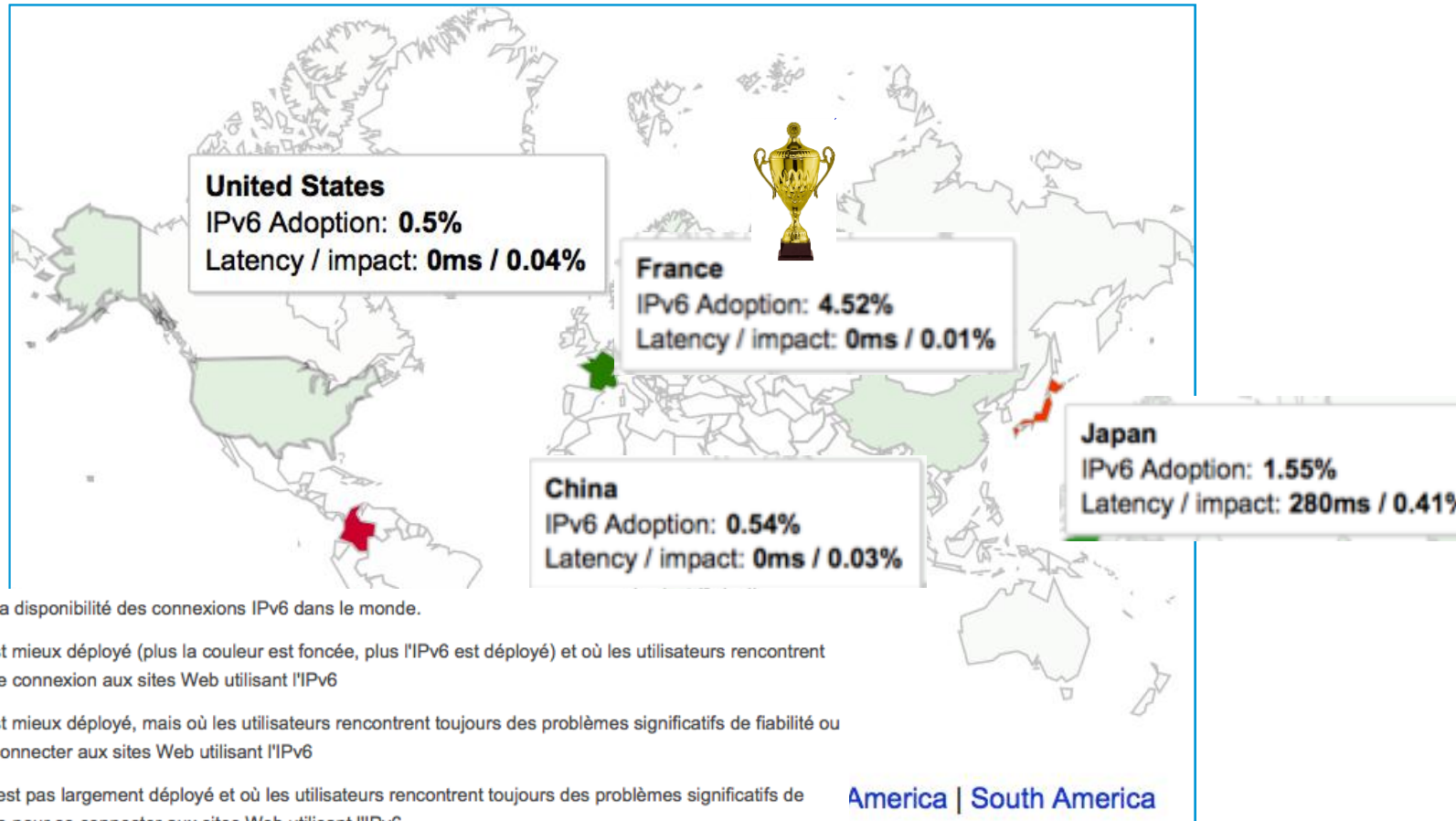Detail: **Prefixes : 44.81%** | **Transit AS : 76.83%** | **Content : 26.87%** | **Users : 2.15%**

Souce : http://6lab.cisco.com/stats/index.php

IPv6 Adoption Metrics: Users per country Mars 2012

United States
IPv6 Adoption: **0.5%**
Latency / impact: **0ms / 0.04%**

France
IPv6 Adoption: **4.52%**
Latency / impact: **0ms / 0.01%**

Japan
IPv6 Adoption: **1.55%**
Latency / impact: **280ms / 0.41%**

China
IPv6 Adoption: **0.54%**
Latency / impact: **0ms / 0.03%**

Le tableau ci-dessus indique la disponibilité des connexions IPv6 dans le monde.

▪ Régions où l'IPv6 est mieux déployé (plus la couleur est foncée, plus l'IPv6 est déployé) et où les utilisateurs rencontrent peu de problèmes de connexion aux sites Web utilisant l'IPv6

▪ Régions où l'IPv6 est mieux déployé, mais où les utilisateurs rencontrent toujours des problèmes significatifs de fiabilité ou de latence pour se connecter aux sites Web utilisant l'IPv6

▪ Régions où l'IPv6 n'est pas largement déployé et où les utilisateurs rencontrent toujours des problèmes significatifs de fiabilité ou de latence pour se connecter aux sites Web utilisant l'IPv6

America | South America

Google Statistics: Per Country IPv6 users, gathered from Google Search

http://www.google.com/intl/en/ipv6/statistics/

IPv6 Adoption Metrics: Users per country
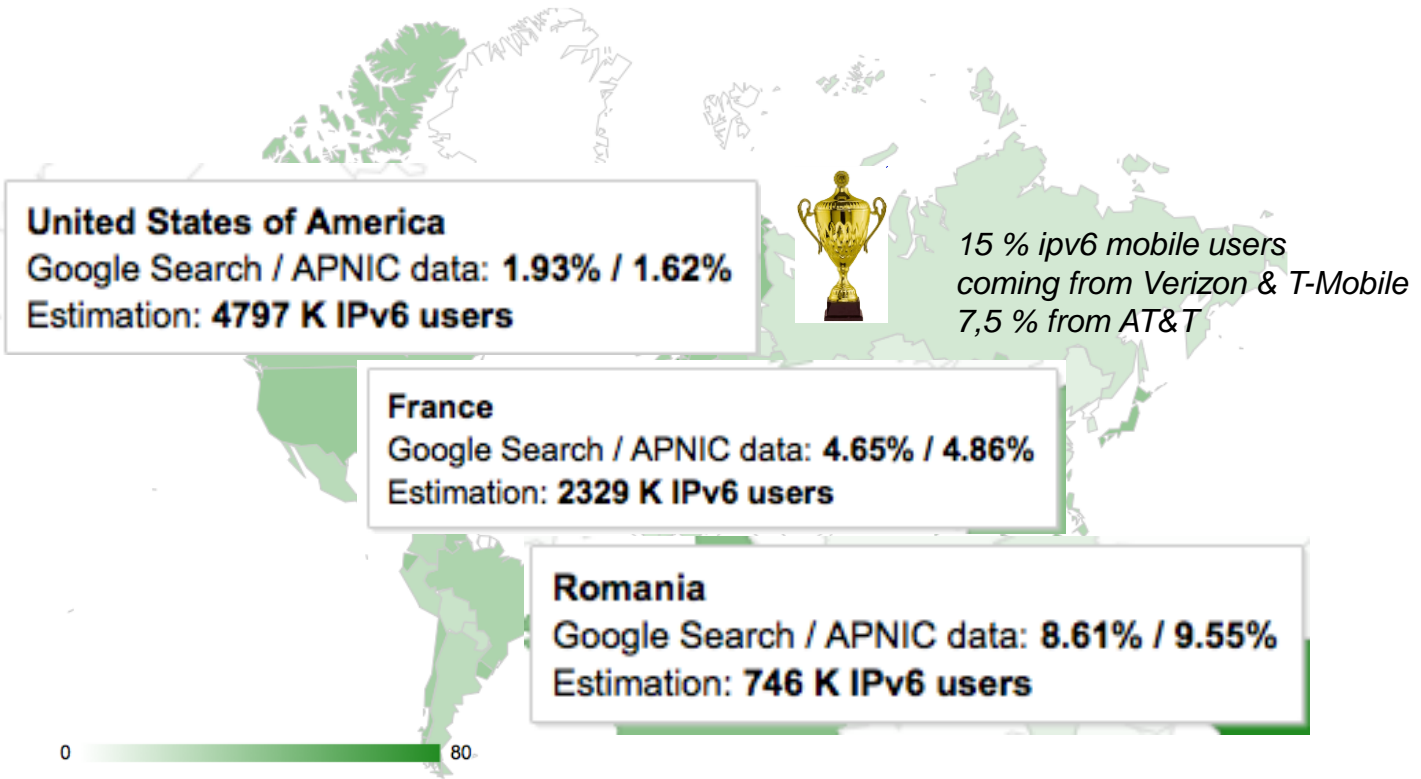## 21th of November 2012

CISCO

Home
World–scale data
Information

Select data type :

All
IPv6 Prefixes
Transit AS
Web Content
Users

✓ J'aime 717
g +1
Tweet

Connecting through :

IPv4☹

United States of America
Google Search / APNIC data: **1.93% / 1.62%**
Estimation: **4797 K IPv6 users**

15 % ipv6 mobile users
coming from Verizon & T-Mobile
7,5 % from AT&T

France
Google Search / APNIC data: **4.65% / 4.86%**
Estimation: **2329 K IPv6 users**

Romania
Google Search / APNIC data: **8.61% / 9.55%**
Estimation: **746 K IPv6 users**

0   80

World | Africa | Asia | America | Europe | Oceania

Souce : http://6lab.cisco.com/stats/index.php

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

IPv6 Adoption Metrics: Users per country
21th of November 2012

Romania
IPv6 overall deployment: **68.45%**
Detail: **Prefixes : 44.44% | Transit AS : 42.6% | Content : 35.22% | Users : 8.61%**

France
IPv6 overall deployment: **48.08%**
Detail: **Prefixes : 52.47% | Transit AS : 68.72% | Content : 38.48% | Users : 4.65%**

United States of America
IPv6 overall deployment: **29.85%**
Detail: **Prefixes : 42.25% | Transit AS : 57.27% | Content : 34.37% | Users : 1.93%**

Home
World–scale data
Information

Select data type :

All
IPv6 Prefixes
Transit AS
Web Content
Users

✓ J'aime 717
+1
Tweet

Connecting through :

IPv4

0   80

World | Africa | Asia | America | Europe | Oceania

Souce : http://6lab.cisco.com/stats/index.php

IPv6 Adoption Metrics: Users per country 21th of November 2012

Global IPv6 capable devices forecast : Stats
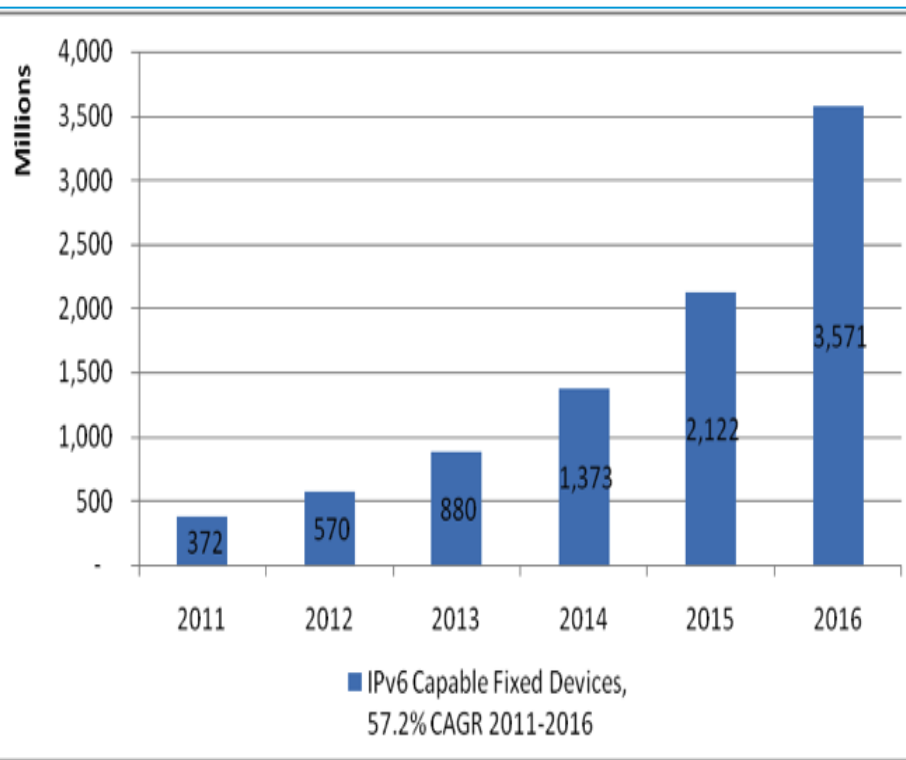
~ 50% of all fixed devices   ~ 71% of smartphone & tablets

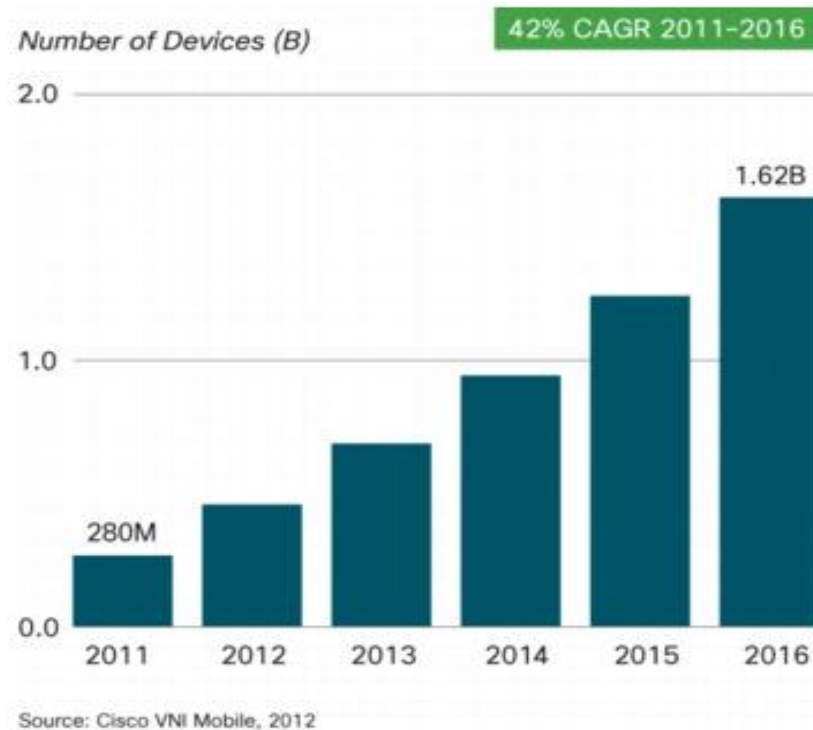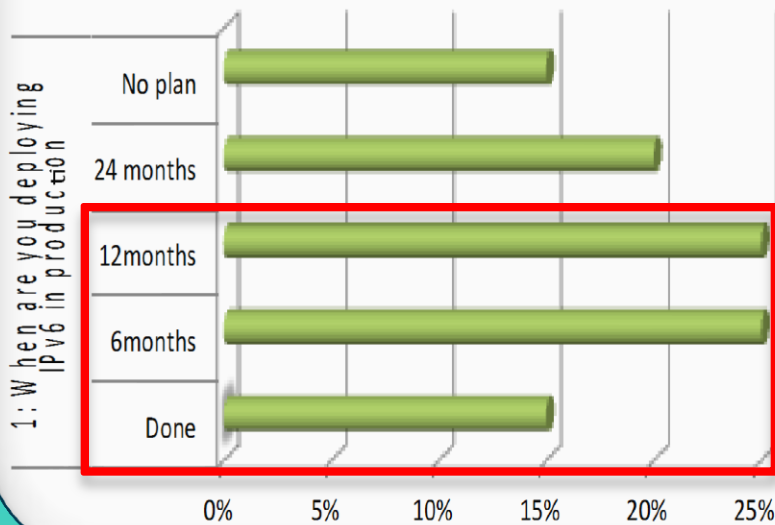**By 2016, 39 percent of all global mobile devices could potentially be capable of connecting to an IPv6 mobile network.** *Over 4 billion devices will be IPv6-capable in 2016.*

http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html
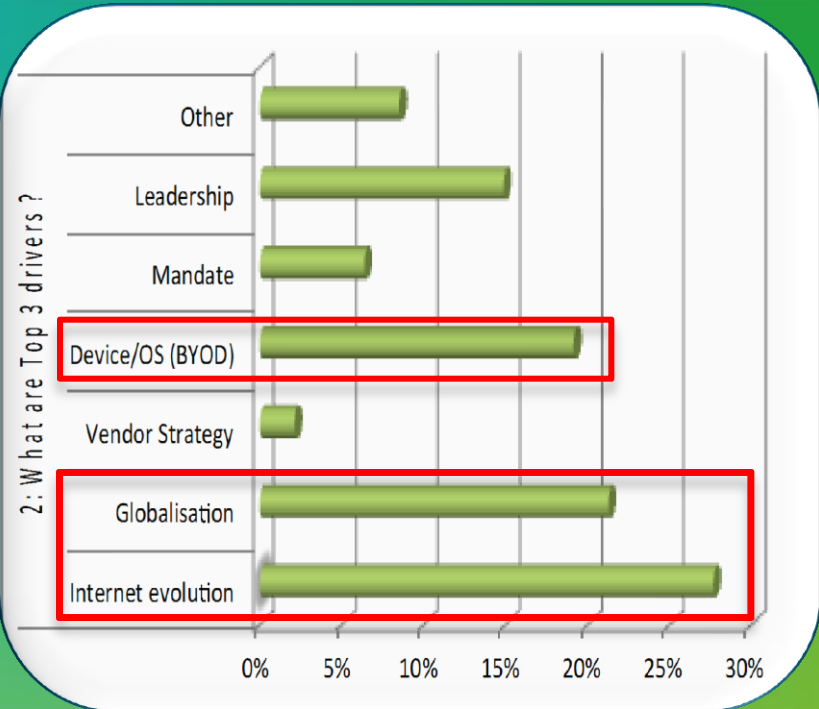
What ETAB customers have to say?

Internet Presence

Chart 1 (1: When are you deploying IPv6 in production):
- No plan: ~15%
- 24 months: ~21%
- 12months: ~25%
- 6months: ~25%
- Done: ~15%

Chart 2 (2: What are Top 3 drivers?):
- Other: ~9%
- Leadership: ~18%
- Mandate: ~7%
- Device/OS (BYOD): ~19%
- Vendor Strategy: ~2%
- Globalisation: ~22%
- Internet evolution: ~28%

Q1. When are you deploying IPv6 in production ?

Q2. What are your MAIN drivers for IPv6?

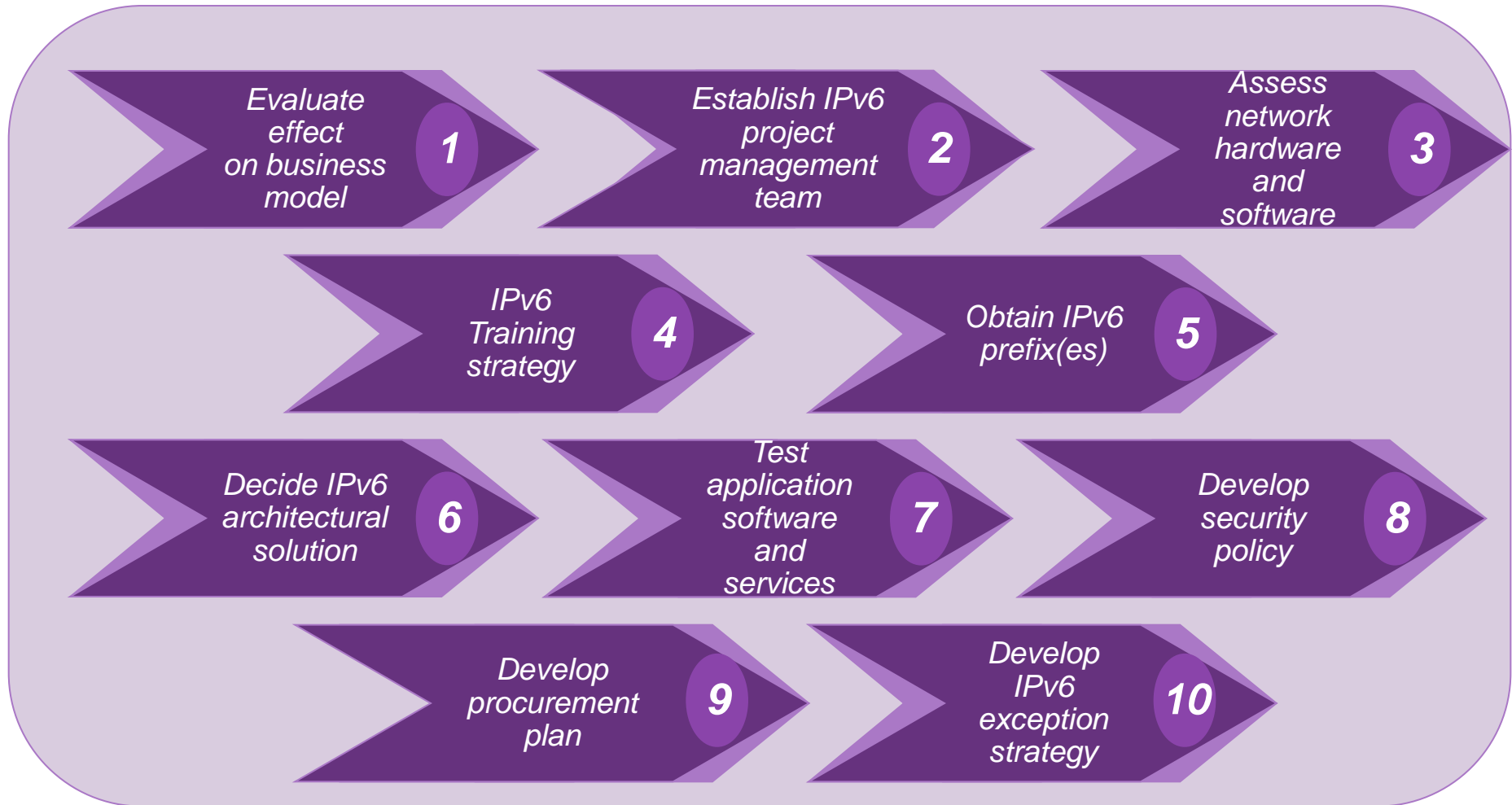70% of Customers deploying IPv6 at Internet Edge in next 24 month

> 25% of Customers consider IPv6 Internet Edge being the business driver

SP must deliver Business grade Internet Service.
IPv6 transition of Internet Facing content is a business opportunity
(Vendors, Services, CDN, Content Hosting, Cloud)

Enterprise Deployment models

IPv6 Planning Steps

Evaluate effect on business model — 1

Establish IPv6 project management team — 2

Assess network hardware and software — 3

IPv6 Training strategy — 4

Obtain IPv6 prefix(es) — 5

Decide IPv6 architectural solution — 6

Test application software and services — 7

Develop security policy — 8

Develop procurement plan — 9

Develop IPv6 exception strategy — 10

Cisco Public

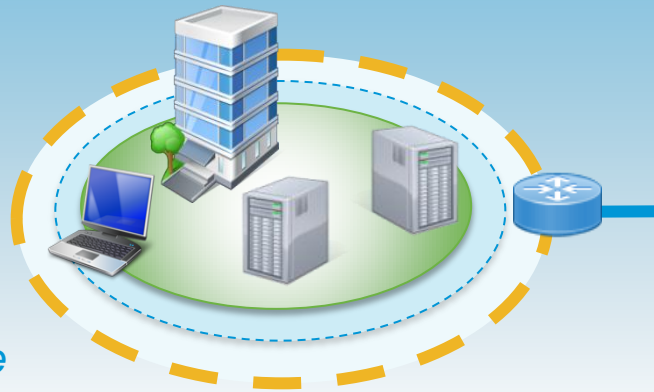# Enterprise Deployment Options

Outside – In
Internet Evolution
Business Continuity
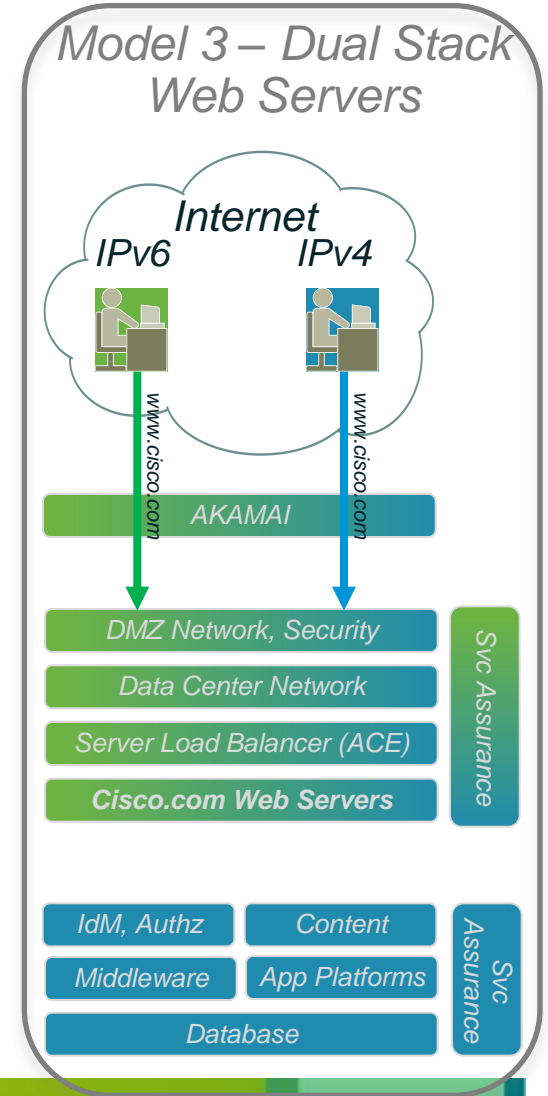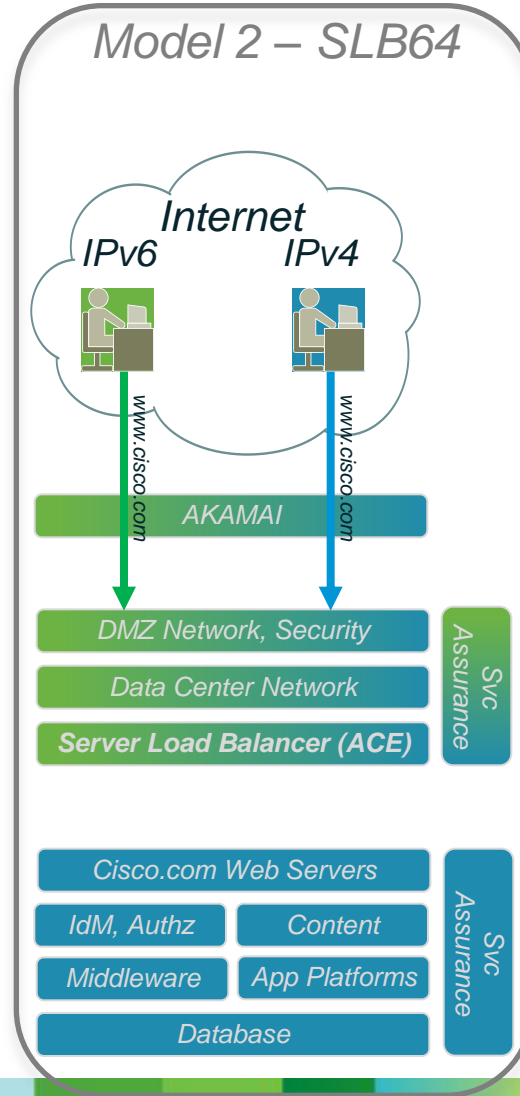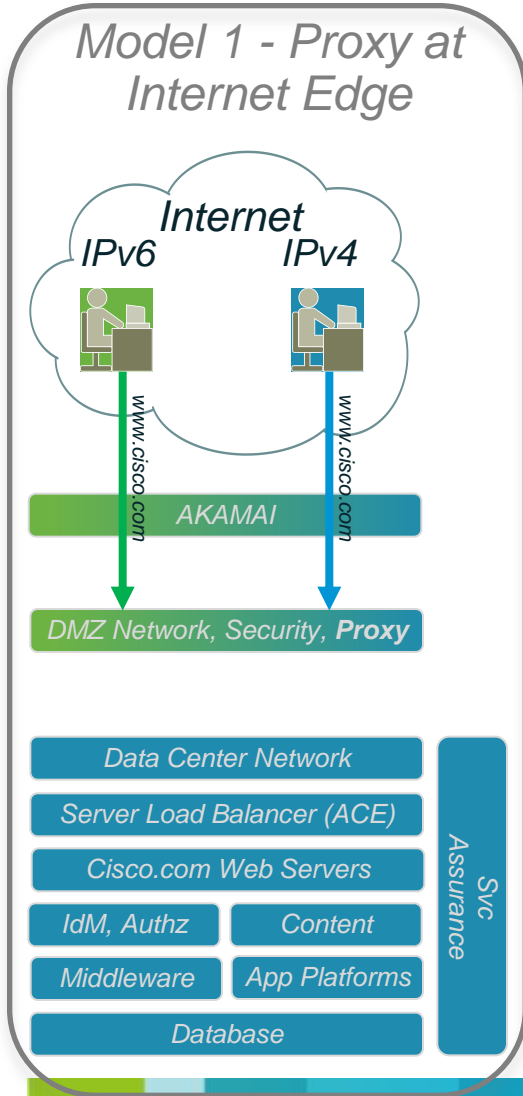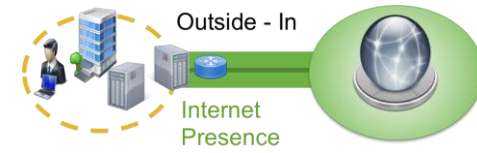*B2C, B2B*
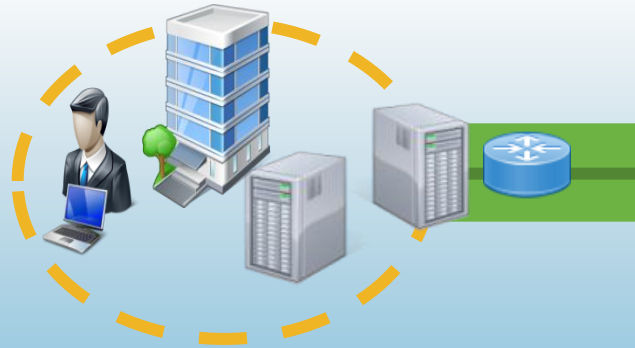
IPv4 Enterprise

IPv6 Internet

Inside – Out
Globalization
Technology Leadership
Industry mandate
BYOD-Security-Visibility
Flatten management plane

Dual-Stack Enterprise

http://www.cisco.com/en/US/netsol/ns817/networking_solutions_program_home.html

Architecture for IPv6 Web Presence

Model 1 - Proxy at Internet Edge

Internet

IPv6   IPv4

www.cisco.com   www.cisco.com

AKAMAI

DMZ Network, Security, **Proxy**

Data Center Network

Server Load Balancer (ACE)

Cisco.com Web Servers

IdM, Authz | Content

Middleware | App Platforms

Database

Svc Assurance

Model 2 – SLB64

Internet

IPv6   IPv4

www.cisco.com   www.cisco.com

AKAMAI

DMZ Network, Security

Data Center Network

Server Load Balancer (ACE)

Cisco.com Web Servers

IdM, Authz | Content

Middleware | App Platforms

Database

Svc Assurance

Svc Assurance

Model 3 – Dual Stack Web Servers

Internet

IPv6   IPv4

www.cisco.com   www.cisco.com

AKAMAI

DMZ Network, Security

Data Center Network

Server Load Balancer (ACE)

Cisco.com Web Servers

IdM, Authz | Content

Middleware | App Platforms

Database

Svc Assurance

Svc Assurance
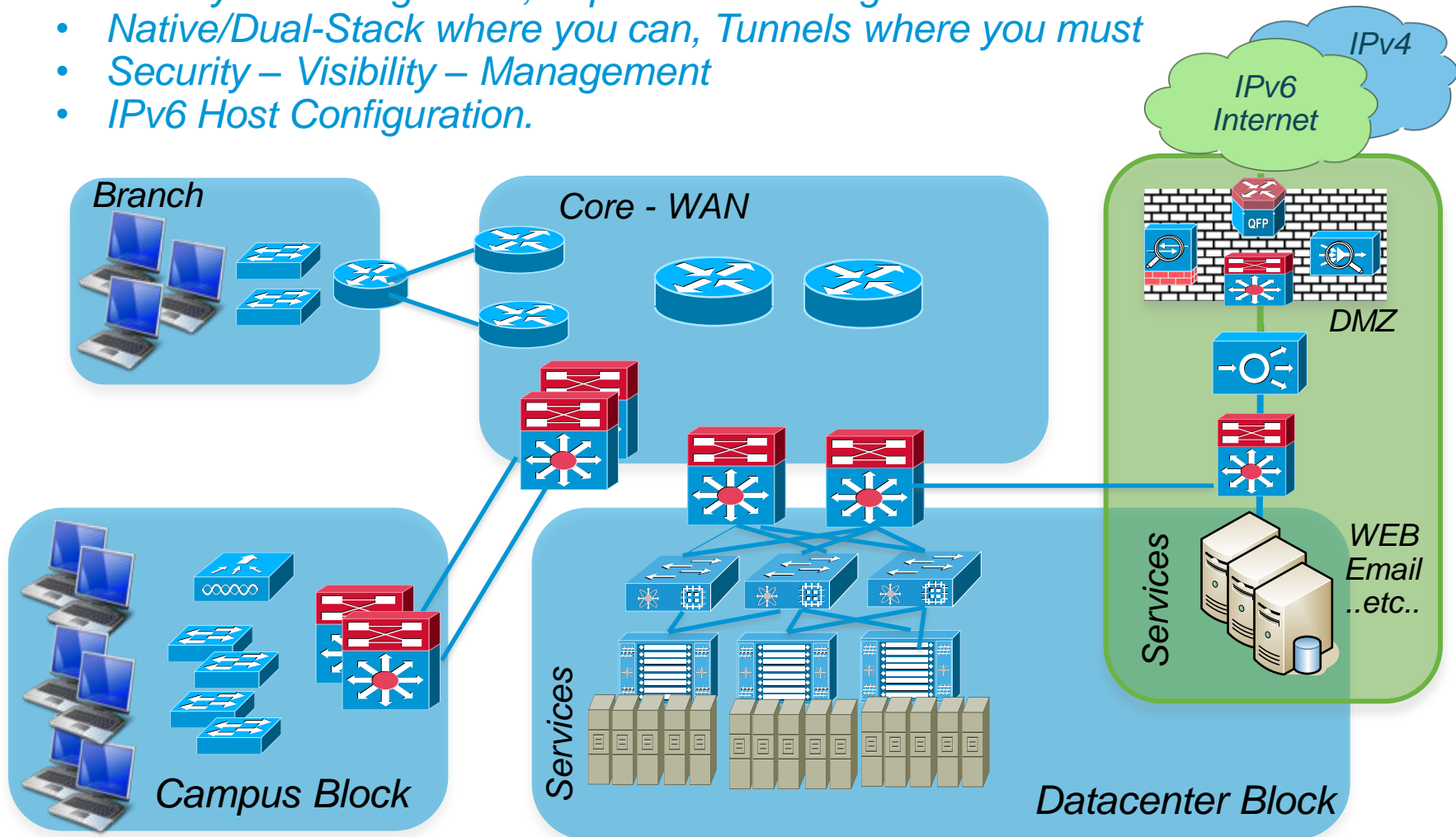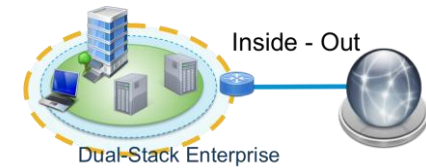
Internal Network: Where do I start ?
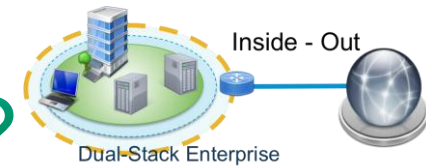
- *Life-Cycle management, depends on Timing and Use case*
- *Native/Dual-Stack where you can, Tunnels where you must*
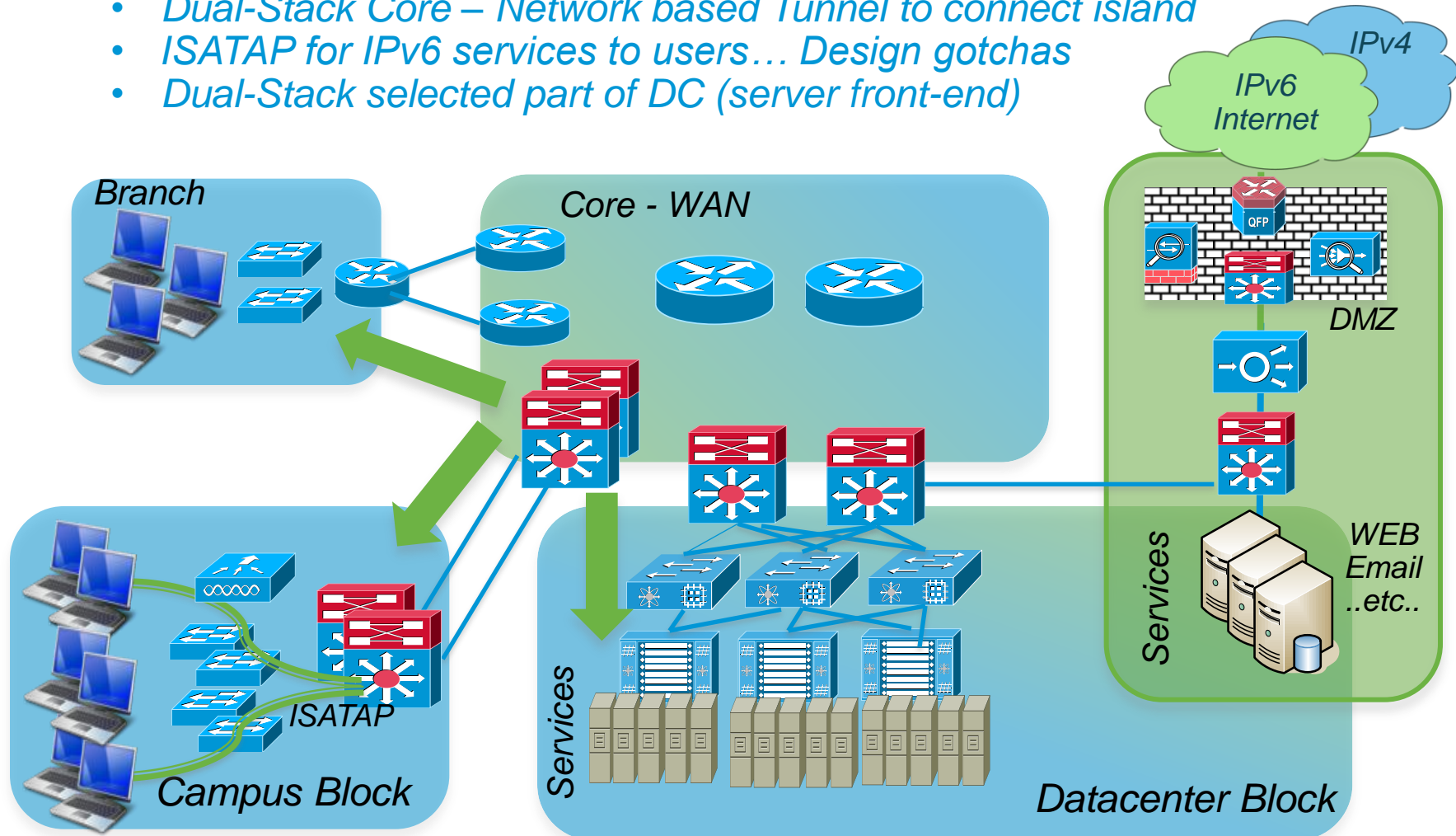- *Security – Visibility – Management*
- *IPv6 Host Configuration.*

IPv4

IPv6 Internet

Branch

Core - WAN

DMZ

Campus Block

Services

Services

WEB Email ..etc..

Datacenter Block

Core to Edge !

Inside - Out

Dual-Stack Enterprise

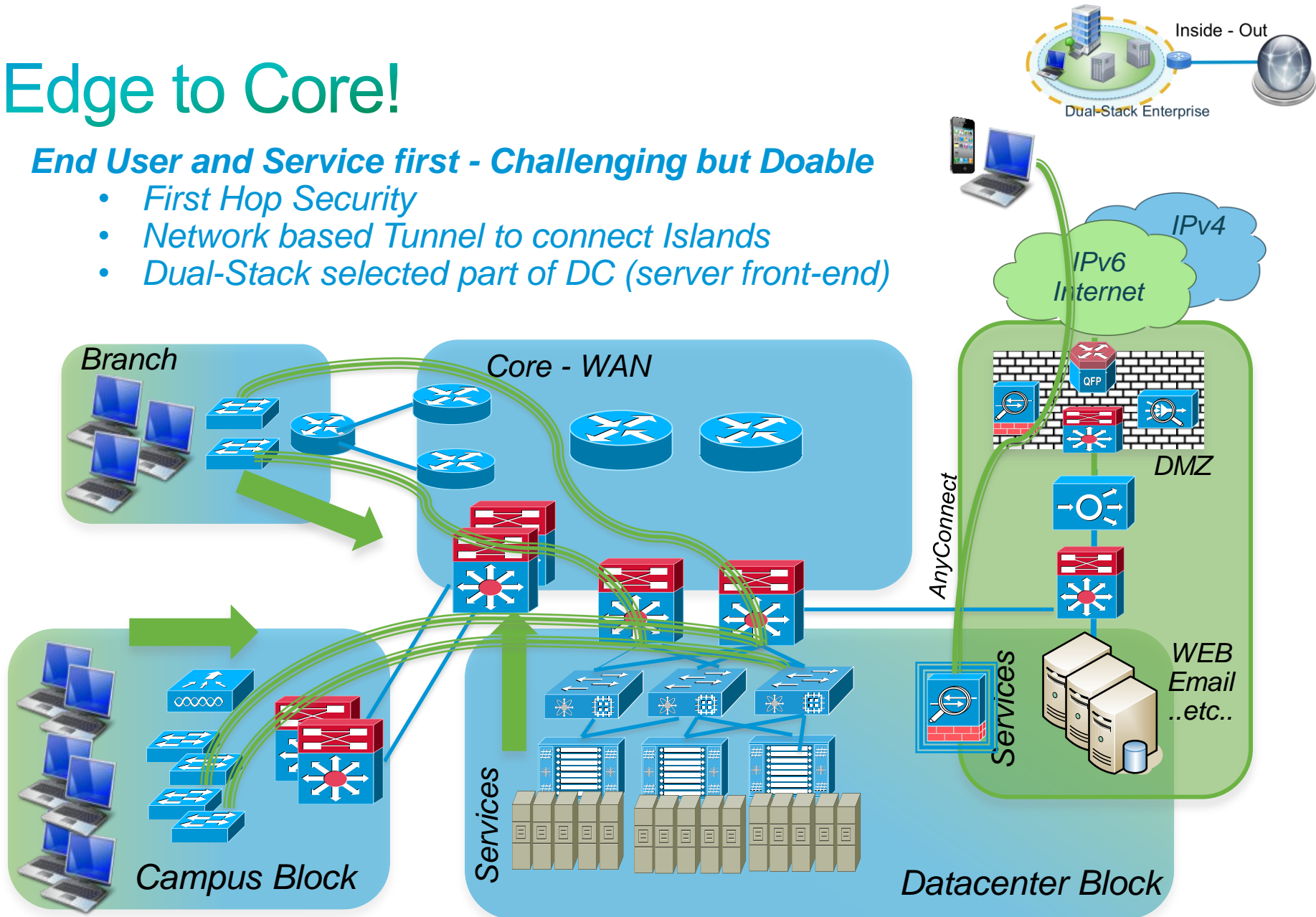***Orderly Transition – Slow to dual-Stack all the way to user***

- *Dual-Stack Core – Network based Tunnel to connect island*
- *ISATAP for IPv6 services to users… Design gotchas*
- *Dual-Stack selected part of DC (server front-end)*

IPv4

IPv6 Internet

Branch

Core - WAN

DMZ

Services

WEB Email ..etc..

ISATAP

Campus Block

Services

Services

Datacenter Block

Edge to Core!

End User and Service first - Challenging but Doable
- First Hop Security
- Network based Tunnel to connect Islands
- Dual-Stack selected part of DC (server front-end)

Inside - Out

Dual-Stack Enterprise

IPv4

IPv6 Internet

Branch

Core - WAN

AnyConnect

DMZ

Campus Block

Services

Services

Datacenter Block

WEB Email ..etc..

Cisco on Cisco
Eating our Own Dog Food

World IPv6 Launch @ Cisco

www.cisco.com architecture

Internet

IPv6   IPv4

www.cisco.com   www.cisco.com

AKAMAI

DMZ Network, Security

Data Center Network

Server Load Balancer (ACE)

Svc Assurance

Cisco.com Web Servers

IdM, Authz   Content

Middleware   App Platforms

Database

Svc Assurance

www.cisco.com	2001:420:1101:1::a
cisco.112.2o7.net	66.235.134.160
ciscosystemsinc.tt.omtrdc.net	70.42.13.100
news-tags.cisco.com	72.163.5.79
sso.cisco.com	72.163.4.70
www.static-cisco.com	2001:420:1101:1::a

www.webex.com	2607:fcf0:1:ffff::1100
api.demandbase.com	23.21.209.74
ciscowebex.112.2o7.net	66.235.138.19
fls.doubleclick.net	74.125.228.27
img.bizographics.com	216.137.41.111
p.rfihub.com	205.210.187.244
sales.liveperson.net	208.89.14.135
view.atdmt.com	65.242.27.32
webex.tt.omtrdc.net	70.42.13.100
www.google.com	2001:4860:800a::93
www.googleadservices.com	173.194.34.25
www.wbximg.com	23.67.250.122
xcdn.xgraph.net	63.116.244.74

Cisco's IPv6 Web Presence Security for www.cisco.com

Internet

Firewall Policy Anti-Spoofing

ASR 1002

QFP

V6-only signatures V4+V6 signatures

IPS 4260

NetFlowv9 (forensic records BGP Blackhole (mitigation)

6500

Si

Arbor (anomaly detection)

Firewall Policy

ASA 5585

Logging

ACE 30
origin-www.cisco.com
2001:420:1101:1::a

ACE 20
origin-www.cisco.com
72.163.4.161
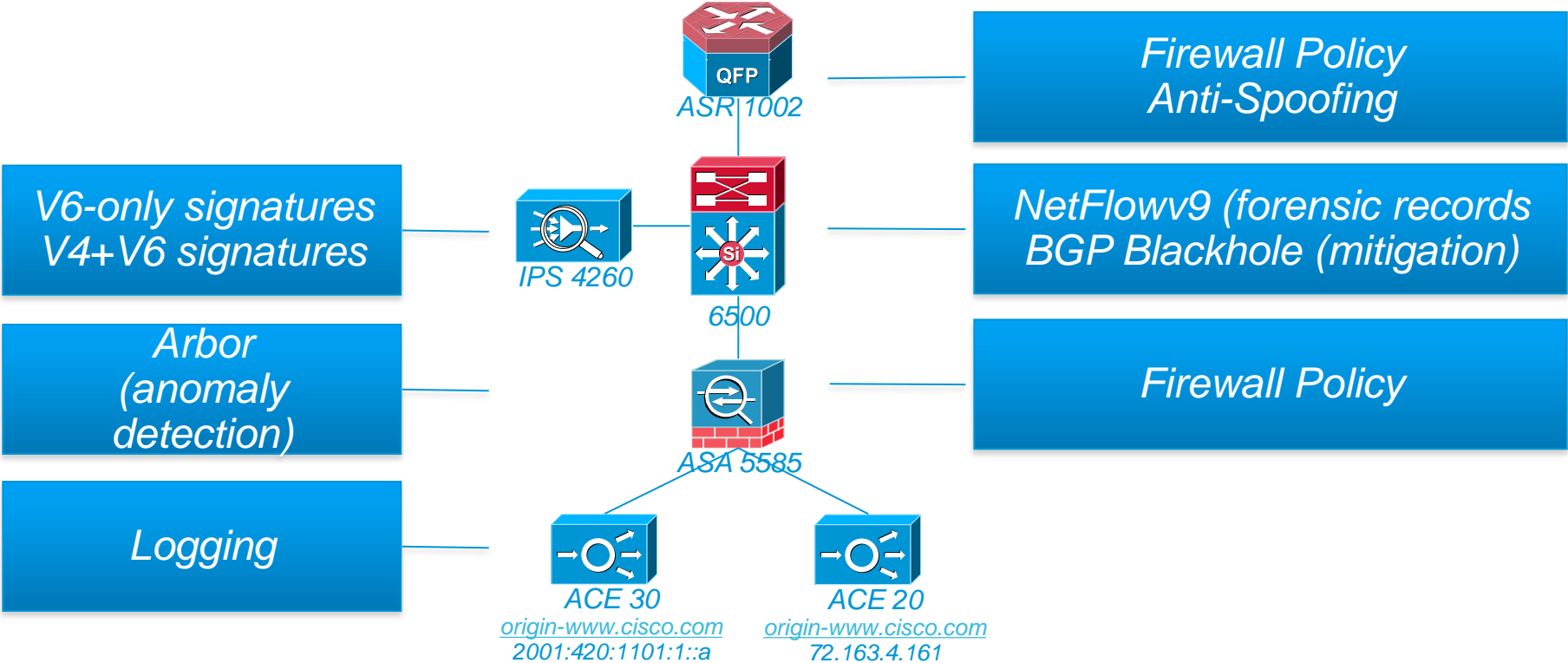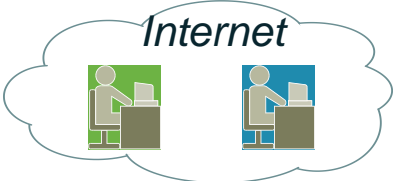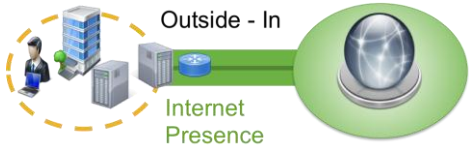
Cisco IT, IPv6 Roadmap

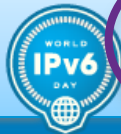| 2002-2009	2010	2011	2012	2013	2014

IPv6 Internet Presence (Outside-In)

www.ipv6.cisco

www.cisco.com
www.webex.com
www.cisco.fr
Home.cisco.com
accessible over IPv6

Entire cisco.com platform accessible over IPv6
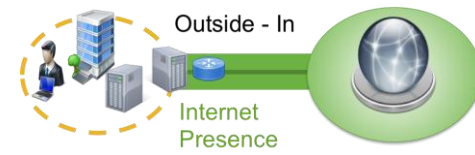
Ubiquitous IPv6 User Access (Inside-Out)

On-demand tunnel services

Dual stack global core + ISATAP + LAB's

Dual stack user access pilot

Dual stack user access (prod)

Dual stack DC and apps

World IPv6 Launch Preparation

- Wide cross functional collaboration across Cisco IT - CIO level buy-in

- Architecture and Design

- Assessment

    Cisco products, features

    Vendors and service providers

    Applications behind www.cisco.com

    Operational capabilities, knowledge, tools

- Readiness

    Software upgrades

    Service provider provisioning

    Application and system-wide testing

    Training and tooling

Why Cisco

At Cisco we are committed architecturally to IPv6 across the board: All of our devices, all of our applications and all of our services.

- John Chambers,
President and CEO of Cisco Systems

Broad Platform Support

FEATURE SET PARITY

Nexus + MDS Family

Service Module
Catalyst 6xxx
ASA-SM,NAM,ACE30

Catalyst 6xxx

Catalyst 4xxx

CRS1 + CRS3

Compact,C2K,C3K

Cisco 7600 + ASR9K Family

ASR5K + ASR1K Family

ISRG2 + SmartGrid Router

Cisco PRIME

Linksys
E& EA Series

Cisco MOVI
Vidéo + IM

CuCM + Unity Cnx

Wireless
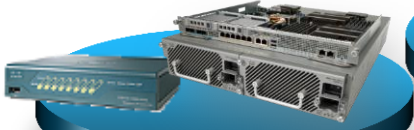
ASA Familly

IPv6 Internet Presence Security

IPv4

IPv6 Internet

QFP   QFP

ASR1k-GSR-6K
IPv6 uRPF, anti-spoofing
Control Plane Policy
Access Control List

IPv6 IOS zone-based Fw
Flexible Netflow, NBAR2
IPsec VPN-Anyconnect
Stateful NAT64

IPS
V6-only signatures
V4+V6 signatures

ASA-SM
16 Gbps IPv6 firewall
ASA feature parity

ASA
First USGv6 FW
Ext. Header filtering
SSL VPN
OSPFv3

2013:
Nexus 1000v
Virtual Security Gw
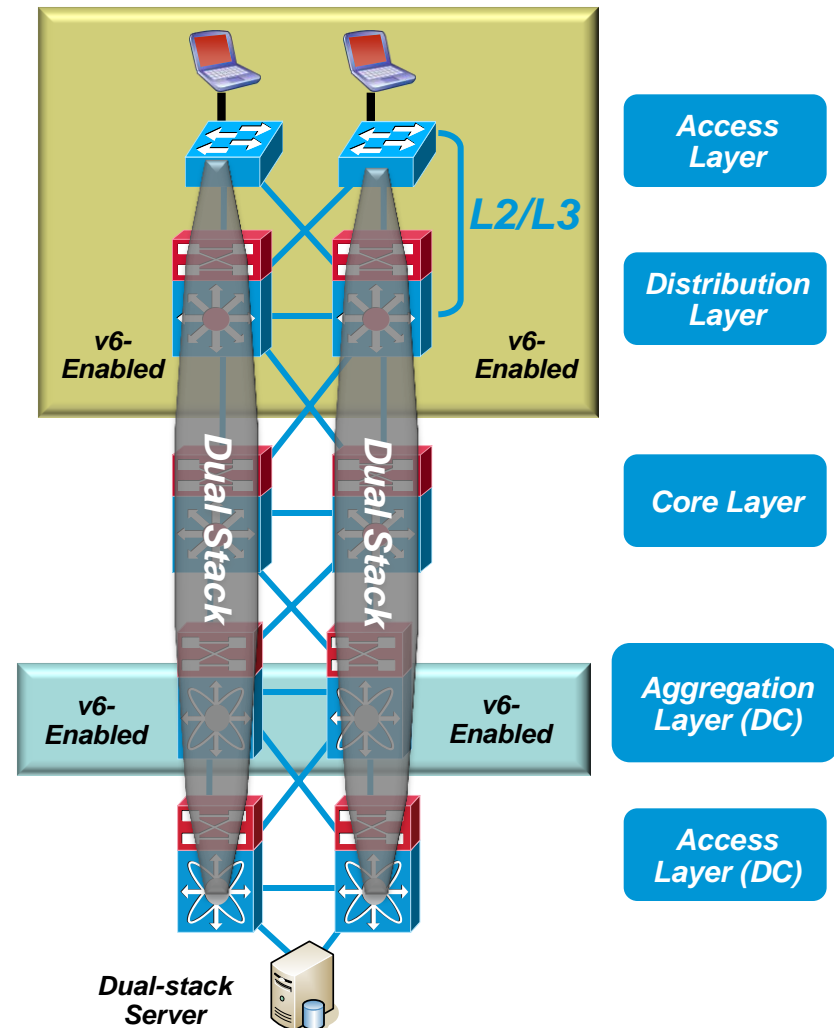*ASA 1000v*
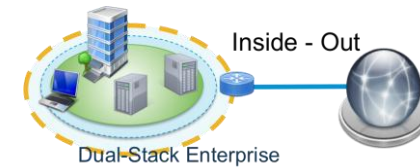
Campus IPv6 Deployment Options
Dual-Stack IPv4/IPv6
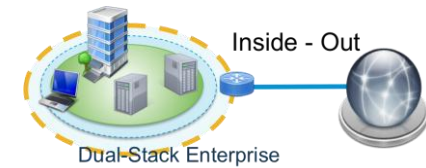
- Dual Stack = Two protocols running at the same time (IPv4/IPv6)

- #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
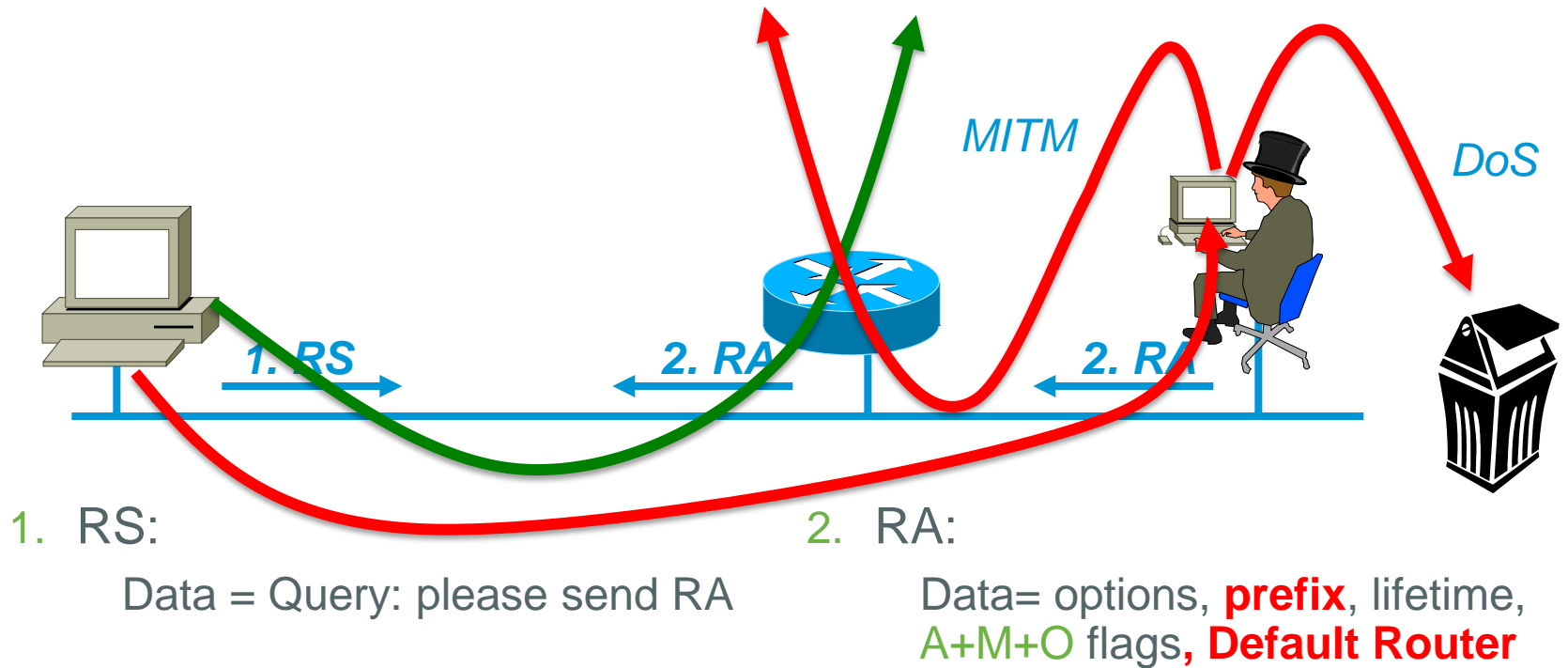
IPv6/IPv4 Dual Stack Hosts

Access Layer

Distribution Layer

Core Layer

Aggregation Layer (DC)

Access Layer (DC)

L2/L3

v6-Enabled

Dual Stack

Dual-stack Server

Inside - Out

Dual-Stack Enterprise

Rogue Router Advertisement

Router Advertisements contains:
-Prefix to be used by hosts
-Data-link layer address of the router
-Miscellaneous options: MTU, DHCPv6 use, …

RA w/o Any Authentication Gives Exactly Same Level of Security as DHCPv4 (None)

MITM

DoS

1. RS

2. RA

2. RA

1. RS:

    Data = Query: please send RA

2. RA:

    Data= options, **prefix**, lifetime, A+M+O flags, **Default Router**

Bored at BRU Airport on Sunday at 22:30…

```
$ ifconfig en1
en1: flags=8863<UP,BROADCAS          TICAST>mtu 1500
        ether 00:26:bb:
        inet6 fe80::226:          scopeid 0x6
inet 10.19.19.118 netmas                    9.19.255
        media: autoselect
        status: active
```

Humm…
Is there an IPv6
Network?

```
$ ping6 -I en1 ff02::1%en1
PING6(56=40+8+8 bytes) fe80::226:bb            ff02::1
16 bytes from fe80::226:                 64 time=0.140 ms
. . .
16 bytes from fe80::ca                  =64 time=402.112 ms
^C
--- ff02::1%en1 ping6 statistics
4 packets transmitted, 4 packets received, +142 duplicates, 0.0% packet loss
round-trip min/avg/max/std-dev = 0.140/316.721/2791.178/412.276 ms
```

Humm…
Are there any IPv6
peers?

```
$ ndp -an
Neighbo
2001:xxxx
. . .
$ ndp -an | wc -l
        64
```

Let's have some fun here… Configure a tunnel,
enable forwarding and transmit RA
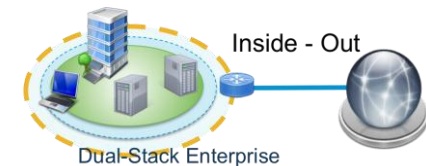
Rogue RA – Mitigation Techniques

| Where	What
Routers	Increase "legal" router preference
Hosts	Disabling Stateless Address Autoconfiguration
Routers & Hosts	SeND "Router Authorization"
Switch (First Hop)	Host isolation
Switch (First Hop)	Port Access List (PACL)
Switch (First Hop)	RA Guard
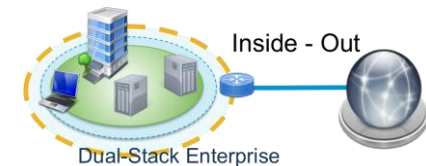
Security at the LAN Access

IPv6 FHS	C6K	C4K	C3K	C2K*	WLC
RA Guard	12.2(50)SY and 15.0(1)SY	15.0.2S	15.0.2SE	15.0.2SE	7.2
DHCP Guard	2013	Q4 CY12	15.0.2SE	15.0.2SE	7.2
Binding Integrity Guard	2013	Q4 CY12	15.0.2SE	15.0.2SE	7.2
Source Guard	2013	2013	15.0.2SE	N/A	7.2
Destination Guard	2013	Q4 CY12	N/A	N/A	7.2

IPv6 First Hop Security Suite

Key Takeaway:
Catalyst & WLAN most secure IPv6 capable Products for your customer's access layer

* 2960S mni
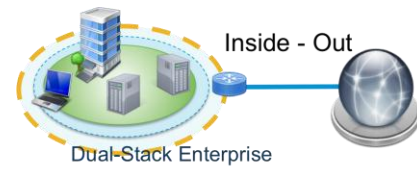
IPv6 Traffic Visibility

Inside - Out

Dual-Stack Enterprise

IPv6 MIBs and host support

IPv6/IPv4 Dual Stack Hosts

NAM Traffic Analyzer
Integrated Management & Reporting Console

L2

L3

Campus
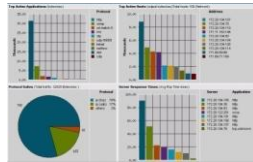
IPv6 Traffic Metering with NAM and Flexible Netflow, including tunnel
(export over IPv4)
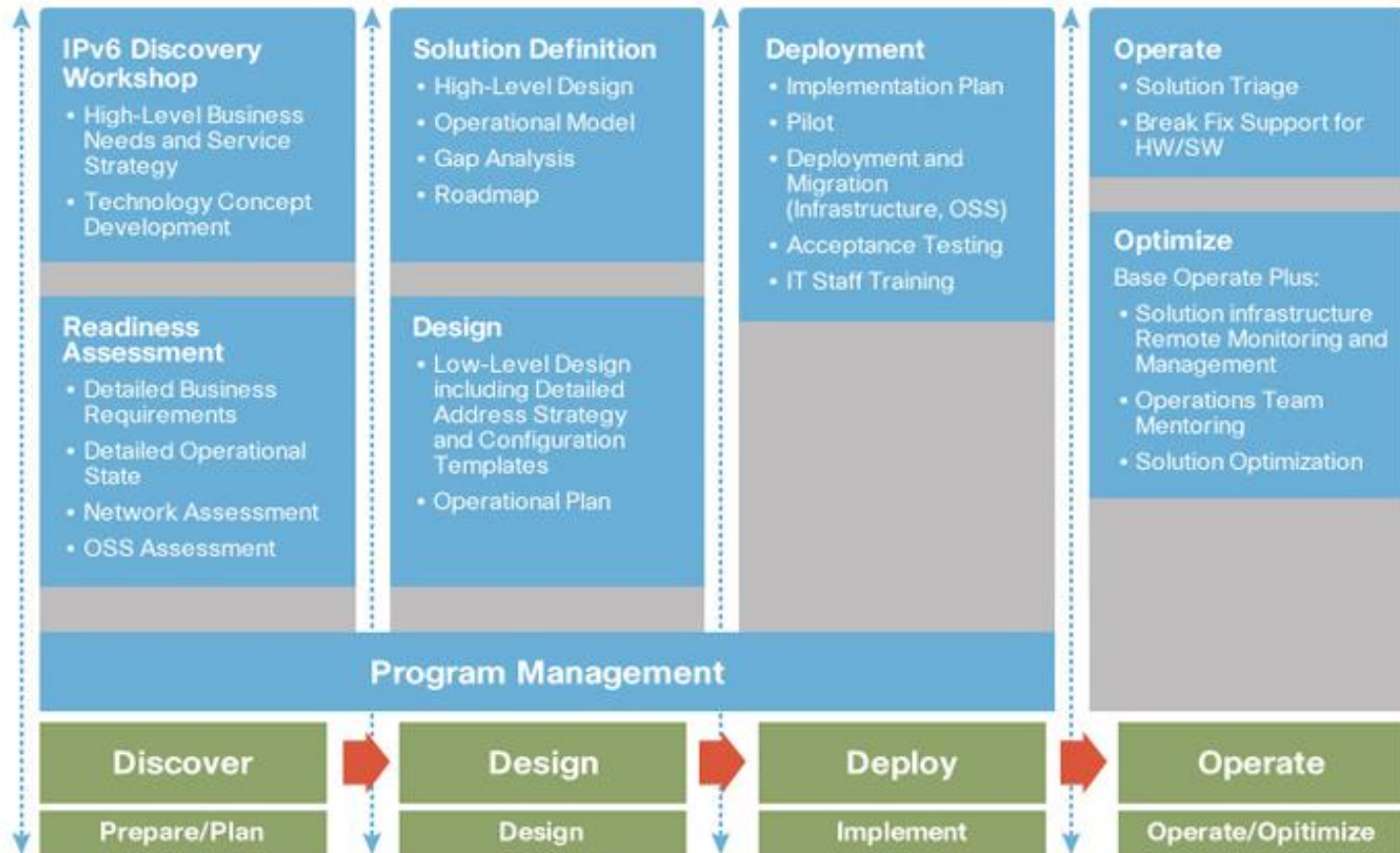
IPv6 over IPv4 tunnel

IPv6 SLA: E2E test, measurement
(UDP-Jitter, UDP-Echo, ICMP Echo, TCP Connect)

IPv4 WAN

IPv6 Apps and Tunnel detection with NBAR2

ASA and IOS Tunnel Filtering
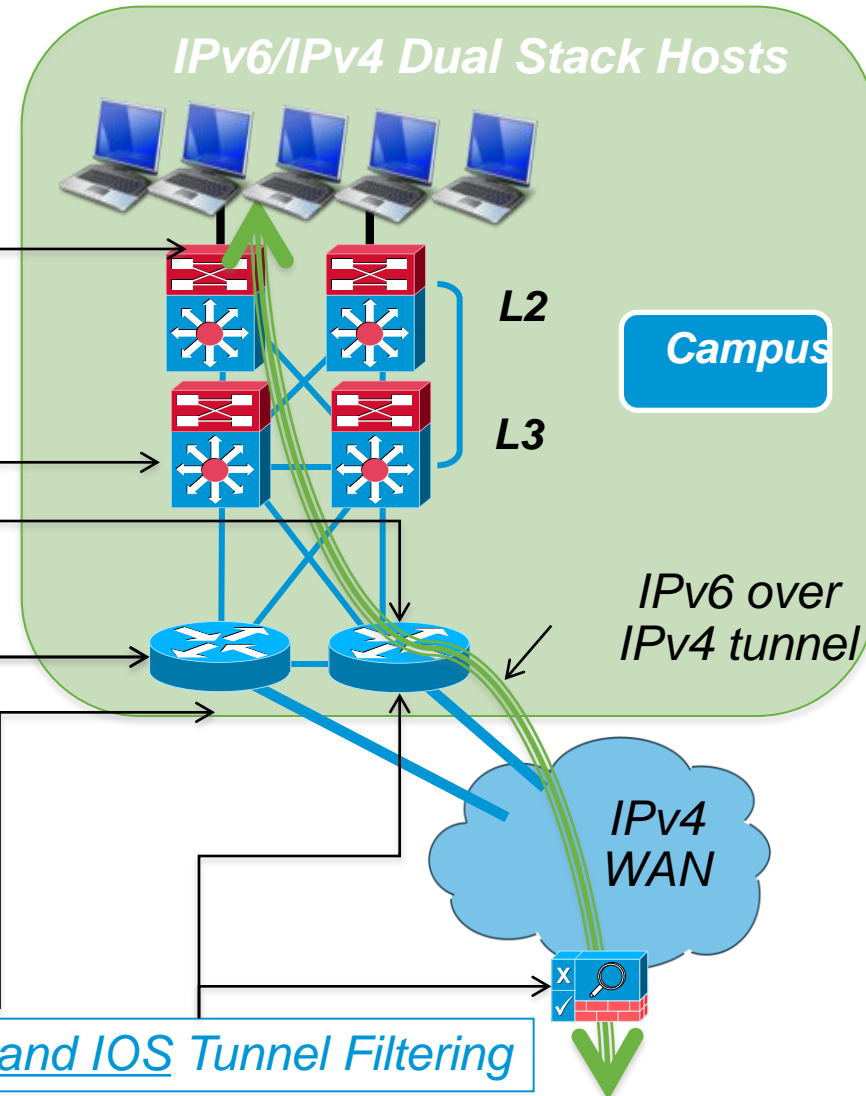
Cisco IPv6 Services Portfolio

IPv6 Discovery Workshop
- High-Level Business Needs and Service Strategy
- Technology Concept Development

Readiness Assessment
- Detailed Business Requirements
- Detailed Operational State
- Network Assessment
- OSS Assessment

Solution Definition
- High-Level Design
- Operational Model
- Gap Analysis
- Roadmap

Design
- Low-Level Design including Detailed Address Strategy and Configuration Templates
- Operational Plan

Deployment
- Implementation Plan
- Pilot
- Deployment and Migration (Infrastructure, OSS)
- Acceptance Testing
- IT Staff Training

Operate
- Solution Triage
- Break Fix Support for HW/SW

Optimize
Base Operate Plus:
- Solution infrastructure Remote Monitoring and Management
- Operations Team Mentoring
- Solution Optimization

Program Management

Discover	Design	Deploy	Operate
Prepare/Plan	Design	Implement	Operate/Opitimize

One stop shop:
www.cisco.com/go/ipv6

- Product
- Solutions
- Services
- Knowledge
- Documentations
- Support community
- Training
- Certifications
- Customer testimonials

Commitment to customer success

- **Comprehensive Advanced Services**

- IPv6 Education
    - Training: IPv6 FD
    - Certified Pro. CCIE/CCDE/CCDP/CCNA/CCNP
    - CiscoLive, Conferences & Webinars
    - Cisco Press

- **IPv6 Knowledge Portal**

- **IPv6 Support Community**

- Leading **in IPv6 Certification**:
  https://www.iol.unh.edu/services/testing/ipv6/usgv6tested.php

… and more …

www.cisco.com/go/ipv6

Thank you.

CISCO

- *"This is not the end. It is not even the beginning of the end. But it is , perhaps, the end of the beginning"*
  - *Winston Churchill*