Présentation IPv6

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Solution Architect IPv6
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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

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.

http://ipv6.he.net/statistics/
RIPE NCC Membership Statistics - November 2012

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

### 16 NAT Sessions
### times millions of users

What’s the cost of a bad user experience?

<table>
<thead>
<tr>
<th>Application</th>
<th># of TCP sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yahoo top page</td>
<td>10~20</td>
</tr>
<tr>
<td>Google image search</td>
<td>30~60</td>
</tr>
<tr>
<td>ニコニコ動画</td>
<td>50~80</td>
</tr>
<tr>
<td>OCN photo friend</td>
<td>170~200+</td>
</tr>
<tr>
<td>iTunes</td>
<td>230~270</td>
</tr>
<tr>
<td>iGoogle</td>
<td>80~100</td>
</tr>
<tr>
<td>楽天(Rakuten)</td>
<td>50~60</td>
</tr>
<tr>
<td>Amazon</td>
<td>90</td>
</tr>
<tr>
<td>HMV</td>
<td>100</td>
</tr>
<tr>
<td>YouTube</td>
<td>90</td>
</tr>
</tbody>
</table>

Web 2.0 (ex: AJAX) Application Behavior Under Constrained
IPv6 – “Full Spectrum” Internet

Call to action: Enable IPv6 content
Enable IPv6 users
CGN Bypass, aka 6rd+CGN

**CGN44 Capex and Opex is growing driven by Subscribers 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

2010: Low impact
Shift limited to mandated and early adopters

2010

2012: Mandates take effect
More than 40% of web content reachable over IPv6 (in most developed countries)

2012

2014: IPv6 is mainstream
Customers without transition infrastructure will experience reduced service levels and customer reach

2014
7.6 Billion IPv6-Capable Devices by 2016
Mobile and Fixed

6th June 2012

THIS TIME IT IS FOR REAL
6 JUNE 2012

Major Internet service providers (ISPs), home networking equipment manufacturers, and web companies around the world are coming together to permanently enable IPv6 for their products and services by 6 June 2012.

DO YOUR PART
JOIN THE LAUNCH!

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

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

Users

80%

Cloud

CDN

Content

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

Today, more than **99% of things** in the physical world are still not connected to the Internet.

But a phenomenon called “The Internet of Everything” will wake up **everything you can imagine**.

By 2020, 37 billion intelligent things will be connected to the Internet.

Internet of Everything connects the physical world to the Internet.

Using microsensors on the network, everyday objects become connected and intelligent.
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

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

World Population
- 6.3 Billion
- 6.8 Billion
- 7.2 Billion
- 7.6 Billion

Connected Devices
- 500 Million
- 12.5 Billion
- 25 Billion
- 50 Billion

Connected Devices Per Person
- 0.08
- 1.84
- 3.47
- 6.58

*Source: Cisco IBSG, 2011*
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

Global IPv6 Transit, Available on a per country basis

IPv6 Network Enablement: % of Transit AS with IPv6 (source Cisco)
IPv6 Adoption Metrics: TOP 500 Content

IPv6 availability from 6/6/2012

1. **Google**
google.com
   Enables users to search the world's information, including webpages, images, and videos. Offers...
   More

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

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

4. **Yahoo!**
yahoo.com
   A major internet portal and service provider offering search results, customizable content, cha...
   More

5. **Baidu.com**
baidu.com
   The leading Chinese language search engine, provides "simple and reliable" search exp...
   More

6. **Wikipedia**
wikipedia.org
   A free encyclopedia built collaboratively using wiki software, (Creative Commons Attribution-Sh...
   More

7. **Windows Live**
live.com
   Search engine from Microsoft.
   More

8. **Twitter**
twitter.com
   Social networking and microblogging service utilizing instant messaging, SMS or a web interface.
   More

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

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

<table>
<thead>
<tr>
<th>Rank</th>
<th>Site Name</th>
<th>URL</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Google France</td>
<td>google.fr</td>
<td>Version française du moteur de recherche. Propose des outils et services pour les internautes. More</td>
</tr>
<tr>
<td>2</td>
<td>Facebook</td>
<td>facebook.com</td>
<td>A social utility that connects people, to keep up with friends, upload photos, share links and ... More</td>
</tr>
<tr>
<td>3</td>
<td>Google</td>
<td>google.com</td>
<td>Enables users to search the world's information, including webpages, images, and videos. Offers... More</td>
</tr>
<tr>
<td>4</td>
<td>YouTube</td>
<td>youtube.com</td>
<td>YouTube is a way to get your videos to the people who matter to you. Upload, tag and share your... More</td>
</tr>
<tr>
<td>5</td>
<td>Wikipedia</td>
<td>wikipedia.org</td>
<td>A free encyclopedia built collaboratively using wiki software. (Creative Commons Attribution-Share... More</td>
</tr>
<tr>
<td>6</td>
<td>Yahoo!</td>
<td>yahoo.com</td>
<td>A major internet portal and service provider offering search results, customizable content, chat... More</td>
</tr>
<tr>
<td>7</td>
<td>Windows Live</td>
<td>live.com</td>
<td>Search engine from Microsoft.</td>
</tr>
<tr>
<td>8</td>
<td>iseboncoin.fr</td>
<td>iseboncoin.fr</td>
<td>Site de petites annonces gratuit et sans commission (produits d’occasion, annonces immobilières... More</td>
</tr>
<tr>
<td>9</td>
<td>Amazon.fr</td>
<td>amazon.fr</td>
<td>Livres en français et en anglais, neufs ou d'occasion, produits culturels.</td>
</tr>
<tr>
<td>10</td>
<td>Orange</td>
<td>orange.fr</td>
<td>Présente les offres de cet opérateur et leurs tarifs, permet de souscrire à certaines d'entre e... More</td>
</tr>
</tbody>
</table>

IPv6 availability from 6/6/2012
Each site that is IPv6 enabled (per worldIPv6launch.org list) is represented proportionally to its % of global internet pages viewed (per www.alexa.com ranking)

Source: Cisco (ISOC + alexa.com), Hugo Kaczmarek
IPv6 Adoption Metrics: Users
November 17, 2012

Source: http://6lab.cisco.com/stats/index.php
IPv6 Adoption Metrics: Users per country
Mars 2012

Google Statistics: Per Country IPv6 users, gathered from Google Search
IPv6 Adoption Metrics: Users per country
21\textsuperscript{th} of November 2012

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

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

15\% ipv6 mobile users coming from Verizon & T-Mobile
7.5\% from AT&T

Source: \url{http://6lab.cisco.com/stats/index.php}
\url{http://www.worldipv6launch.org/measurements/}
IPv6 Adoption Metrics: Users per country
21st of November 2012

<table>
<thead>
<tr>
<th>Country</th>
<th>IPv6 Overall Deployment</th>
<th>Prefixes</th>
<th>Transit AS</th>
<th>Content</th>
<th>Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Romania</td>
<td>68.45%</td>
<td>44.44%</td>
<td>42.6%</td>
<td>35.22%</td>
<td>8.61%</td>
</tr>
<tr>
<td>France</td>
<td>48.08%</td>
<td>52.47%</td>
<td>68.72%</td>
<td>38.48%</td>
<td>4.65%</td>
</tr>
<tr>
<td>United States of America</td>
<td>29.85%</td>
<td>42.25%</td>
<td>57.27%</td>
<td>34.37%</td>
<td>1.93%</td>
</tr>
</tbody>
</table>

Source: http://6lab.cisco.com/stats/index.php
IPv6 Adoption Metrics: Users per country 21st of November 2012
Global IPv6 capable devices forecast: Stats

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.

What ETAB customers have to say?

**Q1. When are you deploying IPv6 in production?**
- 70% of Customers deploying IPv6 at Internet Edge in next 24 months

**Q2. What are your MAIN drivers for IPv6?**
- > 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

1. Evaluate effect on business model
2. Establish IPv6 project management team
3. Assess network hardware and software
4. IPv6 Training strategy
5. Obtain IPv6 prefix(es)
6. Decide IPv6 architectural solution
7. Test application software and services
8. Develop security policy
9. Develop procurement plan
10. Develop IPv6 exception strategy
Enterprise Deployment Options

Outside – In
Internet Evolution
Business Continuity
B2C, B2B

IPv4 Enterprise

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

Dual-Stack Enterprise

IPv6 Internet

Architecture for IPv6 Web Presence

Model 1 - Proxy at Internet Edge
- Internet IPv6
- Internet IPv4
- AKAMAI
- DMZ Network, Security, Proxy
- Data Center Network
- Server Load Balancer (ACE)
- Cisco.com Web Servers
- IdM, Authz
- Content
- Middleware
- App Platforms
- Database

Model 2 – SLB64
- Internet IPv6
- Internet IPv4
- AKAMAI
- DMZ Network, Security
- Data Center Network
- Server Load Balancer (ACE)
- Cisco.com Web Servers
- IdM, Authz
- Content
- Middleware
- App Platforms
- Database

Model 3 – Dual Stack Web Servers
- Internet IPv6
- Internet IPv4
- AKAMAI
- DMZ Network, Security
- Data Center Network
- Server Load Balancer (ACE)
- Cisco.com Web Servers
- IdM, Authz
- Content
- Middleware
- App Platforms
- Database
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.
Core to Edge!

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)
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)
Cisco on Cisco
Eating our Own Dog Food
Cisco’s IPv6 Web Presence Security for www.cisco.com

Internet

V6-only signatures
V4+V6 signatures

Arbor
(anomaly
detection)

Logging

Firewall Policy
Anti-Spoofing

NetFlowv9 (forensic records
BGP Blackhole (mitigation)

Firewall Policy

IPS 4260

ASA 5585

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

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**

- **Compact, C2K, C3K**
- **Catalyst 4xxx**
- **Catalyst 6xxx**
- **Service Module**
  - Catalyst 6xxx
  - ASA-SM, NAM, ACE30
- **Nexus + MDS Family**
- **CRS1 + CRS3**
- **Cisco 7600 + ASR9K Family**
- **ASR5K + ASR1K Family**
- **Cisco PRIME**
- **Cisco MOVI**
- **Vidéo + IM**
- **ISRG2 + Smart Grid Router**
- **Linksys E & EA Series**
- **ASA Family**
- **Wireless**
- **CuCM + Unity Cnx**
- **Cisco PRIME**
IPv6 Internet Presence Security

IPv6 Internet

IPv4

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

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

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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
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)

Data = Query: please send 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,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    ether 00:26:bb:xx:xx:xx
    inet6 fe80::226:bbff:fexx:xxxx%en1 scopeid 0x6
    inet 10.19.19.118 netmask 0xffffff00 broadcast 10.19.19.255
    media: autoselect
    status: active

$ ping6 -I en1 ff02::1%en1
PING6(56=40+8+8 bytes) fe80::226:bbff:fexx:xxxx%en1
16 bytes from fe80::226:bbff:fexx:xxxx%en1, icmp_seq=0 hlim=64 time=0.140 ms
... 16 bytes from fe80::226:bbff:fexx:xxxx%en1, icmp_seq=3 hlim=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

$ ndp -an
Neighbor
...
$ ndp -an | wc -l
64

Humm... Is there an IPv6 Network?

Humm... Are there any IPv6 peers?

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

<table>
<thead>
<tr>
<th>Where</th>
<th>What</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routers</td>
<td>Increase “legal” router preference</td>
</tr>
<tr>
<td>Hosts</td>
<td>Disabling Stateless Address Autoconfiguration</td>
</tr>
<tr>
<td>Routers &amp; Hosts</td>
<td>SeND “Router Authorization”</td>
</tr>
<tr>
<td>Switch (First Hop)</td>
<td>Host isolation</td>
</tr>
<tr>
<td>Switch (First Hop)</td>
<td>Port Access List (PACL)</td>
</tr>
<tr>
<td>Switch (First Hop)</td>
<td>RA Guard</td>
</tr>
</tbody>
</table>
## Security at the LAN Access

### IPv6 FHS

<table>
<thead>
<tr>
<th>Feature</th>
<th>C6K</th>
<th>C4K</th>
<th>C3K</th>
<th>C2K*</th>
<th>WLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA Guard</td>
<td>12.2(50)SY and 15.0(1)SY</td>
<td>15.0.2S</td>
<td>15.0.2SE</td>
<td>15.0.2SE</td>
<td>7.2</td>
</tr>
<tr>
<td>DHCP Guard</td>
<td>2013</td>
<td>Q4 CY12</td>
<td>15.0.2SE</td>
<td>15.0.2SE</td>
<td>7.2</td>
</tr>
<tr>
<td>Binding Integrity Guard</td>
<td>2013</td>
<td>Q4 CY12</td>
<td>15.0.2SE</td>
<td>15.0.2SE</td>
<td>7.2</td>
</tr>
<tr>
<td>Source Guard</td>
<td>2013</td>
<td>2013</td>
<td>15.0.2SE</td>
<td>N/A</td>
<td>7.2</td>
</tr>
<tr>
<td>Destination Guard</td>
<td>2013</td>
<td>Q4 CY12</td>
<td>N/A</td>
<td>N/A</td>
<td>7.2</td>
</tr>
</tbody>
</table>

### Key Takeaway:

*Catalyst & WLAN most secure IPv6 capable Products for your customer’s access layer*

*2960S mni*
IPv6 Traffic Visibility

**IPv6 MIBs and host support**

**NAM Traffic Analyzer**
Integrated Management & Reporting Console

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

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

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

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

- 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
    - Prepare/Plan
  - Design
  - Deploy
    - Implement
  - Operate
    - Operate/Optimize

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

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

• “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