

IPv6 - the real drivers for adoption (IPv6 centric designs / aka what to do with an infinite number of addresses)



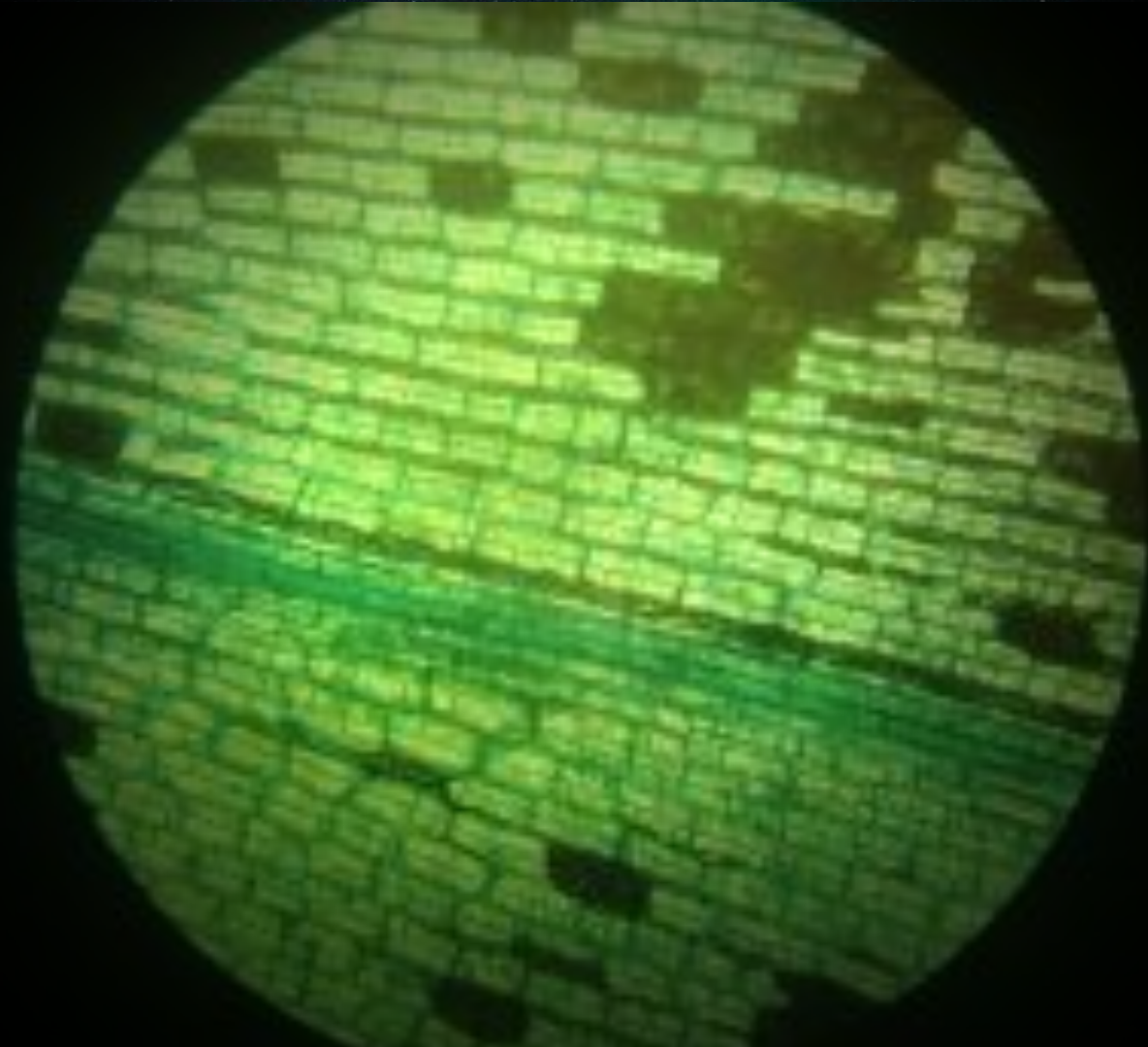
Steve Simlo, IPv6 Product Manager

ssimlo@cisco.com

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twitter

[@stevesimlo](https://twitter.com/stevesimlo)
[@cisco6lab](https://twitter.com/cisco6lab)





nature

THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE



Plant evolution — like
archaea — poses a tough
challenge when ancient
genes take charge. **113**

THE GREEN HOURGLASS

**A WINNING
FORMULA**

What makes the great
LSD? **10**

108

**KEEP THE TEXT
MINE OPEN**

Are there really 1,000
species of elephants? **10**

108

**CREATURE
COMFORTS**

And how many
more than feeding? **10**

108

2 MONTHS FREE

Subscription Form

Subscription Form

Subscription Form



The Genetic Hourglass

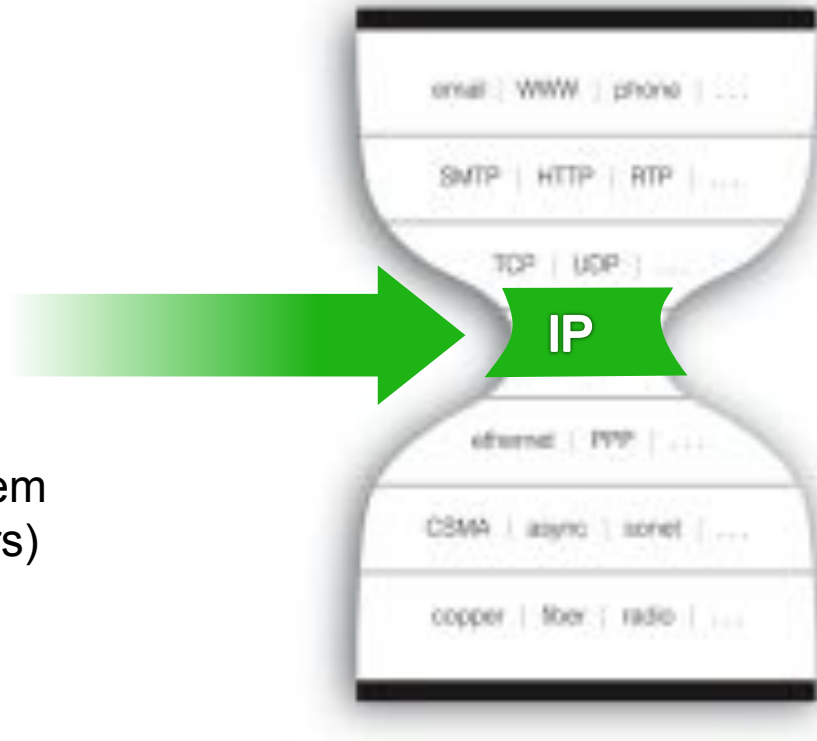
Developmental stages that show the basic architecture of vertebrates



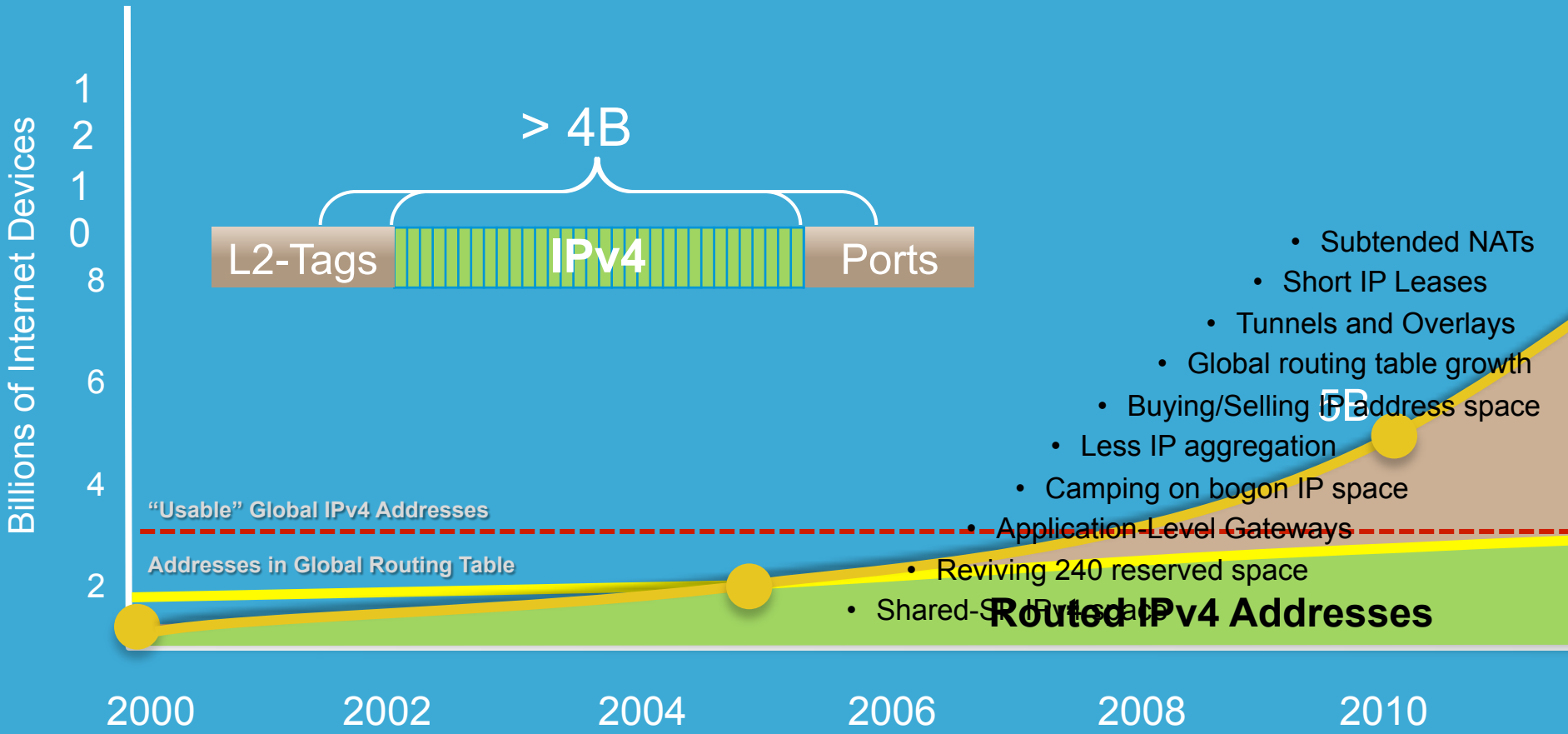
From; "Extraordinary origins, unlikely superpowers: the turtle genome unveiled" by Rachel Gross

The Internet Hourglass

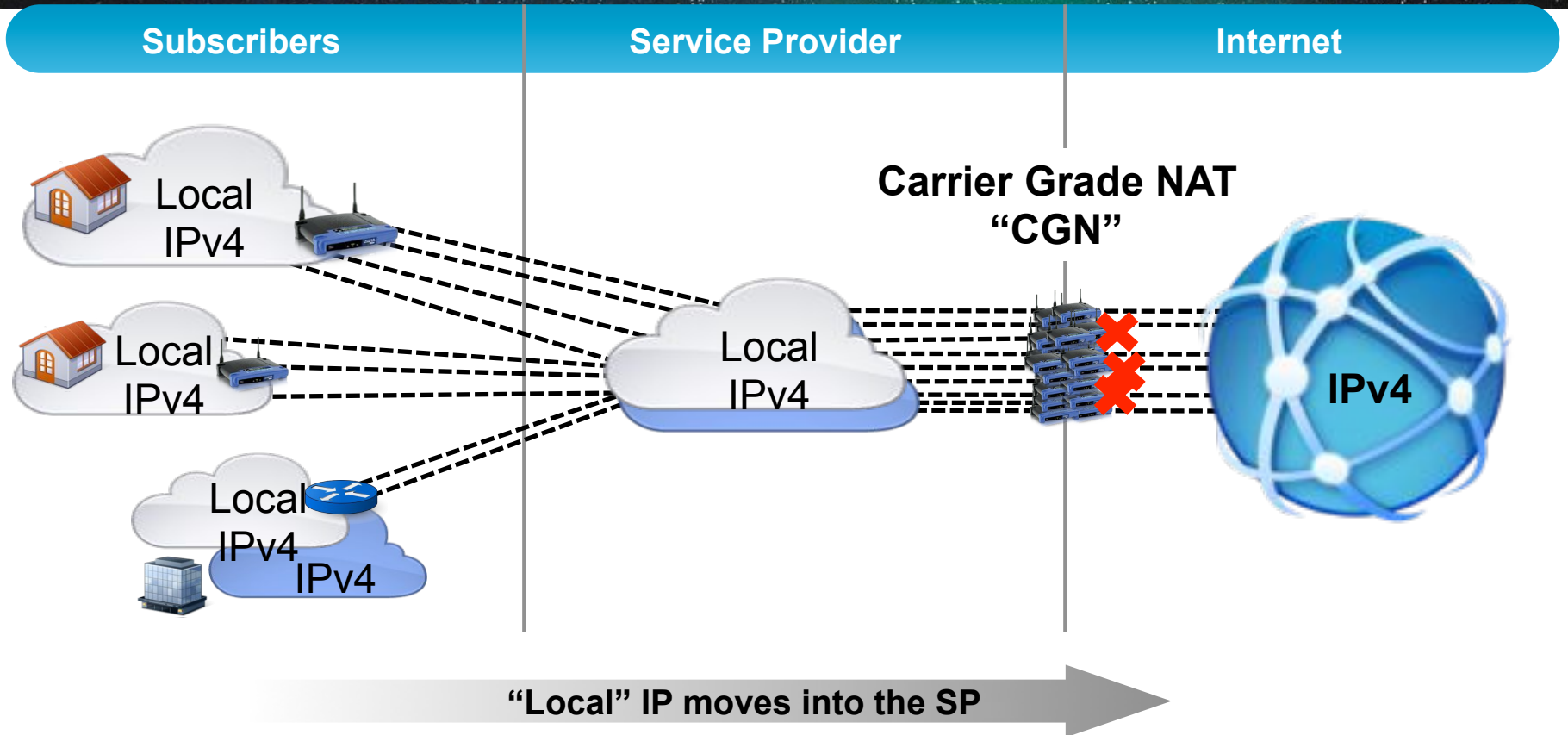
- We've got over a billion unique Building Blocks to work with
- We're using pretty much all of them (for the first time in about 30 years)



Future Growth Challenges Grow With IPv4



Scaling Challenges with IPv4





30

20

15

10

5



30

20

15

10

5



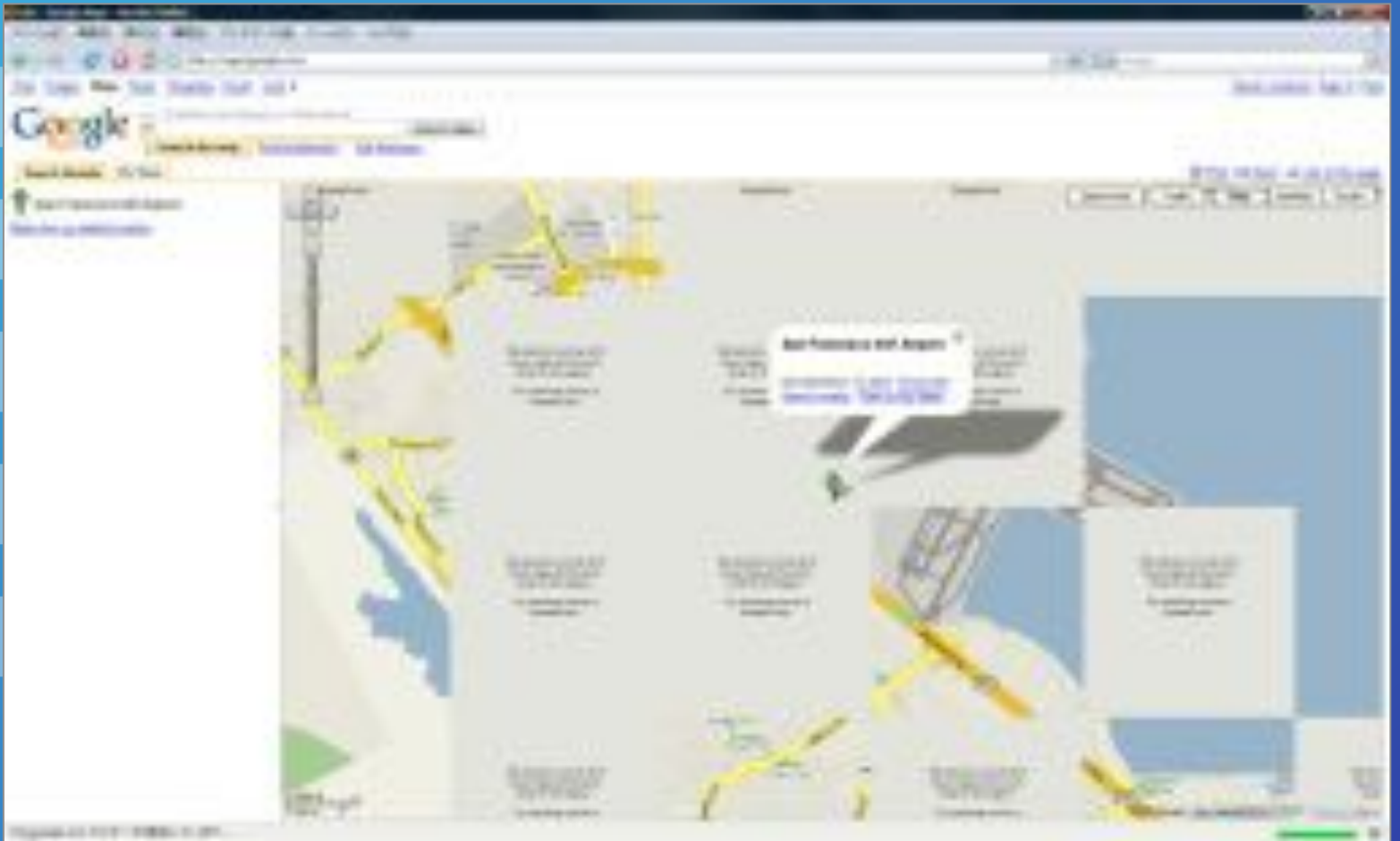
30

20

15

10

5



30

20

15

10

5



30

20

15

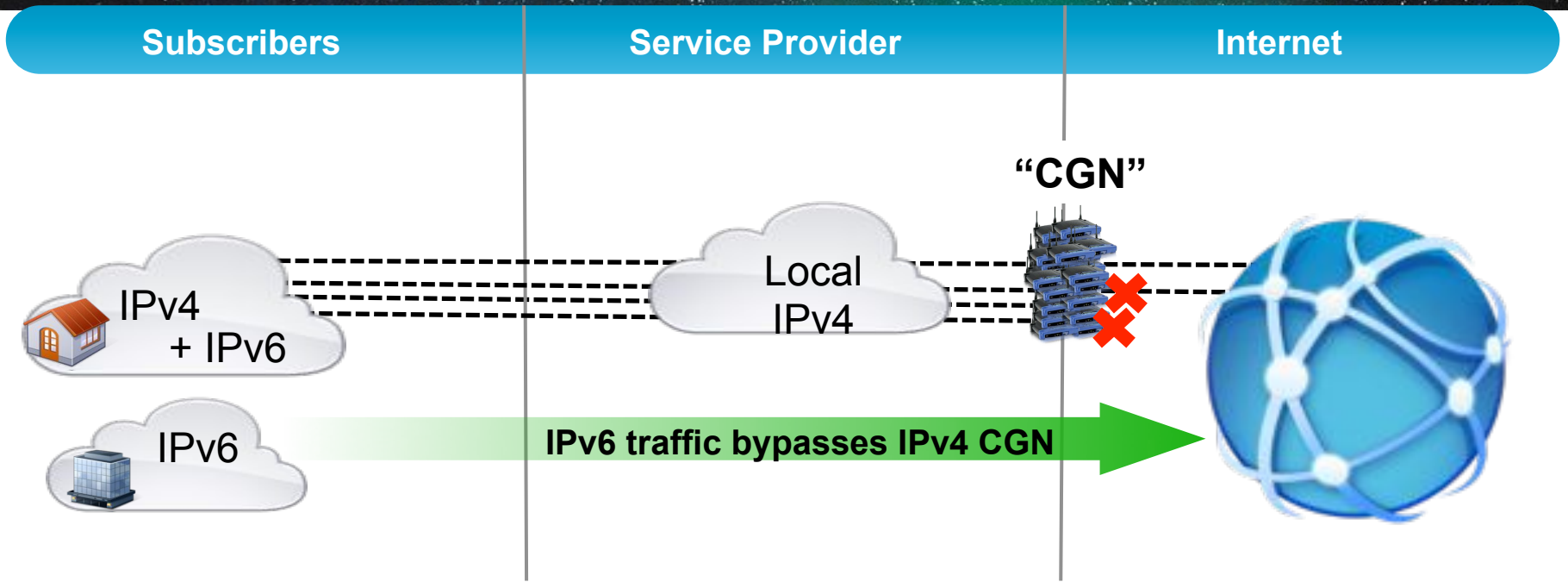
10

5





Solution: Using IPv6 to Bypass the CGN



June 8 2011

00h00-23h59 (UTC)

24-hr IPv6 "Test Flight"

IPv6 access on website's "front door"

(DNS AAAA Record on www.company.com)

Coordinated by:



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

Google

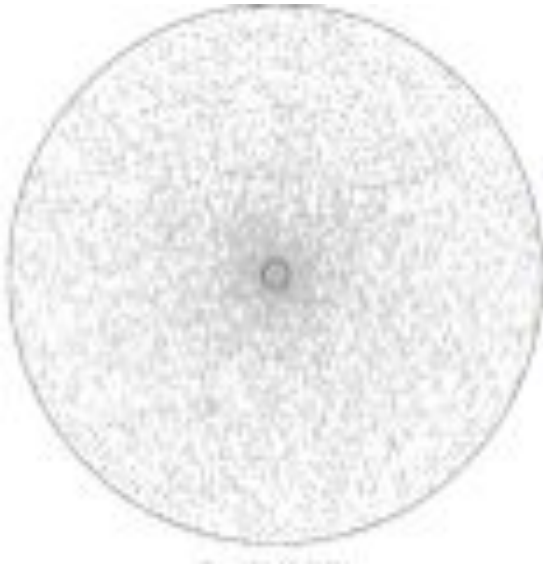


YAHOO!

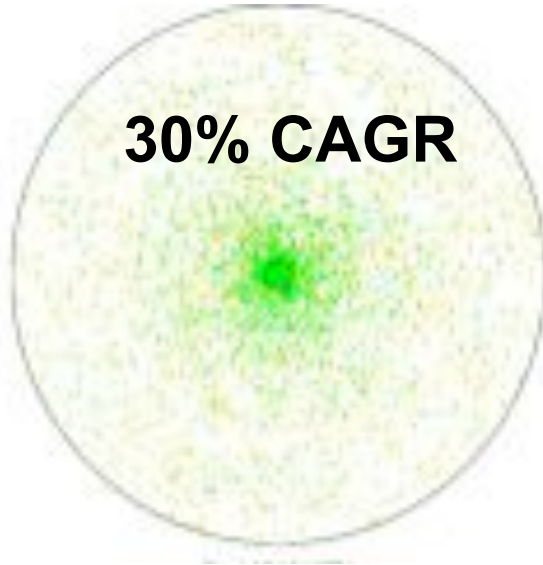


<http://isoc.org/wp/worldipv6day/participants>

The Internet Core is ready !

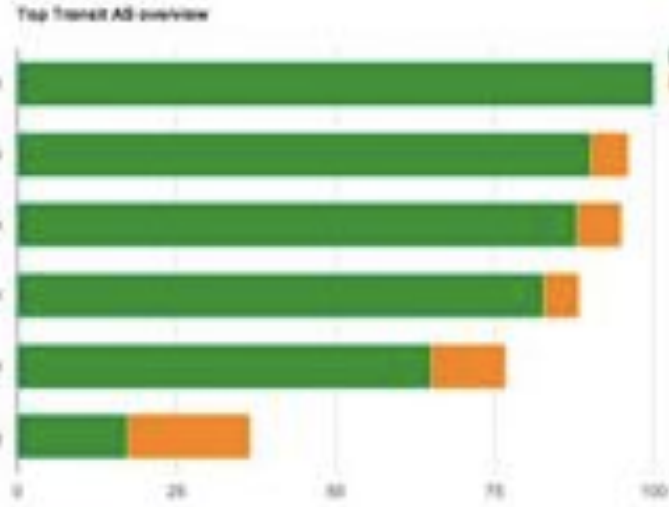


IPv4 transit AS's: 9900



30% CAGR

IPv6 transit AS's: 1693*
IPv6 enabled AS's: 3605



Concentrated in TOP 300
(82% of AS's are IPv6 transit)

~50% Content reachable over IPv6

Switzerland

% of WEB Pages Available over IPv6: **50.85%** | number of sites: **43 / 500**

Others: In development/test : **0.15%** (5/500) | Failing : **0%** (0/500) | Not V6

United States of America

% of WEB Pages Available over IPv6: **46.56%** | number of sites: **27 / 500**

Others: In development/test : **1.21%** (5/500) | Failing : **0.05%** (2/500) | Not V6

China

% of WEB Pages Available over IPv6: **6.59%** | number of sites: **11 / 500**

Others: In development/test : **23.91%** (5/500) | Failing : **10.82%** (2/500)

India

% of WEB Pages Available over IPv6: **53.96%** | number of sites: **33 / 500**

Others: In development/test : **0.24%** (4/500) | Failing : **0.15%** (4/500) | Not V6

Brazil

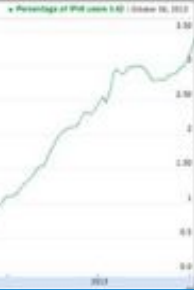
% of WEB Pages Available over IPv6: **55.28%** | number of sites: **66 / 500**

Others: In development/test : **0.5%** (5/500) | Failing : **0.26%** (2/500) | Not V6

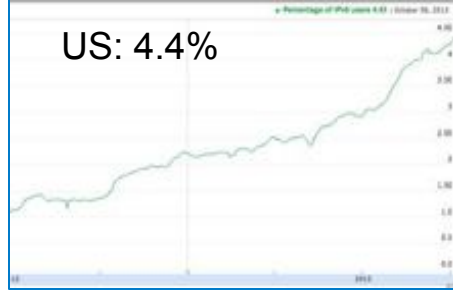
IPv6 Users

Source: 6lab.cisco.com/stats

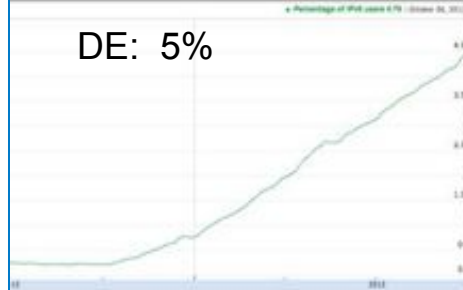
PE: 4.2%



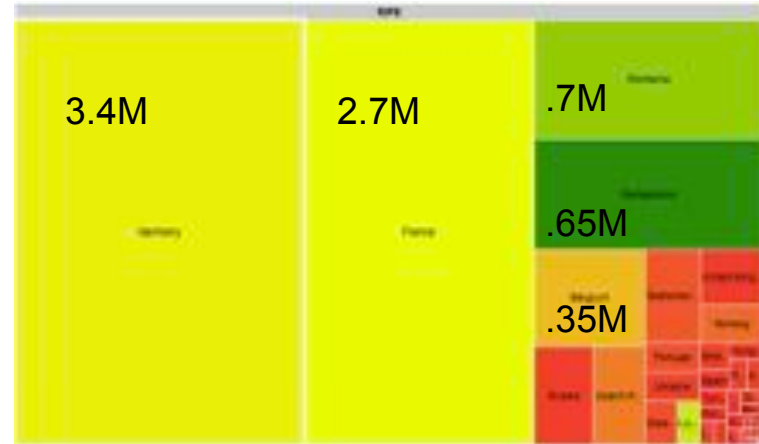
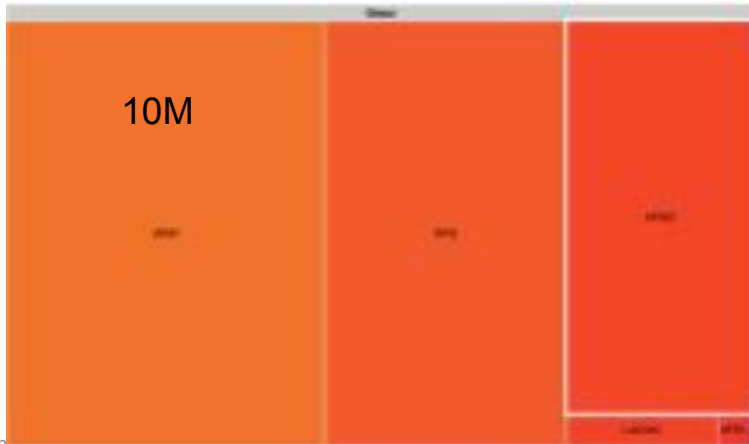
US: 4.4%



DE: 5%

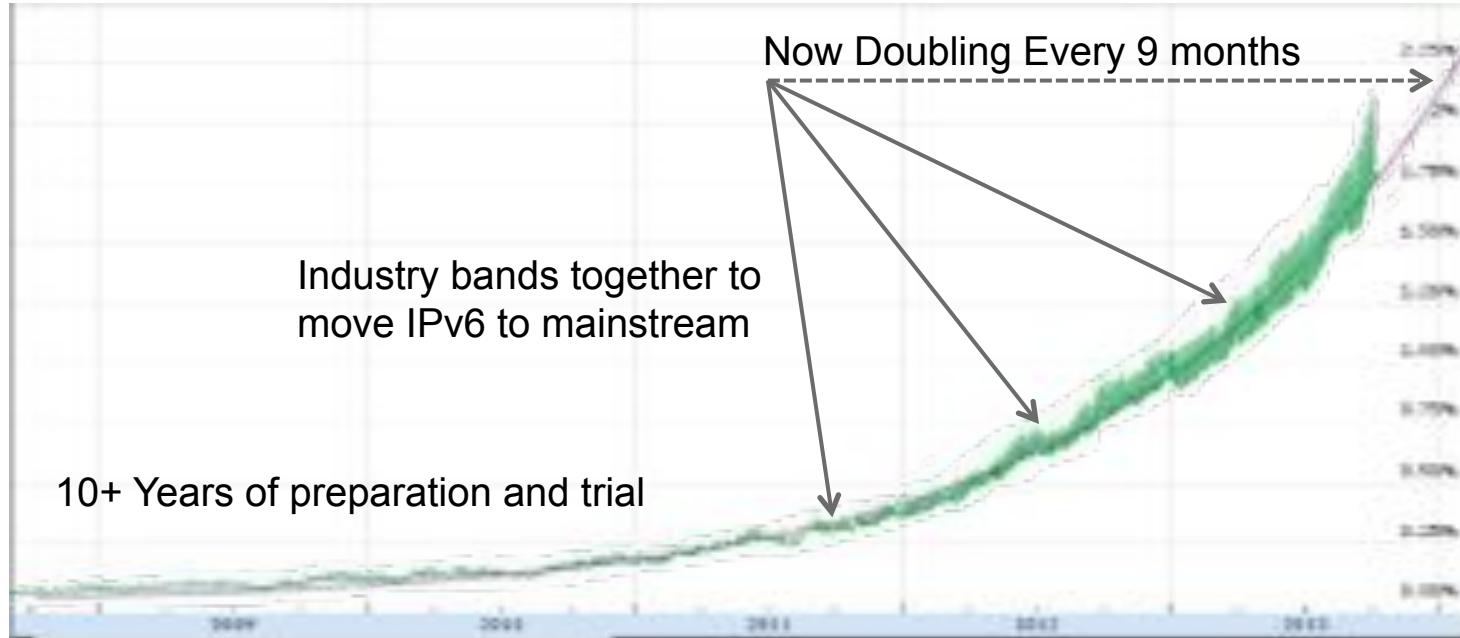


CH: 10%



Global IPv6 Deployment to Users

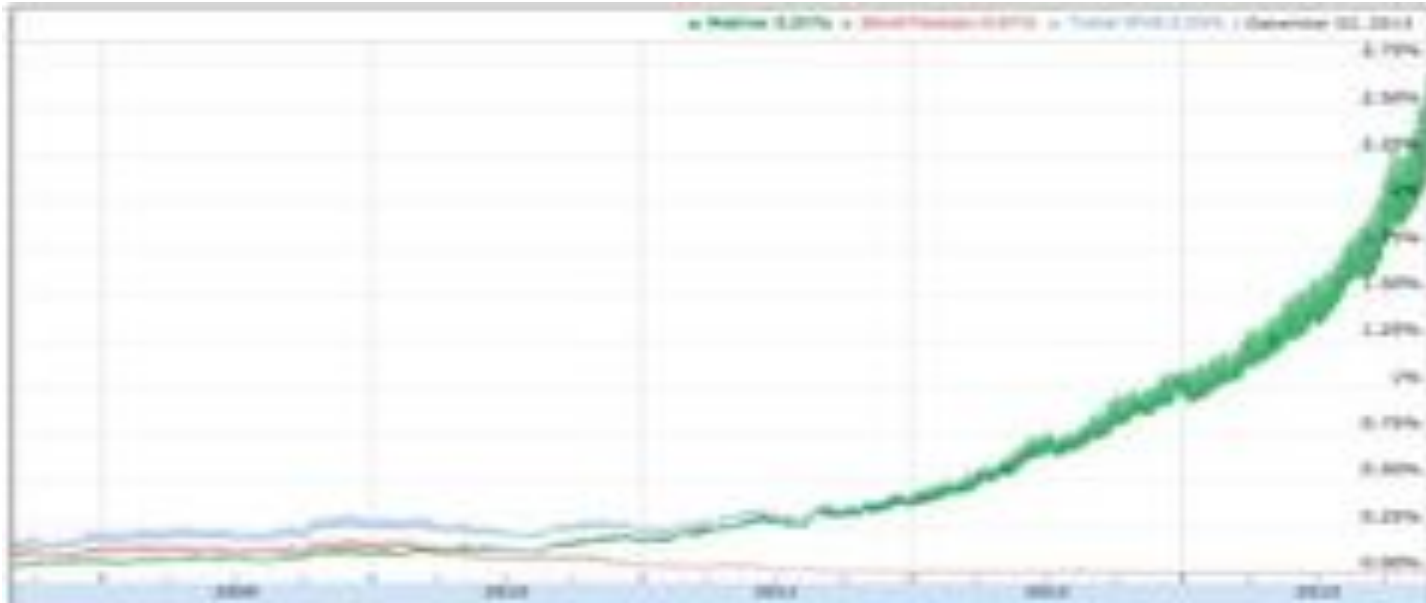
October 2013



<http://www.google.com/ipv6/statistics.html>

Global IPv6 Deployment to Users

December 2013



<http://www.google.com/ipv6/statistics.html>

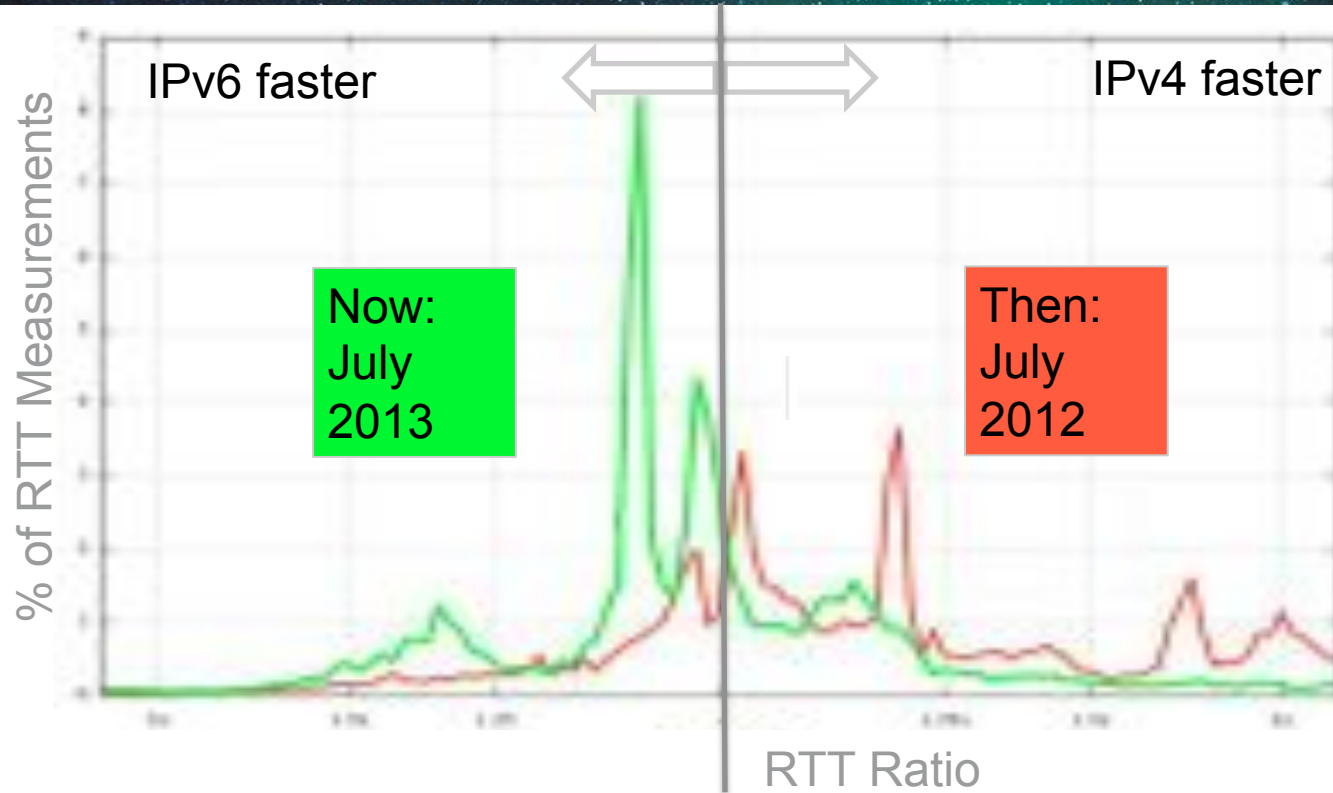
Network operator measurements, 14th November 2013 (notes)

Show entries Search

Participating Network	ASes	IPv6 deployment
Comcast	7043, 7036, 7225, 7822, 11025, 11967, 11181, 20214, 21508, 22216, 31287, 10489, 11490, 11491, 11650, 11611, 11612, 11613, 11654, 11655, 11656, 11657, 11658, 11660, 11661, 11662, 11664, 11665, 11666, 11667, 11668, 16713	16.34%
ATT	6188, 7036, 7112	11.61%
KDDI	2126	8.40%
Free	12322	30.68%
Verizon Wireless	6167, 12394	18.47%
Deutsche Telekom AG	1120	11.24%
BCE & BCI	8718	22.58%
Time Warner Cable	7843, 10796, 11351, 11426, 11427, 12270, 20081	3.37%
Telefonos del Peru	1147	4.30%
Liberty Global	1089, 6830, 10825, 10942	2.24%

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

2012 - 2013: IPv6 v IPv4 RTT comparison



<https://ripe67.ripe.net/presentations/115-2013-10-16-ipv6-launch-365.pdf>

IPv4

Fixed Computing
(you go to the device)

1993

IPv4 + NAT

Mobility / BYOD
(the device goes with you)

500M

2003

IPv6 Launch

Internet of Things
(age of the device)

10B

2013

IPv6 Everywhere

Internet of Everything
(people, process, data, things)

50B

2022

Visual Networking Index forecast

<http://goo.gl/xxLT>



End user OS's all have IPv6 on by default.
It can't be disabled easily (if at all) !

“IPv6 is not only about more devices, it is an upgrade of one of the most fundamental building blocks of the Internet”

IPv4

32 bits (src)

32 bits (dest)

IPv6

128 bits (src)

128 bits (dest)

Low Power
IP
(6lowpan,
6TISCH...)




Homenet



IPv6
Segment
Routing and
E



IPv6 Only
Data
Centers



SmartGrid



“IPv6 is not only about more devices, it is an upgrade of one of the most fundamental building blocks of the Internet”

IPv4

32 bits (src) 32 bits (dest)

IPv6

128 bits (src)

128 bits (dest)

Homenet



Raising the Bar in Home Networking

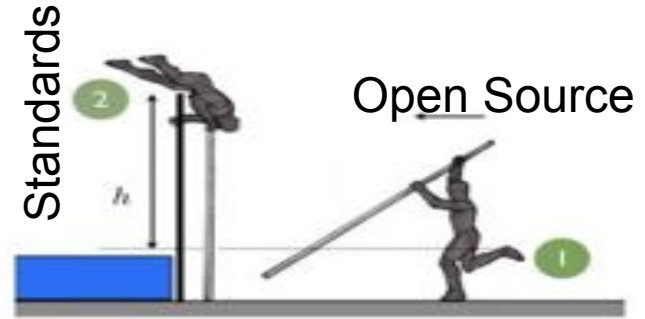
No matter how many routers in a home or how they are connected....



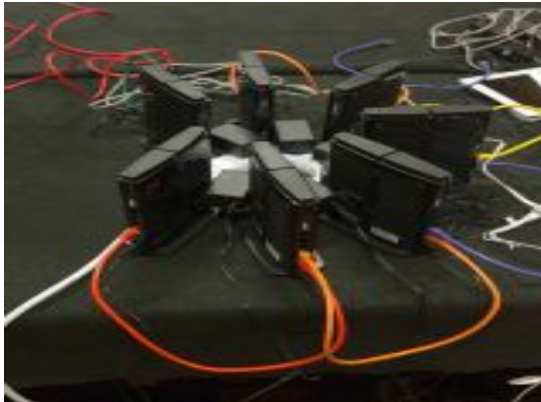
- Networks shall have ample IP address space
- Routers shall know where to send packets
- Names resolve to addresses
- Human touch is not required

Reaching the bar

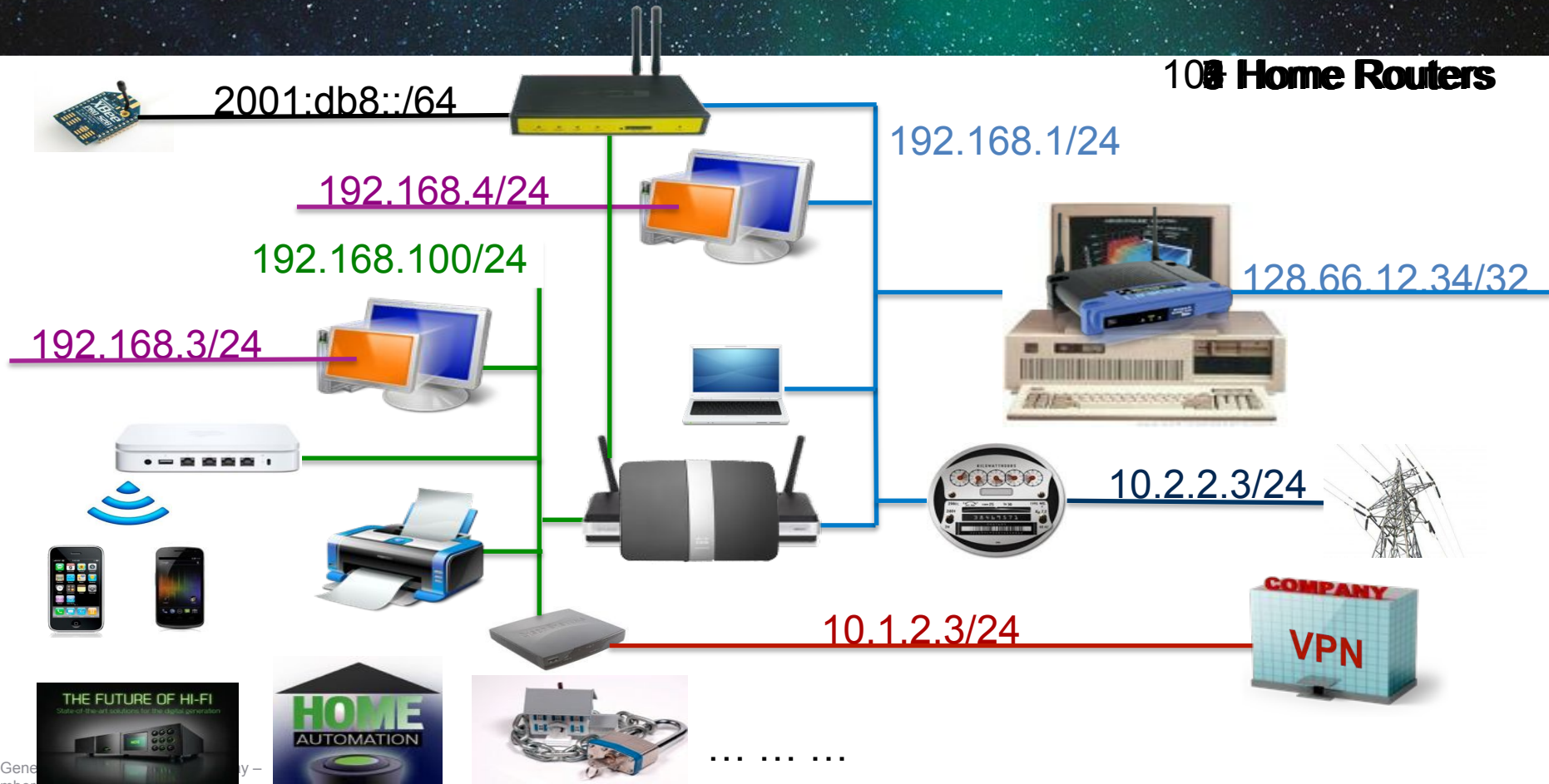
- IETF Homenet Working Group (established July 2011)
 - Interim kickoff meeting at Comcast in PA
 - Of 120+ IETF WGs, homenet is currently in the top 3 most well attended
 - <http://tools.ietf.org/wg/homenet/>



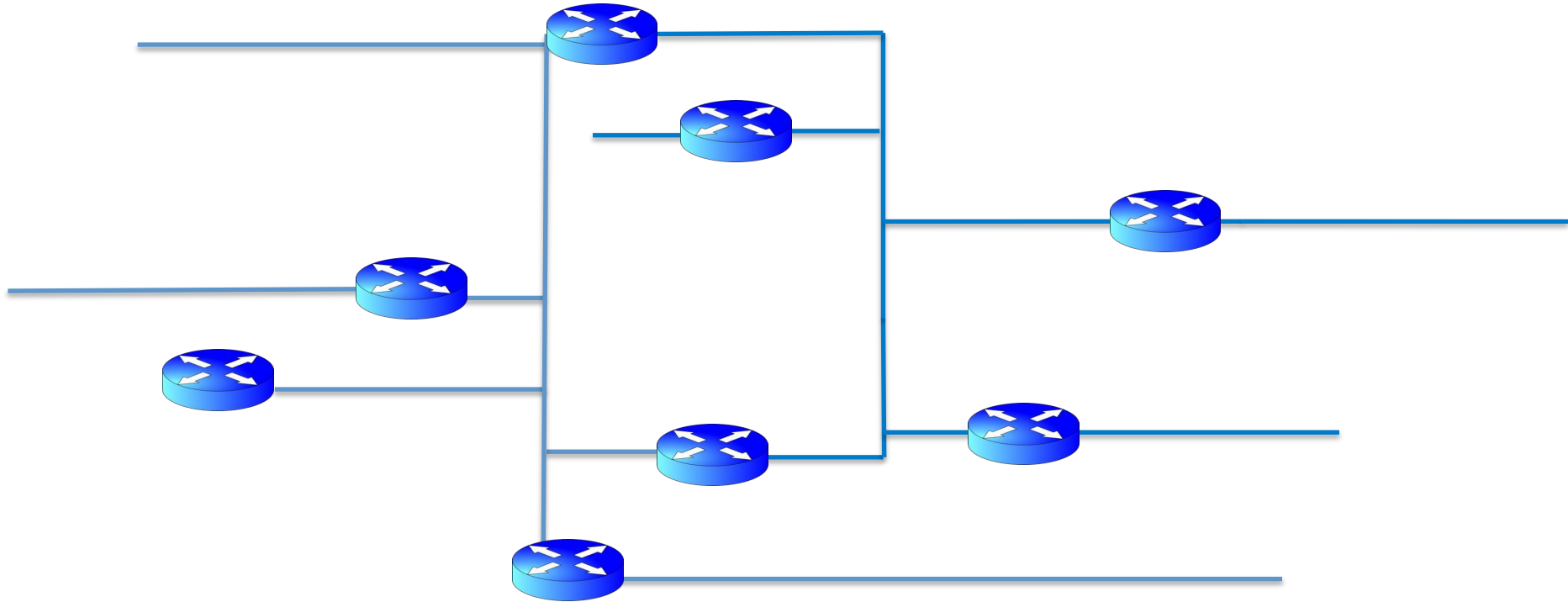
- Cisco Homenet Tech Fund (established June 2012)
 - Funding for open source development, prototyping, etc.
 - Please contribute! The idea is to make this a community effort.
 - irc #homenet
 - <https://github.com/fingon/hnet-openwrt-openwrt-feed>
 - <https://github.com/fingon/bird-ext-lsa>
 - <https://github.com/fingon/hnet-core>



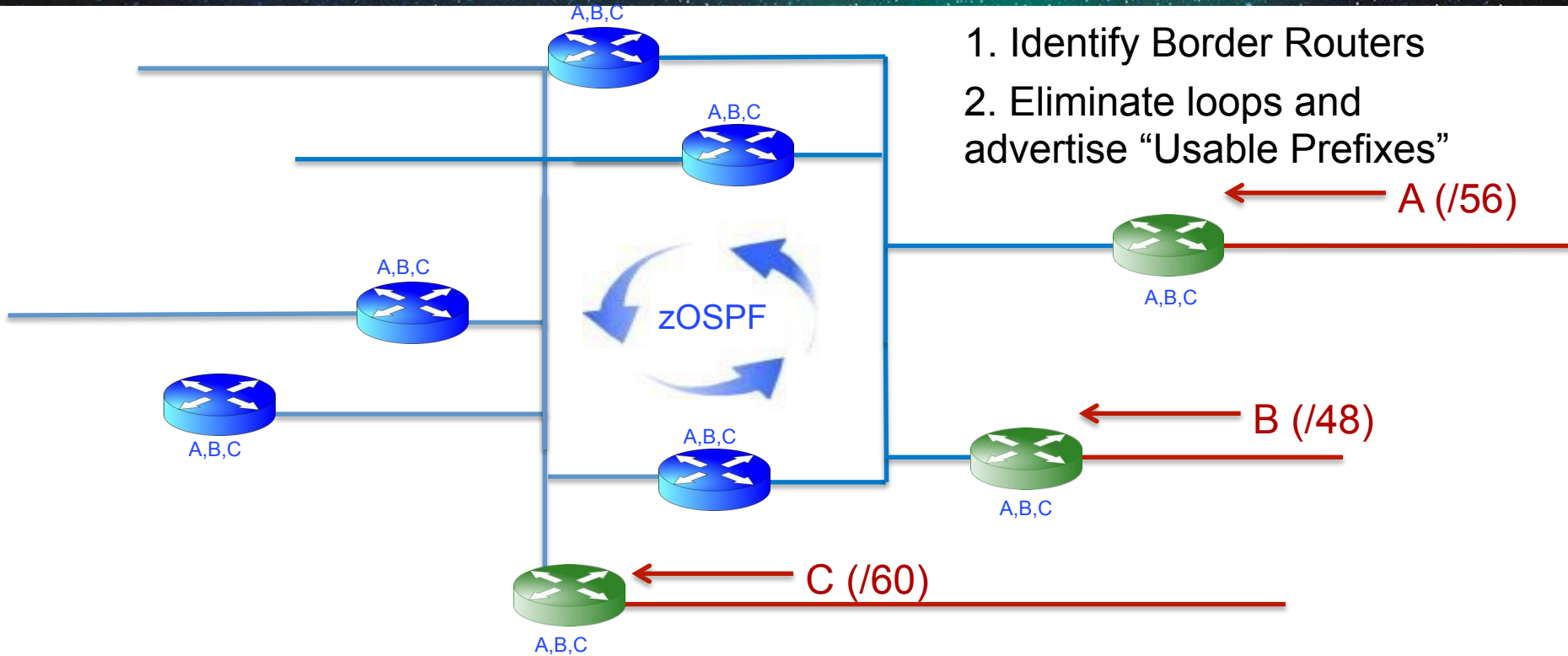
Evolution of a home network – how many routers ?



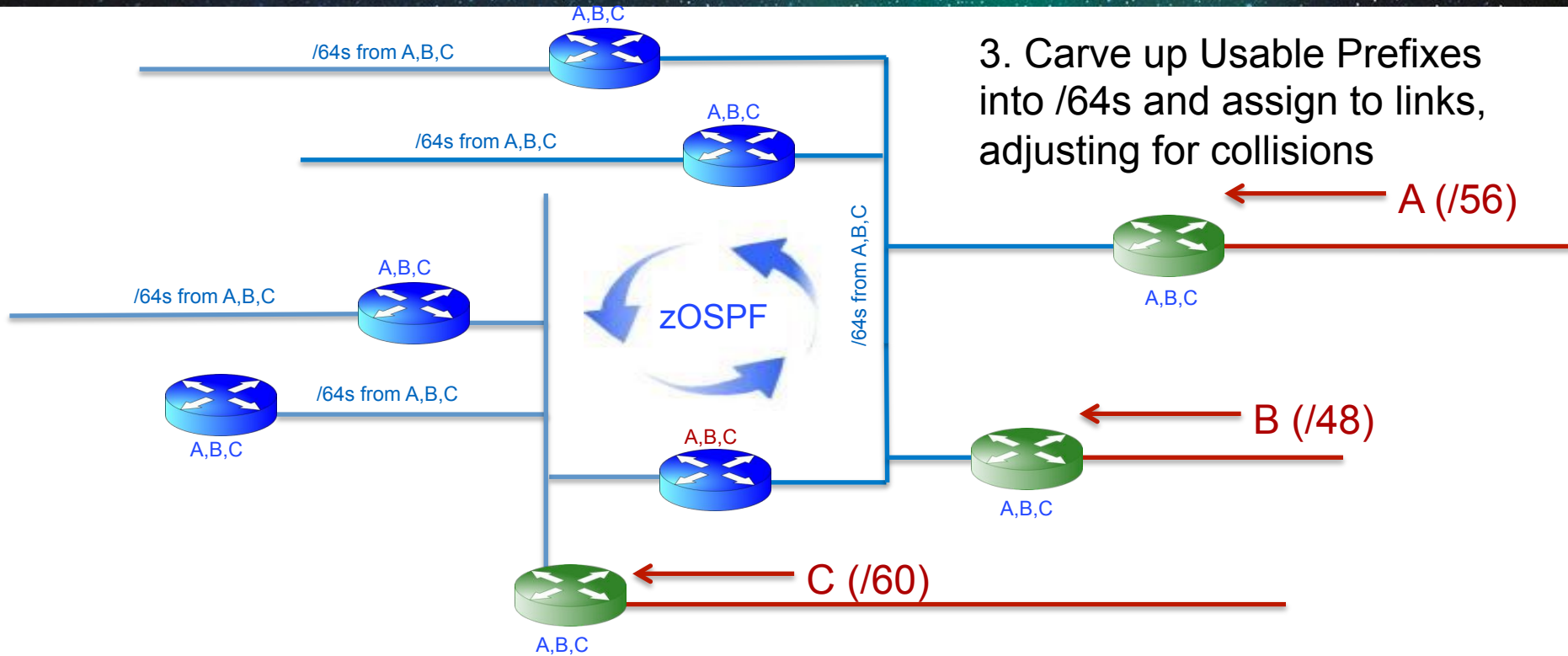
IETF Homenet



IETF Homenet



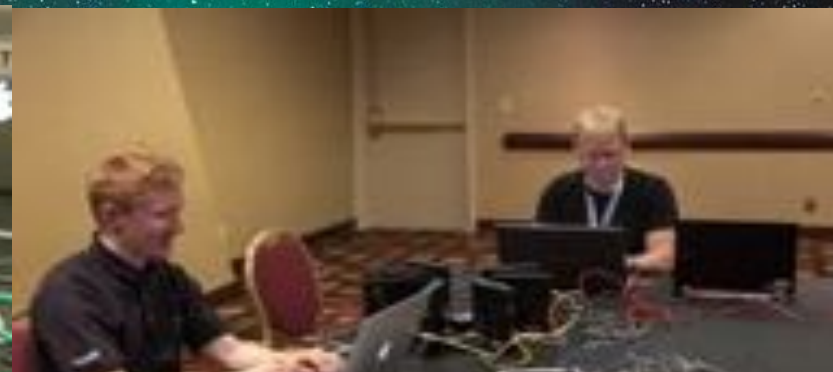
IETF Homenet



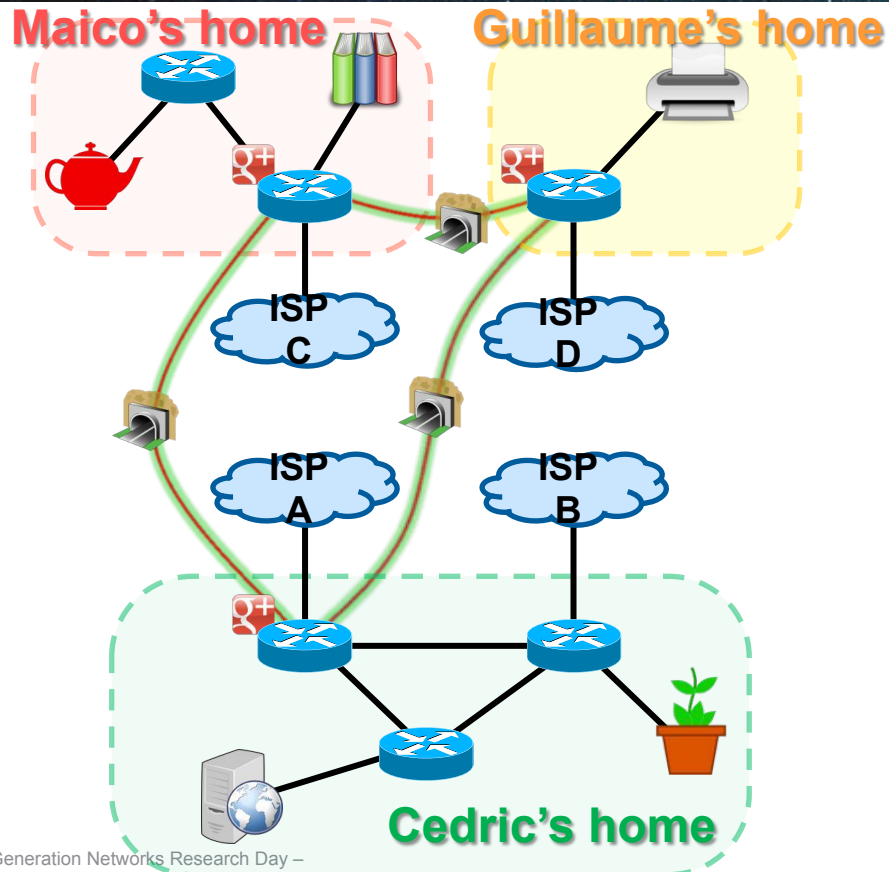
Benjamin Paterson, X09 – Homenet Prefix Assignment Algorithm (Prix de stage de recherché de la Departement d'informatique)



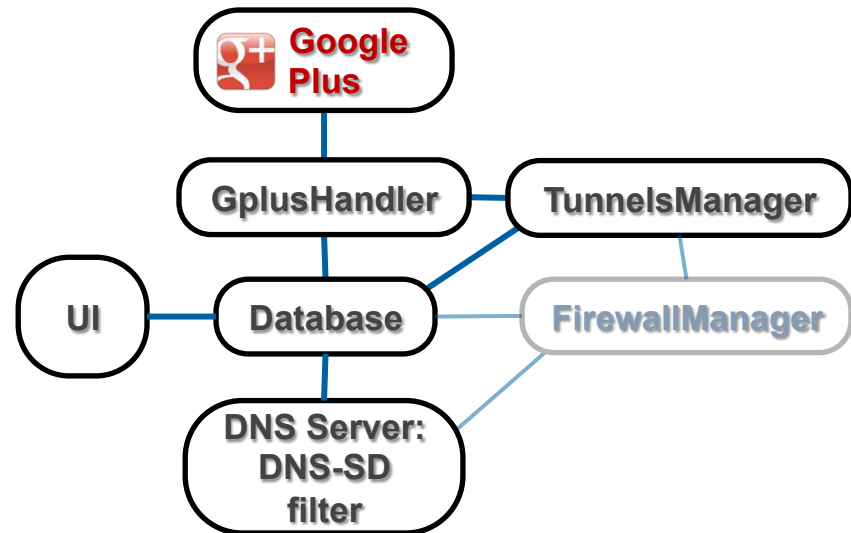
Homenet @ IETF 85 (Atlanta)



Connecting home networks via the social network Google Plus xHomenet



draft-dessez-homenet-googleplus-interconnect



Homenet
Working
Group



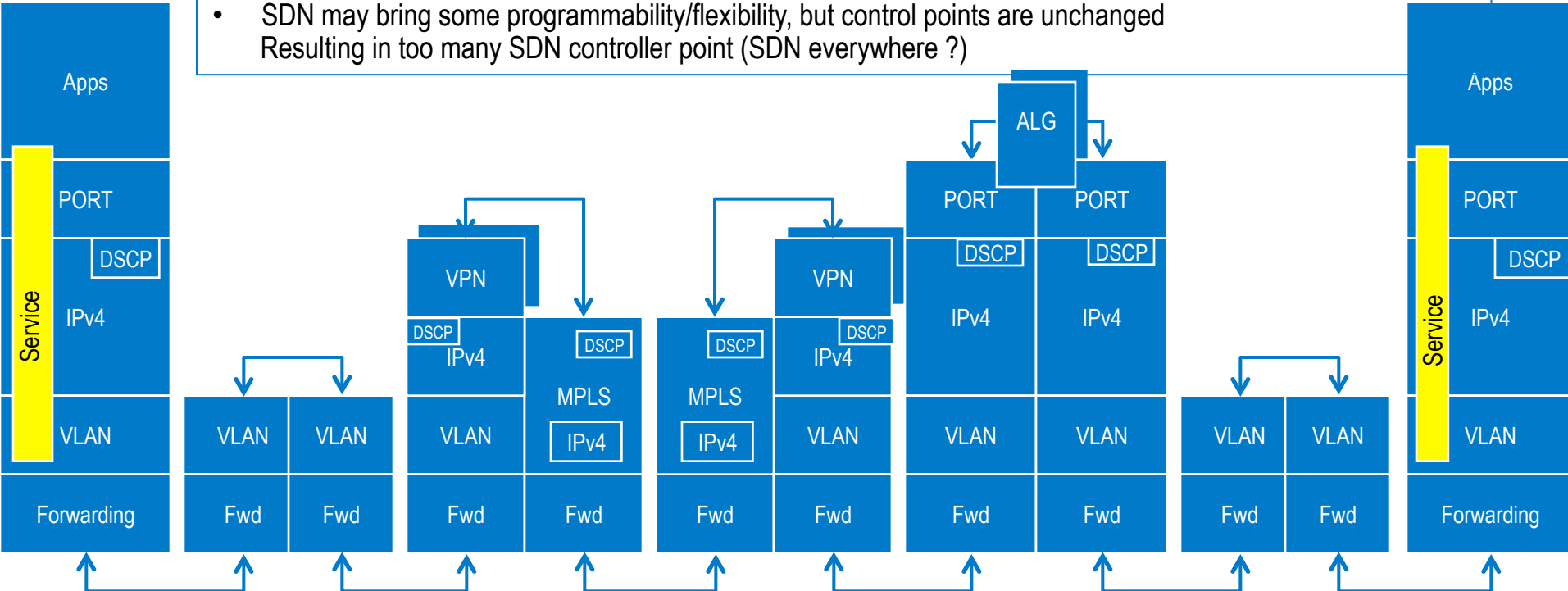
Cedric Dessez, X10
(Prix de la fondation de l'X)



IPv4 + VLAN + MPLS + NAT + Signaling

broken End-to-End, reaching limit of complexity and scale

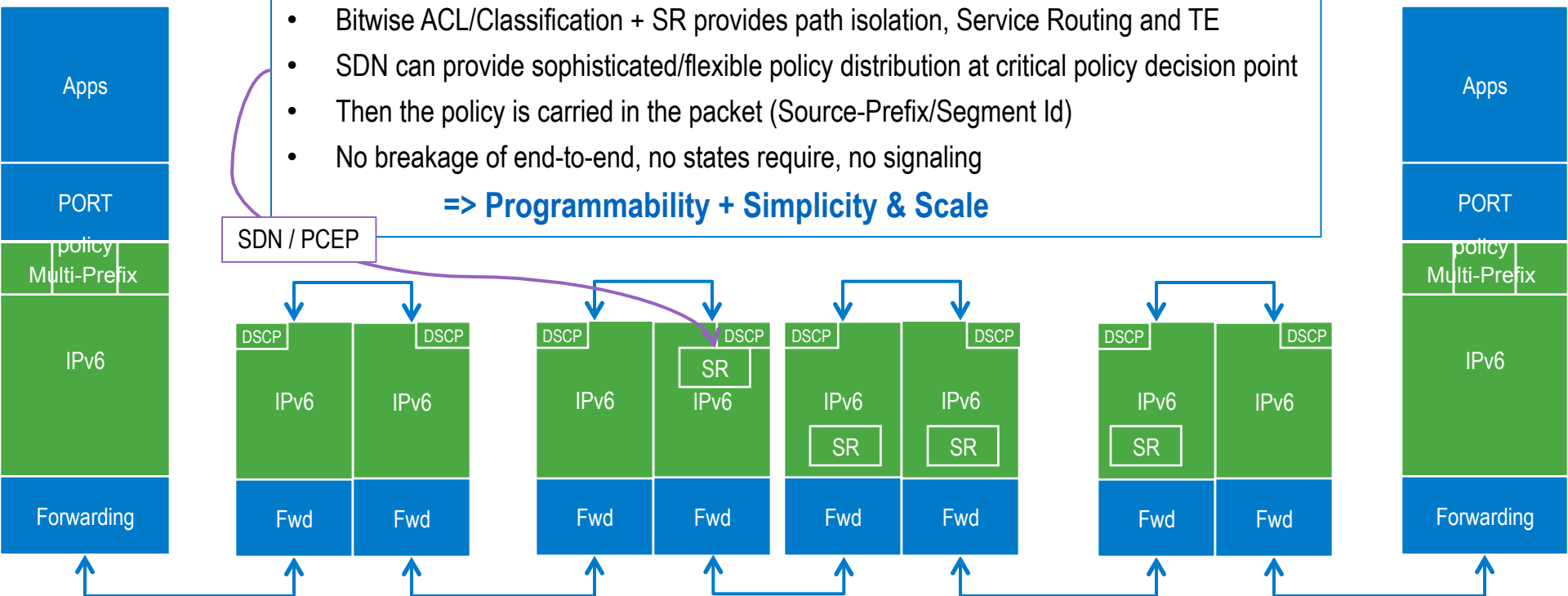
- L2/L3 VPN often use to segregate application services => Voice VLAN/VRF
Any communication across Domain/VPN boundaries requires NAT + ALG + Signaling or even Apps level Gw
- SDN may bring some programmability/flexibility, but control points are unchanged
Resulting in too many SDN controller point (SDN everywhere ?)



IPv6 = Restoring End-to-end

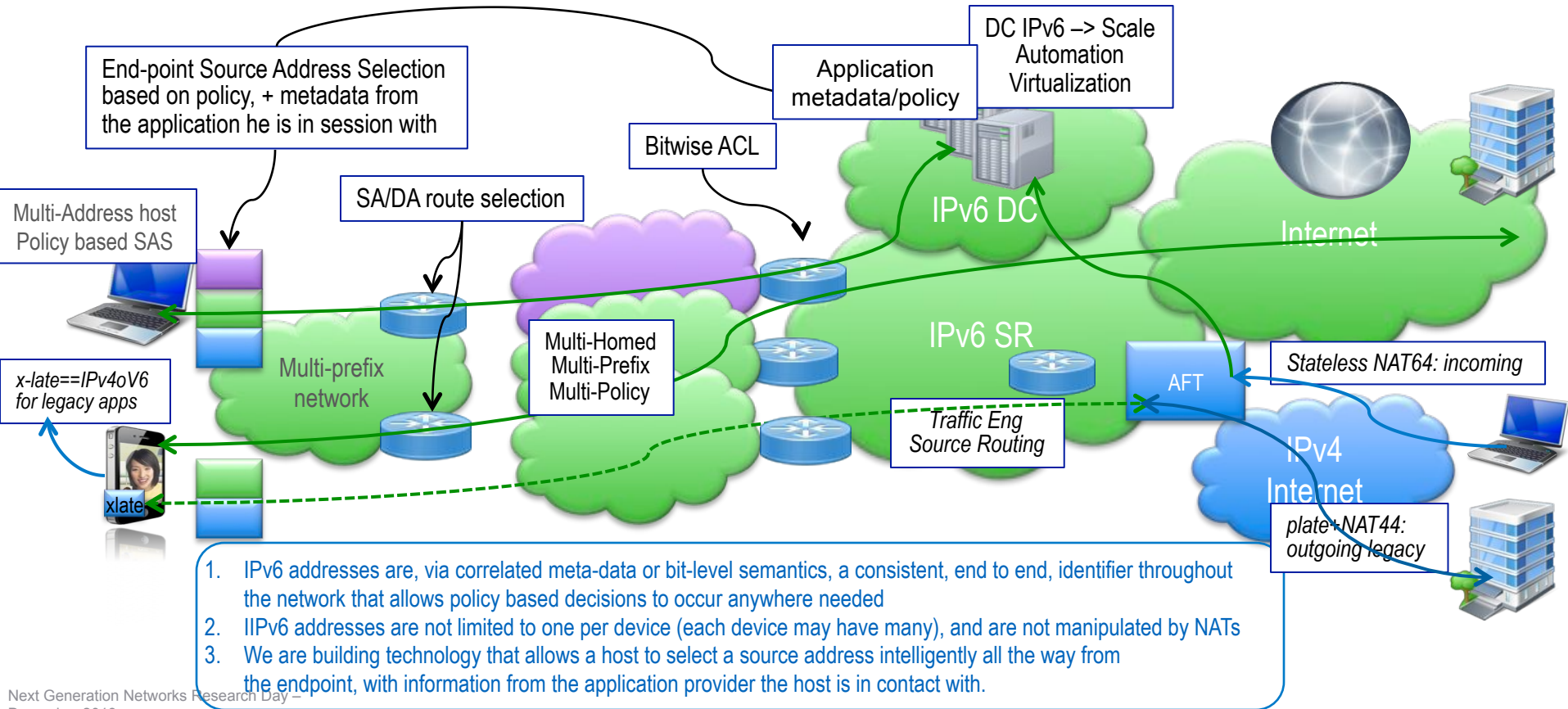
- Multi-Services devices/apps benefit global reach
- Application Metadata correlation to Prefix coloring and SAS
- Bitwise ACL/Classification + SR provides path isolation, Service Routing and TE
- SDN can provide sophisticated/flexible policy distribution at critical policy decision point
- Then the policy is carried in the packet (Source-Prefix/Segment Id)
- No breakage of end-to-end, no states require, no signaling

=> Programmability + Simplicity & Scale



IPv6 Enabled Application-Network Integration

Service Differentiation + Scale + Flexibility



Arriving Now: All-IPv6 Networks and Data Centers

[Perspectiva de un proveedor de Servicio Móvil Avanzado \(Cameron B...](#)



www.youtube.com/watch?v=gl41DCUwfvk

May 8, 2012 - Uploaded by supertelecua
Cameron Byrne, técnico de T- Mobile parl
conferencista en el ... el desarrollo y los se

[IPv6-only Data Center \(built by Tore Anderson\) « ipSpace.net by ...](#)



blog.ioshints.info/2012/.../ipv6-only-data-center-built-by-tore.ht...

by Ivan Pepelnjak - in 749 Google+ circles

May 23, 2012 – A while ago I wrote about uselessness of stateless NAT64 and got in nice discussion with **Tore Anderson** who wanted to use stateless NAT64 ...

[Ian Farrer on the All IPv6 TeraStream Network - YouT...](#)



www.youtube.com/watch?v=QRR5ewjmxxE

Mar 22, 2013 - Uploaded by Cisco
Ian Farrer of Deutsche Telekom talks about the challenges of
working on one of the first all v6 projects to be ...

[More videos for ipv6 terastream »](#)

17.10 The Killer App is Automation in the Cloud



The pace of change in IT infrastructure and services has never been greater. New opportunities abound with the shift to cloud computing and the explosion of mobility. Organizations must automate infrastructure and workload provisioning to remain relevant and compete in the new economy, yet much of the opportunity is only available using IPv6. Thoughts on where the biggest opportunities are and some practical advice will be presented.

Paul Zawacki | Enterprise Architect | ORACLE

[Cisco Demonstrates Mapping Address and Port \(MAP\) Technology f...](#)



www.youtube.com/watch?v=He681zqeUJU

Apr 10, 2013 - Uploaded by Cisco
During V6 World Congress 2013 at the EANTC public multi-
vendor interoperability event, Andrew Yourtchenko ...

IPv6 fuels main Internet Growth Engines

Cloud/MSDC

- Scale
- Virtualization
- Automation
- Simplification



IPv6

End2End Restored
Unlimited Connectivity & Global Reach
Differentiated Services
Isolation without Obfuscation



Mobile Internet

- Scale: 10 Billions
- 4G-LTE / VoLTE
- Simplification
- Mobile networks

Internet of Things

- Scale: 50 Billions
- Automation-Self Networked
- IoT Protocols are IPv6 only



<http://www.cisco.com/go/vni>

Cisco on Cisco ...



<https://cisco.webex.com> 2607:fcf0:1:fe::101
<https://ip.webex.com> 23.32.22.26

- Most Cisco WEB properties
90% of apps support v6 now
~4% of cisco.com users
cisco.webex.com is ON !
- 100% of Core WAN/MAN
- All iPOP / DMZ
- 21 production DC
- Over 120 Buildings & Sale Branch offices
Both Ethernet access and Wifi
~25000 users/devices
25% of user sessions

By The Numbers

\$40 Billion

annual run rate for the main web portal for quoting,
configuring and buying Cisco solutions (CCW)

3.37%* = \$1.3 Billion

IPv6 traffic on tools.cisco.com**

annual run rate of IPv6 traffic on
tools.cisco.com

All of our devices, applications and services...



UC 9.0
CUCM 9.0
CUBE/IOS 15.3



AnyConnect 3.x
(Android, iOS)
Windows. MacOS



ASA 9.1 (incl IPS)
ASA-Cx
AsyncOS 7.6 Email



Webex
Mobile Client



Webex
Meeting EFT



Prime Infra



CNR/CAR

Prime Infra



IOS 15.3
IOS-XE 3.8



WLC 7.3



NXOS 6.2



IOS-XR 4.3
IOS-XE 3.8
StarOS 14.0

100s of IPv6 features

Engineering Process changes – Test and Hardening - USGv6 certified Portfolio

References – IPv6 End to End

- <http://tools.ietf.org/wg/homenet/>
- <https://github.com/fingon/bird-ext-lsa>
- <https://github.com/fingon/hnet-core>
- <http://tools.ietf.org/html/draft-arkko-homenet-prefix-assignment-02>
Network
- <http://tools.ietf.org/html/draft-dessez-homenet-googleplus-interconnect-01>
- <http://tools.ietf.org/html/draft-troan-homenet-sadr-01>
Address
- <http://tools.ietf.org/html/draft-lepape-6man-prefix-metadata-00>
- <https://sites.google.com/site/tmoipv6/464xlat> [
- <http://tools.ietf.org/html/draft-ietf-softwire-map-09>
- <http://datatracker.ietf.org/doc/draft-ietf-softwire-map-t/>

IETF Homenet Working Group

OSPF Auto configuration

Homenet implementation's core package

Prefix Assignment in a Home

Connecting Home Networks via the social
network GooglePlus

IPv6 Multihoming with Source
Dependent Routing (SADR)

IPv6 Prefix Meta-data and Usage

464XLAT -- A Solution for Providing IPv4
Services Over and IPv6-only Network†

Mapping of Address and Port with
Encapsulation (MAP)

Mapping of Address and Port using Translation
(MAP-T)

References – Public Statistics

- <http://6lab.cisco.com/stats/>
- <http://www.google.com/ipv6/statistics.html>
- <http://isoc.org/wp/worldipv6day/participants> |
- <http://www.worldipv6launch.org/measurements>
- <https://ripe67.ripe.net/presentations/115-2013-10-16-ipv6-launch-365.pdf>

Cisco IPv6 Web Portal
Google IPv6 Statistics
SOC World IPv6 Participants
World IPv6 Launch Statistics
Geff Huston Talk at RIPE67

IPv6 - the real drivers for adoption (moving the Internet to IPv6 one prefix at a time)



Steve Simlo, IPv6 Product Manager

ssimlo@cisco.com

follow us on
twitter

[@stevesimlo](https://twitter.com/stevesimlo)
[@cisco6lab](https://twitter.com/cisco6lab)