IPv6 Webinar

Thomas Kernen

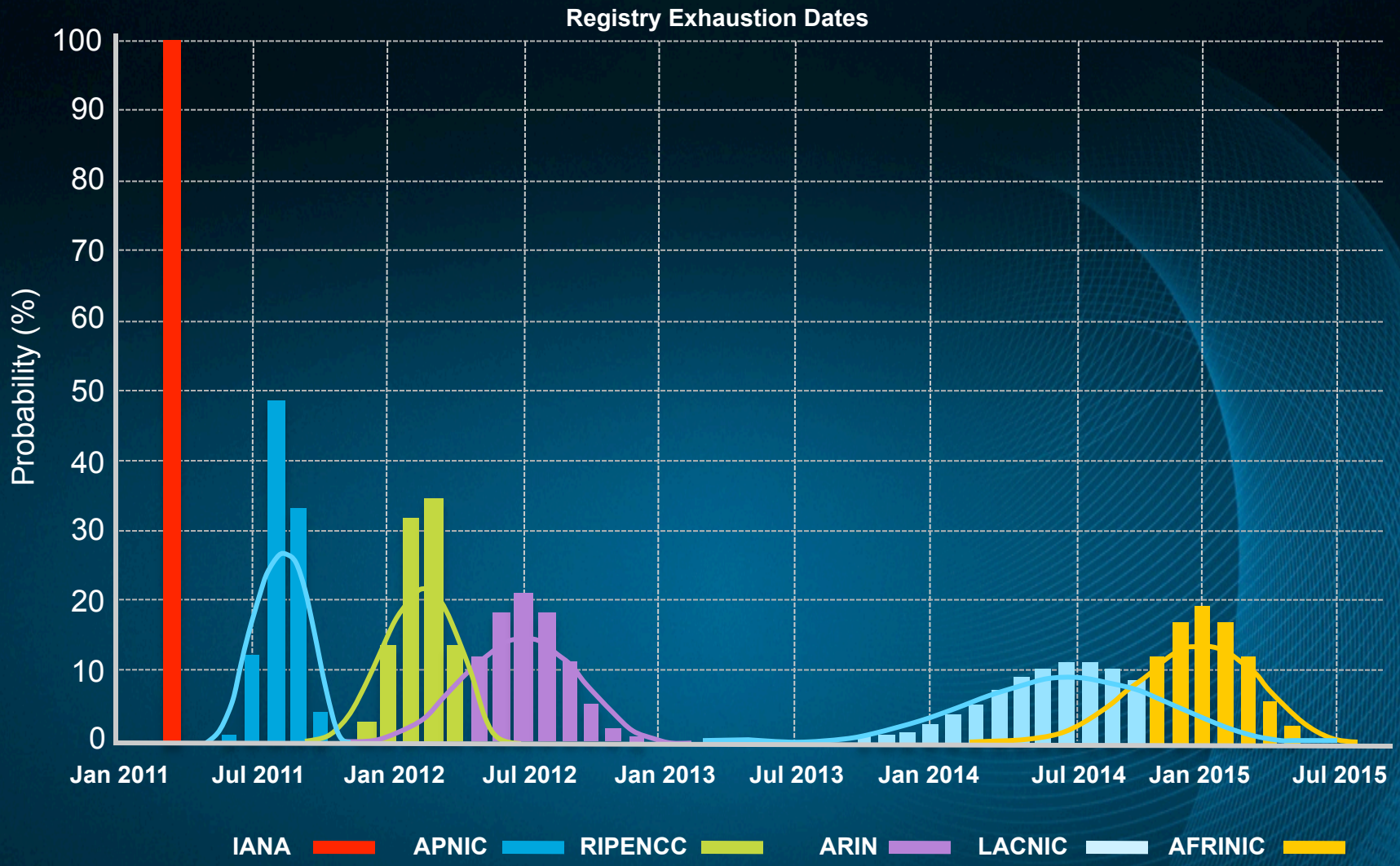
“Nortel selling Internet addresses to Microsoft for $7.5 million”

Total Telcom – 23/03/11

The central IPv4 allocation pool is dry!

Source: Geoff Huston, APNIC

Now the pressure is on the regional pools



Source: Geoff Huston, APNIC

Growth of Connected Devices

Total 500 Million

1/10th of a Device per Person on Earth

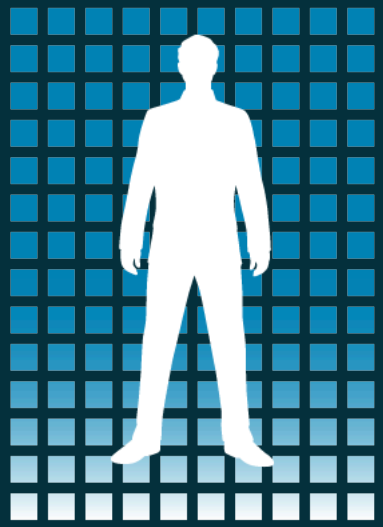
2007

Total 35 Billion

5 Devices per Person on Earth

2010

Total 1 Trillion



140 Devices per Person on Earth

2013

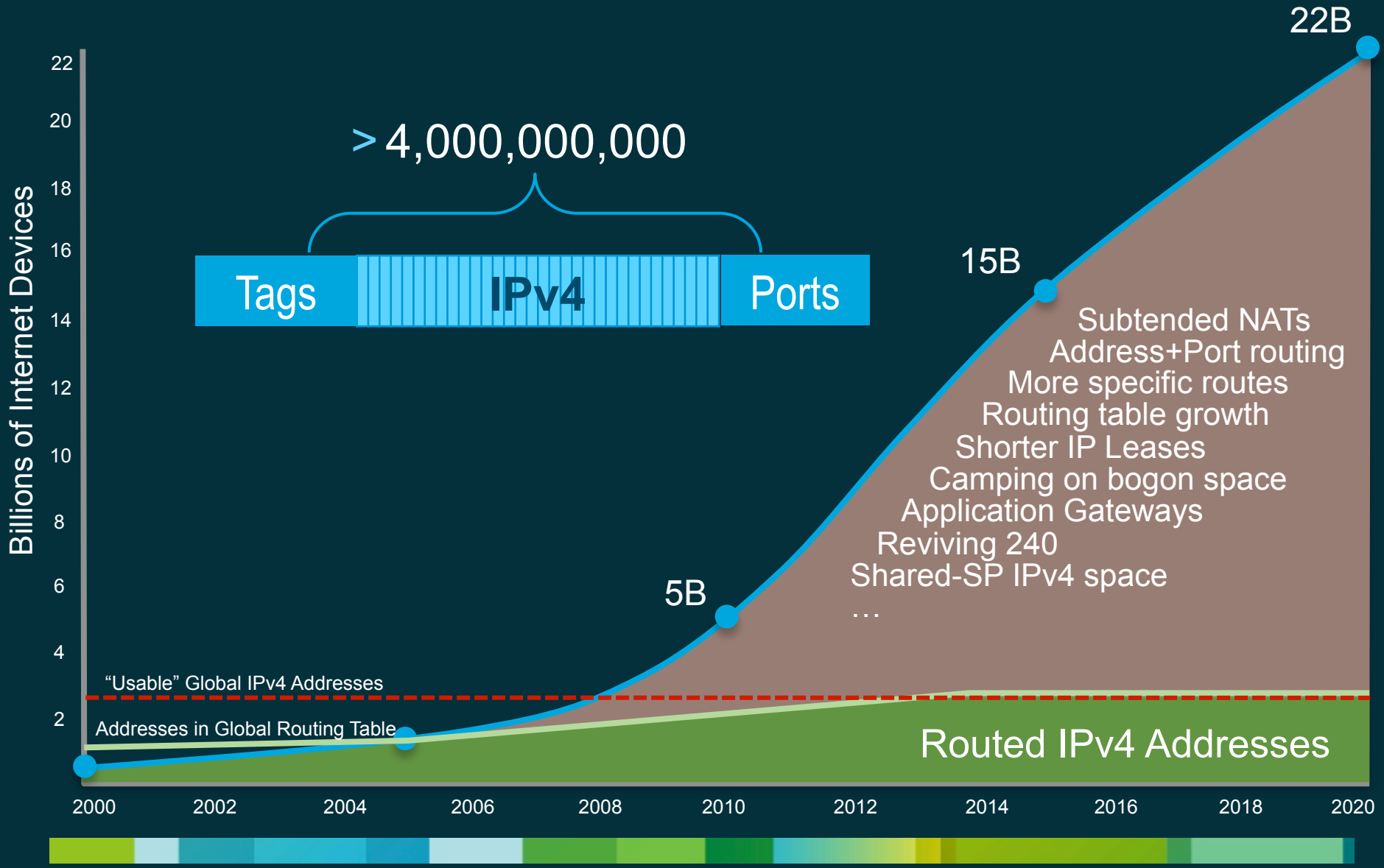
Source: Forrester Research, Cisco IBSG

Worldwide Internet Population

	Population	World %	Internet Users	Internet Penetration %
Africa	1,013,779,050	14.8%	110,931,700	10.9%
Asia	3,834,792,852	56.0%	825,094,396	21.5%
Europe	813,319,511	11.9%	475,069,448	58.4%
Middle East	212,336,924	3.1%	63,240,946	29.8%
North America	344,124,450	5.0%	266,224,500	77.4%
Latin America	592,556,972	8.7%	204,689,836	34.5%
Oceania	34,700,201	0.5%	21,263,990	61.3%
World Total	6,845,609,960	100%	1,966,514,816	28.7%

Source: http://www.internetworldstats.com/stats.htm January 2011

Future Growth Challenges With IPv4

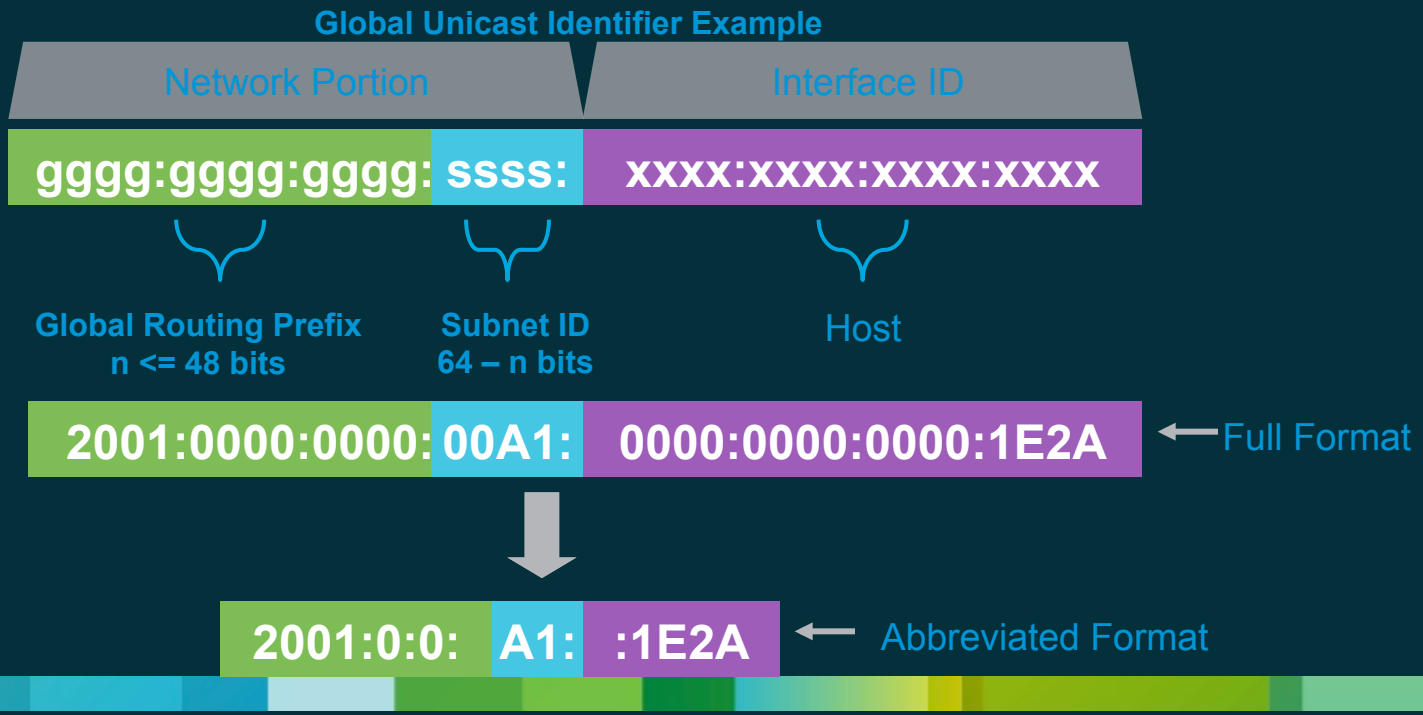


IPv6: A short timeline

- Early 1990s: commercial Internet services take off
  - First efforts to rethink IPv4 address space limitations
- 1995: First IPv6 standard
  - Many additional standards & updates since then
  - Limited traction other than Research and Educational Networks
- 2001: European Commission launched Task Force
  - Publish action plan in 2008 for 25% users over IPv6 by 2010
- 2008: Google launch IPv6 initiative (ipv6.google.com)
  - 2009 adds YouTube and other services
- 2010: T-Mobile US launches IPv6 trial for mobile devices
  - Verizon, Swisscom and others are testing too
- 2011/2012: Android + new mobile handsets support IPv6 over air/ radio interface

IPv6 Addresses

- IPv6 addresses are 128 bits long
  - Segmented into 8 groups of four HEX characters
  - Separated by a colon (:)
  - 50% for network ID, 50% for interface ID
  - Network portion is allocated by Internet registries 2^64 (1.8×10^{19})
  - Still leaves us with ~ 3 billion network prefixes for each person on earth



IPv6 Address Types

- Three types of unicast address scopes

Link-Local – Non routable exists on single layer 2 domain (FE80::/64)

Unique-Local (ULA) – Routable with an administrative domain (FC00::/7)

Global – Routable across the Internet (2000::/3)

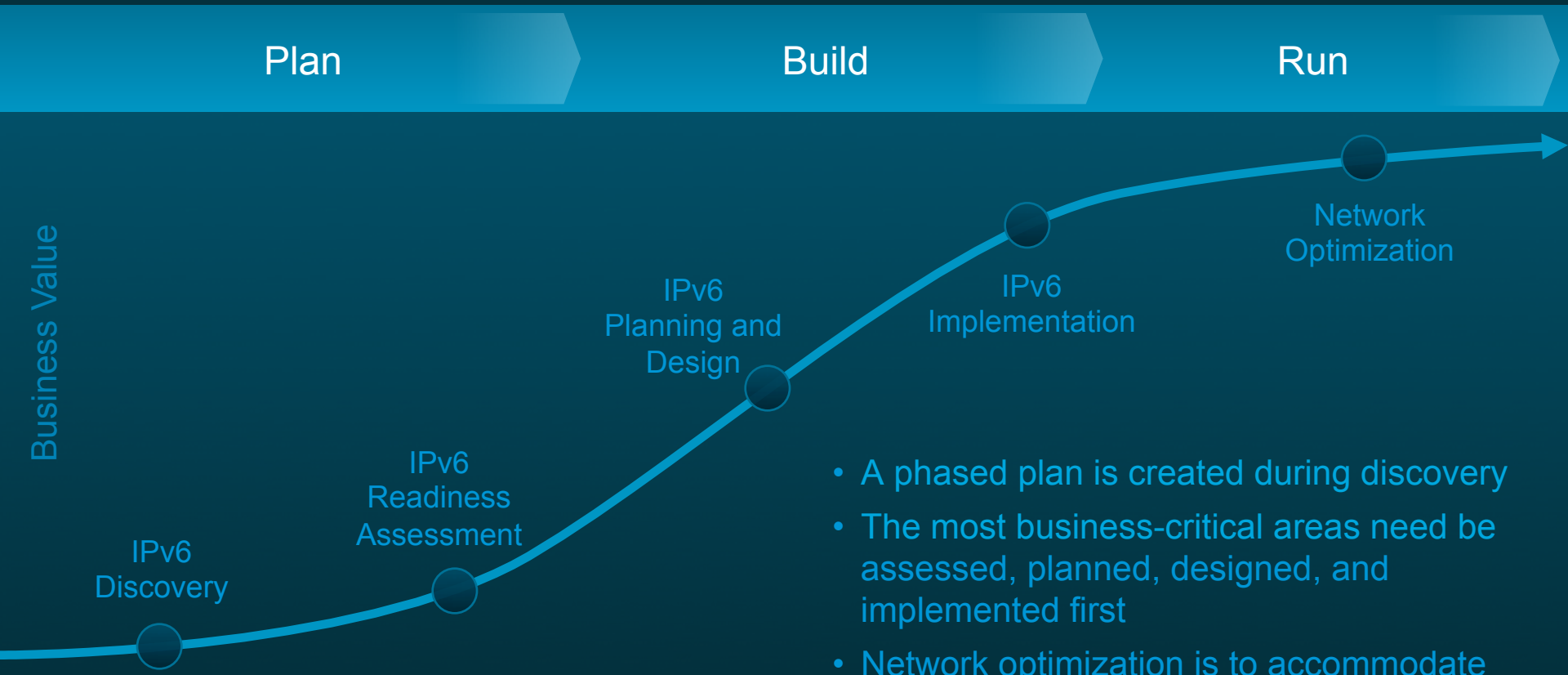
- Interface “expected” to have multiple addresses

- Multicast addresses begin with FF00::/8

IPv6 and DNS

	IPv4	IPv6
Hostname to IP address	A record: www.abc.test. A 192.168.30.1	AAAA record: www.abc.test AAAA 2001:db8:C18:1::2
IP address to hostname	PTR record: 1.30.168.192.in-addr.arpa. PTR www.abc.test.	PTR record: 2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.1.0.0.0.8.1.c.0.8.b.d.0.1.0.0.2.ip6.arpa PTR www.abc.test.

Phased Approach to IPv6 Adoption

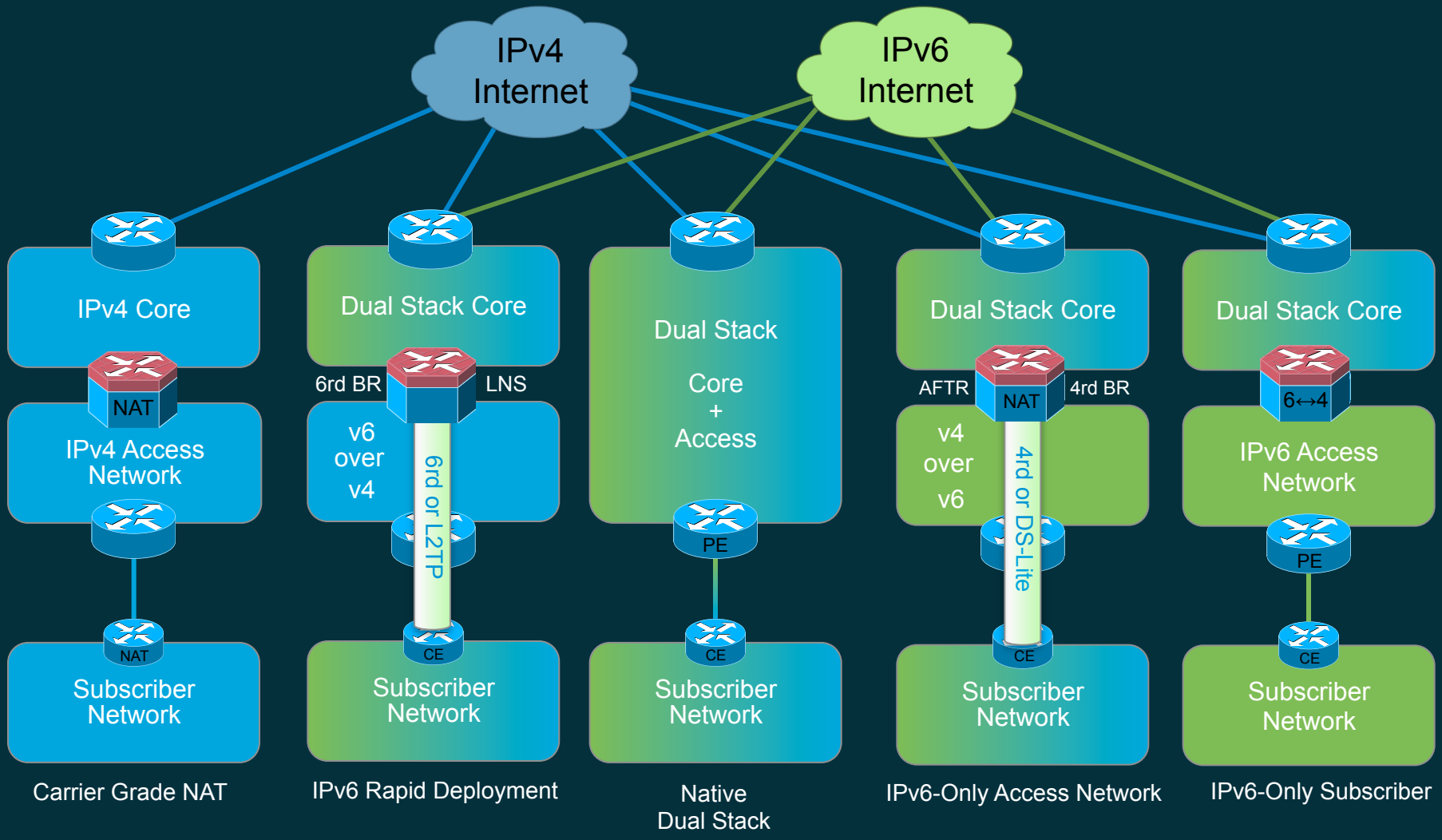


- A phased plan is created during discovery
- The most business-critical areas need be assessed, planned, designed, and implemented first
- Network optimization is to accommodate incremental IPv6 changes

Impact on Internet Connectivity

- 3 approaches currently worked on by Service Providers
  - Dual-stack: SP allocates both IPv4 and IPv6 global addresses to his subscribers
  - Shared IPv4 address: SP relies on Network Address Translation (NAT) in his network to share a couple of global IPv4 addresses and allocates private IPv4 addresses to his subscriber
  - IPv6 only
- It is expected that Service Providers will deploy a combined and phased approach
  - Sharing IPv4 global address is part of the solution
  - IPv6-only as the ultimate goal, there is no alternative plan

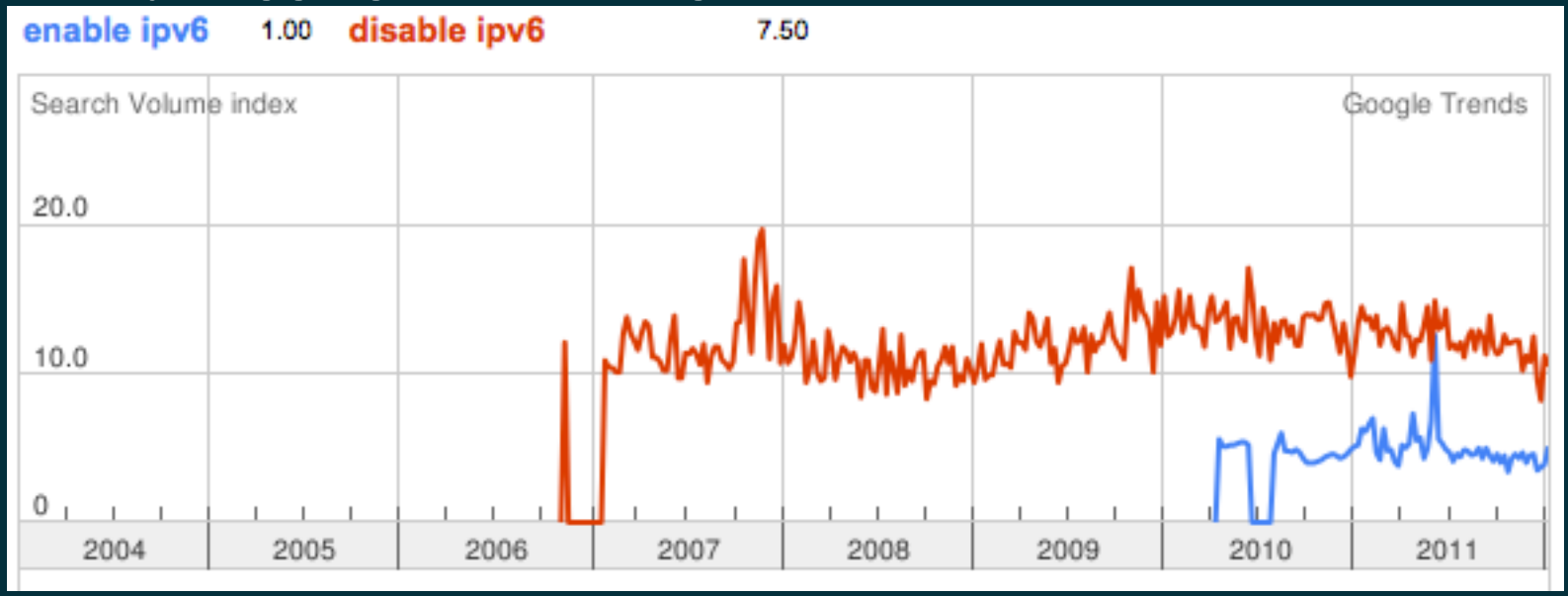
IP Network Transitional Technologies



Preserve Prepare Prosper

Eliminating Incentives to Disable IPv6

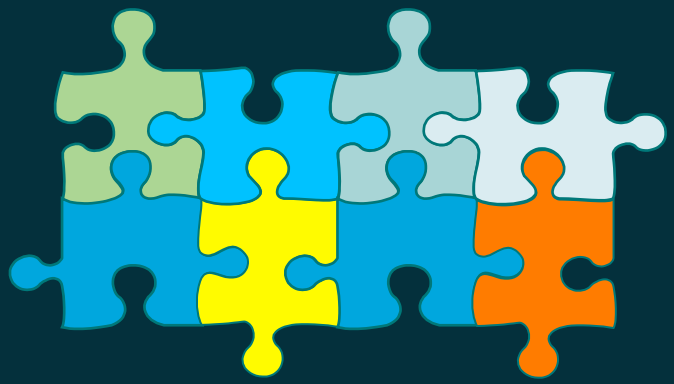
- Deliver production grade IPv6 Connectivity
- Improved Failover in hosts (Happy Eyeballs*)
  - –Chrome and Firefox browsers, OS X Lion
- Security, logging, and management for IT network administrator



* IETF draft-ietf-v6ops-happy-eyeballs

Impact on Content Providers

- Content Providers should expect their customers and partners to have a **mix of connectivity**
  - Public IPv4-only
  - Public IPv4 and IPv6
  - Shared IPv4-only
  - Shared IPv4 and IPv6
  - IPv6 only



Content Providers must be ready for this mix

The days of one public IPv4 for each Internet user are over

Impact on Broadcaster/Content Providers

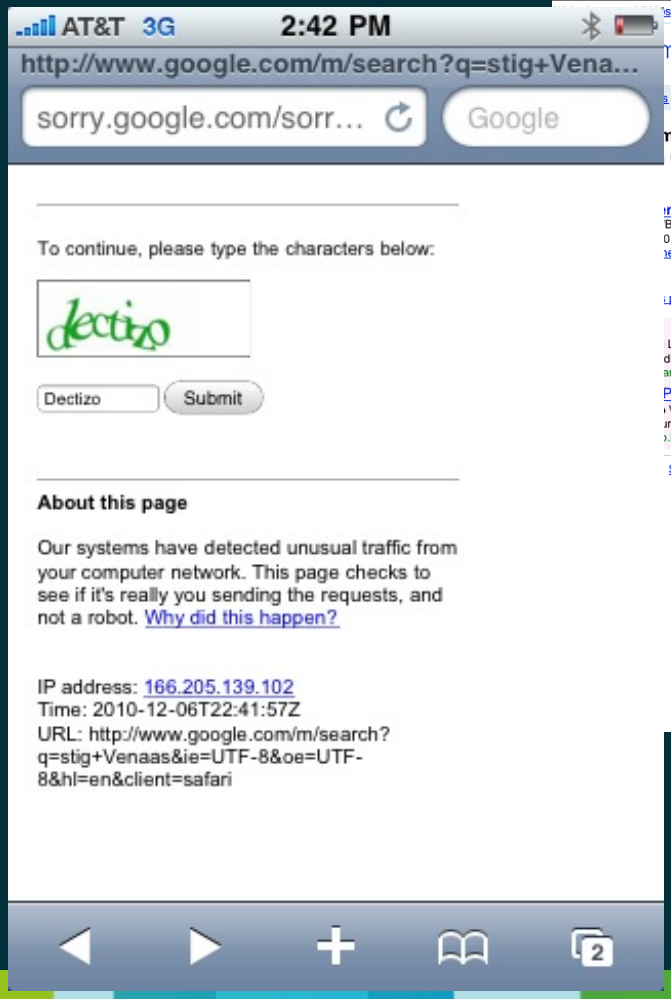
- For content delivery to end users
  - Mix of streaming (live or VOD) and interactive applications
  - User session state and logging
  - No control over the end user connection type
  - There may be some legal “universal access” requirements too
- Media Exchange between broadcasters
  - Occasional Use contribution with a new setup and/or partner
  - Outdoor Broadcast with 3rd party driven requirements
- ENG over IP
  - Breaking news, from anywhere, at anytime, via any (IP) network

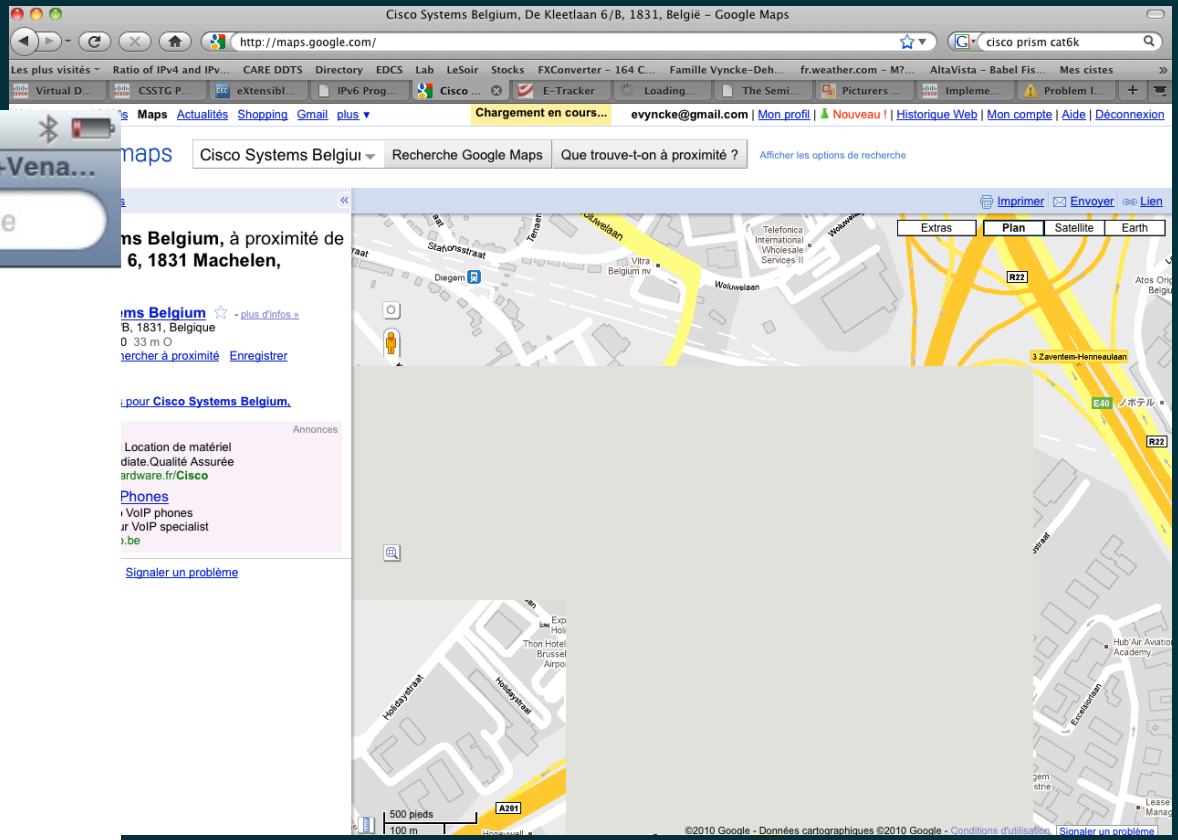
Impact of Shared IPv4 Addresses on Applications

- Applications that may **work poorly or even not at all** when one side uses a shared IPv4 address
  - Multiple TCP connections (like AJAX) in parallel
  - Streaming unicast or multicast sessions
  - Assuming that one IPv4 address = one user (for logging, for load balancing, for access control…)
  - Expecting inbound connections (like active FTP)
  - Using an application not yet supported by the NAT devices

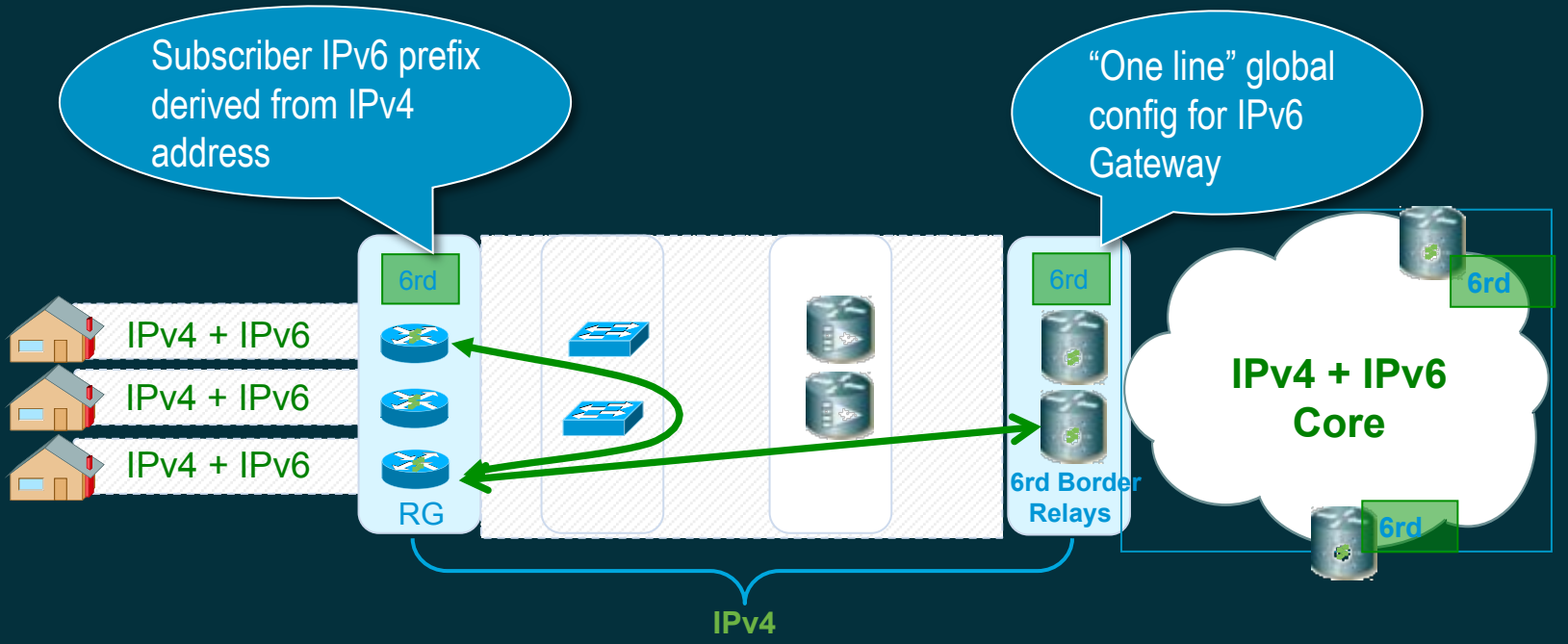
Content Providers should:
Be conservative for their IPv4 users
Be aggressive for their IPv6 plan

Examples of Broken IPv4 Applications





6RD (RFC 5969): IPv6 from SP to end users



- Native dual-stack IPv4/IPv6 in the home or office
- Simple, stateless, automatic IPv6-in-IPv4 encapsulation & decapsulation functions
- IPv6 traffic automatically follows IPv4 routing between home router and Border Relays
- BRs placed at IPv6 edge, addressed via anycast for load-balancing and resiliency

6RD Residential Gateway Implementation

LAN-Side:
Production Native IPv6
Service + Global or Natted IPv4

IPv6 +
IPv4 Dual
Stack

WAN-Side:
IPv6 via IPv4
Global or Natted IPv4

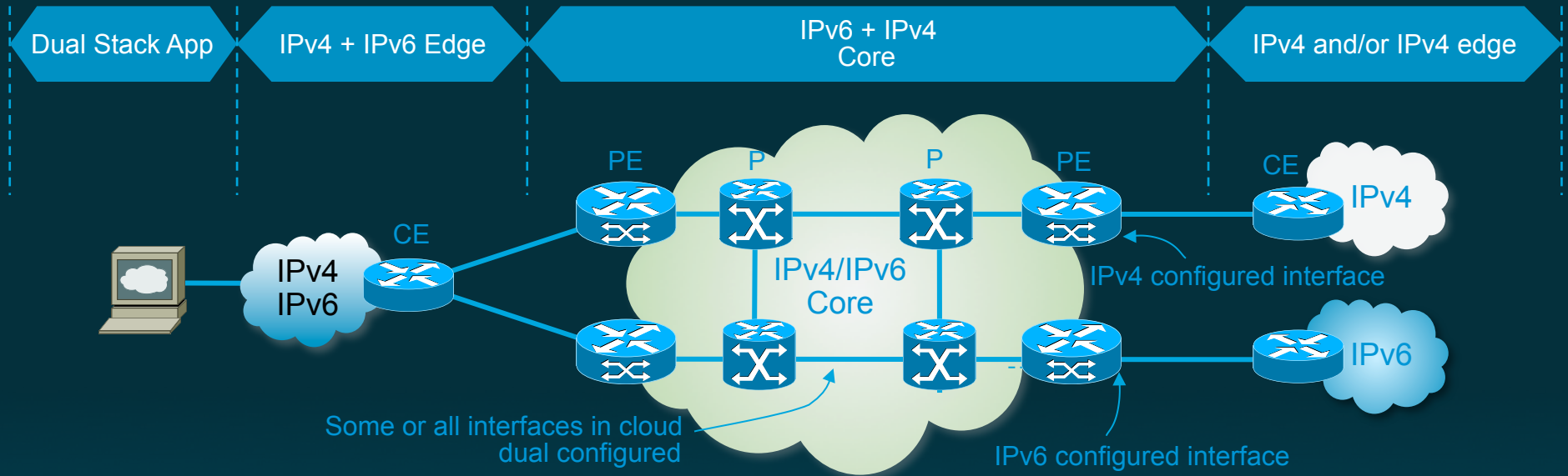
IPv4 SP
Network

IPv6 Internet Access delivered to home, allowing IPv6 enabled applications and content to remain unaffected by IPv4 Exhaustion

6rd lives here

IPv6 in SP Network evolves at its own pace, with its own balance of costs and incentives

IPv6 Using Dual Stack



- All P + PE (core/edge) routers are capable of IPv4+IPv6 support
- Two Internal Gateway Protocols supporting IPv4 and IPv6
- Memory considerations for larger routing tables
- Native IPv6 multicast support
- All IPv6 traffic routed in global space
- Good for content distribution and global services (Internet)

Enabling IPv6 on the web server frontend

This is not a rip-and-replace approach:

- Add native IPv6 to existing web servers
  - –could require some changes in application scripts & logging
- Add a set of IPv6-only web servers
  - –More flexibility and independence of IPv4 & IPv6
- Address Family Translator (AFT) in the load balancers
  - –Accept IPv6 connection from browser
  - –Load balance and connect to server with IPv4
  - –Can insert X-Forwarded-For HTTP header to keep IPv6 add in log
- AFT in reverse web proxies
  - –Quite often reverse proxies are used for security anyway
  - –Same as load balancers including logging

Ex: Service Load Balancer NAT64

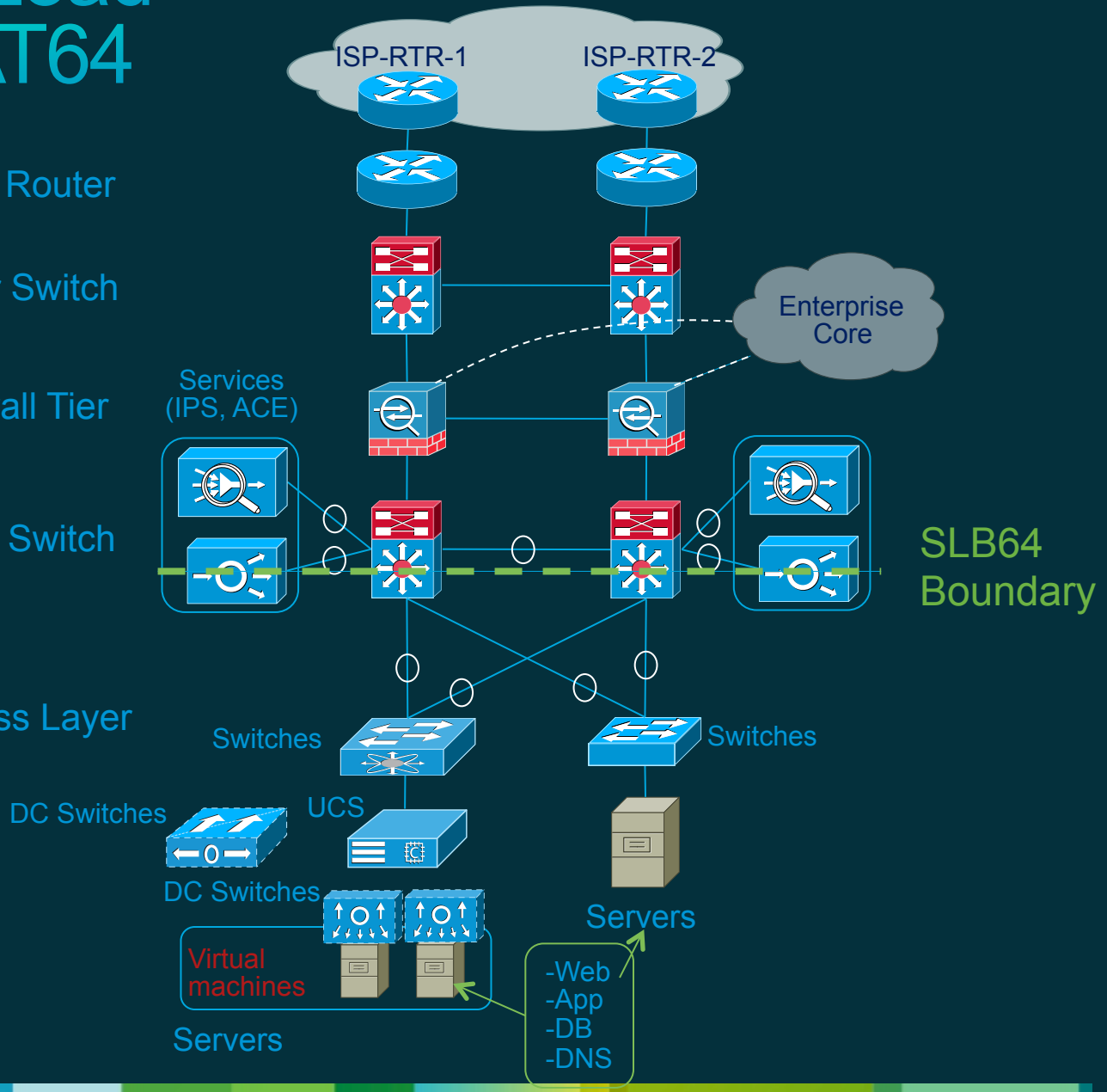
Internet Edge: Edge Router

Internet Edge: Outer Switch

Internet Edge: Firewall Tier

Internet Edge: Inner Switch

Internet Edge: Access Layer



Video related IPv6 standardisation efforts

- Digital TV Group D-Book 7 Part B
  - Part of the Connected TV specification
- YouView Core Technical Specification
  - Managed & Over the Top STB
- DVB IPTV
  - Managed IPTV services specification
- Some media related services with IPv6 enabled
  - Netflix, YouTube, RTBF, Heise, El Mundo, A-pressen Digital Medier, VG Multimedia

World IPv6 Day

- Launched by Internet Society with:
  - Google, Facebook, Yahoo!, Akamai, Limelight
  - Approx 400 companies signed up for the event
- June 8 2011 – 00:00 – 23:59 (UTC)
  - Major content providers enabled IPv6 stack on their main website(s) & AAAA entries in their DNS for www.domain.com
  - IPv4 runs in parallel as usual, no disruption
- Test flight to motivate organisations across the industry to prepare their services for IPv6
  - Break the chicken and egg problem
- Opportunity for the Internet industry to collaborate to test their IPv6 readiness
  - This is not about turning off IPv4!

World IPv6 Day

- “Tech industry’s most-watched event since the Y2K”
- The result: ”There was no news. It worked!”
  - 1000 websites enabled
- Facebook saw over 1M users over IPv6
- Google saw 65% more IPv6 traffic than usual
- Yahoo! saw most IPv6 traffic from France (via free.fr)
- Large Broadcasters involved: BBC, CNN
- Broadcast manufactures too: Sony

World IPv6 Day – Lessons learnt

- Performance testing & user experience
  - Javascripts, UI rendering, cookie behaviour, application bugs
- Network routing topology
  - May not be the same as for IPv4
- Geo-location
  - Location resolution for IPv6 addresses?
- Web analytics
  - Can it process, store, report against an IPv6 address?
- Content delivery service providers
  - DNS resolution (of the AAAA entries)
  - Can they deliver content over IPv6?

World IPv6 Launch

- June 6th 2012 00:00 UTC
- This time IPv6 stays on!
- Content providers:
  - Google, Facebook, YouTube, Yahoo!, Bing, Xbox, Cisco
- Service Providers:
  - ATT, BIT, Comcast, Fastweb, Free, KDDI, TimeWarner, XS4ALL
- Content Delivery Networks:
  - Akamai, Limelight

Summary

- Can IPv4 & IPv6 work in parallel?
- What video relevant standard bodies are working on IPv6?
- Is IPv6 only for the public Internet?
- How are Service Providers rolling out IPv6 to end users?
- What do Content Providers/Broadcasters need to do to support IPv6 services?
- Who has already launched IPv6 based services?
- What happened during World IPv6 Day?

References

- EBU Tech Review: IPv6 & Content Providers
  http://tech.ebu.ch/webdav/site/tech/shared/techreview/trev_2011-Q2_ipv6_kernen.pdf
- World IPv6 Day
  http://www.worldipv6day.org/
- World IPv6 Launch
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- RIPE NCC - World IPv6 Day measurements
  http://v6day.ripe.net
- Deploying IPv6 in the Internet Edge
  http://www.cisco.com/en/US/docs/solutions/Enterprise/Borderless_Networks/Internet_Edge/InternetEdgeIPv6.html

Thank you.