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CROSSING THE IPV6 CHASM

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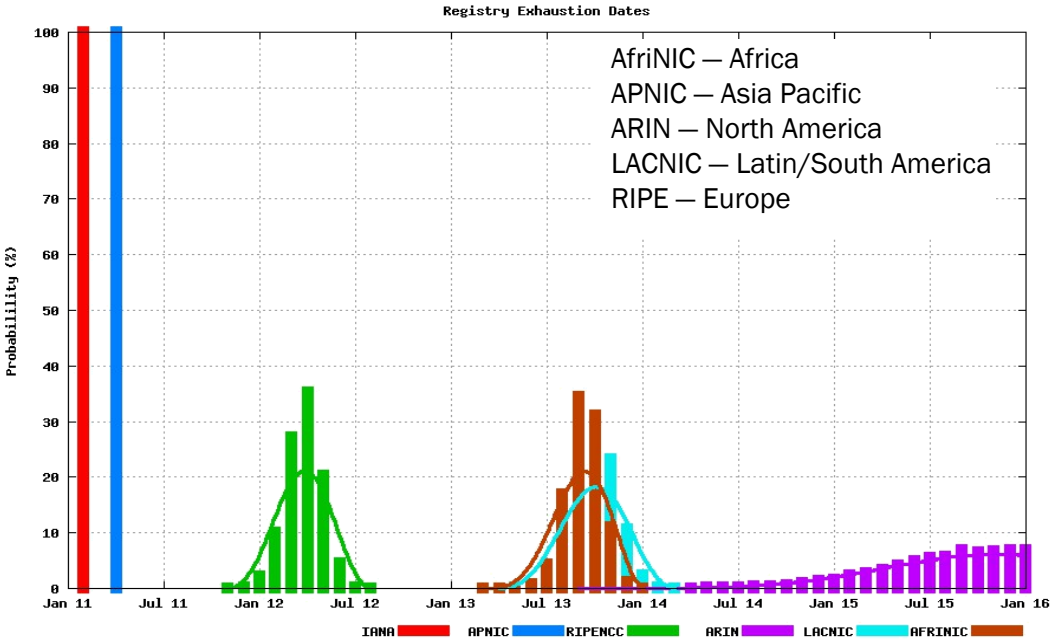
Agenda

- Why All the Sudden Fuss?
- IPv6 Transition
- The Role of Application Delivery Controllers
- Case Study
- Certification and IPv4-v6 Parity
- Summary
- Questions?

Why Are We Talking About This Today?

- IANA allocated the last five IPv4 /8s to the RIRs on February 3, 2011
- APNIC is expected to be out of IPv4 address space soon
  - Strict allocation policy for their last /8 as of April 15, 2011
- RIPE is expected to deplete their allocation in 1H 2012
- AfriNIC, LACNIC, ARIN in 2013-15+



- World IPv6 Day on June 8, 2012 was a huge success to test IPv6 readiness and to drive awareness
- Current Internet IPv4 routing table has 370,928* routes, and the Internet IPv6 routing table has 6,983* routes

* As of Thu, 11 Aug 2011 15:12:45 GMT

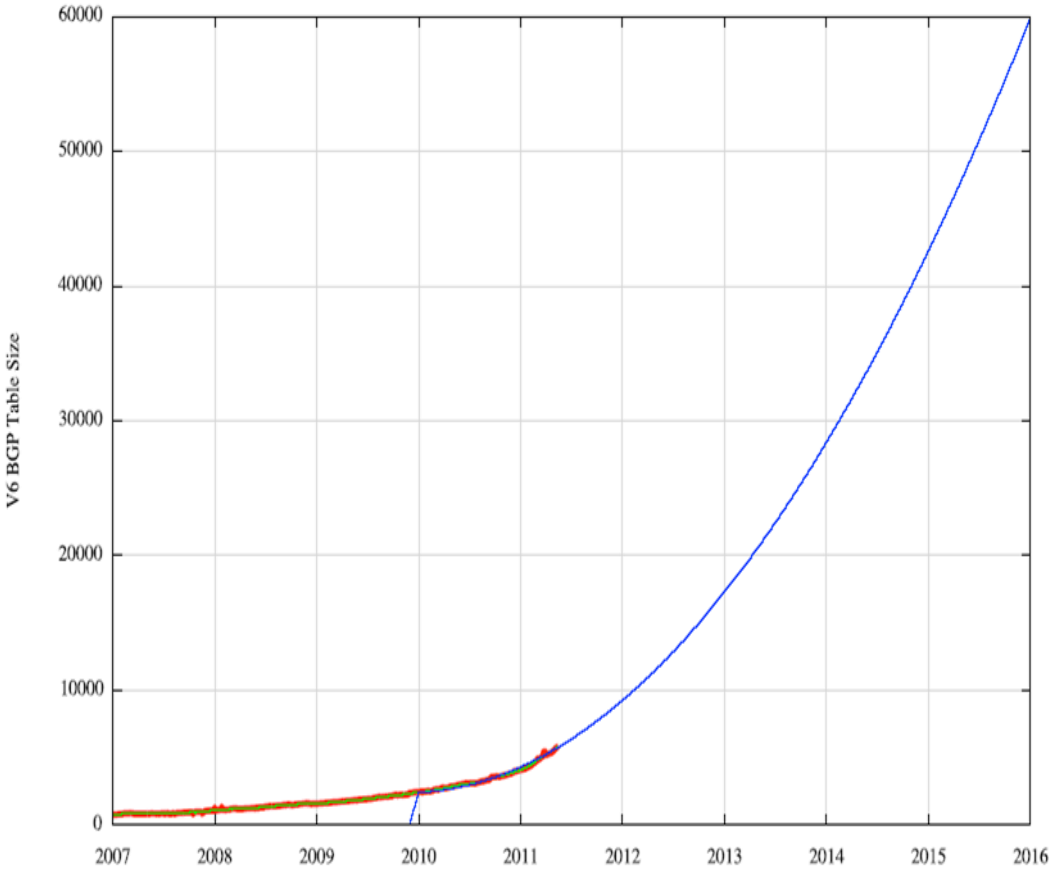
The Limits of Scale: IPv4 Clock Has Stopped

Beginning of a new chapter in Internet history

- Seemingly endless pool of 4 billion IPv4 addresses has been depleted
- IPv6 is the new fabric of the Internet
  - IPv4 addresses will continue to exist for decades
- End-to-end transparency and efficiency offered by IPv6 will trigger new application innovations and business opportunities

IPv6 Routing Table Growth Projections

IPv6 Table Size in 10,000s Scale

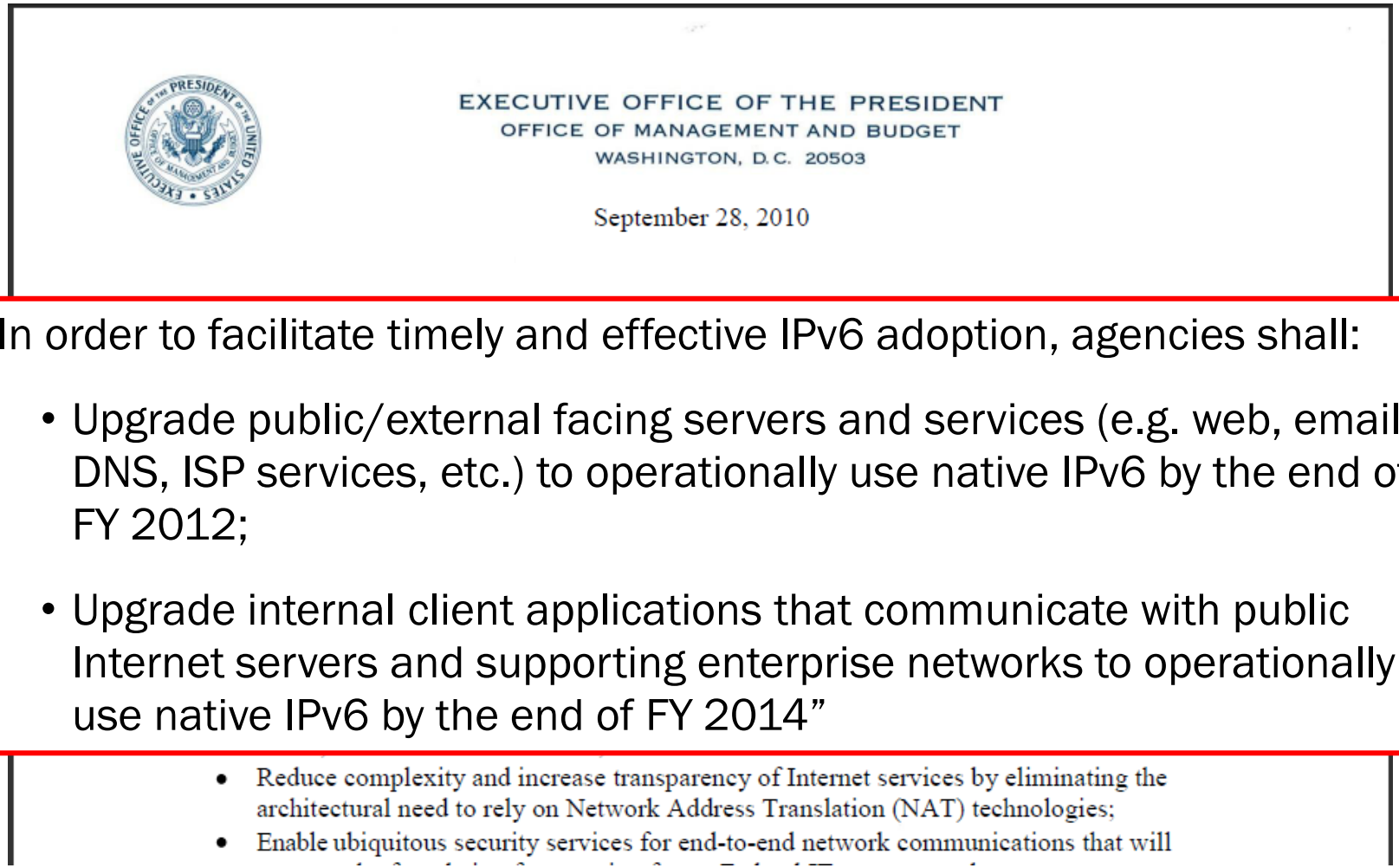


	2008	2009	2010	2011*
Prefix Count	~+50%	+53.75%	+66.67%	+60.53%

- Annual IPv6 table growth trend has increased significantly of late
- If these rates persists, the IPv6 transit AS count will equal the IPv4 transit AS count in 2016
- Global IPv6 adoption growing rapidly, as business and technical obstacles are solved

* As of Mon, 27 Jun 2011 19:12:42 GMT

Governments and Corporations React



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

September 28, 2010

"In order to facilitate timely and effective IPv6 adoption, agencies shall:

- Upgrade public/external facing servers and services (e.g. web, email, DNS, ISP services, etc.) to operationally use native IPv6 by the end of FY 2012;
- Upgrade internal client applications that communicate with public Internet servers and supporting enterprise networks to operationally use native IPv6 by the end of FY 2014"

- Reduce complexity and increase transparency of Internet services by eliminating the architectural need to rely on Network Address Translation (NAT) technologies;
- Enable ubiquitous security services for end-to-end network communications that will

http://www.cio.gov/Documents/Transition-to-IPv6.pdf

What All This Means

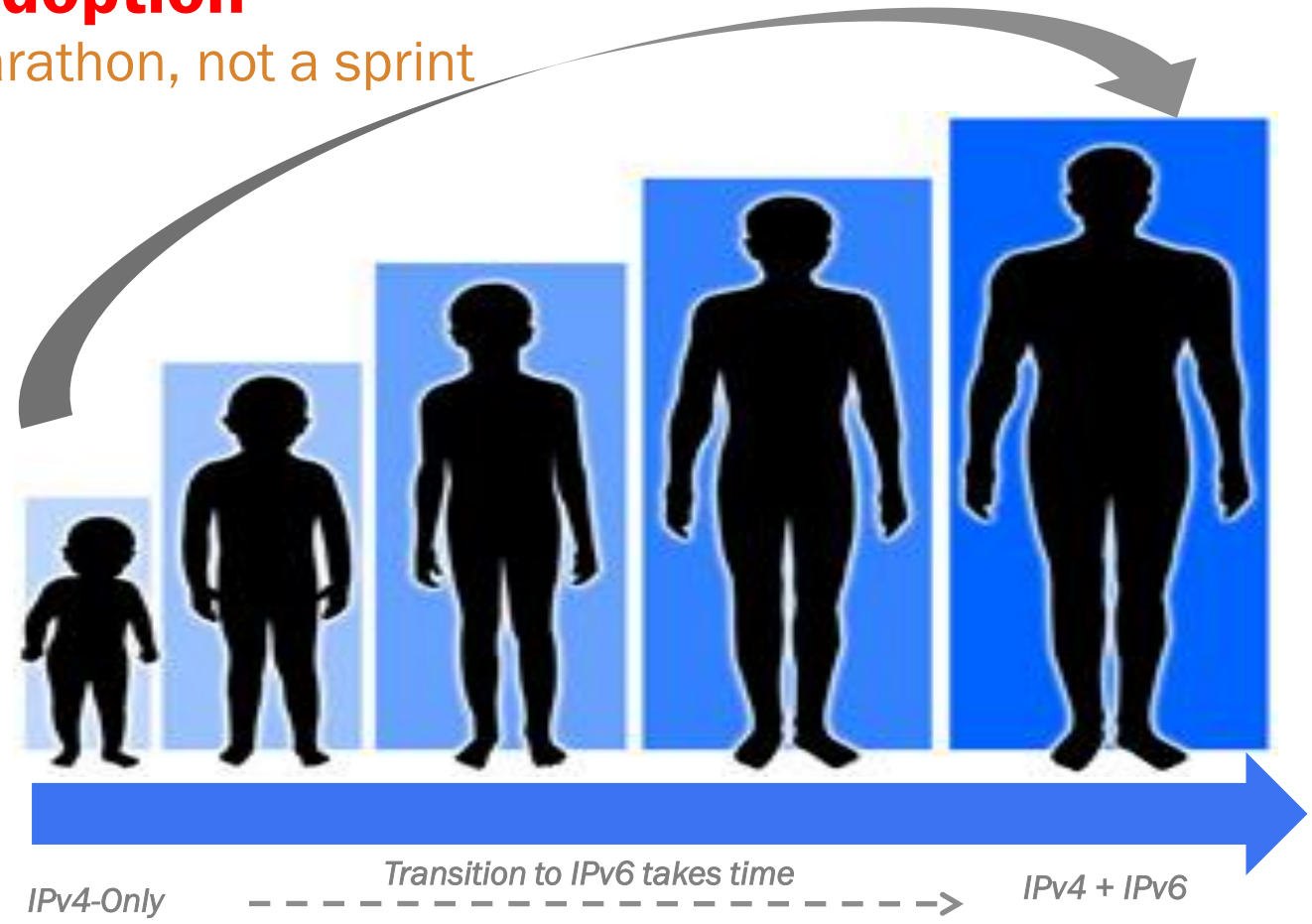
Challenges for IPv6 Providers and Users

- IPv6 transition has begun in earnest
  - The network effect
  - Ability to connect to an external IPv6 network already (will soon be) essential
- Provider challenges:
  - Deliver IPv6 transport or IPv6 services
  - Expand IPv6 POP presence
  - Offer the same performance experience in IPv6 as IPv4
  - Solve the “any-to-any” connectivity need across IPv4 and v6 networks
  - E.g.: Backbone operator, ISP, managed LAN provider, content provider
- User challenges:
  - Ensure smooth IPv6 migration at minimal cost
  - Transition in the shortest time to maintain business continuity
  - Think different … learn from IPv4 challenges
  - E.g. Enterprises or managed LAN providers

IPv6 Transition

IPv6 Adoption

It's a marathon, not a sprint



IPv6 Transition

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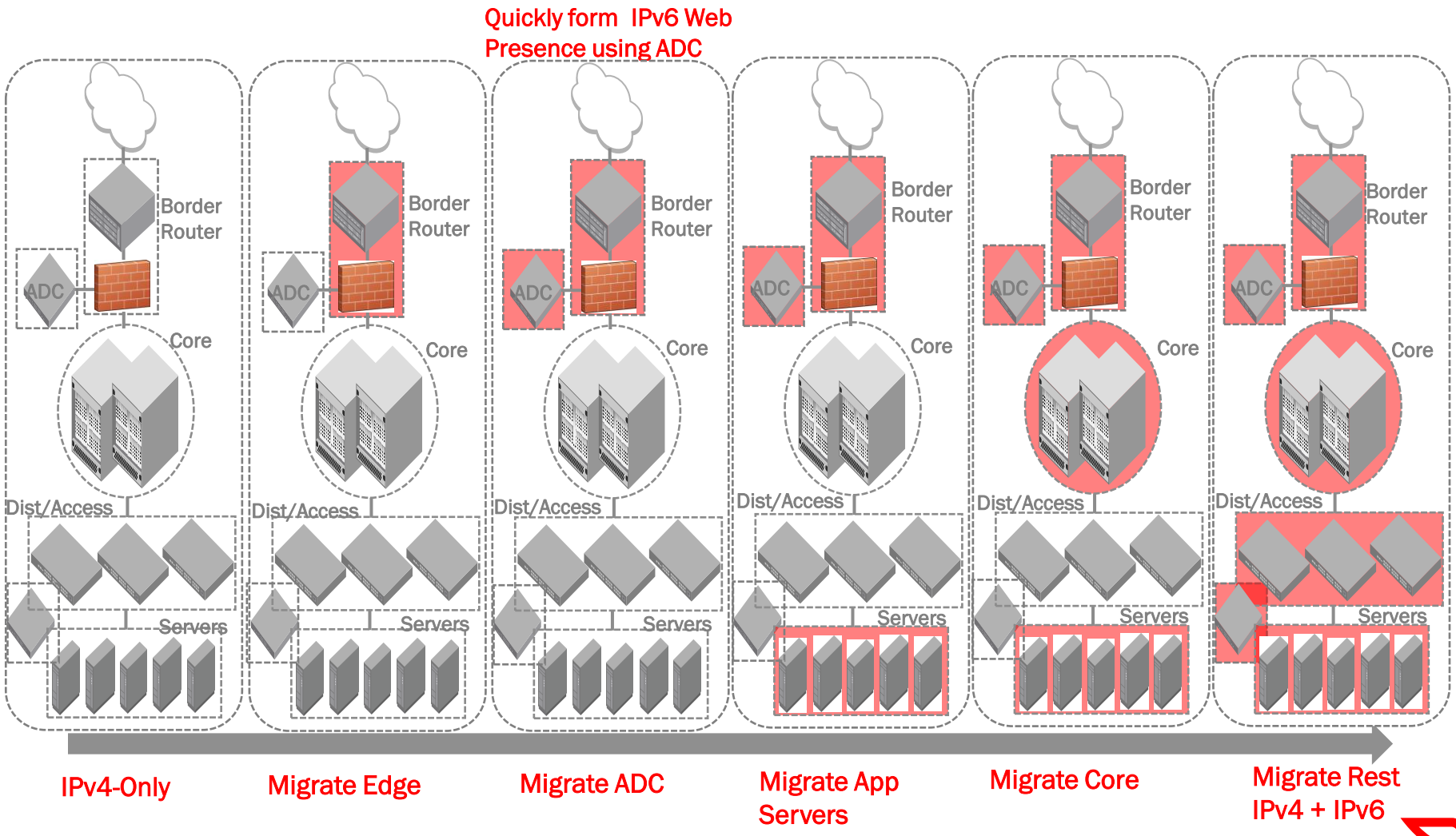
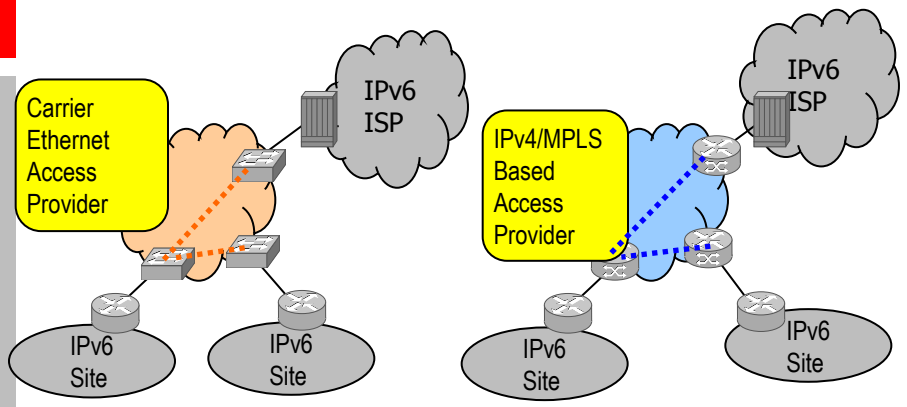
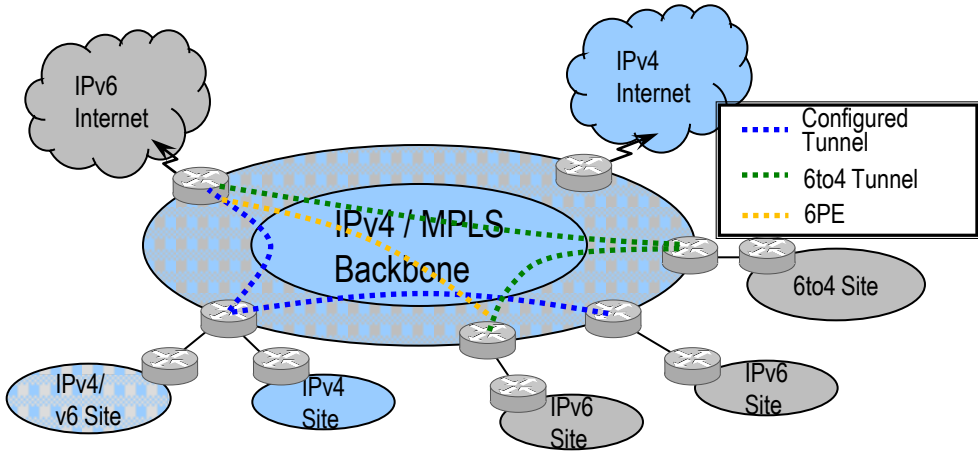


Interconnecting IPv6 Sites: Approaches to Take



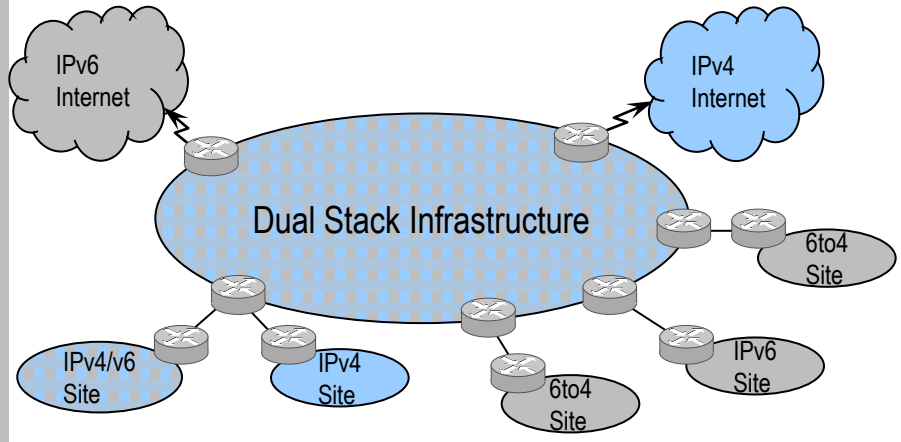
Outsource to a third-party provider who offers one of the following:

- Transparent Carrier Ethernet transport service
- IPv6 transit / tunnel broker services



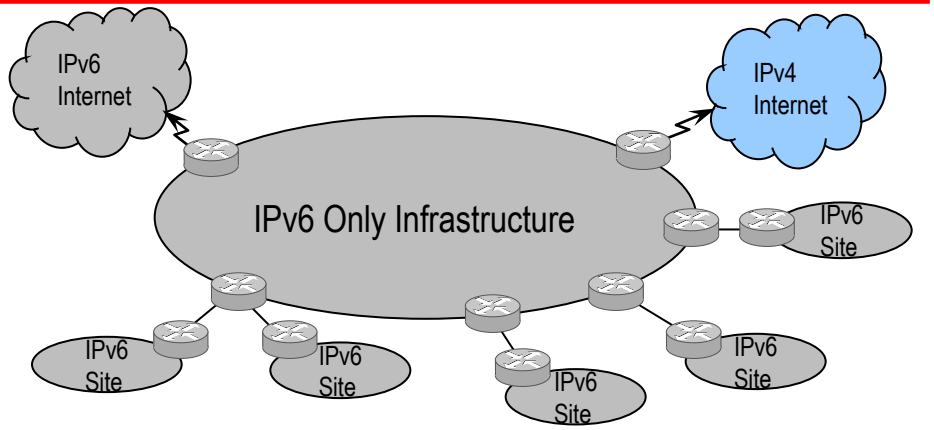
Phased approach

- Dual stack routers at the access layer with tunneling
- 6PE used on MPLS Provider Edge routers to connect IPv6 sites over MPLS



Dual Stack migration

- Upgrade infrastructure with Dual stack capable devices
- Native support of both IPv6 and IPv4 services

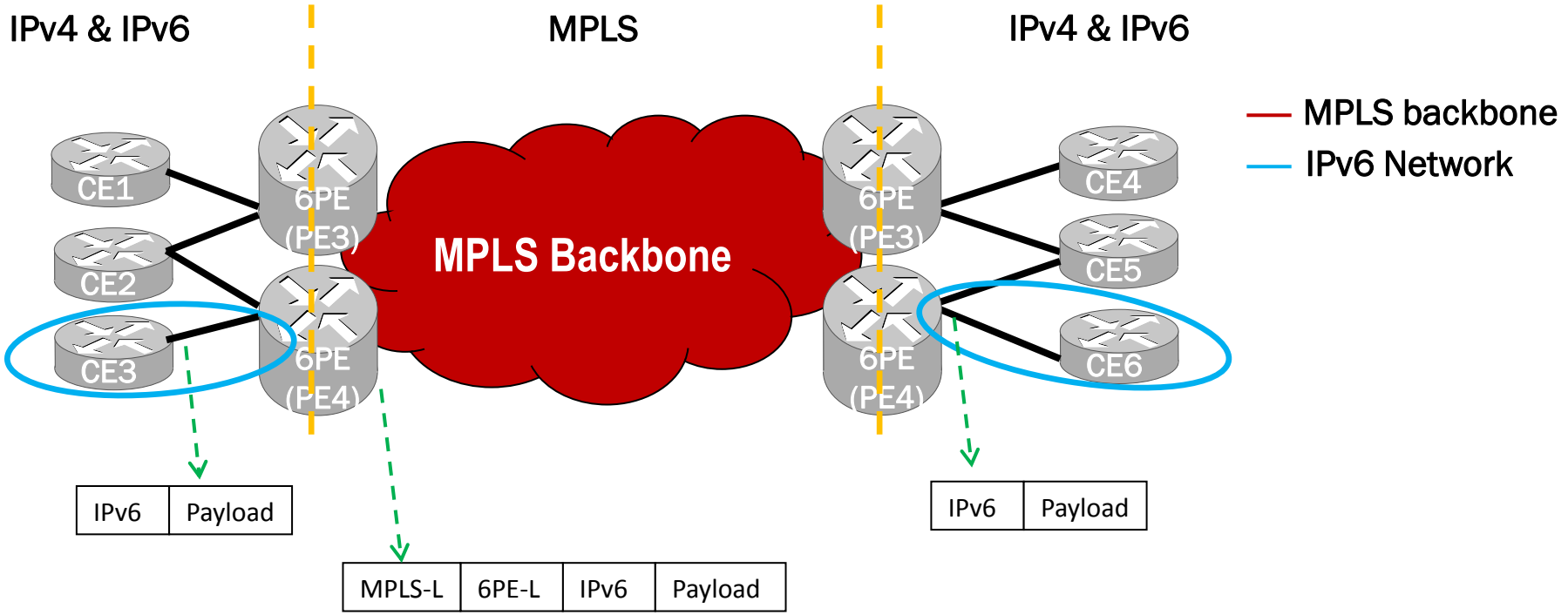


Layer-3 Service Providers, New service build-out

- Augment existing infrastructure with new IPv6 enabled devices
- New service creation

6PE

Propagates IPv6 across an MPLS network

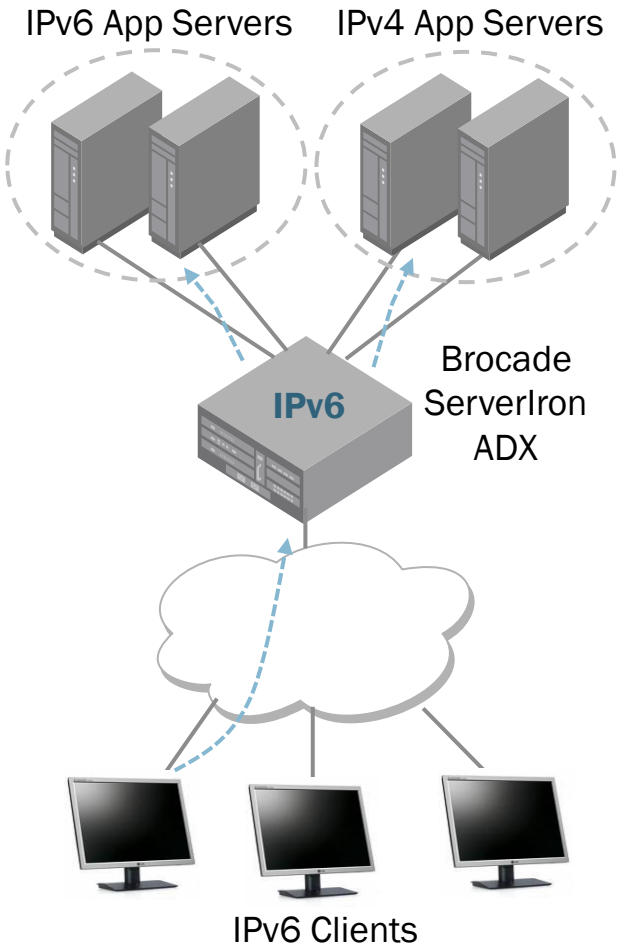


The Role of Application Delivery Controllers in IPv6

IPv6 Application Delivery

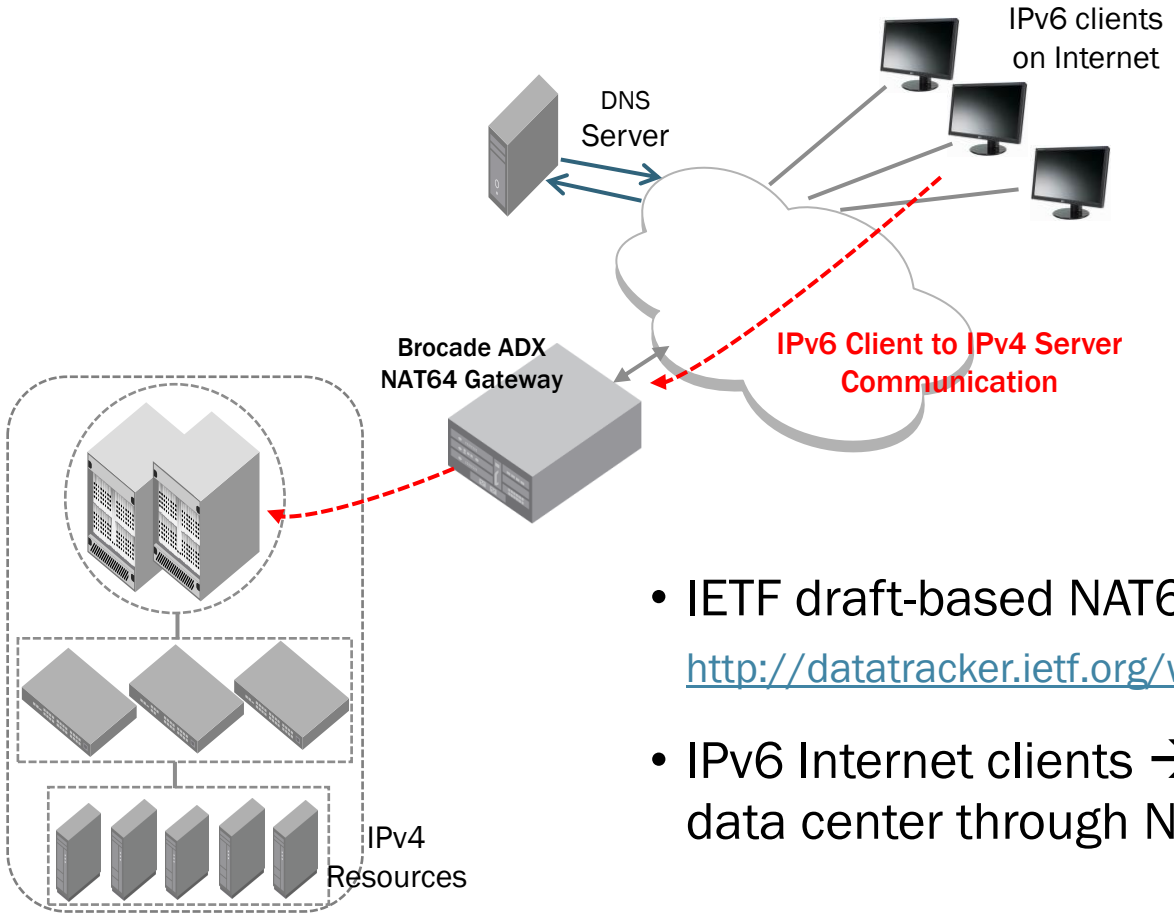
Quickly enable IPv6 Web presence for your IPv4 applications

- Translation service for IPv4 applications
  - IPv6 VIP → IPv4 App Servers (664)
  - IPv6 VIP → IPv6 App Servers (666)
  - IPv6 VIP → IPv4 + IPv6 App Servers (664+6)
- Additional capabilities for IPv6
  - Preservation of source IPv6 address
    - By inserting it into custom HTTP header
  - Content-aware (Layer7) traffic distribution
  - Security for IPv6 Application Services
    - DoS attack (SYN attack) mitigation
    - Application Rate Limiting



NAT64 Gateway (1)

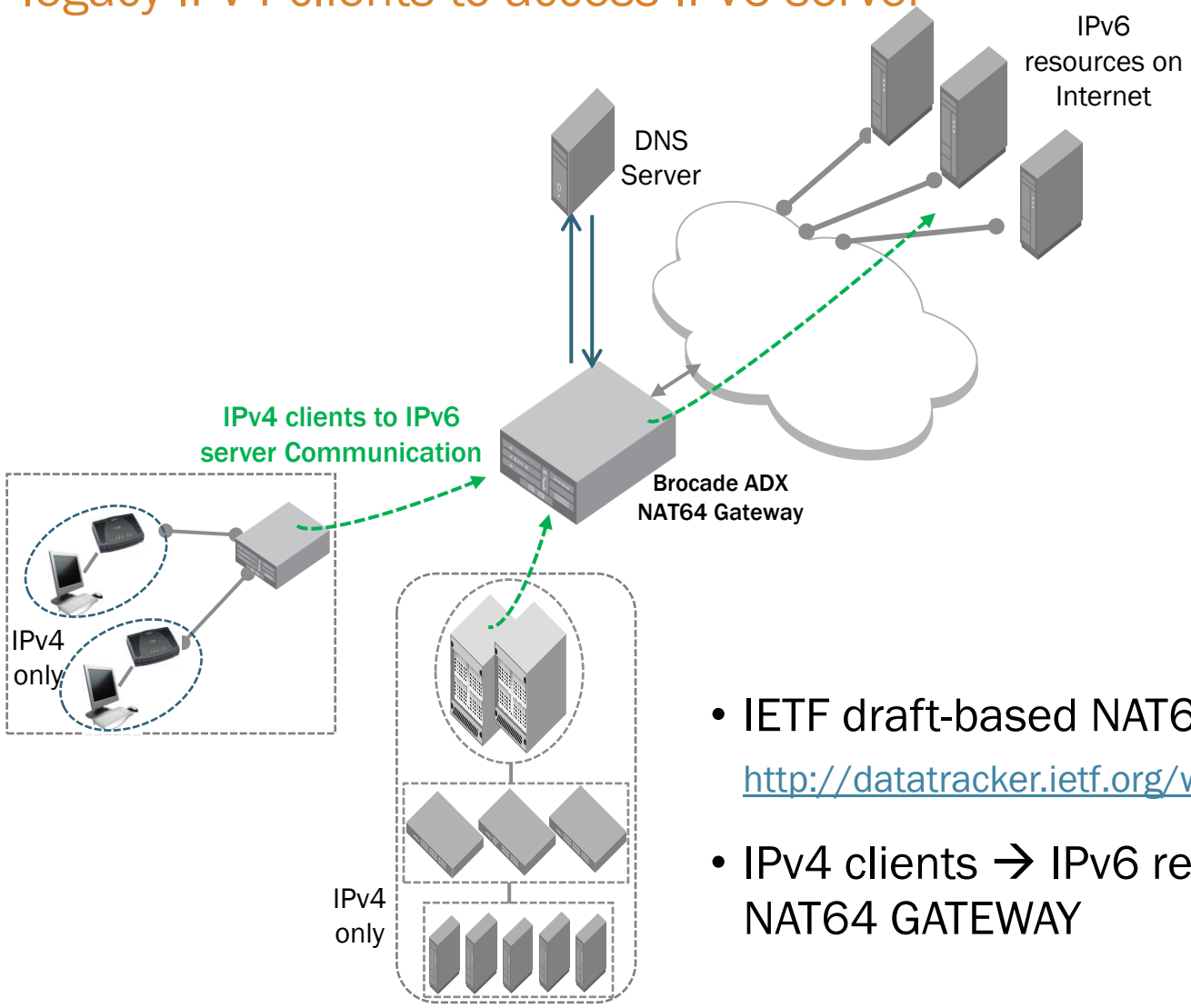
For legacy IPv4 applications to be accessed by IPv6 clients



- IETF draft-based NAT64 capability
  http://datatracker.ietf.org/wg/behave/charter/
- IPv6 Internet clients → IPv4 resources in data center through NAT64 GATEWAY

NAT64 Gateway (2)

For legacy IPv4 clients to access IPv6 server



- IETF draft-based NAT64 capability
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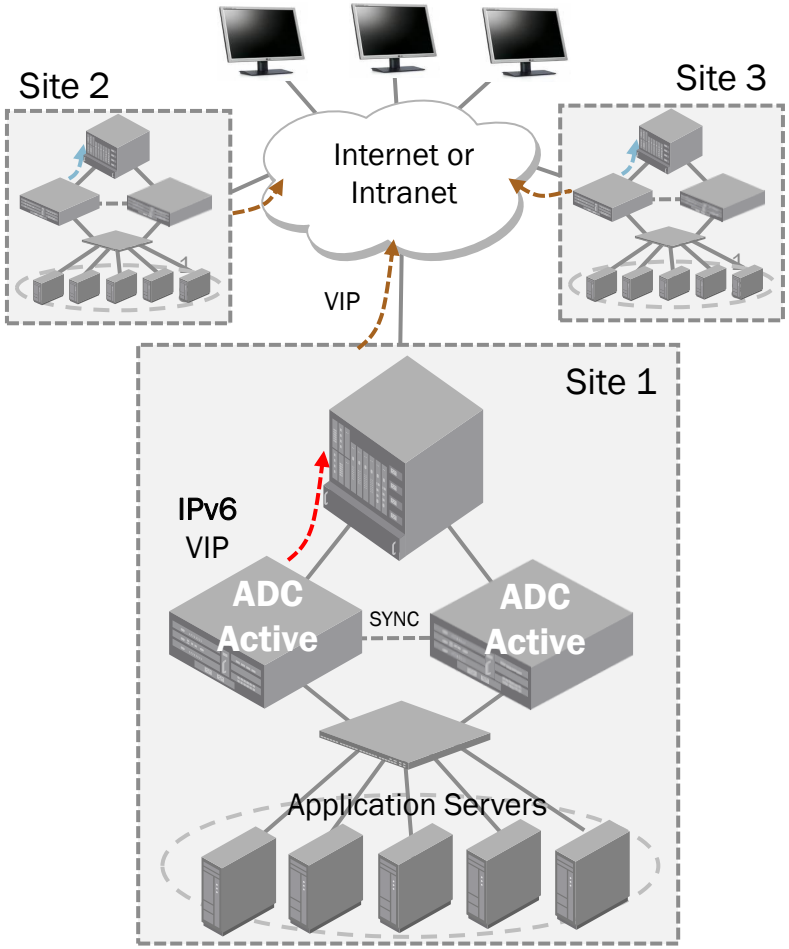
- IPv4 clients → IPv6 resources through NAT64 GATEWAY

Multi-site Redundancy for IPv6

Virtual IP (VIP) address route health injection for IPv6 applications

- Application Delivery Controller (ADC) injects network route for “healthy” IPv6 service
  - Tight integration with routing protocols
- Multiple sites inject same IPv6 route
- IPv6 clients connect to the closet available site
- If one of the sites fail, then network route is withdrawn
  - Clients connects to remaining sites
  - Ensure 24x7 business continuity



Case Study

Success Story: Brocade IT and IPv6

- **June 2010**—Brocade was asked to demonstrate IPv6 commitment
  - DoD/DREN/SPAWAR are pressing vendors for IPv6 timelines
- **August 9, 2010**—Brocade went "green across the board" for DREN's IPv6 capability test for DNS, WWW, and SMTP (20 days ahead of its schedule)
  - Utilized a wide range of Brocade application delivery tools to meet the capability test requirements
  - Project was completed during the biggest campus consolidation in Brocade's history

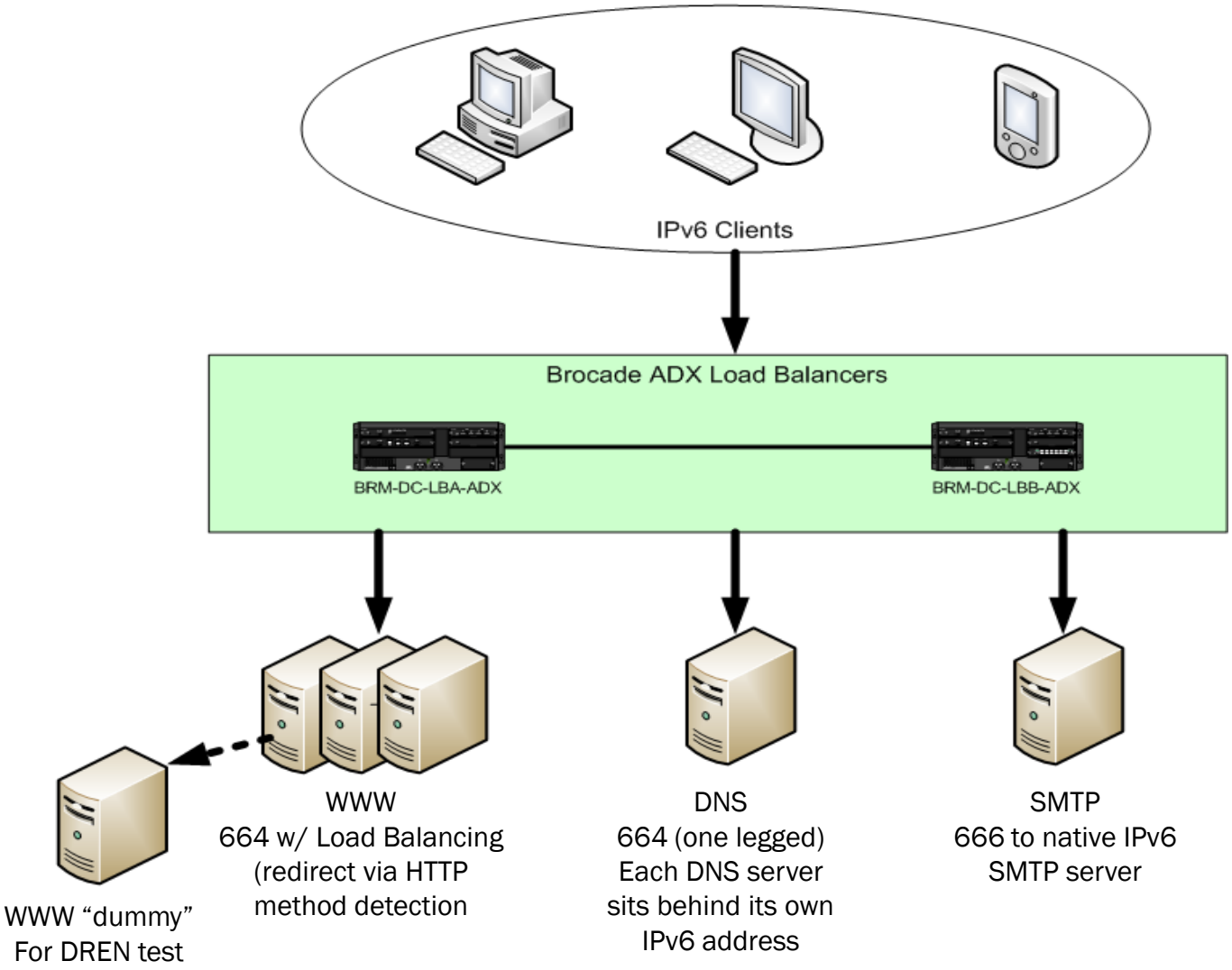
Kelly Brown
Manager, Network Engineering
Brocade IT

Success Story: Brocade IT and IPv6

Establishing IPv6 Presence in the Midst of a Major Campus Transition

- **Border routers (Brocade XMR):** Running dual-stack
- **Brocade ADX 664 Gateway** —To establish IPv6 presence without touching or reworking existing IPv4 infrastructure, the Brocade ADX 664 (aka IPv6 Proxy aka IPv6 termination) feature set was heavily utilized
- **DNS Servers**—Source NAT was used in conjunction with remote server configurations to hide DNS server behind its public IPv6 address; a documented 664 method in a one-legged topology
- **Email Server**—A 666 method was used since the real server had its own IPv6 address
- **WWW Servers**—The 664 method, plus remote server configuration, was used, with full load balancing across the existing WWW front-ends.

IPv6 within Brocade—Deployment



End Result

Vendor	WWW	MAIL (SMTP)	DNS
Brocade.com	PASS	PASS	4/4 4/4

Source: http://www.mrp.net/IPv6_Survey.html

Lessons Learnt (1)

- IPv6 Allocation Assignment Size
  - Originally obtained a /48, had to change to /44
  - Initial plan was to split /48 into /52 for our various sites
  - Not all ISPs advertise routes with larger than /48 prefixes
- Subnet sizing
  - All subnets are /64, including point-to-point
  - Loopbacks are /128
- Unique Local Address (ULA) vs. Global
  - Global of course!
  - Key motivation: Remove NAT
- Reverse DNS (PTR)
  - Best practice: Automatically build PTR record when forward AAAA record is built
  - Will be a challenge for enterprises that must manually input the PTR record

Lessons Learnt (2)

- "IPv6-ifying" IPv4 only services
  - Some of the back-end web application software do not work on IPv6
  - ADX 664 to the rescue!
- Dealing with tunnels
  - Initial reports on access issues across tunnels traced to path MTU (PMTU) messages not following to the target servers
  - Root cause: Web servers not adjusting their MTU after receiving PMTU messages
  - NAT instead of Proxy deemed more efficient: ADX came to the rescue again
  - Firewalls adjusted to allow ICMPv6-type-2 (Packet-too-big) messages
- Staff training
  - More than just network staff
  - Training server operations team on IPv6 to help DNS, Email systems deployment in an IPv6 world

Certifications and IPv4-v6 Parity

IPv6 Interoperability and Certification

- Members of IPv6 Forum
  - http://www.ipv6forum.com/navbar/members/generalmembers.htm
- Participating in industry's largest interoperability testbed (Moonv6 project)
  - http://moonv6.sr.unh.edu/
- IPv6 Ready Logo program
  - http://cf.v6pc.jp/
- U.S. IPv6 Summit
  - http://www.usipv6.com/
- University of New Hampshire (UNH) – IOL IPV6 Certified

Driving Towards IPv4-IPv6 Parity

- Focus on functional parity not just feature parity
- Functional parity on Brocade products for*:
  - Wire-speed performance … v4 or v6
  - Management tools (e.g. telnet, ssh, scp, sFlow, TACACS+/RADIUS etc.)
  - Routing protocols common in Federal networks (e.g. OSPF, Multi-VRF)
  - Redundancy protocols (e.g. VRRP)
  - Layer 3 OA&M protocols (e.g. BFD, ping, traceroute etc.)
- Looking ahead:
  - Goal to continue drive towards functional IPv4-v6 parity rapidly
  - New capabilities built with support for v6 and v4

*Not a full list; representative sample

Key Solutions to Accelerate Your IPv6 Transition

IPv6 Performance without Compromise

Application Delivery Controllers	Aggregation and Edge	Core
Brocade ServerIron ADX Application Delivery Controllers 	**Brocade MLX/MLXe Routers**  **Brocade NetIron CER 2024/48/C/F** 	**Brocade MLXe Routers**  **Brocade XMR Series** 

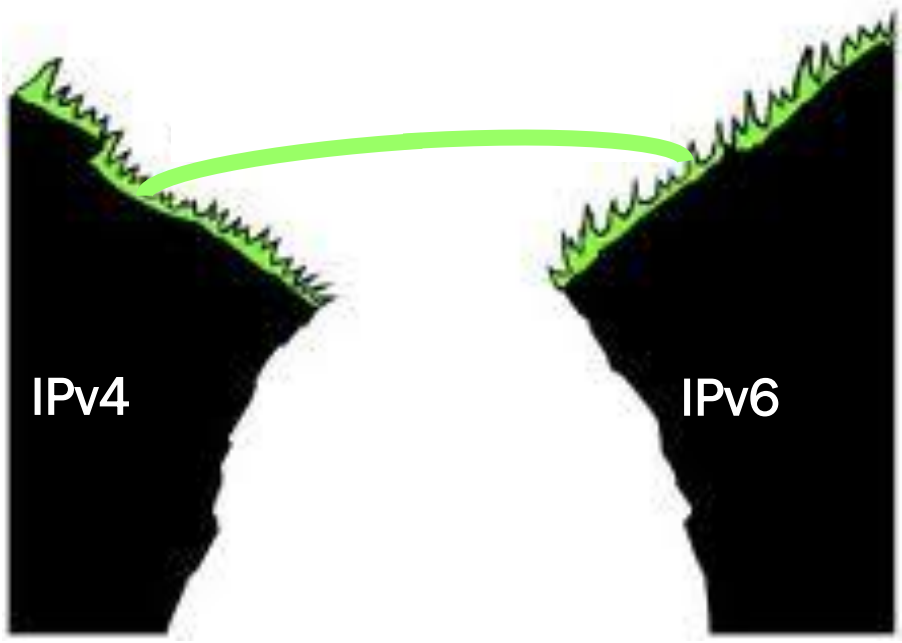
Summary

- IPv6 transition mechanisms for
  - Inter-site connectivity
  - Maintaining business continuity for IPv6-allergic apps!
- Dual stack where you can, tunnel/translate where you must
- Application delivery controllers help accelerate transition
- Expect convergence towards IPv4-v6 functional parity

References

- NIST IPv6 guidance (SP 800-119): Guidelines for the Secure Deployment of IPv6
  - http://csrc.nist.gov/publications/nistpubs/800-119/sp800-119.pdf
- Transitioning to IPv6: A Technology Overview
  - http://www.brocade.com/forms/getFile?p=documents/technical_briefs/Transitioning-to-IPv6-for-SP_GA-TB-380-00.pdf
- How will the Change in Internet Addresses Affect Your Business?
  - http://www.brocade.com/forms/getFile?p=documents/white_papers/IPV6_WP_00.pdf
- Ensuring a Smooth Transition to IPv6
  - http://www.brocade.com/downloads/documents/white_papers/Brocade_SmoothTransitionToIPv6_GA-WP-1574-00_2011-03.pdf

We are Ready to Cross the IPv6 Chasm!



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Questions?

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Thank You