

The Need for IPv6 Deployment in the Domain Business

Hurricane Electric

IPv6 Native Backbone – Massive Peering!

IPv6 AND DNS

ICANN 41

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Agenda - Current state of IPv6 for TLDs

- About Hurricane Electric
 - A global IP backbone with extensive IPv6 experience

- Always saying “yes” to IPv6
 - It’s about time!

- The “Global IPv6 Deployment Progress Report”
 - <http://bgp.he.net/ipv6-progress-report.cgi>

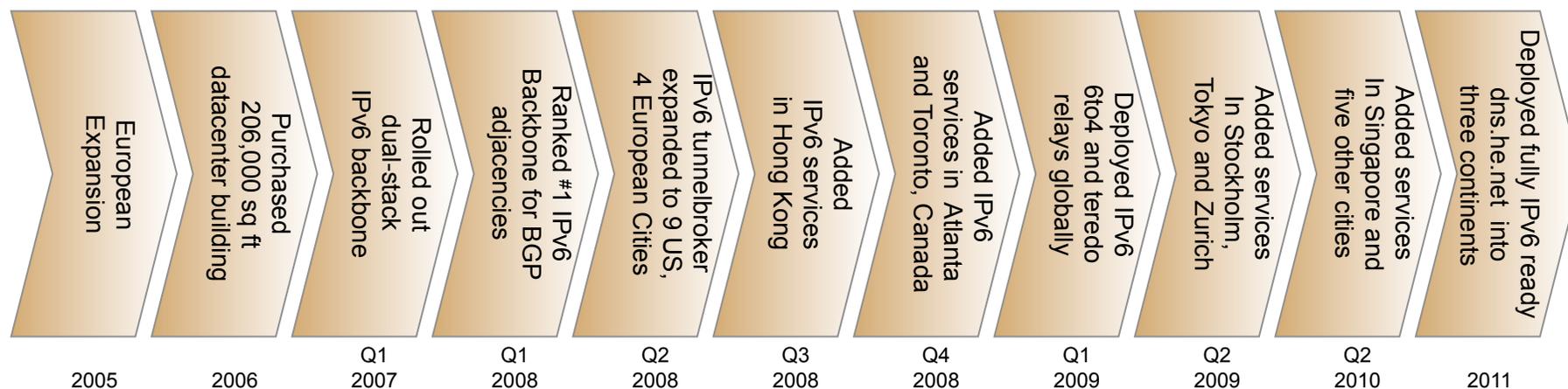
- Why IPv6 is vital for all TLD deployments
 - IPv4 & IPv6 as glue records
 - DNS queries via IPv4 & IPv6 should be treated equally

- Summary



About Hurricane Electric (the quick “IPv6” review)

- Founded 17+ years ago - ISP & datacenter operator
 - 1994 – Roots within the Silicon Valley high-tech community
 - 1999 – Expanded IPv4 network nationwide in the US
 - 2001 – Started IPv6 native and tunnel connectivity (<http://tunnelbroker.net>)
 - 2006 – Full “technology refresh” enabled native dual-stack IPv6 backbone
 - 2008 – Became largest IPv6 backbone globally (> 1Gbps IPv6 traffic level)



- 2009 – Continued expansion into Asia; enabled IPv6 6to4 & Teredo global service
- 2010 – Added more geographic coverage; expanded IPv6 6to4 and DNS service
- 2011 – Stop talking about IPv6; just talk about the “Internet”



Hurricane Electric mindset – always say “yes” to IPv6

- It's 2011 (and not 2005, 2006, 2007, etc)
 - IPv6 capable hardware subsystems are available
 - IPv6 capable operating systems are available
 - IPv6 capable open-source software packages are available
 - IPv6 capable service providers are available
 - IPv6 expertise is absolutely available!

- It's 2011
 - No reason to say “no” to IPv6 anymore

- IPv6 in the registry and TLD requires some thought ...
 - ... and there's no problem finding the answers!



IPv6 in the real world - it's out there!

<http://bgp.he.net/ipv6-progress-report.cgi>

Networks Running IPv6

We can measure the percentage of networks running IPv6 by comparing the set of ASes in the IPv6 routing table to those in the combined set of IPv4 and IPv6. IPv4 and IPv6 RIBs Last Parsed: Mon Jun 20 01:03:29 PDT 2011

IPv4 ASes: 38136

IPv6 ASes: 4259

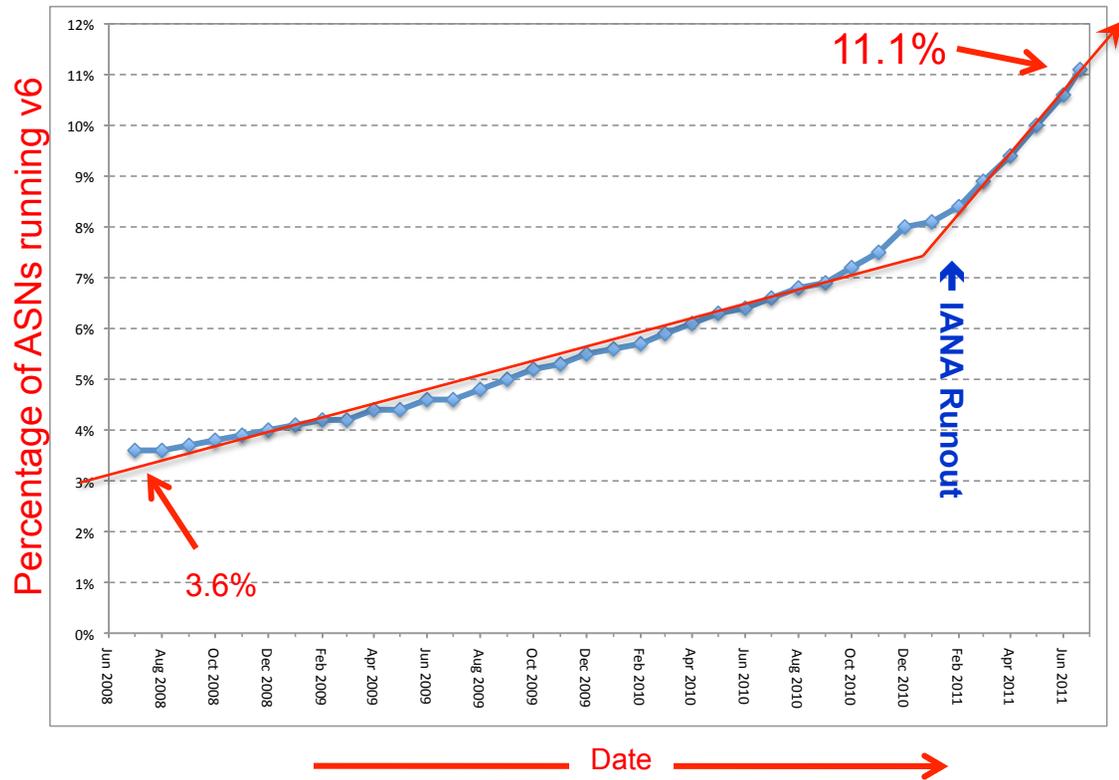
ASes using only IPv4: 33977

ASes using only IPv6: 100

ASes using IPv4 and IPv6: 4159

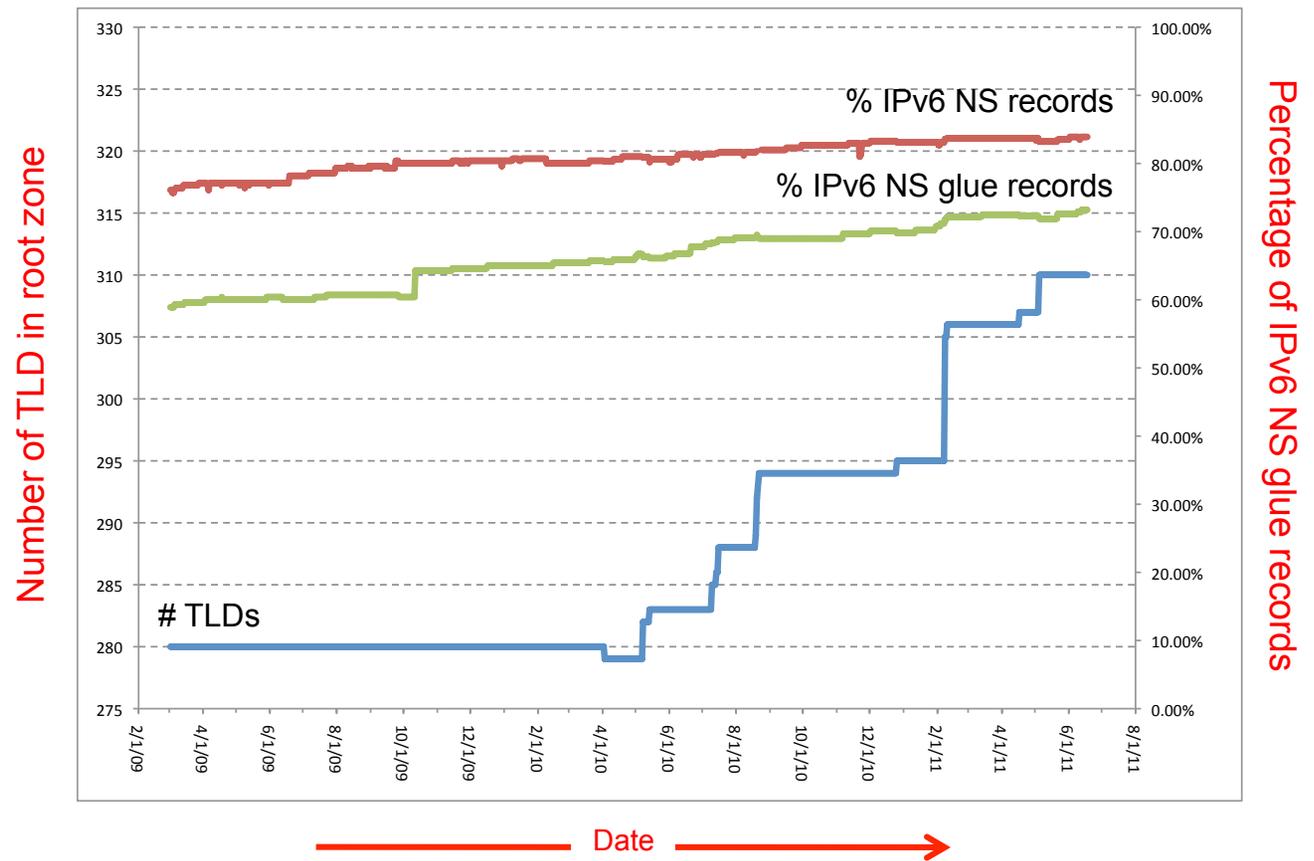
ASes using IPv4 or IPv6: 38236

Percentage of ASes (IPv4 or IPv6) running IPv6: 11.1%



IPv6 in the TLDs – by the numbers

- 83.9% of TLDs have IPv6 enabled nameservers
- 73.2% of TLDs have IPv6 glue records installed in the root



What's special about IPv6 addresses for NS records?

- NS glue records should be “filtered”
 - See http://bgp.he.net/report/dns/com#_aaaarecs
- Make it easy to add AAAA
- Example (do not accept):
 - 2002:: is 6to4
 - ::1 is loopback
 - 3ffe:: is deprecated 6bone
 - etc
- Include IPv6 in documentation

TLD Info **Sample A Records** **Sample AAAA Records**

.com TLD Report

Description: Generic top-level domain

Nameserver Status ✓

IPv4 Enabled Nameservers ✓

A Glue in the Root Zone ✓

IPv6 Enabled Nameservers ✓

AAAA Glue in the Root Zone ✓

Delegated to: VeriSign Global Registry Services

Domains: 95,436,429

A records: 85,265,888

A glue: 1,840,517

AAAA records: 1,553,422

AAAA glue: 1,737

Updated: 20 Jun 2011 02:07 PST

Range	Prefix	Count
unicast		85,078,870
invalid		46,801
this-network	0.0.0.0/8	27,043
RFC1918	10.0.0.0/8	5,682
loopback	127.0.0.0/8	93,565
link-local	169.254.0.0/16	135
RFC1918	172.16.0.0/12	581
documentation	192.0.2.0/24	2
RFC1918	192.168.0.0/16	5,340
multicast	224.0.0.0/4	146
reserved	240.0.0.0/4	7,723

Range	Prefix	Count
unicast	2000::/3	582,935
invalid		215
unspecified	::/128	16,015
v4-compatible	::/96	1,877
localhost	::1/128	878,567
v4-mapped	::ffff:0.0.0.0/96	71,433
teredo	2001::/32	678
unallocated	2000::/3	91
documentation	2001:db8::/32	10
6to4	2002::/16	1,421
6bone	3ffe::/16	35
ULA	fc00::/7	4
link-local	fe80::/10	140
site-local	fec0::/10	1



What's special about IPv6 addresses for NS records? #2

- Review of .com TLD
 - See http://bgp.he.net/report/dns/com#_aaaarecs (data for June 20 2011)

- Invalid NS AAAA values
 - Nearly 900,000 localhost entries
 - 71,000 v4-mapped
 - etc

- Can be teething problems ?

AAAA Record Breakdown		
Range	Prefix	Count
unicast	2000:: 3</td <td>582,935</td>	582,935
invalid		215
unspecified	::/128	16,015
v4-compatible	::/96	1,877
localhost	::1/128	878,567
v4-mapped	::ffff:0.0.0.0/96	71,433
teredo	2001:: 32</td <td>678</td>	678
unallocated	2000:: 3</td <td>91</td>	91
documentation	2001:db8:: 32</td <td>10</td>	10
6to4	2002:: 16</td <td>1,421</td>	1,421
6bone	3ffe:: 16</td <td>35</td>	35
ULA	fc00:: 7</td <td>4</td>	4
link-local	fe80:: 10</td <td>140</td>	140
site-local	fec0:: 10</td <td>1</td>	1



Why IPv6 is vital for all TLD deployments

- Classic reasons for IPv6
 - IPv4 address exhaustion,
IPv4 address exhaustion,
IPv4 address exhaustion!

- DNS and TLD reasons for IPv6 deployment
 - Queries via IPv4 and IPv6 improve interconnection statistics
 - IPv6 Deployment Reports says:
 *“Percentage of IPv6 rDNS Nameservers where IPv6
 is as fast or faster than IPv4 (within 1ms): 73.4%”*
 - Supports broadband users when CGN/LSN is deployed to handle IPv4 exhaustion as the IPv6 path is native

- The right thing to do!



Registered domains with AAAA records per TLD

- Review of “Top Level Domains with IPv6 support” section
 - See <http://bgp.he.net/ipv6-progress-report.cgi> (data for June 20 2011)
- Top 15 TLDs reviewed:
 - Very low percentage use IPv6 glue

- Improving over time!

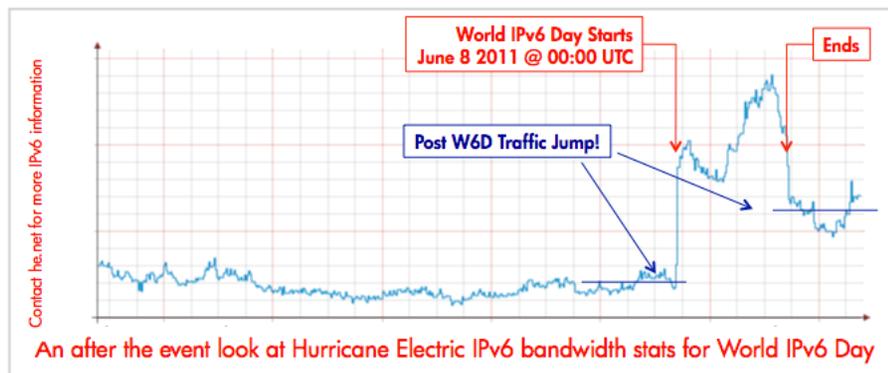
TLD	domains	A	AAAA	A-glue	AAAA-glue
net	13976531	11965948	242776	417895	2150
com	95436429	85265888	1553422	1840517	1737
org	9234523	8096883	150322	280990	1111
info	7860428	6442314	152549	369324	475
de	13155766	11093273	1747117	398186	114
us	1681222	1462186	32233	15570	79
asia	187407	134958	5498	2708	58
mobi	1015426	789050	29844	4820	54
biz	2100696	1773828	45809	21826	34
bg	24721	18819	39	1858	20
ca	1420247	1077088	6020	16053	17
lk	7893	5684	4	13314	16
arpa	9	0	0	12	12
tel	295826	260769	0	337	10
sk	237361	196887	12556	3466	10



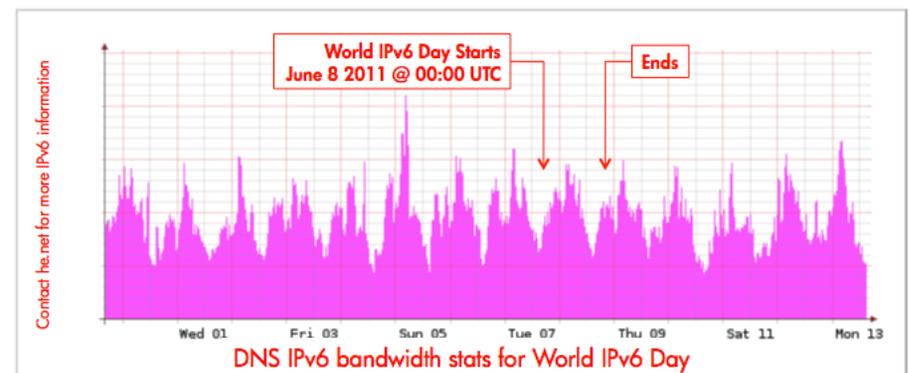
World IPv6 Day and IPv6 DNS traffic

- World IPv6 Day was about enabling web-based traffic for IPv6
 - Should not have any affect on levels of DNS traffic
- Overall DNS (port 53) traffic didn't change during W6D
 - Reverse-DNS lookups for IPv6 addresses did increase
 - See Geoff Huston presentation @ NANOG 52 Denver

WEB



DNS



Summary

- IPv6 within DNS system is well tried-and-tested
- IPv6 is required to support end sites where IPv4 exhaustion exists
- IPv6 is not complex; just needs some focus-time and education
- IPv6 record rules are well documented





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