HURRICANE ELECTRIC
INTERNET SERVICES

IPv6 World View and World IPv6 Day
– A global view of IPv6 commercial readiness

Hurricane Electric
IPv6 Native Backbone – Massive Peering!

"The path from newbie to rock star"

RIPE Regional Dubrovnik 2011 – IPv6 Panel

Dubrovnik, Croatia – 8th September 2011

Martin J. Levy, Director IPv6 Strategy
Hurricane Electric

W6D and the readiness of IPv6 backbones

NATIVE **IPv6** EVERYWHERE

- **Agenda**

  - ❑ Is the IPv6 global Internet ready for real work?

  - ❑ World IPv6 Day (W6D) and it's global traffic
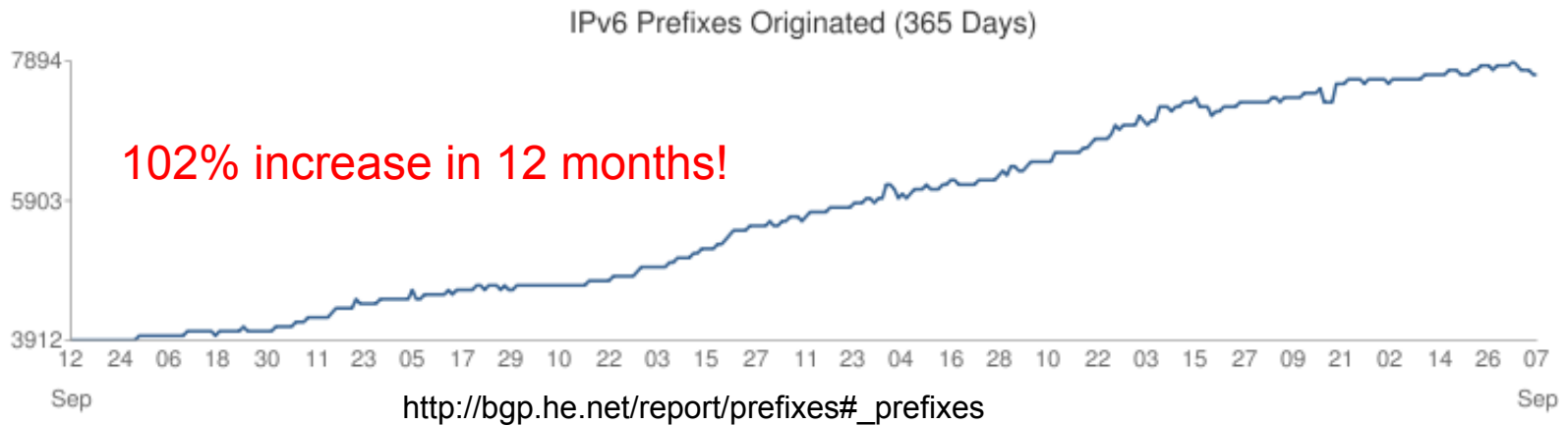
  - ❑ Motivating people to enable IPv6

  - ❑ Summary

Does IPv6 have global coverage?

(Is the IPv6 routing table ready for real world use?)

Is IPv6 routing/interconnect/peering prevalent?

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IPv6 Prefixes Originated (365 Days)

102% increase in 12 months!

http://bgp.he.net/report/prefixes#_prefixes

ASN's with IPv6 Announcements (365 Days)

80% increase in 12 months!

http://bgp.he.net/report/prefixes#_networks

IPv6 measured at via BGP ASNs with IPv6

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: Wed Sep 7 01:06:58 PDT 2011

IPv4 Ases: 38,889
IPv6 ASes: 4,592
ASes using only IPv4: 34,394
ASes using only IPv6: 97
ASes using IPv4 and IPv6: 4,495
ASes using IPv4 or IPv6: 38,986
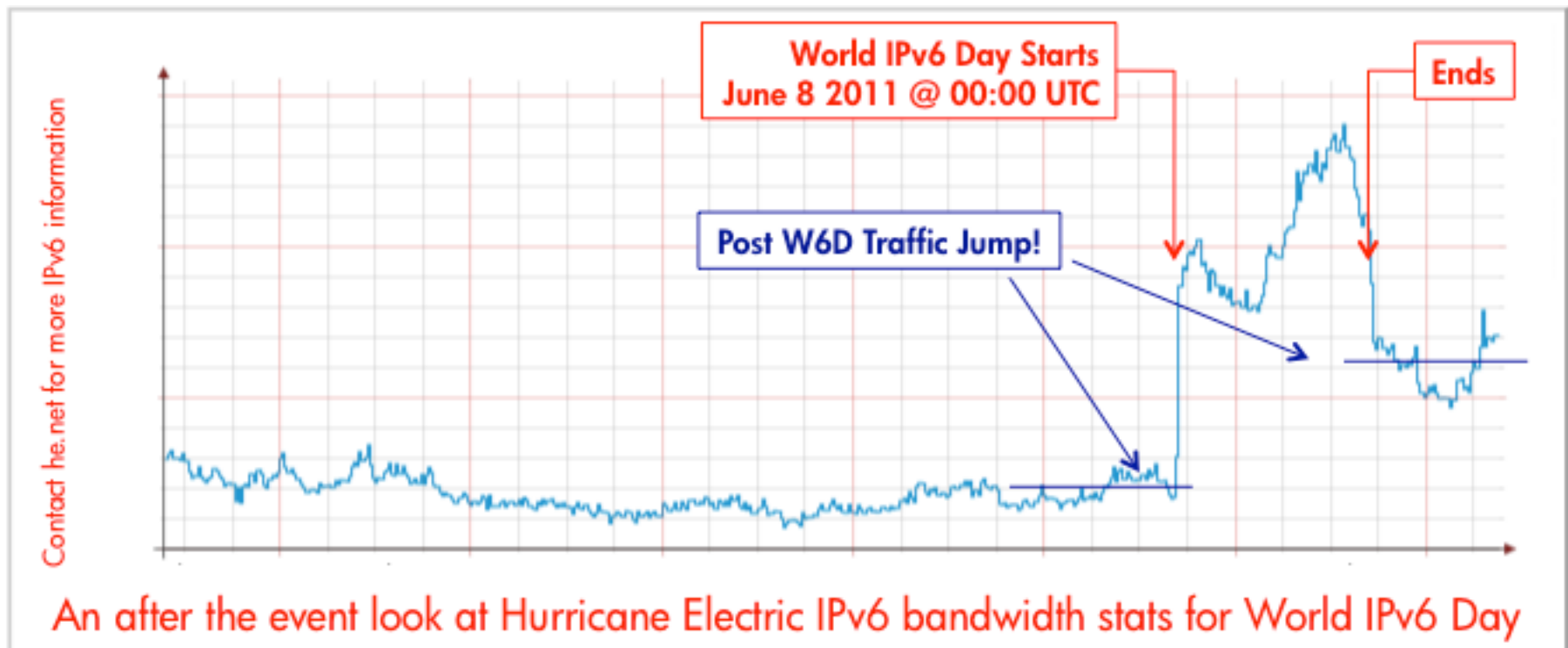Percentage of ASes (IPv4 or IPv6) running IPv6: 11.8%

11.8%

3.6%

Percentage of ASNs running v6

W6D

IANA Runout

Date

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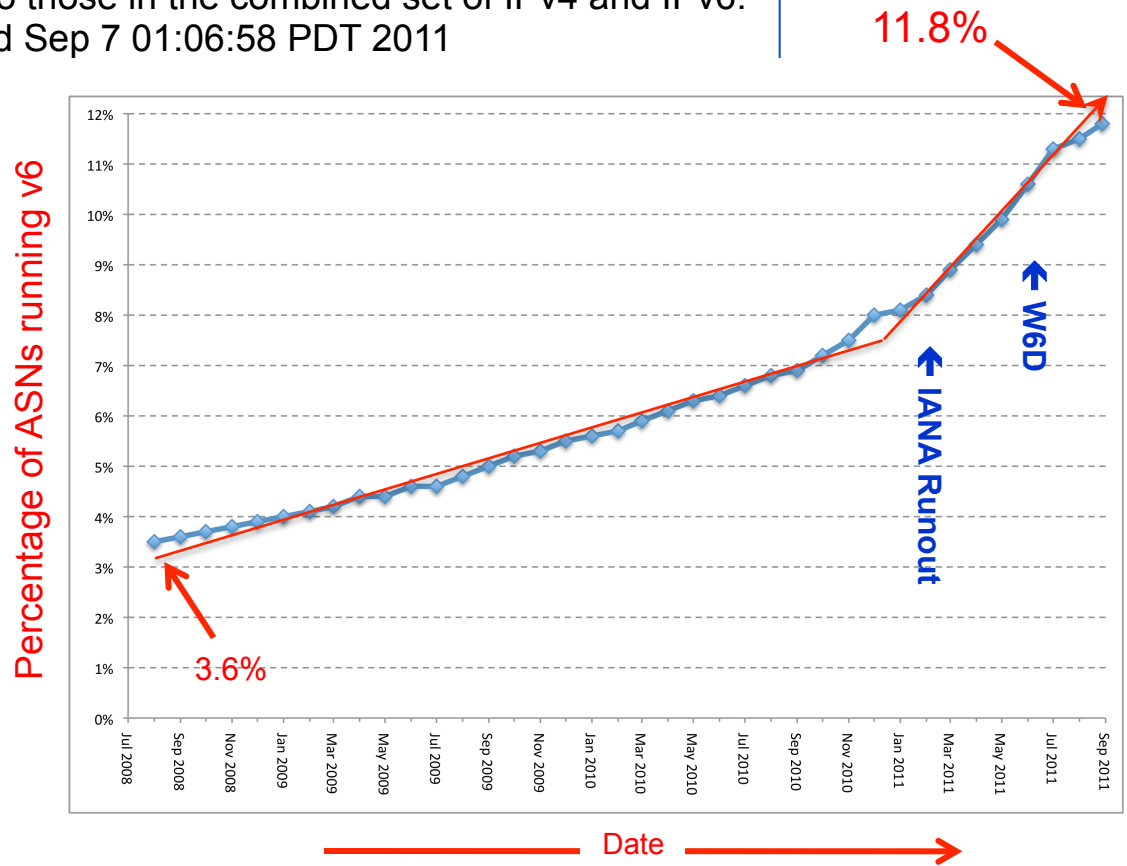
World IPv6 Day

(Not just IPv6 Day, World IPv6 Day)

# World IPv6 Day and real IPv6 traffic

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- World IPv6 Day was about enabling web-based traffic for IPv6
  - Focus on content providers
  - Web (port 80 & 443 TCP traffic) plotted below

Contact he.net for more IPv6 information

World IPv6 Day Starts June 8 2011 @ 00:00 UTC

Ends

Post W6D Traffic Jump!

An after the event look at Hurricane Electric IPv6 bandwidth stats for World IPv6 Day

World IPv6 Day and real IPv6 traffic

- **Long term win since W6D in IPv6 traffic levels**
    - That means there are both content and eyeballs in play

An after the event look at Hurricane Electric IPv6 bandwidth stats for World IPv6 Day
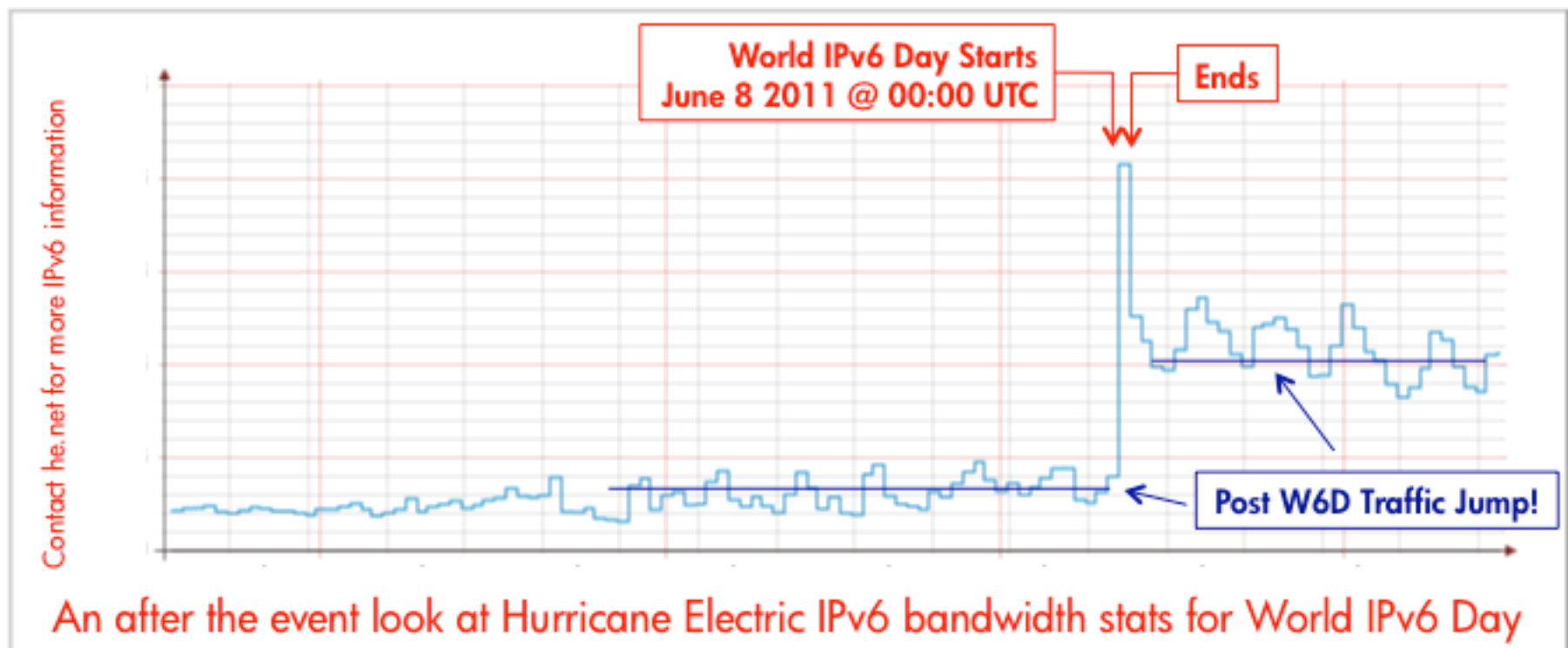
Hurricane Electric W6D and translation traffic

- **Yes – there is 6to4 traffic**
  - Lots of traffic on Hurricane Electric's backbone!
- **Measured on the largest 6to4 global deployment (with Teredo included)**
  - AMS ASH CHI FMT FRA HKG LAX LON MIA NYC PAO PAR SEA SIN SJC STO TYO

6to4 IPv6 bandwidth stats for World IPv6 Day
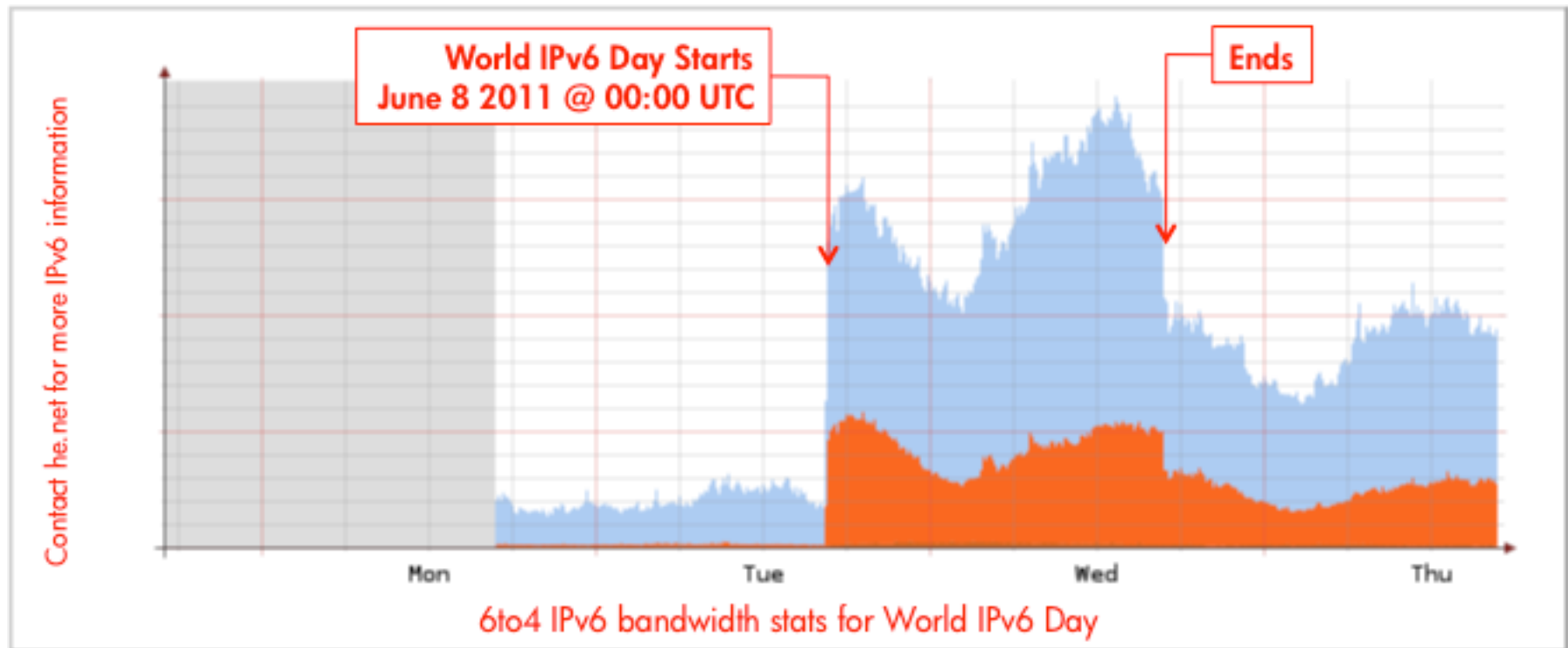
IPv6 measured on the Alexa 1m list

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

Top Websites Running IPv6
A very quick way to measure IPv6 deployment for websites is just to check for a AAAA record in DNS.
Alexa Top 1 Million Domains Downloaded:
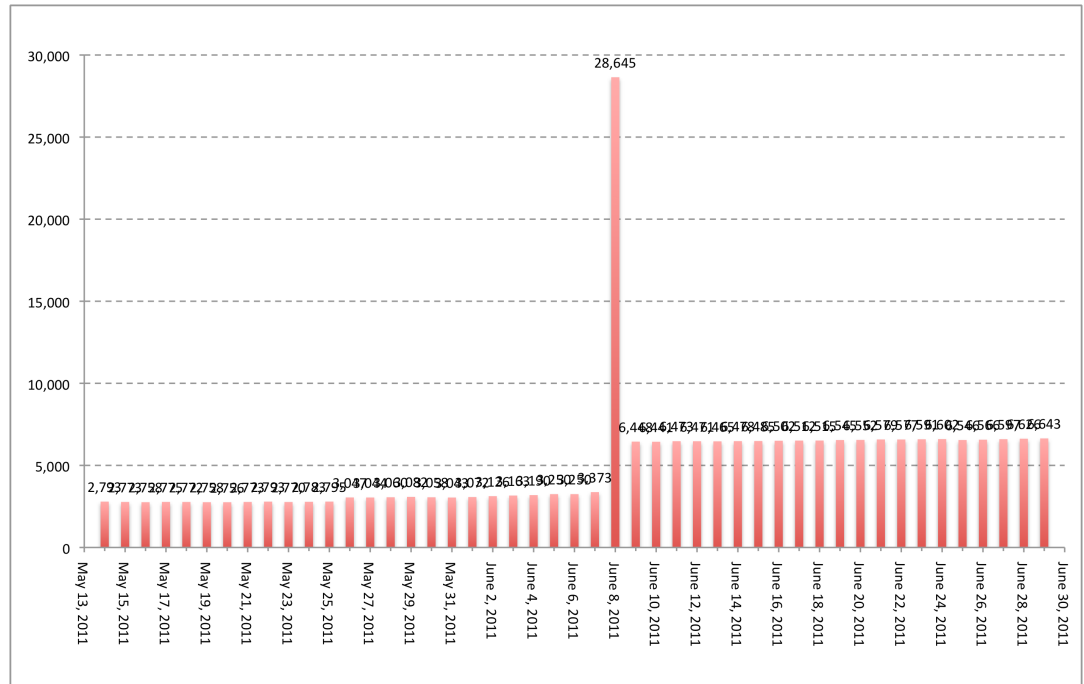Sun Aug 28 00:00:05 2011
Alexa Top 1 Million Domains Processed
Sun Aug 28 00:37:44 2011

Alexa 1M raw domains:
1000000
Alexa 1M raw with a direct IPv4 address: 942156
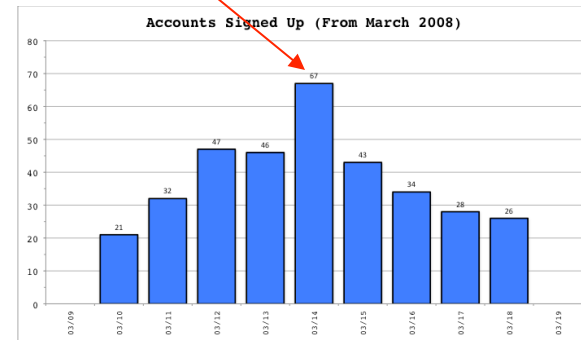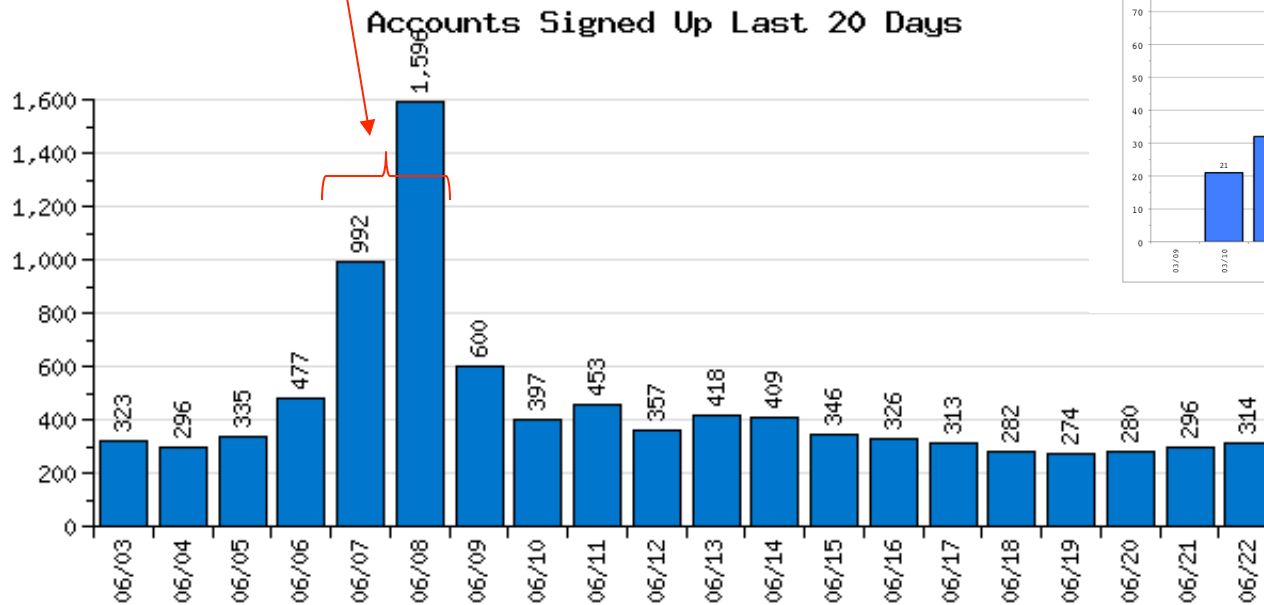Alexa 1M raw with a direct IPv6 address: 9595

Date

World IPv6 Day – tunnelbroker.net users

June 7th 2011 / June 8th 2011
A large jump in new accounts
(shows a great interest in IPv6 on W6D)

Smaller effect
March 2008

Accounts Signed Up Last 20 Days

Accounts Signed Up (From March 2008)

Hurricane Electric W6D – Observed issues

- **PMTU & ICMP6 blocking**
  - Heard again and again all over the net
  - Enabling IPv6 (for the first time) with too-aggressive filtering

- **Two failure modes**
  - Pre W6D testing – normally on "ipv6.example.com"
  - During W6D – affected "www.example.com"

- **Trigger points?**
  - Testing from Teredo or 6to4 enabled end-nodes
  - Real-world tunnels

- **ICMP6 re-explained**
  - Teredo requires end-node to respond to a ping to initiate protocol
  - This breaks classic enterprise firewall/filter setups
 - Consensus is that elements ahead of server perform this function

NATIVE **IPv6**
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Hurricane Electric's Free
IPv6 Certification Program

http://ipv6.he.net/certification/
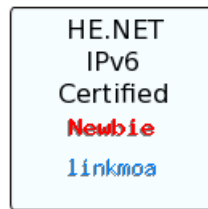
Hurricane Electric – IPv6 Certification (learning?)

- Prove that you have IPv6 connectivity
- Prove that you have a working IPv6 web server
- Prove that you have a working IPv6 email address
- Prove that you have working forward IPv6 DNS
- Prove that you have working reverse IPv6 DNS for your mail server
- Prove that you have name servers with IPv6 addresses that can respond to queries via IPv6
- Prove your knowledge of IPv6 technologies through quick and easy testing

- the format of IPv6 addresses
- AAAA records
- reverse DNS for IPv6
- the IPv6 localhost address
- the IPv6 default route
- the IPv6 documentation prefix
- the IPv6 link local prefix
- the IPv6 multicast prefix
- do an IPv6 ping
- do an IPv6 traceroute
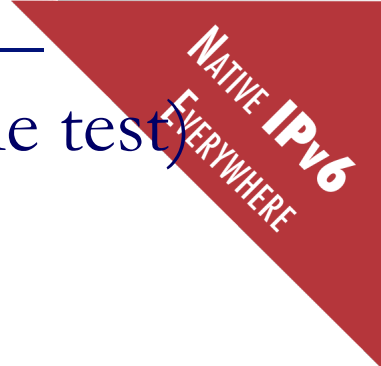- common IPv6 prefix
- and more!

http://ipv6.he.net/certification/
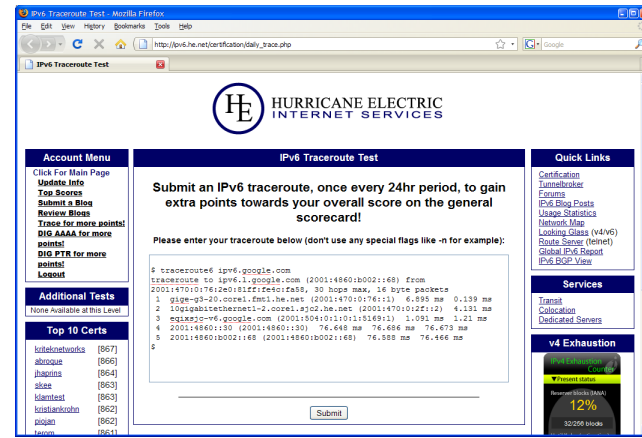
36,500++ Certifications!

Hurricane Electric – IPv6 Certification (sample test)

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http://ipv6.he.net/certification/

The test – to send and receive IPv6 emails

Administrator

Congratulations, you are an IPv6 Enthusiast! The next step after geting your website online is to make it so you can receive email via IPv6. What you will need is:

- An IPv6 enabled mail system
- Note: If you have "Greylisting" enabled, either whitelist ipv6@he.net or: send, wait for your greylist timer to expire and then reset and send again. We are working on a better solution to this issue.

[Reset Test]

Step	Description	Data	
1	Generate a New User Code		Generated
2	Tell us what your IPv6 capable email address is (Including the domain):	[ ]	
3	Schedule a test, and we will email you your new User Code		(Send It!)
4	Tell us what the code was:	[ ]	(->)

Hurricane Electric – IPv6 Certification Levels

Newbie Test
> This is a basic level test of the information here. With this primer at hand these questions should be a snap for you.

Enthusiast Test
> This test validates that you have an IPv6 capable machine setup that can browse the web via IPv6, as well as the fact that you have a web server setup that can serve files via IPv6.

Administrator Test
> This test validates that your SMTP server is able to accept mail over IPv6

Professional Test
> This test validates that Reverse DNS for the IPv6 address of your SMTP server is properly configured.

Guru Test
> This test validates that your nameservers have AAAA records for themselves and that these nameservers can be queried over IPv6 for your domain.

Enthusiast Questionnaire
> These are a few questions to gauge interest and usage level for IPv6 and gather data as to your experiences with IPv6 deployments.

Administrator Questionnaire
> These are a few questions to gauge interest and usage level for IPv6 and gather data as to your experiences with IPv6 deployments.

Professional Questionnaire
> These are a few questions to gauge interest and usage level for IPv6 and gather data as to your experiences with IPv6 deployments.

Guru Questionnaire
> These are a few questions to try to gauge interest and usage level for IPv6 and gather data as to your experiences with IPv6 deployments.

Enthusiast Technical Test
> This test covers technical knowledge of ping and traceroute commands on Linux and Windows.

Administrator Technical Test
> This test covers technical knowledge of DNS and general IPv6 topics.

Professional Technical Test
> This test covers technical knowledge of well known IPv6 prefixes and expands on your understanding of IPv6 related Linux and Windows commands.

Guru Technical Test
> This test covers technical knowledge of IPv6 routing and IPv6 related protocols.

Explorer Test
> This test validates that you have Native or Tunneled IPv6.

Sage Test
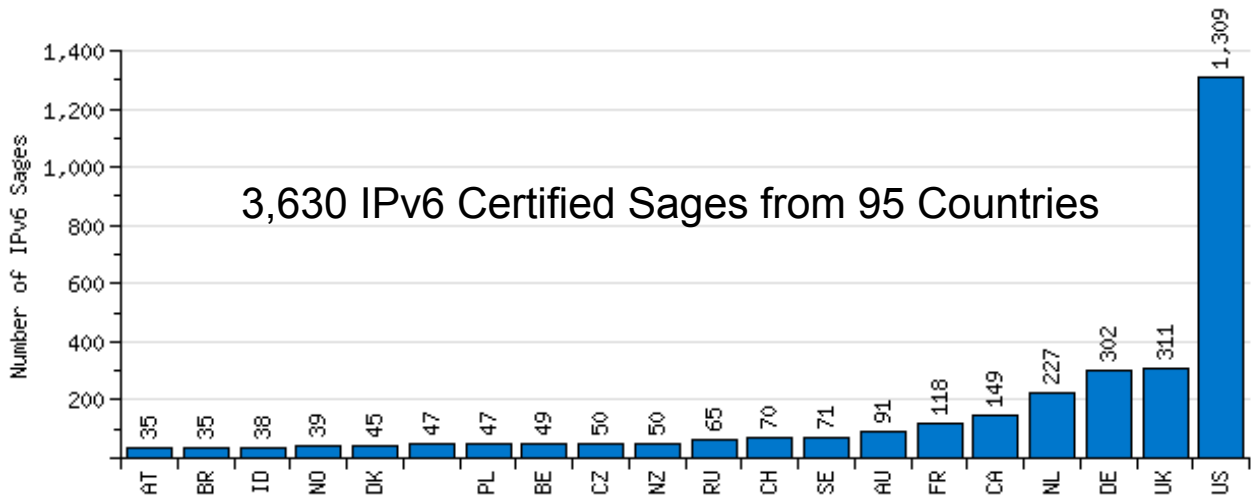> This test validates that you have IPv6 Glue at your registrar

NATIVE IPv6
EVERYWHERE

EU (European Union)	1,474
United States	1,309

Europe	1,684
North America	1,471
South America	61
Asia	207
Africa	16
Oceania	155
Unknown	36
TOTAL	**3,630**

Sage level is the highest level obtainable.

Top 20 IPv6 Sage Countries

3,630 IPv6 Certified Sages from 95 Countries

Country	Number of IPv6 Sages
AT	35
BR	35
ID	38
NO	39
DK	45
PL	47
BE	47
CZ	49
NZ	50
RU	50
CH	65
SE	70
AU	71
FR	91
CA	118
NL	149
DE	227
UK	302
US	311
	1,309

http://tunnelbroker.net/usage/sages_by_country_and_state.php

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IPv6 Certification (on a lighter note) …

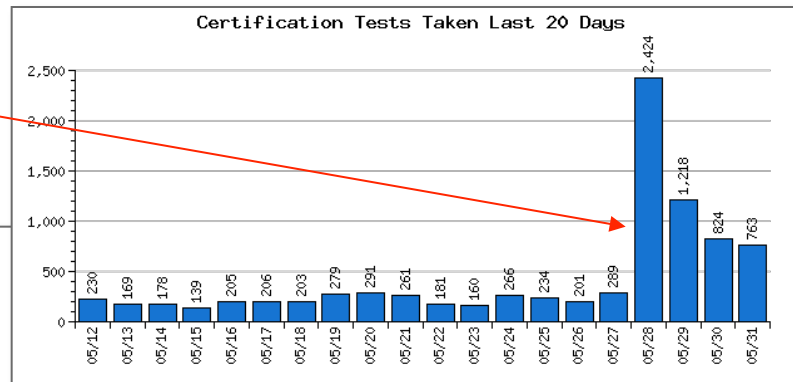# Motivating people to think about IPv6

… maybe t-shirts will help?

Hurricane Electric – IPv6 and t-shirts?

Hurricane Electric sends email saying "free IPv6 t-shirt" for sage-level users

Certification Tests Taken Last 20 Days

From: <ipv6@he.net>
Date: Thu, May 27, 2010 at 11:32 PM
Subject: Hurricane Electric IPv6 Update

…
* Attention Sages!

Hurricane Electric would like to send you an "IPv6" T-shirt!

Please log into http://ipv6.he.net/certification/, and verify your address information which will only be used for shipping out this T-shirt.

After making certain it is correct (remember to click "Update Info" if you made changes, before validating), you will see T-shirt size selections for S/M/L/XL/XXL, and a button that will submit your preferred shirt size and log that you have validated your address.

This is optional, and will only be sent to validated addresses.

We'll be adding on some points to your score for Sages that want to get a T-shirt!

We are looking to get the t-shirts out around the end of June. We need make sure to get enough of each size before sending them out to all of you. …

Hurricane Electric

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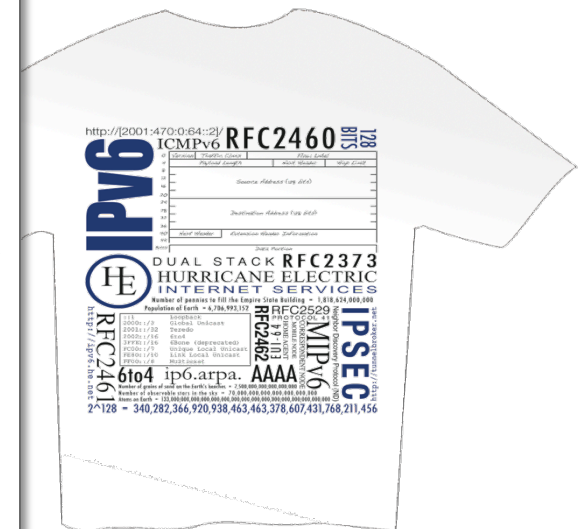
Final thought …

Summary – Have a positive IPv6 mindset

Q&A

?
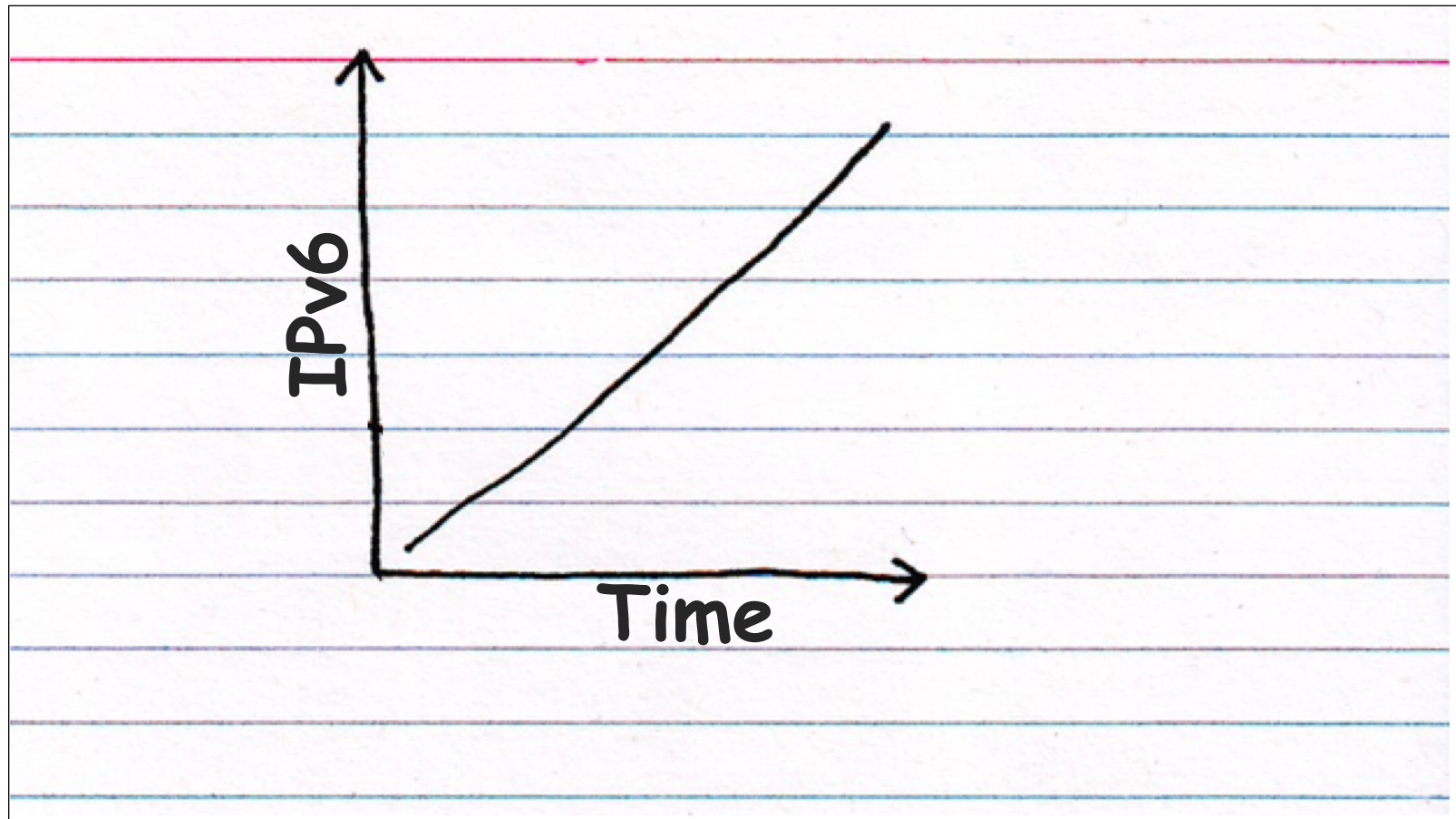
Every Day is v6 Day at Hurricane Electric

Contact:

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Support slides …

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Hurricane Electric – Roots and History

NATIVE IPv6 EVERYWHERE

- Founded 17+ years ago - ISP & datacenter operator

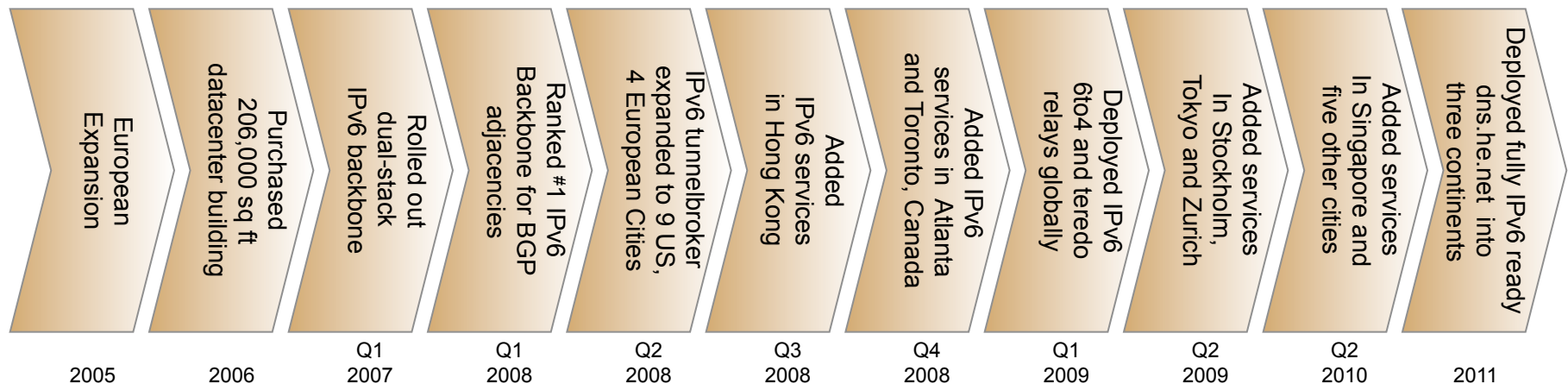 - 1994 – Roots within the Silicon Valley high-tech community
  - 1999 – Expanded IPv4 network nationwide in the US
  - 2001 – Started IPv6 native and tunnel connectivity (http://tunnelbroker.net)
  - 2006 – Full "technology refresh" enabled native dual-stack IPv6 backbone
  - 2008 – Became largest IPv6 backbone globally (> 1Gbps IPv6 traffic level)

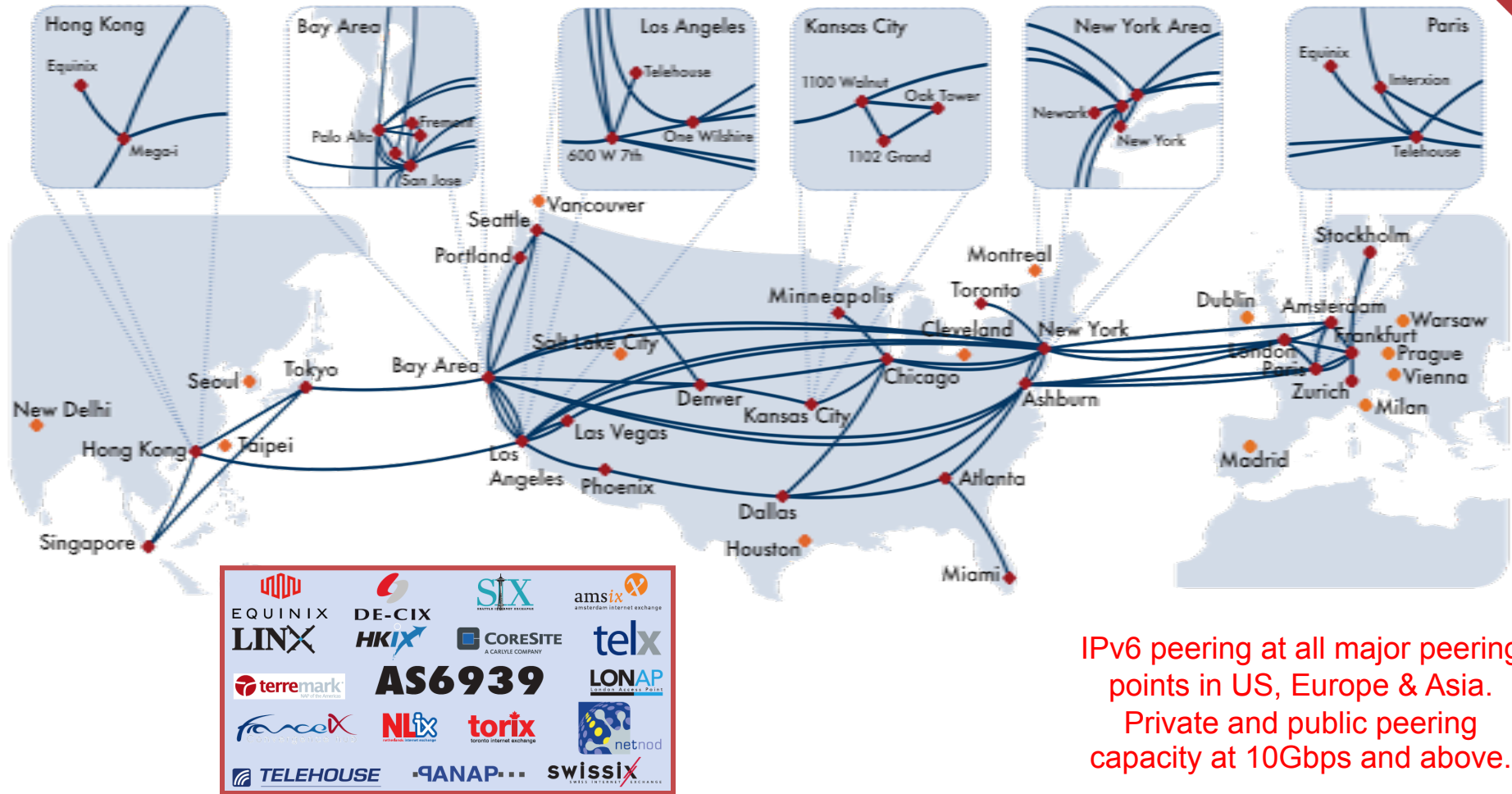| European Expansion	Purchased 206,000 sq ft datacenter building	Rolled out dual-stack IPv6 backbone	Ranked #1 IPv6 Backbone for BGP adjacencies	IPv6 tunnelbroker expanded to 9 US, 4 European Cities	Added IPv6 services in Hong Kong	Added IPv6 services in Atlanta and Toronto, Canada	Added IPv6 6to4 and teredo relays globally	Deployed IPv6 In Stockholm, Tokyo and Zurich	Added services In Singapore and five other cities	Added services In three continents	Deployed fully IPv6 ready dns.he.net into
2005	2006	Q1 2007	Q1 2008	Q2 2008	Q3 2008	Q4 2008	Q1 2009	Q2 2009	Q2 2010		2011

  - 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 – IPv6 Network Reach

All Hurricane Electric POPs are full IPv6 Native routing and peering

Hong Kong
- Equinix
- Mega-i

Bay Area
- Palo Alto
- Fremont
- San Jose

Los Angeles
- Telehouse
- 600 W 7th
- One Wilshire

Kansas City
- 1100 Walnut
- Oak Tower
- 1102 Grand

New York Area
- Newark
- New York

Paris
- Equinix
- Interxion
- Telehouse

IPv6 peering at all major peering points in US, Europe & Asia. Private and public peering capacity at 10Gbps and above.

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