World IPv6 Day - What did we learn?

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NMRG session
RIPE NCC Measurements - World IPv6 Day

• IPv6 Eyechart and 6to4 (not in this talk)

• Active measurements
  - Sources: 40 vantage points (RIPE TTM, CAIDA Ark, ...)
  - Destinations: 53 participant or already dual-stacked sites
  - From 2011-06-01 to 2011-06-11 we measured
    - DNS: A and/or AAAA records
    - ping(6)/traceroute(6)
    - HTTP over IPv4 and IPv6
Measurement vantage points
Lesson: Control
When did World IPv6 Day start?

- Less then 2 days before World IPv6 Day:

![Graph showing DNS negative caching for websites participating in World IPv6 Day]

- Minimum of: minimum TTL in SOA, TTL of SOA
Percentage of vantage points seeing AAAA

v6day

A10 Networks
AOL 1
AOL 3
Akamai
ATT 2
BBN Technologies
cisco.com
CNN
Ericsson
Facebook
Huawei
Internet2
Juniper
Level 3 Communications
Linux Club Zogno Italy
Microsoft Bing
Microsoft Xbox
Mozilla
Spil Games 1
Sprint
T-online
US Department of Commerce
XO Communications
Yahoo
www.miniclip.com
Google
Youtube

Legend:
- 0%
- 0%-10%
- 10%-20%
- 20%-80%
- 80%-90%
- 90%-100%
- 100%
Percentage of vantage points seeing AAAA

Negative caching

v6day
Percentage of vantage points seeing AAAA
Control - lessons learned

• Know your on/off switch
  – Control your DNS

• Set low TTL in case of roll-back

• Set low negative TTL
  – By means of minTTL in SOA / TTL of SOA
Lesson:
Test and monitor
You don’t want this to happen

On IPv4:

On IPv6:

Not Found

HTTP Error 404. The requested resource is not found.
Comparing DNS, ping and HTTP IPv6 measurements to www.commerce.gov from 2011-06-09 0:00 UTC to 2011-06-10 12:00 UTC

- % AAAA queries returning an IPv6 address
- % HTTP responses == 200
- % ICMPv6 ping success
Comparing DNS, ping and HTTP IPv6 measurements to www.commerce.gov from 2011-06-09 0:00 UTC to 2011-06-10 12:00 UTC

% AAAA queries returning an IPv6 address
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v6 on www turned off at end of v6day
Comparing DNS, ping and HTTP IPv6 measurements to www.commerce.gov from 2011-06-09 0:00 UTC to 2011-06-10 12:00 UTC

- % AAAA queries returning an IPv6 address
- % HTTP responses == 200
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During this period:
- v6 on www turned off at end of v6day
- but v6 service still announced
Partial Reachability

- Internet is a collection of interconnecting networks, and can be different on IPv4/IPv6
- For some of our vantage points, not all destinations were reachable
  - Are our vantage points representative?
  - Network partitioning, examples we encountered:
    - Level3 - Hurricane Electric
    - Cogent - Hurricane Electric
Case: Content-NAT Issue (1)

IPv6 proxy

Admin domain

single IPv4 address

IPv4 webserver

Admin domain

per srcIP rate limiting

clients
Case: Content-NAT Issue (2)

• Combine
  – v6-to-v4 proxy, srcNAT to single IPv4 address
  – Webserver with per-source IP rate-limiting

• Hard to catch if not tested under real-life load

• Violating e2e principle can make solutions brittle

• Solution: Keep it simple (no NAT!)
Test and monitor - lessons learned

• Test when deploying something
  - The more real-life, the less likely you !@#$-ed up

• Monitor your infrastructure

• People2people reachability
  - Avoidable situations like Level3 and Dept. Commerce
  - Contact info up to date in RIR databases (whois)
  - Monitor the web (NANOG, Twitter, ...)
Global view
Performance of src/dst pairs on 2011-06-08

- Bell-shaped
  - with fatter IPv4-side
- Dual-stack = two chances for best performance!
  - Real-time apps can exploit this
    - voice
    - gaming
Long term effects - Content

Percentage of web sites in Alexa 1M that can be reached over IPv6

Alexa 1M
Alexa top 25k

Raw data: Dan Wing
(http://banjo.employees.org/~dwing/aaaa-stats.html)
Long term effects - Content

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- Alexa top 25k

8 June: 3.8%
Pre/post 8 June: 0.4% -> 0.7%

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Long term effects - Content

Percentage of web sites in Alexa 1M that can be reached over IPv6

- 8 June: 3.8%
- Pre/post 8 June: 0.4% -> 0.7%
- Around 3 July: 0.7% -> 1.0%
  (Single hoster in DE)

Raw data: Dan Wing

(http://banjo.employees.org/~dwing/aaaa-stats.html)
Long term effects - Content

• Linear extrapolation:
  \(-\) ~ an IPv6 year needed to get to 100%

• Exponential extrapolation:
  \(-\) ~ an IPv6 week needed to get to 100%
Long term effects - Content

• Linear extrapolation:
  - ~ an IPv6 year needed to get to 100%

• Exponential extrapolation:
  - ~ an IPv6 week needed to get to 100%

• Note: extrapolation based on two data points is dangerous and can get you lynched :)}
Long term effects - IPv6 ASes

• Higher growth before v6d: Deployments pushed earlier?
• Lower growth after v6d: Summer-vacation?
• http://v6asns.ripe.net
More information

- Web interface to the measurements
  - http://v6day.ripe.net/
- Analysis on RIPE Labs
  - http://labs.ripe.net/ipv6day
- Raw data availability
Conclusions - what we learned

• IPv6/dual-stack works just fine, but make sure that
  - It is properly tested and monitored (like IPv4)
  - Your network can reach all others (like IPv4)
• Dual-stack = Two chances for best performance
• Days like this ‘work’
  - Raise awareness
  - Give people a target to work towards
  - We’re ready for a next IPv6(day|week|month|year|∞)
Questions?