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Business Transformation One Step at a Time

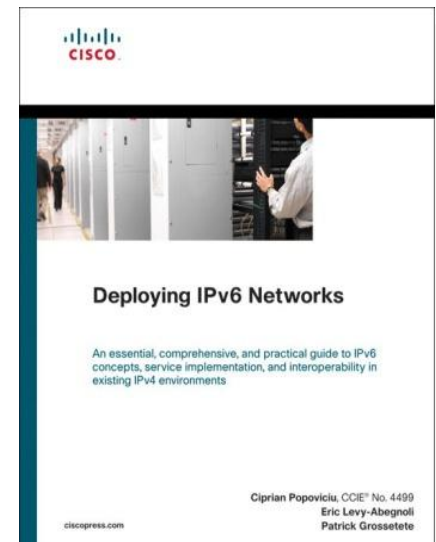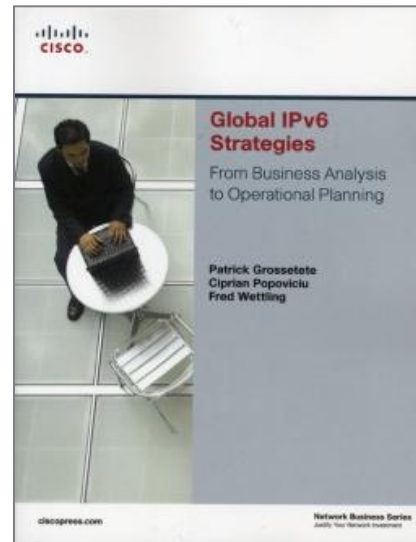# QUANTITATIVE IPV6

Ciprian Popoviciu
President & CEO Nephos6

Standards:
RFC 4779
RFC 5180
RFC 5375
RFC 5741
RFC 6105

Nephos (νέφος) = Cloud, 6 = IPv6

- **Quantitative Perspectives**
- **Operational Data**
- **Data on a Market Vertical**
- **Conclusions**

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1. Quantitative Perspectives

"In God we trust. All others must bring data."

W. E. Deming

Perspectives

Questions We Ask	Data Collection
What is the level of IPv6 adoption?	•IPv6 address assignments •BGP advertisements •Enablement of user access •User access information
What are the IPv6 adoption trends?	•Historical data •Curve fitting •Correlation with other trends (jobs)
What is the level of website IPv6 enablement?	•DNS records •Reachability tests •Advertised offerings
How good is the IPv6 enablement?	•Operational Data

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Adoption Accounting – Interesting Stories

Romania
IPv6 overall deployment: **78.05%**
Detail: **Prefixes : 55.7% | Transit AS : 47.81% | Content : 46.02% | Users : 8.74%**

United States of America
IPv6 overall deployment: **44.79%**
Detail: **Prefixes : 41.88% | Transit AS : 58.66% | Content : 47.08% | Users : 2.46%**

France
IPv6 overall deployment: **62.33%**
Detail: **Prefixes : 46.24% | Transit AS : 68.31% | Content : 48.47% | Users : 5.11%**

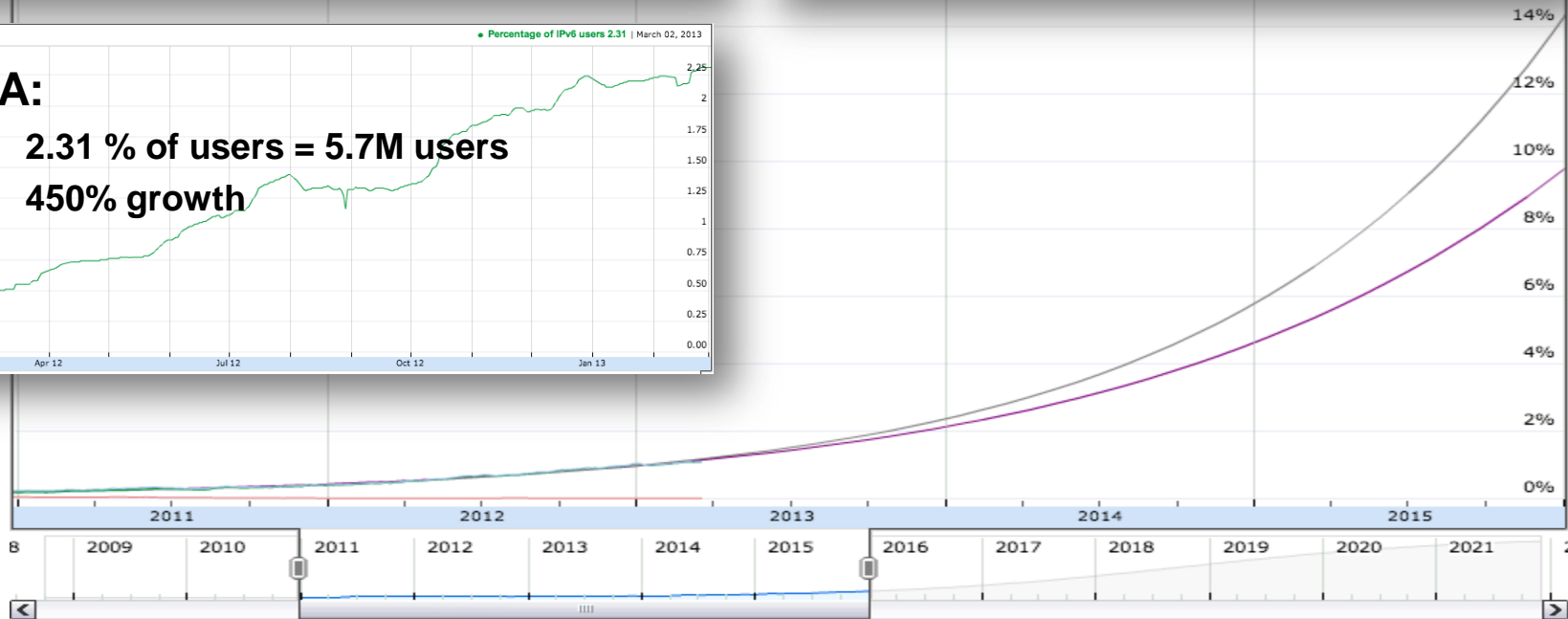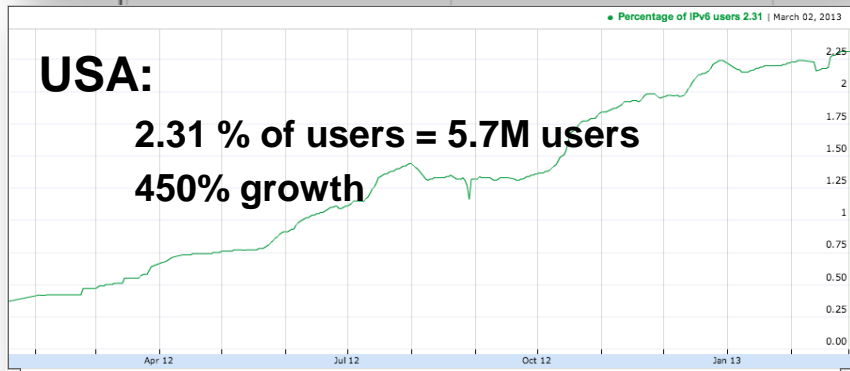**India**
IPv6 overall deployment: **36.61%**
Detail: **Prefixes : 13.96% | Transit AS : 70.43% | Content : 51.94% | Users : 0.24%**

Brazil
IPv6 overall deployment: **28.59%**
Detail: **Prefixes : 18.26% | Transit AS : 34.89% | Content : 52.79% | Users : 0.04%**

Courtesy, Cisco 6lab: http://6lab.cisco.com/stats/

Adoption Trends – Interesting Trends

Germany:
- 1.75% ~ 1M users
- 450% over 6 month !

France:
- 5.3% ~ 2.7M users
- 22% growth

USA:
- 2.31 % of users = 5.7M users
- 450% growth

Adoption Trends – Correlations

Courtesy: http://www.indeed.com

THE FUTURE IS FOREVER
WORLD IPv6 LAUNCH · 6 JUNE 2012

MORE OPERATORS, MORE IPV6 – 2013 OFF TO A FLYING START
Posted on March 26, 2013 by Mat Ford

Czech Republic
% of WEB Pages Available over IPv6: **51.6%** | number of sites: **73 / 500**
Others: **In development/test : 0.63% (9/500)** | **Failing : 6.74% (2/500)** | **N**

United States of America
% of WEB Pages Available over IPv6: **46.56%** | number of sites: **27 / 500**
Others: **In development/test : 1.21% (5/500)** | **Failing : 0.05% (2/500)** | **N**

China
% of WEB Pages Available over IPv6: **6.59%** | number of sites: **11 / 500**
Others: **In development/test : 23.91% (5/500)** | **Failing : 10.82% (2/500)**

India
% of WEB Pages Available over IPv6: **53.96%** | number of sites: **33 / 500**
Others: **In development/test : 0.24% (4/500)** | **Failing : 0.15% (4/500)** | **No**

Brazil
% of WEB Pages Available over IPv6: **55.28%** | number of sites: **66 / 500**
Others: **In development/test : 0.5% (5/500)** | **Failing : 0.26% (2/500)** | **No**

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Operational Data – Where is it?

- What is the performance of the IPv6 infrastructure?

- What is the user experience over IPv6?

- How is performance changing over time?

- What is the geographical perspective on performance?

IPv6 cannot be taken seriously until we start to monitor it

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2. Operational Data

"You cannot manage what you cannot measure."

Bill Hewitt

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What Data Do We Collect?

- Use a global network of agents
- Measure performance for DNS, PING, Connect Time, Full Website download for both IPv4 and IPv6
- Poll every 2 minutes from all agents
- One metric for IPv6 performance: IPv6 Effectiveness

IPv6 Effectiveness = P(Connect over IPv6) * P(Similar UE)

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How Do We Collect the Data?

Good IPv6 Effectiveness

IPv6 Better than IPv4

 http://www.v6sonar.com

Issues – DNS Yahtzee

Frankfurt goes to US
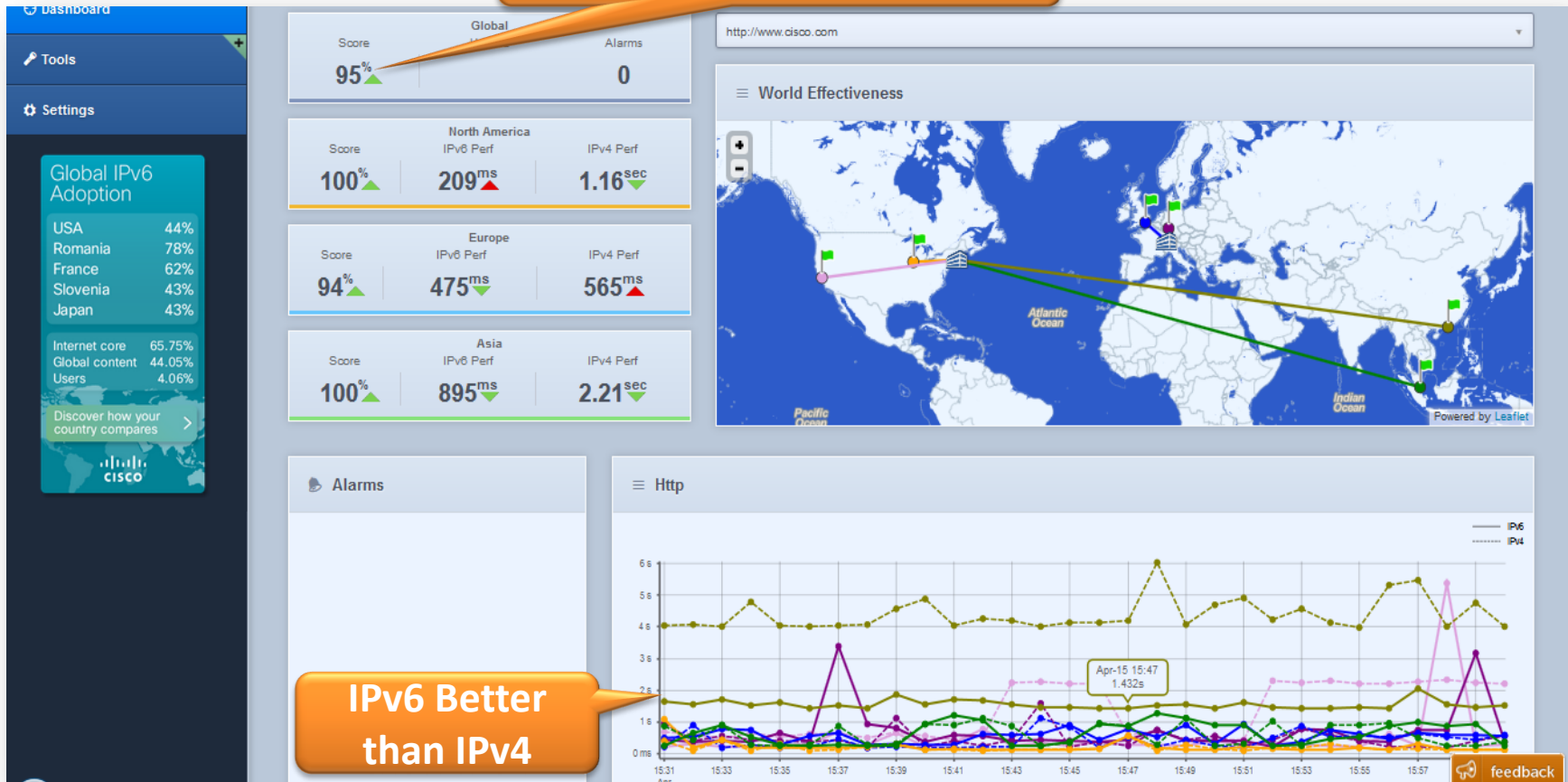
SJ goes to Europe

Issues – Loosing IPv6 Access to Some Resources
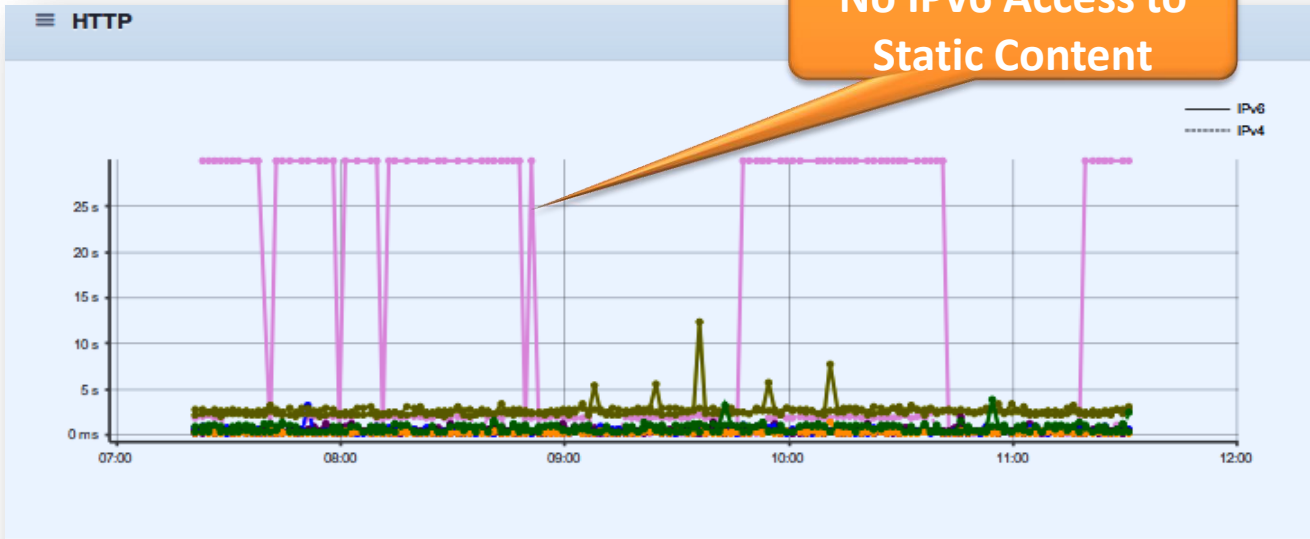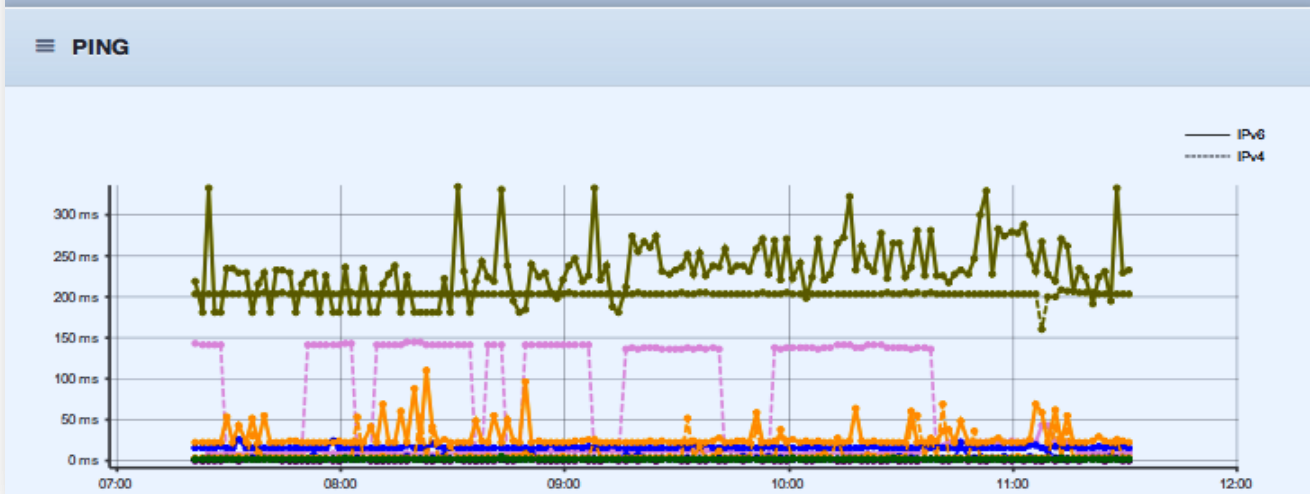
Issues – Hosting and Transport

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Issues – Going Down IPv6 vs IPv6/IPv4

Erratic IPv6 behavior ... for 2 days

25 minutes long outage

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3. Data on a Market Vertical

"If we have data, let's look at data. If all we have, are opinions, let's go with mine."

Jim Barksdale via Alain Fiocco

Federal Space Data

- IPv6 adoption driven by Mandate (OMB 2012)
- IPv6 Enablement tracked
  http://usgv6-deploymon.antd.nist.gov/cgi-bin/generate-gov
- Selected 50 agencies listed "GREEN" for IPv6 enabled web service
- Took 2x 24hours samples

- Detailed IPv6 & DNSSEC Service Interface Statistics for 2013.04.16 -

Domain	Organization	DNS	Mail	Web	DNSSEC
gov.404.	Securities and Exchange Commission	[8] 3/3/3 [O]	[0] 0/0/0 [–]	[3] 0/0/0 [I]	S/V/C
gov.9-11commission.	National Archives and Records Administration	[2] 2/2/2 [O]	[0] 0/0/0 [–]	[1] 0/0/0 [I]	S/V/C
gov.911.	Department of Transportation	[3] 3/0/3 [O]	[0] 0/0/0 [–]	[1] 0/0/0 [I]	S/V/C
gov.911commission.	National Archives and Records Administration	[2] 2/2/2 [O]	[0] 0/0/0 [–]	[1] 0/0/0 [I]	S/V/C
gov.aapi.	Department of Education	[4] 4/0/4 [O]	[0] 0/0/0 [–]	[1] 1/1/1 [O]	S/V/C
gov.abandonedmines.	Department of the Interior	[6] 4/4/4 [O]	[1] 0/0/0 [O]	[1] 0/0/0 [I]	S/V/C
gov.abilityone.	Comm for People Who Are Blind/Severly Disabled	[2] 2/2/2 [O]	[1] 0/0/0 [I]	[1] 0/0/0 [I]	U/-/-
gov.abmc.	American Battle Monuments Commission	[4] 4/0/4 [O]	[1] 0/0/0 [I]	[1] 0/0/0 [I]	U/-/-
gov.access-board-members.	U. S. Access Board	[4] 4/4/4 [O]	[0] 0/0/0 [–]	[1] 0/0/0 [I]	U/-/-
gov.access-board.	U. S. Access Board	[2] 2/2/2 [O]	[1] 0/0/0 [O]	[1] 0/0/0 [I]	U/-/-
gov.acf.	Department of Health And Human Services	[4] 4/4/4 [O]	[0] 0/0/0 [–]	[1] 0/0/0 [O]	S/V/C

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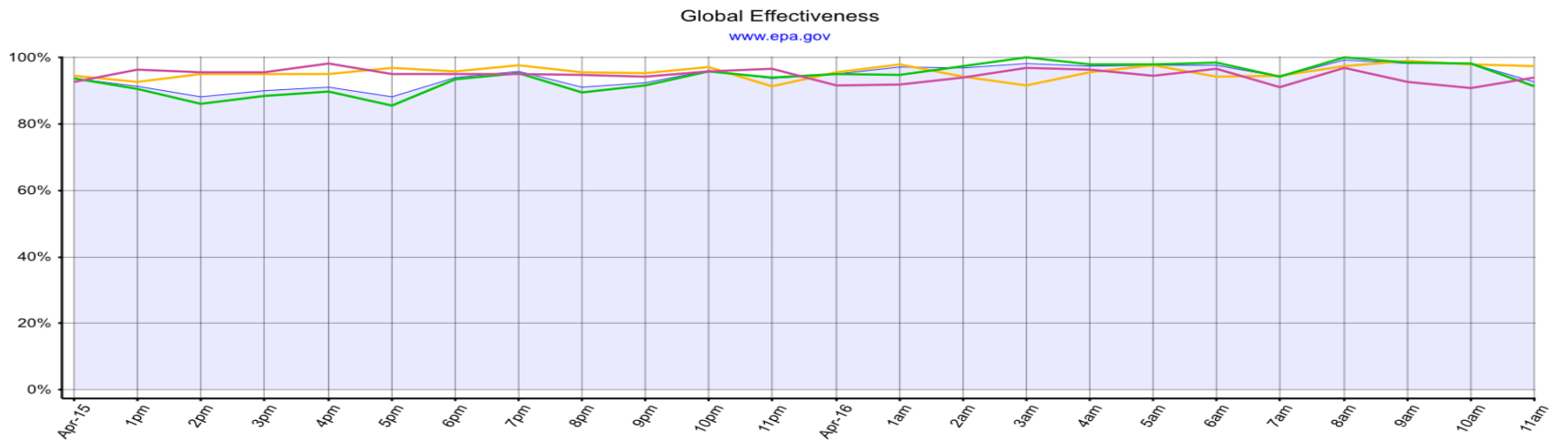# Avg Performance 24 Hours Profile – Very Good

Latency Comparison
www.dren.mil
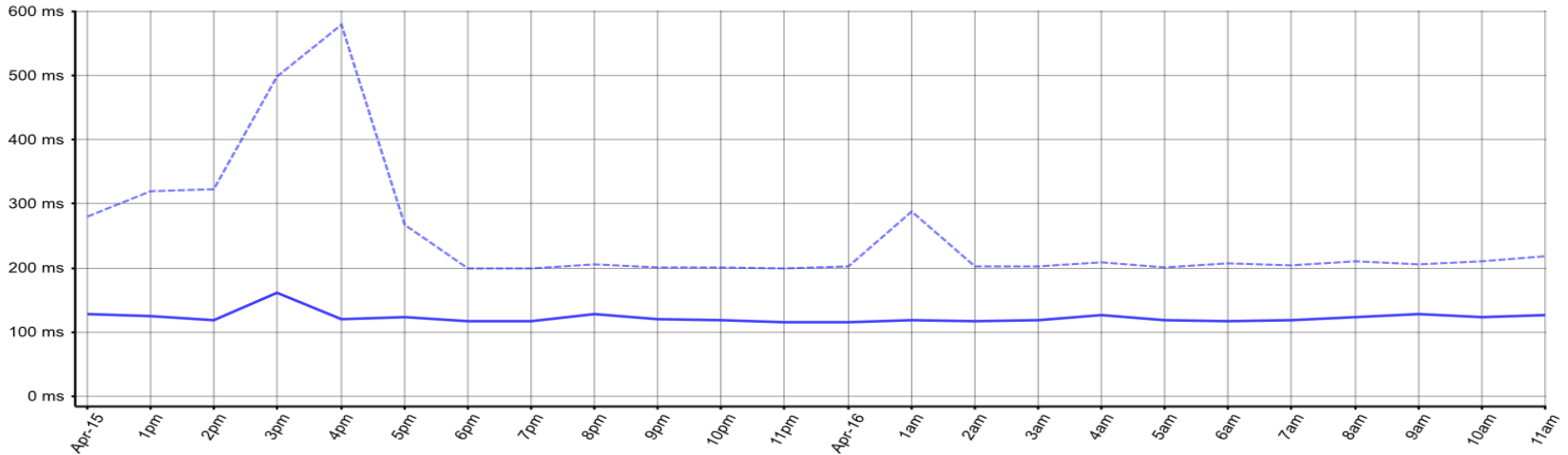
Latency Comparison
www.epa.gov

IPv6   IPv4

IPv6 Effectiveness 24 Hours Profile – Very Good

Global Effectiveness
www.dren.mil

Global Effectiveness
www.epa.gov

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Global   North America   Europe   Asia
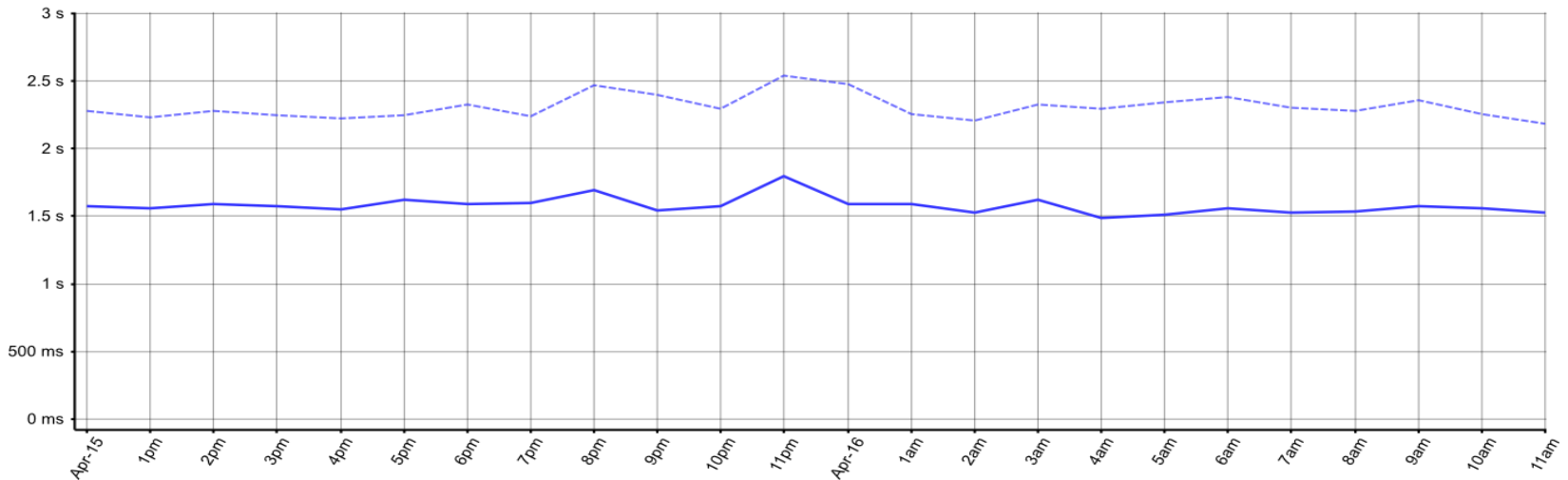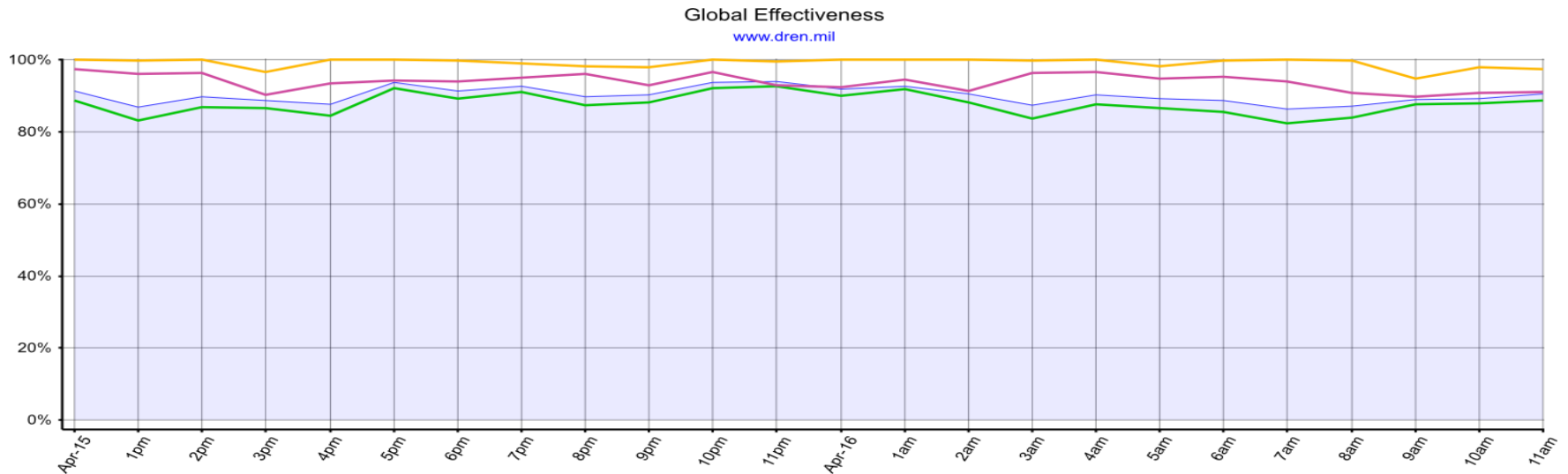
Avg Performance 24 Hours Profile – …

Latency Comparison
www.dol.gov
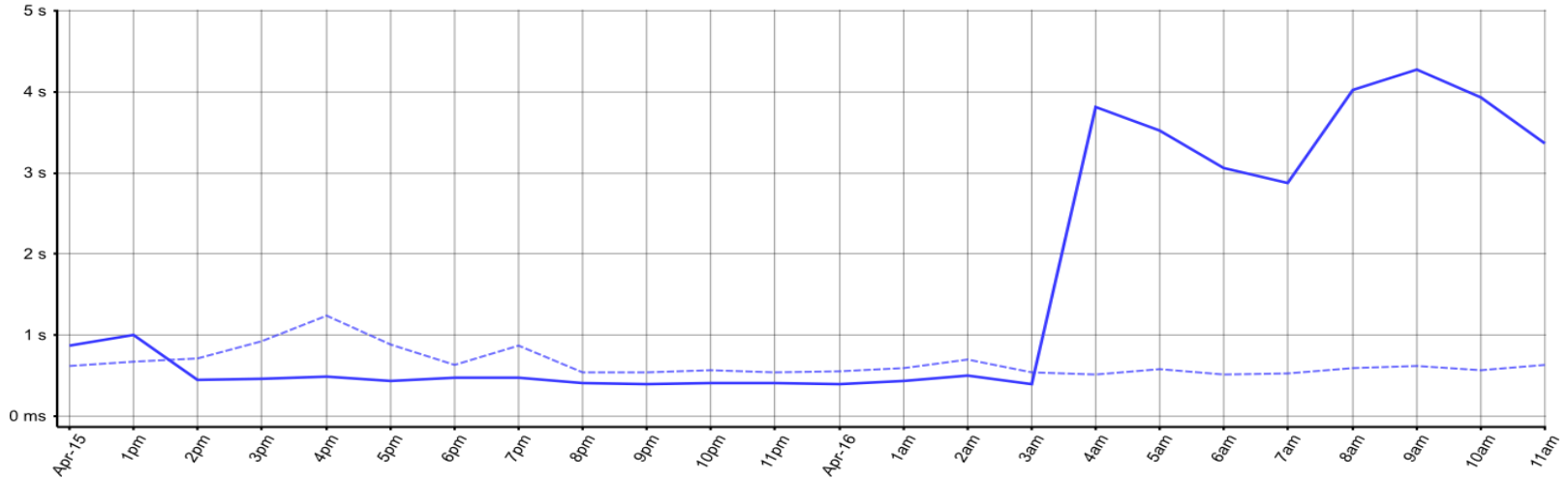
Latency Comparison
www.dhs.gov

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━━ IPv6   ▪▪▪ IPv4
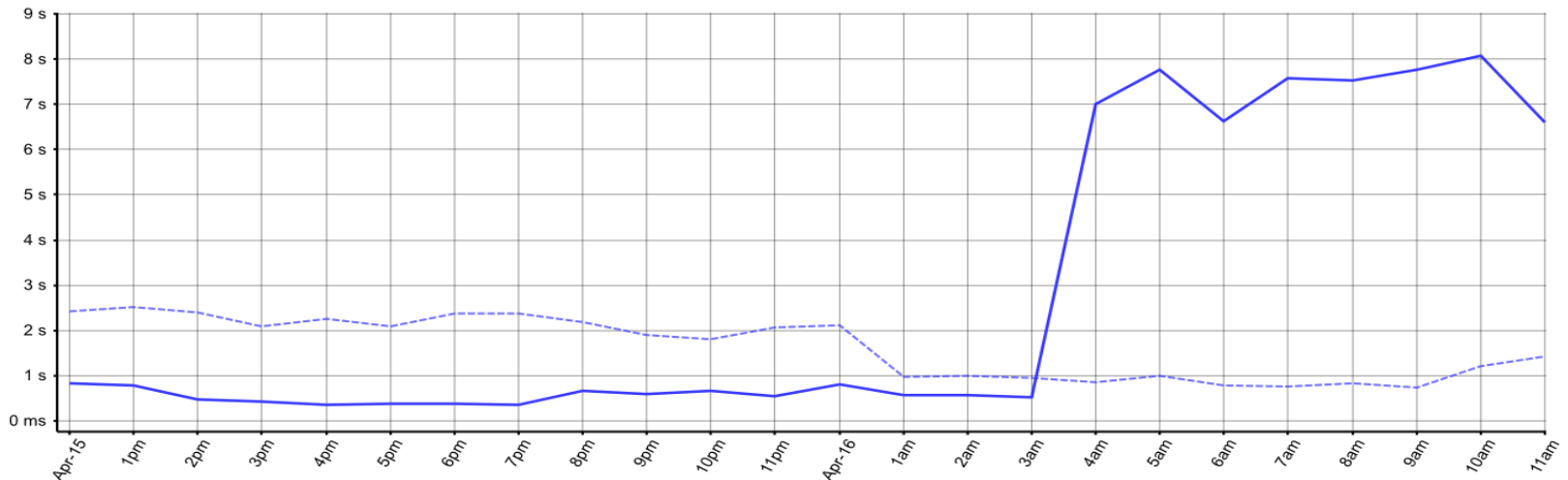
IPv6 Effectiveness 24 Hours Profile – …

Global Effectiveness
www.dol.gov

Global Effectiveness
www.dhs.gov

Global   North America   Europe   Asia
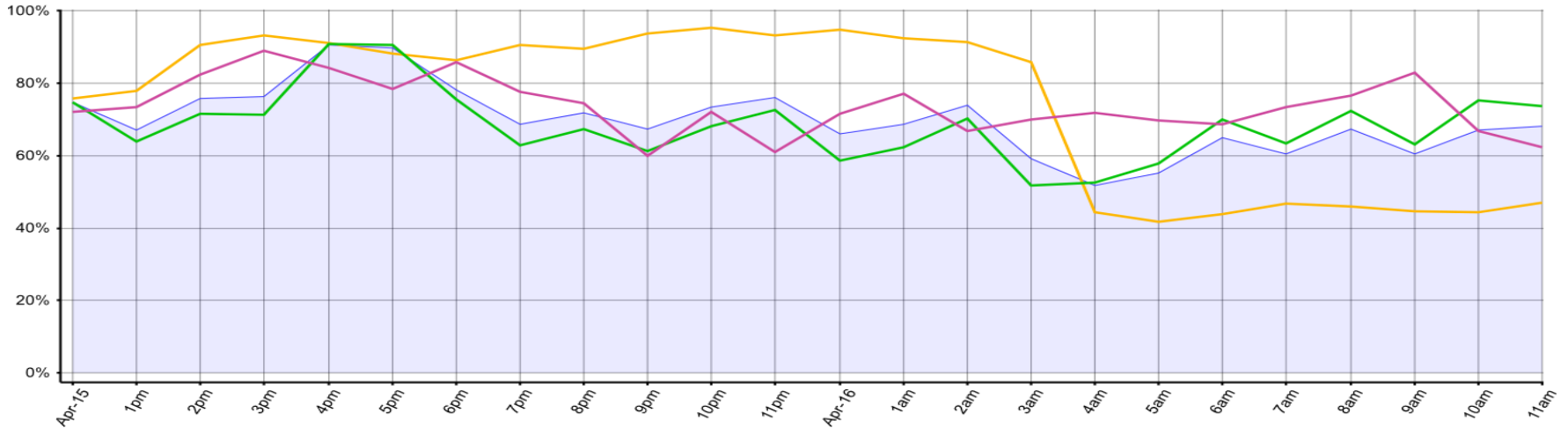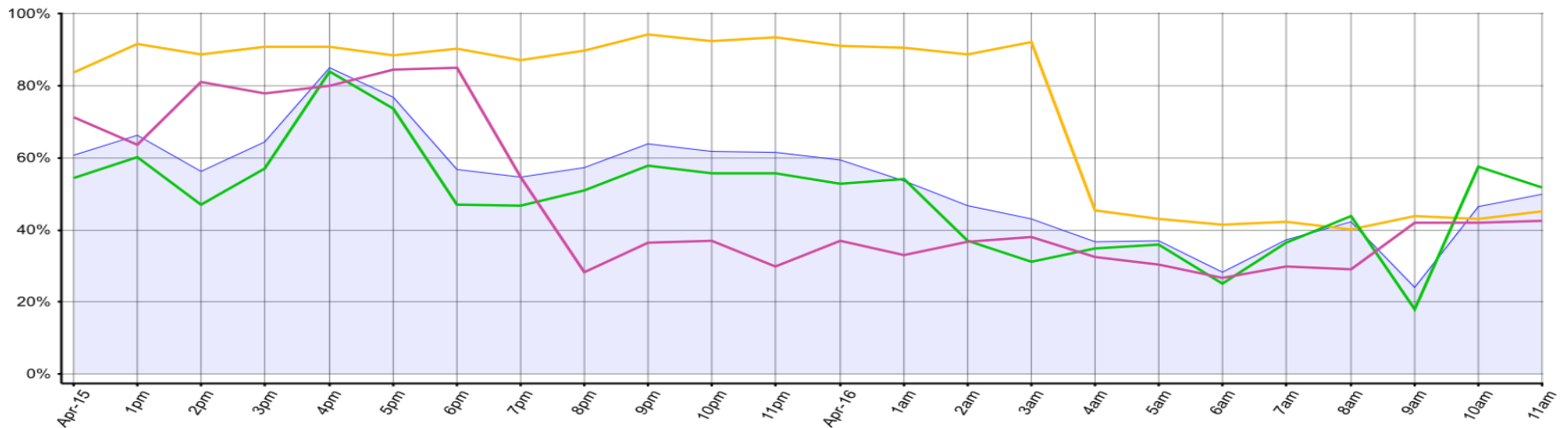
IPv6 Effectiveness 24 Hours Profile – DHS

Global Effectiveness
www.dhs.gov

4/11/2013

Global Effectiveness
www.dhs.gov

4/15/2013

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— Global — North America — Europe — Asia

DHS Case Study – DNS

DHS Case Study – Geography
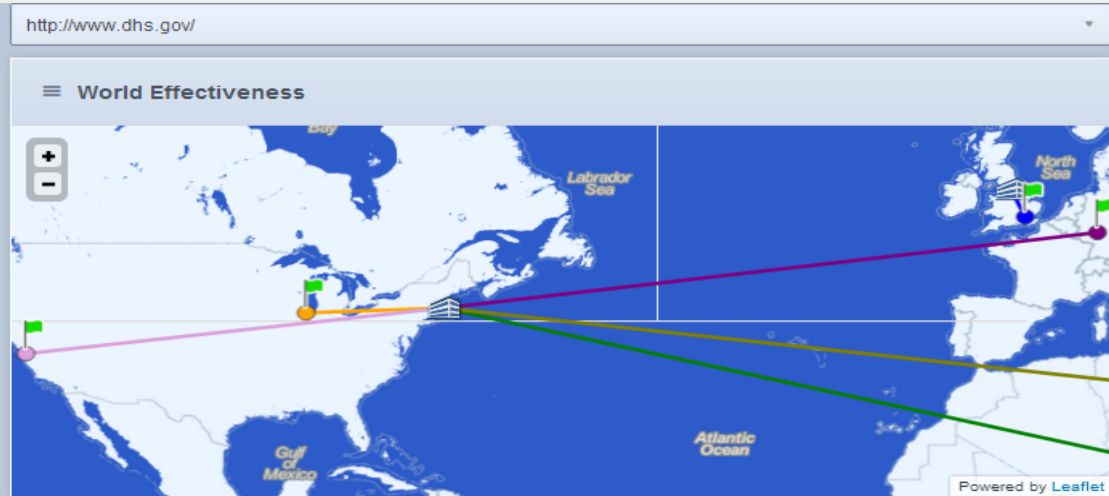
DHS Case Study – More Geography
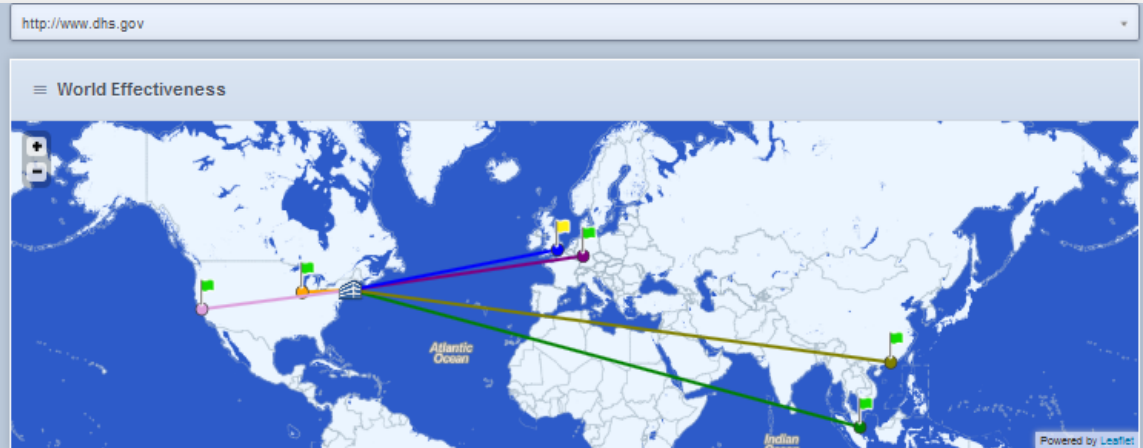
Gov Websites IPv6 Deployment Observations

IPv6 Infrastructure
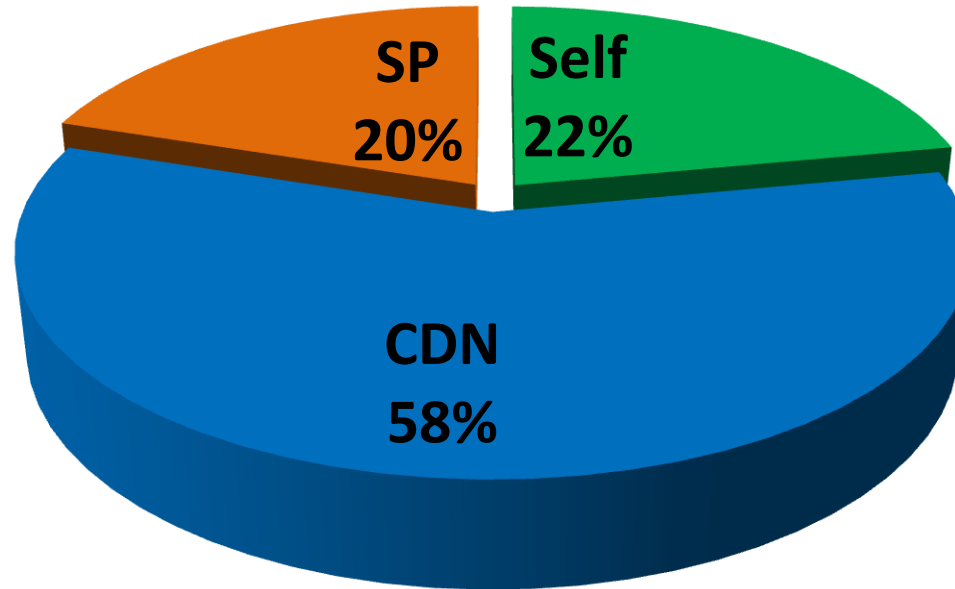
- Most IPv6 enablement is via CDN or CDN/ISP
- Self deployments have the highest IPv6 Effectiveness and the most stabile IPv6 performance
- On average, the poorest IPv6 Effectiveness was for CDN based sites. CDN/ISP IPv6 enabled sites do better

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IPv6 Effectiveness of Tested Gov Websites

IPv6 Effectiveness

0-50%
10%

80-100%
28%

50-80%
62%

IPv6 Effectiveness

90-100%
12%

0-70%
56%

70-90%
32%
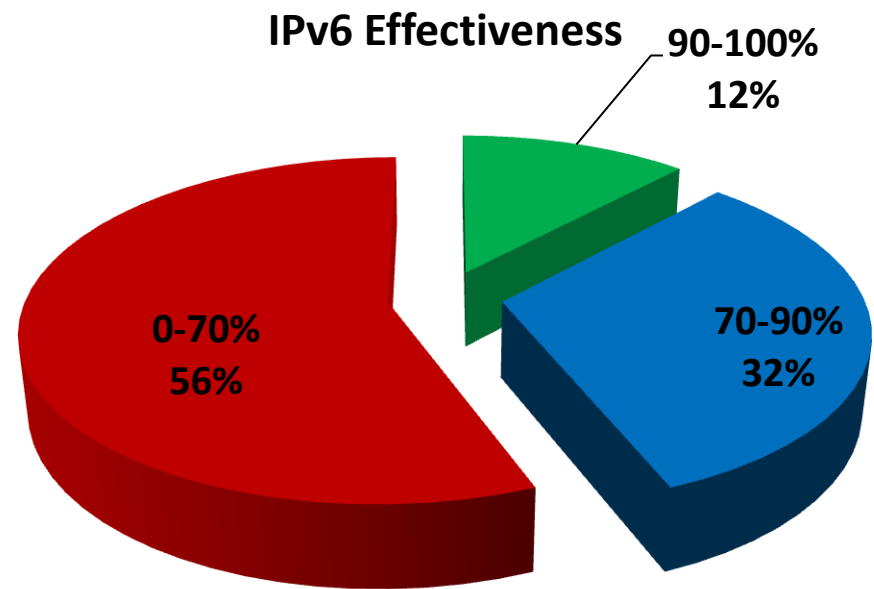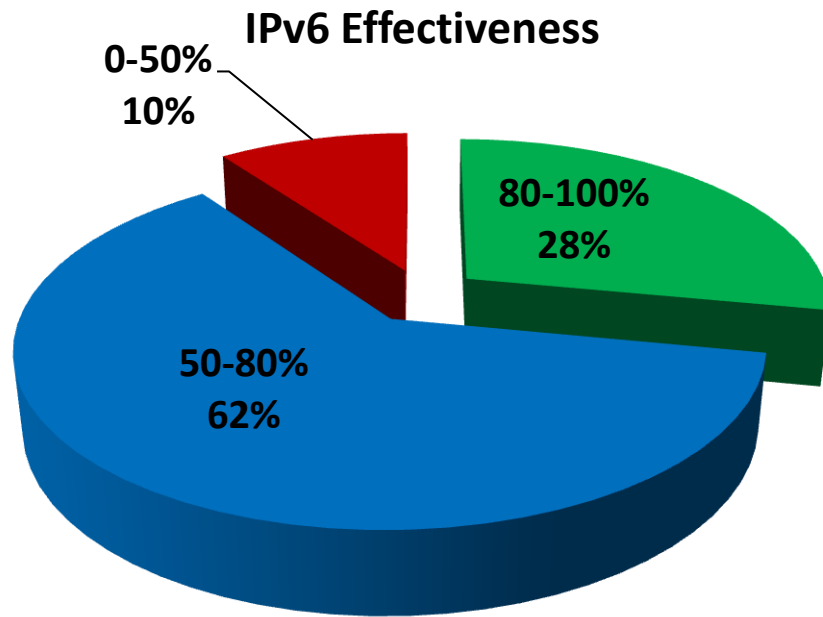
Increasing Expectations

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4. Conclusions

"Not everything that counts can be counted, and not everything that can be counted counts."

Albert Einstein

- What is the ROI of your IPv6 enablement?
- Just because we put in AAAA records and enable IPv6 access it doesn't mean the work is done
- The IPv6 Internet Edge enablement is not production ready until we start monitoring it
- We need IPv6 specific metrics
- We need to drive the stake holders (Service Providers, Cloud Providers, Hosting Providers)

A poorly performing IPv6 enabled website means poor, if not negative ROI. It is time we take IPv6 seriously!
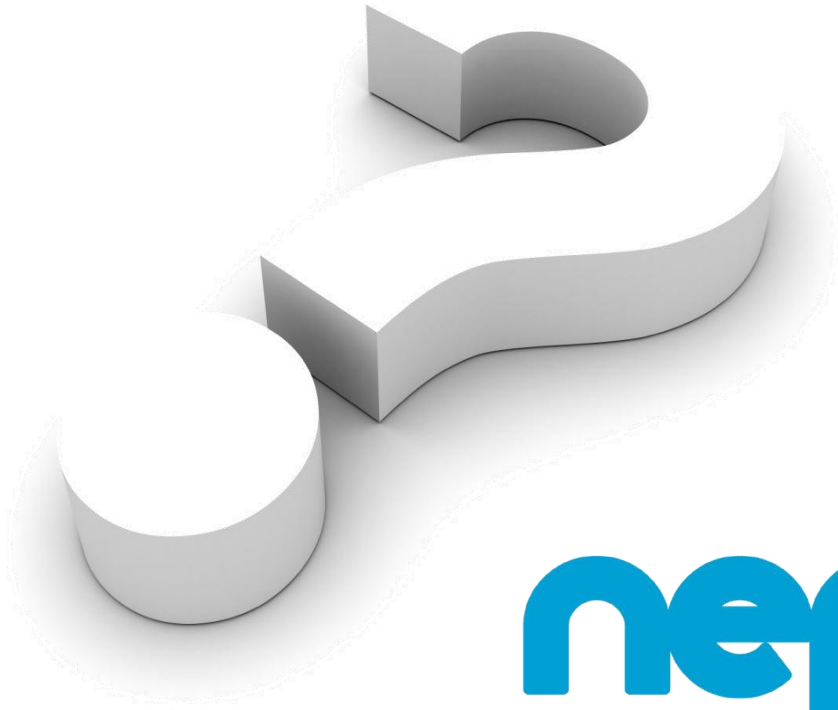
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