Where are we now?
IPv6 deployment update

Internet and IPv6 Infrastructure Security Program

8 – 12 May 2017, Nonthaburi, Thailand
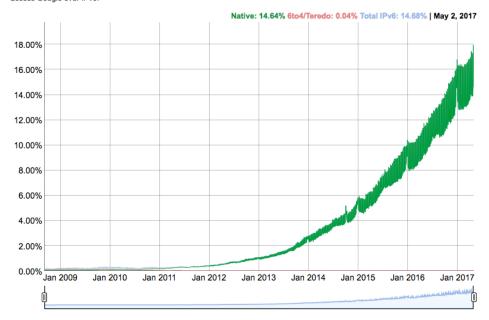
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Agenda

- Update on IPv6 in the world and APNIC region
  - Review of IPv6 deployment statistics
  - IPv6 performance
  - Industry trend: Mobile
  - Conclusion

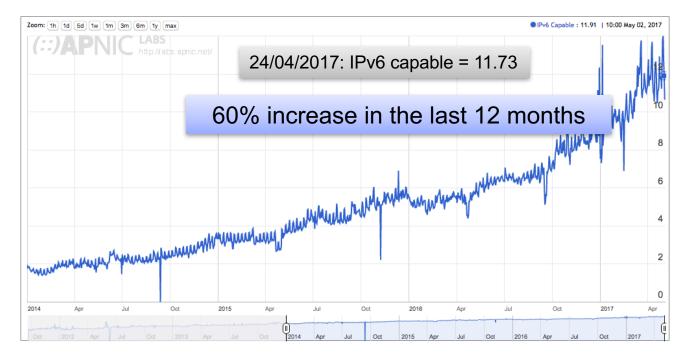# IPv6 adoption statistics by Google

IPv6 Adoption

We are continuously measuring the availability of IPv6 connectivity among Google users. The graph shows the percentage of users that access Google over IPv6.

Native: 14.64% 6to4/Teredo: 0.04% Total IPv6: 14.68% | May 2, 2017

https://www.google.com/intl/en/ipv6/statistics.html   04-05-2017
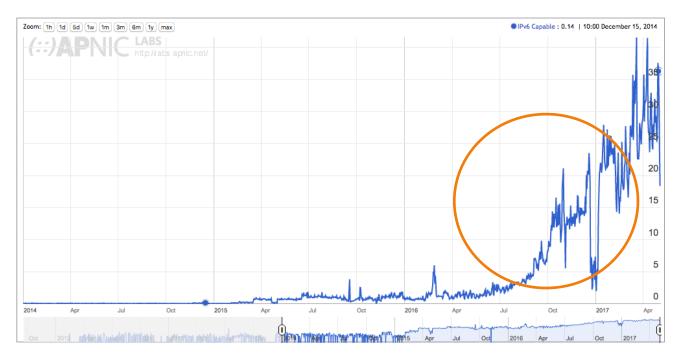
IPv6 measurement by APNIC
End user readiness: World

https://stats.labs.apnic.net/ipv6/XA

The IPv6 economy league table IPv6 capable %

CC	Country	IPv6 Capable
BE	Belgium, Western Europe, Europe	54.05%
DE	Germany, Western Europe, Europe	43.58%
CH	Switzerland, Western Europe, Europe	36.30%
US	United States of America, Northern America, Americas	34.28%
GR	Greece, Southern Europe, Europe	33.06%
IN	India, Southern Asia, Asia	26.20%
LU	Luxembourg, Western Europe, Europe	25.65%
IE	Ireland, Northern Europe, Europe	25.33%
GB	United Kingdom of Great Britain and Northern Ireland, Northern Europe, Europe	24.70%
JP	Japan, Eastern Asia, Asia	23.18%
PT	Portugal, Southern Europe, Europe	21.66%
EE	Estonia, Northern Europe, Europe	18.90%
CA	Canada, Northern America, Americas	18.87%
FR	France, Western Europe, Europe	18.86%
EC	Ecuador, South America, Americas	18.11%
PE	Peru, South America, Americas	17.15%
MY	Malaysia, South-Eastern Asia, Asia	16.33%
NO	Norway, Northern Europe, Europe	15.83%
TT	Trinidad and Tobago, Caribbean, Americas	15.81%
AU	Australia, Australia and New Zealand, Oceania	15.12%

http://stats.labs.apnic.net/ipv6/ as of 4/05/2017

India

https://stats.labs.apnic.net/ipv6/IN as of 4/05/2017

Blog : https://blog.apnic.net/2017/02/07/reliance-jio-boosts-india-past-20-ipv6-capability/
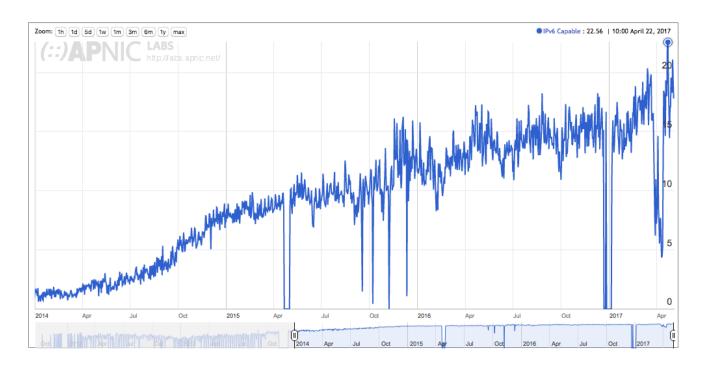
India IPv6 leaderboard

ASN	AS Name	IPv6 Capable
AS55836	Reliance Jio Infocomm Limited	78.80%
AS9829	BSNL-NIB National Internet Backbone	0.03%
AS24560	Bharti Airtel Ltd., Telemedia Services	0.03%
AS45609	Bharti Airtel Ltd. AS for GPRS Service	0.38%
AS24309	Atria Convergence Technologies	0.02%

https://stats.labs.apnic.net/ipv6/IN as of 4/05/2017

Malaysia

as of 4/05/2017

Malaysia IPv6 leaderboard

ASN	AS Name	IPv6 Capable
AS4788	TM Net	24.05%
AS9534	MAXIS-AS1-AP Binariang Berhad	3.74%
AS4818	DiGi Telecommunications	5.22%
AS38466	U Mobile	2.09%
AS10030	Celcom Internet Service Provider	1.48%

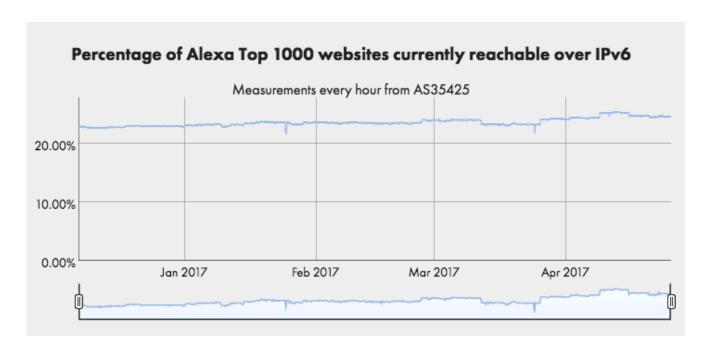https://stats.labs.apnic.net/ipv6/MY as of 4/05/2017

How about others?

CC	Country	IPv6 capable (%)
AF	Afghanistan	0.01%
BD	Bangladesh	0.00%
BT	Bhutan	0.39%
BN	Brunei Darussalam	0.00%
KH	Cambodia	0.01%
IN	India	26.20%
ID	Indonesia	0.18%
IR	Iran	0.15%
LA	Laos	0.02%
MY	Malaysia	16.33%
MN	Mongolia	0.00%

How about others?

CC	Country	IPv6 capable (%)
PK	Pakistan	0.04%
PH	Philippines	0.05%
QA	Qatar	0.01%
SG	Singapore	4.16%
LK	Sri Lanka	2.72%
SD	Sudan	0.11%
TH	Thailand	3.39%
VN	Vietnam	5.86%

https://stats.labs.apnic.net/ipv6/MY as of 4/05/2017

Alexa Top 1000 websites

Percentage of Alexa Top 1000 websites currently reachable over IPv6

Measurements every hour from AS35425

http://www.worldipv6launch.org/measurements/

IPv6 performance

- Enough data accumulated to analyze IPv6 performance
- APNIC R&D, Geoff Huston's recent study
  - Presented @ APRICOT 2016 (Feb, 2016)

- **Is IPv6 as "ROBUST" as IPv4?**
  - Measurement: do all TCP connection attempt succeed?
    - Connection failure = Un-matching incoming SYN and ACK
  - IPv4 connection failure sits at 0.2%
  - IPv6 connection failure sits at 1.8%
    - Came down largely since 2012 (around 5%)
  - Still some space to improve

IPv6 performance

- Enough data accumulated to analyze IPv6 performance
- APNIC R&D, Geoff Huston's recent study
  - Presented @ APRICOT 2016 (Feb, 2016)

- **Is IPv6 as "FAST" as IPv4?** (use of IPv6 unicast)
  - Chronological comparison of RTT since 2012
    - RTT measurements from the SYN-ACK exchange
  - IPv6 as fast as IPv4
  - IPv6 is faster about half of the time

IPv6 performance

- There are good use cases and implementation

- LinkedIn Senior Director of Infrastructure Engineering, Zaid Ali Kahn
  - Presented @ APNIC42 (September, 2016)

- **IPv6 at LinkedIn**
  - For some select networks in Europe, LinkedIn is seeing up to **40% performance improvements over IPv6**, and in the **US, up to 10%.**
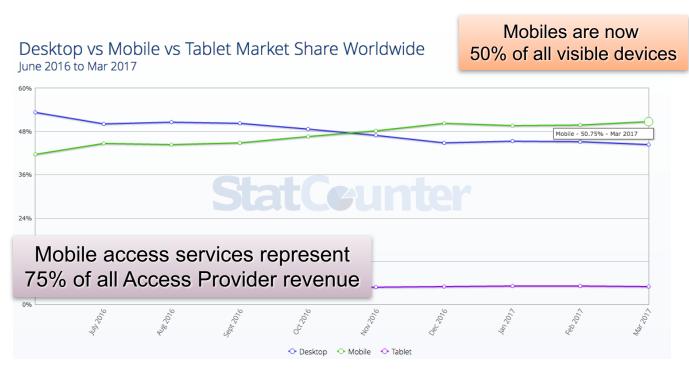 - **TCP timeout on IPv4 over mobile** carrier networks is as high as **4.6%** and **IPv6 timeouts** are on a much lower side at **1.6%.**

https://blog.apnic.net/2016/05/13/linkedin-ipv6-measurements/

Industry trend

Desktop vs Mobile vs Tablet Market Share Worldwide
Mar 2016 to Mar 2017

http://gs.statcounter.com/platform-market-share/desktop-mobile-tablet

Mobility in today's Internet

Desktop vs Mobile vs Tablet Market Share Worldwide
June 2016 to Mar 2017

Mobiles are now
50% of all visible devices

Mobile access services represent
75% of all Access Provider revenue

Mobile - 50.75% - Mar 2017

Desktop   Mobile   Tablet

http://gs.statcounter.com/platform-market-share/desktop-mobile-tablet

Industry trend: Who's in control?

- Mobiles!

- The mobile market is the market "**driver**" for Internet technology:
  - The PC and laptop market is in terminal decline
  - Mobiles represent the highest revenue sector, and show the highest growth numbers
  - The mobile Market was born and raised on NATs
    - The IPv4 model for cellular mobile service is still heavily based on CGNs
  - **The true driver for IPv6 adoption in the Internet is in the mobile sector**

Industry trend: Who's playing?

Global smartphone market share, by operating system

■ Android ■ Apple iOS ■ Others

https://www.theatlas.com/charts/rJ2okAugg

Android has multi-vendor adoption and also extending into tablets and large screens

Smartphone OS	Q3 '15	Q3 '16
Android	84.1%	87.5%
Apple iOS	13.6%	12.1%
Others	2.3%	0.3%

IPv6 in mobile networks

- Mobile devices and IPv6
  - Android supports 464XLAT transition technology
  - Apple iOS 9 supports IPv6 only network services (Aug 2015)
    - All apps submitted to the App Store must support IPv6 starting in early 2016

      https://developer.apple.com/news/?id=08282015a

- Alcatel Lucent

  'Introducing IPv6 into mobile network reduces the CG-NAT bandwidth required by the mobile operator resulting in reduced CAPEX'

  - Whitepaper published in April 2015
    - 464XLAT in mobile networks: IPv6 migration strategies for mobile networks

https://www.apnic.net/community/ipv6-program/IPv6_Migration_Strategies_for_Mobile_Networks_Whitepaper.pdf

IPv6 enabled devices

OS	Version	Installed by default	DHCPv6
Android	5.0 (Lolipop)	Yes	Yes
iOS	4.1	Yes	Yes
Windows Mobile	6.5	Yes	No
Windows Phone	8	Yes	Yes

- Latest releases (April 2017)
  - Android : 7.1.2 "Nougat"
  - iOS: 10.3.1
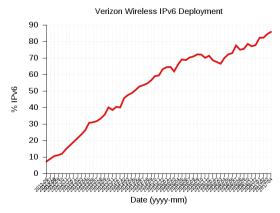 - Windows Mobile: 6.5.3 / February 2, 2010 (discontinue)
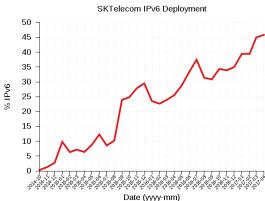 - Windows Phone: 8.1 Update 2 (8.10.15148.160)

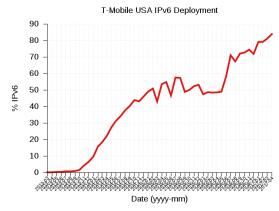https://en.wikipedia.org/wiki/Comparison_of_IPv6_support_in_operating_systems
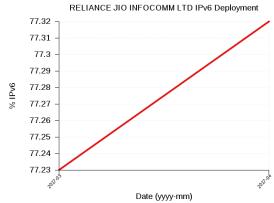
IPv6 in mobile networks: Technology

Carrier	Economy	Note
Verizon Wireless	USA	Deployed dual stack transition technology in 2011
T-Mobile	USA	Deployed IPv6 transition technology (464XLAT) in Oct 2012
Telstra	Australia	Testing IPv6 transition technology (464XLAT) since 2011 Final stage of testing 464XLAT
SK Telecom	Korea	Deployed IPv6 transition technology (464XLAT) in July 2014
Reliance Jio	India	Deployed dual stack transition technology in 2016

IPv6 in mobile networks: Deployment

Verizon Wireless IPv6 Deployment

T-Mobile USA IPv6 Deployment

SKTelecom IPv6 Deployment

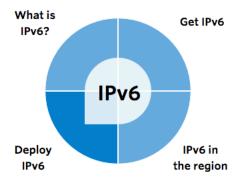RELIANCE JIO INFOCOMM LTD IPv6 Deployment

Mobile Networks

- The business competency of mobile network operators:
  - Shifting from being a traditional voice and messaging provider to a mobile broadband service provider
  - Services on voice, messaging and data are converging on IP based services
  - Rapidly increasing LTE deployment in the region
- Decision makers' (mobile network operators) view
  - Ready to move to Voice over LTE?
  - Mobile cloud computing on top of the LTE network?
  - What are key building blocks for all-IP strategy?
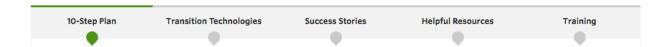
Observations

- IPv6 deployment is increasing steadily
    - New organizations are rapidly getting ready with IPv6
    - But varies among regions, economies, and individual ASNs
    - Not happening simultaneously
    - Some economies and ASNs have been very active in terms of IPv6 deployment
        - Close to 80% of end users are via IPv6 in some ASNs
        - Particularly some mobile network operators and cable TV operators
        - Regional smaller size operators show higher level of IPv6 readiness
        - Once they enable IPv6 in their network and handsets, their end-user readiness grows VERY rapidly
        - It strongly impacts respective economy's IPv6 readiness level

www.apnic.net/ipv6

Deploying IPv6 can be a challenge but many organizations around the world have made the transition successfully. Here's some of the elements you'll need to consider for your organization's deployment of IPv6.

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