

# IPv6: Where are we now?

npNOG-3

11 Dec 2017, Chitwan - Nepal

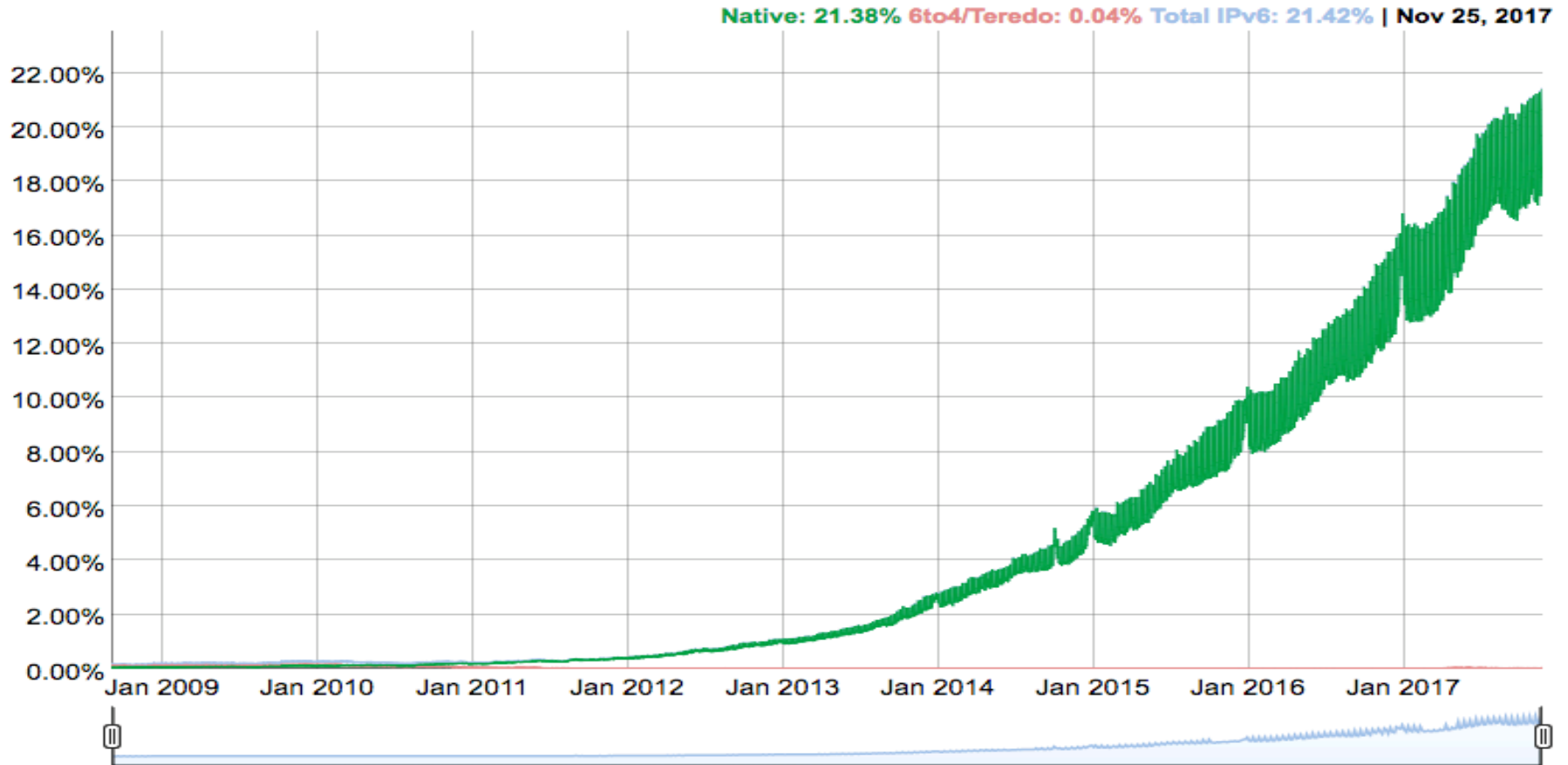
Tashi Phuntsho (Senior Network Janitor)

[tashi@apnic.net](mailto:tashi@apnic.net)

# IPv6 adoption stats - 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.



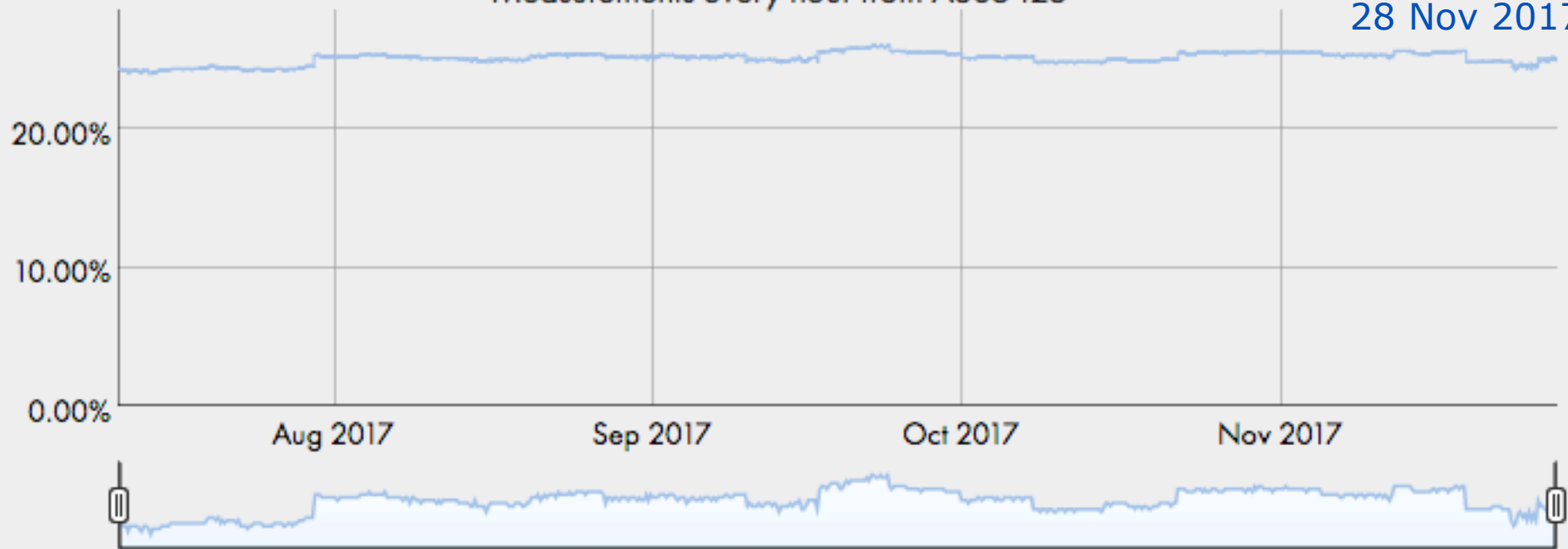
<https://www.google.com/intl/en/ipv6/statistics.html>

# Top 1000 websites - IPv6

Percentage of Alexa Top 1000 websites currently reachable over IPv6

Measurements every hour from AS35425

25% as of  
28 Nov 2017



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

# End-user readiness - APNIC Labs



<https://stats.labs.apnic.net/ipv6/>

# IPv6 Capable vs Preferred

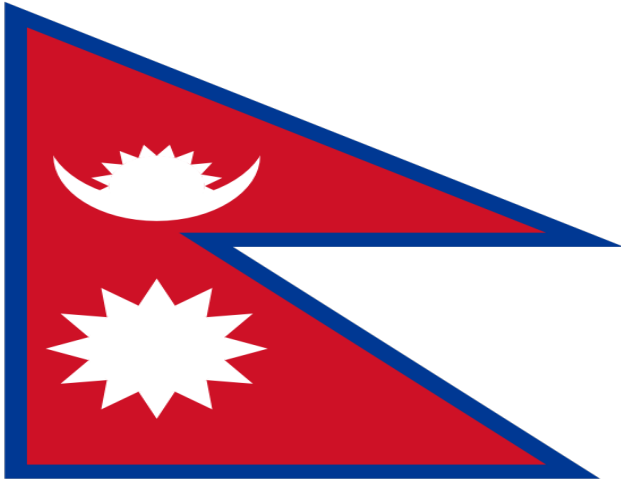
- Uses advertisement to load measurement script (HTML5/flash) on user's browser
  - Over **2M** measurements/day!!
- Script fetches three invisible pixels
  - IPv4 only URL
  - IPv6 only URL
  - Dual-stack URL
- If:
  - Fetches IPv6 URLs (native/dual-stack) over IPv6, device is deemed IPv6 capable
  - Fetches the dual-stack URL using IPv6, its deemed to prefer IPv6 (**HE bias – RFC6555?**)
    - Only Chrome – 300ms (Firefox and Opera parallel; OS X and iOS – 25ms)

# IPv6 table - Asia

CC	Country	IPv6 Capable	IPv6 Preferred	Samples
IN	India, Southern Asia, Asia	51.52%	48.23%	206,754,542
JP	Japan, Eastern Asia, Asia	25.56%	22.70%	5,306,155
MY	Malaysia, South-Eastern Asia, Asia	18.93%	17.81%	9,387,269
TH	Thailand, South-Eastern Asia, Asia	10.60%	10.28%	8,877,676
MO	Macao Special Administrative Region of China, Eastern Asia, Asia	9.19%	8.24%	390,632
KR	Republic of Korea, Eastern Asia, Asia	9.01%	8.28%	10,359,433
VN	Vietnam, South-Eastern Asia, Asia	8.79%	8.41%	38,523,803
SA	Saudi Arabia, Western Asia, Asia	8.06%	7.75%	14,049,841
LK	Sri Lanka, Southern Asia, Asia	6.09%	5.77%	4,414,366
SG	Singapore, South-Eastern Asia, Asia	5.02%	3.82%	2,961,337
AE	United Arab Emirates, Western Asia, Asia	2.50%	2.43%	2,119,109
IL	Israel, Western Asia, Asia	2.49%	2.42%	2,339,120
CN	China, Eastern Asia, Asia	0.81%	0.63%	12,976,094
IR	Iran (Islamic Republic of), Southern Asia, Asia	0.61%	0.60%	183,131
OM	Oman, Western Asia, Asia	0.39%	0.37%	1,791,180
TW	Taiwan, Eastern Asia, Asia	0.38%	0.34%	20,370,611
HK	Hong Kong Special Administrative Region of China, Eastern Asia, Asia	0.35%	0.11%	3,976,323
ID	Indonesia, South-Eastern Asia, Asia	0.21%	0.12%	17,441,827
BT	Bhutan, Southern Asia, Asia	0.19%	0.19%	109,305
CY	Cyprus, Western Asia, Asia	0.15%	0.14%	717,323
AF	Afghanistan, Southern Asia, Asia	0.07%	0.06%	400,210
PH	Philippines, South-Eastern Asia, Asia	0.06%	0.06%	16,669,398
KH	Cambodia, South-Eastern Asia, Asia	0.06%	0.05%	3,635,669
PK	Pakistan, Southern Asia, Asia	0.02%	0.02%	16,283,296
TL	Timor-Leste, South-Eastern Asia, Asia	0.02%	0.01%	42,059
LA	Lao People's Democratic Republic, South-Eastern Asia, Asia	0.02%	0.02%	570,213
NP	Nepal, Southern Asia, Asia	0.02%	0.01%	3,350,785

<https://stats.labs.apnic.net/ipv6/>

# A closer Look - Nepal



29,304,998 people

5,040,459 users

17% penetration

80 ASes

21.13B GDP

## IPv4

**50 in BGP**

526,592 addresses

0.02 per head

98% visible

## IPv6

**14 in BGP**

150,325 M addresses

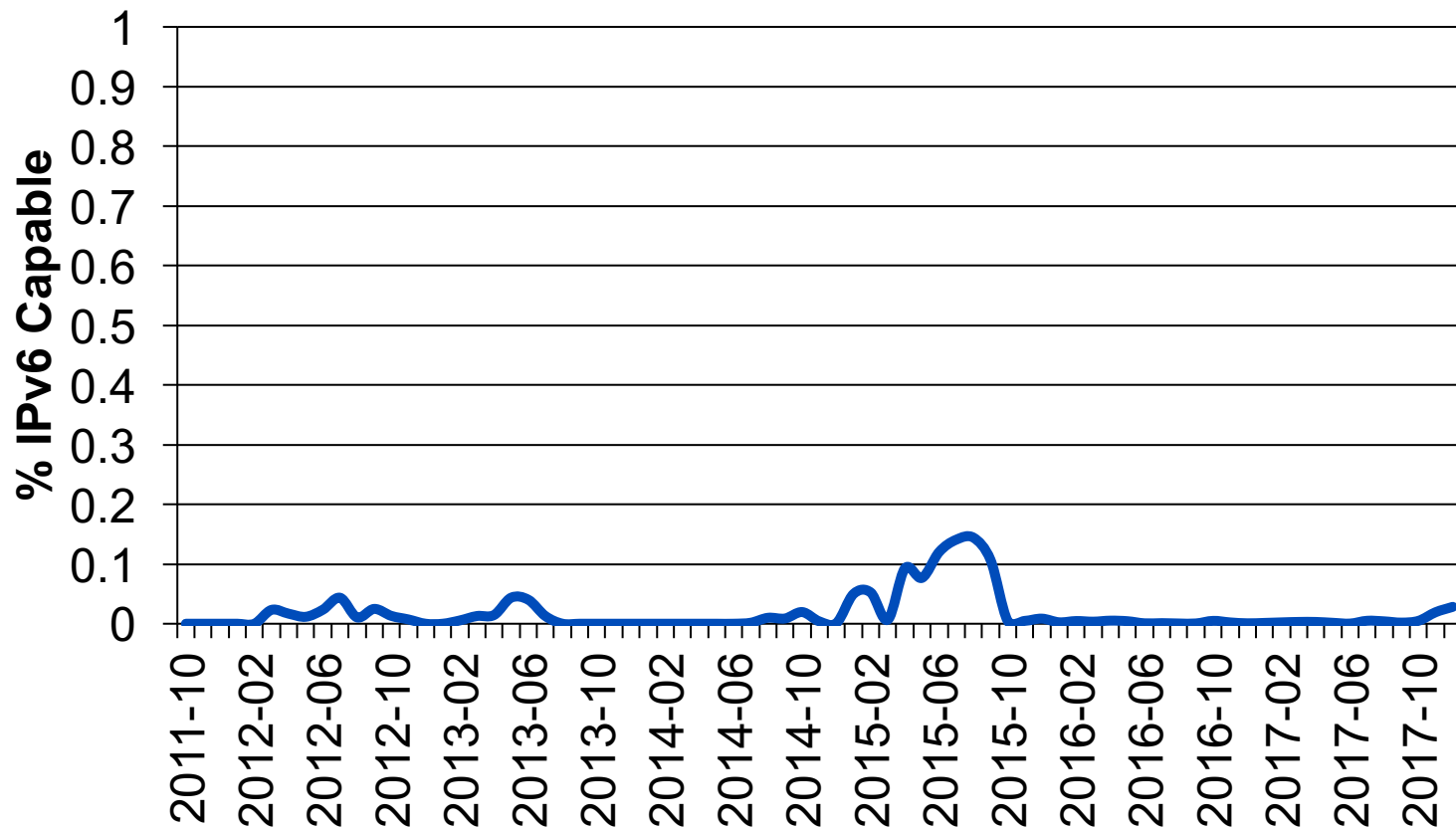
5,129 per head

14% visible

0% capability

# IPv6 capability - Nepal

NP





# IPv6 Samples – Top10

ASN	AS Name	IPv6 Capable	IPv6 Preferred	# Samples
AS17501	WorldLink Communications	0.02%	0.01%	1145554
AS23752	Nepal Telecommunications	0.02%	0.01%	825210
AS4007	Subisu Cablenet	0.01%	0.01%	404544
AS45650	Vianet Communications	0.02%	0.02%	313842
AS38565	Ncell	0.02%	0.02%	304757
AS55915	Classic Tech	0.02%	0.02%	139720
AS58504	Techminds Networks	0.02%	0.02%	94710
AS24550	Websurfer	0.02%	0.02%	89013
AS55427	Broadlink	0.01%	0.01%	75667
AS59343	Otel Communication	0.01%	0.01%	27162

# IPv6 Capable – Top10

ASN	AS Name	IPv6 Capable	IPv6 Preferred	# Samples
ASI36740	Sky Cable T.V.	0.07%	0.04%	2766
AS45845	Nepal International Internet Gateway	0.04%	0.04%	5467
ASI36477	P.D.S. Server Network	0.03%	0.03%	3889
AS4613	Mercantile Office Systems	0.02%	0.02%	12361
AS24550	Websurfer Nepal	0.02%	0.02%	89013
AS38565	Ncell	0.02%	0.02%	304757
AS45650	Vianet Communications	0.02%	0.02%	313842
ASI35327	Cherry World Communication	0.02%	0.02%	15545
AS58504	Techminds Networks.	0.02%	0.02%	94710
AS55915	Classic Tech	0.02%	0.02%	139720

# Delegated vs Routed – Nepal IPv6

ORG/AS	Prefix	Routed
WorldLink (17501)	2400:1A00::/32	YES
Mercantile (4613)	2400:A400::/32	YES
CCNEP (23647)	2403:8700::/32	YES
NP Telecom (23752)	2407:1400::/32	YES
Subisu (4007)	2403:3800::/32	YES
WebSurfer (24550)	2400:9700::/32	YES
Nepal REN (45170)	2404:2C00::/32	YES
ViaNet (45650)	2404:7C00::/32	YES
Techminds (58504)	2406:B700::/32	YES
CWC (135327)	2404:C080::/32	YES
Otel (59343)	2407:9500::/32	YES

ORG/AS	Prefix	Routed
Sky Cable (136740)	2401:5240::/32	NO*
PSNPL-AS (136477)	2400:F0C0::/32	NO*
NCELL (38565)	2400:9500::/32	NO*
Classic (55915)	2407:5200::/32	NO*
NetMax (56204)	2405:1B00::/32	NO
NITC (45353)	2001:DF0:8B::/48	NO
BroadLink (55427)	2402:A300::/32	NO
INFOCom (18395)	2407:D400::/32	NO
UTL (45451)	2400:9900::/32	NO

# What is happening here??

- We also see tunnels!

- Nov & Dec 2017:

- **6to4** (RFC3056)

2002:6733:1151

2002:6733:11ae

2002:6733:13a2

- **Teredo** (RFC4380)

2001:0:4137

2001:0:9d38

- And **Reliance Jio**

2405:204:31ad 2405:204:512a

2405:204:648b 2405:204:6509

2405:204:714e 2405:204:7200

2405:204:8407 2405:204:9005

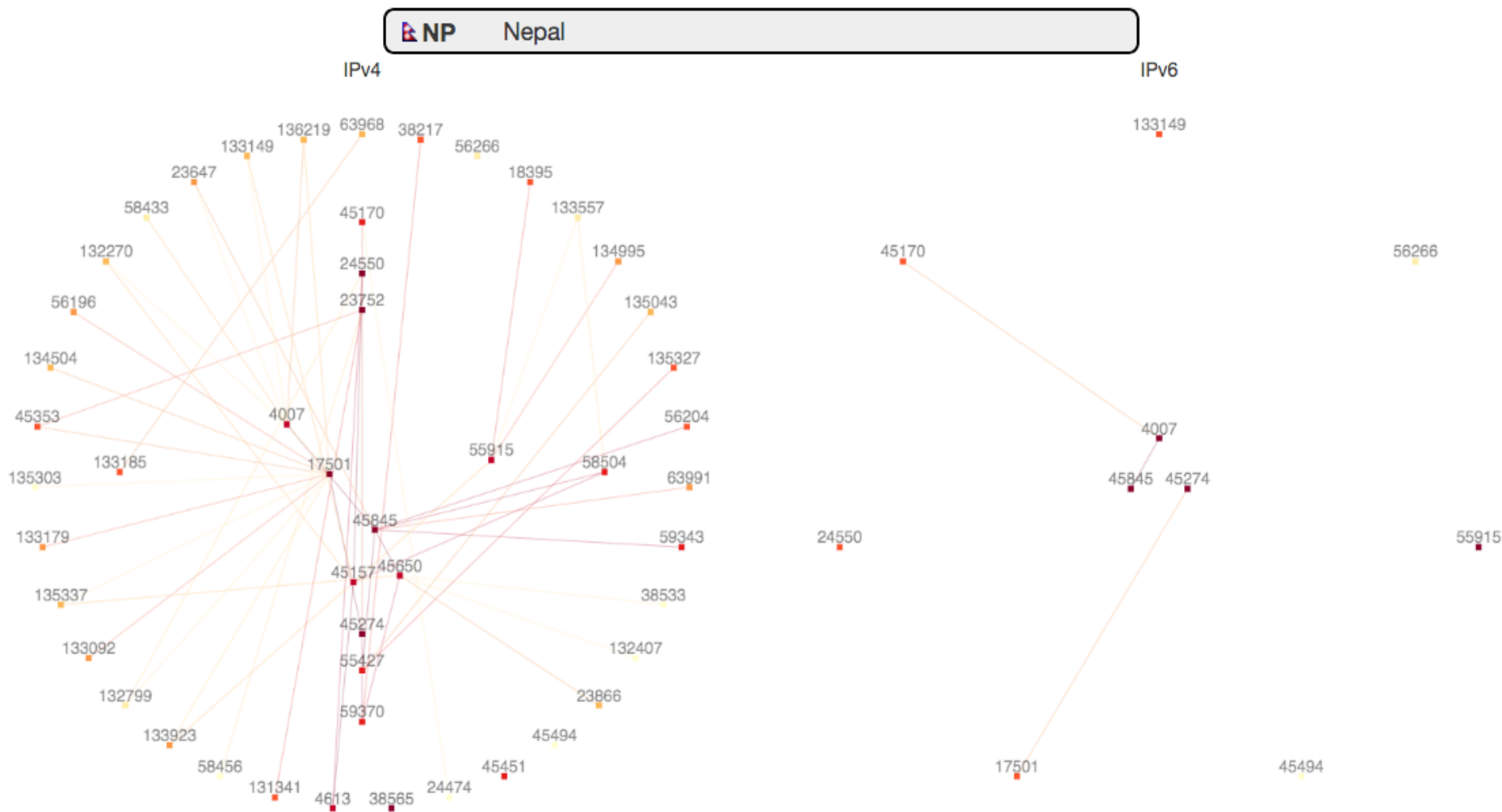
2405:204:90ae 2405:204:9120

2405:204:a01d 2405:204:a491

2405:205:201e 2405:205:64a8

2405:205:a10f

# IPv6 interconnections - Nepal



<https://labs.apnic.net/vizas/index.html#NP>

# IPv6 Performance

- Is IPv6 inferior to IPv4 in terms of service performance?

- Two sessions between the same endpoints
- Same e2e transport protocol
- Same applications at each end
- Different IP protocol used by the two sessions

# IPv6 Performance

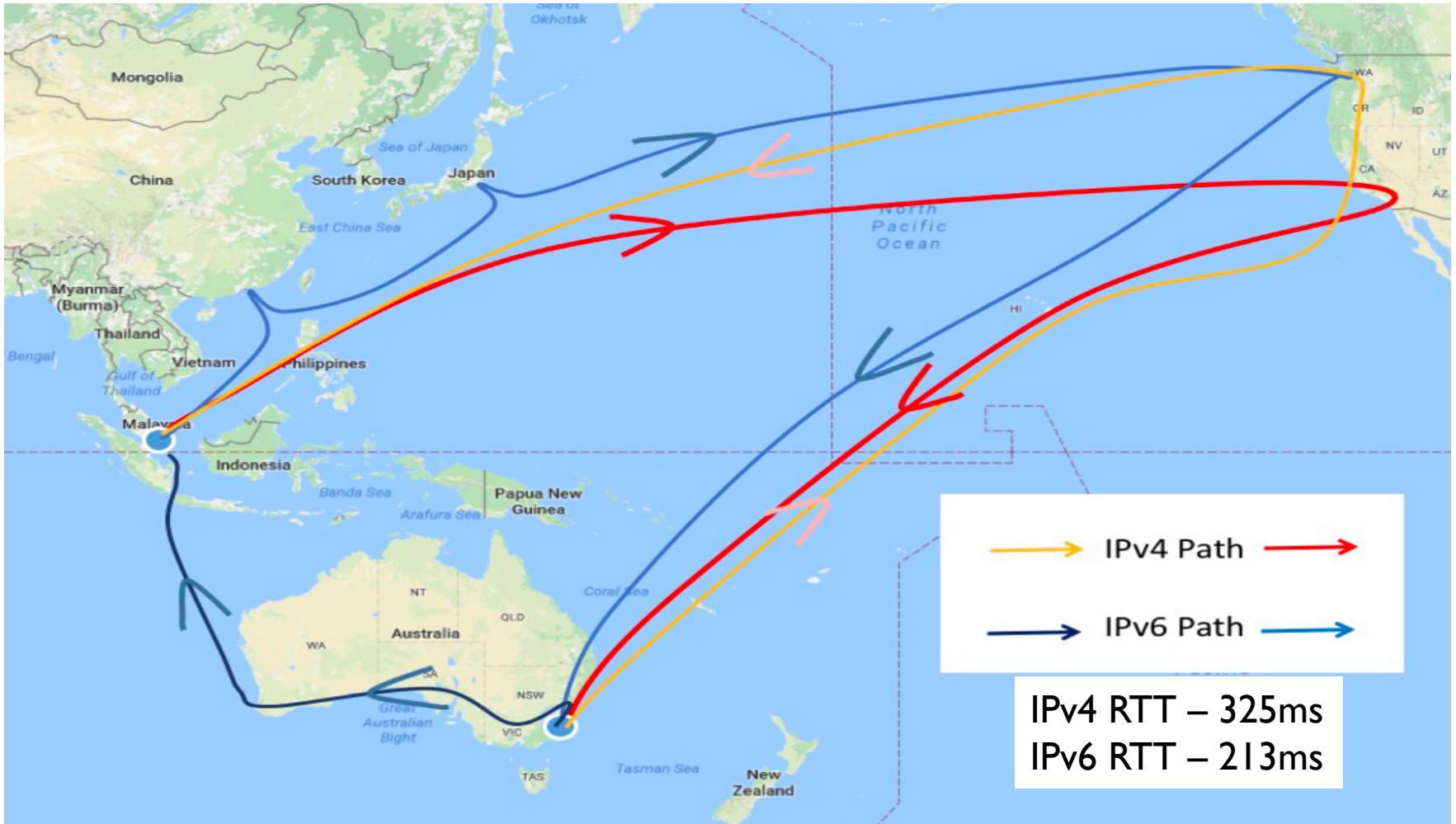
- Enough data collected to analyze IPv6 performance
  - APNIC Labs
- **Is IPv6 as robust as IPv4?**
  - Do all TCP connection attempts succeed?
    - *Connection failure = no ACK for an acknowledged SYN*
  - IPv4 connection failure sits at 0.2%
  - IPv6 connection failure sits at 1.6% (8 times higher!)
    - PMTUD (ICMPv6 filters)?

# IPv6 Performance

- Enough data collected to analyze IPv6 performance
  - APNIC Labs
- **Is IPv6 as fast as IPv4?** (IPv6 unicast)
  - Comparison of RTT (not implicit RTT)
    - Time since *SYN* till *ACK*
    - factors out any congestion issues
  - IPv6 is faster about half of the time
    - **45ms** faster (**80ms** NP)
    - NAT?
    - IPv4 and IPv6 using different paths (different peering policies for IPv4 and IPv6)?
  - **IPv6 as fast as IPv4**



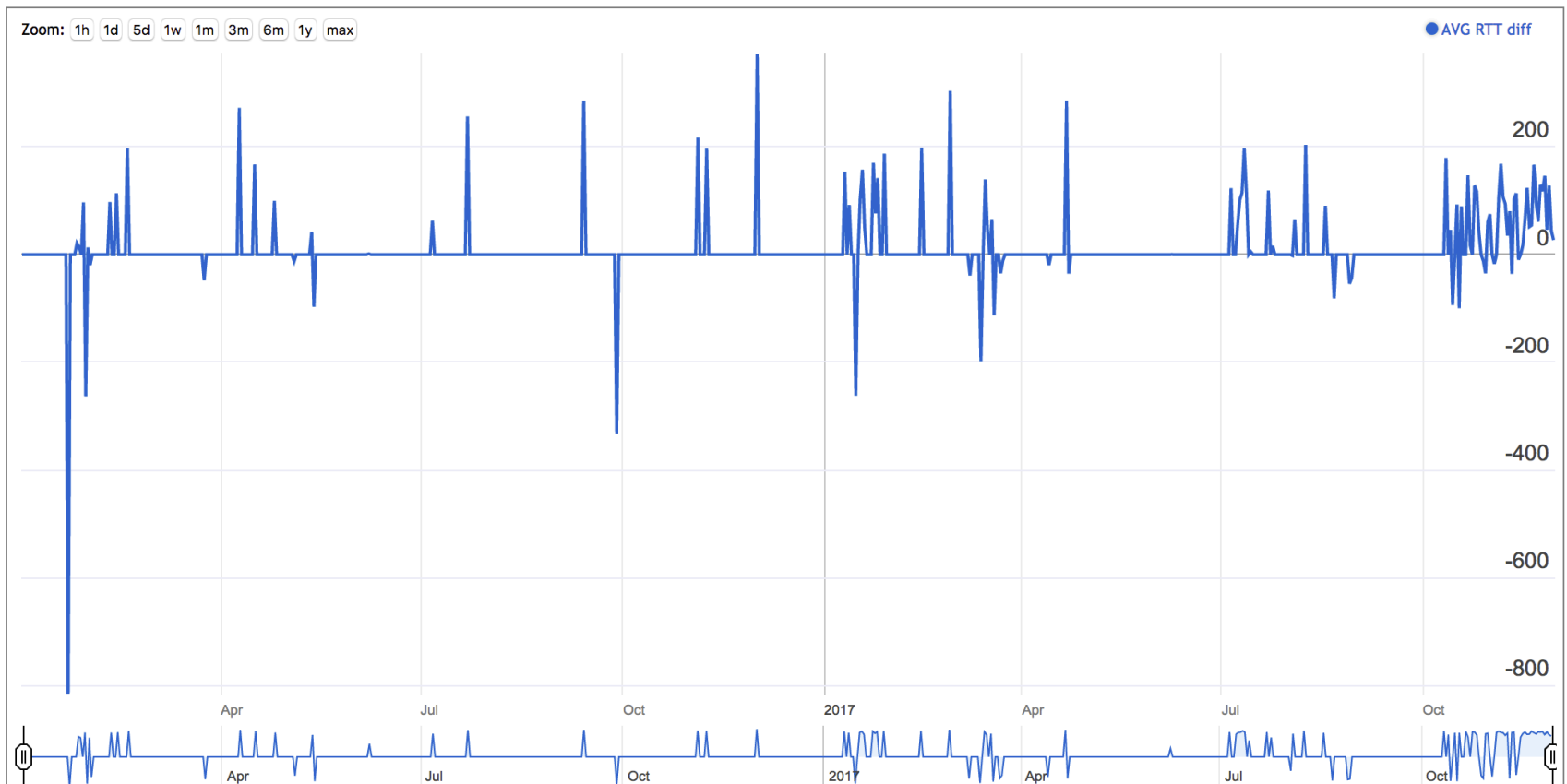
# Routing path & performance



<https://labs.apnic.net/?p=850>

# IPv6 is faster in Nepal

Average RTT Difference (ms) (V6 - V4) for Nepal (NP)



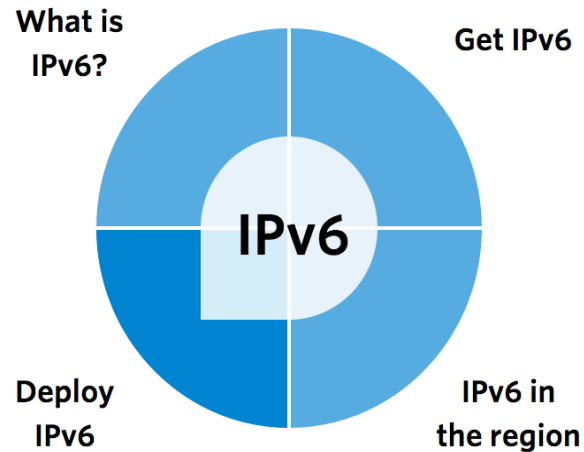
# IPv6 Performance

- Some good use cases
- LinkedIn Senior Director of Infrastructure Engineering, Zaid Ali Kahn
  - @APRICOT42 (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%**
    - CG-NAT configuration (TCP translation timeouts)?

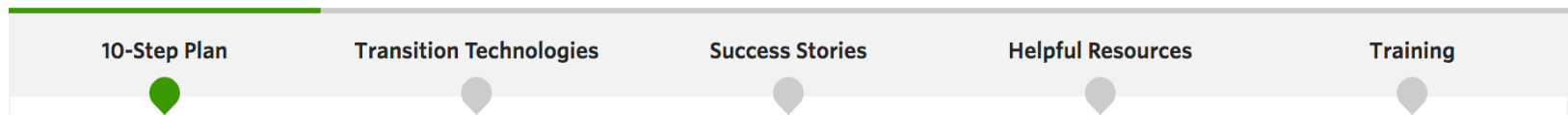
<https://blog.apnic.net/2016/05/13/linkedin-ipv6-measurements/>

# www.apnic.net/ipv6

## Deploy 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.



# Thank You!

END OF SESSION

