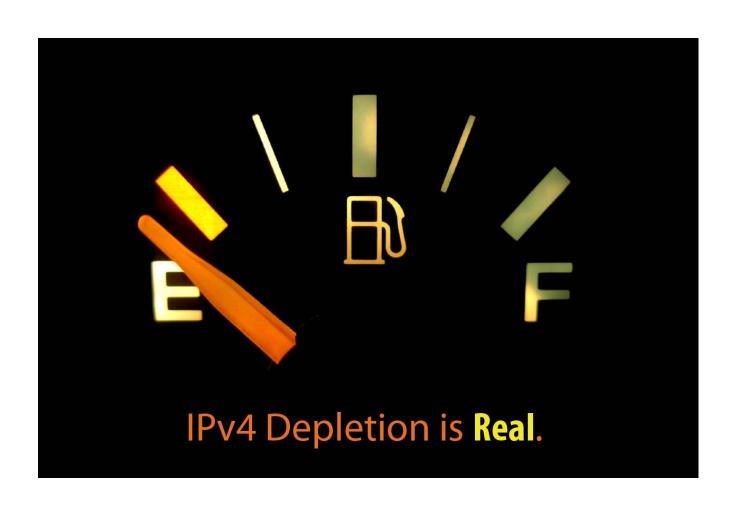


# IPv63



## Everyone know that we are running out with IPv4



## We also know that demand is increasing day by day....

#### Solution



## Capex intensive along with challenges

**CGNAT** 

#### How to uncover IPv6 into your network?











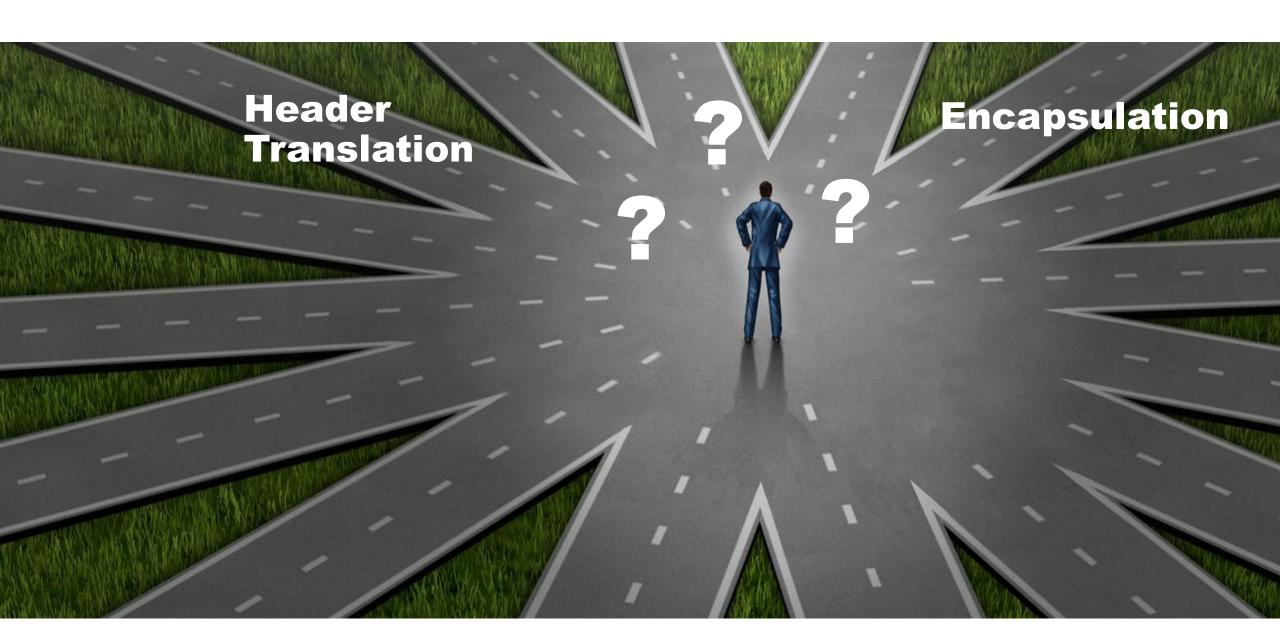


**Validation** 



**Get Set Go....** 

#### **Implementation**



#### We choose



#### Dual Stack

#### Addressing plan we did

**APNIC Assigned Block** 

**/32** 

P2P

/127

Loopback

1128

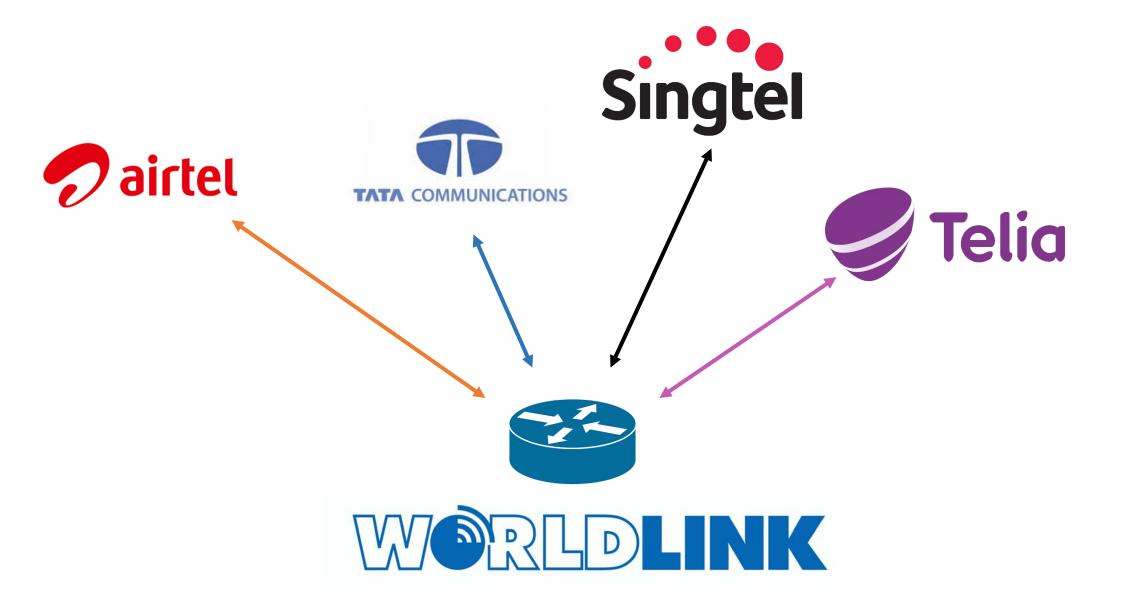
**CPE WAN** 

/64 (one v6 IP)

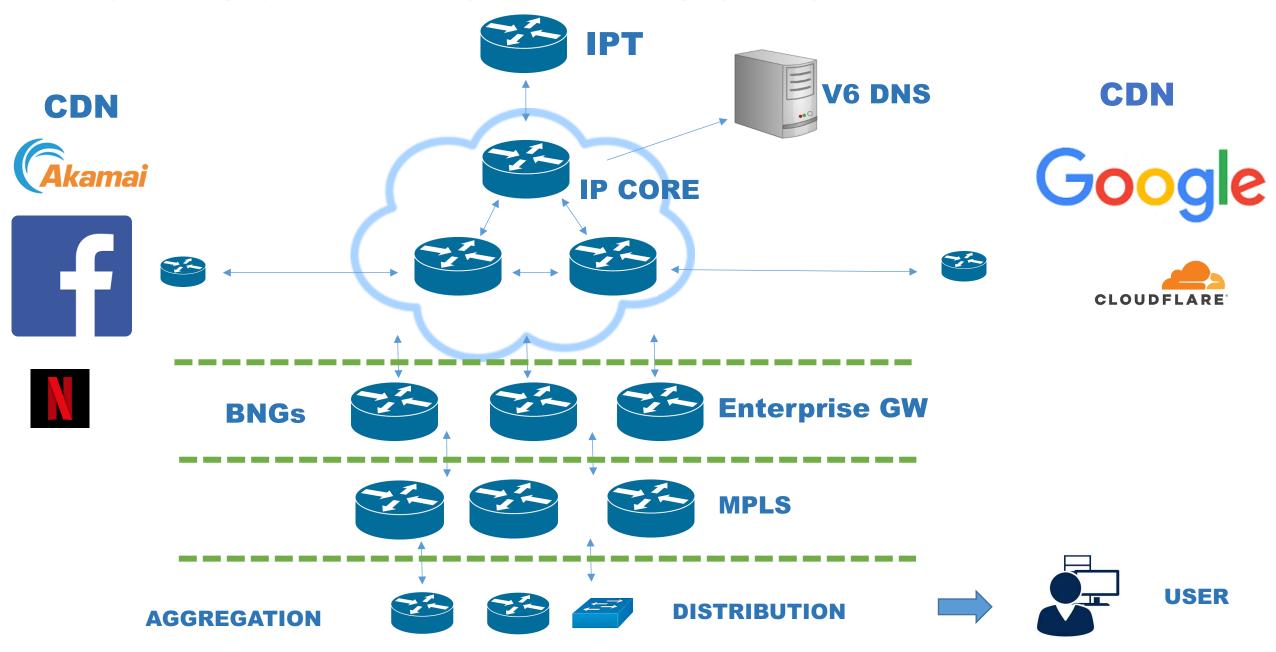
**CPE PD(Prefix Delegation)** 

**/64** 

#### **Enabled - with upstream**



#### **Enabled – Within Network**



#### **Configuration sample**

#### Interface configuration:-

set interfaces xe-0/0/0 unit 0 family inet6 address 2400:1a00:100:10::1/127

#### **IGP** configuration (OSPFv3)

set protocols ospf3 area 0.0.0.0 interface xe-0/0/0 interface-type p2p

#### **BGP** configuration

```
set protocols bgp group IPV6-BGP type internal set protocols bgp group IPV6-BGP local-address 2400:1a00:100:10::1 set protocols bgp group IPV6-BGP family inet6 unicast set protocols bgp group IPV6-BGP local-as 17501 set protocols bgp group IPV6-BGP neighbor 2400:1a00:100:10::2
```

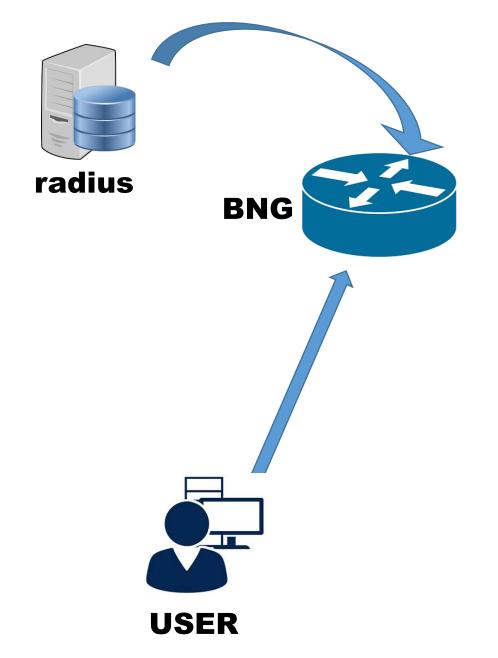
For Juniper Routers

#### **BNG** – Radius attributes for v6



# CHALLENGE

## Bandwidth shaping on Dual stack!!



#### **Get BW value**

### Create dynamic policer

### Create IPv4 in/out Filter

Create IPv6 in/out Filter

## IPv6 traffic blocked on Switching!!

### Before implementing v6 we have deployed multicast filters on switches

```
#entry deny_mac1
     if match all{
          ethernet-destination-address 33:33:00:00:00:00
mask ff:ff:00:00:00:00:
      then{
          deny;
          count denymac1;
#entry deny_mac2
     if match all{
          ethernet-source-address 33:33:00:00:00:00:
     then{
          deny;
          count denymac2;
```

#### IANA MAC ADDRESS BLOCK

```
Registration Procedure(s)

See [RFC7042].

Expert(s)

Donald Eastlake (primary), Juan Carlos Zuniga (secondary)

Reference

[RFC7042]

Note

IANA allocates addresses under the IANA OUI (00-00-5E) as
```

IANA allocates addresses under the IANA OUI (00-00-5E) as explained in [RFC7042]. Unicast addresses under the IANA OUI start with 00-00-5E, while multicast addresses under the IANA OUI start with 01-00-5E. In the lists below, these initial 3 bytes are omitted for brevity. As described in [RFC7042], 48-bit MAC addresses in the range 33-33-00-00-00-00 to 33-33-FF-FF-FF are used for IPv6 multicast.

When the available space for either multicast or unicast EUI-48 identifiers under OUI 00-00-5E has been 90% or more exhausted, IANA should request an additional OUI from the IEEE Registration Authority for further IANA assignment use. The appointed Expert(s) should monitor for this condition and notify IANA.

#### **Need to enable Multicast on OLTs**

Huawei

**Enabled by default** 

Nokia

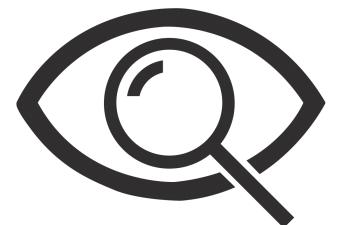
**Need to enable** 

configure vlan id stacked:4000:0 mode residential-bridge name RETAIL\_OUTER\_VLAN in-qos-prof-name name:HSI\_IPTV ipv6-mcast-ctrl



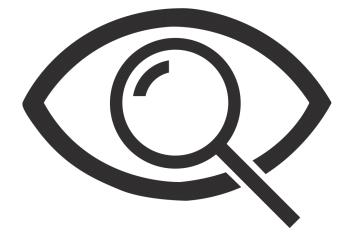
#### **Security Risk**

### No filtering mechanism for IPv6 as of yet on CPEs



#### No visibility of IPv6 Distribution on CPEs to end devices

From CPE, we can't figure out which end device is getting which v6 IP address



#### For V4 we can see as below

#### **Local Devices**

Status	Connection Type	Device Name	IPv4 Address	Hardware Address	IP Address Allocation	Delete
Inactive	Wireless (2.4GHz)	RedmiNote7Pro-Redmi	192.168.1.201	90:78:b2:fa:ae:7a	DHCP	Delete
Active	Ethernet	android-de53307a9d1	192.168.1.81	78:c2:c0:9b:ea:3e	DHCP	Delete
Inactive	Wireless (2.4GHz)	Unknown_e4:46:da:95:7c:39	192.168.1.75	e4:46:da:95:7c:39	DHCP	Delete
Inactive	Wireless (2.4GHz)	android-5371755ee38	192.168.1.168	7c:91:22:f9:bd:17	DHCP	Delete
Active	Wireless (2.4GHz)	Galaxy-S9	192.168.1.92	24:18:1d:71:9b:23	DHCP	Delete
Active	Wireless (2.4GHz)	android-c9b6134e38c	192.168.1.76	f0:ee:10:be:38:6a	DHCP	Delete
Active	Wireless (2.4GHz)	vivo-1726	192.168.1.129	70:b7:aa:f0:77:e1	DHCP	Delete
Active	Wireless (2.4GHz)	android-6426eda8032	192.168.1.65	08:ec:a9:35:8c:cf	DHCP	Delete
Active	Wireless (2.4GHz)	Galaxy-J2-2018	192.168.1.161	3c:57:6c:c1:2c:fa	DHCP	Delete
Inactive	Wireless (2.4GHz)	Bimalas-iPhone	192.168.1.126	98:ca:33:81:ab:9c	DHCP	Delete
Active	Wireless (2.4GHz)	RedmiNote4-SamRidha	192.168.1.78	ac:c1:ee:93:d4:99	DHCP	Delete
Active	Wireless (2.4GHz)	RedmiNote7Pro-Rana	192.168.1.188	90:78:b2:f0:4f:0d	DHCP	Delete

Refresh



### No IPv6 diagnostics tools for troubleshoot on CPEs

**IPv6 Ping** 

**IPv6 Traceroute** 



#### For V4 we can see as below

#### Maintenance>Diagnostics

WAN Connect List	2_INTERNET_R_VID_21	•			
IP or Domain Name	google.com				
Test	□ ping ■ traceroute				
Ping Try Times(1 ~ 1000)	4				
Packet Length(64 ~ 1500)	64				
Max no. of trace hops(1 ~ 255)	30				
	Start Test Cancel				
1 27.34.0.1 6.085 ms 4.284 ms 3.0 2 202.79.40.153 5.833 ms * * 3 202.79.40.170 2.458 ms 7.143 ms 4 103.225.212.161 2.630 ms 2.804 5 180.87.38.172 47.669 ms 53.137 6 74.125.48.190 49.337 ms 45.131 7 108.170.248.209 53.531 ms 108.1	s 2.354 ms ms 2.976 ms ms 53.281 ms				

#### Maintenance>Diagnostics

WAN Connect List	2_INTERNET_R_VID_21		
IP or Domain Name	google.com		
Test	Ø ping □ traceroute		
Ping Try Times(1 ~ 1000)	4		
Packet Length(64 ~ 1500)	64		
Max no. of trace hops(1 ~ 255)	30		
	Start Test	Cancel	

72 bytes from 172.217.27.206: seq=0 ttl=55 time=59.519 ms

72 bytes from 172.217.27.206: seq=1 ttl=55 time=56.292 ms

72 bytes from 172.217.27.206: seq=2 ttl=55 time=59.950 ms

72 bytes from 172.217.27.206: seq=3 ttl=55 time=60.033 ms

--- google.com ping statistics ---

4 packets transmitted, 4 packets received, 0% packet loss round-trip min/avg/max = 56.292/58.948/60.033 ms



#### **Bogons Filter**

#### Apply on routing policy from upstream

```
set policy-options prefix-list ipv6-BOGONS ::/96
set policy-options prefix-list ipv6-BOGONS ::/128
set policy-options prefix-list ipv6-BOGONS ::1/128
set policy-options prefix-list ipv6-BOGONS ::ffff:0:0/96
set policy-options prefix-list ipv6-BOGONS 100::/64
set policy-options prefix-list ipv6-BOGONS 2001::/23
set policy-options prefix-list ipv6-BOGONS 2001::/32
set policy-options prefix-list ipv6-BOGONS 2001:2::/48
set policy-options prefix-list ipv6-BOGONS 2001:3::/32
set policy-options prefix-list ipv6-BOGONS 2001:10::/28
set policy-options prefix-list ipv6-BOGONS 2001:db8::/32
set policy-options prefix-list ipv6-BOGONS 2002::/16
set policy-options prefix-list ipv6-BOGONS 3ffe::/16
set policy-options prefix-list ipv6-BOGONS fc00::/7
set policy-options prefix-list ipv6-BOGONS fe00::/9
set policy-options prefix-list ipv6-BOGONS fe80::/10
set policy-options prefix-list ipv6-BOGONS fec0::/10
set policy-options prefix-list ipv6-BOGONS ff00::/8
```

#### **Control Plane Protection**

#### **Allow infra prefix only**

```
set firewall family inet6 filter ipv6-ProtectRE term allowed from source-address
set firewall family inet6 filter ipv6-ProtectRE term allowed from source-address
set firewall family inet6 filter ipv6-ProtectRE term allowed then count ipv6_RE_protect_count
set firewall family inet6 filter ipv6-ProtectRE term allowed then accept
set firewall family inet6 filter ipv6-ProtectRE term ospf-allowed from payload-protocol ospf
set firewall family inet6 filter ipv6-ProtectRE term ospf-allowed then accept
set firewall family inet6 filter ipv6-ProtectRE term icmp6-allowed from payload-protocol icmp6
set firewall family inet6 filter ipv6-ProtectRE term icmp6-allowed then accept
set firewall family inet6 filter ipv6-ProtectRE term discard then discard
```

#### **Block Exploitable Ports**

```
set firewall family inet filter exploit-port-ff term exploitable-udp-ports-dst from destination-port 11211
set firewall family inet filter exploit-port-ff term exploitable-udp-ports-dst from destination-port 19
set firewall family inet filter exploit-port-ff term exploitable-udp-ports-dst from destination-port 135-139
set firewall family inet filter exploit-port-ff term exploitable-udp-ports-dst from destination-port 2049
set firewall family inet filter exploit-port-ff term exploitable-udp-ports-dst from destination-port 1434
set firewall family inet filter exploit-port-ff term exploitable-udp-ports-dst then count exploit-ports-WLdst
set firewall family inet filter exploit-port-ff term exploitable-udp-ports-dst then discard
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from protocol tcp
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from destination-port 445
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from destination-port 1025
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from destination-port 1337
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from destination-port 1433
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from destination-port 2745
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from destination-port 3001
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from destination-port 3127-3128
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from destination-port 5000
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from destination-port 6129
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from destination-port 7457
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from destination-port 11768
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst from destination-port 15118
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst then count exploit-ports-tcpWLdst
set firewall family inet filter exploit-port-ff term exploitable-tcp-ports-dst then discard
```

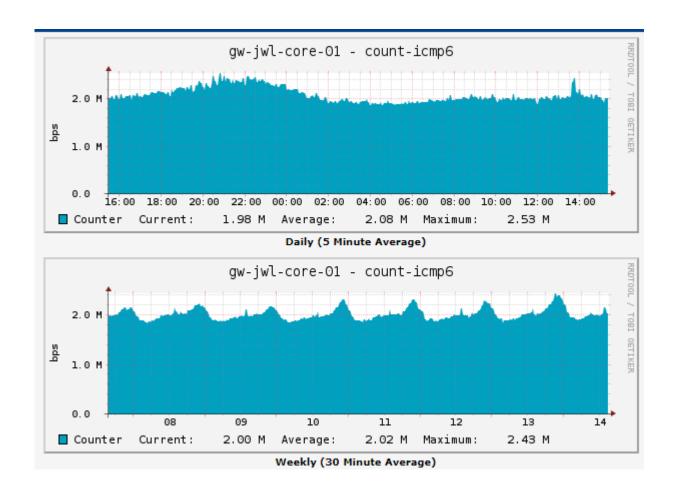
#### RPF Check on GW Router

```
set interfaces aell unit 1127 family inet rpf-check set interfaces aell unit 1127 family inet6 rpf-check
```



#### **Proactive Monitoring**

#### **Measure IPv6 ICMP Traffic**



#### **Few Statistics**





IPv6 Customer 100k

290k

44.0 6 52 22.0 6 52 11.0 6 0.0 6 22 0 2 4 6 10 12 14 15 18 20 27 0 2 4

Traffic Mix

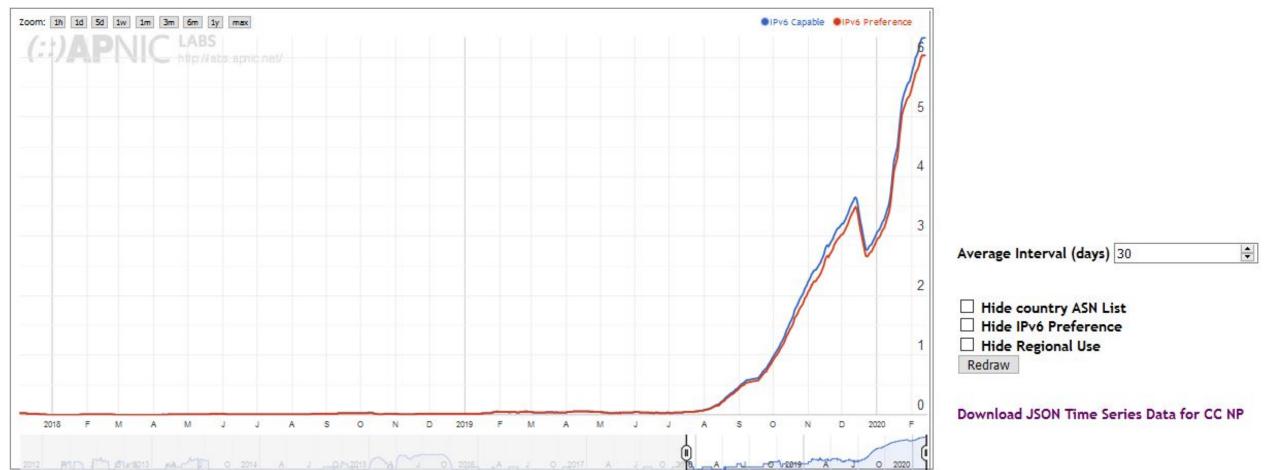
IPv6

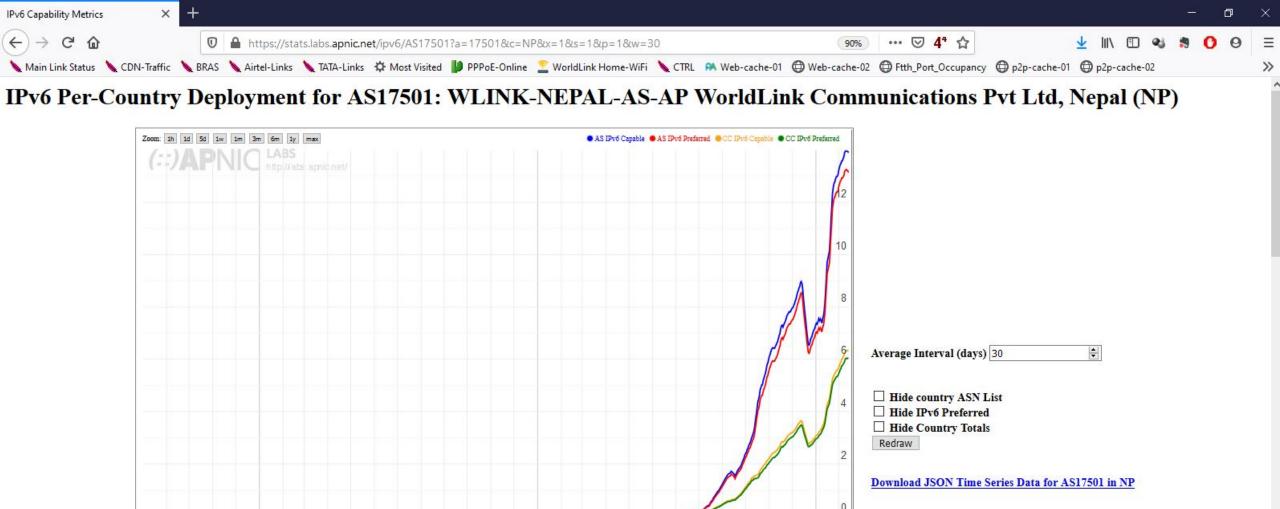
51%

IPv4

49%







J J A S O N D 2019 F



ASN	AS Name	IPv6 Capable	IPv6 Preferred	Samples
AS17501	WLINK-NEPAL-AS-AP WorldLink Communications Pvt Ltd	13.95%	13.18%	187,625
AS23752	NPTELECOM-NP-AS Nepal Telecommunications Corporation, Internet Services	0.02%	0.02%	65,884
AS4007	SUBISU-CABLENET-AS-AP Subisu Cablenet (Pvt) Ltd, Baluwatar, Kathmandu, Nepal		0.01%	50,886
AS45650	VIANET-NP Vianet Communications Pvt. Ltd.	0.01%	0.01%	42,698
AS38565	NCELL-AS-NP Ncell Pvt. Ltd.	0.01%	0.01%	29,183
AS55915	CLASSIC-NP Classic Tech Pvt. Ltd.	18.67%	18.38%	24,575
AS58504	TECHMINDS-NP TECHMINDS NETWORKS PVT. LTD.	0.01%	0.01%	21,991
AS24550	WEBSURFERNP-AS-NP Websurfer Nepal Internet Service Provider	0.01%	0.01%	15,716
AS55427	BROADLINK-AS-AP Broadlink Nepal	0.01%	0.01%	10,664
AS133149	KONNECTNEPAL-AS-AP Konnect Nepal Networks Pvt Ltd	0.02%	0.02%	6,281
AS136734	STPL-AS-AP Smart Telecom Pvt. Ltd	0.00%	0.00%	5,659
AS138388	POKHARA-AS-AP Pokhara Internet Pvt. Ltd.	0.00%	0.00%	3,475
AS63991	ARROWNETPVTLTD-NP Arrownet Pvt.Ltd	0.00%	0.00%	3,083
AS45845	NEPAL-IIG-AS NEPAL INTERNATIONAL INTERNET GATEWAY	0.00%	0.00%	2,089
AS137080	FCPL-AS-AP Firstlink Communications Pvt. Ltd.	13.58%	13.32%	1,885
AS135043	DOENPL-AS-AP DOEN Net Private Limited	0.15%	0.15%	1,341
AS56204	NETMAX-NP Net Max Technologies Pvt. Ltd.	0.00%	0.00%	1,245
AS137829	ACNPL-AS-AP Askina Cable Network Private Limited	0.00%	0.00%	1,114
AS138964	BARAHI-AS-AP Barahi Internet Technologies Pvt. Ltd.	0.00%	0.00%	1,111
AS135327	CWC-AS-AP Cherry World Communication Pvt Ltd	0.00%	0.00%	1,057
AS134995	IZONE-AS-AP I. ZONE PVT. LTD	0.00%	0.00%	966
AS136380	WEB-NETWORKS-AS-AP Web Networks Pvt. Ltd.	0.00%	0.00%	853
AS4613	MOS-NP Mercantile Office Systems	0.00%	0.00%	833
AS139741	WFNPL-AS-AP World Fiber Net Pvt. Ltd.	0.00%	0.00%	662
AS137880	PRIME-AS-AP Prime Network Pvt.ltd	0.00%	0.00%	521
AS133557	LOOPNET-AS-AP Loop Networks Pvt. Ltd.	0.00%	0.00%	488
AS136477	PSNPL-AS-AP P.D.S. Server Network Pvt. Ltd.	0.00%	0.00%	477
AS63968	RMIPL-NP Regmi Media Inc. Pvt. Ltd.	0.00%	0.00%	473
AS136530	ULTRANET-AS-AP Ultranet Communications	0.00%	0.00%	436
AS136763	UCPL-AS-AP Unified Communication Private Limited	0.00%	0.00%	393
S138185	COSMICNETPVTLTD-AS-AP COSMIC NET PRIVATE LIMITED	0.00%	0.00%	379
AS137209	ANT-AS-AP Allied Net Link Technology Pvt Ltd	0.00%	0.00%	377
AS138620	KDMPL-AS-AP Kriti Darshan Media Pvt. Ltd.	0.00%	0.00%	375
AS138500	FIBERTEL2-AS-AP FIBERTEL FIBERNET PVT. LTD	0.00%	0.00%	353
AS136908	SBPL-AS-AP Sky Broadband Pvt. Ltd	0.00%	0.00%	302
AS138495	ALISHA-AS-AP Alisha Communication Link Pvt.Ltd	0.00%	0.00%	268



#### Test your IPv6 connectivity.

Summary Tests Run Share Results / Contact Other IPv6 Sites

Your IPv4 address on the public Internet appears to be 27.34.8.104

Your IPv6 address on the public Internet appears to be 2400:1a00:b050:897e:6594:ec7a:dcca:7991

- Your Internet Service Provider (ISP) appears to be WLINK-NEPAL-AS-AP WorldLink Communications Pvt Ltd
- Since you have IPv6, we are including a tab that shows how well you can reach other IPv6 sites. [more info]
- HTTPS support on this web site is in beta. [more info]
- Your DNS server (possibly run by your ISP) appears to have IPv6 Internet access.

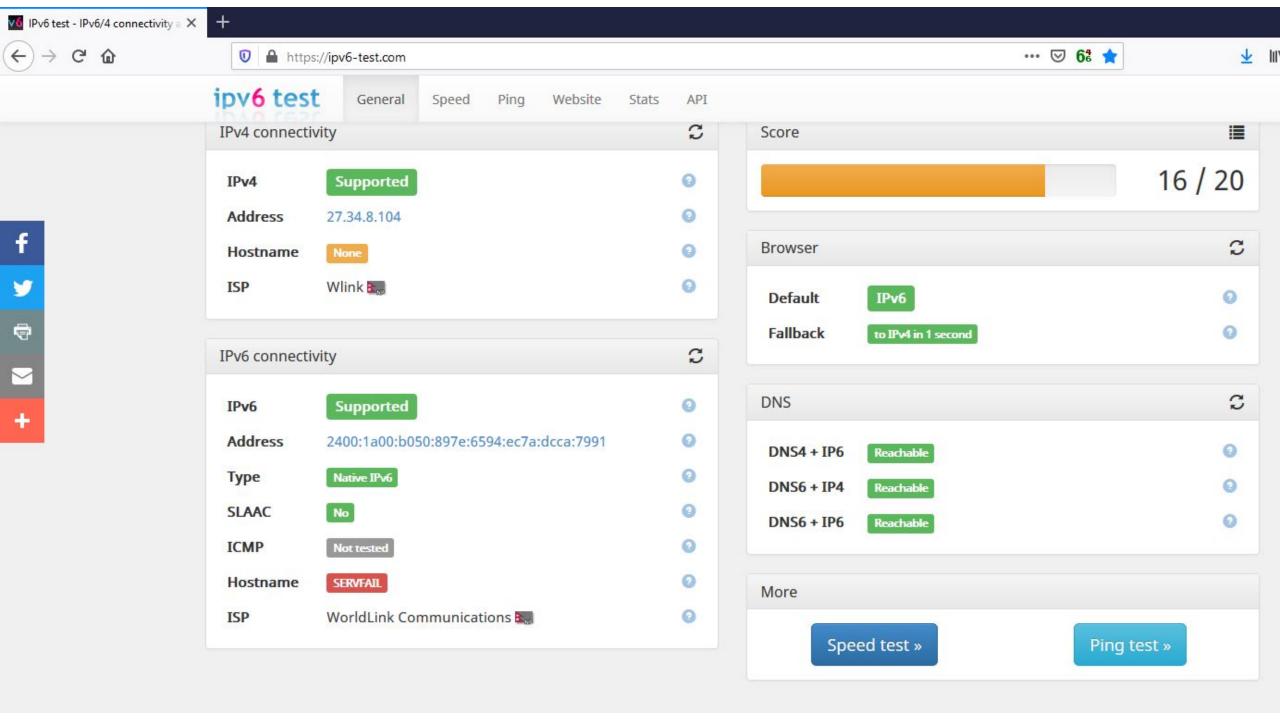
#### Your readiness score

10/10

for your IPv6 stability and readiness, when publishers are forced to go IPv6 only

Click to see Test Data

(Updated server side IPv6 readiness stats)



#### IP settings

IP assignment: Automatic (DHCP)

Edit

#### **Properties**

SSID: rabinmaharjan

Protocol: Wi-Fi 5 (802.11ac)

Security type: WPA2-Personal

Network band: 5 GHz

Network channel: 36

IPv6 address: 2400:1a00:b050:c906:a5ba:b0ee:871b:12f

2400:1a00:b050:c776:a5ba:b0ee:871b:12f

Link-local IPv6 address: fe80::a5ba:b0ee:871b:12f%20

IPv6 DNS servers: 2400:1a00:0:32::165

2400:1a00:8000:4::73 2400:1a00:0:32::165 2400:1a00:8000:4::73

IPv4 address: 192.168.1.72

IPv4 DNS servers: 192.168.1.254

Manufacturer: Intel Corporation

Description: Intel(R) Dual Band Wireless-AC 7260

Driver version: 18.33.17.1

Physical address (MAC): 28-B2-BD-00-80-A2

Сору

# on Laptop and Mobile at my home connection

9:02:36 😝 🚯 🕹 🌂 \* 🔊 🔻 🖊 🗸 44% 🖣 **Network details** Signal strength Excellent Frequency 5 GHz Security WPA/WPA2 PSK Metered **NETWORK DETAILS MAC** address 94:65:2d:f0:d2:54 IP address 192.168.1.74 Gateway 192.168.1.254 Subnet mask 255.255.255.0 2400:1a00:0:32::165 DNS 192.168.1.254 Link speed 866 Mbps

**IPV6 ADDRESSES** 

fe80::9665:2dff:fef0:d254 2400:1a00:b050:897e:9665:2dff:fef0:d254 2400:1a00:b050:897e:312e:dc97:839e:d59

```
C:\Users\rabindra>ping google.com

Pinging google.com [2404:6800:4009:809::200e] with 32 bytes of data:
Reply from 2404:6800:4009:809::200e: time=46ms
Reply from 2404:6800:4009:809::200e: time=55ms
Reply from 2404:6800:4009:809::200e: time=44ms
Reply from 2404:6800:4009:809::200e: time=49ms

Ping statistics for 2404:6800:4009:809::200e:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 44ms, Maximum = 55ms, Average = 48ms
```

#### Low Latency on V6 then V4

C:\Users\rabindra>

C:\Users\rabindra>

C:\Users\rabindra>ping google.com

Pinging google.com [172.217.27.206] with 32 bytes of data:

Reply from 172.217.27.206: bytes=32 time=51ms TTL=54

Reply from 172.217.27.206: bytes=32 time=53ms TTL=54

Ping statistics for 172.217.27.206:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 51ms, Maximum = 53ms, Average = 51ms

C:\Users\rabindra>

```
Microsoft Windows [Version 10.0.18362.476]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\rabindra>ping yahoo.com

Pinging yahoo.com [2001:4998:c:1023::5] with 32 bytes of data:
Reply from 2001:4998:c:1023::5: time=265ms
Reply from 2001:4998:c:1023::5: time=262ms
Reply from 2001:4998:c:1023::5: time=267ms
Reply from 2001:4998:c:1023::5: time=267ms

Ping statistics for 2001:4998:c:1023::5:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:

Minimum = 262ms, Maximum = 267ms, Average = 265ms
```

#### Low Latency on V6 then V4

```
C:\Users\rabindra>ping yahoo.com

Pinging yahoo.com [98.138.219.231] with 32 bytes of data:
Reply from 98.138.219.231: bytes=32 time=299ms TTL=51
Reply from 98.138.219.231: bytes=32 time=299ms TTL=51
Reply from 98.138.219.231: bytes=32 time=301ms TTL=51
Reply from 98.138.219.231: bytes=32 time=300ms TTL=51

Ping statistics for 98.138.219.231:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 299ms, Maximum = 301ms, Average = 299ms

C:\Users\rabindra>
```

```
; <<>> DiG 9.8.2rc1-RedHat-9.8.2-0.62.rc1.el6 9.5 <<>> wlink.com.np NS
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 3848
;; flags: qr rd ra; QUERY: 1, ANSWER: 3, AUTHORITY: 0, ADDITIONAL: 6
;; QUESTION SECTION:
;wlink.com.np.
                                 IN
                                         NS
;; ANSWER SECTION:
wlink.com.np.
                        510
                                IN
                                         NS
                                                 dns3.wlink.com.np.
                                IN
                                         NS
wlink.com.np.
                        510
                                                 ram.wlink.com.np.
wlink.com.np.
                        510
                                IN
                                         NS
                                                 krishna.wlink.com.np.
;; ADDITIONAL SECTION:
                        18
ram.wlink.com.np.
                                 IN
                                                 202.79.32.33
ram.wlink.com.np.
                                         AAAA
                        712
                                IN
                                                 2400:1a00:0:32::33
                        157
                                IN
                                                 202.79.32.35
dns3.wlink.com.np.
dns3.wlink.com.np.
                        734
                                IN
                                         AAAA
                                                 2400:1a00:0:32::35
krishna.wlink.com.np.
                        157
                                IN
                                                 202.79.32.34
                        712
krishna.wlink.com.np.
                                 IN
                                         AAAA
                                                 2400:1a00:0:32::34
;; Query time: 0 msec
;; SERVER: 202.79.32.97#53(202.79.32.97)
;; WHEN: Fri Dec 13 14:12:19 2019
;; MSG SIZE rcvd: 221
```

[rabindra@log ~]\$ dig wlink.com.np NS

# AAAA record For Wlink website

[rabindra@log ~]\$ dig AAAA wlink.com.np +short 2400:1a00:8000:4::70

## 

### Thank You!!