



Network Report

btNOG 13

RIM & RUB OVC, Thimphu

23rd – 28th August 2026

Workshop & Conference Network

- Connectivity sponsored by Bhutan Telecom
- Dual stack network
 - Public /24 for IPv4
 - /64 for IPv6
- We decided to deploy “IPv6 mostly”
- This means:
 - Devices that support will only use IPv6
 - Devices that do not support will use:
 - dual-stack (if they can)
 - IPv4 (if they don't support IPv6)



“IPv6 mostly”: interface configuration

```
interface FiveGigabitEthernet0/0/0
ip address 163.227.23.1 255.255.255.0
ip verify unicast source reachable-via rx
nat64 enable
ipv6 address 2405:D000:1234:AB23::1/64
ipv6 nd ra nat64-prefix 64:FF9B::/96
ipv6 nd ra dns server 2405:D000:0:100::214
ipv6 nd ra dns server 2405:D000:0:100::228
ipv6 nd ra dns server 2405:D000:0:100::205
ipv6 verify unicast source reachable-via rx
!
interface GigabitEthernet0/0/5
description | Link to UPLINK |
ip address 163.227.22.50 255.255.255.252
nat64 enable
ipv6 address 2405:D000:1237:1111::1/64
!
```

Cisco IOS-XE
17.18(2)

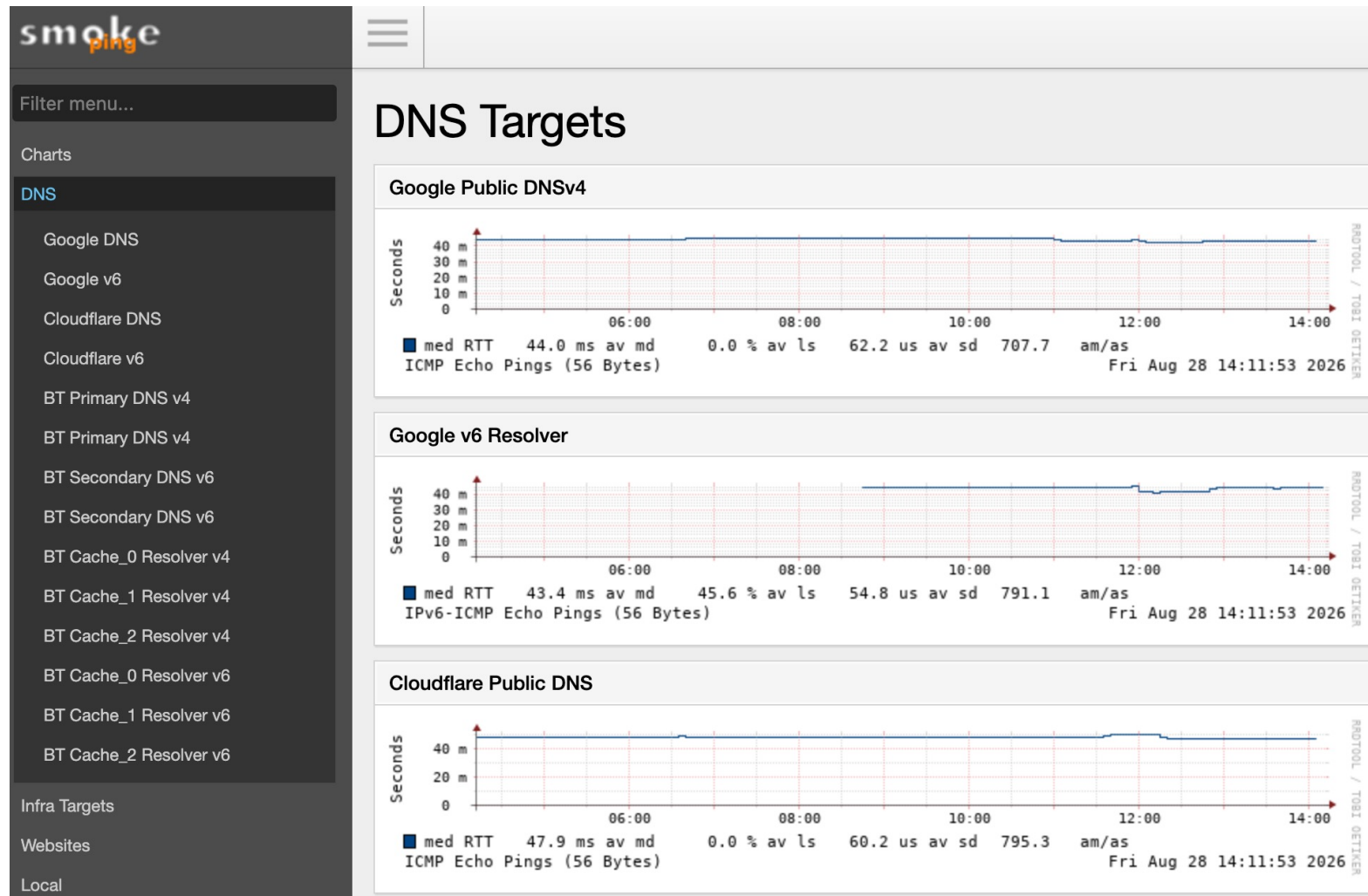


“IPv6 mostly”: nat64 configuration

```
ip dhcp pool BTNOG13
  network 163.227.23.0 255.255.255.0
  default-router 163.227.23.1
  domain-name druknet.bt
  dns-server 202.144.128.214 202.144.128.228 202.144.128.205
  option 108 hex 0000.1518
  lease 0 1
!
ipv6 access-list NAT64-C
  sequence 10 permit ipv6 2405:D000:1234:AB23::/64 any
!
nat64 v4 pool NAT64-P 163.227.24.0 163.227.24.255
nat64 v6v4 list NAT64-C pool NAT64-P overload
nat64 settings fragmentation header disable
!
```

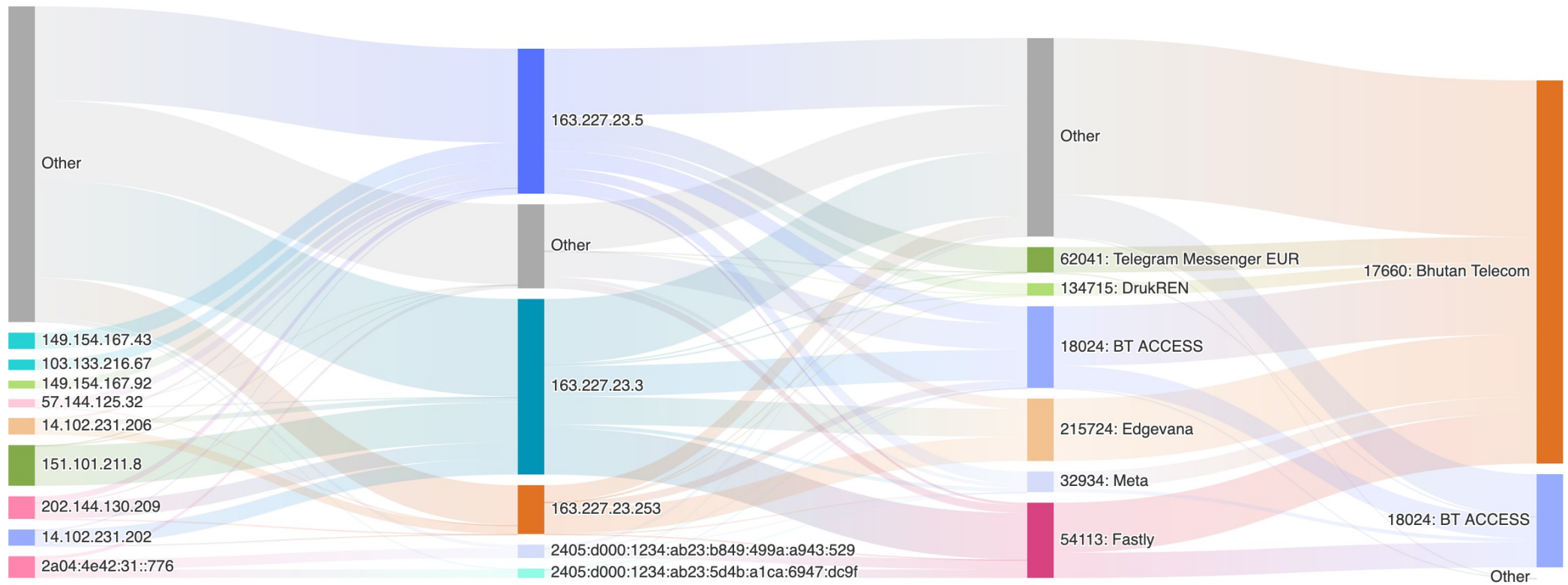


Monitoring Tools: Smokeping



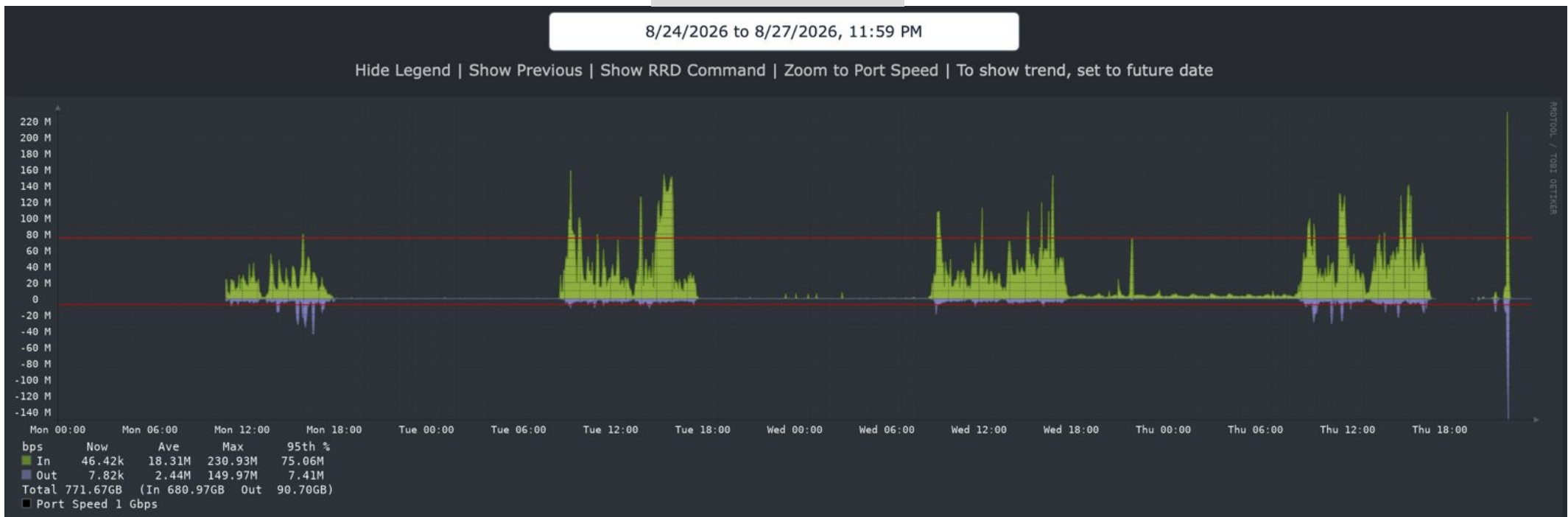
Monitoring Tools: Akvorado

August 25, 2026 7:46 AM — 1:46 PM Sankey ↑ 10 # L3% ↓ SrcAddr, DstAddr, SrcAS, DstAS InIfBoundary = external



Monitoring Tools: LibreNMS

Traffic levels
during Workshops



What we saw

- During the conference, most users on v6 mostly
- The below were not:
 - Yes, really, that's all. 130+ in the OVC conference hall

```
btnog13#sh ip dhcp binding | i Active
```

163.227.23.19	0184.7848.d8e0.88	Aug 28 2026 12:27 PM	Automatic	Active	FiveGigabitEthernet0/0/0
163.227.23.22	01dc.4628.66c8.53	Aug 28 2026 12:51 PM	Automatic	Active	FiveGigabitEthernet0/0/0
163.227.23.31	0128.704e.8c9b.99	Aug 28 2026 12:27 PM	Automatic	Active	FiveGigabitEthernet0/0/0
163.227.23.33	0184.7848.d8ca.78	Aug 28 2026 12:27 PM	Automatic	Active	FiveGigabitEthernet0/0/0
163.227.23.43	017c.5079.ad0b.38	Aug 28 2026 12:50 PM	Automatic	Active	FiveGigabitEthernet0/0/0
163.227.23.113	01dc.4628.6dee.bc	Aug 28 2026 12:55 PM	Automatic	Active	FiveGigabitEthernet0/0/0
163.227.23.121	011e.9b97.27fa.9a	Aug 28 2026 12:41 PM	Automatic	Active	FiveGigabitEthernet0/0/0
163.227.23.152	0168.c6ac.5491.c4	Aug 28 2026 12:44 PM	Automatic	Active	FiveGigabitEthernet0/0/0
163.227.23.162	016c.f6da.854a.12	Aug 28 2026 12:46 PM	Automatic	Active	FiveGigabitEthernet0/0/0
163.227.23.215	0150.bbb5.4173.30	Aug 28 2026 12:46 PM	Automatic	Active	FiveGigabitEthernet0/0/0



What we saw

- What about NAT64?

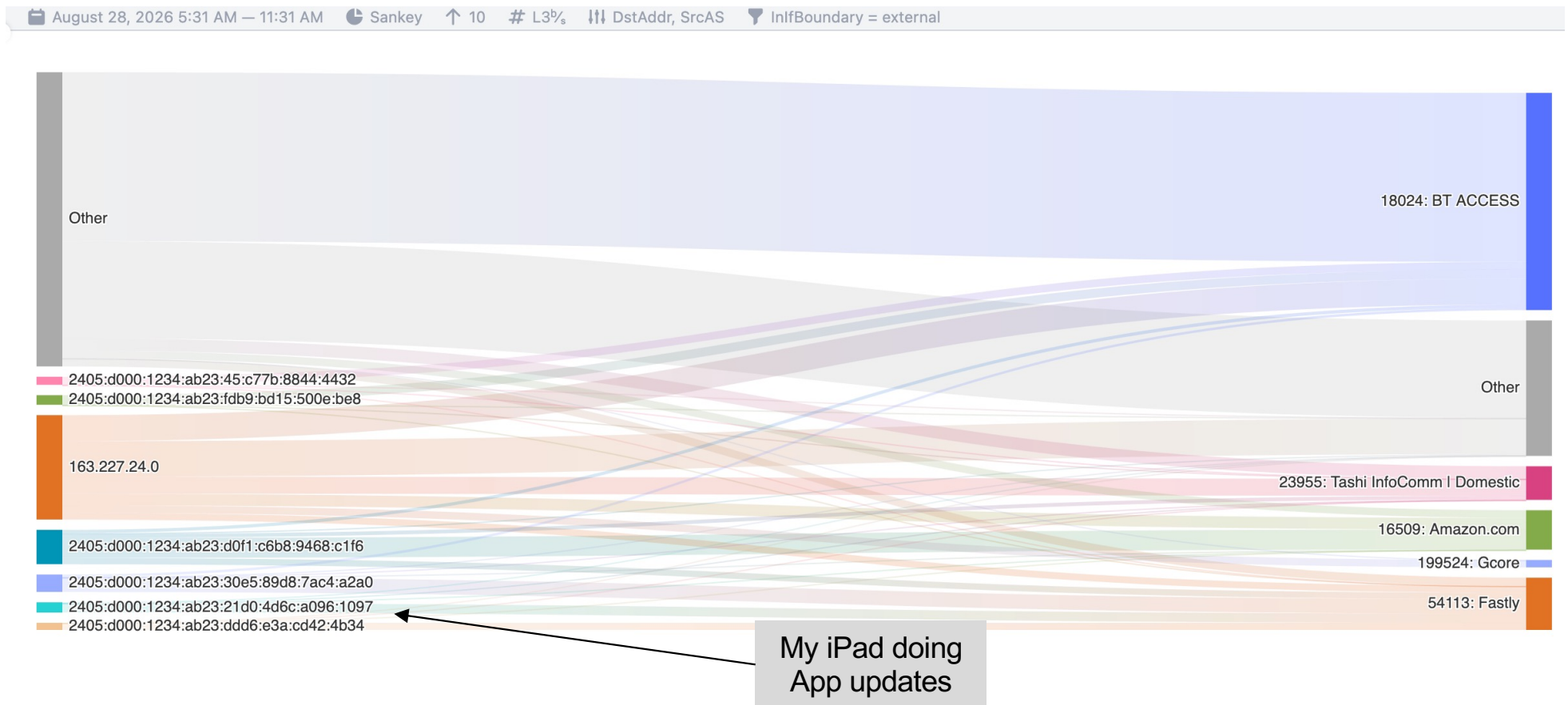
```
btnog13#sh nat64 translations total
```

```
Total number of translations: 9425
```

Proto	Original IPv4 Translated IPv6	Translated IPv4 Original IPv6
tcp	64.86.217.8:443	[64:ff9b::4056:d908]:443
	163.227.24.0:56992	[2405:d000:1234:ab23:c05d:1b2b:ff2f:8c51]:55657
tcp	57.144.243.32:443	[64:ff9b::3990:f320]:443
	163.227.24.0:45528	[2405:d000:1234:ab23:e14f:8221:fc5c:aed8]:45528
tcp	35.199.147.118:443	[64:ff9b::23c7:9376]:443
	163.227.24.0:58989	[2405:d000:1234:ab23:d8ed:1633:9203:3913]:58989
tcp	52.123.129.14:443	[64:ff9b::347b:810e]:443
	163.227.24.0:58321	[2405:d000:1234:ab23:14de:a598:665b:5bdf]:58321
tcp	129.226.103.182:443	[64:ff9b::81e2:67b6]:443
	163.227.24.0:58316	[2405:d000:1234:ab23:eb12:4ea4:65b7:6de1]:58316
tcp	52.22.41.97:443	[64:ff9b::3416:2961]:443
	163.227.24.0:54898	[2405:d000:1234:ab23:ecc2:be1:998e:403d]:54898
tcp	34.54.123.167:443	[64:ff9b::2236:7ba7]:443
	163.227.24.0:43078	[2405:d000:1234:ab23:b807:ed76:fd28:8db9]:43078
tcp	101.32.104.41:80	[64:ff9b::6520:6829]:80
	163.227.24.0:45712	[2405:d000:1234:ab23:4f83:8aed:8deb:a64a]:45712

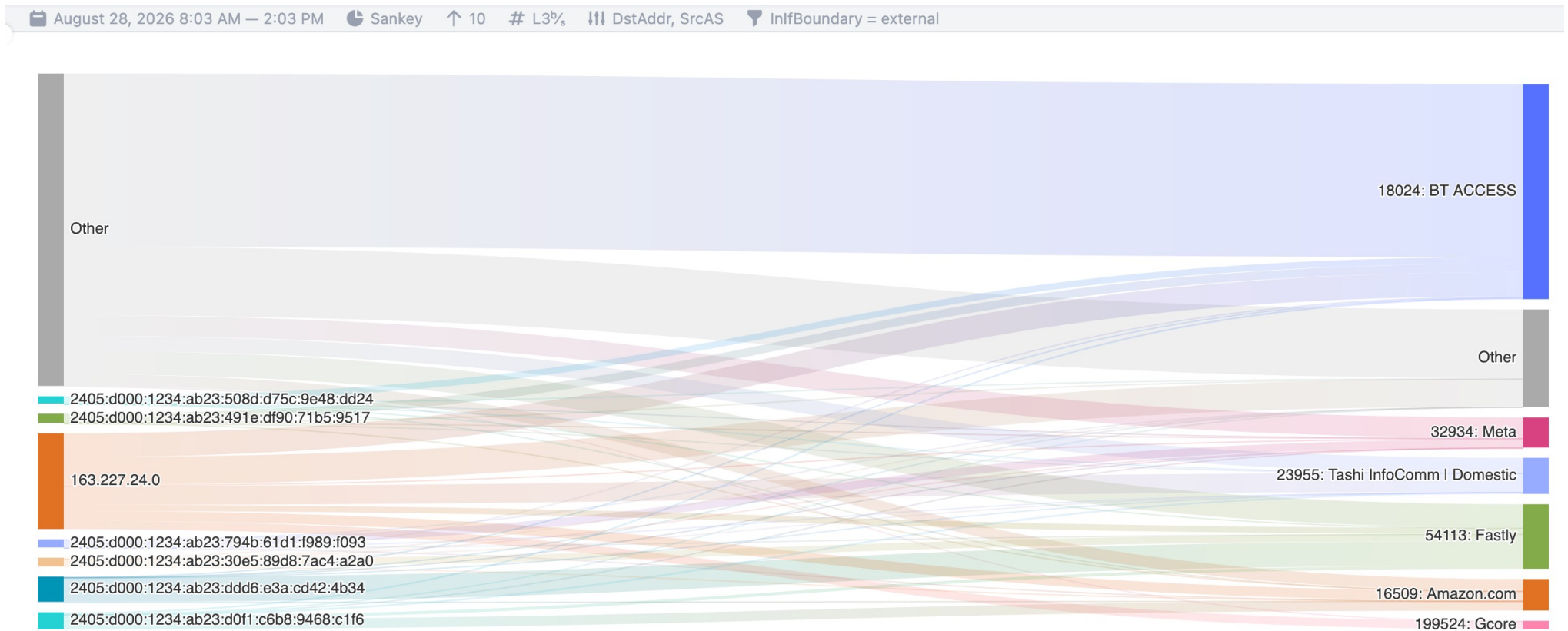
What we saw

- Akvorado Sankey diagram



What we saw

- Akvorado Sankey diagram



Were there problems?

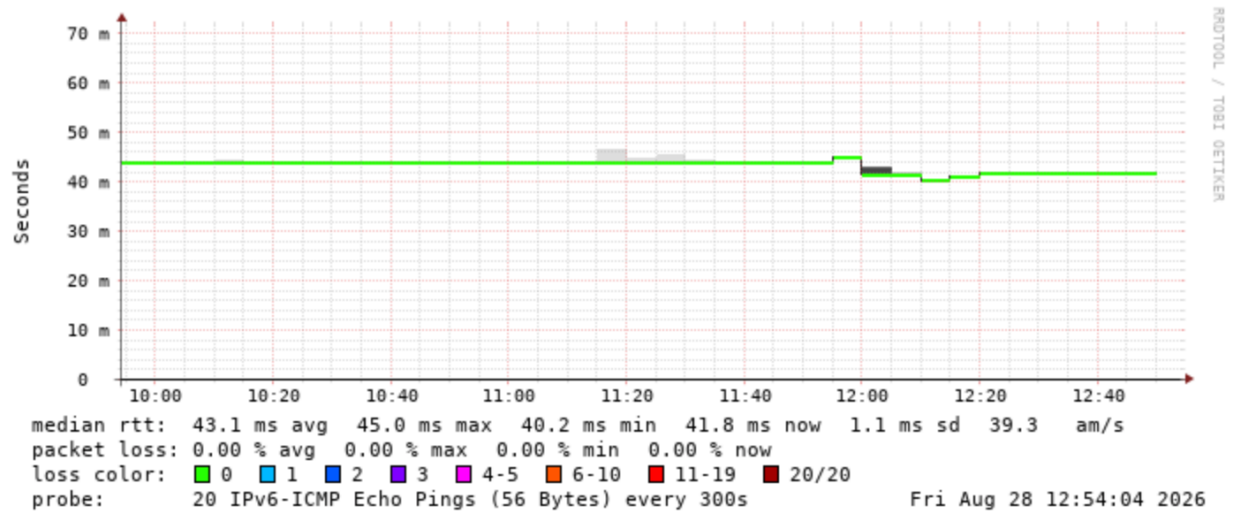
Initial routing issues for the IPv6 /64 assigned by BT meant that their IPv6 resolvers were often unreachable early during BTNOG workshops.

Which meant we had to use Google resolvers in Mumbai (43ms away) until the issue was resolved

No resolver means no IPv6 (nor v6mostly)

Google v6 Resolver

Last 3 Hours from smokeping

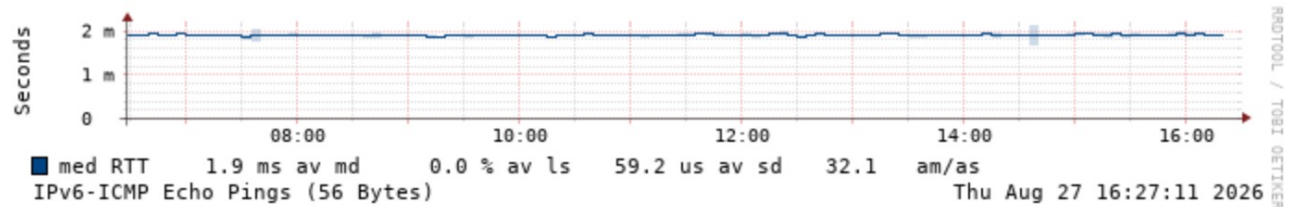


Were there problems?

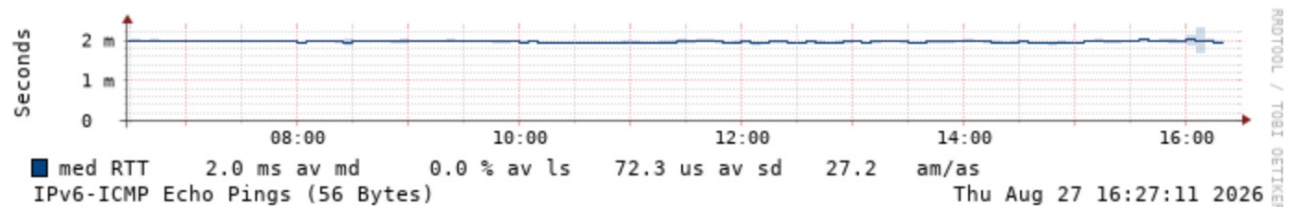
Once routing issues resolved,
we moved to using the BT
resolvers

Smokeping screenshot from
27th August

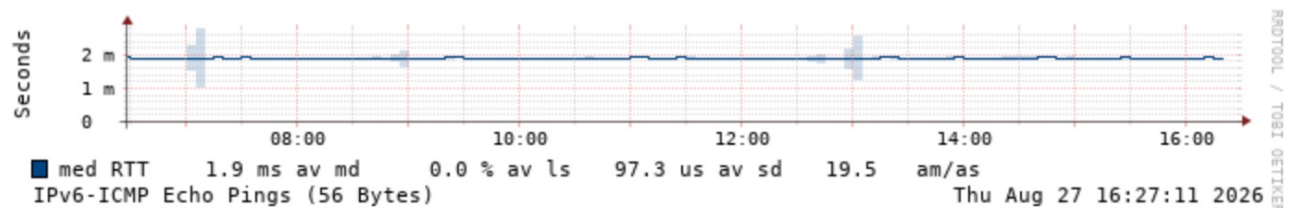
BT Cache_0 Resolver v6



BT Cache_1 Resolver v6



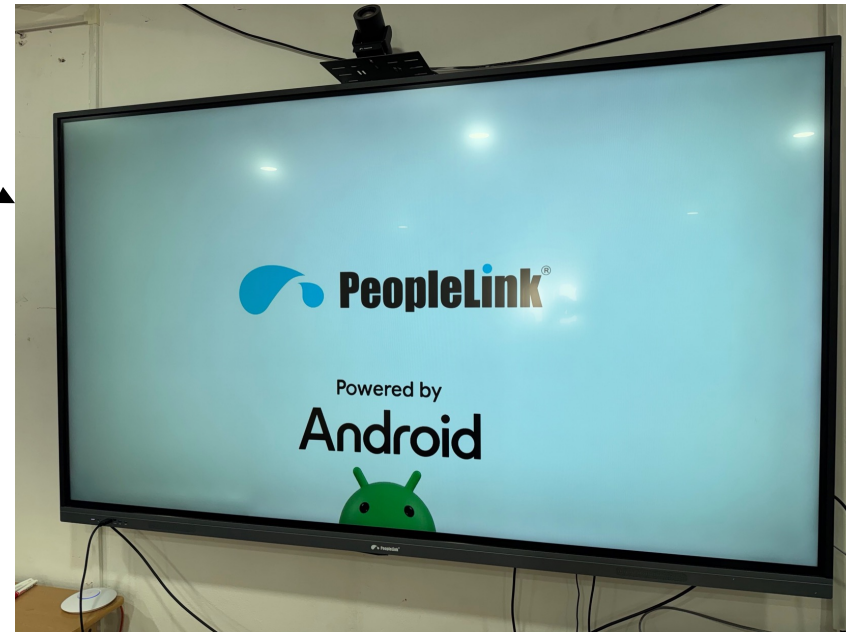
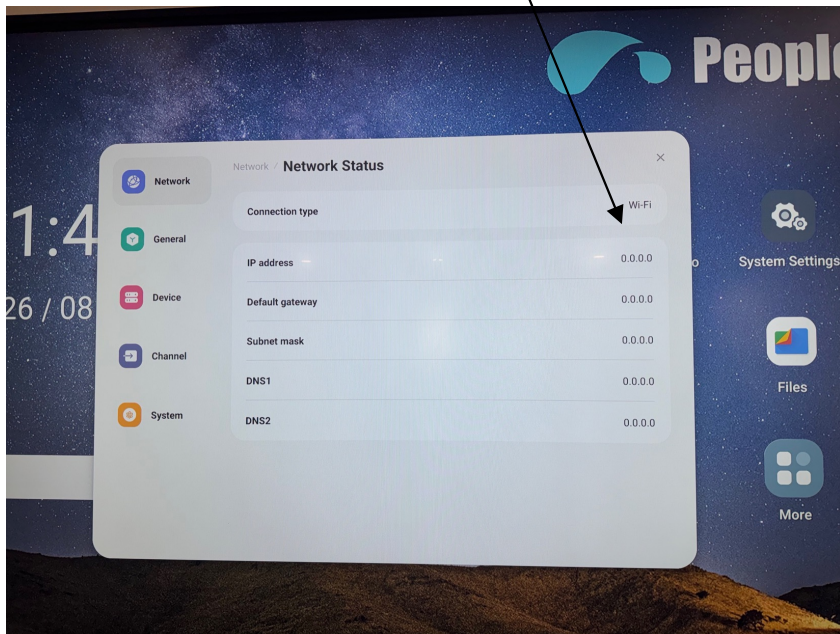
BT Cache_2 Resolver v6



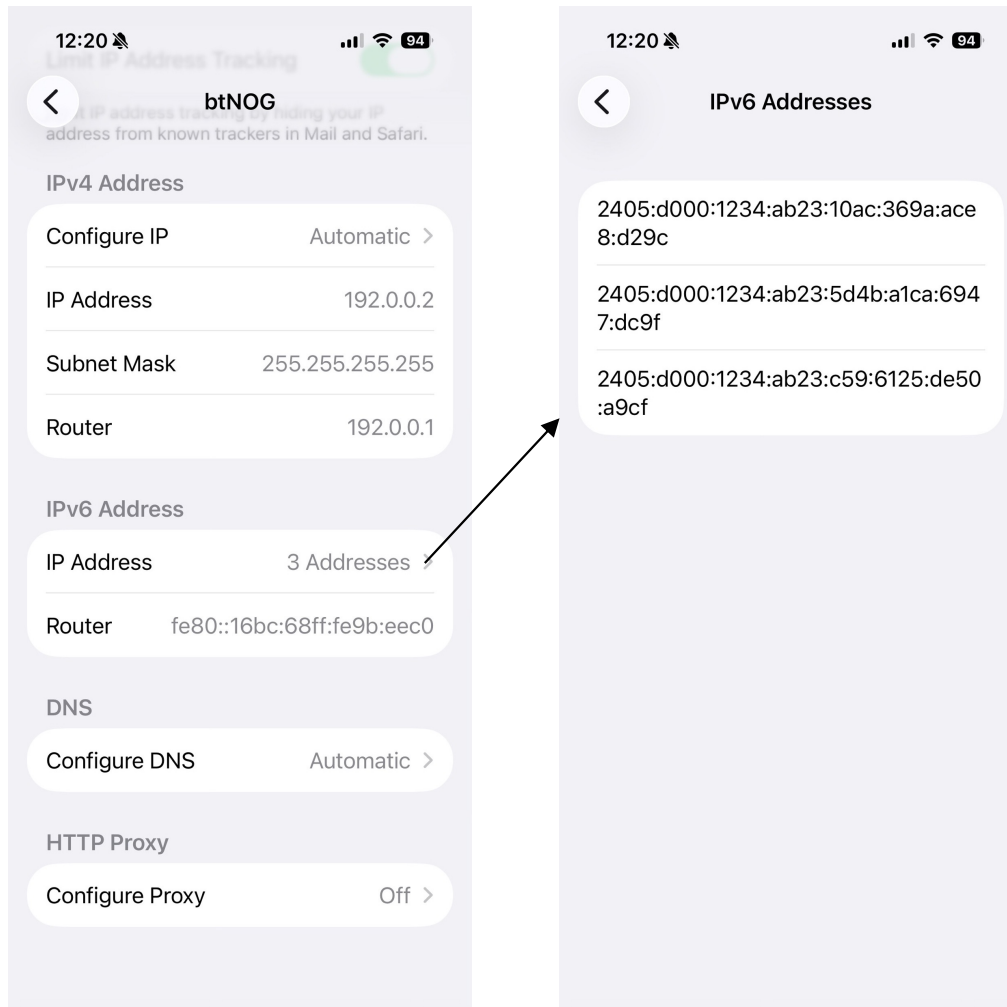
Were there problems?

Android means dual stack and v6 mostly support?

NO!!!!



What users see on devices



Wi-Fi network
configuration settings

iPhone with iOS 26.6.1



What users see on devices

```
philip@pfs-mbp ~ % ifconfig en0
en0: flags=88e3<UP,BROADCAST,SMART,RUNNING,NOARP,SIMPLEX,MULTICAST> mtu 1500
    options=6460<TS04,TS06,CHANNEL_IO,PARTIAL_CSUM,ZEROINVERT_CSUM>
    ether [REDACTED]
    inet6 [REDACTED]7%en0 prefixlen 64 secured scopeid 0x6
    inet6 2405:d000:1234:ab23:c3c:4d37:dece:51cb prefixlen 64 autoconf secured
    inet6 2405:d000:1234:ab23:9d5a:d172:25f3:5ac0 prefixlen 64 autoconf temporary
    inet 192.0.0.2 netmask 0xffffffff broadcast 192.0.0.2
    inet6 2405:d000:1234:ab23:10fc:a254:50ec:5bc5 prefixlen 64 clat46
    nat64 prefix 64:ff9b:: prefixlen 96
    nd6 options=201<PERFORMNUD,DAD>
    media: autoselect
    status: active
```

Wi-Fi network configuration settings

MacBook Pro laptop with macOS 26.6.1



BTNOG13 Wi-Fi @ OVC



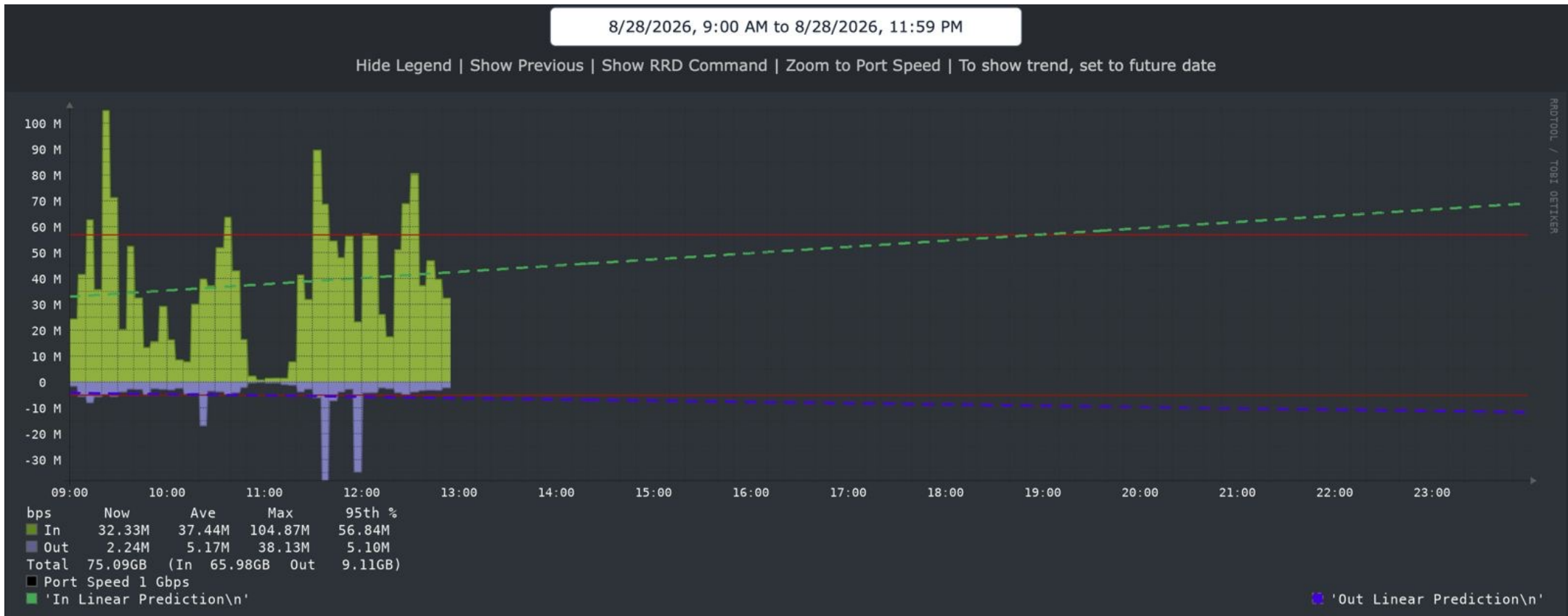
BTNOG13 Wi-Fi @ OVC

btNOG UniFi OS Server											
Network											
UniFi											
Name	Connection	IPv6 Address	WiFi	Experien...	Technol...	Channel	IP Addr...	Activity	Downlo...	Netw...	Vend
0a:c3:f9:ae:9e:...	AP-3 (Upper)	2405:d000:1234:ab23:491:87...	btNOG	Poor	WiFi 7, 2x2	40 (5 GHz, 40 MHz)	163.227.23.133	48 bps	↓ 48 bps	-	-
1e:9b:97:27:fa:9a	AP-2 (Middle)	2405:d000:1234:ab23:2088:b...	btNOG	Excellent	WiFi 6, 2x2	117 (6 GHz, 160 MHz)	163.227.23.121	0 bps	↓ 0 bps	-	-
201007028-Ga...	AP-1 (FRONT)	2405:d000:1234:ab23:eda5:e...	btNOG	Excellent	WiFi 5, 1x1	149 (5 GHz, 40 MHz)	163.227.23.61	0 bps	↓ 0 bps	-	-
ae:fc:f0:05:3b:...	AP-2 (Middle)	2405:d000:1234:ab23:1461:8...	btNOG	Excellent	WiFi 7, 2x2	44 (5 GHz, 40 MHz)	163.227.23.120	344 bps	↓ 200 bps	-	-
Akaa-Rii-17 2a...	AP-1 (FRONT)	2405:d000:1234:ab23:1621:6...	btNOG	Poor	WiFi 5, 1x1	149 (5 GHz, 40 MHz)	163.227.23.134	0 bps	↓ 0 bps	-	-
BT-843 ee:bc	AP-3 (Upper)	2405:d000:1234:ab23:b44a:b...	btNOG	Excellent	WiFi 6, 2x2	37 (6 GHz, 160 MHz)	163.227.23.113	65.3 Kbps	↓ 20.8 Kbps	-	Intel
Choki-s-A55 a...	AP-1 (FRONT)	2405:d000:1234:ab23:981d:9...	btNOG	Excellent	WiFi 6, 2x2	149 (5 GHz, 40 MHz)	163.227.23.94	171 Kbps	↓ 94.3 Kbps	-	-
dBas 4d:5d	AP-2 (Middle)	2405:d000:1234:ab23:586b:9...	btNOG	Excellent	WiFi 6, 2x2	44 (5 GHz, 40 MHz)	163.227.23.29	88 bps	↓ 40 bps	-	-
Dechen-s-A07...	AP-2 (Middle)	2405:d000:1234:ab23:4951:ff...	btNOG	Excellent	WiFi 5, 1x1	44 (5 GHz, 40 MHz)	163.227.23.23	6.44 Mbps	↓ 6.41 Mbps	-	-
Durga-Ghalley...	AP-2 (Middle)	2405:d000:1234:ab23:7143:5...	btNOG	Excellent	WiFi 6, 2x2	44 (5 GHz, 40 MHz)	163.227.23.25	0 bps	↓ 0 bps	-	-
e2:ff:8f:fe:86:67	AP-1 (FRONT)	2405:d000:1234:ab23:1852:7f...	btNOG	Excellent	WiFi 6, 2x2	69 (6 GHz, 160 MHz)	163.227.23.98	0 bps	↓ 0 bps	-	-
f2:42:ea:5b:98...	AP-2 (Middle)	2405:d000:1234:ab23:1875:5...	btNOG	Excellent	WiFi 6, 1x1	6 (2.4 GHz, 20 MHz)	163.227.23.23	640 bps	↓ 440 bps	-	-
Galaxy-A23 b4...	AP-2 (Middle)	2405:d000:1234:ab23:8df1:c6...	btNOG	Excellent	WiFi 5, 1x1	44 (5 GHz, 40 MHz)	163.227.23.28	0 bps	↓ 0 bps	-	-
Galaxy-A55-5...	AP-2 (Middle)	2405:d000:1234:ab23:3f14:cc...	btNOG	Excellent	WiFi 6, 2x2	44 (5 GHz, 40 MHz)	163.227.23.241	22.5 Kbps	↓ 7.14 Kbps	-	-
HONOR-X9d 9...	AP-3 (Upper)	2405:d000:1234:ab23:7b2e:6...	btNOG	Excellent	WiFi 6, 1x1	40 (5 GHz, 40 MHz)	163.227.23.218	824 bps	↓ 240 bps	-	-
ICTSampaDhe...	AP-3 (Upper)	2405:d000:1234:ab23:a15c:c...	btNOG	Excellent	WiFi 6, 2x2	11 (2.4 GHz, 20 MHz)	163.227.23.43	2.76 Kbps	↓ 1.39 Kbps	-	Intel
iPad 06:ed	AP-1 (FRONT)	2405:d000:1234:ab23:8d9:71...	btNOG	Poor	WiFi 6, 2x2	149 (5 GHz, 40 MHz)	163.227.23.112	0 bps	↓ 0 bps	-	-
iPad 98:77	AP-1 (FRONT)	2405:d000:1234:ab23:8b1:5a...	btNOG	Excellent	WiFi 6, 2x2	149 (5 GHz, 40 MHz)	163.227.23.207	0 bps	↓ 0 bps	-	-
iPad ab:93	AP-1 (FRONT)	2405:d000:1234:ab23:7438:4...	btNOG	Poor	WiFi 7, 2x2	149 (5 GHz, 40 MHz)	163.227.23.187	0 bps	↓ 0 bps	-	-

1-100 of 127 Client Devices Rows Per Page: 100



BTNOG13 Wi-Fi @ OVC



BTNOG13 Wi-Fi @ OVC

All

2.4 GHz

5 GHz

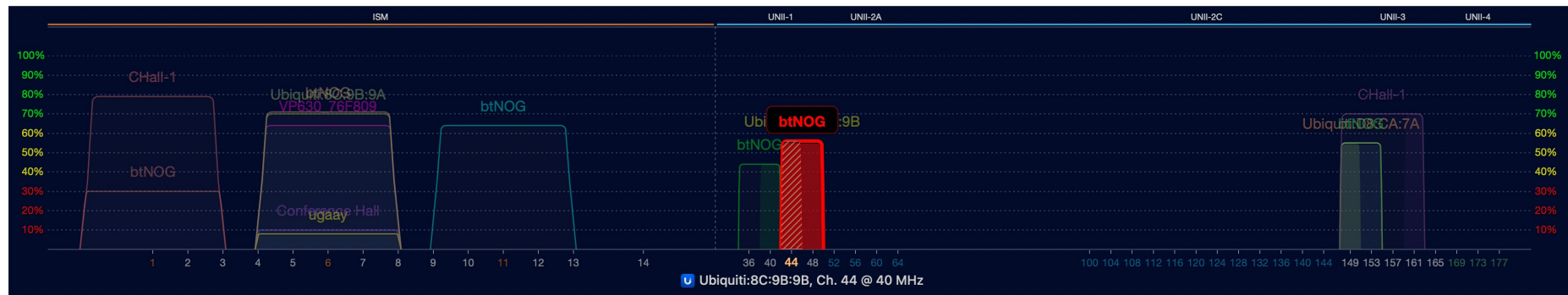
Open

Secure

Filter

BSSID	Network Name	Vendor	Signal	Cha...	Channel Width	Band	Country Code	Mode	Generation	Security	Max Rate	Seen	
00:04:56:AC:FD:F0	CHall-1	Cambium Networks	70%	161	80 MHz	5 GHz	BT	a/n/ac	5	WPA2 (PSK)	866.7 Mbps	Just now	
84:78:48:D8:CA:7A	btNOG	Ubiquiti Networks	55%	149	40 MHz	5 GHz	US	a/n/ac/ax/be	7	WPA2/WPA3 (P...	688.2 Mbps	Just now	
8A:78:48:D8:CA:7A	Hidden Network	Ubiquiti Networks	55%	149	40 MHz	5 GHz	US	a/n/ac/ax/be	7	WPA2 (PSK)	688.2 Mbps	Just now	
8E:78:48:D8:CA:7A	Hidden Network	Ubiquiti Networks	55%	149	40 MHz	5 GHz	US	a/n/ac/ax/be	7	WPA2 (PSK)	688.2 Mbps	Just now	
2E:70:4E:8C:9B:9B	btNOG	Ubiquiti Networks	56%	44	40 MHz	5 GHz	US	a/n/ac/ax...	7	WPA2/WPA3 (...)	688.2 Mbps	Just now	
28:70:4E:8C:9B:9B	Hidden Network	Ubiquiti Networks	56%	44	40 MHz	5 GHz	US	a/n/ac/ax/be	7	WPA2 (PSK)	688.2 Mbps	Just now	
84:78:48:D8:E0:8A	btNOG	Ubiquiti Networks	44%	40	40 MHz	5 GHz	US	a/n/ac/ax/be	7	WPA2/WPA3 (P...	688.2 Mbps	Just now	
8A:78:48:D8:E0:8A	Hidden Network	Ubiquiti Networks	36%	40	40 MHz	5 GHz	US	a/n/ac/ax/be	7	WPA2 (PSK)	688.2 Mbps	10 sec ago	
84:78:48:D8:E0:89	btNOG	Ubiquiti Networks	64%	11	20 MHz	2.4 GHz	US	b/g/n/ax/be	7	WPA2/WPA3 (P...	286.8 Mbps	Just now	
8A:78:48:D8:E0:89	Hidden Network	Ubiquiti Networks	61%	11	20 MHz	2.4 GHz	US	b/g/n/ax/be	7	WPA2 (PSK)	286.8 Mbps	10 sec ago	
5E:8C:30:48:20:A5	Hidden Network	T&W Electronics	1%	11	20 MHz	2.4 GHz	IN	b/g/n	4	WPA2 (PSK)	144.4 Mbps	10 sec ago	
70:A5:6A:A2:14:07	Kezang Dee	C-Data Technology	1%	11	20 MHz	2.4 GHz	C1	b/g/n	4	WPA (PSK)	144.4 Mbps	10 sec ago	
2E:70:4E:8C:9B:9A	btNOG	Ubiquiti Networks	71%	6	20 MHz	2.4 GHz	US	b/g/n/ax/be	7	WPA2/WPA3 (P...	286.8 Mbps	Just now	
28:70:4E:8C:9B:9A	Hidden Network	Ubiquiti Networks	70%	6	20 MHz	2.4 GHz	US	b/g/n/ax/be	7	WPA2 (PSK)	286.8 Mbps	Just now	
8E:AA:B5:76:F8:09	VP630_76F809	Espressif	64%	6	20 MHz	2.4 GHz	CN	b/g		WPA/WPA2 (PS...	54 Mbps	Just now	
D6:21:F9:2D:F2:D2	Conference Hall	Ubiquiti Networks	10%	6	20 MHz	2.4 GHz	BT	b/g/n	4	WPA2 (PSK)	216.7 Mbps	Just now	
6A:5D:9A:2F:C0:14	ugaay	Ubiquiti Networks	8%	6	20 MHz	2.4 GHz		b/g/n	4	WPA2 (PSK)	96.3 Mbps	Just now	
00:04:56:AC:BB:10	CHall-1	Cambium Networks	79%	1	20 MHz	2.4 GHz	BT	b/g/n	4	WPA2 (PSK)	144.4 Mbps	Just now	
8A:78:48:D8:CA:79	Hidden Network	Ubiquiti Networks	40%	1	20 MHz	2.4 GHz	US	b/g/n/ax/be	7	WPA2 (PSK)	286.8 Mbps	10 sec ago	
84:78:48:D8:CA:79	btNOG	Ubiquiti Networks	30%	1	20 MHz	2.4 GHz	US	b/g/n/ax/be	7	WPA2/WPA3 (P...	286.8 Mbps	Just now	

Network DetailsSignal StrengthSpectrum 2.4 / 5 GHzAdvanced Details



Summary

- Success!
- Challenges with IPv6 reliability of upstream link initially
 - Happy-eyeballs meant only v6mostly users noticed
- Wi-Fi working extremely well
- Conference users
 - Did anyone notice we used v6mostly?

