ISLANDS IN THE IPV6 WORLD
GOAL: NATIVE IPV6

BIGGEST OBSTACLES:

-NOT UNEDUCATED BUT UNAWARENESS.

-THESE ARE THE ONLY WORDS COMES TO MINE WHEN I DID THIS PRESENTATION.

THE CASE FOR SOME PACIFIC ISLANDS.

- The Technology is Ready. As it has been in the Internet World for over 2 decades ago.

1. Most Network Devices on Service Provider Network among Smaller Island Nations sits there with IPv6 Capability, yet never being used.
2. I also believe most will be as it is for years to come.
3. Some Provider may have Customer never ask for IPv6 Service, therefore not bother to enable the technology.
4. Even both Customer and Service did upgrade their Network and still not bother to enable IPv6.
5. I believe there will never be a greater reason to do so than pressure from Public WWW Internet at large.
6. For instance if FB, Google, or major Content Provider totally block v4 and allow only v6. Or maybe v6 content priority over v4 etc …that's just my impossible personal imagination though.!!! ☺ ..
7. I understand this is just my imagination but I am just curious why of the reason why not enable IPv6 in smaller islands like mine.
8. So what we should do, just keep waiting till everyone hop in so we can join them …..
9. For TCC my employer in my island kingdom (Tonga) that is not the case anymore.
10. We will start deploy, not just on some P-T-P links on our Core, but to the Customer with Dual Stack.

UNAWARENESS IN PACIFIC SMALLER IS SPECIFICALLY TONGA ???

- There is a reason why I will spend a minute on this notion. It is just to break the ice.
- IPV6 is not only for big providers, it is not only for 1st world Economy, the good people who design and make it intents to reach every corner on this earth.
- It is no longer us in the remotes islands nations of the world look at it as before.
- But we should know it is besides your door. Ready to be opened for you.
- One way of the other your upstream already have it, or your upstream upstream does as well.
- Its just you and me need to Enable it.
- It is not TRUE that we have not been informed about IPV6 since it has been Started.
- Several Training previously conduct in Tonga for general Government Entities was IPv6 Related.
- NGN Training (2004-2005)
- Few PAC Nog's from previous years was held in Tonga.
- Not only that but other training Resource not mention here.
- Even APNIC have done several Onsite Training regarding the Technology in several Small Island Nations like us and many others.

TONGA IN THE IPV6 WORLD
→A BIT MORE HISTORY INTERNET IN TONGA

Case for Tonga Communication Corporation

- ISP Start by British Company Cable and Wireless 1997/98 Dial Up
- First Email Server as well around at the same time.
- 1999 few Copper DSL 32,64,128 kbps(Single Cisco Router) . Single Cisco 2800
- 2000-2006 Wimax and ADSL introduce. (Few more Small Cisco Router Add on) . Few Cisco 3600 and 3800 Added and then Cisco 7200 Series
- 2007 Upgrade to first MPLS Network… L3 Device added . Cisco 3750 , Cisco ASA etc…
- TCC Approve Another Upgrade to support IPv6 (IPv6 Capable Devices) after this we request our IPv6 Prefix same year. (2013)
- 2013-2018 (5 Years Nothing Happen) only point to point links inside our Core … V4 Only from Customer to the Internet.
- The Reason Why for these 5 years cap . Not really sure why we weren't did it back then as someone as was in my position.
- After attending APNIC 46 2018 in New Caledonia... Everything change in our Point of View

WHAT HAS CHANGED.

- Mindset

1. After APNIC46 we notice from all Expert Advice that Everything is ready.

- Network was Ready 5 years ago (2013) . (e.g. Refer Previous Slides)
- Technology is Ready. (e.g. most OS and APP is Capable)
- CPE's is Ready. (From ADSL CPE to Server OS, Window OS, iOS)
- But we human have not I guess. Particularly us from the Smaller Island Nations in the Pacific and I specifically from a Tongan Perspective.
- Our mindset was IPv6 was so distant at least to my own interpretation and Experienced.
- We hear IPv6 all the time from different Training we attend to , but it was just like dreaming when I think about deploying it. Even though we have work in the ISP for over a decade with IPv4.
- So what could be the missing LINK. What could be the cause to all these mindset.
- I believe at least is just the AWARENESS.

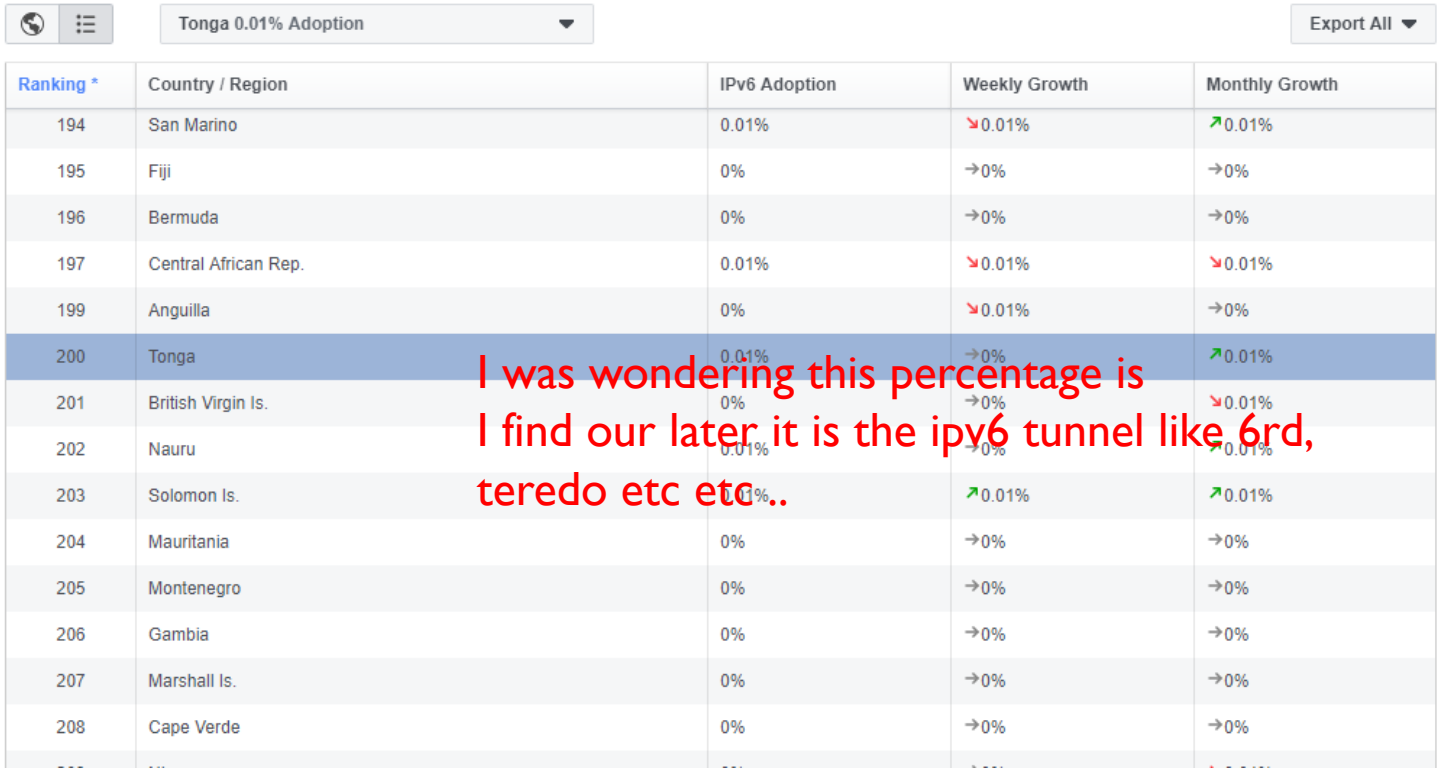
IPV6 AWARENESS IN THE PACIFIC SMALLER ISLAND NATIONS. ***AWARENESS OF WHAT ???***

- I believe there are expert on the topic around the small islands region, some may have work in the Service provider Environment, or not.
- Some maybe Engage in an ICT somewhere overseas.
- Some maybe in a different profession to ISP or IXP environment.
- But from a field engineer who actually work on a local ISP for the last Decade in the Region in Tonga at least , I believe there is very little Awareness not to the Technology itself as I believe there are lot out their who master the topic in the Islands.
- But lack of Awareness that it is already built in to our Current Network Topology, sitting there doing nothing in terms of Accessing the internet.
- Lack of awareness to the IPv6 Deployment Technologies.
- Yes some may have already planned it 5-10 years ago ,including ourselves.
- But it was just there doing NOTHING.
- WILLINGNESS to do it is another reason I may say.
- You only have the will to do something if you know (aware) that it can be done.
- That is what I get from APNIC 46 , The awareness that we can do it after. And it can be done.

IPV6 AWARENESS IN THE PACIFIC SMALLER ISLAND NATIONS. FEW *REASONS TO DEPLOY.*

- Maybe some may have wills to deploy it cos it is good for their JD.
- Maybe one reason is for your own Experience.
- Even Learning the Actual Deployment of the Technology as well.
- Maybe you want to be Competitive with in your Country Operators or within the Region.
- Any other Reason some may think of.
- At least myself to be honest I understand that one of **TCC Mission to be Competitive at ICT in the Region. IPv6 as we all know it is the future so Why NOT TCC Deploy it NOW.**
- That statement shows our Management have envisioned it Decades ago, Previous Engineer PLANNED, Designed it 5-7 years back.
- And it was sitting there doing Nothing. So the Question During APNIC46 WHY NOT Deploy.
- I think personally that's my main Motivation, If the World is READY and already ahead, WHY NOT TONGA.
- Why not our own IPv6 World MAP dotted with Pacific Island Nations flag.
- That is a CALL to my fellow Pacific Island Nations Engineer or any minor ISP's likes ours. Yes it is possible to do it.
- With all the resource we get from APNIC specifically in our case, We can do it on our Broadband only at this stage.

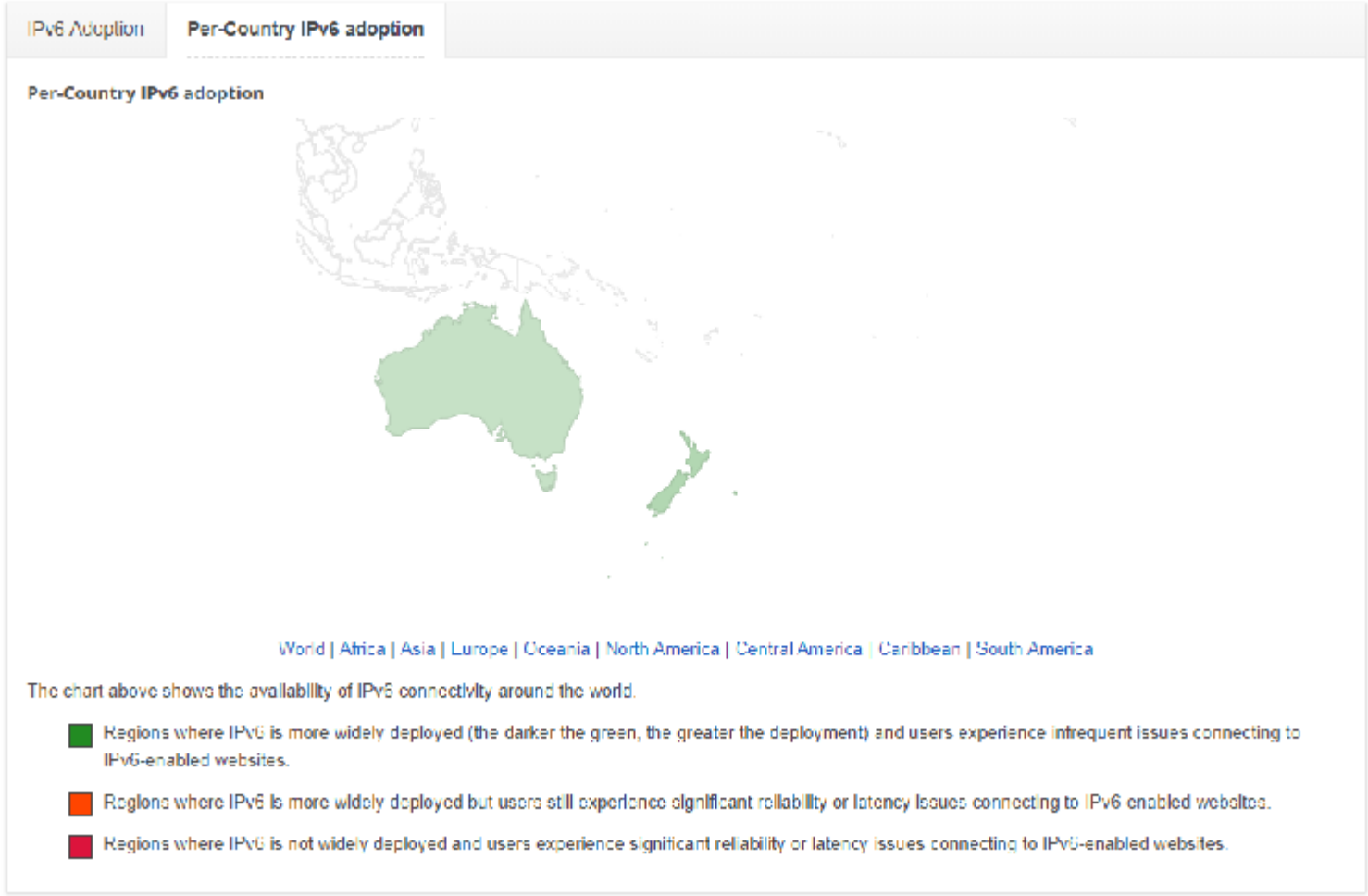
FACEBOOK MEASURE ADOPTION



Ranking *	Country / Region	IPv6 Adoption	Weekly Growth	Monthly Growth
194	San Marino	0.01%	↘0.01%	↗0.01%
195	Fiji	0%	→0%	→0%
196	Bermuda	0%	→0%	→0%
197	Central African Rep.	0.01%	↘0.01%	↘0.01%
199	Anguilla	0%	↘0.01%	→0%
200	Tonga	0.01%	→0%	↗0.01%
201	British Virgin Is.	0%	→0%	↘0.01%
202	Nauru	0.01%	→0%	↗0.01%
203	Solomon Is.	0.01%	↗0.01%	↗0.01%
204	Mauritania	0%	→0%	→0%
205	Montenegro	0%	→0%	→0%
206	Gambia	0%	→0%	→0%
207	Marshall Is.	0%	→0%	→0%
208	Cape Verde	0%	→0%	→0%

I was wondering this percentage is
I find our later it is the ipv6 tunnel like 6rd, teredo etc etc..

GOOGLE MEASURE ADOPTION



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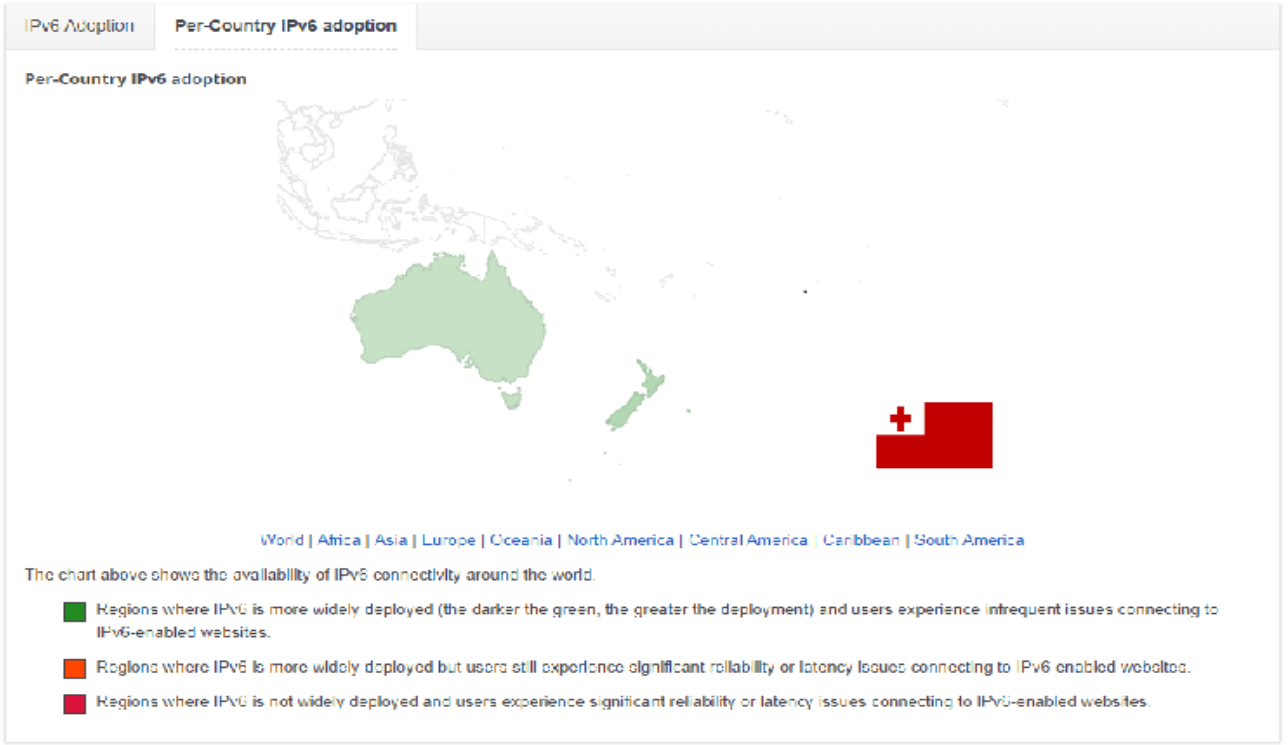
GOOGLE MAP ADOPTION

- We can PUT Tonga on the IPv6 MAP of the World Measured by Google which is currently happening.
- We can name all our end users like 2400:6400:abcd:wxyz:***dcc:d0d:d0***:1234
- Just for fun tcc.to our Company Domain.
- FB does this 2a03:2880:fffe:c:***face:b00c***:0:35



CAN WE DO IT ???

- Thanks to all the collective effort from the start up to Now.
- From Starting of the ISP over the years.
- Planning and Design from Previous Engineers who no longer with our Team today and some are still.
- To Approval of those Design and Planning from Management Staff's , some whom also have left and some are still here today.
- To All Staff from other Sections in TCC whom make possible for our TCC ICT Sections meets it goals up to now. Whether it be ordering Equipment's or something else.
- All these small task as bits of parcel put together and actions amount to what we have now.
- And Yes We are Ready to Deploy.

TONGA FIBRE PROJECT HAPPENS BEFORE OUR DEPLOY.

- The Fibre Project allows TCC to centralise its Resources therefore no need to have different segment of Networks as before.
- Therefore much more simple in term of Deploying IPv6 in Broadband including our remote outer islands as well.

DEPLOYMENT PLAN FOR IPV6
AUDIT AND PLAN DONE YEARS BACK WHEN WE DO OUR SECOND UPGRADE

1. Audit (2007) and (2012)
2. Plan (2007) and (2012)
3. Review by Current ICT Team (2018)
4. Tests by Current ICT Team(2018)
5. Deploy by Current ICT(2018)

DEPLOYMENT STEPS.
3. REVIEW

Network Infra

- Team review it and confirmed IPv6 is not Support by LDP Protocol.
- Core Devices Support 6VPE which can carry IPv6 Prefix.
- Also Current Edge Device Support Dual Stack.
- Speed Based and also Volume Based.
- What our current Infrastructure Offer is ***DUAL STACK***.
- That is IPv4/IPv6 at the same time to our Broadband Customer.

REVIEW CON'T

CPE's

- Windows Natively Support IPv6 SLAAC (type of address assignment in IPv6 Addressing..
- Current ADSL CPE's (Huawei and TPLink Residential ADSL Routers support PPPoE Dual Stack and IPv4 as well but not IPv6 only.
- Linux as well have been support IPv6. **(Resolver)**
- Our Team just need to do minor adjustment to PPPoE Wan setting.
- The LAN settings works our of the box for both ADSL modems we used.

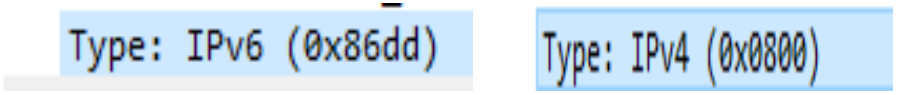
ACTUAL DEPLOYMENTS CONFIGURATIONS FOR OUR BROADBAND (ADSL AND FIBRE AND LAN BEHIND OUR CORPORATE FIREWALLS.

- L2 Switches
- BRAS IPv6 DHCP-PD Configuration
- Radius
- eBGP IPv6 Peer
- Our Upstream Provider Interesting Stories.
- Our Upstream Upstream Provider Very Interesting Upstream
- One thing you will notice I did not include in here is my Address Planning. I know it is one of the important thing for IPv6 deployments. Because you have to consider everything from your Routing perspective and also how you want it to suit your current Topology and look in to the future grow in your network as well at the same time.
- And maybe other specific reason I am not mention here.
- So there is none specific template to all, but what is works for me doesn't really mean it should for you regarding to your deployment Addressing Plan.
- So I think its not that important to add it in here.
- But I am be more than happy if you can ask later if it might help maybe.

CONFIGURATIONS.

- Cisco L2 and Huawei LAN Switches use already support L2 IPv6 Frames.

- B



- Define DHCP-PD Pool

```
ipv6 dhcp pool DHCPv6-PD-DYNAMIC ### Define the DHCP-PD Pool
 vrf ACCESS-DYNAMIC ###MPLS
 prefix-delegation pool DHCP-PD-VRF-DYNAMIC lifetime 1800 600 ###Allocate which Pool to use
dns-server 2400:6400::XXX ### Resolver 1
dns-server 2400:6400:XXX ### Resolver 2
domain-name domain
accounting default ### Direct to which Accounting Profile to be used. Use the same for v4 Accounting.

ipv6 dhcp iana-route-add
ipv6 dhcp binding track ppp ###Track PPP
ipv6 dhcp server vrf enable ### IPV6 DHCP-PD VRF Aware
ipv6 multicast-routing ### Enable Multicast Routing
ipv6 cef accounting prefix-length
```

BRAS CONT…..

- 6VPE Config …….SAME config on all LDP (MPLS) Neighbour

```
address-family ipv6
        neighbor ibgp-peer send-label
        neighbor ipv4 activate
        neighbor ipv4 activate
        neighbor ipv4 activate
        exit-address-family
```

- Local prefix Originating

```
address-family ipv6 vrf AAA
        redistribute connected
        redistribute static
        network 2400:someprefix::/37
        exit-address-family
!
address-family ipv6 vrf BBB
        redistribute connected
        redistribute static
        network 2400:someprefix::/37
        exit-address-family

ipv6 route vrf ACCESS-AAA 2400:someprefix::/37 Null0
ipv6 route vrf ACCESS-BBB 2400:someprefix::/37 Null0
```

BRAS CONT

- Define BBA Group

bba-group pppoe xPREPAID
virtual-template 10
…..

…….

…….

BRAS CON'T

- PPP VTI Interface

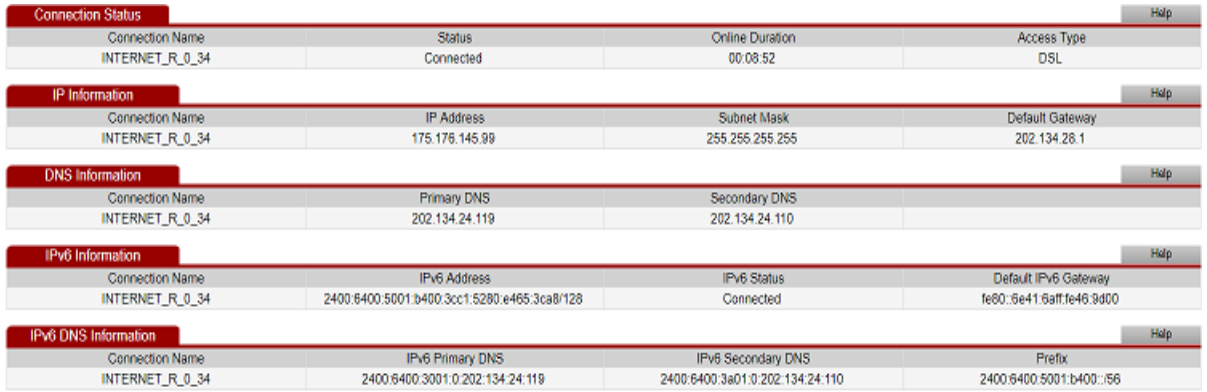
interface Virtual-Template10 ###Refer to previous Slides for VTI number
 description *** PPPoE Name***
 vrf forwarding ACCESS-BBB
 Typical PPPoe Config for IPv4 Omit
 ipv6 enable
 ipv6 mtu 1492
 ipv6 nd other-config-flag ###Assign DNS to DCHP-LAN
 ipv6 dhcp server DHCPv6-PD-DYNAMIC
 peer default ipv6 pool PPP-VRF-DYNAMIC ###Non IPv6 DHCP-PD eg. PC
end

BRAS CON'T

- Binding all these to a VLAN

interface GigabitEthernet0/0/2.320
description ***Examplefor ADSL PRepaid***
encapsulation dot1Q 320
vrf forwarding ACCESS-BBB
pppoe enable group xPREPAID
end

Once an ADSL port is configured on that specific VLAN, a pppoe session starts and Accounting is Collect refer to next slide.!!!



Connection Status — Help

Connection Name	Status	Online Duration	Access Type
INTERNET_R_0_34	Connected	00:08:52	DSL

IP Information — Help

Connection Name	IP Address	Subnet Mask	Default Gateway
INTERNET_R_0_34	175.176.145.99	255.255.255.255	202.134.28.1

DNS Information — Help

Connection Name	Primary DNS	Secondary DNS
INTERNET_R_0_34	202.134.24.119	202.134.24.110

IPv6 Information — Help

Connection Name	IPv6 Address	IPv6 Status	Default IPv6 Gateway
INTERNET_R_0_34	2400:6400:5001:b400:3cc1:5280:e465:3ca8/128	Connected	fe80::6e41:6aff:fe46:9d00

IPv6 DNS Information — Help

Connection Name	IPv6 Primary DNS	IPv6 Secondary DNS	Prefix
INTERNET_R_0_34	2400:6400:3001:0:202:134:24:119	2400:6400:3a01:0:202:134:24:110	2400:6400:5001:b400::/56

RADIUS

- We Store Accounting info to Database.
- We Extract Customer CDR to process from that Database.
- Free radius Readily Accept and Calculate Total Byte Count for v4 & v6 traffic on the Default Counter (RFC 2866)

Acct-Input-Octets
Acct-Output-Octets

- DHCP-PD Prefix on Radius Packet Send from BRAS to Radius. Extraction from Radius Packet
- With configuration previously configured on your BRAS. These extra 3 field is added to the Accounting Radius Packet from BRAS to Radius.

Framed-IPv6-Prefix = 2400:6400:4000:1::/64
Framed-Interface-Id = 792d:c078:87fb:9f2
Delegated-IPv6-Prefix = 2400:6400:4100:300::/56

- Cisco Proprietary Exist on the Radius Packet.
  → If we specifically need to calculate how much v6 traffic, we can process this counter.
  → HOWEVER these XXXX below is already included in the default Counter above.

Cisco-AVPair = "acct-input-octets-ipv6=xxxxxx“
Cisco-AVPair = "acct-output-octets-ipv6=xxxxx"

EBGP

- Single Peer to Fintel.
- Upstream Provider Interesting Story (Fintel)
- First I have to apologise as these are not an official Information but are actual FACT I find out on this journey.

1. First Request for **IPv6 PEER** on around end of **Sept 2018** after coming back from APNIC 46.
2. On Friday ***April 26th 2019*** We first test to FB on v6 and it works perfectly.
3. How ever more test I find out, their (Fintel) enabled v6 peer **(Upstream A)** can not reach v6 Google Service (YouTube etc etc) on the same day based on traceroute stop at Fintel **Upstream** A's Network.
4. Why is that I did not know at the time.
5. Now while I leave my upstream (Fintel) to look at the issue. I also try to find the reason for my self too from other sources.
6. I email several APNIC Staff and other sources as well of the situation and have valuable information.
7. The info I get is , for some reason My immediate Upstream (Fintel) **Upstream A** and Google does not have direct peer relationship confirming the reason why I cannot access google v6 content .
8. To get around it WE have to send traffic to Google over Tunnel to HE which allow us to access Google Service like YouTube and the rest of the v6 Content remain with the path to Fintel **Upstream A**

CON'T

- Now I also aware that Fintel have relationships with another **Upstream B** on V4 ,
- We said to ourselves why not ask them (Fintel) to ask their **Upstream B** for V6 peer as well.
- We make that second request to Fintel regarding their v6 peer with their **Upstream B** on the 29th on April 2019.
- And on Friday the 5th July 2019, that second peer also completely setup between our Upstream and their **Upstream B** as well.
- So Now my Upstream (Fintel) has two relationships now, one to their **Upstream A** and their **Upstream B**
- Now our IPv6 Traffic goes to and from the IPv6 World through Fintel **Upstream B instead their Upstream A.**
- **After these peer established we run tests.**

TEST CASES

- Google 1G File Download
- Download YouTube Video and not Streaming.
- Download Facebook Video and not Streaming.
- Please do note this is not to test which is faster over the other . IPv4 or IPv6.
- But in fact these are results to show how both protocol behave in my deployments in terms of my Customer view to wards the internet from my Island Nations.
- And I believe the case for all other similar islands like Tonga from the Pacific should be similar.
- Please also note I have checked through WHOis Database for these destination.
- Actually I use APNIC WHOIS for v4 (eg. The URL for Facebook) and another for the v6 .
- I want to see how packet physically proceed from my users toward the internet. Which Economy is pass through to be exact.
- So I hope the map used here is at least should gives us how packet looks like toward the internet.
- GRAPHS use here are I/O from Wireshark. And also

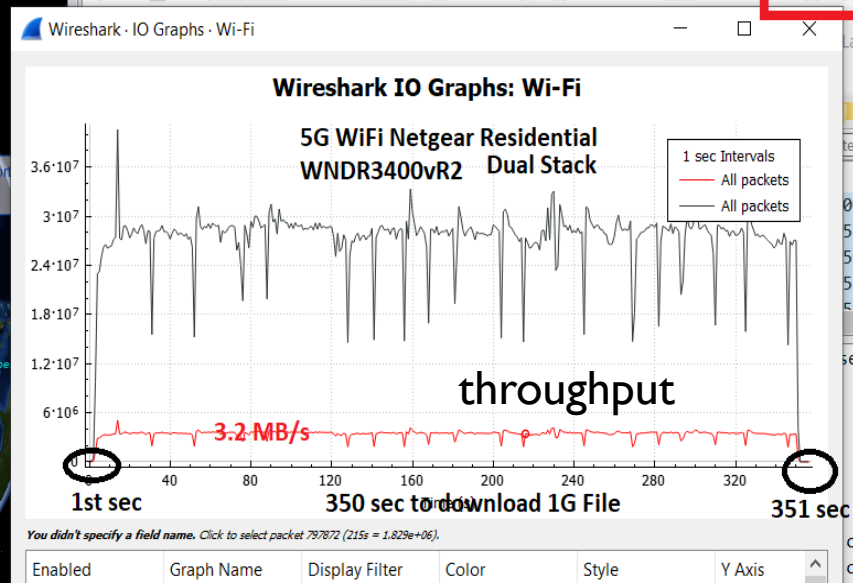
TEST CASES TO GOOGLE 1G FILE
HTTPS://DRIVE.GOOGLE.COM/FILE/D/0B1MVW1MFO2ZMZHVRWEQ3RKC3SVE/EDIT

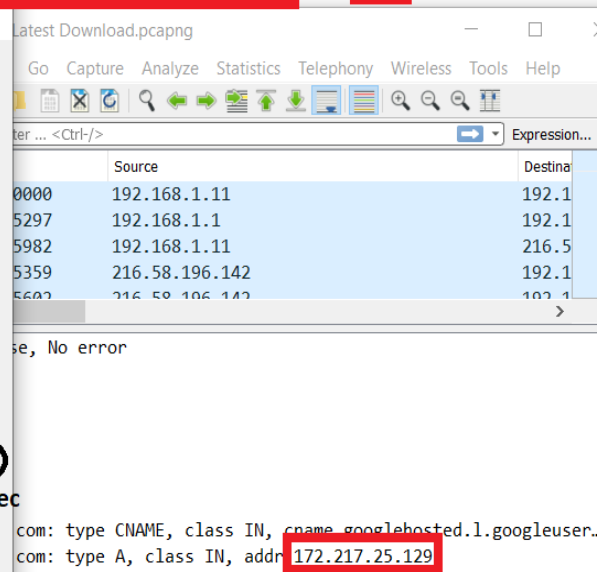
- Dual Stack DSL Modem behind **FIREWALL** for both IPv4 and IPv6.
- I mention firewall here it is important my v4 traffic goes through NAT44 while v6 do not involve NAT.
- IPv4 and IPv6 disabled respectively on my PC to do the Test.
- Run Tests on IPv4 only then Repeat on IPv6 Only.
- Download Static File

IPV4 DOWNLOAD 1G FILE FROM GOOGLE

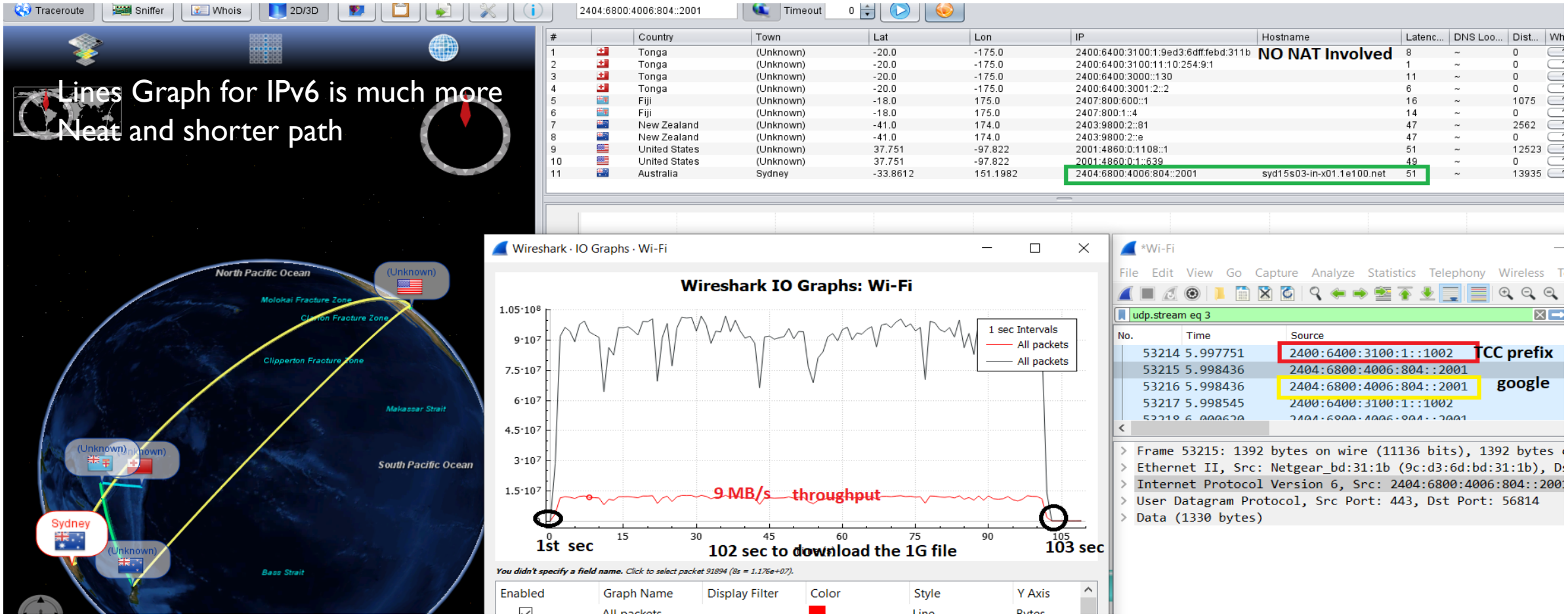
#		Country	Town	Lat	Lon	IP	Hostname	Latency...	DNS Loo...	Distance ...
1		Tonga	Pangai	-19.8	-174.35	192.168.1.1		2	~	0
2		Tonga	Pangai	-19.8	-174.35	10.254.9.3		3	~	0
3		Tonga	Pangai	-19.8	-174.35	202.134.31.130		81	~	0
4		Tonga	(Unknown)	-20.0	-175.0	202.134.30.214	wimax-static-214-30-134-202.kalian...	3	~	71
5		Fiji	Suva	-18.1333	178.4167	202.170.41.113		12	~	723
6		Fiji	Suva	-18.1333	178.4167	202.170.33.2		14	~	0
7		United States	Phoenix	33.4484	-112.074	38.122.92.249	gi0-2-1-4.rcr21.b001848-1.sjc01.atl...	170	~	9341
8		United States	(Unknown)	37.751	-97.822	154.54.3.137	be2095.ccr22.sjc01.atlas.cogentco....	177	~	1374
9		United States	(Unknown)	37.751	-97.822	154.54.5.102	be3144.ccr41.sjc03.atlas.cogentco....	171	~	0
10		United States	(Unknown)	37.751	-97.822	154.54.12.142	tata.sjc03.atlas.cogentco.com	171	~	0
11		United States	Southport	33.997	-78.0729	72.14.198.30		173	~	1826
12		United States	Mountain View	37.4192	-122.0574	108.170.242.253		169	~	3958
13		United States	(Unknown)	35.4676	-97.5164	216.239.62.41		238	~	2202
14		United States	(Unknown)	37.751	-97.822	209.85.246.138		167	~	255
15		United States	(Unknown)	37.751	-97.822	209.85.255.241		167	~	0
16		United States	Mountain View	37.4192	-122.0574	108.170.247.49		166	~	2132
17		United States	Mountain View	37.4192	-122.0574			165	~	0
18		United States	Mountain View	37.4192	-122.0574	172.217.25.129	syd15s03-in-f1.1e100.net	164	~	0

NAT Involved





IPV6 DOWNLOAD 1G FILE FROM GOOGLE



FINDING ON THIS SPECIFIC TEST TO GOOGLE.

- Latency

1. IPv4 (51 ms) latency is triple compared to IPv6 (164 ms)

- **Destinations**

1. If you note the two destinations is not the exact same hosts. So does its physical Locations. V6 destination is very close to us. Maybe this is due to the DNS lookup results returned from Google Authoritative Server answering the query result in the Locations below.

- The Locations.

1. IPv4 content locate in the US while IPv6 in Australia.

- **NAT**

1. Since I mention both IPv4 and IPv6 behind a Firewall.
2. IPv4 goes through the usual NAT 44
3. While IPv6 does not.

- **Throughput for both**

1. IPv4 is average around 3.2 MB/s while IPv6 average around 9.0 MB/s

- **Time to download the 1G file using respective protocol**

1. IPv4 download the file at 350 sec, IPv6 download it at 102 sec . IPv6 download time around 3 times faster.
2. This is because as you can see the IPv6 destination is much closer to us than its counterpart. Also the latency as well is 3rd of V4

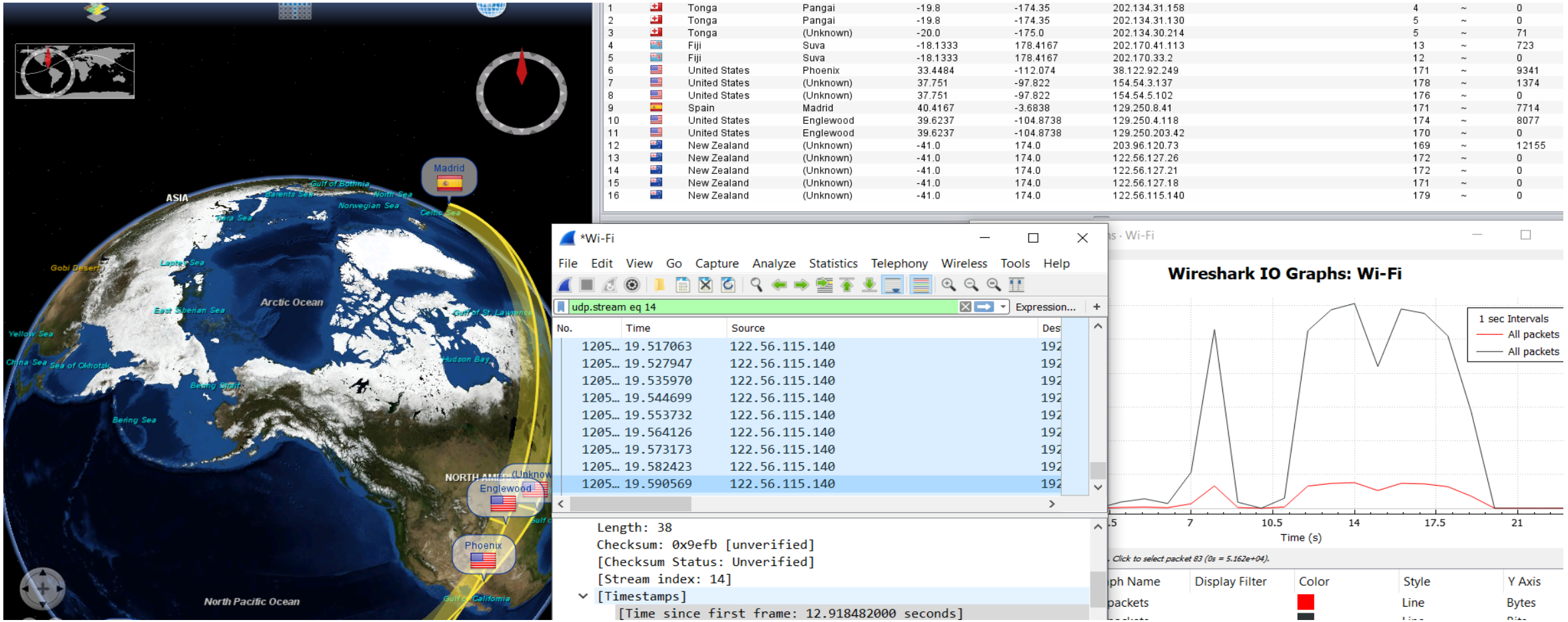
- **Transport Layer Protocol**

1. Download from Google Use UDP on port 443.

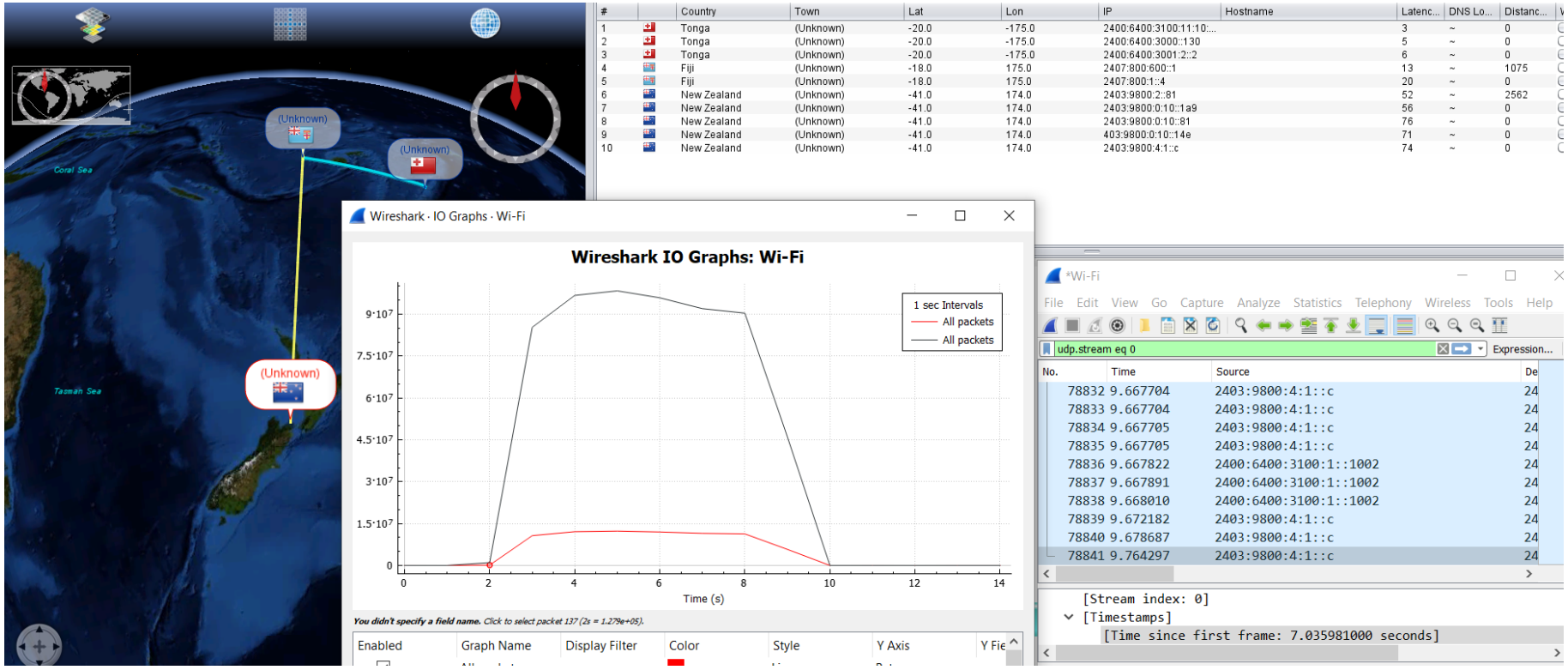
TEST BY DOWNLOAD YOUTUBE VIDEO. USING EXTERNAL URL

- Both IPv4 and IPv6 belong to Spark from my view in term of DNS resolution and routing.
- Resolver gives me Spark IP Prefixes for both protocol.

IPV4 DOWNLOAD YOUTUBE VIDEO



IPV6 DOWNLOAD YOUTUBE VIDEO



#		Country	Town	Lat	Lon	IP	Hostname	Latenc...	DNS Lo...	Distanc...
1		Tonga	(Unknown)	-20.0	-175.0	2400:6400:3100:11:10:...		3	~	0
2		Tonga	(Unknown)	-20.0	-175.0	2400:6400:3000::130		5	~	0
3		Tonga	(Unknown)	-20.0	-175.0	2400:6400:3001:2::2		6	~	0
4		Fiji	(Unknown)	-18.0	175.0	2407:800:600::1		13	~	1075
5		Fiji	(Unknown)	-18.0	175.0	2407:800:1::4		20	~	0
6		New Zealand	(Unknown)	-41.0	174.0	2403:9800:2::81		52	~	2562
7		New Zealand	(Unknown)	-41.0	174.0	2403:9800:0:10::1a9		56	~	0
8		New Zealand	(Unknown)	-41.0	174.0	2403:9800:0:10::81		76	~	0
9		New Zealand	(Unknown)	-41.0	174.0	403:9800:0:10::14e		71	~	0
10		New Zealand	(Unknown)	-41.0	174.0	2403:9800:4:1::c		74	~	0

FINDING FROM YOUTUBE TEST.

- Locations

1. Both prefix IPv4 and IPv6 belong to Spark (NZ).
2. They both physically located in NZ.
3. Note the IPv4 traffic goes to Spain then come back to NZ. Refer Slides … WHAT ???
4. I have no idea what's happens there, why go all the way to Spain then come back to New Zealand for IPv4. Interesting !!!! But not interested ☺ ….

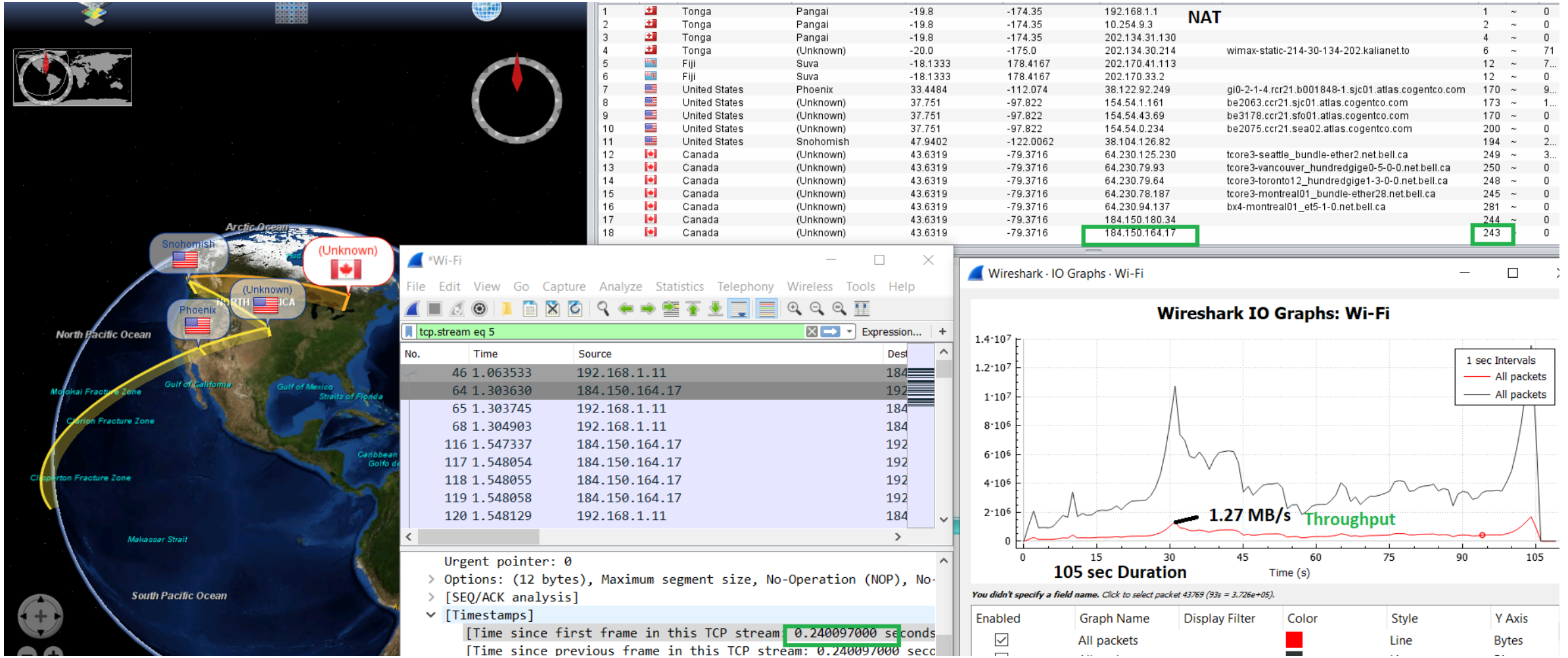
- Transport Layer

1. UDP is still use on port 443 as google previous Test.

FACEBOOK VIDEO DOWNLOAD TEST

- scontent.fymy1-1.fna.fbcdn.net URL where the video is locate in Canada according to the copied URL used.

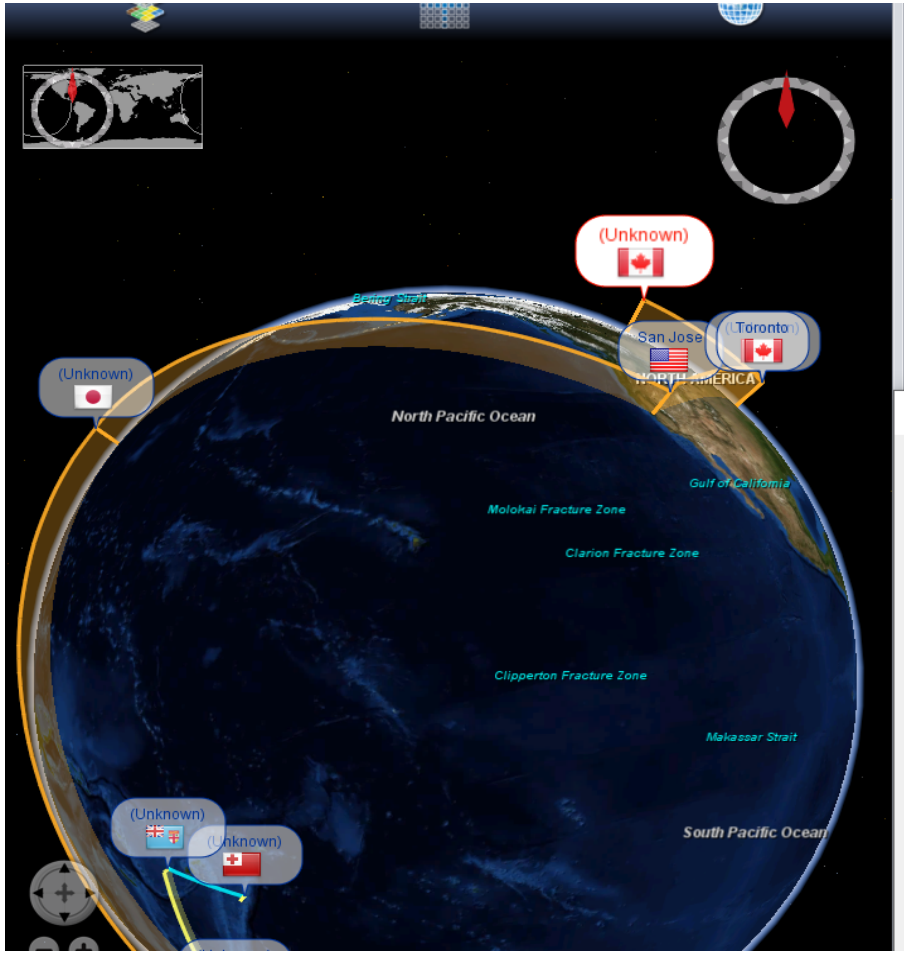
FACEBOOK VIDEO DOWNLOAD IPV4



1	Tonga	Pangai	-19.8	-174.35	192.168.1.1		1	~	0
2	Tonga	Pangai	-19.8	-174.35	10.254.9.3		2	~	0
3	Tonga	Pangai	-19.8	-174.35	202.134.31.130		4	~	0
4	Tonga	(Unknown)	-20.0	-175.0	202.134.30.214	wimax-static-214-30-134-202.kalianet.to	6	~	71
5	Fiji	Suva	-18.1333	178.4167	202.170.41.113		12	~	7...
6	Fiji	Suva	-18.1333	178.4167	202.170.33.2		12	~	0
7	United States	Phoenix	33.4484	-112.074	38.122.92.249	gi0-2-1-4.rcr21.b001848-1.sjc01.atlas.cogentco.com	170	~	9...
8	United States	(Unknown)	37.751	-97.822	154.54.1.161	be2063.ccr21.sjc01.atlas.cogentco.com	173	~	1...
9	United States	(Unknown)	37.751	-97.822	154.54.43.69	be3178.ccr21.sfo01.atlas.cogentco.com	170	~	0
10	United States	(Unknown)	37.751	-97.822	154.54.0.234	be2075.ccr21.sea02.atlas.cogentco.com	200	~	0
11	United States	Snohomish	47.9402	-122.0062	38.104.126.82		194	~	2...
12	Canada	(Unknown)	43.6319	-79.3716	64.230.125.230	tcore3-seattle_bundle-ether2.net.bell.ca	249	~	3...
13	Canada	(Unknown)	43.6319	-79.3716	64.230.79.93	tcore3-vancouver_hundredgige0-5-0-0.net.bell.ca	250	~	0
14	Canada	(Unknown)	43.6319	-79.3716	64.230.79.64	tcore3-toronto12_hundredgige1-3-0-0.net.bell.ca	248	~	0
15	Canada	(Unknown)	43.6319	-79.3716	64.230.78.187	tcore3-montreal01_bundle-ether28.net.bell.ca	245	~	0
16	Canada	(Unknown)	43.6319	-79.3716	64.230.94.137	bx4-montreal01_et5-1-0.net.bell.ca	281	~	0
17	Canada	(Unknown)	43.6319	-79.3716	184.150.180.34		244	~	0
18	Canada	(Unknown)	43.6319	-79.3716	184.150.164.17		243	~	0

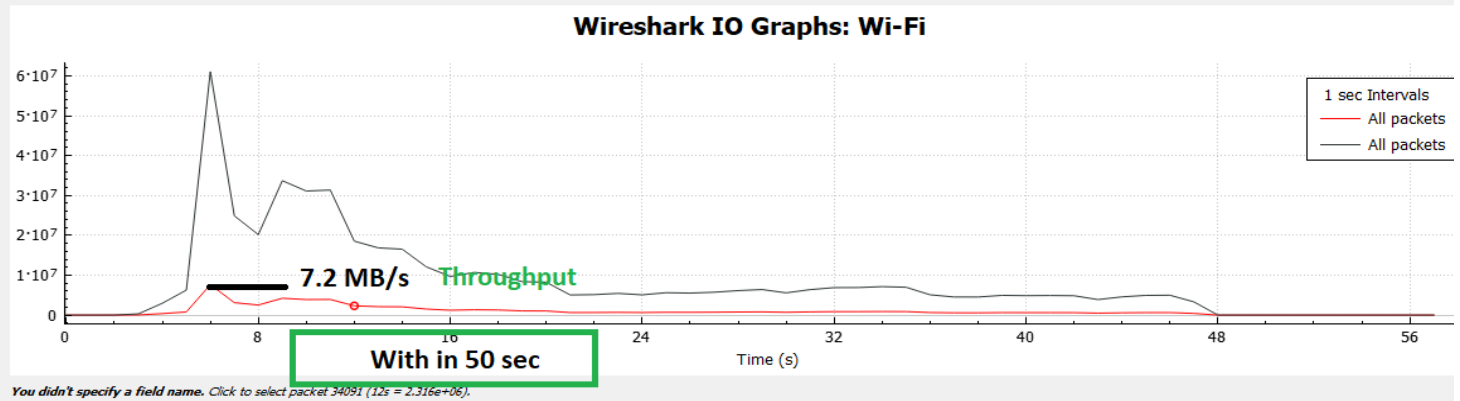
FACEBOOK VIDEO DOWNLOAD IPV6

Note the Red BOX
RFC 4038



1	Tonga	(Unknown)	-20.0	-175.0	2400:6400:3100:1[illegible]ed3:6dff:febd:311b		6	~	0
2	Tonga	(Unknown)	-20.0	-175.0	2400:6400:3100[illegible]10:254:9:1		56	~	0
3	Tonga	(Unknown)	-20.0	-175.0	2400:6400:300[illegible]130		5	~	0
4	Tonga	(Unknown)	-20.0	-175.0	[illegible]		3	~	0
5	Fiji	(Unknown)	-18.0	175.0	2407:800:600::1		13	~	1..
6	Fiji	(Unknown)	-18.0	175.0	2407:800:1::4		12	~	0
7	New Zealand	(Unknown)	-41.0	174.0	2403:9800:2::81		52	~	2..
8	Japan	(Unknown)	36.0	138.0	2001:de8:6::6939:1	6939.syd.equinix.com	200	~	9..
9	United States	San Jose	37.3162	-121.9333	2001:470:0:311::1	10ge3-5.core1.sjc1.he.net	204	~	8..
10	United States	San Jose	37.3162	-121.9333	2001:470:0:55::2	10ge7-2.core1.sjc2.he.net	202	~	0
11	United States	San Jose	37.3162	-121.9333	2001:470:0:1fe::2	100ge8-2.core1.sea1.he.net	218	~	0
12	United States	San Jose	37.3162	-121.9333	2001:470:0:1aa::2		224	~	0
13	Canada	(Unknown)	43.6319	-79.3716	::ffff:64.230.15.223	tcore4-seattle_lo0.net.bell.ca	273	~	3..
14	Canada	(Unknown)	43.6319	-79.3716	::ffff:64.230.15.210	tcore4-vancouver_lo0_core.net.bell.ca	280	~	0
15	Canada	Toronto	43.623	-79.3936	::ffff:64.230.193.150	tcore4-toronto12_lo0.net.bell.ca	271	~	2
16	Canada	(Unknown)	43.6319	-79.3716	::ffff:64.230.15.60	tcore4-montreal01_lo0.net.bell.ca	275	~	2
17	Canada	(Unknown)	60.0	-95.0	2001:4958:300:d::11		270	~	2..
18	Canada	(Unknown)	60.0	-95.0	2001:4958:300:402::2e		272	~	0
19	Canada	(Unknown)	60.0	-95.0	2001:4958:300:470:face:b00c:0:a7		272	~	0

Wireshark · IO Graphs · Wi-Fi



You didn't specify a field name. Click to select packet 34091 (12s = 2.316e+06).

Enabled	Graph Name	Display Filter	Color	Style	Y Axis	Y Field	SMA Period
☑	All packets			Line	Bytes		None
☑	All packets			Line	Bits		None

FINDING FROM FACEBOOK TESTS.

- Location

1. Both IP resource resides in Canada according to the MAP.
2. IPv4 has 18 hops while IPv6 is 19 HOPs away.

- Transport Layer

1. Note that FB use TCP instead compared to Google.
2. Also note the latency IPv4 (243 ms) while IPv6 (272 ms) slightly higher but not that much different.

- However Download Time for IPv6 is half that of IPv4…… That is interesting and I am certainly INTERESTED !!!

1. Note IPv4 105 sec and IPv6 with in 50 sec to download the same Filesize 40.4 MB

- Latency

1. If you note the latency is very close as I mention above yet the time to download the same file is more than half less for IPv6 compare to IPv4 access. IPv4 is 29 sec better than that of IPv6 in term of its latency. But throughput much better for IPv6 than IPv4.
2. This is an INTERSTING CASE I can say. WHY is that ??? Answer is I don't know …sorry ..

- Also Note the usual NAT on IPv4 while there is none for IPv6.

SOME THOUGHT.

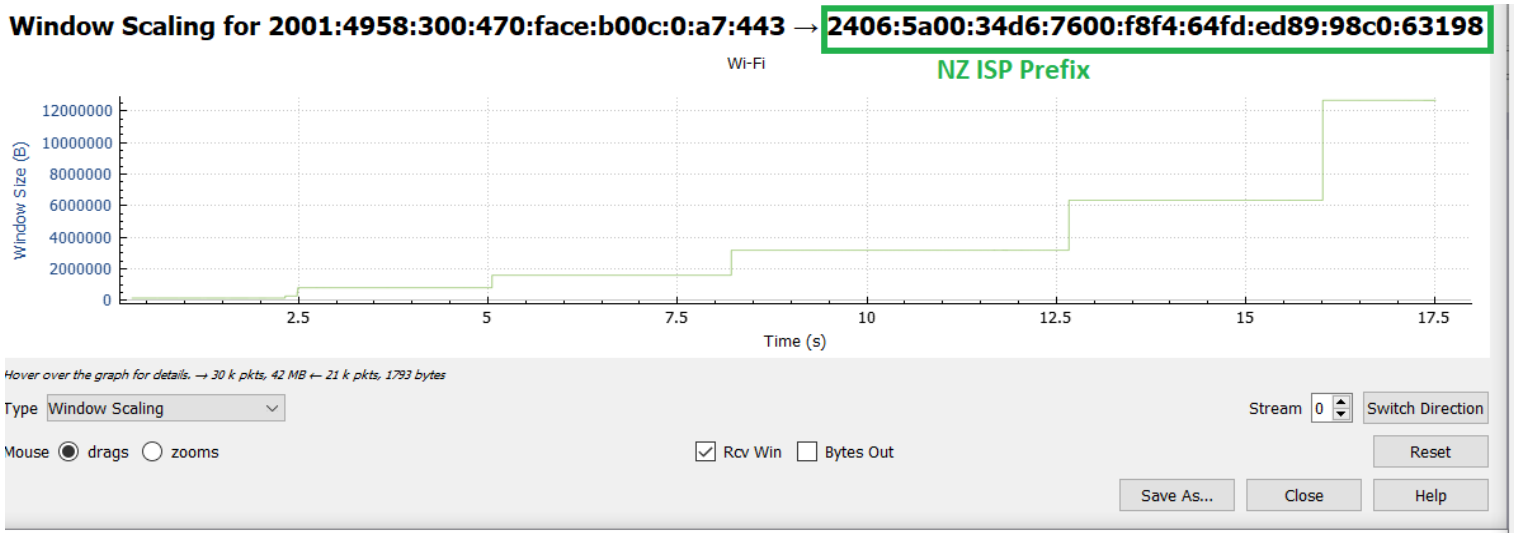
- ***As I said ealier this is not to compare the two protocol , but in stead share the facts of what I happening after we enable v6 to our Broadband Customer.***
- Based on our Traffic (70 % -+) is only FB and Google Services (YT etc). So most of our traffic will be to these destinations. And that's the reason why I focus our test on those two.
- The case for both these traffic destinations.

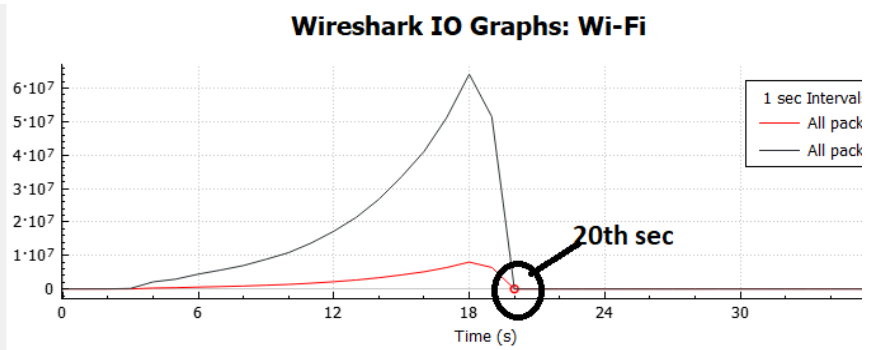
1. **For destinations that is physically close to us, as in the case of YouTube, and Google File Download test made, the difference between the two is not significant in terms of Download Throughput.**
2. **However for Destinations further away from us like the case in Facebook Download, it has significant differences.**

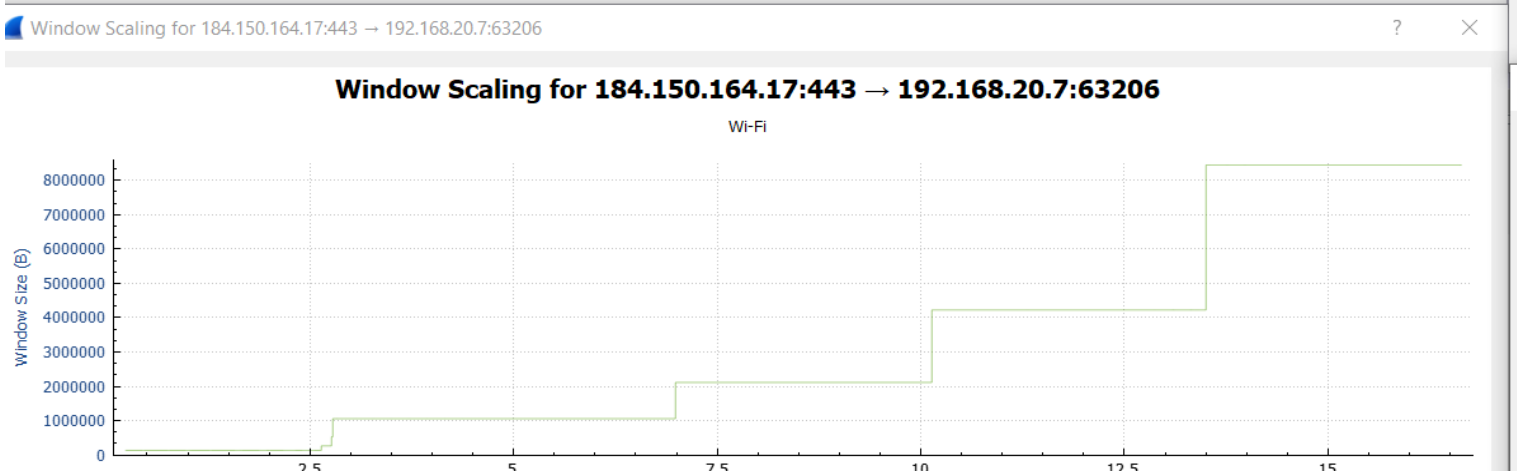
- **The reasons for that trend. I don't know, and even better I don't want to know ☺ !! , cos I understand there are lot happening in between my Customer and the internet. And most of that I have no control of.**
- **Refer the next slide a test I make in NZ on my way here from a Dual Stack Fiber to the Home connections.**

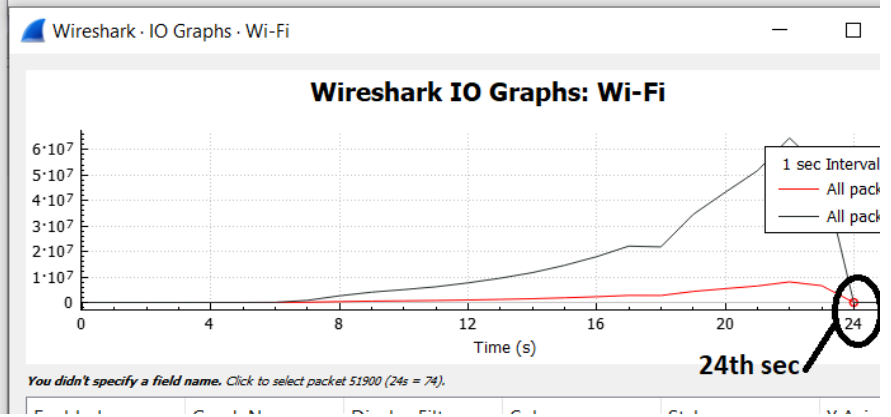
DUAL STACK TEST IN NEW ZEALAND I MADE ON SUNDAY LAYOVER.

MORAL OF THE STORY :





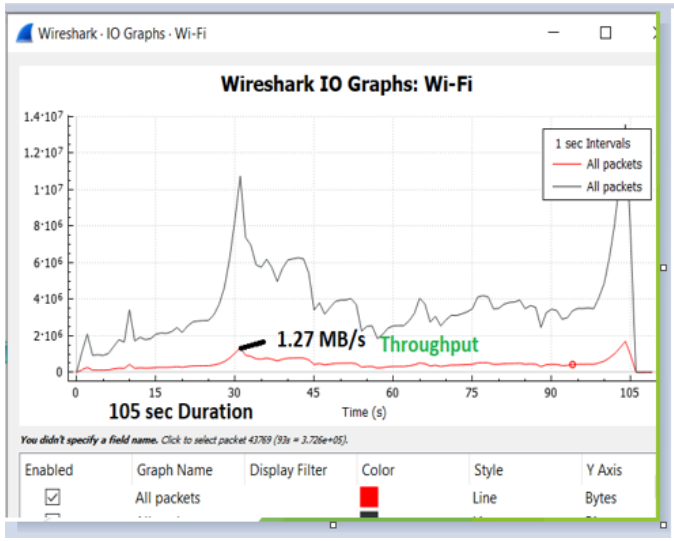




DUALSTACK TEST IN TONGA

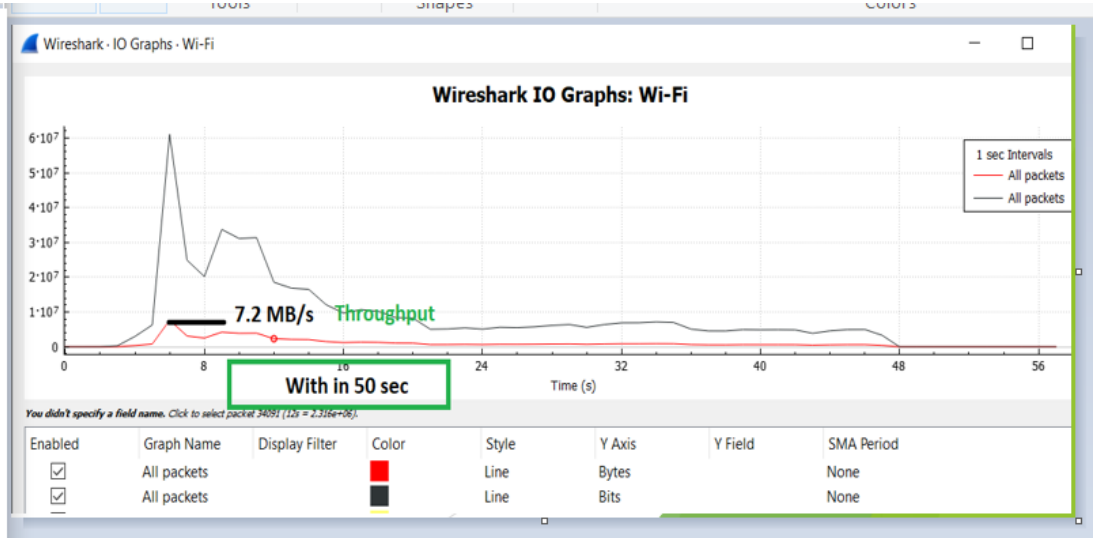
NOTE：

This is from previous Slides



IPv4

IPv6



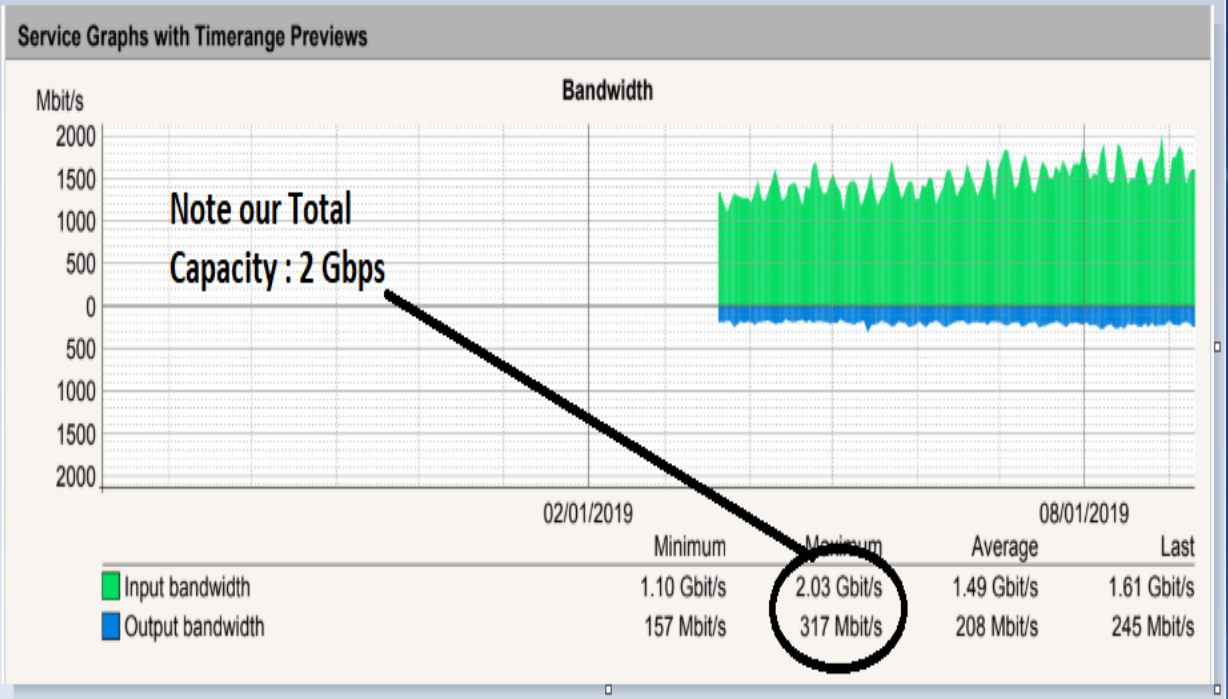
SO SOME FINAL THOUGHTS.

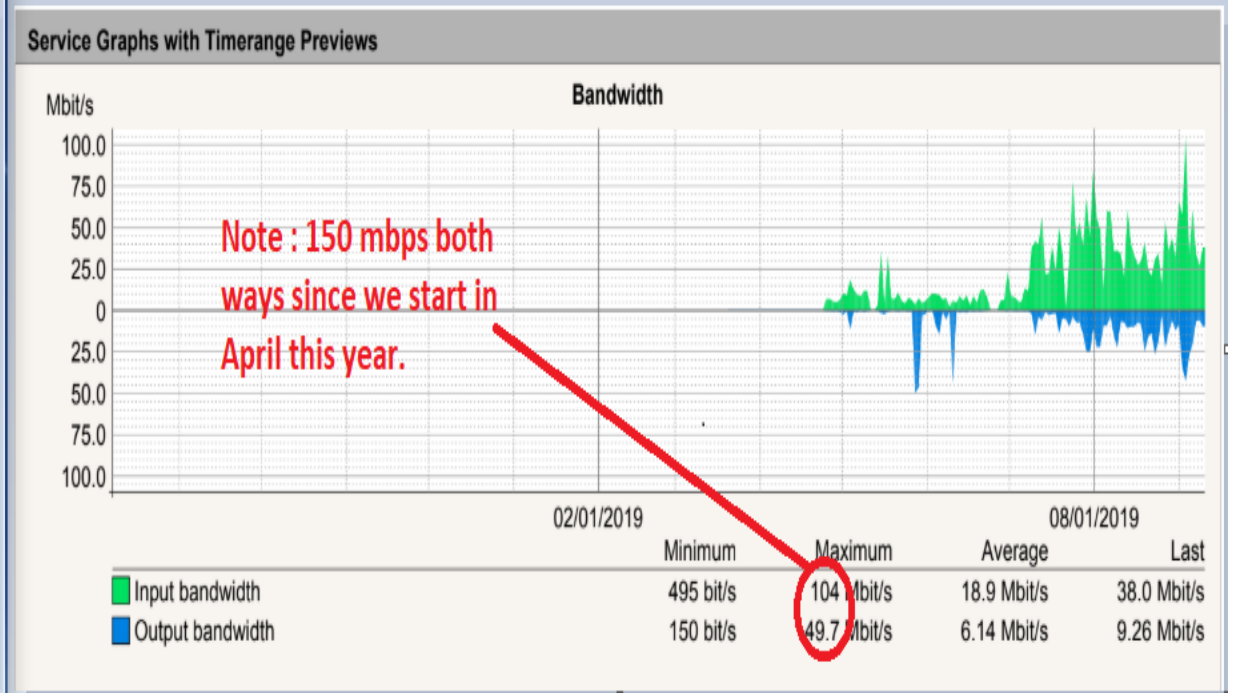
- **The case for our Mobile Network.**

1. **We do NAT for our Mobile Data Clients.**
2. **Our Firewall is at its maximum limit in term of its NAT Limitations, all firewall are.**
3. **We need to buy bigger Firewall to replace that.**
4. **For that I have started the talk to my CTO for his consideration to start deploy IPv6 on our Mobile Network.**
5. **But I am sure as you all understand it is not that straight forward as in the case for Broadband.**
6. **As there are factors to take in to account starting from our Vendor IPv6 Support and Compatibility.**
7. **But from our Teams point of view we have to compare the two options cost, buying a bigger firewall or deploying IPv6 to our Mobile Network.**

- For other LAN's behind the Firewall we have to enable IPv6 so they can use their v6 destination whenever it is available. So Firewall Resource can be free for other V4 NAT.
- So friend if you can ask me that simple question why should we deploy IPv6 ?.
- I can give you these few personal answers.

1. If you have that Firewall problem like mine, definitely you should consider ipv6. If you don't have that Firewall limitation as mine now, I tell you will in the near future, unless you will have the money to keep buying bigger boxes which something we do not have.
2. Learn the Deployments yourself. I tell you personally, APNIC staff can happily assist you ☺ … if you are willing to do it. Not just on your lab , but in fact to your customer.
3. Competitive in your Country and Possibly in the region. In my personnel case, TCC (my employer) mission as mentioned earlier to be recognize in our region in term of it's involvement in ICT, I personally think actually deploying IPv6 to our Customer gives that extra edge over our Competitor within our Island Nations and maybe on the Region.
4. Customer Experience. !!!! This could be one of the main driven for some to deploy, well there will not be much differ for the two Protocol. Like Customer won't even noticed if he is on v4 or v6. But from a Service Provider view. There will be a slight differ. Like in our test case we find for Contents further away it takes less time to download in V6 than in V4. So specifically for those remote destinations but available in V6 , it is better to provide it to your Customer over v6 than v4. Less time to download, means more download over time, meaning customer spending will increase accordingly therefor reflect in your revenue. … ☺ This I have not prove that hypothesis but its just my observation and suggestions based on test I present here.





Note : Graph starts from time our IPv6 enable around April

Our Broadband has been tested and ready but there is still delay from our Marketing Team for MASS Deploy to the Customers. I believe it will be with in one months that should happen.

This IPv6 Traffic you see here are ADSL Customer and also LAN's behind some of our Firewall.

So in the next Month or two there will be large increase in our IPv6 traffic when we enable all our ADSL Broadband Customer.

CONCLUSIONS.

With that total 150 mbps you saw we are third on the APNIC IPv6 measurement Adoptions.
And promise you with in a month or two that amount should increase by 500 % or more when we fully enable it to all our ADSL and Fiber Users.

CC	Country	IPv6 Capable	IPv6 Preferred	Samples	Weight	Weighted Samples
NZ	New Zealand, Australia and New Zealand, Oceania	23.08%	17.75%	189,001	1.91	361,440
AU	Australia, Australia and New Zealand, Oceania	19.92%	19.64%	872,016	2.06	1,799,852
TO	Tonga, Polynesia, Oceania	0.12%	0.12%	4,152	1.04	4,323
NC	New Caledonia, Melanesia, Oceania	0.05%	0.05%	12,056	1.39	16,719
MP	Northern Mariana Islands, Micronesia, Oceania	0.05%	0.00%	4,429	0	0
SB	Solomon Islands, Melanesia, Oceania	0.04%	0.04%	5,426	0.97	5,240
PG	Papua New Guinea, Melanesia, Oceania	0.02%	0.02%	26,582	3.18	84,555
FM	Micronesia (Federated States of), Micronesia, Oceania	0.02%	0.02%	4,504	0.62	2,814
WS	Samoa, Polynesia, Oceania	0.02%	0.02%	9,156	0.53	4,869
PW	Palau, Micronesia, Oceania	0.02%	0.02%	4,853	0	0
PF	French Polynesia, Polynesia, Oceania	0.02%	0.02%	10,850	1.43	15,557
FJ	Fiji, Melanesia, Oceania	0.01%	0.01%	73,217	0.5	36,288

THANKS.

- APNIC Staff and others who help in our Deployments.
- APNIC48 PC Committee for considering my presentations and I understand our individual involvement in this kind of PLATFORM help extend the HUMAN network to places like ours but also DIRECTLY flourish our Technical Capabilities.
- So Thanks you for including myself to be here.
- APNIC Foundation for help funding most of the costs of my trip here. Without your kind help I wouldn't be standing here and do this presentation.
- Thanks to all the fellow's and all of you who are listen and here with us.
- I wish you good luck in your future IPv6 Deployments.
- Thanks you. I do hope you enjoy listening to my story.

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