PacNOG 32

Tonga - TCC IPv6 Project

Acknowledgement :

- Pacnog Committee
- Management Approval (TCC)
- Project Team (Representative)
  - Overcome Challenges
- ISIF & APNIC Foundations
- About myself

- **Share Lesson Learned**
- **Give Back to Community**
- **TPL Green**

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3 Points

- Background
- Motivations
- IPv6 @ TCC

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1.0 History

Fixed and Wireless Broadband (2001 onwards)

- Dial Up
- Fixed and Mobile WiMAX (Alvarion)
- ADSL (Ericson's and Current Vendor)
- DSL
- P-T-P WAN
- PPPoE/DHCP
- VDSL
- Future GPON

Cellular Data (~2010)

- 2.5G
- 3G
- ~2014 4G
- 4G+ Now
- Plan for 5G In the future.

PacNOG 32 2.0 Motivation

- No Capex (Internal) and Uplink IPV6 Ready
  - ISP Fix Deployments
    - Just Turn it ON so other would follow
  - Government Ministry and Enterprises
  - Small Business
  - Individual
  - Equipment >10 yr.'s
    - 0x86dd Ether Type IPV6
    - IPV6 Routing Ready

Just Turn it on !!!

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Motivation

- IPV4 Exhaustion and no NAT
  - ~2016 TPL Smart Meter (Business Case) -Tunnelling
    - IoT
      - 6LOWPAN

      - Spec for Low Power Wireless Mesh Network
      - Each Node has its own Global IPV6 Address
      - This means direct access to Internet
      - Adopt by all sort of smart meter

I am pretty sure all Smart Meter in Tonga use this standard. And most likely anywhere in the World because IPV6 Simplify and Improve things.

→ No NAT and No Tunnelling, Just Pure Routing definitely result in better Performance.

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Motivation

Performance

- Subscriber
  - End User Experience is always Important but Network Operator Decides.
    - Telecom
    - ISP
    - Enterprise
    - Company or Organizations

The Network Operator will have the last say, cos its business at the end of the Day.

Choosing to roll out IPV6 now the right thing to do.

No NAT, No Tunnelling , just pure Routing

❖Btw end user don't care so your call as an operator

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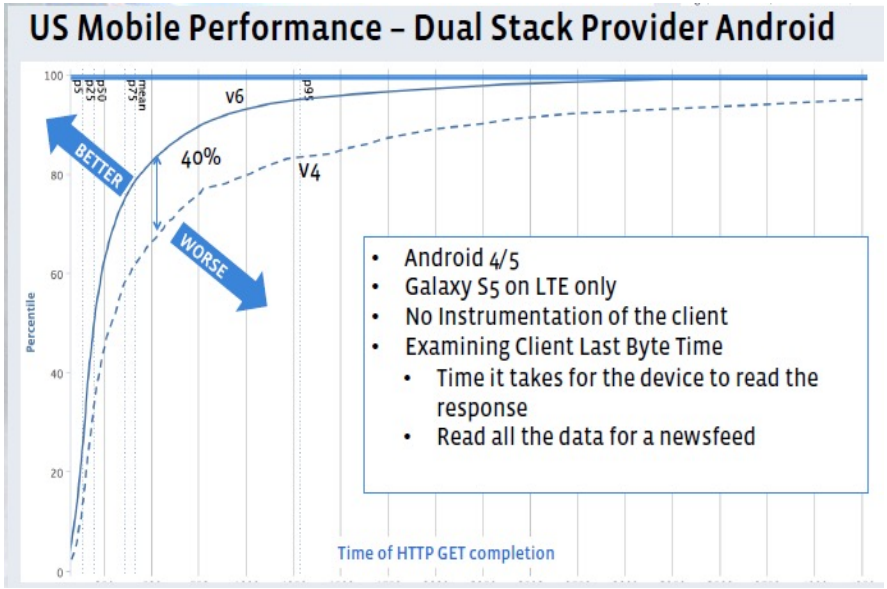
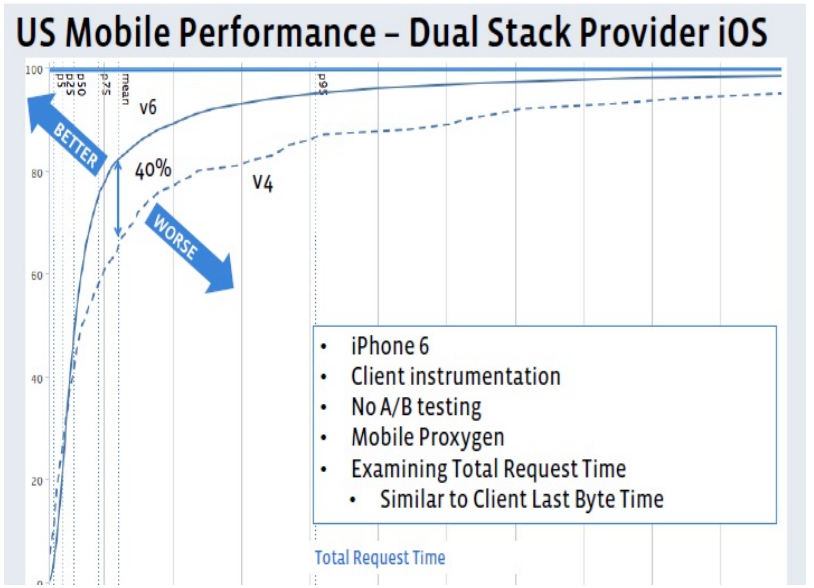
Motivation

Performance

- Internet Service [Paul SAAB ipv6 - Google Search](#) 2015 IPv6 World Congress





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Ipv6 @ TCC

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PacNOG 32 IPV6 @ TCC

How, When, Where and What TCC do with IPV6 ?

- Capable Team and Good Leadership
  - Previous Engineers
  - Management Support

~2008 – 2009 single /32 from APNIC , APT Training in Malaysia.
  - Proof of Concept over satellite IPV6 over IPV4 Tunnels

~2012 Upgrade MPLS Network

- 2013 International Cable Connected
- Loopback and P-T-P Dual Stack on MPLS Network and that's it.

Because

- IPV6 @ CPE rarely Support
- Customer lack the Expertise to setup and Manage
- Customer No reason or Lack of Motivation
- TCC has lots of IPV4 Resource

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Fast forward to 2019

Because

- IPV6 @ CPE greatly Support (No longer True)
- Customer lack the Expertise to setup and Manage
- Customer No reason or Lack of Motivation
- TCC has lots of IPV4 Resource

So why we decide to do IPV6 now !!

Continue without IPV6 is Costly !!!

- NAT/CGNAT
- TCP Resource Utilization
- You can have enough IPV4 Resource, but these will not keep up to that.

For Mobile Cellular Data

- 2020 we upgrade our NAT ~70k USD
- 2022 we need to upgrade once again. ~140k USD

➢ Its an Operator call now.

- No NAT
  - More Direct Path
  - Improve performance and Efficiency between SG and Internet GW

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How we do it @ TCC

MPLS Core

- Ldp only support ipv4 at the time
- So we have to use 6VPE
- MPLS VPN IPV6 traffic over IPV4 MPLS Core.

Fixed Broadband ~ 2019 after APNIC 46

Edge Network

- BRAS / BNG Fixed
  - Dual Stack over MPLS VPN

Access Network

- MSAN & LAN Switches readily support 0X86DD IPV6 L2 Frame Type

CPE

- All Vendors CPE support Dual Stack – just enable it on WAN config

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Fixed Broadband @2019

No CAPEX require at all.

What we consider from an ISP

- NAS (Free radius support IPV6 counter in its Acct Packet)
- DPI Support just enabled
- MPLS VPN 6VPE
- BNG/BRAS AAA Function
- Access Network (0x86dd)
- Computers and ADSL CPE

Deployments in fixed

- ~10% of Total Traffic for fixed is IPV6
- No Auto Provision to do mass Deployments of Dual Stack
- Still work to do here !!!
- Before end of March 2024 to reach 100% for fixed sub.

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Ucall Mobile Network

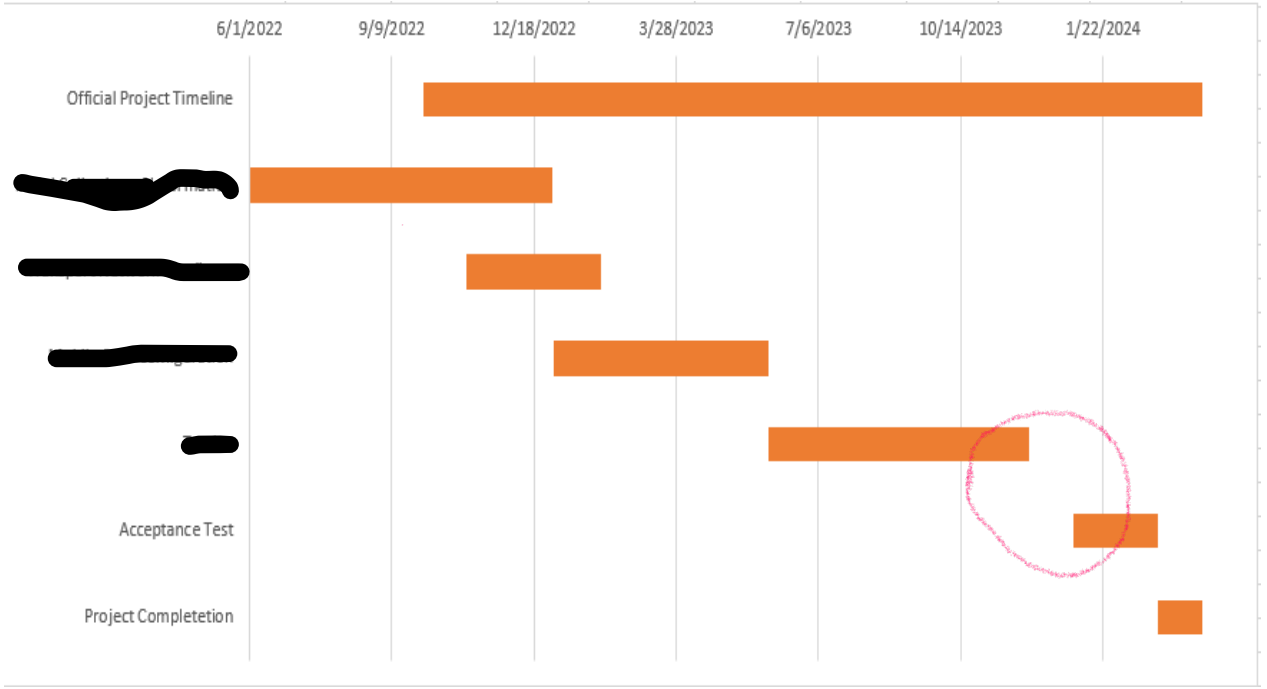
- Require Capex

Funded Project

- ISIF Asia via APNIC Foundation
- 250k USD

Ground Work

- Team Selection – Project Manager
- Layout the Plan
  - Set goals and timeline



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Internal Audit and Review

- Network Audit – Different Network Segment
- What Change – Physically and Logically
- Consider Temporary Changes
- Consider Transition Technology
- Consider Consultant Services
- Purchased Item (License or Hardware)

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Internal Audit and Review

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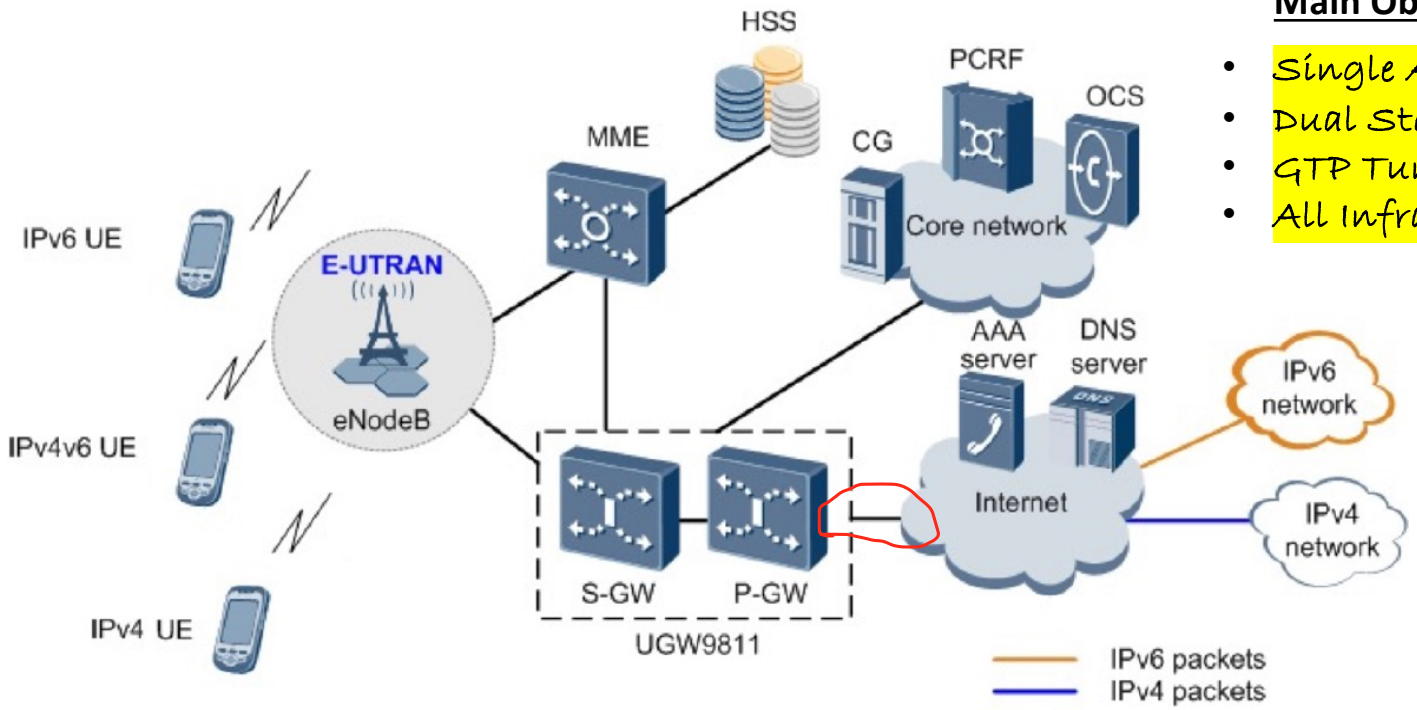

Main Objectives after Review

- Single APN
- Dual Stack to PE in RED
- GTP Tunnel inside EPC
- All Infra remain IPV4 for Now !!

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What we need to Consider

NEs involved in implementation of the IPv4v6 Dual Stack Access feature on EPC networks

Node	UE	eNodeB	MME	HSS	CG	S-GW	P-GW	PCRF	AAA	OCS
	√	√	√	√	√	√	√	--	--	√

License requirements

Node	UE	eNodeB	MME	HSS	CG	S-GW	P-GW	PCRF	AAA	OCS
	--	--	√	√	√	√	√	--	--	--

No need to buy extra hardware but Licenses and its not cheap ☺ …

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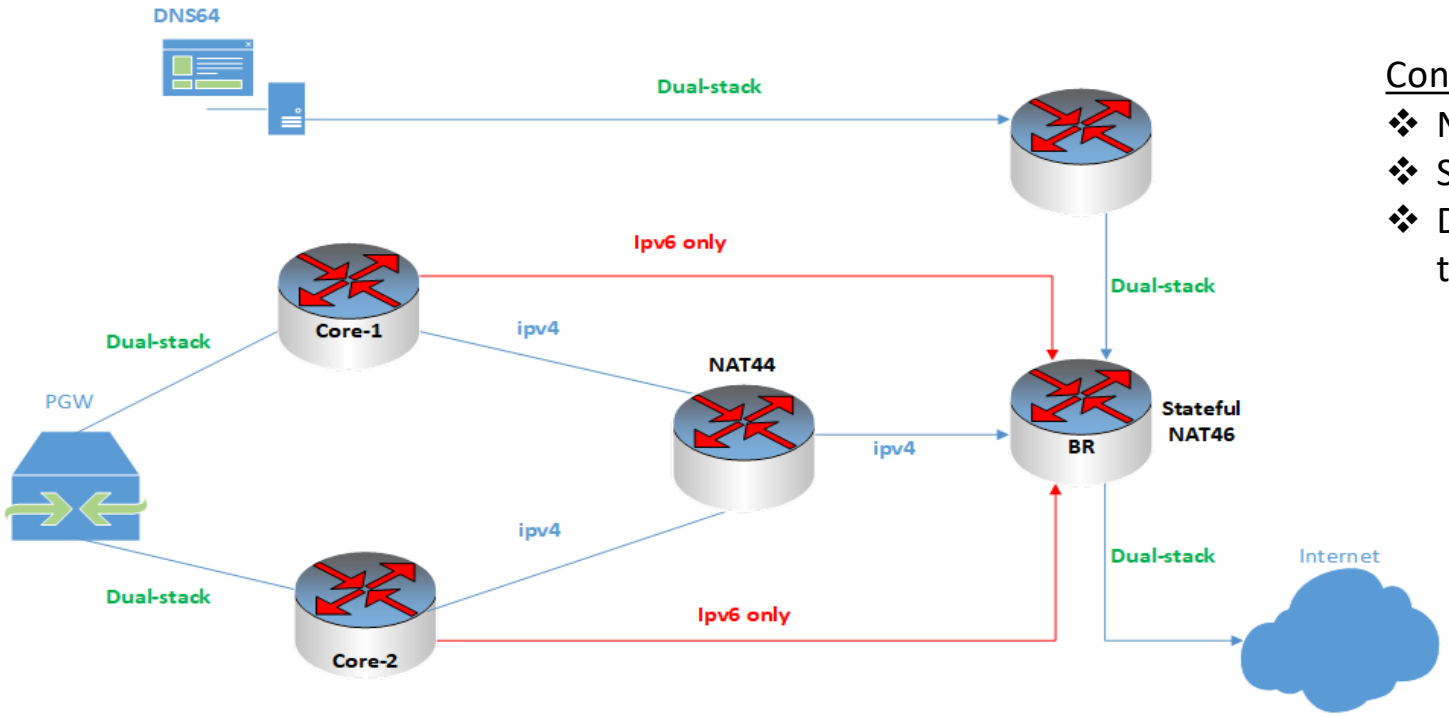
What we need to Consider

ISP Core



Consider in Test Env(Vendor)

- NAT44&NAT64 interface
- Stateful NAT64
- DNS64 Specific Prefixes for test APN's

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Implementation : For Test Env

Parent Prefix (single /32)	1 X /36 (Mobile Core)
IPv4v6 Test APN	1 X /48
IPv6Only – Test APN	1 X /48 (464XLAT)
Live APN's (2 x IPv4v6)	1 X /47 ~70k sub

Note : Mobile Core ability to provide whatever UE request IPv4,IPv4v6 or IPv6.

A single /64 per Single PDP Context with two IP address

- Single Stack / Single PDP Context/Bearers
- Dual Stack / Single Context/Bearer with 2 Address

```
Access type = Iu
NSAPI = 5
Activation initiator = Activation initiated by MS
Ti = 0
APN NI in use = TESTIPV6
APN OI in use = MNC001.MCC539.GPRS
PDN type in use = IPv4v6
IPv4 address in use = 10.20.23.169
IPv6 address in use = 2400:6400:C000:2:539:101:36:8099
```

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Implementation : Production

#	Step	nodes	Service impacts	Comments
1	Change live APN for Handsets to support dual stack	GGSN/PGW	none	Consider the prefix for UE
2	Change live APN for Modems to support dual stack	GGSN/PGW	none	Consider the prefix for Modems
3	Provision test users on both APNs to test	n/a	none	Tests carried out to verify
4	Provision all live users to support dual stack	HLR/HSS	All bearers/PDP Reset	After this step, most users will still be on IPv4 as they are all set to request only IPv4, However there were group of User their UE already in IPv6 enable mode
5	Start migration of UE configuration	n/a	n/a	Team to advise users to change to IPv6 or IPv4v6 as required

UE Vendor

- Later model default to Dual Stack, maybe based on Vendor
- Apple disable IPv6 by Default on all iPhones in our Cellular Network

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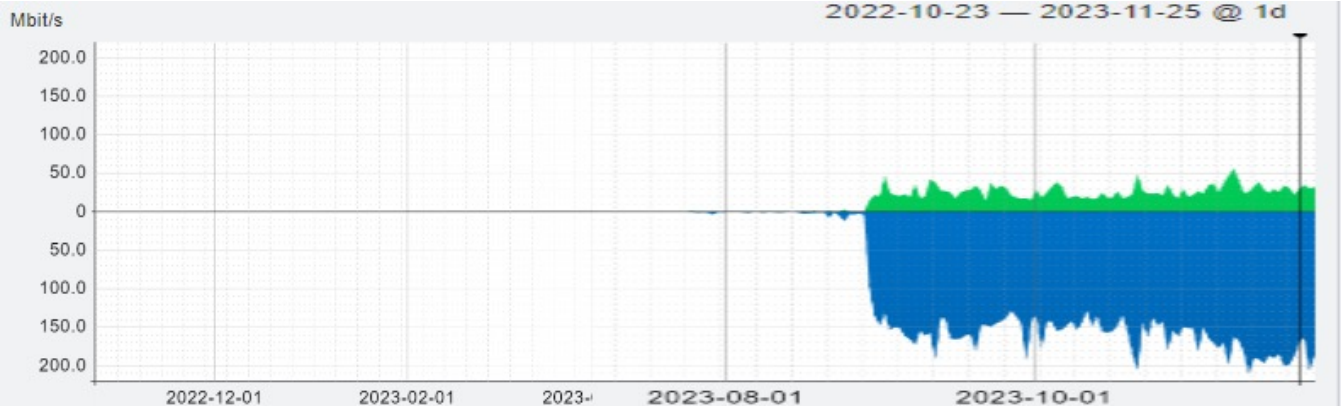
Statistics



- Late August 2023
- ~ 10 % of total sub
- All Androids
- Later Version plus Maker
- iPhones not Enable

What's Next for these Vendor

- Androids User need to change APN Protocol Settings
- Apple , work is still in progress.

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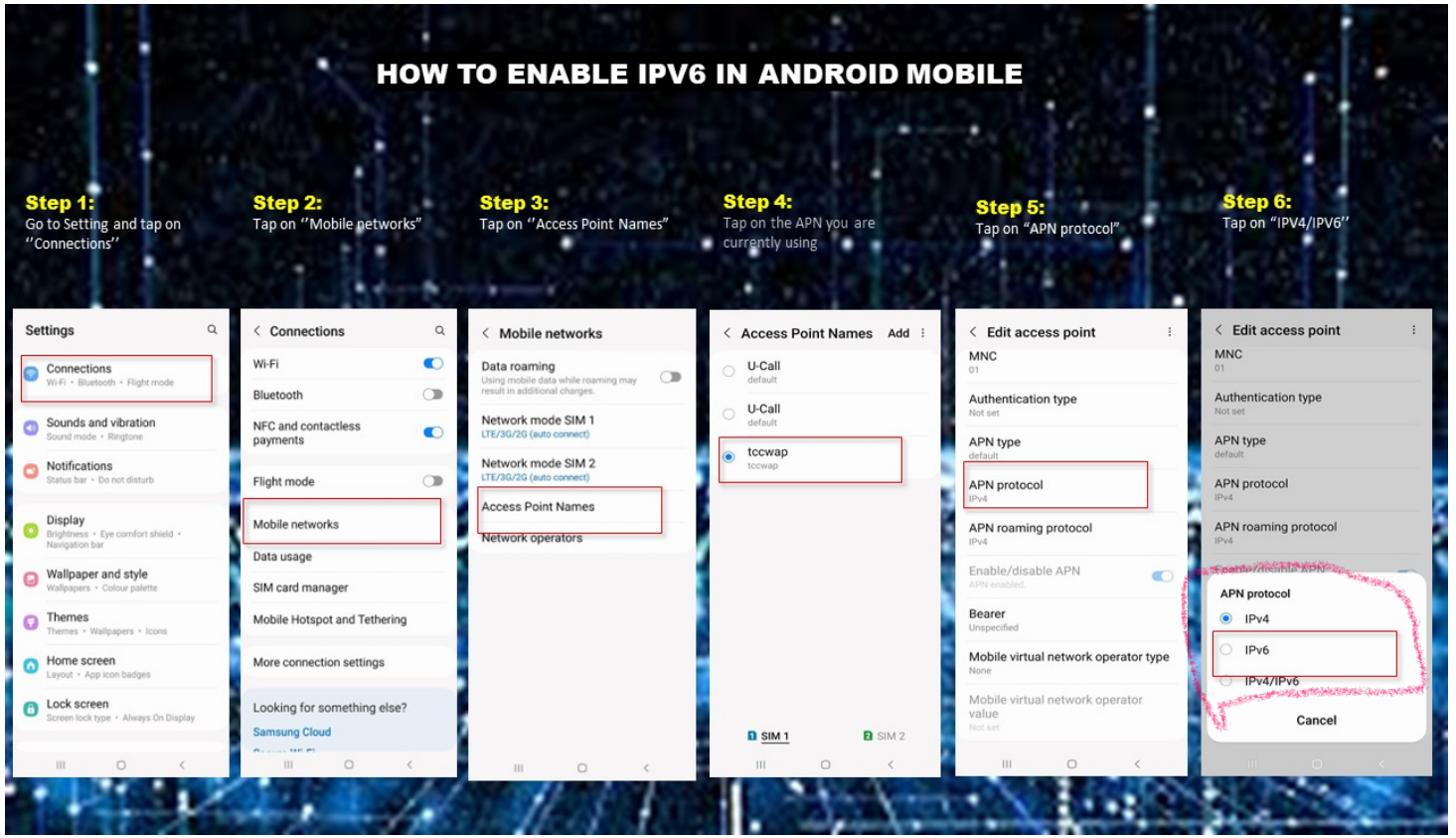
Androids How-To



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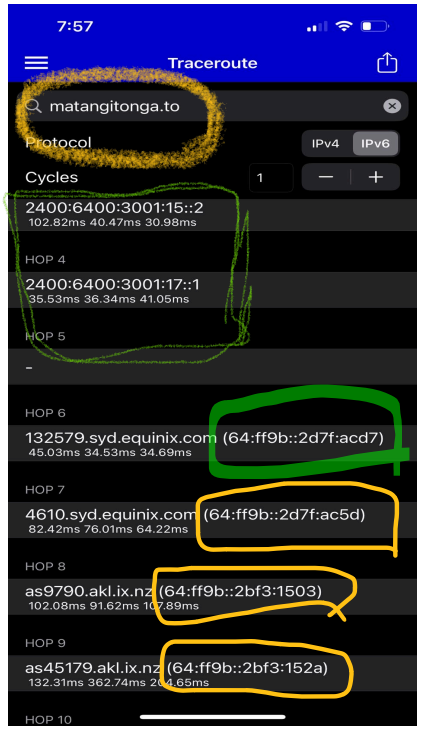
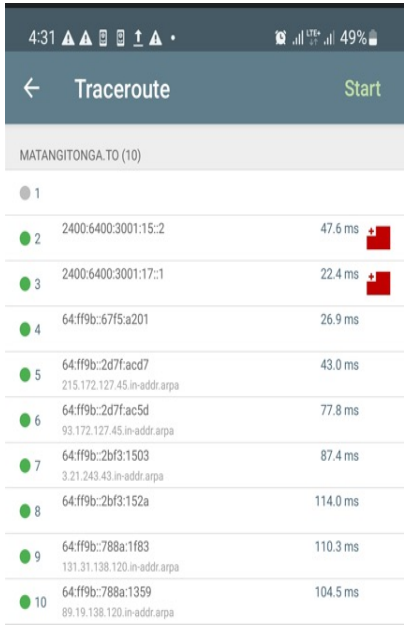
What its look like

iPhone Wi-Fi to IPv6-only UE



IPv6-only UE to IPv4

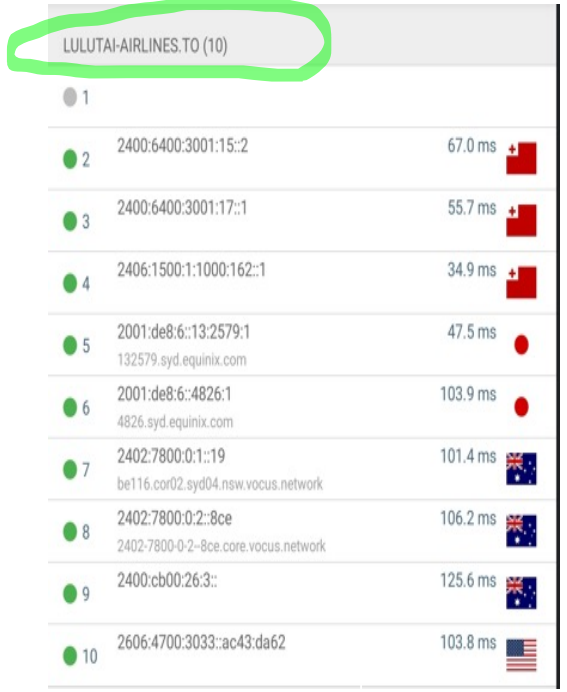


Note :

- Local Media Site
- IPv4 only
- WKP for NAT64 for 464xlat (Tethering Device have to DualStack on WIFI (no CLATD on laptop))

Androids IPv6-only UE

Local Site IPv6 Host



Note :

- Local Airline
- Cloudflare Hosting

No Longer User Driver

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What's about Security !!

- IPsec Built in but its not default enabled in IPv6 Protocol

Which IP protocol is more secure ??

- They are the same
- The payload is the same
- Its only the IP Transport Protocol is either IPV4 or IPV6
    - Its means what ever Security you have in IPV4, mirror is to your IPV6.
        - End Point Security don't Care
        - V4&V6 ACL for BR for examples

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Consideration and Lesson Learned

- IP Address Manager
- Considering Monitoring Systems to Support
- Upstream Caches Dual Stack Support
  - Meta Now Only
  - We request other's as well.
- Its important to Contact Apple from the Beginning for iPhones Support cos it takes time
  - Apple SMTP Email Server .0 IPV4
- For Fixed Deployment
  - Consider TR069
  - Mass IPV6 Deployment Enabler
  - Otherwise Door to Door Visit
    - Change Older Fixed CPE to Dual Stack
    - Newer CPE have Dual Stack enabled by Default
      - 2 Options Here
        - Replace CPE with newer ones
        - Or Change current CPE Settings
        - Common Home Visit

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Thank you for Listening

Enquiries or Question

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