UKNOF
IPV6-ONLY DEVICES ON EE MOBILE

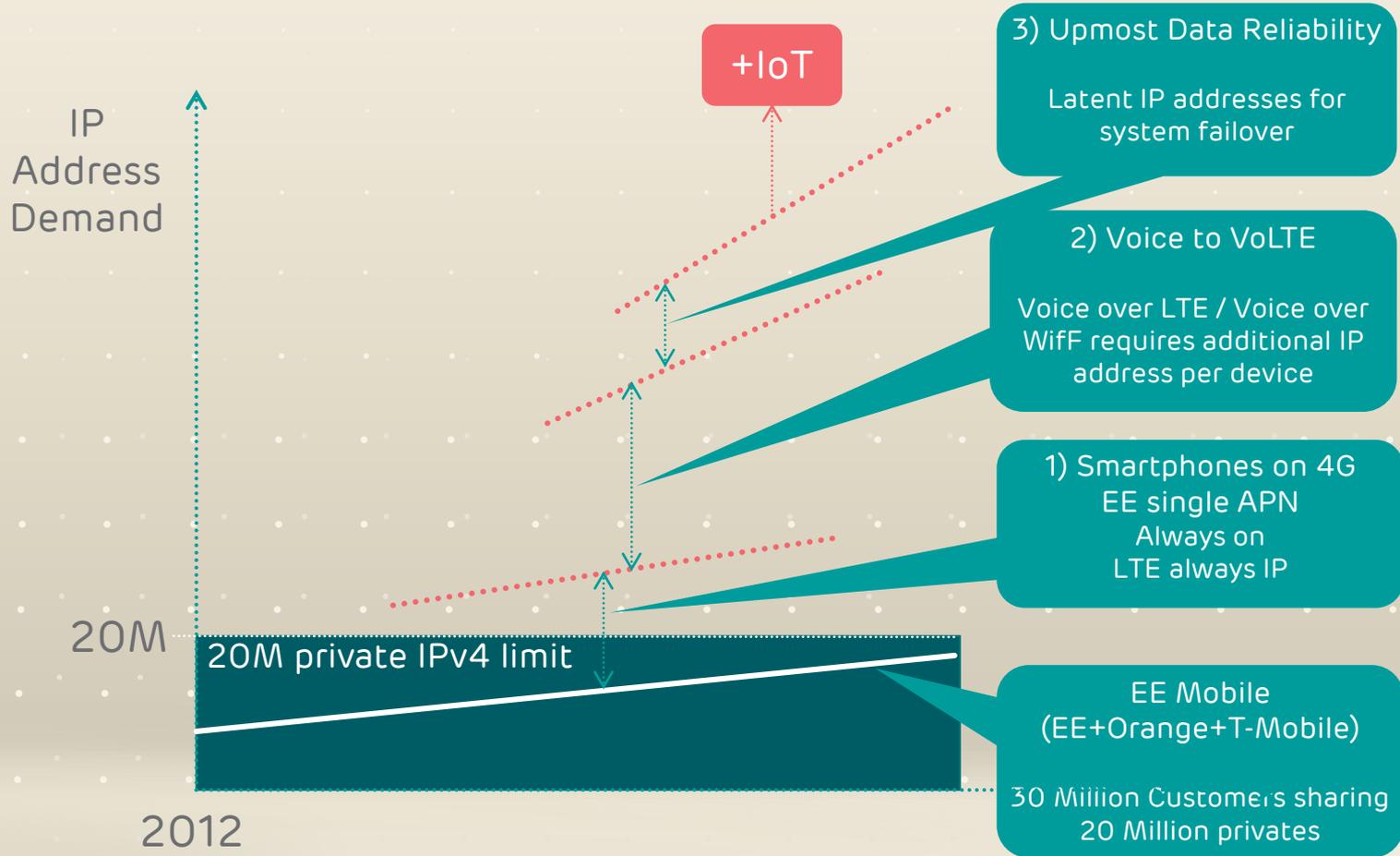19/01/2017 Nick Heatley, Network Architect,

Chief Architect's Office

NAT is well established in Mobile ISPs

- **Mobile operators have extensive experience of Carrier Grade NAT for their internet services.**

- **Any stocks of public IPv4 are augmented by the 20 million private IPv4 ranges.**

- **The mobile web experience through Carrier Grade NAT (NAT44) has proven successful.**

APPARENT 5 YEARS AGO - 20M PRIVATE IPS NOT SUFFICIENT

IP Address Demand

+IoT

3) Upmost Data Reliability

Latent IP addresses for system failover

2) Voice to VoLTE

Voice over LTE / Voice over WifF requires additional IP address per device

1) Smartphones on 4G
EE single APN
Always on
LTE always IP

20M

20M private IPv4 limit

EE Mobile
(EE+Orange+T-Mobile)

30 Million Customers sharing 20 Million privates

2012

Beyond 20 Million – IPv4 Workaround or IPv6?

Questions being asked:

- **Compromised workarounds? Kludge internal numbering with overlapping private address space?**

- **IPv6 will reduce investment in NAT (and associated logging). But is it really a complete solution? Dualstack does not alleviate address exhaustion.**

In EE we ensured the VoLTE APN was IPv6, not overlapping IPv4.

But for mobile data, is dualstack of benefit? Can IPv6-only succeed?

Meanwhile, IPv6 in vast Data Centres

Meanwhile some big names were also asking similar questions on avoiding private IP address exhaustion (Facebook, Google, LinkedIn, Microsoft) – using IPv6-only in the cloud/data centre or within their networks.

Common threads: Reachability, peer-to-peer, E2E openness, simplicity of singular node configuration, homogeneity

Considering vast numbers of endpoints, has a consensus formed?

i.e. IPv6 is the perennial solution to address number shortage.

Single stack may be better for the mobile mass market

Operating two IP address families per terminal is a burden:

- **Radio Access Network Signalling (yes, this is fixed by IPv4v6 bearer in 3GPP Release 8+)**

- **Policy Control and Charging – IPv4 & IPv6 double the sessions (this issue never goes away)**

- **On the customers device, one is better than two (battery drain, Happy Eyeballs, Apps, DNS)**

- **Burden of operating of double network protocols forever on the network and for new services (.need to do this for some while yet though…)**

And of course, an IPv6-only device returns an IPv4 address to the pool…☺

Main Mobile Experience Challenge – Application support

Existence of "IPv4 Literals" hinders IPv6-only

- ### Client side
  - "Traditional VPN client" configured to IPv4 VPN Gateway
  - Spotify client seeks an IPv4 server
  - A few other PC clients use IPv4 literal (Gaming, Skype PC)

- ### Server side
  - Web Server referral/redirect to IPv4 address
  - This is poor coding!

- ### User input
  - Typing into browser http://100.3.2.1/login

The IETF (RFC6877) gives a solution tailored for CGNAT networks – 464xlat.

MOBILE USECASES
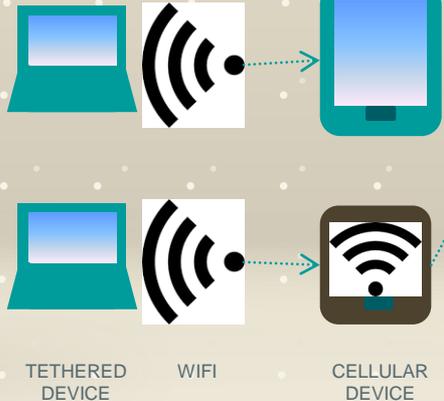
1. Voice/IMS

OPERATOR VOICE OVER
IP / LTE / WIFI

CELLULAR
RADIO

IMS
APN

IMS

OPERATOR NETWORK
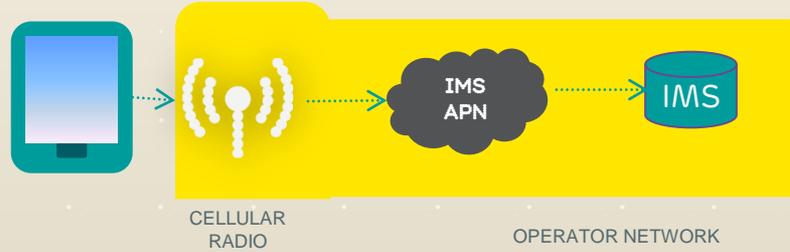
2a. Data

DATA FROM INTERNET
OR OPERATOR SERVICE
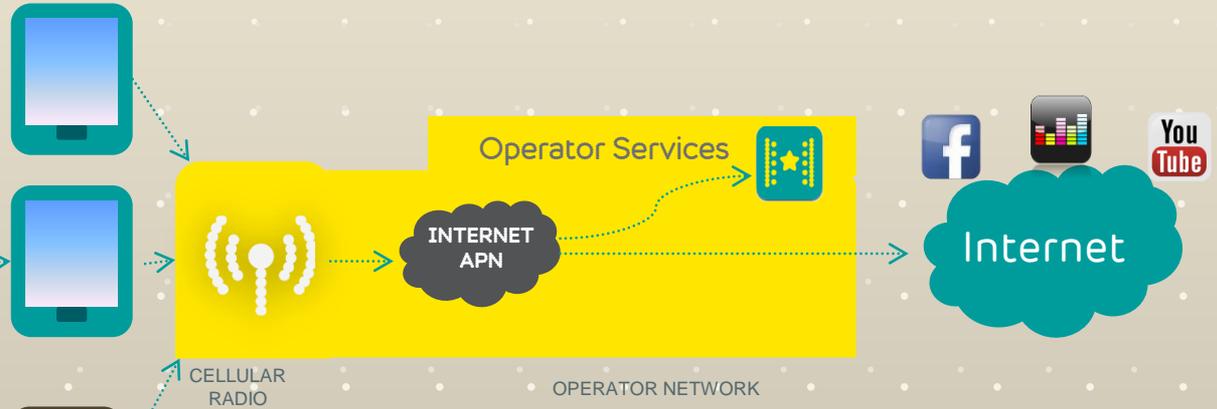
**2b. Tethered
Data**

WIFI TETHERING FROM
HANDSET

**3. Mobile
Broadband**

MYFI OR DONGLE

Operator Services

INTERNET
APN

Internet

CELLULAR
RADIO

OPERATOR NETWORK

TETHERED
DEVICE

WIFI

CELLULAR
DEVICE

HOW 464XLAT FIXES IPV4-BOUND APPS & SERVICES
IPV6-ONLY WITH 464XLAT (RFC6877)

Case1b. Following DNS lookup, v6 dest selected. Pure IPv6 direct.
Case2b. As destination is IPv4 only, DNS64 synthesises v6 DNS response with v6 destination of the NAT64 gateway. NAT64 based connection.
Case3b. IPv4 bound app sends via v4 XLAT stack; 464XLAT 'CLAT' immediately translates to v6 with destination of NAT64 gateway.

IPv6-only Single Stack Bearer

Device Apps

Content Lookup

Agnostic

DNS lookup

IPv4-bound

1b
2b
3b

v6 destination

v4 destination

CLAT

IPv6 address

DNS

DNS 64

V6 FW

NAT 64

IPv6 connection

IPv4 connection

IPv6 Content

IPv4 Content

2a. Data✓

2b. Tethered Data✓

Related IETF RFCs
RFC6877 – 464xlat translation
RFC7050 – auto discovery of NAT64 prefix
RFC7335 – spoof IPv4 address for CLATs
RFC7278 – V6 Prefix sharing on WiFi
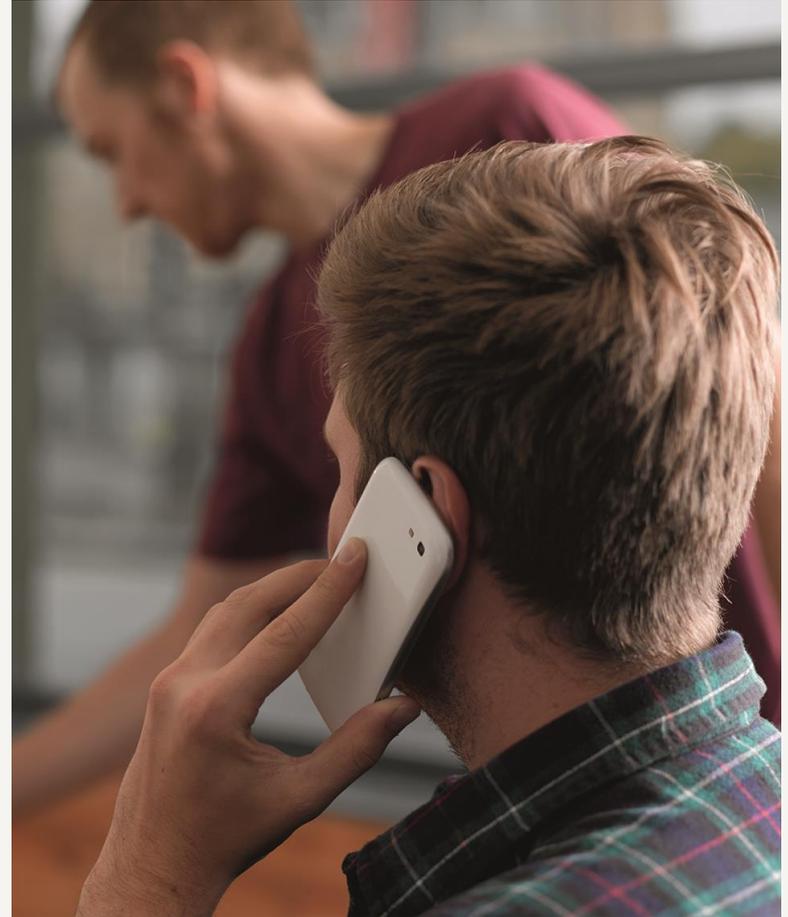
Eligible 464xlat smartphones

IPv6-only with 464xlat (RFC6877)

- ✓ Android OS (default on EE build)
- ✓ All key devices from 2016 onwards:
    - ✓ Samsung GS6 Edge Plus and GS7's
    - ✓ HTC M10
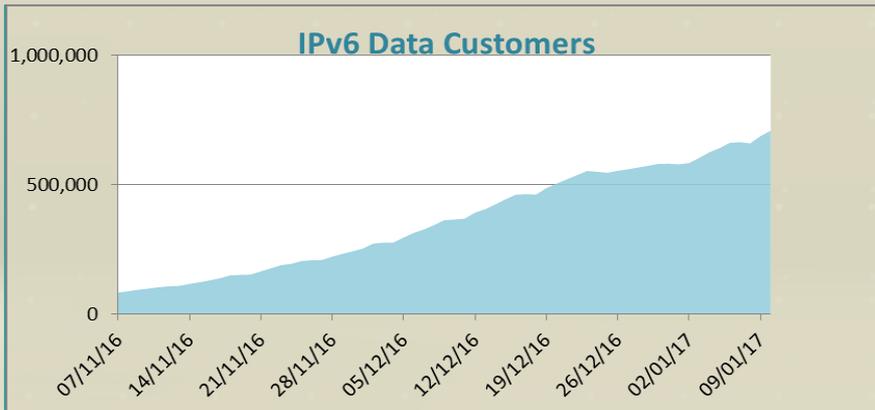   - ✓ LG G5, G5 SE, K7, K8
    - ✓ All Sony's from the Z5
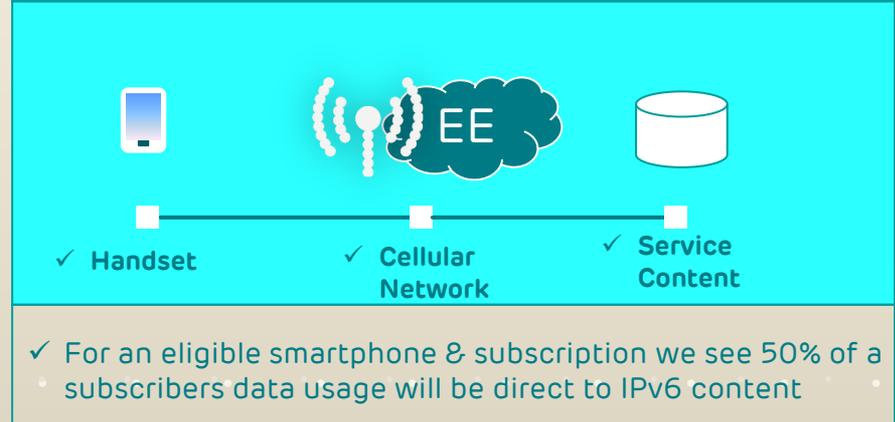
And more to follow in 2017...

EE IPV6 STATUS – JAN 2017

WHAT THE EE NETWORK PROVIDES:

- ✓ In 2014 EE switched on an IPv6 IMS APN; VoLTE now default on for 4G devices that support it.
- ✓ In 2016 H2 EE provided a single Data APN providing IPv4 or IPv6 bearers:
    - ✓ Legacy devices request IPv4 – remain IPv4
    - ✓ Eligible devices that request IPv6/IPv4v6 – receive an IPv6 bearer by default
- ✓ Today only EE postpay consumers eligible.

50% DATA VOLUME

- ✓ Handset
- ✓ Cellular Network
- ✓ Service Content

- ✓ For an eligible smartphone & subscription we see 50% of a subscribers data usage will be direct to IPv6 content

IPv6 Data Customers

DATA APN STATUS: 0.75M

- Currently 0.7 Million Mobile Data customers are using IPv6.
- About halfway through updating the subscriptions in EE postpay consumer base.
- By Feb we expect 1M customers on IPv6 data.

An alternative IPv6-only approach is emerging

Provide an IPv6-only ecosystem protected against IPv4 literals:

- **Fix Apps**
  - Police apps in the app store, ensure IPv6 compliance (no literals)
- **Fix Server-side**
  - Build a bump-in-the-host approach, let the OS help repair literals
  - And clients can perform synthesis of NAT64 destinations themselves (if they discover the NAT64 prefix e.g. RFC7050)

This could enable a pure IPv6-only + DNS64/NAT64 environment

No need for 464xlat.

Potential challenge – IPv6-only tethering of any device (of unknown OS).

THANKYOU

LET'S CHAT

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THANK YOU

Any questions?
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