



# UK IPv6 Council: 464xlat for mobile operators

25<sup>th</sup> September 2018



# Why IPv6 in cellular networks?

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## Major reason - Avoiding IPv4 private address exhaustion

- Increase in users of data, leading to increasing numbers of addressing, driven by:
  - > Customers demand (always connected)
  - > Customers devices (LTE, always IP)
  - > Number of addresses per customers (incl. VoLTE/IMS, tethering additional devices)
- Long term strategy, including IoT driving addressing demands

## Other benefits - Advantage of global addressing of IPv6

- Avoiding IPv4 Public address exhaustion
- Cost avoidance for national regulatory obligations
- Long term strategy including 5G-Convergence

# Mobile Operators have seen successful IPv6 transitions with 464xlat

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## 464xlat (rfc6877):

- Translation based (i.e. NAT, CGN, already extensive in mobile)
- Avoids IPv4 Exhaustion; Eligible devices effectively IPv6-only as operator runs IPv6-only access/core network

## 464xlat (rfc6877) makes use of:

- stateful NAT64 (rfc6146), stateless client (“CLAT”, as per rfc6145)
- NAT64 prefix discovery, (currently rfc7050 which uses DNS64)
- DNS64 (rfc6147) can be scoped for discovery or as part of a wider NAT64/DNS64 regime.

## Traffic of ~100Millions of mobile customers:

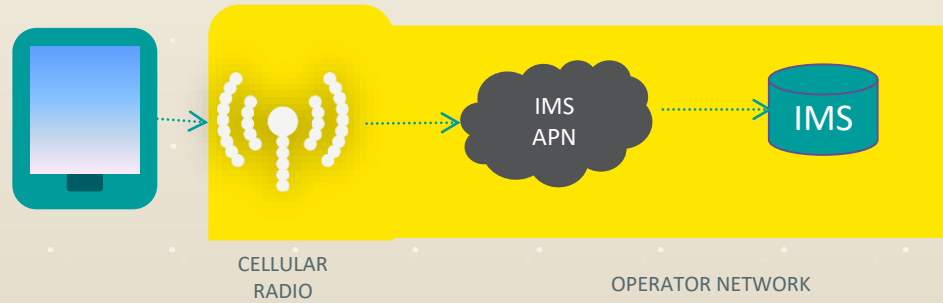
- T-Mobile (US)
- Sprint(US)
- Reliance Jio (IN)
- Orange (PL)
- SK-Telecom(SK)
- Telstra(AU)
- Rogers(CA)
- EE(UK).

# EE MOBILE USECASES

IPv6

## 1. Voice/IMS

OPERATOR VOICE OVER IP /  
LTE / WIFI



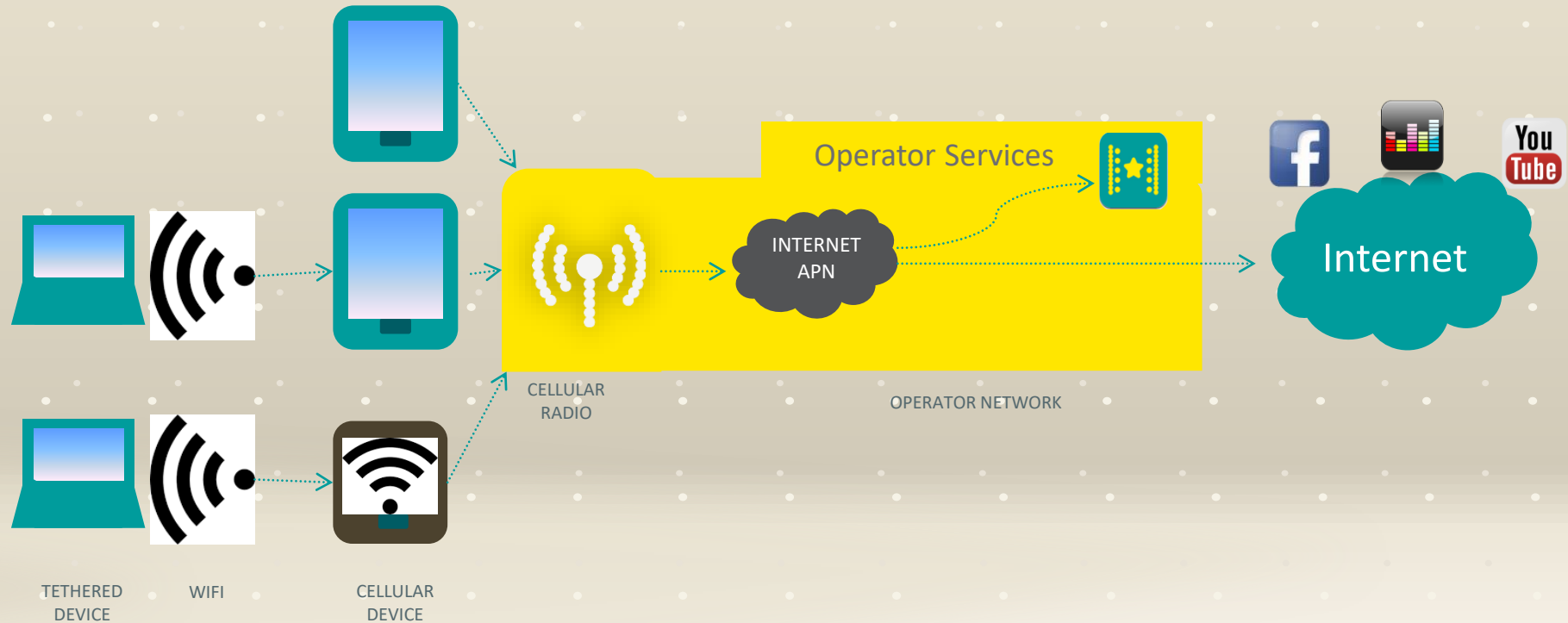
IPv6 +464xlat

## 2a. Data

DATA FROM INTERNET OR  
OPERATOR SERVICE

## 2b. Tethered Data

WIFI TETHERING FROM  
HANDSET

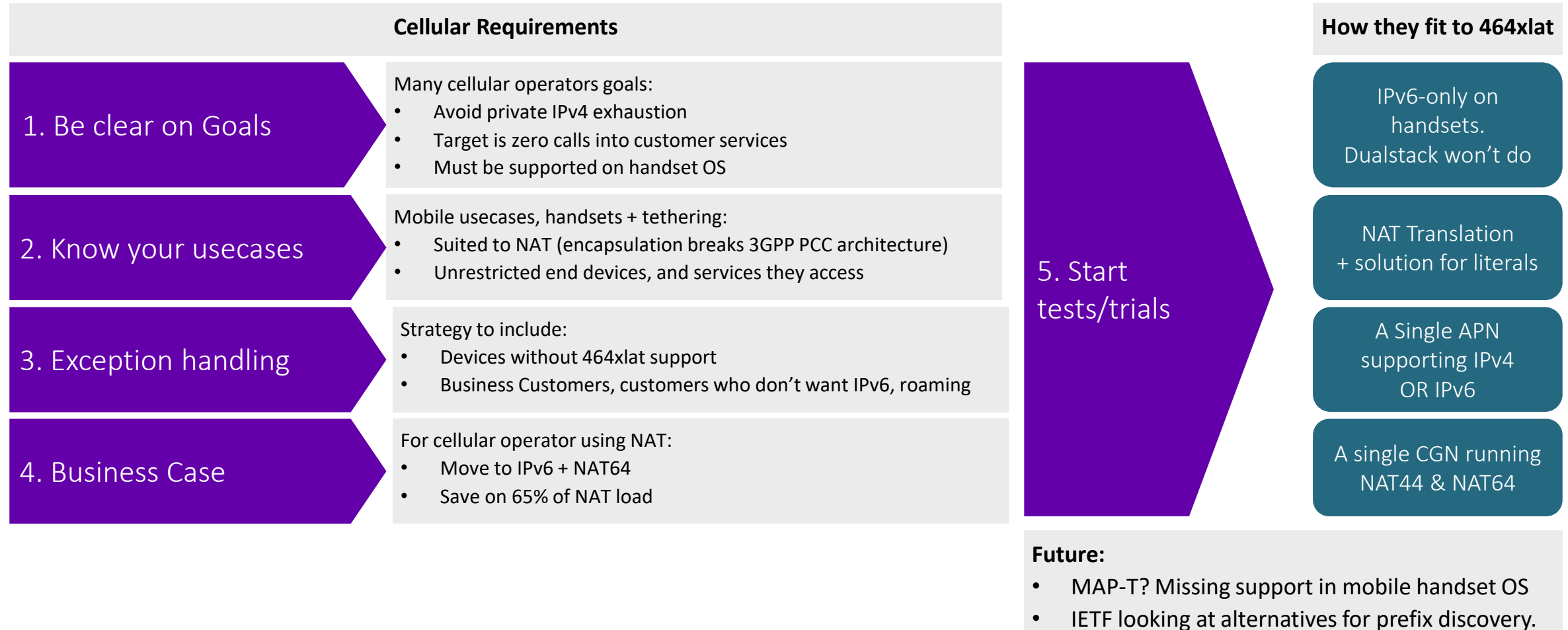


## 3. Mobile Broadband

MYFI OR DONGLE

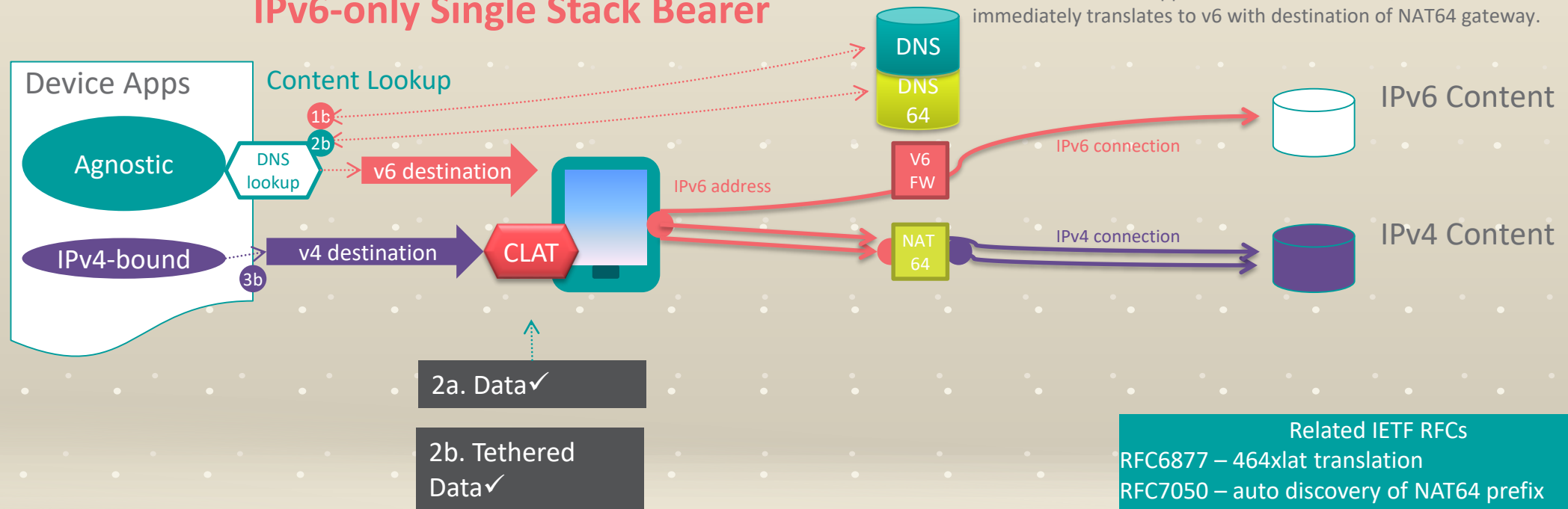
# Technology Selection

464xlat has been the deployment choice of cellular operators, for whom 20 Million private IPv4 are not sufficient



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

## IPv6-only Single Stack Bearer



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.

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

**Both Android and Apple (from iOS12) make use of 464xlat, implementations are different.**

## Apple

TETHERING (via single APN)

- iOS12 invokes 464xlat for tethering

ON-BOARD APPS

- App-store ecosystem immunised against IPv4 literals:
  - Police the Apps to ensure no literals
  - Fix other literals/Server-side:  
Happy Eyeballs v2 (RFC8305)  
A bump-in-the-host approach; let the OS help repair literals; clients can perform synthesis of NAT64 destinations (RFC6050) themselves (after the NAT64 prefix is discovered e.g. RFC7050)

## Android

TETHERING (via single APN)

- Tethering interface mapped via 464xlat (CLAT)

ON-BOARD APPS

- Android uses 464xlat for any apps or server-calls bound to a IPv4-stack

# Related Limitations

## Obvious

- 464xlat uses NAT, which can hinder certain protocols/services e.g. gaming.

## Less obvious

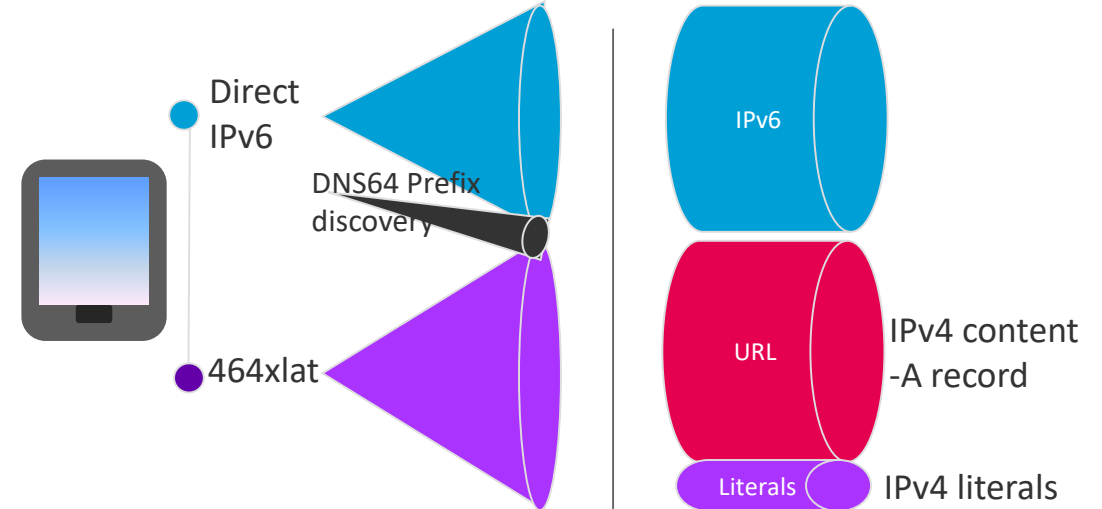
- DNS64 hinders DNSSEC
- DNS64 can hinder content that mixes URL and literal access (where source address expected to be same)

DNS64 Deployment choices – See diagram: 1. for prefix only, relying fully on 464xlat, or 2. full scope.

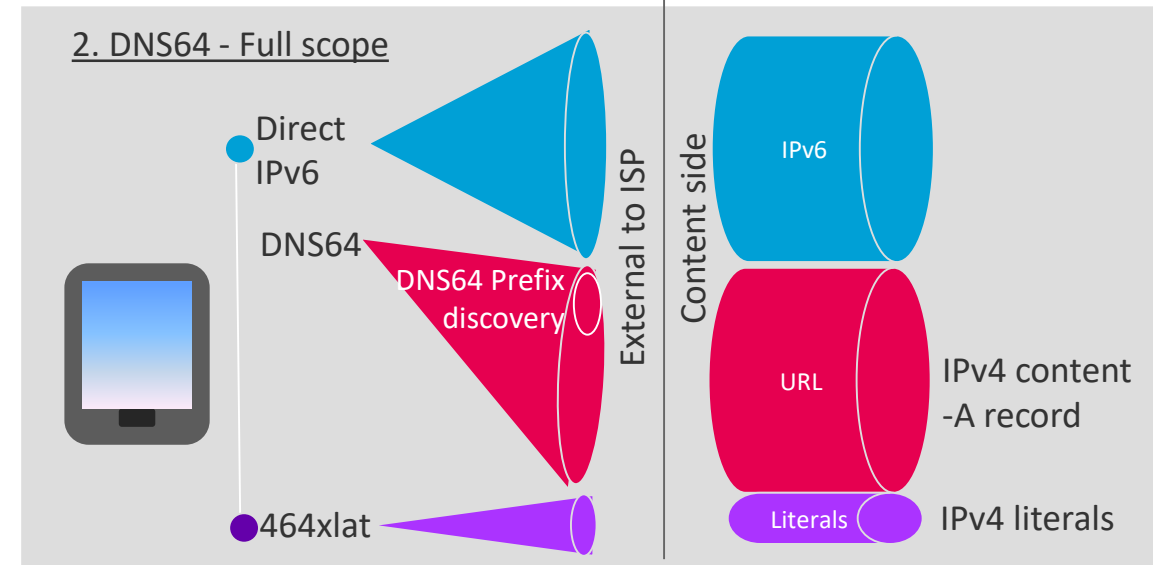
DNS64 is a hack, so why not remove it? Less bad customer experience than a device with no 464xlat.

In all cases enabling IPv6 on content avoids DNS64/NAT64 issues.

## 1. DNS64 – NAT64 prefix discover only (rfc7050)



## 2. DNS64 - Full scope



EXTERNAL BT





# Thank you Any questions?

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