

SKY WIFI & IPv6

SKY



Simone Carturan
(Network Architect)
simone.carturan@skytv.it

Agenda

Sky Wifi & IPv6

1. Sky Wifi Network:

- a. La rete broadband di Sky

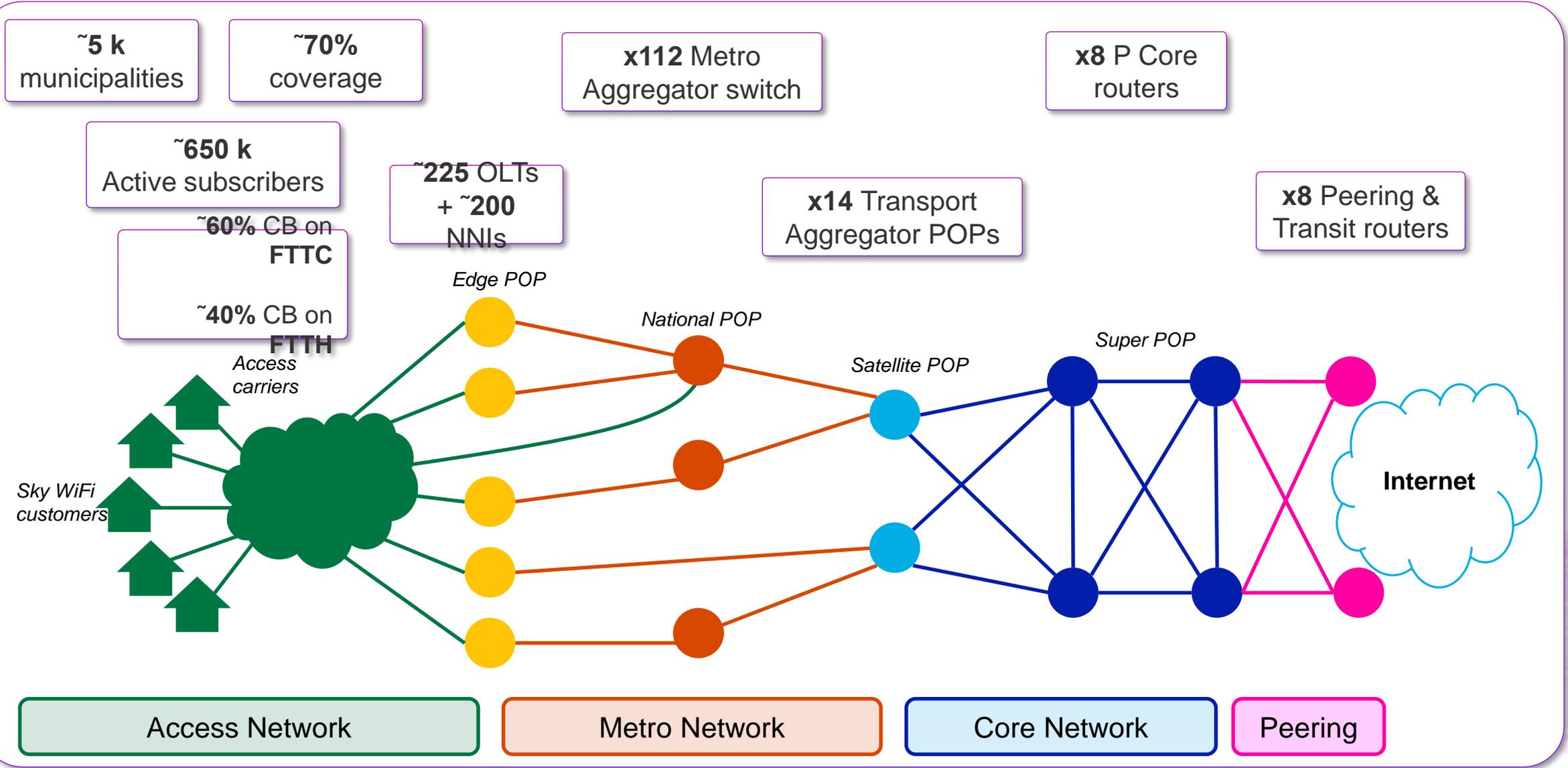
2. Architettura di rete:

- a. Optical Transmission
- b. IP Core
- c. Accesso FTTH/C

3. Servizi:

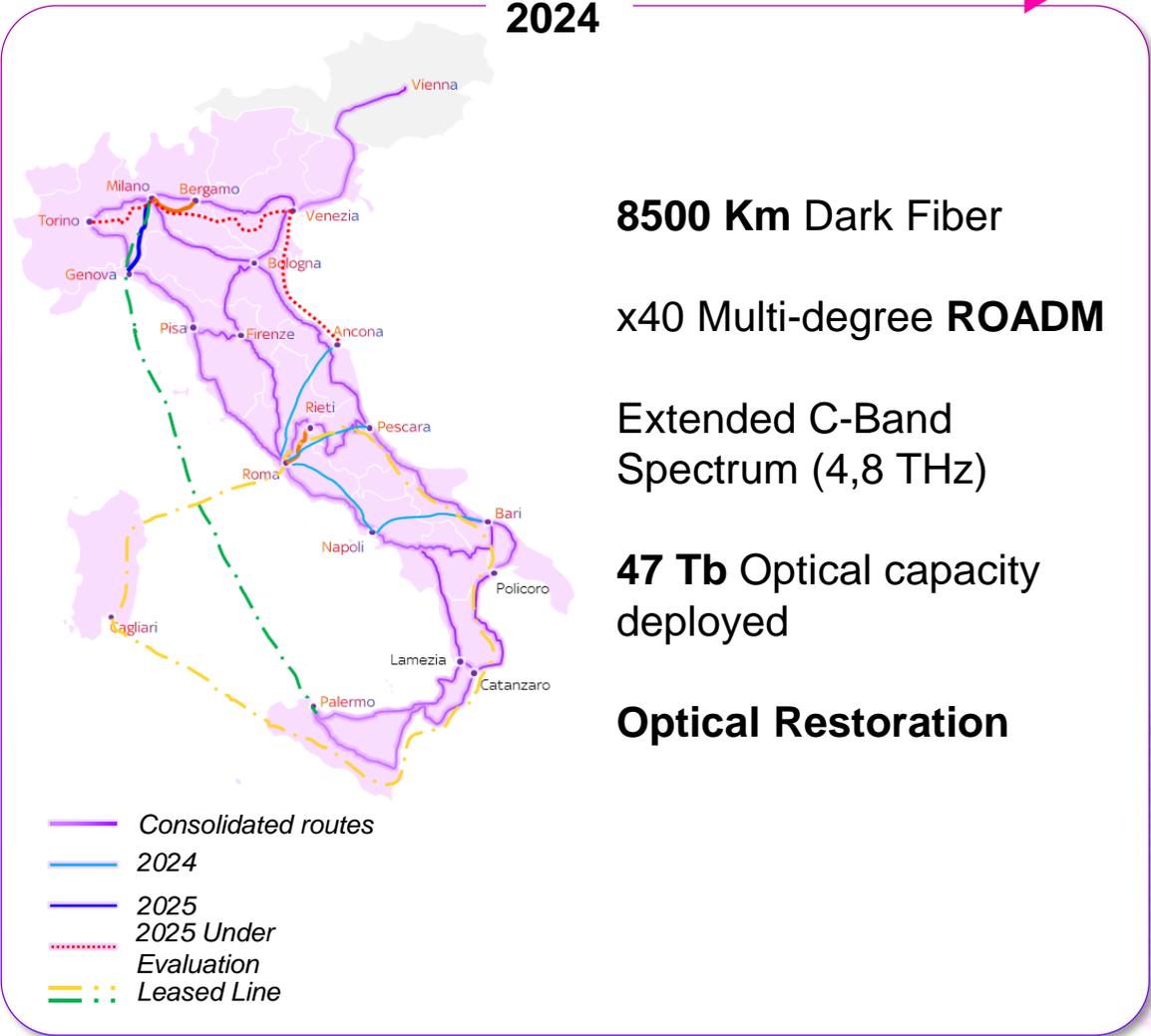
- a. SKY Content Service Provider e Internet Service Provider (OTT, CDN, Peering)
- b. Broadband e IPv6
 - i. MAP-T
 - 1. MAP-T in Sky
 - 2. Sky IPv6 Experience

Sky Wifi



Sky Wifi – Optical Transmission

Optical Transmission Map



8500 Km Dark Fiber

x40 Multi-degree ROADM

Extended C-Band Spectrum (4,8 THz)

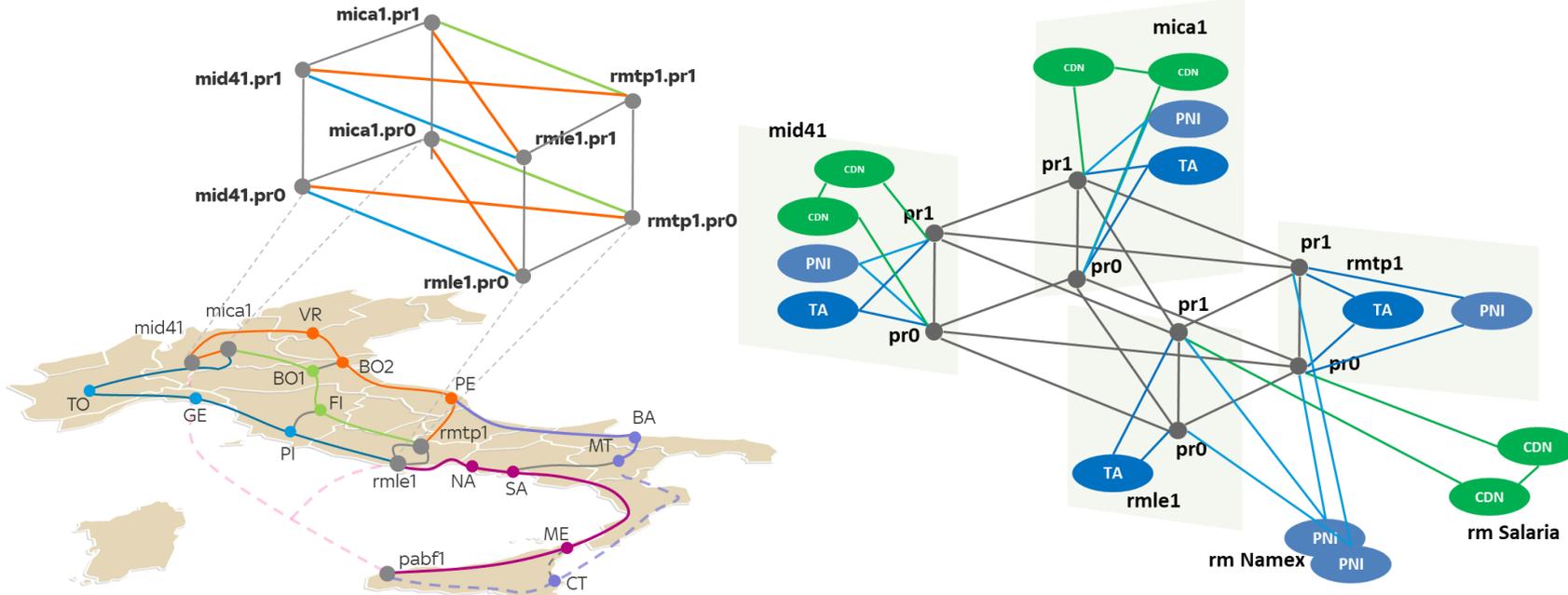
47 Tb Optical capacity deployed

Optical Restoration

Sky Wifi – IP Core

IP Core

PRs

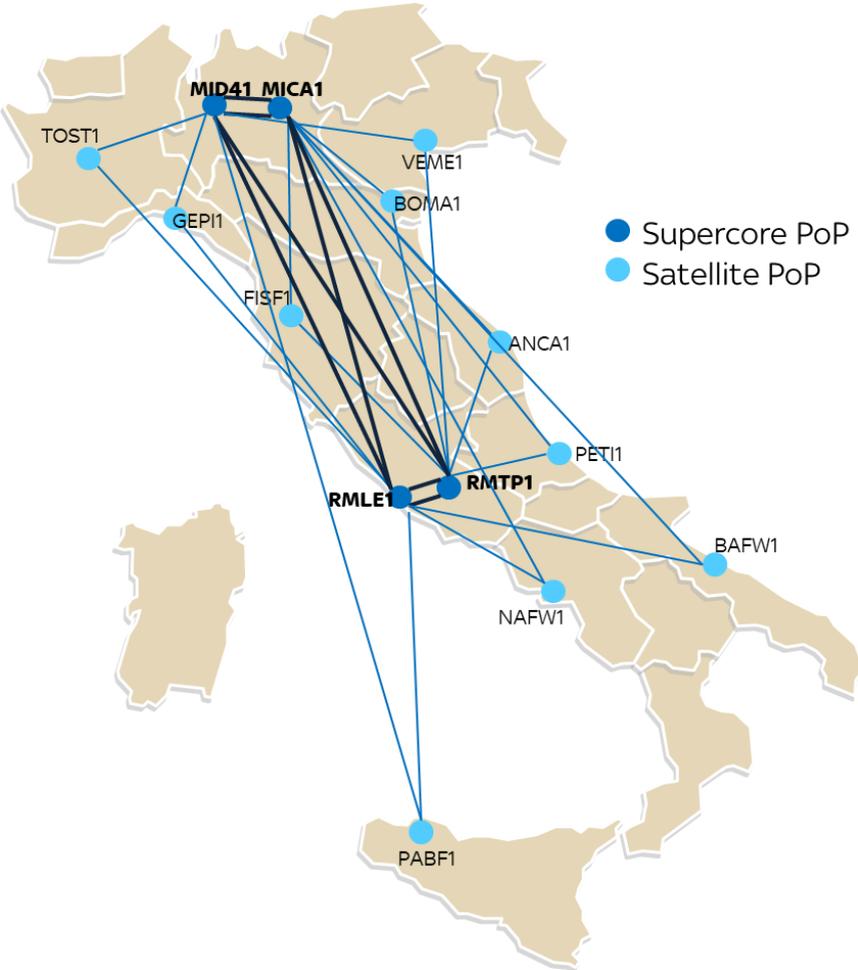


The Sky WiFi Network Supercore is a full mesh topology between the Milan and Rome Super POPs comprising dual Plane of MPLS PRs (Provider Routers).

Sky WiFi IP Network supports both IPv4 and IPv6 for all platforms and services.

Sky Wifi – IP Core

Satellite POPs



PEs Routing Protocols

IGP: ISIS

BGP

SR + MPLS

6PE

Dual HUB Network

Each Satellite POPs is directly connected both Milan and Rome

Sky Wifi – IP + Optical

TI-LFA + Optical Restoration



8500 Km of **Dark Fiber**: multiple fiber cuts and site isolation are not negligible.

TI-LFA < 50 ms

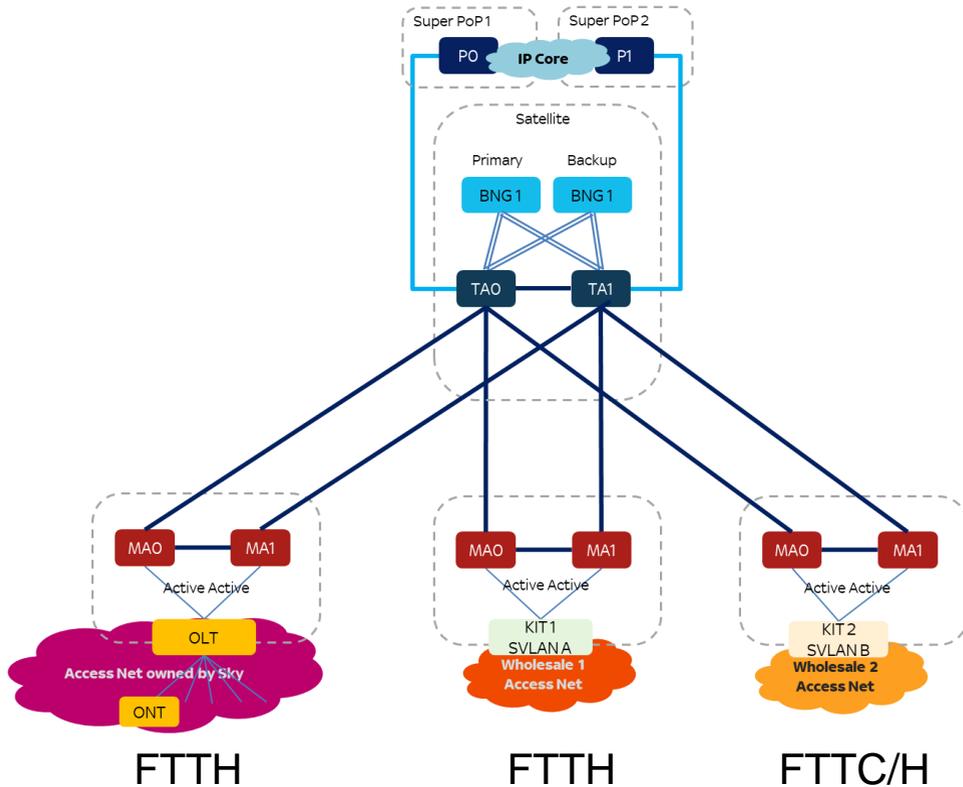
Optical Restoration ~10 min

MTTR < 15 min

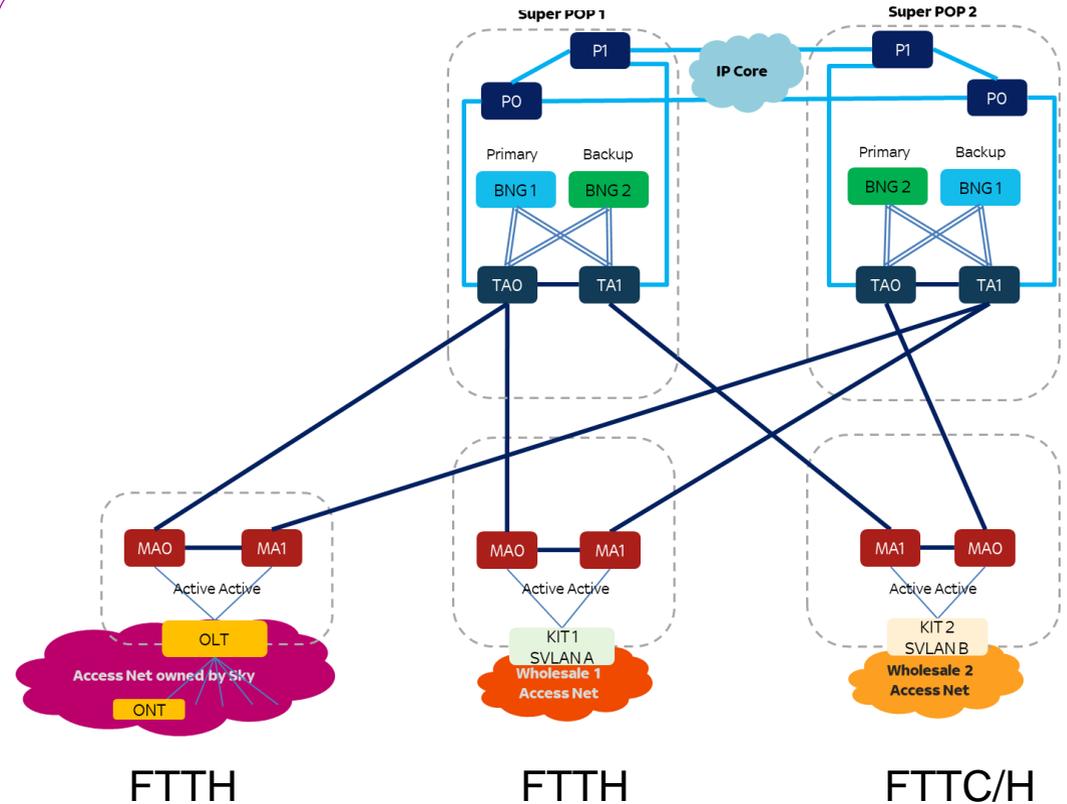
2 IP Core redundant links + multi Optical Paths (at least 3 or more)

Sky WiFi - FTTH / FTTC Access Network

Satellite POPs

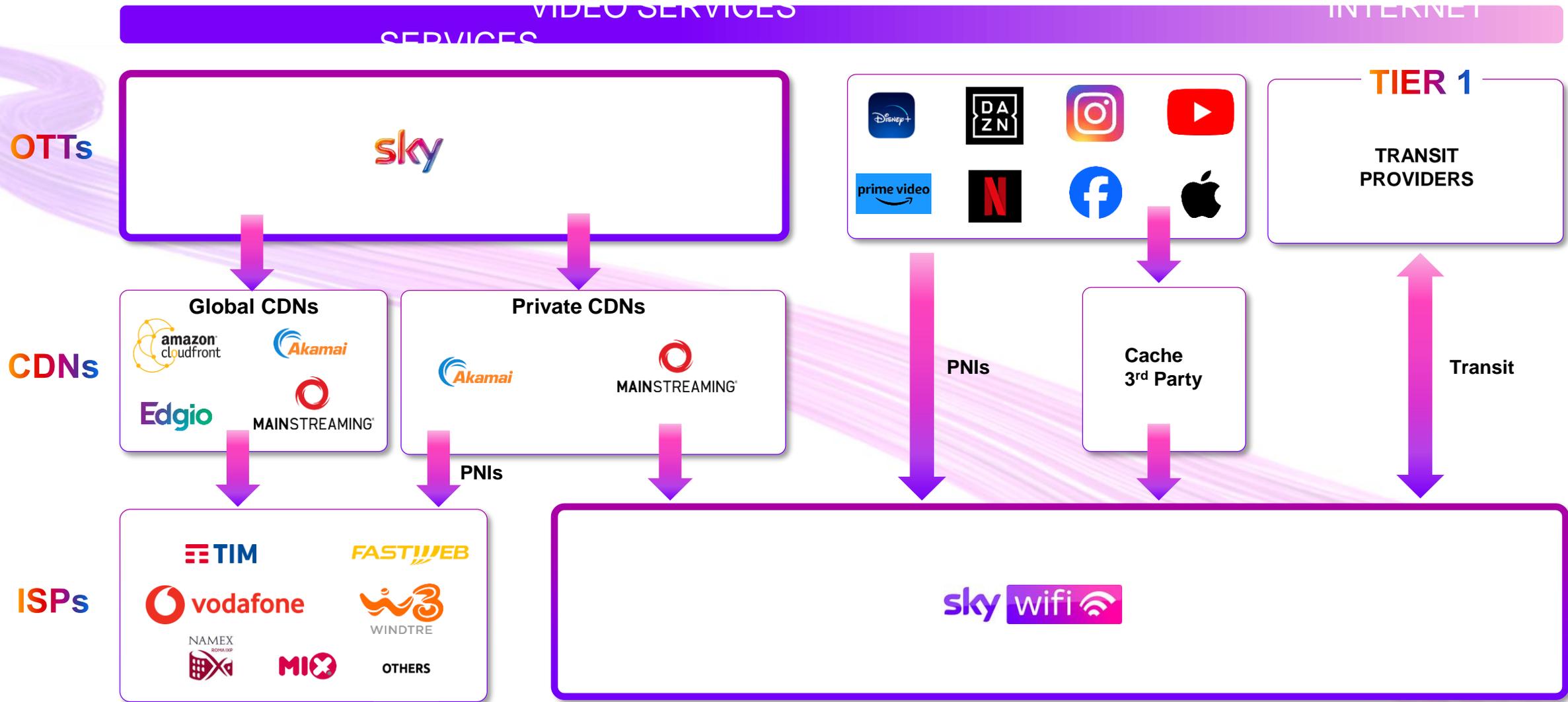


Super POPs



Control Plane EVPN + Data Plane MPLS. It's a multihoming single active EVPN VPWS architecture. Each MA forward traffic to the active BNG via the active VPWS. A backup VPWS towards second BNG will ensure redundancy.

Sky Ecosystem



Inbound / Outbound traffic ratio: 55% / 45%

%

Sky WiFi IPv6 Experience

IPoE Authentication

Green-field network

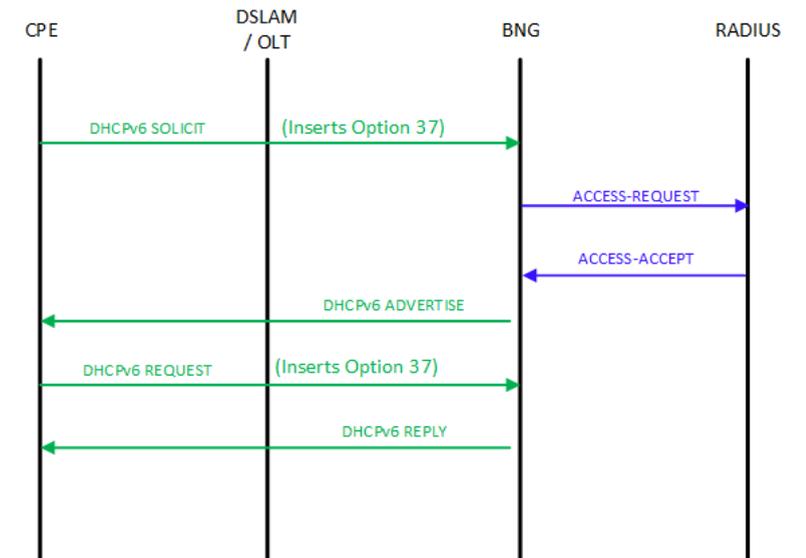
GPON and VDSL2, support native Ethernet framing.

Overhead efficiency compared with PPPoE (+8bytes)

No need for tunneling and encapsulation protocols

Uses **DHCPv6 Option 37: Remote-ID** (Port Based Authentication)

No use CHAP-style <username@domain> + <password> for authentication



Sky WiFi IPv6 Experience

How are we using it?

Sky Italia, few years ago, has purchased a /13 (524,288 IPv4 addresses) from the open market, and assigned a /25 IPv6 address space by RIR.

Each Sky Hub obtains is assigned a Prefix Delegation of size /48 by using stateful DHCPv6 PD.
(Recommended by [RIPE-690 BCOP](#))

An IPv6 prefix of /48 contains 65,535 x /64 prefixes. $2^{(64-48)}$

The Sky Hub currently only uses a single /64 for the LAN (incl. wifi).
Remaining prefixes are available for future use. (IoT, Guest Wifi, etc.)

LAN-side devices acquire IPv6 addressing by using Stateless Address Auto-Configuration (SLAAC).
The Sky Hub doesn't assign IPv6 addresses, it simply advertises the /64 prefix on the LAN and the client devices choose their own address.



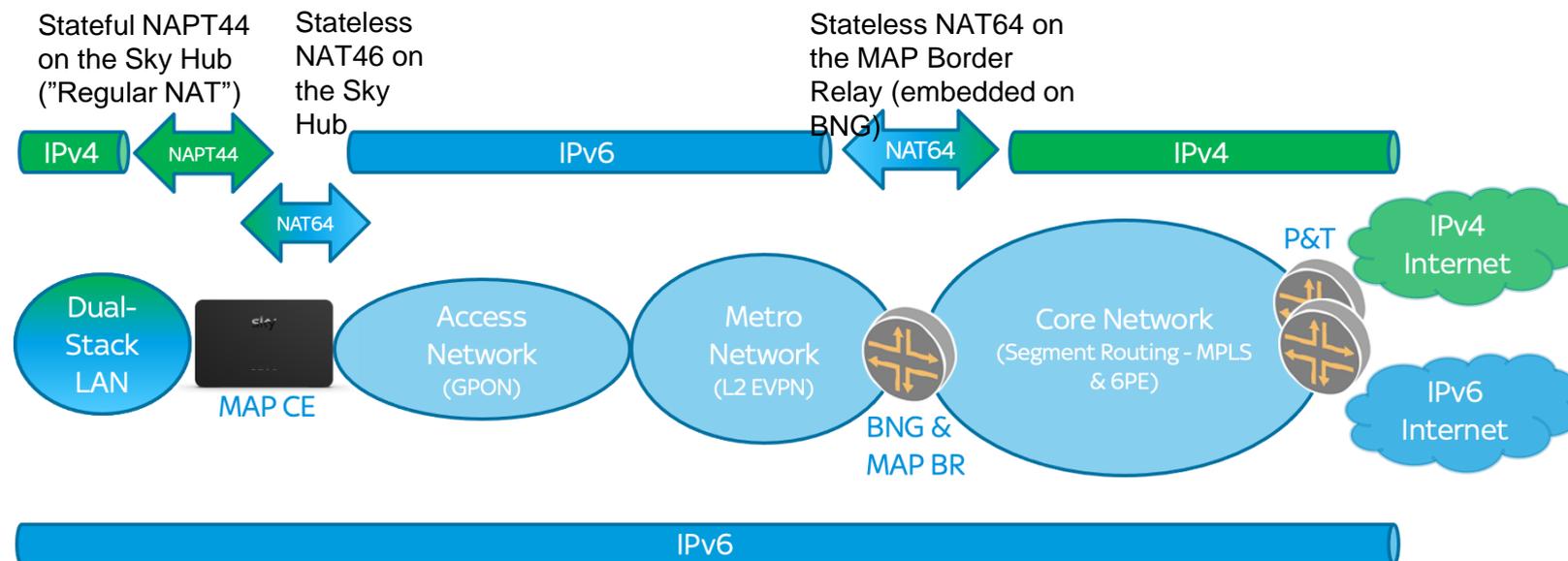
Definition

Mapping of Address + Port (MAP) is a stateless **IPv4-as-a-Service (IPv4aaS)** technology, delivering IPv4 connectivity via IPv6 infrastructure.

The biggest drawback for MAP is that it is **stateless**; it means that devices doing the NAT64 translation, do not have to track of every flow that they're forwarding.

MAP achieves this statelessness by using predefined translation algorithms, or rules, communicated to the MAP devices.

3 distinct points of translation



MAP-T Mapping Rules

Default Mapping Rule (DMR)

The DMR is a mandatory rule and tells the **MAP CE** what **IPv6 prefix** to use when translating an **IPv4 destination address** outside of the MAP domain, to an IPv6 address. (and vice versa).

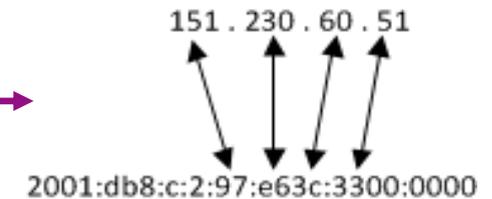
(RFC6052) IPv4-embedded IPv6 addresses used for external host destination address.



Sky uses /64-sized DMR prefixes



PL	0	32	40	48	56	64	72	80	88	96	104	
32	prefix	v4(32)		u	suffix							
40	prefix	v4(24)		u (8)	suffix							
48	prefix	v4(16)		u (16)	suffix							
56	prefix	(8)		u v4(24)	suffix							
64	prefix	u		v4(32)		suffix						
96	prefix											



MAP-T Mapping Rules

Basic Mapping Rule (BMR)

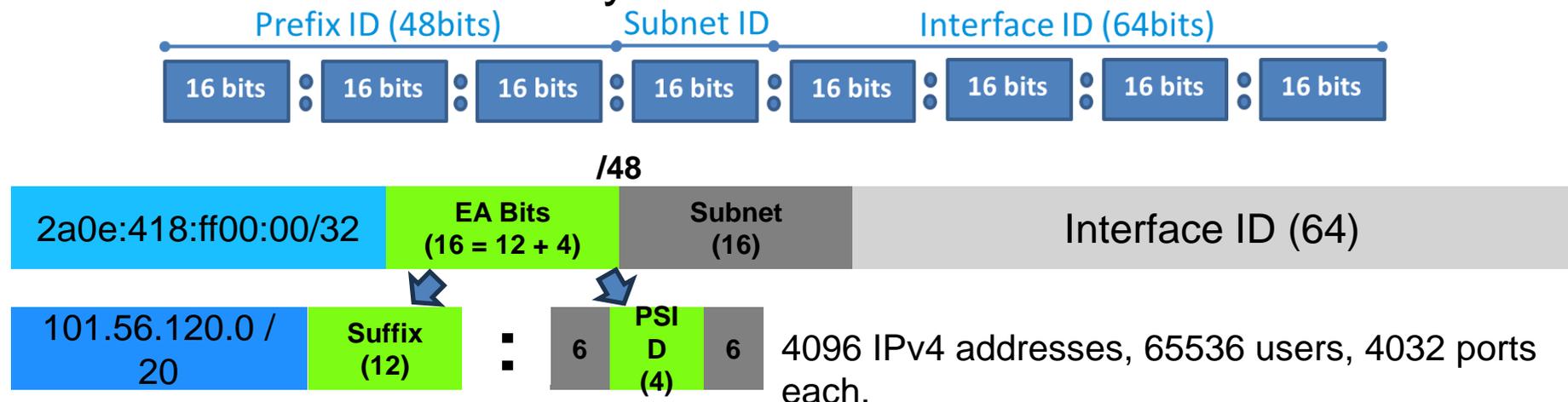
The BMR is the main MAP rule that tells both the **MAP CE** and **Border Relay** how to do the stateless **NAT64 translation**. It also informs the MAP CEs which **layer 4 ports** they're allowed to use.

Each subscriber is assigned a Prefix Delegation of size /48. The Sky HUB currently uses a single /64 for the LAN.

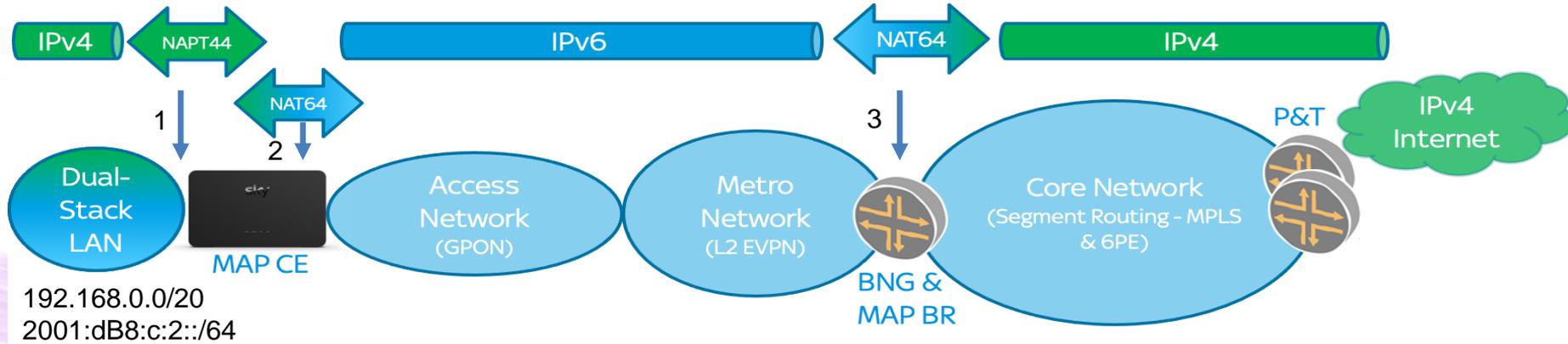
Mapping rules are communicated to the CPE via DHCPv6 option 95 within the lease (RFC7598)

Combination of DHCPv6 PD + Option 95 define the **IPv4 address** and **port** the CPE is allowed to use.

Sky uses 1:16 Ratio



MAP-T IPv4 Packet translation Example



TCP/UDP Header		IPv4 Header (20 Bytes)	
SPORT: 6783	DPORT: 80	SOURCE: 192.168.0.123	DEST: 8.8.8.8

1 ↓ Stateful NAT44 translates both source port and source address

TCP/UDP Header		IPv4 Header (20 Bytes)	
SPORT: 1200	DPORT: 80	SOURCE: 151.230.60.51	DEST: 8.8.8.8

2 ↓ MAP-T on CPE translates source address based on BMR, and destination address based on DMR and RFC6052

TCP/UDP Header		IPv6 Header (40 Bytes)	
SPORT: 1200	DPORT: 80	SOURCE: 2001:db8:c:2:97:e63c:3300:0000	DEST: 2001:db8:ffff:0:8:808:800:0000

3 ↓ MAP-T Border Relay translates source address based on BMR, and destination address based on DMR and RFC6052

TCP/UDP Header		IPv4 Header (20 Bytes)	
SPORT: 1200	DPORT: 80	SOURCE: 151.230.60.51	DEST: 8.8.8.8

Sky WiFi IPv6 Experience

Why MAP-T

Sky Wifi was born as a **Greenfield Network**

IPv6-only Access Layer

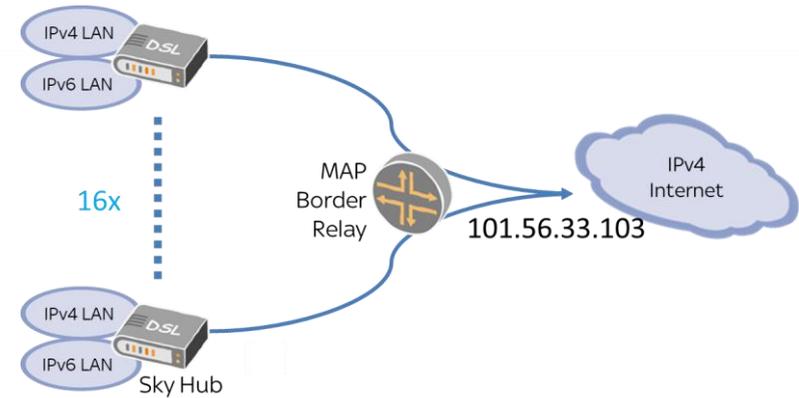
Stateless

MAP Border Relays (BR) do not have to keep track and state of every flow

IPv4 sharing

Sky WiFi uses 1:16 IPv4 ratio sharing

Efficiency



PAYLOAD

TCP/UDP

IPv4



IPv6 40B+

RFC7597: MAP-E (Encapsulation)

Larger per-packet overhead.

IPv4 header remains intact.

PAYLOAD

TCP/UDP

IPv4

IPv6

20B+

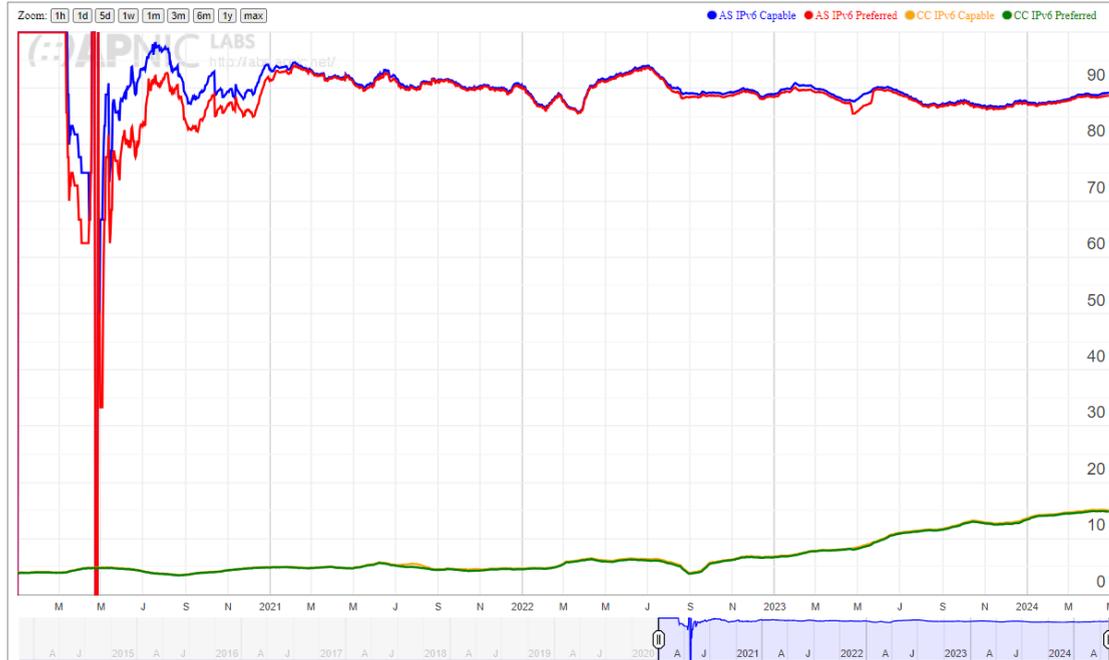
RFC7599: MAP-T (Translation)

Less per-packet overhead (not zero!)

Loses IPv4-only header attributes.

Sky WiFi IPv4 vs IPv6

IPv6 Per-Country Deployment for AS210278: SKYIT-BB, Italy (IT)

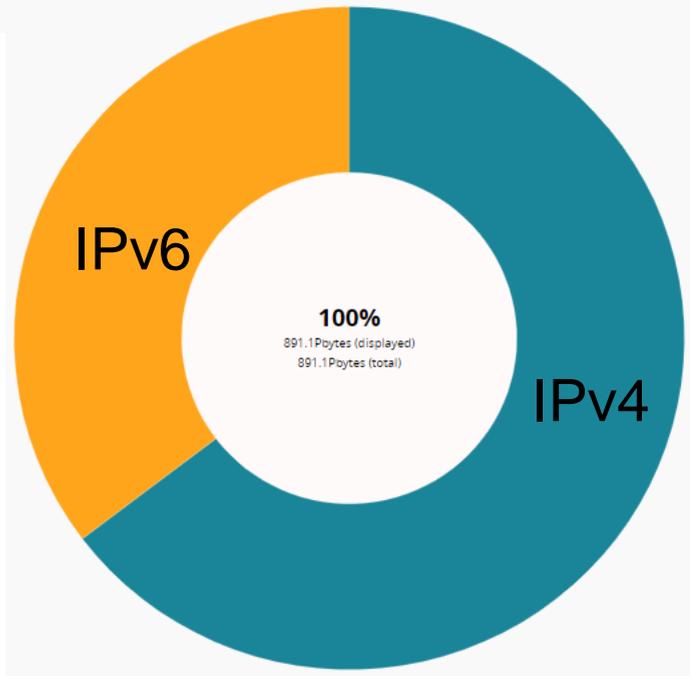
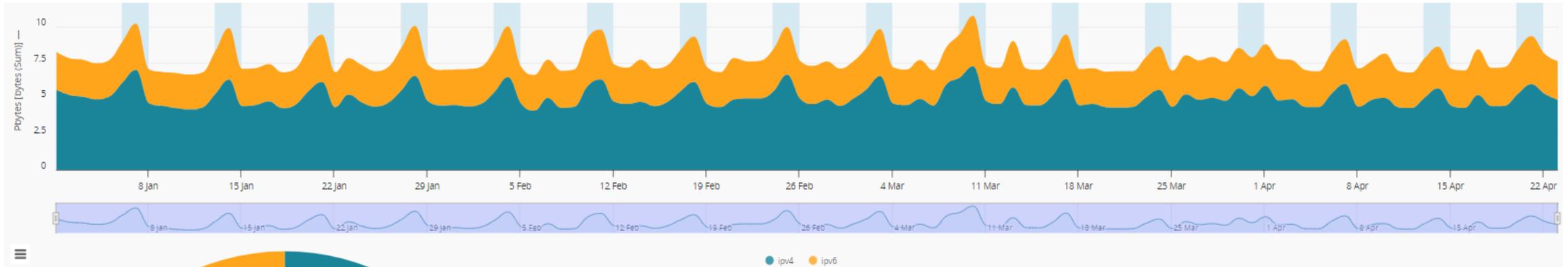


ASN	AS Name	IPv6 Capable	IPv6 Preferred	Users (est.)
AS1267	WINDTRE	30.90%	30.36%	8.263.884
AS30722	VODAFONE ITALIA	4.42%	4.35%	7.880.751
AS3269	TIM	0,17%	0,03%	6.655.848
AS29447	ILIAD ITALIA	10.03%	9.97%	3.794.954
AS12874	FASTWEB	40.79%	40.35%	3.472.978
AS210278	SKY ITALIA	89.24%	88.74%	978.451
AS8612	TISCALI	0.09%	0.03%	688.789
AS35612	NGI	0.19%	0.03%	750.729
AS198471	LINKEM	0.14%	0.04%	418.958

Source: APNIC – IPv6 deployment

Sky WiFi IPv4 vs IPv6

YtD Volumes

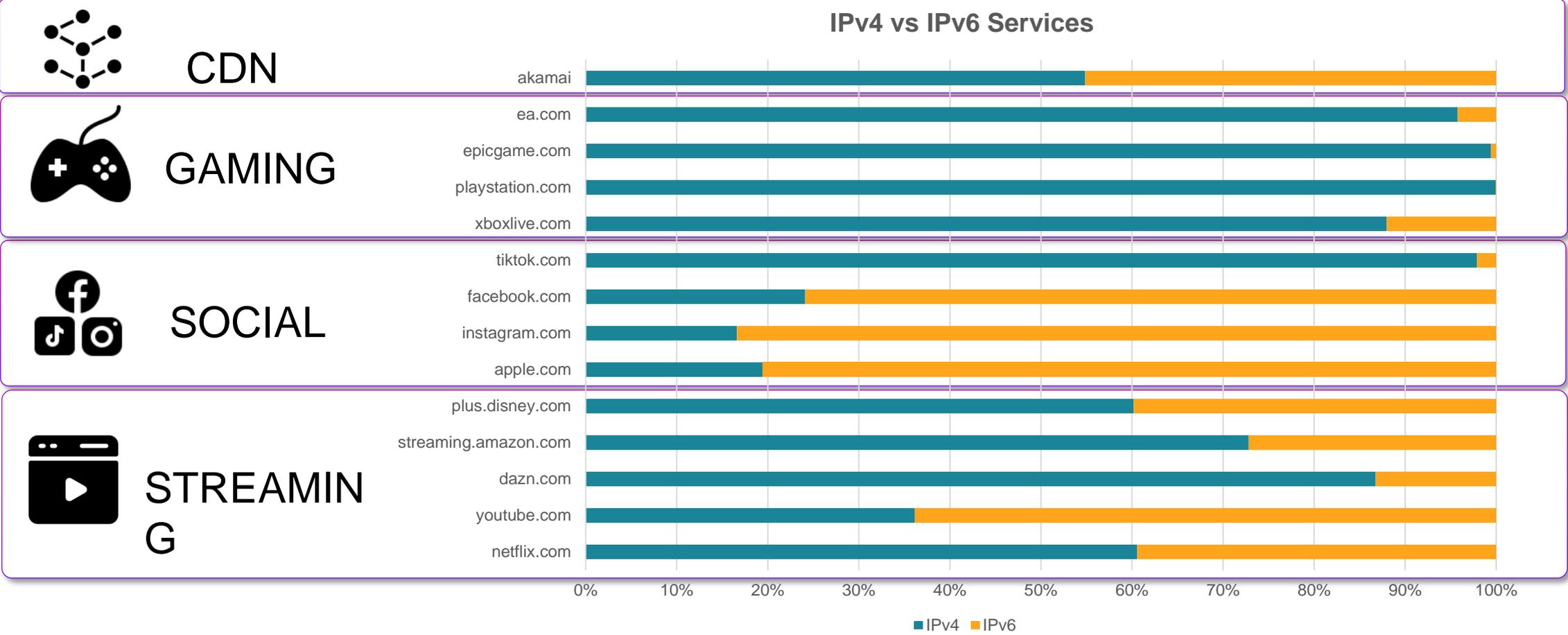


YtD

- 1) By providing IPv6 to all customers we are seeing the following usage of IPv6:
IPv6: 35%  ~3% vs 2023) IPv4: 65%

- 2) Despite all of subscribers are IPv6-only, there is still a good portion of volumes in IPv4.

Sky WiFi IPv4 vs IPv6





SAY

THANK YOU

Simone Carturan
(Network Architect)
simone.carturan@skytv.it