

F5G Update: The Second Release of Use Cases and Demonstrations

Show Floor Moderator:

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F5G Use Case PoC Demo on Fiber-to-the-Room (FTTR)

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Orange Innovation Networks

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Agenda



1. State of art of smart home connectivity : FTTH and WiFi

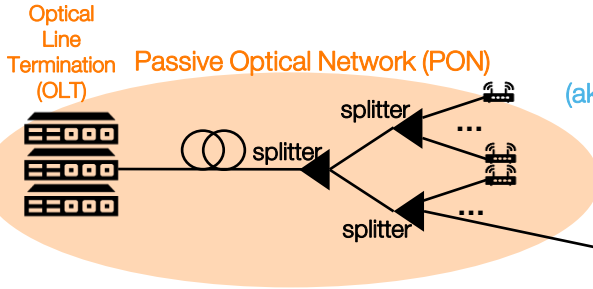
2. The three companions : FTTH, FTTRoom and WiFi

- Passive fiber infrastructure at Home
- Throughput,
- Latency,
- Jitter



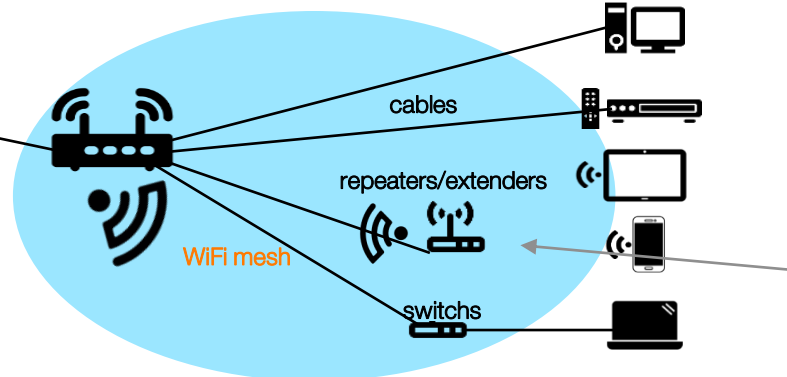
What role does the **smart connectivity at home** have in telco strategy

FTTH network



Home network

residential gateway (aka CPE, home gateway, Box,...) home network infrastructure end-devices



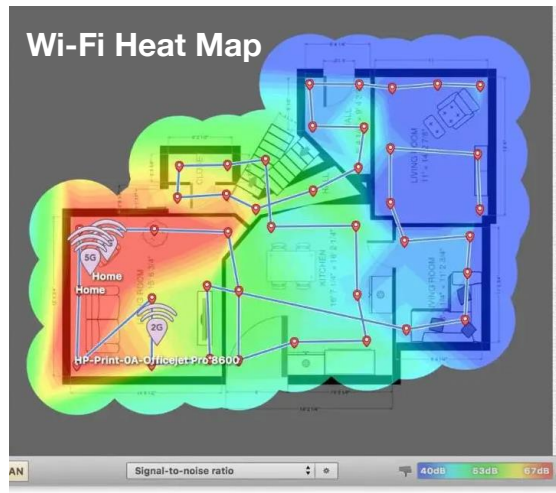
n°1

Power Line Comm.

Ethernet cable (Cat. 5/6)

WiFi extender

For proper coverage, you may need Wi-Fi Extenders





What role does the **smart WiFi** have in telco strategy

Key benefits of Orange Smart Wi-Fi solution



Improve the Wi-Fi of the customer with the best throughput

- ✓ The gateway is always on the **best Wi-Fi channel** (Automatic Channel Selection algorithm) by periodically scanning Wi-Fi environment
- ✓ Devices are automatically put on the **best Wi-Fi band** (Band Steering algorithm)
- ✓ IPTV service over Wi-Fi is protected



Extend Wi-Fi coverage at home with a Wi-Fi repeater

- ✓ Orange Smart Wi-Fi solution is integrated in the Wi-Fi repeater
- ✓ Devices are automatically put on the **best Wi-Fi access point** (Client Steering algorithm) in order to provide the **best throughput**
- ✓ **Seamless roaming** between access points: fast roaming, without service interruption



MESH Wi-Fi system to create an optimal Wi-Fi coverage

- ✓ Adapt the number of Wi-Fi repeaters to customer's home (up to 4 repeaters)
- ✓ The topology of Wi-Fi repeaters is automatic & dynamic : **best access point connection**
- ✓ Compatible with **IPTV and VoWi-Fi services**
- ✓ The **Smart Wi-Fi system has a global view** to



Offer the best user experience

- ✓ Wi-Fi repeater **easy to install**: push button pairing
- ✓ **One Wi-Fi network** (same name & security key) for all the access points, with auto-configuration
- ✓ **Mobile application**, to help the user to install and find a good position for the repeater
- ✓ **Home network map and status** available to the customer
- ✓ **Lot of data are available** to evaluate and improve the solution

Agenda



1.

State of art of smart home connectivity : FTTH and WiFi

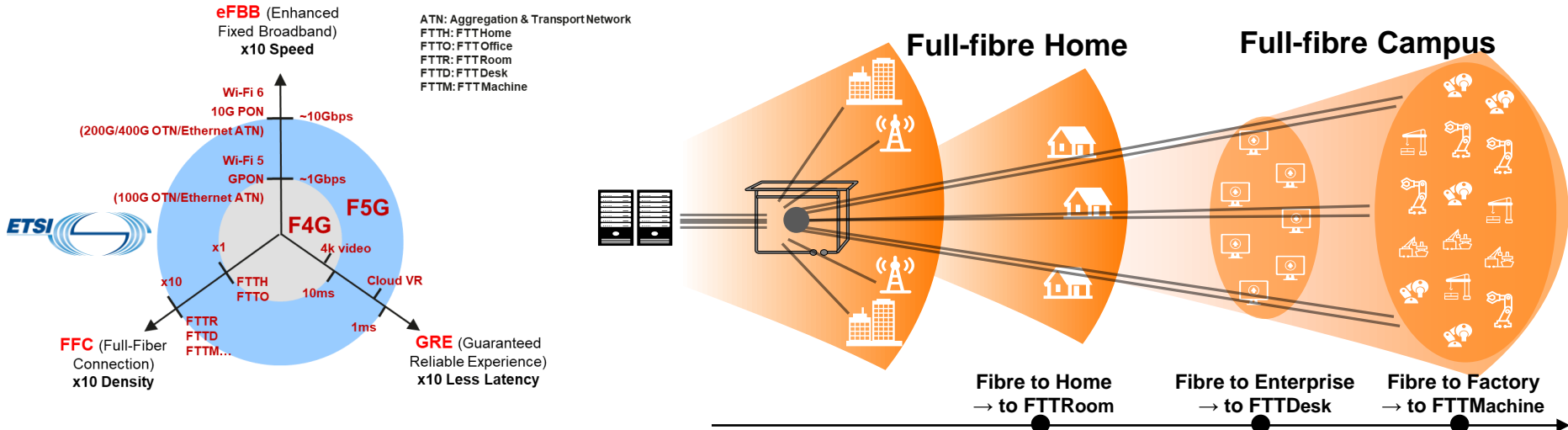
2.

The three companions : FTTH, FTTRoom and WiFi

- **Passive fiber infrastructure at Home**
- **Throughput,**
- **Latency,**
- **Jitter**

Fibre to Everywhere for an unlimited future

Allow evolution of technology and services with F5G



Fiber to Everywhere to make fixed access future proof

- Extending to **more end-user** : Home, Room, Business, Mobile, Device, Machine, etc.
- Reducing everywhere the **fibre-to-end user distance**: Km → 100m → 10m → 1m
- **Number of connections** expanding: X3 (Room), X10 (Desk), X30 (Machine), X100 (Smart city)



Building and in-home optical cabling

Apparent installation on the wall

Refusal from some customers because of aesthetic reasons

→ New solution for a more aesthetic cabling

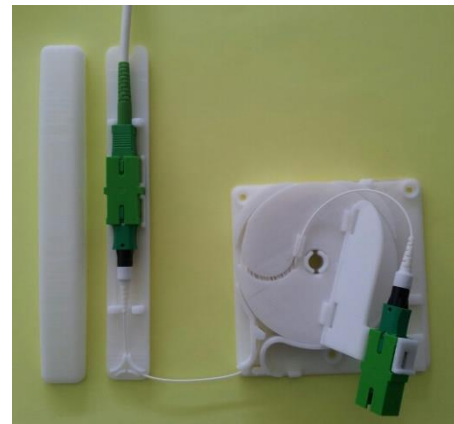
- 900 μ m cable connectorized at both sides
- Optical outlet with a wiring system to manage the overlength of cable
- Accessories to ensure a minimum bending radius in the corners and accessories to pass through the walls



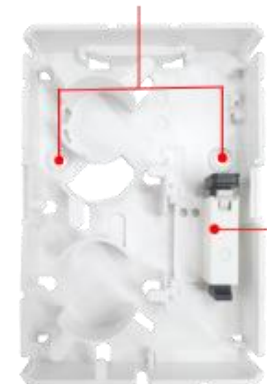
Standard cable



900 μ m cable



Holes of installation on the wall or junction box



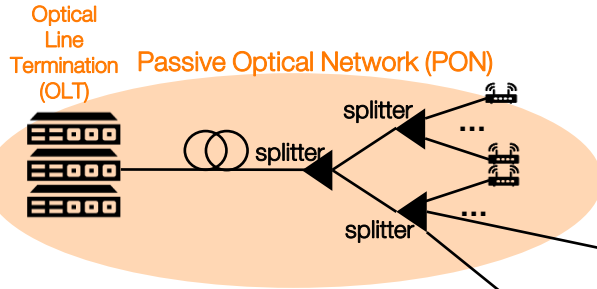
XC adapter

Standardisation in ITU-T Q18/SG15 for « In-premises Networking »



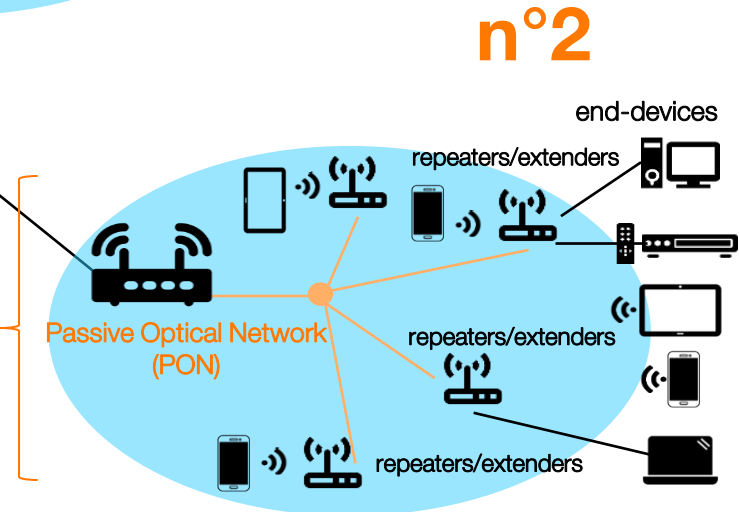
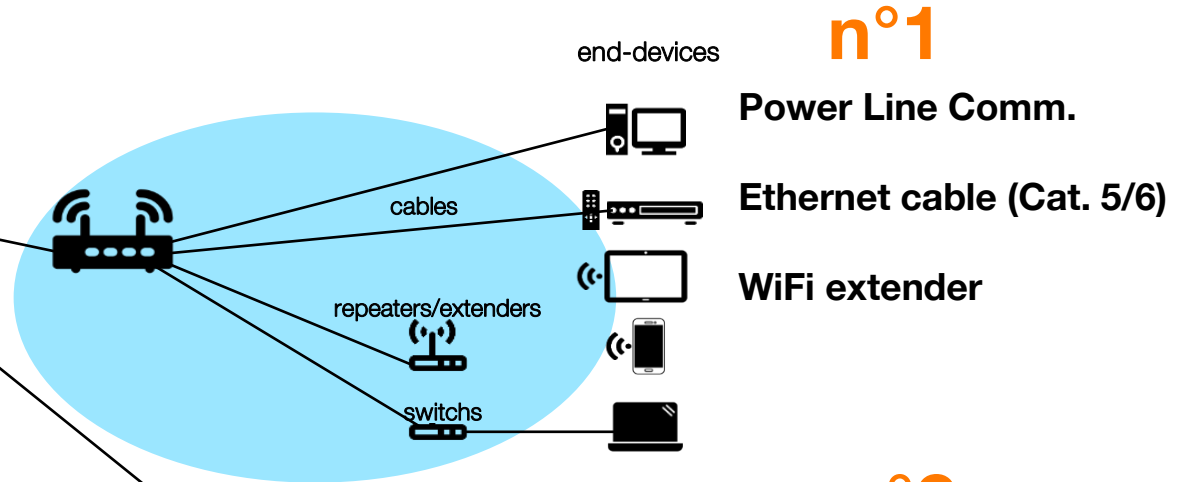
What role does the **smart connectivity at home** have in telco strategy

FTTH network



FTTH with GPON or XGS-PON

Home network



FTTR Gateway : **OLT** functions included **in the residential gateway**

PON fibre plant : **FTTR fibre + passive optical Splitter** (1:4 stages, x4 max)

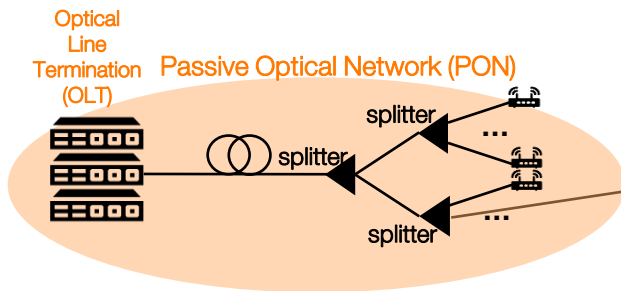
FTTR ONUs : Several **Wi-Fi extenders** with the benefits of a fibre backhaul



PON and WiFi maximum throughput

n°2

FTTH network



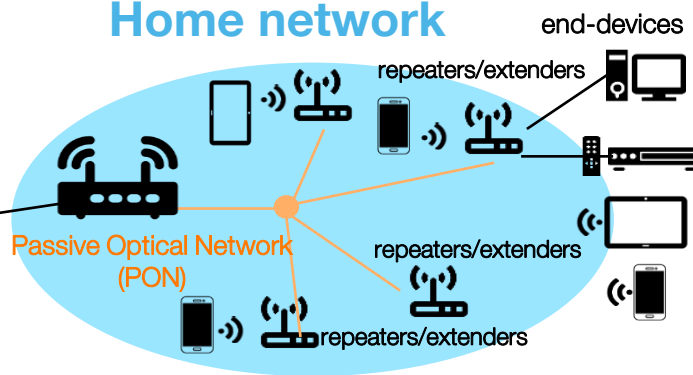
With GPON :

Line rate 2,5Gbit/s – Throughput 1Gbit/s max



Line rate 1,25Gbit/s – Throughput 1Gbit/s max

Home network

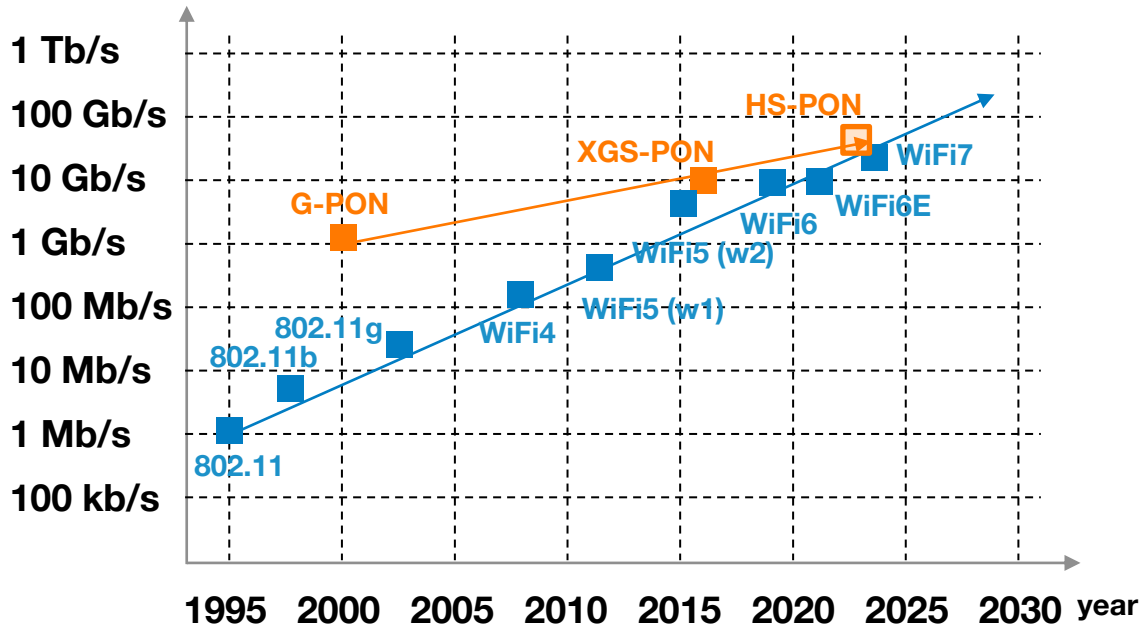


Line rate 2,5Gbit/s – Throughput 1Gbit/s max



Line rate 1,25Gbit/s – Throughput 1Gbit/s max

Maximum physical layer data rate





PON and WiFi maximum throughput for laptop and smartphone devices

The main developments of WiFi

	WiFi 6 /6E	WiFi 7
Frequency	2.4 , 5 , 6 GHz	2.4 , 5 , 6 GHz
Maximum bandwidth	160 MHz	320 MHz
Best modulation	QAM 1024	QAM 4096
MIMO	8	16



WiFi 7 is 20% more data rate close to the access point

	WiFi 6 /6E		WiFi 7		
Bandwidth	80 MHz	160 MHz	80 MHz	160 MHz	320 MHz
Maximum theoretical physical layer data rate	4.8 Gbps (8x8)	9.6 Gbps (8x8)	11.5 Gbps (16x16)	23 Gbps (16x16)	46 Gbps (16x16)
e.g. laptop →→ Maximum theoretical physical layer data rate (3x3:3)	1.8 Gbps	3.6Gbps	2.1 Gbps	4.3 Gbps	8.6 Gbps
e.g. smartphone →→ Maximum theoretical physical layer data rate (2x2:2)	1.2 Gbps	2.4 Gbps	1.4 Gbps	2.8 Gbps	5.7 Gbps

Supported by G-PON

Supported by XGS-PON



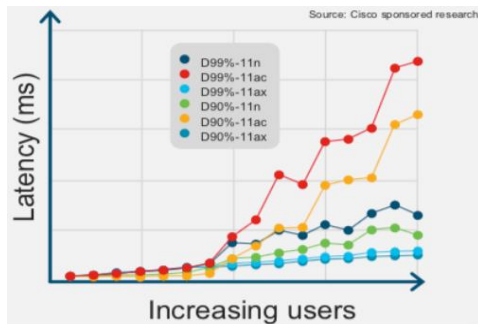
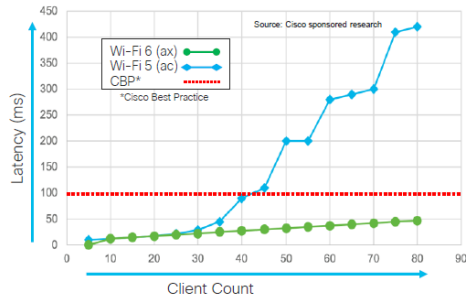
WiFi latency and jitter

WiFi – Latency with 80 devices

WiFi – Latency with 40 devices

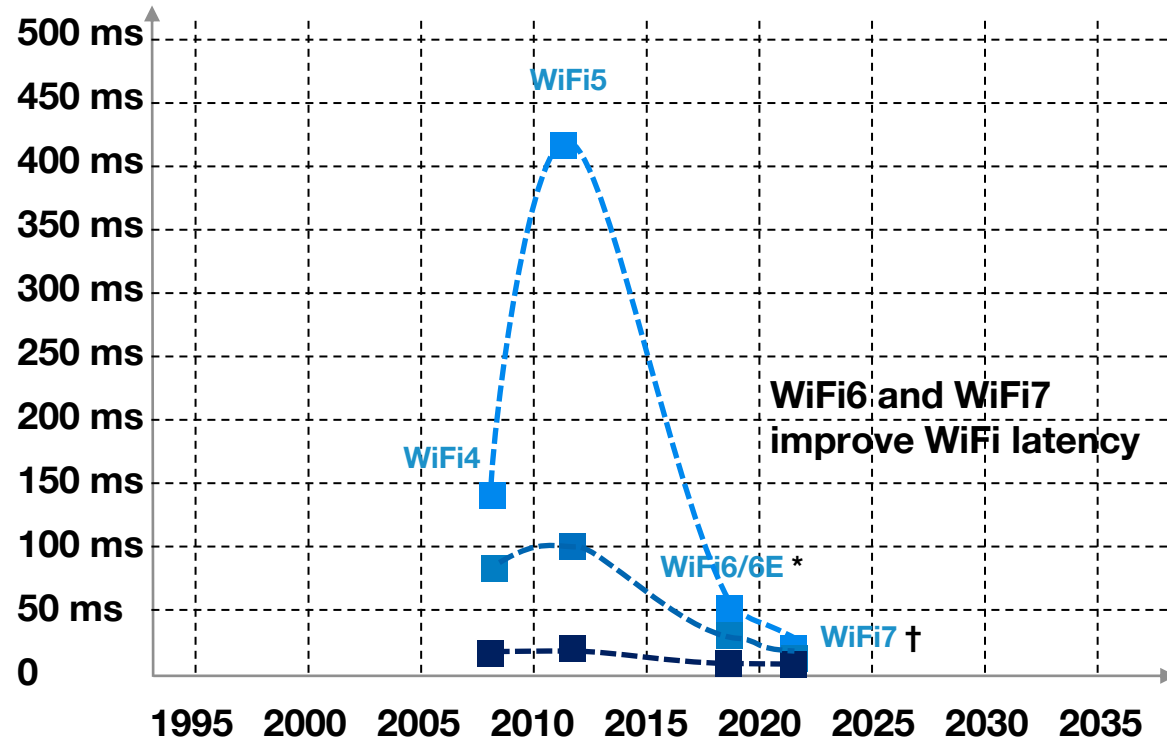
WiFi – Latency with 20 devices

Source Cisco:



WiFi KPI Jitter:

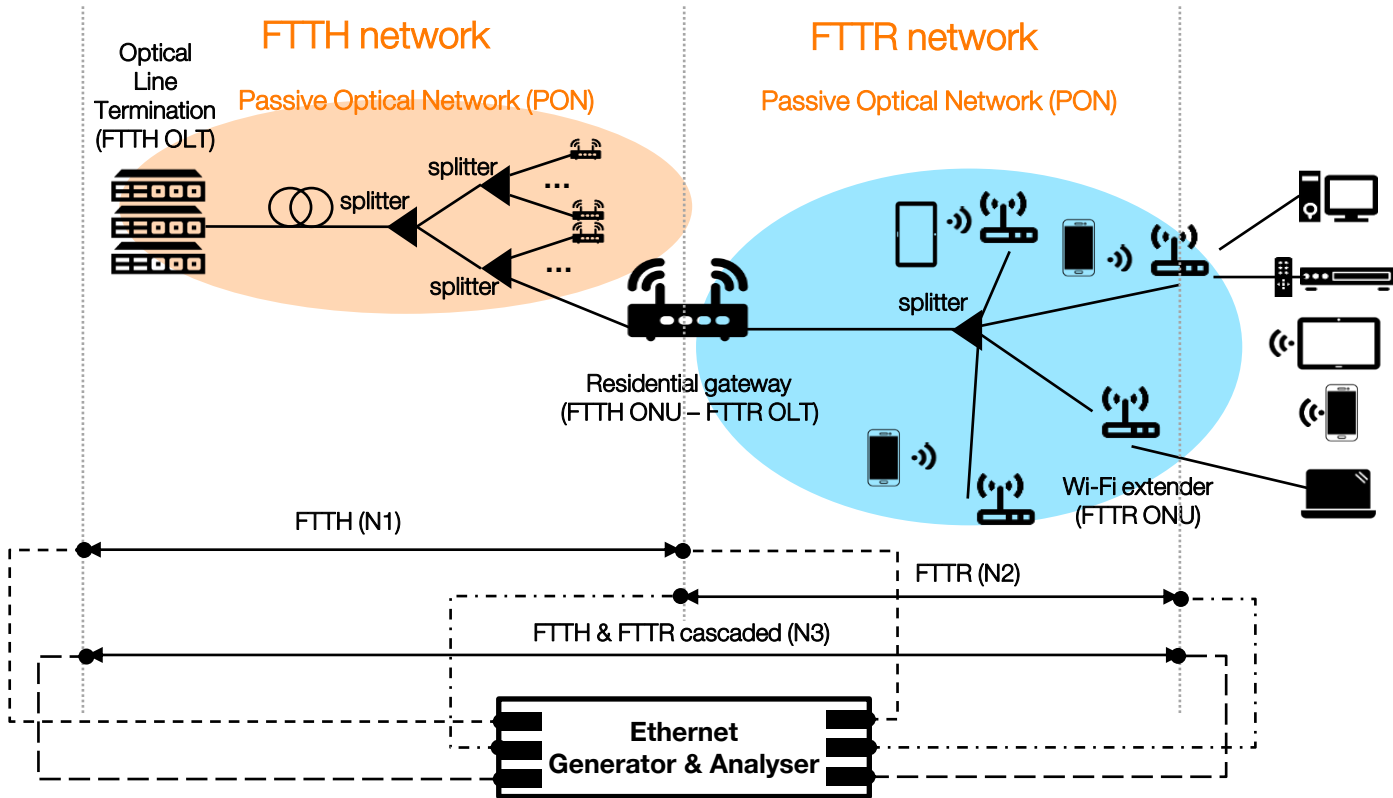
- <20 ms : good
- 20-40 ms : acceptable
- >40 ms : poor



* OFDMA, preamble puncturing features
 † Multi-Link Operation (MLO)



FTTHome + FTTRoom latency and jitter



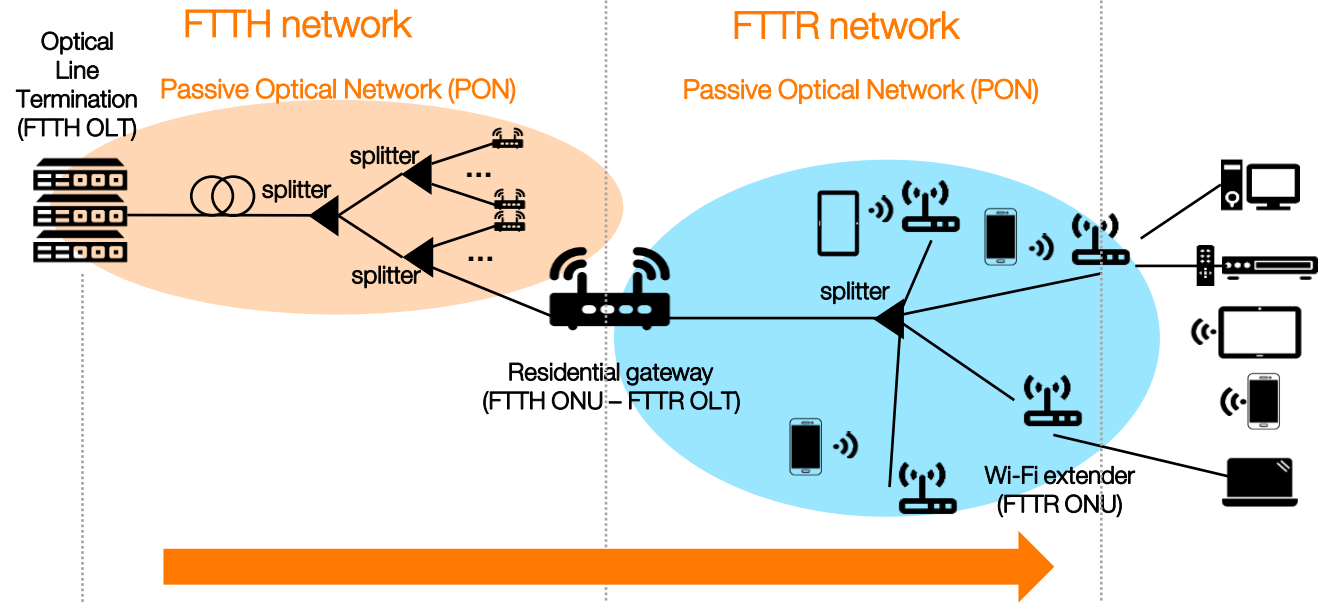
G-PON technology

- DT (Delay Tolerance) of 1 (125 μ s long cycle)
- 100 Mbit/s T-CONT (Transmission-CONTainer) type 1 ("fixed")

No fiber (only patch cord) : 5 μ s/km



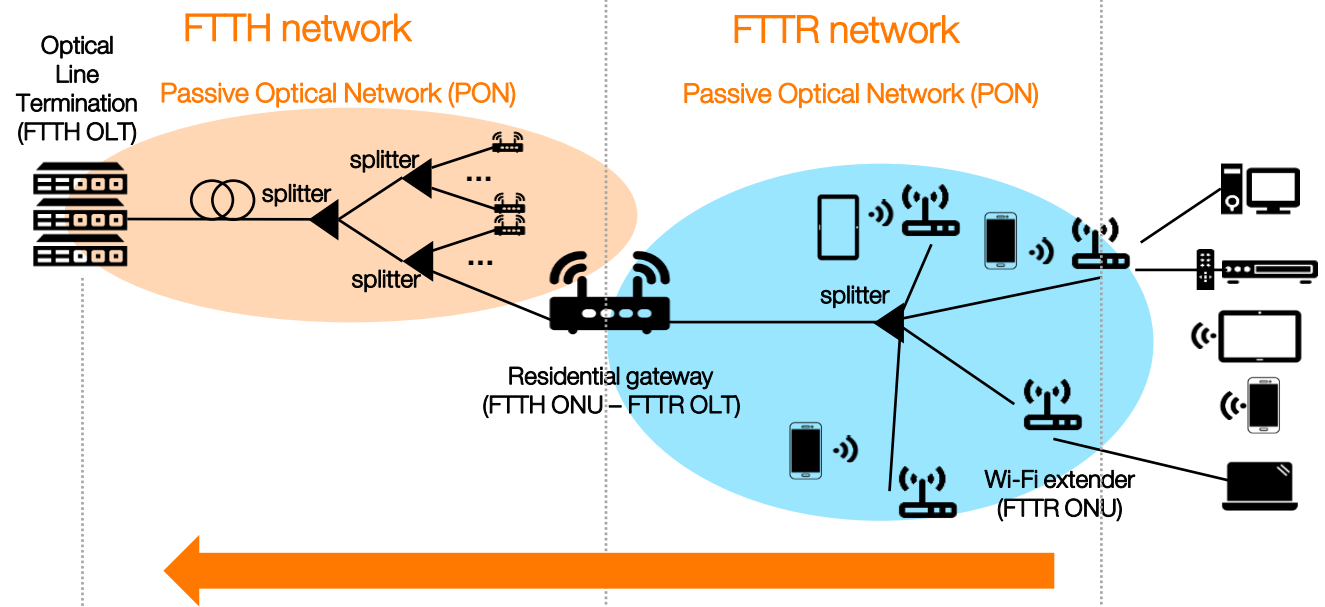
FTTHHome + FTTRRoom latency and jitter



Downstream	FTTHHome	FTTRRoom
Latency (μ s)	Mean = 24.17 [Min 25.57 / Max 28.45]	Mean = 23.64 [Min 22.01 / Max 24.23]
	Mean = 40.19 [Min 38.24 / Max 51.34]	
Jitter (μ s)	Mean = 0.09 [Min 0 / Max 3.87]	Mean = 0.21 [Min 0 / Max 1.84]
	Mean = 0.24 [Min 0 / Max 3.81]	



FTTHome + FTTRoom latency and jitter



Upstream	FTTHome	FTTRoom
Latency (μ s)	Mean = 82.01 [Min 26.65 / Max 391.86]	Mean = 106.7 [Min 19.03 / Max 455.6]
	← Mean = 170.05 [Min 39.24 / Max 590.34] →	
Jitter (μ s)	Mean = 36.78 [Min 0 / Max 348.28]	Mean = 35.75 [Min 0 / Max 230.52]
	← Mean = 36.96 [Min 0 / Max 348.36] →	

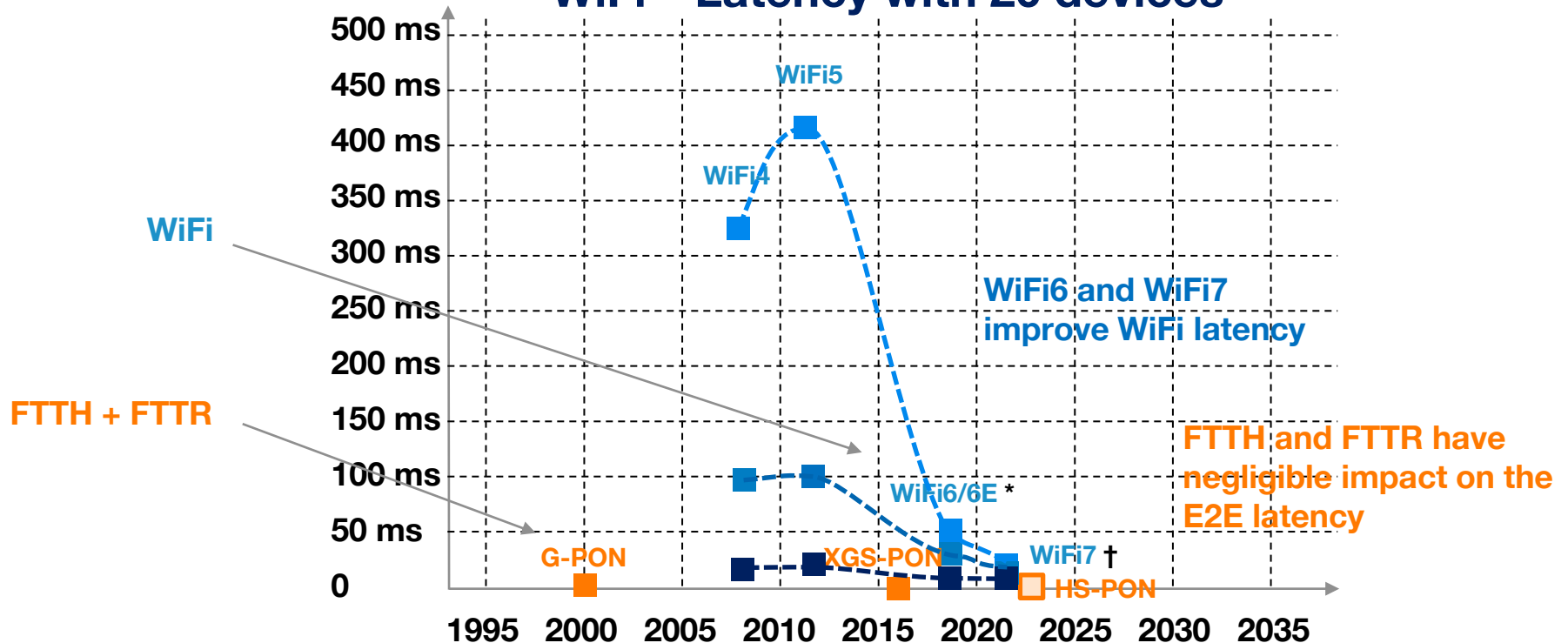


FTTH, FTTR and WiFi latency

WiFi – Latency with 80 devices

WiFi – Latency with 40 devices

WiFi – Latency with 20 devices



Without fiber, Latency PON D/S $40\mu\text{s}$ & U/S $<1\text{ms}$ ($n \times 125\mu\text{s}$)

* OFDMA, preamble puncturing features

† Multi-Link Operation (MLO)



FTTH, FTTR and WiFi latency

Latency synthesis:

- For advanced WiFi typical average value is about 10 to 50 ms
- For FTTH (DT4 and 20 km) + FTTR PON (DT1 and 1 km reach) typical average value is about 150 μ s downstream and 500 μ s upstream.

Jitter synthesis:

- For advanced WiFi typical average value is < 20 ms
- For FTTH (DT4 and 20km) + FTTR PON (DT1 and 1 km reach) typical average value is about < 0.5 μ s downstream and < 50 μ s upstream.

Jitter and Latency conclusion:

- PON is the ideal companion of WiFi with an “ideal” backhaul performance for jitter and latency.



Fiber for smart Home: FTTRoom

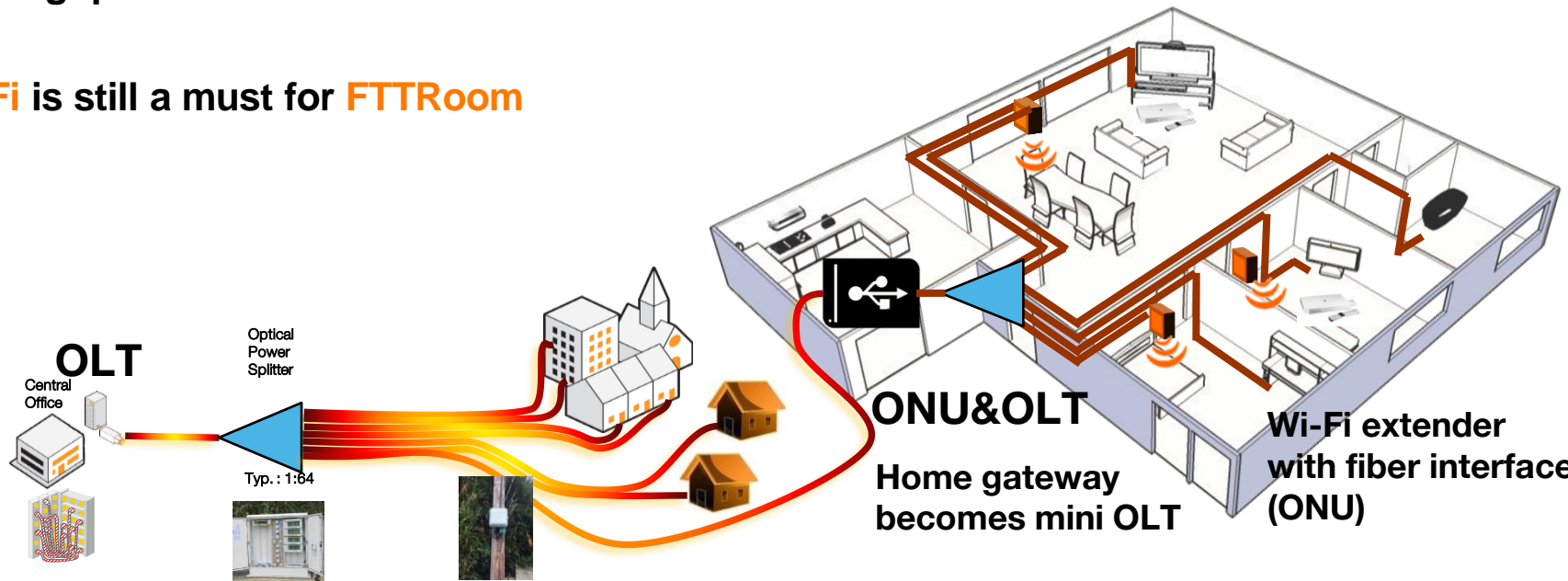
Deeper **fiber** to connect everything at Home: Fiber to the Room

A **cost effective, Home network** infrastructure associating **optical fiber and radio** for a wireless end connectivity to the very high bit rate services everywhere in the home

An ideal **WiFi backhauling of several WiFi Extenders** : no RF interference (RF spectrum resource allocation)

Fiber To The Room: today 1G & 10G-PON based ; perennial infrastructure (fiber) permitting higher throughput in the future

Smart WiFi is still a must for **FTTRoom**



Conclusion



The three broadband companions
FTTHome, FTTRoom, WiFi of ETSI F5G

1 FTTR is an **emerging technology** for enhanced services

2 « **FTTH like** » experience for users & continuity of our field expertise **up to the rooms**

3 PON is the ideal companion of WiFi with an “ideal” in-house backhaul performance for jitter and latency.

4 Valorise and manage Wi-Fi connectivity as the Home Operator



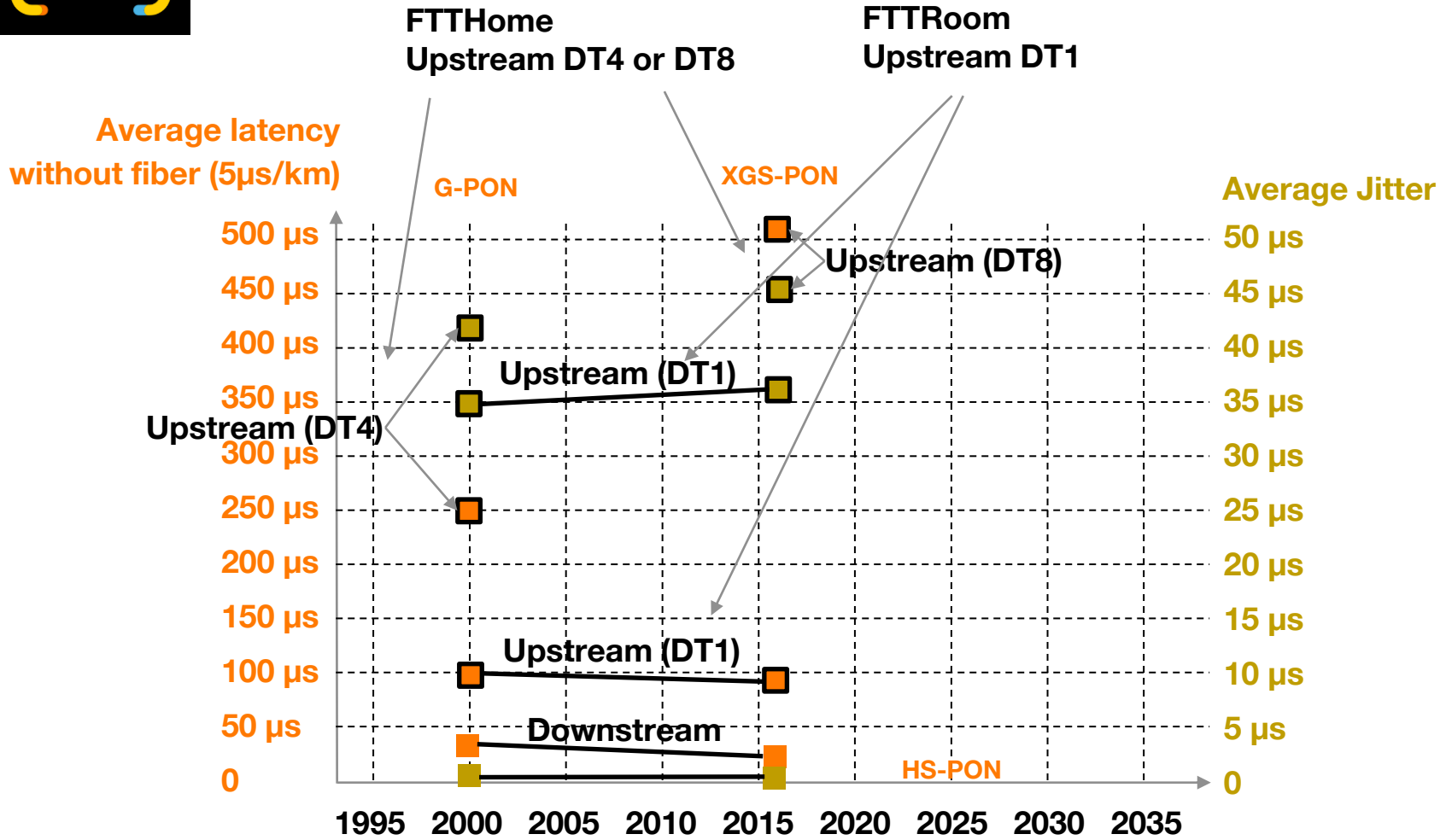


Thank You





FTTHome + FTTRoom latency and jitter



- Downstream
- Upstream

T-CONT type1 100Mbps, 128 bytes frame and 50 Mbps throughput

DT: Delay Tolerance – DT1=125µs, DT4=500µs, DT8=1ms