



Workshop: Future Optical Networks, 21 September 2023

# The Future of Optical Access Network

## FTTx

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Orange Innovation / Networks / WNI / FUN / Fixed Access Networks  
Lannion, France

*21<sup>th</sup> September 2023*





# Outline

1. The right FTTH technology to maintain high quality access at lowest cost
2. PON interoperability & benefits
3. Software for manager and controller
4. Backplane evolution to photonic
5. PON in not only for FTTH
6. Conclusion

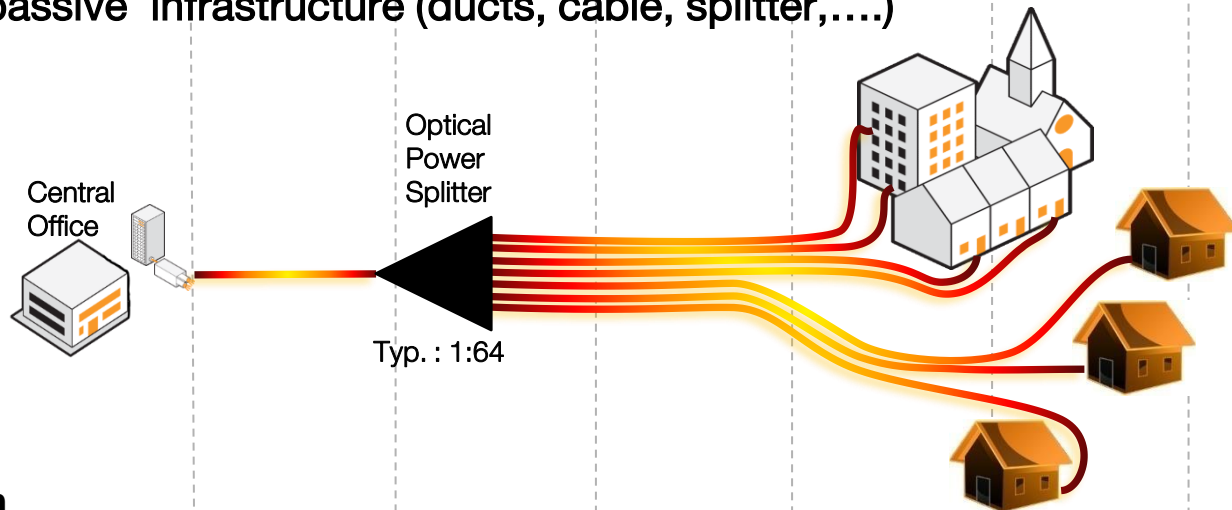


# The right medium to maintain high quality fixed access

## Preserve the passive FTTH plant investments

FTTH CAPEX investment is about

- 10% Active network equipment (OLT, ONU)
- 90% Passive
  - 40% civil work
  - 60% passive infrastructure (ducts, cable, splitter,.....)



Access infrastructure medium

Only Copper

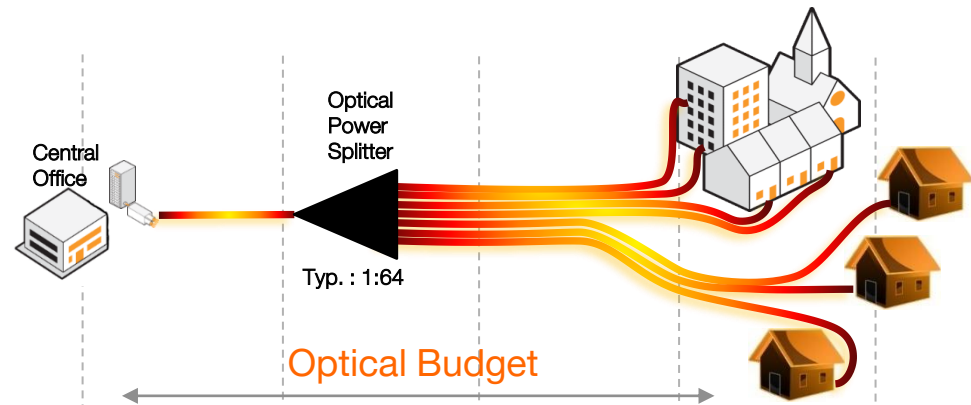
Full Fiber



# The right medium to maintain high quality fixed access

## Preserve the passive FTTH plant investments

Standard	Optical Budget class	Maximum attenuation (dB)
G-PON	A	20
	B	25
	<b>B+</b>	<b>28</b>
	C	30
	<b>C+</b>	<b>32</b>
	D (new)	35
XGS-PON	<b>N1</b>	<b>29</b>
	N2	31
	<b>E1</b>	<b>33</b>
	E2	35



28dB (Class B+) and 32dB (Class C+) are the main classes that need to be preserve

Access infrastructure medium

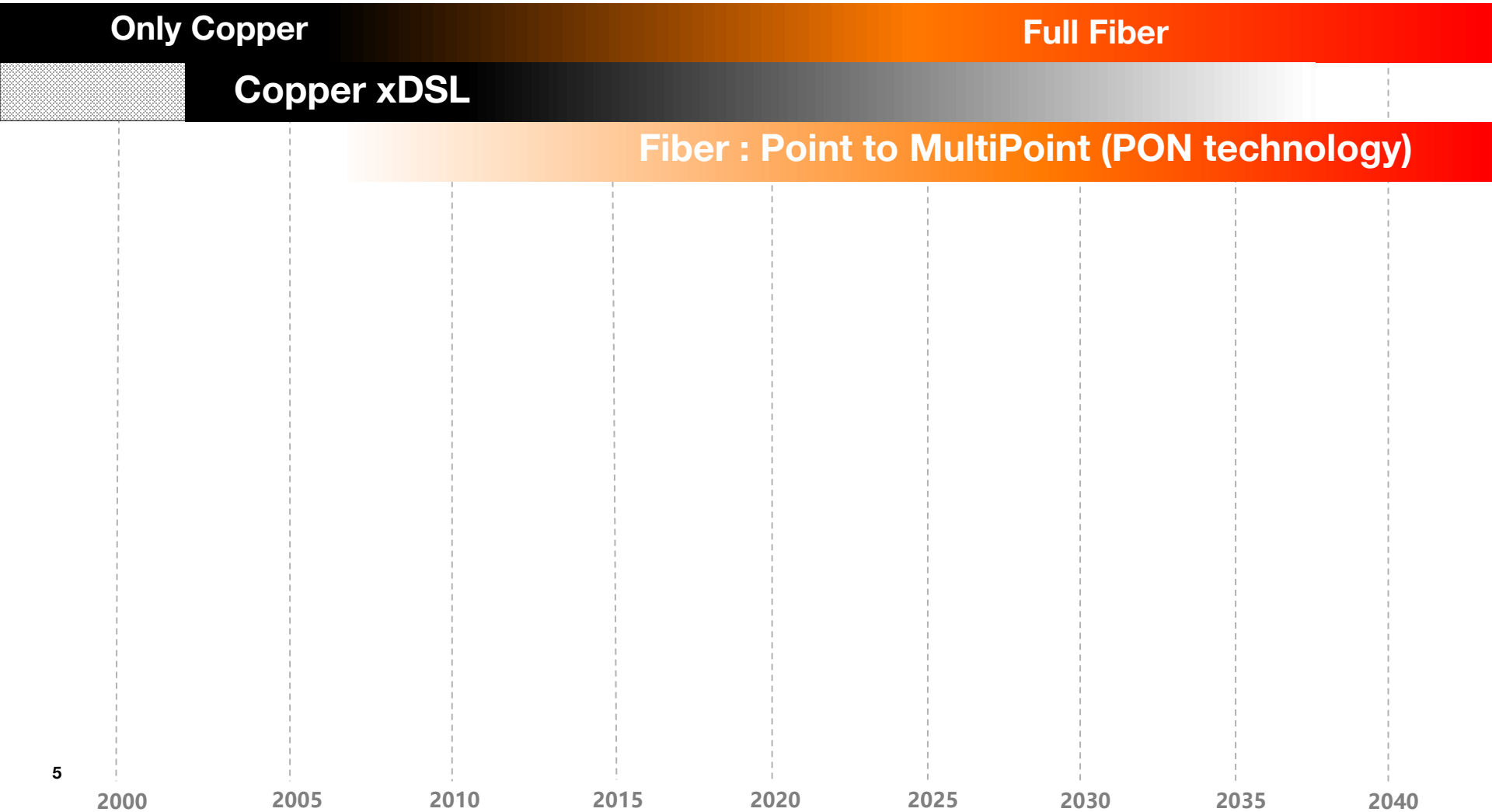
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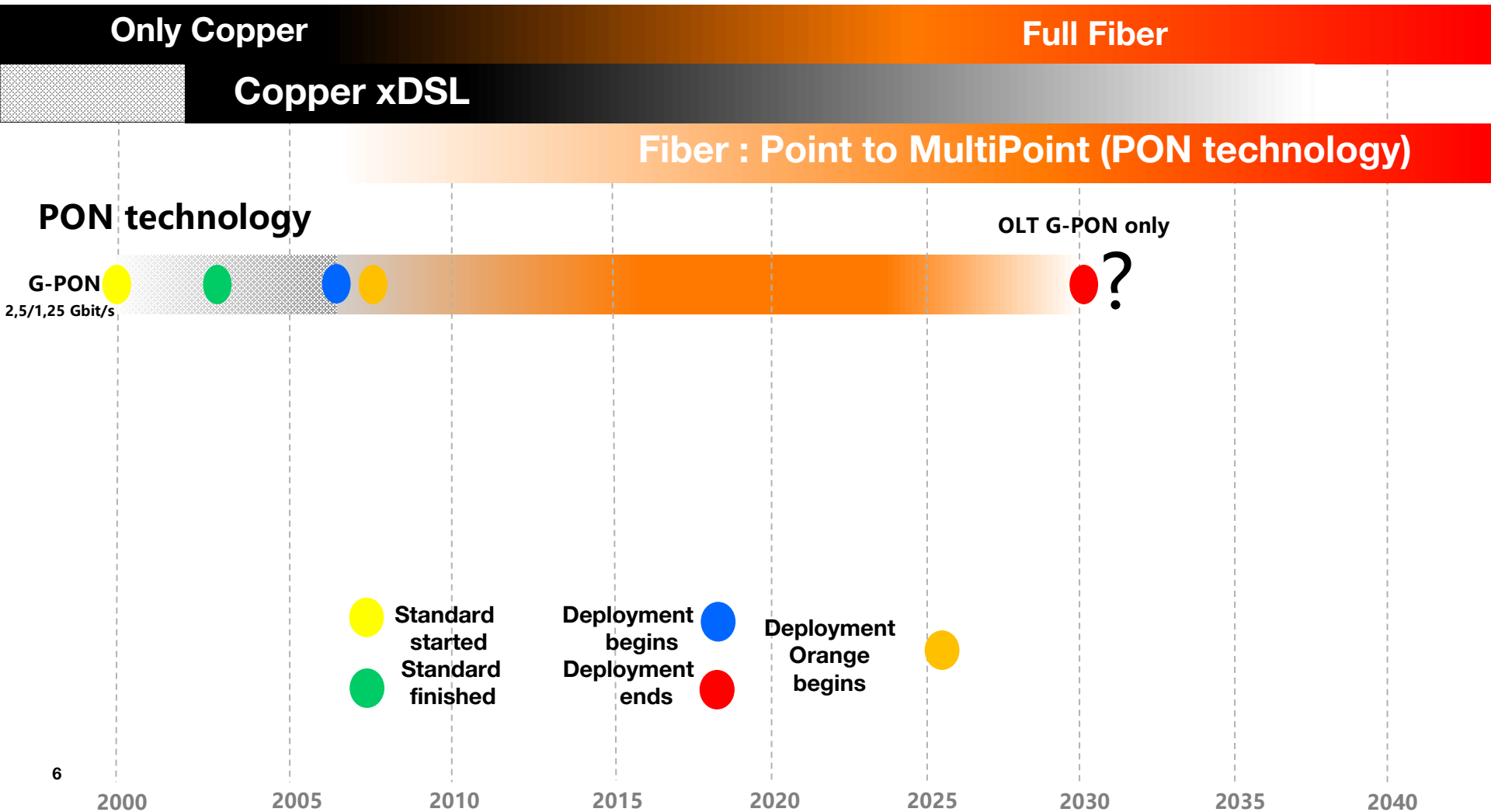
Access infrastructure medium





# The right technology to maintain high quality fixed access

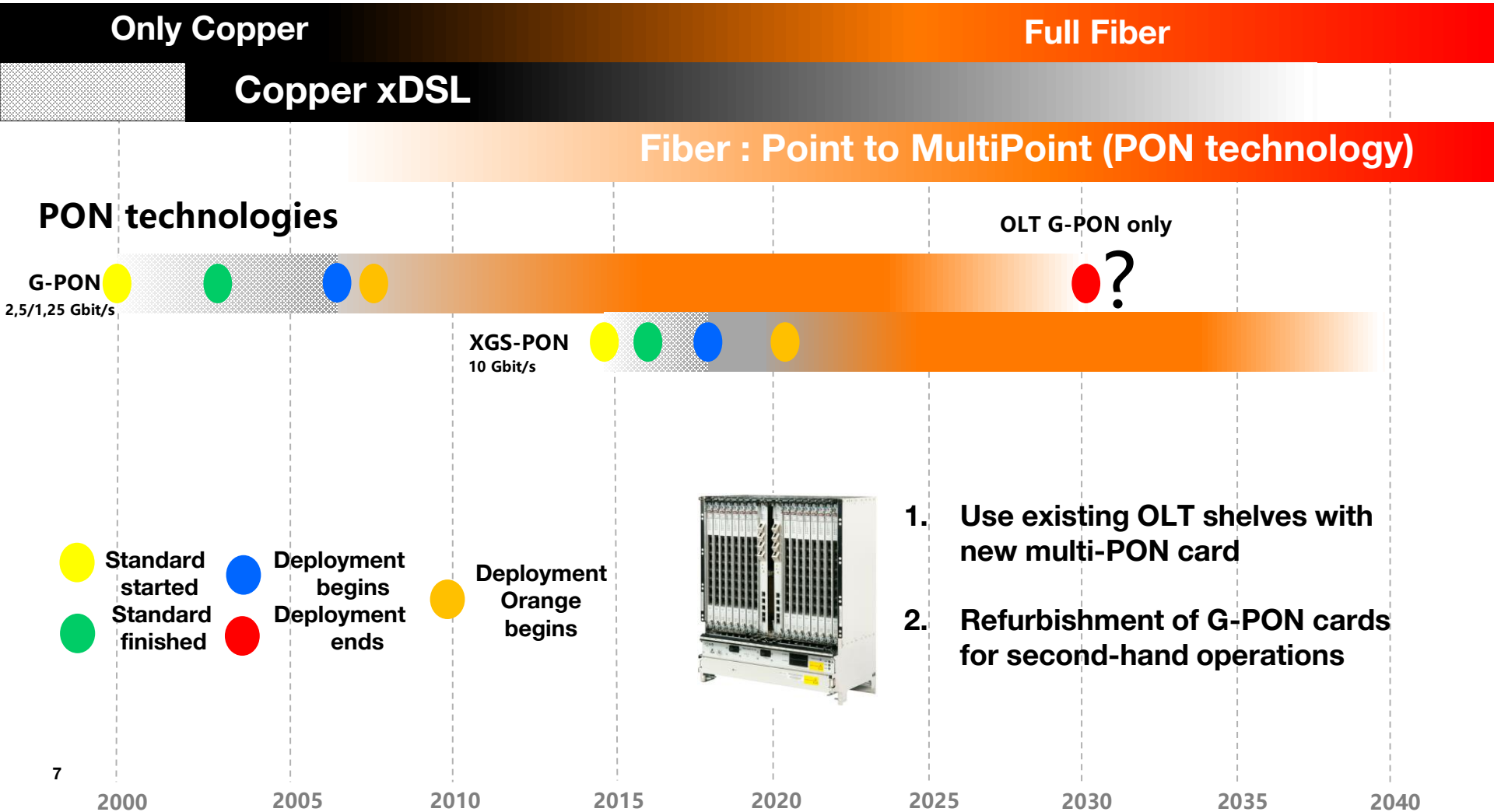
Access infrastructure medium





# The right technology to maintain high quality fixed access

Access infrastructure medium





# The right technology to maintain high quality fixed access

Access infrastructure medium

Only Copper

Full Fiber

Copper xDSL

Fiber : Point to MultiPoint (PON technology)

PON technologies

G-PON  
2,5/1,25 Gbit/s

XGS-PON  
10 Gbit/s

OLT XGS-PON combo

OLT G-PON only

OLT G-PON inside  
combo

1. Use existing OLT shelves with new multi-PON card
2. Refurbishment of G-PON cards for second-hand operations



3. A single OLT's port & transceiver for two PON generations
  - ✓ Only 3W !
  - ✓ 32 and 35dB optical budgets





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Access infrastructure medium



Copper xDSL

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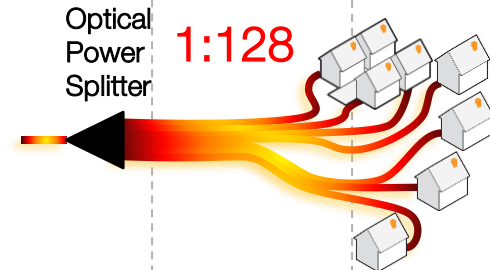
OLT G-PON inside  
combo



1. Use existing OLT shelves with new multi-PON card
2. Refurbishment of G-PON cards for second-hand operations
3. A single OLT's port & transceiver for two PON generations



4. Sustainable and energy efficiency  
Increase splitting ratio : 64  $\Rightarrow$  128





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Full Fiber

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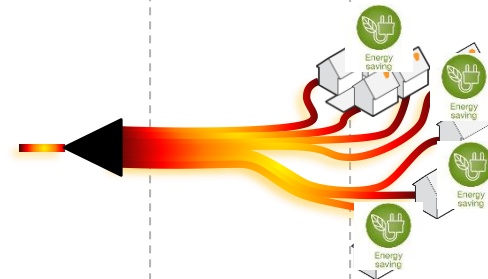
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  4. Sustainable and energy efficiency
- ✓ Increase splitting ratio : 64 ⇒ 128

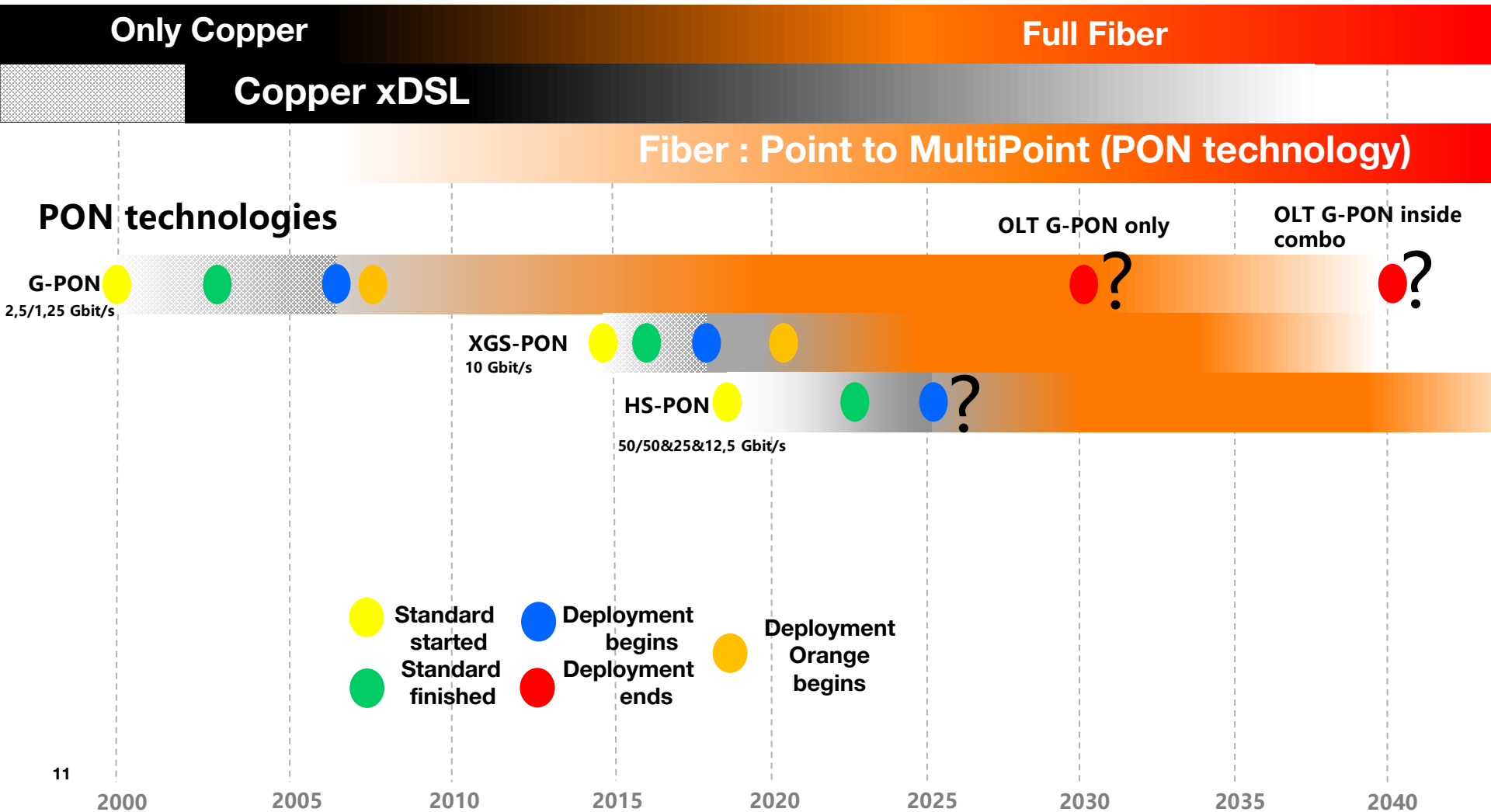
- 4bis. Sustainable and energy efficiency
- ✓ Power saving mechanisms: card, port, transceiver, ONU





# The right technology to maintain high quality fixed access

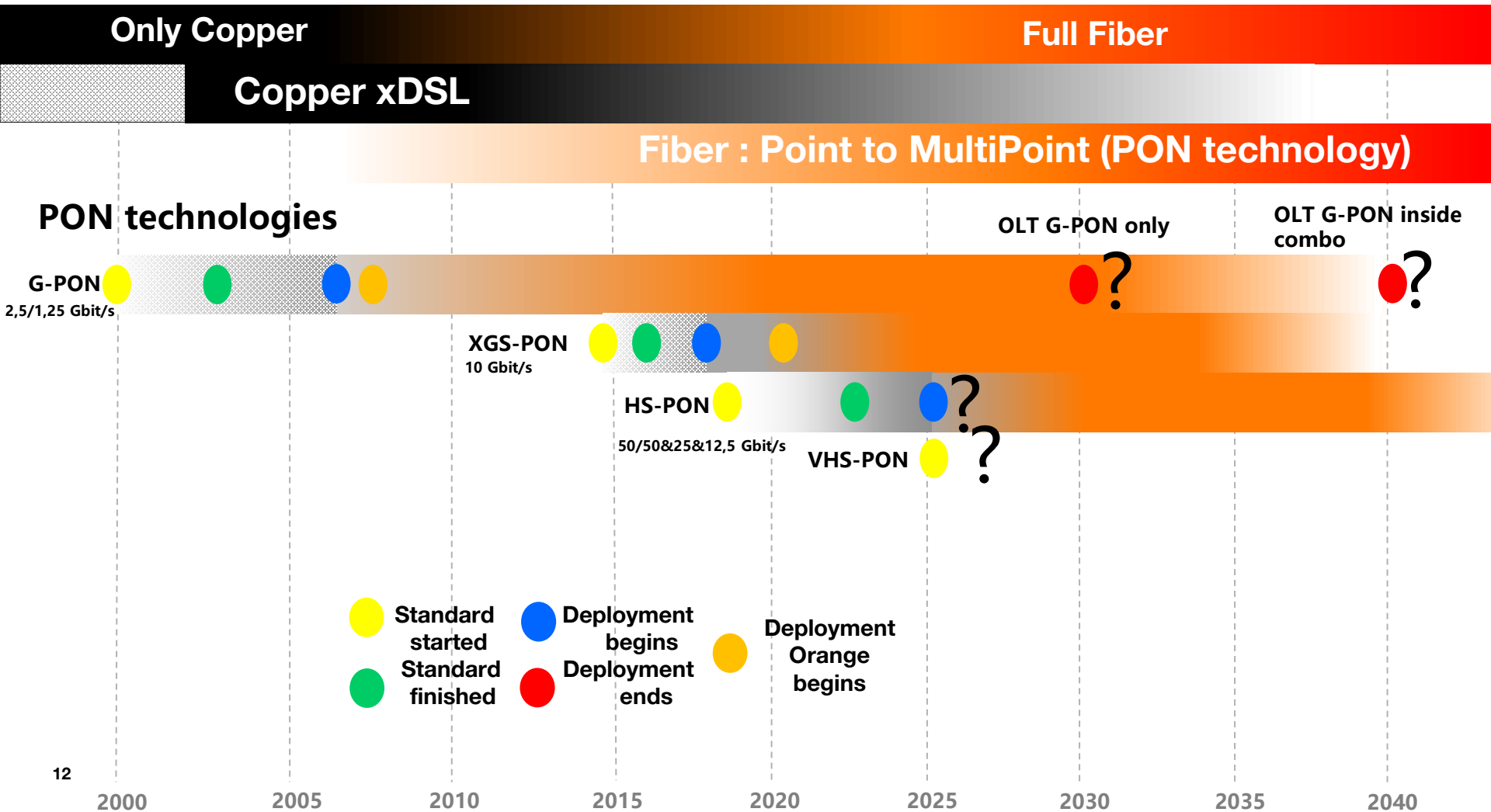
Access infrastructure medium





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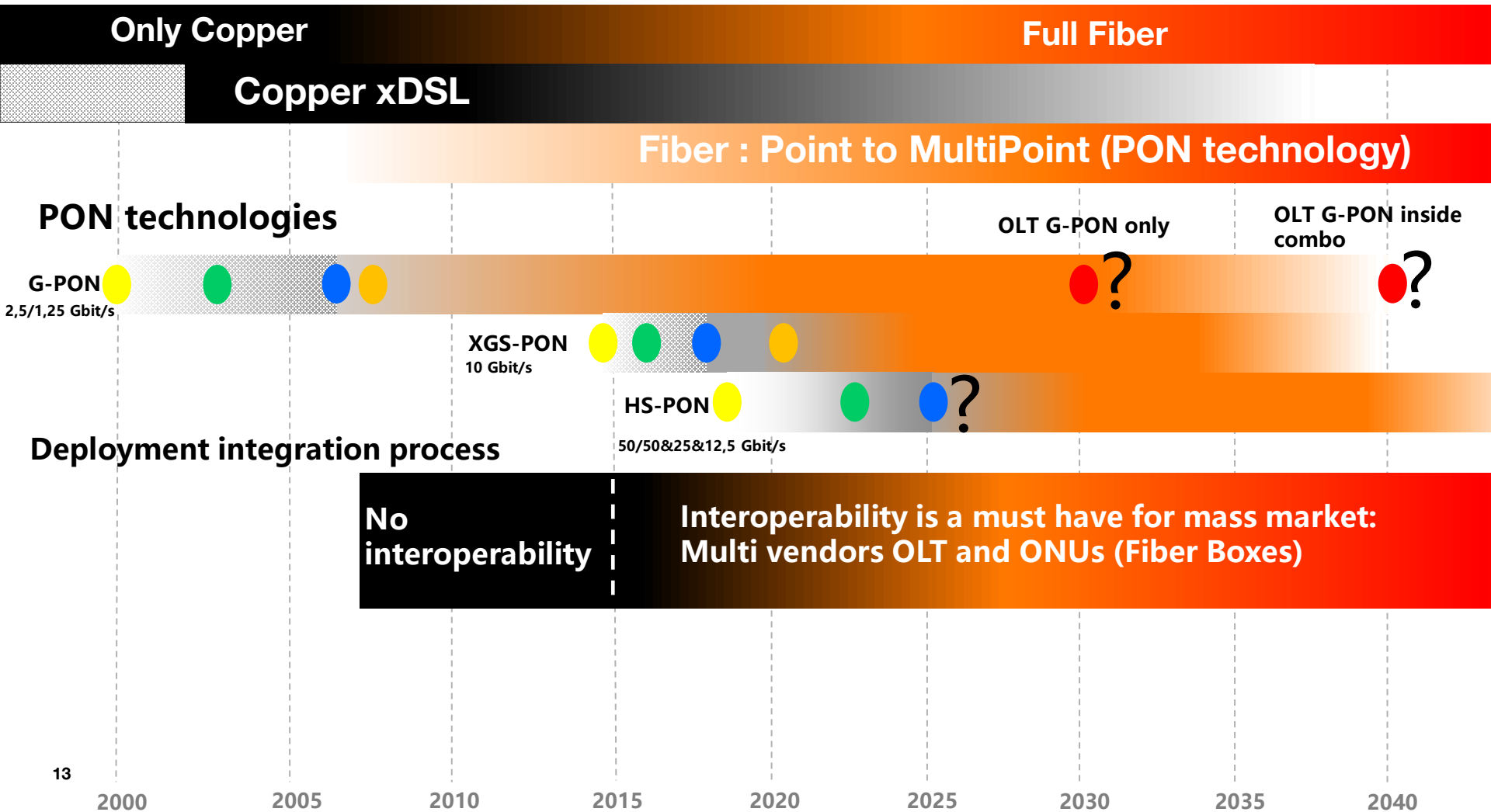
Access infrastructure medium

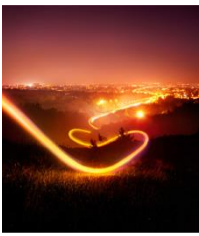




# The right technology to maintain high quality fixed access

Access infrastructure medium





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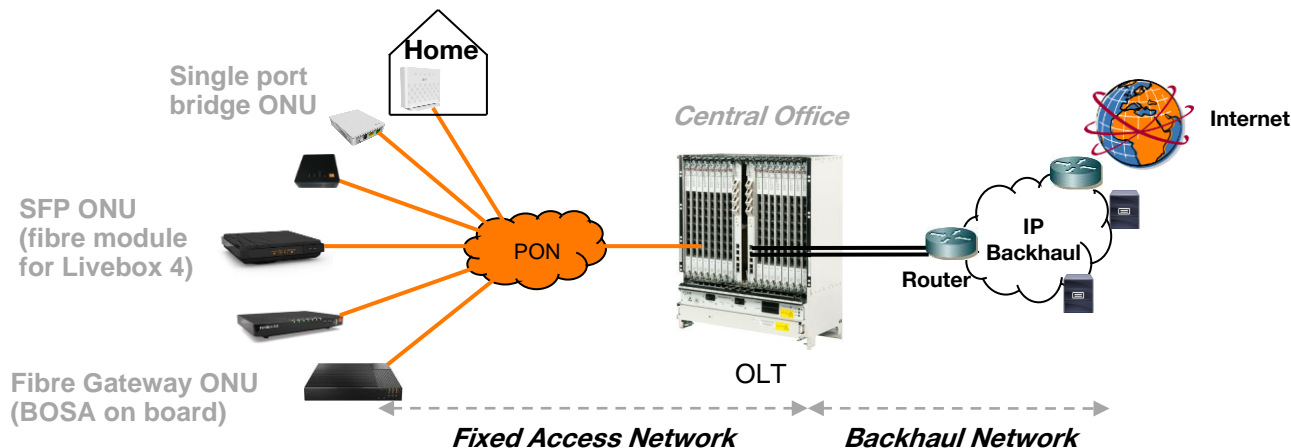
# PON interoperability & benefits for Orange group

## Firsts G-PON deployments [2006 - 2015]:

- Necessary to install ONU from same vendor as OLT
- No possibility to change the market share allocation, low leverage on vendor features

## ONU RFP in 2015 to decrease prices and reduce vendors dependency:

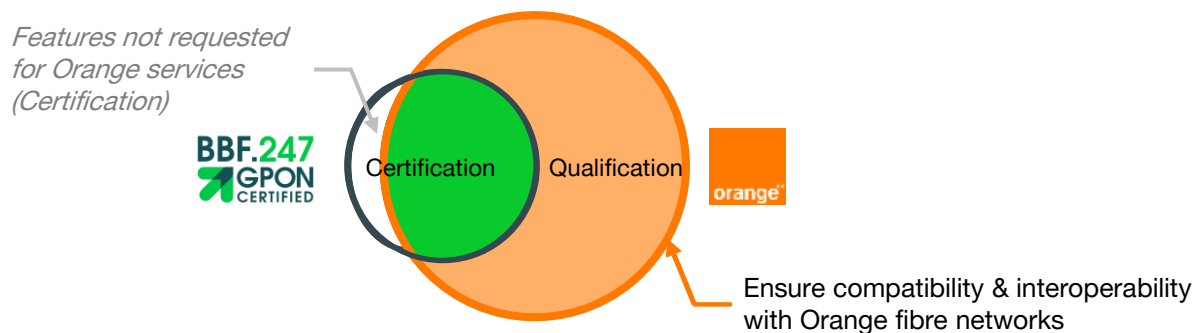
- Interoperability (standards), the key word for sourcing and to respond to increasing volume demands
- Facilitate equipment, network and services evolution: Maintain the existing base with our OLT suppliers and be able to deploy the ONU without any constraint





# Certification & Qualification benefits for PON ONU at Orange group

- For any PON products selection, the **BBF.247 Certification is mandatory** and this is a prerequisite to prove the terminal is mature enough
- The objective of the **Qualification** tests phase is to **verify the OLT - ONU interworking** according to Orange engineering rules



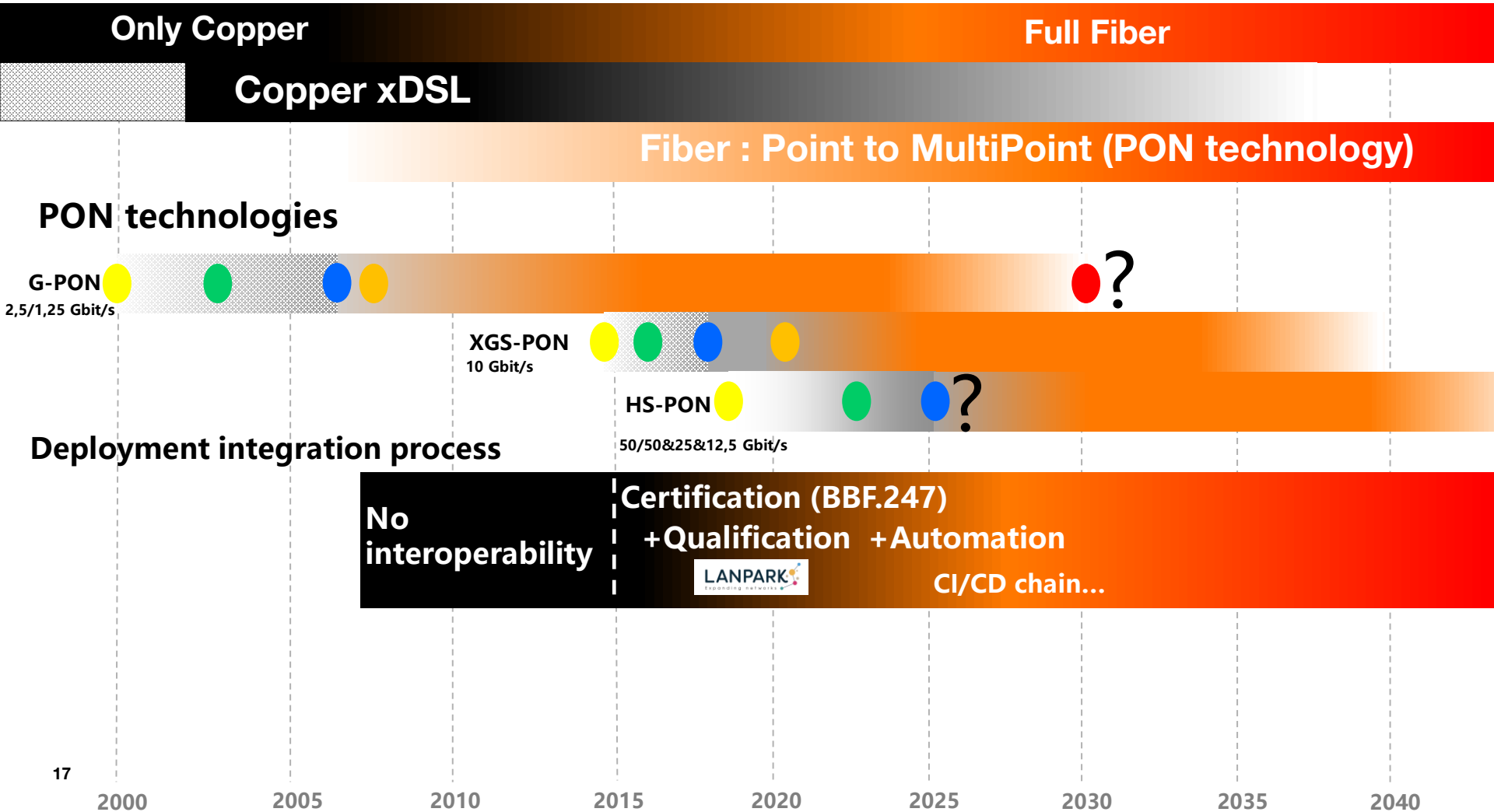
⇒ Certification and Qualification ensure the system is **fully interoperable & compatible with the same OLT than the OLT deployed** in Orange fibre networks





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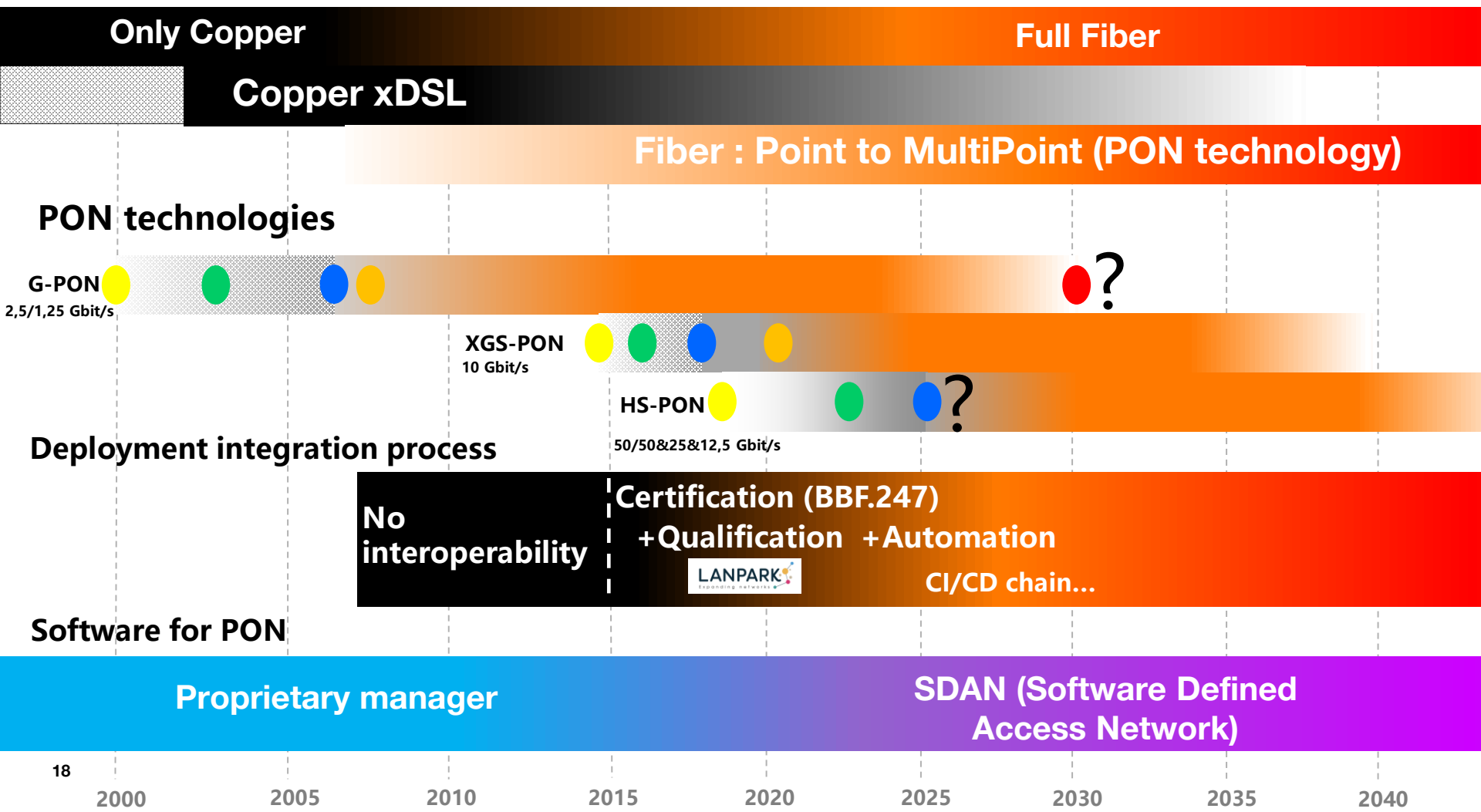
Access infrastructure medium





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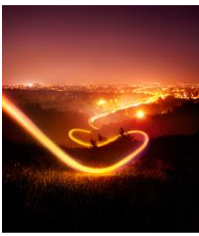




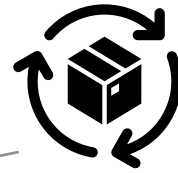
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# The right software to maintain high quality fixed access



Fixed Access OSS (Operations Support Systems)

OLT controller with the promise to be vendor agnostic



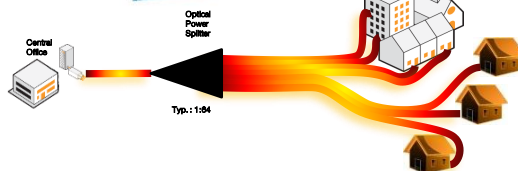
Modern interfaces:

**NETconf / Yang** : Network Configuration Protocol

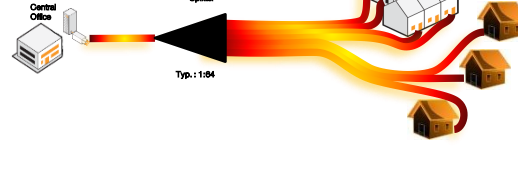
**IPFIX** : Internet Protocol Flow Information Export

**gRPC** : google Remote Procedure Call

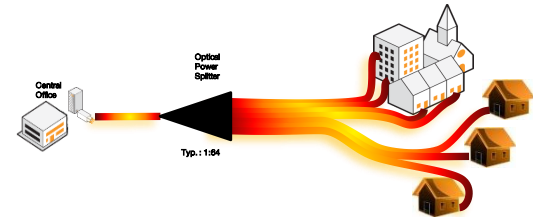
OLT vendor 2



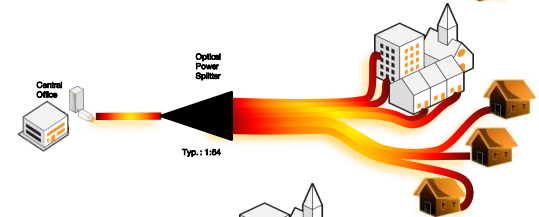
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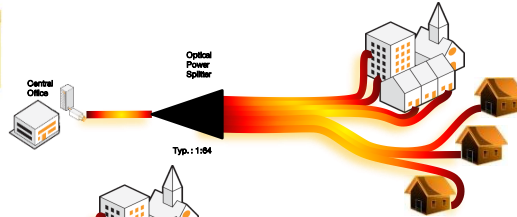
OLT vendor 2



OLT vendor 1



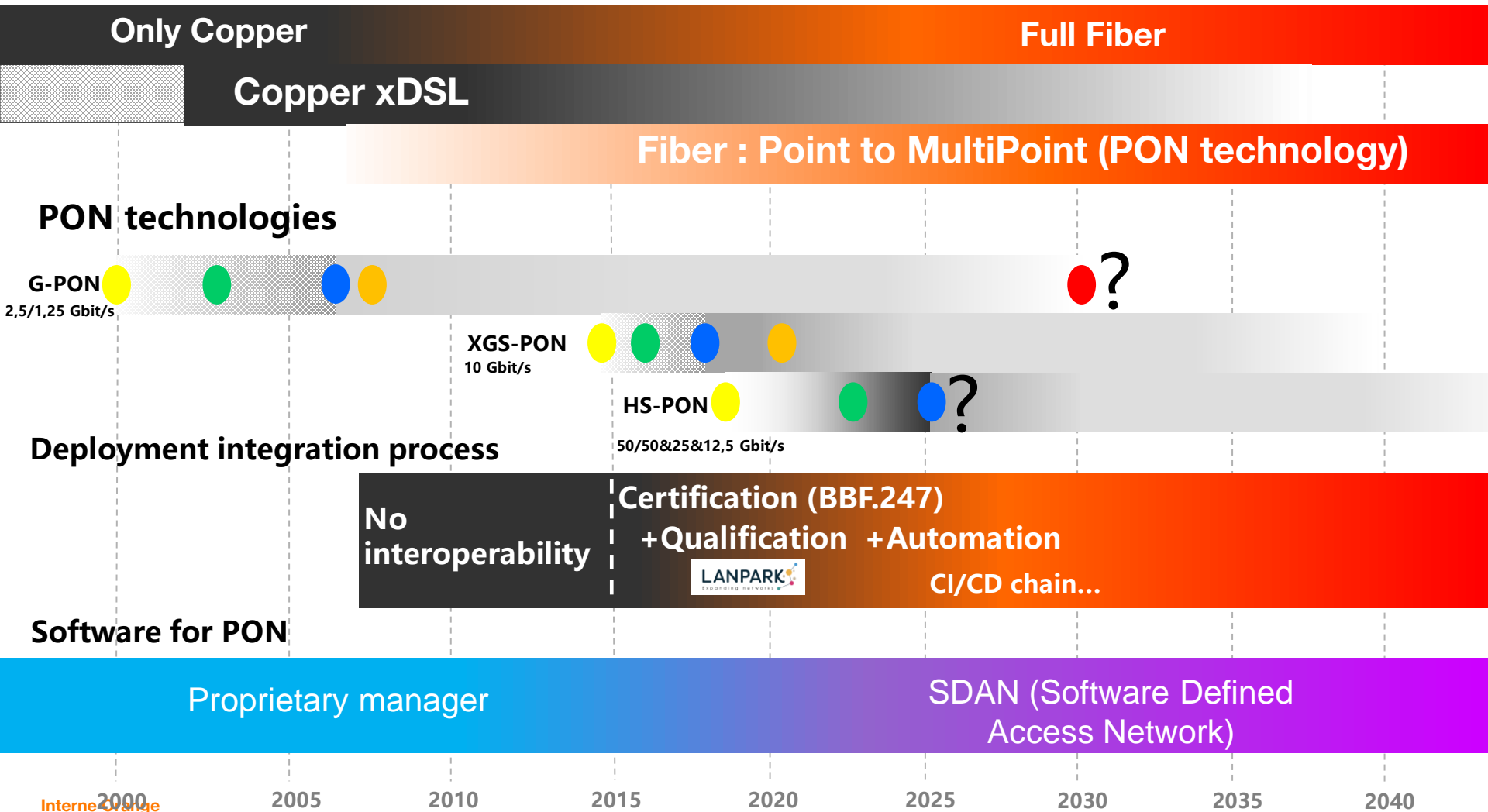
OLT vendor 1





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Access infrastructure medium



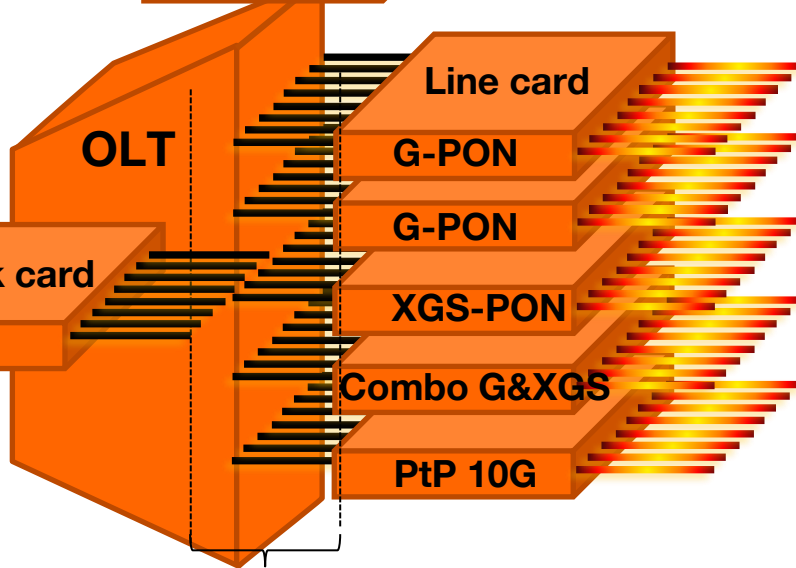


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# OLT : Existing functional blocks



To primary metro network (WDM)

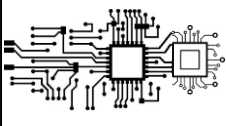
*Single fiber transmission (bidirectional) « a should »*

To user premises

*Single fiber transmission (bidirectional) « a must »*

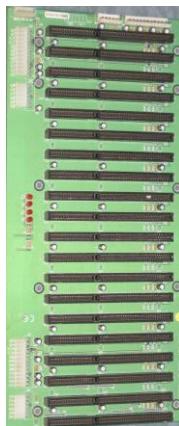
Electronic Switching

MAC Hashing



Electronic Lanes to backplane

Electronic Backplane

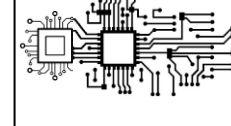


Hashing traffic process

Hashing traffic process

Electronic Switching

Hashing MAC



Electronic Lanes to backplane

N x Optoelectronic Pluggable Transceiver



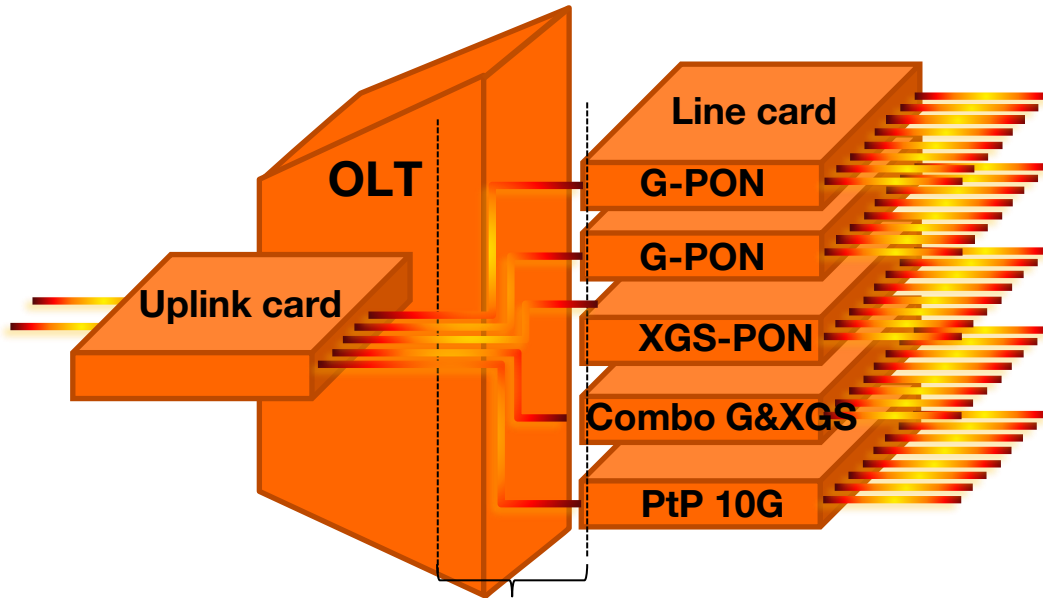




# OLT : photonic backplane

To primary metro network (WDM)

*Single fiber transmission (bidirectional) « a should »*



To user premises

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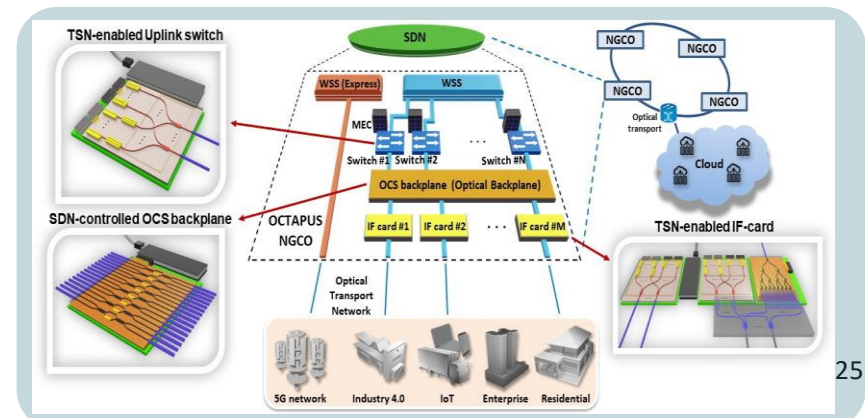


**OCTAPUS**  
funded by European Commission

**Photonic Backplane**

OCTAPUS Goals (3 years – 2022/2025 ):

- Increase (switching) capacity at the Next Gen Central Office (NGCO)
- Efficiently support Disaggregated RAN (i.e. Fronthaul and TSN) and URLLC services.
- Consolidation of SDN with NGCO PHY layer
- Increase energy efficiency





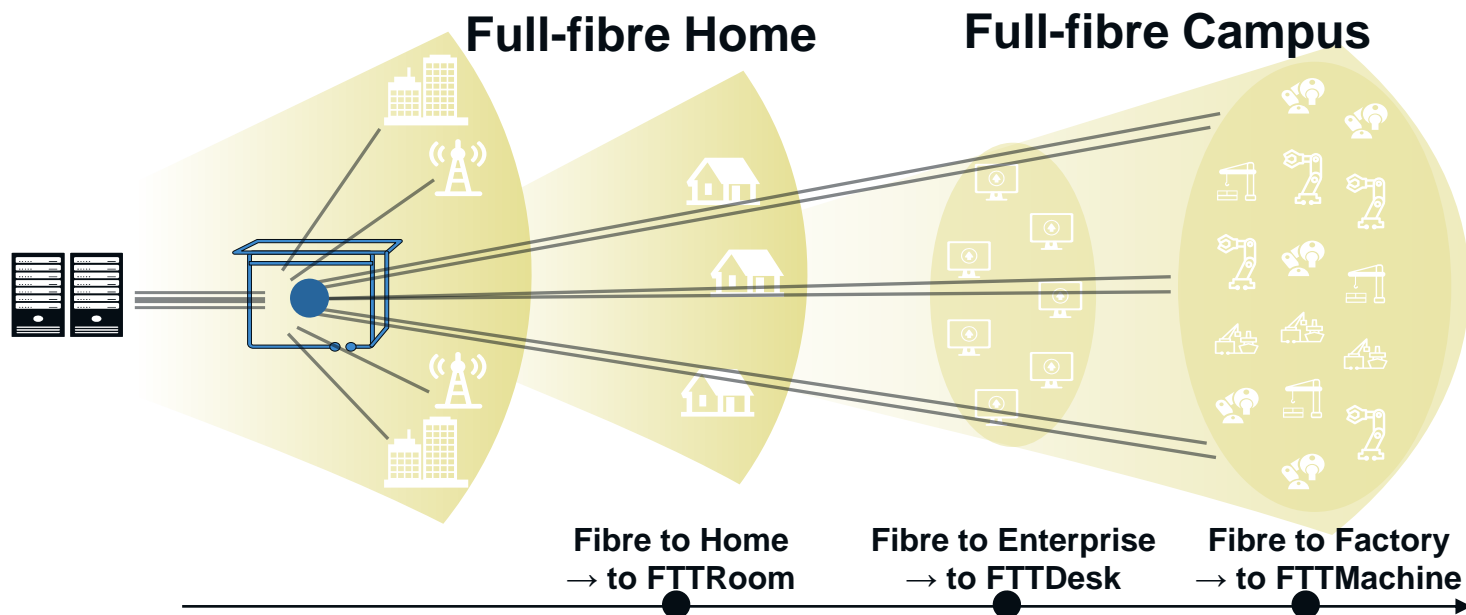
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# PON is not dedicated to FTTHome

## Fibre to Everywhere for an Unlimited Future



### 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)



# 2018, major Decision Orange France: all new large tertiary buildings (over 500 people) will have a POL (Passive Optical LAN) infrastructure

## Technology & business cases evaluation



**Charlety**  
2015  
90 people



**Marcadet**  
2016  
200 people



**Lyon St Priest**  
2017  
400 people



**La Marseillaise**  
19/Q1  
950 people



**La Défense Agora**  
19/Q4  
950 people



**Bagneux Résonance**  
20/Q1  
1000 people



**Rennes Atalante**  
20/Q1  
865 people



**Lyon 2020**  
20/Q3  
1960 people



**Villejuif 2**  
21/Q1  
1100 people



**Orange Head Quarter**  
21/Q3  
2800 people



**Montpellier**  
21/Q3  
1100 people



**Toulouse Balma**  
21/Q4  
1230 people



### Evaluation phase

### Generalisation phase

### Extension under study for

2015

2018 2019

2020

2021 -smaller new buildings  
-existing large buildings

2025



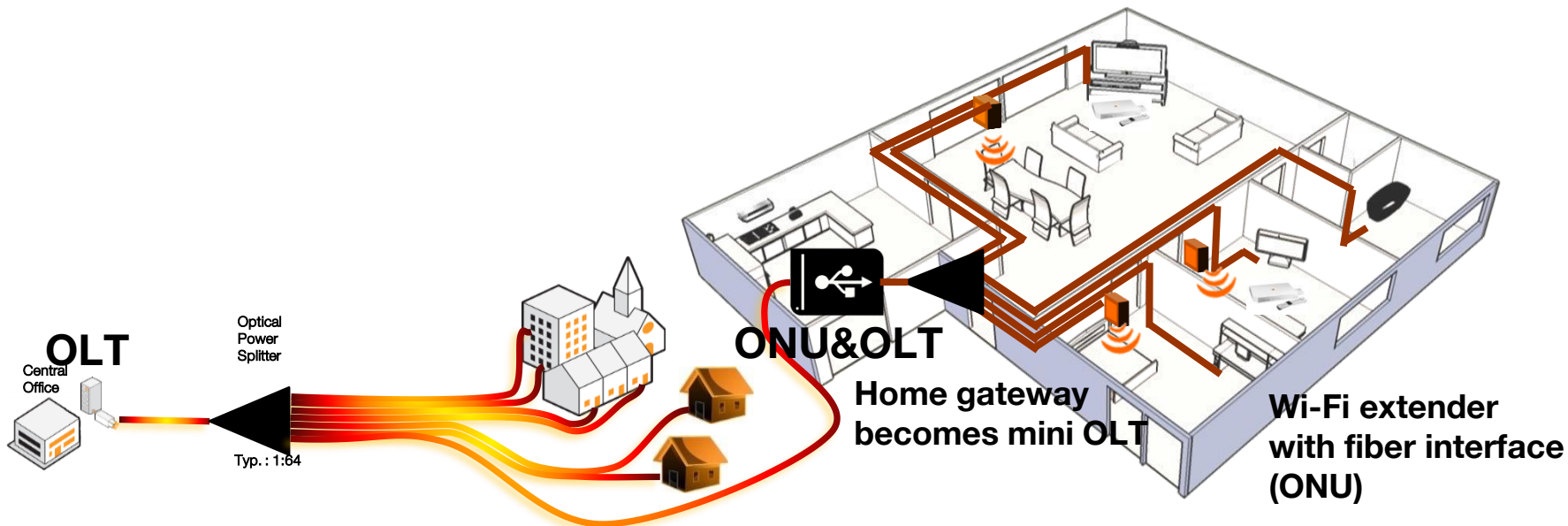
# Fiber for smart Home: FTTRoom

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

**Skills opportunity:** A pool technicians (network operation) with the FTTH skills in time for FTTRoom

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





## Conclusion

# Optical access generations

- 1 Build fiber infrastructure  
G-PON based (class B+)  
multi-vendors : OLT & ONU
- 2 G & XGS-PON coexistence  
Management modernization  
Class C+ and D for “128”  
Not only FTTH: POL campus
- 3 HS-PON  
Multi-vendors : controller & OLT & ONU  
Fiber deeper at home : FTTRoom



# Thank You

# Merci



**OCTAPUS - funded by European Commission**

Optical circuit switched time sensitive network architecture for high-speed passive optical networks and next generation ultra-dynamic and reconfigurable central office environments

HORIZON-CL4-2021-DIGITAL-EMERGING-01-06 Advanced Optical Components

