

# PON 2024

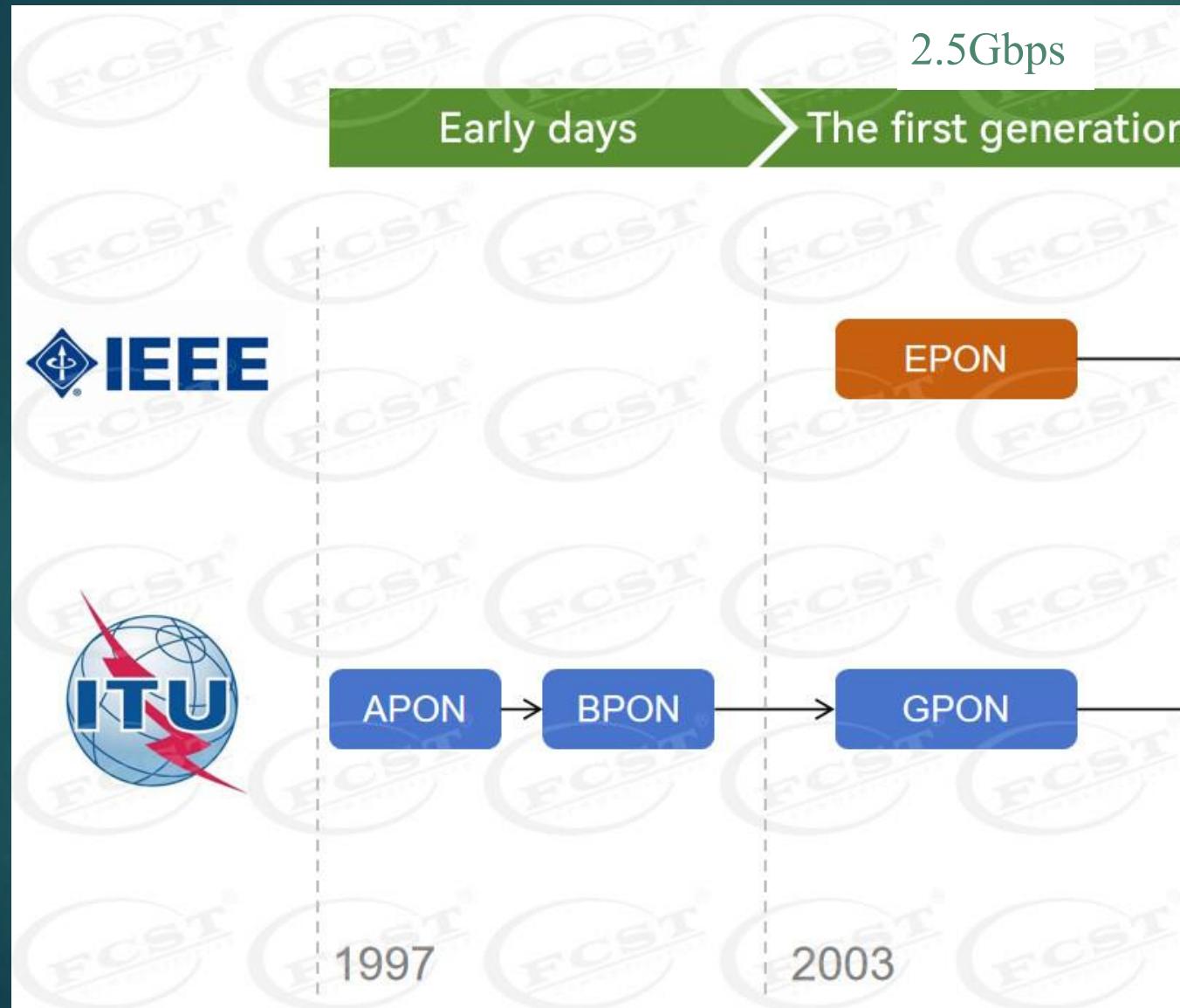
JUG

BANGKOK DATACOM CO., LTD.  
[WWW.BDC.CO.TH](http://WWW.BDC.CO.TH)

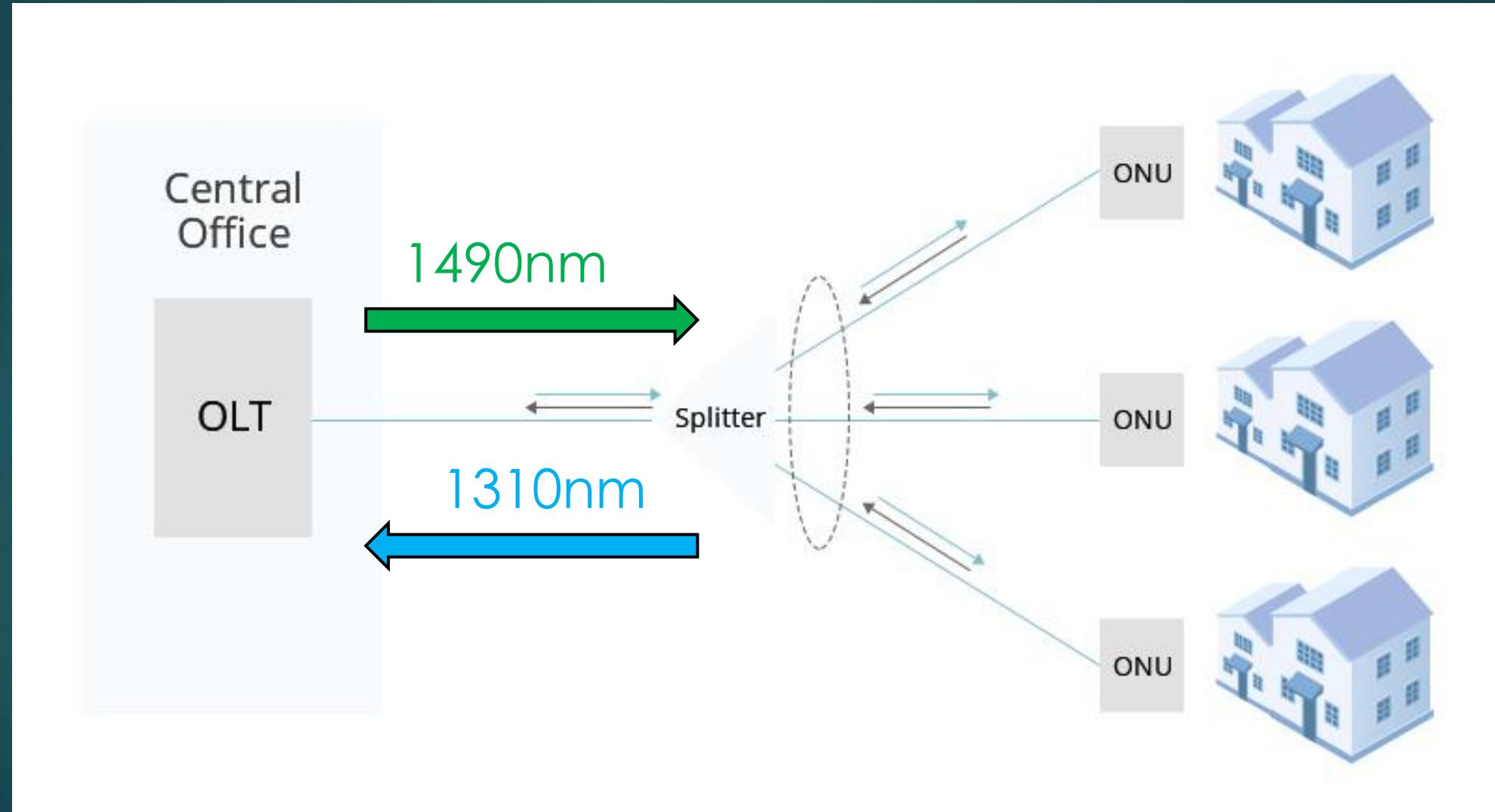
# Topic

- PON standards
- Asymmetric Splitter
- FTTR

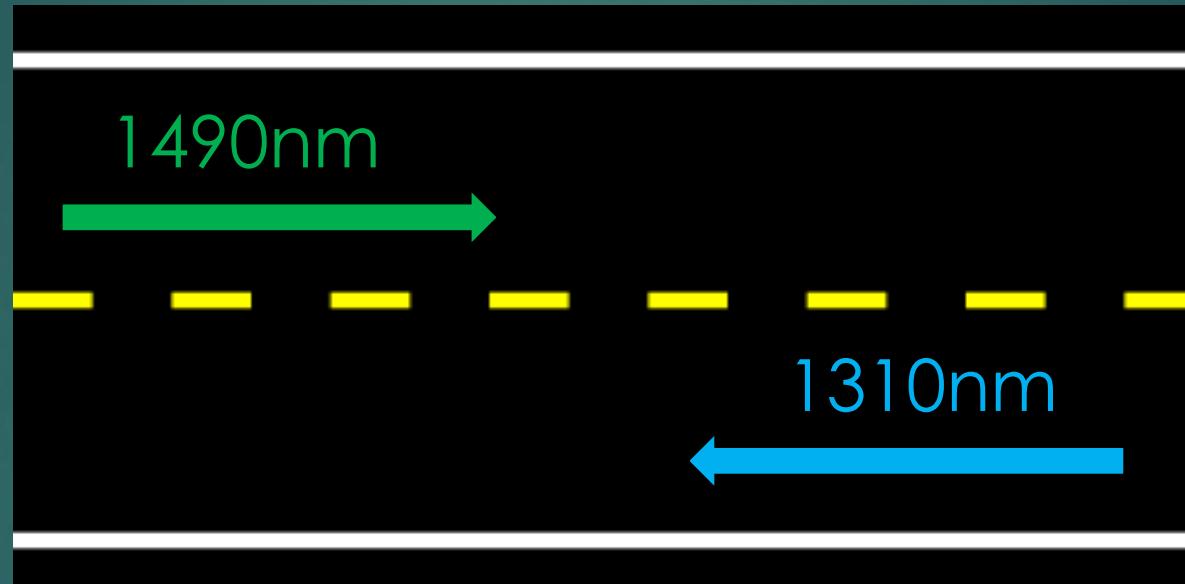
# 2.5G PON standards



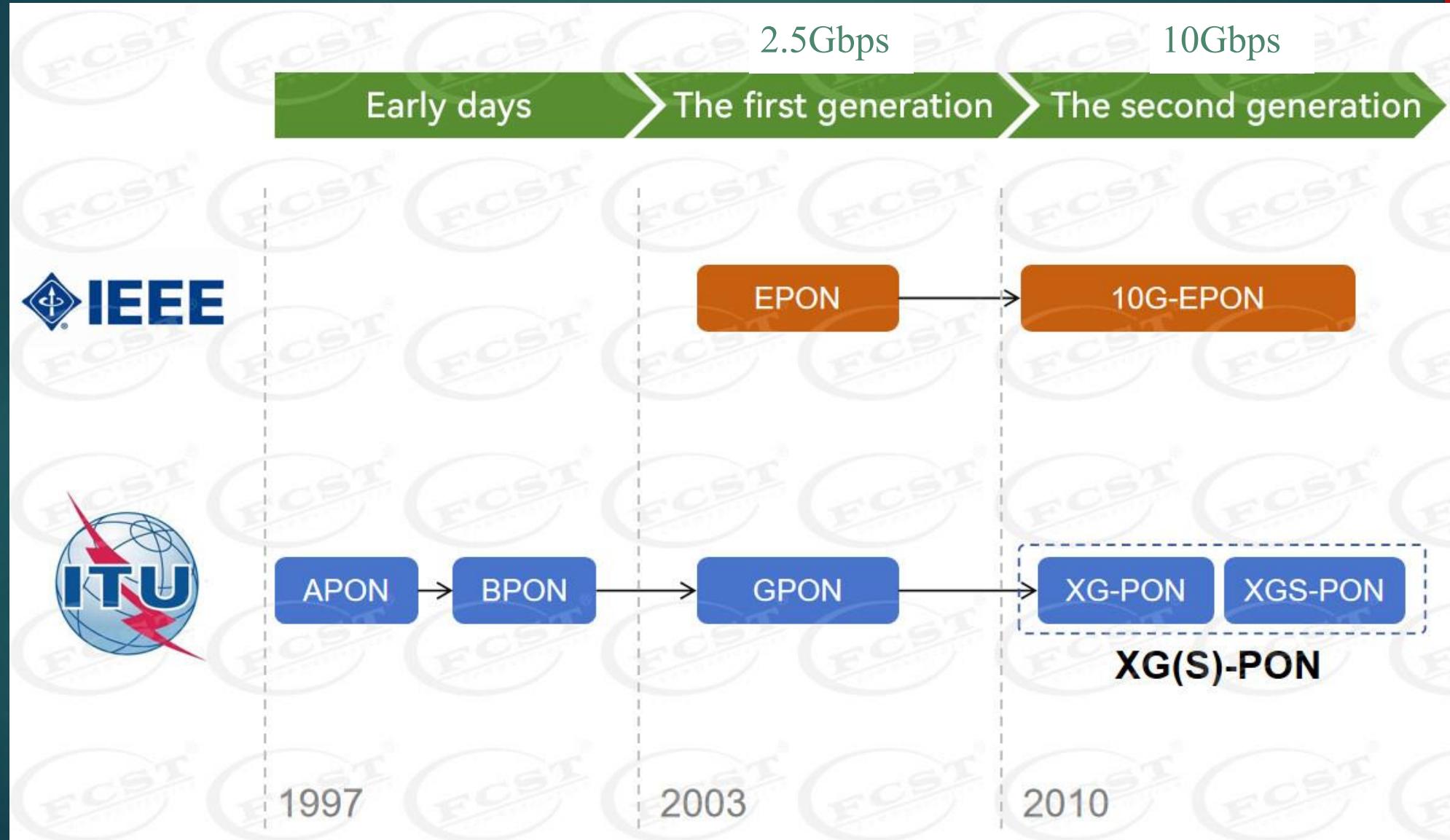
# 2.5G PON Wavelengths



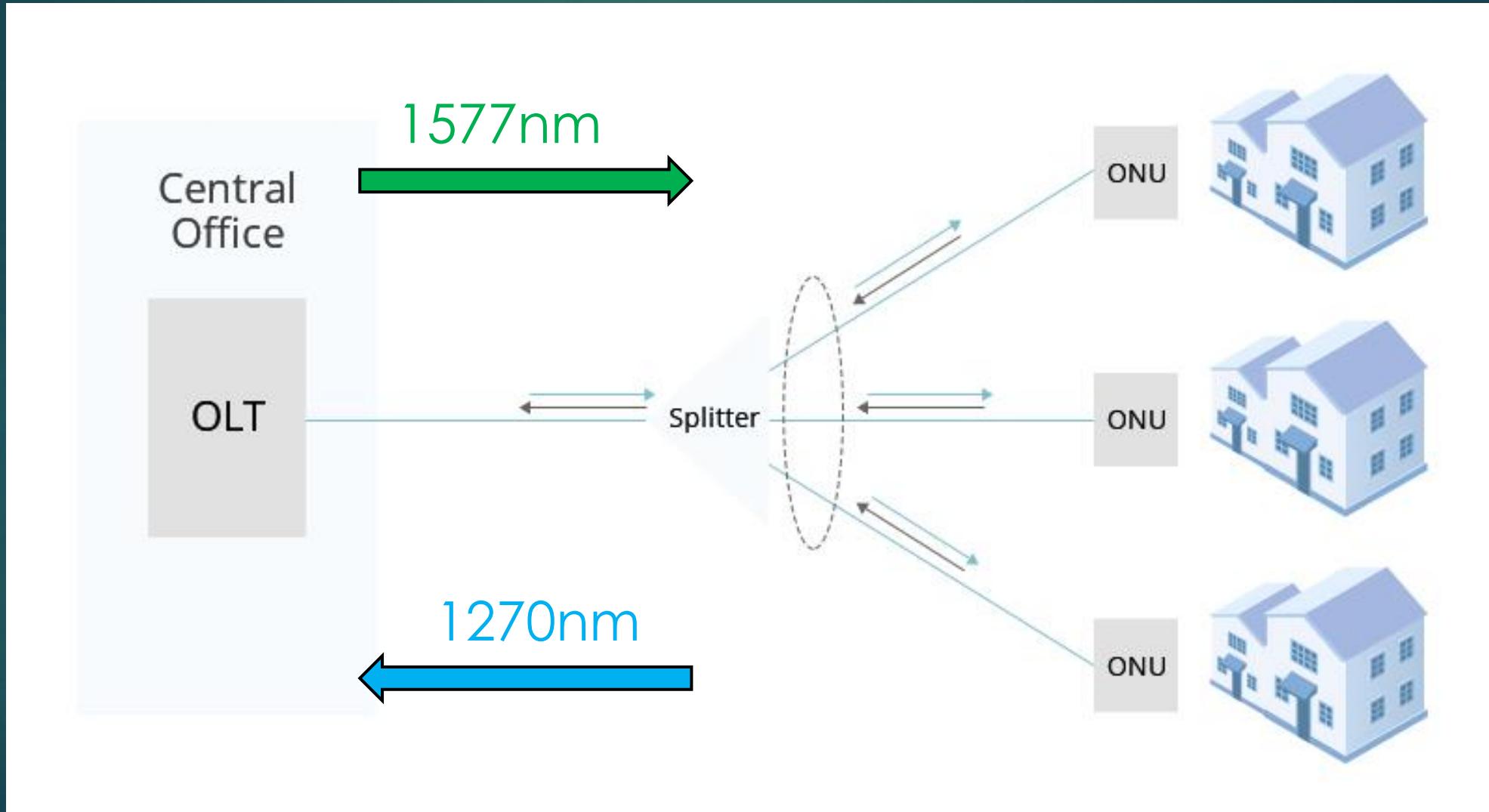
# 2.5G PON Wavelengths



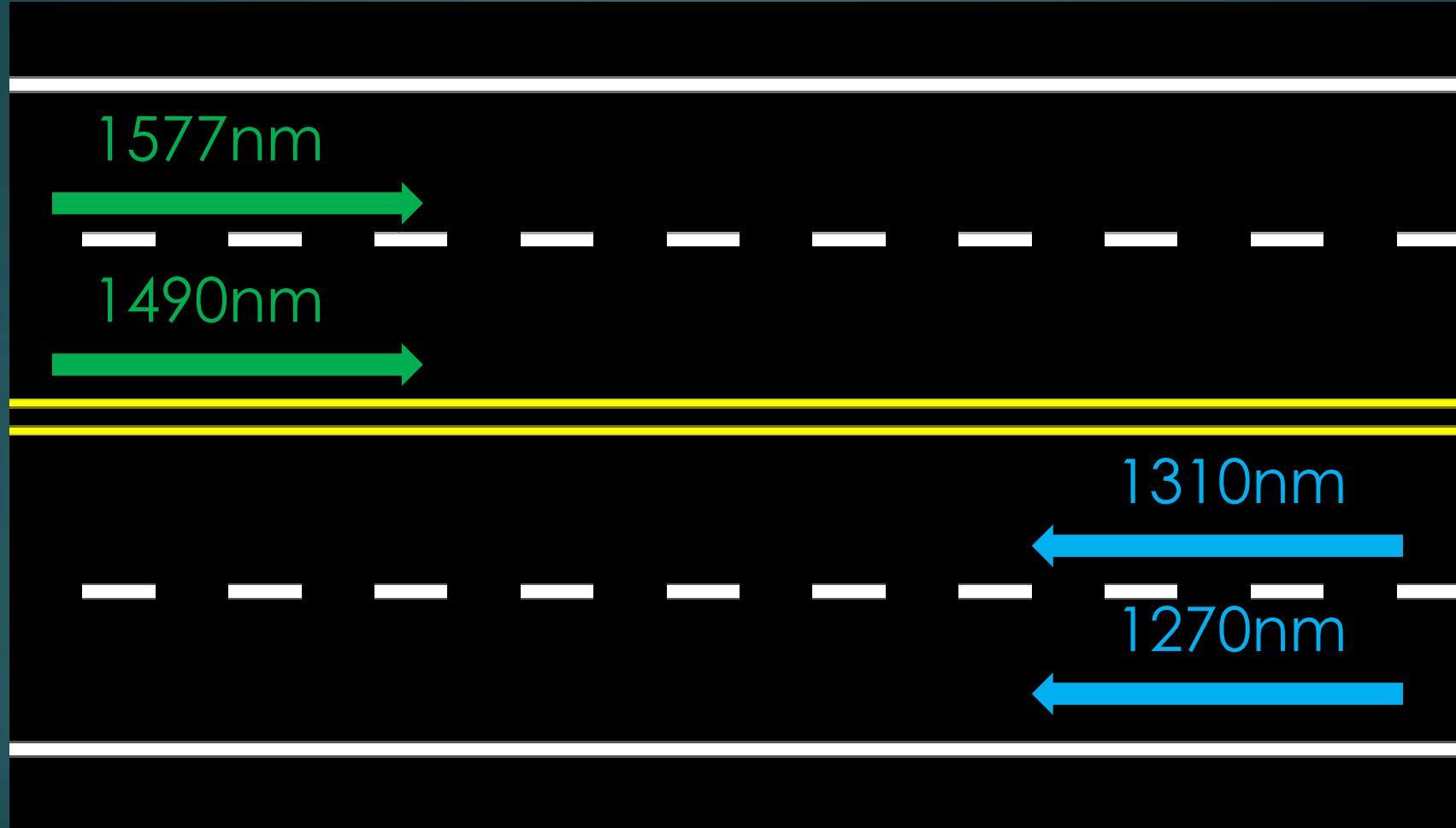
# 10G PON standards



# 10G PON Wavelengths



# 10G PON Wavelengths



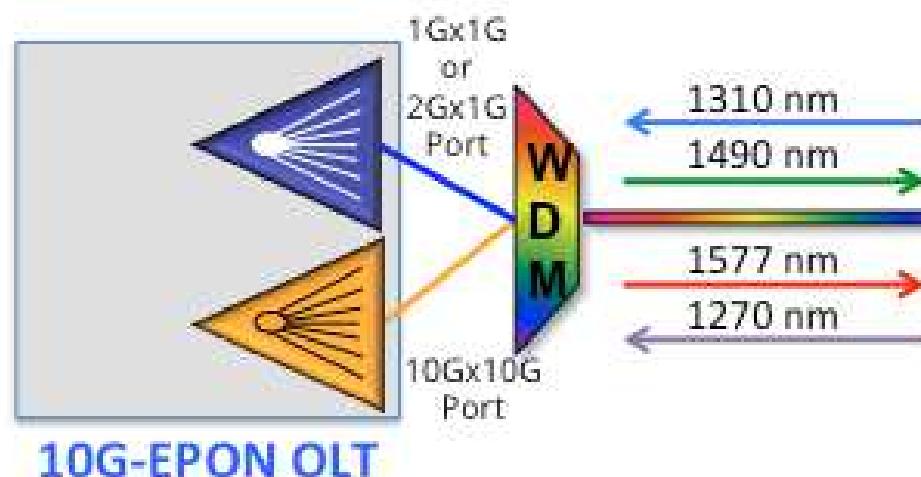
# 2.5G + 10G in same PON network

## Downstream Dual-rate WDM

1G DS 1490nm ±10 "and" 10G DS 1577.5 ±2.5

## Upstream Dual-rate WDMA

1G US 1310nm ±20 "and" 10G US 1270nm ±10

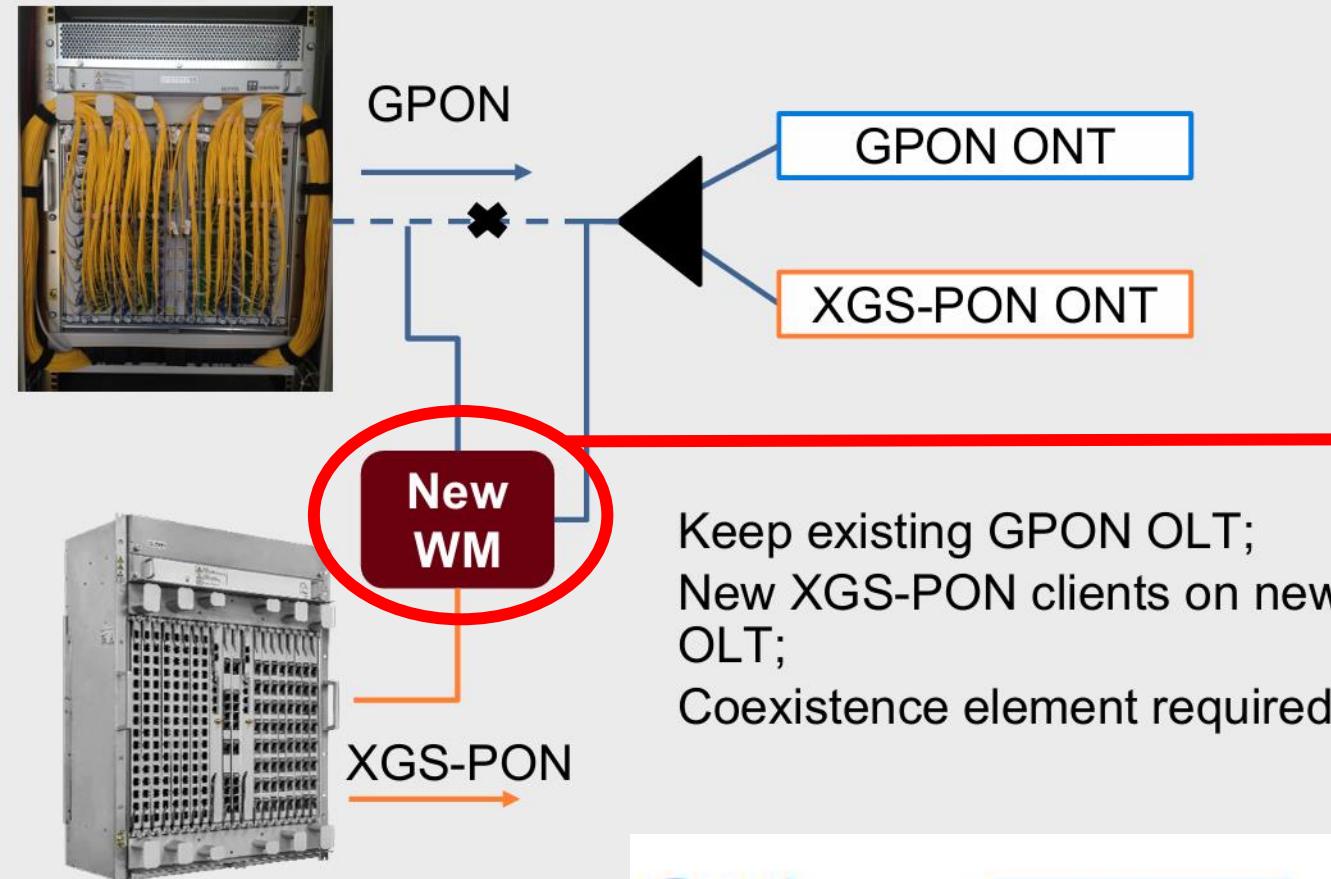


**1G/1G or  
2G/1G ONUs**  
Utilizing G.984.5  
compliant ONU optics

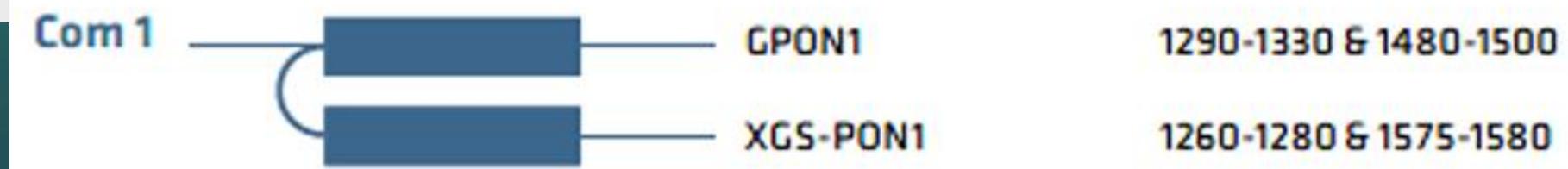
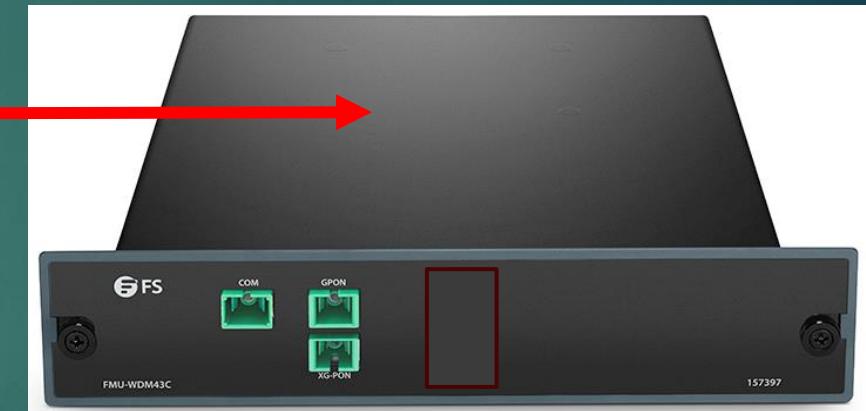
**10G/10G EPON ONU**  
Customer upgrades  
and/or New installs

(Note: 10Gx1G ONUs  
are not supported  
in this option)

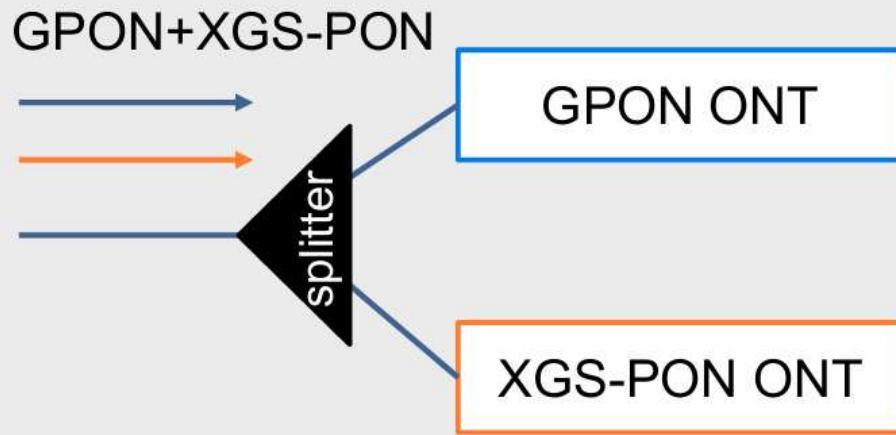
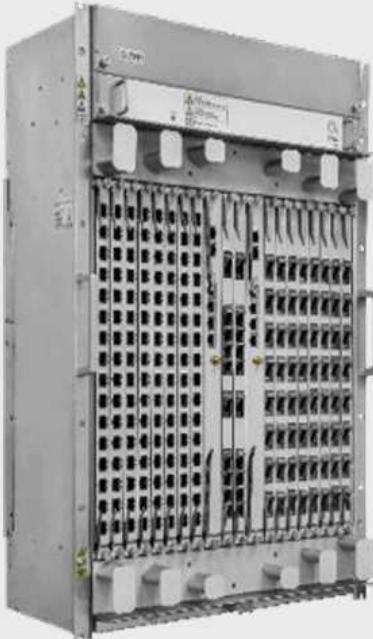
# How to upgrade GPON to XGS-PON



Coexistence Element



# How to upgrade GPON to XGS-PON



- OLTs providing GPON and XGS-PON
- Splitter for MPM Ports

MPM = Multi PON Module

**2.5-10XGSPON-SFP-C**

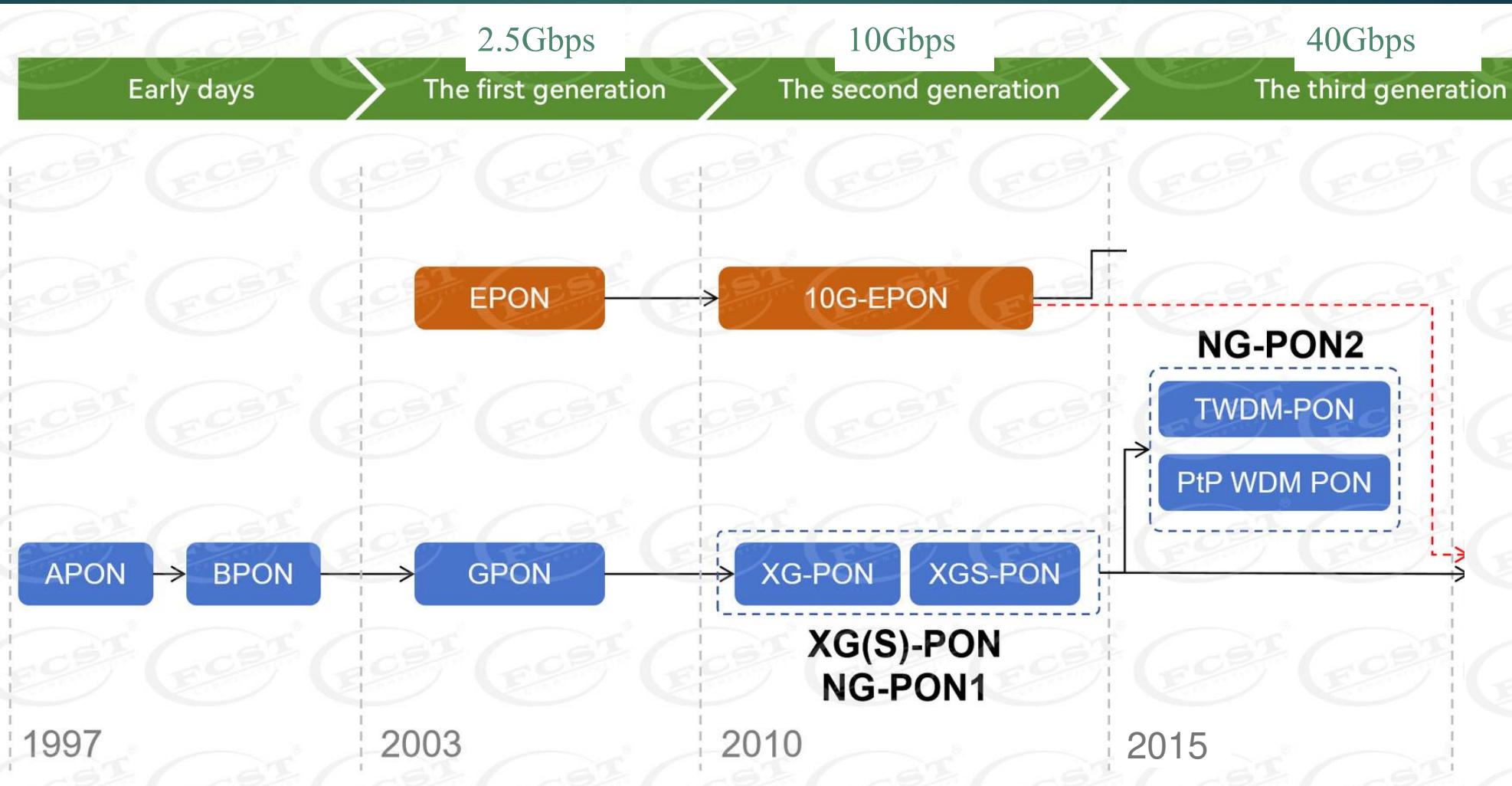
MSA Compatible XGSPON & GPON OLT Combo SFP C+ Module

# Key Highlights

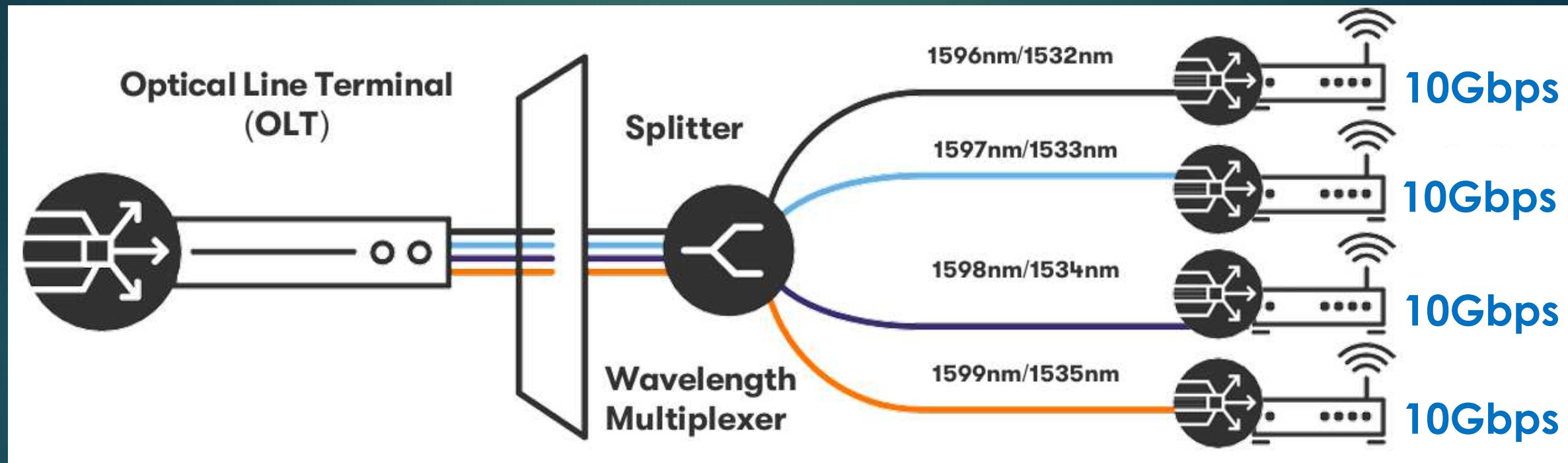
- Type: XGSPON & GPON
- Compatibility: MSA Compatible
- Tx/Rx Wavelength: 1490nm/ 1310nm and 1577nm/ 1270nm
- Media Type: Single-Mode Fiber (SMF)
- Optical Budget: 34 and 35 dB
- Max. Distance: 20 km
- Data Rate XGSPON: D:9.953Gbps/ U:9.953Gbps
- Data Rate XGPON: D:9.953Gbps/ U:2.488Gbps
- Data Rate GPON: D:2.488Gbps/ U:1.244Gbps
- Temperature: Industrial -40°-85°C

# Beyond 10G-PON

# 40G PON Standards



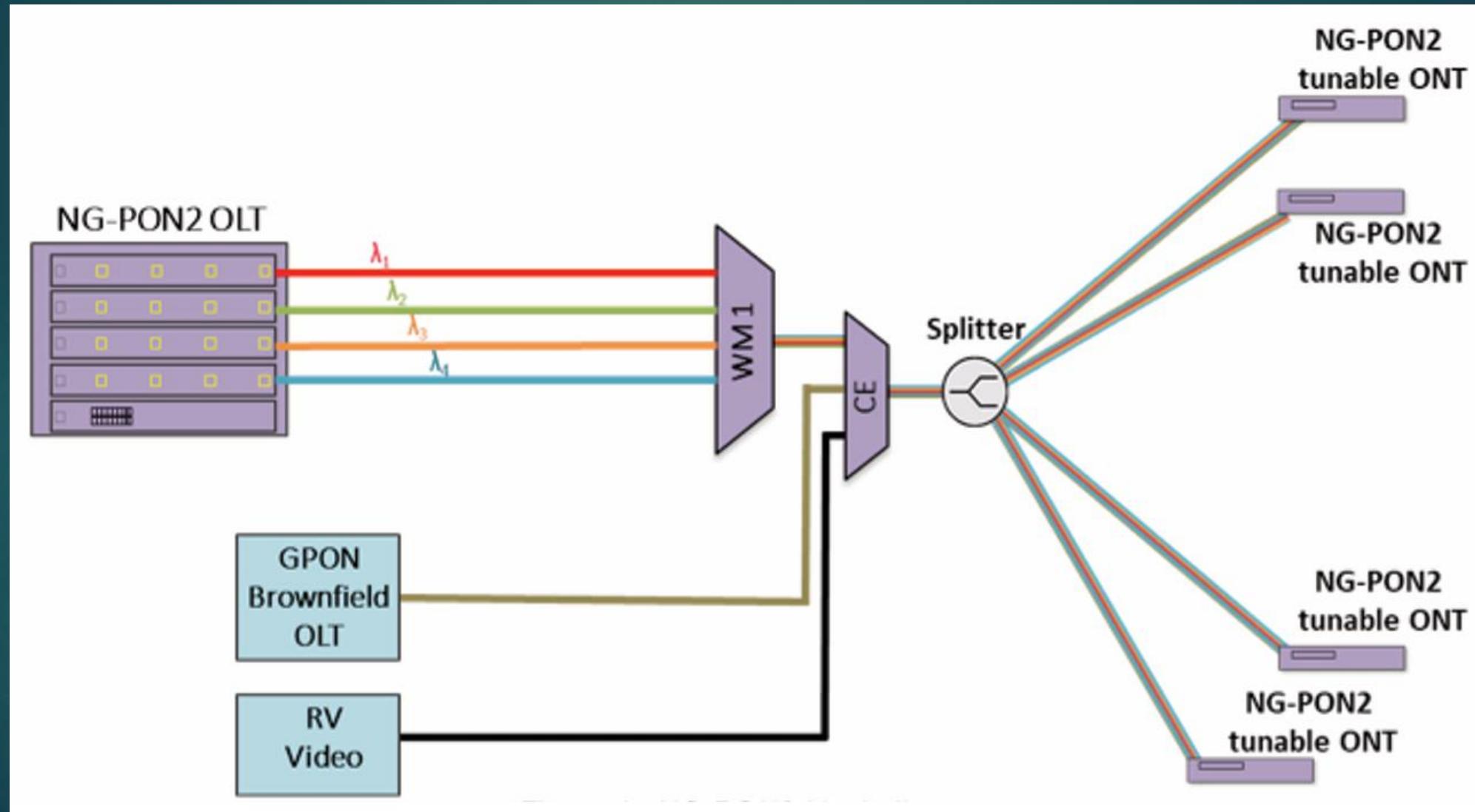
# NG-PON2 (TWDM-PON)



ITU-T G.989

- : DS 4x 10Gbps
- : US 4x 10Gbps

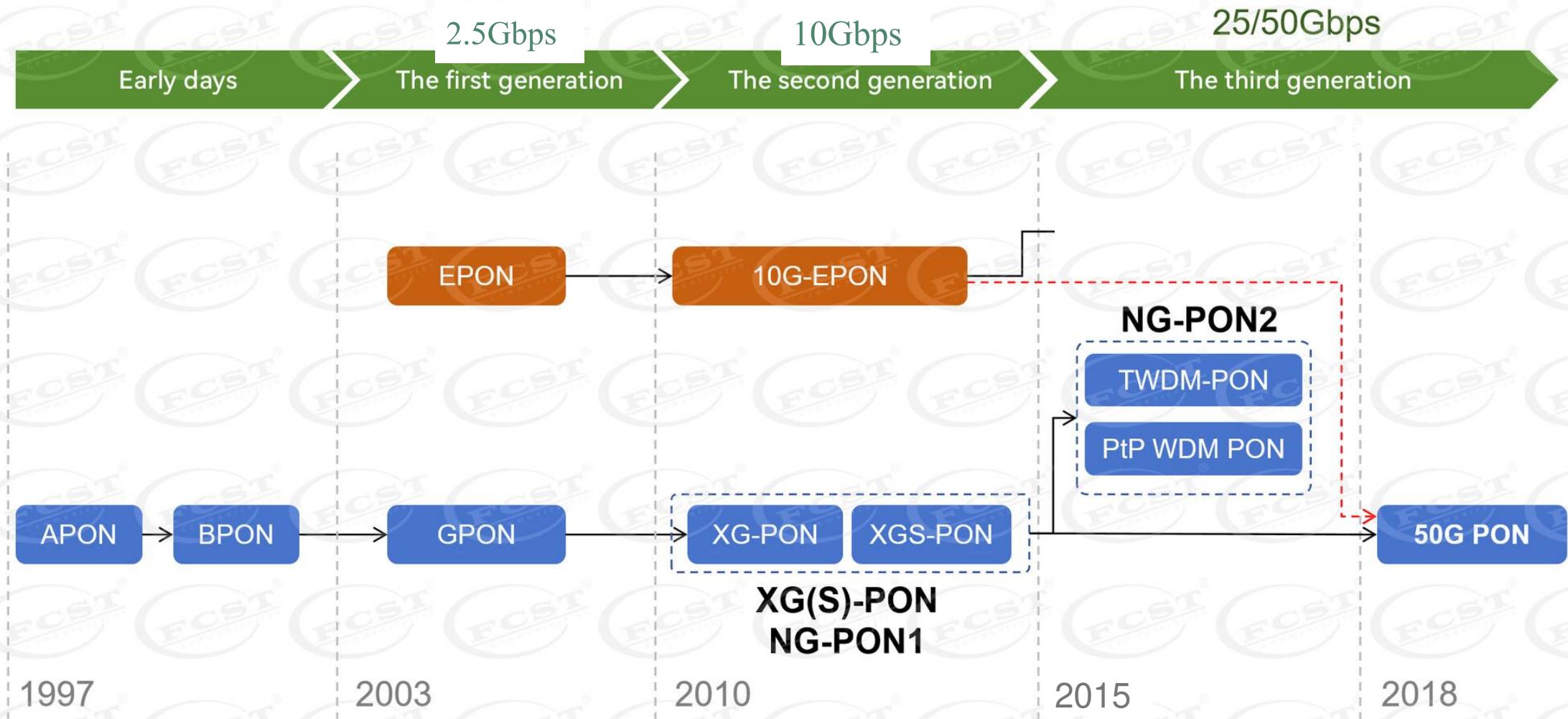
# 40G PON Standards (4 x 10G)



# 40G PON Wavelengths



# 50G PON Standards



# 50G PON Standards

<b>Standard</b>	<b>Common name</b>	<b>Bandwidth downstream</b>	<b>Bandwidth upstream</b>
IEEE 802.3ca-2020	50G-EPON	2x25G	2x10G, 2x25G
ITU-T G.9804	50G-GPON	50G	10/25/50G



Higher Speed PON

# 25GS-PON

## MSA GROUP

bdc

The 25GS-PON MSA Group has created a specification for 25GS-PON, available in the Resources section of this website, which includes:

- An optical specification based on the IEEE 802.3ca 25G EPON standard
- A Transmission Convergence (TC) layer that is an extension of XGS-PON

The 25GS-PON MSA Group invites other industry leaders to join the group to advance the technology and market.

65 vendors

**IEECA**  
TECHNOLOGIES  
Leeeca Technologies

**MACOM**  
MACOM Technology Solutions Inc.

**MAXLINEAR**  
Maxlinear, Inc.

**minisilicon**  
minisilicon

**MitraStar**  
MitraStar Technology Corp

 MT2

 nbn<sup>®</sup>  
NBN Co Limited

 NOKIA  
Nokia

 NTT  
Innovative Devices

 openreach  
Openreach

 OptiComm  
National Broadband Fibre

 PEGATRON  
和碩聯合科技  
PEGA

 PhoVel  
[www.phovel.com](http://www.phovel.com)

 PLANET  
NETWORKS  
Planet Networks

 proximus  
The Proximus Group

 Sagemcom  
Sagemcom Broadband SAS

 SEMTECH  
Semtech Corporation

 SiFotonics  
SiFotonics Technologies

 SP SOURCE  
PHOTONICS  
Source Photonics

 SUMITOMO  
ELECTRIC  
Sumitomo Electric Industries, Ltd

 Taclink

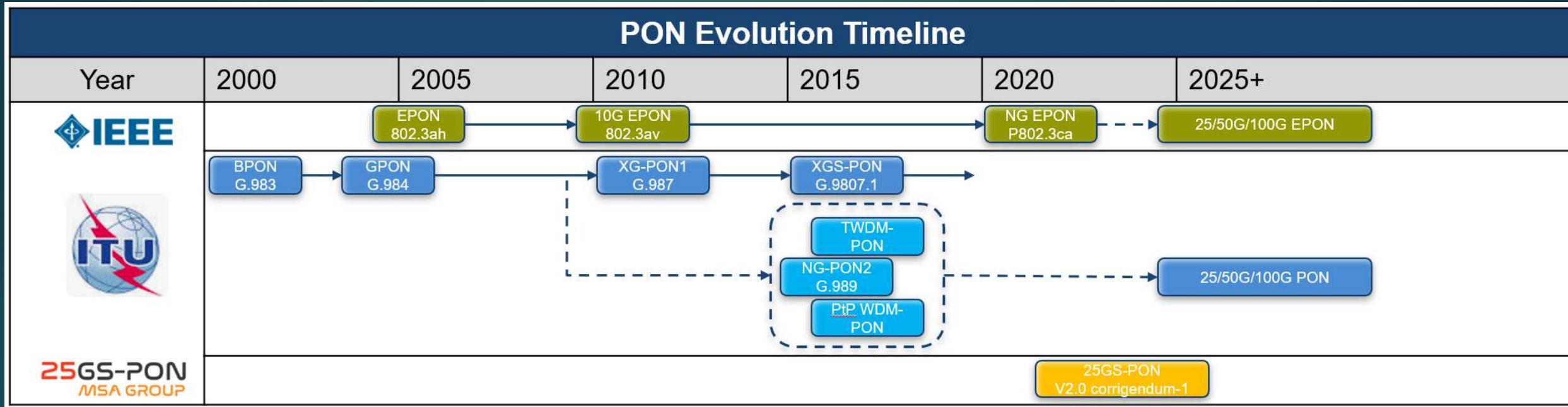
 TELUS<sup>®</sup>  
Telus

 TraceSpan  
communications

 uSenlight  
uSenlight Corporation

 VeEX  
The Verification Experts  
VeEX Inc

# PON Standards



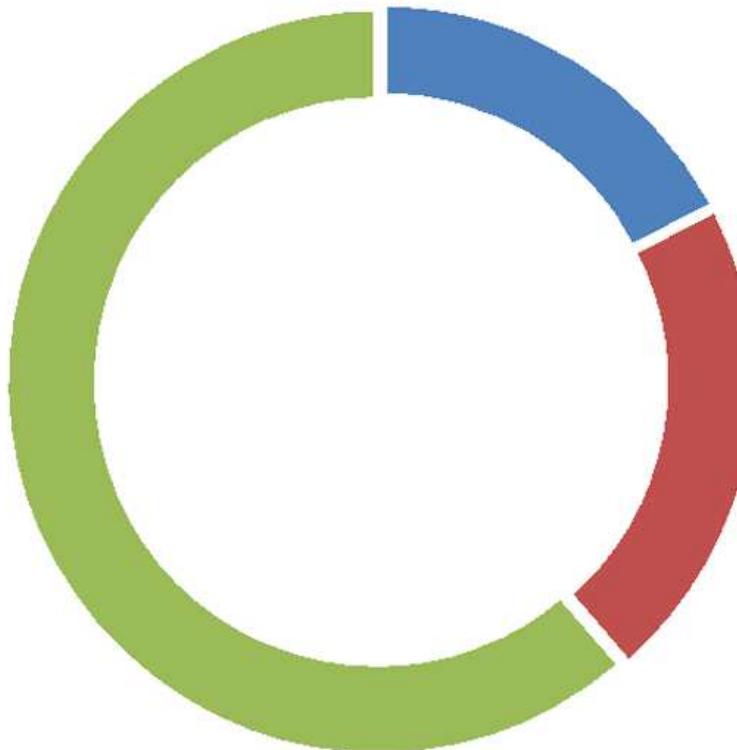
IEEE 802.3ca 50G-EPON  
 ITU-G.9804 50G-PON  
 MSA Group 25GS-PON

: DS 25/50 Gbps, US 25/50 Gbps  
 : DS 50 Gbps , US 50 Gbps  
 : DS 25 Gbps , US 25 Gbps

# Sales forecast

Sales of Next Generation ONUs and OLTs in 2025:  
\$260 million

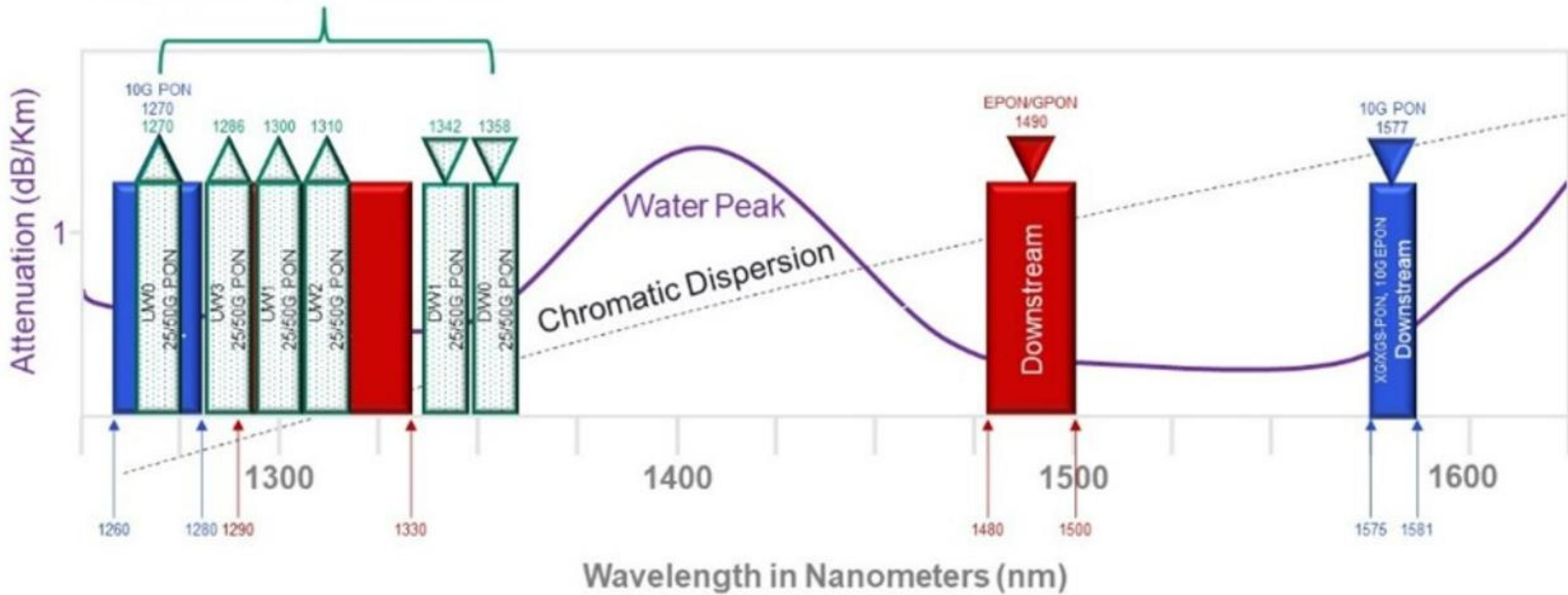
- NG PON2
- 25G PON
- 50G PON



*Source: LightCounting*

# Wavelength plan

IEEE 25G & 25GS-PON



# 25GS-PON Wavelength plan

The 25G-PON standard specifies 1358 nm wavelength in downstream and three options for upstream:

- Option 1: 1300 nm (subset of GPON) for co-existence with XGS-PON.
- Option 2: 1270 nm (same as XGS-PON) for co-existence with GPON.
- Option 3: 1286 nm to support triple co-existence of 25G PON, XGS-PON and GPON.

# 50G-PON Wavelength plan

**Table 9-5 – Optical interface parameters of 49.7664 Gbit/s downstream direction**

Item	Unit	Value
<b>OLT transmitter (optical interface S/Rm)</b>		
Nominal line rate	Gbit/s	49.7664
Operating wavelength	nm	1340–1344
Line code	—	NRZ

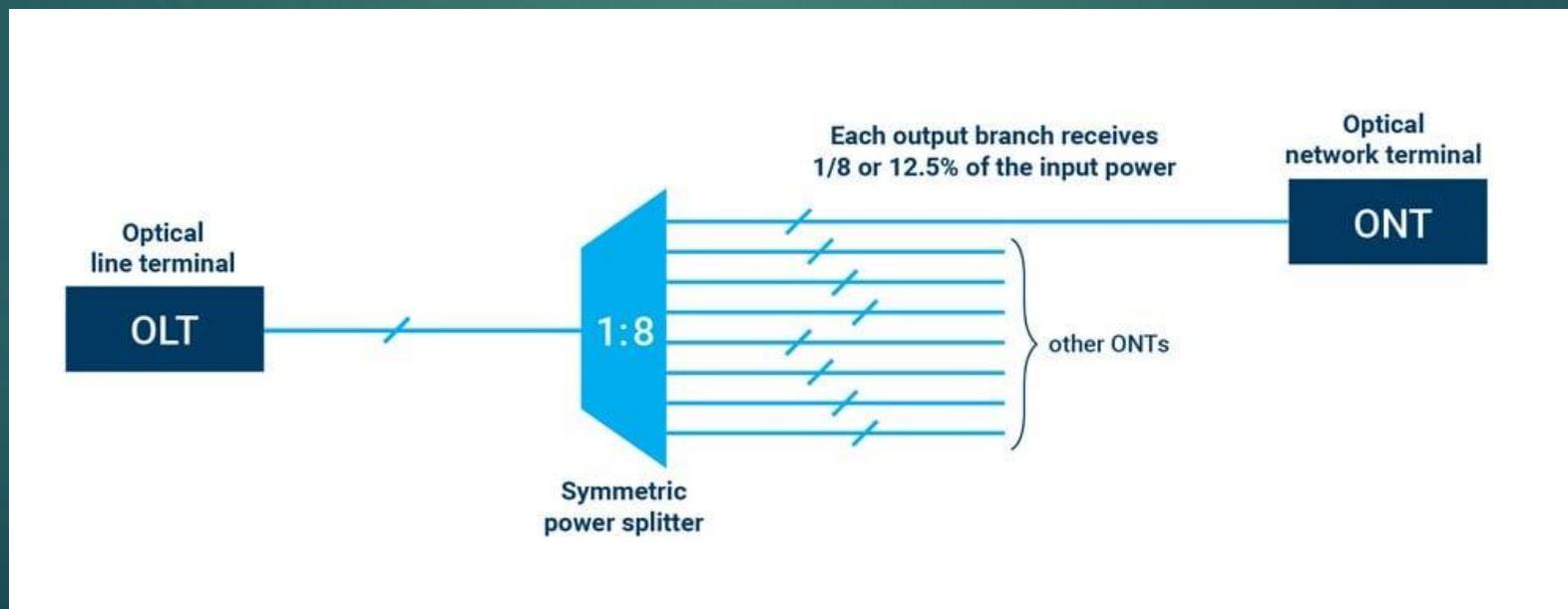
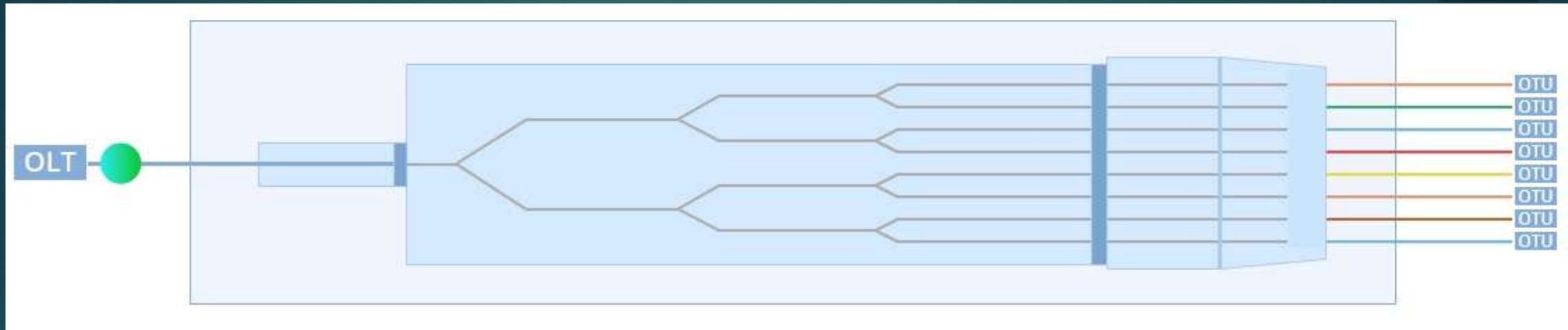
**Table 9-8 – Optical interface parameters of 49.7664 Gbit/s upstream direction**

Item	Unit	Value
<b>ONU transmitter (optical interface R/S)</b>		
Nominal line rate	Gbit/s	49.7664
Operating wavelength	nm	Option 1 1260~1280 Option 2 1290~1310 Option 3 1284~1288
Line code	—	NRZ

# Topic

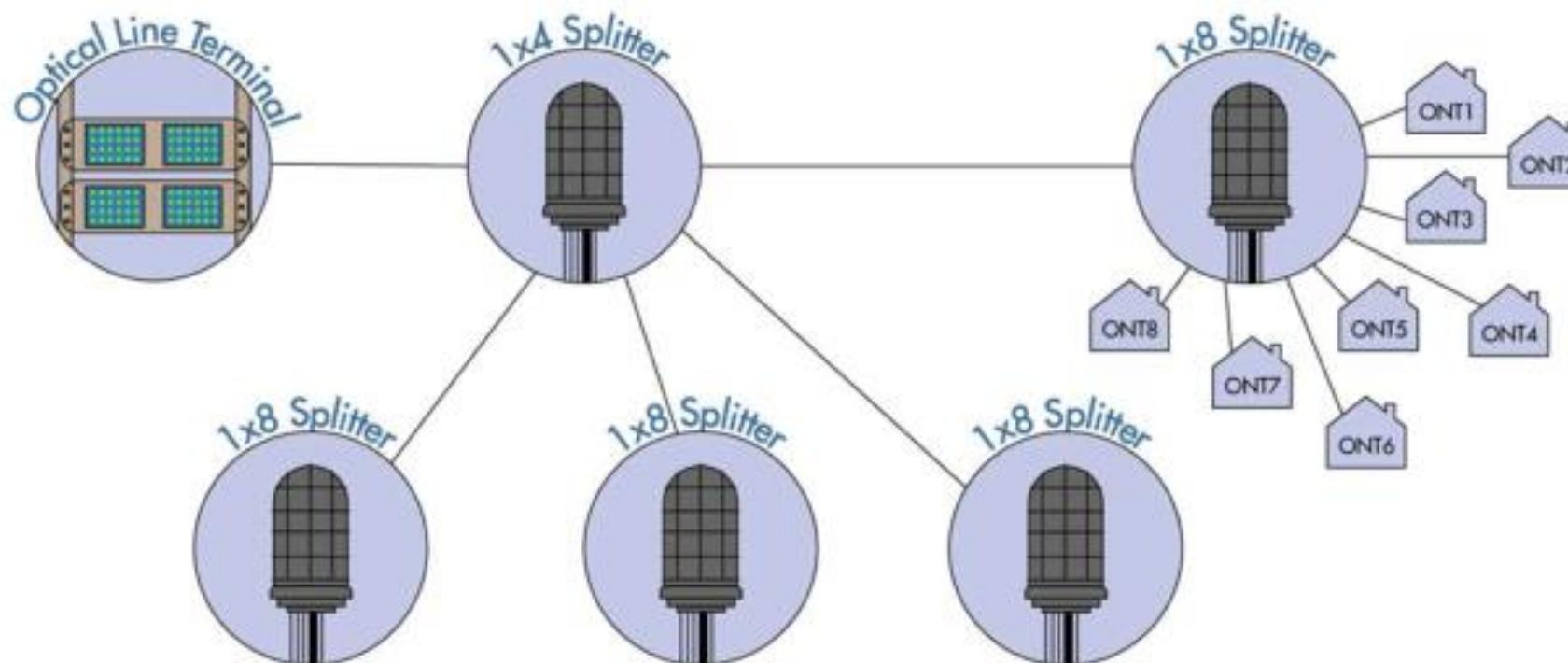
- PON standards
- **Asymmetric Splitter**
- FTTR

# Symmetric Splitter

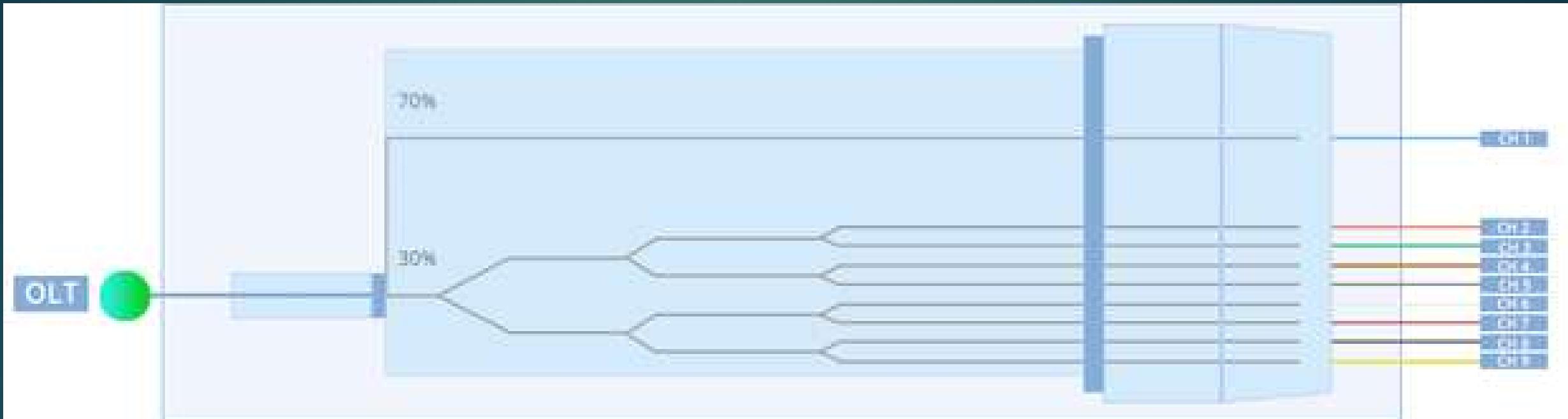


# Symmetric Splitter

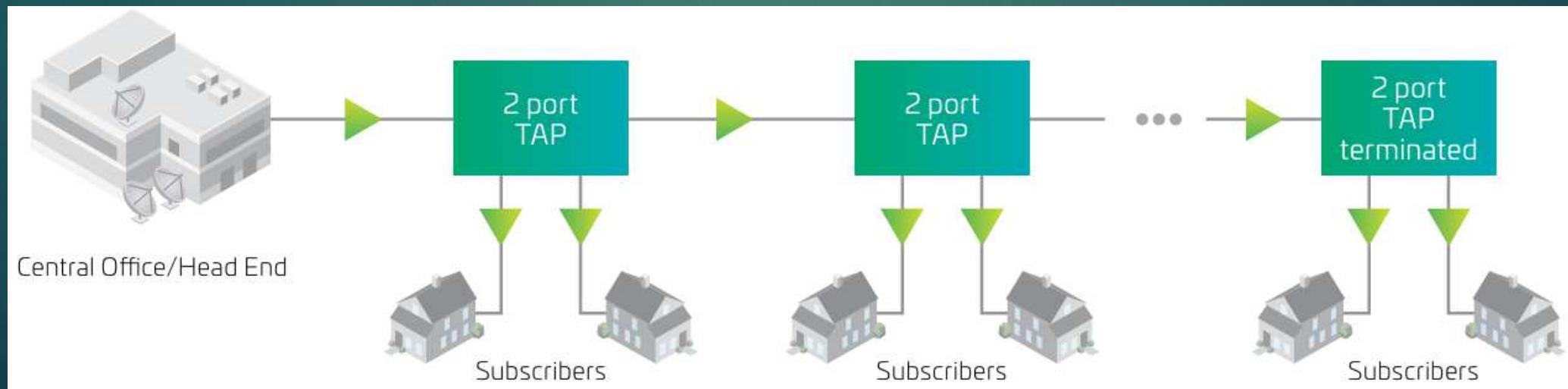
Distributed Split



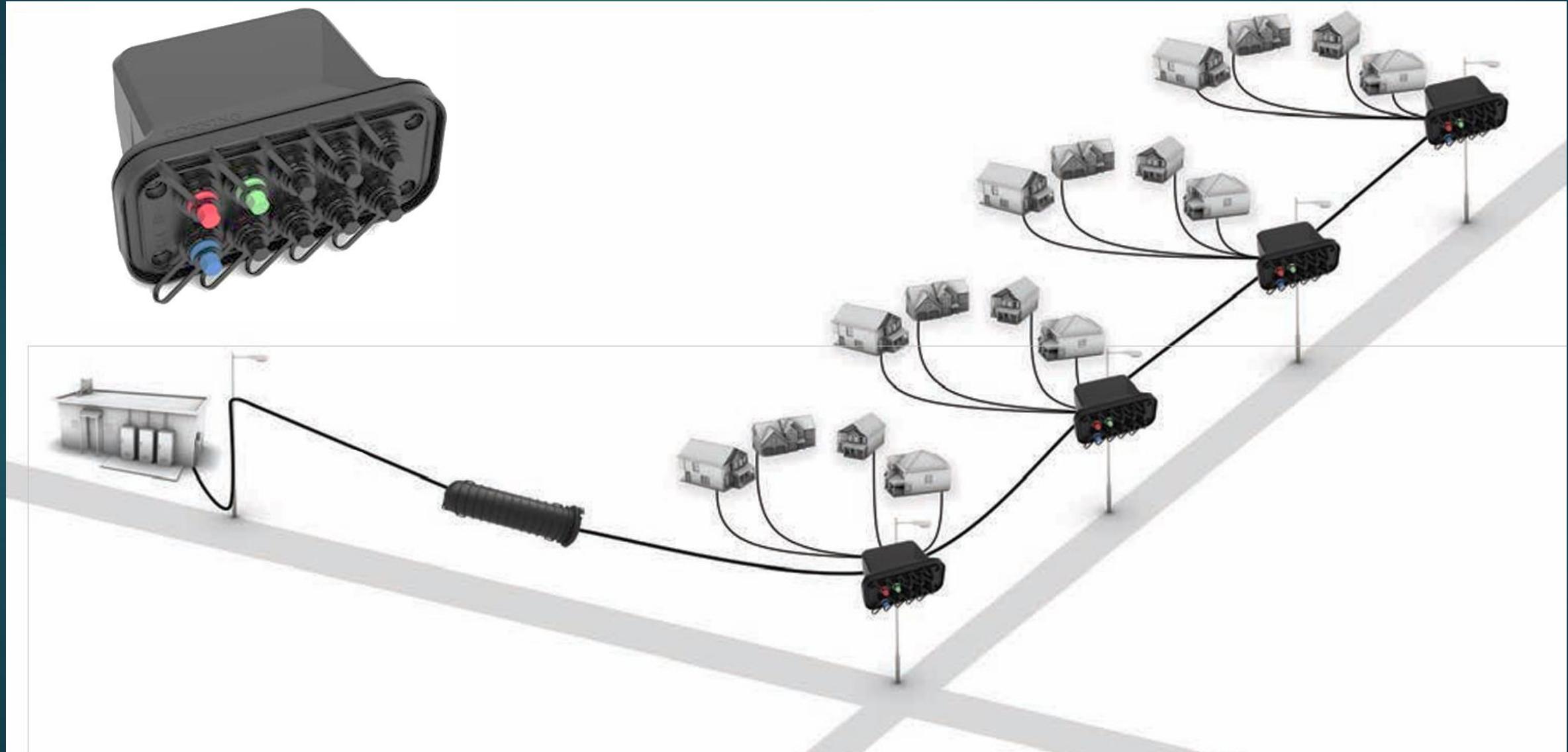
# Asymmetric / Unbalance Splitter



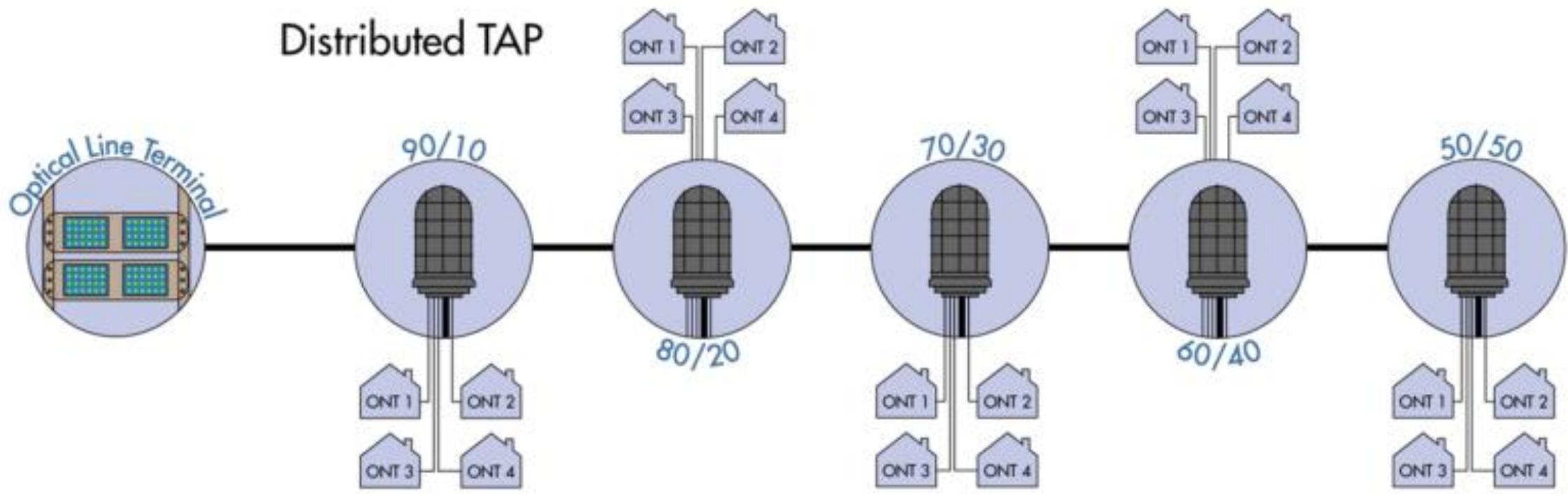
# Rural Area



# Distributed Tap Architecture (DTA)

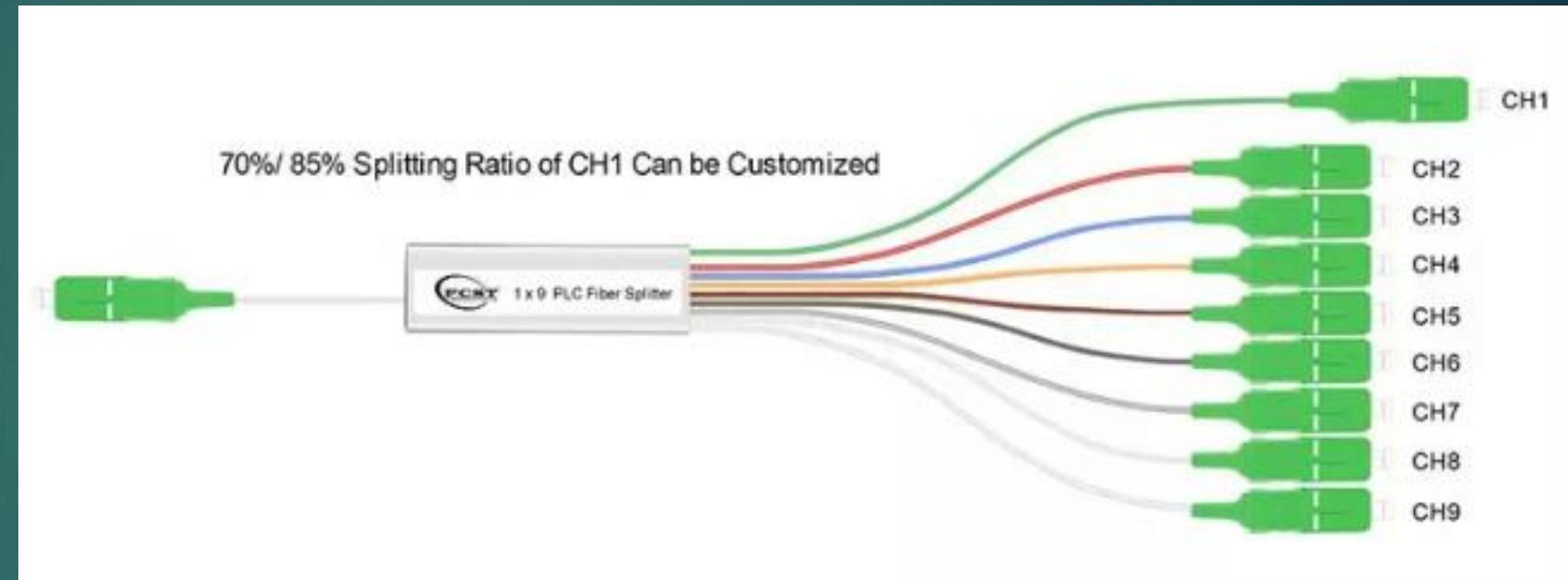


# Distributed Tap Architecture (DTA)

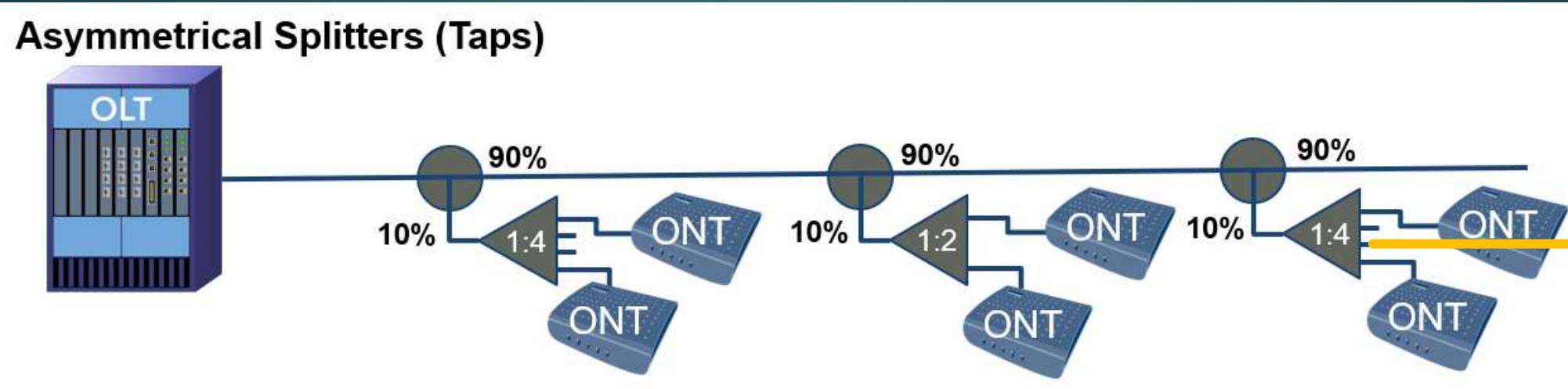


# Unbalance Splitter

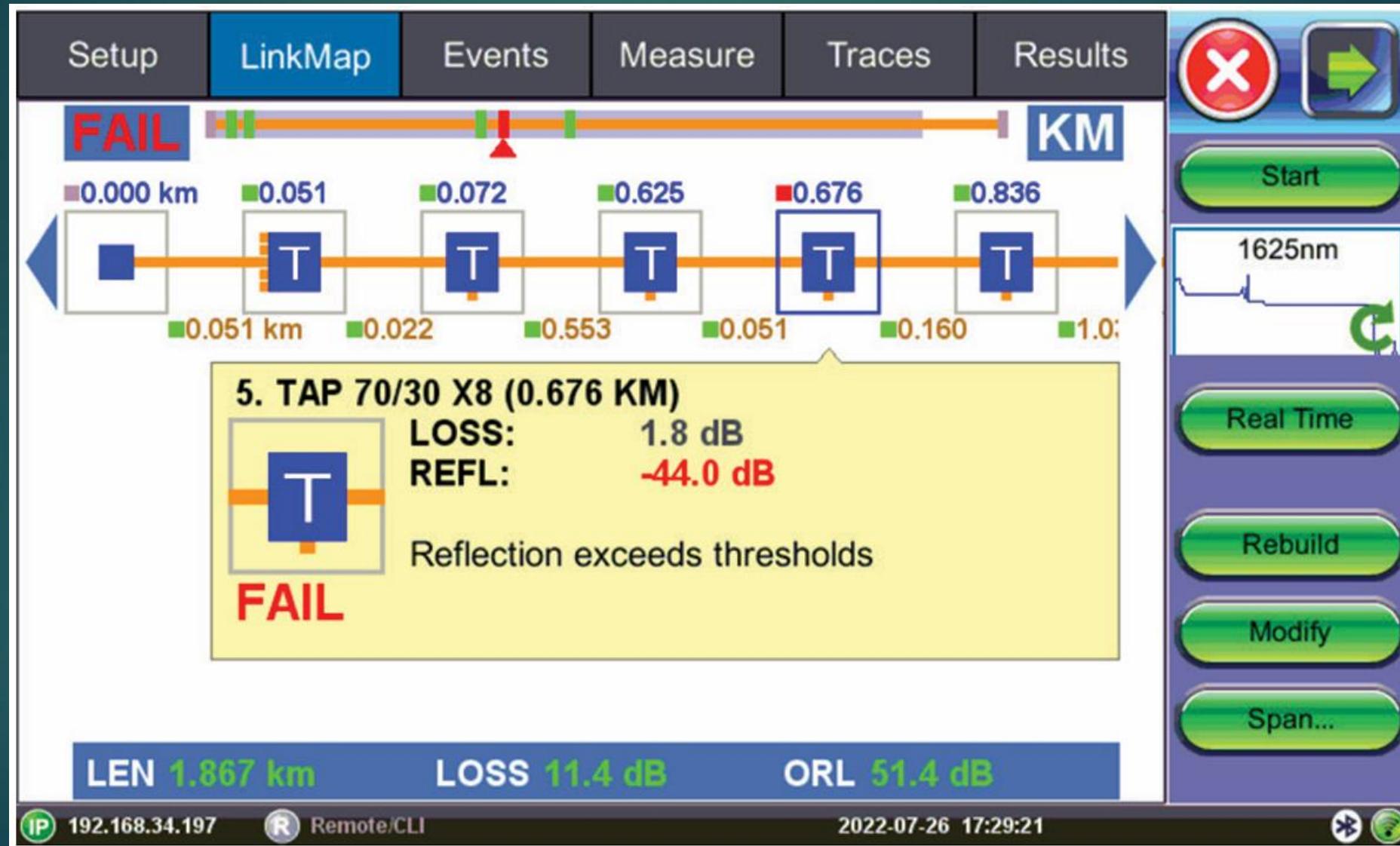
Splitter : 1x5  
1x9  
1x17



# OTDR need to support Unbalance Splitter



# OTDR need to support Unbalance Splitter

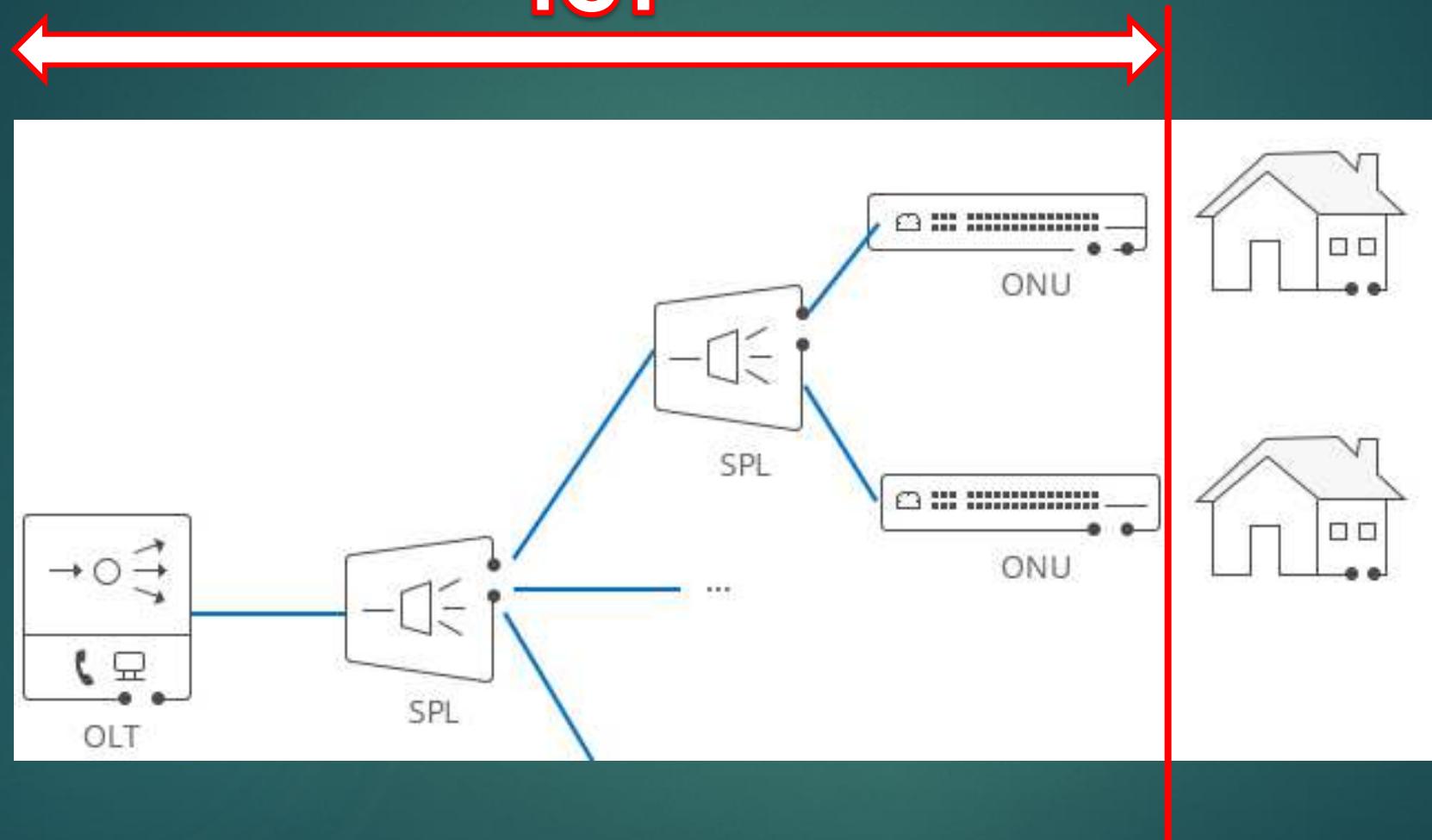


# Topic

- PON standards
- Asymmetric Splitter
- **FTTR**

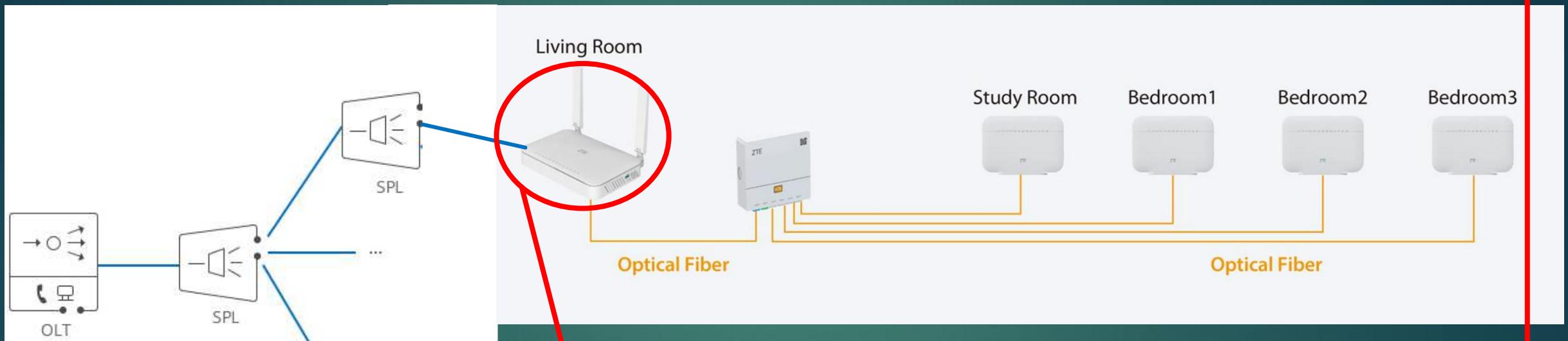
FTTH

ISP



# FTTR-H

# ISP



WAN : ONT  
LAN : OLT

# FTTR-H (Main)



## FTTR GPON Main ONT – ZXHN G6605

The ZXHN G6605 is an AX3000 dual-band GPON gateway, supporting 160MHz @5GHz. It is well suited to Fiber To The Room(FTTR) scenario. It has one 2.5 GE port, three GE LAN ports, one phone port, one USB ports and one RoomPON port. It can form a mesh network with a maximum of 32 FTTR APs to realize whole-home gigabit+ Wi-Fi coverage.

WAN

GPON

LAN

GPON

1 x 2.5GE RJ-45 port (LAN/WAN)

3 x GE RJ-45 ports

1 x FXS RJ-11 port

1 x USB 2.0 + 1 x USB 3.0

2 x 2 802.11b/g/n/ax @2.4GHz

2 x 2 802.11a/n/ac/ax 160MHz @5GHz

# FTTR-H (Main)



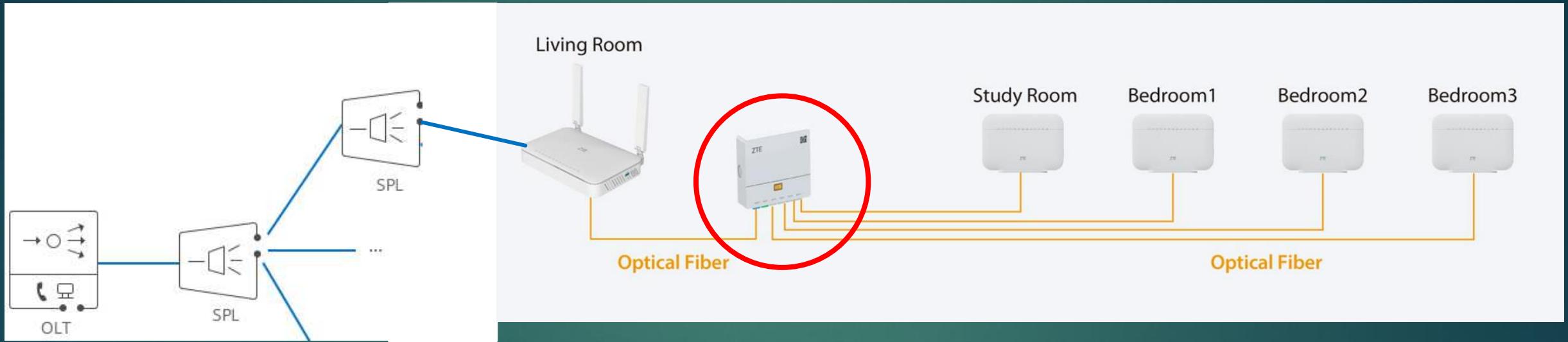
## FTTR XGS-PON Main ONT – ZXHN G8605

The ZXHN G8605 is an AX3000 dual-band XGS-PON gateway, supporting 160MHz @5GHz. It is well suited to Fiber To The Room(FTTR) scenario. It has one 2.5 GE port, three GE LAN ports, one phone port, one USB ports and one RoomPON port. It can form a mesh network with a maximum of 32 FTTR APs to realize whole-home gigabit+ Wi-Fi coverage.

WAN  
XGS-PON

LAN  
GPON  
1 x 2.5GE RJ-45 port (LAN/WAN)  
3 x GE RJ-45 ports  
1 x FXS RJ-11 port  
1 x USB 2.0 + 1 x USB 3.0  
2 x 2.802.11b/g/n/ax @2.4GHz  
2 x 2.802.11a/n/ac/ax 160MHz @5GHz

# FTTR-H (splitter)



# FTTR-H (splitter)



## 1:5 Splitter Terminal Box - GF378-OP-WASCU-6A6

The ZTE GF378-OP-WASCU-6A6 Indoor Terminal Box (TB) is designed for fiber to the room (FTTR) applications. The terminal box has an in-built 1:5 splitter and six adapters for uplinking, cascading and user connection.

**Material**

ABS

**Dimensions**

86 x 86 x 23 mm

**Capacity**

6 cores

**Splitters**

1:5 PLC splitter

**Port insert loss**

NEXT  $\leq$  2.2 dB

USER1-USER4  $\leq$  16.3 dB

**RoHS**

Compliant

# FTTR-H (splitter)



## 1:4 Splitter Terminal Box – GF378-OP-WASCU-5A5

The ZTE GF378-OP-WASCU-5A5 indoor Terminal Box (TB) is designed for Fiber To The Room (FTTR) applications. It has an in-built 1:4 splitter and five adapters for uplinking and user connection.

Material

ABS

Dimensions

86 x 86 x 23 mm

Capacity

5 cores

Splitters

1:4 PLC splitter

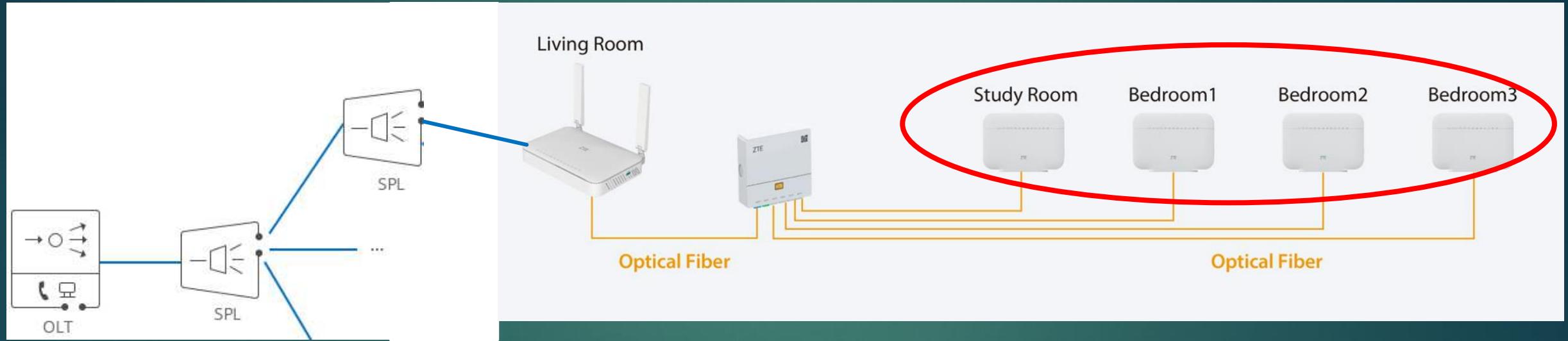
Port insert loss

≤ 7.4 dB

RoHS

Compliant

# FTTR-H (ONU work with main)



# FTTR-H (ONU work with main)

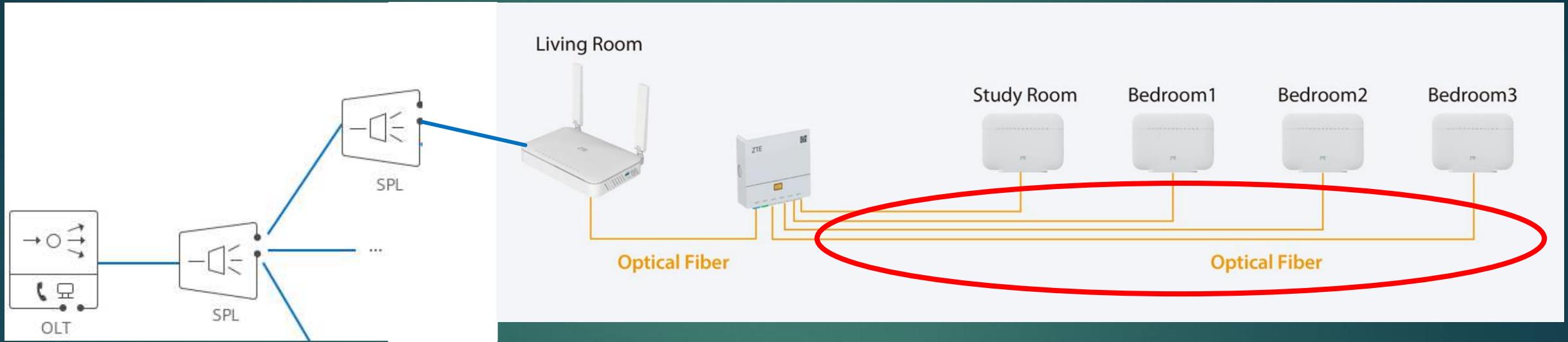


## FTTR Voice Room ONT – ZXHN G1611

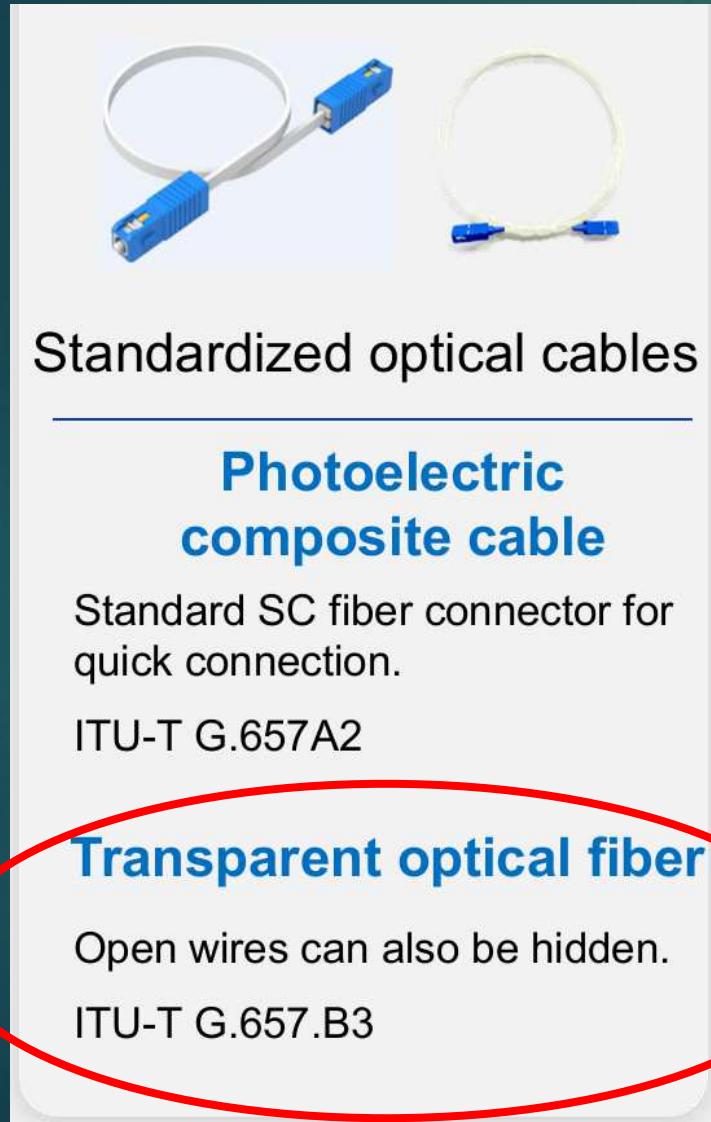
The ZXHN G1611 is an AX3000 dual-band GPON FTTR AP supporting 160MHz @5GHz. It is well suited to the Fiber To The Room (FTTR) scenario. It has four GE LAN ports, one phone port and one USB port. It complies with EasyMesh, making it suited for mesh networking.



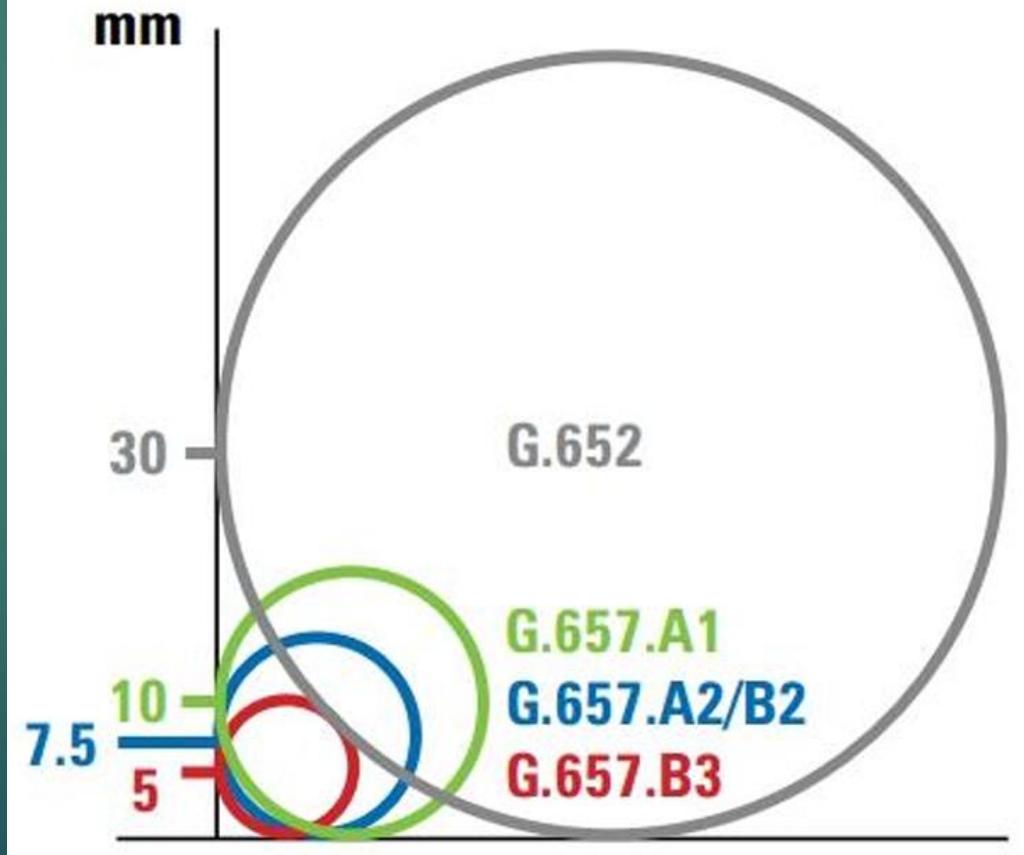
# FTTR-H (Transparent cable)



# FTTR-H (Transparent cable)

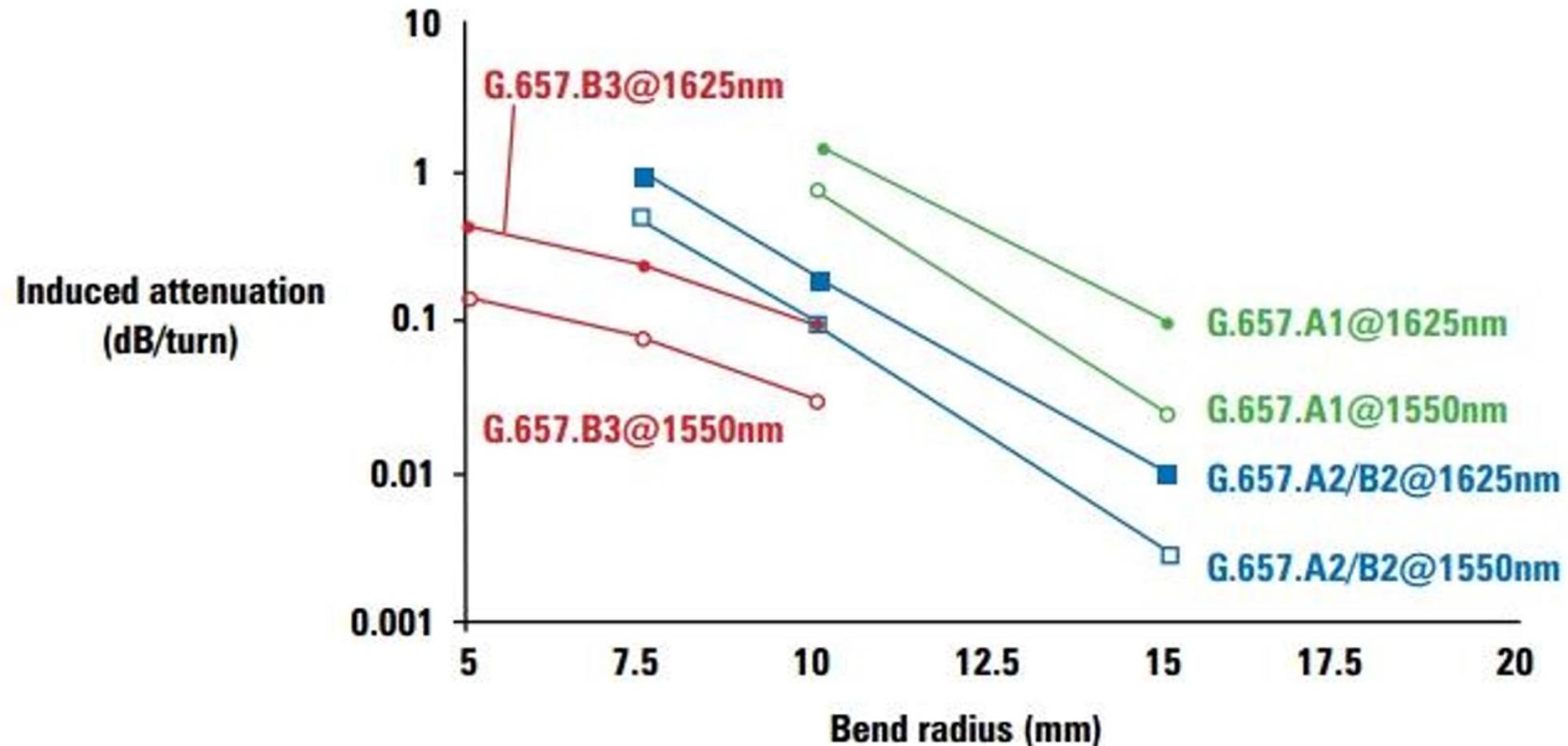


**Figure 2 – Relevant specified bending radii for ITU-T G.652 and ITU-T G.657**



# FTTR-H (Transparent cable)

Figure 3 – Macrobending loss limits for  
ITU-T G.657 fibres



# FTTR-H (Transparent cable)

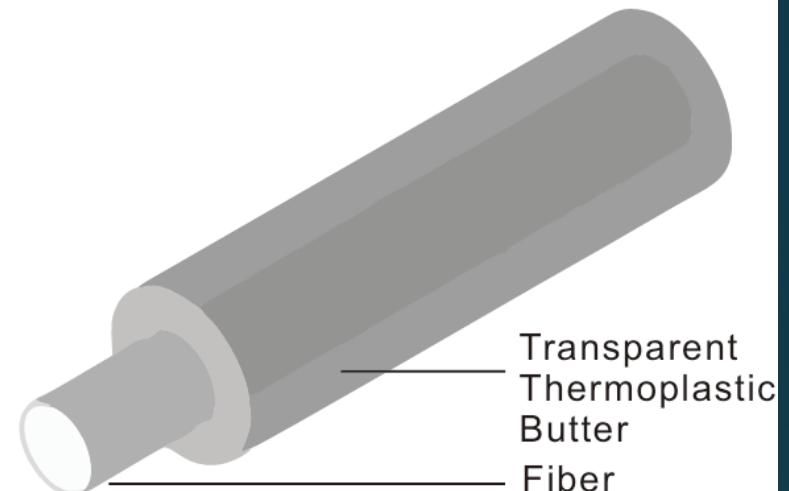
G.657.B3

## 0.9mm Transparent Invisible Cable

The 0.9mm diameter Transparent Invisible optical cables for vertical wiring in buildings, which is a major component of the drop segment in FTTx networks, refer to the drop cables going from ducts in buildings into rooms. Using light and portable hand-held installation tools, installers can quickly and easily install invisible cable on wall skirting, doors and windows.

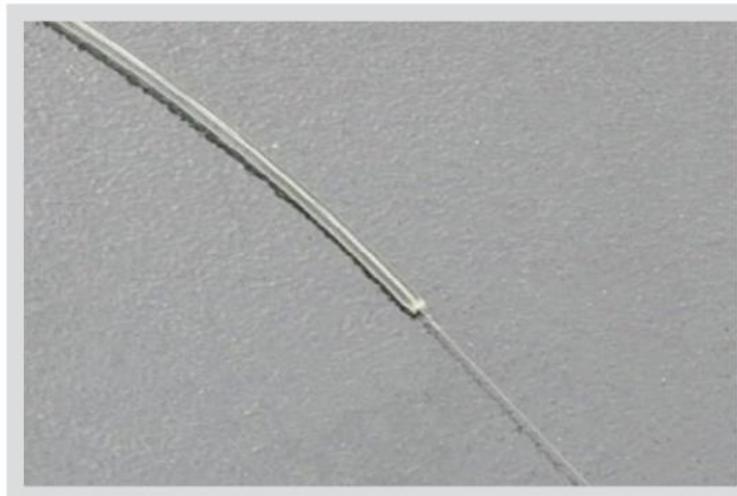
### Features

- Using G657B3 optical fibers, with excellent anti-bending performance
- Small size, precisely controlled route
- Transparent, suitable for indoor application
- Compatible with G.652D and G.657A2 optical fibers



Cable Diameter	Cable Weight	Tensile strength Long/short term	Bending radius Dynamic/static	Crush Long/short term (N/100mm)	Storage temperature
0.9mm	0.7kg/km	3/6N	60/30mm	100/500	-20 to +60 °C

# FTTR-H (Transparent cable)

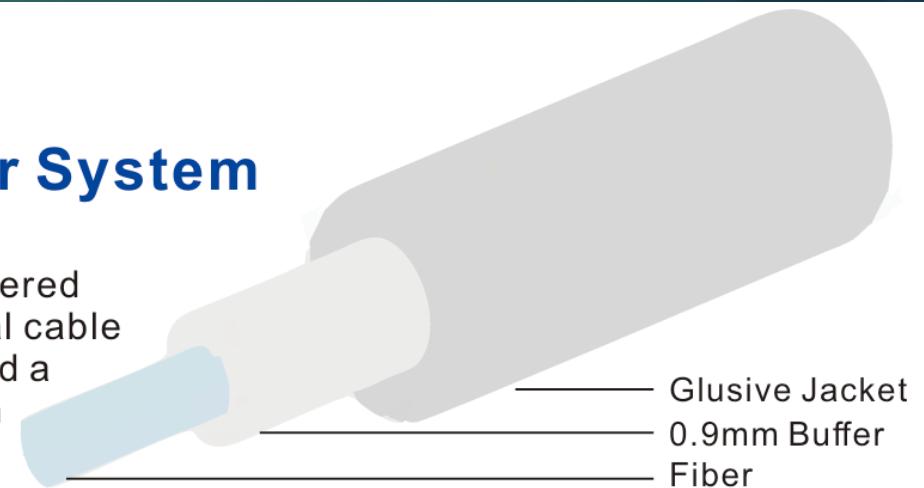


# FTTR-H (Transparent cable)

G.657.B3

## 1.2mm TAC Thermal Adhesive Coated Fiber System

TAC invisible optical cable is the abbreviation for transparent tight-buffered thermal adhesive coated fiber covered with hot melt glue. It is an optical cable composed of G.657.B3 optical fiber, a transparent tight jacket layer, and a layer of hot melt adhesive. Each layer is extruded step by step using an extrusion process, with a nominal outer diameter of 1.2mm.



The application of invisible optical cable is the application where the user does not accept the use of leather fiber optic cable to enter the home or solves the problem of the user's difficulty in entering the home, especially in the old residential area and office. The fiber used is G.657.B3 fiber with a minimum bending radius of 5mm. When laying, there is no need to nail, make brackets, perforate, make pipes, etc., to destroy the original indoor structure, or because of the discontinuity of the laying, the optical cable will sag and fall off and other safety hazards. At the same time, the optical cable is almost transparent so it will not affect the indoor Beautiful, simple construction method, only need hand-held heating installation tools to complete the laying project.

Cable Diameter	Cable Weight	Tensile strength Long/short term	Bending radius Dynamic/static	Crush Long/short term (N/100mm)	Storage temperature
1.2mm	1.0kg/km	40/80N	20/10mm	100/500	-40 to +70 °C

# FTTR-H (Transparent cable)



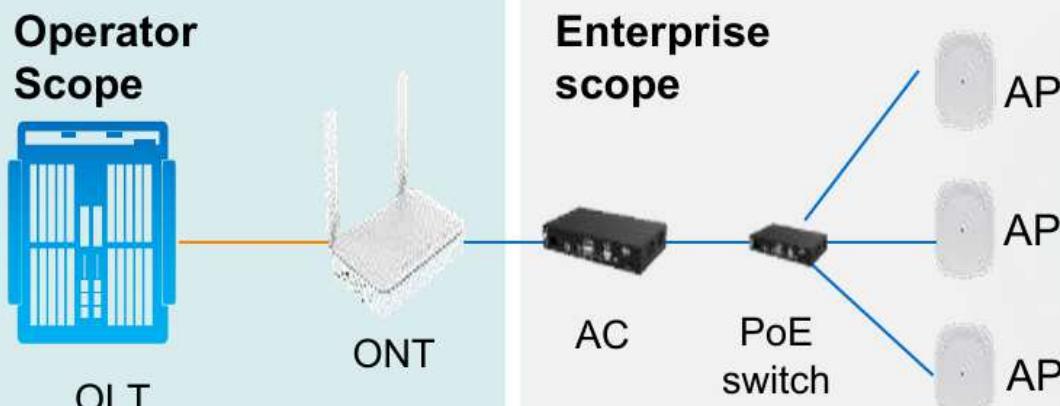
■ **Installation and maintenance upgrade**

Innovative self-adhesive transparent optical cables  
Innovative fiber installation kit

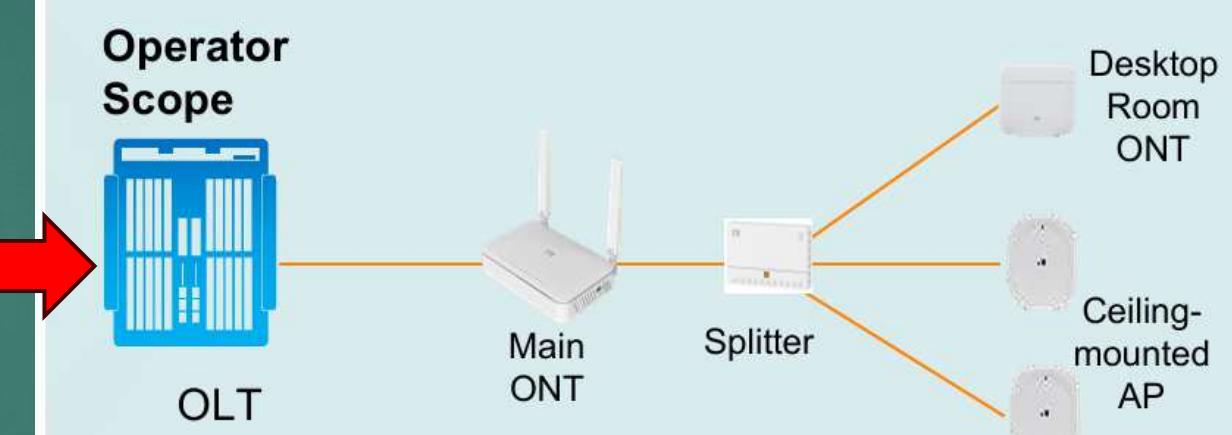
Huawei also provides an innovative fiber installation kit

# FTTR-B (SME Solution)

AC+AP network the operator only provides optical broadband access



FTTR-B SME network operator provide broadband access and SME networking



# Twisted pair limitation

## Twisted pair



- Data signal transmission
- PoE power supply
- Cabling distance: < 100 m

# Optical fiber limitation

## Optical fiber



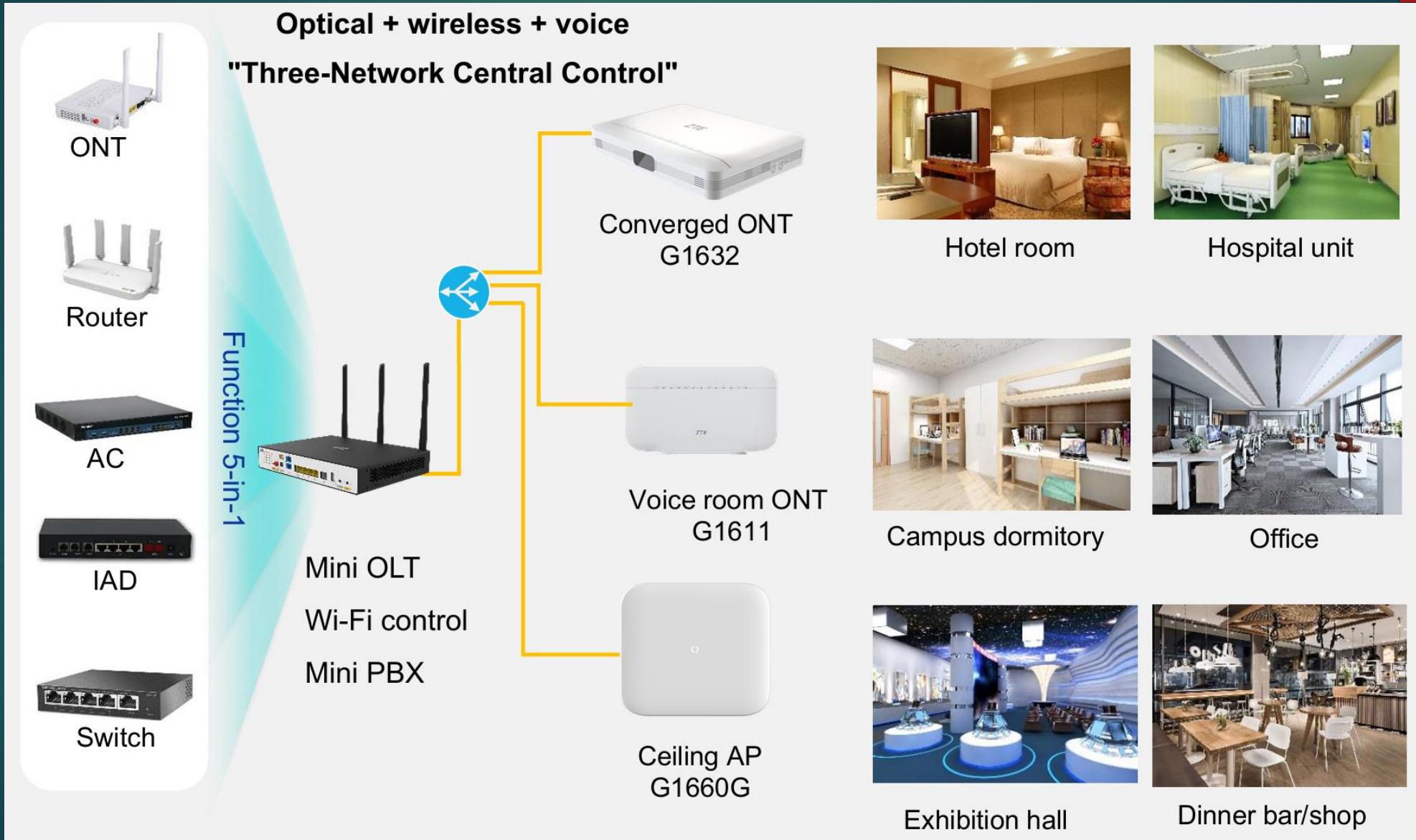
- Faster and farther data signal transmission
- Incapable of conducting electricity

# Hybrid cable



**Hybrid**  
FTTR CABLE

# FTTR-B (SME Solution)



# Q & A