GPON Fundamentals

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References

- ITU-T 984.1
- ITU-T 984.2
- ITU-T 984.3
- ITU-T 984.4

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Objectives

- Upon completion of this course, you will be able to:
  - Describe GPON Network Architecture
  - Outline GPON Basic Concepts
  - Outline GPON Applications

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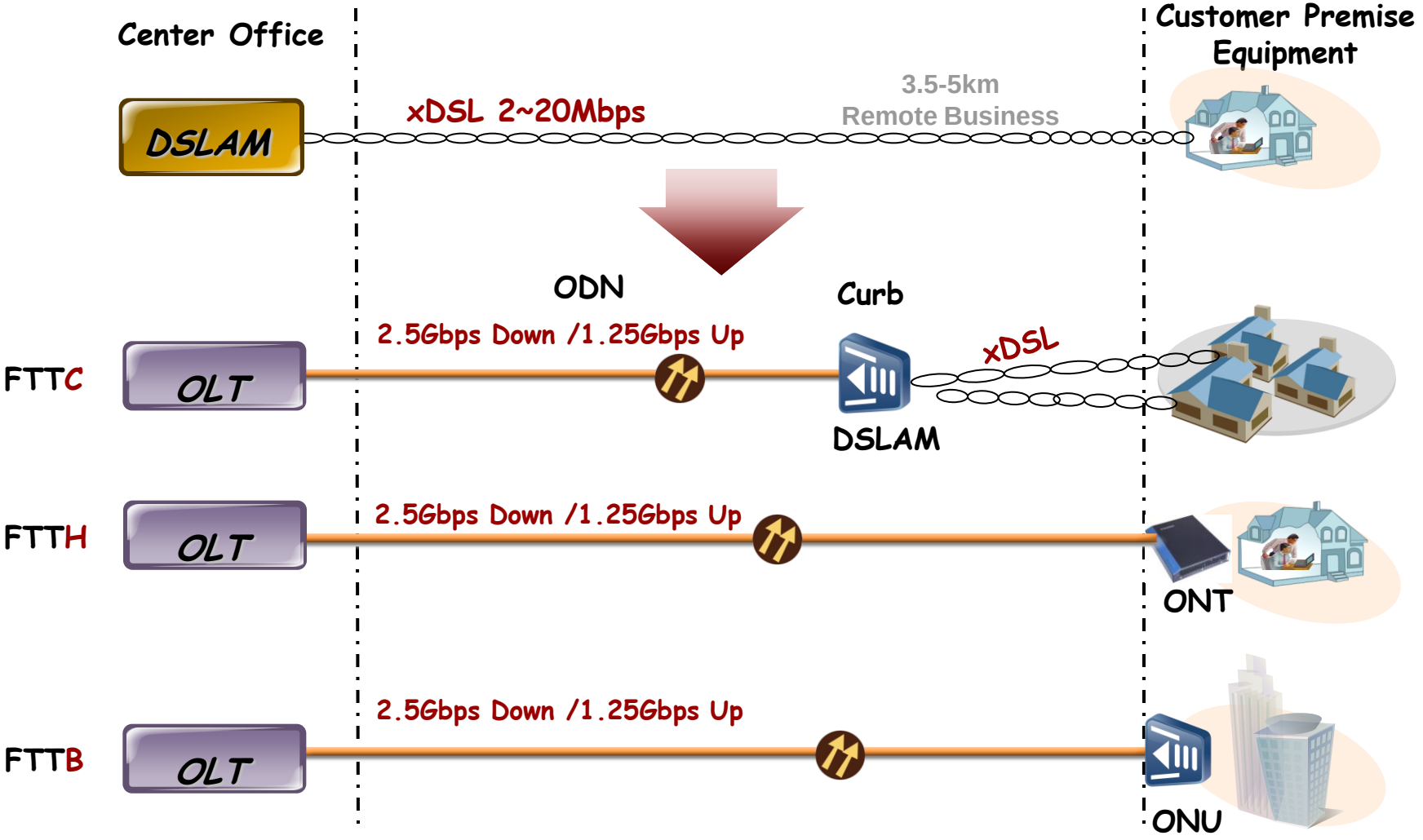
Architecture of Optical Access Network



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What is Optical Access Network?

- From the architecture diagram, the optical access network comprises the following scenarios:
  - **FTTB scenario**
    - SBU : Single business unit ; providing a comparatively small number of ports such as POTS, 10/100/1000BASE-T and DS1/T1/E1 ports
    - MTU :Business Multi-tenant unit ; providing a comparatively larger number of ports, including POTS, 10/100/1000BASE-T and DS1/T1/E1 ports.
  - **FTTC & FTTCab scenario**
    - MDU : Multi-dwelling unit ;providing a comparatively larger number of ports, including 10/100/1000BASE-T, VDSL2, and so on.
  - **FTTH scenario**
    - SFU : Single family unit , providing a comparatively small number of ports, including following types: POTS, 10/100/1000BASE-T, and RF.

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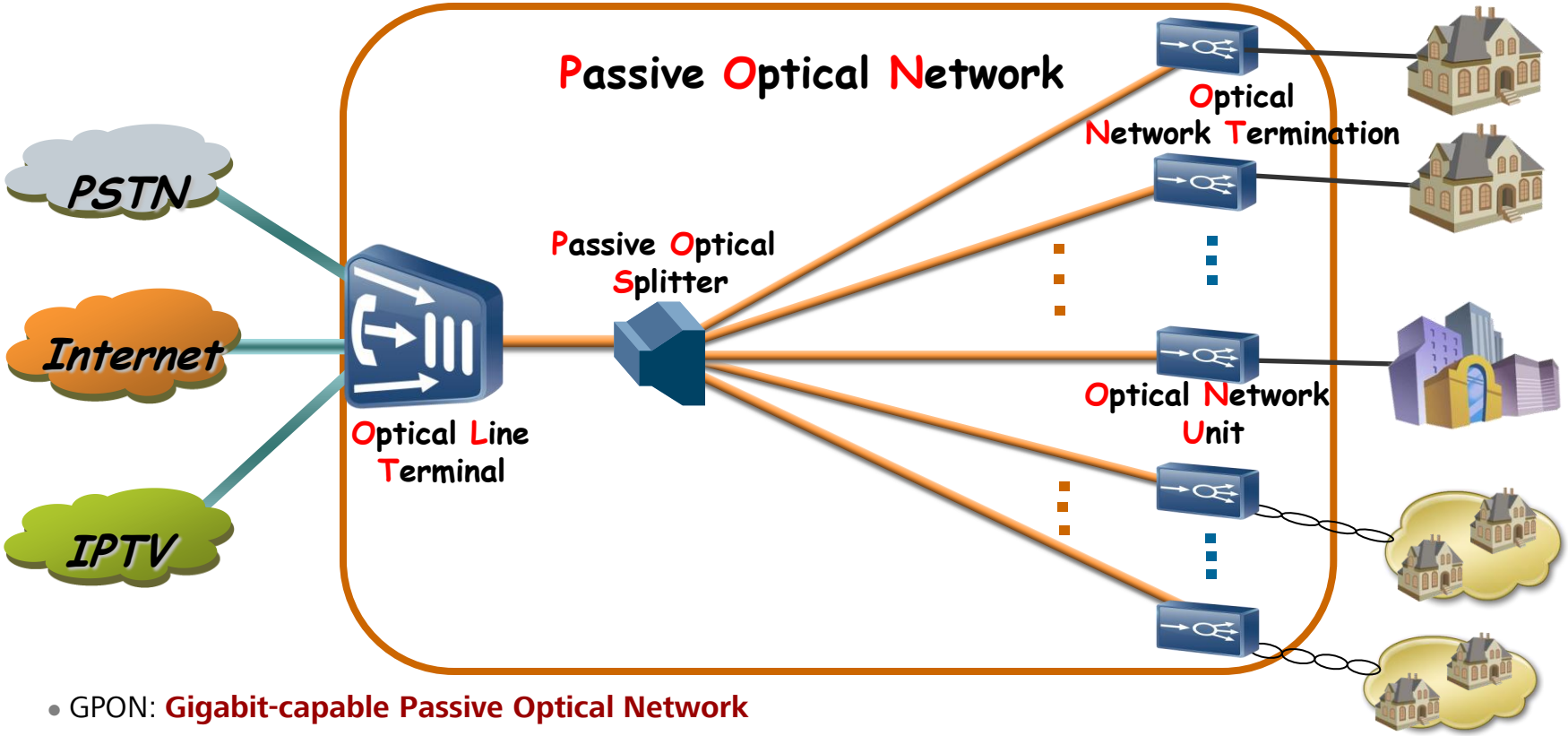
What is GPON?



- GPON: **Gigabit-capable Passive Optical Network**
- PON is short for Passive Optical Network ;
- GPON architecture: Passive optical network featuring one-to-multiple-point;
  - Optical Line Terminal (OLT)
  - Optical Network Unit (ONU)
  - Optical Distribution Network (ODN).

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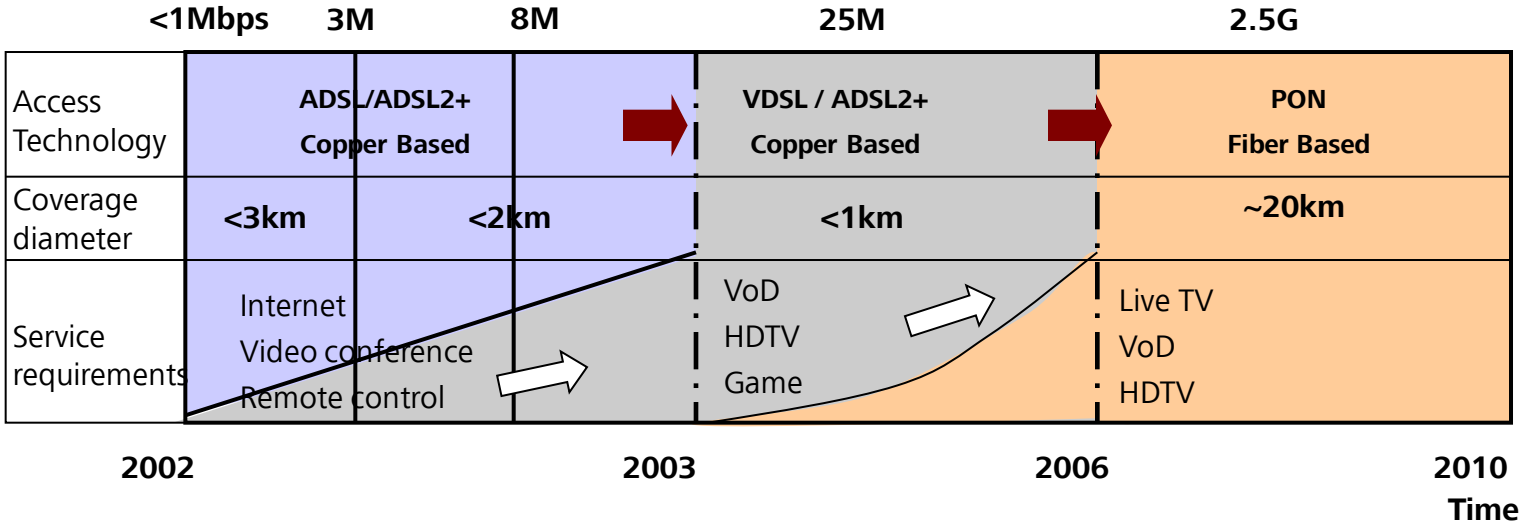
Why GPON?



- GPON supports :
  - Triple-play service
    - HDTV: 16-20M/program;
    - Data: 10M;
    - Video Conference: 4.5M

High-bandwidth up to *1.25Gbps/2.5Gbps*
Long-reach up to 20km

- GPON is the choice of large carriers in the international market.

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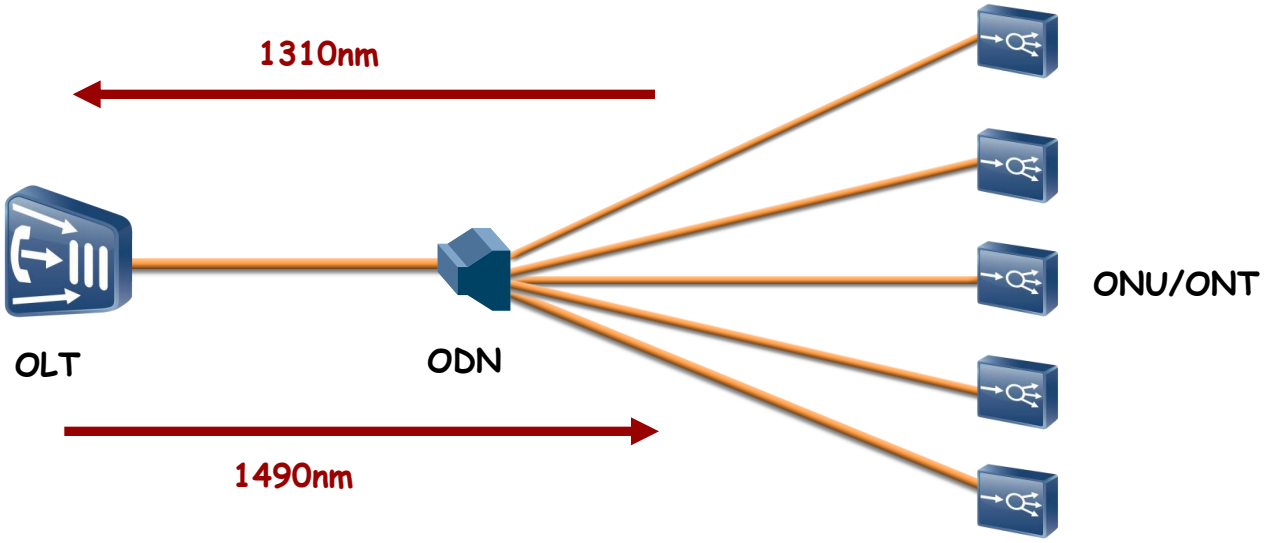
GPON Principle---Data Multiplexing

- GPON adopts Wavelength Division Multiplexing (WDM) technology, facilitating bi-direction communication over a single fiber.



- To separate upstream/downstream signals of multiple users over a single fiber, GPON adopts two multiplexing mechanisms:
  - In downstream direction, data packets are transmitted in a broadcast manner;
  - In upstream direction, data packets are transmitted in a TDMA manner

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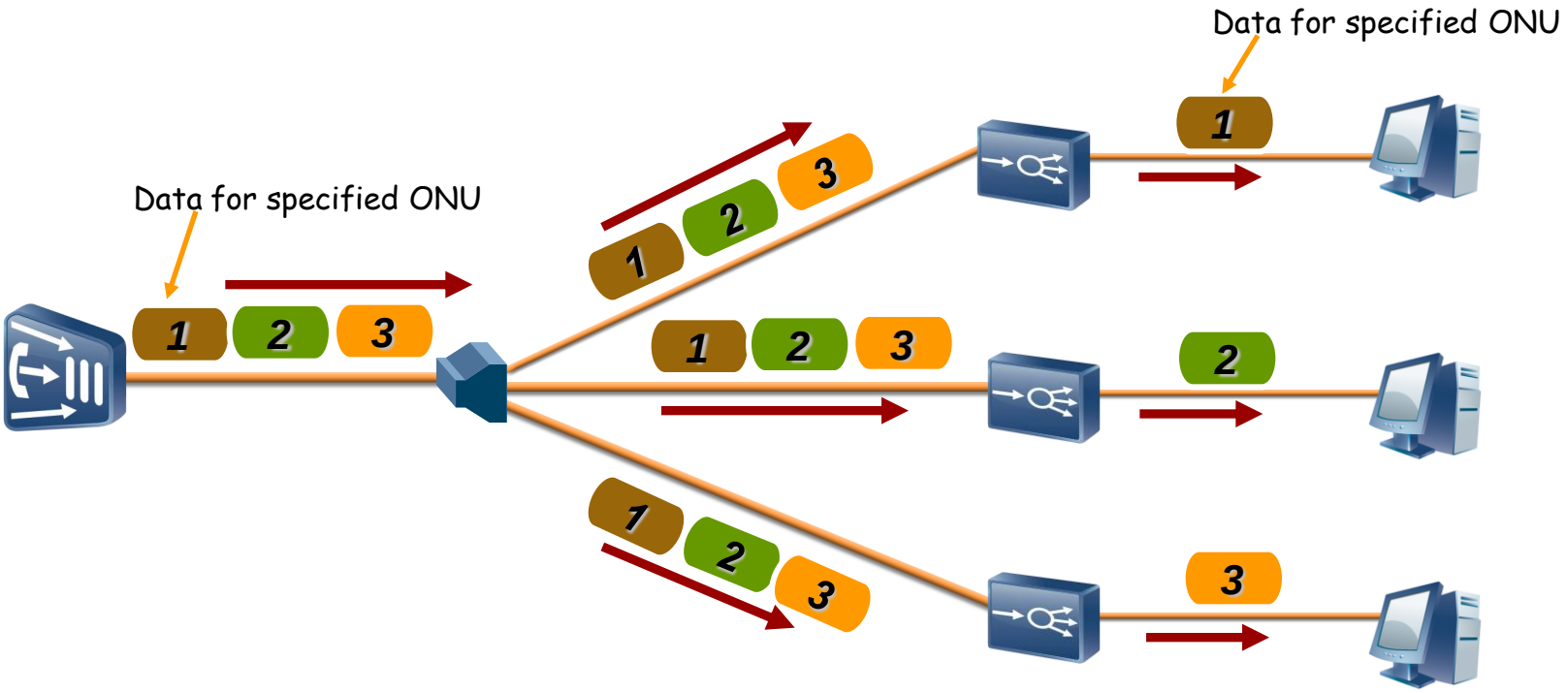
GPON Principle----Downstream



- Broadcast mode

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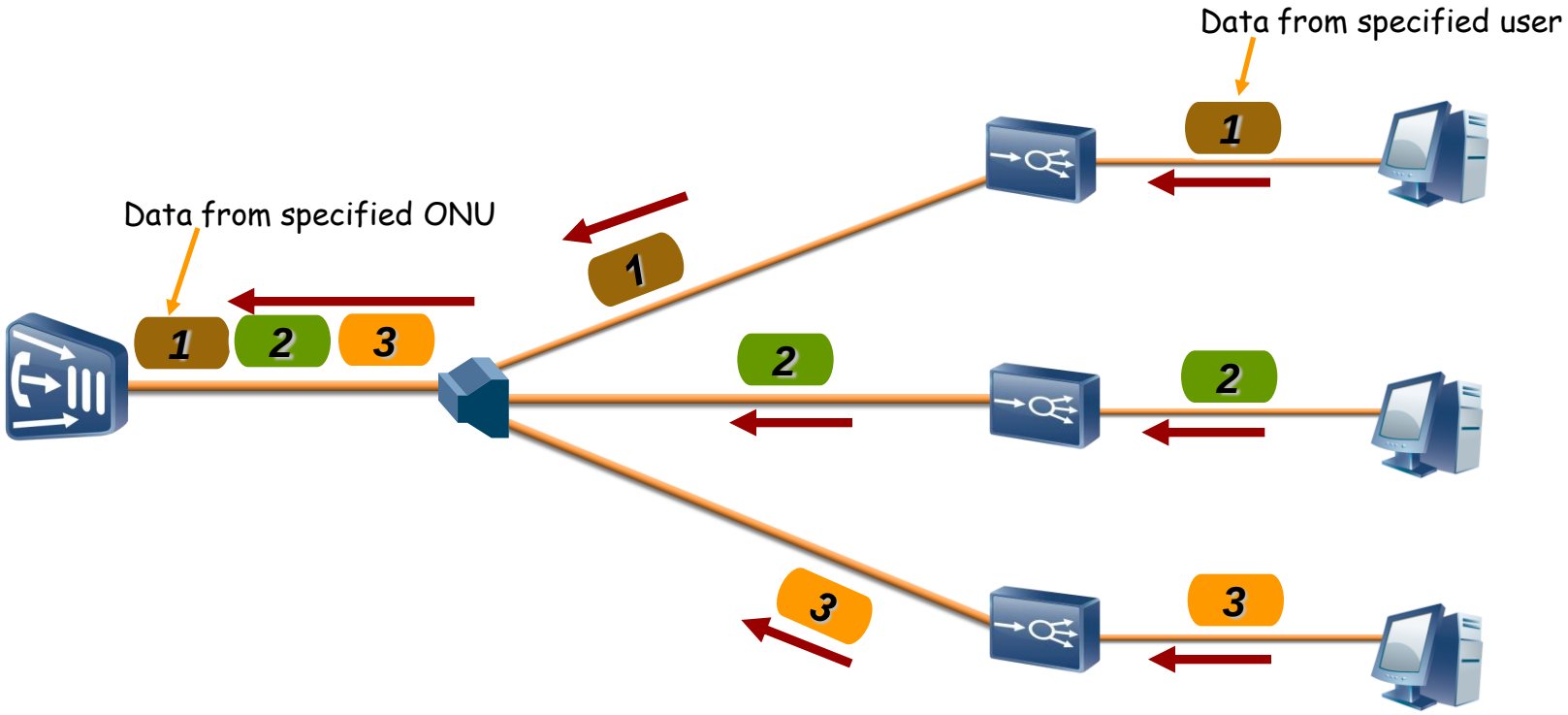
GPON Principle----Upstream



- TDMA (Time Division Multiplex Access) mode

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Basic Performance Parameters

Data Rate (Upstream/Downstream Gbps)	1.24416/ 2.48832
Maximum physical reach	20 km
Maximum differential fibre Distance	20 km
Split ratio	1： 64/up to1： 128

The distance between nearest and farthest ONTs

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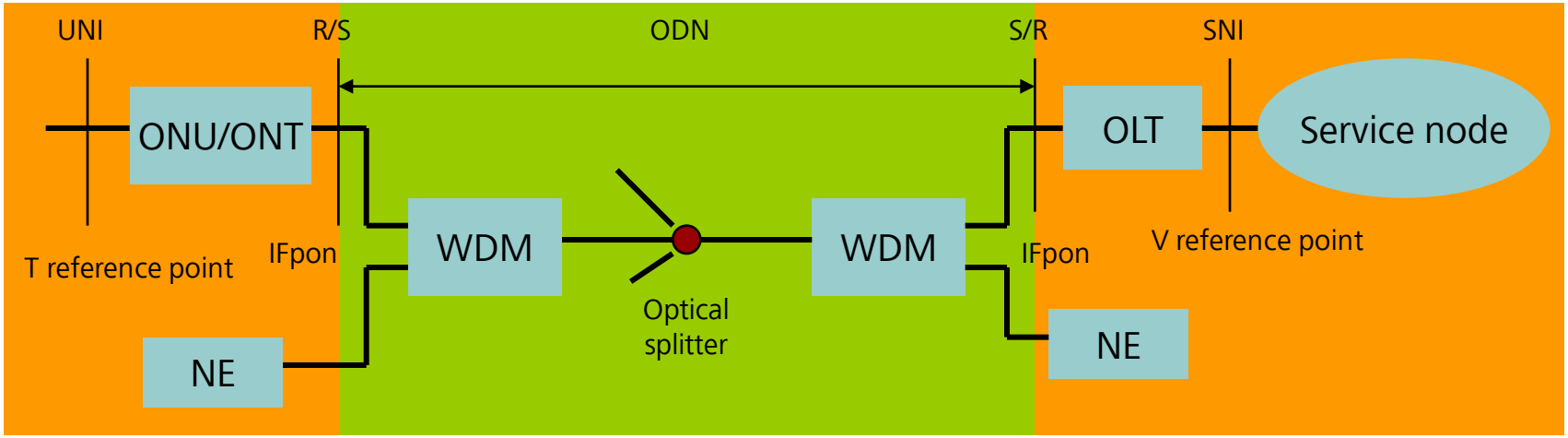
GPON Network Model Reference



- **ONU Optical Network Unit**
- **ONT Optical Network Terminal**
- **ODN Optical Distribution Network**
- **OLT Optical Line Terminal**
- **WDM Wavelength Division Multiplex Module**
- **NE Network Element**
- **SNI Service Node Interface**
- **UNI User Network Interface**

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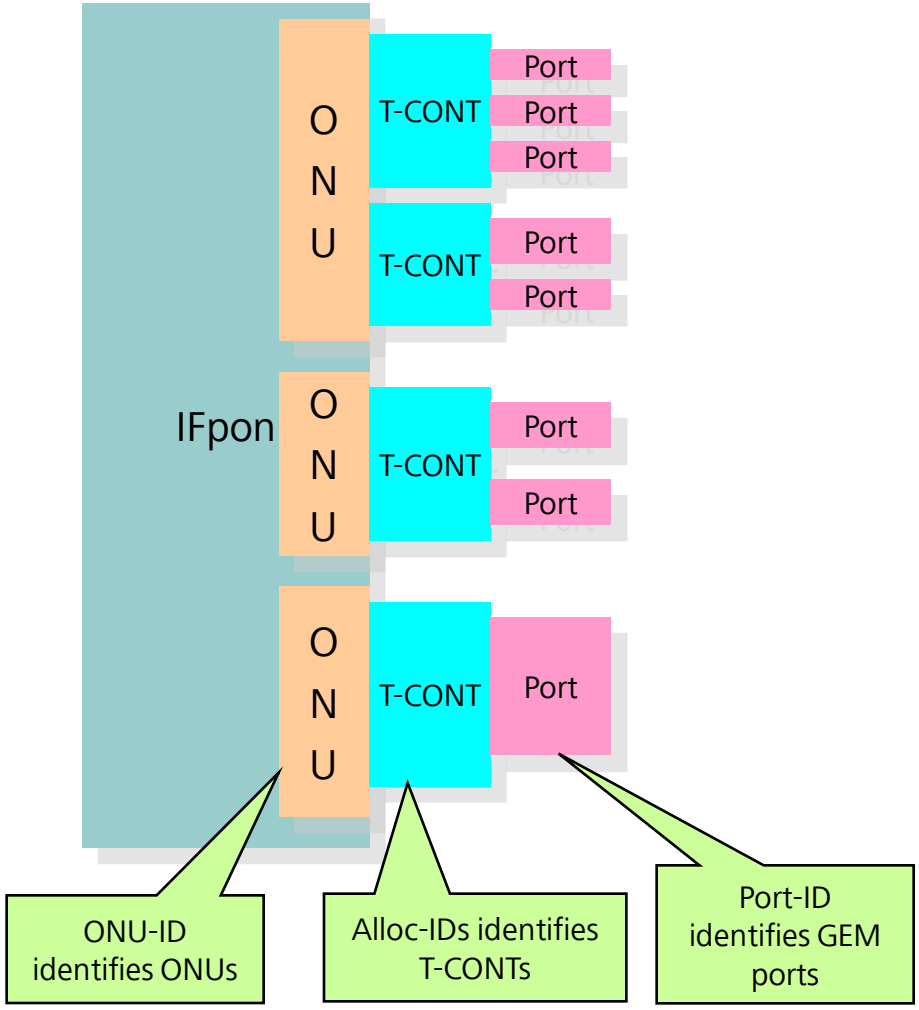
GPON Multiplexing Architecture



- GEM Port: the minimum unit for carrying services.
- T-CONT: Transmission Containers is a kind of buffer that carries services. It is mainly used to transmit upstream data units. T-CONT is introduced to realize the dynamic bandwidth assignment of the upstream bandwidth, so as to enhance the utilization of the line.
- IF pon: GPON interface.
- Based on the mapping scheme, service traffic is carried to different GEM ports and then to different T-CONTs. The mapping between the GEM port and the T-CONT is flexible. A GEM port can correspond to a T-CONT; or multiple GEM Ports can correspond to the same T-CONT.
- A GPON interface of an ONU contains one or multiple T-CONTs.

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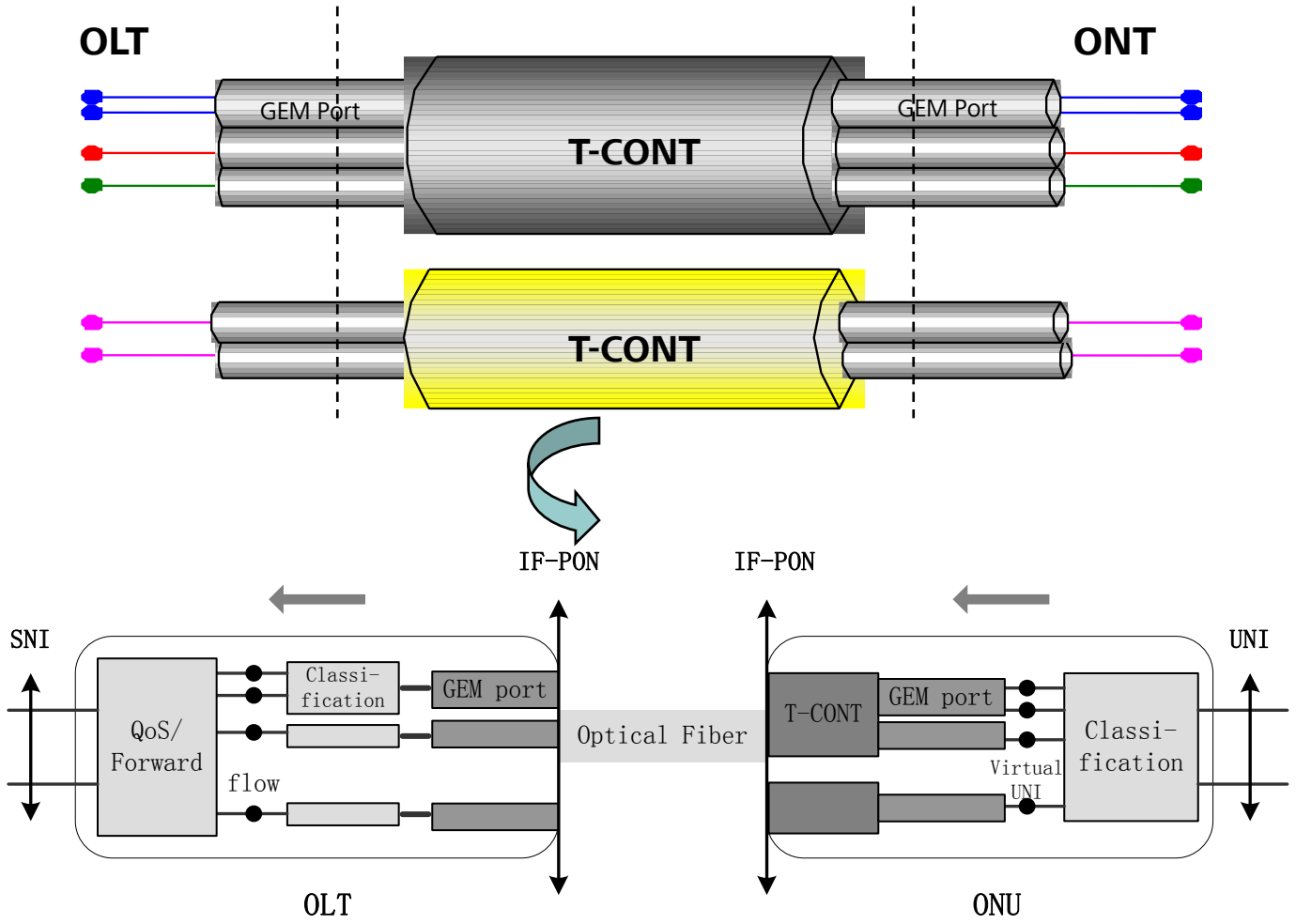
GPON Multiplexing Architecture



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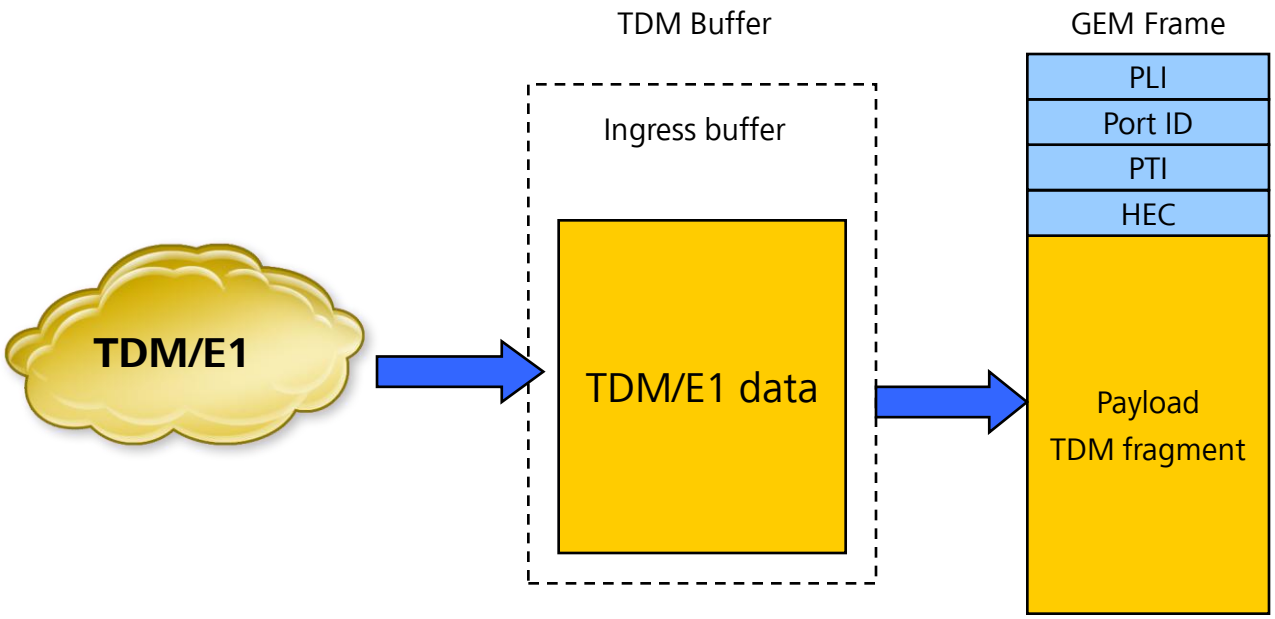
Mapping of TDM Service in GPON



- TDM frames are buffered and queued as they arrive, then TDM data is multiplexed in to fixed-length GEM frames for transmission.
- This scheme does not vary TDM services but transmit TDM services transparently.
- Featuring fixed length, GEM frames benefits the transmission of TDM services

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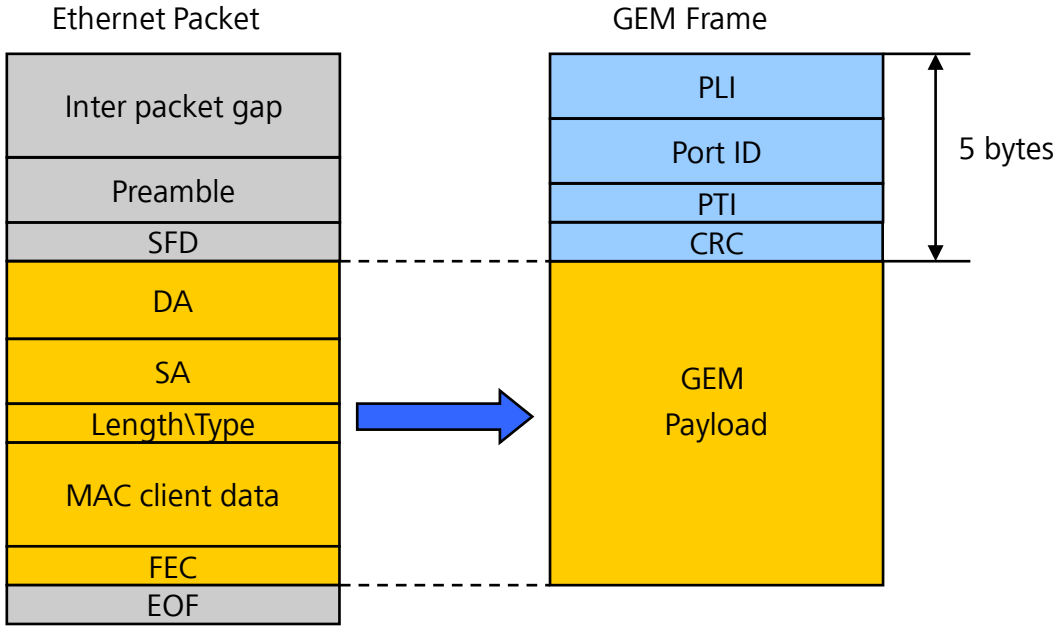
Mapping of Ethernet Service in GPON



- GPON system resolves Ethernet frames and then directly maps the data of frames into the GEM Payload.
- GEM frames automatically encapsulate header information.
- Mapping format is clear and it is easy for devices to support this mapping. It also boasts good compatibility.

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GPON Key Technologies

- T-CONT
- Attenuation

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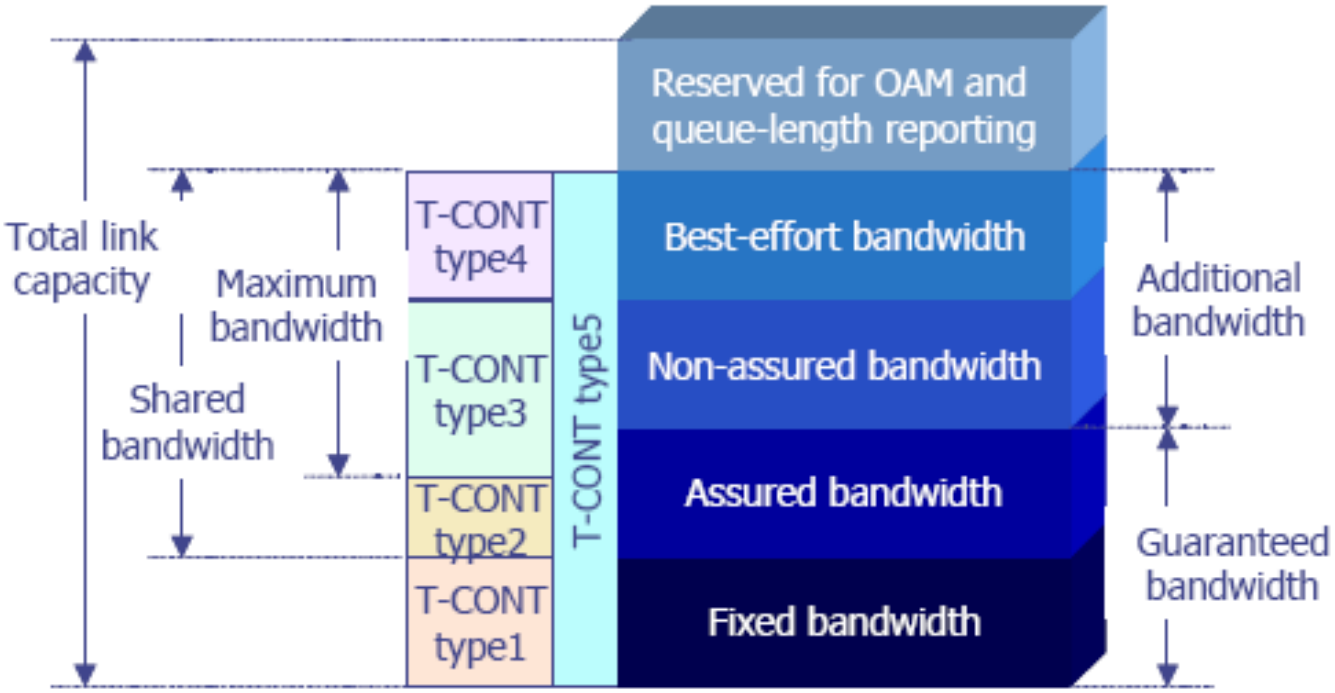
T-CONT Bandwidth Terms

- Transmission Containers (T-CONTs): it dynamically receives grants delivered by OLT. T-CONTs are used for the management of upstream bandwidth allocation in the PON section of the Transmission Convergence layer. T-CONTs are primarily used to improve the upstream bandwidth use on the PON.
- T-CONT BW type falls into FB, AB, NAB, and BE.
- Five T-CONT types: Type1, Type2, Type3, Type4, and Type5.



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Fibre Attenuation and Power Budget

- Fiber attenuation relates to the fibre length ⇒ About 0.35 dB per km for 1310,1490nm
- The attenuation of fibre splicing point is generally less than 0.2dB
- Other factors may cause attenuation, such as fibre bending

Table G.984.2 – Classes for optical path loss

	Class A	Class B	Class B +	Class C
Minimum loss	5 dB	10 dB	13 dB	15 dB
Maximum loss	20 dB	25 dB	28 dB	30 dB

NOTE – The requirements of a particular class may be more stringent for one system type than for another, e.g. the class C attenuation range is inherently more stringent for TCM systems due to the use of a 1:2 splitter/combiner at each side of the ODN, each having a loss of about 3 dB.

Huawei's OLT and ONU 28 dB (Class B+)

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Parameters of GPON (Class B+)

Items	Unit	Single fibre
OLT:		OLT
Mean launched power MIN	dBm	+1.5
Mean launched power MAX	dBm	+5
Minimum sensitivity	dBm	-28
Minimum overload	dBm	-8
ONU:		ONU
Mean launched power MIN	dBm	0.5
Mean launched power MAX	dBm	+5
Minimum sensitivity	dBm	-27
Minimum overload	dBm	-8

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GPON Service Provisioning

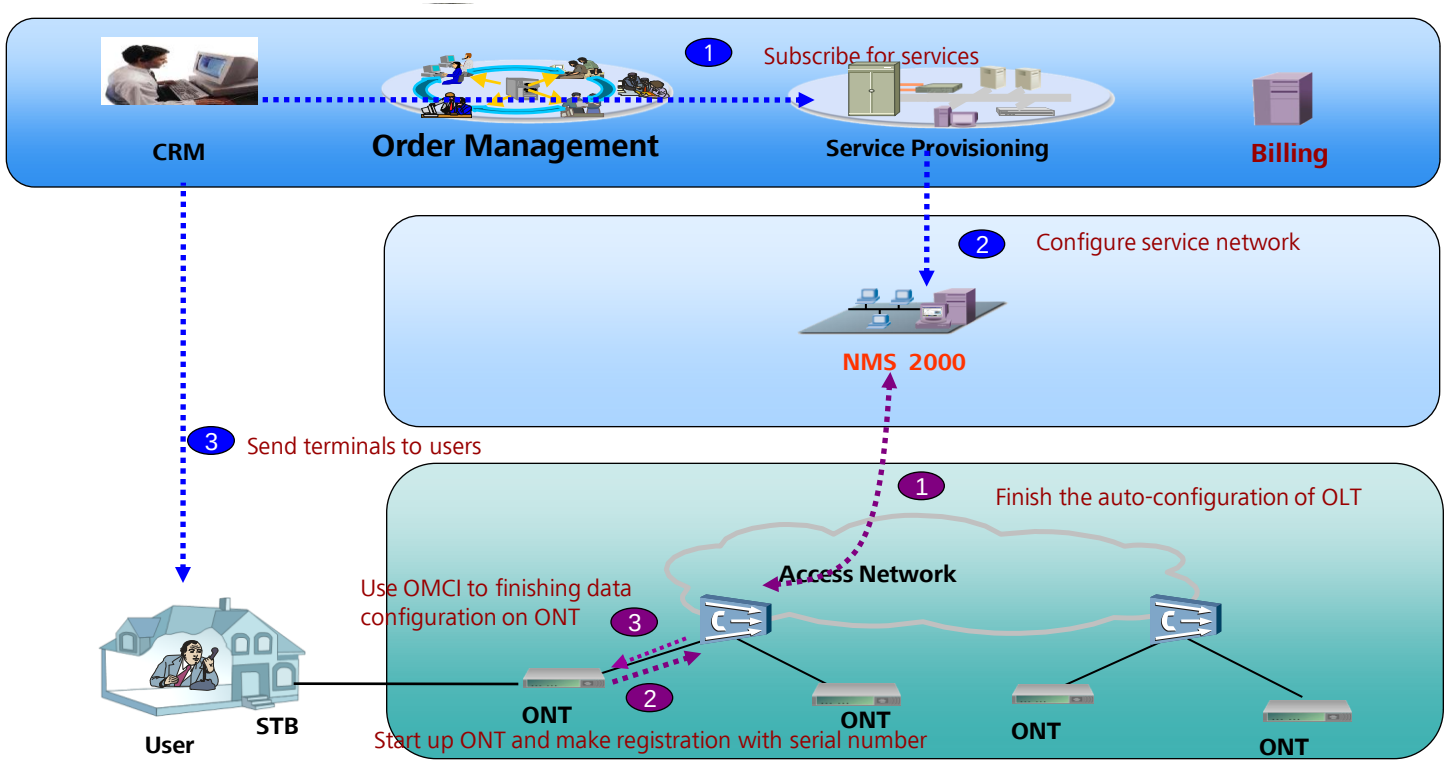
Carriers' nightmare

Initial configurations (such as service system information configuration, data configuration) are required on terminals and then they can be put into use. To finish these configurations, it is not cost-effective to carriers.

Flexible Configuration plan of GPON

GPON supports zero configuration on terminals and plug-and-play of terminals, which is cost-effective.

Application scenario



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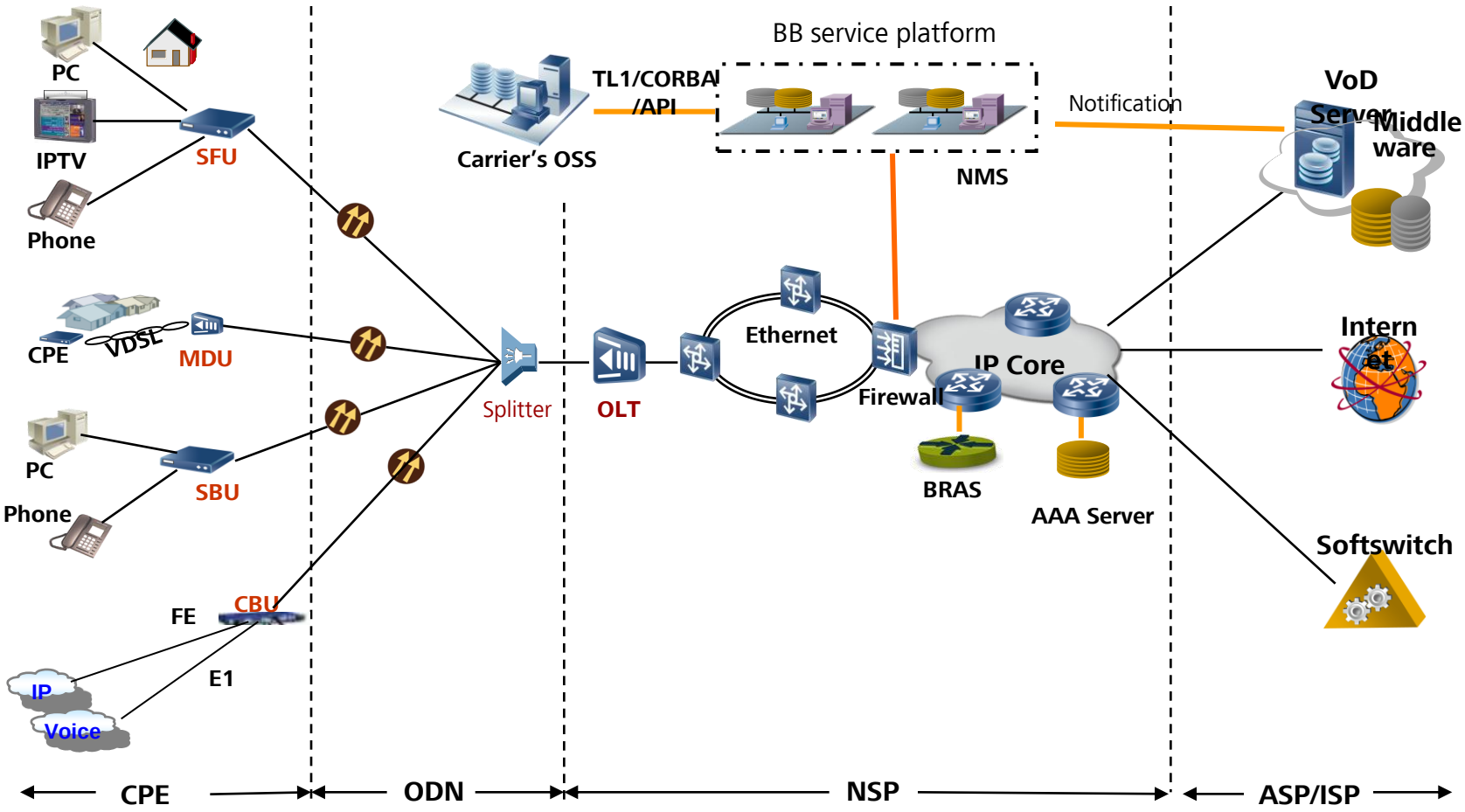
Triple Play Solution in GPON



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Questions

- GPON network architecture?

- Describe GPON service provisioning?

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Summary

- In this presentation, we introduced GPON basic concept ,architecture ,and principle.
- We also discussed about GPON service provisioning and application.

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