

E3-E4 (CFA) EPON & GPON

AGENDA

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- **Limits of Present Access network.**
 - **Passive Optical Network**
 - **EPON / GEPON**
 - **GPON Architecture**
 - **PON Topology and services**
 - **Conclusion**

PRESENT ACCESS N/W



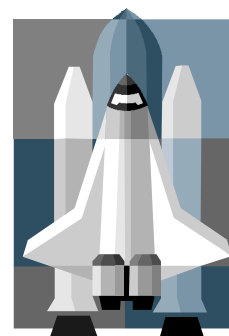
xDSL technology



The xDSL technology cannot solve the contradiction between **distance** and **bandwidth**.

Question: What to do?

Answer: “Replacing Copper Cables with Optical Cables”! Taking the optical access solutions!

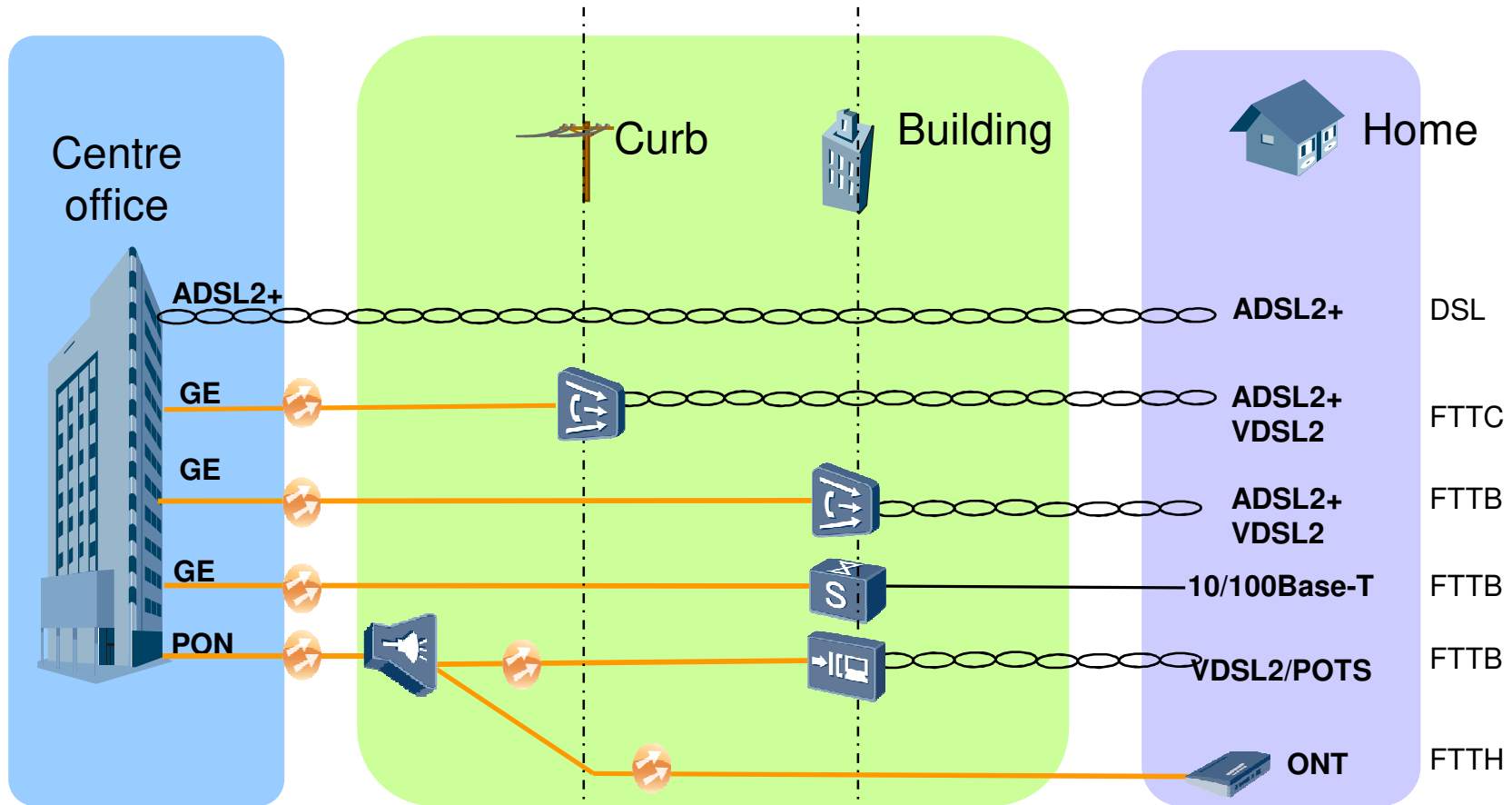


LIMITS OF DSL N/W



- Dial up Modem Speed stops at about 56 Kbps on copper infrastructure.
 - For accessing richer content more bandwidth is required.
 - Broadband access have pushed the data rates but distance restrictions still remains.
 - Multi-play services are bandwidth hungry.
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OPTICAL ACCESS SCENERIO



OFC Being best-fit is the best choice.

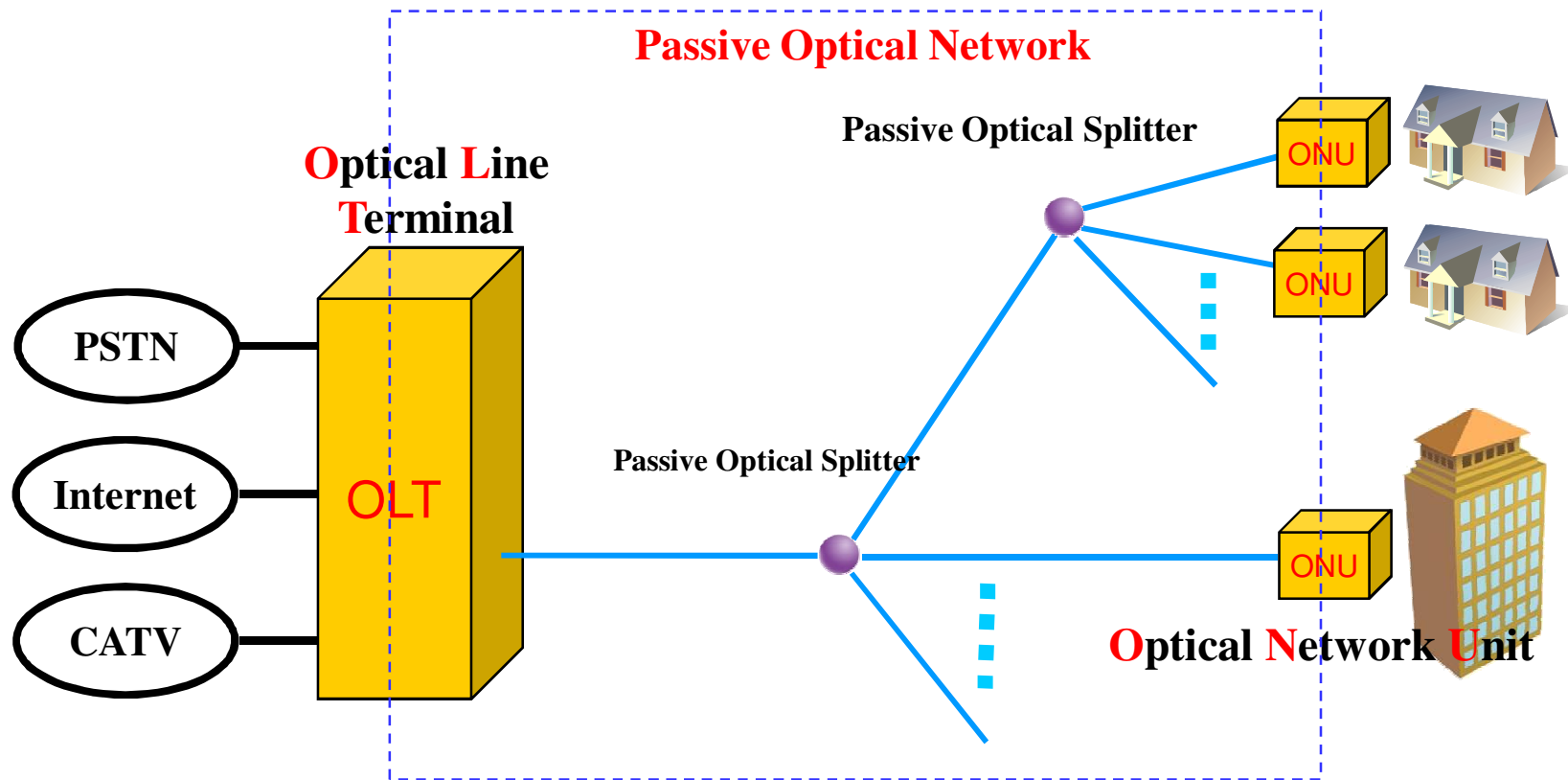
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PASSIVE OPTICAL N/W



- Passive Optical Network (PON) is a new access technology, named as EPON and GPON.
 - It delivers gigabit-per-second bandwidths while offering the low cost and reliability .
 - It is now emerging as the next broadband access technology.
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What is a PON?



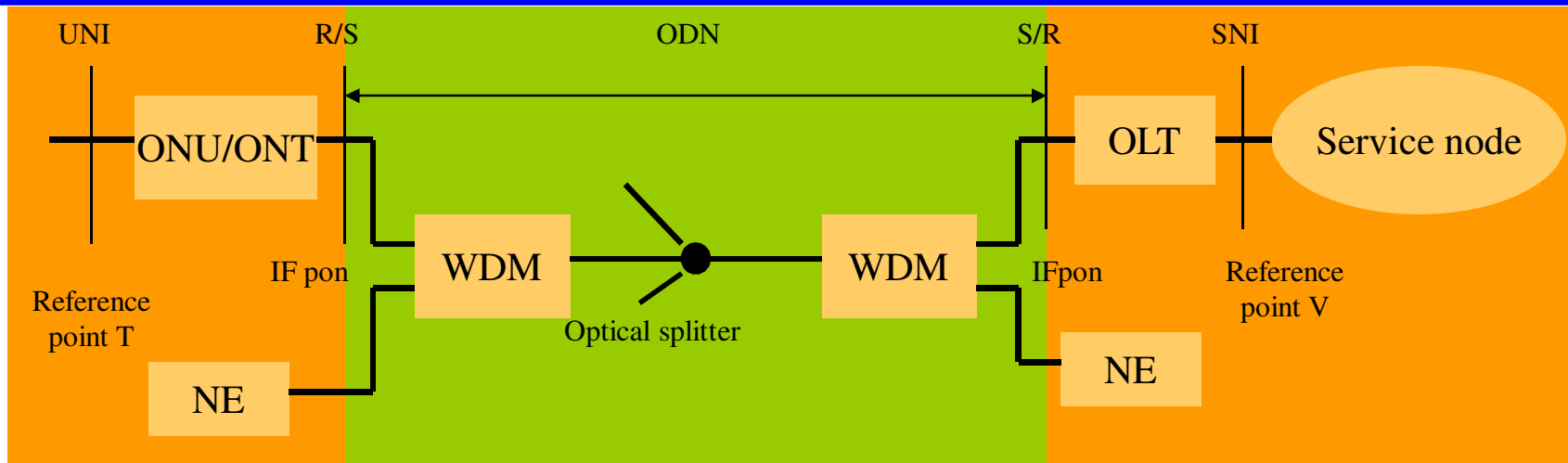
- A PON network is a point to multiple points (P2MP) passive optical network.
- A PON network consists of the Optical Line Terminal (OLT), Optical Network Unit (ONU), and Passive Optical Splitter (POS) .

PON

Passive Optical Network

- A Passive Optical Network (PON) is a single, shared optical fiber that uses inexpensive optical splitters to divide the single fiber into separate strands feeding Bandwidth to individual subscribers.
- PONs are called "passive" because, other than at the CO and subscriber end-points, there are no active electronics within the access network.

Model of a GPON Network



ONU Optical Network Unit

ONT Optical Network Terminal

ODN Optical Distribution Network

OLT Optical Line Terminal

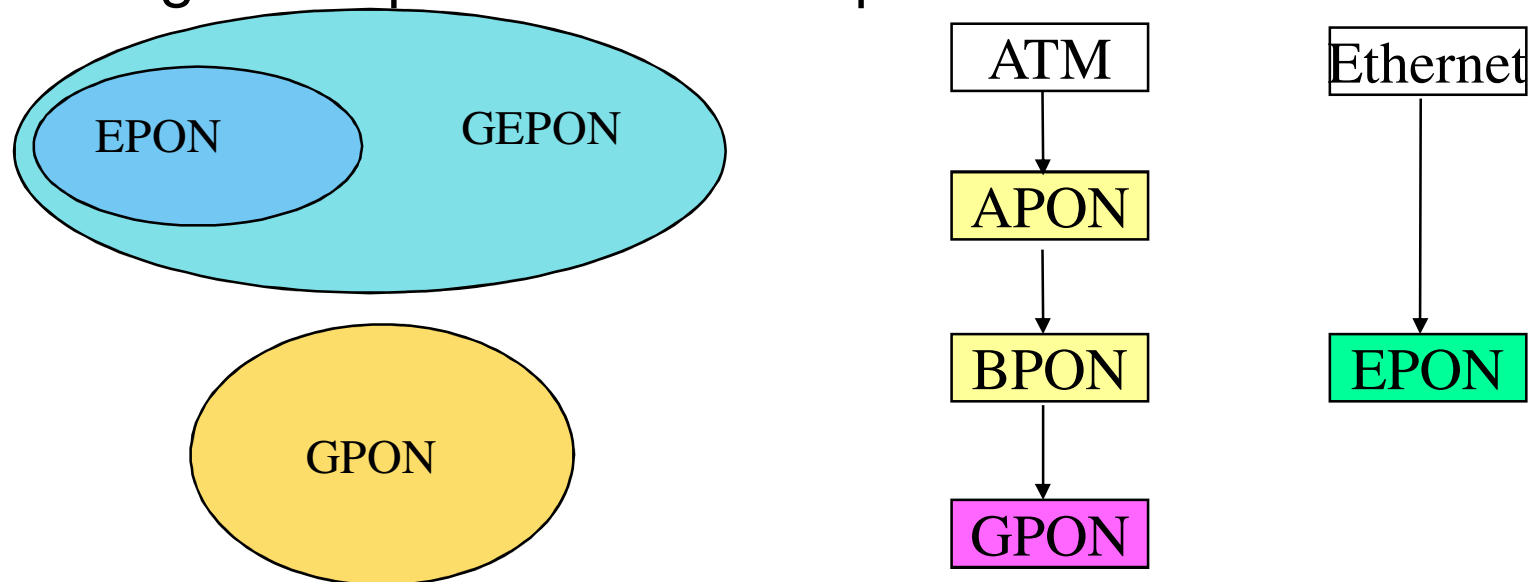
PON Standards

APON: ATM Passive Optical Networks

EPON: Ethernet Passive Optical Networks

GE-PON: Gigabit Ethernet - Passive Optical Networks

GPON: Gigabit-capable Passive Optical Networks



GPON v/s EPON

	P2MP	
	GPON	EPON
organization	ITU.T	IEEE
Rate	2.488G/1.244G	1.25G/1.25G
Split ratio	1:64 - 1:128	1:16 - 1:32
service	ATM, Ethernet, TDM	Ethernet
Bandwidth eff.	92%	72%
QOS	Very good including Ethernet, TDM, ATM	Good, only Ethernet
Optical budget	Class A/B/B+/C	Px10/Px20
Communication with ONTs	OMCI	Not supported
OAM	ITU-T G.984 (Strong)	Ethernet OAM (Weak,)

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EPON / GPON

- EPON (Ethernet Passive Optical N/w) is based on the Ethernet in the First Mile standard of IEEE.
 - GPON is based on the G.984.x series standard of ITU-T.
 - EPON is also called now as Gigabit Ethernet PON (GE-PON).
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Why GPON is Preferred

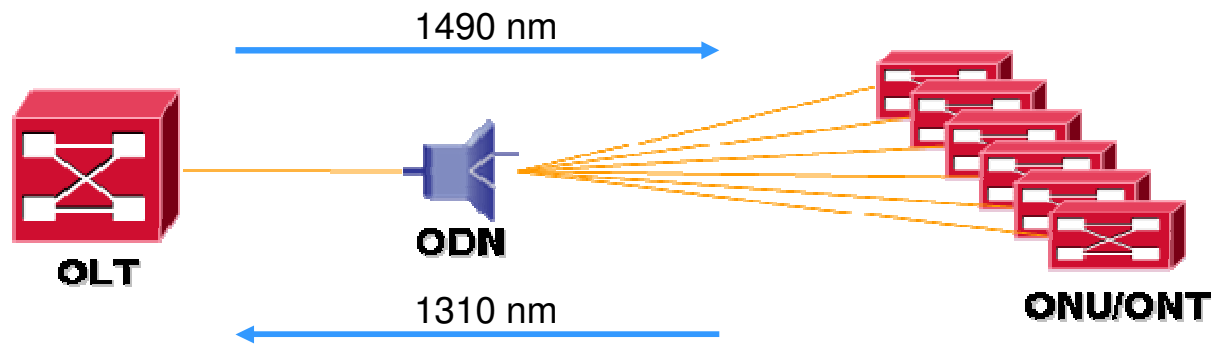


GPON (Gigabit-capable Passive Optical Networks) has three major advantages:

- Longer transmission distance: Transmission over optical fibers reaches the maximum of 20 km.
- Higher bandwidth: downstream 2.5 Gbit/s and upstream 1.25 Gbit/s for each subscriber.
- Optical split feature: The single optical fiber from the CO up to Splitter to save the resources.

GPON TECHNOLOGY

- The GPON system uses the WDM technology to implement the bi-directional transmission over a single fiber (a forced transmission mode).

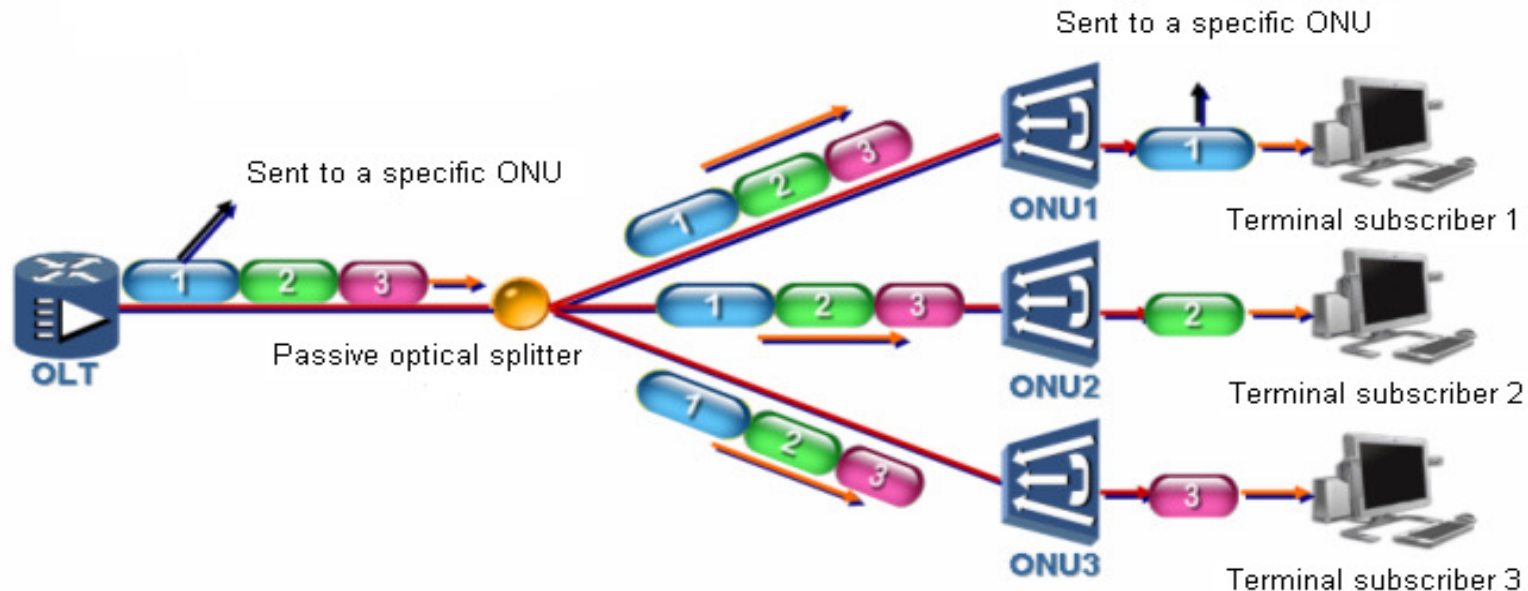


GPON TECHNOLOGY



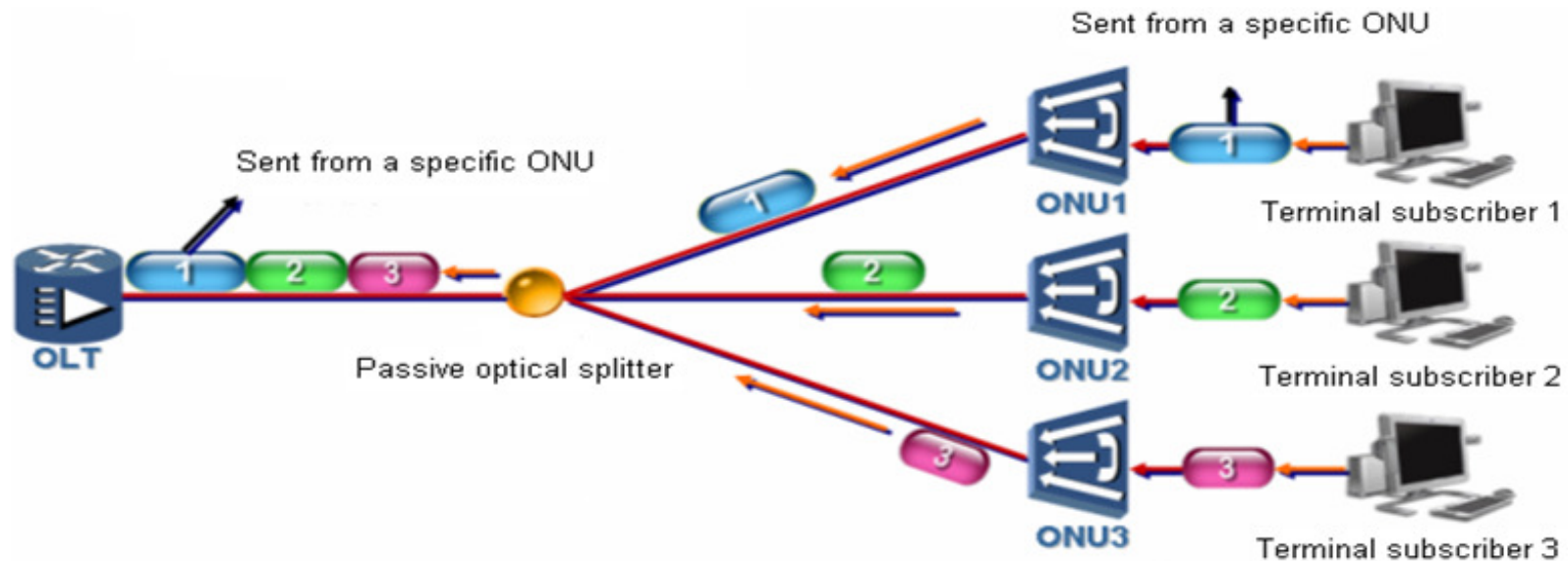
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- Over a single optical fiber, to separate the Tx and Rx signals of multiple subscribers, the GPON system uses the following two multiplexing technologies:
 - The downstream data streams use the broadcast technology.(1490 nm)
 - The upstream data streams use the TDMA technology (1310nm)

GPON - Downstream Data



Broadcast mode: The length of any downstream GPON frame is fixed to 125 μ s and the frames are broad cast to all the ONUs. In this way, all the ONUs can receive the same data.

GPON - Upstream Data



TDMA mode: The upstream GPON data is transmitted in the TDMA mode. The uplink is divided into different time slots, which are allocated to each ONU according to the upstream bandwidth map field in the downstream frames.

GPON TOPOLOGY

■ PON is typically deployed as a tree or tree-and-branch topology, using passive 1: N optical splitters.

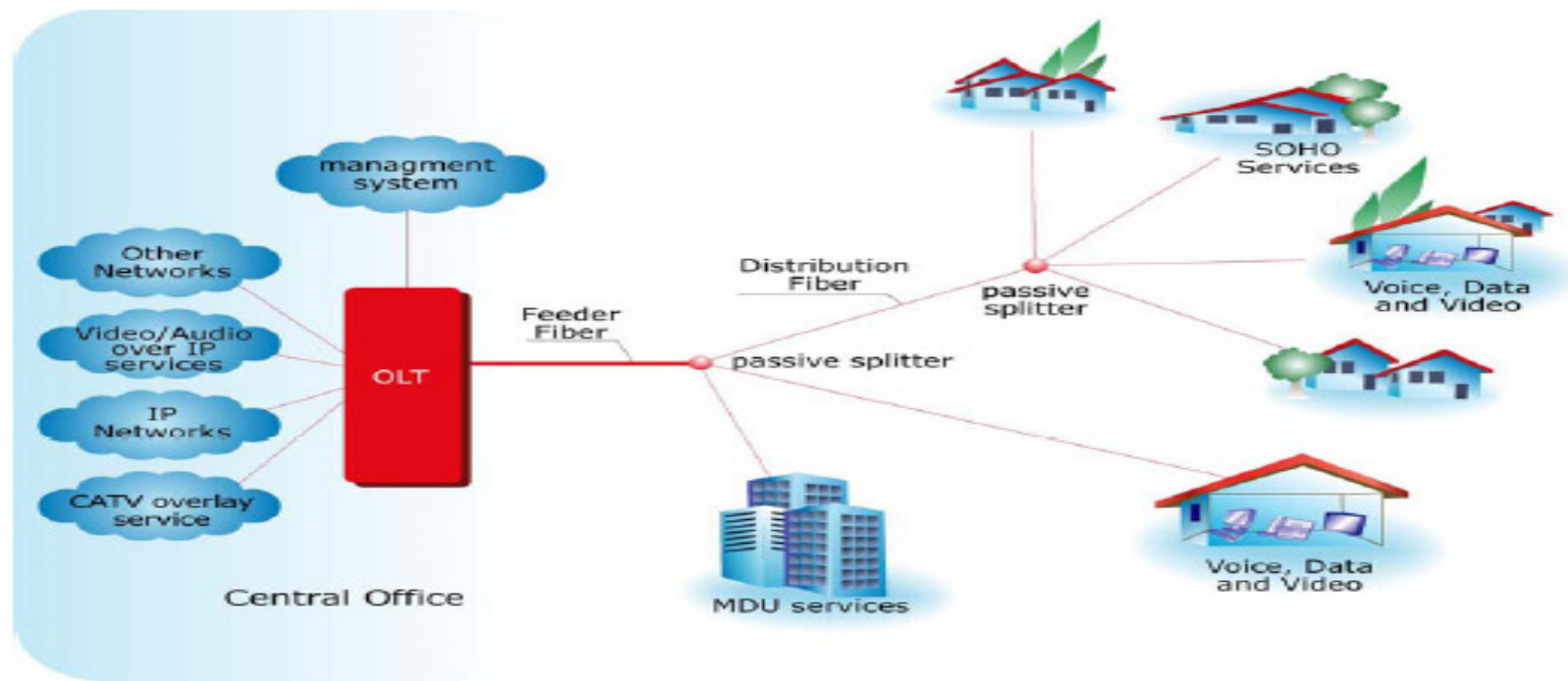


Figure 2: EPON System Architecture

PON NETWORK-OLT



OPTICAL LINE TERMINAL (OLT).

- The OLT resides in the CO (local exchange). The OLT system would typically be an Ethernet switch or Media Converter platform.
- The network interface of the OLT is typically connected to the IP network and backbone of the network operator. Through this interface, multiple services are provided to the access network.
- A PON interface will connect the OLT to the subscribers.

PON NETWORK-ONU



OPTICAL NETWORK UNIT (ONU)

- The ONU resides at or near the customer premise: on the curb outside, in a building, or at the subscriber residence.
- OLT transmits an optical signal to a splitter, from which the signal is distributed to multiple customers with ONU directly or via another splitter .

EPON PROTOCOL



- EPON uses the Multi-Point Control Protocol (MPCP). MPCP performs bandwidth assignment, bandwidth polling, auto-discovery, and ranging. It is implemented in the MAC Layer, introducing new 64-byte control messages:.
 - GATE and REPORT are used to assign and request bandwidth
 - REGISTER and REGISTER_REQUEST are used to control the auto discovery process
 - MPCP provides looks for network resource optimization
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EQUIPMENT DESIGN ASPECTS



- Optical Power Budget
- The Optical power budget is an important consideration in PON design because it determines the number of ONUs (ONTs) that can be supported, as well as the maximum distance between the OLT and ONUs (ONTs). There is a tradeoff between the number of ONUs (ONTs) and the distance limit of the PON because optical losses increase with both split count and fiber

SERVICES ON FTTH NETWORK



- Ethernet access service such as Ethernet Private Leased Lines (EPL), Ethernet Private LAN service (EP-LAN) shall be few of the popular service on PON.
 - These PON technologies shall be one of the ultimate technologies that deliver both high bandwidth and high reliability.
 - End to end provisioning feature on PONs enable the service provider to dynamically manage the customer needs
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SERVICES ON FTTH NETWORK



- Another service that can be proposed is the voice service (TDM or IP), i.e. extension of PSTN lines to the customers. In GPON, this service can be extended using the 64 Kb/s TDM lines from exchange to customer.
 - we may use V 5.2 interface to extend the voice service to the customer premises.
 - In case of GE-PON the voice service can be extended to the using Voice over Internet Protocol (VOIP).
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SERVICES ON FTTH NETWORK



- From the BSNL network point of view GPON, being the TDM based technology, shall integrate into the existing switching network .
 - TDM switches and the NGN are to coexist for up to 2015 as per the NGN vision plan both GPON and GE-PON are the most suitable PON technologies for BSNL. .
 - The video service (RF or IP), which is one of the triple play services, is the next service proposed to be extended to the customer.
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SERVICES ON FTTH NETWORK



- GPON/ GE-PON offer Gigabit connectivity up to the customer premises.
- Both GPON and GE-PON can also roll-out broadcast Cable TV services using the third wavelength at 1550 nm using RF-video. .

CONCLUSION



- PON is a leading new technology that promises quantum leaps in delivered bandwidth for a new generation of bandwidth-intensive applications.
 - While deriving its strength and stability from universally deployed and proven Ethernet technology, it uses passive network components to simplify and to reduce the cost and maintenance challenges associated with active network technologies.
 - EPON is making tremendous gains in Japan, Korea, China.
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Thanks