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# **Considerations for 10G EPON**

## **--- Migration from Gigabit EPON to 10G EPON ---**

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# Outline

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Smooth migration from 1G EPON to 10G EPON is necessary

- ◆ Some Objectives for smooth migration
- ◆ Possible Network Configuration
- ◆ Technical Feasibility
- ◆ Economic Feasibility
- ◆ Summary

## Economic Feasibility - Installation Costs -

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- ◆ 10G EPON market will be a replacement market
  - Many EPON subscribers will exist when deployment of 10G EPON starts
  - Subscribers will move to 10G EPON gradually
- ◆ Total cost of upgrades to 10G EPON should be considered
  - Reduction of installation costs supports economic feasibility

### To avoid a reinvestment to fiber infrastructure

- ◆ Existing EPON infrastructure should be re-used
  - Think about why LX4 and LRM are essential
- ◆ 10G EPON should coexist with existing EPON
  - EPON subscribers will upgrade to 10G at different points in time

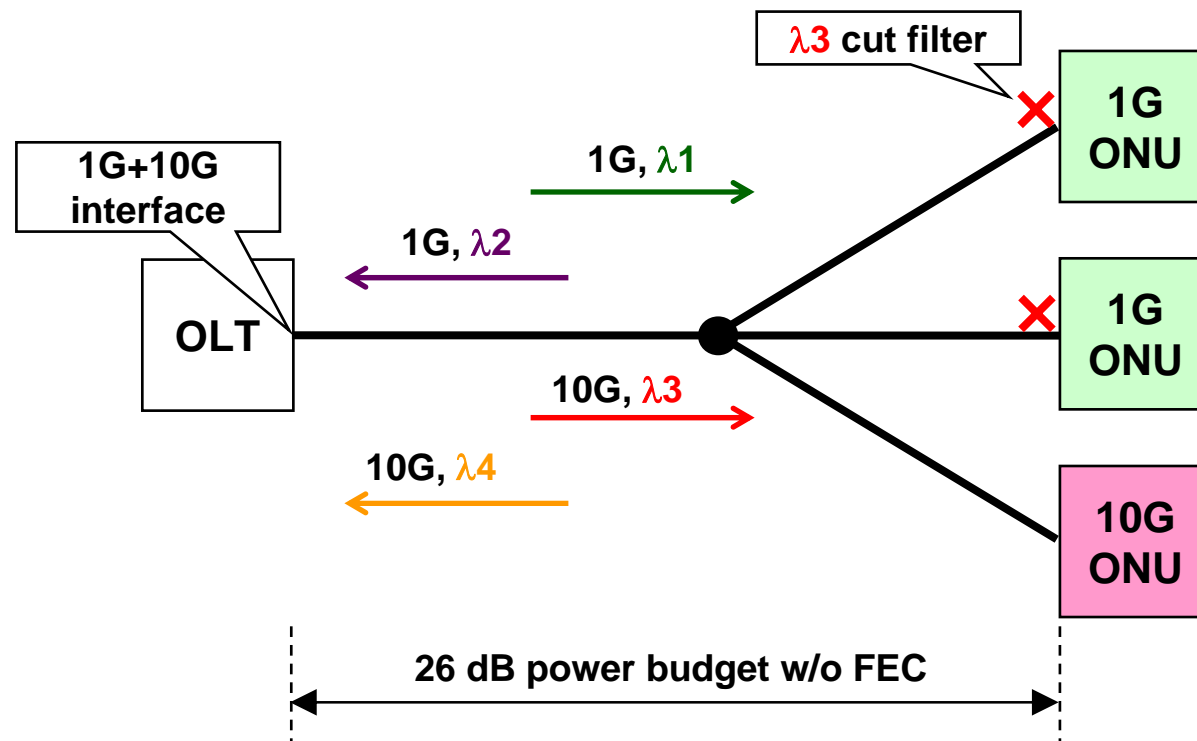
## Some Objectives Related to Fiber Re-use and Coexistence

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- ◆ Support power budget equivalent to EPON case
  - 10Km and 20Km options if cost difference is significant
- ◆ Support optional FEC
  - Same positioning as the case of EPON
- ◆ Use wavelength other than 1310 nm and 1490 nm
  - For coexistence with EPON
- ◆ Use 10G serial
  - LX4 (1269-1356nm) and EPON use the same wavelength band
  - Simple and economical as compared with 4-lane approach

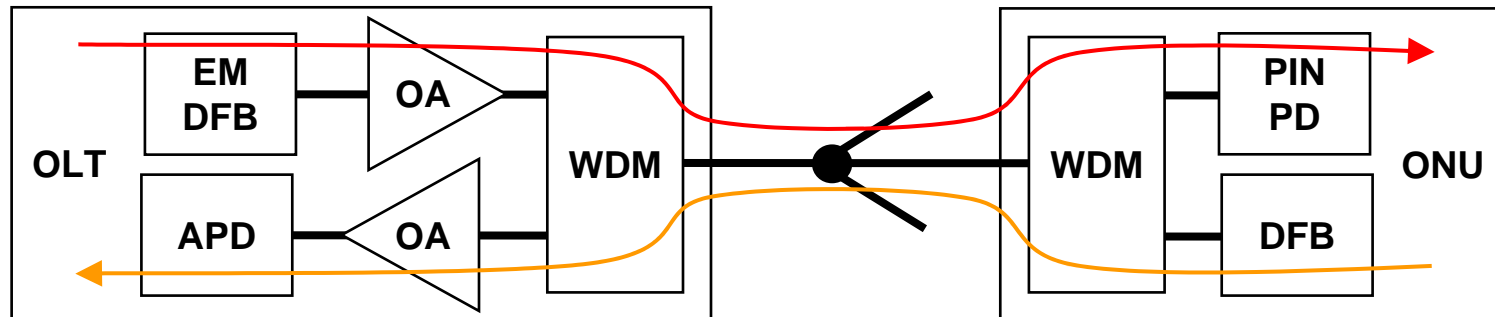
# Possible Configuration

## EPON/10G EPON coexistence by overlay



# Technical Feasibility - Optical Power Budget -

- ◆ Optical Amplifiers (OAs) can be used to achieve the budget
- ◆ Costly parts should be placed on OLT side
  - ONU: DFB LD / PIN PD
  - OLT: EM DFB LD + OA / OA + APD



- ◆ Example power budget

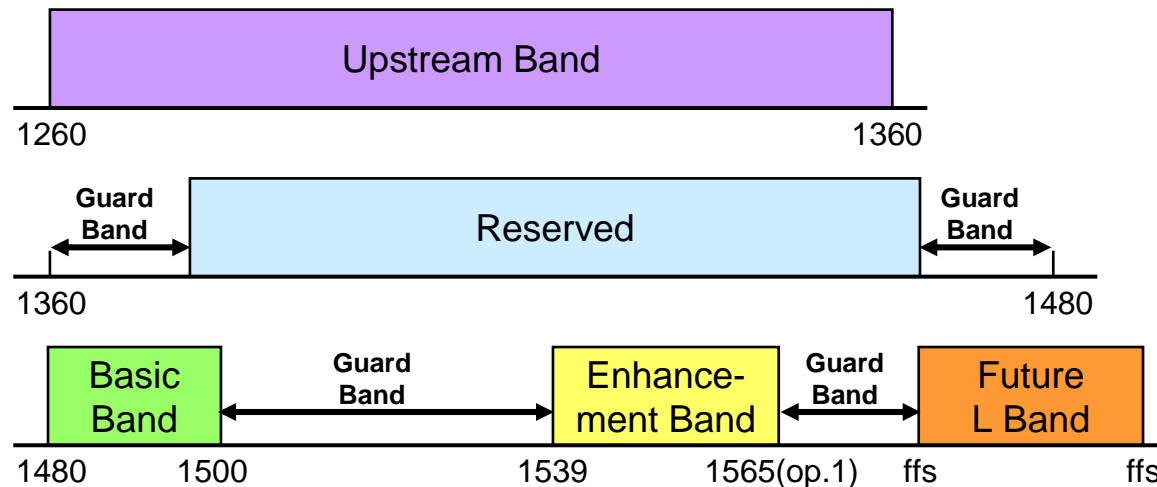
Downstream			
OLT TX		ONU RX	
EM DFB	+0dBm	Pin-PD	-16dBm
Optical Amp	+10dB		
Power Budget = 26 dB			

Upstream			
ONU TX		OLT RX	
DFB	-1dBm	Opt. pre-amp	+4dB gain
		APD	-23dBm
Power Budget = 26 dB			

# Technical Feasibility

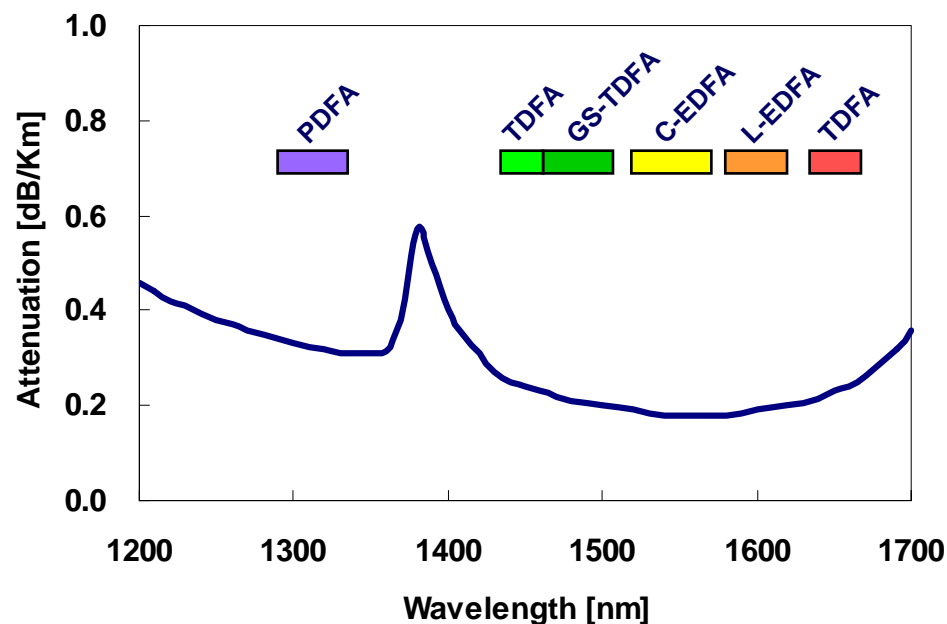
## - Wavelength Plan and Optical Source -

- ◆ C band (1530-1565nm) and/or L band (1565-1625nm) can be used
  - C band is defined for additional digital services by G.983.3
  - L band is reserved for future use
- ◆ Optical sources for C band are proven, e.g. 10GBASE-E
- ◆ Optical sources for L band are not common yet
- ◆ Distance will be limited when an LD is directly modulated
  - Dispersion management on the upstream path is a technical subject



# Technical Feasibility - Optical Amplifier -

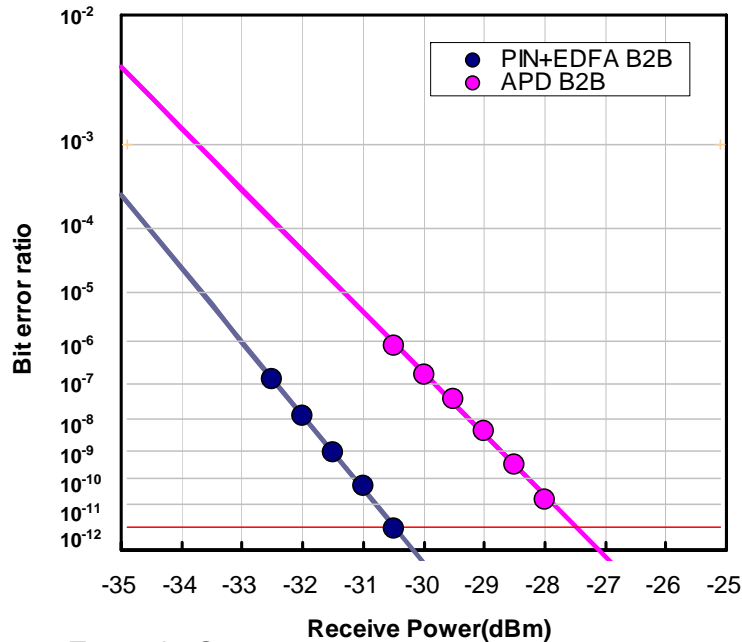
- ◆ EDFA is a mature technology with proven reliability
  - Available for both C band and L band
- ◆ SOA is immature compared with EDFA but cost less and small
- ◆ Fiber non-linearity effect may occur
  - depending on the combination of a light source and an OA



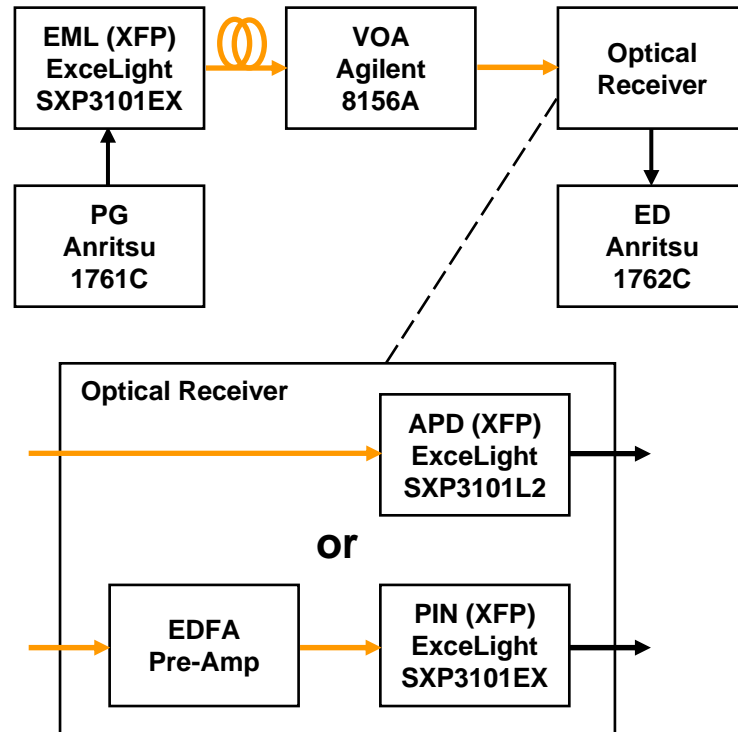


# Technical Feasibility - Optical Receiver -

- ◆ 10G PIN PDs and APDs are generally available
- ◆ Optical pre-amplifier can be used to increase power budget
  - Burst mode operation is a technical subject



Ta: 25 degC  
 Distance: 2m  
 Rate: 10.3125Gbps  
 Pattern: PRBS2^31-1  
 Wavelength: 1.55um



## Economic Feasibility - Cost Factors -

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- ◆ Use of devices for 10GBASE-E supports economic feasibility
- ◆ Components for L band are costly now due to limited availability
- ◆ Current cost of OAs are high for the use of access networks
- ◆ Low cost transmit technique for ONUs is necessary
- ◆ Components used in ONUs will have economies of scale

# Summary

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- ◆ Total cost of upgrades to 10G EPON should be considered
- ◆ Objectives summary
  - **Support existing EPON fiber infrastructure**
    - ◆ Support power budget equivalent to EPON case
    - ◆ Support optional FEC
  - **Support coexistence with EPON on one P2MP fiber**
    - ◆ Use wavelength other than 1310 nm and 1490 nm
    - ◆ Use 10G serial
- ◆ Technical feasibility
  - **Technically feasible in terms of power budget**
  - **Technical subjects related to burst mode operation of optical amplifiers and dispersion management on the upstream path**
- ◆ Economic feasibility
  - **Reduction of installation costs supports economic feasibility**
  - **Low cost optical amplifiers and ONU transmitters are necessary**