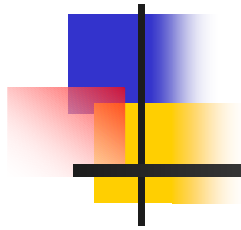


# **Experimental Consideration on EPON Transmission Characteristics at 10Gb/s**



**2006-07-18/20**

**IEEE 802.3 10Gb/s PHY for EPON Study Group Meeting  
San Diego, California, U.S.A.**

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# Introduction

- ◆ Summary of previous meeting

The Study Group adopted the motion to review technical feasibility of symmetric 10Gb/s EPON's power budget at this San Diego meeting.

- ◆ Objective of this presentation

Report results of symmetric 10Gb/s EPON

## Technical Issues of 10Gb/s EPON

- 10Gb/s optical device technology
  - High power LD (DFB-LD)/Modulator (EA)/
  - Optical amplifier (SOA)/High sensitivity APD/PD
  
- 10Gb/s burst optical transmitter/receiver technology
  - Burst receive pre-amplifier
  - Burst LD driver
  - Burst receive CDR
  
- TC layer control technology
  - FEC

# Technical Issues of 10Gb/s EPON

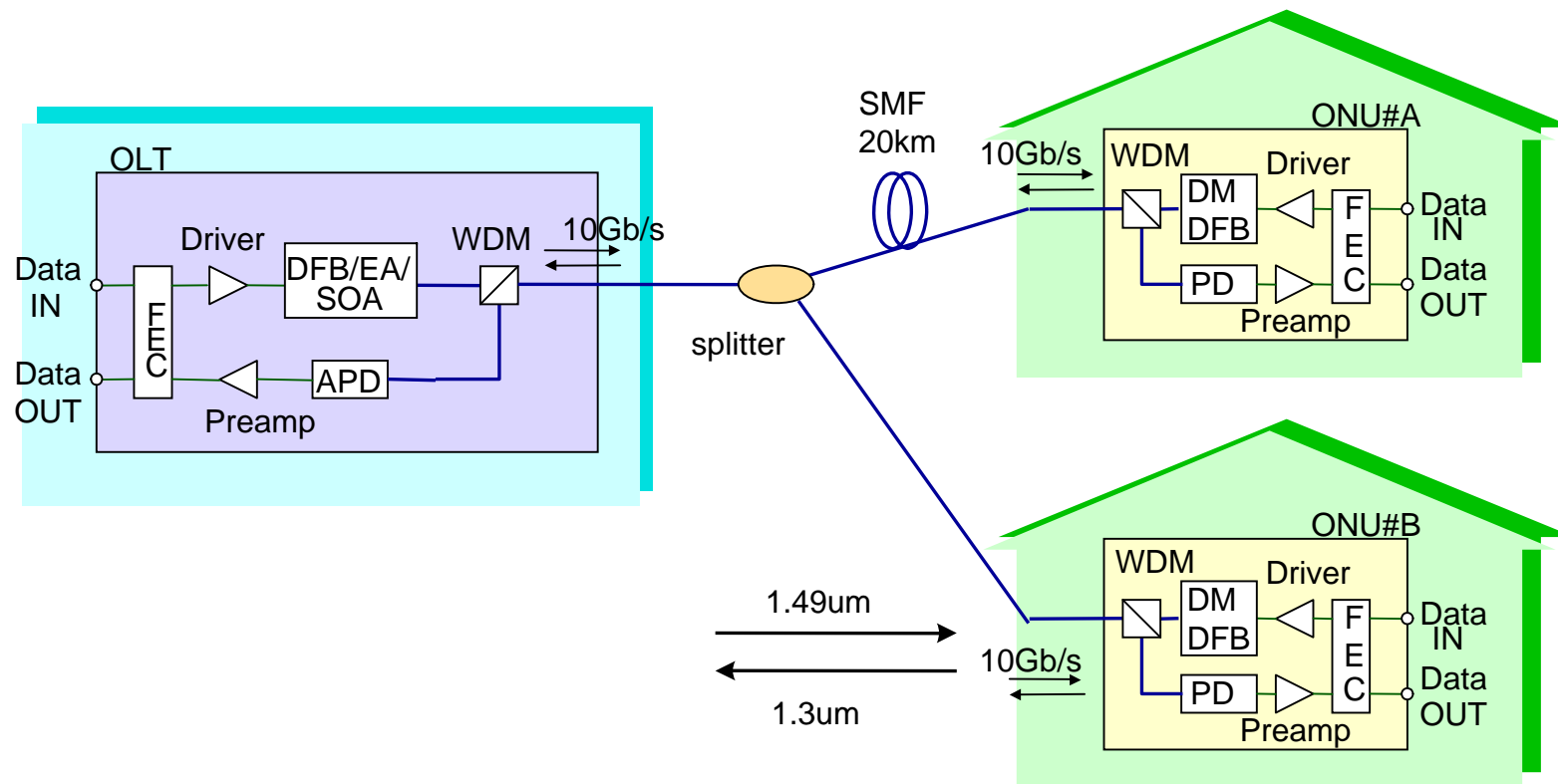
- High performance optical devices are necessary for 10Gb/s EPON

## Optical devices for 10Gb/s EPON

		<b>1Gb/s EPON</b>	<b>10Gb/s EPON</b>
<b>OLT</b>	<b>Tx</b>	<b>DFB (1490nm band)</b>	<b>DFB (1490nm band)+EA+SOA</b>
	<b>Rx</b>	<b>APD pre-amplifier</b>	<b>APD pre-amplifier</b>
<b>ONU</b>	<b>Tx</b>	<b>FP (1310nm band)</b>	<b>Direct modulation high power DFB (1310nm band)</b>
	<b>Rx</b>	<b>PD pre-amplifier</b>	<b>PD pre-amplifier</b>

# Configuration of 10Gb/s EPON Experiment

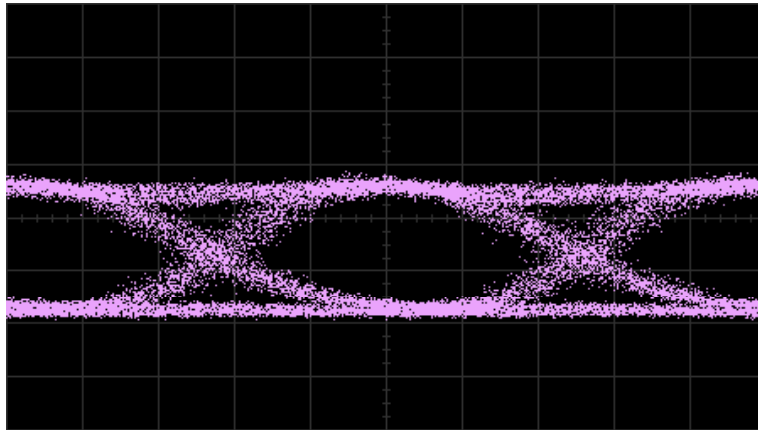
- Downstream: continuous mode
- Upstream: quasi-burst mode (ONU#A and ONU#B send data alternately)



OLT : Optical Line Terminal    EA : ElectroAbsorption  
 ONU : Optical Network Unit    SOA : Semiconductor Optical Amplifier  
 DFB : Distributed FeedBack    APD : Avalanche Photo Diode  
 PD : Photo Diode    DM DFB : Direct Modulation DFB  
 FEC : Forward Error Correction

# Experiment Results of the 10Gb/s EPON

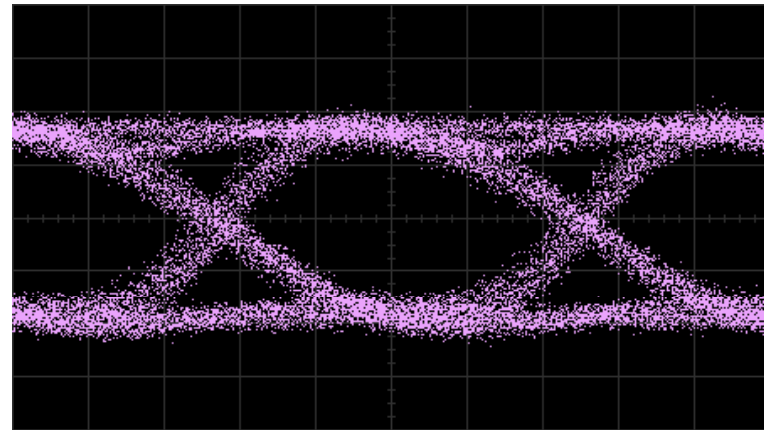
- Optical output waveforms -



**OLT output waveform**

*Output power: +7.8dBm*

*Extinction ratio: 11.0dB*



**ONU output waveform**

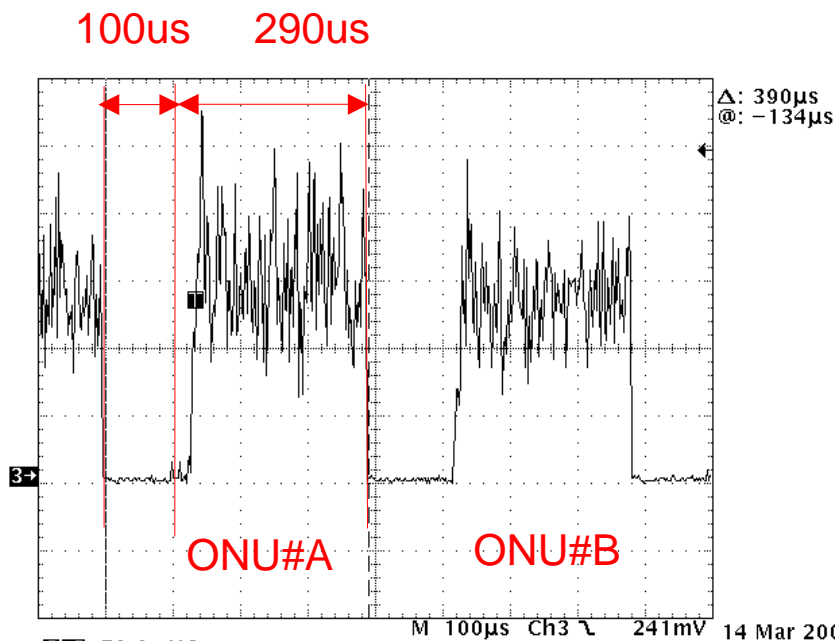
*Output power: +2.0dBm*

*Extinction ratio: 6.3dB*

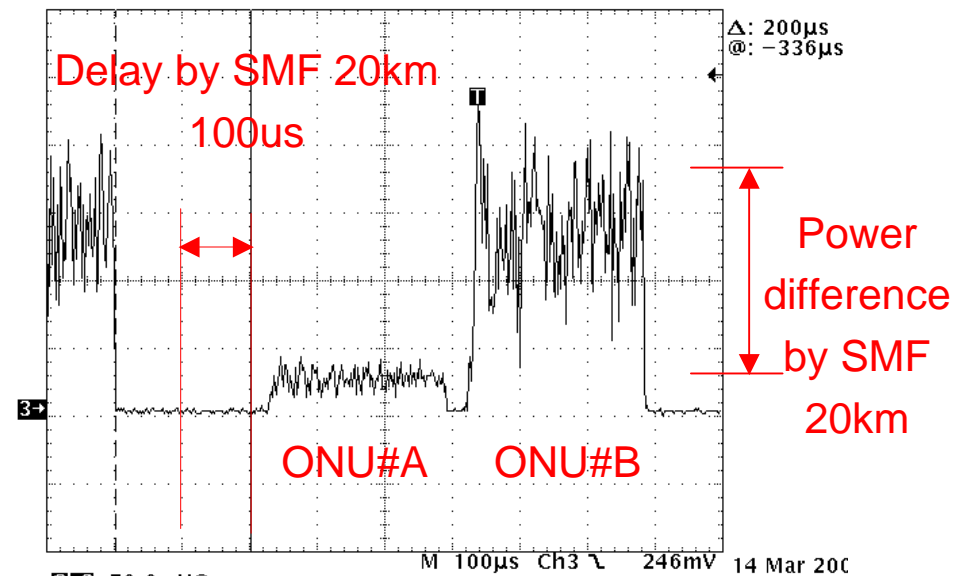
# Experiment Results of the 10Gb/s EPON

## - Received burst waveforms -

- Received burst waveforms from ONU#A and ONU#B
- Good waveforms after transmission over SMF 20km



SMF 0km added to both paths  
of ONU#A and ONU#B

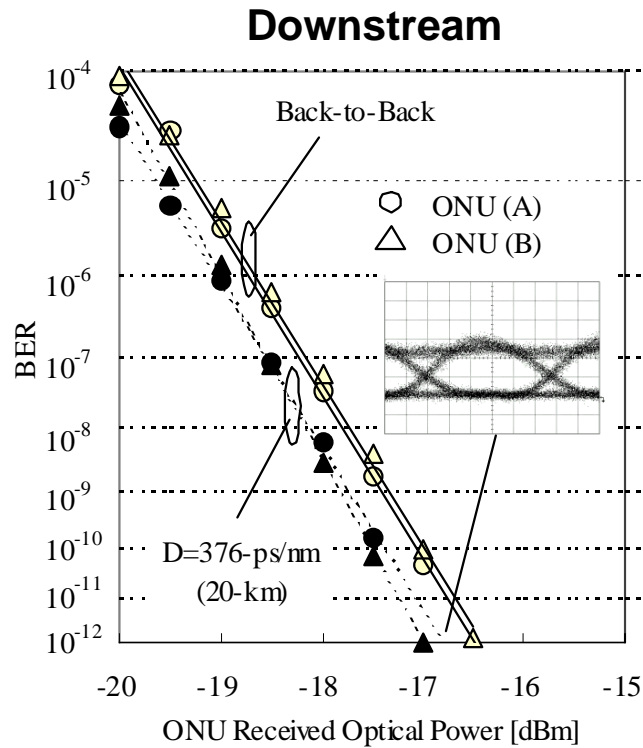


SMF 20km added to the path  
of ONU#A



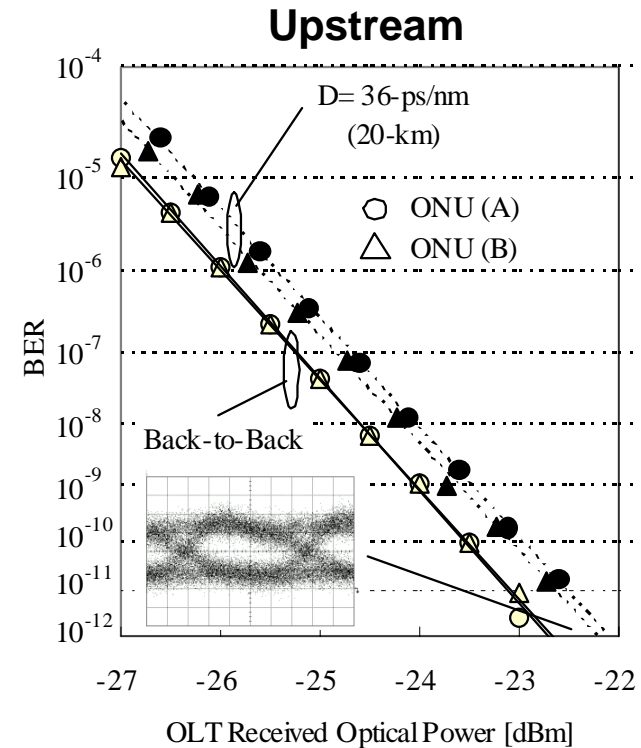
# Experiment Results of the 10Gb/s EPON

- Bit error rate -



- **Minimum Receive sensitivity:**  
**-16.5dBm (@1E-12, FEC OFF)**  
**-19.7dBm (@1E-12, FEC ON)**

- **Penalty: -0.5dB**



- **Minimum Receive sensitivity:**  
**-22.7dBm (@1E-12, FEC OFF)**  
**-27.3dBm (@1E-12, FEC ON)**

- **Penalty: 0.6dB**

# Summary

## Results of the 10Gb/s EPON experiment

	10Gb/s EPON experiment results		Further study issue
	Down	Up	
Power budget (FEC On)	<b>27.5dB</b>	<b>29.3dB</b>	Higher-power SOA
Dispersion penalty	-0.5dB	+0.6dB	
Extinction ratio	11.0dB	6.3dB	Fast burst modulation circuit at ONUs

## Summary (Cont.)

- Further study issues:

- (1) Power budget

- High-power SOA for downstream
- It needs 2 to 3 years for device design and development

- (2) Bandwidth efficiency

- 10Gb/s burst optical transmitter/receiver

  - Burst receive preamplifier

  - Burst LD driver

  - Burst receive CDR

- It needs 2 to 3 years for device design and development

- (3) FEC

- FEC is mandatory