

10G EPON Obstacles

Mitsunobu Kimura

mitsunobu.kimura.be@hitachi.com

Hitachi Communication Technologies, Ltd.

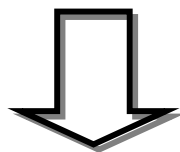
Subject: IEEE 802.3 10Gb/s PHY for EPON Study Group

Abstract: This presentation describes challenging items to pursue 10G EPON implementation under the present circumstances.

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10G EPON Requirements

- Low-cost Infrastructure for apartment houses
- 10 Gbit/s makes more stable P-to-P Applications
(e.g. for Medical, Education)
- Ultra-High Quality Streaming Service



- Bit rate: 10 Gbit/s Downstream & 10 Gbit/s Upstream (in general)
- Transmission Distance: up to 20 km required
- Use existing fibers
- Analog Video Service still remains

Requirements for Equipment

■ Use existing fibers

- (1) Fibers built already = SMF with normal dispersion
- (2) Optical Span Loss > 25 dB (28 dB desirable)
+ Optical Penalty 1 dB (Example)
= Optical Loss Budget: 26-29 dB
- (3) 20 km transmission required

■ Keep existing services

Analog Video Service: WDM (@1550-1560nm) required

■ Economic requirements for parts

- (1) ONT Transmission: DFB-LD direct modulation
Receiving: PIN-PD
- (2) OLT Trans.: DFB-LD direct modulation; Receiving: APD
- (3) Margin for mass production (Launched power range: > 5 dB;
Minimum Receiver Sensitivity margin: > 3 dB)

Limitations of 1G EPON Technologies for 10G

■ Downstream 10 Gbit/s:

- The critical transmission distance is 10 km due to dispersion characteristic of existing fibers (in case of Direct modulation).

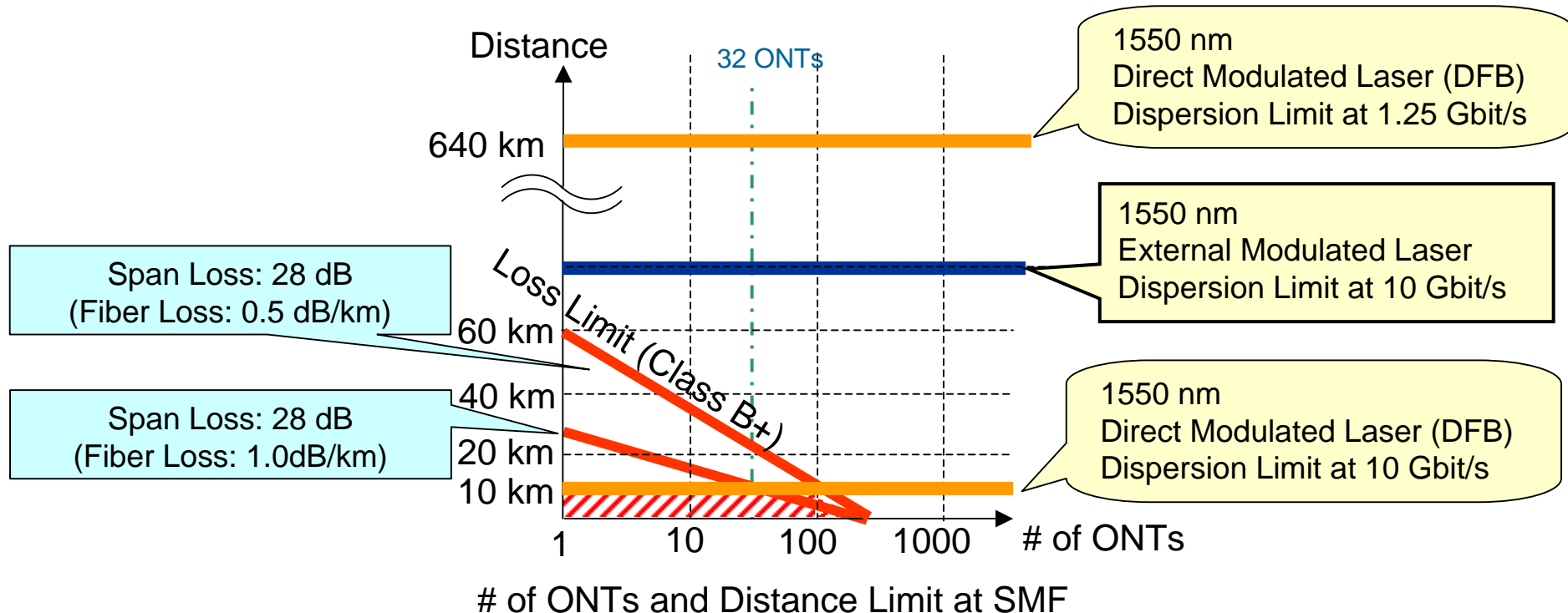
■ Upstream 10 Gbit/s:

- Burst Receiving: Detection of levels between bursts.
Need consideration of preamble length for detecting levels and also sampling clock (more than 3 years are needed?).
- Receiving Sensitivity: Considering power budget.
Bit rate could be no more than 2.5 Gbit/s.

Influence of Dispersion Characteristic of Fibers (Downstream)

Dispersion of Fiber makes Maximum Transmission Distance to 1/64 of 1G-EPON's
(The Max. Trans. Distance is approximately in inverse proportion to the 2nd power of bit rate when power penalty of dispersion remains the same)

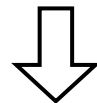
-> Using external modulation expands the distance limit, but how could we cover the additional cost?



Receiver's Characteristics (Example)

	Minimum Light Receiving Power Sensitivity			
Down-stream	PD		APD: Higher Cost	
	Average	Best	Average	Best
1.25G	-24.0 dBm^(*1)	-27.0 dBm	-30.0 dBm	-33.0 dBm
2.5G	-21.0 dBm^(*2)	-24.0 dBm	-27.0 dBm ^(*3)	-30.0 dBm
10G	-15.0 dBm	-18.0 dBm	-21.0 dBm	-24.0 dBm

To secure Loss Budget 29 dB,
Transmission power should be +14 dBm



However, higher transmission power may cause Stimulated Raman Scattering to the analog video wavelength (1550-1560 nm).

*1: IEEE 802.3ah PX20

*2: ITU-T G.984.2 class B

*3: ITU-T G.984.2 class B+

■ Technical Issue

- Need more years to study Upstream 10 Gbit/s feasibility

■ Economical Issue

- Challenge to transmit more than 10 km distance in the existing fibers with current 1G-EPON based technology
- Even if we adopt Upstream 2.5 Gbit/s, it may take about 4 years to realize the same cost as of current 1G-EPON

■ Totally

- We need to discuss optimum system first including fiber characteristics

■ Others

- Challenge to keep analog video service due to Stimulated Raman Scattering to the analog video wavelength (1550-1560 nm)