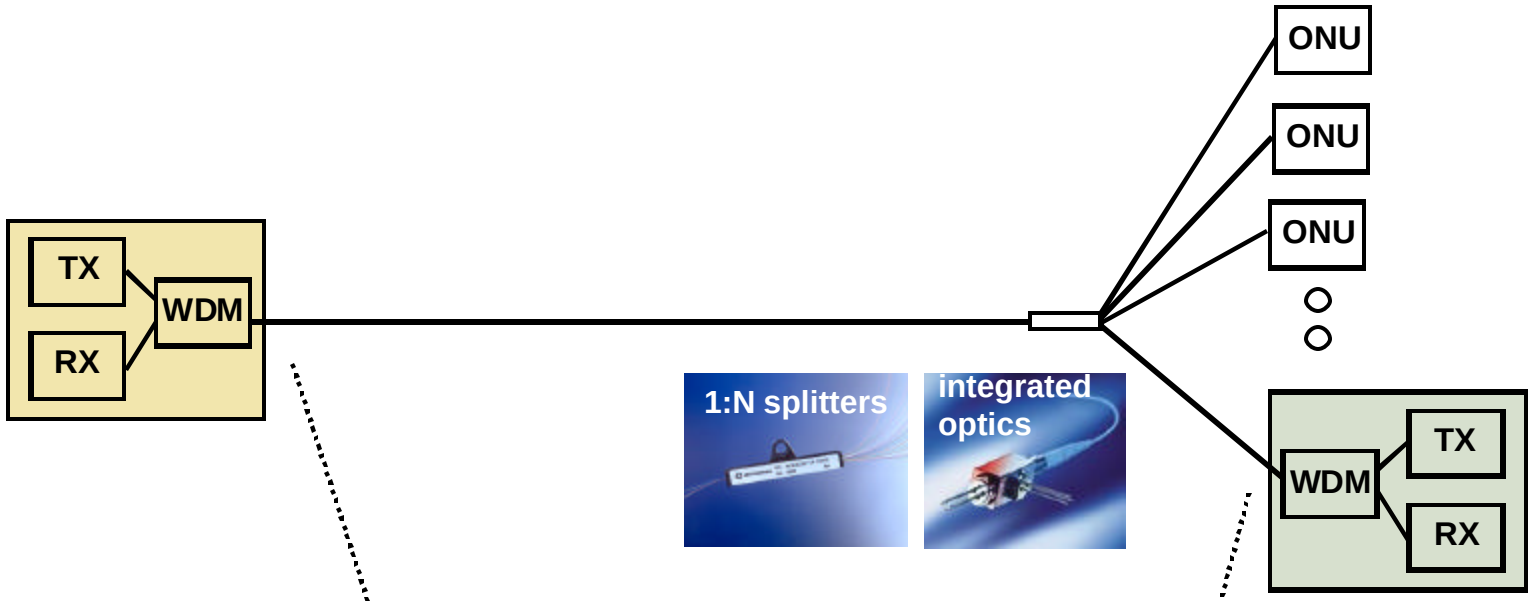
Technical and Economic Feasibility of EPON Transceivers

Anderson, Tony – Zonu
Diab, Wael – Cisco
Gilliland, Patrick - Stratos
Gunning, Shane - Agere
Kabal, David – Picolight
Kuo, JC – Alloptic
Levi, David – Broadlight
Murphy, Tom – Infineon

Optical Power Budget Variables



Central Office OLT

Integrated OLT Transceiver

WDM = Filter, Fused

TX = DFB, VCSEL

RX = PIN, APD

Outside Distribution Network (ODN)

Fiber Loss

Connectors / Splices

Penalties: Modal, Interference

Splitter(s)

Indoor/Outdoor ONU

Integrated ONU Transceiver

WDM = Filter, Fused

TX = FP, DFB, VCSEL

RX = PIN

Optical Link Budget Analysis

1310 FP	
Fiber	5.0 dB
Connectors	2.0 dB
Other Model	2.6 dB
1:16 Splitter	14.3 dB
Power Budget	**23.9 dB**

1310 DFB/VCSEL	
Fiber	5.0 dB
Connectors	2.0 dB
Other Model	1.1 dB
1:16 Splitter	14.3 dB
Power Budget	**22.4 dB**

1550 DFB	
Fiber	3.0 dB
Connectors	2.0 dB
Other Model	1.1 dB
1:16 Splitter	14.3 dB
Power Budget	**20.4 dB**

Assumptions

1310 nm = 1280 to 1350 nm
FP = 2.8 nm, k=0.5
DFB = 0.2 nm, k = 0.0
VCSEL = 0.2nm, k = 0.0
Fiber Attenuation 0.5 dB/km for 1310 window
Fiber Attenuation 0.3 dB/km for 1550 window
1:16 Splitter 14.3 dB max
1:32 Splitter 17 dB max
Connectors 2.0 dB
Temperature –40 to +85C
Integrated Transceiver Isolation 35 dB

Technical Feasibility

Laser	Link Budget	ONU BIDI Laser Power in fiber	OLT BIDI Receiver in fiber
1310 nm FP	**23.9 dB**	-2.1 dBm (FP) -6.1 dBm (FP)	-26 dBm (PIN) up -30 dBm (APD) up
1310 nm DFB/VCSEL	**22.4 dB**	-3.6 dBm (DFB)	-26 dBm (PIN) up
1550 nm DFB	**20.4 dB**	-5.6 dBm (DFB) -3.6 dBm (DFB)	-26 dBm (PIN) up -24 dBm (PIN) dn

Laser and Detector Combinations for 10 km, 1:16 PON
Optical power dBm is specified in fiber in front of optical module (BIDI)
Link Budget is the same for upstream and downstream

Economic Feasibility

Transceiver Normalized Cost Table	**PTP FP 1310 nm (2 l)**	**PTMP FP 1310nm (indoor)**	**PTMP FP 1310nm (2.8 nm + heater)**	**PTMP DFB 1310nm 1550nm (> -20°C)**	**PTMP DFB 1310nm 1550nm (+ heater)**	**PTMP 1310nm VCSEL (Temp?)**
Required power budget	8.7dB	23.9dB	23.9dB	22.4dB 20.4dB	22.4dB 20.4dB	22.4dB
Min. output power in fiber	-11.3dBm	-2.1dBm	-2.1dBm	-3.6dBm -5.6dBm	-3.6dBm -5.6dBm	-3.6dBm
Min. sensitivity in fiber	-21.0dBm	-26.0dBm	-26.0dBm	-26.0dBm	-26.0dBm	-26.0dBm
E/O (Laser)	14	24	35	52	52	14
O/E (PIN/TIA)	10	10	10	10	10	10
WDM filter chip	7	7	7	7	7	7
Optical assembly & test (Bi-directional optic)	30	30	30	30	30	30
El Cheapo heater	0	0	7	0	7	0
Electronic components	25	25	25	25	25	25
Circuit board assembly	7	7	7	7	7	7
Module assembly	7	7	7	7	7	7
Relative	**100**	**110**	**128**	**138**	**145**	**100**

Summary

Based on the analysis, EPON Transceivers are technically and economically feasible.