



For efficient high subscriber density and long-distance transmission

OEO-Based TDMA-PON Reach Extender(RE) Access Network Technology

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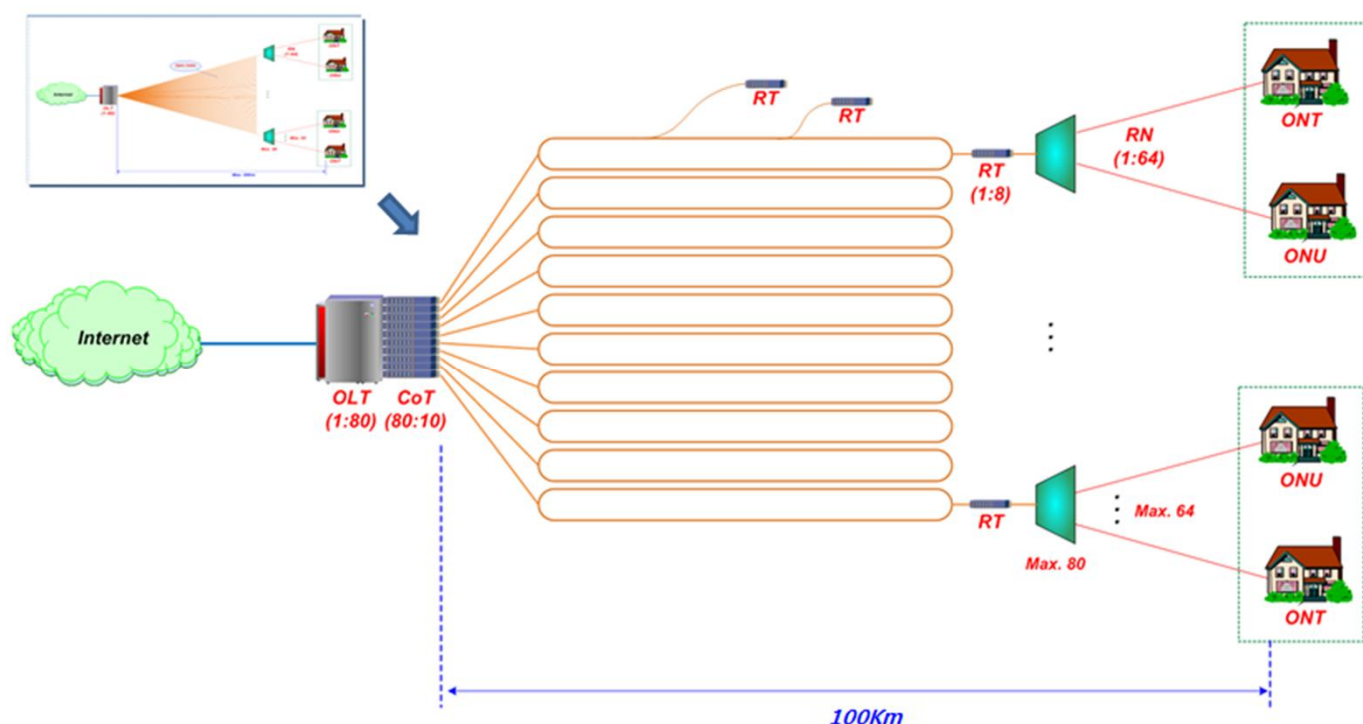
TECHNOLOGY BRIEF

OEO-based PON Reach Extender Technology

Technology Overview

By applying the Reach Extender(RE) technology to the PON link without any change of the legacy PON equipment, the following was available for the technology: expansion of the transmission distance between OLT and ONU from 20km to 100km, accommodation up to 128 customers per PON port, expansion of more than 8 times the original link capacity per PON link through the WDM technique.

- Composed of COT and RT



Keywords

Reach Extender, PON Extender, TDMA-PON, Long-reach PON etc.

TRL 6

Technology Classification Code		
Sector	Sub Sector	Industry
Network	System	Access Network

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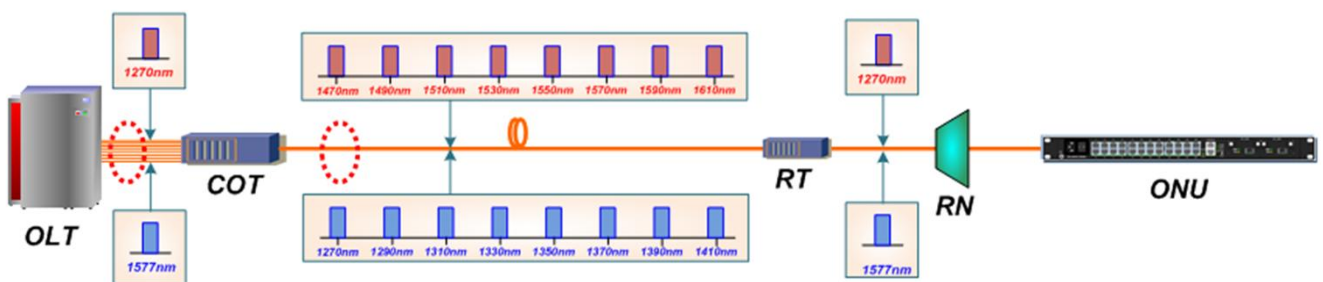
Technology Description

- ▶ **PON elemental technology** that can expand the link capacity per optical fiber by applying the WDM technology at the Feeder section, and that can expand the link budget of 59dB through a signal retiming at remote site
- By the increased link budget, the technology provides at most 100km distance and up to 128 customers
- Optical fiber reduction technology that converts the several PON signals to WDM signals through multiplexing of WDM
- Cost-insensitive FTTH services that expand the coverage area from near-end urban users to far-end rural customers



Specific Technologies

- **PON COT Platform:** Installed together with legacy OLT equipment at central office, PON signals are transmitted and received to single feeder fiber through a WDM wavelength converting
- **PON RT Platform:** Installed at remote nodes, legacy ODN is accommodated by converting the WDM signal back to PON signal, and supports a long-distance transmission through a burst-mode signal detection and restoration



Application Fields

FTTH Service

- **Broadening telecom service:** cost reduction of the access network by the integration of the original telecom companies
- **Optical fiber reduction service:** fiber cost reduction due to multiplexing of many PON signals in single optical fiber
- **Long-reach FTTH service:** provides the same optical wide range service for the minority users without new installations

■ Outstanding Features

- Can be applied to all original WDM technology and low-cost PON OLT/ONU optical transceiver
- Can provide functions that process and retune the burst-mode signal through low-cost FPGA

► Features and pros

- Compatible with the original PON OLT/ONU equipment and applicable easily in the access network
- PON Reach Extender line card is applicable for 1G-EPON, 2.5G-GPON, 10G-EPON through the same platform
- Based on the long-distance transmission technique, a telecom company can manage and conserve metro and access equipment

► Superiority over other technology

- Alternative technology
 - SOA-based PON Reach Extender technology
 - High-power PMD technology
- Superior features
 - 1/8 the price of the SOA technology(Burst mode SOA development request)
 - Additional Gain provided, more than 5dB
 - WDM technology applied to PON link
 - 10Gbps PON technology applicable

Items	SOA-based RE	High-power PMD	OEO-based RE
Layer	L0	L0	L1
Upstream Mode	Burst	Burst	Burst or Continuous
Link Budget	54 dB	33 dB	59 dB
Splitting ratio@reach (Under worst-case ODN)	1:64@50km	1:64@40km	1:128@100km
Remote Management	No	No	Yes (SNMP)
WDM	Bursty WDM	Bursty WDM	Continuous WDM

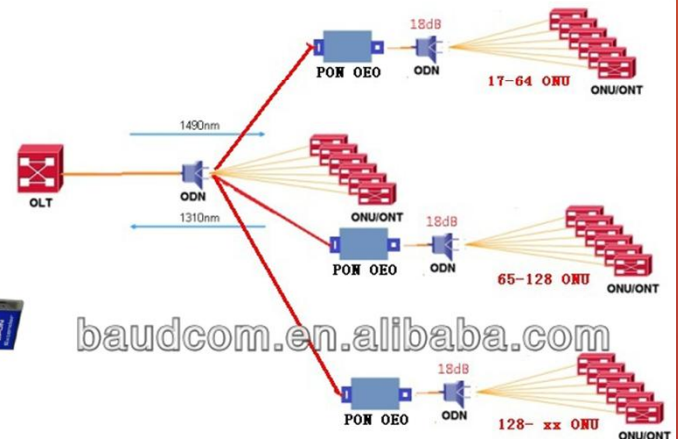
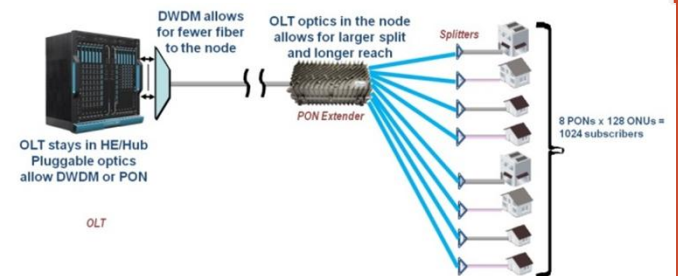
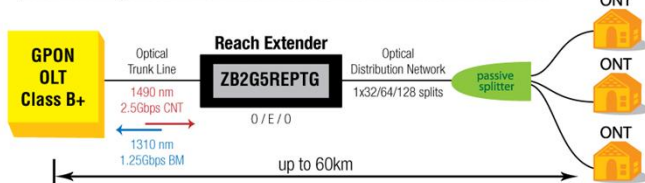
■ IPR Status

No.	Country	Application Number (date)	Status	Title
1	US	9077477(2015.07.07)	Registered	Continuous-mode wavelength conversion apparatus, burst-mode wavelength conversion apparatus, remote termination apparatus, and central office termination apparatus
2	US	8548329(2013.10.01)	Registered	Apparatus and method for relaying in Gigabit Passive Optical Network

□ Technology Trend

- Communications businesses request more money for the decrease in efficient cost in improving the access network
- Normally Reach Extenders for 1st generation PON (EPON, GPON) are developed, WDM cannot be accommodated

Basic Configuration for Extension of Transmission Distance



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□ Korea

- Netvision Telecom commercialized the 1st gen PON Reach Extender through the transfer of ETRI technology
- In 2012, CJHV put EPON Reach Extender into test service
- Dongwon T&I is commercializing CWDM base EPON Reach Extender using ETRI technology to upgrade the KT access network
- Compatibility test for ubiquitous 10G-EPON OLT/ONU used in ETRI's 2nd gen PON Reach Extender was completed
- KT is trying to graft the WDM technology onto the 1st gen PON service network to enhance their access network

□ Global

- In North America, 1st gen PON Extender is commercialized mainly with Go!Foton and Commscope
- China is mainly releasing mini RT products for the 1st gen PON
- Emerging countries such as Brazil and Russia, are highly interested in applying the PON Extender and prefers the set up of WDM base PON link in FTTH infrastructure
- Great Britain's British Telecom is processing the LR-PON project to cover a wide area for the telecom company
- North America's cable TV businesses request services with transmission distance of 100km

■ Market Trend

- In 2012, the global PON market was at a level of about 4.5 billion dollars, and long-distance transmission issue was brought up for the structural improvement of recent 1st gen PON access network
- In 2017, the market is predicted to be about 4.3 billion dollars, and the 10G-EPON market is predicted to grow up to 950 million dollars

▶ Global PON Market (2012-2017, Unit: 100 million dollar)

	2012	2013	2014	2015	2016	2017
BPON	-	-	-	-	-	-
1.25G/2.5G EPON	1,967	1,300	1,224	1,060	929	811
10G EPON	1	17	100	223	485	952
2.5G GPON	2,523	2,792	2,504	2,366	2,191	1,989
10G GPON	-	8	32	102	262	553
Total	4,491	4,118	3,860	3,751	3,868	4,305

- KT is considering the application of 8 channel CWDM-based PON Reach Extender for the improvement of 1st gen PON market's network and through the application, the demand for the 1st gen PON Reach Extender is expected to increase
- Globally, depending on the customer's bandwidth demands, 2nd gen PON technology started to be applied and the demand for 2nd gen PON Reach Extender will increase as well

□ Market Leaders

▶ Global Vendors

- Go!Foton
- Commscope
- Aliphion

▶ Korean Vendors

- Netvision Telecom
- Dongwon T&I

□ Technology Demand

Application	<ul style="list-style-type: none"> • PON-based FTTH Service • PON Equipment Vendors
Industry	<ul style="list-style-type: none"> • FTTH Service Network

■ Scope of Technology Transfer

- **PON link's optical fiber decrease/long-distance transmission, circuit blueprints for the 1st gen PON Reach Extender, PCB Gerber data, test procedure and result documents, ordinary license for the patent**
- **PON COT Platform**
 - 4-channel PON COT circuit technology (PCS schematic, Gerber data)
 - 9-channel WDM MUX/DEMUX technology
 - Transceiver monitoring technology
 - Relevant Technology Documents
 - Test and measurement method technology
- **PON RT Technology**
 - 2-channel PON RT circuit technology (PCS schematic, Gerber data)
 - FPGA design technology and source code for the signal retiming at an upstream and downstream
 - Transceiver monitoring technology
 - Remote control technology (SNMP)
 - Relevant Technology Documents

■ Applications and Effects

► Applications

- 19 inch multi-channel support platform product
 - Optical core reduction service network applied through the accommodation of 4 channel, 8 channel WDM
- Standalone mini devices
 - Applied to outdoor networks that can support long distance transmission without WDM accommodation

► Effects

- Access network's structure improvement
 - A flexible network is possible through long-distance transmission and WDM linkage, management and operating expenses can be highly enhanced through equipment centralization
 - Equal service for the long-distanced minorities
 - 10G PON effective operation possible, Giga Internet service provided

