ETRI

For radio wire optical access network

PON(Passive Optical Network) System

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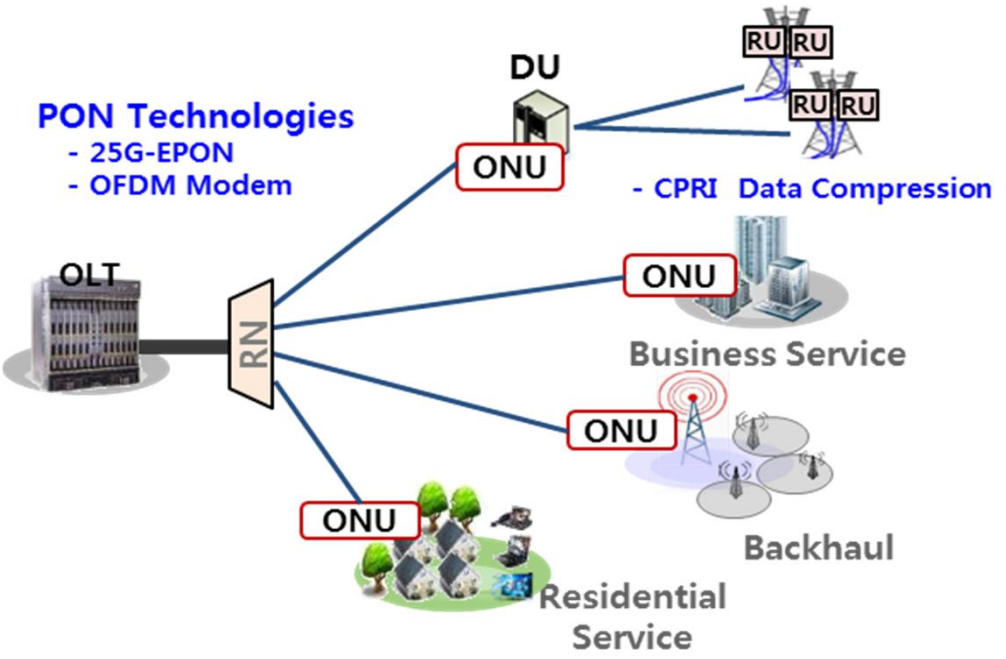
TECHNOLOGY BRIEF

PON(Passive Optical Network) System

▣ Technology Overview

Core technology of optical access network for build mobile communication back haul/ front haul and wire access network by using optical fiber. This 25G-EPON MAC optical transceiver technology, real time OFDM-PON modem technology, CPRI data compression technology for front haul section's transmission capacity reduction allows maximum 25Gb/s of transmission speed.



☐ **Keywords** | 25G-EPON, MAC, Optical Transceiver, OFDM Optical Modem, CPRI, Data Compression

☐ **TRL** 5

Technology Classification Code		
Sector	Sub Sector	Industry
Network	System	Access Network

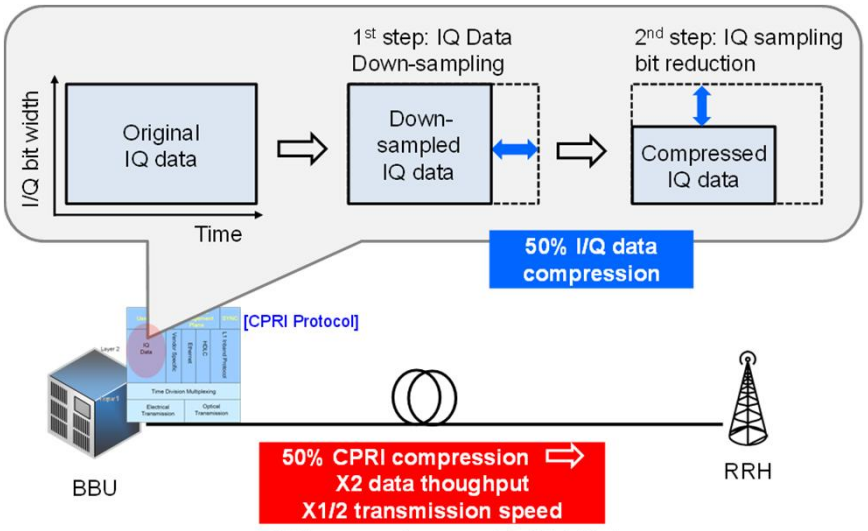
TECHNOLOGY BRIEF

PON(Passive Optical Network) System

▣ Technology Description

▶ Technical details

- 25G-EPON technology : As a technology of 25G-EPON OLT/ONU MAC and optical transceiver, provides minimum data transfer speed of 25.78125Gb/s and maximum of 10.3125Gb/s
- OFDM optical modem : Supply OFDM modem and optical transceiver technology which perform physical layer function in OLT of OFDM-PON system and ONU
- CPRI compress FPGA technology : Supply VHDL coding type and operations control technology for EVM board. It allows Up-down Sampling compression, Non-linear Quantization compression, Block Scaling compression and Partial-bit Sampling compression technology to realize in FPGA.



[CPRI compression concept in BBU side]

▣ Application Fields

▶ General/Business/Back haul/Front haul network

- Apply to mobile communication network such as mobile communication back haul/front haul
- Apply to a wide area access, business subscriber and optical transmission field in data center
- Apply to separated base station using CPRI interface
- Apply to separated base station using OBSAI interface
- Apply to digital optical repeater section

▣ Outstanding Features

- **Use as core technology for increase capacity and distance of next generation optical access network.**
- **It can reduce OPEX/CAPEX investment cost and is needed for increase of LTE/LTE-A traffic.**

▶ Advantages and features of this technology

- **OFDM optical modem technology is OFDM FPGA technology that allows high-speed signal processing. It has high spectrum efficiency by using high-speed parallel technology and 64QAM OFDM signal modem processing technology that enables 10Gb/s real time processing.**
- **CPRI compression technology includes Block Scaling technology, known as IQ compression technology among CPRI data, Non-linear Quantization technology and self-developed Partial-bit Sampling technology. It provides Up-Down sampling by compression technology.**
- **Below the 0.1% EVM for 20km transmit, under 5μsec for additional delay time**

▶ Predominance of this technology

- **Block Scaling compression technology**
- **Non-linear Quantization technology**
- **EVM & additional delay characteristics using FPGA logic**

Items	Non-linear Quantization	Block Scaling	Partial Bit Sampling
EVM degradation (input EVM = 1.5 %)	0.01 %	0.04 %	0.16 %
EVM degradation (input EVM = 2.8 %)	0.01 %	0.02 %	0.08 %
One-way latency	3.2~4.2 μsec	4.8~5.8 μsec	3.2~4.2 μsec
FPGA logic utility	100 %	29.7 %	27.7 %

▣ IPR Status

Apply 2 case of domestic patent

▣ Technology Trend

- Technology standardization of NG-EPON, a next generation EPON technology, was started at IEEE802.3 since 2015, research of associated candidate technologies are in its beginning stages.
- ITU-T completed NG-PON2 standardization, and modulation systems such as OFDM are debated to increase transfer speed and distance per wavelength as a next generation optical access network.
- Heavy increase of data between separated base station because of LTE/LTE-A traffic capacity increase.
- ETSI ORI(Open Radio equipment Interface), international standard, standardized CPRI data compression technology.

□ Korea

- In 2014, ETRI developed optic module and MAC technology for NG-PON2 optical access network. This technology accommodates 4 channels with speed of 10Gbps, and its system capacity is 40Gbps.
- In Jun 2014, SKT developed CPRI compression technology with Ericsson. This technology reduced mobile front haul transfer capacity between DU-RU to 50%.
- In Dec, 2014, regardless of existing CPRI compression technology, SKT separated mobile access PHY function to RU and DU section with NOKIA-SIEMENS. It reduced transfer capacity of mobile front haul to 25%.

□ Global

- By researching digital signal process function realization technology which is core factor of OFDMA-PON since 2009, Bangor University in England realized optical modem of 11.25Gb/s OFDM for the first time.
- ETSI ORI legislated the standard including requirements and IQ data algorithm about CPRI compression technology in Octm 2014.
- Denmark Comcores realized IQ data compression technology that specified at ORI release 4 and sold in IP form.

▣ Market Trend

- Transfer speed of optical access network transceiver is showing tenfold increase of speed over ten years.
- GPON and EPON evolved into XG-PON and 10G-EPON respectively, and also are under standadization to NG-PON2 and 100G-EPON.
- While Ericsson comprises 1st position in mobile communication equipment market based on 2014, Chinese vendors are recording comparable sales with Ericsson.

▶ Global market size of PON equipment and wireless back haul equipment (unit: billion dollars)

Year	2015	2016	2017	2018	2019
Market size	2,726	3,107	3,580	4,097	4,702

▶ Major vendors and market trend

- Currently DASAN Networks, Ubiquoss and Tellion are producing optical subscriber equipment, but the global market share is less than 5 percent.
- Since 2013, tellion is pushing ahead the development of NG-PON2 system.

□ Market Leaders

▶ International Vendors

- Huawei, ZTE, ALU, Ericsson

▶ Domestic Vendors

- DASAN Networks, Ubiquoss, HFR

□ Technology Demand

Application	PON based optical access network business or equipment development business
Industry	FTTH network, mobile back haul/front haul

▣ Scope of Technology Transfer

- 25G-EPON MAC/optical transceiver technology
  - 25G-EPON OLT MAC FPGA technology
  - 25G_EPON ONU MAC FPGA technology
  - 25G-EPON optical transceiver technology
  - Source code, detailed design description, other technical documents
- 10Gb/s real time process OFDM optical modem FPGA technology
  - HDL source and development environment for realization of OFDM optical modem function
  - circuit design technology of 10Gb/s real time process OFDM optical modem
  - Source code, detailed design description, other technical documents
- CPRI compression FPGA technology
  - CPRI compression technology requirement definition
  - CPRI compression technology structure specification
  - CPRI compression technology FPGA realization manual
  - CPRI compression technology test procedure and results
  - CPRI compression technology MATLAB file and MATLAB development environment fie
  - CPRI compression technology VHDL file and Xilinx development environment file
- CPRI compression technology chip management, control technology
  - Xilinx development environment file and VHDL file for CPRI Framer/Deframer matching
  - CPRI compression technology chip management, control C file and SDK development environment file

▣ Applications and Effects

▶ Expected application products

- 100G-EPON system
- OFDM-PON system
- DU-RU separated base station equipment
- Digital optical repeater equipment

▶ Expected effects

- Apply to broadband mobile communication infra(back haul, front haul) providing technology
- Provide high-speed internet service(more than 10Gb/s speed per cable) to subscriber
- Improve competitiveness of domestic system price and get import-substituting effect by CPRI compression technology that can be used to domestic mobile communication equipment company
- Since it includes worldwide standard technology, domestic companies can try overseas expansion by localization