Commercialization of FTTH System for Cable-TV Operators

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A large number of cable-TV operators in Japan are intensely competing with carriers. Also, cable-TV operators are currently considering installing the FTTH systems as an effective solution since their current aging HFC (Hybrid Fiber Coaxial) systems need to be replaced. Broad Net Mux Corporation (BNMUX) has offered the best solution for these cable-TV operators. This paper introduces the features of the FTTH products developed based on the combination of BNMUX's HFC technology and Sumitomo Electric Industry Group's optical fiber and high-speed communication technologies.

Keywords: cable-TV, FTTH, optical transmitter/receiver, optical amplifier, GE-PON, ONU

1. Introduction

Nowadays, the environment surrounding cable-TV operators is undergoing major challenges. One of such challenges is the growing competition with other business operators such as major carriers or satellite broadcast operators. Cable-TV operators have been faced with intense competition particularly with carriers, who have developed the FTTH systems and provided the video streaming services including terrestrial, BS, and CS broadcasts with the FTTH system and the high-speed communication service with GE-PON systems as their strength. Another challenge is that the existing hybrid fiber coaxial (HFC) system used by cable-TV operators will need to be renewed in the near future. Many cable networks have been in use for about ten to twenty years, and there are growing concerns about service suspension or quality loss due to the deterioration of the equipment. Towards the renewal of the aging cable network equipment, some of cable-TV operators have introduced the FTTH systems as carriers have in order to provide more competitive services, even though their facility circumstances and operational conditions are different from those of the carriers. In the future, this will likely be the mainstream replacement method for cable network equipment. Broad Net Mux Corporation (BNMUX) has been providing the best products and systems for adopting the FTTH system to the cable networks by combining Sumitomo Electronic Group's optical fiber technology and high-speed communication access technology, including the GE-PON system with BNMUX's acquired HFC transmission technology.

This paper describes the features of these products and systems, as well as our development efforts in this field.

2. FTTH System in Cable-TV Industry

The HFC system shown in **Fig. 1** is a commonly used cable network. In the HFC system, signals for TV, the Internet, and telephone services are transmitted to an optical node on the outdoor cable network via an optical fiber, and the optical signals are converted into electronic signals on the optical node, then various service signals are transmitted to the customer premises equipment (CPE) via a coaxial cable. Since there is active equipment on the outdoor cable network, such as an optical node and a coaxial amplifier, a power supply is necessary to feed them.

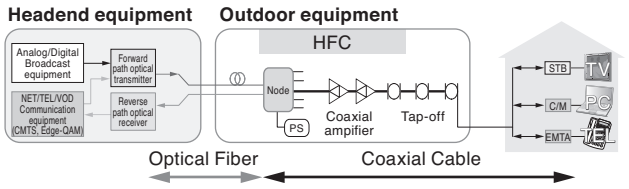

Fig. 1. HFC System

The FTTH system will be increasingly used by cable-TV operators in the future. There are two FTTH system installation methods, one uses the GE-PON system as shown in **Fig. 2**, and the other uses an RFoG*1 system that can be

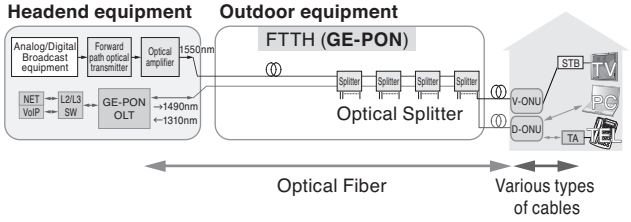

Fig. 2. FTTH System with GE-PON

used with the existing communication system equipment (cable modem equipment) as shown in **Fig. 3**. The cable-TV operators can choose either of them depending on their situation in the market, installation scale of existing communication equipment, and the number of CPE.

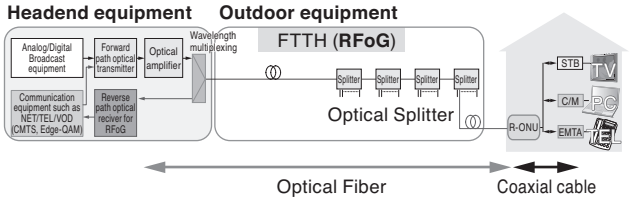

Fig. 3. FTTH System with RFoG

3. Overview of FTTH Major Equipment Functions and System Requirements

3-1 Overview of broadcast equipment

A forward path transmitter and an optical amplifier have been used in both systems, GE-PON and RFoG, on the broadcast equipment at the headend. Only the RFoG system requires a reverse path receiver. V-ONUs are used for receiving a video signal in the GE-PON system, and R-ONUs, for the video and data signals in the RFoG system.

(1) Forward path transmitter

This transmitter can convert RF signals for TV, the Internet, and telephone services provided by cable-TV operators into optical signals, using an optical wavelength range of 1550 to 1560 nm.

(2) Optical amplifier

This unit can amplify an optical signal received from an optical transmitter. The FTTH system requires from hundreds to thousands of optical output ports; therefore a large number of optical amplifiers are needed.

(3) Reverse path receiver (in the RFoG system)

This receiver can convert an optical signal received from CPE into an electronic signal, and is used in the RFoG system only.

(4) V-ONU (video-optical network unit)

This unit is installed on CPE, and can convert a video optical signal into an electronic signal. Currently, a high-sensitive V-ONU is commonly used under the condition that only a digital modulation TV signal (OFDM/QAM modulation) is received.

(5) R-ONU (RFoG-optical network unit)

This unit for the RFoG system is installed on CPE. It is equipped with a video receiver function as well as a laser diode (LD) to convert an electronic signal into an optical signal. The LD is automatically switched to a burst emission mode to output an optical signal, only when a forward RF signal is sent from CPE.

3-2 Overview of communication equipment (GE-PON)

In the cable-TV industry, an IEEE802.3ah-compliant GE-PON system is commonly used in the FTTH system for communication services. The GE-PON system consists of an optical line terminal (OLT) installed at the headend and data-optical network units (D-ONUs) installed at the ONU.

(1) OLT

This unit is installed at the headend, handling multiple D-ONUs connected to optical fiber feeder lines divided by an optical splitter. It can provide broadband access lines, such as Internet access. A cost-effective communication network can be built with only one optical fiber by multiplexing the optical signal on the forward and reverse paths between the OLT and D-ONUs.

(2) D-ONU

This unit is for data communication with an OLT via optical fiber. It is equipped with an Ethernet LAN to connect to a PC, broadband routers at CPE, or VoIP terminal adapter.

(3) GE-PON management system

This system is equipped with necessary functions for cable-TV operations to make it easier to configure an OLT and D-ONUs, manage equipment conditions, search records, and consolidate multiple OLTs and D-ONUs.

3-3 Requirements of FTTH system for cable-TV

Cable-TV operators and major carriers use different FTTH equipment and systems as shown in **Table 1**, and accordingly the operational conditions and requirements for FTTH products are different.

The requirements for communication equipment includes not only installing functions to provide an equivalent level of services and operations as cable modem communication services provided by cable-TV operators, but also cost effectiveness. In the cable-TV industry, an IP address is generally assigned by DHCP[*2]. Therefore, installing a function to support such an assignment is a key to the development of GE-PON systems for the cable-TV market.

4. Features of BNMUX FTTH system

BNMUX has developed an advanced FTTH system, which further enhances the satisfaction of cable-TV operators more than the requirements stated in **Table 1** and supports flexible operation. The features of the BNMUX products for the broadcast and communication services are as follows:

4-1 Broadcast equipment

(1) BN8200C Series (optical transmitter/receiver, optical amplifier)

In the past, BNMUX assembled the chassis structures based on functions. However, to achieve further high-density mounting, BNMUX has developed major FTTH broadcast equipment, such as the optical transmitter, receiver, and amplifier on the assumption that all of them are mounted on one chassis to enable further high-density mounting. This integrated headend equipment, BN8200C Series shown in **Photo 1**, can be mounted on a 3U chassis with up to 12 units. This is the highest mounting efficiency in this industry. Also, it can be operated by Simple Network

Table 1. Comparison with carriers

Item	Carrier	CATV operators	FTTH requirement for CATV
QTY of video channels	60 to 70ch	More than 100ch	High-quality video signal transmission ⇒ **Different fiber by video or data**
Communication equipment operational requirement	GE-PON equipment (Operation: PPPoE)	Cable modem equipment (Operation: DHCP)	**Continuous use of the exsiting method (DHCP) and equipment**
Headend equipment capacity	Small/Medium scale (1 hub per town)	Large scale (1hub per city)	Installation space can be reduced ⇒ **High density packaging**
Equipment type	FTTH equipment only	HFC & FTTH equipment (Dual equipment can be used until HFC is replaced with FTTH equipment)	
Area geographical characteristics	Urban to rural areas	Many of the operators cover only urban areas	Limiting the number of fibers ⇒ **QTY of outdoor branchings is increased**

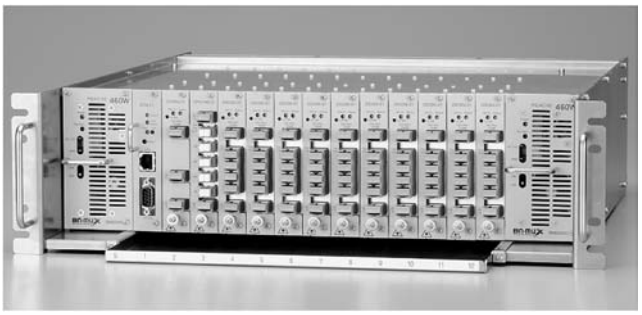

Photo 1. Integrated Headend Equipment (BN8200C Series)

Management Protocol (SNMP) and Web-IF. Thus, it can contribute to the efficiency in installation adjustment, repair, and maintenance work.

(a) Forward path transmitter (BN8200C-T2G6)

This directly-modulated optical transmitter can transmit BS and CS-IF signals (950 to 2602 MHz) in addition to cable-TV signals (70 to 770 MHz) which have been conventionally used. To respond flexibly to various installation circumstances and FTTH operation forms that cable-TV operators have, this forward path transmitter is equipped with two RF signal input ports so that it can be used in multiple ways. In the case of the RFoG system, it can transmit not only TV, Internet, and telephone signals, but also BS and CS-IF signals. One of these three types of signals can be input independently into the circuit if needed. Conventionally, the optical launch level is limited due to Stimulated brillouin scattering (SBS), which is a non-linear phenomenon, and for that reason the number of outdoor optical branches per fiber is limited to 64.

However, this transmitter can control SBS, and can achieve the optical launch level of +17 dBm and reduce the number of optical fibers installed in the service area by increasing the number of outdoor optical branches up to 128. **Table 2** shows the main specifications of this transmitter.

Photo 2. Forward Path Transmitter (BN8200C-T2G6)

Table 2. Main Specification of Forward Path Transmitter (BN8200C-T2G6)

Item	CATV band	BS/CS-IF band
Frequency bandwidth	70 to 770 MHz	950 to 2602 MHz
QTY of channels	Analog: 11 channels Digital: 80 channels	BS/CS 36 channels
RF input level	Analog: 78 dBμV Digital: 68 dBμV	68 dBμV
Optical wavelength	C25: 1557.36 nm / C27: 1555.75 nm C29: 1554.13 nm / C31: 1552.52 nm	
Optical output level	+8.5 dBm (7.0 mW) Typ.	
Noise performance (CNR)	Analog: 46 dB or more Digital: 34 dB or more	28 dB or more
Second distortion characteristics	Analog: -59 dB or less Digital: -49 dB or less	-31 dB or less
Third distortion characteristics	Analog: -58 dB or less Digital: -48 dB or less	-59 dB or less

(b) Optical amplifier (BN8200C-AMP Series)

In response to a request for the efficient optical signal amplification and distribution in the FTTH system, which requires huge quantities of the optical output ports, BNMUX has adopted the multi-port method with a two-stage amplifier configuration, pre-amplifier and post-amplifier, as shown in **Fig. 4**. This helps in allowing for 40 ports if the output power is +20 dBm, and 80 ports, if +17 dBm for one optical input port. This is the highest distribution efficiency in this industry.

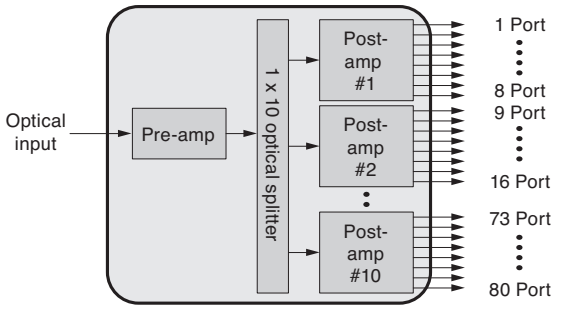

Fig. 4. Optical Amplifier Configuration (Output at +17dBm with 80 ports)

Photo. 3 Fully-populated Optical Amplifier (BN8200C-AMP Series) (Output at +17dBm with 80 ports)

(Fully populated optical amplifier shown in **Photo 3** can support 10,240 subscribers.) In addition, BNMUX has adopted the single cladding-pumped method with high device reliability for this amplifier. The post-amplifier has a four or eight port configuration to avoid a large-scale shutdown at the time of replacement. Such a configuration enhances device reliability, and even if equipment replacement is necessary due to certain contingencies, the influence can be limited to 1,024 households, equivalent to that of the HFC system. The pre-amplifier used in combination with a 1 × 10 splitter has a one port-type output configuration to support a system suitable for single output as with a transmission between the hendends. Thus, except for the multi-port method, this amplifier can be used in the various operation forms that cable-TV operators have. **Table 3** shows the main specifications of this amplifier.

(c) Reverse path receiver (BN8200C-4R100)

Unlike the HFC system, in the case of the RFoG system, an optical fiber is divided into 32 to 64 branches outdoors, then these divided optical fibers are connected to R-ONUs located farther on. Therefore, the optical operating level is significantly low. This receiver was developed for the RFoG system to achieve an optical operating level of -28 to -15 dBm, improving the responsivity and expanding the input range to be better than the HFC system. Also, compared to the HFC system, a large number of reverse optical input ports can be placed more effectively on this receiver by increasing the number of input ports from two to four, and installing up to 48 input ports on one chassis. Moreover, it is equipped with a function to block thermal noise generated inside the equipment, breaking an output circuit if there is no reverse signal. Thus far no Japanese manufacturers have been able to develop such a function. This development can significantly contribute to the improvement in noise elimination for reverse RF signals and to high-quality reverse path transmission. **Table 4** shows the main specifications of this receiver.

Photo 4. Reverse Path Receiver (BN8200C-4R100)

Table. 3 Main Specifications of Optical Amplifier (BN8200C-AMP Series)

Item				
Equipment name	Pre-optical amplifer	Post-optical amplifer	Post-optical amplifer	10 distribution optical splitter
Model code	AMP22URN-P01-01	AMP20DSN-P04-01	AMP17DSN-P08-01	OPS1W210
Optical output	+22 dBm × 1 output	+20 dBm × 4 output	+17 dBm × 8 output	10 distributions
Unit config.	Pre-amplifer: 1 unit + 1 × 10 splitter: 1 unit + Post-amplifer: 10 units			
Noise figure	4.5 dB or less	7 dB or less	7 dB or less	12.5 dB or less (insertion loss)
	6.5 dB or less (Pre+Post-optical amplifer)			

Table 4. Main Specifications of Reverse Path Receive (BN8200C-4R100)

Item	
Frequency bandwidth	5 to 100 MHz
Optical wavelength	1270 to 1610 nm (CWDM 18 wavelengths)
QTY of optical input port	4 ports
Optical input level	-28 to -15 dBm
RF output level	95 dBμV

(2) V-ONU (BNX1036SN)

This unit has transmission bandwidth that includes cable-TV, BS, and CS-IF bands, as with a forward path trans-

mitter. It is specialized for receiving digital modulation TV signals; therefore, compared to the conventional V-ONU, its responsivity is improved by 6 dB, and it can be operated at an input level of -14 to -6 dBm. With the improvement of the responsivity, the number of optical branches can be increased up to four times as much as the conventional ones (about 256 branches), and the number of optical fibers and optical amplifiers installed at the headend can be reduced. This achievement can contribute to cost-effective system establishment. Also, it can support various types of broadcast services that cable-TV operators provide, receiving analog signals under definite conditions and supporting the increase in the number of digital channels.

Moreover, it is equipped with a function to control ON/OFF of RF output for cable-TV, BS, and CS-IF bands by V-ONU from control equipment installed at a headend.

Table 5 shows the main specifications of this unit.

Photo 5. V-ONU (BNX1036SN)

Table 5. Main Specifications of V-ONU (BNX1036SN)

Forward path bandwidth spec.			
Optical input level		-14 to -6 dBm	
Frequency bandwidth		70 to 770 MHz	950 to 2602 MHz
QTY of channels	(Mode 1)	Digital 80 channels	BS/CS 36 channels
	(Mode 2)	Digital 112 channels	BS/CS 36 channels
RF output level	(Mode 1)	85 dBμV	85 dBμV
	(Mode 2)	83 dBμV	85 dBμV
Other			
Power consumption		5.5 W or less (100 V AC input)	
Dimension		H: 224 × W: 139 × D: 56 mm	
Weight		Approx. 0.5 kg (excluding accessaries)	

(3) R-ONU (BNX1230SN)

This unit has the following frequency bandwidth, forward: 2.6 GHz as with V-ONU, and reverse: 10 to 60 MHz. It is equipped with two modes: a burst light mode and an always-on mode. The burst light mode is known as a standard method for reverse transmission in the RFoG system. The always-on mode is controlled remotely to turn the light on even if there is no RF signal.

Photo 6. R-ONU (BNX1230SN)

Table 6. Main Specifications of R-ONU (BNX1230SN)

Forward path bandwidth spec.		
Optical input level	-8 to -2 dBm	
Frequency bandwidth	70 to 770 MHz	950 to 2602 MHz
QTY of channels	Analog: 11channels Digital: 80 channels	BS/CS 36 channels
RF output level	Analog: 95 dBμV Digital: 85 dBμV	85 dBμV
Reverse path bandwidth spec.		
Optical output level	+3 dBm	
Optical wavelength	1610 nm	
Frequency bandwidth	10 to 60 MHz	
RF input level	90 dBμV	
Other		
Power consumption	6 W or less (100 V AC input)	
Dimension	H: 226 × W: 142 × D: 50 mm	
Weight	Approx. 0.7 kg (excluding accessaries)	

In the always-on mode, a stable optical signal can be received at the headend at the time of the R-ONU initial installation and adjustment. That reduces the adjustment workload and time. The remote control function also controls the forward path, and "Through," "ATT6dB," and "Cut" of a reverse RF signal, as well as ON/OFF of optical output. **Table 6** shows the main specifications of this unit.

(4) MDU Node (BNX1310SN)

The RFoG system has an operational issue of optical beat interference (OBI) occurring when multiple reverse optical signals on R-ONUs are transmitted in synchronization with simultaneous transmission of multiple reverse RF signals for a communication service. The cause of this issue is that all the reverse optical signals on R-ONUs use a single wavelength, 1610 nm. In the case, such as the multidwelling units where one R-ONU supports a large number

of subscribers, OBI between this R-ONU and another R-ONU for other subscribers is a concern, since the emission frequency of this R-ONU increase. The MDU node can operate much the same way as the R-ONU; however, it was developed to avoid OBI in the RFoG system, and 18 wavelengths (1270 to 1610 nm) are available on the menu to support Coarse Wavelength Division Multiplexing (CWDM). This node with reverse wavelengths different from that of the R-ONU helps provide stable reverse transmission and communication services, preventing OBI between R-ONUs even if the emission frequency increases. In addition, this node can control the forward or reverse RF and optical signals when used with the remote control system as with R-ONU. **Table 7** shows the main specifications of this node.

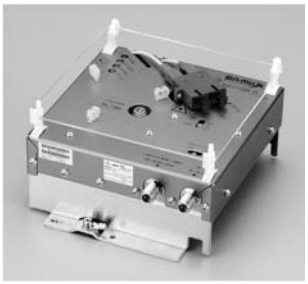

Photo 7. MDU Node (BNX1310SN)

Table 7. Main Specification of MDU Node (BNX1310SN)

Forward path bandwidth spec.		
Optical input level	-8 to -2 dBm	
Frequency bandwidth	70 to 770 MHz	950 to 2602 MHz
QTY of channels	Analog: 11channels Digital: 80 channels	BS/CS 36 channels
RF output level	Analog: 95 dVμV Digital: 85 dVμV	85 dBμV
Reverse path bandwidth spec.		
Optical output level	+3 dBm	
Optical wavelength	1270 to 1610 nm (CWDM 18 wavelengths)	
Frequency bandwidth	10 to 60 MHz	
RF input level	90 dBμV	
Other		
Power consumption	6 W or less (100 V AC input)	
Dimension	H: 151 × W: 132 × D: 79 mm	
Weight	Approx. 1.2 kg (excluding accessaries)	

4-2 Communication system equipment

(1) OLT (FSU6300)

In general, 16 PON line cards can be installed on one chassis; however, a PON line card (FCM6060-TS) with two PON ports was recently developed to increase the density of PON ports, and released for the cable-TV market. This development makes it possible to handle up to 2,048 D-ONUs per OLT chassis, reducing the number of necessary OLTs, and cut a rack space by half. Moreover, the following software functions are additionally installed to achieve sim-

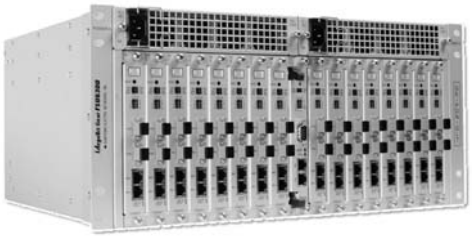

Photo 8. OLT (FSU6300)

Table 8. Main Specification of OLT: FSU6300

Item			Spec.
Chassis	Size	Dimension	Approx. W: 483 × D: 420 × H: 222 mm Hight: 5U
	Power supply	Input voltage	100V AC ± 10%
		Power consumption	With fully-populated: 400 W or less
		Configuration	2 port redundancy cofiguration
	QTY of Installable line cards and ports		Line card: up to 16 cards PON port: 32 port
Line card	PON I/F	QTY of ports	2 ports
		Physical I/F	SC connector
		Compliance standard	1000BASE-PX20
		Optical output signal wavelength	1480 to 1500 nm
		Optical output power range	+3.5 to +7 dBm
		Allowable wavelength range of optical input signals	1260 to 1360 nm
		Allowable power range of optical input signals	-29.5 to -11 dBm
		Power budget	29 dB
		Optical link module type	SFP type
	SNI I/F	QTY of ports	2 port
		Physical I/F	RJ-45
		Compliance standard	1000BASE-T/100BASE-TX
Control card	Interface for monitoring control	QTY of ports	2 port
		Physical I/F	RJ-45
		Compliance standard	100BASE-TX/10BASE-T

ilar operation to a cable modem, as requested by cable-TV operators. ①**The tracing function for an IP address that a subscriber uses under DHCP operation:** internet providers are obliged to identify a sender of information and provide the information related to the sender. It is also necessary to manage the records of IP addresses used. For this reason, the OLT can trace the IP address and ONU used by monitoring the packets of ARP[*3]/NDP[*4] to be sent. ②**The IP masquerade prevention function:** An IP source guard function has recently been developed to block any communication with an IP address other than the IP address assigned by DHCP to prevent a subscriber from deliberately using a static IP address without authorization. ③**The broadcast storm detection/prevention function:** This function automatically detects a failure and stops D-ONU, which is a source of the failure, to prevent a large-scale communication failure caused by a large amount of undesired broadcast packets generated due to improper connections.

Table 9. Main Specification of D-ONU FTE6083

Item			Spec.
Size		Dimension	W: 114 × D: 158 × H: 37 mm
		Weight	Approx. 300 g
		Power supply	100 VAC ± 10%
		Power consumption	5 W or less
I/F	LAN1	Physical I/F	RJ-45
		Compliance standard	1000BASE-T/100BASE-TX/ 10BASE-T
	LAN2	Physical I/F	RJ-45
		Compliance standard	100BASE-TX/10BASE-T
	PON	Physical I/F	SC connector
		Compliance standard	FTE6083-BAN: 1000BASE-PX10 FTE6083-BAL: 1000BASE-PX20
		Optical output signal wavelength	1260 to 1360 nm
		Optical output signal power	-0.5 to +4 dBm
		Allowable wavelength of input optical signals	1480 to 1500 nm
		Allowable power of input optical signals	-25.5 to -3 dBm
		Optical power monitor	Optical input signal power can be monitored

Photo 9. D-ONU (FTE6083)

(2) D-ONU (FTE6083)

In the cable-TV market, it is necessary that one D-ONU should provide both an Internet access service and a primary telephone service. FTE6083 has two LAN ports so that it can be connected to a terminal for Internet access, such as a PC, and to a VoIP terminal adapter for the primary telephone service. Quality of Service (QoS) can be also set for each port. As with a cable modem, this D-ONU has a circuit to measure optical input and output power levels. Thus, this function can help maintain the GE-PON system by monitoring power levels remotely from the management system at the headend.

(3) GE-PON management system (GPMS1000)

This system is equipped with functions listed in **Table 10** to configure an OLT and D-ONUs individually, monitor equipment operational conditions, and search a specific ONU. In response to particularly strong requests from cable-TV operators, an automatic entry function has been developed to install D-ONUs without the prior confirmation and registration of an OLT. With this function, the individual configuration information of each D-ONU can be automatically entered to the OLT port when this management system receives a connection request SNMP trap message from unregistered D-ONUs. This function enables a similar operation to that of a cable modem as cable-TV operators requested.

Table 10. GE-PON Management System Function List

Software function	Spec.
OLT management function	OLT setting, Registration of Splitter to be connected
D-ONU management	QoS for ONU setting, Auto registration of ONU
Search function	Search of ONU, VoIP-TA and Subscribers
Master management function	Registration of Master data for OLT operation
Operation support function	OLT configration backup and restore, Firmware version upgrade
Failure monitoring function	OLT condition monitoring, ONU condition monitoring, Alarm summary display
Syncronization with other systems	Syncronize with Subscriber management system

Photo 10. GE-PON Management System Screen Sample (ONU setting)

(4) GE-PON repeater (BN7000N-GPR-1901/GPR-1101)

The GE-PON system can support a larger number of subscribers by increasing the number of distributions per optical fiber. However, if the number of the distributions increases, the transmission distance becomes short due to power budget limitations, and as a result, one optical fiber's service area will be reduced.

To solve this issue, BNMUX has developed an advanced GE-PON repeater that can transmit a GE-PON signal over a long distance with no constraint of distribution loss. This repeater installed between an OLT and D-ONUs has a 3R regeneration function (re-shaping, re-timing, regenerating), and can relay an optical signal without signal degradation. In addition, it can extend four GE-PON signals up to 60 km and support up to 256 D-ONUs. This makes it possible to expand high-speed communication services to rural areas far from a headend without using hubs, and contributes in building a cost-effective network.

Moreover, it has an electronic distribution function to distribute PON signals converted into electronic signals and can reduce the number of fibers necessary to support the multiple-wavelength transmission of four PON signals between the OLT and the repeater; therefore, a wider network can be built at a low cost.

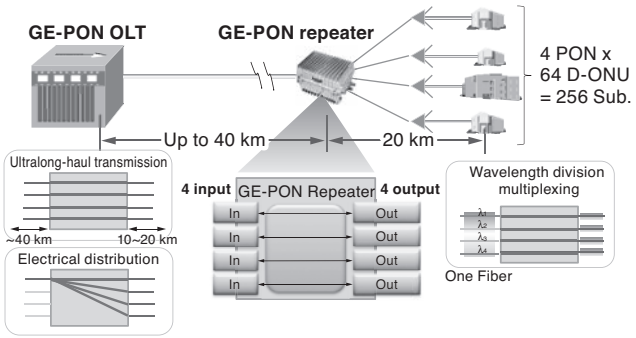

Fig. 5. Example of System Configuration with GE-PON Repeater

The outdoor GE-PON repeater can be equipped with an optical amplifier for a video signal. It can be installed as a strand-mounted hub or a power pole as with an outdoor transmitter on the HFC system to use it as a pole-mounted hub. One outdoor repeater can expand the FTTH system to support approximately 500 households (when the communication service penetration rate is 50%); therefore, cable-TV operators who have an extra optical fiber in a currently used HFC system do not have to install a new optical fiber between a headend and this repeater.

BN7000N-GPR-1901
(Outdoor type)

GPR-1101
(Indoor type)

Photo 11. BN7000N-GPR-1901/GPR-1101

5. Summary

This paper describes the features and specifications of the major products for the FTTH system that can achieve high-speed and large capacity networks for cable-TV operators. The Sumitomo Electric Group will endeavor to provide constant support for cable-TV operators amid intensifying competition by providing them with more satisfactory systems and products.

Technical Terms

∗1 RFoG (Radio Frequency over Glass): A system, one of the FTTH network forms, to transmit an RF signal via an optical fiber. It allows the existing equipment, such as the communication headend equipment and cable modems to be used as it is.

∗2 DHCP (Dynamic Host Configuration Protocol): A protocol to automatically assign an IP address to a PC, and be used for the cable-TV system operation.

∗3 ARP (Address Resolution Protocol): A protocol to obtain a corresponding MAC address from an IPv4 address.

∗4 NDP (Neighbor Discovery Protocol): A protocol to obtain a corresponding MAC address from an IPv6 address.

Reference

(1) Umeda et al., "Development of GE-PON Repeater," SEI Technical Review No.169 (2006)

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