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Technologies for FTTH system in Korea

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Abstract
We review the current FTTH technologies in Korea and report the relevant technical progresses at LS cable.

1. Introduction

The optical access network has been introduced in the 1980s, developed through 1990s and commercially deployed in real field. For example, in Japan, it has been reported that the total number of FTTH subscribers exceeded 2.5M in 2006. In US, there have been numerous announcements of FTTH deployments by both municipalities and operating companies including RBOCs. The home connection vis FTTH technology became more than 2.65M in 2006. In Europe, currently 0.65M subscribers were reported, 80% of which reside in Italy, Sweden, Denmark. From MIC, Korea has more than 3.3M subscribers for FTTB solution and 0.12M subscriber for FTTH solution. The replacement trend from DSL to FTTH is rapidly spreading all over the world. From the forecast of heavy reading, the FTTH subscriber will reach up to 76M by 2011. In this paper, we review the current issues in FTTH system and report the relevant technical progresses achieved at LS cable.

2. FTTH technology in Korea

In Korea, various kind of access network technology has been proposed and deployed. Since 60% of household live multi-dwelling unit such as apartment and the 95% of subscriber located within 4km from central office, digital subscriber line (DSL) was dominant technology. However, the market share (M/S) of DSL was decreasing from 54% in Dec. 2005 to 39% for last 1 year. One of challenging technology is Apt. LAN, one of popular FTTB solution, the M/S of which was reached up to 23%. This is because it is simple and cost-effective solution especially for Korean apartment environment. Conceptually it has double star architecture so that low-cost layer-2 switch with 100Base-Tx interface is installed at underground room of apartment and UTP cable is deployed from switch to each home directly.

Recently several FTTH solutions are commercially available. First one is active optical network (AON) which uses the Layer-2 switch with 100Base-Fx interface. It has similar architecture with Apt. LAN. As Korean government announced the FTTH Emblem mark for promotion of FTTH, it was started to deploy from 2004 due to its cost-effectiveness and technology maturity. From plan of KT, the estimated number of AON subscriber reaches up to 40K.

The most popular technology in Korean market is Gigabit Ethernet passive optical network (GEPON), which connecting from optical line terminal (OLT) to multiple optical network terminals (ONT) through the passive splitter located at manhole or electric pole. From KT, the number of GEPON subscriber will reach up to 1M subscribers by end of 2007. However, as the bandwidth requirement for triple play service increase, the evolution of network technology is essential for the future.

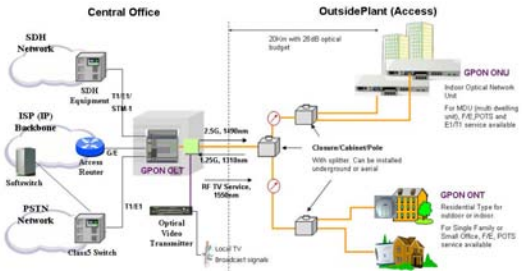

Fig. 1 Service architecture using GPON system

One of emerging technology is Gigabit-capable PON (GPON) and another is WDM PON which is beginning to attract significant attention in Korea. Even though WDM PON has long been considered as an ultimate solution for the access networks due to its large capacity, easy management, network security, and upgradeability, but it has the critical bottleneck due to high cost. In case of GPON, it has lower cost than WDM-PON and several advantages in comparison of GEPON. For example, it has twice bandwidth and better transmission efficiency. It also supports more than 64 splitting ratio and advanced security. In addition, GPON system can support

various services including broadband internet, voice over IP (VoIP), IPTV and leased line service using a single platform. Fig. 1 shows the detailed service architecture using GPON system. It can also support conventional broadcasting service by using RF overlay technology. Therefore GPON will be major technology over the world in the near future.

3. GPON system

Fig. 1 shows the general network architecture using GPON system. It is composed of the active equipment such as OLT and several ONTs and ONUs and the outside plant (OSP) component including the optical cable and splitter located in remote node. The system is fully compatible with ITU-T G.984 standard and supports the triple play service over single platform. The transmission speed is 2.5Gbps and 1.25Gbps for downstream and upstream, respectively, and the maximum splitting ratio is 64. The maximum distance is 60km logically but physically about 20km when the class B+ optical transceiver was used.

Table 1 shows the detailed specification of OLT system. It has open architecture with modular design. When the PON card was fully employed, one OLT support more than 48 PON port. It means that it can support more than 3072 subscribers simultaneously when the splitting ratio at RN is 64. To support full bandwidth for each subscriber, it supports maximum 320Gbps switch capacity and 48Gbps upstream interface. In addition, it has the redundancy system for carrier-class reliability.

Table 1. Specification of OLT

Item	Description
GPON	● ITU-T G.984.x GPON Fully Compliant ● Max. 48 GPON (1:64 Split Ratio) ● 20km Distance at 1:64 Split Ratio ● DS 2.5G, 1490nm ● US 1.25G, 1310nm ● (Optional RF Video) 1550nm
IP	● 24 GbE Interface, 2 10G Interface ● L3 Protocol: Static, OSPF, RIP ● L2 Protocol: VLAN, STP, LACP ● Switch Fabric: 320Gbps, Load Sharing ● Multicasting: IGMP Snooping, PIM-SM/DM ● IPv6: IPv4/IPv6 Support at the Same Platform ● QoS: Marking/Remarking, Rate Limiting, Classification, IEEE802.1p/DSCP Mapping, Shaping, etc.
Console	● RS-232C ● Fast Ethernet
EMS	● Out-of-band (Fast Ethernet) or In-band ● SNMP
OS	● Real-time Linux ● IPC Mechanism
Network Synch.	● Internal (Local Oscillation) ● External (DOTS Receiver)
Physical	● 19” Standard Rack Mountable ● Power Distribution Panel ● Shelf (Front Access) ● FAN

The ONU was developed for business subscriber and supports more than 24 Ethernet port or 12 POTS port or 12 E1 port. By adapting dual architecture, it can provide the PON redundancy as recommend in G.984.1. Two type of ONT was developed for indoor and outdoor application. By using these ONT, the subscriber can receive the VoIP service as well as high-speed internet.

4. OSP solution

For single dwelling unit, the optical splitters are installed at the remote node, which located at the manhole or electric pole, and the feeder cable is deployed from central office to remote node. Usually drop cable is installed from the remote node to home. For multi-dwelling unit, the optical splitter is installed under the apartment so that it is not easy to install the optical cable through the original duct. To overcome these problems, the air-blown fiber (ABF) solution was releases. It is a concept for the installation of fiber-optic networks utilizing viscous air flow to propel blown fiber unit through pre-installed blown tube cable. Blown fiber unit could be proceeding by pushing force of drive wheel and compressed air. The installation speed and blowing distance are limited by the friction force between micro duct and blown fiber unit. By optimizing the fiber structure inside of micro duct and outside coating of blown fiber unit, the maximum blowing distance could be achievable.

5. Conclusion

As the traffic requirement is growing in Korea, a variety of access solution is tried to deploy and competing each other. The Apt. LAN and GEPON solution is the prevailing technology in current situation. To provide the triple play service cost-effectively, GPON and WDM-PON will gain more attention by virtue of high bandwidth and guaranteed quality of service. For the OSP, the drop cable and ABF was introduced and widely deployed in Korea.