Optical Network Systems for Overseas Market

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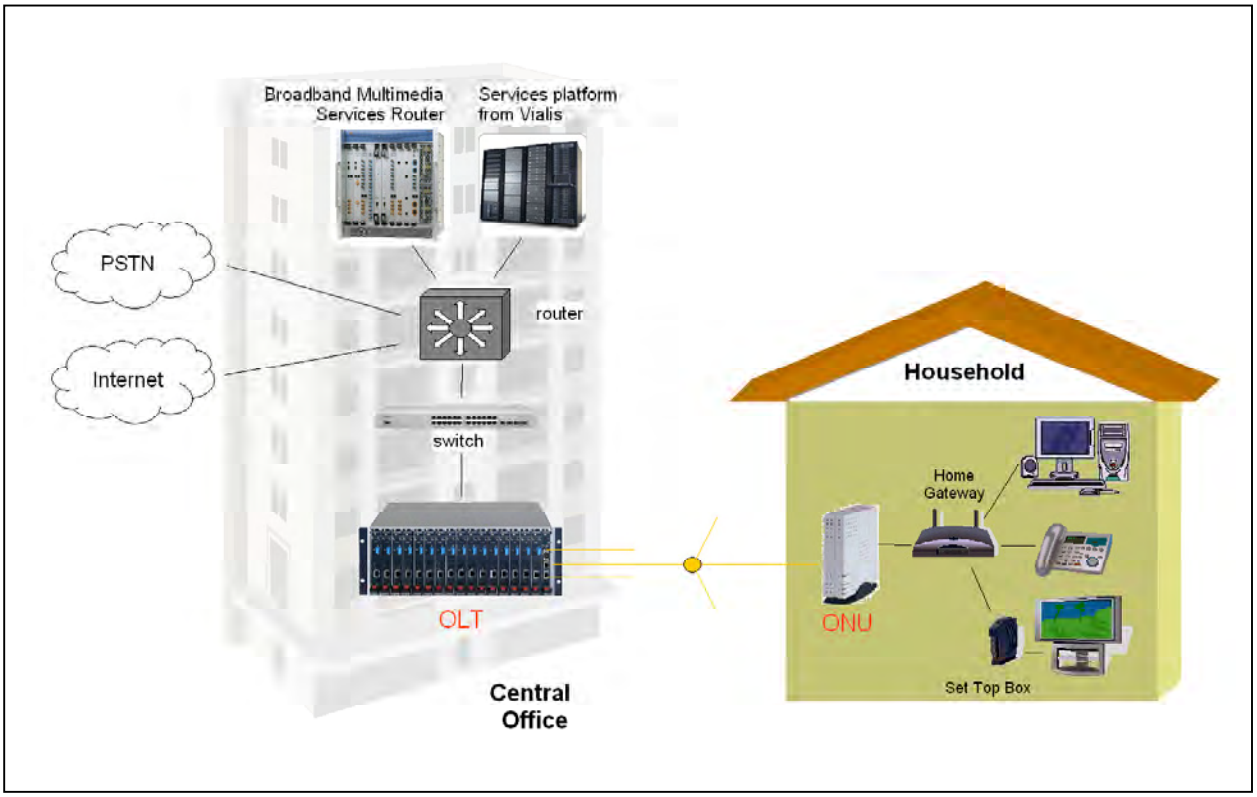
Abstract

In Japan, the number of subscribers to fiber-to-the-home (FTTH) service providing the triple play package of high-speed Internet, telephone, and video distribution has been increasing rapidly. In Europe, however, the mainstream service is still asymmetric digital subscriber line (ADSL), which uses copper wire.

Slowly but steadily, however, introduction of FTTH is gaining ground as governments recognize its importance in IT advancement and economic and social development on both the national and local level. Through the initiative of local governments, major carriers are developing FTTH. In addition to the business plans of major carriers, comparatively small-scaled FTTH introduction projects under the initiative of local governments have been increasingly implemented.

Mitsubishi Electric has conducted trial operations in cooperation with foreign carriers for overseas deployment of FTTH systems using Japan's mainstream Gigabit Ethernet-Passive Optical Network (GE-PON) technology. In January 2007, Mitsubishi Electric launched an FTTH pilot project in cooperation with a local network operator in Colmar in the Alsace region of northeast France.



Configuration of pilot network

The network is a GE-PON configuration that is the mainstream in domestic FTTH systems in Japan, with the OLTs and ONUs provided by Mitsubishi Electric. Home gateways are connected downstream from the ONUs, making it possible to provide triple play services including video, voice, and data transmission.

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1. Trend in the FTTH Market in Europe

1.1 Introduction of FTTH and market trend

In Europe, ADSL service has expanded rapidly since about 2003 to record about 60 million subscribers by the end of 2006. On the other hand, FTTH was introduced to North European countries around 2004 and the number of subscribers today is only about 1.1 million in all of Europe.

As the upstream transmission bandwidth in ADSL depends on the quality of the existing local loop network or the distance between the central office and subscriber, studies are presently focused on "FTTx", which can realize super-broadband service by combining optical fiber and VDSL technologies. At the same time, communication policies in conjunction with unbundling of optical fiber cables are also being studied[2]. This issue in particular is one of the challenges affecting the development of FTTH networks.

FTTH is thus in the initial stage compared with ADSL, but is considered to be the driving force behind economic and social growth in local towns and cities. Not only communications carriers but also national and local governments are deeply interested and engaged in efforts to promote FTTH. As of the end of 2006, more than 80% of the FTTH projects in Europe were initiated by local authorities, power utilities and housing corporations. Future deployment of FTTH may involve the following two business models.

- Vertically integrated business model

Major communications carriers or newly organized operators will invest in the network hardware including optical fiber cables and will also be responsible for providing broadband services to users.

- Horizontally shared business model

Local governments or local public power utilities will invest in the optical fiber arrangement as representative organizers of the respective local communities; the access network operators will make the network available to ISPs that will provide services via the optical fiber cables. Thus, multiple business entities will share the operation of network business. The access network operators will not have direct contact with the end users. The ISPs will be responsible for collecting all necessary service charges and other fees. This scheme is still under consideration.

As of the end of 2006, 95% of all FTTH service subscribers in Europe were limited to five countries: Denmark, Sweden, Norway, the Netherlands, and Italy. Excluding these countries, the most aggressive country in Europe in terms of positive endeavors to deploy FTTH in and after 2006 was France. Activities based on the two business models described above have been actively promoted in France since mid 2006. France Telecom and newly organized operators intend to start services in Paris and other major cities in France and pilot systems initiated by local governments have already been launched in many of the nation's cities. Full-fledged commercial services will likely start in the latter half of 2008, with successful deployment expected.

1.2 Current FTTH technologies in Europe

The majority of FTTH systems in Europe today employ a point-to-point transmission system (referred to as "P-P" hereinafter). The situation appears to be the same as that when FTTH was introduced in Japan and P-P transmission was generally used. Now, however, the advantages of PON-based systems will likely result in its intensive utilization toward full-fledged deployment of FTTH.

IEEE-conforming GE-PON (generally referred to as E-PON in Europe) rapidly introduced for commercial applications in Japan and other Asian nations, and ITU-T-conforming G-PON are the base technologies expected to be used for PON systems in Europe, as of the middle of 2007. Related movements include plans for substantial application of G-PON according to the demand for FTTH in the latter half of 2008 and earlier plans to try PON systems by incorporating GE-PON in FTTH systems initiated by local governments, etc.

2. Outline of Pilot FTTH System

In January 2007, Mitsubishi Electric launched a pilot FTTH project using GE-PON in cooperation with Vialis, a local network operator in Colmar in the Alsace region of northeast France.

Vialis is a conglomerate of companies running public power and gas utilities, CATV service, and Internet service in many cities in the Alsace region, centering on Colmar, which provides financing for the company.

In this pilot project, Mitsubishi Electric provided the GE-PON system (OLT, ONU, EMS (element management system), etc.) as well as technical support, while Vialis installed the optical fiber cables and hardware, operated the network, and evaluated the FTTH service. During the pilot project period, FTTH service was provided to a selection of subscribers who had expressed their wish to help evaluate the service. The service and hardware arrangements were improved step by step during the pilot project period. In parallel with the pilot FTTH project, another project was implemented to study the feasibility of new broadband services. This second project involved the evaluation of FTTH network characteristics and QoS (Quality of Service) management technologies, in cooperation with network research development at the Institute of Technology of the University of Haute Alsace in Colmar (IUT-UHA).

2.1 Configuration of pilot FTTH system

The configuration presented in the "Abstract" describes the pilot FTTH system in Colmar including the access network for providing triple play services for household subscribers in the first phase and the operator-side network.

In the first phase, lead-in optical fiber cables from nearby trunk cable cabinets were installed in three apartment buildings, with optical splitters furnished in the machine rooms of each building. A total of 50 residences were provided with optical fiber cables as a result of work conducted in the buildings. Each residence was then provided with an optical network unit (ONU) as the GE-PON termination device in the subscriber household, an IP telephone adapter, and set top box (STB) for receiving video services. The same set of hardware was installed on the premises of UHA for evaluating the services and functions and studying new services. Figure 1 shows a photo of the optical splitter installed in the machine room of the apartment building.

The GE-PON optical line terminal (OLT) was installed in the central office of the network operator and was connected with the service platform and broadband multi-service router for video delivery to the operator via the Layer 3 (L3) switch and router. The OLT was also connected with the external Internet network and telephone network of the carrier (PSTN).

2.2 Multi-channel delivery

In April 2007, 18-channel video delivery was launched via the operator's broadband multimedia service router (BMR) using the video IP packet multicast flow method. With this configuration, users can switch channels instantly from their residence.

Two methods are available for the video delivery service: one is a simplified method in which users install video viewing software in their PCs in accordance with their video system configuration, and the other is an STB method in which users view videos on a standard TV set connected with STBs. The project also evaluates the simple multicast method in which all channels selected by the users are delivered to all users, and the IGMP multicast method that uses an Internet Group Management Protocol (IGMP) proxy and snooping function. Control of the latter prevents the videos on the channels selected by other users from being delivered to the ONUs of other users. This technology is expected to realize efficient use of transmission bandwidth in multi-channel video transmission service.

2.3 Results of pilot project first-phase evaluation

Vialis took charge of installation and operation of the PON system for the first time in this pilot project. Their optical fiber work, continuity inspection of optical signals, and operation of hardware were all completed smoothly, which has assured us that the GE-PON system operated in Japan is highly compatible with the deployment environment and it interfaces with the peripheral devices available in the European market

Initial system operation used a basic network configuration without VLAN management technology. Today, however, after verifying the basic operation mode, the VLAN management system, which has a QoS control function called "ToS-CoS," is employed for the operation. With this function, the Type of Service (ToS) field in the IP frame is converted to Class of Service (CoS) in the Ethernet frame to realize QoS control, thus providing high-grade triple play service.

According to the results of evaluation by the monitoring subscribers in the first phase of the project, which centered on provision of service for residential areas, the service was highly valued by more than 95% of the

Fig. 1 Optical splitter located in the apartment basement

Fig. 2 GE-PON located in the central office

subscribers, except for several subscribers who viewed video programs via PCs with insufficient capacity. In particular, the quick response of Web browsers and excellent broadband characteristics for uploading were favorably accepted by the users.

As for multi-channel video receiving, the project has proved that the IGMP multicast method is a very important function for both the video distribution service and large-volume data transmission.

The monitoring subscribers have requested improved security such as firewalls and anti-virus measures. They are also interested in the provision of a fixed IP address and expansion of home network including wireless interfaces in their residences. These points are challenges to be studied in terms of services to be provided in the future.

2.4 Major specifications

Tables 1 and 2 show the major specifications of the GE-PON system used in the pilot project.

2.5 Future plans

As the second phase of the pilot FTTH project in Colmar, we plan to deploy PON-based fiber-to-the-business (FTTB) by connecting the system with business-use systems called SME (small and medium enterprises). Mitsubishi Electric will conduct continuous verification and evaluation of the project system in cooperation with Vialis.

References:

(1) Roland Montagne, IDATE: FTTx deployments – Key issues, DigiWorld Summit 2006
(2) ARCEP: Le Très Haut Débit – Points de repères et perspectives – November 10th, 2006

Table 1 Major specifications of GE-PON OLT

Item		Specification
PON interface	Applicable standards	Conforming to IEEE802.3ah
		1000BASE-PX20
	Number of ONUs	32/PON-IF
	Network interface	100/1000BASE-T
	Number per unit	16
Element management interface	Applicable standards	10/100BASE-TX
	Protocols	SNMP, TELNET, FTP
Functions		ONU authentication , DBA , encryption , VLAN , loopback , IGMP , and snooping
Other specifications	Power source conditions	DC-48V (redundant configuration)
	Cooling method	Forced air-cooling (redundant fan)
	Installation style	Mounted on 19-inch rack
	Dimensions	177H x 437W x 492D (mm)

Table 2 Major specifications of GE-PON ONU

Item		Specification
PON interface	Applicable standards	Conforming to IEEE802.3ah 1000BASE-PX10 or 1000BASE-PX20
UNI	Applicable standards	10/100BASE-TX or 10/100/1000BASE-T
Functions		Bridge , priority control , loopback
Other specifications	Power source conditions	AC100V~220V (AC adapter)
	Cooling method	Natural air-cooling
	Installation style	Horizontally placed / hung on wall
	Dimensions	150Hx 39.5W x 135D (mm)