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The Optical Access Technologies and Applications in FTTH

(Invited Paper)

Yuefeng Ji (jyf@bupt.edu.cn), **Yongmei Sun** (ymsun@bupt.edu.cn), **Rikun Liao** (lyfen@sina.com)
(Key Laboratory of Optical Communication and Lightwave Technologies, Ministry of Education,
Beijing University of Posts and Telecommunications, P. R. China)

Abstract

The paper presents the current R&D activities and prospects of optical access networks in China. Main technologies, applications and trends in FTTH are analyzed from the technical and market viewpoint.

1 Introduction

The rapid growth of broadband access subscriber and network traffic leads to urgent requirement for bandwidth in access network, therefore optical access technologies have been widely studied and developed in recent years. As shown in Fig.1, the number of China's broadband subscribes has already reached 137,000,000 in 2006 which 23.4% higher than that of in 2005, and it is expected to increase with the growth rate of more 15% per year next few years [1]. To fulfill the growing user's bandwidth requirements, R&D activities on broadband access technologies have been greatly promoted. Among them, FTTH (Fiber to the Home) has been drawing more attention of both research and industry.

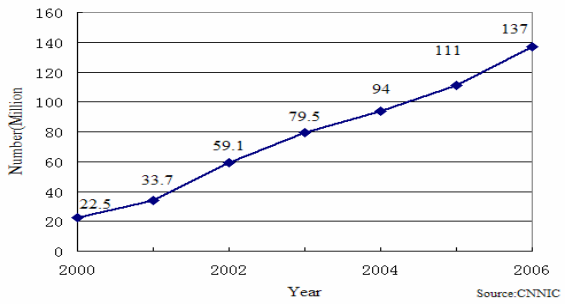

Fig.1. The number of China broadband subscribers

This paper will discuss the current R&D activities in China and analyzes key technologies in FTTH, including passive optical network (PON) and point to point (P2P). The FTTH related field test, applications and trends in China are also given.

2 Challenges and motivation of China's FTTH

At present, the challenges of FTTH mainly come from the relatively high cost and the some regulation. But the service demand and the end users' needs, the biggest drive factors of FTTH deployment, have greatly motivated FTTH development. More and more consumers have the need for lager and more stable broadband as broadband services like P2P TV, IPTV, online game, VOIP, VPN, etc..

Therefore, promoted by the increasing applications and bandwidth requirements, China has made a great progress in FTTH with the effort from research, industry and government in the last few years. Fig.2 shows China's FTTH roadmap for R&D, field trial, and commercial deployment.

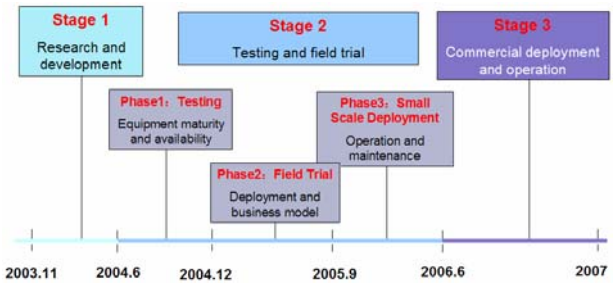

Fig.2. China's FTTH Roadmap

In China, some National Programs, such as O-Time (**O**ptical **T**echnology for **I**P with **M**ulti-wavelength **E**nvironment) program and 3T-net (**T**bps-level router, **T**bps-level optical transmission system and **T**bps-level switching capacity equipment) project, have made great contributions to FTTx. As a part of National 863 Program in Tenth Five-Year Plan, one target of O-Time (2001-2005) is to solve the high efficiency multi-service access problem for the next generation Internet, with main focus on EPON. Some key problems have been studied, such as dynamic bandwidth allocation, related standardization, and construction of application system. The research has been put to use in more than 20 cities and areas. As for 3T-net project (2002-2006), it has been built to form a large-scale interactive TV testing network, which is oriented towards large-scale concurrent

DTV/HDTV broadband stream video and Peer to Peer service application.

3 Key technologies in FTTH

While the service drives the new technology emerged, the technologies are also rely on the users' up-to-date needs. Hereinto, PON and P2P are widely studied and implemented which can best satisfy the multi-services demand in FTTH. For example, EPON or GPON is a high-speed platform fully compatible existing standard and represents the development direction.

Table 1 gives the comparison between xPON and P2P which are complimentary rather than conflicting. At present, among various xPON technologies, EPON is mainly used for FTTH in high population density area, while GPON in corporations that need a large number of TDM leased line services. P2P can be used for both business cases and residential cases. For business case, P2P will be used when the required bandwidth is more than that a PON can provide. For residential case, P2P is preferred when the residential homes are scarcely located. Until now, most local vendors focus on GEPON system. GPON system is under consideration by some vendors. WDMPON and OCDMA are still under research or experiment.

Table.1. xPON vs. P2P access solutions

	xPON	P2P
Subscribers	closely located	sparsely located
Central office	limited	enough
Bandwidth	low	high
Solutions	B/E/GPON	P2P SDH/Ethernet

From the viewpoint of market, EPON can achieve more economical access while GPON fits for business circumstance such as VoIP, IPTV and HDTV. Since the cost of fiber, Ethernet card, passive optical component, etc, keeps dropping, FTTH will be economically acceptable in the coming year.

4 The applications and trends in FTTH

China's 137 million broadband users are potential FTTH subscribers because they have experienced what broadband can bring to them. In the commercial deployment of FTTH, GEPON is widely used and triple-play can be provided as illustrated in Fig.3.

Although the applications of online music/films/TV, Internet games are developed widely, HDTV, P2P and the coming tele-presence services are undoubtedly considered to be the killer applications of FTTH, because they need much more bandwidth than existing ones.

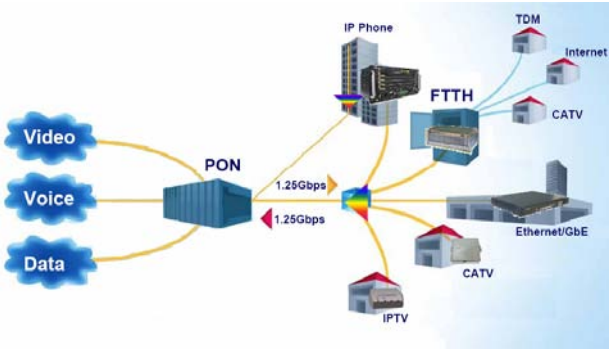

Fig.3. FTTH multi-services based on GEPON

Due to the emerging of various broadband applications, FTTH becomes a hotspot in government, universities and enterprises. In China, by the end of 2006, there are about 60K commercial FTTH subscribers and another 20K in field trials. The total number is expected to reach 160K in 2007 [2]. Beijing, Wuhan, Shanghai are major cities with FTTH deployment, and more than 20 cities are involved. The biggest FTTH network has about 1000 subscribers. Almost all the deployments now are using GEPON.

5 Conclusion

Broadband access and service-driven with dynamic flexibility are typical characteristics and developing trend of future optical access network. Facing the high-bandwidth-required services and applications emerged in endlessly, FTTH will definitely be the most promising solution and will be dominating in future access market.

Acknowledgments

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