

A Study on FTTH Network Construction in New Residential Areas: Postprint

Authors: Wang Haiying

Date: 2023-10-08T00:00:00+00:00

Abstract

With the continuous upgrading and evolution of network access technologies and communication equipment in recent years, users have enjoyed increasingly rich cable television services and more convenient and efficient broadband services. Fiber to the Home (FTTH), as the optimal solution for addressing the “last mile” challenge of the information superhighway, is regarded as the most ideal access network technology currently available. This paper primarily introduces the development of FTTH and its key technologies, elaborates on the essential considerations for FTTH network deployment using a new residential community as a case study, and finally analyzes the development trends and prospects of FTTH.

Full Text

Research on FTTH Network Construction in New Residential Communities

Abstract: With the continuous upgrading of network access technologies and communication equipment in recent years, users have enjoyed richer cable television services and more convenient broadband access. Fiber to the Home (FTTH), as the optimal solution for the “last mile” of the information superhighway, is considered the most ideal access network technology currently available. This paper primarily introduces the development of FTTH and its key technologies, describes the main points of FTTH network construction using a new residential community as a case study, and finally analyzes the future development trends of FTTH.

Keywords: new residential community; FTTH; network construction

Classification Number: TN915.63

Document Code: A

Article ID: 1671-0134(2017)12-093-02
DOI: 10.19483/j.cnki.11-4653/n.2017.01.025

1. FTTH Overview

The scale of the cable television industry continues to expand, with constantly diversifying service offerings. Cable operators now provide two-way digital television, video on demand (VOD), high-speed Internet access, and various educational and entertainment-oriented online services, delivering integrated data, voice, and video services simultaneously. These services undoubtedly impose higher bandwidth requirements, making FTTH one of the better solutions for addressing both service and bandwidth demands. FTTH belongs to broadcasting and television infrastructure and serves as part of the broadcasting service bearer network, carrying both broadcasting television services and broadband access services. FTTH (Fiber to the Home) refers to the installation of ONUs (Optical Network Units) in residential homes, representing the FTTH application type closest to end users. With the continuous growth and improvement of user broadband ecosystems, the costs of various equipment, optical fiber cables, and related components have significantly decreased. FTTH now possesses both technical and cost advantages, making it the most suitable access network solution for full-service delivery. To promote network development, the government has implemented the “Triple-Network Convergence” and “Broadband China” strategies, while the State Administration of Radio and Television has proposed the “Broadband Broadcasting” and “Broadcasting Plus” action plans. These initiatives require accelerating the construction of cable television network infrastructure, promoting fiber to communities, fiber to natural villages, and fiber to buildings, and comprehensively improving cable television network broadband speeds and enhancing network capacity and performance.

2. Key Technologies for FTTH Network Construction

2.1 FTTH Access Technologies Current FTTH access technologies primarily include two types: Passive Optical Network (PON) technology and Active Optical Network (AON) technology, each with distinct advantages that should be selected based on actual network construction conditions and environments.

PON is a point-to-multipoint technology in which the Optical Distribution Network (ODN) between the OLT and ONU contains no active electronic equipment, requiring only basic optical fiber, optical splitters, connectors, and related components. A single optical fiber can serve multiple users. The structure and distribution characteristics of PON networks are as follows: the Optical Line Terminal (OLT) is placed in the operator’s central office, while the passive optical splitter is positioned as close as possible to the user-side Optical Network Unit (ONU). Since the distance from OLT to ONU—equivalent to the current fixed telephone access distance—is typically within a few kilometers, the PON

architecture offers significant advantages. The entire network from central office to user is passive, which not only greatly conserves optical cable resources between the central office and users but also substantially reduces the quantity and scale of central office equipment while decreasing distribution cabling requirements.

AON is a point-to-point (P2P) access technology with mature, low-cost implementations that can easily provide 100M or 1G bandwidth while achieving seamless integration with existing computer networks. Additionally, AON features simple network architecture with low construction, operation, and maintenance costs. It eliminates the need for additional optical cables between the central office and residential communities, concentrates distribution in community equipment rooms, and facilitates easy maintenance and management. This access technology also allows users to freely select their service provider, promoting multi-operator competition that effectively safeguards user interests. Equipment port utilization is very high, enabling gradual expansion as the number of subscribed users increases.

2.2 FTTH Splitting Architectures Currently, FTTH implementations primarily employ two splitting architectures: centralized splitting and distributed splitting. Centralized splitting involves installing optical splitters centrally in community equipment rooms or optical cable 交接 boxes, with all user optical cables extending from the splitting point. This approach enables centralized user management, high PON port utilization, and convenient maintenance. Centralized splitting can appropriately reduce equipment investment costs, though it requires relatively large quantities of optical cable, making it suitable for the initial stages of FTTH construction or communities with concentrated user populations.

Distributed splitting primarily employs two-level or three-level splitting architectures. During network construction, the primary splitter is placed in the community equipment room or optical 交接 box, while secondary user splitters are installed in corridor-mounted distribution boxes within buildings. Compared with centralized splitting, distributed splitting exhibits greater link loss due to its multi-level architecture. Under full coverage scenarios, optical splitter costs are slightly higher, and PON port utilization is lower than in centralized approaches. However, distributed splitting allows flexible splitter placement and significantly reduces optical fiber consumption.

Regardless of the splitting architecture employed, maximizing the utilization of EDFA, PON ports, and optical splitters should be the primary consideration. Additionally, sufficient optical cable capacity should be reserved to accommodate future value-added services such as security monitoring, smart communities, and wireless city initiatives.

2.3 EPON and GPON Technologies Operators are gradually adopting EPON and GPON technologies to replace traditional cable-based access meth-

ods. Current EPON technology is relatively mature and can well satisfy broadband services such as Internet access and VOIP. Although GPON technology offers outstanding advantages in transmission capacity, rate flexibility, splitting ratio, and TDM service support, its greater technical complexity results in significantly higher construction costs and complexity compared to EPON. Consequently, many operators currently prefer EPON technology for broadband access.

3. FTTH Network Planning for New Residential Communities

Using a new residential community FTTH network construction project as an example, community network planning should consider not only high efficiency but also economic viability in fiber access. Based on experience with optical and copper cable construction and combined with the community's actual conditions, advanced ODN (Optical Distribution Network) technology should be employed to design and plan a network construction solution tailored to the community.

First, since ODN construction covers extensive areas, particular attention must be paid to both indoor fiber cables within buildings and outdoor distribution cables when constructing FTTH in new communities. Splitter design and installation should be analyzed based on the number of households in the FTTH project community. Generally, higher splitting ratios cover more users, saving costs on PON interface resources and optical cable installation, though they simultaneously reduce transmission distance. In practical construction, comprehensive community conditions must be considered. Optical cable users require the installation of exposed conduits and junction boxes, though pre-installed concealed conduits may be prioritized when available. Horizontal conduits are installed during service activation, typically at each user's entrance point, while vertical conduits are implemented during the construction phase.

Second, central office OLT placement aims to reduce network construction costs and facilitate future maintenance. OLT coverage range is calculated based on EPON transmission distance, with centralized OLT placement at the central office to simplify equipment room maintenance. OLT equipment should employ mainstream vendor devices commonly used in the industry, as these support multiple services including voice and data transmission, enabling convenient future maintenance and expansion.

Finally, many consider FTTH construction to be little different from traditional optical cable installation, resulting in insufficient attention to FTTH construction practices. However, FTTH construction often represents the key focus and most challenging aspect of projects. Installing building entry optical cables using conventional methods not only increases construction difficulty but also creates significant challenges for future network maintenance and adjustments. Therefore, reasonable FTTH construction methods and associated costs must be included in planning considerations. Additionally, fiber-to-the-home solu-

tions must address not only information panel design concepts but also smart home wiring system design for new residential properties. Terminal ONUs can fully satisfy the needs of small residential units requiring only single voice or broadband services while saving retrofit costs and facilitating future service expansion.

Overall, for multi-story and high-rise residential communities with large, dense user populations, FTTH construction requires professionals to consider actual household distribution patterns when designing and planning cabling routes and construction processes. The goal is to achieve effective integration of cabling and engineering equipment while maximizing line cost savings and completing optical cable installation, commissioning, terminal box installation, fiber set-top box connection, and service activation.

4. Analysis of FTTH Future Development Trends

With continuous updates to network technologies and communication equipment and increasing broadband subscribers, FTTH technology has satisfied users' high demands for broadband access. Although FTTH technology has emerged only within the past decade, during this period various communication technologies and equipment have become more technically advanced and cost-effective, better meeting the low-cost, high-efficiency, scalable deployment, and high service quality requirements of industrial economic informatization and home informatization.

Current residential community cable television network construction represents a significant market segment, with broadcasting and IP operators vigorously promoting FTTH network solutions. Currently, FTTH carries two service types: broadcasting television services and broadband access services. Broadcasting television services include high-definition/standard-definition broadcast, 4K/8K broadcast, VoD 点播, time-shifted television, IP live television, and SDV (Switched Digital Video). Therefore, FTTH must support broadcasting television services with transmission bandwidth capabilities of no less than 6Gbps and the ability to transmit ultra-high-definition video.

5. Conclusion

With the deepening implementation of the "Broadband China" strategy and the speed-upgrade fee-reduction initiative, combined with the vigorous promotion of community "optical migration" models, large-scale FTTH construction will shift toward targeted resource allocation and marketing in existing communities with concentrated cable television users and high-end service experience users. This will drive substantial growth in FTTH networks and user scale, ushering in a new stage of development for FTTH broadband markets and network evolution.

References

- [1] Zhao Yang. Discussion on Standardization of ODN Construction Under Large-Scale FTTH Deployment[J]. Design Techniques of Posts and Telecommunications, 2012(03): 58-60.
- [2] Xu Huadong, Li Hua. Discussion on Urban Optical Network Construction Strategy and Scheme Based on Triple-Network Convergence[J]. Digital Communication, 2013(05): 72-76.
- [3] Zhang Jun, Xu Cheng. On the Innovation of Optical Cable Entry Technology and Process for Existing Residential Buildings—The Second Practice of Shanghai “Urban Optical Network” Technology Innovation and Application[J]. Telecommunications Science, 2012(04): 141-149.
- [4] Zhao Jinmin, Xu Changde, Du Jun, Tang Lin. Analysis and Management Research on Key Issues in FTTH Scale Development Under Triple-Network Convergence[J]. Telecommunications Science, 2011(S1): 150-155.
- [5] Yu Jinhua. Introduction to Guangzhou Huadu FTTH Pilot Community Project[J]. Cable Television Technology, 2011(11): 117-118.
- [6] Bian Aiping. Analysis of Line Planning and Design in Urban Fiber Access Networks[J]. Intelligent Building & City Information, 2012(02): 113-116.

(Author Affiliation: Wenzhou Branch, China Broadcasting Cable Network Co., Ltd.)

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv — Machine translation. Verify with original.