

Analysis of Access Network Development in Tianjin

Dongyang Zhang ^a, Tiemin Jiang ^b and Shuang Wu ^c

School of Control and Computer Engineering, North China Electric Power University, Hebei
071003, China

^abackyla@qq.com, ^b2182221003@ncepu.edu.cn, ^c2217535726@qq.com

Abstract

With the rapid development of China's information technology industry, Internet technology has gradually entered people's daily lives, and has had a profound impact in many fields such as human work, study, entertainment, and culture. At the same time, people have placed increasing demands on the types of services and quality of service. In addition to the general telephone and fax services, high-speed data, visual text, conference television, high-definition television, etc. are required in terms of service types. In terms of quality of service, information is transmitted quickly, accurately, safely and economically whenever and wherever. In other words, the communication network will develop in the direction of digitalization, broadband, intelligence and personalization. The modern communication network is mainly composed of three parts: transmission network, switching network and access network. As far as China's communication network is concerned, the transmission network has developed in recent years, the first-level and second-level trunk lines and the local language of large and medium-sized cities. The trunk has basically realized digitization and fiberisation; the switching network has basically realized program control and digitization; and the access network, which is commonly referred to as the user network, has developed slowly. With the rapid development of transmission networks and switching networks, the rapid development of access networks is inevitable. However, since the access network is a complex part of the entire communication network, difficult to implement, high in investment cost, and large in scope, it is also a key part. Therefore, the access network has become a "bottleneck" in the construction of the communication network. This paper focuses on the development history of Tianjin access network and the types of existing access networks, and analyzes whether Tianjin's existing access network is suitable for Tianjin's local environment, and whether Tianjin's existing access network can meet the needs of users. And whether the existing tariffs of Tianjin's access network satisfy the users, and finally, based on the above discussion, think about the future development and construction of Tianjin's access network.

Keywords

Tianjin, access network technology, development status.

1. Introduction

Throughout the development of access network in the world, China's access network level is not in the forefront, but looking at the development of domestic access network, Tianjin's access network development level is still relatively high, with a relatively long history of construction, so Tianjin's access network development process is also relatively comprehensive, almost experienced the entire development of access network from scratch to a high level, and due to the existence of rural areas The differences between towns and urban areas, there are many forms of access network coexisting in Tianjin in different periods, we can only start from the whole, and explain the historical state of access network development

in Tianjin with a big trend. Generally speaking, the access network in Tianjin can be divided into wired access and wireless access. Wired access includes cable access, optical access and hybrid access, while wireless access includes fixed access and mobile access.

1.1. Wired Access

1.1.1. Cable Access

The predecessor of Tianjin access network is the twisted pair copper wire between the local exchange terminal office and the user telephone in the telecommunication network. It mainly transmits audio signal and low-speed digital signal. In the past, telephone was the main telecommunication service, which was very simple in technology. As we all know, this structure requires a large number of copper cables in the trunk section, which not only occupies a large number of communication pipelines, but also has high failure rate and maintenance cost; the network bandwidth is narrow, only 4kHz, which is not conducive to the provision of new broadband services; the transmission loss of metal cables is relatively large, which makes the coverage radius of the switch smaller, generally less than 5km; in addition, Metal cable access network is affected by signal distortion caused by loss, crosstalk, noise and branching, and the transmission quality cannot meet the requirements of transmission digitalization [1]. At present, the analog transmission of the access network, which is mainly composed of metal cables, not only has poor transmission quality and limited business, but also consumes a lot of non-ferrous copper, which is expensive. In order to make full use of this huge resource, Tianjin uses relatively newer access methods, the most typical of which are HDSL and ADSL.

High speed digital subscriber loop (HDSL): using 2B1Q coding, using high-speed adaptive digital filtering technology to eliminate crosstalk, pulse noise and waveform noise in transmission lines, as well as the interference of echo generated by line impedance mismatch to signal, in the existing local telephone cable, on two or three pairs of copper twisted pair, the digital signal with 2M bit / s rate can be transmitted, The transmission distance without relay can reach 3-5km. HDSL can make full use of the existing copper resources for capacity expansion, the transmission performance is close to the fiber-optic subscriber line, and the bit error rate is also low. To a certain extent, HDSL can solve the needs of some users for broadband signals. The technology basically does not change the original equipment and is convenient for construction. It can transmit video communication and conference telephone signals. The disadvantage is that it can not transmit information with a rate higher than 2m bit / s, and the current common users only have a pair of telephone lines [2]. In addition, the transmission distance is limited.

Asymmetric digital subscriber loop (ADSL): using discrete transmission coding, carrier free frequency modulation and phase modulation technology, three frequency separated channels are used in a pair of copper double glue lines to provide 6Mbit / s or higher rate services. This scheme makes full use of the asymmetry of data communication and image communication, and transmits the interactive broadband service with asymmetric rate on a pair of copper wires. The downlink channel rate is 1.5-6mbit/s, the uplink channel is 64-384kbit / s, and the transmission distance is about 3-4km. But at present, ADSL technology is not mature, especially there is no uniform technical standard in the world, and the cost is also high. All of the above methods are based on the existing copper wire, in order to meet the requirements of high-speed data transmission, a transitional means to tap the potential is not the mainstream direction of the development of Tianjin access network.

1.1.2. Optical Fiber Access Mode

With the improvement of broadband and digital requirements, optical access network has become the main development direction of Tianjin access network because of its huge bandwidth potential, long transmission distance, good confidentiality, strong anti-

interference ability and other characteristics. According to the use of light source, the optical access network can be divided into active optical network (AON) and passive optical network (PON). According to the location of trunk line and sub node terminal equipment, it can be divided into fiber to roadside (FTTC), fiber to building (FTTB), fiber to Office (FTTO), fiber to home (FTTH) and other access modes. The final mode of optical access is FTTO and FTTH.

1.1.3. Hybrid Access Mode of Optical Fiber Cable (HFC)

HFC is developed on the basis of CATV. The purpose is to make full use of the existing cable TV network. In this way, the main line and feeder line are transmitted by optical fiber, the branch line or distribution line is also transmitted by coaxial cable, and the load wave modulation technology and frequency division multiplexing method are used to transmit signals. ITU-T has specified the frequency band division of uplink and downlink signals. Because the bandwidth of coaxial cable can reach 1GHz, this method can not only realize two-way transmission, but also transmit telephone, data, analog broadcast television, interactive image and other signals. It can not only meet the transmission requirements of various services in Tianjin urban area, but also make full use of the existing CATV network. It is indeed an economic and practical scheme, which may be the best scheme before the realization of all fiber access network. However, HFC network is built on the basis of analog frequency division multiplexing. In terms of the general trend of technology development, the future network must be in the direction of digitalization, which is somewhat contrary to the direction of digitalization. And because of the complexity of the network, it also affects its reliability, so it can only be a flash in the pan.

1.2. Wireless Access Mode

Wireless access is to replace the traditional copper access with wireless access, which is a supplement to the wired access. Wireless access is characterized by less investment, flexible use, low maintenance costs and low operating costs, easy to dismantle and reuse. It is suitable for remote and scattered user areas and places where wired systems are not connected. There are many ways of wireless access, such as microwave access, satellite access, forming wireless user loop (WLL), etc. it should be pointed out that now, wireless application protocol (WAP) combines mobile phone and Internet, and is widely used.

2. Access Network Development and Local Environment in Tianjin

The topological structure of user access network is closely related to the average length of user line.

In the 1990s, because the average length of Tianjin urban user line is about 2 km, the average length of district and county user line is only about 3 km, not very long. At that time, the communication service in Tianjin was still narrow-band, so according to the actual situation, most of the communication services used double star structure or ring / star structure. In this way, fiber to cell (fttz), to building (FTTB), to roadside (FTTC) can be developed first, and copper cable or coaxial cable can be used to radiate to users below the optical node. Aon is suitable for rural areas where the average subscriber line is relatively long. It mainly adopts the AON of double star structure, with V interface, and generally concentrates 500-3000 users, mainly transmitting narrow-band services.

At the beginning of the 20th century, the high-speed digital subscriber loop (HDSL, ADSL) system with twisted pair copper wire was suitable for areas with high telephone penetration rate and a large number of metal cable pairs. The advantages of HDSL and ADSL are that they can use the existing copper wire to expand the capacity and solve the urgent need of a small number of users in some areas to transmit narrowband and broadband services. The disadvantages are that the communication quality is not very good, the transmission distance

is also short, and problems such as signal equalization, pulse interference and near-end crosstalk need to be solved. At the same time, for HDSL, the average cost of each channel has also increased a lot. For ADSL, we need to solve the problem of standardization [3].

Switching digital video system (SDV) combines the digital transmission of telecommunication with the analog transmission of video. It not only keeps the advantages of digital transmission and high quality of telecommunication signal, but also retains the analog transmission of video signal. At the same time, the system also has the performance of exchange and other aspects, which adapts to the development of interactive digital video business. Although there are users in Tianjin, the number is not very large.

Fiber coax hybrid network (HFC) is conducive to the same network transmission of Telecom and CATV, so it can be developed in combination with CATV. Especially for rural areas, it has the advantages of less initial investment and convenient use of users. In the recent construction of CATV in Wuqing County, Tianjin, the HFC technology is discussed. Its principle is to modulate the digital signal in the telecommunication network into QAM signal, and integrate the telephone, low-speed data and analog TV signal sent by CATV station through frequency division multiplexing, to transmit them in the optical cable and coaxial cable system in the analog way, and then demodulate them at the receiving end, Recover respective signals. Therefore, it is a more realistic scheme to develop new business with the co-existence of optical fiber and coaxial cable, which is mostly used in Tianjin Radio and television company.

Wireless access network (WLL) system is generally a supplement and extension of the wired access network. It has the advantages of flexible application, fast installation, and mobility. The disadvantages are that the voice quality is not as good as the wired one, the confidentiality is slightly poor, the coverage is small, the transmission distance is short, and the cost is also high. However, this kind of system is promising under certain conditions, most of which exist in some large shopping malls, companies, enterprises and other units in Tianjin. Passive optical network (PON) is used in the area with small node coverage and short subscriber line average. Each optical network unit (ONU) can connect dozens of users generally, and the transmission distance is not far, but its advantage is that it can realize one to many point communication, save the cost of optical communication equipment, and realize the common network transmission with cable television (CATV). It can be said that it is the most used area in Tianjin at present.

Ethernet passive optical network (EPON) is the most widely used passive optical network, which benefits from the rapid development of Ethernet. EPON is the fastest growing of all passive optical networks. It has the following characteristics [4]:

(1) High broadband: at present, EPON can provide symmetrical up and down 1.25Gbit/s bandwidth (the actual effective bandwidth is 900Mbit / s); and with the development of Ethernet technology, it can be upgraded to 10Gbit / s.

(2) Large service scope: EPON, as a kind of point to multipoint network, saves resources with a fan-out structure and serves a large number of users, covering a range of 10-20km.

(3) Low cost: EPON provides larger bandwidth and lower user equipment cost. It adopts PON structure, which reduces the cost of EPON network

A large number of optical fiber and optical devices as well as maintenance costs are reduced, and the equipment funds paid in advance and the operation costs related to SDH and ATM are reduced.

(4) Easy to be compatible: EPON is interconnected, and network cards produced by various manufacturers can be interconnected. Ethernet technology is the most mature LAN technology at present. EPON is only a supplement to the existing IEEE802.3 protocol and is basically compatible with it.

Generally speaking, Tianjin's access network is reasonably selected according to different environments and needs, which can be said to be adapted to local conditions. Of course, everything needs to be updated, and access network is no exception. Access networks in different regions will also be upgraded according to the times. In other words, the access network of Tianjin city is suitable for the local environment.

3. Access Network Development and User Demand in Tianjin

On the whole, the development level of access network in Tianjin is close to the needs of users, and the basic needs of users can be guaranteed. Of course, if some users, such as companies, enterprises, colleges and universities in Tianjin, have higher requirements for the access network, they can still meet them. It's nothing more than the high and low tariff. Of course, one of the reasons why the development level of access network in Tianjin can meet the needs of users is that although Tianjin is a municipality directly under the central government, the development of local Internet is far less than that of North, Shanghai, Guangzhou, Shenzhen and other cities, so the overall users of Tianjin are not very urgent for the development of access network. However, the economic development level of Tianjin is relatively high, and the access network technology automatically develops with the level of the national forefront, which shows that the access network of Tianjin can meet the needs of users.

For example (people's condition in the following refers to local residents in Tianjin by default), from the birth of Tianjin's telecommunication network, we are still mainly fixed line telephone, which is limited to the development of information technology. The emergence of fixed line telephone has given great convenience to people's life. Later, the emergence of mobile phones has further improved people's quality of life. Human nature is yearning for freedom, and the emergence of mobile phone just meets people's needs. After that, xDSL access, the Internet access to thousands of households, people began to be able to quickly access all kinds of information around the world. At that time, people still stay on the text and audio for more information, and the demand for video screen was not very obvious. At the same time, mobile phones have also developed from 2G to 3G. This wireless access mode enables people to access the Internet more freely, rather than just point-to-point calls and messages as before. Later, fiber to the home began to gradually popularize mobile 4G technology, which greatly subverted people's previous understanding of the Internet. The transmission speed has increased dramatically, the quality has risen several grades, and people's demand for video is growing. Until now, the appearance of 5g has aroused people's vision for Internet of things technology, making it possible for driverless, remote operation and precise control. It is worth noting that most of the time, people have higher requirements step by step according to the current access network technology development, rather than because of their urgent needs to promote the development of access network. There is no doubt that demand driven development must be a natural law, but at least for Tianjin, people's demand is definitely not the main driving force for the development of access network technology in Tianjin, and I think it is still the economic dominant driving force.

Take operators for example, building a high-quality access network can get more profits from users than the traditional old access network, and also make them more competitive. Due to the continuous improvement of users' living standards, they are more willing to accept better access network services, so the access network in Tianjin will further develop.

4. Access Network Development and Tariff in Tianjin

Frankly speaking, the access network tariff in Tianjin is not very satisfactory to users. The tariff of the three major operators - China Mobile, China Unicom and China Telecom are generally relatively high. Especially for China Mobile, the cost of SMS has always been a dime a

piece, and the call charge is also high. Because China mobile controls a large number of users, and now the mobile phone number is bound with many accounts, and the number carrying network is not widely used, so there is no trend to reduce the traffic charge at all. Even if the state proposed "reducing the charge and increasing the speed" in 2015, China Mobile is also still indifferent, only at the end of the launch of a few relatively cheap packages, but can not catch up with the growing demand for the network. Broadband service charges are even more exaggerated. When there was a problem of slow network speed and poor quality more than ten years ago, the Internet charges could reach thousands of yuan. At least in the place where I live, most of the time, China Unicom is the only one. Until later, mobile, telecom and radio and television companies have developed broadband services, the charges of online packages have decreased significantly. But relatively speaking, even now, the cost of calling and surfing the Internet can only be unsatisfactory for most users. Maybe in the age of 5g, the cost will drop a little.

5. Consideration on the Construction and Development of Access Network in Tianjin

Although Tianjin's access network technology is relatively advanced, it will continue to develop. In my opinion, it will develop from the following aspects.

5.1. Access Equipment Diversification

Generally speaking, when the access network technology is applied, a port should be set to achieve the transmission effect. In this process, the appropriate processing method should be selected according to the user's personalized needs. Generally speaking, one of the most core requirements for user ports is to be able to support the information transmission requirements of multiple PVC and WLAN networks at the same time. Only by doing this can we effectively meet the needs of diversified network access services.

5.2. Access Platform Integration

It is very common to apply multiple access network technologies comprehensively, which is also a main direction of access network technology development in the future. Through the comprehensive application of a variety of access network technologies, it can achieve the optimal allocation of existing resources, and achieve the purpose of saving resources and improving efficiency. The integration of access platform can promote operators to effectively apply the current access network technologies within their control range, and comprehensively apply a variety of technologies to improve their business capabilities. In addition, the combination of limited access and wireless access can also achieve more ideal application results. For example, the cost of fiber-optic access is high, but its coverage is very wide. Therefore, the combination of fiber-optic access and power line access can effectively improve the practicability of access network technology and better meet people's needs Broadband access requirements.

5.3. Comprehensive Introduction of Optical Fiber Technology

At present, optical fiber technology has become the mainstream trend of access network technology development. This technology not only has very high transmission efficiency, but also has excellent stability. In the current Internet industry, it has been widely popularized. With the continuous improvement of people's requirements for Internet technology, the optical fiber technology must also be adjusted and improved to adapt to people's technical requirements for access network. Therefore, it is necessary to increase the introduction of this technology. However, considering comprehensively that China's optical fiber technology

capacity does not have strong competitiveness in the world, there are still many aspects to be improved.

In addition, the research and development of optical fiber supporting equipment should also be strengthened to ensure the smooth development of new optical fiber technology research and development. From the current situation of the application of optical fiber technology in China, it is still relatively low-level. In the future, the mode of focusing and gradually dispersing can be adopted in the promotion process. With the rapid development of today's technology and the reduction of the cost of relevant supporting equipment, it is believed that optical fiber technology will be gradually popularized and become the first choice for network access [5].

It is worth mentioning that 5g's future has come. In June 2013, the National 863 plan launched the first phase of the major project of 5g mobile communication system's advanced research. The overall goal is to study the 5g network system architecture, wireless networking, wireless transmission, new antenna and radio frequency, new spectrum development and utilization and other key technologies, and complete the performance evaluation and prototype system design, Carry out wireless transmission technology test to support the total service rate of 10Gbps, The spectrum efficiency and power efficiency of air interface are 10 times higher than that of 4G. The main research tasks include: research and development of 5g wireless network architecture and key technology, research and development of 5g wireless transmission key technology, research and development of 5g mobile communication system overall technology, research and Research on 5g mobile communication technology evaluation and test verification technology, etc. the main technical routes to be adopted include: Focus on breaking through high-density, high-throughput, super cellular wireless network technology, key core technologies such as ultra-high rate, ultra efficient wireless transmission technology, new radio frequency technology based on large-scale cooperative antenna, solve key problems such as network cooperation and interference elimination based on ultra micro cell, and increase the system capacity per unit area by about 25 times; Break through the key problems of large-scale antenna high-dimensional channel modeling and estimation and complexity control, carry out wireless transmission technology experiments, improve the wireless transmission spectrum efficiency and power efficiency by one order of magnitude; carry out research on Key Technologies of wireless transmission and networking of new spectrum resources such as high-frequency band, expand the total available spectrum resources of mobile communication system by about four times [6]. It is believed that in the near future, Tianjin will also build 5g signal base station in large area to meet the arrival of 5g era in an all-round way.

6. Conclusion

In a word, with the rapid development of Internet information technology, it has been widely used in all aspects of people's daily life, and influenced by people's increasingly high requirements for access network technology, which has also greatly promoted the development and progress of broadband technology in China. China has a huge market base, and the majority of Internet users have a greater demand for access network technology, so its market development prospects are broad. In the future technology research and development process, it is necessary to further strengthen the research and development of access network technology, focus on optical fiber technology as a breakthrough point, and fully integrate other new technology means, strive to ensure that the existing resources can achieve a reasonable configuration, comprehensively improve the development efficiency of optical fiber technology, so as to achieve greater economic benefits, and at the same time, ensure that the user's Maximize benefits.

Although I discuss it in Tianjin area, its essence is similar to the national access network. The situation of a city is not enough to reflect the situation of the whole country. However, the situation of a country depends on the situation of each city. Finally, I sincerely hope that Tianjin's access network technology is getting better and better, and that China's access network technology is getting stronger and stronger, leading the world.

Acknowledgments

This paper was financially supported by “the Fundamental Research Funds for the Central Universities(2016MS122).

References

- [1] Guo Desheng. User access network technology and suggestions on building user access network scheme in Tianjin [J]. Tianjin communication technology, 1997 (02): 22-24.
- [2] Chen Yang. Analysis of access network evolution [J]. Journal of Xi'an University of Posts and telecommunications, 2000 (03): 11-14.
- [3] Zhang Yu. Planning and design of broadband access network in six districts of Tianjin [D]. Beijing University of Posts and telecommunications, 2009.
- [4] Yi Bin. Planning and design of EPON optical access network in Dayuan District, Tianjin [J]. Cable television technology, 2013,20 (01): 59-63.
- [5] Wang Jianjun. Research on access network technology and development trend [J]. Information recording materials, 2017,18 (12): 170-172.
- [6] Yu Xiaohu, pan Zhiwen, Gao Xiqi, Cao Shumin. 5g mobile communication development trend and some key technologies [J]. Chinese Science: Information Science, 2014,44 (05): 551-563.