Application of Optical Communication Technology of User Access Network

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Abstract: The development of information technology has brought human society with opportunities. The culture and economy of human society has been developed in the information age. As one of the core techniques in information age, optical communication technology applies exchange of optical and electrical signals to achieve transmission, communication and sharing of information. User access network can realize information transmission to users and make them enjoy the whole information services according to the relations among service nodes. Optical communication technology is the main form of user access network and the carrier of full-service development. It plays an important role in full-service broadband communication.

1 INTRODUCTION

With the development of information transmission technology, information can travel to the given direction on optical fiber with the speed close to light. The optical fiber is the key vehicle of information transmission, and light carrier is the load bearing of information. With the development of information technology, more stable and convenient combination of them has brought great opportunity for human society. Optical communication technology, invented in 1960s, has got great progress after going through half a century. Optical signal multiplexing technology is the core problem of research of optical communication technology. At present, wavelength division multiplexing technology is the main application of optical communication technology. In addition, frequency and space division multiplexing techniques are widely used in application of optical communication technology.

2 RISE OF OPTICAL COMMUNICATION TECHNOLOGY AND USER ACCESS NETWORK

2.1 User Access Network and Optical Communication Technology

As a huge network system including the main line, wiring line and entrance line, user access network bears transmission and carrying functions of information. It is the carrier of information communication among user network interfaces and service nodes, as well as the network system for connection among users and service provision points. At present, user access network contains cable, wireless and integrated networks. Optical communication technology is the main form of cable access network. Cable optical communication technology applies the fiber to communicate. It is the main form of user access network. Wireless optical communication technology — free space optical communication (FSO) is widely used. Optical communication technology provides the users with full-service access network, so the users can enjoy more convenient information network services.

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2.2 Rise of Optical Communication Technology

Optical communication technology, started in 1960s, was blocked by disturbance of weather and electromagnetic wave. It was brought to commercialization by a revolution of WDM technology in 1980s. Since 2000, optical communication technology has made great progress in optical transmission media, optoelectronic devices and optical communication systems. Optical communication technology plays an important role in future economic development.

The development of optical communication technology, as the inevitable trend of science and technology progress, can meet the requirements of full-service in access network transmission. Firstly, rise of optical communication can promote information communication of people, thus breaking the technical limit. Secondly, with the development of technology, the cost decrease of optical communication provides users with convenient, quick, economic and efficient access network services, thus promoting communication industry. Thirdly, optical communication technology, with wide capacity and high speed, has been widely applied in society of large communication and fast life rhythm. Fourthly, information can be transferred timely and accurately based on small loss and error rate of optical communication technology.

3 COMPOSITION AND TOPOLOGY STRUCTURE OF OPTICAL ACCESS NETWORK

3.1 Composition of User Access Network

Optical fiber is the main carrier of optical communication. Fiber is applied to connect local side with user side and form convenient and quick information transmission, thus transferring information resources to the user terminal devices. At first, information source is transformed into source encoding, and into channel encoding in transmitting terminal. The transmitting terminal, affected by electric signal, sends electrical signal. Then, the light carrier travelling on fiber is received in the receiving terminal. The source and channel information is encoded to transform the light carrier into optical signal. At last, the optical signal is amplified to form electric signal for the users.

Optical detector plays an important role in optical signal transmission. Fibers, as the transmission medium of electric signal, consist of single-mode and multimode ones. Light carrier is the supporter of electric signal, with three generations of wavelength. The first generation is the multimode fiber with the wavelength of 0.85 pm; the second and third are the hybrid of multimode and single-mode fibers with a wavelength of 1.31 pm; the fourth is the single-mode fiber with a wavelength of 1.55 pm. In optical communication, the light carrier with longer wavelength has less loss and higher efficiency in transmission, thus providing services with higher quality.

3.2 Topology Structure of Optical Access Network

The main form of optical access network involves bus, star and ring structures. Fiber is taken as the common bus in bus structure. User access network is achieved by direct connection with bus. Bus structure can be seemed as canals (user connection lines) derived from the same great river (common bus). This structure, with little disturbance to users, can flexibly expand services and save investment by trunk fiber sharing. The largest disadvantage is that the large dependence on trunk fiber and accumulated loss can affect user access. In star structure, information exchange is controlled by the central node. With simple dilatancy, convenient updating and large complex coefficient, this decoupling has solved the accumulated loss and saved fiber number and construction cost. The disadvantage is high cost of initial construction and large dependence on central node. Ring structure is a closed circuit formed by a fiber, with the largest characteristic of strong self-repair. Besides, tree and net structures have potential in application in future.

4 APPLICATION OF OPTICAL COMMUNICATION TECHNOLOGY IN USER ACCESS NETWORK

4.1 Application Situation of Optical Communication Technology

Optical communication technology is an information communication technique derived from application of optical complex characteristics such as acousto-optic effect, electro-optic effect, etc. Information is resolved to the form of light carrier by technical methods and transferred on fiber. After reaching the user terminal, light carrier is transformed into

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information to achieve full information service of communication. Fiber can be taken as sensitive element for detection of physical quantity, thus achieving overall, high speed and accurate information transmission. It is widely used in fields as the guidance of base network construction and information communication. In application, optical communication technology should be innovated to improve technical methods for human service at first. Then, the coincidence of optical communication technology and user access network requirement should be emphasized. Optical communication should be deeply researched to improve application potential and technology. In addition, feedback, collection and analysis of user information should be emphasized to meet the market requirement. At last, optical communication technology is applied to build a full service transmission platform of information application for the connection of human society. This plat form should be researched in security and stability, thus proving users with quality full information services.

4.2 Wavelength Division Multiplexing Technology in Optical Communication Application

As the most common optical communication technology, Wavelength division multiplexing (WDM) has been widely used in optical transport and access networks. It applies WDM devices to transfer optical carriers with different wavelengths by one fiber. The advantage is to expand capacity of the original cable for service development. Meanwhile, transmission of electric signal is invertible, and different demultiplexing and multiplexing can be completed in one device, thus enhancing flexibility of user access network and transmission capacity. In addition, the transparent data transmission by WDM is easy for detection, with long transmission distance. The most common is the multiplexing of waves with wavelengths of 1.31 and 1.55 pm. WDM is used to achieve information transmission and full information services. At first, the electric signals with different wavelengths sent by transmitter (e.g., r_1 and r_2) are transformed into complex wave by multiplexer (combiner) and transferred into fiber. Then, light carrier is decomposed into electric signals (e.g., α_1 and α_2) with different wavelengths by wave separator and transferred to receiver in the receiving terminal. At last, user terminal receives and applies information by the receiver. With great advantages and developed technology, WDM has been widely used in user access network.

Networking mode of WDM application contains ring, point-to-point and linear network. The transmission capacity can be greatly improved based on dilatancy. Dense wavelength division multiplexing (DWDM) has huge capacity to expand fiber transmission capacity to 8, 16 and 32 times. In addition, with flexible networking, it can apply light carriers with different lengths in different directions to achieve bipolar transmission on one fiber and a large number of data transmissions. Unpredictable service of user access network can be solved. Support of multi user and application can ensure expansion of user access network. Firstly, WDM can greatly decrease application cost of optical communication technology. Ring network is convenient for expansion and application of main network. Secondly, waves with different wavelengths can be integrated to transfer as the form of complex wave by WDM, thus decreasing overload devices and risks in transmission. The service can be inverted to secure path by different wavelengths, thus ensuring fast, reliable and safe full information transmission. Consequently, application of optical communication technology can be easily detected and controlled.

4.3 Other Optical Communication Techniques in Application

Frequency division multiplexing (FDM), as the extension of WDM, is an optical technique derived from frequency-wavelength relation of optical and electric signals. The key of FDM — frequency division multiplexer requires high resolution. Optical signals with different frequencies pass through tunable filter to achieve information transmission by coherent light communication technology. With mature application and high complex coefficient, this technique has been widely used in user access network. Optical time division multiplexing (OTDM) applied time differences of optical signals on the same cable to spread information after information transformation. The coordination of devices and accuracy at high transmission speed are researched for application. OTDM has the largest advantage of huge capacity information transmission. Optical signal processing at high speed realizes convenient AON compatibility. In subcarrier multiplexing (SCM) process, optical or electric signal after frequency division is loaded by light and modulated to transfer on fiber. The compatibility of information data services is improved to strengthen independence of signals and security of optical communication in user access network application.

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4.4 Development of Fiber Techniques in Optical Communication Application

With the development of optical communication technology, optical communication technology has great space to develop in user access network. Optical signal multiplexing technology realizes electric information transmission with high speed, large capacity and digitization. It is the one of the key factors of fiber transmission capacity. As the transmission medium, fiber is another key factor in optical communication application. The wave band of fiber should be expanded to satisfy optical signal multiplexing technology, thus improving transmission capacity. Fiber provides strong support for the development of optical information technology. E.g., G.665 and G.666 fiber, widely used in China, has made a great contribution to application of optical communication.

5 CONCLUSIONS

The development of science and technology has brought us a modern information technology age. Full information transmission service is improved to develop optical communication technology and achieve diversified selection in user access network. It has advantages including high efficiency, large transmission capacity, stable applications and low cost. The increased business requirement makes space for the development of optical communication technology. Some new techniques are researched. Application of optical communication technology should be emphasized to develop theoretical knowledge for the development of information network technology and requirement of internetwork communication.

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