Original Research Article

Research and Exploration of Future Optical Communication Technology

Hongbin Gu,Jungui Xu,Kaitao Tan,Yejun Xie

Department of Control Science and Engineering, Zhanjiang University of Science and Technology, Guangdong, China

ABSTRACT

With the development and implementation of concepts such as triple play, mobile Internet, Internet of things, cloud computing and intelligent city, China is launching the 'broadband China' national development strategy. This will further accelerate the development of broadband in China, and further promote the related industries, especially optical communications technology, systems and devices and the rapid development of electronic information industry, while promoting the metro and trunk optical transport network construction and expansion, and FTTx optical network construction and bandwidth speed. Under the guidance and promotion of the strategy of 'broadband China', China is entering the new period of broadband construction. The three major telecom operators have further accelerated the construction of FTTx optical access network. In order to meet the needs of this development, ultra-high-speed, large capacity, ultra-long distance optical transport network technology research will accelerate; fiber access technology will be the next generation of broadband optical access network NG PON technology development and evolution. This paper mainly discusses the development history and development status of optical fiber communication technology, the technology used and its future development trend

KEYWORDS: optical fiber communication technology characteristics development status quo use technology future development trend

1. History of Optical Communication in China

In 1973, the world's optical fiber communication is not in practical stage yet. Ministry of Posts and Telecommunications Wuhan Institute of Posts and Telecommunications (then Wuhan Institute of Posts and Telecommunications) has begun to study optical fiber communications. As the Wuhan Institute of Posts and Telecommunications Institute use quartz fiber, semiconductor lasers and coding system of the correct technical line of communication technology, this made China take a lot of detours in the development of optical fiber communication technology, which cause small gap of optical fiber communications in high-tech between developed countries and China.

China's research and development of optical fiber communications is in a decade of turmoil, and in a closed state. Foreign technology cannot be learn, China purely their groping by own and do everything themselves, including optical fiber, optoelectronic devices and optical fiber communication systems. On the development of optical fiber, raw material purification, smelting lathe, drawing machine, optical fiber test instruments and connecting tools are all developed by themselves, which face great difficulties. Wuhan Institute of Posts and Telecommunications, knowing that the optical fiber communication can ultimately be used for economic construction, carried out a comprehensive study and development of optical fiber, they also carry out optoelectronic devices and optical fiber communication system development, and this made our country has a complete optical fiber communications industry.

After the reform and opening up in 1978, optical fiber communication research and development work greatly accelerated. Shanghai, Beijing, Wuhan and Guilin have developed optical fiber communication test system. In 1982 the Ministry of Posts and Telecommunications key scientific research project 'eight two projects' opened in Wuhan. The project is called practical engineering, requiring everything to be a commercial product rather than a test piece, to conform to the international CCITT standard, to be designed by the design institute, by the construction of the worker, not by the technician. Since then, China's optical fiber communication is entering into the practical stage.

In the mid-1980s, the rate of digital fiber-optic communications has reached 144Mb / s, can send 1980 phone, more than coaxial cable carrier. As a result, optical fiber communication is widely used in the transmission line as a mainstream to replace the cable. After the national 'six five', 'seven five', 'eight five' and 'nine five' plan, China has built 'eight vertical and eight horizontal' trunk network, connecting the provinces and cities nationwide. Now, China has laid a total length of about 2.5 million km cable. Optical fiber communication has become the main means of communication in China. Under the arrangement of the Ministry of Science and Technology, the Planning Commission and the Economic Commission, the 8 × 2.5Gb / sWDM system produced in China was first opened in Qingdao to Dalian in 1999, followed by the 32 × 2.5Gb / sWDM optical fiber communication system from Shenyang to Dalian. 3.2Tbps large capacity optical fiber communication system in 2005 is opened in Shanghai to Hangzhou, it is the world's largest practical capacity line. China has established a certain scale of optical fiber communications industry. China produced fiber optic cable, semiconductor optoelectronic devices and optical fiber communication systems for domestic construction, and a small amount of exports.

Some people think that China's main fiber optic communications has been completed, fiber optic communication capacity reach Tbps, which almost endless, and then the 2000 IT bubble made the price of fiber went down to 100 yuan per kilometer, which almost unprofitable, so no need to develop fiber-optic communication technology anymore. In fact, the province has a lot of gaps in the construction of rural areas especially in China; 3G mobile communication network constructions also need to support fiber optic network; with the development of broadband services, network expansion, fiber communication is still a huge market. Now the annual sales of fiber optic communications equipment and fiber optic cable are rising.

2. Fiber Optic Communication Technology

Optical fiber communication is the use of light as an information carrier to fiber as a transmission of communication. Optical fiber communication can be seen as a 'wired' optical communication using optical fiber as a transmission medium. The optical fiber is composed of inner core and cladding. The inner core is usually tens of microns or several micrometers, which is smaller than one hair. The outer layer is called cladding. The function of cladding is to protect the optical fiber. In fact, the fiber optic communication system uses a single fiber, but a combination of many optical fibers. Because the glass material is the main material of making the optical fiber, it is the electrical insulator, so there is no need to worry about the grounding circuit; the light wave is transmitted in the optical fiber, and the information leakage in the information transmission does not occur; the fiber is very small, which solve the implementation of the space problem.

2.1. The Characteristics of Optical Fiber Communication Technology

Wide Bandwidth, Large Communication Capacity

Fiber transmission bandwidth is much larger than copper or cable. For single-wavelength optical fiber communication system, since the limitations of terminal equipment often do not play a large bandwidth advantage, so there is a need to increase the transmission capacity of technology. Dense wavelength division multiplexing technology will be able to solve this problem.

Low Loss, Long Relay Distance

At present, the loss of the commercial quartz fiber is the lowest compared with other transmission media; if use non-quartz very low loss transmission medium in future, the theoretical loss of transmission can also be reduced to a lower level. This shows that system construction costs can be reduced and bring better economic benefits through the optical fiber communication system.

Anti-Electromagnetic Interference Ability

Quartz has a strong corrosion resistance and good insulation. It also has an important feature, which the ability to resist electromagnetic interference is very strong, it is not affected by the external environment, or by artificial cable and other interference. This is particularly useful for communication applications in the field of strong electricity, and is also useful in the military.

No Crosstalk Interference, Good Confidentiality

In the process of radio transmission, the spread of electromagnetic waves is easy to leak and poor confidentiality. Crosstalk does not occur the phenomenon of strong confidentiality in light waves optical fiber transmission. In addition to the above characteristics, there are optical fiber fine, light weight, soft, easy to lay; fiber raw materials rich in

resources, low cost; good temperature stability, long life. Because of these advantages, fiber applications become more and more widely.

3. Fiber Optic Communication Technology Status Quo

3.1. Multi-Service Delivery Platform (MSTP)

With the intensification of competition in the telecom operators market, network builders are increasingly concerned with the development of new, market-compliant applications and services in existing networks, which increases the type of business that the network needs to carry. Way to implement the multi-type service in a single basic network is becoming more and more concerned, and it will produce a new technical term - MSTP. (Such as SDH and DWDM) and packet-based multi-service transmission platform (such as based on ip, RPR and MSR, etc.). The multi-service transmission platform is based on the multi-service transmission platform. In the current actual network construction, the former is the most common application which based on SDH multi-service transmission platform, and the latter contains the technology that is still in continuous development and improvement.

3.2. MSTP Based on SDH

SDH-based MSTP basic idea is in the traditional SDH transmission platform, integrated 2-layer Ethernet, ATM and other processing capabilities, the SDH on the real-time business and the two-tier network (such as Ethernet and ATM), or even 3 layer technology has the data processing capabilities of the organic combination to enhance the transmission node for multi-type business integrated carrying capacity. In the actual equipment development and application currently, how to effectively carry the Ethernet business is the focus of attention. The technology development of MSTP-based Ethernet service has experienced two phases: business transmission and 2-layer switching. In order to improve the networking capability and service performance of MSTP-based Ethernet, a large number of new technologies such as VC cascade and virtual concatenation, link capacity adjustment scheme (LCAS), GFP / LAPS / PPP standard encapsulation protocol, Ethernet-based CoS classification, queuing and scheduling, flow control and other mechanisms, 802.1q VLAN and 802.1 ad operator bridging (VLAN stack) technology are used.

3.3. With the Deepening of Application.

It has been found out that the introduction of the techniques above is not sufficient to meet the requirements of the client layer (including the user) effectively. So, the current focus of the new research and development is to consider how to embedded RPR and MPLS technology into MSTP.

The embedded of RPR in MSTP carrying Ethernet services has the following characteristics: to simplify the loop within the packet processing process to improve the efficiency of ring network bandwidth to support the rapid protection switching mechanism, with bandwidth fairness and business classification processing capacity , support for topology discovery, and support for broadcast and multicast services. RPR also has some problems, such as the lack of fine-grained based on a single user QoS guarantee mechanism, only support the ring topology, it is difficult to provide end-to-end user traffic identification and control.

The embedded of MPLS in MSTP carrying Ethernet services has the following characteristics: Ability to implement end-to-end user identification and flow control, with reasonable bandwidth dynamic allocation mechanism and end-to-end QoS guarantee capability; by using MPLS tags, allowing different users to use the same VLAN ID, fundamentally solve the traditional scheme of VLAN address space constraints, due to the use of labeling mechanism, MPLS routing calculation can be based on the Ethernet topology, thus reducing the number and complexity of routing equipment, optimizing the Ethernet data transmission efficiency in MSTP. In addition, the ability to provide layer 2 VPN services is also a feature of embedded MPLS MSTP. Currently, the industry is actively studying how to implement Layer 2 Martini MPLS VPN in MSTP. However, in order to give full play to the advantages of MPLS (such as MPLS VPN services, and by enabling VPN users to automatically find and dynamically configure to improve the availability of VPN services), there is a need for a certain signaling and routing protocols to achieve this relatively complex goal.

Obviously, for different network application environment and Ethernet traffic mode, embedded MPLS and embedded RPR MSTP have advantages and disadvantages, it is difficult, there is no need for a level. It is also a consideration that the two technologies can realize the processing of the Ethernet service together. At this time, the MPLS and RPR technologies are used to control the user traffic and the node pipeline respectively, and the two different stages of the flow control process are appropriate related, and can further improve the capacity of MSTP to handle Ethernet services.

3.4. MSPP and Multi-Service Ring For Base Packet Grouping

The multi-service transmission platform based on packet technology is also an important MSTP solution. It is called MSPP, which mainly includes MSTP based on IP, RPR and MSR. MSTP, based on packet technology, simplifies the protocol hierarchy and reduces the cost of the solution, but also brings the problem that QoS cannot be effectively guaranteed when implementing multi-service (especially QoS-aware real-time service). Therefore, the main goal of the evolution of the program is to effectively solve the QoS guarantee problem.

MSR is the representative of the Wuhan Institute of Posts and Telecommunications on behalf of the Chinese government in February 2002 to ITU-T SG17 recommendations, in October 2003, it formally approved as an international standard (X.87 / Y.1324). MSR is a new type of optical metropolitan area network and application mode. It works above the RPR MAC layer, thus inheriting the many features of the RPR. In addition, the MSR has made significant improvements to the RPR frame format by using the client PDU, and has newly defined the XP (X.87 protocol) frame and introduced the branch (service) concept to realize the integration of transmission and exchange as well as voice, data and video services. Its main feature is to carry different traffic at the data link layer (via Ethernet), voice (via G.702 PDH, TCE (TDM circuit simulation) over MSR, etc.) and video (via DVB and so on) , different network branch form, different types of data traffic (traffic data traffic, network management data NM traffic and signaling CS traffic) organically together to achieve all kinds of data and business of low-level collection and unified packaging. In addition to the features described above, the MSR also supports a number of new features: support 1/1, 1: 1 and 1: 9 protection or backup for 50ms based on service or branch; multicast based on service or branch and node based broadcast and broadcast, symmetric and asymmetric bandwidth limitations based on traffic or branch.

MSR is still need a process in order to use in the construction of telecommunications networks widely, but its international standardization will be a better guide to the construction of metropolitan area network, and to a certain extent, promote China and the world's metropolitan area network system to a higher target development.

3.5. Intelligent Optical Transport Network with ASON

Over the years, intelligent optical transmission technology has been a concern to the industry, people want to build an intelligent optical transmission network to solve the existing problems in two aspects of the transmission network; traditional network is difficult to adapt to the rapid growth of online data business, it is not predictable to achieve the dynamic allocation of network bandwidth; traditional optical transmission network mainly rely on manual configuration network connection, which time-consuming and difficult to adapt to modern network development needs of new business. ASON is in this demand under the traction generated. Compared with the traditional optical network technology, ASON advantages are derived from its own intelligence, specifically from the 'automatic exchange.'

Whether it is technology itself or for practical network applications, ASON surprisingly brings the advanced nature: through traffic engineering, allowing network resources to be dynamically allocated to the route; using a special control plane protocol, rather than only through a small number of primitive set of network management protocol to achieve network control, with a scalable signaling capabilities set to support multi-vendor environment, for connection control; with fast business provision and expansion capabilities, with fast business recovery capabilities, if the network run into a problem it can still maintain a certain level of service; to facilitate the introduction of bandwidth business demand, wavelength wholesale, wavelength rental, dynamic routing, L1 VPN and other new business types, so that the traditional transport network can provide a variety of different QoS class differentiation services to the business network direction, for example, can be combined with different levels of protection to provide different levels of service.

Intelligent optical network is the inevitable trend of network development, but its application in the network will be a gradual evolution of the process. In this evolution, the following factors need to be taken into account: equipment compatibility and network construction economy (including construction costs, operations and maintenance, revenue), smooth transition of business and introduction of new business, networking, and the maturity of node technology, the standardization of signaling, routing and interface protocols.

At present, it has begun to apply to the telecommunications network gradually in order to be able to partially support ASON intelligent optical nodes. From the actual progress, ASON large-scale application will take some time at all levels of the network, it will first apply in the long-distance backbone network and metro backbone network, and then gradually to the edge of the network penetration. Considering the cost of network construction brought by the introduction of an independent control plane, network nodes with full ASON intelligence may not be deployed at the network edge (such as network access layer). A possible choice at the edge of the network is to provide the SDH ECC with the required transmission bandwidth for the ASON control plane and, if necessary, to further reduce the ASON intelligence to reduce resource consumption and ultimately achieve cost-effective intelligent optical transmission nodes.

3.6. Higher Transmission Capacity and Longer Transmission Distance

Over the past two years, the highest transmission capacity based on single channel has been widely used in SDH 10Gb / s. Application requirements still exist for 40Gb / s, but its node technology, network applications and system performance and other aspects of the problem is still not well resolved. In addition, due to the existence of a partially replaceable solution (such as DWDM), it further affected the 40 GB / s SDH system to commercial pace.

From 2001 to the present, the maximum level of optical transmission capacity remained at 10Tb /s since the improvement of DWDM technology. The record of the highest transmission capacity of the optical fiber transmission system reported by OFC 2001 and OFC 2002 has reached 10 Tb / s. OFC 2003 reported a maximum of 6.4 Tb / s. In addition, from the analysis of the demand for trunk line capacity growth trend for next 2-3 years in China, the actual large number of commercial DWDM system, the maximum transmission capacity remained at 1.6Tb / s level.

As with higher transmission capacity, having a longer transmission distance is also one of the directions in which optical communication technology continues to move forward. The technical and applied research on this aspect has reached a high level: OFC2002 has been reported to achieve Tb / s capacity transmission of 11000km. The longest transmission distance reported by OFC-2003 is also 11 000 km and the transmission capacity is 3.73Tb / s. In addition, OFC-2003 reported a maximum transmission rate of 6.4Tb / s, and system transmission distance of up to 3200km. In recent years, the relevant domestic departments attach great importance to ultra-long distance (ULH) optical transmission technology research work, and included in the national 863 program. At the beginning of 2004, the '863' ULH project undertaken by Wuhan Institute of Posts and Telecommunications was successfully passed the acceptance of the 863 expert groups. This project is based on the 1.6Tb / s DWDM system on which the hospital has been commercialized, achieving ULH transmission over more than 3,000 kilometers of actual G.652 / 655 fibers, some of which have been applied to domestic primary engineering.

3.7. Development of Metro WDM Technology and CWDM

With the increasing demand of transmission bandwidth in metropolitan area network, WDM system is more and more used in metro transmission network. Compared with the long-distance optical network, the metro optical network has the characteristics of short transmission distance, flexible topology, and rich access type. Therefore, the WDM system used in the metro environment has large capacity, and also has a flexible network, easy to expand, low cost, easy management and so on. The metro WDM system includes metro DWDM and CWDM.

The metro WDM system equipment configuration and technology development has emerged a series of new features with the changing of application environment. As the transmission distance within the metropolitan area network is generally below 100 km, so the corresponding WDM system usually does not need to use optical amplifiers, the optical transceiver module requirements are significantly reduced. Since the optical amplifier may be omitted, the increase in the number of wavelengths of the WDM system will no longer be limited by the effective gain bandwidth (gain flat) of the optical amplifier, allowing the use of a relatively low wavelength interval, it has a relatively low wavelength accuracy and stability. Module and co-divider devices to further reduce system cost. It is CWDM when the system wavelength interval extend to a certain extent (such as greater than 2nm).

CWDM is also a technology in the metro optical network. Metro DWDM is mainly used in metro backbone network, CWDM more used in the metropolitan area network edge. CWDM requirements for devices are much lower than DWDM. In the case of a demultiplexer, the 100 GHz (0.8 nm) filter used in the DWDM system is typically about 150 layers, while the 2500 GHz (20 nm) filter used in the CWDM system requires only 50 layers, and the cost is 50% less than the cost of the DWDM filter, and is expected to reduce the cost of automated production by 1/3 in the next 2 to 3 years.

3.8. Broadband Passive Optical Network Technology Development

Passive optical network (PON) technology is a developed optical access technology to support point-to-multipoint applications. Due to the use of fiber as the transmission medium and the use of passive optical distribution network, PON can avoid the external equipment, electromagnetic interference and environmental impact, reducing the line and external equipment failure rate, improve system reliability, while saving maintenance costs. Narrowband PON which almost no practical application was replaced by broadband PON (BPON), BPON currently appeared these three kinds of technology which are APON, EPON and GPON.

APON (ATM PON) was developed by FSAN (full service access network) in the mid-1990s and was subsequently identified as ITU standard (G.983). Due to the high complexity and low efficiency of data transmission, although APON technology is relatively mature, it has not been widely used except some scale applications in Japan.

EPON (Ethernet PON) is the standard adopted in November 2000 by IEEE organization 'Ethernet last mile (EFM)' study group. As the most popular enterprises and users' access means, Ethernet has the characteristics of lower

construction costs, lower operating costs, scalability, easy installation and maintenance, and has great potential for development. As a result, there is a great deal of expectation for combining FTTH with the combination of both Ethernet and PON technologies.

GPON is the PON standard in which the FSAN organization began drafting more than 1 GB / s in 2001. In January 2003, two standards related to GPON (G.984.1 and G.984.2) were adopted in the ITU. Basic starting point produced by GPON technology is: different service needs corresponding to different system capacity. The frame structure of the GPON is not encapsulated based on the format of any given type. It is based on the original format of the various user signals. Therefore, it not only provide high-speed bit rate, and also support a variety of access business, in particular, can be very effective to support the original format of data traffic and TDM business.

Compared with GPON, EPON biggest problem is the overall efficiency of its bearer business is not high. As a result of the 8B / 10B encoding as a line code, which in itself introduces a 20% loss of bandwidth, coupled with the EPON adapter service bandwidth utilization is only 60-70%, so that its overall efficiency is only about 50%. The GPON has advantages of high bit rate (up to 2.4Gb / s), does not change the original signal format (ie, transparent transmission), high transmission efficiency (94%), and can support multiple services (TDM and data), so the technology get concerned once raised.

GPON and EPON are no lack of their supporters, it is difficult to finalize who can be in the dominant position for future application. In addition, although the undisputed BPON technology will continue to be the future direction of broadband access technology, but from the current technological development, cost and application requirements of the actual situation, it is widely used in telecommunications access network to achieve the ultimate goal. There will still be a long process of development.

3.9. Metro Ethernet Technology with the Telecommunications Infrastructure Network

Optical Ethernet technology is one of the mainstream technologies to build optical metropolitan area network. It extends the superiority of Ethernet to the metropolitan area network, and has very good scalability, and it can be very convenient to expand the number of users. The main direction of the development of the technology is focus on further improvement of the operational, manageability of optical Ethernet. Under this traction, Metro Light Ethernet is evolving from Ethernet over overtime, Ethernet over DWDM to Ethernet over RPR, and even Ethernet over SDH / SONET.

In order to improve the operational and manageability of Ethernet, people try to transform the traditional Ethernet by adding various technologies to improve their intelligence, including: the use of MPLSoE, bandwidth control technology to achieve Ethernet control and Hierarchical QoS, using VLAN, policy routing, web authentication and other technologies to enhance the security and manageability of Ethernet; use of AAA and other technologies to achieve Ethernet users billing and behavior audit; CDN technology, L4- L7 switching technology is used in Ethernet switching equipment to provide user-oriented personalized network services. It should be noted that, in addition to the new technology to transform the Ethernet, you must try to keep simplicity of Ethernet, reduce node costs, and simplify the configuration. Otherwise it will lose the traditional advantages of Ethernet, and brings more harm than good.

Since 2001, ITU-T has carried out a series of research work around EOT (Ethernet over Transport) technology. As now, has completed the Ethernet network architecture (G.8010), the Ethernet service framework (G.8011 / Y.1307), the Ethernet leased line service (G.8011.1 / Y.1307.1), the Ethernet (G.8012), Ethernet transport network device function block characteristics (G.8021 / Y.1341) and other standards, some other standards are still in the process of discussion, such as Ethernet services Multiplexing (G.esm), Ethernet OAM mechanism (Y.17ethoam) and so on. At the same time, from 2004 onwards, ITU-T MOT (MPLS over Transport) a series of standardization work has also been in full swing. In addition, the Metro Ethernet Forum (MEF) and IEEE have also accelerated the standardization of Ethernet technology. The deepening of the standardization will greatly promote the application and popularization of optical Ethernet technology.

4. Future Development Trend of Optical Communication Technology

For fiber-optic communications, ultra-high speed, large capacity and long distance has always been the pursuit of the goal, and fiber to the home and all-optical network is also a tireless pursuit of the dream.

4.1. FTTH

FTTH (fiber to the home) is the direction of further development of optical fiber communication. It is recognized as the ideal broadband access network. At present, the so-called broadband services, mostly 500kbps film and television programs. In order to make full use of copper resources, operator use ADSL technology, which delayed time of FTTH to become mainstream network access. In the near future, in the case of popular HDTV, ADSL cannot meet the requirements, and advanced ADSL2 + may be able to meet 1chHDTV / households. If 4chHDTV / households with

FTTH more reasonable. In the case of two-way business is widely used, the uplink and downlink asymmetric ADSL difficult to correspond. At present, the developed countries generally use FTTH construction, more developed countries like Japan, South Korea and the United States using a variety of passive optical network PON and Ethernet technology. China's operators and real estate developers have piloted FTTH. Recently, the so-called Internet TV (IPTV), telecom operators put forward the original intention of IPTV, taking into account that number of people having TV is more than number of people having computer. The proposed IPTV is a dedicated set-top box connected to the TV which can browse the contents of the telecommunications network directly. IPTV has a regular TV and both on-demand and time-shifted TV functions and it may replace the conventional TV. Due to the development of IPTV, construction of fiber access network and FTTH is affected. In addition, there is a conflict of interest between telecom operators and broadcasters. Despite the restrictions on licensing policies to protect broadcast operators, the trend is unstoppable. In fact, many radio operators have begun to transform their broadcast network for the digital two-way, but also have the function of developing IPTV. The boundaries of broadcasting operators and telecom operators are starting to be somewhat blurred.

4.2. Large Capacity, Ultra Long Distance Transmission Technology Wavelength Division Multiplexing Technology

It greatly improves the transmission capacity of optical fiber transmission system. In the future, cross-sea optical transmission system has broad application prospects. In recent years, wavelength division multiplexing system is in rapid development and the 1.6Tbit / WDM system become very commercial. At the same time, all-optical transmission distance is also a substantial expansion.

4.3. Optical Soliton Communication

Optical soliton is a special kind of super-short pulse of ps magnitude, because it is in the optical fiber anomalous dispersion area, group velocity dispersion and non-linear effects of mutual balance, so after long-distance transmission of fiber, the waveform and speed remain unchanged. Optical soliton communication is the use of optical soliton as a carrier to achieve long-range, no distortion of the communication, in the case of zero error information up to thousands of miles away. Of course, there is still many technical problems in actual optical soliton communication, but the breakthrough has made people believe there is a bright future that the optical soliton communication can travel in the ultra-long distance, high speed, large capacity all-optical communication, especially in the submarine optical communication system.

The future prospects of optical soliton technology are: the use of ultra-long distance in the transmission speed of high-speed communications, time and frequency domain ultrashort pulse control technology and ultra-short pulse generation and application technology to the current rate of 10-20Gbit / s more than 100Gbit / s; increase the transmission distance in the use of re-timing, shaping, regeneration technology and reduce the ASE, optical filter to increase the transmission distance to more than 100000km; to obtain low noise and high output EDFA in high-performance EDFA.

4.4. All-Optical Network

The traditional optical network achieves all-photonization between nodes, but still uses electrical devices at the network nodes, which limits the further improvement of the total capacity of the current communication network. Therefore, the real all-optical network becomes a very important subject.

All-optical network to replace the node with the optical node, the node is also full of light, the information exchange is always in the form of light transmission, the switch on the user information processing is no longer bit by bit, but according to its wavelength to determine the routing.

All-optical network has good transparency, openness, compatibility, reliability, scalability, and can provide huge bandwidth, large capacity, high processing speed, low bit error rate, simple network structure, flexible network, and can always add new nodes without having to install the signal for switching and processing equipment. Of course, the development of all-optical networks cannot be independent from many of the communication technologies, it must be with the Internet, A M M network, mobile communication network integration [1,8].

At present, the development of all-optical network is still in the early stages, but it has shown a good development prospects. From the development trend point of view, the formation of a real optical network layer which based in WDM technology and optical switching technology, the establishment of pure all-optical network to eliminate the electro-optical bottleneck has become the inevitable trend of future optical communication development, but also the future core of information network. It also is the highest and ideal level of development of communications technology.

With the rapid development of social information, the communication technology put forward higher requirements. With the development of optical communication technology, many optical communication technology problems have made a breakthrough development. Optical fiber communication technology will play an important role in the future information society. For optical fiber communication, ultra-high speed, large capacity and long distance transmission has always been the pursuit of the goal, and all-optical network is also a tireless pursuit of the dream.

5. Conclusion

Since the birth of optical fiber communication, it has brought a revolution to the entire communications field. It makes high-speed, large-capacity communications possible. At present, optical fiber communication has become one of the most important information transmission technology. So far no any other technology can replace it. Even when the global communications industry faces the downturn, the development of optical fiber communications has never stalled. The optical communications market in 2002 compared to 2001 is still growing in China. From the development trend of modern communications, optical fiber communication will also become the mainstream of future communications development. People expect fiber to the home and the real all-optical network era will come in the near future.

References:

1. Gui Youyi. Current situation and development trend of optical fiber communication technology. Jiangxi Communication Technology. 2004: 10-13.
2. Zhang Chengyun, He Zhenjiang, Xu Hui Liang, et al. Development status and trend of optical communication technology. Laser and Optoelectronics Progress. 2004 (41): 26-29.
3. Hu Liao Lin, Liu Zengji. Development status and some key technologies of optical fiber communication. Electronic Technology. 2004 (2): 3-10.
4. Ang Zihua. A new chapter in optical fiber communication. China Data Communication. 2004: 5-7.
5. Peng Chengzhu, Peng Mingyu. Next generation network and its new technology. Radio and Television Information. 2004 (1): 68-71.
6. He Shuzhen, Wang Xiaomei. A new leap in optical communication technology. Network telecom. 2004: 36-39.
7. Zhao Zisen. OFC2004 Optical Fiber Communication Conference. Technological development. 2004: 1-6.
8. Huang Baiheng. All - optical network exploration. China Cable TV. 2004 (17): 42-47.
9. Wang Lei, Pei Li. Optical fiber communication development status and future [J]. China Science and Technology Information .2006. (4).
10. He Shuzhen, Wang Xiaomei. Optical communication technology of the new leap [J]. Network Telecom.2004. (2).
11. Xin Huamei, Li Zhong. On the status and development of optical fiber communication technology. Journal of Shandong Normal University .2003.4.
12. Li Chao. Talking about the status and trend of the development of optical fiber communication technology. Coastal Enterprises and Science and Technology.2007.7.