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An Overview of Optical Label Switching Technology

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Abstract

Optical label switching is a new technology of optical switching, which can overcome the electronic bottleneck of optical communication effectively， optical label switching (OLS) network as a specific implementation of future optical packet network has been paid more and more attention, its key technology is the generation and extraction of optical label. In this paper, subcarrier multiplexing label, OCDM optical code label and orthogonal modulation label are described and discussed. Their strength and weakness are analyzed.

Keywords:optical label switching, subcarrier multiplexing, orthogonal modulation, OCDM optical code label

1. Introduction

With the wide scale deployment of WDM network, the need for great transmission capacity of the network has been met. But in switching nodes, the optical data needs a photoelectric conversion. The mismatch between the transmission capacities offered by the WDM optical layer and the processing speed of switching becomes a bottleneck. Optical label switching comes from optical packet switching, which uses low-speed label signals to make routing and switching, while retaining the high-speed characteristics of optical packet switching. It is a promising way for the future optical packet switching.

2. Optical label switching

Optical label refers to mark packet header address on light package by various methods. In the switching nodes, it is identified and exchanged correspondingly on the basis of the principle of optical label generation, data is transmitted and exchanged in the optical layer, lower rate routing and controlling

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information in each node is converted to electrical signals to produce control information, so as to achieve high-speed all-optical switching, at the same time new label is generate and transmitted to the next switching node to provide routing information.This optical switching technology based on above principle is called as optical label switching.

In the optical label switching, optical signal is labelled as optical packet which is constituted from a packet header and a payload, header contains address information. In exchange node, only the packet header is processed to determine the destination, to choose the routing, according to the contents of the packet header, payload data is transmitted directly in the optical layer without electrical processing[1].

The international community has done a lot of research on optical label switching. Several kinds of optical label mechanism were proposed so far. According to the channel which label lie in, optical label is divided into two categories mainly,. That is the outside to glorify label and an inner to glorify label. The former, such as WDM optical label and subcarrier multiplexing (SCM) optical label, the latter, such as orthogonal modulation optical label and OCDM optical label [2].

Optical label generation, extraction, erase and rewrite are key technology of optical label switching network[3]. Figure 1 shows the network structure of optical label switching network which is made up edge router and core router. Input data packet encapsulated in the edge router goes through into the OLS network and route and forward, and finally left from the purpose edge routers of the network, then the optical packet is split and restored to IP packets .

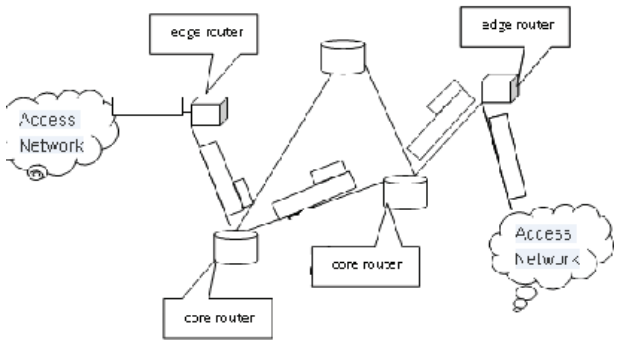

Figure 1 the structure of optical label switching network

3. Orthogonal modulation optical label

In applications of optical label switching network, orthogonal modulation optical label is that two relatively independent modulation is used to modulate two sets of information to the same carrier light wave, one is payload, the other is label. Two sets of information against each other are received, detected and demodulated at the receiving end. Their signal bit rate and pattern are unrelated each other, they are received in independent ways. Payload and label can be modulated by different methods, which generally divided into AM, FM and PM and so on. When payload is intensity modulation, label is differential phase modulation (DPSK) or frequency modulation (FSK), they each other has no effect[4 5].

Label based on amplitude modulation is produced by semiconductor optical amplifier, nonlinear effects of cross-phase modulation, cross-gain modulation and four wave mixing. Label based on FM commonly is generated by carrier demultiplexing method. Label based on phase modulation is generated and extracted through the principle of interference of light[6 7].

As the payload signal and label signal is loaded into an optical wavelength, the orthogonal optical label switching is no additional resource consumption, network bandwidth resource is efficient, it is relatively easy to achieve the separation of label and payload ,it is no strict time synchronization and

simple structure, it is actual operational. In the case of high-speed long-distance, using DPSK for payload, it has anti-non-linear capability[8]. However, due to label and payload modulation are on the same carrier, if it is intensity modulated, the intensity modulation ASK (IM, OOK) extinction ratio can not be too large， otherwise it will affect the other information bit error rate.

4. Subcarrier multiplexed optical label

Subcarrier multiplexed label also is known as subcarrier modulation, the basic principle is that packet header is the label , payload is modulated on baseband, the packet header information is hosted on a suitable sub-carrier, the spectral carrying the packet header information is outside of spectrum of baseband data, they are mixed into one signal and modulated into an optical carrier, the packet header and payload are multiplexed in the same wavelength to achieve the label signal and the baseband data signal to bundle transmission. Label is transmitted parallel with payload, but the rate can be lower than the payload. In subcarrier label, the label is processed asynchronously, which has little impact on the payload, all-optical switching is achieved[9 10].

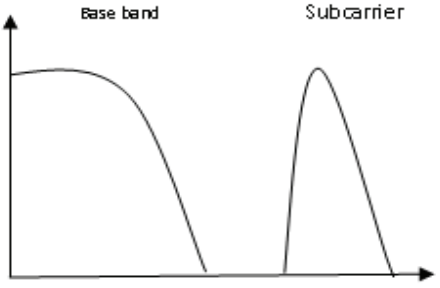

Figure 2 spectrum structure of Subcarrier multiplexed optical label

Figure 2 is spectrum structure of Subcarrier multiplexed optical label. Spectrum of payload baseband and label information spectrum are far enough in the frequency domain to prevent signal degradation caused by interaction modulation, which resulting in power cost.

Figure 3 shows the principle of subcarrier multiplexed optical label generation, the payload is modulated to baseband, label information is modulated on the microwave subcarrier, then the two frequencies are coupled together to modulated a laser, then optical packet goes through fiber, clock controller is to ensure signal synchronization.

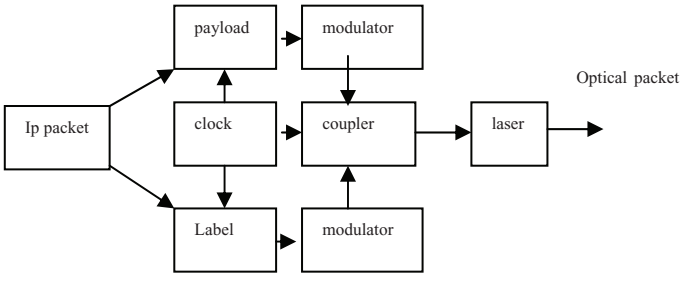

Figure 3 principle of subcarrier multiplexed optical label generation

There are lots of advantages of subcarrier multiplexed optical label. Label generation, extraction and identification are very easy, it does not take up extra resources of wavelength channel, between the label and data it does not need guard time. But this technology also has its quite disadvantages, it is difficult to erase the old label completely, which has impact to receive a new label, the interaction modulation arising from subcarrier multiplexing will seriously affect its transmission performance, limit the transmission distance.

5. OCDM label

Optical code-division multiplexed label comes from the optical code division multiple access network, in the network access of each user's use orthogonal optical CDMA code to replace WDMA wavelength or TDMA time slot. Optical code can also be a time domain, frequency domain, or a combination of two. Orthogonal codes can be used as the packet header in optical packet, optical code is the label.

Optical label switching system based on OCDM code is consists of edge nodes and core nodes. In edge node it has functions of distribution, write and erase of optical code label. In originating edge node data is divided into optical packet by appropriate algorithm and is assigned the corresponding optical code label, in the destination edge node labels are erased. In the core nodes label is identified and exchanged. According to the input label and the local routing table, optical packets are switched to the appropriate output port, assigned a new label to replace the old label, repackaged as optical packet and sent to the next node.

Label identification is key technology of optical code label switching. The principle is that input optical label and label library in the local optical decoder is orthogonal or not. By splitting the input optical label to each decoder in the local label library, the decoder which match the input label will produce a high autocorrelation peak output, the other which does not match the decoder will produce a low correlation peak output. Autocorrelation output of the decoder will be detected to determine the contents of the label, and to control exchange unit to switch packet to the appropriate output port. Only taking label identification computing time of related decoder, which is the reasons why the system can perform with a high-speed optical label identification11 12. The principle of OCDM label identification is shown in Figure 4.

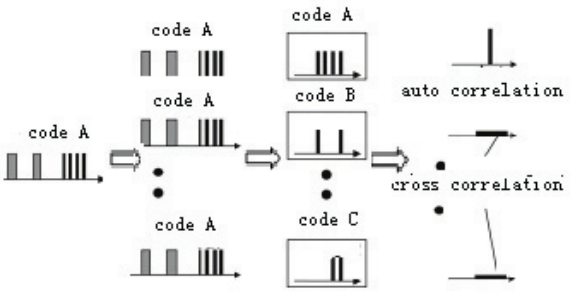

Figure 4 The principle of OCDM Label identification

6. Summary

Optical label switching is the realization of optical packet switching, its key technology is the generation, extraction and exchange of optical label, there are many factors to explore for practical application of OLS.

References

[1] Kefeng Qu. Study on Key Technology In Optical Label Switching Network. Master dissertation. School of Electronics and Electric Engineering Shanghai Jiao Tong University Jan, 2009(In Chinese)

[2] He Zhou，Huang Bo，Huang Dexiu.: Research on optical Label Swapping Technology of Optical Packet Switching Network. TELECOMMUNICATIONS SCIENCE 2008,24(7)pp.75-78

[3] Xiao Pengcheng， Zeng Qinji， Huang Jun， Liu Jimin.: Research 0n Optical label Technology OPTICAL COMMUNICATION. Jan,2003pp.30-33

[4] Jianfeng Zhang, Pahln V. Holm-Nielsen, Nan Chi, Christnphe Peucheret, Palle Jeppesen, DC-balanced line encoding for optical labeling scheme using orthogonal modulation,2003 Optical Society of America

[5] ZHANG Lijia, XIN Xiang jun, LIU Bo, YU Chongxiu.: Novel High Speed Orthogonal Optical Label Switching Technology Based on The 8PSK Modulation. Infrared and Laser Engineering Feb.2010 Vol.39 No.1pp.103-105

[6] DENG Chaogong.: Transmission Performance of Optical Label Switching Networks Based on FSK and ASKSEMICONDUCTOR OPTOELECTRONICS Vol. 30 No. 1 Feb. 2009pp. 104-107

[7] Lijia Zhang, Chongxiu Yu, Xiangjun Xin Liu Bo.: High-Speed Optical Label Switching Based on The 8PSK/ASK Orthogonal Modulation Format

[8] HU Xiao Ming.: THE NEW MODULATION FORMAT RESEARCH OFORTHOGONAL OPTICAL LABEL SWITCHING Master dissertation Master dissertation. Beijing University of Posts and Telecommunications. Feb,2009 (In Chinese)

[9] Xiao Pengcheng， Zeng Qinji， Huang Jun， Liu Jimin : Research 0n Optical Label Technology. OPTICAL COMMUNICATION. Jan ,2003.PP. 30-33(In Chinese)

[10] ZhengMian，Qiu Kun，Ling Yun.: Novel Optical Packet Generation Scheme for Subcarrier multiplexed optical Label Switching. JOURNAL OF UNIVERSITY OF ELECTRONIC SCIENCE AND TECHNOLOGY OF CHINA VOL33NO6,DEC,2004,pp.659-662

[11] TangLin.: Research on Performance of OC—label based Optical Packet Switching. Master dissertation. University of Electronic Science and Technology of DaLian..May，2008(In Chinese)

[12] Li Shuwen, Zhang Qi.:The Research of Optical Label Switching Based on OCDM Optical Code Labels. http://www.paper.edu.cn