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Optical Ethernet: A Review

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ABSTRACT : This paper describes the basic functionality of Ethernet and how to use it in the home and enterprise networks. This article includes the type of Ethernet, Ethernet cable and how the OSI model? With respect to the distance between the Ethernet cable and two different types of specifications, network devices and it uses its topology support. Next Generation Gigabit Ethernet standard is currently under development, it is expected to come out in the coming years. This article focuses on several aspects Gigabit Ethernet, such as market demand, the implementation of structural layer interfaces, coding, frame format, media, equipment and other ongoing

Keywords : Ethernet, OSI modal, Topology, Access Network, Dynamic Programming, Bellman principle

INTRODUCTION

In this article, Ethernet introduced as one of the oldest, but is used to form the largest network still technology. For many years, Ethernet has proven itself to be a very popular, fast and relatively expensive LAN technology. In fact, it will think of the existence of computer networks, Ethernet is not difficult. Thus the great significance of holding the hearts of Ethernet, Ethernet is defined as under. Ethernet is a local area network for controlling data (LAN) is sent in a protocol. The name comes from combining Ethernet word “ether" and “Network”. Ethers, meaning " light bearing " , stands for the use of light as a transmission medium , and the Net is an abbreviated form of the network, which means that the community as a means or a group of interconnected computer data. It is not a wireless technology, because it uses the physical medium is commonly called wires. Mainly, Ethernet specification defines the low-level data transfer protocol.

Brief History of Ethernet

The concept of Ethernet was formulated and introduced by XEROX PARC, now simply known as PARC (Palo Alto Research Centre).This agency proposed to develop a form of system that would permit/allow computers and devices to be connected with one and other using coaxial cables. Engineers BobMetcalfe and D.R Boggs developed Ethernet beginning in 1972. In 1976, a connection two computers were made and data transfer fruitfully took place with the speed of 3MB/second. In 1980, industry standards based on their work were established under IEEE 802.3set of specifications. In 1990’s ,fast Ethernet technology came into existence fulfilling the objective of a)increasing the performance of previous traditional Ethernet b) avoiding the need of completely re-cable existing Ethernet networks.

ETHERNET DEVICES

Ethernet Devices include a) Ethernet network adapters b) Repeater c) Hub d) switches e) Bridges f)RJ-45 connector

(a) Ethernet network adapters

To install or connect Ethernet cables to a computer, a person generally uses a network adapter, also known as a network interface card (NIC) or Ethernet network adapters. Ethernet adapter interfaces directly with a computer’s system bus. The cables in turn utilizeRJ-45 connector used with modern telephones. Ethernet network adapters exist in multiple forms: a) PCI cards :most popular for desktop computers b) PCMCIA (“credit cards”): most popular for notebooks or laptops c) USBE the rnet adapters exist for both desktops and laptops d)Wireless Ethernet adapters.

(b) Repeaters

A Repeater in Ethernet networking is a device that allows multiple cables to be joined and greater distances to be spanned.

(c) Bridge

A Bridge device can join an Ethernet to another network of a different type, such as a wireless network.

How Ethernet works?

Ethernet works by connecting PC and other devices using a cable. One end of the Ethernet cable to the computer, while the other is connected to the connector, such as repeaters, hubs and switches. As for sending signals, Ethernet is basically a chain reaction works. A computer which generates and transmits signals necessary for the operation. The signal through cable, and then through the connector, and then reconnect the cables and finally to its designated receiving computer. In addition, the Ethernet -based random delay time algorithm to determine the appropriate waiting period between retransmissions. In traditional Ethernet, radio listening and collision detection protocol is called CSMA / CD (carrier sense multiple access / collision detection) collision. When the resulting two launch failures, and requires both the sending device resend.

a) Disadvantage of CSMA/CD

By design, as a performance trade-off, the Ethernet standard does not prevent simultaneous transmission.

b) Remedial measure adopted

In order to avoid/overcome this problem, some newer forms of Ethernet have been developed that uses full duplex Ethernet protocol. This Ethernet supports point to point simultaneous transmission, sends and receives signal with no listening required.

Physical Layer Architecture

There are two structures for the physical layer implementation of 10-Gigabit Ethernet: the serial solution and parallel solution. The serial solution uses one high speed (10 Gb/s) PCS/PMA/PMD circuit block and the parallel solution uses multiple PCS/PMA/PMD circuit blocks at lower speed. The two solutions have different advantages and disadvantages which are discussed next. A generic Gigabit Ethernet over WDM network.

Network Architectures

Ethernet over WDM. A WDM ring connects three Gigabit Ethernet nodes capable of providing access to any desired Ethernet speed. Note that any other structure of the WDM network (especially point-to-point or line networks) is possible. Ring networks, however, over redundancy inherently (dashed path in figure 2).

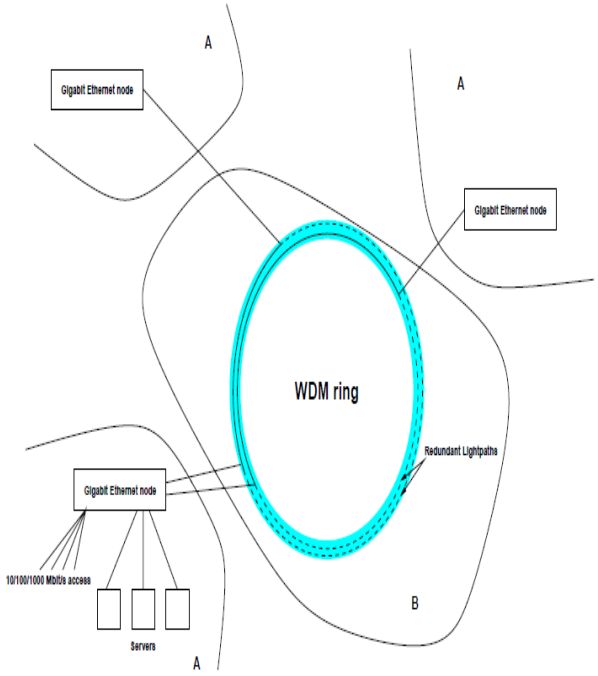

Fig. 1: A generic Gigabit Ethernet over WDM network.

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Serial Implementation

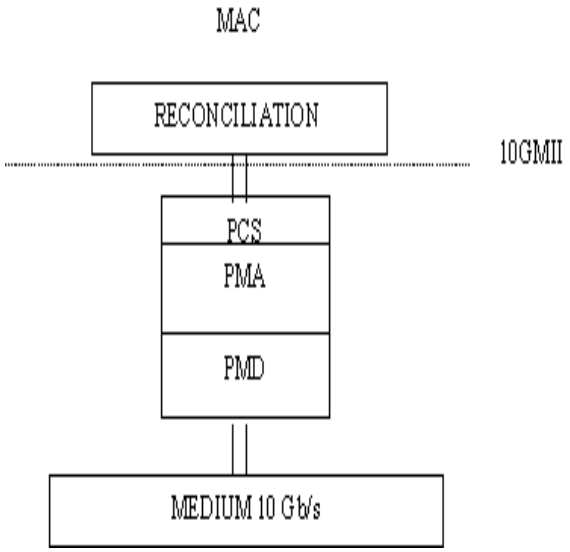

Fig. 2: Serial Physical Layer Implementation

In the serial implementation, there is one physical channel operating at 10 Gb/s as depicted above. The operation is straightforward. For transmission, the reconciliation module passes the signals, corresponding to the MAC data, word by word to the PCS module. The PCS module then encodes the signals with a pre-defined coding technique and passes the encoded signal to the PMA module. The PMA module then serializes the encoded signals and passes the stream to the PMD module. The PMD module transmits the signal stream over the fiber at 10 Gb/s. For receiving, the process is reverse.

There are technologies, for example the 10G-SONET/OC-192, which currently support 10 Gb/operation. The technologies from these existing standards may be borrowed to aid the 10G Ethernet serial implementation. Therefore, for those who want a quick solution and are less concerned about costs, the serial architecture should be a good fit. The strong supporter for the serial implementation is Lucent who has demonstrated a serial transmission at 10 Gb/s and 12.5 Gb/s over the new high-bandwidth MMF up to 300m.

Parallel Implementation

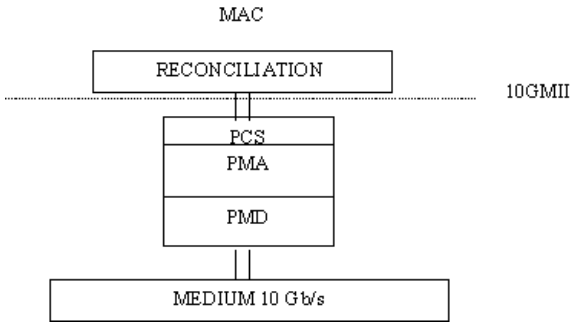

Fig. 3: Serial Physical Layer Implementation

In the serial implementation, there is one physical channel operating at 10 Gb/s as depicted above. The operation is straightforward. For transmission, the reconciliation module passes the signals, corresponding to the MAC data, word by word to the PCS module. The PCS module then encodes the signals with a pre-defined coding technique and passes the encoded signal to the PMA module. The PMA module then serializes the encoded signals and passes the stream to the PMD module. The PMD module transmits the signal stream over the fiber at 10 Gb/s. For receiving, the process is reverse.

Relation of Ethernet with OSI Modal

In the OSI model, Ethernet technology operates at the physical and data link layers- layers one and two respectively. The physical layer of the network focuses on hardware elements, such as cables, repeaters and network interface cards. As far as data link layer is concerned, here the data packets are sent from one node to another. Ethernet uses an access method called CSMA/CD (carrier sense multiple Access/collision detection). This is a system where each computer listens to the cable before sending anything through the network. If the network is clear the computer will transmit. If some other node is already transmitting on the cable, the computer will wait and try again when the line is clear. The CSMA/CD access rules are summarized by the protocol's acronym:

Carrier sense: Each station continuously listens for traffic on the medium to determine when gaps between frame transmissions occur.

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Multiple access: Stations may begin transmitting any time they detect that the network is quiet (there is no traffic).**Collision detection:** If two or more stations in the same CSMA/CD network (collision domain) begin transmitting at approximately the same time, the bit streams from the transmitting stations will interfere(collide) with each other, and both transmission will be unreadable. If that happens, each transmitting station must be capable of detecting that a collision has occurred before it has finished sending its frame. Each must stop transmitting as soon as it has detected the collision and then must wait quasi random length of time(determined by a back-off algorithm before attempting to retransmit the frame).

a) Indication of worst situation

The worst case situation occurs when the two most distant stations on the network, both need to send a frame and when the second station does not begin transmitting until just before the frame from the first station arrives. The collision will be detected almost immediately by the second station, but it will not be detected by the first station until the corrupted signal has propagated all the way back to the station.

b) Methods to detect worst case collision

a) A maximum network diameter is chosen (about2500 meters).

b) The minimum frame length is set to ensure detection of all worst case collision.

c) Slot time method is used to detect time spent during collision. It is the maximum time required to detect collision. It is roughly found to be equal to twice the signal propagation time between the two most distant stations on the network. Ethernet supports all popular network and higher level protocols, principally IP.

Ethernet topology and protocols

Ethernet supports a bus, star and tree topologies. Traditionally Ethernet employs a bus topology, meaning that all devices or hosts on the network use the same shared communication line. Each device possesses an Ethernet address, also known as MAC address. Sending devices use Ethernet addresses to specify the intended recipient of messages. Data sent over the Ethernet exists in the forms of frames. An Ethernet frames contains a header, a data section and a footer having a combined length of no more than 1518bytes. Data sent over the Ethernet is automatically broadcast to all devices on the network.

Types of Ethernet

Presently, there are different variants of the Ethernet technology that are available. The earliest ones are the 10 Bases (the very first standard).

a) Thicknet (10Base 5)

It was the first incarnation of Ethernet technology. The industry used thicknet in the 1980's.

b) Thinnet

It was thinner as compared to thicknet (5millimeters vs. 10 millimeters), more flexible cabling, and easy to install office buildings for Ethernet.

As per the Ethernet specifications, manufacturers of Ethernet equipment must meet the below minimum specifications/standards for short distance segment length. Here segment means a network connection made by a single unbroken network cable.

Table : Traditional Ethernet Types

Name	Max.segment length	Types of cable
10 Base 5	500m/1640ft	RG-8 or RG-11 coaxial
10 Base 2	185m/606ft	RG-58A/U or RG58c/u coaxial
10 Base T	100m/328ft	Category 3 or better UTP

The most common form of is10-BaseT. 10Base T offers better electrical properties than thickest or thinnest because it utilizes

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UTP wiring rather than coaxial. Also it is more cost effective than fiber optic cable.

c) Fast Ethernet

Fast Ethernet standards include:

• 100Base T—(100 Mbps over 2-pair category 5 or better UTP cable). It is a standard that includes100Base-TX(category 5 UTP),100Base-T2(category3 or better UTP) and 100Base-T4(100Base-T2cabling modified to include two additional wire pairs)

• 100base FX—100 Mbps over fiber cable

• 100Base SX—100 Mbps over multimode fiber cable

• 100Base BX-- 100 Mbps over single mode fiber cable

• 1000Base-LX--100Mbps, baseband,long wavelength over optical fiber cable

d) Cable standards/Terms/Symbols used

Common twisted pair standards are 10Base-T,100Base-T and 1000Base-T. The number (10/100/1000) stands for the speed of transmission (10/100/1000megabits/second). The "Base" stands for "baseband "meaning it has full control of the wire on a single frequency, and the 'T' stands for "twisted pair cable".

e) Ethernet cable in current use

The most popular Ethernet cable in current use is category 5 or CAT 5, supports both traditional (supports data transfers at the rate of10Megabits/second) and fast Ethernet (category 5e or CAT 5e supports data transfers at the rate of10Gigabits/second or 10000Mbps). Gigabit Ethernet still remains an active area of research.

Conclusion

This article describes the Ethernet technology, Ethernet basics of how industry and businesses can use. Efforts have been made to discuss the use of Ethernet and Ethernet and the OSI model and the future use of the relationship clearly.

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