Gigabit Ethernet & Optical Links
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Gigabit Ethernet (GbE) is the next strategy networking choice because it is cost-effective, scalable, and fully backwards-compatible with its predecessors, 10Base-T and 100Base-T Ethernet (fast Ethernet).

Enhanced CSMA/CD Protocol. GbE employ enhanced carrier sense multiple access with collision detection (CSMA/CD) protocol. CSMA/CD protocol has been enhanced in order to maintain a 200-meter collision diameter at gigabit speed. Without this enhancement, minimum-sized Ethernet frame could complete transmission before the transmitting station senses a collision, thereby violating the CSMA/CD method. The new packet-bursting feature also allows sever, switch and other device sending burst of small packets in order to full utilize available bandwidth.

Physical Layers over Fiber. There are two physical-layers (PHYs) provide Gigabit transmission over optical fiber. 1000BASE-SX is targeted at lowest cost MMF runs in horizontal and shorter backbone applications. 1000BASE-LX is targeted at longer building MMF backbones and SMF campus backbones.

Enabling Components. New fiber links, built by dispersion-compensating fiber (DCF), non-zero dispersion-shifted fiber (NZ-DSF), and NZ-DSF with large effective area (LEAF) will be employed. GbE Lasers are required to be high modulation speed (>1GHz), high output power, low driving current/voltage, high linearity and narrow spectral width, stable output power unaffected by changes in ambient conditions, low cost and reliable. Modulators require high modulation speed (>1GHz), low driving voltage, high linearity, Small packaging size and low cost. The commonly used types of external modulators are lithium niobate (LiNbO3) Mach-Zehnder (MZ), InP MZ, and InP electro-absorption. Detectors are based on PIN, APD technology. For gigabit Ethernet, high receiver sensitivity, high bandwidth, and low noise are required.

GbE Transceivers:

Fast Serial Optics
Limited distance and significant jitter
May need Temperature control
Require high side-mode suppression laser
Need Laser of low parasitic capacitance
Parallel Optics
This parallel architecture have eye-safety/power budget constraints and MMG launch to ribbon fiber issues. Also both ribbon cables and connectors are expensive. If financial budget is the most concern, WDM transceiver will be a better choice.

Optical-Electronics (OE) WDM Transceivers for GbE
Longer distance on MMF or SMF
Slower, silicon Electronics
Unisolated, uncooled lasers
Slower detectors, large detector area
Lower-speed packaging

All-Optics WDM Transceivers for GbE
No OE or EO conversion is needed. Soliton-based all-optical transceiver systems have potential to carry higher channel bit rate signal than NRZ systems. The key technology in soliton WDM systems is the reduction of collision induced timing jitter and fourwave mixing.

DWDM Transceivers for M-GbE
DWDM allows multiple channels to be transmitted over a single fiber by sending them at different wavelengths. DWDM combines multiple optical signals so that they can be amplified as a group and transported over a single fiber to increase capacity. Each signal carried can be at a different rate (OC-3/12/24, etc.) and in a different format (SONET, ATM, data, etc.)

Compared with both Serial and parallel optics, WDM transceivers are most cost-effective since the low cost MMF is mostly employed and the encoded data rate is far less than the unencoded data rate on the fiber. For example, using a four-channel WDM system to implement a 10Gbps, each channel only need to operate at 2.5 Gbps.

Use of the highest-rate TDM, together with DWDM, provides the most efficient use of network bandwidth. It is the combination of TDM and DWDM that provides this efficiency. With these enabling components and technologies, together with the merit of itself, Gigabit Ethernet could prove just the answer of the high bandwidth backbones.

Enjoy your Finals!