Parallel Optic Technology

Parallel optics is a fiber optic technology primarily targeted for high-data, short-reach multimode fiber systems that are typically less than 150 meters. Parallel optics differs from traditional duplex fiber optic serial communication in that data is simultaneously transmitted and received over multiple optical fibers.

Duplex multimode fiber serial transmission with 850 nm vertical cavity surface emitting lasers (VCSEL) is now being used for data rates up to 16G. Recent 850 nm VCSEL technology advancements have indicated the possibility to support data rates up to 28G. Duplex multimode fiber serial transmission may become impractical beyond 28G due to VCSEL reliability concerns across required operating temperatures. Parallel optics offers an economical solution that typically utilizes OM3 and OM4 multimode fibers, which are optimized for use with VSCEL array sources. For speeds faster then 28G, parallel optics becomes the most practical, cost-effective solution. Current and future protocols expected to use parallel optics include Ethernet, InfiniBand and Fibre Channel.

Parallel optic transmission technology spatially multiplexes or divides a high-data-rate signal among several fibers that are simultaneously transmitted and received. MTP® connectivity is used throughout the parallel optic link and interfaces into the transceiver module. There are two common transmission protocols that now utilize parallel optics, InfiniBand and Ethernet. InfiniBand has the 4X, 8X and 12X parallel optics transmission variants but primarily utilizes the 4X and 12X solutions. InfiniBand specifies various lane speeds defined as single data rate (SDR), double data rate (DDR) and quad data rate (QDR). See Table 1. The 4X solution is a 4-channel transceiver product that is capable of transmitting four channels and receiving four channels. The 12X solution is a 12-channel product that is capable of transmitting 12 channels and receiving 12 channels. Figures 1 and 2 illustrate the channel configurations for InfiniBand 4X and 12X variants.

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<tr>
<th># IB Lanes</th>
<th>Bandwidth (per lane)</th>
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<tbody>
<tr>
<td></td>
<td>SDR 2.5 Gbps</td>
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<tr>
<td>4X</td>
<td>10 Gbps</td>
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<tr>
<td>8X</td>
<td>20 Gbps</td>
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<td>12X</td>
<td>30 Gbps</td>
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Table 1. InfiniBand (IB) Speeds
The Institute of Electrical and Electronics Engineers (IEEE) 802.3ba 40/100G Ethernet Standard was ratified in June 2010. The standard provides specific parallel optics transmission guidance for 40/100G transmission on OM3 and OM4 multimode fibers. The 40GBASE-SR4 and 100GBASE-SR10 Ethernet interfaces are 4 x 10G channels on four fibers per direction and 10 x 10G channels on 10 fibers per direction, respectively.
The MTP® Connector is the connector of choice for parallel optic applications because of the connector’s high density and array design (See Figures 3 and 4). Twelve- and 24-fiber MTP Connectors are utilized to interface into QFSP (40G) and CXP (100/120G) transceivers, respectively.

Optical skew is a factor unique to parallel optic applications that needs to be considered during the migration to parallel interfaces.

Optical skew, the difference in time of flight between light signals traveling on different fibers, is an essential consideration for parallel optics transmission. With excessive skew, or delay, transmission errors can occur. Optical skew is specified for the InfiniBand QDR (10G/lane) and requires a maximum 0.75 ns skew for the optical cable assembly. The cable assembly includes the optical cable with MTP optical connectors at each end of the cable. The IEEE 802.3ba standard includes an optical media skew of 79 ns.

Corning Cable Systems MTP connectivity solutions comply with the strict InfiniBand 0.75 ns skew requirement. When evaluating optical cabling infrastructure solutions for 40/100G applications, selecting one that meets the 0.75 ns skew requirement ensures transparent usage not only for 40/100G, but also for InfiniBand and future Fibre Channel data rates. Additionally, low–skew connectivity solutions validate the quality and consistency of cable designs and terminations to provide long–term reliable operation.
Definitions

Optical Skew - The difference in propagation time between multifibers of a parallel transmission system.

Parallel Optic Transmission - The simultaneous transmission of related signal elements over two or more separate fibers. Parallel optics relies on spatial division multiplexing, in which a signal is spatially divided among multiple fibers and simultaneously transmitted across those fibers.

Serial Optic Transmission - The sequential transmission of signal elements of a data group. The characters are transmitted in a sequence over a single fiber, rather than simultaneously over two or more fibers, as in parallel transmission.

Space Division Multiplexing - A method used to increase the data rate capacity between two points by transmitting data over multiple different channels simultaneously. A single input signal is broken into many segments, each having very short duration. Each segment is transmitted over a separate physical channel to the receive end. At the receive end, the segments are combined back in the correct order into a single data string.