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Parallel Optic Technology

Parallel optic interfaces (POIs) are a fiber optic technology primarily targeted for short-reach multimode fiber systems (less than 300 meters) that operate at data rates greater than 16G. POIs differ from traditional fiber optic communication in that data is simultaneously transmitted and received over multiple optical fibers.

Duplex fiber serial transmission with a directly modulated 850 nm vertical cavity surface emitting laser (VCSEL) has been used to date for data rates up to 10G. Duplex fiber serial transmission becomes impractical at data rates beyond 16G due to reliability concerns when the VCSEL is directly modulated across extreme operating temperatures. POIs offer an economical solution that utilizes multimode fiber, which is optimized with VCSEL sources. This means that for speeds faster than 16G, parallel optics is the most practical, cost-effective solution. Current and future protocols expected to use parallel optics include 40G and 100G Ethernet, InfiniBand and Fibre Channel speeds of 32G and higher.

Parallel optic transmission technology spatially multiplexes or divides a high-data-rate signal among several fibers that are simultaneously transmitted and received. At the receiver, the signals are de-multiplexed to the original high-data-rate signal. MTP® connectivity is used throughout the parallel optic link and interfaces into the transceiver module. There are two common forms of commercially available products for POIs. These are currently used most typically with InfiniBand 4X and 12X protocols. The 4X solution is a 4-channel transceiver product that is capable of transmitting four channels and receiving four channels in one product. The 12X solution is a 12-channel system consisting of an optical transmitter and an optical receiver. Figures 1 and 2 illustrate the channel configurations for InfiniBand 4X and 12X protocols. The IEEE 802.3ba Task Force is currently developing a standard to cover both 40 Gigabit and 100 Gigabit Ethernet transmission speeds. This standard is expected to be completed in May 2010 and will specify the use of parallel optics for 40 and 100 Gigabit Ethernet transmission over OM3 (laser-optimized 50 µm multimode) fiber. It is expected 40G Ethernet transmission will use four 10G channels to transmit and four 10G channels to receive over one 12-fiber assembly. Likewise, 100G Ethernet is expected to use ten 10G channels to transmit and ten 10G channels to receive over two 12-fiber assemblies.

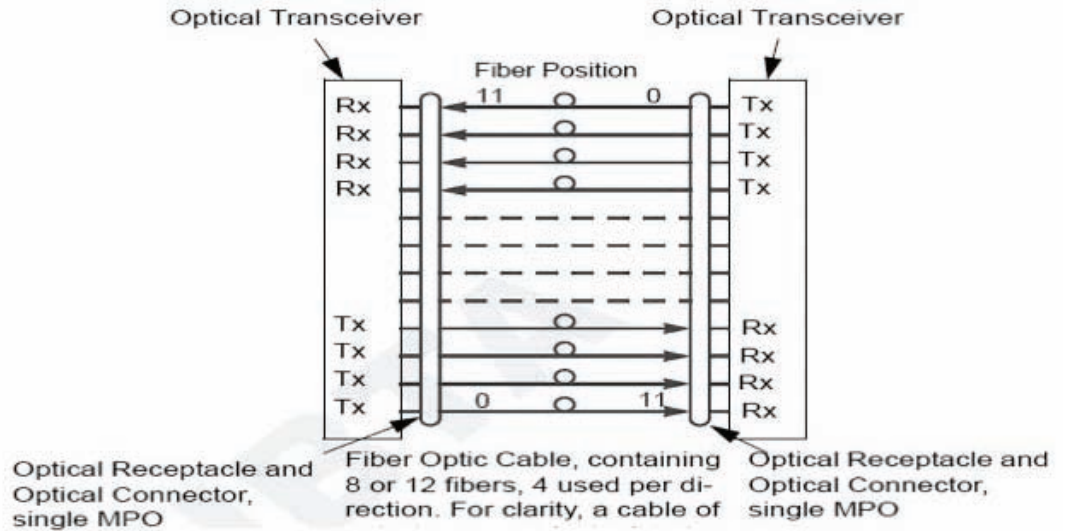


Figure 1: InfiniBand Parallel Optic Link - 4X-SDR, DDR or QDR

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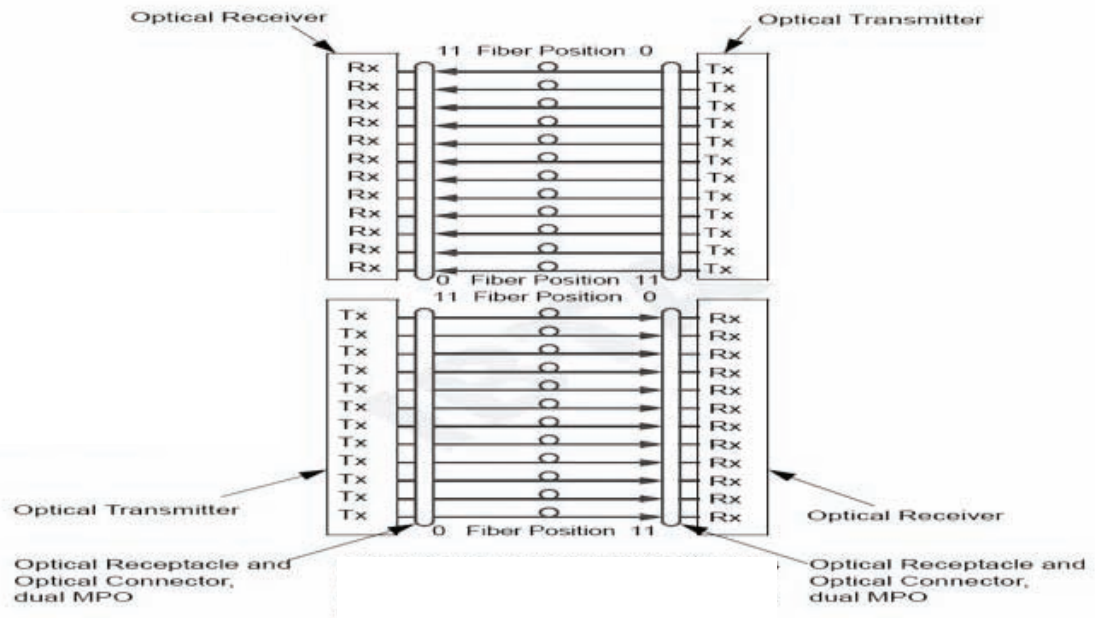


Figure 2: InfiniBand Parallel Optic Link - 12X-SDR, DDR or QDR

The MTP® connector is the connector of choice for parallel optic applications because of the connector's high density and array design (See Figure 3). OM3 fiber will be the most cost-effective solution for short-reach systems because of the ability to use VCSEL arrays at 850 nm. VCSEL arrays can be manufactured with sub-micron precision from a single silicon substrate, allowing the arrays to be manufactured to align with the fiber spacing of an MTP connector.

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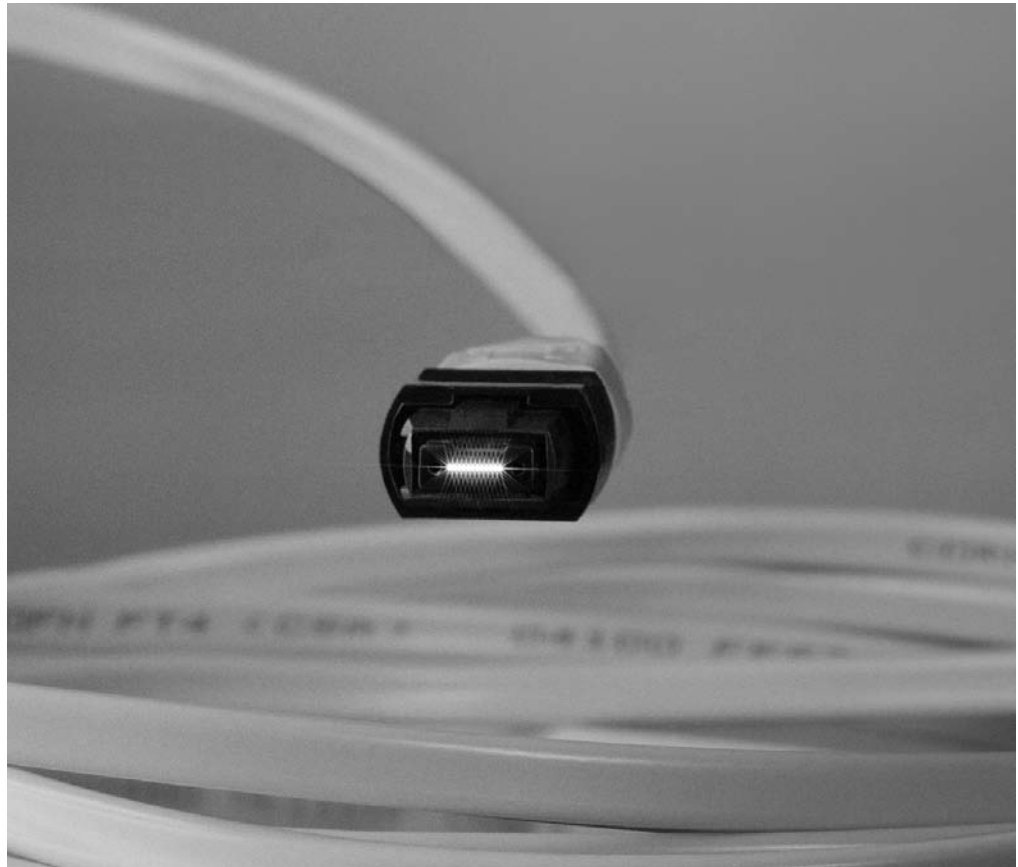


Figure 3: MTP Connector Technology

Parallel optics creates some unique challenges to the fiber optic backbone. Channel insertion loss budgets will continue to shrink, requiring the need for MTP® connectivity solutions with superior loss performance. Optical skew, a factor unique to parallel optic applications, will need to be considered during the migration to parallel interfaces.

Optical skew is the difference in propagation time between multilanes of a parallel transmission system. Said a different way, the propagation delay between the slowest and fastest pulse in the parallel channel of a cable assembly defines the skew of that cable assembly. Since parallel optics relies on spatial division multiplexing, in which a signal is spatially divided among multiple fibers and simultaneously transmitted across those fibers, too much skew can result in transmission errors. Cable designs with low skew performance will be required for a successful migration path to faster network speeds utilizing parallel optics. Optical skew is currently specified for InfiniBand 12X QDR (120G) which 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. Ethernet and Fibre Channel optical skew requirements continue to evolve as parallel solutions are developed.

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.