Reflection Immune Operation - *RIO™*

Enabling Single Fiber Single Wavelength (SFSW) Transceivers

Application Note 121214

SFC™ Transceivers

- ✓ Reflection Immune Operation - RIO™
- ✓ Full Duplex, Single Wavelength
- ✓ Gigabit Ethernet / SONET / CPRI
- ✓ Metro-Ethernet
- ✓ Wireless Backhaul
- ✓ Electric Power Utilities
- ✓ uOTDR™ and RIO™ Patent Pending

Benefits

- ✓ Single Wavelength Operation in Legacy and UPC Networks
- ✓ Never Locks on Reflection
- ✓ Eliminates Optical Loopback
- ✓ Reduced Operating Expenses
- ✓ Lower Overall Cost
- ✓ Simplified Installation

Savings

- ✓ Half the Fiber / Half the Passives
- ✓ Robust Optical Network Operation
- ✓ Installation and Maintenance Labor

SFPs with Reflection Immune Operation – *RIO™*

Eliminate Reflection Problems which Plague Legacy SFSW SFPs.

Single Fiber Single Wavelength (SFSW) Transceivers transmit and receive at the same wavelength, on single fiber, doubling the optical fiber plant capacity. SFSW transceivers offer many potential benefits to the Network Operator – e.g. seamless CWDM integration, half the fiber, half the CWDM passives and easier fiber management.

Open connectors, fiber faults and intermittent connections, which commonly occur in field deployments, create optical reflections of varying intensities. SFSW transceivers can be susceptible to signals generated by these reflections in the optical fiber cable plant. For example, the reflection from an open non-angle polished (PC or UPC - Blue) optical connector is about 15 dB. The reflected signal may return to the receiver section of the originating transceiver at power levels well within the operating sensitivity range of the receiver. This may cause the originating transceiver to detect this false signal, appearing to the network switch (or any host equipment) as though it was receiving a viable signal. But, in fact, an optical loopback condition is created in the network, wreaking havoc with network operations.

Since SFSW transceivers suffer such drawbacks in the presence of optical reflections, their application under real-world conditions has been limited compared to that of their two-wavelength single fiber, or, two-fiber cousins. Because SFSW transceivers offer many potential benefits to the Network Operator, a comprehensive solution to the reflection sensitivity problems would provide significant benefits.

RIO technology solves the SFSW reflection problems. Optical Zonu's SFC™ and iSFC™ Transceivers now incorporate Reflection Immune Operation, or RIO™, for short. This feature means that our transceivers can recognize reflected signals and will never report a link based upon a false reflected signal…ever. Integrated into the SFC and iSFC Transceiver hardware and firmware, RIO is totally automatic in operation and transparent to the host network gear and optical network (PC and UPC Blue or APC Green optical connector types). Now, for the first time, SFC and iSFC SFSW transceivers may be substituted anywhere a standard two-fiber SFP Optical Link exists.

With RIO all of the benefits of SFSW Links are available, without the reflection induced drawbacks.

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While the mechanism of RIO is quite sophisticated (patented and patents pending), the general approach may be understood by the following simple explanations.

Initial Link Start-Up

When first plugged in, or powered up, the SFC or iSFC Transceivers on either end of the Link, turn themselves on in a specific sequence. First, the receiver section becomes active, while the transmitter remains off. The receiver listens for an incoming signal. Since its own transmitter is off, if the receiver detects an inbound signal, it knows that it must be legitimate because it can only be coming from the remote transceiver. Then, the local transmitter section becomes active and the Link is created between the local and remote transceivers.

The remote transceiver goes through the same sequence. Random timing delays and proprietary algorithms are built into the start-up sequences, to guarantee linking (each transceiver ensures that the incoming signal is from an external source). The extra processing guarantees data link, under any circumstances, between 2 transceivers, within less than 700 mSec. The overall timing delay in such an event is well within the typical delays inherent in network "handshake" protocols, so all of this remains invisible to the network operation and the network users.

Interruption of Established Link

The case where a Link is functioning correctly and then is interrupted, is a bit more complex…for RIO, not for the network operator or users.

The case of a PC or UPC Blue connector being inadvertently opened somewhere in the span of the Link presents a different scenario since the reflected signal can be similar, or identical, in amplitude to the incoming signal from the other side. RIO deploys sophisticated digital filtering schemes which allow it to distinguish between the original inbound signal from a remote source, and a signal reflected back to the originating local transceiver. Any interruption of the optical Link will cause brief fluctuation in the optical power levels due to temporary interference patterns in the connector. Fast optical power changes below 0.25 dB are detected and processed by RIO. Following such a brief disruption, the RIO protocol analyzes the signal origin, and distinguishes between a fluctuation in the link (e.g. due to intermittent change in a patch panel) and an open link with reflection.

SUMMARY: The network operator and network users may enjoy the benefits of SFSW operation, without any of the drawbacks associated with legacy systems. Reflection Immune Operation - RIO™ resolves self-reflection from an open connector and/or other reflectors. Only remote data is transferred into the host equipment. In designing a network, overall ORL needs to be taken into account because it may affect the sensitivity of the data receiver. The user must ensure that the supplier tests and guarantees the link budget within the ORL performance of the operational network.

For more information about RIO™, SFC™ and iSFC™ Transceivers, visit our website at www.opticalzonu.com.

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