Superior Dispersion Compensation Paves The Way For 40- And 100-Gbit/s Fiber Transmission

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The primary limiting factor in transmitting very high data rates on fiber-optic cable is signal dispersion. Dispersion is the lengthening of a pulse over distance due to the variation of the speed of light through the fiber at different wavelengths. Also called chromatic dispersion, it can be minimized but not eliminated. However, designers can compensate for it.

Dispersion is holding back the deployment of 40- and 100-Gbit/s fiber transmission systems. As Internet traffic grows and requires higher data rates because of increased video and gaming use, new faster fiber backbones and wide-area network/ metro-area network (WAN/MAN) links are going to be essential. While the IEEE is developing standards for these higher rates, some proprietary systems are already deployed. The challenge in all of these systems is overcoming dispersion.

Proximion Fiber Systems AB has developed a dispersion compensation device that solves this problem. Its Dispersion Compensation Module-Continuous Band (DCM-CB), which is based on Fiber Bragg Grating (FBG) technology, addresses next-generation, dense wave-division multiplexing (DWDM) systems. It covers the full continuous C-band (1530 to 1565 nm) and enables any channel plan, any bit rate, and any modulation format. The result is a low-loss, non-existing latency solution for operators creating high-performance mission-critical networks.

Designers can compensate for dispersion by passing the light pulses through a dispersion-compensating fiber with a dispersion coefficient with the opposite sign compared to the standard single-mode fiber being used. Another approach is to use an FBG, which is a fiber-optic cable with a refractive index that varies periodically along the length of the fiber.

The spacings of the index gratings are selected to match a particular wavelength. When light at that wavelength is sent down the cable, the wave is reflected back to the source while all other wavelengths are passed. The FBG acts like a band reject filter.

Proximion created a module consisting of a length of fiber with a “chirped” FBG along its length (see the figure). Over the length of the cable, the index of reflection is varied continuously over a range of wavelengths. When combined with an optical circulator, the chirped fiber produces a delay line effect that slows down the shorter wavelengths, which tend to travel faster through the cable than the longer wavelengths. This shortens the lengthened input pulse, making way for faster data rates.

The DCM-CB can be inserted into the system at the transmitter output, receiver input, or anywhere else convenient along the transmission path. It is totally passive. Also, it covers the full C or L bands. It’s totally channel-plan independent. And, it complies with ITU fiber specifications G.652 up to 120 km and G.655 up to 240 km.

Proximion’s DCM-ITU dispersion compensation module covers the full C band and operates in 40- and 100-Gbit/s formats. It supports bandwidth-consuming modulation formats at 40 Gbits/s. The bandwidth is wider than 42 GHz while still enabling 100-GHz channel spacing formats. In addition, the company provides channelized solutions with ITU offsets of +33, +50, and +66 GHz. The insertion loss is less than 3 dB.

Proximion CEO Stefan Ekman believes that as much as 40% to 50 % of the cost of future 40- or 100-Gbit/s fiber networks will be devoted to dispersion compensation and related challenges. Both DCMs are well-suited for metro or long-haul fiber networks as well as submarine networks.

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