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OPTICAL PEAKING ON TOP OF SELECTIVE MODE LAUNCH TECHNIQUE FOR EXTENDED REACH SUPPORT ON MULTIMODE FIBER LINKS

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ABSTRACT

Techniques are described herein for implementing optical peaking on top of a selective mode launch technique, thereby providing extended reach support on multimode fiber links. Although this document describes the successful implementation of this solution at 25G, this solution is applicable to all bit rates whenever the link performances are affected by system bandwidth limitations. In this practical implementation, this launch solution for 25G Vertical-Cavity Surface-Emitting Laser (VCSEL) transceivers leverages optical peaking on top of a selective mode launch technique to ensure 300m/400m support over OM3/OM4 optical fibers and therefore smoothless transition from 10G to 25G applications.

DETAILED DESCRIPTION

Moving from 10G to 25G applications is not straightforward for multimode links. 10G applications are specified to meet distances up to 300m/400m over OM3/OM4 optical fibers. Current 25G applications are specified to reach up to 70m/100m on OM3/OM4 optical fibers, therefore falling short as a clean upgrade from 10G to 25G without changing the previously installed base architecture. Different techniques are available to enhance the supported distance for 25G applications such as complex Digital Signal Processing (DSP) on the transmitting side (TX) and/or receiving side (RX) (while impacting the overall transceiver power consumption constraints) or through selective/restricted mode launch techniques.

25G based transceivers for multimode applications are Vertical-Cavity Surface-Emitting Laser (VCSEL) based. Several detrimental factors limit the propagation of 25G signals over multimode fibers (e.g., fiber characteristics such Effective Modal Bandwidth (EMB) and Chromatic Dispersion (CD), transmit penalties such Relative Intensity Noise

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(RIN), and propagation effects such Mode Partition Noise (MPN), Modal Noise (MN), and reflections). The overall effect of TX launch distortion after fiber propagation is summarized into low Signal-to-Noise Ratio (SNR) parameters (e.g., Vertical Eye Closure Penalty (VECP)). The lower the achieved VECP, the longer the distance that can be supported.

Selective mode launch techniques, focusing on optimization of the signal at launch over a few group modes, is functional to minimize the propagation effects due to fiber characteristics but does not ensure alone capability to support 300m/400m over OM3/OM4 optical fibers, which is the target for smoothless upgrade from 10G to 25G applications.

Accordingly, in addition to providing selective mode launch techniques, optical peaking is also implemented at launch. Optical peaking is an optical pre-emphasis/equalization technique applied at launch which enables improving link performance. The frequency peaking can result in pulse shapes that have more optical energy and therefore higher received SNR than uncompensated pulses. Due to the frequency response of optical fibers, boosting the high frequencies typically opens/improves the inner optical eye aperture, which allows higher bit error ratio performance at the receiver end.

Figure 1 below illustrates how optical peaking helps signal quality. Transmit optical peaking, in addition to conditioned launch, enhances the overall quality of the optical signal after propagation prior to reception.

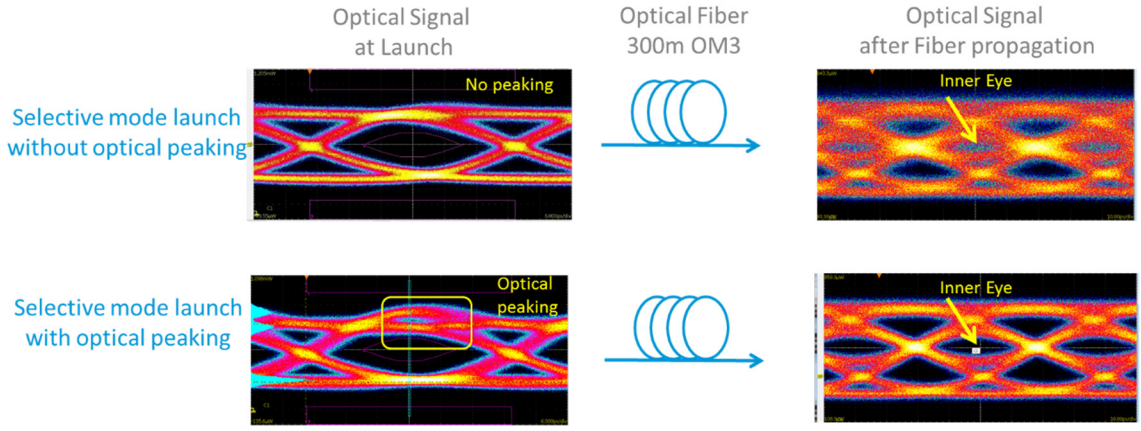

Figure 1

Figure 2 below illustrates how optical peaking helps end-to end link performance. As shown, transmit optical peaking in addition to conditioned launch enhances the overall

quality of the optical link traffic performance. The selective mode launch condition alone is not able to meet the target reach for smoothness upgrade from 10G to 25G applications.

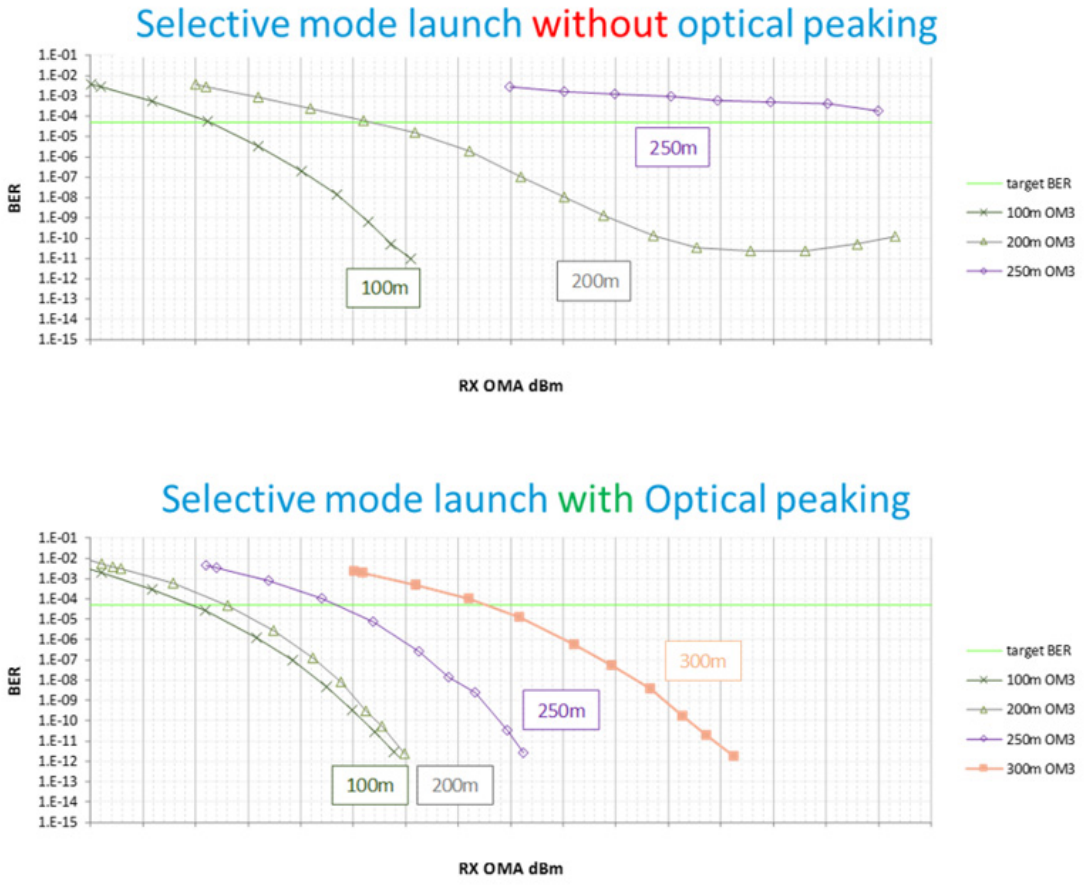

Figure 2

The dual-launch combination described herein is helpful to additionally enhance the supported link length at a higher data rate. It has been determined empirically that optical peaking is crucial for enhancing the link distance.

Techniques are described herein for implementing optical peaking on top of a selective mode launch technique, thereby providing extended reach support on multimode fiber links. Although this document describes the successful implementation of this solution at 25G, this solution is applicable to all bit rates whenever the link performances are affected by system bandwidth limitations. In this practical implementation, this launch solution for 25G VCSEL transceivers leverages optical peaking on top of a selective mode launch technique to ensure 300m/400m support over OM3/OM4 optical fibers and therefore smoothless transition from 10G to 25G applications.