Experimental Demonstration of 84 Gb/s PAM-4 Over up to 1.6 km SSMF Using a 20-GHz VCSEL at 1525 nm

We demonstrate 84-Gb/s four-level pulse amplitude modulation (PAM-4) over up to 1.6-km standard single mode fiber using a 20-GHz single mode short cavity vertical cavity surface emitting laser diode at a transmission wavelength of 1525 nm. Different equalizer approaches including a common feedforward equalizer, a nonlinear Volterra equalizer (NLVE), a maximum likelihood sequence estimator (MLSE) and their combinations are evaluated working either as an equalizer for a standard PAM-4 or a partial response PAM-4 signal with seven levels. It is demonstrated that a standard FFE is not enough for a transmission distance of >0.6 km, while the use of an NLVE or FFE + MLSE is able to improve the transmission distance towards 1 km. The use of partial-response PAM-4 FFE in combination with a short memory MLSE is able to efficiently equalize the bandwidth limitations, showing more than 10-times BER improvement compared to standard NLVE or FFE + MLSE at a transmission distance of 1.6 km. Using a partial-response NLVE instead of an PR-FFE further performance improvement is achieved, resulting in BERs below the KP4 FEC-threshold with a BER-limit of 2E-4 after 1.6-km transmission distance, allowing error free operation.