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Transmission performance of 10 Gbps OOK, 15 Gbps 2-PAM and 20 Gbps 4-PAM data signals over 11 km using a 1310 nm VCSEL

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Abstract: Current optical access network use on-off keying (OOK) modulation format throughout the network regardless of actual end user demand. We propose the use of two pulse amplitude modulation (2-PAM) and 4-PAM formats to increase the aggregated data rates of optical access networks. In this work, we experimentally evaluate the realization of a high capacity passive optical network using 1310 nm vertical cavity surface emitting lasers (VCSELs) in the OOK, 2-PAM and 4-PAM modulation formats. An 11 km of G.652 standard fibre transmission was experimentally investigated at 10 Gbps, 15 Gbps and 20 Gbps data rates per channel for OOK, 2-PAM and 4-PAM modulation formats respectively. An 11 km fibre transmission introduced a penalty of 0.46 dB and 3.45 dB incurred for the 10 Gbps OOK and 15 Gbps 2-PAM formats. However, for the 20 Gbps 4-PAM format, the maximum reach was limited to 3.21 km due to inter-symbol interference at such a high bit rate. All measurements were done in real time and without any data equalization mechanism. The experimental comparison showed that the OOK format vastly outperforms the 2-PAM and 4-PAM formats in terms of tolerance to transmission penalties. Nevertheless, 4-PAM format is still an effective way to double the data rate in access networks. This study provides vital performance awareness information needed for capacity upgrade in next-generation optical access networks.

Keywords: OOK, Pulse amplitude modulation (PAM), VCSEL, optical access network

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