A VCSEL-based backbone extended-reach optical fibre network: Supporting up to 10 Gbps flexible access networks for Africa

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Abstract

In this paper, using vertical cavity surface-emitting lasers (VCSELs) and Raman amplification, a low power consuming, energy-efficient and cheap technique to transmit high speed data signals over optical fibre is experimentally demonstrated. Several channels are joined through dense wavelength division multiplexing (DWDM) technique and transmitted over a single fibre link. With a 24.7 dBm forward Raman pump, a 8 dB flat gain is distributed over a spectral width of 5.2 nm (650 GHz). Moreover, different wavelength paths are realized by tuning the emission of the VCSEL from 1546.8 nm to 1552 nm while adjusting its bias currents. In realizing extended-reach, two DWDM/flexible channels spaced at 50 GHz and with each transmitting at 10 Gbps have been transmitted for 76.8 km while incurring a 3.2 dB power penalty as measured at a bit-error-rate (BER) threshold of 10 –9. In a typical network, the wavelength adjustment of the VCSEL avoids incidences of denial of service whenever there is either fibre-cuts, increased network traffic or channel collisions. Finally, by combining Raman amplification and chromatic dispersion mitigation using negative dispersion shifted fibres, this work presents robust VCSEL-based technique that is tailored to provide 10 Gbps per channel for backbone optical fibre supporting long-haul access networks in Africa.