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Abstract

Long reach passive optical networks (LR-PONs), which integrate fibre-to-the-home with metro networks, have been the subject of intensive research in recent years and are considered one of the most promising candidates for the next generation of optical access networks. Such systems ideally have reaches greater than 100km and bit rates of at least 10Gb/s per wavelength in the downstream and upstream directions. Due to the limited equipment sharing that is possible in access networks, the laser transmitters in the terminal units, which are usually the most expensive components, must be as cheap as possible. However, the requirement for low cost is generally incompatible with the need for a transmitter chirp characteristic that is optimised for such long reaches at 10Gb/s, and hence dispersion compensation is required.

In this thesis electronic dispersion compensation (EDC) techniques are employed to increase the chromatic dispersion tolerance and to enhance the system performance at the expense of moderate additional implementation complexity. In order to use such EDC in LR-PON architectures, a number of challenges associated with the burst-mode nature of the upstream link need to be overcome. In particular, the EDC must be made adaptive from one burst to the next (burst-mode EDC, or BM-EDC) in time scales on the order of tens to hundreds of nanoseconds.

Burst-mode operation of EDC has received little attention to date. The main objective of this thesis is to demonstrate the feasibility of such a concept and to identify the key BM-EDC design parameters required for applications in a 10Gb/s burst-mode link. This is achieved through a combination of simulations and transmission experiments utilising off-line data processing. The research shows that burst-to-burst adaptation can in principle be implemented efficiently, opening the possibility of low overhead, adaptive EDC-enabled burst-mode systems.