A polarization-assisted multicast overlay scheme for WDM-PONs

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Introduction

Multicast overlay techniques [1-2] in WDM-PONs can support delivery of the same data or video service to a designated subset of subscribers, which can also be flexibly reconfigured at the optical line terminal (OLT). In this paper, we propose a novel polarization-assisted scheme for flexible multicast overlay in a WDM-PON, which supports both point-to-point (P2P) downstream and upstream data delivery. With our proposed wavelength assignment and routing schemes, the system performance is greatly improved. No additional dedicated light source for the multicast data is needed. We have experimentally demonstrated 10-Gbit/s transmissions for the P2P downstream and upstream data, as well as the multicast data in a WDM-PON.

Proposed multicast-overlay scheme for WDM-PONs

Fig. 1 depicts the proposed multicast overlay scheme in a WDM-PON with N optical network units (ONUs). At the OLT, the CW optical power at λ_k (for k=1, 2, …, N) from the downstream transmitter #k is split into two parts. The first part is modulated with the respective downstream P2P NRZ-ASK data, via the optical intensity modulator (IM), before being combined with the other modulated downstream P2P wavelengths, via an N×2 array waveguide gratings (AWG1), for delivery to the remote node (RN) over the fiber feeder. The AWG1 is also used to route the upstream wavelengths received from the second fiber feeder to their destined upstream receivers. Note that $\lambda_1, \ldots, \lambda_{N/2}$ are assigned in blue band; while $\lambda_{N/2+1}, \ldots, \lambda_N$ are assigned in red band. A red/blue (R/B) filter is employed at each transceiver to separate the received upstream wavelength and the transmitted downstream P2P wavelength, which are operated in counter-propagating directions. The second part of the CW optical power from each downstream transmitter is fed into a polarization control (PC) unit before being combined with that from all other downstream transmitters, via AWG2. The combined signal is then modulated with the multicast data in DPSK format, via the common optical phase modulator (PM), before being delivered to the RN, via the second fiber feeder. From the wavelength assignment, λ_j {j=[(i-1)+N/2] mod N + 1} is the multicast wavelength destined for ONU#i. In order to enable the multicast data for ONU#i, the polarization control unit at the j^{th} transceiver at the OLT should be set to align the polarization of λ_j with the principal axis of the crystal in the PM, so as to maximize the degree of phase modulation. In contrast, the multicast data can be flexibly disabled by switching the polarization of λ_j to be orthogonal with the principal axis of the crystal in the PM, so as to minimize the degree of phase modulation. The effect of polarization rotation of the multicast wavelength to the modulated DPSK signal is shown in Fig. 2. At the RN, a 2×N AWG, in which its 1st and (N/2+1)th input ports are connected to the first and the second fiber feeders, respectively, is employed. It routes λ_i, which carries the downstream P2P data for ONU#i, from the first fiber feeder and λ_j {j=[(i-1)+N/2] mod N + 1}, which carries the multicast data from the second fiber feeder, to ONU#i, via its i^{th} output port. In this way, the downstream P2P wavelength and the multicast wavelength received at the same ONU are always spaced by at least quadruple wavelength spacing and thus can be separated by an R/B filter. Part of the power of the received multicast wavelength at an ONU is re-modulated with the NRZ-ASK upstream data and thus serves as the respective upstream carrier. The upstream wavelengths from all ONUs are sent back to the OLT, via the second fiber feeder, as shown in Fig. 1. The experimental results and discussions will be presented at the talk. This project was partially supported by RGC GRF No. CUHK4105/08E.

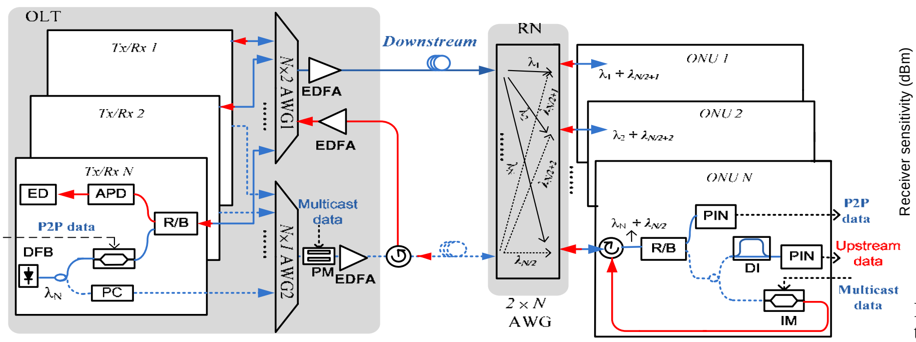

Fig. 1: A WDM-PON with proposed multicast overlay scheme

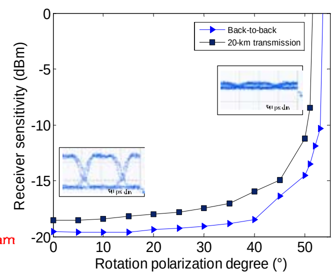

Fig. 2: Measured performance of the demodulated DPSK signal versus the input polarization to the optical phase modulator.

References

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