IMPACT OF SINGLE-MODE FIBER DISPERSION COEFFICIENT ON SIGNAL DISTORTIONS FOR DIFFERENT DATA-RATES AND MODULATION FORMATS

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During the design and in operation pace of transport optical networks one of the major challenges for telecom operators is satisfaction of bandwidth requirements due to considerable Internet traffic growth [1-3]. As experience shows, to stay "cost efficient" as much as possible, networks capacity usually is increased gradually by implementing channels with higher bitrates, e.g., 40 Gbit/s. For these proposes chosen modulation formats differ from traditional deployed non-return to zero (NRZ) encoded on-off keying (OOK). Hence, core network design is based on wavelength division multiplexing (WDM) with multiple data-rates and signal formats [5, 6].

In this paper we will reveal the impact of optical fibers chromatic dispersion (CD) coefficient on optical signal modulation format for certain bitrate. Particularly we will present influence of CD coefficient on broadening of optical spectrum and changes of informative signal power due to XPM. In this work we will consider these modulation formats: 1) 10 Gbit/s NRZ-OOK; 2) 40 Gbit/s NRZ encoded differential phase-shift keying (DPSK); 3) 40 Gbit/s binary orthogonal polarization-shift keying.

10 Gbit/s NRZ-OOK signal spectrums sufficiently changes and its left part broadens if SMF dispersion coefficient is close to 0 ps/nm/km (see Fig. 1 (a)). As for the 40 Gbit/s 2-POLSK and NRZ-DPSK signals, the spectrum distortions are almost no noticeable (see Fig. 1 (b) – (c)). About negligible changes in 2-POLSK and NRZ-DPSK signals are also evidencing filtered channel power level and detected signals Q-factor. 40 Gbit/s 2-POLSK channel power increases but by less than 0.1 dBm if dispersion coefficient is around 0 ps/nm/km as compared with the power levels at D = 16 ps/nm/km/. Whereas, for 40 Gbit/s NRZ-DPSK channel, it is almost constant (see Fig. 1 (d)). Such power level variations of filtered channel lead to some evidence changes in detected informative signals Q-factor values For 40 Gbit/s 2-POLSK channel, it decreases by 0.8 dB whereas, 40 Gbit/s NRZ-DPSK channels experiences some Q-factor increase, if a value of dispersion coefficient is close to 0 ps/nm/km. In contrast, power level of filtered informative 10 Gbit/s NRZ-OOK channel in-

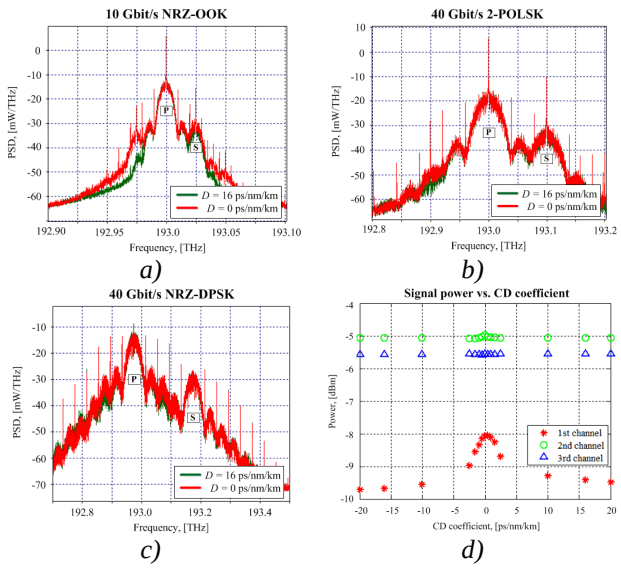

Fig. 1 XPM impact on modulated signal spectrum: a) 10 Gbit/s NRZ-OOK; b) 40 Gbit/s 2-POLSK; c) 40 Gbit/s NRZ-DPSK where P is the pump signal and S is probe or informative signal; d) power of informative signals as a function of SMF dispersion coefficient.

creases sufficiently (by more than 1 dB), if dispersion coefficient changes from 16 to 0 ps/nm/km.

Therefore, must be concluded that chromatic dispersion coefficient and its deviations could sufficiently distort optical signal and make it detection with defined bit-error-rate (BER) on the receiving end impossible. Such distortions are even more evident not only on signal spectrum but also reflects on detected signal quality (BER particularly) if coefficient of chromatic dispersion reduces and become close to 0 ps/nm/km. In general, this would lead to additional power and operational expenditures due to required signal post-processing (forward error correction inclusive). Hence, modulation format and per channel bitrate should be chosen regarding chromatic dispersion coefficient of single-mode fiber and wavelength that particular signal would be transmitted.

References

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