

numerically confirmed in Fig. 9, which shows the performance versus the phase difference between channels under optimized transmitter and receiver filter bandwidths. The memory length of the receiver FIR filter was 6. The figure shows that the performance of the proposed offset-QAM system depended on the phase difference between channels such that phase control at the transmitter, i.e. CoWDM, was needed. In this aspect, the implementation complexity was increased when compared to the no-guard-interval optical OFDM. It is also shown that the optimal performance was obtained when the phase difference was $\pi/2$ or $3\pi/2$. At 1dB OSNR penalty, the phase tolerance range was around $\pm 45^\circ$, $\pm 40^\circ$, $\pm 35^\circ$ for offset 4-, 16-, and 64-QAM, respectively.

5. Conclusions

We have proposed and investigated a CoWDM system using offset 4-, 16-, and 64-QAM to significantly improve the performance and relax the device specifications. We have theoretically derived the condition for crosstalk free operation for the presented system and found that by offsetting the two quadratures by half symbol period in time, the crosstalk and ISI can be eliminated even using practical signal spectral profiles. Based on the implications of the analysis, we have numerically compared this system with recently reported no-guard-interval optical coherent OFDM and Nyquist WDM, and shown that the presented system significantly relaxes the specifications of the system components and enhances the spectral efficiency by enabling the use of higher-level modulation formats, with the achieved performance approaching the theoretical limits using practical devices.

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