RZ-OOK TO NRZ-OOK MODULATION-FORMAT CONVERSION IN MICRORING RESONATOR FOR MIXED WDM SYSTEMS

Elīna Kropačova[1], Oskars Ozoliņš[1], Ģirts Ivanovs[1]

[1]*Institute of Telecommunications, Riga Technical University, LV-1048, Riga, Latvia*
e-mail: elina.kropacova@rtu.lv, oskars.ozolins@rtu.lv

Simultaneous 33% return to zero-on off keying (RZ-OOK) to non-return to zero (NRZ)-OOK and 50% RZ-OOK to NRZ-OOK modulation format conversions using a single ring microring resonator (MRR) in mixed wavelength division multiplexing (WDM) system are numerically demonstrated. Research is carried out using OptSim simulation software.

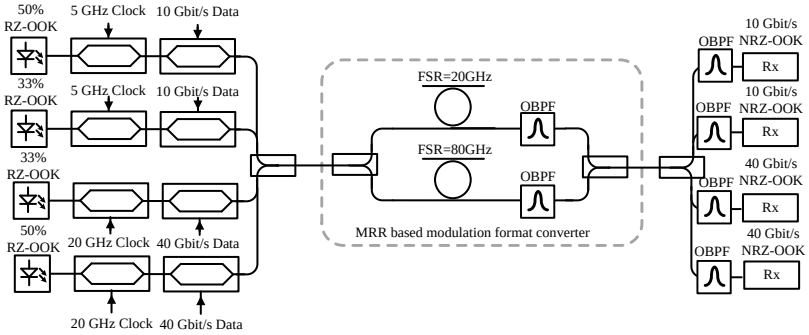

Fig.1 33% and 50% RZ-OOK to NRZ-OOK modulation format conversion scheme.

Modulation format conversion scheme is shown in Fig. 1. There are four channel configuration using RZ-OOK modulation format with 33% and 50% duty cycle and two bitrates 10 Gbit/s and 40 Gbit/s. The principle of modulation format conversion is based on linear filtration process using single ring MRR [1, 2]. To perform modulation format conversion at both bitrates two different single ring MRR models were analysed. 33% RZ-OOK and 50% RZ-OOK modulation format signals at 10 Gbit/s and 40 Gbit/s are generated at the transmitters using two Mach-Zehnder modulators. Four channels are combined with coupler for purposes of transmission. To perform modulation format conversion at two different bitrates the MRR parameters must be altered. Therefore two MRR were used: each for the bitrate employed in mixed WDM system. Through splitter both signal are coupled to MRR filters. 10 Gbit/s bitrate RZ-OOK signals are converted in MRR with FSR 20 GHz and 40 Gbit/s signals - MRR with FSR 80 GHz. MRR filters suppress

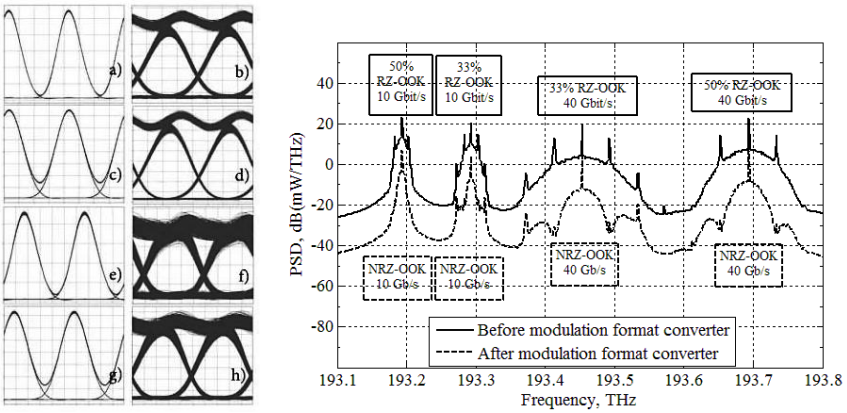

Fig.2 33% RZ-OOK eye diagram at 10 Gbit/s (a), converted (from 33% RZ-OOK) NRZ-OOK eye diagram at 10 Gbit/s (b), 50% RZ-OOK eye diagram at 10 Gbit/s (c), converted (from 50% RZ-OOK)NRZ-OOK eye diagram at 10 Gbit/s (d), 33% RZ-OOK eye diagram at 40 Gbit/s (e), converted (from 33% RZ-OOK) NRZ-OOK eye diagram at 40 Gbit/s (f), 50% RZ-OOK eye diagram at 40 Gbit/s (g), converted (from 50% RZ-OOK)NRZ-OOK eye diagram at 40 Gbit/s (h) and optical power spectral densities (PSD) before and after modulation format converter.

spectral components that do not correspond to NRZ modulation format spectrum and at the converter output we get converted NRZ-OOK. After MRR filters 10 Gbit/s and 40 Gbit/s optical signals are filtered with optical band-pass filters (OBPF) in order to extract from converted spectrum signals that correspond to the bitrate. After that signals of two bitrates are coupled back in one fibre. Converted NRZ-OOK signals before preamplified receiver are filtered with OBPF in order to cut-off amplitude ripples. The eye diagrams and spectrums of optical signals before and after conversion are shown in Fig. 2.

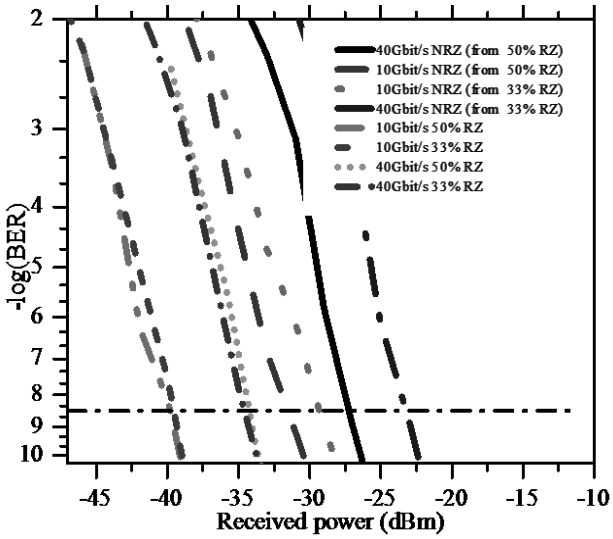

Fig.3 BER calculations for input 33% and 50% RZ-OOK signals and converted NRZ-OOK signals.

In Fig. 3 one can see BER measurements for input 33% and 50% RZ-OOK signals and converted NRZ-OOK signals in each channel. For 33% RZ-OOK to NRZ-OOK modulation format conversion at 10 Gbit/s bitrate we get 10 dB and at 40 Gbit/s we get 11 dB power penalties. For 50% RZ conversion at 10 Gbit/s we get 8 dB and at 40 Gbit/s we get 7 dB power penalties. From eye diagrams in Fig.2b and d we can see that conversion at 10 Gbit/s is successful because of used OBPF. It should be added that for 50% RZ conversion wider OBPF bandwidth is necessary compared to 33% RZ conversion. Conversion quality depends on MRR resonance depth and OBPF filter bandwidth used for cutting amplitude ripples. At higher FSR of single MRR it is possible to get bigger resonance depth, so spectral components are suppressed more effective. For 10 Gbit/s bitrate it is necessary to use very small bandwidth OBPF for cutting ripples to achieve better conversion.

References

1. M.Xiong, O.Ozolins, Y.Ding, B.Huang, A.Yi, H.Ou, C.Peucheret, X.Zhang *Simultaneous RZ-OOK to NRZ-OOK and RZ-DPSK to NRZ-DPSK Format Conversion in a Silicon Microring Resonator* Optics Express, 2012, No. 25, 27263.-27272. pp.
2. Y.Ding, C.Peucheret, M.Pu, B.Zsigri, J.Seoane, L.Liu, J.Xu, H.Ou, X.Zhang, D.Huang *Multi-Channel WDM RZ-to-NRZ Format Conversion at 50 Gbit/s Based on Single Silicon Microring Resonator* Optics Express, 2010, No. 18, 21121-21130. pp.