

# INVESTIGATION OF SPECTRAL EFFICIENCY FOR MIXED DATA RATES COMBINED HDWDM SYSTEMS

Aleksejs Udalcovs, Vjaceslavs Bobrovs, Girts Ivanovs

*Scientific Institute of Telecommunications, Riga Technical University, LV 1048 Riga, Latvia*

E-mail: [Aleksejs.Udalcovs@rtu.lv](mailto:Aleksejs.Udalcovs@rtu.lv)

In this work authors have evaluated one possible realization of mixed data rates combined HDWDM system. This system is offered as a transition stage form traditional WDM systems to HDWDM systems with a higher transmission capacity and spectral efficiency (SE) [1]. That type of system's modernization is necessary to satisfy the demand for channel's bit rate and transmission capacity, because internet traffic keeps doubling every year due to expansion and variety of new information services including data, online and broadband services, and their rapid advance.

As a study object, 9 – channel combined HDWDM systems was chosen. System's channels were grouped by 3. Central group, which contains the 1<sup>st</sup>-3<sup>rd</sup> system's channels, has a following configuration: [1<sup>st</sup>: NRZ – OOK, 40 Gbit/s, 193.025 THz] – [2<sup>nd</sup>: 2 – POLSK, 40 Gbit/s, 193.100 THz] – [3<sup>rd</sup>: NRZ – DPSK, 10 Gbit/s, 193.175 THz]. This configuration represents channel's number, modulation format, per-channel data rate and channel's central frequency at allowed channel spacing, which provides in system channels detected signal BER < 10<sup>-16</sup> (see Fig. 1 (a)). Further channel spacing reduction to 50 GHz leads to channel's spectrum overlapping and as a result the complete transmission failure in the system's 1<sup>st</sup> (the worst system's channel) and 2<sup>nd</sup> channels (see Fig. 1 (b), Fig. 1 (c)).

Assuming, that we operate with discrete noiseless channel and all sent information is received unchanged in other end (BER → 0), then the spectral efficiency is calculated using a following formula:

$$SE = \frac{\sum_{i=1}^N B_i}{N \cdot \Delta f},$$

where N is a number of channel in WDM system, [1];

B – per channel bit rate, which may vary by a factor of 4 or even 16. [2.5, 10, 40 Gbit/s]; Δf – channel spacing, [GHz]. For our investigated system SE=0.4 bit/s/Hz at minimal allowed channel spacing equal to 75 GHz.

Fiber optical transmission systems development strategies, which are based on implementation of combined HDWDM systems, are the most cost-effective and long-term transmission capacity increment solutions [1].

## Reference

1. Udalcovs, A., Bobrovs, V. & Ivanovs, G. *Investigation of Allowed Channel Spacing for Differently Modulated Optical Signals in Combined HDWDM systems // Lithuanian Journal of Electronics and Electrical Engineering*, 2011, No. 5(111).

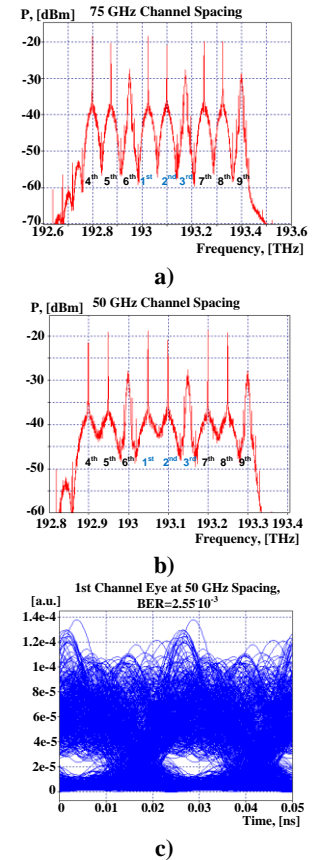


Fig. 1 a) Output spectrum at Δf=75 GHz; b) output spectrum at Δf=50 GHz; c) in 1<sup>st</sup> channel detected signal eye diagram at Δf=50 GHz