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Figure 7 shows the EVM of the different OFDM-based signals transmitted in the three optical channels of the WDM signal when centralized compensation is employed. EVM results obtained when each one of the three optical channels is transmitted individually (the remaining channels are switched-off) are also presented as a reference. The inspection of Fig. 7 shows that the performance of the different OFDM-based signals carried by the three optical channels is similar (the EVM variation of each service along the three channels does not exceed 1 dB) and that all the signals present EVM-compliant levels. The EVM variation not exceeding 1 dB is in agreement with the EVM results shown in Fig. 5. Additionally, the comparison between the results obtained when the three optical channels are transmitted simultaneously and the single-wavelength situation allows concluding that the inter-channel crosstalk is negligible. This conclusion is supported by the reduced EVM degradation observed: although a maximum EVM degradation of 0.4 dB is observed in the LTE signal transmitted at the channel located at 193.2 THz, the EVM degradation obtained in all the other signals is lower than 0.2 dB. These residual different EVM degradations may be attributed to the slight OSNR fluctuations observed along the experiments and also to the very low (and, thus, very sensitive) EVM levels measured in LTE signals.

## 5. Conclusion

The performance of the simultaneous distribution of OFDM-based quintuple-play services along distances indicated for LR-PONs has been assessed experimentally. Single-wavelength and multi-wavelength transmission studies have been performed and a service-transparent centralized impairment compensation using broadband channel sounding has been employed.

It has been shown that the centralized compensation approach enables achieving EVM-compliant levels in all the OFDM-based signals for WDM LR-PONs comprising OLT-ONU distances up to 100 km, and employing three 100 GHz spaced channels. The experimental results have shown also that, for a channel spacing of 100 GHz, negligible crosstalk between the WDM channels is achieved as an EVM degradation due to the WDM transmission not exceeding 0.4 dB is observed regardless the OFDM signal format.

The study performed in single-wavelength transmission has shown that EVM improvements of 6 dB are achieved in the most performance-constrained OFDM signals due to the centralized impairment compensation employed at the central office. These EVM improvements are achieved at the expense of power reduction of the OFDM signals showing better performance when no impairment compensation is realized. Hence, the centralized compensation can be viewed as a low-complexity and adaptive method that automatically adjusts the relation between the power of the different OFDM-based signals taking into account the different channel impairments.

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