Optimal Polarization Launch for Raman Depletion Minimization in GPON and TWDM-PON Coexistence

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ABSTRACT

TWDM-PON (ITU-T G.989) will induce relevant extra attenuation when operating in full coexistence with GPON due to Raman nonlinearity. We give a detailed analysis of optimal polarization launch options.

SYSTEM RESULTS

We considered 1.5 x 10^7 simulations with the following system parameters: link length 20 km, ΔPMD (i.e. the PMD coefficient of the fiber in a range from 0.001 to 0.1 ps/√(km)), link loss equal to 0.22 dB/km, Either 4 or 8 active TWDM-PON channels with power per channel P_{TWDM}.

PDF of the SRS induced depletion of the GPON channel for P_{TWDM} = 10 dBm and 4 active TWDM-PON channels.

- The PDFs of the copolarized and orthogonal configurations have a significant statistical spread.
- The PDFs of the DoP0 are Dirac delta centered around an average value. The behavior of the SRS depletion is thus completely deterministic, independently on the PMD value. This is due to the fact that, in this scenario, the TWDM channels maintain the zero composite DoP, and the Raman depletion is independent on random SOP evolution.

OUTAGE PROBABILITY & MAXIMUM ADMISSIBLE TWDM-PON POWER

We can evaluate the outage probability of GPON, i.e. the probability that the SRS induced depletion is larger than 1 dB. Based on this result, we evaluated maximum admissible TWDM-PON power per channel able to guarantee a target outage probability for GPON of 10^-5

The advantage of the DoP0 configuration is evident: maximum power per channel higher than 2 dB for reasonable PMD values (e.g. 0.02 ps/√(km)).
- DoP0 outperforms the other configurations for any reasonable PMD value.
- The orthogonal configuration would give 0 depletion for PMD values asymptotically close to zero.
- The random launch [3] has performance in between DoP0 and orthogonal configuration.

CONCLUSION

- The DoP0 condition should be enforced in all TWDM transmitters, since the additional implementation complexity increase is actually worth paying in any full-coexistence scenario.
- On the contrary, polarization alignment between GPON and TWDM-PON is not worth the effort since it would give further advantages only for unrealistically low PMD values.
- The same results, besides from numerical differences, will hold for the interaction of TWDM-PON with XG-PON and RF-Video.

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BIBLIOGRAPHY