Impact of Electronic Equalization on Advanced Modulation Formats in Dispersion-Limited Systems

V. Curri[1,2], **R. Gaudino**[1,2] , **A. Napoli**[1]

1.OptCom, Dipartimento di Elettronica, Politecnico di Torino, Torino, Italy, antonio.napoli@polito.it

2. Alps Telecommunications Software S.r.l., Torino, Italy, info@alps-telsoft.com

Abstract

We investigated the use of electronic equalization (EE) in dispersion-limited systems when considering different modulation formats. We demonstrated that EE strongly improves standard NRZ performance, whereas it has a limited effect on Duobinary and DPSK modulation formats.

Motivation

- Chromatic Dispersion (CD) & Polarization Mode Dispersion (PMD) still represent important limiting (linear) effects for an optical communications system (particularly, when we consider a metro optical network scenario).
- EE may be seen as a *simple & cheap* way to reduce their impact.
- Moreover, EE can be used to reduce other system non-idealities.

System & Method

1. The simulated system is affected by ASE-noise and CD only.
2. The EE (made up by a FFE) is placed after the photodiode and the electrical filter, with the following structure

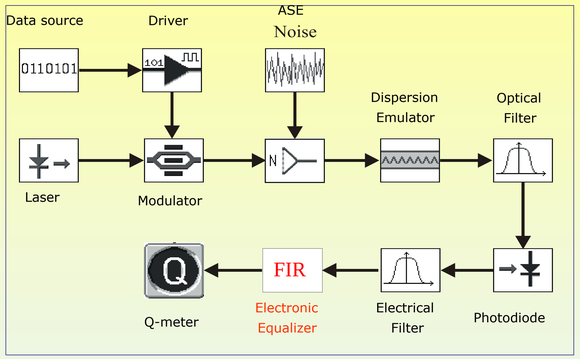
$$y(t) = \sum_{i=0}^{N_{taps}-1} C_i \cdot x(t - i\Delta t)$$

and characterized by the C_i coefficients, the number of taps, and the delay between each tap.

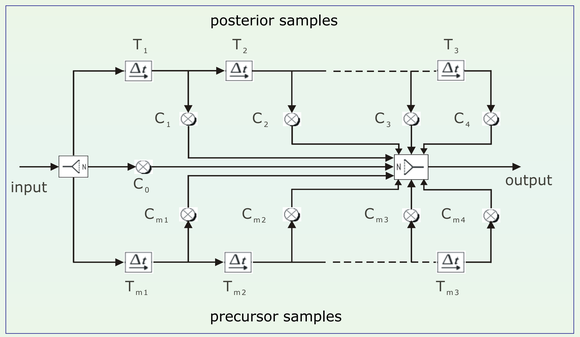
3. The last two parameters were determined by obtaining the best trade-off between system complexity & EE performance.
4. The C_i coefficients have been optimized by maximizing the Q-factor, defined as

$$\mathbf{Q_{dB} = 20 \cdot \log_{10}[erfc^{-1}(2 \cdot BER)]}$$

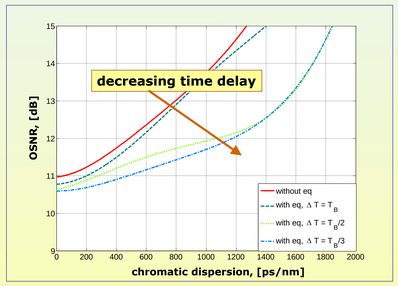
5. The results are presented as contour plots of the Q-factor vs. OSNR & CD.



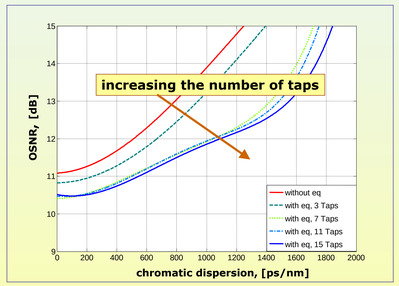
Setup of the analyzed system



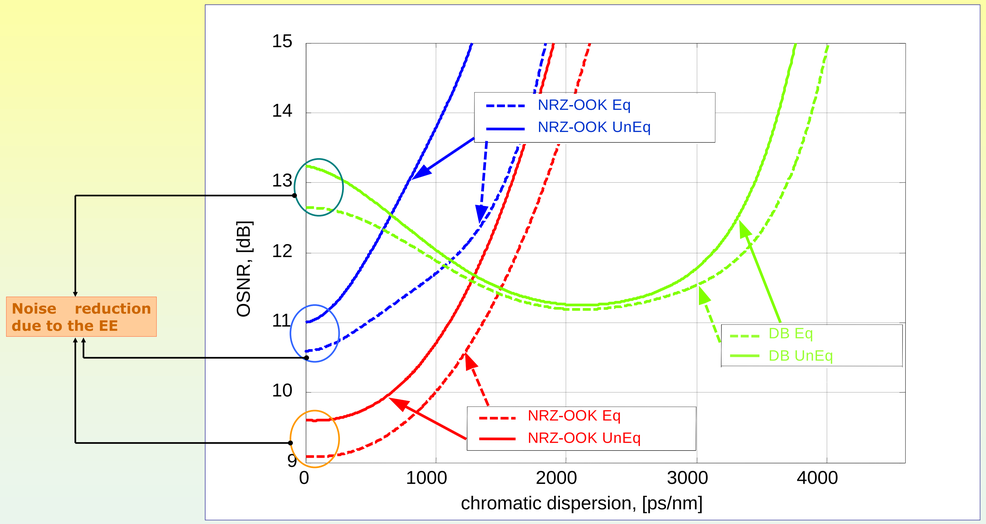
FFE filter considered



Optimization of the tap delay



Optimization of number of taps



Contour plots of Q_{dB} @ 17 dB (i.e. BER ~ 10^{-9}) for all the modulation formats studied. We can clearly see the great benefit due to EE on the standard NRZ, and the negligible advantage of using EE when DB or DPSK format are considered.

Pros

- EE represents a low-cost solution for system affected by linear effects such as CD and PMD only.
- Furthermore, it almost doubles the maximum reachable distance (a reduction of about 750 ps/nm was observed) when a standard NRZ system is considered

Cons

- It does not represent the optimum solution for these effects (since the photodiode makes the system not linear)
- It does not improve the performance (it reduces the amount of CD by 250 ps/nm only) of a dispersion-limited system when advanced modulation formats (such as DPSK and optical DB) are considered.

OPTCOM

www.optcom.polito.it

www.polito.it

PhotonLab

www.photonlab.it