Brussels ecoc 2008 www.ecoc2008.org
34th European Conference and Exhibition on Optical Communication
21-25 September 2008
Brussels Expo
Belgium

Tutorial

High-speed digital signal processing for optical communications

John Sitch
Nortel, Ottawa, Canada

Abstract

Today's electronic processing capability means that it is now possible to perform extensive signal processing at the highest commercial data rates. In this tutorial we discuss the design and technologies behind the use of signal processing for optical communications systems, and the choices available to the designer. Signal processing techniques, originally developed for wireless applications, are finding new uses, albeit at higher date rates, (and very much higher carrier frequencies) in the field of fibre-optic communications. Guided waves in fibre present new phenomena, which we must deal with in order to get the most out of this new application of technology.

John Sitch

John Sitch was born in London, and graduated in Engineering Science from Oxford University. After working as a radio systems development engineer he returned to university, receiving the M.Eng. and Ph.D. degrees from Sheffield University. For the next ten years he taught, first at Nottingham, and then at Sheffield University. Since 1984 he has been with Nortel, Ottawa, working on various aspects of III-V & Si technology, integrated circuits, and optical systems, where he is currently a manager in systems design. The recipient of a 1996 R&D100 award, John Sitch was the Chairperson of the 2001 IEEE GaAs IC Symposium.

Brussels
ecoc 2008
www.ecoc2008.org

34th European Conference and Exhibition on Optical Communication

21-25 September 2008
Brussels Expo
Belgium

Extended Abstract

Outline Semiconductor, in particular CMOS IC technology epitomises mass production, because it relies on photolithography, even custom ASICs, once designed, are inexpensive and represent a cost-effective alternative to traditional optical processing techniques. As systems and technologies evolve, the modulation schemes used will reinforce the trend towards electronic signal processing – no single-channel 100Gb/s scheme is practical without it. The intersection of signal-processing algorithm skills and optical fiber knowledge means the industry can continue to benefit from Moore's law.

In this tutorial, we will start by considering what we are trying to achieve when designing our system, and what obstacles need to be overcome to optimise any particular design approach as synergies may emerge (for example, resolving the incoming state-of-polarization enables both polarization diverse transmission and coherent detection). Next we will consider the tools at our disposal, and relate them to the obstacles.

The body of the tutorial will be an introduction to electronic signal processing techniques and how they can be applied to optical systems – the relative benefits of filter-based & statistic-based, and linear & nonlinear approaches will be discussed, along with the situations in which each may be appropriate. Coefficient setting and updating are then covered, with a discussion of the appropriate loop closure medium (hardware, firmware or software).

Implementation comes next – we will review options for data converters, as well as suitable technology choices for the various functions we want to perform – both analog and digital, with examples taken from recently developed ASICs. We will also touch upon the ways in which digital architecture can affect performance and power dissipation.

We will wrap up with a bit of crystal-ball gazing, looking into the future with the participation of all those present.