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Invited paper

Exploring capacity limits of fibre-optic communication systems

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Abstract

The problem of evaluating the maximum rate of transmission of information, or capacity, of fibre-optic communication systems is discussed. We will describe a procedure we developed to derive a lower bound capacity of the 'fibre channel'. Spectral efficiency of ~5 bits/s/Hz over 2000 km in one polarization will be shown to be theoretically achievable.

Extended Abstract

Fundamental limits on transmission of information over an additive white Gaussian noise (AWGN) channel were established by Shannon more than half a century ago and extended to a variety of communication systems since. However, very little inroad has been made in establishing fundamental limits for the transmission of information over fibre-optic communication systems (or the 'fibre channel'). This mainly originates from the difficulty in dealing with the fibre Kerr nonlinearity.

In this talk, we will first discuss the fundamentals of noise associated with fibre-optic communication systems and how it relates to the AWGN. We will then introduce high spectral efficiency modulation and constellations structures and evaluate their resulting capacities over AWGN. We next include a detailed fibre channel model, including distributed noise and fibre nonlinearity, bandwidth allocation and nonlinearity compensation schemes. The challenges of extending Shannon's theory to the fibre channel specifically will be discussed. Finally, the results of our capacity lower bound calculations will be presented showing that a spectral efficiency of about 5 bits/s/Hz is achievable for transmission over 2000 km using a singly-polarized signal.

Rene-Jean Essiambre

CV

René-Jean Essiambre is a Researcher at Bell Laboratories, Alcatel-Lucent, where he is conducting research on management of fiber nonlinearities and in the design of fiber-optic communication systems. His recent interest includes capacity limits of fiber-optic networks due to fiber nonlinearity, optimization techniques for the design of optical networks, advanced modulation formats, optical phase conjugation and optical regeneration in the context of increasing capacity, reach and functionality of wavelength-division multiplexed communication systems.

Dr. Essiambre has served on the European Conference on Optical Communication (ECOC) and Optical Fiber Communication (OFC) committees. He is a recipient of the 2005 "Engineering Excellence Award" from the Optical Society of America and is Fellow of the same society. He is currently a Distinguished member of Technical Staff (DMTS) at Bell Laboratories at Alcatel-Lucent.