BONE Major Achievements

WP15 : Virtual Centre of Excellence on Transmission Techniques

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WP Objectives

The objective of this workpackage has been to integrate and coordinate the transmission-related research activities within BONE. The workpackage has aimed to bring all the relevant groups closer together by disseminating their activities, identifying key issues in the area, providing a vehicle for networking between its members, and crucially encouraging collaboration between groups with complementary capabilities. The main technical themes targeted have included pushing the limits of high-speed transmission, as well as processing and monitoring of optical signals.

Status at start of the BONE-project

The hot topic under discussion among groups with interest in optical transmission at the start of the lifetime of BONE related to the succession to 40Gbit/s transmission systems. Even though 100Gbit/s transmission was already the strongest contender, other possibilities, such as the adoption of 160Gbit/s OTDM line rates had not been excluded yet. Electronic processing of signals on the receiver side was still considered a niche research area and was much more limited in scope in comparison to the development evidenced by the field recently. In relation to the processing of telecommunication signals, most research questions still related to on-off keying signals. The widespread adoption of complex modulation formats has vastly changed the scene in optical transmission over the last four years or so, as testified by the evolution of the research topics addressed within the workpackage.

Major progress during BONE-project

The Virtual Centre of Excellence on Transmission Techniques (VCE-T) has been active in research on several aspects of high-speed transmission, including the development of both electronic and optical processing techniques for the conditioning of signals and the investigation of novel monitoring systems. For full information on the technical achievements accomplished in the lifetime of the project one should refer to the list of publications generated during the project lifetime. Some highlights of this research however, are outlined below.

As far as high-speed transmission is concerned, the start of the project saw considerable activities examining several different modulation formats for the implementation of 100Gbit/s systems. By the third year of the project, the consortium was demonstrating experimentally ultra-dense differential quaternary phase-shift keying (DQPSK) systems incorporating electronic processing systems for the mitigation of both linear and nonlinear impairments.

VCE-T also witnessed similar rapid developments in the area of all-optical signal regeneration. Within the first year of the project, there were several demonstrations of regenerators suitable for intensity modulated signals. These were based on a variety of technologies, including both highly nonlinear fibres and semiconductor optical amplifiers. Progressively, there has been a shift in the emphasis of all-optical regenerators, and by the third year, demonstrations of all-optical fibre-based regenerators for either differential phase-shift keying (DPSK) or DQPSK signals were experimentally demonstrated.

Several advances were also achieved in the monitoring of optical signals. Techniques that allowed monitoring of several parameters of the system performance were developed. Some of the highlights in this area were the development of a phase-to-amplitude modulation conversion technique for the measurement of the effects of chromatic dispersion on signals. This technique was based on a combination of the induction of a phase shift in a nonlinear medium and its conversion to amplitude modulation in an interferometric array. More recent work has proposed the transmission of a control sequence along with the data signal and its processing using multiple-in-multiple-out (MIMO) techniques to simultaneously determine the effects of chromatic dispersion and differential group delay in polarisation multiplexed signals.

Beyond these main areas of activity, the investigation of other relevant areas has also been encouraged. Such an example was the investigation of fibre Bragg grating filters in terms of their polarisation properties and the development of techniques that can be adopted during their fabrication in order to improve their characteristics.

Many of the afore-mentioned results have been compiled in a book that documents the progress achieved within BONE in addressing several current key issues in transmission.

Added value of the BONE NoE

The workpackage has enjoyed the formation of some strong collaborations during its lifetime. The nature of some of these collaborations was such that it would be difficult to be formed within the scope of more specifically targeted projects. Such examples include the case where several groups involved in simulations of transmission systems created a forum within the workpackage to discuss implications of a number of different modulation formats in terms of their performance against transmission impairments. Collaborations which were formed within European Union STRP projects running in parallel to BONE were strengthened through this project by allowing them to examine more closely problems peripheral to the targets of the STRP projects or carry out mobility actions which were beyond the scope of those projects. Furthermore, a number of short-term collaborations were formed to combine the expertise of several groups for small-scale demonstrations. Finally, many of the partners of the workpackage got involved in an effort to compile a book documenting many of their findings in a cohesive manner. This has represented a large effort which would be difficult to be organised outside the frame of a Network like BONE.