Characterisation of wavelength tuneable lasers for use in coherent burst/packet switched networks employing spectrally efficient modulation formats

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Future networks will need to be capable of offering Triple Play, IPTV, Video-on-Demand, Voice-over-IP and High-Speed Internet Access, combined with guaranteed Quality of Service. These networks will employ WDM technology and advanced modulation formats to achieve the high capacities required. In addition, given the bursty nature of this data it is expected that dynamic bandwidth allocation will be implemented to efficiently use network capacity. The key component in these networks will be the tuneable laser transmitters that generate the different wavelength packets, and the phase noise of these lasers will determine their coherent system performance. It is thus vital to characterise the phase noise of these devices to understand their performance in coherent systems, and to develop technologies to overcome limitations posed by using tuneable lasers in coherent packet switched networks.

Introduction

To address the capacity crunch in optical networks, high spectral efficiency transmission schemes employing high order quadrature amplitude modulation (QAM) formats with coherent detection, cooperating polarization multiplexing (PM), and spatial division multiplexing techniques [1] are being explored. In addition, rapid reconfiguration of the optical network with optical packet/burst switching technology allows the amplification bandwidth of the fibre to be used more efficiently [2-4]. Combining coherent transmission techniques with optical packet/burst switching can enable optical networks which are highly efficient both temporally and spectrally. One of the key elements in these systems will be the laser transmitter, and the phase noise of laser sources has been identified as a crucial characteristic that affects the performance of the coherent detection schemes [5]. In this paper we will present the detailed characterisation of the phase noise of a tuneable laser using an optical quadrature front end [6]. As the instantaneous phase of the laser is recorded in the time domain, the transient variation of the linewidth during switching can be derived by dividing the captured time domain signal into short gating windows at different times during the switching interval. We will then go on to present the performance of these tuneable lasers in various coherent optical communication systems using DQPSK and 16-QAM modulation formats, in both static and switching conditions [5, 7, 8], and identify some of the limitations of using these devices in coherent packet switched networks. Finally we will propose a number of techniques that can be used to overcome these limitations [9, 10].

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