Service Differentiation in Optical Burst Switching: Performance Evaluation under LRD Traffic

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ABSTRACT

This work proposes a method for service differentiation in optical burst switching (OBS) nodes adopting the Just Enough Time, JET, reservation mechanism. It consists of optimizing the number of wavelength converters employed in the node and proper setting of the extra-offset time intervals to satisfy different levels of quality of service (QoS). The ON/OFF model with exponentially distributed OFF periods, both exponentially and heavy-tailed distributed ON periods is adopted to assess the node performance under different traffic patterns. The OBS node investigated in this paper is equipped with $M \times M$ optical interfaces with N wavelengths each at 2.5 Gbits/s. We suppose that wavelength converters are available and that the system is bufferless, i.e., no fiber delay lines are available. One way to reduce the blocking of higher priority users is to grant them a longer extra-offset time. Another way to provide higher priority users with better performance is to allow them only to employ wavelength converters. Low priority incoming bursts can be retransmitted on the output link on the same wavelength only. With both OFF and ON periods exponentially distributed, let wc be the number of wavelength converters and A_0 the offered load. We find that the burst blocking probability is:

$$P_b = \frac{A_0}{1+A_0}\{B(wc, MN\frac{A_0^2}{1+A_0}) + [1 - B(wc, MN\frac{A_0^2}{1+A_0})] \times B(N-1, (N-1)A_0)]\} \quad (1)$$

where $B(x, y)$ is the Erlang B formula. Figure below (left) reports the blocking probability as a function of the load for different sets of wavelength converters comparing analysis with simulation. Traffic exclusively consisting of IP datagrams is then examined: medium and large-size datagrams are 576 and 1500 byte long and a third IP datagram size, equal to 200 bytes, is here introduced. Burst are classified as 1, 2 and 3, ranging from those composed of smallest to the largest datagrams in size. Class 1 bursts are given the highest priority through an additional extra-offset and the use of wavelength converters; class 2 bursts have medium priority by using the converters; class 3 bursts have low priority since they have less offset and cannot exploit wavelength conversion. Aiming to model self-similar traffic, Pareto-distributed ON periods are now considered, with $\alpha = 1.2$. Figure below (right) shows the burst blocking probability of class 1, 2 and 3 bursts as a function of the offered load with a set of 20 wavelength converters. Extra-offset equal to $14.4\mu s$ is given to class 1 bursts.