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IMPROVING PERFORMANCE OF OPTICAL BURST SWITCHING (OBS) NETWORKS BY BURSTIFICATION TIME EFFECT

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Abstract: - Performance of TCP is reduced in buffer-less optical burst switched (OBS) networks due to congestion detection mechanism in the networks. The mechanism in these networks cannot detect burst drop is due to congestion or contention in the network so when a burst drop because of the contention, TCP reduces the size of congestion control (cwnd) in a wrong way assuming a traffic in the network and it leads to significant performance reduction in the network.
In this paper we try to prevent performance reduction by obtaining an appropriate value for burstification time.

Keywords: Burstification time, Optical Burst Switching, TCP Vegas, Transport Control Protocol (TCP).

1. INTRODUCTION

One of the new networks in Optical field is called OBS or Optical Burst Switching network. These networks deploy a switching mechanism in the context of wavelength division multiplexing (WDM). This mechanism helps the network to deal with the large amount of traffic. In these networks, when packets arrive to the edge nodes, they are aggregated to make bursts and they are sent throughout the backbone of the network. One of the important duties of the edge nodes is assembling packets to make a burst in the source nodes and disassembling the burst in the destination nodes to make the sent packets. The sender nodes called ingress and receiver nodes called egress.

The nodes in the route of the bursts called core nodes. The first thing that ingress nodes do in the network is to send a control packet to reserve the resource in the core nodes, after reserving the resource, they send the burst throughout the core nodes. The control packet for reservation contains some information about the burst such as length of the burst or offset time. Offset time is the gap between sending the control packet and the burst. OBS network exploit WDM to carry the heavy traffic. The fiber links bandwidth is so large to carry the burst as a result a link in an OBS network is divided to more than one link and each one can work individually to carry the bursts, this technique is called Wavelength Division Multiplexing (WDM).

One of the major problems in OBS networks is its bufferless nature. OBS networks are bufferless so there is a probability that we will have contention between the bursts. These contention leads to a performance reduction in the network. Sometime the traffic in the network is not heavy but we have contention as a result the sending rate is reduced and it makes performance reduce [1-9].

In this paper we want to change the burstification time to obtain an appropriate time based on the traffic situation in the network to prevent the false congestion detection in the network.

2. RELATED WORKS

Researchers have conducted tremendous amount of studies to find a solution to prevent the performance reduction in OBS networks. One of the solutions to cope with false congestion problem in OBS networks is explicit signaling [10]. Explicit signaling is used in OBS layers to solve the congestion detection problem. The most important flaw of this approach is making a random signal for each burst increases overhead of the network.

Another scheme to solve this problem is burst retransmission and deflection scheme at the OBS layers [11-13]. When this approach is used in the network some of the burst losses are hidden from the upper TCP layers, so we can increase performance of the network.

A threshold-based TCP Vegas is proposed in [9]. This scheme adjusts size of congestion window based on round trip times (RTTs) of packets received at TCP senders. If the number of RTTs that are longer than minimum RTTs exceeds the threshold, it means congestion happens in the network, otherwise there is no congestion in the network.

Three different variants of TCP that are TCP Tahoe, TCP Reno and TCP New Reno have been studied in [14]. This paper represents throughput results from an experimental study of TCP source variants, Tahoe, Reno and New Reno.

3. OBTAINING THE BEST BURSTIFICATION TIME

This section explains the scheme and the changes which we use to reduce the effect of the false congestion detection on the performance when we deploy TCP Vegas in the network. Figure 1 shows the topology that we are using for our OBS networks.

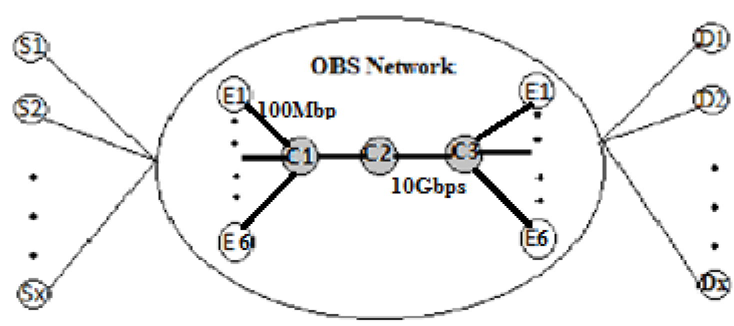

Figure 1: The network topology adopted in the simulation

The OBS network contains 12 edge nodes and 3 core nodes. In this network each edge node is connected to the core nodes with a 1ms propagation delay. These links use 100 wavelength channels for transferring data and data rate of each channel is 1Mbps it means each edge node is connected to the core node with a 100Mbps optical link and each link contains 8 wavelength channels for transferring control packets. The link between core nodes has 100 wavelength channels and data rate of each channel is 100Mbps it means core nodes are connected to each other with 10Gbps bandwidth and the links have 8 wavelength channels for transferring control packets. Data rate of each wavelength channel is 1Mbps.

Because we have burst contention in the network, if burstification time is going to be high, in each contention we will lose more packets so the performance will be reduced. However if we have less packets in each burst, by happening burst contention we will lose less packet, so we will have a better performance. Here the performance is delivered packets.

We are going to use a linear reduction for burstification time (formula (1)), it means if our burstification time is X_n and our burstification time was $Xn-1$ we will have:

$$X_n = \frac{Xn-1}{2} \qquad (1)$$

For simulation and comparing the different results, we have run a lot of tests in NS-2. By using this method we can obtain the best performance for OBS networks. Figure 2 shows the performance of the network when packet lost probability is $10^{-5.}$

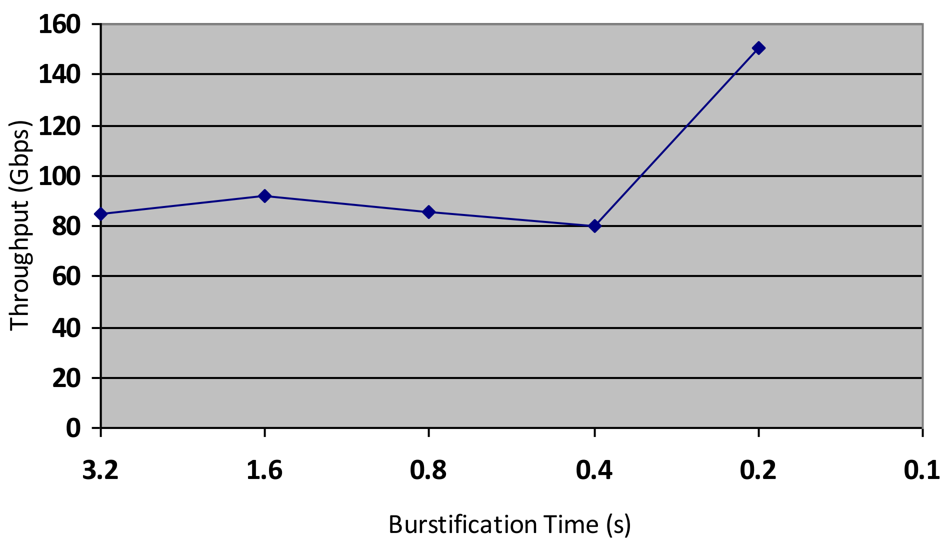

Figure 2: Burstification time adjustment effect on the performance of the network when contention probability is 10^{-5}

The figure shows when we reduce the burstification time, we can increase performance. The reason behind this scheme is the packets number. By reducing burstification time, we assemble less packets in one burst comparing high burstification time, so if we have burst contention in the network for each one we will lose less packets.

Figure 3 shows the performance of the network when packet lost probability is 10^{-4}.

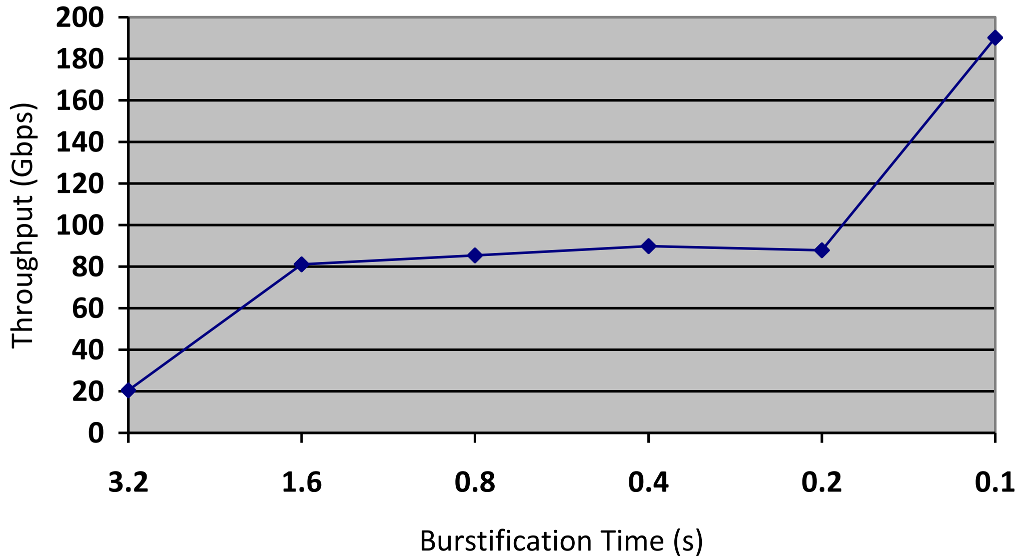

Figure 3: Burstification time adjustment effect on the performance of the network when contention probability is 10^{-4}

As it is clear in the figure, when contention probability is 10^{-4} halving the burstification time leads to a better performance.

Figure 4 shows the performance of the network when packet lost probability is 10^{-3}.

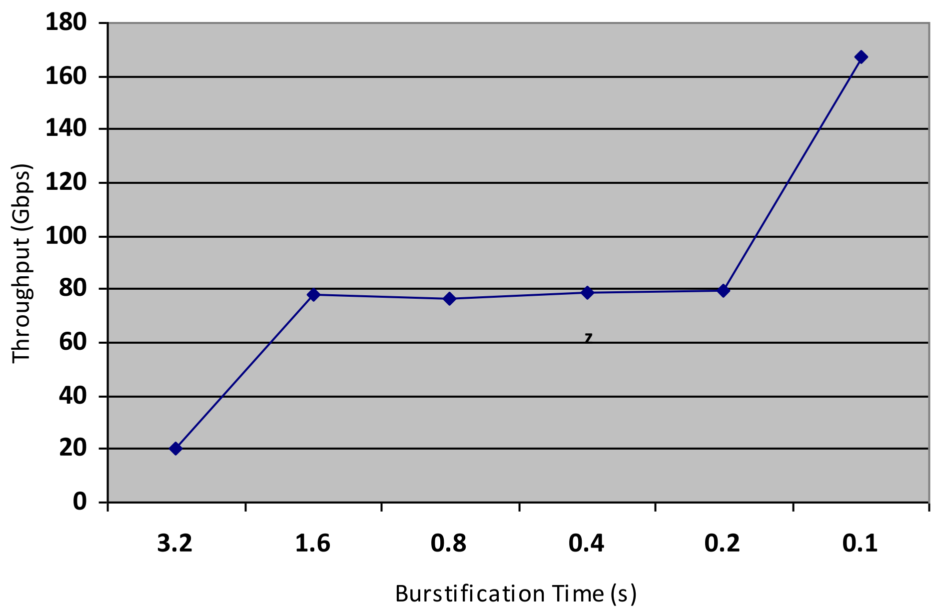

Figure 4: Burstification time adjustment effect on the performance of the network when contention probability is 10^{-3}

Figure 5 shows the performance of the network when packet lost probability is 10^{-2}.

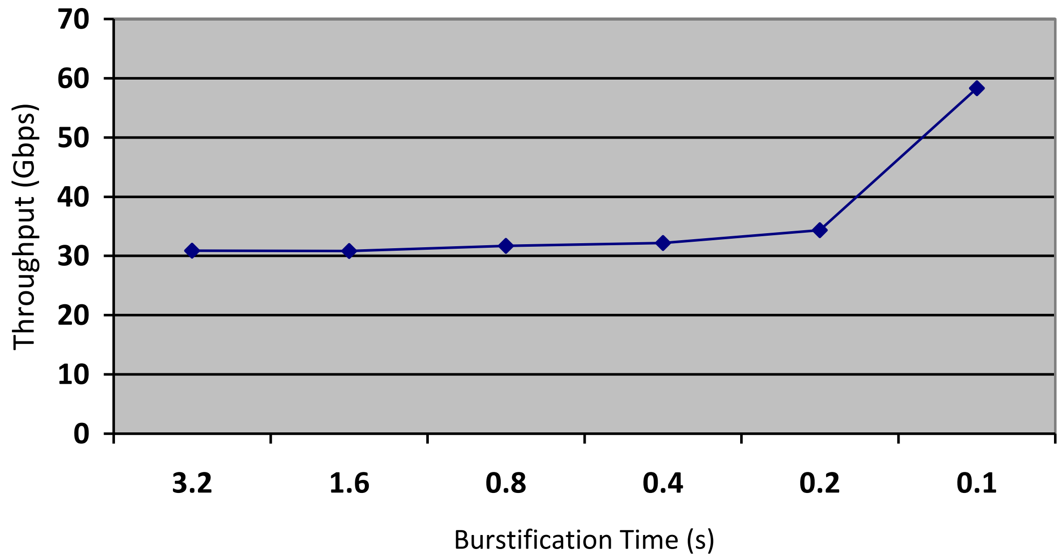

Figure 5: Burstification time adjustment effect on the performance of the network when contention probability is 10^{-2}

All of the figures show halving the burstification time leads to a better performance.

4. CONCLUSION

False Congestion detection in OBS networks is a common problem and it can lead to performance reduction in these networks. In this paper we proposed a scheme for choosing the best burstification time to make the bursts. For this purpose we showed, by halving the burstification time in different contention probabilities and approaching to 0.1, we will have a better performance. . Simulation results in ns-2 environment approved this theory.

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Vol.3 Issue.3, Pg.: 138-143
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