To Evaluate the Effect of Timeout to Send a Burst on the Performance of Optical Burst Switched Network

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ABSTRACT

Optical Burst Switched network is an optical network architecture which is used to tap the enormous bandwidth available with the optical fibers and makes use of the optical fibers to provide global Internet connectivity at a much faster rate. Performance of Optical Burst Switched network has been studied with regard to the 'timeout to send a burst' by the edge routers in this paper. Network simulator NCTUns has been used for simulating the Optical Burst Switched network. It is observed that the throughput is adversely affected by the larger values of the timeout to send a burst.

General Terms

Burst Switching, Network Simulation, Optical Networks

Keywords

NCTUns, OBS, Optical Burst Switched Network, Timeout

1. INTRODUCTION

The amount of the bandwidth offered by the optical fibers is enormous. The Internet traffic which is growing in leaps and bounds, can utilize this vat bandwidth to provide a global connectivity. In order to use the optical fibers for the bursty Internet traffic, OBS [1] is one of the most prominently used optical transport network architecture. The basic OBS network consists of an ingress node (source), an egress node (destination), and a network of OBS switches (core nodes) connected to these nodes. Data packets are assembled at the ingress node to form data bursts, which are then transported over the optical network. In order to reduce the processing and buffering of the data bursts at core nodes, a burst header packet is sent prior to the data burst so that the resources can be reserved [2,3]. The BHP is followed by the data burst after the offset period. The data burst received by the egress node is disassembled into packets which are then sent to their destination clients. [1,4,5,6] provide a detailed description of OBS network, its architecture, and protocols. In [4] authors explore the design choices, features, and issues concerning the OBS network. In [5] author discusses architecture design for terabit burst switching and proposes separate burst level data and control. In [6], authors propose and evaluate the JET protocol for optical networks with high speed bursty traffic. In [7], OBS network was studied in NCTUns and the effect of burst length on its performance was evaluated.

In this paper, the OBS network performance is evaluated considering the timeout to send a burst. The remaining paper is organized as follows: Section II presents the technical terminology used in the paper. Section III establishes the network setup of OBS network used for the carrying out the simulations. Section IV discusses the results achieved after the simulation of OBS network, and finally Section V gives the conclusion of the paper.

2. TECHNICAL BACKGROUND

Burst Header Packet (BHP) - BHPs are the control packets that contain information about the data bursts such as their duration, addresses of their source and destination nodes, their arrival time, etc. BHPs are sent before the data bursts on a dedicated channel and the data bursts follow after the mentioned offset time. The offset time is large enough so that BHPs can be processed and the switches at the core nodes can be configured [2,3].

Traffic Generating Applications - stcp and rtcp (TCP sending program and TCP receiving program) are the two application programs that are run to generate traffic for the simulations. Stcp command includes the port number involved as well as the IP address of the receiving node, while rtcp command consists only of the port number involved [8].

OPT_OBWA module - This is an optical wavelength assignment module which is used in the optical edge router's protocol stack. This module can be used to specify the channels for the burst header packets and data packets. Parameters of the optical burst assembly can also be set in this module [8].

Timeout to send a burst - It is used to specify the timeout period. In OBS networks, packets are accumulated into a burst and the burst must have a certain minimum burst length (MBL) prior to the start of its journey. But, to evade much delay, bursts having length shorter than MBL can be sent after a definite period specified by 'timeout to send a burst' field [8].
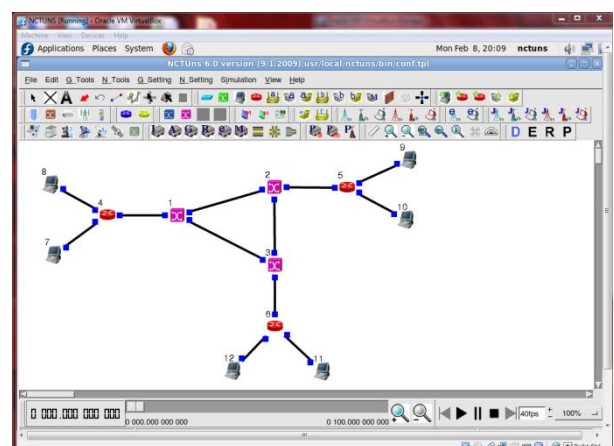

Fig 1: Topology of the OBS network in NCTUns

3. SIMULATION METHODOLOGY

High fidelity network simulator NCTUns was used to execute the simulations. Four modes (draw topology, edit property, run simulation, and playback) of the NCTUns were used for various operations of simulation generation. [8] gives in-detail

insight about all the four modes. The topology for the simulation is drawn in the draw topology mode and must be saved as .tpl file before any further operations can be carried out.

Traffic assignment is done in the edit property mode. Stcp and rtcp traffic generators are used. Table 1 shows the commands used for the generation of network traffic against each host. The link data rate and timeout to send a burst are also changed in this mode only for different simulation scenarios.

Table 1. Commands used for generating network traffic

Host	Command
7	stcp -p 5500 1.0.5.2
8	stcp -p 5600 1.0.7.2
9	rtcp -p 5700
10	rtcp -p 5500
11	stcp -p 5700 1.0.4.2
12	rtcp -p 5600

Configuration files for the simulation are created in the run simulation mode. At the end of simulation, results are stored in .results folder and the mode changes to playback mode. Animated transmission and reception of data can be viewed in the playback mode. Log files can also be plotted in this mode [8]. The simulation is carried at two different link data rates of 1 Gbps and 10 Gbps. Table 2 summarizes the values of various parameters used in the course of the simulation.

Table 2. Simulation parameters

Parameters	Value
Optical burst switches	3
Routers	3
Hosts	6
Optical links	12
Wavelength channels per optical link	3
Transport protocol	stcp, rtcp
Port number	5500, 5600, 5700
Link data-rates (Gbps)	1, 10
Timeout to send a burst (μs)	5, 10, 20

4. RESULTS and DISCUSSION

The log files for the average throughput of incoming packets and outgoing packets were plotted as shown below. Figure 2, 3, and 4 depict the incoming and outgoing throughput attained at 1 Gbps data rate for timeout to send a burst having values 5, 10, and 20 μs respectively. Figure 5, 6, and 7 depict the throughput of incoming and outgoing packets attained at 10 Gbps data rate for timeout to send a burst having values 5, 10, and 20 μs respectively.
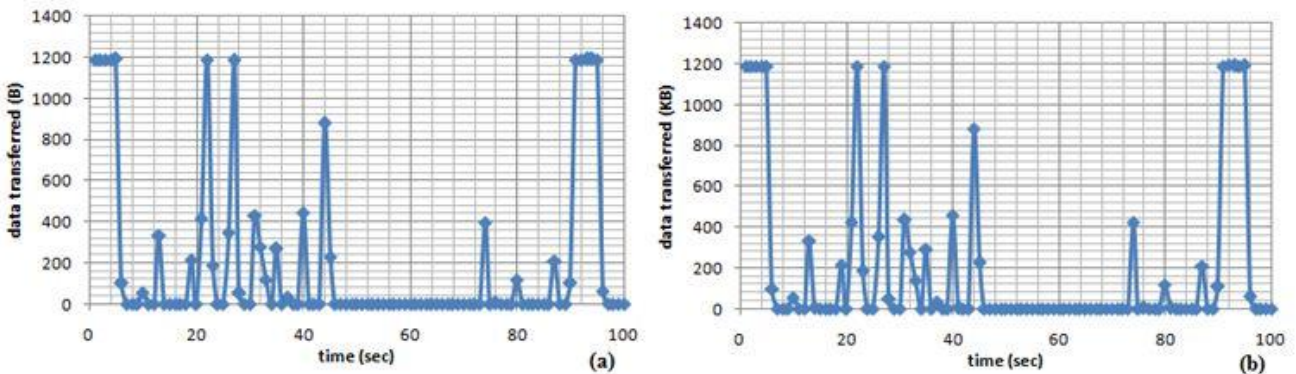

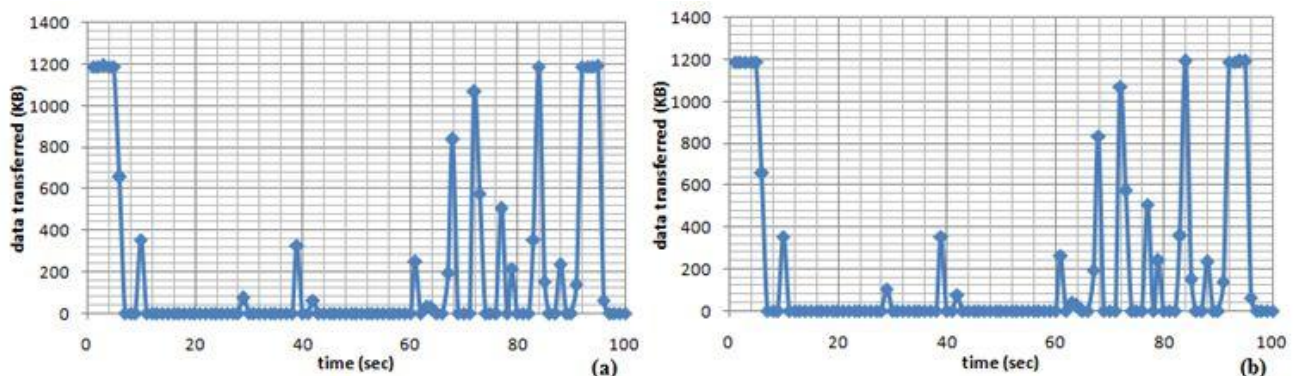**Fig 2: (a) Outgoing Throughput; (b) Incoming Throughput at 1Gbps for timeout value of 5μs**

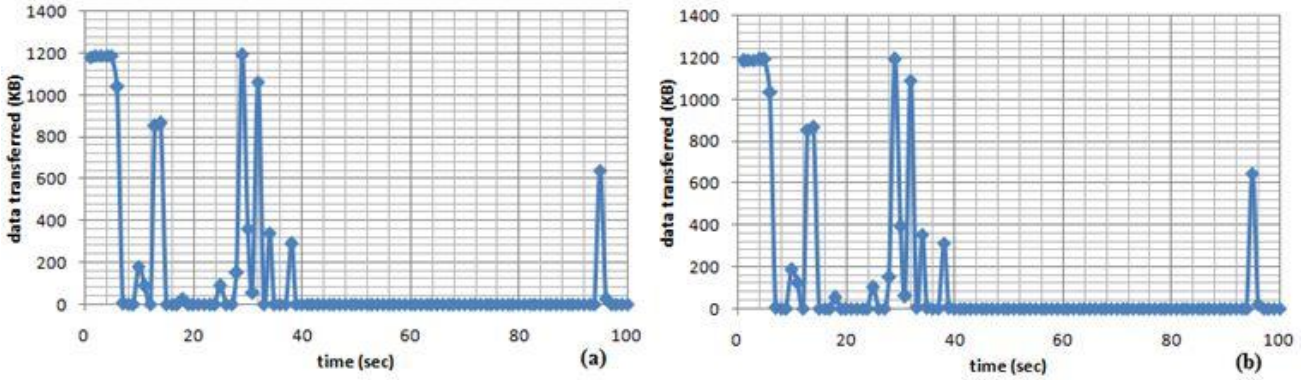**Fig 3: (a) Outgoing Throughput; (b) Incoming Throughput at 1Gbps for timeout value of 10μs**

Fig 4: (a)Outgoing Throughput; (b) Incoming Throughput at 1Gbps for timeout value of 20μs
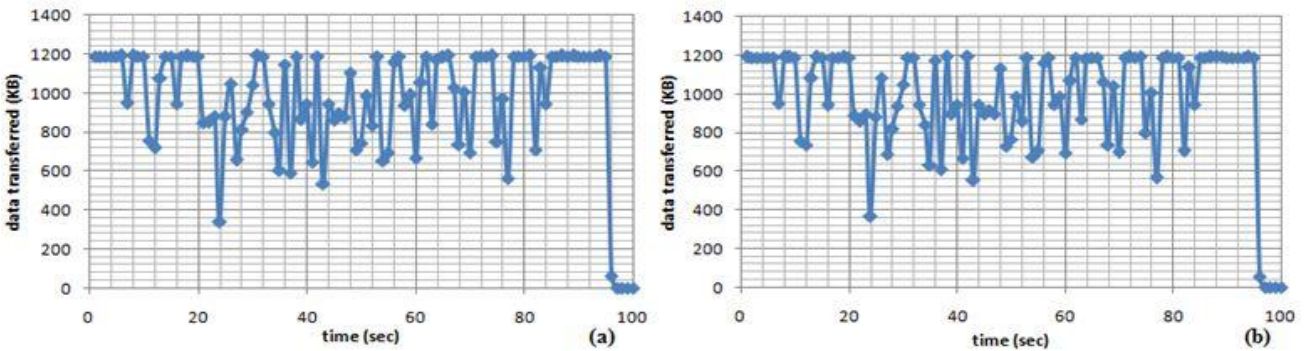

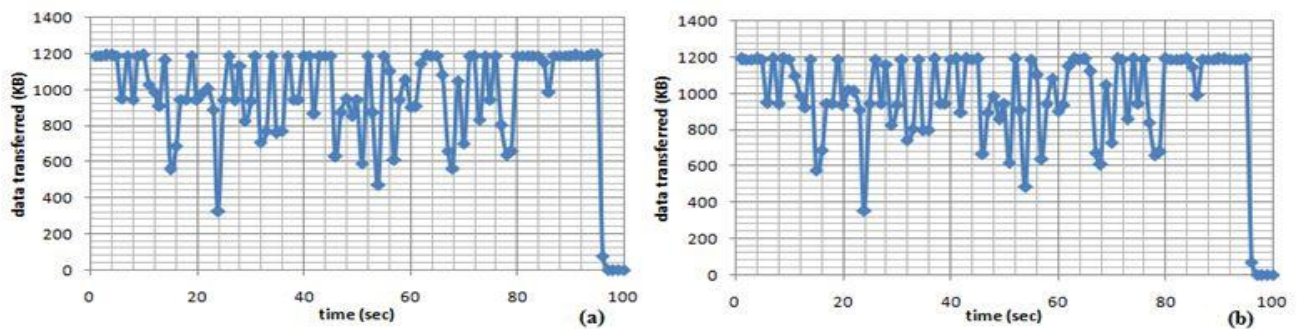**Fig 5: (a) Outgoing Throughput; (b) Incoming Throughput at 10Gbps for timeout value of 5μs**

Fig 6: (a) Outgoing Throughput; (b) Incoming Throughput at 10Gbps for timeout value of 10μs
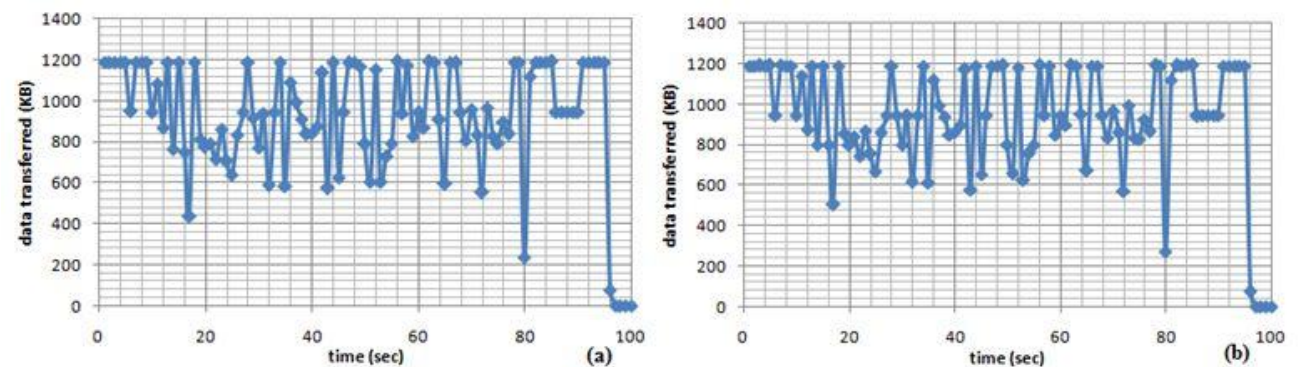

Fig 7: (a) Outgoing Throughput; (b) Incoming Throughput at 10Gbps for timeout value of 20μs

It was observed that the average throughput decreases with increase in the timeout to send a burst. The average throughput attained at 1 Gbps and 10 Gbps for the outgoing packets is summarized in Table 3. Similarly, the average throughput attained at both the link rates for the incoming packets is summarized in table 4.

Table 3. Throughput achieved for outgoing packets

Average Throughput of node 8 (KB/sec)		
Timeout to send a burst	**1 Gbps**	**10 Gbps**
5 µs	196.90644	965.34456
10 µs	181.71062	965.28384
20 µs	134.12132	924.92022

Table 4. Throughput achieved for incoming packets

Average Throughput of node 12 (KB/sec)		
Timeout to send a burst	**1 Gbps**	**10 Gbps**
5 µs	195.76666	956.6616
10 µs	180.31342	955.78116
20 µs	132.14728	911.47074

5. CONCLUSION

In this paper, we performed an event driven simulation on the optical burst switching network. Timeout to send a burst was studied with respect to the throughput attained in the simulation at two different link data-rates of 1 Gbps and 10 Gbps. The graphs of average throughput attained by taking varied values of timeout to send a burst were also plotted. Concluding, it was observed that the average throughput decreases with increase in the timeout to send a burst. In future, we will optimize the variable parameters of the Optical Burst Switched networks to obtain a network with high throughput and minimal contention problem.

6. REFERENCES

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