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Performance Evaluation of Contention Resolution Schemes in Optical Burst Switching

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Abstract— Quality of Service (QoS) provision is one of the most challenges in Optical Burst Switching (OBS) network. This paper compares the performance of different contention resolution schemes, under real traffic condition on Optical Burst Switching (OBS) network. Simulation results show that some algorithms reduce burst loss rate significantly compared to existing techniques. Some proposals have been also made in this paper to reduce the contentions, which represent a good trade-off between various contention resolution techniques.

Keywords— Optical Burst Switching, Contention Resolution, Quality of Service.

I. INTRODUCTION

The growth of internet uses are increasing day-by-day. At the same time the demand of bandwidth for high transmission rates also increasing. In order to use the raw bandwidth in Wavelength Division Multiplexing (WDM) networks, OBS technology is considered as one of the most suitable candidate. Optical Burst Switching is a promising solution for all optical WDM network. It combines the benefits of both optical packet switching and circuit switching while taking into account the limitations of current all-optical technologies [1]. In OBS the user data is collected at the edge node of the network, sorted based on a destination address and grouped into a burst. Before transmitting a burst a control packet is created and immediately sent toward the destination in order to setup a buffer less optical path for its corresponding burst. After an offset delay time the data burst itself is transmitted without waiting for a positive acknowledgement from the destination node. Incase of failure to reserve the path, a burst can be contended and is dropped. To resolve this situation, there are several contention resolution algorithms. These algorithms are based on several physical domains, wavelength, space and time [8]. Based on these following strategies are found [7]: wavelength conversion, deflection routing and fiber delay line.

Buffering using fiber delay line (FDL) is one of them. In buffering the burst can be delayed for few moments. In all-optical network to storage is difficult. But delay using Fiber Delay Line (FDL) is possible. The contending burst can be delayed by using FDL. A FDL can be implemented by using multiple delay lines in stages or in parallel. By deflection routing the contending burst can be deflected through another available route. Wavelength converters are also used to reduce contentions. The data burst is sent from one wavelength channel to another free wavelength by converting the wavelengths. Some combinational schemes are also used for the same purpose.

Several Researches have been found to resolve the contention problem in optical burst switching networks. In [5][6] some FDL based schemes are discussed, in [2][4] some deflection routing based methods are described. Few combinational approaches are as found in [2][3] several literature.

In [2] the authors proposed an intra class contention resolution scheme in OBS network by combining wavelength converters and the enhanced deflection routing algorithm. Instead of setting complete light-path, their function works hop by hop. This means the data burst can change its route in any intermediate node when ever necessary. They showed the performance of their algorithm works better than general OBS. But there are some limitations of their algorithm, like necessity of routing table in every node, extra load to set control header, extra delay. S. Lee [4] et al proposed contention-based limited deflection routing (CLDR) scheme. Their proposal is based on the certain performance criteria, which are dynamically determined during the contention. In [5] the authors' proposed an algorithm that is based on FDL and optical wavelength converters. Their algorithm called k-WDS is for the sparse placement of FDLs at a set of selected nodes in the network and it can handle both uniform and non-uniform traffic pattern. In [6] the authors are investigated the characteristics of an asynchronous optical buffer by using continuous queuing model. Another combinational method was proposed by Cherif M. et al. [3].

In the paper their proposed deals with optical burst loss during contention.

The goal of this paper is to analyze the performances of several contention resolution algorithms and fine out the suitable solution for better Quality of Services.

The paper is organized as follows: Burst-Loss based Contention Resolution Proposition is discussed in section 2. In section 3 Simulation results are depicted. And the following section concludes the paper.

II. BURST-LOSS BASED CONTENTION RESOLUTION PROPOSITION

Traditionally only one contention resolution approach is used in the network topology. In our approach, combinations of two traditional contention resolution techniques (delaying and deflection routing) are used instead of one technique. This combination reduces the burst drop rate significantly in that sense that if one technique fails; another alternative is assigned before the burst dropping. Two versions are discussed; they are Delay-Deflection and Deflection-Delay respectively.

A. Delay-Deflection

In this scheme the blocked bursts/packets are deflected through another output port first. After deflection if still bursts are blocked, these are sent to a FDL buffer for delay a certain time.

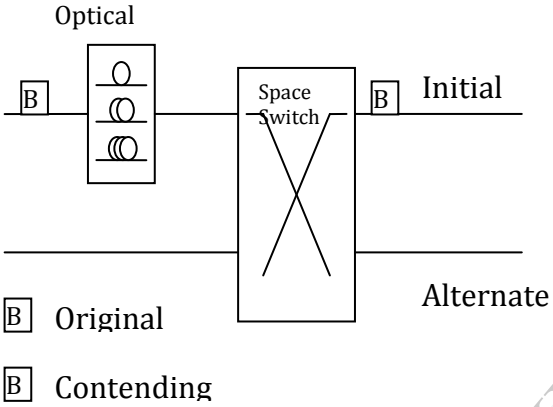

Fig.1. Functional rchitecture of Delay and Deflection

Deflection-Delay

This scheme is the opposite of Delay-Deflection. In this scheme the blocked bursts are delayed by FDL first and if the bursts are still blocked, then the bursts are sent to another output port.

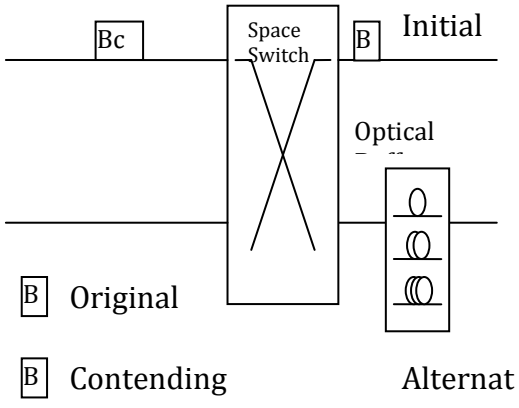

Fig.2. Functional rchitecture of Deflection and Delay

III. SIMULATION RESULTS

A. Simulation Environment

Simulations are conducted in OBS simulator onsim [4] made in visual c++. The performances are examined on 14-node NSF network topology shown in figure 1. In each simulation run, we have simulated 10,000 flows. We assume that traffic flows arrive in a Poisson process with an average arrival rate λ with a default value of 100 flows/s and with an average flow duration of 1/μ (fixed at 1 second). The flow intensity ρ=λ/μ. Within a flow, packet arrival in a self-similar process with the Hurst parameter equal to 0.9, which varies from 106 to 4x106 (packets/sec). We also assume that every node in the network could be the source or destination of a traffic flow with an equal probability. In addition we assume that the number of wavelengths in a fiber is w=8, and the capacity of a wavelength is c=10 Gbps. In the simulation three network topologies are used, they are: 14-node NSF, 16-node Mesh and 9-node Ring showed in Fig. 3.

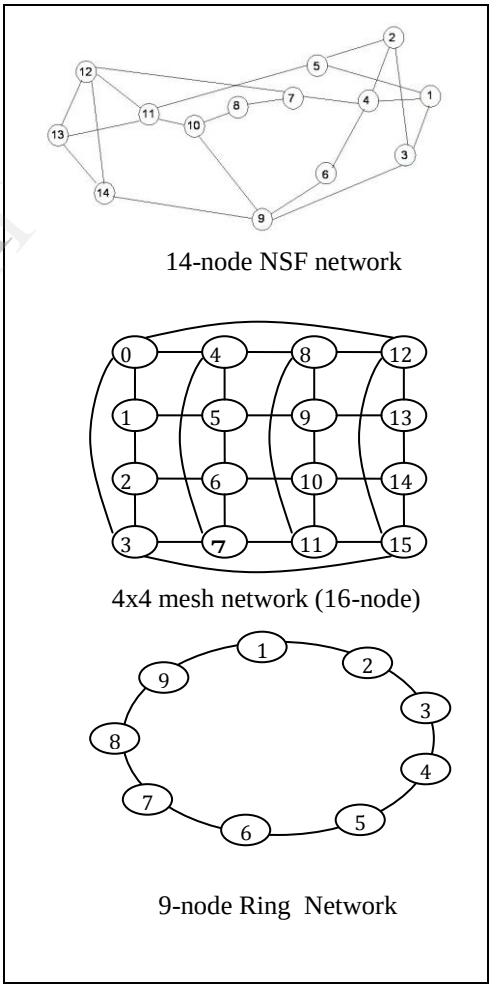

Fig.3. Three common network topologies

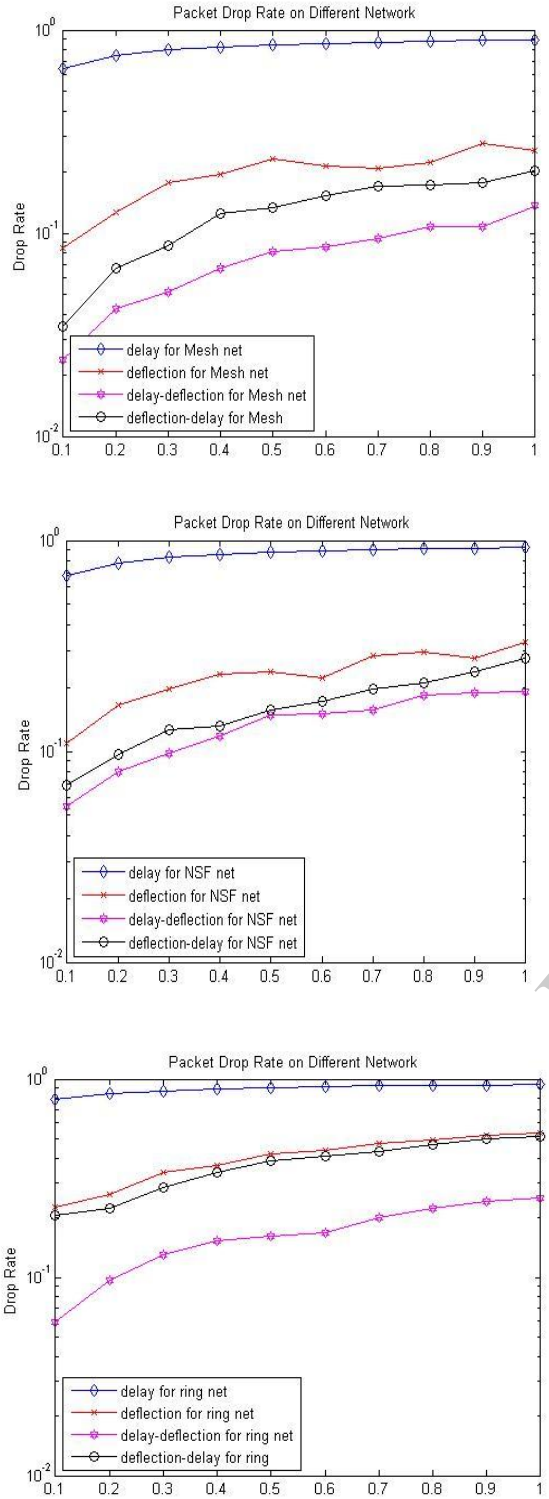

Fig.4. Burst drop rate in different contention resolution policies

B. Result and Discussion

In Fig.4., burst drop rate in three popular networks with different contention resolution algorithms (delay, deflection, delay-deflection and deflection-delay) are examined. In the figure, it is found that, performance of single algorithms like delay only or deflection only is not as good as the performance of combine algorithms. It is also observed that, the delay-deflection has better performances than other approaches in all three networks topologies.

The following figure (Fig.4.) we examined contention resolution techniques in different networks. It is found that the drop rate is minimal in mesh network than the ring and NSF network.

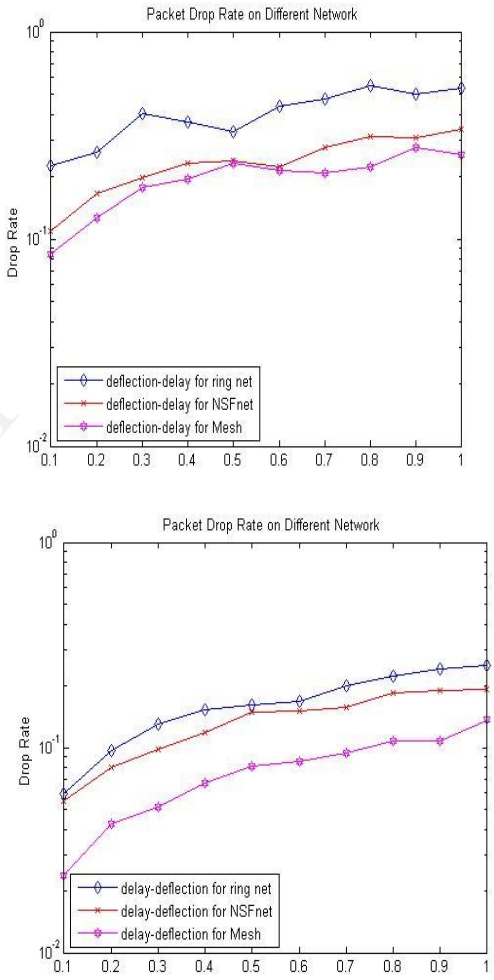

Fig.5. Burst drop rate in different network topologies

IV. CONCLUSION

Optical technology is the most suitable technology for the next generation communication system. Optical Burst switching (OBS) approach provides a short-term workable optical switching solution to evade the current immature optical technology. Contention is the one of the great problem to meet the challenge of communication system. In this paper we studied the different contention resolution techniques under several topologies. After evaluating the performances of contention resolution algorithms we found that combinational schemes perform better among others, especially delay-deflection outperforms the other approaches.

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