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Priority based Burst Assembly for Optical Burst Switched Network

Shweta* **and Shamandeep Singh**

Department of Computer Science and Engineering, Chandigarh University, Mohali-140413, Punjab, India;
shwetabansal012@gmail.com, shaman.528@gmail.com

Abstract

Objective: In this paper, burst is aggregated on the basis of priority of the packets coming from different networks at the edge node of the optical network to enhance the QoS parameters such as burst drop, delay, packet delivery ratio and packet error. **Methods:** To reduce traffic related problems in optical switched network different algorithms are used to assemble the bursts and their scheduling in the core network. Bursts are assembled on the basis of time, length and hybrid technique which are scheduled in the core network to reach the edge node and then to their actual or true destinations. In this study, bursts are aggregated on the basis of priority of packets coming from different networks to enhance the network parameters. High and low priority packets are aggregated separately into ht bursts on the basis of which bursts of high priority packets followed by bursts of low priority packets are scheduled in the network. After reaching at edge node, bursts are dissembled into packets and then sent to their actual destinations. **Findings:** The proposed algorithm is simulated in MATLAB with dynamic number of nodes (50-60 for better results) on area of 2000 * 2000 units. Priority based burst assembly algorithm is used for aggregation of bursts and it has been analyzed in terms of network parameters such as delay, packet error, burst drop and burst delivery ratio. **Applications:** the main application of OBS network is at the backbone of Internet due to which the usage of Internet is easy and faster because data is sent on different bandwidths at the same time.

Keywords: Burst Aggregation, Optical Burst Switching, Scheduling

1. Introduction

To meet up ever-increasing bandwidth demand in long-term and metropolitan networks, many optical network models have been under deep research. There are three main models in optical domains i.e. Optical Packet Switching (OPS), Optical Burst Switching (OCS) and Optical Circuit Switching (OBS). In OCS implementation is easy but deficits in flexibility to cope up with fluctuating traffic and the varying link state[1]; OPS is theoretically ideal but required technologies like optical buffer and optical header processing are under experimental stage till now; OBS is observed as the best solution as it has the advantages of both OCS and OPS[2]. In the electronics domain, by making routing decision it decrease cost and complexity but switching or forwarding data in optical domain[3]. In an OBS network, a data unit is a burst which is aggregated at ingress node having manifold IP packets predestined to same egress node. The transmission of every burst is enticed by transmission of dedicated control packet on fanatical channel. The control packet hoard channels on the core network, entire route from the ingress node to egress node where burst will be disaggregated[2]. The fields of the control packet or header of burst are shown in Table 1.

Table 1. Header of data burst

IP address of ingress node	IP address of egress node	Offset time	Burst Arrival time
Control packet ID	Burst Duration	Priority Bit	CRC

An OBS core has an optical data path with the electronic control path. The optical data path, i.e. the optical cross links with/without wavelength exchangeability. Slotted and unslotted networks behave differently by means of the performance. It can be said that the unslotted OBS network[4] can produce better efficiency and because

* *Author for correspondence*

of unpredictable burst arrival characteristics, burst probability can be high[4].

Dense Wavelength Division Multiplexing (DWDM) technology allows numerous DWDM channels to hover over single optical fiber at speed of 10 GB/s for particular channel. It means the rate of data for a router is up to 10 Tb/s (terabits per second) at every port, which means it has more efficiency than electronic routers[5]. Hence, electronic switching technologies will replace by optical switching technologies to take advantage of a large amount of bandwidth which is made possible by DWDM technologies. DWDM channel scheduling is key design issue in OBS networks[6]. To make Burst Switching a better solution, we have to resolve the two complications at equivalent time i.e. 1) how scheduling algorithms can be designed that available wavelengths can be used readily and 2) how to make algorithm more rapid for scheduler can cope up with rate of incoming of bursts[7]. The basic architecture of OBS network is shown in Figure 1.

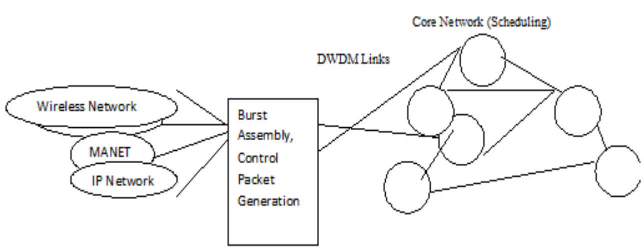

Figure 1. Optical burst switched network.

The delay from one end to other of a burst in an OBS network contains four components: (i) the burst aggregation delay at ingress node (ii) the path setup delay caused by Burst Header Packet (BHP) (iii) the burst transmission time and (iv) the propagation delay in core network[8].

1.1 Offset Time

The variation between the transference time of control packet and data burst is known as offset time. An extra offset time is assigned to the bursts with higher priority due to which higher priority bursts are scheduled before lower priority bursts and have improved choice for reserving wavelength successfully[9].

1.2 Scheduling

When the burst is assembled, it is send to the core network. This process of sending the burst into the core network is known as burst scheduling. It depends on the factors like delay, bandwidth, loss, etc.[10]. Scheduling is done by burst scheduler who reserves the channel for the burst. The bursts having higher priority is scheduled first as that of bursts having lower priority so that the performance of network is enhanced. A preference number (integer) is connected with each process. Like in operating system, the CPU is appointed to the process with the highest priority (least integer ≡ highest priority)[11]. SJF is a priority scheduling where priority is the concluded next CPU burst time. There are two schemes on priority basis: one is non pre-emptive that explains that once CPU given to the process it cannot be preempted until completes its CPU burst and the another is pre emptive that explains when a new process reaches with CPU burst length less than residual time of current executing[12].

2. Burst Assembly and its Techniques

The IP packets are assembled to form a group known as burst. The burst which is assembled on ingress node. It initiates when first packet arrives at an empty queue and continues until a predefined threshold is reached. The arriving packets are moved to burst assembly unit by the switching units[13]. Burst is assembled on the basis of same destination address. The burst aggregation scheme used impact the traffic properties in the network i.e. traffic burstiness and traffic self-similarity[14]. The scheme implemented also determines settle the end to end performance of the network. The objectives of burst aggregation algorithm are:-

- To decrease the packet burstification delay so that the total delay can be reduced
- To enlarge the burst size – this will result in the decrement in the number of bursts produced so that the processing overhead at the core nodes will be reduced[15].

2.1 Burst Assembly Algorithms

There are many burst aggregation algorithms which are discussed in this section. The conventional schemes are time based scheme and burst length based scheme. Another assembly scheme which was proposed was mixed or hybrid time/ burst length based scheme[16].

2.1.1 Time based Algorithm

In the time based algorithm, a timer is initialized at the start of each burst aggregation circle. When a threshold time T is arrived, all packets that would have arrived during that time period would be grouped into a burst[17]. In this algorithm, L_{min} minimum burst size is set due to which all bursts created should be of a size equal to L_{min} or more, but if the burst size is less than L_{min} then it should be filled to a size equal to L_{min}. The value of T is chosen very carefully because if it is too low then many small bursts will be created due to which there is high processing overhead at the core nodes and if it is too high then it may point to additional packet delay at the edge nodes[18].

2.1.2 Burst–length based Algorithm

It is also called size threshold algorithm. This algorithm also uses a fixed burst size L to determine the aggregation of burst. When the burst size reaches to L then burst is created and will be sent to the output port. When traffic is more and burst size is small then it leads to high overhead at the core nodes[19].

2.1.3 Time or Length Hybrid Algorithm

To solve the problems of both the schemes, there is third scheme which is known as hybrid scheme. In this algorithm, burst is aggregated when L or T is reached, whatsoever comes first. When T is reached earliest and the burst size is less than the set L_{min}, then the burst size is filled to L_{min}[20].

3. Results and Discussion

Burst assembly of data in a most favorable way is one of the key problems in optical burst switched networks. Another key issue is contentious; contention arises when more than one data burst tries to preserve the same wavelength channel on an outgoing link[21].

The research is on the basis of traffic problem that shows when packets arrive at an ingress node; a priority based burst assembly algorithm is used to accumulate bursts for different priorities of data packets[22]. The information needed by the assembler such as the expected arrival time of the data burst and their priorities is obtained from the header of the packet. The flow of the work takes place as shown in Figure 2.

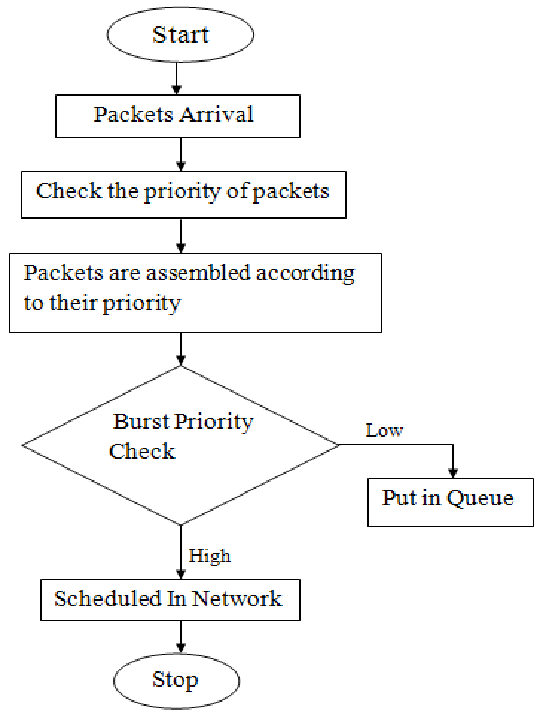

Figure 2. Simulation model.

After burst assembly, bursts are scheduled in network, which is done by scheduler. The scheduler has record of the accessibility of time slots on all wavelength channels. It selects one among the idle channels. The wavelength channels are chosen in an efficient way so as to lessen the burst loss[23]. At the similar time, the scheduler must be effortless and should not utilize any complex algorithm, because the routing nodes work in a very high-speed environment managing a large amount of burst traffic. A compound scheduling algorithm may escort to the premature data burst arrival situation where the data burst arrives earlier than its control packet is processed and ultimately the data burst is dropped[24].

Figure 3 shows the deployment of nodes. In proposed work we have simulated 50 nodes in the width and breadth of 2000 * 2000 having 2 sec of running time.

In proposed work values of three parameters has been shown in Figure 4 like Packet delivery, burst drop and packet error and the obtained values for 5 rounds are packet delivery = 91, burst drop = 40 and packet error = 6.5.

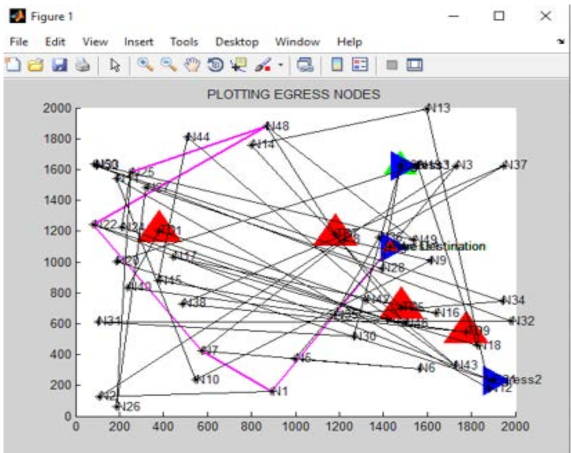

Figure 3. Network deployment.

Figure 5 shows the value of delay for multimedia data like video packets and text packets and the obtained values for video packets are 171, for text packets are 34.7.

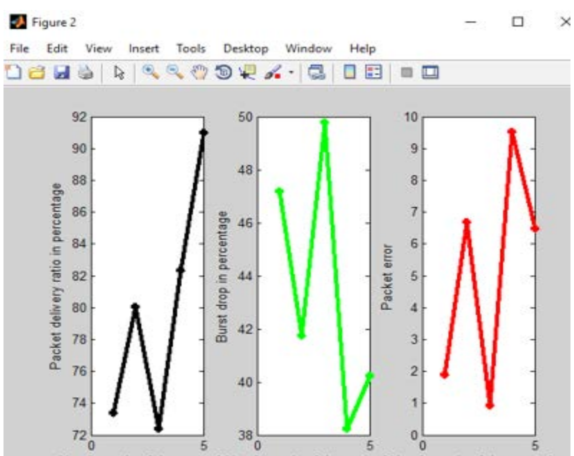

Figure 4. Packet deliver, burst drop and packet error.

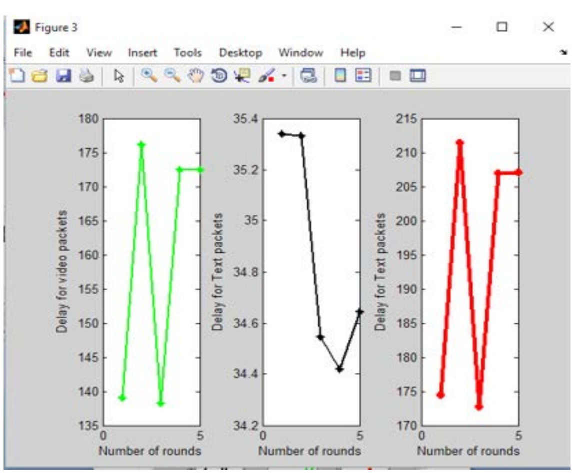

Figure 5. Delay for video packets, text packets.

4. Conclusion

OBS is a promising switching method that has gotten much consideration as of late. A reasonable scheduling calculation can guarantee reasonable bandwidth allotment among various clients and isolate badly carried on clients from ordinary clients in a network. In any case, fair scheduling in OBS systems is hard to actualize because of absence of economical and substantial supports in optical space. In this work, we propose another plan to give decency in OBS network by considering the priority of packets in the assembly of bursts. The priority of packets is taken from their respective headers. On the basis of the bursts priority, they are scheduled in the network. Due to which there is decrease in the loss of high priority data. The simulation parameters, environment and results are elaborated in this research.

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