ANALYSIS OF OPTICAL SIGNAL STRENGTH IN NETWORK APPLICATIONS

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Abstract — Optical Burst Switching (OBS) is a promising paradigm for high speed transmission of data. In OBS, a key problem is to schedule bursts with minimum loss. Single method is not sufficient to improve performance. So, our performance model includes some feasible methods to improve OBS performance without increasing the implementation complexity. The methods include adding fiber delay lines (optical buffers), increasing offset time randomly, channel scheduling and Burst Delay Feedback scheduling (BDFS). FDLs are used only to compensate the node processing time. The random offset time approach does not require additional hardware components in the nodes. Channel scheduling in a window based manner provides better channel utilization capability when FDLs are used in the nodes. Finally Burst Delay Feedback scheduling in addition with these methods can significantly improve OBS throughput and reduce loss rate.

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Keywords – OBS, BDFS, FDL, throuhgphut

I INTRODUCTION

The rapid growth of the optical usage will result in an increased demand for scheduling data to reduce loss rate. Optical Burst Switching can provide better transmission services in optical networks without sophisticated optical hardware. OBS takes advantage of both optical circuit switching and packet switching techniques. The one-way resource reservation of OBS effectively reduces the hardware complexity and is not sensitive to the propagation delay between nodes. The nodes in this network must also complete the routing computations which are used to transmit data bursts along a path. In general, only a first-come-first-served (FCFS) algorithm can be used to schedule the incoming data bursts. The OBS network with large number of hop count paths will make a loss rate high.

Many approaches have been proposed to improve the performance of OBS, for example, adding optical buffers to OBS nodes, burst segmentation, centralized resource reservation, and dynamic routing. However, many of these proposals are not practical because they require much sophisticated implementation than the original OBS scheme. In optical burst switching, a data burst is kept in the optical domain at the intermediate nodes, while its control packet or header can be converted to electronics for processing. Since each burst is transmitted at the full-bandwidth of a wavelength in a WDM network while its control packet or header is transmitted on a separate wavelength, deciding how to schedule bandwidth reservation and set switches should be relatively simpler.OBS mainly based on how and when the network resources, e.g. bandwidth, is reserved and released, and whether control packets and data bursts are separated by using different channels, or by sending one after another with a non-zero offset time. Burst switching technique use one way resource reservation instead of two-way or centralized reservation, for maintaining end to end delay within the acceptable level. Because one way reservation employed OBS does not send acknowledgement back to the source.

In order to improve OBS performance without significantly increasing the implementation complexity, it is necessary to delineate the relationship among control processing time, one-way resource reservation, and OBS such that the merits of different improvement approaches can be fully understood. Our aim is to improve performance with lower implementation complexity. So, we combine different methods to improve OBS throughput and loss rate performance. With this understanding, different performance improvement methods can be combined to further improve the OBS performance.

Our main contributions include the following:

First adding Fiber Delay Lines (FDL) just before the core node to introduce delay. FDL method can be used only for control packet processing time (T_cp) compensation. Adding offset time randomly can also improve system performance even if the T_cpis fully compensated by FDLs.

Channel scheduling in a window based manner that is suitable for OBS with both window time T_wd and T_cp compensated by FDLs.

Finally, we propose Burst Delay Feedback Scheduling (BDFS) approach at core node, with these existing methods. By combining burst feedback scheduling with those methods we can obtain further increased throughput and reduced loss rate. In addition, we use discarded-traffic-retransmit approach for all performance evaluations.

II RELAED WORK

. **Y. Li, P. K. A. Wai, and Victor O.K. Li (2011), "Performance Improvement Methods for Burst-Switched Networks," J. OPT. COMMUN. NETW./VOL. 3, NO. 2:**

According to this paper, a performance model of optical burst switching (OBS) that can explain the degradation of OBS throughput performance when the control packet processing time increases was developed. To improve OBS performance without significantly increasing the implementation complexity three methods was employed: addition of simple fiber delay lines (FDLs), random extra offset time, and window-based channel scheduling (WBS). Additional FDLs can compensate the control packets processing time. The random extra offset time approach does not require any additional hardware and computational capability in the nodes. It simply increases the offset time.

WBS in general can provide better throughput improvement when FDLs are used in the nodes to compensate the processing time. Window Based Scheduling OBS can be considered in two cases (i) both the window time Twd and the control packet processing time Tcp are compensated by FDLs, and (ii) no FDL is used for Twd and Tcp compensation, but Tcp is much larger than the data burst transmission time L. WBS in general can provide better throughput improvement than the random extra offset time approach. Owing to the low requirements of hardware and computational capability, however, the random extra offset time approach should be applied first to OBS systems for improving the throughput performance.

2) **C. Qiao and M. Yoo (1999), "Optical Burst Switching (OBS) – A New Paradigm for an Optical Internet," J. High Speed Netw., vol. 8, pp. 69 – 84:**

The main contribution of this paper is introduction of the new switching paradigm called optical burst switching (OBS). In this paper, the general concept of OBS protocols and in particular, those based on Just-Enough-Time (JET), is described, along with the applicability of OBS protocols to IP over WDM. Specific issues such as the use of fiber delay lines (FDL) for accommodating processing delay and/or resolving conflicts are also discussed.

In order to provide BEST services in an effective and feasible way, one-way reservation paradigm is suitable for sending data requiring a high bit-rate and a low latency but having a relatively short duration compared to the end-to-end propagation delay of the network. A JET-based OBS protocol can also support multi-path routing from a given source to a given destination as long as the (approximate) number of hops along each path is known. To support routing at an intermediate node when there is no bandwidth to reserve on the primary outgoing link, the control packet chooses an alternate outgoing link, and sets the switch accordingly so that the data burst will also follow the alternate path. A JET-based protocol can support limited adaptivity even without using FDLs. Specifically, one can use an extra offset time at the source to account for a possible increase in the total processing delay of the control packet due to routing.

JET-based OBS protocols can achieve good bandwidth utilization by using delayed reservation, and improve fairness by assigning an additional offset time (which is equivalent to a higher priority) to bursts travelling through more hops. OBS can be used to efficiently support multicasting at the optical layer to take advantage of the inherent multicasting capability of some optical switches as well as the knowledge of the physical topology of the WDM layer.

3) **J. Y. Wei and R. I. McFarland Jr. (2000), "Just-In-Time Signalling for WDM Optical Burst Switching Networks," J. Lightwave Technol., vol. 18, pp. 2019–2037:**

In this paper, the architecture, design, and implementation of a novel just-in-time (JIT) signalling protocol for optical burst switching (OBS) in wavelength division multiplexed (WDM) optical networks was described. The JIT-OBS paradigm is designed for ultra-low-latency unidirectional transport of data-bursts across an optical network. It combines the desirable features of circuit-switching and packet-switching. It features out-of-band control signal processing that eliminates buffering of data-burst at intermediate nodes, while minimizing the setup time, and maximizing the cross-connect bandwidth efficiency. The architecture of JIT signaling, and analyze its basic performance was motivated. It presents the detailed signaling message design and discusses the rationale and considerations that went into this design. Various scenarios that illustrate the operations of the JIT signaling protocol (JIT-SP) in connection establishment was examined.

In optical WDM, the tremendous bandwidth of a fiber (potentially a few tens of terabits per second) is demultiplexed into many independent non overlapping wavelength channels. In an all-optical implementation, within certain restrictions, the wavelength channels are transparent in that they can transport data at different bit rates and modulation formats. Each switching paradigm makes different assumptions on the WDM switch hardware, and requires different signaling schemes.

Just-Enough-Time (JET) is the another signalling scheme, which attempts to utilize additional knowledge concerning the duration of burst transmission in order to schedule the cross-connect settings in each intermediate switches. Due to the reduced channel hold time made possible by forward scheduling, JET may deliver better resource utilization than JIT Signal scheme.

III PROPOSED WORK

OPTICAL NETWORKS - AN OVERVIEW

CONTRIBUTION OF OPTICAL FIBERS IN NETWORK:

In recent years, the demand for network bandwidth is growing due to increase in global popularity of Internet and variety of applications. Optical data communication has been acknowledged as the best solution to meet the present bandwidth requirement of users and supporting future network services. This is because theoretically optical fiber has the ability to support bandwidth demand up to 50 THz. Light wave has higher frequency and hence shorter wavelength, therefore more bits of information can be contained in a length of fiber versus the same length of copper. Apart from this, optical fiber provides extremely low bit-error rate of the order of 〖 10〗 ^(-12). Optical signals are immune to electrical interferences. Fiber cables are much more difficult to tap than copper wires, so there is a security advantage in optical communication. All these factors make optical networks as the future networks.

WAVELENGTH DIVISION MULTIPLEXING:

WDM is an optical version for FDM. The idea is that several signals are transmitted at the same time in the same fiber at different wavelengths. Each wavelength supports a single communication channel, operating at whatever rate one decides. Today WDM is the most popular alternative to multiplex signals in the optical domain. WDM Networks are the most widely used optical networking technique. Its main advantages are the signal transparency, scalability and flexibility. The key parameters of any multiplexing system are the total capacity of the system, number of channels, the spectral efficiency and the transmission distance. WDM systems capable of multiplexing up to 40x10 Gbit/s channels in a single fiber have been in commercial use. Generally, WDM networks can be classified as broadcast-and-select networks and wavelength routed networks.

Broadcast and Select Networks:

The main idea of broadcast-and-select networks is that the data is broadcasted at a special wavelength to all nodes. The receivers accept only certain wavelengths, i.e., data channels. Therefore the data is rejected in those nodes that it does not belong to. In this type there is no routing information is provided by the network. Most local area networks (LANs) of today, for example Ethernet, token ring and FDDI networks belong to broadcast-and-select type of networks.

Wavelength Routed Networks:

Wavelength routed networks consist of optical-crossconnects interconnected by point-to-point fiber links in an arbitrary mesh topology, where routing information is provided by the network. Connection between any two nodes in the network is established by setting up a lightpath. Routing of the wavelengths along the optical networks is carried through optical channels called light paths. A light path is a circuit established between any two nodes in the network and is uniquely identified by a route and a wavelength associated with it. The algorithms used for selecting the route and wavelength to establish lightpath are known as routing and wavelength assignment (RWA) algorithms. Once lightpath is established between source-destination pair, data is transmitted between the end points of the lightpath without processing, buffering or optical-electronic-optical (O-E-O) conversion at intermediate nodes.

SWITCHING TECHNIQUES FOR OPTICAL NETWORKS:

Three switching techniques that are well studied to carry IP traffic over WDM networks are optical circuit switching, optical packet switching and optical burst switching.

Optical Circuit Switching:

In Optical Circuit Switching (OCS), the network is configured to establish a circuit, from an entry to an exit node, by adjusting the optical cross connect circuits in the core routers in a manner that the data signal, in an optical form, can travel in an all-optical manner from the entry to the exit node. This approach suffers from all the disadvantages known to circuit switching - the circuits require time to set up and destroy, and while the circuit is established, there sources will not be efficiently used to the unpredictable nature of traffic.

Optical Packet Switching:

Optical packet switching is suitable for supporting bursty traffic since it allows statistical sharing of the channel bandwidth among packets belonging to different source and destination pairs. In optical packet switching, the payload (i.e. data) will remain in the optic form, while its header may be processed electronically or optically. In packet switching, in order to facilitate implementation, headers can be transmitted on a separate wavelength or a subcarrier channel. Specifically, using a separate control wavelength or subcarrier channel makes it possible for a node to process the header (and set the local switch) before the payload is fully stored (in FDLs). In packet switched networks, IP traffic is processed at every router on a packet by packet basis. So, it takes more transmission time. To overcome this limitation, we go for optical burst switching (OBS).

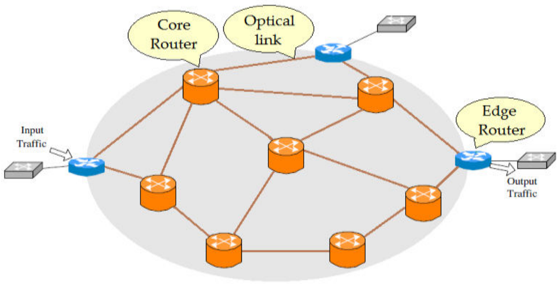

Fig: Architecture of OBS

IV RESULTS AND DISCUSSIONS

In order to evaluate the performance of the proposed feedback scheduling algorithm, a simulation model is developed in NS2 platform. By using the Network Simulator-2, first we used Discarded Traffic Retransmit Approach instead of Discarded

Traffic Clear Approach. There are around 22 nodes are taken into consideration to make Optical Burst Switched Network. The data burst get transferred from source node to destination node are shown in Network Animator (nam). We assume that all links are bidirectional and Burst arrivals to the network are Poisson process. We also assume transmission rate is 1 Gbps. Fixed shortest path routing is used for routing and the reservation scheme is the Just-Enough-Time (JET) protocol. The maximum number of paths per link is 23. Therefore, the maximum throughput per node is 13/23 or around 0.565. This value is our maximum achievable throughput.

In the simulations, we assume negligible switch reconfiguration time in the OBS node (T_sw= 0). The traffic loading to a node is the number of data burst arrivals to the node per unit time divided by the number of wavelength channels per link. Simulations were performed to compare the performance of proposed model with and without existing methods. In the Window Based Channel Scheduling with FDLs, throughput performance was improved. To further improve the throughput and reduce loss, we may combine WBS plus FDL compensation with Burst Delay Feedback Scheduling**.**

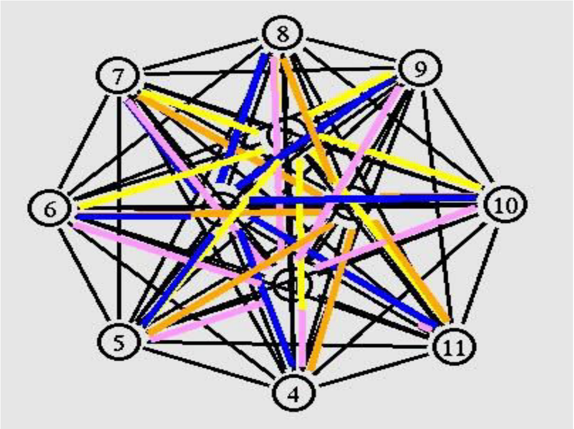

Figure 2 NAM output showing Data Burst Transmission

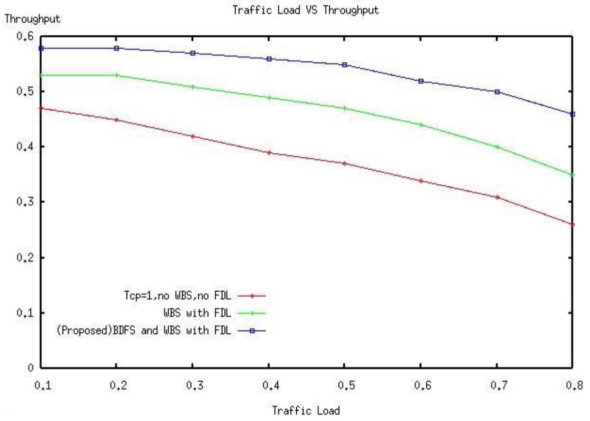

Fig: Trace graph for Traffic load vs Throughput

IV CONCLUSION

Optical Burst Switching (OBS) network has a key problem that is to schedule data bursts with minimum loss. By combining methods such as addition of Fiber Delay Lines, addition of offset time and Window Based Channel Scheduling with proposed Burst Delay Feedback Scheduling, performance improvement of OBS can be achieved. Adding a single FDL to an input port of an OBS node can compensate the〖 T〗_(cp)of incoming data bursts in all wavelength channels of the input port and increase the system performance. The extra offset time approach can increase the throughput with the average extra offset time 〖 T〗_ex. In Window Based Scheduling, both the window time T_wd and the control packet processing time T_cp are compensated by FDLs can provide further throughput improvement. Finally, the combination of BDFS, WBS with window time T_wd and FDL with delay time T_FDL can have better throughput and loss rate performance. And also we measured successful burst delivery ratio. From the simulation results, the throughput is increased and also burst loss rate is reduced significantly.

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