Delayed Reservation and Differential Service For Multimedia Traffic In Optical Burst Switched Networks

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Abstract- The next generation internet requires a new methodology to meet the evolving techniques and economise the network traffic in optical network. Solution is obtained through Optical Burst Switched Networks.OBS needs developments in service differentiation and contention resolution as it retards the support of OBS in internet traffic. Using Serialization of Burst Traffic Load and service differentiation provided by various service classes, this can be achieved. Since serialization has the advantage of lesser drops and service classes the have the advantage of pre-empting earlier packet for a higher priority packet both can used together for a better result.

I. INTRODUCTION

Optical network has been introduced to cater to the needs of fast growing traffic in the internet. This growth in need is further increased by the high bandwidth applications. The internet has become more of an indispensable need. The situation can be improved by using Wavelength Division Multiplexing

. Wavelength Division Multiplexing is where signals of different wavelength with a required minimal amount of spacing between them are multiplexed. Wavelength Division Multiplexing is similar to Frequency Division Multiplexing. Whenever multiplexing is done in optical carrier, it is called as Wavelength Division Multiplexing, whereas in radio carrier it is called as Frequency Division Multiplexing.Though multiplexing and demultiplexing introduces complexity, the benefits reaped out of doing Wavelength Division Multiplexing outweigh it. [1]

The ubiquitous presence of IP in the internet and the use of WDM technique to make high bandwidth applications possible brings them together to form the IP-over-WDM. IP-over-WDM provides an all-optical switching and end-to-end optical path. Also it provides the benefits of protocol independency. Traffic from any protocol can be encapsulated in IP packets and WD can be done on the packets. This makes the network simple and efficient where the IP layer is responsible for routing and the WDM layer for end to end transmission

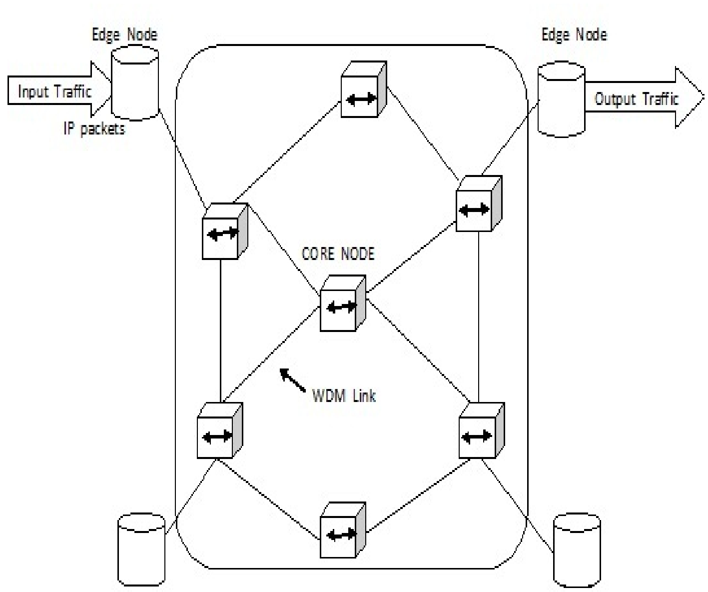


Fig 1 OBS Network Architecture

II. OPTICAL BURST SWITCHING

Optical Burst Switching in a way is a mix of both Optical packet switching and optical circuit switching. Though there has been no unique definition for Optical Burst Switching has been agreed upon, there are some basic characteristics that are accepted[2].

- Their granularity is between circuit and packet switching
- There is not only a separation between header and data but also they are sent on separate channels at different time.
- The allocation of resources is done without end-to-end signalling
- By definition, bursts have variable lengths
- There is no buffering but a slight variation of it may be related to FDLs

Optical Burst Switching has been there since the 1980s but has not been very effective in the very beginning due to complexity and cost issues. The opto-electronic conversion puts an extra overhead to the system but provides a good electronic switching capability. On the other hand if you try to reduce the extra overhead of O-E-O conversion, the all-optical network might become way too complex to implement. So the best method would be a combination of both. What can be done is, we can do the opto-electric conversion for the header alone which is much smaller in size (so the overhead for the conversion is reduced) and the data can be kept as such since the controlling information which has been sent will have been processed and the node will be made ready for the coming data (if resource is available) and therefore the need for conversion of data is averted.

Coming to the types of nodes in the Optical Burst Switched networks, there are two types of them. They are edge nodes and core nodes. The edge nodes are the ones from where the data is collected from the access networks or delivered to the required destination networks (based on requirement) [2] . Here the traffic that is collected is formed into larger chunks which are termed as burst in the Optical Burst Switched Network. Whereas the core nodes are where the processing of header and routing of data based on the specific algorithms used are done. This is what makes the control information indispensable as it is required for the switching of bursts from one node to another, which is the main purpose of the core nodes.

III. WAVELENTGTH RESERVATION SCHEME

The various Optical Burst Switching techniques vary basically based on how the resources in the network are reserved. Optical Burst switching is nothing but a rehash of the Asynchronous Transfer Mode

(ATM) which is also known as the ATM Block Transfer (ABT). It is of two versions. One is with immediate transmission and the other one is with delayed transmission. The difference between immediate transmission and delayed transmission is that, in immediate transmission there is no time gap between the Control Burst (CB) and the Data Burst (DB) whereas in delayed transmission there is an offset value by which a time separation exists between the Control Burst and the Data Burst which take into account the time taken to reach a node and more importantly, the processing time. Tell-And-Go and Just-In-Time are immediate schemes whereas Just-Enough-Time is a delayed scheme.

. We have used the Just-Enough-Time reservations[3] which is more advantageous than the rest, the reasons for which can be seen below. In this type of reservation, the decision on what the size of the burst is to be is made even before the Control Burst is transmitted to the source. The offset between the Control Burst and the Data Burst can be calculated based on the number of hop counts. The reservation of the wavelength is done in the node only at the arrival of the first bit because of which there is no idle time for which a particular wavelength is reserved idly. Also, the reservation of the particular wavelength is only for a certain amount of time which is deduced by the ingress node by using the size of the Data Burst which it gets in the Control Burst.

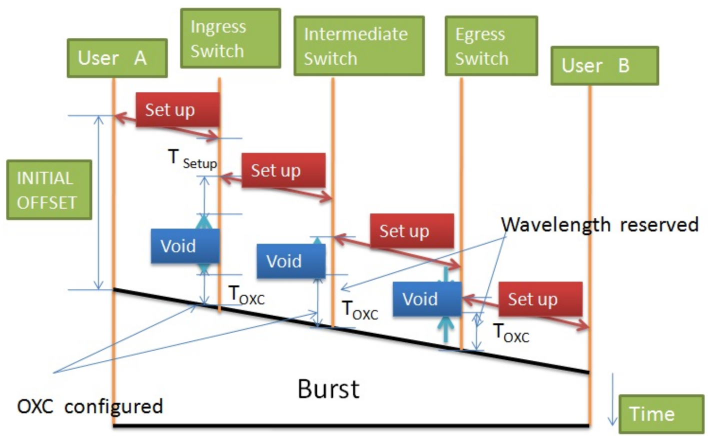


Fig2 Just Enough Time Reservation

- Let T be the time taken by CB to reach a node along the path to the destination
- Let T_{setup} be the time taken b y the OBS node to process the CB
- Let T_{Offset} be the offset value of a burst (i.e. the time after which the DB is sent
- .Let T_{OXC} be the amount of time it takes the OXC to configure its switch fabric to set up a connection from an input port to an output port

Why Just Enough Time Reservation is better than immediate schemes

- In JIT reservation the processing of CB is completed at $T + T_{setup}$, immediately after which the wavelength is reserved.
- The OXC is configured at T_{OXC} . So the total time for the process is $T + T_{setup} + T_{OXC}$.
- The data burst arrives at the node at time $T + T_{offset}$
- In the case of JIT, since reservation is done immediately after processing of CB the wavelength remains idle for $T_{Offset} – T_{Setup} – T_{OXC}$.
- On the contrary, in JET a void is created on the output wavelength between time $(t + T_{Setup})$, when the reservation operation for the upcoming burst is completed, and time $(t_1 = t + T_{Offset} – T_{OXC})$.
- In this way the resource is not reserved unnecessarily during idle time.

The problem with Just Enough Time is that it creates void.These voids are filled using Latest Available Unscheduled Channel with VoidFilling.(LAUC-VF*)* The LAUC-VF scheduling algorithm maintains the starting time and ending time for each scheduled data burst on every data channel. Since the arrival order of BHPs is not necessarily the arrival order of their data bursts at each node due to the variable offset-time and the queuing delay in the SCU, the void between two data bursts in a data channel can be included as available channel capacity. Hence, the algorithm utilizes voids and minimizes voids by selecting the latest available unused data channel for each arriving data burst.

Fig. 3 illustrates an example using the LAUC-VF algorithm. The starting time and ending time of each scheduled data burst *i* are recorded as t_i and t'_i. All data channels are available during the transmission time of the arriving Burst 7. In order to minimize the voids, Channel 4 is selected since the void (t-t'_6) is minimal compared to other voids (t-t'_1), (t-t'_3) and (t-t'_4). After scheduling Burst 7, t_7 and t'_7 record the starting time and ending time of Burst 7.

If there is no data channel available during the transmission time of an arriving burst when scheduling, burst contention occurs, this leads to dropping the arriving burst. The paper [4] has compared the burst loss probability of LAUC and LAUC-VF algorithms. Their simulation results have shown that the LAUC-VF algorithm performs better than the LAUC algorithm. This is because the LAUC-VF algorithm allows the use of voids for burst transmission. Fig. 3 illustrates a scheduling scenario, where an arriving burst is dropped if the LAUC algorithm is used, and is able to be scheduled on a channel if the LAUC-VF algorithm is used. The arriving Burst 9 can be scheduled on the latest available channel, Channel 4, if the LAUC-VF algorithm is used; while, it is dropped if the LAUC algorithm is used, since the earliest available times on all data channels are later than the burst arriving time, t.

IV. FIBRE DELAY LINES

There are no real buffers in optical networks. But this problem can be resolved to a certain extent with the use of Fibre Delay Lines.

A Fibre Delay Line is a big length of fibre. During time of a contention between two bursts for a resource, one can be sent through a Fibre Delay Line which will buy some time for the other burst to be done with its utilization of the resource. The decision on which burst takes the direct route to the resource and which one takes the Fibre Delay Line can be made using a basic level of prioritizing.[5]

V. PRIORITIZING BURST

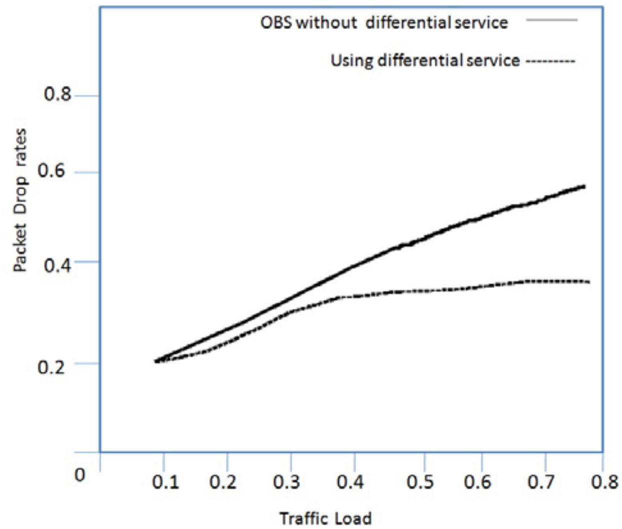
Each burst can be sent in with a priority number based on which a node can decide which one to send first in case of a contention[6]. This proves as a much better alternative to wavelength conversion which puts a overhead to the system[7]. By prioritizing bursts the node can decide which burst goes through the actual channel and which one goes through the FDL and in worst case, even which burst gets dropped. This might be of immense use in situations where dropping of a few bursts does not matter. Here, even though dropping is done only when inevitable and only to the least priority bursts, dropping still exists.

VI. SERIALIZATION OF BURST TRAFFIC LOAD

This is a type of contention avoidance mechanism. Here the possible contentions that might occur in the downstream nodes are presupposed so that the possible contentions can be reduced resulting in lower loss rate. What is done here s that instead of sending bursts using the pre-determined offset time some extra delay can be added by judiciously calculating what amount of delay might be needed for the burst o not contend with another burst at a later time while in downstream. This, even while coming at a cost of extra delay makes sure that not many bursts get dropped because of some contention over a resource. That makes this algorithm very effecting in bringing down the burst loss.[8]

VII. DIFFERENTIAL SERVICE

Both prioritizing bursts and Serialization of Burst Traffic Load do justice to what they stand for. Prioritizing bursts makes sure that the bursts with higher priority don’t get lost in case of a conflict and does so by not using any delay. In the case of Serialization of Burst Traffic Load it is taken care that contention itself is avoided which in the first place is responsible for burst loss. It can be seen that the advantage of one overlaps with the drawback of the other. If of them can be used together, then the results can be better. A simple flag can be assigned to each burst which will denote whether it a service that can afford a few burst losses or if it is a service which cannot afford any loss but can afford a certain amount of extra delay. Based on the value of the flag it can be decided dynamically if an extra delay is to be added to it during burst assembly or not (if it is a service that is sensitive to delay). This method largely improves the packet loss ratio as it includes the advantages of both prioritizing bursts and serialization of bursts.



VIII. RESULT

The proposed system has been tested in Network Simulator 2 for TCP and UDP traffic and it has been found that using differential service provides better results than the traditional OBS network without it.

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