DCDM: Dual constraint-based detouring mechanism to minimize burst loss probability

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Abstract: The switching policy offered by Optical Burst Switching (OBS) in optical network is better than Optical Circuit Switching (OCS) as well as Optical Packet Switching (OPS). However, reviewing the existing system on OBS network is found with few works towards evolving up with a technique to perform a cost effective routing to avoid congestion. Therefore, in order to overcome this issue, we presents a novel protocol called as DCDM i.e. Dual Constraint based Detouring Mechanism by considering both neighbor nodes and traffic load constraints on all the optical nodes in OBS network. The paper introduces two algorithms that uses shortest path algorithm to detour the data packets to less congested traffic when it identifies high congestion traffic. The prime agenda of DCDM is to perform an effective autonomous routing decision by the routers in OBS network for minimizing the burst probability loss.

Keywords: Optical burst switching; optical network; graph theory; error probability; traffic management

1. Introduction

Since the invention of World Wide Web, internet has grown in tremendously fast. In day to day life more and more people turn into internet for all their requirements as such as information, entertainment and communication. By creating new type of applications and advanced services like web browsing, video conferencing, interactive gaming and peer to peer file sharing to satisfy the need of the user. These applications require higher transmission capacity. With this rapid increase in internet has possess a challenge to present computers and communication network to provide high-speed, high-capability network to meet these needs. WDM (Wavelength Division Multiplexing) is one such technology developed with an intension to handle the future bandwidth demands.

The excessively increasing larger bandwidth due to the demand of bandwidth intensive application, remote information access, video on demand, video conferencing, online trading and other multimedia application have motivated for alternatives in compared to the traditionally used electronic network. The well acknowledged optical switching paradigm that are suggested to be used in all optical network is Optical Circuit Switching (OCS), Optical Packet Switching (OPS) and Optical Bursts switching (OBS) (Xue F et al., 2005). Optical Burst Switching is a concept based on the burst switching, and was proposed for voice communication in as early as 1980’s. OBS is technique, which allows the dynamic sub-wavelength switching of the data. The intension of OBS is to provide dynamical sub-wavelength granularity by favorably combining electronics and optics. OBS supports more flexibility in bandwidth compared to
DCDM: Dual constraint-based detouring mechanism to minimize burst loss probability

wavelength routing but need fast switching (Duser M 2002). OCS uses end-to-end light path between the source and destination for the entire period in order to avoid the optical to electronic conversion in the midway nodes. In OPS, access network packets are directly switched into the optical domain along the path which asks for buffering and processing in the optical domain (Yao S et al., 2001). The OBS is aimed to overcome the short comes in these two models and is targeted to make it a possible technology to be used in internet. Compare to conventional network. OBM does not require devoting a wavelength for entire period, between a pair of nodes Compared to packet switching. Another advantage of OBS is that, the data bursts do not need to be buffered and processed at the midway nodes. The present generations of high-speed internet backbone networks are needed to assist a wide range of emerging applications, which do requires large bandwidth, and also needs to assure a high Quality of Service (QoS) requirement (Kaheel A et al., 2002). The data transmissions in these kinds of applications are expected to be highly bursty in nature. In order to overcome the problem of over provisioning of bandwidth resources in such circuits, it is recommended to avoid fixed static bandwidth allocation in order to meet QoS requirements. OBS is seen as a convenient technique between Optical Packet Switching (OPS) and the Optical Circuit Switching (OCS). OBS technique differs from the other two techniques in the way, in OBS control signal is sent separately in advance of the data payload in a dedicated optical channel. The control signals are then electronically processed to allow setting up an suitable path for optical light, to transport the soon to arrive payload called delayed reservation. OBS is a reliable technique that attempts to mitigate the problem of efficiently providing resource in a bursty traffic (Ramesh G et al., 2009).

In OBS, the data packets are streamed into bursts of data at the boundary of the network to create data payload. OBS provides separation between control plane and data plane. Separated wavelength is used to transmit control signal in control channel. Each data burst has a control signal, electronically these control signals are processed by each OBS router. Data burst is sent in optical form from one end of to the network to another end. The data transmission in OBS, takes place in full transparency to intermediate node in the network. Router can accept new reservation once the bursts pass the router. OBS is regarded as a promising technique for the future optical networks because of its ability in providing a practical balance between coarse gained circuit switching and fine gained packet switching (Chou J et al., 2009). OBS overcomes the shortcomings of both OCS, OPS. The major advantages are bandwidth utilization, setup latency, switching speed, processing complexities, traffic adaptability QoS in internet is critical and can be implemented in OBS using the existing contention resolution mechanism in addition with scheduling algorithm. The optical link established using the burst switching protocol will hold the link long enough for the burst to pass there by allowing the reuse of the resource of the network resource by other traffic in the network. The basic concept in OBS is to send a burst of data into the optical network (Vokkarane V.M et al., 2002).

In OBS packets are piled into data bursts at the edge of the network to form data payload. OBS has separation between control plane and data plane. A control signal is transmitted in control channel with separated wavelength. A control signal is provided to each data burst. Control signal are processed electronically by each OBS router. Data bus is transmitted in optical form from one end of to the network to another end. In OBS the data transmission is done in full transparency to intermediate node in the network. Once the burst passes the router it can accept new reservation request. OBS is regarded as a dominant technique for the future optical networks because of its ability to provide practical balance between existing switching technologies (Gandhi R et al., 2014).
The proposed system presents dual strategy for detouring mechanism called as i) DMCN (Detouring Mechanism with Constraints of Neighbors) and ii) DMCL (Detouring Mechanism with Constraints of Load). The prime idea of the proposed system is to perform detouring mechanism to avoid the traffic congestion in OBS network. Section 2 discusses about the related work followed by Section 3 discussing about problem identification. Section 4 discusses about proposed system, while methodology is discussed in Section 5. Section 6 discusses about outcomes followed by conclusion in Section 7.

1.1 Related work

Hu et al., have carried out a study on a 160-Gb/s Ethernet for performance evaluation of OBS traffic. The study shows that the need of optical buffering in silicon packet based switch based optical burst switching can be eliminated by using optical burst switching protocols, which is desirable for optical networking.

Durrad et al., have demonstrated an Analysis of the optical burst switch (OBS) networks with optical label process based on optical code division multiple (OCDM) technology. The work recommends an architecture for resource booking based on just in time (JIT) and the blocking probability of burst-loss, taking into account, the number of wavelengths and traffic attributes. Using traditional optical processing and electronic processing a cost model is developed and compared. The result shows decrease in burst loss and economy of network resources with utilization of optical processing. Chen et al., demonstrates a method of DWDM multimode switching router architecture that provides electronic packet switching, optical circuit switching and optical burst switching to exist on the same integrated router platform. In the suggested approach, the router extends support to many number of cost effective DWDM channels by providing a comparably a small set of electronic switching ports. The reconfiguration of each DWDM channel to different switching node, is provided by this architecture DWDM channel to a different switching mode, On the basis of dynamic traffic load the best suited mode is selected by the individual type of messages inside the application.

Zhang et al., have suggested a dual price-based congestion control (DPCC) method for optical burst switching (OBS) networks. This approach is based on Network Utility Maximization (NUM) this can give an optimal rate-reliability tradeoff by allowing proper traffic to the network and resources. DPCC uses Congestion and reliability prices, feedback information dynamically to adjust the user’s data transmission rate and propagation delay. Evaluation and analysis of performance of DPCC is achieved through simulation. From results it is seen that DPCC achieves good output in case of its convergence and optimality.

Beyravand et al., have recommended a QoS-based model for an optical burst switched (OBS) multiple service network. Blocking probability of the OBS networks is mitigated using a combination of different characteristics of wavelength division multiplex and optical code division Multiple (WDM/OCDM). In the recommended system the blocking probability, transmission rate, OBS network delay, and OCDM probability of error are used as examining criteria for QoS. Bandwidth efficiency is enhanced and controlling of multiplexing interference effect of OCDM is achieved with introducing advanced optical resource allocation. On basis random allocation the recommended strategy is compared with conventional strategy. The comparison shows that recommended systems superiority. By using commonly accepted
DCDM: Dual constraint-based detouring mechanism to minimize burst loss probability

Engset model and 2D Markov model blocking probability of the recommended WDM/OCDM-based OBS scheme is examined. The effect of multiplexing interference is evaluated by computing the probabilities of error and outage. With the help of the predicted value of burst assembly and burst transmit queuing delay an upper limit on the OBS network delay is obtained. A numerically designed for class OBS network is used to illustrate Quality of service differentiation framework, to highlight the merits of the scheme. Numerical examination shows that by using hybrid WDM/OCDM method, the blocking probability of OBS networks is minimized significantly by using intelligent resource allocation. The probabilities of error and outage are also minimized using intelligent resource allocation.

Gavignet et al., have presented a study based on the experiment of a label extracting from labeled optical burst switch (OBS) applications. The extractor utilizes semiconductor optical amplifier in amplification detection mode to extract the label part of the burst with attached payload. A 4db input power range is obtained with asynchronous arrival bursts with 2 burst sizes justifying that the proposed method is suitable for label detection in OBS nodes. Zhang et al., have introduced flexible bandwidth to an optical burst switching (OBS) ring network and proposed a bandwidth-variable OBS (BV-OBS) ring network. In the suggested BV-OBS ring network, the burst duration is retained constant to one timeslot in time domain, whereas in case of frequency domain the bandwidths are changed in accordance to the burst size. The BV-OBS can give a collision free state with high bandwidth efficiency for fixed burst duration. Simulation results indicate that the suggested BV-OBS ring network is suitable for wavelength division multiplexing in throughput and end-end delay compared to previous OBS rings.

Liu et al., have presented a technique for optical burst chain switching (OBCS) model in order to achieve high performance in burst transmission for bursty traffic while mitigating the use of wavelength converters and increased use of optical buffers. This approach adds up the advantages of optical circuit switching and optical burst switching with achievable signaling overhead. Switching unit in the recommended mechanism is a burst chain which includes multiple non-periodic and non-consecutive bursts in single wavelength. Theoretical analysis of throughput and queuing delay of the recommended scheme is performed and is also justified by simulation results. Triay et al., have suggested a medium access control protocol to provide multi-services and QoS stages in optical burst-switching mesh networks without the conversion of wavelength. Two different access scenarios namely queue-arbitrated and pre-arbitrated are allowed by the proposed method for connectionless and connection oriented burst transport. The simulation result of the existing system indicates that it is able discretize connectionless traffic and ensure zero loss of probability for large scale network. In the multiservice scheme by mixing connection based burst and connectionless based burst transmissions, 3 different pre-arbitrated slots scheduling algorithms are assessed, performance of each provide a different result in terms of connection blocking probability. The result demonstrated the suitability of this architecture in future integrated multiservice optical networks.

2. Problem Identification

After reviewing the existing system from the previous section, it can be seen that majority of the existing studies are focusing on evaluating the traffic scenario of OBS network using blocking probability. However, evaluation of the blocking probabilities doesn’t give a fair idea of the effectiveness of the technique with respect to various constraints. The prior researchers have not much emphasized on dynamic
characteristics of the OBS network that results in massive contention in the traffic and leads to uneven traffic congestion that is quite difficult to control. The existing studies were also found to miss the consideration of the burst loss probability and its possible impact on increasing traffic load (or larger size of the burst). Although various types of switching architectures are discussed in existing system, but none of them are found to identify the generation point of the congestion. There is availability of few techniques that uses cost effective shortest path distance to identify the best routes at the time of the dynamic traffic conditions. Hence, the problem statement can be stated as – “It is a computationally challenging task to evolve up with a cost effective routing technique with shortest path that can consider neighbor and load constraints in OBS network.”

2.2 Proposed system

The proposed system aims to search the possibility of using the resource status information for routing decision in a network. The proposed system introduces a technique called as DCDM i.e. Dual Constraint Detouring Mechanism for resisting the transmission of the data packet to heavily congested routes. The term detouring will mean to perform diversion in conventional routing when the system identifies a routes with heavy traffic in OBS network. The term dual will mean consideration of two types of constraints in OBS network i.e. neighbor and load constraints. The schema of the proposed system can be seen in Figure 1.

**Figure 1:** Schema of DCDM

The main focus of DCDM is on to use status information instead of using any estimations. With a intention of reducing the inaccuracies which rise due to propagation delay, we only concentrate on using the neighbor status information instead of considering the all the nodes in the network.

1. To update the status information of the neighboring node in OBS time scale, we intend to include it in burst control packet.
2. When sending a burst to downstream node the current status information of the node is inserted in burst control packet and is delivered to the given downstream node.
3. Provided the traffic in the network is adequately distributed the OBS nodes provide well precise status information of the neighboring nodes.
4. In order to reduce the burst loss probability we introduce a protocol called DCDM that responds to
highly congested node by diverting the traffic to less congested neighbors.

5. In order to avoid loss burst due unavailability of resources in heavy congestion, the DCDM uses diversion allowance which reduces the loss of burst by diverting it to neighboring node.

The proposed system evaluates two routing heuristics based on the status information of the neighbor for rerouting the competing bursts. It’s seen that as the burst size increases the accuracy of the status information in OBS network also increases.

3. Research methodology

In this section we brief about how the resource status information is computed and circulated in burst control packet. We introduce two lightweight routing models namely:

1. DMCN i.e. Detouring mechanism with constraints of neighbor nodes
2. DMCL i.e. Detouring mechanism with constraints for traffic load

In the event of diversion deflection routing consideration these models use the stored neighboring status information to choose a most likely route to the destination, in order to avoid highly populated downstream nodes.

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In DCDM, burst control packets are utilized to circulate the node status information of the node. Particularly our aim in general is to have important node status information, instead of using the description of all available reservation on every individual wavelength channel. By this way the routing consideration at the midway nodes are managed and controlled at ease, thereby preventing the congestion in the network. DCDM particularly inspects allocated percentage of output ports in the nodes as allocation.
DCDM: Dual constraint-based detouring mechanism to minimize burst loss probability

For making computation an easy process, allocation counter can be used to maintain the information of number of allocated ports in the node thereby relieving the OBS from task of computing. We introduce Allocation Percentage Rate (APR) in order to store the information regarding percentage of allocated ports in the node. Soon after burst control packet arrives, APR retrieves the upstream node status information from burst control packet.

Assuming that the burst control packet is departing from source node, First thing to be considered is to check availability of resources towards the downstream. If resources are found to be available, next step is allocating a timeslot in the chosen output wavelength. Burst control packet stores the information of allocated percentage of output ports in the nodes. Soon after arriving at the output node, in case it is a transit node the information of its current status in burst control packet is forwarded to next node. With sufficiently distributed traffic in the network, all nodes preserve precise information related to neighbors’ status information.

The congestion situation is resolved in DCDM scheme by a reaction of deflecting the challenging burst into an alternative output fiber of the node, in accordance to the short path to the destination. In case of all the nodes are reserved in advance, and a burst arrives at the node that burst is likely to be lost. In such scenario the information regarding the neighbors status information not only helps in reactively deciding on the diversion due to contention but also helps in preventing the loss of burst by providing alternate path. In advance when we know the downstream is heavily populated with the neighbors status information we can divert the burst to less loaded neighbors thereby preventing loss of burst even when no contention is occurred in downstream link.

Allocating Diversion in DCDM is initiated when the allocation rate $O_r$ of the downstream node $r$ surpasses threshold $O_{th}$. Excessive use of diversions may give rise to traffic in the network, as the diversion routes are always longer compared to the primary routes. Assuming that $O_r = 0.70$ and $O_{th}$ is set with a value of 0.6, would initiate a allocation diversion in path. Moreover there is possibility that 30% of the output ports that are still idle which can be allocated to the burst. It is always important to know that inaccurate node status information storage may lead to unnecessary allocation diversion.

In order to control the traffic due to excessive diversion, we introduce a parameter $A_{DCDM}$, so that $A_{DCDM}=A(X!O_r>O_{th})$, where $X$ signifies the case of burst to be detoured. Observing that $A_{DCDM}=1.0$ initiates diversion provided that $O_r>O_{th}$. On the contrary, $A_{DCDM}=0.0$ allows diversion to be reactive as in case of the normal scenario. In case the destination node is the downstream node the diversion usages makes no sense.

The network model of the proposed DCDM is designed using Graph $H=(W, F)$, Where $W$ denotes set of nodes and $F$ set of physical WDM links. A group of wavelengths per link is created for this network and is denoted by $Z=\{a_1, a_2, a_3, \ldots, a_l\}$. for each node $w$ (w∈W), we represent its adjacent set as $T(w)$, so that $T(w)=\{w’|(w, w’) \epsilon F\}$. The aim of these technique is to exclude the links connected to the overloaded neighbors from route calculations. Using different policies are applied to the initial graph to transform it to a simplified graph $H’=(W, F’)$. After obtaining the new graph, the diversion route from origin node $a$ to target node $b$ is computed by using Dijkstra shortest path algorithm. Where $a, b \epsilon W$ and $a\neq b$. In DMCN technique, $M$ spots the large number of neighbors that can be used for route calculation. Algorithm selects
the M minimum congested available neighbor departing from T(a). Upon this, downstream node who status as initiated a allocation diverted route that can also be choosen, being one of the M minimum congested one.

3.1 Design of DMCN

In DMCN technique, an available resource (w) verifies that whether the available resources exist at the output port connected to the nearby neighbor w. If no available resources are found then, the edges (a,w) are directly disassociated from transformed graph H’. On detecting idle resources, the existence of the M minimum congested alternative available neighbor is further checked. From above understanding, it means that w is not included in the M minimum congested one. Because of these facts the edges (a, w) are also disabled from the transformed graph H’, as it may lead to increase high loaded neighbors. These operations are examined for all neighbors w ∈ T(a). Finally using the transformed graph H’ shortest path is computed.

DMCN depends on searching a route between allocation rate of the downstream node and the bypass route to the destination. Consider for M=1, forces the burst to going in minimum congested available neighbor, thus ensuring in most situation the burst is not dropped in following hop. This strategy does not consider the distance to the destination when choosing diversion path, which increases the provided traffic and end to end delays. Increasing the value of M, shortest path are found but going through more congested neighbors. In extreme situation when the value of M becomes equal to the nodal degree, the given node behaves like normal routing by considering only the routes using the topological features from source to destination.

Algorithm 1: Detouring mechanism with constraints of neighbor nodes (DMCN)

Input: H = (W,F), M, c, d
Output Q= Diversion Route between c and d
1. H’=H;
2. C=T(c);
3. For w=next (W) do
4. If Available Resource (w) then
5. f=0;
6. For w’= next (C) and w’≠w do
7. If Available Resources (w’) then
8. If O_t>O_h then
9. f++;
10. If f>M then
11. H’=H’-(c,w);
12. Else
13. H’=H’-(c,w)
14. C=C-w;
15. J=Algorithm 3

3.2 Design of DMCL
The principle used in DMCL is similar to DMCN. The strategy used in DMCL is applied to transform the primary graph includes disabling the links connected to neighbors with an allocation ratio higher than $O_{LR} + \Delta O$, where $O_{LR}$ detects the allocation ratio of the least congested neighbor is searched first, next step is all edges associated with non-available neighbors, or associated with any available neighbor $y$ with $O_y > O_{LR} + \Delta O$ are disassociated from the transformed Graph $H'$. The resulting Graph is used for computing the shortest path. As in the case of DMCN, here also the downstream node that has initiated a preventive deflection can be chosen for path computation, as far as its allocation ratio does not surpass $O_{LR} + \Delta O$.

### 3.3 Algorithm 2: detouring mechanism with constraints of load (DMCL)

**Input:** $H = (W,F), \Delta O, c, d$  
**Output** $Q=$Diversion Route between $c$ and $d$

1. $H' = H$  
2. $C = T(c)$;  
3. $r_{LR} = O_{LR} = 1.0$;  
4. For $w = \text{next}(S)$ do  
5. If Available Resource($w$) then  
6. If $O_{c} \leq O_{LR}$ then  
7. $r_{LR}$;  
8. Else  
9. $H' = H' - (c, w)$;  
10. $C = C - w$;  
11. If $r_{LR}$ then  
12. $C = C - r_{LR}$;  
13. For $g = \text{next}(C)$ do  
14. If $O_{g} + \Delta O > O_{LR}$ then  
15. $H' = H' - (c, w)$;  
16. $J = \text{Algorithm 3}$;  
17. Else  
18. $Q = 0$

### 3.4 Algorithm 3: Dijkstra shortest path algorithm

Let us consider the node at which we start as initial node. Let $Y$ be node, distance from the initial node to $Y$ is taken as $Y$. Dijkstra's algorithm assigns some initial distance value and tries to improve them step by step.

1. A tentative distance value is assigned to every node: For initial node it is set to zero, and for all other
node it is set to infinity.
2. Initial node is set as current. All other nodes are marked as unvisited. An unvisited set is created that contains information of unvisited nodes.
3. Tentative distance of the current node is calculated considering all of its unvisited nodes. Newly assigned tentative distance of the current node is compared and a smaller value is assigned.
4. Once we have done checking all the neighboring nodes of the current node, the current node is marked as visited and removed from unvisited set. No visited node is ever checked again.
5. When suggesting a route in between two specific nodes if the destination node is marked visited, or if tentative distance among the nodes is the unvisited set is infinity (when planning a complete traverse occurs when there is no connection between the initial node and remaining unvisited nodes), then stop. The algorithm has finished.
6. The unvisited node marked with smallest tentative distance is set as new current node and continue from step 3.

4. Result analysis

The proposed system is designed in Matlab on a normal 32 bit machine. In order to evaluate the effectiveness of the proposed DCDM, the performance parameters are considered for burst loss probability, offered load per node, and noise for OBS network scenario.

![Figure 2: Analysis of DMCN Algorithm](image)

Figure 2 shows the outcome of the DMCN algorithm considering the various values of probabilities ranging from 0-1. In this scenario the burst losses are observed. Edge node numbers in the network are increased from 8 to 17, load offered to the network is also increased to twice i.e. doubled, for the provided load per node. This factor shifts the operating range of the OBS node below 0.6. The slope of the burst loss probability is more noticeable, with every step in the normalized offering load node reports for twice the offering load to the network in this scenario of DMCN. Hence, it shows that probability factor plays a crucial role in burst loss probability.

Figure 3 shows the outcome of the DMCL algorithm under the same environment where DMCN is tested. For OBS network operating range in this scenario, DMCL is found to exhibits good performance,
mitigating the burst losses by one order of magnitude less than normal routing. Compared to prior scenario, the advantages of DMCL and DMCN are less significant in this scenario. This is due to the fact that since all nodes acts as edge nodes. Traffic is distributed uniformly, this makes load in all nodes of the network appear relatively similar, which results in less effective preventive deflections.

Figure 3: Analysis of DMCL Algorithm

Comparing the performance between DMCN and DMCL is done by setting the best $A_{DCDM}$, $M$, $\Delta O$ values are found. The objective is broadened for the evaluation by considering two different scenarios. In scenario two (DMCL), we consider the same topology used in scenario 1, but here all nodes of the network are taken as edge nodes. Traffic characteristic is identical in both scenarios. We have observed from the results in the scenario 1, the improvement in magnitude of an order of more than one is achieved compared to normal routing in OBS network operational range. DMCN exhibits similar behavior of DMCL for situation under low loaded networks. DMCL exhibits better behavior for high and medium loads. Parameter $M$ in the DMCN routing heuristic turns rough compared to $\Delta O$ in DMCL. The limitations between the bypass path distance and downstream node congestion makes it harder for the DMCN.

Figure 4: Effect of Probability on DCDM

Figure 4 shows the effect of the probabilities on specific constraints on burst loss probability factor. The
cumulative outcome showed here exhibits that for increasing number of offered load in OBS traffic, the effect of probability are less significant. The outcome shows for number of travelled hops by bursts using detouring mechanism with $p=0.5$ and $p=1.0$ for offering load per node value. Considering a random variable denoting the number of travelled hops by bursts, distribution function $E=\mathbb{P}(E=e)$ denotes the probability that $E$ takes a value higher than an integer $e$, $e\geq 0$. This function provides the overview of the end-to-end burst latencies, delay in propagation becomes dominant factor inside the core network. Hence, the outcome shows higher significance of DCDM.

![Figure 5: Effect of traffic on Burst loss probability](image)

Figure 5 shows the effect of the load of the traffic (in terms of data packets) on the Burst Loss Probability. For this evaluation, the proposed system is experimented with 5 GB, 20 GB, 15 GB, and 10 Gb of hypothetical packet size to see the response of burst loss probability in presence of increasing noises. The outcomes shows that distribution curve of DCDM are reduced by a magnitude of one order for $M=4$ compared with $M=5$. Important difference are observed by selecting the value of $\Delta O=0.35$ instead of $\Delta O=0.30$ for DMCL. It is seen that DMCN introduces same kind of latencies as normal routing even using preventive diversions. Hence it is preferred for delay sensitive traffic, whereas the DMCL, which introduces little higher latencies, is preferred for loss-sensitive traffic.

For this experiment, the network link length is maintain fixed to 250km, mean burst size is maintain at 6MB, giving a mean burst length $(\bar{A})$ of 5ms for a 12gbps link. Here we analyze the impact of these parameters on final DCDM performance. The outcome shows the improvement of DCDM over conventional routing in OBS network. Taken as $(AO_{conventional}-AO_{DCDM})/ AO_{conventional}$, plotting this as function of $(\bar{A})/l_{prop}$, where $l_{prop}$ denotes propagation time of the link in the network. For a proposals of 250, 550, and 1050km link lengths, the $l_{prop}$ value is taken as 1.2, 2.8 and 5.3ms respectively. $L_{prop}$, and $(\bar{A})$ have a key role in the precision of the stored resources status information. For long-lived burst the status information will be updated for long time. For a short-lived burst, the status information changes frequently, thus outdating the status information rapidly. For small $l_{prop}$, the downstream node quickly gets the status information from the upstream node of the burst control packet. If the value of $l_{prop}$ is large the status information becomes outdated while reaching the burst control packet through link. The outcome
DCDM: Dual constraint-based detouring mechanism to minimize burst loss probability

also illustrates the improvement of DMCL in compare to conventional routing reducing with (Å). Still notable improvements are seen in DMCL for (Å)/l_{prop}<0.6. In such case information becomes outdated, still helps in avoiding the highly congested downstream nodes. Hence, the proposed DCDM highly resists contention in the OBS traffic and performs efficient detouring mechanism.

Figure 6 shows the cumulative outcome of the DCDM technique, where majorly, we compare both DMCN and DMCL on two probability factors. It can be seen that the impact of l_{prop} on the status information precision, DMCL has quite good performance in medium sized networks. Where we have seen an improvement around 0.7 is observed for (Å) =6ms. the performance of DMCL is seen affected in the case of ultra long haul links. In this case large delay in the propagation in the link commands transmission of very long burst to provide an accurate stored neighbor status information. In this evaluation, we also analyze the protocols with a partial wavelength conversion.

Partial wavelength conversion implies that only a limited number of shared wavelength converters are used in the OBS node so that wavelength conversion is available for a few numbers of bursts at a time. Here we describe the performance of DMCL in compare to conventional routing when using partial wavelength conversion in the network. The conversion ratio is particularly defined as number of shared converters in the node divided by total number of output wavelength channels. For a given conversion ratio the number of wavelength at each node is measured based on its node degree. With an assumption that each fiber will carry 18 output wavelength channels. The outcome shown in Figure 6 presents the result for an offered load associated with every node equals to 0.7 and 0.9. In accordance to result the burst loss probabilities steadily decreases with the increase in the conversion ratio, until a lower end is reached. In the Figure 6, lower end is achieved for an approximate conversion ratio of 0.6. This implies that nearly 60% of the wavelength converters can be avoided in DMCL and conventional routing as in the case of full wavelength conversion. It is seen that difference between DMCL and conventional routing is almost constant for value between 0.6 to 1.2. Further decrease in conversion ratio both mechanism are prone to converge. Interestingly, the outcome essentially, shows that both the schemes can be used on-demand, which means, whenever there is a necessary traffic situation in OBS network, the router will perform detouring mechanism autonomously thereby resisting the contention in traffic.

5. Conclusion
In this paper we are analyzing the possibility of using the resource status information to compute route in OBS network by introducing a protocol called DCDM, which initiates a diversion in highly populated node situation. In order to achieve routing we have introduced two light weight routing heuristic called DMCN and DMCL. The observation from the simulation it is seen that both the heuristics allow DCDM to provide an improvement in order of one magnitude in compare to conventional routing. It is seen that the DCDM with DMCL provided good performance in case of burst loss probability. DCDM along with DMCL is seen to be suited for delay-sensitive traffic. Dependence of the DMCL on the link distance and mean burst length is also observed. It is seen that DMCL outperforms conventional routing in case of medium and small sized network. Due to large propagation delay inaccuracy in status information is observed in ultra-long haul. We have even performed evaluation based on the partial wavelength conversion, it seen that nearly 60% of the wavelength converter can be reduced without degrading the performance.

6. References

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