

CONTROLLER DEPENDENT DUAL LAYER ARCHITECTURE (CDLA) FOR BLOCKING PROBABILITY IN OPTICAL BURST SWITCHING

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Abstract — The exposure of massive internet growth urge us for finding substitute methods for the fast communication in data center networks. The only panacea for the data centers is the deployment of Optical burst switching (OBS). It evolves as a near-future deployment choice to aid dynamic and bandwidth intense traffic difficulties in Data centers. Optical Burst Switching (OBS) promise an efficient support for bursty traffic with high resource utilization without buffer in the Wavelength-division multiplexing (WDM). In order to establish a session in the heterogeneous environment of data center networks (DCNs), OBS need full Wavelength of bandwidth Assigned. The wavelength of intermediate hops also should be free for the circuit establishment. Connection may not be established when the intermediate hops utilize its full wavelength of assigned bandwidth. This is what blocking in OBS. Overall blocking probability have to be minimized for the reliable communication. In this paper, an enhanced analytical model is proposed for the reduction of blocking probability with the use of Controller Dependent Dual Layer Architecture (CDLA). Enhanced Erlang B is used to assess the required optics between core switches and TOR switches of the datacenter Networks. Blocking probability differs based on the allocated wavelength and load employed in the network. The proposed model cover two iterations. The process starts with the offered loads and the second iteration dealt with allocated resources. We model our architecture using green cloud simulator using NS2 with varying workloads through different burst rates by deliberating various edge-to-core network over offering proportion for examining the accomplishment of representations beyond usage patterns. The effects exhibits that the suggested model shows prominent enhancement in route scheduling and comparable achievement in terms of minimized blocking probability relevant to conventional OBS techniques.

Keywords— Optical Burst Switching (OBS), enhanced Erlang-B Formula, blocking probability, Load Estimation Analysis, Data Center, controller dependent dual layer architecture (CDLA).

I.INTRODUCTION

Due to express enlargement of communication network the internet traffic also increases faster. In order to maintain such network growth, the data center networks (DCNs), slowly moves for the deployment of optical communication. Optical communication is a new form of communication which use optical fibers where the information remains as light signals in optical arena from the source to destination. Due to these reasons, it is all over used in many application areas such as (1) video conferencing, scientific computing, real-time medical applications, supercomputing, and cloud computing.

Optical networks are very effective telecommunication which could meet the network applications of data centers. Optical components and the technologies meets the requirements of high efficient data center networks that provide routing, adjusting and reconstructing at the services based on wavelength. Hence Meeting performance goals for data centers networks becomes the main subjects on these networks in selecting routing strategy with minimized blocking probability. OBS networks suffer with the data (burst) loss allegation. This is caused by multiple bursts hold the same outgoing wavelength at the same time. Because of bufferless optical fiber core edges the burst loss is unavoidable in OBS featured optical networks (2). The performance of optical networks suffers due to burst loss and adequate amount of blocking probability (3). Fig 1 shows the data center networks architecture. The controller separates the burst data packet and control packet. The core fast optical switches are connected with the TOR switches.

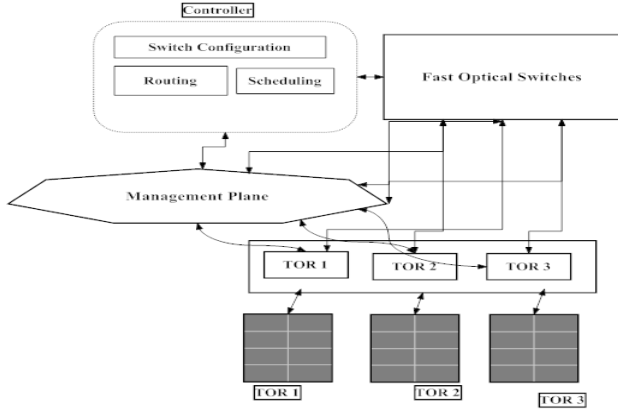


Figure. 1 Architecture Model Of DC Networks

If the associated path between source and destination is not obtainable then the connection is blocked. Observe the example which is demonstrated in Fig. 2.

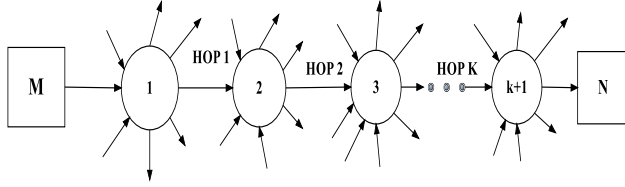


Figure. 2 Source M To Destination N

Source M requests a circuit to Destination N over some path of an optical network and there are K fibers from M to N on this path except exit fibers. There exist the situation such like within having X accessible wavelength but each connection request a full wavelength. If K fibers supports X circuit sessions on different wavelengths then the session request between M and N cannot be linked and blocked. Each node requires the exact wavelength to establish connection. In the absence of a particular wavelength, the connection cannot be established (4). The estimation of possible chances that the blocking could happen is defined as blocking probability. Problem Identification

Basically the data center deploys with edge and core switches. The edge has the electronic top of the rack (TOR) switches and the core has a set of fast optical switches. TOR switches are used to connect the Servers of each Rack using bidirectional optical fibers. Unidirectional connections are deployed between TOR switches and optical switches. O/E/O conversion should be done in the switches in order to transmit the burst data. The front end switches of DCN is responsible for distributing load balance and traffic monitoring which is then link with external network, these switches is connected with core switches. OBS transmits the data with separate control panel and burst model. Packets are grouped into bursts. In order to allocate the resources a control packet is send forward to the intermediate nodes through a committed channel from source to the destination. Here we focus our research for the load distribution and resource utilization in

between core switches and Edge switches (5). Various OBS based existing design proposes various approaches to avoid esteem load such as FDLs, wavelength conversion, segmentation-based dropping and deflection routing, but mostly failed to achieve in eradicating of blocking probability.

A. Objectives

The major objective of this research is carried out with the use of enhanced Erlang-B formula to allow some portion of blocked sessions to immediately retry. The endowment of this research include.

1. We propose a formulation based approach (CDLA) that calculate the load distribution in between the core and edge switches in Optical Burst Switching (OBS).
2. Our architectural design explicitly propose the concept of Enhanced Erlang-B formula in data center networks and establish a novel routing path strategy in a straight and detailed manner.
3. We design our approach to analyze the bandwidth utility in Optical fibers, checking resource availability and offer various methods to resolve it proficiently.
4. The proposed model ideally demonstrate that the framework is capable of reducing the blocking probability, overwhelming the disadvantage of the traditional algorithms.
5. We design a datacenter model for the assessment of suggested model with supervised learning. The outcomes reveal its simplification and enhanced performance.

B. Organization

The rest of the sections that structured in the paper are as follows: the existing blocking probability minimizing approaches in the literature used for OBS are investigated in Section II. The detailed description about the proposed Enhanced Erlang-B formulation model with its clear iterations are represented in Section III. The simulation results of both existing and proposed models are validated with respect to different measures in Section IV. Finally, the overall paper is concluded and the future enhancement that can be implemented in the next phase are stated in Section V.

II. RELATED WORK

In our current study, we noticed that several existing algorithms that used for minimizing blocking probability and distributed load in OBS are surveyed with its advantages and disadvantages.

Fernandez and mekala et al.(6) reviewed all the issues, challenges and research areas in a brief manner. It surveyed all corner of optical Burst Switching (OBS) in every areas. Especially it reviewed the area of blocking probability in Contention Resolution approaches. This contention resolved approaches were Optical Buffering, Wavelength Conversion,

Burst Segmentation, Burst Deflection Routing, Burst retransmission and Burst TCP. It proceeded the survey with lot of challenges in OBS. It encouraged the researchers to focus in OBS to provide fast effective next generation optical communication. *Tariq, et al* (7) Proposed a network that used MPTCP protocol implied in OBS network for DCN. The benefits of MPTCP is combined with optical networking to increase the capacity of bandwidth in DCN and presented the results of MPTCP deployed in OBS. It investigated two kinds of possible inequities. The TCP inequity affected in multi-rooted tree topology for flows with minimum and maximum number of Hops conflicting for an output port and the difficulties of Inequity exist in OBS networks. The advantage of MPTCP than OBS upsurges at greater traffic levels where multiple paths help to remove severe blockages and permits more efficient usage of network possessions.

Imran. Et al (8) utilized and examined fast optical switches in the OBS based DCN. This work assess the fulfillment of OBS deliberated for DCN. Two way reservation protocol was employed in a single hop topology of OBS. The controller accessed as centralized and tried to achieve zero burst loss. Different workload and burst assembly metrics were examined to recognize the optimal parameters. This experiments used Arrayed waveguide grating routers (AWGRs), $1 \times N$ Space Switches and Semiconductor optical amplifiers (SOAs) were used for the analysis. It concluded that using optical switches is the only way to generate outstanding delay completion even with elevated load. *Imran and collier et al*(9) Deployed transmission control protocol (TCP) in datacenter networks with featured optical burst switching (OBS). High throughput was achieved with the use of delayed bandwidth product in OBS through one way reservation protocol. The TCP layer considered the resultant burst loss as heavy contention in the network. This lead to serious degradation of the TCP performance. *Lee and Sriram et al.*(10) proposed a new routing scheme Contention-Based Limited Deflection Routing (CLDR) scheme which was based on determining dynamically whether the burst must be deflection dispatched or forwarded. If the assessment is to deflection route, then the similar can be accomplished using a path depending upon the measures like the topology of the network, nodal configuration, group of attributes obtaining to resources form the node and link, and restrictions that are affected to resource availed. This research found a best alternate path reducing the cost, which clearly accounts for the contention rate along with the burst hop distance.

Imran and collier et al.(11) used fast optical switches for the core edges. This work evaluated the burst transmission and control packet transmission between TOR switches. It used two way reservation protocol in the data center. This was different approach because this protocol is not opt for conventional mainstay of optical networks because of high round trip time (RTT) of the control packet, whereas the RTT is not high in a DCN. Fast optical switches in a single-hop topology with a centralized, software-defined optical control plane increased the capacity deprived of demanding major

recabling and network reconfiguration. *Feng and sun et al.*(12) dealt with the idea of cost effective hybrid switching mechanism of electrical and optical fast switches. It proposed BLOC algorithm which enforces the baseline for the resource allocation and traffic partition combinations. This algorithm allocated the resource based on calculating objective function by using the parameter power consumption. It concluded that resource allocations are exaggerated by the number of resources, and arrival rate of flow. But it enforced the requirement of resources to provide feasible blocking probability. *Misuth and Evan et al.*(13) Used Erlang B in modern VOIP networks to detect the probability of loss of packet. The formula implemented spotted the area of load and the availed trunk lines. The result of this formula could be the prospect of call loss or call waiting. The estimation is based on abstraction of IP infrastructure characteristics to obtain traffic burden in Erlangs and sum of parallel lines. These calculations are then used in original formula to attain packet loss probability. This research concluded that the Erlang B model could be used effectively to determine the maximum limit of this probability in hypothetical worst case consequence when not any buffer is obtainable. It is very useful result that this formula could be used in a bufferless optical communication.

Huang and Yoshida et al.(14) proposed method to sidestep Routing plan for Optical channels in OPS-based Data Center Networks. A reserved Express path (ExP) is allocated from source to destination which is found as shortest path at the time of transmission initiation. The flow of packets routed with the established ExP and incur no contention or loss. The ExP could be expired after the transmission is done. But the proposed idea fails by wavelength reservation pervert the performance when at the time of vast connection establishment. *Hazem and Hatamleh et al.*(15) Used the algorithm of shortest path first (SPF) and finding the Least Hop First (LHF) to detect a pre deflection routing. Through this parameters blocking probability estimated using forward control packet. It gathers the bottleneck price and traffic price along its paths. When the core nodes suffer with heavy congestion, then the proposed model drops that particular node. So that the source node utilize this information to rebuild the length of the burst and offset time. *Leung and Sing et al.* (16) Applied neural network by considering the optical fiber metrics and parameters. The parameters were given to the layers of the NN and the hidden layer classified the possibilities of blocking. It is prediction based approach in optical networks. It concerned with six input parameters of an optical networks 1) E and D related to optical links 2) C and W related to network topology 3) APL and CR. The bufferless OBS could not store the data which was very complex. *Kushwaha and Gumaste et al.*(17) proposed FISSION architecture for fault tolerant in DC networks. It is a supporting protocol to facilitate a large DC fabrics. It enforced a switchless backplane and an interconnection pattern that results in supporting up to a million servers. *Hote and Ghodasara et al* (18) suggested Suggested to design control

state machine with the use of carrier Ethernet switch routers(CESR) and controller with the use of net-work management system (NMS)as well as their inter-actions. NMS tracked the bandwidth that are provisioned on every CESR port individually. On every occasion some new service is designed comprising a precise port. This design seemed better than OSPF/CSPF protocols in the optical environment. It mainly focused in providing service in SDN platform.

Li and Zhao et al(19) proceeded with spectrum defragmentation. It implied defragmentation approach with partial constraint based participation degree. It investigated intra lightpaths different ratios which influenced blocking probability.The required amount of switches rises when the size of the data center itself increases. Performance of two switching planes are limited by highest acceptable values. The complete demand in traffic should balance both the flows of mice and elephant. Balancing traffic through switching planes are vital to accomplish a high network performance. Erlang B formula based computation is very useful for handling the dynamic traffic and detect the sum of resources that fulfill various traffic percentiles.

The load on a data center link is not only reliable on the previous links, but also on obstructive previous resources. We now formulate the alternate optics selection problem by means of the following input parameters: traffic load intensity, availability of resources. The network traffic information could be fetched from the TOR switches and the load intensity from RACK servers. Our Enhanced Erlang B formula computes and finds the alternate paths from this two parameter. From the survey, it is studied that the methodologies concentrated both in hardware and software approaches. This approaches have both benefits and drawbacks, but it mainly lacks with the following limitations:

- Increased overhead and latency
- Computational complexity
- dynamic load balancing over OBS in datacenter networks
- Not ensure to meet out QOS requirements
- Not focus the problem of blocking probability.

There exist many techniques (20-22) to avoid conflict like FDLs, deflection based routing, conversion of wavelength, and dropping using segmentation approach , but Still burst loss is unavoidable in optical networks. Our work propose CDLA design formulation approach to meet the future requirements of data centers. The objective of this algorithm is to minimize the blocking probability and distributing of load between the controller and TOR switches of data centers.

III. PROPOSED METHOD

A. Burst Routing Strategies Using CDLA Design

Our proposed system provide assessment for the blocking probability of connection establishment in the DCN. The blocking can occur at two various Situations in the network:

- Network congestion in edge links.

- Resources limitation.

Initially the load between the core is estimated and edge network links p_l^{net} and resources p_r^{res} based on current status of the switch and the Rack server. The individual blocking probabilities (B_l^{net} and B_r^{res}) can be calculated by the Enhanced Erlang-B formula which depends upon the assumption that session requirement follows a Poisson process. The control plane organize the control in centralized manner. Routing is the major task of the controller by managing the control packet. It tackles the connection requests from all ToR switches, discovered the preferred routes to the destination ToR switch over optical switches and allocates the connection request by choosing appropriate channel to the destination ToR switch by path analyzing using enhanced Erlang B Formula (23). The source TOR ID and Destination ID were collected and the routing path is assigned based on this calculation algorithm. Due to load distribution the suitable path is selected for the burst transmission. The controller preserves a comprehensive connectivity situations of all optical switches. The data plane is employed using optical switches which merely accomplishes data forwarding on a conventional lightpath conjured by the controller. Every individual TOR switch has a separate committed optical transceiver which is linked with the controller over a network.

B. Enhanced Erlang B Calculation Algorithm

Erlang B is a modeling formula that is widely used to estimate the required server for the arriving connection establishment. By using this formula, we can predict the value of the involved third factor, if any two is known.

1. Busy Hour Traffic (BHT):Duration of hours that optical network frustrate with traffic
2. Blocking Probability: number of refused Connection due to not availed wavelength or optical channels.
3. Lines: Availed optical fibers (wavelength) in OBS.

Fig. 3 shows the overall flow of proposed algorithm which is derived from the existing Basic Erlang B formula through a simple modification is implemented regarding availed resource capacity. Basic Erlang B could be used to assess the number of available optics, or channels, needed to manage a connection load during the one hour traffic. However, assumption of formula implied that blocked connections are no more; i.e., if the allocated circuit wavelength is not available, the required connection or data transmission will be blocked.

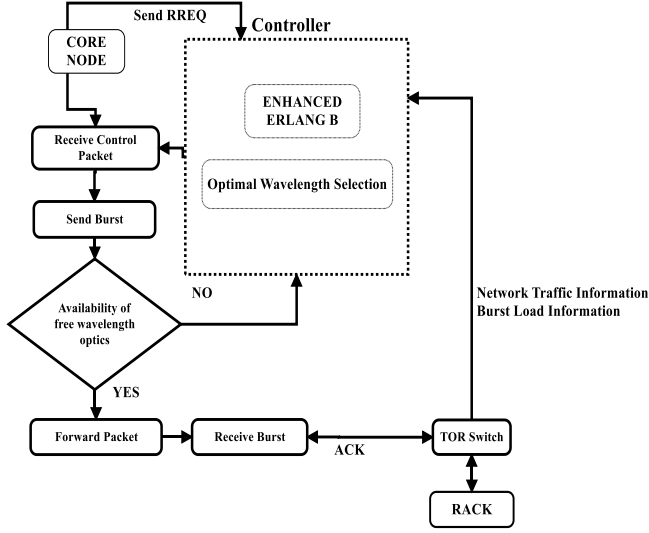


Fig. 3 overall flow of cdla design

This assumption makes that Basic Erlang B can underestimate the offered current load in the traffic and the requirement of burst transmission. So that the formula could be used in situations with few busy signals. But this underestimation of load degrades the overall performance. The new Route request also should be considered to take part of communication. So we go for Enhanced Erlang B which implies the idea of peak loading when there is no available wavelengths in between the aggregate fast switches and TOR switches. When the OBS reaches its peak loading the Enhanced Erlang B automatically consider the new arrivals as special case connections. This special connections are send for the Enhanced Erlang B formulation approach. This approach checks the available bandwidth and the requirement of the connections. If the required wavelength is occupied by elephant job and the required resources are high means the connection will be blocked. If the required wavelength is occupied by mice job and the required resource is minimum means, Enhanced Erlang B takes it into account. Connections are established with the availed resources and burst transmission continues using void filling approach. Void filling is defined as the idle times between the transmissions of consecutive bursts on a wavelength channel. The void filling wavelength are the reserved wavelength between the CORE and TOR switches which has been in use currently. Enhanced Erlang B formulation provides the load intensity and resource consumption parameters for the void filling algorithm (24). The algorithm searches all the wave-length channels in a fixed order and the burst is scheduled based on the load intensity and resource consumption.

C. .Description of Proposed Mathematical Model

Load Estimation

A new algorithm CDLA is introduced by implementing a Modification of fundamental Erlang's B formula to reduce the

blocking probability. In the previous decade, Erlang formula was used to estimate possibility of blocking and intensity of traffic which was given as.

$$B_{pro} = \frac{\frac{T^n}{n!}}{\sum_{i=0}^n \frac{T^i}{i!}} \quad (1)$$

Where, n= Number of channels. B_{Pro} = Blocking Probability, T = Traffic Intensity. To control load distribution in the channel, we have modified the Erlang's Loss Formula. We have developed the relation between load L_g and blocking probability B_{Pro} . The demand of new connection ND is directly proportional to load. As demand of the signal increases, traffic intensity T increases and vice-versa. Also, demand, ND is directly proportional to traffic intensity T . These points can be represented mathematically by equation (ii) & (iii). $ND \propto T$ and $ND = cT$, where c is constant. The traffic intensity is given as:

$$T = \lambda L = \frac{\lambda}{\mu} \quad (2)$$

Where, L = Latency time of connection, λ = Call arrival rate, μ = Average number of requests processed per time.

$$ND = c\lambda L = c \frac{\lambda}{\mu} \quad (3)$$

The load distribution is directly proportional to traffic intensity.

$$ND = c\lambda L = c \frac{\lambda}{\mu} = Lg \quad (4)$$

Now the Enhanced Erlang formula is given as equation

$$B_{pro} = \frac{\left(\frac{Lg}{L_1}\right)^n / n!}{\sum_{i=0}^n \left(\frac{Lg}{L_1}\right)^i / i!} \quad (5)$$

Where, B_{Pro} = Blocking Probability, Lg = Load in the channel, L_1 = Constant Value, N = Number of channels.

In order to imply congestion control, the function of Enhanced Erlang's Model is developed in GreenCloud Software with NS2. First the relation between number of servers (n) and blocking probability (B_{Pro}) will be calculated. Secondly the association analysis between traffic potentiality β and possibility of blocking (B_{Pro}) will be intended. Then, the relation between load intensity L_g and blocking probability will be generated. The mathematical model is designed based on the above equation which is proposed for load intensity control. The proposed model controls the offered load which is easily explained in figure-3.

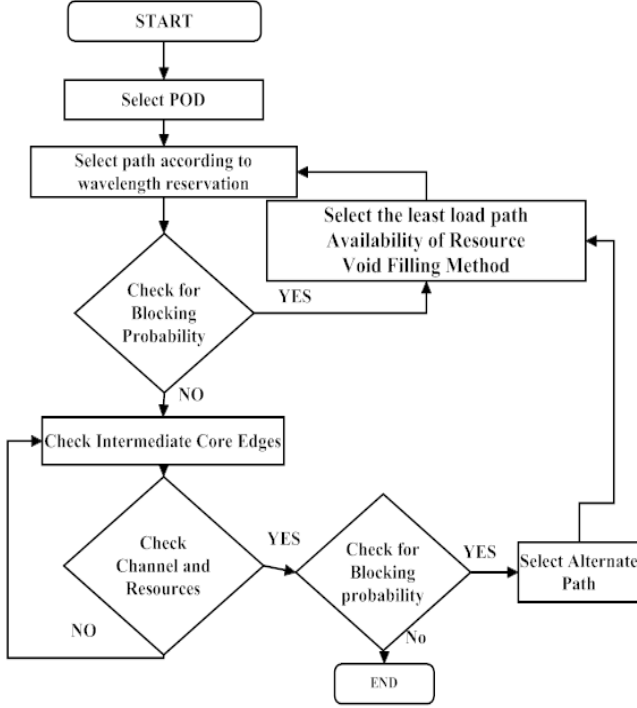


Figure. 4 Flowchart of CDLA Formulation

The fig 4 shows that in the first stage the POD pair is being selected in the data center and the entire optical fiber is being searched which can be used between the selected core and TOR switch pair. The load intensity and the necessity of resources is checked and the blocking possibility of chances is estimated for every individual channel. The optical circuit channel with the least load and blocking probability is selected for the burst transmission.

Resource Allocation

The status of the available resource in between the controller and the TOR switches could be calculated based on the Enhanced Erlang formula which uses the load intensity result from the equation(7).

$$B_r^{res} = \text{Erl}(p_r^{res}, L_r) = \frac{(p_r^{res})^{L_r}}{\sum_{i=0}^{L_r} \frac{(p_r^{res})^i}{i!}} \quad (6)$$

Where, B_r^{res} = Blocking probability of resources, p_r^{res} = Individual network resources, L_r = Resource occupied by the load distribution. The objective function is calculated for the resource allocation for detecting the appropriate number of network connecting devices in both controller and TOR switches, with the specified resource allocation and the equivalent load intention, to fulfill the requirements of network performance that is called as global blocking probability. (12). We consider that all ToR switches occupy a homogeneous setting in which they have the similar network connection and interface speed. Hence the model is designed such that the problem of resource allocation in one framework

instead of all. The traffic intensity could also be another parameter which was our previous work in the research.

D. Delay Calculation to Use Void Filling channel

According to the load intention and resource utilization the channel is determined to use void filling approach. Here the question arises with the channel selection. Every channel has an idle time in between the transmissions of consecutive bursts. Here our CDLA based computation results of every channel is analyzed. The good quality of the channel is selected based on load intensity and resource requirement which should be low. The delay calculation of the channel could be computed by measuring round trip time (RTT). The channels which has high load intensity and resource consuming may not used for the void filling. The channels which has low load could be used for the voids. Thus the algorithm search the optimal channel to employ void filling. Detection of Congestion in Links could be calculated using following.

$cwnd = \text{CongestionBandwidth} \times \text{RoundTrip Propagation time}$
the pipe's BDP (bandwidth-delay product).Burst window tracks RTT of send burst until ack is received at time t

$$RTT_t = RT_{propt} + \eta_t \quad (7)$$

where $\eta \geq 0$ denotes the "Bit error factor" presented by queues with the path. Since changes in the path occur on time scales $\gg RT_{prop}$, a balanced, effective estimator at time T is

$$RT_{pro}^{\wedge} = RT_{pro} + \min(\eta_t) = \min(RTT_t) \quad \forall t \in [T - W_R, T] \quad (8)$$

$\text{deliveryRate} = \Delta d / \Delta t$. Where d is the rate of change in data delivery. This rate must be lesser than the bottleneck rate (the arrival rate is exactly identified so all the ambiguity is in the Δt , which should be greater the true arrival interval; which in turn, the ratio must be lesser the true delivery rate, which is, in turn, upper-bounded by the bottleneck capacity). Therefore, a windowed-max of delivery rate is an effective, balanced estimator of BtlBw:

$$tLBw^{\wedge} = \max(\text{deliveryRate}_t) \quad \forall t \in [T - W_B, T] \quad (9)$$

Where the time window W_B is usually 6 - 10 RTTs. Burst assembler should note the departure time of every burst to calculate RTT.

Algorithm to determine void filling channel.

```

bdp = BtlBwFilter.currentMax
      × RTpropFilter.currentMin
if (cwnd >= cwnd_gain × bdp)
  // wait for ack or retransmission timeout
  return
if (now >= nextSendTime)
  burst = nextBurstToSend()
  if (!burst)
    app_limited_until = inflight
  
```

```

return
burst.app_limited = (app_limited_until > 0)
burst.sendtime = now
burst.delivered = delivered
burst.delivered_time = delivered_time
ship(burst)
nextSendTime
    = now + burst.size / (pacing_gain
        × BtlBwFilter.currentMax)
timerCallbackAt(send, nextSendTime)rtt
    = now - burst.sendTime
updateMinFilter(RTpropFilter, rtt)
delivered += burst.size
deliveredTime = now
deliveryRate = (delivered
    - burst.delivered) / (deliveredTime
    - burst.deliveredTime)
if (deliveryRate
> BtlBwFilter.currentMax || ! burst.app_limited)
    update_max_filter(BtlBwFilter, deliveryRate)
if (app_limited_until > 0)
    app_limited_until
        = app_limited_until - burst.size

```

Repeat steps.

The proposed algorithm is used to find wavelength utilization. This algorithm searches all the possible voids for the time interval $[t_B, t_F]$ and channel selection imparts that minimize the void between the initiation time of the new arrival burst and the finish time of the previous scheduled burst. So that we can determine the throughput of the channel. The throughput of channel will fall with anyone of the following condition.

1. If (Expected Throughput – Actual Throughput) is less than α , then TCP Vegas will increase CWND linearly during the next round of transmission.
2. If (Expected Throughput – Actual Throughput) is greater than β , then TCP Vegas will decrease CWND linearly during the next round of transmission.
3. If (Expected Throughput – Actual Throughput) is between α and β , then the congestion window CWND is unchanged during the next round of transmission.

This conditions are useful to identify the upper bound and lower bound of the channel utilization. According to the dynamic condition, the appropriate channel is selected.

IV. SIMULATION DETAILS

To evaluate the performance of DCNs in OBS, we supplemented simulations design in the Green Cloud simulation structure(25)by altering OBS network representations for Green Cloud with NS2 simulator.

Significant simulation metrics are shown in Table 1. This work implemented single hop topology model which has top of the rack (ToR) switches in the edge and contrary a similar group of fast optical switches in core. This topology provide a good platform to analyze the data transmission which is definitely mounted up and down. In a single hop topology a two way reservation protocol is applied since the controller needs to make up single switch for each request. The control plane is designed as a centralized supervising controller. It contains a distinct data plane and control plane. The main functions of the controller are routing, scheduling and switching configuration. Control packets are send to the ToR switches and the optimal path is determined over optical switches to the destination ToR and also it allocates horizons to the control packets. Data bursts are forwarded via fast optical switches in the data plane through conventional light signals. So as to register burst assembly function, every ToR switch at the edge comprises of $(N-1)$ virtual output queues (VOQs) where N is the number of ToR switches in the network. Every TOR switch of the DCN has its own VOQ. Packets for the same destination TOR are assembled into the same VOQ.

Table 1: Simulation Parameters

Parameter	Value	Unit
Aggregate Switches	4	
Core Switches	2	
TOR Switches	8	
Servers per Rack	144	
Users	10	
ON period		
Average Load/Server:		0.7
Datacenter Load		65.8%
Total Tasks	4026	
Average Tasks/Server	28	
Task Rejected by DC	2586	
Task Failed by Server	0	
Total Energy		197.9 W*h
Switch Energy (agg.)		23.5 W*h
Switch Energy (core):		11.8 W*h
Switch Energy (access)		2.1 W*h
Server Energy		160.5 W*h

Our simulation framework may contain $N = 8$ ToR switches. Every ToR switch has $H = 144$ servers connected to it. The controller and ToR switches are linked via optical fibre connection. Here a fast switch is used which act as an aggregated switch. A high contention model can be utilized in our simulator to reflect the heavy work load in DCN. Packets arrival is considered with several inter-arrival rates in the ON state to examine traffic at various loads. It is assigned that the value of $1\mu s$ for the time of switching regarding optical switches. The Round Trip Time (RTT) of the control packet comprises its time taken for processing (T_{proc})

and overhead (T_{overhead}) at the controller. The overhead time encompasses propagation delay (5 ns for 1m optical fiber), Controllers control packets functionality delay and O-E-O conversion delay.

V. PERFORMANCE ANALYSIS

In this part, the simulation results of existing and proposed minimizing blocking probabilities are experimented by using the parameters of overall throughput of OBS and network efficiency. The results are supervised as shown in the figure below using Green Cloud simulator with NS2. We observed the results that the proposed algorithm are better than the conventional methods which were developed earlier.

A. Blocking probability vs Load Distribution

The results are shown in the figures 5 (a) and (b) which represent the blocking probability with respect to load distribution. Blocking possibility increases with the increased load value. But the proposed CDLA mathematical model reduce the blocking probability to a certain level when increasing the load. With the resultant performance it is observed that by increasing load value produce traffic intensity from 30 erlang to 40 erlang, the value of blocking probability decreases from 0.3-0.2 to 5-3 which is effective result.

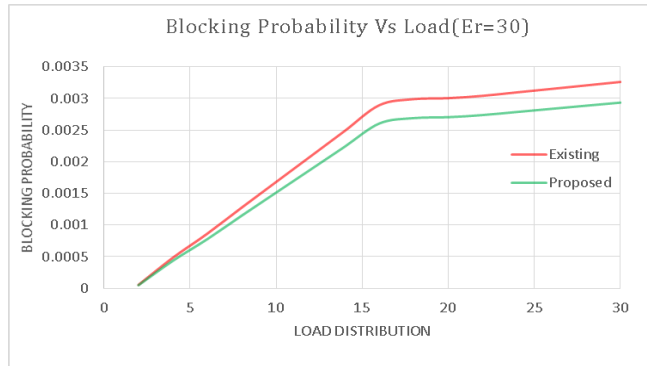


Fig. 5 (a) Blocking probability vs Load Distribution

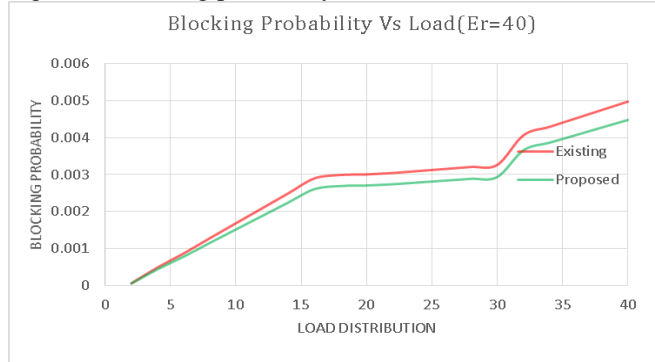


Fig.5 (b) Blocking probability vs increased congestion

Therefore the proposed design model performs better than the existing developed model. This seems very small in our simulation result. But in dynamic Data Center networks where

the given parameters are the multiplication of values which is very large. So the minimization result is very optimal.

B. Blocking probability vs Number of lines

Conventionally when the lines are increased in DCN automatically the blocking probability decreased. It's due to the availability of channels. When there is no wavelength in certain limit. Then at a threshold value it remains constant. Then again due to the traffic intensity the chances of blocking probability increases.

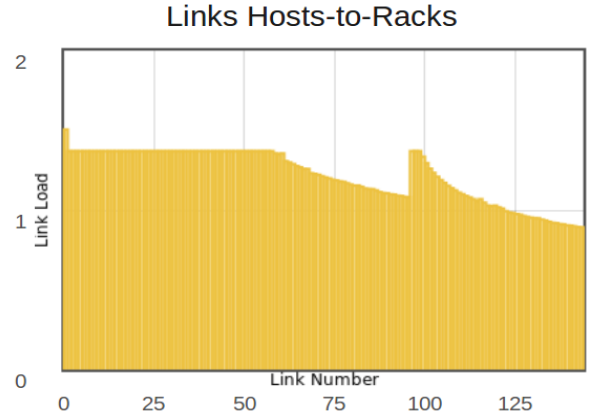


Fig. 6 (a) Blocking probability vs Number of channels

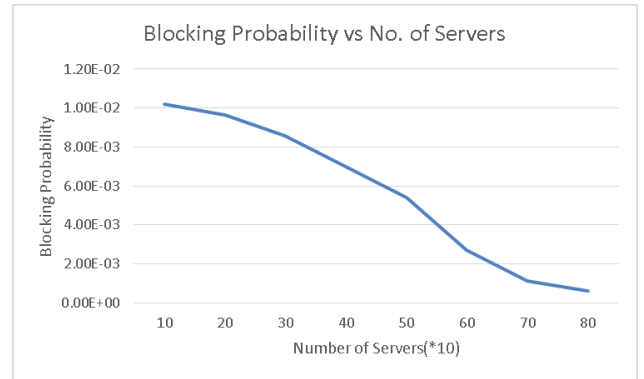


Fig. 6 (b) Blocking probability vs Number of Servers

Figures 6 (a) and (b) shows the representation of the blocking probability concerning the number of channels. The evaluation could have been done for blocking possibility concerning number of servers. The blocking probability is indirect proportional to the count of servers in the data center networks. When there is excessive server than the incoming circuit, then there will not be lack in the availability of resources. The CDLA design model promise the results with minimized blocking probability for DCN. Then it remains constant at a certain limit.

C. Throughput Vs Arrival Rate(Wavelength=64)

In reality when the blocking probability increases the arrival rate of burst reduces. So the overall performance degraded to an extreme level. But when we apply CDLA design model the

throughput is increased. We analyze the simulation model by increasing the wavelength from 64 to 80. We compared our CDLA results with current OBS architecture results in Fig 7 (a) and (b).

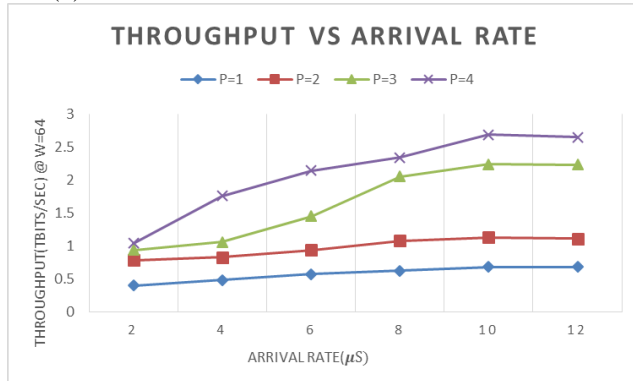


Figure. 7 (a) Analysis of Throughput Vs Arrival Rate

From Fig. 7 (a) it is observed that throughput is increased from 2.23 Tbits to 2.64 Tbits within 12 μsecs. This is 15 % higher than the existing architecture. From Fig 7 (b) it is observed that throughput is increased from 3.93 Tbits to 5.12 Tbits. This is 23 % higher than the existing architecture of OBS. Our CDLA utilize the resources in an effective manner. CDLA involves in finding routing strategy based on void filling approach with the existing architecture. When the channels are increased the load intensity will be decreased.

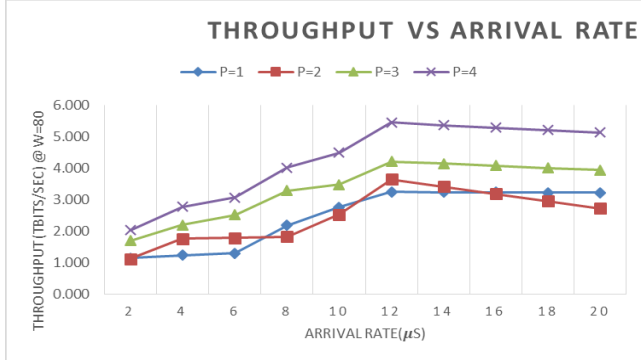


Figure.7 (b) Analysis of Throughput Vs Arrival Rate (W=80)

D. Analysis of Data transmission Vs Simulation Time

The overall data transmission of OBS is observed with the total simulation time. Our proposed designing model works associated with the controller and increases burst transmission. Our Simulation results achieve better burst transmission rate by increasing from 119Tbits to 126Tbits within 3μsecs which is shown in Fig 9. In optical fiber communication this difference of data seems very small. But if we implement Enhanced Erlang B formula for calculating other parameters similar to load distribution, resource availability and dynamic wavelength extension, in future we can achieve zero burst loss and zero blocking probability.

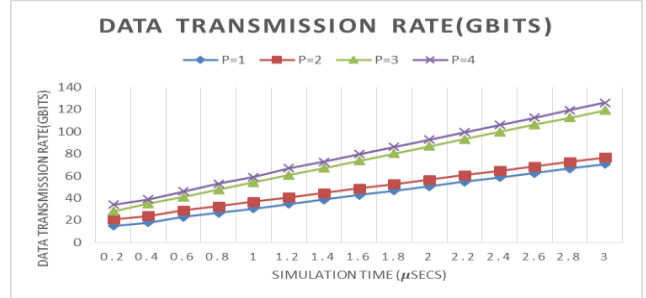


Figure. 9 Analysis of Data Transmission Rate Vs Simulation time

V. CONCLUSION AND FUTURE WORK

This paper a load approximation reduced model called CDLA is proposed to examine the blocking behavior of Optical Burst Switched Data centers. As blocking probability in such networks taking place in network links and in resources, an innovative routing strategy is proposed to reduce blocking probability over simulation analysis and presented the correctness of our model. Moreover, the improved blocking behavior of the DSNs is also demonstrated for our novel routing strategy and compared with the existing routing methods. Particularly, CDLA based load optimization and resource utilization improves the throughput which satisfies the current need of users. CDLA model based computation reduces the overhead burden of controller which is very simplified.

In future, this work can be enhanced by implementing the swarm intelligence method for detecting the interior parameters such like optical-electrical-optical (O-E-O) conversion, wavelength conversion, deflection routing. Applying Enhanced Erlang B for the minimization of blocking probability on the different parameters like wavelength dynamic extension. The work can be enhanced for other networks also like passive optical networks, optical packet switching networks, multi path OBS networks etc.

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