CALCULATION OF BURST LENGTH AND STATIC TRAFFIC IN PASSIVE OPTICAL BURST SWITCHING NETWORK

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Abstract-In this paper, we investigate the problem of multipath traffic engineering in Optical Burst switching (OBS) networks. The well-known Engset model has been widely used and studied. This model is used to analyze the performance of Passive optical burst switching network. Theoretical analysis for the Burst Length and Static Traffic is carried and also demonstrated by simulation results.

Keywords- Optical Network, Passive Optical Network, OBS Network, Generalized Engset Formula, Burst Length, Static Traffic.

I. INTRODUCTION

As the internet traffic increases, the capacity of the networks that transport this traffic must also increase. Further all-optical networks are seen as a way to meet this growing demand [3].With this kind of dramatic increase in the demand and increasing role of internet the global trade and business there also comes the need for a network where it can set at low cost, with high efficiency and with greater reliability. With this kind of traffic comes the data loss and handling the network becomes difficult [2].

Passive Optical Network (PON) uses a dedicated optical fiber, to provide virtually unlimited bandwidth, without using any active component within the network. It offers a true triple play service of voice, video and data on a network. PON uses passive optical splitter to separate the signal towards each user/subscriber. It is called passive because within the central office and the subscribers, there is no power element present; hence the cost of the network and its installation is reduced [1].

Optical Circuit switching (OCS) network as the first all-optical networking technique lack flexibility to convey bursty traffic and has poor bandwidth utilization. Although optical packet switching (OPS) scheme is conceptually ideal and considered as the desired solution, it is restricted by the technological complexities [5]. The network had relied on the Circuit and that of Packet switching where dynamic handling of data was absent and was not efficient respectively. The OBS which has dynamic allocation of wavelength and with the separate control packet that carries in the destination of the data burst had created a better and efficient usage of the bandwidth that is available [2].

In OBS networks, the basic switching unit is a burst. Burst is a set of packets with the same destination and QoS requirements which are aggregated at the ingress of OBS network. Burst header (BH) and Data burst(DB) are sent along separate channels with an offset time [5].

The methods and schemes such as the Just-Enough-Time, Just-in-Time, Optical Buffering, Wavelength conversion and Deflection Routing that are used in the Optical burst switching have enhanced their efficiency. These schemes are great supporters in eliminating the malicious attack. The OBS faces little technical issues of data loss due to aggregation of the burst size [2].

This paper is organized in three sections. Introduction on Optical Network, Passive Optical Network and OBS Network is presented in section I. Section II describes the overview of related work done regarding Optical Burst Switching Network and its related research papers. Section III describes the Proposed Model. Finally Results and conclusion is given in section IV and V.

II. LITERATURE REVIEW

Eric W.M. Wong et. al [3] presented a new method for the estimation of blocking probabilities in bufferless optical burst or packet switched networks in which deflection routing was used to reduce blocking probability. This paper demonstrated that max (EFPA, OPCA) was a reasonably accurate approach to approximate blocking probability of OBS and OPS networks using deflection routing with sufficient protection to avoid instability.

Eric W.M. Wong et. al [4] proposed a new state dependent approximation for a special case of the generalized Engset model that considers packet/burst dumping and demonstrated that the new approximation was accurate.

Hamzeh Beyranvandet. al [5], proposed a QoS differentiation framework for an OBS multiservice network. A Hybrid wavelength division multiplexing and optical code division multiplexing (WDM/OCDM) scheme was used to mitigate the blocking probability of OBS networks. The blocking probability of the proposed WDM/OCDM-based OBS scheme was evaluated by utilizing both the generalized Engset model and 2-D Markov model. To explain the details of QoS differentiation framework, a four-class WDM/OCDM-based OBS network was numerically designed. The result reveal that using OCDM, the BP was reduced and the probabilities of outage and error were decreased employing intelligent resource allocation.

Jianan Zhang et. al [6] considered a bufferless optical burst switching optical cross connect modeled as a continuous-time Markov chain based on a generalized Engset model and focused specifically on critical load and other given levels of high utilization conditions and evaluated the required number of wavelength channels per cable to kept the blocking probability below a given level and also proposed a new blocking probability approximation that was more accurate than previous approximations under critical load condition. To maintain the blocking probability below 10^{-6}, a large number of channels per cable are required under critical load condition. The required number decreases significantly in underload conditions where the utilization was still high.

Andrew Zaleskyet. al [7] considered Optical Burst Switching with acknowledgement in an edge router served by a limited number of wavelength channels and approximated the latency of an arbitrary packet and derived exact expressions for the mean burst and the stationary burst blocking probability for an OBS/A edge router. By adjustment of burst assembly delay, the desired blocking probability was designed and with high probability, the latency requirement of packets was satisfied.

Jianan Zhang et. al [8] studied the sensitivity of the blocking probability to the shape of on and off-time distributions at an OBS OXC and demonstrated that the blocking probability is not very sensitive to these distributions and observed that lower variance may lead to higher blocking probability.

Ms. Denisa S. Gardhariyaet. al [9] considered OBS as a promising switching technique for the next generation of optical networks and compared the result of traffic model with existing Engset model and showed that this model also helped to reduce the burst blocking ratio at the edge node.

III. PROPOSED MODEL

The Engset traffic model explores the relationship between offered traffic usually during the busy hour and the blocking which occur in that traffic and the number of circuits provided where there number of sources from which the traffic is generated is known. The Engset formula is used to determine the blocking probability or probability of congestion occurring within a circuit group. It is similar to the Erlang B formula but specify a finite number of sources. It also assumes that blocked calls are cleared or overflowed to another circuit group.

Each input wavelength channel transmits bursts as an on/off process. On-time refers to burst transmission time and off-time refers to idle time between bursts. Burst Length is the amounts of data send/receive in a single instance and Static Traffic is the fixed traffic send on the channel.

We have presented on-off modeling in the Engset model to calculate Burst Length and effectively allot a static traffic on the channel.

Various symbols used in this model are explained as:

T_{RTP} = Round Trip Delay or Round Trip Time in ms.

T_d = Waiting Time in ms.

$1/\lambda$= Mean OFF Time/ Mean Packet interarrival Time for each buffer in □ s

$1/\mu$= Mean ON Time/ Mean Packet Length for each buffer in B

T_b = Busy Period of buffer

R_{out} =Output Transmission Rate of channel in Gb/s

L_b = Burst Length

S_T = Static Traffic

From [7] it is found that T_d is directly proportional to T_{RTP}, so

$$T_d = \beta T_{RTP} \text{ for } 0 \leq \beta \leq 10 \quad (1)$$

Where β is a constant

T_b from [7] can be expressed as given in equation (2)

$$T_b = \frac{1}{\mu} + \left(\frac{\lambda}{\mu}\right)(T_d + T_{RTP}) \quad (2)$$

Further solving the equations (1) and (2) we get equation (3)

$$T_b = \frac{1}{\mu} + \left(\frac{\lambda}{\mu}\right)(\beta T_{RTP} + T_{RTP}) \quad (3)$$

$$T_b = \frac{1}{\mu} + \left(\frac{\lambda}{\mu}\right) T_{RTP}(\beta + 1)$$

$$T_b = \frac{1}{\mu}(1 + \lambda T_{RTP}(\gamma)) \quad (4)$$

Where γ is a constant

$$\gamma = \beta + 1 \quad (5)$$

L_b from [7] can be expressed as given in equation (6)

$$L_b = R_{out} T_b \quad (6)$$

Further solving the equations (4) and (6) we get equation (7)

$$L_b = \frac{R_{out}}{\mu}\left(1 + \lambda T_{RTP}(\gamma)\right) \quad (7)$$

S_T From [9] can be expressed as given in equation (8)

$$S_T = \frac{T_{RTP} + T_b}{1/(\lambda + T_d)} \quad (8)$$

Further solving the equations (1), (4) and (8) we get the equation (9)

$$S_T = \frac{T_{RTP} + \frac{1}{\mu}(1 + \lambda T_{RTP}(\gamma))}{1/(\lambda + \beta T_{RTP})} \quad (9)$$

Equation (7) and (9) can be taken as the proposed mathematical model. From this equation we can observe that Burst length and static traffic is directly proportional to $\gamma$and increased when γ is increased and also observed that Burst length and static traffic is directly proportional to Round Trip Delay T_{RTP} and increased when Round Trip Delay T_{RTP} is increased. From equation (7) we can observe that Burst Length is directly proportional to Mean Packet Length $(1/\mu)$ and if Mean Packet Length $(1/\mu)$ is increased the Burst Length is also increased and from equation (9) we can observe that static Traffic is directly proportional to Mean Packet Length $(1/\mu)$ if Mean Packet Length $(1/\mu)$ is increased the Static Traffic is also increased.So concluded that with the increase in gamma (γ), Round Trip Delay (T_{RTP}) , Mean Packet Length $(1/\mu)$Burst length and static traffic is also increased.

IV. RESULTS

We set the Output Transmission Rate (R_{out})=1Gb/s, Mean Packet Length $(1/\mu)$=0.025. Figures 1, 2, 3 and 4, we plot the Burst Length v/s Gamma, for T_{RTP} = 0.005, 0.010, 0.015, 0.020s and Mean Packet interarrival Time$(1/\lambda)$= 2, 4, 6 μs, respectively. From Figures, we observe that as the gamma increases, the Burst Length was increased with the increase in Round Trip Delay and Mean Packet interarrival Time.

Table-1 Simulation Parameters for Engset Model

Parameters Symbols	Numerical Values
$\boldsymbol{\beta}$	10
$\boldsymbol{\lambda}$	0.5μs, 0.25μs, 0.1666μs
$\boldsymbol{\mu}$	0.0025 B

R_{out}	1Gb/s
T_{rtp}	0.005s, 0.010s, 0.015s, 0.020s

1. Burst Length v/s Gamma for T_{RTP}=0.005 ms

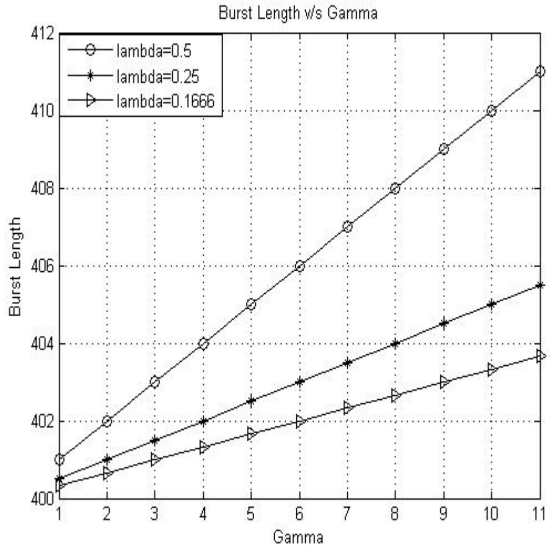

Figure-1 Burst Length v/s Gamma for T_{RTP}=0.005s

2. Burst Length v/s Gamma for T_{RTP}=0.010 ms

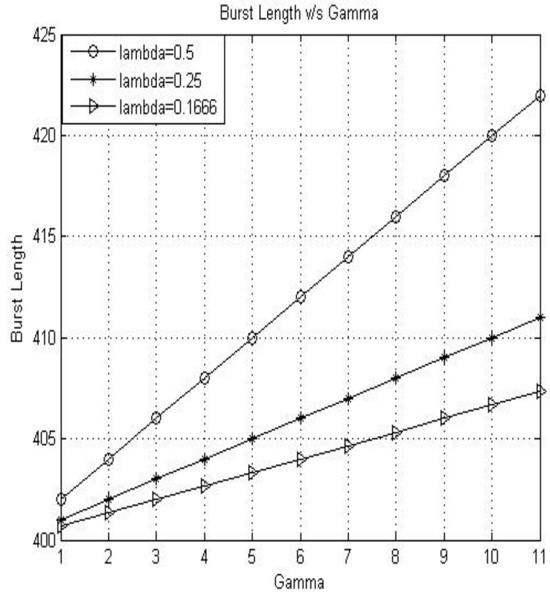

Figure-.2 Burst Length v/s Gamma for T_{RTP}=0.010s

3. Burst Length v/s Gamma for T_{RTP}=0.015 ms

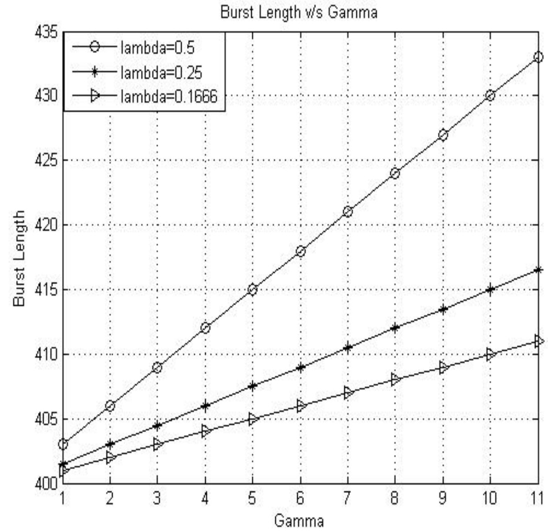

Figure-3 Burst Length v/s Gamma for T_{RTP}=0.015s

4. Burst Length v/s Gamma for T_{RTP}=0.020 ms

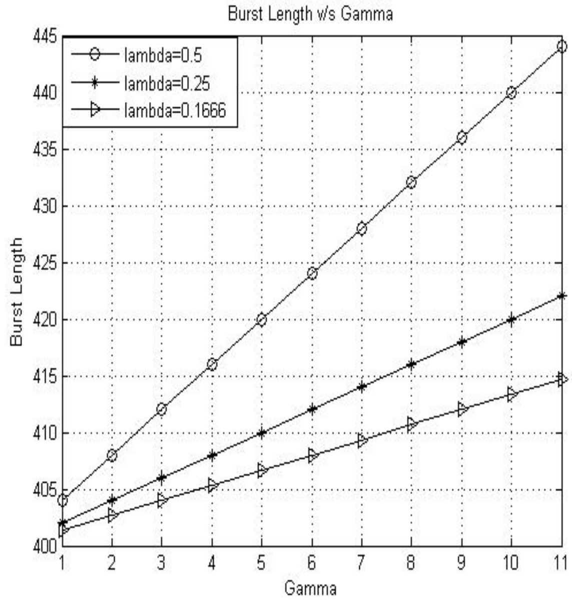

Figure-4 Burst Length v/s Gamma for T_{RTP}=0.020s

5. Static Traffic v/s Gamma for T_{RTP}=0.005 ms

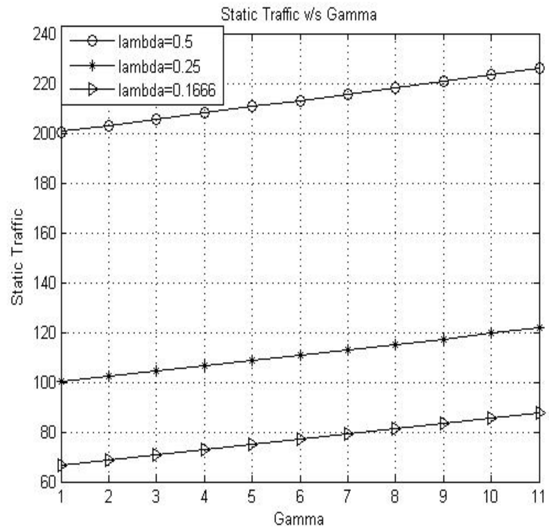

Figure-5Static Traffic v/s Gamma for T_{RTP}=0.005s

6. Static traffic v/s Gamma for T_{RTP}=0.010 ms

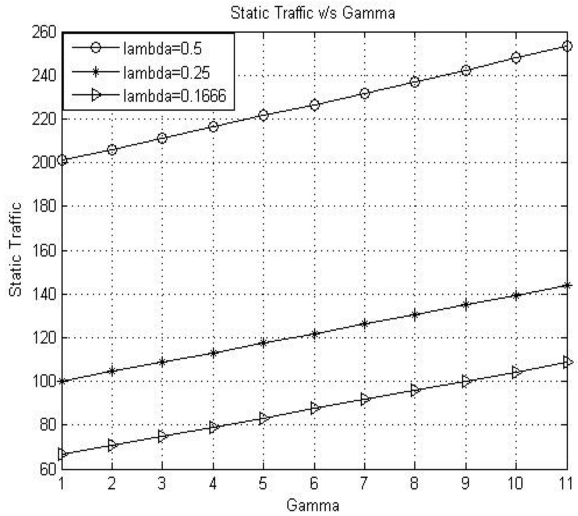

Figure-6Static Traffic v/s Gamma for T_{RTP}=0.010s

7. Static Traffic v/s Gamma for T_{RTP}=0.015 ms

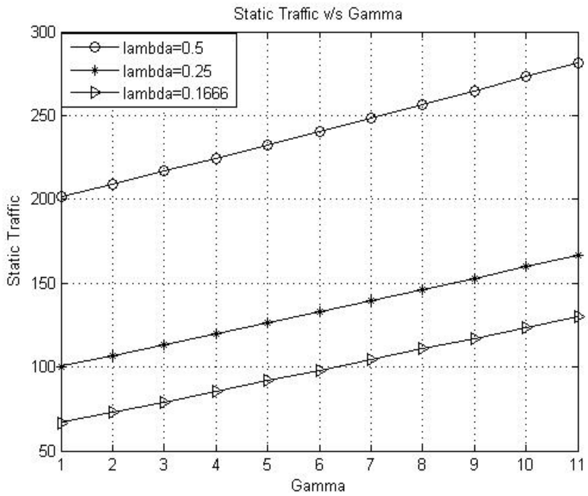

Figure-7Static Traffic v/s Gamma for T_{RTP}=0.015s

8. Static Traffic v/s Gamma for T_{RTP}=0.020 ms

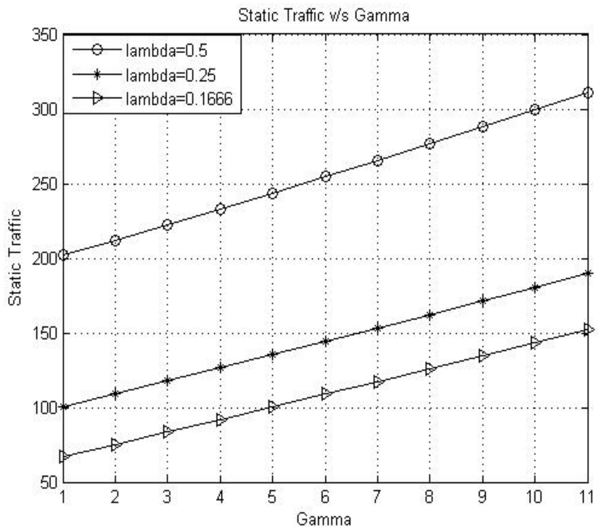

Figure-8Static Traffic v/s Gamma for T_{RTP}=0.020s

V. CONCLUSION

In this paper we have analyzed the performance of Passive optical Burst Switching Network and demonstrated using simulation that by increasing the Round Trip Delay and Mean Packet interarrival Time, the Burst Length and Static Traffic increases with the increase in Gamma.

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