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Examining of Blocking Probability Computation in Optical Network

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Abstract

In this work, we examine analytical techniques; blocking probability is the statistical Probability that a connection cannot be established due to insufficient transmission. Resources in the network, usually expressed as a percentage or decimal equivalent of calls blocked by the network congestion during the busy hour. We also have shown an analytical model for evaluating the blocking probability in optical burst switched networks. This analytical model takes into consideration the effects of the burst offset time and the burst length of blocking probability.

Keywords

Blocking probability, Deflection routing, Congestion control, Optical network, Traffic smoothing

1. Introduction

The current fast-growing Internet traffic is demanding more and more network capacity every day we are seeing dramatic changes in the telecommunications industry that have far-reaching implications for our lifestyles. There are many reasons for these changes. First and foremost is the continuing, relentless need for more capacity in the network. This demand is fueled by many factors. The tremendous growth of the Internet and the World Wide Web, both in terms of number of users and the amount of time, and thus bandwidth taken by each user, is a major factor. Internet traffic has been growing rapidly for many years.

1.1 Optical Network

There is also a strong correlation between the increase in demand and the cost of bandwidth. Technological advances have succeeded in continuously reducing the cost of bandwidth. This reduced cost of bandwidth in turn spurs the development of a new set of applications that make use of more bandwidth and affects behavioral patterns. A simple example is that as phone calls get cheaper, people spend more time on the phone. Despite the variations, these growth estimates are always high, with more recent estimates at about 50% annually. Meanwhile, broadband access technologies such as Digital Subscriber Line (DSL) and cable modems, which provide bandwidths per user on the order of 1 Mb/s, have been deployed widely. For example, in 2008 about 55% of the adults in the United States had broadband access at home, while only10% had access through dialup lines of 28–56 kb/s. This development in turn drives the need for more bandwidth in the network. This positive feedback cycle shows no sign of abating in the near future. Also, traffic in a network is dominated by data as opposed to traditional voice traffic. In the past, the reverse was true, and so legacy networks were designed to efficiently support voice rather than data. Today, data transport services are pervasive and are capable of providing quality of service to carry performance sensitive applications such as real-time voice and video.

1.2 Optical Burst Switching

Optical burst switching (OBS) is the next generation optical Internet with IP over WDM as the core architecture. It can achieve a balance between Optical Circuit Switching (OCS) and Optical Packet Switching (OPS). OBS requires limited delay of the data at intermediate nodes as in OCS, and ensures efficient bandwidth utilization on a fiber link just as in OPS. One of the main aspects in the deployment of OBS services is the development of an optical traffic/performance monitoring scheme allowing the provision of user-specified quality of service (QoS).OBS is a promising switching technology for next-generation Internet backbone networks. One of the key problems hindering the realization of OBS technology in the core networks is the losses due to contention among the bursts at the core nodes. Wavelength Conversion is an effective contention resolution technique used to reduce the number of bursts loss. OBS, which combines the best of optical circuit switching and optical packet switching, was proposed as a future high-speed switching technology and has received an increasing amount of attention from both academia and industry worldwide In OBS networks In OBS networks burst segmentation is an efficient contention resolution for only the overlapped portion of a burst being dropped. However the inherent limitation of burst segmentation is that the policy for dropping segments works in the order of burst head packets arrival times rather than bursts arrival times order. OBS has been considered as an efficient paradigm that delivering traffic directly over wavelength division multiplexing (WDM) links, and received considerable attention since proposed. WDM is essentially the same as frequency division multiplexing (FDM), which has been used in radio systems for more than a century. For some reason, the term FDM is used widely in radio communication, but WDM is used in the context of optical communication, perhaps because FDM was studied first by communications engineers and WDM by physicists. The idea is to transmit data simultaneously at multiple carrier wavelengths (or, equivalently, frequencies or colors) over a fiber. To first order, these wavelengths do not interfere with each other provided they are kept sufficiently far apart. Thus WDM provides virtual fibers, in that it makes a single fiber look like multiple "virtual" fibers, with each virtual fiber carrying a single data stream. WDM systems are widely deployed today in long-haul and undersea networks and are being deployed in metro networks as well.

1.3 Blocking Probability

The concepts of blocking probability, and end-to-end blocking probability, which are used interchangeably, are equivalent to the so-called burst/packet loss ratio defined as a ratio of the bursts/packets that are lost to the bursts/packets that are sent. The main cause of loss is lack of sufficient network resources as losses due to physical layer errors are negligible. Our new method is based on a recently published technique for estimation of blocking probabilities in general overflow loss networks .The blocking probability is reduced if you scale up both traffic and link capacities by the same factor.To illustrate this phenomenon the blocking probability on longer routes and ensure better fairness overall. Otherwise, short routes tend to have much less blocking than long routes. Having more routes to consider usually increases the control traffic in the network and leads to an additional computational burden on the network nodes, but this is not significant in networks with a moderate number of nodes where light paths are set up and taken down slowly. As computer communications and telecommunications continue to converge, the data traffic is gradually exceeding the telephony traffic. This means that many of the existing connection oriented circuit switched networks will need to be upgraded to support packet switched data traffic present a new method for the estimation of blocking probabilities in buffer less optical burst or packet switched networks. In such networks, deflection routing is used to reduce blocking probability an optical network consisting of nodes arranged in tandem. We assume traffic grooming, which permits multiple sub-rate traffic streams to be carried on the same wavelength. This optical network is modeled by a tandem queuing network of multi rate Erlang loss nodes with simultaneous resource possession, with a view to calculating call blocking probabilities.

When there is a huge amount of traffic in the network then we manage the send rate by blocking certain data packets or we can say that any type of data so that we will be able to avoid the congestion by doing this .In other words we manage the congestion by sending data packets in a timely manner. So that this will be helpful for us in order to avoid the congestion or we say that traffic load is reduced by this way.

2. Literature Review

In 2009, Eric W. M. Wong et al. [1] proposed a method for the estimation of blocking probabilities in buffer less optical burst or packet switched networks. In such networks, deflection routing is used to reduce blocking probability. An accurate approach to approximate blocking probability of OBS and OPS networks using deflection routing with sufficient protection to avoid instability.

In 2006, Xianhui Che et al. [2] proposed that congestion control over different time scales has been investigated to support data transport over a switched optical packet LAN. An innovative local access control protocol has been designed to shape different traffic sources to produce smoothed optical packet traffic which has a constant inter-arrival time network models have been built to prove the network performance with high network efficiency and fluent throughput.

In 2005, Arif Ali Rehman et al. [3] proposed that as the size of network increases conventional methods used in telegraphic theory to model these networks become computationally difficult to handle as the state space grows exponentially we presented the analytical model for analyzing WDM switching networks.

In 2004, Ayman Kaheel et al. [4] proposed an analytical model for evaluating the blocking probability in Just-Enough-Time-based optical burst switching networks. The signaling protocol used in an OBS network is crucial in determining the blocking probability for data bursts in the network.

In 2003, Zvi Rosberg et al. [5] propose that a new and unified reduced load fixed Point approximation model to evaluate the blocking probabilities of various policies in an OBS network, OBS bursts use the path links in a time-synchronized manner, while packets use them asynchronously propagation delay is significantly larger than burst transmission time, multiple bursts could simultaneously propagate not only along the same route but also along the same link and wavelength.

In 1998, Ashwin Sridharan et al. [6] proposed there is a term traffic grooming, which permits multiple sub-rate traffic streams to be carried on the same wavelength many traffic streams do not require the bandwidth of an entire wavelength. In fact, a traffic stream may need only a small fraction of the bandwidth A traffic stream can use one or a multiple of these sub-rate units In traffic grooming, lower-rate traffic streams are multiplexed and de-multiplexed onto higher capacity WDM wavelengths, in order to improve wavelength utilization.

3. Computational model of Blocking Probability

The blocking-probability derived from the Erlang distribution to describe the probability of call loss on a group of circuits (in a circuit switched network, or equivalent). It is, for example, used in planning telephone networks. The formula was derived by Agner Krarup Erlang and is not limited to telephone networks, since it describes a probability in a queuing system (albeit a special case with a number of servers but no buffer spaces for incoming calls to wait for a free server).Here our mathematical model use multi-dimemional operations of random vectors or matrices to deal with multiple types of traffic and the both up- and down transmission directions in one time. Employing the mathematical model, we obtain call blocking probability and the optimum time slot Switching-point with the smallest call blocking probability re obtained. Network models it provides a framework for analysis and Performance evaluation of OBS networks. In particular, a new reduced load fixed point approximation Model to evaluate blocking probabilities in OBS networks is introduced. The model is versatile enough to cover known OBS reservation policies such as Just-Enough-Time (JET), Just-In-Time (JIT), Burst Segmentation and Route-dependent Priorities.

3.1.1 Network Structure

Let a network that comprises a set of nodes connected by a set of trunks. Each trunk comprises fibers, each of which supports wavelengths. Therefore, a trunk carries wavelength channels called links. Each unique pair of origin and destination nodes forms a directional origin-destination (OD) pair. The set of all OD pairs in the network is denoted. Directional OD pairs have considered, so represents an OD pair with being the origin and the destination, then and are two different elements in. The traffic demand of each OD pair is composed of bursts transmitted from to that follow a Poisson process with parameter. The burst lengths are exponentially distributed with unit mean. The well-known result has been noted; that the blocking probability of an M/M/k/k system, known as the Erlang B formula, is dependent only on the mean of the service time and it is insensitive to higher moments of the service time distribution. In other words, the Erlang B formula applies to the more general model known as M/G/k/k. This important result has been proven by many authors during the last century. This indicates that the end-to-end results may also not be too sensitive to the distribution of the burst lengths and will mainly depend on their mean. Let us consider a directional pair of nodes, where. This pair of nodes is not necessarily an OD pair and both and can be intermediate nodes in a route between two origin and destination nodes. Let be the set of routes from node to node. The route between and is denoted, so. In networks where a given pair of nodes has more than one route (i.e.), one of the route with the least number of hops is referred to as the primary route denoted .All the other possible routes from to are referred to as alternate routes.

3.1.2 Burst Forwarding

At source node, all bursts with destination node are transmitted on the first trunk of the primary route. At each intermediate node, the burst is forwarded on the next trunk in Primary route until it reaches destination node. If at any node, including the source node, all the links on the trunk of the route are unavailable, the burst is deflected onto an alternate route. If the burst is deflected at node, then the set of alternate routes is preference is given to shorter routes followed by pre-assigned ordering. A given burst is permitted to be deflected at most times. A burst is considered blocked (discarded/lost) if it arrives at a given node where all output trunks are busy or while trying alternate trunks, the burst reaches the maximum allowable number of deflections .In the model assuming an ideal case with no guard bands between bursts. In addition, we do not consider specific OBS reservation protocols, scheduling algorithms, or partial wavelength conversion. Finally, note that the results presented in this paper are equally applicable to a network with no wavelength conversion which has, instead of, fibers per trunk.

3.1.3 Wavelength Reservation

In a network with wavelength channel reservation, some of the capacity on each trunk is reserved for bursts that have not been deflected. Bursts belonging to OD pair, on the primary route between OD pair, are un-deflected bursts. In our network model, we set wavelength channel reservation threshold on each trunk. If the number of links occupied on trunk is greater than or equal, only un-deflected bursts are permitted to use that trunk.

4. Theoretical Model

Consider a WDM switching network as shown in Figure 1. There are *N1* incoming fibers and *N2* outgoing fiber links to the network. The multiplexing degree which corresponds to the number of incoming channels (wavelengths) per fiber is *M*. The network has a provision of a pool of "K" wavelength converters. Each incoming wavelength from the fiber is separated using de-multiplexers

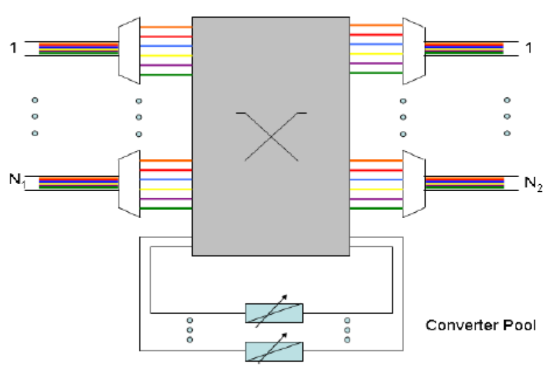

Fig.1. WDM network model [3]

The internal design of the switching node switches the incoming connection requests of particular wavelengths to switching elements specific for those wavelengths. The switched wavelength is sent to the multiplexer of the respective route. In case if the wavelength on the outgoing wavelength is already occupied then the incoming connection request is internally switched to tunable wavelength converters Each tunable wavelength converter can receive wavelength from any switching element and converts to the wavelength which is free on the outgoing fibers and send the wavelength to the respective switching element.

Considering switching network as primary group of n1 servers and wavelength converters as secondary groups n2 servers respectively (fig. 2), the above system can be assumed as an overflow traffic model with following assumptions. The arriving requests exhibit Poisson distribution with intensity λ. The holding time distribution is negative exponential with parameter μ. With parameters λ and μ the intensity of offered traffic is given as λ/ μ. The incoming request is initially offered to primary servers. If all primary servers are occupied then the traffic is over flown to the secondary servers forming an interrupted Poison process (IPP) with traffic intensity α. If all the servers in secondary group are occupied then the incoming request is completely blocked. · The connection on the converted wavelength will simultaneously keep the possession of wavelength converter as well as outgoing fiber as long as it exists. The primary servers have not only to serve the incoming requests but also the converted wavelength requests. With each converted wavelength the number of servers is reduced to serve the new incoming requests. The primary and secondary groups jointly form loss system where number of servers is equal to n1 + n2. The division of the capacity into two parts does not affect the overall behavior of the system, as it always forms M/M/n system. Equivalent random theory (ERT) method provides an approximate method to calculate the blocking

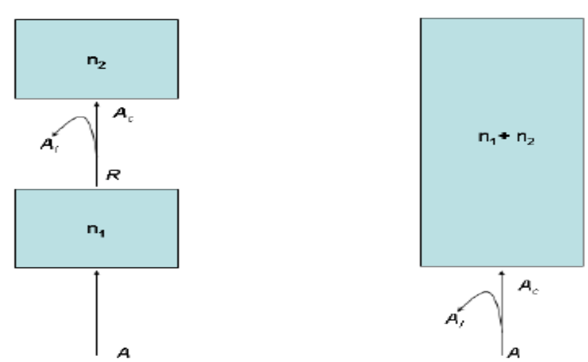

Fig.2. Block diagram representation of overflow system [3]

Probability for non-Poisson traffic .The traffic is defined using mean intensity R and variance V of the occupancy in an infinite system. For the case of

several independent contributors the mean intensity and variance is equal to the sum of individual mean intensities and variances respectively. The idea of ERT method is to get a traffic (R, V) from a fictitious channel with offered traffic A* and number of servers N*. The values of A* and N* are such calculated that the overflow traffic in the fictitious channel has intensity R and V. The values of A* and N* are calculated numerically as described. Thereafter the blocking in the overflow channel is calculated as: ( ). , 1 *R A**E N* + *N** *A** (**1**) and the total blocking of the system are calculated as:
( ). , 1 Σ * + * * *I i A A E N N A* (**2**)

5. Conclusion

In this review paper, we examines blocking probability computational model, for calculating the probability in optical burst switched network due to insufficient transmission calls blocked by network congestion during the busy hours and our main focus is that packets /data are found at the destination or not and retransmits the packets /data which is not transmitted during the busy hours of network congestion in a timely manner to avoid traffic in the network.

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