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Survey on Blocking Probability and Load Balancing Over WDM Networks in MPLS System

Shivani Sharma[1], Chandni Thakur[2]

Department of ECE, SRI SAI University, Palampur, India[1]

V.P.O. Sungal District, Kangra (H.P.) India[2]

Abstract: Multi-protocol label switching is a great solution for problems like scalability, quality-of-service, bandwidth-management, and traffic engineering faced by networks. It is believed that MPLS make an internet environment more efficient for more customer satisfaction. In this paper, our main focus is on the load congestion and blocking probability when traffic is overloaded. In the network load congestion occur. When network resources are too short to accommodate the offered load. It means that the system is completely occupied and the new incoming call undergoes in blocking state. In this paper survey on load congestion and blocking probability is done. This paper also represents MPLS contributing high scalability in computer networks.

Keywords: Blocking Probability, Traffic Congestion, Erlang, Traffic Engineering, Load Balancing.

I. INTRODUCTION

The field of fibre optics communications has exploded over the past two decades. Fibre is an integral part of modern day communication infrastructure and can be found along roads, in buildings, hospitals and machinery. Fibre-optic communication is a method of transmitting information from one place to another by sending pulses of light through an optical fibre. The light forms an electromagnetic carrier wave that is modulated to carry information.Main motivation of fibre optics is to meet demand of increase in the telecommunication data transmission. It totally works on the total internal reflection (critical angle, using Snell's law). An optical fibre is flexible, transparent fibre made of high quality extruded glass (silica) or plastic, slightly thicker than a human hair. It includes a core surrounded by transparent cladding material.

1) Importance of Optical Fibre

- Fibre optics is thinner and more flexible; therefore they are lighter and take up fewer places.
- They can carry more information.
- They use less power and more efficient because they don't degrade as much as overtime.
- They are better suited to carrying digital signals.
- There is no electricity passing through them.

II. MPLS IN OPTICAL NETWORK

Multi-Protocol Label Switching (MPLS) was developed as a packet-based technology and is rapidly becoming key for use in core networks, including converged data and voice networks. MPLS does not replace IP routing, but works alongside existing and future routing technologies to provide very high-speed data forwarding between Label-Switched Routers (LSRs) together with reservation of bandwidth for traffic flows with differing Quality of Service (QoS) requirements.

MPLS uses a technique known as label switching to forward data through the network. A small, fixed-format label is inserted in front of each data packet on entry into the MPLS network. At each hop across the network, the packet is routed based on the value of the incoming interface and label, and dispatched to an outgoing interface with a new label value. The path that data follows through a network is defined by the transition in label values as the label is swapped at each LSR. Since the mapping between labels is constant at each LSR, the complete path is determined by the initial label value. Such a path is called a Label Switched Path (LSP). A set of packets that should be labelled with the same label value on entry to the MPLS network, and that will therefore follow the same LSP, is known as a Forwarding Equivalence Class (FEC).

III. BASIC MODEL OF MPLS

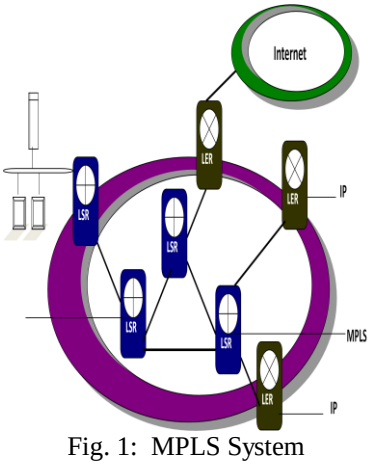

Fig. 1: MPLS System

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IV. MPLS CLASSIFICATION

A. Call Blocking Probability in MPLS system:

The blocking probability describes the probability of call loses in a group of identical parallel resources (telephone lines, circuits, traffic channels). The formula for the blocking probability (P_b) is known as Erlang B formula. The mathematical representation of blocking probability (P_b) is given below. Where A is the traffic intensity and C is the number of channels.

The formula applies under the condition that an unsuccessful call, because the line is busy, is not queued or retried, but instead really disappears forever. It is assumed that call attempts arrive following a Poisson process, so call arrival instants are independent.

B. Erlang method in MPLS:

(E) is a unit of telecommunications traffic measurement. It represents the continuous use of one voice path or it can be said that it is used to describe the total traffic volume in one hour. For example a channel that is occupied for 30 minutes during one hour carries 30/60 = 0.5 Erlang of traffic.

C. Traffic Engineering technique in MPLS system:

The Traffic engineering uses statistical techniques such as queuing theory to predict and examine the behaviour of telecommunications networks such as telephone network and the internet. The motivation of traffic engineering is to reduce the overall cost of operations by more efficient use of bandwidth resources. It means that to manage the traffic and distribute in such a way that channels are neither be over utilized nor underutilized. So some segments of a network can be very congested while other segments along alternative routes are underutilized. To optimize the utilization of resources in a network, an important network optimize technique Traffic Engineering is introduced.

D. Congestion Control:

Congestion occurs when a node or a link carries so much data that it may decline the network service quality. The primary cause of the network congestion is the unbalanced distribution of the network traffic. Traditional routing algorithm like OSPF computes the shortest way to reach destination which is based on destination address. It means that traffic from different sources passing through a router with the same destination assembled and sent through the same path. By these two problems arises, first one the shortest paths from different sources overlap at some links, causing congestion and over utilized.

Second is the longer path are underutilized. Due to congestion the data packet loss, blocking of new connection and delay in packets occurred in the network. It may slow down the network performances. There are different types of routing algorithm like Dijkstra routing algorithm, load balancing algorithm using deviation path and constraint based routing algorithm are used to reduce the blocking probability and congestion problem.

V. RELATED WORK

There are number of work having been considered to reduce the blocking probability and congestion which increased the efficiency of the network. In [1] Shah ram Mohrehkesh, Selah Yousefi, Mahmoud Fathy Faculty of Computer Engineering, Iran University of Science and Technology (IUST) proposed a paper about a new path computation algorithm in Traffic Engineering in MPLS networks for reducing blocking probability of requests about an improvement of TEDB algorithm. The TE-DB is one of best path computation algorithm which is proposed in literatures. The Algorithm deploys multiple path routing and distributes the load more balanced in network. In addition, it reduces the blocking probability of requests. Reducing probability of blocking and distributing load are two important objectives in Traffic Engineering which TEDM improves these two parameters. Four heuristic algorithms are proposed for distributing load among multiple paths. The algorithms are simulated by MATLAB. The results show that TEDBM reduces the blocking probability about 50% in average and distributes the load more balanced than the TEDB algorithm. Hence, the network utilization is also increased. In [2] Haris Hodzic1, Elmir Secerbegovic has investigated the MPLS Traffic Engineering (MPLS TE). The MPLS is one of the fastest growing implementation. MPLS adoption in service provider networks has increased manifold due to its inherent TE capabilities. A purpose of traffic engineering in a network is to setting up paths between the edge nodes of the network to meet traffic demands while optimizing network performance. It is known that total traffic throughput in a network, or resource utilization, can be maximized if a traffic demand is split over multiple paths. MPLS networks can use native TE mechanisms to minimize network congestion and improve network performance. MPLS TE also relay on class of routing algorithms called online routing algorithms to avoid occurrence of congestion and to optimize network resource utilization, but primary objective is to try to minimize the probability of blocking future requests for creation of the new LSP´s on the network. In [3] Ranju Pant_, Teerapat Sanguankotchakorny of Asian Institute of Technology, Thailand proposed a paper that explicit path setup and constraint-based routing make Multi Protocol Label Switching (MPLS) a suitable technology to consider QoS constraints of the user and traffic engineering (TE) objectives of the provider. This work focuses on the problem of selecting bandwidth guaranteed path for MPLS based networks. The selected path should also fulfil the provider's objective of reducing the blocking probability of requests. We achieve this dual target by combining the best of load balancing (to avoid bottle-neck links) and load packing (to avoid resource defragmentation). In addition to this, we also take into consideration the granularity of requests. We further exploit the offline or pre-processing phase for complexity reduction and online phase for interference reduction. Simulation results show that our algorithm is able to reduce the blocking probability of requests in the network for different arrival distribution

(uniform or non-uniform) and varying demand size (small or large). In [4] Fenglin Li and Jianxun Chen Wuhan University of Science and Technology, Wuhan China proposed a paper about load balancing in MPLS TE. He proposed a new load balance algorithm called load balance algorithm using deviation path. Multiple Protocol Label Switching (MPLS) uses its explicit routing technology to implement traffic engineering. The new algorithm is based on this advantage of MPLS and is used to achieve load balance of traffic engineering in MPLS network. The simulation results of Network Simulator (NS2) showed that this algorithm can effectively balance the workload between different links and can improve the network performances with lower delay, smaller loss rate and higher throughput. In [5] Eric W. M. Wong, Senior Member, IEEE, Jay ant Baliga, Moshe Zukerman, Fellow, IEEE, Andrew Zale sky, proposed a paper in which he 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. However, it requires certain wastage due to trunk reservation that must be used to avoid instability. We provide a wide range of simulation and numerical results to validate our new approximation method and demonstrate various effects on blocking probability and utilization, such as network size, trunk size, the maximal number of allowable deflections, and burst/packet length.

VI. CONCLUSION

Traffic Engineering (TE) refers to the process of controlling traffic across a network with the purpose of balancing the load on various links, routers and switches, to make the use of available bandwidth easy and increase the cost efficiency. TE is concerned with performance optimization of operational networks. In MPLS traffic engineering is performed by IP or ATM depending on the protocol. Traffic engineering has become a very important issue in optical networks. MPLS in optical networks are generally used to provide a very high speed of data transmission for huge amount of data. So the performance optimization of MPLS is very much required.

The performance of MPLS network can be measured on various parameters such as blocking probability, traffic congestion, load balancing, packet loss etc. Various algorithms and techniques have been proposed to measure, control and improve all these parameters. We analysed that Erlang methods are better than the other techniques like Dijakstra algorithm. But still lot of improvements can be done on these techniques to achieve desired results.

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