Dynamic WDM Routing solutions

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Abstract

Optical wavelength-division-multiplexing (WDM) networks are being increasingly deployed in the next generation wide area, metropolitan, and local area network infrastructures. WDM is widely becoming accepted as a technology for fulfilling the increased demand of bandwidth in various applications. It establishes communication between pairs of network nodes by establishing paths and assigning wavelength to each path. In this paper, a WDM routing strategy has been proposed. It is dynamic in selecting available wavelengths and process with accordance to the number of channels assigned with the links. It helps in congestion control by symmetrically distribute the data on the links. Proposed algorithm with congestion control in WDM optical network which will improve congestion hit network and will provide us with good cost cutting as it can be implemented to developing countries due to low costing factor.

Keywords:- Optical wavelength-division-multiplexing, Channel allocation, Optical Switches, Blocking probability

1. Introduction

Communication networks reach more people every day, providing new means of information exchange. Consequently, traffic demand is growing rapidly (exponentially), mainly due to data-centric applications, as reported by many service providers [2]. This growth is triggering the development of new technologies, and the advance of existing technologies. Methods to exploit these advances need to be developed to build our future knowledge society.

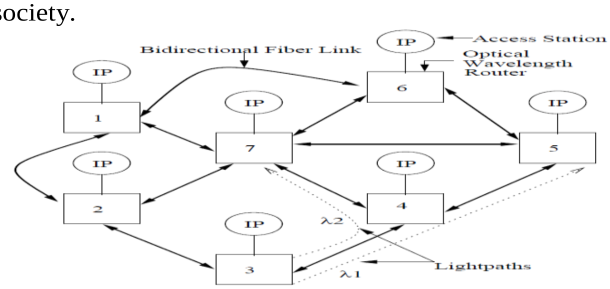

Figure1: Architecture of a WDM Network.

The major technology that is promising to meet the high bandwidth demand of data networks is optical networking. Optical fibre has been used as physical medium by many networking technologies, such as SONET, ATM, due to its high bandwidth and low signal degradation. Optical networks, on the other hand, are designed to exploit the fibre's unique properties, and they are separated from the other fibre-based technologies with this characteristic. The potential bandwidth of a fibre is nearly 50 Tb/s, a speed that today's electronic processing capacity cannot match. Such a large bandwidth can be used by dividing it into smaller bands or channels, and using these channels concurrently. This can be accomplished by a multiplexing technique. Among time division multiplexing (TDM), code division multiplexing (CDM), wavelength (or frequency) division multiplexing (WDM), optical TDM and CDM are futuristic technologies today [3].

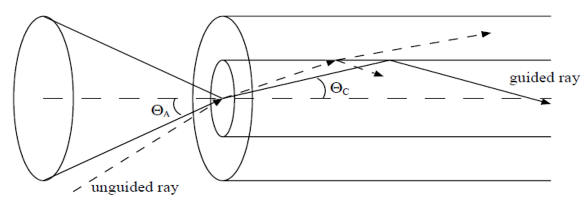

Figure 2: Propagation of guided rays in fibre [3]

Normally optical signal loses its energy because of the transmission impairments in a fibre. Long distance optical transmission is possible only by signal amplifiers that provide a power boost to the signal. The three types of amplifiers are Semiconductor Optical Amplifiers (SOA), Erbium-Doped Fibre Amplifiers (EDFA), and Raman Amplifiers. Among them EDFAs can be used for long distance links, such as submarine fibres, placing them every 80 km along the link. Each of the type has specific spectral range and amplification gain. The gain of EDFA is between 25-51 dB, and its spectral range is 35 nm around 1550 nm.

Optical amplifiers can be placed in three different positions in a link. Power amplifier is placed at the beginning of a link to give a power boost to the clear signal. Pre-amplifier is placed before the receiver, and the line amplifier is placed in the fibre. A recent technology uses a circuit of EDFAs to fully exploit the spectrum of all-wave fibre and it is called *ultra wide-band* EDFA[3].

The various routing strategies are discussed below:

1. First-fit algorithm: In this algorithm, first the wavelengths of the traffic matrix are sorted in the non-decreasing order. Then the algorithm steps through this sorted list for selecting candidate chains joined. Let u_{ij} be the next highest wavelength element in the sorted list. Then, if both the nodes i and j are the end nodes of the two chains, the largest chain is formed by joining the two ends, otherwise the next highest element is considered. This process is carried on until all the chains are considered to form a single chain representing the linear topology.

2. Random algorithm: In this algorithm the wavelength is selected randomly from the available wavelengths. In this algorithm a number is generated randomly and wavelength is assigned to this random generated number.

2. Problem Definition

Optical Wavelength Division Multiplexing is a good solution for networks with huge transmission of traffic is transferred. Normally congestion occurred regularly and it became big bottleneck to flow of data in process. Many strategies are there to avoid but those strategies usually add huge cost associated with quality assurance. These strategies are applicable to the area which is rich in infrastructure and resources but these strategies are very difficult to implement and acceptable in areas where resources are very less (for example: poor countries).

The focus was on to develop a better solution to this problem as to solve congestion issues and to deduct the cost in term of implementation by reducing the devices used in network setups. The proposed survivability strategic algorithm with congestion control in WDM optical network which showed improvement in congestion hit network and it provided us with good cost cutting as it can be implemented to developing countries due to low costing factor.

3. Research Methodology

In this paper, optical routing strategy has been used and for fulfilling the milestones following crieteria are fulfilled as discussed below:

A. Objectives

The network efficiency and quality with accordance to cost is the ultimate target. Some of the targets in parts are fulfilled in following objectives:

- Finding dynamic nature of WDM routing.
- Optimizing the dynamic routing process
- Comparison of the already existing routing.

B. Research Methodology

The research is focused on the prevention of congestion in Wavelength division multiplexing optical networks. We started it in Network simulator version 2 (NS2). We have done implementation with start of literature and found that optical dynamic routing is a good fit for routing process in optical networks. We have done implementation of already proposed algorithms known as random fit and first fit which are static in nature. In making dynamic routing, we find the routes from source node having one or more free wavelengths and list them. We have chosen first two routes R_1 and R_2 from the list through shortest route algorithm. These routes have been considered as primary and secondary routes for communication. Various parameters for this experimentation such as Length of route, Maximum possible cost, Maximum route time, load, Number of hops, average load will be calculated by simulator at backend as defined with optical channel properties. Further we have implemented the sorting of available routes with shortest route algorithm. S-D pair structure has been considered and routes are arranged accordingly. Comparison will be there to reflect the changes in dynamic routing. Finally comparison with static algorithm for routing has been done. Blocking probability is use as parameter for judgement.

4. Experimentation

The various attributes used for experimentation is given below:

Parameters	Value
Simulator	NS2
Simulation Time	90
No of nodes	10
Routing Strategy	WDM
Traffic Model	CBR
Pause Time	100 sec
Channel	Optical

Table 1: Attributes used for experimentation.

The experimentation has been done on ten nodes and blocking probability has been considered for comparison. The various results have been shown below with fixed number of nodes and variation in load:

A. With Two variation

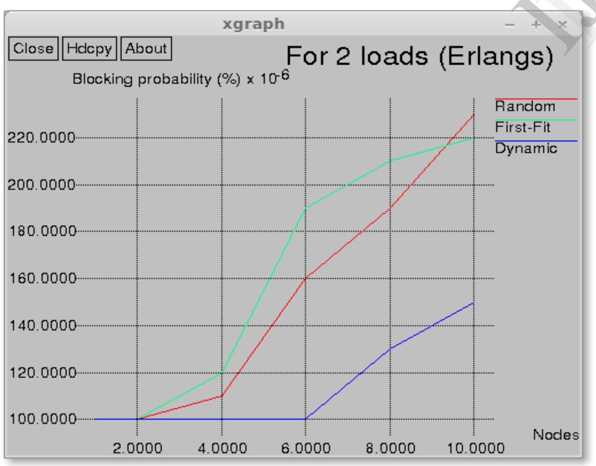

Figure 3: Blocking Probability (%) with two Erlangs for random fit, first fit and proposed conversion

B. With Four variation

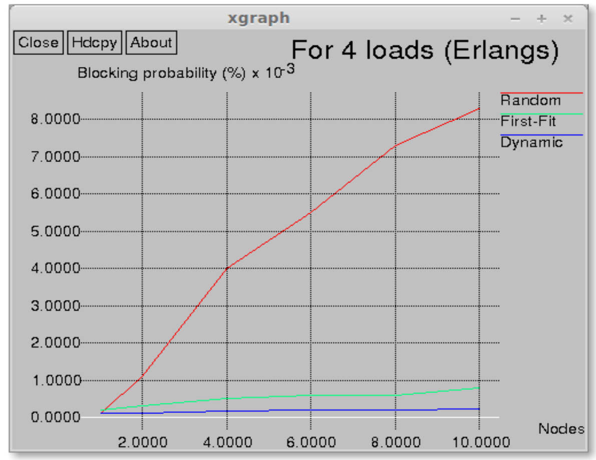

Figure 4: Blocking Probability (%) with four Erlangs for random fit, first fit and proposed conversion

C. With Six variation

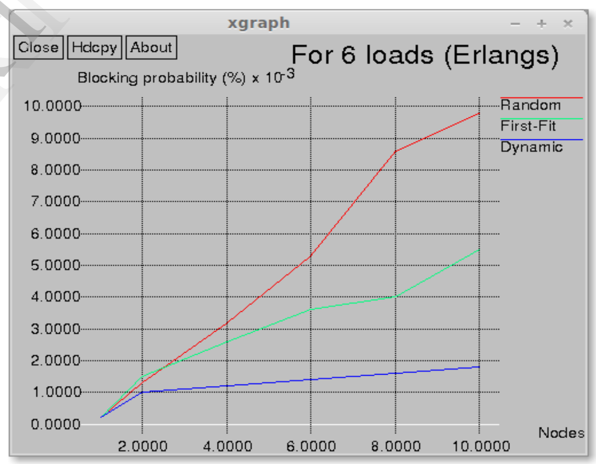

Figure 5: Blocking Probability (%) with six Erlangs for random fit, first fit and proposed conversion

D. With Eight variation

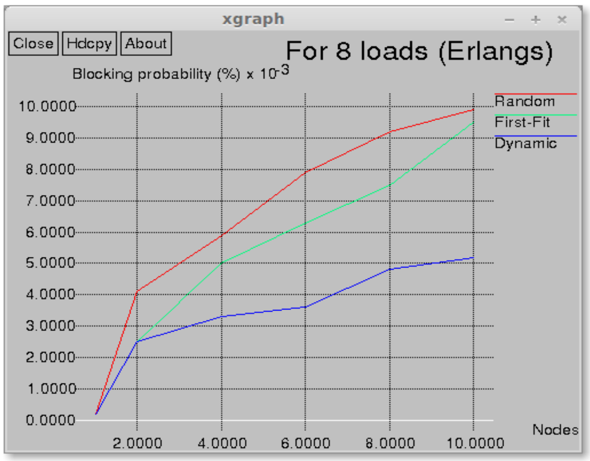

Figure 6: Blocking Probability (%) with eight Erlangs for random fit, first fit and proposed conversion

E. With Ten variation

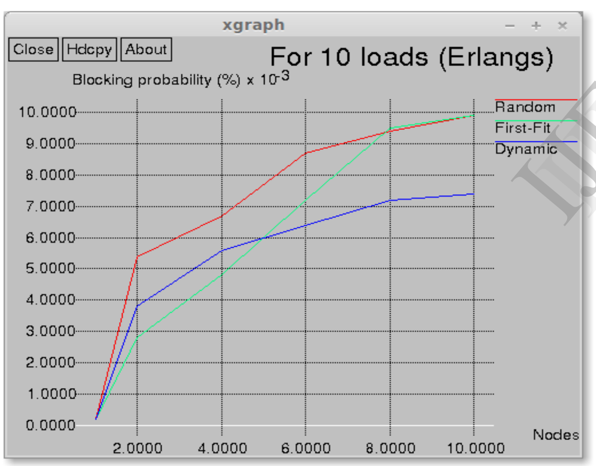

Figure 7: Blocking Probability (%) with Ten Erlangs for random fit, first fit and proposed conversion

Our research saves a lot of resources for communication by improving blocking probability and make network more agile with very less delay.

5. Conclusion

In this paper, we first discussed survivability problem in WDM optical network, then the focus was on commonly used survivability strategy in optical network which is dynamic in nature. We have done experimentation which reduced the blocking probability by trying to symmetrically distribute the traffic over the links to better utilize the resources and it helps in congestion control. The proposed strategy result give better performance the existing strategy in terms of blocking probability and congestion control.

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