Circuits and Systems, 2016, 7, 1068-1077
Published Online May 2016 in SciRes. http://www.scirp.org/journal/cs
http://dx.doi.org/10.4236/cs.2016.76090

Blocking Probability in All-Optical WDM Network Using IMCA

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Received 1 March 2016; accepted 23 May 2016; published 27 May 2016

Abstract

The analysis of WDM (Wavelength-Division Multiplexing) optical network is essential to have the routed wavelength blocking probability with the conversion of wavelength using techniques. In this paper, an enhanced analytical model is proposed to evaluate the blocking performances in topology network and to improve the performances of reduction of blocking probability. The variation of probability is based on the wavelength and load used in the network. The conversion is carried out with the support of optical backbone of the inherent flexibility of the network using the proposed IMCA in Sparse-Partial Wavelength Conversion (SPWC) architecture. It reduces the number of converters significantly with efficient process and provides placement scheme of wavelength converters in the network. The proposed model utilizes the network with the assignment and routing of wavelength using dynamic process of assignment algorithm. The proposed model provides dynamic and static routing process with the range limit to have a minimum conversion for the same probabilities of blocking. The proposed system analysis and the simulation results show the better performances in faster coverage, minimum number of conversions, blocking probability improvement for high load.

Keywords

Wavelength Conversion, Converters Algorithm, Blocking Probability, WDM, Routing, Conventional Network

1. Introduction

In a rapid growth of communication network the internet traffic also increases faster and in data communication the system becomes reliable. Wavelength Division Multiplexing (WDM) is possibly used in optical fiber to unlock the bandwidth by using the most controlling technique. By different channel of wavelength the optical sig-

How to cite this paper: Karpagarajesh, G. and Vijayaraj, M. (2016) Blocking Probability in All-Optical WDM Network Using IMCA. *Circuits and Systems*, **7**, 1068-1077. http://dx.doi.org/10.4236/cs.2016.76090

nal is passed through the same fibers. The Dense Wavelength Division Multiplexing (DWDM) is implemented to verify the differences between the various technologies from the WDM system. Normally the less capacity of fiber fraction is used to exploit the efficiency with more efficiently.

In order to establish the route connection between pair network the Routing and Wavelength Assignment (RWA) algorithm is required for efficient access by establishing light path. The data transmitting is carried out with a high-bandwidth pipe, gigabits per second is required for data transport and unique identification of wavelength and physical path.

The distinct wavelength assignment constraint is required for efficient access and better selection of the route along with a link for quick processing of data access. A wavelength converter is capable of wavelength shifting with corresponding parameters of data format, wavelength, bit-rate, power and polarization. By this converter the performance of the output is provided with high ratio of extinction and low noise. The continuity constraint is avoided by this conversion method and the performance of blocking is improved.

In optical network blocking probability evaluation is done through the generalizing of approximation techniques of reducing load. It is carried out with the least loading routing and fixed routing. It increases the capabilities of converter role with flexibility. The issues of placement and routing are resolved by implementing a new algorithm of conversion [1].

Based on the conversion process of online routing, the corresponding process of connection is calculated and the blocking probability of the conversion wavelength is also estimated. Also, it required high statics of simulation and complex in nature. The reduction of blocking probability provides better network performances with good outputs. **Figure 1** shows the wavelength conversion in the network.

In this paper, the analysis of Sparse-Partial Wavelength Conversion (SPWC) network leads to achieve a probability of blocking with reduction and better performances of the light path through the wavelength converter [2]. By applying the efficient placement and routing in the network the probability function is performed according to the utilization of data access to and from in the network. The Sparse-Partial Wavelength Conversion (SPWC) network architecture is integrated with the conversion process and wavelength routing. So the conversion process reduces the converter count and provides flexible access in routing network.

The optical wavelength division multiplexing network technologies assure the deliver data by multiple wavelengths over several channels at the same time. Moreover, the cost becomes a cost-effectively unpleasant one for high speed of electronics. It will reduce based on generating the revenue in WDM network. The routing nodes are interconnected in the network by the point to point fiber link and each will refer to each other for transmitting and receiving of data. By continuous route of wavelength for sending messages to and from is mentioned as light path. It optimizes the optical conversion to the domain using WDM cross-connects [3].

In previous work SPWC architecture is developed and optimized, but in proposed approach the architecture is designed with the impact of placement and resolving of assigned issues. Also, the blocking probability is evaluated according to the proposed conversion network. The Improved Minimum Converter Allocation (IMCA) is proposed and utilized the converter of wavelength with the complete process of conversion and blocking probability estimation in wavelength-convertible network.

The rest of the paper is organized into section wise, in Section 2 the literature survey of the Wavelength Conversion is carried out. In Section 3 the proposed approach is discussed with its implementation. In Section 4 the performance analysis of the proposed approach and the probability performances is plotted and discussed. Finally, the conclusion of the paper is presented in Section 5.

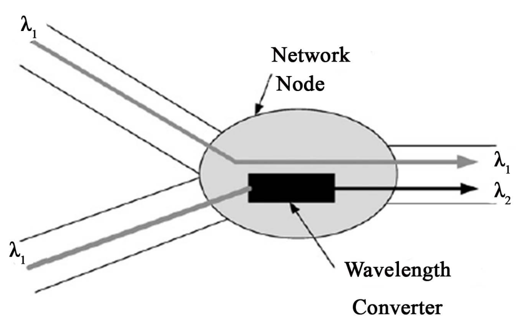

Figure 1. Wavelength conversion.

2. Related Work

In this section the literature review of wavelength conversion and the blocking probability is discussed. All optical networks consider the wavelength converters in routed WDM and consists the constrained in minimum blocking process. To resolve the blocking issues many converters algorithms are implemented and obtain the results using simulation. It enhances large paths in blocking chances to have minimum converter function [4], [5].

In various applications the wideband network has the bandwidth demand and it required to meet the huge bandwidth in optical networks. The transmitting of enormous data are consists around 50 Tera bits per seconds (Tbps) speed and it point out the probability of the function. It explodes the function with the parameters to evaluate the chances of blocking. Finally, it provides 50% of convertible nodes with the available wavelength [6].

The wavelength conversion technique is used to improve the performances of blocking optical network. To resolve the issues, sparse-partial wavelength conversion (SPWC) network architecture is developed with flexible process of conversion. It carried out the conversion with full wavelength to have a better process than the previous conversion and it provides only 1% - 5% of the capability of wavelength conversion [7] [8].

The impact of converters reduces the chances of blocking at the network by designing the topology and it is analyzed by the establishment of static and dynamic light path. The dynamic RWA algorithm is carried out in the conversion, but it has some limitation. So the routing and placement algorithm of first-fit wavelength assignment (WLCR-FF) algorithm and weighted least-congestion routing is considered for both the load and route process with traffic [9] [10].

The assignment and routing strategy will help to improve the blocking probability by using a wavelength converter placement algorithm. It examines the RWA algorithms to have an efficient process of random routing and placement with minimum conversion [11]. Based on the Blocking Island (BI) paradigm the issue of blocking at the network is resolved and it provides general process of routing and placement algorithm in optical networks. The performance is compared with the various heuristic algorithms under the assumption of both dynamic and static traffic [12]. In the improvement of blocking sparse wavelength conversion and the algorithm of routing and placement is implemented. In that the Least-Loaded Routing (LLR) algorithm and Fixed-Alternate Routing (FAR) algorithm is considered for the placement problem. It considered minimum converter of wavelength by weighted maximum segment length procedure [13] [14].

3. Proposed Work

In this section, the proposed approach of light path routing and placement of wavelength conversion is developed and implemented with the estimation of blocking probability of the system. The architecture of SPEC network is same but the algorithm used for the converter is modified for better performances than the existing. After applying the proposed algorithm, the light path utilization and the blocking probability performances are improved. The reduction of probability is provided in an efficient manner.

In a network the dynamic process of link utilization is performed to estimate the conversion of wave length probability. To have a better light path passing and low blocking probability the placement and routing technique is implemented. The proposed assignment algorithm in the conversion is consisting to have minimum converter process and less blocking chance with better improvement in the light path.

The full conversion process of wavelength is considered to be a light path. But in the proposed approach the transmission of data to and from with full utilization is provided in an efficient and easier manner than the existing. In network system the link utilization, Minimum converter allocation wavelength assignment algorithm modification and the estimation of blocking chances in the network is carried out.

The analysis of link utilization shows the chances of blocking at the network. The complete conversion of wavelength is considered with the traffic ratio of blocking at the network. The probability of the route which used to reduce the load and efficient connection process for data transmission is consists as given below.

$$P = \frac{\sum_n \left(A_n B_{R_n} \right)}{\sum_n A_n} \tag{1}$$

According to the process the link behavior of the serving and arrival of the system is in the form of l (loss of the system server). Therefore the network traffic is determined as given below and the route set up is used to estimate the chances of blocking when traffic occurs in the network. It provides free wavelength and shows the better light path. As given in Equation (3) the estimation of blocking probability is carried out in an efficient manner.

$$\alpha_a\left(1-x_a\left(0\right)\right)=\sum\nolimits_{n,a\in R_n}A_n\left(1-B_{R_n}\right) \tag{2}$$

$$B_{R_n}=1-\prod\nolimits_{i=1}^{h(R_n)}\left(1-x_{R_n}\left(i\right)\left(0\right)\right) \tag{3}$$

where α_a is represents the function of the distribution process of connection request of link, R_n & B_{R_n} as blocking probability in route, $x_a\left(m_a\right)$ as the chances of free wavelength in the network. The average utilization is estimated as given below.

$$WU=\frac{T\times\left(1-B\right)\times L}{W\times J} \tag{4}$$

where the blocking is denoted as *B*, The total traffic is as *T*, *L* as load, *W* for wavelength and J is the link in the network. The process of analysis of bypassing traffic is carried out as in SPWC of existing.

The placing of wavelength is consisted with the light path function with the limits and concurrently the node is bypassed in the light path. The conversion processes are used for the bypass utilization and have a complete process of conversion in a flexible manner. Based on the request the process of utilizing the SPWC network is carried out with better converter function in the system of routing and placement. The issue of placement of wavelength converter is resolved by selecting the free wavelength light path in the network.

The Improved Minimum Converter Allocation (IMCA) of wavelength assignment algorithm is developed to have flexible access with less blocking chances and less converter of wavelength in the network. It improves the utilization of converters and light path in choosing free wavelength.

The analytical Model of the proposed approach is the estimation of blocking probability. The work flow of the proposed system is shown in **Figure 2**.

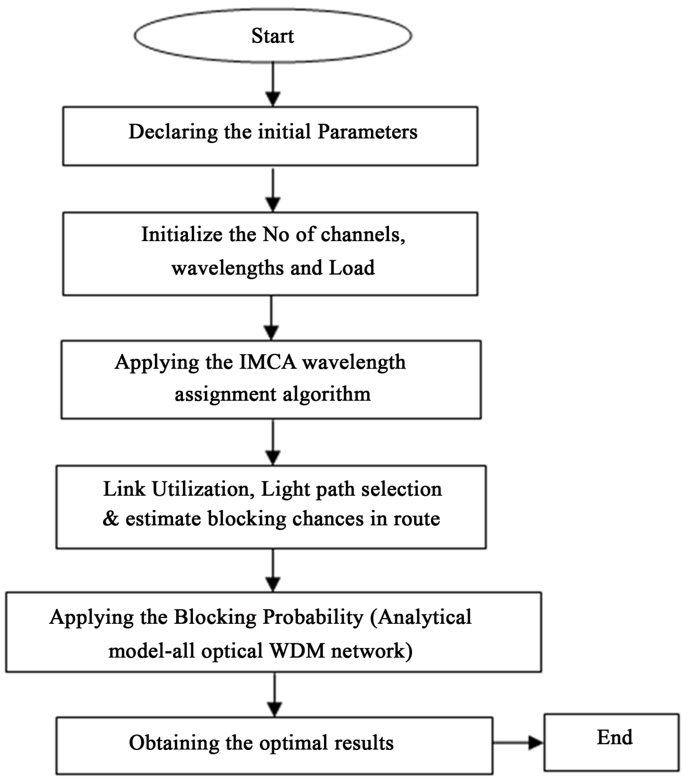

Figure 2. Flow work of proposed approach.

The probability estimation of blocking in all-optical WDM network is considered in the conversion process of wavelength. It represents the parameters of the optical network with and without the wavelength conversion. The light path establishment is considered with the direct process of routing and sets of nodes in the network. In proposing approach the connection of routing is included with the blocking occurrences of wavelength $\left(P_W^r\right)$ and conversion $\left(P_C^r\right)$.

In WDN network the node set as N, directed link as E and direct route as R (r belongs to R) is considered for the establishment of the light path. The all optical networks blocking probability $\left(P_B^r\right)$ are evaluated by applying the following equations.

$$\left(P_B^r\right)=\left(P_W^r\right)+\left(P_C^r\right);\ r\in R \tag{5}$$

$$P_B=\left[\frac{\sum_{r\in R} L_r\left(P_W^r+P_C^r\right)}{\sum_{r\in R} L^r}\right]-\frac{T_B}{T_C} \tag{6}$$

where T_B represents the total blocked calls in the network and the total call generating is denoted as T_C and finally the blocking probability as P_B.

4. Performance Analysis

In this section the analysis of blocking probability in wavelength-convertible network and the proposed approach of converting are estimated to show the better performance than the existing. In optical WDM network the blocking chances by lack of sufficient converter of wavelength is evaluated with the load, wavelength and the nodes. The analysis of the results shows the performances of the system with the improvement in blocking reduction, better selection of the light path and solution for the assignment problem, minimum conversion and fast process. The analysis is made under various load condition in the estimation of probability.

The analysis of the conversion scheme is considering with the topology and compared the performances with existing schemes. The performance analysis of the proposed approach is considered with the estimation of blocking probability for various nodes.

In this process the load and channels are fixed with 3 and 4 respectively. But the total number of nodes varies from 5, 10, 15, 20 and 25. The performances of Node Vs Blocking probability are shown in **Figure 3** with 5 nodes, **Figure 4** with 10 nodes, **Figure 5** with 15 nodes, **Figure 6** with 20 nodes and **Figure 7** with 25 nodes. The time taken for the channel usage is shown in **Figure 8**.

The analysis of blocking chances according to the wavelength (Blocking probability Vs Wavelength) is estimated with the fixed load of 3 and 10 nodes. But the number of channels varies from 2, 4, 6, 8 and 10 respectively.

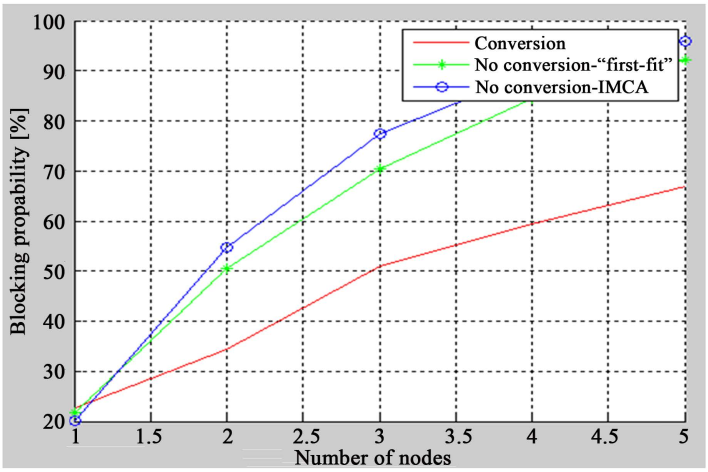

Figure 3. Analysis of blocking probability vs. nodes with 5.

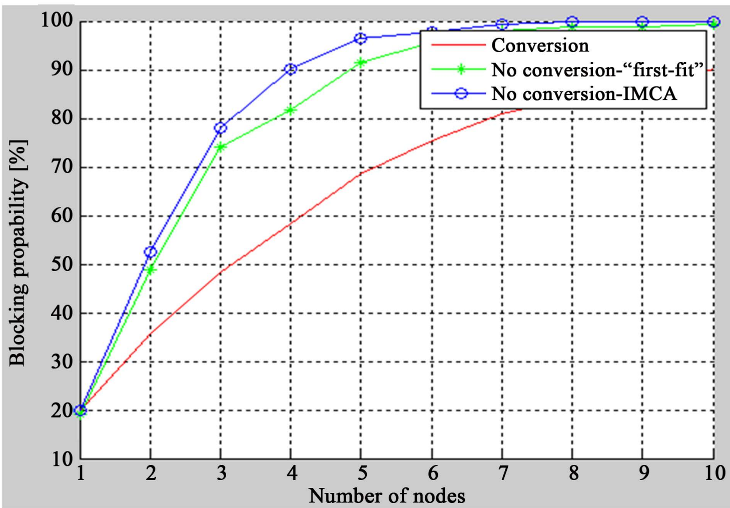

Figure 4. Analysis of blocking probability vs. nodes with 10.

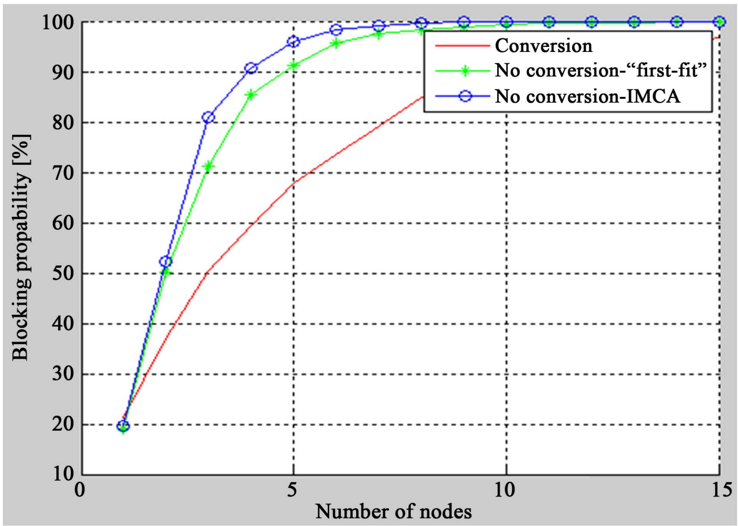

Figure 5. Analysis of blocking probability vs. nodes with 15.

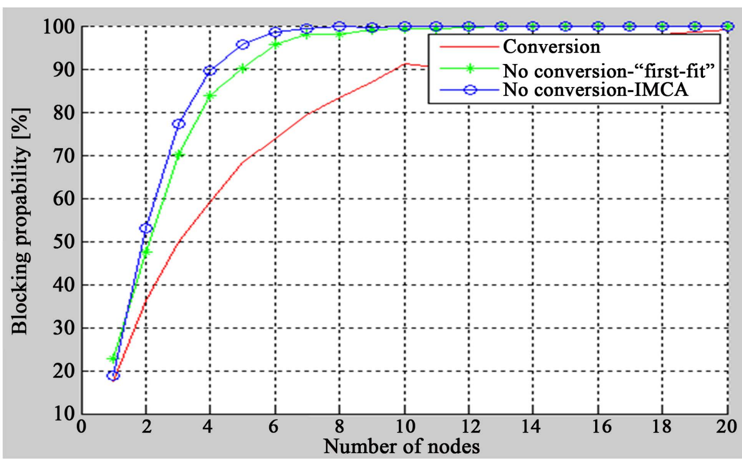

Figure 6. Analysis of blocking probability vs. nodes with 20.

Figure 9 shows the performances of probability with 2 channels, **Figure 10** with 4 channels, **Figure 11** with 6 channels, **Figure 12** with 8 channels and **Figure 13** with 10 channels.

The comparison of blocking chances based on load condition (Blocking vs. Load) is performed with the existing to show better performances than the existing as shown in **Figure 14**. **Figure 15** shows the comparison of the various algorithms of wavelength converter.

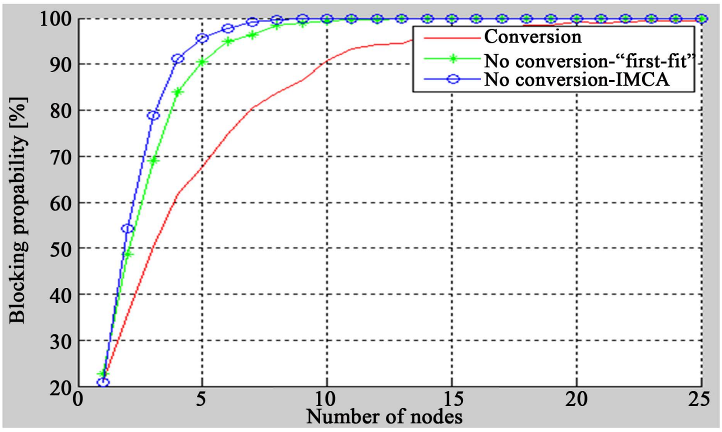

Figure 7. Analysis of blocking probability vs. nodes with 25.

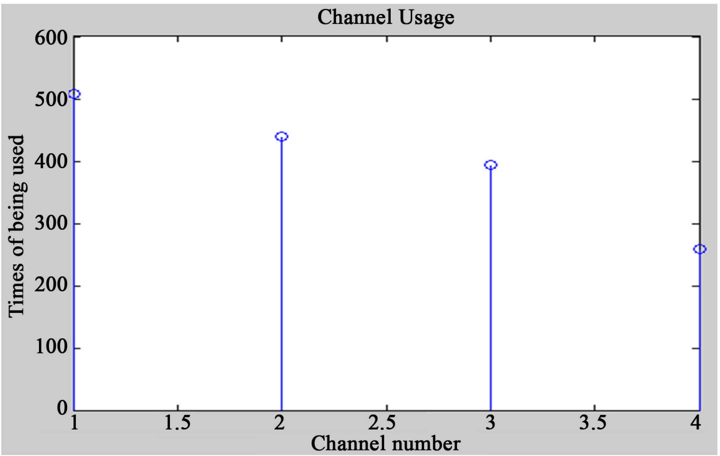

Figure 8. Analysis of channel usage.

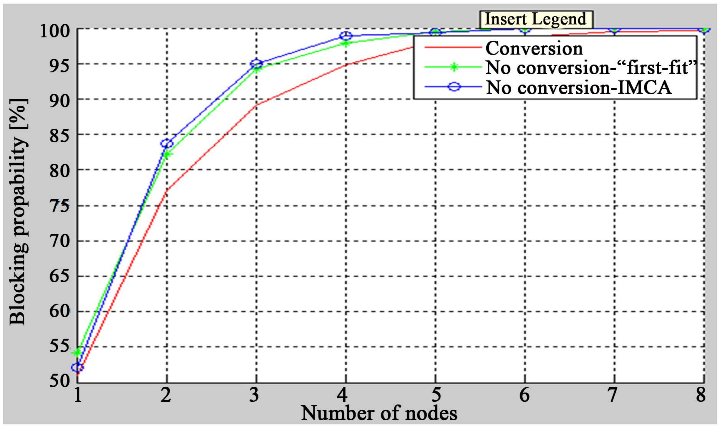

Figure 9. Blocking probability vs. wavelength with 2 channels.

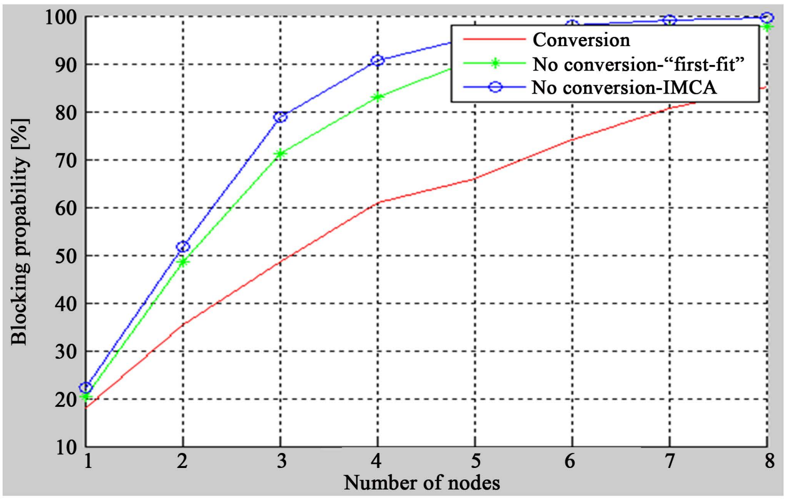

Figure 10. Blocking probability vs. wavelength with 4 channels.

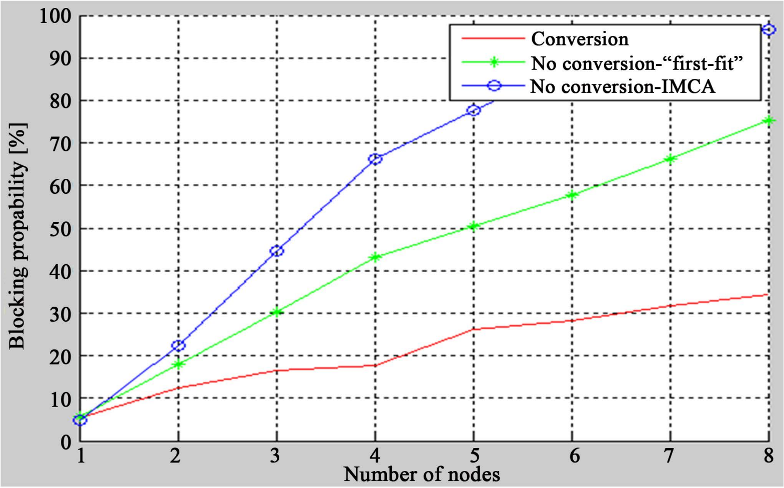

Figure 11. Blocking probability vs. wavelength with 6 channels.

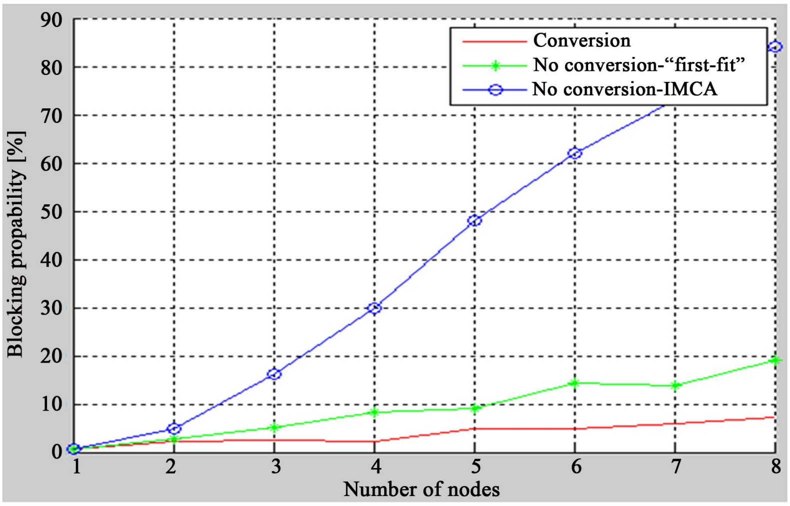

Figure 12. Blocking probability vs. wavelength with 8 channels.

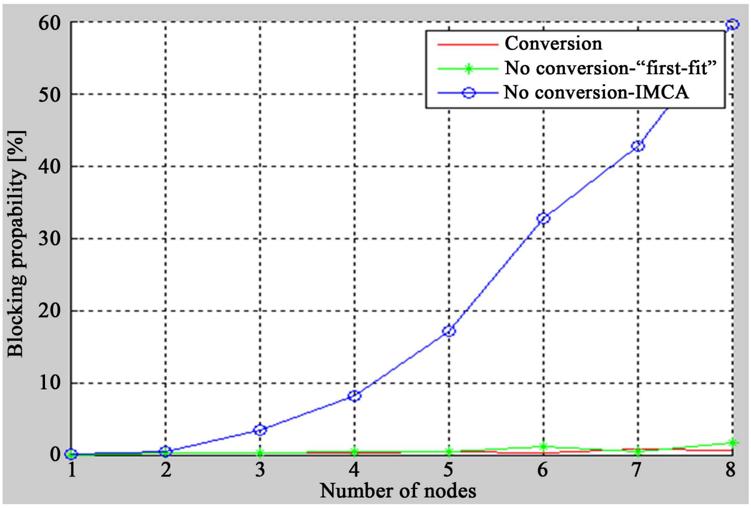

Figure 13. Blocking probability vs. wavelength with 10 channels.

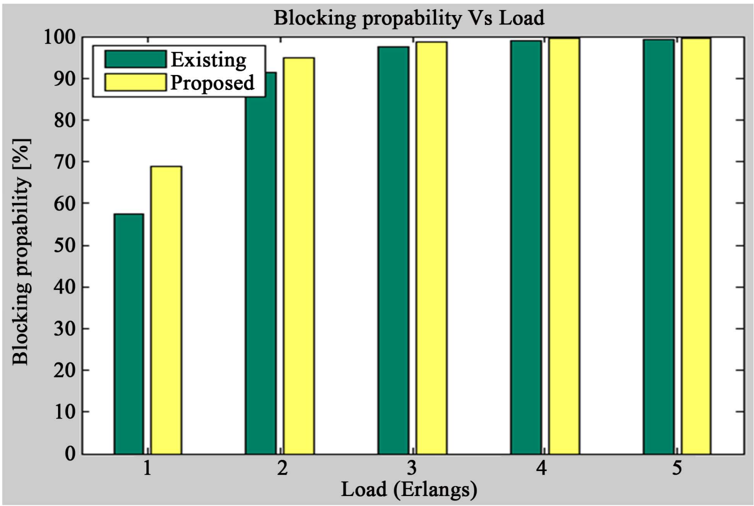

Figure 14. Analysis of blocking probability vs. load.

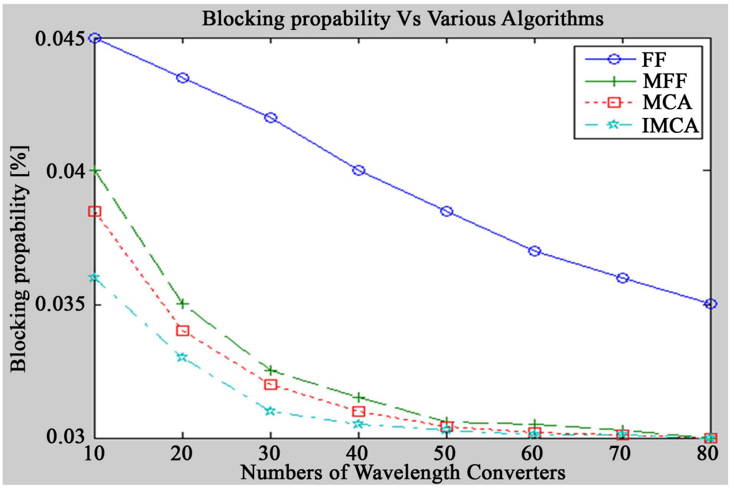

Figure 15. Blocking probability vs. various converters algorithm.

5. Conclusion

In this paper, the utilization of converters in optical WDM networks has been carried out to have an efficient process of minimum conversion, fast access, less probability of block and flexible system. The performance analysis of proposed approach and algorithm comparison shows improvement of the existing in a flexible manner. It provides improvement in the light path with low complexity under variation of load condition. The proposed system is simulated in the system with 512 MB RAM and Intel Pentium IV. The probability finding of blocking is based on the factor of the traffic pattern, load, wavelength and the nodes. The blocking chance has been reduced by the proposed model in the network.

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