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Social Spider Optimization based RWA Approach to Reduce Blocking Overhead in WDM Networks

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Abstract

Wavelength Division Multiplexing (WDM) optical network has the capability of long haul transmission, thereby satisfying the requirements of high-bandwidth applications. Routing and Wavelength Assignment (RWA) is a major issue and remains as a highlighted research area in optical networks. Blocking probability is considered as a significant metric that is to be minimized to enhance the overall network throughput. The First Fit Wavelength Assignment (FFWA) algorithm is one of the conventional WA algorithms whose computational complexity is minimum. Even though the FFWA strategy is simple, there is no balanced utilization of wavelengths that leads to improper optimization of resources in the network. In this paper, a Social Spider Optimization based RWA (SSO-RWA) approach is proposed to overcome the challenges of traditional FFWA strategy. The fitness of the wavelengths is measured using a fitness function that considers both distance and free wavelengths. The computational wavelength optimization is adopted in SSO-RWA to select the best suited wavelength for a particular connection request. The adaptive routing algorithm is applied for routing the connection requests and the dynamic traffic is generated in the fashion of Poisson distribution. Simulation results shows that the SSO-RWA approach drastically reduced the blocking probability when compared with the traditional FFWA algorithm.

Keywords: Wavelength Division Multiplexing, Social Spider Optimization based Routing and Wavelength Assignment Approach, First Fit strategy, Computational Optimization, Blocking probability.

1. Introduction

Internet and telecommunication services serves as a good means to tradeoff the high bandwidth constraints of increased traffic demands. The upcoming telecommunication services aims to achieve two principles, namely, high connection ratio and high accessibility anytime from anywhere. In critical transport applications, escalating bandwidth demands are fulfilled by the application of Wavelength Division Multiplexing (WDM) optical network [1]. WDM optical networks can be simply defined as a collection of transmission channel that supports switching, routing and wavelength assignment. The efficiency of WDM can be extended to its highest level by the wavelength conversion process and by assigning the wavelengths to appropriate paths [2]. On comparison with other optical networks, WDM meets the demand in an effective manner. It has the capability to support the historical technologies and also the upcoming wavelength conversion technologies. The increased network capacity offered by the WDM networks returns the investment within a short period of deployment [1].

Hence, WDM is considered as the backbone of all optical transmission networks. The specialty of WDM networks is that it has the potential to offer better switching options at low cost, when compared to the expensive electronic hardware [1].

The connections in the WDM networks are termed as lighpaths through which the traffic is routed optically in accordance with the wavelength. Although a source and a destination may have the necessity to transmit data, only a single wavelength is accommodated in a lightpath. Instead of selecting the physical links between the source-destination pair, WDM is a combination of Routing and Wavelength Assignment (RWA) processes. In RWA, link restoration complexity is minimized due to the reduction in channel reallocation. In order to utilize the resources until the breakdown of connections in the network, Integer Linear Program (ILP) formulations and effective wavelength assignment algorithms are formulated. The important constraint in WDM optical networks is that the identical wavelength cannot be used in a same fiber to route the traffic. This constraint is termed as the wavelength continuity constraint. As each fiber in may contain more than hundreds of wavelength to cope up with bandwidth demands of current internet usage scenario, it is impossible to reduce the number of wavelength in each fiber. At the same time all the wavelengths in the fiber must be utilized to achieve ultimate resource optimization [3].

With reference to the wavelength continuity constraint, the connection request will be blocked in the absence of the particular wavelength in the mid-hops of the link. Hence, wavelength converters must be employed to convert the available wavelengths to the required wavelength in all the hops of the link. The converters will give rise to complexity and cost overhead. The number of channels in a network must be increased to reduce the traffic contention, which in turn leads to blocking probability. In the wavelength routed optical networks, blocking probability is a significant metric to measure the quality of the network. The attributes such as traffic load, number of fibers, free wavelengths and topology are responsible for blocking probability [4].

From the above explanation, it can be depicted that there exists a close relation between the routing and wavelength assignment problems. Initially, the route for every connection is identified, and then the wavelength assignment is done. The conventional routing strategies include fixed, fixed-alternative and adaptive routing. In fixed and fixed-alternate routing, there should be a prior knowledge to select a route between the source and destination. Whereas, in adaptive routing, the routes are chosen in accordance with the present network condition in a dynamic manner. Among the routing strategies, the adaptive routing greatly minimizes the blocking probability of the network, while having somewhat tedious computations.

There are some traditional strategies for wavelength assignment including First Fit (FF), Random Fit (RF), Round Robin (RR) and so on. The FF serves the connection requests in a first come first serve basis, whereas the RF approach randomly picks a wavelength from the set of free wavelengths. The RR strategy utilizes the wavelengths for a specific time quantum, in which the connection request has to wait for a particular wavelength for a long period. Even though FF is one of the simplest wavelength assignment techniques, it has several drawbacks including underutilization of wavelengths and maximized blocking probability. In order to overcome the issues of FF strategy, a Social Spider Optimization based RWA approach that selects a globally optimal routing path and wavelength is proposed. The SSO-RWA approach does not end up in the local minima but it attains global optimal solution, thereby reducing the blocking probability of the network.

Motivation

The literature has reviewed several strategies for routing and wavelength assignment and identified the pros and cons. From the literature review it is identified that the adaptive routing strategy and FF wavelength algorithm makes a best pair in the RWA approach. Although the adaptive routing strategy results in minimum blocking probability, the FF strategy leads to wastage of resources due to imbalanced wavelength utilization. The main drawback of the FF strategy is that the lower order wavelengths are not properly utilized in all the cases. In addition to this, there is no categorization of wavelength in accordance with the priority or bandwidth requirements of the upcoming connection requests.

In the proposed work, the issues of FF strategy are eliminated by suggesting a Social Spider Optimization based RWA approach that assigns an optimal route and wavelength for the connection request. It adopted the adaptive routing strategy of routing. The wavelength assignment approach assigns the wavelength based on the path length and free wavelengths available in that path. A fitness function is utilized to measure the fitness of each individual wavelength in the network based on its distance between source-destination pair and available wavelengths. The wavelengths are grouped into two sets, namely, higher order and lower order group according to their fitness value. The higher order wavelengths are utilized for shortest path connection requests; whereas the lower order wavelengths are utilized for longest path connection requests.

Contributions of Proposed Work

The contributions of the proposed work are as follows:

- A Social Spider Optimization based RWA approach is proposed to overcome the challenges of FF wavelength assignment strategy in terms of imbalanced wavelength utilization.
- The adaptive routing technique is utilized for routing the connection requests, which in turn helps in reducing the blocking probability.
- A fitness function that considers both the distance and free wavelengths in the route is suggested to partition the higher and lower order wavelengths.
- The computational wavelength optimization is utilized to choose the globally optimal wavelengths in accordance with path length and fitness value of the wavelengths.
- In a nutshell, the blocking probability of the network is reduced by eliminating the local minima, thereby attaining a global maximum.

The paper is organized as follows: Section II reviews the state-f-art techniques of RWA problem in optical networks. Section III explains the proposed SSO-RWA approach and the computational wavelength optimization in detail. Section IV discusses the simulated results. Section V concludes the work with a highlight of the extension work.

2. Related Work

This section reviews some recently proposed state-of-art methods for RWA problems in WDM optical networks. The conventional FF strategy was utilized for spectrum assignment in Elastic Optical Networks (EON) where route selection in accordance with the increasing demand of traffic is an issue. An optimized set of wavelengths based on FF algorithm was generated by the evolutionary method. The blocking probability was drastically reduced by the integration of genetic algorithm and evolutionary algorithm. Still, some of the physical impairments were not solved by this approach [4]. An Evolutionary Programming (EP) algorithm for routing was combined with three wavelength assignment strategies including FF, random and round Robin (RR) algorithm to minimize the lighpath establishment period. The load balancing anomaly was satisfied by combining a soft constraint with a set of hard constraints. On comparison with the conventional bio-inspired algorithms, the EP algorithm reduced the blocking probability and the execution time [5].

Graph coloring and Genetic Algorithm (GA) were combined to reduce the blocking probability for Impairment aware wavelength assignment networks. The optimal routes were identified using the Dijkstra’s shortest path algorithm to minimize distractions such as dispersion and noise. The XPM effect was minimized by the proper ordering of wavelengths. The resource optimization principle was attained by the reducing the number of wavelengths utilized for transmission [6]. The routing approaches based on the path length were evaluated to analyze the network performance. Each connection request was individually optimized to reduce the resource consumption of the network during RWA. It was identified that the path length plays significant role in both network quality and call acceptance ratio. Heuristic algorithms, namely, Shortest Path Pair (SPP), Shortest Longest Path Pair (SLPP) and Longest Shortest Path Pair (LSPP) were analyzed for resolving the link failure problems. The resources were optimized through the selection of links that have excess resources. The Quality of Services (QoS) was not attained upto that level in the paths that have longer length [7].

A fuzzy rule based inference system was constructed to select and assign the routes and wavelengths in WDM optical networks. The fuzzy system considered the following network attributes, namely, path length, data loss, latency, hop count and free wavelengths. A triangular membership function that follows FF, random and RR wavelength assignment algorithms was applied in the formation of fuzzy logic system. The suggested rule based system minimized the blocking probability and execution time [8]. The RWA problem in WDM optical networks were solved by two multi-objective GAs, namely, non-dominated sorting and strength pareto algorithms. The optimal selection of paths are ensured to be valid with the help of the suggested repair method by making small alterations in crossover and mutation operators as well as chromosome coding scheme. Depth First Search (DFS) was adopted to construct the repair process [9]. Three evolutionary algorithms including GA, evolutionary programming and backtracking algorithms were utilized to propose a Random Optimization Algorithm (ROA) for resolving the many cast problem of optical networks. The suggested ROA was a local search strategy that focuses on minimizing the execution time and in enhancing the QoS of the network [10].

A modified version of Intelligent Water Drops (IWD) algorithm was proposed to reduce the blocking probability in WDM optical networks, thereby increasing the call connection ratio. The optimal lightpaths for routing was identified by utilizing the information such as congestion and length of the paths. The proposed IWD algorithm was experimentally simulated using the dynamic traffic of the network. IWD resulted in low blocking ratio and high performance on comparison with the conventional routing methodologies [11]. Due to the scarcity of wavelengths in the optical fibers, the blocking probability becomes very high, which results in demand of numerous lightpaths. To resolve this problem of call blocking and resource scarcity, the priority of each request was considered for RWA. The type of the path including direct and indirect physical path, and the amount of traffic were used to estimate the priority of the connection request. The computation of priority reduced the blocking probability and outperformed the non-priority based RWA schemes [12]. In order to reduce the time complexity and to optimize resource consumption, novel heuristic algorithms were proposed. These algorithms focused on resolving the issues in static RWA mesh networks. Generally, RWA is considered as a Non-Polynomial (NP)-complete problem. The suggested work reduced the complexity to polynomial complete and also reduced the blocking probability, which in turn decreased the consumption of resources [13]. A Priority-based Dispersion Reduced Wavelength Assignment (PDRWA) was suggested to improve the network performance regarding signal quality. The dispersion of signal leads to propagation loss and results in degraded performance.

The hardware based signal quality improvement requires high cost for implementation. The PDRWA algorithm resolved these difficulties by assigning less dispersion wavelengths to the long lighpaths and more dispersion wavelengths to the short lightpaths [14]. A Multi-Neighborhood based Iterated Tabu Search(MN-ITS) algorithm was depicted to attain the wavelength continuity constraint with minimum utilization of wavelengths. A unified incremental evaluation methodology was applied among three neighbors to overcome the RWA problem. The suggested MN-ITS algorithm was experimentally tested in the real time traffic [15]. Integer Programming and cutting plane algorithm was integrated to solve the sub-wavelength path assignment problem. As there is a variation in traffic demand with respect to time, a greedy type on-line algorithm was considered. The small granular paths are considered to enhance the effectiveness of the network [16].

Several multi-objective algorithms including differential evolutionary algorithm, firefly algorithm, particle swarm optimization algorithm and simulated annealing algorithm were reviewed in terms of routing and wavelength assignment for optical networks. The NSFNet topology was used to experiment the abovementioned multi-objective intelligence algorithms regarding load and number of wavelengths. The better utilization of resources in optical networks by the multi-objective algorithms was stated in this paper [17]. Various wavelength assignment algorithms such as random fit, first fit, most used and least used algorithms were studied and their performance were evaluated regarding blocking probability. A mesh optical network was utilized to estimate the blocking probability by varying the number of nodes from 8 to 16 nodes. The results proved that the least used algorithm provided better performance, when there was more number of nodes [18]. A biased random-key genetic algorithm was proposed to solve the max-RWA problem in which minimum wavelengths can be utilized to fulfill the upcoming demand of connection request. The suggested algorithm improved the wavelength assignment process, on comparison with the exact algorithms. The conventional algorithms failed to solve the large real time instances because of the growing size of optical networks [19].

A bio-inspired algorithm, namely, Ant Colony Optimization (ACO) was extended to solve the RWA problem of optical networks. The connection requests were sorted in accordance with their distances across the source-destination pair. The modified version of ACO was evaluated in static and dynamic traffic based networks [20]. The Integer Linear Programming (ILP) formulation was altered using light hierarchy to solve the blocking probability issue in optical networks. To evaluate the proposed algorithm, two blocking models such as partial and full blocking probability models were formulated. The suggested algorithm utilized light hierarchies instead of tradition way of using light trees [21]. An E-model was proposed to optimize the blocking probability of the optical networks even in the presence of massive loads. As the model was designed for all optical networks, it can be applied to diverse network topologies. The suggested model was highly suitable for network with high congestion and traffic [22].

3. Proposed Work

A Social Spider Optimization based RWA approach solves the RWA problem by considering both the distance and free wavelengths. The suggested SSO- RWA approach overcomes the drawback of the conventional FF strategy. In FF strategy, all the available wavelengths are numbered in a sorted order and the allocation is done based on the first come first serve manner. In this case, the wavelengths that are numbered at last are not utilized and the higher order wavelengths get over utilized. This leads to the wastage of resources and hence there is a need to optimize the available resources by balancing the utilization of all the free wavelengths. The wavelengths are grouped into two categories, namely, higher order and lower order group in which the former one contains the wavelengths with high fitness value and the latter consists of low fitness value wavelengths. A fitness function is applied to all the available wavelengths for selecting the suitable wavelength that is sufficient for the data transmission. The fitness function considers both path length and available wavelengths in the corresponding route. In order to eliminate either the best or the worst wavelength to influence the wavelength assignment process, two groups of wavelengths are individually evaluated by separate computational wavelength optimization. The main objective of the suggested SSO-RWA approach is to select the global optimum thereby overcoming the local minimum.

Network Assumptions

- There is same number of wavelengths in each link of the fiber in the network.
- No wavelength converters are adopted in the network.
- The wavelength continuity constraint is satisfied in the network. i.e., distinct wavelengths are allocated to lightpaths of same fiber.
- The network links are bidirectional, i.e., a node can act both as a source and destination.
- Non-negative weights are assigned to the links.
- A blocked connection request will be queued and served later by the network.
- Dynamic traffic is generated using Poisson distribution.

Algorithm

A network N(n,L, λ) that consists of nodes 'n', a set of links 'L' and finite number of 'λ'
$\forall \lambda \in N$(n,L, λ) Compute the fitness function $F(\lambda)$ using eqn(1)
Determine the fitness threshold for the λ population $F(\lambda_{Threshold})$
    If $F(\lambda_i) > F(\lambda_{Threshold})$
    then
        Group λ_i in G_1
    else
Group λ_i in G_2
Find the optimal path length $PL_{optimal}$ of the network
$\forall$ CR find the primary and alternatre routes between the s-d pairs and path length available in the lookup table
    If (isavailable (λ))
        If ($PL_{CRi} > PL_{optimal}$)
        then
            select the λ from G_1using eqn (2)
        else
            select the λ from G_2using eqn (2)
    else
        CR blocked

Initially, the entire set of wavelengths available in the network is partitioned into two sub-groups and termed as G_1 and G_2 using the fitness function. In addition to the hop count and the available wavelengths in a particular route, the WCC is also taken into consideration. While all the wavelengths in a certain route is reserved, the alternate route is selected to continue the data transfer without any interruption. The route that contains no free wavelengths is marked with a negative value to reduce the time consumption during next iteration. The fitness function is defined as follows:

$$F(\lambda) = \left[\alpha \times \frac{PL_{max}-PL_{sd}}{PL_{sd}}\right] + \left[(1-\alpha) \times \left(1 - \frac{\lambda_N-\lambda_{sd}}{\lambda_{sd}}\right)\right] \quad (1)$$

Where,

PL_{max} represents the maximum path length among the set of routes between a source-destination pair

PL_{sd} denotes the path length of a source and destination.

λ_N is the entire wavelength population of the optical network.

λ_{sd} implies the number of wavelength in a particular route of a source-destination pair.

α is a design parameter.

This partitioning is done in accordance with the bandwidth of the wavelengths using a median value, which is termed as the fitness threshold $(\lambda_{Threshold})$. The fitness value of the wavelengths that are higher than the median value are placed in G_1 and the remaining wavelengths are collected in G_2 . The higher order wavelengths are grouped as $G_1 = \{\lambda_{H1}, \lambda_{H2} \dots \lambda_{Hn}\}$ and lower order wavelengths are grouped in $G_2 = \{\lambda_{L1}, \lambda_{L2} \dots \lambda_{Ln}\}$. The union of both groups has the entire wavelength population of the network and it is denoted as follows.

$\lambda_N = G_1 \cup G_2$ where, $\lambda_N = \{\lambda_1, \lambda_2 \dots \lambda_n\}$ in which $\lambda_1 = \lambda_{H1}$, $\lambda_2 = \lambda_{H2}$, $\lambda_{Hn} = \lambda_{n(G_1)}$, $\lambda_{Hn+1} = \lambda_{L1}$, $\lambda_{Hn+2} = \lambda_{L2}$ and $\lambda_n = \lambda_{Ln}$.

In order to select the optimal wavelength for a particular connection request, the selection process is proceeded based on the following computational wavelength optimization. The higher order wavelengths are usually assigned to the connection requests with shortest path, whereas the lower order wavelengths in G_2 are utilized for connection requests with longer path lengths. The wavelengths assigned for shortest paths are reutilized to minimize the blocking probability. The intention of using computational wavelength optimization is to choose the best suitable wavelength for a

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particular connection request. The computational optimized search balances the wavelength utilization factor by providing equal chance to all the wavelengths available in the network. An optimal path length of the network topology is chosen as the threshold value to decide whether the wavelength can be selected from G_1 or G_2. If the length of the connection request is lesser than the threshold length, the wavelength is selected from G_1 otherwise the wavelength is chosen from G_2.

$$\lambda_{Best} = \begin{cases} F(\lambda_i) + \alpha \times BW_{CR1} - F(\lambda_{Threshold}) + \delta\left(\text{rand} - {}^{1}\!/_{2}\right) & \text{for wavelengths in} G_1 \\ F(\lambda_i) + \alpha \left(\frac{\sum_{h=1}^{\lambda N} F(\lambda_h^k)\, BW_{CRn} + h}{\sum_{h=1}^{\lambda N} BW_{CRn} + h} - F(\lambda_i^k) \right) & \text{for wavelengths in } G_2 \end{cases} \quad (2)$$

Where, BW_{CR1} denotest the bandwidth requirement of the first connection request.

$F(\lambda_{Threshold})$ represents the fitness threshold of the entire wavelength population.

$\left(\frac{\sum_{h=1}^{\lambda N} F(\lambda_h^k)\, BW_{CRn} + h}{\sum_{h=1}^{\lambda N} BW_{CRn} + h} - F(\lambda_i^k) \right)$ implies the weighted mean of wavelengths available in G_2.

4. Results and Discussion

The SSO- RWA approach is evaluated using NSFNET topology which is represented by a network topology as N(n,L, λ). Here, 'n' is the number of nodes that is 14 in the NSFNET topology and 'L' is the set of links in the topology that provides a physical connection among the nodes. λ is the finite number of wavelengths available in the network. The network is considered as a directed connected graph with non-negative cost between any two nodes. The indirect connections between the nodes are provided with a cost as ∞. Poisson distribution is followed to generate the connection requests and the exponential distribution is followed to measure the arrival rate of the requests. As the service aggregation may suppress the traffic burst of the network, the Poisson distribution is selected to measure the traffic distribution in an accurate manner.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	0	1100	1600	0	0	0	0	2800	0	0	0	0	0	0
2	1100	0	600	1000	0	0	0	0	0	0	0	0	0	0
3	1600	600	0	0	0	2000	0	0	0	0	0	0	0	0
4	0	1000	0	0	600	0	0	0	0	0	2500	0	0	0
5	0	0	0	600	0	1100	800	0	0	0	0	0	0	0
6	0	0	2000	0	1100	0	0	0	0	1200	0	0	2000	0
7	0	0	0	0	800	0	0	700	0	0	0	0	0	0
8	2800	0	0	0	0	0	700	0	700	0	0	0	0	0
9	0	0	0	0	0	0	0	700	0	900	0	500	0	500
10	0	0	0	0	0	1200	0	0	900	0	0	0	0	0
11	0	0	0	2400	0	0	0	0	0	0	0	800	0	800
12	0	0	0	0	0	0	0	0	500	0	800	0	300	0
13	0	0	0	0	0	2000	0	0	0	0	0	300	0	300
14	0	0	0	0	0	0	0	0	500	0	800	0	300	0

Table 1. Distance matrix of NSFNET topology

The simulation is done using Optical WDM Network Simulator (OWNS) which have a compatible relationship with Network Simulator 2 (NS2). The components of the network including links, nodes and protocols are implemented using C++. The simulation scenarios are configured using Otcl which is an object oriented scirpting language that invokes various commands. RouteLogic and WAssignLogic objects are utilized to implement the routing and wavelength assignment modules respectively. The NSFNET topology is shown in Fig 1.

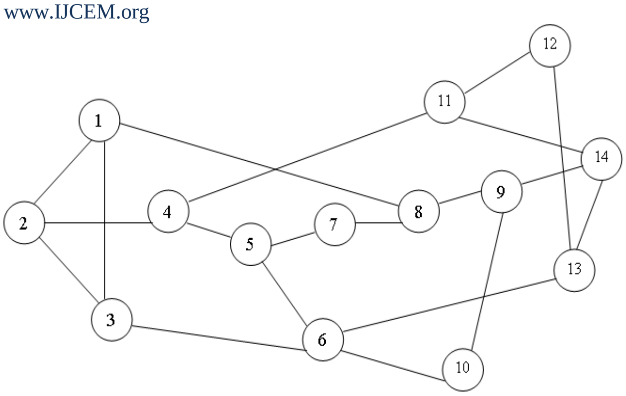

Fig 1. NSFNET Topology

The distance between each node in the NSFNET topology is shown in the distance matrix of Table 1.

The results of the proposed SSO-RWA approach for both long and short distance connection requests are compared with the existing FF algorithm in terms of blocking probability and it is depicted in Fig 2. In general, when the number of wavelengths in the network increases, there is always a decrease in blocking probability. It is clear that the resource optimization reduces the blocking probability. In the graph shown in Figure 3, the blocking probability of the proposed SSO-RWA approach is lesser than the blocking probability of FF wavelength assignment algorithm. The x-axis is plotted with the number of wavelengths, whereas the y-axis shows the blocking probability. When is there is no free wavelength available the blocking probability is one and hence the connection request will be blocked. As the availability of wavelength increases, the blocking probability decreases and allows the connection requests to be established. In Figure 1, it is clearly identified that the blocking probability falls below 0.1, when there are 3500 wavelengths in the network. The lowest blocking probability attained by FF algorithm is 0.01. The SSO-RWA achieved a blocking probability of 0.008 for long path length connection and 0.007 for short path length connection. Hence, the proposed SSO-RWA approach reduced the blocking probability by 30% on comparison with the traditional FF algorithm. The blocking probability is reduced because the SSO-RWA approach measured the fitness of the wavelengths and also considered the number of free wavelength in a specific path.

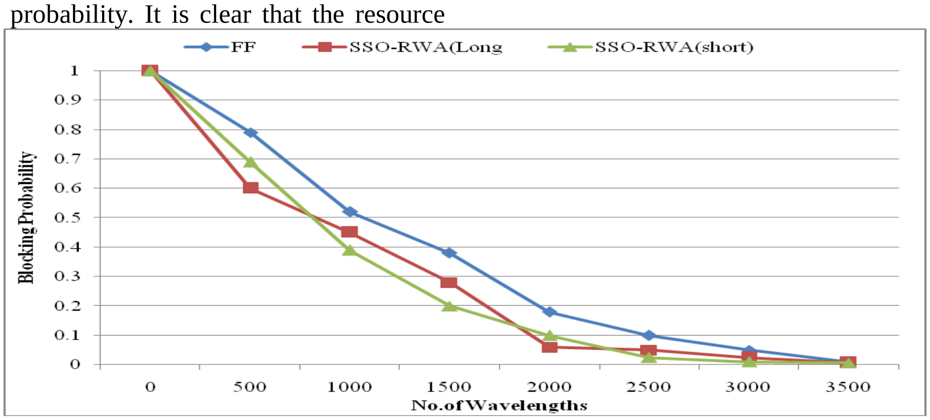

Fig 2. Blocking probability Vs No. of wavelengths for FF and SSO-RWA algorithms

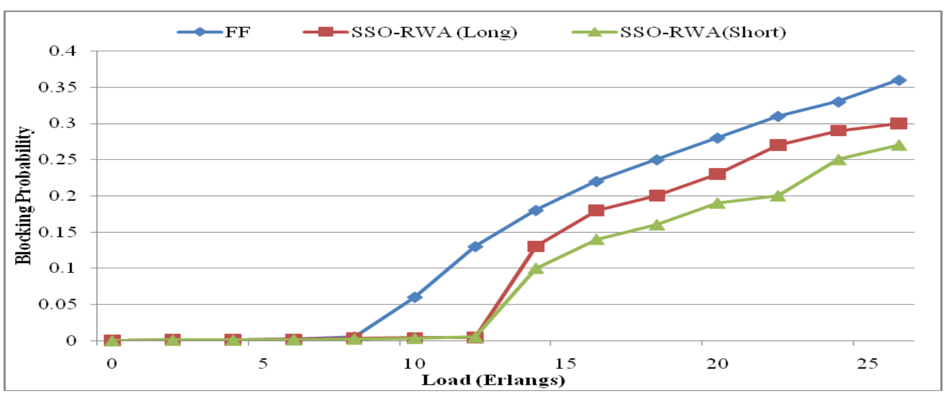

Fig 3. Blocking Probability Vs Load of FF algorithm and SSO-RWA approach

The blocking probability of FF algorithm and SSO-RWA approach are plotted against the load and the simulation results are plotted in Fig 3. The blocking probability of the network increases with increase in the load. The X-axis of the graph is plotted with load, whereas the Y-axis denotes the blocking probability. When compared to the proposed SSO-RWA approach the blocking probability of FF wavelength assignment algorithm is high. A good wavelength assignment algorithm must have reasonably low blocking probability, even in the case of high network load. The shortest path connection request that chooses the wavelength using SSO-RWA approach has less blocking probability than the connection request with longest path. The maximum blocking probability attained by the SSO-RWA approach with long and short path connection requests are 0.3 and 0.27 respectively. The proposed approach showed an improvement of 25% in minimizing the blocking probability than the conventional FF algorithm. Here, in terms of load there is a decrease in blocking probability due to the allocation of wavelength based on the distance of the routes.

CONCLUSION AND FUTURE WORK

In this paper, a SSO-RWA appraoch is proposed to overcome the resource optimization issues faced by the traditional FF strategy. The blocking probabilty is enhanced by the balanced utilization of wavelengths that are selected using the SSO-RWA approach. The wavelengths are assigned to the connection requests that arrive in a poisson distribution fashion in accordance with the fitness value. The path length and the wavelenghts available in that path are taken into consideration while computing the fitness value. The wavelengths are partitioned into two groups and the higher indexed wavelengths are used for short length CRs and the long length CRs are equipped with lower indexed wavelengths. The wavelengths are chosen using the computational wavelength optimization in SSO-RWA approach. The blocking probability of the network is evaluated in terms of the number of wavelengths and load. The simulation is done using NS2-OWNS in the NSFNET topology. The results proved that the SSO-RWA approach attained a minimum blocking probability than the traditional FF strategy. The blocking probability was reduced by 30% and 25% in terms of number of wavelengths and load respectively. In future, it will be applied to the multi-fiber optical networks for the selection of best link and to identify the required fiber count on each link.

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