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Comparison and Implementation of Routing and Wavelength Assignment Strategies in Wdm Optical Networks Utilizing Without Wavelength Conversion Technique (WWCT)

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Abstract: This Paper concentrates on the comparison and realization of routing and Wavelength-Assignment (RWA) quandry in wavelength-routed optical WDM systems. The greater part of the consideration sticks to such systems, which work under the wavelength-continuity constraint, in which light paths are spot up for connection requests between hub sets and a solitary light path should dependably involve the same wavelength on the majority of the connections that it degrees. To set up a light path, a route should be picked and a wavelength corresponding to the light way should be allocated. The connection request is blocked if no wavelength is accessible for this light way on the picked course. In Wavelength Division Multiplexing (WDM) optical systems, there is have to misuse the quantity of associations perceived and to minimize the blocking probability. The RWA situation is analyzed and various routing and wavelength task procedures are compared and executed. The outcome investigation demonstrates the best exhibitions of blocking probability in all the wavelength task procedures that are executed.

Key words: Optical networks · Wavelength-continuity constraint · Routing and Wavelength Assignment (RWA) · Blocking Probability · WDM

INTRODUCTION

Wavelength division multiplexing (WDM) is the procedure essentially used to utilize the bandwidth accessible in optical networks successfully. On account of WDM systems distinctive optical signs are transmitted through the same fiber having diverse accessible wavelengths. These days transmission limit of WDM innovation is in Tbps. Since electronic handling is badly arranged as far as pace of transmission limit, in this way the whole routing and switching is preferred in optical area. With all, as the transmission limit builds the expense of electronic exchanging increments. Networks which route information utilizing wavelengths are called as wavelength routed networks. All optical wavelength routed networks are utilized to evade electronic jam in wavelength routed networks.

Wavelength routed networks which transmit information with no opt-electronic changes in intermediate nodes are known as All Optical Wavelength Routed Networks. To transmit information from source to destination in an optical space a connection must be set up. To build up a connection a path is browsed source to destination and a free wavelength is designated to all the fiber joins in the picked path. This kind of optical path is called as light path.The wavelength can't be allocated to any other connection when the connection is in advancement. In WDM optical networks, there are three principle requirements identified with wavelength. They are wavelength continuity constraint, distinct wavelength assignment constraint and non wavelength continuity constraint.

On account of wavelength continuity constraint, along the route same wavelength has to be utilized. In particular wavelength assignment constraint, two light paths can't use the same wavelength. Competency to convert data on one wavelength to another wavelength is entitled as wavelength conversion capability. On the off chance that the nodes gathering wavelength conversion capability, dissimilar wavelengths can be utilized along the preferred route. This limitation is marked as non wavelength continuity constraint. Wiping out wavelength conversion will diminish the expense of network altogether yet the network efficiency gets lessened. This is on the grounds that more wavelengths are required.

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Routing and Wavelength Assignment Strategies

Routing Strategies: Fixed Routing: Picking the same altered route for a given source-destination pair is considered as the most straight forward methodology of directing a connection. One sample of such a methodology is fixed routing. The shortest-path route for each source-destination duo is calculated off-line utilizing standard shortest-path algorithms for example, Dijkstra's algorithm or the Bellman-Ford algorithm and any connection between the assigned pair of nodes is built up using the pre-decided route.

Fixed Alternate Routing: A way to deal with routing that considers numerous routes is fixed alternate routing. In this routing, every node in the network keeps up a routing table that contains a mandated list of various adjusted routes to every destination node. At the point when a connection demand arrives, the source node endeavors to establish the bond on each of the routes from the routing table in sequence, until a route with a valid wavelength assignment is found. In the event that no offered route is found from the list of alternate routes of action, then the connection request is blocked and lost.

Adaptive Routing: In this, the route from a source node to a destination node is preferred dynamically, contingent upon the network state. The network state is tenacious by the set of all connections that are currently in progress. One type of adaptive routing is adaptive shortest-cost-path routing, which is well-suited for use in wavelength-converted networks.

Wavelength Assignment: The wavelength assignment strategies are (1) Arbitrary, (2) First-Fit, (3) Least-Used (4) Most-Used.

Random Wavelength Assignment (RWA): This plan first inquiries the space of wavelengths to decide the arrangement of all wavelengths that are open on the required route. Among the accessible wavelengths, one is chosen subjectively (generally with uniform probability).

First Fit (FF): In this plan, all wavelengths are numbered. At the point when testing for accessible wavelengths, a lower numbered wavelength is considered in front of a higher-numbered wavelength. The most readily accessible wavelength is then chosen. This plan requires no overall data.

Least Used (LU): LU chooses the wavelength that is the minimum used in the system, in this manner attempting to adjust the load among every one of the wavelengths. This plan winds up breaking the long wavelength paths

Most-Used (MU): MU is in contrary to LU in that it endeavors to pick the most-utilized wavelength as a part of the system. It outflanks LU essentially.

Related Work: Paramjeet Singh, Ajay K. Sharma, Shaveta Rani. [1], proposed the Routing and wavelength assignment in WDM networks with dynamic link weight assignment strategies in which,there is need to maximize the number of connections established and to minimize the blocking probability utilizing circumscribed resources.

Hui Zang, Jason P. Jue, Biswanth Mukherjee. [2] developed a review of routing and wavelength assignment approaches for wavelength routed optical WDM networks where an incipient wavelength assignment scheme, called Distributed Relative Capacity Loss (DRCL) is utilized.

George N. Rouskas. [3] Studied the two variants of RWA quandary namely Static RWA, where by traffic requisites are well-known in advance and Dynamic RWA in which connection requests arrive in random fashion.

R. Ramaswami, K.N. Sivarajan. [4] Verbalized that the Optical networks pedestal on Wavelength Division Multiplexing (WDM) technique is obviously the most promising way to secure the anticipated astronomically immense broadband traffic demand.

J. Kuri [5] proposed the Routing and wavelength assignment of scheduled light path demands, where three dynamic link weight assignment strategies are implemented.

Proposed Work: The projected methodology is to lessen the blocking probability in the network. The topology picked here for the study is the NSFNET (National Scientific Network) topology. NSFNET is a discretionary cross section topology with fourteen hubs connected. NSFNET usually the most normally utilized back bone of engineering and comprises of a astronomically immense number of industries and academic campuses and experimental networks, many of which are interconnected by a more minuscule number of regional and association networks.The NSFNET Backbone Network is an essential signifies of interconnection between the provincial systems. The one in which the investigation was conveyed is appeared in the figure beneath.

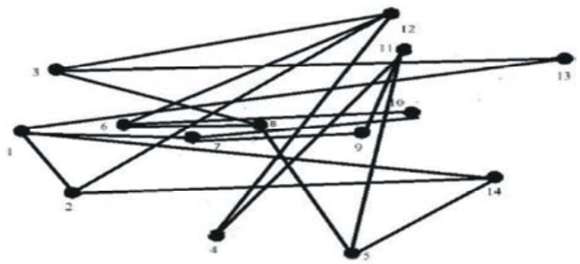

Fig: 1 NSFNET network

Blocking Probability Computation

Notations are

A: Set of nodes in the network.

B: Set of links in the network.

C: cluster of connections.

D: cluster of wavelengths.

N: Total range of wavelengths numbered from 0 to N -1.

I:Total number of connection requests numbered from 0 to I -1.

N: Total number of nodes in the network numbered from 0 to n -1.

Psd: Total number of links along the route for sd connection. s indicates the source d indicates

the destination.

sd[j] indicates jth connection.

Rij represents the route for the connection when s = i and d = j.

Wij represents the wavelength assigned to the connection when s = i and d = j.

rejiconn is the variable used to store the number of connections discarded.

accon is the variable used to store the number of connections accepted.

W^{sd} ij = 0, if s–d connection does not utilize any wavelength on link ij,

= 1, otherwise.

M ^{sd} ij,k = 0, if s–d connection does not use wavelength k on link ij,

= 1, otherwise.

Q^{k} sd = 1, if s–d connection is established on wavelength k,

= 0, otherwise.

Mathematical formulations

Total number of s–d pairs (I), if s–d pairs when s = d included, (s, d A),

= (n(n-1)/2)+ n, if Rij = Rji and wij = wji i, j A,

= nxn, otherwise.

Total number of s–d pairs (I), if s -d pairs when s = d excluded, (s, d A),

= n(n-1)/2, if Rij = Rji and wij = wji i, j A,

= n(n-1), otherwise.

Blocking probability = rejiconn/I = (I -accon)/I.

Objective function = diminish (blocking probability) for fixed number of wavelengths.

Or minimize (N) for zero blocking probability.

Constraints:

1. $\sum_{sd}$ wijsd =N, sd C, ij B.

Wavelengths assigned on a link for all the connections does not exceed N.

2. $\sum_{ij}^{sd}$ mij,k= Psd, if Qksd= 1,

= 0, otherwise sd C, ij B and k D.

3. m ^{sd} ij,k= 1, if w ^{sd} ij= 1 and Q ^{k} sd= 1,

= 0, otherwise sd C, ij B and k D. (4)

Perfomance Analysis: The different Wavelength Assignment (WA) schemes which normally used are implemented and the performance of them was compared in a full optical WDM network with no conversion enabled. Here the simulation conditions were kept virtually identical for the entire wavelength assignment scheme. The result analysis is shown below

Random FIT: The simulation parameter of Random fit wavelength assignment is given in Tab 1, in the selected topology yielded the following results, which are plotted in the Figure 2

Fig. 2: Average Blocking probability of Random fit

The simulation parameter values are:

Tab:1 Random fit wavelength assignment

Load in Erlangs	Average Blocking probablity
0	0
266	0.0713182
488	0.173638
630	0.266303
812	0.33464646
994	0.407061
1176	0.447067
1358	0.487049
1540	0.502523
1722	0.51961
1904	0.557224

First fit: The simulation parameter of first fit wavelength assignment is given in Tab 2, in the selected topology yielded the following results, which are plotted in the Figure 3.

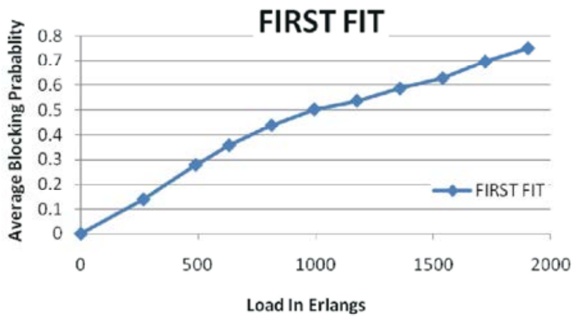

Fig. 3: Average Blocking probability of first fit algorithm

The simulation parameter values are:

Tab: 2 first fit wavelength assignment

Load in Erlangs	Average Blocking probablity
0	0
266	0.139903
488	0.27848
630	0.35792
812	0.439308
994	0.504397
1176	0.539203
1358	0.588203
1540	0.630275
1722	0.697369
1904	0.751687

Most Used: The simulation parameter of most used wavelength assignment is given in Tab 3, in the selected topology yielded the following results, which are plotted in the Figure 4.

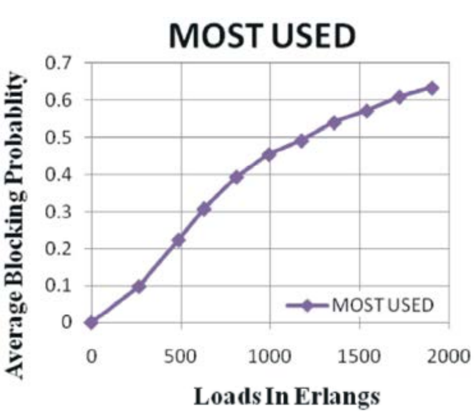

Fig. 4: Average Blocking probability of most used algorithm

The simulation parameter values are:

Tab: 3 most used wavelength assignment

Load in Erlangs	Average Blocking probablity
0	0
266	0.0981588
488	0.223513
630	0.307415
812	0.392745
994	0.454263
1176	0.49128
1358	0.53954
1540	0.571351
1722	0.608501
1904	0.632771

Least Used: The simulation parameter of least used wavelength assignment is given in Tab 4, in the selected topology yielded the following results, which are plotted in the Figure 5

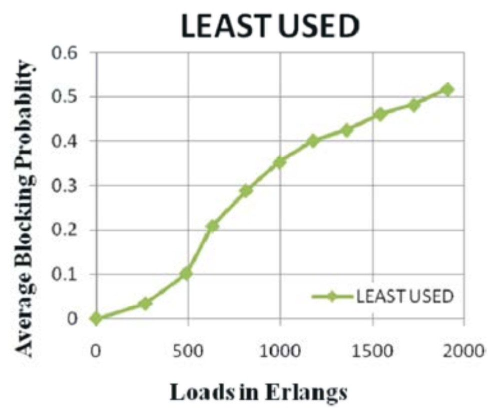

Fig. 5: Average Blocking probability of least used algorithm

The simulation parameter values are:

Tab: 4 least used wavelength assignment

Load in Erlangs	Average Blocking probablity
0	0
266	0.0338625
488	0.101801
630	0.208891
812	0.288716
994	0.352805
1176	0.40211
1358	0.426118
1540	0.461669
1722	0.482048
1904	0.517482

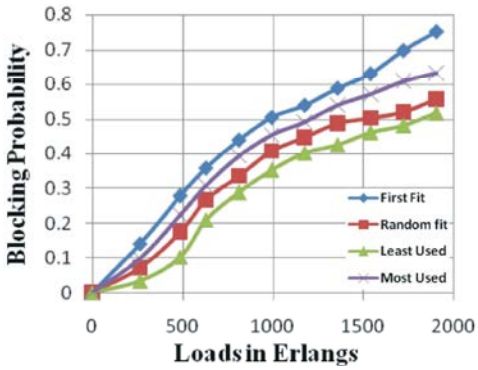

Fig. 6: Comparison graph

The simulation parameter values are:

Tab: 5 comparison table

Load in Erlangs	Average Blocking probablity			
	FIRST FIT	RANDOM FIT	LEAST USED	MOST USED
0	0	0	0	0
266	0.139903	0.0713182	0.0338625	0.0981588
488	0.27848	0.173638	0.101801	0.223513
630	0.35792	0.266303	0.208891	0.307415
812	0.439308	0.33464646	0.288716	0.392745
994	0.504397	0.407061	0.352805	0.454263
1176	0.539203	0.447067	0.40211	0.49128
1358	0.588203	0.487049	0.426118	0.53954
1540	0.630275	0.502523	0.461669	0.571351
1722	0.697369	0.51961	0.482048	0.608501

CONCLUSION

Results show that blocking probability reduces considerably for higher number of wavelengths, even for astronomically immense load per link. Results additionally betoken that differences in the reduction of blocking probability all the four wavelength assignment (WA) schemes are minimal. So depending on the size of the network and the total number of requests arrive in the network least used algorithm accounts for the least average blocking probability. Routing and Wavelength assignment is done utilizing C++ programming language and Hegons compiler.

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