WAVELENGTH ALLOCATION IN WDM OPTICAL NETWORK

***Arvind Kourav, **Dr. Maneesh Shrivastava**

[*]Electronics & Communication, [2]Information & Technology
Globus Engineering College Bhopal M.P. India,
***LNCT College Bhopal M.P. India*

ABSTRACT

Wavelength Division Multiplexed (WDM) is important phenomena which used in optical communication, In Wavelength Division Multiplexed (WDM) optical networks, allocation of wavelength converters has become a basic scheme to increase the efficiency and to minimize blocking of the network reduce blocking probability. The wavelength converter allocation problem has been treated as a mono objective problem minimizing the number of wavelength converters or minimizing blocking; however, both criteria are in conflict with each other. Therefore, the wavelength converter allocation problem is studied here in a pure multi objective optimization context for more appropriate decision. Commonly in network node three techniques used for wavelength conversion re-amplification, reshaping, retiming by using regenerator network cost increase. In this paper we have used Basic RWA technique to solve this problem. The thorough technique is used to find out how to achieve near-ideal performance of the network using minimum number of wavelength converters we used a network of 20-node and 32-link.

Keywords— *Optical Networks, Wavelength Division Multiplexing, Virtual topology, lightpath,.*

INTRODUCTION

This In the telecommunication system the demand of bandwidth increasing by growing Internet users ,is determining an unprecedented increase of network traffic in the high-capacity transport infrastructure. Wavelength Division Multiplexing (WDM) is a good solution to face this terrific demand. While originally it was considered basically a mean to multiplex several high-capacity transmission channels on a common optical fiber, WDM are support such network functions as circuit switching, routing and wavelength conversion and assignment [1].In WDM networks the basic property that distinguishes wavelength routing network ,A number of studies have been undertaken to determine how networks using no, or limited wavelength conversion should be dimensioned in order to support the seme set, or sets, of light paths as an optical layer with full conversion [1], a wavelength is assigned to each piecing together in such a way that all traffic signal is handled in the optical domain, without any electrical processing on transmission. The establishment of these connections are called light paths . The established light paths forms the virtual topology, or logical topology, opposed to the network physical topology made of nodes and fibers. Different light paths on the same fiber must use different wavelengths. To avoid conflicts, proper Wavelength Assignment (WA) at switching nodes must be done: each light path has to be routed being assigned an appropriate wavelength on each output link. The complexity of the WA problem depends on the wavelength-conversion capability of network nodes. In WDM, optical network routing and wavelength assignment is a well known problem. To reduce blocking probability . There are some fundamental ways of achieving wavelength conversion [1]. They are: (1) optoelectronic, (2) optical gating, (3) interferometric and (4) wave mixing. The result can be broadly classified into two categories : offline requests and online requests .The offline problem corresponds to a static network design problem,where only a single set of light paths is to be supported.This set can be supported in a network with nods capable of full wavelength conversion.Online RWA corresponds to the dynamic network design case where lightpaths arise one at a time and have to be assigned routes and wavelengths when the request arrives,[1]

Moreover, similar previous studies aimed at such virtual topology optimization, but assuming that all connection requests must be necessarily satisfied. Results evaluated by different algorithms are thus compared only for instances that satisfy all demands. Nevertheless, given some physical topology, it is difficult to think that heavy traffic demand.
In this we can take a example for logical topology shown in Figure 1 (a) corresponding to a connection request set C =f(0; 2); (2; 4); (4; 0); (1; 3); (3; 5); (5; 1); (0; 1); (2; 5)g to be embedded over a WDM network with six nodes.Figure 1 (b-c) show the physical ring topology and two different lightpaths assignments, in which the logical topology maintains its connectivity in the presence of any single physical link failure when the light path setup is done using the routes shown in (b), and it does not when the setup is done using the routes in (c) .[3]

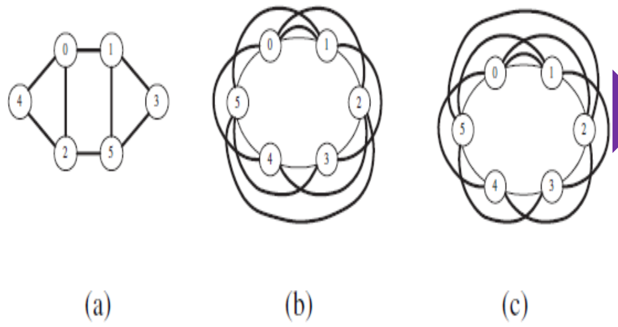


Fig 1Logical Topology

In WDM network OEO regenerators are shared by all the incident links to a node but when a regenerator is busy in converting wavelength of an incoming signal then it cannot be used for further wavelength conversion of another incoming signal until its conversion is done. So, the later incoming signal will be blocked until the conversion of the regenerator is done. This may degrade the network performance. A lot of work has been done [3]. It has been described in section II and the problem statement in section III. The proposed approach and the proposed algorithm have been in sections IV and V respectively. Section VI contains the experimental results.Finally, the article has been concluded in section VII.

II . NETWORK ARCHITECTURE

For the design of we follow assumptions are stated below:
(a) In WDM network design all node connected to each otherdirectional.
.(b) A light path is characterized by a source-destination node pair (s, d). For an N-node network matrix, there exists NX (N-1) distinguishable source-destination node-pairs. So if we consider only shortest-path routing, there can be NX(N-1) different possible light paths considering that only one shortest path is selected (even if there exist multiple shortest paths between a node-pair) depending on the flow of algorithm. Any Routing and Wave-length Assignment (RWA) algorithm can be applied but, the same algorithm should be applied while gathering the utilization statistics and after the allocation of regenerators (using utilization statistics).
(c) The nodes are selected as the regeneration sites, regenerators will act just as wavelength converters.
(d) All the nodes in the network are either opaque OXC or transparent OXC. No translucent OXC are present.
(e) All the opaque OXC nodes provide full-range wavelength conversion from any input wavelength to any other wavelengths (at least, all the wavelengths corresponding to the different wavelength channels).

III PROBLEM SIMULATION

Network blocking under dynamic traffic conditions depends on the applied routing strategy which is influenced by many parameters. Moreover, the parameters are not independent of each other which further increases problem complexity main parameters for network performance are.
• network topology and dimensioning
• node functionality
• technological constraints
• traffic parameters
• searching strategies "wavelength domain": for the selection of a wavelength path not only the way but also the wavelength has to be determined for a request.
• routing strategy: Finally, also the routing strategy itself has many parameters. Fundamental aspects are for example the selection of a way or route for a call is based on the shortest path . In WDM networks there are some specific aspects not known from "classical" networks. An example is the trade-off between path length and converter requirement. the shorter path between s and d requires a converter due to already occupied wavelength channels, whereas the longer alternative needs no conversion but occupies more transmission capacities.[2] There are following step for problem simulation.

N = the number of nodes in WDM optical network.
Ri = number of regenerators required at node i for complete wavelength conversion.
R = the maximum value of the set $\{R_1,R_2,R_3,\ldots\ldots\ldots\ldots\ldots\ldots\ldots R_N\}$.
T = total number of available regenerators.

U = Utilization matrix (of order NX(M + 1)), in which i, jth entry (where 1≤ i ≤N,0≤ j R) denotes the percentage of time that j regenerators are being utilized simultaneously at node i.So, if a node i has j number of regenerators then utilization at node i is $\sum^{j}_{i=1} U_{ij}.x_{ij}$ Given the utilization matrix, U, the regenerator allocation matrix x is to be determined so that (i) the number of regenerators used in the network becomes minimum and (ii) the blocking probability becomes near to zero. Regenerator allocation matrix is a two dimensional NX M matrix where ,xij = 1 if j or more number of regenerators are allocated at node i.
=0 otherwise.

Accordingly the total utilization at node i is ∑Rj=1Uij xij, Subjected to the following constraints:

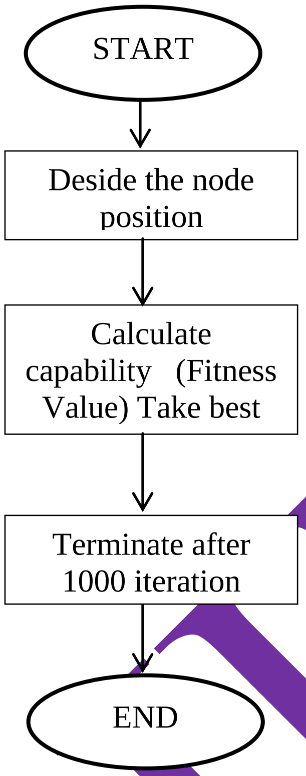
- $\sum^{N}_{i=1} \sum^{R}_{j=1} X_{i,j}=T$
- $X_{i,j} \geq X_{i,j+1}$
- $X_{i,j}$ Ɛ {0,1}

Suppose one solution s = (4,3,1,0,2), its corresponding regenerator allocation converter matrix will be
[1 1 1 1;
1 1 1 0;
1 0 0 0;
0 0 0 0;
1 1 0 0]
Though we have considered STU as the objective function but in some cases it can be observed that two or more non-identical regenerator matrices have the same STU. This condition may arise because STU is of the form ∑Rj=1Uij xij, , So, for the same U but for different X there may be similar entries in U at different nodes. For those cases we have chosen randomly one of the solutions.

IV. PROPOSED ANALYSIS

To find out the regenerator allocation matrix x which will satisfy the above two goals, we have used searching capability of PSO. Representation of the solution: Regenerator allocation matrix is a two dimensional matrix. We can consider the two dimensional matrix as the representation of the solution. But this will increase the search space. So, we have converted this two dimensional matrix into one dimensional vector. Here a solution s can be represented as s=(y_1, y_2……………y_N), where yi =∑Rj=1 xij, and each yi will satisfy the following constraint y i ≤ R i , ∑y i=T, So, in this problem the solution is considered as an N dimensional vector and the search space is an N dimensional matrix. From a given solution s one can find the regenerator allocation matrix corresponding to that solution,because the entries xi,j in the regenerator allocation matrix has the constraints described earlier.Objective function: As described earlier, in this problem we have two goals. One is to find out a regenerator allocation matrix x such that the number of regenerators used in the network becomes minimum and another objective is to find out x so that the blocking probability becomes near to zero. But both of these goals can be fulfilled if the sum of total utilization of all the nodes is considered as objective function and the objective will be to maximize it [4]. This will improve the overall utilization of the regenerators. As a result the overall blocking probability can be smaller. So, here the objective function is sum of total utilization of all nodes. Mathematically STU can be represented in the following way, $\sum_{i=1}^{N}\sum_{j=1}^{R}U_{i,j}X_{i,j}$.

V. ALGORITHM FLOW GRAPH



VI. RESULTS

For simulation purpose we have taken the anetwork [b]. It has 20 nodes and 32 bi-directional links. In this paper we have taken the total number of particles gas 100 for all experiments.

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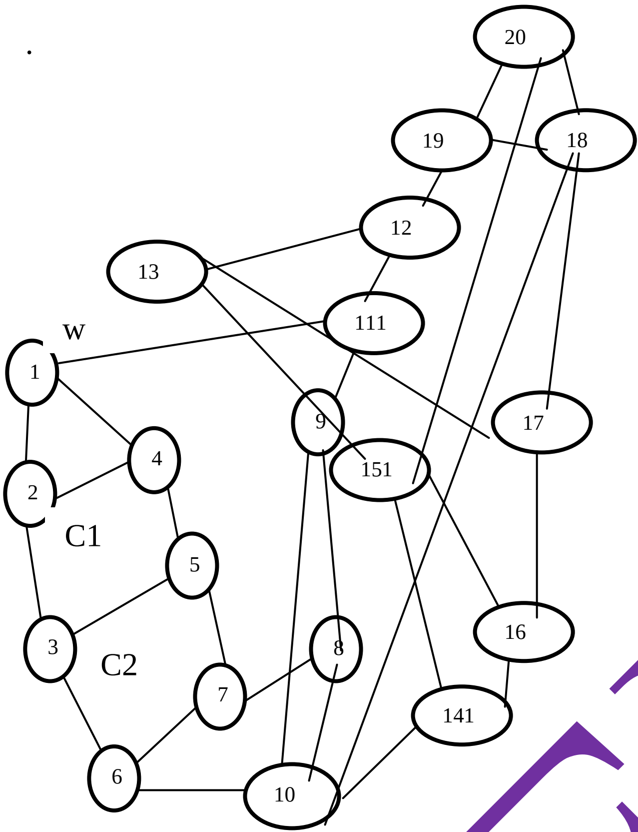

Fig.2. backbone network

The value of w (inertia factor) is taken as 0.9and C1 ,C2 are taken as 1.5 for all of the experiments. Here we have considered the same utilization matrix as in [b]. The convertor allocation matrix for number of convertors, T=22 are used.Matrix for Regenerator allocation matrix, X (for T = 22)

[1 0 0 0 0 0
1 0 0 0 0 0
1 0 0 0 0 0
1 1 0 0 0 0
1 0 0 0 0 0
1 0 0 0 0 0
1 0 0 0 0 0
1 0 0 0 0 0
1 1 0 0 0 0
1 0 0 0 0 0
1 1 0 0 0 0
1 0 0 0 0 0
1 0 0 0 0 0
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1 0 0 0 0 0
1 1 0 0 0 0
1 0 0 0 0 0
1 0 0 0 0 0
1 1 0 0 0 0]

In our analysis the sum of total utilization is 8.32 and 9.10 respectively.

CONCLUSIONS

In this paper we used regenerators as wavelength converters and solve the optimal allocation of wavelength converters problem and compared results with other techniques ,our algorithm produce better result and performance for a for more complex topology is logical topology and for various number of demand sets.For Future our aspect will be how to use this algorithm for long-haul networks.

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