Design Of WDM Networks With Limited Wavelength Conversion

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Abstract: Minimum cost routing and wavelength allocation of all-optical transportation networks multiwavelength using genetic / heuristic approaches is defined. A value model incorporating a reliance on the specifications for related wavelength is adopted. The developed hybrid algorithm uses object-oriented network representation and integrates four operators: path mutations, crossover with a single point, re-route and shift-out. Therefore, an adaptation process to the operator is used to boost operator efficiency. The GA / heuristic hybrids approach provides superior results, as opposed to three recent wavelength-allotment heuristics, except when the network price is mostly dependent on the demand for wavelength, from experimental results obtainable using an Optical Network Optimization, Modeling and Design (NOMaD) method.

Index Terms: Genetic algorithms; Multihopping wave networks, WDM, logically rearrangeable networks.

1 INTRODUCTION

Wavelenght-DIVISION(WDM[1] is an excellent technique for using the massive optical fiber bandwidth. Multiplied channels can be operated concurrently on a single cable, but in fiber-optic communication, it is a fundamental requirement that these channels operate at a varying wavelength. Both channels can be modulated separately for different data types, including certain analog and digital formats, within certain limits. Therefore, when offering channels whose bandwids (1,10 gb / s) are compatible with current digital processing rates, WDM uses a single mode optical fiber's enormous bandwidth (THz). Data can be transferred in a WDM network according to their wavelengths to their respective targets. The use of wavelengths for route information is called routing wavelengths, and a network using this technique is also referred to as routing network wavelengths [2]. Such a network consists of wavelength communication linked by optical fibers (or routing nodes). Some nodes (called cross connections), where data from several end users could be multiplied to a single WDM network, are connected to access stations An access station also offers optical (O / E) conversion and vice versa the optical network interface with conventional electronic devices. A routed wavelength network that transports data from one access station to another without any intermediate O/E conversion is known as a routed wavelength network with all-optical wavelength. For the construction of broad wide-scale networks, such all-optical wave-length networks were proposed[3].

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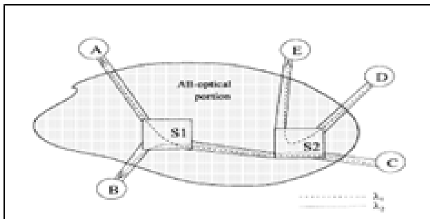


Fig. 1. Data Transfer WDM

A link in the optical layer, analogous to the case of a circuit-switched telephone network, should be set up. This process is achieved by specifying a network route (path) linking the source station to the destination station and by allocating an available (or idle) wavelength on all links in the fiber line. This all-optical path is called a transparent or light path. The entire bandwidth on this path is assigned to the connection during its hold time, during which no other connection may be assigned the corresponding wavelength. When a connection is broken, the corresponding light path is torn down, and on all the connections along the way the wavelength is unfailing again. Take into account the Fig network. 1.1 The wavelength network shows routed network that contains two WDM (S1 and S2) cross-connections and five access points (A to E). There were three light paths (C to A at wavelength, C to B at, and D to E at). In order to determine any light path, we normally require that all links in the path have the same wavelength. This condition is known as the restriction of wavelength consistency and wavelength-routed networks known as continuous networks of wavelength. The restrictions on wave-lengths separate the wave-length network from a circuit -switched network, which only blocks calls if there is no bandwidth over any of the links on the call route. Take into account the network section in Fig. 2(a). 1.2(a). There were two paths in the network: 1) on wavelength from Node 1 to Node 2 and 2) on wave longitudinal wavelength between Node 2 and 3. Now assume that a light path must be formed between node 1 and node 3. If only two wavelengths are available in the network, it is now impossible to establish such a light path from node 1 to node 3, even though each connection in a path from node 1 to node 3is free of the wavelength. This is because both ties have different wavelengths. Therefore, a continuous wavelength network can be blocked higher than a circuit-switched network.

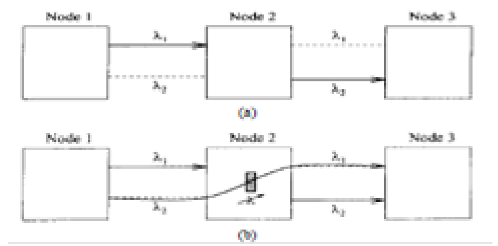


Fig. 2. Wavelength-continuity constraint in a wavelength -routed network: (a) without onverter and (b) with converter

1.2 Benefits of WDM
Wavelength multiplexing channel (WDM) is an important technology used in telecommunication systems today. This works better than other types of customer satisfaction interaction. It has many advantages that make it known to customers including

1.3 Transparency
WDM Networks allow the transmission of data at varying bit rates. A number of protocols are supported as well. Thus the way we want to send the data is not too much restricted. It can therefore be used for several applications of high speed data transmission

1.4 Capacity Upgrade
Optical fiber networking has extremely large bandwidth. The data channel carrier is light here. As a norm, a single beam of light is used. Nevertheless, in WDM lights are added to a single optical fiber of different wavelengths. Further data is then transmitted in the same cable. It significantly increases the network's efficiency.

1.4 Wavelength Reuse
Routing the wavelength is necessary for WDM networks. The same wavelength can be used twice in various fiber connections. This permits reuse of the wavelength and helps to increase the capacity [5].

2 PROBLEM DEFINITION
The problem of the layout of a wave network is to pick the link graph and split the flow to accommodate each dimension of the node-by-node traffic strength matrix between the links that are generated by the connection chart. The performance measurements of interest are the average network delay and network performance. The network delay consists of a delay in propagation and a delay in transmission. Due to geographic distances between nodes, the propagation delay is. The delay is due to the queuing period at each node and the delay in accessing the channel if the channel is split between several destination pairs.

3 LITERATURE REVIEW
The articles [1] discuss the problem of the routing and the assignment of wavelengths in optic networks using WDM technologies. There are two different aspects to the problem: static RWA, which is known to provide traffic and dynamic RWA in a random fashion. Input data for communication network design / optimization problems related to multi-hour traffic or uncertain traffic can consist of the largest traffic matrices [2,3]. Input data for communication network conception [2,3]. The problem formulations for connection dimensioning explicitly consider the matrices. Nonetheless, many of these matrices are typically occupied by others so it is necessary to have proper reserves of connection capacity that support all originals traffic matrices only a relatively small subset of matrices. Therefore, eliminating dominated matrices leads to significantly smaller problems of optimization which can be addressed by modern solvers. They discussed problems behind the identification of dominance of one traffic matrix over another in their paper. We consider two basic cases of dominance: I total domination, where both arrays are subject to the same traffic routing, and (ii) regular domination where traffic based routing is possible. The paper is based on our original findings and generalizes the effects of dominance established for fully linked networks. Because of energy considerations [4,5], not all fiber wavelengths may be used at any given time. In his paper, an empirical model is proposed for the calculation of the blockage quality of optical wavelength networks with and without conversion of wavelength when the available wavelengths in the fiber are limited to a certain maximum number known as wavelength limit. In ring and mesh-torus networks, the effect of the wavelength restriction is studied. The analytical model shows that the outcomes of the test are similar to each other. It is shown that increasing the total wavelength of a fiber is an attractive alternative to the conversion of wavelengths when the same number of wavelengths are kept in one fiber. The paper [5] says that while techniques of optical transmission have been explored for some time, optical' networking' studies were only undertaken in the last decade or so. This field has expanded tremendously over this time, with the production of several papers and PhD dissertations, the construction of a number of prototypes and test beds, several books, the formation of a large number of start-ups, and the very rapid deployment of WDM optical technologies in the marketplaces. The aim of this paper is to sum up the fundamental optical networking methods, report briefly on the WDM implementation strategies of two major US operators, and review current trends of the WDM optical network for research and development.

4 MODELING DEMAND
Network has current traffic, future demand or a dynamic simulation scenario, and if the traffic is static the RWA problem is called SLE, while the DLE (Dynamic Ligthpath Establishment) is dynamic [5]. When the average contact time requested (tC) is lower than the average service request received (tLL). Traffic is complex. The scenario (NP-Complete) is not optimizable, so heuristic algorithms are used and the majority give not necessarily optimal solutions. Computer complexity is an important component of this problem, since it can be minimized when subdivided. On the other hand, when the containment problem is posed and avoided executing a new algorithm procedure, many trails which obtain heuristic algorithms are of great support. The demand variables are similar in nature to the features used in works[6-8].

5 ANALYSIS MODELS
The random and first-fit wavelength algorithms will be included in this section. In this section. we have developed approximate

analysis models. The analyzes are intended to calculate the probability of blockage. The following assumptions are made in order to analyze:

1In an arbitrary topology, the network is connected. The number of wavelengths in each relation is fixed.
2. There is a number of transmitters and receivers in each station where W is the fiber-carried wavelength.
3. Place traffic to level.
4. The contact request is not Queuing. All of a sudden, the connection is blocked. The relation loads are independent of one another.
5. Static Routing is assumed.

5.1 Analyses of wavelength assignment algorithms

In the absence of a wavelength translation, we found the blocking likelihood. For wavelength allocation, the two limits are: 1.

1. Wavelength constraint: the same wavelength will apply to all the connections along the path from the origin to the edge of the destination.
2. Different constraints in wavelength: the different wavelengths should be allocated to each light road using the same reference.

The algorithms used to model the algorithm and random algorithms are first suited. The following algorithms can be shown:

1. **First fit algorithm:** First the traffic matrix wavelengths are sorted in the non-decreasing order in this algorithm. This sorted list is then accompanied by the algorithm to pick candidate chains. Let uij be in the sorted list the next highest wavelength component. Then the end nodes I and J are the end nodes of the two chains; otherwise the next highest element is called, and the chain is generated by connecting the two ends. The process takes place until each chain reflects the linear topology as a single chain..

2. **Random algorithm:** The wavelength of this algorithm is randomly chosen from the wavelengths available. A number is generated randomly in this algorithm, and the wavelength for that random number is allocated.

In all-optical transport networks, the routing and wavelength assignment problem, known to be NP-hard, is considered. There is a lot of heuristics in the literature on this topic. Nonetheless, these heuristics have minimal applicability because they have many basic problems, including high complexity in time and lack of scalability with regard to optimal solutions. We give a hybrid genetic algorithm / heuristic. A value model is implemented which includes a reliance on contact wavelength requirements. The proposed Hybrid algorithm uses an object-oriented networks view and requires four operators: semiconducting path mutations, cross-sections, reroutes and changes. Experimental results from the test networks show that the proposed GA and heuristic hybrid method offers promising results when the network cost depends on heavily allocated wavelengths, compared to recent heuristics of wavelengths.

6 PROPOSED METHODOLOGY

Optimization is the choice of a best element in mathematics under certain constraints from some solutions. The problem of optimization means optimizing or minimizing a real function by systematically selecting input values from the set of values allowed and calculating the function value. A wide range of applied mathematics is used to generalize theory and techniques of optimization in other formulations. More precisely, optimization means that some objective function values can be found "best available" provided a certain domain or set of restrictions. These are listed forms of optimization techniques.

6.1 Classical Optimization Techniques

The classical methods are useful to find the perfect solution or unconstrained limit or lowest possible continuous and differentiable functions. These analysis methods are used to detect the optimal solution with the differential calculus. The classical approaches are limited in practice because some of these methods require non-continuous and/or differentiable objective functions. Nevertheless, the analysis of these classical optimization techniques is the basis for the design of most of the numerical techniques which are advanced and more suitable for current problems. Such techniques assume that the function is two times differentiable from the layout variables and the derivatives are continuous. Three main problems that can be solved with conventional optimization techniques:

i. Single variable functions
ii. Multivariable functions with no constraints,
i. Functions multivariable with limits on equality and inequality. The Lagrange Multiplier approach can be used for problems of equality constraints. If the problem is unfair, the Kuhn-Tucker conditions can be used to find an optimal solution.

These approaches lead to a set of simultaneous nonlinear equations which are difficult to solve.

6.2 Numerical methods of optimization

i. Linear programming: It is a method of achieving the best results in a mathematical model that has linear relationships to represent. A special case of mathematical programming is linear programming. More formally, linear programming is a method for optimizing the linear objective function, with restrictions on linear equality and linear inequality.

ii. Integer programming: The problem of integer programming is a mathematical optimization or workability program where some or all of the variables are limited to integral. The term refers to integer linear programming with a linear function and limitations in many settings..

iii. Quadratic programming: Quadratic programming is a particular type of math problem. It is difficult for the quadratic function of a number of variables to be optimized subject to linear constraints.

iv. In Mathematics, non-linear programming is a method which addresses a problem for optimization identified by a system of inequalities and parallels, collectively called limitations, across a set of real unknown variables and maximizes or minimizes an objective function when some of the constraints or objective functions are non-linear. It is the branch of mathematical optimization that discusses non-linear issues.

v. **Stochastic programming:** Stochastic programming is a method for the simulation of optimization problems involving ambiguity with respect to mathematical optimization.

6.3 Advanced optimization techniques

6.3.1 Genetic Algorithm

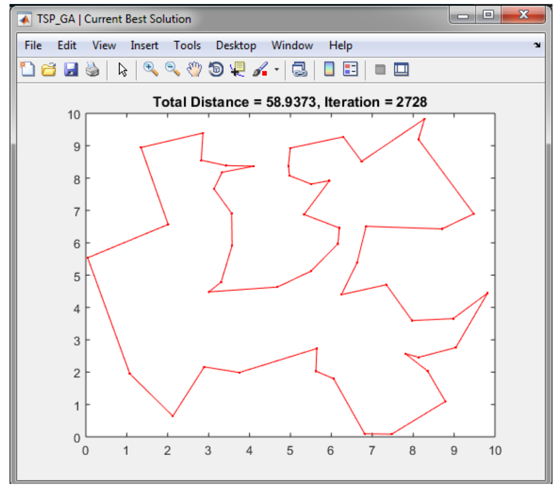
A genetic algorithm is used to look for approximate solutions to search problems. Genetic algorithms are a special class of evolutionary algorithms that apply evolutionary biological inspired techniques such as heritage, mutation, crossover and selection. The evolution starts with an entirely random population, which takes place over centuries. The health of the entire population is measured in each generation. Many individuals from the present population are stochastically picked and converted into a new population. In the next iteration of the algorithm the new population is used.

6.3.2 Fmincon

FMINCON is a function included in the Optimization Toolbox of MATLAB that seeks the minimization of multiple variables ' scalar function, within a linear limit and limit area [10]. The syntax for fminion is x_opt = fminion (fun, x0, A, b, Aeq, beq, lb, ub) where fun is the "function handle"; that is, the name of an M-file that defines the function, preceded by an "@" sign; x0 is an initial value for the optimizer; A, b define a linear inequality constraint A * x <= b on the solution. Aeq, beq define a linear equality constraint Aeq * x = beq on the solution. lb, ub define bounds on the solution, lb<= x <= ub. The GAs is a computer program that simulates the inheritance and development of living organisms [3]. Even multi-modal targets using GAs are feasible because they are multi-point search methods. They are also possible. GAs also refers to discrete problems with search space. GA is thus a strong optimization tool, but not only quite user-friendly [4]. The search area of GA is composed of strings, each of which is a candidate solution to the problem and is called chromosomes. That chromosome's objective function value is its health value. Population and its related state are a collection of chromosomes. Generations are populations generated by GA iteration [5]. Genetic algorithm to look for a variety of solutions in order to identify the best:

7 RESULT AND SIMULATION

In communications in the coming years, optical fiber will be increasingly important. The multi-wave-length multichip architectures make its use as a transmission medium in local area networks possible. Efficient algorithms are needed to solve topology and flow assignment problems for multi-light wave networks in order to use that architecture efficiently. The operators must deliver viable solutions and keep the people within the solution space. Although the algorithm operates very randomly, it performs significantly better than random solutions that are comparable to the heuristic performance of the current algorithm. GA can always find better solutions than its existing heuristics, as with the disconnected types of traffic requirements. Since GA is a parallel search technique, it stops with several solutions of high quality. For cases where node failures and traffic changes are frequent, the existence of alternative configurations is beneficial.



Fig(7.1) *Optical WDM routing.*

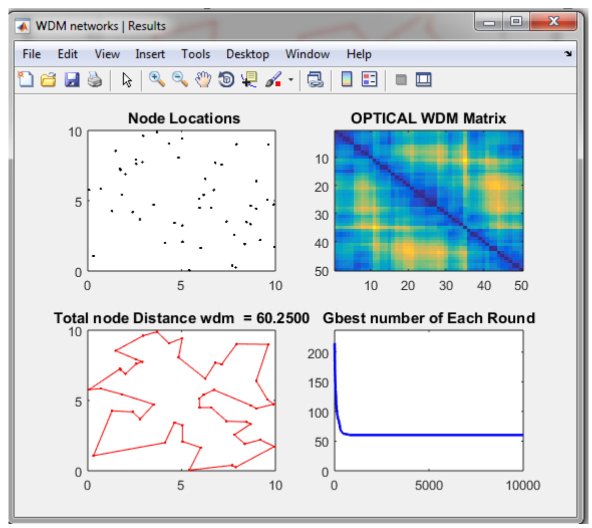


Fig (7.2) *Node location of WDM blocking Probability*

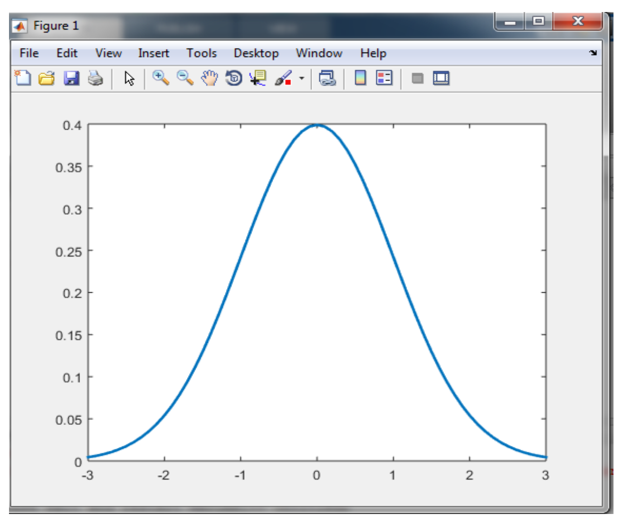


Fig (7.3) *Maximum Probability.*

The results of this simulation demonstrate how with the number of nodes the blocking likelihood (percent) increases. In case of a random algorithm, the probability of blocking will always be higher than that of the first-fit algorithm. Image. 2–fig. 2–fig. 11 shows that the blocking chance of 10 nodes for a load from 1 Erlang to 10 Erlang per reference with wavelength conversion and with no conversion. The blocking probability is minimal when the wavelength is transformed, but the first-fit algorithm has better results than the random algorithm for the allocation of wavelengths in the event of no conversion.

8 CONCLUSION

The paper considered a network model with two-way connections, WDM and Ring-Star-Tree light paths and arbitrary topology networks with light path constraints. Ring and star networks have been shown to be able to perform offline channel allocation and full wave longitudinal conversion with low wave length conversion capabilities. However, in Theorems 5 and 7, the ring and star networks only had to shift the wavelength to their nearest wavelength, which implies that the overall wavelength range was not as wide. Furthermore, it should be noted that if connections, WDM and light paths are unidirectional, the findings of this report can be expanded. The findings of Section 2 ring networks can be extended directly. Theorem 7 (the product of the bidirectional star network) can be generalized to the unidirectional case in the absence of any wavelength conversion (there are two unidirectional connections between the hub and any rim node of the bidirectional star). It is an important open issue to apply all these findings to arbitrary topologies.

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