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Design Of QOS Aware Light Path Planning And Technical Aspects In Wdm Networks

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ABSTRACT:
In this work, theissueofconnectionprovisioning andperformanceanalysisin wavelength division multiplexing (WDM) network is considered. We ensured the quality of service (QoS) requirement of the connection requests from the client in the optical networks. While designing WDM system, the physical layer impairments (PLIs) incurred by non-ideal optical transmission media, accumulates long the optical path degraded the QoS. For high transmission speed Dispersion become a consider able degradation factor and in this work will be concentrated on the effects of dispersion on fibered sign parameters such as band width, delay etc. The overall effect of dispersion is described in terms of quality factor (Q-Factor) and improvement in blocking probability is observed over proposed algorithms and traditional algorithms. In this work the light path provisioning mechanism is based on both Q-Factor and blocking probability. Each path is provisioned that satisfy the requirement of client in the network model. A proposed algorithm and the traditional algorithm provide the improvement in blocking probability for incoming requests while considering impairment issues. In this work, the impact of dispersion on transmission performance of WDM network, by ensuring the QoS requirements, is evaluated. It is necessary to provide the best service to the customers. The aspect WDM network model can be specified in terms of QoS parameters such as bandwidth and delay. The QoS requirement, in terms of Q-Factor, is associated with the optimum light path. For high transmission speed, the dispersion becomes a considerable degradation factor. This work improves the blocking probability while performing the optimum routing.

KEYWORDS: *Blocking probability, Disjoint Path, OVPN, PMD, Q-Factor, Shortest path,WDM. etc.*

I. INTRODUCTION

The efficient optical virtual path network (OVPN) is the recent provisioning mechanism over WDM mesh network by considering the effect of polarization mode dispersions (PMD) [1]. The competitive market pressures demand that service provider continuously upgrade and maintain their networks to ensure they are able to deliver higher speed, higher quality application and services to the customers. The QoS based disjoint path (DJP) algorithm for dynamic routing in WDM network improves the blocking probability [2]. The WDM routed networks provide an optical connection layer which consists of several light paths. Light waves traversing through a wavelength-routed optical network encounter progressive linear and non-linear interactions [3]. The delay model and its application for fiber material selection in order to optimize a suitable OVPN connection with minimum delay [4]. A light path is defined as an optical connection from the source to destination node. In WDM network, the most important issue is routing and wavelength assignment. In this paper a new algorithm for provisioning of high speed optical connection is proposed by considering the effectof dispersion in the fiber.

The concept of QoS in communication system is closely related to the network performance of underlying routing system. Quality of service can be defined as the collective effect of service performance which determines the degree of satisfaction of user of the service. The physical layer impairments and issue challenges are considered in the way of optimum routing [8].At the time of efficient connection provisioning various linear and non-linear impairments has to be considered without physical layer impairment awareness, a network layer provisioning algorithm should not guarantee for signal quality. Some of linear impairments are PMD, Chromatic dispersion, waveguide dispersion, modal dispersion, attenuation, Amplifier spontaneous emission, insertion losses. Some of non–linear impairments are self-phase modulation, cross phase modulation, four wave mixing, stimulated Raman scattering etc. In this paper, Q-Factor is defined as the cost of the network. In the proposed algorithm, the QoS requirement is considered the bandwidth for each path and delay in the fiber due to pulse spreading. This paper discussed the improvement in the blocking probability for proposed algorithm for DJP and shortest path (STP). The QoS based optimum path provisioning mechanism for WDM network by considering maximum bandwidth and minimum delay for each path.

II. ROUTING MECHANISM

In this paper, the QoS is defined in terms of Q-Factor, which is computed in terms of maximum bandwidth and minimum delay associated with the optical fiber light path. The routing and wavelength assignments are necessary for improving the quality of service [6-7]. The maximum value for the Q-Factor is the optimum requirement for the connection request while calculating Q-Factor. The linear impairment factor dispersion is considered in this paper. Due to dispersion pulse is spreads and hence delay for the transmitted signal. The route with minimum delay are optimum path for routing and should have minimum number of node, for minimizing network cost but for the bandwidth, the optimum path is the path which provides maximum bandwidth value.

III. SYSTEM MODEL

The wavelength routed optical network consists of optical cross connects, optical add and drop multiplexers, which are connected through WDM links. This system consisting of three layers, the provider edge layer (PEL), optical core layer and client layer, shown in figure 1.

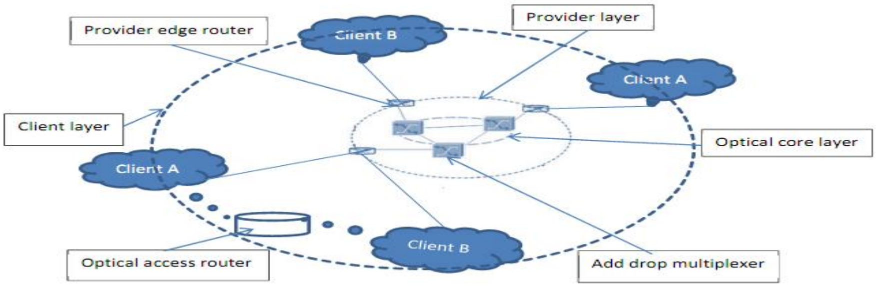

Figure1. System model topology

Provider edge router (PER) belongs to the light path client, which provides the light path services and interface between clients. The optical core router (OCR) is not connected to the client directly. In provider layer the PER are responsible for all non-local management function such as management of optical resource configuration and capacity management, addressing, routing, topology discovery, traffic engineering andrestoration etc. PER maintain the traffic matrices (TM). The Traffic Matrices maintains the network as well as physical layer impairments (PLI). The PLI constraints are such as bandwidth, delay and dispersion and Q-factor matrices for all the possible light path connection in the network belongs to all the layers.

The virtual network model [1] is considered as shown in figure 2.In thisnetwork, a client (m) communicated with client (n) via source PER i to destination PER j.Connectivity in a system is determined by link and wavelength present or not. If linkpresent between two nodes, connectivity is taken as 1 otherwise it is taken as 0.Similarlywavelength is available between two nodes is taken as 1 otherwise it is taken as 0.

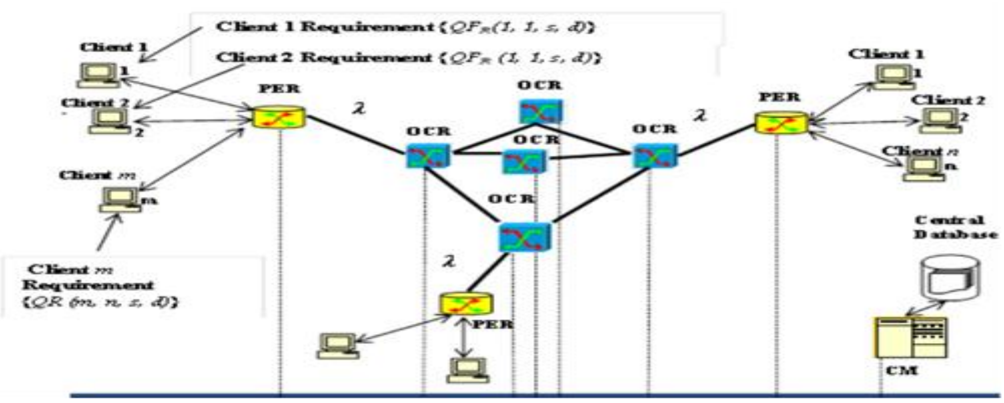

Figure2. Network topology

IV. REQUIRED Q-FACTOR FOR CLIENT POINT OF VIEW

The problem formulations are based on the different QoS parameters such as Q-factor in terms of bandwidth and delay. The Bandwidth and Delay requirements for client 'm' to client 'n' from light path source 's' to destination 'd' are respectively BW(m, n, s, d) and D_{PMD}(m, n, s, d) .If QF_R (m, n, s, d) is the required Q-Factor then it can beformulated [4] as

$$QF_R\ (m, n, s, d) = \frac{BW(m, n, s, d)}{D_{PMD}(m, n, s, d).} \qquad (1)$$

V. REQUIRED Q-FACTOR FOR SYSTEM POINT OF VIEW

The required Q-Factor has been computed in terms of bandwidth, delay and Q-Factor as follows;

a) Bandwidth computation for light path

Assume physical layer constraints are dispersion coefficient and link length. If B (i, j) is the bandwidth between link 'i' and 'j' then it can be formulated [2] as

$$B(i, j) = \frac{\sigma}{DS_{pmd}(i, j) \times \sqrt{L(i, j)}} \qquad (2)$$

Where σ, DS_{pmd}(i,j), L(i,j) are the pulse broadening factor, dispersion coefficient and link length of the fiber respectively.

b) Delay computation for light path

Differential time delay lies between two modes in the fiber. The delay is due to the effect of polarization mode dispersion. It can be formulated [1] as

$$DS_{pmd}(i, j) = DS_{pmd}(i, j) \times \sqrt{L(i, j)/2} \qquad (3)$$

c) Q-Factor for light path

If Q(i, j) is the computed Q-factor for a link pair 'i' and 'j' ,then it can be formulated as-

$$QF(i, j) = \frac{BW(i, j)}{DS_{pmd}(i, j)}$$

d) The total Q-Factor

If the minimum bandwidth and the maximum delay for every link (i, j) consisting of source to destination routes (s, d) are respectively $\left| BW(m, n, s, d \right|_{min}$ and $\left| DS_{pmd}(m, n, s, d \right|_{max}$. The total Q-Factor is formulated as

$$QF(m, n, s, d) = \frac{\left| B(m, n, s, d) \right|_{min}}{\left| DS_{pmd}(m, n, s, d) \right|_{max}} \qquad (4)$$

VI. BLOCKING PROBABILITY

The blocking probability can be defined as the ratio of total number of connection blocked to the total number of connection required. If BP(m, n, s, d) is the blocking probability from client ‘m’ to client ‘n’ via light path source ‘s’ to destination ‘d’. It can be formulated [5] as

$$BP(m,n,s,d) = \frac{TNCB(m,n,s,d)}{TNCR(m,n,s,d)} \qquad (5)$$

Where TNCB is total number of connection blocked and TNCR is the total number of connection is required.

VII. ALGORITHMS AND FLOW CHART

In this paper two types of algorithms are compared are shown in figure 3.

1. Conventional shortest path algorithm (STP, n=1)
2. Proposed disjoint path algorithm (DJP, n=1:N)

The connections are blocked by two ways, if required Q-factor is greater than computed Q-factor ($QF_R > QF_C$) and links are busy.

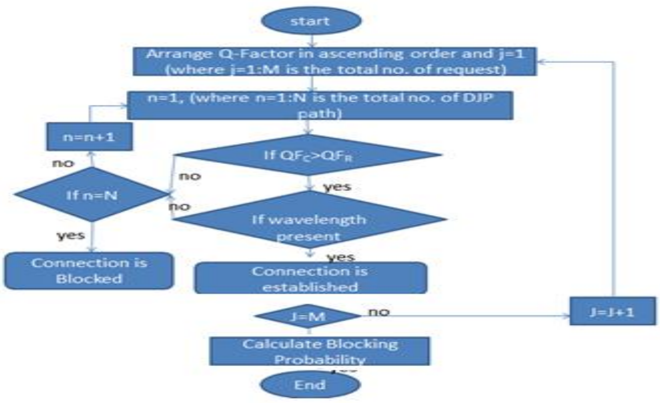

Figure3. Algorithm flow chart

The main steps in the algorithm are given below

Step1: To compute the entire disjoint path and the Q-factor for all these paths and arrange them in the ascending order of Q-factor.

Step2: To start j=1, for first request (j=1: M,where M is the total no. of request).

*Step3:*To start n=1, for first path (n=1 for STP, n=1: N, where N is the total no. of disjoint path)

*Step4***:**Tocompare required Q-Factor with the computed Q-factor for the entire disjoint paths whenever it is satisfied go to step 6.

*Step5***:** To Increase the path number n=n+1, and go to step 3.If entire path checked then connection is blocked.

Step6: To check availability for wavelength, then blocking probability is to be computed, if it not present go back to step 5 otherwise connections is established.

*Step7***:**To Increase the path number j=j+1, and go to step 2.

*Step8***:** To compute blocking probability. If entire request completed then end the program.

VIII. SIMULATION

Simulation is performed for WDM network with different nodes and links. The simulation model is shown in figure 4.

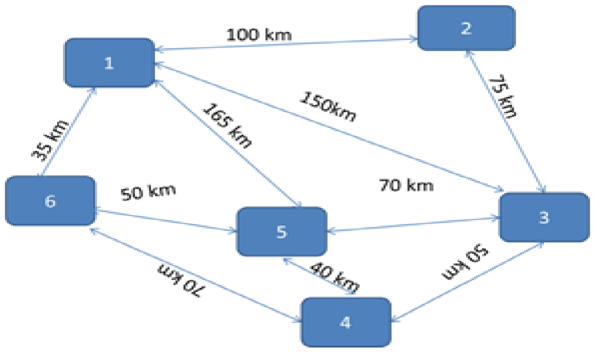

Figure4. Simulation model

This simulation model consists of 6 nodes and 10 links.In this simulation the value of various parameter are fixed. It is tabulated in table 1.

TABLE1: Simulation Parameter

Parameters	Parameter value
1. Polarization mode dispersion coefficient(ps/$\sqrt{km}$) $DS_{PMD}(i, j)$	0.2
2. Wavelength (nm) λ	1300-1600
3. Pulse broadening factor σ	0.1

The simulation result is for source 3 to destination 5. For this we considered 10 disjoint paths, and for each path computed minimum bandwidth and maximum delay is considered. In this paper Q-Factor is computed by taking ratio of minimum bandwidth to maximum delay for each path is shown in table2. In this table, 4 optimum paths are chosen out of 10 paths. The paths, in which minimum and maximum Q-Factor are 35.4 and 70.7 respectively.The Q-factor for shortest path is 50.5.

TABLE 2: Simulation connection for STP and DJP

S.N	DISJOINT PATH	SHORTEST PATH	BW(I,j) (GHz)	Tpmd(i.j) (Pico sec)	QF(I,j)	DPS	SPS
1	3-1-5		38.9	1.82	21.4		
2	3-2-1-5		38.9	1.82	21.4		
3	3-4-6-1-5		38.9	1.82	21.4		
4	3-4-5		70.7	1.00	70.7	3-4-5	
5	3-5	3-5	59.8	1.18	50.5	3-5	3-5
6	3-1-6-5		40.8	1.73	23.6		
7	3-2-1-6-5		50	1.41	35.4	3-2-1-6-5	
8	3-4-6-5		59.8	1.18	50.5	3-4-6-5	
9	3-1-6-4-5		40.8	1.73	23.5		
10	3-2-1-6-4-5		40.8	1.73	23.5		

DPS: disjoint path selected, **SPS**: shortest path selected.

The comparsion are shown in figure 5, in which single STP has 4 wavelength. The STP can handle maximum 4 request at time whenever it is greater than QF_R, but in case DJP entire requests are handled, due to more number of QF_C associated with DJP paths , are available.

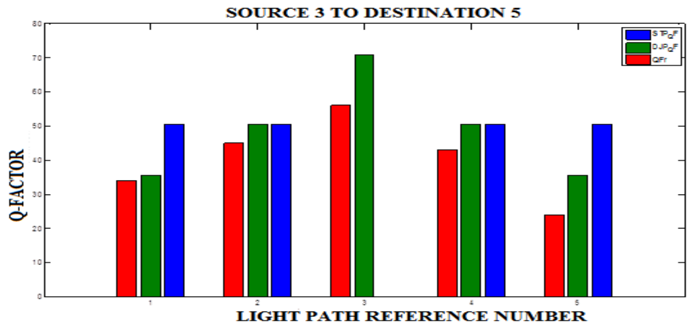

Figure5. Comparsion of Q-Factors

In each path 4 wavelengths are available. As the number of request increased blocking probability are also increased for STP and DJP. The blocking probability is about 90% for STP and 60% for DJP. The improvements in blocking probability for disjoint path (DJP), over shortest path (STP) are shown in figure 6 (a). The QoS requirement from clients in the optical network are also analyzed for source-destination pair (1,5) and (2,5). The figure 6b and 6c shows the plot of corresponding blocking probability. The blocking probability is calculated from the number of call blocked and the total number of call generated as given in equation number 5. Our proposed algorithm helps to analyses both bandwidth and delay in terms of Quality Factor. This algorithm determine the best possible path between source and destination pair for each connection request and select the best possible path based on the requirement of the client.

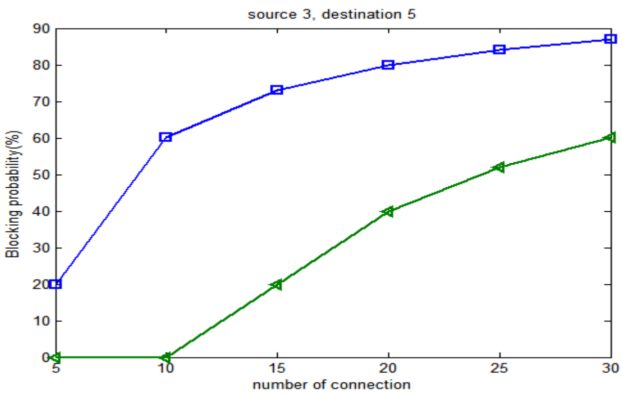

Figure 6a. blocking probability comparsion for STP and DJP.

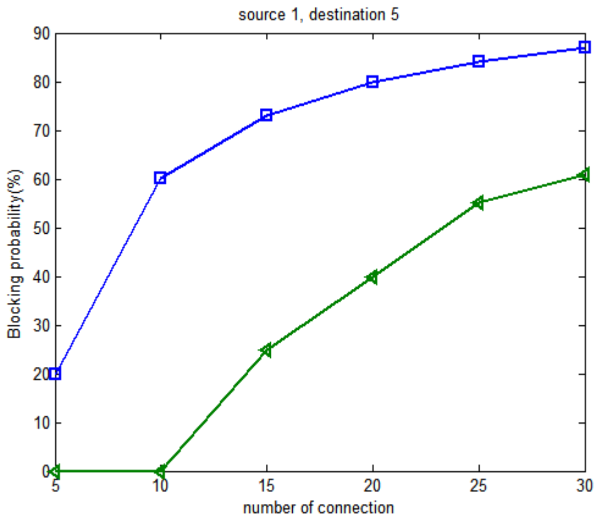

Figure 6b blocking probability for s-d pair(1,5)

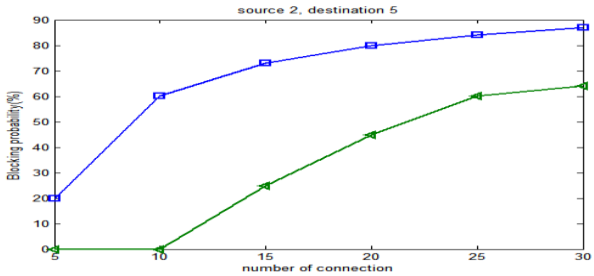

Figure 6c blocking probability for s-d pair(2,5)

IX. CONCLUSION

In this paper we have presented the improvement of DJP algorithm over traditional STP algorithm, by considering physical layer impairments. In case of light path, provisioning is based on Q-Factor. The responding path will be a guaranteed service. The proposed method provides a light path selection mechanism, which is flexible to the service provider as well as client.

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