ISSN:2320-0790

COMPUSOFT
An International Journal of Advanced Computer Technology

Simulation analysis of WDM

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Abstract: An optical network provides a common infrastructure over which a variety of services can be delivered. These networks are also capable of delivering bandwidth in a flexible manner, supports capacity up gradation and transient nature in data transmission. It consists of optical source (LED, LASER) as transmitter and optical fiber as transmission medium with other connectors and photo detector, receiver set. But due to limitation of electronic processing speed, it's not possible to use all the BW of an optical fiber using a single high capacity channel or wavelength. The primary problem in a WDM network design is to find the best possible path between a source-destination node pair and assign available wavelength to this path for data transmission. To determine the best path a series of measurements are performed which are known as performance matrices. From these performance matrices, the Quality of Service parameters are determined. Here we have designed four different network topologies have been studied and analyzed different number of nodes. We have simulated all these networks with different scenario to obtain the performance matrices. Then we have compared those performance matrices to suggest which network is best under the present case.

WDM

In this digital era the communication demand has increased from previous eras due to introduction of new communication techniques. As we can see there is increase in clients day by day, so we need huge bandwidth and high speed networks to deliver good quality of service to clients. Fiber optics communication is one of the major communication systems in modern era, which meets up the above challenges. This utilizes different types of multiplexing techniques to maintain good quality of service without traffic, less complicated instruments with good utilization of available resources .Wavelength Division Multiplexing (WDM) is one of them with good efficiency. It is based on dynamic light-path allocation. Here we have to take into consideration the physical topology of the WDM network and the traffic. We have taken performance analysis as parameter to analyse which type of topology is best suited to implement in real life application without degrading quality of service (QoS).

1 Introduction:

In optical communication, wavelength division multiplexing (WDM) is a technology which carries a number of optical carrier signals on a single fibre by using different wavelengths of laser light. This

allows bidirectional communication over one standard fibre with in increased capacity. As optical network supports huge bandwidth; WDM network splits this into a number of small bandwidths optical channels. It allows multiple data stream to be transferred along a same fibre at the same time. A WDM system uses a number of multiplexers at the transmitter end, which multiplexes more than one optical signal onto a single fibre and demultiplexers at the receiver to split them apart. Generally the transmitter consists of a laser and modulator. The light source generates an optical carrier signal at either fixed or a tuneable wavelength. The receiver consists of photodiode detector which converts an optical signal to electrical signal [1]. This new technology allows engineers to increase the capacity

1.1. Different types WDM network:

The optical network has huge bandwidth and capacity can be as high as 1000 times the entire RF spectrum. But this is not the case due to attenuation of signals, which is a function of its wavelength and some other fibre limitation factor like imperfection and refractive index fluctuation. So

1300nm (0.32dB/km)-1550nm (0.2dB/km) window with low attenuation is generally used.

According to different wavelength pattern there are 2 existing types as:-

- WDM (Wavelength Channel Multiplex wavelength Division Multiplexing)
- DWDM (Dense Wavelength Division Multiplexing)

1.2. Benefits of WDM:

Wavelength Channel Multiplexing (WDM) is important technology used in today's telecommunication systems. It has better features than other types of communication with client satisfaction. It has several benefits that make famous among clients such as:

1.2.1. Capacity Upgrade:

Communication using optical fiber provides very large bandwidth. Here the carrier for the data stream is light. Generally a single light beam is having different wavelength are multiplexed into a single optical fiber. So in the same fiber now more data is transmitted. This increases the capacity of the network considerably of network without laying more fiber. It has more security compared to other types of communication from tapping and also immune to crosstalk [2].

1.2.2. Transparency:

WDM networks supports data to be transmitted at different bit rates. It also supports a number of protocols. So there is not much constraint in how we want to send the data. So it can be used for various very high speed data transmission applications.

1.2.3. Wavelength Reuse:

WDM networks allows for wavelength routing. So in different fiber links the same wavelength can be used again and again. This allows for wavelength reuse which in turn helps in increasing capacity [5].

1.2.4. Scalability:

WDM networks are also very flexible in nature. As per requirement we can make changes to the network. Extra processing units can be added to both transmitter and receiver ends. By this infrastructure can redevelop to serve more number of people.

1.2.5. Reliability:

WDM networks are extremely reliable and secure. Here chance of trapping the data and crosstalk is very low. It also can recover from network failure in a very efficient manner. There is provision for rerouting a path between a source-destination node pair. So in case of link failure we will not lose any data [9].

1.3. QoS

WDM Network Quality of Service (QoS) parameters refer to certain parameters which are used to determine performance of a WDM network. To determine QoS first all the possible light paths are found out. Then a number of measurements are performed on these light paths using simulation software, whose results are called performance matrices. From these performance matrices QoS is determined.

Few QoS parameters are Delay, Network Congestion, and Single Hop Traffic/Offered Traffic [7]. For better performance, delay should be low, Network Congestion should be less and Single Hop Traffic/Offered Traffic should be more. So while designing the network, these conditions should be taken into account.

2. Problem Statement & Network Design:

In WDM technology to be deployed we need a physical topology. After topology design we need routing and wavelength assignment to make it fully functional. Here we have taken three problem statements as:

- To design 60 Gbps capacity topology and compare performance matrices.
- To design 100 Gbps capacity topology and compare the performance matrices with 60 Gbps topology.
- To design a network to study the case of link failure and check the performance matrices.

2.1. Routing and Wavelength Assignment:

A connection needs to be established in the optical layer in order to carry the information between the clients of the network. The optical connection that is maintained between a source node, s and destination node, d is known as an optical path or light path. The problem of finding a route for a light path and assigning a wavelength to the light path is referred to as the routing and wavelength assignment problem (RWA) [divided into two parts:-

- Routing
- Wavelength Assignment

In the traffic model, the RWA problem is considered as two:-

- Static Light path Establishment (SLE): The idea is to reduce the number of wavelengths needed to accommodate the given connection set.

- Dynamic Light path Establishment (DLE): The idea is to reduce the blocking probability.

2.2. Existing Wavelength Assignment:

Algorithms There are different types of wavelength assignment algorithms are used in WDM network. It is important task after designing a physical topology upon which whole network quality depends. So the existing wavelength algorithms are follows as:

2.2.1. Random Wavelength:

Assignment In this algorithm, first all possible routes between a source-destination node pair is determined. Then all the free wavelengths (which are currently not being used) are found out. Then randomly a wavelength is assigned for data transmission to take place[6].

2.2.2. First-fit Wavelength Assignment:

Here, each and every wavelength is numbered. When a connection request is made, the wavelength which is having the lowest assigned number is selected from the available wavelength set.

2.2.3. Most-used Wavelength Assignment:

The wavelength that is used by the highest number of links in the network is the most used wavelength. The most used wavelength is selected by the most used algorithm from the available wavelength on the path.

2.3. Constraints:

The two fundamental constraints to be followed for the purpose of wavelength assignment are as follows:

2.3.1. Wavelength Continuity Constraint:

Along the path from the source to destination nodes, a light path must use the same wavelength on all the link.

2.3.2. Distinct Wavelength Constraint:

Within a link all the light paths must be assigned different wavelengths.

2.4. Performance Analysis:

The objective is to determine all possible paths from source to destination in WDM optical network. If there is a connection request from a source node to a destination node, first all possible paths are determined, then a series of measurements are performed using a simulation tool. The results are called performance matrices. Then comparing these performance matrices best possible paths is determined [22].Here we have designed four different network topologies having different number of nodes, but each having equal capacity. Then we have simulated them with different scenarios to obtain the performance matrices. Then we have compared those to suggest which network is best for the present case.

2.5. Network Design:

We have designed four different mesh network topologies (fully connected) having 6, 9, 12 and15 nodes. Also we have further designed two 9-nodes networks to analyse the link failure case. We have designed an .xml code to design each network. The .xml contains the list of nodes and fibre links in the network. Per node information is composed by the X and Y coordinates of the node measured in kilometres over a Euclidean plane, number of E/O transmitters, O/E receivers, node population, node type (or node level), number of nodes and the name of each node. Per link information is the maximum number of wavelengths per link and the number of optical fibres.

Refrences

[1] Jun Zheng & Hussein T.Mouftah, Optical WDM networks, concepts and Design IEEE press John Wiley -Sons, Inc., Publication , p.1-4,2004.

[2] R. Ramaswami, K.N. Sivarajan, "Optical Networks-A Practical Perspective, Second Edition, Morgan Kaufmann -Publishers An Imprint Of Elsevier , New Delhi, India, 2004.

[3] Glass WDM & GMPLS simulator http://www-x.antd.nist.gov/glass/.

[4] Biswanath Mukharjee "Optical WDM Networks" springer Science+ Business Media, 2006.

[5] G. Ramesh, S. Sundaravadivelu, "Reliable Routing and Wavelength Assignment Algorithm for Optical WDM Networks", European Journal of Scientific Research ISSN 1450-216X Vol.48 No.1, 2010.

[6] Biswanath Mukherjee, "WDM Optical Communication Networks: Progress and Challenges" IEEE journal, 2000.

[7] User's Manual and Programmer's Guide of MatPlanWDM.61. www.ait.upct.es/~ppavon/matplanwdm/help/MatPlanWDM061/matplanwdmHelp.html.

[8] "OPNET network simulator." http://www.mil3.com, 1998.

[9] A.S. Acampora," A multichannel multihop local light wave net-work", Proceedings, IEEE Globecom'87, Tokyo, Japan, Vol.3,1987.

[10] G. P. Agrawal, Fibre Optic Communication system, 3rd edition, Willey Intersience, 2002.

[11] **jump up** ITU-T G.694.2, "WDM applications: CWDM wavelength grid" ITU-T website