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Situation Based Queue adaptation in Virtual Topology WDM Network

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Abstract- In today's world, optical networks are critical for providing fast and reliable communication in global backbone connections. Various study in the subject of QoS, WDM based multiplexing, which is beneficial to identify light path out of n number of paths has been done in optical networks for the efficiency enhancement. Our goal in this research is to improve QoS in a WDM-Optical network by adopting dynamic queue management in a virtual topology. With the use of a light route, wave division multiplexing in an optical network may send data from numerous sources to multiple destinations utilising separate channels. Due to the restricted capacity of fibre optical cable in the modern era of technology, network congestion is increasing day by day. In wired communication, the optical network is the most efficient mode of communication in terms of data delivery, throughput, and latency, among other factors. So, in this research, we use a dynamic queue in a virtual topology under WDM to tackle that problem. Every intermediary node in the dynamic queuing approach creates an incoming and outgoing queue for each linked connection. If a link is heavily used or a queue is almost full during real-time communication, the size of the queue for that connection is increased immediately, while the queue for other low-used related links in the same intermediate node is reduced accordingly. The proposed DQ-VTWDM (dynamic queue virtual topology virtual topology WDM) improves network efficiency. Network simulator-2 was used to simulate the network, with the input being a hybrid topology with a total of 49 (unidirectional) and 48 (bidirectional) physical links. We find that the new DQ-VTWDM approach delivers higher QoS in terms of number of data receives, percentage of data drop, delay, and percentage of data receives when compared to current VT-WDM.

Keywords: WDM, Dynamic Queue, Virtual Topology, Light Path, QoS, Optical Network.

I. INTRODUCTION

The incorporation of computational topology into physical topology reduces the number of nodes involved in network propagation. The Virtual Topology is a graph of nodes in the topology and edges of the real network corresponding to the lights.

A virtual topology is designed to reduce such objective functions such as AVT (Average Weighted Hop Count), congestion, etc. The simulated topology originally planned for a single traffic cannot be adapted for shifting traffic. In response to changing traffic demands or due to a lack of network elements, the virtual topology built over IP can require changing. Certain tracks are heavily filled, so new traffic signals are to be set up. Similarly, there could be no traffic on other lightpaths and those lightpaths may be withdrawn. This method is called Virtual Topology Reconfiguration [1] to shift current virtual topology to new one in order to respond to the complex traffic change or the loss of network components. One of the hot topics in the networking science community was the complex reshaping of optical networks.

One of WDM's essential optical network functionality is the reconfiguration [2]. Reconfiguration [3] is accomplished by offering the framework for WDM optical networks where logical links can be integrated through the physical connections. The optical cross links optical and wavelength transmitters and converters, which enable the operators to reconfigure optical network connections in compliance with changing traffic conditions. The virtual topology reconfiguration to handle complex traffic has two distinct approaches [4][5] respectively. For each shift in the traffic a new virtual topology has been developed to ensure improved efficiency, however a significant number of improvements in the light path could be accomplished. The second approach is to reconfigure the objective value of the function and to minimize the amount of shifts in the light direction. Wavelength routed WDM networks have the potential to avoid the three problem- lack of wavelength reuse, power splitting loss, and scalability to wide area networks of broadcast and select networks. In the section I introduction are describe, In the section II related work, In the section III describe about our proposed approach, Section IV describe about proposed algorithm for conversion process of physical topology to virtual topology, section V detail describe about proposed architecture, section VI detail describe simulation parameter, result analysis and section VII contain conclusion of our proposed work.

II. RELATED WORK

In this section describe about existing work in the field of WDM optical network, virtual topology management, light path identification and quality of service in WDM network.

Author suggested a WDM-OOFDM access network employing a centralized optical transceiver at the Central Office, which is based on a single optical broadband slicing source and is provided as a low-cost solution in this research. Such a network, which employs double sideband modulation and optical carrier re-use, provides downlink and uplink signal transmission, as well as dynamic bandwidth allocation, multiple band selection, and adjustable OFDM band selection in reconfigurable networks, all at low bit rates. For downlink and uplink transmission rates less than 2 Gb/s, this study proposes a low-cost WDM-OOFDM network that is based on a centralized optical broadband source at the Central Office, employs double sideband modulation, and makes advantage of optical carrier re-use. The approach's adaptability has been shown in a number of applications, including dynamic bandwidth allocation, OFDM band selection in reconfigurable networks, and multiple adjustable OFDM band selection [6].

They present both static and dynamic assignment strategies for mesh topologies. With his ideas, he attempts to make use of available wavelengths in such a manner that competition for the same wavelength is minimized. We had to depend on extensive simulations in order to demonstrate that our ideas were effective. They used dynamic and static assignment procedures, which surpassed approaches previously described in the literature, to improve their performance. When compared to Random assignments and First-fit, the suggested dynamic assignment, dubbed "DWA," has a very low blocking probability, according to the authors. A performance increase of around 20% is realized when using the Random assignment method instead of the randomized assignment method. When comparing the results with the First-fit assignment, the improvement is more than 70% [7].

Dynamic light path protection in survivable WDM networks, according to the author's proposal, entails the discovery of two different routes (i.e., a main route and a backup route that are both link-disjoint) that form a cycle upon the receipt of a new connection request. They describe a hybrid adaptive survival method that combines the beneficial benefits of restoration with the beneficial effects of protection. It is the overarching objective of the suggested technique to increase the efficiency of restoration by allowing for choices between proactive preservation and dynamic restoration. Specifically, in this paper, they present a unique hybrid adaptive method for fault tolerance in survivable WDM networks with wavelength conversion that is both efficient and effective. It blends the concepts of static protection with those of dynamic restoration. Furthermore, according to the simulation findings, under high loads, the suggested method achieves a much lower blocking probability, a greater throughput, a higher utilization, and a significantly shorter restoration time than the standard survivable algorithms. Also included in this plan is the use of an analytical technique. The findings produced analytically are almost equivalent to the ones obtained using the ns-2 Simulated method [8].

Quasi-dynamic optical route scheduling (QDORS), a technology suggested by the authors, allows for the flexible and efficient integration of packet-based traffic in OBS functions and Internet-based networks. It contemplated blowing a legitimately large number of data plans in order to minimize better channel utilization, greater efficiency, and the likelihood of blocking. The suggested technique QDORS is used to transport data from the source to the destination in an efficient manner. Maintaining the route and data in the OBS network requires the analysis of route traffic and packet headers, as well as the discovery of neighbor nodes. When compared to the present way, this strategy improves the performance of the OBS network in terms of latency, packet delivery ratio, and throughput [9].

Wavelength scheduling techniques for converging ring-based WDM-PON systems are presented in this study, which may be used to better use network capacity while also providing QoS (in terms of data delivery time) for both mobile and stationary users. Due to its capacity to allow dynamic allocation of network resources, a fully shared LAN capability among end users, as well as inherent survivability features, the ring-based WDM-PON topology was selected for this project. The authors describe heuristic methods for wavelength selection and scheduling, as well as an ILP formulation, for both the scenario where the downstream packets do not have any priority and the case when priorities are present [10].

The authors of this study explain load-balanced routing and admission control for point-to-multipoint traffic flows in elastic optical networks, as well as the application of these techniques. EONs have emerged as a viable technology for delivering high capacity to next-generation networks in a cost-effective manner. The efficiency of spectrum use is improved when bandwidth allocation is elastic. They take up the subject of creating bandwidth guaranteed trees for on-demand point-to-multipoint session request, and they find it to be somewhat challenging. If it is possible to create a multicast tree with appropriate bandwidth on each connection, a request is considered approved [11].

The dependability of the SDVN system is improved in this study in terms of service rate, which will result in improved communication services. We have examined the performance of the SDVN model when applied to M/M/1 and M/M/m queuing theories, respectively. SDVN and VANET system models benefit from our suggested approach, which enhances multi-hop cooperative data transmission in these models. It was determined that the analytical findings were correct by running simulations on several metrics such as resource consumption and utilization, mean response time, service latency (delay), reliability, and throughput. The queuing mechanism has been included in the model to deliver services at the SDN controller in the data plane and the control plane, as well as the data plane [12].

A worst-case latency estimation model has been used to estimate the latencies of traffic flows, and they have implemented it both in the MIP formulation and the ALFA-SA algorithm by including a set of restrictions in both of these formulations. They have conducted extensive numerical experiments in various network topologies and situations in order to analyze the performance of both optimization approaches as well as the performance of the NGFI network in order to assess their performance. They took into account a variety of factors, including the amount of traffic needs, network nodes, and connection lengths [13].

The unassigned bandwidth margin is virtually optimal, with the least amount of US delay and PDR, as well as good throughput, demonstrating that this DBA may significantly enhance the OLT performance in a realistic manner. With a minor over allocation, there is a tiny danger of diminished throughput; however it does result in a well - controlled delay [14].

The suggested method, which is based on an XG-PON system, is optimized in terms of wavelength selection and bandwidth allocation according to the various grades of ONUs. The method is capable of achieving upstream bandwidth allocation, with five different kinds of T-CONTs and four different bandwidth allocation modes available. When combined with a variety of service level agreements (SLAs), the priorities of ONUs are completely taken into consideration in order to satisfy the needs of various bandwidths. The suggested algorithm is thus capable of supporting a wide range of traffic types while also enabling multi-traffic Broadband access [15].

Author K. Chandarvanshi detailed analyze the routing overhead under mobile ad hoc network using the destination routing effect agent (DREAM) modified technique which is further incorporate under optical network [16].

K. Chandravanshi discus the approach of energy based routing strategy which analyzes the network energy consumption by the routing device that work helps to tune the optical parameter to resolve the problem of network capacity detection [17].

Numerical simulations are used to compare the performance of the proposed cluster-based PON with DUDTS scheme and the existing dynamic hybrid slot-size bandwidth allocation (DHSSBA) algorithm in order to demonstrate the effectiveness of this scheme. The results of the simulations are used to validate and improve the proposed scheme. When compared to the previous DHSSBA scheme, the cluster-based PON with DUDTS scheme achieves superior results in terms of the grant to request ratio, end-to-end latency, packet loss probability, and fairness. Specifically, they present a cluster-based PON design that incorporates an expanded version of the dynamic upstream data transmission sequence (DUDTS) algorithm in this study. The proposed cluster-based PON with DUDTS scheme mitigates the limitations of typical non-cluster-based PON systems by combining the advantages of both technologies. The suggested cluster-based PON with DUDTS scheme has a significant influence on GTRR because it distributes extra windows from the lightly loaded ONUs to the heavily loaded ONUs of a cluster and accumulates unutilized windows from a cluster to the succeeding cluster. Furthermore, the DUDTS method guarantees a greater priority for assigning earlier time-slots for data transmissions of the heavily loaded ONUs, hence reducing the WTTD as well as the chance of packet loss in such transmissions [18].

III. DYNAMIC QUEUE DATA TRANSMISSION PROCESS IN WDM OPTICAL NETWORK

Data transmission process start while route is established, source node calls the routing module which provide route information between sources to destination. Source generate the data stream and send to network layer which form the packet and forward to next connected router using optical link. The entire incoming packet in router temporary hold on buffer and forward to next router, the above process executes till end of destination reachable. Router continues check the status of buffer, cache memory and incoming outgoing channels which helps to detect congestion in the network. In the network while more than one device shares the common channel and router its chance to come up congestion in the network and network performance degrade. To resolve the problem of congestion every router actively monitor the buffer space, channel and cache capacity and if router detect device access higher resource which is greater than the threshold value (i.e. buffer, channel, cache) than router send back the acknowledge to source node to reduce the data rate with respect to inversely proportional to resource utilization. The data rate reduction technique minimize the control the congestion of the technique which helps to improve the network QoS improvement in terms of packet delivery ratio, throughput, data receive and minimize delay, overhead etc.

IV. PROPOSED ALGORITHM

Algorithm 3: Congestion Detection & Prevention DQ-VTWDM

Input:

C_s: Congestion Status (Low, High) ∈ Nr
D_{type}: TCP, UDP
D_r: data rate
Ack_i: send i^{th} acknowledge to S_n
δ: rate change

Output: Congestion Status, Detection R_t load

Procedure:

Step1: Data_module(S_n, K_n, D_{type})
Step2: **If** S_n execute D_{type} to K_n **than**
Call Routing DV(S_n,K_n)
DV Provide L_{path_n}
S_n Send D_{type} to K_n by multipath DV
Monitor R_t during communication
Step3: **If** R_t ($Q_t \geq Avg(Q_i)$ & $CU_{cache\_t} \geq Avg(CU_{cache\_i})$ & $Ch_{capacity\_t} \geq Avg(Ch_{capacity\_i})$) **than**
C_s(High)
$Q_t \leftarrow Q_t + \delta$
Send Ack_i about minimize (D_r, - δ)
S_n update D_r
$D_r = D_r - \delta$
Else
C_s(Low)
S_n Send D_{type} to K_n by multipath DV
Monitor R_t(Q_t, CU_{cache_t}, $Ch_{capacity\_t}$)
End if
Else
Wait R_t response for communication
End if
End Procedure

V. FLOW CHART OF DATA RECEIVES

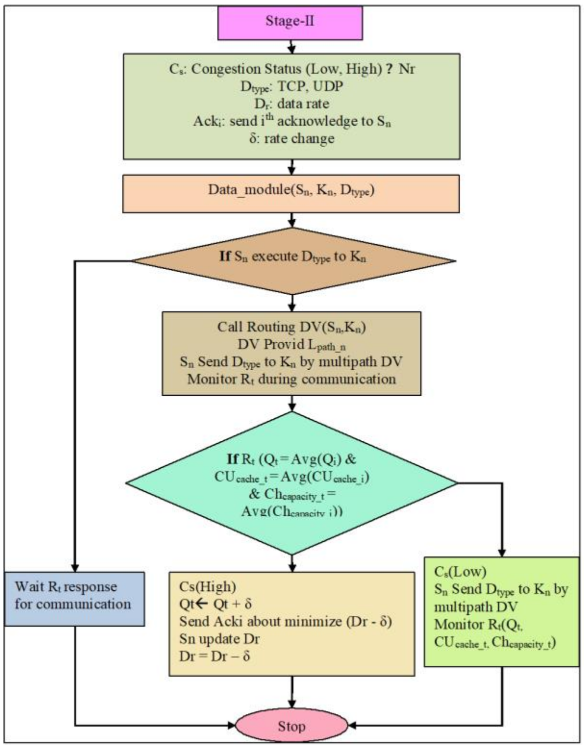

Figure 1: Flow Chart of DQ-VTWDM

VI. SIMULATION TOOL NETWORK SIMULATOR-2

The fundamental architecture of NS2 is seen in figure 1. When using NS2, users may run the executable command "ns," which accepts a single input parameter, the name of a Tcl simulation scripting file. When a simulation trace file is produced, it may be plotted and/or animated, as is common in most situations. CCC and Object-oriented Tool Command Language are the two primary languages used in NS2 (OTcl).

Whereas the CCC describes the core mechanism of the simulation (i.e., a backend), the OTcl is responsible for setting up the simulation by assembling and configuring the objects as well as scheduling discrete events in the simulation (i.e., a frontend). Through the use of TclCL, the CCC and the OTcl are connected. When a variable in the OTcl domains is mapped to a CCC object, it is referred to as a handle in certain cases.

A. Simulation Parameters of Wired Fiber Optic Communication

In this section describe about simulation structure of DQ-VTWDM and existing work where network deploy based on given parameters in table 1. The simulation parameter useful for designing the network where number of node taken as fifty nodes, number of physical link is 49 unidirectional and 98 bidirectional connection is taken and other parameters is also incorporate as per value given in table 1.

Table 1: Wired Fiber Optic Communication Topology

Parameters	Values
Simulator Tool	Network Simulator-2
Physical Topology	Random
Number of Nodes	Fifty Nodes
Number of Physical Link	49 (Unidirectional)/98(Bidirectional)
Virtual Topology	Hybrid
Traffic Pattern	0 to 1.56 per link
Routing Algorithm	Distance Vector
Maximum Light path Capacity Utilization	100%
Bandwidth [Kbps]	100 Kbps
No of Router	30
No of Source	20
No Destination	20

B. Wired Fiber Optic Communication Network in NS-2:

In this section deploy the network of optical wired network using network simulator-2, where some node treated as source and receivers and some of treated as router which functions to provide communication between two different networks. Optical network provide fast communication as compare to other communication structure. To improve the network QoS we inbuilt the dynamic queue system which helps to minimize the network congestion and increase the reliability of optical network which is useful for communication.

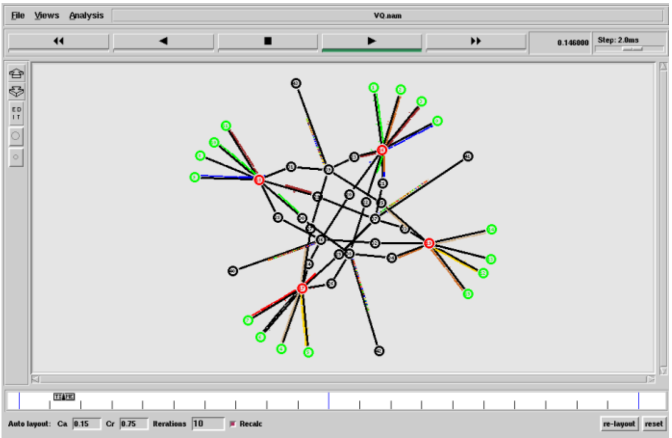

Figure 2: Wired Fiber Optic Communication Topology

C. End to End Delay

End to End delay is a time taken (per unit time) between the sources to destination data transmission, with the help of per packet end to end to delay we calculate average end to end delay which is formulize as in equation(1) that helps to analyze the network performance with respect to delay in average case. Data transfers between sources to destination are measure in mille second (ms). In Figure 3 it is clearly mentioned that the delay in case of proposed scheme is less as compared to the proposed scheme. The number of packets is more received at destination showing less delay, it means the queue management system is more effective and efficient for normal traffic in network.

$$Avg(EtoE) = \frac{\sum_{i=1}^{n} Packet_i * Time\ Taken}{Total\ No\ of\ packets} \quad (1)$$

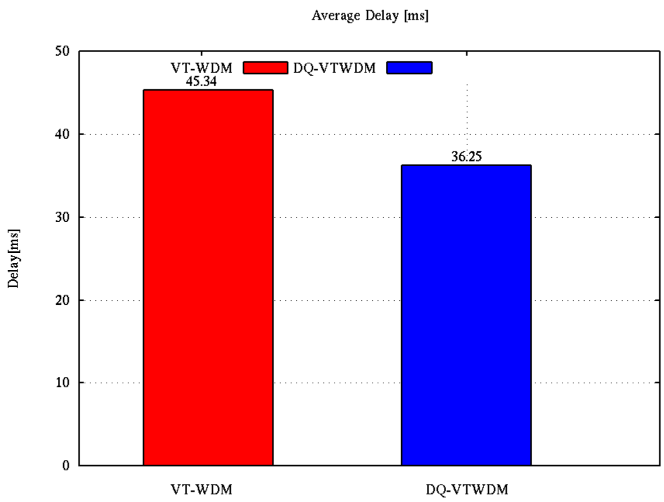

Figure 3: End to End Delay [ms]

D. Data Drop Analysis

The data dropping is drops the data and degrades the performance of network. The more data dropping means the more degradation and more receiving means more enhancements in performance. In the given figure 4, measure the performance of previous VT-WDM and proposed DQ-VTWDM. In the VT-WDM about 32445 data packets dropped and by using DQ technique we would found that the drop of data is only 5073 as compare to VT-WDM. The less number of packets dropping means more amount of packets successfully received at destination and reduces the extra overhead in retransmission.

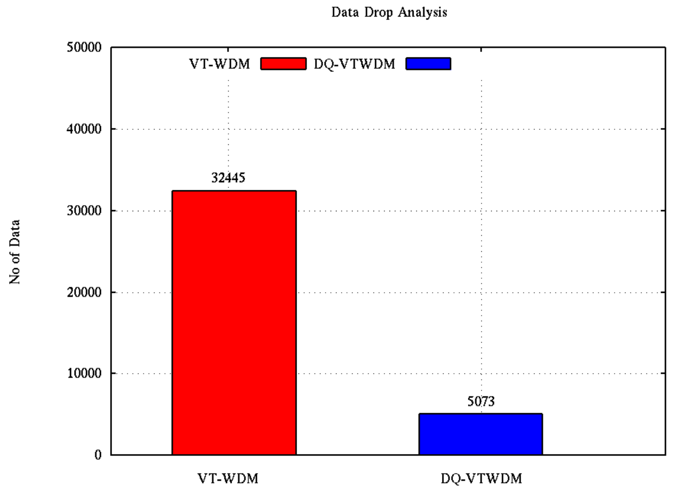

Figure 4: Data Drop Analysis

E. Data receiving Percentage Analysis

The comparison of VT-WDM and DQ-WDM over 50 of data packets are sending in the wired optical network mentioned in figure 5. The following result are obtained, the percentage of data receives in VT-WDM is 77.06% up to end of simulation time and the average percentage of data receives in DQ-WDM is 96.36%. It means there is a 23% improvement in performance of data receiving. If the percentage of data receiving is increases then the performance of network also better and decrease the overhead and delay in network. The proposed scheme provides 23% improvement in the performance as compare to the existing scheme in the network.

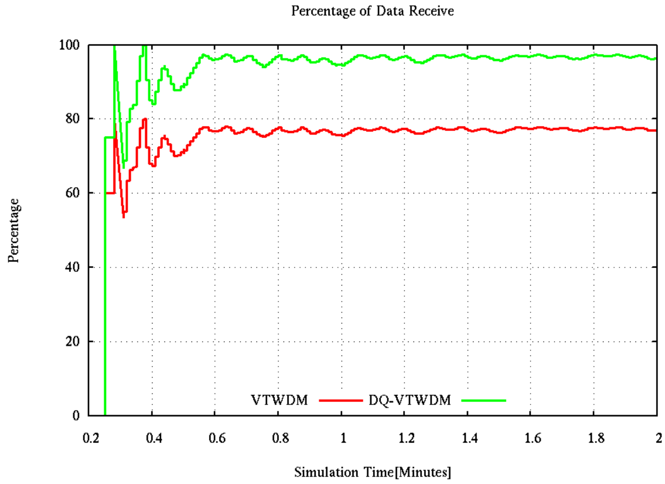

Figure 5: Percentage of Data Receives

VII. CONCLUSION

In today's world, optical networks are critical for providing fast and reliable communication in global backbone connections. Various study in the subject of QoS, WDM based multiplexing, which is beneficial to identify light path out of n number of paths has been done in optical networks for the efficiency enhancement. Our goal in this research is to improve QoS in a WDM-Optical network by adopting dynamic queue management in a virtual topology. With the use of a light route, wave division multiplexing in an optical network may send data from numerous sources to multiple destinations utilising separate channels. Due to the restricted capacity of fibre optical cable in the modern era of technology, network congestion is increasing day by day. In wired communication, the optical network is the most efficient mode of communication in terms of data delivery, throughput, and latency, among other factors.

In the simulation scenario created by network simulator-2, the impact of WDM networks on throughput, packet delivery ratio, delay, and other factors are analysed. The results of the proposed DQ-VTWDM technique are compared to existing WDM networks, and it is concluded that the proposed approach is suitable for use in WDM optical networks and provides better QoS.

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