DIFFERENCE BETWEEN SONET AND OBS

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ABSTRACT

This paper present a brief observation of SONET and OPTICAL BURST SWITCHING (OBS) and compare them on the basis of various parameters. Firstly, enough theory is provided in order to provide any beginner with the sufficient amount of the underlying technology. Then a brief review of the early work on burst transmission is provided followed by the description of a new emerging protocol for SONET i.e. (NGSONET) and then OBS networks called Just-Enough-Time (JET) and WB-OBS are considered. Also tradeoffs between their performance and implementation complexities are discussed. Recent work on QoS support, IP/WDM multicast, TCP performance in OBS networks and Labeled OBS is also described, and several open issues are mentioned.

INTRODUCTION

SONET & SDH[1][6] are multiplexing protocols which are used to send the digital bits over the fiber optics cable with the help of LASER or LED. If the data rates could be compensated in terms of speed then it could be transmitted via electrical interface. These are designed for the replacement of PDH systems used for telephonic data and other data over the same fiber optics cable at an improved speed. SONET allowed the user to communicate with different user's at different speeds i.e. in the asynchronous speed. So it is not just as the communication protocol but also a transport protocol. So it becomes the first choice to work in the asynchronous transfer mode. So they are used widely in the world. The SONET is used in the United States and Canada and SDH is used in the rest of the world. [5]

OBS is a kind of switching which lies in between the optical circuit and optical packet switching. This type of switching is appropriate for the provision of light paths from one to another node for many services/clients. It operates at the sub level wavelength and it is designed to improve the utilization of wavelength by quick setup. In this the data from he client side is aggregated at the network node and the sends on the basis of assembly/aggregation algorithm. [5]

SONET

SONET [1] encodes bit streams into optical signals propagated over optical fiber. SONET defines a technology for carrying many signals of different capacities through a synchronous, flexible, optical hierarchy. A bit-way implementation providing end-to-end transport of bit streams. All clocks in the network are locked to a common master clock so that simple TDM can be used. Multiplexing is done by byte interleaving. SONET is backward compatible to DS-1 and E-1 and forward compatible to ATM cells[5].

SONET ARCHITECTURE

SONET [7]topology can be a mesh, but most often it is a dual ring. Standard component of

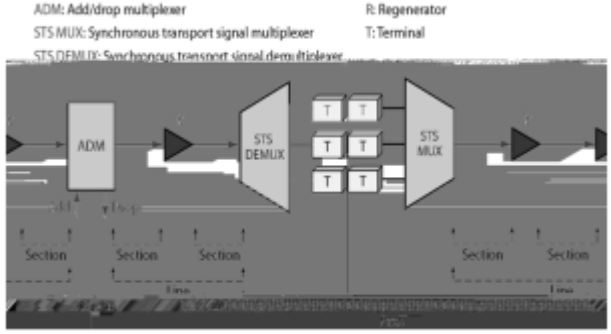

Fig. 1: Sonet Architecture

SONET ring is an ADM (Add/Drop Multiplexer)Drop one incoming multiplexed stream and replace it with another stream. Used to make up bi-directional line switching rings.

SONET LAYERS

The SONET [8] standard includes four functional layers: the photonic, the section, the line, and the path layer. They correspond to both the physical and the data link layers.

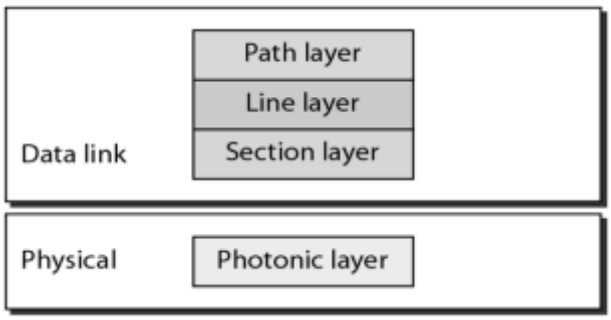

Fig. 2: Sonet Layers

Using SONET equipment, one can create a SONET network that can be used as a high-speed backbone carrying loads from other networks. We can roughly divide SONET networks into three categories:

Linear Networks

Ring Networks

Mesh Networks

Traditionally, a metropolitan area network (MAN) is regarded as an extension of the telecommunication core infrastructure. MANs have used synchronous optical network (SONET) as their transport layer. This is because SONET has been the most reliable and available transport for voice services, which provided most of the revenues, while data traffic was insignificant and less profitable. However, in recent years, the deployment of faster protocols such as Gigabit Ethernet at the enterprise and consumer level and the increasing demand for data services such as virtual private networks, Ethernet private lines (EPL), and storage area networks, have significantly increased data traffic within the MAN and forced providers to upgrade their networks with more fiber and faster SONET equipment at a substantial cost and investment.

OBS (OPTICAL BRUST SWITCHING)

Optical burst switching (OBS)[2][3] is an optical networking technique that allows dynamic sub-wavelength switching of data. OBS is observed as a compromise between full optical packet switching (OPS) and the mostly static optical circuit switching (OCS). It differs from these paradigms because OBS control information is sent separately in a reserved optical channel and in advance of the data payload. It observes Offset time between control packet and data burst. These control signals can then be processed electronically to allow the timely setup of an optical light path to transport the soon-to-arrive payload. This is known as delayed reservation.

PURPOSE

The purpose of optical burst switching (OBS) is to dynamically provision sub-wavelength granularity by optimally combining electronics and optics. OBS considers sets of packets with similar properties called bursts. Therefore, OBS granularity is finer than optical circuit switching (OCS). OBS provides more bandwidth flexibility than wavelength routing but requires faster switching and control technology. OBS can be used for realizing dynamic end-to-end all optical communications.

OPTICAL PACKET SWITCHING NETWORK AND TOPOLOGIES

SONET network architecture made up of 2x2 optical network nodes, interconnected uni-directionally. They have optical add-drop Multiplexers. The higher node allows user to connect to other sub-networks by Wavelength Division Multiplexing. The switching is controlled by electronic logic circuits which are based on packet-by-packet, which is determined only by header processing. [1]

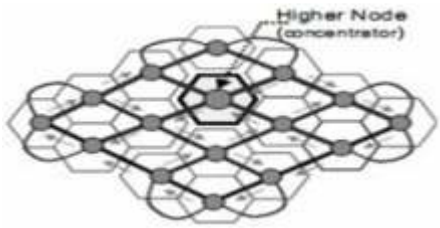

Fig. 3: Unidirectional Mesh topology optical network

The overall switching time is less than two microseconds for every packet and is independent of payload size. This architecture helps to use the deflection routing to avoid collisions and there is no need for further buffering and thus cost reduces [2][3].This provides the optical nodes to be operated asynchronously. Our solution is given for MAN access and distribution, having 15km length and networks having less than 48 nodes [2].Mesh topology is selected for the analysis of throughput and to find the load on each node. The motive is to find which links are more frequently used and should be secured to avoid loss of critical service. These considerations also include the cost parameter.

MESH TOPOLOGY

Mesh topologies involve the concept of routes. Unlike each of the previous topologies, messages sent on a mesh network can take any of several possible paths from source to destination. (Recall that even in a ring, although two cable paths exist, messages can only travel in one direction.) Some WANs, most notably the Internet, employ mesh routing. A mesh network in which every device connects to every other is called a full mesh. As shown in the illustration below, partial mesh networks also exist in which some devices connect only indirectly to others.

SOME RESULTS AND CONCLUSIONS

The throughput for mesh topology is shown in the figure.3. Here, we can observe that SONET performed well in the mesh network and brilliant in the condition of higher number of nodes. From this we can conclude that mesh topology is providing the high capacity without considering the cost of installation. We can see the traffic analysis of MS-24, MS-32, MS-48 and the protocols used in this analysis is "store and forward".

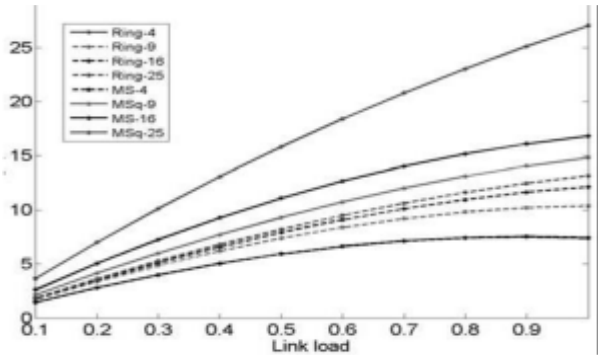

Fig. 4: Comparative Throughput for mesh using the new method

Although in the above mentioned technique i.e. Store & Forward, the sent packets have to wait so as to provide them a shortest path for their destination, it doesn't matter because here we are just considering the utilization of links and their corresponding distribution of traffic. But ideally we should restrict ourselves to overload the certain links so as to minimize the failures, and we must take decision that where to apply protection mechanisms.

NET WORK PROTECTION AND FAILURE ANALYSIS

In mesh network, the links which are failed and less used, made a slight change in the performance of the network. The simulations include the MSq-24, MS-32, and MSq-48. We observe that in mesh topology the performance and the throughput reduced but the rate of reduction is almost half as compare to ring topology. In the mesh topology some more features are seen like protection of network, location of failure and finally restoration. So, all such problems are reduced in the mesh topology.

NG-SONET(NEXT GENERATION SONET)

NG-SONET is another approach which is most recent and in this there is provision of the carriers for optimizing the allocation of bandwidth and uses the unused and fragmented capacity in the SONET ring. It also matches the better client rate. It uses some new protocols to accomplish these tasks such as generic framing for encapsulating data and virtual catenation for using fragmented bandwidth and (LACS) link

capacity adjustment for resizement of existing links [9][10]. But it has some drawbacks which are:-

1. Over provisioning of links in case of Ethernet usage.
2. LCAS latency.

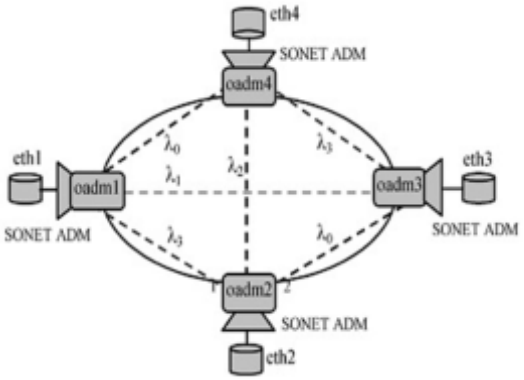

Fig. 5: SONET & NG-SONET Network Models

WR-OBS (WAVELENGT H ROUTED OBS)

In WR-OBS, the control packets are processed at a central node to determine the actual path to send the packets at the destination. The acknowledgements are sent to the source nodes and decided whether these are destroyed or transmit the data bursts. So this technique is best for optimal path selection which in turn gives the congestion control and helps in balancing the traffic over links. It has time delay consists of aggregation time and connection establishment time. It provides less delay than SONET & NG-SONET for low bandwidth links. This is due to the Ethernet packet transmissions are independent of time slot and frames. [11][12][13]

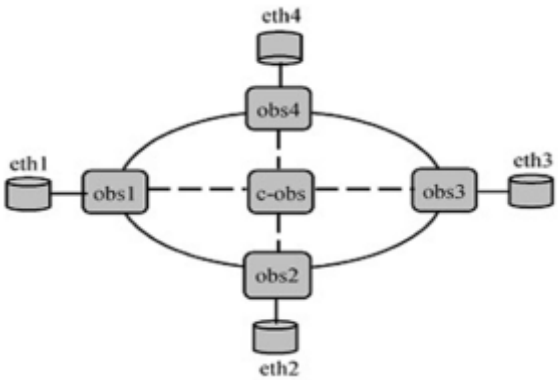

Fig. 6: OBS-JET & WR-OBS Network Models

JET-OBS (JUST ENOUGH TIME)

In this an offset time is transmitted before the data burst is sent and processed electronically at each node for preserving the resources for the each data bursts. But the offset time must be carefully chosen so that there should not be problem aroused of queuing and delay problem between the hops[10][11][12].

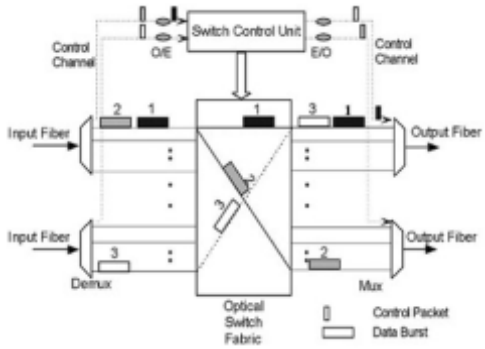

Fig. 7: Architecture of OBS-JET core node [12]

COMPARISON BETWEEN SONNET AND OBS

OBS is a kind of switching which lies in between the optical circuit and optical packet switching whereas SONET is multiplexing protocols which are used to send the digital bits over the fiber optics cable [5]. OBS has three wavelengths for data and one wavelength for control channel whereas SONET has all four wavelengths available for data transmissions. OBS has data loss due to scheduling contentions while in SONET data loss is due to excessive delays [12]. OBS is of two types Just Enough Time (JET) OBS & Wavelength Routed (WR) OBS while SONET is of one type NG-SONET. OBS is not good for ring model network while SONET works best in ring network. OBS uses deflection routing to avoid contention whereas in SONET there is no such algorithm. OBS uses the forwarding tables for mapping the bursts whereas SONET has no such facility. OBS is preferred for busty traffic whereas SONET is not preferred for a busty traffic [11].In case of SONET demultiplexing is quite easy. Many problems associated with other topologies in OBS are reduced in case of mesh topology.

CONCLUSION

We have studied and analyzed the capacity and throughput of SONET & OBS in mesh topology and have reached at the decision that OBS is better than the SONET when using mesh topology. If we talk about the protection, then we observe that the failure of links has more impact on ring topology [4] instead of mesh topology. Also in the mesh topology, the impact on capacity due to failed links is much less and is less critical than the ring topology and this confirm that the mesh topology is robust in nature.

SONET encounters two major problems when supporting data traffic due to its fixed bandwidth allocation. First, if the traffic load is less than the capacity of the allocated connection, the link utilization is low as statistical multiplexing gain is hard to achieve. Second, if the traffic load is higher than the allocated capacity, data packets will be queued at the ingress node and the average delay would exceed acceptable limits. Several metro-focused and non-SONET-based solutions have been developed and proposed to provide a more elastic transport for data traffic. One of these solutions is the optical burst switching (OBS) framework and proposed for metro Ethernet traffic .For details to more emerging technologies in SONET and OBS refer to our forthcoming research papers.

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