ABSTRACT:

Optical burst switching is a promising solution for all optical WDM networks. It combines the benefits of optical packet switching and wavelength routing while taking into account the limitations of current all optical technology. In OBS, the user data is collected at the edge of the network, sorted based on destination address, and grouped into variable-sized bursts. Prior to transmitting a burst, a control packet is created and immediately sent toward the destination in order to setup a buffer-less optical path for its corresponding burst. After an offset delay time, the data burst itself is transmitted without waiting for positive acknowledgement from the destination node. The OBS framework has been widely studied in the past few years because it achieves high traffic throughput and high resource utilization. In this paper, we present in a systematic way the main objectives of OBS design parameters and the solutions that have been proposed.

INTRODUCTION:

Optical communication has been used for a long time and it very much popular with the invention of wavelength-division multiplexing (WDM). Current WDM works over point-to-point links, where optical-to-electrical-to-optical (OEO) conversion is required over each step. The elimination of OEO conversion in all optical
networks (AON) allows for unprecedented transmission rates. AON’s can further be categorized as wavelength-routed networks (WRNs), optical burst switched networks (OBSNs), or optical packet switched networks (OPSNs). Now we discuss here about optical burst switching (OBS).

In optical burst switching (OBS) data is transported in variable sized units called bursts. Due to the great variability in the duration of bursts, the OBS network can be viewed as lying between OPSNs and WRNs. That is, when all burst durations are very short, equal to the duration of an optical packet, OBSN can be seen as resembling an OPSN. On the other hand, when all the burst durations are extremely long, the OBSN may seem resembling a WRN. In OBS, there is strong separation between the data and control planes, which allows for greater network manageability and flexibility. In addition, its dynamic nature leads to high network adaptability and scalability, which makes it quite suitable for transmission of bursty traffic.

In general, the OBS network consists of interconnected core nodes that transport data from various edge users. The users consist of an electronic router and an OBS interface, while the core OBS nodes require an optical switching matrix, a switch control; unit and routing and signaling processors. OBS has received considerable attention in the past few years, and various solutions have been proposed and analyzed in an attempt to improve its performance. Here we describe the various OBS architectures by grouping the material logically per OBS design parameter.

**BURST AGGREGATION:**
OBS collects upper layer traffic and sort it based on destination addresses and aggregate it into variable size bursts. The exact algorithm for creating the bursts can greatly impact the overall network operation because it allows the network designers to control the burst characteristics and therefore shape the burst arrival traffic. The burst assembly algorithm has to consider a preset timer and maximum and minimum burst lengths. The burst aggregation algorithm may use bit-padding, the differentiation of class traffic, create classes of service by varying the preset timers and maximum/minimum burst sizes.

One of the most interesting benefits of burst aggregation is that it shapes the traffic by reducing the degree of self-similarity, making it less bursty in comparison to the flow of the original higher-layer packets. Traffic is considered bursty if busy periods with a large of arrivals are followed by long idle periods. The term self-similar traffic refers to an arrival process that exhibits burstiness when viewed at varying time scales: milliseconds, seconds, minutes, hours, even days and weeks. Self-similar traffic is characterized by longer queuing delays, therefore degrades network performance. Therefore reducing self-similarity is a desirable feature of the burst assembly process, and it is concluded that traffic is less self-similar after the assembly.

**CONNECTION SETUP MECHANISMS:**
This setup procedure consists of three main components, they are signaling, routing, and wavelength allocation. Signaling is used to setup and tear down the connections for the bursts. Routing is used to decide the path of a burst through the OBS network. Wavelength allocation is used to determine on which wavelength to transmit the burst.

**SIGNALING FOR OBS:**

Signaling specifies the protocol by which the OBS nodes communicate connection requests to the network and its operation determines whether or not the resources are utilized efficiently.

**Distributed Signaling With One-Way Reservation:**

In this, prior to transmitting a burst, a user transmits a control packet to its ingress OBS node. This control packet contains information about the corresponding burst and is electronically processed by the ingress OBS node and all the subsequent nodes along the path of the destination user. The control packet is transmitted in an out-of-band control channel which may be a wavelength dedicated to signaling or a separate electronic control network such as an IP or asynchronous transfer mode (ATM) network. In either case, the separation of control and data in both time and physical space is one of the main advantages of OBS. It facilitates flexibility in the user data format and rate because the bursts are transmitted entirely over an optical signal and remain transparent.
throughout the OBS network. The burst itself is transmitted after a delay known as the offset without waiting for a positive acknowledgement that the entire path has been successfully established.

Due to the one-way reservation scheme, burst loss may occur in an OBSN because the control packets may not succeed in reserving resources at some of the intermediate OBS core nodes. In addition, burst loss is possible if the control channel itself suffers from congestion or other failure. Because of these reasons, the burst loss probability is an important performance measure of an OBS architecture. Despite the fact that burst loss is possible in OBS, the proposed architectures do not implement retransmission of lost bursts. One reason is the high data rate which makes it unmanageable to keep copies of all previously transmitted at the OBS edge nodes. Therefore, retransmission of lost bursts in an OBS network is left as a responsibility of the higher layer protocols. It is also possible that an application may tolerate burst loss in which case there is no need of retransmission.

Centralized Signaling With End-to-End Reservation:

Contrary to the more common one-way signaling, this centralized signaling method termed wavelength routed optical burst switching (WR-OBS) which utilizes an end-to-end resource reservation procedure. In this design, there is a centralized request server responsible for resource scheduling of the entire OBS network. When an OBS ingress node receives a setup request from a user, it sends a control packet to the
centralized scheduler where it is queued up based on the destination address. This centralized server has global knowledge of the state of the OBS switches and wavelength availability along all the fiber links. The responsibility of this central server includes processing incoming control packets, determination of routes of the required destinations and assignment of available wavelength along each link. The central server processes the control packet and sends a positive ACK to the OBS user upon receipt of which the node transmits the burst.

**ROUTING:**

The routing of a burst through an OBS network can be done on a hop by hop basis as in an IP network using a fast table lookup algorithm to determine the next hop. Another approach is to use multi protocol label switching (MPLS). The MPLS idea is to assign control packets to forward equivalent classes at the OBS user’s in order to reduce the intermediate routing time to the time it takes to swap the labels. A third approach is to use explicitly precalculated setup connections which can be established via Constraint Based Route Label Distribution Protocol (CR-LDP) or Resource Reservation Protocol with Traffic Engineering (RSVP-TE). Explicit routing is very useful in a constraint based routed OBS network where the traffic routes have to meet certain QoS metrics such as delay, hop count, bit error rate or bandwidth. In addition, in order to deal with node or link failures, OBS routing should also be augmented with fast protection and restoration schemes. Unfortunately, this is a weak point for explicit routing schemes.
because sometimes the routing tables can become outdated due to the long propagation time until a failure message reaches all of the OBS nodes

**Wavelength Allocation: With or Without Conversion**

In an OBS network with no wavelength converters the entire path from source to destination is constrained to use a single wavelength. The other possibility is an OBS network with a wavelength converter capability at each OBS node. In this case if two bursts contend for the same wavelength on the same output port the OBS node may optically convert one of the signals from an incoming wavelength to a different outgoing wavelength. In addition the conversion capability at an OBS node can be classified further as full or sparse. In the former case there one converter per each wavelength whereas in the latter case the number of converters is less than the total number of wavelengths. Wavelength conversion is a desirable characteristic in an OBS network as it reduces the burst loss probability. However it may not necessarily be a practical assumption since all optical converters are still an expensive technology. Another important thing about OBS wavelength allocation scheme is the fairness achieved between the successful transmission of bursts over long and short paths. The fairness issue is inherent to all optical networks not just OBS networks and it is due to the fact that it is easier to find free wavelengths along all of the links of a short path than it is for a longer one. Therefore the proposed all optical architectures should consider heuristics that try to improve the fairness among the connections with different number of hops.
PRETRANSMISSION OFFSET TIME:

An OBS user first transmits a control packet and after an offset time it transmits the burst. This offset allows the control packet to reserve the needed resources along the transmission path before the burst arrives. Furthermore, the OBS nodes need this offset time to setup their switching fabrics so that the data burst can “cut through” without the need for any buffers. Ideally, the offset estimation should be based on the number of hops between source and destination and the current level of congestion in the network. Obviously, an incorrect offset estimation would result in data loss because the burst may arrive at an OBS node before the optical cross connect has been completely set up. Therefore determining this offset is a key design feature of all OBS networks, and its effectiveness is measured in terms of burst loss probability. There are variations in the OBS literature on how exactly to determine the pretransmission offset time and how to reserve the needed resources at the core OBS nodes. Despite their differences, however, all of the proposed OBS architectures have dynamic operation which result in high resource utilization and adaptability.

1. Fixed Offsets:
2. Statistical Offsets
3. WR-OBS Offsets:

SCHEDULING OF RESOURCES: (RESERVATION AND RELEASE):
Upon receipt of the control packets sent from the OBS users the OBS nodes schedule their resources based on the included information. The proposed OBS architectures differ in their resource (wavelength) reservation and release schemes. These schemes are classified based on the amount of time a burst occupies a path inside the switching fabric of an OBS node. In explicit setup, a wavelength is reserved and the optical cross connect is configured immediately upon processing of the control packet. In estimated setup, the OBS node delays reservation and configuration until the actual burst arrives. The allocated resources can be released after the burst has come through using either explicit release or estimated release. In explicit release, the source sends an explicit trailing control packet to signify the end of a burst transmission. In estimated release, an OBS node knows exactly the end of the burst transmission from the burst length and therefore can calculate when to release the occupied resources based on this classification. The following four possibilities exist: they are explicit setup/explicit release, explicit setup/estimated release, estimated setup/explicit release, and estimated setup/estimated release.

The burst assembly strategy implemented at the OBS users also dictates how resources are reserved and released in the OBS network. The two architectures explicit setup/explicit release and explicit setup/estimated released schemes were used by the Jumpstart project. The other two schemes were disregarded because of their necessity for a scheduler at each node. The Jumpstart signaling protocol, however, is designed to be implemented mostly in hardware and does not use a scheduler. One more OBS resource scheduling scheme is Horizon. This scheme can be classified as explicit setup/estimated...
release In horizon the control packets contain both the offset time and burst length therefore the scheduler can maintain a deadline(horizon) when each resource will be freed and available for future scheduling This scheme is categorized as explicit setup because as soon as the control packet arrives at an OBS core node a wavelength is immediately scheduled for the future burst arrival The horizon scheme is practical and simple and its look ahead resource management minimizes the wasteful gap between reservation time and the actual burst arrival

**Variations On Burst Dropping:**

Most of the OBS literature specifies that if all the resources are occupied at the moment of a burst arrival the entire data burst is lost An interesting OBS variation designed to reduce the probability of burst losses is presented here It is built on the JET architecture and combines burst segmentation with deflection routing Specifically in this OBS model each burst is divided into multiple segments in the case of resource contention instead of dropping the entire burst either the head or tail segment is deflected to an alternate route to the destination There were two ways to implement this which are segment first or deflect first In the former the lengths of the currently scheduled burst and the new contending burst are compared the shorter one is segmented and its tail deflected In the deflect first policy the contending burst is deflected if the alternate port is free However if the port is busy similar to the segment first policy
the lengths of the currently scheduled and contending bursts are compared and the tail of the shorter one is dropped

**Classes Of Traffic:**

It is desirable for an OBS architecture to support different classes of traffic in the user plane. One reason is that applications such as video cannot tolerate long queuing delay and therefore may need to be given higher priority than regular data traffic. In addition, in order to ensure proper operation, OBS protection and restoration traffic must also be given priority over regular user data. Specifically in an OBSN, filtering of upper layer data and assignment of priorities to bursts will occur at the edge of the network during the burst assembly process. Therefore, in order to minimize the end-to-end delay of high priority traffic, the burst assembly algorithm can vary parameters such as preset timers or maximum/minimum burst sizes. However, selecting the values for these parameters is a difficult task because of the throughput interdependence. Some of the proposed solutions include:

1. **Classes Based On Extended Offsets:**
2. **Classes Based On Priority Queues:**
3. **Classes Based On the Optical Signal Properties and Pre-emption:**

**OBS Ring Networks:**
We have focused on OBS networks with mesh topology. In order to complete our review of OBS we now discuss the operation of ring networks. OBS ring architecture consists of ‘n’ OBS nodes connected by optical fibers which support ‘n+1’ wave lengths.

Each of the OBS nodes has a fixed transmitter set to one of the ‘n’ wave lengths and a tunable receiver. So that it can receive bursts along the transmission wave lengths of the other nodes. In addition each of the OBS nodes is having a secondary pair of fixed transmitter and a receiver set to the separate control wave length in order to communicate control information along the ring. In this architecture it is possible for two OBS nodes to send bursts over lapping in time towards the same destination node consequently these bursts will contend for the tunable receiver of the destination node and one of them will be dropped.

**Conclusion:**

In this we survey the OBS technology, a rapidly growing solution for all optical WDM networks. We have described the various OBS design characteristics such as connection establishment mechanism, offset time, scheduling of resources, aggregation and loss of bursts, implementation of classes of traffic and additional multicast capability. We present the ideas of deflection routing partial bursts dropping and fiber delay lines because of their potential to lower the bursts loss probability in an OBS network. With respect to the current state of technology OBS combines the best features of both circuit switching and packet switching.
The OBS network architecture

one way reservation