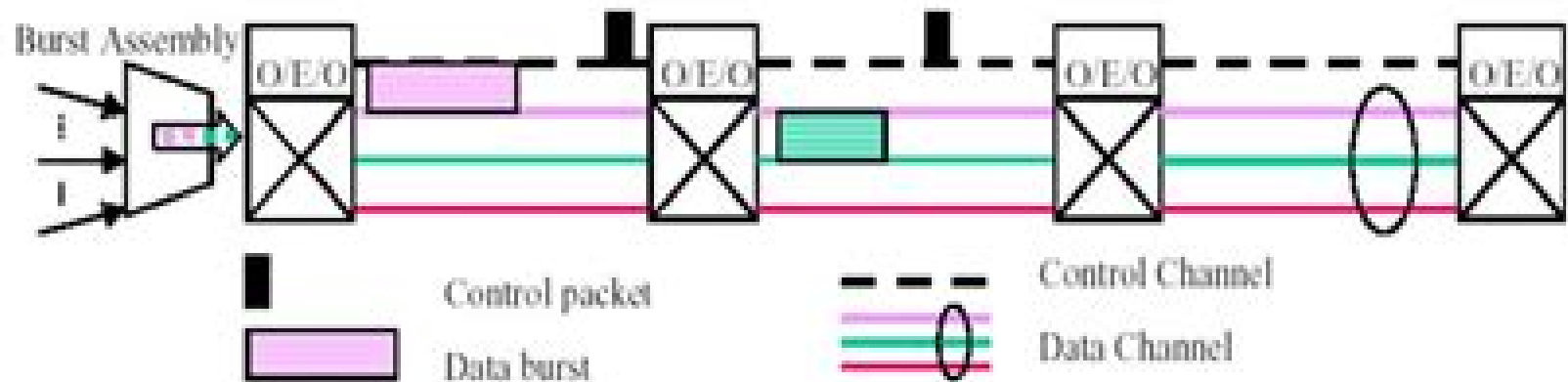


# Optical Burst Switched Networks



# Optical Burst Switched Networks

**Tzvetelina Battestilli**



## **Optical Burst Switched Networks:**

**Optical Burst Switched Networks** Jason P. Jue,Vinod M. Vokkarane,2006-06-07 Next generation high speed Internet backbone networks will be required to support a broad range of emerging applications which may not only require significant bandwidth but may also have strict quality of service QoS requirements Furthermore the traffic from such applications are expected to be highly bursty in nature For such traffic the allocation of static fixed bandwidth circuits may lead to the over provisioning of bandwidth resources in order to meet QoS requirements Optical burst switching OBS is a promising new technique which attempts to address the problem of efficiently allocating resources for bursty traffic In OBS incoming data is assembled into bursts at the edges of the network and when the burst is ready to be sent resources in the network are reserved only for the duration of the burst The reservation of resources is typically made by an out of band one way control message which precedes the burst by some offset time By reserving resources only for the duration of the burst a greater degree of utilization may be achieved in the network This book provides an overview of optical burst switching Design and research issues involved in the development of OBS networks are discussed and approaches to providing QoS in OBS networks are presented Topics include Optical burst switching node and network architectures Burst assembly Signaling protocols Contention resolution Burst scheduling Quality of service in OBS networks Quality of Service in Optical Burst Switched Networks Kee Chaing Chua,Mohan Gurusamy,Yong Liu,Minh Hoang Phung,2007-12-24 Optical Burst Switching OBS offers a promising switching technique to support huge bandwidth requirements in optical backbone networks that use Wavelength Division Multiplexing This book details the quality of service QoS issue in OBS networks It examines the basic mechanisms to improve overall QoS in OBS networks as well as discusses the relative QoS differentiation among multiple service classes in OBS networks Coverage also details absolute QoS provisioning in OBS networks end to end QoS provisioning in OBS networks and some non mainstream research issues and future research directions in OBS networks

Optical Burst Switched Networks Jason P. Jue,Vinod M. Vokkarane,2008-11-01 Next generation high speed Internet backbone networks will be required to support a broad range of emerging applications which may not only require significant bandwidth but may also have strict quality of service QoS requirements Furthermore the traffic from such applications are expected to be highly bursty in nature For such traffic the allocation of static fixed bandwidth circuits may lead to the over provisioning of bandwidth resources in order to meet QoS requirements Optical burst switching OBS is a promising new technique which attempts to address the problem of efficiently allocating resources for bursty traffic In OBS incoming data is assembled into bursts at the edges of the network and when the burst is ready to be sent resources in the network are reserved only for the duration of the burst The reservation of resources is typically made by an out of band one way control message which precedes the burst by some offset time By reserving resources only for the duration of the burst a greater degree of utilization may be achieved in the network This book provides an overview of optical burst switching Design and

research issues involved in the development of OBS networks are discussed and approaches to providing QoS in OBS networks are presented Topics include Optical burst switching node and network architectures Burst assembly Signaling protocols Contention resolution Burst scheduling Quality of service in OBS networks     **An Analytical Approach to Optical Burst Switched Networks** T. Venkatesh,C. Siva Ram Murthy,2010-03-16 This book presents the state of the art results on modeling and analysis of OBS networks It provides researchers with new directions for future research and helps them gain a better understanding of modeling OBS networks This book classifies all the literature on modeling and analysis of OBS networks and serves as a thought provoking material for the researchers working on the analysis of high speed networks The scope of this book however is not limited to OBS networks alone but extends to high speed communication networks with limited or no buffers     **Performance Analysis of Optical Burst Switched Networks** ,2002 In this dissertation we studied the performance of Optical Burst Switching OBS OBS is a promising new solution for the next generation optical Internet In the first part of the dissertation we studied a novel WDM ring network with OBS The ring consists of N nodes and each node owns a home wavelength on which it transmits its bursts The ring operates under the fixed transmitter tunable receiver FTTR scheme Control information is transmitted on a separate control channel We proposed five different burst switching access protocols We also studied the performance of these access protocols in terms of throughput packet delay throughput fairness and delay fairness under different network parameters average packet arrival rate maximum burst size and minimum burst size Finally we proposed a new offset calculation method which can significantly simplify the access protocol design and reduce the packet delay for all access protocols In the second part of the dissertation we analyzed an edge node of a WDM OBS mesh network using a new burst arrival process which is more realistic than the well known Poisson process The edge node is modeled as a closed non product form queueing network consisting of special nodes with orbiting customers Despite the rich literature in queueing network analysis this particular queueing network with orbiting customers has not been analyzed before We developed algorithms for both the single class and multi class queueing networks The single class queueing network is solved using Marie s method In the case of no converters we obtained a closed form expression of the conditional throughput of the special node with orbiting customers The multi class queueing network is analyzed by decomposition Specifically a multiple class queueing network is decomposed into a set of two class queueing networks and each of them is then solved by Neuse and Chandy s Heuristic Aggregation Method We also developed a much faster appr     **Control and Survivability Issues for Optical Burst Switched Networks** Salim Youssef Said,2005 Optical burst switching OBS is the most promising all optical architectures for the next generation Internet OBS is still being developed and several issues still need to be addressed Several studies have stressed the importance of the choice of the offset time and its criticality in influencing the burst loss phenomenon in OBS networks The main problem arises in estimating the initial delay that is compatible with the optical burst switching architecture implemented This thesis aims to

provide a mechanism to calculate the offset time and to study its effect on the network performance and refining QoS levels. The study is extended to networks under failure to investigate the influence of the delay factor on the restoration process especially in compensating failed network performance degradations. The simulation studies validated the proposed mechanism and formed an annex that can be integrated on any OBS restoration mechanism. A new QoS parameter is defined to meet service differentiation with respect to the data losses and delays.

**Performance Analysis of Optical Burst Switched Networks with Dynamic Simultaneous Link Possession**, 2004. Given the current state of the technology the Optical Burst Switched OBS architecture is a practical optical switching solution for the optical networks. In OBS the user data is transmitted in variable size data units called bursts which travel as an optical signal along the entire route. The control information for each burst is transmitted prior to its corresponding burst and it is electronically processed at each hop along the route. The dynamic nature of OBS allows for network adaptability and scalability which makes it very suitable for the transmission of bursty traffic. In this thesis we study and analyze the performance of OBS networks. We consider the case when the bursts are large enough to simultaneously hold wavelengths on multiple links along the route. Since the size of the bursts varies and the link distance between two adjacent network nodes also varies a burst may simultaneously occupy wavelengths on a variable number of links as it travels from its source to its destination. As the burst propagates through the network it dynamically acquires and releases wavelengths from link to link. In this thesis we propose queueing network models that feature dynamic simultaneous link possession and analyze them in order to obtain the end to end burst loss probabilities. This thesis is structured into five parts. In the first part we describe the Optical Burst Switch architecture and summarize its main design components. In the second part we define and motivate the simultaneous link possession problem. In the third part we study an OBS network where the bursts are large enough to simultaneously hold wavelengths on one or two consecutive links. In the fourth part of this thesis we analytically study an OBS network with simultaneous link possession and a very large number of wavelengths per link. In the fifth part we address the problem of how to analytically evaluate the performance of OBS networks when the arrival traffic is bursty.

Performance Analysis of Optical Burst Switched Networks  
Lisong Xu, 2002. Keywords: optical networks, protocol design, queueing theory, optical burst switching, performance analysis.

**Performance Evaluation of Optical Burst Switched Networks** Siamak Azodolmolky, Anna Tzanakaki, Ioannis Tomkos, 2012-06. This book focuses on the performance evaluation of the Optical Burst Switched OBS networks. A simulation framework based on OPNET Modeler is designed and implemented to evaluate the performance of an OBS network in the presence of self similar traffic sources. The impact of self similar traffic sources and specific design parameters imposed on the network is assessed in terms of burst assembly delay, its jitter and burst loss ratio. The performance metrics have a strong dependency on parameters such as number of packets per burst, assembly timeout, number of available wavelengths and the degree of the traffic self similarity. Furthermore the impact of time and size based burst assembly algorithms utilized in edge

routers on the self similarity level of the output traffic is evaluated Both static adaptive approaches are examined This research utilizes the OPNET Modeler r focusing on the characteristics of the output traffic Various Hurst parameter estimators have been applied to estimate the Hurst parameter of the aggregated input and output traffic streams The performance impact of the burst assembly approaches in terms of burst assembly delay and its jitter is measured **Quality of Service in Optical Burst Switched Networks** Kee Chaing Chua,Mohan Gurusamy,Yong Liu,Minh Hoang Phung,2008-11-01 Optical Burst Switching OBS offers a promising switching technique to support huge bandwidth requirements in optical backbone networks that use Wavelength Division Multiplexing This book details the quality of service QoS issue in OBS networks It examines the basic mechanisms to improve overall QoS in OBS networks as well as discusses the relative QoS differentiation among multiple service classes in OBS networks Coverage also details absolute QoS provisioning in OBS networks end to end QoS provisioning in OBS networks and some non mainstream research issues and future research directions in OBS networks **Design and Implementation of Optical Burst Switched Networks for Future Applications** Georgios Zervas,2008 **Optical Switching Networks** Martin Maier,2008-02-11 Optical Switching Networks describes all the major switching paradigms developed for modern optical networks discussing their operation advantages disadvantages and implementation Following a review of the evolution of optical WDM networks an overview of the future trends out The latest developments in optical access local metropolitan and wide area networks are covered including detailed technical descriptions of generalized multiprotocol label switching waveband switching photonic slot routing optical flow burst and packet switching The convergence of optical and wireless access networks is also discussed as are the IEEE 802 17 Resilient Packet Ring and IEEE 802 3ah Ethernet passive optical network standards and their WDM upgraded derivatives The feasibility challenges and potential of next generation optical networks are described in a survey of state of the art optical networking testbeds Animations showing how the key optical switching techniques work are available via the web as are lecture slides [www.cambridge.org/9780521868006](http://www.cambridge.org/9780521868006) *A Study of Optical Burst Switched Networks with the Jumpstart Just in Time Signaling Protocol* Jing Teng,2004 Keywords OBS JIT Jumpstart **A Study of Optical Burst Switched Networks with the Jumpstart Just In Time Signaling Protocol** ,2004 This thesis studies the optical burst switched OBS networks It consists of three parts In the first part we present a detailed analysis of three major wavelength reservation schemes for OBS networks JIT JET and Horizon The contributions include i analytical models of JET and Horizon on a single OBS node that are more accurate than previously published ones and valid for general burst length and offset length distributions ii determination of the regions of parameter values such as burst offset length optical switching and hardware processing overheads so that a more complex reservation scheme reduces to a simpler one and iii a new reservation scheme JIT which is as simple to implement as JIT and its performance tracks that of Horizon and JET We compare the performance in terms of burst drop probability of the four wavelength reservation schemes on a single OBS

node as well as on a path of OBS nodes with cross traffic under various sets of parameter values Our major finding is that under reasonable assumptions regarding the current and future state of the art technologies in optical switch and electronic hardware the simplicity of JIT and JIT seems to outweigh any performance benefits of Horizon and JET In the second part of this thesis we present the results of a simulation analysis of OBS networks employing the Jumpstart JIT signaling protocol We study the performance of various network topologies in terms of burst drop probability and investigate the effects of several system parameters including message processing time OXC configuration delay user to switch propagation delay and switch to switch propagation delay We also investigate the effect of wavelength converters In the third part we develop a suite of adaptive and non adaptive wavelength assignment policies for OBS networks We also apply traffic engineering techniques to reduce wavelength contention through traffic isolation Our performance study indicates that

*Loss-free Architectures in Optical Burst Switched Networks for a Reliable and Dynamic Optical Layer* Thomas Coutelen, 2010

For the last three decades the optical fiber has been a quite systematic response to dimensioning issues in the Internet Originally restricted to long haul networks the optical network has gradually descended the network hierarchy to discard the bottlenecks In the 90 s metropolitan networks became optical Today optical fibers are deployed in access networks and reach the users In a near future besides wireless access and local area networks all networks in the network hierarchy may be made of fibers in order to support current services HDTV and the emergence of new applications 3D TV newly commercialized in USA The deployment of such greedy applications will initiate an upward upgrade The first step may be the Metropolitan Area Networks MANs not only because of the traffic growth but also because of the variety of served applications each with a specific traffic profile The current optical layer is of mitigated efficiency dealing with unforeseen events The lack of reactivity is mainly due to the slow switching devices any on line decision of the optical layer is delayed by the configuration of the devices When the optical network has been extended in the MANs a lot of efforts has been deployed to improve the reactivity of the optical layer The Optical Circuit Switching paradigm OCS has been improved but it ultimately relies on off line configuration of the optical devices Optical Burst Switching OBS can be viewed as a highly flexible evolution of OCS that operates five order of magnitude faster Within this architecture the loss free guaranty can be abandoned in order to improve the reactivity of the optical layer Indeed reliability and reactivity appear as antagonists properties and getting closer to either of them mitigates the other This thesis aims at proposing a solution to achieve reliable transmission over a dynamic optical layer Focusing on OBS networks our objective is to solve the contention issue without mitigating the reactivity After the consideration of contention avoidance mechanisms with routing constraints similar as in OCS networks we investigate the reactive solutions that intend to solve the contentions None of the available contention resolution scheme can ensure the 100% efficiency that leads to loss free transmission An attractive solution is the recourse to electrical buffering but it is notoriously disregarded because 1 it may highly impact the delays and 2 loss can occur due to buffer overflows The efficiency

of translucent architectures thus highly depends on the buffer availability that can be improved by reducing the time spent in the buffers and the contention rate. We show that traffic grooming can highly reduce the emission delay and consequently the buffer occupancy. In a first architecture traffic grooming is enabled by a translucent core node architecture capable to re aggregate incoming bursts. The re aggregation is mandatory to de groom the bursts in the core network i.e. to demultiplex the content of a burst. On the one hand the re aggregation highly reduces the loss probability but on the other hand it absorbs the benefits of traffic grooming. Finally dynamic access to re aggregation for contention resolution despite the significant reduction of the contention rate dramatically impacts the end to end delay and the memory requirement. We thus propose a second architecture called CAROBS that exploits traffic grooming in the optical domain. This framework is fully dynamic and can be used jointly with our translucent architecture that performs re aggregation. As the de grooming operations do not involve re aggregation the translucent module can be restricted to contention resolution. As a result the volume of data submitted to re aggregation is drastically reduced and loss free transmission can be reached with the same reactivity end to end delay and memory requirement as a native OBS network.

**Quality of Service Mechanisms in Optical Burst-switched Networks** Qiong Zhang, University of Texas at Dallas. Graduate Program in Computer Science, 2005

**Quality of Service in Optical Packet Switched Networks** Akbar G. Rahbar, 2015-01-23 This book is a comprehensive study on OPS networks its architectures and developed techniques for improving its quality of switching and managing quality of service. The book includes Introduction to OPS networks OOFDM networks GMPLS enabled optical networks QoS in OPS networks Hybrid contention avoidance resolution schemes in both long haul and metro optical networks Hybrid optical switching schemes.

Network Control and Engineering for QoS, Security and Mobility, V Dominique Gaiti, 2007-01-26 The increasing demand for sophisticated network applications allied to the growth of the Internet traffic has led to great efforts in the search of improvements in data transmission technologies with the intention of satisfying the increasing demand for bandwidth. So far as optical networking is concerned WDM Wavelength Division Multiplexing appears as the main advance in the transmission area because it allows transmission rates near to the theoretical limit of optical fibers of the order of dozens of terabits a second. 1 An essential issue in optical network design is defining how the network will be controlled that is what type of signalling will be responsible for resource reservation route determination and fault handling among other functions that constitute the control plane. Label switching which in IP networks is exemplified by MPLS Multiprotocol Label Switching 2 was extended through GMPLS Generalized Multiprotocol Label Switching 3 to operate with several different network technologies where the label can be represented in other ways for example as time slots in TDM networks as physical switch ports and as wavelengths  $\lambda$ s in WDM networks.

**Performance Analysis of Optical Burst Switched Networks with Dynamic Simultaneous Link Possession** Tzvetelina Battestilli, 2005 Keywords simultaneous possession queueing

network optical networks optical burst switching performance evaluation **Design of Routers for Optical Burst**



**Switched Networks** Jeyashankher Ramamirtham, 2004

## Decoding **Optical Burst Switched Networks**: Revealing the Captivating Potential of Verbal Expression

In an era characterized by interconnectedness and an insatiable thirst for knowledge, the captivating potential of verbal expression has emerged as a formidable force. Its ability to evoke sentiments, stimulate introspection, and incite profound transformations is genuinely awe-inspiring. Within the pages of "**Optical Burst Switched Networks**," a mesmerizing literary creation penned by a celebrated wordsmith, readers embark on an enlightening odyssey, unraveling the intricate significance of language and its enduring effect on our lives. In this appraisal, we shall explore the book's central themes, evaluate its distinctive writing style, and gauge its pervasive influence on the hearts and minds of its readership.

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