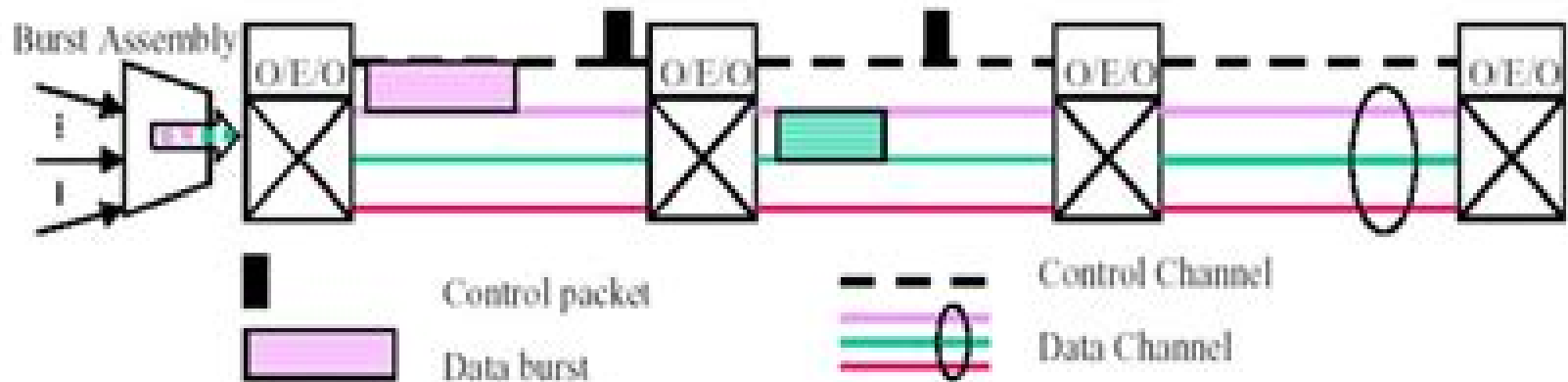


# Optical Burst Switched Networks



# 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

**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

**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

**Quality of Service in Optical Burst Switched Networks** Kee Chaing Chua, 2007 Quality of Service in Optical Burst Switched Networks is a broad review and reference for researchers and professionals of Quality of Service QoS support in Optical Burst Switching OBS networks The authors start with an overview of OBS architecture then categorize and discuss existing QoS support in OBS including relative and absolute models mechanisms for supporting multiple traffic classes edge to edge provisioning and other non mainstream mechanisms Optical networking professionals will find the literature review as an up to date coverage of topics which is both timely and helpful 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 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

*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 **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 *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

**A Study of Optical Burst Switched Networks with the Jumpstart Just in Time Signaling Protocol** Jing Teng, 2004  
 Keywords OBS JIT Jumpstart *Performance Analysis of Optical Burst Switched Networks* Lisong Xu, 2002 Keywords optical networks protocol design queuing theory optical burst switching performance analysis *Design and Implementation of Optical Burst Switched Networks for Future Applications* Georgios Zervas, 2008 **Quality of Service Mechanisms in Optical Burst-switched Networks** Qiong Zhang, University of Texas at Dallas. Graduate Program in Computer

Science,2005      *Selected Topics in Optical Burst Switched Networks Performance Analysis* Laura Capdevila Masdeu, Davide Careglio, École polytechnique fédérale de Lausanne, 2011      Providing High Throughput and Controllable Performance in Burst-switched Optical Networks Neil Barakat, 2006 In this thesis I examine the problem of providing high throughput and controllable and predictable performance in OBS networks I present new analytical models which for the first time allow one to quantify precisely the effect of offsets on the performance of OBS networks I then present a new OBS signaling architecture called dual header optical burst switching DOBS which allows for precise control of offsets in every node of the network I show how DOBS signalling can reduce the complexity of core node burst schedulers from  $O(\log W)$  to  $O(1)$  where  $W$  is the number of wavelengths in the system I also present a new scheduling algorithm that minimizes burst blocking in core nodes of a DOBS network This allows the system to support an offered load that is between 10% and 50% higher than that of a single header OBS system for a given target blocking probability By increasing the understanding of the effect of OBS offsets and by providing mechanisms by which they can be precisely controlled the contributions of this work provide OBS researchers with a powerful toolset for providing the reliable and predictable end to end performance guarantees required by next generation Internet applications and brings optical burst switching one step closer to commercial viability Optical fiber networks and in particular wavelength division multiplexing are the only technologies capable of supporting the huge bandwidth demand that has accompanied the explosive growth of the Internet Optical burst switching OBS has emerged as a very promising candidate architecture for next generation optical networks because it combines the simple optical technology of optical circuit switching with the flexibility and bandwidth efficiency of optical packet switching The most distinguishing feature of OBS is the use of a time offset between the header and payload of each burst These offsets allow for the time required to perform switching and forwarding operations in each node and directly affect the complexity throughput performance and end to end delay of OBS systems      **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      **Loss-free Architectures in Optical Burst Switched Networks for a Reliable and Dynamic Optical Layer** Thomas Coutelen, 2010      **Design of Routers for Optical Burst Switched Networks** Jeyashankher Ramamirtham, 2004      *Analysis and Synthesis of Optical Burst Switched Networks*, 2014

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