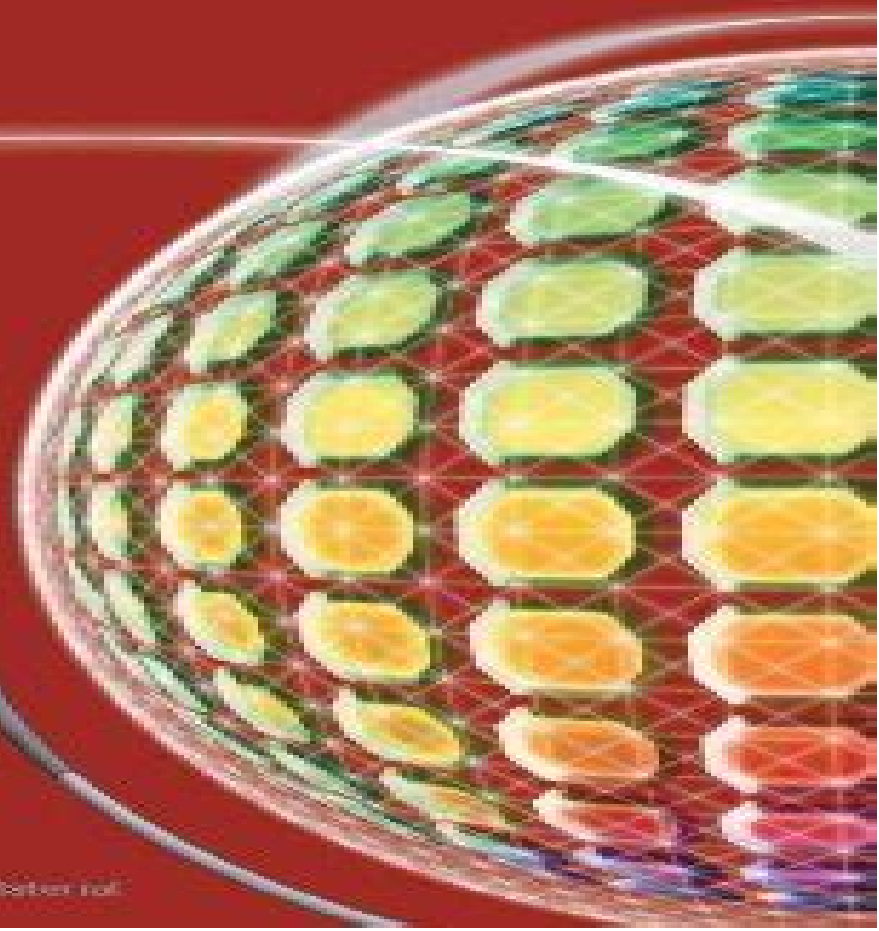




Survivable Optical WDM Networks

Canhui (Sam) Ou
Biswanath Mukherjee



OPTICAL NETWORKS SERIES

Survivable Optical Wdm Networks

Hussein T. Mouftah, Pin-Han Ho



Survivable Optical Wdm Networks:

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Survivable Optical WDM Networks Canhui (Sam) Ou, Biswanath Mukherjee, 2010-07-19 Survivable Optical WDM Networks investigates different approaches for designing and operating an optical network with the objectives that 1 more connections can be carried by a given network leading to more revenue and 2 connections can recover faster in case of failures leading to better services Different networks wavelength routed WDM networks wavelength routed WDM networks with sub wavelength granularity grooming and data over next generation SONET SDH over WDM networks are covered Different approaches are proposed to explore every aspect of a protection scheme such as 1 Protection granularity a At wavelength granularity b At sub wavelength granularity 2 Protection entity a Path protection b Sub path protection c Segment protection 3 Routing a Single path routing b Multi path routing Tradeoffs between different objectives e g resource efficiency vs recovery time are explored and practical approaches are proposed and analyzed

Optical Networks Hussein T. Mouftah, Pin-Han Ho, 2003 Special emphasis has been given to the design of meshed middle sized and wavelength routed networks with dynamic traffic in the optical domain such as the next generation Metropolitan Area Network

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Abstract Optical networks with Wavelength Division Multiplexing WDM technology provide huge bandwidth to meet the ever increasing traffic demand of the next generation Internet But the high speed nature of WDM networks also makes the network more vulnerable to failures Even a single network failure for a very short duration can result in enormous loss of data In this thesis we concentrate on designing a survivable WDM network In essence survivability concerns two important aspects fast fault detection and localization and fast fault recovery We first study fast fault detection and localization in WDM optical networks Our work is based on the notion of monitoring cycle m cycle Compared with other fault detection schemes an m cycle based fault detection scheme provides fast fault detection and requires less number of expensive monitors Aiming at further cutting down the implementation cost we propose the notion of super monitor Instead of having a dedicated monitor for each m cycle a single super monitor can be placed at the junction of a set of overlapped m cycles In this thesis we formulate and solve the monitor placement problem We then focus on enhancing the capacity efficiency of fast fault recovery schemes Shared backup path protection SBPP schemes can provide 100% protection against any single link failure This is

achieved by establishing a pair of link disjoint active and backup paths upon each call arrival. The bandwidth on different backup paths can be shared for protecting different calls. In this thesis a new SBPP scheme is designed based on a two step routing approach where the active and backup paths are sequentially optimized with different objectives in mind. We then shift our focus to design fast protection scheme for multicast broadcast communications. To this end we refine the existing concept of blue red tree. Blue red tree is a pair of spanning trees where the connectivity between the root and any destination node is ensured upon a network failure. In particular two efficient integer linear programs ILPs are formulated for finding the optimal blue red trees. Last but not the least we investigate the survivability in IP networks. We notice that existing efforts on IP fast reroute IPFRR are effective in enhancing the IP resilience. But the impact of IPFRR on the end to end TCP performance is ignored. Notably path rerouting can interfere with the TCP congestion control mechanism and thus cause severe throughput degradation. To address this problem we propose a duplicate acknowledgement ACK suppression scheme. The key idea is to detect whether an out of order packet arrival event is due to IPFRR or not. If it is due to IPFRR duplicate ACKs triggered will be suppressed by the TCP receiver so as not to cause unnecessary slow down at the TCP sender.

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Subjects: Wavelength division multiplexing, Optical communications, Design and construction

Power Source Aware Survivable Optical WDM Networks Mark Boddie, 2013

Survivability Approaches for Multiple Failures in WDM Optical Networks Pallab Datta, 2005

The explosive growth of Web related services over the Internet is bringing millions of new users online thus fueling an enormous demand for bandwidth. Wavelength Division Multiplexed WDM networks employing wavelength routing have emerged as the dominant technology to satisfy this growing demand for bandwidth. As the amount of traffic carried has increased any single failure can be catastrophic. Survivability becomes indispensable in such networks. Therefore it is imperative to design networks that can quickly and efficiently recover from failures. Most research to date in survivable optical network design and operation focuses on single link failures however the occurrence of multiple link failures are not uncommon in a network topology. Multi link failure scenarios can arise out of two common situations. First an arbitrary link may fail in the network and before that link can be repaired another link fails thus creating a multi link failure sequence. Secondly it might happen in practice that two distinct physical links may be routed via the same common duct or physical channel. A failure at that shared physical location creates a logical multiple link failure. Such instances where separate fiber optic links share a common failure structure is often referred to as SRLG (Shared Risk Link Groups). In this dissertation we study survivability paradigms for surviving multiple link failures. We study the network design and upgrade problem in WDM backbone networks and formulate it using a simulated annealing based technique. This framework provides a cost effective way of upgrading the network by identifying how much resources to budget at each stage of network evolution. This results in significant cost reductions for the network service provider. We study protection reconfiguration using two different survivability paradigms namely sub graph routing and shared mesh protection. Initially

sub graphs are defined taking into account link SRLG or node failures and could in the event of an unrelated or subsequent multi link failure incorporate the reactive form of sub graph fault tolerance Reactive sub graph fault tolerance employs a recursive approach for tolerating numerous sequential overlapping failures It can tolerate simultaneous multiple link failures by simply serializing the handling of each individual fault Connection re routing and network reconfiguration is one of the primary challenges in sub graph routing methodology We propose a constrained subgraph routing methodology which restricts the connections to be routed using the same trunk and channel in the subgraphs thus minimizing reconfiguration The subgraph based routing methodology is further explored to tolerate multiple link failures in the form of shared risk link groups and node failures The generalized diverse routing problem for finding two diverse routes between a source and destination has been shown to be NP Complete Recent studies have also proven the NP completeness of the SRLG diverse routing We propose a polynomial time graph transformation algorithm for solving the diverse routing problem for certain specific SRLG s which includes link sets incident on a common node The proposed graph transformation methodology for diverse routing is also studied for shared risk node group SRNG failures

Survivability and Traffic Grooming in WDM Optical Networks Arun Somani, 2006-01-12 This book provides coverage of survivability and traffic grooming two key issues in modern optical networks

Emerging Optical Network Technologies Krishna M. Sivalingam, Suresh Subramaniam, 2006-01-16 Optical networks have moved from laboratory settings and theoretical research to real world deployment and service oriented explorations New technologies such as Ethernet PON traffic grooming regional and metropolitan network architectures and optical packet switching are being explored and the landscape is continuously and rapidly evolving Some of the important issues involving these new technologies involve the architectural protocol and performance related issues This book addresses many of these issues and presents a birds eye view of some of the more promising technologies Researchers and those pursuing advanced degrees in this field will be able to see where progress is being made and new technologies are emerging Emerging Optical Network Technologies Architectures Protocols and Performance provides state of the art material written by the most prominent professionals in their respective areas

Reliability, Survivability and Quality of Large Scale Telecommunication Systems Peter Stavroulakis, 2003-09-11 Competition within the telecommunications companies is growing fiercer by the day Therefore it is vital to ensure a high level of quality and reliability within all telecommunications systems in order to guard against faults and the failure of components and network services Within large scale systems such quality and reliability problems are ever higher The metrics of Quality and Reliability have to date only been available in journals and technical reports of companies which have designed or produced major parts of systems used in large applications This book provides a self contained treatment enabling the reader to be able to produce define and utilise the metrics of Quality and Reliability required for the design and implementation of a large application such as a world class event as the Olympic Games An additional outcome is that this

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