Analysis and Optimization of SONET/SDH Networks for Path Computation, Protection and Provisioning System

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Abstract – There is very limited work over SONET/SDH path protection mechanism. Path protection for single link failure has been analyzed and reported in research but development of the techniques for more than one link failure is very limited. Path protection techniques using Integer Liner programming (ILP) already have limitation over the implementation over the physical parameters of SONET/SDH network. The developed work using ILP is also limited for structure based optical network. Working path protection techniques on the physical parameters of the SONET/SDH or any optical network is the great motivation for the research.

Index Terms - Dedicated protection, SONET/SDH, NP-completeness, Shared Risk Link Group (SRLG), Link, Trail.

I. INTRODUCTION

SONET stands for Synchronous Optical Network and SDH stands for Synchronous Digital Hierarchy, Similar and compatible, it is standard to be used for fibre optics, Recommendation for Fibre Optic Transmission Systems, Used Single Reference Clock, Synchronize Transmission. It defines optical carrier (OC) levels and electrically equivalent synchronous transport signals (STSs) for the fiber-optic-based transmission hierarchy. SONET 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 done by byte interleaving. Demultiplexing is easy.

1.1 SONET ARCHITECTURE

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

- TERMINOLOGY: Protection uses pre-assigned capacity to ensure survivability. Restoration reroutes the affected traffic after failure occurrence by using available capacity. Survivability property of a network to be resilient to failures.

Fig 1.2 SONET/SDH architecture
II. RELATED WORK

1. Asuman, E., Ozdaglar and Dimitri P., “Routing and Wavelength assignment in optical networks”, LIDS report Dept. of Electrical Engineering and Computer Science M.I.T., Cambridge, Mass., pp.1-23, 2001. Given the physical network structure and the required connections, the Routing & Wavelength Assignment problem was to select a suitable path and wavelength among the many possible choices for each connection so that no two paths sharing a link are assigned the same wavelength. The main advantage of these formulations was to determine the number of wavelengths required on each link, fixed to ring network topology and its traffic pattern.

2. Li (Erran), Milind M. Buddhikot, Chandra Chekuri, “Routing Bandwidth Guaranteed Paths with Local Restoration in Label Switched Networks”, IEEE International Conference on Network Protocols, Nov 2002. introduced the concept of “backtracking” to bound the restoration latency used a link cost model that captures bandwidth sharing among links using various types of aggregate link state information. Advantage Provided improvement in bandwidth usage Disadvantage Does not provide improvement in restoration latency.


6. Canhui (Sam) Ou et (2004) investigated the dedicated path protection. For this, the author claimed that for dedicated path provisioning establishing a link under protection-connection (PAC) is NP complete. Author proposed heuristics for protection at line path to enhance efficiency. There is scope of research for more than one link failure and optimization of network resources for such cases.

2. A single failure on a network can disrupt at most one of the paths. So, there is a problem of finding a pair of disjoint paths in the network.

3. Existing work in the area has mostly focused on finding a lightpath routing that survives a single physical link failure.

4. For this, the main goal in this work is to fully characterize the structures that contribute to the reliability in a layered network. This gives us the precise optimization criterion for maximizing the reliability.

III Methodology

In this work, firstly it provides the scenario of dedicated path protection for path computation, protection and provisioning by creating a network engine in MATLAB.
3.1 Complete Flowchart of System

3.2 Proposed Scenario
3.3 Flowchart of Methodology

II. Implementation
4.1.1 The study of behavior of SONET/SDH in a standard network which uses 50 nodes (users) and 175 links (logical) connections were performed. A network operating Engine is designed which implements the call requests on real time basis. It can allow or reject or could keep in queue the coming requests at an instance.

### Table

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<th>Destination</th>
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</table>

4.2.2 Request generating system

Request generating system, created here is a key to initiate any request. This system helps in putting the call requests into the Engine. For simplification purpose of request generation, certain parameters were kept constant and predefined accordingly. However, on alpha basis, it allows to generate a request from any one node to any other node within the network limits. The request Source, Destination and the Relative weight (Alpha) can only be varied within permissible ranges to be selected.

4.2.4 Alpha (α)

Alpha is the relative weight assigned for a Virtual channel (VC) allotted for a particular voice or data communication. This value gives the amount of bandwidth to be used for creating a mutually independent channel within the SONET fiber.

4.2.5 Blocking Probability

- Throughput: The amount of data transferred over the period of time expressed in kilobits per second (Kbps).

III. RESULTS AND PERFORMANCE ANALYSIS

![Graph](image_url)
4.3 Alpha=0.1
4.5 Alpha = 0.4

4.4nAlpha 0.8

4.6 Np of Request Vs alp
V. CONCLUSION 

- This Paper also provides the comparison of proposed scheme with dedicated and shared protection in terms of bandwidth utilization.

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