1. INTRODUCTION

Fast growth of internet traffic increases data transmission capacity demand dramatically. Optical fibers are replacing the metal wires, especially at the backbone networks, to meet the increasing bandwidth demand.

The huge bandwidth of an optical fiber is exploited by Wavelength Division Multiplexing (WDM) technology [1]. Multiple wavelengths are carried on a single fiber link, with the use of WDM technology.

Optical fiber strands are laid in bundles (864 strands/ bundle) and bundles are laid in conduits (10 bundles/ conduit). [1] Multiplying the total capacity of multiplexed wavelengths per fiber with strand count in a conduit, the huge capacity of bandwidth an optical link provides can be calculated.

In an optical WDM network, optical fiber links form the physical topology. A wavelength path which spans several physical links and uses one wavelength on each link along its path is referred to as a lightpath. Wavelengths along a lightpath are connected to each other by Optical Cross Connects (OXCs). At the source node of a lightpath, a transmitter generates an optical signal from an electronic signal. At the destination node, a receiver converts the optical signal into an electronic signal.

All the lightpaths established in an optical network form the virtual topology. Connection requests are routed over the lightpaths, i.e. virtual topology. In other words, routing connections in an optical network involves sub problems of building the lightpaths and routing the connections over the lightpaths; thus is a two-layer (physical, virtual) routing problem.

There is a large gap between the capacity of a WDM channel (OC-48, OC-192, OC-768) and the bandwidth requirement of a typical connection request. If whole bandwidth of a wavelength channel is allocated for one single connection, a huge bandwidth capacity will remain unused, will be wasted. Multiplexing low-speed traffic streams onto high-speed lightpaths, in order to use the network resources efficiently, is referred to as traffic grooming. [2] Routing solutions for WDM networks should consider traffic grooming ability, too.

Routing methods developed for WDM networks can be classified in two groups, depending on the type of traffic conditions they are built for. The first group of solutions is designed for the case when all traffic requests are known in advance (static traffic). The second group of solutions is designed for the case where connections arrive one at a time (dynamic traffic).

1.1 Problem and Solution

Various methods for solving routing problem in a groomable network, under dynamic traffic conditions were examined. An auxiliary graph method was selected and implemented. Since the auxiliary graph method handles routing problem in two layers jointly (single-layer solution), it performs better in terms utilizing network resources efficiently.

Under static traffic conditions, i.e. when the set of traffic requests are known in advance, it is possible to put the requests in the optimal order so that the resource utilization is minimized, when the connections are routed. Under dynamic traffic conditions, on the other hand, connections are routed as soon as they arrive; there is no chance of sorting requests for better resource utilization. A connection may be routed through a long route, because it is the shortest route available at the time of request's arrival. However, by attempting to reroute this type of connections, more efficient routes might be discovered, since the network state is continuously changing due to terminating and arriving connections.

Rerouting connections in dynamic traffic environment has not been widely considered. Furthermore, existing rerouting studies concentrate on two layers separately. Virtual Topology Reconfiguration (VTR) concentrates on rerouting lightpaths through different physical paths, for adapting changes in traffic patterns. Connection rerouting concentrates on rerouting connections through different existing lightpaths. These approaches are not suitable, when routing is performed on a single-layer auxiliary graph.

Starting with implementation of rerouting method used in [3]; in this study, various rerouting enhancements for dynamic traffic are proposed, on a single-layer traffic grooming architecture. The enhancements can be summarized as,

1. Selecting a lightpath for deletion and rerouting effected connections through existing lightpaths, only if more source-efficient new routes can be found.
2. Selecting a lightpath for deletion and searching for more source-efficient new routes on the whole auxiliary graph,
3. Checking cost deviation instead of cost, in the search of lightpath to delete.