Abstract

Optical networks have been widely deployed because of their high speed transmission and enormous amount of data. Lightpath provisioning has been a major issue in optical networks because improper provisioning may cause huge data loss during failures. In addition to traditional single-domain networks, where a single administrator manages the entire network with full knowledge of network resources, multi-domain networks appear to become more scalable and manageable. In this thesis, we focus on the lightpath provisioning issues in both single and multi-domain optical networks. Several problems have been investigated with the objective of either maximizing the number of connections established with guaranteeing survivability, or minimizing the failure probability of connections when both working and backup paths disconnect at the same time.

We first investigate the problem of resource allocation strategy in traditional survivable single-domain optical networks, where each connection is protected end-to-end by provisioning bandwidth along a sequence of lightpaths through either dedicated or shared connection-level protection. We propose an improved resource allocation strategy with SLA along with the development of ILPs for shared path protection in single domain WDM optical networks with the objective of maximizing the total number of connection established with minimum wavelength utilization. We were able to increase the number of connections established and reserve the resources for the future connection requests.

We investigate the problem of survivable routing strategy in multi-domain wavelength routed optical networks with the impact of physical layer impairments in our next work. We propose heuristics and ILP for the routing strategy with the impact of physical layer impairments. Here we have considered Four-Wave Mixing (FWM) noise as physical layer impairment as it has the impact in long-haul data transmission. We found that the blocking probability increases as compared to the FWM unaware cases.

We next worked on lightpath assignments in survivable multi-domain wavelength convertible WDM optical networks. Here we have investigated the impact of Amplifier

Spontaneous Emission (ASE) noise and Four-Wave Mixing (FWM) noise while establishing lightpaths. We found that the interference of FWM noise is higher in short distance communications and interference of ASE noise is higher in the long distance communication due to the placement of amplifiers or repeaters along the lightpath. Here, for every inter-domain connection requests, the lightpath is computed and the number of FWM components available along the lightpath is calculated for the establishment of connections. We have calculated the blocking probability for different amount of FWM components permitted along the lightpath. We observed that the blocking probability increases in limiting the FWM components along the lightpath i.e., the routing strategy reduces the erroneous connections as the connection involves multiple domains in the connection establishment.

Finally, we investigate the problem of batch provisioning in WDM optical networks. Here we have mathematically modeled the Path Computation Element (PCE) for batch processes. It has been seen that the blocking probability gets reduced when the connection requests are queued and served. We have also developed heuristic algorithms for connection provisioning in batches and evaluated it with the help of simulations.

Keywords: Light-path Provisioning, Survivability, WDM, Optical Networks, FWM noise, PCE.