

**Availability-aware optical WDM networks
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ABSTRACT

Single link failure is the most common cause behind the unavailability of transport network services. Thus, the usual way of providing failure survivability to a customer requiring a point-to-point connection is by implementing two link-disjoint end-to-end circuits between the end points of the connection. This way of addressing the problem of maintaining network operation in spite of the occurrence of failures has two main drawbacks: firstly, established connections are not protected against multiple failures; secondly, the required level of availability (one important performance metric found in Service Level Agreements (SLA) in the area of telecommunications services) is not taken into account, which could lead to under/over provisioning of the network.

Recognizing these drawbacks, in the past 5 years there has been increasing interest in providing availability guarantees to the connections established in optical WDM networks. In this case, no assumption is done regarding the number of simultaneous link failures experienced by the network. Instead, each link is characterized by its failure probability and primary and backup paths are established in such a way that a minimum level of availability is guaranteed to the connection.

Availability-aware networks can be classified as those applying dedicated protection, shared protection and a mixed of both. In the first case, as many end-to-end circuits as necessary are established to meet the required availability of all network connections. In the second case, backup resources are shared among different connections. For example, one channel is allocated as a backup resource to several primary connections. This is done in such a way that the probability of two or more primary connections requiring the same backup resource is low enough as to comply with the required level of availability. In the last case, some connections are protected using dedicated protection and others using shared protection.

The provision of availability-aware connections using shared protection is the most challenging task, as every time a backup resource is shared by a new connection, the availability of all connections protected with the shared resource is degraded. In a network where all connection requests are processed at one, this problem can be solved by means of Integer Linear Programming (ILP) techniques aiming at minimizing the required number of backup channels, subject to a

minimal availability level constraint. This problem can be formulated as a large-scale integer linear programming problem, but it is very hard to solve. In a dynamic setting, where connections arrive one at a time, an ILP approach is not possible and then, efficient heuristics must be devised.

In this talk, we review the main approaches used to solve the problem of availability-aware optical WDM networks, present our latest results on availability-aware networks using shared protection as well as some open research problems.