Advanced Optical Facility Protection Methodologies

In fiber-optic communications, wavelength-division multiplexing (WDM) is a technology which multiplexes multiple optical carrier signals on a single optical fiber by using different wavelengths (colors) of laser light, allowing for a multiplication in the traffic capacity. Due to high capacity being carried on this fiber, having multiple diverse paths, or protection as it is commonly known, is essential for many organizations to ensure the availability of the link and the data being carried.

Recent changes in worldwide legislation have meant that companies in every sphere of the global market need to have in place disaster recovery and business continuity procedures. This ensures that data is stored in different facilities and, at the same time that this data is transported over different paths.

In typical protected WDM networking solutions, a customer will have two or more sites, connected by diverse paths to each other, thus providing extremely high availability of the network at all times. However, fibre cuts can occur for many reasons including building works, street maintenance, and carrier faults.

Optical Facility Protection Methods

Two optical facility protection methods will be discussed in this white paper. The first, electrical switching, uses a cross connect to duplicate and select the working or protecting path, using two independent optics per each path and two sets of Mux/DeMux. The second option, optical switching, uses an optical switch to select the working or protected path.

Electrical Switching

In the first method each service is simultaneously transmitted/received to/from two dark fibers (see Figure 1). The service signal emanating from the left hand side device is transmitted to both working and protecting fibre. According to the optical power level of each wavelength, the service signal is delivered to the far end device.

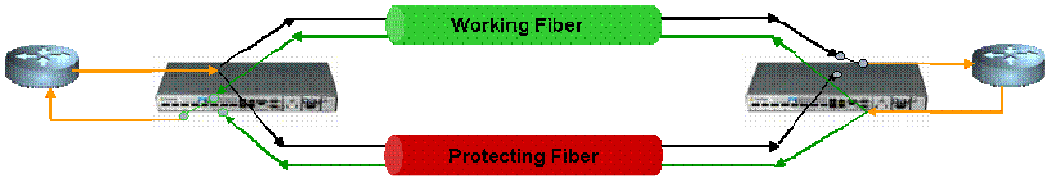

Figure 1

Figure 2 shows a more detailed diagram of how the cross connect duplicates (Tx) signals and selects the working and protecting path (Rx) for the receiving signal. The Tx signal is sent through the cross connect and duplicated through both transponders. On the Rx direction, the cross connect switches according to the receiving optical power of the transponder.

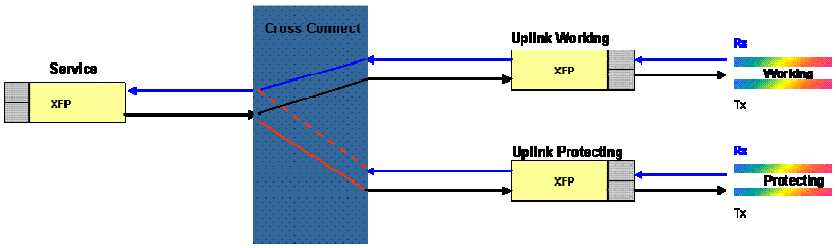

Figure 2

Using this method has its advantages and disadvantages. First, and perhaps most important, the WDM optic is protected as two uplink transponders are utilized per service, one for the working fibre and one for the protecting. This adds another level of protection above and beyond just the fibre being protected. Also, protection is carried out per service, so if a single service needs to be switched, the other service signals are not disturbed. This method of protection also supports all network topologies (point to point, linear add/drop and ring). An additional significant advantage is that there is no power budget loss associated with this protection method.

However, more WDM optics and an addition Mux/DeMux are used by the solution, meaning that fewer services can be transported through each unit; increasing overall solution costs.

Optical Switching

In this method an optical switch is responsible for duplicating the data to the working and protecting fibre with an optical splitter, and selecting the operating fibre according to the optical power signals of all the services. (See Figure 2)

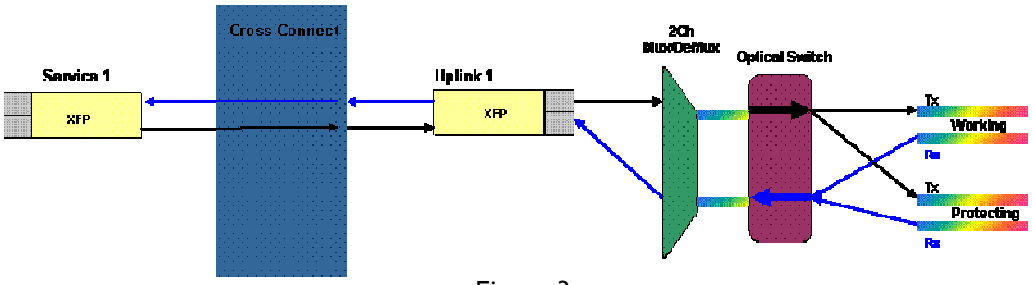

Figure 3

This method also has its pro's and con's. As this method does not offer protection for the WDM optic, there are more available ports on each unit, thus lowering the total cost of the solution. This method also saves on the additional passive Mux/DeMux required in the first solution.

However the insertion of the Optical Switch lowers the optical power budget by 4.3 dB, negatively impacting the power budget for the solution. The switching is performed for all the channels simultaneously. Furthermore, this method cannot support ring topologies because add and drop functionality is not available per wavelength.

Summary

Electrical switching offers high levels of redundancy by protecting the optics, and offers enhanced functionality such as switching per wavelengths, no power budget degradation, and supporting ring topologies amongst others. However, this functionality requires added costs in employing more WDM optics and an additional Mux/DeMux per unit.

The second option, optical switching, saves cost, particularly in DWDM applications where the optic cost is significant and provides basic link protection. However, the power budget of the solution is affected negatively, and certain topologies are not supported.

The applicable facility protection method needs to be selected only after reviewing each project independently, taking into account power budget, topology, cost, and the level of protection needed.

About PacketLight Networks, Ltd.
PacketLight Networks offers a suite of Leading 1U Metro CWDM and DWDM solutions, for transport of data, voice and video applications, over dark fiber and WDM networks, featuring high quality, reliability and performance at affordable prices. Our products are distinguished with low power consumption ideal for CLE (Customer Located Equipment) allowing maximum flexibility as well as ease of maintenance and operation and providing real Pay-as-you-grow architecture. PacketLight customers are carriers, service providers, IT integrators and enterprises who are active in meeting the demands for metro Ethernet, business continuity, Triple Play solutions and enterprise data sharing applications. For product and reseller information, Please contact info@packetlight.com