Maximizing Fibre Utilization using WDM Systems

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1.0 Introduction

Many of today's leading organizations and governments are employing fibre as their data transport medium. Optical fibre (or fiber) is a glass or plastic fibre designed to guide light along its length. Fibre optics is the overlap of applied science and engineering concerned with the design and application of optical fibers. Optical fibers are widely used in fibre-optic communication, which permits transmission over longer distances and at higher data rates than other forms of communications. Fibers are used instead of metal wires because signals travel along them with less loss, and they are immune to electromagnetic interference.

2. Wavelength Division Multiplexing

Wavelength Division Multiplexing – WDM - is a method of transmitting data from different sources over the same fibre optic link at the same time whereby each data channel is carried on its own unique wavelength over a fibre optic cable. Typically WDM is used to increase signaling and bandwidth capacity over single mode fibre optic cable, the result is a link with an aggregate bandwidth that increases with the number of wavelengths employed. In this way WDM technology can maximize the use of the fibre optic infrastructure that is available; what would normally require two or more fibre links instead requires only one.

Wavelength routed optical networks have emerged as a technology that can effectively utilize the enormous bandwidth of the optical fibre. Dense Wave Division Multiplexing (DWDM) combines up to 64 wavelengths onto a single fibre. DWDM technology uses an ITU standard 100GHz or 200GHz spacing between the wavelengths, arranged in several bands at ~1500-1600nm. With DWDM technology, the wavelengths are close together (compared to CWDM), meaning that transponders are generally more complex and expensive than CWDM. However, with DWDM, the advantage is a much higher density of wavelengths, and also longer distances, especially with PacketLight's PL-400, Multi Service CWDM and DWDM Data Transport Device.

3. WDM Technology

WDM technology is made up of a number of building blocks. When put together into a network, these blocks provide a complete solution for multi-wavelength services, and bandwidth enhancement over a single or dual fibre strand. For example, PacketLight's PL-400 can provide up to 8 services of up to 4Gb, such as 1G / 2G / 4G FC (Fibre Channel), FICON, ESCON, Fast Ethernet, GbE, STM-1 / OC-3, STM-4 / OC-12, STM-16 / OC-48, 2.66G OTN, video and 2.488G / 1.244 G GPON in any mix. These can be efficiently combined with the PL-1000, for transporting 10G services over the same fibre infrastructure such as 10G Ethernet LAN / WAN, OC-192 / STM-64, OUT-2 and 10G FC in any mix. Furthermore, in combination with the PL-300, PacketLight's passive optical Mux / Demux, up to 32 services from 2Mb to 10Gb, in any mix, can be transported over a single fibre pair.

PacketLight's carrier class equipment also supports various configurations, including fibre and optic protection, link protection and EDFA to provide an efficient wideband amplification for the C-band, to name a few. Also various topologies such as Ring, Linear Add and Drop and Point to Point networks can be managed from a single IP address, making management of the PacketLight network simple and effective.

4. Maximizing Fibre Utilization

A method and system for maximizing wavelength reuse in an optically protected wavelength-division-multiplexed (WDM) network, the WDM network supporting a plurality of service connections, includes associating service connections supported by non-overlapping paths to form respective service channel groups, and for each service channel group, assigning at least one common wavelength channel for establishing the service connections.

Conventional WDM systems provide up to 16 channels in the 3rd transmission window (C-band) of silica fibers around 1550 nm. DWDM uses the same transmission window but with denser channel spacing. Channel plans vary, but a typical system would use 40 channels at 100 GHz spacing or 80 channels with 50 GHz spacing. Some technologies are capable of 25 GHz spacing (sometimes called ultra dense WDM). New amplification options (Raman amplification) enable the extension of the usable wavelengths to the L-band, more or less doubling these numbers.

CWDM in contrast to conventional WDM and DWDM uses increased channel spacing to allow less sophisticated and thus cheaper transceiver designs. To again provide 16 channels on a single fibre CWDM uses the entire frequency band between second and third transmission window (1310/1550 nm respectively) including both windows (minimum dispersion window and minimum attenuation window) but also the critical area where OH scattering may occur, recommending the use of OH-free silica fibers in case the wavelengths between second and third transmission window shall also be used. Avoiding this region, the channels 31,49,51,53,55,57,59,61 remain and these are the most commonly used.

Using PacketLight's PL-400 DWDM wavelengths can be implanted into an already crowded CWDM wavelength spectrum. Thus redefining what was an 8 service capability into a potential 36 service mix of services such as 1G / 2G / 4G FC (Fibre Channel), FICON, ESCON, Fast Ethernet, GbE, STM-1 / OC-3, STM-4 / OC-12, STM-16 / OC-48, 2.66G OTN, video and 2.488G / 1.244 G GPON in any mix.

5. Conclusion

To conclude, for many organizations today implementing fibre network connections, the key to effective return on investment is how the fibre is utilized. Using CWDM can offer up to 8 multi-service protocols, but with PacketLight's PL-400 and PL-1000, the same fibre can support up to 32 services of any mix from 2Mb to 10Gb, offering fast ROI, secure and reliable data transport, and maximizing the use of fibre, the future of data communications.

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