What is Wavelength Division Multiplexing?

Wavelength Division Multiplexing (WDM) is a technology that makes use of multiple colors of light (channels) to be send simultaneously over a single optical fiber network. WDM has since the ‘70s been the preferred choice for transporting large amounts of data streams between sites.

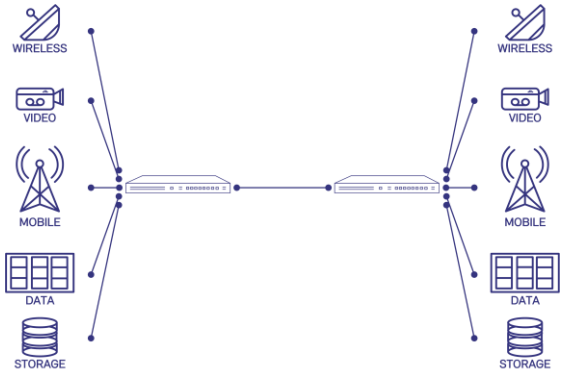
WDM has previously been a technology primarily for service providers and telecom operators with a demand for supporting the carrier network between local or nationwide sites. Today the technology is being adopted by enterprises, public governments, and data centers with a demand for more capacity between sites. In many cases this is implemented on the existing infrastructure. Previously the technology has been complex with large systems and quite costly – today the systems are easy to implement, high density (up to 40 channels per 1RU chassis) and very attractive compared to renting or owing own dark fiber.

Individual fibers between sites

Transmission of data streams such as Ethernet, Fiber Channel, Video and Voice has traditionally been on individual dedicated fibers as shown below where there is a need for five pair of dark fibers between the sites. This terminology is well known but lacks flexibility and comes with a high implementation cost due to renting or owing own dark fiber.

Multiple services between sites

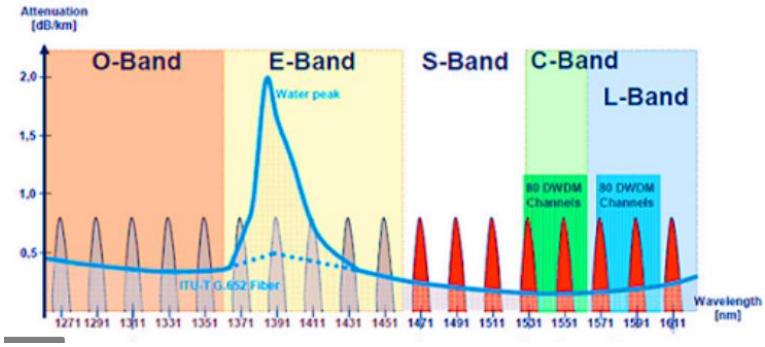
With the implementation of WDM the data streams will be sent on dedicated wavelengths (channels) which in one end is Muxed (and Demuxed at the other end) onto one fiber pair compared to five dark fiber pairs as previous described. Allowing different data streams to be send over the same fiber network the bandwidth is increased synchronously with the number of data streams. Hence optimizing the fiber with cost savings from either renting or owing own fiber infrastructure.



WDM technologies

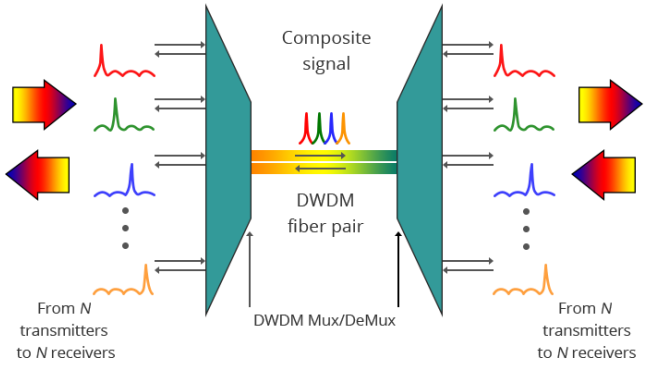
CWDM

Course Wavelength Division Multiplexing (CWDM) is designed for short distance communications and to allow simultaneous transmission of several wavelengths with enough separation to permit the use of uncooled sources. The maximum capacity is limited to 18 predefined CWDM channels with a 20 nm spacing per channel in the O- to L-band (1260 nm - 1625 nm spectrum). CWDM is a compact and cost-effective option for shorter distances up to 70 km and with a bandwidth limitation per channels up to 16 Gb Fiber Channel or 25 Gb Ethernet, due to the physical attenuations in fibers and muxes.



DWDM

Dense Wavelength Division Multiplexing (DWDM) is designed for long-haul communications with different channels packed tightly together, as depicted below. With the tight spacing a DWDM system can typically support 80 channels at 50 GHz (0.4 nm) spacing and supports a large amounts of data streams only limited by physical constraints.



Active DWDM systems normally utilizes transponders and muxponders to ‘translate’ various low order client signals into DWDM channel specific signals with higher bitrate bandwidth.

This makes active DWDM systems highly scalable and flexible solution supporting 8/16/32 Gb Fiber Channel and 1/10/25/50/100/200/400Gb Ethernet. When boosted by Erbium Doped-Fiber Amplifiers (EDFAs) an amplifier for high-speed communications these systems can work over thousands of kilometers.

WDM systems

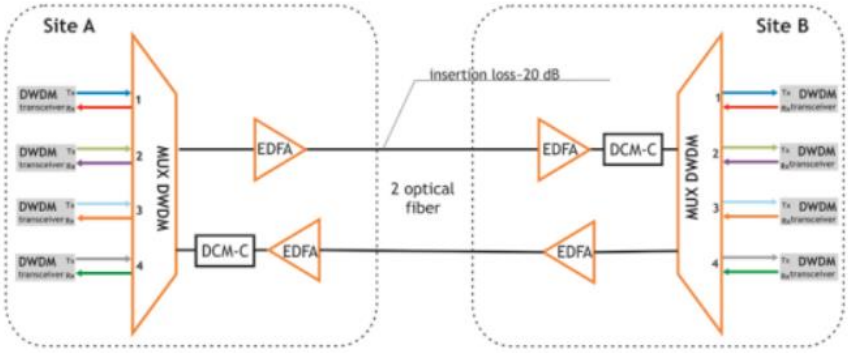
Passive WDM systems

Passive WDM systems can increase the capacity of dark fiber tenfold, without investing in extra fiber connections. At the same time, you ensure the scalability and flexibility for future expansions. A passive WDM system is filters without supervision and management capabilities, which multiplexes and demultiplexes data transmitted over one fiber pair.

WDM filters support either CWDM (Coarse Wavelength Division Multiplexing) or DWDM (Dense Wavelength Division Multiplexing) technology with up to 18 and typically 80 channels respectively. A CWDM system can be expanded with an additional 16 DWDM wavelengths (via the 1530 nm and 1550 nm channels) for a total capacity of 30 channels in a hybrid solution. The planning and implementation of a passive WDM system is easy and can be implemented ‘on-the-fly’ with channel-specific SFPs.

Active DWDM systems

Active DWDM systems can transmit multiple 40 GbE and 100 GbE links in parallel with lower bandwidths and other protocols such as Fiber Channel, at distances up to several thousand kilometers. With built-in transponders and muxponders, multimode and singlemode signals are converted to DWDM channels that can be monitored in real time.



You can add Layer 1 encryption of the traffic on the client or line side. Layer 1 encryption requires less bandwidth and is more powerful than traditional MACSec (Layer 2) and IPSec (Layer 3) protocols. With the demand for higher speed like 100/400G or 32G Fiber Channel the needs for active DWDM solutions are required, and there are a lot of different solutions even from the same vendor.

Itectra holds tens of years of experience within designing and building WDM systems and supports a broad portfolio of CWDM and DWDM elements for designing both passive and active WDM systems.