

# ***Best of Both Worlds:*** **Expanding Existing CWDM infrastructure** **For supporting 36 wavelengths**

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## **Introduction**

In today's world of intensive communication needs and requirements, "fiber optic cabling" has become a very popular phrase. In the field of telecommunications and data/video networking, fiber optic cabling is highly desirable for today's communication needs due to the enormous bandwidth availability, as well as reliability, minimal loss of data packets, and increased security.

Since the physical fiber optic cabling is expensive to implement, its capacity expansion using a Wave Division Multiplexing (WDM) is a necessity. WDM is a concept that describes combination of several streams of data/video/or voice on the same physical fiber-optic cable by using several wavelengths (frequencies) of light with each frequency carrying a different type of data.

There are two types of WDM architecture: Coarse Wave Division Multiplexing (CWDM) and Dense Wave Division Multiplexing (DWDM). CWDM systems typically provide 8 wavelengths, separated by 20nm, from 1470nm to 1630nm. Some DWDM systems provide up to 144 wavelengths, typically with no more than 2nm spacing, roughly over the same range of wavelengths.

The main advantage of CWDM is the cost of the optics which is typically 1/3<sup>rd</sup> of the cost of the equivalent DWDM optic. This difference in economic scale, the limited budget that many customers face, and typical initial requirements not to exceed 8 wavelengths, means that CWDM is a more popular entry point for many customers. With PacketLight's WDM equipment, a customer can start with 8 CWDM wavelengths but then grow by introducing DWDM wavelengths into the mix, utilizing the existing fibre and maximizing return on investment.

By utilizing CWDM and DWDM or the mixture of thereof, carriers and enterprises are able to transport from services of 2MB up to 10GB of data over 36 different channels. This white paper explains this capability of such expansion and its associated cost.

## **CWDM vs DWDM**

CWDM implementation is much more cost effective than cost of implementing DWDM infrastructure. DWDM solutions are more expensive because DWDM lasers are cooled DFB lasers and provide an excellent solution for long-haul transport and large metro ring topologies requiring high capacity. Since this application is designed for carriers and communication providers, the cost is generally divided over the large number of customers served. However, for Metro access networks, customers have much lower bandwidth capacity requirements and are more cost-conscious. This is where CWDM proves to be the leading candidate.

CWDM transceivers are typically three times less expensive than those of DWDM. Since DWDM laser die tolerances are much more exact ( $\pm 0.1$  nm) than CWDM ( $\pm 2-3$  nm), it is necessary to cool the DWDM transceivers, leading to more expensive technology. In addition, the cost of the passive optical multiplexers and demultiplexers of CWDM are also much less than those of DWDM due to fewer numbers of layers in the filter design. These and other factors lead to overall system costs 3 or 4 times less in CWDM architecture than in DWDM solution making it much more affordable for SMB's, alternative carriers, enterprises, data center connectivity and campuses.

With PacketLight's innovative solution, a customer can start with CWDM infrastructure while enabling easy future growth. As demand grows, additional services can be added over the same fiber infrastructure ranging from 100Mbps up to 10G. The fiber capacity can easily be boosted to support four times the capacity used for CWDM initially. PacketLight application provides both the short term and the long term planning solution of your dark fiber needs economically and in a "pay-as-you-grow" architecture.

## Best of Both Worlds

Typically CWDM solutions provide 8 wavelengths capability enabling the transport of 8 client interfaces over the same fiber. However, the relatively large separation between the CWDM wavelengths allows expansion of the CWDM network itself with an additional 32 wavelengths utilizing DWDM technology, thus expanding the existing infrastructure capability up to 36 wavelengths and utilizing the same equipment as part of the integrated solution.

Additionally, the typical CWDM spectrum supports data transport rates of up to 4.25GB, while DWDM is utilized more for large capacity data transport needs of up to 10GB. By mapping DWDM channels within the CWDM wavelength spectrum as demonstrated below, much higher data transport capacity on the same fiber optic cable can be achieved without any need for changing the existing fibre infrastructure between the network sites.

As demonstrated by *Figure 1.0*, CWDM occupies the following nm: 1470nm, 1490nm, 1510nm, 1530nm, 1550nm, 1570nm, 1590nm, and 1610nm, each separated from the other by 20nm. PacketLight can insert into any of the of the 4 CWDM wavelengths (1530,1550,1570 and 1590), a set of additional 8 wavelength of DWDM separated from each other by only 0.1nm. By doing so up to 4 times, the CWDM network capability can easily expand by up to 28 additional wavelengths.

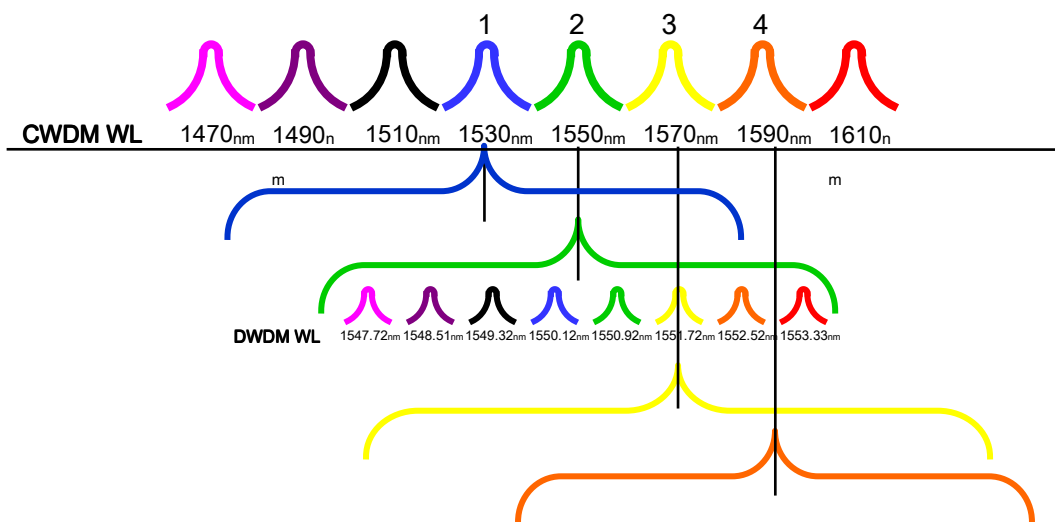


Figure 1.0

Figure 2.0 further demonstrates in detail the expansion capabilities via the DWDM spectrum. As seen below, a single outgoing and incoming wavelength of the existing CWDM infrastructure is used for 8 DWDM channels multiplexing into the original wavelength. Since the PacketLight solution is integrating the DWDM transponders, DWDM Mux/DeMux and EDFA (optical amplifier if needed), the entire solution is delivered just by adding a very compact 1U unit.

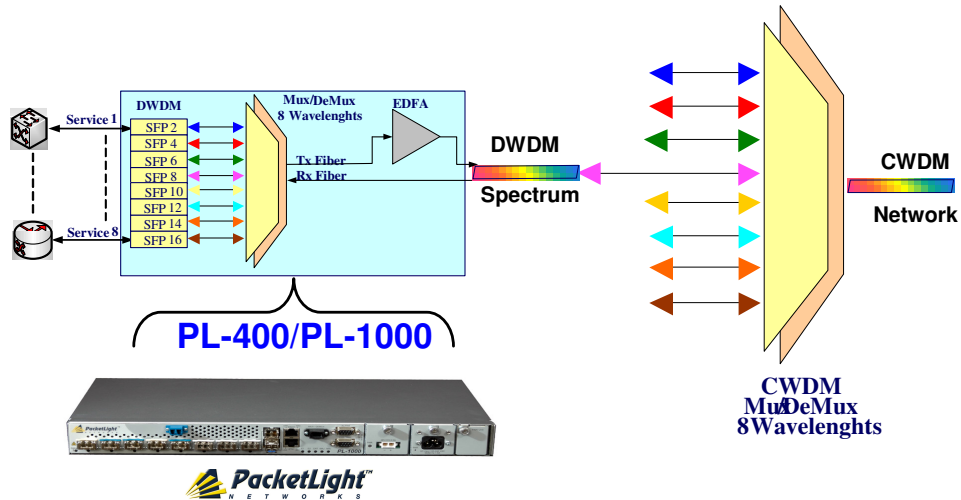


Figure 2.0

This expansion is achieved with no service interruption to the remaining network services, or to the data, and without the need to change or replace any of the working CWDM infrastructures.

## Summary

PacketLight's CWDM and DWDM equipment is a serious contender for today's optical transport requirements. It provides the following advantages:

- Low-cost initial setup with targeted future growth path
- Low incremental cost: "Pay as you grow" Architecture
- Easy conversion and upgrade capabilities up to 36 wavelengths
- Easy upgrade to support 10Gbps services
- Seamless, non traffic effective network upgrades
- Provides reliable, secure, and standards based architecture
- Is simple to install and maintain
- Provides full performance monitoring

With PacketLight's compact CWDM solutions, you can receive all of the above benefits and much more (such as remote monitoring and setup, integrated amplifiers, protection capabilities, and integration with 3<sup>rd</sup> party networking devices, etc.) in a cost effective 1U unit, allowing you to expand as you grow, and utilize your financial as well as physical resources to the maximum.

## About PacketLight WDM products

PacketLight Networks has been manufacturing high-end data transport equipment for over seven years and has vast experience in dealing with customers that require secure, reliable and protected solutions to transport data over WDM. Two specific units manufactured by PacketLight provide connectivity of a variety of services over dark fiber, using WDM technology to multiplex these various services over the fiber. The PL-400 can transport any mix of 32 services from 100Mbps up to 4.25Gbps, whereas the latest product in the range, the PL-1000 can transport up to 32 channels of any mix of up to 10Gbps services over dark fiber.



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