Making the Most of Existing Fiber Networks

DWDM and grey optics show promise to help service providers increase the capacity of existing optical fiber.

By Michał Owca / *Salumanus*

Nowadays, network users want more data capacity and less latency. Data centers, enterprises and telecom operators face the challenge of constantly increasing throughput. Meanwhile, changes to a network's backbone are often extremely expensive or impossible. The best choice is to scale the transmission capacity in existing optical networks using dark fiber solutions, such as grey transceivers and wavelength division multiplexing (WDM) technology.

Dark fiber is commonly defined as unlit, unused optical fiber that could potentially benefit a network's capacity significantly. Thanks to dark fiber, network operators can connect two locations through point-to-point connections and scale network transmission capacity. Regardless of whether the fiber pair is part of the infrastructure or has access to it based on a lease agreement, there are many advantages to using existing lines.

One of the most significant advantages of dark fiber is the scalability and flexibility in developing throughput, allowing operators to expand networks when and if needed. This also gives users complete independence and control of network development. Similarly, dark fiber offers almost unlimited bandwidth and eliminates common public network elements, thus making networks more secure, especially for organizations in critical sectors.

GREY OPTICS SHOW PROMISE

Grey optics with higher bit rates can speed up data transmission. Grey optics, also known

DWDM-LONG HAUL EQUIPMENT TO SURPASS WDM METRO GROWTH

DWDM long-haul equipment is heading into a new growth cycle. According to a Dell'Oro Group report, demand for optical transport DWDM equipment is forecast to surpass $17 billion by 2026. Over the next five years, the research firm expects DWDM long-haul system sales to grow faster than WDM metro system sales.

Dell'Oro said DWDM long-haul revenue is forecast to grow at a five-year compounded annual growth rate (CAGR) of 5 percent. Meanwhile, WDM metro revenue is predicted to grow at a five-year CAGR of 3 percent.

Despite seeing what he calls "market turbulence," Jimmy Yu, vice president at Dell'Oro Group, said the research firm is "projecting continuous growth for DWDM system revenues."

Yu added, "We expect more growth from DWDM long haul since IPoDWDM should lower the use of WDM metro systems in data center interconnect."

A WDM system enables the capacity of existing optical fiber to be increased.

as grey transceivers or standard transceivers, are the most popular type of transceivers. They work at wavelengths of 850nm, 1310nm or 1550nm in two fibers (one fiber in one direction) and often come in different forms, such as SX, LX, EX or ZX, SR, LR and ER. However, the phenomenon of chromatic dispersion has limitations.

Chromatic dispersion happens when different wavelengths in a light beam arrive at their destination at slightly different times. This creates a distribution or spreading in the pulses that convey digital information. To ensure that optical fibers deliver their maximum capacity, operators must compensate for chromatic dispersion. In the case of transmissions of 100 Gbps and more, one solution is using optical modules with a more significant number of lasers and carrying part of the transmission at each wavelength.

XWDM MULTIPLIES POSSIBILITIES

WDM technology enables the capacity of existing optical fiber to be further increased.

Two complementary inserts are needed, one wavelength per transmission direction, to implement a WDM link. The simplest solution is to use BiDi modules. Transmission in both directions using two different wavelengths is realized in a single fiber. When a transmitting (TX) module at 1310nm and a receiving (Rx) module at 1550nm are mounted on one side of the link, an inverse module (Rx 1310 and Tx 1550) must be mounted on the other side.

The bit rates on the existing pair of single-mode optical fibers can also be increased by migrating toward coarse wave division multiplexing (CWDM) technology.

Further development in the direction of wavelength multiplication is dense wave division multiplexing (DWDM). Compared with CWDM, DWDM technology significantly reduces the width of the channel. There are several options, which differ in the width of the channel plan grid: 100GHz, 75GHz, 50GHz and more. The 100GHz grid uses 0.8nm spacing between the channels, which allows network operators to organize a 48-channel plan.

The next step is to use a 50GHz grid and reduce the channel width to 0.4nm. The frequency of 50GHz allows the use of 96 independent transmission channels. Thanks to DWDM technology, the aggregate capacity of the link has increased significantly.

The main advantage of DWDM technology is the possibility of a cost-effective, flexible approach to capacity development based on the available pair of single-mode fibers. At the same time, systems with a different mesh can be used and expanded if necessary. Systems using 100GHz can be used simultaneously with 75GHz and 50GHz optical modules. It is possible to mix systems with different grid designs in one optical fiber, a technology called ROADM. This allows users to manage their bandwidth more efficiently. The best solution is to choose the channel width for the bitrate size.

Dark fiber solutions present numerous benefits over new links, from cost reductions to scalability and increased transmission capacity. ❖

Michał Owca is the product manager at Salumanus, which develops data transmission technologies to optimize tele-communications networks.