

Future-Proof Fiber

Wave-division multiplexing – the use of the same fiber to carry multiple signals, each on its own wavelength – is already being used to avoid deploying additional fiber

Adapted from a report by ADC

Recent growth in bandwidth needs has, of course, placed additional demands on fiber optic networks. In most cases, there's a simple fix: coarse wavelength division multiplexing (CWDM) technology. The idea is a century old; copper wire can transmit multiple signals at different frequencies. For fiber, CWDM adds bandwidth while increasing the flexibility, accessibility, adaptability, manageability and protection of the network; distances up to 60 km (35 miles) are easy to bridge.

CWDM can be viewed as a "third generation" of WDM technology. WDM was originally developed so that data and RF video signals could be carried on the same strand of glass; it traditionally employed 1310 nm and 1550 nm wavelength signals.

Next, as providers with a fixed number of fibers ran short of bandwidth due to rapid growth or unforeseen demand, they began multiplexing a signal on top of the existing 1310 nm wavelength to create additional channels. However, demand continued to increase dramatically, creating the need for very fine channel spacing to add even more wavelengths (or channels) to each fiber.

Dense WDM (DWDM) was a major breakthrough; equipment providers pushed to offer new DWDM equipment, promising nearly unlimited bandwidth potential. DWDM was quickly adopted for long-haul and transoceanic optical networking, but its use in regional, metropolitan and campus environments was, in most cases, cost prohibitive; local traffic usually does not require all the wavelengths DWDM can provide.

A more targeted and cost-effective solution soon followed: CWDM, which uses a standard of channel spacing developed by the International Telecommunication Union (ITU) in 2002. This standard calls for a 20 nm channel spacing grid using wavelengths between 1270 nm and 1610 nm (see Figure 1). The cost of deploying CWDM architectures today is significantly lower than its DWDM predecessors.

Even though the ITU's 20 nm channel spacing offers 20 wavelengths for CWDM, the reality is that wavelengths below 1470 nm are considered "unusable" on older fibers meeting the ITU G.625 specification due to the increased attenuation in the 1310–1470 nm bands. However, new fibers with little or no "included water" in the glass (they conform to the newer G.652.C and G.652.D standards) nearly eliminate the "water peak" attenuation area.

This enables a CWDM system to operate effectively at the low end of the ITU grid as well. For example, an Ethernet LX-4 physical layer uses a CWDM consisting of four wavelengths near the 1310 nm wavelength, each carrying a 3.125 Gbps data stream. Together, the four wavelengths can carry 10 Gbps of aggregate data across a single fiber.

One issue of little import to network builders: The ITU CWDM standard uses signals that are not spaced appropriately for amplification by EDFAs (erbium-doped fiber amplifier lasers). This limits the total CWDM optical span between amplification stages to the 60

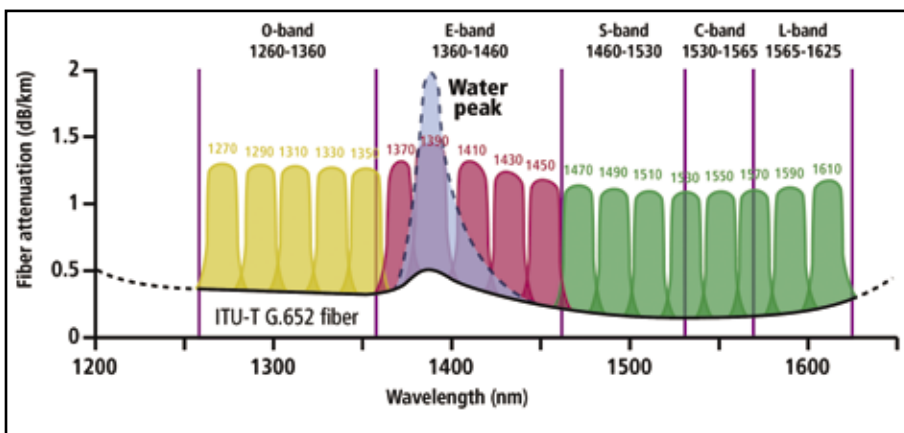


Figure 1. CWDM wavelength grid as specified by ITU-T G.694.2. Today's standardized CWDM is better defined as a cost-effective solution for building a metropolitan access network that promises all the key characteristics of a network architecture service providers dream about – offering transparency, scalability, and low cost.

