Testing DWDM in Deep Fiber Applications

In the Testing CWDM in Deep Fiber Applications , we talked about testing and troubleshooting Coarse Wave Division Multiplexing (CWDM) in cable network applications. In this tip, we take a closer look at Dense Wave Division Multiplexing (DWDM), which provides up to 160 channels per fiber depending on the spacing used.

DWDM is defined by ITU-T 694.1 and was initially developed for use in the C-band (1525 nm – 1565 nm) for core network deployment. It featured up to 80 channels with 100 GHz spacing (about 0.8 nm) and could use Erbium-Doped Fiber Amplifiers (EDFAs) to extend its reach. Spacing of 100 GHz is still the most common, but today's DWDM systems can support 50 GHz (0.4 nm) and even 25 GHz spacing with up to 160 channels possible. To put this in perspective, CWDM has a spacing of 20 nm per channel.

Because the DWDM channels are so close, DWDM transmitters require precision temperature control to operate properly, and wavelength filters must do their job of passing the correct wavelength while blocking others. This means that an issue with one channel could easily create issues with the channels on either side. Think of it like a NASCAR race where the cars are going side-by-side, very close together and at a very high rate of speed. If one car has a problem, there is a good chance that it will affect the cars on either side and the result could be catastrophic.

Much like we discussed in the CWDM tech tip, testing and maintaining DWDM networks is more complex than traditional HFC networks. The fiber is live with other traffic, and features wavelength-specific components (muxes, demuxes, add/drop devices). Like CWDM, you'll need to isolate the path for new customer turn-up, or troubleshooting a problem service or wavelength, without disrupting other subscribers. The problem wavelength should be on your trouble ticket. With that information, you're ready to test.
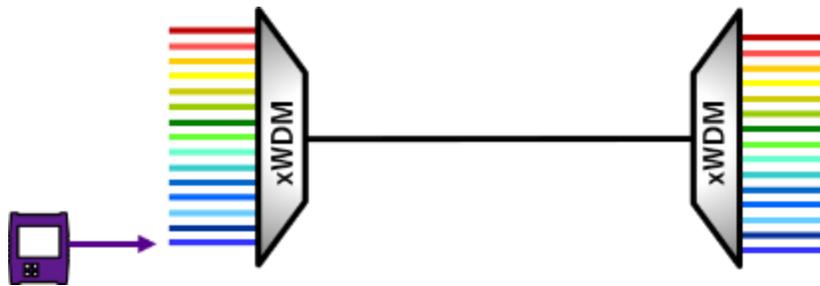
1) Check for Wavelength and Power Levels

You'll use a DWDM power meter (aka channel checker) such as the VIAVI OCC-56C for this. Connect the tester to the fiber and scan the channels and power levels that are present. Similar to CWDM testing, once you select the correct ITU-T spacing, the device will preload the appropriate grid showing all channels and power levels present. With DWDM, there is a higher risk that issues due to wavelength drift or bad component filters will occur.

Results can be displayed in either table or graphical views with PASS/FAIL standards applied. Is the wavelength present? Are the power levels within acceptable ranges? If you received passing results for both questions, the problem is not with the fiber route. Replace the laser transmitter and verify operation. If either of the tests failed, there is likely a fiber issue and you will need to go to the next step.

2) Use an OTDR to Find the Problem

A DWDM based OTDR, such as the VIAVI T-BERD 2000 or 4000 with 41DWDMx OTDR module, is needed to test through the wavelength-specific components without disrupting other adjacent channels. The OTDR sends a pulse of light through the fiber and traces the fiber route to find a problem. For example, it may show a break in a fiber or a bad mux. It could also show a high loss or high reflection, which means you have a dirty connector. Correct the issues as needed. You can also use a DWDM OTDR to test a wavelength route that is not yet in service.

3) Replace the Mux / Demux, Add / Drop Device or Laser Transmitter

If the OTDR found a problem with a wavelength specific mux or add/drop in the fiber route, replace that component. Note: depending on the component, traffic may need to be re-routed. If no fiber issues are found, replace the laser transmitter and verify operation with the DWDM channel checker.

There is one more important consideration to make with DWDM. DWDM can run over a CWDM network by using the 1531/1551 nm or express port on a CWDM mux. If you come across this situation, you may need to use a combination of DWDM and CWDM OTDRs and channel checkers even though it's running on a CWDM network.

Learn more about DWDM OTDRs. There is also a great OTDR poster that can quickly show you the capabilities of the testers.

Products You'll Use for Testing:

FiberChek Probe Microscope

FiberChek Sidewinder

T-BERD 2000

T-BERD 4000v2

OTDR 4100 Series Modules

DWDM OTDR Module

OCC-55/56 Optical Channel Checker