New Installation and Maintenance Tools for CWDM Networks

Service providers are showing a renewed interest in deploying coarse wavelength division multiplexing (CWDM)-based systems for a variety of applications. Because of its simplicity and lower price points, CWDM is emerging as a technology of choice for metropolitan networks.

Component cost is one of the driving factors for the implementation of CWDM systems and test tools, and procedures must be part of these cost savings.

Installing and upgrading CWDM equipment in the field requires several steps to guarantee correct, error-free system setup when brought into service. Field testing serves as an important component in the installation and upgrade process and must be conducted at several stages during the process.

CWDM Standards and Technical Constraints

Wavelength Allocation

The ITU-T G.694.2 recommendation defines the nominal wavelength grid supporting CWDM systems. Figure 1 shows it as a large wavelength range covering 1271 to 1611 nm with 20 nm spacing.

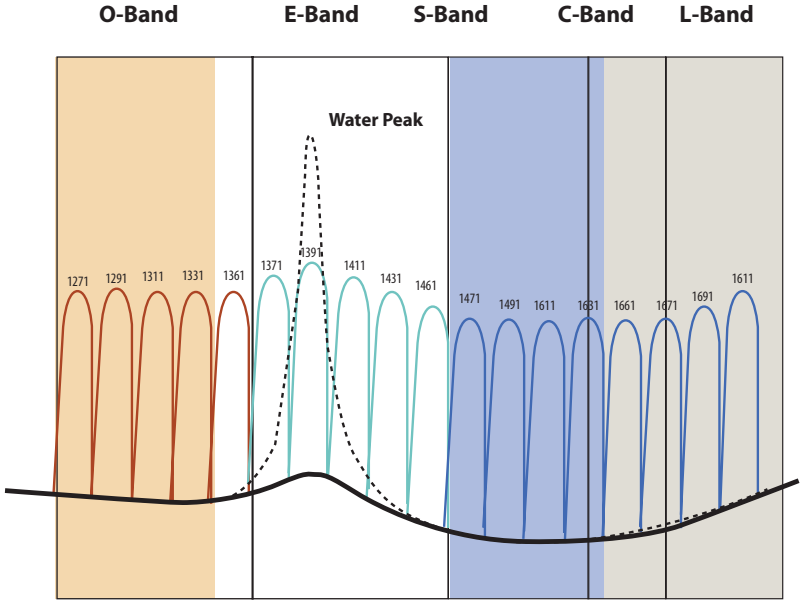

Figure 1. CWDM channel allocation according to ITU-T G.694.2 wavelength grid

Central Wavelength and Drift Tolerance

The lasers used for CWDM systems are directly modulated distributed feedback (DFB) lasers with bit rates of up to 2.5 G. The relaxed specifications in these two key areas represent the dominant cost savings for transmitters: central wavelength accuracy and wavelength drift over system lifetime. Wider spacing with CWDM allows for up to +6.5 nm central wavelength to drift, improving the yield of the lasers while reducing cost.

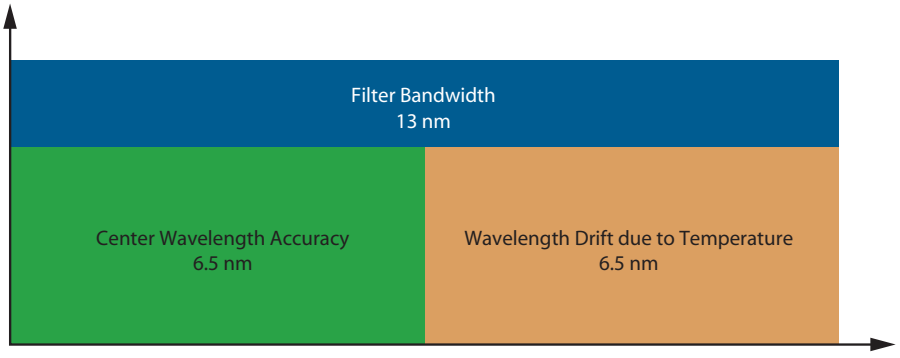

Figure 2 . CWDM laser transmission tolerance according to filter bandwidth specification

Multiplexer and Demultiplexer

Thin-film filter technology is used in both dense wavelength-division multiplexing (DWDM) and CWDM systems. CWDM signals, with 20 nm channel spacing, enable use of filters with fewer technical constraints than DWDM signals, dramatically lowering costs.

CWDM Network Implementation

CWDM systems are primarily deployed as customer premises equipment (CPE) in the metro/access portion of the network. In enterprise networks, CWDM is used for storage area networking applica-tions. In addition to lowering component costs as much as possible, reducing system implementation costs must follow suit. Hence, the CWDM systems must be interoperable between existing transmission systems, minimally constrain the fiber plant, and enable easy maintenance and upgrades. Using high-performance tools typically applicable to DWDM are more expensive and provide capabilities that are unnecessary for CWDM networks.

New Test Tools

As mentioned previously, CWDM was designed to provide a low-cost alternative solution to DWDM systems for implementation in metro and access networks. The new test tools reduce overall capital expense (CapEx) yet provide the same capabilities at lower costs, making them a better-suited solution. They also reduce operating expenses (OpEx) because they require minimal training making them the Go/No-Go point solution.

OCC-55

Large channel spacing and relatively short distances eliminate the need to measure the optical signal-to-noise ratio (OSNR) prior to installing a CWDM system. Also measurement accuracy of the channel wavelength must only be within a few dozen picometers, because of the relaxed laser specifications. Using a full-featured, high-performance optical spectrum analyzer (OSA) provides more capabilities, but at a much higher cost, than needed to turn up a CWDM system.

The new OCC-55 is ideal for CWDM testing prior to installation because it offers full-range optical channel verification according to the CWDM ITU-T G.694.2 grid for wavelength and power level measurements, and at less than three times the cost of a traditional full-featured OSA.

Figure 3. OCC-55 CWDM Optical Channel Checker

- New class of handheld/battery-operated channel analyzer
- Cost-optimized solution
- Easy to use and requires no configuration, saves results directly into internal memory, and displays pass/fail information according to pre-defined CWDM grid (ITU-T G.694)
- Users can transfer results directly using a USB key
- Generate immediate results using a Microsoft Excel-based application

COSA-4055 CWDM Optical Spectrum Analyzer Module for T-BERD®/MTS-2000/-4000 Platforms

The smallest CWDM OSA on the market, this module offers the functionality and speed of an OSA in a handheld form factor at a fraction of the price of a traditional OSA. It is an ideal test tool for service providers to install, maintain, and upgrade metro/access links and CWDM systems. It measures channel wavelengths and power levels and displays the complete spectrum.

Figure 4. JDSU T-BERD/MTS-4000 with COSA-4055 module

- Smallest handheld, fully-functional CWDM OSA available
- Fast scanning speed (4s)
- Zoom and marker functions
- Pass/Fail analysis
- Comprehensive suite of PC software tools for results post-processing including FiberTrace (OFS-100) and FiberCable (OFS-200)

OSA-110M and OSA-110H

Use these tools as second or third maintenance-level testers when conducting in-depth investigations. The OSA test tools are still required for advanced system verification. Meanwhile, unlike DWDM system verification tests, the requested capabilities are more limited than with traditional DWDM OSAs, requiring alternative, reduced specification OSAs.

The JDSU solutions meet these needs perfectly. They perform service verification testing with dedicated performance at a much lower cost and meet the expectations of the CWDM environment.

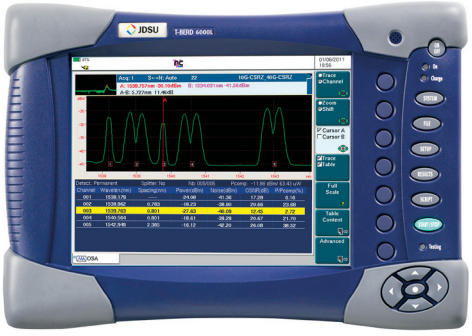

Figure 5. JDSU T-BERD/MTS-6000 with OSA-110M and OSA-110H modules

- Advanced provisioning and maintenance testing of CWDM networks
- Cost-effective CWDM and DWDM testing
- DWDM testing in systems with channel spacing of 50 GHz or higher
- High power measurement option with the OSA-110H

The Right Combination

The OCC-55 is the must-have tool for technicians who install or maintain CWDM networks. It is the most widely deployed handheld instrument for technicians that provides essential information for their daily work.

The OSA-110M and OSA-110H modules are more advanced testing solutions for network engineers and are used for specific/advanced maintenance requirements or when CWDM is combined with DWDM. They are deployed sparingly in dedicated areas, mainly in COs or headends.

Simplified Testing Procedure

Without compromising results, these new test tools reduce network qualification time before installation and minimize technician training before they start conducting tests.

Transmitter Wavelength and Output Power

The channel wavelength measurement can indicate possible wavelength shifts or installation of an incorrect transponder. Using uncooled lasers and CWDM filters with 7 nm bands decreases the need for wavelength accuracy, as long as it remains within range.

Output power is the signal strength delivered from the transmitter module measured in dBm. CWDM networks are not designed for long-distance transmissions and typically are not amplified, so it requires checking the power level measurement at each channel output and comparing it to the desired performance level in the CWDM system specifications.

Measurement specifications:

- Wavelength-measurement range: 1260 to 1625 nm
- Wavelength accuracy: <0.3 nm
- Power-level measurement range: +23 to –65 dBm
- Power-level accuracy: ±0.5 dB

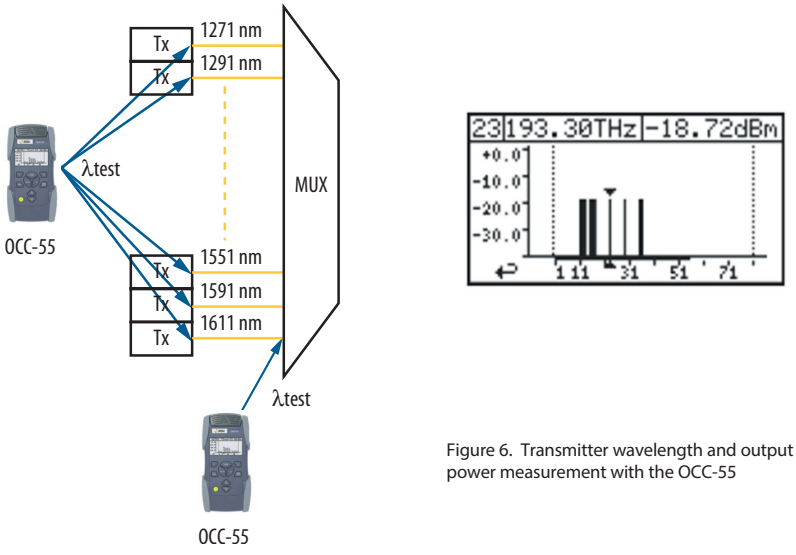

Figure 6. Transmitter wavelength and output power measurement with the OCC-55

Mux/Demux/OADM

When test access points are available at the multiplexer and demultiplexer, technicians can verify that all the transmitted wavelengths have been correctly multiplexed without excess loss on one of the channels. Testing wavelength and power level are mandatory and should only take a few minutes, including product turn-on, configuration, connection, test, and analysis.

Performing a continuity check at the OADM ensures that the right wavelength is routed in the right direction. Technicians can verify a wavelength's presence and its associated power level.

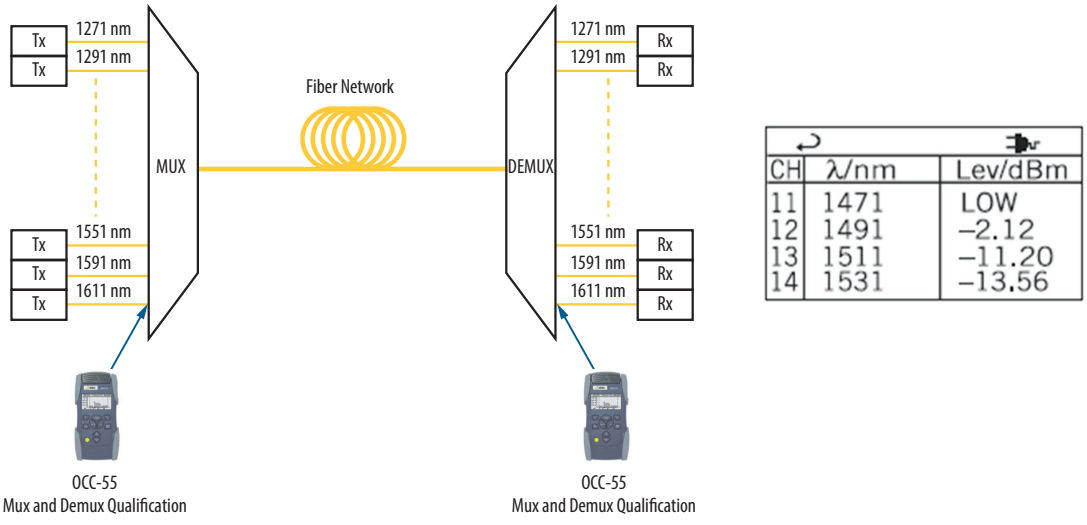

Figure 7. Mux and demux verification with the OCC-55

Receiver Wavelength and Input Power

Verify correct demultiplexing of the wavelength, for example, to ensure that excess loss has not occurred, and that the right channel wavelength arrives at the right receiver at the required power level.

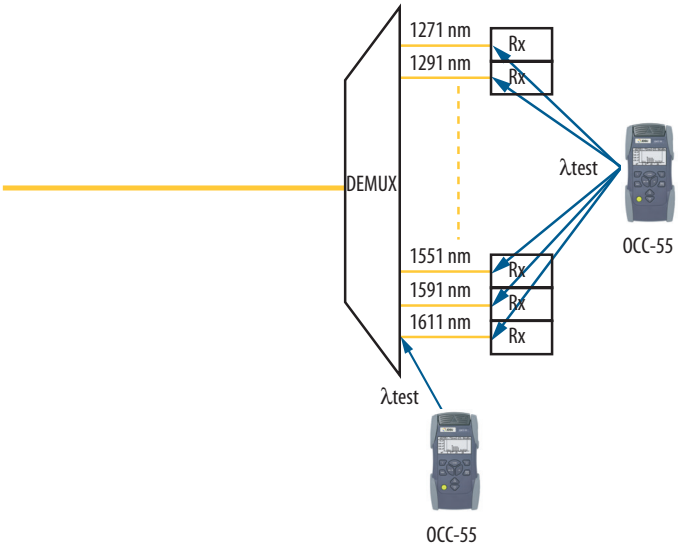

Figure 8. Continuity check and wavelength input power measurement with the OCC-55

Maintaining the Transmission System at Full Operation

The OCC-55 will be the *first on-site* test tool for troubleshooting featuring a pass/fail indicator that provides immediate channel indication according to the ITU-T wavelength grid.

Additional testing capabilities, such as drift analysis over time, requires leaving the OSA-110M plugged in for a dedicated period and scanning repeatedly to gather power or wavelength fluctuations. Remote control capability allows for online access.

For other advanced troubleshooting requiring more precise information, such as verification of multiplexer insertion loss, the OSA-110M and OSA-110H provide the ultimate solution.

Conclusion

JDSU understood early on the cost constraints for CWDM transmission systems and the demand for test solutions that were both easy to deploy and to use. JDSU considered these dilemmas when we developed our new dedicated range of test tools.

The OCC-55 , the COSA 4055, the OSA-110M and OSA-110H modules combine for successfully deploying CWDM systems and for providing effective and efficient maintenance and troubleshooting.

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