Application Note

New Turn-Up and Maintenance Tools for CWDM Networks

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Introduction

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, test tools and procedures must be part of these cost savings.

Installing and upgrading CWDM equipments in the field requires several steps to guarantee that systems are set up correctly and are working error free when brought into service. Field testing serves as an important component in the turn-up and upgrade process and must be conducted at several stages during the process.

CWDM Standards and Technical Constraints

Wavelength Allocation

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.

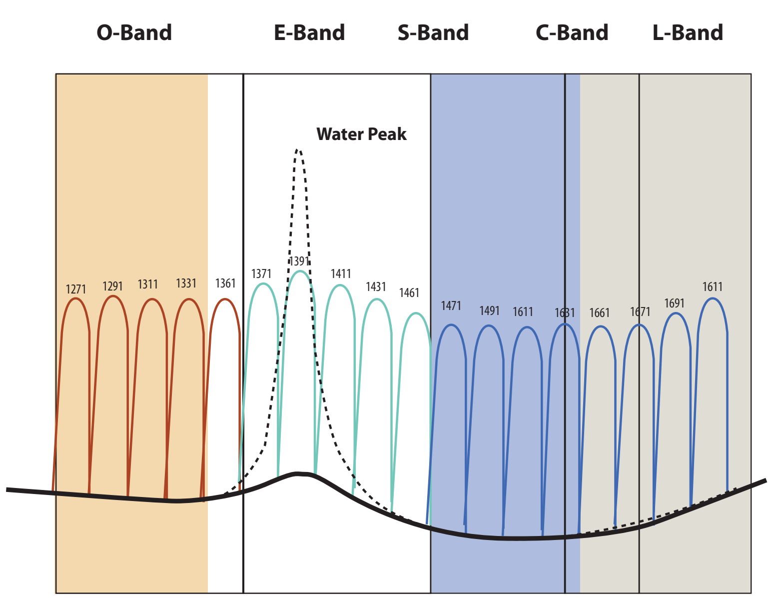

Figure 1 CWDM channel allocation according to ITU-T G.694.2 wavelength grid

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 Gb/s. The relaxed specifications in these two key areas represent the dominant cost savings for transmitters: central wavelength accuracy and wavelength drift over system lifetime. The wider spacing with CWDM allows for a central wavelength to drift by as much as ±6.5 nm, improving the yield of the lasers while reducing cost.

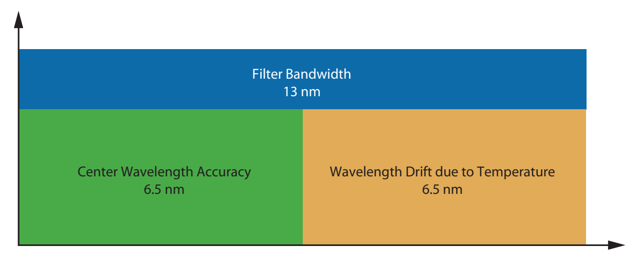

Figure 2 CWDM Laser transmission tolerance according to filter bandwidth specification

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, allow for the use of filters with fewer technical constraints than DWDM signals, lowering costs dramatically.

CWDM Network Implementation

CWDM systems are primarily deployed as customer premises equipment (CPE), or in the metro/access portion of the network. In enterprise networks, CWDM is used for storage area networking applications. In addition to lowering component costs as much as possible, reducing the costs of implementing the system must follow suit. Hence, the CWDM systems must be interoperable between existing transmission systems, bring minimum constraints on the fiber plant, and must be easily maintained and upgraded. Using high performance tools typically applicable to DWDM are less desirable because they are expensive and provide much more capability than is needed for CWDM networks.

New Test Tools

As mentioned previously, CWDM was designed to provide a low-cost alternative solution to DWDM systems when implementing in the Metro and Access network area. The new test tools add to this equation by reducing the overall capex while providing the same capabilities at lower costs making them a better-suited solution. They also reduce operating expenses because they require minimal training making them the Go/No-Go point solution.

OCC-55

Because of the large channel spacing and the relatively short distances, testing for the optical signal-to-noise ratio (OSNR) measurement is not required prior to turning up a CWDM system. Also the channel wavelength measurement accuracy must only be within a few dozen picometers, because of the relaxed laser specifications. Using the full featured, high performance optical spectrum analyzer (OSA) provides more capabilities at a much higher cost point than needed to turn up a CWDM system.

The new OCC-55 is ideal for CWDM testing before turn up. It allows optical channel verification according to the CWDM ITU-T G.694.2 grid over the full wavelength range, providing wavelength and power level measurements. Save more than three times the cost of a traditional full featured OSA.

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, displays Pass/Fail information according to pre-defined CWDM grid (ITU-T G.694)
- Transfer results directly using USB key
- Generate immediate results using Microsoft Excel-based application

OSA-150

Use the OSA-150 as second or third maintenance level tester when conducting in-depth investigations. The OSA test tool is still required for advanced system verification. Meanwhile, unlike DWDM system verification tests, the requested capabilities are more limited than with traditional DWDM OSAs, so alternative and reduced specification OSAs are needed.

The OSA-150 is the JDSU OSA solution that exactly meets the demand for such a tool. It performs service verification testing with dedicated performance at a much lower cost to meet the expectations of the CWDM environment.

JDSU T-BERD/MTS- 8000 with OSA-150 module

- Advanced provisioning and maintenance testing of CWDM networks
- Cost-effective CWDM + DWDM testing
- DWDM testing in systems with ch-spacing of 100 GHz or higher

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 instrument for technicians to carry that provides essential information for their daily work.

OSA-150 is the more advanced testing solution for network engineers and is used for specific/advanced maintenance requirements or when CWDM is combined with DWDM. It is 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 turn-up 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 makes the wavelength accuracy less critical, as long as it is within range.

The 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 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

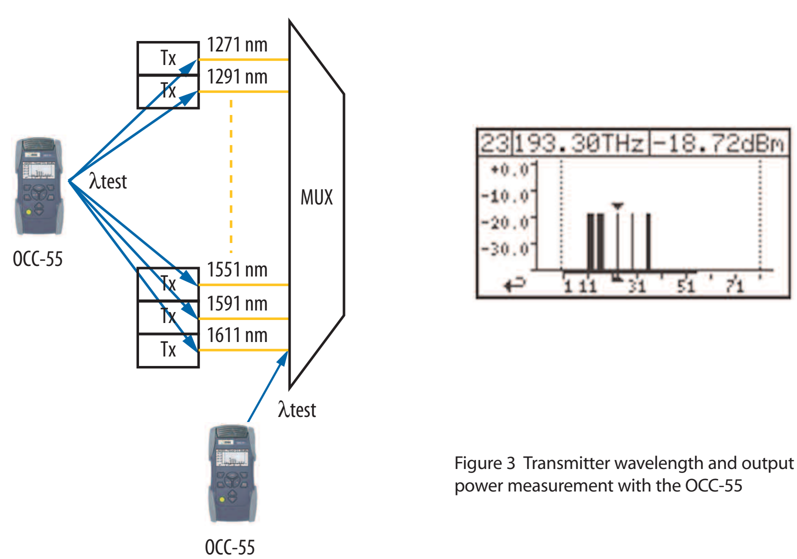

Figure 3 Transmitter wavelength and output power measurement with the OCC-55

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 with no 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 can ensure the right wavelength is routed in the right direction. Technicians can verify a wavelength's presence and its associated power level.

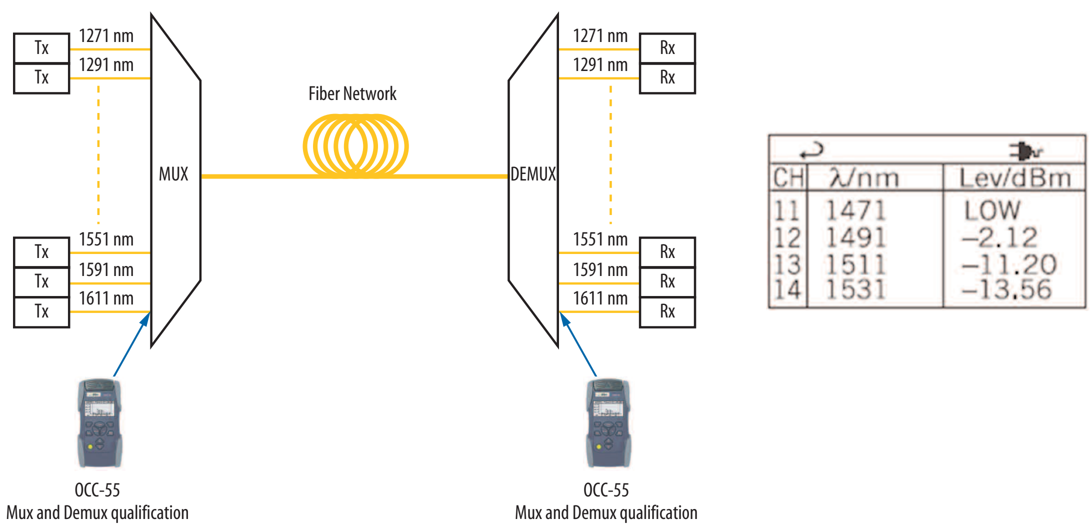

Figure 4 Mux and Demux verification with the OCC-55

Receiver Wavelength and Input Power

Check that the wavelength is correctly demultiplexed, for example, no excess loss occurred, and that the right channel wavelength arrives at the right receiver at the required power level.

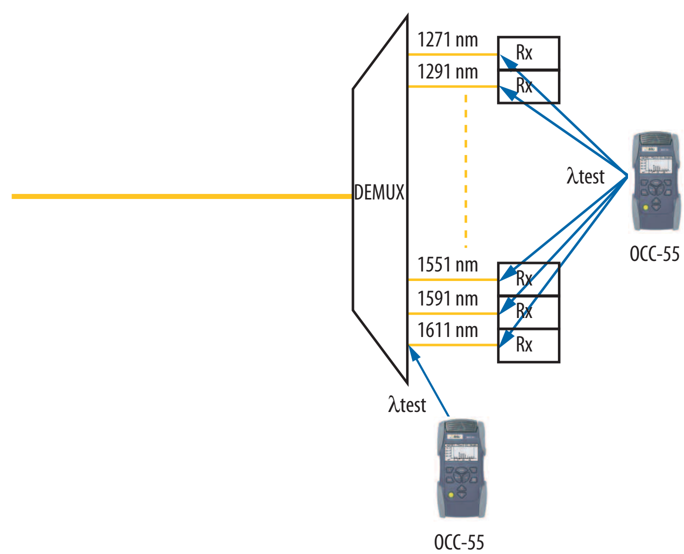

Figure 5 Continuity check and wavelength input power measurement with the OCC-55

Maintaining The Transmission System at Full Operation

The OCC-55 will be the *first-on-site* test tool for troubleshooting. It features a Pass/Fail indicator and provides immediate channel indication according to the ITU-T wavelength grid.

Additional testing capabilities, such as drift analysis over the time, require leaving the OSA-150 plugged in for a dedicated period and performing repetitive scans to gather power or wavelength fluctuations. Remote control capability allows for online access.

For other advanced troubleshooting that requires more precise information, such as Multiplexer Insertion Loss verification, the OSA-150 provides 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 and the new OSA150 combine for successful deployment of CWDM systems and provide effective and efficient use in maintenance and troubleshooting situations.

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