# Advanced Test Equipment Can Shorten TIme To Market For New Fiber Optic Communication Gear

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The recent battering of optical network and related stocks, along with those of other technology companies, belies the underlying fundamentals of the communications industry. In the face of financial turbulence and consolidations, the long-term outlook for optical networking remains positive. Companies such as Marconi, Nova Crystals, Alcatel and others continue to announce capacity expansions for opto devices. These expansions are being coupled with vigorous cost reduction efforts to help bring down component and system prices, which the industry recognizes as a necessity. One manufacturer predicts that prices need to drop by as much as 40% if present growth rates are to be maintained.

Although triple digit growth rates seen by some manufacturers probably will not be repeated, there still is a strong effort to expand fiber optic cable capacity by increasing the use of Dense Wavelength-Division Multiplexed (DWDM) technology. This unique technology is the most economical way to expand bandwidth on existing networks and provide much faster transmission of data, voice and video signals. Because of the high cost of installing new terrestrial and undersea cable, these sectors in particular should continue to provide the impetus for strong growth in DWDM componentry.

## New Technologies in Transmitter Modules

In DWDM transmitter modules, tunable lasers are becoming a hot item. As the number of transmitted channels increases from 16 to 400+ over the next few years, the challenge of developing scaleable cost effective DWDM systems with fixed wavelength lasers will increase. For the laser manufacturer, tunability provides process and yield improvements, since a given chip can be tuned to any one of the ITU-T channels. This eliminates the need to build an inventory of laser diode wafers for each major wavelength. Similar benefits accrue to transmitter module builders as well as network operators

This undoubtedly was a major factor in Nortel's 2000 acquisition of CoreTek, a manufacturer of tunable lasers for 1550nm transmissions. CoreTek uses VCSEL (vertical cavity surface-emitting laser) and MEMs (micro-electromechanical systems) technology in its tunable products. This technology uses tiny movable mirrors to change the wavelength of its semiconductor lasers. Besides its other advantages, such tunability opens up the potential for optical networks to change wavelengths in real time, so traffic can be monitored and re-routed to improve performance.

Non-tunable VCSELs are coming into play for the 1300nm and above transmission window. Nova Crystals, San Jose, CA recently announced availability of a 1310nm VCSEL for WDM networks. Previously, VCSELs operated reliably only at the 850nm wavelength, which limited their use to copper-fiber interfaces for very short haul networks. Since VCSELs are much cheaper to manufacture and test than edge emitting lasers, you can look for manufacturers to begin offering them with higher power outputs and more wavelengths in the 1300 - 1600nm range. These should find applications in optical networks for LAN/WAN/MAN and access environments.

## New Amplifiers and Pump Lasers for Less O-E-O

In 2001, work on the upgrading of network repeaters to higher power optical amplifiers should intensify. This is a crucial step toward all-optical networks. Currently, Optical-Electrical-Optical (O-E-O) regenerators in DWDM systems are a major capital outlay. Optical amplification helps reduce equipment costs, improve network performance, and increase system reliability.

Erbium Doped Fiber Amplifiers (EDFAs) operating at 980nm and 1480nm wavelengths are the current workhorses of optical amplification. Although making ever more powerful EDFAs may not be viable in the long run, there appear to be opportunities for further improvement. Pump laser manufacturers are increasing the drive current and power output of their products while working hard to reduce

production costs. This should extend the life of EDFA applications for a while, particularly in the low loss 1480nm area.

However, sales of Raman amplifiers1 are expected to grow rapidly as higher power pump lasers come on the market this year. In Raman amplification, a continuous-wave (CW) laser signal is launched from the receiver end of the fiber toward the source, turning the full transmission length into an amplifier. These amplifiers, designed to work in both the 1310nm and 1550nm windows with silica-based fiber, offer higher power and lower crosstalk potential than EDFAs. Since Raman amplifiers are installed at the receiver end of a network, they can actually complement EDFAs. When used together, the two types of amplifier do not create a power boost that would cause unacceptable four-wave mixing, a source of crosstalk. Also, Raman ampliers can selectively amplify individual channels carried on a fiber, which is not possible with EDFAs. This allows specific channels to be amplified by an amount that is tailored to the type of fiber used and its channel loss profile.


Keithley's Model 2440 SourceMeter® provides the high current output and measurement resolution needed for testing the latest generation of pump lasers.

For Raman amplifiers that require higher power lasers, instrument manufacturers are introducing new production test equipment. This includes source and measurement instruments with ratings up to 5A, which are needed for the higher drive currents of the latest pump lasers. For instance, Keithley Instruments

recently introduced its Model 2440 SourceMeter(r) with a maximum 50W, 5A output, which can also measure voltages with 1_V resolution, and photodetector dark currents with 100pA resolution. To meet the needs of pump laser manufacturers to increase production test automation and improve yields, Keithley includes a number of enhancements in their SourceMeters, including a built-in comparator that performs pass/fail testing in 500_S, and a source memory list for storing and automatically executing up to 100 test configurations, including custom L-I-V sweeps on laser diodes.

## More Partnering Between Communications and Test OEMs

Telecommunication is quickly evolving along different technology lines - analog, digital, cable, and wireless. Taking aside analog, the same is true of datacom. With all these technologies, fiber optic networks will play a key role in communications. Network manufacturers, and vendors who support them with materials, components and test systems, are now forming alliances to speed up the infusion of new technologies and equipment that improve network bandwidth and reliability. These partnerships are likely to increase, particularly in the test equipment area.

The need for higher accuracy, speed, and functionality from test equipment that occupies less real estate is a major challenge. This requires close cooperation between production test users and the engineers that design and build the measuring instruments. A good example is the testing of Laser Diode Modules (LDMs). LDMs can cost upwards of $15,000 each and are expected to last 30 years or more. So, it is crucial that each component of an LDM operate perfectly before value is added in the progressive assembly toward finished module. However, L-I-V testing of these modules varies with each manufacturer and the types of laser being used. Operation and testing of an LDM involves a delicate balance of measurement, power management, and temperature control to avoid having a $15,000 component go up in smoke. Therefore, every test system

requires a substantial degree of customization to gain the highest throughput while assuring product quality at each stage of production.

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1 Raman amplification occurs as high intensity pump light excites the molecules of a glass fiber "acoustically", which produces "vibrations" that amplify the signal as it passes by.