NetSeminar Q&A for Leading-Edge Techniques for Testing Advanced Optical Components (May 7, 2002)

The following questions pertain to the Agilent 40G Industry Buzz:

Q: The polling question was: In 40G systems, CD and PMD issues are: a) easily solvable using today's methods, b) solvable but require next generation components and measurement techniques, or c) very difficult, requiring a breakthrough?

A: The results of the viewer poll are: a) 0%, b) 78%, c) 21%. I think that's what we would expect. It matches the discussion we had here today that these are solvable, but we really do need these next generation components and measurement techniques.

The following questions pertain toward Testing Advanced Optical Components:

Q: Can you give an example on Interferometry out of daily life?

A: Taken as an example, maybe the interference of an oil film on water. In this case the oil film acts like a multi-path interferometer. There are multiple back and forth reflections which support just a single wavelength for so-called constructive interference. This gives rise to the colorful impression we see from an oil film on water when illuminated by sunlight.

Q: What are the advantages or disadvantages of combining a TLS and OSA for narrow band component testing?

A: The advantages of combining a tunable laser source (TLS) and optical spectrum analyzer (OSA) are that you can perform fast measurements, you can make use of the optical spectrum analyzer graphical user interface, and that it provides high dynamic range. We have seen during the presentation that this is very important when testing optical components, especially filters.

There are some disadvantages to this approach. First, there are problems with the synchronization of a tunable laser source, a spectrum analyzer and swept length measurements. Second, an OSA has only one or two ports, so it's not really suitable for multi-channel applications. Plus OSAs are typically resolution bandwidth limited. The tunable laser source and power meter approach is a more generic approach that fits many more applications than a tunable laser source and optical spectrum analyzers.

Q: Can you explain Swept Homodyne Interferometry (SHI) in simple terms?

A: In interferometries, the light is divided into so-called reference and signal paths, so we are comparing phases of lightwaves and then we check for constructive add-on of destructive interference. Swept Homodyne Interferometry (SHI) is an interferometer where the wavelength is tuned over wavelength. As the phase relationship changes with wavelength, for example by the device under test, so does the intensity of the resulting interference pattern. These interference fringes contain the device, the phase information, and the dispersion information on the device under test. Basically the physics behind it is very similar to the oil film on water analogy.

Q: When do you measure GD and what when do you measure DGD?

A: Group Delay (GD) is maybe the first parameter that you have to take care of if you are moving towards high speed data networks. At 10G, you are required to typically control and measure group delay. In many cases you can control and manage group delay of chromatic dispersion using special compensators or dispersion compensating fibers, but if you are moving to higher speeds, the margins become more narrow, so you have to take into account polarization effects as well.

We discussed the analogy between loss and PDL. When you move to 40G systems, Differential Group Delay (DGD) becomes a major issue in addition to group delay. When you move to higher speeds, you have to take care of all parameters, that is spectral loss, PDL, group delay for 10G, and DGD for 40G.

Q: What trend can be expected to emerge earlier, 25 GHz channel spacing or 40G bit rate?

A: We expect that 25 GHz channel spacing will emerge earlier than 40G and will be deployed in 2003. Most likely, 40G systems will not be deployed before 2004, and then first in very short reach networks, then metro, then long haul. This is related to the impairments due to dispersion effects in high-speed transmission networks. There are a lot of problems still to be solved as the viewer's poll indicated. With 25 GHz channel spacing, the objective is to use the current 10G and EDFA type long haul systems we have today, but to get the capacity that you may see in 40G systems.

Q: What are some examples of devices that would require all-parameter testing instead of just loss?

A: Basically all components that will be deployed in 40G systems or in networks that use narrow channel spacing must be tested for loss and dispersion. Some examples are fiber Bragg gratings that are used for multiplexers, for instance, waveguide gratings, so basically pass for optical components, narrow band components, but also systems, optical fibers and optical amplifiers.

Q: What is Intersymbol Interference?

A: Basically intersymbol interference (ISI) is the effect that occurs when two optical pulses overlap. We have seen that an optical pulse can spread out due to dispersion. If two pulses or two consecutive pulses overlap, they cannot be distinguished from each other. The consequence is that information is lost, which is expressed in increased bit error rate. This effect is called intersymbol interference.

Q: Is a swept measurement the same as stepping through the wavelengths?

A: No, it's not. In step measurements the laser steps from one wavelength to another, with the laser settling at each wavelength. In swept measurements the laser does not stop, it is sweeping continuously across the wavelength range without stopping and settling at certain wavelength points. The advantage of swept measurements is that they are performed much faster than stepped ones. There is a real difference between step measurements and swept measurements. I think state-of-the-art today for component testing is swept measurements.

Q: Do you provide multi-channel all-parameter testing?

A: The all-parameter test solution is part of the Agilent Lightwave Measurement System. It has a modular concept so that you can combine different modules to provide a lot of flexibility. The multi-channel loss measurements are a capability of this lightwave measurement platform. Multi-channel all-parameter tests will definitely come in the future.

Q: What challenges to integration do actives and passives pose to such measurements?

A: The challenge is that you need to combine testing capabilities for passive components with the testing capabilities testing active components. For instance, planar waveguide integrated with SOAs, or something like that. It is really important to have combined test solutions measuring the loss properties of the passive components there and even filter components and the amplifier features.

Q: Does the all-parameter analyzer always measure all parameters or can one change the test content?

A: The test content as well as the parameters can be individually set through the specific test needs. For example, if one wishes to measure only in transmission, you can do so. Or you can choose to only measure loss and PDL or loss and group delay. It is not required to measure all parameters at all times. The important point here is that the all-parameter analyzer provides this capability, and the user can select whatever he wants to measure.

Q: Is there a book or handout to study all these terms presented today?

A: Please review the eSeminar "Dispersion Measurement Challenges for the Next Generation 40Gb/s Optical Network" held on March 5, 2002. That presentations describes these topics in much greater detail, such as what is behind the phenomenon like group delay or DGD. You can access it via http://www.netseminar.com/index.cgi?sem_num=584

Q: Are there any industry standards on testing like this?

A: There are standards developed by Telcordia, IEC, TIA or others that define how to test optical components, how to perform certain types of measurements, and how to test DWDM components. For optical component

qualification, Telcordia is the main source of standard publications, such as the GR1209-Core or the GR1221-Core. For standards on how to perform certain tests, IEC and TIA have released several publications. Please refer to the websites of these organizations for further information on standards for optical component testing.

Q: Can I get a copy of the presentation?

A: Yes, go to slide 68 of the eSeminar archive. From there you can get a copy of the presentation plus find many valuable links for more information on the subject. There is also a 40G discussion forum link (http://www.agilent.com/find/forums) if you would like to pose/review other questions.