High Speed Coherent Component and Systems Test

Submitted by Keysight Technologies

Historically, intensity modulation and direct detection have been used in optical communications to transmit information. This scheme is still used for short reach applications; however, the spectral efficiency and data rate is very limited. For example, a 100 Gbps signal using an intensity modulation scheme requires either very large bandwidth components or parallel transmission of several lower speed signals.

To support the high data rates required by today's applications, modern communications systems must provide capabilities beyond traditional intensity modulation and direct detection schemes. Increasing demand for bandwidth has pushed the telecom industry to use coherent transmission techniques. Coherent data transmission takes advantage of amplitude, phase and polarization characteristics of light to enable transmission rates of 200 Gbps and more by transmitting complex symbols, each carrying multiple bits of information.

In addition to speed, small size and low power consumption are key requirements for the circuit design. To address these needs, new integrated analog coherent optics modules (ACOs) and digital coherent optics modules (DCOs) have been developed and are being used in many network systems. The modules feature integrated abilities for both transmission and reception in a standardized pluggable module and include these sub systems:

- Narrow linewidth laser source,
- Polarization-multiplexed IQ modulator (PMQ), and
- Intradyne coherent receiver (ICR)

An implementation agreement for an integrated component containing all those sub-systems is currently being developed within the optical internetworking forum (OIF) and is called IC-TROSA (Integrated Coherent Transmitter-Receiver Optical Subassembly).

Any coherent transceiver requires a digital signal processor (DSP) to code and decode the coherent signal. Specifications for the interface between the coherent optical devices (or the ACO module) and the DSP are critical for achieving error-free data transmission. The difference between the ACO and DCO concept is that for DCOs, there is a permanent connection between the coherent optical devices and the DSP, while for ACO, there is a pluggable interface between coherent optical devices and the DSP.

Finding alignment on the interface specifications between the coherent optical devices and the DSP is a challenging task that requires a lot of testing. These tests are comprised of device characterizations as well as system performance measurements. Testing coherent optical transmit devices or assemblies requires stimulating electrical signals, generated using a high-speed arbitrary waveform generator and suitable software. The resulting optical output signal is received and analyzed using an optical modulation analyzer (OMA). For the receive side coherent optical devices or assemblies, an optical stimulus, which can either be a reference signal or an unmodulated tunable laser, and a high-speed digitizer with the same analyzing functions as the

OMA is needed. Performing automated tests with the same set of equipment without intermediate reconnections saves time and ensures repeatable results. The Keysight M8290A Optical modulation analyzer High-speed digitizer test solution is an example of integrated hardware and software optimized to perform coherent optical device test.

Watch this video for details on high speed coherent component and systems test