Agilent Technologies

Why LED is the preferred light source for multimode fiber attenuation measurement?

Multimode fiber gives the best combination of low system cost and higher cable lengths for enterprise network designers. It is increasingly common to use 850nm VCSEL light source for Gigabit Ethernet network communication over the fiber. Accurate testing of the attenuation performance of the fiber links is critically important for ensuring network performance, and eliminating costly system downtime after the deployment.
Multimode fiber test standards like TIA-TSB-140 specify the use of LED as a light source for test instrument, even when the final deployment is VCSEL ("The advantage of using the overfilled LED source to test multimode fiber is that the same light source or OLTS can be used to test either 62.5 μm or 50 μm fiber links …").
This paper describes why the test instrument using LED as a light source provides a better representation of the multimode fiber performance than the one using VCSEL.

Coverage of Fiber Cross-section

The optical signal launched in a MM fiber by a Laser is mostly confined to the center of the fiber core, whereas the signal launched by an LED spans a large cross-section (see Fig 1). In other words, an LED excites a larger number of higher order modes of optical propagation as compared to VCSEL. This extended set of higher order modes as launched with an LED allows the entire fiber core to be tested. Any defects in any part of the fiber core and core-cladding interface will be reliably uncovered. These defects, if not noticed, can result in sharp degradation of fiber performance due to slight misalignment of connectors[1]. Another advantage of LED is in testing of multimode fibers with different core diameters (50μm and 62.5μm). In this case, the larger modal structure of the LED makes the instrument using LED as a light source suitable for testing fibers with different core diameters.

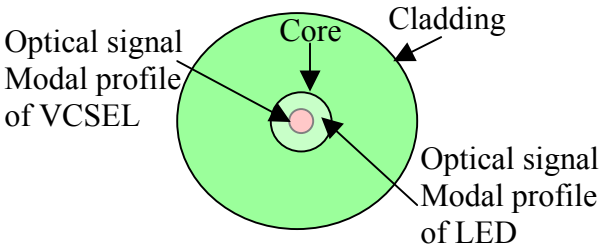

Fig 1: The optical signal from LED covers larger part of the fiber cross-section during the test, uncovering fiber formation defects

Repeatability and Reliability

The modal profile of the optical signal launched by a VCSEL, with highly focused light beam, varies along the fiber length. This variation is not only defined by the fiber construction, but also by the cable layout plan. A bend, for example, can drastically change the modal profile of the optical signal propagating in the fiber and as such influence the measured attenuation.

[1] It should be noted here that an LED might also excite lossy cladding modes of propagation. This may result in a conservative measurement of attenuation. It is a standards recommended practice to use a mandrel wrap in the reference measurement as a 'cladding modes filter' to eliminate the effect of these modes from the final measurement.

Furthermore, cable interconnections might introduce modal noise, which in turn can disturb the measurements. The LED, with its larger modal content, effectively aggregates these modal profile variations and gives a highly repeatable and hence reliable test result.

Wavelength Range

Fiber data links allow lasers with various wavelengths to be utilized. For instance, the Fiber Channel physical interface specification (200-M5-SN-I) lists a wavelength range of 830nm to 860nm for a data signaling rate of 2125Mbaud. Using an LED light source allows a fiber to be tested across a wide wavelength range as compared to VCSEL source (see Fig. 2)

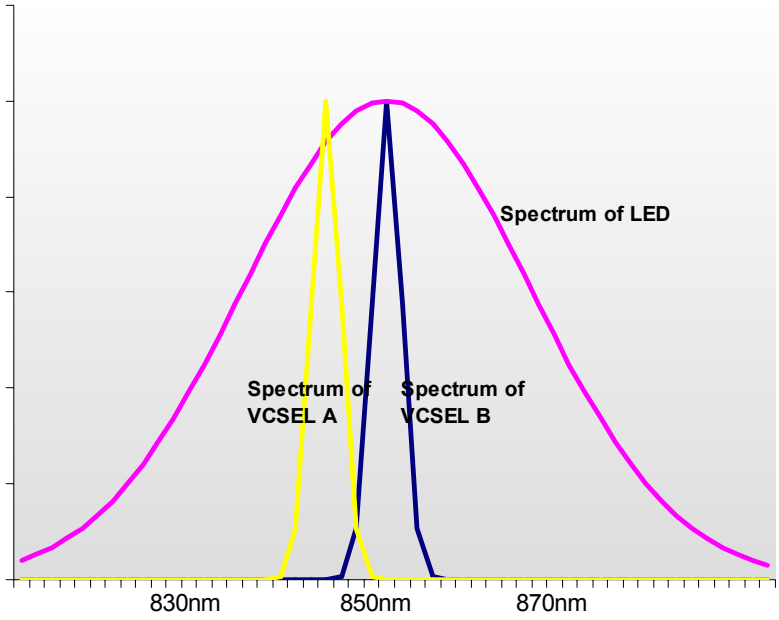

Fig 2: The spectrum of a VCSEL is narrow and different devices may have slight offset in the central wavelength. The spectrum of an LED, on the other hand, is much broader.

Summary

Using the LED as a light source for measuring attenuation in multimode fiber links allows irregularities in the fiber structure and optical properties to be detected that might go unnoticed when a Laser light source is utilized. It is because of these considerations that MM fiber vendors use LED based test instruments to perform lab tests on the fiber.

FrameScope 350 fiber kits

Agilent Technologies' FrameScope 350 is an all-in-one field test instrument specially designed to address the testing requirements during installation and commissioning of networking infrastructure. The instrument includes a level III compliant copper cable certification testing, multimode and singlemode fiber certification testing, and complete network performance monitoring; all in an easy to use handheld instrument.

The fiber adapters for FrameScope 350 ideally suit the measurement requirements with low cost attachment to this handheld battery operated tester unit. The fiber test adapters, or Fiber Smart Probe+, use Laser for testing single mode fiber and LED for testing multimode fiber.