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# Small, Rugged and Secure: The Challenges of Connector Design for Covert LIDAR Applications

*BY SCOTT UNZEN*

**Scott Unzen, Director of Marketing at Omnetics, talks to Soldier Mod about the advantages of LIDAR in a world where 'application specific' systems are key.**

Military environments are notoriously unpredictable, constantly presenting new challenges in both the short-term and long-term. These changing challenges are the root cause for the constant evolution of military technologies across the board. In the world of connectors and cable systems, this means the need for design and adaptation to new formats needed to keep pace with these technologies. It's a world of 'application specific' systems, with those that meet the needs of changing situations most readily and efficiently the ones that lead the way.

That need to adapt is at the heart of what Omnetics does, using its 30 years of experience in world-class miniature connector design to produce connectors including micro-miniature and non-miniature options to ensure they provide the right capability for the right application. This includes connectors for Portable Military and High density LIDAR (Light Detection and Ranging) Systems – remote sensing technology that uses pulsed laser light from a transmitter to measure distances to a target item or area of interest. LIDAR brings a range of benefits in the field, from its speed - a million times faster than sonar - and ability to focus on one specific object, to its lower frequency that provides lower focal capabilities and detection limits.

## The Shift to LIDAR

"A LIDAR system simply includes a laser, a scanner, and an electronic reference such as the soldier's current position and/or a reference to a GPS receiver. A key advantage over general optical scopes and older laser detectors is accuracy and the ability to see through masking items such as leaves, trees and even camouflaged netting. LIDAR systems can feature high spatial resolution, because of the small focus diameter of the beam and benefits from a higher pulse repetition rate," explains Unzen. "Military drones and the larger UAVs employ LIDAR 14 to site, collect and transmit data back to a command station. Some items under surveillance are in motion and tracking electronics can be added to LIDAR systems similar to the older radar Gun-Fire-Control electronics." In addition to LIDAR pulse and firing control systems, modern systems have the capability to add display monitors and data processing computers. However, despite additional applications and usage possibilities, portability and ruggedness remain key concerns. This means the need for integration of applications, surveillance data and intelligence, says Unzen. For LIDAR instrument packs, this means a requirement for high density connectors within circuit boards, as well as small and flexible cable routing to various signals, power and display data from module to module. "The connectors must be small, rugged and easily connected while in the field," explains Unzen. On top of this, any alignment of connectors needs to take into account the fact that soldiers often use gloves in a battlespace environment. Other application-specific elements include an ability to remain secure despite shock, vibration and environmental extremes, as well as plating connectors black to avoid light reflections and detection in covert surveillance settings."

## Designing for LIDAR

When it comes to creating application-specific systems for LIDAR, the first considerations are light frequency and application. By defining which of these provide the best data, it is then possible to decide which cables and connectors are most appropriate. "Wavelengths most often include applications from the infrared frequencies through the visible light range and beyond," explains Unzen. "Board designs using higher frequencies and shorter wavelength systems will need to include coaxial cable in some portions. When lightweight and portability is required, Nano-coax systems may be the best choice. Size and weight is low but the key elements of microwave signal control are easily obtained. Nano-coax systems should be fully tested with board launch mechanisms designed to capture the very X-es processor high speed Nano Connectors Gigahertz signals passing through. Pre-tested board modules are best for performance and protocol management. To avoid problems in the field of service, tightly locked and mated Nano-coax is critical. Many button type coax exist for up to 2 to 3 gigahertz, but rarely survive active travel on military vehicles."

Another factor to consider is the ability to carry large amounts of data - especially in the command or base stations that portable surveillance systems communicate with in the field. "These base stations, as well as those in satellites, must also be able to handle the new signal volume and retain signal integrity of the mass amount of data produced by LIDAR systems," says Unzen. This need has led to the development of connectorised single unit processing systems that are designed and built to fit into large modular stations whilst remaining compact, rugged and intact in the field.

These same factors of ruggedness, low weight and size are paramount when it comes to designing for the satellites that LIDAR systems rely on. LIDAR's multispectral light systems, including infrared, overlaid on visual or higher frequency spectrum lights, can identify target images even through obstacles such as forest canopies and even track them as they move. Combining this capability with GPS data, these systems can map direction, rate of travel and even possible destination. Again, cable and connector design is critical, with continuous signal integrity - even in the face of high shock or vibration - vital and often reliant on good mounting methods. "Often the cable must be exceptionally flexible, but also shielded to protect from electro-motive interference, (EMI)," says Unzen.

On top of this, interconnect systems in space systems are required to use materials that follow NASA specifications for 'outgassing' - the escape of unwanted gas caused by fluctuations in temperature during orbit, which can destroy silicone chips in their system. While many commercial connectors are rarely exposed to these conditions and offer good performance on earth, specialist application-specific products are needed for space systems and satellite applications.

## A Need for Adaptation

The evolution of military technologies means connector and cable systems are rapidly designed and often adapted to new formats needed, with LIDAR a strong example of why this is so important. That doesn't mean designers should ignore commercial off-the-shelf (COTS) and standard connectors, says Unzen - in fact, quite the opposite as they can be easily converted to meet new performance needs.

"Signals are changing from digital to analogue, circuit speeds are ramping above 2Gbps and on beyond 10Gbps. Photon signal management is enhancing performance and protects from cyber intrusion," he observes. "Today's connector designer can change to meet that need. Most connector designs are institutionalized inside computers, most materials and processing methods exist and solid modeling are used to offer quick adaptations to meet new technologies. Connectors and cable are smaller as circuit chips run on lower voltage and use less current and we all feel the push for smaller, rugged, and portable. Rapid design and design adjustments are here and are undertaken every day. We are living in an era of 'application specific' connector and cable systems, in the leading edge of our military and high-tech industry. I predict it will become standard throughout the industry as other segments see how easy it is."

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