

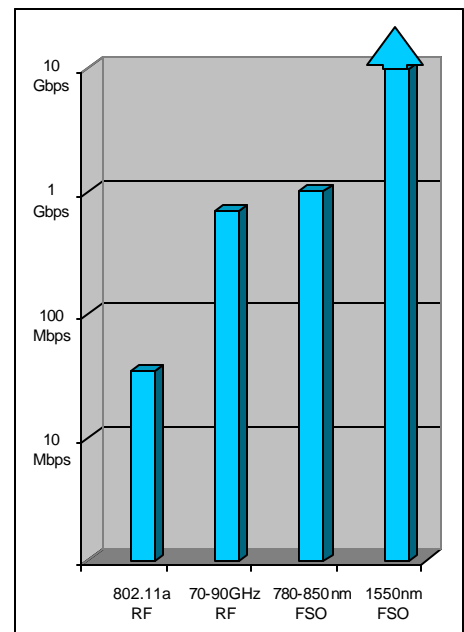
## Application Note – 1550nm Transmission for Military Applications

*A general scan of the current free-space optics (FSO) market shows that FSO products are conspicuously divided into two categories when it comes to transmission wavelength: 780-850nm and 1550nm. Both categories are considered “near-infrared” and are invisible to the naked eye. Both have similar light attenuation properties when propagating through the atmosphere. So what’s the difference? Plenty. A closer look at the situation reveals that 1550nm transmission has some significant advantages, especially for military applications.*

### The Growing Trend in Technology

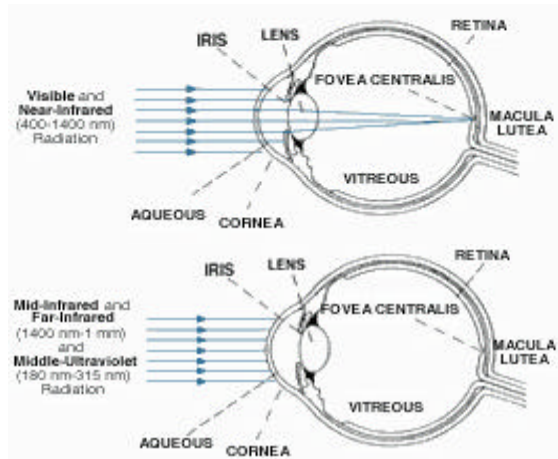
From the same scan of the market it is immediately obvious that the large majority of FSO products in fact fall into the 780-850nm category. This is understandable because, historically, efficient and reliable direct semiconductor diode-based sources have been more available in those wavelengths. Moreover, much of the technology used in the compact disc industry uses 780nm lasers, which offers a certain amount of cost savings as well.

However, *for almost a decade now the telecommunications industry has been steadily shifting the situation in favor of 1550nm technology.* Since this is the wavelength most commonly specified for terrestrial fiber-based optical communications, the supporting technical infrastructure for 1550nm (such as a wide selection of passive components, signal generators, practical optical amplifiers, and photodetectors) is vast and growing rapidly every year. Also, the intense cost competition that characterizes the fiber communications industry ensures that 1550nm-based systems will always be able to access new cost-effective technologies offering improved performance.



For example, 1550nm diode lasers are now widely available that can operate at 2.5 Gbps, with devices capable of 10 Gbps operation also beginning to appear. By contrast, the highest data rate possible with commercial 785nm diode lasers is ~ 1 Gbps. Moreover, the wide availability of WDM components for 1550nm systems opens up a straightforward approach for scaling to higher throughputs, while using standard commercial components. Such components are not readily available for devices in the 780 to 850nm spectral range. Consequently, *1550nm technology paves the way for higher-bandwidth communication and the latest state-of-the-art in voice, video, and data applications for all phases of military operation.*

## Eye-Safety Advantages of 1550nm



The maximum amount of power that an FSO system can transmit is limited by the requirement to remain eye-safe. That is, the system should not launch so much laser power that it becomes hazardous to the human eye. This requirement must be met regardless of the transmission wavelength being used. However, different wavelengths have different effects on the eye. Shorter wavelength 780-850nm light, being closer to the visible part of the spectrum, passes easily through the eye's lens and is focused onto the retina. Too much power causes damage to the retina. 1550nm light, however, is largely absorbed by the cornea and lens before it gets focused onto the retina. Consequently, the power can be increased to 50 times greater intensity before risking damage to the eye, as per international eye-safety standards.

Higher power levels translate directly into longer ranges for FSO links, or similarly into greater availability at the same range. *The end result for a 1550nm system is a higher-performance system that poses no safety hazard to the human eye.*

## Visibility on the Battlefield

FSO transmission is inherently secure compared to other wireless technologies because the width of the transmitted beam is extremely narrow (they are sometimes referred to as "pencil beams"). But this security can be compromised if the beam itself can be seen by the enemy. In fact, *780-850nm light is readily detected by standard night-vision equipment.* As the light reflects off of mist or dust in the air, the very lines of communication so critical to command and control operations can be exposed to the enemy's night-vision, making them much more vulnerable to interception.

Similarly, the transmitted light that overflows around the receiver can conceivably reflect off other objects (e.g. buildings, other communication equipment...), exposing those object to enemy night-vision as well. Planes flying overhead using night-vision could potentially confuse friendly equipment with enemy targets.

By contrast, *1550nm transmission is completely invisible to standard night-vision equipment,* maintaining the maximum level of security on the battlefield and in foreign territory.

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