

Free-Space and Undersea Narrow-Beam Optical Communications Networking

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Free space optical (FSO) communications can deliver extremely high-bandwidth communications links with low-SWaP terminals. However, the links require line-of-sight, are degraded or denied by adverse weather, and the terminals are often more expensive than high-bandwidth radios. The comparative advantages of FSO are compelling (and in need of additional research) in the following areas

1. High altitude and space communications. Weather does not affect the communications, and the low SWaP enables long-range, long-living links. The primary barrier to use is the high cost of the precision gimbals used as beam directors. Low cost beam directors and compact (or integrated) photonics for the transmitter and receiver are important research areas.
2. Ad-hoc high-volume backhaul. In many situation high-bandwidth inter-network links are needed, but fiber is not an option. This encompasses disaster areas where temporary command centers need internet connection but the fiber infrastructure is damages, as well as forward expeditionary forces (civilian exploration or military) where there is no infrastructure. Research areas include low cost beam directors, networking protocols, and packaging to simplify deployment and interfaces with local networks.
3. Undersea communications. Optical bands (specifically blue and green light) are the only modality for high-bandwidth wireless communication in water (acoustics is intrinsically low bandwidth, radio frequencies have extremely high attenuation). This approach allows contact-less high-volume data transfer between platforms (e.g. transfer of sonar mapping data). Additionally, optics is the only method for moderate-to-high data rates that can bridge the air-water interface. Research areas include adapting FSO techniques using telecom bands and technology to the available components in visible light, and developing methods to more efficiently couple light between platforms above and below the air-water interface.

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