Laser Communications

ONR Program Code 30, 31 — August 2008

At a Glance

What is it?

- Laser communications (Lasercomm), also referred to as free space optical (FSO) communications, can provide very high bandwidths under stressed tactical military situations.

How does it work?

- Two modes of Lasercomm--the 'direct mode' and the 'retro-reflector mode'-- are of interest for communications between land, surface (water) and airborne nodes. The direct mode, between two symmetrical Lasecomm transceiver terminals, offers very high bandwidth. The retro-reflector mode has very little power requirements and is unburdened by active pointing/tracking.

What will it accomplish?

- Multiple military missions have one common thread--ubiquitous connectivity, so commanders, both at the strategic, as well as the tactical level can take quick and correct decisions closing the loop between sensors and the shooters. The combat and mission effectiveness is reliant on high data rate communications under stressed conditions, which can be accomplished by Lasercomm.

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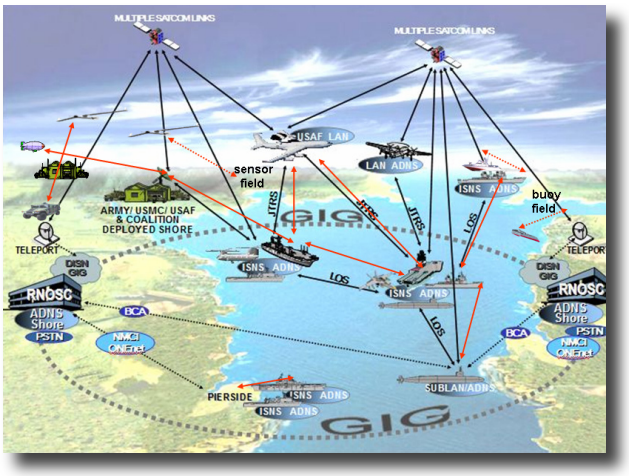

The Office of Naval Research's (ONR) Lasercomm program began in FY 2004 with an effort to quantify the propagation of optical beams through the maritime atmosphere. As part of this research, new devices and systems were developed to accomplish very high bandwidth free space optical data links over several tens of nautical miles (nm). The research culminated in the 2006 Trident Warrior demonstration of 300 Mbps live video transfer between two moving ships 9 nm apart, as well as a 2007 Sea Hawk demo of 600 Mbps very high resolution imagery transport between two land nodes over the San Diego bay. An enabling capability program is planned in the near future.

The ONR program is currently looking at technologies that mitigate laser beam breakup and wavefront distortion through index-of-refraction turbulence:

- *Wavefront distortion corrections using adaptive optics*
- *Aperture averaging via large area low noise detectors and pixel switching techniques*
- *Time diversity including forward error correction and automatic repeat request*
- *Network route diversity*

Program challenges include: accurate pointing, acquisition and tracking between tactical mobile platforms with unique vibration dynamics, and velocity/acceleration profile including those caused by rough sea states or uneven terrain, and, possibly aero-optics effects.

The primary warfighter payoff will be a reduced kill chain for missions due to high bandwidth information transfer, including scenarios where anti-jam and low-intercept operation may be required, and/or where SATCOM access is denied, or when RF spectrum is unavailable as in foreign locations. A side benefit is low size, weight, power and cost when compared to equivalent RF systems – especially in the use of retro-reflector mode for asymmetric data transfer (hockey puck sized data exfiltrators on small platforms/sensors using minimum wall-plug power).

Research Challenges and Opportunities

- *Mitigating atmospheric scintillation and turbulence*
- *Minimizing pointing and tracking inaccuracies for mobile platforms*
- *Overcoming degradations from clouds, aerosols and bad weather*

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