Optical Wireless Sensor-to-Warfighter Video Link

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NSWC Crane

ELECTRO-OPTIC (EO) TECHNOLOGY DIVISION

- Airborne EO Systems
- Surface EO Systems
- EO Displays and Peripherals
- EO Systems Integration
- Special Missions EO Systems
- Security Sensors
- Laser Systems
- Visual Augmentation Systems
- EO Multi Sensors
- Special Projects Branch

Situational Awareness Problem

1) **Firing from exposed position.**
2) **One man with true SA.**

http://thetension.blogspot.com/2007/03/combat-camera-soldiers-maneuver.html
U.S. Army Pfc. far left, lays down cover fire as his squad prepares to maneuver down a street during a patrol. U.S. Army photo by Staff Sgt. Sean A. Foley

Solution

1) **Indirect relay of rifle scope image to user**
   - 'CornerShot' or periscope rifle (specialty weapon)
   - Video cable to head-mounted display possible.
   - Wireless transmission of scope image?

2) **Distribute video**
   - Other Squad HMDs
   - Recording device.

Image from video posed to YouTube by 'Funker530'
http://www.youtube.com/watch?v=uZ2SWWDt8Wg&feature=plcp&context=C49c163aVDvjVQa1PpcFO6NWgkASaiMkfj1uk_lr4ShFADjEAQahM%3D

Wireless Data Link Technologies

Optical

- Ready Technology
- No EMCON restrictions
- No ordinance interference
- Intercept / Interference unlikely
- Encryption possible
- Likely line-of-sight

RF

- Mature technology
- EMCON (Emissions Control) restricted
- HERO (Hazards of Electromagnetic Radiation to Ordinance) restrictions
- Intercept / Interference
- Computationally intensive encryption required
- Non line-of-sight

Other Technologies

• Tethered Video Cable	High bandwidth, Low maneuverability
• Ultrasonic Communications	Low bandwidth, Non line-of-sight
• Magnetic Induction	High power, Limited range, Non line-of-sight

Optical Communications

Laser Comms:

Long Range	miles +
High Bandwidth	10's of Gbps
Highly Directional	
High Power	Watts

- Commercially available, e.g. cellular backhaul

- Government Implementations: NRL Lasercomm Test Facility

  Moore et al., *Overview of NRL's maritime laser communication test facility*, Proc. of SPIE, **5892**, 2005

Range:	32 km path
Bandwidth:	< 2.5 Gbps
High Power:	5 Watts

LED Comms (light emitting diode):

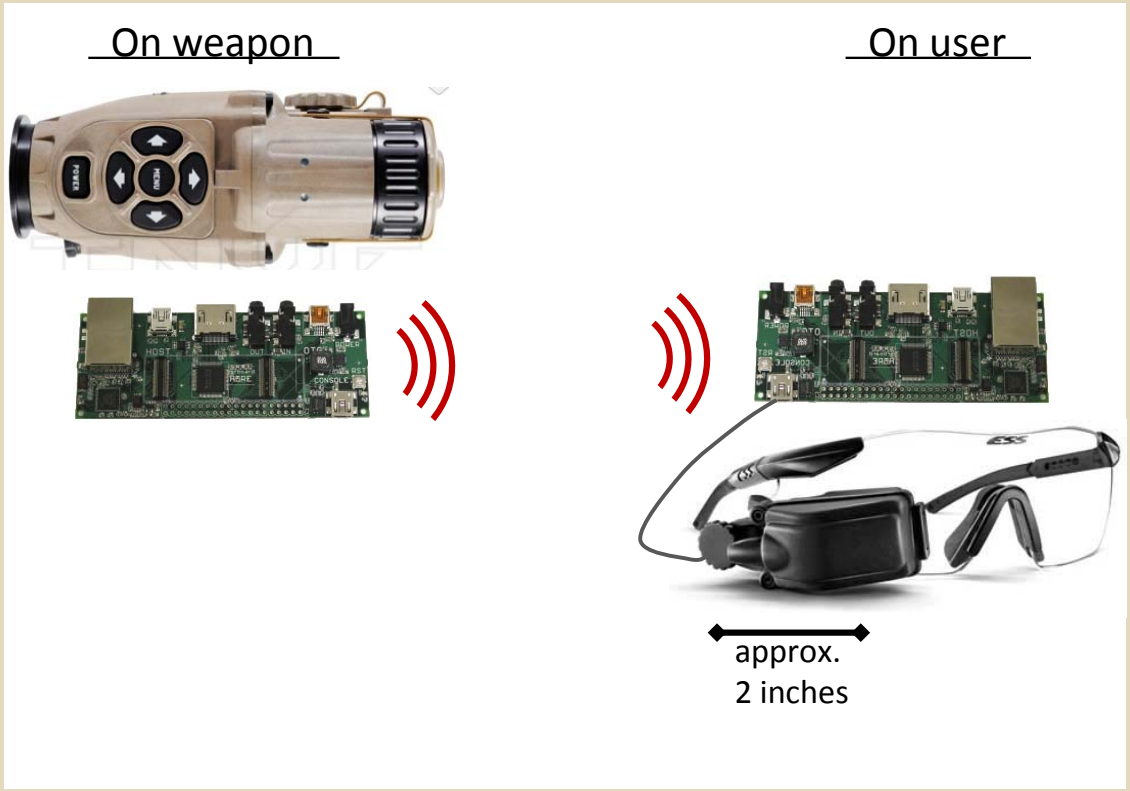
Short Range	~ feet
Medium Bandwidth	10's Mbps
Omnidirectional	
Low Power	milliwatts

Low SWaP

Scale Concept

Standard analog video source

Custom ADC – LED transmitter board



Custom receiver DAC board

Standard analog video display (Liteye,Rockwell Collins, Vuzix)

Shown: TNVC SU-232/PAS thermal scope, Gumstix micro-computer, Vuzix Tac-eye

Technical Considerations

Bandwidth

	Resolution (pixels)	Bitrate	Frame Rate (frames/sec)	Uncompressed Bandwidth (Mbps)	MPEG2 standard compression
Thermal Scope	320 x 240	8 (Grayscale)	30	18.4	Main Profile / Low Level 4.0 Mbps
High Def.	1920 x 1080	24 (Color)	30	1500	Main Profile / High Level 80 Mbps

Power

Microcomputer (Gumstix Verdex 400) streaming video < 400 mA
LED transmitter < 100 mA

At a 500mA draw, a ANSI 15A (AA) battery supplies 1500mAh (3 hours)

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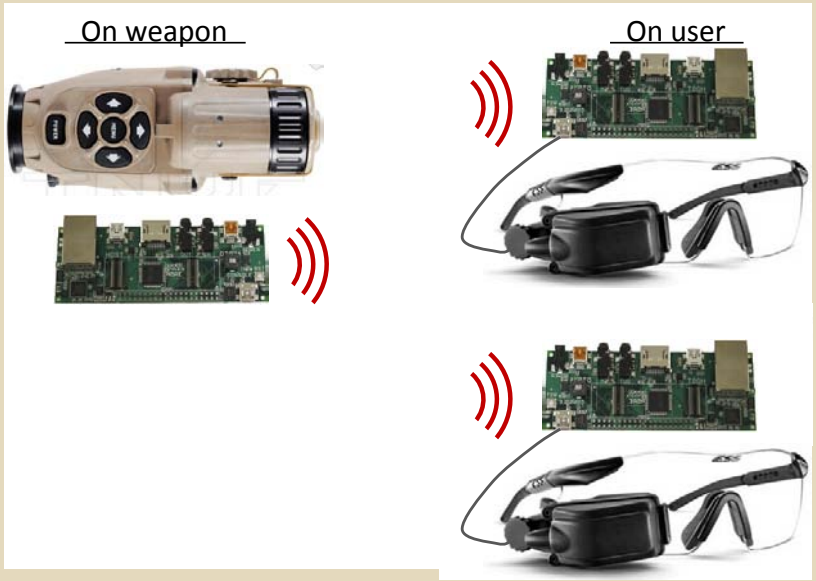
Objectives

This project will seek to enhance the technology of transmitting data and video via a free space optical data link between a data source and display. This project investigates and tests an alternative to Radio Frequency (RF) wireless communication, i.e. transmitting/receiving computer data without a cable from a weapon-mounted gunner's scope sensor to a head/helmet mounted display (HMD). Non-RF covert communications, specifically for weapons video feeds, have been identified as technology gaps across several agencies, including the Army, Marines, and USSOCOM to provide a secure data link and improved mobility on the battlefield.



Approach

Developing a concept system that is mindful of SWaP and interfaces to the sensor and head mounted display. Proof of concept technologies will be explored and tested for evaluation.

- Market research of related, relevant optical technologies.
- Acquisition of base hardware components.
- Test and configuration of video link (bandwidth, software, etc.)

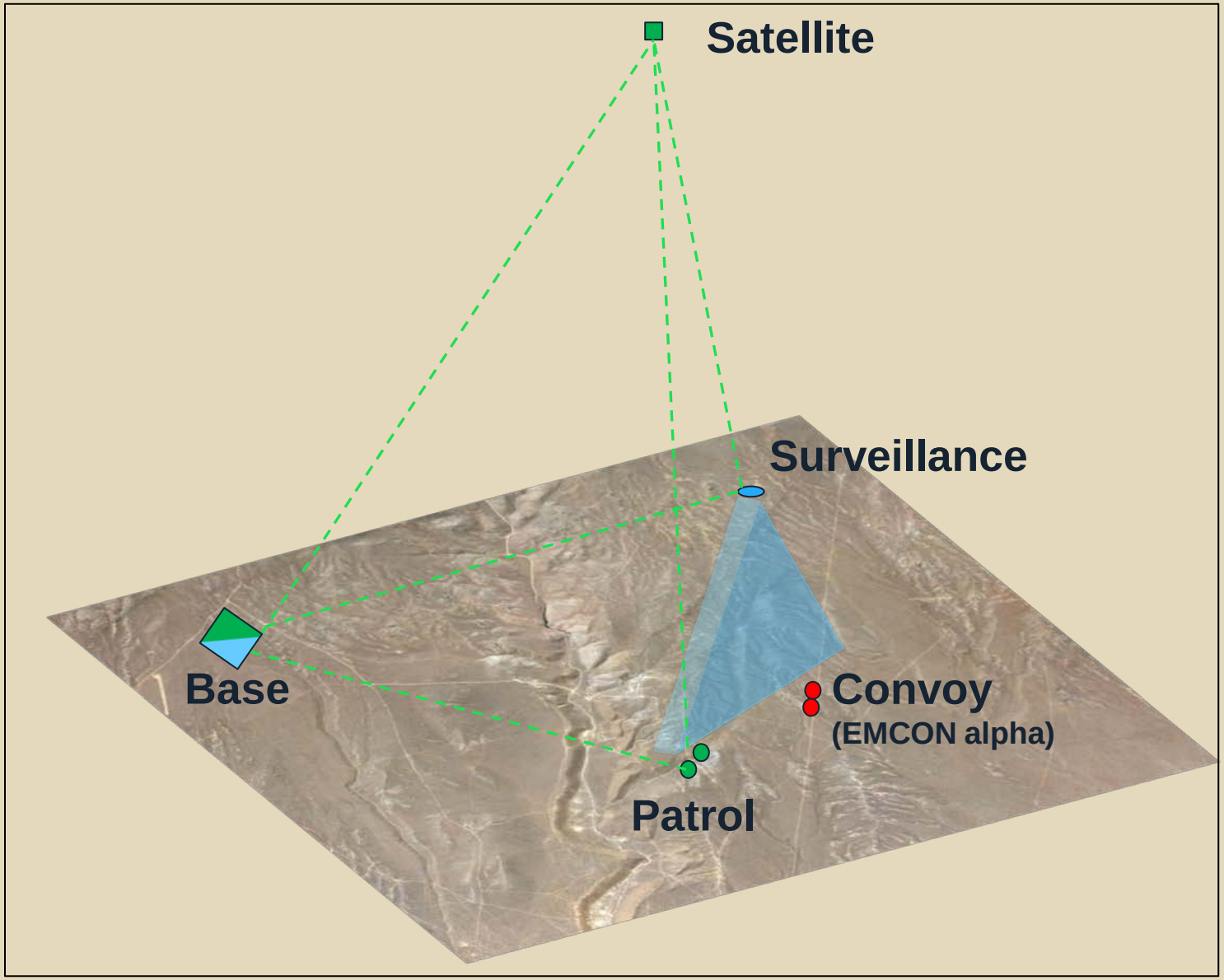
Status

- Preliminary test of video streaming has been completed.
- Create a demonstration system mindful of SWaP to interfaces the sensor and to head mounted display.
- Demonstrate the feasibility of the technology in lab then outdoors environments.

Current Picture

- RF comms
- Video
- NO comms

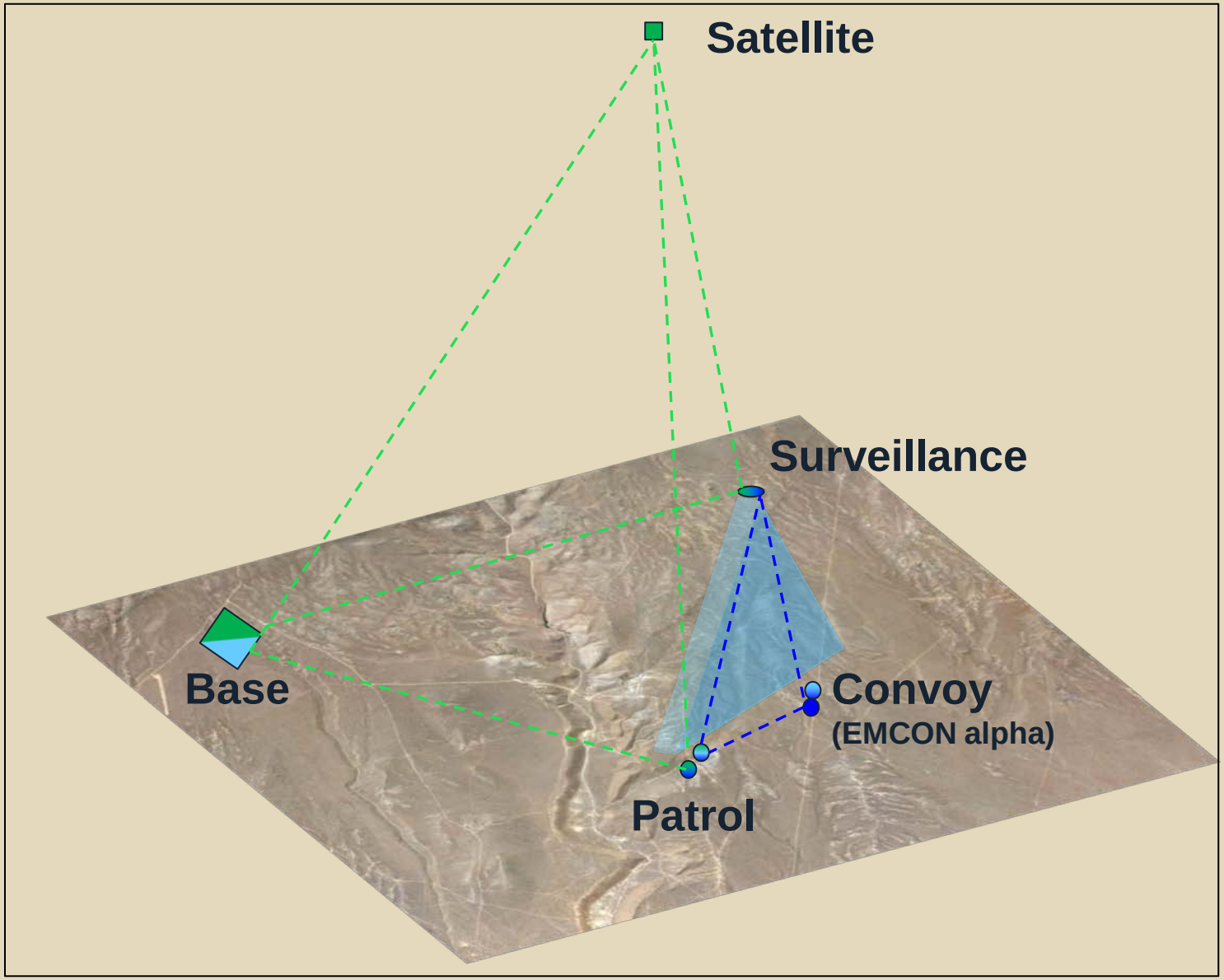
Communications on the Battlefield



Future Picture

- RF comms
- Video
- NO comms
- Optical comms

Communications on the Battlefield



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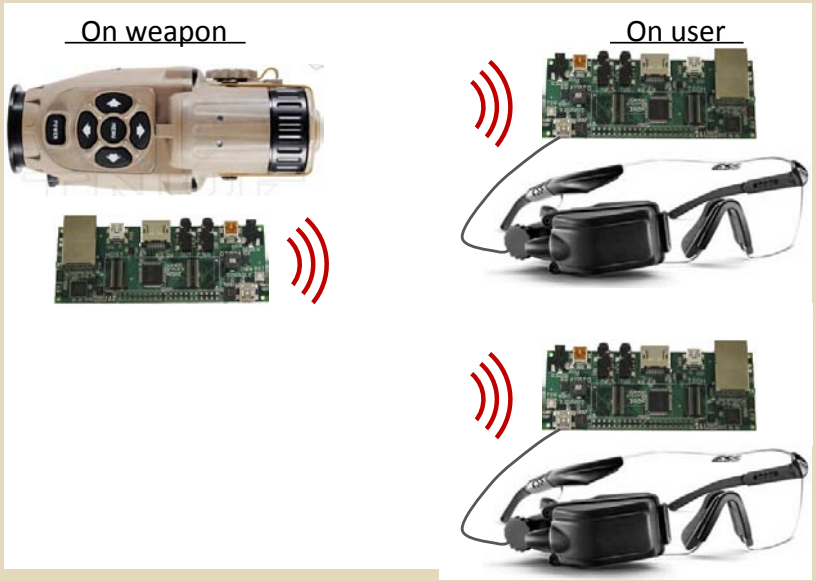

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