Army Space S&T Efforts

Information Assurance / Network Defense

1. Assured Communications
2. Rapid Situational Understanding
3. Enabling Technologies

Support Functions and Analysis
- Concepts Analysis Lab
- Space Lab

INTEGRATED DEMONSTRATION
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INTEGRATED DEMONSTRATION

"Secure the High Ground"
UNCLASSIFIED

Assured Communications (LEO SATCOM)

Common C2 Architecture

Army Networks Integration

Information Assurance / Network Defense

Concept Analysis Lab

Space Laboratory

“Secure the High Ground”
First Nanosat Relay of Voice Comm
6 November 2012

- Successful voice relay through SMDC-ONE nanosatellites
- Standard issue, unmodified PRC-152 handheld radio
- SNaP JCTD satellites have even higher gain

Technology adapted for the Soldier’s needs
No new equipment in the field
**Mission:** Demonstrate orbital tactical communications for the disadvantaged warfighter while maturing small satellite capabilities and components

**Objectives**
- Demonstrating beyond-line-of-sight communications
- On-orbit use of encryption
- Data exfiltration from unattended ground sensors (UGS)
- Nanosatellite propulsion

**Results**
- Comms Huntsville, AL & Mayport, FL (>540mi apart) during OpDemo ✔
- Cold gas propulsion activation ✔
- AES-256 hardware-based encryption (first on-orbit) ✔
- Analog voice, digital voice, image, and text data transmission ✔
- Unattended Ground Sensors
- Brigade Combat Team (BCT) and below operations in UHF via Army Tactical Radio Equipment
- On The Move (OTM) Ka band
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INTEGRATED DEMONSTRATION

Common C2 Architecture
Army Network Integration
Rapid Situational Understanding (LEO Imagery)

Kestrel Eye (KE) BLK I
COMPLETED 2012

KE BLK II
Launch in 2017

KE BLK II TBD

KE BLK III TBD

Electro-Optical (EO) Visible
1.5 m GSD
Task from Theater

EO & Infrared (IR)
Hosted Payload on ISS

Low Light EO & IR
Low Drag
Steerable payload

INTEGRATED DEMONSTRATION NETWORK

Worldwide Warfighter Tasking Constellation Mission Mgmt Global TT&C Capability DCGS-A Integration Enable Tactical Commercial Imagery Dissemination

Common C2 Architecture

Army Networks Integration

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FUTURE PROGRAM OF RECORD

Resilient Global / Theater On-Demand Imagery Direct Theater Tasking Automated Data Dissemination

"Secure the High Ground"
• KE2M deploy from ISS and demo in Q2FY17
  – Independent evaluation of military utility
  – Tasking uplinked and image downlinked directly to the same Warfighter

• KE2A
  – Evaluating options

• Kestrel Eye Ground Station
  – Designed for both satellites
  – SMDC CAL took software dev. Lead
  – Earned Air Space and Missile Defense Association Technical Achievement Award for a Government Team
Army Space S&T Efforts

- Information Assurance / Network Defense
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INTEGRATED DEMONSTRATION

“Secure the High Ground”
UNCLASSIFIED

CAL/Space Lab

Coverage Analysis

Orbital Lifetime

Satellite Control

Software Production
Warfighter Assisting LEO Tracker (WALT)

- Alignment Errors
- = Loading and Tracking Errors

Kestrel Eye
Spacecraft

Pointing variation
due to structure
movement, alignment
and tracking

-3dB points are
+/- 1.5 Degrees from
the boresight
with a 2.4M Antenna

2.4m Antenna

Vertical
Alignment

Wind

Wind induced loads
Move the antenna structure

Ground Station
Workstation

Quasarix
Comma
Radios

LNA
Receive

Power
Amplifier
Transmit

Match

SDR
(Ettus
USRP)

Tracking
Receive

Transmit/
Receive

Diplexer

CAT 6 Ethernet

SDR
(Ettus
USRP)

Match
### Army Cost Efficient Spaceflight Research, Experiments, & Demonstrations (ACES RED)

**Spacecraft Flight Test** | **Technology Objective** | **Status**  
---|---|---  
ADACS Flyer | Test and fully evolve ADACS standard set | Design Phase  
Vector Signal Generator Flyer | VSG radio test | Concept  
EO/IR Flyer | Infrared and optics test | Concept  
Environment / GPS Flyer | Measure drag, fields, and rad. GPS at LEO to improve TLE | Concept  

**ACES RED Exp 1 will fly on ISS Dec 2018**
Responsive Launch

Multi-purpose Nano-Missile System ~ 2010

- Investigation into low cost launch for small satellites
- Precursor to SWORDS

Soldier-Warfighter Operationally Responsive Deployer for Space ~ 2014

- SWORDS was a low cost launch vehicle design effort
- Conclusion – development too costly for one organization
- Currently – Army looking to emerging commercial solutions

Small space community needs alternative to rideshare
Conclusions

- Army increasingly interested in the utility of small satellites to benefit warfighters
- Continue to leverage previous Army efforts
- Primary focus on rapid situational understanding and communications
- Army Science and Technology (S&T) funds for these efforts have been steadily increasing
- Greater recognition for the potential of small satellites
- Working to technology roadmap to address current and future Army warfighter needs

Small space has great potential to address warfighter needs
Questions?

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- Mark Ray – mark.e.ray.civ@mail.mil
BACKUP SLIDES
Enabling Technologies

- SWIFT™ Tactical UHF and K-Band SATCOM
  - Software-defined radio (SDR), SDR-based Processing, and antenna pointing methodologies
  - Small Business Innovative Research (SBIR) subsequent (2nd) Phase II
- Redundant High Bandwidth Communications
  - High data rate in Ka band and moderately high data rate in X band
  - Three SBIR Phase I Programs
  - Efficient security for data in transit and overcomes current device-level and network security processing issues on MANETs (or fixed networks)
  - SBIR Phase II
- Reliable Expandable Satellite Testbed