



USASMD/ARSTRAT

U.S. Army Small Space Update

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Army Space S&T Efforts



Information Assurance / Network Defense



Army Network Integration

Common C2 Architecture

1  Assured Communications

2  Rapid Situational Understanding

3 Enabling Technologies

INTEGRATED DEMONSTRATION



Support Functions and Analysis

Concepts Analysis Lab

Space Lab

Information Assurance / Network Defense

Information Assurance / Network Defense

Army Space S&T Efforts



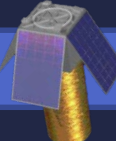
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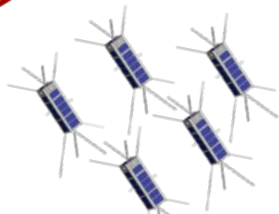
Information Assurance / Network Defense

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Assured Communications (LEO SATCOM)



SMDC ONE
Launched
8 DEC 2010



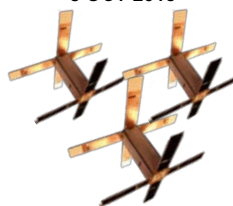
Over the Horizon (OTH)
UHF Communications
UGS Data Exfiltration

SNAP I
Launched
6 DEC 2013



Beyond Line of Sight
(BLOS) UHF Comms with
Hand Held Radios (HHR)

SNAP 3
Launched
8 OCT 2015



BLOS UHF Comms
On Vehicle Propulsion
Type 1 SDR Encryption
HHR Comms
Text Messaging
UGS Data Exfiltration

ARGOS TD
Launch in 2019



BLOS UHF & On-the-Move
(OTM) Ka-Band Comms
Hi Data Rate
Minimal Forward Footprint

INTEGRATED DEMONSTRATION NETWORK



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

FUTURE PROGRAM OF RECORD



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

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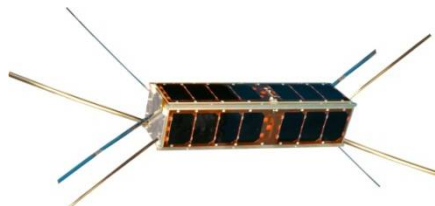
Concept Analysis Lab

Space Laboratory

UNCLASSIFIED

First Nanosat Relay of Voice Comm

6 November 2012



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

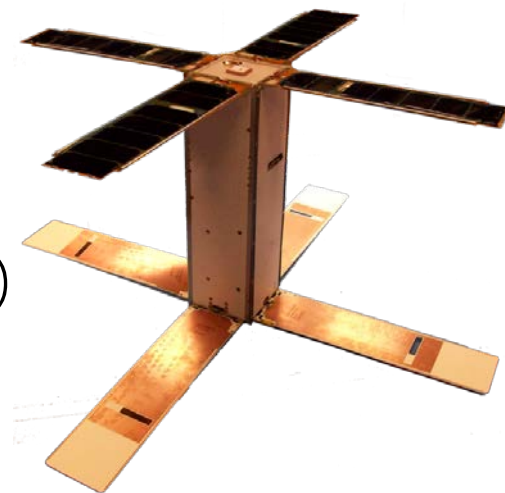


Technology adapted for the Soldier's needs
No new equipment in the field

SNaP



- **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 ✓

ARGOS



- 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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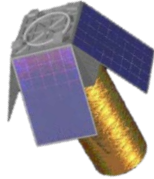
Information Assurance / Network Defense

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Rapid Situational Understanding (LEO Imagery)



Kestrel Eye (KE) BLK I
COMPLETED
2012



KE BLK II
Launch in 2017



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

KE BLK II
TBD



EO & Infrared (IR)
Hosted Payload on ISS

KE BLK III
TBD



Low Light EO & IR
Low Drag
Steerable payload

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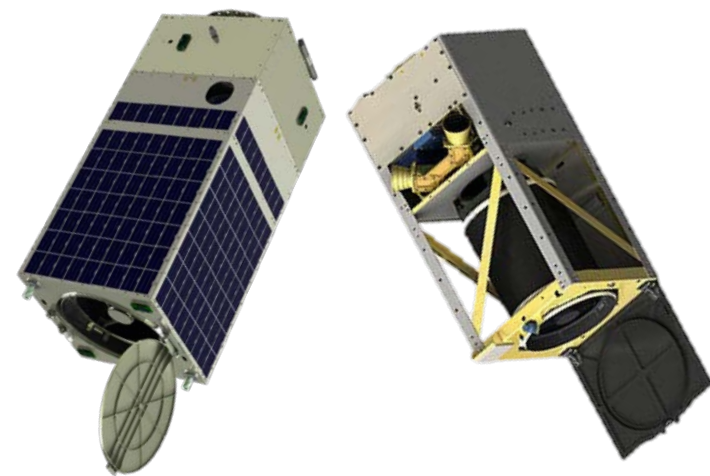
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Kestrel Eye

- 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



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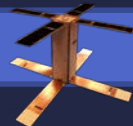
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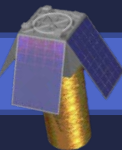
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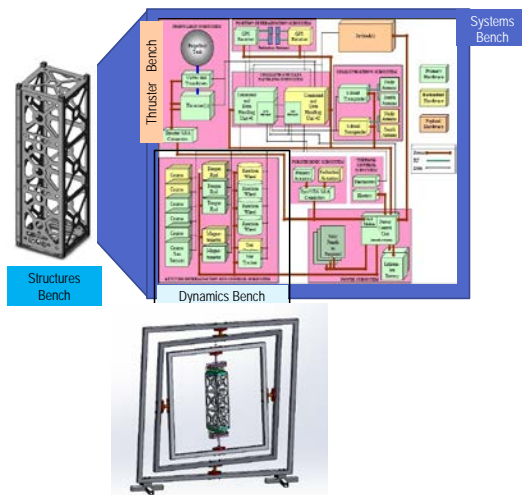
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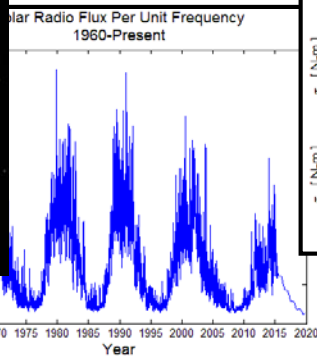
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CAL/Space Lab

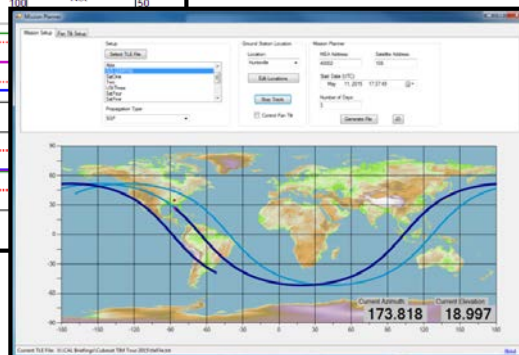
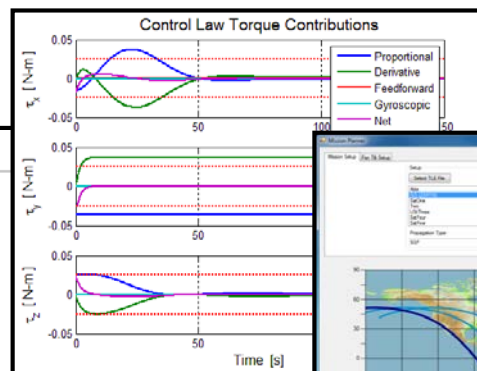


Coverage Analysis



Orbital Lifetime

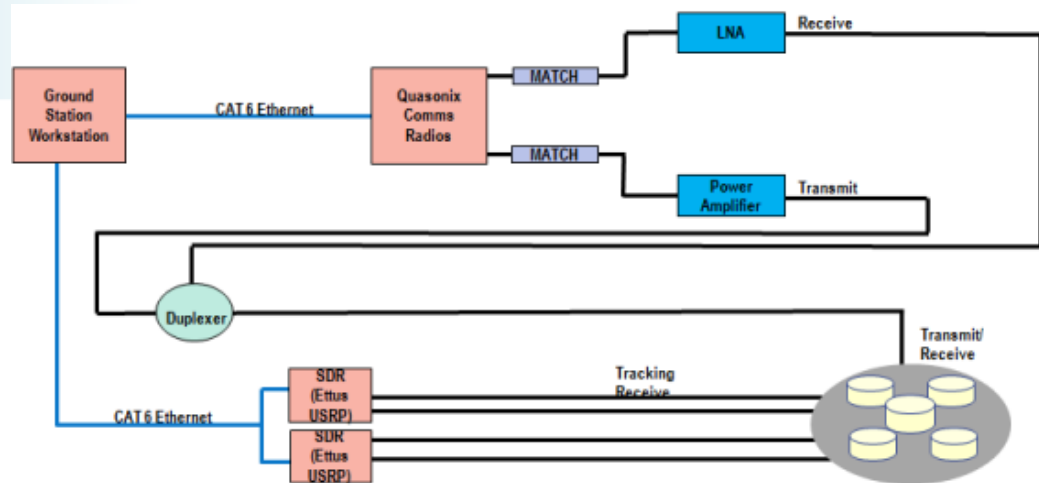
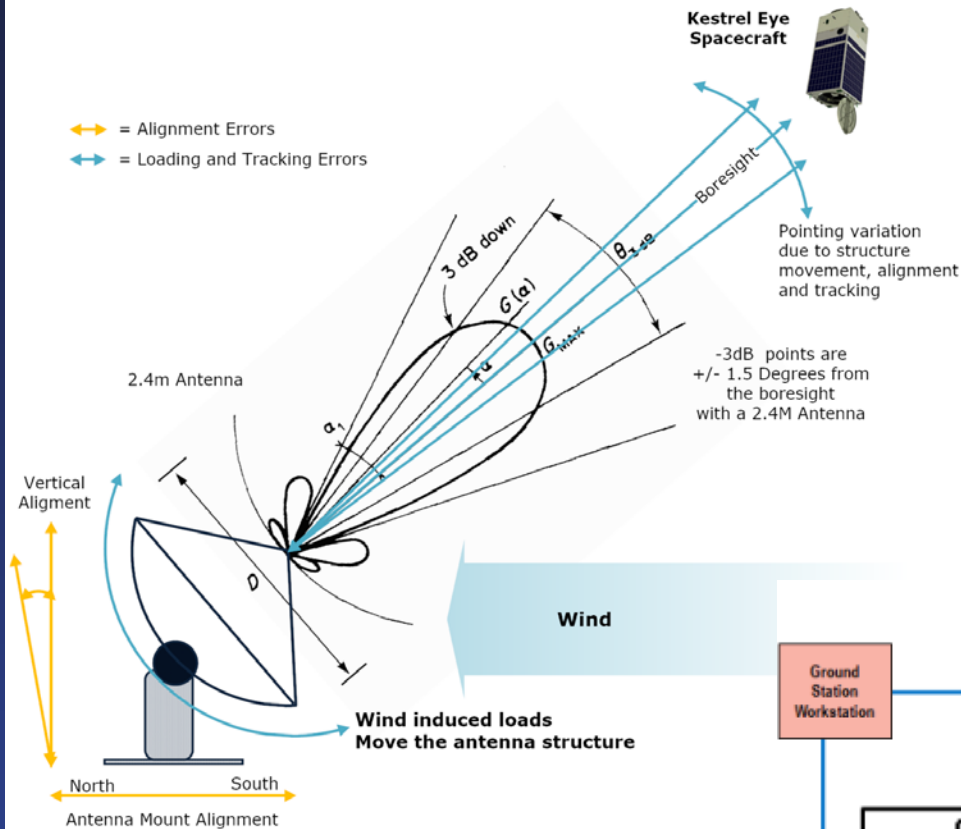
Satellite Control



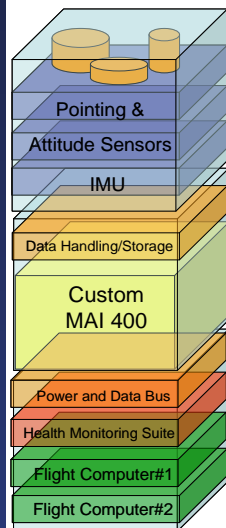
Software Production



Warfighter Assisting LEO Tracker (WALT)



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



ACES RED Exp 1 will fly on ISS Dec 2018

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



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
- ElectronicVeil™: Security for Mobile AdHoc Networks.
 - 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