Bringing Space Capabilities to the Warfighter: Virtual Mission Operations Center (VMOC)

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Problem/Solution

- **Problem**
  - Each satellite system currently relies on its own, unique, stand-alone, stovepipe architecture creating single-points-of-failure and legacy systems that are difficult to maintain
  - Satellite assets are not always as responsive as field operators need them to be
  - No direct user interface to sensors and sensor data
    - Rigid man-in-the-loop sanctuary based processes
    - Current mission data not available to maneuver commander

- **Solution**
  - Utilization of standard Internet Protocols (IP) to acquire satellite data, dynamically task satellite payload, and perform Telemetry, Tracking, and Control (TT&C) of on-orbit assets
Implementation

- Internet Protocols:
  - Commercial standards; COTS equipment
  - Ability to integrate components during the design stage (Estimated 25% savings in design costs)
- Satellite operations:
  - Can have reduced manpower if desired
  - Can have a measure of survivability/mobility
- Enable sharing of Network Resources
  - Ground Stations, Space-base assets, Air and Ground Assets (vehicles, sensors, etc...)
- Net-centricity and Transformation
  - Bringing space to the user – “tactical”
  - Enables Operationally Responsive Space
Cisco Router in Low Earth Orbit (CLEO)

- Fly and compile operations data on the first commercially available network device (a miniature Cisco router) in space
  - Modify and qualify the device for flight on UK-DMC satellite
  - Operate the device on orbit under a wide variety of conditions

- CISCO mini router
  - PC104 form
  - 4” by 4” size
  - Current: 100 Mbps; Future: 1 Gbps+
  - Draws 10 Watts
If IP networks are in place in the ground segment, and IP in space is the next step, how do I command and control my assets?
Security and Control

VMOC Control Layers
The Right Person, Time, and Command

- Autonomous Network Security Monitoring / Countermeasures
- Electronic Certificate Control (External Session Scheduling)
- User Authentication and Data Encryption (External User Access Control)
- Command Authorization (Biometric-Based Internal User Access Control)
- Command Verification (Command Appropriateness)
- Command Contention Control (Command Prioritization)
- User Contention Control (User Prioritization)
- Command Execution
  - Non-Repudiation at All Levels
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Mission Lifecycle Benefits

Enable Field Control

System Developers: Concept Testing

Instrument Manufacture: Component Testing

Develop As Vehicle Will Fly

Warfighters: Data Users

Senior Staff: System Status

Platform Integrators: Pre-Build Testing

Platform Integrators: Final Integrated Testing

Commercial Ground Station Network

Fusion Engines: Multiple Data Sources

Platform Integrators: Pre-Flight Testing

Fly Vehicle As Tested

Legacy Systems: Data

Data Analyst: Direct Satellite Data

Platform Operators: C2

Test As Vehicle Will Fly

Senior Staff: System Status

Platform Integrators: Pre-Flight Testing
Operators used deployable field equipment to connect to the VMOC server and access the UK-DMC satellite

- 14 AF personnel performed TT&C operations and retrieved satellite systems’ status
- Army space operators requested data from satellite payload
  - Retrieved available data from a Knowledge Management system
  - Directly tasked the satellite if data was not available

Demonstrate seamless C4ISR and enable horizontal integration of space effects
Demonstration Objectives

• Does VMOC provide TT&C capabilities and access to payload information for the warfighter?  Yes

• Can field users request information from a platform or sensor?  Yes

• Can field users request information from existing databases?  Yes

• Are internet protocols suitable for operations?  Yes

Non space operators able to perform tasks within minutes
**Scenarios**

- 8 User Scenarios based on Demonstration Objectives
  - 4 TT&C scenarios
  - 2 Sensor tasking scenarios
  - 2 Obtain historical (database) sensor information scenarios

- 2 System scenarios
  - Failover from CERES VMOC to NASA GRC VMOC
  - Failover from NASA GRC VMOC to CERES VMOC
VMOC Demo Architecture
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Vandenberg AFB Demonstration Site
Space Support Element Tool Set (SSET)

- The SSET provides Space Support Element (SSE) functional support to the tactical user or units.

- The intent of the SSET is to provide a mobile space operations node, into which critical space-related data are received, processed or manipulated, and the resulting products (in user useable format) are disseminated to in-theater user(s).
Future Applications

- Single System VMOC applications
  - TacSat 1
  - TacSat 2 / Roadrunner
  - IP/SAT (Completely IP Based)
  - High Altitude Airship
  - Near Space VMOC
- System VMOC’s
  - System of System VMOC’s
  - Embedded VMOC’s
- IP Compliant World/Transformational Communications
VMOC Partnership

- 14 Air Force (14 AF)
- United States Strategic Command CL18
- 30 Space Wing (30SW)
- Air Force Space Battlelab (AF SB)
- Air Force Research Lab (AFRL)
- Space and Missile Systems Center (SMC) Det 12 / CERES
- Naval Research Lab (NRL)
- Army Space and Missile Defense Battle Lab (SMDBL)
- DoD Chief Information Officer (CIO)
  - Rapid Acquisition Incentive – Net Centricity (RAI-NC)
- Air Force Information Warfare Center (AFIWC)
- NASA Glenn Research Center
- General Dynamics
- Cisco
- Universal Space Networks
- SSTL
- Western DataCom
- Integral Systems Inc.
QUESTIONS???

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