TacSat-4 Mission and the Implementation of the Bus Standards

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TacSat-4 Program

- TacSat-4 is a Combination of the COMMx Payload and the Phase 3 Standard Bus Program
  - COMMx is sponsored by the Office of Naval Research as part of the Space Innovative Naval Prototype
  - The Standard Bus is sponsored by the Office of Force Transformation

- The Standard Bus has Completed Integration and Bus Level Environmental Testing

- The COMMx Payload has Completed Integration and is in the Middle of COMMx Level Environmental Testing, Scheduled for Completion in October 2008

- Combined Standard Bus/COMMx Payload EMI and Magnetic Balance Testing will be Performed in October-November 2008

- Launch is Scheduled for September 2009
TacSat-4 Mission Objectives

- Provide TACSAT/ORS Comms-on-the-Move Capability (Legacy and Wideband)

- Collect and Distribute From Blue Force Tracking Devices in Underserved Areas

- Perform Buoy/Sensor Data-X on Moderate-to-High Power Transmissions

- Demo High Dwell Operationally Responsive Space (ORS) Capability via a Highly Elliptical Orbit (HEO)

- Evaluate and Mature Phase 3, System Level Standard Spacecraft Bus in Realistic I&T, Launch, and Flight Operations Environment
TacSat-4 Mission Highlights and CONOPS

- High Elliptical Orbit
  - Up to 2+ Hours Dwell
- Command Uplink
- X-Band & UHF Uplink/Downlink
- Data Exfiltration
- Blue Force Tracking
- In-Theater Ground Terminal
- Common Footprint
  - 2000 nm Dia.

- Blossom Point Node
- Ground Station(s)

- Standard Dissemination Methods & Secret Internet Protocol Router (SIPRNET)
Example Highly Elliptical Orbit Coverage

Orbit Provides Daily Coverage of Four Hours or More in Most of the World
COMMx Payload Technical Achievements

• Dish Reflector Development:
  - 12’ Deployable Dish Reflector successfully developed with completely new technology design that takes advantage of loose mechanical tolerances allowed operating at UHF frequencies.

• Passive Intermod (PIM) Test Set:
  - To test the COMMx payload for PIM, a test set was developed capable of testing for PIM across a broad portion of the UHF spectrum.
  - PIM Test Set is likely the only one in the country capable of testing for PIM across such a broad portion of the UHF spectrum with sufficient sensitivity for COMMx.

• Multipactor Test Set:
  - Multipactor test set successfully developed capable of testing all the COMMx high-power UHF hardware (UHF Feed, Quadripole, Circulator, cables, loads and filters) for Multipactor.
Payload Development and the OFT Phase 3 Standard Bus

- Being the First Payload for the OFT Phase 3 Standard Bus Presented Some Unusual Challenges for the Development of the COMMx Payload.
  - Standard Bus requirements were being developed while COMMx was being designed
  - Standard Bus requirements were NOT based on the COMMx payload or the TacSat-4 mission
Challenging Standard Bus Driven Requirements

• Maximum of 200W Orbit Average Power Provided by Bus for Payload Operations.
  – 200W orbit average power not enough to satisfy the COMMx requirement to operate for 2 hours during an orbit with the baseline design.
  – RF electronics customized for significantly improved efficiency to meet requirement rather than using off the shelf components as planned.

• Payload Stiffness Requirement of >50 Hz.
  – This stiffness requirement is extremely challenging to meet for 150+ kg payloads.
    This requirement significantly increased the complexity of the design, analysis and integration of the COMMx primary structure.

• Payload Thermally Isolated From the Bus.
  – COMMx and HEO payloads tend to be on for long periods of time and then off for long periods of time, this led to the need for a complex thermal system.
  – On COMMx, the payload runs at 600W while the payload is on and 30W while the payload is off. These two thermal requirements along with the isolation from the Standard Bus led to the need for a state-of-the-art Loop Heat Pipe thermal control system on COMMx.
Lessons Learned

• All Portions Of The Mission Should Be Developed On The Same Timeline.
  – Failure to develop all portions of the mission simultaneously can lead to technical problems and cost increases down the line.
  – Late developing subsystems can cause design changes on other subsystems which will be more expensive to accommodate due to their higher level of maturity.

• Understand Test Fixtures And Test Equipment Required Thoroughly When Developing Program Cost And Schedule.
  – Cost and complexity of these systems just as important as the cost and complexity of the flight hardware but can be overlooked as people focus on the flight hardware.

• Avoid Developing Budgets Based on Schedule Targets Rather Than a Bottoms Up Approach.
  – Given schedule targets, it is easy to develop budgets that are artificially low if the schedule targets are not achievable.
  – Subsystem schedules must be created independently and then fed into the master schedule/budget.
Launch in September 2009

- The TacSat-4 Team is Looking Forward to a Launch in September 2009

- TacSat-4 will Support a Variety of Users Across the Department of Defense

- Opportunities Exist for Other Interested Users
  - Contact Keith Akins at the Naval Research Laboratory (202) 404-2903

COMMx in Anechoic Chamber for Self Compatibility and Alignment Tests