Development and Experimentation With a Small Satellite Bus Standard

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Background: OFT/SMC Four Phase Bus Standard Development

- Phase 1 – Analysis and Team Building (MIT/LL Led)
- Phase 2 – Test Bed and Standard Avionics (AFRL Led)
- Phase 3 – Gov’t / Industry Prototype Standard Bus System Development
  - Naval Research Lab (NRL) & JHU Applied Physics Lab (APL) Led
- Phase 4 – Production Phase (SMC Led)
  - Leadships Coordinated, Working Level Coordination In Progress

All Phases Supported by the Nation’s Collective System Engineering Expertise
Four Phase Development Plan with Phase III Highlighted
Phase III Objectives

- Bridge the Gap Between S&T and Operational Bus Capability
  - Establish standard bus performance and interface requirements
    - Review and incorporate results from other standards efforts
  - Retire some non-recurring engineering costs
  - Develop a prototype bus demonstrating the use of the bus standards
    - Feed these results back into the bus standards
- Establish a national systems engineering working group to engage and vest U.S. small satellite industry and academia to develop and maintain ORS/JWS bus standards
- Develop a transition plan to Phase IV
  - Performed in conjunction with SMC
- Active engagement with the industrial base and the user community
Phase III Philosophy and Assumptions

- Initial operational capability will use an inventory model for the bus
  - Spacecraft buses are procured and placed “on the shelf” to be mated with a payload when needed
    - Bus development/build schedule not critical to responsiveness
    - Payload integration, SV testing, launch operations, and on-orbit checkout must be responsive
    - Limits the number of bus classes/versions that can be supported

- Bus technologies must be mature by the Phase IV procurement

- The bus standard is not fixed
  - New technologies/interfaces/etc. can be added as they mature
Industry Systems Engineering Team

• Purpose: Provide an industry and user perspectives on bus standards and interfaces to ensure a smooth transition to Phase IV

• Members competitively selected from U.S. industry providers
  – Broad range of companies represented
  – User community members appointed by their organizations

• Initial meeting held 3 June 2005, two meetings held since
  – Weekly telecons, monthly face-to-face meetings

• Open BAA solicits industry ideas
  – Presentations to the ISET
  – Funded study of specific topics of interest to the ISET
Bus Standards and Products

Payload Envelope
*(Payload User’s Guide)*

Operational Payloads

I&T and GSE Standards

AFSCN GS Spacecraft Ops Center (SOC) Standards
*(On-Orbit S/C Operations and Maintenance)*

Bus Standards
*(Bus Requirements and Configuration Options)*

LV PAF Standard

LV Options and Range Operations Standards
*(e.g., ESPA, EELV Aux, FALCON, etc.)*

Tactical/Mobile GS Payload Ops Center (POC) Standards
*( Defined Modes of Operation)*
ISET Discussion Topics (1)

• Industry perspective on bus standards and standard buses
  – Elements critical to the success of a bus standards development effort
  – Lessons learned from previous bus standards or standard bus efforts

• Design differences between LEO and HEO missions
  – MIT study assumed that the ORS bus could support LEO or HEO
  – Understand the potential commonality between these buses

• Payload envelopes
  – Evaluate the requirements of candidate payloads
  – Build on the Phase I work to define the payload support requirements

• Launch vehicle envelopes
  – Review of interface requirements of existing and under development launch vehicles
ISET Discussion Topics (2)

• Bus system functional decomposition
  – Determine whether the bus standard should mandate a bus functional decomposition
  – If so, develop a functional decomposition that allows targeted upgrades without forcing a wholesale redesign

• Test and verification approaches
  – Develop a cost-effective test and verification approach, particularly for multiple-spacecraft builds
  – Identify means of minimizing the cycle time from call-up (mating of a payload to the bus) through on-orbit checkout

• Mission-level requirements and CONOPS development
  – Develop the envelopes of CONOPS to be supported, including approaches for tactical support
  – Identify the derived bus requirements from this CONOPS
Summary

• OFT/ORS is a structured, coordinated approach to bring an operationally responsive bus capability to reality
• The ORS bus team is actively seeking broad industry, government, academic, and user input through a wide range of channels
• ORS Phase III is now underway
  – Key products have been identified
  – An industry systems engineering team has been selected and is now tackling the critical challenges of defining a bus standard