NASA SBIR 2016 Phase I Solicitation

H10.01 Improved Test and Launch Operations via Interface Design

Lead Center: KSC

Participating Center(s): SSC

This subtopic seeks to improve ground and surface processing in both the operational and test environments through improved interface design concepts. A substantial portion of pre-launch processing involves the integration of spacecraft assemblies to each other or to the ground/surface systems that supply the commodities, power or data. Each assembly requires an interface that connects it to the adjacent hardware which includes flight critical seals or connectors and other components. The impact of these interface-driven tasks are of particular concern for surface systems where the additional work must be accomplished by crew performing Extra-Vehicular Activities (EVAs) or by purpose-built robotic systems.

The interfaces between payloads, boosters and ground/surface support equipment have historically been drivers of numerous delays and unplanned work prior to launch. The developmental impact of interface design and requirements development includes extensive design labor and validation for any new integrated launch system. Finally, the historical trend of having unique interface types for different launch systems has hampered recent efforts to establish a multi-user capability for existing launch infrastructure.

Development and adoption of improved, standardized interfaces holds the potential of reducing the cost and complexity of future space systems and their related design and implementation, which can increase the funding available for flight hardware and drive down the cost of government and commercial access to space.

Standardization of interfaces used during testing or launch processing also provides eventual benefits to autonomous servicing, a key space technology for future missions. Future in-space and surface servicing of multiple spacecraft/user types such as satellites becomes more feasible if a common interface approach can be developed and widely adopted.

Technologies sought for interface design are grouped in the following two focus areas:

Physical Interfaces

- Modular architectures of expandable surface systems that minimize the adverse impact of interface connections.
  - Interfaces suitable for modular, reliable, cryogenic propellant liquefaction architectures that enable incremental system approaches for increasing capacities as needed.
  - Dust-tolerant interface approaches that drive highly reliable and/or autonomous connections.
- Development of earth based analog test hardware to test and validate these surface system interface concepts (module equipment interfaces and/or surface to vehicle interfaces).
  - Connector technologies including ports, disconnects or couplers that enable standardization across the industry for the transfer of cryogenic and storable propellants or other servicing fluids, power,

    - and/or data for Governmental and Commercial launch providers and/or future surface system analog testing.
    - Interface concepts that simplify or standardize future Interface Requirements Documents (IRDs) or enable increased use of off-the-shelf hardware for future flight and exploration support systems.
    - Solutions that promote standardization of key payload to launch vehicle and subsystem interface standards to reduce the cost associated with analysis, design, configure, integration, and preparation of space systems for launch and reusability through standard servicing interfaces.
    - Novel concepts for adaptation of common interface architectures from relevant industries and the analysis and development required to adapt them to space and exploration architectures. Adaptation should include providing the relevant certification planning required for acceptance by government and industry.

Software/Data Interfaces

- Concepts for embedded intelligence within interfaces that include software attributes to enhance the usage of interface data for tasks such as self-testing, diagnostics, configuration verification and/or management of the interface.
- Concepts for the use of industry standards and/or open source software to reduce or eliminate the need for dedicated interfaces by more efficiently managing system configurations. Software addressable interfaces conducting fault isolation and recovery, and decrease of software integration costs.
- Interface concepts that simplify or standardize future Interface Requirements Documents (IRDs) or enable increased use of off-the-shelf hardware for future flight and exploration support systems.

For all above technologies, research should be conducted to demonstrate technical feasibility during Phase I and show a path toward Phase II demonstration, and delivering a demonstration package for NASA testing at the completion of the Phase II contract.

Phase I Deliverables - Research to identify and evaluate candidate technology applications, demonstrate the technical feasibility, and show a path towards a demonstration. Concept methodology should include the path for adaptation of the technology, infusion strategies (including risk trades), and business model. Identify improvements over the current state of the art for both operations and systems development and the feasibility of the approach in a multi-customer environment. Bench or lab-level demonstrations are desirable.

Phase II Deliverables - Emphasis should be placed on developing and demonstrating the technology under simulated operational conditions with analog earth-based systems including dynamic events such as commodity loading, disconnect or engine testing. The proposal shall outline a path showing how the technology could be developed into or applied to mission-worthy systems. The contract should deliver demonstration hardware for functional and environmental testing at the completion of the Phase II contract. The technology concept at the end of Phase II should be at a TRL of 5 or higher.