

Innovation

Topic Number:
AF06-261

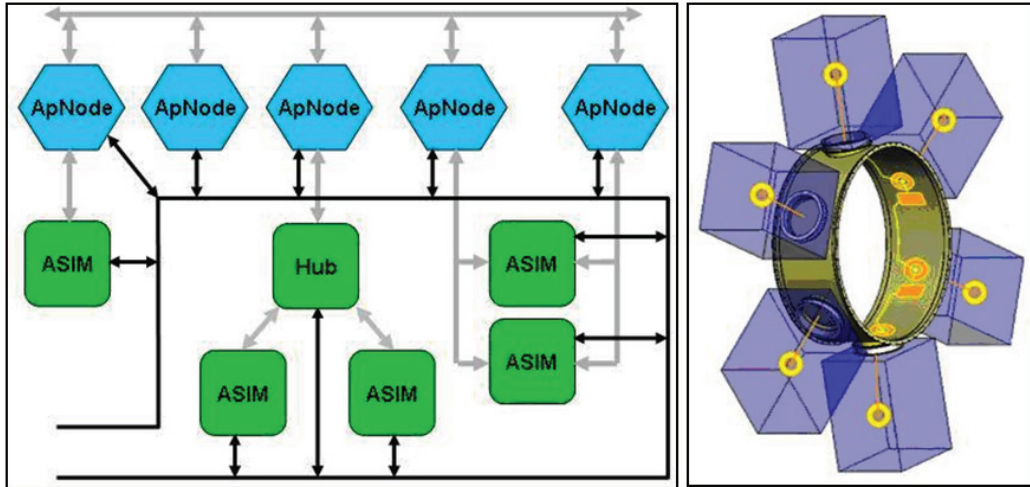
Title:
Standardized Satellite
Electrical Internal
Interface

Contract Number:
FA9453-07-C-0074

Company Name:
sysRAND Corporation,
Parker, CO

**Technical Project
Office:**
AFRL Space Vehicles
Directorate, Kirtland
AFB, NM

This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.



Left: Test Bypass supports numerous integration and maintenance functions. Right: Space Plug and Play avionics will enhance interfaces to launch platforms.

Leveraging Commercial Off-the-Shelf Plug and Play Electronics Protocols for Space Applications

- The stated objectives of Operationally-Responsive Space require that satellites can be quickly assembled, integrated, and tested from bus and payload modules using Space Plug and Play Avionics (SPA) and other modular methodologies instead of conventional, low-level components
- The SPA-U interface elaborates Universal Serial Bus (USB) protocols with an out-of-band maintenance bus, avionics power, a systolic pulse-per-second, and other features
- The company enhanced the SPA concept with a clean-sheet Debug Monitor based on prior sysRAND remote servicing experience
- When coupled with workstation-based tools, the Debug Monitor can support the entire life cycle of a spacecraft from concept through decommissioning
- sysRAND applied commercial, industrial, and avionics standards and best practices to extend and enhance the existing SPA-U Plug and Play serial bus

377ABW-2010-0828

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Air Force Requirement

The stated objectives of Operationally-Responsive Space require that satellites can be quickly assembled, integrated, and tested from bus and payload modules using Space Plug and Play Avionics (SPA) and other modular methodologies instead of conventional, low-level components. Mission and platform functionality must be partitioned in such a way that bus and payload modules can construct custom spacecrafts which are widely variable in resulting configurations.

Such a partitioning can then be expeditiously supported in design, manufacturing, integration, and operations phases of spacecraft life cycles. The result will be a major reduction of Non-Recurring Engineering (NRE) costs and schedules through the expediency of pre-designed, pre-manufactured and, wherever possible, pre-integrated spacecraft busses and payloads.

This paradigm allows for design, manufacturing and partial spacecraft integration to be elastic queues, while final spacecraft and launcher integration and operations can be optimized for rapid delivery from shrink-wrapped stock to commissioning on-orbit.

SBIR Technology

The SPA-U interface elaborates Universal Serial Bus (USB) protocols with an out-of-band maintenance bus, avionics power, a systolic pulse-per-second, and other features. In this SBIR project, sysRAND Corporation applied commercial, industrial, and avionics standards and best practices to extend and enhance the existing SPA-U Plug and Play serial bus.

The company enhanced the SPA concept with a clean-sheet Debug Monitor based on prior sysRAND remote servicing experience. The Debug Monitor adapts both the USB link and AFRL's Test Bypass testbench maintenance link to remote servicing of nodes with features which include remote reset, power cycling, boot-from-link, program breakpoints, data watchpoints, single-step, and other operations.

A fulltime maintenance link connects to each processor node, using the Debug Monitor to support

a spacecraft's life cycle well beyond the truncated support of conventional Integrated Development Environments (IDEs). IDEs are typically restricted to programming and debug phases of code development. In support of modeling, design, manufacturing, integration and operations, the Debug Monitor was envisioned to become a gateway which enables diagnostics, health and performance monitoring, Independent Verification & Validation, Automated Integration & Test, and on-orbit operations.

The Debug Monitor was also demonstrated to practically support remote hardware and software operations over an interposed network, both local and long-distance, using Virtual Control Network (VCN) protocols.

Potential Air Force Application

The Debug Monitor is an unobtrusive program which terminates the Test Bypass links in each of the satellite's processor modules. As a gateway, the Debug Monitor allows a spacecraft to be re-missioned, to participate in hardware-in-the-loop simulation, to be reconfigured, to debug software and more, all while on-orbit.

Extensive tools for the test bench are also available during operations. The Debug Monitor can also serve to capture routine and exception metadata so that a satellite's state can be tracked in exquisite detail. These features provide the tools necessary to implement platform autonomy and self-repair activities.

When coupled with workstation-based tools, the Debug Monitor can support the entire life cycle of a spacecraft from concept through decommissioning.

Company Impact

"The Phase II SBIR afforded an opportunity for sysRAND to apply its industrial and avionics experience to address a number of AFRL's rapid-response and small spacecraft initiatives," states Gary Rodriguez, Systems Architect and Chief Executive Officer. "The project better positioned sysRAND's internal operations to service other spacecraft development, including NASA projects. A comprehensive working architecture also emerged from these developments."



SBIR/STTR

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