



NASA SBIR 2016 Phase I Solicitation

Z6.01 Wireless Technology

Lead Center: ARC

Participating Center(s): GRC, JSC, MSFC, SSC

Wireless sensor networks can effectively support an array of sensors able to measure structural properties, the heat profile for thermal protection, impact detection for orbital debris and other functions requiring distributed sensors. Moreover, embeddable passive wireless sensors can greatly increase the capabilities of the sensing and telemetry portion of a spacecraft. This would be relevant to any of the ascent and landing systems needed for planetary exploration as part of the spacecraft or mission support systems. Of particular interest is the capability of adding sensors at a low cost - enabling better Integrated Health Management and Spacecraft Autonomy functions, which depend upon better sensing of spacecraft state and environment. If developed under STMD, the resulting technology has high potential for infusion into SMD and HEOMD Programs leading to more effective ascent vehicles, better spacecraft management, new entry, descent and landing systems and future planetary exploration systems.

While wireless sensors have been slowly improved, tested and deployed on earth, their extension to aerospace has not occurred. The technology itself does not limit such extension, but rather traditional methods using wired interconnects have proven adequate for most vehicles and missions. However, there are major advantages conferred by wireless technology for aerospace avionics that make adoption favorable.

Wireless technology

- Reduces the mass and volume of spacecraft by eliminating large heavy cable runs. This is particularly useful for small satellites, where internal volume is often highly constrained particularly for subsystem cables and connectors. This would enable smaller and lighter spacecraft.
- Can transfer data across pressure interfaces, into remote locations where it is difficult to run cables and onto movable structures where cables are at risk of failure.
- Provides less intrusive measurement and health monitoring capability by enabling sensors within fuel tanks and pipes and across pressure interfaces without breaching the structure.
- Supports late additions or mission enhancements by significantly limiting changes to vehicle structure and data paths.
- Functions despite structural failures that can break physical wires such as those caused by micrometeorite impacts or connector contamination, thereby creating heterogeneous redundancy for critical systems that improve reliability and safety.
- Supports dynamic reconfiguration of networks and components, enabling robust response to faults or changes in operating mode.

In time, wireless interconnects and interaction methods could largely supplant (or perhaps more importantly, complement) wired methods. Consider the adoption of mobile computing devices, which rely on purely wireless interfaces for communication, printing and even peripheral connection. Such advantages can apply to spacecraft,

distributed sensor networks and even distributed instruments and planetary surface exploration systems.

Specifically, this subtopic solicits the following technologies:

- Low power, low mass, and small volume components, where sensor/actuator modules are less than 20 grams in mass and less than 1 cc in volume. Of particular interest are highly scalable systems for measurement and data acquisition where total subsystem mass would be under 1 Kg and would operate under 3 W of power.
- Components capable of surviving and operating in aerospace environments requiring tolerance to extreme temperatures, shock and vibration, and radiation effects that exist for satellites, launch vehicles, planetary and space habitats, deep space exploration systems and landing/re-entry systems.
- Techniques that decrease reliance upon batteries or eliminate the need for charging and battery replacement, including novel approaches for electromagnetic energy harvesting, generating and storage methods; including capacitive, hybrid and acoustic power harvesting technologies.
- Wireless technology, protocols, architectures and software systems that support redundant networks that can dynamically reconfigure to reestablish connectivity and function after temporary interruptions or component failures, including internal fault detection capability.

The major NASA and commercialization thrust for wireless technology would be its maturation for use in aviation and space. The end product of this SBIR subtopic is likely to be a series of demonstrations of capability of interest to NASA Programs for Phase III maturation. Significant commercial opportunities for these products are available in the existing aerospace market, particularly for aviation.