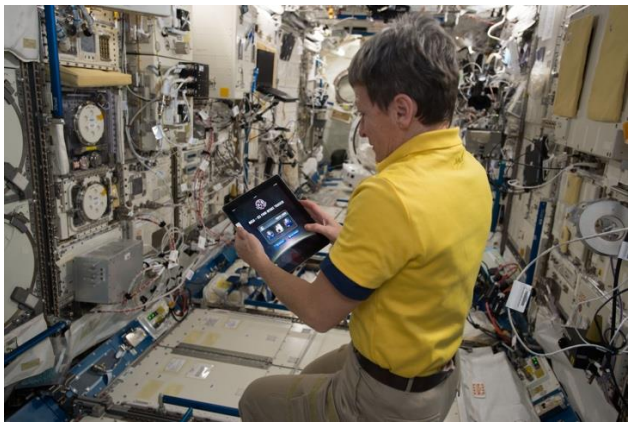
Wireless Sensors for NASA's Space Bases



Name of Technology:
Wireless Sensor Networks

Participating NASA Centers:
ARC(Lead); GRC, JPL, LaRC, MSFC

Technological Area:
Z8.10 Wireless Communication for Avionics and Sensors for Space Application

Vision for the Technology:
Wireless sensor networks are needed to provide internal environmental and situational awareness data for lunar and planetary bases. Other desired data includes logistics inventory and localization, and housekeeping data monitoring. NASA's goals are for the sensors to have reduced mass, simplified integration, improved system flexibility, serviceability, and expandability.

Challenges:
Wireless sensors (temperature, humidity, pressure) have been prototyped that are compatible with the Radio-frequency identification (RFID) Enabled Autonomous Logistics Management (REALM) system that has been demonstrated on ISS. While the sample rate of this system is low, battery life exceeds mission lifetime requirements. The REALM development is only sufficient to address some logistics tracking and will not meet the sensing gap. The Wireless Sensor Piconet Radio (WiSPiR) SBIR project also has some relevance to the closure of this gap.

NASA applications have increased SWaP (size, weight, and power consumption). This poses limitations with system resiliency, expandability, and serviceability. In addition, wiring harnesses will limit the distribution of sensors, especially for rotating or articulated structures.

NASA Seeks to Meet the Following Specs:

Key performance parameters include:

- Sensor area: <5 cm2
- Sensor types: temperature, humidity, pressure, strain, accelerometers, gas sensors, radiation, etc.
- Sampling rate: average 0.1 Hz, select nodes at 5 kHz
- Sensing precision: 12-bit
- Item inventory accuracy 90%
- Localization accuracy: 90% of items localized within 50 cm RMS
- TID radiation tolerance: 100 krad (SiO2)
- Destructive SEE immunity: ≥37 MeV-cm2/mg (threshold), ≥60 MeV-cm2/mg (goal)
- Lifetime: 15 years

Overview of Student Project:
NASA seeks innovative wireless sensors solutions that will be small, lightweight, easy to integrate and service, and can be expandable for lunar and planetary bases. Ideally, the solution would consist of a network of "plug and play" sensors that would provide internal environmental and situational awareness data, logistics inventory and location identification, and housekeeping data monitoring.

Innovative Areas Student Projects Can Address: Wireless Sensor Networks

- Accelerometers sensors
- Environmental sensors
  - Temperature
  - Humidity
  - Pressure
- Gas sensors
- Logistics tracking
- Strain

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Research Funded by NASA on this Topic:

Proposal Number: 12-1 A3.08-8846
Passive Wireless Temperature Sensor for Harsh Environments

Proposal Number: 09-1 X8.02-8598
Rapid hydrogen and methane sensors for wireless leak detection

Proposal Number: 07-2 T6.01-9878
Passive Wireless SAW Humidity Sensors and System

Proposal Number: 16-1 Z6.01-8580
Wireless Sensor Piconet Radio (WiSPiR)

References:

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S13.05 In Situ Instruments/Technologies for Lunar and Planetary Science

AVIS Wireless Avionics Intra-Communications (WAIC)