NASA SBIR 2016 Phase I Solicitation

S3.09 Command, Data Handling, and Electronics

Lead Center: GSFC

Participating Center(s): JPL, LaRC

NASA's space based observatories, fly-by spacecraft, orbiters, landers, and robotic and sample return missions, require robust command and control capabilities. Advances in technologies relevant to command and data handling and instrument electronics are sought to support NASA's goals and several missions and projects under development.

The 2016 subtopic goals are to develop platforms for the implementation of miniaturized highly integrated avionics and instrument electronics that:

- Are consistent with the performance requirements for NASA science missions.
- Minimize required mass/volume/power as well as development cost/schedule resources.
- Can operate reliably in the expected thermal and radiation environments.
- Successful proposal concepts should significantly advance the state-of-the-art. Proposals should clearly:
- State what the product is.
- Identify the needs it addresses.
- Identify the improvements over the current state of the art.
- Outline the feasibility of the technical and programmatic approach.
- Present how it could be infused into a NASA program.

Furthermore, proposals developing hardware should indicate an understanding of the intended operating environment, including temperature and radiation. It should be noted that environmental requirements can vary significantly from mission to mission. For example, some low earth orbit missions have a total ionizing dose (TID) radiation requirement of less than 10 krad(Si), while some planetary missions can have requirements well in excess of 1 Mrad(Si). For descriptions of radiation effects in electronics, the proposer may visit (http://radhome.gsfc.nasa.gov/radhome/overview.htm).

If a Phase II proposal is awarded, the combined Phase I and Phase II developments should produce a prototype that can be characterized by NASA.

The technology priorities sought are listed below:

- *Spaceflight Multicore Middleware* - Current and emerging spaceflight processors are leveraging multi-core architectures to satisfy the ever increasing onboard processing demands. These architectures can provide increased processing bandwidth, power efficiency, and fault tolerance for onboard processing applications. However, these advantages come at the cost of increased hardware and software complexity. As software development is a major cost driver for missions, this increased complexity has the potential to significantly increase cost for future NASA missions. To address this risk, this subtopic solicits Spaceflight Multicore Middleware technology providing machine management for multicore processing devices. This middleware software layer shall primarily reside between the application layer and the operating system, with extensions into and below the OS as necessary, to provide intelligent resource, fault, and power management. By providing these functions, application software can be largely agnostic to underlying hardware, thereby reducing cost and complexity. It is desired that the middleware software support multiple processor architectures. Examples include, but not limited to, ARM, Freescale, Tilera, and LEON, and those that support a number of cores ranging from 2-32.

- *Advanced Spaceflight Memory* - As spaceflight processor technology advances to provide increased bandwidth, power efficiency, and flexibility, advanced spaceflight memory devices are needed to fully leverage these improvements. This subtopic solicits technologies enabling power efficient, high performance volatile spaceflight memory incorporating high speed, fault tolerant, serial interfaces, internal EDAC, power and fault management, and 2.5/3D manufacturing processes enabling implementation of miniaturized, highly-reliable fault tolerant systems.
- *Point-of-Load Power Converters* - Emerging spaceflight processors require multiple supply voltages, and multiple switched services for many of these voltages. Using currently available point-of-load power converters, an unacceptably large portion of future spaceflight computer boards will need to be dedicated for these devices. To address this concern, this subtopic solicits technologies enabling miniaturized spaceflight point-of-load power conversion and switching.
- *Radiation Shielding* - Innovative additive manufacturing and/or deposition technologies starting at TRL 3 are sought to create integral one-piece surface claddings of graded atomic number (Z) materials for use as radiation shielding for electronics. Shielding thicknesses must be able to achieve up to 3 g/cm^2 for initial shielding applications. At the end of Phase I, delivery of layered slabs and/or half sphere samples is expected with areal densities from 1 -3 g/cm^2; samples must be able to show a strong interface property to avoid delamination and consistent density and thickness (areal density) uniformity.

This subtopic also solicits technologies enabling the use of COTS micropower/ultra-low power computing devices in highly reliable spacecraft avionics systems.