NASA SBIR 2005 Phase I Solicitation

X1.01 In-Space Computing and Reconfigurable Electronics

Lead Center: GSFC
Participating Center(s): JSC, MSFC

The goal for this subtopic is the development of advanced space technology to further high-performance computers and computing architectures and reliable electronic systems that can operate effectively for long periods of time in harsh environments. These systems require management of low power and radiation, and must be reliable, robust and reconfigurable.

The objective for this development goal is to elicit novel architectural concepts and component technologies that have realistic potential and achievable applications and are responsive to the priority areas of this subtopic. Technologies will be selected based on the potential that their final end products are sustainable (affordable, reliable/safe and effective), and will advance solutions to the challenges of reusability, modularity and autonomy. Priority areas are:

Data processing

- General purpose processors (piece part, rather than an entire board) possessing fault tolerance at cell and or die levels, floating point and error correction.
- Technologies that reduce the physical size and power requirements of computing systems: making the data system more adaptable, modular, and cost effective.
- New standard models for analysis of interplanetary radiation and radiation belts, and technologies that enable radiation measurements such as total dose and single event effects in computing systems: enhances capability to design radiation tolerant data systems, monitor systems in flight, and predict errors and contingencies.

Reconfigurable Electronics and Implementations

- Reconfigurable designs and architectures that support fault tolerance and are functionally and physically modular.
• Solutions, designed around generic blocks, for recovery from multipoint failures (as opposed to single fault) component failure, where a system can monitor and identify the failing components, and self-repair or bypass small portions of the electronics. These prioritized generic blocks would enable graceful degradation of higher functions while maintaining the system core functionality.

Data System Support Electronics

• Radiation-hard microcontrollers, phase lock loops (PLL), and high-speed oscillators (greater than 150 MHz, equal duty cycle).

• FPGA: Environmentally tested, reliable, tolerant IO, radiation hardened cell structures, Anti-Fuse or reconfigurable.

• Robust and reliable non-volatile storage devices such as EEPROMs and FLASH memory.

Command and Data Transfer

• Inter-system data transfer communications between spacecraft subsystems based on standard interfaces that address high multi-drop throughput (10 to 100 mbps), self diagnosis, inherent redundancy and low power, and support subsystem data transfer to realize higher autonomy.

• Intra-system data transfer communications within the spacecraft subsystems, between cards within a box, to replace the conventional passive backplanes, e.g., switched fabric backplanes with fault detection and serial interfaces.