The strategic plan within the Office of Space Science at NASA calls for intense exploration of a wide variety of bodies in the solar system within a modest budget. To achieve this will require revolutionary advances over the capabilities of traditional spacecraft systems and a broadening of the tool set through the introduction of new kinds of space exploration systems. These systems will include, but are not limited to, orbiters, landers, atmospheric probes, rovers, penetrators, aerobots (balloons), planetary aircraft, subsurface vehicles (ice and soil), and submarines. Also of interest are delivery of distributed sensor systems consisting of networks of tiny nanosensors.

Nanosensors

The nanosensing and bio-nanotechnology for the sensing aspect of this subtopic seeks to leverage breakthroughs in the emerging fields of nano-technology and biotechnology to develop advanced sensors and actuators with increased sensitivity and small size for solar system exploration. Technologies should provide enhanced capabilities over the current state-of-the-art and be able to operate in an extreme environments. This harsh environment includes steady operation and cycling in the temperature range of -180°C to 100°C, and high radiation. Of particular interest are harsh environment-operable nanosystems for single molecule sensing and manipulation, on-chip biomolecular analysis, and semiconductor laser diodes in the 2–5 µm and detectors in the greater than 15 µm wavelength range.

Flexible Electronics

Electronically steerable L-band phased array antennas are needed for missions to the Moon, Mars, Titan and Venus. L-band provides the capability to detect surface and subsurface topology including ice or features hidden by the surface dust. Flexible, lightweight active arrays enable better packaging efficiency for the antenna and are critical for these missions. Currently, manufacturing reliable passive arrays with required tolerances is challenging and the only method for integration of the electronics is to attach and interconnect the electronic components on the surface. This method is expensive, unreliable and impractical for large arrays. Technologies enabling large area flexible antennas including flexible electronics are needed. State-of-the-art flexible, printable electronics have low switching frequencies. Innovative new materials or processes will be needed to enable devices that can handle the gigahertz frequencies needed for radar. In addition, large area manufacturing methods are needed to manufacture these passive and active antennas.
Research should be conducted to demonstrate technical feasibility during Phase I and show a path toward a Phase II hardware and software demonstration, and when possible, deliver a demonstration unit or software package for JPL testing at the completion of the Phase II contract.