NASA seeks revolutionary, highly innovative, "transformational" communications and navigational technologies to potentially enable breakthrough performance improvements for science, exploration systems, and space operations mission applications. Research focuses on (but is not limited to) the following areas:

- Use of quantum entanglement or innovative breakthroughs in quantum information physics to specifically address curious effects and critical unknowns relevant to revolutionary improvements in communicating data, information, or knowledge between independent entities across space-time. Methods or techniques that demonstrate extremely novel means of effectively packaging, storing, encrypting (e.g., quantum key distribution), and/or transferring information or knowledge in space-to-space or space-to-ground links;

- Innovative methods of using X-ray or radio pulsar signals for precise navigation or positioning of spacecraft. Small, low mass, reliable detectors, improvements in position accuracy, digital signal processing advances for time of arrival, drift estimation, and position estimation;

- Development of nano-scale communication devices and systems (e.g., FET arrays, nano-antennas, nano-transceivers, etc.) for nano-spacecraft applications;

- RF Micro Electro-Mechanical Systems (MEMS) devices. MEMS devices have low spatial volume, are lightweight, and have low-power consumption, making them attractive to operate as high Q components and perform frequency selectivity (i.e., agile pre-selectors, multi-couplers, and diplexers). Selectivity, or Q, for band pass filters currently comes at an unacceptably high penalty in size and mass. At present, most high rejection diplexers for space-based radios are quite large. To build and design high performance, tightly coupled, low volume space radios, compact selectivity-determining devices are a critical enabler. Most high Q filters above 400MHz, such as inter-digital filters and others involving resonant cavities, are wholly mechanical assemblies which can be "folded" in their design and lend themselves to micro machining techniques; and

- Other areas of investigation to consider lie within the area between MEMS and micro-machined devices, including electromechanically tuned filters, 3D micro-machined RF resonators, filter configurations consisting of cantilevered structures, as well as carbon nano-tube waveguides. Development of RF MEMS circuitry that applies and demonstrates significant advantages that proliferate the implementation of next-generation lightweight communications systems.