Advanced Extravehicular Activity (EVA) systems are necessary for the successful support of future human exploration space missions. Advanced EVA systems include the space suit pressure garment, the portable life support system, tools and equipment, and mobility aids such as rovers. Exploration EVA missions require innovative approaches for maximizing human productivity and for providing the capability to perform useful work tasks. Top-level requirements include reduction of system weight and volume, increased hardware reliability, maintainability, durability, and operating lifetime, increased human comfort, and less-restrictive work performance capability in the space environment, in hazardous ground-level contaminated atmospheres, or in extreme ambient thermal environments. Areas in which innovations are solicited include the following:

Environmental Protection

- Radiation protection technologies that protect the suited crewmember from radiation;
- Puncture protection technologies that provide self-sealing capabilities when a puncture occurs and minimizes punctures and cuts from sharp objects;
- Dust and abrasion protection materials or technologies to exclude or remove dust and withstand abrasion; and prevent dust adhesion; and
- Flexible space suit thermal insulation suitable for use in vacuum and low ambient pressure.

EVA Mobility

- Space suit low profile bearings that maximize rotation necessary for partial gravity mobility requirements and are lightweight.

Life Support System
• Long-life and high-capacity chemical oxygen storage systems for an emergency supply of oxygen for breathing;

• Low-venting or non-venting regenerable individual life support subsystem(s) concepts for crewmember cooling, heat rejection, and removal of expired water vapor and CO₂;

• Fuel cell technology that can provide power to a space suit and other EVA support systems;

• Lightweight convection and freezable radiators for thermal control;

• Innovative garments that provide direct thermal control to crewmember;

• High reliability pumps and fans that provide flow for a space suit but can be stacked to give greater flow for a vehicle;

• CO₂ and humidity control devices that, while minimizing expendables function in a CO₂ environment; and

• Variable conductivity flexible suit garment that can function as a radiator for high metabolic loads and as an insulator during period of low physical activity and low metabolic rates.

Sensors, Communications, Cameras, and Informatics Systems

• Space suit mounted displays for use both inside and outside the space suit-outside mounted displays will be compatible with the space environment;

• CO₂, bio-med (heart rate and blood oxygen level), radiation monitoring, and core temperature sensors with reduced size, lightweight, increased reliability, decreased wiring, and packaging flexibility;

• Visible spectrum camera that provides environment awareness for crewmembers and the public and are integratable into a spacesuit that is lightweight and low power;

• Lightweight sensor systems that detects N₂, CO₂, NH₄, O₂, ammonia, hydrazine partial pressures, including self-powered sensors;

• Lightweight, low power, radio and laser communications with the capability to integrate audio, video, and data on the same data stream to provide reliable communications between the crew and a lander or habitat; and

• Low power, lightweight, radiation hardened, or radiation tolerant informatics computer systems with standard graphics outputs and standard audio inputs and outputs, capable of running commercial operating systems and applications.

Integration

• Robot control by EVA crewmember via voice control or other methods;

• Minimum gas loss airlocks providing quick exit and entry and can accommodate an incapacitated crewmember; and

• Work tools that assist the EVA crewmember during operations in zero gravity and at worksites; specifically, devices that provide temporary attachments, which rigidly restrain equipment to other equipment and the EVA crewmember, and that contain provisions for tethering and storage of loose articles such as tool sockets.
EVA Navigation and Location

- Systems and technologies for providing an EVA crewmember real-time navigation and position information while traversing on foot or a rover; and

- Systems and technologies for managing and locating tools during planetary surface science and maintenance EVA sorties.