NASA Centennial Challenges Workshop
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Thanks for inviting me to speak today. This workshop is an excellent way to reach out to a broad community of innovators for concepts that will be necessary to fulfill the Nation's objectives for space exploration. I would like to say just a few words about those objectives.

When Neil Armstrong first stepped onto the moon in 1969 it seemed that space had somehow been conquered, at least in the popular imagination. Today we know much more about the difficulties of space exploration by humans or machines, and our thinking about space has evolved with our growing awareness of its costs and hazards. If we truly want to make space part of the human domain, then we are going to have to have a sustained approach radically different from the singular effort of the Apollo program.

President Bush has framed such an approach to space exploration that is at once visionary and pragmatic. "In preparation for future human exploration," he said, "we must advance our ability to live and work safely in space and, at the same time, develop the technologies to extend humanity's reach to the Moon, Mars, and beyond." I believe the Nation's space enterprise will be strengthened by this vision, which will continue a brilliant record of NASA discoveries that have literally changed the way we view the universe.

The President's vision for space exploration is that of "a journey, not a race," a concept that differs profoundly from the Apollo paradigm of a single massive project requiring a large budget spike and a demanding schedule. The vision calls for an affordable and long term sustainable effort to achieve access to space, and in the President's words: "…extend the human presence across our solar system, making steady progress one mission, one voyage, one landing at a time." The President envisions that eventually humans will incorporate accessible space into their zone of routine activity. That entails the long term build up of capabilities – of infrastructure extending out from Earth – that lowers the cost and risk for all space missions.

The confluence of available resources and emerging technologies will pace the effort. The US will invest in R&D, and take advantage of capabilities in the private sector, "harvesting" technologies as they mature. In this new vision, milestones are established to guide planning on a series of discrete and mutually reinforcing technological projects, whose aim at each step is to reduce the cost and the risk of subsequent missions.

To sustain this process over the long term, and eventually make space a part of our economic life, requires innovation not only in technologies, but in how we do business. Not only do we need better end products; we also need to better processes for getting them. As I understand it, that is what today's Workshop is all about.

The *Centennial Challenges* are designed to tap the nation's ingenuity to make revolutionary advances that can support the President's Vision for Space Exploration. This kind of approach has many historical precedents. Probably many of you have read Dana Sobel's prizewinning book "Longitude," an account of an 18th century navigation prize. The "longitude problem," – how a ship could know its distance west or east from its home port – was an urgent issue, and an obstacle to the development of world trade.

Newton, Cassini, Galileo, and Halley – famous names to space cognoscenti – all attacked the longitude problem, but none of them managed a practical solution. In 1714, the British Parliament offered a prize of £20,000 (almost $4 million current dollars) to anyone who could solve the problem, and established a "Board of Longitude" of expert judges. More than half a century passed before the prize was awarded, and in the end it went not to a science super-star but to a Yorkshire carpenter turned clockmaker, John Harrison, who created the first accurate sea-going chronometer.

The *Centennial Challenges* are intended to create similar spirited competition. They are about going outside traditional sources, reaching out to entrepreneurs and individuals who are normally not part of the Nation's space activities. Like the 18th century navigation prize, the *Challenges* are about creating enabling technologies. The idea is not to achieve a stand alone product, but to forge components that make further sustained exploration possible.

The President's vision recognizes that new technologies required for sustained space exploration will enhance all space activities, and will likely provide Earth-side applications as well. Eventually, these entrepreneurial efforts will bring space within the economic reach of the Nation's – and the world's – business communities. Prizes like this also stir the public imagination, increase science-interest among young people, and create lively and attractive educational opportunities.

The *Centennial Challenges* concept is not a new invention. It is consistent with a recommendation from an important 1999 National Academy of Engineering report that called upon Congress to encourage federal agencies to experiment with inducement prize contests in science and technology. The report argued that prizes could help identify new or unorthodox ideas or approaches to particular intractable technical challenges, and complement traditional research and development. Prizes can have a broad range of objectives—some highly specified, others very broadly defined. Today's Workshop is designed to sift through the range of possibilities and identify approaches that fit the needs of the space exploration vision.

The *Centennial Challenges* is a great opportunity to build the broader technical community that will be needed to sustain space exploration in the long haul. I am pleased that such a wide diversity of participants is here today and I look forward to seeing the products of this meeting. Thank you.