
A NEW WAY TO LOOK AT THINGS

by

George C. Nield*

Good evening everyone.

I am not sure how many of you are aware of it, but today is the anniversary of a very significant event in the development of mankind's understanding of the Universe. It was on 24 May 1543, that Nicolaus Copernicus is said to have published his most important work, which was titled "On the Revolutions of the Celestial Spheres." Previously, based on the writings of Aristotle and Ptolemy, it had been assumed that the Earth was located at the very center of the universe. Copernicus rejected that approach. Instead, he showed how a model of the Solar System in which the Earth and other planets traveled in orbits around the Sun was better able to account for the observed motions of the heavenly bodies. Although Copernicus did not attempt to explain what would cause such motions, the publication of his heliocentric theory provided a new way to look at things, and it is often hailed as marking the beginning of the scientific revolution.

We have come a long way since then in our knowledge of physics, mathematics, and astronomy. At the same time, with the recent retirement of the Space Shuttle, we are currently in the process of undergoing a huge change

* Associate Administrator, Commercial Space Transportation, Federal Aviation Administration, Washington, DC, USA.

in how we travel to and operate in outer space, and how we think about spaceflight.

Ever since the very beginning of the space age, more than 50 years ago, almost every space activity, milestone, and accomplishment has been under the direction and control of national governments, which in the US has meant NASA or the Department of Defense. Going forward, that is not always going to be the case. From now on, private industry is going to be playing a very important role, especially for transportation to and from low Earth orbit, and for suborbital activities.

I have the privilege of leading the Office of Commercial Space Transportation, which is part of the Federal Aviation Administration (FAA). We have a two-fold mission: first, to ensure public safety during commercial launch and reentry activities, and second, to encourage, facilitate, and promote commercial space transportation. This is a very exciting time for us, and I'd like to take a few minutes tonight to describe what I see happening in commercial space, both now, and in the years ahead.

I mentioned the increased activity we are starting to see in the private sector. What are some of the reasons for this change in the American space program? First and foremost, there just is not enough money for NASA to do everything it would like to do, from aeronautics research and earth science, to operating the International Space Station (ISS), to exploring the solar system. But by turning over to industry some of the missions that are well understood, like sending cargo and astronauts into low Earth orbit, something that has been happening for more than 50 years now, NASA will be able to devote its time, energy, and limited budgetary resources to working on new challenges, like visiting an asteroid, or sending astronauts to Mars.

We are also starting to see some extremely supportive government policies, which recognise the importance of a healthy aerospace industrial base, and which encourage government agencies to reap the potential benefits of lower costs and increased innovation. The current National Space Policy, published in June of 2010, notes that "The United States is committed to encouraging and facilitating the growth of a US commercial space sector that supports US needs, is globally competitive, and advances US leadership in the generation of new markets and innovation-driven entrepreneurship."

We are seeing a number of those entrepreneurs, people who are truly passionate about space, putting their money and their efforts towards activities that are making a significant impact on the US space program.

An excellent example of that took place back in October of 2004, when Burt Rutan and his team at Scaled Composites successfully flew SpaceShipOne to the edge of space twice in a two-week period, thereby winning the US \$10 million Ansari X Prize. That was really proof of the fact that these days, with the amazing progress that has been made in technology over the last several decades, it does not necessarily take a government, with thousands of people, and billions of taxpayer dollars, in order to build a spaceship.

In fact, there are a number of wealthy individuals who have really stepped forward to make a difference. Paul Allen, one of the co-founders of Microsoft, helped to support Scaled Composites' efforts in the X Prize competition, and recently formed the Stratolaunch enterprise. Richard Branson, the leader of a wide range of international businesses, started Virgin Galactic with the intent of it becoming the world's first spaceline. Jeff Bezos, the founder of Amazon.com, created a company called Blue Origin to build and operate reusable launch vehicles. Elon Musk, who

invented the PayPal system for conducting financial transactions on the Internet, became the founder, CEO, and Chief Technical Officer of SpaceX.

Another aerospace entrepreneur is Robert Bigelow, who made his money in the hotel business, but who has formed a company that is building inflatable modules that can be used as part of a commercial space station. And do not forget John Carmack, a video game software programmer, whose team at Armadillo Aerospace went on to win NASA's Lunar Lander Challenge back in 2008.

It is important to recognise that when we are talking about space, it is not really a question of who does it better – government or industry. Government brings to the table the impressive expertise of its workforce, more than 50 years' worth of real-world space experience, and a continuing need for space products and services. At the same time, industry has demonstrated the ability to operate with lower costs, increased innovation, and perhaps a greater tolerance for risk than the typical government program. If we are able to find the sweet spot between government needs and industry capabilities, we have the potential for a real win-win partnership, with a genuine opportunity for progress.

Looking to the future, I see three different kinds of commercial space missions taking place over the next 10 years or so: missions intended to provide services to the government, such as transporting cargo or crewmembers to the International Space Station; missions that take advantage of previously-demonstrated technologies, but with new vehicles and new markets, such as suborbital space tourism; and missions related to exploration, with examples ranging from lunar rovers to Mars flybys.

A perfect example of a commercial services arrangement is NASA's Commercial Cargo Program. The Commercial Orbital Transportation Services or COTS effort,

for an US\$ 800 million investment, has resulted in the development of two new rockets and two new spacecraft, plus the supporting ground infrastructure and mission control capability to go with them. SpaceX has already completed its COTS program milestones successfully, and Orbital Sciences, with the recent launch of its Antares rocket, appears to be well on its way to doing the same. Both companies have signed fixed-price contracts with NASA, involving a total of 20 cargo delivery flights to the ISS.

When it comes to human spaceflight, NASA is currently working with three American companies that are interested in taking over the task of transporting astronauts to and from low Earth orbit: Sierra Nevada, SpaceX, and Boeing. NASA's current target date for one or more of those firms to deliver NASA astronauts to the International Space Station is 2017, but that is highly dependent on how much funding Congress provides for the program in NASA's upcoming appropriations.

United Launch Alliance, the launch operator of choice for both Boeing and Sierra Nevada, has continued to rack up an enviable success record with launches of the Atlas V and the Delta IV, which is scheduled to be used in an FAA-licensed test launch of NASA's Orion spacecraft in September of 2014.

NASA and the FAA have been working together very closely on the Commercial Crew Program, and one of the first issues that we had to resolve had to do with FAA licensing. Under current law, all US launches need to have an FAA license in place unless they are being conducted "by and for the government". The commercial crew launches will clearly be conducted "for" the government; however, they are not being done "by" the government; hence, an FAA license will be required. Under a Memorandum of Understanding on Commercial Human Spaceflight signed last year, all operational missions to the ISS will be licensed

for public safety by the FAA, with NASA retaining responsibility for crew safety and mission assurance.

Commercial companies have been making progress in other areas, too. For example, SpaceX has been trying out vertical takeoffs and landings with a rocket-powered system they call Grasshopper at their test site in McGregor, Texas. The tests are intended to eventually allow the first stage of their Falcon 9 launch vehicle to fly back to the launch site for refurbishment and reuse.

NASA recently announced that it had awarded a US\$ 17.8 million contract to Bigelow Aerospace to attach what will essentially be an extra room to the International Space Station. The Bigelow Expandable Activity Module will remain attached to the Station for a two-year test period, which should allow us to learn a lot about how inflatable modules can be operated in a space station environment.

One of the frontrunners in the suborbital arena, Virgin Galactic, has successfully completed more than two dozen glide flights of SpaceShipTwo out in Mojave, California, and they just had their first rocket-powered test in April 2013. Once the flight tests are complete, Virgin will be moving out to Spaceport America in New Mexico, which will be the primary location for their initial commercial operations.

Right now, there are eight FAA-licensed spaceports in the US, but that number may be increasing in the near future. We have recently been contacted by state and local officials in Alabama, Georgia, Texas, Colorado, and Hawaii, all of whom are interested in pursuing the possibility of a spaceport in their state.

Several of the suborbital vehicle developers are already looking at how to broaden their markets beyond just Space Tourism or suborbital science. For example, Virgin Galactic is planning to use its WhiteKnightTwo carrier

aircraft in conjunction with an expendable upper stage they call LauncherOne, to take small satellites all the way to orbit.

Paul Allen and his team at Stratolaunch are planning to use the same basic approach, but on a much larger scale. The carrier aircraft for this venture will be the largest aircraft ever built, with a wing span of 388 feet. Scaled Composites is under contract to build the aircraft, which will be powered by six engines from Boeing 747s. Orbital Sciences has been given the task of building the launch vehicle. Design work for these systems is now well underway, and there is a huge new hangar that has been constructed out at Mojave to support the manufacture and assembly.

When it comes to exploration efforts beyond low Earth orbit, one might assume that most of the work would be done by the government, but we are starting to see quite a few private sector initiatives as well. The Google Lunar X Prize is offering US\$ 30 million in prizes for non-government teams that can successfully land a rover on the moon, translate over the lunar surface, and send back high-definition video, before the deadline of 31 December 2015. There are currently 23 active teams who are in the hunt, and it will be interesting to see how many teams will be able to actually launch some hardware. As a government agency, NASA is not eligible to compete for the prize money, but they have promised to purchase some of the data that is collected.

Space Adventures, which has previously arranged all eight orbital space flights by private citizens, has worked out a plan with the Russians to allow two people to fly in a modified Soyuz spacecraft as part of an Apollo 8 style fly-around of the Moon. The ticket price is said to be on the order of US\$ 100 million.

Last December, a group called Golden Spike announced their intention to organise and conduct 2-person

scientific expeditions to the surface of the Moon. They believe that once the initial design and development have been completed, funded by an investment of around US\$ 6 billion, individual missions could be accomplished for approximately US\$ 1.5 billion each, about the same cost as some of NASA's recent robotic missions.

Rusty Schweickart and Ed Lu, a couple of former NASA astronauts, have formed the B612 Foundation, a 501(c)(3) non-profit organisation, and have partnered with Ball Aerospace to build, launch, and operate an infrared telescope that will be able to locate hundreds of thousands of asteroids that cannot be tracked with current telescopes.

Dennis Tito, the original space tourist, a couple of months ago announced the formation of a group called Inspiration Mars, which hopes to conduct a privately-funded, 501-day mission to Mars. The plan would be for a two-person crew to fly to within 100 miles of the surface of the red planet, using a free-return trajectory, after launching in January of 2018. There are certainly plenty of skeptics, but when it comes to ambitious, audacious, and inspiring projects, this one will be tough to beat.

Since this is an international conference, it is important to point out that exciting new space initiatives are not just limited to the United States. In fact, we are seeing great progress being made all around the globe, ranging from design work on next generation launch vehicles and spaceports, to the development of new laws and regulations for commercial space transportation.

There are several new suborbital vehicles in development in Europe from such companies as EADS Astrium, Swiss Space Systems, Booster, and Reaction Engines. We have even seen proposals for high altitude balloons that can carry people to the edge of space.

In addition to countries that already have facilities for launching expendable rockets, there is a lot of discussion about the development of spaceports that could attract suborbital vehicles designed to carry people. Some of the locations said to be under consideration include Curacao, Japan, Singapore, Spain, Sweden, the United Kingdom, and the United Arab Emirates.

So that is a quick rundown on what has been happening in commercial space. It is a pretty exciting time. And one of the reasons for that is that we are now tantalisingly close to a situation in which anyone who can afford to buy a ticket is going to have an opportunity to personally experience spaceflight. I would be happy to answer any questions you may have, but before I do, I have got a question for you.

Are you ready to go?