

# Coming soon: Ticket to ride?

The brilliant Sun blazing in an ink-black sky was instantly familiar. So was the vista of Earth, its clean tans and grays stretching to a horizon softened by the delicate blue of the atmosphere. The video of brightly colored M&Ms and motes of dust drifting weightless in the cockpit took me back to my own sense of wonder at first experiencing the sights and sensations of free fall. But this sky-high view didn't come from the flight deck of the space shuttle—it was the cockpit of SpaceShipOne, last fall's winner of the Ansari X-Prize competition for suborbital flight.

When pilot Brian Binnie flared SpaceShipOne smoothly over the Mojave, Calif., runway and brought his prototype rocket ship back to Earth on October 4, 2004, he and designer Burt Rutan opened the era of private suborbital sightseeing. Coming on the heels of the vehicle's second successful subor-

bital venture above 100 km on September 29, the back-to-back flights by Binnie and Scaled Composites LLC test pilot Mike Melvill captured the \$10-million Ansari X-Prize.

The spaceborne triumph gave a coordinated boost to the September announcement by entrepreneur Sir Richard Branson that SpaceShipOne would serve as the prototype vehicle for his passenger-carrying rocket plane service, Virgin Galactic. The new Virgin Group spinoff plans to offer suborbital hops aboard the flagship VSS Enterprise beginning in 2007. The price? A mere \$190,000.

### Gauging demand

Branson and Rutan will probably have plenty of customers. A 2004 analysis by Futron, a Bethesda, Md., consulting firm, found that the budding space tourism industry will tap into strong demand from adventure travelers. In a Zogby poll of 450 wealthy Americans, 19% said they would be willing to spend \$100,000 for a 15-min, 50-mi.-high suborbital flight, and 7% said they would pay \$20 million for a two-week trip to orbit.

By 2021, Futron predicted, suborbital spaceflight could generate 15,000 passengers a year and \$700 million in annual revenues. Orbital expeditions, although more daunting technically (and thus more expensive), could nevertheless draw up to 60 passengers a year and produce annual revenues of \$300 million.

### Launching commercial spaceflight

Efforts to establish a commercial space tourism market have made headlines but only fitful skyward progress over the past 15 years. Japanese reporter Tohiro Akiyama and Mars Confectionery chemist Helen Sharman visited the Mir station separately in the early 1990s, but their visits were sponsored by employers or commercial concerns; the guest cosmonauts did not have to come up with the cash themselves. Two more recent flights to the International Space Station, by Dennis Tito of the U.S. and Mark Shuttleworth of South Africa—who paid \$20 million each for the privilege—marked the true beginning of privately funded space tourism.

Although these two visitors to LEO felt they had come close to experiencing paradise, the Russian sale of tourist seats to the ISS was not a match made in heaven. Tito's visit, the first to ISS by an adventure traveler, generated chronic headaches for NASA in the months leading up to his April 2001 arrival at the station. Dan Goldin, then the NASA administrator, opposed the visit at first, saying it would upset operations and adversely affect safety; he reluctantly compromised when it became apparent that the cash-strapped Russian space agency would launch Tito to ISS no matter how much NASA protested.

With the visit officially sanctioned at last, the Expedition Two crew welcomed Tito aboard, but NASA astronauts Jim Voss and Susan Helms were put in the awkward position of having to tell their fellow citizen that the U.S. modules on the station were off limits.

"Being good soldiers, we tried to honor what our management was telling us that we had to do, [while] still trying to be reasonable people and good crewmates," said Voss in 2003. "There was only one real incident where I questioned where Dennis was going, because he was in part of the U.S. segment where he wasn't supposed to be."

*SpaceShipOne launched from near the dry lakebeds near Edwards AFB, and Mojave, Calif., at bottom left. Los Angeles is at top left, the Mojave Desert bottom left, and the snowcapped Sierra Nevada at center right.*





Two Soyuz Taxi crewmembers, South African spaceflight participant Mark Shuttleworth (left) and flight engineer Roberto Vittori of ESA, and cosmonaut Yuri I. Onufrienko (center), Expedition Four mission commander, float in the Unity node on the ISS. The Taxi crew arrived at the orbital outpost on April 27, 2002, as the two vehicles flew over Central Asia. Onufrienko represents Rosaviakosmos.

Shuttleworth's week-long stay aboard ISS a year later went more smoothly. Expedition Four flight engineer Carl Walz reported that "Mark Shuttleworth wasn't a typical tourist. He paid for his own flight up [and] spent his own time and his own money to develop experiments...to try to make that a meaningful experience not just for him, but also for South Africa." But the visiting crew inevitably disrupted work routines, and raised carbon dioxide levels so high they briefly overwhelmed the station's atmospheric cleansing capability, literally giving headaches to the expedition residents. "It was very noticeable," says Walz.

Helms of Expedition Two points out that, like a nuclear submarine, the ISS was not designed for tourism. "It's an operational vehicle that's doing a very serious mission. Just as it can be dangerous under improper conditions to take tourists aboard operating nuclear submarines, I feel [the] station is in the same category. However, I think that space tourism is a fantastic idea. I'm not one of those people who think space ought to be for just a special few." Helms suggests that a dedicated hotel destination geared to space tourism, analogous to a dive boat or small cruise ship, would provide a better experience for paying guests.

### From suborbital to orbit

The successful SpaceShipOne flights are an undeniable breakthrough on the way to making LEO a vacation destination. Although it came 43 years after Yuri Gagarin's first orbital flight and Alan Shepard's suborbital Mercury mission, Rutan's Scaled Composites achievement is remarkable. His innovative design relied not on a military ballistic missile, but on a reusable carrier aircraft/spaceplane combination that merged new materials with a clever flight profile to take direct aim at the X-Prize.

SpaceShipOne exceeded the 62-mi. (100-km) competition threshold by attaining a peak velocity of about Mach 3 (2,150 mph). By contrast, Shepard's MR-3 flight atop a Redstone ballistic missile in 1961 reached a speed of 5,134 mph and an altitude of nearly 116 mi. By aiming carefully at the 100-km altitude mark, Rutan avoided the near-1,000 F reentry heating experienced by Shepard's Freedom 7 capsule.

SpaceShipOne's composite structure also did not have to stand up to the 11.6 gs Shepard faced on reentry. As pilots Melvill and Binnie fell back into the atmosphere, with their ship's movable tail booms locked in a stable, shuttlecock configuration, they encountered a relatively mild 5-g deceleration.

Rutan says that he wants to give passengers aboard future versions of SpaceShipOne at least the same

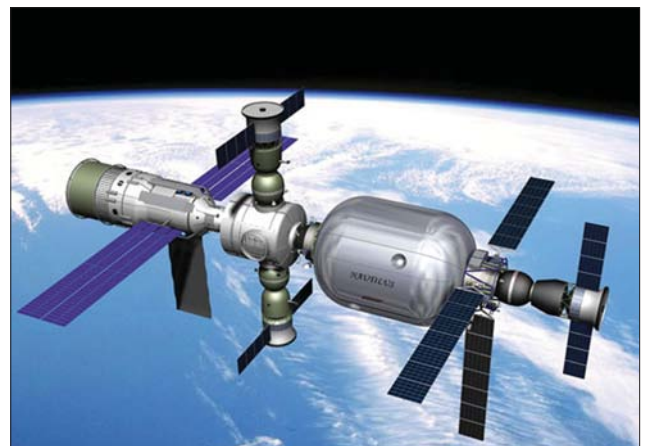
safety margins as those of early airliners like the 1930s-vintage Douglas DC-3. His ship's three impressive flights above 100 km prove he has a workable approach to that goal.

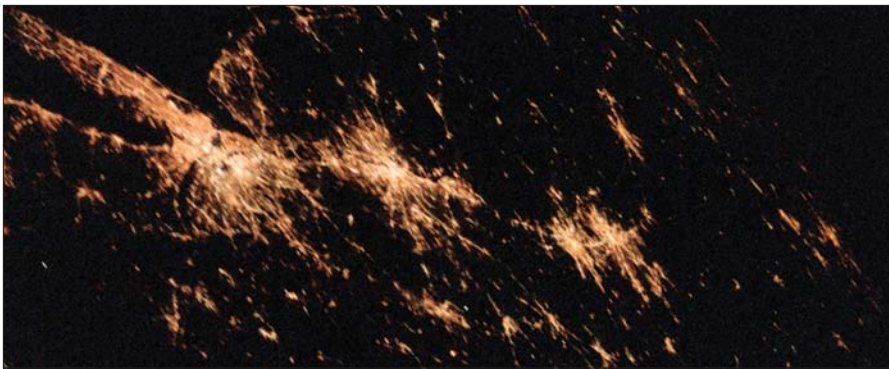
But these first flights were pioneering test missions and encountered problems (such as the uncommanded series of rolls on the first X-Prize run in September) that will need to be ironed out before commercial flights take wing. Rutan and Branson know that safety is one of the keys to luring customers—and turning a profit. Says Branson, "It's an adventure where we hope to make money, because I don't think space has a future unless people make money."

Beyond SpaceShipOne and the advent of suborbital commercial trips lies a much more daunting challenge: private orbital flight. Hotel executive Robert Bigelow, founder of Bigelow Aerospace, has challenged the commercial space industry to compete for America's Space Prize, a \$50-million purse that goes to the first outfit to launch five or more space travelers to Earth orbit before January 10, 2010. The winning team will have to orbit the Earth twice at 250 mi. or higher, then repeat the achievement within 60 days.

The technical challenges are enormous; an orbital vehicle will need nearly 30 times the kinetic energy of SpaceShip-

*Bigelow Aerospace has challenged the commercial space industry to compete for America's Space Prize, and the company is working on a competitor of its own.*





This beautiful view of the East Coast is one of the payoffs for tomorrow's space traveler.

One to reach orbital velocity. Protecting a lightweight composite structure from the scorching heat loads of reentry—nearly 3,000 F—will require a robust heat shield, either reusable or easily replaceable. But Rutan has already claimed he has plans for just such a vehicle, and his competitors in the X-Prize contest say they, too, are moving on to the orbital challenge.

### The experience

Rutan's X-Prize achievement and Bigelow's new orbital goal already have sparked the same public excitement about commercial spaceflight that Charles Lindbergh generated for air travel with his 1927 solo New York-to-Paris flight (he won the \$25,000 Orteig Prize for that first non-stop transatlantic journey). But space entrepreneurs would be wise not to oversell the actual experience of suborbital flight.

At most, passengers on a commercial version of SpaceShipOne will get 10 minutes of free fall—barely enough time to unstrap and bob a few tentative inches out of their seats. There will be little time for taking in the scenery. And how many times can you twirl a pen or a camera in front of you before it becomes old hat?

Space tourists will truly experience space only when they can achieve orbit. And private space travelers are unlikely to be satisfied with just the minimum couple of orbits specified by America's Space Prize, because most will feel less than exuberant in free fall for those first few hours. Even with preventive medication, space adaptation syndrome (the headward bodily fluid shift and inner ear upsets that begin immediately upon entering free fall) keeps most astronauts feeling a bit "fragile" on their first day in orbit.

About two-thirds of first-time space

passengers will feel some symptoms—nausea, headache, congestion—under the assault of this strange environment. Ideally, a tourist should stay aloft for at least two days (including a night's sleep) to truly enjoy the physical experience of free fall. To get the most from it, and from the spectacular vantage point, prospective tourists will need an orbital hotel.

The digs won't have to be as sophisticated as the orbiting Hilton created by Stanley Kubrick in the 1968 film *2001: A Space Odyssey*—just the basic facilities for food and hygiene, a generous amount of window space, and enough elbow room to really experiment with free fall. The firm that offers a spaceflight package with those elements will have customers lined up at the base of their launch pad.

### Tourists and pioneers

For 40 years, spaceflight has been almost entirely the exclusive domain of test pilots, scientists, and engineers—professional explorers, if you will. That era is ending. No longer will space be a mysterious, little-understood adventure granted only to astronauts. And that's a good thing. Greater access to space and its remarkable experiences will build the public excitement and demand that can support ambitious exploration of the Moon, the asteroids, and Mars. To sustain a decades-long program of vigorous solar system exploration, entrepreneurial space commerce—including tourism—must thrive in Earth orbit.

If privately built craft like SpaceShipOne can blaze a commercial trail to orbit, NASA should shift its basic Earth-to-orbit transportation needs to a smart, profit-driven, yet safety-minded contractor. Freed of shuttle-era costs for deliveries of crew and cargo to the ISS and other LEO

destinations, the space agency could devote its always-strapped resources to more distant frontiers. And competition in Earth-orbit access can be only good news for a host of commercial activities, from tourism to entertainment to manufacturing, which are now too expensive to get off the ground.

The high public interest in the exploits of Rutan and his imperturbable band of space pilots is just the first swell of a wave of fascination that will come with regular suborbital, and then orbital, commercial space travel. Already, companies like Zero-Gravity and Space Adventures offer enthusiasts some of the thrills of astronaut training; the latter firm promises to offer its own suborbital flights (using a Russian-built vehicle) soon. For armchair space explorers who aim higher than Earth orbit, it should be possible within a decade to teleoperate a commercial rover on the lunar surface. Soon after, students and virtual reality tourists may explore a corner of Mars from their desktops using data gathered by robot explorers.

It will be decades before adventure travelers head for the Moon and beyond, but Earth orbit, just a hundred miles up, will always offer the memories of a lifetime. On a science mission aboard Columbia eight years ago, I spent off-duty hours with my STS-80 crewmates drifting weightless on the flight deck, drinking in views of the night sky and our darkened planet below. With our faces filling the shuttle windows, we gazed down at Earth, and I tried to capture our sense of wonder on my tape recorder:

*Now I can look out over the tail, from the port overhead window, and see the curve of the West Indies, from the Virgin Islands all the way down towards the South American coast...Montserrat, Martinique, and Grenada...you can see them curving all the way down...all outlined in lights. Just saw a meteor enter right over these little West Indies, southeast of St. Thomas. The Southern Cross is over there to the southeast of us, on the southern horizon. And now we're out over the Atlantic...Vernier jets now firing with one- or two-second pulses. I see the tail slightly glowing, silhouetted by the backwash [exhaust] of the verniers. That was a marvelous pass.*

When can I get a return ticket?

**Thomas D. Jones**  
tjones.aiaa@cox.net