LauncherOne: Revolutionary Orbital Transport for Small Satellites

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ABSTRACT

Virgin Galactic offers LauncherOne, an affordable, dedicated, and responsive ride to orbit for small satellites. No longer will small satellite users be forced to choose among the limitations of flight as a secondary payload, paying dramatically more for a dedicated launch vehicle, or waiting for timely access to space. We are leveraging our background as the world's first commercial spaceline, specifically through the development of the SpaceShipTwo suborbital passenger and cargo system and the WhiteKnightTwo carrier aircraft, to bring LauncherOne to market. LauncherOne will be capable of delivering on the order of 500 lbs (225 kg) to LEO, ideally suited to service the growing microsatellite community and specifically ESPA-class payloads.

VIRGIN GALACTIC COMMERCIAL SPACELINE

Virgin Galactic, a privately funded company, is on track to become the world's first commercial spaceline. We are a U.S. company with research, development, manufacturing, and operations capabilities spread across multiple locations. We are currently building and operating three vehicles:

- SpaceShipTwo (SS2): Air-launch sub-orbital spacecraft for 8 passengers (2 crew, 6 customers).
- LauncherOne (L1): Air-launch orbital launch vehicle for small satellites.
- WhiteKnightTwo (WK2): Air-launch platform for carrying SS2 and L1 to 50,000 feet for safe release.

Virgin Galactic was founded 2004 to commercialize the technology behind SpaceShipOne and WhiteKnight, the Ansari X PRIZE-winning suborbital spaceflight system that made history by becoming the first privately-built vehicle to safely carry human beings into space. Beginning in 2005, Virgin Galactic began work on a larger, more advanced version of that spaceflight system. Like its predecessor, this system consists of two vehicles: the mothership, WhiteKnightTwo, and the air-launched suborbital spacecraft, SpaceShipTwo. Both of these vehicles have been constructed and have made substantial progress through their test flight programs. WhiteKnightTwo has flown more than 100 times and SpaceShipTwo has conducted numerous subsonic glide tests and most recently a supersonic (Mach 1.2) powered flight test. These vehicles are designed for frequent, affordable, and safe suborbital voyages, and customers range from tourists to researchers and educators to automated payloads.

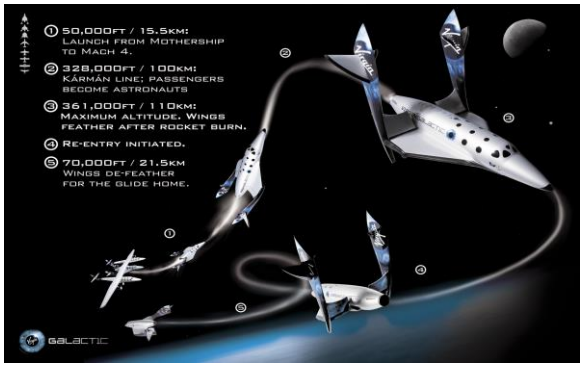

Figure 1: SpaceShipTwo (SS2) Mission Profile

Figure 2: SpaceShipTwo (SS2) First Powered Flight (April 2013)

Both SpaceShipTwo and WhiteKnightTwo share much of the same basic design as SpaceShipOne and its mothership, but are being built to carry six customers

on sub-orbital space flights, allowing an out-of-the-seat, zero-gravity experience and offering astounding views of the planet from the black sky of space.

In late 2011, NASA became a customer of research payload flights on board SpaceShipTwo, purchasing a full flight with options for further flights through the Flight Opportunities Program.

Our suborbital test flight program is well under way, and we expect to begin commercial operations, which will be based at Spaceport America in New Mexico, in the near future. Already, more than 580 future astronauts have signed up to fly to space with us, along with a growing number of researchers and educators who want to affordably fly their payloads to space.

LAUNCHERONE OVERVIEW

In July 2012, Virgin Galactic announced LauncherOne, which is designed to give satellite operators a radically better option for carrying their small satellites into orbit. The system is also designed to deliver significant responsive launch capability.

No longer will small satellite users be forced to choose among the limitations of flight as a secondary payload, paying dramatically more for a dedicated launch vehicle, or waiting for timely access to space.

LauncherOne will be capable of delivering on the order of 500 lbs (225 kg) to a low inclination Low Earth Orbit (LEO), and 225 lbs (100 kg) to a higher altitude, Sun-Synchronous Low Earth Orbit. Payloads will be accommodated within a fairing approximately 40 inches (1 meter) in diameter.

LauncherOne itself is a two stage, liquid propulsion (LOX/RP) rocket released at a high altitude by WhiteKnightTwo. LauncherOne's horizontal launch approach allows operations from a variety of locations, allowing customers to select various launch azimuths and increasing available orbital launch windows.

LauncherOne is being designed for easy integration of ESPA-class payloads. L1 will be configurable for dedicated primary or multiple primary microsatellite-class payloads, including being able to accommodate multiple CubeSat dispensers. We will provide several classes of service (e.g .power, telemetry, etc.) ranging from minimal interfaces to more custom oriented solutions.

In general, our approach to LauncherOne leverages Virgin Galactic's commercial space system development, manufacturing, integration, test, and operations personnel and facilities to distribute costs. For instance, we use much of the same infrastructure originally created to support SpaceShipTwo-in particular, our unique, high-performance mothership, WhiteKnightTwo.

In the near term, for LauncherOne operations, WhiteKnightTwo will be based at Spaceport America. After coordinating with the customer and with regulatory bodies like the FAA, WhiteKnightTwo will fly out to the customer's desired launch facility and conduct operations from there. Our system allows for a minimal amount of ground infrastructure and the minimum level of range costs for our customers. For the foreseeable future, LauncherOne operations will be conducted from the United States. We anticipate commercial operations to commence in 2016.