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The rocketplane phoenix suborbital satellite launch spaceplane

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Rocketplane Global Inc (RGL) is continuing its preliminary engineering and development effort for its Mach 12 spaceplane design, based on a 20 year legacy of systems engineering for a variety of high Mach suborbital spaceplanes. The RGL Phoenix spaceplane is a winged horizontal takeoff and landing configuration using military turbofans for takeoff and landing and a LOX/kerosene rocket engine for the main propulsion on the zoom climb to a Mach 12 140 km apogee. Once the rocket engine shuts down and the vehicle is on a ballistic coast the payload bay doors are opened and the satellite payload and upper stage stack are released in a gentle exo-atmospheric mechanical separation. The upper stage is then ignited, taking the payload on its insertion trajectory. The spaceplane closes the payload bay doors and orients for reentry. Once the vehicle has completed the reentry deceleration maneuver and is in a subsonic glide the jet engines are restarted for a powered landing – either at the original spaceport or at a downrange recovery runway. A key enabling technology for this system is the use of a KDC- 10 tanker aircraft to transfer the majority of the propellant load to the spaceplane once the vehicle is in the air and flying at normal subsonic jet speed. The tanker carries the 64,000 kg of LOX plus additional kerosene to replace the fuel used by the turbofans during takeoff and the tanking maneuver. By taking off "light" with only a fraction of the fuel and oxidizer required and then transferring this propellant load in flight, the vehicle dry mass fraction challenges are greatly reduced. This in turn reduces vehicle development and operations cost and enables the disruptive reduction in launch price to less than $20 million for a 2 ton LEO satellite or deployment of multiple 150 kg microsats from a dispenser. The vehicle is piloted, for several reasons. First, the aerial refueling maneuvers are routine for military aviators while autonomous aerial refueling technologies are still at an early stage of development and testing. Second, the vehicle architecture has applications for point-to-point transportation in and out of existing airports. This will require pilots onboard for both regulatory and customer acceptance reasons. This paper will present the RGL Phoenix spaceplane architecture and operations concepts, and the engineering legacy of multiple spaceplane design iterations which underlie the design. The projected launch price of less than $10,000/kg also enables the creation of new markets such as satellite assembly and servicing, as well as providing direct GTO access for a new generation of small GEO satellites in the 400 kg class which are now beginning to be discussed. The same trend of satellite bus miniaturization that has become common in LEO systems can now start to provide significant economic benefits to the GEO satellite community, especially when coupled with in-space fabrication and assembly technologies.

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