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LAUNCH VEHICLE OPTIMIZED FOR CERTAIN LEO/VLEO SATELLITES AND CONSTELLATONS

Abstract

Recently there has been an enormous surge in proposals for satellites in Low Earth Orbit (LEO)and Very Low Earth Orbit (VLEO)worldwide. The ITU has received over 70 requests last year for orbital registering such satellites in various radio frequency bands. These satellites are generally in constellations numbering from a few satellites to over a 1000 (e.g., OneWeb, SpaceX, etc.). The LEO/VLEO satellite implementation surge is in part due to low transmission time latency of these orbits for communications as compared to geosynchronous orbits and the more effective operation of optical/environmental sensors when closer to the earth's surface. There is no single launch vehicle which could meet all LEO/VLEO requirements effectively and economically. For the very large LEO/VLEO constellations, the use of large launchers (i.e., Ariane, Falcon9, Long March, etc.) is chosen so that many satellites can be launched simultaneously for quickly populating the constellation. However, for smaller constellations, other launch characteristics are required. One is that the total cost of the launch, including transportation and testing of the satellite(s)at the launch site, is low. Secondly, the ability to launch quickly, particularly in response to an orbital satellite failure. LEO/VLEO satellites can fail due to lifetime limits, internal equipment malfunction, premature re-entry and collision with orbital debris, the latter being a very significant problem at these orbital altitudes. A third characteristic is to be able to launch quickly from a site close to the satellite manufacturer into the required orbit without the bureaucratic delays currently typical of the major launch ranges. Lastly, launch sites may also be required to be in specific latitudinal areas to have an efficient propulsion profile for a desired orbit. The paper describes a launch vehicle under development which provides the above characteristics. Among its features are low cost, high availability, and launch flexibility, including launch from a water based platform which can be docked for launch or used to launch from an ocean position. Another feature is the use of IDRS, which allows for transmission of the launch vehicle TTC (Tracking, Telemetry Command) directly to/from desired control centers instantaneously without resort to launch range TTC facilities. The IDRS capability can also be extended to the satellite being launched up to final stage separation. The launch vehicle employs an aerospike propulsion engine to provide efficient thrust throughout main engine operation. The engine provides for a fully reusable SSTO (single stage to orbit).