

IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Future Space Transportation Systems (4)

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## ASSESSMENT OF MULTIPLE MISSION REUSABLE LAUNCH VEHICLES

**Abstract**

Recently, the launcher development has become highly dynamic again. Major technical successes are achieved in rapid succession. Key players are the US companies SpaceX and Blue Origin. Falcon 9 is now routinely returning the used first stages with high accuracy back to Earth. The successful first launch of Falcon Heavy is another impressive achievement with almost synchronized landing of the side boosters. Blue Origin demonstrated reuse of suborbital stages with New Shepherd and is now working on a much larger, partially reusable launcher New Glenn. The ultimate challenge is raised by the announcement of Elon Musk at the last IAC, intending as soon as possible the development of a fully reusable two-stage launcher to LEO of very large size, called “BFR”. This vehicle should be more than a classical launch system with payload release in orbit. Besides delivering heavy cargo up to 150 t, the BFR is planned as an interplanetary manned space-ship and as an ultrafast rocket-based point-to-point transport on Earth. These are quite diverse missions to be served by the same or similar or at least a vehicle. Multiple mission reusable launch vehicles could be an interesting and attractive option of the future with cost saving potential. A similar RLV-configuration capable of fulfilling very different needs might significantly reduce the development effort compared to individual developments of several dedicated crafts. Further, production reaches higher numbers for the same type which likely has a positive impact on manufacturing expenses.

However, the technical side of the multiple mission reusable launch vehicles might be very demanding. Overstretching the mandatory technical requirements to fulfill diverse tasks has a detrimental effect on cost savings. An appropriate compromise is to be looked for.

DLR’s SpaceLiner concept is similar in certain aspects to the idea of multiple mission reusable launch vehicles. While in its primary role conceived as an ultrafast intercontinental passenger transport, in its second role the SpaceLiner is intended as an RLV capable of delivering heavy payloads into orbit. Simulations proof that the SpaceLiner orbital version stays within the load constraints of the PAX-version which confirms feasibility of the multiple mission intention [1].

The paper provides multidisciplinary technical analyses of the different proposed multi-mission RLV-concepts. The characteristic flight conditions of winged gliding stages with those of rocket-decelerated vertical landing vehicles are compared. Performance, size and safety aspects are evaluated.