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Author: Prof. Jean-Marc Salotti

Laboratoire de l'Intégration du Matériau au Système, France, jean-marc.salotti@ensc.fr

EUROPEAN MARS MISSION ARCHITECTURE USING AN ENHANCED ARIANE LAUNCHER

Abstract

In a recent paper, it was proposed to revisit Mars semi-direct and to use 4 Space Launch System (American launcher) and Orion to implement a human mission to Mars. We address the same problem but from the European viewpoint with European capabilities. Interestingly, possible evolutions of the Ariane 5 rocket for a Mars mission have already been studied. The Ariane Super Heavy launcher has 100 tons LEO capability and 36 tons capability for transMars injection ($V_{infini}=3.5\text{km/s}$). In order to simplify the scenario and to minimize the costs, it is proposed to avoid the assembly of a huge vehicle in LEO and to send all vehicles directly to Mars as originally suggested by Zubrin in Mars semi-direct. 5 Super Heavy Ariane launches are required in this architecture. The 5 payloads are: 1) Mars ascent vehicle; 2) Consumables and surface vehicles; 3) Habitable module (for outbound trip and surface) 4) and 5) the 2 parts of the Earth return vehicle. There are several advantages: First, whatever the payload, it is possible to use the same landing space vehicle with mass and size compatible with the payload capability of the launcher. Second, the use of relatively small landers allows the use of simple deployable rigid heatshields, which could be used for aerocapture and atmospheric entry. The use of small landers also reduces the complexity of the tests for the qualification of the descent and landing systems and procedures, which is a critical aspect of the preparation phase. All in all, as this architecture is relatively simple and based on a relatively low cost evolution of the Ariane rocket (same Vulcain 2 engines), it could be well considered an interesting and affordable option for European countries if they had the will to participate to human space exploration beyond Earth orbit.