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ARCHITECTURAL ANALYSIS OF THE GATEWAY

Abstract

As humans move out of the low earth orbit and into cis-lunar-space new challenges must be faced. This paper analyzes and discusses a possible architecture, from the orbit selection to the life support system and concept of operations of a potential cis-lunar space station. The investigation will not focus directly on the planned Gateway concept, but will use an independent approach for the concept definition and the analysis. The final part of the analysis is the identification of differences between the newly developed architecture and the currently proposed architecture from NASA. The pro and cons of both concepts are then discussed. The first part of the architecture is the life support system, which is analyzed with a combination of multi-criteria analysis and Equivalent System Mass to select an optimal life support system. Additionally, the required initial launch mass of the systems as well as the required continuous resupply mass is calculated based on the selected life support system. The next step is the selection of a suitable orbit, which is performed by using the System Tool Kit to develop an optimization tool for the overall delta-v demand of the mission. The optimization considers the calculated mass and volume requirements from the initial analysis as transportation requirements for the Earth – Gateway orbit. In addition, different further mission to the lunar surface and/or Mars can be defined to identify trade off points between different orbits that might be preferable for different combinations of Earth – Gateway, Gateway – Moon and Gateway – Mars flights. For the further analysis a suitable orbit which minimizes the overall delta-v demand of the architecture is selected. Based on the calculated required delta-v and transport requirements possible launch vehicles and their suitability to the mission are discussed. In addition, a concept of operations is presented. The concept is based on an interface minimization approach which considers the number and complexity of interfaces and minimizes the overall complexity of interfaces between different international ground control centers and the individual console positions of the ground control centers. The developed architecture is then compared to the currently proposed architecture of Gateway where possible and applicable.