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Near Term Strategies for Lunar Surface Infrastructure (1)

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BUILDING BLOCKS ANALYSIS FOR FLEXIBLE SPACE EXPLORATION ARCHITECTURES

Abstract

While system and mission design for a specific objective or destination has been successfully demonstrated repeatedly and is well understood, the complex design and optimization of exploration architectures pose a greater challenge. They often have to address multiple goals and objectives from various stakeholders, to incorporate human as well as robotic assets and missions, to provide flexibility and sustainability programmatically and technically in a highly politicized environment, and to outline a time-dependent development and integration of capabilities. Thus, space exploration architecture development is not only a systems-of-systems task, but furthermore a thorough assessment of functions and their distribution between systems and over time.

The approach outlined in this paper provides an analysis of driving aspects and requirements for exploration architectures and brings them in context with destinations and capabilities. This allows the identification of functional distributions and of architecture building blocks, that can best address the needs of a given campaign, but that are also able to be rearranged in case of changed priorities or architecture trades. It is achieved by a careful analysis of building block size with respect to transportation capabilities, where each building block represents a function rather than necessarily a full system. By doing so, greatest flexibility in the combination of building blocks can be achieved, while similarities between destinations can be incorporated.

An example of this approach is presented in the analysis of lunar exploration architectures. The challenging aspect is finding the minimum amount of building blocks to represent all required architecture functions while allowing a maximum of combinations regarding time-dependent, location-dependent and programmatically influenced campaign implementations. It is used to outline different lunar surface exploration scenarios with both fixed and mobile assets and varying financial perspectives.