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BUILDING AN ECONOMICAL AND SUSTAINABLE LUNAR INFRASTRUCTURE TO ENABLE HUMAN LUNAR MISSIONS

Abstract

To enable return of human missions to the surface of the Moon, a new plan was formulated to gradually develop an evolvable, economical and sustainable lunar infrastructure using a public-private partnerships approach. This approach would establish partnerships between NASA and industry to mutually develop lunar surface capabilities in the development phase and then allow for transfer of operation of these infrastructure services back to its industry owners for commercial use. These infrastructure services include: power stations, energy storage devices, communication and navigation satellites and towers, thermal management systems and human life support systems for human habitats. The public/private partnerships approach for this study leverages best practices from NASA's Commercial Orbital Transportation Services (COTS) program which introduced a new innovative and economical approach for partnering with industry to develop commercial cargo services to the International Space Station (ISS). In this approach, NASA and industry shared cost and risk which led to dramatically reducing development and operational costs of these services. Following this approach, a Lunar COTS concept was conceived to develop low-cost infrastructure systems to provide economical, operational services that will enable long-term and sustainable human lunar missions. A lunar infrastructure system with power, thermal, communication and navigation elements as well as life-support systems was conceptually designed to support initial human sortie missions of a few days with gradual evolution steps to support an eventual human lunar outpost. The human infrastructure system will have capabilities to support human missions of several months with minimal maintenance and replacement of parts. This infrastructure system will also maximize use of existing lunar resources, such as, oxygen from regolith, water from ice deposits at the poles, long-duration solar energy from eternal peaks of light and use of metals, such as iron and aluminum, from lunar regolith. The plan includes a gradual buildup of these capabilities using a phased-development approach that will eventually lead to operational infrastructure services. By partnering with industry to develop and own the infrastructure services using the COTS model, this plan will also result in significant cost savings and increased reliability and mission probability of success. This presentation will describe the Lunar COTS concept goals, objectives and approach for developing an evolvable, economical and sustainable human lunar infrastructure. It will also describe the technical challenges and advantages of each infrastructure element as well as the technical roadmap that will lead to large-scale infrastructure systems to enable a human lunar outpost.