European Architecture for Lunar Exploration. O. Mongrard[1], J. Schlutz[2] and B. Hufenbach[3], [1] ESA, The Netherlands, olivier.mongrard@esa.int, [2] Institute of Space Systems, Stuttgart Germany, schlutz@irs.uni-stuttgart.de [3] ESA, The Netherlands, bernhard.hufenbach@esa.int.

Introduction: In view of the evolving European and international context, ESA is analyzing and defining the potential role of Europe in an international space exploration programme through the study and development of long-term scenarios and supporting architecture for space exploration.

High-level objectives and requirements for the Exploration Architecture have been defined through consultation with representatives of the relevant stakeholder communities including industrialists, politicians and scientists. The analysis of the space exploration architecture has been performed in collaboration with European space industry. The reference architecture is defined as a strategic tool to identify European strategic interests and priorities, define technology roadmaps, and to inform discussions at an international level on future exploration architectures and associated needs and opportunities for international coordination and collaboration.

A phased approach has been derived for the Exploration Architecture, which ensures fulfillment of the requirements, while also incorporating the incremental build up of the architecture in terms of time, technology development, political and financial constraints.

Various trades and options have been studied within the study in order to derive a reference lunar architecture. The trades performed include the potential robotic lunar landing systems, the communication infrastructure, the crew transportation scenario to the surface (e.g. launcher class, staging location, and propulsion type) and the type of crew lunar surface operations (sorties, super-sorties, outpost or base).

A key conclusion from the Architecture study was that while current launcher capability are sufficient to support foreseen robotic missions, heavier launch vehicles are required for sustainable Human lunar missions. The proposed reference lunar transportation scenario is based on a medium lift launcher (50 tons to LEO) and lunar orbit rendezvous of the crew transportation system with a pre-deployed lunar lander such as to offers the necessary payload performance and flexibility to enable both orbital lunar missions as well as surface access.

A full Ariane 5 based lunar lander has been identified has a strategic element in an international lunar exploration architecture. It provides payload capability and flexibility for a multitude of robotic lunar missions, small element delivery and for human surface exploration support (e.g. logistics).

Moon-Mars synergies have also been highlighted during the course of the studies and will be described in particular with respect to the surface activities.

Based on the defined European reference architecture, potential collaboration scenarios for future exploration with international partners will be derived such as to create benefits to all actors (such as increased safety, re-use of common capabilities, cost reduction, additional exploration opportunities). The identification of synergies and interfaces with different international actors constitutes a first step toward the definition of an international reference architecture for space exploration.