# Flight Opportunity for CubeSats to Lunar Orbit

## The Lunar Services Pathfinder Mission

A potential flight opportunity for one or more CubeSats to lunar orbit has arisen from the ESA European Exploration Envelope Programme (E3P). The ESA Directorate of Human & Robotic Exploration (D/HRE) has entered into Phase 1 of a commercial partnership agreement with SSTL and Goonhilly Earth Station for "Commercial Lunar Mission Support Services" within E3P. Phase 2 of the partnership consists of the Lunar Services Pathfinder mission with a launch envisaged in 2022, aiming to provide transportation and communication services for CubeSats and hosted payloads, as well as initial data relay communication services for other lunar assets.

The ESA contribution to the Lunar Services Pathfinder mission is proposed to be funded from E3P as part of the programme proposal to CM19. **In return for its contribution, ESA will receive a ~20 kg allocation of the total payload mass to lunar orbit, which is sufficient to carry CubeSats of up to 12U volume in total (e.g. a single 12U, two 6U, or four 3U CubeSats).** Data relay services to/from the deployed CubeSat(s) will also be provided by the Pathfinder spacecraft for a period of up to six months via inter-satellite links. Hence, the costs related to launch, transportation to lunar orbit, and communications with the CubeSat(s) in lunar orbit do not need to be borne by the CubeSat developer selected for the flight opportunity. Flight opportunities beyond the 20 kg allocation for ESA can be commercially procured from SSTL/GES.

## Lunar CubeSat technology demonstrator(s) on Pathfinder

European CubeSats have not previously flown in lunar orbit, thus putting the emphasis on technology demonstration relevant to achieving lunar exploration/science objectives at low-cost. Key advanced technologies to be demonstrated on a lunar CubeSat mission include long range inter-satellite links/networking with the mothercraft, miniaturised propulsion for reaction control and transfer from the deployment orbit to the final operational orbit, and miniaturised payload instrumentation enabling niche lunar science and/or exploration-relevant measurements. Additional radiation hardness assurance of COTS electronics will also be necessary given the lunar radiation environment.

It is planned to fund the design, development and operation of the lunar CubeSat(s) to be embarked on the Lunar Services Pathfinder mission within the FLY element of the ESA General Support Technology Programme (GSTP).

An open competitive Invitation To Tender (ITT) for the Phase A study of the lunar CubeSat mission is anticipated to be published in Q3 2018. In the frame of this ITT, proposals for lunar CubeSats to be flown on the Lunar Services Pathfinder in 2022 will be assessed by ESA for their contribution to scientific/exploration/demonstration objectives, as well as their proposed programmatic implementation. As GSTP is an optional programme, potential bidders will need funding support in advance from their delegation(s). One or more CubeSat missions compliant with the constraints of the flight opportunity (12U total volume to lunar orbit) will then be selected for Phase A mission/system definition contract award. The Phase A study results will be used by ESA to assess the technical feasibility, risks, cost & schedule, and compatibility with the Pathfinder interfaces. The follow-on implementation phase (B,

C/D and E) would be initiated after CM19, subject to positive assessment, availability of further funding support, and approval of the Lunar Pathfinder mission in E3P at CM19.

**Procurement Policy**: this Phase A activity will be performed as part of the CubeSat mission framework already approved by IPC (GSTP activity ref. GT37-001SY). Parallel study contracts may be awarded, depending on the CubeSat volume and the quality of proposals. Entities with proposals for the CubeSat payload only should partner with a CubeSat system integrator in order to submit a mission proposal.

**Budget:** 300 kEuro
**Duration**: 10 months (completion before CM19)

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For further information see:
https://www.esa.int/Our_Activities/Human_Spaceflight/ESA_signs_collaboration_agreement_for_commercial_Lunar_missions.