Space safety monitoring unit for Lunar Gateway cargo

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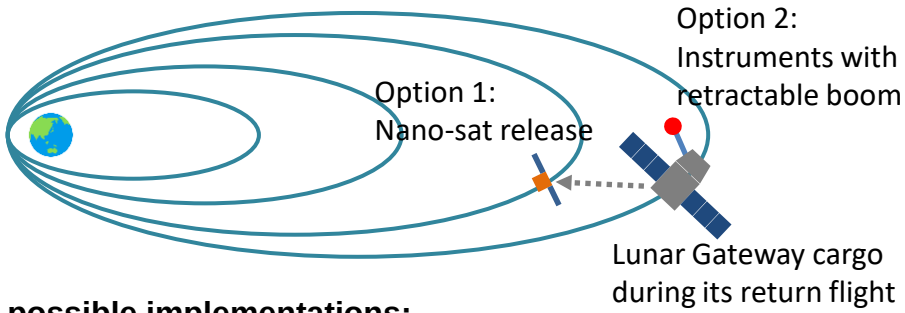
Frequent and recurring Lunar Gateway cargo flights are used as a platform to monitor space weather and observe space debris distribution for space safety



Background:
Frequent and recurring Lunar Gateway cargo flights cover a wide range of the near-Earth environment. If we can use it as a platform during the return flight, it will bring a new opportunity of **quasi-continuous monitoring and investigation of a key region for space safety** at possibly low cost.

Space weather monitoring:

- Solar energetic particles (SEP) event is the main cause of satellite malfunction. Since the SEP comes along IMF, the solar wind monitoring at L1 is not sufficient. **Quasi-continuous observation using cargos allows giving last-minute warning of SEP events for Geosynchronous satellites.**
- Extraordinary air drag for satellites by the enhanced density is a critical factor for the satellite operation (e.g. massive loss of Starlink satellites in February 2022). **The wide range coverage of cargo flights enables measurements of density profile down to the altitude where neither sounding rockets nor satellites can easily reach.**

Space debris distribution:
Whereas the space debris is expanding toward the higher altitude, those located at the high altitude is hard to detect from the ground. **Cargo flights between the Lunar Gateway to the Earth reveal space debris vertical distribution even at the higher altitude.**

Two possible implementations:

1. **Instruments deployed from the cargo with a short boom and retract it before re-entry.** Instruments are re-usable.
2. **Nano-satellite released from the cargo** for a short-term measurement. The idea is similar to a sounding rocket, but from near Earth-Moon L1 toward ionosphere. Highly-elliptic orbit allows monitoring/observation even at lower ionosphere.

Tasks: Feasibility studies and the cost estimate

Cost: 30-50 MSEK / 3-5 years

Swedish heritage:

- Sounding rockets (SSC), nano-satellites (IRF, Munin), CubeSat (universities), booms (OHB/IRF/KTH)
- Mechanical system (scanner) on MEX/VEX (IRF)
- Light-weight and small instruments (IRF/KTH)

Other Merit:

- Science: Strengthen our leading position in ionospheric studies and magnetospheric ion dynamics
- Swedish space industry: Once such platform is made by Sweden, ESA might choose it as its subsystem