INTUITIVE MACHINES: COMMERCIALLY ENABING INTERNATIONAL LUNAR SCIENTIFIC EXPLORATION.

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Introduction: Intuitive Machines (IM) is a lunar services company that is providing access to the Moon and its orbit for both science and exploration. Our lunar access capabilities consist of four components. 1. Fixed lunar surface services, 2. Lunar rover services, 3. Lunar hopper services, and 4. Satellite delivery services.

Fixed Lunar Surface Services: IM is part of NASA's Commercial Lunar Payload Services (CLPS) initiative. As of February 2023, NASA has awarded eight CLPS contracts for lunar delivery services of payloads to the Moon's surface. IM has won three of those contracts. All three will use the IM-designed Nova-C lander. Nova- C uses one VR-900 bipropellant engine to deliver over 130 kg of payload to anywhere on the Moon. It can land on slopes up to 10° and uses a hazard detection and avoidance system to ensure a safe landing. Multiple mounting points on the lander are available, and it provides power and communications to the payloads for the duration of the mission. If the mission requires it, IM can use a NOVA-D lander which has payload capacity up to 2500 kg, depending on the launch vehicle.

Figure 1: Nova C lander capable of delivering more than 130 kg of payload to anywhere on the Moon

Lunar Mobility Services: IM has formed a strategic partnership with Lunar Outpost to provide rover mobility solutions to customers. Lunar Outpost has several rovers from the 20 kg MAPP rover (with ~10 kg payload) to the > 500 kg HL-MAPP that can traverse 100s of kilometers and survive through multiple lunar nights.

Lunar Hopper Services: IM has developed a hopper mobility platform, called Micro Nova, that conducts regional exploration after it is delivered to the lunar surface by a Nova-C or Nova D. Micro Nova permits extreme access by being able to visit locales not accessible to a rover, such as lunar pits, of quick access to the floor of large impact craters, including permanently shadowed regions. Micro Nova is essentially a fully independent spacecraft with its own propulsion, power, and communication systems. It can carry a maximum of 8 kg of payload and can traverse more than 25 km after the initial landing. Different flight profiles are possible, including parabolas, and flying at a constant altitude

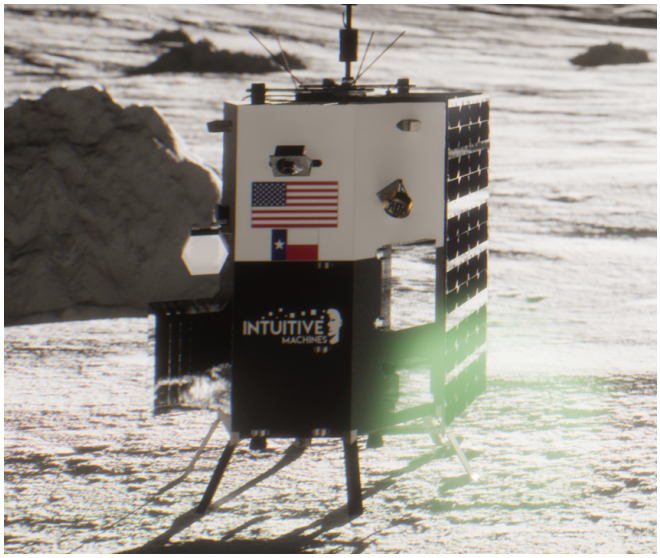

Figure 2: IM hopper. Approximately 1 meter tall, and capable of flying 8 kg of payload more than 25 km.

Satellite Delivery Services: In parallel to conducting a lunar surface delivery, IM can drop off satellites into a variety of orbits. These range from deploying up to 1000 kg into a 185 km x 380 000 km translunar injection orbit to deploying a 375 kg satellite into a 100 km circular orbit.

Additional Services: In addition to the four core services described above, IM offers ancillary capa-bilities to enhance data return from the moon. A key one is our communications infrastructure. IM has developed the first private, secure, interoperable lunar distance network. We have agreements with ground stations located around the world, which combined with our own communication relay spacecraft, provide a complete lunar communications and navigation solution. We are delivering a lunar communications relay spacecraft into lunar orbit every mission, starting with IM-2, our second mission, in late 2023.

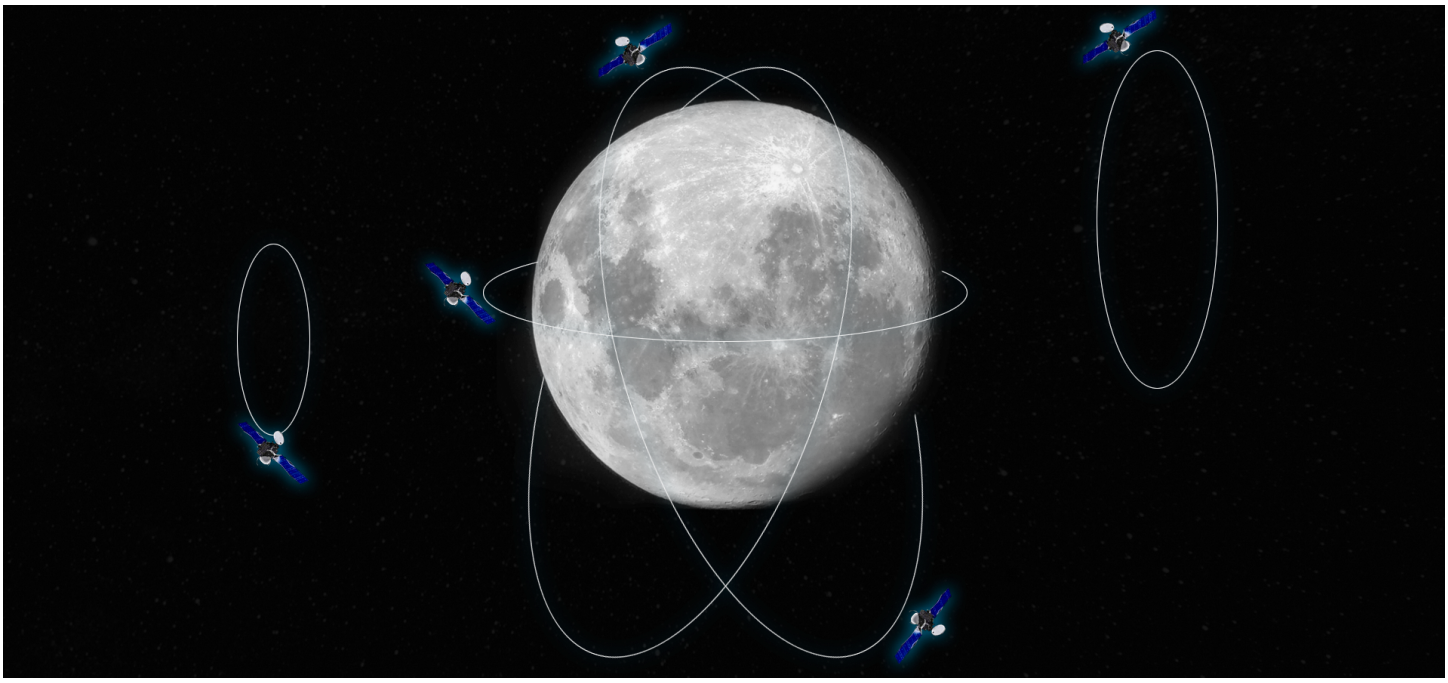

Figure 3: Depiction of the IM constellation of KHON lunar communication relays.

Upcoming Lunar Missions: IM-1, our first lunar mission, is scheduled to fly in the second quarter of 2023. A Nova-C will land near Malapert-A in the Moon's south polar region. The payload consists of NASA CLPS payloads as well as several commercial payloads. This is followed by IM-2, also to the south polar region. This carries the NASA PRIME-1 instrument that consists of the same Trident drill and M-SOLO mass spectrometer that are manifested to fly on NASA's VIPER rover in 2024. IM-2 also carries the IM Micro Nova as well as two rovers and other payloads. IM-2 will also drop off into lunar orbit KHON-1, IM's first lunar communications relay satellite. IM-3 is scheduled to land in the Moon's Reiner Gamma region in the second quarter of 2024. IM-3 will carry the CLPS payload Lunar Vertex as well as instruments from Korea, and the European Space Agency.
It is IM's goal to fly at least one lunar lander every year. Providing this regular cadence of lunar access permits customers the most flexibility for planning lunar exploration.