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MetNet Landers for Mars Missions

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Abstract

For the next decade several Mars landing missions and the construction of major installations on the Martian surface are planned. To be able to bring separate large landing units safely to the surface in sufficiently close vicinity to one another, the knowledge of the Martian weather patterns, especially dust and wind, is important. The Finnish – Russian – Spanish low-mass meteorological stations are designed to provide the necessary network which can provide the in-situ observations for model verification and weather forecasts.

1. Introduction

The Mars MetNet Precursor Mission (MMPM) has recently completed all flight qualifications for Lander system and payload. At least two units will be ready for launch in the 2013/14 launch window or beyond. With an entry mass of 22.2kg per unit and 4kg payload allocation the MetNet Landers (MNL) [1] can be easily deployed from a wide range of transfer vehicles. The simple structure allows the manufacturing of further units on short notice and to reasonable prices.

The autonomous operations concept makes the implementation of complex commanding options unnecessary while offering a flexible adaptation to different operational scenarios.

2. Deployment Scenario

The MNL will be separated from the transfer vehicle either during the Mars-approaching trajectory or from the Martian orbit. The point of separation relative to the Martian orientation and the initial deployment angle define the final landing site, which additionally is influenced by atmospheric parameters during the descent phase. For the two initial precursor missions only low latitude / low altitude landing sites are planned to maximize the success of the descent and the information gained from the MNL's behavior during its flight across the different layers of the Martian atmosphere. This information is transmitted to the transfer vehicle via dedicated beacon antennas already during the descent phase. For the precursor missions this results in an initial velocity of 6080 m/s, a relative entry angle of -15º and a landing velocity of about 50 m/s. Later units will go also to higher latitudes and altitudes, using optimized payloads and power systems.

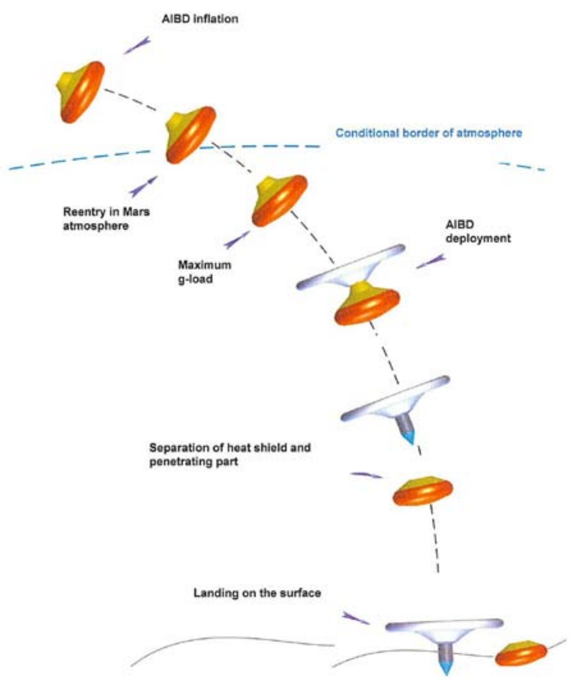

Figure 1: Descent and landing of the MNL

3. Payload

The core payload contains the meteorological sensors for temperature, pressure and humidity measurements, a 4-lense panoramic camera and a 3-

axis accelerometer for descent control. For the precursor missions this is extended to include also a 3-axis gyroscope device. Additionally a Solar Incident Sensor with a wide range of dedicated wavelength filters, an optical dust sensor, a 3-axis magnetometer and a radiation monitor are included in the first units' payload.

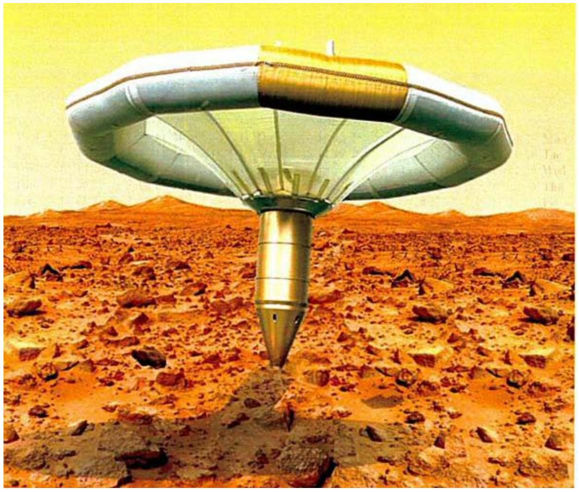

Figure 2: MetNet Lander at the Martian surface

4. Power Sources

The low-latitude MNLs are powered by two Lithium-ion batteries in a thermally sealed container, charged by flexible solar cells on the upper side of the Additional Inflatable Breaking Unit (AIBU), which provide a daily power average of about 300mW. For high-latitude landing sites radioactive sources will be used.

5. Launch opportunities

As the requirements for a transfer vehicle are not very extensive, the MNL(s) could be launched with any mission going to Mars. This could be a piggy-bag solution to a Martian orbiter from ESA, NASA, Russia or China or an add-on to a planned larger Martian Lander like ExoMars. Also a dedicated launch with several units from LEO is under discussion.

References

[1] Project web-site http://metnet.fmi.fi