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Future Plans for MetNet Lander Mars Missions

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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 observation data network which can provide the in-situ observations for model verification and weather forecasts. As the requirements for a transfer vehicle are not very extensive, the MetNet Landers (MNLs) [1] 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. The data link implementation uses the UHF-band with Proximity-1 protocol as other current and future Mars lander missions which makes any Mars-orbiting satellite a potential candidate for a data relay to Earth.

Currently negotiations for possible opportunities with the European and the Chinese space agencies are ongoing aiming at a launch window in the 2015/16 time frame. In case of favorable results the details will be presented at the EGU.

During 2011 the Mars MetNet Precursor Mission (MMPM) has 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 MNL(s) 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. This simplifies the integration into the transfer vehicle where besides the deployment mechanism only a power cable is needed to fully charge the batteries before separation. A bi-directional data link would be of advantage allowing besides a full system checkout also the last-minute adjustments of operational parameters once the most likely landing area is defined. The initial landing sites are selected in a latitude range of +/- 30 degrees and at low altitudes, thereby allowing the use of only solar panels as energy source and avoiding the political problems of including radioactive generators into the Lander. For high-latitude missions radioactive heaters will be necessary to make the systems survive the Martian winter.

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. The behavior of the MNL's during its flight across the different layers of the Martian atmosphere is monitored by 3-axis accelerometers and 3-axis gyroscopes. 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 -15° 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.

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.

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 600mW.

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