Finnish Meteorological Institute
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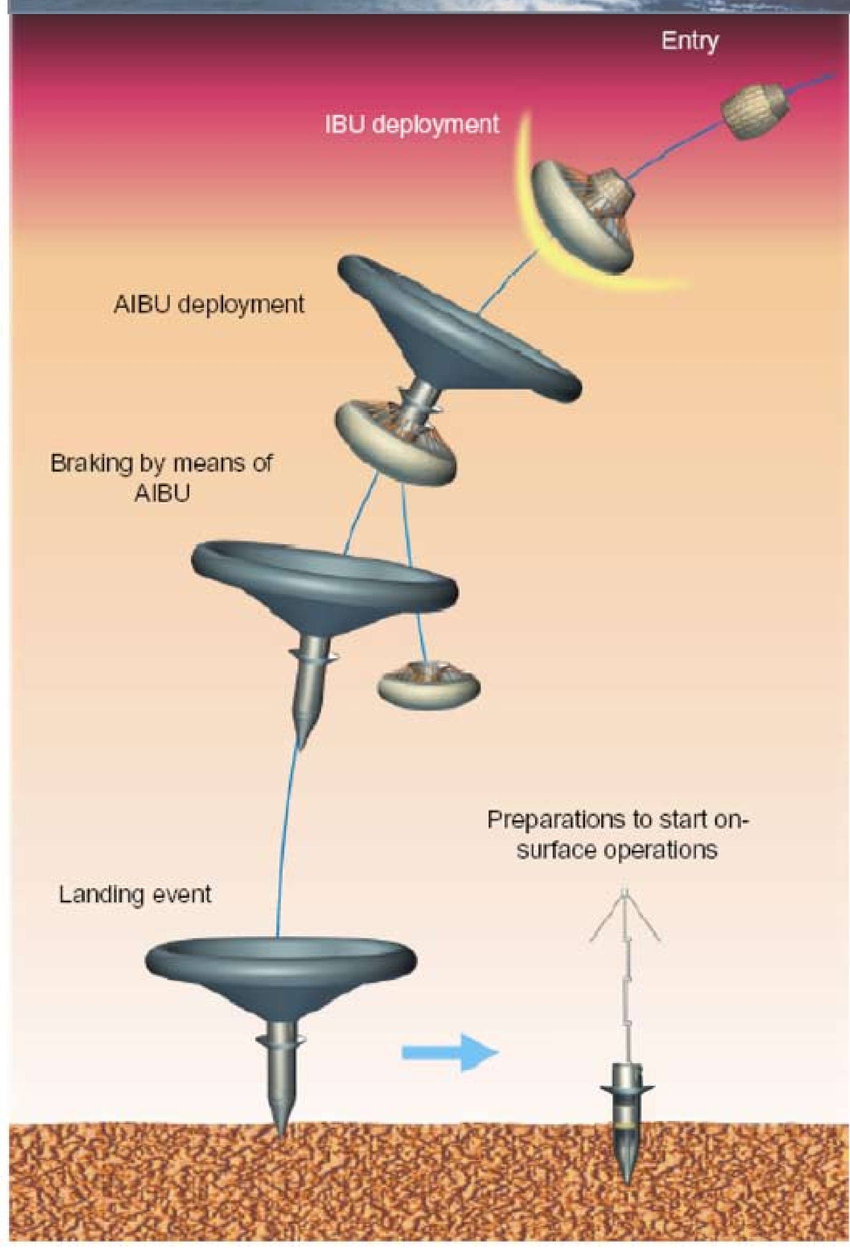
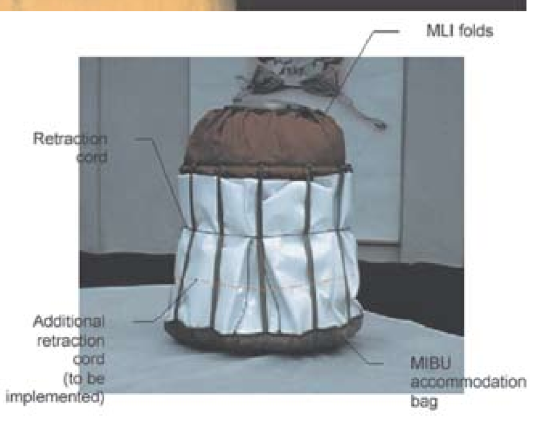
INTA, Spain

METNET
The Next Generation Lander Mission For Martian Atmospheric Science

MetNet
The New Generation of Atmospheric Observation Network for Mars

http://www.space.fmi.fi/metnet-portal





The MetNet Mission

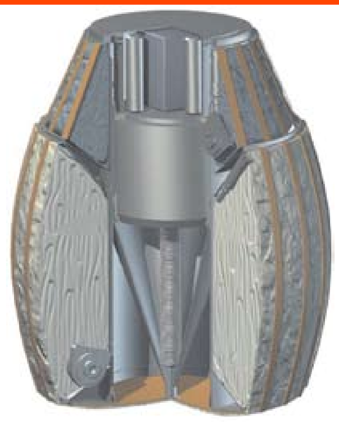
Ultimate Goal:
- Wide-spread surface observation network around Mars to investigate atmospheric structure, physics and meteorology.

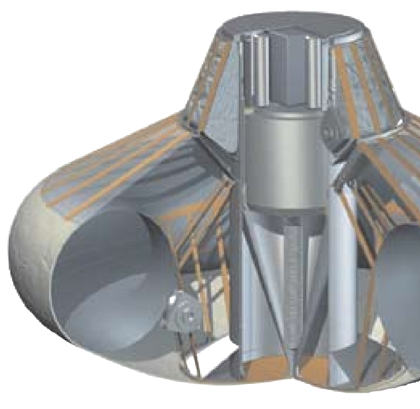
Status:
- The Descent Vehicle has been fully qualified for Martian environment.
- Precursor mission development under way.

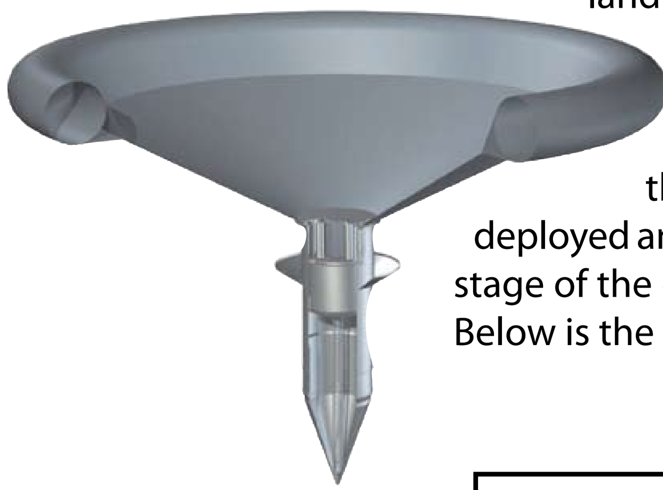
Future:
- Precursor mission with one lander in 2011.
- More landers likely to be deployed in the succeeding launch windows.

Legacy:
- "Successor" of the Netlander Mission's atmospheric leg.
- Making uses of the Mars 96 Mission experience.

Consortium:
- FMI: Mission lead, payload lead together with IKI.
- LA: Systems lead.
- INTA: MetNet Lander (MNL) payload.
- Additional collaborators.







The MetNet Technology

The MetNet mission to Mars is based on a new semi-hard landing vehicle called MetNet Lander (MNL). The MNL will be able to withstand with a shock of at least 500G for 50 ms.

The novel idea is to use state-of-the-art inflatable Entry, Descent and Landing Systems (EDLS) instead of the previously used rigid heat shields and parachutes. This way the overall reliability is increased due to diminished number of pyrotechnical devices, the ratio of the payload mass to the overall mass is optimized and more mass and volume can be used for the science payload.

The life time design goal of a MNL is to survive several martian years. The three images on the left present the MNL in its three different descent and landing stages and the one on the right presents the entry descent and landing phases. The uppermost is an illustration of the MNL in its cruise and entry configuration.

Quite soon after entering the Martian atmosphere the first cascade of the inflatable braking device is deployed and when the MNL has deccelerated enough the final stage of the device is deployed and the first stage is jettisoned. Below is the current mass budget of the MNL.

System	kg	kg
EDLS		7,9
Landing Module		8,9
Lander Body	*4,9*	
Equipment Module	*4*	
Total Entry Mass		16,8

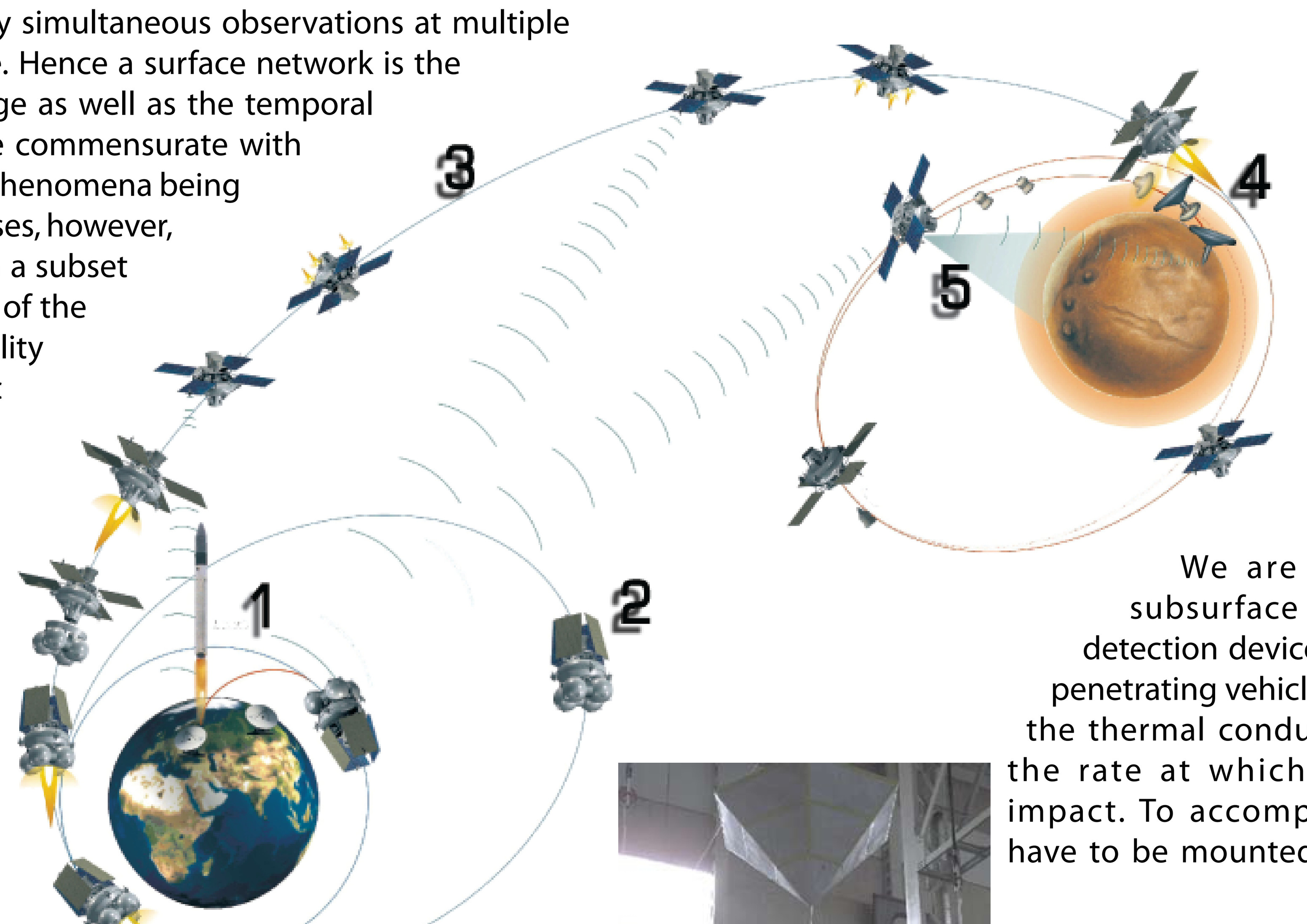
The Precursor Mission

The MetNet mission is currently taking shape and the mission development organization is being put together. The first real mission step is to have MetNet Mars Precursor Mission (MMPM) with a one MNL deployed to Mars as depicted in the Figure below.

One possibility is to launch the MMPM with a missile equipped with an extra upper stage and a specific cruise phase carrier.

MetNet Mars Precursor Mission Scientific Objectives

Since meteorological and climatological phenomena have both temporal and spatial variations, characterisation of such phenomena requires ideally simultaneous observations at multiple locations and over a sufficiently long period of time. Hence a surface network is the preferred means of observation. The spatial coverage as well as the temporal duration and resolution of observations need to be commensurate with the characteristic spatial and temporal scales of the phenomena being observed. The MetNet Mars Precursor Mission comprises, however, a single lander and can therefore address on its own a subset of the objectives of a network. The key contribution of the MetNet Mars Precursor Mission is hence an availability of new, high-quality and resolution atmospheric vertical structure as well as long-duration (of the order of a Martian year) *in situ* meteorological and imaging observations at a single landing site. A longer-term benefit of a successful MetNet Mars Precursor Mission and the accompanying proof of concept is the demonstrated feasibility of the lander concept for a meteorological network mission. This would consederably enhance the possibilities of finally implementing a globally dispersed in situ network.



The MetNet Science

The MetNet mission will be an excellent tool for enhancing our understanding of the Martian atmosphere. Having a network of *in situ* instrument payloads all over the Martian surface operating simultaneously is what the atmospheric science community has dreamed of for decades. This can now be realized using the MetNet concept. The long life time of a MNL will allow us to expand the network during severall successive launch windows.

When there are 20 or more observation posts we can already create a global network. If the number of observation posts would significantly exceed 20 it is possible to create a global network including sections where the observation post density is remarkably higher than elsewhere.

This dense section would be placed on an area of particular interest from the atmospheric science point of view, e.g. in the vicinity of expanding and retreating polar caps, Hellas region, Valles Marineris or Tharsis volcanoes. Access below the Martian surface provides the MetNet mission also with some unique opportunities for studying the Martian soil.

We are seeking for the presence of subsurface water by means of a water ice detection device mounted in the front part of the penetrating vehicle body. Also, we envisage studying the thermal conductivity of the soil by measuring the rate at which the probes cool down after impact. To accomplish this, temperature sensors have to be mounted on the forepart body structure.

The System Development

Study and Concept Selection

The system development has been going on since 2001. Initial selection between several different descent and landing scenarios was made after a study in 2002. Since then the MetNet concept has gone through a set of thorough system and material tests and simulations.

Soil Penetration and Drop Tests

The set of photos on the left have been taken during the penetration tests of the MNL. A set of soil models were used and the performance of the system was even better than envisaged. The photograph on the right shows a setup for MNL drop tests.

Aerodynamic Stability Tests

The aerodynamic stability of the MNL on the supersonic stages of the EDL phases has been proven by windtunnel tests using miniatyrized models and by numerical simulations. The performance during the subsonic phases has also been studied by using life size models of the different stages in a larger wind tunnel setup (photo below left).

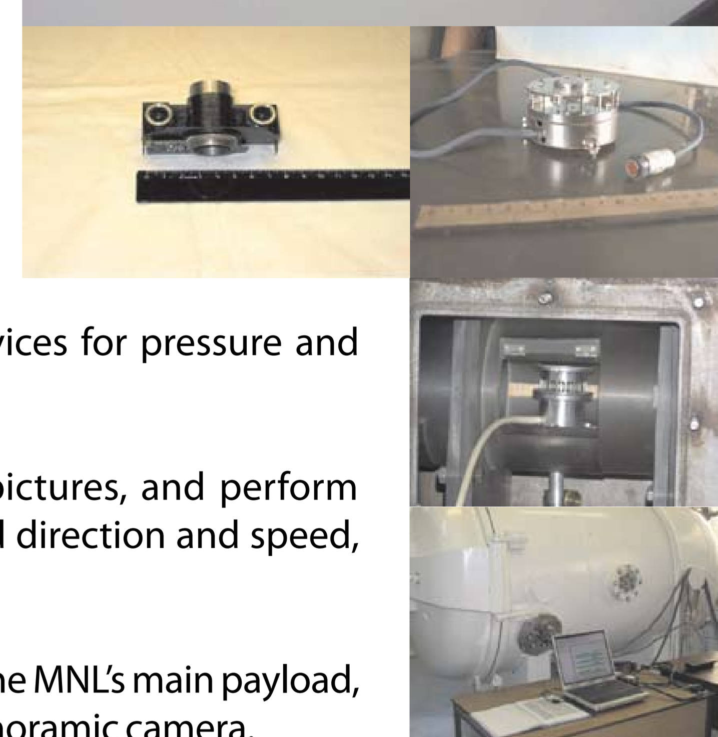
The Instrumentation

The science payload of the MNL has separate instrument packages for the atmospheric entry and descent phase.

During the descent an imager, accelerometers and devices for pressure and temperature observations will be used.

At the Martian surface the MNL will take panoramic pictures, and perform measurements of pressure, temperature, humidity, wind direction and speed, as well as the optical depth of the atmosphere.

The photograph on the top right shows the prototype of the MNL's main payload, below it are the prototypes of the wind sensor and the panoramic camera. The remaining two pictures show instrument tests in progress.

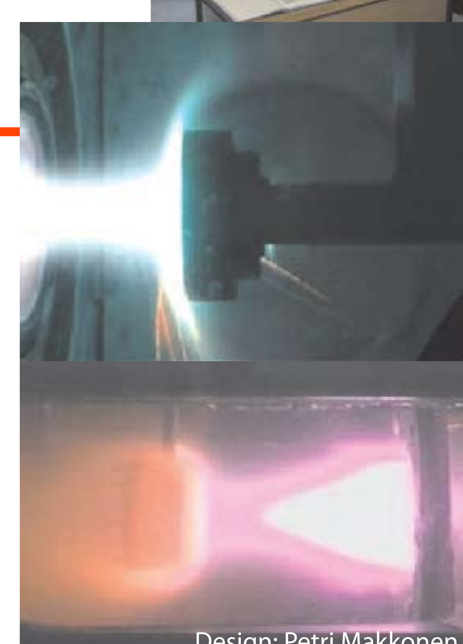


Material Tests

The materials on the flexible structures are new and have had to be properly tested. For example the heatshield material has been tested using hot plasma to qualify it's performance in the proper conditions (the two photos on the right).

System Functionality Tests

The system as a whole has gone through a set functional tests to prove the overall functionality of the concept.



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