INTERMARSNET: A JOINT ESA/NASA MISSION TO MARS IN 2003

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INTERMARSNET is a joint ESA/NASA network and orbital mission to investigate the interior, surface and atmosphere of Mars (1). It is one of the five Phase-A studies competing for the next medium-size (M3) mission of the Scientific Programme of the European Space Agency (ESA). The final selection will be known in the spring of 1996. The industrial studies are being conducted by a European consortium including Dornier, Aérospatiale and Alenia Spazio and by Lockheed-Martin in the U.S. A joint ESA/NASA Science Working Group has been defining the scientific objectives of the mission, while engineering teams from ESTEC, ESOC and JPL have been assessing the feasibility of the mission scenario and spacecraft design.

The INTERMARSNET mission consists of three landers to be placed on the surface of Mars and a data-relay spacecraft in Mars orbit. The small landers will define a regional/global network of stations to carry out simultaneous geophysical and meteorological measurements and to investigate the local geology and geochemistry of the landing sites during the operational lifetime of the stations on Mars of one martian year (687 days). Two stations will be landed in the Tharsis region, which is the most likely area to still show tectonic activity, and the third station at the antipode in the eastern hemisphere to gather information about the martian core.

The INTERMARSNET scientific objectives to be addressed by a highly-sophisticated and miniaturised payload will focus on three main areas: interior, surface and atmosphere, to be studied both from the lander network and from the orbiter. The objectives of the landers are the following: internal structure and activity; geodesy and rotational dynamics; surface geology and morphology; mineralogy and geochemistry of rocks, soils and volatiles; atmospheric structure, global circulation and meteorology. The objectives of the orbiter will emphasize investigations directly complementing the network science (atmospheric sounding) and data still missing from the martian surface (roughness).

The INTERMARSNET model payload will have a mass of about 20 kg for each station including deployment mechanisms. Sharing of electronics will allow many of the sensors to be grouped into a smaller number of instrument packages. All three stations will carry an identical core payload devoted to network science and imaging (i.e. seismometer, meteorological package, atmospheric structure and descent imager, panoramic camera and α-proton-x-ray spectrometer). In addition, each station will carry a complementary payload adapted to each landing site. Station A will focus on volatile chemistry at high latitudes (including an evolved gas analyser coupled to a drilling mechanism and a sampling acquisition system, a Mössbauer spectrometer and a close-up imager), while stations B and C will concentrate on rock and soil geochemistry at low latitudes (including an IR spectrometer, a Mössbauer spectrometer, a close-up imager and an instrument deployment device to provide mobility to the geochemical instruments within several metres from the station. The relay spacecraft will carry an orbital payload of about 30 kg consisting of an atmospheric thermal mapper, an atmospheric imager, a roughness radar and a plasma package.

The current INTERMARSNET mission scenario includes a dedicated Ariane-5 launch in June 2003 into direct interplanetary hyperbolic trajectory with a cruising time of about seven months. The probe/landers will be independently targeted and have a cruise mass below 415 kg each. The design of these free-flyers will be derived from that of the US Mars Surveyor 98 lander. The landers will reach the martian surface at $\sim$2.5 m/s and have a mass of about 200 kg. After landing, the seismometer and meteorological boom will be deployed. The altitude of the data-relay orbiter in circular polar martian orbit is about 600 km and the orbital period about 2 hours. The baseline

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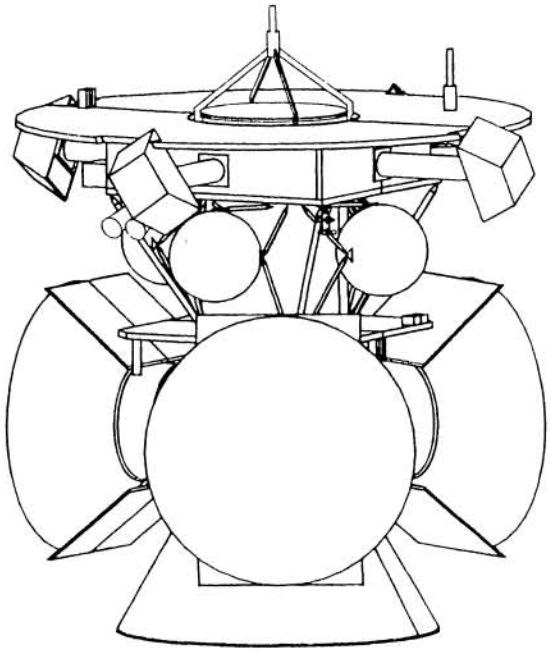

Figure 1: *INTERMARSNET launch configuration.*

configuration of the data-relay orbiter is a spin-stabilised spacecraft with a dry mass of about 574 kg, while the fuel mass is about 678 kg. All masses mentioned include margins. The average instrument data volume (limited by ground station and link budgets) is about 10 Mbit/day for each lander and 100–450 Mbit/day for the orbital science depending on available resources during the mission.

The INTERMARSNET mission is a joint ESA/NASA contribution to the international exploration of Mars. It represents the only network mission in the International Mars Exploration Working Group (IMEWG) scenario (2). In the current mission baseline, ESA would provide a data-relay orbiter and an Ariane-5 dedicated launcher, while NASA would contribute three free-flyer type probe/landers in the framework of the long-term Mars Surveyor exploration programme.

The INTERMARSNET mission would therefore contribute to provide a global perspective of the inner structure of Mars, a global monitoring of the martian meteorology, as well as geological and geochemical characterisation of the landing sites. INTERMARSNET represents the next step in the exploration of Mars following previous and complementary American and Russian missions, and before sample return endeavours. A joint ESA/NASA network and orbital mission to Mars is ideally suited to an appropriate division of effort and sharing of scientific return between the European and the US scientific communities. The estimated cost of the mission would be about US M$ 400 to ESA, 200 to NASA and 100 to European national agencies for their share of the orbiter and lander instruments.

References:

(1) Chicarro A., Scoon G. and Coradini M., INTERMARSNET – An International Network of Stations on Mars for Global Martian Characterisation, ESA Journal, vol. 18/3, 207-218 (1994).
(2) Chicarro A., Squyres S. et al., Together to Mars: An Initiative of The International Mars Exploration Working Group, ESA BR-105, 8 pp. (1994).