MARS-NEXT – A FUTURE STEP IN THE EUROPEAN EXPLORATION OF MARS. A. F. Chicarro[1] and the Mars-NEXT Team, [1]European Space Agency, ESTEC, Postbus 299, 2200 AG Noordwijk, The Netherlands (agustin.chicarro@esa.int).

The Mars-NEXT concept represents a new mission to Mars within the Aurora Exploration Programme of the European Space Agency (ESA). Mars-NEXT is planned after ExoMars and before the Mars Sample Return (MSR) and includes a number of landers to establish a network on the surface of Mars, to investigate the interior of the planet, its atmospheric dynamics and the geology of each landing site. The mission would be launched in 2016 onboard a Russian Soyuz rocket from Kourou. The Mars-NEXT mission includes a spacecraft carrying three (or four) lander probes to be released from an hyperbolic arrival trajectory to establish a Network of stations on the surface of Mars. The carrier spacecraft would be placed into orbit and carry a few instruments to complement the Network. Such network-orbiter combination represents a unique tool to perform new investigations of Mars, which could not be addressed by other means. In particular, i) the internal geophysical aspects concern the structure and dynamics of the interior of Mars including the state of the core and composition of the mantle; the fine structure of the crust including its paleomagnetic anomalies; the rotational parameters (axis tilt, precession, nutation, etc) that define both the state of the interior and the climate evolution; ii) the atmospheric physics aspects concern the general circulation and its forcing factors; the time variability cycles of the transport of volatiles, water and dust; surface-atmosphere interactions and overall meteorology and climate; iii) the geology of each landing site concerns the full characterization of the surrounding area including petrological rock types, chemical and mineralogical sample analysis, erosion, oxidation and weathering processes to infer the geological history of the region. Characterization of the landing site area from a geosciences point of view requires a degree of mobility (instrument deployment device or robotic sampling arm). To complement the science gained from the Martian surface, investigations need to be carried out from orbit in a coordinated manner, such as i) global atmospheric mapping to study weather patterns and opacity; ii) accurate mapping of the planet's gravity field with a sub-satellite; iii) following Mars Global Surveyor's initial mapping of the crustal magnetic anomalies, a complete and detailed map from lower orbit (150 km) needs to be gathered; iv) also, these magnetic anomalies need to be studied in light of the magnetic field induced by the solar wind interaction with the upper atmosphere of the planet.

The Network Mission concept is based on the fact that some important science goals on any given terrestrial planet can only be achieved with simultaneous measurements from a number of landers located on the surface of the planet (primarily internal geophysics and meteorology). The concept of a Network Mission on Mars is not new [1, 2, 3, 4, 5, 6], and indeed previous studies support the great maturity of such a mission. A purely meteorological network would include as many stations as possible. For seismology, however, the number of stations (one to four) has a direct bearing on the scientific return achieved, four being the ultimate goal of the mission. The Geophysical Package (GEP) onboard ExoMars will allow to determine the level and frequency band of martian seismicity in order to calibrate the Mars-NEXT seismometers. Given the multiplicity of elements in the mission (landers, orbiter, science payload), numerous opportunities exist to share the efforts in an equitable way between ESA and other partners. The Mars-NEXT Mission is not only complementary to previous missions to Mars, including ExoMars, but is to be seen within the context of future astrobiological investigations of Mars, as we do not know which parameters did inhibit or favour the development of life on Earth. For instance, is plate tectonics a necessity, as well as an intrinsic magnetic field, a large orbiting moon, a thick atmosphere and a permanent ocean (to name a few) to preserve lifeforms on a terrestrial planet. Therefore, Mars-NEXT represents the logical step for Europe to undertake in the exploration of Mars, between ExoMars (2013 launch) and MSR (2020+ launch), providing unique science unavailable by other means.

References: [1] Mission to Mars – Report of the Mars Exploration Study Team (1990), Chicarro A. Editor, ESA SP-1117, 138 pp. [2] Marsnet – Report of the Phase-A Study (1993), Chicarro A. Editor, ESA SCI(93)2, 128 pp. [3] Intermarsnet – Report of the Phase-A Study (1996), Chicarro A. Editor, ESA SCI(96)2, 158 pp. [4] Mars Environmental Survey (MESUR) Science Definition Team meetings (1990-96), NASA/JPL. [5] The Netlander Mission, CNES (1998-2003) http://smsc.cnes.fr/NETLANDER/ [6] MetNet, FMI (1996-2007) http://www.space.fmi.fi/metnet/ [7] Mars Express – The Scientific Payload (2004), Chicarro A. Editor, ESA SP-1240, 216 pp.