INSPIRE : A MARS NETWORK SCIENCE MISSION. T. Voirin[1] J. Larranaga[1] G. Taylor[1] J.M. Sanchez[2] J.P. Prost[3] C. Cavel[4] and P. Falkner[1] , [1] European Space Agency, ESTEC, Noordwijk The Netherlands, email: thomas.voirin@esa.int, [2] European Space Agency, ESOC, Darmstadt Germany, jose-manuel.sanchez.perez@esa.int [3]Thales Alenia Space, Cannes France, [4]Airbus Defence & Space, Toulouse France.

Introduction:
ESA's Mars Robotic Exploration Preparation (MREP) takes Mars exploration as global objective, and Mars Sample Return (MSR) mission as long term. To establish a sustainable programme of Mars exploration for the future, Europe needs to gradually build its capabilities to land safely on Mars and perform surface exploration by incrementally achieving key technological objectives.

An existing and mature mission concept on this path while also offering outstanding science opportunities is the Network Science mission which has been of continuing interest and considered of importance to the Mars science and exploration community in Europe for over 20 years and which consists in landing safely 3 network science landers on the surface of Mars.

In order to asses the technical and programmatic feasibility of the network science mission, a CDF study has been performed by ESA in 2011, which was building on past network science mission studies, in particular MarsNext, and taking best benefit of ExoMars and MREP recent technology developments ; the MarsNext network mission concept has been reviewed with the aim to de-risk the mission and make it more affordable as an ESA only mission called INSPIRE ; in particular, compared to MarsNext, INSPIRE does not include any science or relay orbiter, does not rely on any RHU and performs direct Mars hyperbolic entry. INSPIRE has been subject to two parallel industrial pre-phase A studies in 2013/2014 in the frame of the European Mars Robotic Exploration Program (MREP 2) with a design-to-cost approach.

Science objectives
The main scientific objectives of the mission are to investigate the interior of Mars, its rotational parameters and its atmospheric dynamics. The mission will focus on the geological evolution of Mars throughout its history, providing essential constraints on geophysical, geochemical, and geological models of Mars and allowing a better understanding of SNC meteorites as well as any future samples that may be returned from Mars. Simultaneous measurements from 3 landers on the seismology, geodesy and surface heat flow will allow localisation of the quakes, determination of the fine structure of the mantle and core as well as the state (liquid or solid) of the core. A long lived network of meteorological stations will also help to fully characterise the activity of the Martian atmosphere at various spatial and temporal scales, from the turbulent scale with boundary-layer processes to the global scale with planetary waves.

INSPIRE carries for that purpose the following science payload, for a total mass of ~ 15 kgs :
- SEIS seismometer, similar to the one to be flown on NASA's Insight in 2016
- HP3 "mole" package for subsurface investigations
- RSE radio-science experiment
- Meterological package
- Camera

Mission profile

The mission concept is based on a Soyuz-Fregat or Ariane 5 shared launch from Kourou, with a GTO transfer. The GTO launch scenario is preferred to the direct one to increase the mass available per probe, which is needed to make the mission as robust as possible (i.e. to allow for implementation of a direct to Earth data link, to increase entry descent and landing margins and to allow for flexible payload deployment by means of a robotic arm and lifetime of one full Martian year). One of the challenges of the mission is the phased release of 3 probes by a single carrier S/C. The release sequence needs to be short enough to minimize coasting duration and hence minimize the impact on probe design (mostly on thermal / power subsystem) ; but the coasting sequence needs also to be long enough to allow for accurate DeltaDOR measurements before each probe release and to allow for sufficient margin to recover from any anomaly on-board (e.g. safe mode, or probe release abort) or on-ground (e.g. DeltaDOR measurement failure). A key aspect in the release sequence strategy is to limit dispersions at entry interface point for each probe to meet the landing accuracy requirement of 100 km. A significant effort has therefore been put on the understanding of the operational implications of a multi-probe release strategy for a direct entry mission, resulting in an optimization of the release sequence from an operations standpoin.

This paper will summarise the overall mission study results with an emphasis on the operational release strategy.