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Geoscientific Instrumentation Methods and Data Systems Discussions
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Interactive comment on "The MetNet vehicle: A lander to deploy environmental stations for local and global investigations of Mars" *by* A.-M. Harri et al.

Anonymous Referee #1

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This paper deserves to be published once the comments below have been addressed. It promises to give a good overview of a mission concept of interest for flight initially as a demonstrator / piggyback and then as a full network deployment.

Abstract, lines 5-6: I suggest 'simultaneous, distributed in situ measurements' (set of points rather than 2D spatial coverage).

Mass breakdown: mass fraction of approximately 17% - does this include mass maturity margin and payload system margin?

p1 line 24: savings on mass - Potentially, yes - but not only mass; depends on approach to thermal qualification. It might instead just give you a wider range of qualified

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components to choose from.

p1 lines 29-31 and p2 lines 114-118: I suggest to cite Ralph Lorenz's relevant paper in these two places: doi:10.1016/j.asr.2011.03.033.

p1 line 60: Seismology being another area (microseismometer).

p1 line 69: 'efficiently' - yes, albeit not precisely. Actual burial depth and thus thermal environment will depend on the surface properties at the impact site.

p2 lines 78-79: Reword and be more precise vs. the impact speeds foreseen for the Mars 96 and DS-2 designs.

p2 lines 82-90: Reword based on the actual order of the sections and sub-sections that follow.

p2 line 95: 'it payload' - change to 'its payload and critical systems'.

p2 lines 114-118: Also mention MarsNet hard lander/penetrator as first European study of such a vehicle? See yellow book, Chicarro, A., Coradini, M., Fulchignoni, M., Liede, I., Lognonne, F., Knudsen, J.M., Scoon, G.E.N., Wanke, H. MARSNET Assessment Study Report, ESA Publication SCI(91)6, European Space Agency, Noordwjik, The Netherlands, January 1991.

[MAJOR] p3 lines 184-185 and p16 lines 877-878, 888-889: Pyros are very reliable components, so surely these are not the major driver of overall reliability (show me an EDL failure attributed to a pyro failing...)... I would expect the reliability to be gauged rather by EDL outcome when parameters of the vehicle's entry state, physical characteristics, GNC approach and atmospheric conditions are dispersed over the expected ranges in a Monte Carlo simulation. In other words, one could have perfect pyro performance (or zero pyros) but still have an unreliable system!

p3 lines 185-186: 'control commands' - What's meant here? EDL on-board control steps (e.g. time based or event-triggered)?

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p3 lines 186-189: Again, mass is just one impact of reduction in T range reqt. - see comment above for p1 line 24.

p3 lines 195-196: Relative or inertial entry speeds? Does this limit the interplanetary trajectories that can be used?

p3 line 223: estimates of what?

p4 line 258: 'deployed during the entry phase' - triggered how, e.g. at what g load or Mach no.?

p4 line 260: +18° FPA is a rising, not descending trajectory! Check!

p4 line 262 & p5 line 273: altitude above what level? 0km MOLA or (as perhaps indicated by line 273) pressure-defined?

p5 line 282-283: I assume this 500g load is limited by the piston-like shock-limiting mechanism and its stroke length. What loads are experienced by the external shell?

p5 lines 307-309: Unclear wording... the forebody is stowed, ... once deployed...?

p5 lines 345-348: What is the rigid TPS material used? Only that of the flexible TPS is mentioned.

p6 Figure 3 caption: add legend for the numbered labels.

p7 Figure 4: (b) seems to be covering up something 842mm wide in (a)?

p8 Figure 9 caption: 'The light grey bars...' - Surely the other way round, as per legend? The light grey ranges are smaller.

[MAJOR] p8 Figure 9 caption: The depths shown, are they for the natural, undisturbed surface materials, or do they take into account the thermal short circuit introduced by the presence of the lander (thermally conductive metal structure)? This makes an important difference to the temperature environment the equipment has to withstand.

p8 line 476: REFERENCE missing.

p8 line 493: DEFINition missing.

[MAJOR] p9 lines 512-515: A preliminary power profile would be useful to illustrate the standby, measurement and data relay operations, and demands for heating, e.g. of battery and day vs. night.

p11, line 648: 'temperatures up to 1500 K' - What's the peak heating experienced (W/cm2)?

p11, line 679: 4586 m/s - isn't this too slow for hyperbolic entry? Please check.

[MAJOR] p13 lines 726-728: Does the comprehensive sterilisation of the entire lander include that of the batteries, which presumably have a max. non-op. T below that needed for sterilisation by DHMR? Please clarify bioburden control approach vs. AIT constraints.

p13 lines 739-741: I think the Pascal Mars Scout mission proposal (Haberle et al., ∼2000) deserves inclusion in this list.

p16 line 956: REFs missing.

[MAJOR] Please provide an estimate of the data volume that could be relayed. How often could a relay pass be supported, from an energy point of view?

[MAJOR] Please clarify if the MNL is under normal circumstances expected to go dormant waiting for sufficient energy to charge its battery and start operations again, and thus has to wake up with no knowledge of the time. Does the MNL never know ahead of time when a relay pass is expected and thus relies on overlap of its 'link check' status with a relay pass of an orbiter? Given that this is presumably only for a few minutes each sol, doesn't the MNL waste quite some energy listening for a signal? Or is the MNL always expected to keep track of the time and when the next relay passes are?

I also suggest that some of the elements of the MNL and the configuration at each step of the EDL sequence could be clarified by the inclusion of a product tree or block

diagram. This would help understanding section 3.

Some typos for correction:

Abstract, line 2: phenomena, plural

Abstract, line 9: 'number of launches' rather than 'amount of launchers'.

p1 line 20: orient

p2 line 123: mission, singular.

p2, line 125: Mars 96 was never meant to achieve a *stable* Earth orbit, I don't think, only a temporary orbit before the Earth escape burn. Better to say 'failed to achieve Earth escape trajectory'.

p5 line 319: unit, not unity.

p8 Figure 9 caption: modelled, not modellied.

p9 line 518: telescopic, not telescope.

p11, line 644: Fig. 13, not 12, I think.

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