MARTIAN GEODESY WITH NETLANDER AND MARS INFRASTRUCTURE CONSTELLATION. S. C. Wu[1], Y. E. Bar-Sever[1], S. Nandi[1], and L. J. Romans[1], [1]Jet Propulsion Laboratory California Institute of Technology, Mail Stop 238/600, 4800 Oak Grove Drive, Pasadena, CA 91109. E-mail: scw@cobra.jpl.nasa.gov

Introduction: In the past, investigation of Martian geodesy has been relying on observations of Viking and Mars Pathfinder landers from Earth Deep Space tracking network. The proposed Mars Express Geodesy Experiment (MEGE) will improve the accuracy of Mars geodesy by 1 to 2 orders of magnitude [1] with doppler measurements between Mars Express orbiter and Netlanders.

As part of NASA's Mars exploration program in the new millennium, a Mars infrastructure constellation was proposed to provide planetary communication and navigation needs [2]. The first orbiter of this constellation may be put into Mars orbit in 2003, and subsequent ones in 2005, and opportunities therafter. During the period 2006–2008 when the MEGE take place, 3 Network orbiters may be available. Doppler measurements from these orbiters would potentially strengthen the positioning for Netlander and, in turn, would further improve Martian geodesy parameters.

In this paper, we will present the results of a simulation analysis assessing the potential capability of infrastructure satellites for improving Netlander positioning and Martian geodetic parameter determination. The effects of different constellation configurations on the level of enhancement capability will be investigated.

Mars Express Geodesy Experiment: The proposed MEGE will take place during 2006–2008. Four landers will be placed on the Martian surface separated by a few thousand kilometers. The candidate sites of these landers are as shown in Table 1.

Table 1. Netlander Candidate Sites

Name	*Code*	*Longitude*	*Latitude*
Lycus Sulci	LYS	130°W	27.5°N
Menomnia	MEM	160°W	12.5°S
Tempe Terra South	TTS	70°W	35°N
Hellas East	HEE	85°E	32.5°S

The position of these sites, as well as the key rotation parameters characterizing Martian geodesy will be monitored by weekly doppler measurements from Mars Express, a Mars orbiting satellite. with a 6-hour elliptical orbit. The Mars express orbit will in turn be determined by doppler measurements from NASA's Deep Space Network located at Goldstone, CA; Canberra, Australia and Madrid, Spain.

Mars Network Orbiter: The baseline design calls for the gradual deployment of 3 or more micro satellites that will be launched every 26 months, starting in 2003. Each Microsat will have a 5–6 year life expectancy and will carry a transceiver package integrating communications and navigation functions for landed and orbiting users, as well as an X-band link to Earth. This will result in a constellation of 3 Microsats during MEGE era by 2007. This constellation will provide wide geometrical coverage of doppler measurements for better determination of Netlander sites, yielding Martian geodetic parameters at higher accuracy.

Sample Results: Weekly 3-hour passes of 1-way and 2-way doppler measurements between each of the 4 Netlanders and each of the 4 Mars orbiters (Mars Express and 3 Microsats) were simulated over a full Martian year. The Netlanders' position vectors and 24 Martian rotation parameters were estimated with different combinations of these data sets and intercompared. A sample of these results are given in Fig. 1.

Fig. 1 compares Netlander site positioning accuracy with 1-way doppler measurements from Mars Express and from the Microsat. The error sources include a 0.5-mm/sec doppler noise at 60-sec intervals, and a one part per 10^{11} clock instability. The results show an improvement with Mars Network Microsats by a factor of 4 over the nominal Mars Express tracking.

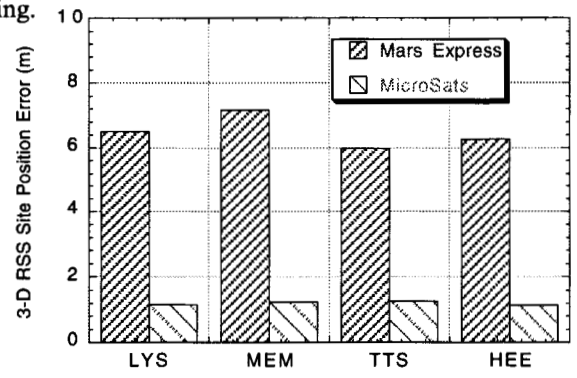

Fig. 1. Netlander site positioning accuracy with doppler measurements from Mars Express and from Microsats

The final paper will include the results for Martian geodetic parameters. The impact of 2-way in place of 1-way doppler measurements and of longer data passes will be assessed.

References: [1] W. M. Folkner, et al. (1998) *Mars Netlander workshop*, Paris, France, Nov. [2] T. A. Ely, et al. (1999) Paper 99-301, *AAS/AIAA Astrodynamics Specialist Conf.*