

NASA's Telecommunications Strategy for Mars Exploration  
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Abstract

Over the past year NASA and its international partners have carried out a significant planning activity to re-assess the sequence for Mars exploration over the coming decade. This paper will summarize the resulting new Mars exploration architecture, identifying the key telecommunications challenges and the strategies for meeting them. The need for increased data return will be quantified in terms of specific science goals and science instrument capabilities, while operational paradigms for second-generation lander/rover surface activities will drive link connectivity requirements. Robust characterization of entry, descent, and landing system performance will demand a combination of low-threshold, low-rate "semaphore" signaling to Earth along with high-rate proximity link telemetry collected from relay assets positioned above the descent vehicle. The potential role of competed, low-cost, scout-class missions in the new program architecture, and their enabling requirement on energy-efficient relay communications, will be described. Finally, radio tracking observables generated on these communications links will support precision navigation needs including approach navigation, surface positioning, and orbiting sample canister orbit determination. A low-cost approach to meeting these needs is centered around the development of the Electra payload, a standardized proximity link communications/navigation payload that can be flown on all future Mars science orbiters and, in the longer term, on dedicated Mars telecommunications orbiters. The telecommunications and navigation capabilities and services of Electra will be described, along with the end-to-end data return capabilities for various orbiter options. The evolving capabilities of the orbiting Mars infrastructure as envisioned in the new program architecture will be quantified, demonstrating the potential for orders-of-magnitude increase in data return from the Martian surface by the end of the decade.