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Opportunistic MSPA: An Overview of the Proof-of-Concept Demonstration

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The Opportunistic Multiple Spacecraft Per Antenna (OMSPA) concept seeks to provide smallsat missions and other spacecraft with a low-attributed-aperture-fee alternative for obtaining routine downlink, while making efficient use of the Deep Space Network's (DSN's) limited number of antennas. Unlike traditional MSPA in which the number of supportable spacecraft are limited by the number of available copies of the analog intermediate frequency feed and receivers to attach to the feed, OMPSA makes use of a wideband recorder at each station that is capable of capturing IF signals from every spacecraft in the antenna beam within the frequency bands of interest. When smallsat missions see one or more opportunities to intercept the traditionally scheduled antenna beam of a "host" spacecraft, they can transmit open loop while in the beam. Via a secure internet site, the smallsat mission operators can then retrieve relevant portions of the digital recording for subsequent demodulation and decoding, or subscribe to a service that does it for them.

During the past year, a proof-of-concept demonstration was performed to provide prospective smallsat users and the DSN, as the prospective service provider, with demonstrable proof that the OMSPA concept does, in fact, work. The demonstration involved treating Mars Odyssey as a "smallsat" and Mars Reconnaissance Orbiter (MRO) as the "host" spacecraft. Using a specially created Beam Intercept Planning System (BIPS) and a DSN 7-Day Schedule Cross-Comparison tool (7-DSC), opportunities were identified when Mars Odyssey would be transmitting while in MRO's ground antenna beam. Existing Very Long Baseline Interferometry (VLBI) Science Receivers (VSRs) were used to record the Mars Odyssey downlink telemetry during these opportunities. The recordings were played back to a secure server at JPL. The demonstration team's signal processing personnel retrieved the recordings from this server and downloaded them to a workstation containing an OMSPA Software Demodulator (OSD) tool to demodulate and decode the Mars Odyssey signal. Validation of the recovered data was then accomplished by comparing the transfer frames obtained through OMSPA with those recovered via Mars Odyssey's formally scheduled downlink.

BIPS and 7-DSC successfully enabled identification of OMSPA opportunities to within a minute or so of the formally scheduled downlink times. And, the team was able to successfully playback the VSR recordings to the secure server, transfer them to the OSD workstation, demodulate and decode them – all within the one-to-two day target timeframe. In each case, at least 99.95% of the transfer frames were successfully recovered.