

**NASA MOBILE LUNAR AND PLANETARY SCIENCE MODULE.**

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NASA and university researchers have specified a fundamental suite of scientific instrumentation focused on surface composition determination for the calibration and validation of NASA orbiting sensors for mobile planetary exploration. The instruments have been integrated with navigation and clocks to create a scientific data base that is searchable by location, time of acquisition, and instrument. The time and location controlled data stream is then transmitted via a tiered hybrid wireless and network for lunar and planetary scientific analyses within remote sensing and lunar-spatial and planet-spatial information systems as well as a custom-designed navigation-system-aware Internet Browser. The system is designed specifically to provide surface composition information for lunar and planetary orbiting imagers. The base suite of scientific instrumentation for planetary surface analysis and orbiter calibration and validation consists of high-resolution video cameras, three spectroradiometers, an infra-red thermometer, Geiger counter, an astronaut operated microscope and associated sampling gear. These instruments have been integrated with two remotely controlled microcomputers within the test-bed that control the instruments and act as intermediate servers to store data as they are acquired. NASA astronauts have tested the system for ergonomic and HCI functionality with regard to the acquisition of scientific measurements. Each scientific measurement was then digitized, time and location stamped and converted to an ASCII data stream compatible with TCP/IP. These data were carried along with remote control signals and video and voice-over-IP data streams from the mobile unit. The slow-start and packet lengths of the TCP/IP algorithm have been modified to make it more suitable for long-delay hybrid wireless and wired communication. The lunar and planetary exploration network was modeled with a wired Ethernet LAN on the mobile science platform itself that was linked to a mock local lunar or planetary surface point-of-presence via an 11Mbps wireless LAN. The wireless LAN is in turn linked by a 100Mbps wireless backbone to a lunar or planetary communications gateway via a 45Mbps 2-way IP-over-geosynchronous satellite circuit which linked the test field site in Arizona to the NASA Glenn wireless gateway in Ohio. The signal was then routed via terrestrial networks to NASA's NREN and then on to other science team members at the NASA ExPOC at Mission Control. The mobile lunar and planetary science data system prototype includes the capability to add a delay of several seconds to several tens of minutes in order to model the communications delays inherent in lunar and planetary exploration. The simulated delay is used by the science team to develop behavioral protocols for scientists on earth interacting with the astronauts, science data system, robots and the scientific experiments themselves. Orbiter data are currently modeled with existing NASA multi-spectral and hyper-spectral imagers and were successfully exchanged between the astronaut and ExPOC teams over the network.