Mars Pathfinder Mission Operations Concept

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Mars Pathfinder is one of the first of NASA's new series of low cost planetary missions conducted as part of the Discovery Program. A number of innovative development techniques and management practices have been adopted during the development phase to remain within the $150M (FY'92) cost cap. With the upcoming December 1996 launch, the same faster, better, cheaper spirit has been used to develop a low cost approach for mission operations. This paper will describe the operations requirements, philosophy, flight team organizational structure, GDS environment, and operations processes planned for Pathfinder.

The Mars Pathfinder mission starts with launch from Cape Canaveral Air Station from December 2-25, 1996. The spacecraft is a simple spinner which remains near Earth point for the seven months of cruise. Operationally, this period of the mission should be relatively quiescent, since no science activities arc planned and the only key events are four trajectory correction maneuvers. The operationally intensive part of the mission starts on July 4, 199-?, when the spacecraft enters the Martian atmosphere and lands. The prime surface mission then lasts for thirty Martian days. During this period, the flight team must generate and uplink new operations sequences on a daily basis. This command cycle is particularly important during the seven day rover prime mission.

The fundamental mission operations architecture used for Mars Pathfinder is based on a "skunk works" model in which a small team of highly trained personnel perform all critical operations activities. These personnel, called Flight Engi ricers, are generalists who understand both the mission objectives and flight system design, and are capable of hands-on use of the ground data system (GDS). One of the chief advantages of this approach is that it reduces compartmen talization and does not rely on formal interfaces. in fact, these Flight Engineers are empowered to work directly with the science investigators without needing interface "middle-men" .

The operability of the flight system and GDS are instrumental in enabling this approach. A single powerful on-board computer controls all elements of the spacecraft including the payload. This flight system architecture, plus the use of high level commands, allows the spacecraft to be flown as a system rather than a collection of subsystems. As a result, a few key system engineers can perform all uplink functions (planning, sequence, command) without significant subsystem support, Subsystem engineers are used for performance anal ysis and anomaly resolution

The Pathfinder GDS is an augmentation of the JPL institutional Multimission Ground Data System. Considerable effort has been made to simplify the user interfaces and integrate the system into a unified control system. As a result, hands-on use of the GDS toolset is now possible without the need for a large staff of toolsmiths. The uplink elements of the GDS have been integrated in a single shell to provide end-to-end planning, sequence, and command capabilities. In addition, sophisticated telemetry handling capabilities have been included to track the state of the spacecraft and provide quick assessments of the system level performance of the vehicle.

Detailed operational processes and procedures are currently being developed for Pathfinder. Although the skunk works approach reduces the need for formal procedures, some effort is required to understand the overall operations timeline. This is particularly important during the surface mission, when the daily downlink assessment and sequence/command planning activities must be completed in 17 hours, Preliminary operations procedures have been developed which satisfy this requirement, but the project plans to perform extensive. operational readiness testing to verify this.