

*Automating the SMAP
Ground Data System to
Support Lights-Out
Operations*

SpaceOps 2014

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*Soil Moisture
Active and Passive
(SMAP) Mission*

<http://smap.jpl.nasa.gov>



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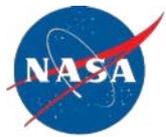
SMAP-GDS-1



Introduction to SMAP



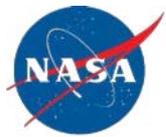
- Soil Moisture Active/Passive (SMAP) is a first tier mission in NASA's Earth Science Decadal Survey
- SMAP will provide global mapping of soil moisture and its freeze/thaw states
 - Enhances the understanding of processes that link the terrestrial water, energy, and carbon cycles
 - Enhances weather and forecast capabilities
- NASA's Jet Propulsion Laboratory selected as lead center for the development and operation of SMAP
 - SMAP represents a new area of JPL focus towards low cost Earth science missions



SMAP Ground Data System



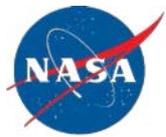
- The SMAP Ground Data System (GDS) is the integrated set of ground hardware, software, facilities, and networks required to support mission operations
- The SMAP GDS is consistent with prior JPL missions and allows SMAP to inherit GDS architecture, design, and implementation
- Key functions performed by the GDS include:
 - Sequence and command generation and uplink
 - Real-time and playback telemetry processing
 - Navigation
 - Ephemeris generation and distribution
 - Data management and accountability
 - Time correlation
 - Station Scheduling



Automation Challenges



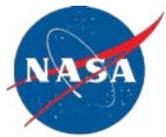
- Automation of the GDS must meet the following challenges in order to achieve lights-out operations for SMAP:
 - Reliable performance of the GDS functions
 - Including automated commanding of the SMAP spacecraft
 - Reliable operations by small ops team
 - Simple automation configuration and maintenance
 - Reliable monitoring of automation health and status
 - Closed loop monitoring is required



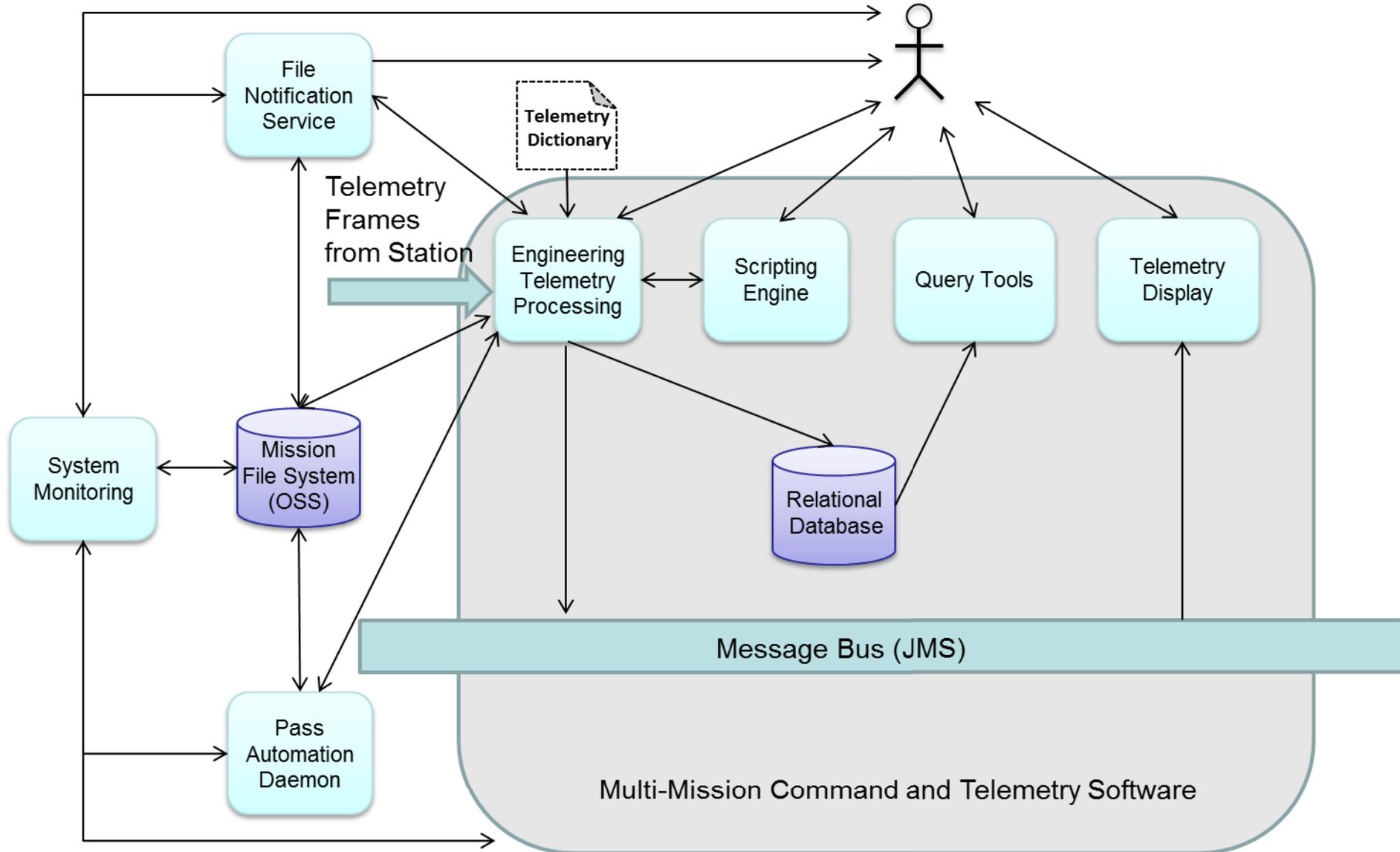
Automation Approach



- Identification and Implementation of Automation Patterns
 - File-Based Automation
 - Pass-Based Automation
 - Time-Based Automation
- Automation design inheritance from prior JPL Earth science missions
 - Jason-1 and WISE
- Leveraging of multi-mission and open-source software
 - Automation software provides thin layer around proven software capabilities
- Use of system monitoring



Automation Architecture

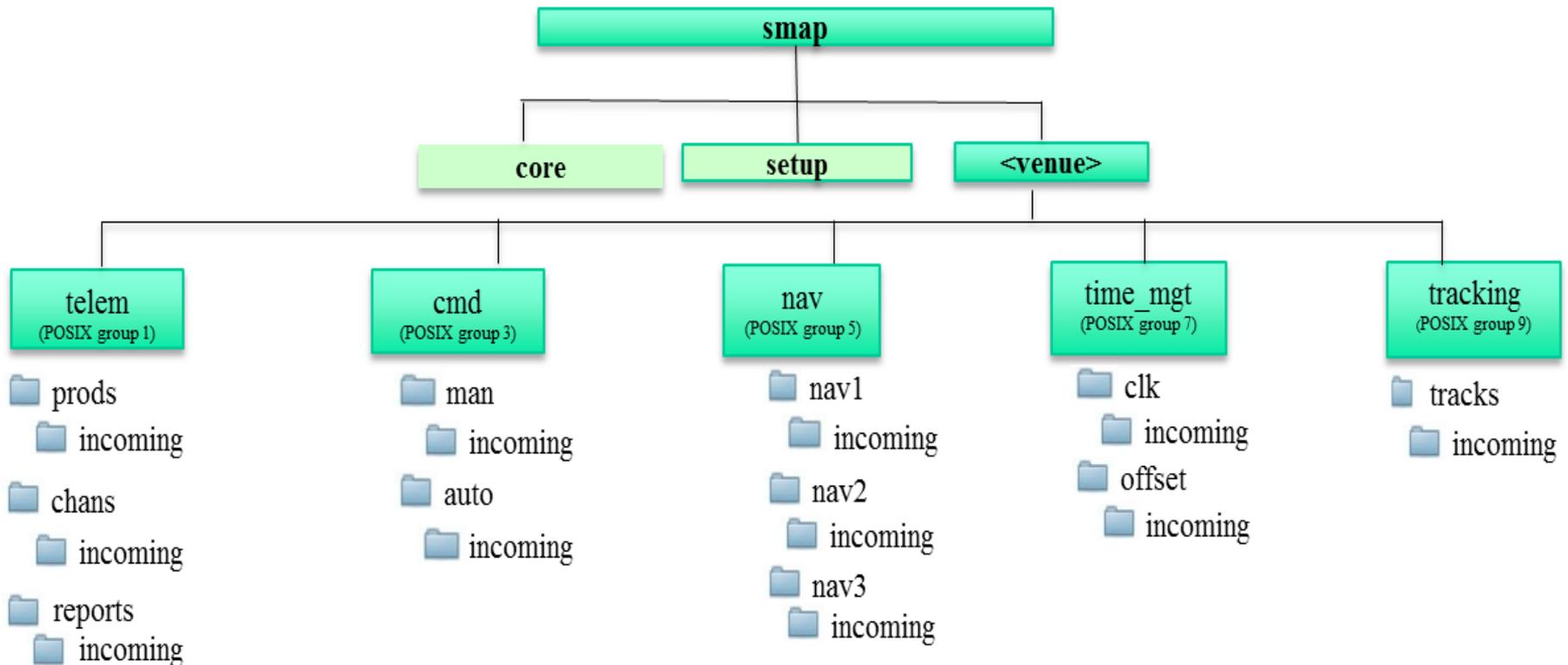




Operations Storage Server



- An NFS-based file system that implements a hierarchical directory structure that provides storage for the data that is exchanged among the various SMAP teams





File Notification Service



- The File Notification Service (FNS) provides file-based automation within the OSS
- FNS can be configured to monitor any number of directories within the OSS
 - invokes user specified processing upon detection of new files stored to the OSS
- FNS provides a set of atomic operations that can be performed upon file detection
- FNS provides notification of file arrival events and success/failure status of the atomic operations
- The FNS provided detect/process/notify construct that allows the implementation of workflow automation within the OSS



Pass Automation Daemon



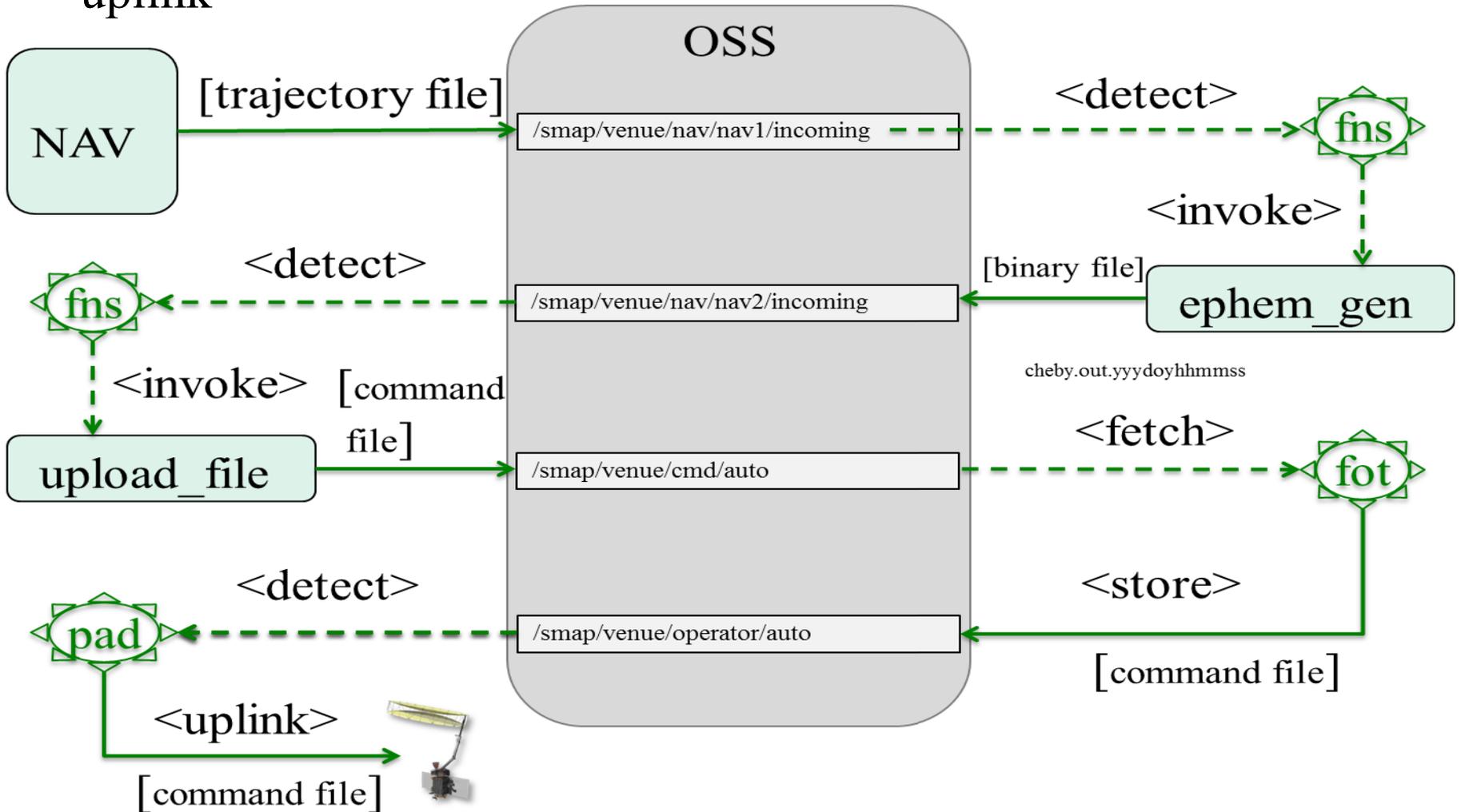
- The Pass Automation Daemon (PAD) provides pass-based automation
- PAD orchestrates all activities associated with unattended tracking passes
- PAD is driven by a pass list which is derived from the tracking pass schedule
- PAD allows the automation of pre-pass, in-pass, and post-pass activities such as:
 - Station connection management
 - Automated uplink
 - Telemetry processing
 - Invocation of custom flight operations scripts
 - Data management
 - Time correlation

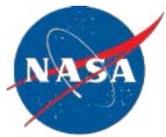


Workflow Automation



- Sample FNS, PAD, and OSS interactions to enable ephemeris uplink





Time-based Automation Scheduler



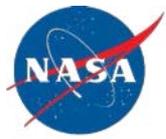
- The Time-based Automation Scheduler (TAS) provides time-based automation
- TAS provides a flexible means to construct and manage sets of time-based automation activities
- The task scheduling algorithms in TAS are aware of the SMAP ground station tracking pass times
 - Allows scheduling of automation activities outside of tracking pass times
- Automation activities supported by TAS include
 - Data management
 - Report generation
 - Data archival



System Monitoring



- Successful operation of the SMAP mission requires the reliable use of robust GDS automation
 - The automation software must be highly available
 - Automated procedures must be performed in a timely manner
- System monitoring will be used to detect and respond to anomalous system behavior
- A monitoring solution based on the open-source Zabbix and Nagios software will perform the system monitoring function for SMAP
- The system monitoring solution will
 - Monitor GDS automation resources
 - Restart failed processes
 - Provide closed-loop notification to the GDS support team



Summary



- As SMAP GDS development continues towards a November 2014 launch date, upcoming system tests will certify the readiness of the GDS automation for lights-out operations
- Although lights-out operation has been partially demonstrated in the past, SMAP represents the first JPL mission that will utilize a fully lights-out approach for routine operations
- The architecture and approaches used by SMAP will set the baseline for future JPL Earth science missions