

Automated Mission Planning and Scheduling (AMPS) Support of Autonomous Operations for the ST5 Constellation

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ST-5 is a three satellite constellation technology-validation mission under the New Millennium Program at NASA. The constellation launched from Vandenberg Air Force Base (VAFB) on February 2006, with the 90-day mission terminating on June, 2006. New ground system technologies were utilized to satisfy flight requirements for both constellation and autonomous operations. The cornerstone of the operations concept was use of a mission planning system to develop and execute a validated plan of ground and spacecraft activities. This approach was supported by another of the new technologies, a model-based operations system, to adjust the plan in near real-time. The system was designed with the goal of providing the routine and periodic services rendered by traditional operations controllers. The overall approach relied on software components that could effectively communicate over a common bus. The GSFC Mission Services Evolution Center (GMSEC) middleware bus was used to support that requirement. The key highlights of this approach were:

- Devise and validate a plan off-line that is directly executed for automated control of a constellation of spacecraft
- Provide self-updating predictive models to support plan validation off-line and to report changes in constrained ground, network and spacecraft resource availability in the real-time
- Autonomously re-plan in real-time in response to reported changes in resource availability
- Standardize message interfaces (GMSEC) to allow for application communication and easy removal of selected ground components and replacement with new components

Our experiences during operations clearly demonstrated the utility of this architectural and operational approach. Despite radical changes in operational requirements, the operations team was able to easily meet mission requirements with relatively minor changes in ground implementation details. Furthermore, they were able to continue to tune the autonomy approach as the mission cycle progressed. This presentation will highlight the architecture used, operations concept employed and the resultant experiences and lessons learned spanning ground system development through End-Of-Mission.

Biographies:

Mr. Shendock graduated from East Stroudsburg University in 1976 with a BS in Mathematics. Currently, he has twenty-eight years experience in payload development, mission operations and missile systems. Responsibilities include all project phases from design requirement definition through post-mission analysis. He has supported integration and test of two spacecraft from box level testing through final launch site preparations. Mission operations support includes statistical analysis, mathematical modeling and engineering support for Attitude, Power, Thermal, Flight Software, Communications and Propulsion subsystems. Ground segment activities include design, development, test and operational use of real-time and off-line systems utilizing COTS/GOTS software. Missile system responsibilities were related to Boost Guidance Systems and Flight Performance. He has provided direct support to twenty orbital missions at NASA GSFC (Greenbelt), NOAA (Suitland), Vandenberg Air Force Base (VAFB), Canaveral Air Station (CAS) and ASFCF (STC).

Jenny Williams has 9 years experience implementing spacecraft planning and scheduling programs for ground systems and 30 years of general software development experience. Ms. Williams built the mission planning system for ST5 using the framework provided by the Automated Mission Planning System (AMPS). She has supported the extension of AMPS and its predecessor, MOPSS (Mission Operations Planning and Scheduling System), for EO-1 and TRMM. She has been instrumental in developing prototypes of planning systems using AMPS as the planning framework.