3/29/96 Operations IPT Strawman System Architecture &Mission Concepts

Thursday morning I met with a subset of the IPT (Steve Tompkins, Lou Hallock and Jack Leibee) to discuss a strawman high-level conceptual breakout for the "NGST Data System Functional Architecture".

I offer each of you the opportunity to review, question and comment on this material prior to April 9 (by e-mail to: kkalinowski@hst-popb8.gsfc.nasa.gov). Our objective is progress toward making these or substitute "structures" the basis for sub-dividing the IPT's efforts. Such structures may, of course, be modified over time.

Steve's strawman divides NGST's operations architecture into five major groupings. Sub-elements may exist wholly within one group or bridge groups. A purpose of keeping the number of major groups small is to avoid losing sight of the forest for all the trees. The idea is that we will identify major-group leads and/or teams that will work each group's sub-elements; we will use our larger meetings to status these efforts, cross-fertilize concepts, and critique and iterate options. Please assess the diagram and element descriptions for appropriateness of the divisions and for completeness.

We further discussed the definition of several "higher-level mission concepts." We will need to assess, compare and contrast the nature of, and development and operations costs of functional architectures for each of these mission concepts. These architectures will exhibit commonalities and divergences. By completing these comparisons we should be able to provide the larger NGST community with distinct choices among options having different pros and cons. For now, all of these assume an L2 orbit. Only one may be practical for a 1x3 AU orbit.

These are the strawmen mission concepts we will discuss/alter/adopt:

1. A mission governed by stored program commands periodically uplinked to the spacecraft. A 1 Mbps downlink is available nearly continuously.

2. A mission governed by stored program commands periodically uplinked to the spacecraft. A 10 Mbps downlink is available for periodic, burst-mode transmission of data to the ground. Sub-options for engineering telemetry are: a) burst transmission of a full telemetry record or windowed subset temporarily stored on-board, b) continuous low-rate downlink of a small telemetry subset or beacon-mode signal, or c) some combination of a) and b), perhaps using b) as a trigger for a).

3. A mission controlled in real-time ("IUE mode") with block scheduling of guest observer time allocations and support for an "observer at home" remote interface. ("Observatory science", e.g., systemmatic surveys could still be handled by NGST staff.)

Finally, we've firmed up or made tentative "assignments" of other IPT jobs to our members. These include:

Spacecraft IPT sub-discipline liasons:

Communications - Steve Tompkins
ACS/PCS - Lou Hallock

Science Module IPT liason - Rodger Doxsey

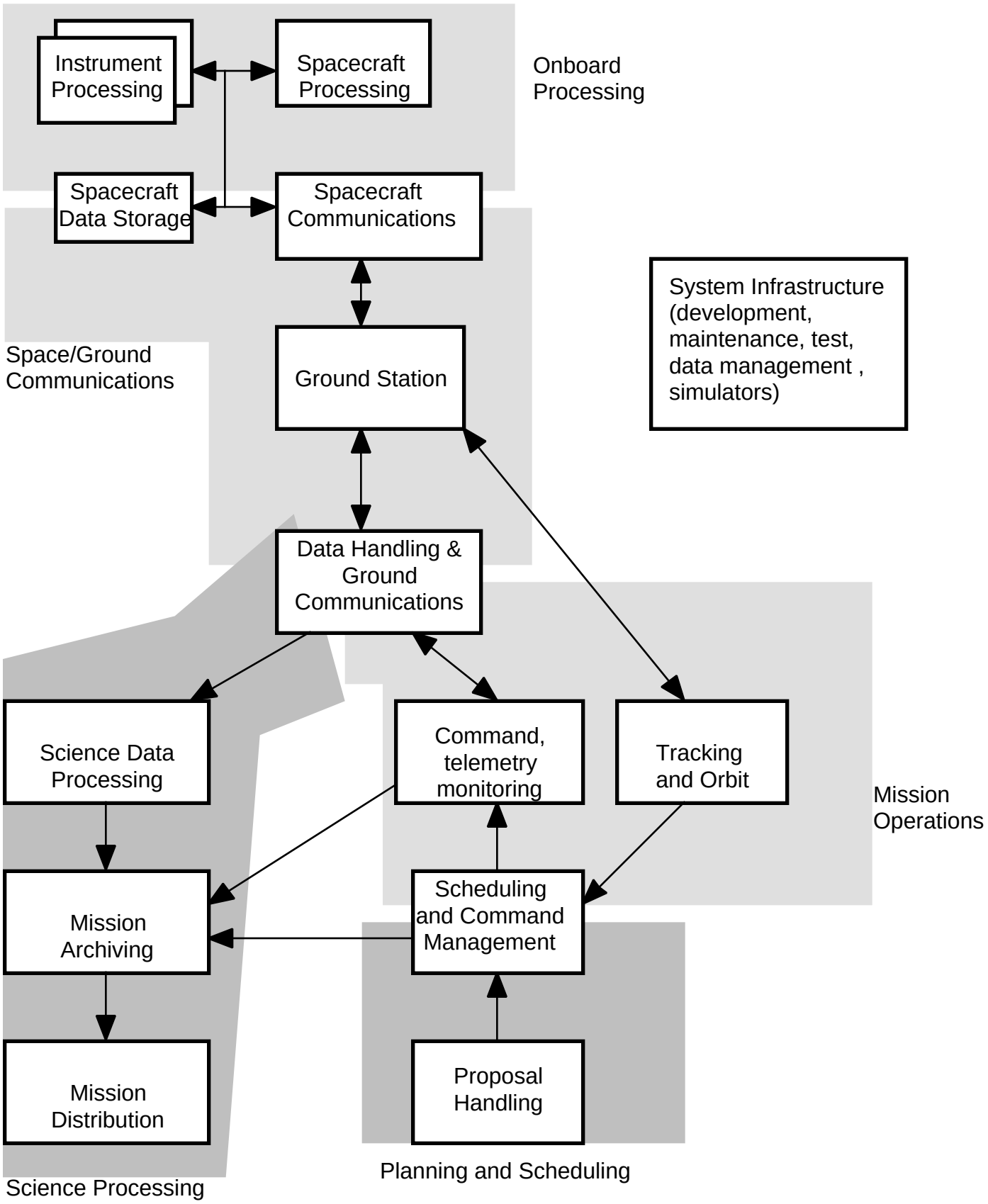
Design Reference Mission Content - Ted Gull

DRM Implementation - Larry Petro

Suggestions for other areas needing similar assignments will be welcomed.

Steve Tompkin's text and diagram are attached

Keith Kalinowski


Instrument Processing
Spacecraft Processing
Onboard Processing
Spacecraft Data Storage
Spacecraft Communications
System Infrastructure (development, maintenance, test, data management , simulators)
Space/Ground Communications
Ground Station
Data Handling & Ground Communications
Science Data Processing
Command, telemetry monitoring
Tracking and Orbit
Mission Operations
Mission Archiving
Scheduling and Command Management
Mission Distribution
Proposal Handling
Planning and Scheduling
Science Processing

3/28/96

The NGST Data system Functional Architecture is intended to be a generic architecture that can be used to support the Operations IPT efforts without presuming a particular solution. It was developed with some assumptions in mind (for example, L2 orbit, preplanned proposal driven mission) but it is hoped that this architecture could be adapted to other mission concepts without significant modifications.

The functions could be combined or distributed. In particular, many of the ground system functions could be performed at least in part onboard in the spacecraft or instrument processing function.

Instrument Processing. Includes all functions performed within the instruments - data compression, data formatting, target acquisition, peak-up, macro command expansion, buffering, attitude determination support, instrument housekeeping data monitoring, instrument safemode, instrument autonomous functions.

Spacecraft processing. Stored command processing (absolute time and relative time). Attitude and position determination. Data formatting. Housekeeping data monitoring. Safe mode. Onboard autonomy.

Spacecraft data storage. Records data.

Spacecraft communications. RF communications with the ground and implements the onboard portions of any space/ground protocol.

Ground Station. RF communications with the spacecraft.

Data Handling and ground communications. Moves the data from the applications onboard to the applications on the ground and vice versa. May be performed by the protocol.

Command, Telemetry monitoring. Generates commands or directives for the spacecraft and instruments and monitors their performance. May be distributed. If needed, performs engineering analysis of spacecraft and instrument parameters. This function is also used to perform the integration and test of the spacecraft prior to launch.

Scheduling and command management. Schedules the observations, the contacts with the ground station, any housekeeping/engineering activities, including calibrations, checks for constraints, distributes schedules to all components, generated command loads.

Proposal management. Accepts and formats proposals and tracks them through the system.

Science processing. Processes the outputs of the instruments (along with ancillary data) into science products.

Mission archiving. Permanent storage of NGST products. May include archived plans, operations history, and engineering data as well as science products.

Mission Distribution. Distribution of data to users.

Tracking and Orbit. All orbit functions including orbit determination, orbit prediction and maneuver planning.

System Infrastructure. Development systems, maintenance systems (including flight software maintenance), test systems, simulators, and supporting data repositories (e.g., project data base, documentation).

These functions (other than the system infrastructure) can be chunked into 5 larger groupings. Note that some functions appear in more than 1 grouping.

Onboard Processing. Includes the instrument processing, the spacecraft processing, the spacecraft communications, and the spacecraft data storage.

Space/Ground Communications. Includes the Spacecraft data storage, the spacecraft communications, the ground stations and the data handling andground communications function.

Science Processing. Includes the Data handling and ground communications, the science data processing, the mission data archiving and the mission data distribution functions.

Planning and scheduling. Includes proposal management and scheduling and command management function.

Mission Operations. Includes the command and telemetry monitoring, the tracking and orbit, the data handling and ground communications, and the scheduling and command management functions.