Multi-Mission Support for Current and Future Systems

The Joint Polar Satellite System (JPSS) Common Ground System (CGS), developed and deployed by Raytheon Intelligence, Information and Services (IIS), manages and supports numerous missions, as shown in Figure 1. The CGS architecture was upgraded to:

1. Support JPSS-1 launch in early 2017
2. Increase operational robustness
3. Leverage lessons learned in operations to date
4. Take advantage of newer technologies

The CGS provides three different types of services:

1. **Managed Mission Services**: CGS flies the satellite, manages mission resources, acquires and/or routes raw data, and generates and delivers data products
2. **Data Processing Mission Services**: Same as above, minus flying the satellite and managing the mission
3. **Data Acquisition and Routing Mission Services**: CGS acquires and/or routes the raw data

Figure 2 shows how these services are applied to multiple missions today and into the near future.

CGS Scalability for Adding Missions

Scalability is a key tenet of the CGS. Table 1 summarizes the CGS scalability requirements and associated architectural enablers. Figure 3 shows a level-deeper picture of the architecture, annotated with a mapping to the Joint Architecture Reference Model (JARM) and locations of CGS extension points for scalability. These extension points enable the addition of new missions to the CGS, and essentially serve as a “checklist” per each new mission, which has been demonstrated in expanded CGS multi-mission support to date.

For example, the addition of Data Acquisition and Routing support for DMSP required the use of extension points 1 (configuration of CGS receptors at McMurdo) and 6 (connection to the service delivery point for the 557th Weather Wing). The addition of Data Acquisition and Routing support for Metop required the use of extension point 6 (connection to the service delivery point for EUMETSAT). The addition of Data Processing support for GCOM-W1 required the use of extension points 1 (shared antenna usage at SvalSat), 2 (routing to the NSOF for data processing), 4 (code to package the raw data into HDF) and 5 (delivery of the raw data to a local delivery point at the NSOF).

Modeling Additional Missions in the JPSS CGS: Tools

To support systems engineering and hardware sizing activities, Raytheon developed a system simulation tool: the CGS Architecture and Mission Performance Unified Simulation (CAMPUS). See Figure 4. CAMPUS is a discrete-event, queue-based model of the JPSS CGS, built in ExtendSim. CAMPUS models the latency, throughput, and data volume from sensor collection to data delivery, and was validated against the Block 1.2 CGS currently in operations.

New missions can be easily added to CAMPUS. They can be fully integrated to use the same pathways (Ground Stations/WAN/JSH/IDPS) or they can be routed such that they only use some of these resources. Assumptions are made when modeling a new mission, including:

- Timing/Latency of desired Algorithms
- Orbital Parameters of Spacecraft
- Ground Stations used to downlink data
- Data Volumes of sensors and products

As the CGS continues in operations through Block 2.0 and beyond, we can use these capabilities to better assess and predict performance when adding new missions.