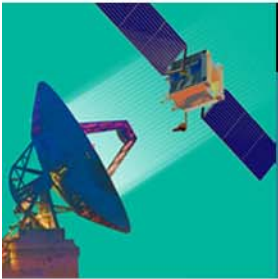Session 11E

Flight Software Ground System Impacts

## Working Group Preview

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AEROSPACE

Ground System Architectures Workshop

Working Group Session 11E

A short session to discuss developmental and operational impacts of flight software on the ground system.
This session will expand the work done in GSAW2008 and GSAW2009. There are significant areas
where flight software impacts the ground—telemetry, increasing vehicle telemetry, and the increased involvement in the ground to support poorly designed and tested software. In particular, the discussion should try to elicit techniques that foster more collaboration between space and ground to minimize negative impacts.
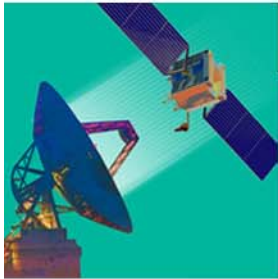
Key Points – Core Problems

- Conflicting goals between spacecraft manufacturers, ground system developers, and operators
  - Development, scheduling, data exchange milestones are not always synched
- Complexity is key -- in space or on the ground
  - Space ground trades are "not always done well"
  - Moving complexity to the spacecraft to simplify the ground can be a double edged sword as new ground tools may be required to monitor new onboard functionality
- High level of coupling of ground software to flight
  - Spacecraft commanding is at the wrong level of abstraction leaving ops talent doing mundane tasks
  - Automation seems to be in the wrong place and difficult to validate
- Need early involvement of ops in flight and ground software development
- Need a common language everyone understands
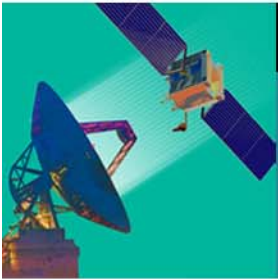
Key Points – Improve Collaboration

- Involve operations team in software development early
  - "Operate before launch"
  - Convince management of the value
  - Remove barriers that inhibit collaboration
- Involve software developers in operations
- Transition operations experts through the spacecraft lifecycle (integration and test through operations)
- Hold early multi-organization meetings to build ops concept agreements and to align goals
  - Doing so makes everyone a stakeholder
- Incentivize organizations / companies to collaborate
- Provide a mechanism for "Ground Education" about flight software capability and requirements
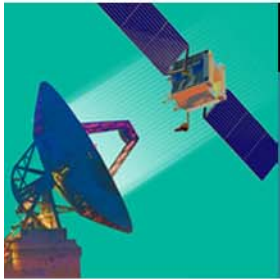
Key Points – Use Model-based Methods

- Use model-based engineering approaches
- Standardize methods for spacecraft modeling and data representation
  - Use existing standards (e.g., XTCE, business process modeling)
  - Standardize a domain-specific subset of existing general modeling languages like UML
  - Identify new standards that may be needed
- Model behavior – not just "things"
- Spacecraft manufacturer should validate the model
- Ground system developers and operators can develop and *validate* against that same model
- Avoid re-invention: reuse models (not code)