Working Group Outbrief

Ground System Architectures Workshop

Session 11D

Flight Software Ground System Impacts

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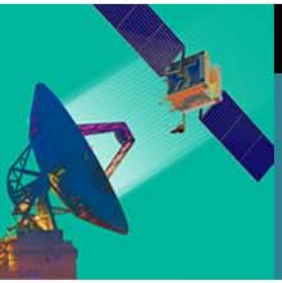
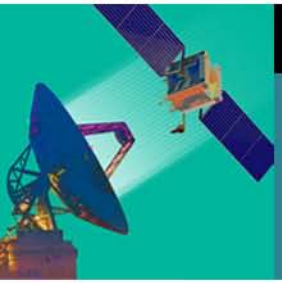


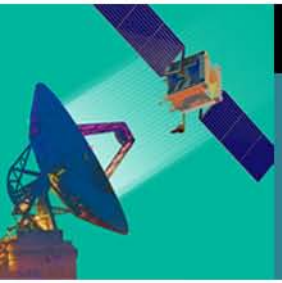
Session Goals

- To discuss and expose issues related to the impact of flight software on ground systems and vice versa
- To identify solutions, actions, and ways to improve



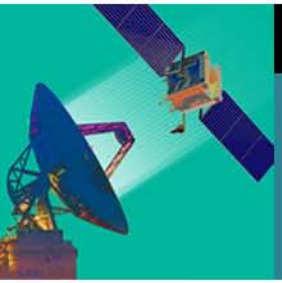
Presenters/Panelists

- Panelists:
  - Vera Horoschak — Boeing Satellite Systems
  - Anneli Kyner — Boeing Satellite Systems
  - Jane Marquart — NASA Goddard Space Flight Center
  - Robert Rasmussen — Jet Propulsion Laboratory
  - Mary Rich — The Aerospace Corporation
  - Gerry Simon — Integral Systems, Inc.
  - Takahiro Yamada — Japan Space Exploration Agency
- Panel expertise included flight and ground software
  - Some panelists had extensive experience in both areas



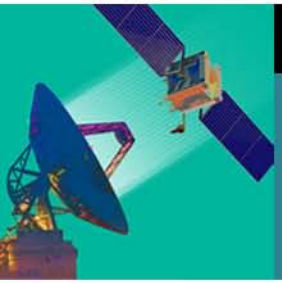
Key Points – Core Problems

- 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



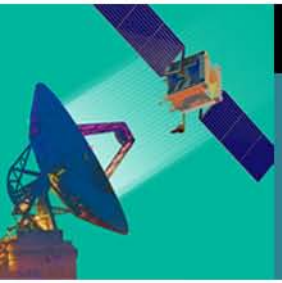
Key Points – Improve Collaboration

- 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)



Conclusions

- “It’s important and possible to improve.”
- We can do this by:
  - Remembering architecture is key – engineer the whole system, not just ground or space
  - Improving collaboration between flight and ground teams
  - Employing model-based techniques and standards
  - Creating *template implementations* for space domain standards that can be used to kick start development programs