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