

SPACE / GROUND TRADEOFFS

GROUND SYSTEM ARCHITECTURES WORKSHOP

Breakout Session 3

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Panel Participants

- **Nevin A. Bryant** **Virtual Ground Station of the Future**
 - Jet Propulsion Laboratory
- **Robert Zmarzlak** **Future Trends Towards Increased**
 - TRW Space & Electronics **Ground and Space Systems Autonomy**
- **Paul Nussbaum** **Key Mission Systems Engineering Trades**
 - - TRW **for Determining System Architecture**
- **Rex Pendley** **Use of a Design-To-Debris Prototype in**
 - Computer Science Corp **Space / Ground Trades**
- **Dave Welch** **Space / Ground Architecture Trade Offs**
 - Allied Signal Technical Services Corp
- **Eighteen Others from National Programs / Black Programs / Commercial Programs & Science Programs**

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- **What is meant by Flight Ground Trades?**
 - **How Do You Decide What Goes On-Board the Spacecraft**
 - **How Do You Decide What Goes On the Ground**
 - **Can we:**
 - “Put it on the ground unless there’s a compelling reason to put it in space?”
 - **Answer Depends on the Mission**

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SPACE / GROUND TRADE CRITERIA

- **What are the Drivers (or Criteria) for Making Flight/Ground Trades?**
 - **Cost ****
 - **Power and Weight**
 - **Performance ****
 - Cost and Overall Performance Effect All Mission Types
 - Bits / \$
 - Return on Investment
 - **Risk****
 - **Function of the mission type**
 - **Swarm of Cookie Cutter Comm Satellites**
 - **Expensive National Security Satellites**
 - **Science Spacecraft**
 - **RISK IMPACTS ON MISSION TYPES**
 - **National - Risk of Failure UNACCEPTABLE**
 - **Comm - Risk of Failure MORE ACCEPTABLE Due to Sheer Numbers of Satellites**
 - **Science - Risk of Failure is UNDESIREABLE**
 - **Workforce & Skill Level**
 - **Standards**
 - **Flexibility**
 - **Margins**
- **Multi-Dimensional Trade Space**

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DISCUSSION ITEMS

- **Validation and Verification of On-Board Systems**
 - **How Do We Accomplished This?**
 - Experience Has Shown Insufficient Time to Fully Test Existing Flight Software (FSW)
 - Moving More Capabilities On-Board Increases Size of FSW to be Tested
 - Confidence, Expectations (When is S/W Ready to be Launched?)
 - Test on Ground, then Launch
 - Testing in a Parallel Ops Mode
 - Maintain Manual Capability, Through Evolution of Autonomy
- **Are we Prepared to Fly COTS?**
 - Trading “First on the Block” vs: Well Tested, Fully Functional Capabilities
 - Science Experience with Brouser--Poor Response, Capabilities De-Selected
 - National Program -- Increased Operations by 50 O&M Personnel)
 - `We Are
“Tail Wagging the Dog”
- **How Do We Capture The Knowledge Of The Flying System?**

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ISSUES

- **Need for a Common Underlying Architecture for Both Ground and Space Segments**
 - Doesn't Matter Where We Put Functionality.
- **Feasibility of Spacecraft As a Node or Device on the Network.**
 - What is the "State of Practice" (STRV1b, DS1, etc.)
- **Applicability of ISO Standards to the Space Component.**
- **Assess COTS Hardware for Flight Readiness.**
- **How Do We Address the Increased Complexity of Constellation Trades--Rather than Single Spacecraft Trades**
- **Need More "Smarts" Onboard to Automate Health and Safety and Minimize Ground Support.**
 - National Program--Minimize Ground Interaction
 - Science Program--More Driven By Operation Scenerios
- **Acceptability of an In-Orbit Testing and Autonomy Evolution**
- **Develop a Process/Framework/Checklist to Facilitate Trading Space/ground.**
- **Testing Techniques to Validate On-board Systems.**
- **Are We Prepared to Give up "Hands On" Control of the Spacecraft?**
 - "That's Why You Have a PI and We Have a Commander!"