A Common System for the Life of a Spacecraft

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Perspective

- Traditional satellite deployment methodologies have utilized multiple control systems
  - *Spacecraft sub-system test*
  - *Spacecraft system test*
  - *Launch and early orbit*
  - *In-Orbit test & evaluation*
  - *On-orbit control*

- Each control system generally utilizes a different set of database parameters
  - *Command definition*
  - *Telemetry definition*
  - *Alarm limits*

- Synchronization of the databases has proven to be difficult
  - *Costly manual management of database contents*
  - *Errors become increasingly expensive as the deployment process proceeds*
Future Directions

- Satellite manufacturers are recognizing the value of utilizing a single control system throughout the life of a spacecraft
  - Cost savings
  - Schedule reduction
  - Less on-orbit errors

- Use of a single control system requires process modifications
  - Development of a single requirement specification
    - Collection of requirements from several in-plant organizations
    - Coordination with existing and future customers
  - Investment in the development of a new system
  - Modifications to system maintenance approaches

- Implementation of a multi-purpose control system requires a commitment to on-going maintenance and evolution
  - Satellite advances will require the system to keep pace
  - General technological growth will force changes
  - The use of COTS systems eases maintenance concerns
System Attributes - Databases

• The database structure needs to be implemented as a result of a carefully considered system approach to information flow
  – A single source for any given piece of data
  – Database structure planned well in advance by a combination of spacecraft and software experts
  – Maintainability is a key consideration

• Support tools must be developed
  – Customer changeable parameters identified
  – Easy to use editor for modifiable parameters
  – The capability to deliver database delta files is necessary
  – Tools to check for proper use of data structure calls must be developed

• The database must be able to dictate the operational use of the system and contain trigger parameters to control functions
System Attributes - Interfaces

• The system requires a modular design to manage data interfaces with multiple external processes
  – *Varied hardware*
    • Test equipment
    • Operational baseband equipment
    • Antennas
  – *Flight dynamics software*
  – *Analysis software*

• The addition of new interfaces cannot be expensive

• The internal data management approach must be source independent
Lessons Learned

• The deployment of a multi-purpose control system requires very close interaction between the satellite manufacturing organization and the development group.

• Detailed requirement definition is critical prior to system design:
  – Spacecraft sub-system test engineers
  – Spacecraft system test engineers
  – In-house Mission Control Complex operators
  – External customers

• An open system design must be utilized:
  – Requirement changes
  – System evolution
  – Multiple external interfaces
Summary

• The use of several different systems to test, launch and fly a spacecraft is not efficient

• Implementation of a multi-purpose system requires a different development paradigm
  – Requirements collection
  – System design
  – System maintenance

• The use of open COTS products aids in the deployment of multi-purpose system control systems

• The use of a multi-purpose control system is in place today and is not just a future vision