



**communications**

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**Storm Control Systems**

*A Common System for  
the Life of a Spacecraft*

**James E. Corrigan**  
**Director of Software Development**

# Perspective

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- **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*

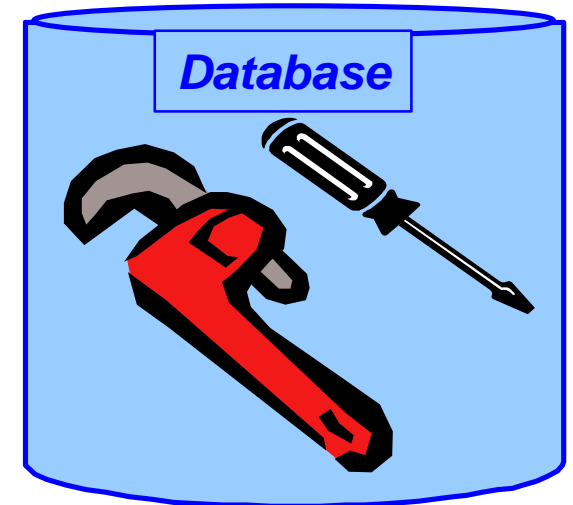
# Future Directions

- **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*

□ = **Formula to Success**

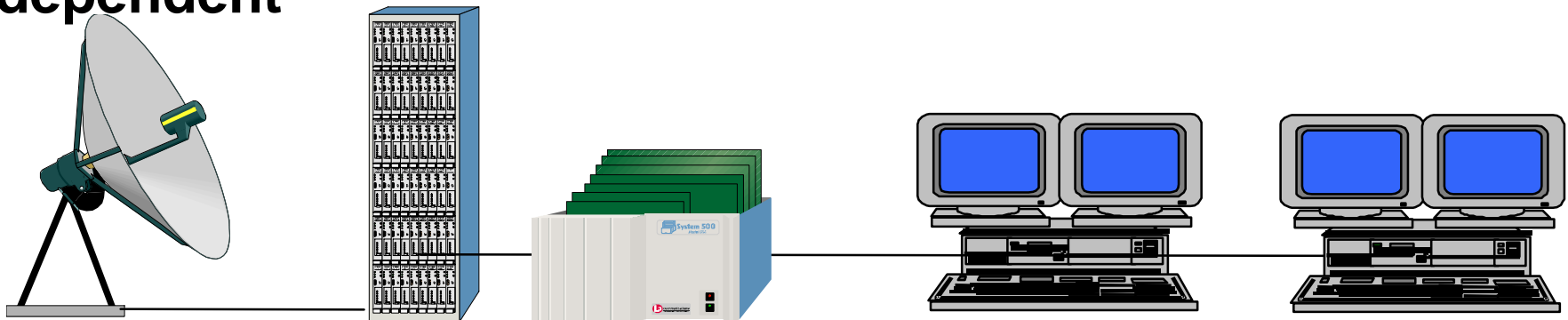
# System Attributes - Databases

- **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

