Software Evolution from TET-1 to Eu:CROPIS

Olaf Maibaum
German Aerospace Center (DLR)
Outline

- Eu:CROPIS Mission
- Layered Software Architecture
- Eu:CROPIS AOCS
- Timing TET-1 vs. Eu:CROPIS
- Tasking Framework
  - Magnetic Torque Control
- Diagnostic Reporting Service
- Summary
Eu:CROPIS Payloads

- Development of a restartable, sustainable life support system,
  - Production of food and atmosphere
  - Utilization of waste (Urine, Phosphate)
  - Long duration operations (6 Months)
- Molecular biological research of markers for the reception of gravity, photosynthesis and cell activities
- Long term radiation measurement
- Power cells in space
Eu:CROPIS Satellite Bus

- DLR compact satellite
  - Height: 1100 mm
  - Diameter: 1000 mm
  - Mass: ~230 kg
  - Orbit: SSO ~500 km
  - Communication: S-Band
  - Spin stabilized

- Variation of Gravity by Modification of Rotation Speed
  - Two identical experiment set-ups
  - Sequenced operations
  - Target spin rates providing:
    - 0.16 g – Moon;
    - 0.38 g – Mars
Eu:CROPIS: AOCS

- **Actuators:**
  - 3x Magnetic Torquer, fast step response time
  - 1x Passive Nutation Damper

- **Sensors:**
  - 2x Magnetometer
  - 10x Sun Sensor
  - 4x Angular Rate Gyroscope
  - 2x GPS

- **Modes**
  - Detumble (DTM)
  - Deployment (DPM)
  - Spin Up (SPUP)
  - Spin (SPIN)
  - Safe (SFM)
Timing TET-1 vs. Eu:CROPIS

Conservative scheduling in one code block (TET-1):  

Tasks with ASAP scheduling (Eu:CROPIS):
Tasking Framework

- Task Channel
  - Management of data
  - Synchronization
  - Examples:
    - Double Buffer
    - FIFO
- Task Event
  - Periodic or relative timer
- Task Input
  - Control scheduling on data arrival
  - Association between Task Channels and Tasks
- Task
  - Computations
Tasking Framework: Magnetic Torque Control

- Control Torque Channel
- MTC Timer Event
- MTC State Channel
- Command State Channel
- Timeout TC Event
- MTC Message In Channel
- Request State Channel
- Time Out TM Event

1, final
1
0, final
1
0, final
1
2

Diagnostic Reporting Service

- Filter types:
  - Percentage difference
  - Absolute difference
  - Upper limit (immediate)
  - Lower limit (immediate)
  - Epsilon environment (immediate)
Summary

- Tasking Framework
  - ASAP Scheduler
  - Reactive scheduling on
    - Data Items
    - Periodic events
    - Relative trigger
  - Inherent parallelization

- Diagnostic reporting service
  - All data addressable
  - Extend filter mechanisms
  - Immediate filtering
Tasking Framework: Process

- TaskMessage
- TaskInput
- Task
- TaskSet
- Scheduler
- Executor

- push
- notifyInput
- activate
- isActivated*
- perform
- signal
- synchronizeStart
- synchronizeEnd
- execute
- reset
- reset*
- reset
OBC-NG: Task Reconfiguration

- Tasks running on one computing node:

Processing Unit 4
OBC-NG: Task Reconfiguration

- Tasks running on two computing nodes: