

DESC

Embedded System Control Software for DPS4D



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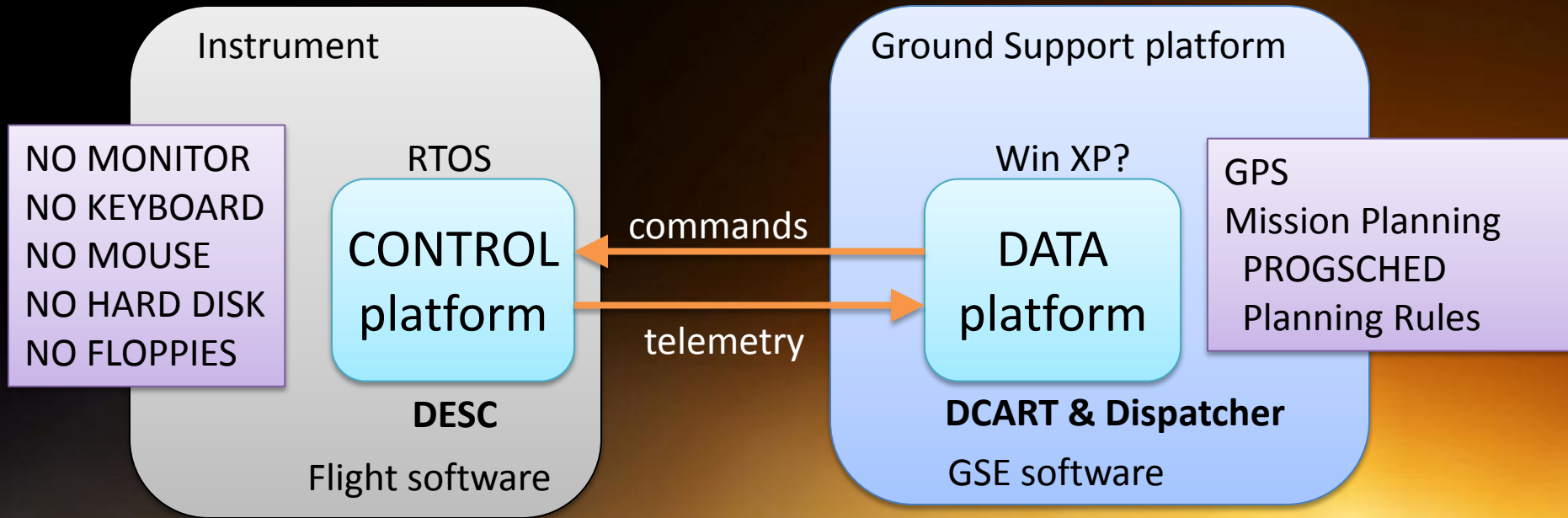
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Acknowledgements

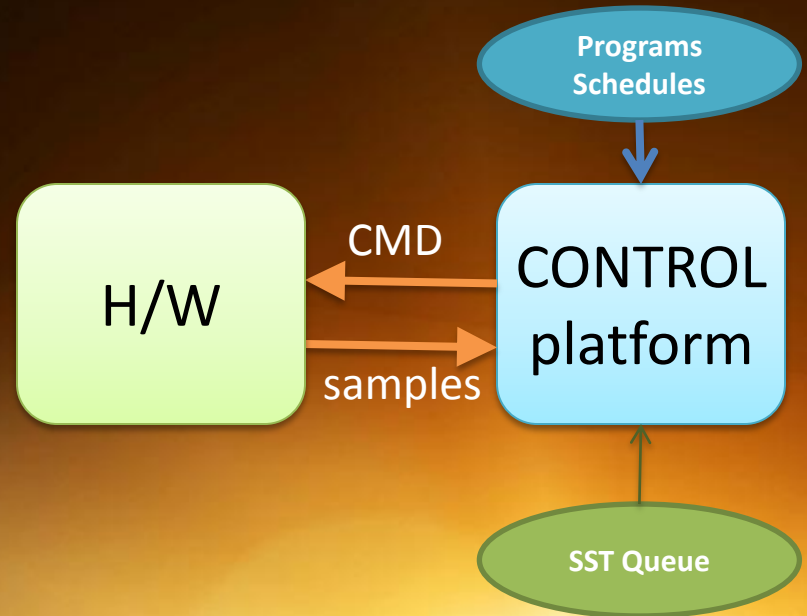
- Grigori Khmyrov
- George Cheney
- Chris Granz
- Alexander Kozlov

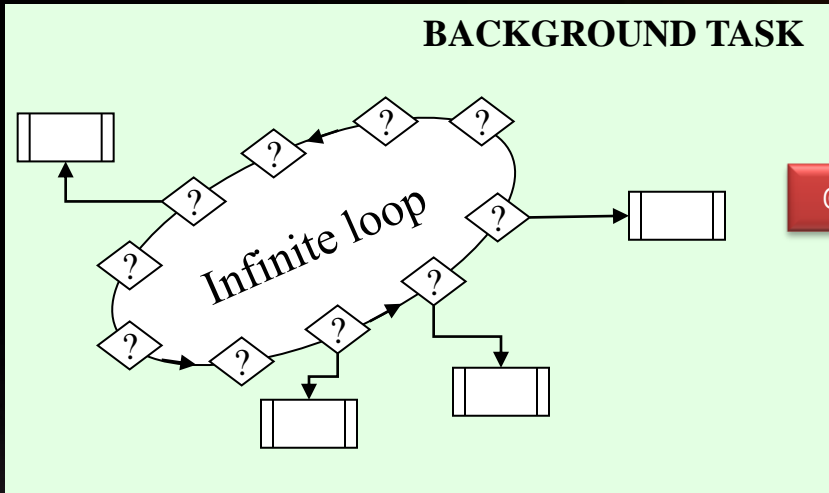
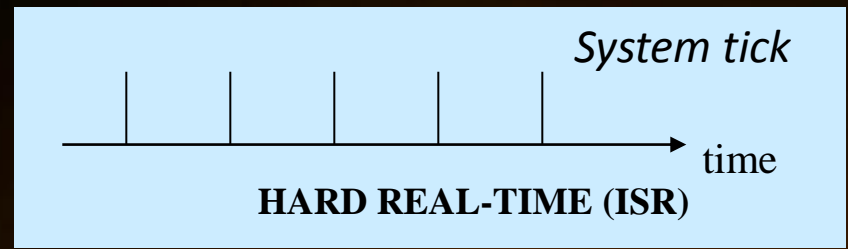
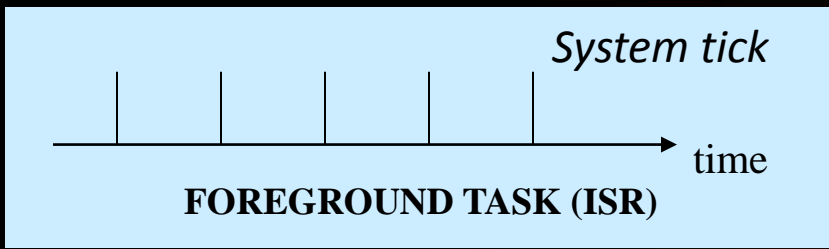
DESC and DCART



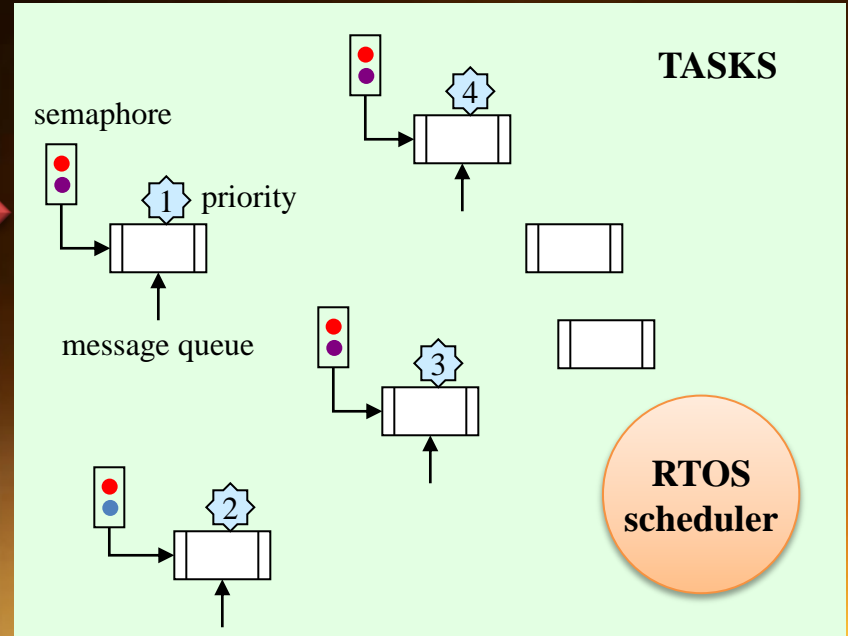
DESC Responsibilities

- **Scheduling digisonde measurements**
 - Switching schedules at given times
 - Schedule progression per schedule definition
 - Synchronization to the GPS time reference
- **Measurement progression per program definition**
 - Hardware control
 - Setting up transmission and reception in all measurement modes
 - Initiation of hardware tasks
 - Data Acquisition
 - Collection of raw data during the measurements
 - Collection of housekeeping data during BIT
 - Packaging and delivery of the sample data to the DATA Platform
- **Accepting configuration changes**
 - Program and schedule definitions,
 - Schedule start times,
 - Restricted Frequency Interval Lists (RFIL),
 - Digital receiver configuration,
 - Tracking filter configurations.
- **Switching operational states in response to commands**





Interrupts happen at various points of the loop
 Changes to the loop affect timing
 CPU upgrade affects timing



Operating system manages precise timing of tasks

RTOS Choices

- Starting in 2006, we use RTEMS
 - Attractive price of \$0
 - Active community with ties to aerospace
- Moving to Embedded Linux with Real-Time Kernel
 - Pro: Rapid compatibility with updated computer hardware (drivers)
 - Pro: Applications are decoupled from the kernel
 - **Application can fail while kernel is still up and communicating**
 - **Multi-threading can be used with shared memory rather than piping**
 - **Input-output with hardware and comms can be done via drivers**
 - **Can execute multiple applications in a variety of languages**
 - OK: Spacecraft applications are known and recommended
 - Con: Existing DESC code has to be reworked
 - **Work started in April 2014; language of choice: POSIX C**
 - **POSIX C: fast track to flight hardware running other RTOS**

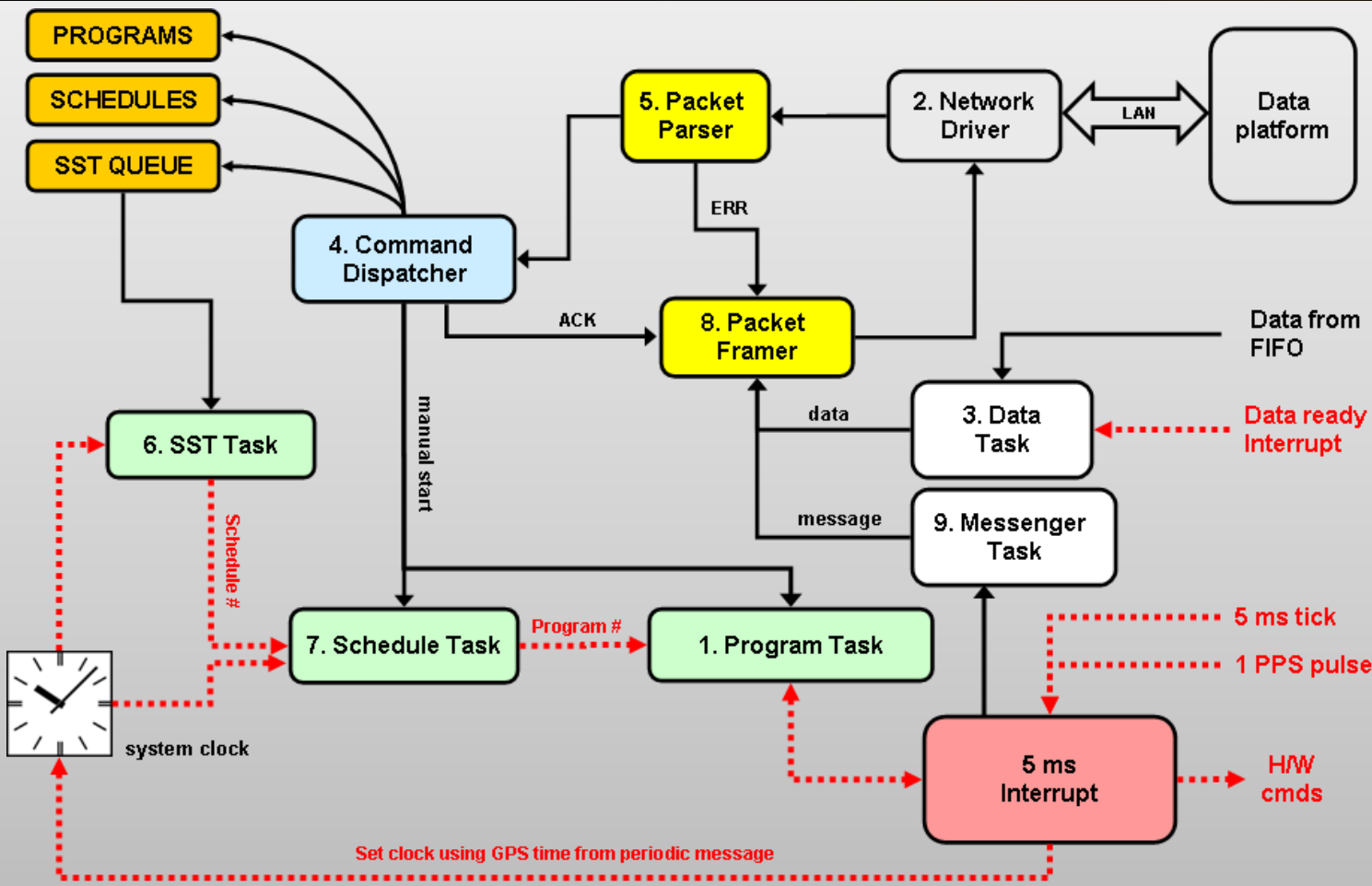
Pressure of Heritage Designs

BENEFITS

- Faster development
- Tighter schedules
- Meets interface constraints
- Documentation available
 - ICD to DCART carved in stone
- TESTED, PROVEN, “FLOWN”

RISKS

- Poorly documented design decisions
- Loss of quality through changes and adaptations
 - Different OS, for example
- Difficult to predict schedule and cost
- SOMETHING IMPORTANT HAS CHANGED



- Measurement Progression
- Hard Real-Time
- Communications

Dalu

감사합니다

Gracias

Danke

Ευχαριστίες

THANK YOU

Obrigado

Köszönöm

Спасибо

Dank

Tack

Grazie

谢谢

Merci

ありがとう

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