Operating System Abstraction Layer (OSAL)

Flight Software Workshop
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Agenda

• What is the OSAL?
• Where does it fit in our current FSW architecture?
• How does it work?
• Directory structure
• What functionality does the OSAL provide?
• OSAL releases
• Metrics
• Open Source Software
• Future Plans
What Is The OSAL And What Are Its Benefits?

• What is the Operating System Abstraction Layer?
  – A small layer of software that allows programs to run on many different operating systems and hardware platforms
  – Independent of the underlying OS & hardware
  – Self-contained

• Why do we want it?
  – Removes dependencies from any one operating system
  – Promotes portable, reusable flight software
  – Core FSW can be built for multiple processors and operating systems
  – Example: different missions require different hardware & operating system

• What does it do?
  – Allows developers to write and maintain one version of code
  – Allows for easy reuse across different missions with different hardware
  – Bonus: Allows for desktop development of flight software; reduces impact of potential hardware delays
Where Does It Fit in Our Current Flight Software Architecture?

Application 1  Application 2  ...  Application N

Core Flight Executive (cFE)

OS Abstraction Layer

Real Time Operating System  Drivers

Board Support Package

Flight Computer Hardware
How Does It Work?

OS Abstraction Layer call to create a new task

Implementation for VxWorks
- taskSpawn

Implementation for RTEMS
- rtems_task_create
- rtems_task_start

Implementation for POSIX (Linux, Mac OS X)
- pthread_create

- Implemented by make files
- Compiles in only the files needed for a specific OS/architecture
Directory Structure

- osapi
  - os
    - OS type (linux, rtems, vxworks, os x)
      - osapi.c
      - osfilesys.c
  - arch
    - platform (coldfire, ppc, x86)
      - board (mac, mcp750)
        - os (rtems, vxworks)
          - bsp, exe
    - prolog.mak
Functionality - Standard API's

- Abstracted ID's and information
  - All entities named

- Task API
  - Create, Delete, Exit, Delay, Set Priority, Get Info, Register, Get ID, Get ID by Name

- Queue API
  - Create, Delete, Get (w/ timeout), Put, Get ID, Get ID by Name, Get Info,

- Semaphore API
  - Binary Semaphores
  - Counting Semaphores
  - Mutexes
  - Create, Delete, Take, Give, Get Info, Timed Wait, Get ID by Name

- Misc API
  - Millisecs to System Ticks, Ticks to MicroSecs, Get Time, Interrupt
  Disable/Enable and Lock/Unlock, Printing utility
Functionality (2) - File System API's

• Abstracted FS
  – The file system has the same interface to the user no matter the underlying OS

• File System API
  – Make FS, Remove FS, Init FS, Mount, Unmount, Get Physical Device Name

• File API
  – Create, Remove, Open, Close, Read, Write, Lseek, Rename, Copy, Move Files
  – Make, Remove, Open, Close, Read Files
  – Get Info on File Descriptors
  – Send Shell Command to a file
OSAL Releases

- Version 1.0 (Released August 2004)
  - Developed by Alan Cudmore / code 582
  - Currently being used on SDO
  - Open source via a Flight Software Branch Technology Initiative
  - Capabilities: Creation of OS resources, Interrupt and Exception API, Hardware and memory API

- Version 2.0 (Released July 2005)
  - Used with the cFE for LRO (and previously HRV)
  - Additional Capabilities: dynamic object creation, deletion of resources, file system layer, networking functions, general API improvements with parameters and error codes

- Version 2.10 (Release Before 2008)
  - Currently being used by the cFE, LRO mission, SDO mission, ESA EDROOM, DISILCAS.
  - Additional Capabilities: Counting semaphores
  - Enhancements made to almost all aspects of the OSAL, including file system, task, queue, and semaphore code
Metrics

• Executable Lines of code: 8168

• Average Lines per BSP: 1500
  – Number of distinct BSP's: 7
  – VxWorks on MCP750 skews results

• Number of OS's supported: 4
  – VxWorks
  – RTEMS
  – Linux
  – OS X

• Number of boards supported: 6
  – M5282lite
  – m5235bcc
  – Mcp750
  – Intel Mac
  – PPC Mac
  – x86 Desktops
Open Source Software

• Version 2.0
  – Available at http://opensource.gsfc.nasa.gov/projects.php

• NASA Open Source License (2004)
  – Allows users to redistribute code, but must include source code
  – Allows additions to software, but additions must be the work of the author
  – Requests users to register software
  – Requests users to inform us of modifications
Future Plans

- Continue development of threaded model

- Support Current Customers

- Develop Version 3.0
  - Conversion from Thread Model to Process Model
  - Shared Memory API