UNIBAP

SpaceCloud®

SPACECLOUD CLOUD COMPUTING AND IN-ORBIT DEMONSTRATION

Agenda
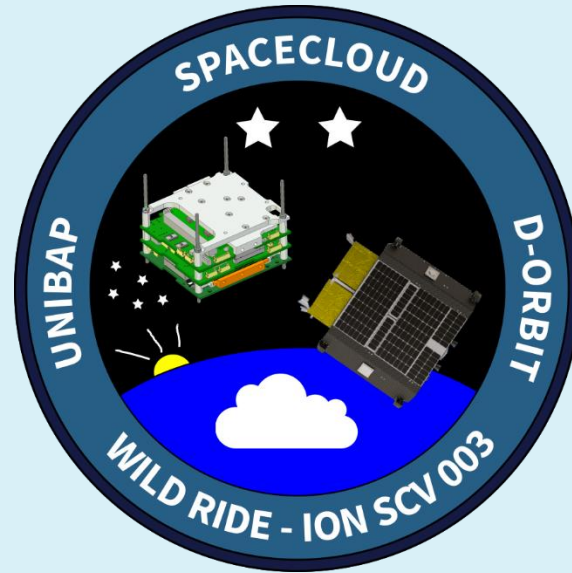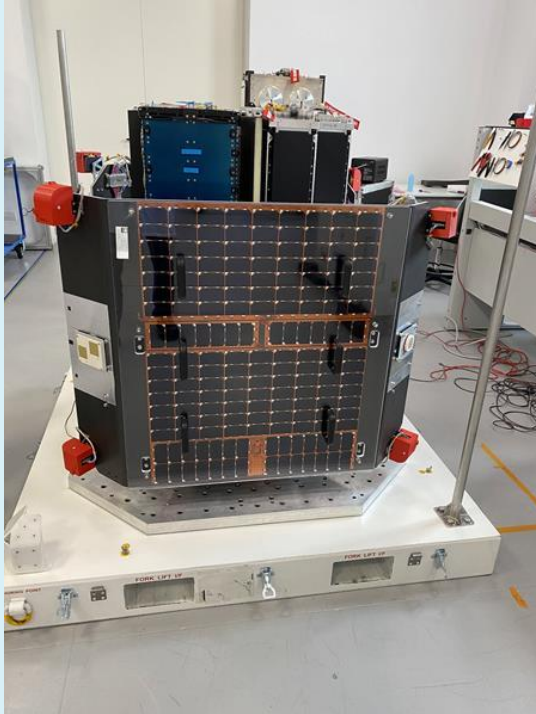
- Intro
- Look at a background to the mission
- Spacecloud
    - HW
    - OS / Robustness
    - FW

- Some of the applications

Authors

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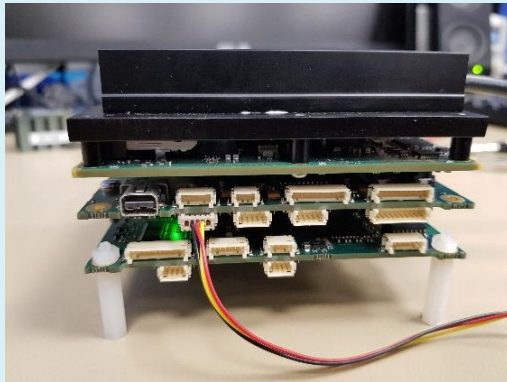
Wild Ride – Dauntless David

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Goals

- Test application development in the SpaceCloud stack and SpaceCloud FW
    - Operating between several companies
- Understand impact of apps and framework in LEO conditions
- Develop necessary components for integrating this on the ION craft
- Development time of 3 months
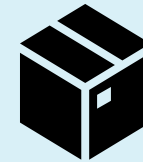
Spacecloud

HW

iX5 or iX10

OS

SpaceCloud OS (SCOS) with SafetyChip/SafetyBoot
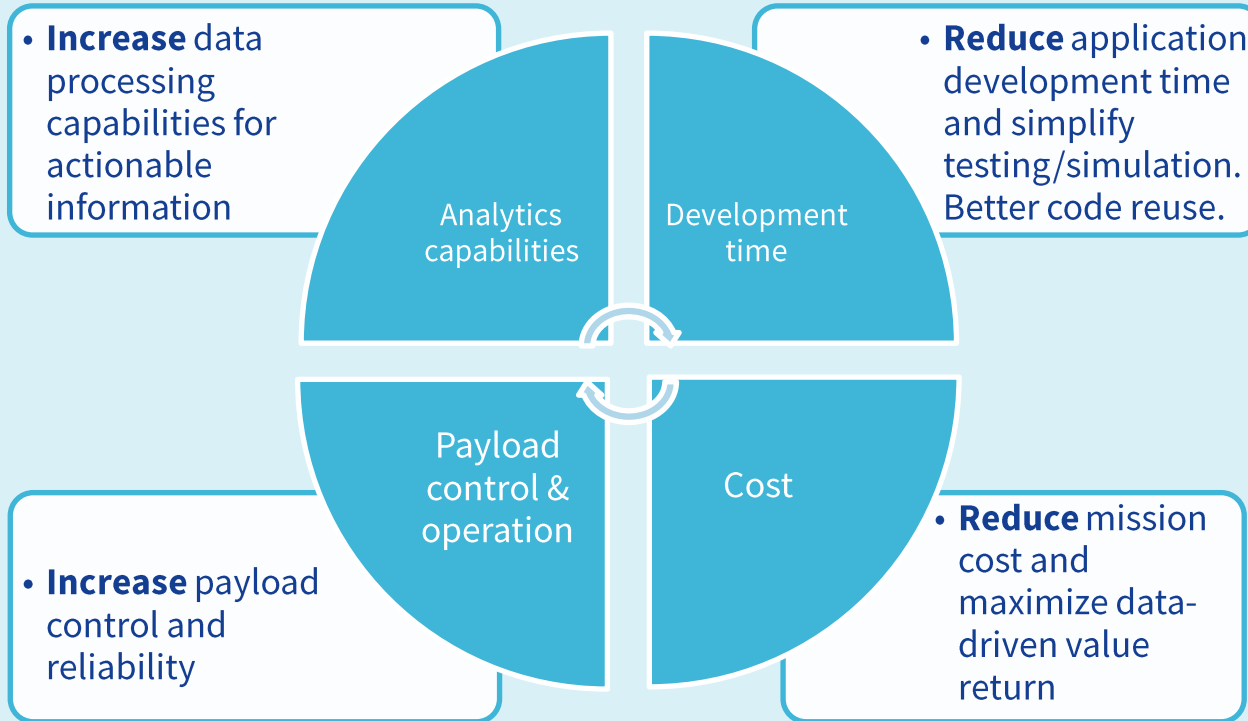Linux data processing on Ubuntu Server (x86) and FreeRTOS

FW

• Dockerized deployment
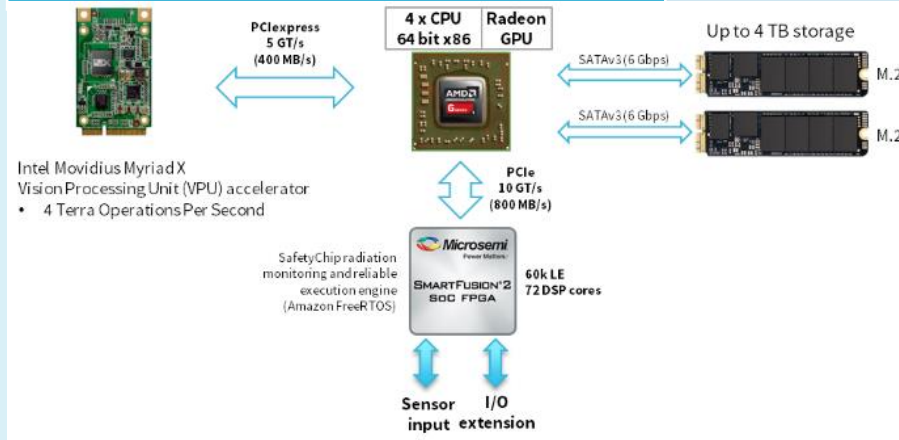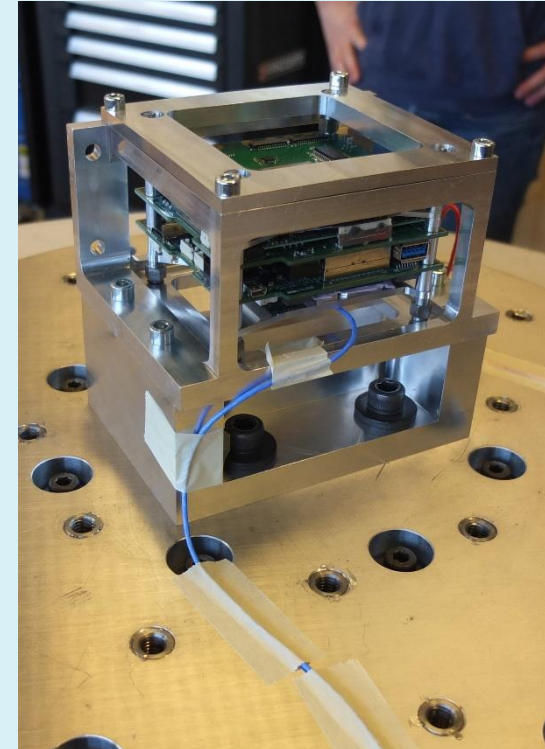• HW abstraction for apps

gRPC

Containerized applications

SpaceCloud

- **Increase** data processing capabilities for actionable information

- **Reduce** application development time and simplify testing/simulation. Better code reuse.

- **Increase** payload control and reliability

- **Reduce** mission cost and maximize data-driven value return

Analytics capabilities

Development time

Payload control & operation
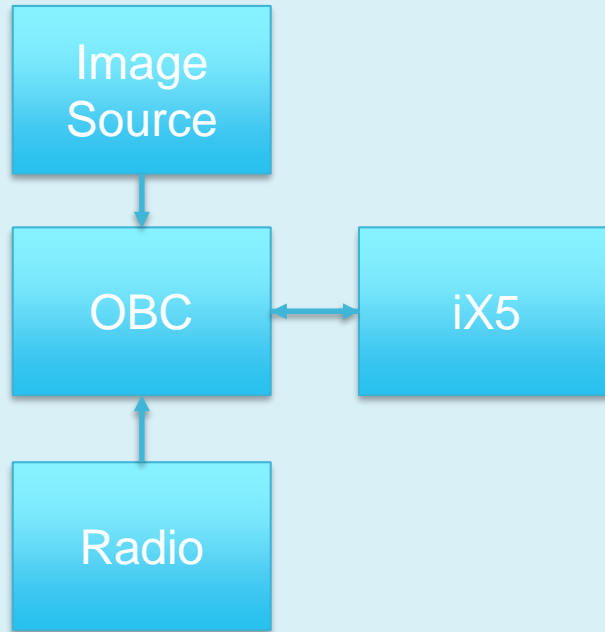
Cost

SpaceCloud HW: iX5 series

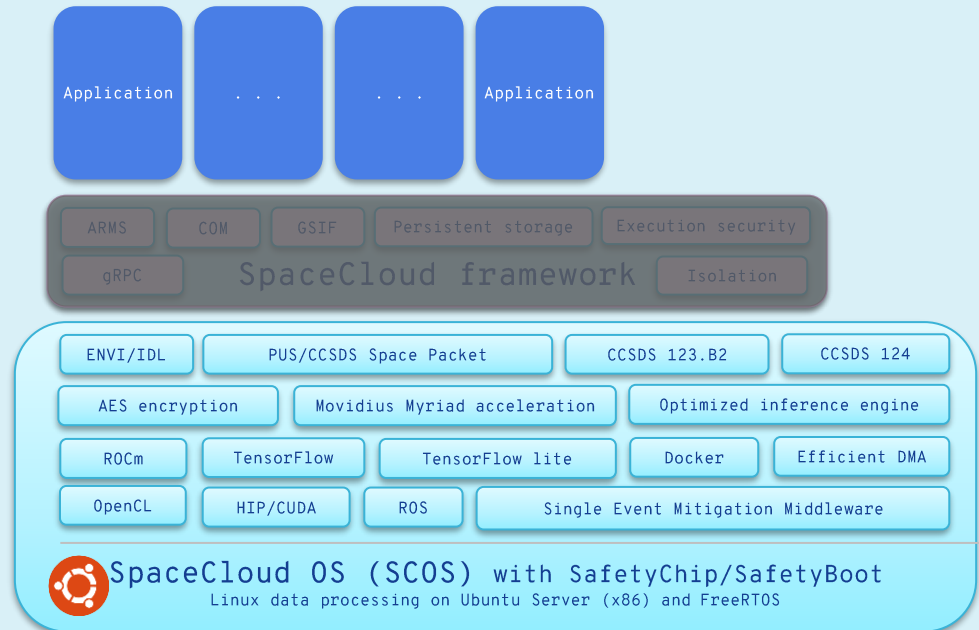| Compute device	Theoretical Peak Performance
Quad core, 64-bit x86 CPU (AMD Jaguar) with AVX vector instructions	40 GFLOPS
AMD Radeon GPU	87 GFLOPS
Intel Movidius Myriad X Vision Processing Unit	4 TOPS
Microsemi SmartFusion2 FPGA	72 DSP cores + fabric
Storage with redundant boot (through SafetyBoot mechanism)	2 x 128 GB M.2 SATA SSD (SLC Nand flash memory type)

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System setup

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SpaceCloud OS

- Based on Ubuntu 18.04
- With SafetyChip/SafetyBoot
- FPGA Drivers
- Optimized drivers for GPU
- SDKs for connected hardware (none in this case)
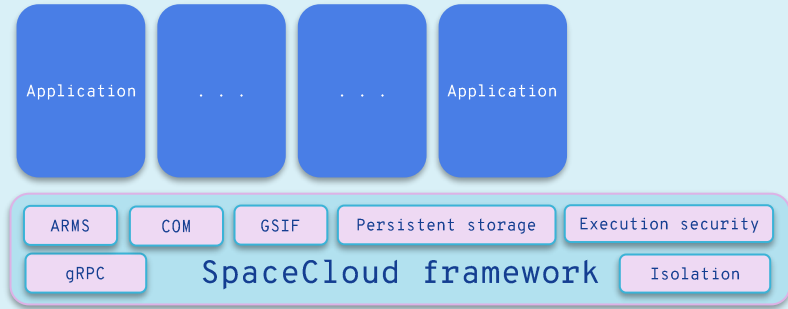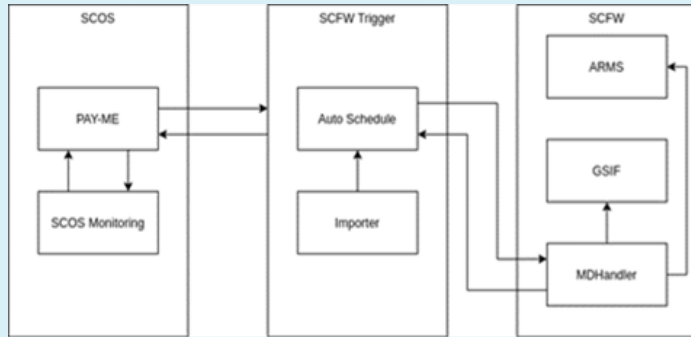- Package of software compiled for this platform

Robustness

- Safetyboot
    - Boot from ssd0/ssd1 or redundany backup option
    - Controlled from the MCU boot flagged from the OS

- SafetyChip
    - Watchdog functionality
    - Optional state tracking from the MCU
    - Chanins of watchdogs
- Middleware and hardware checks to check functionality of execution hosts
    - I.e. run test program on movidus before execution to make sure it has a valid state
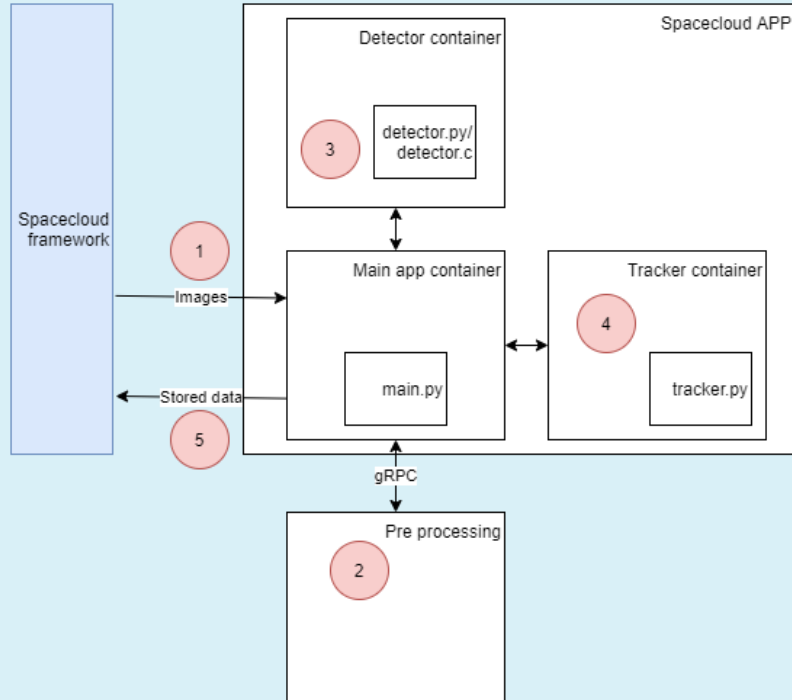
Spacecloud FW

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Saraniaapp

- Use a series of neural networks to efficiently find moving airplanes in 8kx10k pixel tiles
- Input is a tiled map of data
- Output is a tightly cropped image with position in kmz format
  - Can be visualized like this

Spacecar

Examples of other apps

- ML based ship detection
  - Myriad deep learning inference
- Video compression
  - OpenCL optimized
- Hyper spectral image compression (CCSDS-123.0-B-2
  - Multi core cpu implementation
- FDL Worldfloods
  - Myriad deep learning inference

- ESA scientific workloads
  - Tensorflow lite CPU ML
- Max power test
  - All execution hosts
- Systems application
  - FDIR tests
  - Disk check tests
- PUSopen
  - Connectivity from spacecloud to other hosts on satelite or ground

Thanks!