Developing Lunar Flashlight and Near-Earth Asteroid Scout Flight Software Concurrently using Open-Source F Prime Flight Software Framework

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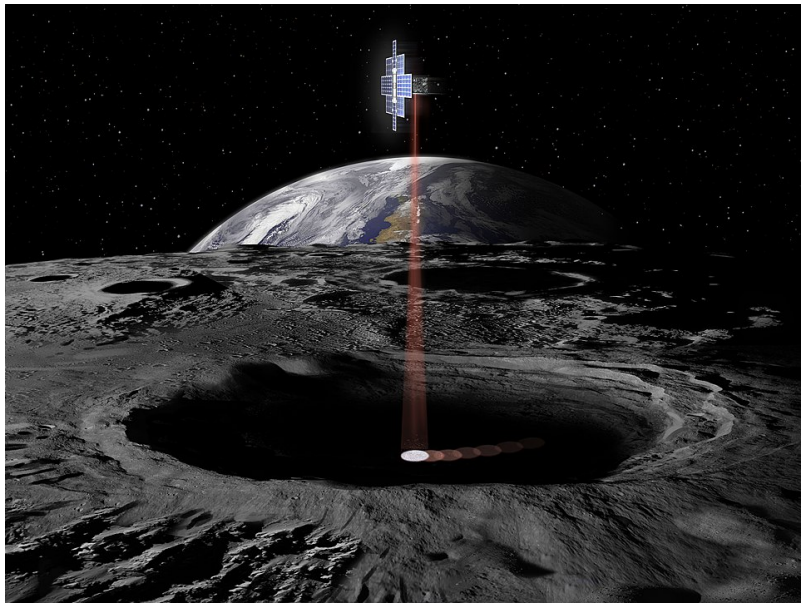
Introduction

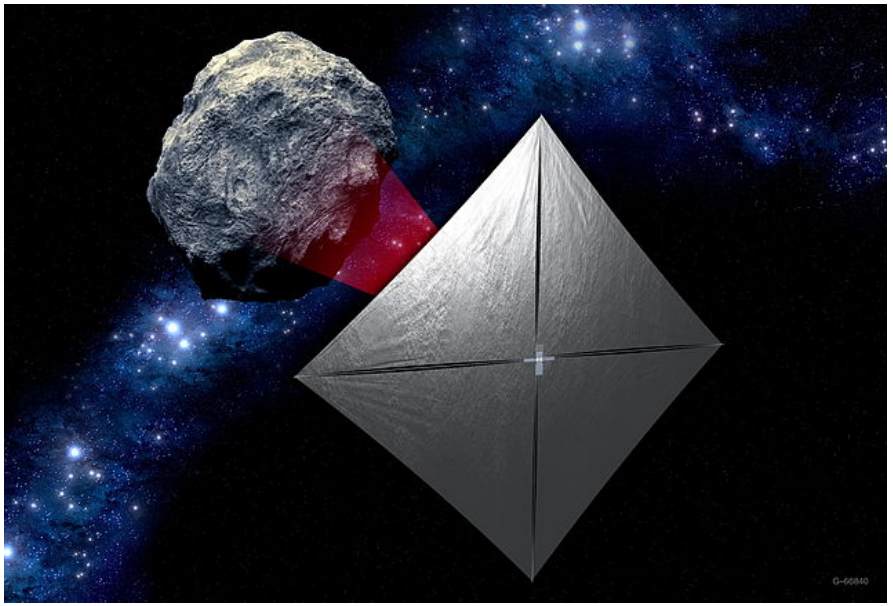
Lunar Flashlight CubeSat



Illuminate permanently-shadowed regions and detect water ice absorption bands in the near-infrared.

Expected launch: early 2023

NEA Scout CubeSat



Rendezvous with an asteroid using solar sail and gather detailed imagery.

Expected launch: Aug/Sep. 2022

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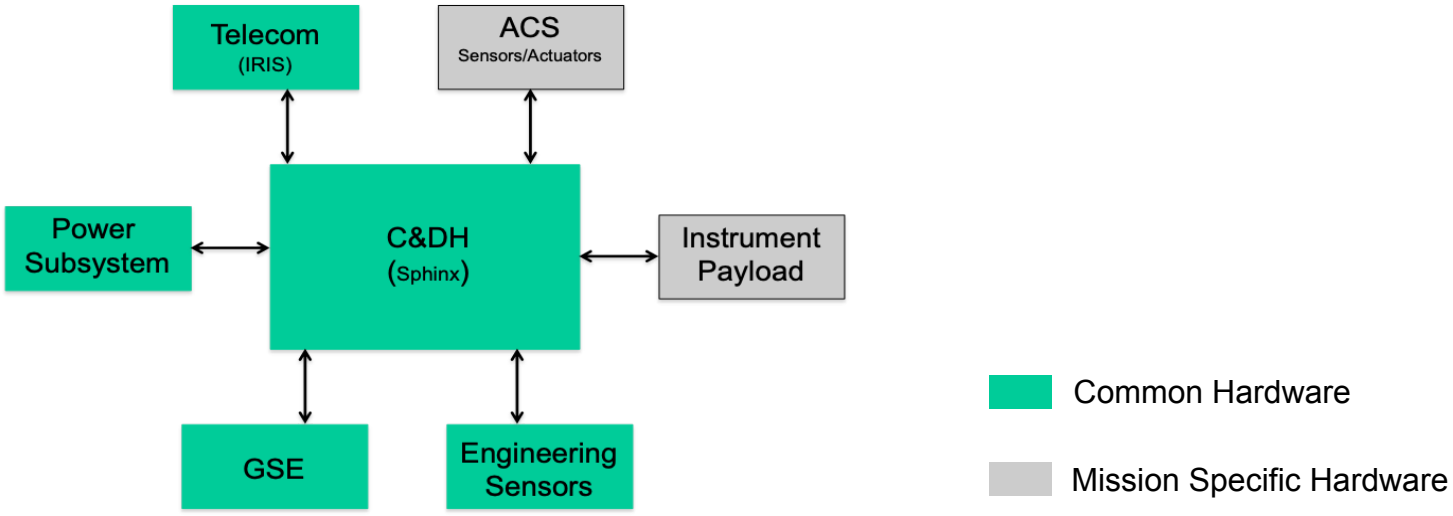
Lunar Flashlight and NEA Scout Commonalities

- Same avionics hardware
- Same software architecture
- Same teams (C&DH, software, comm, power)



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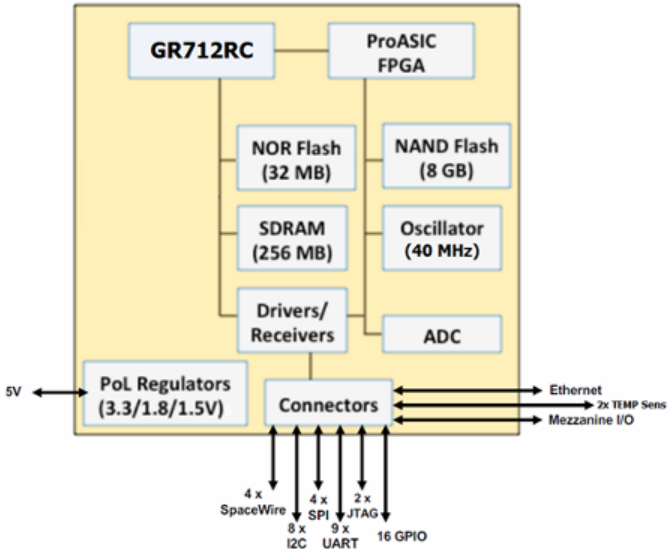
Sphinx C&DH Board

Avionics platform used on Lunar Flashlight and NEA Scout

Category	Design Features
Memory (EDAC protected)	256 MB SDRAM 32 MB NOR Flash 8GB NAND Flash
Data Interfaces	2x SpaceWire with RMAP 7x UART (4x RS-422) 2x UART RS232 for GSE 4x SPI (10 available slaves) 8x I2C (masters) 2x 32-bit GPIOs 2x JTAGs (processor and FPGA) 1x Ethernet PHY RMIII (for GSE) 8x analog channels
System Features	External watchdog with boot-bank swapping Supports up to 4 software image selections



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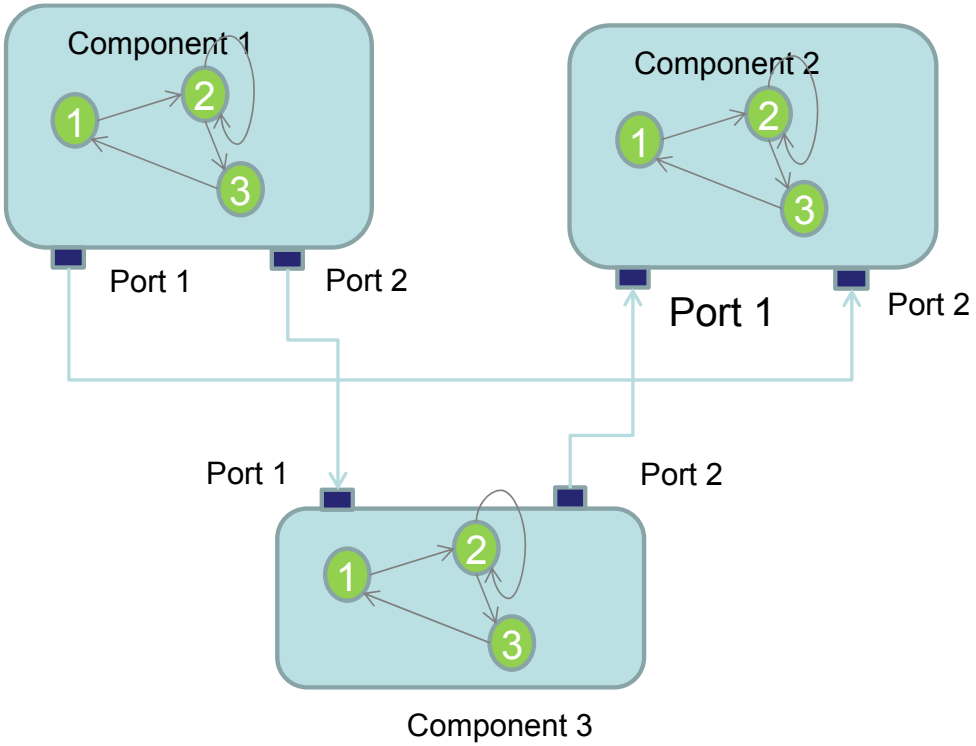
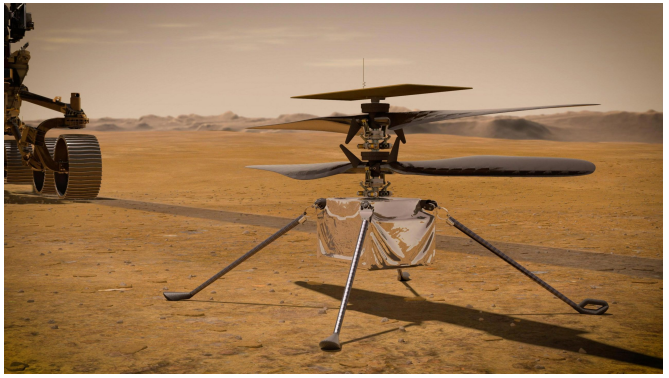
F Prime Product Line

https://github.com/nasa/fprime

Open-source software framework for the rapid development and deployment of embedded systems and spaceflight applications





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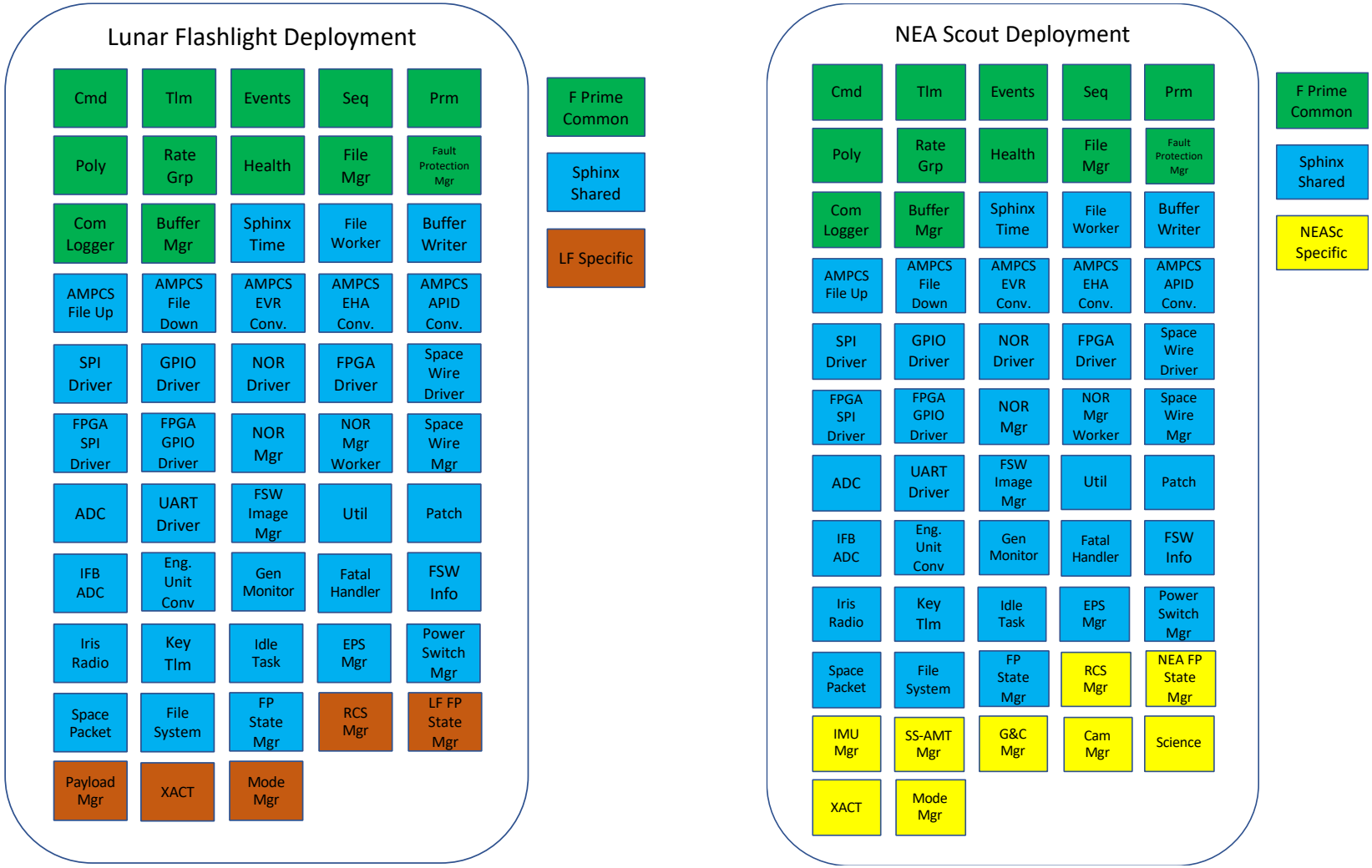
Mission Specific Software Deployments

Lunar Flashlight and NEA Scout Software Deployments



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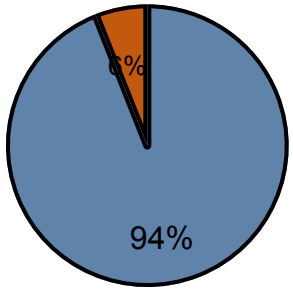
Software Metrics

Deployment SLOC (Source Lines of Code) Metrics Comparison

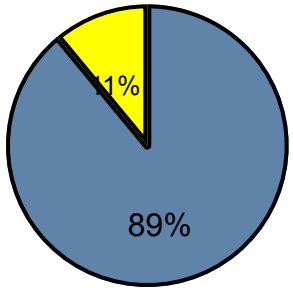
Lunar Flashlight FSW SLOC Metrics



F Prime, Sphinx Common and Auto-coded Software
LF Specific Hand Coded Software

Total SLOC = 320,985

NEA Scout FSW SLOC Metrics



F Prime, Sphinx Common and Auto-coded Software
NEASc Specific Hand Coded Software

Total SLOC = 355,793

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Sphinx Common Deployment

- Lunar Flashlight and NEA Scout leveraged the use of Sphinx common deployment to develop mission specific applications enabled by F Prime Product Line's reusability and modularity

- A version of the Sphinx common deployment has been released as open-source: https://github.com/fprime-community/fprime-sphinx

- The open-source Sphinx common deployment can be used as a starting point for a future project using the Sphinx platform

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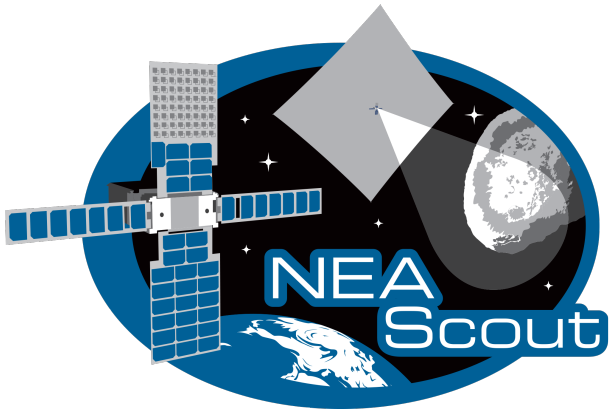
Conclusion

- Reusability and modularity of F Prime enabled concurrent development of flight software for both Lunar Flashlight and NEA Scout CubeSats

- Components developed using F Prime were deployed on both CubeSats resulting in significant software commonality between the two CubeSats



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