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Design of a Custom Secondary On-Board Computer for the NEUDOSE CubeSat Mission

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One Mission, Two On-Board Computers

The NEUtron DOSimetry & Exploration (NEUDOSE) CubeSat is the first small satellite mission from McMaster University. The mission includes two on-board computers (OBCs): a commercial off-the-shelf (COTS) board as the primary OBC, and a custom student-designed board, the secondary on-board computer (SOBC), as a secondary payload to the mission.

Primary On-Board Computer

The primary on-board computer being used is the NanoMind A3200 from GomSpace. A COTS option was chosen for it's high TRL, thereby reducing mission risk.

The primary OBC will process all ground commands and telemetry, manage the satellite state machine, and store scientific payload data.

Figure 1: The NanoMind A3200 from GomSpace, based on the AVR32 microcontroller [1].

Secondary On-Board Computer

The SOBC is based on the Xilinx Zynq-7000 System-on-Chip. This custom board was designed with radiant tolerance in mind, using both radiation and non-radiation hardened components, as required.

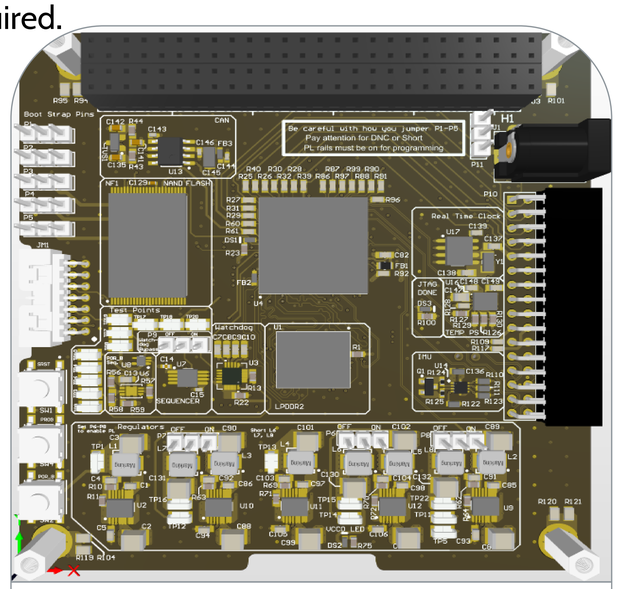

Figure 2: Render of the custom Secondary On-Board Computer for the McMaster NEUDOSE mission.

Software

Both OBCs will use the open-source real-time operating system FreeRTOS. Additionally, mission-specific software is being developed using NASA's open-source core Flight System (cFS).

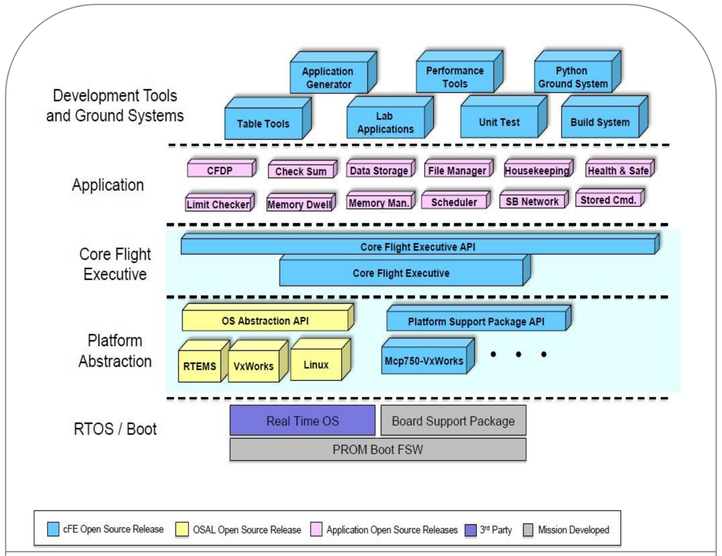

Figure 3: Software Architecture of NASA's core Flight System which is being used to develop mission-specific applications [2].

Conclusion

The dual system was chosen to minimize risk associated with McMaster University's first space mission, increase the Technological Readiness Level (TRL) of the custom design, and provide McMaster students with the unique ability to design custom hardware and software being flown in space.

Acknowledgements

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References

[1] GomSpace, "NanoMind A3200", Dec 2019.
[2] Prokop and Wilmot, "NASA's Core Flight Software - A Reusable Real-Time Framework", Dec 2014.