E1.01 Radiation-Tolerant Crew Laptop

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Texas State University - Effectively Grounded

Purpose and Importance

The project serves as a proof of concept for using a RISC-V processor on the mainboard of a laptop designed for deep-space missions. Leveraging NASA and Microchip's High-Performance Spaceflight Computing (HPSC) processor, this project demonstrates the feasibility of a resilient, energy-efficient laptop capable of withstanding space radiation.

Radiation Challenges:

- **Single Event Effects:** Can disrupt electronic components when high-energy particles strike a device. These effects can cause bit shifts, altering the state of a circuit (eg., changing a '0' to a '1'), which may lead to software errors or system crashes.
- **Total Ionizing Dose:** Causes undesirable charge collection at silicon and insulator interfaces, leading to performance issues and potential failure over time. TID can permanently damage in affected components.

Board Features

- Wired and Wireless Network Connectivity
- Storage and Memory Capabilities
- Integrated Audio and Video Capabilities
- Comprehensive USB Hub and Connectivity Options
- Automotive Grade Components for Increased Radiation Tolerance

Subsystems

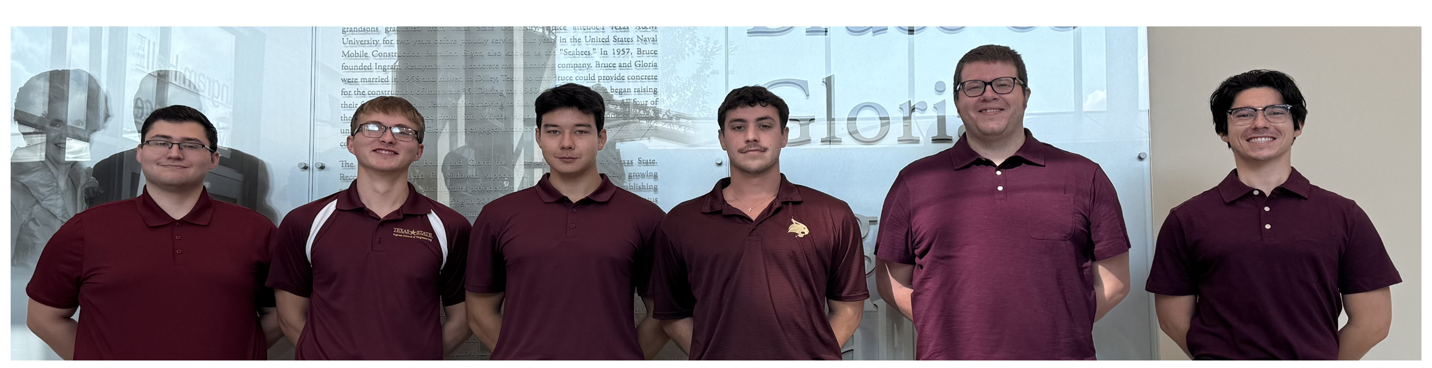


Figure 1: Left to Right: Alex Johnston, Hunter Savage-Pierce, Daniyar Boztayev, Josh Muniga, John Gellerup, Aidan Bachmeyer

USB	Aidan Bachmeyer
Memory and Storage	Dan Boztayev
Processor	John Gellerup
Power	Alex Johnston
Network	Alex Johnston
Camera and Audio	Josh Muniga
PCIe	Hunter Savage-Pierce

Laptop Mainboard Implementation

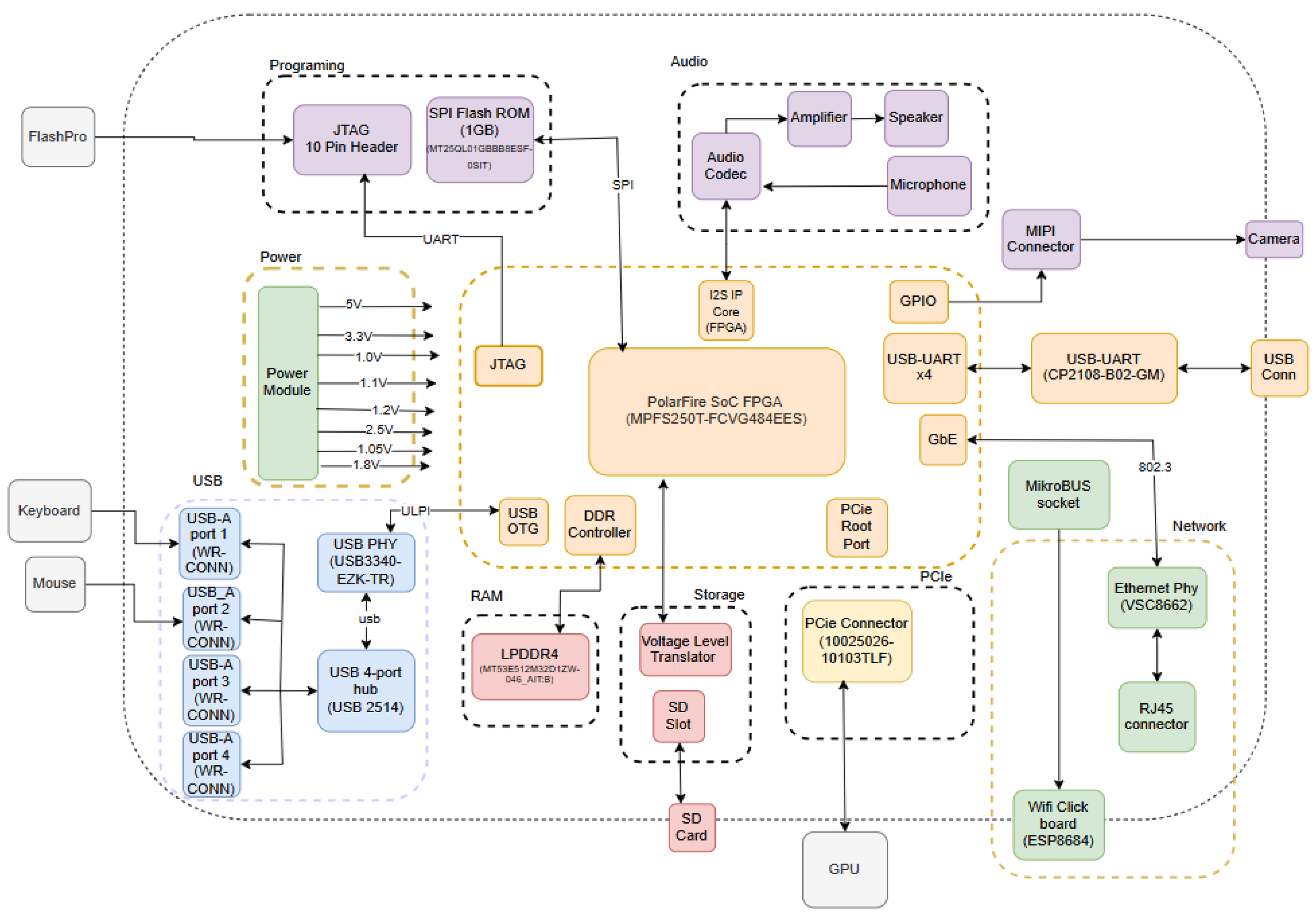


Figure 2: Top-level block diagram of the laptop mainboard.

Accomplishments

- Successfully booted Linux on both the Icicle Kit and the Curiosity Kit, demonstrating proficiency in system initialization and hardware-software integration.
- Completed detailed schematics for the Icicle kit, which will ensure precision in the design of the RISCV Business board.
- Conducted a comprehensive trade study evaluating available RISC-V processors to identify the best options for our project requirements.
- Established direct communication with Microchip, leveraging their expertise to enhance the board design and development process.

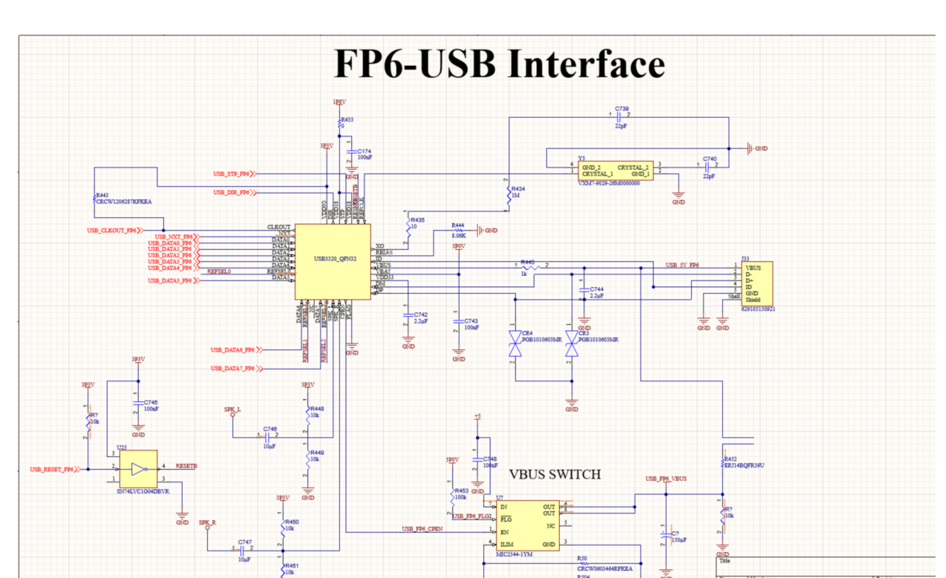


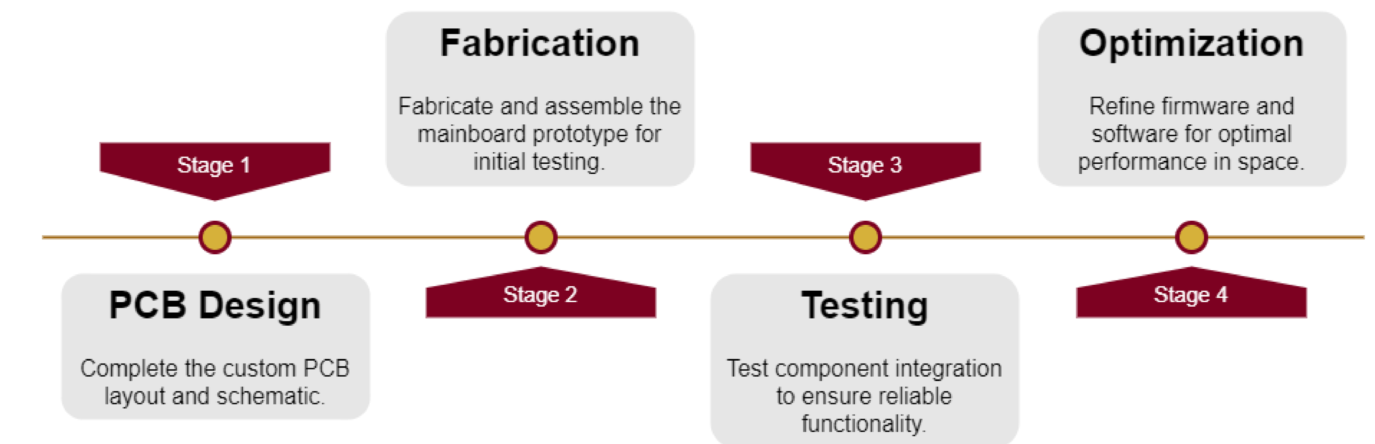
Figure 3: Altium schematic of USB interface.

Figure 4: Icicle kit functioning.

Path Forward

Next Steps and Development Goals:

- Completing the finalization of the RISC-V business design process
- Managing prototype fabrication and ensuring accurate assembly tasks
- Conducting system integration tests to ensure full compatibility
- Optimizing firmware and software to improve functionality and efficiency



A Platform for Continuous Innovation:

The Radiation-Tolerant Crew Laptop project provides a path toward a HPSC processor based crew laptop suitable for deep space missions. Our project will work as a proof of concept, so future teams can build off our design and work toward an HPSC based laptop.

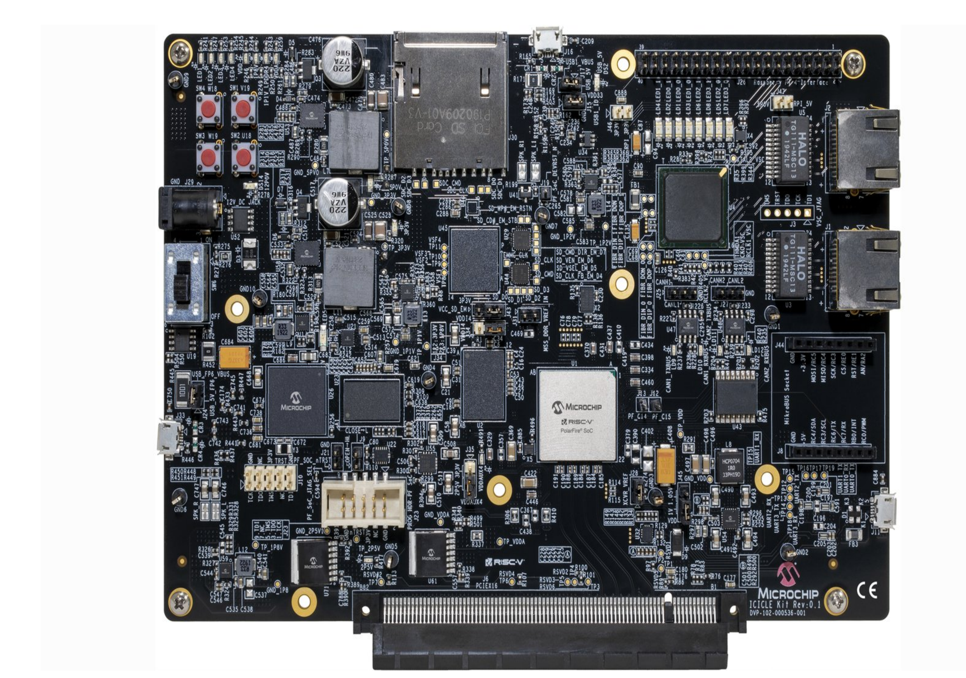
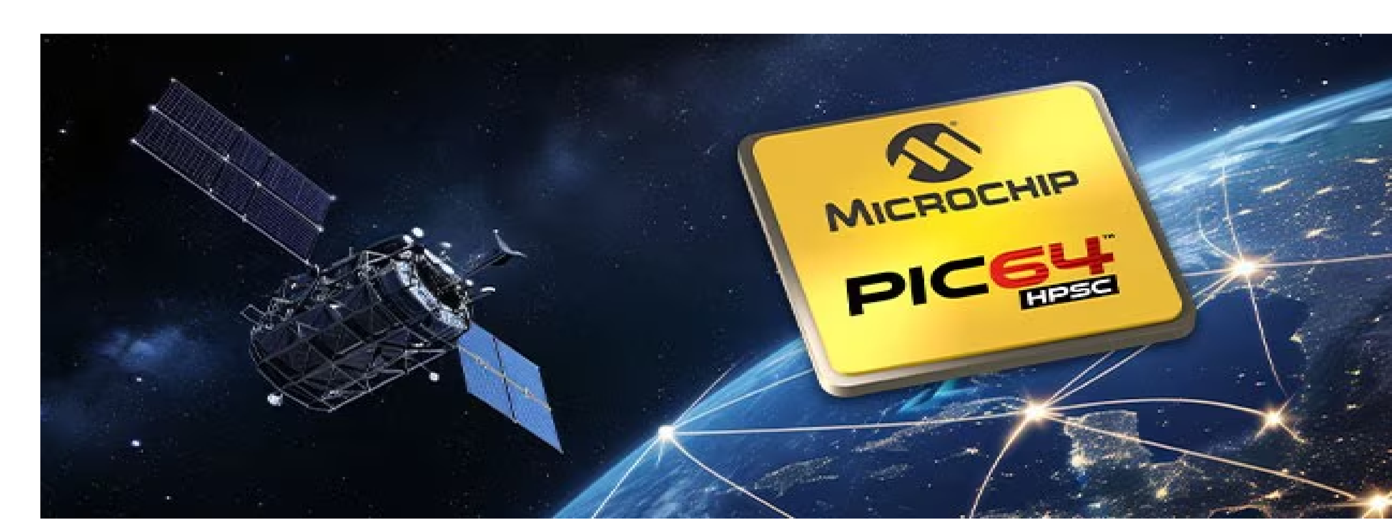


Figure 5: Icicle Kit Development Board (Courtesy of Microchip)

Acknowledgments



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