TEXAS SPACE GRANT CONSORTIUM
DESIGN CHALLENGE

TOPIC # - TDC - 103

RADIATION-TOLERANT CREW LAPTOP

BACKGROUND

This project's goal is to prototype a radiation-tolerant laptop for astronauts using the open-source Framework Laptop platform. Students will be tasked with designing, fabricating, and testing a new mainboard for the Framework Laptop 16 that utilizes NASA and Microchip's High Performance Spaceflight Computing (HPSC) processor, which is designed to be radiation-hardened and energy-efficient.

PROBLEM/DESCRIPTION

Creating a laptop from the ground up is no small feat - luckily for us there exists an open-source hardware and open-source software laptop called the Framework. Using this platform, the student teams that are up to tackling this real-world engineering problem will be tasked in prototyping a radiation-tolerant motherboard for the Framework Laptop 16 utilizing the HPSC processor. (https://github.com/FrameworkComputer)

NASA has partnered with Microchip to create the High Performance Spaceflight Computing (HPSC) processor, a high-performance spaceflight computing processor that will support future space missions. Some key features of the HPSC are:

- Performance: The processor will enable spacecraft computers to perform calculations up to 100 times faster than today's state-of-the-art space computers.
- Scalability: The processor architecture will significantly improve the overall computing efficiency for these missions by enabling computing power to be scalable, based on mission needs. The HPSC will deliver newly designed multicore computing chips with multiple processing cores on each chip, bundled with operating software to run them.
- Radiation Hardened: Natural radiation in space damages electronic parts, eventually leading to their failure, and also introduces errors into the computations performed there. HPSC will be specially designed to survive in space and also contain features to ensure it is able to operate and provide reliable results.
- Energy Efficiency: HPSC is designed to be able to process data 100 times faster than current space-qualified computers using the same amount of power. It also allows functions to be turned off when they are not in use and less power if it is not needed
- Potential Applications: Many space activities have to be performed without help from Earth due to the time it takes for signals to travel from Earth to distant locations in space. HPSC is designed to support these autonomous operations. Examples of potential commercial market applications include Industrial automation and robotics, Edge computing, Industrial Time Sensitive Networking (TSN), Edge AI/ML, and Internet of Things (IoT) Gateways.

(https://www.nasa.gov/high-performance-spaceflight-computing-hpsc/)
(https://www.microchip.com/en-us/about/media-center/blog/2022/spaceflight-computing-processor)

The high-level identified tasks are to:

- Get familiar with the HPSC
- Design an HPSC "mainboard" for the Framework Laptop
- Create/fabricate the mainboard
- Buy a Framework Laptop 16
- Test the mainboard

Note that during the execution of the challenge, the mentor and teams can adjust the scope of the project to meet 3rd party timelines (PCB fabrication is highly dependent on HPSC release date).

Student licenses for the ECAD software, Altium, are available directly from the company for free, in addition to an online Course Curriculum to learn the software (https://education.altium.com/).

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DELIVERABLES

Project documentation (charter, proposal, management plan, etc.), design and ECAD files (schematics, layouts), and prototype printed circuit boards (PCBs).

DESIGN TEAM PROFILE

NASA MENTOR:	Justin Bautista (justin.r.bautista@nasa.gov)
LEVEL:	Undergraduate students of any level
MAJOR/DISCIPLINE:	Electrical Engineering,Computer Engineering
TEAMS:	3
DURATION:	One or Two-Semester Project