The backplane is the main focus of the project, providing the main connections between all the avionics components. The backplane houses connections for two autopilot PCIe cards (a primary card and a secondary card), which output their signals through the PCIe slot to the FPGA.

- The FPGA uses a watchdog timer and a "heartbeat" signal from the AP boards to determine if the main board is functioning properly. If not, it will switch control to the secondary autopilot card.
- All flight sensor devices (Lidar, Airspeed, GPS) connect to the backplane through a CAN bus.
- All Servos and ESC motors are controlled through PWM output ports.

### Power and FPGA

- The Board is powered by the onboard avionics battery, which provides 26V DC to the board through the main battery connector. This voltage is then stepped down to 5V and 3.3V through two DC-DC converter modules. The FPGA and autopilot cards run on these power rails.
- There are power ports available for powering any external devices.
- The FPGA is a Xilinx Spartan 3E on a Xylo-L dev board. Its purpose is to take the control signals from the two autopilot cards, including a watchdog signal, and multiplex the signals and output the right signals to control the motors and aero surfaces on the drone.

### Data transfer and I/Os

- The Autopilot board is contained with all different specs of JST-GH connectors for different sensors, and for power connections. Ready for peripheral sensors and GPS modules to plug and play.
- The Autopilot board is USB type C ready. Flight data setting would also simple and easy.
- This board connects to the backplane via the PCIe-x8 connectors, and each autopilot card can connect to one expansion card through the larger corresponding PCIe-x16 slot.

### Mechanical aspect

- The base bracket is designed to hold the backplane and autopilot cards in the fuselage to withstand force, vibration and thermal impact.
- The isolators are placed between upper and lower carbon fibre plate which dampens the vibrations passing from the frame of the drone to the backplane.
- Isolators have silicon rubber dampers placed on all four corners on which the backplane is placed.
- The vertical mounts placed on the backplane are designed to hold the autopilot cards from shaking during the flight.

### Future Work, References, and Acknowledgments

- The next steps for this project is to take the designs to the manufacturing phase, manufacture the Printed Circuit Boards, and build and assemble the final redesigned avionics bay.
- The physical hardware also needs to be tested once built to ensure design is practically sound, and will not fault under actual flight conditions.
- An additional improvement would be to integrate the FPGA with the backplane instead of using the Xylo-L dev board.

### References:

- Altium Designer PCB Design Resource [https://designer.altium.com/](https://designer.altium.com/)
- Electronic Components Search Engine [https://componentsearchengine.com/](https://componentsearchengine.com/)

### Acknowledgments:

Faculty: Professor Ananthan, Professor M.P. Anantram
TAs: Daniel King, Shruti Mista
Volansi: Dalibor Djuran, Ahmad Ansari, Luis Valbuena
Reyes, Alexander Spalding, Jacob Cralib, Kenneth Thompson