Fault-Tolerant Quadcopter

ECE 453 Project Proposal (Fall 2018)
University of Wisconsin-Madison

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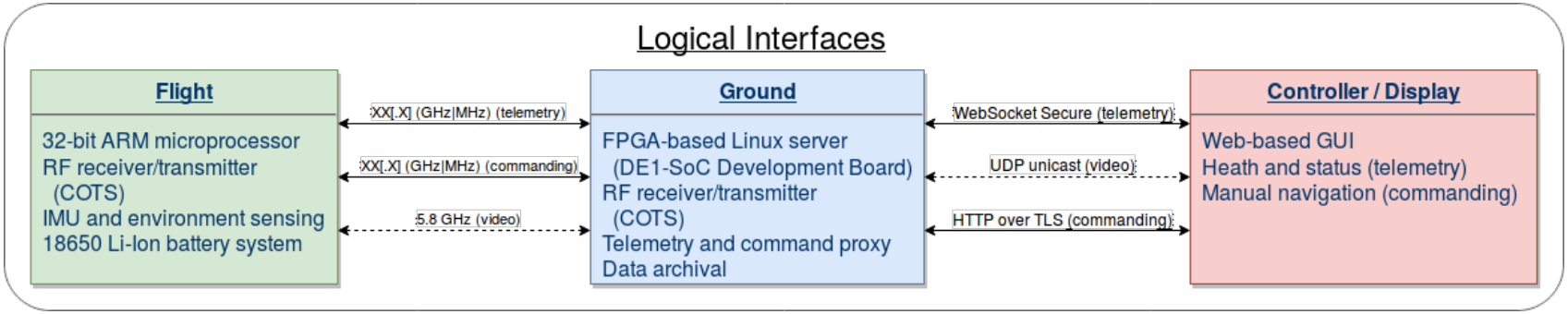
Overview



Quadcopter – Battery-powered, four-motor flying machine

Ground Station – Linux server managing the quadcopter's radio endpoint, hosts wired-network services (i.e. telemetry)

Web-based UI – A modern dashboard for visualizing data and manually commanding the vehicle

Learning Objectives and Features

Exposure to:

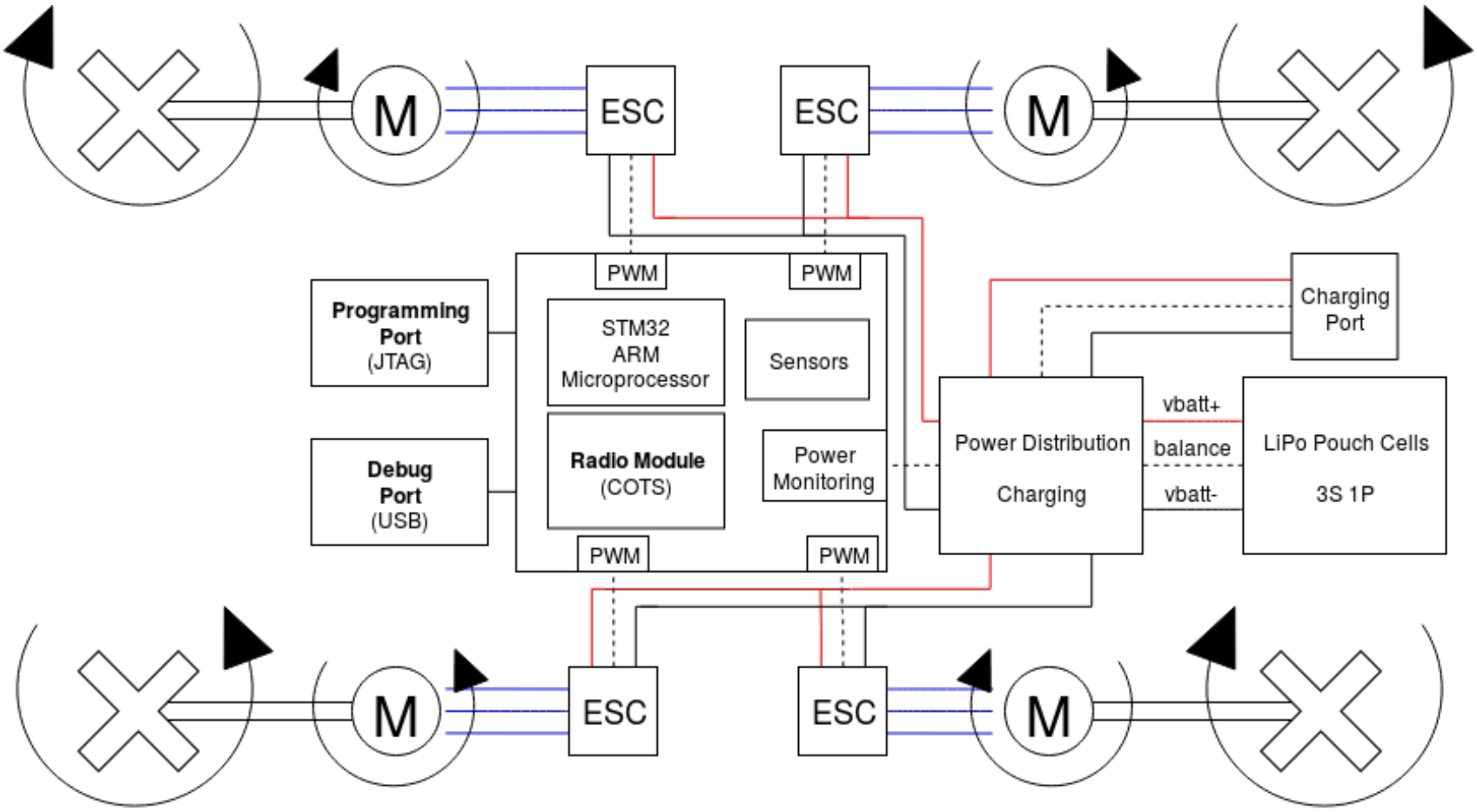
- Radio-frequency communication
- Control theory
- SoC platform(s)
- Data pipelining in the aerospace/avionics problem space
- Modern user-interface design and implementation

Features:

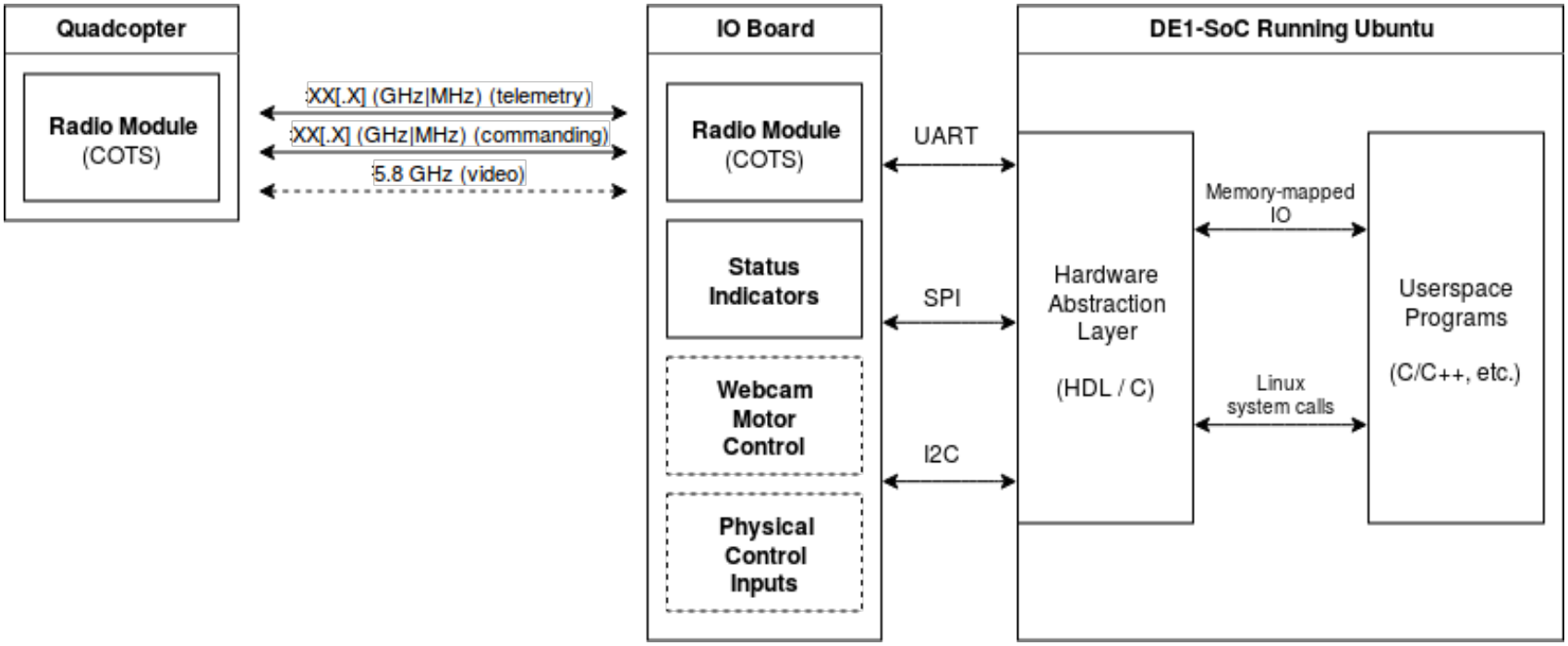
Single-Fault Tolerant – Land safely in the event of communication "heartbeat timeout"

Telemetry Archival – Implement long-term telemetry storage for post-flight data analysis

Quadcopter


M
ESC
ESC
M
PWM
PWM
Programming Port (JTAG)
STM32 ARM Microprocessor
Sensors
Charging Port
Debug Port (USB)
Radio Module (COTS)
Power Monitoring
Power Distribution
Charging
vbatt+
balance
vbatt-
LiPo Pouch Cells
3S 1P
PWM
PWM
M
ESC
ESC
M

Ground Station



User Interface

API Commands (A)

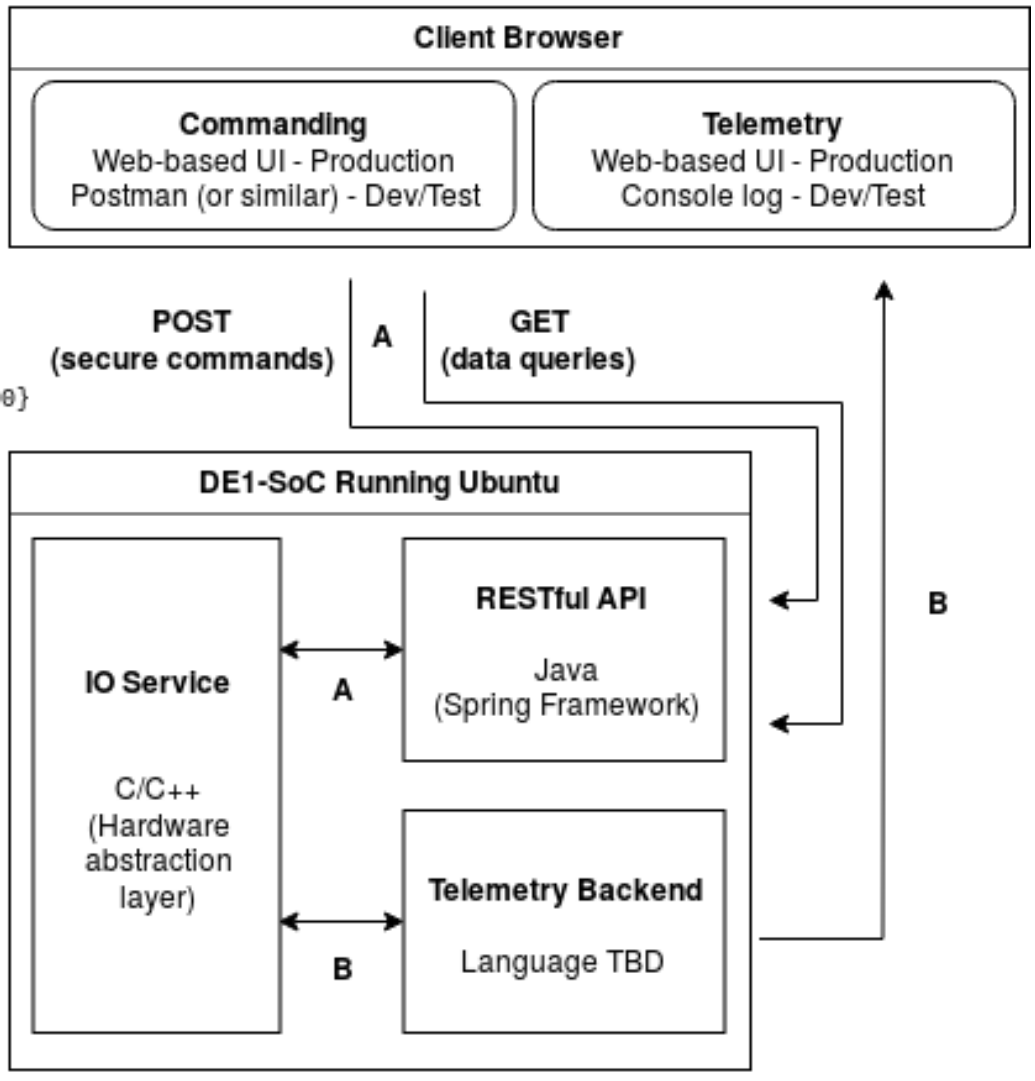
HTTP over TLS

```
https://host/move/up/{0 - 100}
https://host/move/down/{0 - 100}
https://host/move/left/{0 - 100}
https://host/move/right/{0 - 100}
https://host/move/forward/{0 - 100}
https://host/move/back/{0 - 100}
https://host/move/rotate/{-100 - 100}
...
```

Telemetry Data (B)

Secure WebSocket

```
telemetry_packet {
  timestamp: 1536646557,
  age: 15,
  type: "sensors",
  data: [
    temperature: 22,
    pressure: 101325,
    gyro: {
      rate_xy: -1,
      rate_xz:  2,
      rate_yz: -3
    }
    ...
  ]
}
```



Inter-process communication over local-loopback socket streams (TCP)