PRISM FPV

A Low-Latency Digital Video Link for High-Performance FPV.

Overview

- Introduction
- Design Details
- Project Management
- Conclusion
- Questions

TODO: [ADD DECISION MATRICES FOR ALL BUDGET ITEMS]

Introduction

- Transmit video from drone to pilot
- Minimize latency in various conditions

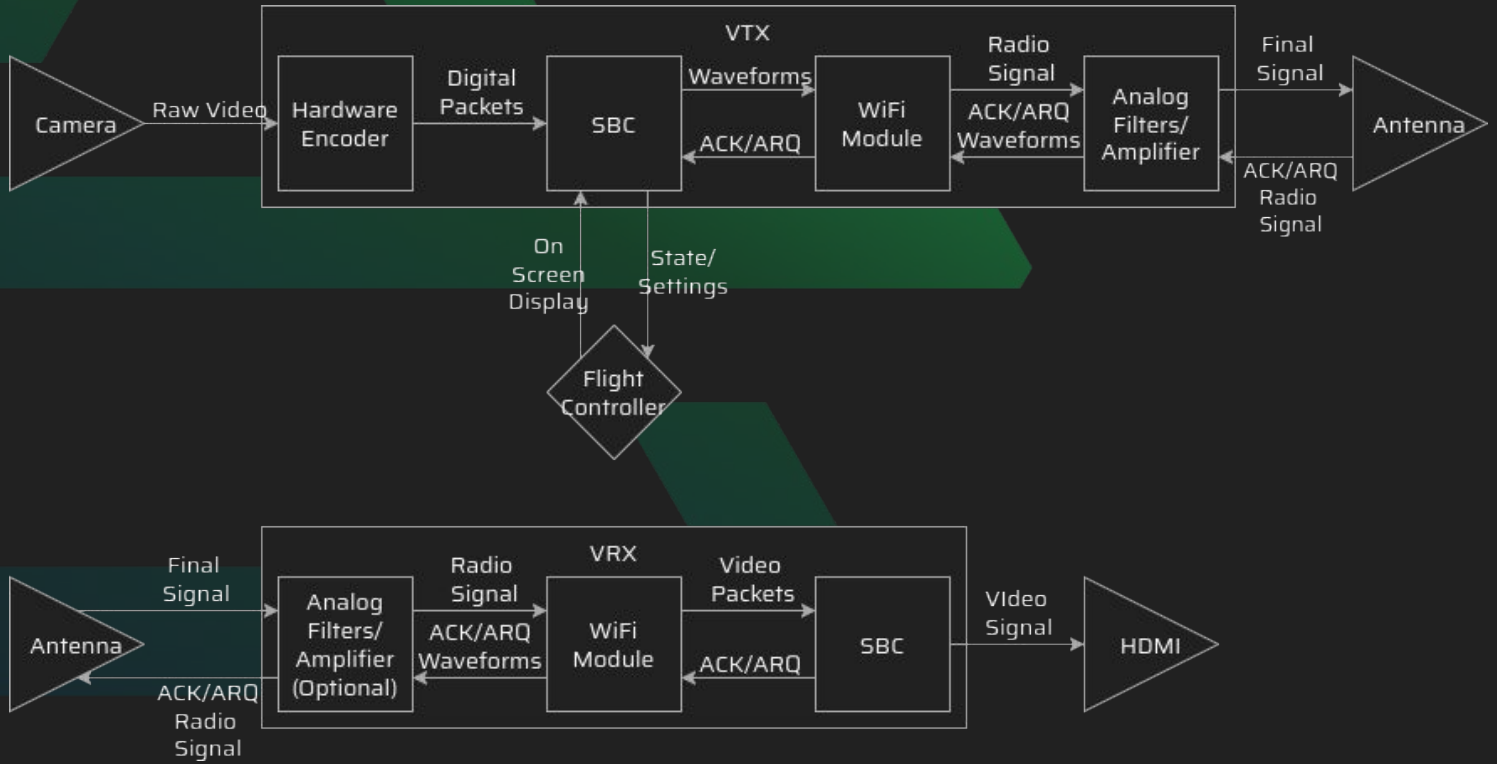
Problem

- Existing systems choose between quality and latency
  - This choice is built into the system
  - Users locked to one or the other
- Exciting learning experience
  - Embedded development
  - Radio protocols

Impact

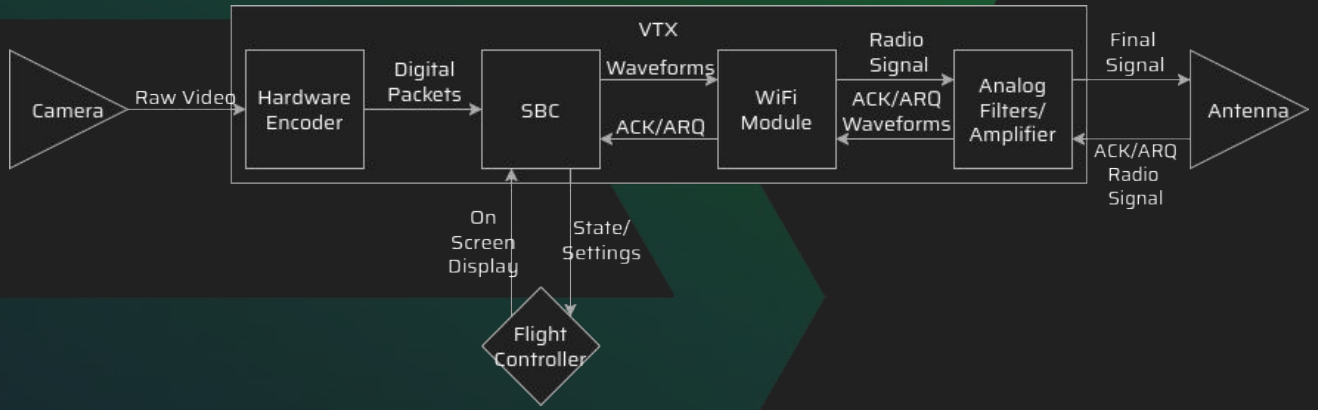
- Pilots no longer need to choose between quality and performance
- Provide a cost friendly option for digital FPV
- Could impact other streamed video applications

System Overview



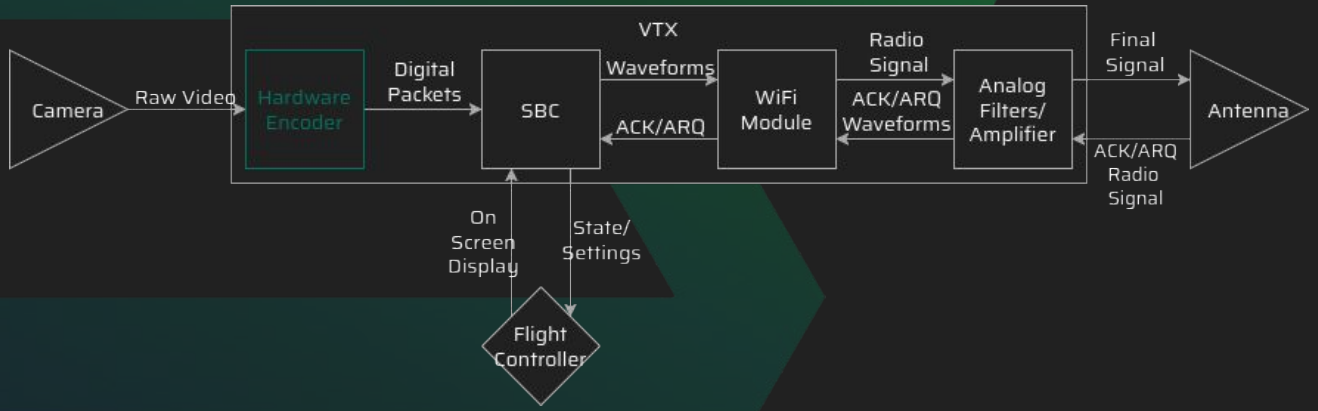
Video Transmitter (VTX)

- Unit mounted onboard the drone
- Connects to camera and flight controller
- Sends data to Video Receiver



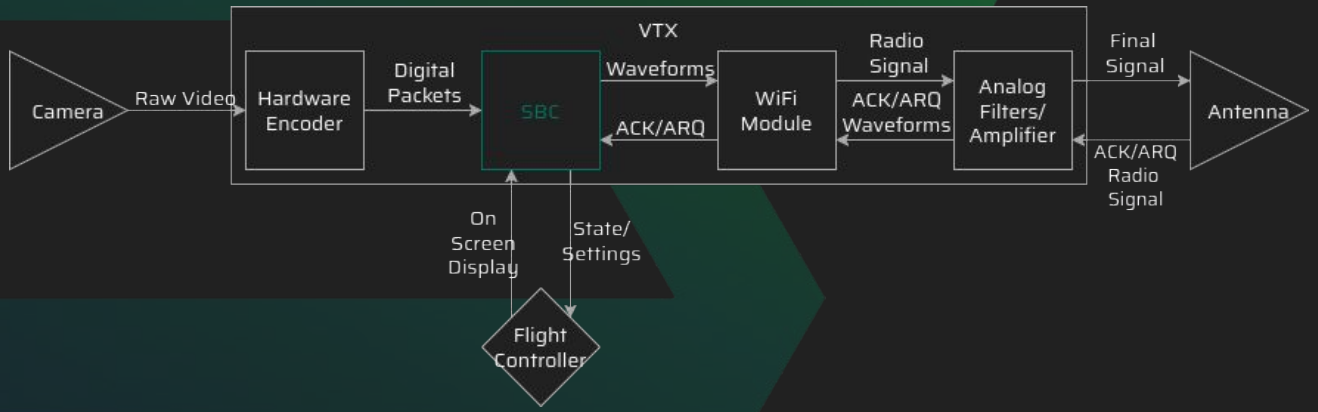
Hardware Encoder

- Converts raw camera data into digital stream
- Compresses image into manageable size
- Separate IC to decrease load on CPU



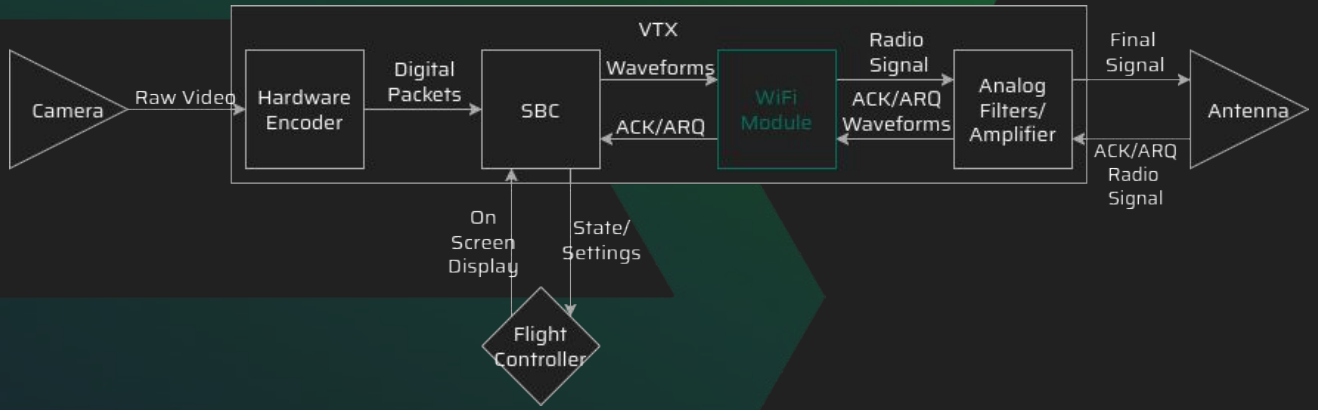
SBC (Single Board Computer)

- Processes image data into wifi packets
- Handles ACK from receiver (when required)
- Handles communication with flight controller



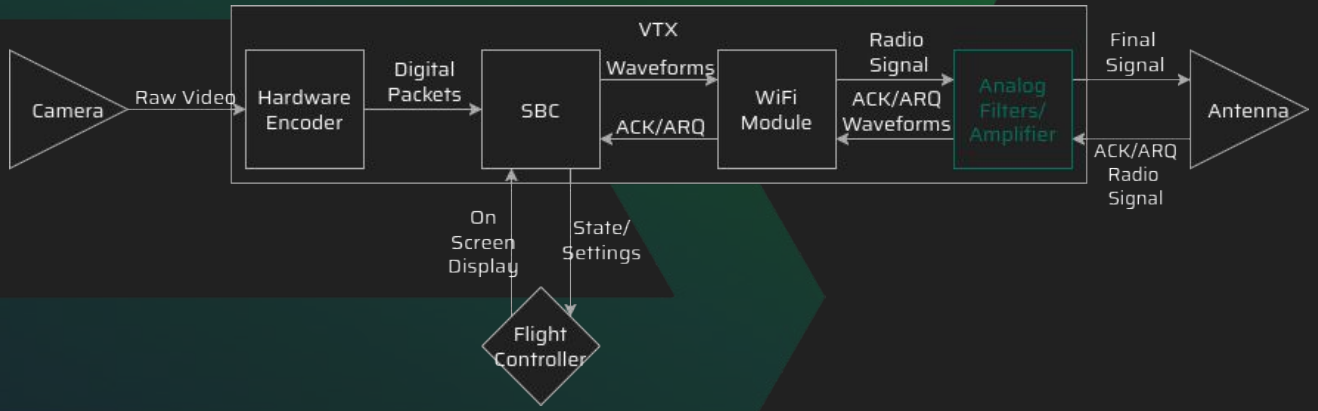
WiFi Module

- Encodes video packets to waveforms
- Transmits waveforms over 5.8 GHz channels
- Handles reception of ACK



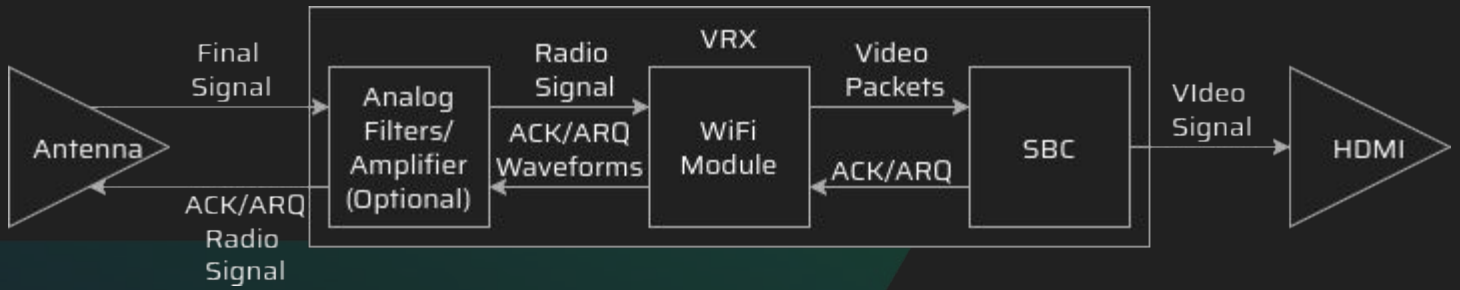
Analog Filters/Amplifier

- Boosts signal to higher power for longer range
- Applies any signal processing necessary for reception of ACK



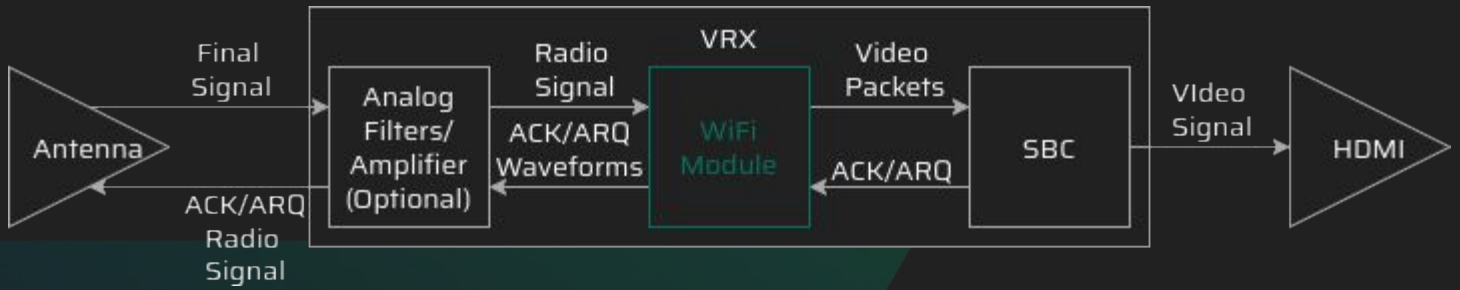
Video Receiver (VRX)

- Receives packets from VTX
- Converts to HDMI video signal
- Verifies packet reception and sends ACK (if necessary)



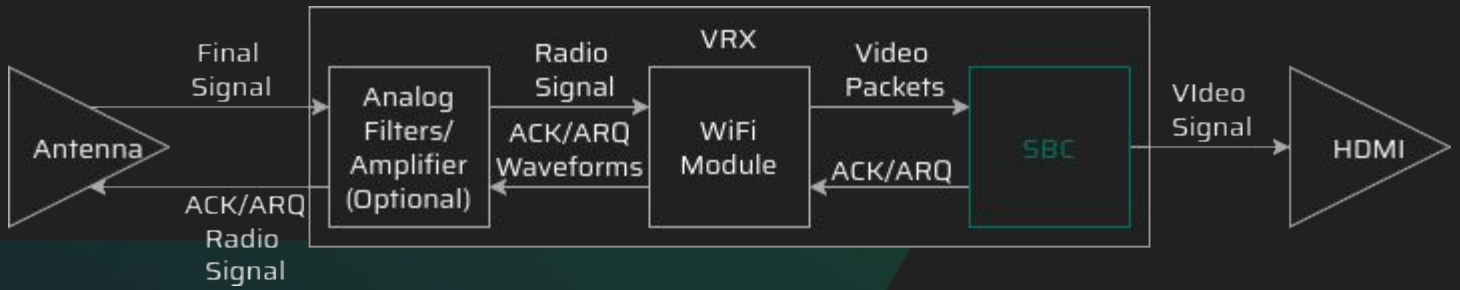
WiFi Module

- Receives video signal from VTX
- Converts to digital stream

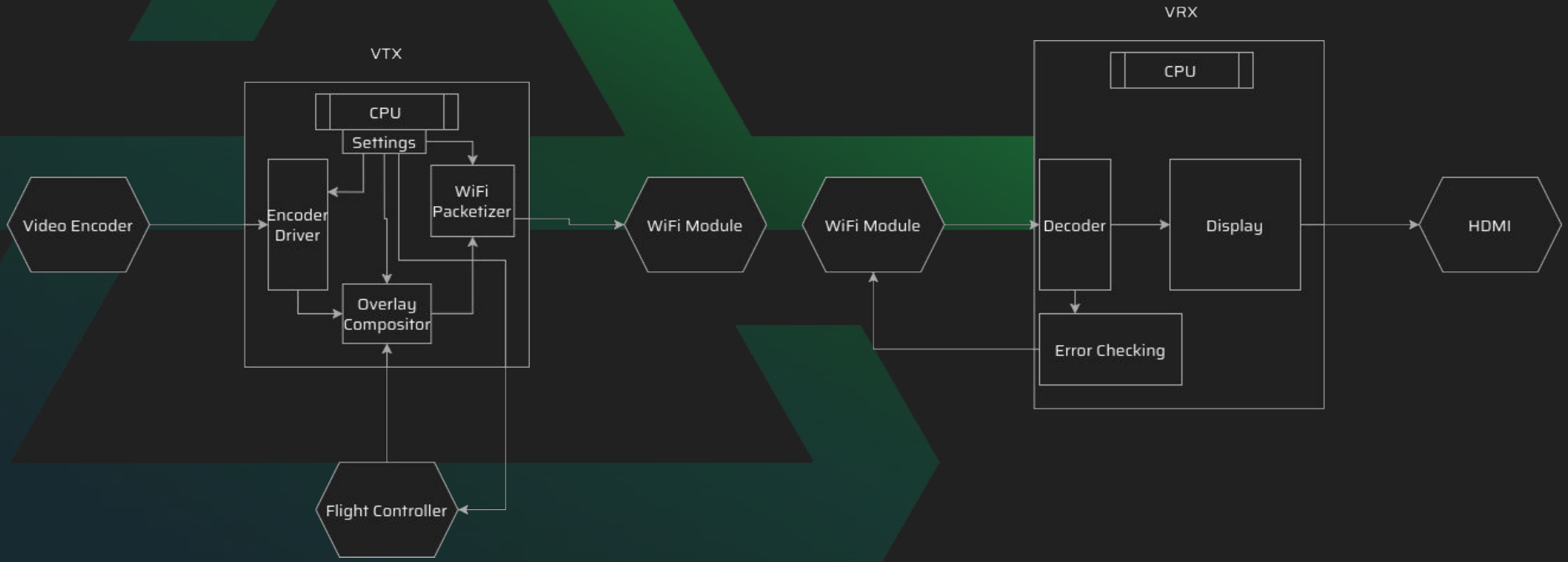


SBC

- Converts to HDMI signal
- Verifies signal integrity
- Sends ACK when necessary

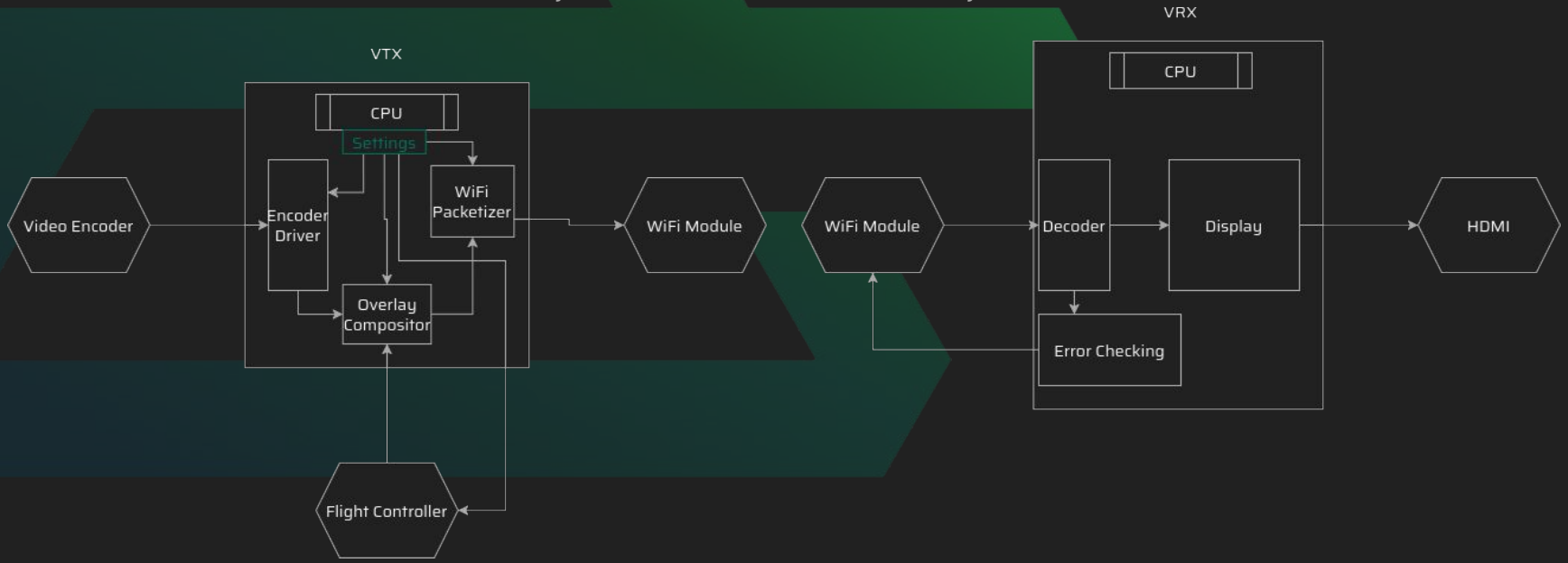


Software Diagram



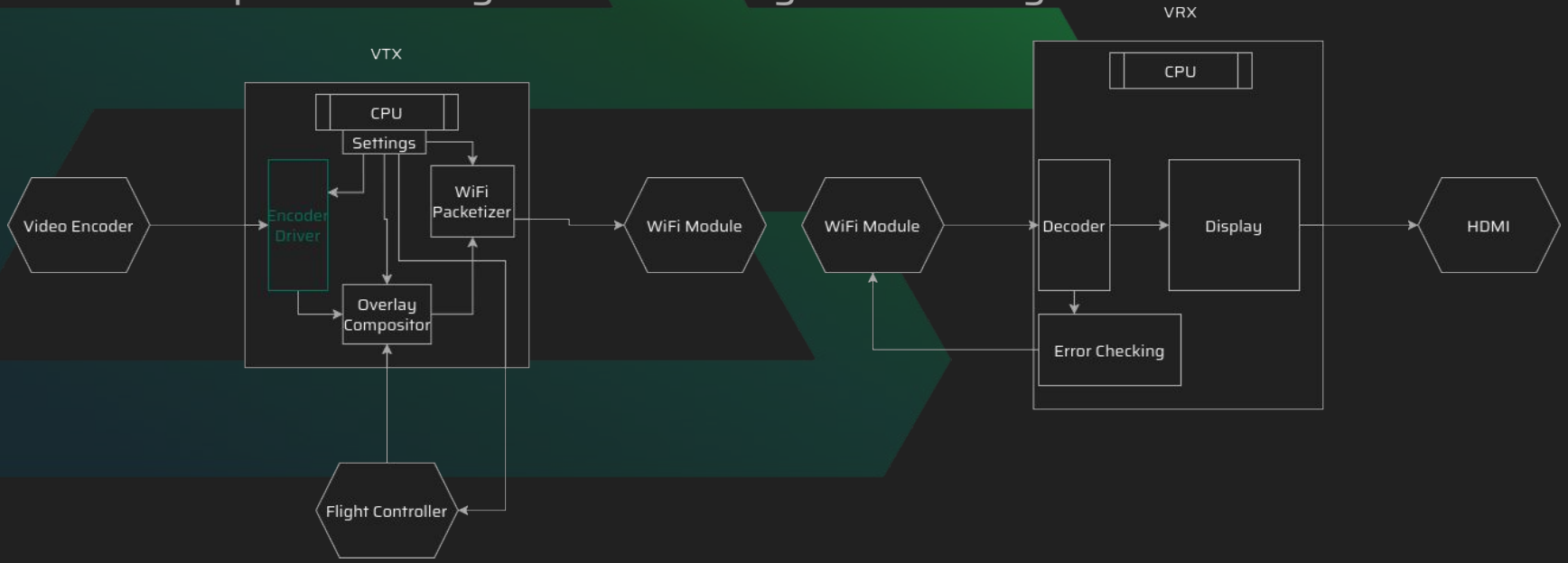
Settings

- User defined running information
- Ex: Transmission Power, Transmission Mode, Channel



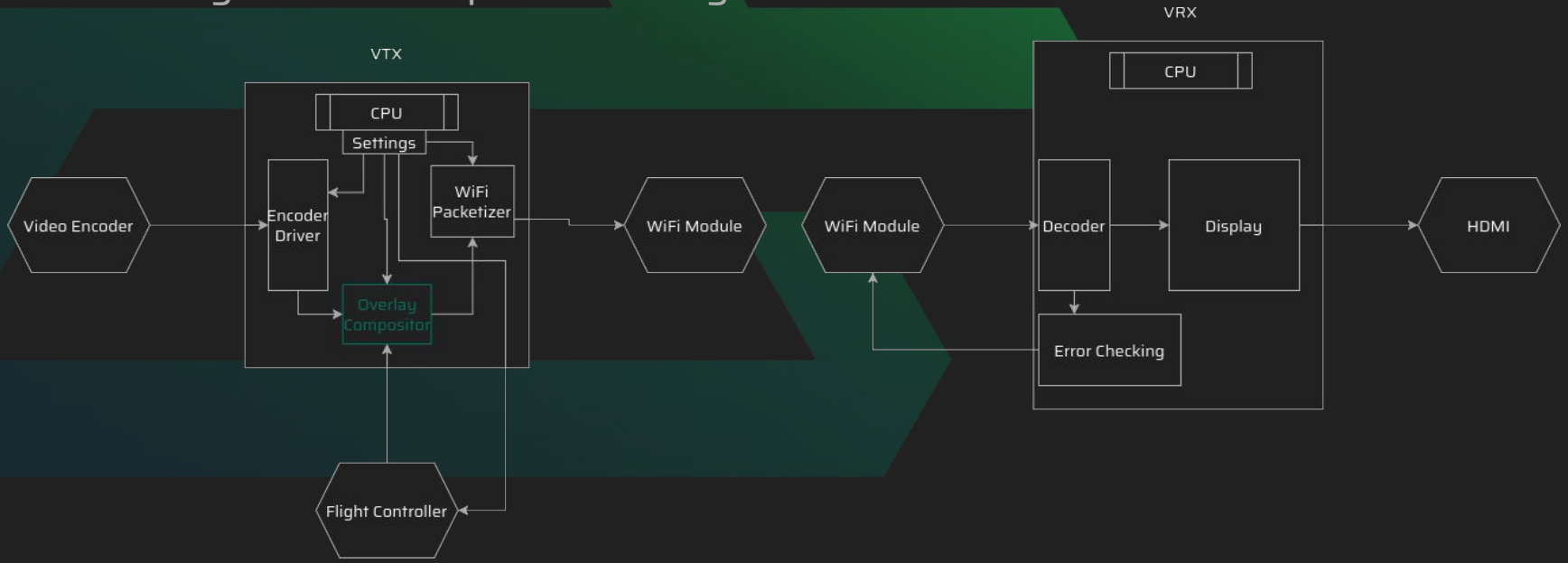
Encoder Driver

- Communicates with video encoder
- Sets required settings and reads digital video signal



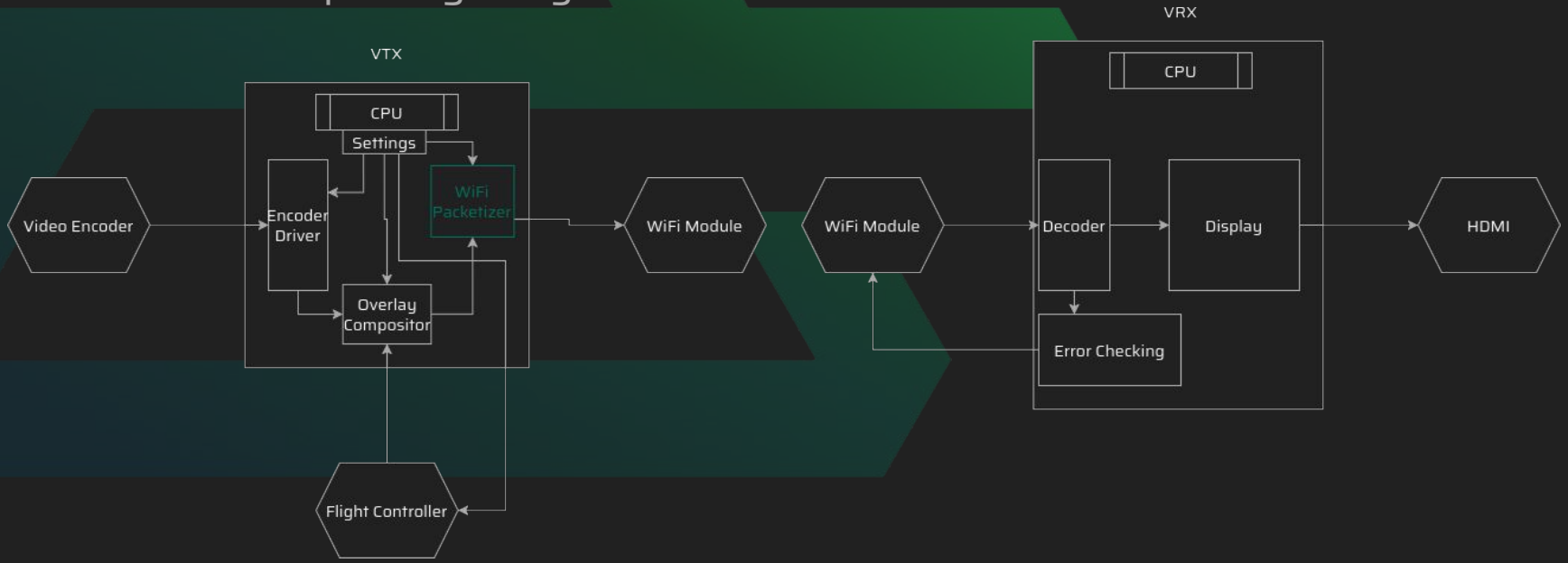
Overlay Compositor

- Receives On Screen Display (OSD) signal from Flight Controller
- Overlays OSD on top of video signal



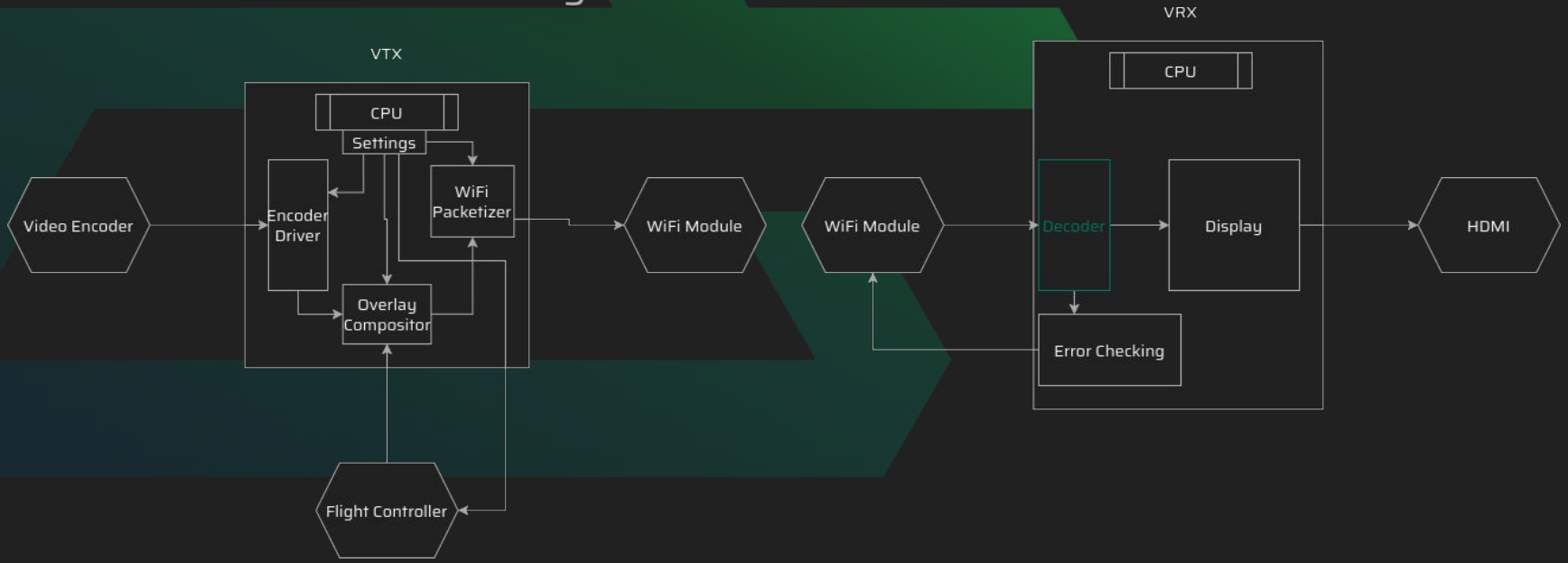
WiFi Packetizer

- Receives final video stream
- Chunks and packages bytes for transmission



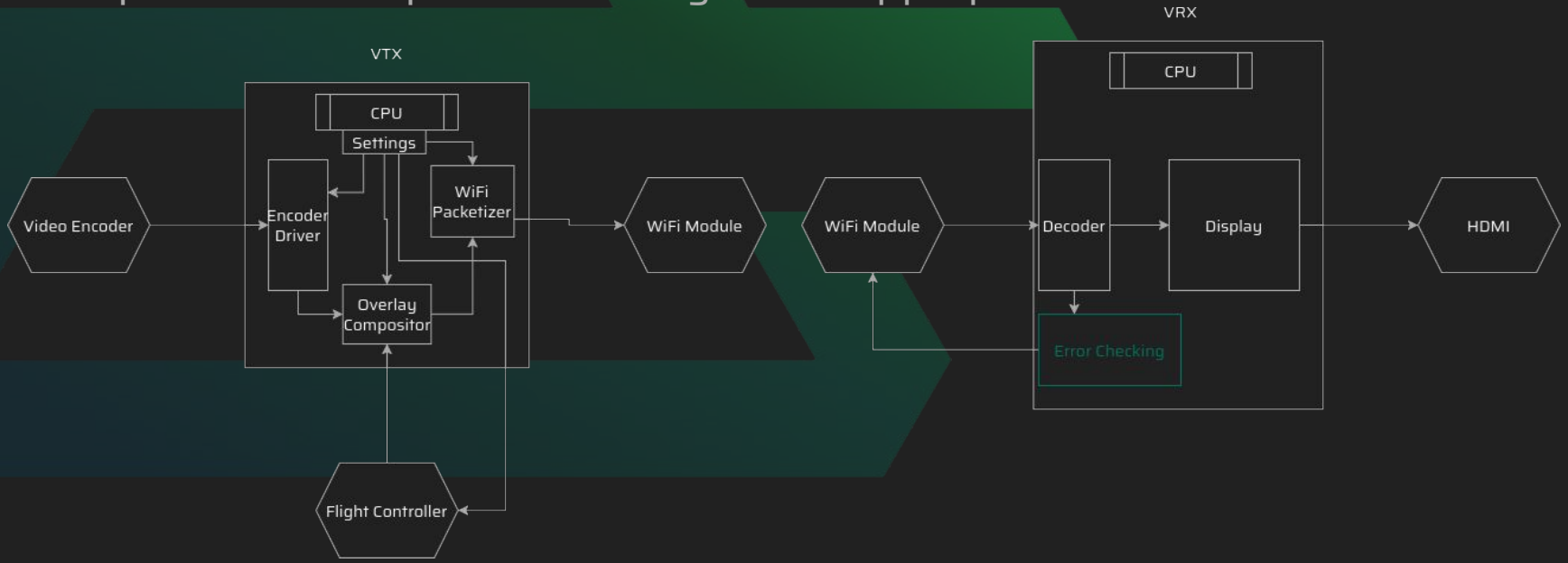
Decoder

- Receives WiFi Packets
- Reconstructs chunked signal into video stream



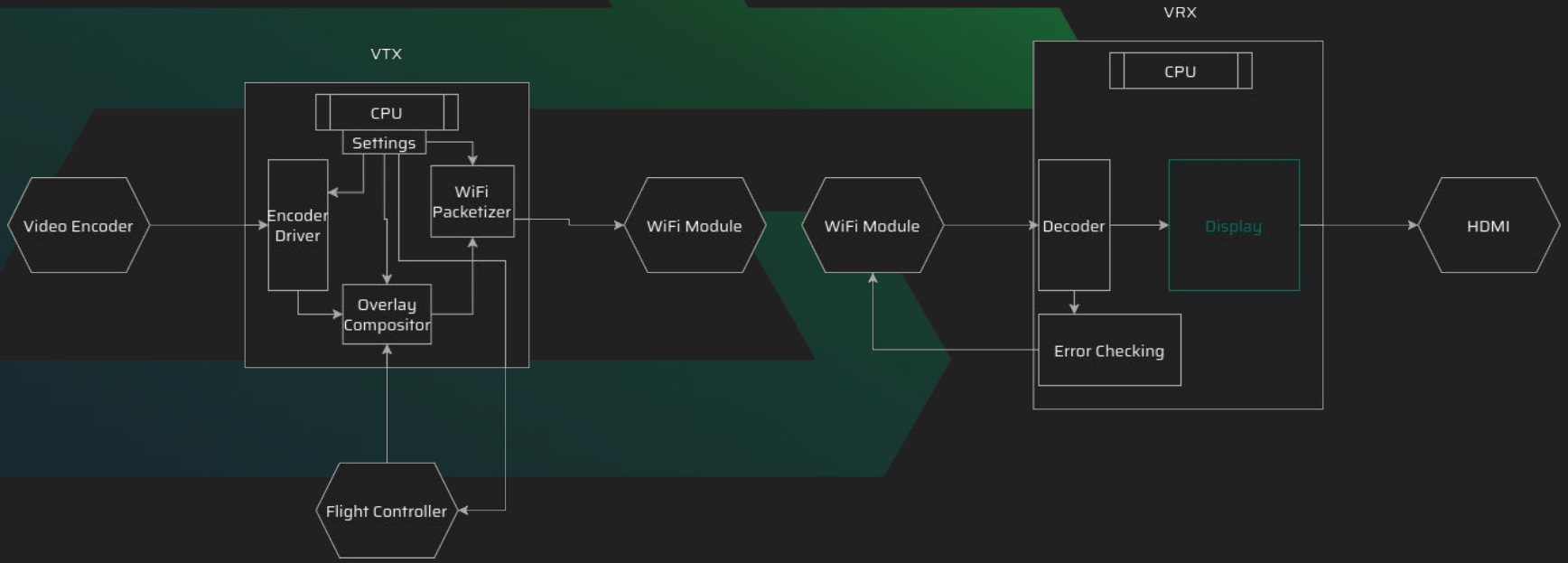
Error Checking

- Reads received bytes and checks integrity and order
- If packet is corrupted or missing sends appropriate ACK



Display

- Reads reconstructed video stream
- Formats stream and sends to HDMI



Architecture Decision Matrix

	Cost	Complexity	Flexibility	Time to Implement	Total
Weight	0.2	1	0.8	1	
SBC + WiFi	4	4	4	4	12
MCU + FPGA	2	1	5	1	6.4
AIO	1	5	1	5	11

Processor Decision Matrix

	Cost	Complexity	Flexibility	Power	Total
Weight	0.2	1	0.8	1	
SBC	2	3	4	4	10.6
MCU	2	4	4	1	8.6

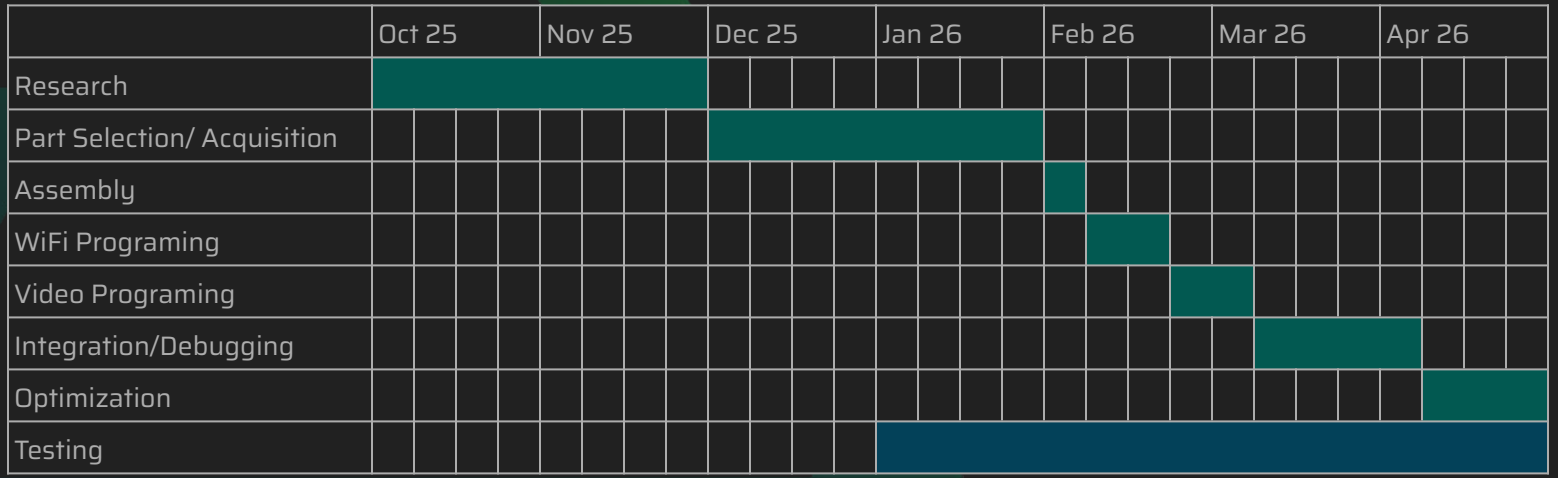
Encoder Decision Matrix

	Cost	Complexity	Flexibility	Time to Implement	Total
Weight	0.2	1	0.8	1	
Dedicated	4	4	4	4	12
FPGA	3	1	5	1	6.6

Radio Decision Matrix

	Cost	Complexity	Flexibility	Time to Implement	Total
Weight	0.2	1	0.8	1	
WiFi Chip	4	5	2	5	12.4
MCU	4	3	4	2	9
General Purpose SDR	2	1	5	2	7.4

Schedule


Oct 25
Nov 25
Dec 25
Jan 26
Feb 26
Mar 26
Apr 26
Research
Part Selection/ Acquisition
Assembly
WiFi Programing
Video Programing
Integration/Debugging
Optimization
Testing

Budget

- SBC (Raspberry Pi Zero 2 W) x2
  - $15-25 x2
- Hardware Encoder
  - $5-45
- WiFi Chip x2
  - $5-15 x2
- Antenna x2
  - $5-10 x2
- Motherboard
  - $3-10 x2
- Total
  - $61-175

Questions?