NOAA GOES-R Satellite Receiver

Fall 2020, Senior Design Team 3

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Introduction

The Geostationary Operational Environmental Satellite 16 (*GOES-16*) provides near real-time images of the Earth to anyone capable of receiving the signal. The receiver is useful for hobbyists and emergency responders. The data provided by the GOES-16 satellite provides crucial imagery data to project weather patterns that pose risk to lives and risk of destruction. During inclimate weather, the GOES-16 will transmit focused image data of concerning areas.

Design Requirements

Functional:

- System must download a current Earth image from the GOES-16 satellite.
- RPi4 will host a website to display information about the system process.

Non-functional:

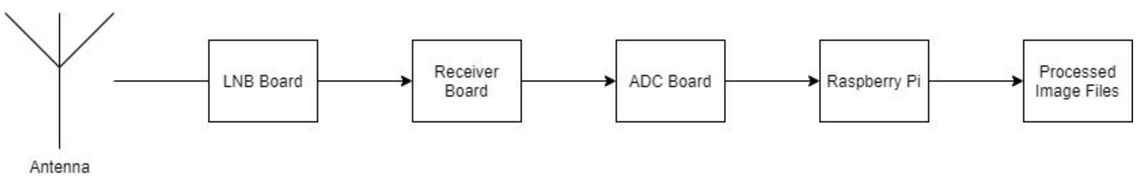
- System must receive and demodulate 1694.1 MHz signal
- Baseband signal must be digitized and output binary information
- Software must decode binary information and create image file

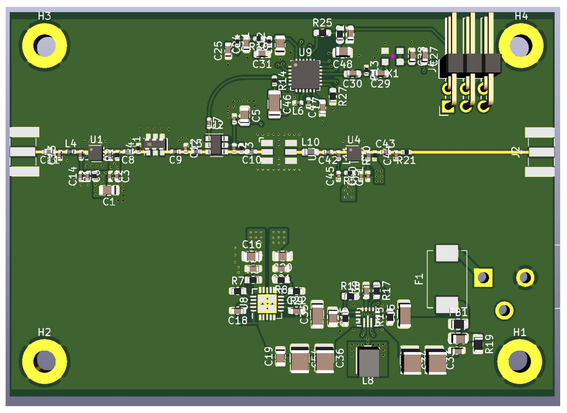
Operating Environment:

- The system uses a combination of typical lab equipment and an outdoor environment.
- The antenna must be outdoors long enough on a clear day to receive the transfer of the image data; processing of the image will happen indoors.

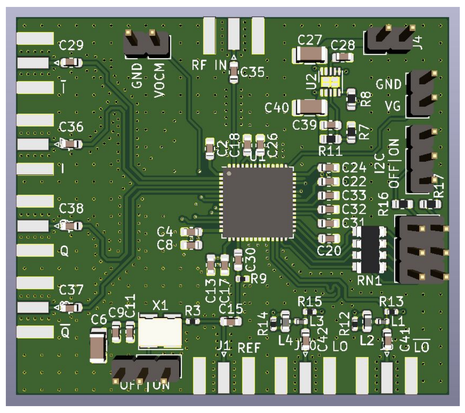
Design Approach

System Block Diagram

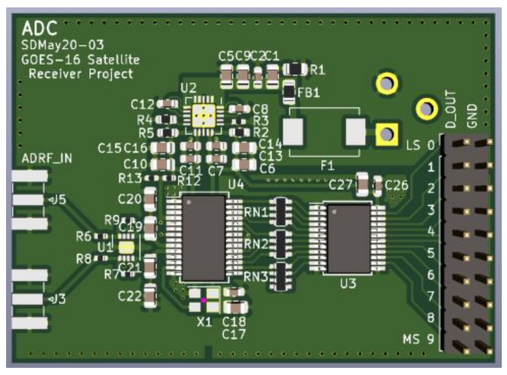




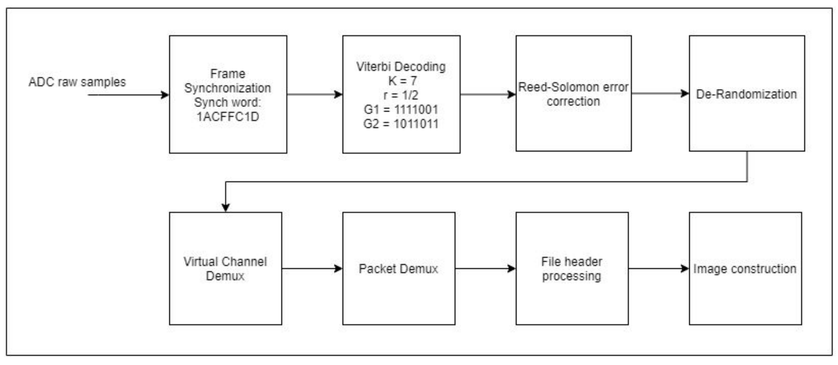
LNB Board: Amplifies, filters, and down-mixes incoming signal



Receiver Board: Down-mixes IF from LNB Board to baseband. Provides I & Q.



ADC board converts the analog I & Q daa into a digital bit stream for processing on the RPi4.



Software block diagram.

Engineering Standards and Design Practices

- Agile Development
- IEEE 145-2013: IEEE Standard for Definitions of Terms for Antennas
- IEEE 149-1979: IEEE Standard Test Procedures for Antennas
- IEEE Standard 211-2018: IEEE Standard Definitions of Terms for Radio Wave Propagation

Technical Details

Software and Libraries:

- GitLab
- C and Python programming languages
- OpenSat Library (Lukas Teske)

Hardware:

- ADRF6850 I/Q Demodulator
- LCOM 2.4GHz 24 dBi Dish Antenna
- SKY67151 LNA
- BFCN-1690 BPF
- MAX2680 Mixer
- ADF4360 Synthesizer
- MAX1426 DS ADC
- Raspberry Pi4

Testing

- Antenna placement tested by observing signal on SDR
- Signal strength confirmed with GOES software on RPi4 to check decoding errors
- Testing not completed on hardware due to COVID-19
- Software tested with test data from OpenSat project blog