

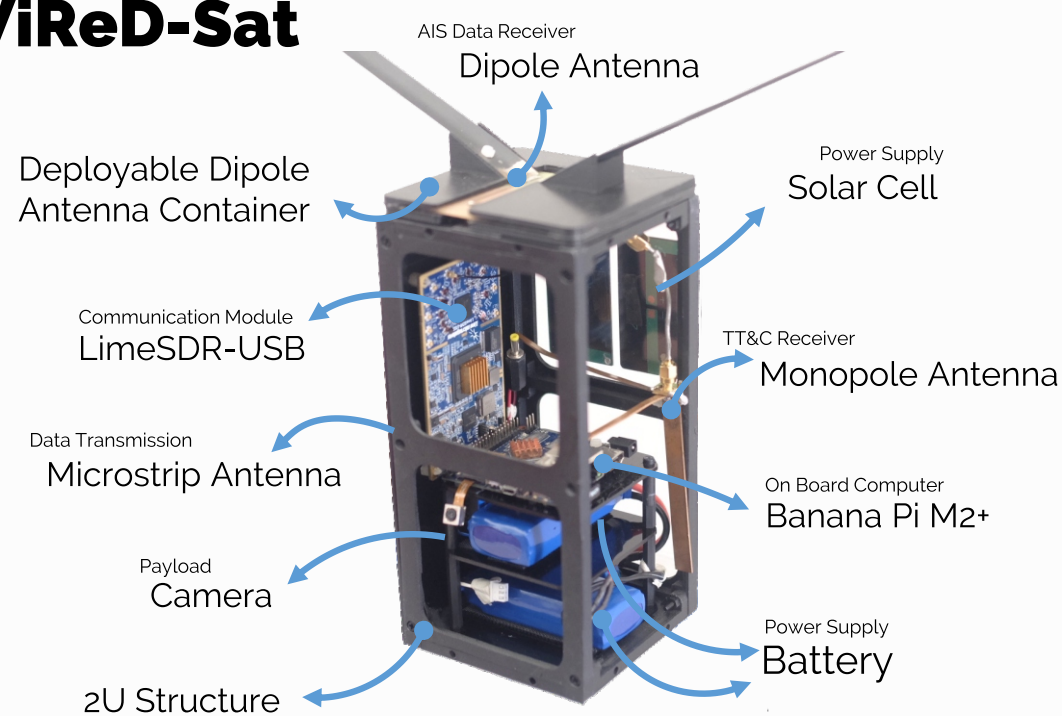


CUBESAT DEVELOPMENT FOR MARITIME PURPOSES

BACKGROUND

Maritime communication plays a major role in both economy and business, especially in Indonesia. In order to prevent criminal actions in the sea, such as illegal fishing, Ministry of Transportation released laws that allow ships to be identified, widely known as Automatic Identification System (AIS). However, the terrestrial system only allows a maximum distance of 75 kilometres from shores for ships to be identified. Even so, AIS signals can reach up to 700 kilometres above the sea. Our solution is to use CubeSat as a relay point, called WiReD-Sat.

WiReD-Sat



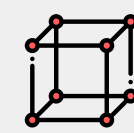
OBJECTIVES



Design a communication system using SDR for three different frequency bands, VHF for AIS, UHF, and S-band



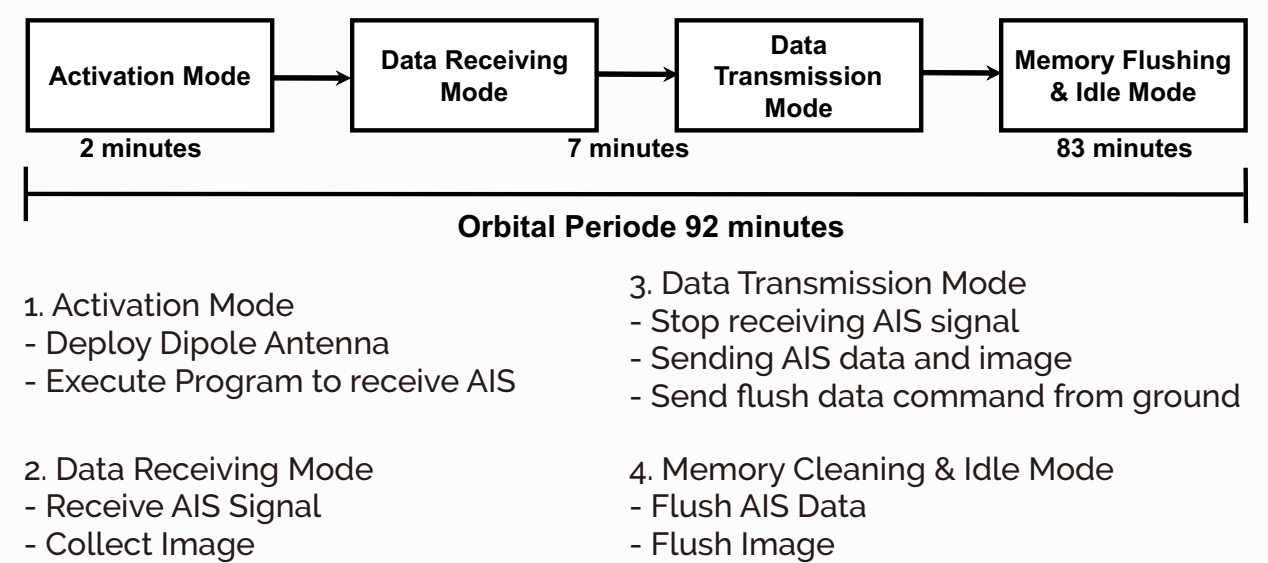
Build antenna for S-band, UHF and VHF that can fit into CubeSat



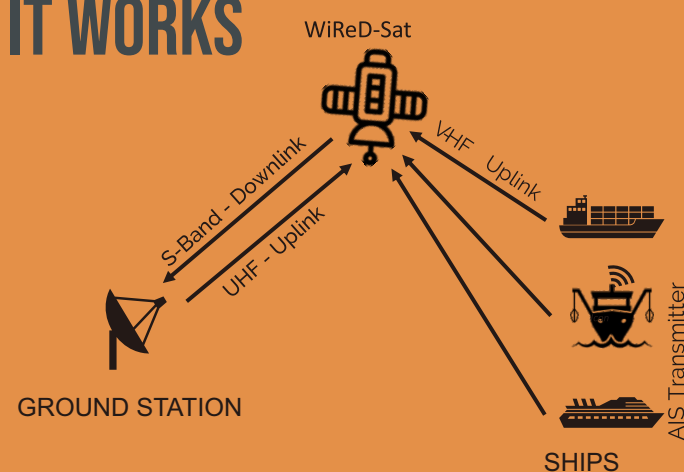
Design a CubeSat structure that can hold every components



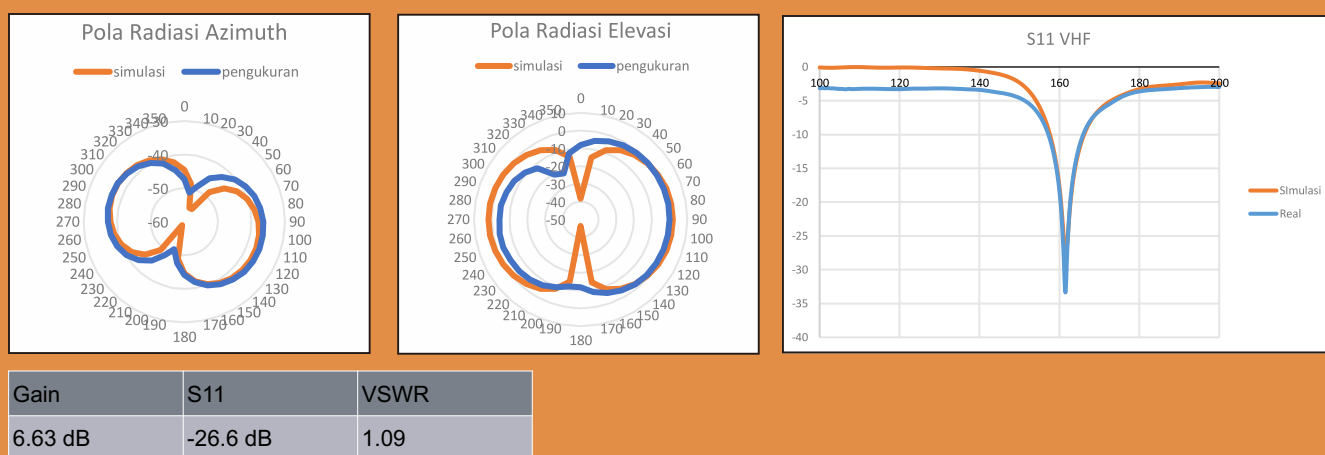
Integrate a scheduling system for CubeSat activities



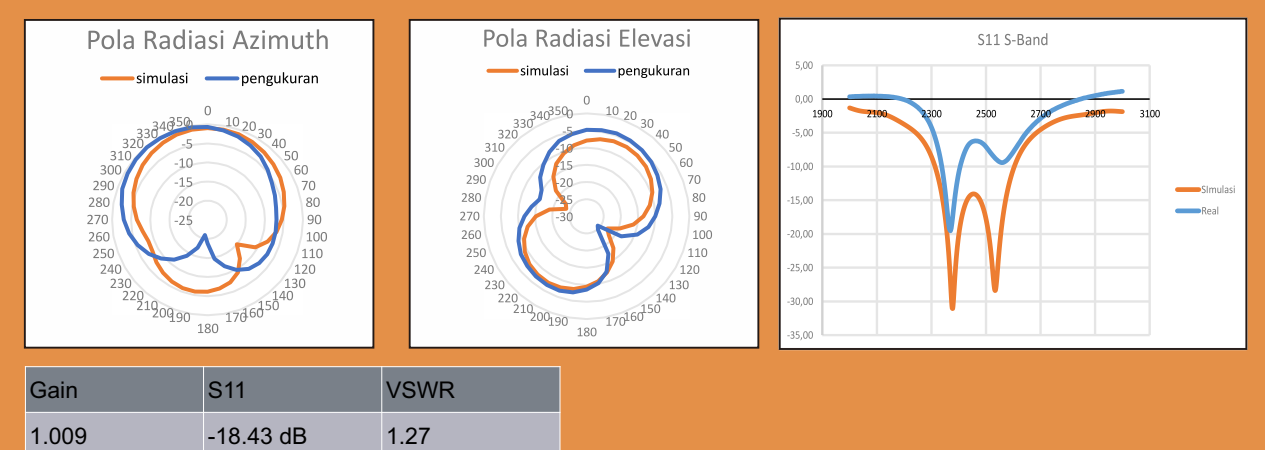
HOW IT WORKS



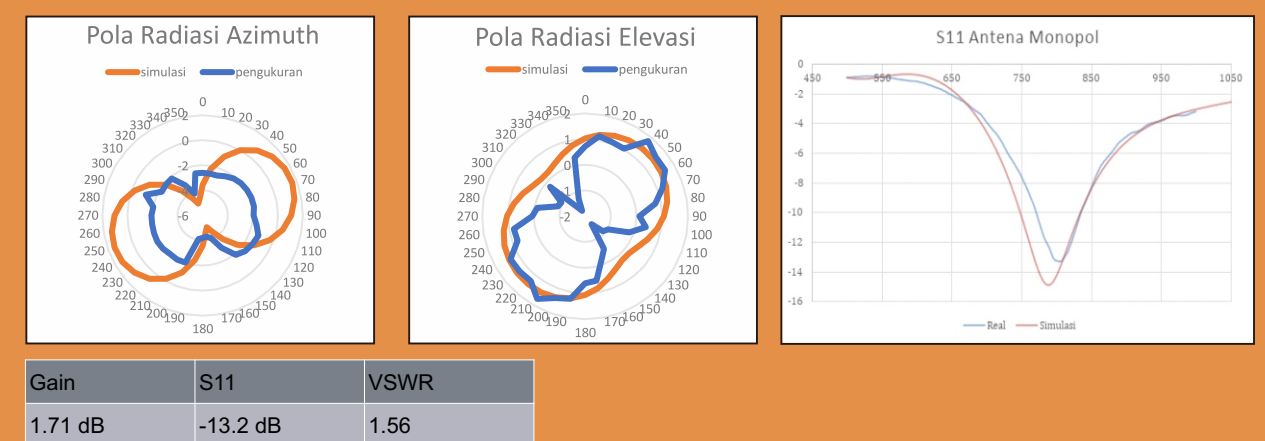
VHF Antenna Parameter



S-Band Antenna Parameter



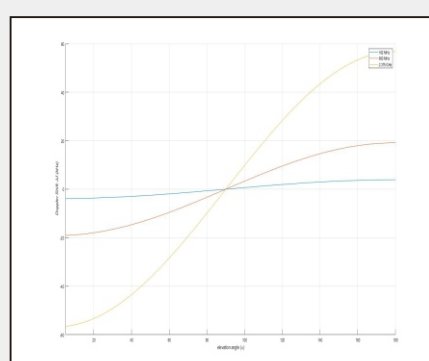
UHF Antenna Parameter



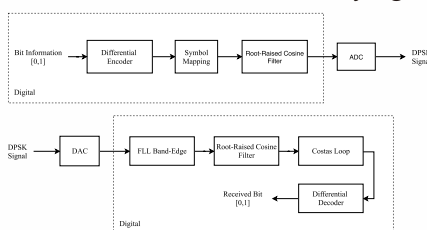
COMMUNICATION SYSTEM

Band	S-Band	VHF	UHF
Frequency	2.375 GHz	162 MHz	800 MHz
Modulation	DPSK	GMSK	GMSK
Data Rate	1 Mbps	9600 bps	9600 bps
Received SNR	13.79 dB	22.43 dB	15.12 dB
SNR Minimum (BER = 10 ⁻⁵)	10.3	9.6	9.6
Link Margin	3.49 dB	12.83 dB	5.52 dB

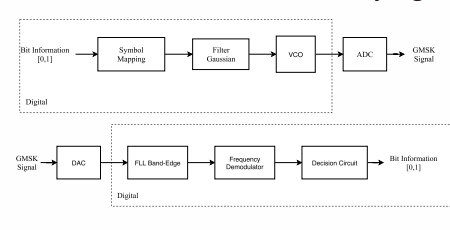
Doppler Shift



Differential Phase Shift Keying



Gaussian Minimum Shift Keying



CONCLUSION

1. Communication system is designed to use three different frequency bands, S-band, VHF and UHF. It uses two different modulation schemes, DPSK in S-band and GMSK in VHF and UHF. It is implemented using GNU Radio software on LimeSDR-USB. The program can send and receive data successfully. It can also mitigate doppler shift caused by orbital velocity located 400 kilometres above the earth. Based on link budget analysis, link margin values are 5.52 dB, 3.49 dB and 12.83 dB for TT&C, data communication and AIS respectively. It is designed to have BER at least 10⁻⁵. Even so, data communication on CubeSat can only be achieved by using LNA with at least 38 dB gain.
2. CubeSat 2U dimension and mass are in accordance to CSD with 10.1 x 10.1 x 21 centimetres and 949 grams. All of the CubeSat components can be integrated successfully. The scheduling system is done by dividing the CubeSat activities into four modes, the activation mode, data receiving mode, data transmitting mode, and memory cleaning and idle mode. The four modes duration is set according to the duration of the CubeSat while orbiting above Indonesia, which is 7.3 minutes from one orbital periode of 92.6 minutes.
3. The monopole antenna has meet the design specification with S11 parameter at 800MHz is -13.2dB. The microstrip antenna has meet the design specification with S11 parameter at 2.375GHz is -18.43 dB. The dipole antenna can be fold up to 4cm and has meet the design specification with S11 parameter at 162MHz is -26.6dB.