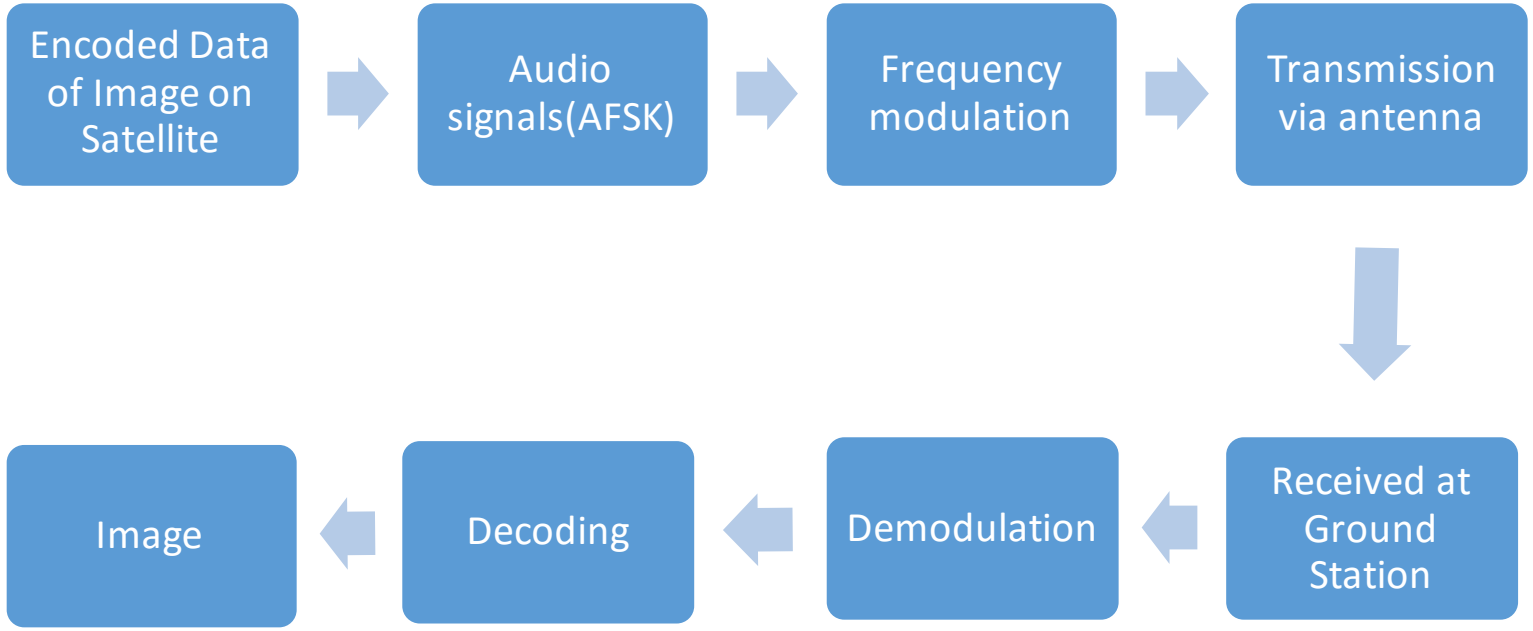
Advitiy payload: SSTV Radio

IIT Bombay Student Satellite Project

What is SSTV?

- SSTV (Slow-Scan TV) is picture transmission method used mainly by amateur radio operators, to transmit pictures via radio.
- Image is encoded to audio frequencies, transmitted through radio waves, received and decoded at the other end

The Complete Payload



Bottlenecks foreseen

There exist no precedents within the team for the following:

- Conversion of digital value of frequency to audio freq. signal (AFSK).
- Onboard data storage and handling capabilities (no. of images)

Allocation of required bandwidth

Conversion of digital value of frequency to audio signal.

- SSTV transmission mechanism
- The complete process requires audio frequency signal at certain value in the range of audible frequency to be given as input to FM transmitter.
- Possible modules: AD9833/2/5

Storage of Data

Method of Transmission: PD90

Image size: 320x256 pixels

With average: (320x256 pixels)x (2 Bytes on average per pixel) = 160 kB

For 1 picture storage requirement: 160 kB

For more images we will be requiring more storage.

Solution: Space grade EEPROM AT69170E (4 Mb of memory) can be used for this purpose.

One EEPROM can store 3 images. More can be used for higher number of images

External Factors affecting success of payload

- Availability of FM Modules
  - FM module RDA1846 was found with a development board DRA818U/V
  - Problem: No proof of the board to be able to survive space environment
  - However, power amplifier RF5110G (COTS) successfully worked as Pratham's beacon, even though it wasn't space qualified
- Outreach Potential of the Payload
  - Tie-ins: Development of HAM/SSTV Receiving stations in schools
  - Subject to resource availability

On-Ground Testing

- Before and after integration, testing of the link by keeping the distance between the transmitter and receiver sufficiently large (~few kms) to establish proof of concept.
- Testing of the setup in anechoic chamber for characterization

Requirements on Communication

- Communication subsystem should be able to transmit SSTV signals throughout the world.
- They shall setup a ground station at IIT Bombay.
- They shall design low-cost receivers for use by other universities/villages/communities.

Requirements on Control Subsystem

- 3 axis stability/ spin stability for antenna transmission

Requirements on Power Subsystem

- The transmitter module DRA818U/V has a power requirement of 3.375W.
- Earlier, power requirement by beacon and downlink: 2.74W and 2.30W respectively.
- However, with the increase in efficiency of solar panels (from Pratham's 18% to 27%), the power requirements are expected to be met (power produced would be 1.5 times the earlier)

Future Tasks

- Beacon and SSTV combined implementation
- Implementation of AFSK generator
- Implementation of storage of encoded image data
- Implementation of the FM transmitter setup
- Integration of the above setups
- Final integration of this complete setup

Components Used

- AFSK Module – AD9833
  - Low power(13mW) programmable waveform generator with 28 bit resolution (0.1Hz @ 25MHz reference clock)
  - Programmed via SPI
- FM transmitter - RDA1846
  - Single chip transceiver for both VHF and UHF band with bandwidths 12.5kHz/25kHz
  - Programmed via I2C
- Transceiver module – DRA818U (includes RDA1846)
  - Voice transceiver module for UHF band with bandwidth 25kHz and output power 27/30 dBm
  - Programmed via UART
- Power Amplifier - RF5110G (if DRA818U is not used)
- Memory Element – EEPROM
  - Size 4Mb

PD90 protocol

- Sync pulse 20.000ms 1200hz
- Porch 2.080ms 1500hz
- Y scan (from odd line)
- R-Y (Cr) scan averaged for two lines
- B-Y (Cb) averaged for two lines
- Y scan (from even line)