Sputnik Product Development Specification

William Harrington, Jake Heath, Shan Quinney, Michael Mathis

ECE412 Capstone

January 24, 2016

Requirements

Must

- Environment
  - Have a radiation tolerant watchdog system
  - Be able to operate in an Industrial Operating Temperature Range (-40C to 80C)
  - Acceleration: must handle 15g in the "Z" axis
  - Vibration TBD
- Communication block ("radio")
  - Operate in the 70 cm band (436 to 438 MHz)
    - Use IARU specified frequency for RF comms and make appropriate changes if necessary
  - Meet FCC Amateur Radio Licensing requirements (Title 47 CFR part 97)
  - Meet 400km ISS orbit link budget by a margin of 6 dB
  - Have bidirectional communication interface to Payload and System Controller
  - Local storage for communication in/out queues
- Energy storage
  - Use an energy storage system to power the energy when not in sunlight

    - Monitor the state of charge of the battery
        * Voltage
        * Current
        * Charge (Coulombs)
    - Charge the energy storage using input from energy harvesting system
- Energy harvesting
    - Handle 6 photovoltaic panel inputs
- Energy Switching/Control
    - Be able to seamlessly switch energy sources to the load
- System controller
    - Radiation tolerant "system watchdog" controller
    - Power switches to turn other blocks on and off
    - Monitor energy storage and energy harvesting systems
    - Communication link with communication block
- CubeSat requirements
    - Conforms to latest CubeSat specification where applicable
    - Fits in 1/4 1U CubeSat
    - Weighs less than 250 g

Should

- In general
    - Use as many COTS (Commercial Off The Shelf) parts as possible
- Environment
    - Operate in Automotive Operating Temperature Range (-40C to 125C)
- Communication block ("radio")
    - Use a frequency of 436.5 MHz for RF communication

May

- Environment
    - Operate in Military Operating Temperature Range (-55C to 125C)

Deliverables

- Hardware
  - 2 working Sputnik boards
  - 1 running Sputnik demo (not flight) code
  - 1 running UART to Sputnik radio adapter for test/debug
  - 1 working test setup
- Firmware
  - Basic Sputnik functionality for KW0x microcontroller
  - Drivers
    - Timers and Interrupts
    - SPI
    - UART
    - Radio
  - System Controller
    - Simple monitoring of power system
    - Simple watchdog system to turn on and off other system blocks
- System Level
  - Radio works, demonstrated over 10 km
  - System controller can turn other blocks on and off
  - Power system charges batteries from external input