SAMS COM Requirements

# CONOPS

The SAMS Communications (COM) system serves to facilitate all transmit and receive capabilities on the CubeSat. The SAMS COM system will be able to uplink commands and data from a trusted ground station and send that information to CDH. The COM system will also be able to securely downlink quantities of data that may take longer than one ground pass to downlink fully without error. Besides these primary uplink and downlink functionalities, the COM system will also be able to regularly and consistently downlink state of health data that is prepared by CDH so that ground teams can ensure the functionality of SAMS.

# Requirements

## Technical Requirements

1. The SAMS COM system shall have the ability to communicate with a ground station network.
2. The SAMS COM system shall not radiate RF energy for [TBD] minutes after deployment.
3. The frequency at which the SAMS COM system operates at shall be licensed to AGSL by the Federal Communications Commission (FCC).
4. The SAMS COM system shall have a Bit Error Rate (BER) of less than 10-5.
5. The SAMS COM system shall have a Frame Error Rate (FER) of less than 10-4.
6. The SAMS COM system shall be able to establish reliable communication with a ground station at an orbit height of (at most) 410 km.
7. The SAMS COM system shall operate with a data rate of [TBD] bps.

## Operational Requirements

## Safety Requirements

## Reliability Requirements

1. The SAMS COM system shall be able to transmit a complete data stream within [TBD] minutes.
2. The SAMS COM system shall conform to standards developed by the Consultative Committee for Space Data Systems (CCSDS).
   1. The SAMS COM system shall utilize a CCSDS recommended modulation scheme.
   2. The SAMS COM system shall limit Equivalent Isotropically Radiated Power (EIRP) to a level recommended by the CCSDS.
   3. The SAMS COM system shall limit spurious emissions to -60 dB.
3. The SAMS COM system shall interface with EPS.
4. The SAMS COM system shall interface with the CDH system.
   1. The interface between COM and CDH shall conform to CCSDS standards.
5. The SAMS COM system shall interface with the TMS system.
6. The SAMS COM system shall comply with ISS safety standards.
7. The SAMS COM system shall have the ability to operate within the environment of LEO.
8. The SAMS COM system shall survive launch loads.
9. The SAMS COM system shall survive handling loads.

SAMS COMMUNICATION SYSTEM REQUIREMENTS

1. SAMS COM system shall be able to transmit/receive data at a minimum rate of 1,200 bps.

Rationale: The satellite may fly at the approximate height of the International Space Station (408,773 m) at a speed which allows the satellite to pass within range of a ground station for 10.0 - 12.0 min. For data to be transmitted completely and received completely, the data must transfer at a minimum rate of 1,200 BPS. Considerations for data rate requirements include the projected transmission and propagation delay, 1 s and 0.00136 s respectively.

1. SAMS COM system shall have a duplex system on the satellite and ground station.

Rationale: A duplex system conserves space and weight for the aircraft. The duplex system will ensure a faster transmission of data than occurs with separate uplink and downlink antennas. The duplex system also reduces power usage.

1. SAMS COM system shall have a bit error rate less than 10^-6 for uplink and a frame error rate less than 10^-4 for downlink.

Rationale: With this bit error rate, the satellite will be able to reliably transmit any sort of data including but not limited to audio and video. This ensures the proper operation of the CONSEC/TRANSEC subsystem and supports backwards compatibility.

1. SAMS COM system shall operate with a COMSEC/TRANSEC (communication/ transmission security) subsystem.

Rationale: The COMSEC system handles all decoding and encoding of transmission which prevents interception of unauthorized users during information transit. Within the COMSEC system, TRANSEC protects against exploitation of information and jamming of communications.

1. SAMS COM system shall operate on UHF, VHF, or S bands.
2. SAMS COM system shall have a modulation system.

Rationale: Using a modulations system and coding schemes allows for the cubesat to conserve valuable space condensing coverage digitally. Modulation schemes are also very energy efficient, allowing the power to be spent somewhere else.

1. SAMS COM system shall have an emergency recovery mode.
   1. Must provide continuous uplink and downlink coverage over the entire unit
   2. Must be able to transmit telemetry data and receive commands no matter the attitude of the satellite

Rationale: In the event the satellite rotates out of range the emergency system should be able to contact the satellite until the satellite returns to assigned rotation.

GROUND STATION COMMUNICATION SYSTEM REQUIREMENTS

1. SAMS Ground station shall be free of physical obstructions such as wide and tall buildings, mountains, and heavy clouds.
2. SAMS Ground station shall have a programmable computer.
3. SAMS Ground station must be capable of interfacing with the cubesat’s communication system.
4. SAMS Ground station shall be capable of front-end processing including
   1. Radio Frequency signal processing
   2. Command and telemetry stream formatting
   3. encryption/decryption
   4. Network interfacing
5. SAMS Ground Station shall have an emergency recovery mode
   1. Must be able to transmit commands and receive telemetry data no matter the attitude of the satellite