UNIVERSITY OF ARIZONA
STUDENT SATELLITE PROJECT
Technical Note

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Subject: Groundstation Approach for SEDSAT Operational Profile **Date:** 9/13/1998

Written by: Dana Irvin

Reviewed by:

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Revision 1.0: Initial Draft (9/13/1998)

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1. Document Overview

This document is meant to give an overview of the groundstation hardware and software that will be used to create an operational profile using the satellite SEDSAT. SEDSAT is to be launched as a secondary payload on October 15, 1998 on a Delta II launch vehicle whose primary payload is Deep Space 1. The groundstation that will be used for this profile is in ENGR 303, which is also the office of the University of Arizona Amateur Radio Club. Much work, energy, and finances have already gone into the construction of the groundstation by both UAARC and the U of A chapter of SEDS, Students for the Exploration and Development of Space, in preparation for this launch. Because of this, SEDSAT and the groundstation already constructed offers a unique opportunity for members of the Tracking, Telemetry and Command team, as well as any other member of SSP to acquire experience in mission operations.

2. Requirements

2.1 All software and hardware must be constructed and tested by launch.

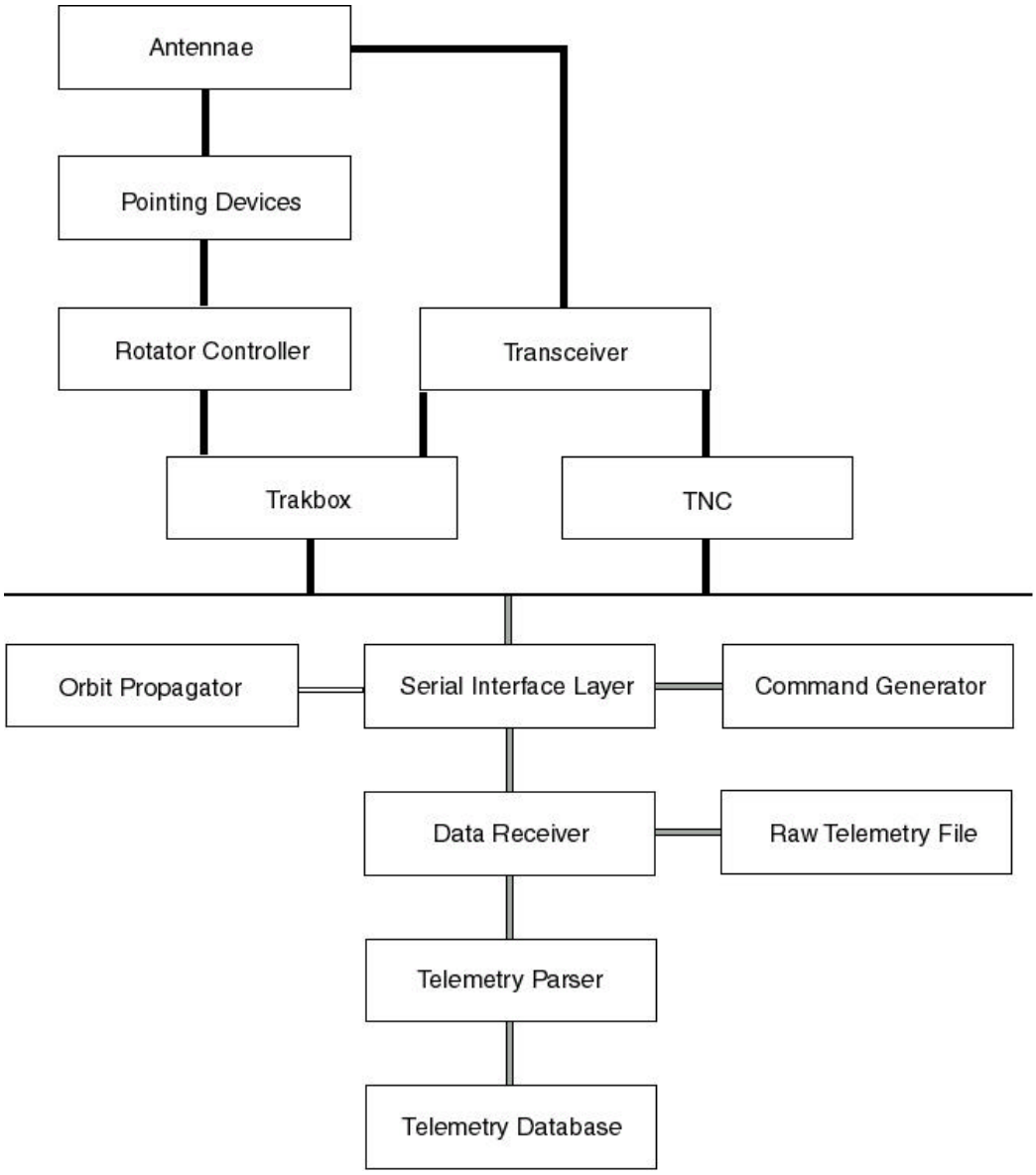
This is required for obvious reasons.

2.2 All software must be written in Java where possible.

This is required because as a portability of this software is highly desired. It also allows easy integration into the Web environment.

3. Descriptions/Designs/Discussion

3.1 Approach Diagram



3.2 Explanation of Diagram

The links between each part of the groundstation is represented by a rectangle in one of three colors. Black designates a hardware link, with gray as a software link. The white link is present between the serial interface layer and the orbit propagator because of an uncertainty. This is gone into detail in section 8. The large horizontal bar near the vertical center of the diagram represents the groundstation computer.

3.2.1 Antennae

This block represents the antennae that will be used to communicate with SEDSAT.

They consist of a 2m Yagi antenna with approximately 16 dB gain, a 70cm Yagi antenna with approximately 16.8 dB gain, and a 23cm Yagi antenna with approximately 18 dB gain.

3.2.2 Pointing Devices

This block represents the devices used to point the antenna array, such as the azimuth rotator and also the elevation rotator.

3.2.3 Rotator Controller

This block represent the rotator controller, a device that allows external control of the rotators, either manually or by electronic means.

3.2.4 Transceiver

This block represents the actual radio used to transmit commands or receive telemetry/data from the satellite. Currently, this is a Yaesu FT-736R satellite transceiver, which has been modified to allow transmit/receive of a 9600 baud FSK signal**.**

3.2.5 Trakbox

This block represents a device called the Trakbox. It is a device that used to be available as a kit from TAPR (Tucson Amateur Packet Radio), an organization that specializes in utilizing digital communications via radio links. This device is used to allow automated control of the rotator controllers and also has the capability to change the frequencies of the transceiver, allowing automatic Doppler corrections. It has an onboard orbit propagator, or it can be instructed via a serial connection where to point the antennae, or to what frequency the transceiver it to be tuned to.

3.2.6 TNC

This block represents the TNC, or Terminal Node Controller. It operates similarly to a standard modem, except it utilizes radio communications instead of analog phone line communications. It may also be referred to as a packet modem. The current model used at the groundstation is an AEA DSP-2232.

3.2.7 Orbit Propagator

This block represents the piece of the software that determines the availability to communicate with the satellite. It also determines pass duration, range, AOS, LOS, and also azimuth/elevation coordinates in reference to the groundstation. This software may or may not be necessary, for reasons discussed in section 8.

3.2.8 Serial Interface Layer

This block represents the piece of software that allows communications between different pieces of the groundstation software and the desired external devices, such as the TNC. Since one of the objectives of the groundstation software is to allow easy portability between groundstation control computers, this piece, as well as all others, is to be written in the Java programming language using the Java Communications API. This allows most pieces of the groundstation software to be easily ported to a different platform, without any, or very little changes to the source code.

3.2.9 Command Generator

This block represents the piece of software used to generate and uplink commands to the satellite.

3.2.10 Data Receiver

This block represents the piece of software used to get the data stream from the serial interface and pass the raw data to the places it needs to go. This is most likely be accomplished by having a secondary piece of software that will look for connections on a TCP/IP port and for each connection output the concurrent frames, as received.

3.2.11 Raw Telemetry File

This block represents a raw telemetry file that will automatically be output by the Data Receiver package. This is backup and archiving purposes.

3.2.12 Telemetry Parser

This block represents the piece of software that will decode and display the telemetry stream being received by the Data Receiver package in semi-real time.

3.2.13 Telemetry Database

This block represents the relational database that decoded telemetry will be stored in, as to allow queries and statistical analysis of telemetry and data gathered by the satellite. This data will be entered by the Telemetry Parser package.

4. Lists

5. Interface Requirements and Specifications

No interface requirements and specifications are defined at this time.

6. Current Status

All hardware is ready with exception of the Trakbox. It is constructed, but not tested. Also the transceiver is currently under repair at the Yaesu facility in Cerritos, CA. It is scheduled to be sent back shortly. None of the groundstation software is developed or tested. This will be remedied shortly.

7. Test Plan

7.1 Trakbox

The Trakbox will be tested thoroughly using the firmware provided onboard, and as test software written by the groundstation crew using the specifications set included with the kit.

7.2 Software

The software will be thoroughly tested per introduction of new piece to ensure optimum functionality. The Serial Interface Layer will be the first to be constructed, with the Data Receiver second. After the Data Receiver is constructed, tested, and ensured to work, the Telemetry Parser will be constructed and tested. At the same time the Command Generator will be constructed, tested, and ensured to work as desired with the Serial Interface Layer. The Orbit Propagator will be the last to be constructed as this is the less critical piece, given that the onboard orbit propagator on the Trakbox is working sufficiently.

8. Concerns and Open Issues

8.1 Issue with Orbit Propagator package and the onboard orbit propagator within the Trakbox.

It is still undefined whether we will want to rely on the Trakbox's orbit propagator or on an externally written one. More will be known once the Trakbox has be tested.

9. References