Kauai Community College Ground Station Overview

Network, Radio Equipment, and Antenna Information

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Acronyms

KCC - Kauai Community College
NOAA - National Oceanic and Atmospheric Administration's ()
CRSRA - Commercial Remote Sensing Regulatory Affairs ().
HMOC - HSFL Missions Operations Center
GSN - Ground Station Network
HEC - Header Error Control
TNC - Terminal Node Controller

Overview

The initial build-up of the KCC ground station was designed to provide ground station services for the HawaiiSat-1 mission, in addition to supporting local KCC activities. To communicate with the satellites, the ground station has been specified to include UHF, VHF, and S-band subsystems; all equipped with rotors that can be automated to track future satellites.

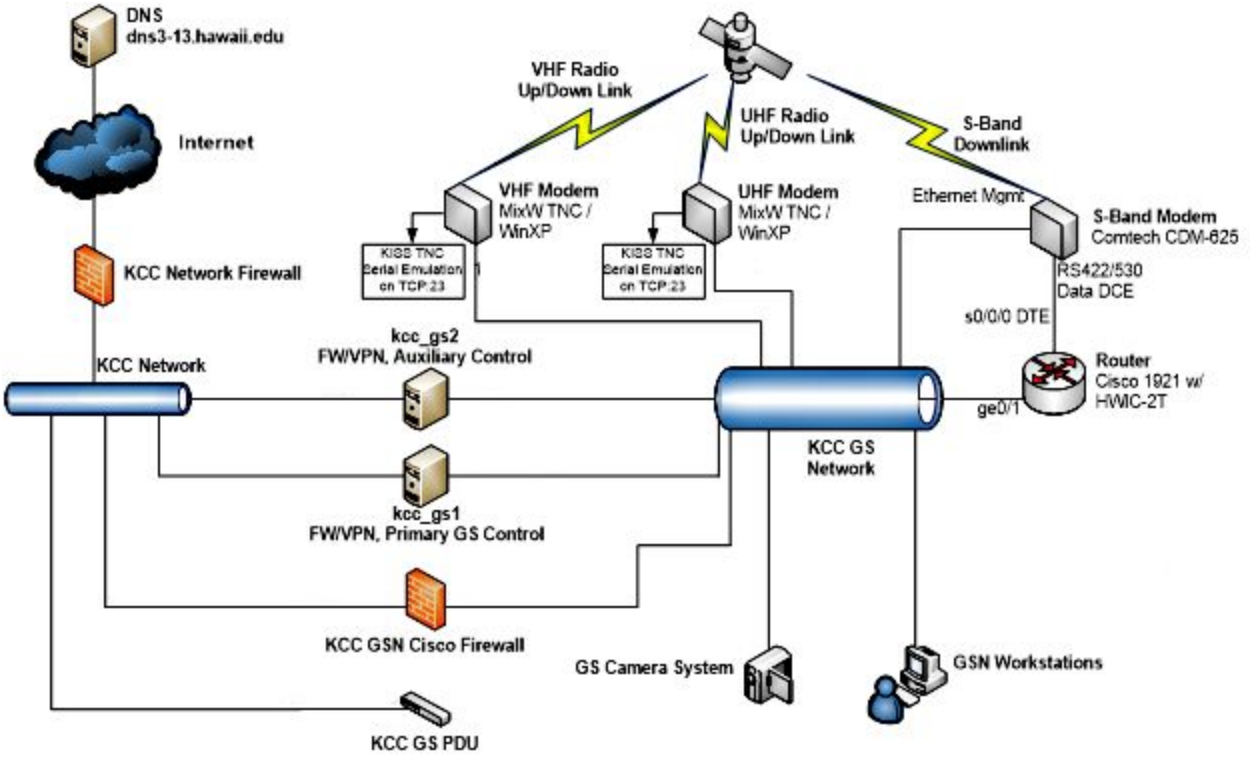
This ground station is a custom build, and as such, the ground station is extensible to support 3rd party satellites, different frequency ranges, and different signal types.

In addition, in order to support the future missions, the ground station must be operated, monitored, and secured to protect potentially sensitive remote sensing data. This is to maintain compliance with United States remote sensing laws which are audited and enforced by the National Oceanic and Atmospheric Administration's (NOAA) Commercial Remote Sensing Regulatory Affairs (CRSRA).

Networking

To allow for HSFL managed information security for the ground network, all IP enabled devices for the ground station are installed on a private network, protected from any activity occurring on the Internet, or local shared network. The only exceptions are the devices that provide VPN services to link this private network and HMOC, and other low level lights-out management devices such as IP enabled power distribution units if they can be protected by other means.

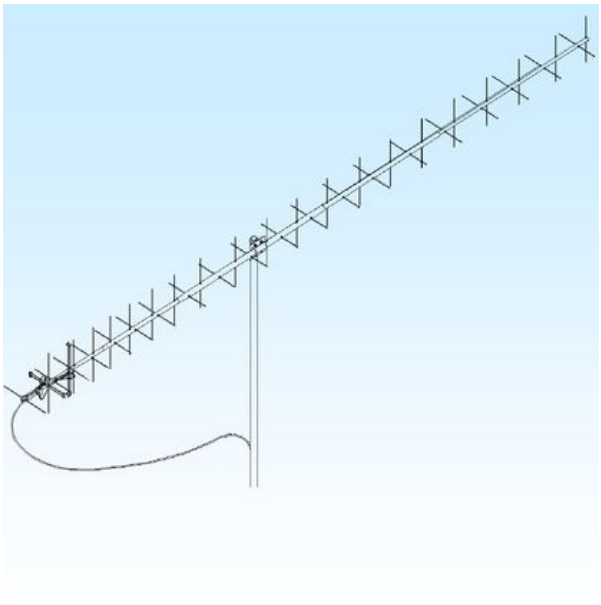
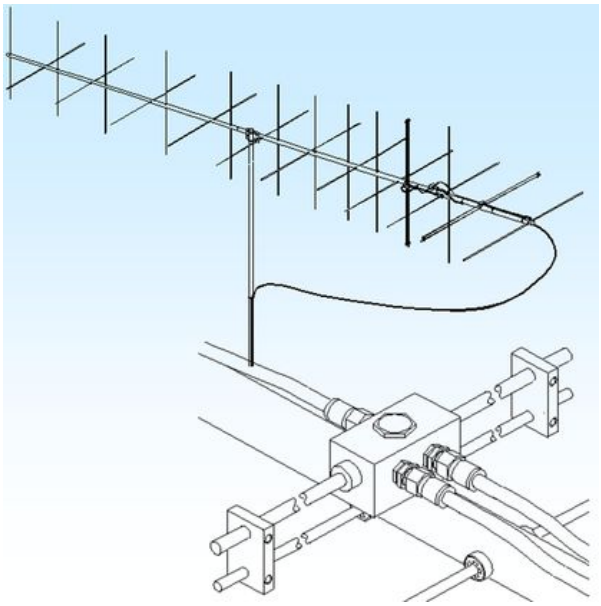
The following diagram shows the ground station equipment network, referred to as the ground station network (GSN) as opposed to the KCC network.



UHF/VHF Hardware

Device	Usage
ICOM IC-9100 Radio for UHF / VHF 	Frequency control and power feedback
MixW TNC Emulation Interface for UHF*	UHF Data
MixW TNC Emulation Interface for VHF*	VHF Data
Yaesu G-5500 GS-232A Az/El Controller 	UHF/VHF Pointing

*Images of device are unavailable

Device	Usage
M2 Antenna 436CP42UG 	Antenna for UHF
M2 Antenna 2MCP22 	Antenna for UHF

Downlink

Data packets that can come down on the downlink include IP/AX.25 packets, and HEC/AX.25 packets. The ground station software will be required to set up a Linux ‘tun’ IP interface on XXX.XXX.XXX.X to utilize IP/AX.25 packets. HEC/AX.25 packets shall be processed by the ground station software.

IP/AX.25 packets are utilized for high level mission data transfer, e.g. telemetry and IP response. Downlink IP traffic shall only be transferred when a ground contact with the satellite has been established. All downlink IP/AX.25 traffic shall be addressed to the ground station control computer XXX.XXX.XXX.X. No direct routing of downlink IP packets is allowed.

HEC/AX.25 packets are utilized for low level satellite health telemetry and command responses. This can be transmitted at any time that radio silence has not been requested.

Uplink

To search for satellites, HEC/AX.25 packets shall be used to establish contact. These packets are generated by the ground station control computer, and sent via the appropriate uplink TNC. Responses can be requested to be returned to the same radio channel (half-duplex), or the 'other' command channel (either UHF or VHF) for full-duplex operation.

Once contact has been established, HEC/AX.25 packets are used to open up cryptography sessions with the satellite for low level control.

In addition, once contact has been established, IP/AX.25 packets are now allowed to be transmitted on the uplink, and allowed to be received and forwarded by the satellite. An open contact session with the satellite also enables downlink IP/AX.25 traffic. All uplink IP/AX.25 traffic shall be addressed to the flight computer at XXX.XXX.XXX.X.

Specifications

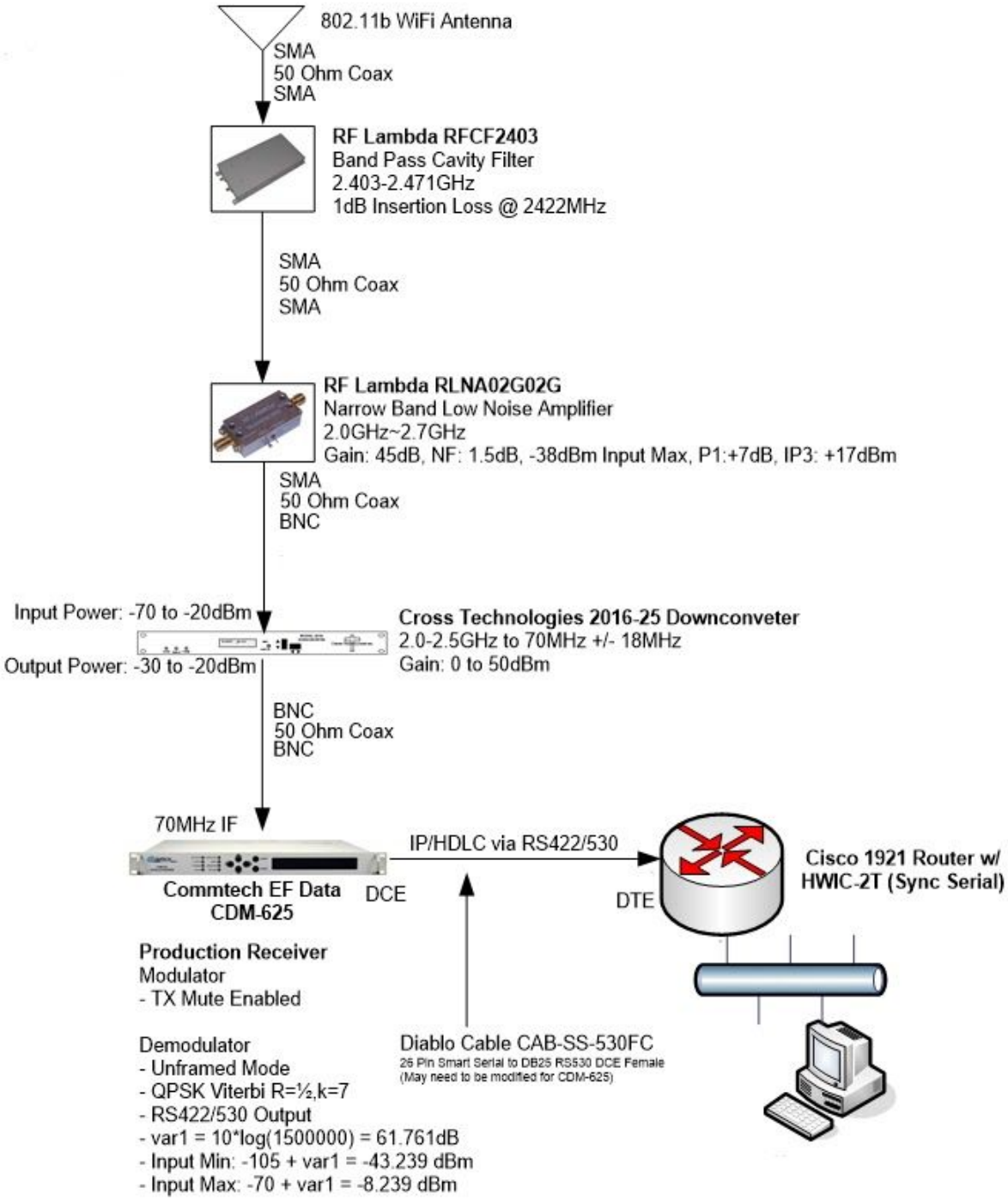
1. M2 Antenna 436CP42UG

Model	436CP42UG	Ellipticity	1.5 dB Typical
Frequency Range	430 - 438 Mhz	Beamwidth	21° circular
Gain	18.9 dBic	Feed Impedance	50 Ohms
Front to Back	25 dB Typical	Feed Type	Folded Dipole
Maximum VSWR	1.5:1	Power Handling	1kW

2. M2 Antenna 2MCP22

Model	2MCP22	Ellipticity	>3 dB Typical
Frequency Range	144 - 148 Mhz	Beamwidth	38° circular
Gain	14.39 dBic	Feed Impedance	50 Ohms
Front to Back	25 dB Typical	Feed Type	Folded Dipole
Maximum VSWR	1.4:1	Power Handling	1.5 kW

S-Band Hardware



Downlink

For the downlink, the satellite shall be commanded to enable its S-band radio, and start transmitting IP packets destined for XXX.XXX.XXX.X only.

When transmissions are complete, the S-band radio will be turned off, or timed out to power off.

IP Data Routing

Received packets shall be reassembled by the Cisco 1921, and because the destination is XXX.XXX.XXX.X, shall be routed to the ground station control computer via Ethernet. No further routing or other IP destinations are expected.

Neutron-1 Data

Uplink	
Transmission Power	50.00 dbW
System Link Margin (S/N Method)	27.70 dB
System Link Margin (Eb/No Method)	29.30 dB
Downlink	
Transmission Power	26.33 dbW
System Link Margin (S/N Method)	7.40 dB
System Link Margin (Eb/No Method)	9.30 dB