IARU Coord. 108/103

Carl Huie

From: Carl Huie **Sent:** Thu 5/29/2003 4:18 PM
To: lfranklin@quakefinder.com
Cc: jseelbach@quakefinder.com; Bob.Twiggs@stanford.edu
Subject: RE:
Attachments:

I need to see documentation submitted to them that contains correct frequency.

-----Original Message-----
From: Lew Franklin [mailto:lfranklin@quakefinder.com]
Sent: Thu 5/29/2003 3:21 PM
To: Carl Huie
Cc: jseelbach@quakefinder.com; Bob.Twiggs@stanford.edu
Subject:

To: Carl Huie, FCC

From: Lewis Franklin, Quakefinder, LLC

Subject: Copy of email from IARU Satellite Advisor, to Professor Bob Twiggs

Carl. Note that the frequency that Hans refers to is not correct. The QuakeSat frequency is centered on 436.675 Mhz.

From: Hans van de Groenendaal, ZS5AKV

P O Box 90438

Garsfontein 0042

South Africa

Fax +27 12 991 5651

zs5akv@amsat.org

Dear Bob

1. I have reviewed all the comments and recommendation from the Frequency Coordination panel. I regret that I have to **decline coordinating a frequency** for this project for the following reasons:

2. he request does not meet requirement (b) in the Instructions, i.e., it must certify that the organisation making the request understands fully the IARU paper, and that the spacecraft's operation in the amateur-satellite service will be consistent with the intent of this IARU paper, and the laws of the responsible national administration.

3. The request states that it is no longer possible to change the frequency from 436.675 MHz. Thus, the requirement stated in the sixth paragraph of the Instructions that requests for frequency coordination should be made as far in advance of launch as possible, and in any event before the final selection of operating frequencies, has not been complied with.

We have to therefore decline to coordinate frequencies for the project.

4. I would like specifically refer you to my first comment. From the information received it is not all sure that the project qualifies for operation on an amateur frequency or meets the legal requirements in the USA.

5. Each request for coordination is reviewed on merit. The decline to coordinate a frequency for Quakesat in no way setting a president for any future requests for frequency coordination.

I look forward to working with you on future projects

73

Hans ZS6AKV
IARU Satellite Adviser

Department of Aeronautics and Astronautics
Space Systems Development Laboratory
Stanford University
Stanford, CA 94305-4035

May 2, 2003

IARU Satellite Advisor:
Hans van de Groenendaal, ZS5AKV
PO Box 1842
3650 Hillcrest
Republic of South Africa
E-mail: zs5akv@amsat.org
Telefax: +27 31 765 6456

Dear Hans;

Attached please find our **INTERNATIONAL AMATEUR RADIO UNION AMATEUR SATELLITE FREQUENCY COORDINATION REQUEST** form for out university student built satellite. We look on this as a significant educational experience for the university students and a great potential for building interest in the amateur satellite community.

We appreciate you review of this request and return questions at your earliest convenience.

Sincerely,

Prof. Robert J. Twiggs, Director – KE6QMD
Space Systems Development Laboratory
Durand Rm. 271
Aeronautics & Astronautics
496 Lomita Mall
Stanford University
Stanford, CA 94305-4035
(650) 723-8651 voice
(650) 723-1685 fax
E-mail: Bob.Twiggs@Stanford.Edu
Web: http://ssdl.stanford.edu

INTERNATIONAL AMATEUR RADIO UNION
AMATEUR SATELLITE FREQUENCY COORDINATION REQUEST

DETAILS OF ORGANISATION	
Name of Organisation	**Stanford Space Systems Development Laboratory SSDL)**
Physical Address	**Stanford University SSDL** **Durand Hall, Room 269, MS-4035** **Stanford, CA 94305-4035**
Postal address	**Professor Robert Twiggs – KE6QMD** **Stanford SSDL, MS-4035** **Stanford, CA 94305-4035**
Telephone Number	**650-723-8951**
Fax Number	**650-723-1685**
Email	**Robert.twiggs@stanford.edu**
Website	**http://ssdl.stanford.edu**
Details of person responsible for the coordination request	
First name	**Jamie**
Last name	**Cutler**
Call sign	**KF6RFX**
Postal address	**450 Gates Building, MS-9040** **Stanford, CA 94305-9040**
Telephone number	**650-723-8651 (Day), 650-776-7482 (cell)**
Fax number	**650-723-1685**
Email	**jwc@stanford.edu**
Position in Organisation	**Stanford Graduate Student (PhD Candidate)**

Details of the project	
Purpose and mission of the Satellite *Supply as much detail as possible. Use additional pages if required*	**The satellite missions are:** **1. to demonstrate that low-cost student-built satellites using commercial electronic components, packaged in the modular CubeSat and P-Pod construction, results in a new low-cost short-schedule paradigm for space research and communications technology experiments,** **2. to demonstrate that significant scientific research may be accomplished by incorporating a science research payload. The expected results are:** **a) extend research into validating reported outer space presence of ELF earthquake precursor signals. If successful, this could lead to 2-weeks or more warning of impending dangerous Magnitude >6 earthquakes, and enable advance activation of the amateur radio emergency services activity and other regional public safety measures.** **b) gain understanding on the propagation characteristics of 1-1000Hz (ELF) electromagnetic signals from earth sources thru the ionosphere to the QuakeSat payload above the ionosphere.** **3. Conduct "Digipeater" experiments following completion of the first two missions.**
Structure of the Satellite *Describe the structure, size, mass. Attach drawings where available*	**QuakeSat is a triple CubeSat (4" x4" x12"), with an axial 3-section telescoping boom containing the magnetometer sensor that deploys after satellite ejection from the PPOD launch tube. The orbiting satellite mass is 9.75 lbs. See the attached "QuakeSat Specification Sheet".**
Payload *Describe each payload planned power of each transmitter, details antennas, batteries, solar cells etc*	**The Science Payload is a set of selectable ELF receivers in the 1-1000 Hz radio frequency band feeding a 16 bit A/D converter. The data is stored in memory of the Prometheus computer for real-time or delayed download, using AX.25 protocol and a TEKK T-Net transceiver operating simplex mode on 436.75 MHz with <1.2 watts of omni-directional effective radiated power. Further details are in the attached QuakeSat Specification Sheet, and the student design reports available on:** **http://ssdl-delta.stanford.edu/LM-CubeSat/Team4/index.htm**

Command Structure *Provide details, planned command frequencies etc* ***(Command frequencies will not be published***	**All ground-to-space and space-to-ground communications occur on the same 436.675 MHz 9600 baud 3kHz FSK (~20 kHz bandwidth) simplex (half-duplex) link. Communications can be initiated either by the ground station(s) or the satellite (using a stored program, or in a beacon mode). The AX-25 Protocol is basically a UI Frame packet format with error detection only. At the end of a specified number of packets that constitute a message, the receiver (either spacecraft or ground station) requests retransmission of any packets with errors. This is repeated until all the message packets are received error-free. All communications, whether commands, telemetry, computer reprogramming or data conform to this protocol. There is no encryption feature in the information stream, but there is a command available to zip spacecraft files for data compression. The initial packet of each session includes a privacy address code, which has not yet been selected, and no response will occur if this address is wrong, or contains errors.** **The satellite can only initiate transmissions in response to the ground station initiating a communications session, or in response to two on-board stored program sets. These two are:** **1. Beacon (Chirp) stored program mode to assist in ground station acquisition, the computer is pre-programmed before launch to transmit a short message every 10 seconds. This mode is to be used during the first passes over Stanford to assist in acquisition if the orbit differs significantly from the planned orbit. Once the stable orbit is determined and is being regularly received from NORAD, this mode will be switched to a 60 second interval, or off.** **2. Pre-programmed telemetry/data download stored program mode. This mode is in anticipation of the availability of additional receive-only ground stations, and transmissions that may be scheduled for amateur radio satellite experiments. In addition, periods of receiver operation could be scheduled for experimental ground-to-space transmissions by amateur radio experimenters with transmitters in the vicinity of 500 Hz.** **The ground-to-space command structure consists of the following categories of commands:** **1. Query Commands** **2. Hardware Control Commands** **3. Data Collection Commands** **4. Digipeater response (when enabled)** **The actual commands are still being finalized, and will be provided after shipment in early May 2003.**

What systems are in place or planned to command satellite off?	**The satellite is always on when battery voltage exceeds 6.2 Volts. The transmitter is always off unless the computer presents a data file (telemetry, science data, response to ground command or digipeater file) to the modem/transmitter. Thus, to prevent the satellite from transmitting, activities that select a file to transmit must be inhibited. This is accomplished by:** **1. Sending a ground command to turn off the Chirp mode if enabled,** **2. Sending a ground command to clear the stored program que, if any delayed transmissions are unexecuted,** **3. Not sending any ground commands with a valid satellite address, which would initiate a response.**	
Telemetry format *Please provide details of the telemetry format*	**Housekeeping telemetry data is sampled every second by the computer, read to a computer file, and downloaded by command using AX.25 packets. Data includes solar cell currents, battery voltages, temperature sensors, and earth sensor.**	
Launch Arrangements *Has a launch been secured? Please supply details of the launch agency*	**QuakeSat is manifested on a 30 June Rockot (converted SS-19) launch from Plesetsk, Russia, arranged by the German EUROCKOT Gmbh joint venture for the University of Toronto Space Flight Laboratory.**	
Planned launch date and location	**30 June 2003 starts a 10 day launch window**	
Planned orbit *Apogee & pergiee heights, inclination, period and planned lifetime of on board systems*	**The orbit is determined by the prime payloads requirements. We have been informed to expect a 840 km circular sun-synchronous dawn-dusk orbit at ~98 degrees (retrograde).**	
What frequencies would be preferred? *Please give reasons why and for which payload the frequencies will be required*	**The frequency of 436.675 has been assigned as suitable for the flight transmitter and the mission ground station transmitter. This frequency is fixed, and is no longer accessible to change in the satellite. Because the simplex scheme, only 1 frequency is required for ground-to-space, and space-to-ground communications.**	
Control Operator Who will be the control operator?	*Name*	**Jamie Cutler**
	Call sign	**KF6RFX**
	Email	**jwc@stanford.edu**
	Telephone	**650-723-8651 (Day)**

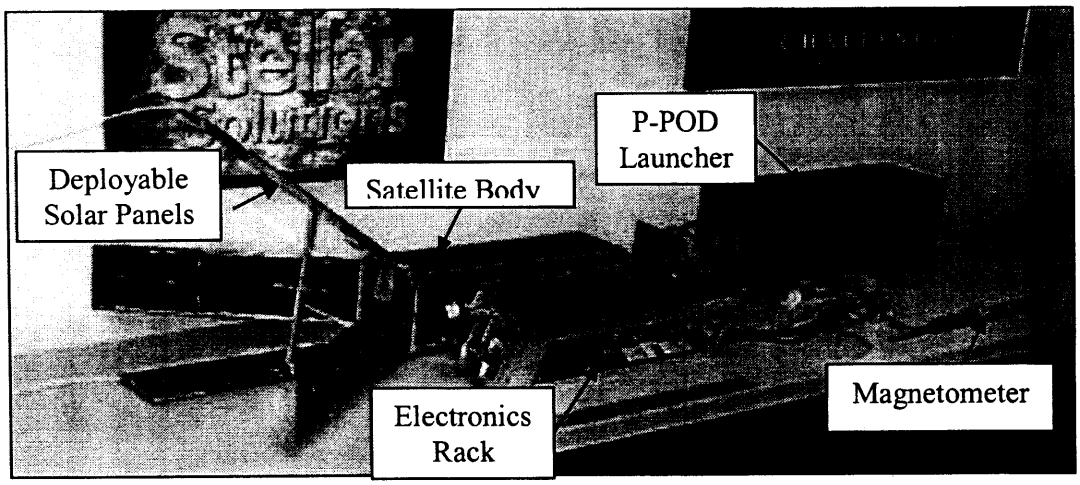
Ground Station Requirements	
What would typical ground station requirements are to communicate with the planned satellite	**The main Stanford Ground Station (SGU) is located on the roof of Durand Hall on the Stanford University Campus; 37.442N, 122.163W, altitude 100 ft. The street address is 496 Lomita Mall, MC-4035, Stanford, CA 94305-4035. A second SGU is co-located in the Stanford Amateur Radio Club (Stanford building Site 530) near the Stanford 50 meter dish approximately 1 mile West of Durand Hall, and is available to ensure that there is a redundant station to command the station in the event of interference.** **The main SGU is part of the Stanford Small Satellite Development Laboratory (SSDL) under the direction of Professor Robert Twiggs (650-723-8651).** **The student responsible for the SGU on the QuakeSat project is James W. Cutler (graduate student), KF6RFX, office phone 650-723-8651, 450 Gates Building, MS-9040, Stanford, CA, 94305-9040. jwc@stanford.ed** **The alternate responsible student for the SGU is Allen R. Lorenz, KD7OVB, Allen.r.lorenz@lmco.com** **Any ground station with a point-able antenna with 6 db minimum gain, and a 436.75 Mhz receiver with AX.25 decoder can receive the 10 or 60 second beacon chirp signal and any telemetry and data downloads that are scheduled in their vicinity. We request that any amateur radio operators that are successful forward copies of their files to the QuakeSat Center via internet. Instructions will be posted after the satellite checkout.**
Other information	
Please supply any additional information that may assist the panel in coordination your request(s)	**All the technical and design information relating to QuakeSat is in the public domain, and there is no proprietary information reserved by QuakeFinder, LLC of Palo Alto, CA, who contributed the science payload to the student project.**

QuakeSat Specification Sheet

QUAKEFINDER

Rev 2 (4/14/03)

QuakeSat



Specifications:

Size: Satellite -Stowed 14 In x 4.5 in.
Deployed 60 in x 32 in
P-POD 16 in x 8 in x 6 in with mounting pads

Weight: Satellite 9.75 lbs (4.5 kg) with hysteresis rods
P-POD 6.1 lbs (2.8 kg) with mounting pads

Power: 2 Li Ion batteries 1.5 AmpHr each (3.0 AmpHr total)
12 solar panels (4 fixed, 4 double-sided deployable)
Each panel contains 10 triple junction GaAs cells
(10v @ 700+ ma or 7 watts each)
4 panels can see sun simultaneously x 50% (angle) = 14 watts BOL (+ albedo)

Loads: CPU, Receiver and Power board ~ 3.6 watts continuous
Payload 0.6 to 2.2 watts depending on filter channels selected (1-2 watts typ)

Attitude Control: Magnetically stabilized to Earth's magnetic field vector
Four 4.0 x 0.25 in Alnico magnets, magnetometer boom is "north seeking"
Two 12.25 in x 0.5in x 0.25 in Hysteresis rods for damping