

QUESTION 6: PURPOSE OF EXPERIMENT

Is this authorization to be used for providing communications essential to a research project? (The radio communication is not the objective of the research project)? If "YES", include as an exhibit the following information:

a. A description of the nature of the research project being conducted.

The Kentucky Satellite (KySat) Research Program

The SSC program at MSU has partnered with four Kentucky universities (University of Kentucky, University of Louisville, Western Kentucky University, and Murray State University), Kentucky Science and Technology Corporation (KSTC), Stanford University, the California Polytechnic University, and NASA Ames to develop KySat, the first satellite ever to be flown by a state. KySat is a cubesat project recognizing the educational value of immersing students in systems level design, particularly in space systems development. The goal is to design, construct and fly a CubeSat composed of a student-designed satellite bus and a significant scientific payload. KySat will be accessible statewide via tracking by reasonably simple ground stations. Data and telemetry from the satellite may be downloaded by students, including those at a pre-college level. A long-term intent of this project is to create a workforce in Kentucky of students and graduates with the high-tech skills required to support the National Space Initiative and commercial space ventures. The satellite is being constructed at universities located in Kentucky: it will be integrated at the California Polytechnic University and launched from Kazakhstan on a Dnepr (SS 18) rocket. KySat will primarily be controlled by students utilizing the MSU 21 Meter Space Tracking Antenna and UHF/VHF antenna systems. The KySat project will be ongoing, with a new CubeSat (featuring an increasingly sophisticated scientific payload) launched and flown every 18-24 months, giving Kentucky a permanent presence in space. The role of the SSC in KySat 1.0 (as well as future versions of KySat) is to lead ground operations (Ground Ops) and to participate in satellite systems design, particularly communication systems, on-board antenna systems, and remote sensors. Although the primary purpose of KySat is education, public outreach and workforce development, the potential for commercial development in the state is significant. The KySat project directly supports the development of a space-related industry in Kentucky.

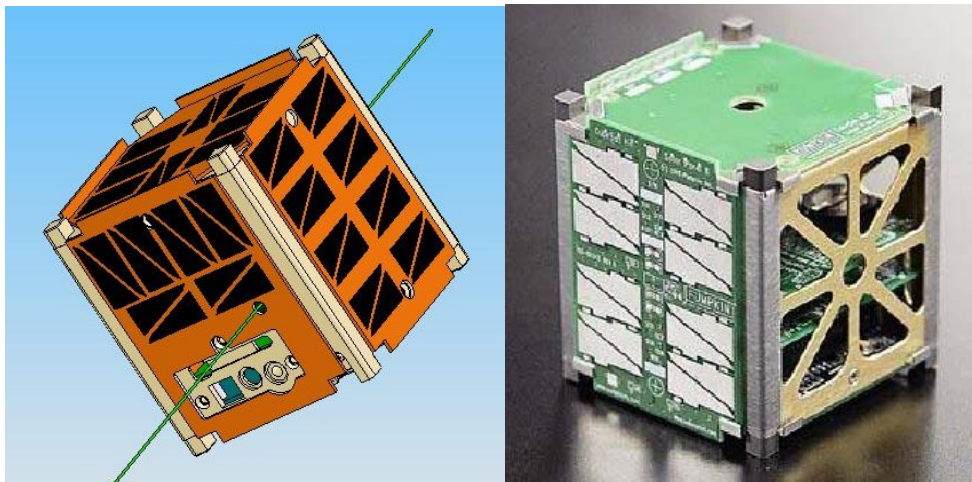


Figure 2.0 KySat. (L) CAD Drawing of KySat (R) Photograph of KySat-1

The specific research being conducted on KySat One Orbital (for which this request is being made) is the development of an effective satellite bus for the cubesat standard, the development of a modular payload interface module, a system support module, and to test the S-band Microhard MHX 2400 frequency hopping spread spectrum radio in the space environment.

b. A showing that the communications facilities requested are necessary for the research project.

This request centers on the use of a commercially available OEM radio, manufactured by MicroHard, type MHX-2400. Data from the nameplate of the device shows FCC ID of NS9000P4, IC: 3143391185A, Power: 1 W, Frequency: 2.4-2.4835 GHz (ISM band). License to use this radio for this purpose has been obtained previously by other organizations

This radio is intended for terrestrial applications such as computer networking in the 2.4 GHz ISM band where antenna gain is limited. This application is for use of a high gain terrestrial, directional parabolic antenna with low sidelobes in order to close the link with the satellite. The antenna intended as the earth station is the Morehead State University 21 Meter Space Tracking Antenna. This antenna has the virtue of terrain masking due to the geometry of the surrounding land, and it is believed that due to the infrequent usage schedule (four 15 minute duration passes per day) and the very low antenna sidelobes, that the system will not cause any interference to terrestrial local users of this frequency allocation.

The S-band radio system consists of a MHX-2400 Microhard Radio (identical to one on the spacecraft) mounted at the prime focus of the 21 meter system. The MHX-2400 is a high-performance embedded wireless data transceiver, operating in the 2.4000 to 2.4835 GHz ISM band. This frequency-hopping spread-spectrum module is capable of providing wireless data transfer using an asynchronous serial interface. The transceiver has a data rate of between 2,400 and 115,200 bps sent uncompressed in a half-duplex transmission scheme and approximately 100 kbps sustained in intelligent asymmetrical full-duplex transmission mode. This is the primary reason to attempt to use this radio for low cost LEO applications: High data rate. A second very important reason is that it is a low cost, type accepted unit of proven performance. The transceiver has a system gain of 135 dB, sensitivity of 105 dBm, and a selectable output power of 1 to 1000 mW. The transceiver will be connected to a custom S-band feedhorn designed to properly uniformly illuminate the 21 meter parabola with low spillover.

Because the radio is a DSSS system with frequency hopping, as specified for this type of unit, the problem with synchronization is exacerbated due to the long range and low receive signal level. The use of the 21 meter antenna is desired to 1.) Increase EIRP in the direction of the satellite, 2.) Discriminate against terrestrial users of this band due to the extreme directivity of the antenna (<.5 degree -3 dB beamwidth), and 3.) Increase the receive signal power by virtue of the antenna gain. It is not possible to use this type of system with a low gain antenna.

Morehead State University's 21 Meter Space Tracking Antenna will be used to support the KySat1 S-band mission. The 21 meter dish is a research and education

instrument that supports two generic missions; a research program in radio frequency astrophysics and space tracking services (telemetry, tracking, and control) for satellite telecommunications applications. The facility provides a state-of-the art laboratory for researchers and students in astrophysics, satellite telecommunications, engineering, and software development. The 21 meter system has a drive system that is capable of tracking LEO satellites at an altitude of 350 nautical miles and a maximum elevation angle of 77° . The 21 M will be outfitted with an S-band feed that utilizes the Microhard MHX 2400. Thus, the satellite (KySat1) and the ground station (MSU's 21 M) will operate the same radios allowing them to synchronize with each other for uplink (satellite commanding) and downlinking of data and telemetry.

Additionally, it should be pointed out that the FCC has allocated use of this frequency for this exact application, using the Microhard MHX 2400 for two previous satellite missions: MAST (flown by Tethers Unlimited in 2007) and the NASA GeneSat mission 2007, both of which used exactly the same radio, associated hardware, power emission, and modulation scheme.

c. A showing that existing communications facilities are inadequate.

Limited or no access to other S-band Earth stations is currently available to this project. As the nature of the project is both research and educational, having the 21 M system located at Morehead State University with an appropriate frequency allocation for the project is critical to the project's success and to the educational component of the project.