SRI Meteorburst Antenna Exhibit 22 July 2019
For file no. 0581-EX-CN-2019

Background

The proposed experiment will use a link operating between transceiver stations at two fixed sites.

The fixed locations are in an antenna complex at Stanford University near SRI's headquarters in Menlo Park, California, and at the Hat Creek Radio Observatory near Burney, California. Both sites are managed by SRI.

Antenna Type

To accommodate the desired tuning range for our experiment, we have selected a log periodic antenna, model no. 30-70LP7 from M^2 Antenna Systems, with a nominal boresight gain of 6.0 dBi and a front-to-back ratio of 15 dB. When mounted for horizontal polarization, this antenna has an azimuth beamwidth of 70° and an elevation beamwidth of 138°. Each antenna will be mounted on a standard radio mast not more than 15 feet above the local ground level.

Antenna Pointing Information

Stanford Antenna

The Stanford antenna beam will be pointed at 9° azimuth (relative to true north) and 24° elevation towards the Hat Creek radio Observatory site.

Hat Creek Observatory Antenna

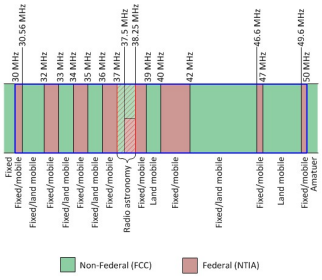
The Hat Creek Radio Observatory antenna beam will be pointed at 189° azimuth and 24° elevation towards the Stanford Site.

Frequency Use

The planned experiment will include testing on different center frequencies to assess how the sensitivity of performance to frequency tuning. In addition, we will perform site surveys at each location before starting operations to determine local use of spectrum so that we may avoid interfering with other band users.

We have selected a set of subbands for potential operation after consulting the Code of Federal Regulations, Title 47, §90.248. We are avoiding the use of spectrum managed by the National Telecommunications and Information Administration. Also, we are not requesting the use of the radio astronomy bands between 37.0 MHz and 38.25 MHz.

We have planned our tests for flexibility, so we would be happy to adjust our plans to address any concerns raised by nearby radio operators, if needed.



36.25 and 41.71 MHz	Petroleum radio service for spill containment and cleanup.
37.5 – 38.25 MHz	Radio astronomy spectral line observation band. No new fixed or mobile allocations.
40.66 – 40.70 MHz	Shared allocation/ISM band. Must accept ISM interference. Use subject to 47 CFR 90.248.
30.85 – 34.0 MHz 37.0 – 38.0 MHz 39.0 – 40.0 MHz 42.0 – 47.41 MHz	Low-power police transmitters (secondary licenses).

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Emission Information

During our tests, each transceiver will send digitally modulated packets to probe for an open channel created by the presence of a meteor ionization trail. The transceivers will be operated half duplex and will require approx. 12 µs to switch between transmit and receive. The detection of a received packet indicates that a usable meteor trail is present with a suitable geometry (expected once every few minutes). The secondary will send an acknowledgement packet of a smaller duration at a fixed turnaround delay. The primary will then send another 100 µs packet containing the appropriate correction factor.

Commented [RS1]: Check on T/R switch time. This may also be limited by software response time (ms?)

Commented [RS2]: 100 bits at 1 MHz.

Upon detecting a received packet, the transceiver at each site will exit the channel probing mode to send an acknowledgement packet at a fixed turnaround delay to allow each site to measure the propagation delay in the channel and to compute a synchronization correction for its clock based on sync information in the signal from the other station. This operation may be viewed as packet data transmission using a custom protocol on a half-duplex channel.

Allowing for switching time, propagation delay in the channel, and for time offsets at the two sites due to imperfectly synchronized clocks, we believe that the maximum supportable duty cycle will approach but not reach 50%. Our signal design will be flexible and will allow us to operate at lower duty cycles, if desired.

Pulses transmitted by both transceivers will include both a digital data portion, in which data and a spreading sequence will be phase-modulated onto the carrier, and a linear frequency chirp that sweeps through the frequency subbands included in experimental license (if granted). The digital portion will be modulated with a bandwidth of less than 1 MHz. The chirp signal will be digitally generated and notch-filtered to ensure that the emissions are restricted to the allowed spectral subbands (see preceding section). The frequency chirp will allow more precise measurements of the channel propagation delay and will also enable the detection of multipath conditions occurring when more than one meteor ionization trail is present.

Based on the above description, the system emission designator will be 1M00Q1BAT, signifying phase-modulated pulses with a 1 MHz modulation bandwidth containing digital information (no subcarrier) followed by a linear frequency chirp (within allowed subbands) containing no information. The channel will be shared using time-division multiplexing. (In addition, the two transceivers need not transmit on the same frequency.)