STA Application Narrative

This application ("Application") is submitted on behalf of Caos Capital ("Caos"), holder of an existing Experimental Radio Station Construction Permit and License to operate at Desert Center, California in the 220-225 MHz, 222.5 MHz, and 500-520 MHz bands (0095-EX-CN-2024) ("Desert Center License"). By this Application, and following coordination with the Air Force Spectrum Management Office (AFSMO), Caos requests Experimental Special Temporary Authority ("STA") to operate facilities in the 228-233 MHz band as specified in the Application during the period of May 1, 2025 to May 30, 2025.

Caos is testing a prototype radar system to (i) determine the necessary EIRP of a custom radio frequency transmitter device, (ii) measure waveform parameters, and (iii) record the return of the transmitted pulse between two receivers which are spatially in the same location. In particular, Caos is conducting experimental operations to determine how closely it can synchronize receiving a transmitted pulse into two receivers, with the goal of developing precision synchronization of spatially separate RF receivers.

Caos respectfully submits that the public interest would be served by granting this request for a license to operate in the 228-233 MHz band at Desert Center as specified in the instant application. Caos is developing air traffic and maritime radars for the United States Air Force and intends to develop a similar radar product for commercial shipping applications in addition to commercial air surveillance. To aid in product development, Caos needs access to the requested frequencies from the Desert Center, California location. Such access is necessary in order to complete research and development of radar phenomenology where Caos intends to test different receive signal processing algorithms on the transmitted radar pulse, by using the unpopulated mountain-top mentioned as a reflector. To minimize the risk of interference, Caos has carefully coordinated with AFSMO to select the 228-233 MHz band.

This location does not have any permanent residents. Instead, it is a remote, privately-owned sporting club.[1] While the Chuckwalla Club does operate a private airport, no flights arrivals or departures are permitted without prior approval from the Chuckwalla Club management, and Caos will not conduct its tests during airport activities. As shown in Exhibit A, the proposed transmitter site will be located at least 1 kilometer from the airport runway, and will be oriented away from the areas where visitors will be located.

Caos intends to aim the main beam at a portion of elevated ground at an unpopulated mountain-top located approximately 15 kilometers away (est. coordinates: 33° 46' 3.37"N, 115° 9' 3.06"W), at an elevation of approximately 550 meters above mean sea level, and measure the backscatter. Testing the new proposed frequency band at this location will provide additional data points for the conducted tests.

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[1] *See Chuckwalla Valley Racing Club* (https://chuckwalla.com/) (last visited Jan. 28, 2025).

Caos continues to develop and refine new signal processing algorithms that will increase its ability to detect and receive the transmitted pulse signals. No change to the transmission equipment previously authorized in the Desert Center License will be necessary, and the technical information provided in the Desert Center License application (other than frequency and EIRP, which are different in this application) remains true and correct.

Approval of the instant request will improve Caos's ability to continue testing a new prototype radar device that can be used to enhance public safety and support the application of new technological approaches in the radar systems.

Contract Information: The operations proposed in this Application are supported by, and the authorization will be used for fulfilling obligations of a contract with, U.S. Air Force Research Laboratory/AFWERX under Contract No. FA864924P0424.[2] The contract points of contact are Thomas Shea (thomas.shea.3@us.af.mil) and Joshua Ortiz (joshua.ortiz.3@us.af.mil, 937-713-9886).

Technical Specifications:

1) Frequencies Desired: As a complement to (and not a replacement of) the Desert Center License, Caos requests STA to operate in the 228-233 MHz spectrum band as specified in the Application. The specified frequency range was intentionally selected to eliminate any requirement to conduct pre-coordination with the Federal Aviation Administration.

Moreover, based on a search of the FCC's databases, there does not appear to be any co-channel licensed facilities with transmitter sites within 50 km of the proposed operations (Exhibit B) for the requested spectrum band.

2) Transmit and Effective Radiated Power Levels: The unit to be tested will operate with a range of transmit power levels, beginning with 1 watt. The Application specifies a maximum transmit power of 10 kilowatts.

Caos intends to continue using an Ettus software-defined radio, along with commercially-available, off-the-shelf RF components, including (i) an amplifier (creating up to 2 MW, or 93 dBm, EIRP using the 10 dBi gain antenna), (ii) bandpass filters, and (iii) a TV-style VHF antenna with a 70-degree wide main beam.

3) Modulation and Emissions: The unit is capable of operating with either frequency or phase modulation. The Application specifies emission designators for both frequency and phase modulations.

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[2] By separate applications, Caos has received conventional experimental licenses to test in the 223-224.9 MHz band at sites in Hermosa Beach and Hawthorne, CA pursuant to the same contract with the U.S. Air Force (*see* 1138-EX-CN-2024 and 0817-EX-CN-2024).

4) Antenna Information: The antenna will be mounted in a manner that will not require prior approval under FAA or FCC rules and regulations.

a) Width of beam in degrees at the half-power point: a) H-Plane: 140 degrees; b) E-Plane: 70 degrees;

b) Orientation: Caos intends to radiate either in full horizontal polarization or full vertical polarization at any given time, but not both simultaneously. In the vertical plane, we will be oriented to point from 0 degrees up to 60 degrees off the horizon.

c) The Antenna Gain is 10 dBi in the main beam

d) The Azimuth Direction is 85.6 degrees true from the transmitter site to the target.

5) Operations: Caos will conduct the proposed tests with no more than one (1) unit operating at a time. The unit will operate with up to a 30% duty cycle, and transmissions will be no more than 300 microseconds long. It is expected that the testing of the unit will be no more than 1 hour per day, at intervening periods during the license period.

6) Radiation Hazard Analysis: Caos has confirmed that the proposed operations will comply with the FCC's RF exposure guidelines with respect to the prototype antennas and test station transmissions, for uncontrolled (general population) and controlled (occupational) environments, as specified by Section 1.1310 of the Commission's rules.

In particular, the lowest E-field strength limit requirement for general population/uncontrolled exposure at our bands is listed as 27.5 V/m. We anticipate only occupational/controlled exposure, as this test site is a private site and we anticipate only our employees being allowed in the area, but we use the uncontrolled exposure limit to be conservative.

The transmitter consists of a 10 dBi main beam gain antenna with a -20 dBi backlobe mounted to a stand and connected to an RF source which generates the signal. The maximum EIRP from this configuration is 2 MW, or 93 dBm. The outdoor location consists of flat desert terrain where it will be easy to observe humans in near proximity to the system.

From our radiation hazard analysis, humans will need to be 311 meters away from the direction the antenna (main beam) is pointed, and this range extends 70 degrees to each side. Directly opposite the direction the antenna mainbeam is pointed, in the backlobe, humans need to be 26 meters away and this range extends 110 degrees each side of the back of the antenna. We will emplace a fenced-off area during testing according to this analysis and place a radiating light in the area that turns on during transmission, so that all humans are kept at a safe distance during transmission.

Additionally, markers, likely in the form of cones, will be placed to designate these areas, and prior to transmission we will determine if humans are in this area and will not transmit if humans are present in the area. These areas will cover both occupational (controlled) and general population (uncontrolled) exposure limits since they are under the general population exposure

limit. If the antenna is tilted in any direction, up or down, these ranges become more conservative thus being below the general population limit as well.

Hence, any transmissions will not occur in proximity to and will comply with the exposure limits with respect to the general population. All Caos personnel operating and maintaining the equipment will be trained on proper handling of the equipment to mitigate radiofrequency exposure. Furthermore, all transmissions will be positively controlled by Caos personnel during testing who will be able to cease transmissions at any time.

Interference Mitigation:

Caos is well aware of its obligations under Part 5 of the Commission's rules to avoid interference to co-channel licensees in non-experimental services, and will take all necessary steps to ensure compliance with this obligation. Should interference occur, Caos will take immediate steps to resolve the interference, including discontinuing operations if necessary. To date, no interference complaints have been received during the Desert Center License period.

In addition, the following factors will help mitigate any interference issues:

1. Each test will be limited in time and location to protect other spectrum users.
2. Emissions will be active for short durations no longer than 1 minute at a time. During a test, emissions will be activated periodically, and will not be continuous.
3. The site specified in the Application is located approximately one (1) kilometer from the closest airport. The airport is a privately-owned, permit-only, facility and Caos will coordinate with the airport to cease operations during any scheduled departures and arrivals. Additionally, the airport will have the stop buzzer information provided below.
4. A waiver of the Station ID requirements of Section 5.115(a) of the Commission's rules is requested.

Stop Buzzer:

The following will be available by wireless telephone and will act as the "stop buzzer" if any issues arise during testing:

- Primary: Bo Marr – Mobile: 310-487-5016;
- Secondary: Rick Boman – Mobile: 206-795-6527