This experiment shown, in Exhibit 1, consists of a short-range radar chirp centered at 64 GHz with a 5 GHz bandwidth transmitted from a a fixed location with the transmitter pointed in the direction of a drone flying nearby as outlined in Exhibit 2 (<.25 miles distance, <400 feet elevation) overhead on the MITRE grounds. The transmitter consists of a custom SDR generated signal that is amplified (Exhibit 4) and sent through a horn antenna (Exhibit 5). A ground-based receiver on a tripod with the same antenna is used to capture the reflected pulse from the drone. This transmit antenna and other experimental hardware will be located near the softball fields on the MITRE property detailed below:

Transmit Location- MITRE:
202 Burlington Rd.
Bedford Ma. 01730
42°30'11.6"N 71°14'03.4"W

The Drone will fly within an area with MITRE property boundaries as depicted in yellow shading in Exhibit 2, and 3 and will not transmit within +/- 45 degrees North or +/- 45 degrees South.

The drone will only fly within the geographical boundaries of the MITRE campus and will only transmit at a +/- 45° East or West antenna heading and between 0°-20° in elevation as detailed in Exhibit 2 and 3. The drone does not transmit for this experiment.

Exhibit 1: Block Diagram Radar: A Ground Transmitter with a horn antenna attached to a tripod transmits a radar chirp pointed in the direction of an Air platform (drone) nearby (< 0.1 mile). The maximum transmit EIRP for either transmitter will be kept < 10W, likely lower with 1 to 3 dB of additional attenuation in front of the horn antenna
Maximum transmitter EIRP power < 10Watts

Exhibit 2: Transmit direction Details: Details on transmit waveform and Ground Transmitter and Air Transmitter test locations. Note that both transmitters will only transmit +/- 45° due East or due West, within an elevation range of +/- 20°

Exhibit 3: Transmit Location Details: Variation of the transmit locations and flight boundaries, still within The MITRE property boundaries. Flight areas marked by yellow shading. As noted previously both transmitters will only transmit +/- 45° due East or due West, within an elevation range of +/- 20°

> *Note that the application filing is for North +/- 135° due to standard filing format. However no transmit will take place within the range of North +/- 45°*

Exhibit 4: Amplifier Details: Will be operated below the p1dB point with maximum output power of +17.5 dBm

Exhibit 5: Horn Antenna Details: Transmit horn details. Note the gain range for the requested frequencies is <24.2 dBi . Up to 3dB of additional attenuation will be used before the antenna for antenna gain to keep maximum well below EIRP of 10W.

Exhibit 6: Time Domain Signal Details: The transmit signal consists of an emulation of a “Transportable” (TPS) radar signal narrowband radar chirp that can be described as a Linear Frequency Modulated (LFM) pulse. The experiment consists of a radar system transmitting a 6GHz wide chirp at a <12% duty cycle centered at a constant frequency within the frequency range:
61-67 GHz

Exhibit 7: Spectral mask of worst case transmit across frequency range. Out of band roll off detailed.

Exhibit 8: If all the answers to Items 4, 5, 6 are "NO", include as an exhibit a narrative statement describing in detail the following items:

a. The complete program of research and experimentation proposed including description of equipment and theory of operation:

An experimental chirp type radar waveform will be transmitted to an airborne drone where it will reflect from. This testbed uses commercial off-the-shelf (COTS) software defined radios components, as well as COTS amplifiers, filters, and frequency converters.

b. The specific objectives sought to be accomplished:

This is a proof-of-concept experiment in the field of radar transmit/receive to emulate specific real targets.

c. How the program of experimentation has a reasonable promise of contribution to the development, extension, expansion or utilization of the radio art, or is along line not already investigated:

Target identification and tracking is a critical research area with new and evolving threat targets that are largely unavailable or impractical to test against radar systems. An effective testbed for classifying targets has not been fully developed to meet the testing needs of DoD radar users. MITRE is working on cost effective and improved radar target classification method to fill this need.