

University of North Dakota
FCC Registration Number (FRN): 0017947490
Experimental License Application

NARRATIVE STATEMENT

The University of North Dakota (UND, or "Applicant"), seeks a 3 year experimental license beginning **July 15, 2015**, to evaluate and demonstrate a prototype L-band Control and Non-Payload Communications (CNPC) radio. Tests will be performed in collaboration with Rockwell Collins (RC) of Cedar Rapids IA, who is developing the prototype radio under a separate effort, a jointly funded Cooperative Agreement with the National Aeronautics and Space Administration (NASA). This separate NASA effort has in part objectives of performing Verification and Validation (V&V) testing of new Minimum Operational Performance Standards (MOPS) for Command and Control (C2) systems for Unmanned Aircraft Systems (UAS), which are being developed under the auspices of the Federal Aviation Administration (FAA) via RTCA Special Committee (SC)-228. UND tests to be performed under this experimental license will complement the V&V testing being performed under the NASA initiative, extending understanding of CNPC performance under a variety of representative operational scenarios and equipage installations.

A. Introduction and Specific Proposed License Request:

UND seeks a 3-year experimental license to accommodate demonstrations and testing of CNPC transmission and receive equipment that operates within the 961-975 MHz RF Spectrum band. Specifically, 8 channels on odd integer MHz centers with 2 MHz spacing (961, 963, 965, 967, 969, 971, 973, & 975 MHz) will be utilized for both uplink and downlink transmissions. Multiple different bandpasses will be tested to emulate network and high bandwidth (video) applications. All radios to be utilized will have a maximum RF power output of 1.6 Watts (W). Test objectives will include assessment of multiple mobile transceivers (airborne and ground vehicles) operating within range of multiple ground radio transceivers, the latter in both fixed and mobile installations.

B. Purpose of Operation:

The proposed operation will allow UND and RC to test and demonstrate new UAS communications infrastructure equipment at Beyond Visual Line of Sight (BVLOS) distances. UND-RC tests performed under this spectrum request will utilize only CNPC radios operating in compatibility with specifications established under the SC-228 C2 MOPS. The testing to be performed under this license is independent of NASA's V&V efforts, but is planned to be complementary to NASA's activities. Tests will extend Rockwell Collins and NASA's current manned aircraft based testing to include investigations using UAS and surrogate UAS with various antenna configurations, and to multiple-vehicle multiple-tower network tests under more realistic low-level operational scenarios.

UND does not seek authority to conduct market studies nor provide communications services under the requested experimental authority. UND does not propose to market, sell, or lease prototype equipment to end users in conjunction with this test. All non-UND participants such as suppliers, tower owners and/or contractors working with UND in this test will be advised that: (1) the test is being conducted under an experimental authority issued to UND, (2) UND is the party responsible for the operations, (3) all operations must be conducted on a non-interference basis, and (4) after the test is completed, UND will retrieve and recover all devices that do not comply with FCC regulations. In addition, no fees will be

charged to any entity using the equipment during this test. UND understands that the FCC may specify these as well as other conditions on its authorization.

C. Technical Specification:

1. Transceiver Equipment

Rockwell Collins CNPC-1000 L-Band Radio Transceiver

Power: 1.6 W Peak TPO

Effective Radiated Power: 4 W Peak

Necessary Bandwidths: 75 kHz, 125 kHz, 350 kHz, 650 kHz, and 700 kHz channels

Time Division Duplexing for Uplinks/Downlinks

Time Division Multiple Access for Ground-to-Air Uplinks

Frequency Division Multiple Access for Air-to-Ground Downlinks

Modulation: Gaussian Minimum Shift Keying using a Bandwidth-Time (BT) Product of 0.2

Emissions: G1D

Airborne Antennas: $\frac{1}{4}$ wavelength monopole on ground plane; circularly polarized hemi omni on ground plane

Ground Station Antennas: Single element dipole antenna; eight dipole collinear array antenna, circularly polarized hemi omni on ground plane

2. Antenna Information

The described transceiver equipment will be installed in multiple different configurations. This will include two different antennas in an airborne unit to evaluate impact of antenna characteristics on signal properties and performance, as well as the same installations in a mobile ground vehicle that will be used to emulate an airborne mover under select test conditions. For the ground segment, the described transceiver equipment will be installed on a fixed base tower, but also installed in a mobile ground vehicle which will be pre-positioned in various stationary locations for select test objectives. The mobile ground vehicle will also use different antenna configurations to evaluate their impact on signal properties and performance.

Proposed Airborne and Ground Mobile Antenna Specifications

$\frac{1}{4}$ Wavelength Monopole Antenna by UB Corporation, P/N AO(968)MON(TNC)

Omni-directional

Mounted on circular ground plane with minimum $\frac{1}{4}$ wavelength radius

Vertical orientation during straight and level flight

+2.2 dBi max gain at peak of main lobe

Tuned Frequency: 968 MHz (9% bandwidth, ~3" element length)

Mounting height: When airborne, less than 914m AGL. When on vehicle, less than 3m AGL.

Circularly Polarized Antenna by Antcom, P/N 2G0.81-0.96RR-P-XTBC-1

Hemispherical Omni-directional

Circularly Polarized (RHCP)

+4.6 dBi max gain at 90° (zenith)

810 – 960 MHz Bandwidth

Mounting height: When airborne, less than 914m AGL. When on vehicle, less than 3m AGL.

Proposed Mobile Base Antenna Specifications**Low Gain/Wide Elevation Angle Antenna by Southwest Antennas, Model 1087-032**

Omni-directional single element dipole

Vertical orientation

+2 dBi max gain at horizon

850 – 1010 MHz Bandwidth

Mounting height: On mobile vehicle, less than 3m AGL.

Circularly Polarized Antenna by Antcom, P/N 3G0.81-0.96RR-P-XTBC-1

Hemispherical Omni-directional

Circularly Polarized (RHCP)

+4.6 dBi max gain at 90° (zenith)

810 – 960 MHz Bandwidth

Mounting height: On mobile vehicle, less than 3m AGL.

Proposed Fixed Base Antenna Specifications**High Gain Omni-directional Antenna by Antenna Products, Model DPV-77A**

Omni-directional 8-element collinear dipole array

Vertical orientation

+8 dBi max gain at peak of main lobe (2° - 5° above horizon)

960 – 1215 MHz Bandwidth

Mounting height: 60m AGL.

3. Proposed Locations

Figures 3-1 and 3-2 illustrate proposed locations for airborne operations, ground mobile unit and mobile base operations, and a fixed base location, which are described in the following subparagraphs.

Airborne Operation Proposed Site Locations

Airborne experimental operations will take place in North Dakota, within a circle centered at 47°27'23.00"N, 98°30'0.00"W) with radius of 90 nmi (167Km), as illustrated in Figure 3-1. Flight operations may occur up to an altitude of 10,000 ft. above Mean Sea Level (MSL), though most flights currently planned will occur on small UAS at less than 3,000 ft. Above Ground Level (AGL).

Ground Mobile Units and Mobile Base Proposed Site Locations

Ground mobile configurations comparable to the airborne configurations will be installed in vehicles that will be used to emulate an airborne mover under select test conditions. There are two proposed ranges of operating locations for such ground mobile units. Primary experimental operations will take place in North Dakota, within the same geographical extent as illustrated in Figure 3-1. Ground testing at Rockwell Collins facilities in Iowa are proposed to be within a circle centered at IOW Airport (41°38'21.00"N, 91°32'33.00"W) with radius of 102.6 nmi (190 km), as illustrated in Figure 3.2.

The airborne and ground mobile units will communicate with two different base units, one fixed base (see below) and one mobile base. The proposed ranges of operating locations for the

mobile base unit is the same geographical extent in North Dakota and in Iowa as the ground mobile units, described in the previous paragraph.

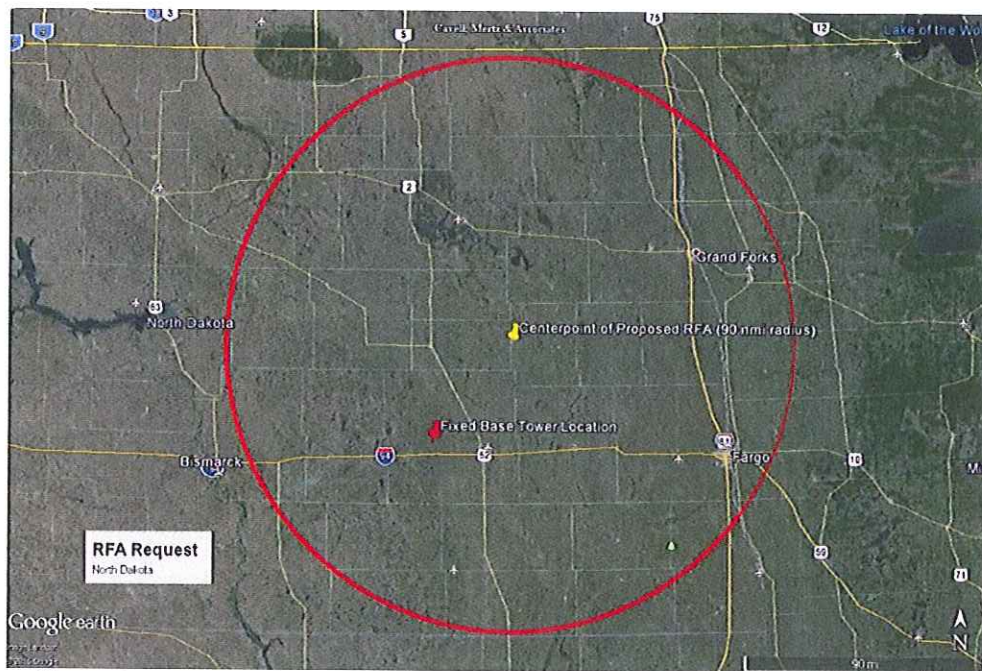


Figure 3-1: Proposed UND Testing Locations for CNPC Radios in North Dakota

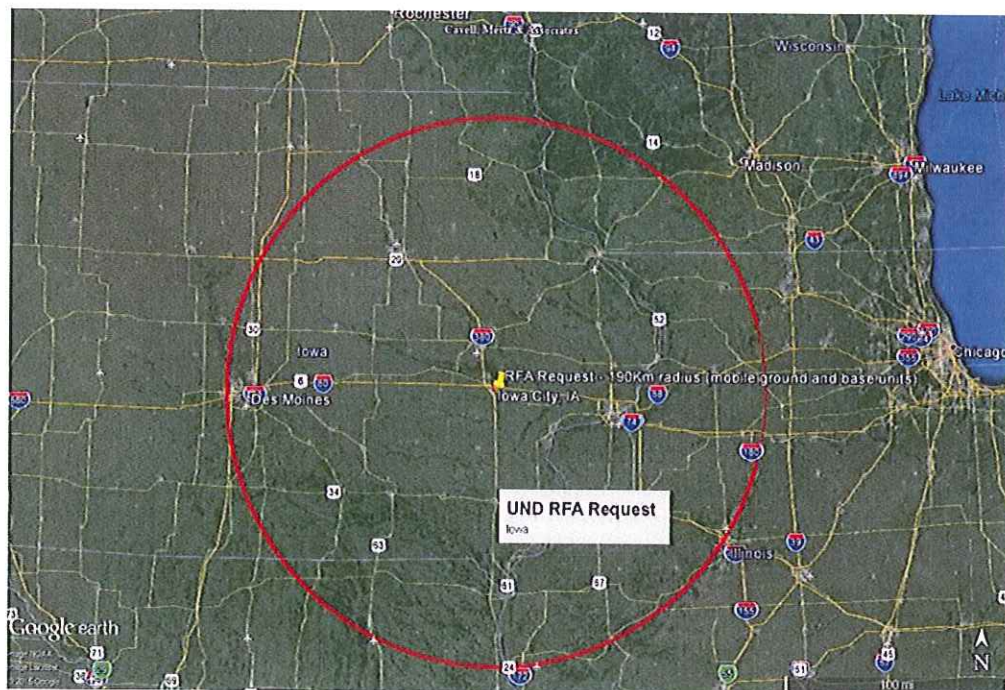


Figure 3-2: Proposed UND Testing Locations for CNPC Radios in Iowa

Fixed Base Proposed Site Location and Structure

A fixed base location is proposed that is within the geographical extent of the proposed mobile base range of operation in North Dakota.

	Site Location (NAD 27):	46-56-54.0 N 99-06-38.6 W
	Site Location (NAD 83):	46-56-54.0 N 99-6-40.0 W
	FCC Structure Registration #:	1040007
File #:	A0047087	Structure Height: 60.3 meters
Structure Type:	TOWER	Height Overall: 70.1 meters
Registered To:	State of North Dakota	Overall Height AMSL: 670.9 meters
Structure Address:	6400 32 nd St SE, Cleveland, ND	FAA Determination: 10/21/1993
ASR Issued:		FAA Study #: 93-AGL-2753-OE
Date Built:	01/01/1961	FAA Circular #: 70/7460-1H
Site Elevation:	600.8 meters	Paint & Light FAA Chapters: 4, 6, 13

4. Spectrum Requirements

The experiment will be conducted on a number of channels with varying bandwidths across the lower range of the L-band allocated for UAS by the World Radio Conference (WRC) in 2012. Specifically, 8 channels on odd integer MHz centers with 2 MHz spacing (961, 963, 965, 967, 969, 971, 973 & 975 MHz) will be utilized for both uplink and downlink transmissions. Multiple different bandpasses will be tested to emulate network and high bandwidth (video) applications.

5. Interference

All transmissions will be done within L-band spectrum allocated during WRC-12 for CNPC Line-of-Sight communications (960 – 977 MHz). Requested frequencies were selected away from the band edges to provide guard bands for equipment operating adjacent to the CNPC band. Each requested frequency is separated by 2 MHz to avoid adjacent channel interference within the CNPC band. The radio hardware also contains an internal selectable transmit bandpass filter designed to filter out frequencies at 978 MHz and higher to avoid interference with Universal Access Transceiver (UAT) operation and other nearby systems.

The low 1.6 W maximum transmit power of the radio hardware coupled with typically low antenna heights (3,000 feet AGL for most UAS) will limit the effective range of transmissions. Numerous flight tests and other over-the-air testing of the CNPC waveform have been successfully conducted by NASA using higher output powers and higher aircraft elevations in the Cleveland, OH and Cedar Rapids, IA areas. NASA has been operating under an existing Radio Frequency Authorization (RFA) granted on 27 September 2012 (Serial Number NASA127501) for several locations around the country. Testing with NASA and Rockwell Collins will continue in parallel with this request. Testing of the CNPC waveform on FAA UAS is also planned.

The proposed ground testing location in Iowa directly overlaps the existing RFA's area in Iowa (NASA127501). Rockwell Collins is a participant in the existing NASA RFA activities and will also so be in this requested RFA, and will ensure no simultaneous broadcast will occur. In the unlikely event of both entities wishing to use their RFA for testing at the same time, UND recognizes that NASA activities have priority and will re-plan accordingly.

6. Testing Scope

The primary objective of the testing is to characterize performance of the CNPC waveform on various UAS platforms utilizing a variety of antenna types. Waveform performance while taxiing, takeoff and landing, and during dynamic maneuvers for the various waveform modes will be assessed.

Testing will involve flying a UAS in the vicinity of ground stations, including direct overhead flight paths, as well as at distances at the maximum operational range of a CNPC ground station (nominally 69 nmi, though a somewhat greater range is expected). Mitigation of multipath interference and antenna polarization mismatch loss will be assessed using various combinations of antennas at the UAS and ground stations. Testing will progress to include multiple UAS or mobile participants operating in a single CNPC network.

7. Protection and Certifications

7.1 Airspace Protection

The proposed site is a registered structure with the FCC Antenna Structures Database file # A0047087. UND does not propose to modify or increase the overall height of this structure and thus will not increase their existing airspace impact.

7.2 Environmental Protection

None of the facilities will place more than 5% of the uncontrolled exposure limit for radio frequency energy within two meters above the ground, and therefore the proposed operation is a minor environmental action at the proposed transmitter site.

7.3 Anti-Drug Abuse Certification

Applicant certifies that neither Applicant nor any party to this application is subject to denial of federal benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. Section 862.

7.4 Restrictions on Operation

UND understands that the FCC permits (1) companies to enter into agreements and contracts to manufacture new products and (2) manufacturers to sell—but not deliver—products on a conditional basis to wholesalers and retailers. UND also understands that the FCC permits the operation of equipment for, among other things, compliance testing, demonstration at trade shows and other exhibitions with appropriate notices displayed, and evaluation of product performance and customer acceptability at the manufacturer's facilities or at certain nonresidential sites during the developmental, design and pre-production stages. See Marketing Rule Revisions, § 2.803; Part 15 Revisions, 6 FCC Rcd 1683, 1685 (1991).

Notwithstanding these general rules, the FCC requires parties to seek authorization to use devices that normally require a license to operate or that will be operated at residential locations. Such authority may be granted under the FCC's experimental rules set forth in Part 5 of the Code of Federal Regulations, 47 C.F.R. Part 5 (2010). Accordingly, UND seeks an experimental license to conduct experimental operations permitted under Part 5 of the Commission's rules.

UND does not seek authority to conduct market studies nor provide communications services under the requested experimental authority. UND does not propose to market, sell, or lease

prototype equipment to end users in conjunction with this test. After the test is completed, UND will retrieve and recover all devices that do not comply with FCC regulations. If any different treatment becomes necessary during the course of its experimentation, UND will seek separate and additional authority from the agency.

UND also recognizes that the operation of any unapproved or unlicensed devices under experimentation must not cause harmful interference to authorized facilities. Should interference occur, UND will immediately take reasonable steps to resolve the interference, including if necessary discontinuing operation. To that end, UND would advise entities using the equipment that permission to operate the equipment has been granted under experimental authority issued to UND, is strictly temporary and may be canceled at any time. It will also advise entities that operation is subject to the condition that the equipment may not cause harmful interference. Specifically, UND proposes to label the equipment conspicuously as follows:

FCC STATEMENT

Permission to operate this device has been granted under experimental authority issued by the Federal Communications Commission (FCC) to the University of North Dakota, is strictly temporary, and may be canceled at any time. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received including interference that may cause undesired operation. This device has not been authorized as required by the rules of the Federal Communications Commission. This device is not, and may not be, offered for sale or sold until the approval of the FCC has been obtained. Thus, the user does not hold a property right in the device and may be required to return the device.

Moreover, UND submits that its experimental operations are unlikely to cause interference. First, UND plans to coordinate its operations with existing holders of experimental license for the same frequency usage. Second, UND intends to monitor use of the relevant frequencies before commencing transmissions, and it will not operate if the frequencies are in use or interference is expected to be observed.

7.5 Public Interest

UND submits that issuance of a license is in the public interest, convenience, and necessity. Grant of a license will permit UND to test a critical technology for safe Command and Control of UAS in the National Airspace. The results of this testing will provide valuable data to the FAA and FCC in the development of policy and rules in this band for CNPC operations.

8. Contact Information

The following people may be contacted for further information regarding this application:
Mr. Douglas Olsen, Principal Investigator/ Project Manager, 701-777-3543, olsen@aero.und.edu
B. Gen. (Ret.) Alan Palmer, Director UAS Center, 701-777-5061, apalmer@aero.und.edu
Mr. John Nordlie, Project Assistant 701-777-6112, nordlie@aero.und.edu

9. Signatures


Doug Olsen, Principal Investigator


Date