FCC response for modification of licenses – May 2021

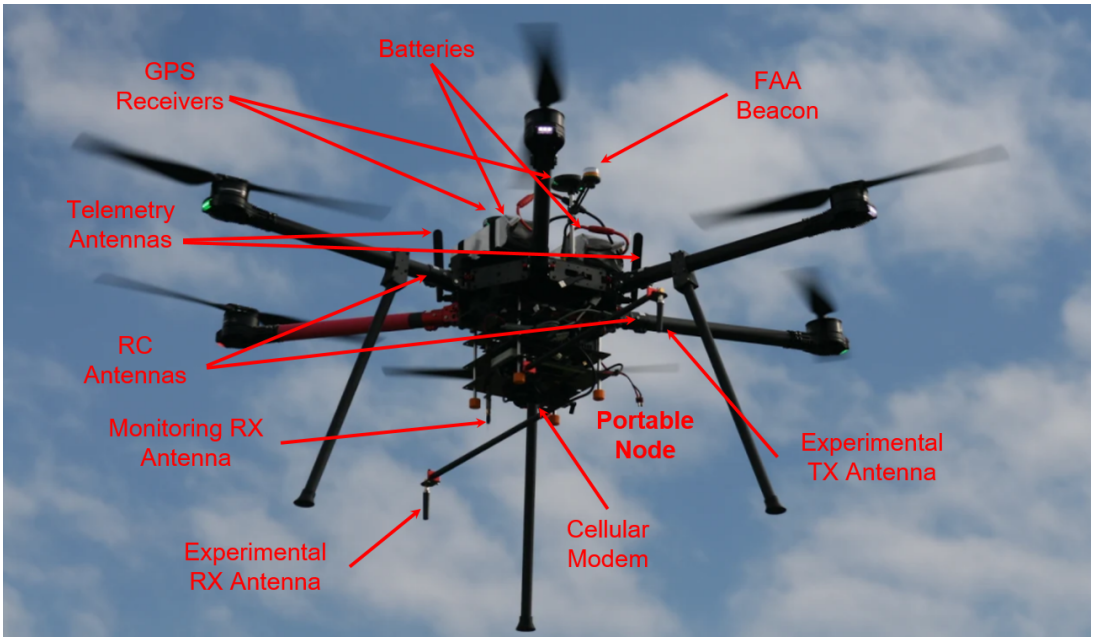
Applicant:	North Carolina State University
File Number:	0074-EX-CM-2021
Correspondence Reference Number:	61736
Date of Original Email:	05/05/2021

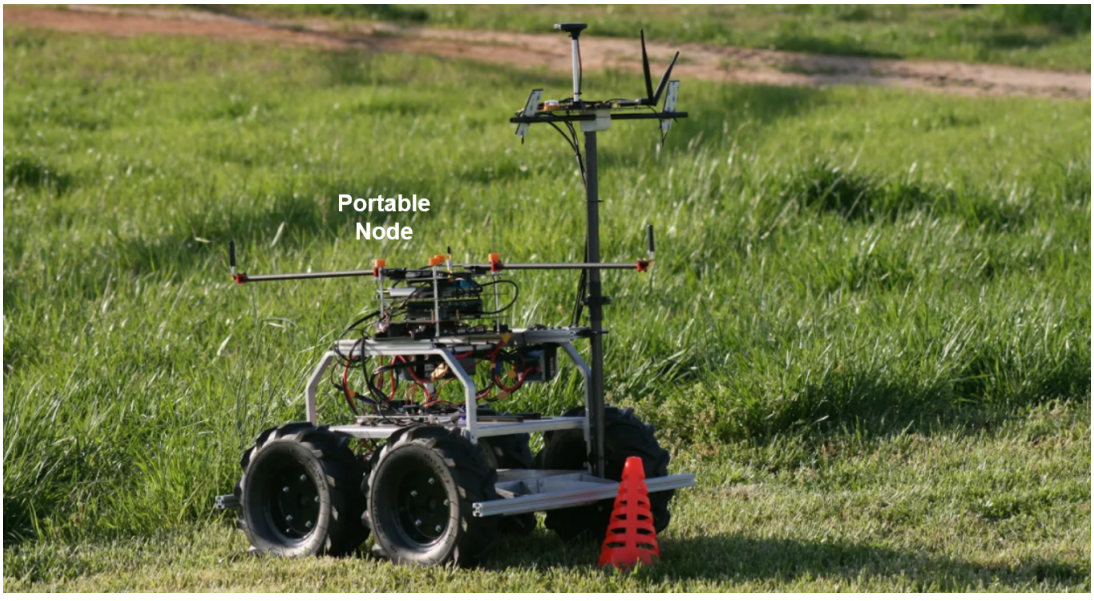
1) Submit an exhibit that clearly describes your modification request. If you are adding frequency or frequencies for an existing location, then mention that in your exhibit. If you're adding a new location with few frequencies that specify that in your exhibit. Provide a purpose for your modification request.

Response:

- We are not adding a new location to our previous request. This request is for i) Lake Wheeler (LW) and ii) Centennial Campus (CC) experimentation zones of AERPAW.
- We are adding the new frequency 3.3-3.55 GHz TDD band at both LW and CC, while the 1.7/2.1 GHz FDD band will be used only at the LW location.
- 1.755-1760 GHz and 2.155-2.160 GHz FDD bands will be used by the Ericsson BS, to support LTE transmissions (for 5G NSA experiments, with 5G NR operating at 3.7 GHz). It is not planned to be used by SDRs in the short term.
- 3.3-3.55 GHz band will be used for SDR (USRP) experiments at both LW and CC.
- In addition, we are asking to extend the 3.7-3.8 GHz experiments requested in the original experimental license, now to support experiments with Ericsson BSs and UEs for 5G NR (NSA) and LTE transmissions at LW location.
- There will be one (1) Ericsson BS (with 3 radio heads) located in the LW area which will start being used once the experiment request is approved. We anticipate two (2) more Ericsson BSs in the LW area to become operational later in 2022.
- We will initially have 2 UEs from Motorola and 2 UEs from Essential to experiment with the Ericsson network, and multiple additional UEs are expected in the future. We expect that the UEs will be exclusively located in the LW area during experiments.
- There is 1 SDR (USRP) tower (fixed node) in LW and 2 SDR (USRP) towers in CC. We anticipate four (4) more SDR towers in LW and one (1) more SDR tower in CC to become operational later in 2022.
- In addition to 3 fixed nodes, there will also be three (3) portable nodes that will include smaller SDRs. We anticipate 10 additional portable nodes to be operational by the summer of 2022. A portable node includes two USRPs: one of them will be used in the experiment while the other will be monitoring the spectrum utilization and can stop an experiment in case of non-compliance. Both USRPs are connected to an Intel NUC computer. A portable node can be carried by an unmanned aerial vehicle (UAV) or an unmanned ground vehicle (UGV), or can be placed on a fixed location e.g. on a tripod. An example portable node that is carried by a UAV and UGV are shown in the next page. The portable nodes will be used primarily in experiments at the LW area, while some experiments (including experiments with a UAV or UGV at 3.3-3.55 GHz band) may also be made in the CC. At this time experiments with UAVs at the CC location may require FAA waivers which we plan to obtain in 2022.

- Both the fixed nodes and the portable nodes will include frequency monitoring SDRs. If an SDR transmits outside of its permitted frequency band, the experiment will be stopped by the experiment oversight software, to avoid any interference with nearby licensed receivers.

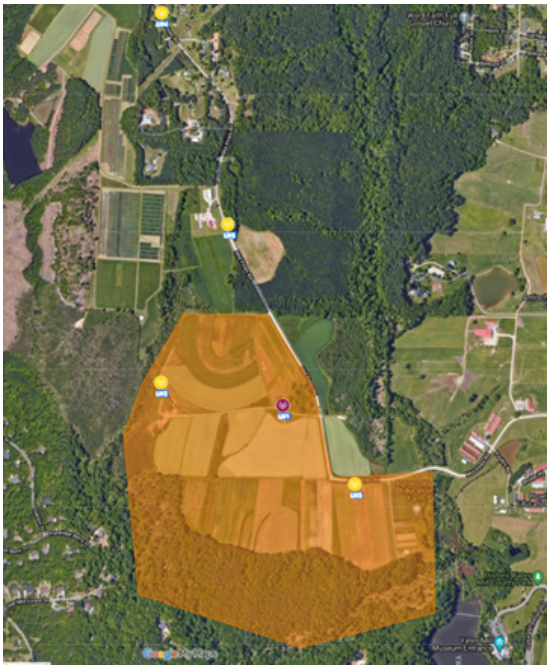


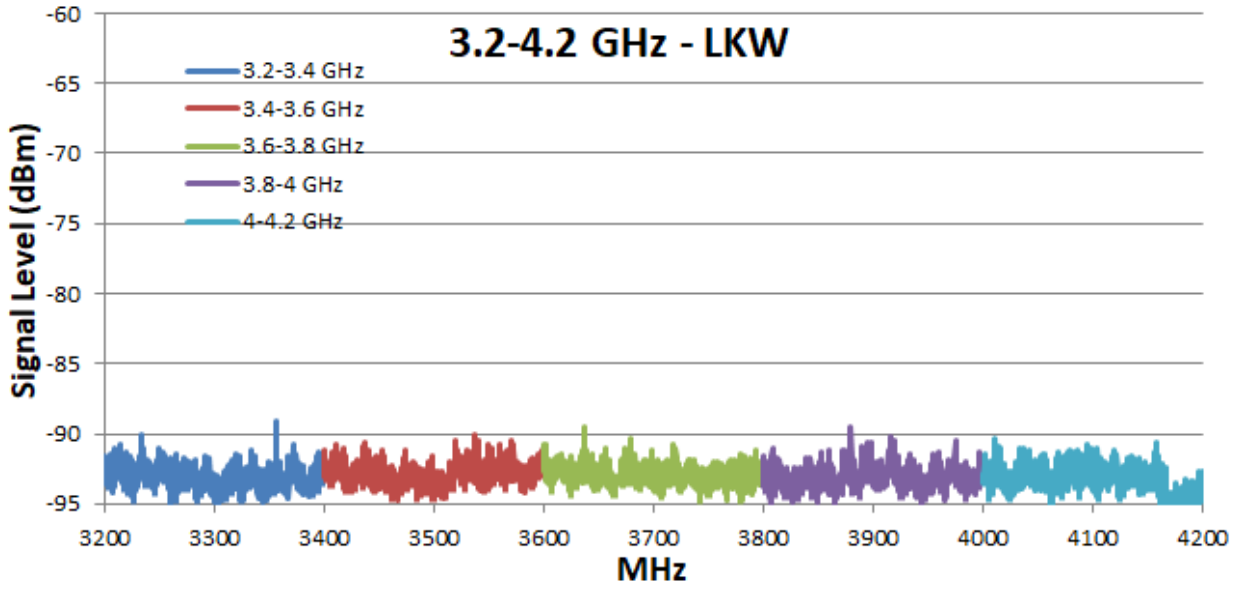


2) Are you conducting airborne operation at any particular location? If yes, then provide the maximum altitude in feet. Please remember the condition from your previous grant: North Carolina State University is prohibited from operating in the 3500 - 3700 MHz band due to an explicit airborne prohibition in our CBRS Service rules.

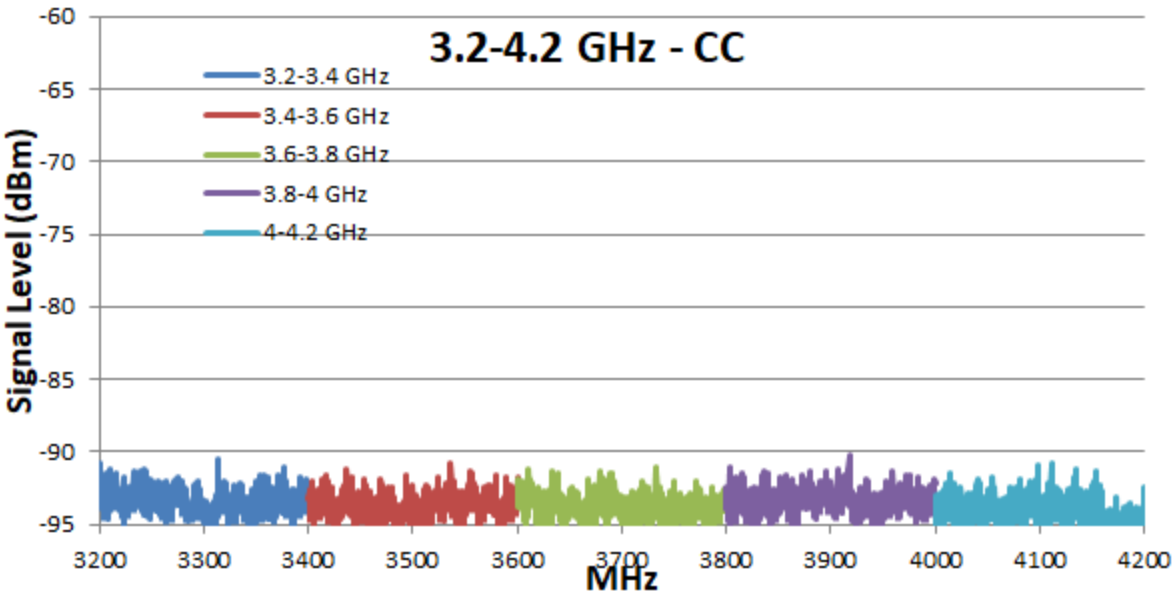
Response:

- The airborne operations will be primarily carried out in the LW area until the 2022 Summer. Note that the LW area is a rural environment with limited spectrum utilization based on our initial spectrum measurements (see photos and spectrum measurement data below) and we do not anticipate interference with legacy users in this location at the 3.3-3.55 GHz spectrum. We will carry spectrum measurements in LW at various bands over longer time spans and document spectrum utilization in this area in the future.





- We may be doing limited airborne transmission testing in the CC. This is for pre-planning for future possible airborne experiments in the CC, if FAA waivers to fly there can be secured in 2022 and beyond. Spectrum measurements in the CC location are provided below.



- The maximum height of airborne transmissions will be 400 feet for drones based on FAA Part 107 regulations. The portable nodes can carry SDRs to communicate with ground SDRs (at portable or fixed nodes on the ground), or a commercial mobile handset (to communicate with the Ericsson BS).
- We are also planning to use one (1) helikite platform in the LW area in 2022 to carry out airborne experiments. The maximum height of the helikite will be limited to 700 feet. It can carry portable node(s) with SDRs and/or a mobile UE.
- We acknowledge that we do not presently intend to have any airborne transmissions in the CBRS band of 3.55-3.7 GHz. Note: Our understanding is that the statement above was meant to refer to 3.55-3.7 GHz spectrum rather than 3.5-3.7 GHz spectrum. We will collect spectrum CBRS utilization in the LW area from ground and aerial spectrum sensors in the future. If there is continued limited spectrum activity, and we can guarantee non-interference to legacy users, we may explore use of this band (in cooperation with a SAS) for airborne transmissions in the future.