



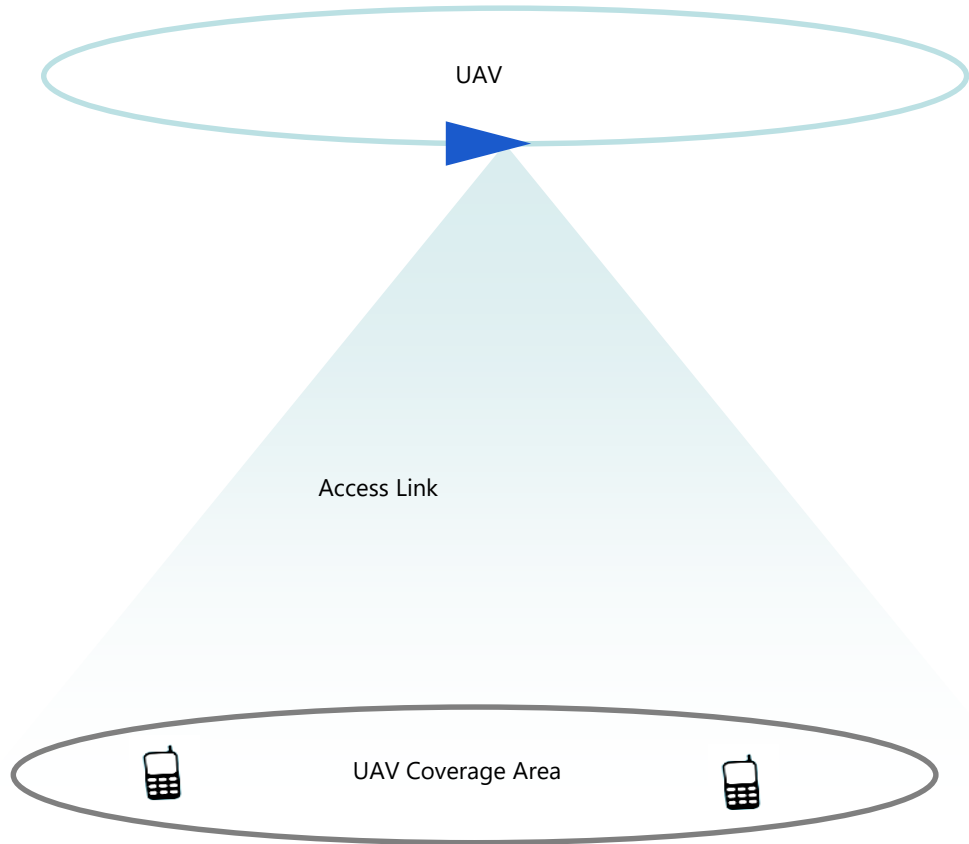
Experimental License Application to FCC for UAV Networks

July 30, 2019

Proprietary

- The goal of our studies, is to implement, and evaluate, defined wireless network architectures, in which voice, video and data communications, to and from UEs (commercial cell phones operating at specific frequencies), are relayed via a node located on a UAV.
 - The UAV will be flown in a loiter path over an area of 1km diameter, or less, at altitudes of 500m, or less, centered on the indicated ground locations.
 - UEs will be used within a 1km radius area at the same locations.
 - Flight operations will be conducted in accordance with FAA guidelines and under FAA authorization. Targeted applications include Private, IoT and Emergency Networks .
- The networks will consist of COTS, and/or vendor-supplied prototype equipment
- The network configuration will include either
 - A single band transceiver, with integrated e-node B functionality. Appropriate, 2x2 MIMO directional antennae (6-9 dBi gain) will be attached to the underside of the UAV in fixed, downward pointing orientation.
 - A dual band transceiver, for both uplink and downlink communications, with e-node B functionality located in a ground station. Antennae on the UAV will be 2x2 MIMO antennae similar to case 1. The ground station antenna will be an upward-pointing large MIMO array, which can be focused on and electronically track the UAV path.
- The coverage in all instances will be restricted, by the UAV flight plan and the directionality and/or control of the UAV and ground station antennae. This will reduce the potential for interference with other users or carriers in the area.
- Prior to operation, we will request permission from other identified users in the area.
- We will also use a base station analyzer, located at the identified locations, to monitor activity within the approved experimental range, before, and during, flight operations.
 - If activity is detected before flight, we will either move our transmission to an unused part of the approved band, or void the experiment. If activity is detected during flight, transmission will be terminated by remotely interrupting electrical power to the transmitter on the UAV.

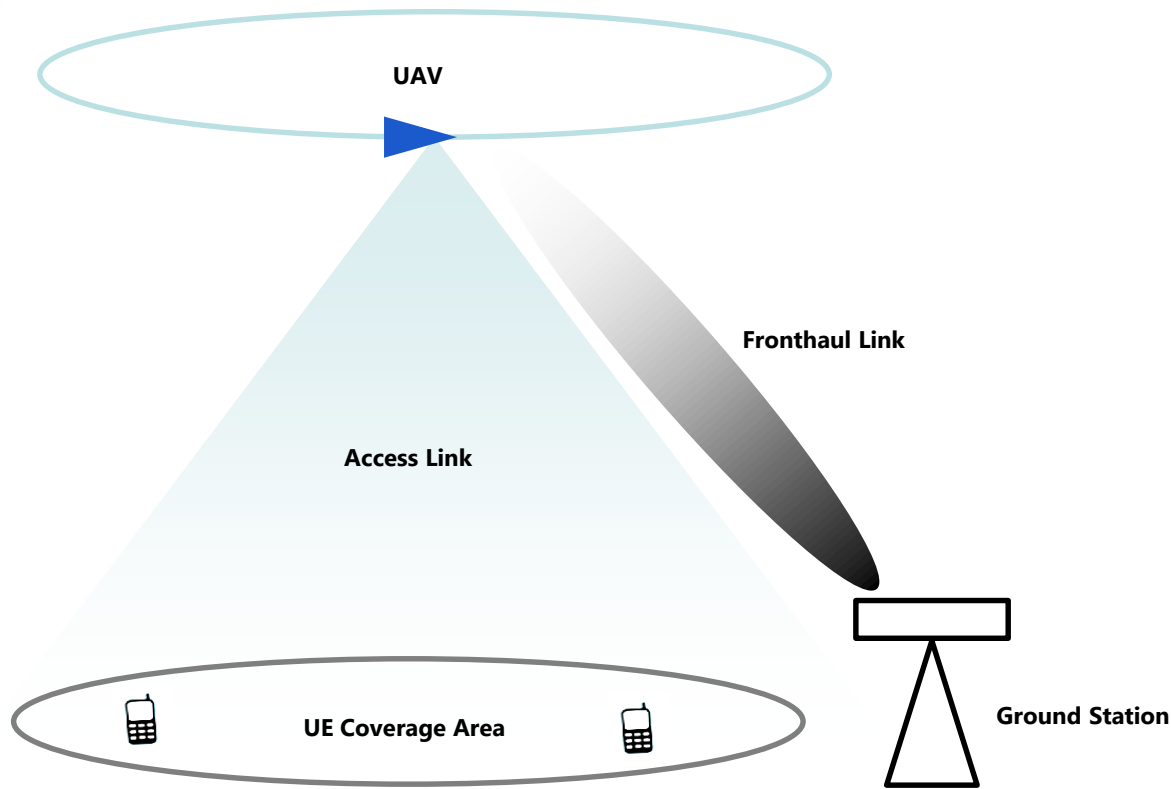
UAV Network: Configuration 1



UAV to UE Transmission
Frequencies (MHz)

- 716-728 MHz
- 768-788 MHz
- 2620-2690 MHz

UAV Network: Configuration 2



Transmission
Frequencies (MHz)

➤ UAV to UE
2620-2690

➤ UAV to GS
2100-2110

➤ GS to UAV
1920-2010

– Transcievers

- Deltenna: BlackWolf R2 (UAV)
- Prototype Small Cell (UAV)
- Prototype (MMIMO Ground Station)

– Antenna

- Cell-Fi: MIMO panel antenna #A52-X12-100
- L-Com: MIMO panel antenna # HG72708XWPP-NF
- Prototype MIMO (UAV) & MMIMO (ground station)