

FCC Narrative Statement

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License Type: Conventional Experimental License

Authorized person filing application: Arpad G. Kovesdy (FRN: 0026721944) on behalf of Beamlink Inc.

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In response to:

FCC Narrative Statement

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.
- b. The specific objectives sought to be accomplished.
- 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.

Proposed Program Description: This program of experimentation is proposed in order to develop, test, and verify the operation of a new "temporary cellular base station" that is specifically used after natural disaster or in emergency circumstances. The cellular base station consists of radio hardware, a computing system, power supply, and other supporting systems such as a display and GPS module. The hardware is designed to be portable enough for a single person to carry and use extremely minimal power. The base station can create an "ad-hoc" cellular network, where new telephone numbers may be assigned to mobile stations to allow calling, texting, and data services to be provided with minimal reliance of outside systems. Alternatively, the base station can connect to the existing systems of cellular carriers to augment emergency systems in emergencies.

Description of Radio Equipment

1. Software defined radio: The bladeRF series SDRs (x40 and x115 models and potentially newer models) are capable of independent RX/TX on frequency range of 300 MHz to 3.8 GHz. These modules are the sole radiators and receivers of radio energy in the system. Their purpose is to receive instructions from the computing system and communicate through GSM/GPRS/UMTS/LTE protocols with cellular mobile devices. Their frequency range is limited through software to very specific ARFCN(s) within a given frequency band of operation for cellular devices.
2. Antennas: Quad-band SMA, omni-directional antennas, one for TX and one for RX per SDR module. Includes:
 - a. Part No: ADH-151XSAXX with gain 2 dBi, vertical polarization, capable of operation in range 890-960 MHz/1710-1880 MHz. Quantity: 4

- b. Part No: DELTA2D/X/SMAM/S/RA/34-ND with gain 2 dBi, linear polarization, capable of operation in frequency bands GSM 800, GSM 900, GSM1800, GSM1900 Mhz, 3G 2100 MHz. Quantity: 4
3. Amplifiers (note: will be enabled to verify compatibility, good signal integrity, and power draw but transmitting amplifier will be limited by lowering input signal through software in the SDR)
 - a. Power amplifier (TX): ZFL-2500B+ by Mini-Circuits (31 dB gain typical, Coaxial SMA Medium power amplifier)
 - b. Low noise amplifier (RX): HiLetgo 4330353723 RF Wideband Amplifier 0.1-2000 MHz
4. Other electronic equipment, including power supply, single board computer, GPS module, and display do not fall under the purview of this application.

Theory of Operation

The base station communicates via one or multiple test “devices”, or mobile stations on an unused frequency by other cellular providers. The base station acts like a roaming network provider’s base station, offering alternative service to the installed SIM card. The mobile station only connects to IMSIs that are already listed on the “whitelist” in the base station’s database (which are the test devices).

Specific Objectives

1. Test and debug connectivity between the temporary base stations and our test mobile devices in a short range to:
 - a. Verify the self-registration procedure of the mobile device with the standalone tower.
 - b. Verify the call handover process between two temporary base stations.
 - c. Verify routing table configuration changes by the proprietary automatic algorithms in a real-world test environment with physical mobile devices.
 - d. Test the maximum load each base station is capable of handling by loading the stations with calls and other data services from physical devices.
 - e. Verify SMS and MMS function normally.
 - f. Verify Internet connectivity through the provided data service.
2. Test the radio hardware to verify its continued operation even under adverse conditions, including but not limited to water contact and submersion and extreme temperatures.

Mitigation of Interference

1. A closed, independent test network will be created for each test. The test will limit connections of phones based on the device IMSIs as mentioned in the theory of operations. Only the IMSIs of the test mobile devices will be permitted on the network. Other devices that are able to connect to GSM base stations may be aware of the presence of the tower as it will register as a valid roaming station, however, this will not interfere with any normal operation because cellular users’ primary carriers will always take priority thanks to cellular firmware embedded in mobile devices, the base station will refuse connections with non-testing phones, and because of the next point.
2. The radio devices are attenuated to limit the effective radiated power. This attenuation is done through software, which reduces the power sent from the SDR modules to the antennas. The attenuation will reduce the range of base station testing to at most 40-50 feet (power sent to transmitting antennas will be less than 6 mW).