

1. Introduction

By the instant application (“Application”), BAE Systems Information and Electronic Systems Integration Inc. (“BAE Systems”) requests that the Commission grant a two year conventional experimental license to permit BAE Systems to operate the facilities (the “Facilities”) specified in the instant application.

While TV White Spaces operation has been generally authorized by the Commission,¹ the IEEE 802.22 White Space equipment for which the license is being requested has not yet received equipment authorization from the Commission. Thus, BAE Systems requests a license to use equipment that is still in the approval process.

2. Purpose of the Operation

This testing is a critical part of technology development for the DARPA Rapid Attack Detection, Isolation and Characterization Systems (RADICS) program. This program is investigating the transmissions in the un-used TV channels aka TV White Space to meet the nation’s critical infrastructure and power grid communications needs in case they come under cyberattack. The purpose of this test is to demonstrate communication network functionality on the TV White Space.

The testing will occur at 4 locations - in New Hampshire, New York, Illinois and Connecticut on a temporary-fixed basis. Within each radius, a base station unit and up to six subordinate CPE units will be temporarily fixed for operations. For each location, unused TV White Space channels have been selected from an approved White Space Database Provider (Google).

Waiver of the Station ID rules set forth at Section 5.115 is respectfully requested.

A. IR&D and Contract Support

These operations will be in support of Internal Research and Development and the following government contract:

Customer/Agency: Defense Advanced Research Projects Agency (DARPA)
Contract No.: FA8750-16-C-0177
Gov’t Contract POC: Walter Weiss (w.weiss@darpa.mil)
Tel No.: 703-526-1487

¹ See *In the Matter of Unlicensed Operation in the TV Broadcast Bands*, Second Memorandum Opinion And Order, FCC 10-174, ET Docket Nos. 04-186 and 02-380 (2010); *In the Matter of Unlicensed Operation in the TV Broadcast Bands*, Third Memorandum Opinion And Order, FCC 12-36, ET Docket Nos. 04-186 and 02-380 (2012); *In the Matter of Amendment of Part 15 of the Commission’s Rules for Unlicensed Operations in the Television Bands*, Notice of Proposed Rulemaking, FCC 14-1444, ET Docket No. 14-165 and GN Docket No. 12-268 (2014).

NOTES:

- The License is requested to permit operation in support of the above contract AND ALSO for Internal Research and Development.
- Accordingly, a Station Class of XD or XT is requested, to permit operation in support of both the contract and IR&D.

3. Other Issues

A. Transmit Directionality

Up to two base stations and six CPEs total will be located within each location radius. The base station unit will transmit with an omni-directional antenna. The CPE units will transmit with directional antenna that may be aligned along any azimuthal line of bearing.

B. Antenna Data

Omni Antenna:

Mfg.	Model Number	Frequency Range	Gain	BW		
Telimart	TM520V-OMNI-6	470-570 MHz	6 dBi	Freq <u>MHz</u> 470-570 MHz	E-Plane <u>deg</u> 30	H-Plane <u>deg</u> 360

Directional Antenna:

Mfg.	Model Number	Frequency Range	Gain	BW		
Telimart	TM550L-LPDAYG-9	400-700 MHz	9 dBi	Freq <u>MHz</u> 400-700 MHz	E-Plane <u>deg</u> 60	H-Plane <u>deg</u> 45

Beamwidth/Orientation:

Location 1 (NH) – Beamwidth/Orientation:

- (a) Width of beam in degrees at the half-power point: 60

(b) Orientation in horizontal plane (degrees from True North):
180 degrees for 3 CPEs and 270 degrees for the other three

(c) Orientation in vertical plane (degrees from horizontal): 0 degrees

Location 2 (NY) – Beamwidth/Orientation:

- (a) Width of beam in degrees at the half-power point: 60
- (b) Orientation in horizontal plane (degrees from True North): 315 degrees for 4 CPEs located on the Plum Island, NY, 225 degrees for one CPE located on the Long Island, NY and another CPE located in New London, Connecticut, at 225 degrees.
- (c) Orientation in vertical plane (degrees from horizontal): 0 degrees

Location

3 (IL) – Beamwidth/Orientation:

- (a) Width of beam in degrees at the half-power point: 60
- (b) Orientation in horizontal plane (degrees from True North): 315 degrees for 4 CPEs, 225 degrees for one CPE and another CPE located at 225 degrees. All CPEs will operate at the University of Illinois Urbana Champagne Campus.
- (c) Orientation in vertical plane (degrees from horizontal): 0 degrees

Location 4 (CT) – Beamwidth/Orientation:

- (a) Width of beam in degrees at the half-power point: 60
- (b) Orientation in horizontal plane (degrees from True North): 315 degrees for 4 CPEs located on the Plum Island, NY, 225 degrees for one CPE located on the Long Island, NY and another CPE located in New London, Connecticut, at 225 degrees.
- (c) Orientation in vertical plane (degrees from horizontal): 0 degrees

C. RF Source

The transmitted signal for the base units will be provided by the Saankhya Laboratories White Space Base Station (Model No. SLB802ODU) using a non-directional antenna (Model No. TM520V-OMNI-6). Transmission from the satellite CPE units will be provided by the Saankhya Laboratories White Space Customer Premises Equipment (Model No. SLC802ODU) using a directional antenna (Model No. TM550L-LPDAYG-9). The output power of the system will be measured and verified to meet the radiated output power limits set forth in the license and the TV WhiteSpace Regulations (e. g. 4Watts EIRP).

D. Prevention of Interference

BAE Systems hereby advises the Commission that the tests to be conducted under the requested Commission authorization are to be conducted at each location within the 3-mile radius of operation being requested. For each of those physical locations, the operators will verify if the TV WhiteSpace Channels are available based on the commercial white space databases.

Station Location 1: For operations in New Hampshire, the transmission will be conducted primarily at the BAE Systems Merrimack and Litchfield facilities. Up to two base stations and six CPEs total will be located at the two facilities, with the number of transmitters at each location determined by the results of testing. Such location will result in the separation of the test facilities from other existing transmit or receive facilities.

The IEEE 802.22 Base Station (BS) will be located at the BAE Systems 130 Daniel Webster Highway, Merrimack New Hampshire Test Range. The BS will use an omni directional antenna. Three Customer Premises Equipment (CPEs) will also be located at this site. They will use directional antennas. Their antennas will point in the direction of Base Station at 100 degrees with respect to True North going clockwise.

Additional Three CPEs will be located at the BAE Systems Litchfield Facility. The antennas of these three CPEs will be pointing towards the Base Station located at the 130 Daniel Webster Highway Facility. Their antennas will be pointing at 75 degrees anti-clockwise from the True North. All antenna placements will be 10 meters above the Ground Level.

Please see Figure 1 attached for map.

Station Location 2: For operations in New York, the transmission will be conducted primarily on Plum Island. The base station will be located there, and up to five CPE's will also be located on the island with directional antennas oriented such that their line of bearing is directed towards the base station. A CPE may be located on Long Island, at the Plum Island Animal Disease Center Reception Facility, with its directional antenna oriented such that its line of bearing is towards the base station on Plum Island. Another CPE will be placed in New

London Connecticut and will communicate with the White Space Base Station located on the Plum Island, NY.

The IEEE 802.22 Base Station (BS) will be located in Plum Island. It will use an omni directional antenna. We anticipate 4 CPE s to be also located within 100 meters of the Base Station. Another CPE will be located near the Orient Point Ferry on the Long Island. Its antenna will be pointed at the BS at 45 degrees clockwise from true North. Finally another CPE will be placed at the New London, CT facility. All antenna placements except for the one in New London, CT will be at 10 meters above the Ground.

Please see Figure 2 attached for map.

Station Location 3: For operations in Illinois, the transmission will be conducted on the campus of the University of Illinois at Urbana-Champaign. It is anticipated that separation between CPEs and base station will be relatively small (~100 m) and will take place in the vicinity of the Coordinated Science Laboratory.

The Base Station will be located at the Coordinated Science Laboratory with three CPEs located within 100 meters of the BS. Another CPE may be located 200 meters away from the Base Station in the South West Direction and one more CPE will be placed in the North East Direction at 300 meters from the BS. All antenna placements will be 100 meters above the ground level.

Please see Figure 3 attached for map.

Station Location 4: For the transmissions originating from the New London, CT location, the Customer Premises Equipment (CPE) will be placed on top of a hotel building. It will be using a directional Yagi antenna that will have its beam-pattern in the direction of Plum Island where the IEEE 802.22 Base Stations using an Omni Directional antenna will be located. The New London, CT, CPE will communicate with the Base Station on the Plum Island. We anticipate the antennas to be placed on top of a hotel building structure. It will not extend more than 6m above the top of the building structure. We anticipate the overall height above the ground to the tip of the antenna to be 40 m. The Elevation of the ground at the antenna site above the mean sea level is 10 m.

The CPE directional antennas placed at the New London Site will be facing away from the nearest aircraft landing area located at the Groton New London Airport. The aircraft landing area is at 110 degrees clockwise from the True North, whereas our directional antenna will be pointed at approximately 225 degrees clockwise from the true north.

Please see Figure 4 attached for map.

E. **Stop Buzzers**

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Alternate: Apurva N. Mody – (404) 819-0314

LOCATION MAPS

Station Location 1 (NH):

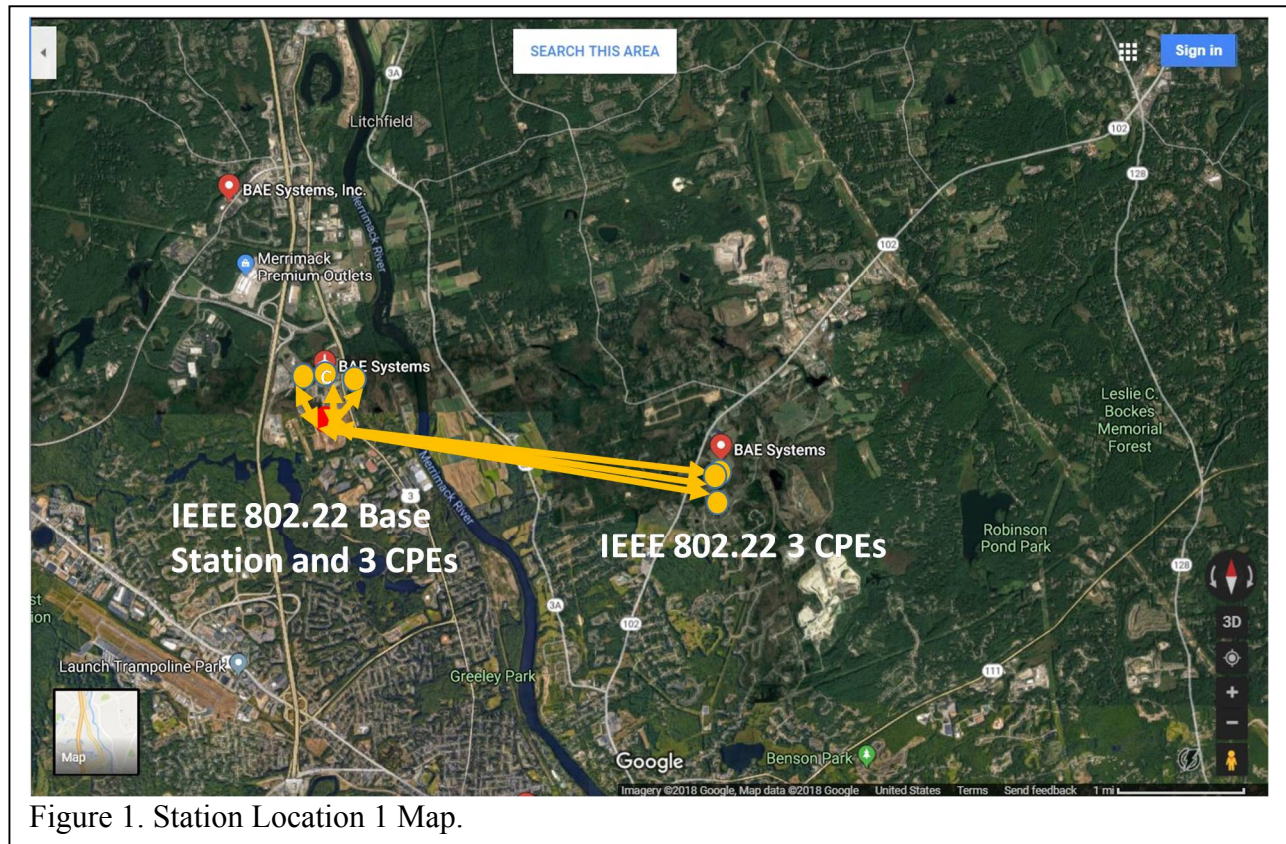


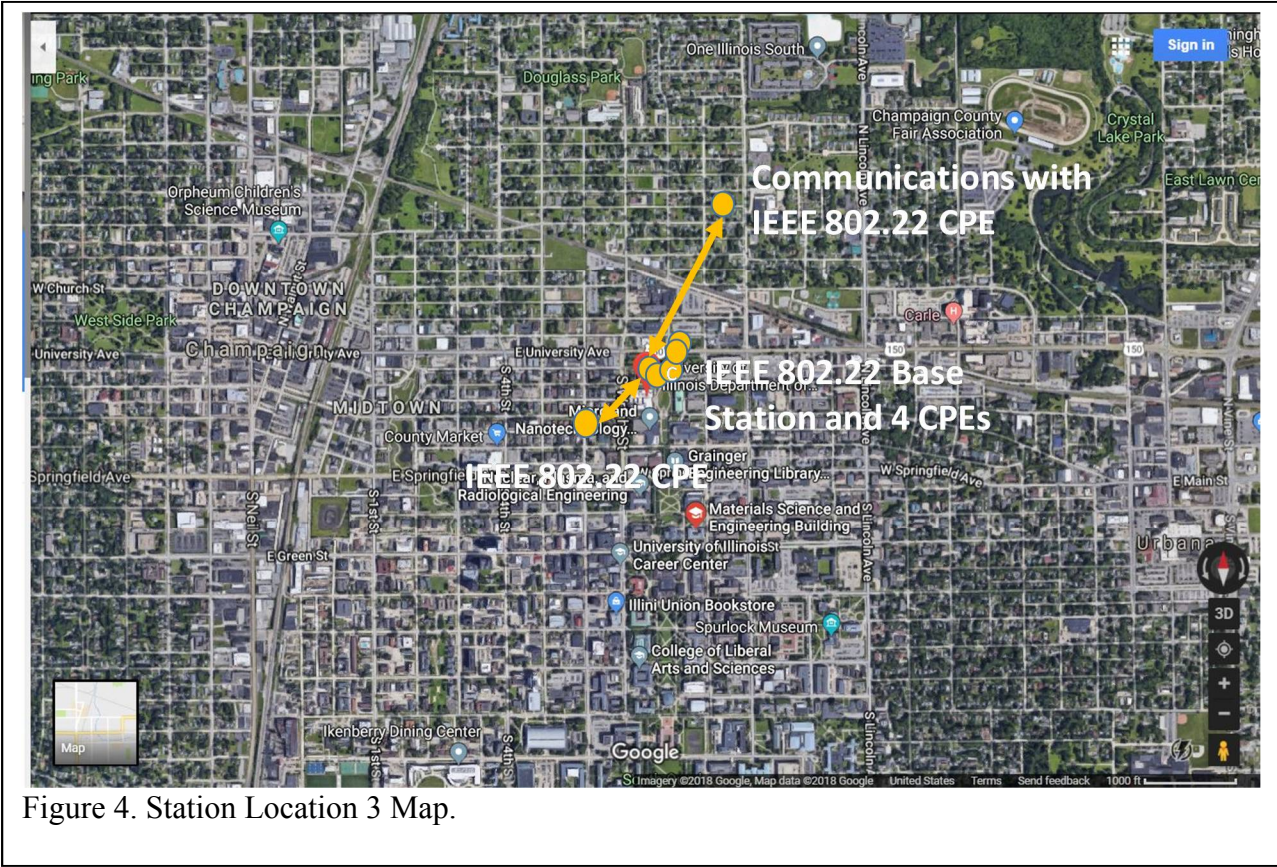
Figure 1. Station Location 1 Map.

Station Location 2 (NH):



Figure 2. Station Location 2 Map.

Station Location 3 (IL):



Station Location 4 (CT):

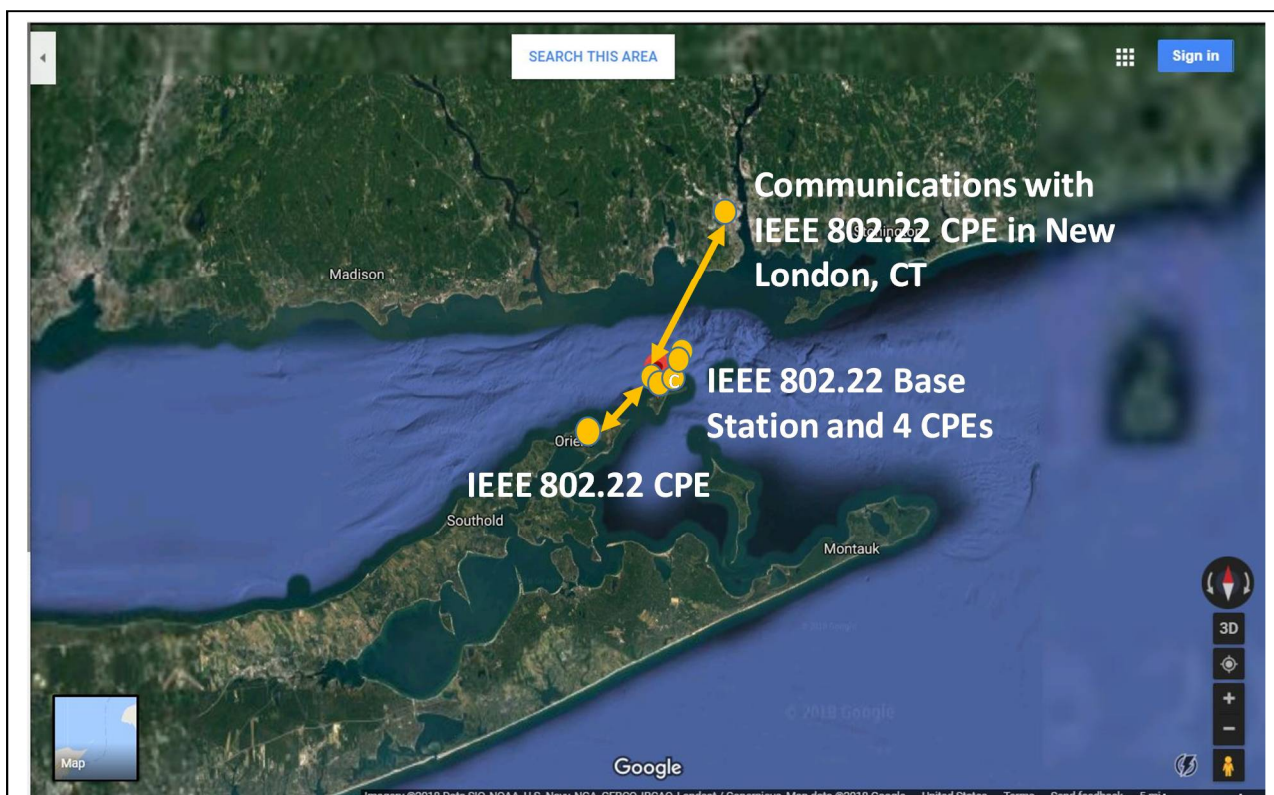


Figure 4. Station Location 4 Map.