

Appendix A  
SideBand Systems Report

# RADIO FREQUENCY FIELD STRENGTH STUDY

LAFAYETTE APARTMENTS

PORTLAND, ME

By:



***SideBand Systems***

## SECTION-1: INTRODUCTION

Lafayette Apartments located at 638 Congress Street in Portland, Maine will be going through a renovation and has been identified as a facility that may require a bi-directional amplifier system in order to facilitate communications for the Portland Fire Department.

Sideband Systems performed a radio frequency field strength study on January 31<sup>st</sup>, 2013 on the first level and basement floors of the facility. The results are included in this report.

## SECTION-2: TEST PROCEDURES

Measurements were taken through the use of a Berkley Varitronics Test Set tuned to the 800 MHz frequency range. For the purposes of testing and the design of a system the following Portland Fire Department public safety frequencies were used:

### Repeater transmit frequency

1. 851.0625
2. 851.2875
3. 851.3125
4. 851.5625
5. 851.7875
6. 852.2875
7. 852.7875
8. 853.2875
9. 853.5375
10. 853.7875

Measurements were taken on the first level and basement floors. Continuous signal level measurements were taken on each floor with each test point result being the average of a minimum of 48 signal level samples. The first level signal levels ranged from -91 dBm to -73 dBm. For the basement level signals ranged from -102 dBm to -79 dBm. Sideband has determined that a good portion of the basement level does not meet reliable public safety levels for communication and would require a BDA system.

## SECTION 2: LINK ANALYSIS

Typically, signal levels greater than a -95 dBm will provide for communications at a 95/95 reliability (95% area/95% of the time). Public Safety radio systems are designed to meet this reliability and signal level. In designing an in-building amplifier system a link analysis is performed to determine what the minimum levels would be for a particular installation. The

installation for the Lafayette Apartments will utilize a new Bi-directional amplifier system located on the basement level floor.

Table 1 below identifies a worst case talk out from a dispatcher or another radio outside of the facility to a public safety portable radio located within the facility.

**TABLE 1**

Gain or Loss	Value
Received signal from existing 800 MHz trunked repeater (measured on roof)	-48 dBm
Outdoor 800 MHz Yagi Gain	+ 5 dB
135 ft of 1/2" transmission line loss	-2.7 dB
Bi-directional amplifier gain	+70
Output Signal from Bi-directional amplifier	+24.3 dBm
Splitter losses	-3 dB
200 ft of 1/2" transmission line loss	-4 dB
Connector/jumper loss	-2 dB
Antenna gain	0 dB
Free space loss @ 100 ft.	-62 dB
Portable antenna inefficiency and body loss	-8 dB
Interior building loss	-5 dB
Received signal level at portable	<b>-59.7 dBm</b> <b>Level is greater than -95 dBm</b>

Table 2 below identifies the talk in to the existing fire department 800 Mhz trunked repeater from a portable radio within the facility. Again as in Table 1 this is a worst case scenario.

**TABLE 2**

Gain or Loss	Value
Portable transmit power	+34 dBm
Portable antenna inefficiency and body loss	-8 dB
Free space loss @ 100 ft.	-62 dB
Interior building loss	-5 dB
Antenna gain	+0 dB
Splitter losses	-3 dB
200 ft. of 1/2" transmission line loss	-4 dB
Connector loss	-2 dB
Bi-directional amplifier gain	+70 dB
135 ft. 1/2" transmission line loss (to outside antenna)	-2.7 dB
Antenna gain (roof antenna)	+5 dB
Free space loss @ 3 miles	-104.8 dB
Received signal level at fire or police repeater	<b>-82.5 dBm</b> <b>Level is greater than -95 dBm</b>

As both tables indicate, adequate signals will be present to provide for reliable portable communications with the new system.

### SECTION 3: ACCEPTANCE TEST PLAN

After the installation of the system there needs to be a procedure for quantifying the performance. The following is a proposed acceptance test plan for the basement level.

- Overlay a grid pattern on the floorplan drawings. Each grid to be a maximum of 20' x 20'.
- Perform a portable radio test from each grid that uses an agreed upon test message. Talk-out and Talk-in quality will be recorded using the industry standard Delivered Audio Quality (DAQ) test (see below).
- Each test will be witnessed by a representative from the Portland Fire Department. Record the DAQ for each grid.

Delivered audio quality is a numeric rating of speech intelligibility. Listening panels (groups of individuals convened to subjectively assess perceived speech quality) score the perceived intelligibility of speech samples using the rating scale below:

DAQ 1	Unusable. Speech present but not understandable.
DAQ 2	Speech understandable with considerable effort. Requires frequent repetition due to noise/distortion.
DAQ 3	Speech understandable with slight effort. Requires occasional repetition due to noise/distortion.
DAQ 3.4	Speech understandable without repetition. Some noise/distortion present.
DAQ 4	Speech easily understood. Occasional noise/distortion present.
DAQ 5	Perfect.

The system will be deemed acceptable if 95% of the grids meet a DAQ of 3.4 or better.