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FCC Mail Room

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the matter of	)	
	)	WT Docket No. 10-4
Amendment of Parts 1, 2, 22, 24, 90 and	)	
95 of the Commission's Rules to Improve	)	
Wireless Coverage Through the Use of Signal Boosters	)	
	)	

EX-PARTE COMMENTS REGARDING NOTICE OF PROPOSED RULEMAKING

August 12, 2012

The following comments are in reference to the proposed rulemaking as it applies to Part 90 Public Safety communications use of signal boosters. The issues pertaining to commercial signal boosters are significantly different and not addressed here.

New Signal Booster Classifications

Currently, Part 90 rules permit Class A signal boosters to retransmit a single licensed channel outside of confined spaces without separate licensing. The rules permit Class B signal boosters to retransmit multiple signals within confined spaces also without separate licensing. Licensing is not required in either case because the probability of interference from such signal boosters is very low, and equipment certification is adequate to ensure compliance.

Petitioners have requested the authorized use of Class B signal boosters outside of confined spaces because:

- Class B signal boosters are less expensive than Class A signal boosters
- Class B signal boosters are not likely to cause interference if properly design and installed
- Class A signal boosters are incompatible with newer digitally modulated narrowband signals.

Cost should not be a valid reason for increasing the likelihood of interference. What constitutes a properly designed and installed system is in the eyes of the beholder, well-defined accepted standards for either do not exist. There may not be many reported instances of interference from illegally installed Class B signal boosters because the interference effects of wideband noise and IM interference are difficult to isolate. Receiver noise floors increase by significant amounts above thermal noise, but it is difficult to pinpoint the source of interference. Intermodulation interference is intermittent, and occurs only for short periods of time when conditions are right. However, as the number of in-building signal coverage systems increases significantly in compliance with NFPA 72, the opportunity for interference will also increase significantly. The lowest cost system should not be the primary objective for in-building coverage systems. Public safety agencies need to be directly involved in the design, installation and test of these systems to ensure that the systems that they have mandated by the new fire codes do not erode the capabilities of their current radio systems, and that these radio systems will perform effectively in an emergency.

Most commenters seem to agree that the incompatibility of narrowband digital signals with the current Class A signal booster emission standards is sufficient to warrant a change to the rules regarding wideband signal boosters. However, widening the bandwidth of a signal booster to more than a single channel bandwidth poses risks to other

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users because wideband amplifiers engender intermodulation products, wideband transmitted noise, and the re-transmission of unauthorized signals. The magnitude of the risk to other users is very proportional to the passband of the signal booster. A signal booster that has a passband that is a relatively few channels wide, and has significant filtering outside of this passband poses a risk only to the few channels in the passband. A signal booster that is as wide as the service band poses a risk to all users in the band.

To accommodate narrowband digital signals, it is recommended that a new class of signal booster (i.e. Class C or AB) be authorized that permits a passband wider than the occupied bandwidth of the licensed channel(s), and limits emissions both within and outside of the authorized bandwidth. This is in lieu of permitting Class B signal boosters from being connected to external antennas. Because of the potential interference, this new class of signal booster should be frequency coordinated/licensed so that other users within the authorized bandwidth are aware of potential impacts to their services, and have the opportunity to not permit such interference. Outside the of the authorized bandwidth, emissions should be limited by bandpass filtering and other methods so as to not pose any risk to out of band users.

It is recommended that the existing Class A and Class B signal booster classes be retained, and continue to be authorized without separate licensing in accordance with the current rules, because there are design circumstances where they can and should be used and should not be burdened by unnecessary licensing.

New Signal Booster Class - In Band Signal Emission Limits

Within the authorized bandwidth of the new signal booster class, the objective should be to minimize unnecessary noise and spurious outputs, which might cause interference to other users within this band. Intermodulation products falling on channels licensed to other users, but within the authorized bandwidth of the signal booster, would be in-band to the signal booster, and controlled by this specification.

In-Band Thermal Noise

A "well designed" signal booster might have a noise figure of 6 dB. To achieve the maximum allowable signal booster EIRP of 37 dBm, a typical signal booster might have 80 dB of amplifier gain, and 10 dB of antenna system gain. The signal booster in-band noise ERP would be:

-174 dBm/Hz + 6 dB (NF) + 80 dB (Amp Gain) + 10 dB (Ant Gain) = -78 dBm/Hz or – 38 dBm in a 10 kHz bandwidth.

Intermodulation Products

The magnitude of the third order intermodulation products in a wideband amplifier is equal to IM_3 (dBm) = $3(P_o) - 2(OIP_3)$ for two-carrier products and IM_3 (dBm) = $3(P_o) - 2(OIP_3) + 6$ dB for three carrier products. Three carrier products generally have a higher magnitude.

A typical signal booster amplifier might have an OIP_3 of 55 dBm and a multi-carrier output signal level of 27 dBm. The IM_3 level would nominally be (3*27) - (2*55) + 6= -23 dBm or -50 dBc. Assuming a 10 dB antenna gain, the IM ERP would be -13 dBm per IM product.

Signal Booster Licensing

If the signal booster will be used by more than one agency, it should be separately licensed to each agency using the booster by authorized frequency, with a designated lead agency authorized for the entire bandwidth.

The license application should contain all details of the proposed configuration, especially the passband characteristics of the signal booster amplifier system, the licensed bandwidth, licensed and unlicensed channels in the bandwidth, and the location of the receiving and transmitting antennas. If requested by other licensees, the ERP on unlicensed channels within the licensed bandwidth should be provided.

After installation, the licensee should certify that the signal booster has been installed and tested in accordance with the approved license, and that the emissions on unlicensed channels do not exceed the requirements of the rules.

Signal Booster Definition

The term signal booster is commonly considered to be a band limited amplifier that is certificated as a signal booster, although the Part 90.219 rules clearly apply to more than this single hardware component.

Part 2.1 of the rules should be amended to include a definition for a signal booster as a communications system that receives, amplifies, conditions and retransmits a communications signal and includes all of the system component devices such as receive antenna systems, fiber optic devices, amplifiers, and transmit antennas that accomplish this signal booster function.

Confined Space Definition

The term confined space in Part 90.219 of the rules is not well defined. The rules should be amended to clarify this confined space as tunnels or underground areas where there is generally no signal leakage into or out of the space from normal terrestrial transmissions.

Signal Booster Amplifier Power Levels

Current Class A and Class B signal booster systems are currently limited to 5 watts per channel ERP. This per channel signal level should be retained and adopted for this new class of signal booster because it is comparable to the output level of a portable transceiver and limits the interference potential of the signal booster. It is also a level generally adequate to provide a reliable communications link. Even with the 5 watt limit, there is significant potential for interference with the proposed new signal booster rules, and therefore this ERP limit should not be raised.

There is no apparent reason to limit the total power of a wideband multicarrier signal booster provided that there is some sort of fail-safe, inherent, or automatic control of individual carrier levels. A 300 watt signal booster that provides multiple 5 watt signals should be permitted provided that emission limits are satisfied.

Signal Booster Amplifier Noise Floor/Noise Figure

The noise figure or noise floor of the signal booster will not adequately control the noise ERP level, which is influenced by many factors including the gain of the booster, and the characteristics of the input signal. This is better controlled by an overall ERP emission limit.

Signal Booster Amplifier Equipment Certification

Since the signal booster amplifier only comprises part of the overall signal booster system, it should only be tested to the capabilities that it is specified to provide by the manufacturer, such as noise figure, gain, AGC value, passband filtering etc. The only pass-fail criteria should probably be the manufacturer's own specifications since by itself it cannot satisfy the overall signal booster system requirements.

Signal Booster Self Oscillation Prevention

Some of the rules being proposed for Part95 and Part22 devices should also be extended to Part90 Public Safety SMR and Commercial SMR (Sprint-Nextel), for example the feedback oscillation prevention. The FCC should allow the signal booster to transmit periodically a test pilot tone for a short period of time, perhaps less than 250 milliseconds, when there is no traffic on the Agency channels, to support such a function.

Signal Booster Design and Installation

Because compliance with the rules cannot be accomplished merely by equipment certification, it is recommended that the agency licensed for the signal booster installation shall be responsible for compliance with the rules. In other words, a building owner might self-install or contract the installation of a signal booster, but the agency licensed for the signal booster should be responsible for compliance with the rules, because of the potential impact to public safety. This is quite different than the self-installation of a cell signal booster.

My Background

I am a retired communications system engineer.

I have provided consulting engineering services to the Boston Central Artery Project for the tunnel radio systems supporting the Mass State Police, Boston Fire, Boston Police and Boston EMS. I also provided engineering design for the NYC MTA East Side Access Project tunnel radio system as an engineer for the Parsons Transportation Group. This system will support FDNY and EMS, NYPD, MTAPD, and the LIRR. I am also a former Managing Director for the Comsat Communications Systems Division in Clarksburg, MD, with a BS in Electrical Engineering.

Respectfully submitted,

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