Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Parts 1, 2, 22, 24, 27, 90 and 95 of the Commission's Rules to Improve Wireless Coverage Through the Use of Signal Boosters	)	WT Docket No. 10-4
	)	

EX-PARTE SUPPLMENTARY COMMENTS ON NOTICE OF PROPOSED RULEMAKING

Bird Technologies ("Bird"), consisting of Bird® Electronic Corporation and TXRX Systems Inc. ("TX RX"), pursuant to the Commission's Notice of Proposed Rulemaking ("NPRM") of April 6, 2011[1], at the request of FCC Staff, would like to supplement its comments in the above-referenced proceeding.

Company Background

Bird Technologies is a global innovative supplier of RF products, systems, services and educational solutions. Bird specializes in developing and manufacturing products that serve both the management and measurement of radio frequency signals. TX RX has established itself as a leader in the design and manufacture of signal boosters, tower top amplifiers, transmitter and receiver multicoupler systems, duplexers, cavity filters, and a vast range of RF components primarily serving the public safety market where reliable, mission critical systems provide life saving communication.

TX RX, with more than 30 years experience serving critical Public Safety needs, has earned an unrivaled reputation for delivering high quality, reliable systems that enhance and extend the range of FCC Part 90 licensed radio communications to basements, subways, high-rise building and other locations where obstacles challenge life saving communications. TX RX Systems is the supplier of choice to major radio system operators and OEMs in North America. The equipment designed and manufactured by TX RX is the standard for interference mitigation and high-performance in many small, medium, and large enterprise communications systems as

[1] FCC 11-53, released April 6, 2011

well as mission-critical, agency-wide, county, city and statewide communication systems. TX RX's resume of projects includes the New York City Transit System, Hoover Dam, Department of Homeland Security, State of Pennsylvania, Washington MTA, University Health Care System (NC), Los Angeles MTA, Los Angeles Detention Center and Harbor, Disney, Cook County, Coors Brewery and many others.

TX RX is a leader in the specialized field of signal booster design and manufacturing and has the distinction of being the first American manufacturer that offered complete, fully-integrated signal booster systems. Since its deployment in 1980, the first TX RX signal booster system has provided uninterrupted radio service deep inside a coal mine in the Midwest. Today, TX RX has thousands of units in use around the world as a vital part of two-way radio, paging, data transmission, telemetry and control systems operating on frequencies from 132 to 960 MHz. Applications include communication systems for major international airports, high-rise buildings, subway systems, hydroelectric dams, copper and coal mines, aircraft carriers, nuclear reactor containment buildings, and the tunnel under the English Channel.

Summary

Bird Technologies applauds the Commission for its ongoing efforts to clarify and augment its rules to reduce the interference caused by signal boosters without undercutting the valuable service they provide in increasing wireless coverage inside buildings and other structures.

In response to a request from the Commission for further technical comment on various issues, Bird will attempt to clarify several of our previous positions with additional technical information. Bird will limit its following comments to part 90 signal boosters only.

If acted upon, the comments and suggestions below, when taken with our previous comments and the comments of others, will certainly lead to a reduction of interference caused by signal boosters. Additionally, these suggested rule changes and specifications are not so burdensome as to make the resulting equipment substantially more expensive to manufacture or install.

Section 90.219 - Power Limits

For the reasons mentioned in Bird's previous comments[2], we continue to support the 5W power limitations of section 90.219(b). However, the wording of this section is somewhat confusing and can be interpreted differently by individual TCB's. The existing wording is "Class A narrowband signal boosters must be equipped with automatic gain control circuitry which will limit the total effective radiated power (ERP) of the unit to a maximum of 5 watts under all conditions. Class B broadband signal boosters are limited to 5 watts ERP for each authorized frequency that the booster is designed to amplify."[3] This seems to imply that a class A signal booster is limited to 5 Watts of composite power and a class B signal booster is limited to 5 Watts per channel. It is the opinion of Bird that both class A and class B signal boosters should be limited to 5 Watts of output power per channel. There would be little risk to allowing class A signal boosters to operate on 5W per channel as class B boosters have been allowed to operate for 16 years.

Also, it should be noted that Effective Radiated Power (ERP) is a function of both the output power of the signal booster as well as the gain or loss of the antenna system. When a booster is certified, it is certified based on direct connect measurements and an assumed antenna system loss/gain is documented in the test report. It is then left up to the system designer and installer to ensure that the 5 Watt ERP is not exceeded. Thus, compliance with this rule is more of a concern for deployment of the signal booster.

Bird also suggests that the power output tests should be explicitly tied to the spurious and intermodulation products tests that are used to certify 90.210 (or similar) compliance. They should not be based on the compression point of the power amplifier. This is specified in TIA Standard 156 (para. 4.1)[4]. Currently, the lab tests required by the TCB's do not explicitly link maximum output power to spurious or intermodulation products as these are separate and unrelated parts of the tests. This should be explicitly updated in the Part 2 rules as suggested later in our comments.

Passband Width

[2] BTG NPRM Comments, filed July 25, 2011, page 2
[3] 47 C.F.R. 90.219
[4] TIA-156-A, Section 4.1

As stated in previous comments, much interference has been caused by signal boosters with overly-wide passbands. For this reason, Bird previously suggested requiring the passband of signal boosters be limited to "the smallest contiguous set of frequency bands that contain the licensee's frequencies."[5] However, Bird would advise against creating a certification rule that would only allow a single part of a band to be certified (ie. the NPSPAC band or the ESMR band). This is because the best configuration is largely installation- dependent. In some circumstances less interference will be caused by using an integrated piece of equipment that was specifically designed to amplify all parts of that band, as opposed to using a separate signal booster for each part of the band. Many problems are caused by multiple entities installing wide-band boosters with overlapping frequency windows. These problems can be avoided when a system is properly engineered by experienced professionals to take into account the existing signal environment. These experienced professionals are best equipped to determine on a case by case basis whether individual signal boosters per sub-band would create less interference than one signal booster that amplifies the entire band.

Passband Noise

While the passband noise in the output of a signal booster can certainly cause interference, it is difficult to specify meaningful limits. The main concern is the noise pedestal generated in-band by the booster. This noise pedestal is the sum of the input noise level, the gain of the signal booster and the noise figure of the signal booster. So, to minimize the amount of noise at the output of the booster, the booster should be designed with a low noise figure, and the licensee should use the minimum amount of gain to provide the desired coverage.

For noise figure, an additional certification rule may be warranted. This will limit how much a signal booster can degrade the signal to noise ratio of a system. While one may argue that this is a system-performance issue and not an interference issue, it can become an interference issue when (inadvertently) boosting other licensee's signals in a class B signal booster or in a multiple channel filter of a class A signal booster. Bird would suggest a limit of 10dB at maximum gain and 25dB over the entire gain adjustment or automatic gain adjustment (AGC) range of the booster.

[5] BTG NPRM Comments, filed July 25, 2011, page 5

A certification limit on the gain of a signal booster is not recommended. In certain installations high gain may be required by the system design and not pose a problem. An example of this would be a system connected to an extensive indoor coaxial DAS that has significant splitting and cable loss. In this case, a 95dB gain booster may be warranted without causing any interference issues. This is another example that points to the importance of using skilled professionals for the design and installation of signal booster systems.

Passband Edge Rolloff

Bird Technologies reiterates our earlier recommendation that the gain of a signal booster be required to roll off 35dB at 1MHz outside its passband. This specification should be tighter for UHF and VHF frequency bands, 0.5MHz for UHF and 0.25MHz for VHF, due to the frequency plans utilized in these bands. Others have suggested requiring passband rolloffs similar to the 3GPP standards.[6] However, it is Bird's view that these rolloffs are far too gradual. Signal boosters designed to these specifications would apply significant amplification to bands adjacent to the intended band.

Additionally, Bird would like to propose specifications for out-of-band noise. While the gain rolloff specification proposed above goes a long way to reduce inter-band interference, it does not eliminate the possibility of a signal booster generating significant noise outside its passband. The output filter limits the noise from the power amplifier. Therefore, if the output filter is chosen to have minimum rejection or is placed before the power amplifier, it will have a negative effect on out of band noise transmitted by the signal booster. The input filter typically has very little if any impact on the out of band noise transmitted by the signal booster. Bird suggests a maximum noise spectral density specification of -105dBm/Hz at 1MHz off the passband of the signal booster, assuming an input noise level of -174dBm/Hz.

Alternatively, if the Commission does not wish to specify a hard limit due to the difficulties of measurement and enforcement in the field, Bird would suggest it specify a roll off of the noise spectral density outside the passband. A value of 20dB for every 1MHz away from the passband would be an appropriate roll-off specification. This would be equivalent to the above specified -105dBm/Hz value for a signal booster with 80dB of gain and 5dB noise figure.

[6] CommScope NPRM Comments, filed July 25, 2011, page 3

Emissions

Although within Part 90 a signal booster is considered to be different than a transmitter (as it does not actually generate its own signals only amplifies them) the TCB labs still test them for compliance with 90.209 and 90.210. A look at any TCB report for a signal booster will show this. The tests are done by passing various signals through the signal boosters and verifying that the signal coming out complies with the required bandwidth specifications. Likewise, they test the spurious response by passing several signals through the signal booster and looking at the output for harmonics, intermodulation products and spectral regrowth. Bird believes these tests to be valuable and they should continue to be done, but the language of the rules should be clarified to ensure that all TCBs test the signal boosters in the same manner and it should be moved to a separate section specifically related to signal boosters. As mentioned earlier, this should include explicitly defining the rated output power of the signal booster as the maximum output power at which the signal booster still complies with the emissions criteria.

Rules Should Apply Equally to PLMR and Commercial services

It is the opinion of Bird that since public safety and commercial services share many of the same frequency bands or are in adjacent frequency bands, the above discussed rules should pertain to both types of services.

Signal Booster shutdown

However, as stated in Bird's previous comments[7] [8], if the Commission decides to mandate the automatic shutdown of signal boosters in the event of oscillation or non-compliance with technical parameters, this requirement should not apply to PLMR signal boosters that are used to extend radio coverage for public safety personnel. Radio coverage to these personnel is critical even if a signal booster is out of compliance with technical parameters or oscillating intermittently.

Linear Phase Digital Filtering

[7] BTG NPRM Comments, filed July 25, 2011, page 8
[8] BTG NPRM Reply Comments, filed August 24, 2011, page 4

Many of today's Class A signal boosters use digital filtering to obtain the sharp cutoffs required to only pass a single channel. As some have noted,[9] many times the bandwidths of these digital filters need to be widened to reduce the group delay of the signal booster which can be detrimental and cause inter-symbol interference in areas of multipath. In the interest of still providing steep rejection and low delays, some have proposed and implemented non-linear phase digital filters as they have lower delay at the center of their passband than linear phase digital filters. A comparison between a linear phase filter (left) and a non-linear phase (right) filter can be seen below in figure 1. While the non-linear phase filter exhibits a sharper amplitude rolloff for similar delay at the center frequency, the substantial passband group delay variation can be seen as you approach the corner frequency of the filter.

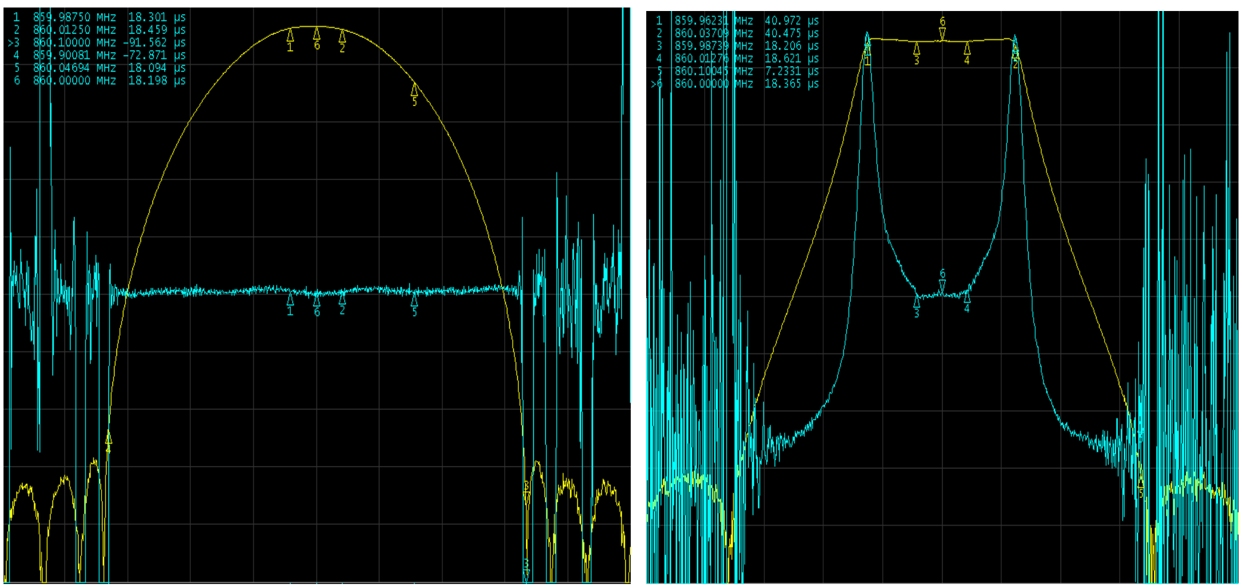

Figure 1

The result of this is that while the intended signal passing through the center of the non-linear phase filter will be relatively un-distorted, any adjacent channel signal passing through the filter could be drastically distorted, thus causing interference to that licensee. Bird would suggest the Commission specify a maximum group delay variation of 1 microsecond anywhere within the passband of a signal booster.

<u>Certification Rules</u>

[9] Jack Daniel NPRM Comments, filed July 25, 2011, page 15

As Bird stated in our earlier comments,[10] Part 2 of the Commission's Rules was never updated to add a section devoted to signal boosters and the Commission's labs never recognized them as a separate equipment class, but rather certify them as a "non-broadcast transmitter" or "amplifier." The only indication that the device is to be used as a signal booster is placed on the equipment certification as a comment. Furthermore, there has never been an indication on a Part 90 certification as to whether the equipment is Class A or Class B. Bird suggests that the Commission's Rules in Part 2 and Commission Forms be updated to more clearly define the certification of signal boosters.

Conclusion

The above proposed specifications, when taken with the previous comments of Bird and others, will certainly reduce the interference caused by signal boosters. As mentioned above, this potential for interference is reduced even more when the system engineering and installation are done by experienced professionals.

Bird Technologies Group respectfully asks that the Commission takes our views expressed above into account when drafting final rules in this proceeding.

Respectfully submitted,
BIRD TECHNOLOGIES

[10] BTG NPRM Comments, filed July 25, 2011, page 4