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February 7, 2002

Mr. William F. Caton, Acting Secretary  
Federal Communications Commission  
445 12th Street SW  
Washington DC 20554

**Re: ET Docket No. 98-153 -- Revision of Part 15 of the Commission's Rules Regarding  
Ultra-Wideband Transmission Systems  
*Ex Parte Communication***

Dear Mr. Caton:

Pursuant to Section 1.1206(a)(1) of the Commission's Rules, on behalf of XtremeSpectrum, Inc., I am electronically filing this written ex parte communication in the above-referenced proceeding.<sup>1</sup>

XtremeSpectrum responds to the February 1, 2002, filing of Qualcomm Inc. ("Qualcomm Filing").

This submission continues an ongoing exchange between XtremeSpectrum and Qualcomm. We respond here only to new arguments, and will not burden the record by revisiting old ones. *Our disinclination to reply yet again to repetitive arguments is not an acquiescence to those arguments.*

XtremeSpectrum has previously established that Qualcomm's interference analysis relied on incorrect assumptions which, when corrected, predict *no interference* from UWB into GPS-

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<sup>1</sup> XtremeSpectrum, with 67 employees, conducts research in ultra-wideband communications systems as its sole business. XtremeSpectrum intends to become a ultra-wideband communications manufacturer once the Commission authorizes certification of such systems. XtremeSpectrum takes no position on ultra-wideband radar applications.

based E911.<sup>2</sup> In order to maintain a purported showing of such interference, Qualcomm must now recant some of its previous positions and substitute new ones.

At the outset, we note that XtremeSpectrum offered *five months ago* to support the UWB restrictions in the GPS band that Qualcomm demands here.<sup>3</sup>

The attached "Technical Statement of XtremeSpectrum, Inc." is not an appendix, but an integral part of this submission. It documents the following points:

- The Qualcomm analysis assumed much higher UWB emissions levels than those supported by any party to the proceeding. The much lower levels proposed by XtremeSpectrum are safe for E911.
- Qualcomm's original analysis of E911 performance degradation used an appropriate methodology, which cannot now be deemed irrelevant.
- Qualcomm's original choice of GPS signal levels was appropriate, and should not now be retroactively changed.
- Qualcomm's analysis does not support its new assertion that PCS and cellular bands need the same level of protection as GPS.
- Qualcomm's use of free-space propagation over 100 meters indoors seriously misrepresents how radio waves behave.
- Qualcomm's test of UWB interference in isolation from all other RF sources greatly overestimates UWB interference.
- Qualcomm's demand for 10 dB of RF link margin is unjustifiable for a noise-limited system.

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<sup>2</sup> See our ex parte filing of January 3, 2002.

<sup>3</sup> See our ex parte filing of September 10, 2001.

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If there are questions about this submission, please call me at the number above.

Respectfully submitted,

Mitchell Lazarus  
Counsel for XtremeSpectrum, Inc.

cc: Chairman Michael Powell  
Commissioner Kathleen Q. Abernathy  
Commissioner Michael J. Copps  
Commissioner Kevin J. Martin  
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Lisa Gaisford, Chief of Staff, OET  
Karen E. Rackley, Chief, Technical Rules Branch, OET  
John A. Reed, Senior Engineer, Technical Rules Branch, OET

## **Technical Statement of XtremeSpectrum, Inc.**

In comments filed February 1, 2002, Qualcomm responded to a critique by XtremeSpectrum of their recent GPS E911 analysis.<sup>1</sup> Qualcomm not only fails to address many of our claims in this new response, but also makes several new and unsubstantiated claims. In particular, Qualcomm now asserts:

1. Its original quantitative measurements of GPS E911 performance are not to be used as a basis for establishing protection levels for GPS. Instead, Qualcomm now says, only C/No ratio analysis is relevant.
2. Both the PCS and cellular bands *also* need 35 dB of protection relative to Part 15.
3. GPS E911 service needs some type of *additional* RF link margin for safety

XtremeSpectrum has already proposed to limit UWB emissions in the GPS band to 34 dB below Part 15 levels, with an additional 10 dB suppression of spectral lines.<sup>2</sup> These proposals are shown to provide adequate protection in previous filings and continue to provide all of the protection that Qualcomm will need for its GPS E911 technology.<sup>3</sup> Claims for additional protection in the GPS band or excessive limitations in other bands are not substantiated. The following paragraphs detail a few of these recent claims made by Qualcomm and demonstrate that none have merit.

**Qualcomm claim:** *Qualcomm used appropriate emissions levels.*

Qualcomm now says its study used Part 15 levels (far above any now supported by any party) merely as a starting point to compute how much attenuation is needed below Part 15. Although that might have been a reasonable approach, it is not the approach Qualcomm actually used. Instead, Qualcomm assumed Part 15 UWB levels to raise a false alarm about supposed UWB interference out to 75 meters. Using XtremeSpectrum's proposed emissions levels, interference does not extend beyond a few tens of centimeters.

**Qualcomm claim:** *Analyses and measurements that quantify actual degradation in E911 system performance due to UWB emissions are inappropriate and irrelevant.*

Qualcomm faults XtremeSpectrum's analysis of measured GPS E911 performance degradation as irrelevant. In addition, Qualcomm notes that even the staff of the OET presented analyses showing the effect of various UWB emission levels on GPS E911 position error, and states that these too are irrelevant. Instead, Qualcomm claims that only their newest analysis based on carrier-to-noise ratios should be used as a basis for determining effective UWB emission limits.

XtremeSpectrum responds that measurements of GPS E911 performance degradation are completely relevant and that both XtremeSpectrum and OET were clearly motivated by the same analyses that Qualcomm presented in its original study. Yet Qualcomm now disavows its own previous analyses and expects all parties to rely only on its new idealistic noise floor analysis.

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<sup>1</sup> See Qualcomm *ex parte* filing dated January 11, 2002.

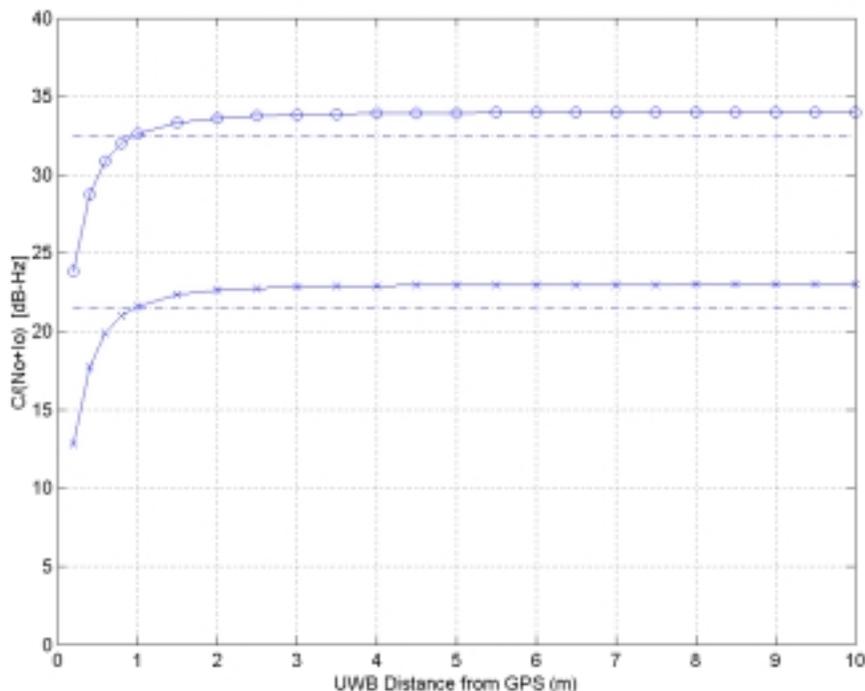
<sup>2</sup> See XtremeSpectrum filing dated September 10, 2001.

<sup>3</sup> See XtremeSpectrum filing dated January 23, 2002

***Qualcomm claim:*** *Qualcomm's initial analyses were based on GPS signals at -136 dBm, but all further analysis should be based on much weaker GPS signals (-147 dBm).*

This claim is misguided for two reasons. First, although Qualcomm might regret their initial choice of test parameters, even their own data show that signals levels as low as -147 dBm are only present in 5% or less of in-building cases, and that in-vehicle signal levels are likely to be higher.<sup>4</sup>

Second, and more importantly, Qualcomm's own analyses show that the received signal power doesn't matter in terms of the effect of UWB on GPS E911. To see this, we recall that GPS E911 is severely **noise-limited**: even relatively strong signal levels (e.g. -136 dBm) are already 300 times lower than the thermal noise power in the bandwidth of the GPS receiver.<sup>5</sup> Instead, it is the relationship between the received UWB power and the effective noise floor of the receiver that determines the effect of UWB emissions on GPS E911.



**Figure 1:  $C/(No+Io)$  for signal levels of both -136 dBm (upper curve) and -147 dBm (lower curve) versus UWB-GPS separation. Also shown for each case (dashed lines) is the effective performance limit with the inclusion of ambient non-UWB RFI at levels sufficient to raise the effective noise floor by 1.5 dB.**

<sup>4</sup> Qualcomm comments dated January 11, 2002 show in Figure 3-6 that the vast majority of in building case have signal levels higher than -147 dBm and they also indicate on page 14 that in-vehicle cases are more likely to exhibit stronger signal levels than in-building cases.

<sup>5</sup> It is helpful to understand that while Qualcomm uses values like 34 dB-Hz or 23 dB-Hz to represent the  $C/No$  ratio (carrier-to-noise-density ratio), these values are actually equivalent to -29 dB and -40 dB  $C/N$  ratio (carrier-to-noise power ratio) after subtracting 63 dB to account for the 2 MHz GPS bandwidth. Thus, a signal level of -147 dBm is equivalent to a  $C/N$  ratio of -40 dB, or a signal level 10,000 times smaller than the noise power in the GPS band.

This result is clearly seen in Figure 1 which presents the same results give by Qualcomm,<sup>6</sup> but here analyzed using the proposed UWB emission limit of 34 dB below Part 15 in the GPS band. We clearly see that the received signal power does not change the *effect* of UWB emissions on GPS E911, but rather it only changes the *magnitude* of the  $C/(N_o+I_o)$  ratio—as it would even if the UWB were not present. The plot clearly shows that even under interference-free conditions the UWB has no effect on the  $C/(N_o+I_o)$  ratio at ranges greater than about two meters.

Also shown in Figure 1 is the effect of real-world non-UWB RFI in these situations. In each case, a dashed line shows the upper bound on  $C/(N_o+I_o)$  when RFI is present at realistic levels.<sup>7</sup> This bound shows that real-world non-UWB essentially results in a degradation of the receiver noise figure. Under such conditions, the UWB emissions can have no effect on the GPS E911  $C/(N_o+I_o)$  ratio at ranges greater than **one meter**. It is important to remember that even the  $C/(N_o+I_o)$  results in Figure 1 are conservative estimates because they do not reflect any *measured* degradation in actual GPS performance. Despite Qualcomm's insistence that this  $C/(N_o+I_o)$  ratio should be the only basis for GPS E911 interference protection, their earlier filings clearly show that there is no detectable change in the GPS performance until the separation range is *significantly less* than the predicted range where the noise floor was impacted by 1 dB. This means that *detectable interference* only occurs when the separation is on the order of *centimeters*.

***Qualcomm claim:*** *PCS and cellular bands require the same level of protection as the GPS band because these systems provide one element of the GPS E911 solution.*

Qualcomm states that “XtremeSpectrum’s submission pretends that the only challenge to E911 service is in the GPS band” and that UWB emissions need to be 35 dB below Part 15 limits in the both the PCS and cellular bands.

XtremeSpectrum responds: Qualcomm’s submission provides absolutely no justification for the assertion that PCS and cellular service need the same level of protection as GPS. XtremeSpectrum has filed detailed analyses of the potential impact of UWB on PCS operations.<sup>8</sup> We have shown that 12 dB of attenuation relative to Part 15 levels is more than adequate to protect PCS networks in any realistic scenario.

***Qualcomm claim:*** *Qualcomm's original use of ideal free-space propagation was appropriate.*

Qualcomm does not justify its decision to assume free-space propagation to ranges in excess of 75 meters from UWB emitters to *indoor* GPS receivers. Even Qualcomm’s most recent filing still contains a plot of predicted noise-floor degradation that assumes

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<sup>6</sup> In comments dated February 1, 2002, Qualcomm presents such results for UWB emission levels corresponding to Class B limits, as well as for levels 12, 15 and 21 dB below Class B limits in Figures 4 through 7. Their analyses assume ideal conditions with no RFI and free space propagation to 70 meters.

<sup>7</sup> In this case we assume ambient environmental noise levels due to man-made and natural sources result in an increase of 1.5 dB above the receiver thermal noise floor. Noise floor measurements made by Sprint PCS (comments filed January 30, 2002) show levels of RFI at 1-1½ dB above thermal noise in the comparable 1.9-2.0 GHz band.

<sup>8</sup> See XtremeSpectrum filings dated April 25, 2001; May 10, 2001 and January 3, 2002.

UWB emissions at Part 15 Class B limits *and* free-space propagation to 100 meters, far beyond that 10 meter range that Qualcomm admits might be appropriate.<sup>9</sup>

**Qualcomm claim:** *Qualcomm's original test plan to isolate E911 receivers from any non-UWB RFI or non-ideal propagation effects resulted in a realistic picture of the effect of UWB on GPS receivers.*

It is certainly reasonable that Qualcomm would design a test to isolate the effect of UWB on GPS E911 receivers. But it is not reasonable to then present the results of this experiment as if they represent the expected system operation in a real-world RF environment. As we stated before:<sup>10</sup>

The measurements represent one component in a procedure that allows one to separately measure, understand, and apply (1) the effect of noise generated by UWB devices, (2) the effect of man-made and natural noise in the environment (i.e. RFI), and (3) the effect of propagation losses and distortion caused by the indoor surroundings. However, rather than considering each and adding them together, Qualcomm's analysis ignored propagation losses and RFI -- yet presented the results as if the tests represented a realistic and complete real-world view. In fact, the results represent a simplistic measurement of only a single factor affecting the performance of GPS receivers.

The effect of real-world RFI was clearly shown in the results of Figure 1 above. Qualcomm's continued disregard for other real-world factors and conditions only ensures that their results will be irrelevant to any real-world environments.

**Qualcomm claim:** *Safety-of-life systems (such as E911) need as much as 10 dB of RF link margin.*

As we showed above, GPS E911 systems operate at signal levels far below the GPS band thermal noise power. In this operating regime, these GPS receivers are already ***noise-limited***. There is no way that additional reduction of ambient RFI—UWB or otherwise—can possibly provide this additional margin to the GPS E911 link budget.

## **CONCLUSION**

Qualcomm has failed to justify any of its claims made in response to XtremeSpectrum's critique of the earlier GPS E911 analysis. XtremeSpectrum's proposed emission limits are safe for GPS E911.

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<sup>9</sup> Qualcomm comments dated February 1, 2002, Figure 1-2, page 11.

<sup>10</sup> XtremeSpectrum comments dated January 23, 2002, page 2.