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

In the Matter of	)	
	)	
Revision of Part 15 of the Commission's Rules	)	ET Docket 98-153
Regarding Ultra-Wideband Transmission	)	
Systems	)	

SPRINT REPLY COMMENTS

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Summary

Sprint has never opposed ultra-wideband ("UWB") technology. Sprint does object, however, to Commission rules that would permit UWB to cause harmful interference to Sprint's wireless operations. This interference will have the effect of lowering the quality of Sprint's services and reducing the capacity of its network. After paying the U.S. Treasury some $3 billion to use certain PCS frequencies and spending billions more constructing a state-of-the-art CDMA network, the Commission cannot now suggest that Sprint should attempt to redesign its network to minimize the interference impacts of UWB devices on its PCS network.

Sprint raises the following points in its reply comments which it is submitting in support of its reconsideration petition:

1. The record evidence is now undisputed that UWB devices will cause harmful interference to CDMA-based PCS networks. Time Domain Corporation ("TDC") and XtremeSpectrum, Inc. ("XSI") do not contest any of the technical errors that Sprint identified in the *UWB Order* concerning the CDMA air interface and the effect of UWB emissions in the PCS band. The few technical arguments TDC does make address peripheral points only and are factually incorrect. (XSI makes no technical response to Sprint's detailed technical demonstration.)

2. TDC concedes in its Opposition that the Commission can reduce the indoor UWB limits in the PCS band by 15 dB without impacting UWB performance. Although XSI claims that "some" of its products might be harmed by higher emissions limits, it fails to cite a single product that would be adversely affected.

3. TDC and XSI do not dispute that they have failed to meet their burden of proof by demonstrating that their proposed use of licensed spectrum will not cause harmful interference. This alone is grounds to reconsider the *UWB Order*.

4. TDC does not contest that the indoor UWB emissions limit in the PCS band is unexplained. XSI's assertion that the limit is explained is unsupported and factually erroneous.

5. TDC does not contest the fact that the *UWB Order* conflicts with the Commission's E911 policies and requirements. XSI's assertion that there is no conflict is unsupported and incorrect.

6. TDC does not challenge the Commission's error in not adjusting UWB emissions limits in the PCS band to account for the cumulative effect of multiple UWB devices. XSI's assertion that there is no cumulative effect problem, when it concedes that UWB signals do add, has been rejected by the Commission with respect to emissions limits established for bands other than PCS.

7. TDC and XSI do not challenge Sprint's demonstration that the *UWB Order* misclassified UWB surveillance systems and, accordingly, applied the wrong UWB emissions limits.

8. TDC and XSI do not challenge Sprint's demonstration that the Commission needs to impose send/acknowledge requirements on indoor UWB devices.

9. TDC and XSI have not opposed Sprint's request for a Commission order requiring them to make their UWB devices available for testing.

10. The Commission may not unlawfully introduce new interference in the PCS band or require Sprint to redesign its nationwide network The interference generated by UWB devices is fundamentally different and more severe than Part 15 devices. Since Sprint paid the federal government some $3 billion for its right to use certain PCS bands, the Commission may not now require Sprint to redesign its nationwide work to use a minimum signal level of –96 dBm rather than the –105 dBm it had been using.

11. The Commission should correct XSI's apparent belief that its UWB devices are exempt from the Part 15 interference rules. XSI erroneously believes that its devices are exempt because UWB emissions in the PCS band are spurious only.

12. The *UWB Order* does not reflect a conservative approach, and the Commission should promptly enter its reconsideration order so as to minimize the extent of harmful interference to licensed services. The record evidence is undisputed that UWB devices designed in compliance with the *UWB Order* will cause harmful interference to licensed PCS services. The traditional remedy for harmful interference is not practical with UWB devices: there may be many UWB devices; consumers will likely not know that the problem they encounter with their PCS service may be due to interference from UWB devices; many UWB devices will be mobile; and even if the interfering device could be identified, the PCS customer may have no realistic ability to stop the interference (because the customer does not control the offending UWB device). As a practical matter, only effective UWB emissions levels will protect PCS and other licensed services. The longer the Commission waits to revise its UWB emission limits, the greater the number of non-compliant UWB devices that will be sold and used in the marketplace.

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SPRINT CORPORATION REPLY COMMENTS

Sprint Corporation, on behalf of its wireless division, Sprint Spectrum L.P., d/b/a Sprint PCS ("Sprint"), submits these reply comments in support of its June 17, 2002 Petition for Reconsideration.[1] Sprint requests that the Commission expeditiously reconsider its *UWB Order* because the record evidence is now undisputed that UWB emissions will cause harmful interference to licensed PCS and MMDS services at the levels the Commission established in its *Order*.

Only two parties – Time Domain Corporation ("TDC") and XtremeSpectrum, Inc. ("XSI") – have opposed Sprint's Petition.[2] Sprint demonstrates below that the few arguments TDC and XSI advance in their oppositions lack merit. More fundamentally, TDC and XSI do not challenge most of the points that Sprint raised in its Petition. As a result, Sprint is entitled to reconsideration as a matter of law. The record evidence is now undisputed and, if the Commission does not correct the errors made in adopting UWB emission levels in the PCS band, its *Order* will be subject to challenge as arbitrary and capricious decisionmaking.

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[1] By motion dated August 13, 2002, Sprint sought the Commission's leave to submit reply comments longer than ten pages. The additional pages are needed to respond to the points made by TDC and XSI in their oppositions and to highlight the reconsideration issues they have not challenged.

[2] Several parties supported Sprint's Petition, including AT&T Wireless Services, Inc., the U.S. GPS Industry Council, and Wireless Communications Association International, Inc.

Two brief comments concerning XSI's Opposition merit mention at the outset. First, XSI would give the Commission the impression that its *UWB Order* will be affirmed on appeal so long as the Commission provides an explanation for its actions – *any* explanation.[3] XSI's argument is a misstatement of the law. This is evidenced by the recent *Aircell* appellate decision where the court held that explanations similar to those employed in the *UWB Order* did not meet the minimum requirements of the Administrative Procedures Act.[4] An agency decision will be affirmed on appeal only if the Commission considers all the record evidence and provides reasons based on that evidence.

> Conclusory explanations for matters involving a central factual dispute where there is considerable evidence in conflict do not suffice to meet the deferential standards of our review. Basic principles of administrative law require the agency to "examine the relevant data and articulate a satisfactory explanation for its action, including a rational connection between the facts found and the choice made."[5]

In this case, the Commission provided no explanation for the indoor UWB emissions limit in the PCS band; it ignored entirely certain highly relevant evidence (*e.g.,* the Telcordia Model, the Sprint Ambient Noise Study); and the conclusions it made concerning the CDMA air interface are factually inaccurate. As demonstrated below, neither TDC nor XSI challenges any of these points. Thus, based on the uncontraverted record evidence, the Commission must correct its conclusions in the *UWB Order* or its decision will be subject to challenge as arbitrary and capricious decisionmaking.

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[3] *See, e.g.,* XSI Opposition at 2 ("The PCS carriers may disagree with the Commission's explanations, but they cannot deny that the explanations exist."); at 13 (same).

[4] *See AT&T Wireless* v. *FCC,* 270 F.3d 959 (D.C. Cir. 2001), discussed in the Sprint Reconsideration Petition at 15-16.

[5] *AT&T Wireless* v. *FCC,* 270 F.3d at 968 (internal citations omitted).

Second, XSI's Opposition contains many sweeping and unsupported statements. Most of these statements are also factually inaccurate, as Sprint documents in Attachment 3. Past incorrect and unsupported statements have already distorted the Commission's decision in this proceeding. The Commission should take this opportunity to correct its reliance on these factual misstatements by issuing a reconsideration order that is properly supported by the record evidence.

Sprint appreciates that the subject of UWB technology is highly politicized. But the fact remains that the Commission is required by law to base its decision on the facts. As demonstrated below and in Attachment 3, the record evidence is undisputed: CDMA systems will encounter harmful interference at the UWB emissions levels established for the PCS band, and the Commission accordingly committed reversible error in its *UWB Order*.

I. TDC AND XSI DO NOT CHALLENGE MOST OF SPRINT'S DETAILED SHOWING THAT THE COMMISSION'S UNDERSTANDING OF CDMA TECHNOLOGY WAS FUNDAMENTALLY FLAWED

The Commission, in establishing UWB emissions limits in the PCS band, stated that it did "not have any data regarding the actual signal levels employed in PCS systems."[6] This statement is not accurate. Sprint specifically advised the Commission that it designs its state-of-the-art CDMA network to use a handset receive sensitivity of –105 dBm.[7] Sprint further advised the Commission that the limited field tests it conducted with TDC were consistent with Telcordia PCS/UWB Interference Model.[8]

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[6] Potential Interference to PCS from UWB Transmitted Based on Analysis from Qualcomm, ET Docket No. 98-153 (May 3, 2002)("FCC PCS/UWB Staff Report"). As Sprint previously pointed out, it is not apparent how a Commission order released on April 22, 2002 can rely on a Staff Report that was not submitted in the record until May 3, 2002.

[7] *See, e.g.,* Sprint Ex Parte Letter at 6 (Feb. 21, 2001).

[8] *See id.* at 5-6.

TDC and XSI responded by making a variety of unsupported arguments, which Sprint demonstrated were inaccurate in addition to being unsupported.[9] Yet, the Commission chose to rely on TDC and XSI misstatements – even though they have no experience in building and operating CDMA networks. The Commission also chose to ignore the Telcordia Model – even though TDC acknowledged that the Model "is an excellent theoretical analysis of the interaction between a 1.9 GHz CDMA PCS system and TM-UWB emissions,"[10] with XSI acknowledging that the Model is "well designed and carried out."[11]

Sprint demonstrated in its Reconsideration Petition that the Commission's understanding of CDMA technology was fundamentally flawed, largely because it relied upon the misstatements of TDC and XSI. Specifically, Sprint demonstrated that the following eight Commission statements were factually inaccurate:

Commission Statements:	**Sprint Demonstration in Response:**
A. "[T]he staff does not agree with Sprint that its PCS system is designed to work at a thermal noise level of –105 dBm."[12]	Sprint demonstrated that because of the spreading gain inherent in the CDMA air interface, the PCS handset, in fact, has a sensitivity (minimum decodable signal level) on the order of 13 dB below the thermal noise floor of the handset.[13]

[9] *See, e.g., compare* TDC Reply Comments at 39 (Oct. 27, 2000) *with* Sprint Ex Parte Letter at 5-6 (Feb. 21, 2001); *compare* XSI Ex Parte Letter at 4-9 (Jan. 3, 2002) *with* Sprint Ex Parte Letter at 2-7 (Jan. 31, 2002).

[10] TDC Reply Comments at 39 (Oct. 27, 2000).

[11] XSI Ex Parte Letter at 4 (Jan. 3, 2002).

[12] FCC PCS/UWB Staff Report at 4.

[13] *See* Sprint Reconsideration Petition, Attachment 1 at 4.

B. "The statement from Sprint PCS that PCS systems operate at the –105 dBm thermal noise floor is unreasonable."[14]	Sprint demonstrated that considering the design of the entire CDMA system, including the effects of other-cell interference, in-cell interference, and thermal noise, as well as the signal-to-interference plus noise ratio (SINR) requirements for the overhead (common) channels, a total received power from each base station that is near the thermal noise floor at the cell edge is a logical design.[15]
C. "[T]he staff sees no basis for protection of PCS receivers from a signal level that increases the thermal noise floor of the receiver by 1 dB, *i.e.,* from an emission that is 6 dB below the PCS receiver thermal noise floor."[16]	Sprint demonstrated that even fairly small increases in the effective noise floor can significantly degrade PCS network coverage.[17]
D. "TDC believes that the theoretical model of Telcordia does not accurately describe the results of real world open field testing, adding that it is not possible for the PCS receivers to detect UWB emissions even at separation distances less than 1 meter. . . . XSI also believes that the earlier Sprint PCS/TDC tests demonstrated that UWB devices would not cause substantial harmful interference to PCS. . . . We find that the testing in the anechoic chamber permitted the PCS receiver to function properly down to the thermal noise floor of the receiver. Once this equipment was placed outdoors in a simulated environment, the UWB emissions had no significant interference effect except at distances less than one meter."[18]	Sprint demonstrated that TDC's and XSI's assertions that the field tests were inconsistent with the Telcordia Model and anechoic chamber tests, and the Commission's conclusion to the same effect, are factually inaccurate.[19]
E. "XSI noted that the Sprint model did not . . . provide an allowance for interference from other base stations although this effect is shown to be significant, resulting in as much as	Sprint has demonstrated that this XSI assertion was false, because the Telcordia Model did take into account the effects of other cell interference.[21]

[14] FCC PCS/UWB Staff Report at 6.

[15] *See* Sprint Reconsideration Petition, Attachment 1 at 9-11.

[16] FCC PCS/UWB Staff Report at 4.

[17] *See* Sprint Reconsideration Petition, Attachment 1 at 21-23.

[18] *UWB Order* at ¶¶ 157-59.

[19] *See* Sprint Reconsideration Petition, Attachment B.

a 5 dB rise in the effective noise floor."[20]	
F. "XSI stated that it is important to note that the anechoic chamber eliminated all external RF noise and any potential interference due to other CDMA cells or multi-path which it says are the most important factors in understanding potential interference for a PCS network."[22]	Sprint demonstrated that the effect of a given UWB interference level on coverage reduction is the same, whether or not fading is explicitly taken into account.[23]
G. "XSI concluded that the live testing by Sprint PCS showed that effects such as interference, noise, and Rayleigh fading were severe enough to mask any effects predicted by the analytical model."[24]	Sprint demonstrated that with IS-95 CDMA, fading statistics are normally much less severe than indicated by the Rayleigh model, due to the use of multipath diversity, implemented in the RAKE receiver, typically using maximal ratio combining.[25]
H. "According to TDC, the model developed by Telcordia predicted that in an anechoic chamber IS-95 cellphones should not experience frame error rates greater than 2 percent at received signals levels as low as –105 dBm; however, in the open field the FER would jump momentarily to as much as 8 percent even when the received signal was as great at –85 dBm."[26]	Sprint demonstrated that frame errors are expected to occur even at high signal levels, because of the way in which the IS-95 downlink power control operates. A frame error is typically used as the trigger for a power increase. Power is reduced a small amount for each error-free frame. When a frame error occurs, power is increased (typically by 1 dB). Therefore, even in a static situation (no fading or change in path loss or interference), frame errors will occur on a regular basis.[27]

XSI's Opposition does not challenge the accuracy of any of these eight points, as Sprint demonstrates in Attachment 3.[28] TDC's Opposition references only two of the eight points, but

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[20] *UWB Order* at ¶ 158.

[21] *See* Sprint Reconsideration Petition, Attachment 1 at 6-9.

[22] *UWB Order* at ¶ 158.

[23] *See* Sprint Reconsideration Petition, Attachment 1 at 19.

[24] *UWB Order* at ¶ 158.

[25] *See* Sprint Reconsideration Petition, Attachment 1 at 18-20.

[26] *UWB Order* at ¶ 157.

[27] *See* Sprint Reconsideration Petition, Attachment 1 at 20-21.

[28] *See* Attachment 3 at 4-6.

the areas it questions involve peripheral matters that are not central to the two points mentioned.[29]

TDC's and XSI's failure to address these Sprint technical points means that the record evidence is now undisputed that the Commission's conclusions regarding the CDMA air interface are factually incorrect and that, as a result, the UWB emissions limits the Commission adopted for the PCS band are inconsistent with the record evidence. Accordingly, these limits must be changed on reconsideration, and the Commission should act quickly in this matter.

II. TDC CONCEDES THAT THE COMMISSION CAN REDUCE THE INDOOR UWB LIMITS IN THE PCS BAND BY 15 DB WITHOUT IMPACTING UWB

Sprint demonstrated in its Petition that the Commission's failure protect licensed PCS services is inexplicable because UWB emissions in the PCS band would be spurious emissions only – meaning they are not necessary for UWB devices to perform their designed functions.[30] TDC agrees with this Sprint point, describing its UWB emissions in the PCS band as "useless signals."[31] In fact, TDC acknowledges that the Commission could tighten the indoor UWB emissions limit by about 15 dB without having any negative impact on UWB devices. This is demonstrated by Figure 1 in TDC's Opposition, which Sprint reproduces below:

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[29] *See id.* at 1-4,

[30] *See* Sprint Reconsideration Petition at 26-27. Given this fact, the Commission's repeated assertions that it adopted a conservative approach in implementing UWB are simply not accurate. *See* Part XII *infra.*

[31] TDC Opposition at 5.

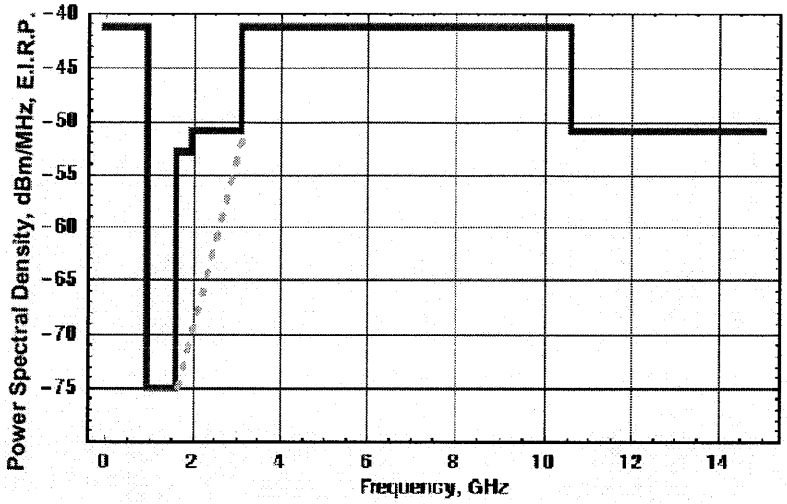

Figure 1. The FCC's indoor UWB mask. The dotted green line suggests how real UWB signals will roll off below 3.1 GHz.

As can be seen, the dotted line, which according to TDC represents the spectral rolloff of an actual UWB signal, crosses the 2 GHz PCS line at a level of about –68 dBm/MHz and drops rapidly as frequency decreases. This means that the indoor UWB emission limit in the PCS band (currently –53.3 dBm/MHz) could be reduced by about 15 dB (to –68 dBm) without impacting UWB designs in any way.

In contrast, XSI asserts that imposing more rigorous emissions limits on UWB devices in the PCS band "would, *in some cases*, impair performance" of its UWB devices.[32] XSI does not, however, identify any of its products that would, in fact, be impaired by the Commission's adoption of tighter emissions limits in the PCS band, but merely states that the "physics of UWB systems generally yields a shallow curve of emissions against frequency."[33] In addition, XSI's

[32] XSI Opposition at 21 (emphasis added).

[33] *Id.* If there were such a product, one would ordinarily have expected XSI to identify it in its opposition. It bears remembering, however, that the legal standard is not whether UWB manufacturers can design every possible UWB device they want, but whether proposed devices would interfere with licensed services. In this particular instance, based on TDC's own data, the Commission could provide additional protection to PCS services without negatively impacting UWB design in any way.

unsupported assertion that some of its products might be impaired by more rigorous limits on UWB spurious emissions is contradicted by the data TDC provided in Figure 1 above.

In summary, based on the evidence TDC submitted in its Opposition, the Commission should establish an indoor UWB emissions level in the PCS band of –68 dBm. It is noteworthy that –68 dBm is the indoor level Sprint recommended in its Reconsideration Petition.[34]

III. TDC AND XSI DO NOT DISPUTE THAT THEY HAVE FAILED TO MEET THEIR BURDEN OF PROOF

Neither TDC nor XSI challenges the demonstration Sprint made in its Petition that UWB proponents failed to make "an affirmative showing that their proposed devices would not cause harmful interference to existing licensees."[35] XSI, but not TDC, instead argues that it is excused from showing that its proposed use of licensed spectrum will not cause interference to existing licensees:

> The statutory language [of Section 7 of the Communications Act] places the burden of showing harm squarely on the opponents.[36]

XSI is mistaken. Section 7 has little (if any) relevance to this proceeding, and this statute certainly does not shift to licensees the burden of proof concerning the interference issue.

Section 7, which Congress enacted nearly 20 years ago,[37] provides that new technologies should be encouraged and that persons opposing a new technology "shall have the burden to

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[34] *See* Sprint Reconsideration Petition at 16-17.

[35] Sprint Reconsideration Petition at 10. Among other things, UWB developers largely ignored the Commission's request for the submission of interference studies even though, as a practical matter, only they could conduct such tests (because only they had access to their UWB devices). *See id.* at 8-9.

[36] XSI Opposition at 5.

[37] *See* PUB. L. NO. 98-214, § 12, 97 STAT. 1471 (Dec. 8, 1983).

demonstrate that such proposal is inconsistent with the public interest."[38] Neither Sprint nor any other CMRS provider has opposed UWB on public interest grounds.[39] In this regard, XSI recognizes that "no Petitioner contests the strong public interest in UWB."[40] Accordingly, the issue before the Commission was not whether UWB is in the public interest; instead, the issue was and remains whether UWB will cause harmful interference to PCS and other licensed services.

The Commission has consistently held – in decisions adopted both before and after the enactment of Section 7 – that persons proposing use of spectrum licensed to others must make "an affirmative showing" and "demonstrate conclusively" that their proposed use of licensed spectrum will entail "no potential for interference."[41] Neither XSI nor any other UWB proponent challenges the point that they have not met this burden as applied to the PCS band. This alone is grounds for the Commission to vacate its *UWB Order* as applied to the PCS band.

IV. TDC DOES NOT CONTEST THAT THE INDOOR UWB EMISSIONS LEVEL IN THE PCS BAND IS UNEXPLAINED

Sprint demonstrated in its Petition that the Commission did not comply with the core requirements of the Administrative Procedures Act ("APA") because it provided no explanation for its choice of -53.3 dBm as the indoor UWB emissions level in the PCS band.[42] TDC makes

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[38] 47 U.S.C. § 157(a). The inapplicability of this statute to this proceeding is further confirmed by the fact that the Commission did not, as the statute directs, complete action on the original UWB petition "within one year after such petition or application is filed." *Id.* at § 157(b). Had the Commission believed that this statute governed this proceeding, it would have completed it within the time periods specified by the statute.

[39] To the contrary, Sprint has been very clear that it "supports innovative new technologies, including ultra-wideband." Sprint Reconsideration Petition at 1.

[40] XSI Opposition at 2.

[41] *See* Commission decisions cited in Sprint Reconsideration Petition at 8 nn. 25-27. Besides, it is difficult for licensees to establish UWB interference where, as here, UWB developers have declined to make their devices available for testing.

[42] *See* Sprint Reconsideration Petition at 14-19.

no attempt to rebut this Sprint demonstration. In contrast, XSI contends that the Commission "clearly explained" its choice of –53.3 dBm for the indoor UWB limit:

> The basis for the indoor UWB limit of –53.3 dBm/MHz is clearly explained in the FCC staff analysis. The FCC's analysis . . . shows that the 12 dB of protection is more than adequate to protect PCS operations in all situations.[43]

The Commission in its *UWB Order* could not have possibly relied on the PCS/UWB Staff Analysis because that Analysis was not submitted in the public record until two weeks *after* the Commission released its *Order*, suggesting strongly that the Analysis had not been completed until after the *Order* was released.[44] In addition, nowhere in the Staff Analysis is there any explanation of why the Commission chose –53.3 dBm as the indoor emissions limit for UWB devices, as opposed to some other emissions level – as evidenced by the fact that XSI is unable to cite to any page in the Staff Analysis where the Staff allegedly explained the Commission's choice of the –53.3 dBm level. The fact is that the Commission's decision to adopt a –53.3 dBm emissions level for UWB devices in the PCS band is never explained – in the *UWB Order* or in the later PCS/UWB Staff Analysis.[45]

As noted above, TDC now concedes that the Commission could establish an indoor UWB emissions level in the PCS band of –68 dBm without impacting in any way the ability of UWB devices to perform as designed. Given this concession, the Commission should adopt an indoor

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[43] XSI Technical Statement at i.

[44] The Commission released its *UWB Order* on April 22, 2002. The Staff Analysis, while post dated back to February 14, 2002, was not submitted in the public record until May 3, 2002. It is reasonable to assume that the Commission would have released the Staff Analysis with its *Order* had the Analysis been prepared by that time.

[45] The Commission did seek comment on a –53.3 dBm emissions level in the NPRM, *see UWB NPRM*, 15 FCC Rcd 12086, 12103 ¶ 39 (2000), but the NPRM never explained this level and Sprint demonstrated in response that this level was insufficient to protect its PCS network from harmful interference.

UWB emissions level in the PCS band of –68 dBm, as Sprint proposed in its Reconsideration Petition.[46]

V. TDC DOES NOT CONTEST THE FACT THAT THE UWB ORDER CONFLICTS WITH THE COMMISSION'S E911 POLICIES AND REQUIREMENTS

Sprint demonstrated in its Petition that several portions of its *UWB Order* are arbitrary and capacious as applied to E911 service, a safety of life service, including:

- The Commission erred in not providing a 6 dB safety margin in the GPS band to account for uncertainties in the link budget analysis;[47]
- The Commission's refusal to add a 6 dB margin to the indoor UWB emissions level in the GPS band to account for the cumulative effect of multiple UWB devices is unexplainable, given that the Commission added such a margin to protect outdoor use of GPS from the effects of multiple UWB devices and given that proliferation of UWB devices will be more problematic indoors than outdoors;[48]
- The Commission's refusal to add a 6 dB margin to the indoor UWB emissions level in the GPS band to account for the greater sensitivity of satellite acquisition is unexplainable, given its decision to add such a margin for outdoor GPS use.[49]
- The Commission's decision not to extend any of the above protections to the PCS band is unexplainable, given that protections afforded in the GPS band are of no value unless similar protections are afforded in the PCS band.[50]

Sprint further questioned how the Commission can impose accuracy requirements on PCS carriers (and threaten them with enforcement action for any failure to comply), and then take steps that inhibit the ability of PCS carriers to achieve the accuracy requirements.[51]

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[46] *See* Sprint Reconsideration Petition at 16-17.

[47] *See id.* at 22-23.

[48] *See id.* at 23.

[49] *See id.* at 23-24.

[50] *See id.* at 24-26.

[51] *See id.* at 26.

TDC makes no attempt in its Opposition to rebut this showing. In contrast, XSI asserts that the *UWB Order* "is entirely consistent with the E911 mandate."[52] However, the extent of XSI's argument is limited to the following three sentences:

> [T]he PCS-band limits are more than adequate to protect the PCS link from UWB under actual operating conditions. Indeed, the Commission chose those limits in part to protect E911 operations. Indoor E911 is a difficult application that may not always work; but if it fails in a given situation, UWB will not be the reason.[53]

These sweeping and unsupported generalizations are wholly inadequate to rebut the detailed showing that Sprint made in its Reconsideration Petition.

TDC's and XSI's failure to address the technical points that Sprint made in its Reconsideration Petition means that the record evidence is uncontroverted: the *UWB Order* fails to protect the provision of E911 services in both the PCS and GPS bands.

VI. TDC DOES NOT CHALLENGE THE COMMISSION'S ERROR IN NOT ADJUSTING UWB EMISSIONS LIMITS IN THE PCS BAND TO ACCOUNT FOR THE CUMULATIVE EFFECT OF MULTIPLE UWB DEVICES

Sprint demonstrated in its Reconsideration Petition that the Commission erred in not providing additional protection to licensed PCS services to account for the cumulative effect of multiple UWB devices, given its recognition that PCS systems were subject to this increased risk of interference and given that it provided 6 dB of additional protection in the GPS band to account for cumulative interference.[54] TDC makes no attempt to rebut this Sprint demonstration. XSI readily concedes that UWB "signals do add,"[55] but then (inconsistently) denies that multiple UWB devices can cause cumulative interference, asserting the aggregation of UWB emissions is

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[52] XSI Technical Statement at vii.

[53] XSI Opposition at 24.

[54] *See* Sprint Reconsideration Petition at 27-29.

[55] XSI Technical Statement at ix.

"the long-standing urban myth of this proceeding."[56] The simple response is that the Commission has rejected XSI's position by providing additional protection to bands other than PCS to protect services from the effects of cumulative interference.[57]

XSI's discussion of aggregate interference warrants closer scrutiny. XSI first asserts in this portion of its Opposition that only the nearest UWB device has the potential to cause interference: "First, any interference scenario involving multiple UWB emitters is strongly dominated by the nearest emitter. All others combined make only a trivial contribution."[58] In support, XSI cites to two of its ex parte letters.[59] But these two letters do not contain any analysis; they rather contain the same unsupported conclusions that XSI repeats in its Opposition. Repeating over and over the same unsupported assertion does not make the assertion accurate.

XSI continues: "Any different result requires hopelessly unrealistic numbers of UWB emitters,"[60] and it then asserts that the Telcordia Model "assumed a UWB density of one device per 10 square meters":

> This is 100,000 devices per square km – equivalent to 10 UWB devices for every man, woman, and child in metropolitan New York City, all operating simultaneously.[61]

The XSI implication that the Telcordia Model assumed combined interference from multiple UWB emitters is false. The Telcordia Model did not examine the cumulative effect of UWB in-

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[56] XSI Opposition at 27.

[57] *See, e.g., UWB Order* at ¶¶ 87, 94, 195-96.

[58] XSI Opposition at 28.

[59] *See id.* at n.92.

[60] *Id.* at 28.

[61] XSI Opposition at 28.

terference because it conservatively assumed the validity of XSI's unsupported assertion that aggregate interference is a "myth":

> Assuming that the effect on the PCS handset is determined by only the nearest active UWB transmitter (that is, power addition from multiple UWB devices is ignored) . . . .[62]

The Telcordia Model did examine various densities of UWB devices to determine the probability that one UWB device would be sufficiently close to a PCS handset to cause harmful interference. However, the Model did not, as XSI asserts, "assume a UWB density of one device per 10 square meters." The summary curves given in Figures 13-16 of the Telcordia Model show the effect on a PCS system versus UWB device density, which ranges from 0 to 0.2 UWB devices per square meter.[63] Thus, in the Telcordia Model, the UWB density was treated as a parameter, not a fixed quantity.

Even so, it is noteworthy that in an office environment, one UWB device for each 10' x 10' cubicle (roughly 10 square meters) is hardly unreasonable. Such a density in an office environment does not mean that the same density will exist throughout an entire metropolitan area, as Telcordia clearly pointed out.[64] In addition, given XSI's statement that it will sell "tens of millions" of UWB devices,[65] it is clear that the likelihood PCS networks will face high densities of UWB devices in certain locations will be very strong.

XSI finally asserts in its aggregate effect section that UWB devices "cannot transmit at once in a small area":

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[62] Telcordia Model at 5.

[63] Telcordia Model at 20-21.

[64] *See* Telcordia Model at 10 ("Obviously, the average density of active UWB devices will be highly dependent on the environment (e.g., home, office, common public space, etc.).").

[65] *See* XSI Opposition at 6.

> Because UWB devices share a common radio channel, those within range of each other must take turns.[66]

This unsupported assertion is inaccurate – and somewhat surprising, coming from an entity that has UWB expertise. The large UWB bandwidth offers the potential for a large codespace and high processing gain, with the attendant multiple-access capacity. This means that in a properly designed UWB network, many channels can be supported simultaneously in the same spectrum, allowing large numbers of UWB devices to transmit at the same time. CDMA PCS and cellular systems are living examples of this principle. CDMA operates with a 1.25 MHz frequency channel and numerous CDMA handsets can (and do) use this bandwidth simultaneously. UWB will operate with a far wider bandwidth, with the result that even more UWB devices should be able to share the same bandwidth.

In summary, the sheer number of misstatements contained in XSI's Opposition only confirms that XSI is unable to present any facts rebutting the detailed technical demonstration that Sprint has made.

VII. TDC AND XSI DO NOT CHALLENGE THE MISCLASSIFICATION OF UWB SURVEILLANCE SYSTEMS

Sprint demonstrated in its Reconsideration Petition that the Commission erred in treating UWB surveillance systems as through wall-imaging systems when the Commission acknowledged that these devices are not imaging systems and that as a result, the Commission established the wrong emissions levels for UWB surveillance systems.[67] TDC and XSI make no attempt to rebut this demonstration in their respective Oppositions.

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[66] XSI Opposition at 28-29.

[67] *See* Sprint Reconsideration Petition at 30-35.

VIII. TDC AND XSI DO NOT CHALLENGE THE NEED TO IMPOSE SEND/ ACKNOWLEDGEMENT REQUIREMENTS ON INDOOR UWB DEVICES

Sprint demonstrated in its Reconsideration Petition that Commission erred in not imposing send/acknowledgement requirements on indoor UWB devices.[68] TDC and XSI in their Oppositions make no attempt to rebut this demonstration. They have also not challenged the fact that the Commission never explained its choice for a 10-second send/acknowledgement period, nor have they opposed Sprint's recommendation that the Commission instead use a three or five second send/acknowledgement period.

IX. TDC AND XSI HAVE NOT OPPOSED A COMMISSION ORDER REQUIRING THEM TO MAKE THEIR DEVICES AVAILABLE FOR TESTING

Although they have the burden of demonstrating non-interference and although the Commission specifically asked for the submission of interference studies, TDC and XSI chose not to submit such studies in the record (other than the Sprint/TDC-submitted Telcordia Model and tests).[69] These same UWB developers have been unwilling to share their devices so others can conduct such interference tests.[70] Sprint therefore asked the Commission to require TDC and XSI "to make available their devices (devices that comply with the *UWB Order*) to industry for testing" and that it further require them to provide "multiple UWB devices, so tests of the cumulative effect can be undertaken."[71] Neither TDC nor XSI opposes this recommendation.

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[68] *See* Sprint Reconsideration Petition at 35-36.

[69] TDC and XSI have never explained whether this omission is due to the fact that they have not conducted such studies, or they have conducted such studies but decided not to submit the results because the results were not helpful to their case.

[70] *See, e.g.,* Qualcomm Reconsideration Petition at 13 ("To date, the major proponents of UWB have refused to make their devices available to QUALCOMM for such testing.").

[71] Sprint Reconsideration Petition at 38.

X. THE COMMISSION MAY NOT LAWFULLY INTRODUCE NEW INTERFERENCE IN THE PCS BAND OR REQUIRE PCS CARRIERS TO REDESIGN NETWORKS ALREADY CONSTRUCTED

Sprint demonstrated in its Reconsideration Petition that the Commission erred in holding that PCS licensees do not hold exclusive licenses.[72] TDC and XSI in their Oppositions largely repeat the rationale the Commission used in rejecting Sprint's arguments. But what the TDC and XSI Oppositions do not do is address, much less rebut, are the points Sprint made in its Reconsideration Petition.

TDC states that under the Communications Act, "Sprint does not own the spectrum in fee."[73] But Sprint has never asserted that it "owns" a portion of the PCS frequencies. Rather, in TDC's words, Sprint has a "permit to use."[74] But in Sprint's case, the permit is supported by the government's receipt of valuable consideration (over $3 billion), which gives Sprint contractual rights against the government, rights not possessed by those holding radio licenses acquired by a comparative hearing or a lottery.[75]

XSI remarkably asserts that the Commission has "not authorized UWB in PCS spectrum."[76] Admittedly, many UWB applications must use spectrum above 3.1 GHz for their designed application. But the spurious emissions that the Commission approved certainly constitute use of the PCS band. The interference consequences on PCS licensees are the same, whether the UWB emissions are intentional or spurious.

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[72] *See* Sprint Reconsideration Petition at 4-8.

[73] TDC Opposition at 3.

[74] *Id.*

[75] Thus, the *Aircell* court decision referenced by XSI (*see* Opposition at 15-16), is not dispositive of this contract issue because the court decision involved cellular licenses for which the government received no consideration.

[76] XSI Opposition at 16-17.

The principal argument TDC and XSI advance is to repeat the arguments the Commission made in its *UWB Order* – namely, Part 15 devices were authorized at the time Sprint acquired its PCS spectrum and UWB emissions are lower than those established for Part 15 devices.[77] Admittedly, Sprint acquired its PCS spectrum with knowledge that certain Part 15 devices were allowed to emit in the PCS band. But the Part 15 rules can hardly be used to justify an entirely new use of the PCS band, which will raise the noise floor and adversely affect Sprint PCS' network coverage and service quality, because the Part 15 rules had prohibited virtually all UWB devices.

In short, Sprint paid the federal government some $3 billion for the right to use its PCS frequencies, subject to the interference that Part 15 devices may cause. The Commission may not now lawfully introduce entirely new and radically more severe interference after Sprint built its network under the expectation that only traditional Part 15 devices would be permitted. Nor may the Commission reasonably tell Sprint that it must redesign its $10 billion nationwide network to use a minimum signal level of –96 dBm, rather than –105 dBm, so as to make room for UWB interference. The injection of this new interference constitutes a modification of Sprint's PCS licenses and a reduction of Sprint's rights to use the PCS bands.[78]

The TDC and XSI argument that PCS licensees are protected because UWB emission limits are more stringent than the limits imposed on Part 15 devices is factually incorrect.[79] The Commission itself has recognized that UWB emissions are "considerably different from those of unintentional radiators and conventional Part 15 transmitters" and that as a result, would cause "a

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[77] *See* TDC Opposition at 4-7; XSI Opposition at 17-19.

[78] TDC's assertion – the "Commission's UWB decision does not modify their [PCS] licenses" (TDC Opposition at ii) – is unsupported and factually inaccurate.

greater amount of harmful interference to other radio operations than digital [Part 15] devices."[80] Sprint further submitted its Ambient Noise Study which documented the validity of the Commission's conclusions – but the *UWB Order* ignored this Study altogether.

As a general rule, one party to a contract has the flexibility to breach the terms of a contract – although such a breach ordinarily subjects the breaching party to damages liability. Sprint submits that same basic rule of contract law applies here.

XI. THE COMMISSION SHOULD CORRECT XSI'S FUNDAMENTAL MISUNDERSTANDING OF THE PART 15 INTERFERENCE RULES

Part 15 devices involve a secondary service, which means that they must accept any interference caused by other devices and may not cause any interference to licensed services. Commission Rule 15.5(b) is very clear on this point:

> Operation of an intentional, unintentional, or incidental radiator is subject to the conditions that no harmful interference is caused . . . .[81]

Operators of Part 15 devices that cause interference to licensed services must stop using their device and "may not resume until the condition causing the harmful interference has been corrected."[82]

Despite the clarity of the Commission's rules, XSI would give the impression that its devices are exempt from these core Part 15 requirements because its emissions in the PCS band will be spurious rather than intentional:

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[79] TDC's assertion – "Arguments that UWB is so different from what could heretofore be authorized in the PCS bands are similarly misplaced" (*id.* at 6) – is also unsupported and factually inaccurate.

[80] Sprint Reconsideration Petition at 6, *quoting UWB NPRM,* 15 FCC Rcd 12086, 12104 ¶ 40 (2000).

[81] 47 C.F.R. § 15.5(b).

[82] *Id.* at § 15.5(c).

> We have no doubt that the PCS carriers could stop a high-powered service whose *intentional* emissions caused actual harmful interference in their band, no matter what the service is called.[83]

The Part 15 interference rules apply to all emissions of Part 15 devices, whether "intentional, unintentional, or incidental."[84] The Commission should therefore remind XSI that its UWB devices are not exempt in any way from the basic Part 15 interference rules.

XII. THE UWB ORDER DOES NOT REFLECT A CONSERVATIVE APPROACH AND THE COMMISSION SHOULD PROMPTLY ENTER ITS RECONSIDERATION ORDER SO AS TO MINIMIZE THE EXTENT OF THE HARM

The Commission was led to believe that its *UWB Order* incorporated a "conservative" approach.[85] This belief is not supported by the facts, however. For example,

- According to TDC, an indoor UWB emissions level in the PCS band of –68 dBm would not affect the performance of UWB devices in any way.[86] A conservative approach would have used this emissions limit as the starting point for analysis. The Commission, however, instead adopted (without any explanation) an indoor UWB limit of only –53.3 dBm.
- The Commission has imposed rigorous location accuracy requirements on mobile carriers in connection with 911 calls, because of the importance of 911 service to safety of life. A conservative approach would have provided additional protection to PCS services to ensure that location accuracy provided to public safety agencies is not degraded because of UWB interference. The Commission provided some additional protection in the GPS band but without explanation it provided no additional protection in the PCS band. This action is inexplicable because in certain environments (*e.g.,* indoors), the CDMA network rather than GPS signals will provide the primary means of locating 911 callers.
- The Commission assumed an unrealistically high (–96 dBm) PCS minimum signal level to help justify its arbitrary UWB emission limits in the PCS band, even

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[83] XSI Opposition at 19 (emphasis added)

[84] 47 C.F.R. § 15.5(b).

[85] According to TDC, the word "conservative" appears 30 times in the *UWB Order,* the word "cautious" appears 11 times, and the word "limited" appears 36 times. *See* Ralph Petroff, Prepared Testimony before the House Committee on Energy and Commerce, FCC's UWB Proceeding: an Examination of the Government's spectrum Management Process (June 5, 2002).

[86] *See* TDC Opposition at 5, Figure 1.

> though Sprint specifically advised the Commission that it has used a –105 dBm receiver sensitivity in designing its network.

The Commission's failure to adopt a conservative approach for UWB emissions levels in the PCS band will cause irreparable injury to Sprint. Based on the now undisputed facts, the Commission has authorized UWB devices that will cause harmful interference to Sprint. Among other things, Sprint will be able to serve fewer customers with its existing PCS network, and the quality of its PCS services will be reduced, as customers face coverage gaps that did not exist before and as customers experience dropped calls they do not encounter today.[87]

The problem the Commission has created for PCS carriers is exacerbated because UWB developers say they will produce "tens of millions" of UWB devices.[88] Identifying the source of UWB interference so it can be stopped will be virtually impossible, because most consumers will have no idea that the reason their mobile phone no longer works is due to UWB interference and because so many UWB devices will be mobile. The Commission's observations concerning Part 15 radar detectors is equally applicable to UWB devices:

> Part 15 requires the operator of an unlicensed device (in this case, the user of a radar detector) to cease operation in the event the device causes harmful interference, even if that device is not subject to specific emission limits. However, identifying each individual source of interference from radar detectors is not practical for a satellite operator because these devices are mobile and therefore interfere intermittently.[89]

As a practical matter, it will also be impossible to remedy UWB interference even if the interfering UWB device could be identified:

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[87] *See* Sprint Reconsideration Petition at 10-14.

[88] *See* XSI Opposition at 6.

[89] *Part 15 Radar Detector Order*, ET Docket No. 01-278, FCC 02-211, at ¶ 11 (July 19, 2002).

> Further, these [UWB] interference sources are not under the control of the [PCS] operator, so in most cases it is not possible for the [PCS] operator to remedy the interference even if the source could be identified.[90]

The Commission has an obligation to protect licensed services from harmful interference. The record evidence is now undisputed that UWB devices sold in the market using the emissions levels adopted in the *UWB Order* will cause interference to both PCS and MMDS networks.[91] The Commission should expeditiously reconsider its UWB emissions levels in the PCS band, because, as it has recognized in a related context, "the only reasonable solution to this interference situation is to require [UWB devices] to comply with [effective] emissions limits before they are marketed."[92] The longer the Commission delays modifying its UWB emissions levels, the greater damage will be done to PCS and MMDS networks, because of the larger number of UWB devices that will have been sold in the market.

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[90] *Id.*

[91] Sprint concurs with the comments filed by the Wireless Communications Association International, Inc., and it will not repeat here the points WCA makes in its comments.

[92] *Part 15 Radar Detector Order*, ET Docket No. 01-278, FCC 02-211, at ¶ 11 (July 19, 2002).

XIII. CONCLUSION

For the foregoing reasons, Sprint requests that the Commission modify its *UWB Order* consistent with the position set forth above and in its June 17, 2002 Reconsideration Petition. Because of importance of the issue and because the vast majority of Sprint's reconsideration points are not challenged by anyone, Sprint further requests that the Commission enter its reconsideration order promptly.

Respectfully submitted,

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August 14, 2002

Sprint Reply Comments
Reconsideration of First Report and Order
ET Docket 98-153
August 14, 2002

Attachment 3[1]

Sprint's Response to the Time Domain and XtremeSpectrum Technical Arguments

Introduction

In Part A below, Sprint responds to the two technical arguments that Time Domain Corporation ("TDC") presents in its July 31, 2002 Opposition to its Reconsideration Petition. In Part B, Sprint responds to those arguments that XtremeSpectrum, Inc. ("XSI") presents in its July 31, 2002 Opposition and which it characterizes as "technical issues," although closer examination reveals that XSI does not present a single technical argument in its "technical issues" section. In Part C Sprint identifies some of the many unsupported (and erroneous) statements that XSI makes in its Opposition.

A. Response to TDC's Technical Arguments

TDC states in its Executive Summary that the extensive data which Sprint submitted in its Reconsideration Petition support rather than undermine the *UWB Order*:

> "On the technical side, the PCS interests provide information that undergirds rather than undercuts the Commission's conservative approach to UWB emissions from consumer devices."[2]

However, nowhere in its Opposition does TDC support this sweeping assertion. To the contrary, TDC confines its technical comments to two minor issues, neither of which have any bearing on the points made by Sprint in its Petition. Sprint addresses these two minor issues below.

1. Multipath Fading and RAKE Receivers. The FCC appeared to accept XSI's assertion that Rayleigh fading would mask any interference from UWB devices.[3] Sprint documented in its Reconsideration Petition that "fading does not serve to 'mask' the effect of UWB interference or make it less significant" and also observed:

> [W]ith CDMA, the effects of fading on the required signal power are not nearly as severe as would be suggested by considering a pure Rayleigh model, due to the effect of the RAKE receiver and the multipath diversity it provides."[4]

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[1] Attachments 1 and 2 are appended to Sprint's June 17, 2002 Reconsideration Petition.

[2] TDC Opposition, ET Docket No. 98-153, Executive Summary at ii (July 31, 2002).

[3] *See UWB Order* at ¶ 158.

[4] Sprint Reconsideration Petition, Attachment 1 at 20.

In an apparent reaction to this observation, TDC stated in its Opposition:

> "Sprint's argument implies that rake receiving sufficiently negates the impact of Rayleigh fading that *no fading margin is required* and, thus, a PCS handset can operate closer to its thermal noise floor."[5]

TDC has misrepresented Sprint's point. Sprint neither stated nor implied that the use of RAKE receivers would *eliminate* the effect of fading. To the contrary, Sprint clearly stated that the effect of the RAKE receiver would be to *reduce the severity* of the fading.

TDC also engages in a speculative and totally unsupported discussion about RAKE receiver implementation and the ability of a CDMA receiver to track signal path changes and to adapt as the handset moves around in a multipath environment. TDC refers to the outdoor Sprint/TDC test results, where there was an apparent signal variation due to multipath of about 4 dB. TDC then states that this 4 dB multipath induced variance in an outdoor environment is "close to the 5 dB variance assumed by TDC":

> Indoors, with a moving handset, the environment is much less benign. The receiver must be constantly adapting to the more widely varying multipath. In order to combine the signals from the three rake fingers properly, the receiver must recalculate numerical weights. Additionally, the rake fingers are more likely to lose their signals altogether further reducing the value of rake receiving. During this period of loss, there is no gain from the rake finger.[6]

On the basis of the foregoing, TDC asserts that "real-world data suggests that a 5 dB fading margin is reasonable and conservative."[7]

Importantly, TDC offers no technical references or any other credible basis to support its assertions. In fact, CDMA RAKE receiver architectures have been in operation for many years, and the CDMA air interface is designed to work at vehicular speeds in severe fading environments. In contrast, speeds are very limited in an indoor environment, and the fade rate indoors is correspondingly low.[8] Therefore, logic suggests that receiver reaction time will not be a limiting factor for indoor operation.

For example, the wavelength is 6 inches at a frequency of 1970 MHz. For a moderate indoor walking speed of three feet per second (roughly two miles per hour), on average there would be 12 fades cycles per second in severe multipath (reflected signals arriving from 360° around the receiver), or a complete fade cycle roughly every 83 milliseconds. This is over four times the 20-millisecond frame duration for IS-95, and will allow more than adequate time for adjustment of RAKE receiver parameters.

It is therefore unclear why TDC believes that the indoor environment will challenge reaction time of CDMA receivers, which have operated successfully for years at vehicular speeds. It is

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[5] TDC Opposition at 8 (emphasis added).

[6] *Id.* at 8-9.

[7] *Id.* at 9.

[8] Fade rate, or "Doppler," is proportional to the speed at which the handset or the environment around it is moving.

even less clear how TDC can conclude, based on the results of a single test, that "a 5 dB fading margin is reasonable and conservative."

More importantly, TDC has completely ignored the central point that Sprint made in response to the FCC's misconception that fading will mask the effects of UWB interference. Sprint specifically documented that the "supposition that fading somehow 'masks' the effect of external interference is . . . incorrect":

> If the desired signal must be X dB with respect to the noise floor (X can be negative in the CDMA case), and some margin Y dB must be allowed for fading, then the average received signal level must be $X+Y$ dB relative to the noise floor (the exact value of the margin will depend on the fading statistics). The average received signal level therefore must be $N+X+Y$ dBm. If the noise floor is raised by some amount Δ dB due to UWB interference, then the average received signal level must be $N+\Delta+X+Y$ dBm. The effective noise floor increase therefore translates directly to an increase in the required receive signal power, whether the desired signal is fading or not.[9]

In summary, TDC's first technical point, besides mischaracterizing what Sprint had said, is completely unsupported and does not address the principal point that Sprint made – namely, that multipath fading will not mask UWB interference.

2. The F_{no} Non-Orthogonality Factor. The FCC appeared to accept TDC's assertion that the limited Sprint/TDC field tests were inconsistent with the Telcordia Model, notwithstanding the Model's author's conclusion to the contrary.[10] In its Reconsideration Petition, Sprint reviewed the TDC calculations that the FCC relied upon and concluded that it is "unclear how TDC arrived at its result, but it seems to have misunderstood the [Telcordia] Model and, accordingly, misinterpreted the test results."[11] In passing, Sprint further noted TDC had not explained its choice of $F_{no} = 0.1$.[12] (The parameter F_{no} is the "non-orthogonality factor," which indicates the degree to which the orthogonality of the transmitted downlink codes is compromised at the receiver by multipath.)

Although this observation was not central to Sprint's overall critique of TDC's application of the Telcordia Model to the test results, it was the only point that TDC raised in its Opposition. TDC now explains that it chose the value, $F_{no} = 0.1$, "because it is a conservative value":

> Sprint states "[i]f perfect orthogonality is preserved over the propagation channel, then $F_{no} = 0$ and there is no in-cell interference. For system-level calculations, a typical value of F_{no} that is used is on the order of 0.5." If TDC had chosen a value 0.5, which Sprint states is typical, our analysis would have shown that UWB was even more negligible than TDC stated in its NPRM submission.[13]

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[9] Sprint Attachment 1 at 19.

[10] *Compare UWB Order* at ¶¶ 157 and 159 *with* Sprint Ex Parte Letter at 5-6 (Feb. 21, 2001).

[11] Sprint Reconsideration Petition, Attachment 2 at 6.

[12] *Id* at 5.

[13] TDC Opposition at 9 (emphasis in original).

The final sentence of this passage is puzzling, and unsupported by any calculations in the TDC Opposition, or references to calculations in other documents.

As is quite clear from Sprint's discussion that precedes the review of the TDC calculations, F_{no} plays *no role at all* in the relationship between the level of UWB interference and the required increase in downlink traffic channel power. Sprint stated that "the additional received traffic channel power required to compensate for the UWB interference is $\Delta P_{rx,traf} = I_{uwb}/M$,"[14] where I_{uwb} is the UWB interference power received by the handset and M is the jamming margin. Thus, contrary to TDC's new assertion, the value of F_{no} has no bearing on the additional downlink traffic channel power required to overcome the UWB interference.

Furthermore, the apparently arbitrary choice of F_{no} by TDC is not related to the errors that TDC made in its calculations. What *is* noteworthy is that TDC chose to take issue with an incidental remark in Sprint analysis while remaining completely silent on Sprint's critique of TDC's flawed attempt to claim that the test results were inconsistent with the Telcordia Model's predictions.

3. The Sprint Technical Points That TDC Does Not Attempt to Rebut. TDC's Opposition addresses minor points in only two of the eight technical errors that Sprint identified in its Reconsideration Petition. As demonstrated above, TDC does not contest the two points made, but rather addresses peripheral matters that do not affect the points Sprint made.

What is more significant, however, is that TDC does not even attempt to challenge the other six errors that Sprint identified in its Reconsideration Petition. Among other things:

- TDC no longer contends that Sprint should redesign its network to use a receiver sensitivity of –95 dBm, and it does not question Sprint's demonstration that it is reasonable for a CDMA network operator to design its network using a –105 dBm receiver sensitivity.
- TDC made no attempt to challenge Sprint's demonstration that the limited Sprint/TDC field tests are consistent with the Telcordia Model.

The technical errors that Sprint has identified, and which TDC does not challenge, require the FCC to recalculate the UWB emissions levels in the PCS band. On this issue, the record evidence is undisputed.

B. Response to XSI's "Technical" Arguments

Sprint advised the FCC that its IS-95 CDMA PCS system is designed for a minimum handset signal level of –105 dBm, which is equal to the noise floor of a CDMA receiver with an 8-dB noise figure.[15] FCC Staff stated that it does "not agree with Sprint that its PCS system is designed to work at a thermal noise level of –105 dBm," concluding that a receiver sensitivity of –96 dBm "appears to be acceptable as a minimum cellular signal level on which a decision regarding the impact of harmful interference can be based."[16] (It is rather remarkable that the FCC has

[14] Sprint Reconsideration Petition, Attachment 2 at 3.

[15] *See, e.g.,* Sprint Ex Parte Letter at 5-6 (Feb. 21, 2001).

[16] FCC PCS/UWB Staff Report at 4 and 6.

decided that Sprint does not know how to design its own network, especially given the FCC's concession that it does "not have any data regarding the actual signal levels employed in PCS systems."[17]) Nevertheless, Sprint documented in its Reconsideration Petition that these FCC conclusions are factually incorrect. Sprint specifically demonstrated that not only do PCS handsets have a sensitivity on the order of 13 dB below the thermal noise floor of the handset, but also that a total received power from each base station that is near the thermal noise floor at the cell edge is the logical network design.[18]

XSI in its Opposition makes no attempt to challenge the points that Sprint made in its Reconsideration Petition. Instead, XSI asserts that the FCC established UWB emission limits by taking into account "real world limitations on PCS operation[s]" and that Sprint and other PCS carriers "dispute" the FCC's receiver sensitivity of –96 dBm "but they offer no evidence as to why it is wrong."[19]

XSI's arguments are baseless. First of all, the FCC could not have possibly considered "real word limitations on PCS operations" given the FCC's statement that "we do not have any data regarding the actual signal levels employed in PCS systems."[20]

Second, Sprint explained in great detail (using mathematical formulas) why the FCC's conclusions are factually inaccurate – a demonstration that XSI has not questioned in any way. Thus, there is no factual predicate for XSI's assertion that Sprint offered "no evidence" demonstrating the FCC's errors.

Third, the only justification the Staff provided for its –96 dBm receiver sensitivity benchmark was its reference to the PCS boundary emissions level Rule 24.236.[21] But Sprint has already demonstrated the error in the Staff's analysis.[22] Specifically, the –96 dBm limit adopted by the Staff includes *all* power received from a PCS system at its coverage border, not just the power received from a single cell. Thus, using the total power limit of –96 dBm as the minimum desired signal power received from a single cell by a handset is not reasonable. Significantly, XSI makes no attempt to challenge this Sprint demonstration.

The FCC appears to have adopted a position that a CDMA handset receiver sensitivity of –96 dBm is supported by the limited Sprint/TDC field tests, with the FCC stating that "outdoors in a simulated environment, the UWB emissions had no significant interference effect except at distances less than one meter. We find that it is extremely unlikely that UWB devices will be located this close to a PCS receiver."[23]

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[17] *Id.* at 6.

[18] *See* Sprint Reconsideration Petition, Attachment 1 at 9-11.

[19] XS1 Opposition at 21. XSI makes the same arguments in its attached Technical Statement. *See* XSI Technical Statement at i-ii.

[20] FCC PCS/UWB Staff Report at 6.

[21] *See id.*

[22] *See* Sprint Reconsideration Petition, Attachment 1 at 8-9.

[23] *UWB Order* at ¶ 159.

As explained in Sprint's Reconsideration Petition, the downlink signal level received by the handset in the outdoor test varied between –96 and –92 dBm, or ±2 dB about an average of –94 dBm, a level which is roughly 10 dB higher than a typical cell-edge signal strength. At this –94 dBm level, the downlink traffic channel power allocation to the handset would be well below its maximum value, in the absence of UWB interference.

This is clearly shown in the Sprint/TDC test results. Without the UWB interference, the transmitted traffic channel power varied between 16 and 21 dBm without the UWB interference, compared to the maximum allowed value of 29 dBm (*i.e.,* the traffic channel power allocation was on average about 10 dB below its maximum). If the downlink signal level of –94 dBm truly represented a "minimum" signal level, then the traffic channel power would have been at or near its maximum value at that point, without the UWB interference.

However, this was not the case, and there was significant margin in the available traffic channel power to accommodate additive UWB interference, and in fact, the UWB transmitter had to be positioned within about one foot of the PCS handset before that margin was exhausted. At that point, the maximum allowed downlink traffic channel power was no longer adequate to overcome the UWB interference and the call eventually dropped.

These observations, taken directly from the outdoor live system test, clearly confirm that a downlink signal level within the observed range, –92 to –96 dBm, does *not* represent a realistic minimum level for PCS systems. If it did, there would not have been 8 to 13 dB of margin in the downlink traffic channel power allocation.

To summarize, the FCC selected the nominal –96 dBm "minimum" PCS signal level based on the border signal level limits in Rule 24.236, and has attempted to support that choice based some misleading statements from UWB proponents. Then, based on an observation from a single test with a downlink signal at approximately that level, the FCC concluded that "we do not believe that UWB devices will present a significant risk of harmful interference to PCS, particularly when evaluated under actual operating conditions instead of in a laboratory environment."[24] However, this entire chain of logic depends on the assumption that –96 dBm represents a realistic minimum signal level. The same test results that the FCC used to help justify its decision show that it does not.

C. Numerous XSI Assertions Are Not Explained or Supported

XSI makes numerous sweeping statements in its July 31, 2002 Opposition that it does not explain or support in any way. Many of these unsupported XSI statements are not factually correct, as Sprint demonstrates below:[25]

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[24] *UWB Order* at ¶ 163.

[25] Sprint limits this section to XSI misstatements that address the PCS band. Comments filed by others suggest there are similar problems in other portions of XSI's Opposition. *See, e.g.,* Multispectral Solutions Reply Comments.

XSI Unsupported Assertion No. 1:

> "The Commission's treatment [of UWB emissions in the PCS band] is detailed and thorough, taking up and addressing each major result from all submitted studies" (XSI Opposition at 2).

Response: This statement is false. The FCC ignored the Telcordia PCS/UWB Interference Study, presumably because it erroneously believed that the test results were inconsistent with the Model's predictions. The FCC also ignored entirely Sprint's Ambient Noise study, which demonstrated that UWB devices pose a much greater risk to PCS networks than traditional, narrowband Part 15 devices.[26]

XSI Unsupported Assertion No. 2:

> "But the Commission showed that the indoor (higher) limit is adequate to protect PCS under all realistic conditions" (XSI Opposition at 3).

Response: In fact, the FCC provided no explanation at all for its choice of an indoor UWB emissions limit of –53.3 dBm. Sprint has documented that virtually every assumption the FCC made and every conclusion it reached concerning CDMA is erroneous, and XSI has not challenged this Sprint demonstration in any way.

XSI Unsupported Assertion No. 3:

> "[S]everal petitioners allege potential interference to their services from UWB. But none of these have merit, and for the same reason: Each argues from hypothetical conditions that cannot arise in practice" (XSI Opposition at 3).

Response: Sprint provided specific facts detailing the errors in the FCC's analysis, including "real-world" PCS operations. XSI can hardly assert that Sprint's demonstration lacks merit, when XSI makes no attempt to demonstrate that anything Sprint stated was inaccurate.

XSI Unsupported Assertion No. 4:

> "Petitioners have not presented either factual or legal grounds for reconsideration" (XSI Opposition at 4).

Response: In fact, Sprint has submitted specific facts demonstrating the numerous errors in the FCC's analysis, and XSI has been unable to point to errors in Sprint's extensive critique.

XSI Unsupported Assertion No. 5:

> "All but one of the Petitions assert that UWB communications devices pose a risk of interference to licensed services. But none of the Petitions supports its claim" (XSI Opposition at 4).

Response: Sprint submitted two Attachments, totaling 30 pages single-spaced, which describe the FCC's errors in great detail. XSI has not even attempted to demonstrate that any of this Sprint analysis is flawed.

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[26] *See* Sprint Ex Parte Letter (Jan. 30, 2002). Appendix A, *Ambient Office Noise/Personal Computers and the Relative Impact of UWB Devices* (Jan. 18, 2002)("Sprint Ambient Noise Study").

XSI Unsupported Assertion No. 6:

> "The rules adopted in the First Report and Order adequately constrain UWB devices and eliminate any realistic threat of interference" (XSI Opposition at 4).

Response: XSI has not presented facts to support its assertion that the rules adopted adequately protect licensed PCS services from UWB interference.

XSI Unsupported Assertion No. 7:

> "[T]he Petitioners have failed [to] establish any significant defect in the First Report & Order, on either legal or technical grounds, that would justify reconsideration" (XSI Opposition at 5).

Response: Sprint has submitted 30 pages of detailed technical analysis showing errors that the FCC committed. XSI makes no attempt to demonstrate that any of the Sprint analysis is inaccurate in any way.

XSI Unsupported Assertion No. 8:

> "But UWB opens spectrum for tens of millions of new wireless devices . . . with negligible effect on existing services" (XSI Opposition at 6).

Response: XSI does not present a single fact in support of its assertion that UWB devices will have a "negligible effect" on licensed PCS services.

XSI Unsupported Assertion No. 9:

> "Because it can share fully-occupied spectrum without causing interference, UWB exploits spectrum capacity that would otherwise go unused" (XSI Opposition at 6-7).

Response: XSI does not present a single fact in support of its assertion that UWB devices will not cause interference to licensed PCS services. Indeed, as another major UWB developer has advised the FCC, "while some UWB advocates have claimed that UWB . . . can superimpose its emissions on existing services without interference thereby 'creating spectrum,' such statements are without basis in fact and, in fact, have shown to be false."[27]

XSI Unsupported Assertion No. 10:

> "The Petitioners' objections to UWB are premised on a presumed risk of interference into their respective services" (XSI Opposition at 7).

Response: Actually, UWB proponents have the burden of establishing that their proposed use of spectrum will not cause harmful interference to licensed services and, as Sprint demonstrated in its Reply Comments, no UWB proponent claims to have met this burden as applied to the PCS band. In addition, Sprint has documented that UWB will cause harmful interference to licensed PCS services, and neither XSI nor any other UWB proponent has demonstrated any error in Sprint's analysis.

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[27] Multispectral Solutions Comments at 12 (Sept. 12, 2000).

XSI Unsupported Assertion No. 11:

> "[T]hese [PCS] Petitioners do not challenge the adequacy of the Commission's analysis so much as the result" (XSI Opposition at 11).

Response: In fact, Sprint challenges both the result and the FCC's analysis, as is clearly indicated by the detailed technical papers Sprint appended to its Reconsideration Petition.

XSI Unsupported Assertion No. 12:

> "The discussion [in the *UWB Order*] systematically takes up and evaluates all of the major findings of all the submitted studies" (XSI Opposition at 11).

Response: This XSI assertion is not accurate, as the *UWB Order* ignored the Telcordia Model and Sprint's Ambient Noise Study.

XSI Unsupported Assertion No. 13:

> "The PCS carriers are free to disagree with the Commission's explanations. But they cannot deny that the explanations exist" (XSI Opposition at 13).

Response: In fact, the UWB Order provides no explanation at all for the –53.3 dBm indoor UWB emissions level in the PCS band. XSI also does not contest that virtually every assumption the FCC made and conclusion the FCC reached concerning the CDMA air interface is factually erroneous.

XSI Unsupported Assertion No. 14:

> "[A]ll of the interference claims presented here were addressed and resolved in prior stages of the proceeding. The petitioners add no new facts or analysis, but merely recycle arguments from their prior filings" (XSI Opposition at 19).

Response: As XSI should know, the principal purpose of reconsideration is not to introduce new issues, but rather to examine the FCC's decision in light of the existing record.[28] Sprint is compelled to "recycle" its evidence because the FCC largely ignored this evidence in its *UWB Order.*

XSI Unsupported Assertion No. 15:

> "[T]he Commission set UWB emissions limits that take into account real world limitations on PCS operation" (XSI Opposition at 21).

Response: This XSI assertion is not accurate, since the *UWB Order* contains no explanation or analysis regarding how the FCC arrived that the UWB emissions levels it adopted for the PCS band.

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[28] *See* 47 C.F.R. § 1.429(b).

XSI Unsupported Assertion No. 16:

> "The PCS carriers dispute [the Commission's] approach, but they offer no evidence as to why it is wrong" (XSI Opposition at 21).

Response: In fact, Sprint submitted detailed evidence in Attachments 1 and 2 to its Reconsideration Petition. What is noteworthy is that XSI has not even attempted to challenge the points that Sprint makes in these papers.

XSI Unsupported Assertion No. 17:

> "Setting aside unsupported assertions, the Petitions contain nothing to show that UWB under the adopted rules will interfere with PCS under actual operating conditions" (XSI Opposition at 21).

Response: XSI does not cite to a single statement in Sprint's Reconsideration Petition and Attachments that it thinks are "unsupported." XSI's additional assertion that these reconsideration papers contain "nothing" demonstrating the interference risk of UWB to PCS is palpably false.

XSI Unsupported Assertion No. 18:

> "Although XtremeSpectrum devices do not carry data at those [PCS] frequencies, implementing further cuts below 3100 MHz would, in some cases, impair performance in other parts of the spectrum" (XSI Opposition at 21).

Response: XSI does not recite a single UWB device that would be impaired if the FCC adopted more rigorous UWB emission limits in the PCS band. In fact, TDC recognizes that the FCC could reduce the limits by 15 dB (from –53.3 dBm to roughly –68 dBm) without negatively impacting UWB performance.[29]

XSI Unsupported Assertion No. 19:

> "[T]he PCS band limits are more than adequate to protect the PCS link from UWB under actual operating conditions" (XSI Opposition at 24).

Response: XSI does not present a single fact in support of its assertion that the emission limits established in the *UWB Order* are "more than adequate" to protect PCS from UWB interference.

XSI Unsupported Assertion No. 20:

> "Indoor E911 is a difficult application that may not always work; but if it fails in a given situation, UWB will not be the reason" (XSI Opposition at 24).

Response: Once again, XSI does not present a single fact in support of its assertion that UWB devices will not cause interference to PCS services when used in dialing 911 emergency calls or when used in identifying the location of the PCS caller.

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[29] *See* TDC Opposition at 10, Figure 1.

XSI Unsupported Assertion No. 21:

> "Some petitioners continue to insist the Commission adjust emission levels to account for cumulative UWB interference. The supposed aggregation of UWB emissions is the long-standing urban myth of this proceeding" (XSI Opposition at 27).

Response: XSI may believe that cumulative interference is a "myth," but the FCC nonetheless added 6 dB to the UWB emissions limits in the GPS band specifically to protect the use of the GPS band from the cumulative interference effects of multiple UWB devices."[30] Where the FCC erred is in not extending the same protection to the PCS band, especially when the FCC recognized that PCS networks are at risk to cumulative UWB interference.[31]

XSI Unsupported Assertion No. 22:

> "The basis for the indoor UWB limit of –53.3 dBm/MHz is clearly explained in the FCC staff analysis" (XSI Technical Statement at i).

Response: This assertion is inaccurate, as the FCC PCS/UWB Staff Report nowhere explains how the FCC arrived that the indoor UWB limit of –53.3 dBm, as opposed to a different limit.

XSI Unsupported Assertion No. 23:

> "The FCC's analysis (and that of others, such as XSI) shows that the 12 dB of protection is more than adequate to protect PCS operation in all situations" (XSI Technical Statement at i).

Response: This XSI assertion is also inaccurate, as neither the *UWB Order* nor the FCC PCS/UWB Staff Report explains why the 12 dB of protection is "more than adequate" to protect PCS operations in all situations.

XSI Unsupported Assertion No. 24:

> "Sprint's claim that the FCC could have provided adequate protection in the PCS band without impacting the functionality of UWB devices is unfounded. In fact, arbitrarily low limits for out of band emissions will impact the performance, functionality and economic feasibility of UWB devices" (XSI Technical Statement at i).

Response: Not only does XSI fail to support this assertion with a single fact, but also XSI's assertion is inconsistent with the position taken by another major UWB developer, TDC.[32]

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[30] *See UWB Order* at ¶ 87, Table 1, and ¶ 94.

[31] *See id.* at ¶ 233.

[32] *See* TDC Opposition at 10, Figure 1.

XSI Unsupported Assertions No. 25:

> "The FCC Office of Engineering and Technology (in staff comments filed Feb. 14, 2002 pages 5-6) demonstrated that –96 dBm is a reasonable minimum level" (XSI Technical Statement at i).
>
> "In fact, the FCC gives a reasoned justification in its comments dated February 15, 2002 (*id.* at ii).

Response: First of all, the FCC Staff Report was filed not on February 14, 2002, but on May 3, 2002 – or two weeks after the FCC released its *UWB Order*. Second, although the FCC Staff did decide that –96 dBm was a reasonable minimum level, Sprint has demonstrated that the Staff's analysis is fundamentally flawed,[33] and the analysis cannot as a result, be accurately characterized as "a reasoned justification." Significantly, XSI has not even attempted to challenge this Sprint critique of the Staff's analysis.

XSI Unsupported Assertion No. 26:

> "The FCC staff analysis contains a clear and appropriate explanation of the basis for the minimum signal levels determined by the FCC" (XSI Technical Statement at ii).

Response: While the FCC Staff did give an explanation for its choice for a CDMA receiver sensitivity of –96 dBm, Sprint has demonstrated that the Staff's supporting analysis is flawed,[34] and XSI has not questioned the validity of Sprint's critique.

XSI Unsupported Assertion No. 27:

> "The FCC staff analysis . . . also shows that they carefully considered all of the information submitted by the PCS companies and other parities in the public record" (XSI Technical Statement at ii).

Response: This XSI assertion is not accurate. The FCC Staff did not consider the Telcordia Model, presumably because of Staff's mistaken belief that the test results were inconsistent with the Model's predictions. The FCC Staff also did not consider at all Sprint's Ambient Noise Study.

XSI Unsupported Assertion No. 28:

> "None of the more recent claims made in the petitions for reconsideration undermine the FCC's justification for the adequacy of the current regulations" (XSI Technical Statement at ii).

Response: This XSI assertion is palpably false, as demonstrated above.

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[33] Sprint Reconsideration Petition Attachment 1 at 8-9.

[34] *Id.*

XSI Unsupported Assertion No. 29:

> "In its analysis, the FCC explains that even if PCS operation in an anechoic chamber is possible at levels as low as –105 dBm, real world conditions require signal margin to combat the effects of multipath fading, RFI, interference from other cells, sub-optimal antenna alignment, and potential signal attenuation due to the users hands, head, etc." (XSI Technical Statement at ii).

Response: As Sprint has explained, the anechoic chamber tests used a test set to generate the downlink signal, with no automatic power control, to verify PCS handset sensitivity and the coupling between the UWB transmitter and the PCS handset receiver under controlled conditions.[35]

As is well-known, the factors mentioned by XSI, which relate to the path attenuation of the desired signal and the interference received from other cells, are constantly changing in the "real world," and CDMA systems use closed-loop transmit power control to compensate for these changes, maintaining the signal to noise plus interference ratio (SINR) at the required level, or more precisely, maintaining the average frame error rate at the required level. Sprint explained the operation of downlink power control in its Reconsideration Petition.[36] As can be clearly seen in the "live system" test results, the downlink will vary the traffic channel power allocation to the handset in response to changes in path loss and interference.[37]

XSI Unsupported Assertion No. 30:

> "The FCC determination is completely supported by other data submitted by Sprint that documents the degree of multipath fading that can be experienced in real world systems. This data shows that receive signal fading causes signal fluctuations of up to 30 dB in the first plot (Figure 11), and even under *extremely optimistic* assumptions of 3 equal strength Rayleigh components, sophisticated rake processing still results in multiple fluctuations of 8-10 dB in signal level at the rake combiner output (figure 12)" (XSI Technical Statement at ii).

Response: Although the point of this assertion is unclear, it suggests a fundamental lack of understanding about CDMA PCS system operation. As has been explained by Sprint, the RAKE receiver reduces the severity of the signal variation due to multipath. The residual signal variation is mitigated by a combination of power control and averaging over the 20-millisecond CDMA frame, depending on the fade rate. At vehicular speeds (*e.g.*, 60 mph), the faded signal may vary significantly over the frame. Symbol interleaving, combined with convolutional coding and soft-decision Viterbi decoding effectively averages the signal variations over the frame. At pedestrian speeds, the signal variation during a frame will be minimal, but closed-loop power control compensates for the fading, as noted above. In either case, the net result is to maintain the average SINR at the level required to deliver the target average frame error rate.

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[35] Sprint Reconsideration Petition Attachment 2 at 1-2.

[36] Sprint Reconsideration Petition Attachment 1 at 20-21.

[37] *See, e.g.,* Sprint Reconsideration Petition Attachment 2 at 3, equation (4).

CERTIFICATE OF SERVICE

I, Jo-Ann Monroe, hereby certify that on this 14th day of August 2002, copies of the foregoing "Sprint Reply Comments" were served by U.S. first-class mail, postage prepaid, to the following:

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