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	)	

To: The Commission

REPLY COMMENTS OF SiRF TECHNOLOGY, INC. & TRIMBLE NAVIGATION LIMITED

SiRF Technology, Inc. ("SiRF") and Trimble Navigation Limited ("Trimble"), pursuant to Section 1.415 of the Commission's Rules, 47 C.F.R. § 1.415, hereby submit their Reply Comments in connection with the Commission's Notice of Proposed Rule Making ("*NPRM*") in the above-captioned proceeding.[1] SiRF and Trimble provide their specific perspective on subject and implications of ultra wideband ("UWB") devices on receivers operating with the Global Positioning System ("GPS") and other radio services that operate under the Commission's longstanding frequency domain spectrum management regime.[2]

Spectrum Stewardship is Needed to Protect the National Information Infrastructure ("NII")

The intent of this submission is to express our deep concern for preserving the NII, and the world's International Information Technology (IT) economic engine that is critically dependent on predictable and reliable management of the broadcast radio

[1] *Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, Notice of Proposed Rule Making, FCC 00-163, slip op. (rel. May 11, 2000) ("*NPRM*").

[2] As a member of the U.S. GPS Industry Council, Trimble also fully endorses the views and positions that are expressed in the Council's Reply Comments that are being filed in the instant proceeding today.

frequency spectrum. Except for direct satellite broadcast television, the vast majority of services for the NII and the world's IT engine reside in frequency bands below 3 GHz. In addition to GPS, these services include, but are not limited to Personal Communications Service, cellular radio, mobile-satellite services, Multichannel Multipoint Distribution Service, broadcast radio and television, Satellite Digital Audio Radio Service, and restricted services for aviation and public safety.

Spectrum Stewardship Requires Comprehensive Testing

As these affected services become aware of the potential for interference from UWB, there is an increasingly broad consensus on the need for comprehensive and exhaustive testing of UWB prior to the adoption of any rules that permit the introduction of devices using UWB technology. However, the focus of testing to date under programs being conducted by Stanford University (for the Department of Transportation), the University of Texas/Austin (for Time Domain Corporation, a UWB proponent), and the National Telecommunications and Information Administration ("NTIA") has been limited to determining the susceptibility of GPS receivers to a few individual, assumedly representative, UWB waveforms (or more accurately, "pulse trains"). In particular, NTIA is looking at the potential for only single emitter UWB interference to aviation systems such as radars. While the objective of these tests is to accumulate a body of data on interference susceptibility, the limited UWB and GPS equipment involved will yield only anecdotal information.

Apparently due to expedited time constraints, NTIA testing is primarily based on measurements of average power that can be made more easily, rather than on peak

power, which are far more difficult to measure. Measuring the average power of UWB devices over a one-second interval, instead of the peak power of UWB pulses on a per-nanosecond basis, ignores the potential non-linear effects and therefore understates the interference risk. This will therefore produce results that are not indicative of the interference to be caused.[3] Additionally, the loss of resistance of a GPS receiver to pulsed interference at a higher duty cycle cannot be measured with the single or small number of UWB generators planned for these tests. No set of measurements on an individual UWB source can correctly capture the effect of multiple interference sources. If an individual source yields a pulsed waveform at the output of the filters in the front end of the GPS receiver, then it may have a small interference effect. However, an aggregation of UWB interference sources will not have such a modest effect. Taken together, they will occupy a larger fraction of time and their effect will be much worse.

Expedited Testing and Analysis Will Lead To Flawed Data

In parallel with this testing effort, the NTIA has collected a series of GPS/UWB operational scenarios in an effort to derive performance parameters for link budget analysis as the basis for developing acceptable interference thresholds. These thresholds would then become the basis for a regulatory regime that could permit UWB spectrum sharing at "acceptable" interference levels. The cornerstone output of the NTIA test program is the link budget analysis described in its September 7 Plan (see http://www.ntia.doc.gov/osmhome/uwbtestplan/gpstestfr.htm). This plan assumes

[3] The front end of many GPS receivers is wideband. The narrowband filters only appear deep inside the receiver. Consequently, the front-end elements are exposed to the peak power of the UWB pulse. They do not enjoy the protection of a filter to smooth the UWB waveform into a more nearly

simple extrapolation to define composite interference. The assumption is made that data obtained from tests of a limited number of individual UWB emitters can be used in a simple calculation to predict composite interference from extrapolated aggregate use. Instead of using instantaneous peak power calculations, the link budget plan calls for interference threshold levels, UWB transmit power levels, and the EIRP to be calculated on the basis of an average over 20 MHz when the individual monocycle UWB pulse operates at 1-2 GHz. Consequently, the UWB peak power, which is different from the average power, will not be reflected in this analytic model, leading to a significant understatement of the potential for interference. Again, the impact of the pulsed signal, the effect of which does not increase linearly with pulse width, is inadequately represented by this model.

Proposed Link Budget Analysis Leads to Inappropriate and Flawed Conclusions

To compound matters, applying link budget analysis to mixes of continuous waves and pulsed transient signals is unreliable for predicting interference. Mixes of continuous wave and pulsed transient waveforms should instead be analyzed in a time-frequency analysis. Therefore, the expedited output analysis being carried out by NTIA will lead to an inappropriate and flawed conclusion and cannot serve as a reliable basis for the adoption of rules ostensibly designed to protect GPS, let alone for the protection of any of the other affected commercial services which are not even considered. Even if the analytical techniques could be corrected, the NTIA test program does not include 1) the demonstrated instability of the UWB waveform due to near-field antenna

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continuous waveform that could be characterized by average power. As such, any thorough evaluation of interference to GPS must include an examination of possible non-linear effects in the receiver front end.

coupling; 2) experimental verification of the multipath and pulse aggregation effects of multiple networked UWB devices; 3) transfer of measurement instrumentation and expertise from the high-energy physics community to capture composite real-time energy data for interference analysis; and 4) experimental verification of large scale limited geographic area deployment.

UWB Interference Places New Burdens on the Consumer

While the NPRM began with the objective of introducing a new radar-like technology on a non-interfering basis, one UWB proponent, Time Domain, acknowledges that its devices do interfere.[4] (see footnote). The original proposal objective thus seems to have significantly expanded. No longer is the focus on non-interference sharing by generating only signals below the noise floor; now it is on how much interference should the victim services take from UWB – a dramatic shift of the burden and risk of interference directly onto the consumer. In its "General Comments on the Proposed Scenarios" submitted to NTIA on October 18, 2000, Time Domain states that the consumer could "control interference by turning one of the devices off or increasing the separation between them."[5] Furthermore, in its comments Time Domain prepares the grounds for avoiding responsibility associated with the potential negative consequences of interference by stating that the nation's spectrum managers would not

[4] *See* Comments of Time Domain Corporation on Proposed NTIA GPS/UWB Operational Scenarios (October 18, 2000), at 2 (filed in ET Docket No. 98-153 as an *ex parte* submission).

[5] *Id.* at 2.

allow them to share spectrum on an interfering basis.[6] It appears that this position leaves the Commission with the Hobson's choice of either abdicating its regulatory role of protecting the public interest or accepting liability for consumer harm that occurs under rules permitting unlicensed operation of UWB devices.

No Technical Basis For Rule Making Exists

While the majority of commenters are waiting for comprehensive testing, the short-term answers from the current NTIA approach leads to flawed and incomplete conclusions and would be at best be overly optimistic. Even if all the known technical problems are adequately resolved, simply testing the effects of UWB on GPS is inadequate to protect the NII and the world's IT economic engine. Clearly, the most efficient way to come to an understanding of whether it is possible to overlay time domain devices upon the dozens of radio services now using spectrum allocated in the frequency domain would be to understand the basic underlying science involved. While the National Research Council's proposal for an 18 month study program may seem at first glance too long for a study of the basic science, it could very well be the fastest way to an answer which adequately protects the nation's IT economic engine.[7] Without the clear theoretical foundation that is now missing from the NTIA testing program, both

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[6] *See* Time Domain Comments at 4 (Time Domain asserts that "[i]f any UWB uses are found by the Commission to pose a credible risk of causing harmful interference to GPS systems by the FAA or the aviation industry, [Time Domain] fully expects that the Commission will not authorize those uses").

[7] *See* Concept for a National Research Council, Computer Science and Telecommunications Board Study on Ultra Wideband Technologies. Among the questions to be addressed in the study are the key questions of whether future applications and demands for UWB radio are likely to pose spectrum allocation questions; how might spectrum allocation be conducted in light of UWB technologies; and what implications would the long-term spectrum requirements have for short-term regulatory decisions regarding UWB. *Id.* at 3. The National Research Council proposed that 18 months would be a sufficient time to completely analyze the technical, policy and regulatory aspects of UWB.

UWB proponents and existing information technology services will be exposed to a long period of uncertainty in technical and regulatory risk.

No Regulatory Rationale For Expedited Rule Making Exists

The expediting of the rule making on UWB is based on the erroneous assumption that UWB is a revolutionary new technology with great unrealized benefits. In actual fact, the transmission technology is very similar to the ultrawideband Marconi spark gap radio that was introduced early in the twentieth century and that was rejected by the Federal Radio Commission in favor of a frequency-domain approach to spectrum management. Furthermore, the pulse position modulation technique has been abandoned for the last half century in the commercial world following the publication of Shannon's insights. UWB technology simply cannot compete on an efficiency basis (data rate per unit of bandwidth and energy per bit) with modern coding techniques. As a result, Section 7 of the Communications Act of 1934 (47 U.S.C. § 157), which contains provisions specifically designed to encourage the introduction of new technology, simply does not apply in this case. Consequently, the justification does not exist for expedited rule making, and the burden of demonstrating consistency with the public interest remains squarely on the proponents of UWB technology.

A Possible Way Forward: A Strategic Experiment

The Commission and NTIA are in an unenviable position. On the one hand, they could take the prudent approach to protecting the nation's IT economic engine and postpone adoption of rules permitting any introduction of UWB technology until the

basic science is fully understood and that comprehensive testing has been completed for all affected services. This step, unfortunately, would mean postponing the reintroduction into the information infrastructure of an intriguing technology. On the other hand, the Commission and NTIA could strive to find a way to minimize the risks and responsibly allow some introduction of UWB technology. While not free of risks to existing services, the latter alternative may be able to be accomplished through a strategic experiment that:

1) establishes a band for UWB above 3 GHz where UWB technology could be used on a non-interfering basis to non-restricted bands, with unwanted out-of-band emissions in restricted bands kept to levels that are at least 30 dB down from in-band levels;

2) prohibits unlicensed operation of UWB devices; and

3) precludes transmissions in bands below 3 GHz until such time as the basic science has established methods of controlling composite power of networked devices and confirmed the validity of these methods through comprehensive testing.

This approach would allow some opportunities for commercial development of UWB. More importantly, it would allow NTIA and the Commission to avoid placing the NII and the world's IT infrastructure at immediate risk while comprehensive testing and analysis are conducted.

Conclusion

. The nation should not be forced to choose between exploring a potentially useful new technology or acting on faith that the nation's information infrastructure will not be harmed. A responsible way forward, one that maximizes potential benefits while minimizing risks, is to correct the flaws in the NTIA program, establish a sound scientific

basis for time-frequency interference analysis and regulatory framework, and conduct a limited strategic experiment with UWB using known band segmentation techniques above 3 GHz.

Respectfully submitted,

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TECHNICAL CERTIFICATION

I, James M. Janky, hereby certify under penalty of perjury that I have either prepared or reviewed the technical information contained in the foregoing Reply Comments of SiRF Technology Inc. and Trimble Navigation Limited, and that I find this information to be complete and accurate to the best of my knowledge and belief.

By:___/s/_____
James M. Janky
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Dated: October 27, 2000