United States
GPS Industry Council

February 16, 2011

3GPP TSG-RAN WG4 Chairman
Mr. Takaharu Nakamura
n.takaharu@jp.fujitsu.com

cc
3GPP TSG-RAN Chairman
Mr. Takehiro Nakamura
nakamurata@nttdocomo.co.jp

3GPP TSG-SA Chairman
Mr. Stephen Hayes
Stephen.hayes@ericsson.com

Dear Mr. Nakamura:

The United States Global Positioning System (GPS) Industry Council ("USGPSIC") is an industry body representing manufacturers of user equipment for an installed user base in the United States and worldwide that depends on the uninterrupted availability of signals from GPS and Global Navigation Satellites Systems (GNSS).

We understand that you received the report, R4-110371 ("Report") "Preliminary results on Overload Characteristics of GPS Receiver in Proximity to LightSquared's L-band Terrestrial Base Stations and User Equipment" as part of the 3rd Generation Partnership Project (3GPP) Technical Specification Group-Radio Access Network (TSG-RAN) Working Group 4 (WG4) consideration of modifications to 3GPP technical specifications to include terrestrial mobile systems operating in the "L-band" in the United States. We appreciate the opportunity to read and comment upon this report.

The members of our organization have several concerns about the assumptions used in the Report which we would like to bring to your attention. Simply stated, we think that the assumptions used in the report are not sufficient and that more realistic interference assumptions would result in much different conclusions. To begin with, we will highlight the most important assumptions, and the reasons we think they should be different.

Assumption: *Using a cellular coverage model to predict interference*

2000 K Street, NW • Suite 600 • Washington, DC 20006-1809
Tel. (202) 416-6282

The Report uses a well-established communication link methodology aimed at ensuring the entire coverage area is guaranteed to receive a minimum level of power. However, this isn't the question that should be asked of an interfering signal. For an interferor, one should instead ask how strong the interferor could be in the coverage area. Three examples of this are

- *Walfisch-Ikegami path loss link model*. A Walfisch-Ikegami path loss model, which is used in the Report for interference prediction, is a well-respected stochastic model used to determine urban communications coverage. The stochastic aspect of this relates to wide variance of signal strength that might be seen at the same distance from the transmitter, based on differences in building diffraction and obscuration. The Walfisch-Ikegami path loss model is useful for communication modeling since its predictions target the low end of the signal strength variance. However, it is exactly this quality that makes it inappropriate for an interference model. A free-space model would more appropriately target the higher part of the variance.

- *Body Blockage*. In the Report -5 dB is assumed for body blockage. This only applies if a person's body is actually between the transmitter and the GPS receiver. This is good methodology for predicting minimum communication coverage, but a poor way of predicting interference power levels.

- *Receiver Antenna Gain*. In the Report, a GPS receiver antenna gain is assumed to be -3 dBi (as part of the table in figure 3). Most GPS antennas have a zenith gain on the order of 5 dBi. The -3 dBi assumption is only valid if the receiver is pointed so that the transmitter is near the horizon of the GPS antenna. Portable devices will have significant tilt during their use, and in some applications (dashboard mounted GPS, for example) may have tilt by design. It could be that some of this discrepancy is polarization loss – which isn't stated in the Report – but that would not account for all of the difference. Thus we feel the -3 dBi antenna gain model is optimistic for predicting interference.

Assumption: *Using a corner-case interference criterion for GPS*

In using complete loss of position as a threshold criterion for interference, no margin is provided for the GPS receiver. One problem with this assumption is that signal acquisition requires less jamming to be successful than continuous tracking of the signal. So a GPS receiver that loses signal reception for any other reason may not be able to reacquire due to interference below the suggested criterion in the Report.

Another problem is the citation that 47 meters is an acceptable level of error for a service that typically provides less than 15 meters of error. While perhaps outside of the scope of this report, this is an especially worrisome to precision GPS applications whose users expect – and get – accuracy as low as 2 cm.

Perhaps the biggest problem with the interference criterion is the associated assumption of -130 dBm GPS received signal strength. While cited as the "specified minimum," this is actually the most power a GPS receiver is guaranteed receive, and it is reduced by foliage and building multipath, particularly in an urban setting where the terrestrial broadcast is intended to

be rolled out. In this setting GPS receivers are already operating at a reduced signal-to-noise. Failure to take this factor into account makes the proposed interference criterion even less realistic.

Assumption: *Test results are equivalent to guaranteed results*

There is a significant difference between what a design – which is comprised of specified components – and a test – which is a sample of the design – will say about interference. Any given sample may show better interference results than can be guaranteed because the components are always at least as good as specified. A test will never show worse results than can be guaranteed. It probably isn't fair to expect that the authors of the Report have the expertise to properly derate the test results based on the designs, however a conclusion is drawn by the authors without having done so.

Assumption: *Transmit Antenna model*

The level of interference is very sensitive to the transmit antenna pattern. The pattern identified in this report may be close to the final pattern, but it is clear that it is not final, and changes necessary to finalize it may have a significant impact. We note, for example, that the pattern in Figure 3 of the Report does not meet the upside pattern requirements of the ATC rules (47CFR25.253(e)), and thus will have to be modified.

From assumptions, let us turn our attention to the timing receiver antenna highlighted in the Report. This antenna appears to be a prototype rather than a commercially available product. Over several months of trying, one of our member companies was unable to obtain a sample. Looking at the data sheet for this antenna, the key performance parameter – attenuation at 1555 MHz – is a "typical" number, in other words, not specified, which means that it cannot be relied upon. Furthermore it is clear from the pictures that the overall attenuation comes from replacement of all the filters in the amplifier chain, which means the first LNA – the component most sensitive to desensitization from this kind of interference – gets much less protection than it might initially appear. Finally, the modified antenna has an increase in Noise Figure of 2.7 dB, which directly translates into lower sensitivity of the timing receiver.

In closing, we note that the Report does not deal with other GPS applications, including those in aviation, surveying, construction, and car navigation, some of which use additional parts of the signal or have special governmental requirements that shape the design. These applications may be considered beyond the scope of the report, so we will not dwell on the here, other than to say that they are as big a concern to the GPS Industry as the two applications cited in the Report.

Sincerely,

F. Michael Swiek, Executive Director
United States GPS Industry Council