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Ex Parte

August 11, 2015

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Amendment of Parts 1 and 22 of the Commission's Rules with Regard to the Cellular Service, Including Changes in Licensing of Unserved Areas, WT Docket No. 12-40; RM-11510.

Dear Ms. Dortch:

Verizon supports adopting power spectral density ("PSD") limits for cellular licensees to promote mobile broadband deployment in the cellular band. PSD limits, which allow transmitter power limits to be applied on a per MHz of bandwidth basis, are necessary to eliminate the bias in the current cellular power rules towards narrowband technologies. The attached technical statement from Verizon engineer Scott Townley supplements the record in support of Verizon's proposed PSD limits. Mr. Townley's statement (1) demonstrates that the proposed PSD limits would only slightly change signal strength levels on the ground near base stations; (2) explains why PSD limits should apply on a per transmitter basis; and (3) proposes new service area boundary ("SAB") and field strength limit formulas that more accurately determine coverage and field strength boundaries when PSD limits are used.

This letter is being filed pursuant to Section 1.1206 of the Commission's Rules. Should you have any questions, please contact the undersigned.

Sincerely,

Andre J. Lachance

cc: (via e-mail)
Roger Noel
Lloyd Coward
Thomas Derenge
Nina Shafran
Moslem Sawez
Chris Helzer
Keith Harper
Michael Wilhelm
Bahman Badipour

Attachment

TECHNICAL STATEMENT OF SCOTT TOWNLEY[1]

Comparison of Current PFD Levels with those that Would Be Produced under Verizon's Proposed PSD Limits

The PSD limits proposed by Verizon – 1000 W/MHz in urban areas and 2000 W/MHz in rural areas[2] -- will only slightly increase the power flux density ("PFD") levels produced by transmitters currently used in the cellular bands. PFD levels are the signal strength produced by transmitters on the ground in close proximity to the transmitters. Verizon modeled PFD levels, measured per MHz of bandwidth – referred to as power flux spectral density or "PFSD" – in certain "worst case" configurations by CDMA transmitters currently operating in the cellular bands. The PFSD levels produced by transmitters currently operating in the cellular band represent the signal levels capable of impairing the performance of mobile and portable units used by adjacent licensees.

To determine the current PFSD levels, Verizon modeled several antenna configurations with different target cell radii, antenna height, and antenna downtilt considered representative of suburban, urban, and dense urban environments. Each configuration modeled is represented by a different colored line in the tables below, and the parameters of each configuration (coverage radius, height, and downtilt) are set forth to the right of graph in each table. In general, the worst case PFSD results were produced by the antenna configuration represented by the green line (the line farthest to the right) in each table. This is because that antenna has the most downtilt, meaning it is pointed towards the ground resulting in higher PFSD levels at ground level. The propagation model used was a simple ground-bounce model[3] with a single 1.25 MHz wide CDMA transmitter operating at the current urban ERP limit of 500 W, yielding a transmit PSD of 400 W/MHz. The results from that study are shown in Table 1 below.

[1] Mr. Townley is Fellow, RF Technology Planning at Verizon, where he has led technical initiatives concerning wireless network coverage, capacity, spectrum usage, and interference management since 2001. Mr. Townley holds a BSEE from the University of Colorado, Boulder and an MSEE from Arizona State University.

[2] Comments of Verizon, WT Docket No. 12-40 (Jan. 21, 2015) ("Verizon Comments") at 2.

[3] The ground-bounce model assumes one direct ray and one reflected ray from a nearly-perfectly reflecting earth (for example, Terman, *Radio Engineers' Handbook*, pp. 682-695). A perfectly reflecting surface would have a (voltage) reflection coefficient of 2.0. In this model a reflection coefficient of 1.6 is used to model a more realistic ground surface.

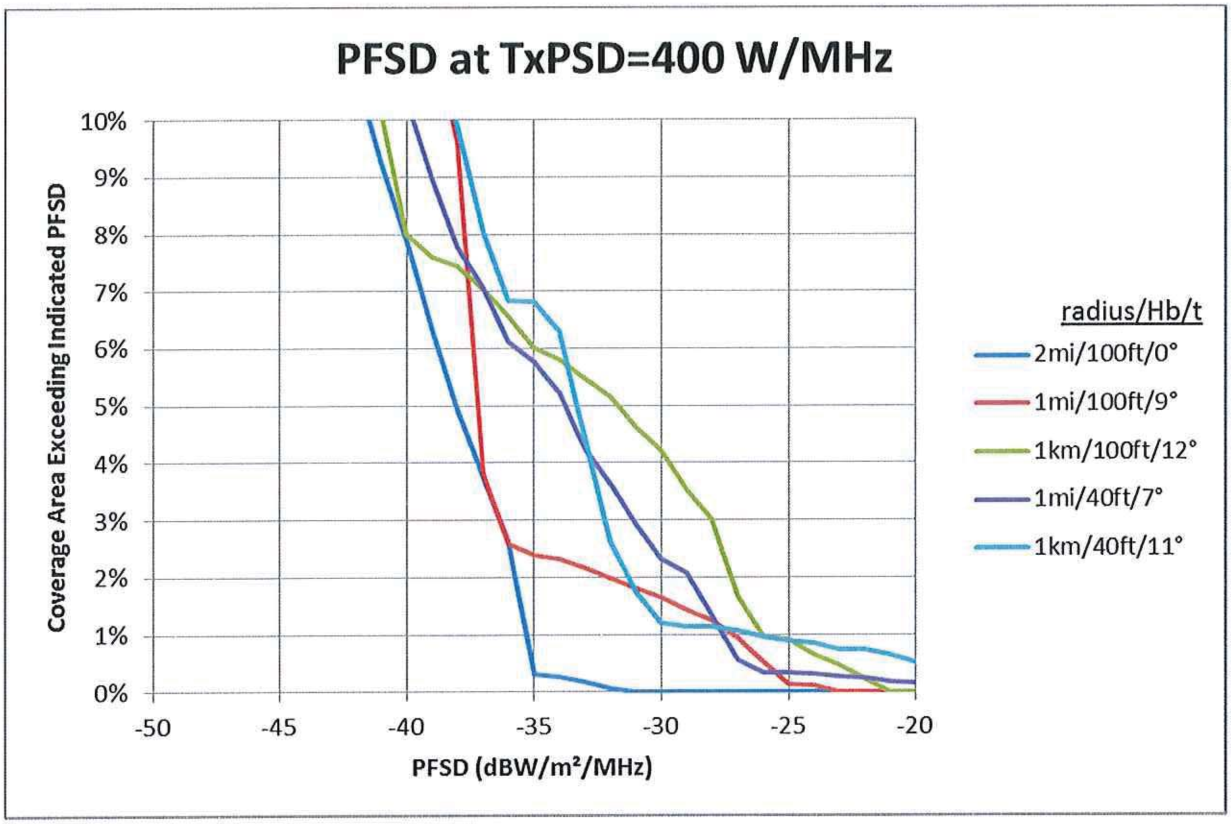

Table 1

The results show that for each configuration modeled, the PFSD produced did not exceed -26 dBW/m²/MHz in more than one percent of the ground area near the base station. This PFSD level represents the worst case PFSD level produced by CDMA transmitters currently operating in the cellular band.

To demonstrate how transmitters operating at the higher PSD limits proposed by Verizon affect PFSD levels, Verizon also modeled the PFSD levels produced by the same antenna configurations operating at the urban area PSD limit proposed by Verizon -- 1000 W/MHz. Those results are shown in Table 2 below.

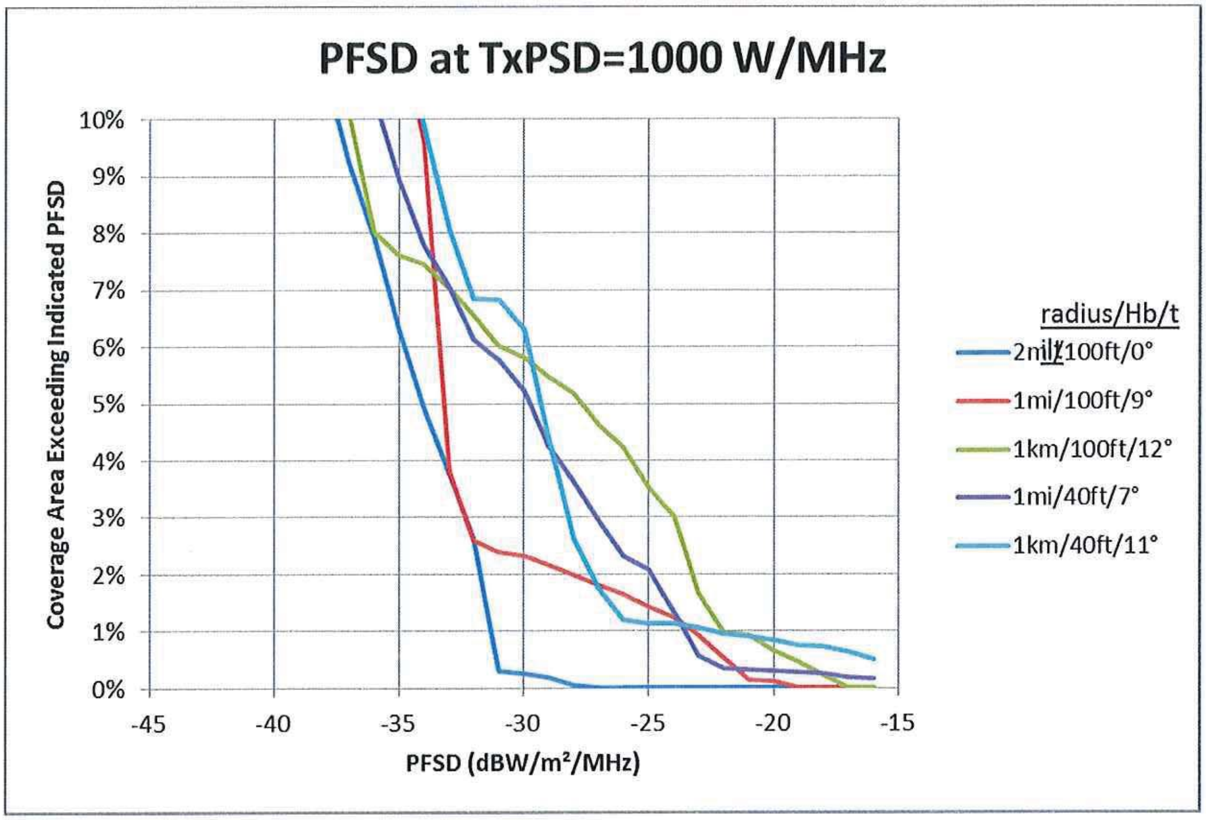

Table 2

The results show that for each configuration modeled, the PFSD produced did not exceed -26 dBW/m²/MHz in more than four percent of the ground area near the base station. This area is only slightly larger than the results produced by transmitters operating today in the cellular band.

PSD Limits should Be Applied Per Transmitter

Consistent with current cellular power limits, the PSD limit adopted for cellular should be applied on a per transmitter basis. It is common practice for carriers to add transmitters at each sector of a base station to increase the capacity (and therefore spectral efficiency) of a base station. Carriers deploy multiple transmitters in wideband systems, such as LTE, and in older technologies like CDMA. Multiple transmitter configurations used with existing technologies deployed in the band have always increased the total PSD in the band. Thus, applying PSD limits on a per transmitter basis will not significantly change the current environment. If the PSD limit adopted were to apply cumulatively to all transmitters deployed at a sector, then each transmitter deployed at a sector would have to operate at lower power, thus eliminating the benefit of multiple transmitter configurations.

The SAB Formula Should Be Changed

The formula used to determine service area boundary ("SAB") of cell sites and the cellular geographic service area ("CGSA") of all cell sites in a cellular system should be changed when PSD limits are adopted. The new formula proposed should be used unless using the new formula results in a smaller SAB, in which case licensees should have the option to continue to calculate SAB using the old formula. The change is needed because the current SAB formula produces results that vary depending on the transmitter power variable in the formula. Thus, in a PSD regime, where the power variable will be higher for wideband technologies, the current SAB formula would produce larger SABs and CGSAs for wider band technologies. The current SAB formula ("ERP formula") can be used with a PSD representation of transmitter power to develop a new SAB formula ("PSD formula"), as long as PFSD is substituted for dBuV/m (field strength). The resulting formula would then be:

$$dBu/MHz - 146 = dBW/m^2/MHz$$

The PSD formula produces results that are consistent with the ERP formula. To illustrate, consider a base station with an ERP of 500 watts transmitting a signal with an occupied bandwidth of exactly 1 MHz. Using the ERP formula, which uses ERP (watts) to yield the distance (miles) to implicit median field strength (dBu), the example transmitter produces a field strength of 40 dBu[4] at 10 miles. Likewise, applying the proposed PSD formula using a base station PSD of 500 W/MHz yields a PFSD of 40-146= -106 dBW/m²/MHz at a distance of 10 miles (see discussion below showing that a 40 dBu border field strength equates to a -106 dBW/m²/MHz PFSD field strength limit). Changing the occupied bandwidth of the transmitted signal from 1 MHz to 10 MHz while maintaining the same PSD of 500 W/MHz will result in a contour boundary distance of 10 miles. But, if the ERP formula were applied to a transmitter operating at this configuration, the formula would produce a contour distance much greater than 10 miles, even though a receiver located 10 miles away, with any given (fixed) bandwidth, would detect absolutely no change.

The Field Strength Limit Should Be Stated in Terms of PFSD

To ensure consistent field strength results once PSD limits are adopted, the Commission should adopt a PFSD field strength limit for cellular of -106 dBW/m²/MHz received PFSD. The current 40 dBu border field strength can be converted to a (total) received signal power by an isotropic receiving antenna using

$$P_{RX}\,(dBm) = -77.2 - 20\log(MHz) + dBu$$

40 dBu is therefore equivalent to a received signal of -96 dBm in the 850 MHz band. As shown in the discussion of the previous section, dividing 40 dBu by MHz gives a PFSD of -106 dBW/m²/MHz, and it also gives a receive PSD of -96 dBm/MHz. Assuming that a typical mobile device has a noise figure of 8 dB, the receiver noise PSD can be found as -174 dBm/Hz + 8 + 60 = -106 dBm/MHz. The adoption of a -106 dBW/m²/MHz border PFSD would then

[4] *See* 47 C.F.R. § 22.983 (establishing 40 dBμV/m as the median field strength limit for cellular).

equate to a border SNR of 10 dB for wideband systems regardless of their bandwidth. This SNR is adequate for good throughput performance.

Scott Townley

August 11, 2015