Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of Parts 1 and 22 of the	)	
Commission's Rules with Regard to the	)	WT Docket No. 12-40
Cellular Service, Including Changes in	)	
Licensing of Unserved Areas	)	
	)	

To: The Commission

COMMENTS OF PERICLE COMMUNICATIONS COMPANY AND SHULMAN, ROGERS, GANDAL, PORDY & ECKER, P.A.

These comments are submitted in response to FCC 14-181, Report and Order and Further Notice of Proposed Rulemaking, adopted November 7, 2014.

Pericle Communications Company ("Pericle") is a consulting engineering firm specializing in wireless communications. Founded in 1992, Pericle consults for the public safety, personal wireless, transportation and broadcast industries. Through its client, the City and County of Denver, the company was deeply involved in the formulation of the 800 MHz rebanding plan adopted by the Commission in 2004. Pericle continues to help public safety agencies hunt down and resolve 800 MHz interference, including recent work for the City of Oakland, California.

Shulman, Rogers, Gandal, Pordy & Ecker, P.A. ("Shulman Rogers") is a full service law firm located in Potomac, Maryland. The Firm's Telecommunications Department represents clients involved in all areas of communications, including private radio, common carrier, broadband and broadcast. The firm also represents hundreds of public safety licensees (state, counties and cities) in securing spectrum for their operations and negotiations involving the 800 MHz Rebanding Program.

While the band separation created by 800 MHz rebanding greatly mitigated the public safety interference problem, public safety radios are still vulnerable to cellular band interference. Nowhere is this vulnerability more evident than in the City of Oakland where dozens of Sprint and A-Band cellular sites have been mitigated to overcome harmful interference to the City's subscriber radios. This interference will only increase over time as Sprint builds out its new 800 MHz CDMA and LTE networks and both operators build new sites with low antenna heights. Increasing the authorized cellular band ERP will only worsen this problem unless it is accompanied by a power flux density limit.

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I. SUMMARY

Pericle and Shulman Rogers file these joint comments based upon each Firm's work for over ten years in mitigating interference from cellular licensees to public safety entities. Pericle and Shulman Rogers' work in this area is extensively documented in WT Docket No. 02-55, and extensively supplemented with current experience attempting to achieve cellular interference mitigation in various areas of the country, most particularly Oakland, California and Ann Arbor, Michigan.

Initially, it should be noted that Pericle and Shulman Rogers support the concept of using Power Flux Density ("PFD") as the benchmark for cellular operation. Changing the measuring standard for new technologies is consistent with the Commission's actions in the past, including changing most of the Part 90 narrowband measurement standards from output power to ERP. Against this background, moving from ERP to PFD for broadband services brings numerous benefits. However, as with the transition from output power to ERP, the proper standard to utilize in this conversion must be carefully analyzed to ensure that other services are not harmed.

While the band separation created by 800 MHz rebanding greatly mitigated the public safety interference problem, public safety radios are still vulnerable to cellular band interference. As discussed herein, nowhere is this vulnerability more evident than in the City of Oakland, California where dozens of Sprint and A-Band cellular sites have been mitigated to overcome harmful interference to the City's subscriber radios. This interference will only increase over time as Sprint builds out its new 800 MHz CDMA and LTE networks and both operators build new sites with low antenna heights. Increasing the authorized cellular band ERP will only worsen this problem unless it is accompanied by a power flux density limit.

Our purpose in submitting these comments is threefold: (1) create an understanding of the strong signal intermodulation and blocking performance of typical public safety radios, (2) show through real-world examples the extent of cellular band interference to public safety radios and (3) endorse the adoption of a power flux density limit at ground level.

We have no objection to adopting new ERP and power spectral density limits in this band and we are sympathetic with the desire to harmonize with the 700 MHz band, but these rule changes must be accompanied by a limit on power flux density. Further, Verizon's proposed power flux density limit of 3,000 $\mu W/m^2$ will result in significant interference to some manufacturer's radios in some jurisdictions, and for this reason, we ask that the FCC emphasize that its proposed rules do not excuse the cellular operator from compliance with Parts 22.970-22.973. In addition, we encourage the FCC to adopt receiver standards as part of the Commission's review of comments in ET Docket No. 13-101 as a permanent solution to this problem.

II. BACKGROUND

We are concerned that an increase in ERP in the band without an accompanying limit on power flux density on the ground will dramatically worsen an existing problem. While we advocate a power flux density limit, we also realize an extremely low limit will create an unfair burden on the cellular operator.

Specifying a power flux density limit is difficult because the ability of the public safety receiver to operate in the presence of high power flux densities depends on several factors:

- Strength of the forward link (outbound path) public safety signal
- Receiver design attributes such as a high IIP3 amplifier and AGC
- Receiver bandpass filter
- Number of radio frequency carriers operating from the cell site
- The mathematical relationship among the carriers and whether they create harmful intermodulation products.

It is not practical to specify a limit that works at all locations and within all public safety jurisdictions. Some jurisdictions will enjoy a densely populated repeater network and state-of-art subscriber radios while others do not have an optimal operating environment. As we shall show in Section III of these comments, in the presence of strong interfering cellular signals (e.g., -13 dBm), it is common for subscriber radios to have less than 45 dB of intermodulation rejection, requiring a desired signal of -58 dBm to overcome this harmful interference. Those who have modeled or measured land mobile radio coverage know that desired signals this strong occur only in a small fraction of the service area. In the absence of a huge public investment into upgrading public safety infrastructure nationwide (which is ongoing, but is a lengthy process) the public safety agency needs a lower power flux density limit, at least for the current generation of land mobile radio equipment.

III. RECEIVER PERFORMANCE

When the 800 MHz rebanding rules were adopted by the Commission in 2004, certain receiver standards were specified for land mobile radios before such radios were eligible for protection from 800 MHz cellular interference (e.g., from ESMR, cellular A or cellular B). FCC Parts 22.970 and 90.672 specify performance for 12 dB SINAD sensitivity (-116 dBm), adjacent channel rejection (70 and 75 dB for portables and mobiles, respectively), and intermodulation rejection (also 70 and 75 dB). The implied standard for measurement was TIA-603-B. Because the major source of interference was Sprint cell sites employing the iDEN airlink standard and all leading manufacturers published these values in their datasheets, the standards made sense at the time. Unfortunately, two problems were not adequately considered in 2004:

The first problem involved bandpass filters to be used post-rebanding. The purpose of rebanding was to separate dissimilar services so the near-far problem is manageable. But separation alone does not solve the problem entirely if the receiver front end still passes cellular signals. These strong cellular signals can still cause blocking and intermodulation interference. An essential part of the plan was to eventually install narrower bandpass filters (851-861 MHz) to reject cellular signals, but until such time as rebanding has been completed nationwide (which was expected to have been concluded by now), there is still a need for public safety radios in many areas of the country to pass "old NPSPAC" (i.e., 866-869 MHz) frequencies.

The second problem is that the TIA-603-B standard for intermodulation interference is measured with interfering signals in the range of -50 to -45 dBm, but cellular interference on the street is often measured above -20 dBm[1]. Two radios with identical TIA-603-B intermodulation rejection of 70 dB may show dramatically different intermodulation rejection above -50 dBm.

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[1] Pericle and Shulman Rogers have assisted the City of Oakland with interference mitigation since September, 2012. After mitigating dozens of cell sites with the cooperation of the A-Band operator, Pericle found that harmful blocking typically occurs when the total power on the ground was between -20 dBm and -16 dBm using a half-wave monopole antenna similar to those used by the public safety portable radio. There are many sites in Oakland where these power levels occur.

A. Types of Cellular Band Interference

The two main types of interference created by strong cellular signals are blocking and strong signal intermodulation. Both occur in the public safety receiver.

Blocking is caused by one or more strong interfering signals within the RF passband of the receiver which do not have the mathematical relationship to cause intermodulation. It is measured referenced to the receiver's sensitivity (typically -120 dBm) and a good receiver will achieve blocking rejection between 95 and 105 dB.[2]

Strong signal intermodulation is a mixing of two or more interfering signals in the receiver front end to create an intermodulation product that overlaps the receive frequency. The strong signal intermodulation (IM) rejection at interfering levels of -13 dBm, for example, vary widely by manufacturer make and model and can range from 32 dB to 75 dB. Even the best make and model radio does not match typical blocking rejection. Thus, strong signal IM, when it occurs, is the most difficult type of interference to mitigate.

And it does occur. Because of frequency separation between bands, an A-Band cell site alone normally causes blocking or 5th order IM (which are weaker) rather than 3rd order IM because for third order products to fall in the public safety band, the upper 1.5 MHz of the band (890-891.5 MHz) must be involved and frequencies this high are normally attenuated by the receiver's filter. Sprint, on the other hand, operates with two broadband carriers and can put IM products in the upper part of the public safety band. See Figure 1.

[2] Pericle has measured blocking rejection of several public safety radio makes and models using the TIA-603-D method.

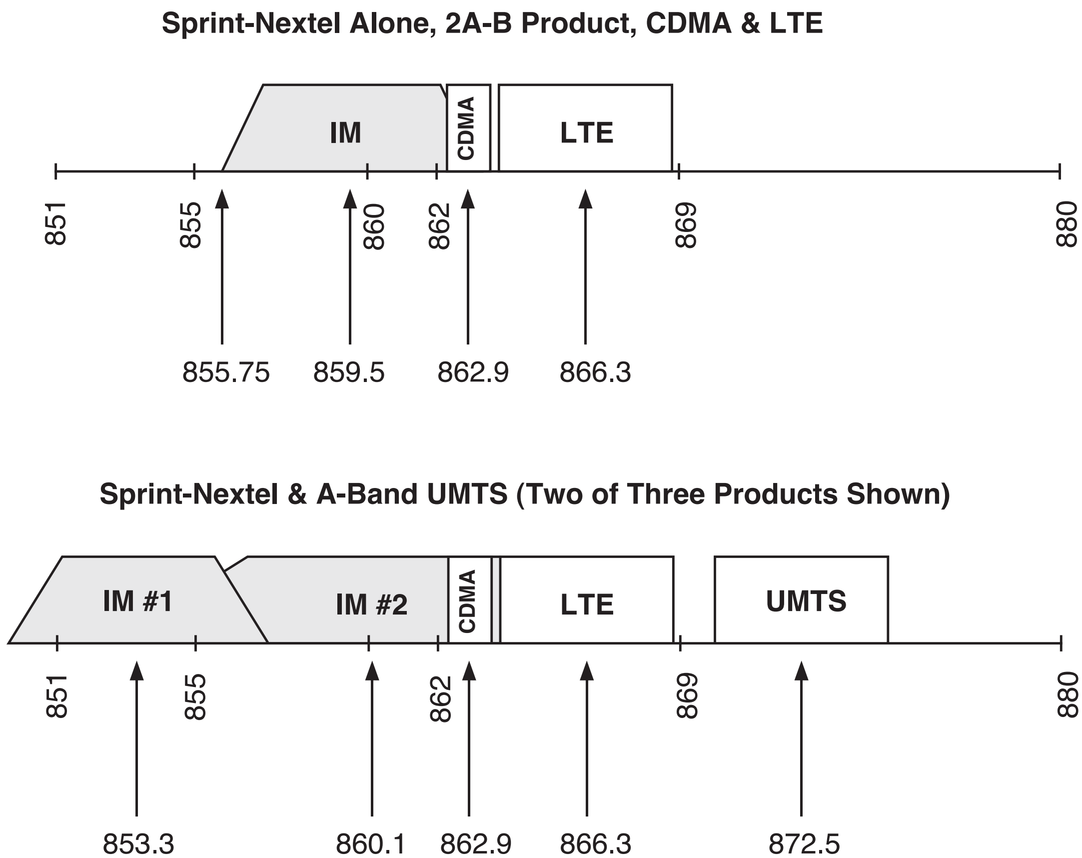

Figure 1 - 800 MHz Cellular Intermodulation Products (amplitude not to scale)[3]

The worst-case situation is a co-location of Sprint and the A-Band operator. In this case, three third-order products together span the entire public safety band, from 851 to 861 MHz. See the lower half of Figure 1.

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[3] The third product in the co-location case is A+B-C type, roughly 12.25 MHz wide and centered on 856.7 MHz. In general, the bandwidth of an IM product is a function of the order of the product and is roughly equal to the sum of the products of each interferer's bandwidth and its IM product coefficient (a crude but useful approximation). The power density of these IM products is typically not uniform even if each interferer is uniform (i.e., square) because the convolution of the two signals creates a trapezoidal shape in the frequency domain.

B. Receiver Design Issues

To better understand the design challenges of the manufacturer when faced with strong signal intermodulation, consider the typical digital receiver shown in Figure 2.

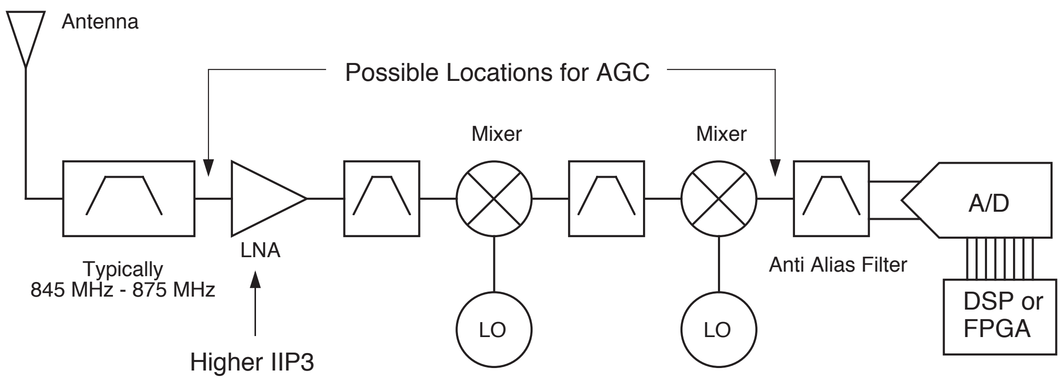

Figure 2 - Typical Modern Digital Receiver

The near-far problem is essentially a dynamic range problem and because the dynamic range of the digital section of the receiver is limited by the number of bits in the A/D, manufacturers typically (but not always) perform a double down conversion prior the A/D. By doing so, the A/D is protected somewhat from harmful signals outside the IF bandwidth. The front end bandpass filter passes the ESMR and much of the cellular A Band, so the LNA is often presented with strong signals. The brute force way to fend off intermodulation (IM) interference is to employ an LNA with a high third order intercept (IIP3). Unfortunately, amplifiers with very high IIP3 draw more current and are therefore not practical in battery-operated portable devices. They are more practical in mobile radios.

Automatic gain control (AGC) is another technique to combat strong interferers, but AGC power detectors are usually broadband RF diodes that cannot distinguish between desired and undesired signals. Putting an AGC attenuator in front of the LNA will increase the noise figure of the receiver and thereby desensitize it. A more sophisticated type of AGC might use a second detector at the second IF to detect the amplitude of the desired signal and then apply the right amount of attenuation in front of the LNA to optimize sensitivity of the receiver. This is possible in the case of intermodulation interference because 1 dB of attenuation in front of the LNA attenuates the desired signal by 1 dB, but results in a 3 dB reduction in the 3rd order IM product. Also, because most receivers can tolerate higher levels from blocking than from IM (typically 95 dB versus 75 dB best case), a receiver that can distinguish between the two types of interference can adapt the AGC accordingly.

In Figure 3 we have plotted the strong signal IM rejection of four radio models from two different manufacturers.[4] In each case, the desired frequency was 851.1750 MHz and the two interfering signals were at 859.6750 and 868.1750 MHz. The performance between radios is dramatically different, but all radios employed essentially the same filter which did not roll off until 874 MHz (well inside the cellular A band). Because the third order intercept of the radios can be derived from the TIA-603-B IM rejection which was similar between radios (75-80 dB), we must conclude that other techniques are used in the better performing radios.

[4] These radios were measured by Pericle Communications Company independently of the manufacturers.

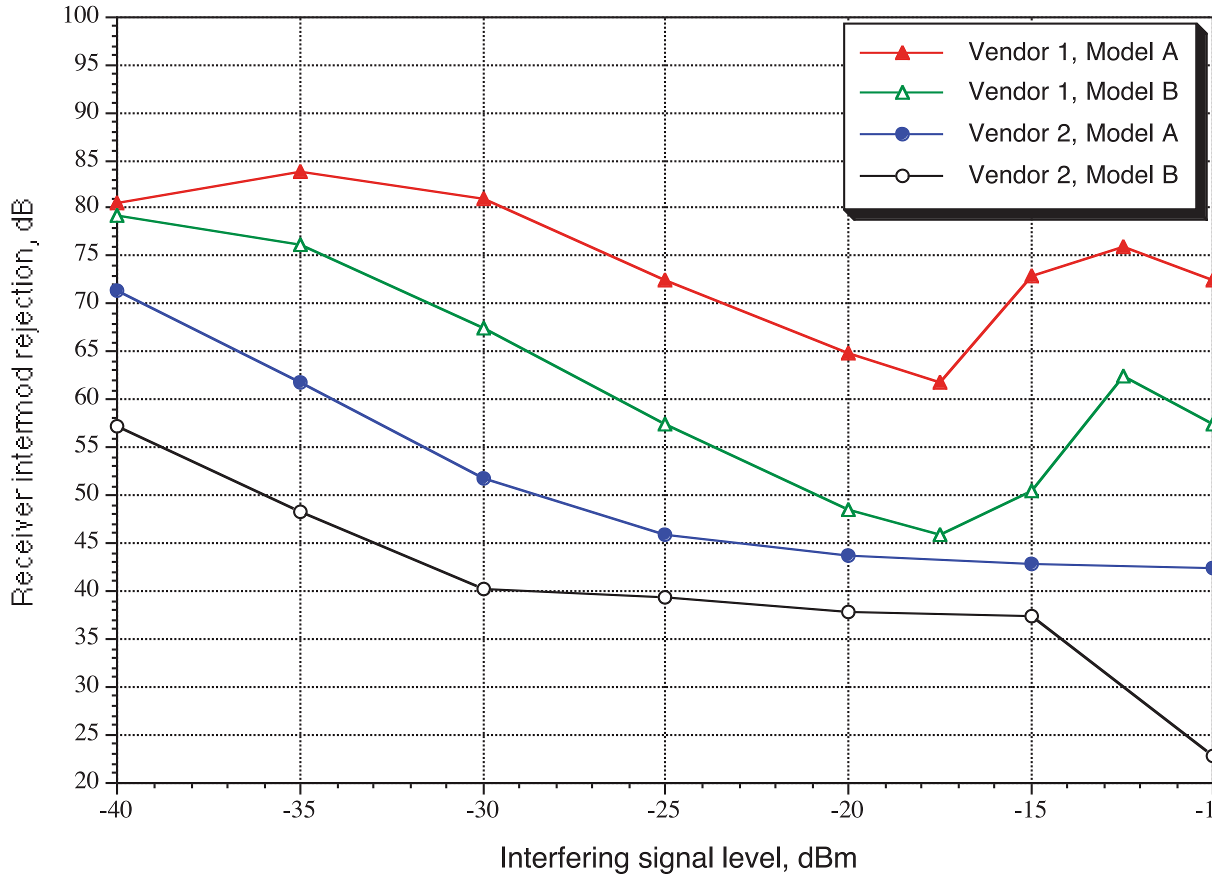

Figure 3 - Strong Signal IM Performance of Several Receivers

C. Practical Implications

At this point, one might ask what are the practical implications of Figure 3? Consider a public safety agency using Model A from Vendor 1 and Sprint and the cellular A-Band operator are creating two equal power IM interferers at -20 dBm at street level. In this case, the desired signal must be at least -20 dBm - 65 dB = -85 dBm to overcome this interference. However, if the same agency is using Model B from Vendor 2, the IM rejection is only 38 dB and the desired signal must be –58 dBm. According to the datasheet, the two radios both have IM performance above 75 dB (and comply with Part 22.970) but the real performance difference in a harsh environment does not show on the datasheet.

The significant performance difference with nearly identical bandpass filters illustrates another important principle: If the Commission took a narrow view of the problem, it might specify a minimum filter rejection as the receiver standard. But this approach would miss the point and possibly stifle innovation. What matters is blocking rejection and strong signal IM rejection.

Many of the older measurement standards such as TIA-603-D (the most current version) assume signals with continuous phase modulation (e.g., FM) and a peak-to-average ratio of 1. In practice, cellular signals such as UMTS and LTE have high to peak-to-average ratios. The semiconductors in the receiver will likely react to peak power, not average power, when IM products are created so the peak-to-average power ratio must be considered when specifying both the environment and the method to test for compliance. More bench measurements are required to understand whether bit-error rate or SINAD are ultimately affected by peak power or average power as each is measured over a time period that is long compared to the time-variations of the signal envelope.

D. Unequal Power Levels

In co-location situations or situations where the Sprint and A-Band cell sites are nearby, interferer powers are almost always unequal. Unequal interferer power has important implications for strong signal IM in the receiver and for the mitigation of IM interference.

For an amplifier operating in its linear region, the equivalent two-tone IM power for two unequal power interferers and the resulting 3rd order product is given by

$$P_{IM-Equiv} = \frac{2P_{strongest} + P_{weakest}}{3} \quad ,$$

where all values are in dBm. For example, consider a situation where the interference power from a Sprint cell site is -20 dBm and the interference from an A-Band cell site is -60 dBm. The equivalent two-tone IM power is -33 dBm which is only 13 dB below the strongest interferer despite the fact that the second interferer is *40 dB weaker*. Thus, the strong signal IM problem is not just one of Sprint alone and co-location sites, but also one of Sprint and *nearby* A-Band cell sites. Further, mitigation of the A-Band cell site by reducing its power would have very little effect on this problem. Efforts should be focused on the Sprint site instead.

IV. POWER FLUX DENSITY & RECEIVER PERFORMANCE

Power flux density at ground level is the preferred metric because it translates directly to power captured by the public safety receiver while PSD and ERP limits can create strong or weak power flux density on the ground depending on antenna height, topography and antenna elevation pattern. Verizon Wireless proposes a PFD limit of 3,000 $\mu W/m^2$. In Figure 3 above, we plotted the measured strong signal IM rejection performance of four typical receivers as a function of two-tone interference measured in dBm. To understand the impact of this proposed PFD limit on real-world receivers, it will be convenient to first translate the PFD limit into a receive power level in the portable or mobile radio. Assuming far-field plane wave propagation, a power flux density of 3,000 $\mu W/m^2$ is equivalent to an electric field strength of E = 1.06 V/m (found by applying Ohm's law and assuming free space impedance of 120π). Ignoring body loss for now, the gain of a half-wave monopole on a typical portable radio is $G = 0$ dBd or 2.15 dBi (1.64 ratio). The antenna factor is given by

$$AF = \frac{9.73}{\lambda\sqrt{G}}$$

where λ is the radio carrier wavelength in meters (0.35 m @ 851 MHz) and G is the antenna gain (ratio). For our example, $AF = 21.7$ m^{-1} and the voltage at the antenna terminals is E/AF or 0.049 volts. Assuming a 50 Ohm receiver, **the corresponding receive power at the antenna terminal for a PFD of 3,000 μW/m^2 is -13.2 dBm**.

Referring back to Figure 3 of these comments, we see that Model A from Vendor 1 offers 75 dB of strong signal IM rejection at -13.2 dBm, but this radio is the best Pericle has ever measured. In Oakland, levels this high cause significant blocking and for Sprint and co-location sites, severe strong signal intermodulation.

While we are sympathetic to the 3,000 μW/m^2 PFD limit because it harmonizes with the 700 MHz band rules, the Commission should recognize that if adopted, it will result in strong interference levels in the public safety radio receiver and will cause harmful interference to public safety users who are in close proximity to Sprint and cellular A-Band cell sites.

V. INTERFERENCE IN OAKLAND, CALIFORNIA

The City of Oakland, California operates an 800 MHz P25 trunked radio network using Harris Corp. infrastructure and Harris subscriber radios (mobile and portable). Virtually all subscriber radios in use today were furnished by Sprint as part of the rebanding process. Oakland's post-rebanding forward link (outbound) frequencies span 851 to 855 MHz. Pericle and Shulman Rogers were retained by the City of Oakland in September, 2012 to investigate complaints of interference from Sprint and A-Band cell sites. As Sprint wound down its iDEN network the remaining problems were attributable to the A-Band operator. Following initial field testing, Pericle quickly ruled out out-of-band emissions as the source of the problem and discovered that blocking and strong signal intermodulation were the culprits. The A-Band operator, AT&T Mobility, cooperated fully with mitigation efforts and over time, over 78 A-Band sites and 26 Sprint sites were investigated. Of these, 25 A-Band and 8 Sprint sites were mitigated, primarily through transmit power reductions. Seven sites were co-located sites and these proved the most difficult to fix as greater power reductions were required to overcome strong signal IM interference.

Sprint shut down its U.S. iDEN network on June 30, 2013 and started deploying a CDMA and LTE broadband network in the 862-869 MHz band. By June, 2014, problems appeared in Oakland and mitigation was required at eight sites (seven were co-located with the A-Band operator). This work is ongoing.

While it has been argued that Sections 90.672 et. seq. and 22.970 et. seq. provide remedies when interference from cellular carriers arise, the reality is that these rule sections do not provide for compensation to the impacted licensee for its costs in attempting to locate the interfering system, or for its work with the carriers to abate the interference. Therefore, the carrier has every incentive to engage in a lengthy, drawn out process, creating a war of attrition and potential public relations battle with the municipality. Thus, for example, because this abatement work was performed post-rebanding, the City of Oakland was forced to cover its costs, as well as those of its abatement vendors, which presently amounts to several hundred thousand dollars (not including Harris costs). It is important to note that significant investigation, coordination and field measurements are required to identify and mitigate 800 MHz interference. For practical reasons, the burden of proof falls on the public safety licensee as the agency must gather the evidence and coordinate the mitigation effort. Outside engineering and legal assistance are required in this effort. Thus, as part of this proceeding, Pericle and Shulman Rogers recommend that as part of this change to cellular measurement standards, the Commission also amend the Part 22 and Part 90 interference abatement rules to provide for compensation to impacted Part 90 licensees for legitimate abatement costs. In this way, cellular operators will be be properly incented to work quickly and efficiently to abate interference, minimizing time and costs for all.

To be clear, the problem is not confined to Oakland. We have become aware of (or are directly involved in) cellular band interference complaints in other jurisdictions, including Arvada, CO; El Paso County, CO; Ann Arbor, MI[5]; Orange County, CA; Seattle, WA and Charleston, SC. Thus, even if the Oakland experience is not typical, it is certainly not unique and the danger going forward is that 800 MHz public safety agencies across the country will continue to expand massive amounts of time and money to rectify what rebanding was designed

[5] The Ann Arbor Transportation Authority spent almost one year attempting to rectify interference caused at one transmitter site by the A-Band operator.

to address.

VI. MEASUREMENT CONSIDERATIONS

Measuring power flux density for this purpose is similar to measuring human exposure limits regulated by the Commission in Parts 1.1307-1.1310 with guidelines found in OET-65. The test instrument should be broadband and designed to accurately measure relatively strong power densities, but remain accurate at levels well below the public exposure limit. At cellular frequencies, an E-field probe is the only practical type to be used (versus H-field). The antenna should be isotropic and calibrated with the instrument, but it must also be physically small so that the body of the operator and nearby objects do not distort its pattern or alter its impedance. Because the operator will want to differentiate between his signals and others that might emit from a co-location site, a spectrum analyzer display is desirable.

An understanding of the sensor's response (peak or average) is important as modern cellular signals have a high peak-to-average ratio. The Commission must specify whether the PFD limit is an average or peak power limit.

Human exposure measurements are performed as a spatial average, but a whole-body spatial average is not appropriate for this application because the public safety radio is normally operated from hip or head level. On the other hand, searching for absolute spatial peak levels may prove to be too conservative and make the measurement survey unwieldy. A compromise would be a spatial average measured in a cylindrical volume from hip to head. Otherwise, most guidance in OET-65 and ANSI C95.3-2002 is appropriate. The Narda SRM-3006 Selective Radiation Meter is one example of a suitable instrument for this purpose. (It uses an average power detector). General-purpose spectrum analyzers and typical EMC antennas (i.e., large and non-isotropic) are not well suited to this application.

VII. RECOMMENDATIONS AND CONCLUSIONS

Adoption of the proposed rules for increased ERP in the cellular 800 MHz band in the absence of ground-level PFD limitations is likely to have a significant detrimental effect on public safety radio performance in the immediate vicinity of 800 MHz cell sites, especially Sprint cell sites and co-located Sprint and A-Band cell sites. This is largely a receiver performance issue, but the receiver problem will not be corrected in the near term. While future generations of equipment may be more interference-resistant, the reality is that a large scale replacement of public safety equipment on a nationwide basis today is not a feasible alternative. Thus, the Commission must deal with the interference environment as it stands today, while addressing future equipment requirements in ET Docket No. 13-101.

To mitigate the harmful effects of the proposed rulemaking, we make the following recommendations:

1. Adopt a PFD limit. Adopt a ground-level power flux density limit on a per-sector basis (not per RF carrier). While we have demonstrated in these comments that Verizon's proposed limit of 3,000 $\mu W/m^2$ will result in harmful interference in many cases, we are reluctant to suggest a specific lower limit at this time, as there is not sufficient data to show what percentage of public safety radio coverage nationwide would be affected by Verizon's proposed limit. There are simply too many variables involved, including the desired signal strength

distribution and highly variable receiver performance between manufacturers and between different models from the same manufacturer. We encourage a study (in which Pericle and Shulman Rogers would be happy to participate) that would estimate this percentage by modeling coverage and interference in a statistically significant sample of jurisdictions, using real-world receiver performance as part of the study model.

The V-Comm report cited in Verizon's Comments is not useful in this regard because the company measured only blocking, not strong signal IM, and it collected measurements from just one model radio (apparently). Also, V-Comm's conjecture that -40 to -35 dBm is typically not exceeded on the ground is not supported in its report by any empirical evidence. In contrast, Pericle has measured significantly higher levels (-20 to -16 dBm) at numerous locations in Oakland.[6]

The PFD limit must be specified as a peak or average power limit as the test instrument must employ the appropriate detector to match the standard. That said, it is not entirely clear to us whether performance metrics like bit-error rate and SINAD measured over time will respond differently to a continuous phase modulation interferer (e.g., FM, GMSK) than a UMTS or LTE interferer for the same average power. We are collecting such measurements at the time of this writing and hope to have results by the Reply Comment deadline.

2. <u>No Relief From Responsibilities Under Parts 22.970-22.973</u>. As we have shown in these comments, a PFD limit of 3,000 μW/m^2 will not preclude harmful public safety

[6] One possible explanation for this discrepancy is that V-Comm was measuring Verizon Wireless CDMA signals while Pericle was measuring AT&T Mobility UMTS signals. Antenna elevation patterns and antenna heights might also vary between the two operators.

interference. But eliminating the possibility of interference in the worst-case public safety jurisdiction would require such a low PFD limit that a large number of existing cell sites would not comply, much less new sites with higher ERP. Thus, the current interference reporting and mitigation process, described in Parts 22.970 - 22.973, must remain in place. The Commission should state explicitly that its adoption of a PFD limit in no way relieves the Part 22 licensee from his obligations under Parts 22.970 - 22.973. Further, the Commission should amend Part 90 and Part 22 to specify that carriers must also be responsible for legitimate costs incurred by Part 90 licensees (both public safety and business/industrial) to assist in interference abatement.

3. Require PFD Limit Compliance at All ERP Levels. Because many of the problem cell sites have antennas very close to the ground, even sites with ERPs below 500 W can exceed 3,000 $\mu W/m^2$ on the ground. For users in parking garages, in office buildings, on elevated freeway ramps and on steep terrain, even tall sites may exceed this PFD limit at “ground” level. The PFD limit must apply regardless of ERP.

4. Address Pre-Existing Conditions. There are likely many locations with PFD levels higher than 3,000 $\mu W/m^2$ today, even with existing ERP limitations. For a user in the main lobe of the sector antenna, a 500 W ERP signal will create 3,000 $\mu W/m^2$ at a distance of 150 meters (ignoring ground reflections). In Oakland, many of the problem areas are within 150 meters of a cell site. The FCC must also require that these existing problems be corrected.

5. Control How the PFD Limit is Demonstrated. Measurements of every cell site to verify PFD compliance are not practical, so propagation modeling should be allowed, with measurements required after complaints are filed by the public safety agency. Most modeling software is crude in the sense that a single clutter loss factor (in dB) is applied regardless of distance from the cell site. But most, if not all, real-world problems occur when the user is line-of-sight with the sector antenna. Plus, most propagation models ignore reinforcing ground reflections. Thus, normal propagation modeling is not appropriate for this problem. Instead, a model similar to the OET-65 recommendations should be used, i.e., a free-space propagation model with a reflection factor of 2.56 should be used, and the model should include the azimuth and elevation patterns of the sector antenna (preferably near-field patterns).

6. Do Not Allow *Any* Ground Level Location in 1 km Radius to Exceed the PFD Limit. The Commission asked whether it could require that the PFD not be exceeded over more than 5% or 10% of the area within 1 km of the transmitting structure. Because the problem areas are typically in the immediate vicinity of the cell site, allowing even 5% of the area within 1 km of the site to exceed the PFD limit is unacceptable. Recall from above that the PFD limit for a 500 W sector occurs at roughly 150 meters (neglecting reflections). For a 3-sector site, this 150 meter radius is just 2.25% of the 1 km radius study area. Allowing a blanket 5% would defeat the entire purpose of the PFD limit. Instead, the Commission should only allow non-compliance at locations well above ground level and these should be limited to a small percentage of the study area, say 1%.

7. Require PFD Limit in All Areas, Not Just Pre-Rebanding Areas. In the foreseeable future, public safety receivers will continue to be vulnerable to 800 MHz cellular interference in part due to the lack of post-rebanding filters in subscriber radios. Thus, the PFD limit must apply to all regions of the U.S., not just those that are pre-rebanding.

8. Adopt Instrument Recommendations. See Section VI above.

9. Pursue Receiver Standards Rulemaking in ET Docket No. 13-101. Rules regarding receiver standards, or more accurately, harm claim thresholds, should be pursued by the Commission for a variety of reasons, but most notably to protect public safety users from harmful interference. We believe it is the best way to encourage all radio manufacturers to adopt more robust designs. A PFD limit adopted in this proceeding is consistent with the harm claim threshold philosophy, but this proceeding is not structured to create a process to implement such a threshold in its entirety, including a transition period to allow manufacturers to incorporate new designs and to allow public safety agencies time to retire poorly-performing radios.

Respectfully submitted,

PERICLE COMMUNICATIONS COMPANY and
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