Wireless Innovation Forum's Comments to the FCC regarding the Report and Order in the Matter of Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band

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Before the

Federal Communications Commission

Washington, D.C. 20554

In the matter of	)	
	)	
Amendment of the	)	
Commission's Rules with	)	GN Docket No. 12-354
Regard to Commercial	)	
Operations in the 3550 to	)	
3650 MHz Band	)	

PETITION FOR RECONSIDERATION

The Wireless Innovation Forum (Forum) is a U.S. based international non-profit organization driving technology innovation in commercial, civil, and defense communications around the world. Forum members bring a broad base of experience in Software Defined Radio (SDR), Cognitive Radio (CR) and Dynamic Spectrum Access (DSA) technologies in diverse markets and at all levels of the wireless value chain to address emerging wireless communications requirements through enhanced value, reduced total life cost of ownership, and accelerated deployment of standardized families of products, technologies, and services.

In its Report and Order establishing rules for the Citizens Broadband Radio Service ("CBRS") in the 3550 MHz band, the Commission observed that "a multi-stakeholder group focused on the complex technical issues raised by this proceeding could provide us with a wealth of valuable insights and useful information."1 The Wireless Innovation Forum commends the Commission for providing industry the opportunity to develop answers to the questions and issues raised in the CBRS rules. As the Commission is aware, the Wireless Innovation Forum's Spectrum

[1] FCC 15-47 at Paragraph 416.

Sharing Committee ("SSC") was specifically formed to develop the solutions and standards that will encourage rapid development of the CBRS ecosystem, protect incumbent operations, and benefit all potential stakeholders in the band.2 And as the Commission is aware, the SSC benefits from participation of a broad based group that includes wireless carriers, network equipment manufacturers, potential SAS Administrators, satellite operators, existing 3650-3700 MHz band licensees, and other parties with an interest in the 3550 MHz band.

The SSC has formed four work groups that work collaboratively to develop the reports, recommendations and standards necessary to establish a commercial CBRS ecosystem. These work groups were presented to the Commission previously and are as follows:

- Work Group 1: Operations and Functional Requirements
- Work Group 2: Security Requirements
- Work Group 3: Protocol Specifications
- Work Group 4: Testing and Certification

In addition, the committee has formed multiple sub-groups/task groups, including a Joint WG1/WG3 architecture group and a FSS Incumbent protection Subgroup under WG1. Participation in these work groups and task groups currently encompasses some 120 participants from over 40 different organizations.

The members of the Forum commend the Commission on adopting the three-tier spectrum sharing framework envisioned in the PCAST report[3] in the subject report and order, and in opening

[2] Reference Ex Parte filing dated 26 February 2015
[3] "Realizing The Full Potential Of Government-Held Spectrum To Spur Economic Growth," http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf

up to 150 MHz for use in this new "innovation band" for GAA and PAL use. The Forum also applauds the commission for the reduction in exclusion zones adopted in the order and the clarifications with respect to ESC's.

Nonetheless, the members of the Forum are concerned that certain elements of the order could dampen investment in the 3.5 GHz band, and therefore discourage the development of innovative services for American consumers. The Forum therefore asks the FCC to modify its framework in the following respects:

- The FCC should modify the reconfiguration response time specified in Part 96.15(b)(4) from 60 seconds to a response time of 600 seconds for relocation

- the FCC should raise the conducted and EIRP power levels to be higher for both indoor and outdoor uses;

- the FCC should remove the elevation reporting requirement for CBSD's and have the SAS compute the elevation based on location; and

- the FCC should modify the PAL protection criteria to protect a PAL licensee's supplied claimed protection area.

With these technical changes, the Forum believes the FCC will encourage the commitment of capital necessary for the robust development of innovative services at 3.5 GHz.

1 60 Second Reconfiguration Time (Rule Part 96.15)

Regarding Rule: Part 96.15 - Protection of Federal Incumbent Users, specifically 96.15(a)(4) "Within 60 seconds after the ESC communicates that it has detected a signal from a federal system in a given area, the SAS must either confirm suspension of the CBSD's operation or its relocation to another unoccupied frequency, if available.”, we find the 60 second reconfiguration response time both too low and in need of greater nuance given the complex system of systems characterizing the Part 96 environment.

Our request is that the FCC modify the reconfiguration response time specified in Part 96.15(a)(4) from 60 seconds to a response time of 600 seconds for relocation due to the detection of a signal from a federal system in the area. As part of this process, we believe that a majority of the CBSDs can be cleared from the channel within 300 seconds.

There will be multiple SAS’s/administrators executing the reconfiguration and confirmation procedure upon receiving the signal to reconfigure. Each SAS/administrator and managed network has a requirement to optimize the reconfiguration/vacation subject to various dynamic calculations and constraints while maintaining incumbent protection as the highest priority. From a global perspective, this system of systems is a peer-to-peer distributed architecture necessarily subject to at least in part complex non-linear transmission, queuing, and processing delays that will require ongoing design, tuning, and optimization, so supporting increased response time requirements with a more probabilistic and attainable approach.

The fast decay in CBSDs active in the band allow for large-scale relocation within a few minutes, while allowing the band to support an infrequent but important tail of services which have more stringent handover requirements. For instance, the Commission sets out support for critical infrastructure use cases as a goal for the band (paragraph 411). Such applications may require more time than 60s to effect a safe handover. Furthermore, end-user applications which are being used in emergency situations may require more care in arranging handover by service providers. Such situations would be expected to be rare within the 3.5GHz ecosystem, but at the same time, such low-density applications would be expected to offer negligible interference, statistically, to incumbent operations.

Since section 96.39(c)(2) specifies a 60s vacate time when a CBSD is signaled by SAS, by using a re-authorization time period of about nine minutes, a SAS would be able to effect this rule. Since re-authorization times would be distributed throughout the device population, however, most devices would actually be cleared after only about half that interval: five minutes.

2 Conducted and Emitted Power Limits (Rule Part 96.41)

Conducted and Emitted Power Limits given in ‘Part 96.41 - General Radio Requirements, specifically 96.41(b) Conducted and Emitted Power Limits’ give both maximum EIRP and maximum conducted powers for EUDs, Category A CBSDs, Category B Non-rural CBSDs, and Category B Rural CBSDs. The rules allow a maximum of 6 dBi antenna gain for indoor Category A, a maximum of 16 dBi antenna gain for Category B Non-rural outdoor, and a maximum of 17 dBi antenna gain for category B Rural outdoor.

(b) *Conducted and Emitted Power Limits*: Unless otherwise specified in this subsection, the maximum conducted output power, maximum transmit antenna gain, maximum EIRP, and maximum Power Spectral Density (PSD) of any CBSD and End User Device must comply with the limits shown in the table below:

Device	**Geographic Area**	**Maximum Conducted Output Power (dBm/10 megahertz)****	**Maximum EIRP (dBm/10 megahertz)**	**Maximum Conducted PSD (dBm/MHz)**
End User Device	**All**	**n/a**	**23**	**n/a**
Category A CBSD	**All**	**24**	**30**	**14**
Category B CBSD*	**Non-Rural**	**24**	**40**	**14**
Category B CBSD*	**Rural**	**30**	**47**	**20**

* Category B CBSDs will only be authorized for use after an ESC is approved and commercially deployed consistent with sections 96.15 and 96.67.

Part 96.41(b) makes EIRP provisions for Category A uses that are generally too low for significant indoor coverage. The order makes EIRP provisions for Category B uses that are too low for appreciable outdoor coverage. The order makes conducted power provisions for Category B that are too low for appreciable outdoor coverage without the use of high gain, sectorized, directional antennas, thus effectively requiring such sectorized antennas for all outdoor uses, and preventing the use of lower gain antennas. In many urban scenarios, such sectorized installations are not practical.

The distinction between a maximum allowed rural antenna gain of 17 dBi and a maximum allowed non-rural antenna gain of 16 dBi makes little practical sense. In reality, the same types of panel antenna will be deployed with different allowed conducted powers. Forum members therefore propose that the same maximum allowed antenna gain of 17 dBi is assumed for both Non-rural and Rural environments. Given that these allowed conducted power levels are below conventional unlicensed power levels commonly used for Wi-Fi air interfaces in unlicensed bands, Forum members propose that the indoor power limits be raised by 6 dB to match such conventional unlicensed power levels for indoor applications for Category A CBSDs.

We further propose that the outdoor Category B Non-rural and Rural EIRP power levels to be raised by 9 dB over the order.[4] This includes 6 dB to match conventional unlicensed and 3 dB to accommodate transmitter diversity for outdoor applications. This affords the conducted power to be raised to a conventional 1 x 10 or 2 x 5 Watt maximum power level commensurate with

[4] Note that Intelsat Corporation does not agree with the WInnForum proposal. The Intelsat position is that increased CBSD EIRP will increase the risk of interference to FSS earth stations, and will therefore require larger separation distances. Intelsat's position is that the current EIRP limits are consistent with parameters for small cell studies in other forums; if new power levels are to be considered in this proceeding, additional analysis would need to be conducted. Moreover, Intelsat contends that increased EIRP will lead to wider areas of coverage for small cell networks and will lead to increased difficulty in identifying and rectifying interference events.

conventional urban pico-cellular products and deployments. It allows for antenna gains as high as 17 dBi, but with reduced conducted powers.

- For Non-rural Category B, this allows for a maximum allowed EIRP of 49 dBm for all cases.

- For Rural Category B, this allows for a maximum allowed EIRP of 56 dBm for all cases, which preserves the same 7 dB ratio over Non-rural that was in the order.

Given that such higher antenna gains are currently allowed in the order, this proposal allows the conducted limits to be both raised and restated to allow higher conducted power levels with lower gain antennas. We propose the allowed conducted power be scaled up 1 dB for each 1 dB lost in antenna gain, up to the maximum of 10 watts conducted power. This is proposed so as not to preclude the use of omni-directional antennas while still maintaining adequate coverage areas for outdoor deployments.

In many urban deployment scenarios in cluttered environments, lower gain antennas or omni-directional gain antennas are preferred. We propose the following tables that allow higher EIRPs and higher conducted powers for lower gain antennas in the outdoor cases.

The following four tables state the proposed changes and summarize the maximum allowed conducted and EIRP power levels.

1) For End User Devices, this represents no changes.

End User Device [All Cases]			
Allowed Antenna Gain	Maximum Conducted Output Power	Maximum Conducted PSD	Maximum EIRP
(dBi)	(dBm per 10 MHz)	(dBm per MHz)	(dBm per 10 MHz)
n/a	n/a	n/a	23

2) For Indoor Category A CBSDs, this represents a 6 dB increase.

CBSD Category A			
Allowed Antenna Gain	Maximum Conducted Output Power	Maximum Conducted PSD	Maximum EIRP
(dBi)	(dBm per 10 MHz)	(dBm per MHz)	(dBm per 10 MHz)
6	30	20	36

3) For Outdoor Category B Non-rural CBSDs, this represents a 9 dB EIRP increase and allowances for lower antenna gains.

CBSD Category B - Non-rural			
Allowed Antenna Gain	Maximum Conducted Output Power	Maximum Conducted PSD	Maximum EIRP
(dBi)	(dBm per 10 MHz)	(dBm per MHz)	(dBm per 10 MHz)
17	32	22	49
16	33	23	49
15	34	24	49
14	35	25	49
13	36	26	49
12	37	27	49
11	38	28	49
10	39	29	49
9	40	30	49

For non-rural outdoor applications, some antenna gain would always be deployed for maximum range, so conducted power levels higher than 40 dBm (for potential use with lower gain antennas) are not proposed.

4) For Outdoor Category B Rural CBSDs, this represents a 9 dB increase and allowances for lower antenna gains.

CBSD Category B - Rural			
Allowed Antenna Gain	Maximum Conducted Output Power	Maximum Conducted PSD	Maximum EIRP
(dBi)	(dBm per 10 MHz)	(dBm per MHz)	(dBm per 10 MHz)
17	39	29	56
16	40	30	56

For rural applications, sectorized antenna gain would always be deployed for maximum range, so conducted power levels higher than 40 dBm (for potential use with lower gain antennas) are not proposed.

These new proposals for Part 96.41(b) Conducted and Emitted Power Limits are 6 dB higher in EIRP than the current Report and Order Rules for indoor applications to match existing indoor unlicensed power levels. These are 9 dB higher in EIRP than the current Report and Order Rules for outdoor applications. These proposed rules allow for a maximum of 40 dBm outdoor conducted power with reductions for increased antenna gains and allow more flexible deployment strategies and a wider range of equipment. Specifically, these proposed rules changes avoid the need for large area panel antennas, with heights up to 24 inches, in order to achieve the 17 dBi antenna gain required to meet the maximum allowed EIRP.

Forum members note that the use of highly directional antennas in urban environments, especially those with narrow vertical (elevation plane) half power beamwidths is often not advantageous for urban coverage scenarios.

3 Elevation Accuracy Requirements (Rule Part 96.39)

Rule Part 96.39(a)(1) states that all CBSDs must be able to determine their geographic coordinates (referenced to North American Datum of 1983 (NAD83)) to an accuracy of +/- 50 meters horizontal and +/- 3 meters of elevation. Note that this requirement essentially applies to professionally installed CBSDs as well as per 96.39(a)(2). While the CBSD horizontal accuracy requirement is readily achievable, the elevation accuracy requirement significantly exceeds the capability of standard GPS equipment. (GPS elevation accuracy is often 1.5 to 3 times worse than horizontal locating accuracy, which is typically on the order of +/-15 meters, depending on several factors.) It is also anticipated that many professional installers will rely on standard GPS equipment. As such, we believe that the industry would be well served by relaxing or re-casting this requirement.[5]

One preferred approach would be to allow the SAS system to estimate CBSD elevation/ground level using detailed terrain databases, based on the unit's reported operating location. For Category A devices, installation reports must include the horizontal location and the highest floor from which the device will operate. For Category B devices, the CBSD itself, or a professional installer, would report a horizontal location (meeting the above horizontal accuracy requirements), and an antenna height above ground level (meeting a +/- 3 meter accuracy requirement) to allow accurate interference protection computations in the SAS system. Forum members recommend that the Commission strike the detailed elevation reporting requirement from Rule 96.39 (a) (1), such that it reads:

All CBSDs must be able to determine their geographic coordinates (referenced to North American Datum of 1983 (NAD83)) to an accuracy of +/- 50 meters horizontal.

The SAS database system would then be required to compute elevation for the CBSD. We further believe that alternate locating means should also be allowed by rule or clarification. For example, indoor units may not be capable of automated geolocation techniques (e.g., GPS). Thus, other location reporting techniques such as specifying a CBSD's operating street address (and floor level) should be allowed (possibly through a rule clarification, as long as the specified CBSD horizontal location accuracy requirements are met). The SAS system could accurately convert street addresses into geo-locations (and elevations) in many cases. Similar professional installation constraints would have to be followed in regards to street address and floor level accuracy.

[5] Intelsat Corporation does not agree with the WInnForum position. The Intelsat position is that all new devices implemented under this proceeding should be required to have geolocation capabilities because absent such capabilities, there is a high risk that inaccurate location data is the SAS will result in interference to FSS earth stations.

In addition, members concur that that the 3.5 GHz eco-system would be well served by allowing differing CBSD geo-location techniques. In general, less accurate geolocation techniques could be allowed, if the reduced accuracy is fully taken into account in the SAS system (by using worst case operating location assumptions). For example, if a device could be operated on a first floor or a second floor in the same building, the SAS could assume that the device is operated on the second floor to model interference. If the floor of operation is not provided, then the highest floor in the building will be used in calculations. Similarly, if the building is large (e.g., covering several hundred meters), a worst case location (e.g., the one closest to another affected device) could be utilized in the interference modeling computations. In this manner, we believe that the same level of interference protection could be obtained in the band, while allowing for a wider range of equipment and applications (e.g., indoor) to be fielded.

4 PAL Protection Criteria (Rule Part 96.41)

In part 96.41(d) the Commission defines the protection of CBSDs deployed by PAL licensees as an aggregate signal strength limit of co-channel CBSDs at any point on the census tract boundary (the Service Area of the PAL license) of -80dBm (measured over the 10 MHz license channel) at an elevation of 1.5 meters. In paragraph 195 of the Report and Order (1547A1) the Commission invites consideration by a multi-stakeholder group of the implementation of such a protection criterion and its application.

This protection criterion creates five problems the Commission did not consider in the Report and Order, and so the Commission should reconsider and modify this rule.

1) The requirement places very large burdens on Spectrum Access Systems

The Commission requests feedback on whether the described protection is possible to implement. While it may be possible, it places a very large burden on Spectrum Access Systems. The task of modeling point-to-point and point-to-area interference characteristics for a known service area of the CBSD being protected is a field of much research, and can be handled appropriately given existing tools. Modeling point-to-line interference characteristics is a much less well developed field. While simple approximations are possible (and may be required to make the calculations tractable), the need to carry out the extensive research required to apply more sophisticated models would delay the dense deployment of devices into the band, perhaps significantly.

The difficulty hinges on the Commission's specifying that aggregate co-channel RMS power "at any point" along the boundary must be limited. Unsophisticated models allow the placement of loose bounds on this interference power, and this is sufficient to model the protection criterion. The application of more site specific higher accuracy techniques (such as terrain and clutter modeling) requires point-to-point calculations which are much more taxing. In practice, it will require sacrificing some of the gains of the more sophisticated model, since they require the modeling of the infinite number of points present along the boundary. In practice, once the size of the census tract boundary is within the usual application of point-to-area modeling, this becomes tractable using a similar scheme of sampling points and assuming continuity between them.

While there are some urban census tracts which are comparable in size to the coverage area of a CBSD, those will tend not to dominate the calculation. The protection zones which will dominate the calculation are the larger rural zones where existing techniques do not work as well. In such areas, assuming lower density, an approach to make this tractable would require using sparser point sampling, thus sacrificing accuracy, or sacrificing more sophisticated models altogether if sparse sampling is challenging to characterize.

2) The requirement does not necessarily provide protection to PAL CBSDs

Interference protection applied at the service area edge does not imply protection of the CBSD itself. This is because of topographical relief present at the natural boundaries followed by many census tracts. For instance, a census tract which has borders in deep valleys may have interior points which have much higher elevations, and so CBSDs sited at higher elevations may therefore be victims of much higher interference levels than exist at the census tract boundaries.

Figure 1 illustrates this weakness with a specific example near Pittsburgh, PA. The eastern edge of the highlighted census tract is at the bottom of a deep gorge. Points at 1.5m AGL at the census tract edge deep in this gorge will have very little RF energy, and if interfering CBSDs are also above the level of the gorge, applying protections at the low elevation boundary will be quite unrelated to the potential interference to a CBSD located several hundred feet higher in the populated areas.

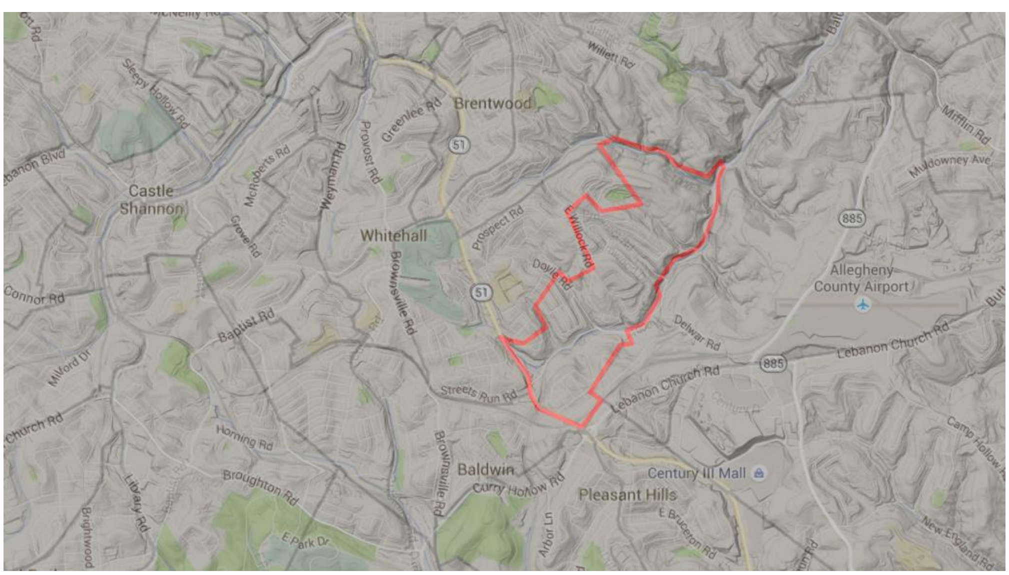


Figure 1. An outline of a census tract near Pittsburgh, PA.

The Commission's rules do not specify that the SAS provide protection to the actual CBSD location (or its actual coverage area) from interference, relying on the license area boundary protection to accomplish that goal. In many cases such as this, the goal is not accomplished by license area boundary protection as written. The cell-to-cell interference protection criterion should consider interior points within the coverage area of the base station, and, of course, the location of the base station itself.

3) High elevation census tract boundaries will dramatically impact PAL deployments

If the census tract edge crosses or follows high relief topology, PAL deployment seams may be pushed back dramatically, since aggregation limits push LOS interference out to the nearby density. This is true for PAL and GAA alike. This scenario is the complement to the example of a census tract edge which follows a valley. The Commission's specification that aggregate RMS power be limited "at any point" along the census tract edge here means that even sophisticated path loss modeling will be unhelpful in providing high density deployments. Even if a PAL is deployed far away from the highest elevation point along its license area boundary, and that point is not within its coverage area that point with a large HAAT will tend to dominate the protection of that CBSD from neighbors.

Figure 2 illustrates the problem with a census tract near Los Angeles, CA. The southern edge of the highlighted census tracts is placed high above the more populated areas of the census tracts, with HAATs around 1000 feet. Such census tract boundary points naturally have a much larger HAAT, and even a 1.5m AGL point at these high elevations commands a large view over dozens of high density census tracts to the north. Even a sophisticated model, confronted with line-of-sight paths to a high elevation point, will tend to produce free space path loss estimates (an in fact, many such hills in and around the Los Angeles area are host to large antennas for precisely this reason).

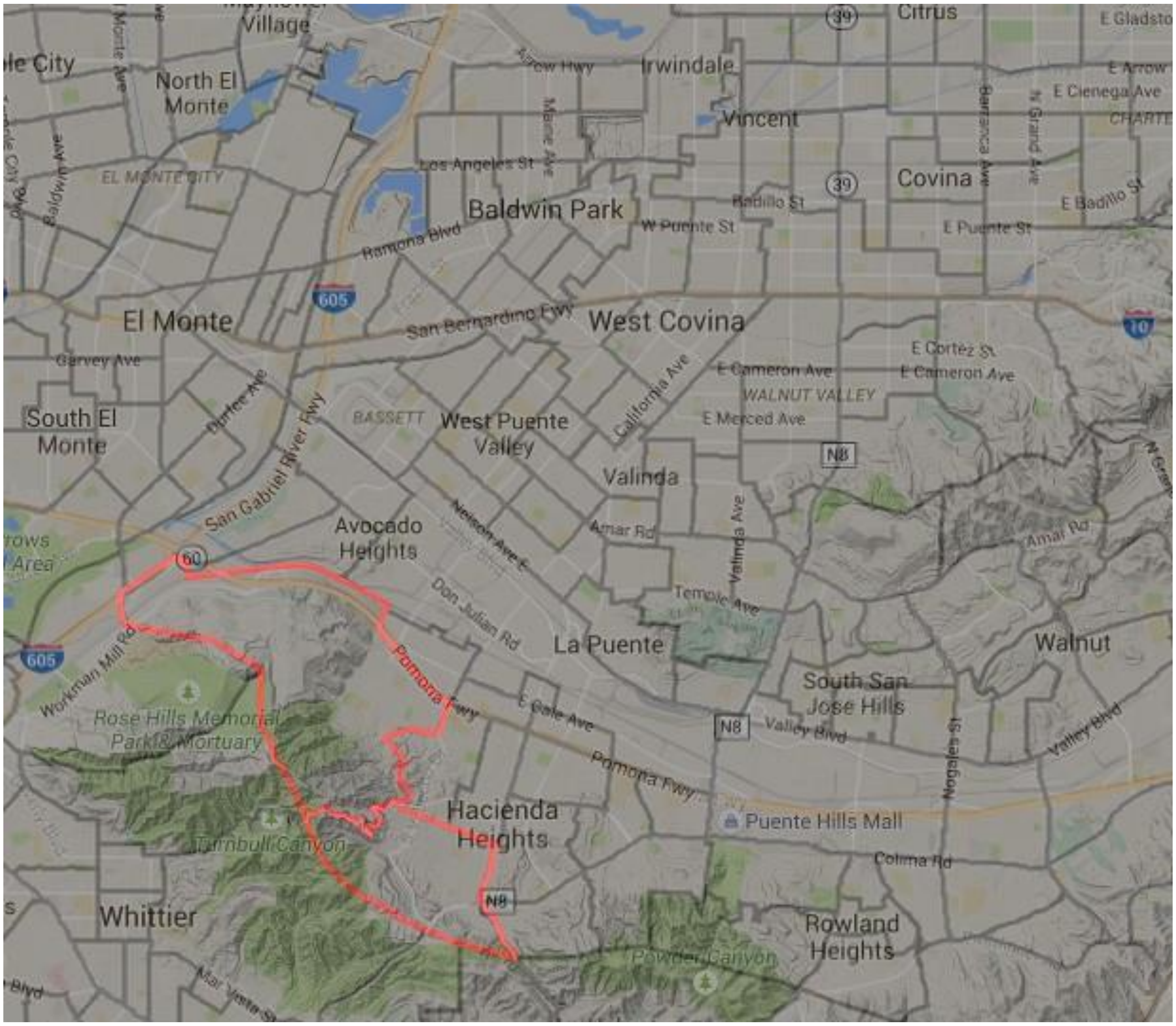


Figure 2. Census tracts near Los Angeles, CA

In this context, protecting the census tract boundary dramatically overprotects the CBSDs located inside it, and will tend to cause any co-channel operation, whether by PAL or GAA, to be required to push much farther away than a protection of the actual CBSD and its coverage area would require.

4) The requirement will unnecessarily block co-channel devices

Definition of the protection area edge as the licensed census tract edge potentially creates a large impact on potential deployment of noninterfering CBSDs. There are many rural census tracts with an area very much greater than the coverage area of a CBSD. The deployment of a single PAL CBSD within such a census tract would unnecessarily limit noninterfering co-channel deployments of GAA devices within other areas of the census tract or adjacent census tracts. Alternatively, CBSDs deployed at the center of the census tract would block many otherwise non-interfering devices far away at the edge. Most of the area of the United States is potentially impacted by this protection criterion. A sample of census tracts of areas greater than 10 km^2 is shown in Figure 3. As can be seen, outside of major metropolitan areas, virtually all the land in the United States is potentially impacted, thus reducing the utility of the band in serving rural customers.

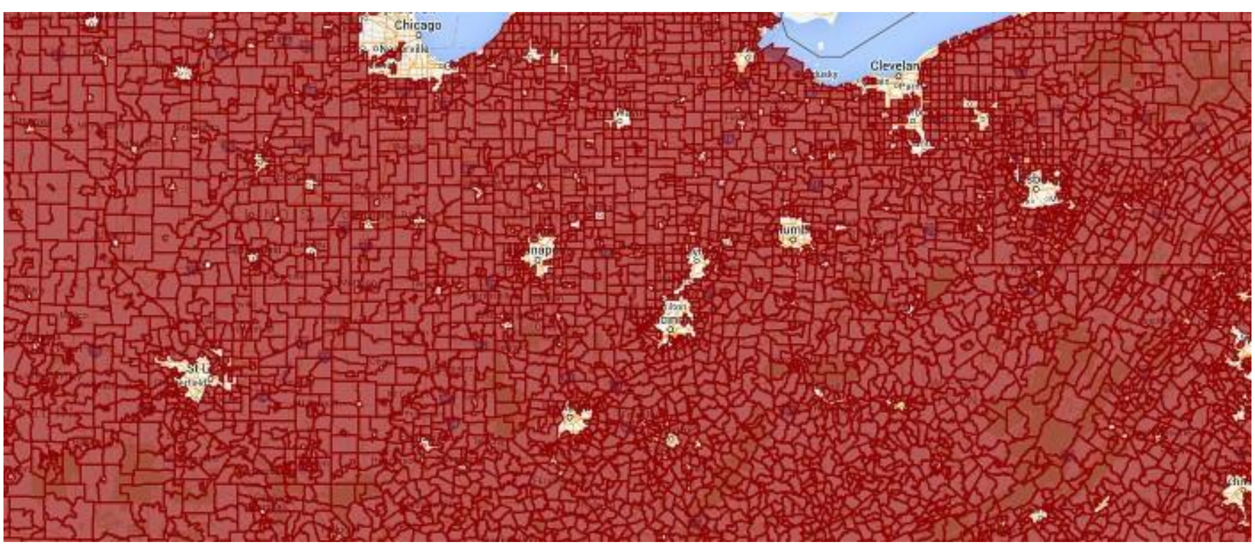


Figure 3. Census tracts in the Midwest with an area greater than 10 km^2.

Nowhere is this most obvious than in those census tracts which are not simple closed areas, but have exclaves. In such a case, the census edge protection would be applied to the exclave, which might not even contain a CBSD being protected. This means co-channel CBSDs would be forbidden from operating near such areas, even though there is no CBSD to protect, because of the protection applied to license area boundary instead of coverage area boundary.

We request that the SAS be able to protect PAL deployments using a licensee-defined protection area in place of the protection criterion currently in the Commission's rules:

1) The CBSD itself and any end user devices operating anywhere within the claimed protection area of that CBSD be protected by the SAS to -80dBm/10MHz from aggregate interference[6];
2) The protection area is to be defined by the operator of the PAL CBSD and registered with the SAS given the following constraints[7]:
    a. EUDs may reasonably expect service from the PAL CBSD in a large fraction of the protection area, and may not reasonably expect service from the PAL CBSD outside the protection area;
    b. The protection area must be contained completely within the PAL licensee's service area and may not overlap the boundary of a service area (that is, the contiguous license areas owned by the same licensee);
    c. Multiple protection areas may be claimed within the same license area or service area;

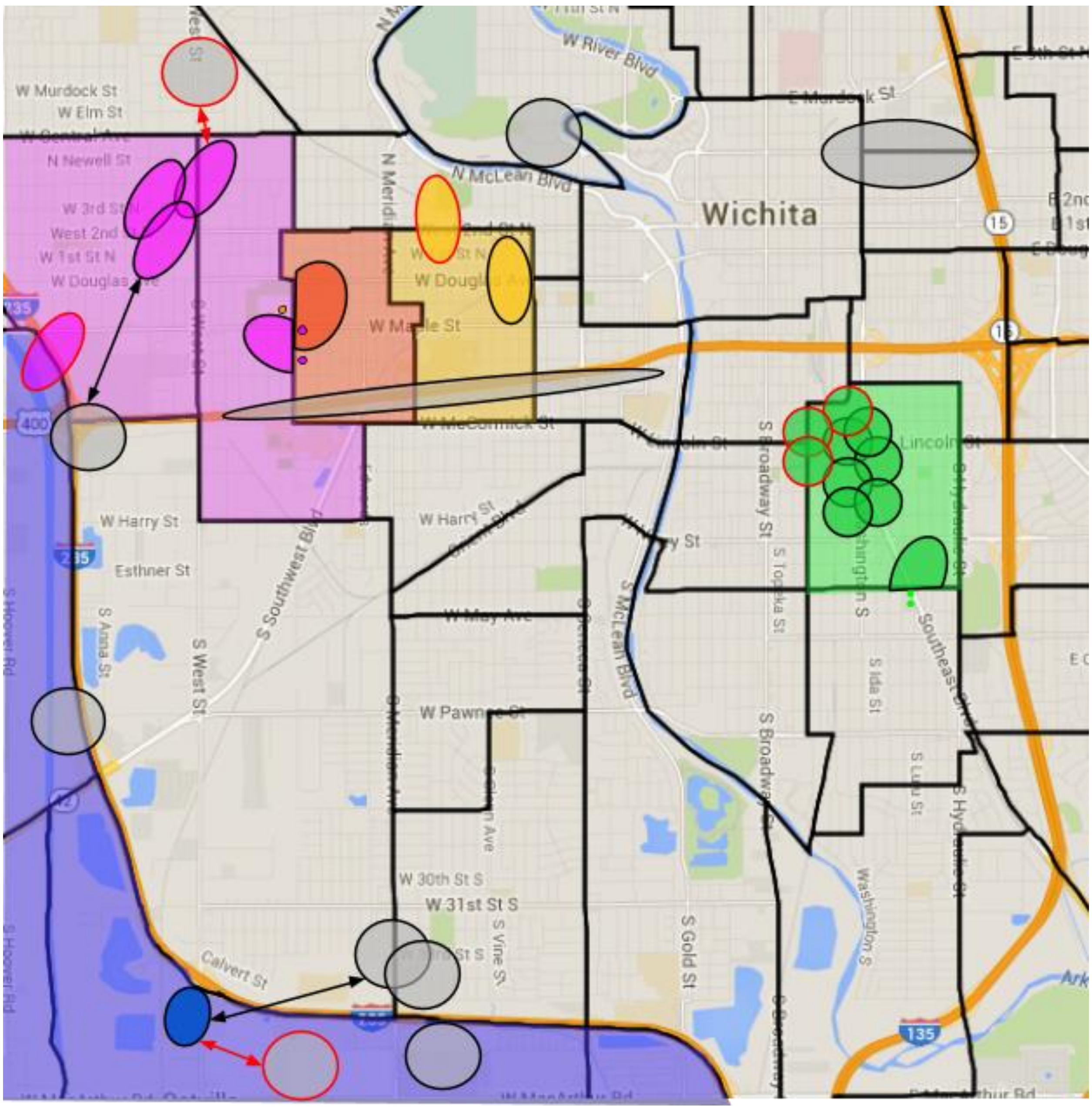
This modification addresses all the above concerns, as well as being relevant to the definition of use of a PAL license area. First, it provides protection to the actual PAL CBSD providing coverage, which may be mounted high within the license area, or in a different RF

6 This means that interior points in the protection area receive protection. This can be modeled by the SAS sampling interior points at 1.5m AGL or another defined criteria agreed to by the license holder, and ensuring that the protection limits are not violated.

7 For example, the protection area can be specified using the same series of vertex points descriptions which define census tracts, or in terms of a point and radius, or parameters for an ellipse.

propagation environment than that obtaining at the census tract border. Second, it provides protection to end user devices communicating with that PAL CBSD. Third, it establishes that the protection area is to be defined by the operator of the PAL CBSD, who is in the best position to estimate it, while establishing limits on that area such that it not be made too large or too small. Fourth, it does not require that the protected PAL CBSD be restricted to -80dBm/10MHz on its own license area border. This is a very restrictive requirement. Instead, the PAL is simply required to not interfere with other co-channel PAL CBSD operations in their own respective protection areas (which may be quite distant from the closest license area edge in a large census tract). Fifth, the corresponding definition of use is that the part of the census tract in use by a PAL is that part within a PAL protection area. This provides an engineering interference based definition of use: GAA CBSDs in a large census tract far from any deployed PAL CBSDs and their respective protected areas could still make use of that channel if they do not introduce aggregate interference exceeding the PAL protection limits. Similarly, GAA CBSDs in small census tracts adjoining a PAL license area could not make use of the channel if they introduce aggregate interference exceeding PAL protection limits into the protected area. Sixth, it allows use cases such as GAA point-to-point, which may be highly directional and noninterfering, to operate co-channel with PAL licensees in the same census tract, so long as they do not cause interference into the protected area(s). Seventh, this approach relies on more well studied point-to-area interference models, which the SAS will need to implement. Simple approaches to such models are feasible. Importantly, it requires those models be applied where there is actually a PAL CBSD and a claimed protection area to protect, rather than applying them to complex boundaries which may be far from any deployed CBSD. The terrain in which deployment of small cells in the band is expected will be easier to manage (that is, be much more uniform) than is randomly selected terrain. While census tracts must provide complete cover of the United States area, small cells will be concentrated in areas of higher population density, which tend to be in areas of lower terrain complexity, thus making the interference modelling more tractable for most CBSDs.

Example of service area, license area, and protection area definitions:



The colors represent different service areas (note that some service areas encompass multiple license areas). The solid same colored bordered areas represent correct protection areas. The red bordered areas are disallowed protection areas.

The green protection areas are OK, even though they overlap they are all from the same PAL licensee and completely within a service area. The odd shaped protection area has been truncated to lie completely within the service area. While it may be possible for some end user devices to receive coverage outside this area (in the green spots shown), they will not receive protection. Note that there is no -80dBm level necessary at the southern protection area (service area) boundary here, since there is no PAL to protect on the other side.

The orange and pink licensees have an arrangement to waive interference. Their adjoining protection areas are cooperatively aligning interference and so are not protected from each other. Therefore, even though they adjoin areas, devices in one protection area would be modeled by the SAS as interfering (since they are so close), but they coordinate to mitigate this. This enables UEs in adjacent areas to still receive service across service area boundaries (pink and orange spots).

Even if the pink licensee has a similar arrangement with the blue licensee, the protection area may not overlap the border of the service area, so the illustrated red bordered pink PAL is not allowed.

Similarly, the red bordered yellow and green PAL protection areas are not allowed since they overlap the service area borders (albeit into an area where there is no licensee at this channel).

The gray circles represent GAA deployments. They are all permitted so long as their stand-off distance is sufficient to provide aggregate protection for all the defined protection areas that are operating co-channel. Note that some of these GAAs are within the service area of the PAL. By the protection area definition of use, if they do not interfere with the PAL protection area, they may operate co-channel within the service area. Of note: the long point-to-point gray Category B GAA link which is stretching down the freeway is within the PAL service area, and quite close to the PAL, but since it is a very directional beam it is not be interfering with any of the PAL operations within the claimed protection areas (pink, orange, and yellow ellipses).

The gray circles with red outlines are not allowed. They are too close to the indicated PAL protection areas.

5 Other Concerns: Protection for High Elevation CBSD Deployments

In Part 96.41(d) the Commission defines the protection of CBSDs deployed by PAL licensees as an aggregate signal strength limit of co-channel CBSDs at any point on the census tract boundary of -80dBm (measured over the 10 MHz license channel) at an elevation of 1.5 meters AGL. The Commission did not specify any limits on the height of Category B CBSDs. The protection criterion is supposed to act as a barrier to high elevation deployments by intrinsically offering decreasing protection at increasing CBSD elevations. We applaud the Commission for not excluding high elevation (macrocell) use of the spectrum. However, the rule leads to the following problems.

A Category B CBSD could be deployed at a high elevation that operates in the downlink direction only and is not affected by decreased (or no) protection offered to the CBSD as long as the EUDs are protected. A high elevation PAL CBSD could bar co-channel use of the spectrum by other PAL licensees for large distances from the CBSD location (or at least up to a census tract edge under the current rules). A high elevation GAA CBSD could use up a majority of the interference protection margin, leaving little opportunity for other CBSDs to operate co-channel.

The interference protection offered to CBSDs as well as EUDs at high elevations is not bounded. They may have to endure interference that significantly exceeds the -80 dBm threshold specified at 1.5 m AGL. For example, interference from one PAL CBSD to another PAL CBSD may be very high if they are in line of sight. This is especially challenging in a hilly terrain environment. Also, interference received by an EUD located in a building on a high floor near a window could also be very high.

We propose that the Commission considers modifying the interference protection criterion in a manner that also protects high elevation CBSDs and EUDs with specific or at least bounded levels of interference at their respective locations. This is an area where the multi-stakeholder group may be able to contribute.

6 Conclusion

Forum members urge the Commission to adopt changes on reconsideration that would enhance investment and innovation in the 3.5 GHz band. In particular, we respectfully request that the Commission:

- modify the reconfiguration response time specified in Part 96.15(b)(4) from 60 seconds to a reconfiguration response time of 600 seconds

- raise the conducted and EIRP power levels to be higher for both indoor and outdoor uses;

- should remove the elevation reporting requirement for CBSD’s and have the SAS compute the elevation based on location; and

- should modify the PAL protection criteria to protect an PAL licensee supplied claimed protection area.

With these changes, Forum members believe the FCC will best accomplish its goal of making the 3.5 GHz a home for development of robust range of innovative services for American consumers.

Respectfully submitted,

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