Regional Planning Committee

FCC Region 8 – 700 MHz

Public-Safety Communications Plan

Guidelines for Section 9

Window One

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1. SECTION 9 GUIDELINES

The purpose of these Guidelines is to identify areas in Section 9 of the RPC 8 700 MHz Plan that need further clarification. The overall objective is to facilitate the application process by ensuring sufficient clarity to avoid delays in application development and review for Window One.

In summary these guidelines further illuminate areas on:

- *How the Longley-Rice (L-R) propagation model should be applied*
- *A concise Definition of the Protected Service Area or PSA*
- *The addition of a radial limit to identify all the required points to be evaluated in the Radiation Control and System Design portion of the plan (Section 9.3)*
- *The description of a process to perform the Area Reliability Degradation (ARD) (Section 9.4) requirement of the plan*

General Guidelines

These general guidelines are relevant for applicants to note for their overall efforts to complete their applications.

- Applicants must submit a checklist showing that all procedures (such as tile size, propagation parameters, etc.) are followed.
- Be it graphic, tabular or otherwise, applicants must submit results of the ARD requirement as they impact their application. This should be clearly done for each co- and adjacent channel applied for as an indication to the Technical Subcommittee that it was considered. An applicant can claim that his application has no interference in any CAPRAD co- or adjacent area, but that claim shall be well demonstrated in a form suitable for a peer review process by the Technical Subcommittee.
- Propagation graphics and matrixes shall be submitted in a tile resolution range between 3 arc seconds (maximum) and 9 arc seconds (minimum). The subcommittee preference is 6 arc seconds, as this represents a reasonable compromise between resolution and data file size.

Guidelines for Section 9 – Window One

1.1 Guidelines for Section 9.1, Recommended System Reliability

No guidelines are provided for Section 9.1.

1.2 Guidelines for Section 9.2, Coverage-and Interference-Prediction Methodology

This section further clarifies the Longley-Rice (L-R) parameters that the Technical Subcommittee is expecting the applicant to follow when invoking the L-R model.

This states the necessary propagation modeling parameters to reasonably ensure that propagation modeling results and interference calculations are consistent and repeatable.

These settings shall be followed:

- The L-R propagation model version 1.2.2 shall be employed
- All L-R NTIA error codes shall be ignored
- The LULC attenuation values given in TSB-88 (latest edition), Section 6.6.1 Table 17, shall be employed in the prediction model
- A mobile receive antenna height of 2 meters and a portable receive antenna height of 1 meter shall be employed

Further, the following parameters given in Table 1 shall be employed as the baseline Longley-Rice parameters in the model:

Table 1, L-R Parameters

Parameter	Value
Time %	50
Location %	50
Confidence %	50
Conductivity (S/m)	0.005
Dielectric constant	15.0
Climate Zone*	Maritime Temperate Over Land
Service Application	Mobile

** The Technical Subcommittee requires applicants use Maritime Temperate Over Land for the Climate Zone setting when performing L-R calculations. This Climate Zone setting shall be used as the RPC 8 baseline for Longley-Rice calculations. Applicants may use other Climate Zones but shall identify which Climate Zones were used in their applications and give an explanation for the change.*

1.3 Guidelines for Section 9.3, Responsible Radiation Control and System Design

This subsection represents part of a two-step process to ensure proper spectrum coordination by controlling RF power. This subsection intends to control the amount of power that is propagating beyond the PSA of a given applicant.

1.3.1 Definition of the PSA

The protected service area is the jurisdictional boundary of the applicant. Be that county, town, city, or region. Therefore, the jurisdictional boundary of the applicant is not limited to county size. It can be larger, smaller, or encompass a number of counties or parts of a county.

The required 8 km (or 5 mile) buffer cited in this section is an additional boundary to the PSA and not part of the PSA.

1.3.2 The Extent of the L-R Propagation

The intent of this section is to keep 80% of the overall radiation within the PSA and the buffer. We here define a second outermost boundary for the purposes of where the maximum extent of the propagation shall be considered. That outermost boundary is 70 miles from the PSA boundary. This value (70 miles or 113 km) is consistent with the desired range for similar considerations in RPC 8's 800 MHz plan and the rules in 47 CFR Part 90.621. Therefore, the process would be to:

- Take each site under study and run L-R for it as specified in subsection 9.2 and create a matrix containing the strongest signal at each tile.
- Calculate the sum of all the tiles within the 113 km boundary that are ≥ 50 dBµ (-82 dBm). That area shall represent the possible sum of all the tiles for the study. Call that the sum N.
- Sum all the points within the PSA plus 8 km that are ≥ 50 dBµ (-82 dBm) and call that M. This value (M) shall be 80% or greater than N, or stated mathematically, $M \geq 0.8N$.

1.3.3 Check for Incursions into Co and Adjacent Allotments

Since the intent of the outcome of Sections 9.3 and 9.4 is to result in responsible radiation control for the purposes of minimizing or eliminating interference on allotments (in-pool assignments) and incumbents, it is the responsibility of the applicant to demonstrate that his design does not exceed the ARD for co- and adjacent allotments and users over their entire PSA.

To that end, applicants are expected to demonstrate for the entire PSA that they have either,

- No RF incursions into any co- and adjacent allotments and incumbents, and

- If there is an RF incursion into any co- or adjacent allotments or incumbents, that the incursion can represent no more than 2.5% ARD over the entire PSA (per the process in Section 9.4 of the Plan).

1.3.4 Determining Co and Adjacent Allotments

It is the responsibility of the applicants to determine all the co- and adjacent allotments and users over the 113 km distance from their PSA. Commensurate to that, an applicant can use the CAPRAD site to make that determination. It should be noted that this is a requirement for all co- and adjacent allotments and users over the 113 km distance from their PSA not just the co- and adjacent allotments and users within RPC 8. When considering the 113 km range, the applicant should include all co and adjacent CAPRAD county boundaries that are included or cut by that boundary. If the 113 km boundary just cuts through a CAPRAD county boundary (partial boundary) then the entire CAPRAD county boundary needs to be considered in the co and adjacent ARD calculations.

1.3.5 Required Submittal Exhibits.

Applicants shall submit graphical representations of the propagation coverage for each of the sites in their application that show all of the co- and adjacent county pooled allocations (per CAPRAD).

Given that in most cases this is likely to make it difficult for the subcommittee to visually determine if an incursion has occurred, the applicant shall submit detailed drawings for the coverage of each site detailing the counties individually that are co- and adjacent allotments and incumbents.

Please note: These drawing submittals do not relieve the applicant of the required electronic submittal for each site's propagation matrix. The evaluation committee may require that the applicant make a presentation to clarify technical issues regarding his application. This presentation shall take place at a time and location to be determined by the Technical Sub-committee.

1.4 Guidelines for Section 9.4, Pool-to-Pool Reliability Degradation Threshold

This Section's intent is to detail the process for determining ARD; which is the Plan's methodology for determining interference and the extent of allowable interference. The process of ARD can be completed using a number of commercially available applications and software tools.

CAPRAD was designed to minimize interference and maximize frequency reuse, yet there still is a possibility that interference could exist due to individual system designs. If the applicant can graphically, or in a table, demonstrate that no incursion > -124 dBm occurs, then the applicant does not have anything further to report.

Applicants who have some incursion of radio energy into a co- or adjacent allotment boundary (i.e., CAPRAD county boundary) must demonstrate to the committee that they do not exceed the ARD power level in more than 2.5% of this protected boundary (e.g. the "victim" boundary).

There may not be a single software application that is a complete solution to determine ARD. Applicants may have to calculate site matrixes in one application then manipulate those matrixes in another software tool such as a GIS tool or a spreadsheet. For example, one could use an application that calculates a L-R matrix for a proposed site (i.e., RSSI and Lat. /Lon.). Applicants could then Export it to a spreadsheet file to filter only the geo-located tiles (~3 to 9 arc seconds) from the tiles that the site matrix has in common with a co- or adjacent county PSA. If the ARD determination results in an ARD that is ≤ 2.5%, the applicant has demonstrated compliance with Section 9.4 of the plan.

This means that if a site has co-channel RF power above -124 dBm (or adjacent channel power adjusted by lowering signal by 40 dB that remains above -124 dBm), then the victim's reliability in all (ubiquitous) locations at that value is considered below 90% reliable. Therefore, the applicant must determine the number of tiles (at the desired resolution, e.g., 3 to 9 arc seconds) that this incursion has affected in the victim boundary and report that (as a percentage of the entire victim's PSA) to the Technical Subcommittee.

1.4.1 Process for Calculating ARD to Unused Pool Assignments (Using the Ubiquitous Coverage Rule)

Using the CAPRAD database, all CAPRAD identified co- and adjacent allotments need to be considered for ARD consistent with section 9.4 of approved plan. Protection must be provided to the entire PSA intersected by the applicant's 113 km boundary (boundary as detailed in Section 1.3.2).

To accomplish the determination of ARD, the Faded Performance Threshold (FPT) parameter needs to be part of the stated unused parameters given in Section 9.4 of the plan. Based on the parameters given in the plan, the FPT is calculated to be -106 dBm (-124 dBm + 18 dB).

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The process to calculate the signal level that provides 90% reliability based on the formula given in the plan (which is for reliability in the presence of noise only) is:

- Employing the 90% one-tailed Z value (1.28) and the plan's given standard deviation value of 7 dB, calculate the reliability margin. In this case, it is calculated to be ≈ 9 dB (1.28 X 7 dB).
- Add the calculated reliability margin (9 dB) to the FPT value (-106 dBm) to arrive at the signal level of -97 dBm, which is the signal level that provides 90% reliability in this instance.
- Calculate the total margin needed to provide for the plan's given Channel Performance Criterion (CPC) and calculated reliability margins. In this case (when using the Ubiquitous Coverage Rule), it is the sum of the plan's given CPC value of 18 dB and the calculated reliability margin of 9 dB, for a total margin of 27 dB.
- Subtract the total margin value of 27 dB from the 90% reliability signal level of -97 dBm to at arrive at a signal level of -124 dBm. Therefore, any interfering signal level > -124 dBm will cause a loss of reliability.

For applicants that have simulcast systems planned or plan to have technology that will result in multiple co-channel signals arriving at a given co- or adjacent location at the same time, we detail acceptable methods for combining multiple interfering signal levels for multiple sites.

All applicants should note that the Technical Subcommittee will assume simultaneous signals arriving at a co- or adjacent allotment from co-channel applicants. This assumption will be made in order to determine that the allotment or incumbent (being protected) does not exceed 5% total ARD consistent with Section 9.4 of the approved plan. To that end, one of these three methods will be employed:

- The Monte Carlo method, as detailed in TSB-88.2–C (see Section 6.10.2 Page 80)
- The linear summing method (simple addition of the signal levels in watts and then converting back to dBm a/k/a superposition), as detailed in TSB-88.2–C (see Section 5.4.5 Page 37)
- The Equivalent Interferer Method, as detailed in TSB-88.2–C (see Section 6.10 Page 77)

The final steps in the process to calculate the ARD based on unused pool assignments having ubiquitous coverage are:

- For the County being investigated, determine the total number of tiles (from the propagation prediction matrix) within the entire County
- Total the number of tiles (from the propagation prediction matrix) within the entire County that are ≤ -124 dBm
- To calculate the ARD, divide the number of tiles ≤ -124 dBm by the total number of tiles and subtract this value from one

1.5 Guidelines for Sections 9.5 and Sections 9.6, Outside-to-Pool Reliability Degradation Threshold and Evaluation of Adjacent-Channel Effects

Region 8 will not accept any out of pool applications under Window One.

The subcommittee has no guidelines at this time for Section 9.5, just the position that this section is likely to be immaterial for Window One. It is deemed that Section 9.5 will be inconsequential to the first Window process. Section 9.6 is principally intended to evaluate applications with one bandwidth to another. In the first window, this would not be very relevant to applications, as applicants are primarily protecting allotments under the ubiquitous rule only. Therefore, the Technical Subcommittee instructs (as a guideline for Window One applicants) that applicants consider the Adjacent-Channel Coupled Power Ratio value (ACCPR) for the purposes of ARD on adjacencies to be 40 dB as needed to consider the ubiquitous rule only. *Any overlap not covered by Table 9 of the Plan shall be treated as a co-channel*.

Until such time as incumbencies with known air-interfaces become known, Table 9 of the Plan, *Adjacent-Channel Coupled Power Ratio Values* are not directly applicable.

APPENDIX A: SECTION 9 OF PLAN (FOR REFERENCE PURPOSES)

This section defines the interference-protection criteria, system deployment constraints and assumptions that Region 8 employs in its application-evaluation process.

9.1 Recommended System Reliability

It is recommended that proposed facilities in Region 8 be designed to provide 50 dBµ (-82 dBm) received-power levels for reliable portable-coverage operations, and 40 dBµ (-92 dBm) received-power levels for reliable outdoor mobile-coverage operations.

9.2 Coverage- and Interference-Prediction Methodology

Both TSB-88 (latest edition) and the Longley-Rice propagation model in median mode (50/50/50) shall be used to evaluate coverage and interference for proposed systems in Region 8. The Longley-Rice model is used because it is freely available in the public domain and has consistent implementations across propagation-modeling programs of different sources, unlike the Okumura-Hata-Davidson model. All radiated- and received-power levels are referenced to a dipole antenna. Please see Appendix G, Antenna Pattern Information Form.

9.3 Responsible Radiation Control and System Design

In order to promote responsible use of 700-MHz spectrum resources, all applicants are required to control unnecessary radio-frequency (RF) radiation. Therefore, for all proposed facilities within the Region, 80% of the 50 dBµ (-82 dBm) Protected Service Area (PSA) must lie within the jurisdictional boundary plus an eight-kilometer buffer zone. The 50 dBµ (-82 dBm) PSA shall be assessed using Longley-Rice analyses.

9.4 Pool-to-Pool Reliability Degradation Threshold

Applications for facilities that have been pre-allotted within the National Pool (in-pool assignments) are required to provide co- and adjacent-channel interference protection to other in-pool assignments.

Each in-pool application (which may consist of multiple facilities) must pose no more than 2.5% Area Reliability Degradation (ARD) at 90% reliability levels to any incumbent's protected service area. All facilities (including licensees and all approved allotments) in aggregate must pose no more than 5.0% cumulative area reliability degradation at 90% reliability levels to any incumbent's protected service area.

The process for determining ARD is as follows:

- Compute the baseline Longley-Rice 3-second (minimum) tile coverage for each incumbent (victim) co- and adjacent-channel licensee within its jurisdictional area.
  - If any co- or adjacent-channel pool assignment remains unused, treat its jurisdiction/county as having ubiquitous 40 dBµ (-92 dBm) service levels.

- Co- or adjacent-channel pool licenses and/or previously accepted facilities shall be protected based upon their facility-specific parameters.

- Evaluate the baseline total number of tiles within the victim jurisdiction that achieve 90% or greater reliability levels using TSB-88 (latest edition) in conjunction with parameters for Channel Performance Criterion (CPC), receiver noise floor, and log-normal standard deviation (σ). If any co- or adjacent-channel pool assignment remains unused, use the following as its deployed parameters:
  - Receiver Noise Floor = -124 dBm,
  - CPC_f = 18 dB, and
  - σ = 7 dB.
  - These, along with the 40 dBμ (-93 dBm at 800 MHz), give the following reliability throughout the service area:

    R^1 = 1 – Q^2[(-93 dBm – (-124 dBm) – 18 dB)/7 dB)] ~= 97%
  - Once a facility-specific application has been granted, the baseline area reliability for co- or adjacent-channel pool licenses and/or previously accepted facilities shall be evaluated based upon these facility-specific parameters.

- Evaluate the received-power levels of all proposed facilities at all tiles within the victim jurisdictional area. Combine these into an equivalent interferer using the process outlined in TSB-88 (latest edition).

- Re-evaluate the total number of tiles within each victim jurisdiction that achieve 90% or greater reliability levels, considering the effects of all proposed facilities.

- The ARD is defined as one minus the ratio of the number of tiles at 90% reliability (or greater) considering proposed facilities and the baseline number of tiles at 90% reliability (or greater).

9.5 Outside-to-Pool Reliability Degradation Threshold

Applications for facilities that have not been pre-allotted within the National Pool (outside-pool assignments) are also required to provide co- and adjacent-channel interference protection to other in-pool assignments.

Each outside-pool application (which may consist of multiple facilities) must pose 0% ARD at 90% reliability levels to any incumbent's protected service area. ARD is computed as was outlined in Section 9.4.

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[1] R = Reliability in decimal, converted to percent.

[2] Marcum's Q-function represents the cumulative area under a Gaussian distribution curve:

$$Q_1(a,b) = \int_b^\infty x \cdot \exp\left[\frac{-\left(x^2 + a^2\right)}{2}\right] \cdot I0(a \cdot x)\, dx$$

[3] Adopted from the National Coordination Committee, "Pre –Assignment Rules and Recommendations," July 2002.

This reliability degradation threshold also applies to Region 8 in-pool assignments that are proposed outside of their National Pool county area, but allowed under the Region 8 plan as described in Section 9.4

9.6 Evaluation of Adjacent-Channel Effects

The evaluation of adjacent-channel interference will follow Sections 9.1 through9.5, except that the effective radiated power of the proposed stations shall be de-rated to account for Adjacent-Channel Coupled Power Ratio (ACCPR) effects. Please refer to Table 9, Adjacent-Channel Coupled Power Ratio Values, for the appropriate ACCPR values; note that the channel bandwidth should be larger than the technology-specific emissions bandwidth.

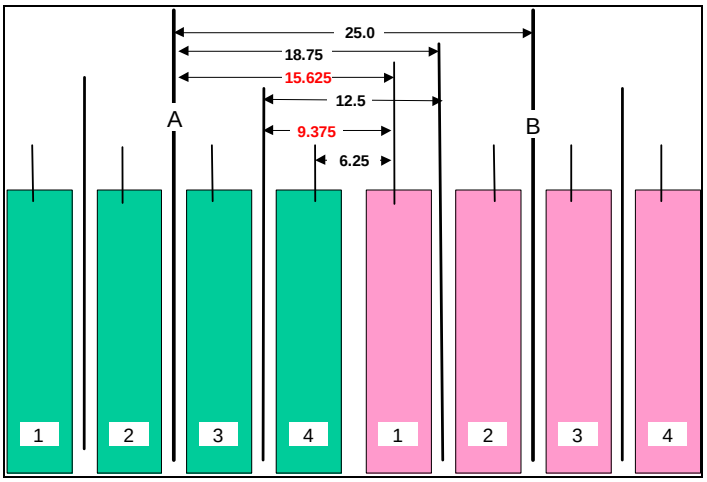

Figure13, Potential Frequency Separations[3]

Table 9, Adjacent-Channel Coupled Power Ratio Values[14]

Case	Spacing	ACCPR
25 kHz to 25 kHz	25 kHz	65 dB
25 kHz to 12.5 kHz	18.75 kHz	65 dB
25 kHz to 6.25 kHz	15.625 kHz	40 dB
12.5 kHz to 12.5 kHz	12.5 kHz	65 dB
12.5 kHz to 6.25 kHz	9.375 kHz	40 dB
6.25 kHz to 6.25 kHz	6.25 kHz	65 dB