REGION 43 REGIONAL REVIEW COMMITTEE

700 MHz APPLICATION REVIEW PROCEDURES

PURPOSE

The purpose of these Procedures is to outline the material to be included in an application for frequencies covered by the Regional Plan for the Public Safety 700 MHz Band in Region 43 (Washington) ["Region 43 700 MHz Plan"] and to explain the Regional Planning Committee's application review processes. It is intended as a guide to allow Applicants to make sure their initial application package is complete so it can receive timely treatment by the Application Review Committee, which is a subcommittee of the Regional Planning Committee ("RPC").

MATERIAL TO BE PROVIDED IN A COMPLETE APPLICATION PACKAGE

It is the practice of the RPC to have all the Application Review Committee members evaluate every application for its technical merit and conformance to the Plan. Therefore, each Applicant must submit one original paper copy and an electronic copy of all materials in PDF file format directly converted from the native file formats (i.e. no paper scans), on CD if necessary, to the Chair of the Region 43 700 MHz Regional Planning Committee (RPC). This material must be submitted by one of the Filing Window deadlines specified in the Plan (the first filing window closes 6 Months after the acceptance of the Plan, or December 28, 2006; the 7 subsequent filing windows described in the Plan close at 6 month intervals [June and December] following the closing of the first filing window). The Committee Chair will distribute the material to Committee members within 5 days after the deadline.

The Application package should include, as a minimum:

1. **Properly completed license application forms with proposed frequencies clearly identified in the application (FCC Form 601 and any forms required by the Frequency Coordinator used by the Applicant).**

2. **A system coverage exhibit which consists of one or more maps or overlays showing the computer calculated 40 dBu service contour, the 5 dBu co-channel interference contour, and the 60 dBu adjacent/alternate channel interference contour for each proposed site in the application. These exhibits should also clearly show the Applicant agency's geo-political boundaries or the service area, which ever is larger, and any County boundaries within the exhibit, on the same map if possible. It is preferred that all maps or coverage contour overlays should be presented on 1:250,000 scale USGS or equivalent maps, but 1:500,000 scale or larger USGS or equivalent maps and overlays can be used if necessary to depict the coverage areas.**

All maps shall include a title block or an attached table indicating the following:

- **name of the Applicant agency,**
- **the name of each site identified on the map and each site's:**

  latitude, longitude and elevation,

  the height of any support tower or structure at the site,

  the height above ground level of the transmit antenna, and the antenna's height above average terrain, and effective radiated power.

  A detailed description of the propagation model and digitized terrain database used to produce the contour maps or the grid-based propagation maps described below, and the assumptions used in the model, including time and location variability, and the confidence factor assumed in the contour calculations.

The application package must also include horizontal and vertical plane antenna patterns for each transmitting antenna used in the system (preferably in both tabular and polar graphical form) and the specification sheet(s) for the proposed antenna(s).

The contour showings shall demonstrate that the proposed 5 dBu F(50,50) contour does not overlap the 40 dBu service contour of any co-channel system, and that the proposed 60 dBu F(50,50) contour does not overlap the 40 dBu service contour of any adjacent or alternate channel system. The adjacent/alternate channel contour analysis shall be performed for any configuration of channels (e.g. 25 kHz channels, 12.5 kHz channels, or 6.25 KHz channels) in adjacent 25 kHz channel blocks.

A grid-based propagation prediction study may be submitted in lieu of the contour overlap study described above. Such a grid based study shall show the composite predicted 40 dBu F(50,50) coverage, the predicted 60 dBu F(50,50) adjacent/alternate channel interference coverage, and the predicted 5 dBu F(50,50) co-channel interference coverage produced by all sites in the proposed system. Predicted 40 dBu F(50,50) coverage for pertinent co-channel and adjacent/alternate channel systems shall also be shown on each of the two interference maps. In circumstances where the 40 dBu desired coverage of other systems overlaps the interfering 60 dBu (adjacent/alternate channel) or 5 dBu (co-channel) from the proposed system, a separate carrier-to-interference map shall be submitted. This carrier-to-interference map shall demonstrate that the desired-to-undesired signal ratios embodied in the contour showings above are maintained within the service areas of pertinent co-channel and adjacent/alternate channel systems. These desired-to-

undesired signal ratios are: +35 dB (based on non-overlap of the 40 dBu service contour and the 5 dBu interference contour) for co-channel systems; and -20 dB (based on the non-overlap of the 40 dBu service contour and the 60 dBu interfering contour) for adjacent/alternate channel systems.

Systems shall be designed as much as is practical to limit the extension of the 40 dBu F(50,50) contour beyond the proposed service area or geopolitical boundaries. The following extension distances for systems covering different types of areas are provided to serve as guidelines for system design :

Type of Area	Extension (miles)
Urban (20 dB Buildings)	5
Suburban (15 dB Buildings)	4
Rural (10 dB Buildings)	3

It is understood that the shape and extent of geopolitical boundaries, the availability of specific sites, the nature of the elevated sites typically used within Region 43 and their relationship to surrounding terrain features, and other factors will have an impact on the ability to limit the extension of the 40 dBu contour beyond these boundaries. Also, all three types of areas may be included within the service area of a particular system. Each application shall include a description of the system design techniques employed to limit the extension of the proposed 40 dBu coverage.

Grid-based coverage and interference showings may also be used to demonstrate that the desired-to-undesired signal levels implicit in the contour values listed above are maintained within the boundaries of the County in which a co-channel or an adjacent/alternate channel assignment exists, if the channel(s) are not yet used in an existing system.

The contour values shown above are based on the NCC 700 MHz Pre-Assignment Rules/Recommendations, which are attached as Appendix A. Applicants may submit a more detailed supplemental interference analysis showing based on the co-channel and adjacent/alternate channel protection assumptions embodied in Appendix A to take into account other system design factors that may reduce the levels of predicted interference caused by their particular system design.

When necessary, the local Frequency Advisor associated with the Applicant's Frequency Coordinator will use the Longley-Rice propagation model and the 3 arc-second elevation data base, or some other appropriate model and terrain database, to confirm an application's coverage predictions. Propagation will be calculated at the 95% confidence level with radials spaced at 1 degree intervals and elevations calculated at 0.05 mile increments on each radial. A factor of 12 dB will be included to account for foliage and urban clutter.

3. Any exhibits required to demonstrate compliance with the Canadian Border

protection requirements shown in §90.533 of the FCC's Rules and in the *"Sharing Arrangement Between the Department of Industry of Canada and the Federal Communications Commission of the United States of America Concerning the Use of the Frequency Bands 764 to 776 MHz and 794 to 806 MHz by the Land Mobile Service Along the Canada-United States Border"*, if the proposed system employs sites located within any of the U.S.-Canada Border Zones in the State of Washington.

4. **A complete implementation schedule for the proposed system.**

5. **A funding statement or resolution signed by the governing council, agency, executive or appropriate official with authority indicating that sufficient funds are available or will be made available to meet the proposed implementation schedule.**

6. **Proposed loading of each frequency requested, in accordance with Section 9.3 of the Region 43 700 MHz Plan.**

7. **A list of all existing frequencies, and their use, that are licensed to the Applicant requesting the new frequencies. Also any frequencies the Applicant plans to give back to the FCC in accordance with Section 9.7 of the Region 43 700 MHz Plan, and a schedule showing when the channels will become available.**

8. **A statement describing how the Applicant will implement and support the 700 MHz Interoperability Tactical channels as required by Sections 6.3 and 6.4 of the Region 43 700 MHz Plan.**

9. **A narrative, based on the applicant's coverage and interference showings (described above), discussing any difference between the Applicant's service area and the predicted system coverage area shown in the applicant's map exhibits, and describing what steps will be taken to eliminate interference to systems in other jurisdictions.**

10. **Complete contact information for the person or persons who can answer technical and/or administrative questions about the application.**

11. **Any other material required by the Regional Planning Committee, by the FCC, or by the Frequency Coordinator selected by the Applicant to make the application complete.**

12. **Applicants shall have one year from the date the application is approved by the RPC to file the application with the appropriate Frequency Coordinator, or the approval granted by the RPC will be withdrawn and the requested channel(s) will be returned to the pool of available channels.**

The Chair of the RPC will review the application package to assure that it is complete. Incomplete applications will be returned to the Applicant. Complete application packages will be date stamped and electronic copies of the complete application package will be forwarded to the full Committee for review.

APPLICATION REVIEW PROCESS

The Chair of the RPC may appoint an Application Review Subcommittee to review the application. Upon receipt of an application, each Committee member will begin to evaluate the information. Three members of the Committee will be specifically designated as an application review sub-committee. These three individuals will begin a detailed review of the application and supporting documents. Specific concerns, questions and comments from Committee members will be directed to the Chair of the Review Sub-committee so these issues can be incorporated into the overall review of the application.

During the review of an application it may be necessary to request further information and clarification from the Applicant and/or from other interested parties. This may be as simple as the exchange of written material or may involve one or more appearances before the Committee to further explain various aspects of the proposed system. The goal of this interactive process is to assure that the committee has all the information it needs to render a fair decision on the application.

After there has been adequate time for the full Committee to consider all applications on hand and, if necessary, for subsequent meetings to be held with the Applicant and/or other interested parties to collect information to better evaluate the applications, the Chair of the RPC will convene a meeting of the full Committee to consider and act on all applications on hand. This meeting will be set on or before the action deadline established in the Plan for the particular Filing Window. The Applicant and any other interested parties will be encouraged to attend this meeting to be able to answer further questions or to provide additional information.

The Application Review Sub-committee will report on its findings. This report will include a recommendation for either Approval as submitted, Approval if certain modifications are made to the application, or Disapproval. Any recommendation for Disapproval must be accompanied with an explanation of the specific aspects of the Plan that were not conformed to and any other reasons for the disapproval recommendation. In situations where there is no competition for available channels, the Committee will base its decision for approval or disapproval on the conformance of the application to the Plan.

In situations where there are applications for more than the available number of channels, the Committee will still base its decisions on conformance to the Plan, but the Committee will also use the weighted criteria outlined in Section 9 of the Plan, "Explanation of How Needs Were Assigned Priorities in Areas Where Not All Eligibles Could Receive Licenses" Points will be assigned in the following manner:

- **All competing applications will be evaluated for their demonstration of merit in relation to each of the criteria and point values will be assigned based on the comparative information for each criterion. For example, the application that exhibits the highest demonstrated immediate need to protect life and property under the Service category in Section 9.1 will be assigned 6 points. The application with the next highest demonstrated need will be assigned 5 points and this process will continue with descending point assignments as needed. In the event that the Committee feels there is an equal demonstration of need more than one application may be assigned the same value.**

- **The same approach will be used for each of the other criteria until each application has been evaluated against all the criteria. An accumulated total point value will be determined for all applications and the applications will then be rank ordered based on these point totals.**

- **Once the applications are ordered by rank, the Committee will attempt to assign as much of the requested channel capacity to the highest ranked application while still attempting to meet at least a portion of the needs of lower ranked applications. During this process the Committee will continue to work with all competing Applicants to attempt to find system implementation approaches that will allow all Applicants to meet their needs.**

In either of the above situations, the quorum of the Regional Planning Committee ("RPC") attending the meeting will be polled by its Chair and the results of the poll will be documented. If the application is Approved, the Chair will inform the Applicant of the results and the Applicant will forward the original application package, along with the letter of approval from the RPC, to the appropriate Frequency Coordinator for further processing.

If the Committee agrees with a recommendation to approve an application if certain modifications are made, the Chair of the RPC will write a letter to the Applicant outlining the changes required and a deadline for return of the revised application to the Committee. When the Application Review Sub-committee is satisfied that the appropriate changes have been made, it will inform the Chair of the RPC who will document the results and advise the Applicant, who will forward the corrected original application package to the appropriate Frequency Coordinator for further processing.

Any application that is disapproved will be returned to the Applicant with a letter from the Chair of the RPC explaining why the application was disapproved and explaining the Applicant's right to re-apply in the next Filing Window or to appeal the decision, as described in Section 13.3 of the Plan.

APPEAL PROCESS

If the Applicant is not satisfied with the decision of the Regional Review Committee, the applicant can appeal the decision of the RPC following the appeal procedures described in Section 13.3 of the Plan.

If the Applicant is not satisfied with the decision of the Appeal Subcommittee of the RPC, the applicant may appeal that decision directly to the 700 MHz National Planning Oversight Committee or other body formally designated by the FCC to handle matters of this nature, as described in Section 13.3.4 of the Plan.

During the appeal to the National Planning Oversight Committee or other body designated by the FCC, the Committee may receive an application in the subsequent Filing Window for frequencies that are in competition for frequencies under appeal. If this occurs the latter Applicant will be advised that the frequencies in question are currently under appeal and that the RPC will not be able to act on the application until the appeal is resolved. The Chair will work with the Applicant to determine if other frequencies can be used to fill the Applicant's needs so that that application can proceed without being delayed by the pending appeal. If the latter applicant decides to leave their application on file until the end of the appeal, their application will be dealt with in the next Filing Window.

Appendix A
NCC 700 MHz Pre-Assignment Rules/Recommendations

Introduction

A process for doing the initial block assignments of 700 MHz channels before details of actual system deployments is required. In this initial phase, there is little actual knowledge of what specific equipment is to be deployed and where the sites will be. As a result, a high level simplified method is proposed to establish guidelines for frequency coordination. When actual systems are deployed, additional details will be known and the system designers will be required to select specific sites and supporting hardware to control interference.

Overview

Assignments will be based on a defined service area of each applicant. For Public Safety entities this will normally be a geographically defined area such as city, county or by a data file consisting of line segments creating a polygon that encloses the defined area.

For co-channel assignments, the 40dBμ contour will be allowed to extend beyond the defined service area by 3 to 5 miles, depending on the type of environment, urban, suburban or low density. The interfering co-channel 5 dBμ will be allowed to touch but not overlap the 40 dBμ contour of the system being evaluated. All contours are (50,50).

For adjacent and alternate channels, the interfering channels 60 dBμ will be allowed to touch but not overlap the 40 dBμ contour of the system being evaluated. All contours are (50,50).

7.4.1.1 Discussion

The FCC limits the maximum field strength to 40 dB relative to 1μV/m (customarily denoted as 40 dBμ). It is assumed that this limitation will be applied similarly to the way it is applied in the 821-

824/866/869 MHz band. That is, a 40 dBµ field strength can be deployed up to a defined distance from the edge of the service area, based on the size of the service area or type of applicant, i.e. city, county or statewide system. This is important as the potential for interference from CMRS infrastructure demands that public safety systems have adequate margins for reliability in the presence of interference. The value of 40 dBµ corresponds to a signal of -92.7 dBm, received by a half-wavelength dipole (λ/2) antenna. The thermal noise floor for a 6.25 kHz receiver would be in the range of -126 dBm, so there is a margin of approximately 33 dB available for "noise limited" reliability. Figure 1 shows show the various interfering sources and how they accumulate to form a composite noise floor that can be used to determine the "reliability" or probability of achieving the desired performance in the presence of various interfering sources with differing characteristics.

Allowing for a 3 dB reduction in the available margin due to CMRS OOBE noise lowers the reliability and/or the channel performance of Public Safety systems. TIA TR8 made this allowance during the meetings in Mesa, AZ, January 2001. In addition, there are various channel bandwidths with different performance criteria and unknown adjacent and alternate channel assignments need to be accounted for. The co-channel and adjacent/alternate sources are shown in the right hand side of Figure 1. There would be a single co-channel source, but potentially several adjacent or alternate channel sources involved.

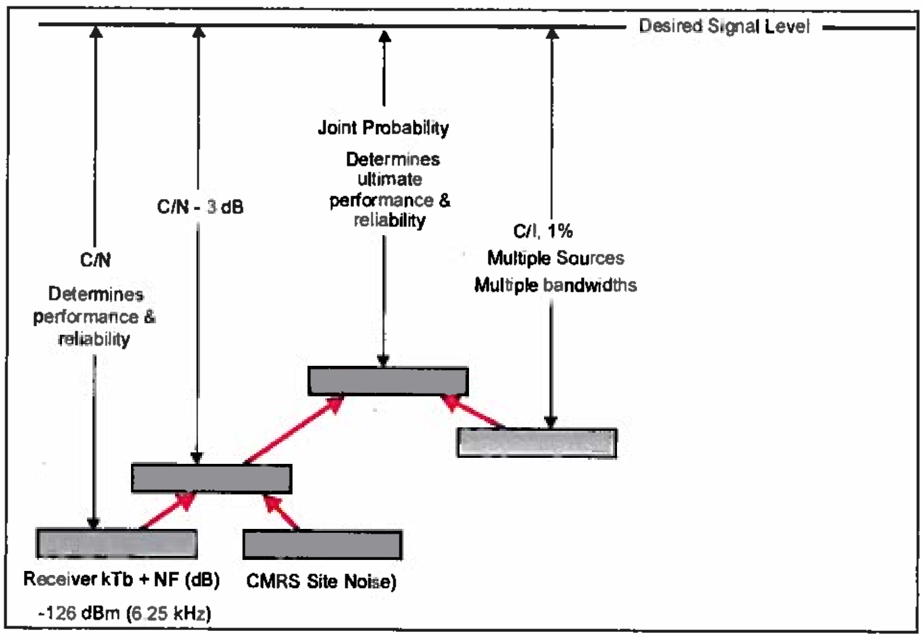

Figure 1 - Interfering Sources Create A "Noise" Level Influencing Reliability

It is recommended that co-channel assignments limit the C/I at the edge (worst case mile) be sufficient to limit that interference to <1%. A C/I ratio of 26.4 dB plus the required capture value required to achieve this goal.. A 17 - 20 dB C/N is required to achieve channel performance. Table 1 shows estimated performance considering the 3 dB noise floor rise at the 40 dBµ signal level. Performance varies due to the different Cf/N requirements of the different modulations and channel bandwidths. These values are appropriate for a mobile on the street, but are considerably short to provide reliable communications to portables inside buildings.

Comparison of Joint Reliability for various configurations				
Channel Bandwidth	6.25 kHz	12.5 kHz	12.5 kHz	25.0 kHz
Receiver ENBW (kHz)	6	6	9	18
Noise Figure(10 dB)	10	10	10	10
Receiver Noise Floor (dBm)	-126.22	-126.22	-124.46	-121.45
Rise in Noise Floor (dB)	3.00	3.00	3.00	3.00
New Receiver Noise Floor (dB)	-123.22	-123.22	-121.46	-118.45
40 dBu = -92.7 dBm	-92.7	-92.7	-92.7	-92.7
Receiver Capture (dB)	10.0	10.0	10.0	10.0
Noise Margin (dB)	30.52	30.52	28.76	25.75
C/N Required for DAQ = 3	17.0	17.0	18.0	20.0
C/N Margin (dB)	**13.52**	**13.52**	**10.76**	**5.75**
Standard deviation (8 dB)	8.0	8.0	8.0	8.0
Z	1.690	1.690	1.345	0.718
Noise Reliability (%)	**95.45%**	**95.45%**	**91.06%**	**76.37%**
C/I for <1% prob of capture	36.4	36.4	36.4	36.4
I (dBu)	3.7	3.7	3.7	3.7
I (dBm)	-129.0	-129.0	-129.0	-129.0
Joint Probability (C & I)	**94.2%**	**94.2%**	**90.4%**	**75.8%**
40 dBu = -92.7 dBm @ 770 MHz				

Table 1 Joint Probability For Project 25, 700 MHz Equipment Configurations.

To analyze the impact of requiring portable in building coverage, several scenarios are presented. The different scenarios involve a given separation from the desired sites. Then the impact of simulcast is included to show that the 40 dBμ must be able to fall outside the edge of the service area. From the analysis, recommendations of how far the 40 dBμ extensions should be allowed to occur are made.

Table 2 Estimates urban coverage where simulcast is required to achieve the desired portable in building coverage. Several assumptions are required to use this estimate.

- Distance from the location to each site. Equal distance is assumed.
- CMRS noise is reduced when entering buildings. This is not a guarantee as the type of deployments is unknown. It is possible that CMRS units may have transmitters inside buildings. This could be potentially a large contributor unless the CMRS OOBE is suppressed to TIA's most recent recommendation and the "site isolation" is maintained at 65 dB minimum.
- The 40 dBμ is allowed to extend beyond the edge of the service area boundary.
- Other configurations may be deployed utilizing additional sites, lower tower heights, lower ERP and shorter site separations.

Estimated Performance at 2.5 miles from each site				
Channel Bandwidth	6.25 kHz	12.5 kHz	12.5 kHz	25.0 kHz
Receiver Noise Floor (dBm)	-126.20	-126.20	-124.50	-118.50
Signal at 2.5 miles (dBm)	-72.7	-72.7	-72.7	-72.7
Margin (dB)	53.50	53.50	51.80	45.80
C/N Required for DAQ = 3	17.0	17.0	18.0	20.0
Building Loss (dB)	20	20	20	20
Antenna Loss (dBd)	8	8	8	8

Reliability Margin	8.50	8.50	5.80	-2.20
Z	1.0625	1.0625	0.725	-0.275
Single Site Noise Reliability (%)	**85.60%**	**85.60%**	**76.58%**	**39.17%**
Simulcast with 2 sites	97.93%	97.93%	94.51%	62.99%
Simulcast with 3 sites	99.70%	99.70%	98.71%	77.49%
Simulcast with 4 sites	99.96%	99.96%	99.70%	86.30%

Table 2, Estimated Performance From Site(s) 2.5 Miles From Typical Urban Buildings.

Table 2 shows for the example case of 2.5 miles that simulcast is required to achieve public safety levels of reliability. The difference in performance margin requirements would require more sites and closer site-to-site separation for wider bandwidth channels.

Figures 2 and 3 show how the configurations would potentially be deployed for a typical site with 240 Watts ERP. This is based on:

- 75 Watt transmitter, 18.75 dBW
- 200 foot tower
- 10 dBd 180 degree sector antenna +10.0 dBd
- 5 dB of cable/filter loss. - 5.0 dB

23.75 dBW ≈ 240 Watts (ERPd)

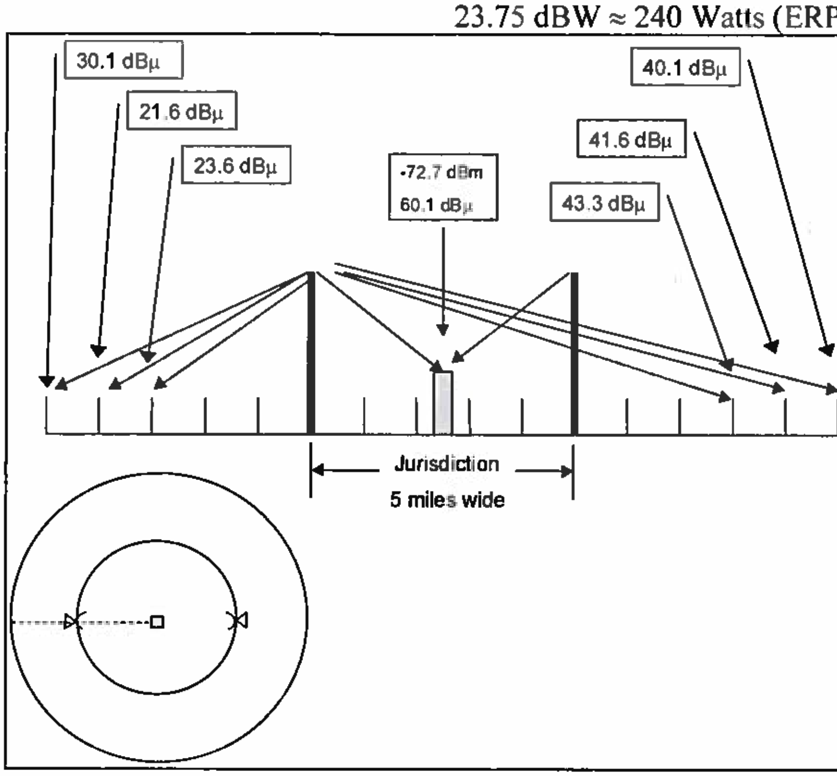

Figure 2 - Field Strength From Left Most Site.

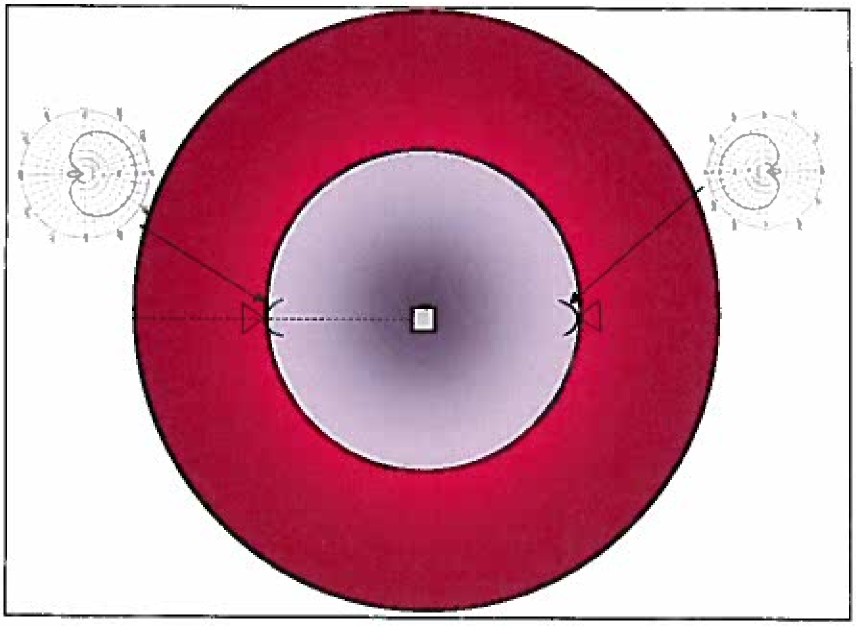

Figure 3 - Antenna Configuration Required To Limit Field Strength Off "Backside"

Figure 2 is for an urbanized area with a jurisdiction of a 5-mile circle. To provide the necessary coverage to portables in buildings at the center of the jurisdiction requires that the sites be placed along the edge of the service area utilizing direction antennas oriented toward the center of the service area (Figure 3). In this case, at 5 miles beyond the edge of the service area, the sites would produce composite field strength of approximately 40 dBμ. Since one site is over 10 dB dominant, the contribution from the other site is not considered. The control of the field strength behind the site relies on a 20 dB antenna with a Front to Back Ratio (F/B) specification as shown in Figure 3. This performance may be optimistic due to backscatter off local obstructions in urbanized areas. However, use of antennas on the sides of buildings can assist in achieving better F/B ratios and the initial planning is not precise enough to prohibit using the full 20 dB.

The use of a single site at the center of the service area is not normally practical. To provide the necessary signal strength at the edge of the service area would produce field strength 5 miles beyond in excess of 44 dBμ. However, if the high loss buildings were concentrated at the service area's center, then potentially a single site could be deployed, assuming that the building loss sufficiently decreases near the edge of the service area allowing a reduction in ERP to achieve the desired reliability.

The down tilting of antennas to control the 40 dBμ is not practical as the difference in angular discrimination from a 200-foot tall tower at 2.5 miles and 10 miles is approximately 0.6 degrees.

Tables 3 and 4 represent the same configuration, but for less dense buildings. In these cases, the distance to extend the 40 dBm can be determined from Table Z. Recommendations are made in Table 6.

Estimated Performance at 3.5 miles from each site				
Channel Bandwidth	6.25 kHz	12.5 kHz	12.5 kHz	25.0 kHz
Receiver Noise Floor (dBm)	-126.20	-126.20	-124.50	-118.50
Signal at 2.5 miles (dBm)	-77.7	-77.7	-77.7	-77.7
Margin (dB)	48.50	48.50	46.80	40.80
C/N Required for DAQ = 3	17.0	17.0	18.0	20.0
Building Loss (dB)	15	15	15	15
Antenna Loss (dBd)	8	8	8	8
Reliability Margin	8.50	8.50	5.80	-2.20
Z	1.0625	1.0625	0.725	-0.275
Single Site Noise Reliability (%)	**85.60%**	**85.60%**	**76.58%**	**39.17%**
Simulcast with 2 sites	97.93%	97.93%	94.51%	62.99%
Simulcast with 3 sites	99.70%	99.70%	98.71%	77.49%
Simulcast with 4 sites	99.96%	99.96%	99.70%	86.30%

Table 3 - Lower Loss Buildings, 3.5 Mile From Site(s)

Estimated Performance at 5.0 miles from each site				
Channel Bandwidth	6.25 kHz	12.5 kHz	12.5 kHz	25.0 kHz
Receiver Noise Floor (dBm)	-126.20	-126.20	-124.50	-118.50
Signal at 2.5 miles (dBm)	-82.7	-82.7	-82.7	-82.7
Margin (dB)	43.50	43.50	41.80	35.80
C/N Required for DAQ = 3	17.0	17.0	18.0	20.0
Building Loss (dB)	10	10	10	10
Antenna Loss (dBd)	8	8	8	8
Reliability Margin	8.50	8.50	5.80	-2.20
Z	1.0625	1.0625	0.725	-0.275
Single Site Noise Reliability (%)	**85.60%**	**85.60%**	**76.58%**	**39.17%**
Simulcast with 2 sites	97.93%	97.93%	94.51%	62.99%
Simulcast with 3 sites	99.70%	99.70%	98.71%	77.49%
Simulcast with 4 sites	99.96%	99.96%	99.70%	86.30%

Table 4 - Low Loss Buildings, 5.0 Miles From Site(s)

Note that the receive signals were adjusted to offset the lowered building penetration loss. This produces the same numerical reliability results, but allows increasing the site to building separation and this in turn lowers the magnitude of the "overshoot" across the service area.

Table 5 shows the field strength for a direct path and for a path reduced by a 20 dB F/B antenna. This allows the analysis to be simplified for the specific example being discussed.

Overshoot Distance (mi)	Field Strength (dBμ)	20 dB F/B (dBμ)
1	73.3	53.3
2	63.3	43.3
2.5	60.1	40.1
3	57.5	37.5
4	53.3	33.5
5	50.1	30.1
...	...	
10	40.1	
11	38.4	
12	37.5	
13	36.0	
14	34.5	
15	33.0	

Table 5 - Field Strength Vs. Distance From Site

This allows the overshoot to be 11 miles so the extension of the 40 dbm can be 4 miles for suburbanized territory. For the more rural territory, the limit is the signal strength off the back of the antenna. So the result is that for various types of urbanized areas the offset of the 40 dbm should be:

Type of Area	Extension (mi.)
Urban (20 dB Buildings)	5
Suburban (15 dB Buildings)	4
Rural (10 dB Buildings)	3

Table 6 - Recommended Extension Distance Of 40 Dbμ Field Strength

The 40 dBμ can then be constructed based on the defined service area without having to perform an actual prediction. Since the 40 dBμ is beyond the edge of the service area, some relaxation in the level of I is reasonable. Therefore a 35 dB ratio is recommended and is consistent with what is currently being licensed in the 821-824/866-869 MHz Public Safety band.

Co-Channel Recommendation

- Allow the constructed 40 dBμ (50,50) to extend beyond the edge of the defined service area by the distance indicated in Table 6.
- Allow the Interfering 5 dBμ (50,50) to intercept but not overlap the 40 dBμ contour.

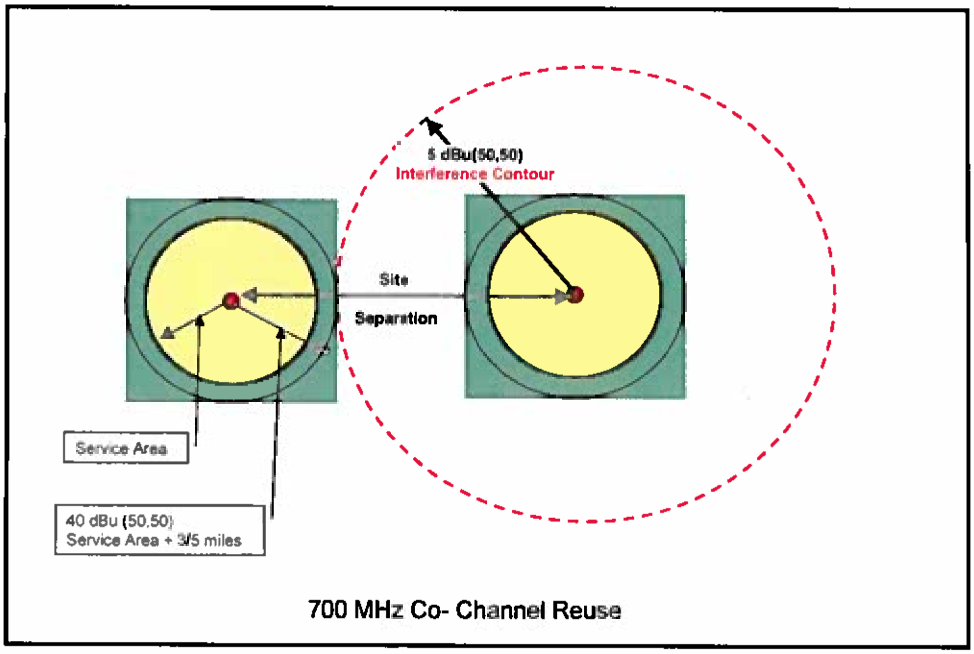

Figure 4 - Co-Channel Reuse Criterion

Adjacent and alternate Channel Considerations

Adjacent and alternate channels are treated as being noise sources that alter the composite noise floor of a victim receiver. Using the 47 CFR § 90.543 values of ACCP can facilitate the coordination of adjacent and alternate channels. The C/I requirements for <1% interference can be reduced by the value of ACCPR. For example to achieve an X dB C/I for the adjacent channel that is -40 dBc a C/I of [X-40] dB is required. Where the alternate channel ACP value is -60 dBc, then the C/I = [X-60] dB is the goal for assignment(s). There is a compounding of interference energy, as there are numerous sources, i.e. co channel, adjacent channels and alternate channels plus the noise from CMRS OOBE.

There is insufficient information in 47 CFR § 90.543 to include the actual receiver performance. Receivers typically have "skirts" that allow energy outside the bandwidth of interest to be received. In addition, the FCC defines ACCP differently than does the TIA. The term used by the FCC is the same as the TIA definition of ACP. The subtle difference is that ACCP defines the energy intercepted by a defined receiver filter. ACP defines the energy in a measured bandwidth that is typically wider than the receiver. As a result, the FCC values are optimistic at very close spacing and somewhat pessimistic at wider spacing, as the typical receiver filter is less than the channel bandwidth.

In addition, as a channel bandwidth is increased, the total noise is allowed to rise, as it is initially defined in a 6.25 kHz channel bandwidth. However, the effect is diminished at very close spacing as the noise is rapidly falling off. At greater spacing, the noise is essentially flat and the receiver's filter limits the noise to the specified 3 dB rise in the thermal noise floor.

Digital receivers tend to be less tolerant to interference than analog. Therefore a 3 dB reduction in the C/(I+N) can reduce a DAQ = 3 to a DAQ = 2 which is threshold to complete receiver muting. Therefore at least 17 dB plus the margin for keeping the interference below 1% probability requires a total margin of 43.4 dB. However, this margin would be at the edge of the service area and the 40 dBμ is allowed to extend past the edge of the service area.

Frequency drift is controlled by the FCC requirement for 0.4-ppm stability when locked. This equates to approximately a 1 dB standard deviation, which is negligible when associated with the recommended initial lognormal standard deviation of 8 dB and can be ignored.

Project 25 requires that a transceiver receiver have an ACIPR of 60 dB. This implies that an ACCPR ≥ 65 dB will exist for a "companion receiver". A companion receiver is one that is designed for the specific modulation. At this time the highest likelihood is that receivers will be deploying the following receiver bandwidths at the following channel bandwidths.

Estimated Receiver Parameters	
Channel Bandwidth	Receiver Bandwidth
6.25 kHz	5.5 kHz
12.5 kHz	5.5 or 9 kHz
25 kHz	18.0 kHz

Table 7 - Estimated Receiver Parameters

Based on 47 CFR ¶ 90.543 and the P25 requirement for an ACCPR ≥ 65 dB into a 6.0 kHz channel bandwidth and leaving room for a migration from Phase 1 to Phase 2, allows for making the simplifying assumption that 65 dB ACCPR is available for both adjacent 25 kHz block.

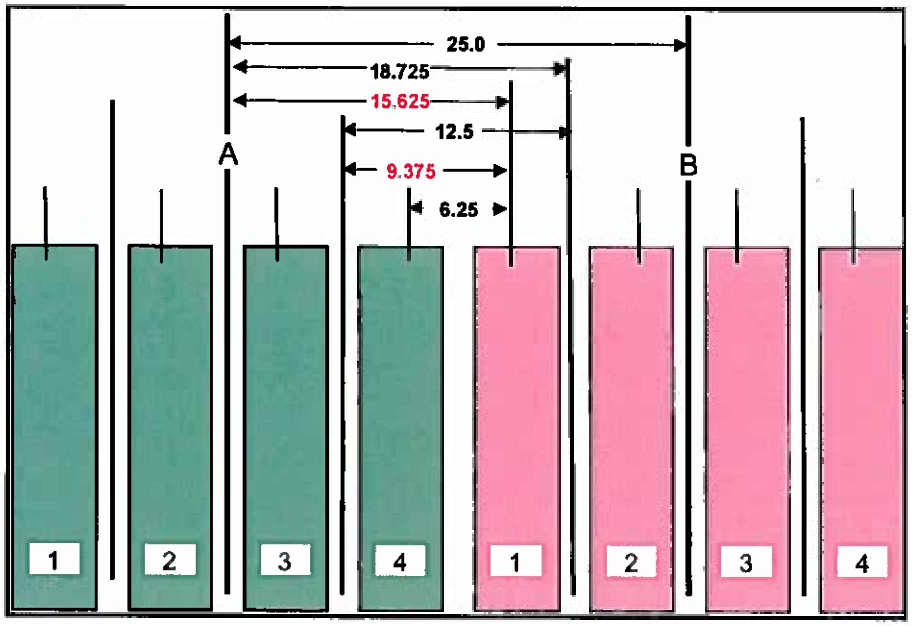

Figure 5, Potential Frequency Separations

Base initial (presorts) on 25 kHz channels. This provides the maximum flexibility by using 65 dB ACCPR for all but one possible combination of 6.25 kHz channels within the 25 kHz allotment.

Case	ACCPR
25 kHz	65 dB
18.725 kHz	65 dB
15.625 kHz	>40 dB
12.5 kHz	65 dB
9.375 kHz	>40 dB
6.25 kHz	65 dB

Table 8 - ACCPR Values For Potential Frequency Separations

All cases meet or exceed the FCC requirement. The most troublesome cases occur where the wider bandwidths are working against a Phase 2 narrowband 6.25 kHz channel. If system designers keep this consideration in mind and move the edge 6.25 kHz channels inward on their own systems, then a constant value of 65 dB ACCPR can be applied across all 25 kHz channels regardless of what is eventually deployed.

For other blocks, it must be assumed that transmitter filtering in addition to transmitter performance improvements with greater frequency separation will further reduce the ACCPR.

Therefore it is recommended that a consistent value of 65 dB ACCPR be used for coordinating adjacent 25 kHz channel blocks. Rounding to be conservative due to the possibility of multiple sources allows the "I" contour to be approximately 20 dB above the 40 dBμ contour, 60 dBμ.

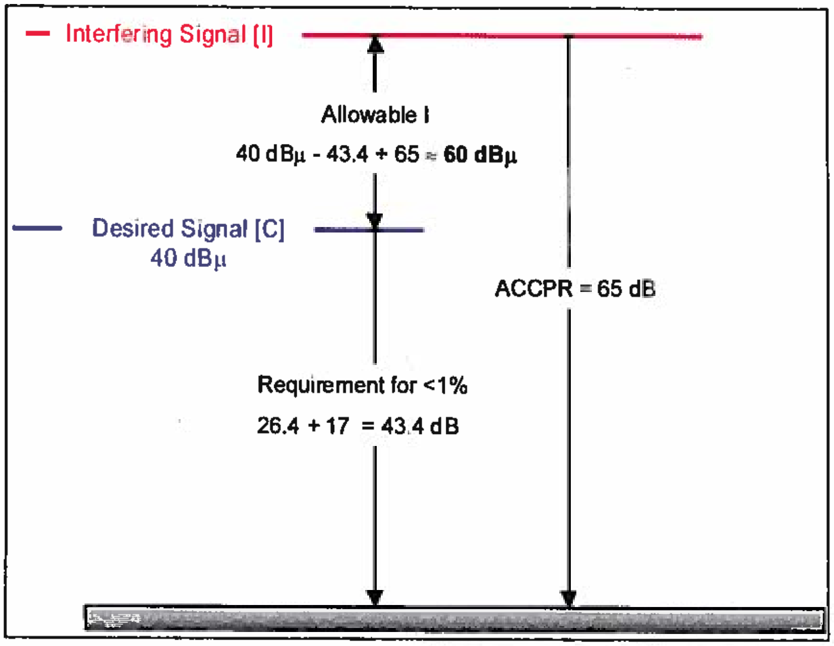

Figure 6 - Adjusted Adjacent 25 kHz Channel Interfering Contour Value

An adjacent Interfering (25 kHz) channel shall be allowed to have its 60 dBμ (50,50) contour touch but not overlap the 40 dBμ (50,50) contour of a system being evaluated. Evaluations should be made in both directions.

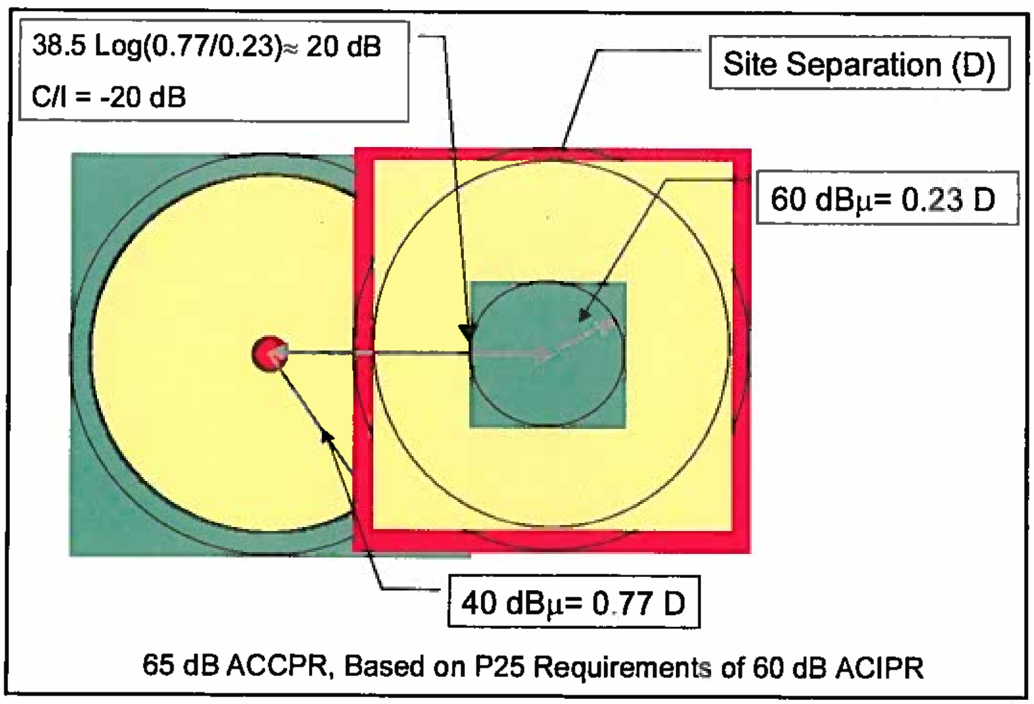

Figure 7 - Example Of Adjacent/Alternate Overlap Criterion

This simple method is only adequate for presorting large blocks to potential entities. A more detailed analysis should be executed in the actual design phase to take all the issues into consideration. Additional factors that should be considered include:

- Degree of Service Area Overlap
- Different size of Service Areas
- Different ERP's and HAAT's
- Actual Terrain and Land Usage
- Differing User Reliability Requirements
- Migration from Project 25 Phase 1 to Phase 2
- Actual ACCP
- Balanced Systems
- Mobiles vs. Portables
- Use of voting
- Use of simulcast
- Radio specifications
- Simplex Operation
- Future unidentified requirements.

Special attention needs to be paid to the use of simplex operation. In this case, an interferer can be on an offset adjacent channel and in extremely close proximity to the victim receiver. This is especially critical in public safety where simplex operations are frequently used at a fire scene or during police operation. This type operation is also quite common in the lower frequency bands. In those cases, evaluation of base-to-base as well as mobile-to-mobile interference should be considered and evaluated.

Carrier to Interference Requirements

There are two different ways that interference is considered.

- Co Channel
- Adjacent and Alternate Channels

Both involve using a C/I ratio. The C/I ratio requires a probability be assigned. For example, a 10% Interference is specified; the C/I implies 90% probability of successfully achieving the desired ratio. At 1% interference, means that there is a 99% probability of achieving the desired C/I.

$$\frac{C}{I}\% = \frac{1}{2} \bullet erfc\left(\frac{\frac{C}{I}\text{margin}}{2\sigma}\right) \qquad (1)$$

This can also be written in a form using the standard deviate unit (Z). In this case the Z for the desired probability of achieving the C/I is entered. For example, for a 90% probability of achieving the necessary C/I, $Z = 1.28$.

$$\frac{C}{I}\% = Z \cdot \sqrt{2} \cdot \sigma \qquad (2)$$

The most common requirements for several typical lognormal standard deviations (σ) are included in the following table based on Equation (2).

Location Standard Deviation (σ) dB	5.6	6.5	8	10
Probability %				
10%	10.14 dB	11.77 dB	14.48 dB	18.10 dB
5%	13.07 dB	15.17 dB	18.67 dB	23.33 dB
4%	13.86 dB	16.09 dB	19.81 dB	24.76 dB
3%	14.90 dB	17.29 dB	21.28 dB	26.20 dB
2%	16.27 dB	18.88 dB	23.24 dB	29.04 dB
1%	18.45 dB	21.42 dB	26.36 dB	32.95 dB

Table A1 - Probability Of Not Achieving C/I For Various Location Lognormal Standard Deviations

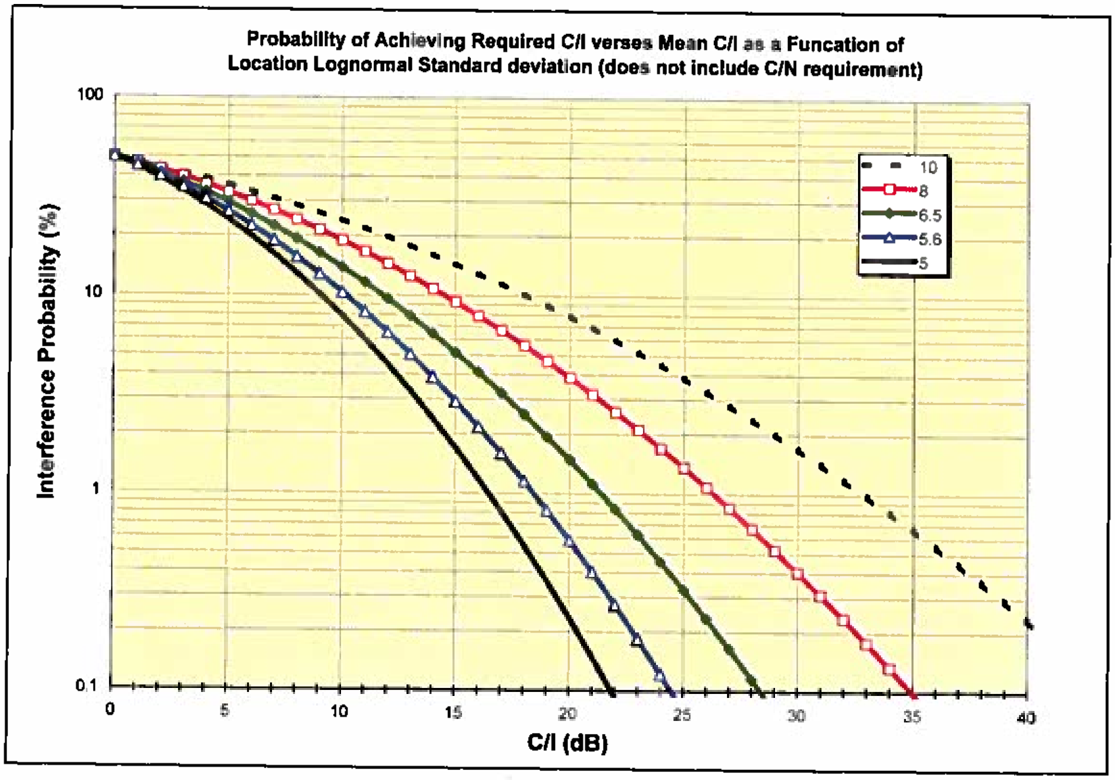

Figure A1, Probability Of Achieving Required C/I As A Function Of Location Standard Deviation

For co-channel the margin needs to include the "capture" requirement. When this is done, then a 1% probability of co channel interference can be rephrased to mean, there is a 99% probability that the "capture ratio" will be achieved. The capture ratio varies with the type of modulation. Older analog equipment has a capture ratio of approximately 7 dB. Project 25 FDMA is specified at 9 dB. Figure A1 shows the C/I requirement without including the capture requirement.

The 8 dB values for lognormal location standard deviation is reasonable when little information is available. Later when a detailed design is required, additional details and high-resolution terrain and land usage databases will allow a lower value to be used. The TIA recommended value is 5.6 dB. This provides the additional flexibility necessary to complete the design

To determine the desired probability that both the C/N and C/I will be achieved requires that a joint probability be determined. Figure A2 shows the effects of a family of various levels of C/N reliability and the joint probability (Y-axis) in the presence of various probabilities of Interference. Note that at 99% reliability with 1% interference (X-axis) that the reduction is nearly the difference. This is because the very high noise reliability is degraded by the interference, as there is little probability that the noise criterion will not be satisfied. At 90%, the 1% interference has a greater likelihood that it will occur simultaneously when the noise criterion not being met, resulting is a less degradation of the 90%

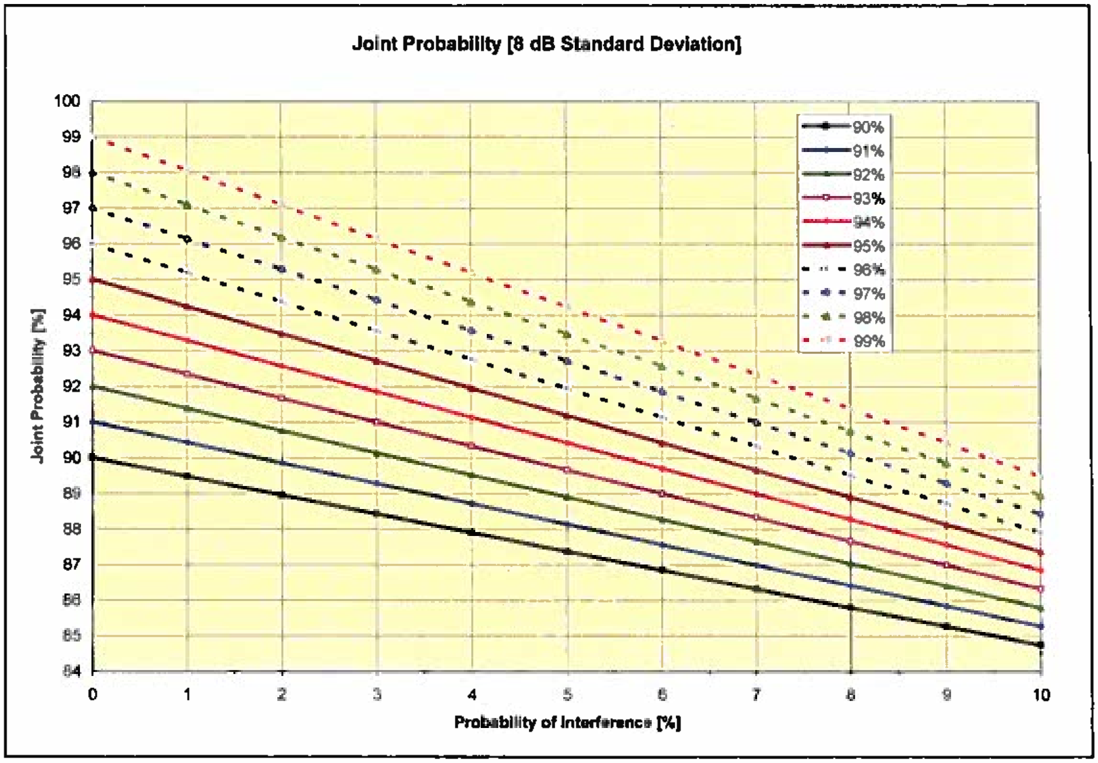

Figure A2 - Effect Of Joint Probability On The Composite Probability

For adjacent and alternate channels, the channel performance requirement must be added to the C/I ratio. When this is applied, then a 1% probability of adjacent/alternate channel interference can be rephrased to mean, there is a 99% probability that the "channel performance ratio" will be achieved.