Before the
Federal Communications Commission
Washington, DC 20554

In the matter of	)	
	)	
Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules	)	WT Docket No. 99-168
	)	

Petition for Reconsideration by The National Public Safety Telecommunications Council

The National Public Safety Telecommunications Council ("NPSTC") submits this Petition for Reconsideration of the Commission's Second Memorandum Opinion and Order in the above captioned proceeding.[1] NPSTC takes great exception to the Commission's decision to not modify certain technical rules for commercial operations in the 747-762 and 777- 792 MHz bands as requested in a previously filed petition for reconsideration.[2] NPSTC's members strongly believe that the Commission's actions will greatly increase harmful interference to 700 MHz public safety operations and cause serious damage to the usefulness of public safety's 700 MHz allocation. Partially relying on new technical analyses just completed by the Telecommunications Industries Association (TIA), NPSTC urges the FCC to reconsider its decision to allow high power, commercial base station operations in the 777-792 MHz band and

[1] *In the Matter of Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules*, WT Docket No. 99-168, *Second Memorandum Opinion and Order*, FCC 01-2, 66 Fed. Reg. 9035 (Feb. 6, 2001) ("Second *MO&O*"). In accordance with Section 1.429 of the Commission's Rules, this petition is timely since it is being filed within 30 days of the February 6, 2001 Federal Register publication date of the *Second MO&O*.

instead revert to the original 700 MHz original band plan adopted in the First Report and Order of this proceeding.[3]

I. BACKGROUND

NPSTC is an umbrella organization representing the full breadth of the public safety community. Its member agencies include:

American Association of State Highway and Transportation Officials (AASHTO)
Association of Public Safety Communications Officials – International (APCO)
Federal Law Enforcement Wireless Users Group (FLEWUG)
Forestry Conservation Communications Association (FCCA)
International Association of Chiefs of Police (IACP)
International Association of Emergency Managers (IAEM)
International Association of Fire Chiefs (IAFC)
International Municipal Signal Association (IMSA)
National Association of State Foresters (NASF)
Public Safety Wireless Network (PSWN)

NPSTC was created to encourage and facilitate implementation of the findings and recommendations of the Public Safety Wireless Advisory Committee (PSWAC) - a federal advisory committee jointly established to advise the Federal Communications Commission (Commission) and the National Telecommunications and Information Administration (NTIA). Specifically, the NPSTC charter directs that NPSTC shall develop and make recommendations to appropriate governmental bodies regarding Public Safety communications issues; shall serve as a standing forum for the exchange of ideas and information regarding Public Safety communications; shall develop recommendations regarding Public Safety communications policies

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[2] Petition for Reconsideration filed by Motorola, Inc., WT Docket No. 99-168, submitted August 11, 2000 (*hereafter Motorola Petition*).

[3] *In the Matter of Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules*, WT Docket No. 99-168, *First Report and Order*, 15 FCC Rcd. 476 (2000) ("*700 MHz First Report and Order*").

that promote greater interoperability and cooperation between federal, state and local Public Safety agencies; shall identify and promote methods for funding development of Public Safety communications systems; shall sponsor and conduct studies of Public Safety communications and; shall perform such other functions as the Governing Board deems appropriate, consistent with relevant law. Pursuant to the mandate of its charter, NPSTC submits this Petition for Reconsideration .

NPSTC's member agencies directly represent the users that will deploy 700 MHz systems including law enforcement, fire, emergency medical service, and forest wildfire oragnizations for mission critical activities where interference to their communications can be life threatening and cannot be tolerated. Public safety personnel are the ones whose lives are at risk when communications fail because of interference. Public safety organizations also must divert tax supported personnel from more productive activities to seek resolution of interference when it does occur. Therefore, NPSTC believes the protection of public safety against interference is a higher public interest priority than maximizing flexibility to deploy commercial base transmitters in both segments of the band.

The reallocation of the 746-806 MHz band from the broadcast television service was a direct result of a Congressional mandate to the FCC to provide additional radio spectrum for public safety services and to "*ensure* that public safety licensees continue to operate free of interference from any new commercial licensees."[4] In August of 1998, the FCC responded to this mandate with the adoption of the *First Report and Order and Third Notice of Proposed Rulemaking* in

[4] Balanced Budget Act of 1997, Conference Report to accompany H.R. 2015, 105th Cong., 1st Sess., Report 105-217, at 580 (July 30, 1997) (*emphasis added*).

WT Docket No. 96-86.[5] That order established service rules for the 764-776/794-806 MHz public safety allocation and set a standard orientation for base station transmissions in the lower portion of the public safety allocation and mobile station transmissions in the upper portion of the allocation.[6] The FCC noted that the standard base/mobile pairing is "essential to facilitating the rapid deployment of reasonably priced mobile and portable radios."[7]

Subsequently, the FCC turned its attention to the service rules for the remaining 36 MHz of spectrum in the 746-806 MHz band to be used for commercial services. In January of 2000, the *700 MHz First Report and Order* adopted a general band plan for the spectrum surrounding the public safety allocation that considered a variety of spectrum management priorities "including protection of public safety operations from interference."[8] Of particular interest, this order established "guard bands" at 746-747/776-777 MHz and 762-764/792-794 MHz to ensure that "the activation of services in these 36 Megahertz of spectrum will not impair public safety operations in the former channels 63-64 and 68-69 through harmful interference."[9] In addition, the *700 MHz First Report and Order* established a standard pairing orientation as was done in the public safety allocation – high powered base and fixed transmissions were limited to the lower portion of the commercial allocation (*i.e.*, 746-764 MHz) and low power mobile and fixed

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5 *In the Matter of The Development of Operational, Technical and Spectrum Requirements For Meeting Federal, State and Local Public Safety Agency Communication Requirements Through the Year 2010*, WT Docket No. 96-86, *First Report and Order and Third Notice of Proposed Rule Making*, FCC 98-191, released September 29, 1998, 63 Fed. Reg. 58645 (November 2, 1998) [*hereafter First Report and Order* or *Third NPRM*].

6 *Id.* at ¶29.

7 *Id.*

8 *700 MHz First Report and Order* at ¶2.

9 *Id.* at ¶33.

transmissions were restricted to the upper portion of the commercial allocation (*i.e.*, 776-794 MHz).[10]

Several parties petitioned for reconsideration of the *700 MHz First Report and Order* urging that the Commission abandon its band plan orientation in order to allow for high powered Time Division Duplex base station transmissions in either portion of the 700 MHz commercial allocation.[11] The FCC addressed those petitions in June, 2000, with the adoption of the *Memorandum Opinion and Order and Further Notice of Proposed Rulemaking* in which the Commission reversed its decision to maintain a standard pairing orientation for the 36 MHz and instead allowed high powered base stations to operate in either portion of the commercial allocation.[12] In so doing, the Commission noted that "although permitting base station operations in the upper band also raises the possibility of "base-to-mobile" interference into the 764-776 MHz public safety band, this interference condition should be addressed by the uniform 76 + 10 log P OOBE limit that is applied to fixed stations operating in the upper band."[13] Further, the FCC noted that this out-of-band emission requirement "were based on the views of NTIA, FLEWUG, and Motorola" but that it did not "accept any specific analysis as determinative."[14]

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10 *Id.* at ¶40.

11 *See, e.g., Petition for Reconsideration,* Adaptive Broadband Corporation, WT Docket No. 99-168, February 22, 2000, at 4. *Petition for Reconsideration or Clarification*, WT Docket No. 99-168, TRW Inc., February 11, 2000, at 3, *Petition for Reconsideration of ArrayComm Inc.*, WT Docket No. 99-168, February 22, 2000, at 14.

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13 *Id.* at ¶9.

14 *Id* at ¶21.

On August 11, 2000, Motorola sought reconsideration of the Commission's decision in the FCC's *Memorandum Opinion and Order* providing new technical analysis of interference scenarios raised by the operation of commercial base stations in the 777-792 MHz band. In January of 2001, the FCC issued its *Second Memorandum Opinion and Order* that took issue with many of the premises of the Motorola analysis and concluded that the FCC sees "no need to provide the implicitly requested degree of protection at this time."[15] Believing that "where instances of interference actually occur … they can be readily addressed on a case-by-case basis," the FCC instead relies on the fact that "historically-followed coordination procedures, requiring cooperation and accommodation by both commercial and public safety entities, will generally be able to resolve such interference."[16] However, if such routine coordination procedures fail to resolve the interference, the FCC indicated that it would "consider other appropriate mitigation measures, including requiring: 1) greater out-of-band attenuation of commercial transmitters; 2) the use of directional antennas; or 3) the use of additional filtering."[17]

II. PETITION FOR RECONSIDERATION

Section 1.429 of the Commission's rules indicates that petitions for reconsideration that "relies on facts which have not previously been presented to the Commission" will be granted only under the following circumstances:[18]

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15 *Second MO&O* at ¶9.

16 *Id.* at ¶13.

17 *Id.*

18 47 C.F.R. §1.429(b).

1. The facts relied on relate to events which have occurred or circumstances which have changed since the last opportunity to present them to the Commission,
2. The facts relied on were unknown to petitioner until after his last opportunity to present them to the Commission, and he could not through the exercise of ordinary diligence have learned of the facts in question prior to such opportunity, or
3. The Commission determines that consideration of the facts relied on is required in the public interest.

NPSTC understands that the FCC has already considered and rejected Motorola's Reconsideration Petition on this same issue. NPSTC believes that the FCC should further reconsider its action based on the information contained in this instant petition. Clearly, the public interest necessitates that the FCC ensure that public safety communications systems operate free from interference. This was a specific mandate from Congress as stated in the Balanced Budget Act of 1997.[19] The FCC should not mistakenly view this as "a Motorola issue." The potential harm from the Commission's rules would fall upon public safety users and not any manufacturer.

In addition, NPSTC has reviewed the attached report recently prepared by the TIA that demonstrates considerable likelihood of interference between 700 MHz public safety system deployment and high powered commercial transmitters operating in the 777-792 MHz band. The TIA report (submitted to the duly chartered FCC federal advisory committee - the Public Safety National Coordinating Committee (NCC) at the request of the NCC) was completed after the release of the *Second MO&O*. NPSTC believes that the TIA's rather pessimistic warnings provide the FCC with new information and new perspective on the issues facing public safety deployments.

Finally, seeking reconsideration of the *Second MO&O* is the most appropriate way for NPSTC to address its concerns about ensuring that the 700 MHz public safety allocation provides the useable spectrum so needed by public safety agencies. As further discussed below, public safety agencies are already frustrated by increasing levels of interference to 800 MHz systems caused by adjacent band commercial cellular based digital communications systems. This needs to be prevented at 700 MHz before deployment begins and NPSTC fails to understand the FCC's view that allowing high-powered base stations to operate within 2 MHz instead of 30 MHz of the public safety base station receivers requires no additional interference protection rules. NPSTC needs to be assured that the FCC is not favoring technical flexibility over public safety protection. If the FCC fails to fully consider this request, NPSTC and the entire public safety user community will need to pursue other venues to find those assurances.

Originally in this proceeding, the Commission had adopted service rules for commercial operations on the 747-762 MHz ("lower block") and 777-792 MHz ("upper block") bands that required commercial base stations to transmit in the lower block frequencies and corresponding mobile stations to transmit in the upper block frequencies.[20] This organized approach was more compatible with the adjacent public safety frequency bands at 764-776 and 794-806 MHz, in which similar base/mobile pairing rules apply.

While some of our members are not technical radio experts, we are all well aware of the critical role that good radio communications plays in performing our primary job—to protect the lives and property of the entire population. We are also painfully aware that current commercial

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[19] 47 U.S.C. §154(o).

[20] *700 MHz First Report and Order*, 15 FCC Rcd at 521-522 (para. 111), 547-548 (Appendix B, Final Rules, § 27.50(a)).

systems operating under Commission rules do interfere with public safety operations, a situation which should not be allowed to spread to the new 746 MHz public safety band.

Traditionally, the public safety community has seen significant benefit from deployment of 800 MHz radio communications systems. Those benefits are ongoing as 800 MHz systems are being expanded to keep pace with the increasing demands of effective public safety operations. However, the implementation of cellular-type commercial system infrastructure amidst (interleaved within), or immediately adjacent to, the public safety channels has caused intolerable interference to some Public Safety (PS) licensees. The functional impact is that radio communications to public safety providers has been reduced or eliminated in the vicinity of 800 MHz cellular-type Commercial Mobile Radio Service (CMRS) infrastructure sites, including the following locations that have been formally documented.[21]

> Atlanta, GA; Auburn & Lewiston, ME; Baltimore, MD; Baton Rouge, LA; Bellingham, WA; Cary, NC; Chandler, AZ; Denver, CO; Douglasville, GA; Ft. Lauderdale, FL; Gladstone, MO; Green Bay, WI; Howell, MI; Lakewood, CO; Largo, FL; Memphis, TN; Miami, FL; Missouri City, TX; Olathe, KS; Ontario, CA; Orlando, FL; Phoenix, AZ; Richmond, CA; Savannah, GA; Seattle, WA; Stuart, FL; Tigard, OR; Vancouver, WA; Victoria, BC.

It is generally acknowledged that such interference is potentially widespread. As the public safety community becomes aware of this source of interference, additional interference locations are being identified throughout the United States.[22]

This interference creates a very unsafe condition for first response personnel of Public Safety providers. These providers include agencies or departments that provide the following

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[21] *See* PSWN/APCO *800 MHz Interference Report (attached).*

services: Law Enforcement, Fire, EMS, Forest Wildfire Suppression, and Road Maintenance. Simply stated, Public Safety personnel are unable to communicate vital dispatch messages, assistance needs, equipment needs, and (most importantly) person in-danger messages involving both PS personnel and the general public.

Our experience has been that even in situations where public safety entities, carriers, and manufacturers cooperate, public safety licensees still experience interference. An after-the-fact attempt at resolving interference is a very poor substitute for preventing it at the outset. In addition to creating an unsafe situation for public safety entities, all parties involved must dedicate resources in attempts to compensate for FCC rules that provide inadequate protection. These resources could be better used elsewhere. Public safety employees are tax supported, so the public pays the cost of wasted resources. Carriers and manufacturers no doubt would rather have their resources dedicated to revenue generating activities.

It is imperative that this situation be avoided as new public safety spectrum becomes available and as the Commission allocates other services in spectrum adjacent to public safety allocations. Therefore NPSTC recommends the FCC modify its rules to provide greater protection at the outset and adopt rules enforcing a position of "Zero Tolerance Of Interference To Public Safety" from Commercial Licensees in the 700 MHz band, should interference occur. The FCC is well aware of the experience regarding the 800 MHz spectrum[23] and that learning process should support the "no tolerance of interference" position of NPSTC.

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22 *See Best Practices Guide,* Joint 800 MHz CMRS/Public Safety Task Force.

23 *Ibid.*

In an effort to protect the new 700 MHz PS band, the NCC recommended that the FCC adopt guard bands on each side of the new band. The FCC responded favorably to that recommendation. However, both the NPSTC and NCC are concerned that these guard bands alone will not afford adequate protection.

In its 2nd MO&O, the Commission rejected Motorola's technical arguments concerning the potential for interference. Subsequently, the NCC requested the Telecommunications Industry Association, an ANSI accredited body, to examine the interference issue and provide recommendations. Attached as Appendix A is a new study by the TIA which embodies the support of multiple manufacturers who provide equipment to the public safety market. This study, completed after release of the Commission's 2nd MO&O, shows the increased potential for interference and recommends establishment of the 3 dB rise in noise floor as a measurable benchmark to assess interference from CMRS to public safety in the 746 MHz band.[24] The TIA report also recommends specific modifications to Section 27.53 of the Commission rules. NPSTC hereby endorses the TIA recommendation and urges the Commission to modify its rules to reduce the chance for CMRS interference into the public safety bands.

The FCC rules must also require that any commercial license holders in the 747-762/777-792 MHz band who ultimately cause interference to any public safety system in the 700 MHz PS band be required to eliminate such interference to the satisfaction of the impacted public safety licensee(s) or cease operation. Specifically, after discussion with the TIA's Land Mobile Section on January 23, 2001, there is consensus that a measurable level of interference be defined as "the

[24] Motorola's previous analysis used a 1 dB rise in the noise floor.

aggregate of interference from any number of out-of-band transmitters that raise the noise floor within any 6.25 kHz public safety channel by more than 3 dB above thermal noise."

Experience at 800 MHz has shown that, while a single transmitter may meet the FCC's requirements and not cause interference, the aggregate effect of several co-located transmitters results in unacceptable interference. A basic interference threshold is necessary because the Commission's regulatory flexibility within the CMRS assignment does not specify technologies that will be permitted to occupy the CMRS spectrum. Additionally, this 3 dB figure is the minimum that can be readily identified and measured with commonly available test equipment.

In creating theoretical scenarios, parameters such as antenna height, gain and pattern, factors impacting propagation, and equipment parameters are often subject to interpretation. In arriving at a practical interference threshold that truly protects public safety communications, a methodology that is deliberated absent of these variables is imperative. In cases where standard references are desired, including the analysis methodology, the use of industry standards are necessary.

III. CONCLUSION

NPSTC appreciates the efforts of the Commission and Congress to allocate additional spectrum to public safety in the 700 MHz band. Coupled with recent follow-up actions such as the recent endorsement of NCC's recommendations on interoperability and the public notice specifying requirements for State license applications, the Commission is getting closer to actually making the spectrum available for use in areas where television incumbency is not an issue. Additional future Congressional or Commission steps to help ensure television is cleared will expand actual availability of the spectrum to additional public safety entities. However, all of this important activity on the part of the Congress, the Commission the public safety

community and manufacturers users will be undercut if the 700 MHz public safety band turns out to be merely a repository for interfering CMRS out of band signals. Therefore, NPSTC urges the Commission to reconsider its 2nd MO&O and adopt rules recommended herein that 1) provide additional protection against interference; and 2) establishes a "Zero Tolerance of Interference to Public Safety." To be effective, the zero tolerance policy should be based upon "the aggregate of interference from any number of out-of-band transmitters that raise the noise floor within any 6.25 kHz public safety channel by more than 3 dB above thermal noise."

Respectfully Submitted,

/s/ Marilyn Ward

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March 7, 2001

Attachment- TIA Study Submitted To The NCC on 02/20/01

Protection of Public Safety Systems from 700 MHz CMRS Band Interference

Private Radio Section
Mobile Communications Division
Telecommunications Industry Association

FEBRUARY 20, 2001

Protection of Public Safety Systems from 700 MHz CMRS Band Interference

The current rules for the 700 MHz band provide insufficient isolation from 'on frequency' noise generated and radiated by CMRS transmitters. The TIA TR8 meeting in Mesa Arizona, 1/22 - 1/23/01 agreed that Public Safety systems should be able to handle Out Of Band Emissions (OOBE) noise from transmitters that increase the composite noise floor in a victim receiver by 3 dB. This requires CMRS operators to suppress the composite OOBE from their site so that the noise intercepted by a victim Public Safety receiver is equivalent to the thermal noise floor of the victim receiver. The thermal noise of a typical Public Safety receiver varies from -126 dBm in a 6.25 kHz channel bandwidth to -120 dBm in a 25 kHz channel bandwidth. Since the noise being emitted is on the desired frequency of the victim receiver, there is no filtering that will eliminate this noise at the receiver. It must be suppressed at the source, either by design or by the inclusion of additional external filtering

There are four different interference mechanisms.

1. CMRS Base to Public Safety Mobiles.
2. CMRS Base to Public Safety Base Stations
3. CMRS mobiles to Public Safety Mobiles
4. CMRS mobiles to Public Safety Base Stations

The current FCC base station requirement limiting OOBE to a maximum of -46 dBm into 6.25 kHz bandwidth inside the Public Safety band is insufficient for cases 1) and 2). The purpose of this document is to evaluate the situation and to provide recommendations for increasing the OOBE suppression to prevent interference from obstructing and degrading critical Public Safety communications.

Base to Mobile Interference

The industry frequently uses the term Site Isolation to define the loss between the input port of the base station antenna and the output of the mobiles antenna port; i.e. port-to-port loss. Historically a value of 75 dB has been consistently available. However this historical value is no longer valid as CMRS deployments have changed over time. In the past they deployed relatively tall towers (around 100 feet tall) with omni directional antennas. Over time they have changed to sectored antennas and lowered the tower heights. Sectored antennas have wide vertical beamwidths so antenna discrimination is lessened. Figures 1 through 3 demonstrate the calculated port to port isolation of the older configurations and the more commonly deployed current configurations. The loss of site isolation is obvious! Two calculations are shown in each figure. One is for free space loss without any addition loss. The second adds 6 dB of loss. This 6 dB represents the additional losses under the condition where the signal is just grazing over local obstacles that have a reflection coefficient of zero[1]. Field experience and the finds measured data to be clustered between the two curves. Even omni-directional antennas when deployed at low tower heights deviate from the calculations due to local reflections filling in the antenna pattern nulls. See also the "A Best Practices Guide", Avoiding Interference Between Public Safety Wireless Communications Systems and Commercial Wireless Communications Systems at 800 MHz.[2]

As can be seen from the baseline of Figure 1 and the newer deployments of Figure 2 and 3, there is definite erosion from the historic 75 dB isolation value. With shorter towers being deployed the loss of isolation is even greater. With a 60-foot tower, the isolation drops to 60 to 65 dB. Microcell deployments in major metropolitan regions have already been observed and in this region the isolation drops below 60 dB. The jaggedness of the graphs is due to the antenna pattern resolution.

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[1] "The Mobile Radio Propagation Channel". J.D. Parsons, ISBN 0-470-2184-X, Page 43.

[2] This reference can be found at:http://www.apco911.org/ Additional links to experience and lessons learned are available there as well.

Note that in Figure 2, a sectored antenna's wide beamwidth eliminates many of the variations of the omnidirectional antenna in Figure 1. The wider beamwidth reduces the port-to-port isolation.

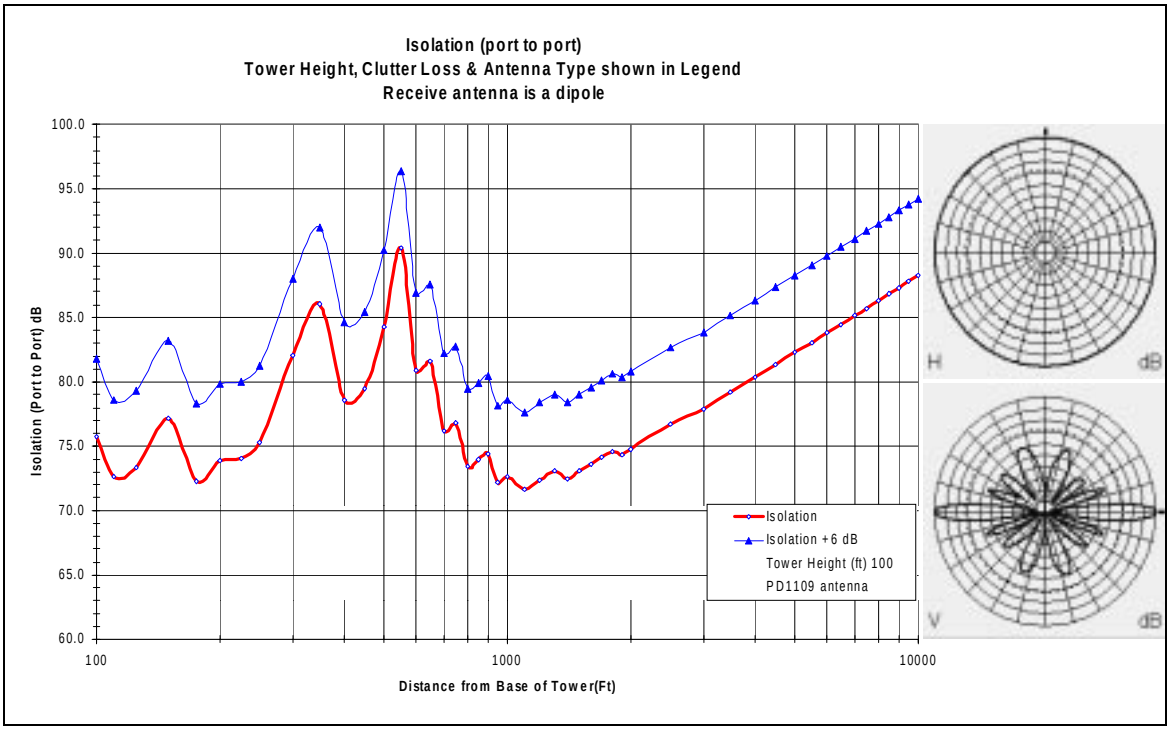

Figure1, A 100 ft tower utilizing a 9 dBd omni-directional antenna

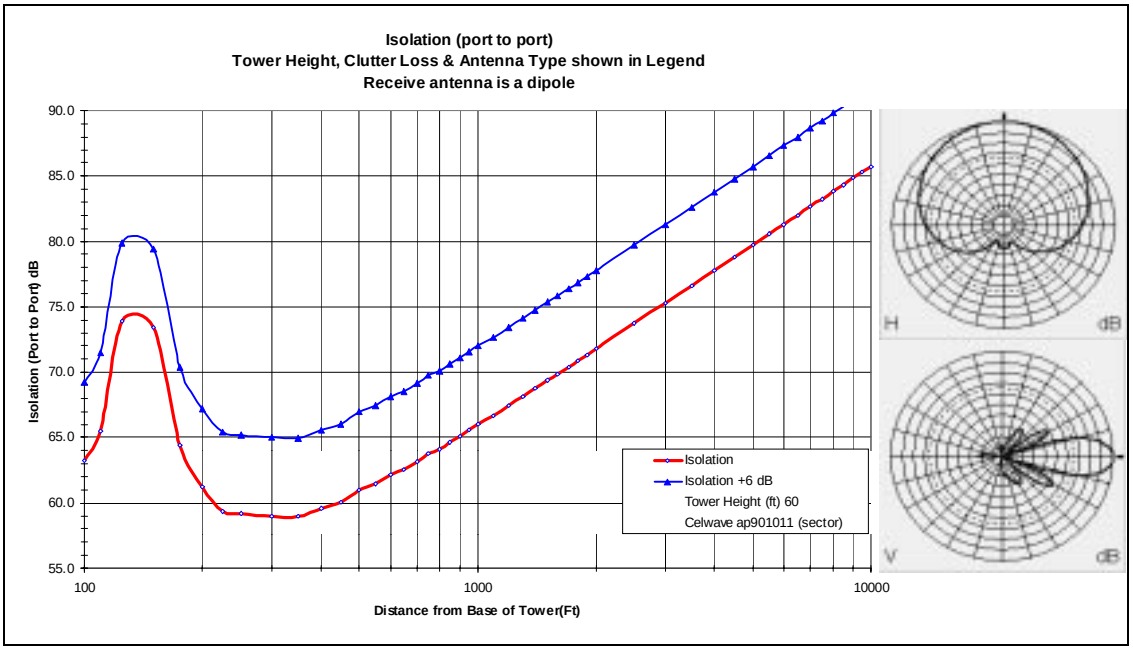

Figure2, a 60 ft tower utilizing a 105° sector antenna with 10.5 dBd directional gain

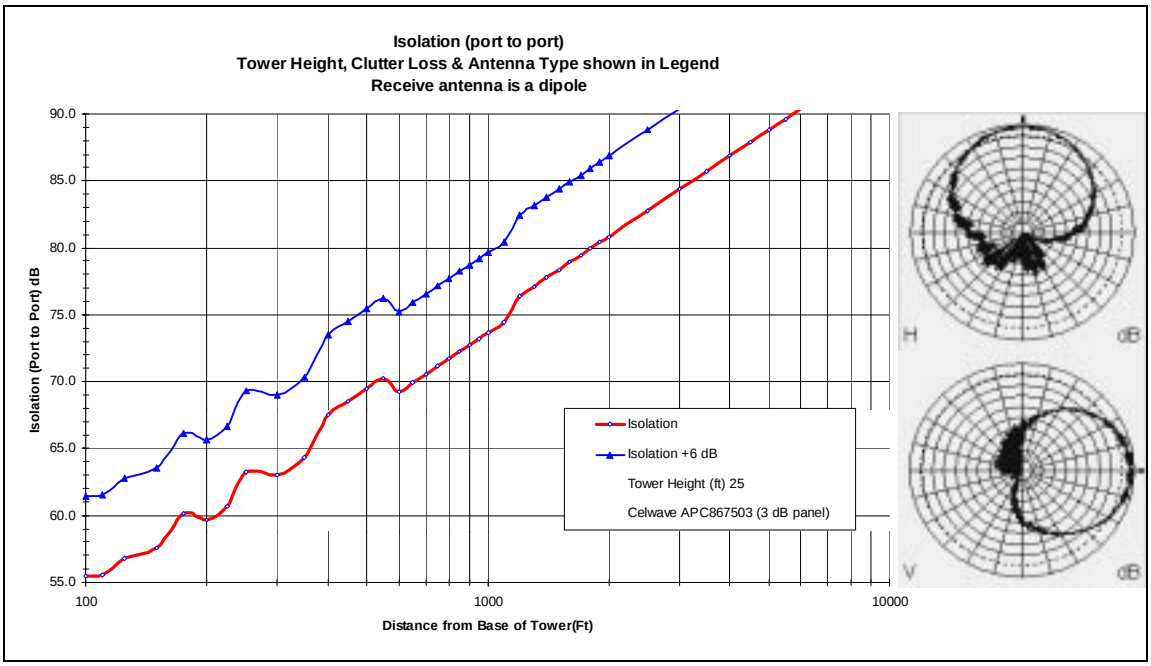

Figure 3, a Microcell arrangement utilizing a 25-ft tower with 3 dB panel antennas.

The increased level of OOBE due to the reduced site isolation produces coverage dead zones as the distance from the desired site is increased and the proximity to the CMRS emitter site is decreased.[3] This is frequently referred to as a "Swiss Cheese" result, as the round block of cheese has multiple and increasing large holes as the edge is approached.

As a result of this degradation in site isolation, the composite of all the OOBE energy needs to be suppressed so that it produces a -126 dBm total power. Utilizing a value of 65 dB, this calculates to a suppression value of -61 dBm, from all the transmitters at a given site into any 6.25 kHz channel bandwidth in the Public Safety mobile receive band. Portable antenna inefficiencies allow for the 65 dB values to be used. Mobiles or portables utilizing mobile antennas will receive more interfering energy.

Base to Base Interference

The base to base direction was not initially considered as it was generally assumed that the large frequency spacing (>32 MHz) would allow transmitter filters to adequately suppress OOBE in the base receiver portion of the band to a benign level. However, since the CMRS licensees can place high power transmitters into the upper portion of the CMRS band then the ability to easily filter is no longer valid (>2 MHz) and tremendous interference potential will exist if the existing -46 dBm OOBE criterion is retained.[4]

This mechanism is more detrimental as the interfering path is normally line of sight and includes gain antennas at both ends and typically a mast top amplifier at the Public Safety site to compensate for low portable talk-in power.

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[3] Ibid.

[4] Memorandum Opinion and Order and Further Notice of Proposed Rulemaking FCC 00-224 ¶ 13 - 27 and CFR47 § 27.53 Emission Limits

At one mile, Figure 4 and 5, free space loss equals 90 dB. Free space loss requires approximately 24 feet clearance at the midpoint of a one-mile path. This is easily achieved with CMRS tower or deployment on building tops or their sides. Public safety towers are generally tall so they are above the local environmental clutter. The CMRS antennas were historically above the local clutter as well.

There are two issues that make the achievement of 90 dB of isolation impossible. The base to base path must include the gain of two antennas and the affect of a mast head amplifier of approximately 5 dB. This essentially reduces the amount of isolation by 25 dB, back to the 65 dB for the base to mobile case.

Due to the large number of CMRS sites required for capacity, a site separation of 2 miles between CMRS deployments is assumed. Figure 4 illustrates that there will be two potential interferers if the Public Safety site is midway between the CMRS sites. The antenna patterns shown are not to scale and don't represent the wider vertical beamwidths currently being deployed. The exaggerated vertical scale makes the angles exaggerated. Angles are much less than Figure 4 would imply

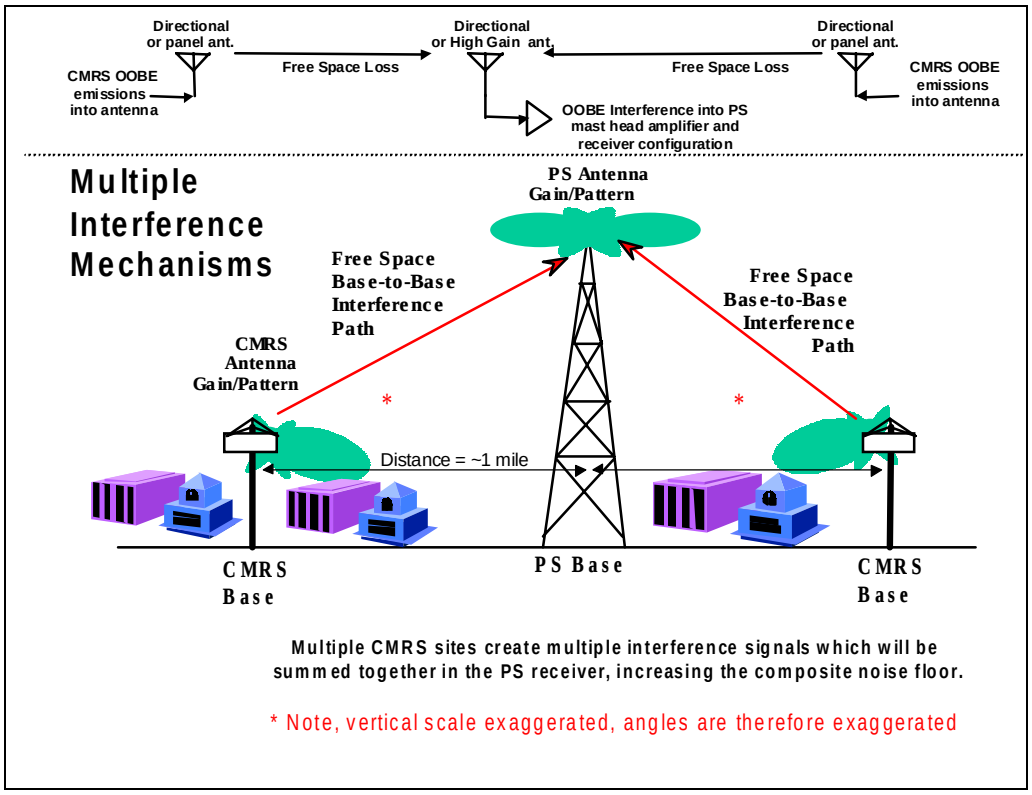

Figure 4, Base to Base interference

With shorter CMRS towers, there is a decreased likelihood of having the clearance for free space loss. However, as a site is moved from the midpoint toward one of the sites, one signal increases and has a higher likelihood of having the necessary clearance. Figure 6 shows that if one of the sites is moved so that it is 0.1 mile from the dominant interfering site, the free space loss is reduced by 20 dB (the interfering power is increased by 20 dB). When very close spacing occurs, the antenna gains are not as prevalent due to antenna discrimination. Therefore a reduction of ~20 dB represents a realistic scenario, especially when there will be voting receiver sites that frequently have lower antenna height than base transmitters. The voting receivers will be on the same frequency as the base receiver.

This requires the OOBE specification for transmitters in the upper portion of the CMRS band be increased to - 80 dBm into any 6.25 kHz channel in the upper portion of the Public Safety band, and -61 dBm into the lower portion of the Public Safety band.

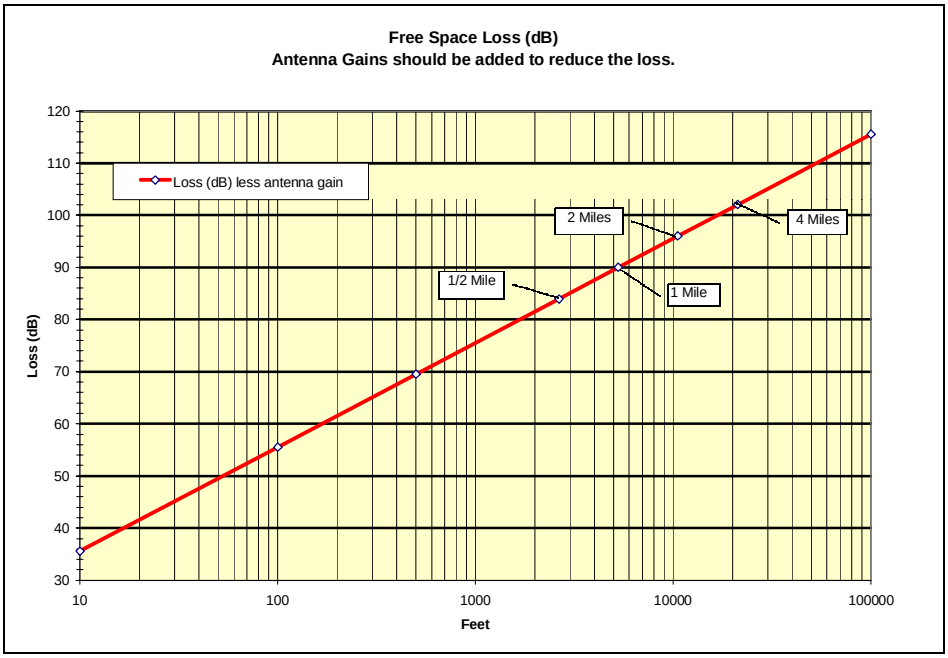

Figure 5, Free Space Loss

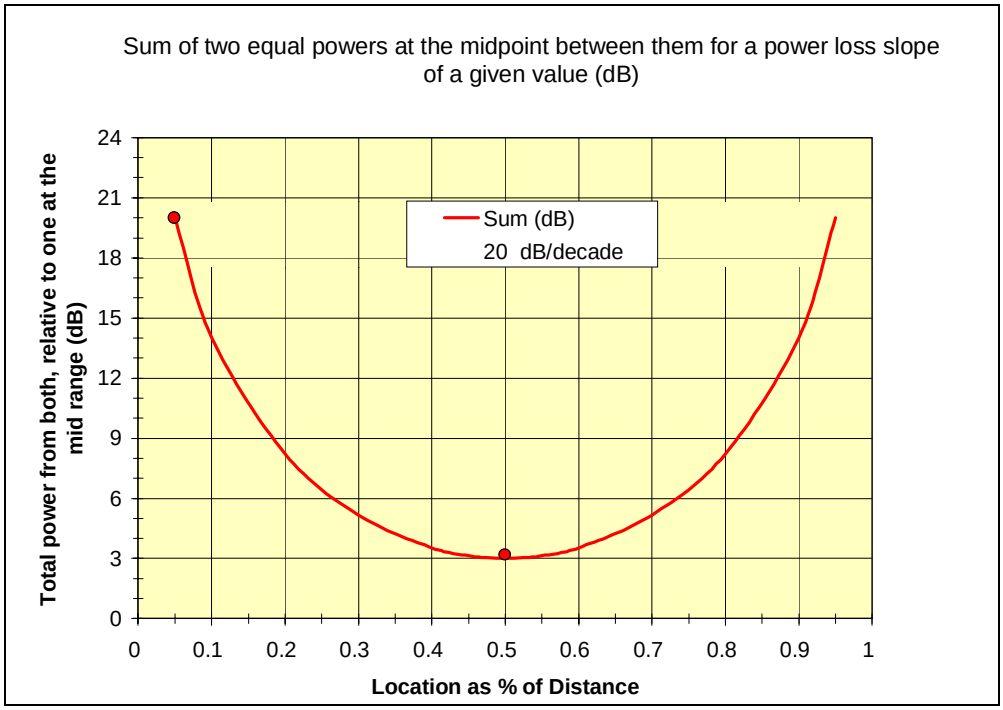

Figure 6, Power variations as a function of separation

Differences between Public Safety and CMRS requirements

Public Safety requirements are dramatically different than CMRS. Public Safety deals in life and property. Dead zones must be controlled so that there is very low probability of an officer not being able to communicate while involved in potential life threatening situations. Current reported situations in the 800 MHz band have pointed out the very real problems of "dead zones" around CMRS type deployments.

CMRS systems are revenue generators and have control over blocks of frequencies such that they control their own interference environment. When they have interference, they either modify the configuration slightly to eliminate it, since they control all the elements this is relatively simple from an administrative point of view. As they add capacity by adding sites, they create new interference scenarios but have control over the solution. In a cellular type deployment, which services the general population in a one to one type basis (interconnect), it is economically sound to add sites as they will increase system capacity thereby allowing additional users. In a Public Safety system that provides service to a specific population of users distributed over a large service area, it is economically unsound to provide additional sites or use additional frequencies at additional sites as channel loading criterion cannot be met.

Placing these diametrically different types of deployments in close frequency proximity and having their service areas overlap creates the requirement to control the OOBE of CMRS sites.

IV. REQUIREMENTS FOR PUBLIC SAFETY DIGITIAL COMMUNICATIONS

There is a dramatic difference between analog FM signals and digital signals in the presence of interference. Digital signals are more sensitive and will eventually cease to operate satisfactorily when the Bit Error Rate (BER) probability becomes large enough. TSB 88A outlines the various faded carrier to noise rations required for Delivered Audio Quality (DAQ) values of 3, 3.4 and 4. It does not provide values for DAQ 2 which is defined as "Understandable with considerable effort. Frequent repetition due to Noise/Distortion"[5]. This level of performance is unacceptable to Public Safety and is not used as a design criterion. More important is that the difference in faded C/N (C_f/N) between DAQ = 3[6] and DAQ = 2 is only 2.5 dB (14 dB Cf/N for DAQ = 2 for Project 25 Phase 1 Digital modulation). Even lower C_f/N causes the radio to cease proper decoding. This is nearly the same as the recommended allowance of the rise in the noise floor of a victim receiver.

Consider a normal mobile on the street design, using the TIA model. The requirement for DAQ=3 is 16.5 dB above the thermal noise floor of -126 dBm (-126 dBm + 16.5 dB = -109.5 dBm. Assuming a receiver antenna and cable loss of 0 dBd, leaves the requirement the same. To provide 90% reliability requires an additional 7.2 dB (standard deviation = 5.6 dB) requiring a median signal level design -102.3 dBm.

Using the existing -46 dBm OOBE requirement and the 65 dB of site isolation produces an interfering noise level of -111 dBm. Since this noise is from a site quite close to the victim, there is essentially 100% probability of that level being realized. The difference between the -111 noise source and the internal noise floor is large enough so that the external noise dominates. Therefor the C_f/N is now only 8.7 dB verses a requirement of 16.5 dB for DAQ = 3 and 14.0 dB for DAQ = 2. As a result the reliabilities for DAQ = 3 and DAQ = 2 (essentially unusable or radio muted) are 8% and 17% respectively.

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[5] TSB88A, page 23, Table 1

[6] TSB88A, page 105, Table A-1

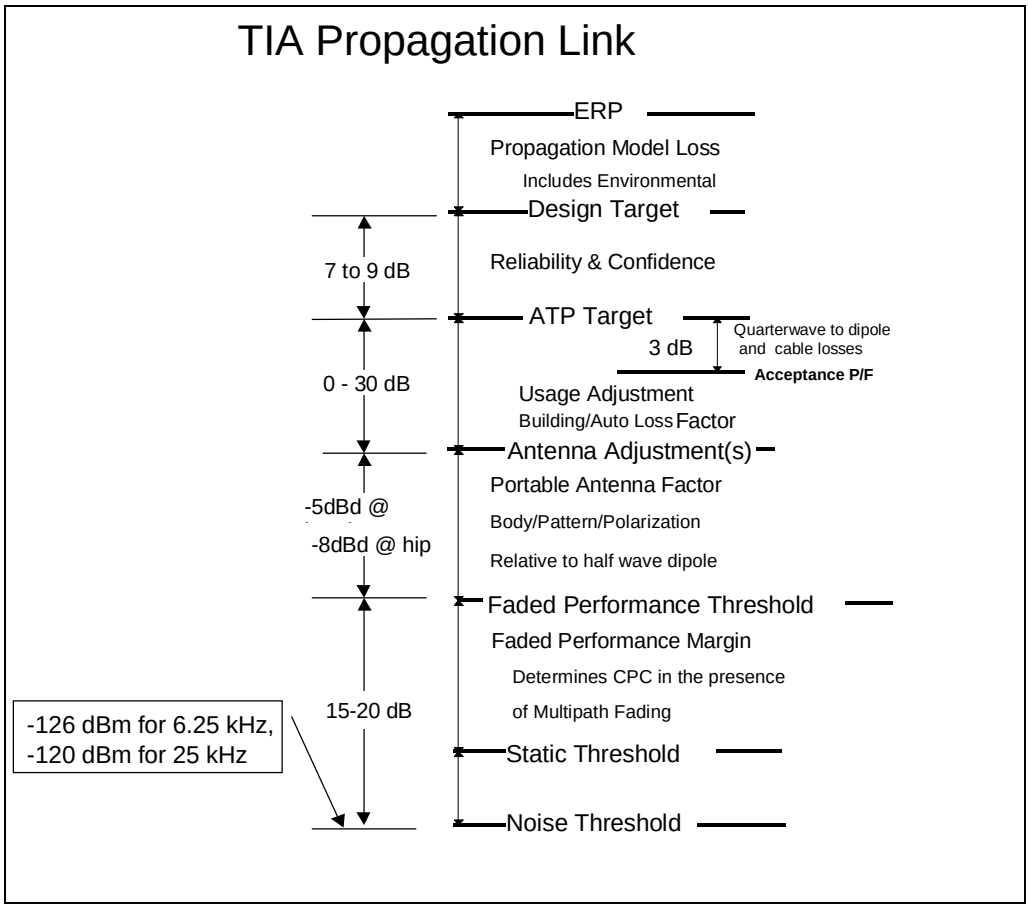

Figure 7, TIA Propagation Link Budget

Using a modified design based on assuming there will be a 3 dB rise in the noise floor requires a slightly higher design target of -106.5 dBm. Now the interfering signal level is -126 dBm, creating an internal noise floor of -123 dBm.

	DAQ = 3	DAQ = 2
Normal Design Reliability, thermal noise only	90%	96%
Reliability with -46 dBm interference source	8%	17%
Reliability with -61 dBm[7] interference source and 0 dB boost in the design criterion	75%	88%
Reliability with -61 dBm interference source and 3 dB boost in the design criterion for external noise	90%	96%

Table 1 - Reliability with and without potential CMRS interference

[7] This recommendation is slightly more optimistic than one made by Motorola in an exparte presentation to the FCC on 12/8/2000. Their -63 dBm recommended value was based on slightly different assumptions, but produced a similar conclusion.

As can be seen from Table 1, by changing the OOBE to the recommended value and designing for a 3 dB boost in average signal levels, the previous level on reliability can be achieved without requiring a massive amount of additional sites. Boosting the noise floor by 3 dB, assuming a fixed ERP and the same reliability requirement, reduces a site's coverage radius to 84% and the site's area coverage at the same reliability of 70%. This effect will occur for all potential channel bandwidths as the noise contribution will be 3 dB for all configurations

The base to base scenario is similar. In this case, the base receiver is exposed to an OOBE noise source that will vary with the distance between the Public Safety site and the CMRS sites. In this case, using the -80 dBm OOBE requirement and the currently typical site deployment of a 60 foot tower and a 10 dBd sectored antenna against a 200 foot tower, 10 dBd omni-directional antenna and a mast top amplifier providing 5 dB of gain can be solved for a distance that would produce a 3 dB rise in the overall noise floor of approximately 600 feet. At this separation, there is the potential for some antenna discrimination or agreements to co-locate and use vertical isolation on the same structure.

CMRS Band Issues

The current rules that allow base transmitters to be deployed in either the 747 - 762 MHz or 777 - 792 MHz portion of the band poses potential intra CMRS interference between Blocks C and D. The current rules only limit OOBE emissions of -13 dBm outside these blocks with the exception of the Public Safety blocks. It is anticipated that this low value will cause extreme interference when TDD and FDD technologies are deployed in the same portion of the CMRS band, (i.e., a TDD in Block C and FDD in Block D) Infact unless they are exclusively data and reach agreements on sharing time increments, both will suffer extreme interference dramatically reducing potential system capacity.

Recommendation.

It is recommended that the FCC review the current recommendations for 47 CRF § 27.53 and incorporate these recommended values. It is further recommended that fixed stations comply with the base station requirements rather than mobile requirements as their interference potential is equivalent to that of a base station. Figure 8 graphically shows the recommendation.

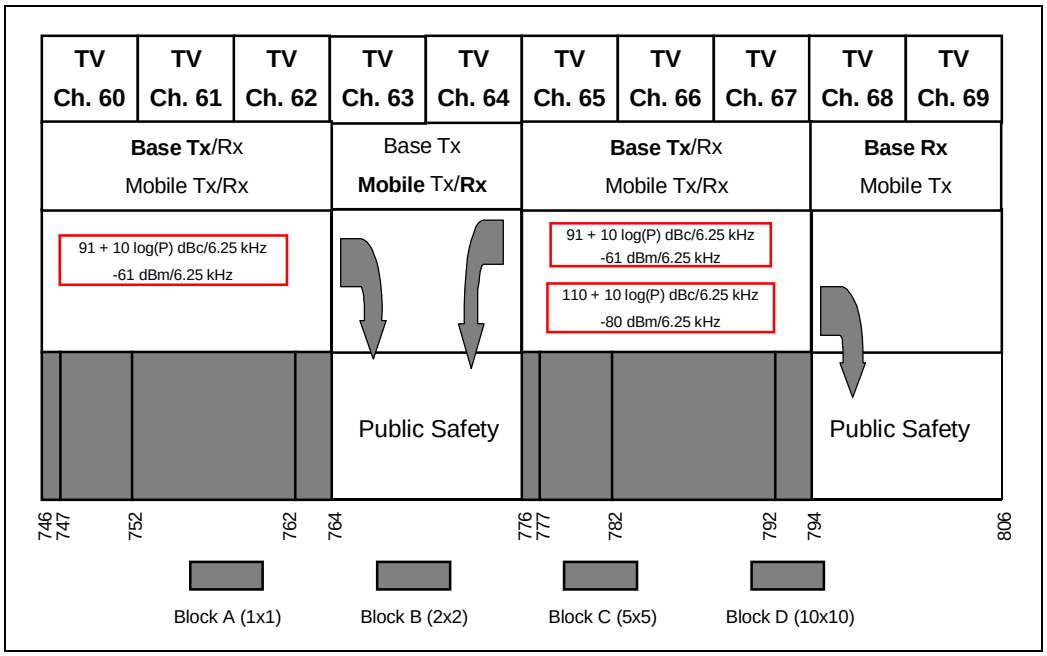

Figure 8 - Recommended CMRS Out of Band Emissions

§ 27.53 Emission limits.

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(c) For operations in the 747 to 762 MHz band and the 777 to 792 MHz band, the power of any emission outside the licensee'' frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed bands(s) of operation, measured in Watts, in accordance with the following:

(1) On any frequency outside the 747 to 762 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + l0 log (P) dB;
(2) On any frequency outside the 777 to 792 MHz band, the power of any emission shall be attenduated outside the band below the transmitter power (P) by at least 43 + l0 log (P) dB;
(3) On all frequencies between 764 to 776 MHz and 794 to 806 MHz, by a factor not less than 110 + 10 log(P)dB in any 6.25 kHz band segment, for base and fixed stations at any location;
(4) On all frequencies between 764 to 776 MHz and 794 to 806 MHz, by a factor not less than 91 + 10 log(P)dB in any 6.25 kHz band segment, for mobile and portable stations;

Recognizing that external filters may be required to meet these rigorous but necessary requirements, the FCC should also add wording permitting their effect to be included in meeting these criteria.