MAJOR CITIES CHIEFS
OFFICE OF THE PRESIDENT

February 15, 2002

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
Room TW-A325
445 Twelfth Street, SW
Washington, DC 20554

In the Matter of: DA 02-260
Auction of Licenses in the 747-762 MHz and
777-792 MHz Bands

Comments of the Major Cities Chiefs

1. The Major Cities Chiefs Association (MCC), an organization of Chiefs of Police of the 59 most populous cities in the United States and Canada, submits these comments in the Commission's Public Notice # DA02-260.

2. The Notice inquires as to "issues of interference with other spectrum bands" (page 7). The MCC has filed numerous comments regarding interference from existing commercial carriers operating near or between established public systems in the existing 800 MHz bands.

3. The MCC has also supported multiple public safety organizations that have filed comments to recommend that the Commission modify the proposed Commercial Mobile Radio Service (CMRS) rules for the 700 MHz band as addressed in the petition of the National Public

Safety Telecommunications Council (NPSTC).

4. The MCC continues to support limiting base stations to the 747-762 MHz portion of the commercial allocation, and the other proposals by NPSTC to eliminate interference in the 700 MHz band. Once again we support the concept of ‘zero tolerance’ for any interference by commercial carriers to public safety and the rule changes as proposed by NPSTC based upon the report of the Telecommunications Industry Association (TIA) (attached) to further protect Public Safety radio systems that will operate in the new 700 MHz band.

5. The MCC again reminds the Commission that it should have no higher priority than protecting the communications capabilities of public safety agencies and the citizenry that they serve.

Respectfully submitted,
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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 zero1. 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.

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.

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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.

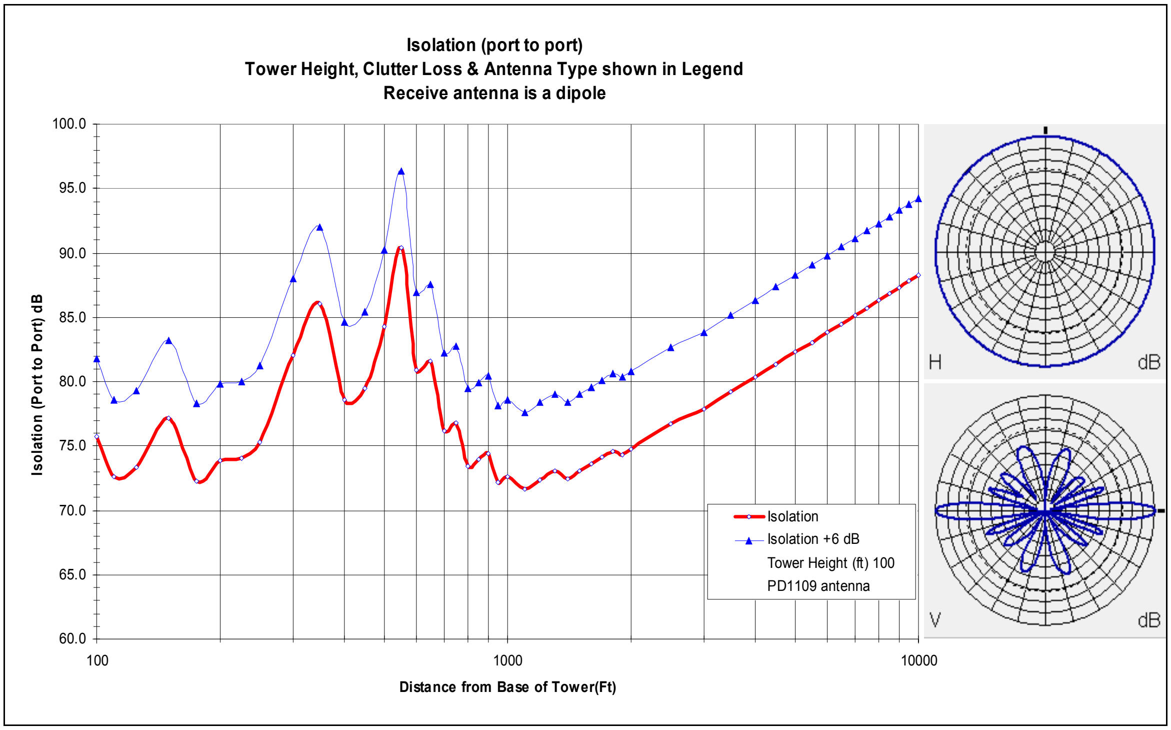

Figure1, A 100 ft tower utilizing a 9 dBd omni-directional antenna

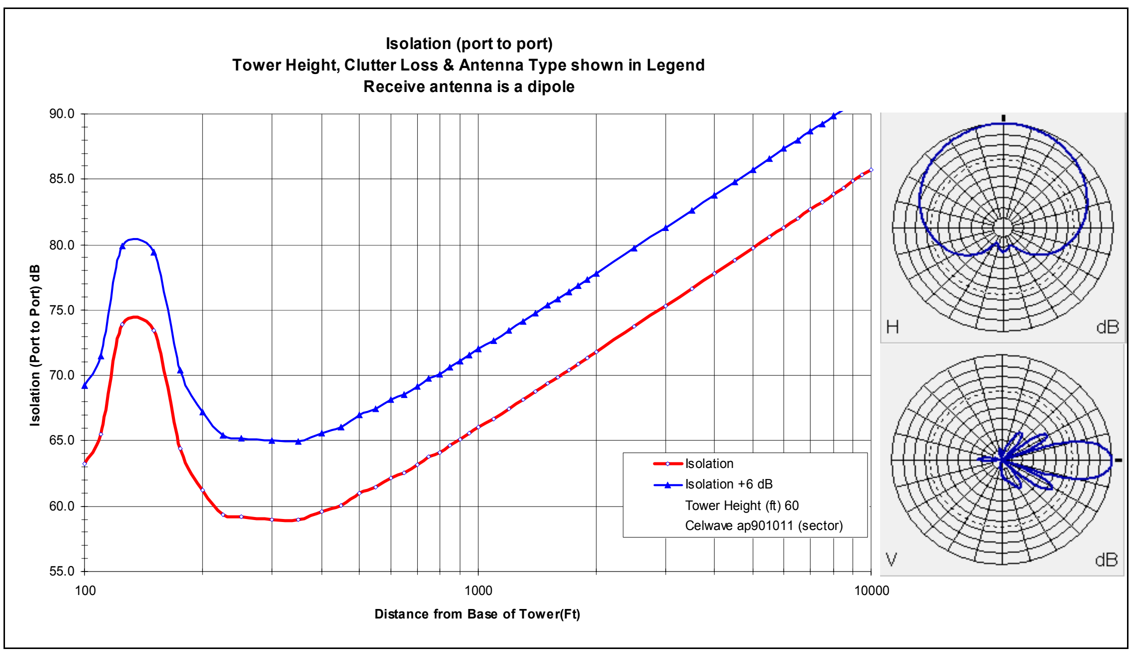

Figure2, a 60 ft tower utilizing a 105° sector antenna with 10.5 dBd directional gain

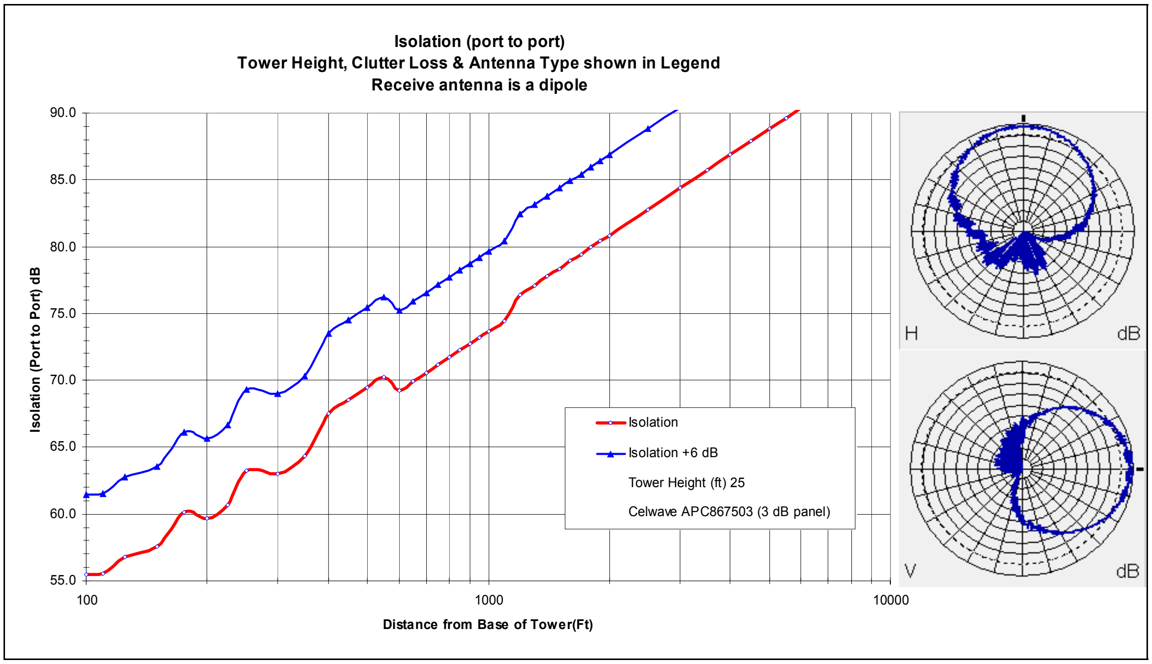

Figure 3, a Microcell arrangement utilizing a 25-ft tower with 3 dB panel antennas.

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.

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

3 Ibid.

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

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

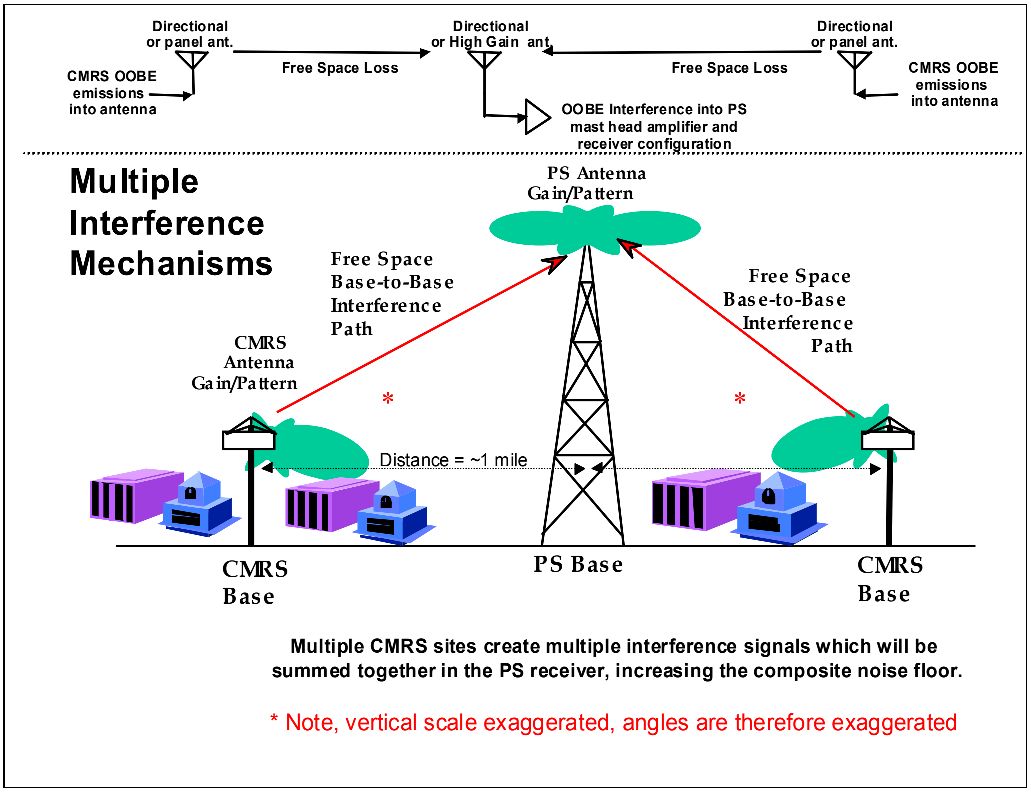

Figure 4, Base to Base interference

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.

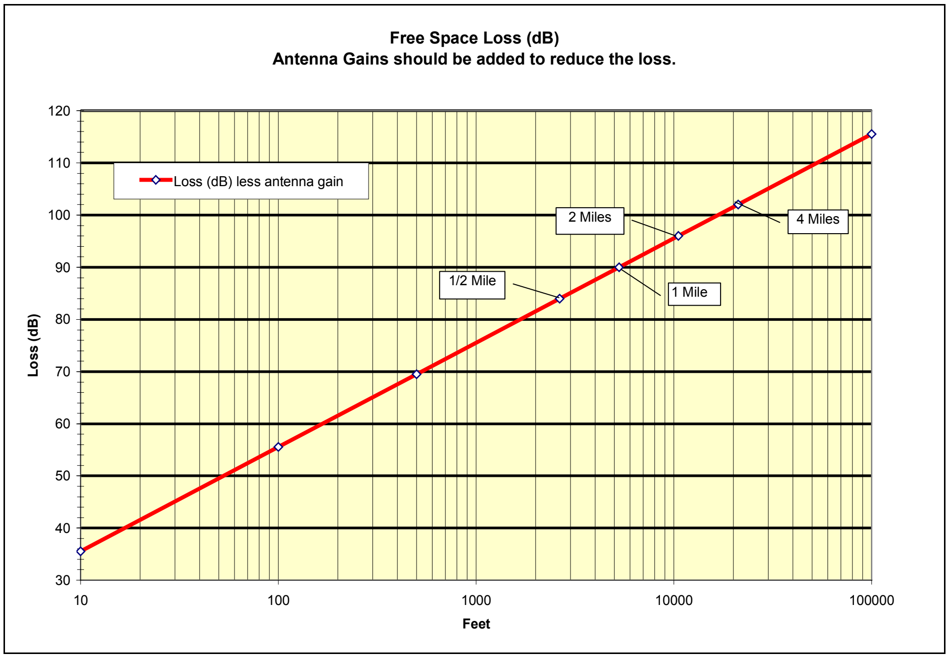

Figure 5, Free Space Loss

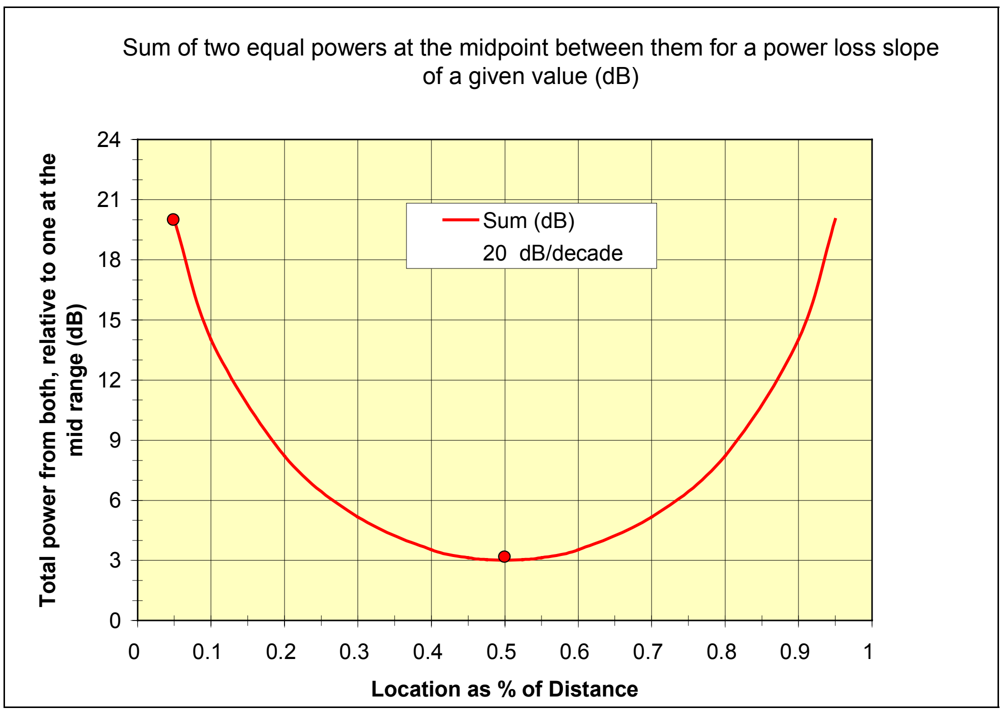

Figure 6, Power variations as a function of separation

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.

I. 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.

5 TSB88A, page 23, Table 1

6 TSB88A, page 105, Table A-1

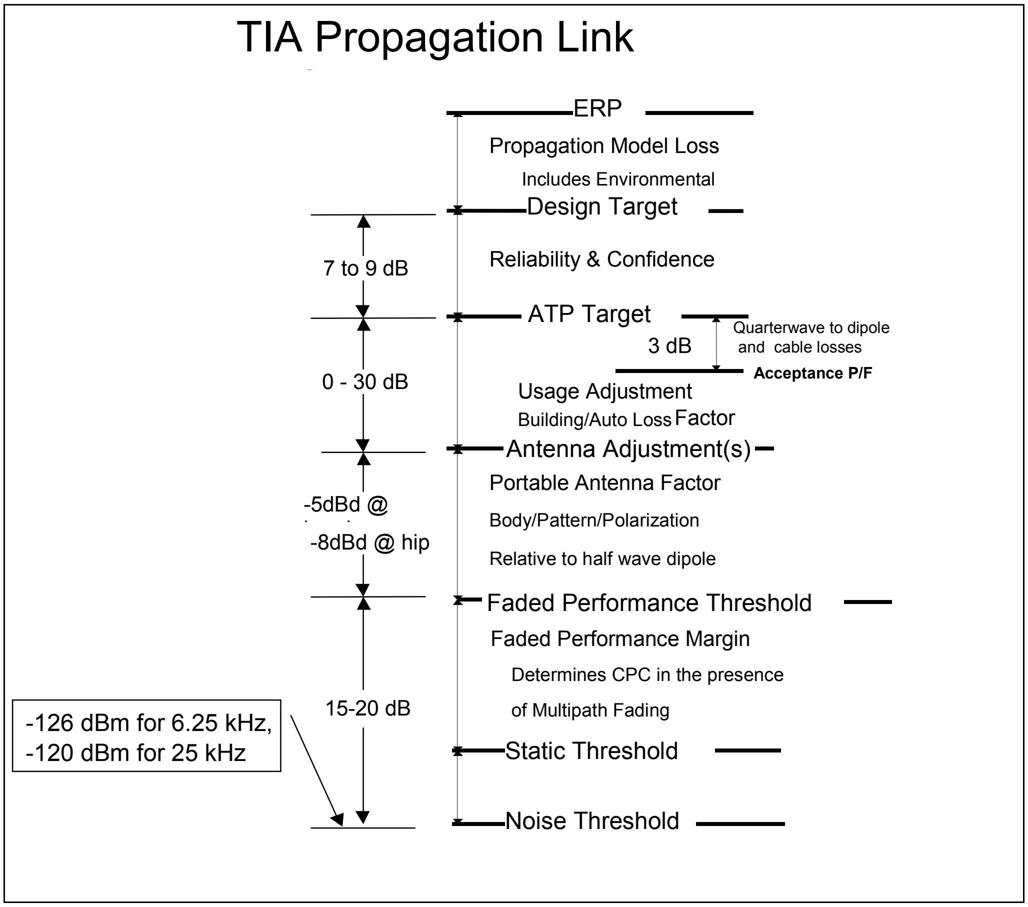

Figure 7, TIA Propagation Link Budget

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 dBm7 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

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

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.

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.

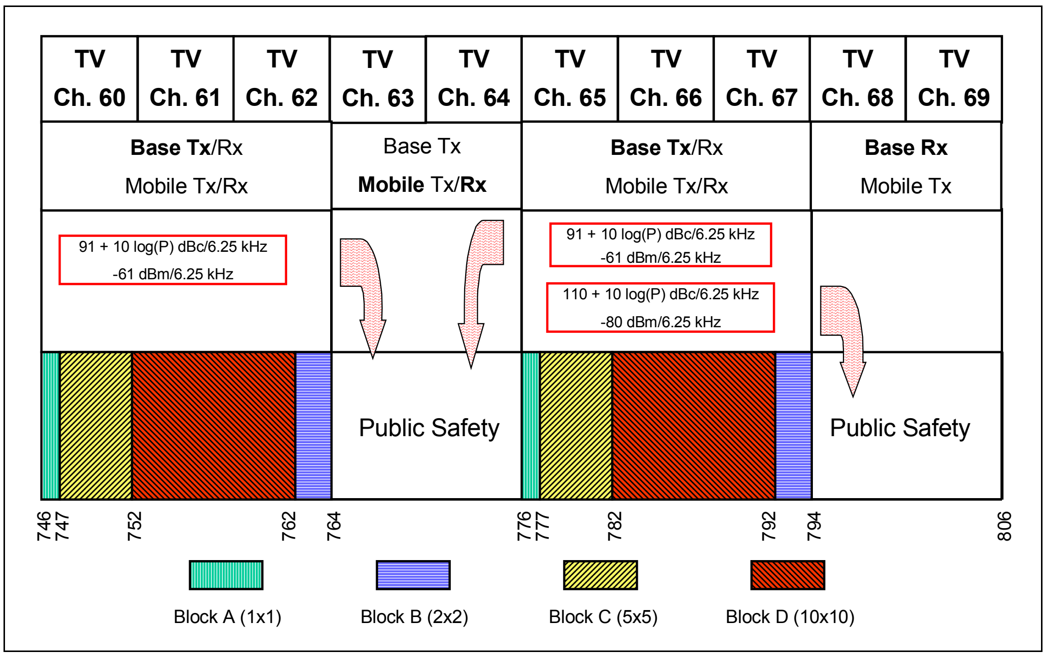

Figure 8 - Recommended CMRS Out of Band Emissions

§ 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.