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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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In the Matter of	)	
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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
	)	
	)	
	)	

OPPOSITION TO PETITION OF MOTOROLA FOR RECONSIDERATION OR CLARIFICATION

BellSouth Corporation (hereinafter "BellSouth"), opposes Motorola's petition for reconsideration or clarification[1] in the above referenced proceeding. The record in this proceeding fully justifies the Commission's decision to permit high-power commercial base/fixed stations to operate in the 777-792 MHz (or "upper") band. As shown below, nothing in the Motorola Petition requires the Commission to change that decision. Accordingly, the Commission should deny the Petition.

BACKGROUND

In the *700 MHz First Report and Order*[2], the Commission adopted service rules for the commercial use of the 747-762 MHz and the 777-792 MHz bands. Among other things, the Commission adopted rules that limited commercial base/fixed transmitters to operate in the 747-762 MHz frequency (or "lower") band.[3] It also adopted out-of-band emission limits for these

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[1] Petition of Motorola for Reconsideration or Clarification, WT Docket No. 99-168, filed August 11, 2000 ("Motorola Petition").

[2] *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*").

[3] *700 MHz First Report and Order*, Appendix B, § 27.50, 15 FCC Rcd at 547-48.

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commercial stations at 76 + 10 log (P) below the fundamental emission power, as measured in a 6.25 kHz bandwidth.[4]

Numerous petitions for reconsideration were filed in response to the *700 MHz First Report and Order*. BellSouth filed reply comments in response to those petitions. Specifically, BellSouth demonstrated that restricting commercial base/fixed transmitters to operating in the lower band would produce undesirable levels of interference on commercial mobile stations receiving in this lower band. The interference would be caused by high-power UHF TV stations 59 and below.[5] Adaptive, TRW and US West also demonstrated that restricting such operations to the lower band would essentially prohibit the 700 MHz spectrum from being used by TDD technologies.[6]

On the basis of these showings, the Commission decided to modify its rules to permit commercial base/fixed stations to operate in the upper band.[7] At the same time, it decided to retain the 76 + 10 log (P) out-of-band emissions limit to provide the same level of protection for the 700 MHz public safety bands.[8]

The Commission fully considered the record evidence proffered by Motorola regarding possible interference with public safety operations by commercial base/fixed stations operating in the upper band.[9] Motorola's Petition does not directly challenge the foundation of the

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[4] *700 MHz First Report and Order*, Appendix B, § 27.53, 15 FCC Rcd at 548-49.

[5] Reply Comments of BellSouth Corporation, filed March 17, 2000, WT Docket No. 99-168, at 2-4 ("BellSouth Reply Comments").

[6] Petition for Reconsideration by Adaptive Broadband Corporation, WT Docket No. 99-168, filed February 22, 2000; Petition for Reconsideration or Clarification of TRW Inc., WT Docket No. 99-168, filed February 11, 2000; Petition for Expedited Reconsideration of US West Wireless, LLC, WT Docket No. 99-168, filed February 3, 2000.

[7] *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, released June 30, 2000, at 6-7, ¶¶ 7-10.

[8] *Id.* at 11-12, ¶¶ 21-27.

[9] *Id.* at 6-7, ¶ 9.

Commission's decision on reconsideration. For example, Motorola does not challenge BellSouth's showings that, under the scheme adopted in the *700 MHz First Report and Order*, the extremely high power used by UHF TV stations would have interfered with the reception of mobile stations used by commercial operators in the 747-762 MHz band.[10]

Rather, Motorola asks the Commission to reconsider the decision to permit licensees to use commercial base/fixed transmitters within the upper band on the basis of various claims regarding interference from 700 MHz commercial operations into 700 MHz public safety radios.[11] As shown below, Motorola's assertions are incorrect, and its desire to limit high-power base/fixed emissions to the lower band is misguided.

1. Limiting High-Power Commercial Use to the 747–762 MHz Block Does Not Reduce the Level of Out-of-Band Emissions Allowed in the Public Safety Bands

Motorola's request to return the rules to their original untenable state is not only counter to the evidence in this record but, more importantly, *it would not grant any additional protection to the public safety bands.* The out-of-band emissions limit for commercial base/fixed transmitters into the public safety bands remain 76 + 10 log (P) regardless of whether those transmitters operate in the lower or upper 700 MHz band. Based on the consistent application of out-of-band emissions limits to the lower and upper bands, restricting commercial base/fixed operations to the lower band will not provide any additional regulatory protection to public safety operations.

Motorola points out that if the commercial base/fixed stations were limited to the lower block, they would be separated by 32 MHz from public safety receivers, rather than the 2 MHz

[10] BellSouth Reply Comments at 2-4.

[11] Motorola Petition at 4-8.

separation that is achieved if the base/fixed stations operate in the upper band.[12] Motorola further assumes that greater separation would result in lower levels of out-of-band emissions from the base/fixed stations into the public safety band. However, manufacturers of base/fixed stations (including Motorola) design the commercial equipment to meet Commission limits, and include a safety margin for manufacturing tolerances.

Economically, there is no point in designing and building commercial equipment to exceed FCC requirements. Commercial base/fixed stations will be targeted to achieve the 76 + 10 log (P) emission limit (plus safety margin) regardless of the frequency block in which they operate. To the extent that these out-of-band constraints are the factor that actually limits interference to 700 MHz public safety base stations from base station transmissions in the lower band – if these constraints are actual limiting – then switching the uses back to the original bands will not improve the situation.

If additional filtering is required in specific circumstances to alleviate an interference problem, base/fixed transmit filters that roll off sufficiently fast over 2 MHz are not substantially more difficult to produce than filters that roll off over 32 MHz. In fact, the guard bands are in place mainly to allow for roll-off of transmit filters.

Motorola fails to acknowledge the well established fact that transmit filtering is easier to achieve in a base/fixed station than in a mobile station. For that reason, Motorola should be *encouraging* and not discouraging deployment of fixed/base stations in the 777–792 MHz band.

Perhaps Motorola is concerned that its own public safety radio receivers are not sufficiently filtered to reject base/fixed fundamental (in-band) emissions that are 2 MHz away in frequency. To the extent this is the case, Motorola should use improved filtering in its public

[12] Motorola Petition, Appendix B at B1.

safety receivers rather than urge the Commission to place capricious deployment requirements on other users in other parts of the radio spectrum.

At the very least, Motorola should openly and explicitly identify this concern if it is the true basis of its Petition. BellSouth's analysis indicates that Motorola's stated concern--protection of public safety receivers from out-of-band emissions from commercial transmitters--is more easily achieved for base station transmitters operating in the upper band than for commercial mobile/portable transmitters operating in the same band.

2. Motorola's Analysis of Coverage Holes Is Based on an Unreasonable Definition of "Outage"

In its Petition, Motorola analyzes the fraction of public safety coverage area that is subject to "outages" due to interfering emissions from commercial transmitters. However, Motorola erred in its use of a 1 dB degradation in the noise floor of a public safety radio to define an "outage."[13] In fact, a 1 dB noise floor degradation does not represent anything close to an outage situation.

Historically, the 1 dB figure is derived from the fixed microwave world and represents an acceptable level of interference into a fixed link so as not to cause excessive degradation of performance in terms of carrier-to-noise ratio or fade margin. It can be an appropriate standard for fixed microwave and satellite applications.

However, a 1 dB noise floor degradation is, in fact, difficult to measure even using sensitive laboratory test equipment. It would be unnoticeable to any user of a public safety radio. It is certainly nowhere near an "outage" in the sense that an outage is commonly understood as a condition that causes the user's radio communications to fail. It is well known that the received strength of land mobile signals varies greatly due to the effects of shadowing, reflections, and

[13] Motorola Petition at 6 and Appendix B.

other factors. A 1 dB change in the noise floor is unlikely to have any practical effect in most systems.

If Motorola had computed its outage simulation to determine the fraction of public safety coverage area where the carrier-to-(noise + interference) was reduced to a level that constitutes a true outage, it would find that the coverage hole fraction would be extremely small. Indeed, it would have virtually vanished as demonstrated in the analysis set forth in Attachment A hereto. In that situation, when properly analyzed, the coverage hole radius computed by Motorola as 350 meters shrinks essentially to zero.

3. The Level of Interference from Public Safety's Own Radios Will Be Greater than Interference from Commercial Base/Fixed Transmitters

Public safety mobile radios will often be operated in very close proximity to each other and to public safety base stations. Under Motorola's logic, such portable public safety units, which are held to approximately the same out-of-band limits as the commercial base stations, are potentially a far more potent source of interference than a commercial base station operating nearby.

If the Commission were to grant the Motorola Petition, it would also have to adopt rules that insure that public safety mobile and portable units, when operating in close proximity to public safety base stations, cannot increase the noise floor by more than 1 dB.

4. Operation of Commercial Base/Fixed Stations in the 777–792 MHz Band Will Lead to a Decrease in Interference Problems, Not an Increase

Motorola asserts that, because commercial base/fixed stations transmit with higher power, higher antenna gains, and taller antenna sites, interference from these commercial stations into public safety base stations will be more severe than if the commercial base/fixed stations

operated only in the 747–762 MHz band. In fact, this argument is entirely contrary to long-standing RF engineering practices of frequency coordination.

According to those RF engineering practices, operators of fixed stations can locate those fixed stations in such a way as to minimize potential interference. Commercial operators, such as BellSouth, would work diligently with public safety agencies to insure that their base stations do not interfere with public safety transmissions.

If, on the other hand, the upper band was restricted to mobile operations only, there would be no way to achieve any level of coordination because commercial operators cannot control where their mobile stations are located. A social event, a demonstration, or a traffic problem could create a large crowd near a public safety base station. Multiple consumer portable units transmitting in the upper band could result in out-of-band emissions with far more serious effects on the performance of the public safety base stations than a commercial base station operating in the upper band would have had.

There also is an important issue of uncertainty and planning. According to Motorola's own analysis, a commercial base station may slightly reduce the reliable service range of a public safety base station.[14] Under the scenario Motorola describes, such a reduction would be relatively constant and repeatable. Because it could be detected, engineering solutions could be developed and deployed. In contrast, loss of service due to emissions from mobile units would be far more difficult to forecast or resolve. Motorola stated that "a subscriber device within 1.2 kilometers from a public safety station would degrade public safety fringe area coverage."[15]

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[14] Motorola Petition at 5-6 and Appendix B.

[15] Motorola Petition at 5.

Realistically, it will be impossible to control use of subscriber devices in the vicinity of public safety base stations. Indeed, such devices may be operated by public safety personnel.

Motorola itself refers to coordination of cellular-type base stations with other base stations, such as public safety, as "time-tested" and useful to "avoid or ... resolve interference situations if they occur."[16]

As noted above, Motorola's desire for frequency coordination cannot be achieved if its own request to require commercial mobiles to operate in the 777–792 MHz band is granted. BellSouth therefore is confused by Motorola's position on this matter.

CONCLUSION

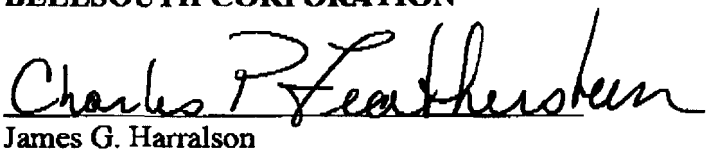
Motorola's desire to limit deployment of commercial base/fixed stations to the lower 700 MHz block will not have any effect on potential levels of interference into public safety bands. In fact, most of the interference is likely to arise from public safety radios themselves.

If public safety officials remain concerned about interference, the time-tested method of coordination is the best avenue to pursue. Voluntary coordination is far better than imposing unnecessary regulatory constraints that may make the 700 MHz band unusable for commercial applications and may make future coordination impossible.

[16] Motorola Petition, Attachment to Appendix A, at 17.

Accordingly, the Commission should deny Motorola's Petition.

Respectfully submitted,
BELLSOUTH CORPORATION



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September 15, 2000

CERTIFICATE OF SERVICE

I do hereby certify that I have this 15th day of September 2000, served the following parties to this action with a copy of the foregoing Opposition to Petition of Motorola for Reconsideration or Clarification by hand delivery or by placing a true and correct copy of the same by U.S. mail, addressed to the parties listed below.

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Technical Annex
Coverage Hole Analysis Using a Reasonable Outage Criterion

This annex re-computes Motorola's coverage hole analysis using a more reasonable definition of an outage.

Consider interference from a 700 MHz commercial base station into a 700 MHz public safety mobile radio, as Motorola addressed in its "Attachment to Appendix A." In Motorola's analysis, they used an unreasonable definition of outage that was determined by a 1 dB degradation in the noise floor of a public safety receiver. This annex will use a Carrier-to-(Noise + Interference), or $C/(N+I)$, approach and a correct (but still conservative) definition of outage.

Urban public safety base station transmitters are allowed to use a maximum ERP of 1000 W at an antenna height (HAAT) not exceeding 304 m (47 CFR §90.635c). For this computation, we will assume that the public safety base station is operating at an ERP of 500 W, which corresponds to an EIRP of 840 W or $P_B = 59.1$ dBm, where P_B represents the public safety base station EIRP. We further assume that the base antenna height is 122 m (400 ft), the public safety handheld radio is at a height of 1.5 m, and that the radius of the coverage area is $D_{max} = 16$ km (10 miles, as assumed by Motorola). Using the COST231 propagation model (cf. TIA TSB84A, "Licensed PCS-to-PCS Interference", 1999; COST231 is valid for larger distances than the free-space + clutter model used in the Motorola filing), the propagation loss over a distance of 16 km is $L_P =$ 124.8 dB. The carrier power C received by the public safety handheld is then:

$$C = P_B - L_P + G_A = 59.1\,\text{dBm} - 124.8\,\text{dB} + 0\,\text{dB} = -65.7\,\text{dBm},$$

where we have assumed that the handheld antenna gain G_A is 0 dB.

The noise power (including noise figure) in a single 6.25 kHz channel, as derived in the Motorola filing, is approximately $N = -126$ dBm. The interference level from an interfering 700 MHz commercial base station located 350 meters away is –132 dBm, also as derived in the Motorola filing for the 1 dB noise floor degradation case. Given these parameters, the $(N+I)$ figure is –125 dBm, and the corresponding $C/(N+I)$ figure is:

$$\frac{C}{N+I} = -65.7\,\text{dBm} - (-125\,\text{dBm}) = 59.3\,\text{dB}.$$

Typical digital communications systems work essentially error-free when $C/(N+I)$ equals or exceeds approximately 15 dB. Depending on the type of system, usable $C/(N+I)$ ratios can be as small as 0 dB or even less for spread spectrum systems. Using a conservative value of 15 dB shows that the example $C/(N+I)$ is some 44.3 dB above the required $C/(N+I)$, <u>far from an "outage" condition as asserted by Motorola.</u>

We will now re-compute the size of the coverage hole making a much more reasonable (but still conservative) definition of an outage as being where $C/(N+I) \leq 15$ dB. Using this definition, we want to compute the distance D_{out} at which

$$(N+I) = C - 15\,\text{dB} = -65.7\,\text{dBm} - 15\,\text{dB} = -80.7\,\text{dBm}.$$

Given that $N = -126$ dBm is negligible compared to –80.7 dBm, we can essentially neglect the noise term and simply find the distance at which the interference power I = –80.7 dBm. Following Motorola's analysis of required propagation loss,

$$L_P = -46\,\text{dBm} - (-80.7\,\text{dBm}) = 34.7\,\text{dB},$$

where –46 dBm (–76 dBW) is the noise power allowed in a single 6.25 kHz channel due to out-of-band emissions from the 700 MHz commercial base station, and we have assumed the same antenna gains, cable losses, etc., as used by Motorola. Using the Motorola free-space + clutter propagation loss model (which is valid over short distances), we find the distance to achieve a propagation loss of 34.7 dB, and hence the radius of the coverage hole, is:

$$\begin{aligned} 20\log(D_{out}) &= L_P - 20\log f - 32.45 - L_{clutter} \\ &= 34.7\,\text{dB} - 57.66 - 32.45 - 5 \\ &= -60.4, \end{aligned}$$

which yields a coverage hole radius of

$$D_{out} = 0.1\,\text{cm (sic)},$$

which for all intents and purposes is zero, and no interference will occur to a properly designed public safety system.

Below is Figure 3 from Motorola's Appendix A. This figure shows operation of commercial mobile base stations causing an alarming pattern of holes in the coverage of the public safety radio system. Upon analysis and recognition that the coverage holes are each smaller than an ant, the picture does not cause so much concern.

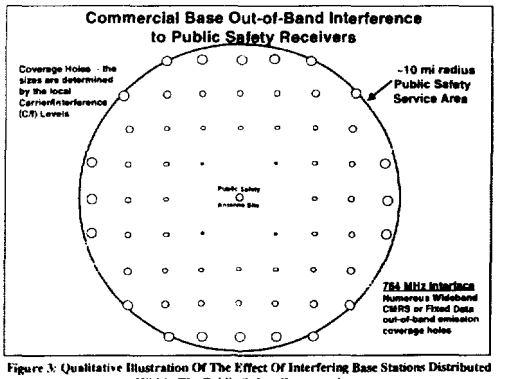

Figure 3: Qualitative Illustration Of The Effect Of Interfering Base Stations Distributed Within The Public Safety Coverage Area

I have reviewed this technical analysis and I declare under penalty of perjury that, to the best of my knowledge, it is true and correct.

/s/

Charles L. Jackson, Ph.D.
September 15, 2000

I am an independent consultant on technology issues. I teach a course on wireless networks at George Washington University. A copy of my biography is available at www.jacksons.net.