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EX PARTE OR LATE FILED

November 8, 1999

BY HAND

Magalie Roman Salas, Secretary  
Federal Communications Commission  
445 Twelfth Street, S.W. - Suite TW-A325  
Washington, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION  
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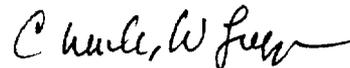
Re: Written *Ex Parte* Communication  
Service Rules for the 746-764 and 776-794 MHz Bands,  
And Revisions to Part 27 of the Commission's Rules  
WT Docket No. 99-168

Dear Ms. Salas:

Transmitted herewith for inclusion in the public record of the above-referenced "permit but disclose" proceeding are two copies of a written *ex parte* letter that was delivered this day to Thomas J. Sugrue, Chief of the Wireless Telecommunications Bureau.

Please direct any questions concerning this filing to the undersigned.

Sincerely,



Charles W. Logan

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November 8, 1999

By Hand

Thomas J. Sugrue, Chief  
Wireless Telecommunications Bureau  
Federal Communications Commission  
445 Twelfth Street, S.W. – Third Floor  
Washington, D.C. 20554

Re: Written *Ex Parte* Communication  
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

Dear Mr. Sugrue:

FreeSpace Communications (FreeSpace) submits this letter to respond to a October 29, 1999 letter filed by Motorola, Inc. in the above-referenced rulemaking proceeding.<sup>1</sup> FreeSpace has proposed that the Commission establish guard bands in the bands adjacent to public safety spectrum that would be subject to power spectral density limits to protect public safety communications from interference. FreeSpace, which has developed an innovative broadband wireless communications systems, has also proposed that *any* interested party be permitted to bid for a license to operate in these guard bands provided it complies with power limits and other technical rules to prevent interference to public safety communications. FreeSpace has opposed Motorola's guard band proposal under which 6 MHz of the 36 MHz of spectrum at issue in this proceeding would be set aside for exclusive private radio use.

In its October 29, 1999 letter, Motorola speculates that the FreeSpace system could possibly cause interference to public safety communications depending on its deployment and type of emission. This speculation is unfounded and incorrect. FreeSpace has been actively working with representatives of the public safety community to inform them of the details of the FreeSpace system. We note that one such party that FreeSpace has contacted, the Association of Public-Safety Communications Officials-

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<sup>1</sup> Letter of Steve B. Sharkey, Motorola, Inc. to Magalie Roman Salas, FCC Secretary, WT Docket No. 99-168 (filed Oct. 29, 1999).

International, Inc (APCO), has recently filed a letter with the Commission that states that the "FreeSpace proposal appears to provide excellent interference protection for public safety."<sup>2</sup>

To provide further details confirming APCO's statement, FreeSpace submits the attached technical description of its how its proposal would provide effective interference protection for public safety communications. FreeSpace is submitting this additional information to APCO as well as Kathleen Wallman, Chair of the National Coordination Committee.

Motorola's October 29, 1999 letter makes a number of other statements regarding the appropriate use of the 36 MHz of spectrum at issue in this proceeding that are worth noting. As noted above, Motorola has proposed that the Commission set aside 6 MHz of this spectrum for exclusive private radio use, with only private radio band managers eligible to bid for the spectrum. In an October 27, 1999 letter to the Commission, FreeSpace urged the Commission to reject this proposal for an exclusive private radio set aside as contrary to section 337(a)(2) the Communications Act, which requires that this spectrum be allocated for "commercial use." Motorola's October 29 letter makes clear that it seeks an exclusive set aside for private radio that directly contradicts the Act.

In particular, Motorola's October 29 letter states that "Motorola disagrees that the spectrum immediately adjacent to public safety is appropriate for commercial use" and "that commercial operations, such as the one proposed by FreeSpace, can be accommodated in bands designated for commercial services." The letter goes on to urge the FCC to license 30 MHz of spectrum in the 746-764 and 776-794 MHz bands for "commercial use" and the remaining 6 MHz of spectrum in these bands for "private uses."

Motorola's proposal flatly contradicts section 337(a)(2) of the Communications Act, as amended. This section states that the Commission "*shall* allocate ... 36 megahertz [of the spectrum in the 746-806 MHz band] for *commercial use* to be assigned by competitive bidding ...." 47 U.S.C. § 337(a)(2) (emphasis added). This section consequently designates the *entire* 36 MHz for "commercial use." The Commission does not have the authority to license any portion of this spectrum for exclusive "private uses," as advocated by Motorola. The Commission must consequently reject Motorola's proposal.

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<sup>2</sup> Letter of Robert M. Guss, Attorneys for APCO, to Magalie Roman Salas, FCC Secretary, WT Docket No. 99-168 (filed Oct. 22, 1999).

Please direct any questions concerning this filing to the undersigned.

Respectfully submitted,



Ruth M. Milkman  
Charles W. Logan

Counsel to FreeSpace Communications

Attachments

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James D. Schlichting  
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## **PROTECTING CURRENT AND FUTURE PUBLIC SAFETY OPERATIONS IN THE 700 MHz BAND: THE FREESPACE PROPOSAL**

Pursuant to Section 337 of the Communications Act,<sup>1</sup> the Federal Communications Commission has reallocated 24 MHz in the 764-776 MHz and 794-806 MHz bands to public safety services. It has also reallocated 36 MHz in the 746-764 MHz and 776-794 MHz bands for commercial use as required by the Act. In the pending *Notice of Proposed Rulemaking* in WT Docket No. 99-168, the Commission is considering proposals regarding licensing rules for these commercial uses.

In devising rules for the commercial services that will operate in the 746-764 and 776-794 MHz bands, the Commission is required by the Act to "establish rules insuring that public safety services licensees [in the 746-806 MHz band] shall not be subject to harmful interference from television broadcast licensees."<sup>2</sup> In addition, the legislative history of these provisions states that the Commission should "ensure that public safety service licensees continue to operate free of interference from any new commercial licensees."<sup>3</sup> A number of public safety parties have emphasized the vital need to carry out the statutory mandate to protect public safety communications from interference, and have suggested the creation of a guard band to do so.<sup>4</sup>

FreeSpace Communications (FreeSpace) has proposed that the Commission establish guard bands adjacent to public safety spectrum that would be subject to stringent power spectral density limits. These limits would provide strong protection against interference to current *and* future adjacent-channel public safety systems. Indeed, the Association of Public-Safety Communications Officials-International, Inc. has recently filed a letter with the FCC that states that the "FreeSpace proposal appears to provide excellent interference protection for public safety."<sup>5</sup>

Under the FreeSpace proposal, the Commission would establish guard bands adjacent to public safety spectrum in the 700 MHz band (*i.e.*, guard bands at 762-764 MHz, 776-778 MHz, and 792-794 MHz). Licensees in these guard bands would be required to comply

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<sup>1</sup> 47 U.S.C. § 337(a).

<sup>2</sup> *Id.* at § 337(d)(4).

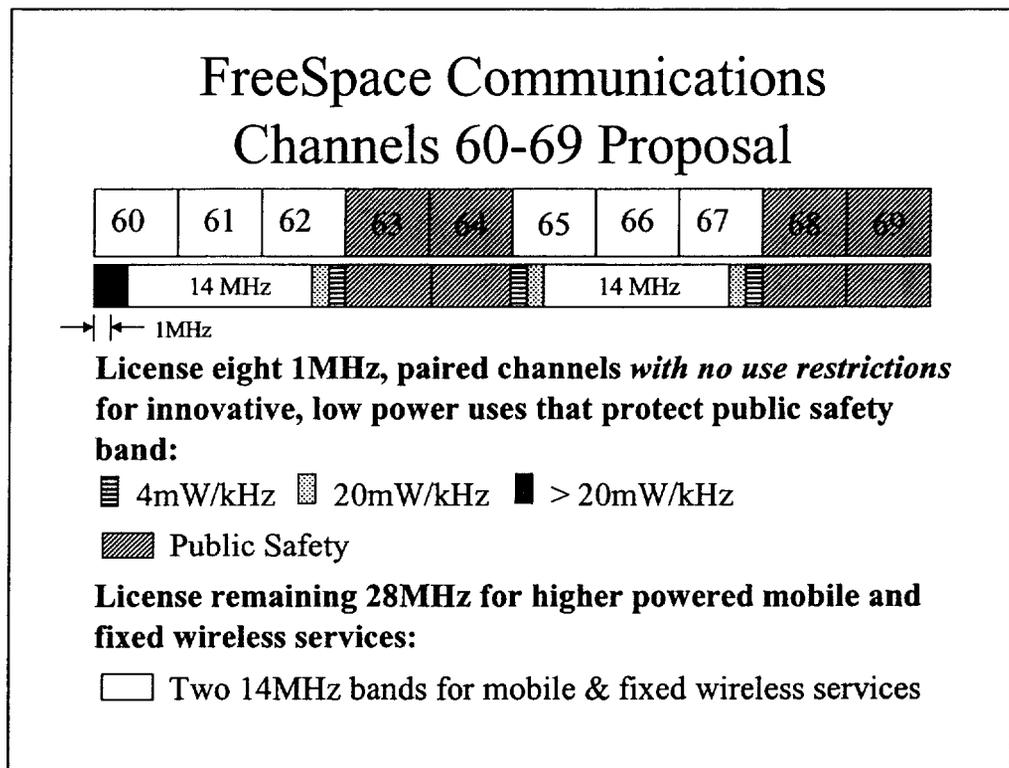
<sup>3</sup> Balanced Budget Act of 1997, Conference Report to Accompany H.R. 2015, 105<sup>th</sup> Cong., 1<sup>st</sup> Sess., Report 105-217, at 580 (July 30, 1997).

<sup>4</sup> Comments of Association of Public-Safety Communications Officials-International at 3. *See also* Letter from Kathleen M. H. Wallman, Chair, National Coordination Committee, to Chairman Kennard, WT Docket No. 99-168 (Aug. 25, 1999).

<sup>5</sup> *See* Letter of Robert Gurs, Wilkes, Artis, Hedrick & Lane, to Magalie Roman Salas, FCC Secretary, WT Docket No. 99-168 (filed Oct. 22, 1999).

with strict power spectral density limits to protect public safety communications.<sup>6</sup> Protection to public safety operations under this plan is due to two factors: the use of the 1MHz bands as guard bands separating public safety operations from high power mobile and fixed services, and the specification of in-band power spectral density emissions limits.

The details of this band plan are depicted below. This letter describes in technical detail how FreeSpace will provide superior protection to public safety operations under the proposed plan.



#### Guard Bands Protect Public Safety from Nearby High Power Services

The first and most fundamental way that the proposed band plan protects public safety operations is by establishing guard bands between the public safety bands and high power mobile and fixed services. As argued by Motorola and other parties to this proceeding, there is potential for interference between high power services such as traditional CMRS systems and public safety systems. A primary source of interference is out-of-band emissions from the base stations of high power services. Motorola has estimated that a

<sup>6</sup> See Letter of Ruth Milkman, Lawler, Metzger & Milkman, to Thomas J. Sugrue, Chief, Wireless Telecommunications Bureau, at 2-6 (filed Oct. 13, 1999 in WT Docket No. 99-168).

minimum of 1.5MHz should be allocated to provide separation between high power services and public safety bands so that the high power licensee's out-of-band emissions from the channel nearest the public safety band can be sufficiently attenuated. The FreeSpace plan would exceed this proposal by specifying a 2MHz separation, thereby providing a greater degree of protection to prevent interference to public safety communications.

### Power Spectral Density Limits Establish a Bound on Interference Power

With the proper set of restrictions, it is possible to make use of the guard band spectrum for wireless services. However, it is essential when doing so to establish rules that maintain protection to the adjacent public safety bands. There are a number of modes by which interference can arise. Two of the dominant modes are blocking and spurious emissions.

“Blocking” occurs when a strong out-of-band interfering signal that lies too close in frequency to a weak desired signal desensitizes a receiver, thereby preventing the reception of an otherwise acceptable signal. The ability of a receiver to reject these blocking signals typically improves with frequency separation. It is particularly difficult and costly to implement receivers that are selective enough to reject strong blockers in immediately adjacent spectrum. Thus, in the interest of providing maximum protection to public safety units, the FreeSpace band plan would specify stringent limits on transmit power in the bands adjacent to the public safety bands. Specifically, FreeSpace’s proposal calls for a power spectral density limit of 4mW/kHz in the 1MHz bands directly adjacent to the public safety bands, and a power spectral density limit of 20mW/kHz in the 1MHz bands that are “second adjacent” to the public safety bands (*i.e.*, the 1MHz bands that are adjacent to the 1MHz bands subject to the 4mW/kHz limit). The use of power spectral density limits rather than peak power limits specifically would prohibit any use of the band that would concentrate power into a narrow bandwidth and present a blocking hazard to public safety operations. The proposed limit would only permit a maximum of 4W (36dBm) in the immediately adjacent 1MHz bands if the entire 1MHz band were used for a single channel. If multiple, narrower channels are used, then the aggregate power across *all* such channels may not exceed 4W. This clear restriction to low-power usage provides strong, effective protection to adjacent public safety bands. Additional protection is achieved by limiting the power spectral density in the “second adjacent” 1MHz bands to 20mW/kHz (43dBm).

The second mode of interference is caused by out-of-band spurious emissions, especially those due to broadband transmitter noise and nonlinearities. A limit on in-band power, such as proposed by FreeSpace, is effective in limiting these emissions, because their power depends directly on the carrier power. The Commission has proposed that out-of-band spurious emissions be attenuated by  $43+10\log_{10}(P)$  dB, where P is the transmitter power in watts, or 80dB, whichever is less. Two public safety parties -- the International Association of Fire Chiefs, Inc. (IAFC) and the International Municipal Signal Association (IMSA) -- have filed comments with the FCC expressing the concern “that if the interfering transmitter exceeds 1000W of power or the power of the public safety

mobile radio system's base station is less than 1,000 watts, the proposed standard would be insufficient to protect the mobile radio receiver."<sup>7</sup> To address this concern, IAFC/IMCA recommend "that the out-of-band emissions limitation should be  $43+10\log_{10}(P, \text{ in watts})$  decibels transmitter power attenuation *or* -13 dBm maximum output power, whichever represents the lower out-of-band power, for any emission or all frequencies outside the licensee's authorized spectrum."<sup>8</sup>

FreeSpace agrees with the concern expressed by these parties and with their recommendation. FreeSpace's proposed guard band plan would eliminate the high power uses in the spectrum adjacent to the public safety bands. In fact, the maximum transmit power in the adjacent guard band under the proposed power spectral density limit is more than two orders of magnitude smaller than a transmitter operating at 1000 watts. With these power spectral density limits, an attenuation of, at most, 49dB would be required for any radio licensed to operate in the 1MHz guard bands adjacent to public safety bands. This level of attenuation is readily achievable and current emissions masks often exceed it. For these reasons, FreeSpace is confident that its system can exceed the proposed FCC emissions requirements, and would support a more stringent requirement on out-of-band emissions such as that proposed by IAFC/IMSA. In addition, as explained in the next section, the fact that the FreeSpace system will be using low antenna heights will provide even greater interference protection that far exceeds the FCC's proposed standard.

In addition to meeting concrete power spectral density limits and spurious emissions limits, FreeSpace technology incorporates active power control mechanisms that cause each unit to operate on the minimum transmit power required at any given time. This further reduces the potential for interference into other systems, and FreeSpace would support a requirement that units operating in the guard bands adjacent to public safety operations incorporate active power control. Public safety units themselves are already required, under amended Part 94 rules, to incorporate power control to reduce interference problems. Such a requirement on systems operating in adjacent bands would provide similar benefits.

### Low Antenna Heights Provide Even Greater Protection

The systems that most naturally meet FreeSpace's proposed power limits in the guard bands address short range, low antenna height applications. Not only does a short range system reduce the potential for interference, but the use of low antenna heights brings the transmitters into more obstructed environments where propagation effects attenuate radiated signals more rapidly with distance. Mathematically, signal power is attenuated in

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<sup>7</sup> Comments of International Association of Fire Chiefs, Inc. and International Municipal Signal Association at 2, WT Docket No. 99-168 (filed July 19, 1999).

<sup>8</sup> *Id.* at 2-3 (emphasis in original).

proportion to the fourth power of distance in such environments.<sup>9</sup> This situation is typically referred to as a “fourth-law roll-off” to distinguish it from unobstructed propagation where signal powers fall off only with the square of distance.

A simple example illustrates how a fourth-law roll-off aids isolation and results in even greater interference protection. Assuming a maximum transmit power of 4W (36dBm) and using the proposed out-of-band emissions requirement that specifies attenuation of all out-of-band emissions by  $43+10\log_{10}(P)$ , where P is in watts, yields a required attenuation of 49dB. FreeSpace reiterates that this requirement could be improved to provide attenuation beyond 49dB, but as we will show, even with 49dB of attenuation adequate protection to public safety operations can be ensured. By meeting the 49dB attenuation requirement, the out-of-band power in a 1MHz bandwidth would be less than -13dBm, or -73dBm/Hz.<sup>10</sup> Considering the fourth-law propagation environment separating a FreeSpace site from a public safety site, we can determine the approximate distance at which the interference falls below noticeable levels. An empirical expression relating distance to the attenuation between two dipole antennas that is based on field measurements is,

$$L = -26 + 45 \log(d) - 40 \log(\lambda),$$

where  $d$  is the distance between transmitter and receiver in meters,  $\lambda$  is the wavelength of the carrier frequency in meters, and  $L$  is the isolation or path loss in dB.<sup>11</sup> Based on this formula, a path loss of 91dB occurs for a distance of only 170m at 775MHz. With 91dB of path loss, the out-of-band emissions would have a power spectral density of less than -164dBm/Hz, *which is only 10dB above the background thermal noise floor.*

The majority of FreeSpace sites will typically be located at distances much greater than 170m, which will result in even more path loss, thus providing complete protection against harmful out-of-band emissions. FreeSpace would support a requirement that users of the low power guard bands immediately adjacent to public safety bands locate their base stations designated distances from public safety sites in order to achieve the necessary path loss and provide additional protection against interference from out-of-band emissions. Public safety communications would thus benefit from even greater protection than that provided by the FCC's proposed  $43+10\log_{10}(P)$  dB attenuation requirement.

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<sup>9</sup> D.M.J. Devasirvatham, et al, “Four-Frequency CW Measurements in Residential Environments for Personal Communications,” IEEE International Conference on Universal Personal Communications, San Diego, CA 1994, pp. 140-143.

<sup>10</sup> 47 CFR § 27.53(a)(4).

<sup>11</sup> D.M.J. Devasirvatham, et al, “Four-Frequency CW Measurements in Residential Environments for Personal Communications,” IEEE International Conference on Universal Personal Communications, San Diego, CA 1994, pp. 140-143.

Furthermore, internetworked systems, such as the FreeSpace system, could be designed to automatically avoid situations that may lead to interference. For example, by making a database of public safety site locations available over the network, those units that find themselves positioned too close to a public safety site could automatically switch channels or shut down to avoid interference. This would require a unit to know its own position, which could easily be accomplished through the use of an embedded Global Positioning System (GPS) receiver, or by having a technician log the location of the unit in a network database upon installation. Future public safety systems could then be accommodated by simply updating the public safety database to include new installations. This is one example of how modern technologies might be applied to further improve the protection of public safety systems.

### TDMA Technology Prevents the Accumulation of Power from Multiple Units

An additional benefit of the FreeSpace system arises through the use of TDMA technology. In TDMA systems, the radio channels are time-shared between different units. When combined with specific limits on transmit power spectral densities, the use of TDMA techniques guarantees that the *aggregate* power of units operating in the same vicinity will never exceed the limit for a single radio. It follows that the total transmit power present in each 1MHz guard band adjacent to a public safety band will never exceed 4W, *regardless of how many units may be operating in close proximity*. To further the goal of protecting public safety operations from harmful interference, FreeSpace Communications would support a restriction specifying the use of TDMA or other technologies that achieve this effect in the guard bands adjacent to public safety bands.

### Nationwide Licenses Simplify Coordination and Resolution of Interference Issues

As set forth above, FreeSpace's proposed low power guard band would provide robust interference protection for public safety services. In the event a public safety operator nonetheless has a concern about the potential for interference, it will be important for licensees in this guard band to coordinate with public safety officials to expediently resolve these concerns as they arise. To this end, FreeSpace believes that the issuing of nationwide licenses simplifies coordination and resolution of interference problems by making a single party responsible for operations in each guard band. Should interference arise, the affected public safety organization would know immediately who to contact to resolve the problem. As a licensee of the spectrum in the guard band, FreeSpace, which will have complete information about the location of all the base stations and customer units that make up its wireless network, would be committed to working cooperatively and quickly to resolve interference concerns raised by public safety licensees.

In sum, FreeSpace's guard band proposal would provide clear, effective interference protection for current and future public safety operations and provide a means for the Commission to carry out its statutory mandate to protect these operations.