

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

In the Matter of

**Establishment of Policies and Service
Rules for the Mobile Satellite Service
in the 2 GHz Band**

**IB Docket No. 99-81
RM-9328**

**SUPPLEMENTAL COMMENTS OF
THE BOEING COMPANY**

The Boeing Company (“Boeing”), by its attorneys and pursuant to Section 1.415 of the Commission’s rules, 47 C.F.R. § 1.415, hereby provides supplemental comments on the hybrid methodology proposed by the Federal Communications Commission (“FCC” or “Commission”) to assign spectrum among Mobile-Satellite Service (“MSS”) licensees in the 1990-2025 and 2165-2200 MHz frequency bands (“2 GHz MSS band”).¹

I. INTRODUCTION

Boeing supports the Commission’s objective of establishing a flexible spectrum assignment policy that allows the dictates of the market—rather than of regulation—to determine the technical designs of 2 GHz MSS systems. The hybrid methodology proposed in the *Public Notice* appears consistent with this objective. In order to realize the full potential of the 2 GHz MSS band, the Commission’s methodology should also promote the efficient use of spectrum

¹ See *International Bureau Requests Further Comment on Selected Issues Regarding Authorization of 2 GHz MSS Systems*, Public Notice, DA 00-22 (Feb. 7, 2000) (“*Public Notice*”).

resources and should take into account the global environment in which most 2 GHz MSS licensees expect to operate.

Therefore, Boeing urges minor modification of the proposed hybrid assignment methodology to divide cleared spectrum between CDMA and TDMA/FDMA systems² and to keep the Commission's assignment policy as harmonious as possible with international allocations of the 2 GHz MSS band.

II. IN ORDER TO PROMOTE SPECTRUM EFFICIENCY, THE COMMISSION SHOULD DIVIDE CLEARED 2 GHz MSS SPECTRUM BETWEEN CDMA AND TDMA/FDMA SYSTEMS

The division of cleared spectrum between CDMA and TDMA/FDMA systems would greatly enhance spectrum efficiency in the 2 GHz MSS band. Because CDMA systems operating in adjacent frequency bands can coordinate sharing of sidelobe spectrum, it is spectrally efficient to assign CDMA systems to "home" bands that are adjacent to those of other CDMA systems. Such efficiency is lost, however, if TDMA or FDMA systems operate in home bands that are adjacent to or interspersed among CDMA systems. TDMA/FDMA systems cannot share sidelobe spectrum with CDMA systems and require much larger guard bands against interference. Accordingly, the Commission should promote spectrum efficiency by dividing cleared spectrum into separate zones of assignment for CDMA and TDMA/FDMA systems.

² Code Division Multiple Access ("CDMA") is a transmission technique in which the signal occupies a bandwidth larger than that needed to contain the information being transmitted. *See Establishment of Policies and Service Rules for the Mobile Satellite Service in the 2 GHz Band*, Notice of Proposed Rulemaking, 14 FCC Rcd 4843, 4850 n.29 (1999). Time Division Multiple Access ("TDMA") is a transmission technique in which users of the same frequency band are provided alternating time slots for their transmissions in the system. *See id.* at n.30. Frequency Division Multiple Access ("FDMA") is a transmission technique in which frequencies are assigned to particular end users.

CDMA technology possesses technical characteristics that are well suited to promoting efficient spectrum use. A standard IS-95 type of CDMA signal has a channel spacing of 1.25 MHz.³ The operation of three channels would require 4.0 MHz at the first spectral null, plus small guard bands for Doppler effects, as shown below in Figure 1.

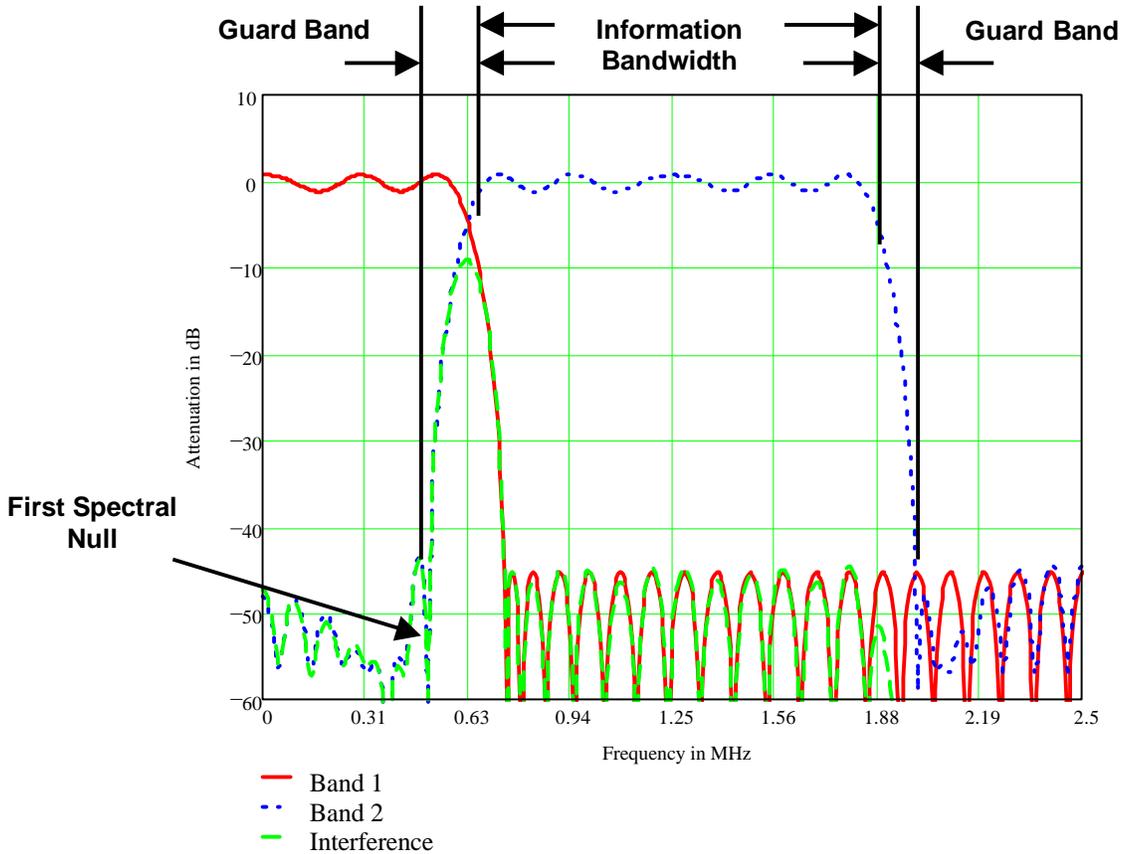


Figure 1. IS-95 Spectra.

However, if a CDMA system operates in a home band that is adjacent to another CDMA system, then both systems likely would be able to coordinate the sharing of the spectral sidelobe bands. Adjacent CDMA systems would only require small guard bands to account for Doppler

³ Boeing proposes to use an IS-95 CDMA signal as part of its system design. See *Application for Authority to Construct, Launch, and Operate a Non-Geosynchronous Medium Earth Orbit Satellite System in the 2 GHz Band Mobile-Satellite Service and in the Aeronautical Radionavigation-Satellite Service*, File Nos. 179-SAT-P/L/97(16), SAT-AMD-19980318-00021 (90-SAT-AMEND-98) (Sep. 26, 1997) (Attachment 1).

shifts relative to the two systems. This greatly reduces the amount of spectrum wasted in providing interference protection. It would then be possible to support three 1.25 MHz channels within the 3.888 MHz of uplink and downlink spectrum that the Commission is expected to grant to each 2 GHz MSS licensee.⁴

By contrast, if a TDMA or FDMA system operates in home bands adjacent to a CDMA system, then sharing of the spectral sidelobes is not possible, and large guard bands are necessary between the systems. This would reduce traffic capacity, and the affected CDMA system would be able to offer only two 1.25 MHz channels in order to protect against interference. This decrease of available channels would reduce by a third the amount of traffic capacity that CDMA systems will be able to offer. Because the cost of service is inversely related to amount of traffic carried, such a decrease in capacity will increase the cost of service to the public.

Although the proposed hybrid methodology does not account for this loss of spectrum efficiency, it could be easily modified to do so. Instead of assigning home spectrum solely on a first-come, first-served basis anywhere in the cleared 2 GHz MSS band—heedless of any loss of spectrum efficiency—the Commission should establish an initial dividing line down the middle of the cleared spectrum and group similar systems together on either side of the dividing line.⁵ For example, if the Commission adopts a terrestrial relocation policy that initially clears only

⁴ The Commission has allocated a total of 35 MHz of spectrum for the development of non-geostationary orbit MSS systems (“NGSO MSS”) in each of the uplink and downlink frequency bands. *See Amendment of Section 2.106 of the Commission’s Rules to Allocate Spectrum at 2 GHz for Use by the Mobile-Satellite Service*, First Report and Order and Further Notice of Proposed Rulemaking, 12 FCC Rcd 7388, 7395 (1997). At this time, up to nine licensees seek use of this spectrum for their systems. An even division of the 35 MHz in each of the uplink and downlink bands by the number of proposed systems results in 3.888 MHz per system.

⁵ This initial dividing line may need to be redrawn in the future in the unlikely event that a disproportionate number of licensees elect a particular system of multiple access, or if more than five systems are implemented, which would necessitate the clearing out of BAS channel 2 from the 2008-2025 MHz uplink band. In such a situation, some licensees may have to adjust their home spectrum assignments. Any reassignments would be done on a first-launched, first-served basis, with early entrants having priority in selection of home spectrum, regardless of the home spectrum selections of later entrants.

Broadcast Auxiliary Service (“BAS”) channel 1 (1990-2008 MHz) in the uplink direction, then the Commission should establish 1999 MHz as the initial dividing line. CDMA applicants would be free to select a home band to the left of the dividing line (i.e., 1990-1999 MHz), and TDMA/FDMA applicants may select a home band anywhere to the right of the line (i.e., 1999-2008 MHz). In the downlink band, the initial dividing line would be at 2185 MHz (after separating out the 2165-2170 MHz band for use by regional geostationary orbit (“GSO”) systems).⁶ Such a policy would encourage the collocation of systems that are able to share spectrum and would promote spectrum efficiency by maximizing the amount of frequencies available for communications services. Figures 2.1 and 2.2 provide graphical illustrations of Boeing’s proposal.

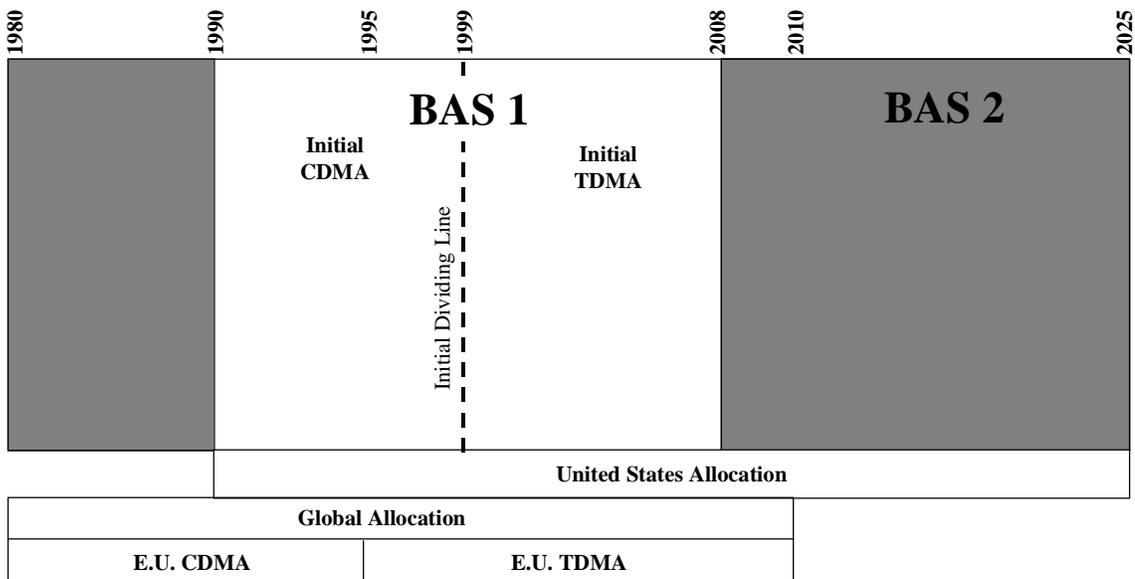


Figure 2.1. Proposed 2 GHz Uplink Band Plan

⁶ For further discussion of the need to separate 2 GHz spectrum for use by regional GSO systems, see Part III, *infra*.

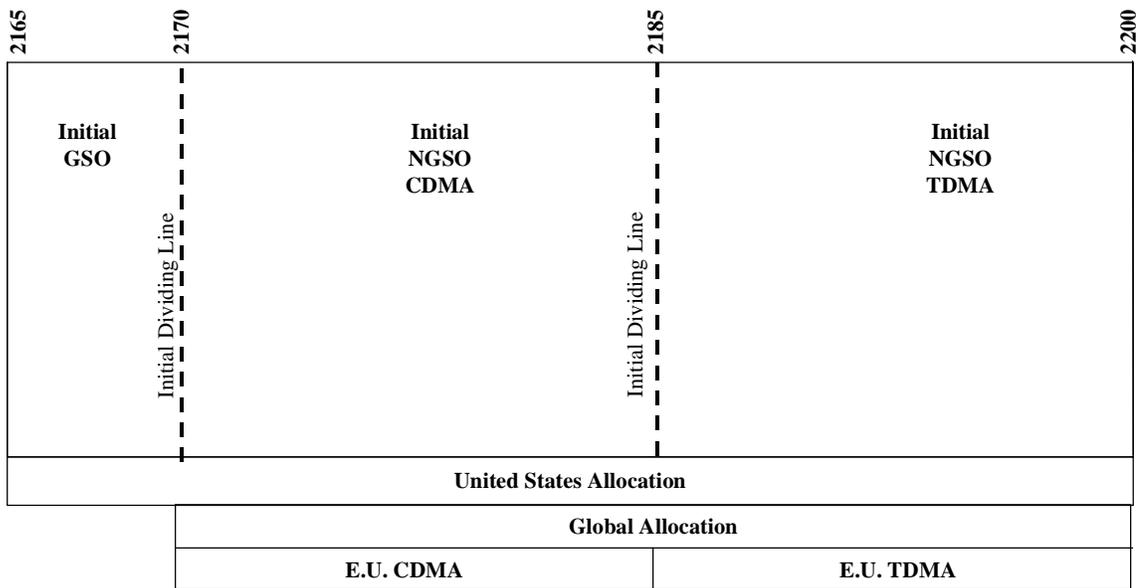


Figure 2.2. Proposed 2 GHz Downlink Band Plan

The division proposed by Boeing is entirely feasible. The European Union (“E.U.”) already recognizes a division of spectrum for CDMA and TDMA systems as part of its frequency assignment policy, as shown above in Figures 2.1 and 2.2.⁷ Assigning CDMA systems spectrum to the left of the initial dividing line, and TDMA systems spectrum to the right of the line, parallels the general division made by the E.U. and would facilitate the implementation of global MSS systems.

Under Boeing’s proposal, licensees retain flexibility in selecting their system design. Although each licensee would have to disclose its multiple access system as part of its home frequencies selection, this should not present a problem because a licensee’s home spectrum assignment would not be made until after the licensee’s first satellite is launched, by which time

⁷ See European Radiocommunications Committee Decision of 30 June 1997 on the Harmonized Use of Spectrum for Satellite Personal Communications Services (S-PCS) operating within the bands 1610-1626.5 MHz, 2483.5-2500 MHz, 1980-2010 MHz and 2170-2200 MHz (ERC/DEC/(97)03).

a choice between CDMA or TDMA/FDMA must already be made.⁸ Thus, prospective 2 GHz MSS licensees would not suffer any additional burden on the selection of their system designs.

Boeing's proposal also does not affect the ability of a licensee to operate outside of its home band assignment, as proposed by the Commission in the *Public Notice*. Furthermore, the incentive of licensees to expedite the implementation of their systems would not diminish under the proposal, because the ability of a licensee to obtain its preferred home frequency assignment still depends on the expeditious launch of its system into orbit.

III. THE COMMISSION SHOULD SEEK TO HARMONIZE ITS ASSIGNMENT POLICY WITH INTERNATIONAL ALLOCATIONS IN THE 2 GHz MSS BAND

Many of the 2 GHz MSS licensees desire to provide service to the public on a global basis. Although the frequency bands allocated to MSS in the United States do not exactly match the allocations made to MSS internationally, there is sufficient overlap between domestic and international allocations to allow 2 GHz MSS licensees to provide service in the United States on the same frequencies that they are assigned internationally. The ability to offer service around the world on the same set of frequencies facilitates both economies of scale and convenience of service that greatly increase the potential of 2 GHz MSS licensees to provide new and innovative services to the public. The Commission should make the most of this potential by assigning home frequencies to global systems in those parts of the 2 GHz MSS band that are also allocated internationally to MSS.

There is sufficient overlap between domestic and international allocations of MSS spectrum to harmonize the frequency assignments of MSS in the United States with those in

⁸ In addition, Section 25.114 of the Commission's rules requires the provision of a detailed frequency plan as part of a space station application, as well as details of the modulation and link performance, which cannot be provided without first selecting a system for a multiple access. See 47 C.F.R. § 25.114(6) & (8) (1998).

other parts of the world. As demonstrated by Figure 3, frequencies are available in the 2 GHz uplink band at 1990-2010 MHz for the global provision of MSS. Likewise, frequencies are available in the downlink band at 2170-2200 MHz for the provision of MSS both domestically and internationally.

	International table of allocations	US table of allocations
Uplink	1980 to 2010	1990 to 2025
Downlink	2170 to 2200	2165 to 2200

Figure 3. International vs. Domestic Frequency Allocations

In the 2 GHz downlink band, regional MSS systems should be initially assigned spectrum in the 2165-2170 MHz band, which is allocated for MSS in the United States, but not internationally. This assignment will leave spectrum in the 2170-2200 MHz band available primarily for those systems that plan to operate on a global basis. Boeing acknowledges, however, that the 2170-2200 MHz band should be available to regional systems to the extent that the number of regional systems launched exceeds the capacity of the 2165-2170 MHz band.

In the uplink band, Boeing understands that the Commission may decide against clearing out BAS channel 2 at this time. This would mean that only the 1990-2008 MHz band would be initially available for global provision of MSS in the 2 GHz uplink band. Although the entire 18 MHz of the 1990-2008 MHz band is allocated globally to MSS, Boeing believes that the Commission should state publicly that it intends eventually to relocate regional MSS systems to regional spectrum (i.e., 2010-2025 MHz) if and when the spectrum is cleared.

As noted above, efficiency is enhanced if the Commission assigns spectrum that has been allocated to MSS internationally to licensees that propose global systems. By contrast, the

Commission should initially assign spectrum that has been allocated to MSS only domestically to licensees that propose purely regional systems. Such action by the Commission would encourage other countries to follow its example, thereby increasing the amount of common spectrum available internationally for the implementation of global 2 GHz MSS systems.

IV. CONCLUSION

The Commission has the opportunity to realize the full potential of 2 GHz MSS systems through a spectrum assignment policy that combines market-based flexibility with spectrum efficiency, and that is as consistent as possible with international MSS allocations. Boeing urges the Commission to take advantage of this opportunity by implementing an assignment policy that does not needlessly waste spectrum by placing incompatible systems adjacent to one another and that promotes the global provision of MSS services through harmonization with international allocations of the 2 GHz MSS band.

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