Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, Including Third Generation Wireless Systems	)	ET Docket No. 00-258
	)	
Amendments to Parts 1, 2, 27 and 90 of the Commission's Rules to License Services in the 216-220 MHz, 1390-1395 MHz, 1427-1429 MHz, 1429-1432 MHz, 1432-1435 MHz, 1670-1675 MHz, and 2385-2390 MHz Government Transfer Bands	)	WT Docket No. 02-8

To: The Commission

COMMENTS OF CINGULAR WIRELESS LLC

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To: The Commission

COMMENTS

Cingular Wireless LLC ("Cingular") hereby submits its Comments in response to the *Fourth Notice of Proposed Rulemaking*, FCC 03-134 (July 7, 2003) (*NPRM*), *summarized*, 68 Fed. Reg. 52156 (Sept. 2, 2003). Cingular supports the Commission's proposal to work in coordination with the National Telecommunications & Information Administration ("NTIA") in order to migrate federal government operations out of the 1710-1850 MHz band as a prerequisite to using the 1710-1755 MHz segment for third-generation ("3G") mobile services, also known as Advanced Wireless Services ("AWS").

DISCUSSION

I. PREREQUISITES MUST BE MET BEFORE ANY AWS AUCTION

The *NPRM* proposes, as part of the groundwork for government migration, to modify footnote US346 of the U.S. table of allocations, 47 C.F.R. § 2.106. This would allow the Department of Defense ("DoD") to use the 2025-2110 MHz band on a co-primary basis, as

recommended in the July 2002 NTIA *Viability Report*.[1] This migration is only one hurdle that must be cleared prior to conducting an auction of AWS spectrum. Additional prerequisites include:

- Conclusion of a rulemaking to relocate multipoint distribution service ("MDS") licensees from the 2150-2155 MHz band and rules in place to effectuate such relocation. This rulemaking also should include clearing the 2155-2180 MHz band to be used for an asymmetric allocation or as a reserve frequency for future use, as Cingular has previously pointed out.[2]

- Conclusion of a rulemaking for the purpose of minimizing interference to commercial operations from use of the 2110-2120 MHz band at the NASA Goldstone facility and from use of the 1710-1755 MHz band at ground stations located at Cherry Point, NC, and Yuma, AZ.

- Conclusion of a rulemaking setting forth the auction rules and procedures, *e.g.*, bidding rules, designated entity eligibility, if any.

In addition, Congress will have to pass legislation to establish a trust fund that will facilitate the use of auction proceeds to pay the cost of relocating government operations.[3]

The establishment of the trust fund, related spectrum-clearing rulemakings, and auction rules will have to be completed in a timely manner in order to permit the federal government operations to be relocated by December 2008[4]. It is important that the auction not be held until these prerequisites, including the government relocation, are met or rules are in place for them to be met in a timely manner. If the auction is held well in advance of the time the spectrum is to be cleared, or at a time when there remains any uncertainty as to when or whether it will be

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1 NTIA, *An Assessment of the Viability of Accommodating Advanced Mobile Wireless (3G) Systems in the 1710-1770 MHz and 2110-2170 MHz Bands* (July 22, 2002) (*Viability Report*), *available at* <http://www.ntia.doc.gov/ntiahome/threeg/va7222002/3Gva072202web.htm>.

2 *See* Comments of Cingular Wireless LLC in response to *Third Notice of Proposed Rulemaking*, ET Docket 00-258 *et al.*, at 6, 9-10 (April 14, 2003).

3 Cingular agrees with the Commission's proposal to clear aeronautical mobile service from 1710-1755 MHz. There does not seem to be any significant problem with allocating 2360-2395 MHz for this purpose.

4 Federal users of the 1710-1755 MHz band will have to relocate or modify their operations not later than December 2008, in accordance with the NTIA *Viability Report.*

cleared, bidders will be deterred from bidding the full value of the spectrum.[5] Bidders will place more value on the spectrum when they know that they will be able to use the spectrum without delay, to recoup its cost.

II. CO-PRIMARY GOVERNMENT USE OF 2025-2110 MHz

Cingular agrees with the proposal to permit DoD to use 2025-2110 MHz for earth stations that support military space operations (known as "tracking, telemetry, and commanding" or "TT&C") on a co-primary basis with non-government users. *See NPRM* at ¶¶ 1, 26-39. Nevertheless, as the *NPRM* points out, there is a need for carefully-established limits on such government usage, because high-power government operations have the potential to disrupt non-government operations in nearby frequency bands. *See id.* at ¶¶ 34-37. As noted by the FCC, the main impact to wireless mobile systems will be in the bands that are directly adjacent, and in close proximity, to the 2025-2110 MHz band. *See id.*

Cingular is concerned about out-of-band emissions ("OOBE") and receiver overload affecting commercial mobile radio service ("CMRS") operations in the adjacent 2110-2155 MHz AWS band and the nearby 1930-1990 MHz broadband personal communications service ("PCS") band, as well as the PCS "G Block," which has been proposed for 1910-1915/1990-

[5] The Commission was made aware of this fact in connection with the 700 MHz spectrum, which will not be cleared for several years, if at all. The Administrator of NTIA explained that "if you auction spectrum too far away from the time that the bidders will actually get access to it, you have two problems. One is that the bidders don't really know how to value the spectrum. But even more importantly from the spectrum management standpoint, you have no assurance that the people who will actually need and be in the best position to use the spectrum at the time it becomes available will actually be participating in the auction." Interview with Nancy Victory, Administrator of NTIA, published in The Hill (May 22, 2002); *see also* Letter from Thomas E. Wheeler, President, CTIA, to Michael K. Powell, Chairman, FCC (April 3, 2002) at 2 ("Without a reasonable understanding of when the band could be made available for commercial service, it is exceptionally difficult for industry to make rational business decisions as to whether even to participate in an auction.").

1995 MHz.[6] The following chart illustrates the proximity of these bands to the government relocation band:

Table 1. Potential CMRS victims of interference and proximity to the 2025-2110 MHz band.

Frequency Range	Service	Uplink/Downlink
2110-2155 MHz	AWS	Mobile Station Rx
2025-2110 MHz	Relocated DoD Operations	Ground Station Tx
• • •		
1990-1995 MHz	PCS G-Block (proposed)	Mobile Station Rx
1930-1990 MHz	PCS	Mobile Station Rx
• • •		
1910-1915 MHz	PCS G-Block (proposed)	Base Station Rx
1850-1910 MHz	PCS	Base Station Rx
• • •		
1710-1755 MHz	AWS	Base Station Rx

A. Impact of 2025-2110 MHz DoD Operations on CMRS

The DoD systems in the 2025-2110 MHz band could impact CMRS services through OOBE that fall directly into a CMRS band and also through receiver overload, or blocking. The CMRS services that are closest to the 2025-2110 MHz band would suffer the greatest impact from any interference. Thus, the following analysis will concentrate on the AWS 2110-2155 MHz band and the PCS 1930-1995 MHz band (including the proposed G Block), which are (or will be) used in the mobile-receive (base station transmit) mode of operation.[7]

According to the *NPRM,* the TT&C earth stations will not transmit unless their antenna's main beam is 3º above the horizon, with additional limitations on equivalent isotropic radiated

[6] *See Advanced Wireless Services,* ET Docket 00-258, *Third Report and Order, Third Notice of Proposed Rulemaking, and Second Memorandum Opinion and Order,* FCC 03-16, ¶¶ 47-53 (2002). It is also likely that the proposed DoD systems could impact the Mobile Satellite Service ("MSS") and MSS Ancillary Terrestrial Component ("ATC") allocations in the 2000-2025 and 2180-2200 MHz bands, *see id.* at ¶ 28.

[7] Theoretically, DoD systems could interfere with the other bands listed above, because the base-receive bands would have higher antenna gain at the cell site. This is a less likely outcome than interference to the mobile-receive bands, however, because in the latter bands there will be a much larger number of receivers at uncontrolled mobile locations.

power ("EIRP") adopted from ITU regulations. *See NPRM* at ¶ 32. The specifics of the TT&C antenna patterns and power levels are not disclosed, but the general EIRP limit specified is 40 dBW / 4 kHz for any transmission towards the horizon (although there seems to be no limit if the main beam of the antenna is greater than 5°). *See id.* at ¶ 32 n.91. Also, the limit given may not be exceeded by more than 10 dB, so it is possible that an EIRP of 50 dBW / 4 kHz is actually the maximum limit.

The Commission must clarify these points so that the true characteristics of the TT&C earth stations and the definition of the maximum power and EIRP are known.

B. Out-of-Band Emission Limits

The specific rules for OOBE from Federal earth stations are given in paragraph 35 of the *NPRM*. According to the information provided, the TT&C uplink channels are 4 MHz wide and the signal levels are typically reduced by 20-25 dB at the channel edge (2 MHz from the center frequency).[8] In this case, the EIRP level at the edge of the band (*e.g.*, 2110 MHz) could be as high as 100 W in a 4 kHz bandwidth (calculated as 40 dBW – 20 dB = 20 dBW). If a UMTS channel (3.84 MHz bandwidth) is directly adjacent to 2110 MHz (*e.g.*, its center frequency = 2112.5 MHz), the total power in the UMTS channel bandwidth would be 50 dBW / 3.84 MHz (equivalent to 80 dBm / 3.84 MHz).

[8] The *NPRM* does not indicate whether this takes into account the gain of the antenna pattern in the vertical plane below the horizon (as would be appropriate for determining OOBE at mobile receivers) at frequencies outside the government station's transmit band. For purposes of this analysis, Cingular has assumed that the antenna gain has been accounted for. If this is not the case, the effect of OOBE could be greater. The Commission should clarify this important factor.

Assuming a UMTS mobile receiver with a noise figure of 8 dB, the mobile receiver has an effective noise floor of –100 dBm / 3.84 MHz.[9] Accordingly, it would experience a 1 dB increase in noise+interference with a received interference level of –106 dBm / 3.84 MHz.[10] With a transmit EIRP of 80 dBm / 3.84 MHz, as given above, and a receive antenna gain at the mobile of 0 dBi, the required propagation loss in this case is 80 dBm – (-106 dBm) = 186 dB. Assuming free-space propagation conditions, this is equivalent to a required protection distance of approximately 22,500 km. However, using a simple two-slope propagation model with a loss exponent of 3.5 yields a protection distance of approximately 200 km.[11]

Based on the assumptions above, a TT&C earth station operating at the upper edge of the 2025-2110 MHz band could adversely affect[12] a UMTS mobile 200 km away operating at the lower edge of the 2110-2155 MHz band. Without additional details on the TT&C operating parameters it is difficult to evaluate this scenario in greater detail. However, given that several of the 11 TT&C locations are in close proximity to large metropolitan areas, it is clear that a

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[9] The noise floor is calculated from N = KTB + NF, where K is Boltzman's constant $1.38*10^{-23}$ J/K, T is 290K, B is 3.84 MHz, and NF is the noise figure of the receiver.

[10] An interference to noise ratio (I/N) of –6 dB will result in an effective 1 dB "noise-rise." In the case that the noise floor is –100 dBm, this will occur at an interference level of -106 dBm.

[11] *See, e.g.*, K. Feher, WIRELESS DIGITAL COMMUNICATIONS 73 (Prentice Hall, 1995). In the two-slope model, path loss is defined to be equal to free-space loss (*i.e.*, exponent = 2) up to a breakpoint. For distances greater than the breakpoint, the path loss exponent is increased to a value between 2.0 and 5.0. The breakpoint distance is given by $(4*H_b*H_m)/?$ where H_b is the base station antenna height, H_m is the antenna height, and ? is the wavelength. Note that this calculation is made using an assumed TT&C antenna height of 10m, a mobile antenna height of 1.5m, and mobile antenna gain of 0dBi. As the antenna heights and other parameters are changed, the required protection distance would increase or decrease accordingly. Similarly, the path loss exponent of 3.5 may be overly pessimistic in some cases and a smaller exponent may be appropriate. In this case, the required protection distance calculated with the two-slope model would increase. *See also* note 8, *supra.*

[12] The analysis used is based on a 1 dB increase in the noise+interference floor. In the commercial wireless industry, this measurable increase in interference produces adverse effects, *i.e.*, a significant reduction of coverage, capacity, and/or quality, whether or not the Commission deems it "harmful interference."

protection distance of 200 km is much larger than what is desired to protect mobile receivers used in Advanced Wireless Services.

This analysis assumes that the TT&C signal is attenuated by 20 dB at the edges of its operating bandwidth in the 2025-2110 MHz band. It is possible that additional attenuation at the band edge could be achieved through increased filter selectivity and/or additional frequency separation. One alternative may be to allow TT&C operation only within the central portion of 2025-2110 MHz band, thus providing a guard band to allow the OOBE levels to decrease. If additional attenuation were included (through either increased filter selectivity or frequency separation), the required protection distance would be reduced as shown in Table 2 below.

Table 2. Required Protection Distances for UMTS Mobile Receivers Determined by the OOBE Level at the Edge of the 2025-2110 MHz Band.

Attenuation at Edge of Band	Required Path Loss	Required Protection Distance	
		Free Space Model	Two-Slope Model
20 dB	186 dB	22,500 km	200 km
30 dB	176 dB	7,130 km	100 km
40 dB	166 dB	2,250 km	60 km
50 dB	156 dB	710 km	30 km

C. Receiver Overload (Blocking) Limits

The received power limits for blocking in UMTS mobile stations range from –30 dBm / 3.84 MHz to approximately –65 dBm / 3.84 MHz, depending on the frequency separation between the interferer and the specified UMTS operating band.[13] Using an EIRP of 40 dBW / 4 kHz (equivalent to 100 dBm / 3.84 MHz) and a blocking level of –65 dBm / 3.84 MHz, the required path loss in this case is equal to 100 dBm – (-65 dBm) = 165 dB. In this case the required protection distance for free space is 2010 km. Using the two-slope model with a loss

[13] *See* Third Generation Partnership Project ("3GPP") TS 25.101 UE Radio Transmission and Reception, Release 5, Version 5.8.0, 2003-09.

exponent of 3.5, the required distance is 53 km. Additional results are shown in Table 3, below, for both free space path loss and the two-slope model.[14]

Table 3. UMTS Receiver Blocking Levels and Required Protection Distances.

Frequency Separation	Blocking Level (dBm/3.84 MHz)	Required Path Loss	Required Protection Distance	
			Free Space Model	Two-Slope Model
5 MHz	Approx. –65	165 dB	2010 km	53 km
10 MHz	-56	156 dB	713 km	30 km
15 MHz	-44	144 dB	179 km	13.5 km
65 MHz	-30	130 dB	36 km	5.3 km

As shown in the table, as the frequency separation increases, the receive filter in the UMTS mobile provides additional attenuation to the signal and much smaller protection distances are required. For example, assuming a UMTS carrier is centered at 2112.5 MHz and a TT&C carrier is centered at 2097.5 MHz, this would provide 15 MHz of frequency separation and a much smaller protection distance would be required than if there were only 5 MHz separation. Therefore, similar to the results for the OOBE limitations, it may be necessary to limit the TT&C transmitters to the central portion of the 2025-2110 MHz band.

It may also be possible to allow the DoD to use the 2020-2025 MHz band along with the 2025-2110 MHz band. However, due to the decreased frequency separation between the 2020-2025 MHz band and the 1930-1995 MHz band, the adverse impact on the 1930-1995 MHz band will be greater.

D. Conclusions regarding Government Use of 2025-2110 MHz

Both the OOBE and receiver blocking could impact receivers operating in the AWS and PCS bands. Depending on the limitations on OOBE levels and the out-of-band, below-horizon power level of the TT&C signal, either OOBE levels or receiver blocking levels could require

[14] As before, the two-slope calculation assumed a TT&C antenna height of 10 m, a mobile receiver height of 1.5 m, and mobile antenna gain of 0 dBi.

the larger protection distance. Both of these potential interference scenarios should be considered carefully as the FCC develops the regulations for the 2025-2110 MHz band. As mentioned above, considering the extremely high EIRP levels that are possible, one way to reduce the impact of OOBE and receiver blocking would be to limit the TT&C operations to the central portion of the 2025-2110 MHz band. For example, if the TT&C systems were not allowed in the 10 MHz portion closest to either end of the band, this would still allow TT&C operations within the 2035-2100 MHz band, which may be sufficient for the operation of the 11 earth stations.

III. OTHER ISSUES

A. Spectral Mask for Digital Broadcast Auxiliary Services

The *NPRM* raises a specific question related to the spectral mask requirement for digital broadcast auxiliary service ("BAS") transmitters. From the rules in 74.637(a)(2), the spectral mask allows emissions for digital transmissions as high as –13 dBm in a reference bandwidth of 4 kHz for frequencies that are removed from the assigned frequency by more than 250 percent of the authorized bandwidth. This is equivalent to 11 dBm in a 1 MHz bandwidth which is much higher than the allowed OOBE levels for PCS (-13 dBm / 1 MHz). Also, according to the measurements described in Section 74.637(c)(3), the resolution bandwidth for measurements above 1 GHz is defined to be 1 MHz. However, according to the rule, the attenuation requirement is actually reduced accordingly to account for the difference in the reference and resolution bandwidths. Thus, even with a resolution bandwidth defined to be 1 MHz, the limit would still be 11 dBm / 1 MHz. To fully evaluate the interference possibilities in the 2110-2155 MHz band, the Commission should clarify the exact OOBE limits for the systems to be deployed in the 2025-2110 MHz band.

B. The Commission Must Consider Existing UMTS Receiver Standards

The *NPRM* describes receiver overload and comments that "such receivers do not presently exist." *NPRM* at ¶ 37 & n.96. While this may be true in the U.S., the 2110-2170 MHz band has been allocated for 3G mobile services in Europe for several years and the receiver specifications have been standardized by 3GPP, as referenced in the sections above. As such, it would be extremely difficult to change the specifications at this point. A question is also raised in terms of what could be done in the receivers to protect against this type of interference.[15] While improved filter selectivity in the mobile receivers might help against receiver blocking, this would provide no reduction to the OOBE that fall directly into the 2110-2155 MHz band. Also, while it is obvious that filters with enhanced selectivity would reduce the impact in terms of blocking, there are practical limits in terms of what is realizable in a mobile device and this would have to be addressed within the 3GPP standards committees.

CONCLUSION

For the foregoing reasons, Cingular supports the proposals in the *NPRM*, subject to completion of all steps necessary for the auction and clarification of technical issues.

Respectfully submitted,

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[15] Note 97 also relates this to the NOI on receiver interference immunity.