SOCIETY OF BROADCAST ENGINEERS
FCC LIAISON COMMITTEE

ELECTRONICALLY FILED

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April 14, 2003

Marlene H. Dortch
Office of the Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Dear Ms. Dortch:

SBE hereby files its comments to the ET Docket 00-258 Third Notice of Proposed Rulemaking concerning Advanced Wireless Services (AWS), also know as Third Generation, or "3G," devices. Because these comments are also pertinent to ET Docket 95-18 (MSS), they are also being filed as *ex parte* comments to that rulemaking.

Sincerely,

/s/ Dane E. Ericksen

Dane E. Ericksen

Enclosure

cc: All SBE FCC Liaison Committee members
All SBE Officers and Directors

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

In the Matter of	)	
	)	
Amendment of Part 2 of the Commission's	)	ET Docket No. 00-258
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	)	

To: The Commission

Comments of the Society of Broadcast Engineers, Inc.

The Society of Broadcast Engineers, Incorporated (SBE), the national association of broadcast engineers and technical communications professionals, with more than 5,000 members world wide, hereby respectfully submits its comments in the above-captioned Third Notice of Proposed Rulemaking regarding Third Generation Wireless Systems.

I. 3G Handsets and 3G Base Stations Must Not Cause Interference to 2 GHz TV BAS

1. In the February 10, 2003, Third Report & Order ("Third R&O") the Commission re-allocated 1,990–2,000 MHz, and 2,020–2,025 MHz, from the Mobile Satellite Service ("MSS") to the Personal Communications Service ("PCS") for use by advanced wireless systems ("AWS"), also know as third generation wireless systems ("3G"). SBE supports this decision, because a) it believes that PCS/3G will be able to make more efficient use of 2 GHz spectrum than would MSS and b) this will necessitate going to a single-step transition for moving broadcaster's out of present TV Broadcast Auxiliary Service ("BAS") Channels A1 (1,990–2,008 MHz) and A2 (2,008–2,025 MHz). SBE has long supported a single-step transition, and believed that the two-step "Phase 1" and "Phase 2" transition scheme adopted by the Second R&O to ET Docket 95-18 (MSS) was never practical.

2. However, SBE wishes to ensure that 3G operations at 1,990–2,000 MHz, and especially for the 2,020–2,025 MHz portion, have sufficiently strict out-of-band emission limitations to ensure that no interference is caused to re-farmed TV BAS operations at 2,025–2,110 MHz.

3. Because the February 10, 2003, IB Docket 01-185 R&O (the Terrestrial MSS, *aka* Ancillary Terrestrial Component, or "ATC," rulemaking) selected the "forward band mode" for

terrestrial MSS operations, only low-power MSS handsets will be using 2,000-2,020 MHz, so this does not raise a brute force overload (BFO) issue to TV BAS operations at 2,025–2,110 MHz (present TV BAS Channels A3 through A7) or to 2,450–2,483.5 MHz (TV BAS Channels A8 and A9) or to 2,483.5–2,500 MHz (grandfathered operations on former TV BAS Channel A10). It does, however, raise BFO issues for AWS base stations operating at either 1,990–2,000 or 2,020–2,025 MHz. In the February 10, 2003, R&O to IB Docket 01-185 ("Terrestrial MSS") the Commission decided to allow terrestrial Big Leo MSS transmitters at 2,492.5–2,498 MHz, which similarly raise BFO issues to TV BAS operations at both 2.5 and 2 GHz. Fortunately, the IB 01-185 R&O was quite clear in stating, at Paragraph 116, and again at Appendix C1 ("Technical Evaluation of 2 GHz MSS ATC Proposals"), Page 168, that terrestrial MSS base stations will have to protect TV BAS receive sites, including electronic news gathering ("ENG") receive-only ("RO") sites, from BFO. SBE is presuming that this same policy will also apply to 3G base stations.

4. Both high and low-power PCS AWS operations raise adjacent-channel interference ratio (ACIR) issues. ACIR is, in turn, a function of ACLR (adjacent channel leakage ratio) and ACS (adjacent channel selectivity). ACIR, ACLR and ACS are ITU 8F/587 ("Coexistence Between IMT-2000 TDD and FCC Radio Interface Technologies Operating in Adjacent Bands and in the Same Geographical Area") terms. ACS is a function of the selectivity of the protected station's receiver, whereas ACLR is a function of the interfering station's transmitter. The relationship between ACIR, ACLR and ACS is as follows:

$$ACIR = [1/(1/ACLR + 1/ACS)]$$

This formula is similar to the formula for two resistors in parallel, and the two interference modes of ACLR and ACS can be thought of in terms of two parallel resistors. That is, if you have a 100 kohm resistor in parallel with a 10-megohm resistor, the total resistance of 99.0 kohms is mostly a function of the 100 kohm resistor and not very much a function of the 10-megohm resistor. But, if you have two 100 kohm resistors in parallel, then the aggregate resistance of 50 kohms is significantly affected by each resistor.

5. In a similar fashion, the aggregate interference from adjacent channel operations (ACIR) is a function both of the selectivity of the receiver being used by the protected station and is also a function of the out-of-band spurious energy emitted by the undesired transmitter. That is, ACS is helpful for allowing a receiver to reject any undesired out-of-band or out-of-channel signals, but is of no help if the undesired transmitter is radiating spurious energy that falls in the pass band (*i.e.*, channel) of the protected station. This means that low power portable AWS devices

must have sufficiently good out-of-band emission limits so that even if such a device is being used near a 2 GHz TV BAS receive site, the out-of-band emissions from the AWS device, seen as in-channel interference by the protected TV BAS receiver, is below the effective noise floor of the 2 GHz TV BAS system. For an AWS base station, with the possibility of much higher equivalent isotropic radiated powers ("EIRPs"), correspondingly more stringent ACLRs would be necessary.

6. So this becomes a balancing act between ACLR and ACS. A 2 GHz TV BAS receiver with an excellent ACS (because it uses, say, double conversion intermediate frequency ("IF") stages, with each IF using surface acoustic wave ("SAW") filters), is wasted if the undesired adjacent band transmitters have poor ACLRs. And requiring undesired adjacent band transmitters to have heroic ACLRs is wasted if the TV BAS receivers they are trying to protect have a poor ACS. Put another way, both the ACLR and ACS need to be "100 kohm" resistors, not one a 100 kohm resistor and the other a 10 megohm resistor.

7. The issue of how good of an ACLR that an AWS device will need to have to ensure that no interference to re-farmed 2 GHz TV BAS operations is caused is further based on a plethora of assumptions about credible worst case separations and geometries between an AWS device and 2 GHz TV BAS receiving systems. The problem is more manageable for fixed AWS stations, because these separations and geometries can be calculated in advance, and additional band pass filtering for fixed station transmitters is entirely practical. But the amount of filtering that is practical for a handset device or portable device is limited by size, weight, and cost constraints, because these would be mass produced devices.

8. The required ACLR for portable AWS devices can be estimated given a) the highest allowable AWS device EIRP; b) the receiver noise floor of the protected TV BAS system; c) the assumed gain of the 2 GHz receiving antenna; d) the assumed minimum separation between the AWS device and the 2 GHz receiving antenna; and e) the geometry between the AWS device and the 2 GHz receiving antenna. For example, if we assume an AWS device EIRP of 1 Watt (0 dBW), a 2 GHz TV BAS receiver noise floor of -99 dBm, a 2 GHz receiving antenna gain of 20 dBi, a separation of 500 feet, and a geometry that places the AWS device in the main beam of the 2 GHz receiving antenna, an ACLR of -36.9 dB is required. If the separation distance is instead 1,000 feet an ACLR of just -30.8 dB is sufficient. And if the separation distance is just 100 feet an ACLR of -50.8 dB becomes necessary. For example, what would happen if several portable AWS devices are simultaneously in use from the observation deck on the 86th floor of the Empire State Building and just 50 feet above that deck is an omnidirectional 2 GHz RO antenna,

with just 20 dB of elevation pattern rejection towards the ESB observation deck? Maddeningly intermittent and unpredictable interference could easily result.

9. Band aide solutions like prohibiting portable AWS device use in certain places would not, in SBE's opinion, be wise or useful. Since broadcasting is now considered to be part of the nation's critical telecommunications infrastructure, posting or announcing such bans would be an open invitation for evildoers wishing to cause malicious interference to know where use of an AWS device would do the most damage. Further, we now know that police, fire and emergency management, with their new emphasis on telecommunications interoperability and functionality, would be among the first groups to have these portable AWS devices in the field, and expect to be able to use them without geographic restrictions.

10. Finally, what sort of ACLR would an AWS portable device need to have in order to be a reasonable match to a modern-day 2 GHz TV BAS receiver? Because such receivers indeed use dual-conversion IF stages, each with SAW band pass filters, they have an ACS of around -50 dB. Therefore, an AWS portable devices would need ACLRs of -50 dB or better if the ACS of the 2 GHz TV BAS receiver is not to be "wasted." Although ITU 8F/587 Table 4 suggests that such ACLRs for base stations is achievable, Table 5 indicates that for mobile devices ACLRs in the -33 dB to -43 dB range are typical. However, in its Petition for Rulemaking to re-farm the 2,500–2,690 MHz ITFS/MMDS band to allow cellularized, two-way operations (RM-10586[1]), the Wireless Cable Association International (WCA) Technical Rules Revision (TRR) Group found that better ACLRs would be necessary to ensure that low-power mobile devices operating in the proposed Lower Band Segment (LBS) and in the proposed Upper Band Segment (UBS) not cause interference to traditional high-power, big-stick ITFS operations that would remain in the Mid-Band Segment (MBS). The LBS can be considered as analogous to AWS operations, and the MBS can be considered as analogous to re-farmed 2 GHz TV BAS operations. The engineering issues that mandate good ACLRs for portable devices in the LBS or UBS having to protect receivers in the MBS are equally applicable to AWS devices needing to protect 2 GHz TV BAS operations.

III. Possible New Band Plan for 2 GHz TV BAS

11. As a result of AWS and MSS both being allocated spectrum on what is presently TV BAS Channels A1 and A2, and with those allocations now straddling both channels, the two-step "Phase 1/Phase 2" transition plan adopted by the Second R&O to ET Docket 95-18 is no

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1 Now WT Docket 03-66.

longer viable.[2] Therefore, a new transition plan will have to be adopted. This will also require re-visiting the Phase 2 band plan.

12. A critical issue is selecting a band plan so that channel center frequencies (and split-channel center frequencies) fall on integer multiples of 250 kHz, because this is the current step increment for the frequency synthesizers in modern-day 2 GHz TV BAS radios. Thus, a band plan with six 12 MHz channels and one 13 MHz channel, or a band plan with five 12 MHz channels and two 12.5 MHz channels, would work, in that the center frequencies of those channels and their channel splits would all be integer multiples of 250 kHz, but a band plan composed of seven 12.142857 MHz channels would be problematic, as would even seven 12.1-MHz wide channels, whose channel splits would require a frequency synthesizer with a 50-kHz step resolution.

13. However, an even more elegant solution is a bandplan comprised of seven exactly 12-MHz wide channels, plus two 0.5 MHz wide data return link (DRL) bands, one at each end of the re-farmed 2,025–2,110 MHz TV BAS band. These DRL bands would be available for narrowband downstream control channels to TV Pickup transmitters (*e.g.*, ENG trucks, helicopters, blimps, *etc.*), letting the mobile transmitter know if it could reduce its EIRP for the path in question (and possibly with sufficiently fast processing to allow dynamic power control even for fast-moving airborne platforms). Such DRL channels could additionally let both ENG crews and news directors know when an ENG path was getting near the "cliff" threshold that applies to digitally modulated signals. SBE envisions twenty 25-kHz wide DRL channels at each end of the re-farmed 2 GHz TV BAS band, with reverse band protocols. That is, a TV Pickup station operating on re-farmed Channels A1, A2, A3, A4 or A5 would use one of the narrowband DRL channels just above re-farmed Channel A7 (2,097.5–2,109.5 MHz, under this scenario), and a TV Pickup station operating on re-farmed Channels A4, A5, A6 or A7 would use one of the narrowband DRL channels just below re-farmed Channel A1 (2,025.5–2,037.5 MHz). This would still give channel (and split-channel) center frequencies evenly divisible by 250 kHz.

14. At Paragraph 48 of the ET Docket 01-75 R&O (Updating and Harmonizing of the Part 74 BAS rules), the Commission adopted automatic transmitter power control (ATPC) for BAS, even though it recognized that most BAS links wouldn't be able to use this feature, since most BAS links are one-way (*i.e.*, simplex). The creation of downstream narrow band DRL channels would allow ATPC for 2 GHz TV Pickup operations, which the Commission should like. Further, because DRL channels would be narrow band and would only need to relay limited data

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[2] SBE expects to file similar comments to an expected FNPRM to ET Docket 95-18.

(*e.g.*, the bit error rate ("BER") of the signal being received at a central receive site), the DRL transmitter could use low power (1 watt?) and a very robust and simple modulation type (binary frequency shift keying, or BFSK?). Such a low power DRL signal, even when co-located with a 2 GHz receiver at an ENG RO site, should be a compatible use (*i.e.*, not cause BFO) if a reverse-band protocol is used.

15. For compatibility purposes, using a DRL channel to provide ATPC for TV Pickup transmitters could be via a separate modularized receiver, which would interface to the RS-232 data input port that most modern-day 2 GHz coded orthogonal frequency division modulation ("COFDM") radios have. That is, this would be an additional, but compatible, enhancement available to 2 GHz TV Pickup BAS operations. Since under this proposal there would be forty DRL channels, even in a Category I "LA" market[3] with channel splits, providing fourteen ENG channels instead of just seven, there would be a sufficient number of DRL channels to accommodate an enhanced, ATPC mode of operation for all TV Pickup stations wishing to do so. A "polite protocol," where a DRL transmitter steps through each of the 20 possible DRL channels in the pertinent lower or upper DRL band (as appropriate for the TV Pickup channel to which it is to be associated), and starts transmitting on the first available channel, may be practical.

IV. Summary

16. SBE applauds the reallocation of 15 MHz of spectrum from MSS to AWS. However, it will be imperative that AWS base stations and AWS portable devices have sufficiently stringent limits on their out-of-band emissions so that no interference to adjacent-band TV BAS operations is caused. The re-allocation of the 35 MHz of spectrum now occupied by TV BAS Channels A1 and A2 in a manner that now straddles both channels will require a single-step transition by BAS operations out of 1,990–2,025 MHz. A single-step transition also allows a more innovative bandplan for such re-farmed TV BAS operations.

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[3] As categorized by SBE, and as adopted in the July 3, 2002, ET Docket 95-18 Second R&O, the four categories of 2 GHz BAS use are:

Category I: "Los Angeles" or "LA." Extremely heavy use, mostly split channel. There is lots of itinerant use and channel borrowing and sharing; even so, seven channels aren't enough.
Category II: "Metro." Spectrum is heavily used, especially during the news hours. There is some split channel use, not a lot, and some itinerant use. There is regular channel borrowing and sharing.
Category III: "Light." There is some electronic news gathering (ENG), some fixed link, maybe even some channels mostly vacant most of the time. Typically, a small-market, low-competition situation.
Category IV: "Rural." ENG is unheard of, the use is for fixed, long-haul relays to small-market TV stations, to TV translator stations, and to cable television headends. In some areas not all channels are even used.

List of Figures

17. The following figures or exhibits have been prepared as a part of these ET Docket 00-258 Third NPRM comments:

Respectfully submitted,

Society of Broadcast Engineers, Inc.

/s/ Troy Pennington, CSRE
SBE President

/s/ Dane E. Ericksen, P.E., CSRTE
Chairman, SBE FCC Liaison Committee

/s/ Christopher D. Imlay, Esq.
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April 14, 2003

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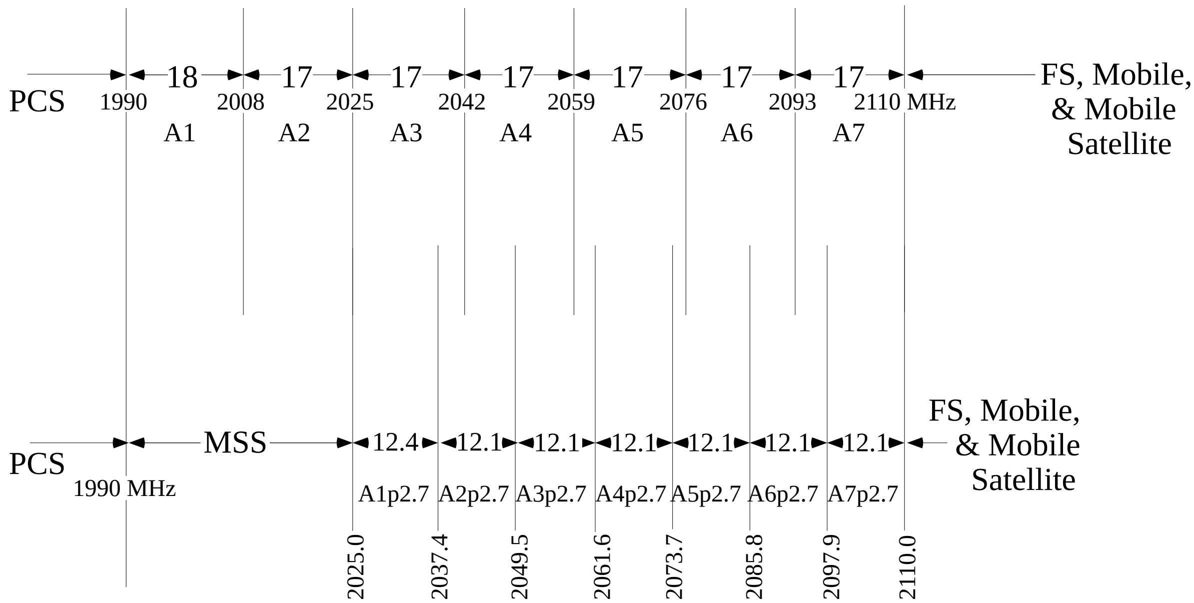
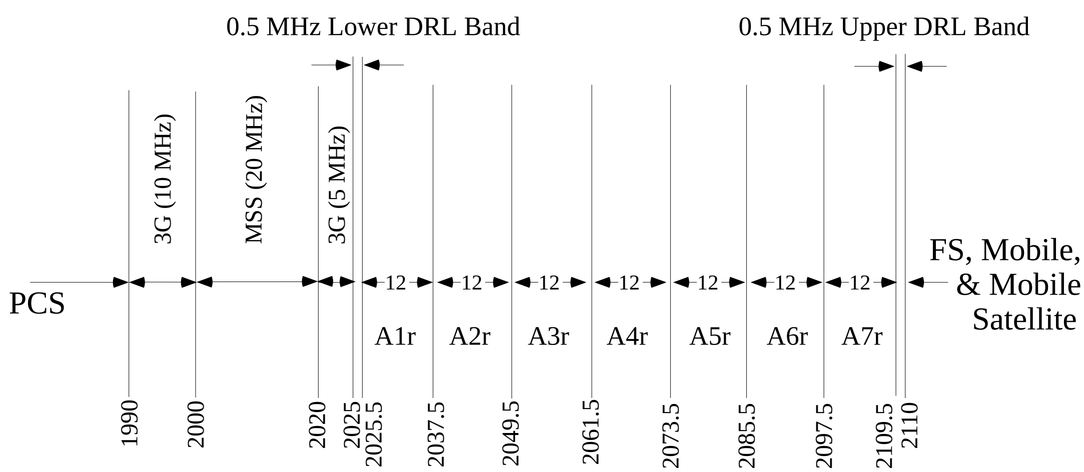
ET Docket 95-18 Second Report & Order

Existing v. Phase Two 2 GHz BAS Band Plan
(Indefinite Adoption Date)
with a 5-Channel Phase Two Option



Original Phase Two Band Plan
(7-Channel Option)



Possible New Band Plan

DRL = Data Return Link

All frequencies and bandwidths are in MHz.

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Figure 1