

SBE White Paper on DoD Uplinks in the 2 GHz TV BAS Band

In the July 7, 2003, ET Docket Fourth Notice of Proposed Rulemaking (NPRM) the FCC proposed relocating up to eleven Department of Defense (DoD) tracking, telemetry and commanding (TT&C) satellite uplinks from the 1,761–1,842 MHz federal government Space Ground Link System (SGLS) band to the refarmed 2,025–2,110 MHz TV Broadcast Auxiliary Services (BAS) band. This move was triggered by the reallocation of the 1,710–1,755 MHz federal government band to the commercial sector, for still more Advanced Wireless Services (AWS) spectrum. Congress favors this, because AWS spectrum is subject to lucrative spectrum auctions; and, when Congress favors a particular spectrum issue, the FCC gets the message loud and clear. Resulting FCC rulemakings then seem destined to conclude that there are no engineering issues that would be in the way.

The non-military federal government point-to-point links at 1,710–1,755 are accordingly in the process of being relocated to the SGLS band. This, in turn, supposedly meant finding a new home for eleven DoD uplinks now operating in that band. DoD, IRAC (Interdepartmental Radio Advisory Committee), NTIA (National Telecommunications and Information Administration (NTIA)), and, of course, the FCC, decided that the 2 GHz electronic news gathering (ENG) band would be a good place for these relocated DoD uplinks.

The DoD uplinks are located in TV markets such as Los Angeles, San Francisco, Boston, Denver, Albuquerque, Orlando, Colorado Springs and Honolulu. The uplinks have transmitter power outputs (TPOs) of up to 70 dBm (*i.e.*, 10 kilowatts) operating into a 10-meter uplink dish with a gain of around 45 dBi, so the equivalent isotropic radiated power (EIRP) of these DoD monsters is around 115 dBm. The side lobe suppression of the uplink dish is only about 60 dB or so, meaning that the leakage toward the horizontal (and therefore toward ENG receive only (ENG-RO) sites) will be on the order of 55 dBm. Since a typical ENG truck has an EIRP of around 65 dBm, this means that the DoD uplinks would be co-channel to, and only 10 dB or so less power than, an ENG truck.

The SBE comments to the ET Docket 00-258 Fourth NPRM pointed out these "train wreck" technical problems, and that the sharing of 2 GHz spectrum between ENG and DoD uplinks missed the mark by about 60 dB. The SBE comments noted, though, that this shortfall might be overcome if a) all ENG operations got converted to digital (reducing the required desired-to-undesired (D/U) signal ratio from 60 dB to perhaps just 30 dB), and if b) the eleven DoD uplinks had their transmitting antenna side lobe suppression upgraded from 60 dB to 90 dB. If these two events both occurred, then the situation might change from that of an incompatible *frequency sharing* to an entirely practical *frequency re-use*. SBE sees frequency sharing with DoD as impractical because the interference would be one-way, from DoD uplinks to ENG-RO sites, giving DoD little incentive to be a good spectrum neighbor under the spectrum "golden rule." Additionally, and in all candor, SBE cannot envision a less likely candidate for good faith, real-time frequency coordination than DoD. Further, while one TV Pickup licensee could, as a last resort, file a complaint with the FCC against another TV Pickup licensee that repeatedly failed to properly frequency coordinate the use of a shared channel, that recourse would most likely be effectively unavailable against a DoD uplink causing interference; indeed, probably even an FCC inspector would not have the right to march into the control room of a DoD uplink facility and demand the cessation of interference-causing behavior.

In its ET Docket 00-258 Fourth NPRM comments, SBE asked why it wouldn't be a far simpler to frequency coordinate a relatively small number of re-farmed federal government point-to-point



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microwave links being moved from 1.7 GHz to the 1.8 GHz SGLS band with DoD uplinks at just eleven sites; it would be one fixed application being coordinated with another fixed application, and the refarmed federal government fixed links would presumably use at least Category B microwave dishes at their receive ends. Whereas trying to coordinate DoD uplinks with probably hundreds of ENG-RO sites, each using highly sensitive receivers and omnidirectional or remotely steerable receiving antennas, would likely be an impossible task. SBE never got a satisfactory answer to its question, and the October 21, 2004, ET Docket 00-258 Seventh Report and Order (R&O) concluded that the re-allocation could go forward, with frequency coordination between co-channel DoD uplinks and TV BAS stations somehow being hammered out. Further, the R&O claimed that SBE had said that the sharing would work, because all 2 GHz ENG operations are being converted to digital, thanks to the WT Docket 02-55 rulemaking and Sprint Nextel.

SBE Petition for Reconsideration of the DoD Uplinks Decision & the ET Docket 00-258 Fourth MO&O

On November 24, 2004, SBE filed a Petition for Reconsideration, pointing out that it had stated that *two* conditions must happen before the reallocation would work: The aforementioned conversion to digital ENG, and the upgrading of the uplink dishes, to reduce their side lobe leakage by at least 30 dB. On April 6, 2006, the FCC issued a Fourth Memorandum Opinion and Order (MO&O), denying the SBE reconsideration petition, and re-affirming the decision to allow DoD uplinks to share the 2 GHz TV BAS band, on a co-primary basis. While the MO&O conceded that in "some" cases frequency coordination would be "difficult," the Commission nevertheless concluded that somehow things could be made to work.

The FCC decision did not come as all that big of a surprise to SBE, as it seemed that the "fix" was in on this rulemaking. However, the Seventh R&O had indicated that, when DoD uplinks were ready to make their move, they would then have to demonstrate that those facilities protected all existing TV BAS facilities. And, in the Fourth MO&O, the Commission confirmed that this included ENG-RO sites, in addition to the receive ends of fixed, point-to-point TV BAS stations.

Receiver Threshold Protection Criteria

The interference criteria adopted in the Seventh R&O was no more than a 0.5 dB degradation of the protected receiver's threshold. This is a very strict protection requirement; by comparison, EIA/TIA Telecommunications System Bulletin 10-F, "Interference Criteria for Microwave Systems" (TSB-10F), allows up to a 1 dB degradation of a protected receiver's threshold, so when the Seventh R&O adopted an even more stringent 0.5 dB protection criteria SBE saw that decision as one of the few pieces of good news regarding DoD uplinks. A 0.5 dB receiver threshold protection requirement constitutes a *frequency re-use* criteria, and not a *frequency sharing* criteria. Under frequency re-use, two or more stations can be on the air in the same area and at the same time, without causing interference to each other. Frequency re-use is common for fixed, point-to-point microwave paths, where the same frequency can be re-used in the same area by employing highly directional parabolic dish transmitting and receiving antennas.

For fixed link paths using digital modulation, calculating the receiver threshold degradation is a two-step process. First, the required signal strength at the receiver input for a specified path reliability (typically 99.99%, but sometimes 99.999% or even 99.9999%) is calculated; let's assume that those



SBE White Paper on DoD Uplinks in the 2 GHz TV BAS Band

calculations show, for the path length and frequency band in question, and with due regard for multipath and rain attenuation, that a receive carrier level (RCL) of -55 dBm is needed. Applying the assumed digital-into-digital D/U ratio of 30 dB gives -85 dBm for the undesired DoD signal. So that would mean the co-channel interfering signal could be no stronger than -90.9 dBm at the receiver input, because $(-90.9 \text{ dBm}) + (-85 \text{ dBm}) = -84 \text{ dBm}$, a 1 dB degradation of the receiver threshold.

This changes, though, when the protected signal is from an ENG truck, whose location is not known in advance. In that case the appropriate receiver threshold is the receiver's noise threshold. For an MRC CodeRunner4 receiver in digital (COFDM) mode, the manufacturer reports the weakest useable incoming signal as about -95 dBm; let's assume that this represents a 6 dB carrier-to-noise (C/N) ratio, meaning a receiver thermal noise of -101 dBm. To not degrade this receiver thermal threshold by more than 0.5 dB (the more stringent criteria adopted by the Seventh R&O), the undesired, co-channel DoD signal can be no stronger than -110.1 dBm at the protected receiver's input (*i.e.*, $(-101 \text{ dBm}) + (-110.1 \text{ dBm}) = -100.5 \text{ dBm}$, or a 0.5 dB degradation). When one considers that no receiving antenna discrimination can be assumed for an ENG-RO site, because such sites use either omnidirectional receiving antennas or remotely steerable directional antennas, and therefore the receiving antenna could be aimed near, or even directly toward, a DoD uplink (for example, a news event at the Buckley AFB uplink site in Denver), demonstrating no more than a 0.5 dB degradation in the noise threshold of a ENG-RO receiver becomes a tall order indeed. In fact, SBE suspects that, when the time comes, DoD engineers will find that if a particular uplink has line-of-sight to an ENG-RO site, it will prove impossible to demonstrate the required protection. And, since the whole point of placing ENG-RO sites near the top of a tall tower, on the top of a high-rise building, or on a convenient mountain, is to increase the likelihood that an ENG truck will have line-of-sight to at least one ENG-RO site, most, if not all, of the DoD uplinks will turn out to have line-of-sight to at least one ENG-RO site. This also means that shielding berms around a DoD uplink are unlikely to work: Any berm tall enough to block line-of-sight to ENG-RO sites would likely render the uplink useless for communicating with non-geostationary orbit (NGSO) spacecraft, which often require low uplink elevation angles. Since DoD probably has many NGSO spacecraft, the inability of an uplink to operate at low elevation angles would be intolerable.

Possible Attempt to Abandon the Noise Floor Protection Criteria Adopted in the Seventh R&O

Unfortunately, buried in the last sentence of a half-page long footnote at page 17 of the Fourth MO&O was the statement that the 0.5 dB threshold degradation criteria might be dispensed with. Upon reading this, SBE "pulled the fire alarm," and on May 2, 2006, filed a second Petition for Reconsideration. Like all SBE filings, a copy of this filing (and the earlier SBE filings) can be found posted on the SBE web site at www.sbe.org. If DoD is successful in doing a sleight-of-hand, back-door change to the stringent protection criteria adopted in the Seventh R&O, it will be bad news for the 2 GHz TV BAS band.

FIA

There is one additional issue that licensees of 2 GHz TV BAS spectrum need to be aware of: FIA, which stands for Future Imagery Architecture. From the February 11 and 21, 2006, issues of the *Wall Street Journal*, of all places, comes what SBE suspects to be the real reason why DoD uplinks



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couldn't stay where they are, at 1.8 GHz, and be frequency coordinated with the displaced federal government fixed point-to-point links. FIA is a plan to greatly expand military spy satellites. Such an expanded system would presumably need an expanded uplink and control capability. Thus, the informal, "back channels" information provided to SBE, that only four or so of the eleven uplink sites would actually be used, and that such use would be scheduled to only occur at night, so as to minimize the likelihood of interference to ENG operations, is to be taken with a very large grain of salt. In reality, once DoD uplinks are moved into the 2 GHz TV BAS band, broadcasters will likely have no effective recourse should a DoD uplink cause interference to local ENG operations. For example, if a military spacecraft is in trouble, and tumbling end-over-end and so only the low-gain, omnidirectional receiving antenna can be used, is there any doubt that a rescue attempt by DoD will use every watt of available uplink power, and will transmit regardless of the time of day?

SBE is not saying that military defense or homeland security issues are less important than a ENG operations. But SBE is saying that because of the possible critical nature of transmissions by DoD uplinks, only frequency re-use, and not frequency sharing, would be practical.

What Users of 2 GHz TV BAS Spectrum Can Do

SBE asks that users of 2 GHz TV BAS spectrum, including CARS and LTTS licensees, file comments with the FCC in support of the May 2, 2006, SBE Petition for Reconsideration. The stringent 0.5 dB receiver threshold interference criteria adopted in the Seventh R&O must not get watered down. The Association for Maximum Service Television, Inc. (MSTV), has already filed in support, on May 12, 2006. In-support comments should emphasize the fact that TV news coverage in particular plays a crucial role in times of emergency. Hurricane Katrina was a prime example: Federal, state and local authorities ultimately relied more heavily on images from TV ENG helicopters than any other resource. TV ENG crews were more experienced in providing critical real-time live news feeds than federal, state or local authorities, and were ready to go at a moment's notice. Should DoD uplinks in the 2 GHz TV BAS band hamper this kind of broadcaster activity, all of the government entities that so often rely on TV news images could be seriously effected.

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