V. THERE IS NO REASON TO ALTER THE FCC'S EXISTING SITE MEASUREMENT PROCEDURES TO ACCOUNT FOR MULTIPATH

EchoStar argues that the Commission should recommend increasing the signal strength that defines a household as "served" -- as a "penalty" in light of possible multipath problems. EchoStar Comments at 5.

In support of this argument, Hammett & Edison cite (at 8) data from some of the DTV field measurement campaigns, claiming that, at 12% of tested sites, there was sufficient signal strength but still no picture. H&E's figure -- in effect, an 88% success rate -- is similar to, but slightly lower than, the 90% figure reported by Meintel Sgrignoli & Wallace in their Engineering Statement. (That is, Meintel Sgrignoli & Wallace report that, nine out of ten times, getting a signal above the DTV minimums translated into a high-quality digital picture.)

The reasons the MSW 90% figure is more reliable than the H&E 88% figure include the following: (i) the percentage reported by MSW is based on more complete set of data (from 15 testing campaigns), and (ii) the MSW figure averages the percentages from each campaign, rather than averaging the entire body of tests, to avoid unduly emphasizing those testing campaigns in which the sample size was unusually large. MSW Reply Engineering Statement, ¶¶ 28-29.

As demonstrated in NAB's initial filing, the 90% figure cited by Meintel Sgrignoli & Wallace would be higher if the same tests were done today, because the latest generation of DTV receivers is far better than earlier generations at achieving a high-quality picture in spite of even severe multipath problems. MSW Engineering Statement, ¶¶ 68, 93-103. Nor has technical ingenuity been exhausted in this area: soon, *sixth* generation boxes will be available that will be better still. MSW Reply Engineering Statement, ¶ 16.

Hammett & Edison also suggest increasing the signal strength required to be considered "served" to account for white noise enhancement that occurs when equalizers attempt to overcome multipath. H&E Statement at 8-9. (Although H&E mention 2 dB as a high figure, *id.* at 9, their own tests show average white noise enhancement of only 0.2 dB, *id.* at 13.) Again, however, any small increase in white noise caused by equalizers is much more than offset by the factors that currently make the DTV planning factors *conservative*, including the large gains available from use of a preamplifier.

VI. ECHOSTAR'S CLAIMS ABOUT MAN-MADE NOISE ARE INACCURATE AND DO NOT REQUIRE ANY CHANGE IN SITE TESTING PROCEDURES OR LONGLEY-RICE

Strangely, EchoStar argues, based on a 2001 NTIA report, that manmade noise presents a major threat to reception of low-band DTV channels. But that study says exactly the opposite: the authors find that man-made noise in *residential* areas is very low -- only 3.6 dB. Robert J. Achatz & Roger A. Dalke, *Man-Made Noise Power Measurements at VHF and UHF Frequencies*, NTIA Report No. 02-39, at 25 (Dec. 2001). The figure quoted by H&E (at 10) -- referring to median noise levels approaching 20 dB -- is for *business* areas, not residential areas. *Id.* In addition, far from finding that man-made noise is increasing, another NTIA report found that "residential [man-made noise] has *decreased dramatically*." R.J. Achatz *et al.*, *Man-Made Noise in the 136 to 138-MHz VHF Meteorological Satellite Band*, NTIA Report 98-355, at 31 (1998) (emphasis added).

EchoStar's claims about man-made noise are, in any event, limited to low-VHF stations. Under current DTV channel assignments, only a little more than two dozen ABC, CBS, Fox, or NBC stations are expected to transmit their digital signals on low-VHF channels, and that number is likely to decline in the next stages of the transition to 2% or less of all Big-4 affiliates. *See* Reply Engineering Statement of Meintel Sgrignoli & Wallace, ¶ 32.

If the Commission *were* to conclude that there is a concern about man-made noise with low-VHF digital channels, the way to address it would be to alter the plans for the DTV transition – for example, by authorizing low-VHF digital channels to transmit at higher power. If that occurred, the Commission could consider – as part of an integrated package -- urging Congress to raise the dBu levels that qualify a household as "served" by a digital low-VHF station.[4] Moreover, penalizing those broadcasters using low-VHF digital channels by deeming substantial portions of their markets "unserved," when the stations are doing exactly what they are supposed to do to replicate their analog service areas in conformity with the Commission's DTV transition plans, would be arbitrary and without justification.

VII. NONE OF ECHOSTAR'S OTHER ARGUMENTS HAVE MERIT

Based on measurements performed by Hammett & Edison, EchoStar argues that differences in receiver sensitivity warrant an increase in the minimum dBu levels that make a household "served" by a digital signal. EchoStar Comments at 4. For four reasons, the Commission should reject that suggestion. *First,* as discussed above, only Congress can change the minimum dBu levels for purposes of SHVERA, so the Commission could not lawfully implement EchoStar's suggestion on its own in any event. *Second,* none of H&E's tests was of a fifth-generation receiver, and one of the models tested was virtually an antique (from 2000). *Third,* H&E incorrectly used over-the-air signals, rather than signals generated in the lab, in doing its receiver sensitivity tests, which makes it impossible to determine whether the claimed

[4] As discussed above, Congress would need to take that step, because SHVERA locks in the specific dBu levels set forth in 47 C.F.R. § 73.622(e)(1) for purposes of determining eligibility to receive distant digital signals.

differences in sensitivity are due to (for example) multipath, rather than to differences in receiver sensitivity. MSW Reply Engineering Statement, ¶¶ 40-41. *Fourth*, even though H&E tested only early-generation receivers, the differences in sensitivity are small and well within the "safety zone" that already exists in the DTV planning factors, particularly given the easy availability of preamplifiers that greatly improve on the performance assumed by the Commission in the DTV transition process. *Id.*, ¶ 43.

Hammett & Edison also raise a concern about possible future interference issues. (H&E Statement at 14-15.) They offer no data in support of this speculative concern, and EchoStar itself does not urge any change in testing procedures or in the Longley-Rice model based on it. In any event, a properly-oriented directional rooftop antenna – which EchoStar disparages but the Commission has always assumed as the standard – minimizes interference problems. *See* MSW Reply Engineering Statement, ¶ 47.

Conclusion

For these reasons, the Commission should make recommendations concerning testing and prediction of over-the-air digital signals in accordance with the suggestions discussed above and in NAB's initial comments.

Respectfully submitted,

/s/

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July 5, 2005

Before the
Federal Communications Commission
Washington, D.C. 20554

In Re Technical Standards for Determining	)	
Eligibility for Satellite-Delivered Network	)	**ET Docket No. 05-182**
Signals Pursuant to the Satellite Home	)	
Viewer Extension and Reauthorization Act	)	

Reply Engineering Statement of Meintel, Sgrignoli, & Wallace Concerning Measurement and Prediction of Digital Television Reception

1. At the request of the National Association of Broadcasters, the undersigned have prepared this Reply Engineering Statement for consideration by the Commission in connection with its inquiry into available methods for measuring and predicting the ability of households to receive over-the-air digital television signals.

2. This Reply Engineering Statement is principally directed to the Statement submitted by Hammett & Edison ("H&E") in support of the Comments filed by EchoStar on June 17, 2005. The H&E Statement discusses the six primary issues described in the FCC's Notice of Inquiry regarding the SHVERA. Below, we address H&E's comments on each of these issues.

Consumer Receiving Antennas

3. **Outdoor Receiving Antennas and Rotors**. H&E correctly states that "implicit in the Commission's distant network eligibility rules is the assumption that all viewers employ outdoor directional antennas, which are adjusted (rotated) to achieve optimum reception." (See 47 CFR § 73.686(d)(2)(iv) as well as OET Bulletin No. 72.) This is consistent with the FCC's statement in its Notice of Inquiry that households are expected to "exert similar efforts to receive DTV broadcast stations as they have always been expected to exert to receive NTSC analog TV

signals." Notice of Inquiry, ¶ 6. This assumption was the basis of the entire DTV transition, including the channel allocations (RF channel, effective radiated power, antenna patterns, etc.) that were premised on DTV reception via properly aimed *outdoor* antennas. Likewise, direct broadcast satellite (DBS) reception requires an *outdoor* antenna oriented in a particular direction, often with much more precise adjustments than terrestrial antennas and with absolutely no blockage of the signal's direct path. It would be unreasonable to assume "mispointing" of terrestrial antennas by the same households that must precisely orient their satellite antennas to obtain any reception at all.

4. H&E asserts that "only a small fraction (perhaps 10-15%) of households having outdoor antennas also utilize an antenna rotor." But H&E does not evaluate how many of these households actually *need* a rotor for reception of over-the-air TV stations. As discussed in our initial Engineering Statement, many households are located in areas where four nearby network-affiliated transmitters are effectively co-located and there is no need for an antenna rotor. In any event, the statement in the Notice of Inquiry – that viewers are expected to exert efforts to receive digital TV signals comparable to those the Commission always expected them to exert to receive NTSC signals – is reasonable.

5. The use of a rotor, whether for analog or digital reception, has always had to address the issue of latency. But there is nothing new about that issue. And thanks to modern technology, this concern has been minimized: consumers can acquire fast-moving motorized rotors or electronically-steerable antennas that are automatically controlled by a television set (see MSW Engineering Statement, ¶ 44). Consumers can also acquire rotors that remember the exact location of the antenna direction needed for good signal reception.

6. **Antenna Pointing Errors**. H&E asserts that "in most markets, not all television stations transmit from a common site." H&E used the Terrain Integrated Rough-Earth Model ("TIREM"), as opposed to the Longley-Rice model, to analyze the coverage area of all full-service NTSC stations in the U.S. over a random sample of 4.4 million calculation points. H&E states that for those households that could receive two or more NTSC (presumably Grade B or better) signals, the majority had at least one station separated by 25 degrees from the rest. This result, they claim, would cause degraded reception (about 3 dB lower received signal level since 25 degrees is the half-power point of the reference antenna assumed in the FCC planning factors). H&E then asserts that most weak-signal "fringe" viewers in their study would receive signals from stations that were more than 25 degrees apart from each other. They conclude, "from these data, it seems clear that most viewers will not be able to receive optimally all available DTV stations without a properly oriented rotatable antenna."

7. Of course, the Commission *assumed* use of a properly-oriented rooftop antenna in planning the DTV transition, so it would not be surprising if some households needed to use rotors to ensure that their antennas are properly oriented. But in any event, the H&E study exaggerates the extent to which households will need to use rotors.

8. For one thing, the H&E study ignores the fact that, in many cases, a viewer will have no need to reorient an antenna to point it towards a transmitter in a different direction. Particularly in the crowded Eastern Seaboard, but in many other areas as well, many households are predicted to get two (or more) affiliates *of the same network* over the air. A household in Baltimore, for example, can receive the local ABC, CBS, Fox, and NBC stations over the air without a rotor, because the four Baltimore affiliates have essentially co-located towers. Although the household may *also* be predicted to receive a Grade B intensity signal from the

Washington, D.C. Big-4 affiliates, there is no need for the household to acquire a rotor when the same network programming is available from the Baltimore stations.

9. In addition, the H&E study appears to have included all stations and not just the Big-4 network affiliates relevant to the SHVERA. The antenna re-orientation they describe would likely be reduced greatly if one considered only the signals of network affiliates. And if a household at the outer edges of the coverage area of local stations wishes to receive other local TV stations, a directional antenna with a rotor will probably be necessary in any event.

10. As described in our initial Engineering Statement (¶ 44), in many U.S. markets (112 of 135, or 83%, of those markets with all four network affiliates), viewers at some distance from the transmitter see essentially co-located transmitter sites (i.e., the angle of separation is much less than 25 degrees). Viewers in these areas can therefore use a *single* antenna (meeting the FCC's planning factor of ±25 degrees) oriented in the general direction of the transmitter sites for good DTV reception of the four network-affiliated local stations. For those locations in these markets where stations are separated by a larger angle, and in markets in which towers are not co-located, a rotor (or dual-antenna system) can be employed for households in areas of relatively low signal strength. If a household in an area of relatively weak signal strength needs to compensate for the small loss of dB caused by slight differences in angle to different stations, a low-noise amplifier will more than make up the difference.

11. The H&E study also suffers from a separate problem: the points selected were apparently randomized based on *land mass*, rather than on where households are actually located. To illustrate this point, we analyzed the digital UHF signals of 10 network-affiliated stations located in various types of terrain, using the FCC's OET-69 methodology with 1-km cell size and, per the Commission's instructions for the ILLR model, ignoring Longley-Rice error

flags. Within the station's predicted Grade B contours, this study examined 365,527 cells. The study found that 96.1% of the *population* in the cells was predicted to receive a field strength at or above the 41 dBu threshold, but that only 83.9% of the *cells* were predicted to be above the threshold. In other words, the cells that were predicted to be served were more heavily populated than the cells predicted to be unserved. Randomly selected locations are thus *not* a good indicator of overall service availability; the points selected for analysis must be representative of where people actually live. This result also indicates, as one would expect, that TV stations seek to deliver signals where the population is located and not waste power reaching areas where there is no population.

12. **Indoor Antennas**. H&E correctly states that "indoor receiving antennas are generally not very directional, have less gain than most outdoor antennas, and are often not easily adjusted." They go on to say that "[t]he service signal strength levels specified by the FCC in Section 73.622(e), which are predicated on the use of an outdoor antenna, are inadequate when the receiving antenna is an indoor model." On this much, there is agreement, at least for viewers in the outer reaches of a station's service area. Compare MSW Engineering Statement, ¶¶ 37-38. The superiority of rooftop antennas to indoor antennas is the very reason the FCC's planning factors were based on directional *outdoor* antenna reception; otherwise there would be no way to give all NTSC stations an extra 6 MHz channel without causing excessive interference to each qualifying television station during the transition. The entire DTV channel allocation, including transmitter antenna patterns and ERP, were critically based on the assumption of a directional outdoor antenna. While indoor DTV reception will be possible in many areas where the signal strength inside households is sufficient and newer 5th generation receivers are

employed, a household should not be considered "unserved" if it can receive a digital signal with a directional rooftop antenna.

13. In addition, as pointed out in our initial Engineering Statement (¶ 40), outdoor directional antennas that are properly and carefully pointed provide better and more reliable performance for *both* terrestrial DTV and DBS services. Since DBS antennas must be properly mounted outside, it is reasonable to assume that antennas for terrestrial DTV reception will (at least in areas of weaker signal strength) likewise need to be mounted outside.

Cluster Measurements

14. **Antenna Rotation**. The Commission's existing rules for testing of signal strength at individual households call for measurements at a cluster of five locations (within a three square meter area) near the household. Each of the five measurements is to be made with the antenna pointed to receive maximum signal strength. The purpose of this is to take into account the location variability at a particular site. The mean value is considered the field strength at the site, and accounts for variations in signal strength due to multipath from objects near and far.

15. H&E states that "the small percentage of consumers having or using rotatable antennas calls into question continued justification of the requirement under Section 73.686(d) that the measurement antenna be rotated for greatest signal strength." As discussed above, this is not a reason to abandon the long-standing FCC requirements for antenna orientation for maximum signal strength, nor the requirement that viewers exert the same efforts to receive DTV signals as they have done in the past with analog NTSC (including use of a rotor, when needed).

16. H&E also comments that "the direction of maximum signal strength often produces a poor picture (or no picture in the case of DTV)." This implies that signal strength is not a good metric for predicting successful DTV reception. But actual measurements show that this implication is incorrect. Some very early DTV receivers sometimes required a narrow range of antenna pointing angles in order to use the antenna's null to minimize the multipath that the equalizers could not handle (*e.g.*, multipath longer than the equalizer hardware). However, the vastly improved performance of the 5th generation ("5G") DTV receivers, as described in our initial Engineering Statement (¶¶ 93-115), can easily handle these multipath conditions. Even with older DTV receivers, field tests yielded encouraging results: a net 90% accurate prediction rate of DTV reception when the measured field strength was above the FCC minimums (*e.g.*, 41 dBμV/m for UHF). The new 5G receivers (expected out in the market by fall 2005) are significantly better than the first three generations used in the early field tests, and would have provided an even higher accuracy of predicted DTV reception based on field strength alone. The 6th generation of DTV receivers – expected soon -- will be better still.

17. H&E also suggests that "[i]t would seem logical when taking cluster measurements to orient the measurement antenna in the same direction as other antennas in the area, since it can be assumed that those antennas would be oriented toward a direction that provides the best reception overall (but perhaps not optimum for any station)." We do *not* recommend making such assumptions since there is no way of knowing if those antennas are actually being used within those homes; if they are being used for analog or digital; or if they are properly adjusted to receive a good signal or have been adjusted by the prevailing winds in the area. Nor would there be any simple, standard method for determining which "other" antennas should be considered, *e.g.*, if the household is a long distance from any other residence.

18. In addition, newer antennas will be electronically steerable under control of an algorithm in the DTV receiver via the current CEA909 interface standard, and will adjust automatically (without viewer interaction). In the meantime, the current batch of rotors on the market (including one with memory that automatically adjusts the antenna to the previously stored position for a given channel) can be employed with good success.

19. **Time Variability**. As H&E point out, prediction of DTV reception assumes at least 50% of the locations and 90% of the time, as determined by the Commission. When making cluster measurements at five nearby locations (*i.e.*, covering a 3 square meter area) over a relatively short period of time, only location variability is being determined, not time variability. H&E states that since a "single set of cluster measurements is assumed to capture the median time signal strength value, it cannot adequately characterize the time variability to provide reasonable assurance that the DTV signal will be available 90% of the time."

20. H&E proposes that the test measure the five cluster locations, find the median value, and assume that it represents the median time value. Then, H&E would subtract from the measured field strength a value (in dB) equal to the difference in the FCC(50, 50) and FCC(50, 90) curves for that particular distance from the transmitter and the transmitter's height above average terrain ("HAAT").

21. In support of this proposal, H&E performed a small field test over a two-week period in May 2005. Fourteen DTV signals were measured (although only six were reported in the comments and no explanation was given as to why the other eight were left out) in their Sonoma, CA office.

22. It is generally accepted that time variability is a *long-term* measurement process – including multiple seasons -- to properly determine the statistics for a given location. The

original TASO studies in the late 1950's that provided the current FCC statistical propagation curves were meticulously determined from testing and evaluation performed over a three-year period. In most cases, data were collected over a period of at least six months and sometimes longer than two years, and for a multitude of locations (FCC Office of Chief Engineer Report No. R-6602). Therefore, a measurement program consisting of only six paths taken over a two-week period is not statistically valid and has little value, particularly when the other eight tests conducted are not reported. Nevertheless, the results for this short-term test illustrate some known facts about RF propagation. Short, line-of-sight paths have Ricean characteristics (one strong, main path with smaller amplitude delayed paths) and have minimal variance about the mean (*e.g.*, 2-3 dB) while longer line-of-sight paths have more signal strength variability.

23. H&E's assumption that the measured signal strength represents the median over time is unlikely to be correct: field strength measurements, which are taken during the daytime, will typically be *lower* than at night (*e.g.*, "primetime") when the majority of television viewing occurs. According to FCC Report No. R-6602 discussed above, signal strengths for UHF signals are roughly 2 – 3 dB lower during the daytime, depending on the path distance. Thus, signal strength measurements during the daytime are likely to be *below* the median over time.

24. H&E also discusses the plethora of empirical data from field measurements that concerns *narrow*-band RF signal level variations (including the 1971 NTIA report by Longley et al comparing predicted and measured values). They also state that the "FCC's statistical propagation curves and the Longley-Rice propagation model are based upon the statistical distributions of such data." But they question whether this applies exactly to *wide*-band DTV signals or not. The issue is whether the "wide-band" 6 MHz channel is wide enough to require different statistical propagation methods or models. However, it has been our experience, after

conducting thousands of DTV measurements, that the signal level across the 6 MHz DTV channel is in general fairly even.

25. **90% vs. 99% time variability**. H&E then suggests that even though the DTV transition is based on 90% time variability, the figure should be raised to 99% for purposes of determining whether households are "unserved."[1/] They assert that with a 90% figure, there will be DTV signal failure 10% of the time, or 36.5 days per year. But that assertion does not fairly capture the meaning of the 90% time variability assumption. First, the assumed 10% loss of service is *only* at the outermost limit of the service area; it is not a "typical" figure across the station's entire service area. *Second*, these 36.5 days are not consecutive, nor is the particular time or duration that these "outages" occur known. Many outages are likely to occur during parts of the day when no one is watching or be of such short duration that they only cause a momentary service interruption. *Third*, even for the very small percentage of households at the very edge of the station's service area, the household can improve its reception (and reduce the number of outages) substantially with a mast-mounted low-noise amplifier ("LNA").

26. *Finally*, and most important, the entire DTV allocation process was based on certain key assumptions, and one of these is the 90% time variability value. According to H&E, the 99% time variability requirement would require a 17.5 dB UHF correction factor, based on the six tests that they elected to report. Since stations cannot deliver these additional dB without violating the Commission's limits on ERP, it is difficult to see how stations can fairly be penalized (through loss of viewers) for not meeting this brand-new standard.

1/ EchoStar does not cite any figures about its own service reliability, or about the extent of problems caused by "rain fade" or by obstructions created by trees, buildings, or other physical obstacles. DBS rain fade, for example, can occur even in relatively dry areas, if the signal passes through rainy areas on its way from the satellite (above the equator) to the satellite dish.

Factors Other Than Signal Strength that Affect Reception

27. H&E discuss four commonly known factors that affect DTV reception: C/N, multipath, noise interference (particularly impulse noise on low-VHF), and interference from other signals (both analog and digital). While H&E claims that "adequate signal strength is necessary but is not, by itself, sufficient for DTV reception," the available data show that even with early-generation receivers, signal strength predicts successful reception 90% of the time, and that figure will be greatly improved with the new 5G receivers.

28. H&E asserts that the data show an 88% (rather than 90%) System Performance Index (*i.e.*, percentage of locations with above-minimum signal strength that also achieve successful reception). But H&E does not rely on the data obtained *after* the cited August 1999 paper was released. The August 1999 paper refers only to field tests with receivers that use first and second generation VSB decoder chip sets.

29. In addition, in the calculations reported in our initial Engineering Statement, we reported the average of the SPI percentages for each testing program. Because some of the programs had (for irrelevant reasons) much larger sample sizes, this method more accurately captures the national picture. (H&E also cites percentages for *indoor* reception, which should not be considered for the reasons stated above.)

30. In addition, 5G receivers offer striking performance improvements compared to older receivers. Even H&E agrees that "[f]uture DTV receivers will undoubtedly be able to produce a DTV picture in some locations where the earlier receivers could not …." In the early field tests, many of the failed DTV sites with signals above the minimum FCC required level were due to the following equalizer hardware problems with the Grand Alliance receiver: (1) both pre-echo and post-echo multipath existed that was longer than the Grand Alliance receiver's

equalizer hardware, (2) faster dynamic multipath existed than what the equalizer could handle (either due to the very slow Automatic Gain Control ("AGC") speed or the fact that the equalizer hardware that canceled long multipath used only the training signal and not the data itself), or (3) strong multipath caused the receiver to not lock up or the equalizer to diverge from the optimum solution. All of these issues have been dealt with in the latest generations in receivers, culminating in the new 5G performance. The 5G receivers can handle much stronger, longer, and faster multipath than the earlier generations of DTV receivers.

31. H&E also refer to (worst case) white noise enhancement that affects the threshold value of the DTV receiver when its equalizer is canceling or minimizing large multipath. While multiple equalizer taps become active to *cancel* the correlated multipath, the statistically independent tuner input noise samples passing through each of the taps add up at the output to enhance the noise. Therefore, the impairment-free 15 dB signal-to-white-noise error threshold is increased to some value slightly higher, which requires the incoming signal to be slightly higher. However, this calculation is a *worst* case number, and is indicative of typical feed-forward, tapped delay line type of equalizers that do not use any noise-reduction circuitry. (H&E report (at p.13) *typical* white noise enhancement values of only 0.2 dB.) The small amount of noise enhancement in DTV receivers, some of which has been reduced in the new 5G receivers, is easily mitigated through the use of a mast-mounted LNA.

32. Man-made noise is an issue that relates primarily to low-VHF channels. As described in our initial Engineering Statement (¶ 13), very few network-affiliated stations (28 out of about 846 total full power Big-4 network affiliate stations, or about 3%) are currently scheduled to use low-VHF. (H&E report essentially the same figure.) We have determined that 8 of these 28 stations had no choice in the first round channel election since both their analog and

digital channels were in the low-VHF band. In addition, 5 others had elected a low-VHF channel since their other channel was out of the FCC's designated core spectrum (channels 2- 51). We believe that a number of these stations will elect to move off the low-VHF band when given the opportunity in the third round of the DTV channel election, which is scheduled to occur next spring. Still other stations may depart the low-VHF band for other reasons. This may leave 2% or less of all network-affiliated stations on low-VHF.

33. Because of the lack of empirical data, it is not known whether the minimum-signal levels specified in the DTV planning factors for low-VHF DTV reception will be sufficient to overcome natural and man-made impulsive noise in difficult reception situations. Should the Commission conclude that there is a concern about impulsive noise for low-VHF DTV, the solution would be to authorize higher ERP levels for these channels. If the Commission did so, it could then recommend to Congress increasing the minimum signal levels that define a household as "unserved." *It would be inappropriate, however, to punish stations for failing to deliver signal levels that the Commission's own rules prevent them from delivering.*

Predictive Model

34. H&E discuss the possibility of alterations to the ILLR model used in the SHVA context. These suggestions are in the areas of:

- use of F(50, 90) or F(50, 99) statistics for DTV
- use of building penetration loss (for indoor DTV reception); and
- antenna / tuner mismatch loss and DTV receive system noise figure increase

35. **Use of F(50, 90) or F(50, 99) statistics for DTV**. The ILLR model for DTV should be based on field strength predictions using F(50, 90), just as is done with DTV application processing . To use 99% of the time for determining distant-network programming

availability when the entire DTV broadcast allocations were based on F(50,90) would be unfair to the local broadcaster who is following the rules set down by the Commission. To meet the 99% standard would require higher transmitting power (causing much more interference) than was allocated to DTV channels. To change the rules at this time in the transition would be unfair to broadcasters who have built their facilities as required based on the FCC planning factors. In addition, as discussed above, time variability issues can be mitigated with a mast-mounted preamplifier that can provide 12 – 15 dB of margin (or more) beyond what the planning factors require.

36. **Use of building penetration loss (for indoor DTV reception)**. As shown previously, indoor DTV reception should not be considered for distant-network programming determination, but rather only outdoor directional antenna reception.

37. **Antenna / tuner mismatch loss and DTV receive system noise figure increase**., Any additional impedance mismatch loss between the antenna and the tuner, as well as a higher DTV receiver noise figure, can be mitigated by a mast-mounted LNA. The LNA isolates the antenna impedance from that of the downlead coaxial cable and the DTV tuner input impedance, and also provides an output impedance much closer to the 75 ohm coaxial cable impedance. Therefore, the DTV tuner will see an impedance at the output of the coaxial downlead cable (*i.e.*, at its own input) that is much closer to the matched condition under which it is tested.

38. Both mismatch loss and noise figure enhancement are significantly reduced with the use of a low-noise, mast-mounted preamplifier that has good isolation capability and a well-controlled input and output impedance. When the entire receive system is considered, the

preamplifier mitigates the problems entirely by providing additional margin (12 –15 dB or more over that of the FCC planning factors).

Variability Among Consumer Receivers

39. H&E acknowledges that "[c]onsumer receivers continue to evolve." They tested five DTV receivers (four consumer and one professional model) and found that sensitivity did not meet the FCC planning factors of –81.2 dBm for VHF and –84.2 dBm for UHF, but rather were 2 – 6 dB below the goal stated in the FCC planning factors.

40. The traditional test methodology to determine compliance for the FCC planning factors is to perform a well-controlled *laboratory* test with easily repeatable results. This entails using a well-defined 8-VSB RF source (SNR values of >30 dB, absolutely constant DTV level and minimal splatter, no multipath or antenna-like signal spectrum tilt, no other adjacent channel signals, etc.) before carefully attenuating the signal to threshold of errors. However, the H&E test was performed with an off-air (rather than a laboratory) signal, and no levels of multipath or interference were cited.

41. The first three receivers tested by H&E (the LG LST-4200A, Samsung SIR-T451, and Motorola HDT101) are more recent units, all probably of the 4th generation vintage (*i.e.*, the VSB decoder chip). The measured sensitivity levels for these three newer units were found to be off by 2.3 dB at CH 12 and a maximum 3.8 dB at UHF. How much of this problem is due to any existing short delay multipath or interference cannot be determined from their test data.

42. The last two units are much older units (RCA DTC 100 is considered generation 1.5, and the Zenith DTV Demod-S is either 2nd or 3rd generation depending on when it was purchased). Both of these early units were known to have much worse sensitivity performance. The two paper references cited in the H&E comments regarding earlier published test results are

from presentations given in April 2000 at the NAB conference. Based on that date, it means that these tested DTV receivers (described in both those presentations) were either first- or second-generation consumer receivers. However, it is important to determine the performance of 5G DTV receivers with regard to not only sensitivity, but also to multipath and interference performance. As shown in our initial Engineering Statement (¶¶ 93-115), the 5G receivers are significantly improved in many areas.

43. Variations in DTV receiver sensitivity can be caused by a number of design issues (*e.g.*, high tuner noise figure, lack of enough IF gain, equalizer noise enhancement due to a poor algorithm, internally-generated beats within the RF and IF band, etc.). While the noise figure of some robust DTV receivers (robust in terms of multipath and interference) may in the worst case be 10 dB (rather than 7 dB in the planning factors), that effect can be mitigated where necessary with a mast-mounted LNA. But as shown in our initial Engineering Statement (¶¶ 49-51), these sensitivity variations are small enough that, along with other planning factor variations, a mast-mounted low-noise preamplifier can mitigate all of them together.

Building Penetration Loss and Clutter

44. **Building Penetration.** H&E refers to building penetration losses for *indoor* testing of DTV reception. For the reasons stated above, we do not believe that indoor field testing should be considered. Likewise, Longley-Rice prediction should not be considered for anything other than outdoor directional antenna reception.

45. Even if predictions based on indoor antennas were appropriate, the wide variability in indoor reception conditions would make such predictions extremely difficult. For example, the 1992 building attenuation study cited by H&E conducted in England for a six-story building varied from 16.4 dB at ground level to only about 2.5 – 4.2 dB at the top floor.

However, the related chart in the H&E comments indicate some unexpected results, with the building attenuation *increasing* as the height increases for the first couple of floors before decreasing with increasing height as would be expected.

46. Studies from indoor field tests in the U.S. have found that there is a great variance in the signal levels found indoors versus that found at 30' above ground level immediately outside the house under test. Besides the obvious signal decrease in signal strength due to a lower receive antenna HAAT (although there are some exceptions), building attenuation can vary significantly depending on house construction types and materials. Parameters that cause great variation in indoor signal strength are: single-story versus multi-story, type of construction such as brick, frame, aluminum siding, the number and size of windows and doors, the directions that the windows are facing with respect to the transmitter, the internal wall construction of plasterboard versus plaster over wire mesh, etc.

47. **Interference**. H&E mention the issue of interference, but do not offer any specific recommendation relating to that issue. Of course, a directional rooftop antenna with a good front-to-back ratio has always been helpful in combating interference. In addition, current DTV receiver design has improved significantly on the performance of earlier generations of DTV receivers in handling interference. Improvements in overload characteristics provide better inter-modulation and cross-modulation performance as well as image performance. Some suggested improvements have been made publicly,[2/] such as wideband tuner AGC, but the final verification is laboratory and field testing of actual consumer units.

48. **Clutter**. H&E refers to including "realistic clutter factors in the predictive model used for DTV coverage," but proposes no specific values. As discussed in our initial

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[2/] Charles Rhodes and Gary Sgrignoli, *Interference Mitigation for Improved DTV Reception*, 51 IEEE Transactions on Consumer Electronics, No. 2 (May 2005).

Engineering Statement, the Longley-Rice model is both very accurate in predicting whether particular locations can receive a signal above the Commission's threshold levels *and* well-balanced between overpredictions and underpredictions.

Respectfully Submitted:

_______/s/_______________
William Meintel

_______/s/_______________
Gary Sgrignoli

_______/s/_______________
Dennis Wallace

July 5, 2005

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Remington Arms Company, Inc.	)	ET Docket No. 05-182
Request for Waiver of Part 15	)	
	)	

SBC'S REPLY COMMENTS[1]

As with other parties in this proceeding,[2] SBC is concerned about the interference effects of Remington's device with other transmitting devices in the 2.4 GHz band. The device's transmit power of 1000 mW will cause interference to all other systems in the vicinity operating in the same frequency. The video surveillance application of the device will generate a continuous waveform for the entire period the device is in operation, making the spectrum unusable by any other devices within range. Depending on the surrounding environment, such interference could degrade the performance of—or render completely inoperable—other systems as far away as a few hundred meters to a few kilometers. Specifically, the Remington device could render inoperable WiFi systems within the vicinity of the device. Given the rapid proliferation of WiFi systems, the interference caused by Remington's device thus could have far-reaching effects: it could effectively disable wireless broadband access for anyone within range of the device. The Commission should give strong consideration to the magnitude of such effects. At a minimum, the Commission should impose stringent use and user restrictions, *e.g.*,

1 SBC Communications Inc. files these reply comments, on behalf of itself and its wholly-owned subsidiaries, including: Southwestern Bell Telephone LP, Pacific Bell, Nevada Bell, Ameritech Illinois, Ameritech Indiana, Ameritech Michigan, Ameritech Ohio, Ameritech Wisconsin, the Southern New England Telephone Company, ASI, AADS Illinois, AADS Michigan, AADS Indiana, AADS Ohio, AADS Wisconsin, SBC LD, and SBC Telecom (collectively "SBC").

2 *See, e.g., Cisco Systems Comments.*

limiting the sale and use of the device to federal, state and local police and public safety organizations for use only in life threatening situations, as a condition of granting Remington's request for waiver.

Respectfully Submitted,

/s/ Jim Lamoureux

Jim Lamoureux
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