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

In Re Measurement Standards for Digital Television Signals Pursuant to the Satellite Home Viewer Extension and Reauthorization Act	))))	**ET Docket No. 06-94**

Reply Engineering Statement of Meintel, Sgrignoli, & Wallace Concerning Measurement Stanadards for Digital Television Signals

1. At the request of the National Association of Broadcasters ("NAB"), the ABC Television Affiliates Association, CBS Television Network Affiliates Association, and NBC Television Affiliates ("Affiliate Associations"), and the Association for Maximum Service Television ("MSTV") (collectively "Broadcasters"), the undersigned have prepared this Reply Engineering Statement for consideration by the Commission in connection with it Notice of Proposed Rulemaking regarding Measurement Standards of Digital Television Signals pursuant to the Satellite Home Viewer Extension and Reauthorization Act.

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 in this proceeding. The H&E Statement discusses several issues described in the FCC's Notice of Proposed Rulemaking regarding the SHVERA. Below, we address the major issues raised by H&E.

Receiver Performance

3. The H&E comments discuss the November 2005 DTV receiver testing by the Commission's Technical Research Branch at the OET's laboratories in Columbia, Maryland. The Commission studied the reception capability of various relatively-current (during 2005), but

"reasonably-priced" DTV receivers. The main purpose was to determine if there were differences in reception performance, and, if so, whether there was any difference in reception capability of these DTV sets that could be linked to the relative *price* of the sets. The test focused on three major parameters: signal level (sensitivity) and two types of impairments (white noise threshold and multipath).

4. The sensitivity and white noise threshold testing was performed on Channels 3, 10, and 30 (*i.e.*, all three TV bands) using a clean, lab-generated ATSC (8-VSB) signal. Sensitivity was determined by reducing the signal level until the threshold of visible errors ("TOV") was reached. White noise threshold testing was performed by adding white Gaussian noise to a strong signal level until TOV was reached. Multipath testing was performed on Channel 30 using an RF data playback machine capable of playing back previously-captured (25-second duration) RF signals from real-world receive sites. This laboratory testing was performed in lieu of actual field testing, which would have been very time-consuming and impractical for 28 DTV sets (some of which were large screens).

5. The FCC carefully performed this test using the ATSC's 50 RF data captures that provide a real-world, pseudo *worst-case* scenario of DTV reception. These RF data captures were taken in the Washington, D.C. area and in New York City at very difficult reception sites, using a variety of simple (and inexpensive) consumer antennas. Of the 50 RF test files, only 10 were recorded with the receive antenna at 30' AGL; the rest were at 6' AGL. <u>It is clear that these RF data capture tests are *not* statistically representative of typical roof-top reception (either 20' or 30' AGL) with a gain antenna, but rather represent very difficult reception conditions -- with 80% of the files representing indoor reception (most at 6' AGL) in urban areas with severe ground clutter</u>.

6. The H&E report asserts that the "FCC's study seems to have focused on higher-cost receivers, with only five of 28 units tested being set-top boxes." However, the FCC sought to obtain a set of DTV receivers that had a range of prices, but with "emphasis on the lower end of the price range." The Commission acquired two types of off-the-shelf consumer products: (1) set-top boxes (STB) and (2) DTV sets with integrated over-the-air ATSC tuners. The STBs offer the lowest-cost alternative, and allow either analog or newer DTV monitors to be used to view the digital programming. The FCC obtained and tested a total of 28 DTV products for these laboratory investigations to "provide a degree of statistical confidence in the results." Some of these units were recent entries to the market; others were just about to come on the market; and yet others had been on the market for some time (about a year). The FCC Report explicitly states that "all set-top box models were relatively old designs -- introduced in the year 2004 or, in one case, 2003 -- even though they were the latest models available on the market." The integrated DTV sets were selected from among low-priced units as well as mid-to-high-priced units to balance out the testing from a variety of manufacturers, and included units with CRT, LCD, DLP, and plasma displays. Contrary to H&E claims, the FCC receiver test did indeed include a representative cross-section of receivers, from different cost ranges, that were available on the market at that time.

7. The H&E report refers to some DTV receiver sensitivities exhibiting as much as 11.3 dB worse performance than the planning factors. But ***this is a worst case result***, not a median or mean result. The Commission found that the largest sensitivity variation occurred in the low-VHF band where there is a higher probability of self-induced electromagnetic interference ("EMI") occurrences. However, two of these DTV receivers with unusually poor sensitivities were from the *same* consumer manufacturer and exhibited performance that was

10.6 dB and 12.5 dB worse than the median. Yet the ***median*** value of sensitivity for STB units was only 0.5 dB worse than the OET-69 planning factor for low-VHF (in fact, integrated units had sensitivities that were slightly *better* than OET-69 values). H&E also noted that receiver performance for high-VHF and UHF (which is where approximately 98% of the current post-transition DTV channels are expected to reside) had the poorest (up to 2.1 dB and 2.6 dB, respectively) sensitivities. Yet the median sensitivity values reported by the FCC indicated that at UHF, there was only a 0.5 dB worse median sensitivity for STB units (integrated sets had 0.1 dB *better* sensitivity than OET-69). These results are a far cry from those painted by H&E's worst-case sensitivity values.

8. In any event, it is well known that these small amounts of receiver sensitivity degradation can be easily accounted for (along with other noncompliant planning factors, such as receive antenna gain, downlead cable loss, and the presence of a splitter) by using a simple mast-mounted preamplifier. Likewise, it must be remembered that the FCC STB products under test were *older* units from 2003 and 2004 and did not perform as well as newer units. It is also important to note that minimum sensitivity can be due to several factors (such as tuner noise figure, VSB decoder chip white noise threshold performance, limited AGC range, and self-induced EMI), and that STB products often use the same front end components as their integrated DTV set "cousins." The FCC concluded that "[m]ost of the variation in reception performance among the tested receivers was due to differences in receiver noise figure rather than the required CNR." This means that the VSB decoder chips utilized in all the units (STB and integrated) were fairly consistent regarding performance in the presence of added white noise.

9. The H&E Statement asserts that the FCC Report shows that all the DTV receivers tested were unable to produce a picture when certain types of multipath were present, including only 62% for the best-performing receiver. However, as stated above, these 50 (actually 47) RF data captures are ***NOT*** a statistical representation of typical receive sites in the field. The 50 files were selected by ATSC to be ***very difficult*** reception sites that would challenge even the best of receivers. These difficult sites – as data captures – provide a way for receiver manufacturers to test their designs against exceedingly challenging reception conditions. Remember that most of these captures were taken *not* outdoors at 30' AGL, but at 6' AGL with indoor antennas and *not* with typical outdoor directional (gain) antennas.

10. DTV receiver multipath performance in the FCC testing can be separated into two groups. The FCC states that "both tiers of performance appeared in all three price ranges of DTV receivers," which indicates that multipath performance is not a major factor in the price of the DTV receiver. The receivers with the lower level of performance performed reasonably well in the severe indoor environments, which means, that they will perform very well outdoors with (20' or 30' AGL) directional gain antennas, while the best-performing units performed very well. Of course, the best-performing units are likely soon to become the norm for all DTV consumer set purchases. It can also be noted that none of the highest-performance receivers were STBs because all of the STB units tested were of the older 4G or 3G design (2003 and 2004), which has nothing to do with the unit price. The highest-performance receivers tested by the FCC were units that were all sold after March 2005, which corresponds with the known introduction of the earliest 5G receivers. Of all the post-March 2005 DTV receivers tested, 48% of them had 5G performance.

11. Over time, of course, more and more set-top boxes will rely on *at least* fifth-generation chipsets, which were originally introduced more than a year ago (in May 2005). In addition, NAB and MSTV recently awarded a contract to LG Electronics and Thomson Consumer Electronics to produce a prototype of a high-quality, low-priced DTV STB receiver. Early versions, which have been demonstrated at various trade shows earlier this year, meet the strict RF reception (as well as minimal feature set) requirements put forth by NAB and MSTV in their 2005 RFP, which *exceeds* that described in the ATSC's A/74 document. Final versions of these low-cost, high-performance prototype receivers are expected to be demonstrated by the end of 2006. Having 5G / 6G performance in these mass-produced STB units will allow the same or better performance as the 5G units tested by the FCC.

12. Finally, there is a key practical point: when consumers do choose to buy satellite service, their STB receivers are almost certain to be supplied *by EchoStar* or another satellite company, which will certainly have the ability to make sure that either 5G or soon-to-be-available 6G technology is in their receivers. Indeed, as a manufacturer (or bulk purchaser) of the relevant boxes (including the chips that process over-the-air signals), EchoStar is in a strong position to ensure that the cost of the boxes is as low as possible.

A Correction Factor Should Not Be Applied to Field Measurements

13. EchoStar and its engineering consultants have proposed that a correction factor be applied to field strength measurements made to determine if an adequate digital signal from a local network station is present at a specific home.

14. The Commission has established minimum field strength levels for reception of digital television (DTV). These levels were derived using the planning factors provided in the table and formula listed below.

Planning Factors for DTV Reception (from FCC OET Bulletin 69)				
Planning Factor	**Symbol**	**Low VHF**	**High VHF**	**UHF**
Geometric mean frequency (MHz)	**F**	**69.0**	**194.0**	**615.0**
Dipole factor (dBm-dBu)	**K_d**	**-111.8**	**-120.8**	**-130.8**
Dipole factor adjustment	**K_a**	**none**	**none**	**20 log[615/(channel mid-frequency)]**
Thermal noise (dBm)	**N_t**	**-106.2**	**-106.2**	**-106.2**
Antenna Gain (dB)	**G**	**4.0**	**6.0**	**10.0**
Downlead line loss (dB)	**L**	**1.0**	**2.0**	**4.0**
System noise figure (dB)	**N_s**	**10.0**	**10.0**	**7.0**
Required Carrier/Noise ratio	**C/N**	**15.0**	**15.0**	**15.0**

$$\text{Field (dB}\mu^{1/}) = C/N - K_d - K_a - G + L + N_t + N_s$$

This formula yields the following values of field strength for each of the television bands.

Low VHF 27.6 dBμ[2/]

High VHF 35.6 dBμ[1]

UHF 40.6 dBμ[1] [3/]

1/ Decibels above 1 μVolt/meter.

2/ Decibels above 1 μVolt/meter.

3 At 615 MHz (Channel 38) – the field strength for other UHF channels can be determined by applying the dipole factor adjustment using the formula listed in the table

/

These field strength values are deterministic (*i.e.*, determined from a specific set of fixed values -- *not* statistical) and were derived assuming an outdoor DTV receive installation at 30 feet above ground level.

15. To predict TV service, the FCC uses a propagation prediction model that is based on *empirical* data gathered from actual field tests, not simply on statistical calculations. The model relies on two variables -- location (L) and time (T) -- to determine the signal level as a function of distance. Specifically, the FCC uses F(50, 90) to predict the coverage of a digital television station. The location variability is set to the median condition, or, in statistical terms, the 50th percentile. Time variability, which accounts for fading due to propagation conditions, on the other hand, is set to the 90th percentile. As mentioned, the statistics for these two variables were determined using *empirical* data. The location variability statistics were derived using short-term field measurements similar to those described here, while the time variability statistics were derived using long-term measurements (six months or longer) to account for fading due to atmospheric changes such as diurnal or seasonal variation.

16. Making a relatively small number of measurements at a specific location within a short period of time can help determine the effects of intervening terrain and other obstacles related to the median value predicted, thus correcting for location variability in the equation. The measurements do *not* provide the same information with regard to the time variability since these measurements are of short duration and do not provide any indication of whether the atmospheric conditions as measured were above or below the median predicted value. On the other hand, a large number of measurements taken over many months or years would be required to assess the variability due to changes in atmospheric conditions and to determine the percentage of time these changes would have a sufficient adverse impact on the signal such that

it would fall below the level for acceptable service. (The Commission itself made this point in its 2005 Report to Congress in response to a similar comment from EchoStar in that proceeding.) This variability would also change with the distance from the transmitter and the specific height of the desired station.

17. For the reasons discussed above, the primary purpose for making the short-term measurements as addressed in this proceeding is to ascertain the effect on the incoming signal due to the specific location. It is *not* possible to make any assessment of the effects of time on the signal level by taking a single measurement or even a series of measurements over a short period of time. To the extent that any consumer would find that the signal level in their specific location varies substantially over time, easy to install and low-cost mitigations such as a pre-amplifier would easily compensate for any time variability of the signal level.

18. EchoStar has asked the FCC to make the assumption that the measured signal level is always at or above the mean and therefore should be adjusted downward to insure that service is available 90% of the time. Such a correction is not valid and has no technical basis. In fact, one could just as easily make the opposite assumption and make a case for increasing the measured value. Since it is impossible to know, based on a short term assessment, the precise point on the time variability curve where the short-term measurement was taken, the FCC should reject the request that the measured signal level be adjusted to account for differences in time variability.

The Measurement Heights Should Not Be Altered

19. Finally, EchoStar asks the Commission to allow measurements to be made at less than the 20 or 30 foot heights proposed in the NPRM and to then use a formula to estimate the field strength value at the appropriate height for the specific dwelling (20 or 30 feet).

20. There are a number of reasons the Commission should reject this request. The first is that the DTV service was designed for reception based on the use of outside antennas at a height of 30 feet above the ground. This has already been compromised by allowing measurements to be made at 20 feet for homes that are only a single story. Furthermore, allowing measurements to be made at any lower height can introduce serious impairments from ground reflections and site-specific obstructions such as houses and other objects. Since the potential scenarios for local site-specific, low-level obstructions and their location with respect to the transmitter are infinite, it would be impossible to extrapolate these measurements to obtain a meaningful result for a height of 20 or 30 feet. And finally, it would more easily allow for the measurement process to be manipulated by selecting points where site-specific objects and obstructions would have the greatest impact. Therefore, the Commission should reject EchoStar's suggestion to allow measurements at heights other than 20 feet and 30 feet.

Respectfully Submitted:

/s/
William Meintel

/s/
Gary Sgrignoli

/s/
Dennis Wallace

August 21, 2006