

**ORIGINAL**

Before the  
**FEDERAL COMMUNICATIONS COMMISSION**  
Washington, DC 20554

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In the Matter of )  
 )  
Establishment of an Improved Model )  
for Predicting the Broadcast Television )  
Field Strength Received at )  
Individual Locations )  
\_\_\_\_\_ )

ET Docket No. 00-11

To the Commission:

**REPLY COMMENTS OF ECHOSTAR SATELLITE CORPORATION**

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Dated: March 14, 2000

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## SUMMARY

EchoStar Satellite Corporation (“EchoStar”) hereby submits its reply comments to the Notice of Proposed Rulemaking (“NPRM”) in the above-captioned proceeding,<sup>1</sup> where the Commission has set out to implement the Satellite Home Viewer Improvement Act’s requirement that it establish a point-to-point predictive model for reliably and presumptively determining the ability of individual locations to receive an over-the-air television broadcast signal.<sup>2</sup>

As the vast majority of commenters agree, Congress instructed the Commission to rely on the Individual Location Longley-Rice (“ILLR”) model that the Commission developed in Docket No. 98-201, and also to ensure that the model take into account terrain, building structures, and other land cover variations. The NPRM contains specific proposals intended to account for some such variations. As EchoStar stated in its Comments, EchoStar supports these proposals and does not object to the clutter loss values proposed by the Commission for the Land Use Land Cover (“LULC”) variables found in the United States Department of the Interior Geological Survey (“USGS”) database based on work performed by Thomas N. Rubinstein.

At the same time, use of these values represents a small part of the necessary adjustments. As EchoStar also demonstrated in its Comments, there are in fact additional variables that the Commission should take into account to improve the ILLR model’s predictive

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<sup>1</sup> *In the Matter of Establishment of an Improved Model for Predicting the Broadcast Television Field Strength Received at Individual Locations*, ET Docket No. 00-11, Notice of Proposed Rulemaking, FCC 00-17 (rel. January 20, 2000).

<sup>2</sup> *See Satellite Home Viewer Improvement Act of 1999 (“SHVIA”), Title 1 of the Intellectual Property and Communications Omnibus Reform Act of 1999*, P.L. 106-113, 113 Stat. 1501, Appendix I (1999).

powers. EchoStar urges the Commission to incorporate into the ILLR model the clutter loss values associated with these additional categories of factors, including: USGS LULC variables where there is no Fresnel clearance (since the condition of clearance proposed by the Commission would improperly ignore the losses experienced by very large numbers of households); additional, more refined, land use/land cover variables; and, perhaps most significant, impairments due to ghosting, which may themselves be capable of correlation to land use or cover variations.

Despite this very specific statutory mandate, the broadcast industry opposes *any* modification to the ILLR model. According to the NAB, “if the scales are to be tipped in one direction or another, they should be tipped in favor of broadcasters, not the satellite industry.”<sup>3</sup> In particular, the NAB and other broadcasters start from the position that the Commission should *never* make any adjustments to the ILLR model because the model itself already underpredicts whether particular households can receive a signal from an affiliated station, and the proposed changes can only exacerbate existing errors. Setting aside the fact that the predictive model also suffers from a severe overprediction problem – it overpredicts who can receive an adequate signal by use of 50% confidence and time variability factors, the Commission does not need to decide this issue again here, as the statutory requirement moots this discussion. The statute requires the Commission to “ensure that such model takes into account terrain, building structures, and other land cover variations.”<sup>4</sup> Clearly, Congress would not have imposed this

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<sup>3</sup> Comments of the Association for Maximum Service Television, Inc. (“AMST”) and the National Association of Broadcasters (“NAB”) at 9.

<sup>4</sup> SVHIA, Title I, Section 1008, “Rules for Satellite Carriers Retransmitting Television Broadcast Signals,” to be codified at 47 U.S.C. § 339(c)(3).

requirement if it had believed that such additional considerations were unnecessary in light of what the broadcasters depict as an “underprediction” of served households by the ILLR model. In brief, there is no doubt that, under the statute, the Commission must incorporate into the ILLR predictive model all terrain and land cover variations that affect signal reception quality.

The broadcast interests next try to cast doubt on the technical integrity of the Commission’s proposed approach. For example, some broadcasters argue that the USGS data are out of date compared with the more recent Rubinstein measurements, and that the LULC categories should instead be compared with the TASSO measurements. However, the TASSO data are seriously incomplete as well as badly dated. Indeed, the logic of the broadcasters’ argument – that because the LULC categories are older, the data used to assign values to the categories should be old too – risks lessening the accuracy of the prediction as opposed to improving it. Nor is it true either that the ILLR model already incorporates land use/cover variations or that Anita Longley’s urban study demonstrates essentially no clutter loss at the Grade B contour fringe. In fact, the similarity of Rubinstein’s clutter factors to Anita Longley’s urban factors strongly corroborates Rubinstein’s results and their appropriateness for incorporation in the ILLR model.

Additionally, a number of broadcasters suggest that the Rubinstein measurements are inaccurate because they are based on presumed different transmit and receive antenna heights than are typical for broadcast signal paths. However, Rubinstein’s measurements were conducted in virtually all cases using antenna heights similar or identical to those used by broadcast stations. While additional refinements in evaluating the extent of antenna height

variations may be useful, such variations do not remotely constitute a decisional flaw in the Rubinstein measurements.<sup>5</sup>

In short, broadcasters cannot find serious technical fault with the Commission's proposals, and their technical arguments cannot sustain their requests – effectively to substitute values of close to, or even below, *zero* for some LULC variables. In addition to illustrating the extremes to which these broadcasters are willing to go (a negative value implies that a land use obstacle can actually *facilitate* propagation), these requests are alternative ways of asking the Commission to do nothing, in violation of the statutory directive. At the same time, the Commission should be mindful that mere adoption of the Rubinstein data is not nearly enough to implement that objective, and must strive to incorporate in the model predicted values for all effects associated with land use/cover variations, including multi-path impairment.

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<sup>5</sup> Other broadcasters suggest that a 5 dB “polarization discrimination” adjustment should be applied to the Rubinstein measurements. However, the matter of cross-polarization discrimination is irrelevant to the vitality or validity of the Rubinstein measurements for purposes of the proposed clutter factors. Similarly, there is no support offered for the broadcasters' suggestion that Rubinstein's data are contaminated because Rubinstein did not have sufficient Fresnel zone clearance when he conducted his survey, and that this requires a subtraction of 4-5 dB in his clutter loss values.

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<sup>1</sup> *In the Matter of Establishment of an Improved Model for Predicting the Broadcast Television Field Strength Received at Individual Locations*, ET Docket No. 00-11, Notice of Proposed Rulemaking, FCC 00-17 (rel. January 20, 2000).

<sup>2</sup> *See Satellite Home Viewer Improvement Act of 1999 (“SHVIA”), Title 1 of the Intellectual Property and Communications Omnibus Reform Act of 1999*, P.L. 106-113, 113 Stat. 1501, Appendix I (1999) (relating to copyright licensing and carriage of broadcast signals by satellite carriers). The Commission commenced this proceeding in response to the requirements set forth in SHVIA. The signal intensity for determining eligibility is the Grade B standard set forth in 47 C.F.R. §73.683(a).

**I. CONGRESS CLEARLY DIRECTED THE COMMISSION TO IMPROVE THE RELIABILITY OF THE ILLR MODEL BY TAKING INTO ACCOUNT ADDITIONAL CRITERIA**

EchoStar joins a number of commenters in support for the Commission's endeavor to refine the ILLR model developed in Docket No. 98-201<sup>3</sup> by including USGS variables and assigning clutter loss values to them, an undertaking that is specifically required under the statute. EchoStar further agrees with the values proposed by the Commission for certain variables based on work performed by Thomas N. Rubinstein.<sup>4</sup> As one commenter noted: "We agree that LULC attenuation should be added to the implementation of the SHVIA. We are very familiar with Mr. Rubinstein's work, and agree that it could form a basis for such implementation."<sup>5</sup>

The broadcast industry, however, disagrees, essentially arguing that the Commission should do nothing to implement Congress' directive to take considerations such as terrain, building structures and land cover variations into account in developing a reliable, ILLR based predictive model. Such a position is completely contrary to the statute.

In particular, the NAB and the AMST start from the position that the Commission should *never* make any adjustments to the ILLR model because the model itself already

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<sup>3</sup> See *Satellite Delivery of Network Signals to Unserved Households for Purposes of the Satellite Home Viewer Act Part 73 Definition and Measurement of Signals of Grade B Intensity*, Report and Order ("SHVA Report and Order"), CS Docket No. 98-201, 14 FCC Rcd. 2654 (1999), *recon. granted in part and denied in part*, Order on Reconsideration, FCC 99-278 (rel. Oct. 7, 1999) ("SHVA Order on Reconsideration").

<sup>4</sup> See Thomas N. Rubinstein, "Clutter Losses and Environmental Noise Characteristics Associated with Various LULC Categories," *IEEE Transactions on Broadcasting*, Vol. 44, No. 3, September 1998 ("Rubinstein Paper").

<sup>5</sup> Comments of RadioSoft at 1.

underpredicts whether particular households can receive a signal from an affiliated station, and the proposed changes can only exacerbate existing errors.<sup>6</sup> EchoStar and the Satellite Broadcasting and Communications Administration have both shown in the Commission's first Grade B rulemaking that the model also suffers from massive *over*-prediction of served households because of the use of 50% confidence and time variability factors, meaning that a consumer can be deemed served if there is 50% confidence that he/she can receive an adequate signal and if he/she can receive such a signal 50% of the time. In any event, the Commission does not need to decide this issue again here. Congress directed the Commission to rely on the ILLR model "and ensure that such model takes into account terrain, building structures, and other land cover variations."<sup>7</sup> Clearly, Congress would not have done so if it had believed that such additional considerations would decrease the accuracy of the ILLR model. To the contrary, the language of Section 339(c)(3) strongly suggests that Congress believed that such considerations were precisely the type of modification required to improve the ILLR model's accuracy. Such a belief is echoed in the legislative history, in particular the Conference Report, which states: "[t]he provision requires the Commission to attempt to *increase its accuracy further by taking into account not only terrain, as the ILLR model does now, but also land cover variations such as buildings and vegetation.*"<sup>8</sup> Neither the NAB, nor any other commenter, reliably provides persuasive explanation for why doing nothing would be legal.

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<sup>6</sup> Comments of NAB at 11-15.

<sup>7</sup> See SHVIA, Title I, Section 1008, "Rules for Satellite Carriers Retransmitting Television Broadcast Signals," to be codified at 47 U.S.C. § 339(c)(3).

<sup>8</sup> H.R. Conf. Rep. No. 106-464, at 12 (Nov. 9, 1999).

At least one broadcaster makes the related argument that the ILLR model itself already includes some clutter effects.<sup>9</sup> Setting aside the fact that Congress appears to believe otherwise, most of the data used to develop the ILLR model are derived from measurements that used “carefully sited” receivers, implying that care was taken to locate the receive antennas so that clutter effects would be minimized.<sup>10</sup> Thus, the ILLR model does not take into account clutter effects except by accident (a failure in its design, which was to minimize them). In fact, the very purpose of this proceeding is, among other things, to refine the ILLR model so that it does accommodate clutter effects. This argument is essentially another way of asking the Commission to do what the SHVIA does not allow – nothing.

In addition to their general opposition to any modifications to the ILLR model, the broadcast interests also take specific issue with the Commission’s proposal to use the USGS LULC categories to account for clutter loss, as well as with the clutter loss values offered by Rubinstein in his paper. For example, they allege that the USGS data are out of date compared with the Rubinstein measurements, and that the LULC categories should instead be compared

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<sup>9</sup> Comments of Joint Networks at 4, 33.

<sup>10</sup> *Id.* at 5, n. 9 and Comments of MSTV and NAB, at 11. See Rice, P.L., A.G. Longley, *et al.*, “Transmission Loss Predictions for Tropospheric Communication Circuits,” NBS Technical Note No. 101 (Revised), Vol. 2, May 1, 1966, p. I-2. “For this data sample [TASO 1959], average fields are low mainly because the receiver locations were not carefully selected, as they were for most other paths for which data are shown.” (emphasis added). See also A.G. Longley, *et al.*, “Measured and Predicted Long-Term Distributions of Tropospheric Transmission Loss,” U.S. Department of Commerce, ITS, OT/TRER 16, July 1971, p. 5, “Some of the differences between predicted and measured median values may be caused by terrain clutter, such as buildings and trees, which has not yet been included in the prediction models. Such surface clutter would increase transmission loss, especially at UHF and higher frequencies.”

with the TASO measurements.<sup>11</sup> However, review of the TASO measurements reveals that there are arrays of missing data that are critical to accurately describing the referenced paths.<sup>12</sup> These data gaps may limit the utility of the TASO measurements as surrogates for other, more reliable data. Indeed, there is every reason to believe that the TASO data, as they are much older than those measured by Rubinstein, may in fact be less reliable and accurate. Indeed, the logic of the broadcasters' argument – that because the LULC categories are older, the data used to assign values to the categories should be old too – risks *lessening* the accuracy of the prediction as opposed to improving it.<sup>13</sup>

Several broadcasters request that the Rubinstein values be adjusted to a value near 0 or even a negative value – an argument that by itself demonstrates the unjustified extremes to which they are willing to go, as it appears to assume that land use/cover obstacles can *facilitate*

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<sup>11</sup> AFCCE Comments at 3. The TASO data are a subset of the measurement data at [ftp://www.fcc.gov/pub/Bureaus/Engineering\\_Technology/Databases/mmb/fm/model/taso/taso\\_data.txt](ftp://www.fcc.gov/pub/Bureaus/Engineering_Technology/Databases/mmb/fm/model/taso/taso_data.txt).

<sup>12</sup> The TASO data contain no description of the transmit antenna patterns, and, as documented in the accompanying description (*id.*, at *.../taso\_description.txt*), the receiving site elevation and median field strength values are sometimes missing. The New York City measurements contain receive antenna heights above ground that are very great, indicating that some of the measurements were conducted on building roofs. The applicability of measurements at such large receive antenna heights to other, more typical antenna heights, is uncertain. *See also* Joint Comments of ABC, CBS, FOX, and the NBC Television Network Affiliate Associations (“Joint Networks”) at 25-26. EchoStar agrees with the suggestion by Joint Networks that the resolution of the LULC database may be somewhat coarse, Comments of Joint Networks at 24, but it remains a perfectly acceptable source until, in a subsequent Commission proceeding, refinements may be adopted.

<sup>13</sup> The measurements contained in the FCC's TASO database bear dates that indicate they were collected as early as 1954 (St. Louis, Missouri), but more typically during the early 1960s. AFCCE supports evaluation of any database that leads to more reliable clutter estimates. *See* AFCCE comments at 4. Consistent with the intent of the statute to refine the accuracy of the ILLR model, EchoStar agrees that the Commission should consider factors and data that enhance the predictive accuracy of the ILLR model.

propagation. They alternatively request that the Commission base its modifications on the urban study developed by Anita Longley instead.<sup>14</sup> They base these requests on their assertions that Longley's clutter factors demonstrate essentially no clutter loss at the Grade B contour fringe and that Rubinstein employed different transmit and receive antenna heights than is typical and/or misapplied a depolarization factor.<sup>15</sup> This is incorrect on all counts.

*First*, Longley's urban factor, in fact, provides a loss range of 8.0 to 25.3 dB for urban clutter.<sup>16</sup> Indeed, the similarity of Rubinstein's clutter factors to Longley's urban factors strongly corroborates Rubinstein's results and their appropriateness for incorporation in the ILLR model. For example, at a path distance of 50 km, the average difference between Longley's urban factor and the proposed clutter factor is 1.3 dB.<sup>17</sup>

*Second*, a number of broadcasters suggest that the Rubinstein measurements are inaccurate because they are based on presumed different transmit and receive antenna heights than are typical for broadcast signal paths.<sup>18</sup> This argument is at best misleading. Rubinstein's

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<sup>14</sup> See, e.g., Comments of Richard L. Biby, PE at 11-12.

<sup>15</sup> See, e.g., Comments of Joint Networks at 27, 32.

<sup>16</sup> See Longley, Anita G. (1978), "Radio Propagation in Urban Areas," OT Report 78-144, United States Department of Commerce, NTIA, ITS. Table 2, at p.23, shows urban factors of 8.0-25.3 dB, depending upon frequency, for moderately large cities in rather smooth terrain at typical Grade B distances of 50-80 kilometers.

<sup>17</sup> See Longley, *ibid.*, and NPRM at Table 3. For the "Mixed Urban/Buildings" category, Table 3 contains clutter loss values of 10, 15, and 17 dB for the VHF-low, VHF-high, UHF-low bands, respectively. Longley gives values of 10.0, 14.8, and 20.7 dB for the frequencies of 100, 200, and 500 MHz, respectively. These represent differences of 0, 0.2, and 3.7 dB, respectively, with an average difference of 1.3 dB. Even with the impact of variations in antenna height (3.0 m for Longley, 1.5 m for Rubinstein), the net effect on the urban clutter factor would be negligible.

<sup>18</sup> See, e.g., Comments of Joint Networks at 12.

measurements were, in fact, conducted in virtually all cases using transmit antenna heights similar or identical to those used by broadcast stations.<sup>19</sup> While additional refinements in evaluating the extent of antenna height variations may be useful, there is no reason to conclude that such variations represent some sort of decisional flaw in the Rubinstein measurements or the proposal to use those measurements in the USGS LULC clutter factor. Further, the broadcasters' suggestion of applying a single value to all situations is neither reasonable nor justifiable. It therefore cannot be concluded that the Rubinstein measurements do not represent a reasonable basis for establishing a basic, workable set of values for the clutter factor as required by the Commission in this proceeding.

*Third*, the broadcasters also suggest that a 5 dB “polarization discrimination” adjustment should be applied to the Rubinstein measurements.<sup>20</sup> This suggestion too is without merit. While antenna cross-polarization discrimination may indicate how an antenna of one polarization responds to the signals of another polarization, it is clearly not related to the measure of clutter. Even if there were a viable issue of cross-polarization discrimination, *i.e.*, using different polarizations at transmit and receive locations, Richard L. Biby correctly notes in his comments that “[i]n an urban setting . . . where multipath fading caused by scattering and

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<sup>19</sup> Many of Mr. Rubinstein’s measurements were taken at heights comparable to those used by broadcast stations. In the case of the Los Angeles measurements, the sources were all located atop Mt. Wilson, which is a major broadcast site. In the case of the San Diego measurements, the sources were located atop Mt. Woodson, which is a minor broadcast site and similar in height to one of the major broadcast sites (Mt. San Miguel). In the case of the Atlanta measurements, the sources were located atop Stone Mountain, which is a minor broadcast site and is similar in height to other broadcast sites. In the case of the Whatcomb County, Washington measurements, the 162 MHz source was located in Canada at a low-elevation site; the 460 and 860 MHz sources were located on Mt. Constitution, a broadcast site for Bellingham, Washington.

<sup>20</sup> See, *e.g.*, Comments of Joint Networks, Attachment at 7.

reflection from buildings and trees is common, the resulting field is largely depolarized.”<sup>21</sup> Accordingly, the matter of cross-polarization discrimination is irrelevant to the vitality or validity of the Rubinstein measurements for purposes of the proposed clutter factors.

At least one broadcaster suggests that Rubinstein’s data are contaminated because Rubinstein did not have sufficient Fresnel zone clearance when he conducted his survey, and that this requires a subtraction of 4-5 dB in his clutter loss values.<sup>22</sup> However, there is no support offered for this suggestion in terms of the paths Rubinstein used for his measurements. Indeed, Rubinstein generally selected paths that were not heavily shadowed by terrain, and he quantified this by expressing the shadowing in terms of a Fresnel parameter. These effects can largely be removed by averaging the data over many locations, as Rubinstein did, and the result is close to the values given by Okumura in his study. It is imperative, as EchoStar has argued in its comments, that the Commission employ at least the values developed by Rubinstein also in cases where there is no Fresnel clearance.

Thus, the broadcasters are simply incorrect that serious technical fault casts doubt on the Commission’s proposal to incorporate Rubinstein’s data into the LULC clutter variable. On the other hand, this proposal is hardly enough. EchoStar emphasizes that the ILLR predictive model must be further improved by including other important clutter loss factors such as ghosting, as suggested by others,<sup>23</sup> and Fresnel shadowing.

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<sup>21</sup> Comments of Richard L. Biby, PE, at 49, quoting Longley (1978), *op. cit.*, p. 13.

<sup>22</sup> Comments of Joint Networks at 17.

<sup>23</sup> See Comments of Richard L. Biby, PE at 13.

## II. THE PREDICTIVE MODEL MUST TAKE INTO ACCOUNT ADDITIONAL FACTORS, INCLUDING GHOSTING

As EchoStar pointed out in its Comments, the proposed variables are under-inclusive and account only for a small portion of the impairments due to land use and land cover variations. EchoStar urges the Commission to incorporate into the ILLR model the clutter loss values associated with these additional categories of factors, including: USGS LULC variables where there is no Fresnel clearance (since the condition of clearance proposed by the Commission would improperly ignore the losses experienced by very large numbers of households); additional, more refined, land use/land cover variables; and impairments due to ghosting, which may themselves be capable of correlation to land use or cover variations.

As mentioned in its Comments, EchoStar has undertaken an intense study to produce values for these additional variables, as well as predicted values correlating land use/land cover variables with multi-path improvement levels. With respect to ghosting in particular, the Commission must seek to incorporate ghosting impairment in the model – this effort is required by the statutory objectives of ensuring reliable prediction and taking into account the effect of all building structures and other land cover variations.<sup>24</sup>

While EchoStar recognizes the difficulty of integrating a phenomenon that is not measured in terms of signal strength into a model predicting signal intensity, this difficulty is surmountable, and indeed EchoStar has developed a methodology that may allow achieving the desired integration based on some simple principles. This methodology is based, *first*, on a correspondence between ghosting impairment and signal intensity loss based on the effect each has on reception quality (largely based in turn on work that has been undertaken already).

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<sup>24</sup> 47 U.S.C. § 339(c)(3).

*Second*, ghosting impairment measurements (or, more precisely, their strength loss equivalent) must in turn be correlated to land use/land cover variables, allowing the Commission to integrate into the predictive model the ghosting impairment (measured in terms of its signal intensity equivalent) predicted for defined land use/cover variations. EchoStar has launched this project as well and expects results to be available shortly.

### **III. THE COMMISSION SHOULD ESTABLISH QUALIFICATION CRITERIA FOR DESIGNATED TESTERS**

With regard to identifying qualified entities to perform testing pursuant to 47 C.F.R. § 73.686(d), EchoStar believes that the Commission should endorse a set of qualification criteria and provide that the tests may be undertaken by entities demonstrably satisfying these criteria. As stated in its comments, EchoStar is working with the Satellite Broadcasting and Communications Association (“SBCA”) to develop a proposed list of criteria for the Commission’s consideration. Moreover, EchoStar agrees with the proposal of DIRECTV to extend test results to neighboring households, so as to “avoid any undue burden on any party” as required by the statute.<sup>25</sup>

Additionally, the Commission should extend the same qualification standards to tests conducted *prior* to the waiver stage of the technical contest over eligibility. Indeed, in order to provide network retransmission service to a subscriber, the satellite provider must, *ab initio*, assess eligibility using the signal intensity standard in effect under 17 U.S.C. §119(d)(10)(A). To make that assessment in situations in which the predictive model predicts a household is served but, in fact, reception is limited or affected by local propagation anomalies or marginal

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<sup>25</sup> Comments of DIRECTV at 10.

paths, the satellite provider effectively has two options: *first*, it may choose to deny service based on the prediction of the model, and wait for the waiver process to play out before any signal measurements are conducted at the subscriber's request, subject to the loser-pays rule. *Second*, it may conduct a test to assess eligibility at that stage. In the event this early test demonstrates that the subscriber is eligible to receive satellite retransmissions of network signals, the subsequent process of waiver and its inherent delay will have been mooted.

As EchoStar pointed out in its Comments, there is nothing in the statute that prohibits the satellite provider from conducting such prior tests. Measurement is a fundamental method for determining whether the "unserved household" condition is met, and the law cannot be read as preventing the satellite carrier from ascertaining eligibility in this fashion.

In that respect, EchoStar can agree that, to ensure the integrity of such early testing as well, testers conducting these measurements should be subject to the same qualification criteria applicable for testing after a waiver denial. Accordingly, the Commission should expressly rule that the same criteria for qualifying testers to conduct tests upon waiver denial apply also to the pre-waiver stage.

#### IV. CONCLUSION

In conclusion, doing nothing or essentially nothing is not an option, and the Commission should swiftly dismiss broadcaster requests to that effect. EchoStar reiterates here, as it did in its Comments, that the Commission should improve the ILLR predictive model by including all improvements associated with terrain, building structures and land cover variations, to keep this rulemaking open to accommodate the results of intensive studies being conducted by EchoStar, and to establish qualification criteria for designated testers.

Respectfully submitted,

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Dated: March 14, 2000

## ENGINEERING CERTIFICATION

I hereby certify that I am the technically qualified person responsible for the engineering information contained in the foregoing reply comments, that I have either prepared or reviewed the engineering information contained therein, and that it is complete and accurate to the best of my knowledge and belief.

By:   
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**CERTIFICATE OF SERVICE**

I, Colleen Sechrest, hereby declare that copies of the foregoing Reply Comments of EchoStar Satellite Corporation were sent this 14th day of March, 2000 by messenger or first class mail to the following:

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