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

In the Matter of	)	
	)	
Establishment of an Improved Model for	)	
Predicting the Broadcast Television Field	)	ET Docket No. 00-11
Strength Received at Individual Locations	)	

FIRST REPORT AND ORDER

Adopted: May 22, 2000; Released: May 26, 2000

By the Commission:

TABLE OF CONTENTS

I. INTRODUCTION

1. In this First Report and Order, we prescribe an improved point-to-point predictive model for determining the ability of individual locations to receive an over-the-air television broadcast signal of a specific intensity through the use of a conventional, outdoor rooftop receiving antenna. This model will be used to establish whether individual households are eligible to receive certain satellite home viewing services. Under the provisions of the 1988 Satellite Home Viewer Act (SHVA), a household that cannot receive the over-the-air signal of a local network affiliate is eligible to receive the distant network signal through satellite carriers.[1] In the absence of on-site measurements of signal intensity, this model will provide a reliable and presumptive means for determining whether the over-the-air signal of a network affiliated television station can be received at an individual location. In prescribing the improved predictive model, we are complying with new statutory requirements set forth in the Satellite Home Viewer Improvement Act of 1999 (SHVIA).[2]

2. In addition to prescribing the model to be used for these determinations, we are also providing for the model's continued refinement by the use of additional data as they become available. Refinements based on such additional data may be proposed by referencing the docket of this proceeding, which will be held open for this purpose.

II. BACKGROUND

3. Statutory Basis. The SHVIA revises and extends statutory provisions established by Congress in the SHVA. With regard to prediction of signal availability, the SHVIA adds a new section 339(c)(3) to the Communications Act of 1934, as amended (47 U.S.C. § 339(c)(3)), which requires that "[W]ithin 180 days after the date of enactment of the Satellite Home Viewer Improvement Act of 1999, the Commission shall take all actions necessary, including any reconsideration, to develop and prescribe by rule a point-to-point predictive model for reliably and presumptively determining the ability of individual locations to receive signals in accordance with the signal intensity standard in effect under section 119(d)(10)(A) of title 17, United States

[1] *See* 1988 Satellite Home Viewer Act, 17 U.S.C. § 119 (1988). Congress enacted the SHVA as an amendment to the Copyright Act in order to protect television broadcasters' copyright interests while simultaneously enabling satellite carriers to provide the signals of broadcast network stations to those satellite subscribers who are unable to obtain local network stations over-the-air. Congress considered these subscribers to be "unserved" by their local stations.

[2] *See* Satellite Home Viewer Improvement Act of 1999 ("SHVIA"), Title I of the Intellectual Property and Communications Omnibus Reform Act of 1999 ("IPACORA"), PL 106-113, 113 Stat. 1501, Appendix I (1999) relating to copyright licensing and carriage of broadcast signals by satellite carriers, codified in scattered sections of 17 and 47 U.S.C., signed by the President on November 29, 1999.

Code."[3] Section 339(c)(3) further provides that "[I]n prescribing such a model, the Commission shall rely on the Individual Location Longley-Rice model set forth by the Federal Communications Commission in Docket No. 98-201, and ensure that such model takes into account terrain, building structures, and other land cover variations. The Commission shall establish procedures for the continued refinement in the application of the model by the use of additional data as it becomes available."[4] The SHVIA also requires that the courts rely on the Individual Location Longley-Rice (ILLR) model established by the Commission for making presumptive determinations of whether a household is capable of receiving broadcast television signals of at least a certain threshold intensity.[5] The threshold signal intensity for determining eligibility is the Grade B standard set forth in §73.683(a) of the Commission's rules (47 CFR § 73.683(a)).[6]

4. In a *Notice of Proposed Rule Making* (*Notice*) issued on January 20, 2000, we addressed the statutory requirement for prescribing the Individual Location Longley-Rice model.[7] At issue is how the basic Longley-Rice radio propagation prediction model should be refined so that it will accurately take land cover variations into account as required by the SHVIA. In the *Notice* we proposed a specific computational procedure based on a certain

[3] *See* SHVIA, section 1008.

[4] In CS Docket No. 98-201 the Commission endorsed a prediction procedure it referred to as the Individual Location Longley-Rice model. 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*, adopted February 1, 1999, 14 FCC Rcd 2654 (1999). The Individual Location Longley-Rice (ILLR) radio propagation model is used to make predictions of radio field strength at specific geographic points based on the elevation profile of terrain between the transmitter and each specific reception point. A computer is needed to make these predictions because of the large number of reception points that must be individually examined. Computer code for the ILLR point-to-point radio propagation model is published in an appendix of NTIA Report 82-100, *A Guide to the Use of the ITS Irregular Terrain Model in the Area Prediction Mode*, authors G.A. Hufford, A.G. Longley and W.A. Kissick, U.S. Department of Commerce, April 1982. Some modifications to the code were described by G.A. Hufford in a memorandum to users of the model dated January 30, 1985. With these modifications, the code is referred to as Version 1.2.2 of the Longley-Rice model.

[5] *See* SHVIA, section 1005. Section 1005 of the SHVIA amends section 119(a)(2)(B) of title 17 of the United States Code (Copyrights) to require that "[I]n determining presumptively whether a person resides in an unserved household ... a court shall rely on the Individual Location Longley-Rice model set forth by the Federal Communications Commission in Docket No. 98-201, as that model may be amended by the Commission over time under section 339(c)(3) of the Communications Act of 1934 to increase the accuracy of that model."

[6] The SHVIA also directs the Commission to evaluate all possible standards and factors for determining eligibility for retransmission of signals of network stations to determine whether it may be appropriate to recommend, in a report to Congress, modifying or replacing the Grade B intensity standard for the purpose of determining eligibility, and, if appropriate, to make a further recommendation relating to a standard for digital signals. See section 339(c)(1) of the Communications Act of 1934, as amended by the SHVIA, section 1008. The Commission will address the signal intensity matter in a separate proceeding.

[7] *See Notice of Proposed Rule Making*, ET Docket No. 00-11, FCC 00-17, released January 20, 2000, 65 FR 4923.

database of land cover variations published by the United States Geological Survey. According to this procedure, individual locations are to be identified as lying in one of 10 land use and land cover (LULC) categories ranging from open land to urban environments.[8] The computational procedure then finds a clutter loss value (a reduction in available signal intensity) associated with this environmental class for the TV channel of interest, and subtracts that clutter loss from the signal intensity predicted by the Longley-Rice model.

5. We also proposed a specific set of clutter loss values based on the results published in a recent engineering journal by Thomas N. Rubinstein.[9] However, since the Rubinstein values of clutter loss are derived exclusively from measurements made at receiver sites with Fresnel clearance, we proposed that the values should apply only to matching situations.[10] For other situations, the clutter loss was to remain equal to the default value of zero dB, the value it effectively has in the basic Longley-Rice model where there is no explicit use of LULC data. We requested comment on whether other data are available that would allow us to expand the application of clutter loss considerations, and whether there are other approaches that are scientifically supported and could be integrated into the ILLR model to take into account losses due to vegetation and man-made structures.

6. Fifteen parties, representing the interests of satellite service providers, television network affiliates, consumers, and engineering firms, submitted comments and/or reply comments. There is general agreement in these comments that the ILLR model should be held to high standards of prediction accuracy. However, the comments recommend changes in the proposed model. Commenters representing satellite services believe the proposed model does not go far enough in applying the data developed by Rubinstein; commenters representing the interests of television network affiliates believe the model is flawed and inappropriate; and engineering firms have provided diverse suggestions for improving or replacing the model.

III. DISCUSSION

7. There are three major issues to be resolved in this matter. These are first, whether it would improve the accuracy of the ILLR model to assign clutter loss values as a function of the LULC category of the receiving location, as proposed in the *Notice*; second, whether there are

---

[8] The LULC database is provided by the United States Geological Survey. See USGS web page at <http://edcwww.cr.usgs.gov/glis/hyper/guide/1_250_lulc>. The 10 categories proposed for use with the ILLR model were designed by EDX Engineering, Inc. and have been suggested for use in radio propagation analysis by the WG8.8 Committee of the Telecommunications Industry Association in document TSB-88.

[9] Thomas N. Rubinstein, "Clutter Losses and Environmental Noise Characteristics Associated with Various LULC Categories," *IEEE Transactions on Broadcasting*, Vol. 44, No. 3, September 1998.

[10] Fresnel clearance is a geometrical property of the radio path from transmitter to individual receiving location. The receiver is considered to be in a shadowed location if a terrain elevation point along the path extends 0.6 of the way into the first Fresnel zone.

specific clutter loss values that would have the desired effect of improving prediction accuracy; and third, the provisions to be made for the introduction of further improvements in prediction accuracy as additional data become available. We also address certain matters of technical detail raised by the comments having to do with error flags and the surface refractivity parameter of the ILLR model. In a separate but related matter, we designate an independent and neutral entity to designate who shall conduct the objective test of received signal intensity for verification purposes in case a satellite provider and network station cannot agree on a person to conduct such a test.

The ILLR Model

8. Clutter Loss Assignment by LULC Category. The proposal to assign clutter loss values according to LULC category is supported by the major providers of direct-to-home satellite services, DIRECTV, Inc. (DIRECTV) and EchoStar Satellite Corporation (EchoStar). These organizations state that the LULC database is a source of credible and verifiable information regarding vegetation, water and other features on the land surface, and that it is widely relied upon by the scientific and technical communities for a variety of applications. The engineering firms generally agree that this approach has merit, at least until a more up-to-date source of land use and land clutter information with finer resolution, such as Landsat, becomes available.[11]

9. Commenters representing terrestrial broadcasting interests, however, argue that increased prediction accuracy will not be obtained by the approach proposed in the *Notice*. The ABC, CBS, FOX and NBC Television Affiliates Association (Affiliates Association) states that there are serious deficiencies with the LULC database that make its use for purposes of modifying the ILLR model highly questionable. According to the comments of the Affiliates Association and the joint comments of the National Association of Broadcasters and the Association for Maximum Service Television, Inc. (NAB/AMSTV), the grid scale used in the LULC database is far too coarse to accurately reflect the land cover variations at the receiving antenna site. These organizations also point out that the USGS=s LULC database was generated from data obtained more than 20 years ago and, consequently, much of the data for urban regions and their immediate environs are likely to be wrong due to development over the past two decades. Fox Television Stations, Inc., and Fox Broadcasting Company (collectively "FOX") state that Rubinstein himself noted that the LULC categories are not ideal for application to radiowave propagation. FOX believes the over-generalization of types of ground clutter proposed in the *Notice* will not produce reliable predictions of service or lack of service because,

[11] The latest member of the Landsat family of earth satellites, Landsat 7, was launched into orbit on April 15, 1999. Landsat satellites, a NASA program, gather remotely sensed images of the land surface and surrounding coastal regions for global change research, regional environmental change studies and other civil and commercial purposes. Previous Landsat missions provided the information incorporated in the USGS LULC database. After data reduction, Landsat 7 will provide data of greater significance for radio propagation prediction. Industrial and governmental organizations in Canada are already deriving radio propagation prediction databases from the latest Landsat images.

for example, the losses from different types of houses change dramatically depending on the radio opacity of the materials used in constructing the house, and the LULC database does not provide any information about the height of buildings and vegetation, without which no reasonable calculation of loss is possible.

10. We find that the assignment of clutter loss values based on LULC categories would enhance the accuracy of predictions made with the ILLR model. Therefore, although they are not ideal, we are adopting the LULC categories proposed in the *Notice* as an integral part of the ILLR. The addition of these LULC categories will provide the ILLR with an approximate means for accounting for the reception environment of individual locations, as those environments are affected by vegetation and building structures as well as the specific terrain elevation features already accounted for by the basic Longley-Rice model. The comments did not provide any alternate schemes for categorizing the reception environment of individual locations with respect to vegetation and buildings, and we are not aware of any such scheme from other technical or scientific sources. We recognize that the LULC categories are rather coarse and that the LULC database does not reflect the urban development that has occurred during the last 20 years. The LULC database is, however, the best resource available at this time for defining land use and clutter characteristics, and we find that its use would, on balance, significantly enhance the accuracy of predictions made with the ILLR model. The LULC categories defined in the *Notice* therefore represent the best choice available to us for this purpose. We also note that if satellite service subscribers are concerned that the environment at their locations has changed such that the LULC data are no longer accurate for prediction purposes, those subscribers would, as discussed below, have the option of requesting a test to verify their inability to receive signals that meet the signal intensity standard. The effect of each reception environment on signal reception is dependent on the clutter loss value assigned to each of the LULC categories. Those clutter loss values are discussed below.

11. Clutter Loss Values. Commenters express strongly opposing views on the specific clutter loss values to use for improving ILLR predictions. DIRECTV and EchoStar urge that the ILLR model be defined as including the clutter losses of the Rubinstein technical journal article as proposed in the *Notice*, but without any limitation relative to Fresnel clearance. The opposite is urged by parties representing the interests of television network affiliates. The Affiliates Association, FOX, NAB/AMSTV, and Paxson Communications Corporation (Paxson) all argue that the Rubinstein measurements are not directly applicable to television reception but instead apply to land mobile radio where reception conditions are significantly different, especially with regard to the height of the receiving antenna, its polarization, and the frequencies at which the Rubinstein measurements were made. Several engineering consulting firms offer advice similar to that advanced by television affiliates. The Association of Federal Communications Consulting Engineers (AFCCE) notes that Rubinstein's clutter loss values are derived by comparison of measurements with the predictions of a propagation model developed by Okumura for land mobile operation rather than the Longley-Rice model.[12] The firm of du Treil, Lundin & Rackley

[12] Okumura, Y., E. Ohmori, T. Kawano, and K. Fukuda (1968), "Field strength and its variability in VHF and UHF land-mobile radio service", (Tokyo), *Rev. Elec. Com. Lab.* 16, pp. 825-873.

(dLR) calls the *Notice*'s reliance on Rubinstein's analysis "an imprecise approach" because its baseline signal level reference is the Okumura model rather than Longley-Rice. In the view of Harry R. Anderson of EDX Engineering, Inc. (EDX), the results of Rubinstein's analysis are not clutter losses, but simply propagation model corrections that include clutter loss. As evidence of this, EDX points to the fact that Rubinstein's clutter loss table contains odd values that are difficult to justify with physical reasoning, like high clutter losses in "open areas."

12. While DIRECTV and EchoStar recommend specific values for clutter loss, namely those proposed in the *Notice*, parties representing the interests of the network affiliates believe that the predictions of the ILLR model in its present form already include the effects of clutter so that no prescription of additional losses is appropriate. Middle ground is found in the comments of engineering firms. These generally favor assignment of clutter loss values to be determined by further study of existing measurement data or data acquired by further measurement programs. Richard L. Biby (Biby) urges the adoption of a scheme based on a combination of theory, the measurements made by Okumura, and Biby's own experience in estimating clutter loss.[13]

13. We believe the values assigned as clutter losses should be determined by statistical study of actual measurements in the specific LULC environments to which they are to be applied. The results of a study of this type are reported in the comments of NAB/AMSTV.[14] The NAB/AMSTV study compared predictions of all the various proposed models with measured data to determine the relative accuracy of the models. See the tables below. The prediction at each of approximately 1000 locations was classified as correct, an under-prediction, or an over-prediction. A model was deemed to have made an **under-prediction** if it predicted that a location could *not* receive a signal of at least Grade B strength, when the location in fact *did* receive a Grade B signal; it was charged with an **over-prediction** if it predicted that a location *could* receive a signal of at least Grade B when the household in fact was measured *not* to receive a Grade B signal.

---

[13] The Biby scheme uses the urban factor developed by Anita G. Longley (the Longley partner of the Longley-Rice model) and reported in "Radio Propagation in Urban Areas", OT Report 78-144, United States Department of Commerce, Office of Telecommunications, 1978. Biby applies the whole or specific fractions of this urban factor to receiving locations according to their LULC category.

[14] The NAB/AMSTV study compared approximately 1,000 field intensity measurements in five different geographic regions -- Miami, Baltimore, Pittsburgh, Raleigh/Durham, and Charlotte, North Carolina -- with the corresponding ILLR prediction results for those locations. The field intensity measurements include: (1) over 600 measurements taken near 500 randomly selected households for purposes of the *PrimeTime 24* litigation in federal court in Miami and North Carolina, and (2) nearly 400 measurements taken at neutrally selected radial and grid points in the Charlotte area as part of the Grand Alliance DTV system field testing in the early 1990s.

Table 1

Comparison of Effect of Clutter Modifications on Accuracy of ILLR Model

– VHF Channels –

Station & Model	% Correct Predictions	% Over-Predictions	% Under-Predictions
WBTV, Charlotte, Channel 3			
ILLR, Clutter Loss 0 dB	88	1	11
Biby	86	1	13
DirecTV/EchoStar	78	1	21
WFOR, Miami, Channel 4			
ILLR, Clutter Loss 0 dB	100	0	0
Biby	100	0	0
DirecTV/EchoStar	100	0	0
Charlotte, NC, DTV Test Channel 6			
ILLR, Clutter Loss 0 dB	88	5	7
Biby	83	5	12
DirecTV/EchoStar	80	5	15
WTVD, Durham, Channel 11			
ILLR, Clutter Loss 0 dB	96	0	4
Biby	80	0	20
DirecTV/EchoStar	77	0	23
WJZ, Baltimore, Channel 13			
ILLR, Clutter Loss 0 dB	91	4	5
Biby	75	3	22
DirecTV/EchoStar	83	2	15

Table 2

Comparison of Effect of Clutter Modifications on Accuracy of ILLR Model

– UHF Channel 53 –

Station & Model	% Correct Predictions	% Over-Predictions	% Under-Predictions
Charlotte, NC, DTV Test Channel 53			
ILLR, Clutter Loss 0 dB	81	16	3
Biby	79	8	13
DirecTV/EchoStar	79	6	15
WPGH, Pittsburgh, Channel 53			
ILLR, Clutter Loss 0 dB	79	17	4
Biby	75	6	19
DirecTV/EchoStar	74	6	20

14. For VHF channels, the comparisons shown in Table 1 indicate that a prescription of additional losses would make the ILLR model less accurate because it already produces more under-predictions than over-predictions (a condition that favors the interests of satellite service providers). UHF comparisons are shown in Table 2. For both VHF and UHF, the ILLR model without clutter corrections proves superior to other models by making the correct prediction more often. For UHF, however, even though more correct than the competing models, the ILLR model tends to over-predict the field intensity substantially more often than it under-predicts. This is a condition that could be restored to approximate balance by assigning clutter losses.

15. Therefore, based on the available measured data of television signals, we are reducing the clutter loss values from those proposed in the *Notice* in order to make the ILLR model more accurate. We are setting the clutter loss values for VHF channels to zero because the measurement data of Table 1 indicate that larger values produce fewer correct predictions. Thus the ILLR model is not being changed for VHF. For UHF channels, we are setting small clutter loss values in order to obtain a better balance between under-predictions and over-predictions. Specifically, we are reducing the clutter loss values to one-third of those proposed in the *Notice* because our assessment of the data indicates that this will produce a better balance between under-predictions and over-predictions without adversely affecting the overall percentage of correct predictions.

16. The comments were nearly unanimous in recommending that the improved ILLR model should not limit the application of clutter loss measurements to situations with Fresnel clearance. In the *Notice* we prescribed this limitation so that clutter losses would be applied only to situations matching those in which the Rubinstein measurements were made. We now accept the technical advice offered by nearly all commenters -- that Rubinstein's analysis excludes sites without Fresnel clearance in order to make proper use of the Okumura model, not because clutter loss is less significant in the absence of Fresnel clearance. We therefore will not limit the applications of clutter loss measurements to only situations where there is Fresnel clearance.

17. Error Flags. In the *Notice* we proposed to presume lack of service in the rare instances where the output of the Longley-Rice computational procedure includes an error flag along with the predicted field strength to indicate a possible error in the prediction. DirecTV supports this convention, while Fox and NAB urge that the error condition be treated as indicative of service, as it was in the development of digital television allotments. No argument can be made for the accuracy of either convention, since the error flag simply indicates uncertainty in the predicted value of field strength due to the fact that the parameters presented to the ILLR are somewhat outside their proper limits. We believe that the best approach is to ignore the error flag and simply accept the predicted value for comparison with the signal intensity standard. Thus, in uncertain cases we are preferring neither under-prediction nor over-prediction errors. This procedure is prescribed in Appendix A.

18. Surface Refractivity. The comments of FOX and the Affiliates Association point out that predictions of the ILLR model depend to some extent on the value presumed for surface refractivity.[15] These commenters state that it could improve the accuracy of the ILLR model to use the actual surface refractivity in the geographical region between the transmitter and individual reception point in place of the fixed median value proposed in the *Notice*.[16] However, commenters have not proposed a precise algorithm or particular database for determining the refractivity value to be used for individual radio paths. While we agree that it would be desirable to include surface refractivity in the ILLR model as a geographic variable, we believe the effects on the precise signal strength predictions made by the ILLR model would be too small to make a difference, as a practical matter, in the determination of served/unserved status of individual locations. Therefore, lacking a precise procedure and database for this proposed ILLR refinement, we are retaining the fixed median value of surface refractivity in the ILLR model that we proposed in the *Notice*.

[15] The exact strength of the signal at individual reception locations depends to some extent on the refractive index of air for propagation of radio waves. The index is a function of atmospheric pressure, temperature, and humidity; and it largely determines the amount a radio wave is bent, or refracted, as it passes through the atmosphere. Surface refractivity, the value of this index at the earth's surface, is an externally settable parameter of the ILLR model.

[16] The median value we proposed is commonly used. It corresponds to an effective earth radius 4/3 times the actual radius of the earth.

19. Additional Technical Matters. Some commenters urge that we address the creation of a predictive model that would take into account additional factors including ghosting and urban noise. For example, EchoStar has initiated engineering studies to determine the feasibility of correlating LULC categories with signal quality as affected by ghosting. Additionally, several parties recommend that we modify the ILLR model to account for urban noise on the basis of the measurements of noise included in the Rubinstein report. However, we believe these are matters of signal quality rather than intensity. In this rule making we are concerned with the ability of the ILLR model to predict the availability of signals of a specific intensity as directed by Congress, and we decline to extend the scope of the issues addressed in this proceeding to include signal quality.

20. The Improved ILLR Model – Summary. Consistent with the above decisions, the new ILLR model to be used in determining whether a houshold is eligible to receive distant network signals transmitted by satellite shall consist of Longley-Rice 1.2.2 augmented by considerations of clutter loss according to the LULC categories defined in Appendix A. These categories remain the same as proposed in the *Notice* while the associated clutter loss values have been modified to make the model predictions as accurate as possible in view of the analyses of measurement data provided in the comments. The field strength predicted by the basic Longley-Rice model shall be reduced by the clutter loss value associated with the respective LULC category.[17] For VHF channels the clutter loss values have been set to zero; for UHF channels the clutter loss values have been reduced from those proposed in the *Notice* in order to obtain a better balance between under-predictions and over-predictions.

Other Matters

21. Provisions for Further Improvements in Prediction Accuracy. The comments indicate that improvements in the accuracy of the ILLR model beyond those specifically proposed may be possible either by obtaining additional measurement data or through further analysis of existing data. The AFCCE suggests that the TASO database maintained on the FCC web site is an appropriate source of existing data.[18] DIRECTV comments that the *Notice* correctly anticipates that industry efforts and the availability of higher quality data, such as the data being collected by Landsat satellites, may contribute to further improvements. In the *Notice* we stated that, because of the copyright law implications of the SHVIA, future changes to the

[17] To avoid confusion, we point out that some of the Longley-Rice 1.2.2 input parameters have values different from those utilized for application of the model to DTV service. The Longley-Rice model used for analysis of DTV and analog TV service in the DTV proceeding is described in "Longley-Rice Methodology for Evaluating TV Coverage and Interference," OET Bulletin 69, Federal Communications Commission (July 2, 1997) <http://www.fcc.gov/oet/info/documents/bulletins/#69>. Longley-Rice is the Commission's designated methodology for determining the area where service is provided by a DTV station. *See* 47 C.F.R. §73.622(e). *See also Advanced Television Systems: Sixth Report and Order* ("DTV Sixth Report and Order"), 12 FCC Rcd 14588, 14672-76.

[18] ftp://www.fcc.gov/pub/Bureaus/Engineering_Technology/Databases/mmb/fm/model/taso/

ILLR model should be introduced by rule making. We will initiate a further rule making, *i.e.*, a standard notice-and-comment procedure, to improve the accuracy of the ILLR model upon the filing of a petition for such rule making that is supported by high quality engineering studies containing conclusions based on reliable and publicly available measurement data. The highly technical nature of the comments reinforces our view that engineering studies of such high quality are requisite. Changes to the ILLR model based on such additional data may be proposed by referencing the present Docket, which will be held open for this purpose.

22. Designation of Neutral and Independent Entity for Signal Tests Purposes. The SHVIA relies on the ILLR model to determine presumptively whether a subscriber is served or unserved for purposes of eligibility to receive satellite retransmission of distant network signals.[19] The SHVIA further provides that subscribers who are denied retransmission of distant signals may request that the satellite carrier seek a waiver of the denial from the network station that is asserting that retransmission is prohibited.[20] If the network station rejects the waiver request, the subscriber may submit to the carrier "a request for a test verifying the subscriber's inability to receive a signal that meets the signal intensity standard . . ."[21] The SHVIA specifies that under these circumstances, "the satellite carrier and the network station or stations asserting that retransmission is prohibited shall select a qualified and independent person to conduct a test in accordance with section 73.686(d) of [the Commission's] regulations."[22] The statute requires that the test be conducted "within 30 days after the subscriber submits a request for the test" and if the test demonstrates that the subscriber "does not receive a signal that meets or exceeds the signal intensity standard . . ., the subscriber shall not be denied the retransmission of a signal of a network station . . ."[23]

23. To address those circumstances in which the satellite provider and network station cannot "agree on such a person to conduct the test, the person shall be designated by an independent and neutral entity designated by the Commission by rule."[24] In the *Notice*, we sought comment on this requirement,[25] but received very few comments and none that proposed

[19] 17 U.S.C. § 119(a)(2)(B)(ii)(I) (*as amended by* § 1005 of the SHVIA).

[20] 47 U.S.C. § 339(c)(2) (*as amended by* § 1008 of the SHVIA).

[21] 47 U.S.C. § 339(c)(4) (*as amended by* § 1008 of the SHVIA).

[22] *Id.* at § 339(c)(4)(A).

[23] *Id.*

[24] *Id.* at § 339(c)(4)(B).

[25] *See Notice of Proposed Rule Making*, ET Docket No. 00-11, FCC 00-17, released January 20, 2000, 65 FR 4923 at 15.

specific entities to perform this function.[26] The American Radio Relay League (ARRL) has offered to serve as the independent and neutral entity to designate the person or organization to conduct measurements if the satellite carrier and the network station are unable to agree on the selection of a tester. We believe that the ARRL is particularly appropriate in this role since it has no commercial connection with delivery of television services, its field offices cover the United States, and its members are actively engaged in activities related to the measurement of radio field intensity. We are providing in the rules, at §73.686, that the ARRL shall serve as the independent and neutral entity to perform the functions set forth in the SHVIA. It is not required that the ARRL find persons qualified to conduct the tests in question. Instead, the ARRL may examine the qualifications of persons proposed as testers by any interested party after their qualifications have been submitted in writing. Based on its review of these written qualifications, the ARRL will designate a qualified and independent person to conduct the test in accordance with the statute and the Commission's rules.[27] The ARRL indicates through an exchange of letters with the Commission that it will accept this responsibility.[28]

IV. PROCEDURAL MATTERS

24. Paperwork Reduction Act of 1995 Analysis. The decision herein has been analyzed with respect to the Paperwork Reduction Act of 1995 (the "1995 Act") and would impose no new or modified information collection requirements on the public.

[26]The responses to the *Notice*'s request for recommendations on this matter tended to address the technical qualifications of the testers rather than the identity of the independent and neutral entity to be designated by the Commission. DIRECTV proposed that the Commission appoint a "joint working group composed of representatives of the trade associations of each of the broadcasting and satellite industries, which would then be responsible for identifying, if possible, one or more qualified consulting engineers in each Designated Market Area (DMA) of the United States, who in turn could be called upon to settle particular testing disputes in the relevant DMA."

[27]*See* 17 U.S.C. § 119(a)(2)(B)(ii)(II) (*as amended by* § 1005 of the SHVIA); 47 U.S.C. § 339(c)(4) (*as amended by* § 1008 of the SHVIA); and 47 C.F.R. §73.686(d).

[28] Letter dated May 4, 2000 to Mr. David Sumner, Executive Vice President, American Radio Relay League, Inc. from Dale N. Hatfield, Chief, Office of Engineering and Technology, FCC.

25. Final Regulatory Flexibility Certification. The Regulatory Flexibility Act of 1980, as amended (RFA)[29] requires that a regulatory flexibility analysis be prepared for rulemaking proceedings, unless the agency certifies that "the rule will not have a significant economic impact on a substantial number of small entities."[30] The RFA generally defines "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[31] In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.[32] A small business concern is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).[33]

26. In this First Report and Order, the Commission prescribes a prediction technique for determining the ability of individual households to receive television signals broadcast over-the-air by local stations. The prediction technique applies exclusively to the sources of data for certain engineering calculations and to the manner in which these calculations are made. Television station licensees, Direct Broadcast Satellite (DBS) operators, and other Direct to Home (DTH) Satellite operators may use the technique to establish the eligibility or non-eligibility of individual households for satellite delivery of distant television programming. These determinations will usually be made at the point of sale of satellite receiving equipment for homes and will tend to increase the number of eligible customers. As noted in paragraph 3, *supra*, the statute requires that we increase the accuracy of the prediction model based on technical data regarding terrain and land cover variations. Thus, the prediction technique we prescribe is of a purely electrical engineering, scientific nature, and our aim is to improve its scientific accuracy. Moreover, the changes we are prescribing in the technique are small and will have only a minor effect on the proportion of households that are eligible to receive distant network signals. The number of viewers served by network affiliate stations will not be significantly reduced, and hence the economic effect on network affiliates and satellite carriers will not be significant. Therefore, we certify that the requirements of this First Report and Order will not have a significant economic impact on a substantial number of small entities. The Commission will send a copy of the First Report and Order including a copy of this final certification, in a report to Congress pursuant to the Small Business Regulatory Enforcement

---

[29] The RFA, *see* § 5 U.S.C. S 601 *et. seq.*, has been amended by the Contract With America Advancement Act of 1996, Pub. L. No. 104-121, 110 Stat. 847 (1996) (CWAAA). Title II of the CWAAA is the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

[30] 5 U.S.C. § 605(b).

[31] 5 U.S.C. § 601(6).

[32] 5 U.S.C. § 601(3) (incorporating by reference the definition of "small business concern" in Small Business Act, 15 U.S.C. S § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

[33] Small Business Act, § 15 U.S.C. S 632.

Fairness Act of 1996, *see* 5 U.S.C. § 801(a)(1)(A). In addition, the First Report and Order and this certification will be sent to the Chief Counsel for Advocacy of the Small Business Administration, and will be published in the Federal Register. *See* 5 U.S.C. § 605(b).

V. ORDERING CLAUSES

27. IT IS ORDERED that, pursuant to Sections 1, 4(i), 4(j) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154(i), and 154(j); Section 1008 of the Intellectual Property and Communications Omnibus Reform Act of 1999, PL 106-113, 113 Stat. 1501, Appendix I; and Section 119(d)(10)(a) of the Copyright Act, 17 U.S.C. § 119(d)(10)(a), the rule amendments set forth in Appendix B SHALL BE EFFECTIVE 30 days after publication of this First Report and Order in the Federal Register.

28. IT IS FURTHER ORDERED that the Commission's Consumer Information Bureau, Reference Information Center, SHALL SEND a copy of this First Report and Order, including the Final Regulatory Flexibility Certification, to the Chief Counsel for Advocacy of the Small Business Administration.

29. For additional information concerning this matter, contact Robert Eckert (202-418-2433), Harry Wong (202-418-2437), or Nam Pham (202-418-2438), Office of Engineering and Technology, Technical Research Branch.

FEDERAL COMMUNICATIONS COMMISSION

Magalie Roman Salas
Secretary

APPENDIX A

Technical Data

This appendix specifies technical details and input parameters that are to be used with Longley-Rice Version 1.2.2 to qualify the latter as the Individual Location Longley-Rice (ILLR) propagation prediction model per Section 73.683(d) of the FCC rules. The method for including Land Use and Land Clutter (LULC) classifications of locations with attributed clutter loss values is defined here. This appendix will be republished as OET Bulletin No. 72 and included in FCC rules by reference.

Computer code for the Longley-Rice radio propagation prediction model is published in an appendix of NTIA Report 82-100, *A Guide to the Use of the ITS Irregular Terrain Model in the Area Prediction Mode*, authors G.A. Hufford, A.G. Longley and W.A. Kissick, U.S. Department of Commerce, April 1982. The report may be obtained from the U.S. Department of Commerce, National Technical Information Service, Springfield, Virginia, by requesting Accession No. PB 82-217977. Some modifications to the code were described by G.A. Hufford in a memorandum to users of the model dated January 30, 1985. With these modifications, the code is referred to as Version 1.2.2 of the Longley-Rice model. It is available for downloading at the U.S. Department of Commerce Web site, <http://elbert.its.bldrdoc.gov/itm.html>.

When run under the conditions given in Table 1, the Longley-Rice model is the ILLR prescribed by Section 73.683(d) of the FCC rules. Note especially the following unique features of the ILLR prediction procedure (these distinguish the ILLR model from, for instance, the use of Longley-Rice for digital television coverage and interference calculations as detailed in OET Bulletin No. 69):

- the time variability factor is 50%, presuming that the ILLR field strength prediction is to be compared with a required field (the Grade B field intensity defined in Section 73.683(d) of the FCC rules) that already includes an allowance for long term (daily and seasonal) time fading;
- the confidence variability factor is 50%, indicating median situations;
- the model is run in individual mode;
- terrain elevation is considered every 1/10 of a kilometer;
- receiving antenna height is assumed to be 6 m (20 feet) above ground for one-story buildings and 9 m (30 feet) above ground for buildings taller than one-story;
- in the rare cases that error code 3 occurs (KWX=3), the predicted field strength is nevertheless accepted as indicative of whether a Grade B field strength is available at that location;
- land use and land cover (e.g., vegetation and buildings) considerations are included through a look-up table of clutter losses additional to those inherent in the basic Longley-Rice 1.2.2 model and keyed to the Land Use and Land Cover categories defined by the United States Geological Survey.

The field strength of a network TV station at an individual location is predicted as follows:

1) Find the engineering facilities data for the network affiliate station of interest by, for example, consulting the FCC Web site at <http://www.fcc.gov/mmb/vsd/>. The most accurate source of these data should be used. Necessary data are station latitude and longitude, height above mean sea level of the radiation center, and the effective radiated power (ERP) in the direction of the individual location under study.

2) Run Longley-Rice 1.2.2 in the point-to-point mode with the parameters specified in Table 1 to find the propagation path loss relative to free space propagation.

3) Find the USGS Land Use and Land Cover classification of the individual location under study by consulting the LULC database, available from the USGS web page at <http://edcwww.cr.usgs.gov/glis/hyper/guide/1_250_lulc>.

4) Convert the USGS Land Use and Land Cover classification to the corresponding ILLR clutter category using Table 2, and find the associated clutter loss from Table 3.

5) Finally, calculate the ILLR field strength prediction from the formula

   Field = (Free Space Field) – (Longley-Rice 1.2.2 Path Loss) – (ILLR Clutter Loss)

   where the Free Space Field in dB: = $106.92 + 10\log_{10}(\text{ERP}) - 20\log_{10}(\text{distance})$, and distance is the path length in kilometers from transmitter to the individual location under study.

HG(1) in Table 1 is the height of the radiation center above ground. It is determined by subtracting the ground elevation above mean sea level (AMSL) at the transmitter location from the height of the radiation center AMSL. The latter may be found in the FCC's TV Engineering Data Base while the former is retrieved from the terrain elevation data base as a function of the transmitter site coordinates also found in the TV Engineering Data Base.

Terrain elevation data at uniformly spaced points between the transmitter and receiver must be provided. The ILLR computer program must be linked to a terrain elevation data base with values every 3 arc-seconds of latitude and longitude or closer. The program should retrieve elevations from this data base at regular intervals with a spacing increment of 0.1 kilometer (parameter XI in Table 1). The elevation of a point of interest is determined by linear interpolation of the values retrieved for the corners of the coordinate rectangle in which the point of interest lies.

Table 1.

Parameter Values for ILLR Implementation of the Longley-Rice Fortran Code

Parameter	Value	Meaning/Comment
EPS	15.0	Relative permittivity of ground.
SGM	0.005	Ground conductivity, Siemens per meter.
ZSYS	0.0	Coordinated with setting of EN0. See page 72 of NTIA Report.
EN0	301.0	Surface refractivity in N-units (parts per million).
IPOL	0	Denotes horizontal polarization.
MDVAR	1	Code 1 sets individual mode of variability calculations.
KLIM	5	Climate code 5 for continental temperate.
XI	0.1 km	Distance between successive points along the radial from transmitter to individual reception point.
HG(1)	see text	Height of the radiation center above ground.
HG(2)	6 m, or 9 m	Height of TV receiving antenna above ground. Use 6 m for one-story building; otherwise 9 m.
KWX	numeric error marker	KWX is an output indicating the severity of a possible error due to parameters being out of range. Accept the field strength prediction when KWX is 3.

Table 2.

Regrouping of LULC Categories for ILLR Applications*

The United States Geological Survey (USGS) maintains a database on land use and land cover indicating features such as vegetation and man-made structures. It is often called the LULC database and is available from the USGS web page at <http://edcwww.cr.usgs.gov/glis/hyper/guide/1_250_lulc>.

LULC Classification Number	LULC Classification Description	ILLR Clutter Category Number	ILLR Clutter Category Description
11	Residential	7	Residential
12	Commercial and services	9	Commercial/industrial
13	Industrial	9	Commercial/industrial
14	Transportation, communications, & utilities	1	Open land
15	Industrial and commercial complexes	9	Commercial/industrial
16	Mixed urban and built-up lands	8	Mixed urban/buildings
17	Other urban and built-up land	8	Mixed urban/buildings
21	Cropland and pasture	2	Agricultural
22	Orchards, groves, vineyards, nurseries, and horticultural	2	Agricultural
23	Confined feeding operations	2	Agricultural
24	Other agricultural land	2	Agricultural
31	Herbaceous rangeland	3	Rangeland
32	Shrub and brush rangeland	3	Rangeland
33	Mixed rangeland	3	Rangeland
41	Deciduous forest land	5	Forest land
42	Evergreen forest land	5	Forest land
43	Mixed forest land	5	Forest land
51	Streams and canals	4	Water
52	Lakes	4	Water
53	Reservoirs	4	Water
54	Bays and estuaries	4	Water
61	Forested wetland	5	Forest land
62	Non-forest wetland	6	Wetland

* This regrouping into 10 categories for use with the ILLR model was designed by EDX Engineering, Inc.

Table 2, Continued.

Regrouping of LULC Categories for ILLR Applications

LULC Classification Number	LULC Classification Description	ILLR Clutter Category Number	ILLR Clutter Category Description
71	Dry salt flats	1	Open land
72	Beaches	1	Open land
73	Sandy areas other than beaches	1	Open land
74	Bare exposed rock	1	Open land
75	Strip mines, quarries, and gravel pits	1	Open land
76	Transitional areas	1	Open land
77	Mixed barren land	1	Open land
81	Shrub and brush tundra	1	Open land
82	Herbaceous tundra	1	Open land
83	Bare ground	1	Open land
84	Wet tundra	1	Open land
85	Mixed tundra	1	Open land
91	Perennial snowfields	10	Snow & ice
92	Glaciers	10	Snow & ice

Table 3.

Clutter Loss as a Function of ILLR LULC Clutter Category and TV Channel

ILLR Clutter Category Number	ILLR Clutter Category Description	Clutter Loss dB to be added to Longley-Rice prediction of path loss			
				UHF Band	
		Low Band VHF, Channels 2-5	High Band VHF, Channels 7-13	Channels 14-36	Channels 38-69
1	Open Land	0	0	4	5
2	Agricultural	0	0	5	6
3	Rangeland	0	0	3	6
4	Water	0	0	0	0
5	Forest Land	0	0	5	8
6	Wetland	0	0	0	0
7	Residential	0	0	5	7
8	Mixed Urban/Buildings	0	0	6	6
9	Commercial/Industrial	0	0	5	6
10	Snow and Ice	0	0	0	0

APPENDIX B

Rule Changes

Part 73 of Chapter I of title 47 of the Code of Federal Regulations is amended as follows:

PART 73 – RADIO BROADCAST SERVICES

1. The authority citation for Part 73 continues to read as follows:

   Authority: 47 U.S.C. 154, 303, 334, and 336.

2. The title of Section 73.683 is amended to read as follows:

   Section 73.683 Field Strength Contours and Presumptive Determination of Field Strength at Individual Locations.

3. A new subsection 73.683(d) is added as follows:

   (d) For purposes of determining the eligibility of individual households for satellite retransmission of distant network signals under the copyright law provisions of 17 U.S.C. §119(d)(10)(A), field strength shall be determined by the Individual Location Longley-Rice (ILLR) propagation prediction model. Guidance for use of the ILLR model for these purposes is provided in OET Bulletin No. 72. This document is available through the Internet on the *FCC Home Page* at http://www.fcc.gov.

4. A new subsection 73.686(e) is added as follows:

   (e) In the case of measurements to determine the eligibility of individual households to receive satellite retransmission of distant network signals under the copyright law provisions of 17 U.S.C. §119(d)(10), if a satellite carrier and the network station or stations asserting that the retransmission of a signal of a distant network station is prohibited are unable to agree on a person to conduct the test, the American Radio Relay League, Inc., 225 Main Street, Newington, CT 06111-1494, shall designate the person or organization to conduct measurements based on the technical qualifications and independence of proposed testers. The satellite carrier and network station shall propose testers and provide their qualifications in writing to the American Radio Relay League (ARRL). Individuals may also volunteer themselves as testers by submitting their qualifications to the ARRL. The ARRL can be reached by telephone at 860-594-0200, or email at hq@arrl.org.

APPENDIX C

Parties Filing Comments and Reply Comments

Parties Filing Comments

1. ABC, CBS, FOX, and NBC Television Affiliates Association
2. Association of Federal Communications Consulting Engineers
3. Communications Technologies, Inc.
4. DIRECTV, Inc.
5. EchoStar Statellite Corporation
6. Fox Television Stations, Inc., and Fox Broadcasting Company
7. Harry R. Anderson (EDX Engineering, Inc.)
8. National Association of Broadcasters and Association for Maximum Service Television, Inc.
9. National Rural Telecommunications Cooperative
10. Paxson Communications Corporation
11. Peter Moncure (RadioSoft)
12. Richard L. Biby, P.E.
13. Satellite Broadcasting and Communications Association
14. du Treil, Lundin & Rackley, Inc.

Parties Filing Reply Comments

1. Richard L. Biby, P.E.
2. EchoStar Statellite Corporation
3. Fox Television Stations, Inc., and Fox Broadcasting Company
4. National Association of Broadcasters and Association for Maximum Service Television, Inc.
5. National Rural Telecommunications Cooperative
6. Potomac Instruments, Inc.