



PEER REVIEW REPORT — FEBRUARY 27, 2006

Title of Review: Influential Scientific Information Peer Review -- *Development of Possible HDFS/FSS Gateway Earth Station Sharing Criteria*

Agency: Federal Communications Commission

Category: Highly Influential Scientific Assessment
 Influential Scientific Information

Type of Review: Individual
 Panel
 Alternative Process _____

Number of Reviewers: Three

Reviewers Selected by: Agency
 Designated Outside Organization

Primary Disciplines and Expertise of Reviewers

The Panel is comprised of three senior level engineers and attorneys with extensive telecommunications policy experience including satellite interference issues. The members are John Wong, Chief, Engineering Division, Media Bureau, Wayne McKee, Assistant Chief, Engineering Division, Media Bureau and Rosalee Chiara, Senior Attorney, Policy Division, Media Bureau. Mr. Wong is an engineer. Mr. McKee is both an attorney and engineer and Ms. Chiara is an attorney.

The reviewers did not participate in the creation of the report under review, do not have any financial or other interest in the finding under review, and are in compliance with the federal ethics requirements contained in 18 U.S.C. § 208, 47 U.S.C. § 154 (b) and 5 C.F.R. Part 2635.

Subject of Review:

The 1992 World Radiocommunication Conference (WRC), with the strong support of the United States, decided that the 37.5 GHz to 42.0 GHz band could be shared by both Fixed Service (FS) and Fixed Satellite Service (FSS) (space-to-Earth) on a co-primary basis. In Region 2 (which includes the United States), the U.S. delegation to the WRC realized that sharing the band between these two services would be difficult and therefore adopted a "soft-segmentation" scheme. "Soft-segmentation" uses service rules that would allow both FS and FSS to



operate in the band, but would encourage FS deployment below 40 GHz by imposing more restrictive power flux density (PFD) limits on satellite operators below 40 GHz, and promote FSS deployment above 40 GHz by imposing more liberal PFD limits above 40 GHz.

In a previous Report and Order, the Commission decided that during periods of little or no rain fade¹ the FSS downlinks in the 37.5-40.0 GHz band would operate 12 dB below the internationally agreed PFD limits to provide added protection of the FS. This PFD level is called the "clear-air" PFD limit. The Commission also decided that during times of increased rain fade the FSS could increase their PFDs up to the international PFD limit (i.e., 12 dB above the clear-air PFD limits) in order to help maintain their required link availability. The Commission did not determine, however, how or for what percentage of the time the transition from clear-air PFDs to 12 dB above clear-air PFDs was to be implemented or regulated.

In addition to the WRC actions, an on-going study within the ITU sought to refine the information on the V-band FSS and FS systems and to document possible techniques that could be used to examine sharing between the FSS and FS. The study provided a number of "typical" parameters for FS and FSS systems. The study also asked the ITU experts on propagation (ITU-R Working Party 3M, or WP3M) to clarify the relationship between the rain fade on the satellite-to-earth station² link and rain-induced losses experienced between the satellite and an FS station located some distance away from the earth station. The ITU study reasoned that, if FSS operators increased the satellite PFDs to compensate for the increased rain losses between the FSS satellite and the earth station, an FS station co-located with the earth station's would not see any increase in PFD because the rain storm simultaneously causes the increased losses and absorbs all PFD increases, thereby providing a shield to the FS stations near the Earth station. At some distance away from the earth station, however, the rain storm may not shield an FS station from the total increase in PFD, and at distances far from the earth station, the storm may not provide any shielding and an FS station may experience the full increase in PFD. WP3M developed a bounding equation which predicts the maximum percent of time that

¹ The terms "rain fade" and "rain loss" are used here in the same way as the more general technical term "hydrometer loss." They describe attenuation in a communication channel caused by atmospheric water in its various forms such as rain, sleet, snow, clouds etc.

² The FSS satellite antenna is assumed to be pointed directly at the Earth station.



point a given distance from the earth station can expect to experience a given change in the level of PFD.³

Purpose of Review:

The staff study sought to investigate the relationship between the increases in PFD in the FSS downlink required to overcome rain fades and the PFD levels experienced at an FS station operating some distance from the FSS earth station. The study sought ultimately to create service rules that would consider the exposure of the FS to increased PFDs to FSS gateway stations.

Scope of Review:

IB seeks peer review of the assumptions, calculations, and methodology in the Staff Report, and conclusions drawn from the analysis, to verify that the assumptions, calculations, methodology, and conclusions conform to generally accepted standards in the radio engineering field. We also seek comment on any revisions or improvements that might be necessary to ensure the Staff Report conforms to generally accepted standards in the field. In particular, IB seeks to ensure the accuracy and potential for replication of the study, that scientific uncertainties are clearly identified and characterized, and that the potential implications of the uncertainties for the technical conclusions drawn are clear.

Specific Charges and Responses:

IB seeks responses to the following questions with specific suggestions for improvement, if necessary:

1. Do the assumptions contained in the Staff Report conform to generally accepted standards in the radio engineering field?
2. Do the calculations in the Staff Report conform to generally accepted standards in the radio engineering field?
 - a. Are the results accurate?
 - b. If statistical methods are used, are the techniques appropriate for the problem?
 - c. If software is used, is the software appropriate for the problem and current?
3. Does the methodology contained in the Staff Report conform to generally accepted standards in the radio engineering field?
4. Do the conclusions contained in the Staff Report conform to generally accepted standards in the radio engineering field?

³ See ITU-R Document 4-9S/299 4 June 2002 entitled: Liaison Statement To Working Party 4-9S Concerning The Percentage Of Time During Which Fixed-Satellite Service Nominal Clear-Sky Power Flux-Density Levels May Be Exceeded To Overcome Fading Conditions, While Protecting The Fixed Service, And Permitting Operation Of FSS Earth Stations In The Bands 37.5-40 GHz And 42-42.5 GHz



Are there any revisions, improvements, or extensions the reviewer recommends to ensure that the Staff Report conforms to generally accepted standards in the radio engineering field?

Response to the Charge:

- 1. Do the assumptions contained in the Staff Report conform to generally accepted standards in the radio engineering field?**

Yes, when assumptions are required, the Report is based on conservative assumptions that result in added safety margins. In some instances, the Report is based on ITU assumptions, whereas in other instances, the IB staff modified or set aside ITU assumptions and conducted its own analysis based upon more recent and appropriate parameters. For example, on page 9 in the second full paragraph, the Report deviates from ITU studies and instead is based on more realistic assumptions. Also on page 10, the Report uses a Monte Carlo approach to model FS and FSS interactions using assumptions based upon values the staff considers most likely to prevail in actual situations. The Panel believes the assumptions contained in the Report adhere to sound engineering standards in the radio engineering field.

- 2. Do the calculations in the Staff Report conform to generally accepted standards in the radio engineering field?**

The Panel did not revisit the calculations contained in the Report but the calculations appeared to be correct. They are based on standard formulas and established satellite industry practices including formulas from the ITU, modified as necessary. Another example is the use of the Monte Carlo approach which is one of the textbook standards for communications systems simulation.

- 3. Does the methodology contained in the Staff Report conform to generally accepted standards in the radio engineering field?**

Yes. The Report uses accepted standards such as the Monte Carlo approach, free space analysis, rain fade calculations etc. It also employs standard procedures and methodologies recommended by the ITU (ITU-R Rec.). These are generally accepted in the field.



4. Do the conclusions contained in the Staff Report conform to generally accepted standards in the radio engineering field?

The Report's conclusions are reasonable and naturally follow from the methodologies used as they relate to satellite radio engineering and the special applications necessary to evaluate satellite systems. We also believe the derived conclusions for FS systems conform to standards used to analyze communications systems.

5. Are there any revisions, improvements, or extensions the Panel recommends to ensure that the Staff Report conforms to generally accepted standards in the radio engineering field?

The Report should incorporate the revisions and improvements suggested by the Panel and reflected in the IB bureau response to the Panel dated February 13, 2006 (attached). The Report could be improved by being more explicit in defining and explaining the "costs" to FS operations as referenced in part 4.4.

In summary, as discussed above, we find that the assumptions, calculations, and methodologies used to conduct this study of HDFS/FSS gateway earth station sharing criteria are proper and consistent with sound engineering practices. The Report conforms to generally accepted standards in the field of telecommunications and satellite radio engineering. The Panel has noted and suggested some minor clarifications and revisions which we understand will be incorporated in the final draft. The Panel believes that the study is well founded and the results are repeatable.

Respectfully submitted,

John Wong
Wayne McKee
Rosalee Chiara