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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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JUL 31 1997

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of	)	
	)	
Petition of DirecTV Enterprises, Inc.	)	
to Amend Parts 2, 25 and 100	)	RM-9118
of the Commission's Rules to Allocate	)	
Spectrum for the Fixed-Satellite Service	)	
and the Broadcasting-Satellite Service	)	

To: The Commission

COMMENTS OF SKYBRIDGE L.L.C.

SkyBridge L.L.C. ("SkyBridge"), by its attorneys, submits these comments in response to the Petition for Rulemaking (the "Petition") filed by DirecTV Enterprises, Inc. ("DirecTV") on June 5, 1997, and placed on Public Notice by the Commission on July 1, 1997.[1] The Petition asks the Commission to initiate a rulemaking proceeding to amend the Commission's rules to provide, inter alia, for the use of the 17.3-17.8 GHz band for BSS expansion.[2]

1/ In the Matter of the Petition of DirecTV Enterprises, Inc. to Amend Parts 2, 25 and 100 of the Commission's Rules to Allocate Spectrum for the Fixed-Satellite Service and the Broadcasting-Satellite Service, RM No. PRM97MM, filed June 5, 1997; Public Notice, Report No. 2208 (July 1, 1997).

2/ The Petition was filed in connection with an application (the "DirecTV Application") filed by DirecTV on the same date, requesting authority to construct, launch and operate an expansion system of six direct broadcast satellites. File No. 75/76/77-SAT-P/LA-97 (filed June 5, 1997).

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I. SKYBRIDGE'S INTEREST IN THE PROCEEDING

SkyBridge currently has on file with the Commission an application (the "SkyBridge Application") for authority to launch and operate the "SkyBridge System," a global network of nongeostationary orbit ("NGSO") communications satellites operating at Ku-band, designed to provide broadband services in the Fixed-Satellite Service ("FSS").[3/] SkyBridge proposes to operate its "Gateway" earth stations in the 17.3-17.8 GHz band.

Although a key feature of the SkyBridge System is its ability to share spectrum with geostationary orbit ("GSO") and Fixed Service ("FS") systems, the DirecTV proposal involves a mode of operation that may threaten the ability of BSS systems to coexist with the SkyBridge System, as well as other GSO, FS, and NGSO systems. While SkyBridge proposes to operate uplinks in the 17.3-17.8 GHz band, DirecTV proposes to introduce BSS downlinks into the band.

II. STATUS OF THE 17.3-17.8 GHz BAND

In ITU Region 2, the 17.3-17.7 GHz band is currently allocated on a primary basis only to FSS uplinks. See 47 C.F.R. 2.106. Pursuant to footnote S5.516, however, use of this allocation is restricted to BSS feeder links. As demonstrated in Section V and Appendix B of the SkyBridge Application, the SkyBridge System can readily share the subject band with BSS feeder links (or other GSO uplinks, for that matter).

[3/] In the Matter of the Application of SkyBridge L.C.C. for Authority to Launch and Operate a Global Network of Low Earth Orbit Communications Satellites Providing Broadband Services in the Fixed Satellite Service, File No. 48-SAT-P/LA-97, filed February 28, 1997; Amendment, filed July 3, 1997.

The 17.7-17.8 GHz band is currently allocated on a primary basis to FSS uplinks and downlinks, and to the Fixed and Mobile[4/] Services. Again, use of the allocation for FSS uplinks is restricted to BSS feeder links (see S5.516). In the U.S., the band is assigned for downlink only to FSS, which must share the band coequally with the terrestrial services. See 47 C.F.R. 25.202.

Footnote S5.517 of the Radio Regulations states that, in Region 2, the 17.3-17.8 GHz band will be allocated to BSS for downlinks on a primary basis effective April 1, 2007. At such time, use of the band by FSS uplinks shall become secondary. Pursuant to the ITU Radio Regulations, therefore, use of the 17.3-17.7 GHz band for GSO downlinks of any kind is not contemplated prior to April 1, 2007. Use of the 17.7-17.8 GHz band for GSO downlinks prior to this date is contemplated for FSS downlinks only.

III. ANALYSIS OF DIRECTV'S PROPOSED RULES

Notwithstanding the current U.S. and international allocations, DirecTV urges the Commission to provide for use of the 17.3-17.8 GHz band for BSS downlinks prior to April 1, 2007, in order to allow licensed BSS operators to expand their direct-to-home ("DTH") systems. The proposed amendment, DirecTV argues, will: (1) maximize the efficient use of orbital spectrum resources; (2) implement the ITU's Final Acts of WARC-92; (3) alleviate an alleged shortage of BSS capacity in the U.S.; and (4) further the competitiveness of United States industry in the

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[4/] The allocation to the Mobile Service is primary only until April 1, 2007.

provision of DTH satellite services.[5] As demonstrated below, none of these arguments has any merit, and some border on specious. Particularly in light of the serious spectrum sharing concerns outlined below, there is no rational public interest basis for allowing the premature use of these bands for BSS downlinks.

A. The requested allocation will not maximize efficient use of the spectrum.

As DirecTV notes in its Application, "[t]he DIRECTV expansion system must coexist with other satellite systems." DirecTV Application at 44. However, DirecTV has presented no analysis it its Petition or Application to demonstrate its ability to share with other GSO or NGSO systems, such as the SkyBridge System. DirecTV acknowledges that uplink stations at 17.3-17.8 GHz may create interference into DirecTV customer receive terminals operating in the vicinity of those stations, id. at 44, but does not quantify the potential interference. Rather, DirecTV simply concludes that "such cases will be limited in scope, and can be easily addressed through reasonable interference protection measures that will not burden the uplink operator." DirecTV Application at 44. Furthermore, the measures proposed by DirecTV -- limiting uplink power levels, minimizing uplink antenna sidelobes, and deploying shielding around uplink sites, see DirecTV Petition at 9 -- all constrain the uplink operator, without putting any burden whatsoever on the BSS downlink operator.

By contrast, as the Commission is well aware, the SkyBridge System has been designed from the start to be capable of sharing the subject band with GSO

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[5] DirecTV Petition at 2.

uplinks operating according to the current U.S. and international allocations and rules.[6] The SkyBridge System will not degrade the quality of service or availability of GSO or terrestrial links, and will impose no operational constraints on operators of these systems.[7] As a result, SkyBridge can coexist with many services in this band, maximizing efficient use of this spectrum.

As discussed in detail in Appendix A attached hereto, SkyBridge has analyzed the potential for interference in the 17.3-17.8 GHz band between BSS downlinks and the SkyBridge System, based on DirecTV parameters presented in the DirecTV Application. The study indicates that sharing of the subject band between DirecTV and SkyBridge, or between DirecTV and another GSO or FS system, may be quite problematic. Specifically, Appendix A illustrates the very real potential for SkyBridge Gateway (or other GSO uplink) interference into DirecTV consumer DTH dishes. This is the case even though the SkyBridge Gateways use fully compliant, state-of-the-art, antenna patterns and are far from being the most powerful uplink transmitters, and shielding of the Gateways with an RF fence was assumed in the

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[6] For example, DirecTV proposes to operate TT&C uplinks in the 14.0-14.5 GHz band. See Direct TV Application at 6. SkyBridge also proposes to use this band for uplinks. However, the SkyBridge System has been designed to share this band with GSO uplinks. Therefore, SkyBridge uplinks and DirecTV TT&C uplinks can coexist in this band.

[7] SkyBridge achieves these goals by, inter alia, switching off spot-beams to avoid potential interference situations, and using a specific waveform, including spreading, to limit power flux densities. These and other steps ensure that the power levels contributed by SkyBridge to any GSO or terrestrial system will be well below the noise floor of the receivers of such systems. These techniques are discussed in detail in the SkyBridge Application, and in particular in the July 3, 1997, Amendment.

analysis. Coordination to mitigate such interference appears impractical due to the ubiquitous nature of the DTH dishes, and the fact that the location of these dishes is not under the control of the DTH operator. Efficient use of orbital spectrum will not result if such systems cannot coexist in the band.

If BSS operators were themselves to take steps to allow sharing of the 17.3-17.8 GHz band, it might be possible to maximize spectrum utilization. However, DirecTV proposes no such steps, other than to require that BSS systems adhere to the power flux density ("pfd") limits of Section 25.208 of the Commission's Rules, 47 C.F.R. § 25.208. Direct TV Application at 9. These limits, however, were intended to protect terrestrial systems, and will not solve the problem of reverse-band sharing among satellite services.

B. Adoption of the requested allocation is premature.

Adoption of the requested allocation at this time will not implement the ITU's Final Acts of WARC-92. Under the ITU rules, use of the subject band for BSS downlinks is not scheduled until April 1, 2007. Furthermore, this future allocation was intended solely for "next generation" BSS applications, specifically high definition television services. Although DirecTV in its Application mentions that its proposed expanded system is anticipated to include high definition (in addition to standard) formats, DirecTV largely justifies its need for the additional spectrum by proposing other services such as data and multimedia services, for which this spectrum was not intended. See DirecTV Application at 4-5. Importantly, as DirecTV notes, the U.S. did not support the future allocation of this band to BSS, DirecTV Petition at 4, finding that any future HDTV needs could be accommodated

in the 12 GHz band, or if necessary, at the 24.65-25.25 GHz band. Allocation of the 17.3-17.8 GHz band for BSS expansion in the U.S. prior to 2007 is therefore clearly premature at best, and unnecessary at worst.

C. There is no current shortage of BSS capacity in the U.S.

DirecTV demonstrates no current shortage of BSS capacity in the U.S. A number of licensed systems have yet to be constructed (e.g., USSB's, MCI's), and DirecTV has made no showing whatsoever that it has exhausted the technical capacity of its existing system or that its current channel capacity is inadequate to compete against, e.g., existing cable systems. Without any demonstration of need, DirecTV's request could readily be characterized as attempted warehousing.

D. The requested allocation is not needed to further DTH competitiveness.

Finally, DirecTV argues that its proposal will further the competitiveness of United States industry in the provision of DTH satellite services. DirecTV does not propose to permit new entry into the DTH market through use of the BSS expansion spectrum; rather, it proposes to allow existing licensees to expand program offerings. However, DirecTV provides no evidence that increasing the capacity of current DTH systems will allow DTH to be more competitive with cable and other current and future providers of video programming.

The current offerings of the DirecTV service include 189 channels of programming. As discussed supra, DirecTV fails to offer any evidence that its current capacity (with or without additional compression) is inadequate to compete either with other DBS systems or state-of-the-art cable systems.

IV. CONCLUSION

According to SkyBridge's assessment (and in the absence of any analysis by DirecTV to the contrary), it appears that allocation and assignment of the 17.3-17.8 GHz band to BSS downlinks would inhibit efficient spectrum utilization, by leading to an interference situation that cannot be mitigated by coordination (due to the ubiquitous nature of DTH consumer dishes). Furthermore, such a rule change at this time is premature, and not necessary for promoting the DTH industry in the United States. If the Commission should nonetheless decide that the allocation is in the public interest, the Commission should seek to assure that the rules governing BSS downlinks in the band require these downlinks to share the band with current licensees and applicants in the band, while posing no additional operating constraints on these licensees and applicants.

Respectfully submitted,

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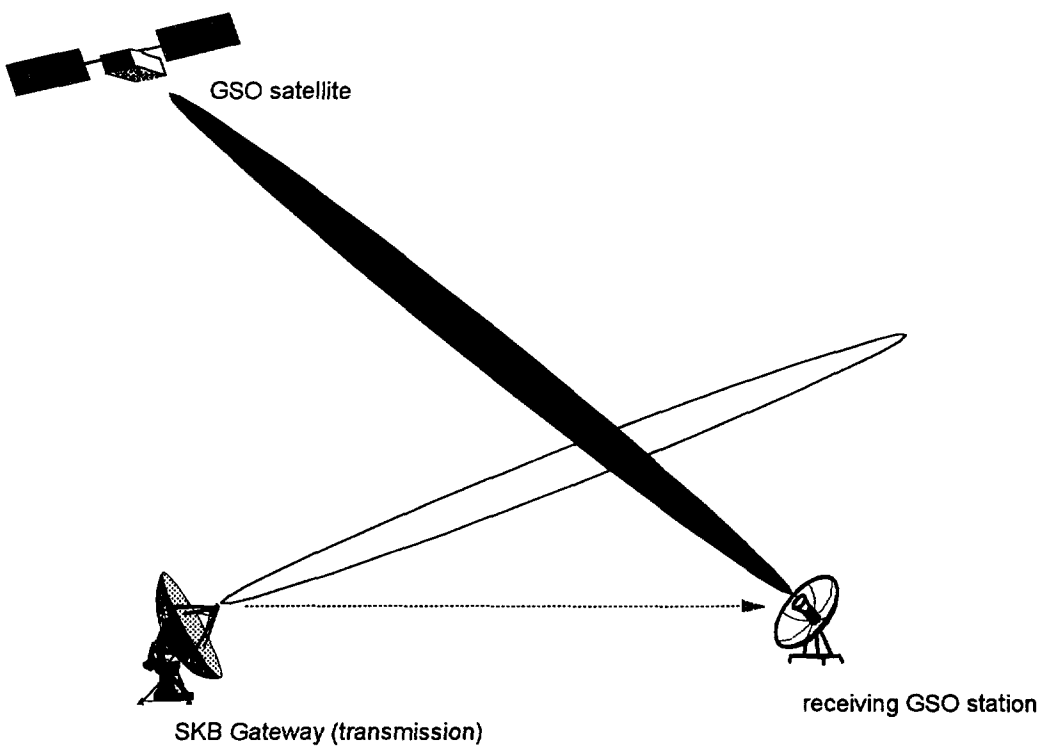
Appendix A: Sharing Analysis

In this Appendix, SkyBridge assesses the potential interference from SkyBridge "Gateway" earth stations[1/] to DTH consumer receiving dishes operating in the 17.3-17.8 GHz band, and derives the coordination distances required to protect the DTH system.[2/] The worst case interference would be caused by the transmission of the secondary lobes of SkyBridge Gateways into secondary lobes of DTH receiving dishes, as illustrated below:



1/ As discussed in the Amendment to the SkyBridge Application filed July 3, 1997 (the "SkyBridge Amendment"), SkyBridge does not intend to use the 17.3-17.8 GHz band for its "User Terminals." (See SkyBridge Amendment at 9.)

2/ Other potential interference configurations, such as satellite-to-satellite, appear upon first examination to be non-problematic.

DTH Parameters

For this analysis, the following nominal parameters, based on data contained in the DirecTV Application at pages 39-42, are used to describe the DTH downlink:

Antenna Diameter of the DTH Dishes	45 cm
Antenna Pattern of the DTH Dishes	Appendix 29[3/]
DTH Satellite EIRP	53.7 dBW[4/]
Admissible C/I from Adjacent GSO Downlinks	11.9 dB[5/]
Noise Temperature of the DTH Dishes	135 K
Carrier Bandwidth	24 MHz

Using these parameters, it is possible to assess the power density of the DTH signal received by the DTH dishes and the noise power density, for both the clear sky and rain fade situations.

3/ From link budgets and C/I values from other GSO satellites spaced at 4.5°, it can be deduced that the antenna pattern of the DirecTV dishes follow Appendix 29, i.e., the antenna pattern is $52 - 10 \log(D / \lambda) - 25 \log(\theta)$.

4/ It is not at all clear what EIRP should be used for this analysis. The nominal figure used in the link budget on page 42 was applied here, but it should be noted that lower figures appear in the DirecTV Application (50 dBW for edge of coverage on page 22, and 44 dBW for Anchorage on page 20). Use of a lower EIRP in the analysis will lead to larger coordination distances required to protect DTH dishes. On the other hand, as demonstrated below, it appears that higher EIRPs than those presented in the DirecTV Application will be required in order for the system to meet DirecTV's availability goals. If higher powers are in fact used, the coordination distances would decrease.

5/ This figure corresponds to the 4.5° satellite spacing proposed in the DirecTV Petition at 2.

DTH Clear Sky Link Budget

The following nominal link budget for the clear sky situation is based on the above parameters, and parameters derived from data found on pages 39-42 of the DirecTV Application:

Satellite EIRP	53.7	dBW
Free Space Loss	-208.9	dB
Atmospheric Loss	-0.9	dB
Pointing Loss	-0.5	dB
Receiving Antenna Gain[6/]	36.7	dBi
Downlink Noise Temperature[7/]	135	K
G/T	15.4	dB/K
Bandwidth	73.8	dBHz
C	-193.7	dB(W/Hz)
N	-207.3	dBW

6/ This figure was derived from the antenna diameter and efficiency stated in the DirecTV Application at 39-40.

7/ This figure was derived using the G/T figure specified in the DirecTV Application at 42, and the receive antenna gain computed above.

Uplink C/N[8/]	17.4	dB
Downlink C/N	13.6	dB
Crosspolarization Interference	20.9	dB
Interference from Adjacent Satellites	11.9	dB
Total C/(N+I)	8.7	dB
Required C/(N +I)	5.1	dB
Margin	3.6	dB

8/ In the link budget on page 42 of the DirecTV Application, there are two inconsistent figures listed for "Uplink C/N" (17.4 dB and 21.4 dB). The figure of 17.4 dB was used here because it results from the calculations presented in the first section of DirecTV's link budget, and thus appears more credible.

DTH Rain Fading Link Budget

Rain fading is calculated with the Crane model (the model DirecTV assumes on page 39 of its Application), using the availability specified by DirecTV for its system (99.7% over "most of CONUS"; see DirecTV Application at 39). The increase in noise temperature is then calculated as $T_{rain}=T_{clear} + 290 \cdot (1 - 10^{-A/10})$, where A represents the amount of rain fading.

The following nominal link budget for the rain fading situation is based on the above parameters, and parameters derived from data found on pages 39-42 of the DirecTV Application. In this budget, the satellite EIRP has been left as a variable so that the actual value of the EIRP at various geographic locations can used in the computations.

Satellite EIRP	**X**	dBW
Free Space Loss	-208.9	dB
Pointing Loss	-0.5	dB
Rain Loss plus G/T Loss	**M**	dBi
G/T	15.4	dB/K
Bandwidth	73.8	dBHz
Boltzmann's Constant	228.6	dB(W/Hz)
Downlink C/N	**Z**	dB

Uplink C/N[9/]	17.4	dB
Downlink C/N	Z	dB
Crosspolarization Interference	20.9	dB
Interference from Adjacent Satellites	11.9	dB
Required C/(N +I)	5.1	dB

Working backwards, to obtain the required C/(N+I), a downlink C/N, or Z, of 6.6 dB is needed. Again working backwards, this leads to

M = X - 45.8 dB.

Using the geographic locations and satellite EIRPs specified on page 20 of the DirecTV Application, the following table can be computed, which compares the amount of rain fading expected to the total available rain margin according to the link budget above. In other words, the rain margin presented in the last column is the maximum rain fade condition for which the link budget is satisfied.

9/ In the link budget on page 42 of the DirecTV Application, there are two inconsistent figures listed for "Uplink C/N" (17.4 dB and 21.4 dB). The figure of 17.4 dB was used here because it results from the calculations presented in the first section of DirecTV's link budget, and thus appears more credible.

Location	Satellite EIRP (dBW)	Rain Fading (dB)	Rain Margin (dB)
Boston	54	3.7	4.4
Chicago	54	3.3	4.4
Denver	51	1.6	2.4
Houston	56	4.8	6.0
Los Angeles	51	1.6	2.4
Miami	57	7.8	6.9
Minneapolis	51.5	3.2	2.7
New York	54	3.6	4.4
San Antonio	52.5	4.8	3.4
San Francisco	51	1.6	2.4
Seattle	51	1.4	2.4
Utah	51	1.6	2.4
Anchorage	44	1.7	negative
Honolulu	54	2.1	4.4

The results indicate inconsistencies between the availability goals and the EIRP capabilities of the proposed DirecTV system. In the case of Miami, Minneapolis, San Antonio, and Anchorage, the expected rain fade exceeds the rain margin in the link budget. In fact, in Anchorage, the rain margin is negative. Even when the rain margin exceeds the expected rain fade, the difference is quite small. Therefore, it appears that the DirecTV system will be very sensitive to interference from other sources, such as FSS and BSS uplinks.

SkyBridge Parameters

The SkyBridge System parameters used in this analysis are summarized in the table below. They are identical to those used in Appendix C of the SkyBridge Amendment for determining the coordination distances required to protect FS receivers from SkyBridge earth station transmissions.

On-axis SkyBridge Gateway EIRP	52.1 dBW	
G_{max} - G (Isolation)	36.9 dB (@6°)	59.4 dB (backlobes)
Bandwidth (22.6 MHz)	73.5 dB(Hz)	
Power Density in Direction of DTH Dish	-58.3 dB(W/Hz)	-80.8 dB(W/Hz)

Derivation of Coordination Distances

For each of three geographical locations (Anchorage, Hawaii, and elsewhere in the United States), two cases are examined:

- A worst-case situation occurring when a SkyBridge Gateway transmits at an elevation of 6°, with no azimuthal discrimination with respect to the DTH dish; and
- A nominal case where the SkyBridge Gateway transmits at an elevation of 25°, with an azimuthal discrimination of 40° with respect to the DTH dish, with the dish providing the isolation of its back lobes.

The elevations of the DTH dishes are 10° for Anchorage, 20° for Honolulu and >30° for the rest of the US.

For this analysis, the following non-interference criterion was selected:

Non-interference criterion: At least a 24 dB C/I, leading to a I/N ratio of 10 dB.

To assess the possibility of SkyBridge and DirecTV coexistence in the subject band, the minimum distance between SkyBridge Gateways and DirecTV consumer dishes required to satisfy the criterion for each of the three geographic locations is derived as follows:

Anchorage	worst case	nominal case
SkyBridge Power Density in Direction of DTH Dish	-58.3 dB(W/Hz)	-80.8 dB(W/Hz)
SkyBridge RF Fence Protection	25 dB	25 dB
DTH Dish Receiving Gain	12.9 dBi (@10°)	-4.1 dBi
I (dB(W/Hz))	-70.4 dB(W/Hz)	-109.9 dB(W/Hz)
Admissible I	-217.7 dB(W/Hz)	-217.7 dB(W/Hz)
Required Free Space Loss	-147.3 dB	-107.8 dB
Coordination Distance	**31 km**	**320 m**

Honolulu	worst case	nominal case
SkyBridge Power Density in Direction of DTH Dish	-58.3 dB(W/Hz)	-80.8 dB(W/Hz)
SkyBridge RF Fence Protection	25 dB	25 dB
DTH Dish Receiving Gain	5.4 dBi (@20°)	-4.1 dBi
I (dB(W/Hz))	-77.9 dB(W/Hz)	-109.9 dB(W/Hz)
Admissible I	-217.7 dB(W/Hz)	-217.7 dB(W/Hz)
Required Free Space Loss	-139.8 dB	-107.8 dB
Coordination Distance	**14 km**	**320 m**

Elsewhere in U.S.	worst case	nominal case
SkyBridge Power Density in Direction of DTH Dish	-58.3 dB(W/Hz)	-80.8 dB(W/Hz)
SkyBridge RF Fence Protection	25 dB	25 dB
DTH Dish Receiving gain	1 dBi (@30°)	-4.1 dBi
I (dB(W/Hz))	-82.3 dB(W/Hz)	-109.9 dB(W/Hz)
Admissible I	-217.7 dB(W/Hz)	-217.7 dB(W/Hz)
Required Free Space Loss	-135.4 dB	-107.8 dB
Coordination Distance	**8 km**	**320 m**

These results vary, of course, with the EIRP of the DTH satellite. Except for Anchorage, the table on page 20 of the DirecTV Application specifies EIRPs for various cities in the U.S. ranging from 51.0 to 57.0 dBW. If the EIRP in the above computations is reduced from the nominal 53.7 dBW[10/] to 51.0 dBW, the coordination distances for locations in the U.S. other than Anchorage and Honolulu

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10/ See note 4 supra.

increase to **12 km** for the worst case, and **450 m** for the nominal case. If the EIRP is increased to 57.0 dBW, the distances decrease to **6 km** and **230 m**. In the case of Anchorage, for which an EIRP of 44 dBW is specified on page 20 of the DirecTV Application, the coordination distances increase to **35 km** for the worst case, and **1100 m** for the nominal case.[11/]

Conclusion

In its Petition (at 9), DirecTV states that sharing is possible so long as existing gateways operating uplinks in the subject bands have a good antenna pattern, a limited EIRP, and a RF fence, and asserts that these gateways are not numerous. However, although SkyBridge Gateways have a good antenna pattern and an RF fence, and are far from being the most powerful transmitting gateway stations, the above results show that maintaining minimum coordination distances is still important.

Given the above results, such coordination appears to be impractical given the ubiquitous nature of DTH consumer dishes, and the fact that their location is not under the control of the DTH operator.

11/ These results assume 45 cm DTH dishes, as specified on, e.g., page 39 of the DirecTV Application. However, it appears that the link budget will not close at some locations (such as Anchorage) with the dish size and EIRPs specified in the Application. Therefore, it seems that the dish size or the EIRP will need to be increased in some areas. Either action will reduce somewhat the coordination distances computed above.

CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing Comments was served by hand this 31st day of July 1997 to the following:

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