

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

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<i>Application of</i>)	
)	
DIRECTV ENTERPRISES, LLC)	Call Sign:
)	
For Authorization to Launch and)	File No. SAT-LOA-_____
Operate DIRECTV KU-45W, a)	
Ku-Band Space Station, at 45° WL)	
_____)	

**APPLICATION FOR AUTHORIZATION TO
LAUNCH AND OPERATE DIRECTV KU-45W**

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TABLE OF CONTENTS

	<u>Page</u>
I. GRANT OF THIS APPLICATION WOULD SERVE THE PUBLIC INTEREST	2
II. INFORMATION REQUIRED UNDER SEC. 25.114 OF THE COMMISSION’S RULES...	3
1. Name, Address, and Telephone Number of Applicant	3
2. Name, Address, and Telephone Number of Counsel.....	3
3. Type of Authorization Requested	4
4. General Description of Overall System Facilities, Operations and Services	4
5. Operational Characteristics	4
5.1 Frequency and Polarization Plan	4
5.2 Communications Payload	5
5.2.1 Uplink Transmissions	5
5.2.2 Downlink Transmissions	6
5.3 TT&C Subsystem.....	6
6. Orbital Locations	7
7. Predicted Spacecraft Antenna Gain Contours.....	8
7.1 Uplink Beams8	
7.2 Downlink Beam	8
7.3 TT&C Beams8	
8. Service Description, Link Description and Performance Analysis, Earth Station Parameters	9
8.1 Service Description.....	9
8.2 Link Performance.....	9
8.3 Earth Station Parameters	10
9. Satellite Orbit Characteristics	10
10. Power Flux Density.....	10
11. Arrangement for tracking, telemetry, and control	11
12. Physical Characteristics of the Space Station	11
13. Spacecraft Bus Subsystem	11
14. Common Carrier Status.....	12
15. Schedule.....	12
16. Public Interest Considerations	12
17. Interference Analysis	12
18. Orbital Debris Mitigation.....	18
III. ITU Cost Recovery	24
IV. CONCLUSION	24
Appendix A: DIRECTV KU-45W Link Budget Analysis	
Appendix B: Antenna Beam Contours	
Appendix C: TT&C Link Budget Analysis	
Appendix D: Compatibility Analysis of DIRECTV KU-45W with INTELSAT 14	

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**APPLICATION FOR AUTHORITY TO LAUNCH AND
OPERATE DIRECTV KU-45W, A KU-BAND SATELLITE, AT 45° W.L.**

DIRECTV Enterprises, LLC (“DIRECTV”) hereby applies for authority to launch and operate a geostationary Ku-band spacecraft, at the nominal 45° W.L. orbital location. A completed Form 312 and accompanying Schedule S related to this application are attached. DIRECTV intends to use this satellite, to be designated DIRECTV KU-45W, to provide high quality direct-to-home (“DTH”) satellite service, including high-definition (“HD”) video programming. This application provides the information required by the Commission’s rules in support of the proposed satellite authorization. Expedient grant of this application will enable DIRECTV to extend its leadership in digital home video entertainment innovation in Brazil.

I. GRANT OF THIS APPLICATION WOULD SERVE THE PUBLIC INTEREST

Since initiating service in 1994, DIRECTV has become the leading provider of DTH digital television services in the United States, with approximately 20 million subscribers. It currently has a fleet of eleven in-orbit spacecraft operating in the Ku- and Ka-bands, which have enabled DIRECTV to maintain and extend its leadership in HD services and to inaugurate 3D services as well. Its affiliate, DIRECTV Latin America (“DTVLA”), is the leading provider of DTH digital television services throughout Latin America, serving nearly 14.6 million subscribers in over 10 countries using Ku-band satellites. This includes over five million subscribers served by DTVLA’s affiliate Sky Brasil Servicos Ltda., commonly referred to as Sky Brasil, which is growing by more than one million subscribers per year despite intensifying competition. These companies strive to combine unique and compelling content with technological innovation and industry-leading customer service to make DIRECTV and DTVLA the clear choice among consumers throughout the Americas.

This application seeks launch and operating authority for a new Ku-band spacecraft at 45° W.L., which DIRECTV intends to use to expand its DTH capabilities still further in order to support an expansion of programming and the ongoing transition to HD services in Brazil. Transmitting programming in HD (and, in the future, 3D or ultra-HD) format requires significantly more capacity than transmitting the same programming in SD format. As more programmers migrate to higher resolution formats, DIRECTV will need to make sure that its system has the additional capacity available to handle the demands of an increasingly robust slate of such programming. The need for additional capacity is especially acute in Brazil, where Sky Brasil’s existing use of a Ku-

band satellite at 43° W.L. would complement the use of Ku-band satellite assets at the adjacent 45° W.L. location.

Granting this application will serve the public interest in several ways. First, the Commission will enable DIRECTV, and its affiliate DTVLA, to increase the amount of HD programming available to subscribers in Brazil. Second, the ability to keep pace with HD programming demands will make DTVLA better able to compete against cable and telco multichannel video services in Brazil. Third, the rich and varied HD services offered from this orbital location will give subscribers additional incentive to upgrade to digital television sets, further promoting the digital transition. Fourth, operating a satellite at 45° W.L. will provide back-up capacity for Sky Brasil's existing operations at 43° W.L.

For all of these reasons, DIRECTV submits that the Commission should grant this application as expeditiously as possible.

II. INFORMATION REQUIRED UNDER SEC. 25.114 OF THE COMMISSION'S RULES

1. Name, Address, and Telephone Number of Applicant

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2. Name, Address, and Telephone Number of Counsel

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3. Type of Authorization Requested

DIRECTV hereby applies for authority to launch and operate DIRECTV KU-45W, a geostationary Ku-band satellite that will operate at the nominal 45° W.L. orbital location.

4. General Description of Overall System Facilities, Operations and Services

DIRECTV KU-45W will consist of a geostationary satellite located at the nominal 45° W.L. orbital location and associated ground station equipment. DIRECTV KU-45W is designed to provide DTH service in the FSS extended Ku-band and in part of the conventional Ku-band (*i.e.*, 10.95-11.2 GHz , 11.45-11.7 GHz and 11.95-12.2 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space)). The on-station Telemetry, Tracking and Control (“TT&C”) functions will be provided at the edges of these same frequency bands.

The DIRECTV KU-45W satellite is capable of supporting thirty-six 36 MHz Ku-band transponders (eighteen vertical polarization and eighteen horizontal polarization) providing downlink coverage via a Brazilian national beam. The Brazilian national coverage beam is designed to provide coverage to all of Brazil. This beam will carry national programming material, which will be transmitted to the satellite from within Brazil via multiple uplink spot beams. The DIRECTV KU-45W system and associated ground Ku-band assets will be capable of transmitting approximately 180 channels of HD programming.

5. Operational Characteristics

5.1 Frequency and Polarization Plan

Details of the DIRECTV KU-45W frequency/channelization and polarization plan, including the TT&C frequencies, are included in the accompanying Schedule S,

which is hereby incorporated by reference as if fully set forth herein. The emission designator for transmissions in the communications payload uplink and downlink will be 36M0G7W. The allocated bandwidth for these emissions is 36 MHz.

The interconnection capability of each national programming uplink channel to its corresponding downlink channel for the DIRECTV KU-45W is shown in the accompanying Schedule S. Note that because of the national coverage design, the downlink channels can only be used once. Also note that multiple uplink sites are used to provide sufficient uplink bandwidth to “feed” the downlink spectrum.

5.2 Communications Payload

5.2.1 Uplink Transmissions

The maximum receive antenna gain, receive system noise temperature, and maximum G/T of the DIRECTV KU-45W satellite receive beams are all specified in the accompanying Schedule S. Note that the G/T will decrease, dB-for-dB, from the maximum as the uplink location moves away from beam peak. All Brazilian national uplink channels are to be transmitted from locations within Brazil.

The DIRECTV KU-45W uplink channels will be routed to the appropriate band-limiting input multiplexer (“IMUX”) comprising the receive channel filters to limit the bandwidth of received signals. Representative performance of these filters is shown in Table 5-1. The received signals will then be frequency translated to the desired output channel frequency. The filtered and frequency translated signals will be amplified by channel amplifiers with selectable fixed/Automatic Level Control (“ALC”) modes prior to final amplification. The fixed gain mode will have at least 20 dB of gain adjustment with a step size of 1 dB. The ALC will hold the output level constant over an input

dynamic range of at least 15 dB and will have a minimum output level adjustment of 10 dB in 0.5 dB increments.

Parameter	Frequency (F_c)	Specification
Insertion Loss Variation	±9 MHz	0.15 dB _{p-p}
	±11.6 MHz	0.19 dB _{p-p}
	±14.4 MHz	0.40 dB _{p-p}
	±18.0 MHz	1.14 dB _{p-p}
Out of Band Rejection	±22.8 MHz	3.0 dB
	±35.5 MHz	30.0 dB
	±56.3 MHz	30.0 dB

Table 5-1. Response Characteristic of Representative DIRECTV KU-45W IMUX Channel Filter

5.2.2 Downlink Transmissions

The national coverage downlink beam will use 150 Watt TWTAs which, when combined with the transmit antenna gain, results in a maximum EIRP of 53 dBW. The peak transmit antenna gain and associated contours are specified in the accompanying Schedule S (see also Section 7.2).

DIRECTV KU-45W will employ output multiplexer (“OMUX”) filters to limit the bandwidth of transmitted signals. Representative performance for these filters is shown in Table 5-2.

Parameter	Frequency (F_c)	Specification
Insertion Loss Variation	±9 MHz	0.10 dB _{p-p}
	±11.6 MHz	0.15 dB _{p-p}
	±14.4 MHz	0.22 dB _{p-p}
	±18.0 MHz	0.38 dB _{p-p}
Out of Band Rejection	±26.3 MHz	3.0 dB
	±33.3 MHz	25.0 dB

Table 5-2. Response Characteristic of Representative DIRECTV KU-45W OMUX Channel Filter

5.3 TT&C Subsystem

The TT&C subsystem provides redundant telemetry, tracking, and command channels for the spacecraft. The principal functions of the subsystem are:

1. Reception and amplification of the radio frequency command uplinks and demodulation of baseband for subsequent signal processing and command distribution.
2. Modulation, up-conversion, amplification, and transmission of all telemetry data.
3. Reception and retransmission of ground-station-generated ranging signals.

The subsystem is configurable to accommodate the unique requirements of pre-launch, orbit raising, and on-station orbit operations. Access at initial spacecraft acquisition and major orbit-raising maneuvers will be via the wide-beam (+Z) and narrow-beam (-Z) omni antennas. Normal on-station commands will be received through the receive communications antenna, while on-station telemetry will be transmitted through the transmit communications antenna. The command and telemetry frequencies and antenna polarizations are shown in the accompanying Schedule S. The minimum cross-polarization isolation for the on-station command and telemetry antennas will be 30 dB.

The telemetry and command link performance is summarized in the link budget analysis in Appendix C. The antenna patterns for the TT&C subsystem are discussed in Section 7.3. The emission designators associated with the TT&C subsystem are 1M30F9D for command and 106KG9D for telemetry, with associated allocated bandwidths of 1.3 MHz and 106 kHz for each of these emissions, respectively.

6. Orbital Locations

The DIRECTV KU-45W satellite will operate at the nominal 45° W.L. orbital location, and specifically at 45.2° W.L. (*see also* Section 18 and GSO Orbit tab of Schedule S).

7. Predicted Spacecraft Antenna Gain Contours

7.1 Uplink Beams

The satellite will receive communications signals from within Brazil in the 14.0-14.5 GHz frequency band in multiple spot beams using both vertical and horizontal polarizations (*see also* Sections 5.1 and 5.2.1). Typical DIRECTV KU-45W receive antenna gain contours are provided in GXT format in the accompanying Schedule S and are also included in Appendix B. All uplink beams will have a minimum cross-polarization isolation of 30 dB.

7.2 Downlink Beam

The national coverage beam for DIRECTV KU-45W will cover all of Brazil using both vertical and horizontal polarizations. The peak transmit gain, and the antenna gain contours in GXT format, are provided in the accompanying Schedule S. These gain contours are also graphically depicted in Appendix B. The downlink beam will have a minimum cross-polarization isolation of 30 dB. (*See also* discussion in Sections 5.1 and 5.2.2.)

7.3 TT&C Beams

The TT&C coverage during transfer orbit and on-station contingency will be provided by the wide angle TT&C antennas, which will be oriented around the nominal +Z direction and the nominal -Z direction. The TT&C on-station coverage will be provided by the receive communications antenna for command and by the transmit communications antenna for telemetry. The receive antenna pattern for on-station command and the transmit antenna beam pattern for on-station telemetry are provided in

GXT format in the accompanying Schedule S (*see also* Sections 7.1 and 7.2 above). The wide beam TT&C antenna coverage pattern is shown in Appendix B as Figure B-4.¹

8. Service Description, Link Description and Performance Analysis, Earth Station Parameters

8.1 Service Description

As discussed more fully in Section II of this application, DIRECTV will use the DIRECTV KU-45W satellite to transmit HD digital video and audio entertainment, and educational and informational programming to customers throughout Brazil who will receive this programming using small dish antennas.

8.2 Link Performance

A representative link budget is shown in Appendix A as Table A-1. This analysis assumes a receive antenna size of 65 cm and also includes the interference contribution for immediately adjacent satellites. This analysis recognizes that Intelsat is operating the INTELSAT 11 satellite, and has a pending application to operate the INTELSAT 9 satellite, at the nominal 43° W.L. location. The potential impact of interference from these satellites was specifically accounted for in this link budget. In addition, it assumes operation of a hypothetical satellite at the nominal 47° W.L. location using 1.2 meter transmit earth stations with transmit power spectral density comparable to that of DIRECTV KU-45W, and with satellite transmit power density comparable to that of DIRECTV KU-45W. Note that an availability of 99.7% has been assumed for these link budgets.

Representative link budgets for the telemetry and command links are shown in Appendix C as Tables C-1 and C-2, respectively.

¹ To the extent necessary, DIRECTV has sought a waiver of the requirement to provide the antenna gain contours for these wide beam TT&C antennas in GXT format.

8.3 Earth Station Parameters

There are essentially two types of earth stations that will be used with the DIRECTV KU-45W satellite: feeder-link earth stations and subscriber terminals. The feeder-link stations will be relatively large transmit antennas, typically 9.1 meters or larger, that track the satellite electronically and are used for transmitting national HD programming material to the satellite. The subscriber terminals are effectively 65 cm receive antennas that are installed at the customers' premises and have fixed pointing, which is optimized at installation.

9. Satellite Orbit Characteristics

The DIRECTV KU-45W satellite will be maintained in geosynchronous orbit at its nominal orbital location with a North-to-South drift tolerance of ± 0.05 degrees and an East-to-West drift tolerance of ± 0.05 degrees. The antenna axis attitude will be maintained so as to keep the beam pointing error to within 0.1 degrees.

10. Power Flux Density

Power flux density ("PFD") limits for space stations are specified in Section 25.208 of the Commission's rules. There are no PFD limits in the 11.95-12.2 GHz space-to-Earth frequency band to be used by DIRECTV KU-45W. Section 25.208 does, however, specify PFD limits for the 10.95-11.2 GHz and the 11.45-11.7 GHz bands. The maximum PFD levels versus elevation angle for DIRECTV KU-45W were calculated for these two frequency bands and the results are shown in Tab S8 of the accompanying Schedule S for communications carriers. The maximum PFD level for the telemetry signals, which will be transmitted in the 11.45-11.7 GHz band, is shown in Tab S13. As this maximum is less than the minimum angle-dependent limit specified in Section

25.208, this PFD level is necessarily compliant with that rule. These results demonstrate that the emissions of DIRECTV KU-45W do not exceed the applicable limits.

11. Arrangement for tracking, telemetry, and control

DIRECTV has not yet contracted for the construction of the DIRECTV KU-45W satellite, and therefore has not yet finalized arrangements for tracking, telemetry and control. DIRECTV does, however, currently maintain a fleet of eleven satellites as part of its existing business, and it is envisioned that TT&C for DIRECTV KU-45W would be handled in a manner similar to that of DIRECTV's existing satellites. DIRECTV will evaluate its options and take all necessary steps to ensure that proper arrangements are in place, well before satellite launch, to control the DIRECTV KU-45W satellite through its launch and transfer orbit phase and into and during the operational lifetime phase of the satellite mission, including post-operation disposal.²

12. Physical Characteristics of the Space Station

DIRECTV has not yet contracted for the construction of the DIRECTV KU-45W satellite and therefore has not yet settled upon exact specifications for the physical characteristics of the satellite. Accordingly, the payload envelope has been sized to allow more than one spacecraft currently available with extensive heritage and fully qualified technology to serve as the design platform. With this proviso, DIRECTV anticipates that the key spacecraft characteristics for DIRECTV KU-45W could be as summarized in the appropriate sections of the accompanying Schedule S.

13. Spacecraft Bus Subsystem

As discussed in Section 12 above, DIRECTV has not yet contracted with a manufacturer for the construction of the DIRECTV KU-45W satellite and DIRECTV

² To the extent necessary, DIRECTV has sought a waiver of the requirement to provide contact information for the remote operation point to be used for TT&C at this time.

does not wish to show a preference by providing data specific to any one manufacturer. As such, it is difficult to discuss any specific characteristics of what may comprise the spacecraft bus subsystem beyond that already included in the accompanying Schedule S.

DIRECTV will provide the Commission with any and all required spacecraft bus characteristics once a final spacecraft provider has been selected and a final satellite design has been adopted.

14. Common Carrier Status

DIRECTV intends to operate DIRECTV KU-45W on a non-broadcast, non-common carrier basis. DIRECTV may sell and/or lease a portion of its capacity on a non-common carrier basis for complementary business purposes.

15. Schedule

DIRECTV will contract for, begin construction of, and launch and operate DIRECTV KU-45W in accordance with any Commission imposed satellite construction milestones, such as those specified in Section 25.164 of the Commission's rules.

16. Public Interest Considerations

See Section I above.

17. Interference Analysis

The link budget included in Appendix A demonstrates that the DIRECTV KU-45W satellite design described in this application will operate successfully within the two-degree spacing environment established by the Commission's policy and implementing rules. Additionally, the proposed DIRECTV KU-45W satellite will remain in compliance with the relevant technical rules established by the Commission.

DIRECTV notes that the Commission-authorized INTELSAT 14 satellite is currently operating at the 45.0 W.L. orbital location. That satellite is authorized to

operate in the 14.0-14.5 GHz (Earth-to-space) and 11.45-11.95 GHz (space-to-Earth) frequency bands. The entire uplink band, and part of the downlink band, for DIRECTV KU-45W overlap with that of INTELSAT 14. DIRECTV notes, however, that the lower half of the uplink band (*i.e.*, 14.0-14.25 GHz) is used only in the INTELSAT 14 Europe/Africa receive beam which is well isolated geographically from Brazil (*i.e.*, Brazil is well outside of the -20 dB contour), and therefore does not introduce an interference concern (see Figure 17-1 below from the FCC application for INTELSAT 14 at 45W (SAT-RPL-20090123-00007) with DIRECTV KU-45W uplink locations added). The upper half of the uplink band (*i.e.*, 14.25-14.5 GHz) is used in the INTELSAT 14 Americas beam, which is also well isolated from Brazil (see Figure 17-2 below). In addition, only the DIRECTV KU-45W uplink site 1 (UL-1) will use this shared portion of the uplink spectrum. As can be seen, the INTELSAT 14 Americas beam provides at least 20 dB of isolation in the direction of this uplink location. The isolation of this beam, when combined with the location of the uplink sites for DIRECTV KU-45W in Brazil (shown added in Figure 17-2), provides sufficient protection of INTELSAT 14 from the uplink emissions of DIRECTV KU-45W, and also provides sufficient protection of DIRECTV KU-45W from the uplink emissions of INTELSAT 14. A detailed interference analysis of this uplink scenario is provided in Appendix D.

EXHIBIT 5G: Ku-BAND EUROPE-AFRICA RECEIVE BEAM
(Schedule S Beam ID: KEUH)

Beam Polarization: Horizontal

Peak Beam Gain: 35.3 dBi

Peak Beam G/T: 7.6 dB/K

Saturated Flux Density @ Peak Beam G/T: -103.0 to -82.0 dBW/m²

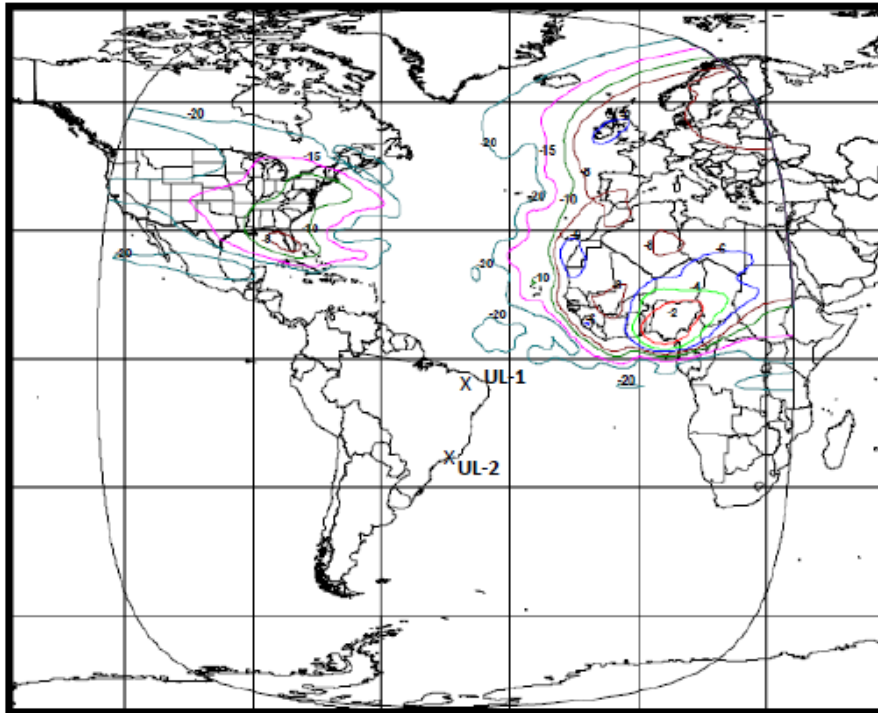


Figure 17-1. INTELSAT 14 Europe/Africa Receive Beam at 45.0W

EXHIBIT 5J: Ku-BAND AMERICAS RECEIVE BEAM
(Schedule S Beam ID: KAUV)

Beam Polarization: Vertical
Peak Beam Gain: 30.8 dBi
Peak Beam G/T: 2.8 dB/K
Saturated Flux Density @ Peak Beam G/T: -101.2 to -80.2 dBW/m²

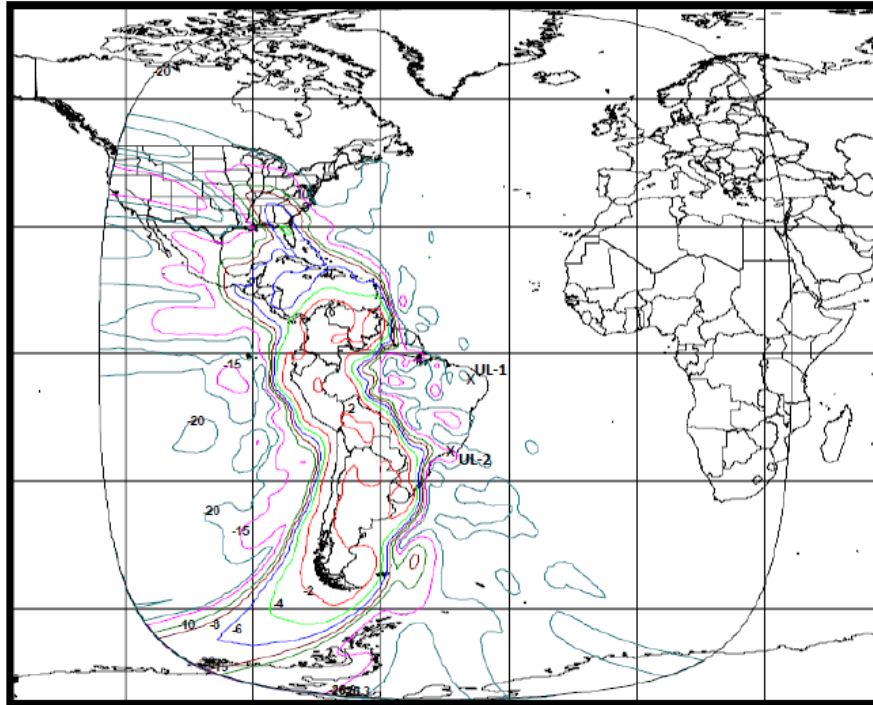


Figure 17-2 – INTELSAT 14 America's Receive Beam at 45.0W

The only common portion of downlink spectrum shared by DIRECTV KU-45W and INTELSAT 14 is the 11.45-11.7 GHz band. This portion of the downlink spectrum is used only in the INTELSAT 14 Europe/Africa beam, which again is well isolated geographically from the proposed Brazilian downlink beam of DIRECTV KU-45W. Note that the INTELSAT 14 Europe/Africa transmit beam contours are essentially identical to the receive contours of Figure 17-1 above.

In terms of uplink interference compatibility of DIRECTV KU-45W with other adjacent satellites, there are two networks at 43° W.L. to consider. The first is the

INTELSAT 11 satellite currently operating at 43° W.L.; however, this satellite does not receive in the 14.0-14.5 GHz band, and thus is of no concern. Second, there is a pending application for INTELSAT 9 at 43.1° W.L., and this satellite does include the 14.0-14.5 GHz receive band to be used by DIRECTV KU-45W. The INTELSAT 9 application includes a minimum uplink power density in the link budgets of -53.2 dBW/Hz into a 3.0 meter antenna with 49.6 dBi gain. This results in a minimum earth station transmit EIRP density for this network of -3.6 dBW/Hz. The feeder link antennas to be used with DIRECTV KU-45W will be compliant with Section 25.209 and the maximum off-axis EIRP density in the direction of INTELSAT 9 for these feeder link antennas will be on the order of -49 dBW/Hz, resulting in a C/I at the INTELSAT 9 satellite of greater than 45 dB. This clearly is compatible with the INTELSAT 9 operations.

With regard to uplink compatibility with other hypothetical adjacent satellites, it was assumed that the transponder gains of the DIRECTV KU-45W satellite and its neighboring satellites can be matched to result in similar input signal spectral density levels at the satellites. In this case, the uplink C/I will be a function of the difference between the gain of the transmitting earth stations at boresight and the gain at the topocentric off-axis angle. The topocentric off-axis angle for a geocentric separation of 2° is approximately 2.2°. The off-axis gain at 2.2° for an antenna that just meets the 29-25 log(Θ) reference pattern is 20.4 dBi. The boresight gain will be a function of the antenna size of the transmitting earth station. Table 17-1 illustrates the C/I that would result from different size transmitting earth stations.

Antenna size (m)	On axis Gain (dBi)	Off-axis Gain	C/I (dB)
1.2	43.2	20.4	22.8
1.8	46.7	20.4	26.3
2.4	49.2	20.4	28.8
3.0	51.1	20.4	30.7
6.1	57.3	20.4	36.9
9.0	60.7	20.4	40.3

Table 17-1. Uplink C/I for 2° geocentric spacing

This table illustrates that, like the case of compatibility with the specific INTELSAT 9 satellite network discussed above, the uplink emissions from nine-meter feeder link antennas communicating with DIRECTV KU-45W will be compatible with any adjacent satellite spaced at least 2° away.

In terms of downlink interference compatibility, it was again recognized that the INTELSAT 11 satellite is currently operating at 43° W.L. and this satellite does transmit in the 10.95-11.2 GHz band over Brazil. In addition, there is a pending application for INTELSAT 9 at 43.1° W.L., and this satellite includes the 11.45-11.7 GHz and the 11.95-12.2 GHz bands to be used by DIRECTV KU-45W, but transmits only in a part of the 11.45-11.7 GHz band over Brazil. According to their respective Commission applications, INTELSAT 11 and INTELSAT 9 have peak EIRP density values of approximately -20 dBW/Hz, which is more than 2 dB greater than the peak EIRP density value for DIRECTV KU-45W. Similar to the uplink case, the downlink C/I will be a function of the difference between the gain of the receiving earth stations at boresight and the gain at the topocentric off-axis angle. The topocentric off-axis angle for a geocentric separation of 2° is approximately 2.2°. The off-axis gain at 2.2° for an antenna that just meets the 29-25 log(Θ) reference pattern is 20.4 dBi. The boresight gain will be a function of the antenna size of the receiving earth station. Assuming that the downlink

EIRP density of the DIRECTV KU-45W satellite and neighboring satellites is equal, Table 17-2 illustrates the C/I that would result from different size receiving earth stations. The C/I results for the specific case of DIRECTV KU-45W versus INTELSAT 9 or INTELSAT 11 at 43° W.L. would be 2 dB greater due to the 2 dB peak EIRP density differential in favor of the Intelsat networks.

Antenna size (m)	On axis Gain (dBi)	Off-axis Gain	C/I (dB)
0.65	36.3	20.4	15.9
1.2	41.7	20.4	21.2
1.8	45.2	20.4	24.7
2.4	47.7	20.4	27.2

Table 17-2. Downlink C/I for 2⁰ geocentric spacing vs. receive antenna size

Assuming that the minimum receive earth station size and minimum required C/N for a digital service for neighboring networks is 1.2 meters and 8 dB, respectively, the worst case C/I for a 1.2 meter earth station (*i.e.*, 21.2 dB) would only degrade the C/N by 0.2 dB, equivalent to an increase of 4.7% in the interfered-with signal's noise floor. This increase is less than the 6% coordination trigger specified in the ITU Radio Regulations. Note that DIRECTV intends to use 65 cm receive earth stations (first line in Table 17-2 above) and that the worst case potential C/I from immediately adjacent satellites would be 15.9 dB (and about 2 dB less from INTELSAT 9 or 11). This has been accounted for in arriving at the value of aggregate receive C/I in the link budget set forth in Appendix A. As this link budget clearly shows, even with this aggregate C/I the DIRECTV link budget closes with adequate margin.

18. Orbital Debris Mitigation

DIRECTV intends to incorporate the material objectives set forth in this application into the technical specifications established for procurement and construction of DIRECTV KU-45W. DIRECTV will include provisions for review of orbit debris

mitigation as part of the preliminary design review and critical design review for the spacecraft, and for incorporation of these objectives, as appropriate, into its test plan, including a formal analysis of orbital debris risks associated with the TT&C, propulsion, and power generation and storage systems. Because this mitigation statement is necessarily forward looking, the process of procuring, designing, building, and testing may result in minor changes to the parameters discussed herein. If appropriate, DIRECTV will modify this mitigation statement to reflect such changes.

Spacecraft Hardware Design

DIRECTV has assessed and limited the amount of debris released in a planned manner during normal operations. DIRECTV KU-45W will not be a source of debris during launch, drift, or operating mode, as DIRECTV does not intend to release debris during the planned course of operations of the satellite.

DIRECTV will also consider the possibility of DIRECTV KU-45W becoming a source of debris by collisions with small debris or meteoroids that could cause loss of control of the spacecraft and prevent post-mission disposal. As such, DIRECTV will take steps to address this possibility by incorporating redundancy, shielding, separation of components, and other physical characteristics into the satellite's design. For example, omni-directional antennas will be mounted on opposite sides of the spacecraft, and either will be sufficient to support orbit raising. The command receivers and decoders, telemetry encoders and transmitters, and the bus control electronics will be fully redundant, physically separated, and located within a shielded area to minimize the probability of the spacecraft becoming a source of debris due to a collision. DIRECTV will continue to review these aspects of on-orbit operations with the spacecraft manufacturer and will make such adjustments and improvements as appropriate to assure

that its spacecraft will not become a source of debris during operations or become derelict in space due to a collision.

Minimizing Accidental Explosions

DIRECTV will contract for an overall spacecraft design that limits the probability of accidental explosion. The key areas reviewed for this purpose will include leakage of propellant and mixing of fuel and oxidizer as well as battery pressure vessels.

The basic propulsion design (including component and functional redundancy, and the placement of fuel tanks inside a central cylinder which provides a high level of shielding), propulsion subsystem component construction, preflight verification through both proof testing and analysis, and quality standards will be designed to ensure a very low risk of propellant leakage and fuel and oxidizer mixing that can result in subsequent explosions. During the mission, batteries and various critical areas of the propulsion subsystem will be continually monitored (for both pressure and temperature) to preclude conditions that could result in the remote possibility of explosion and subsequent generation of debris.

After DIRECTV KU-45W reaches its final disposal orbit, all on-board sources of stored energy will be depleted, all fuel line valves will be left “open,” any pressurized system will be vented, and all batteries will be left in a permanent discharge state. The solar cells will be slewed away from the sun to minimize power generation.

Through this process, DIRECTV will assess and limit the possibility of accidental explosions during mission operations and assure that all stored energy at the end of the satellite’s operation will be removed.

Safe Flight Profiles

DIRECTV will assess and limit the probability of DIRECTV KU-45W becoming a source of debris by collisions with large debris or other operational space stations through detailed and conscientious mission planning. DIRECTV has reviewed the list of licensed systems and systems that are under consideration by the Commission for the 45.2° W.L. orbital location it has requested. In addition, in order to address non-U.S. licensed systems, DIRECTV has reviewed the list of satellite networks in the vicinity of 45.2° W.L. for which a request for coordination has been submitted to the ITU. Only those networks that are operating, or are planned to be operating, within $\pm 0.2^\circ$ have been taken into account in this review.

As a consequence of this review, DIRECTV has determined that Intelsat is operating the INTELSAT 14 satellite at the 45.0° W.L. location ($\pm 0.05^\circ$ stationkeeping). In addition, EchoStar has applied for authority to operate the ECHO-45W satellite at the 45.1° W.L. location ($\pm 0.05^\circ$ stationkeeping). As a result of these findings, DIRECTV is applying for the 45.2° W.L. location ($\pm 0.05^\circ$ stationkeeping) so as to ensure no overlap of stationkeeping volumes with these satellites.

With regard to ITU filings within ± 0.2 degrees of 45.2° W.L., DIRECTV has found the following networks for which coordination requests have been submitted to the ITU:

- YAHSAT-N-45W, YAHSAT-FSS-45W, YAHSAT-G6-45W. All three of these UAE networks are located at 45.0° W.L. DIRECTV can find no evidence that UAE has a satellite under construction for any of these networks.

- B-SAT-3A-1 (45.1W), B-SAT-1A-1 (45.0W). These are Brazilian AP 30/30A BSS filings which were the subject of a Brazilian spectrum auction in 2011, through which Brazil awarded the license to EchoStar. It is believed that EchoStar intends to operate a BSS satellite at the 45.1° W.L. location, which would not overlap with the requested location of 45.2° W.L. Should this not be the case, DIRECTV will conduct physical coordination of DIRECTV KU-45W with EchoStar.
- NEW DAWN 29. This is a PNG network. DIRECTV can find no evidence that PNG has a satellite under construction for this network.
- IOMSAT-45W. This is an Isle of Man network for which DIRECTV can find no evidence that a satellite is currently under construction.

Given the situation above, it is difficult to precisely assess what satellites will actually be operating in the immediate vicinity of the 45.2° W.L. position at the time that DIRECTV KU-45W is to be launched. As such, DIRECTV will certainly revisit this issue once a satellite construction contract is in place and make any necessary adjustments to the location of DIRECTV KU-45W along with filing the appropriate request for license modification with the Commission.

Frequency and physical coordination during orbital drift cannot be undertaken until the spacecraft and launch vehicle manufacturers are selected and a launch plan has been developed. No pre-operational orbits requiring special temporary authority are currently anticipated.

Post-Mission Disposal

Consistent with the requirements of Section 25.283(a) of the Commission's rules, at the end of the operational life of the satellite, DIRECTV will maneuver DIRECTV KU-45W into a disposal orbit with an altitude no less than that calculated using the IADC formula:

$$36,021 \text{ km} + (1000 \cdot C_R \cdot A/m).$$

Based on its experience with other satellites in its fleet, DIRECTV anticipates that, once the satellite's actual characteristics have been determined, this calculation will lead to a disposal orbit with a minimum perigee of somewhat less than 300 km above the normal GSO operational orbit.³ Accordingly, DIRECTV currently anticipates that it will maneuver DIRECTV KU-45W to an altitude 300 km above GSO orbit at the end of its operational life, which should provide additional margin above the results of the IADC formula.

DIRECTV currently intends to allocate and reserve approximately 10 kg of propellant for final orbit raising maneuvers to this altitude. This value was determined through a detailed launch vehicle propellant budget analysis applied to the parameters of one of DIRECTV's most recently designed satellites. In addition, DIRECTV has assessed fuel gauging uncertainty and this budgeted propellant provides an adequate margin of fuel reserve to ensure that the disposal orbit will be achieved despite such uncertainty.

³ For example, the disposal orbit perigee calculated for the DIRECTV 12 satellite was approximately 289 km above GSO orbit altitude, which DIRECTV rounded up to 300 km to provide adequate margin.

ENGINEERING CERTIFICATION

The undersigned hereby certifies to the Federal Communications Commission as follows:

- (i) I am the technically qualified person responsible for the engineering information contained in the foregoing Application,
- (ii) I am familiar with Part 25 of the Commission's Rules, and
- (iii) I have either prepared or reviewed the engineering information contained in the foregoing Application, and it is complete and accurate to the best of my knowledge and belief.

Signed:

/s/

Jack Wengryniuk
Senior Director
DIRECTV Engineering

February 5, 2013

Date

APPENDIX A

DIRECTV KU-45W LINK BUDGET ANALYSIS

DIRECTV KU-45W	Rio de Janiero	Clear Sky	Rain Dn
Uplink C/N (thermal), dB	Transmit power, dBW	5.1	7.9
	Transmit power density dBW/Hz	-70.5	-67.7
	Transmit losses, dB	-2.0	-2.0
	Ground antenna gain, dB	60.7	60.7
	Antenna pointing loss, dB	-0.5	-0.5
	Free space loss, dB	-207.6	-207.6
	Atmospheric loss, dB	-0.2	-0.2
	Uplink rain loss, dB	0.0	-2.8
	Satellite G/T, dB/K	9.0	9.0
	Bandwidth, dB-Hz	74.8	74.8
	Boltzmann's constant, dBW/Hz K	228.6	228.6
Total Uplink C/N		18.4	18.4
Downlink C/N (thermal),dB	Satellite EIRP, dBW/36 MHz	53.0	53.0
	Free space loss, dB	-206.0	-206.0
	Atmospheric loss, dB	-0.2	-0.2
	Downlink rain loss, dB	0.0	-2.0
	Rain temp increase, dB	0.0	-1.9
	Rcv. antenna pointing loss, dB	-0.5	-0.5
	Ground G/T, dB/K	14.0	14.0
	Bandwidth, dB-Hz	74.8	74.8
	Boltzmann's constant, dBW/Hz K	228.6	228.6
Total Downlink C/N		14.1	10.2
		Clear Sky	Rain Dn
Totals	Uplink C/N (thermal), dB	18.4	18.4
	Downlink C/N (thermal), dB	14.1	10.2
	x-pol interference, dB	30.0	30.0
	C/I from ASI	10.8	10.8
	Total C/(N+I), dB	8.6	7.1
	Required C/(N+I), dB	5.7	5.7
	Margin, dB	2.9	1.4

Table A-1. DIRECTV KU-45W Link Budget – Brazilian National Coverage

APPENDIX B

ANTENNA BEAM CONTOURS



Figure B-1. DIRECTV KU-45W Receive Beam 1



Figure B-2. DIRECTV KU-45W Receive Beam 2

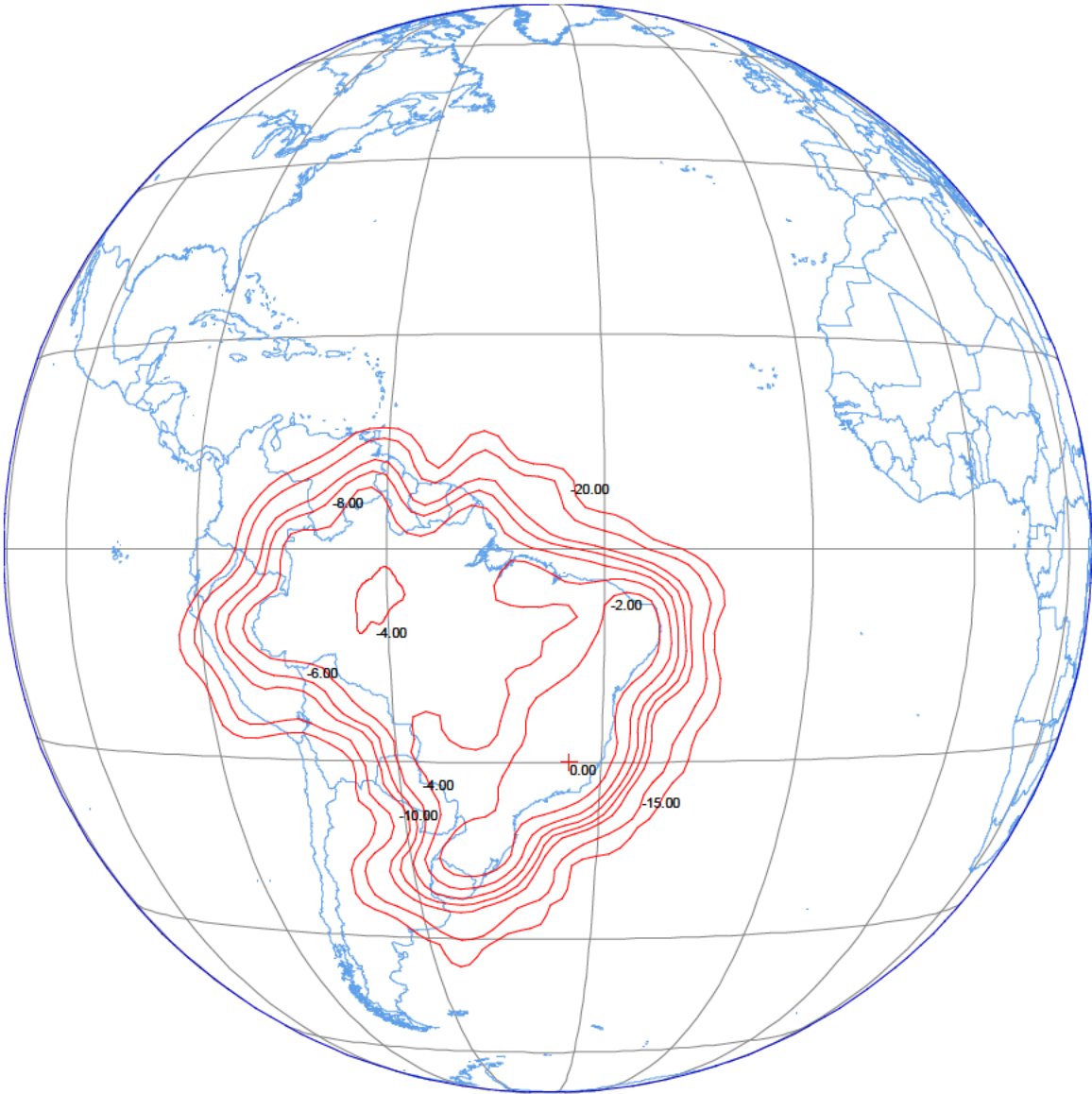


Figure B-3. DIRECTV KU-45W Transmit Beam

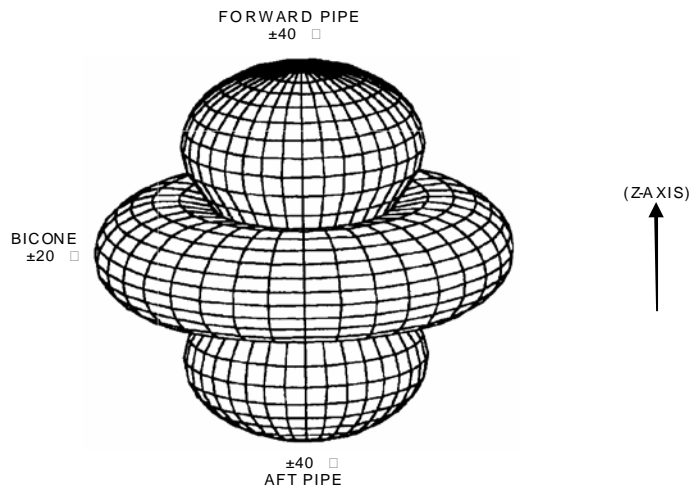


Figure B-4. DIRECTV KU-45W Wide Beam TT&C Antenna Coverage

APPENDIX C

TT&C LINK BUDGETS

Frequency	11705	MHz
Transmit power	-7.5	dBW
Transmit losses	5.0	dB
Antenna gain at EOC	27.4	dB _i
EIRP	14.9	dBW
Spec.	12.0	dBW
Margin	2.9	dB

Table C-1. DIRECTV KU-45W On-Station Telemetry Link Budget

Frequency	14005	MHz
Flux density at S/C	-90.5	dBW/m ²
Isotropic area	-44.4	dB-m ²
Antenna gain	39.2	dB
Receive losses	19.0	dB
Command receiver input power	-84.7	dBm
Command receiver threshold	-122.0	dBm
Margin	37.3	dB

Table C-2. DIRECTV KU-45W On-Station Command Link Budget

APPENDIX D

COMPATIBILITY ANALYSIS OF DIRECTV KU-45W WITH INTELSAT 14

Link Budget Parameters From DIRECTV KU-45W FCC Application

E.S. size (m)	9.1
E.S. gain (dBi)	60.7
Carrier type	Digital
Carrier bandwidth (kHz)	36000
Transmit EIRP (dBW)	63.8
Uplink EIRP density (dBW/Hz)	-11.8

Link Budget Parameters From INTELSAT 14 FCC Application

E.S. size (m)	6	6	6	6	6	1.17
E.S. gain (dBi)	57.2	57.2	57.2	57.2	57.2	43.1
Carrier type	TV/FM	Digital	Digital	Digital	Digital	Digital
Carrier bandwidth (kHz)	36000	36000	10300	100	1450	400
Transmit EIRP (dBW)	79	80.8	74.3	54.8	66.9	47
Uplink power density (dBW/Hz)	-44.2	-51.2	-51.2	-51.2	-51.2	-50.9
Uplink EIRP density (dBW/Hz)	Note 1	6	6	6	6	-7.8
Resultant IS14 C/I (dB) (Note 2)	35.2	37.8	37.8	37.8	37.8	24.0
Resultant DIRECTV KU-45W C/I (dB)	19.8	17.2	29.0	29.0	29.0	42.8

Note 1: For the TV/FM carrier case, C/I was based on total carrier EIRP, as opposed to EIRP density.

Note 2: Assumes DIRECTV KU-45W uplink location is on IS14 -20 dB contour

Note 3: Assumes IS-14 uplinks are located on DIRECTV KU-45W -35 dB contour