ATTACHMENT 1

TECHNICAL ANNEX

ECHOSTAR-16

Cross-Polarization Isolation Performance of Certain Spot Beams

A.1 INTRODUCTION

This technical annex reports on the measurements of the cross-polarization isolation ("XPI") performance of certain antenna beams on the ECHOSTAR-16 satellite, which were taken recently when the satellite was tested, as built, by EchoStar Satellite Operating Corporation's ("ESOC") satellite manufacturer. Also included herein is an explanation as to why the resulting XPI performance will not negatively affect any licensee or satellite operator that uses the spectrum.

A.2 COMPACT ANTENNA TEST RANGE ("CATR") MEASUREMENTS

Measurements of the overall satellite antenna performance are routinely carried out late in the stage of the manufacture of a communications satellite. These measurements are performed using a Compact Antenna Test Range ("CATR"). ESOC recently received the ECHOSTAR-16 satellite's CATR measurements after testing was completed. From these measurements, ESOC identified the XPI deficiencies described below and determined there were no physical means to improve them in a reasonable time prior to the planned shipment of the spacecraft.

Prior to the CATR measurements the antenna performance is predicted using computer models of the antenna. Those predictions were the basis of the data provided to the Commission in the application for the ECHOSTAR-16 satellite filed on September 2, 2011.[1]

A.3 NON-CONFORMING XPI RESULTS

DBS spot beams are usually required to serve areas further down the gain slope than might be required for a larger regional beam, such as a continental United States ("CONUS") beam.

[1] Furthermore, the cross-polarization specification in ESOC's contract with the satellite manufacturer was in fact 30 dB or better with the exception of coverage over Bermuda, the Caribbean, and parts of Mexico as set forth in the EchoStar 16 LOA application and approved by the Commission. *See* Stamp Grant, File No. SAT-LOA-20110902-00172 (granted June 22, 2012).

Typically, because of the odd geographic shape of the Designated Market Areas ("DMAs") that the spot beams must serve, it may be necessary to operate down to the -5 to -8 dB relative gain contour to reach all the designated market areas ("DMAs"), allowing for spacecraft mispointing effects. This reduces the achievable XPI performance because good XPI performance is most readily achieved relatively close to beam peak.

Table A-1 lists the worst-case XPI performance of those spot beams on ECHOSTAR-16 whose XPI within their service area was measured at below 30 dB, based on the CATR measurements. This is very much worst case in the sense that it gives the lowest XPI towards the furthest extreme of the worst DMA that might possibly be covered by that beam.

Table A-1: ECHOSTAR-16 Spot Beams and Channels with XPI Less Than 30 dB

DMA	Beam #	Channel #	Pol.	Lowest XPI (dB)
Austin - R	SP67	21	R	28.8
Denver - R (proper)	SP68	21	R	28.3
Denver - R (outlying)		21	R	26.8
Parkersburg - L	SP32	28	L	28.5
Pittsburgh - L	SP52	20	L	28.5
Sacramento - R	SP20	21	R	29.4
Gilbert - L	R02L	Any	L	28.8
Gilbert - R	R02R	Any	R	27.5
Monee - L	R03L	Any	L	28.5
Mt. Jackson - L	R04L	Any	L	28.8
New Braunfels - L	R05L	Any	L	28.6
New Braunfels - R	R05R	Any	R	26.4
Spokane - L	R06L	Any	L	29.2
Spokane - R	R06R	Any	R	28.3

The following should be noted:

(a) Five of the beams listed in Table A-1 are transmit beams and eight are receive beams. Only a minority of the total transmit spot beams (6 of the 71) have XPI below 30 dB.

(b) There is frequency dependence to the measurements for the downlink spot beams. For example, spot beam SP52 operates on channels 18, 20, and 30, however only channel 20 has XPI slightly below the 30 dB limit.

(c) Only one of the 71 transmit spot beams ever drops below 27 dB XPI in any channels used, and then only at the edges of the beams coverage area (SP68 over the Denver DMA).

(d) The worst case uplink spot beam is beam R05R, which performs at an isolation of 26.4 dB. All the other uplink spot beams in Table A-1 perform with XPI of 27.5 dB or better.

(e) For the uplink beams listed in Table A-1, and for the channels used by these beams, the XPI performance for any particular channel is generally better than that stated in the Table. Table A-1 states the lowest measured XPI value for any channel used by the relevant uplink beam.

In addition, the CONUS beam has a cross-polarization isolation of between 28 and 30 dB over approximately 3% of its coverage area when operated on channel 21, between 29 and 30 dB over 2% of its coverage area when operated on channel 23, and between 29 and 30 dB over 1% of its coverage area when operated on channel 27. Nominally, these channels will not be operated in CONUS mode since they are planned to be operated for spot beams, however the shortfalls are included for completeness of the application.

A.4 ASSESSMENT OF THE IMPACT OF NON-COMPLIANT XPI PERFORMANCE

This section assesses the impact of the shortfall in XPI to the ECHOSTAR-16 satellite network as well as adjacent networks.

A.4.1 Uplink

EchoStar notes that an XPI shortfall in the uplink direction can have no adverse effect on adjacent satellite networks. Uplink cross-polarization interference is an intra-system design issue and therefore cannot affect adjacent satellite networks.

The lowest XPI for all of the ECHOSTAR-16 satellite's uplink spot beams is 26.4 dB (New Braunfels beam with RHCP). This XPI level increases the uplink C/I into the left-hand circularly polarized New Braunfels beam by less than 0.006 dB relative to the case where the XPI is 30 dB. This level of increased interference is considered to be negligible. The

ECHOSTAR-16 satellite's link budgets are sufficiently robust to compensate for the negligible degradation caused by the reduced XPI performance. A similar conclusion is reached for the other uplink beams that have an XPI less than 30 dB.

A.4.2 Downlink

The lowest XPI for all of the ECHOSTAR-16 satellite's downlink beams is 26.8 dB (Denver beam with RHCP). This XPI level increases the downlink C/I into any left-hand circularly polarized beam of an adjacent network, regardless of orbital separation, by less than 0.005 dB relative to the case where the XPI is 30 dB.[2] This level of increased interference resulting from the satellite's downlink non-compliance is negligible relative to the primary, co-polar interfering signal. A similar conclusion is reached for the other downlink beams that have an XPI less than 30 dB.

A.5 CONCLUSION

The impact of the reduction in XPI performance of certain spot beams on the ECHOSTAR-16 satellite will have a negligible interference impact on all users of the spectrum, as demonstrated above.

[2] In such a comparison, the level of increase in C/I leads to an equivalent level of degradation to the C/(N+I) of the adjacent network.

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this application, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this application and that it is complete and accurate to the best of my knowledge and belief.

/s/

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