ECHOSTAR-113W

ATTACHMENT A

TECHNICAL DESCRIPTION

A.1 GENERAL DESCRIPTION

The ECHOSTAR-113W satellite will operate at the 113°W.L. orbital location to provide international and domestic FSS ("Fixed Satellite Service") services to North America. The satellite will use the 18.3-18.8 GHz and 19.7-20.2 GHz downlink bands and 28.35-28.6 GHz and 29.25-30.0 GHz uplink bands.

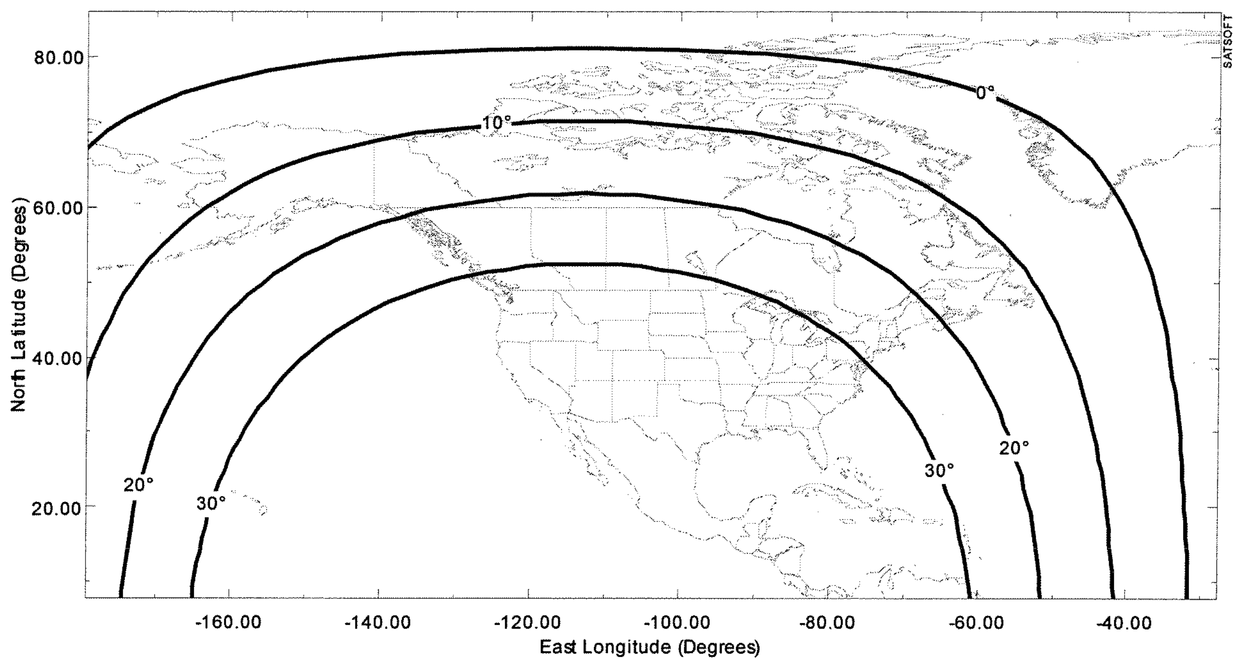
Employing a high frequency reuse factor, the satellite will utilize 64 active transponders using eight 115 MHz channels across 1000 MHz of the Ka-band spectrum in each direction. The transponders will operate with multiple contiguous spot beams across North America on both uplink and downlink, in order to be able to provide broadband two-way services to small user terminals and other potential services.

A.2 ORBITAL LOCATION

EchoStar requests Commission authority to use the 113°W.L. geostationary orbital location for the ECHOSTAR-113W satellite. This orbital location has been selected because, among other things, it provides high elevation angles to all of North America, which is very important for satellite services to large numbers of small and inexpensive consumer earth stations. The high elevation minimizes the risk of signal blockage due to buildings and foliage, and also minimizes the atmospheric and rain attenuation, a very important consideration for the Ka-band uplink and downlink frequencies.

Figure A.2-1 shows the elevation angles to the 113°W.L. orbital location from the service areas of the proposed ECHOSTAR-113W satellite. Note that the majority of CONUS is above the 30° elevation angle and the most populated portions of Canada are above the 20° elevation angle. The only parts of the CONUS service areas that are below 30° are parts of North East CONUS (where the elevation angle is still greater than 20°). Due to its westerly location, the 113°W.L. slot allows for services to be provided to Alaska and Hawaii.

Figure A.2-1 – Elevation Angles to the 113°W.L. Orbital Location



A.3 SATELLITE COVERAGE

The ECHOSTAR-113W satellite will be able to provide two-way broadband services to small consumer terminals located in CONUS, Canada and Mexico. The Ka-band beam coverage is made up of multiple contiguous spot beams for both uplink and downlink. Sections A.5 and A.6 provide full details of the antenna beams used to provide the satellite coverage.

A.4 FREQUENCY AND POLARIZATION PLANS

The ECHOSTAR-113W satellite Ka-band frequency plan is given in Table A.4-1, indicating channel center, upper and lower frequencies, as well as channel polarizations. The channels are of nominal 115 MHz usable bandwidth, with a spacing between channel center frequencies of 125 MHz. Circular polarization is used on both the uplink and downlink with the downlink polarization being orthogonal to the uplink for each channel. There is no frequency offset between orthogonally polarized channels.

Table A.4-1 – Channel Frequency Plan for Ka-band

	UPLINK				DOWNLINK			
Txpdr #	Pol'n	Center Freq	F_{low}	F_{high}	Pol'n	Center Freq	F_{low}	F_{high}
Ka - 1	LHCP	29,312.50	29,255.00	29,370.00	RHCP	18,362.50	18,305.00	18,420.00
Ka - 2	RHCP	29,312.50	29,255.00	29,370.00	LHCP	18,362.50	18,305.00	18,420.00
Ka - 3	LHCP	29,437.50	29,380.00	29,495.00	RHCP	18,487.50	18,430.00	18,545.00
Ka - 4	RHCP	29,437.50	29,380.00	29,495.00	LHCP	18,487.50	18,430.00	18,545.00
Ka - 5	LHCP	28,412.50	28,355.00	28,470.00	RHCP	18,612.50	18,555.00	18,670.00
Ka - 6	RHCP	28,412.50	28,355.00	28,470.00	LHCP	18,612.50	18,555.00	18,670.00
Ka - 7	LHCP	28,537.50	28,480.00	28,595.00	RHCP	18,737.50	18,680.00	18,795.00
Ka - 8	RHCP	28,537.50	28,480.00	28,595.00	LHCP	18,737.50	18,680.00	18,795.00
Ka - 9	LHCP	29,562.50	29,505.00	29,620.00	RHCP	19,762.50	19,705.00	19,820.00
Ka - 10	RHCP	29,562.50	29,505.00	29,620.00	LHCP	19,762.50	19,705.00	19,820.00
Ka - 11	LHCP	29,687.50	29,630.00	29,745.00	RHCP	19,887.50	19,830.00	19,945.00
Ka - 12	RHCP	29,687.50	29,630.00	29,745.00	LHCP	19,887.50	19,830.00	19,945.00
Ka - 13	LHCP	29,812.50	29,755.00	29,870.00	RHCP	20,012.50	19,955.00	20,070.00
Ka - 14	RHCP	29,812.50	29,755.00	29,870.00	LHCP	20,012.50	19,955.00	20,070.00
Ka - 15	LHCP	29,937.50	29,880.00	29,995.00	RHCP	20,137.50	20,080.00	20,195.00
Ka - 16	RHCP	29,937.50	29,880.00	29,995.00	LHCP	20,137.50	20,080.00	20,195.00

Note that Table A.4-1 shows only 16 Ka-band channels (using both polarizations) although there are 64 Ka-band transponders. The satellite will employ a 4-frequency spatial re-use scheme such that any 115 MHz channel is re-used a minimum of 4 times by a combination of polarization and spatial frequency re-use. This more than meets the requirements for full frequency re-use of the spectrum as required by §25.210(d) of the Rules. The assignment of transponders to individual beams is explained in more detail in section A.21 below.

TT&C operations will take place in portions of the main service link frequency ranges of the satellite, as discussed in detail in Section A.19. Exact frequency plans for the TT&C transmissions are not yet available.

A.5 SATELLITE TRANSMIT CAPABILITY

Figure A.5-1 shows the -3 dB contours of the 44 downlink spot beams used at Ka-band. The service area of each spot beam actually extends beyond the -3 dB contour and therefore provides service to those small parts of CONUS not contained within the -3 dB contour of the beams shown in Figure A.5-1. One of these beams is shown in detail in Figure A.5-2 in terms of its relative gain contours. All spot beams are nominally identical, and each has a peak antenna gain of 45.5 dBi.

Each Ka-band transponder will use one 125 Watt TWTA (21.0 dBW) dedicated to one downlink spot beam. The losses between the TWTA output and the antenna input amount to 2.0 dB. The resulting beam peak saturated EIRP level for these transponders will be 64.5 dBW (i.e., 45.5+21.0-2.0), and the saturated EIRP level at the –4 dB contour, which is typically the edge of coverage of the service area of each spot beam, will be 60.5 dBW.

The cross-polar isolation of the satellite transmit antennas will exceed 30 dB within the -4 dB gain contour at all transmit frequencies.

Figure A.5-1 – Ka-Band Downlink Beam Coverage – All Beams

(Contours shown are -3 dB relative to the beam peak)

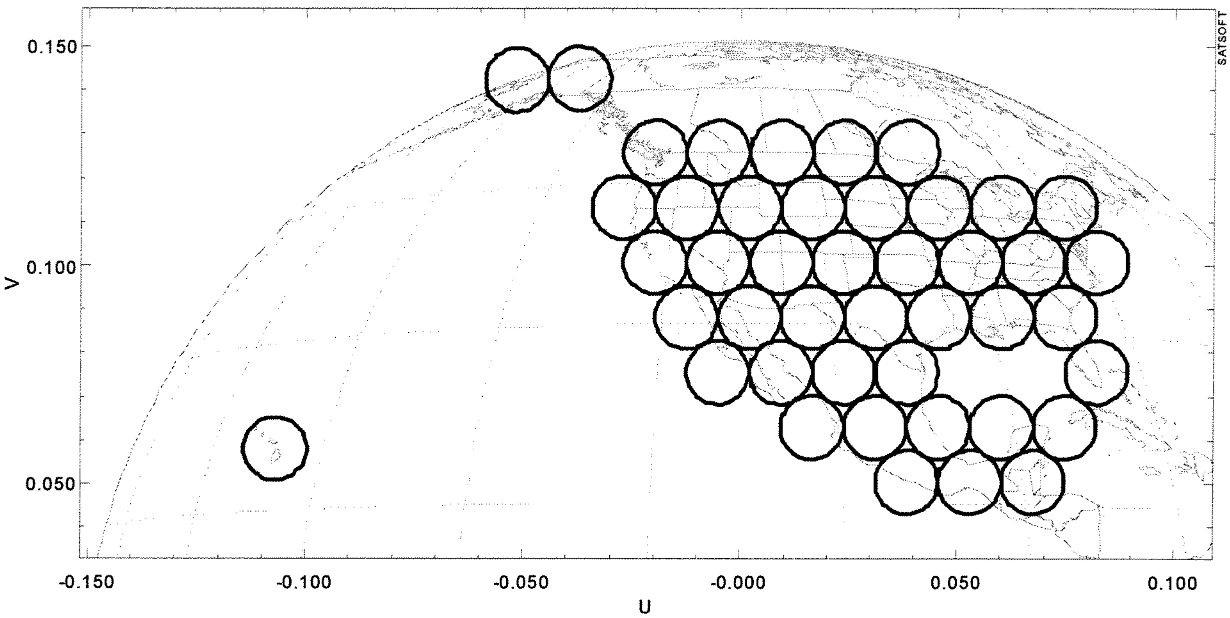
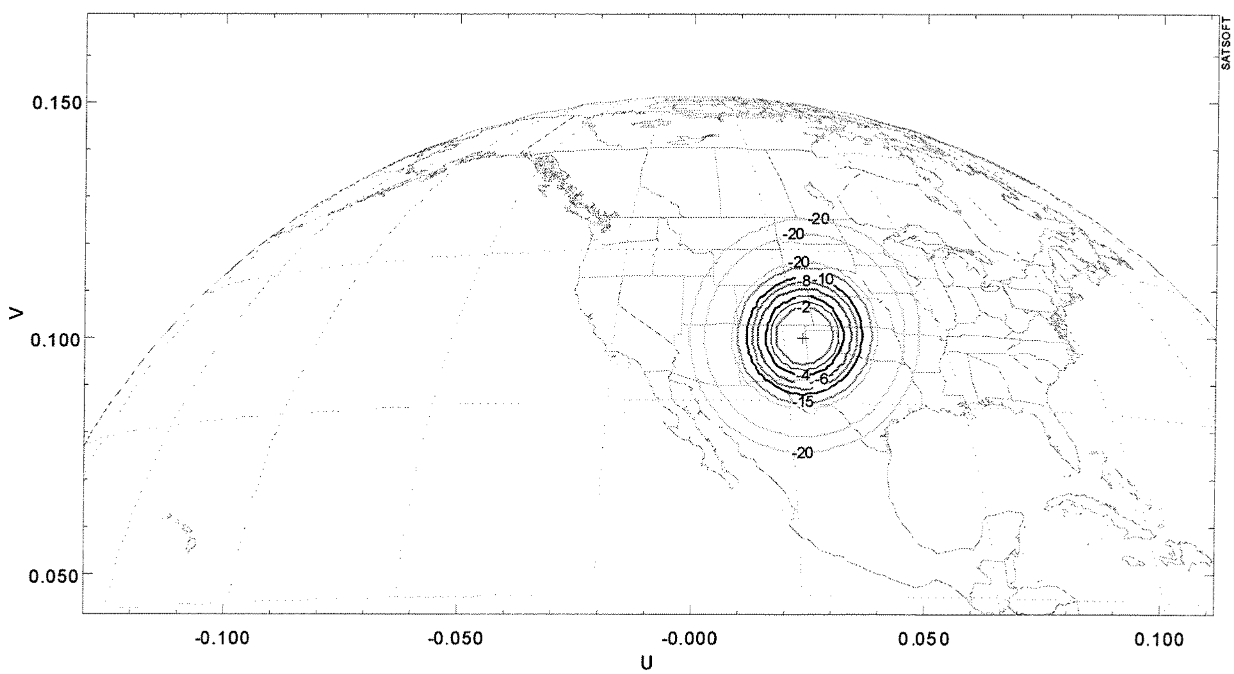


Figure A.5-2 – Ka-Band Downlink Beam Coverage – Sample Beam

(Contours shown are -2, -4, -6, -8, -10, -15, and -20 dB relative to the beam peak)



A.6 SATELLITE RECEIVE CAPABILITY

Figure A.6-1 shows the -3 dB contours of the 44 uplink spot beams used at Ka-band. One of these beams is shown in detail in Figure A.6-2 in terms of its relative gain contours. All spot beams are nominally identical, and each has a peak antenna gain of 45.5 dBi.

The satellite receive system noise temperature is 790 K (equivalent to 29.0 dB-K). Therefore the beam peak G/T performance is +16.5 dB/K (i.e., 45.5-29.0), and the performance at the -4 dB relative gain contour is +12.5 dB/K.

The cross-polar isolation of the satellite receive antennas will exceed 30 dB within the -4 dB gain contour at all transmit frequencies.

Figure A.6-1 – Ka-Band Uplink Beam Coverage – All Beams

(Contours shown are -3 dB relative to the beam peak)

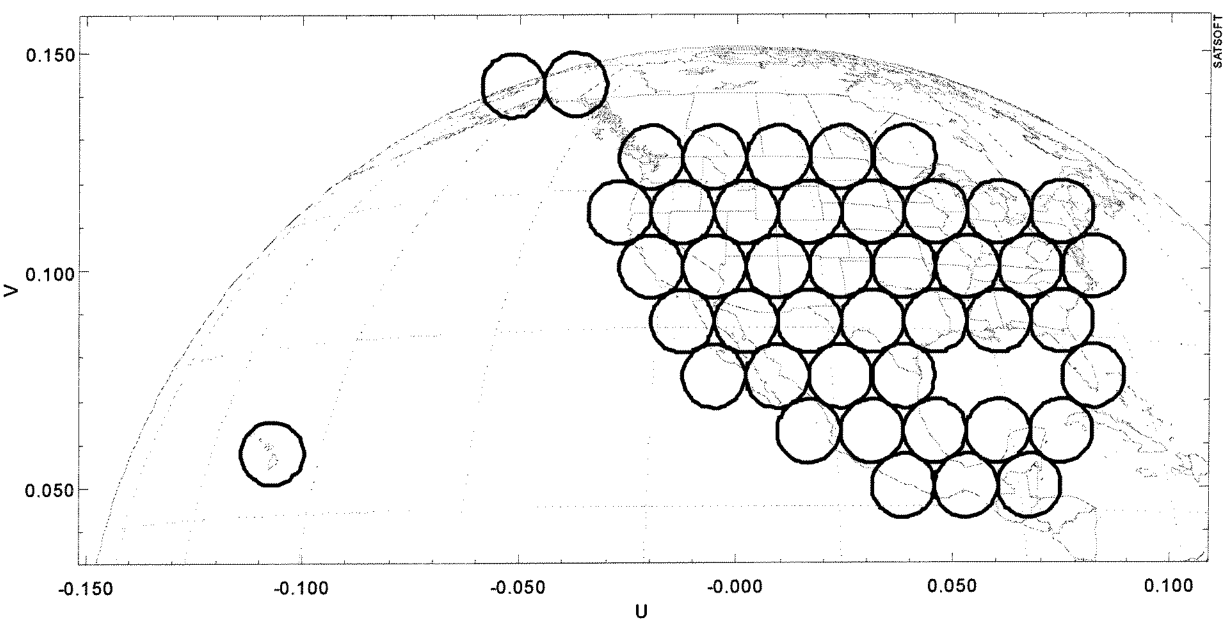
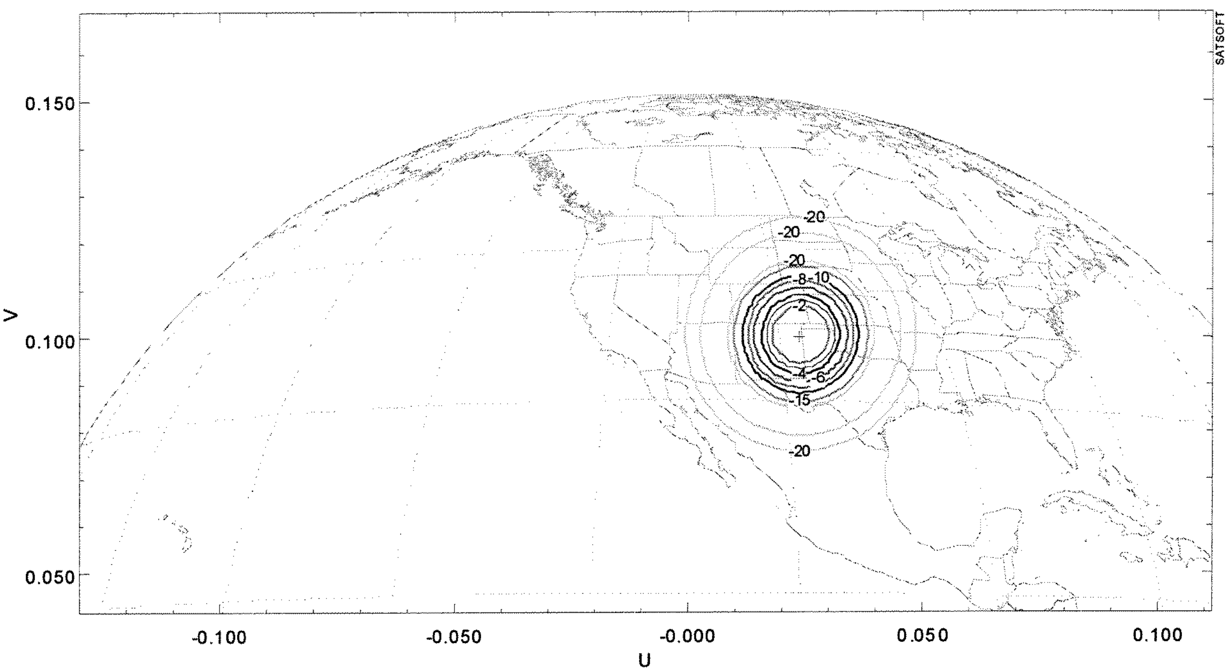


Figure A.6-2 – Ka-Band Uplink Beam Coverage – Sample Beam

(Contours shown are -2, -4, -6, -8, -10, -15, and -20 dB relative to the beam peak)



A.7 TRANSMISSION SCHEMES

In the uplink direction, Frequency Division Multiplex Access ("FDMA") is used. In the downlink direction, a single carrier comprised of Time Division Multiplexed ("TDM") information is transmitted to all users assigned to a particular channel. Uplink to downlink beam interconnectivity is achieved by the use of an on-board processor ("OBP").

For each uplink signal within the 115 MHz of Ka-band uplink spectrum, the signal is demodulated and routed to the appropriate downlink beam where the baseband information is multiplexed with the other signals destined for the same downlink beam. This combined waveform is then modulated onto the 115 MHz TDM carrier. The use of OBP allows for different channel bandwidths and connectivities to be established at different times between uplink and downlink spot beams, making it flexible for changing or unpredictable traffic requirements.

A.8 TRANSPONDER GAIN CONTROL AND SATURATION FLUX DENSITY

The transponders will be operated in a fixed gain mode, with the actual gain being programmable for each transponder individually by ground command. The SFD will be adjustable within the range -105 to -85 dBW/m^2 in 1 dB steps. The maximum transponder gain is 129.5 dB.

A.9 SATELLITE TRANSPONDER FILTER RESPONSE

The specification for the overall transponder in-band filter response and out-of-band attenuation is dictated by the following considerations:

1. The in-band gain and group delay response must be flat enough so as not to degrade significantly the bit error rate performance of the digital carrier(s) in the transponder;
2. The out-of-band attenuation must be high enough, in the adjacent transponder frequency band, to suppress adequately the multi-path transmission through adjacent transponders.
3. The out-of-band attenuation must also be sufficient to suppress any unwanted signals in frequency bands adjacent to the transponder frequency band, which could otherwise cause overload of the active amplifiers in the communications payload, or waste the available power of the TWTAs.

A.10 UNWANTED EMISSIONS

The out-of-band emissions will not exceed the limits of §25.202(f) (1), (2) and (3).

A.11 EMISSION DESIGNATORS AND ALLOCATED BANDWIDTH OF EMISSION

The emission designators are listed below:

51K2G7W
102KG7W
500KG7W
2M00G7W

6M80G7W

115MG7W

For TT&C the emission designators will be as follows:

Telecommand (including ranging):	1M00F2D
Telemetry (including ranging):	1M00F2D

A.12 EARTH STATIONS

The primary subscriber Ka-band transmit/receive earth station to be used with the ECHOSTAR-113W satellite will be a 65 cm antenna. Such terminals are expected to be deployed in large numbers across the service areas (several millions). In some areas and for certain applications, where higher clear-sky performance is required, larger antennas may be used (typically 90 cm, 120 cm, 150 cm or 180 cm).

In addition there will be a small number of medium and large gateway earth stations that are used for transporting signals back to the terrestrial networks, such as for Internet connections. These gateway stations will use an antenna in the range 3.7 meters to 11 meters, depending on the network requirements.

A.13 LINK BUDGETS

The ECHOSTAR-113W satellite will support a variety of uplink data rates ranging from 64 kbps to high-speed. The supportable uplink date rate is dependent on the size of the subscriber's antenna, the rain zone, the link elevation angle and the location of the subscriber relative to the gain contour of the satellite's receive beam. Tables A.13-1 through A.13-5 show representative link budgets for different uplink data rates and antennas sizes. All link budgets assume the uplink location is within ITU-R Rain Zone "K", there is a 30 degree elevation angle towards the satellite and the uplink location lies on the -3 dB receive beam gain contour. Link availabilities are in excess of 99.6%

Table A.13-1 – Uplink Link Budget for 65 cm antenna (51K2G7W)

Link Parameters		Clear Sky (- 3dB Contour)	Faded (-3 dB Contour)	
Carrier:				
Uncoded Data Rate	(kbps)	56.0	56.0	
Modulation		QPSK	QPSK	
FEC		0.69	0.69	
Carrier Bandwidth	(kHz)	51.2	51.2	
Link Geometry:				
Elevation Angle	(degrees)	30.0	30.0	
Tx E/S Range to Satellite	(km)	38,612	38,612	
Uplink:				
Carrier Frequency	(MHz)	29,800	29,800	
Tx E/S Antenna Diameter	(m)	0.65	0.65	
Tx E/S Power to Antenna	(W)	0.06	0.2	
Tx E/S Antenna Gain	(dB)	43.9	43.9	
Tx E/S EIRP per Carrier	(dBW)	31.7	36.9	
Atmospheric and Other Losses	(dB)	0.7	8.0	99.6% availability
Free Space Loss	(dB)	213.7	213.7	
G/T towards Tx E/S	(dB/K)	13.5	13.5	
(Eb/No) - Thermal Uplink	(dB)	10.4	8.3	
(Eb/Io) - (Adjacent satellite interference)	(dB)	16.0	16.0	
(Eb/No+Io) - Total Actual	(dB)	9.3	7.6	
(Eb/No+Io) - Total Required	(dB)	7.0	7.0	
Excess Margin	(dB)	2.3	0.6	

Table A.13-2 – Uplink Link Budget for 65 cm antenna (102KG7W)

Link Parameters		Clear Sky (- 3dB Contour)	Faded (-3 dB Contour)	
Carrier:				
Uncoded Data Rate	(kbps)	104	104	
Modulation		QPSK	QPSK	
FEC		0.69	0.69	
Carrier Bandwidth	(kHz)	102	102	
Link Geometry:				
Elevation Angle	(degrees)	30.0	30.0	
Tx E/S Range to Satellite	(km)	38,612	38,612	
Uplink:				
Carrier Frequency	(MHz)	29,800	29,800	
Tx E/S Antenna Diameter	(m)	0.65	0.65	
Tx E/S Power to Antenna	(W)	0.12	0.4	
Tx E/S Antenna Gain	(dB)	43.9	43.9	
Tx E/S EIRP per Carrier	(dBW)	34.7	39.9	
Atmospheric and Other Losses	(dB)	0.7	8.0	99.6% availability
Free Space Loss	(dB)	213.7	213.7	
G/T towards Tx E/S	(dB/K)	13.5	13.5	
(Eb/No) - Thermal Uplink	(dB)	10.7	8.6	
(Eb/Io) - (Adjacent satellite interference)	(dB)	16.0	16.0	
(Eb/No+Io) - Total Actual	(dB)	9.6	7.9	
(Eb/No+Io) - Total Required	(dB)	7.0	7.0	
Excess Margin	(dB)	2.6	0.9	

Table A.13-3 – Uplink Link Budget for 65 cm antenna (500KG7W)

Link Parameters		Clear Sky (- 3dB Contour)	Faded (-3 dB Contour)	
Carrier:				
Uncoded Data Rate	(kbps)	512	512	
Modulation		QPSK	QPSK	
FEC		0.69	0.69	
Carrier Bandwidth	(kHz)	500	500	
Link Geometry:				
Elevation Angle	(degrees)	30.0	30.0	
Tx E/S Range to Satellite	(km)	38,612	38,612	
Uplink (per carrier):				
Carrier Frequency	(MHz)	29,800	29,800	
Tx E/S Antenna Diameter	(m)	0.65	0.65	
Tx E/S Power to Antenna	(W)	0.5	2.0	
Tx E/S Antenna Gain	(dB)	43.9	43.9	
Tx E/S EIRP per Carrier	(dBW)	40.9	46.9	
Atmospheric and Other Losses	(dB)	0.7	8.0	99.6% availability
Free Space Loss	(dB)	213.7	213.7	
G/T towards Tx E/S	(dB/K)	13.5	13.5	
(Eb/No) - Thermal Uplink	(dB)	10.0	8.7	
(Eb/Io) - (Adjacent satellite interference)	(dB)	16.0	16.0	
(Eb/No+Io) - Total Actual	(dB)	9.0	7.9	
(Eb/No+Io) - Total Required	(dB)	7.0	7.0	
Excess Margin	(dB)	2.0	0.9	

Table A.13-4 – Uplink Link Budget for 0.65 m antenna (2M00G7W)

Link Parameters		Clear Sky (- 3dB Contour)	Faded (-3 dB Contour)	
Carrier:				
Uncoded Data Rate	(kbps)	2,048	2,048	
Modulation		QPSK	QPSK	
FEC		0.69	0.69	
Carrier Bandwidth	(kHz)	2,000	2,000	
Link Geometry:				
Elevation Angle	(degrees)	30.0	30.0	
Tx E/S Range to Satellite	(km)	38,612	38,612	
Uplink:				
Carrier Frequency	(MHz)	29,800	29,800	
Tx E/S Antenna Diameter	(m)	0.65	0.65	
Tx E/S Power to Antenna	(W)	2.0	8.0	
Tx E/S Antenna Gain	(dB)	43.9	43.9	
Tx E/S EIRP per Carrier	(dBW)	46.9	53.0	
Atmospheric and Other Losses	(dB)	0.7	8.0	99.6% availability
Free Space Loss	(dB)	213.7	213.7	
G/T towards Tx E/S	(dB/K)	13.5	13.5	
(Eb/No) - Thermal Uplink	(dB)	10.0	8.7	
(Eb/Io) - (Adjacent satellite interference)	(dB)	16.0	16.0	
(Eb/No+Io) - Total Actual	(dB)	9.0	7.9	
(Eb/No+Io) - Total Required	(dB)	7.0	7.0	
Excess Margin	(dB)	2.0	0.9	

Table A.13-5 – Uplink Link Budget for 1.0 m antenna (6M80G7W)

Link Parameters		Clear Sky (- 3dB Contour)	Faded (-3 dB Contour)	
Carrier:				
Uncoded Data Rate	(kbps)	6,968	6,968	
Modulation		QPSK	QPSK	
FEC		0.69	0.69	
Carrier Bandwidth	(kHz)	6,800	6,800	
Link Geometry:				
Elevation Angle	(degrees)	30.0	30.0	
Tx E/S Range to Satellite	(km)	38,612	38,612	
Uplink (per carrier):				
Carrier Frequency	(MHz)	29,800	29,800	
Tx E/S Antenna Diameter	(m)	1.0	1.0	
Tx E/S Power to Antenna	(W)	3.0	11.0	
Tx E/S Antenna Gain	(dB)	47.7	47.7	
Tx E/S EIRP per Carrier	(dBW)	52.4	58.1	
Atmospheric and Other Losses	(dB)	0.7	8.0	99.6% availability
Free Space Loss	(dB)	213.7	213.7	
G/T towards Tx E/S	(dB/K)	13.5	13.5	
(Eb/No) - Thermal Uplink	(dB)	10.1	8.5	
(Eb/Io) - (Adjacent satellite interference)	(dB)	16.0	16.0	
(Eb/No+Io) - Total Actual	(dB)	9.1	7.8	
(Eb/No+Io) - Total Required	(dB)	7.0	7.0	
Excess Margin	(dB)	2.1	0.8	

Table A.13-6 shows a representative downlink link budget with a 65 cm antenna located at the -3 dB contour and in ITU-R Rain Zone "K". Link availability is in excess of 99.7%. Higher link availabilities can be attained through the use of larger receive antennas.

Table A.13-6 – Downlink Link Budget for 65 cm antenna (115MG7W)

Link Parameters		Clear Sky (- 3dB Contour)	Faded (-3 dB Contour)	
Carrier:				
Uncoded Data Rate	(kbps)	117,760	117,760	
Modulation		QPSK	QPSK	
FEC		0.69	0.69	
Carrier Bandwidth	(kHz)	115,000	115,000	
Link Geometry:				
Elevation Angle	(degrees)	30.0	30.0	
Rx E/S Range to Satellite	(km)	38,612	38,612	
Downlink:				
Carrier Frequency	(MHz)	20,000	20,000	
Saturated EIRP	(dBW)	64.5	64.5	
EIRP per Carrier towards Rx E/S	(dBW)	61.5	61.5	
Atmospheric and Other Losses	(dB)	0.6	5.0	99.7% availability
Free Space Loss	(dB)	210.2	210.2	
Rx E/S Antenna Diameter	(m)	0.65	0.65	
Antenna Mis-pointing Error	(dB)	0.50	0.50	
Rx E/S Antenna Gain	(dB)	40.5	40.5	
Rx E/S G/T	(dB/K)	17.5	15.0	
System (LNA+Sky) Noise Temp.	(K)	200	354	
(Eb/No) - Thermal Downlink	(dB)	15.5	8.7	
(Eb/Io) - (Adjacent satellite interference)	(dB)	16.0	16.0	
(Eb/No+Io) - Total Actual	(dB)	12.8	7.9	
(Eb/No+Io) - Total Required	(dB)	7.0	7.0	
Excess Margin	(dB)	5.8	0.9	

A.14 STATION-KEEPING AND ANTENNA POINTING ACCURACY

The satellite orbital inclination and longitudinal drift will be maintained within ±0.05° of nominal. The antenna axis attitude will be maintained within ±0.12° of nominal during normal mode and ±0.15° of nominal during orbit maneuvers (i.e., station-keeping).

A.15 POWER FLUX DENSITY AT THE EARTH'S SURFACE

§25.208(c) contains FSS Power Flux Density ("PFD") limits that apply in the 18.3-18.8 GHz band. The PFD limits of §25.208(c) are as follows:

- -115 $dB(W/m^2)$ in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;
- $-115+(\delta-5)/2$ $dB(W/m^2)$ in any 1 MHz band for angles of arrival δ (in degrees) between 5 and 25 degrees above the horizontal plane; and
- -105 $dB(W/m^2)$ in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

In addition, §25.208(d) contains FSS Power Flux Density ("PFD") limits that apply in the 18.6-18.8 GHz band produced by emissions form a space station under assumed free-space propagation conditions as follows:

- -95 $dB(W/m^2)$ for all angles of arrival. This limit may be exceeded by up to 3 dB for no more than 5% of the time.

Compliance with these limits is demonstrated below using a simple worst-case methodology.

The maximum saturated EIRP per transponder is 64.5 dBW. The shortest distance from the satellite to the Earth is 35,786 km, corresponding to a spreading loss of 162.06 dB. Therefore the maximum possible PFD at the Earth's surface could not exceed –97.56 dBW/m^2 in the 115 MHz transponder usable bandwidth (i.e., 64.5–162.06). Allowing for the use of digital modulation with an almost flat spectrum, the corresponding maximum PFD at the Earth's surface measured in a 1 MHz band would not exceed –118.2 dBW/m^2. This is less than the PFD limit value (which is –115 $dBW/m^2/MHz$) that applies at the low elevation angles (5° and below).[1] Therefore compliance with this PFD limit is assured. In fact the margin relative to the PFD limit is actually

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[1] It should be noted that the maximum PFD value is also below the value given in §25.138 (a)(6) for blanket licensing of small user terminals.

much greater than this because, over much of the beam coverage the elevation angle is actually higher than 25°, at which the PFD limit is 10 dB higher (-105 $dBW/m^2/MHz$).

In addition, §25.208(d) provides an additional aggregate PFD limit in the 200 MHz wide band 18.6-18.8 GHz of -95 dBW/m2. In the worst case this would correspond to a PFD limit per MHz of -118 dBW/m2/MHz (i.e., -95-10*log(200)). Therefore, from the worst-case calculation in the preceding paragraph which results in a value of -118.2 dBW/m2, compliance with the §25.208(d) is also assured.

A.16 FREQUENCY TOLERANCE

The satellite local oscillator frequency stability will determine the accuracy of the frequency conversion between uplink and downlink transmissions. This frequency conversion error will not exceed ±5 in 10^6 under all circumstances.

A.17 CESSATION OF EMISSIONS

Each satellite transponder can be individually turned on and off by ground telecommand, thereby causing cessation of emissions from the satellite, as required.

A.18 LAUNCH VEHICLES

The spacecraft are compatible with several commercially available launch vehicles. A decision on the actual launcher to be used has not yet been made.

A.19 TT&C

The TT&C frequencies will be within the Ka-bands. The final selection of TT&C frequencies within the band is partly dependent on the choice of spacecraft supplier, based on their preferred on-board TT&C equipment. It also depends on the availability of a global TT&C earth station network to support the Launch and Early Operations Phase ("LEOP") of the satellite mission. Therefore, EchoStar proposes to define the precise TT&C frequencies shortly after it selects the satellite manufacturer for the ECHOSTAR-113W satellite. The selection of the frequencies will also need to take into account the coordination required with the neighboring satellites. At that time EchoStar will inform the Commission of its selected TT&C frequencies, provide the associated link budgets and request the necessary authorization.

Regardless of the exact TT&C frequencies used, the satellites will be configured to operate their TT&C functions through omni-directional spacecraft antennas during the LEOP, as well as in the event of a spacecraft emergency where attitude control might be disturbed. When operating correctly on-station the TT&C function will be switched to a high gain satellite antenna to permit lower power TT&C transmissions on both uplink and downlink.

Once the satellites are on-station EchoStar will use its existing Spacecraft Operations Center and TT&C earth station facilities to control the satellites.

A.20 SPACECRAFT CHARACTERISTICS

The spacecraft manufacturer for the ECHOSTAR-113W satellite has not yet been selected, and EchoStar does not wish to show preference by providing any data specific to any one manufacturer in this application. The design of the satellite has been based around the expected characteristics of the 3-axis stabilized spacecraft available from the three major U.S. suppliers (Boeing, Lockheed Martin and Loral) in the time frame necessary for these satellites.

The communications payload of the EchoStar-113W satellite requires approximately 14 kW d.c. power. Total spacecraft power requirements are approximately 16 kW d.c. power which necessitates beginning of life solar array power production capability of approximately 18 kW. The communications payload mass (including antenna) will be approximately 650 kg which results in a total spacecraft dry mass of approximately 2400 kg. The total spacecraft launch mass is in the range 5400 to 5800 kg depending on launch vehicle selected. The satellite operational lifetime will be between 12 and 15 years.

The spacecraft reliability will be consistent with current manufacturing standards in place for the major suppliers of space hardware. Bus reliability will be greater than 0.8 with an overall spacecraft reliability to EOL of greater than 0.6. Transponder sparing will be consistent with documented failure rates which allow attaining the overall spacecraft reliability numbers listed above.

EchoStar will provide the Commission with full and precise spacecraft physical characteristics when the final supplier and product has been selected. Estimates of these characteristics are included in the Schedule S form.

A.21 COMMUNICATIONS PAYLOAD

The Ka-band communications payload is designed around the use of 44 uplink and 44 downlink spot beams, interconnected using 64 active transponders, each of 115 MHz usable bandwidth and 125 Watts saturated output power. The signal received by each beam is separately amplified, filtered and downconverted and then input to the on-board processor (OBP).

The OBP is used to provide flexibility in the interconnection of traffic between uplink and downlink beams, and to allow the uplink and downlink access techniques to be optimized. On the uplink, FDMA is used, with various carrier bandwidths available in the range 64 kbps to 8.448 Mbps. This permits each transmitting earth station to be equipped with a suitably sized power amplifier to support the constant data rate it is designed for, rather than having to support high power, high data rate bursts that would be necessary in a TDMA uplink access scheme. Each of the uplink carriers received by a beam is digitally filtered and demodulated on board the satellite, and the resulting baseband bit stream is routed through to be eventually transmitted in the appropriate downlink beam. Various bit streams destined for the same downlink beam but received by different uplink beams are combined into a high-speed digital multiplex and then modulated onto a 115 MHz downlink carrier. There is one such downlink carrier transmitted through each TWTA, operating close to saturation.

The functions of the OBP are programmable by ground command, so that time-varying traffic requirements can be accommodated. Both packet-switched and circuit-switched traffic routing is under consideration at the present time. Regardless of the eventual routing technique the capacity and frequency re-use of the satellite are the same, as described below.

The 44 uplink and downlink beams are arranged such that a 4-frequency spatial re-use scheme may be applied. In such a scheme no two adjacent beams operate at the same frequency, and the first time that a frequency can be re-used is in a beam removed by at least one beamwidth.

Each of the 44 beams is permanently allocated one of the 64 transponders. The remaining 20 transponders are then flexibly allocated to beams that are likely to have greater traffic requirements. Up to three transponders can be allocated to any one beam. The choice of channel frequencies and polarizations is made in such a way as to minimize the intra-system interference between the beams, optimizing the isolation available from both the polarization discrimination and the spatial separation between co-frequency beams.

The 115 MHz bandwidth signals at the output of the OBP are up-converted and amplified before being input to the 125 Watt Traveling Wave Tube Amplifiers (TWTA). The output of the TWTAs are combined (where more than one transponder is connected to a single downlink beam) and connected to the appropriate downlink beam.

A.22 INTERFERENCE STATEMENT

Compliance with the FCC two-degree spacing policy is assured provided:

1) The maximum PFD levels are lower than the PFD values given in §25.138 (a)(6) of the Rules for blanket licensing of small user terminals;

2) The uplink off-axis EIRP density limits of §25.138 (a)(1) of the Rules are not exceeded.

Section A.15 showed the maximum PFD that can be transmitted by the ECHOSTAR-113W satellite at any angle of arrival is -118.2 dBW/m^2/MHz. This value is lower than the PFD value given in §25.138 (a)(6) of the Rules for blanket licensing of small user terminals.

The clear sky uplink off-axis EIRP density limits are equivalent to a maximum uplink input power density of -56.5 dBW/Hz. Table A.22-1 compares the uplink input power densities derived from the uplink link budgets contained in Tables A.13-1 through A.13-5 (uplink antenna moved to -4 dB contour) with the clear sky limits of §25.138 (a)(1) of the Rules. It can be seen that in all cases the clear sky uplink power limits are met.

Table A.22-1 – Demonstration of Compliance with the Uplink Power limits of §25.138 (a)(1)

Uplink Antenna Size	Emission	Maximum Clear Sky Uplink Input Power Density (dBW/Hz)	Clear Sky Uplink Input Power Density Limit of §25.138 (a)(1) (dBW/Hz)	Excess Margin (dB)
65 cm	51K2G7W	-58.3	-56.5	1.8
65 cm	102KG7W	-58.3	-56.5	1.8
65 cm	500KG7W	-59.0	-56.5	2.5
65 cm	2M00G7W	-59.0	-56.5	2.5
100 cm	6M80G7W	-62.6	-56.5	6.1

A.23 IN-ORBIT COLLISION AVOIDANCE STATEMENT

In considering current and planned satellites that may have a station-keeping volume that overlaps the ECHOSTAR-113W satellite, EchoStar reviewed the lists of FCC licensed systems and systems that are currently under consideration by the FCC. In addition, non-USA networks for which a request for coordination has been submitted to the ITU in the vicinity of 113° W.L., have also been reviewed. Only those networks that either operate, or are planned to operate, within ± 0.2 degrees from 113° W.L. have been taken into account in the analysis.

Based on our review, no US satellite operator has been authorized to operate at 113° W.L., nor is there a US system under consideration to be licensed by the FCC. SATELITES MEXICANOS, S.A. DE C.V. ("SatMex") operates the SOLIDARIDAD-2 satellite at 113° W.L. The Administration of Mexico has a number of satellite networks filed with the ITU for the 113° W.L. slot. The Administrations of Australia and the UK have filed the ROEBUCK-B and UKSAT-11 networks, respectively, at 113° W.L. We can find no evidence that satellite construction contracts have been awarded for either the Australian or the UK networks, nor does the Federal Aviation Administration Commercial Space Station Second Quarter 2004 Report show a pending launch for any of these networks.

Physical coordination of the EchoStar and SatMex satellites will be required. EchoStar will begin coordination with SatMex approximately two years before the expected launch of the ECHOSTAR-113W satellite.

There are a number of potential flight dynamic solutions to be explored in consultation with SatMex to ensure avoidance of in-orbit collision between the two satellites, including the possibility of operating the satellites at small angular offsets from their nominal position. In the event that a coordination agreement requires operation of the satellite at an offset from its assigned nominal position, EchoStar will seek any necessary modifications to its authorization from the Commission. EchoStar will similarly seek to coordinate with any new satellites that may be authorized and launched into the 113° W.L. orbital location.

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 pleading, 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 pleading, and that it is complete and accurate to the best of my knowledge and belief.

____________/s/______________

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