

## Technical Appendix

## **Appendix 1 – Interference Analysis**

### **A. Interference from other BSS systems into 45-cm receive antenna**

A 45-centimeter receive antenna satisfying ITU-R recommendation BO 1213-1, has an on-axis co-pol gain of 35.7dBi (55% efficiency) at 17.3 GHz and an off-axis gain of 13.9 dBi at 4.0 degrees off the main axis, or 21.7 dB lower than the maximum, on-axis gain. This would result in a carrier to adjacent satellite interference ratio, C/ASI of 21.7 dB, if both the interfering and interfered with system use the maximum allowed downlink EIRP over the receive noise bandwidth of the Pegasus system which satisfy the PFD limit at the surface of the Earth. Taking into account the two entries from both nearby satellites, the resulting C/ASI is 18.7 dB.

The actual downlink EIRP of the Pegasus system depends on the transponder type used (i.e. single 130W TWT, two 130W TWTs or four 130W TWTs). The difference between the maximum EIRP allowed to meet the PFD limit over the Pegasus noise bandwidth and the actual EIRP used by the Pegasus transponder subtracted from the C/ASI of 18.7 dB gives the actual carrier to adjacent satellite interference ratio. The value of the difference in the EIRPs above was calculated and used in the link budget computations for each type of transponder. The results show that the system can operate in a 4-degree environment. In addition, the 4-degree offset angle used in the calculations, is a topocentric angle and corresponds to the geocentric angle of 3.64 degrees, i.e. an orbital spacing of 3.64 degrees, providing additional flexibility in future operations.

### **B. Uplink interference**

Pegasus plans to use uplink earth stations with 5-meter antennas. The EIRP of such antenna at a 4-degree offset angle from the main beam is 45.75 dB below the main beam EIRP, resulting in a C/ASI of 45.75 dB, or 3 dB lower if the two entries are assumed and if both

interfering earth stations use the same EIRPs as the Pegasus earth station. In the absence of EIRP data for the interfering earth stations, it is difficult to compute the total uplink interference precisely. Since the C/ASI in the uplink is fairly high and does not have significant impact on the overall link performance, a conservative value of the total uplink C/ASI of 30 dB was assumed in all the link budget calculations.

### **C. Earth station EIRP density limits**

The Commission specified the uplink EIRP density limits from an earth station operating in the 24.75-25.25 GHz band (47 C.F.R. § 25.223). For a 5-meter antenna meeting the off-axis performance requirements (47 C.F.R. § 25.209), the EIRP density at 2 degrees from the main axis should not exceed 24.97 dBW/MHz. The maximum EIRP per 24 MHz transponder (carrier noise bandwidth = 20 MHz) and for a 5-meter earth station antenna used at a feeder link station can be derived as follows:

$$\begin{aligned} \text{EIRP max (dBW)} &= \text{FCC limit (dBW/MHz)} + 10 \log 20 \\ &+ \text{Difference between max gain and off-axis gain of 5m antenna (dB)} \end{aligned}$$

For an off-axis angle of 2 degrees, the FCC limit is 24.97 dBW/MHz and the difference between the maximum gain and the 2 degree off-axis gain is 38.2 dB. Thus, the maximum EIRP is

$$\text{EIRP max} = 24.97 + 13 + 38.2 = 76.17 \text{ dBW}$$

Since the antenna off-axis radiation characteristics satisfy the requirements in 47 C.F.R. § 25.209, the requirements of 47 C.F.R. § 25.223 are satisfied, if the EIRP of 76.17 dBW is not exceeded.

As shown in the link budget calculations, all the uplink EIRP values used in the Pegasus system are well below this limit, thus satisfying the FCC EIRP density limits of 47 C.F.R. § 25.223.

**D. Space path interference in reverse band operation**

In order to protect receiving DBS satellites from unacceptable levels of interference, coming from transmitting BSS satellites in the 17 GHz band, the Commission proposed to adopt an off-axis PFD coordination trigger of -93 dBW/m<sup>2</sup>/24 MHz at the DBS receiving antenna. Coordination with affected co-frequency licensees, both existing and planned, would be required in the event that the 17/24 GHz BSS satellite exceeds this level at the DBS receiving antenna; coordination would not be required in cases where no frequency overlap occurs. In the comments requested by the Commission, several operators suggested that a minimum orbital separation between the BSS and DBS systems should be introduced in addition to the coordination above trigger. However, the Commission has not adopted any rules yet. Pegasus will design its satellite system to comply with any such new rules, including a PFD trigger coordination requirement. As explained above, Pegasus has incorporated margins in the adjacent satellite interference levels used in link budget calculations and can operate offset from its requested orbital locations (up to some 0.36 degrees), should it become necessary.

**E. Interference with adjacent satellites**

In the sections above, it was shown that the proposed system can operate in the 4-degree spacing environment. It was also shown that the system has a flexibility to operate even at closer than 4-degree spacing without giving more interference than if it operated at the 4-degree spacing.

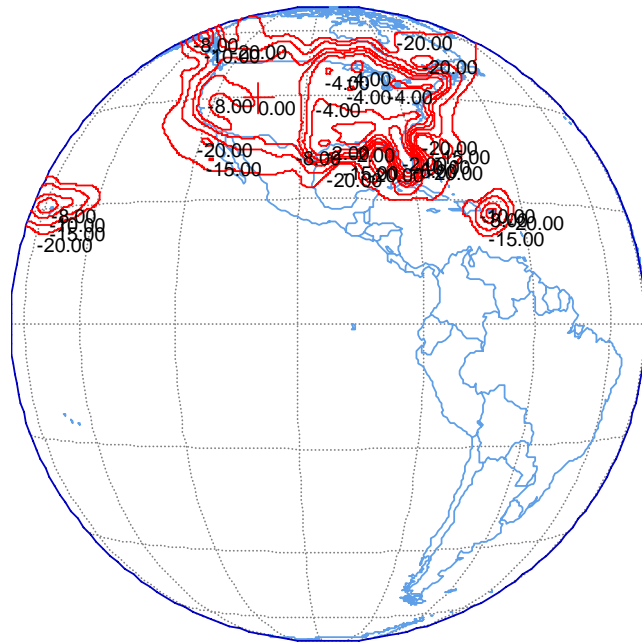
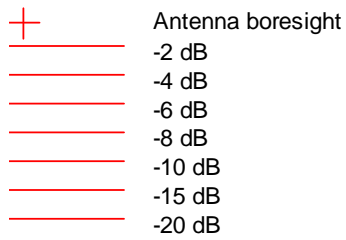
Pegasus is not aware of any satellites operating in the frequency bands sought in this application and within +/- 4 degrees of 95.15°W.

Also, Industry Canada has licensed 17/24 GHz satellites at several orbital locations, and Pegasus will undertake frequency coordination with those satellites.

## Appendix 2 – Nominal Antenna Coverage Contours from 95.15W

### CONUS DOWNLINK

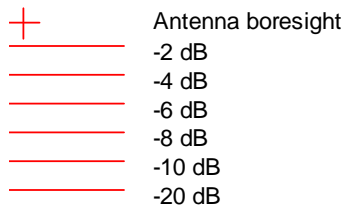
Notice ID : 1  
Administration : USA  
Satellite Network : PEGASUS 95.15W  
Beam : CONTL  
Emission / Reception : E  
Polarization : C  
Service Area Number : 0  
Service Area Name :  
Reason : C  
Satellite Position : -95.150



Beam Peak 37.1 dBi

# CONUS UPLINK

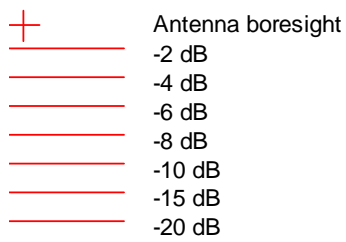
Notice ID : 1  
Administration : USA  
Satellite Network : PEGASUS 95.15W  
Beam : CONRL  
Emission / Reception : R  
Polarization : C  
Service Area Number : 0  
Service Area Name :  
Reason : C  
Satellite Position : -95.150



Beam Peak 33.1 dBi

# MEXICO DOWNLINK

Notice ID : 1  
Administration : USA  
Satellite Network : PEGASUS 95.15W  
Beam : MEXTL  
Emission / Reception : E  
Polarization : C  
Service Area Number : 0  
Service Area Name :  
Reason : C  
Satellite Position : -95.150



Beam Peak = 37.0 dBi



## Appendix 3 Link Budgets:

Satellite	95.15W
Coverage	CONUS
Uplink earth station	Los Angeles, USA-CA
Downlink earth station	Los Angeles, USA-CA
Transponder type	T1
Modulation	4-PSK

Link Parameters	Up	Down
Frequency	25.150	17.7
Polarization	Circular	Circular
Rain Model	ITU (19.7)	ITU (19.7)
Availability (av. year)	99.99	99.72
Antenna aperture	5	.45
Antenna efficiency/gain	55	55
Antenna tracking/ mispoint error	.1	1
LNB noise figure/temp		+200
Antenna noise		30
Adj. carrier int.	30	30
Adj. satellite int.	30	13.9
Cross pol. int.	25	25
Uplink HPA OBO	1	
Uplink power control	20	

Satellite Parameters	Value	Units
Receive G/T	3.5	dB/K
Saturation flux density	-100	dBW/m <sup>2</sup>
Satellite attenuator pad	12	dB
Satellite ALC	15	dB
EIRP (saturation)	50.7	dBW
Transponder bandwidth	24	MHz
Input back off total	3	dB
Output back off total	1	dB

Carrier Parameters	Value	Units
Required Eb/No with FEC coding	2.9	dB
Information rate	25.6	Mbps
FEC code rate	.64	
System margin	0	dB

General Calculations	Up	Down	Units
Elevation	43.34	43.34	degrees
Antenna gain	59.80	35.83	dB <sub>i</sub>

Uplink Calculation	Clear	Rain Up	Rain Dn	Units
Uplink transmit EIRP	72.30	72.30	72.30	dBW
Transp. IBO (total)	3.00	3.00	3.00	dB
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	211.95	211.95	211.95	dB
Atm. absorption	0.38	0.38	0.38	dB
Tropo. scintillation	0.34	0.34	0.34	dB
Atm. losses total	0.72	0.72	0.72	dB
Path loss (excl. rain)	212.66	212.66	212.66	dB
Rain attenuation	0.00	11.51	0.00	dB
Uplink power control	0.00	20.00	0.00	dB
C/No (thermal)	91.63	91.63	91.63	dB.Hz
C/N (thermal)	18.62	18.62	18.62	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	30.00	30.00	30.00	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	16.16	16.16	16.16	dB

Downlink Calculation	Clear	Rain Up	Rain Dn	Units
Satellite EIRP total	50.70	50.70	50.70	dBW
Transponder OBO (total)	1.00	1.00	1.00	dB
Satellite EIRP per carrier	49.70	49.70	49.70	dBW
Mispoint loss	1.00	1.00	1.00	dB
Free space loss	208.89	208.89	208.89	dB
Atm. absorption	0.16	0.16	0.16	dB
Tropo. scintillation	0.24	0.24	0.24	dB
Atm. losses total	0.40	0.40	0.40	dB
Path loss (excl. rain)	209.29	209.29	209.29	dB
Rain attenuation	0.00	0.00	1.29	dB
Noise incr. due to prec.	0.00	0.00	1.16	dB
Downlink degradation	0.00	0.00	2.45	dB
Total system noise	230.00	230.00	300.13	K
Figure of merit (G/T)	11.22	11.22	10.06	dB/K
C/No (thermal)	80.22	80.22	77.78	dB.Hz
C/N (thermal)	7.21	7.21	4.77	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	13.90	13.90	13.90	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	5.22	5.22	3.15	dB

Totals (end-to-End)	Clear	Rain Up	Rain Dn	Units
C/No (thermal)	79.92	79.92	77.60	dB.Hz
C/N (thermal)	6.91	6.91	4.59	dB
C/ACI	26.99	26.99	26.99	dB
C/ASI	13.79	13.79	13.79	dB
C/XPI	21.99	21.99	21.99	dB
C/IM	46.99	46.99	46.99	dB
C/(No+Io)	78.97	78.97	77.02	dB.Hz
C/(N+I)	5.96	5.96	4.01	dB
Eb/No+Io)	4.88	4.88	2.94	dB
Required Eb/(No+Io)	2.90	2.90	2.90	dB

Satellite	95.15W
Coverage	CONUS
Uplink earth station	Los Angeles, USA-CA
Downlink earth station	Los Angeles, USA-CA
Transponder type	T1
Modulation	4-PSK

Link Parameters	Up	Down	Units
Frequency	25.150	17.7	GHz
Polarization	Circular	Circular	
Rain Model	ITU (19.7)	ITU (19.7)	mm/h
Availability (av. Year)	99.99	99.5	%
Antenna aperture	5	.45	m
Antenna efficiency	55	55	%
Antenna mispoint error	.1	1	dB
LNB noise temp		+200	K
Antenna noise		30	K
Adj. carrier int.	30	30	dB
Adj. satellite int.	30	13.9	dB
Cross pol. Int.	25	25	dB
Uplink HPA OBO	1		dB
Uplink power control	20		dB

Satellite Parameters	Value	Units
Receive G/T	3.5	dB/K
Saturation flux density	-100	dBW/m2
Satellite attenuator pad	12	dB
Satellite ALC	15	dB
EIRP (saturation)	50.7	dBW
Transponder bandwidth	24	MHz
Input back off total	3	dB
Output back off total	1	dB

Carrier Parameters	Value	Units
Required Eb/No with FEC coding	3.3	dB
Information rate	28.4	Mbps
FEC code rate	.71	
Noise bandwidth	73.01	dB.Hz

General Calculations	Up	Down	Units
Elevation	43.34	43.34	degrees
Antenna gain	59.80	35.83	dB <sub>i</sub>

Uplink Calculation	Clear	Rain Up	Rain Dn	Units
Uplink transmit EIRP	72.30	72.30	72.30	dBW
Transponder IBO (total)	3.00	3.00	3.00	dB
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	211.95	211.95	211.95	dB
Atm. absorption	0.38	0.38	0.38	dB
Tropo. scintillation	0.34	0.34	0.34	dB
Atm. losses total	0.72	0.72	0.72	dB
Path loss (excl. rain)	212.66	212.66	212.66	dB
Rain attenuation	0.00	11.52	0.00	dB
Uplink power control	0.00	20.00	0.00	dB
C/No (thermal)	91.63	91.63	91.63	dB.Hz
C/N (thermal)	18.62	18.62	18.62	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	30.00	30.00	30.00	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	15.71	15.71	15.71	dB

Downlink Calculation	Clear	Rain Up	Rain Dn	Units
Satellite EIRP total	50.70	50.70	50.70	dBW
Transponder OBO (total)	1.00	1.00	1.00	dB
Satellite EIRP per carrier	49.70	49.70	49.70	dBW
Mispoint loss	1.00	1.00	1.00	dB
Free space loss	208.89	208.89	208.89	dB
Atm. absorption	0.16	0.16	0.16	dB
Tropo. scintillation	0.21	0.21	0.21	dB
Atm. losses total	0.37	0.37	0.37	dB
Path loss (excl. rain)	209.26	209.26	209.26	dB
Rain attenuation	0.00	0.00	0.68	dB
Noise incr. due to prec.	0.00	0.00	0.69	dB
Downlink degradation	0.00	0.00	1.37	dB
Total system noise	230.00	230.00	269.69	K
Figure of merit (G/T)	11.22	11.22	10.53	dB/K
C/No (thermal)	80.25	80.25	78.88	dB.Hz
C/N (thermal)	7.24	7.24	5.87	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	13.90	13.90	13.90	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	4.79	4.79	3.65	dB

Totals (end-to-End)	Clear	Rain Up	Rain Dn	Units
C/No (thermal)	79.95	79.95	78.65	dB.Hz
C/N (thermal)	6.94	6.94	5.64	dB
C/ACI	26.99	26.99	26.99	dB
C/ASI	13.79	13.79	13.79	dB
C/XPI	21.99	21.99	21.99	dB
C/(No+Io)	78.99	78.99	77.92	dB.Hz
C/(N+I)	5.98	5.98	4.91	dB
Eb/No+Io)	4.45	4.45	3.39	dB
Required Eb/(No+Io)	3.30	3.30	3.30	dB

Satellite	95.15W
Coverage	CONUS
Uplink earth station	Los Angeles, USA-CA
Downlink earth station	Los Angeles, USA-CA
Transponder type	T2
Modulation	8-PSK

Link Parameters	Up	Down	Units
Frequency	25.150	17.7	GHz
Polarization	Circular	Circular	
Rain Model	ITU (19.7)	ITU (19.7)	mm/h
Availability (av. Year)	99.99	99.67	%
Antenna aperture	5	.65	m
Antenna efficiency	55	55	%
Antenna mispoint error	.1	1	dB
LNB noise temp		+200	K
Antenna noise		30	K
Adj. carrier int.	30	30	dB
Adj. satellite int.	30	17.6	dB
Cross pol. Int.	25	25	dB
Uplink HPA OBO	1		dB
Uplink power control	20		dB

Satellite Parameters	Value	Units
Receive G/T	3.5	dB/K
Saturation flux density	-100	dBW/m2
Satellite attenuator pad	12	dB
Satellite ALC	15	dB
EIRP (saturation)	52.7	dBW
Transponder bandwidth	24	MHz
Input back off total	3	dB
Output back off total	1	dB

Carrier Parameters	Value	Units
Required Eb/No with FEC coding	5.7	dB
Information rate	42.3	Mbps
FEC code rate	.71	
Noise bandwidth	72.98	dB.Hz

General Calculations	Up	Down	Units
Elevation	43.34	43.34	degrees
Antenna gain	59.80	39.03	dB <sub>i</sub>

Uplink Calculation	Clear	Rain Up	Rain Dn	Units
Uplink transmit EIRP	72.30	72.30	72.30	dBW
Transponder IBO (total)	3.00	3.00	3.00	dB
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	211.95	211.95	211.95	dB
Atm. absorption	0.38	0.38	0.38	dB
Tropo. scintillation	0.34	0.34	0.34	dB
Atm. losses total	0.72	0.72	0.72	dB
Path loss (excl. rain)	212.66	212.66	212.66	dB
Rain attenuation	0.00	11.52	0.00	dB
Uplink power control	0.00	20.00	0.00	dB
C/No (thermal)	91.63	91.63	91.63	dB.Hz
C/N (thermal)	18.65	18.65	18.65	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	30.00	30.00	30.00	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	13.98	13.98	13.98	dB

Downlink Calculation	Clear	Rain Up	Rain Dn	Units
Satellite EIRP total	52.70	52.70	52.70	dBW
Transponder OBO (total)	1.00	1.00	1.00	dB
Satellite EIRP per carrier	51.70	51.70	51.70	dBW
Mispoint loss	1.00	1.00	1.00	dB
Free space loss	208.89	208.89	208.89	dB
Atm. absorption	0.16	0.16	0.16	dB
Tropo. scintillation	0.23	0.23	0.23	dB
Atm. losses total	0.39	0.39	0.39	dB
Path loss (excl. rain)	209.28	209.28	209.28	dB
Rain attenuation	0.00	0.00	0.90	dB
Noise incr. due to prec.	0.00	0.00	0.87	dB
Downlink degradation	0.00	0.00	1.78	dB
Total system noise	230.00	230.00	281.24	K
Figure of merit (G/T)	14.41	14.41	13.54	dB/K
C/No (thermal)	85.43	85.43	83.65	dB.Hz
C/N (thermal)	12.45	12.45	10.67	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	17.60	17.60	17.60	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	7.77	7.77	6.41	dB

Totals (end-to-End)	Clear	Rain Up	Rain Dn	Units
C/No (thermal)	84.50	84.50	83.01	dB.Hz
C/N (thermal)	11.52	11.52	10.03	dB
C/ACI	26.99	26.99	26.99	dB
C/ASI	17.36	17.36	17.36	dB
C/XPI	21.99	21.99	21.99	dB
C/(No+Io)	83.10	83.10	81.98	dB.Hz
C/(N+I)	10.12	10.12	9.00	dB
Eb/No+Io)	6.84	6.84	5.71	dB
Required Eb/(No+Io)	5.70	5.70	5.70	dB

Satellite	95.15W
Coverage	CONUS
Uplink earth station	Los Angeles, USA-CA
Downlink earth station	Miami, USA-FL
Transponder type	T1
Modulation	4-PSK

Link Parameters	Up	Down	Units
Frequency	25.150	17.8	GHz
Polarization	Circular	Circular	
Rain Model	ITU (19.7)	ITU (95.6)	mm/h
Availability (av. Year)	99.99	99.7	%
Antenna aperture	5	.45	m
Antenna efficiency	55	55	%
Antenna mispoint error	.1	1	dB
LNB noise temp		+200	K
Antenna noise		30	K
Adj. carrier int.	30	30	dB
Adj. satellite int.	30	15.4	dB
Cross pol. Int.	25	25	dB
Uplink HPA OBO	1		dB
Uplink power control	20		dB

Satellite Parameters	Value	Units
Receive G/T	3.5	dB/K
Saturation flux density	-100	dBW/m2
Satellite attenuator pad	12	dB
Satellite ALC	15	dB
EIRP (saturation)	58.2	dBW
Transponder bandwidth	24	MHz
Input back off total	3	dB
Output back off total	1	dB

Carrier Parameters	Value	Units
Required Eb/No with FEC coding	3.3	dB
Information rate	28.4	Mbps
FEC code rate	.71	
Noise bandwidth	73.01	dB.Hz

General Calculations	Up	Down	Units
Elevation	43.34	55.56	degrees
Antenna gain	59.80	35.88	dB <sub>i</sub>

Uplink Calculation	Clear	Rain Up	Rain Dn	Units
Uplink transmit EIRP	72.30	72.30	72.30	dBW
Transponder IBO (total)	3.00	3.00	3.00	dB
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	211.95	211.95	211.95	dB
Atm. absorption	0.38	0.38	0.38	dB
Tropo. scintillation	0.34	0.34	0.34	dB
Atm. losses total	0.72	0.72	0.72	dB
Path loss (excl. rain)	212.66	212.66	212.66	dB
Rain attenuation	0.00	11.52	0.00	dB
Uplink power control	0.00	20.00	0.00	dB
C/No (thermal)	91.63	91.63	91.63	dB.Hz
C/N (thermal)	18.62	18.62	18.62	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	30.00	30.00	30.00	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	15.71	15.71	15.71	dB

Downlink Calculation	Clear	Rain Up	Rain Dn	Units
Satellite EIRP total	58.20	58.20	58.20	dBW
Transponder OBO (total)	1.00	1.00	1.00	dB
Satellite EIRP per carrier	57.20	57.20	57.20	dBW
Mispoint loss	1.00	1.00	1.00	dB
Free space loss	208.76	208.76	208.76	dB
Atm. absorption	0.29	0.29	0.29	dB
Tropo. scintillation	0.36	0.36	0.36	dB
Atm. losses total	0.65	0.65	0.65	dB
Path loss (excl. rain)	209.41	209.41	209.41	dB
Rain attenuation	0.00	0.00	6.29	dB
Noise incr. due to prec.	0.00	0.00	2.88	dB
Downlink degradation	0.00	0.00	9.17	dB
Total system noise	230.00	230.00	446.04	K
Figure of merit (G/T)	11.27	11.27	8.39	dB/K
C/No (thermal)	87.66	87.66	78.49	dB.Hz
C/N (thermal)	14.65	14.65	5.48	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	15.40	15.40	15.40	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	10.20	10.20	3.48	dB

Totals (end-to-End)	Clear	Rain Up	Rain Dn	Units
C/No (thermal)	86.19	86.19	78.28	dB.Hz
C/N (thermal)	13.18	13.18	5.27	dB
C/ACI	26.99	26.99	26.99	dB
C/ASI	15.25	15.25	15.25	dB
C/XPI	21.99	21.99	21.99	dB
C/(No+Io)	83.66	83.66	77.76	dB.Hz
C/(N+I)	10.65	10.65	4.75	dB
Eb/No+Io)	9.12	9.12	3.22	dB
Required Eb/(No+Io)	3.30	3.30	3.30	dB

Satellite	95.15W
Coverage	CONUS
Uplink earth station	Los Angeles, USA-CA
Downlink earth station	Miami, USA-FL
Transponder type	T2
Modulation	8-PSK

Link Parameters	Up	Down	Units
Frequency	25.150	17.7	GHz
Polarization	Circular	Circular	
Rain Model	ITU (19.7)	ITU (95.6)	mm/h
Availability (av. Year)	99.99	99.6	%
Antenna aperture	5	.45	m
Antenna efficiency	55	55	%
Antenna mispoint error	.1	1	dB
LNB noise temp		+200	K
Antenna noise		30	K
Adj. carrier int.	30	30	dB
Adj. satellite int.	30	17.4	dB
Cross pol. Int.	25	25	dB
Uplink HPA OBO	1		dB
Uplink power control	20		dB

Satellite Parameters	Value	Units
Receive G/T	3.5	dB/K
Saturation flux density	-100	dBW/m2
Satellite attenuator pad	12	dB
Satellite ALC	15	dB
EIRP (saturation)	60.2	dBW
Transponder bandwidth	24	MHz
Input back off total	3	dB
Output back off total	1	dB

Carrier Parameters	Value	Units
Required Eb/No with FEC coding	4.8	dB
Information rate	38.4	Mbps
FEC code rate	.64	
Noise bandwidth	73.01	dBHz

General Calculations	Up	Down	Units
Elevation	43.34	55.56	degrees
Antenna gain	59.80	35.83	dB <sub>i</sub>

Uplink Calculation	Clear	Rain Up	Rain Dn	Units
Uplink transmit EIRP	72.30	72.30	72.30	dBW
Transponder IBO (total)	3.00	3.00	3.00	dB
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	211.95	211.95	211.95	dB
Atm. absorption	0.38	0.38	0.38	dB
Tropo. scintillation	0.34	0.34	0.34	dB
Atm. losses total	0.72	0.72	0.72	dB
Path loss (excl. rain)	212.66	212.66	212.66	dB
Rain attenuation	0.00	11.52	0.00	dB
Uplink power control	0.00	20.00	0.00	dB
C/No (thermal)	91.63	91.63	91.63	dB.Hz
C/N (thermal)	18.62	18.62	18.62	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	30.00	30.00	30.00	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	14.40	14.40	14.40	dB

Downlink Calculation	Clear	Rain Up	Rain Dn	Units
Satellite EIRP total	60.20	60.20	60.20	dBW
Transponder OBO (total)	1.00	1.00	1.00	dB
Satellite EIRP per carrier	59.20	59.20	59.20	dBW
Mispoint loss	1.00	1.00	1.00	dB
Free space loss	208.71	208.71	208.71	dB
Atm. absorption	0.28	0.28	0.28	dB
Tropo. scintillation	0.34	0.34	0.34	dB
Atm. losses total	0.62	0.62	0.62	dB
Path loss (excl. rain)	209.33	209.33	209.33	dB
Rain attenuation	0.00	0.00	5.21	dB
Noise incr. due to prec.	0.00	0.00	2.69	dB
Downlink degradation	0.00	0.00	7.90	dB
Total system noise	230.00	230.00	427.24	K
Figure of merit (G/T)	11.22	11.22	8.53	dB/K
C/No (thermal)	89.69	89.69	81.79	dB.Hz
C/N (thermal)	16.68	16.68	8.78	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	17.40	17.40	17.40	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	10.75	10.75	5.27	dB

Totals (end-to-End)	Clear	Rain Up	Rain Dn	Units
C/No (thermal)	87.54	87.54	81.36	dB.Hz
C/N (thermal)	14.53	14.53	8.35	dB
C/ACI	26.99	26.99	26.99	dB
C/ASI	17.17	17.17	17.17	dB
C/XPI	21.99	21.99	21.99	dB
C/(No+Io)	85.03	85.03	80.61	dB.Hz
C/(N+I)	12.02	12.02	7.60	dB
Eb/No+Io)	9.19	9.19	4.77	dB
Required Eb/(No+Io)	4.80	4.80	4.80	dB

Satellite	95.15W
Coverage	CONUS
Uplink earth station	Los Angeles, USA-CA
Downlink earth station	Miami, USA-FL
Transponder type	T2
Modulation	8-PSK

Link Parameters	Up	Down	Units
Frequency	25.150	17.7	GHz
Polarization	Circular	Circular	
Rain Model	ITU (19.7)	ITU (95.6)	mm/h
Availability (av. Year)	99.99	99.35	%
Antenna aperture	5	.45	m
Antenna efficiency	55	55	%
Antenna mispoint error	.1	1	dB
LNB noise temp		+200	K
Antenna noise		30	K
Adj. carrier int.	30	30	dB
Adj. satellite int.	30	17.4	dB
Cross pol. Int.	25	25	dB
Uplink HPA OBO	1		dB
Uplink power control	20		dB

Satellite Parameters	Value	Units
Receive G/T	3.5	dB/K
Saturation flux density	-100	dBW/m2
Satellite attenuator pad	12	dB
Satellite ALC	15	dB
EIRP (saturation)	60.2	dBW
Transponder bandwidth	24	MHz
Input back off total	3	dB
Output back off total	1	dB

Carrier Parameters	Value	Units
Required Eb/No with FEC coding	5.7	dB
Information rate	42.3	Mbps
FEC code rate	.71	
Noise bandwidth	72.98	dBHz

General Calculations	Up	Down	Units
Elevation	43.34	55.56	degrees
Antenna gain	59.80	35.83	dB <sub>i</sub>

Uplink Calculation	Clear	Rain Up	Rain Dn	Units
Uplink transmit EIRP	72.30	72.30	72.30	dBW
Transponder IBO (total)	3.00	3.00	3.00	dB
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	211.95	211.95	211.95	dB
Atm. absorption	0.38	0.38	0.38	dB
Tropo. scintillation	0.34	0.34	0.34	dB
Atm. losses total	0.72	0.72	0.72	dB
Path loss (excl. rain)	212.66	212.66	212.66	dB
Rain attenuation	0.00	11.52	0.00	dB
Uplink power control	0.00	20.00	0.00	dB
C/No (thermal)	91.63	91.63	91.63	dB.Hz
C/N (thermal)	18.65	18.65	18.65	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	30.00	30.00	30.00	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	13.98	13.98	13.98	dB

Downlink Calculation	Clear	Rain Up	Rain Dn	Units
Satellite EIRP total	60.20	60.20	60.20	dBW
Transponder OBO (total)	1.00	1.00	1.00	dB
Satellite EIRP per carrier	59.20	59.20	59.20	dBW
Mispoint loss	1.00	1.00	1.00	dB
Free space loss	208.71	208.71	208.71	dB
Atm. absorption	0.28	0.28	0.28	dB
Tropo. scintillation	0.30	0.30	0.30	dB
Atm. losses total	0.58	0.58	0.58	dB
Path loss (excl. rain)	209.29	209.29	209.29	dB
Rain attenuation	0.00	0.00	3.75	dB
Noise incr. due to prec.	0.00	0.00	2.33	dB
Downlink degradation	0.00	0.00	6.07	dB
Total system noise	230.00	230.00	393.17	K
Figure of merit (G/T)	11.22	11.22	8.89	dB/K
C/No (thermal)	89.72	89.72	83.65	dB.Hz
C/N (thermal)	16.74	16.74	10.67	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	17.40	17.40	17.40	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	10.33	10.33	6.38	dB

Totals (end-to-End)	Clear	Rain Up	Rain Dn	Units
C/No (thermal)	87.56	87.56	83.01	dB.Hz
C/N (thermal)	14.58	14.58	10.03	dB
C/ACI	26.99	26.99	26.99	dB
C/ASI	17.17	17.17	17.17	dB
C/XPI	21.99	21.99	21.99	dB
C/(No+Io)	85.03	85.03	81.94	dB.Hz
C/(N+I)	12.05	12.05	8.97	dB
Eb/No+Io)	8.77	8.77	5.68	dB
Required Eb/(No+Io)	5.70	5.70	5.70	dB

Satellite	95.15W
Coverage	CONUSi
Uplink earth station	Los Angeles, USA-CA
Downlink earth station	OAHU-Honolulu USA-HI
Transponder type	T2
Modulation	4-PSK

Link Parameters	Up	Down	Units
Frequency	25.150	17.7	GHz
Polarization	Circular	Circular	
Rain Model	ITU (19.7)	ITU (40.4)	mm/h
Availability (av. Year)	99.999	99.1	%
Antenna aperture	5	.65	m
Antenna efficiency	55	55	%
Antenna mispoint error	.1	1	dB
LNB noise temp		+200	K
Antenna noise		30	K
Adj. carrier int.	30	30	dB
Adj. satellite int.	30	16.75	dB
Cross pol. Int.	25	25	dB
Uplink HPA OBO	1		dB
Uplink power control	20		dB

Satellite Parameters	Value	Units
Receive G/T	3.5	dB/K
Saturation flux density	-100	dBW/m2
Satellite attenuator pad	12	dB
Satellite ALC	15	dB
EIRP (saturation)	52.2	dBW
Transponder bandwidth	24	MHz
Input back off total	3	dB
Output back off total	1	dB

Carrier Parameters	Value	Units
Required Eb/No with FEC coding	2.9	dB
Information rate	25.6	Mbps
FEC code rate	.64	
Noise bandwidth	73.01	dBHz

General Calculations	Up	Down	Units
Elevation	43.34	17.00	degrees
Antenna gain	59.80	39.03	dB <sub>i</sub>

Uplink Calculation	Clear	Rain Up	Rain Dn	Units
Uplink transmit EIRP	72.30	72.30	72.30	dBW
Transponder IBO (total)	3.00	3.00	3.00	dB
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	211.95	211.95	211.95	dB
Atm. absorption	0.38	0.38	0.38	dB
Tropo. scintillation	0.34	0.34	0.34	dB
Atm. losses total	0.72	0.72	0.72	dB
Path loss (excl. rain)	212.66	212.66	212.66	dB
Rain attenuation	0.00	23.52	0.00	dB
Uplink power control	0.00	20.00	0.00	dB
C/No (thermal)	91.63	88.11	91.63	dB.Hz
C/N (thermal)	18.62	15.10	18.62	dB
C/ACI	30.00	26.48	30.00	dB
C/ASI	30.00	26.48	30.00	dB
C/XPI	25.00	21.48	25.00	dB
Eb/(No+Io)	16.16	12.65	16.16	dB

Downlink Calculation	Clear	Rain Up	Rain Dn	Units
Satellite EIRP total	52.20	52.20	52.20	dBW
Transponder OBO (total)	1.00	1.00	1.00	dB
Satellite EIRP per carrier	51.20	51.20	51.20	dBW
Mispoint loss	1.00	1.00	1.00	dB
Free space loss	209.42	209.42	209.42	dB
Atm. absorption	0.73	0.73	0.73	dB
Tropo. scintillation	0.92	0.92	0.92	dB
Atm. losses total	1.64	1.64	1.64	dB
Path loss (excl. rain)	211.06	211.06	211.06	dB
Rain attenuation	0.00	0.00	3.31	dB
Noise incr. due to prec.	0.00	0.00	2.19	dB
Downlink degradation	0.00	0.00	5.50	dB
Total system noise	230.00	230.00	380.62	K
Figure of merit (G/T)	14.41	14.41	12.22	dB/K
C/No (thermal)	83.13	83.13	77.65	dB.Hz
C/N (thermal)	10.12	10.12	4.64	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	16.75	16.75	16.75	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	8.05	8.05	3.26	dB

Totals (end-to-End)	Clear	Rain Up	Rain Dn	Units
C/No (thermal)	82.57	81.95	77.48	dB.Hz
C/N (thermal)	9.56	8.94	4.47	dB
C/ACI	26.99	24.88	26.99	dB
C/ASI	16.55	16.31	16.55	dB
C/XPI	21.99	19.88	21.99	dB
C/(No+Io)	81.52	80.85	77.12	dB.Hz
C/(N+I)	8.51	7.84	4.11	dB
Eb/No+Io)	7.44	6.76	3.00	dB
Required Eb/(No+Io)	2.90	2.90	2.90	dB

Satellite	95.15W
Coverage	MEXICO
Uplink earth station	Los Angeles, USA-CA
Downlink earth station	Ciudad de Mexico, Mexico
Transponder type	T3
Modulation	8-PSK

Link Parameters	Up	Down	Units
Frequency	25.150	17.7	GHz
Polarization	Circular	Circular	
Rain Model	ITU (19.7)	ITU (26.5)	mm/h
Availability (av. Year)	99.999	99.44	%
Antenna aperture	5	.45	m
Antenna efficiency	55	55	%
Antenna mispoint error	.1	1	dB
LNB noise temp		+200	K
Antenna noise		30	K
Adj. carrier int.	30	30	dB
Adj. satellite int.	30	13.4	dB
Cross pol. Int.	25	25	dB
Uplink HPA OBO	1		dB
Uplink power control	20		dB

Satellite Parameters	Value	Units
Receive G/T	3.5	dB/K
Saturation flux density	-100	dBW/m2
Satellite attenuator pad	12	dB
Satellite ALC	15	dB
EIRP (saturation)	56	dBW
Transponder bandwidth	24	MHz
Input back off total	3	dB
Output back off total	1	dB

Carrier Parameters	Value	Units
Required Eb/No with FEC coding	4.8	dB
Information rate	38.4	Mbps
FEC code rate	.64	
Noise bandwidth	73.01	dBHz

General Calculations	Up	Down	Units
Elevation	43.34	66.77	degrees
Antenna gain	59.80	35.83	dB <sub>i</sub>

Uplink Calculation	Clear	Rain Up	Rain Dn	Units
Uplink transmit EIRP	72.30	72.30	72.30	dBW
Transponder IBO (total)	3.00	3.00	3.00	dB
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	211.95	211.95	211.95	dB
Atm. absorption	0.38	0.38	0.38	dB
Tropo. scintillation	0.34	0.34	0.34	dB
Atm. losses total	0.72	0.72	0.72	dB
Path loss (excl. rain)	212.66	212.66	212.66	dB
Rain attenuation	0.00	23.52	0.00	dB
Uplink power control	0.00	20.00	0.00	dB
C/No (thermal)	91.63	88.11	91.63	dB.Hz
C/N (thermal)	18.62	15.09	18.62	dB
C/ACI	30.00	26.47	30.00	dB
C/ASI	30.00	26.47	30.00	dB
C/XPI	25.00	21.47	25.00	dB
Eb/(No+Io)	14.40	10.88	14.40	dB

Downlink Calculation	Clear	Rain Up	Rain Dn	Units
Satellite EIRP total	56.00	56.00	56.00	dBW
Transponder OBO (total)	1.00	1.00	1.00	dB
Satellite EIRP per carrier	55.00	55.00	55.00	dBW
Mispoint loss	1.00	1.00	1.00	dB
Free space loss	208.59	208.59	208.59	dB
Atm. absorption	0.12	0.12	0.12	dB
Tropo. scintillation	0.14	0.14	0.14	dB
Atm. losses total	0.27	0.27	0.27	dB
Path loss (excl. rain)	208.85	208.85	208.85	dB
Rain attenuation	0.00	0.00	1.70	dB
Noise incr. due to prec.	0.00	0.00	1.39	dB
Downlink degradation	0.00	0.00	3.09	dB
Total system noise	230.00	230.00	316.85	K
Figure of merit (G/T)	11.22	11.22	9.83	dB/K
C/No (thermal)	85.96	85.96	82.88	dB.Hz
C/N (thermal)	12.95	12.95	9.87	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	13.40	13.40	13.40	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	7.14	7.14	5.32	dB

Totals (end-to-End)	Clear	Rain Up	Rain Dn	Units
C/No (thermal)	84.92	83.90	82.33	dB.Hz
C/N (thermal)	11.91	10.89	9.32	dB
C/ACI	26.99	24.88	26.99	dB
C/ASI	13.31	13.19	13.31	dB
C/XPI	21.99	19.88	21.99	dB
C/(No+Io)	82.24	81.46	80.66	dB.Hz
C/(N+I)	9.23	8.45	7.65	dB
Eb/No+Io)	6.40	5.61	4.81	dB
Required Eb/(No+Io)	4.80	4.80	4.80	dB



Satellite	95.15W
Coverage	MEXICO
Uplink earth station	Los Angeles, USA-CA
Downlink earth station	Ciudad de Mexico, Mexico
Transponder type	T3
Modulation	4-PSK

Link Parameters	Up	Down	Units
Frequency	25.150	17.7	GHz
Polarization	Circular	Circular	
Rain Model	ITU (19.7)	ITU (26.5)	mm/h
Availability (av. Year)	99.999	99.89	%
Antenna aperture	5	.45	m
Antenna efficiency	55	55	%
Antenna mispoint error	.1	1	dB
LNB noise temp		+200	K
Antenna noise		30	K
Adj. carrier int.	30	30	dB
Adj. satellite int.	30	13.4	dB
Cross pol. Int.	25	25	dB
Uplink HPA OBO	1		dB
Uplink power control	20		dB

Satellite Parameters	Value	Units
Receive G/T	3.5	dB/K
Saturation flux density	-100	dBW/m2
Satellite attenuator pad	12	dB
Satellite ALC	15	dB
EIRP (saturation)	56	dBW
Transponder bandwidth	24	MHz
Input back off total	3	dB
Output back off total	1	dB

Carrier Parameters	Value	Units
Required Eb/No with FEC coding	3.3	dB
Information rate	28.4	Mbps
FEC code rate	.71	
Noise bandwidth	73.01	dBHz

General Calculations	Up	Down	Units
Elevation	43.34	66.77	degrees
Antenna gain	59.80	35.83	dB <sub>i</sub>

Uplink Calculation	Clear	Rain Up	Rain Dn	Units
Uplink transmit EIRP	72.30	72.30	72.30	dBW
Transponder IBO (total)	3.00	3.00	3.00	dB
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	211.95	211.95	211.95	dB
Atm. absorption	0.38	0.38	0.38	dB
Tropo. scintillation	0.34	0.34	0.34	dB
Atm. losses total	0.72	0.72	0.72	dB
Path loss (excl. rain)	212.66	212.66	212.66	dB
Rain attenuation	0.00	23.52	0.00	dB
Uplink power control	0.00	20.00	0.00	dB
C/No (thermal)	91.63	88.11	91.63	dB.Hz
C/N (thermal)	18.62	15.09	18.62	dB
C/ACI	30.00	26.48	30.00	dB
C/ASI	30.00	26.48	30.00	dB
C/XPI	25.00	21.48	25.00	dB
Eb/(No+Io)	15.71	12.19	15.71	dB

Downlink Calculation	Clear	Rain Up	Rain Dn	Units
Satellite EIRP total	56.00	56.00	56.00	dBW
Transponder OBO (total)	1.00	1.00	1.00	dB
Satellite EIRP per carrier	55.00	55.00	55.00	dBW
Mispoint loss	1.00	1.00	1.00	dB
Free space loss	208.59	208.59	208.59	dB
Atm. absorption	0.12	0.12	0.12	dB
Tropo. scintillation	0.20	0.20	0.20	dB
Atm. losses total	0.32	0.32	0.32	dB
Path loss (excl. rain)	208.91	208.91	208.91	dB
Rain attenuation	0.00	0.00	4.65	dB
Noise incr. due to prec.	0.00	0.00	2.47	dB
Downlink degradation	0.00	0.00	7.12	dB
Total system noise	230.00	230.00	406.54	K
Figure of merit (G/T)	11.22	11.22	8.74	dB/K
C/No (thermal)	85.91	85.91	78.79	dB.Hz
C/N (thermal)	12.90	12.90	5.78	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	13.40	13.40	13.40	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	8.43	8.43	3.50	dB

Totals (end-to-End)	Clear	Rain Up	Rain Dn	Units
C/No (thermal)	84.88	83.86	78.57	dB.Hz
C/N (thermal)	11.87	10.85	5.56	dB
C/ACI	26.99	24.88	26.99	dB
C/ASI	13.31	13.19	13.31	dB
C/XPI	21.99	19.87	21.99	dB
C/(No+Io)	82.22	81.44	77.78	dB.Hz
C/(N+I)	9.21	8.43	4.77	dB
Eb/No+Io)	7.68	6.90	3.25	dB
Required Eb/(No+Io)	3.30	3.30	3.30	dB

Satellite	95.15W
Coverage	CONUS
Uplink earth station	Los Angeles, USA-CA
Downlink earth station	Anchorage, USA-AK
Transponder type	T2
Modulation	4-PSK

Link Parameters	Up	Down	Units
Frequency	25.150	17.7	GHz
Polarization	Circular	Circular	
Rain Model	ITU (19.7)	ITU (22.4)	mm/h
Availability (av. Year)	99.9	99.6	%
Antenna aperture	5	.65	m
Antenna efficiency	55	55	%
Antenna mispoint error	.1	1	dB
LNB noise temp		+200	K
Antenna noise		30	K
Adj. carrier int.	30	30	dB
Adj. satellite int.	30	16.75	dB
Cross pol. Int.	25	25	dB
Uplink HPA OBO	1		dB
Uplink power control	20		dB

Satellite Parameters	Value	Units
Receive G/T	3.5	dB/K
Saturation flux density	-100	dBW/m2
Satellite attenuator pad	12	dB
Satellite ALC	15	dB
EIRP (saturation)	52.2	dBW
Transponder bandwidth	24	MHz
Input back off total	3	dB
Output back off total	1	dB

Carrier Parameters	Value	Units
Required Eb/No with FEC coding	2.9	dB
Information rate	25.6	Mbps
FEC code rate	.64	
Noise bandwidth	73.01	dBHz

General Calculations	Up	Down	Units
Elevation	43.34	7.62	degrees
Antenna gain	59.80	39.03	dB <sub>i</sub>

Uplink Calculation	Clear	Rain Up	Rain Dn	Units
Uplink transmit EIRP	72.19	72.19	72.19	dBW
Transponder IBO (total)	3.00	3.00	3.00	dB
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	211.95	211.95	211.95	dB
Atm. absorption	0.38	0.38	0.38	dB
Tropo. scintillation	0.23	0.23	0.23	dB
Atm. losses total	0.61	0.61	0.61	dB
Path loss (excl. rain)	212.55	212.55	212.55	dB
Rain attenuation	0.00	3.97	0.00	dB
Uplink power control	0.00	20.00	0.00	dB
C/No (thermal)	91.63	91.63	91.63	dB.Hz
C/N (thermal)	18.62	18.62	18.62	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	30.00	30.00	30.00	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	16.16	16.16	16.16	dB

Downlink Calculation	Clear	Rain Up	Rain Dn	Units
Satellite EIRP total	52.20	52.20	52.20	dBW
Transponder OBO (total)	1.00	1.00	1.00	dB
Satellite EIRP per carrier	51.20	51.20	51.20	dBW
Mispoint loss	1.00	1.00	1.00	dB
Free space loss	209.63	209.63	209.63	dB
Atm. absorption	0.66	0.66	0.66	dB
Tropo. scintillation	1.23	1.23	1.23	dB
Atm. losses total	1.89	1.89	1.89	dB
Path loss (excl. rain)	211.52	211.52	211.52	dB
Rain attenuation	0.00	0.00	3.23	dB
Noise incr. due to prec.	0.00	0.00	2.00	dB
Downlink degradation	0.00	0.00	5.23	dB
Total system noise	230.00	230.00	364.79	K
Figure of merit (G/T)	14.41	14.41	12.41	dB/K
C/No (thermal)	82.69	82.69	77.45	dB.Hz
C/N (thermal)	9.68	9.68	4.44	dB
C/ACI	30.00	30.00	30.00	dB
C/ASI	16.75	16.75	16.75	dB
C/XPI	25.00	25.00	25.00	dB
Eb/(No+Io)	7.69	7.69	3.08	dB

Totals (end-to-End)	Clear	Rain Up	Rain Dn	Units
C/No (thermal)	82.16	82.16	77.29	dB.Hz
C/N (thermal)	9.15	9.15	4.28	dB
C/ACI	26.99	26.99	26.99	dB
C/ASI	16.55	16.55	16.55	dB
C/XPI	21.99	21.99	21.99	dB
C/(No+Io)	81.19	81.19	76.95	dB.Hz
C/(N+I)	8.18	8.18	3.94	dB
Eb/No+Io)	7.11	7.11	2.87	dB
Required Eb/(No+Io)	2.90	2.90	2.90	dB