Digital Link Budget

Produced using Satfinder

Thursday, November 11, 2004

Service Name	Richardson Test Satcom-On-The-Move
Coverage	CONUS
Uplink earth station	Fort Gordon, GA
Downlink earth station	Dallas
Satellite name	Intelsat 707

Link Input Parameters	Uplink	Downlink	Units
Site latitude	33.45N	32.78N	degrees
Site longitude	82.2W	96.80W	degrees
Magnetic variation	5.8W	5.1E	degrees
Site altitude	0.1	0.1	km
Frequency	14.2	11.9	GHz
Polarization	Horizontal	Vertical	
Rain climatic zone (model)	E (ITU)	E (ITU)	
Availability (average year)	95	95	%
Water vapour density	3	3	gm/m3
Surface temperature	23	23	°C
Antenna aperture	0.6	2.4	metres
Antenna efficiency / gain	+37.3	+47.4	% (+ prefix dBi)
Coupling loss	1.2	0.1	dB
Antenna tracking / mispoint error	0.1	0.1	dB
LNB noise figure / temp		+65	dB (+ prefix K)
Antenna noise		43	K
Adjacent carrier interference	60	60	dB
Adjacent satellite interference	65	65	dB
Cross polarization interference	30	30	dB
Uplink station HPA output back-off	2		dB
Number of carriers / HPA	1		
HPA C/IM (up)	22		dB
Uplink power control	0		dB
Uplink filter truncation loss	0		dB

Satellite Input Parameters	Value	Units
Satellite longitude	53W	degrees
Transponder type	TWTA	
Receive G/T	1.0	dB/K
Saturation flux density	-89	dBW/m2
Satellite attenuator pad	1	dB
Transmit EIRP at saturation	48.7	dBW
Transponder bandwidth	72	MHz
Input back off total	4.7	dB
Output back off total	AUTO	dB
Intermodulation interference	AUTO	dB

Carrier/Link Input Parameters	Value	Units
Modulation	4-PSK	
Required bit error rate performance	10^-6	
Required Eb/No without FEC coding	10.53	dB

Required Eb/No with FEC coding	3.0			dB
Information rate	2.048			Mbps
Overhead	0			%
FEC code rate	0.477			
Spreading gain	0			dB
Roll off factor + 1	1.2			
Carrier spacing factor	1.4			
Bandwidth allocation step size	0.001			MHz
System margin	0			dB

Calculations at Saturation	**Value**	**Units**
Gain 1m^2	44.50	dB/m2
Uplink C/No	97.10	dB.Hz
Downlink C/No	98.06	dB.Hz
Total C/No	94.54	dB.Hz
Uplink EIRP for saturation	74.80	dBW

General Calculations	**Uplink**	**Downlink**	**Units**
Elevation	40.10	29.82	degrees
True azimuth	134.60	119.45	degrees
Compass bearing	140.40	114.35	degrees
Path distance to satellite	37770.41	38625.87	km
Propagation time delay	0.13	0.13	seconds
Antenna efficiency	67.37	61.35	%
Antenna gain	37.30	47.40	dBi
Availability (average year)	95	95	%
Link downtime (average year)	438.300	438.300	hours
Availability (worst month)	88.439	88.439	%
Link downtime (worst month)	84.456	84.456	hours
Spectral power density	-16.32	-3.60	dBW/4kHz

Uplink Calculation	**Clear**	**Rain Up**	**Rain Dn**	**Units**
Uplink transmit EIRP	49.07	49.07	49.07	dBW
Transponder input back-off (total)	4.70	4.70	4.70	dB
Input back-off per carrier	25.74	25.99	25.74	dB
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	207.04	207.04	207.04	dB
Atmospheric absorption	0.09	0.09	0.09	dB
Tropospheric scintillation fading	0.08	0.08	0.08	dB
Atmospheric losses total	0.17	0.17	0.17	dB
Total path loss (excluding rain)	207.30	207.30	207.30	dB
Rain attenuation	0.00	0.26	0.00	dB
UPC (or manual power boost)	0.00	0.00	0.00	dB
Uncompensated Rain Fade	0.00	0.26	0.00	dB
C/No (thermal)	71.36	71.10	71.36	dB.Hz
C/N (thermal)	7.25	7.00	7.25	dB
C/ACI	60.00	59.74	60.00	dB
C/ASI	65.00	64.74	65.00	dB
C/XPI	30.00	29.74	30.00	dB
C/IM	22.00	22.00	22.00	dB
Eb/(No+Io)	8.08	7.83	8.08	dB

Downlink Calculation	**Clear**	**Rain Up**	**Rain Dn**	**Units**

Satellite EIRP total	48.70	48.70	48.70	dBW
Transponder output back-off (total)	3.17	3.17	3.17	dB
Output back-off per carrier	24.21	24.47	24.21	dB
Satellite EIRP per carrier	24.49	24.23	24.49	dBW
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	205.70	205.70	205.70	dB
Atmospheric absorption	0.10	0.10	0.10	dB
Tropospheric scintillation fading	0.09	0.09	0.09	dB
Atmospheric losses total	0.19	0.19	0.19	dB
Total path loss (excluding rain)	205.98	205.98	205.98	dB
Rain attenuation	0.00	0.00	0.23	dB
Noise increase due to precipitation	0.00	0.00	0.50	dB
Downlink degradation (DND)	0.00	0.00	0.73	dB
Total system noise	113.76	113.76	127.78	K
Figure of merit (G/T)	26.74	26.74	26.24	dB/K
C/No (thermal)	73.85	73.59	73.12	dB.Hz
C/N (thermal)	9.74	9.48	9.01	dB
C/ACI	60.00	59.74	60.00	dB
C/ASI	65.00	64.74	65.00	dB
C/XPI	30.00	29.74	30.00	dB
C/IM	5.61	5.09	5.61	dB
Eb/(No+Io)	5.17	4.73	4.96	dB

Totals per Carrier (End-to-End)	**Clear**	**Rain Up**	**Rain Dn**	**Units**
C/No (thermal)	69.42	69.16	69.14	dB.Hz
C/N (thermal)	5.31	5.05	5.03	dB
C/ACI	56.99	56.73	56.99	dB
C/ASI	61.99	61.73	61.99	dB
C/XPI	26.99	26.73	26.99	dB
C/IM	5.51	5.01	5.51	dB
C/(No+Io)	66.49	66.11	66.35	dB.Hz
C/(N+I)	2.38	2.00	2.24	dB
Eb/(No+Io)	3.38	3.00	3.24	dB
System margin	0.00	0.00	0.00	dB
Net Eb/(No+Io)	3.38	3.00	3.24	dB
Required Eb/(No+Io)	3.00	3.00	3.00	dB
Excess margin	0.38	0.00	0.24	dB

Earth Station Power Requirements	**Value**	**Units**
EIRP per carrier	49.07	dBW
HPA power per carrier	11.77	dBW
Uplink power control	0.00	dB
HPA output back off	2.00	dB
Waveguide loss	1.2	dB
Filter truncation loss	0	dB
Number of HPA carriers	1	
Total HPA power required	14.97	dBW
Required HPA power capability	31.39	W
Spectral power density	-16.32	dBW/4kHz

Space Segment Utilization	**Value**	**Units**
Overall link availability	90.25	%
Information rate (inc overhead)	2.0480	Mbps

Transmit rate	4.2935	Mbps
Symbol rate	2.1468	MBaud
Occupied bandwidth	2.5761	MHz
Noise bandwidth	64.11	dB.Hz
Minimum allocated bandwidth required	3.0055	MHz
Allocated transponder bandwidth	3.0060	MHz
Percentage transponder bandwidth used	4.18	%
Used transponder power	24.49	dBW
Percentage transponder power used	0.79	%
Max carriers by transponder bandwidth	23.95	
Max carriers by transponder power	126.92	
Maximum carriers limited by:-	Transponder bandwidth [23.95 carriers]	
Total transponder capacity	49.05	Mbps