Digital Link Budget

Produced using Satfinder

Thursday, June 30, 2005

Service Name	Richardson Test Satcom-On-The-Move
Coverage	CONUS
Uplink earth station	Dallas
Downlink earth station	Dallas
Satellite name	Horizons 1

Link Input Parameters	Uplink	Downlink	Units
Site latitude	32.78N	32.78N	degrees
Site longitude	96.80W	96.80W	degrees
Magnetic variation	5.0E	5.0E	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	127.0W	degrees
Transponder type	TWTA	
Receive G/T	2.0	dB/K
Saturation flux density	-91.1	dBW/m2
Satellite attenuator pad	1	dB
Transmit EIRP at saturation	49	dBW
Transponder bandwidth	36	MHz
Input back off total	7.6	dB
Output back off total	AUTO	dB
Intermodulation interference	AUTO	dB

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

Required Eb/No with FEC coding	2.8			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	96.00	dB.Hz
Downlink C/No	98.59	dB.Hz
Total C/No	94.09	dB.Hz
Uplink EIRP for saturation	72.71	dBW

General Calculations	**Uplink**	**Downlink**	**Units**
Elevation	39.95	39.95	degrees
True azimuth	227.07	227.07	degrees
Compass bearing	222.07	222.07	degrees
Path distance to satellite	37782.47	37782.47	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	-22.22	-5.83	dBW/4kHz

Uplink Calculation	**Clear**	**Rain Up**	**Rain Dn**	**Units**
Uplink transmit EIRP	46.17	46.17	46.17	dBW
Transponder input back-off (total)	7.60	7.60	7.60	dB
Input back-off per carrier	26.53	26.82	26.53	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)	207.31	207.31	207.31	dB
Rain attenuation	0.00	0.29	0.00	dB
UPC (or manual power boost)	0.00	0.00	0.00	dB
Uncompensated Rain Fade	0.00	0.29	0.00	dB
C/No (thermal)	69.47	69.18	69.47	dB.Hz
C/N (thermal)	2.35	2.06	2.35	dB
C/ACI	60.00	59.71	60.00	dB
C/ASI	65.00	64.71	65.00	dB
C/XPI	30.00	29.71	30.00	dB
C/IM	22.00	22.00	22.00	dB
Eb/(No+Io)	6.30	6.01	6.30	dB

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

Satellite EIRP total	49.00	49.00	49.00	dBW
Transponder output back-off (total)	4.79	4.79	4.79	dB
Output back-off per carrier	23.73	24.01	23.73	dB
Satellite EIRP per carrier	25.27	24.99	25.27	dBW
Mispoint loss	0.10	0.10	0.10	dB
Free space loss	205.50	205.50	205.50	dB
Atmospheric absorption	0.08	0.08	0.08	dB
Tropospheric scintillation fading	0.06	0.06	0.06	dB
Atmospheric losses total	0.14	0.14	0.14	dB
Total path loss (excluding rain)	205.74	205.74	205.74	dB
Rain attenuation	0.00	0.00	0.19	dB
Noise increase due to precipitation	0.00	0.00	0.42	dB
Downlink degradation (DND)	0.00	0.00	0.61	dB
Total system noise	113.76	113.76	125.31	K
Figure of merit (G/T)	26.74	26.74	26.32	dB/K
C/No (thermal)	74.87	74.58	74.26	dB.Hz
C/N (thermal)	7.75	7.46	7.14	dB
C/ACI	60.00	59.71	60.00	dB
C/ASI	65.00	64.71	65.00	dB
C/XPI	30.00	29.71	30.00	dB
C/IM	3.50	2.93	3.50	dB
Eb/(No+Io)	6.11	5.62	5.94	dB

Totals per Carrier (End-to-End)	**Clear**	**Rain Up**	**Rain Dn**	**Units**
C/No (thermal)	68.37	68.08	68.22	dB.Hz
C/N (thermal)	1.25	0.96	1.10	dB
C/ACI	56.99	56.70	56.99	dB
C/ASI	61.99	61.70	61.99	dB
C/XPI	26.99	26.70	26.99	dB
C/IM	3.44	2.87	3.44	dB
C/(No+Io)	66.31	65.91	66.22	dB.Hz
C/(N+I)	-0.81	-1.21	-0.90	dB
Eb/(No+Io)	3.19	2.80	3.11	dB
System margin	0.00	0.00	0.00	dB
Net Eb/(No+Io)	3.19	2.80	3.11	dB
Required Eb/(No+Io)	2.80	2.80	2.80	dB
Excess margin	0.39	0.00	0.31	dB

Earth Station Power Requirements	**Value**	**Units**
EIRP per carrier	46.17	dBW
HPA power per carrier	8.87	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	12.07	dBW
Required HPA power capability	16.12	W
Spectral power density	-22.22	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	4.2935	MBaud
Occupied bandwidth	5.1522	MHz
Noise bandwidth	67.12	dB.Hz
Minimum allocated bandwidth required	6.0109	MHz
Allocated transponder bandwidth	6.0110	MHz
Percentage transponder bandwidth used	16.70	%
Used transponder power	25.27	dBW
Percentage transponder power used	1.28	%
Max carriers by transponder bandwidth	5.99	
Max carriers by transponder power	78.20	
Maximum carriers limited by:-	Transponder bandwidth [5.99 carriers]	
Total transponder capacity	12.27	Mbps