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A VSAT LINK MARGIN CALCULATION A TURBO-C PROGRAMME

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Abstract: This article describes all the TX. STATION details RX.STATION details and link margin calculation of a typical VSAT network. Also all the parameters of satellite and link analysis is described. Finally the turbo-c program is executed and results are compared with link analysis.

Indexing terms: VSAT; TX; RX; LINK MARGIN; C/N; ebnt;

I. INTRODUCTION

The VSAT is described in detail with all satellite parameters and TX.STATION, RX. STATION details and link analysis i.e. LINK MARGIN calculation by hand is described. Also the TURBO-C program is executed and results are obtained.

II. DESCRIPTION:

V-SAT
Data @ 9.6 Kbps 1.0m to 1.0 BPSK 0.5
FEC K.U. Band link Calculations

SATELLITE PARAMETERS

01.	Satellite Name:	INSAT 3B
02.	Orbital Location:	83,00 degrees EAST
03.	G/T	-2.00 dB/degree kelvin
04.	SFD	-83.00 dBw/m.A2
05.	Input B O :	10,00dB
06.	Output OB :	4.50 dB
07.	EIRP (Saturation):	45.00 dBw
08.	Transponder BW	72.00 MHz
09.	Uplink Frequency	14375.00 MHz
10.	Down link Frequency	11575.00 MHz
11.	IM Product	18.00dB 3.00dB
12.	Sat. Trans. Ant Gain	30.00dB 3.00dB
13.	Sat. Rx. Ant. Gain/m.^2	44.50 dB/m.A2

LINK PARAMETERS 205.07Db 206.95dB

01.	Carrier Information RATE	9.6 Kbps
02.	FEC Code Rate	0.5
03.	Modulation	BPSK
04.	No. of bits per symbol	1
05.	Transmission rate	19.20 Kbps
06.	Noise Band width Factor	1.20
07.	Noise Band width	23.0kHz
08.	E b/No Required	10.0dB
09.	Clear SKY C/No Required	49.80 dB-Hz
10.	Clear SKY C/N Required	6.2 dB

TX STATION DETAILS

01.	Tx. Antenna. Diameter	1.0mt
02.	Tx .Antenna Efficiency	70.0%
03.	Tx .Gain	41.0dB
04.	1 x .Ant .Pointing Losses	0.5dB

RX STATION DETAILS

01.	Rx.Ant.Dia	1.0mt
02.	Rx.Ant.Efficiency	70.0%
03.	Rx.Ant. Pointing Losses	0.5dB
04.	Pre LNA Losses	0.0dB
05.	LNA Noise Temperature	65.0degree k
06.	Ant. Noi se Temperature	50.0 degree k
07.	Clear SKY Noise Temperature	35.0degree k
08.	Clear SKY G/T	17.0 dB/degree k

MISCELLANEOUS LOSSES

01.	Uplink Rain Attenuation
02.	Downlink rain Attenuation
03.	Up link Freespace loss
04.	Down link Free space loss
05.	Up link Atn. Atten
06.	Downlink Atn Atten

V-SAT UPLINK ANALYSIS

01.	Tx Eirp of E/S In clear SKY		41.0dB
02.	Lpu(Freespaceloss)		= 207 .45dB
03.	Power At Sat Ant.	=41.0-207.45	=-166.45dbw
04.	Sat Ant RX Gain/m.^2		=44.5db/m.^2
05.	PFD at input of sat ant = sat.Ant RX gain/m.^2±power at sat ant.	=44.5-166.45	=-121.95dBW/m^2,
06.	Input Back off (IBO)		= 38.95dB
07.	Sat G/T		= -2.0 dB/degree k
08.	K		=228.6 dBw/degree k /Hz
09.	Uplink c/no EIRPe-Lpu+(G/T) sat -K-Tx ant.pointing losses	=41-206.95 -2-.5+228.6	60.15dB-Hz
10.	Uplink C/No		=60.15dB-Hz
11.	Uplink C/N	= C/No-10logBW(Hz)	=60.1 10Log 23000=16.55dB
12.	Uplink PSD	=C/N - (C/No) uplink	16.55-60.15 = 43.6dB/Hz

V-SAT DOWNLINK ANALYSIS

01.	Saturation EIRP	=45.0dBw
02.	Output B.0	=4.5dB
03.	Output BO/Carrier	=33.45 dB

04.	EIRP (Carrier Downlink)	=EIRP Saturation -0b0/Carrier 45-33.45 =11.55 dB
05.	(G/T) Rx	=17.0 dB/k
06.	Rx Ant, losses	=0.5 dB
07.	K	=-228.6 dBw /k/Hz
08.	(C/No) downlink	=EIRP-Lpd free space +(G/T) earth =11.55-205.07+17-0.5+228.6 =51.58dB-Hz
09.	Downlink C/No	=51.58dB-Hz
10.	Downlink C/N .(C/No)-(10log(10) 23000)	=51.58-43.6=7.98dB
11.	Downlink PSD	=-62.05 dBW/Hz

TOTAL LINK ANALYSIS

1. Uplink C/N =16.5dB
2. Downlink C/N =7.98dB
3. IM Product =18dB
4. Composite (C/N) t =1/(N/C)u+(N/C)d+ Im/C =7.04 dB
5. Required C/N=6.2 dB
6. Link margin =7.04-6.20 =0.84Db
7. LINK MARGIN
8. A Poor receiver should be provided with more margin
9. The link budget is a natural starting point for a system engineer for considering all sorts of potential tradeoffs.
10. Margin is rain induced attenuation antenna vs transmitter power and so on. The received power (Eb/No) Rx (dB), can be written as EIRP dBw +Gr(dBi)- R(dB-bits/sec) —KT(dBw/Hz)-Ls(dB)-Lo(dB)
11. EIRP is the Transmitter power
12. No dBw /Hz
13. Gr Ant gain
14. R Data rate in decibels referred to bit/Sec T System effective temperature
15. K Boltzmans constant
16. Ls Free space loss
17. La Losses due to misc.factors
18. The link margin can be as low as 1 dB if all the sources of gain loss and noise have been estimated for the worst case accurately and the link parameters with large variances and such as fades/ attenuation to atmosphere and rain.
19. Adjacent and co channel interference Receiver noise
20. In analog receivers the noise bandwidth seen by the demodulator is usually greater than the signal Bandwidth and SNR is the main parameter for measuring the performance of system quality. However in digital receiver's correlation for matched filters are usually implemented and signal bandwidth is taken to be equal to noise bandwidth.
21. Assuming that all the received power is in the modulating signal.
22. S/No =Eb/No *R
23. Where s -> Average modulating signal power No -> Noise power in 1 Hz Bandwidth
24. Eb/No -> bit energy per noise spectral density R-› Bit rate
25. Each Eb/No Yields a specified error probability
26. For estimating the margin or safety factor M it is necessary to differentiate between the required (Eb/No) and the received (Eb/No) Rx
27. The difference between the (Eb/No) required & (Eb/No) Rx is link margin.

```
#include <stdio.h>
#include <conio.h>
#include
<stdlib.h>
#include
<stdarg.h>
#include <dos.h>
#include <math.h>
```

#include
<float.h>

28. #define urm 3.0 #define drm
2.5 #define oblq
3.0 #define k
124. 1 #define x 228.6 #define tklu 2.0 #define obld 1.0 #define dbod 3.0 #define gts 6.0 #define gr 41.2 #define sfd 86.0 #define temp 24.0
29. void main()
30. double fu, fl, z; doUble br,p,eirpe,gs;
31. int s;.
32. float y,eirpav,m,ipu,lpd,dbou,ebnt;
33. float end,gte,eirpa,cnUp,ebnd,unbe,dnbe,ebnup,cnupdb,cnddb,cnt;
34. clrscr();
35. m = 82.9;
36. s=10;lpu=206.02.;lpd=203.02;
37. y=21.45;dbou=3.04
38. printf(" enter the value of uplink eirp in db ,eirpe:Max 100.0"); scanf("%d",&eirpe);
39. fflush(stdin);
40. printf("\n enter the value of uplink frequency in MXz,fu:Max 15000'); scenf("%d",&fu);
41. fflush(stdin);
42. printf("\n enter the value of power,eirpav: Max 50.0"); scanf("%f",&eirpav);
43. fflush(stdin);
44. printf(" \n enter the value of bit rate,br:Max 200000");
45. scanf(" 6d"-,&br)1 fflush(stdin);
46. gs=(abs)(eixpav+sfd+m+dbou+y);
47. printf(" \n enter the value of downlink frequency in MHz,f1:Max 14000"); scanf("%d",4f1);
48. fflush(stdin);
49. cnup=(abs)(eixpe- 1pu -oblu - tklu + gts + X) ;
50. p=(dotble)log10(br);
51. ebnup=(abs)(cnup-(s*p));
52. eirps =(abs)(eirpay-lpd-obld+gs) ;
53. gte=(abs)(gr-temp);
54. cad =(abs)(eirps-lpd-obld-drm+gte+x);
55. ebnd =(abs)(cnd-(s*p));
56. unbe=(float)(10/ebnup);
57. dnbe =(float)(10/ebnd);
58. z=(dotble)(1/(unbe+dnbe));
59. ebnt =(float)(10*log10(7.));
60. printf("gs=12f\n",gs);
61. printf("ebnt=%f\n",ebnt);
62. cnupdb=(float)(10*1pg10(cnup));
63. cnddb=(float)(10*logiO(cnd));
64. cnt=(abs)(cnupdb-cnddb);
printf("cht=8f\h",cht);
printf("cnupdb=8f\n",cnupdb) ;
printf("cnddb=8f\n",chddh);

V-SAT LINK MARGIN CALCULATION RESULTS (TURBOC PROGRAM RESULTS)

1. gs=243.0
2. ebnt=18.3
3. cnt=7.0
4. cnupdb=13.61
5. cnddb=21.03
6. ebnup=1305
7. ebnd=1409

III.CONCLUSION

It is very interesting to analyze the link margin with turbo-c program as it is very useful for all VSAT network engineers and as the program when executed will ask for inputs and calculates all the link margin parameters.

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