RECOMMENDATION ITU-R S.1328-4

Satellite system characteristics to be considered in frequency sharing analyses within the fixed-satellite service

(Questions ITU-R 205/4, ITU-R 206/4 and ITU-R 231/4)

(1997-1999-2000-2001-2002)

The ITU Radiocommunication Assembly,

considering

a) that a database containing the characteristics of typical systems in the fixed-satellite service (FSS) is needed for use in frequency sharing studies within ITU-R;

b) that to be most readily usable such a database should be in the same format for all systems and should be available in electronic form;

c) that the World Radiocommunication Conference (Geneva, 1995) (WRC-95), in Resolutions 116 (WRC-95) and 117 (WRC-95), allocated frequencies to the FSS for use by feeder links of non-GSO MSS systems;

d) that WRC-95, in Resolution 118 (WRC-95), provided for parts of the 30/20 GHz bands in the FSS to be used by the non-GSO FSS without the restrictions of Radio Regulations (RR) No. S22.2;

e) that WRC-95, in Resolution 120 (WRC-95), provided for parts of the 30/20 GHz band in the FSS to be shared with feeder links of the non-GSO MSS;

f) that WRC-95, in Resolution 121 (WRC-95), advocated the development of interference criteria and methodology for sharing between feeder links of the non-GSO MSS and networks of the GSO FSS;

g) that the World Radiocommunication Conference (Geneva, 1997) (WRC-97) in Resolution 130 (WRC-97), advocated the development of interference criteria and methodology for sharing between non-GSO FSS and networks of the GSO FSS,

recommends

1 that representative technical characteristics of existing and planned satellite systems be compiled in an electronic databank available from the Radiocommunication Bureau (BR) for the purpose of conducting sharing studies in Radiocommunication Study Groups. Details of the tables in the databank are contained in Annex 1, as *pro forma* to be used for the submission of technical characteristics (see Notes 1 and 2). Information on validation of the data, and descriptions of the parameters requested are given in Annexes 2 and 3;

2 that, in the planning and development of new FSS networks, both GSO and non-GSO, and feeder links for MSS systems affecting the FSS allocations, the representative technical characteristics of existing and planned satellite systems in the databank be taken into consideration;

3 that, in studies pertaining to the development of sharing criteria between satellite systems, the representative technical characteristics of existing and planned systems in the databank may be used in interference analyses;

4 that administrations planning modifications to these systems or proposing future satellite system networks in FSS bands are urged to submit their representative technical characteristics to the ITU-R using the *pro forma* in Annex 1 to update this databank (see also Annexes 2 and 3 and Notes 3, 4, 5 and 6).

NOTE 1 – The data in the databank are to be regarded as representative examples of system technical characteristics, to be used only for sharing studies within Radiocommunication Study Groups and not as a basis for coordination between satellite networks. The databank should not be interpreted as a comprehensive source of data on the number of satellite systems or their particular characteristics, and is thus not suitable for statistical studies or evaluations.

NOTE 2 – Additional information (textual and/or graphical) which cannot readily be incorporated into the spreadsheet format may be appended as a text file.

NOTE 3 – The existing information annexed hitherto to this Recommendation will be held by BR until one year after approval of this revision to the Recommendation. Administrations are requested to resubmit existing technical characteristics using the *pro forma* in Annex 1.

NOTE 4 – Only data submitted in response to this Recommendation shall be included in the databank.

NOTE 5 – In order to ensure rapid and error-free incorporation into the databank, administrations are strongly encouraged to submit data in electronic format (preferably Microsoft EXCEL).

NOTE 6 – An explanation of the requested fields in the databank is included in Annex 2 of this Recommendation, while Annex 3 gives an explanation of a simple check on the validity of the input data which is included in the spreadsheets. This validity check is not intended as a filter to eliminate data from the databank, but serves only to minimize the risk of inaccurate entry of the data.

ANNEX 1

Tables for submission of satellite system characteristics

This Annex includes *pro forma* tables for the submission of new and revised data for the electronic databank of satellite system characteristics. Data should be submitted to the BR for consideration by Working Party 4A on paper and additionally in spreadsheet format using these tables, blank copies of which can be downloaded from the Working Party 4A web pages at: http://www.itu.int/ITU-R/study-groups/sg/sg4/info/index.html .

Additional supporting information which cannot readily be incorporated into the spreadsheet may be appended in the form of a text file, to be associated with the spreadsheet, and clearly referenced therein.

TABLE 1

Representative characteristics of GSO satellite systems

1		GSO SYSTEMS	UNITS	*Example (a)*	*Example (b)*	Add as many columns as required
2	**1**	**SYSTEM**				
3	*1.1*	Information provider		*Xxland*	*Yyland*	
4	*1.2*	Space station name in ITU filing		*XX-1*	*YY-4*	
5	*1.3*	Carrier designation		*LDR-1*	*SCPC*	
6	**2**	**SATELLITE PARAMETERS**				
7	*2.1*	Orbital position	deg. East	*201*	*158*	
8	*2.2*	Type of transponder (*Transp*-transparent; *Remod*-remodulating)		*Remod*	*Transp*	
9	**3**	**CARRIER PARAMETERS**				
10	*3.1*	Uplink type (i.e. maximum, minimum or typical e.i.r.p. and C/I levels)	See Note	*Typical*	*Typical*	
11	*3.2*	Downlink type (i.e. maximum, minimum or typical e.i.r.p. and C/I levels)	See Note	*Minimum*	*Typical*	
12	*3.3*	Centre frequency of uplink band	GHz	*29.75*	*28.4*	
13	*3.4*	Uplink polarization (RHC, LHC, VL, HL or offset linear)		*RHC*	*RHC (RR No. 1.145)*	
14	*3.5*	Centre frequency of downlink band	GHz	*19.95*	*18.6*	
15	*3.6*	Downlink polarization (RHC, LHC, VL, HL or offset linear)		*LHC*	*RHC (RR No. 1.145)*	
16	*3.7*	Access type (end-to-end if transparent transponder, on downlink if remodulating transponder)		*TDM*	*FDMA*	
17	*3.8*	Uplink access type for carriers using remodulating transponders		*TDMA*	*N/A*	
18	*3.9*	Modulation type (e.g. FM, BPSK, QPSK etc.) (end-to-end if transparent transponder, on downlink if remodulating transponder)		*QPSK*	*QPSK*	
19	*3.10*	Uplink modulation type for carriers using remodulating transponders		*QPSK*	*N/A*	
20	*3.11*	Uplink occupied bandwidth per carrier	MHz	*1.7*	*0.034*	
21	*3.12*	Downlink occupied bandwidth per carrier	MHz	*81*	*0.034*	

22	**4**	**SPACE STATION PARAMETERS**				
23	*4.1*	Peak receive antenna gain	dBi	*47*	*43.8*	
24	*4.2*	Receive antenna gain in the direction of the transmit earth station	dBi	*45.7*	*42.7*	
25	*4.3*	Receive antenna gain pattern (e.g. Rec. ITU-R S.672, CR/58 data file, etc.)		*S.672* L_S=–*20 dB*	*Shaped*	
26	*4.4*	Satellite receive noise temperature	K	*700*	*1202*	
27	*4.5*	Transmit e.i.r.p. per carrier in the direction of the receive earth station	dBW	*57*	*15.8*	
28	*4.6*	Peak transmit antenna gain	dBi	*50.5*	*38.8*	
29	*4.7*	Transmit antenna gain in the direction of the receive earth station	dBi	*49*	*38.8*	
30	*4.8*	Transmit antenna gain pattern (e.g. Rec. ITU-R S.672, CR/58 data file, etc.)		*S.672* L_S=–*20 dB*	*Shaped*	
31	*4.9*	Transmission gain of transparent transponder link, as defined in RR App. 8	dB	*N/A*	*–8.9*	
32	*4.10*	Automatic level control range of transponder (0 if none)	dB	*0*	*0*	
33	**5**	**EARTH STATION PARAMETERS**				
34	*5.1*	On-axis e.i.r.p. per carrier from transmit earth station	dBW	*41.9*	*38.8*	
35	*5.2*	Peak transmit antenna gain	dBi	*48*	*64.6*	
36	*5.3*	Transmit antenna gain pattern (e.g. Rec. ITU-R S.465, Rec. ITU-R S.580, etc.)		*S.580*	*S.580*	
37	*5.4*	Uplink power control range (>0, 0 dB if none)	dB	*12*	*10*	
38	*5.5*	Power control step-size (if power control used)	dB	*0.1*	*<1*	
39	*5.6*	Receive antenna –3 dB beamwidth	deg.	*1*	*0.55*	
40	*5.7*	Peak receive antenna gain	dBi	*44.5*	*53.1*	
41	*5.8*	Receive antenna gain pattern (e.g. Rec. ITU-R S.465, Rec. ITU-R S.580, etc.)		*S.465*	*S.580*	
42	*5.9*	Noise temperature of receive earth station	K	*250*	*250*	
43	*5.10*	Elevation angle of transmit earth station towards the satellite	deg.	*30*	*40*	
44	*5.11*	Elevation angle of receive earth station towards the satellite	deg.	*20*	*33*	
45	**6**	**INTERFERENCE PARAMETERS**				
46	*6.1*	Uplink C/I from internal sources (e.g. intermod, xpol, multi-beam frequency reuse, etc.)	dB	*15.4*	*100*	
47	*6.2*	Uplink C/I from external sources (i.e. terrestrial and other satellites)	dB	*15*	*23.5*	

48	*6.3*	Downlink C/I from internal sources (e.g. intermod, xpol, multi-beam frequency reuse, adjacent carrier, etc.)	dB	*18.4*	*20*	
49	*6.4*	Downlink C/I from external sources (i.e. terrestrial and other satellites)	dB	*16.8*	*21.4*	
50	**7**	**NETWORK PERFORMANCE REQUIREMENTS**				
51	**7(a)**	**Transparent or remodulating transponder – Performance at input to demodulator in receive earth station**				
52	*7.1*	Long-term (clear-sky) C/(N+I) ratio	dB	*12.1*	*13.31*	
53	*7.2*	Short-term C/(N+I) ratio (i.e. unavailability threshold)	dB	*6.8*	*5.9*	
54	*7.3*	Percentage of time for which short-term C/(N+I) should be exceeded	%	*99.5*	*99.88*	
55	*7.4*	C/(N+I) at which loss of demodulator synchronization occurs	dB	*5*	*5.3*	
56	**7(b)**	**Remodulating transponder only – Performance at input to demodulator in satellite receiver**				
57	*7.5*	Long-term (clear-sky) C/(N+I) ratio	dB	*8.5*	*N/A*	
58	*7.6*	Short-term C/(N+I) ratio (i.e. unavailability threshold)	dB	*7.6*	*N/A*	
59	*7.7*	Percentage of time for which short-term C/(N+I) should be exceeded	%	*99.5*	*N/A*	
60	*7.8*	Curve linking C/N to BER				
61	**8**	**ADDITIONAL NOTES**				
62		Additional information may be attached in text files, if required				
63		NOTE – If a given carrier may be operated within a range of e.i.r.p. levels on the uplink and/or downlink, separate columns should be included giving the maximum, minimum and typical e.i.r.p. levels and the corresponding C/I ratios. If the performance requirements differ for e.i.r.p. levels within the range, the appropriate C/(N+I) thresholds and time percentages should be shown.				
64	**9**	**DERIVED PARAMETERS**				
65	*9.1*	Uplink path loss	dB	*–213.6*	*–213.1*	
66	*9.2*	Satellite receive input power	dBW	*–126.0*	*–131.6*	
67	*9.3*	Satellite receive noise power	dBW	*–137.8*	*–152.5*	
68	*9.4*	Derived uplink C/N	dB	*11.8*	*20.9*	
69	*9.5*	Uplink C/I	dB	*12.2*	*23.5*	
70	*9.6*	Derived uplink C/(N+I)	dB	*9.0*	*19.0*	
71	*9.7*	Downlink path loss	dB	*–210.4*	*–209.5*	
72	*9.8*	Earth station receive input power	dBW	*–108.9*	*–140.6*	

73	*9.9*	Earth station receive noise power	dBW	*–125.5*	*–159.3*	
74	*9.10*	Derived downlink C/N	dB	*16.7*	*18.7*	
75	*9.11*	Downlink C/I	dB	*14.5*	*17.6*	
76	*9.12*	Derived downlink C/(N+I)	dB	*12.4*	*15.1*	
77	**9(a)**	**Transparent transponder systems**				
78	*9.13*	Derived total (end-to-end) C/(N+I) in clear-sky conditions	dB	–	*13.6*	
79	*9.14*	Required long-term (clear-sky) C/(N+I) ratio	dB	–	*13.3*	
80	*9.15*	***End-to-end clear-sky margin***	***dB***	**–**	***0.3***	
81	**9(b)**	**Remodulating transponder systems**				
82	*9.16*	Derived uplink C/(N+I) in clear-sky conditions	dB	*9.0*	–	
83	*9.17*	Required long-term (clear sky) uplink C/(N+I)	dB	*8.5*	–	
84	*9.18*	***Uplink clear-sky margin***	***dB***	***0.5***	**–**	
85	*9.19*	Derived downlink C/(N+I) in clear-sky conditions	dB	*12.4*	–	
86	*9.20*	Required long-term (clear sky) downlink C/(N+I)	dB	*12.1*	–	
87	*9.21*	***Downlink clear-sky margin***	***dB***	***0.3***	**–**	

TABLE 2

Representative characteristics of non-GSO satellite systems

1		**NON-GSO SYSTEMS**	**UNITS**	*Example (a)*	*Example (b)*	Add as many columns as required
2	**1**	**SYSTEM**				
3	*1.1*	Information provider		*Xxland*	*Yyland*	
4	*1.2*	Space station name in ITU filing		*LEO-XX*	*HEO-YY*	
5	*1.3*	Carrier designation		*SMS-X1*	*IDS-Y*	
6	**2**	**ORBITAL PARAMETERS**				
7	*2.1*	Shape of orbit: circular or elliptical		*circular*	*elliptical*	
8	*2.2*	Orbit radius (circular orbit) or semi-major axis (elliptical orbit)	km	*7 850*	*41 500*	
9	*2.3*	Inclination angle	deg	*54*	*63*	
10	*2.4*	Eccentricity for elliptical orbits		*N/A*	*0.66*	
11	*2.5*	Argument of perigee for elliptical orbits		*N/A*	*270*	
12	*2.6*	If repeating ground track, repeat period	h	*660*	*8*	

13	*2.7*	Do all satellites follow the same ground track? (Yes or No)		*No*	*No*	
14	*2.8*	Number of orbit planes		*16*	*3*	
15	*2.9*	Number of satellites per plane		*4*	*4*	
16	*2.10*	Longitude of ascending node of first plane (if repeating ground track)	deg. East	*0*	*357.2*	
17	*2.11*	True anomaly of first satellite in first plane	deg.	*0*	*36*	
18	*2.12*	Separation between adjacent satellites in each plane	deg.	*30*	*N/A*	
19	*2.13*	Satellite phasing between planes	deg.	*90*	*120*	
20	**3**	**CARRIER PARAMETERS**				
21	*3.1*	Centre frequency of uplink band	GHz	*29.5*	*17.8*	
22	*3.2*	Uplink polarization (RHC, LHC, VL, HL or offset linear)		*RHC*	*RHC*	
23	*3.3*	Centre frequency of downlink band	GHz	*19.95*	*12.6*	
24	*3.4*	Downlink polarization (RHC, LHC, VL, HL or offset linear)		*LHC*	*LHC*	
25	*3.5*	Access type (e.g. TDMA, CDMA, FDMA, etc.) (end-to-end if transparent transponder, on downlink if remodulating transponder)		*TDM*	*FDMA/ TDMA*	
26	*3.6*	Uplink access type for carriers using remodulating transponders		*TDMA*	*N/A*	
27	*3.7*	Modulation type (e.g. FM, QPSK, BPSK etc.) (end-to-end if transparent transponder, on downlink if remodulating transponder)		*QPSK*	*QPSK*	
28	*3.8*	Uplink modulation type for carriers using remodulating transponders		*QPSK*	*N/A*	
29	*3.9*	Uplink occupied bandwidth per carrier	MHz	*2.4*	*24*	
30	*3.10*	Downlink occupied bandwidth per carrier	MHz	*81*	*24*	
31	**4**	**SPACE STATION PARAMETERS**				
32	*4.1*	Type of transponder (*Transp*-transparent; *Remod*-remodulating)		*Remod*	*Transp*	
33	*4.2*	Transponder output bandwidth	MHz	*10*	*24*	
34	*4.3*	Number of transmit beams per satellite		*16*	*10*	
35	*4.4*	Number of receive beams per satellite		*16*	*10*	
36	*4.5*	Downlink cell shape/diagonal length	km	*Hexagon 750*	*Hexagon 1 818*	
37	*4.6*	Downlink cell frequency reuse distance	km	*1 675*	*3 150*	
38	*4.7*	Down-beam pointing method (tracking or fixed relative to sub-satellite point)		*Tracking*	*Sticky beams*	

39	*4.8*	Down-beam frequency reuse pattern (e.g. hexagonal, 1-in-7)		*1-in-7*	*1-in-4*	
40	*4.9*	Transmit e.i.r.p. per carrier in the direction of the receive earth station	dBW	*40.3*	*58*	
41	*4.10*	Peak transmit antenna gain	dBi	*33*	*38*	
42	*4.11*	Transmit antenna –3 dB beamwidth	deg.	*3.8*	*2.5*	
43	*4.12*	Transmit antenna gain pattern (e.g. Rec. ITU-R S.672, CR/58 data file, etc.)		*S.672* $L_N = -20$ *dB*	*S.672* $L_N = -15$ *dB*	
44	*4.13*	Transmit beam adapted for constant cell size (Yes or No)		*Yes*	*Yes*	
45	*4.14*	Transmit beam adapted for constant pfd at Earth's surface (Yes or No)		*Yes*	*No*	
46	*4.15*	Transmission gain of transparent transponder link, as defined in RR App. 8	dB	*N/A*	*–6*	
47	*4.16*	Peak receive antenna gain	dBi	*29*	*24*	
48	*4.17*	Receive antenna gain in the direction of the transmit earth station	dBi	*26*	*24*	
49	*4.18*	Receive antenna –3 dB beamwidth	deg	*6*	*13*	
50	*4.19*	Receive antenna gain pattern (e.g. Rec. ITU-R S.672, CR/58 data file, etc.)		*S.672* $L_N = -20$ *dB*	*S.672* $L_N = -15$ *dB*	
51	*4.20*	Satellite receive noise temperature	K	*900*	*800*	
52	*4.21*	Uplink cell shape/diagonal length	km	*Hexagon 700*	*Hexagon 1 818*	
53	*4.22*	Uplink cell frequency reuse distance	km	*1 500*	*3 150*	
54	*4.23*	Up-beam pointing method (tracking or fixed relative to sub-satellite point)		*Tracking*	*Tracking*	
55	*4.24*	Up-beam frequency reuse pattern (e.g. hexagonal, 1-in-7, etc.)		*1-in-7*	*1-in-4*	
56	*4.25*	Receive beam adapted for constant cell size? (Yes or No)		*Yes*	*Yes*	
57	*4.26*	Automatic level control range of transponder (0 if none)		*0*	*0*	
58	*4.27*	Basic satellite selection strategy (e.g. highest elevation)		*Highest elevation*	*Highest elevation*	
59	*4.28*	GSO system protection principle (switching angle if satellite diversity)	deg.	*±10*	*40*	
60	*4.29*	Non-GSO system protection principle (satellite and/or earth station switching angles if satellite diversity)	deg.	–	–	
61	**5**	**EARTH STATION PARAMETERS**				
62	*5.1*	On-axis e.i.r.p. per carrier from transmit earth station	dBW	*40.7*	*77*	
63	*5.2*	Peak transmit antenna gain	dBi	*45*	*55*	

64	*5.3*	Transmit antenna –3 dB beamwidth	deg.	*1.36*	*0.35*	
65	*5.4*	Transmit antenna gain pattern (e.g. Rec. ITU-R S.465, Rec. ITU-R S.580, etc.)		*S.580*	*S.580*	
66	*5.5*	Uplink power control range (>0, 0 dB if none)	dB	*12*	*10*	
67	*5.6*	Power control step size (if power control used)	dB	*0.1*	*<1*	
68	*5.7*	Receive antenna –3 dB beamwidth	deg.	*2*	*1.3*	
69	*5.8*	Peak receive antenna gain	dBi	*38.5*	*42.5*	
70	*5.9*	Receive antenna gain pattern (e.g. Rec. ITU-R S.465, Rec. ITU-R S.580, etc.)		*S.465*	*S.580*	
71	*5.10*	Noise temperature of receive earth station	K	*300*	*240*	
72	*5.11*	Lowest elevation angle for which the system is designed	deg.	*20*	*40*	
73	**6**	**INTERFERENCE PARAMETERS**				
74	*6.1*	Uplink C/I from internal sources (e.g. intermod, xpol, multi-beam, etc.)	dB	*20*	*100*	
75	*6.2*	Uplink C/I from external sources (i.e. terrestrial and other satellites)	dB	*20*	*23.5*	
76	*6.3*	Downlink C/I from internal sources (e.g. intermod, xpol, multi-beam, etc.)	dB	*20*	*20*	
77	*6.4*	Downlink C/I from external sources (i.e. terrestrial and other satellites)	dB	*20*	*21.4*	
78	**7**	**NETWORK PERFORMANCE REQUIREMENTS**				
79	**7(a)**	**Transparent or remodulating transponder – Performance at input to demodulator in receive earth station**				
80	*7.1*	Long-term (clear-sky) C/(N+I) ratio	dB	*12.1*	*13.31*	
81	*7.2*	Short-term C/(N+I) ratio (i.e. unavailability threshold)	dB	*6.8*	*5.9*	
82	*7.3*	Percentage of time for which short-term C/(N+I) should be exceeded	%	*99.5*	*99.88*	
83	*7.4*	C/(N+I) at which loss of demodulator synchronization occurs	dB	*5*	*4*	
84	**7(b)**	**Remodulating transponder only – Performance at input to demodulator in satellite receiver**				
85	*7.5*	Long-term (clear-sky) C/(N+I) ratio	dB	*8.5*	*N/A*	
86	*7.6*	Short-term C/(N+I) ratio (i.e. unavailability threshold)	dB	*7.6*	*N/A*	
87	*7.7*	Percentage of time for which short-term C/(N+I) should be exceeded	%	*99.5*	*N/A*	
88	*7.8*	Curve linking C/N to BER				

89	**8**	**ADDITIONAL NOTES**				
90		Additional information may be attached in text files, is required				
91		NOTE – If a given carrier may be operated within a range of e.i.r.p. levels on the uplink and/or downlink, separate columns should be included giving the maximum, minimum and typical e.i.r.p. levels and the corresponding C/I ratios. If the performance requirements differ for e.i.r.p. levels within the range, the appropriate C/(N+I) thresholds and time percentages should be shown.				
92	**9**	**DERIVED PARAMETERS**				
93	*9.1*	Uplink path loss	dB	*–191.1*	*–208.8*	
94	*9.2*	Satellite receive input power	dBW	*–124.4*	*–107.8*	
95	*9.3*	Satellite receive noise power	dBW	*–135.3*	*–125.8*	
96	*9.4*	Derived uplink C/N	dB	*10.9*	*17.9*	
97	*9.5*	Uplink C/I	dB	*17.0*	*23.5*	
98	*9.6*	Derived uplink C/(N+I)	dB	*9.9*	*16.9*	
99	*9.7*	Downlink path loss	dB	*–187.7*	*–205.8*	
100	*9.8*	Earth station receive input power	dBW	*–108.9*	*–105.3*	
101	*9.9*	Earth station receive noise power (inc. transmission gain for transparent system)	dBW	*–124.7*	*–131.0*	
102	*9.10*	Derived downlink C/N	dB	*15.9*	*25.7*	
103	*9.11*	Downlink C/I	dB	*17.0*	*17.6*	
104	*9.12*	Derived downlink C/(N+I)	dB	*13.4*	*17.0*	
105	**9(a)**	**Transparent transponder systems**				
106	*9.13*	Derived total (end-to-end) C/(N+I) in clear-sky conditions	dB	–	*13.9*	
107	*9.14*	Required long-term (clear-sky) C/(N+I) ratio	dB	–	*13.3*	
108	*9.15*	***End-to-end clear-sky margin***	***dB***	**–**	***0.6***	
109	**9(b)**	**Remodulating transponder systems**				
110	*9.16*	Derived uplink C/(N+I) in clear-sky conditions	dB	*9.9*	–	
111	*9.17*	Required long-term (clear sky) uplink C/(N+I)	dB	*8.5*	–	
112	*9.18*	***Uplink clear-sky margin***	***dB***	***1.4***	**–**	
113	*9.19*	Derived downlink C/(N+I) in clear-sky conditions	dB	*13.4*	–	
114	*9.20*	Required long-term (clear sky) downlink C/(N+I)	dB	*12.1*	–	
115	*9.21*	***Downlink clear-sky margin***	***dB***	***1.3***	**–**	

ANNEX 2

Description of requested input parameters (fields in the databank)

This Annex contains a brief description of each of the fields in the spreadsheet, to ensure unambiguous entry of the required input parameters.

GSO system parameters of Table 1

1 SYSTEM

1.1 Information provider – *The name of the administration or Sector Member that submitted the data to update the content of the data bank.*

1.2 Space station name in ITU filing – *The name by which the space station is identified.*

1.3 Carrier designation – *A designator produced by the contributor of the data which uniquely identifies the links submitted.*

2 SATELLITE PARAMETERS

2.1 Orbital position – *The orbital longitude of the GSO satellite. Positive values are assumed to be East of Greenwich.*

2.2 Type of transponder – *The type of transponder used on the satellite. It will be either transparent (bent pipe), which consists of a frequency translation, or remodulating, which involves demodulating the signal to baseband.*

3 CARRIER PARAMETERS

3.1 Uplink type – *An indication as to whether the carrier provided is a typical link, a minimum link over a range of values or a maximum link of a range of values. If min/max is used, two link budgets must be used to identify both ends of the range.*

3.2 Downlink type – *An indication as to whether the carrier provided is a typical link, a minimum link over a range of values or a maximum link of a range of values. If min/max is used, two link budgets must be used to identify both ends of the range.*

3.3 Centre frequency of uplink band – *The uplink frequency in which the link might be deployed (GHz).*

3.4 Uplink polarization – *The polarization of the uplink, e.g. RHC, LHC, VL, HL or offset linear.*

3.5 Centre frequency of downlink band – *The downlink frequency in which the link might be deployed (GHz).*

3.6 Downlink polarization – *The polarization of the downlink, e.g. RHC, LHC, VL, HL or offset linear.*

3.7 Access type – *The method by which different users share satellite resources. This is usually done by sharing the usage of the transponder either in time (TDMA), frequency (FDMA) or by code (CDMA). Enter end-to-end access type if transparent transponder, on downlink if remodulating transponder.*

3.8 Uplink access type for carriers using remodulating transponders – *The method by which different users share satellite resources. This is usually done by sharing the usage of the transponder either in time (TDMA), frequency (FDMA) or by code (CDMA). Enter end-to-end access type if transparent transponder, on uplink if remodulating transponder.*

3.9 Modulation type – *The method by which the baseband signal is converted to RF (e.g. FM, BPSK, QPSK, 8-PSK, OQPSK, etc.). End-to-end for transparent transponders, or on downlink for remodulating transponders.*

3.10 Uplink modulation type for carriers using remodulating transponders – *The method by which the baseband signal is converted to RF (e.g. FM, BPSK, QPSK, 8-PSK, OQPSK, etc.).*

3.11 Uplink occupied bandwidth per carrier – *The bandwidth utilized to transmit the carrier.*

3.12 Downlink occupied bandwidth per carrier – *The bandwidth utilized to transmit the carrier.*

4 SPACE STATION PARAMETERS

4.1 Peak receive antenna gain – *The highest value of the receive antenna gain towards the surface of the earth.*

4.2 Receive antenna gain in the direction of the transmit earth station – *The isotropic gain of the space station receive antenna in the direction of the transmit earth station for nominal station keeping values.*

4.3 Receive antenna gain pattern – *A description of the antenna radiation pattern of the space station receive antenna (e.g. Rec. ITU-R S.672, CR/58 data file, etc.).*

4.4 Satellite receive noise temperature – *The thermal noise contribution from the space station modelled as a noise source injected at the input of the satellite low noise amplifier.*

4.5 Transmit e.i.r.p. per carrier in the direction of the receive earth station – *The equivalent isotropically radiated power per carrier in the direction of the receiving earth station.*

4.6 Peak transmit antenna gain – *The maximum gain of the space station transmit antenna.*

4.7 Transmit antenna gain in the direction of the receive earth station – *The isotropic gain of the space station transmit antenna in the direction of the receive earth station for nominal station keeping values.*

4.8 Transmit antenna gain pattern – *A description of the antenna radiation pattern of the space station transmit antenna (e.g. Rec. ITU-R S.672, CR/58 data file, etc.).*

4.9 Transmission gain of transparent transponder link, as defined in RR App. 8 – *The transmission gain of a transparent transponder, defined as the ratio of the output of the receiving antenna of the space station to the output of the receiving antenna of the earth station.*

4.10 Automatic level control range of transponder – *The range of automatic level control of the transponder, if ATPC is used, 0 if not used.*

5 EARTH STATION PARAMETERS

5.1 On-axis e.i.r.p. per carrier from transmit earth station – *The equivalent isotropically radiated power per carrier from the earth station in the direction of the antenna main beam.*

5.2 Peak transmit antenna gain – *The highest value of the transmit antenna gain towards the space station.*

5.3 Transmit antenna gain pattern – *A description of the antenna radiation pattern of the earth station transmit antenna (e.g. Rec. ITU-R S.465, Rec. ITU-R S.580, etc.).*

5.4 Uplink power control range – *The range (> 0) of uplink power control, if used; 0 if not used.*

5.5 Power control step size – *The size of steps in the range of power control, if uplink power control is used.*

5.6 Receive antenna –3 dB beamwidth – *The half-power beamwidth of the earth station receive antenna.*

5.7 Peak receive antenna gain – *The highest value of the receive antenna gain towards the space station.*

5.8 Receive antenna gain pattern – *A description of the antenna radiation pattern of the earth station receive antenna (e.g. Rec. ITU-R S.465, Rec. ITU-R S.580, etc.).*

5.9 Noise temperature of receive earth station – *The thermal noise contribution from the earth station modelled as a noise source injected at the input of the low noise amplifier.*

5.10 Elevation angle of transmit earth station towards the satellite – *The elevation angle of the transmit antenna in the direction of the satellite.*

5.11 Elevation angle of receive earth station towards the satellite – *The elevation angle of the receive antenna in the direction of the satellite.*

6 INTERFERENCE PARAMETERS

6.1 Uplink C/I from internal sources – *The total carrier-to-interference ratio on the uplink from all internal sources, e.g. from intermodulation products, cross-polarization, multi-beam frequency reuse schemes, etc.*

6.2 Uplink C/I from external sources – *The total carrier-to-interference ratio on the uplink from all external sources, e.g. from terrestrial sources and other satellites.*

6.3 Downlink C/I from internal sources – *The total carrier-to-interference ratio on the downlink from all internal sources, e.g. from intermodulation products, cross-polarization, multi-beam frequency reuse schemes, etc.*

6.4 Downlink C/I from external sources – *The total carrier-to-interference ratio on the downlink from all external sources, e.g. from terrestrial sources and other satellites.*

7 NETWORK PERFORMANCE REQUIREMENTS

7(a) Transparent or remodulating transponder – Performance at input to demodulator in receive earth station

7.1 Long-term (clear-sky) C/(N+I) ratio – *The long-term carrier-to-noise-plus-interference ratio, as defined for clear sky propagation conditions, end-to-end for transparent transponders, on the downlink for remodulating transponders.*

7.2 Short-term C/(N+I) ratio – *The unavailability threshold, in terms of short-term carrier-to-noise-plus-interference ratio, end-to-end for transparent transponders, on the downlink for remodulating transponders.*

7.3 Percentage of time for which short-term C/(N+I) should be exceeded – *The short-term performance requirement for the unavailability threshold.*

7.4 C/(N+I) at which loss of demodulator synchronization occurs – *The carrier-to-noise-plus-interference ratio at which the demodulator will lose synchronization.*

7(b) Remodulating transponder only – Performance at input to demodulator in satellite receiver

7.5 Long-term (clear-sky) C/(N+I) ratio – *The long-term carrier-to-noise-plus-interference ratio, as defined for clear sky propagation conditions, on the uplink for remodulating transponders.*

7.6 Short-term C/(N+I) ratio – *The unavailability threshold, in terms of short-term carrier-to-noise-plus-interference ratio, on the uplink for remodulating transponders.*

7.7 Percentage of time for which short-term C/(N+I) should be exceeded – *The short-term performance requirement for the unavailability threshold.*

7.8 Curve linking C/N to BER – *Insert equation or attach curve in graphical format.*

8 ADDITIONAL NOTES

Additional notes may be attached, which will be appended to a text file which accompanies the databank. Examples of what might be included are details of satellite beams, spot beam coverages, additional information on radiation beam patterns, etc.

Non-GSO system parameters of Table 2

1 SYSTEM

1.1 Information provider – *The name of the administration or Sector Member that submitted the data to update the content of the data bank.*

1.2 Space station name in ITU filing – *The name by which the space station is identified.*

1.3 Carrier designation – *A designator produced by the contributor of the data which uniquely identifies the links submitted.*

2 SATELLITE PARAMETERS

2.1 Shape of orbit – *State whether orbit is circular or elliptical*.

2.2 Orbit radius (circular orbit) or semi-major axis (elliptical orbit) – *The radius of circular orbits or the semi-major axis for elliptical orbits.*

2.3 Inclination angle – *The angle of inclination between the plane of the orbit and the reference plane, generally the equatorial plane.*

2.4 Eccentricity for elliptical orbits – *The ratio of the distance between the foci of the ellipse and the length of the major axis.*

2.5 Argument of perigee for elliptical orbits – *The angle, measured at the Earth's centre, from the ascending node to perigee.*

2.6 If repeating ground track, repeat period – *The time taken for the ground track to be repeated.*

2.7 Do all satellites follow the same ground track? – *Yes or no.*

2.8 Number of orbit planes – *The number of planes in the constellation*.

2.9 Number of satellites per plane – *The number of satellites in each plane of the constellation*.

2.10 Longitude of ascending node of first plane – *The angle between the ascending node (i.e. the point at which the northbound satellite crosses the equator) and the Greenwich meridian, for repeating ground tracks only.*

2.11 True anomaly of first satellite in first plane – *The angular distance of a satellite, within its orbit plane, from its perigee as seen from the centre of the Earth. For circular orbits, the ascending node may be substituted for perigee.*

2.12 Separation between adjacent satellites in each plane – *The angular separation between satellites in each plane of the constellation.*

2.13 Satellite phasing between planes – *The angle between satellites in adjacent planes*.

3 CARRIER PARAMETERS

3.1 Centre frequency of uplink band – *The uplink frequency in which the link might be deployed (GHz).*

3.2 Uplink polarization – *The polarization of the uplink, e.g. RHC, LHC, VL, HL or offset linear.*

3.3 Centre frequency of downlink band – *The downlink frequency in which the link might be deployed (GHz).*

3.4 Downlink polarization – *The polarization of the downlink, e.g. RHC, LHC, VL, HL or offset linear.*

3.5 Access type – *The method by which different users share satellite resources. This is usually done by sharing the usage of the transponder either in time (TDMA), frequency (FDMA) or by code (CDMA). Enter end-to-end access type if transparent transponder, on downlink if remodulating transponder.*

3.6 Uplink access type for carriers using remodulating transponders – *The method by which different users share satellite resources. This is usually done by sharing the usage of the transponder either in time (TDMA), frequency (FDMA) or by code (CDMA). Enter end-to-end access type if transparent transponder, on uplink if remodulating transponder.*

3.7 Modulation type – *The method by which the baseband signal is converted to RF (e.g. FM, BPSK, QPSK, 8-PSK, OQPSK, etc.). End-to-end for transparent transponders, or on downlink for remodulating transponders.*

3.8 Uplink modulation type for carriers using remodulating transponders – *The method by which the baseband signal is converted to RF (e.g. FM, BPSK, QPSK, 8-PSK, OQPSK, etc.).*

3.9 Uplink occupied bandwidth per carrier – *The bandwidth utilized to transmit the carrier.*

3.10 Downlink occupied bandwidth per carrier – *The bandwidth utilized to transmit the carrier.*

4 SPACE STATION PARAMETERS

4.1 Type of transponder – *The type of transponder used on the space station. It will be either transparent (bent pipe), which consists of a frequency translation, or remodulating, which involves demodulating the signal to baseband.*

4.2 Transponder output bandwidth – *The bandwidth of the satellite transponder.*

4.3 Number of transmit beams per satellite – *The number of transmitting beams on each satellite in the constellation.*

4.4 Number of receive beams per satellite – *The number of receiving beams on each satellite in the constellation.*

4.5 Downlink cell shape/diagonal length – *An indication of the shape and size of the downlink cells at the surface of the Earth.*

4.6 Downlink cell frequency reuse distance – *The distance between cells using the same downlink frequency.*

4.7 Down-beam pointing method – *The type of beam pointing employed, e.g. tracking (or sticky) beam, fixed relative to sub-satellite point.*

4.8 Down-beam frequency reuse pattern – *The type of frequency reuse scheme employed, e.g. hexagonal, 1-in-4, etc.*

4.9 Transmit e.i.r.p. per carrier in the direction of the receive earth station – *The equivalent isotropically radiated power per carrier in the direction of the receiving earth station*.

4.10 Peak transmit antenna gain – *The maximum gain of the space station transmit antenna.*

4.11 Transmit antenna –3 dB beamwidth – *The half-power beamwidth of the space station transmit antenna.*

4.12 Transmit antenna gain pattern – *A description of the antenna radiation pattern of the space station transmit antenna (e.g. Rec. ITU-R S.672, CR/58 data file, etc.).*

4.13 Transmit beam adapted for constant cell size – *State whether transmit beam adapts to maintain a constant cell size: yes or no.*

4.14 Transmit beam adapted for constant pfd at Earth's surface – *State whether transmit beam adapts to maintain a constant pfd at the surface of the Earth: yes or no.*

4.15 Transmission gain of transparent transponder link, as defined in RR App. 8 – *The transmission gain of a transparent transponder, defined as the ratio of the output of the receiving antenna of the space station to the output of the receiving antenna of the earth station.*

4.16 Peak receive antenna gain – *The highest value of the receive antenna gain towards the space station.*

4.17 Receive antenna gain in the direction of the transmit earth station – *The isotropic gain of the space station receive antenna in the direction of the transmit earth station for nominal station keeping values.*

4.18 Receive antenna –3 dB beamwidth – *The half-power beamwidth of the space station receive antenna.*

4.19 Receive antenna gain pattern – *A description of the antenna radiation pattern of the space station receive antenna (e.g. Rec. ITU-R S.672, CR/58 data file, etc.).*

4.20 Satellite receive noise temperature – *The thermal noise contribution from the space station modelled as a noise source injected at the input of the satellite low noise amplifier*.

4.21 Uplink cell shape/diagonal length – *An indication of the shape and size of the uplink cells*.

4.22 Uplink cell frequency reuse distance – *The distance between cells using the same uplink frequency.*

4.23 Up-beam pointing method – *The type of beam pointing employed, e.g. tracking beam, fixed relative to sub-satellite point*.

4.24 Up-beam frequency reuse pattern – *The type of frequency reuse scheme employed, e.g. hexagonal, 1-in-7, etc.*

4.25 Receive beam adapted for constant cell size? – *State whether receive beam adapts to maintain a constant cell size: yes or no.*

4.26 Automatic level control range of transponder – *The range of automatic level control of the transponder, if ATPC is used, 0 if not used.*

4.27 Basic satellite selection strategy – *An indication of the type of selection strategy for the satellites in the constellation, e.g. highest elevation, etc.*

4.28 GSO system protection principle – *The method by which interference to GSO systems is minimized, e.g. switching angle, if using satellite diversity*.

4.29 Non-GSO system protection principle – *The method by which interference to other non-GSO systems is minimized, e.g. satellite and/or earth station switching angles, if using satellite diversity.*

5 EARTH STATION PARAMETERS

5.1 On-axis e.i.r.p. per carrier from transmit earth station – *The equivalent isotropically radiated power per carrier from the earth station in the direction of the antenna main beam.*

5.2 Peak transmit antenna gain – *The highest value of the transmit antenna gain towards the space station.*

5.3 Transmit antenna –3 dB beamwidth – *The half-power beamwidth of the earth station transmit antenna.*

5.4 Transmit antenna gain pattern – *A description of the antenna radiation pattern of the earth station transmit antenna (e.g. Rec. ITU-R S.465, Rec. ITU-R S.580, etc.).*

5.5 Uplink power control range – *The range (> 0) of uplink power control, if used; 0 if not used.*

5.6 Power control step size – *The size of steps in the range of power control, if uplink power control is used.*

5.7 Receive antenna –3 dB beamwidth – *The half-power beamwidth of the earth station receive antenna.*

5.8 Peak receive antenna gain – *The highest value of the receive antenna gain towards the space station.*

5.9 Receive antenna gain pattern – *A description of the antenna radiation pattern of the earth station receive antenna (e.g. Rec. ITU-R S.465, Rec. ITU-R S.580, etc.).*

5.10 Noise temperature of receive earth station – *The thermal noise contribution from the earth station modelled as a noise source injected at the input of the low noise amplifier*.

5.11 Lowest elevation angle for which the system is designed – *The lowest elevation angle of the earth station at which the system will operate.*

6 INTERFERENCE PARAMETERS

6.1 Uplink C/I from internal sources – *The total carrier-to-interference ratio on the uplink from all internal sources, e.g. from intermodulation products, cross-polarization, multi-beam frequency reuse schemes, etc.*

6.2 Uplink C/I from external sources – *The total carrier-to-interference ratio on the uplink from all external sources, e.g. from terrestrial sources and other satellites.*

6.3 Downlink C/I from internal sources – *The total carrier-to-interference ratio on the downlink from all internal sources, e.g. from intermodulation products, cross-polarization, multi-beam frequency reuse schemes, etc.*

6.4 Downlink C/I from external sources – *The total carrier-to-interference ratio on the downlink from all external sources, e.g. from terrestrial sources and other satellites.*

7 NETWORK PERFORMANCE REQUIREMENTS

7(a) Transparent or remodulating transponder – Performance at input to demodulator in receive earth station

7.1 Long-term (clear-sky) C/(N+I) ratio – *The long-term carrier-to-noise-plus-interference ratio, as defined for clear sky propagation conditions, end-to-end for transparent transponders, on the downlink for remodulating transponders*.

7.2 Short-term C/(N+I) ratio – *The unavailability threshold, in terms of short-term carrier-to-noise-plus-interference ratio, end-to-end for transparent transponders, on the downlink for remodulating transponders.*

7.3 Percentage of time for which short-term C/(N+I) should be exceeded – *The short-term performance requirement for the unavailability threshold.*

7.4 C/(N+I) at which loss of demodulator synchronization occurs – *The carrier-to-noise-plus-interference ratio at which the demodulator will lose synchronization*.

7(b) Remodulating transponder only – Performance at input to demodulator in satellite receiver

7.5 Long-term (clear-sky) C/(N+I) ratio – *The long-term carrier-to-noise-plus-interference ratio, as defined for clear sky propagation conditions, on the uplink for remodulating transponders.*

7.6 Short-term C/(N+I) ratio – *The unavailability threshold, in terms of short-term carrier-to-noise-plus-interference ratio, on the uplink for remodulating transponders.*

7.7 Percentage of time for which short-term C/(N+I) should be exceeded – *The short-term performance requirement for the unavailability threshold.*

7.8 Curve linking C/N to BER – *Insert equation or attach curve in graphical format*

8 ADDITIONAL NOTES

Additional notes may be attached, which will be appended to a text file which accompanies the databank. Examples of what might be included are details of satellite beams, spot beam coverages, additional information on radiation beam patterns, satellite switching strategies, frequency reuse schemes, etc.

ANNEX 3

Validation of input data

The spreadsheet includes in § 9 a simple check on the basic validity of the input data. The purpose of this check is for the benefit of the submitting organization, to help to ensure that input data are inputted accurately. It is not intended as a filter to eliminate submitted data from the databank.

The check calculates an elementary link budget, based on free-space propagation only, to compute a derived C/(N+I) ratio, total (end-to-end) for systems with transparent transponders and separately for the uplinks and downlinks of systems with remodulating transponders. The derived C/(N+I) ratios are then compared with the required clear-sky C/(N+I) ratios as defined in the input data, to yield a "margin". If the resulting margins are negative, or significantly larger than a few dB, then the submitting organization is invited to review the input data.

The following gives a brief explanation of the fields in § 9, where *ES* refers to the earth station and *Sat* refers to the satellite.

9 DERIVED PARAMETERS

9.1 Uplink path loss (dB): $L_{up} = -20 \log\left(\frac{4\pi\ f_{up}\ d_{up}}{3\times10^{-4}}\right)$

Uplink path length (km): $d_{up} = r_E\left(\sqrt{\left(\frac{r_S}{r_E}\right)^2 - \cos^2\theta_{up}} - \sin\theta_{up}\right)$

f_{up}: uplink frequency (GHz): θ_{up}: uplink elevation angle

r_E: Earth's radius (km): r_S: radius of satellite orbit (km)

9.2 Satellite receive input power (dBW): $P_{sat} = e.i.r.p._{ES} + G_{sat} + L_{up}$

9.3 Satellite receive noise power (dBW): $N_{sat} = kT_{sat}B_{up}$

9.4 Derived uplink *C*/*N* (dB): $(C/N)_{up} = P_{sat} - N_{sat}$

9.5 Uplink *C*/*I* (dB):

$$(C/I)_{up} = -10 \log\left(10^{-0.1(C/I)_{up-internal}} + 10^{-0.1(C/I)_{up-external}}\right)$$

9.6 Derived uplink *C*/(*N*+*I*) (dB):

$$C/(N+I)_{up} = -10 \log\left(10^{-0.1(C/N)_{up}} + 10^{-0.1(C/I)_{up}}\right)$$

9.7 Downlink path loss (dB): $L_{down} = -20 \log \left(\frac{4\pi \, f_{down} \, d_{down}}{3 \times 10^{-4}} \right)$

Downlink path length (km):

$$d_{down} = r_E \left(\sqrt{\left(\frac{r_S}{r_E} \right)^2 - \cos^2 \theta_{down}} - \sin \theta_{down} \right)$$

f_{down}: downlink frequency (GHz): θ_{down}: downlink elevation angle

r_E: Earth's radius (km): r_S: radius of satellite orbit (km)

9.8 Earth station receive input power (dBW):

$$P_{ES} = e.i.r.p._{sat} + G_{ES} + L_{down}$$

9.9 Earth station receive noise power (dBW): $N_{ES} = kT_{ES}B_{down}$

9.10 Derived downlink *C*/*N* (dB): $(C/N)_{down} = P_{ES} - N_{ES}$

9.11 Downlink *C*/*I* (dB):

$$(C/I)_{down} = -10 \log \left(10^{-0.1(C/I)_{down-internal}} + 10^{-0.1(C/I)_{down-external}} \right)$$

9.12 Derived downlink *C*/(*N*+*I*) (dB):

$$C/(N+I)_{down} = -10 \log \left(10^{-0.1(C/N)_{down}} + 10^{-0.1(C/I)_{down}} \right)$$

9(a) Transparent transponder systems

9.13 Derived total *C*/(*N*+*I*) (dB):

$$C/(N+I)_{total} = -10 \log \left(10^{-0.1C/(N+I)_{up}} + 10^{-0.1C/(N+I)_{down}} \right)$$

9.14 Required *C*/(*N*+*I*) (dB): $= C/(N+I)_{CS}$ = clear sky value

9.15 End-to-end margin (dB): $M = C/(N+I)_{total} - C/(N+I)_{CS}$

9(b) Remodulating transponder systems

9.16 Derived uplink *C*/(*N*+*I*) (dB): $= C/(N+I)_{up}$ = value derived in Field 9.6

9.17 Required uplink *C*/(*N*+*I*) (dB): $= C/(N+I)_{up\_CS}$ = clear sky uplink value

9.18 Uplink margin (dB): $M_{up} = C/(N+I)_{up} - C/(C+I)_{up\_CS}$

9.19 Derived downlink *C*/(*N*+*I*) (dB): $= C/(N+I)_{down}$ = value derived in Field 9.12

9.20 Required downlink *C*/(*N*+*I*) (dB): $= C/(N+I)_{down\_CS}$ = clear sky downlink value

9.21 Downlink margin (dB): $M_{down} = C/(N+I)_{down} - C/(N+I)_{down\_CS}$

For additional clarity, the following Table lists the code for this simple check on the validity of input data. Note that the cell references refer to the spreadsheet for GSO systems only. The cell references will be different for the non-GSO system spreadsheet.

Code for simple check on data validity

9	**DERIVED PARAMETERS**		
9.1	Uplink path loss	dB	=-20*LOG(4*PI()*(E12/0.3)*6376000*(SQRT((42162/6376)^2-(COS(RADIANS(E43)))^2)-SIN(RADIANS(E43))))
9.2	Satellite receive input power	dBW	=E34+E24+E65
9.3	Satellite receive noise power	dBW	=-228.6+10*LOG(E26*E20*1000000)
9.4	Derived uplink C/N	dB	=E66-E67
9.5	Uplink C/I	dB	=-10*LOG(10^(-E46/10)+10^(-E47/10))
9.6	Derived uplink C/(N+I)	dB	=-10*LOG(10^(-E68/10)+10^(-E69/10))
9.7	Downlink path loss	dB	=-20*LOG(4*PI()*(E14/0.3)*6376000*(SQRT((42162/6376)^2-(COS(RADIANS(E44)))^2)-SIN(RADIANS(E44))))
9.8	Earth station receive input power	dBW	=E27+E40+E71
9.9	Earth station receive noise power	dBW	=-228.6+10*LOG((E42*E21*1000000))
9.10	Derived downlink C/N	dB	=E72-E73
9.11	Downlink C/I	dB	=-10*LOG(10^(-E48/10)+10^(-E49/10))
9.12	Derived downlink C/(N+I)	dB	=-10*LOG(10^(-E74/10)+10^(-E75/10))
9(a)	**Transparent transponder systems**		
9.13	Derived total (end-to-end) C/(N+I) in clear-sky conditions	dB	=IF(LEFT(TRIM(E8),1)="T",-10*LOG(10^(-E70/10)+10^(-E76/10)),"-")
9.14	Required long-term (clear-sky) C/(N+I) ratio	dB	=IF(LEFT(TRIM(E8),1)="T",E52,"-")
9.15	***End-to-end clear-sky margin***	***dB***	***=IF(LEFT(TRIM(E8),1)="T",E78-E79,"-")***
9(b)	**Remodulating transponder systems**		
9.16	Derived uplink C/(N+I) in clear-sky conditions	dB	=IF(LEFT(TRIM(E8),1)="R",E70,"-")
9.17	Required long-term (clear sky) uplink C/(N+I)	dB	=IF(LEFT(TRIM(E8),1)="R",E57,"-")
9.18	***Uplink clear-sky margin***	***dB***	***=IF(LEFT(TRIM(E8),1)="R",E82-E83,"-")***
9.19	Derived downlink C/(N+I) in clear-sky conditions	dB	=IF(LEFT(TRIM(E8),1)="R",E76,"-")
9.20	Required long-term (clear sky) downlink C/(N+I)	dB	=IF(LEFT(TRIM(E8),1)="R",E52,"-")
9.21	***Downlink clear-sky margin***	***dB***	***=IF(LEFT(TRIM(E8),1)="R",E85-E86,"-")***