1	**Interference Calculations for FSS Uplinks Interfering with LMDS Rec**					
2						
3	**LMDS System Parameters**					
4	System Proponent		Video/Phone			
5	Link		Hub to Sub			
6	Modulation		FM			
7	Digital Data Rate		N/A			
8	Channel Bandwidth		20 MHz			
9	Antenna Pattern Used		Proponent			
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5			
11						
12	**FSS System**		T1 - TST			
13						
167	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	25.9	50.7	65.7	
168	Required Separation (21 mm/hr rain on interference up to 4 km)	km	0.1	0.0	0.0	
169	Path Loss Allocation:					
170	Free Space	dB	99.3	74.9	59.9	
171	Atmosphere	dB	0.0	0.0	0.0	
172	Rain	dB	0.3	0.0	0.0	
173	*LMDS 180 degree Backlobe*					
174	Required Path Loss	dB	-93.6	-68.9	-53.9	
175	Margin at 1 km (clear sky)	dB	28.2	53.0	68.0	
176	Required Separation (clear sky, no radio horizon)	km	0.0	0.0	0.0	
177	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	31.9	56.7	71.7	
178	Required Separation (21 mm/hr rain on interference up to 4 km)	km	0.0	0.0	0.0	
179	Path Loss Allocation:					
180	Free Space	dB	93.5	68.9	53.9	
181	Atmosphere	dB	0.0	0.0	0.0	
182	Rain	dB	0.1	0.0	0.0	

1	**Interference Calculations for FSS Uplinks Interfering with LMDS Rec**				
2					
3	**LMDS System Parameters**				
4	System Proponent		Video/Phone		
5	Link		Sub to Hub		
6	Modulation		16 QAM		
7	Digital Data Rate		45 Mbps		
8	Channel Bandwidth		22.5 MHz		
9	Antenna Pattern Used		Proponent		
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5		
11					
12	**FSS System**		T1 - TST		
13					
14	**Required Separation (clear sky, incl. 100 km radio horizon)**				
15	ES angle from boresight		40 - ITU	40-conserv.	40-optimistic
16	LMDS receiver pointing angle				
17	Boresight	miles	2.21	0.13	0.02
18	5 Degree Sidelobe	miles	1.57	0.09	0.02
19	45 Degree Sidelobe	miles	0.04	0.00	0.00
20	180 Degree Backlobe	miles	0.02	0.00	0.00
21	**Required Separation (rain on all paths, incl. 100 km radio horizon)**				
22	ES angle from boresight		40 - ITU	40-conserv.	40-optimistic
23	LMDS receiver pointing angle				
24	Boresight	miles	2.96	0.61	0.15
25	5 Degree Sidelobe	miles	2.33	0.47	0.11
26	45 Degree Sidelobe	miles	0.27	0.02	0.00
27	180 Degree Backlobe	miles	0.11	0.01	0.00
28					
29	**Calculations**				
30					
31	**LMDS Signal Link Carrier Level at Cell Edge**		Clear Sky		Rain Conditions
32	Transmitted Power	dBW/channel	-20		-20
33	Transmitter Antenna Gain	dBi	38		38
34	EIRP (clear sky)	dBWi/channel	18		18
35	Power Control (rain)	dB	0		5.8
36	Distance to Cell Edge	km	1.61		1.61
37	Rain Attenuation (cell edge)	dB	0		-5.8
38	Free Space Path Loss (cell edge)	dB	-125.9		-125.9
39	Receiver Antenna Gain	dBi	29.9		29.9
40	Carrier Level at Cell Edge	dBW/channel	-78.0		-78.0
41	Notes:				
42	Rain attenuation from WG1/52 (rev. 5)				
43	Power control is the minimum necessary to overcome rain fade without exceeding ma		Video/Phone max power control: 10 dB		
44					
45					
46	**Interference Density into LMDS**		Clear Sky		Rain Conditions
47	k (Boltzmann's Constant)	dBW/K/Hz	-228.6		-228.6
48	Receiver Noise Figure	dB	7.5		7.5
49	Receiver Noise Temperature	K	1631		1631
50	Channel Bandwidth	MHz	22.5		22.5
51	Receiver Noise Floor	dBW/channel	-123.0		-123.0
52	Minimum Required C/(N+I)	dB per channel	27		27
53	Cell Edge C/N	dB	44.9		44.9
54	Cell Edge C/N	linear	30958		30958
55	Required C/(N+I)	linear	501		501
56	Allowed Interference Power (w/o BW correction)	dBW/channel	-105.1		-105.1
57	Allowed Interference Power	dBW	-104.4		-104.4
58	Notes:				
59					
60					
61	**Interference Density Generated**				
62	Teledesic TST FSS Uplink into LMDS Receivers				
63					
64	Earth Station Angle From Boresight		40 - ITU	40-conserv.	40-optimistic

1	**Interference Calculations fo. FSS Uplinks Interfering with LMDS Rec**					
2						
3	**LMDS System Parameters**					
4	System Proponent		Video/Phone			
5	Link		Sub to Hub			
6	Modulation		16 QAM			
7	Digital Data Rate		45 Mbps			
8	Channel Bandwidth		22.5 MHz			
9	Antenna Pattern Used		Proponent			
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5			
11						
12	**FSS System**		T1 - TST			
13						
65	Earth Station Output Power (no rain)	dBWi/channel	0.85	0.85	0.85	
66	Maximum Antenna Gain	dBi	36.0	36.0	36.0	
67	Sidelobe Discrimination	dB	38.3	63.0	78.0	
68	Antenna Gain toward LMDS Receiver	dBi	-2.3	-27.0	-42.0	
69	Single Channel BW	MHz	26.5	26.5	26.5	
70	Number of Interfering Channels	dB	0	0	0	
71	LMDS Receiver Bandwidth	MHz	18	18	18	
72	Interference Subtotal (clear sky)	dBW	-1.4	-26.2	-41.2	
73	Rain Rate	mm/hr	Not Used	Not Used	Not Used	
74	Length of rain cell	km	Not Used	Not Used	Not Used	
75	Path Length through rain	km	Not Used	Not Used	Not Used	
76	Rain Attenuation	dB	Not Used	Not Used	Not Used	
77	Power Control (rain)	dB	17.1	17.1	17.1	
78	Interference Subtotal (rain on signal path)	dBW	15.7	-9.1	-24.1	
79	Notes:					
80	Antenna Gain is the maximum elevation pattern gain in the direction of the LMDS rece					
81	the earth station is pointing in the direction of the LMDS receiver					
82	Antenna Gain is antenna mask specified in ITU Appendix 29					
83	Lin Model used for rain attenuation on interference path					
84	0.02 dB/km of atmospheric attenuation included in new calculations (climatic zones 3-					
85						
86						
87	LMDS Receiver Antenna Gain					
88	Boresight	dBi	29.9			
89	5 Degree Sidelobe	dBi	26.9			
90	45 Degree Sidelobe	dBi	-4.1			
91	180 Degree Backlobe	dBi	-12.8			
92	Note:					
93	Negative margin indicates C/(N+I) objective not met at 1 km separation					
94	All path loss values indicate positive loss (negative gain) regardless of sign					
95						
96						
97	**LMDS Signal: clear sky, Satellite Signal: clear sky**					
98	**ES angle from boresight**		40 - ITU	40-conserv.	40-optimistic	
99	*LMDS Boresight*					
100	Required Path Loss	dB	-132.9	-108.2	-93.2	
101	Margin at 1 km (clear sky)	dB	-11.1	13.7	28.7	
102	Required Separation (clear sky, no radio horizon)	km	3.6	0.2	0.0	
103	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-7.4	17.4	32.4	
104	Required Separation (21 mm/hr rain on interference up to 4 km)	km	1.7	0.2	0.0	
105	Path Loss Allocation:					
106	Free Space	dB	126.5	107.4	93.0	
107	Atmosphere	dB	0.0	0.0	0.0	
108	Rain	dB	6.3	0.7	0.1	
109	*LMDS 5 degree Sidelobe*					
110	Required Path Loss	dB	-129.9	-105.2	-90.2	
111	Margin at 1 km (clear sky)	dB	-8.1	16.7	31.7	
112	Required Separation (clear sky, no radio horizon)	km	2.5	0.1	0.0	
113	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-4.4	20.4	35.4	
114	Required Separation (21 mm/hr rain on interference up to 4 km)	km	1.4	0.1	0.0	
115	Path Loss Allocation:					

1	**Interference Calculations for FSS Uplinks Interfering with LMDS Rec**					
2						
3	**I MDS System Parameters**					
4	System Proponent		Video/Phone			
5	Link		Sub to Hub			
6	Modulation		16 QAM			
7	Digital Data Rate		45 Mbps			
8	Channel Bandwidth		22.5 MHz			
9	Antenna Pattern Used		Proponent			
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5			
11						
12	**FSS System**		T1 - TST			
13						
116	Free Space	dB	124.7	104.6	90.1	
117	Atmosphere	dB	0.0	0.0	0.0	
118	Rain	dB	5.2	0.5	0.1	
119	*LMDS 45 degree Sidelobe*					
120	Required Path Loss	dB	-98.9	-74.2	-59.2	
121	Margin at 1 km (clear sky)	dB	22.9	47.7	62.7	
122	Required Separation (clear sky, no radio horizon)	km	0.1	0.0	0.0	
123	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	26.6	51.4	66.4	
124	Required Separation (21 mm/hr rain on interference up to 4 km)	km	0.1	0.0	0.0	
125	Path Loss Allocation:					
126	Free Space	dB	98.6	74.1	59.2	
127	Atmosphere	dB	0.0	0.0	0.0	
128	Rain	dB	0.3	0.0	0.0	
129	*LMDS 180 degree Backlobe*					
130	Required Path Loss	dB	-90.2	-65.5	-50.5	
131	Margin at 1 km (clear sky)	dB	31.6	56.4	71.4	
132	Required Separation (clear sky, no radio horizon)	km	0.0	0.0	0.0	
133	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	35.3	60.1	75.1	
134	Required Separation (21 mm/hr rain on interference up to 4 km)	km	0.0	0.0	0.0	
135	Path Loss Allocation:					
136	Free Space	dB	90.1	65.5	50.5	
137	Atmosphere	dB	0.0	0.0	0.0	
138	Rain	dB	0.1	0.0	0.0	
139						
140						
141	**LMDS Signal: rain Satellite Signal: rain**					
142	**ES angle from boresight**		40 - ITU	40-conserv.	40-optimistic	
143	*LMDS Boresight*					
144	Required Path Loss	dB	-150.0	-125.3	-110.3	
145	Margin at 1 km (clear sky)	dB	-28.2	-3.4	11.6	
146	Required Separation (clear sky, no radio horizon)	km	24.3	1.5	0.3	
147	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-24.5	0.3	15.3	
148	Required Separation (21 mm/hr rain on interference up to 4 km)	km	4.8	1.0	0.2	
149	Path Loss Allocation:					
150	Free Space	dB	135.4	121.6	109.4	
151	Atmosphere	dB	0.1	0.0	0.0	
152	Rain	dB	14.5	3.6	0.9	
153	*LMDS 5 degree Sidelobe*					
154	Required Path Loss	dB	-147.0	-122.3	-107.3	
155	Margin at 1 km (clear sky)	dB	-25.2	-0.4	14.6	
156	Required Separation (clear sky, no radio horizon)	km	17.5	1.0	0.2	
157	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-21.5	3.3	18.3	
158	Required Separation (21 mm/hr rain on interference up to 4 km)	km	3.7	0.8	0.2	
159	Path Loss Allocation:					
160	Free Space	dB	133.3	119.4	106.6	
161	Atmosphere	dB	0.1	0.0	0.0	
162	Rain	dB	13.6	2.8	0.6	
163	*LMDS 45 degree Sidelobe*					
164	Required Path Loss	dB	-116.0	-91.3	-76.3	
165	Margin at 1 km (clear sky)	dB	5.8	30.6	45.6	
166	Required Separation (clear sky, no radio horizon)	km	0.5	0.0	0.0	

1	**Interference Calculations for FSS Uplinks Interfering with LMDS Rec**					
2						
3	**LMDS System Parameters**					
4	System Proponent		Video/Phone			
5	Link		Sub to Hub			
6	Modulation		16 QAM			
7	Digital Data Rate		45 Mbps			
8	Channel Bandwidth		22.5 MHz			
9	Antenna Pattern Used		Proponent			
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5			
11						
12	**FSS System**		T1 - TST			
13						
167	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	9.5	34.3	49.3	
168	Required Separation (21 mm/hr rain on interference up to 4 km)	km	0.4	0.0	0.0	
169	Path Loss Allocation:					
170	Free Space	dB	114.4	91.1	76.2	
171	Atmosphere	dB	0.0	0.0	0.0	
172	Rain	dB	1.6	0.1	0.0	
173	*LMDS 180 degree Backlobe*					
174	Required Path Loss	dB	-107.3	-82.6	-67.6	
175	Margin at 1 km (clear sky)	dB	14.5	39.3	54.3	
176	Required Separation (clear sky, no radio horizon)	km	0.2	0.0	0.0	
177	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	18.2	43.0	58.0	
178	Required Separation (21 mm/hr rain on interference up to 4 km)	km	0.2	0.0	0.0	
179	Path Loss Allocation:					
180	Free Space	dB	106.7	82.5	67.5	
181	Atmosphere	dB	0.0	0.0	0.0	
182	Rain	dB	0.6	0.0	0.0	

1	**Interference Calculations for FSS Uplinks Interfering with LMDS Rec**				
2					
3	**LMDS System Parameters**				
4	System Proponent		TI Dig Hub #1		
5	Link		Hub to Sub		
6	Modulation		QPSK		
7	Digital Data Rate		52 Mbps		
8	Channel Bandwidth		52 MHz		
9	Antenna Pattern Used		Proponent		
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5		
11					
12	**FSS System**		T1 - TST		
13					
14	**Required Separation (clear sky, incl. 100 km radio horizon)**				
15	ES angle from boresight		40 - ITU	40-conserv.	40-optimistic
16	LMDS receiver pointing angle				
17	Boresight	miles	16.06	0.98	0.18
18	5 Degree Sidelobe	miles	1.29	0.07	0.01
19	45 Degree Sidelobe	miles	0.54	0.03	0.01
20	180 Degree Backlobe	miles	0.54	0.03	0.01
21	**Required Separation (rain on all paths, incl. 100 km radio horizon)**				
22	ES angle from boresight		40 - ITU	40-conserv.	40-optimistic
23	LMDS receiver pointing angle				
24	Boresight	miles	46.21	3.14	1.27
25	5 Degree Sidelobe	miles	4.10	0.76	0.20
26	45 Degree Sidelobe	miles	2.15	0.40	0.09
27	180 Degree Backlobe	miles	2.15	0.40	0.09
28					
29	**Calculations**				
30					
31	**LMDS Signal Link Carrier Level at Cell Edge**		Clear Sky		Rain Conditions
32	Transmitted Power	dBW/channel	-12		-12
33	Transmitter Antenna Gain	dBi	12		12
34	EIRP (clear sky)	dBWi/channel	0		0
35	Power Control (rain)	dB	0		12
36	Distance to Cell Edge	km	5		5
37	Rain Attenuation (cell edge)	dB	0		-15
38	Free Space Path Loss (cell edge)	dB	-135.8		-135.8
39	Receiver Antenna Gain	dBi	34		34
40	Carrier Level at Cell Edge	dBW/channel	-101.8		-104.8
41	Notes:				
42	Rain attenuation from WG1/52 (rev. 5)		Antenna gains include pointing loss		
43	Power control is the minimum necessary to overcome rain fade without exceeding ma		TI max power control: 12 dB		
44					
45					
46	**Interference Density into LMDS**		Clear Sky		Rain Conditions
47	k (Boltzmann's Constant)	dBW/K/Hz	-228.6		-228.6
48	Receiver Noise Figure	dB	8		8
49	Receiver Noise Temperature	K	1830		1830
50	Channel Bandwidth	MHz	52		52
51	Receiver Noise Floor	dBW/channel	-118.8		-118.8
52	Minimum Required C/(N+I)	dB per channel	13		13
53	Cell Edge C/N	dB	17.0		14.0
54	Cell Edge C/N	linear	50		25
55	Required C/(N+I)	linear	20		20
56	Allowed Interference Power (w/o BW correction)	dBW/channel	-117.0		-124.6
57	Allowed Interference Power	dBW	-117.0		-124.6
58	Notes:				
59					
60					
61	**Interference Density Generated**				
62	Teledesic TST FSS Uplink into LMDS Receivers				
63					
64	Earth Station Angle From Boresight		40 - ITU	40-conserv.	40-optimistic

1	**Interference Calculations for FSS Uplinks Interfering with LMDS Rec**				
2					
3	**LMDS System Parameters**				
4	System Proponent		TI Dig Hub #1		
5	Link		Hub to Sub		
6	Modulation		QPSK		
7	Digital Data Rate		52 Mbps		
8	Channel Bandwidth		52 MHz		
9	Antenna Pattern Used		Proponent		
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5		
11					
12	**FSS System**		T1 - TST		
13					
65	Earth Station Output Power (no rain)	dBWi/channel	0.85	0.85	0.85
66	Maximum Antenna Gain	dBi	36.0	36.0	36.0
67	Sidelobe Discrimination	dB	38.3	63.0	78.0
68	Antenna Gain toward LMDS Receiver	dBi	-2.3	-27.0	-42.0
69	Single Channel BW	MHz	26.5	26.5	26.5
70	Number of Interfering Channels	dB	0	0	0
71	LMDS Receiver Bandwidth	MHz	18	18	18
72	Interference Subtotal (clear sky)	dBW	-1.4	-26.2	-41.2
73	Rain Rate	mm/hr	Not Used	Not Used	Not Used
74	Length of rain cell	km	Not Used	Not Used	Not Used
75	Path Length through rain	km	Not Used	Not Used	Not Used
76	Rain Attenuation	dB	Not Used	Not Used	Not Used
77	Power Control (rain)	dB	17.1	17.1	17.1
78	Interference Subtotal (rain on signal path)	dBW	15.7	-9.1	-24.1
79	Notes:				
80	Antenna Gain is the maximum elevation pattern gain in the direction of the LMDS rece				
81	the earth station is pointing in the direction of the LMDS receiver				
82	Antenna Gain is antenna mask specified in ITU Appendix 29				
83	Lin Model used for rain attenuation on interference path				
84	0.02 dB/km of atmospheric attenuation included in new calculations (climatic zones 3-				
85					
86					
87	LMDS Receiver Antenna Gain				
88	Boresight	dBi	35		
89	5 Degree Sidelobe	dBi	12.6		
90	45 Degree Sidelobe	dBi	5		
91	180 Degree Backlobe	dBi	5		
92	Note:				
93	Negative margin indicates C/(N+I) objective not met at 1 km separation				
94	All path loss values indicate positive loss (negative gain) regardless of sign				
95					
96					
97	**LMDS Signal: clear sky, Satellite Signal: clear sky**				
98	**ES angle from boresight**		40 - ITU	40-conserv.	40-optimistic
99	*LMDS Boresight*				
100	Required Path Loss	dB	-150.6	-125.8	-110.8
101	Margin at 1 km (clear sky)	dB	-28.7	-4.0	11.0
102	Required Separation (clear sky, no radio horizon)	km	25.8	1.6	0.3
103	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-25.0	-0.3	14.7
104	Required Separation (21 mm/hr rain on interference up to 4 km)	km	5.1	1.0	0.3
105	Path Loss Allocation:				
106	Free Space	dB	135.9	122.0	109.9
107	Atmosphere	dB	0.1	0.0	0.0
108	Rain	dB	14.5	3.8	0.9
109	*LMDS 5 degree Sidelobe*				
110	Required Path Loss	dB	-128.2	-103.4	-88.4
111	Margin at 1 km (clear sky)	dB	-6.3	18.4	33.4
112	Required Separation (clear sky, no radio horizon)	km	2.1	0.1	0.0
113	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-2.6	22.1	37.1
114	Required Separation (21 mm/hr rain on interference up to 4 km)	km	1.2	0.1	0.0
115	Path Loss Allocation:				

1	**Interference Calculations for FSS Uplinks Interfering with LMDS Rec**				
2					
3	**LMDS System Parameters**				
4	System Proponent		TI Dig Hub #1		
5	Link		Hub to Sub		
6	Modulation		QPSK		
7	Digital Data Rate		52 Mbps		
8	Channel Bandwidth		52 MHz		
9	Antenna Pattern Used		Proponent		
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5		
11					
12	**FSS System**		T1 - TST		
13					
116	Free Space	dB	123.6	103.0	88.3
117	Atmosphere	dB	0.0	0.0	0.0
118	Rain	dB	4.5	0.4	0.1
119	*LMDS 45 degree Sidelobe*				
120	Required Path Loss	dB	-120.6	-95.8	-80.8
121	Margin at 1 km (clear sky)	dB	1.3	26.0	41.0
122	Required Separation (clear sky, no radio horizon)	km	0.9	0.1	0.0
123	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	5.0	29.7	44.7
124	Required Separation (21 mm/hr rain on interference up to 4 km)	km	0.7	0.0	0.0
125	Path Loss Allocation:				
126	Free Space	dB	118.1	95.6	80.8
127	Atmosphere	dB	0.0	0.0	0.0
128	Rain	dB	2.4	0.2	0.0
129	*LMDS 180 degree Backlobe*				
130	Required Path Loss	dB	-120.6	-95.8	-80.8
131	Margin at 1 km (clear sky)	dB	1.3	26.0	41.0
132	Required Separation (clear sky, no radio horizon)	km	0.9	0.1	0.0
133	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	5.0	29.7	44.7
134	Required Separation (21 mm/hr rain on interference up to 4 km)	km	0.7	0.0	0.0
135	Path Loss Allocation:				
136	Free Space	dB	118.1	95.6	80.8
137	Atmosphere	dB	0.0	0.0	0.0
138	Rain	dB	2.4	0.2	0.0
139					
140					
141	**LMDS Signal: rain Satellite Signal: rain**				
142	**ES angle from boresight**		40 - ITU	40-conserv.	40-optimistic
143	*LMDS Boresight*				
144	Required Path Loss	dB	-175.3	-150.5	-135.5
145	Margin at 1 km (clear sky)	dB	-53.4	-28.7	-13.7
146	Required Separation (clear sky, no radio horizon)	km	258.9	25.6	4.8
147	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-49.7	-25.0	-10.0
148	Required Separation (21 mm/hr rain on interference up to 4 km)	km	74.4	5.1	2.0
149	Path Loss Allocation:				
150	Free Space	dB	159.2	135.9	128.0
151	Atmosphere	dB	1.5	0.1	0.0
152	Rain	dB	14.5	14.5	7.5
153	*LMDS 5 degree Sidelobe*				
154	Required Path Loss	dB	-152.9	-128.1	-113.1
155	Margin at 1 km (clear sky)	dB	-31.0	-6.3	8.7
156	Required Separation (clear sky, no radio horizon)	km	33.0	2.1	0.4
157	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-27.3	-2.6	12.4
158	Required Separation (21 mm/hr rain on interference up to 4 km)	km	6.6	1.2	0.3
159	Path Loss Allocation:				
160	Free Space	dB	138.2	123.6	111.9
161	Atmosphere	dB	0.1	0.0	0.0
162	Rain	dB	14.5	4.5	1.2
163	*LMDS 45 degree Sidelobe*				
164	Required Path Loss	dB	-145.3	-120.5	-105.5
165	Margin at 1 km (clear sky)	dB	-23.4	1.3	16.3
166	Required Separation (clear sky, no radio horizon)	km	14.4	0.9	0.2

1	**Interference Calculations for FSS Uplinks Interfering with LMDS Rec**					
2						
3	**LMDS System Parameters**					
4	System Proponent		TI Dig Hub #1			
5	Link		Hub to Sub			
6	Modulation		QPSK			
7	Digital Data Rate		52 Mbps			
8	Channel Bandwidth		52 MHz			
9	Antenna Pattern Used		Proponent			
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5			
11						
12	**FSS System**		T1 - TST			
13						
167	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-19.7	5.0	20.0	
168	Required Separation (21 mm/hr rain on interference up to 4 km)	km	3.5	0.7	0.1	
169	Path Loss Allocation:					
170	Free Space	dB	132.6	118.1	105.0	
171	Atmosphere	dB	0.1	0.0	0.0	
172	Rain	dB	12.6	2.4	0.5	
173	*LMDS 180 degree Backlobe*					
174	Required Path Loss	dB	-145.3	-120.5	-105.5	
175	Margin at 1 km (clear sky)	dB	-23.4	1.3	16.3	
176	Required Separation (clear sky, no radio horizon)	km	14.4	0.9	0.2	
177	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-19.7	5.0	20.0	
178	Required Separation (21 mm/hr rain on interference up to 4 km)	km	3.5	0.7	0.1	
179	Path Loss Allocation:					
180	Free Space	dB	132.6	118.1	105.0	
181	Atmosphere	dB	0.1	0.0	0.0	
182	Rain	dB	12.6	2.4	0.5	

1	**Interference Calculations for FSS Uplinks Interfering with LMDS Rec**				
2					
3	**LMDS System Parameters**				
4	System Proponent		TI Dig Sub #1		
5	Link		Sub to Hub		
6	Modulation		QPSK		
7	Digital Data Rate		52 Mbps		
8	Channel Bandwidth		52 MHz		
9	Antenna Pattern Used		Proponent		
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5		
11					
12	**FSS System**		T1 - TST		
13					
14	**Required Separation (clear sky, incl. 100 km radio horizon)**				
15	ES angle from boresight		40 - ITU	40-conserv.	40-optimistic
16	LMDS receiver pointing angle				
17	Boresight	miles	1.69	0.10	0.02
18	5 Degree Sidelobe	miles	1.69	0.10	0.02
19	45 Degree Sidelobe	miles	1.69	0.10	0.02
20	180 Degree Backlobe	miles	1.69	0.10	0.02
21	**Required Separation (rain on all paths, incl. 100 km radio horizon)**				
22	ES angle from boresight		40 - ITU	40-conserv.	40-optimistic
23	LMDS receiver pointing angle				
24	Boresight	miles	5.38	0.91	0.25
25	5 Degree Sidelobe	miles	5.38	0.91	0.25
26	45 Degree Sidelobe	miles	5.38	0.91	0.25
27	180 Degree Backlobe	miles	5.38	0.91	0.25
28					
29	**Calculations**				
30					
31	**LMDS Signal Link Carrier Level at Cell Edge**		Clear Sky		Rain Condition
32	Transmitted Power	dBW/channel	-12		-12
33	Transmitter Antenna Gain	dBi	34		34
34	EIRP (clear sky)	dBWi/channel	22		22
35	Power Control (rain)	dB	0		12
36	Distance to Cell Edge	km	5		5
37	Rain Attenuation (cell edge)	dB	0		-15
38	Free Space Path Loss (cell edge)	dB	-135.8		-135.8
39	Receiver Antenna Gain	dBi	12		12
40	Carrier Level at Cell Edge	dBW/channel	-101.8		-104.8
41	Notes:				
42	Rain attenuation from WG1/52 (rev. 5)		Antenna gains include pointing loss		
43	Power control is the minimum necessary to overcome rain fade without exceeding ma		TI max power control: 12 dB		
44					
45					
46	**Interference Density into LMDS**		Clear Sky		Rain Condition
47	k (Boltzmann's Constant)	dBW/K/Hz	-228.6		-228.6
48	Receiver Noise Figure	dB	8		8
49	Receiver Noise Temperature	K	1830		1830
50	Channel Bandwidth	MHz	52		52
51	Receiver Noise Floor	dBW/channel	-118.8		-118.8
52	Minimum Required C/(N+I)	dB per channel	13		13
53	Cell Edge C/N	dB	17.0		14.0
54	Cell Edge C/N	linear	50		25
55	Required C/(N+I)	linear	20		20
56	Allowed Interference Power (w/o BW correction)	dBW/channel	-117.0		-124.6
57	Allowed Interference Power	dBW	-117.0		-124.6
58	Notes:				
59					
60					
61	**Interference Density Generated**				
62	Teledesic TST FSS Uplink into LMDS Receivers				
63					
64	Earth Station Angle From Boresight		40 - ITU	40-conserv.	40-optimistic

1	**Interference Calculations for FSS Uplinks Interfering with LMDS Rec**				
2					
3	**LMDS System Parameters**				
4	System Proponent		TI Dig Sub #1		
5	Link		Sub to Hub		
6	Modulation		QPSK		
7	Digital Data Rate		52 Mbps		
8	Channel Bandwidth		52 MHz		
9	Antenna Pattern Used		Proponent		
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5		
11					
12	**FSS System**		T1 - TST		
13					
65	Earth Station Output Power (no rain)	dBWi/channel	0.85	0.85	0.85
66	Maximum Antenna Gain	dBi	36.0	36.0	36.0
67	Sidelobe Discrimination	dB	38.3	63.0	78.0
68	Antenna Gain toward LMDS Receiver	dBi	-2.3	-27.0	-42.0
69	Single Channel BW	MHz	26.5	26.5	26.5
70	Number of Interfering Channels	dB	0	0	0
71	LMDS Receiver Bandwidth	MHz	18	18	18
72	Interference Subtotal (clear sky)	dBW	-1.4	-26.2	-41.2
73	Rain Rate	mm/hr	Not Used	Not Used	Not Used
74	Length of rain cell	km	Not Used	Not Used	Not Used
75	Path Length through rain	km	Not Used	Not Used	Not Used
76	Rain Attenuation	dB	Not Used	Not Used	Not Used
77	Power Control (rain)	dB	17.1	17.1	17.1
78	Interference Subtotal (rain on signal path)	dBW	15.7	-9.1	-24.1
79	Notes:				
80	Antenna Gain is the maximum elevation pattern gain in the direction of the LMDS rece				
81	the earth station is pointing in the direction of the LMDS receiver				
82	Antenna Gain is antenna mask specified in ITU Appendix 29				
83	Lin Model used for rain attenuation on interference path				
84	0.02 dB/km of atmospheric attenuation included in new calculations (climatic zones 3-				
85					
86					
87	LMDS Receiver Antenna Gain				
88	Boresight	dBi	15		
89	5 Degree Sidelobe	dBi	15		
90	45 Degree Sidelobe	dBi	15		
91	180 Degree Backlobe	dBi	15		
92	Note:				
93	Negative margin indicates C/(N+I) objective not met at 1 km separation				
94	All path loss values indicate positive loss (negative gain) regardless of sign				
95					
96					
97	**LMDS Signal: clear sky, Satellite Signal: clear sky**				
98	**ES angle from boresight**		40 - ITU	40-conserv.	40-optimistic
99	*LMDS Boresight*				
100	Required Path Loss	dB	-130.6	-105.8	-90.8
101	Margin at 1 km (clear sky)	dB	-8.7	16.0	31.0
102	Required Separation (clear sky, no radio horizon)	km	2.7	0.2	0.0
103	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-5.0	19.7	34.7
104	Required Separation (21 mm/hr rain on interference up to 4 km)	km	1.5	0.1	0.0
105	Path Loss Allocation:				
106	Free Space	dB	125.1	105.3	90.7
107	Atmosphere	dB	0.0	0.0	0.0
108	Rain	dB	5.4	0.6	0.1
109	*LMDS 5 degree Sidelobe*				
110	Required Path Loss	dB	-130.6	-105.8	-90.8
111	Margin at 1 km (clear sky)	dB	-8.7	16.0	31.0
112	Required Separation (clear sky, no radio horizon)	km	2.7	0.2	0.0
113	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-5.0	19.7	34.7
114	Required Separation (21 mm/hr rain on interference up to 4 km)	km	1.5	0.1	0.0
115	Path Loss Allocation:				

1	**Interference Calculations for FSS Uplinks Interfering with LMDS Rec**				
2					
3	**LMDS System Parameters**				
4	System Proponent		TI Dig Sub #1		
5	Link		Sub to Hub		
6	Modulation		QPSK		
7	Digital Data Rate		52 Mbps		
8	Channel Bandwidth		52 MHz		
9	Antenna Pattern Used		Proponent		
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5		
11					
12	**FSS System**		T1 - TST		
13					
116	Free Space	dB	125.1	105.3	90.7
117	Atmosphere	dB	0.0	0.0	0.0
118	Rain	dB	5.4	0.6	0.1
119	*LMDS 45 degree Sidelobe*				
120	Required Path Loss	dB	-130.6	-105.8	-90.8
121	Margin at 1 km (clear sky)	dB	-8.7	16.0	31.0
122	Required Separation (clear sky, no radio horizon)	km	2.7	0.2	0.0
123	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-5.0	19.7	34.7
124	Required Separation (21 mm/hr rain on interference up to 4 km)	km	1.5	0.1	0.0
125	Path Loss Allocation:				
126	Free Space	dB	125.1	105.3	90.7
127	Atmosphere	dB	0.0	0.0	0.0
128	Rain	dB	5.4	0.6	0.1
129	*LMDS 180 degree Backlobe*				
130	Required Path Loss	dB	-130.6	-105.8	-90.8
131	Margin at 1 km (clear sky)	dB	-8.7	16.0	31.0
132	Required Separation (clear sky, no radio horizon)	km	2.7	0.2	0.0
133	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-5.0	19.7	34.7
134	Required Separation (21 mm/hr rain on interference up to 4 km)	km	1.5	0.1	0.0
135	Path Loss Allocation:				
136	Free Space	dB	125.1	105.3	90.7
137	Atmosphere	dB	0.0	0.0	0.0
138	Rain	dB	5.4	0.6	0.1
139					
140					
141	**LMDS Signal: rain Satellite Signal: rain**				
142	**ES angle from boresight**		40 - ITU	40-conserv.	40-optimistic
143	*LMDS Boresight*				
144	Required Path Loss	dB	-155.3	-130.5	-115.5
145	Margin at 1 km (clear sky)	dB	-33.4	-8.7	6.3
146	Required Separation (clear sky, no radio horizon)	km	42.6	2.7	0.5
147	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-29.7	-5.0	10.0
148	Required Separation (21 mm/hr rain on interference up to 4 km)	km	8.7	1.5	0.4
149	Path Loss Allocation:				
150	Free Space	dB	140.6	125.1	114.0
151	Atmosphere	dB	0.2	0.0	0.0
152	Rain	dB	14.5	5.4	1.5
153	*LMDS 5 degree Sidelobe*				
154	Required Path Loss	dB	-155.3	-130.5	-115.5
155	Margin at 1 km (clear sky)	dB	-33.4	-8.7	6.3
156	Required Separation (clear sky, no radio horizon)	km	42.6	2.7	0.5
157	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-29.7	-5.0	10.0
158	Required Separation (21 mm/hr rain on interference up to 4 km)	km	8.7	1.5	0.4
159	Path Loss Allocation:				
160	Free Space	dB	140.6	125.1	114.0
161	Atmosphere	dB	0.2	0.0	0.0
162	Rain	dB	14.5	5.4	1.5
163	*LMDS 45 degree Sidelobe*				
164	Required Path Loss	dB	-155.3	-130.5	-115.5
165	Margin at 1 km (clear sky)	dB	-33.4	-8.7	6.3
166	Required Separation (clear sky, no radio horizon)	km	42.6	2.7	0.5

1	**Interference Calculations for FSS Uplinks Interfering with LMDS Rec**				
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3	**LMDS System Parameters**				
4	System Proponent		TI Dig Sub #1		
5	Link		Sub to Hub		
6	Modulation		QPSK		
7	Digital Data Rate		52 Mbps		
8	Channel Bandwidth		52 MHz		
9	Antenna Pattern Used		Proponent		
10	Date/Revision of System Parameters	WG 1/52	9/20/94 Rev 5		
11					
12	**FSS System**		T1 - TST		
13					
167	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-29.7	-5.0	10.0
168	Required Separation (21 mm/hr rain on interference up to 4 km)	km	8.7	1.5	0.4
169	Path Loss Allocation:				
170	Free Space	dB	140.6	125.1	114.0
171	Atmosphere	dB	0.2	0.0	0.0
172	Rain	dB	14.5	5.4	1.5
173	*LMDS 180 degree Backlobe*				
174	Required Path Loss	dB	-155.3	-130.5	-115.5
175	Margin at 1 km (clear sky)	dB	-33.4	-8.7	6.3
176	Required Separation (clear sky, no radio horizon)	km	42.6	2.7	0.5
177	Margin at 1 km (3.7 dB rain attenuation on interference)	dB	-29.7	-5.0	10.0
178	Required Separation (21 mm/hr rain on interference up to 4 km)	km	8.7	1.5	0.4
179	Path Loss Allocation:				
180	Free Space	dB	140.6	125.1	114.0
181	Atmosphere	dB	0.2	0.0	0.0
182	Rain	dB	14.5	5.4	1.5

September 23, 1994

Joint Views and Proposed Rules for LMDS/Non-GSO MSS Feeder Link Sharing Submitted by Constellation Communications, Inc., Loral QUALCOMM Partnership, L.P., Mobile Communications Holdings, Inc., and TRW Inc.

Constellation Communications, Inc. ("Constellation"), Loral QUALCOMM Partnership, L.P. ("LQP") Mobile Communications Holdings, Inc. ("MCHI"), and TRW Inc. ("TRW") are applicants for licenses to construct and operate Non-geostationary mobile satellite systems, pursuant to the cut-off date of June 3, 1991, established by Public Notice dated April 1991 (Report No. DS-1068). Constellation, LQP and MCHI all applied to utilize frequencies at or below 15 GHz for feeder links. TRW applied to utilize spectrum in the 29.5 to 30.0 GHz band. The FCC, in its Notice of Proposed Rulemaking in CC Docket No. 92-166, stated that:

> ...we are preparing to conduct a Negotiated Rulemaking to assist us in assigning the 27.5-30.0 GHz frequency band. We expect, in the context of that proceeding, to be able to identify sufficient spectrum within that band to satisfy the Earth-to-space feeder link requirements of all MSS above 1 GHz applicants that may be licensed in this proceeding. Notice, at para. 77.

As such, the Commission identified Constellation, LQP, MCHI, and TRW as interested parties in the instant proceeding.

Constellation, LQP and MCHI are working with the Commission, other U.S. government agencies, and within the ITU Radiocommunication Sector to identify appropriate means of utilizing frequency bands below 15 GHz for their feeder links, and are hopeful that these efforts will be fruitful. TRW is working with the Commission, other government agencies and within the ITU Radiocommunication Sector to utilize spectrum in the 29.5 to 30.0 GHz band.

Nevertheless, Constellation, LQP, MCHI and TRW believe that the instant 28 GHz NRM must provide for a rule which would address sharing between LMDS systems and feeder links used by their Non-GSO MSS systems (including licensing provisions), in the event that use of spectrum in the 27.5-29.5 GHz band for their systems' feeder links is required. If these systems' feeder links are located in this frequency range, between 300 MHz and 400 MHz per system will be required.

Constellation, LQP, MCHI and TRW propose that a rule be adopted which would provide important elements which differ from those included in the Non-GSO MSS feeder link licensing provisions proposed by Motorola and Suite 12 in NRMC- 84 (Rev.1). These elements include the opportunity for Non-GSO MSS systems other than Motorola to provide notice of feeder link locations at a time when these Non-GSO MSS systems will have

reasonable certainty as to whether the use of the 27.5-29.5 GHz band will be required and a mechanism for coordinating Non-GSO MSS feeder link sites with LMDS operations.

While Constellation, LQP and MCHI are hopeful that the Commission will provide, within the near future, a positive indication that feeder link spectrum below 15 GHz may be utilized for their systems. It is also necessary to revise the International Table of Allocations as well as the U.S. Table of Allocations. These three parties contemplate the following sequence of events: (1) an affirmative statement of policy with respect to allocation of the feeder link spectrum currently being sought by these parties in the Commission's Report and Order in CC Docket No. 92-166; (2) conditional authorizations to use the bands requested; (3) a U.S. proposal for revisions to the International Table of Allocations including the feeder link spectrum requirements of these parties; and (4) adoption by the 1995 World Radiocommunication Conference of the necessary allocations. Based on this timetable, Constellation, LQP and MCHI will not have certainty that they will not be required to use the spectrum in the 27.5-29.5 GHz band until the end of WRC-95, in November, 1995. TRW, as well, does not at the present time have certainty that it will be permitted to use all of the feeder link spectrum it requires, even though the 29.5-30.0 GHz band is presently allocated both domestically and internationally for FSS use (including MSS feeder links).

Consequently, Constellation, LQP, MCHI, and TRW propose that any rule adopted by the Commission, governing sharing of spectrum between Non-GSO MSS feeder links and LMDS systems, and licensing of Non-GSO MSS feeder links, include the following elements:

(1) the rules must address the entire 27.5-29.5 GHz band, in view of the feeder link spectrum requirements of the Non-GSO MSS systems, in the event the Commission determines that this band must or may be used for Non-GSO MSS feeder links which cannot be accommodated in other frequency bands;

(2) the rules must permit all the Non-GSO MSS applicants to identify feeder link locations in the 27.5-29.5 GHz band prior to LMDS auctions;

(3) the rules must provide a mechanism for the Non-GSO MSS applicants which have requested spectrum outside the 27.5-29.5 GHz band to identify location of gateway earth stations in the 27.5-29.5 GHz band in the United States, following WRC-95 (on or before March 31, 1996), in the event the U.S. is not successful in obtaining international allocations which will satisfy the parties' requirements. These stations could be located anywhere outside of the top 100 MSAs in the continental United States;

(4) the rules must provide a mechanism for coordination of Non-GSO MSS feeder links with affected LMDS systems.

The coordination contour approach between Non-GSO MSS feeder link operations and LMDS can be modeled after existing approaches in Part 25, Subsection C, as well as ITU-R recommendations. These approaches provide methods of calculating a coordination contour

around a Non-GSO MSS feeder link earth station, outside of which it may be assumed that unacceptable interference would not be caused to LMDS receivers. (See NRMC-18, NRMC-19, NRMC-20, NRMC-57 and NRMC-54). This method would include the specification of a maximum permissible interference level at the interfered-with LMDS receiver, the calculation of the required propagation loss between the Non-GSO MSS feeder link earth station and LMDS receiver, and the minimum separation distance at which the required loss would be achieved. This coordination contour method could be adapted to develop a flexible coordination distance contour methodology to govern coordination between Non-GSO MSS feeder link earth stations and LMDS systems based on the technical parameters and propagation models employed in this proceeding or otherwise a matter of record before the Commission.

Consequently, because of the strong public interest in accommodating Non-GSO MSS systems, and in order to minimize interference between Non-GSO MSS and LMDS, Constellation, LQP, MCHI and TRW recommend that the Commission adopt the following rules.

6.3 Rules

1. Amend proposed rule section 21.1002 by adding new subsection (c) as follows:

21.1002 Frequencies

(c) Special requirements for operations in the 27.5-29.5 GHz Band

(1) Non-geostationary mobile satellite service ("Non-GSO MSS") systems which filed applications by the cut-off date of June 3, 1991 established by Public Notice dated April 1, 1991 (Report No. DS-1068) may use the [X] GHz band for earth-to-space transmissions from feeder link earth station complexes to the extent these stations propose or are required to use the [X] GHz band for feeder link operations.

(2) Each Non-GSO MSS operator licensed to operate feeder link earth stations in the [x] GHz band may concurrently operate up to ten (10) feeder link earth station complexes in the contiguous United States, plus one each in Alaska, Hawaii and Puerto Rico/Virgin Islands.

(3) LMDS receive stations operating on frequencies in the [X] GHz band within the coordination contour of a Non-GSO MSS feeder link earth station complex shall accept any interference caused to them by such earth stations and shall claim no protection from such earth stations. However, the Non-GSO MSS earth station licensee shall provide the affected LMDS licensee with a copy of its channel plan and, except for certain occasional satellite control operations, the Non-GSO MSS earth station licensee may not utilize an occupied bandwidth of more than 400 MHz at any single location.

(4) The locations of the Non-GSO MSS feeder link earth station sites subject to this rule shall be determined as follows:

(i) At least 45 days prior to the commencement of LMDS license auctions, an applicant defined in (c)(1) which proposes to utilize a portion of the [X] GHz band for its feeder link operations, shall specify locations of its feeder link earth station complexes in accordance with the following requirements: no complex may be located in the largest 8 metropolitan statistical areas ("MSAs"), ranked by population; no more than two (2) complexes may be located in MSAs 9-25, and one or both of those complexes can alternatively be located in MSAs 26 to 100; no more than one (1) complex may be located in MSAs 26 to 50, with the possible addition of one or both of the two complexes from MSAs 9 to 25; no more than (3) complexes may be located in MSAs 51 to 100, on of which must be Honolulu, Hawaii (for a complex at Waimea), with the possible addition of any of the complexes from MSAs 9 to 50; and remaining complexes, with the possible addition of any of the complexes from MSAs 9 to 100, must be located at least 75 nautical miles from the borders of the 100 largest MSAs. For purposes of this paragraph (i), the coordination contours of these earth station complexes shall be a circle with a radius of 75 nautical miles centered on the geographical coordinates specified by the Non-GSO MSS feeder link applicant.

(ii) On or before March 31, 1996, a Non-GSO MSS earth station applicant defined in (c)(1) which proposes to utilize frequencies in the [X] GHz Band, shall specify the location of their feeder link earth station complexes and their associated coordination contours. These coordination contours shall lie entirely outside the 100 largest MSAs in the continental United States.

(iii) After March 31, 1996, a Non-GSO MSS earth station applicant defined in (c)(1) may file applications only for complexes located entirely beyond 75 nautical miles of the 100 largest MSAs. During the coordination of such complexes and their associated earth stations with the Non-GSO MSS operator, the LMDS applicant or licensee shall still cooperate fully and make reasonable efforts to resolve technical problems, but it shall not be obligated to re-engineer its proposal or make changes to its system.

(5) (i) LMDS providers proposing to operate hub stations on frequencies in the [X] GHz band at locations outside of the 100 largest MSAs shall serve copies of their applications on all Non-GSO MSS applicants, permittees or licensees which are authorized to operate or which have applied to operate feeder link earth station complexes in that band, or have been required by the Commission to utilize any portion of that band for feeder link earth station complexes.

(ii) Non-GSO MSS feeder link earth station applicants shall serve copies of their applications on all LMDS providers whose authorized operating areas are included in whole or in part within the earth station complex coordination contour.

(iii) If an LMDS permittee or licensee determines that its proposed LMDS receive stations have the potential to receive unacceptable interference from a planned feeder link earth station, it shall notify the earth station applicant of the planned location and characteristics of its planned LMDS facilities. Upon such notification, the Non-GSO MSS and LMDS parties shall have 120 days within which both to attempt to accommodate both the feeder link earth station(s) and LMDS receive stations and to notify the Commission of the results of those consultations. The Non-GSO MSS and LMDS parties shall work together in good faith to resolve technical problems in the least disruptive manner possible and either party may request the Commission to assist in the resolution of any identified interference problems.

(6) For purposes of this section:

(i) A "Non-GSO MSS feeder link earth station complex" is defined as an aggregation of up to three (3) earth stations, with each earth station having up to four (4) antennas, that is used for Non-GSO MSS Earth-to-space feeder link transmissions for Non-GSO MSS systems that use the [X] GHz band for feeder link operations.

(ii) The term "100 largest MSAs" shall not include any MSAs located within Hawaii, Alaska or Puerto Rico/Virgin Islands. The MSAs referred to in this section are those defined by the Office of Management and Budget as of June 30, 1993 using estimated populations as of December 31, 1992.

2. Amend proposed rule section 21.1004 by adding new subsection (b)(5)(x) as follows:

21.1004 Content and Form of Applications

(b)(5)(x). Exhibit X: Demonstration of Compliance with Technical Rules

3. Amend proposed rule section 21.1007(c)(i) by substituting the following language:

21.1007(c)(i) The boundaries of the GSA must include at least 25% of the population of the BTA.

4. Add new rule section 21.1018 as follows:

21.1018 LMDS Single Station EIRP Limit. Point-to-point stations in the [x] GHz band for the LMDS backbone between LMDS hubs shall be limited to a maximum allowable EIRP of [23 dBWi/MHz]* in any one megahertz in clear air, and may exceed this limit by employment of adaptive power control in cases where link propagation attenuation exceeds the clear air value and only to the extent that the link is impaired.

[**Note:** The foregoing rule should also be implemented by making the appropriate modification or deletion to Section 21.107(b).]

5. Add new rule section 21.1019 as follows:

21.1018 LMDS Subscriber Transmissions. LMDS licensees shall not operate transmitters from subscriber locations in the [x] GHz band.

6. Add new rule section 21.1020 as follows:

21.1020 Hub Transmitter EIRP Spectral Area Density Limit. LMDS applicants shall demonstrate that, under clear air operating conditions, the maximum aggregate of LMDS transmitting hub stations in a Basic Trading Area in the [x] GHz band will not transmit a co-frequency hub-to-subscriber EIRP spectral area density in any azimuthal direction in excess of X dBWi/(MHz-km^2) when averaged over bandwidth equal to the smallest necessary bandwidth of any Non-GSO MSS feeder link licensed to operate in this band, where X is defined in Table 1. Individual hub stations may exceed their clear air EIRPs by employment of adaptive power control in cases where link propagation attenuation exceeds the clear air value and only to the extent that the link is impaired.

The EIRP aggregate spectral area density is calculated as follows:

$$10\log\left(\frac{1}{A}\sum_{i=1}^{N} P_i G_i\right) dBWi\ /MHz\text{-}km^2$$

where:
N = number of co-frequency hubs in BTA
A = area of BTA in km^2
P_i = spectral power density into antenna of the i-th hub (in W/MHz)
G_i = gain of the i-th hub antenna at zero degree elevation angle
Each P_i and G_i are in the same 1 MHz

The climate zones in Table 1 are defined for different geographic locations within the U.S., as shown in Appendix 28 ITU Radio Regulations and Section 25.254 of the Commission's Rules.

Table 1

Climate Zone	EIRP Spectral Density (dBWi/MHz-km^2)
1	[-23]*
2	[-25]*
3,4,5	[-26]*

Note: LMDS system licensees in two or more BTAs may individually or collectively deviate from the spectral density computed above by averaging the power over any [200 km by 400 km]* area, provided that the aggregate interference to the satellite receiver is no greater than if the spectral area density were as specified in Table 1. A showing to the Commission comparing both methods of computation is required.

7. Add new rule section 21.1021 as follows:

21.1021 Hub Transmitter EIRP Spectral Area Density Limit at Elevation Angles Above the Horizon. LMDS applicants shall demonstrate that, under clear air operating conditions, the maximum aggregate of LMDS transmitting hub stations in a Basic Trading Area in the [X] GHz band will not transmit a co-frequency hub-to-subscriber EIRP spectral area density in any azimuthal direction in excess of X dBWi/(MHz-km^2) when averaged over bandwidth equal to the smallest necessary bandwidth of any Non-GSO MSS feeder link licensed to operate in this band, where X is defined in Table 2. Individual hub stations may exceed their clear air EIRPs by employment of adaptive power control in cases where link propagation attenuation exceeds the clear air value and only to the extent that the link is impaired.

The EIRP aggregate spectral area density is calculated as follows:

$$10\log\left(\frac{1}{A}\sum_{i=1}^{N} EIRP(a_i)\right) dBWi\ /MHz\text{-}km^2$$

where:
N = number of co-frequency hubs in BTA
A = area of BTA in km^2
$EIRP(a_1)$ = equivalent isotropic radiated spectral power density of the i-th hub (in W/MHz) at elevation angle a.

Table 2

Elevation Angle (a)	**Relative EIRP Density (dBWi/MHz-km^2)**
$0^\circ \leq a \leq 4.0^\circ$*	EIRP(a) = EIRP(0°) + 20 log((sin nx) (1 nx)) where x = (a + 1)/7.5°*
[4.0° ≤ a ≤ 7.7°]*	[EIRP(a) = EIRP(0°) - 3.85 a + 7.7]*
[a > 7.7°]*	[EIRP(a) = EIRP(0°) - 22]*

where a is the angle in degrees of elevation above the horizon. EIRP(0°) is the hub EIRP area density at the horizon used in Section 21.1020. The nominal antenna pattern will be used for elevation angles between 0° and 8°, and average levels will be used for angles beyond 8°, where average levels will be calculated by sampling the antenna patterns in each 1° interval between 8° and 90°, dividing by 83.

[**Note:** See note to 6 above.]

8. Add new rule section 21.1022 as follows:

21.1022 Power Reduction. LMDS hub transmitters shall employ methods to reduce average power levels received by Non-GSO MSS satellite receivers.

9. Modify rule Section 21.2 by inserting new definitions in the appropriate alphabetical order as follows:

Local Multipoint Distribution Service Hub Station. A fixed point-to-multipoint radio station in a Local Multipoint Distribution Service System that provides two-way communication with Local Multipoint Distribution Service Subscriber Stations and other Local Multipoint Distribution Service Subscriber Stations and other Local Multipoint Distribution Service Hub Stations.

Local Multipoint Distribution Service System. A fixed point-to-multipoint radio system consisting of Local Multipoint Distribution Service Hub Stations and their associated Local Multipoint Distribution Service Subscriber Stations.

Local Multipoint Distribution Service Subscriber Station. Any one of the fixed microwave radio stations located at users' premises. lying within the coverage area of a Local Multipoint Distribution Service Hub Station, capable of receiving one-way communications from or providing two-way communications with the Local Multipoint Distribution Service Hub Station.

* The numbers in these brackets were based on the analysis performed between the Iridium and Suite 12 system. Any values adopted should accommodate all the Non-GSO MSS systems encompassed by this rule.

RECOMMENDATIONS FOR ASSURANCE OF ACCESS BY EDUCATIONAL AND PUBLIC TELECOMMUNICATIONS ENTITIES IN THE EVENT THAT SPECTRUM AUCTIONS ARE USED FOR AWARD OF LMDS LICENSES

If the Federal Communications Commission concludes that auctions should be used to allocate spectrum among LMDS operators, fixed satellite service operators and mobile satellite service operators in the 27.5 to 29.5 GHz band, any auction regulations the Commission promulgates must provide for educational use of this spectrum by non-profit educational and public telecommunications entities. There are several methods by which educational participation in LMDS auction assigned licenses could be encouraged. For example, the Commission could use the following methods:

1) Bidder credit equal to the percentage of spectrum operated by the educational and public telecommunications entity, and/or

2) Educational and public telecommunications spectrum set aside.

Other possible methods, such as a reservation of a sufficient amount of spectrum for use by educational or public telecommunications entities at preferential, incremental cost-based rates, could also assure the necessary access. Use of such methods would encourage educational and public telecommunications entities to develop beneficial educational use of the LMDS technology.

1) Commercial bidder credit equal to percentage of educational and public telecommunications entity operations

The Commission could grant a commercial bidder in the LMDS license auction a credit on its auction bid amount equal to the percentage of noncommercial spectrum that a non-profit educational or public telecommunications entity would operate on an LMDS system constructed by the commercial bidder. This would encourage LMDS applicants to make cooperative operational arrangements with educational and/or telecommunications institutions. For example, if an educational entity had an agreement with an LMDS commercial applicant for the educational entity to operate 40% of the spectrum, then the Commission could give that commercial bidder a 40% credit, which would result in the LMDS commercial operator having to pay the Commission 60% of the winning bid amount.

2) Educational and public telecommunications spectrum set aside

The Commission could allocate only one commercial LMDS license to be granted by auction for 1000 MHz of the LMDS spectrum in each Rand McNally Basic Trading Area (BTA) and could set aside 1000 MHz of spectrum in each BTA to be operated by an educational or public telecommunications entity to disseminate educational information and programs. To encourage rapid implementation of educational LMDS systems, the Commission could allow the educational and public telecommunications entities to develop excess airtime capacity leasing agreements. These leasing agreements would allow a portion of the educational spectrum to be leased either to the winner of the commercial LMDS auction for that BTA or to another company that would be interested in operation cooperatively on the educational spectrum in the BTA with an educational or public telecommunication entity.

Conclusion

The Public Interest Parties strongly urge the Commission to adopt one or both of the alternatives or a similar method to encourage educational participation in the LMDS if the Commission decides to auction the LMDS spectrum. Without an incentive plan, such as the above, educational participation in this innovative service could be blocked either because of the prohibitive expense of the auction bidding process or because, in some jurisdictions, educational and public telecommunications entities may be prohibited from expending public funds on spectrum auctions.

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September 19, 1994

Memorandum for: Mr. William Luther, Facilitator
Negotiated Rulemaking Committee

Subject: Non-Technical Items Not Included in Body of Report But To Be Forwarded as Added Information

References: (a) NRMC-69
Dated September 11, 1994

Reference (a), prepared on behalf of the Digital Microwave Corporation and Harris Corporation-Farinon Division was considered by the Negotiated Rulemaking Committee at its September 13, 1994 meeting and referred to Working Group 1 for further action. The attached is a revision of Reference (a) based on discussions in Working Group 1. Despite being revised, the attached did not in the end receive consensus support. Accordingly, the attached is submitted herewith to be appended to the Final Report of the Negotiated Rulemaking Committee as a matter that was considered, garnered some support, but failed to receive consensus support.

Leonard R. Raish

Leonard R. Raish