Cerfifications

12. WAIVER AND CERTIFICATIONS

In accordance with Section 304 of the Communications Act of 1934, as amended, 47 U.S.C. 304, HCI hereby waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise.

HCI certifies that neither the Applicant nor any of its shareholders, nor any of its officers or directors, nor any party to this application is subject to a denial of Federal benefits pursuant to authority granted in Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. § 862.

The undersigned certifies individually and for HCI that all of the statements made in this Application are true, complete, and accurate to the best of his information, belief and knowledge, and are made in good faith.

Respectfully submitted,

Hughes Communications, Inc.

By: _____

Jerald F. Farrell
President
September 25, 1997

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Conclusions

13. CONCLUSION

For the reasons set forth in this Application, HCI respectfully requests that the Commission promptly grants this application to enable HCI to bring to the public the significant benefits described above at the earliest possible time.

Respectfully submitted,

Hughes Communications, Inc.

By: _____

Jerald F. Farrell
President
September 25, 1997

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Appendix A
Transmission Characteristics

APPENDIX A. TRANSMISSION CHARACTERISTICS

This appendix contains the StarLynx™ communication link budgets. The link analysis covers both GSO and MEO satellites and the portable and mobile terminals. Tables A-2 through A-9 show the V-band budgets. Tables A-10 through A-15 show the C-band TT&C budgets. Table A-1 provides an index to the various V-band and C-band communication link budgets contained in Appendix A.

Table A-1. Communications Budget Index

Communications Links	Budget Contained in:
GSO Portable V-Band Link	Table A-2
GSO Mobile V-Band Link	Table A-3
MEO Portable V-Band Link	Table A-4
MEO Mobile V-Band Link	Table A-5
GSO Portable V-Band Link In Rain	Table A-6
GSO Mobile V-Band Link In Rain	Table A-7
MEO Portable V-Band Link In Rain	Table A-8
MEO Mobile V-Band Link In Rain	Table A-9
GSO C-Band Command Links - On - Station Planar Array	Table A-10
GSO C-Band Command Links - On - Station Pipe Antenna	Table A-11
GSO C-Band Telemetry Links	Table A-12
MEO C-Band Command Links - On - Station Planar Array	Table A-13
MEO C-Band Command Links - On - Station Pipe Antenna	Table A-14
MEO C-Band Telemetry Links	Table A-15

Table A-2. GSO Portable V-Band Link

GSO Portable Clear Conditions

SUMMARY of Uplink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	50.0			GHz
Link			99.0	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			5256	minutes
CDMA Chip Rate	81.9			Mcps
User Data Rate	2.0			Mbps
Coded Data Rate	3.4			Mcbps
Array Power	10.0			W
Transmitter Pwr	10.0			dBW
Power Back-off	1.0		1.0	dB
# of Amplified Carriers	1.0			
Transmitter Losses	0.5			dB
Antenna	0.3			m
Min. Antenna Gain	33.2			dBi
EIRP per carrier		41.7	41.7	dBW
Point./Pol. Loss		0.5	0.5	dB
GEO Slant Range	38182			km
Space Loss		218.1	218.1	dB
Atm. Gas Att.		3.6	3.8	dB
Cloud Att.		2.6	2.6	dB
Rain			8.4	dB
Sat. Antenna Gain	52.5			dBi
System Noise Temp	649.2			°K
System Noise Temp	28.1			dBK
Satellite G/T		24.4	24.4	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		69.9	61.3	dB/Hz

SUMMARY of Downlink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	40.0			GHz
Link			99.0	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			5256	minutes
Chip Rate	81.9			Mcps
User Data Rate	2.0			Mbps
Coded Data Rate	3.4			Mcbps
Satellite TWTA	100.0			W
Sat. Transmit Power	20.0			dBW
Sat. HPA Backoff	2.0			dB
# of FDM Carriers/HPA	3.0			
# CDMA/FDMA Band	12.0			
Transmitter Losses	0.5			dB
Sat Min. Ant. Gain	53.0			dBi
EIRP of D/L Beam	70.5			dBW
EIRP/ FDM carrier	65.7			
EIRP per CDMA User		54.9	54.9	dBW
GEO Slant Range	38182			km
Space Loss		216.1	216.1	dB
Atm. Gas Att.		1.0	2.9	dB
Cloud Att.		1.7	1.7	dB
Rain			6.9	dB
Ant. Pointing		0.5	0.5	dB
Peak Antenna Gain	31.5			dBi
Receiver Sys. Temp.	334.8		527.3	°K
Receiver Sys. Temp.	25.2		27.2	dBK
Station G/T		5.8	3.8	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		69.9	59.2	dB/Hz

Regenerative Payload

Uplink	Clear		Rain	Units
Uplink Total C/I	8.6			dB
C/Io		88.2	88.2	dB/Hz
Available C/(No+Io)		69.9	61.3	dB/Hz
Available Eb/(No+Io)		6.8	-1.8	dB
Required Eb/No		6.0	6.0	dB
Total Uplink		0.8	-7.8	dB

Downlink	Clear		Rain	Units
Downlink Total C/I	8.6			dB
C/Io		88.3	79.6	dB/Hz
Available C/(No+Io)		69.9	59.1	dB/Hz
Available Eb/(No+Io)		6.8	-4.0	dB
Required Eb/No		6.0	6.0	dB
Total Downlink		0.8	-10.0	dB

Table A-3. GSO Mobile V-Band Link

GSO Mobile Clear Conditions

SUMMARY of Uplink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	50.0			GHz
Link			99.0	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			5256	minutes
CDMA Chip Rate	81.9			Mcps
User Data Rate	8.2			Mbps
Coded Data Rate	13.7			Mcbps
Array Power	12.0			W
Transmitter Pwr	10.8			dBW
Power Back-off	1.0		1.0	dB
# of Amplified Carriers	1.0			
Transmitter Losses	0.5			dB
Antenna	0.6			m
Min. Antenna Gain	39.2			dBi
EIRP per carrier		48.5	48.5	dBW
Point./Pol. Loss		0.5	0.5	dB
GEO Slant Range	38182			km
Space Loss		218.1	218.1	dB
Atm. Gas Att.		3.6	3.8	dB
Cloud Att.		2.6	2.6	dB
Rain			8.4	dB
Sat. Antenna Gain	52.5			dBi
System Noise Temp	649.2			°K
System Noise Temp	28.1			dBK
Satellite G/T		24.4	24.4	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		76.7	68.1	dB/Hz

SUMMARY of Downlink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	40.0			GHz
Link			99.0	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			5256	minutes
Chip Rate	81.9			Mcps
User Data Rate	8.2			Mbps
Coded Data Rate	13.7			Mcbps
Satellite TWTA	100.0			W
Sat. Transmit Power	20.0			dBW
Sat. HPA Backoff	2.0			dB
# of FDM Carriers/HPA	3.0			
# CDMA/FDMA Band	6.0			
Transmitter Losses	0.5			dB
Sat Min. Ant. Gain	53.0			dBi
EIRP of D/L Beam	70.5			dBW
EIRP/FDM carrier	65.7			
EIRP per CDMA User		57.9	57.9	dBW
GEO Slant Range	38182			km
Space Loss		216.1	216.1	dB
Atm. Gas Att.		1.0	2.9	dB
Cloud Att.		1.7	1.7	dB
Rain			6.9	dB
Ant. Pointing		0.5	0.5	dB
Peak Antenna Gain	37.5			dBi
Receiver Sys. Temp.	334.8		527.3	°K
Receiver Sys. Temp.	25.2		27.2	dBK
Station G/T		11.8	9.8	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		78.9	68.2	dB/Hz

Regenerative Payload

Uplink	Clear		Rain	Units
Uplink Total C/I	7.1			dB
C/Io		86.6	86.6	dB/Hz
Available C/(No+Io)		76.3	68.0	dB/Hz
Available Eb/(No+Io)		7.2	-1.1	dB
Required Eb/No		6.0	6.0	dB
Total Uplink		1.2	-7.1	dB

Downlink	Clear		Rain	Units
Downlink Total C/I	7.1			dB
C/Io		86.7	79.6	dB/Hz
Available C/(No+Io)		78.3	67.9	dB/Hz
Available Eb/(No+Io)		9.1	-1.3	dB
Required Eb/No		6.0	6.0	dB
Total Downlink		3.1	-7.3	dB

Table A-4. MEO Portable V-Band Link

MEO Portable Clear Conditions									
SUMMARY of Uplink					SUMMARY of Downlink				
	Clear		Rain	Units		Clear		Rain	Units
Site Elevation	35.0			deg	Site Elevation	35.0			deg
Site Altitude (ASL)				km	Site Altitude (ASL)				km
Frequency	50.0			GHz	Frequency	40.0			GHz
Link			99.0	%	Link			99.0	%
Rain Model Used			CCIR		Rain Model Used			CCIR	
CCIR Rain Region			K		CCIR Rain Region			K	
Average Outage/Yr.			5256	minutes	Average Outage/Yr.			5256	minutes
CDMA Chip Rate	81.9			Mcps	Chip Rate	81.9			Mcps
User Data Rate	1.5			Mbps	User Data Rate	1.5			Mbps
Coded Data Rate	2.5			Mcbps	Coded Data Rate	2.5			Mcbps
Array Power	10.0			W	Satellite TWTA	50.0			W
Transmitter Pwr	10.0			dBW	Sat. Transmit Power	17.0			dBW
Power Back-off	1.0		1.0	dB	Sat. HPA Backoff	2.0			dB
# of Amplified Carriers	1.0				# of FDM Carriers/HPA	3.0			
Transmitter Losses	0.5			dB	# CDMA/FDMA Band	6.0			
Antenna	0.3			m	Transmitter Losses	0.5			dB
Min. Antenna Gain	33.2			dBi	Sat Min. Ant. Gain	41.3			dBi
EIRP per carrier		41.7	41.7	dBW	EIRP of D/L Beam	55.8			dBW
					EIRP/ FDM carrier	51.0			
Point./Pol. Loss		0.5	0.5	dB	EIRP per CDMA User		43.2	43.2	dBW
MEO Slant Range	12391			km	MEO Slant Range	12391			km
Space Loss		208.3	208.3	dB	Space Loss		206.3	206.3	dB
Atm. Gas Att.		3.6	3.8	dB	Atm. Gas Att.		1.0	2.9	dB
Cloud Att.		2.6	2.6	dB	Cloud Att.		1.7	1.7	dB
Rain			8.4	dB	Rain			6.9	dB
					Ant. Pointing		0.5	0.5	dB
Sat. Antenna Gain	40.8			dBi	Peak Antenna Gain	31.5			dBi
System Noise Temp	649.2			°K	Receiver Sys. Temp.	334.8		527.3	°K
System Noise Temp	28.1			dBK	Receiver Sys. Temp.	25.2		27.2	dBK
Satellite G/T		12.7	12.7	dB/K	Station G/T		5.8	3.8	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz	Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz	Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz	Noise BW	79.5			dBHz
Available C/No		68.0	59.4	dB/Hz	Available C/No		68.0	57.2	dB/Hz
Regenerative Payload									
Uplink					Downlink				
	Clear		Rain	Units		Clear		Rain	Units
Uplink Total C/I	10.0			dB	Downlink Total C/I	10.0			dB
C/Io		89.6	89.6	dB/Hz	C/Io		89.7	79.6	dB/Hz
Available C/(No+Io)		68.0	59.4	dB/Hz	Available C/(No+Io)		68.0	57.2	dB/Hz
Available Eb/(No+Io)		6.2	-2.4	dB	Available Eb/(No+Io)		6.2	-4.6	dB
Required Eb/No		6.0	6.0	dB	Required Eb/No		6.0	6.0	dB
Total Uplink		0.2	-8.4	dB	Total Downlink		0.2	-10.6	dB

Table A-5. MEO Mobile V-Band Link

MEO Mobile Clear Conditions

SUMMARY of Uplink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	50.0			GHz
Link			99.0	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			5256	minutes
CDMA Chip Rate	81.9			Mcps
User Data Rate	6.0			Mbps
Coded Data Rate	10.0			Mcbps
Array Power	12.0			W
Transmitter Pwr	10.8			dBW
Power Back-off	1.0		1.0	dB
# of Amplified Carriers	1.0			
Transmitter Losses	0.5			dB
Antenna	0.6			m
Min. Antenna Gain	39.2			dBi
EIRP per carrier		48.5	48.5	dBW
Point./Pol. Loss		0.5	0.5	dB
MEO Slant Range	12391			km
Space Loss		208.3	208.3	dB
Atm. Gas Att.		3.6	3.8	dB
Cloud Att.		2.6	2.6	dB
Rain			8.4	dB
Sat. Antenna Gain	40.8			dBi
System Noise Temp	649.2			°K
System Noise Temp	28.1			dBK
Satellite G/T		12.7	12.7	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		74.8	66.2	dB/Hz

SUMMARY of Downlink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	40.0			GHz
Link			99.0	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			5256	minutes
Chip Rate	81.9			Mcps
User Data Rate	6.0			Mbps
Coded Data Rate	10.0			Mcbps
Satellite TWTA	50.0			W
Sat. Transmit Power	17.0			dBW
Sat. HPA Backoff	2.0			dB
# of FDM Carriers/HPA	3.0			
# CDMA/FDMA Band	5.0			
Transmitter Losses	0.5			dB
Sat Min. Ant. Gain	41.3			dBi
EIRP of D/L Beam	55.8			dBW
EIRP/ FDM carrier	51.0			
EIRP per CDMA User		44.0	44.0	dBW
MEO Slant Range	12391			km
Space Loss		206.3	206.3	dB
Atm. Gas Att.		1.0	2.9	dB
Cloud Att.		1.7	1.7	dB
Rain			6.9	dB
Ant. Pointing		0.5	0.5	dB
Peak Antenna Gain	37.5			dBi
Receiver Sys. Temp.	334.8		527.3	°K
Receiver Sys. Temp.	25.2		27.2	dBK
Station G/T		11.8	9.8	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		74.8	64.0	dB/Hz

Regenerative Payload

Uplink	Clear		Rain	Units
Uplink Total C/I	8.2			dB
C/Io		87.8	87.8	dB/Hz
Available C/(No+Io)		74.6	66.1	dB/Hz
Available Eb/(No+Io)		6.8	-1.6	dB
Required Eb/No		6.0	6.0	dB
Total Uplink		0.8	-7.6	dB

Downlink	Clear		Rain	Units
Downlink Total C/I	8.2			dB
C/Io		87.9	79.6	dB/Hz
Available C/(No+Io)		74.6	63.9	dB/Hz
Available Eb/(No+Io)		6.8	-3.9	dB
Required Eb/No		6.0	6.0	dB
Total Downlink		0.8	-9.9	dB

Table A-6. GSO Portable V-Band Link In Rain

GSO Portable Rain Conditions

SUMMARY of Uplink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	50.0			GHz
Link			98.4	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			8410	minutes
CDMA Chip Rate	81.9			Mcps
User Data Rate	0.5			Mbps
Coded Data Rate	0.9			Mcbps
Array Power	10.0			W
Transmitter Pwr	10.0			dBW
Power Back-off	1.0		1.0	dB
# of Amplified Carriers	1.0			
Transmitter Losses	0.5			dB
Antenna	0.3			m
Min. Antenna Gain	33.2			dBi
EIRP per carrier		41.7	41.7	dBW
Point./Pol. Loss		0.5	0.5	dB
GEO Slant Range	38182			km
Space Loss		218.1	218.1	dB
Atm. Gas Att.		3.6	3.8	dB
Cloud Att.		2.6	2.6	dB
Rain			6.5	dB
Sat. Antenna Gain	52.5			dBi
System Noise Temp	649.2			°K
System Noise Temp	28.1			dBK
Satellite G/T		24.4	24.4	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		69.9	63.2	dB/Hz

SUMMARY of Downlink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	40.0			GHz
Link			96.4	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			18922	minutes
Chip Rate	81.9			Mcps
User Data Rate	0.5			Mbps
Coded Data Rate	0.9			Mcbps
Satellite TWTA	100.0			W
Sat. Transmit Power	20.0			dBW
Sat. HPA Backoff	2.0			dB
# of FDM Carriers/HPA	3.0			
# CDMA/FDMA Band	12.0			
Transmitter Losses	0.5			dB
Sat Min. Ant. Gain	53.0			dBi
EIRP of D/L Beam	70.5			dBW
EIRP/ FDM carrier	65.7			
EIRP per CDMA User		54.9	54.9	dBW
GEO Slant Range	38182			km
Space Loss		216.1	216.1	dB
Atm. Gas Att.		1.0	2.9	dB
Cloud Att.		1.7	1.7	dB
Rain			3.3	dB
Ant. Pointing		0.5	0.5	dB
Peak Antenna Gain	31.5			dBi
Receiver Sys. Temp.	334.8		466.8	°K
Receiver Sys. Temp.	25.2		26.7	dBK
Station G/T		5.8	4.3	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		69.9	63.3	dB/Hz

Regenerative Payload

Uplink	Clear		Rain	Units
Uplink Total C/I	10.4			dB
C/Io		89.9	89.9	dB/Hz
Available C/(No+Io)		69.9	63.2	dB/Hz
Available Eb/(No+Io)		12.8	6.1	dB
Required Eb/No		6.0	6.0	dB
Total Uplink		6.8	0.1	dB

Downlink	Clear		Rain	Units
Downlink Total C/I	10.4			dB
C/Io		90.0	79.6	dB/Hz
Available C/(No+Io)		69.9	63.2	dB/Hz
Available Eb/(No+Io)		12.8	6.1	dB
Required Eb/No		6.0	6.0	dB
Total Downlink		6.8	0.1	dB

Table A-7. GSO Mobile V-Band Link In Rain

GSO Mobile Rain Conditions

SUMMARY of Uplink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	50.0			GHz
Link			98.7	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			6833	minutes
CDMA Chip Rate	81.9			Mcps
User Data Rate	2.0			Mbps
Coded Data Rate	3.4			Mcbps
Array Power	12.0			W
Transmitter Pwr	10.8			dBW
Power Back-off	1.0		1.0	dB
# of Amplified Carriers	1.0			
Transmitter Losses	0.5			dB
Antenna	0.6			m
Min. Antenna Gain	39.2			dBi
EIRP per carrier		48.5	48.5	dBW
Point./Pol. Loss		0.5	0.5	dB
GEO Slant Range	38182			km
Space Loss		218.1	218.1	dB
Atm. Gas Att.		3.6	3.8	dB
Cloud Att.		2.6	2.6	dB
Rain			7.3	dB
Sat. Antenna Gain	52.5			dBi
System Noise Temp	649.2			°K
System Noise Temp	28.1			dBK
Satellite G/T		24.4	24.4	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		76.7	69.2	dB/Hz

SUMMARY of Downlink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	40.0			GHz
Link			98.5	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			7884	minutes
Chip Rate	81.9			Mcps
User Data Rate	2.0			Mbps
Coded Data Rate	3.4			Mcbps
Satellite TWTA	100.0			W
Sat. Transmit Power	20.0			dBW
Sat. HPA Backoff	2.0			dB
# of FDM Carriers/HPA	3.0			
# CDMA/FDMA Band	6.0			
Transmitter Losses	0.5			dB
Sat Min. Ant. Gain	53.0			dBi
EIRP of D/L Beam	70.5			dBW
EIRP/ FDM carrier	65.7			
EIRP per CDMA User		57.9	57.9	dBW
GEO Slant Range	38182			km
Space Loss		216.1	216.1	dB
Atm. Gas Att.		1.0	2.9	dB
Cloud Att.		1.7	1.7	dB
Rain			5.5	dB
Ant. Pointing		0.5	0.5	dB
Peak Antenna Gain	37.5			dBi
Receiver Sys. Temp.	334.8		509.5	°K
Receiver Sys. Temp.	25.2		27.1	dBK
Station G/T		11.8	9.9	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		78.9	69.7	dB/Hz

Regenerative Payload

Uplink	Clear		Rain	Units
Uplink Total C/I	9.7			dB
C/Io		89.3	89.3	dB/Hz
Available C/(No+Io)		76.5	69.2	dB/Hz
Available Eb/(No+Io)		13.4	6.1	dB
Required Eb/No		6.0	6.0	dB
Total Uplink		7.4	0.1	dB

Downlink	Clear		Rain	Units
Downlink Total C/I	9.7			dB
C/Io		89.4	79.6	dB/Hz
Available C/(No+Io)		78.6	69.3	dB/Hz
Available Eb/(No+Io)		15.5	6.2	dB
Required Eb/No		6.0	6.0	dB
Total Downlink		9.5	0.2	dB

Table A-8. MEO Portable V-Band Link In Rain

MEO Portable Rain Conditions

SUMMARY of Uplink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	50.0			GHz
Link			98.2	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			9461	minutes
CDMA Chip Rate	81.9			Mcps
User Data Rate	0.4			Mbps
Coded Data Rate	0.6			Mcbps
Array Power	10.0			W
Transmitter Pwr	10.0			dBW
Power Back-off	1.0		1.0	dB
# of Amplified Carriers	1.0			
Transmitter Losses	0.5			dB
Antenna	0.3			m
Min. Antenna Gain	33.2			dBi
EIRP per carrier		41.7	41.7	dBW
Point./Pol. Loss		0.5	0.5	dB
MEO Slant Range	12391			km
Space Loss		208.3	208.3	dB
Atm. Gas Att.		3.6	3.8	dB
Cloud Att.		2.6	2.6	dB
Rain			6.0	dB
Sat. Antenna Gain	40.8			dBi
System Noise Temp	649.2			°K
System Noise Temp	28.1			dBK
Satellite G/T		12.7	12.7	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		68.0	61.7	dB/Hz

SUMMARY of Downlink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	40.0			GHz
Link			95.4	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			24178	minutes
Chip Rate	81.9			Mcps
User Data Rate	0.4			Mbps
Coded Data Rate	0.6			Mcbps
Satellite TWTA	50.0			W
Sat. Transmit Power	17.0			dBW
Sat. HPA Backoff	2.0			dB
# of FDM Carriers/HPA	3.0			
# CDMA/FDMA Band	6.0			
Transmitter Losses	0.5			dB
Sat Min. Ant. Gain	41.3			dBi
EIRP of D/L Beam	55.8			dBW
EIRP/ FDM carrier	51.0			
EIRP per CDMA User		43.2	43.2	dBW
MEO Slant Range	12391			km
Space Loss		206.3	206.3	dB
Atm. Gas Att.		1.0	2.9	dB
Cloud Att.		1.7	1.7	dB
Rain			2.9	dB
Ant. Pointing		0.5	0.5	dB
Peak Antenna Gain	31.5			dBi
Receiver Sys. Temp.	334.8		455.0	°K
Receiver Sys. Temp.	25.2		26.6	dBK
Station G/T		5.8	4.4	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		68.0	61.9	dB/Hz

Regenerative Payload

Uplink	Clear		Rain	Units
Uplink Total C/I	10.8			dB
C/Io		90.4	90.4	dB/Hz
Available C/(No+Io)		68.0	61.7	dB/Hz
Available Eb/(No+Io)		12.3	6.0	dB
Required Eb/No		6.0	6.0	dB
Total Uplink		6.3	0.0	dB

Downlink	Clear		Rain	Units
Downlink Total C/I	10.8			dB
C/Io		90.5	79.6	dB/Hz
Available C/(No+Io)		68.0	61.8	dB/Hz
Available Eb/(No+Io)		12.2	6.1	dB
Required Eb/No		6.0	6.0	dB
Total Downlink		6.2	0.1	dB

Table A-9. MEO Mobile V-Band Link In Rain

MEO Mobile Rain Conditions

SUMMARY of Uplink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	50.0			GHz
Link			98.5	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			7884	minutes
CDMA Chip Rate	81.9			Mcps
User Data Rate	1.5			Mbps
Coded Data Rate	2.5			Mcbps
Array Power	12.0			W
Transmitter Pwr	10.8			dBW
Power Back-off	1.0		1.0	dB
# of Amplified Carriers	1.0			
Transmitter Losses	0.5			dB
Antenna	0.6			m
Min. Antenna Gain	39.2			dBi
EIRP per carrier		48.5	48.5	dBW
Point./Pol. Loss		0.5	0.5	dB
MEO Slant Range	12391			km
Space Loss		208.3	208.3	dB
Atm. Gas Att.		3.6	3.8	dB
Cloud Att.		2.6	2.6	dB
Rain			6.7	dB
Sat. Antenna Gain	40.8			dBi
System Noise Temp	649.2			°K
System Noise Temp	28.1			dBK
Satellite G/T		12.7	12.7	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		74.8	67.9	dB/Hz

SUMMARY of Downlink	Clear		Rain	Units
Site Elevation	35.0			deg
Site Altitude (ASL)				km
Frequency	40.0			GHz
Link			96.4	%
Rain Model Used			CCIR	
CCIR Rain Region			K	
Average Outage/Yr.			18922	minutes
Chip Rate	81.9			Mcps
User Data Rate	1.5			Mbps
Coded Data Rate	2.5			Mcbps
Satellite TWTA	50.0			W
Sat. Transmit Power	17.0			dBW
Sat. HPA Backoff	2.0			dB
# of FDM Carriers/HPA	3.0			
# CDMA/FDMA Band	5.0			
Transmitter Losses	0.5			dB
Sat Min. Ant. Gain	41.3			dBi
EIRP of D/L Beam	55.8			dBW
EIRP/ FDM carrier	51.0			
EIRP per CDMA User		44.0	44.0	dBW
MEO Slant Range	12391			km
Space Loss		206.3	206.3	dB
Atm. Gas Att.		1.0	2.9	dB
Cloud Att.		1.7	1.7	dB
Rain			3.3	dB
Ant. Pointing		0.5	0.5	dB
Peak Antenna Gain	37.5			dBi
Receiver Sys. Temp.	334.8		466.8	°K
Receiver Sys. Temp.	25.2		26.7	dBK
Station G/T		11.8	10.3	dB/K
Boltzmann's		-228.6	-228.6	dBW/K-Hz
Detection Bandwidth	90.1			MHz
Noise BW	79.5			dBHz
Available C/No		74.8	68.1	dB/Hz

Regenerative Payload

Uplink	Clear		Rain	Units
Uplink Total C/I	10.2			dB
C/Io		89.8	89.8	dB/Hz
Available C/(No+Io)		74.7	67.8	dB/Hz
Available Eb/(No+Io)		12.9	6.1	dB
Required Eb/No		6.0	6.0	dB
Total Uplink		6.9	0.1	dB

Downlink	Clear		Rain	Units
Downlink Total C/I	10.2			dB
C/Io		89.9	79.6	dB/Hz
Available C/(No+Io)		74.7	67.8	dB/Hz
Available Eb/(No+Io)		12.9	6.1	dB
Required Eb/No		6.0	6.0	dB
Total Downlink		6.9	0.1	dB

Table A-10. GSO C-Band Command Links - On - Station Planar Array

Contribution	Value	Note/Link Parameter
Command Uplink Frequency, GHz	6.523	Wavelength, m=0.046
Max Ground Station EIRP ,dBW	79.0	11 m antenna
Space Loss, dB-m^2	-200.3	40° elevation
Max Slant Range, Km		**37,781**
Clear sky loss, dB	-0.1	
Pointing error, dB	-0.1	
Spacecraft Reflector Gain, dB	25.0	Scaled from USDBS
Polarization Loss, dB	-0.1	
Path Loss to CR, dB	-16.3	
Power at TCR input, dBW	-112.9	
CR command threshold,dBW	-135.0	
Command margin,dB	22.1	
Command margin with rain fade,dB	20.6	99.95% availability

Table A-11. GSO C-Band Command Links - On - Station Pipe Antenna

Contribution	Value	Note/Link Parameter
Command Uplink Frequency, GHz	6.524	Wavelength, m=0.046
Max Ground Station EIRP ,dBW	79.0	11 m antenna
Space Loss, dB-m^2	-200.3	40° elevation
Max Slant Range, Km		**37,781**
Clear Sky Loss, dB	-0.1	
Pointing Error, dB	-0.1	
Pipe Antenna Gain, dB	2.0	On-axis C-band
Polarization Loss, dB	-0.1	
Path Loss to CR, dB	-6.3	
Power at TCR Input, dBW	-125.9	
CR command Threshold,dBW	-135.0	
Command Margin,dB	9.1	
Command Margin with Rain Fade,dB	7.6	99.95% availability

Table A-12. GSO C-Band Telemetry Links

Parameter	Spot Antenna	Omni Pipe	Comments
Telemetry Downlink Frequency, GHz	3.699	3.698	Wavelength, m=0.081
Minimum EIRP, dBW	8.0	0.0	Estimate
Space Loss, dB/m^{-2}	-195.3	-195.3	40° elevation; Max Slant Range, Km=37,781
Atmospheric Absorption, dB	-0.1	-0.1	Estimate; Clear Sky
Ground Station G/T, dB/K	33.2	33.2	11 m Antenna
Polarization Mismatch, dB	0.0	0.0	Assume Ground Station Receives Linear Polarization
Boltzmann's Constant, dBW/°K-Hz	-228.6	-228.6	
Downlink C/No. @ TM Receiver, dB-Hz	74.4	66.4	
Minimum C/No @ TM Receiver, dB-Hz	53.0	53.0	For 4 Kbps Stream
Clear Weather C/No Margin, dB	21.4	13.4	0.7 dB Fade 99.95% Availability
S/No Computation for Ranging:			
Receiver Baseband S/No, dB-Hz	69.1	61.1	
Carrier Recovery:			
TM Receiver Loop Bandwidth, dB-Hz	40.0	40.0	10 KHz PM demod PLL BW
Margin, dB	25.2	17.2	
Subcarrier Recovery:			
TM Receiver IF Bandwidth, dB-Hz	57.0	57.0	500 KHz BW
Margin, dB	27.1	19.1	
BER Computation:			
Demodulation Loss ($2J1^2(0.85)$), dB	-5.2	-5.2	
PM Demodulator Loss, dB	-1.0	-1.0	
Bit Sync Loss, dB	-1.5	-1.5	
Received Baseband S/No, dB-Hz	66.6	58.6	
Eb/No, dB-Hz	30.6	22.6	For 4 Kbps Stream
Minimum Eb/No for 10^6 BER, dB-Hz	10.5	10.5	Coherent PSK
Margin, dB	20.1	12.1	

Table A-13. MEO C-Band Command Links - On - Station Planar Array

Contribution	Value	Note/Link Parameter
Command Uplink Frequency, GHz	6.426	Wavelength, m=0.047
Max Ground Station EIRP ,dBW	77.0	9 m antenna
Space Loss, dB-m^2	-190.6	30° elevation
Max Slant Range, Km		12,601
Clear Sky Loss, dB	-0.1	
Pointing Error, dB	-0.1	
Pipe Antenna Gain, dB	25.0	
Polarization Loss, dB	-0.1	
Path Loss to CR, dB	-16.3	
Power at TCR Input, dBW	-105.2	
CR command Threshold,dBW	-135.0	
Command Margin,dB	29.8	
Command Margin with Rain Fade,dB	28.3	99.95% Availability

Table A-14. MEO C-Band Command Links - On - Station Pipe Antenna

Contribution	Value	Note/Link Parameter
Command Uplink Frequency, GHz	6.427	Wavelength, m=0.047
Max Ground Station EIRP ,dBW	77.0	9 m antenna
Space Loss, dB-m^2	-190.6	30° elevation
		Max Slant Range, Km=12,601
Clear Sky Loss, dB	-0.1	
Pointing Error, dB	-0.1	
Pipe Antenna Gain, dB	2.0	
Polarization Loss, dB	-0.1	
Path Loss to CR, dB	-6.3	
Power at TCR Input, dBW	-118.2	
CR command Threshold,dBW	-135.0	
Command Margin,dB	16.8	
Command Margin with Rain Fade,dB	15.3	99.95% Availability

Table A-15. MEO C-Band Telemetry Links

Parameter	Spot Antenna	Omni Pipe	Comments
Telemetry Downlink Frequency, GHz	3.601	3.602	Wavelength, m=0.083
Minimum EIRP, dBW	8.0	0.0	
Space Loss, dB/m^{-2}	-185.6	-185.6	30° elevation; Max Slant Range, Km=12,601
Atmospheric Absorption, dB	-0.1	-0.1	Clear Sky
Ground Station G/T, dB/°K	31.0	31.0	9 m Antenna
Polarization Mismatch, dB	0.0	0.0	Assume Ground Station Receives Linear Polarization
Boltzmann's Constant, dBW/°K-Hz	-228.6	-228.6	
Downlink C/No. @ TM Receiver, dB-Hz	81.8	73.8	
Minimum C/No @ TM Receiver, dB-Hz	53.0	53.0	For 4 Kb/s Stream
Clear Weather C/No Margin, dB	28.8	20.8	0.7 dB Fade 99.95% Availability
S/No Computation for Ranging:			
Receiver Baseband S/No, dB-Hz	76.6	68.6	
Carrier Recovery:			
TLM Receiver Loop Bandwidth, dB-Hz	40.0	40.0	10 KHz PM demod PLL BW
Margin, dB	32.7	24.7	
Subcarrier Recovery:			
TLM Receiver IF Bandwidth, dB-Hz	57.0	57.0	500 KHz BW
Margin, dB	34.6	26.6	
BER Computation:			
Demodulation Loss ($2J1^2(0.85)$), dB	-5.2	-5.2	
PM Demodulator Loss, dB	-1.0	-1.0	
Bit Sync Loss, dB	-1.5	-1.5	
Received Baseband S/No, dB-Hz	74.1	66.1	
Eb/No, dB-Hz	38.1	30.1	For 4 Kbps Telemetry Data
Minimum Eb/No for 10^6 BER, dB-Hz	10.5	10.5	Coherent PSK
Margin, dB	27.6	19.6	

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Appendix B
Interference Analysis

APPENDIX B: INTERFERENCE ANALYSIS

Sharing criteria and results of interference analyses between StarLynx™ and other systems are presented in this section. The four subsections show (1) system parameters, (2) C/I results, (3) satellite diversity analyses, and (4) intra-service sharing, respectively.

For the following cases: (1) GSO into NGSO uplink, (2) GSO into NGSO downlink, (3) NGSO into GSO uplink, and (4) NGSO into GSO downlink, the worst-case interference is due to the transmission from a GSO-system uplink to an NGSO system. Figure B-1 provides an illustration of these four cases.

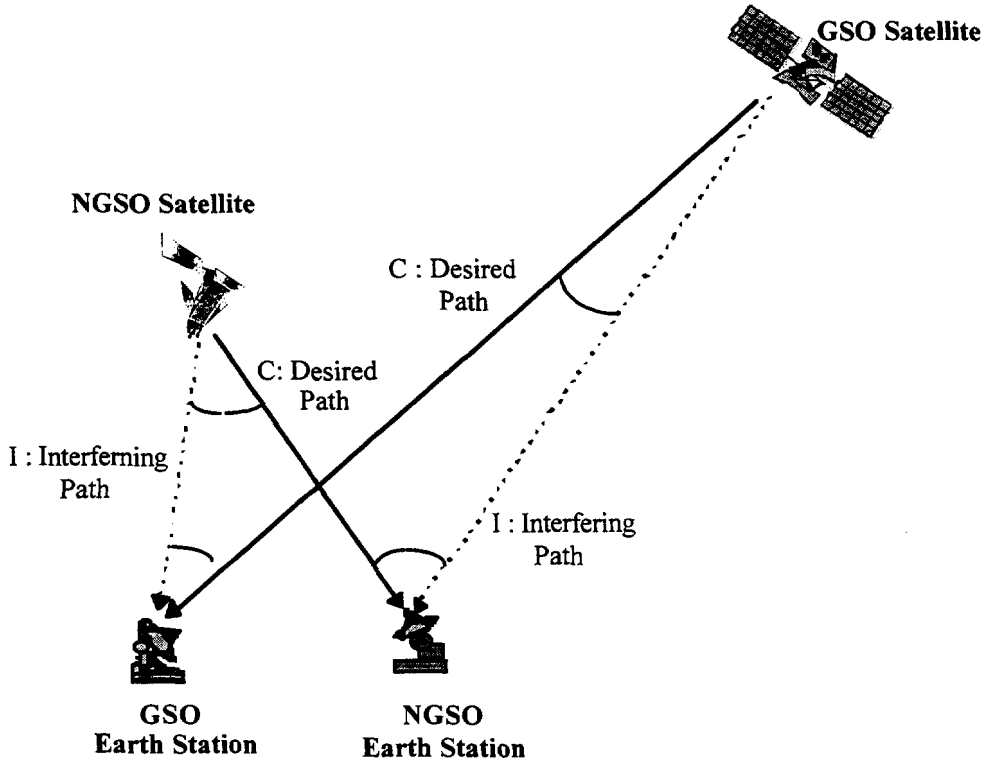

Figure B-1. Example of Interference Between a GSO and an NGSO System

B.1. System Parameters Used in Simulation

Table B-1. StarLynx™ GSO and Expressway™ Link Parameters

SYSTEM PARAMETER TABLE			StarLynx™ GSO vs Expressway™		
	UPLINK		DOWNLINK		
LINK PARAMETER	Expressway™	StarLynx™ GSO	Expressway™	StarLynx™ GSO	UNITS
Spacial Separation	2		2		deg.
Signal frequency	46	46	38	38	GHz
Tx Power (Earth/Satellite)	30	10	100	100	W
Tx HPA Backoff	3	1	2	2	dB
Tx Losses	0.5	0.5	1	0.5	dB
Number of Carriers	1	1	10	36	
Slant Range	37,000	37,000	37,000	37,000	km
Earth-Station Tx Antenna Size	2.5	0.3			m
Earth-Station Rx Antenna Size			2.5	0.3	m
Earth-Station Tx Ant. Peak Gain	59.4	33.2			dBi
Earth-Station Rx Ant. Peak Gain			57.7	31.5	dBi
Satellite Tx Ant. Peak Gain			52	56	dBi
Satellite Rx Ant. Peak Gain	52	56			dBi
Band Width of Signal	285	90	285	90	MHz
Rx Noise Temperature	650	650	450	335	K

Table B-2. StarLynx™ MEO and Expressway™ Link Parameters

SYSTEM PARAMETER TABLE			StarLynx™ MEO vs Expressway™		
	UPLINK		DOWNLINK		
LINK PARAMETER	Expressway™	StarLynx™ MEO	Expressway™	StarLynx™ MEO	UNITS
Spacial Separation	2		2		deg.
Signal frequency	46	46	38	38	GHz
Tx Power (Earth/Satellite)	30	10	100	50	W
Tx HPA Backoff	3	1	2	2	dB
Tx Losses	0.5	0.5	1	0.5	dB
Number of Carriers	1	1	10	18	
Slant Range	37,000	10,500	37,000	10,500	km
Earth-Station Tx Antenna Size	2.5	0.3			m
Earth-Station Rx Antenna Size			2.5	0.3	m
Earth-Station Tx Ant. Peak Gain	59.4	33.2			dBi
Earth-Station Rx Ant. Peak Gain			57.7	31.5	dBi
Satellite Tx Ant. Peak Gain			52	44.3	dBi
Satellite Rx Ant. Peak Gain	52	44.3			dBi
Band Width of Signal	285	90	285	90	MHz
Rx Noise Temperature	650	650	450	335	K

Table B-3. StarLynx™ GSO and StarLynx™ MEO Link Parameters

SYSTEM PARAMETER TABLE			StarLynx™ GSO vs StarLynx™ MEO		
	UPLINK		DOWNLINK		
LINK PARAMETER	StarLynx™ MEO	StarLynx™ GSO	StarLynx™ MEO	StarLynx™ GSO	UNITS
Spacial Separation	2		2		deg.
Signal frequency	46	46	38	38	GHz
Tx Power (Earth/Satellite)	10	10	50	100	W
Tx HPA Backoff	1	1	2	2	dB
Tx Losses	0.5	0.5	0.5	0.5	dB
Number of Carriers	1	1	18	36	
Slant Range	10,500	37,000	10,500	37,000	km
Earth-Station Tx Antenna Size	0.3	0.3			m
Earth-Station Rx Antenna Size			0.3	0.3	m
Earth-Station Tx Ant. Peak Gain	33.2	33.2			dBi
Earth-Station Rx Ant. Peak Gain			31.5	31.5	dBi
Satellite Tx Ant. Peak Gain			44.3	56	dBi
Satellite Rx Ant. Peak Gain	44.3	56			dBi
Band Width of Signal	90	90	90	90	MHz
Rx Noise Temperature	650	650	335	335	K

Table B-4. StarLynx™ GSO and StarLynx™ GSO Link Parameters

SYSTEM PARAMETER TABLE			StarLynx™ GSO vs StarLynx™ GSO		
	UPLINK		DOWNLINK		
LINK PARAMETER	StarLynx™ GSO	StarLynx™ GSO	StarLynx™ GSO	StarLynx™ GSO	UNITS
Spacial Separation	2		2		deg.
Signal frequency	46	46	38	38	GHz
Tx Power (Earth/Satellite)	10	10	100	100	W
Tx HPA Backoff	1	1	2	2	dB
Tx Losses	0.5	0.5	0.5	0.5	dB
Number of Carriers	1	1	36	36	
Slant Range	37,000	37,000	37,000	37,000	km
Earth-Station Tx Antenna Size	0.3	0.3			m
Earth-Station Rx Antenna Size			0.3	0.3	m
Earth-Station Tx Ant. Peak Gain	33.2	33.2			dBi
Earth-Station Rx Ant. Peak Gain			31.5	31.5	dBi
Satellite Tx Ant. Peak Gain			56	56	dBi
Satellite Rx Ant. Peak Gain	56	56			dBi
Band Width of Signal	90	90	90	90	MHz
Rx Noise Temperature	650	650	335	335	K