# 8. PROJECTED SYSTEM COST

Satellites within the StarLynx™ constellation will have a useful life of up to fifteen (15) years. The cost of developing, launching, and operating the StarLynx™ constellation for one year is estimated to be $2.871 billion. This investment covers the development and design cost for the satellite, ground infrastructure, and user antennas. It also covers the cost of building, launching, and insuring the satellites, and the associated ground infrastructure to manage, communicate, and operate the system for one year. Cost estimates for the StarLynx™ system are based on industry experience and projectsions. Customer equipment costs are not included. Table 8-1 provides detailed information on projected capital investment.

**Table 8-1. StarLynx™ Investment**

| Capital Expenditures | $M |
|---|---|
| • Research and Development | 535 |
| • Satellite Construction, Launch & Insurance | 2222 |
| • Ground Segment Construction | 104 |
| First Year Operating Costs | 10 |
| Total | $2,871 |

THIS PAGE INTENTIONALLY LEFT BLANK

## 9. FINANCIAL QUALIFICATIONS

Hughes Communications Inc. is an indirect wholly-owned subsidiary of Hughes Electronics Corporation (HE), a large aerospace, electronics manufacturing, and satellite communications company. HE, in turn, is an affiliate of General Motors Corporation (GM). Although the Commission has not yet established financial qualification requirements for MSS systems at V-band, as demonstrated in Appendix D, which shows the consolidated financial statements of HE, HE has sufficient current assets to fund the construction, launch, and first-year operating costs of the StarLynx™ satellite system.

THIS PAGE INTENTIONALLY LEFT BLANK

## 10. REQUEST FOR WAIVER OF THE COMMISSION'S RULES

HCI hereby requests a waiver of the Table of Frequency Allocations, 47 C.F.R. § 2.106, with respect to this application to allow StarLynx™ to provide Mobile-Satellite Service downlinks in the 37.5-38.6 GHz band (which, for satellite use, currently is allocated internationally only to the Fixed-Satellite Service[5]) and to provide Fixed-Satellite Service uplinks in a contiguous 1.1 GHz of spectrum in the 45.5-46.7 GHz band (which, for satellite use, currently is allocated only to the MSS and the Radionavigation-Satellite Service). As discussed above, HCI proposes to provide service to both mobile and portable customer terminals as part of the StarLynx™ satellite system. Service to and from the mobile terminals (which are capable of communicating while they are moving) falls within the definition of MSS.[6] Service to and from the portable terminals (which are not capable of

---

[5] The 37.5-40.5 GHz band has an international primary FSS allocation. While currently only the 38.6-40.0 GHz band has a domestic primary FSS allocation, in RM-8811 and IB Docket 97-95, the Commission is considering conforming the domestic allocation at 37.5-38.6 GHz with the international allocation for that band. HCI respectfully reserves the right to conform this application to reflect the outcome of those proceedings and/or any changes in the international Radio Regulations.

[6] *See* 47 C.F.R. § 2.1(c) ("Mobile-Satellite Service" and "Mobile Earth Station"); *Qualcomm, Inc.*, 4 FCC Rcd. 1543, ¶ 4 n. 7 (1989) ("mobile stations operate while moving"); *cf.* 47 C.F.R. § 20.7 (mobile satellite services include those provided over "terminals capable of transmitting while a platform is moving, but excluding satellite facilities provided through a transportable platform that cannot move when the communications service is offered").

communicating while they are moving) falls within the definition of FSS.[7] In addition to the communication links between the StarLynx™ constellation and these mobile and portable user terminals, HCI contemplates communication links between the StarLynx™ constellation and a limited number of 60 x 60 cm or larger antennas at fixed locations, which will serve as System Access Node terminals.[8]

HCI proposes to use the entire 37.5-38.6 GHz band for downlinks to any and all of the types of StarLynx™ Earth stations and to use a contiguous 1.1 GHz spectrum in the 45.5-46.7 GHz band for uplinks from any and all of the types of StarLynx™ user terminals. Due to the technological convergence of StarLynx™ FSS and MSS services, service to mobile and portable terminals in the same frequency bands can be provided without creating either unacceptable intra-StarLynx™ system interference or unacceptable interference to other satellite systems operating under the likely parameters of the FSS and the MSS at V-band.

As demonstrated in Appendix A, StarLynx™ downlink transmissions in the 37.5-38.6 GHz band, whether transmitted by the GSO or NGSO portions of the system, do not vary according to the type of terminal -- mobile, portable, or SAN -- that is the target of the transmission. Thus, downlink transmissions from any

---

[7] *See* 47 C.F.R. § 2.1(c) ("Fixed-Satellite Service"); *Qualcomm, Inc.*, 4 FCC Rcd. 1543, ¶¶ 4 n. 7, 8 n. 14 (1989) (transportable Earth stations operate from fixed locations although the sites from which they operate will vary as the stations are moved from location to location).

[8] While the transmissions to these System Access Node terminals fall within the definition of FSS (and therefore are consistent with the international allocation for the 37.5-38.6 GHz band), transmissions from these terminals are also permitted in the 45.5-46.7 MSS band as these terminals serve as feeder links for an MSS system. *See* 47 C.F.R. § 2.106 at 45.5-47.0 GHz, n. 903; 47 C.F.R. 2.1(c)

StarLynx™ satellite appear the same, and have the same interference potential, regardless of whether the StarLynx™ station that is receiving that downlink transmission is a portable (i.e. fixed) or mobile.[9] As demonstrated in Appendix B, downlink transmissions from the StarLynx™ system will be compatible with GSO systems spaced 2° away and with NGSO systems that are designed to employ spectrum sharing techniques. Therefore, the inclusion of the MSS capability to StarLynx™ in the downlink band via the mobile terminal does not create any additional interference potential from the StarLynx™ system downlinks that does not already exist by virtue of the FSS service capability.[10]

The same is true with respect to the inclusion of an FSS capability in the StarLynx™ 45.5-46.7 GHz uplink band. In fact, the uplink transmissions from the StarLynx™ portable terminal -- the terminal that presents the non-conforming, FSS use at 45.5-47.6 GHz -- yield a lesser potential for interference into a hypothetical, neighboring GSO MSS satellite than the MSS uplink transmissions which represent a conforming use of the band.[11] Uplink transmissions from the StarLynx™ mobile terminal will be compatible with a GSO MSS system that is spaced 2° away along the geostationary arc and that uses spectrally efficient uplink transmission technology similar to that used in StarLynx™, instead of the omnidirectional uplink

---

("Mobile-Satellite Service") ("This service may also include feeder links necessary for its operation.")

[9] *See* Appendix B.

[10] *See Geostar Positioning Corporation,* 4 FCC Rcd. 1543, 1544 (1989) (no reason to preclude MSS in FSS band when the downlink appears identical regardless of whether it is being received by fixed or mobile terminals).

[11] *See* Appendix B.

transmissions characterized by existing GSO MSS systems in other frequency bands. Therefore, the addition of FSS capability via the portable terminal does not create any interference potential beyond that which already exists by virtue of the StarLynx™ mobile terminal uplinks.[12]

Thus, HCI seeks a waiver of the Table of Allocations to transmit downlink signals to the StarLynx™ mobile terminals in the entire 37.5-38.6 GHz band and to transmit uplink signals from the StarLynx™ portable terminals in a contiguous 1.1 GHz in the 45.5-46.7 GHz band. In each case, HCI will operate the non-conforming transmissions on a no-harmful-interference basis in conformance with existing Commission policy and precedent.

The Commission's precedent clearly supports the grant of HCI's waiver. The Commission has in a number of instances, consistent with its general policy of flexibility in implementing its allocation table, permitted a non-conforming use of a frequency band where that use would not cause unacceptable interference to permitted users of that band.[13] For example, HCI's proposal to provide MSS in an

---

[12] Thus, this situation presents a much simpler technical case than the recent case where the Commission allowed MSS uplinks in an FSS band on a non-interference basis in analogous circumstances. *See Mobile Satellite-Based Communications by Crescomm Transmission Services, Inc. and Qualcomm, Inc.*, 11 FCC Rcd. 10944 (1996) (authorizing provision of maritime MSS in FSS bands on a secondary basis).

[13] *See id; Motorola Satellite Communications, Inc.*, 11 FCC Rcd. 13952, ¶¶ 10-11 (1996) (provision of FSS in MSS bands on a no-harmful-interference basis); *USA Today Sky Radio*, 7 FCC Rcd. 7943, ¶ 6 (1992) (provision of AMSS in FSS bands on a no-harmful-interference basis); *COMSAT and AMSC*, 5 FCC Rcd. 4117, 4118, ¶ 8 (1990) (provision of LMSS and AMSS in MMSS bands on a no-harmful-interference basis); *AMSC Authorization Order*, 4 FCC Rcd. 6041, 6048, ¶ 51 (1989) (provision of FSS in MSS bands on a non-interference basis); *Geostar Positioning*

FSS band is supported by the *Qualcomm* line of cases, where the Commission granted a waiver of the Table of Allocations to allow Qualcomm to transmit downlink signals to mobile user terminals in a frequency band allocated to the FSS.[14] In permitting Qualcomm's use of this FSS band on a non-interference basis for its OmniTRACS MSS system, the Commission emphasized that Qualcomm's downlink transmissions would appear identical to all ground stations, whether mobile or fixed, and that these transmissions would be consistent with the existing FSS policies and rules in the frequency band in question.[15]

HCI's proposal to provide FSS services via portable terminals in the MSS band is supported by *Motorola Satellite Communications, Inc.*, where the Commission, again granted a waiver of the Table of Allocations to permit non-conforming operations on a no-harmful-interference basis.[16] The Commission, following a similar ruling in *AMSC Authorization Order*,[17] allowed Motorola to provide

---

*Corp.*, 4 FCC Rcd. 4538, 4539, ¶ 5 (1989) (provision of RDSS in FSS bands on a non-interference basis); *Qualcomm, Inc.*, 4 FCC Rcd. 1543, 1544, ¶ 11 (1989) (provision of MSS in FSS bands on a non-interference basis); DBS Systems, 92 FCC 2d 64, 68, ¶ 4 (1982) ("the Commission generally allows non-conforming uses in appropriate situations"). Such waivers are consistent with Commission rule section 2.102 and international Radio Regulation 342. *See COMSAT and AMSC*, 5 FCC Rcd. 4117, 4118, ¶¶ 8, 8 n. 18 (1990).

[14] *Mobile Satellite-Based Communications by Crescomm Transmission Services, Inc. and Qualcomm, Inc.* , 11 FCC Rcd. 10944 (1996), *Qualcomm, Inc.*, 4 FCC Rcd. 1543, ¶¶ 11, 15 (1989) ("Qualcomm").

[15] *Qualcomm* at ¶ 12.

16 Motorola Satellite Communications, Inc., 11 FCC Rcd. 13952, ¶ 11 (1996) ("Motorola").

[17] *AMSC Authorization Order*, 4 FCC Rcd. 6041, 6048, ¶ 51 (1989).

ancillary FSS service -- both uplinks and downlinks -- in a frequency band allocated for the MSS.[18]

Just as in *Qualcomm*, the StarLynx™ downlink signals -- whether received by a mobile, portable, or SAN station -- will appear identical to all users operating in the 37.5-38.6 GHz band and will conform to the service rules for FSS transmissions in this band. Consistent with the Commission's rulings in *Motorola* and *AMSC Authorization Order*, the StarLynx™ uplink signals from its portable terminal will cause no greater interference potential to any other co-frequency spectrum users than the StarLynx™ mobile terminal. Therefore, the Commission should grant a waiver of the Table of Allocations to permit HCI to transmit downlink signals to the StarLynx™ mobile terminals in the entire 37.5-38.6 GHz band and to transmit uplink signals from the StarLynx™ portable terminals in an entire contiguous 1.1 GHz in the 45.5-46.7 GHz band, in each case on a no-harmful-interference basis.

Finally, to the extent that Part 25 of the Commission's rules is deemed to apply to the V-band,[19] HCI requests a waiver of the requirements of Section 25.210 with respect to the NGSO portion of StarLynx™. That rule mandates certain technical standards that are intended to apply to GSO systems, and that are inapposite in the case of an NGSO system. With its highly efficient spectrum reuse capabilities, StarLynx™ complies with the spirit of those requirements.

---

[18] Motorola at ¶¶ 10-11.

[19] The Commission has not yet considered what service rules will apply to the V-band or whether any current Part 25 rules need to be modified to accommodate global V-band systems.

## 11. ENGINEERING CERTIFICATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this application, that I am familiar with Part 25 of the Commission's Rules, that I have either prepared or reviewed the engineering information submitted in this application, and that it is complete and accurate to the best of my knowledge and belief.

By: Daniel P. Sullivan

Dan P. Sullivan, Ph.D.
Vice President, Engineering
Hughes Communications, Inc.
September 25, 1997

THIS PAGE INTENTIONALLY LEFT BLANK

## 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

THIS PAGE INTENTIONALLY LEFT BLANK

# 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

THIS PAGE INTENTIONALLY LEFT BLANK

# 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 |