

Telesat

Telesat Canada

REPORT
ON
COMPARATIVE EVALUATION
OF
THE U.S. FILING APPLICATIONS TO THE FCC
FOR A LICENCE TO CONSTRUCT AND OPERATE
A SATELLITE BASED MOBILE COMMUNICATIONS SYSTEM

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Prepared for
DEPARTMENT OF COMMUNICATIONS
by
TELESAT CANADA

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1. INTRODUCTION

The FCC of the United States of America issued a Notice of Proposed Rule-Making (NPRM) on January 28, 1985. The Notice called for applicants to construct and operate a commercial mobile satellite system. It also proposed allocation of 4+4 MHz in the 800MHz band and 14+14 MHz in the L-Band for mobile satellite services. One of the requirements specified by the FCC is that the applicant has to demonstrate system compatibility with Canadian MSAT.

In response to the NPRM, there were twelve applications submitted to the FCC. They are:

1. GLOBAL LAND MOBILE SATELLITE, INC. (PORT ARTHUR, TEXAS)
2. GLOBESAT EXPRESS (LOGAN, UTAH)
3. HUGHES COMMUNICATIONS CORPORATION (EL SEGUNDO, CALIFORNIA)
4. MCCA AMERICAN SATELLITE SERVICES CORP. (JACKSON, MISSISSIPPI)
5. McCAW SPACE TECHNOLOGIES, INC. (BELLEVUE, WASHINGTON)
6. MOBILE SATELLITE CORPORATION (KING OF PRUSSIA, PA)
7. MOBILE SATELLITE SERVICES, INC. (CROSSVILLE, TENNESSEE)
8. NORTH AMERICAN SATELLITE SERVICES, INC. (NEW YORK, NEW YORK)
9. OMNINET CORPORATION (LOS ANGELES, CALIFORNIA)
10. SATELLITE MOBILE TELEPHONE COMPANY (NEW YORK, NEW YORK)
11. SKYLINK CORPORATION (BOULDER, COLORADO)
12. WISMER & BECKER/TRANSIT COMMUNICATIONS, INC. (PASADENA, CALIFORNIA)

In the Public Notice Report No. DS-415 released by the FCC in June, 1985, the FCC acknowledged the receipt of the applications. After brief review, the FCC concluded that the Applications are acceptable for filing and that the process of applications is considered to be a restricted adjudicative proceeding. All ex parte contacts are prohibited with respect to these proposals. However, comments or petitions on the applications may be filed at the Commission.

Since the Canadian MSAT concept is based on the approach of Canada/U.S. joint program development, it is important to know the US domestic requirements in order to have effective cooperation and negotiation in developing common or compatible system requirements. To facilitate the process, Telesat Canada is tasked to review the FCC submissions under the MSAT Engineering Support Contract.

2. OBJECTIVES AND STUDY METHODOLOGY

The objectives of the task are:

- (1) To provide Telesat executives with an overall summary of U.S. applications to FCC, so as to develop an appropriate negotiating strategy for a joint North American shared system.
- (2) To provide DOC with an overall summary of U.S. applications to FCC, so as to formulate an appropriate strategy for frequency sharing negotiations.

The overall project management of this Task was undertaken by the Satellite Service Planning and Development Division. Considerable contributions in the areas of System concept, space segment were provided by the Communication System Engineering Division and the Space System Division respectively. Each filing was reviewed on a broad-brush basis by all three Divisions with respect to the following criteria:

- (1) Service Concepts
 - System features
 - Proposed organization
 - Proposed cooperative arrangement
- (2) System Concepts
 - Frequency band
 - Frequency polarization
 - Channel spacing
 - Modulation
 - Satellite access technique
 - Channel assignment protocols
 - No. of beams
 - Coverage
 - Orbit location
 - System capacity
 - Required satellite EIRP
- (3) Space Segment Concepts
 - No. of satellites
 - Class of satellite
 - Life estimate
 - Ecliyse capability
 - TT&C frequency
 - Satellite G/T
 - Payload configuration
- (4) Economic & Finance
 - Current asset
 - Source of funds
 - Total program cost
 - Revenue
 - Rate of return (if specified)

The results of such review are listed in the Table of Detailed Comparisons, which is included as an Appendix in this report.

Based on the Table, the applicants were compared on the basis of:

- (1) Proposed services
- (2) System concept and technical highlight
- (3) Program financing status

The results of such comparison were further analyzed in terms of the following four critical factors which are considered as essential to bring the program to a successful launch:

- (1) Financial capability
- (2) Canada coverage
- (3) Canada/US cooperation
- (4) System compatibility

3. COMPARATIVE EVALUATION

3.1 Proposed Services

The services proposed by all the applicants are as follows:

- (1) mobile telephone service
- (2) mobile radio service
- (3) aeronautical mobile service
- (4) marine service
- (5) tone, voice or alphanumeric paging
- (6) Rural telephone
- (7) remote data broadcast and data collection services

In addition to the above services, Global Land Mobile Satellite Inc. propose to offer facsimile and electronic mail services. Other companies such as

- (1) MCCA American Satellite Service Corporation (MCCA)
- (2) Mobile Satellite Corporation (Mobilesat SM)
- (3) Omninet Corporation (Omninet)
- (4) Skylink Corporation (Skylink)
- (5) Wismer & Becker/Transit Communication, Inc. (W&B/TCI)

intend to provide the following services:

- (1) Radio determination or position location
- (2) Interactive Date Services.

MCCA, Omninet and W&B/TCI will provide radio determination services by using coarse acquisition code signals from the Navstar Global Position System (GPS). Mobilesat SM and Skylink will use a two-satellite system concept to offer such a service.

3.2 System Concept

The applicants propose a variety of system configuration which are based on the use of large aperture antennas and multiple spot beams. Among the twelve applicants, seven companies propose to provide Canadian coverage in addition to the North American coverage. These companies also intend to co-operate with Canada in providing mobile satellite services to both countries. With the exception of Globesat Express which employs low orbit satellites, and Omninet which proposes to use four in-orbit-satellites, the majority of the applicants propose to use two in-orbit satellites. Table 1 provides a summary of the payload configuration of these satellites.

SPACECRAFT PAYLOAD	NO. OF APPLICANTS	
UHF, L-BAND, Ku Integrated		Total
		6
- PAM DII Plus	5	
- PAM D	1	
separate singles (UHF/Ku and L/Ku)		1
UHF, Ku, PAM DII Plus		1
UHF, L-BAND, PAM DII Plus		1
UHF ONLY, Low Orbiting Satellites		1
L-BAND, C-BAND, PAM D		1
UHF, C-BAND, PAM DII Plus		1

TABLE 1 PAYLOAD CONFIGURATION DISTRIBUTION

From the table, it appears that the majority of the applicants propose to employ PAM D II plus type of spacecraft with integrated payload (UHF, L-Band and Ku-Band). Each applicant proposes some new technologies. Table 2 summarizes the technical highlights of such technologies. Based on this Table, one could form his/her own opinion of the risk involved in each technology.

Skylink Corporation	UHF/L-band helaps SSPA, rectangular spectrum modulation, deployable 4.3m antenna, orbit reuse & cross-polarization, both RHCP & LHCP in each beam at L-band
Hughes Communications Corp.	UHF&L-band duplexer design, 80w UHF & 20w L-band Envelope Extraction & Reconstruction (EER) amplifier with 40% efficiency, frequency scanning feed with focusing sub-reflectors
Mobile Satellite Corp.	dual band horns, UHF SSPA, commandable power control in both the mobile & gateways. TX & RX are orthogonally polarized, cross-polarization for frequency reuse at UHF & L-band
Omninet Corporation	frequency reuse through spot beams, and polarization reversal between the 2 satellites, deployable 9m antenna, overlapping beam topology not using shared horn with low level beam forming network.
Global Land Mobile Satellite, Inc.	frequency reuse through spot beams, deployable 15m antenna received signal strength measurement (RSSM) to group weak signals.
Globesat Express	SS TDMA/FDMA spread spectrum, low orbit satellite.
McCaw Space Technologies, Inc.	large antenna, 36' at UHF and 8' solid reflector for L-band. mobile requires one RHCP antenna for TX and LHCP antenna for RX
MCCA American Satellite Service Corporation	100 w UHF HPA (low IM. & high efficiency) 39' large antenna, cross-polarization
Mobile Satellite Service Inc.	dual band payload on PAM-D, 400w SSPA at UHF 400w SSPA at L-band
Satellite Mobile Telephone Company	15m unfurlable reflector, deployed transponder feed RF beam pointing (no N-S station-keeping); Frequency reuse appears unworkable.
Wisner & Becker/ Transit Communications, Inc	4.8m unfurlable reflector
North American Mobile Satellites, Inc.	10m unfurlable reflector (ATS-6), centre-fed deployed transponder/feeds, reverse frequency operation

TABLE 2 TECHNICAL HIGHLIGHTS

The current MSAT baseline system definition are based on the concept of 5 KHz channel spacing and a UHF only or a dual band (UHF and L-Band) geosynchronous satellite. Other concepts, although they may be technically feasible, are considered to be incompatible. Such concepts are outlined as follows:

- (1) Global Land Mobile Satellite, Inc. proposes a channel spacing of 15 KHz;
- (2) Globesat Express employes low orbiting satellites;
- (3) McCaw Space Technologies, Inc. plans to use separate mobile antennas for transmit and receive.
- (4) MCCA American Satellite Service Corporation proposes a 30 KHz channel spacing.
- (5) Mobile Satellite Service, Inc. proposes to use PAM D type of spacecraft to carry a dual band payload;
- (6) Satellite Mobile Telephone Company's frequency re-use scheme appears unworkable.
- (7) W&B/TCI provides only L-Band services.

3.3 PROGRAM FINANCING STATUS

Table 3 summarizes the program financing status. It is generally understood that a company, which has the source of fund identified and full funding committed, is most likely to succeed in launching a service. On the other hand, if a company does not have any source of funding, probably it may not be able to implement a system in a timely manner.

Source of fund identified with full funding committed	Hughes Communication Corp. American Satellite Service Corporation Skylink Corporation
Source of fund identified with some dollars amount committed	Mobile Satellite Corporation McCaw Space Technologies, Inc. North American Mobile Satellite, Inc. Mobile Satellite Service, Inc.
Source of fund identified with no dollar amount committed	Globesat Express Omninet Corporation
No Source of fund identified with no dollar amount committed	Global Land Mobile Satellite, Inc. Satellite Mobile Telephone Co. Wisner & Becker/Transit Communications, Inc.

TABLE 3 PROGRAM FINANCING STATUS

4. SUMMARY

Table 4 below provides an overall viewpoint of the comparative evaluation with respect to financial capability, Canadian coverage, proposal of Canada/U.S. cooperation, and technical compatibility with the current baseline MSAT system concept.

There are nine companies that have identified the sources of fund. Although some of them do not have dollar amount committed, they are considered as having the financial capability to construct and operate a satellite-based mobile communications system.

From the radio-frequency coverage point of view, seven companies propose to provide Canadian coverage. Among these seven companies, five of them have some schemes for Canada/U.S. co-operation and appear favourable to spectrum sharing.

From the system compatibility point of view, there are five companies whose system concepts are more in-line with current MSAT system definition.

Companies	Financial Capability	Canadian Coverage	Canada/US Cooperation	Technical Compatibility
Skylink Corporation	x	x	x	x
Hughes Communications Corp.	x	x	x	x
Mobile Satellite Corp.	x	0	-	x
Omninet Corporation	x	x	x	x
Global Land Mobile Satellite, Inc.	-	-	0	-
Globesat Express	x	0	-	-
McCaw Space Technologies, Inc.	x	x	x	-
MCCA American Satellite Services Corporation	x	x	0	-
Mobile Satellite Service Inc.	x	-	-	-
Satellite Mobile Telephone Company	-	x	0	-
Wisner & Becker/Transit Communication Inc.	-	0	0	-
North American Mobile Satellites, Inc.	x	x	x	x

TABLE 4 SUMMARY RESULTS

Legend: X Yes
 0 No firm commitment
 - No

Appendix: Table of Detailed Comparisons

AREAS OF COMPARISON		SERVICE CONCEPTS
COMPANIES	SYSTEM FEATURES	PROPOSED ORGANIZATION
SKYLINK CORPORATION	3 Classes of Network Services ° L-Band high & low power ° UHF high & low power ° Dynamic allocation of BW, power, and time	Skylink America consortium of 8 firms
HUGHES COMMUNICATIONS CORP.	UHF: MTS, MRS, data L : rural tel., data, aeronautical	MSSLP Limited partnership
MOBILE SATELLITE CORP.	Dynamic bw allocation Interactive data & surveillance (IDS)	Mobilesat SM Consortium of 6 firms Staff of 74 persons
OMNINET CORPORATION	UHF: Cellular compatible L : Non-cellular compatible RDSS using GPS Dynamic BW allocation	Partnership
GLOBAL LAND MOBILE SATELLITE, INC.	Voice: 15 KHz, UHF Data : 10 Kb/s, UHF L-Band for feederlink	Limited partnership
GLOBESAT EXPRESS	Low orbit satellites UHF for 1st generation L for 2nd generation 5 KHz or spread spectrum	Partnership
MCCA AMERICAN SATELLITE SERVICE CORPORATION	Voice: 30 KHz NBFM Data : 300 to 56 bps	Affiliation of local carrier
MCCAW SPACE TECHNOLOGIES, INC.	Integrated with SBS Interconnected with AT&T, MCI, Sprint, SBS, satellite co-located with SBS's	Partnership
MOBILE SATELLITE SERVICE, INC.	Interactive Data & Surveillance	Consortium
SATELLITE MOBILE TELEPHONE COMPANY	Land Mobile Satellite Services Aeronautical Mobile Sat. Services	Subsidiary
WISMER & BECKER/ TRANSIT COMMUNICATION, INC.	L-Band only, RDSS via GPS	Partnership
NORTH AMERICAN MOBILE SATELLITES, INC.	UHF only C-Band feederlink	Intelsat type Open

AREAS OF COMPARISON COMPANIES	SERVICE CONCEPTS PROPOSED COOPERATIVE ARRANGEMENT
SKYLINK CORPORATION	Skylink America & Telesat own & operate separate but compatible satellites, Joint service restoral, cross-leasing
HUGHES COMMUNICATIONS CORP.	MSSLP & Telesat own & operate separate but compatible DAMA satellite & TT&C, Service restoral, Lease or buy-back L-Band payload
MOBILE SATELLITE CORP.	No specific proposal suggested; government to resolve frequency sharing issues
OMNINET CORPORATION	For first 2 flight, cost and capacity sharing: U.S.A. 54.2% Canada 29.1% = \$86.8M to \$99.5M Mexico 16.7% Separate feederlink frequency for Canada
GLOBAL LAND MOBILE SATELLITE, INC.	Possible service back-up with Canada
GLOBESAT EXPRESS	Welcome Canadian participation by investment, ownership, joint R&D, joint operating agreement for second generation.
McCAW SPACE TECHNOLOGIES, INC.	Canada/US cooperative sharing for first generation, Possible equity participation
MCCA AMERICAN SATELLITE SERVICE CORPORATION	No specific plan but would permit Canadian equity participation in MCCA
MOBILE SATELLITE SERVICE INC.	No plan for international cooperation
SATELLITE MOBILE TELEPHONE COMPANY	Proposed to sell Canada 800 5-KHz channels per month at US \$4M/month
WISMER & BECKER/TRANSIT COMMUNICATION, INC.	Share with Canada the construction cost in a joint implementation program
NORTH AMERICAN MOBILE SATELLITES, INC.	agreed with Telesat's "Principles of Cooperation." suggested Intelsat type of arrangement

AREAS OF COMPARISON	SYSTEM CONCEPTS		
	FREQUENCY BAND	POLARIZATION	CHANNEL SPACING KHz
COMPANIES			
SKYLINK CORPORATION	UHF 4 + 4 MHz L-Band 6 + 6 MHz Ku-Band 40 + 40 MHz	UHF: RHCP L-Band: R & LHCP Ku-Band: Linear	5
HUGHES COMMUNICATIONS CORP.	UHF 4 + 4 MHz L: 1st Gen. 6 + 6 MHz 2nd Gen. 10 + 10 MHz Ku: 114 + 129 MHz	RHCP Linear Ku	5 4 L-Band LP
MOBILE SATELLITE CORP.	UHF: 4 + 4 MHz L: 14 + 14 MHz Ku: 498 + 498 MHz	R & LHCP	UHF: 5 L: 4
OMNINET CORPORATION	UHF: 4 + 4 MHz L: 10 + 10 MHz Ku: 500 + 500 MHz	R & LHCP Linear Ku	5
GLOBAL LAND MOBILE SATELLITE, INC.	UHF: 4 + 4 MHz L: 5 + 4 MHz	R & LHCP	15
GLOBESAT EXPRESS	UHF: 4 + 4 MHz	Linear	5
MCCAW SPACE TECHNOLOGIES, INC.	UHF: 4 + 4 MHz L: 1 + 1 MHz Ku: 500 + 500 MHz	R & LHCP Linear Ku	5
MCCA AMERICAN SATELLITE SERVICE CORPORATION	UHF: 4 + 4 MHz Ku: 32 + 31 MHz	R & LHCP Linear Ku	30
MOBILE SATELLITE SERVICE INC.	UHF: 4+4 & 6+6 MHz L: 15 + 15 MHz Ku: 500 + 500 MHz	R & LHCP	4, 15 30
SATELLITE MOBILE TELEPHONE COMPANY	UHF: 4 + 4 MHz L: 14 + 14 MHz Ku: 500 + 500 MHz	R & LHCP	5
WISMER & BECKER/TRANSIT COMMUNICATION, INC.	UHF: none L: 14 + 10 MHz C: 5 + 5 MHz	RHCP	5 8 KHz for AMSS
NORTH AMERICAN MOBILE SATELLITES, INC.	Baseline: UHF 4 + 4 MHz C-Band : 70 + 70 MHz Alt. UHF & L-Band (15 + 14 MHz) & C-Band	RHCP Linear for Feederlink	5

COMPANIES	AREAS OF COMPARISON		SYSTEM CONCEPTS	
	MODULATION	ACCESS TECHNIQUES	CHANNEL ASSIGNMENT PROTOCOLS	
SKYLINK CORPORATION	BRSM (data & control) ACSSB	FDMA/SCPC, TDMA for data (within FDMA)	PDAMA: dynamic assignment of bandwidth, power & time	
HUGHES COMMUNICATIONS CORP.	ACSSB	FDMA/SCPC	DAMA	
MOBILE SATELLITE CORP.	CSSB	FDMA/SCPC	DAMA	
OMNINET CORPORATION	ACSB GMSK (LPC)	FDMA/SCPC MF TDMA for short data	DAMA + I-AMAP	
GLOBAL LAND MOBILE SATELLITE, INC.	FM voice MPSK (digital)	SCPC/FDM	Modified slotted ALOHA	
GLOBESAT EXPRESS	ACSSB Spread spectrum for data	FDMA/SCPC	-	
MCCAW SPACE TECHNOLOGIES, INC.	ACSSB LPC/GMSK	FDMA/SCPC ra/TDMA	DAMA ALOHA	
MCCA AMERICAN SATELLITE SERVICE CORPORATION	NBFM DPSK & QPSK	FDMA/SCPC	DAMA	
MOBILE SATELLITE SERVICE INC.	NBFM, LPC or ACSSB, PSK or FSK	FDMA/SCPC	-	
SATELLITE MOBILE TELEPHONE COMPANY	ACSSB	FDMA/SCPC	-	
WISMER & BECKER/TRANSIT COMMUNICATION, INC.	LPC (voice) GMSK (data)	FDM/SCPC	I-AMAP POLLING	
NORTH AMERICAN MOBILE SATELLITES, INC.	-	FDMA/SCPC	-	

COMPANIES	AREAS OF COMPARISON	SYSTEM CONCEPTS		
		NO. OF BEAMS	COVERAGE	ORBIT LOCATION
SKYLINK CORPORATION		2 UHF 8 L-Band 1 Ku	Canada & USA	75°, 136°w 106° (Canada)
HUGHES COMMUNICATIONS CORP.		Freq. scanned virtual beams 2U, 4L, 1Ku	Canada & USA	135°w
MOBILE SATELLITE CORP.		4 UHF 11 L-band 4 Ku	U.S.A. & Mexico No mention of of Canada	85°, 125°
OMNINET CORPORATION		12 UHF 17 L-Band 2 Ku	Canada, Mexico, & USA no L-Band cover- age for Canada	89°, 119°
GLOBAL LAND MOBILE SATELLITE, INC.		6 UHF 6 L-Band	U.S.A	94°, 129°
GLOBESAT EXPRESS		1 UHF Per satellite	Circular beams of 200 km radius for N. America, no Canada coverage	LEO 57° inclination 500 km
MCCAW SPACE TECHNOLOGIES, INC.		20 UHF 2 L-Band 1 Ku	N. & Central America & Caribbean basin	101° or (95 - 110)
MCCA AMERICAN SATELLITE SERVICE CORPORATION		10 UHF (8 if Canada coverage req'd)	CONUS, Alaska & Puerto Rico	96°w
MOBILE SATELLITE SERVICE INC.		1 UHF 1 L-Band	USA, no Canadian coverage	85°, 125°
SATELLITE MOBILE TELEPHONE COMPANY		12 UHF 40 L-Band	UHF: Canada & USA L : USA only	75°, 120°
WISMER & BECKER/TRANSIT COMMUNICATION, INC.		5 L-Band C-Band	CONUS & Alaska, Canada coverage pending	80°, 113°
NORTH AMERICAN MOBILE SATELLITES, INC.		6 UHF C-Band	USA & Canada	129° (120 - 130)

AREAS OF COMPARISON	SYSTEM CONCEPTS	
	SYSTEM CAPACITY (CHANNELS)	REQUIRED SATELLITE EIRP/CXR - dBw
COMPANIES		
SKYLINK CORPORATION	UHF: 800 L-Band: 1600 Ku-Band: 2400	UHF: 22.6 or 28.6 L: 26.4 or 30.3 Ku: 12 or 25
HUGHES COMMUNICATIONS	U: 800 L: 1465 (2 sat.)	U: 28.3 Max L: 17 or 27 Ku: 2 downlinks at 38.8 1 downlink at 37.0
MOBILE SATELLITE CORP.	U: 800 L: 5225	U: 20.1 L: 22.2 Ku: 10.1
OMNINET CORPORATION	U: 2208 L: 3840	U: 26.2 L: 29.3 Ku: 9.9
GLOBAL LAND MOBILE SATELLITE, INC.	U: 266, 367(E) + 286(W) L: feederlink	U: 39 L: -
GLOBESAT EXPRESS	790	U: 10
MCCAW SPACE TECHNOLOGIES, INC.	U: 1700 (360 to Canada) L: 90	UHF: 27.7 dBw Total: 46.85 (2nd), 49.88 (Prime) L: 44.3 Ku: 38.3
MCCA AMERICAN SATELLITE SERVICE CORPORATION	U: 640 (512 for 8 beam)	U: 35.8 Ku: 54.7 (Total)
MOBILE SATELLITE SERVICE INC.	U: 5000 L: -	UHF: 25.6 L: 24.6
SATELLITE MOBILE TELEPHONE COMPANY	U: 2400 L: 8400	UHF: 28.6 L: 34.7 K: 15
WISMER & BECKER/TRANSIT COMMUNICATION, INC.	L: 796	L: 33.3 (for Omni) C: 6.5
NORTH AMERICAN MOBILE SATELLITES, INC.	U: 800 L: 800 (Alt.)	U: 30 - 33 Hybrid: U: 29 - 32 L: 31.3 - 34.6

NOTE: U = UHF
L = L-Band

AREAS OF COMPARISON	SPACE SEGMENT CONCEPTS			
	NO. OF SATELLITE	CLASS OF SATELLITE & DRY WEIGHT (Kg)	LIFE (Yr)	ECLIPSE CAPABILITY
COMPANIES				
SKYLINK CORPORATION	2 US 1 Can	PAM D2 Plus 1015	7	50%
HUGHES COMMUNICATIONS CORP.	1 US 1 Can	PAM D2 Plus (HS 393) 1035	10	100%
MOBILE SATELLITE CORP.	2 or 3	PAM D2 Plus 825	8	25%
OMNINET CORPORATION	2 UHF 2 L-Band	PAM D2 Plus U: 930 L: 974	10	25%
GLOBAL LAND MOBILE SATELLITE, INC.	2	PAM D2 Plus 1364	7, 8 10	100%
GLOBESAT EXPRESS	50 5 GRD Spare	Gas/Hitchiker 50	5	0% s/c 100% (System)
MCCAW SPACE TECHNOLOGIES, INC.	1 in-orbit 1 on-ground space	PAM D2 Plus	10 1550	100%
MCCA AMERICAN SATELLITE SERVICE CORPORATION	1 Prime 1 in-orbit	PAM D2 Plus 1100	10	100%
MOBILE SATELLITE SERVICE INC.	2 in-orbit 1 on-ground space	PAM D 483	7	30%
SATELLITE MOBILE TELEPHONE COMPANY	2 Incl. 1 Spare	PAM D2 Plus 1325	7	30%
WISMER & BECKER/TRANSIT COMMUNICATION, INC.	2 Incl. 1 Spare 1 on-ground	PAM D 563	7	0%
NORTH AMERICAN MOBILE SATELLITES, INC.	2 Incl. 1 Spare	PAM D2 + UHF: 844 Hybrid: 975	U: 8 H: 7	U-100% H- 60%

NOTE: U = UHF
H = Hybrid (UHF & L-Band)

AREAS OF COMPARISON COMPANIES	SPACE SEGMENT CONCEPTS	
	TT&C FREQUENCY BAND	SATELLITE G/T (dB/°K)
SKYLINK CORPORATION	Within Communications Ku-Band	UHF: -0.5 L: 3.7 Ku: -3.5
HUGHES COMMUNICATIONS CORP.	K	U: 2 L: 3 Ku: -4
MOBILE SATELLITE CORP.	K	U: 2.2 L: 7.5 Ku: 3.7
OMNINET CORPORATION	K	U: 4 L: 10 Ku: -2.5
GLOBAL LAND MOBILE SATELLITE, INC.	L	U: 11 L: 11
GLOBESAT EXPRESS	-	-25
MCCAW SPACE TECHNOLOGIES, INC.	K	U: 7.3 L: -0.3 K: -4
MCCA AMERICAN SATELLITE SERVICE CORPORATION	K	U: 11.1 K: -1.6
MOBILE SATELLITE SERVICE INC.	K	U: -2 L: 3 Ku: -0.1 (+2)
SATELLITE MOBILE TELEPHONE COMPANY	K Alternative KA	U: 8 L: 14 Ku: 8
WISMER & BECKER/TRANSIT COMMUNICATION, INC.	C (3 to 5 GHz)	L: 4.2 C: -3.4
NORTH AMERICAN MOBILE SATELLITES, INC.	C	L: 5.2 L: 6.23 C: -1.12 or 3.23 (Hybrid)

AREAS OF COMPARISON	SPACE SEGMENT CONCEPTS			
	COMPANIES	Type	PAYLOAD	
Weight (Kg)			Power (w)	
SKYLINK CORPORATION	UHF/L/Ku INTEGRATED	207	3700	2 14 ft.
HUGHES COMMUNICATIONS	UHF/L/Ku INTEGRATED	188	1840	1 16 ft.
MOBILE SATELLITE CORP.	UHF/L/Ku INTEGRATED	181	2400	1 UHF 1 L-Band 14 ft.
OMNINET CORPORATION	UHF/Ku OR L-BAND/Ku	UHF: 215 L: 240	U: 2100 L: 2500	2 30 ft.
GLOBAL LAND MOBILE SATELLITE, INC.	UHF/L-BAND	-	1900	1 50 ft.
GLOBESAT EXPRESS	UHF	-	10	8 Monopoles (0.5 dBi)
MCCAW SPACE TECHNOLOGIES, INC.	UHF/L/Ku INTEGRATED	-	1700	1 UHF 36 ft. 1 L 8 ft. Solid
MCCA AMERICAN SATELLITE SERVICE CORPORATION	UHF/Ku	-	1700	1 39 ft. 27 ft. for 8 Beams
MOBILE SATELLITE SERVICE INC.	UHF/L/Ku INTEGRATED	85	-	1 10 ft.
SATELLITE MOBILE TELEPHONE COMPANY	UHF/L/Ku INTEGRATED	632	5000	1 50 ft.
WISMER & BECKER/TRANSIT COMMUNICATION, INC.	L-BAND/ C-BAND	90	745	1 16 ft.
NORTH AMERICAN MOBILE SATELLITES, INC.	UHF/C-BAND OR UHF/L-BAND	205 293	1800 2800	1 1 33 ft.

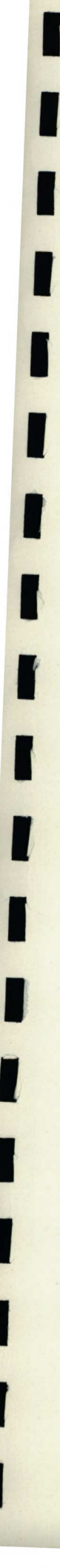
AREAS OF COMPARISON	ECONOMIC & FINANCE	
COMPANIES	CURRENT ASSET	SOURCE OF FUNDS
SKYLINK CORPORATION	Skylink Corp. \$ 1.5M Option Holders Assets \$ 8B	Bank of America: \$105M Equity Contribution: \$ 17M Option Holders: 43% of the system
HUGHES COMMUNICATIONS CORP.	HCMSS - MSSLP - HAC \$ 3.8B	Bank of America: \$300M Letter of Credit to Hughes Aircraft Company (HAC)
MOBILE SATELLITE CORP.	\$770K	Mobilesat Stockholders: \$ 42M Man. Hanover Trust Co.: \$140M *Morgan Stanley & Co. Inc.: \$200M
OMNINET CORPORATION	OGI & OMNINET \$2.2M	Citicorp Ind. Credit, Inc. Drexiel Burnham Lambert Man. Hanover Trust Union Bank
GLOBAL LAND MOBILE SATELLITE, INC.	\$1K	Limited partnership to attract capital
GLOBESAT EXPRESS	\$133K	1st Security Bank of Utah: \$45M
MCCAW SPACE TECHNOLOGIES, INC.	McCaw S.T. \$150K 2 Other Partners: \$231M	Provident Nat'l Bank: \$ 50M *Paine Webber Inc.: \$250M
MCCA AMERICAN SATELLITE SERVICES CORPORATION	MCCA Parent \$120M MCCA \$1K	1st Nat'l Bank of Chicago: \$400M Parent Corp. MCCA: \$ 10M
MOBILE SATELLITE SERVICE INC.	\$0.5M	1st Nat'l Bank of Crossville: \$150M
SATELLITE MOBILE TELEPHONE COMPANY	Private Networks Inc. \$88K	D.H. Blair believes they can obtain necessary financing
WISMER & BECKER/TRANSIT COMMUNICATION, INC.	\$5K	W&B Contracting Engineers Committed to raise capital
NORTH AMERICAN MOBILE SATELLITES, INC.	\$1K	Manufacturers Hanover Trust Co. \$20M

Legend: HCMSS - Hughes Communication Mobile Satellite Service
MSSLP - Mobile Satellite Service Limited Partner

* FUND RAISING COMPANIES

AREAS OF COMPARISON	ECONOMIC & FINANCE *U.S. SHARE				
	COMPANIES	NO. OF SAT.	SERVICE PERIOD	TOTAL PROGRAM COST \$US	REVENUE \$M US
SKYLINK CORPORATION	1 Can 1 U.S.	7	282*	** 541	15 On Equity
HUGHES COMMUNICATIONS CORP.	1 Can 1 U.S.	10	399*	*** 1,004	14 Equity
MOBILE SATELLITE CORP.	3 U.S.	7	408	** 1,064	20
OMNINET CORPORATION	4 OP 1 SP	10	1,073	** 3,801	25
GLOBAL LAND MOBILE SATELLITE, INC.	2 OP	8	817	*** 2,207	24 Before Tax
GLOBESAT EXPRESS	50 OP 5 SP	5	64.6	*** 120.2	21 IRR
MCCA SPACE TECHNOLOGIES, INC.	1 OP 1 SP	7	499	*** 801	-
MCCA AMERICAN SATELLITE SERVICE CORPORATION	1 OP 1 SP	10	295.6	*** 654	-
MOBILE SATELLITE SERVICE INC.	2 OP 1 SP	7	171 (2 Sat)	*** 1,116	10 On Investment
SATELLITE MOBILE TELEPHONE COMPANY	2 OP For Each Gen.	10	2,226 (4 Sat)	*** 2,572	-
WISMER & BECKER/TRANSIT COMMUNICATION, INC.	2 OP 1 SP	8	1,073	** 2,419	30% On Investment
NORTH AMERICAN MOBILE SATELLITES, INC.	1 U.S. 1 Can 1 SP	7	194*	*** 474	16 ROI Pre-tax

NOTE: * U.S. Operator's Share of Joint Venture
 OP = Operational
 SP = Spare
 ** Required Revenue
 *** Projected Revenue



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