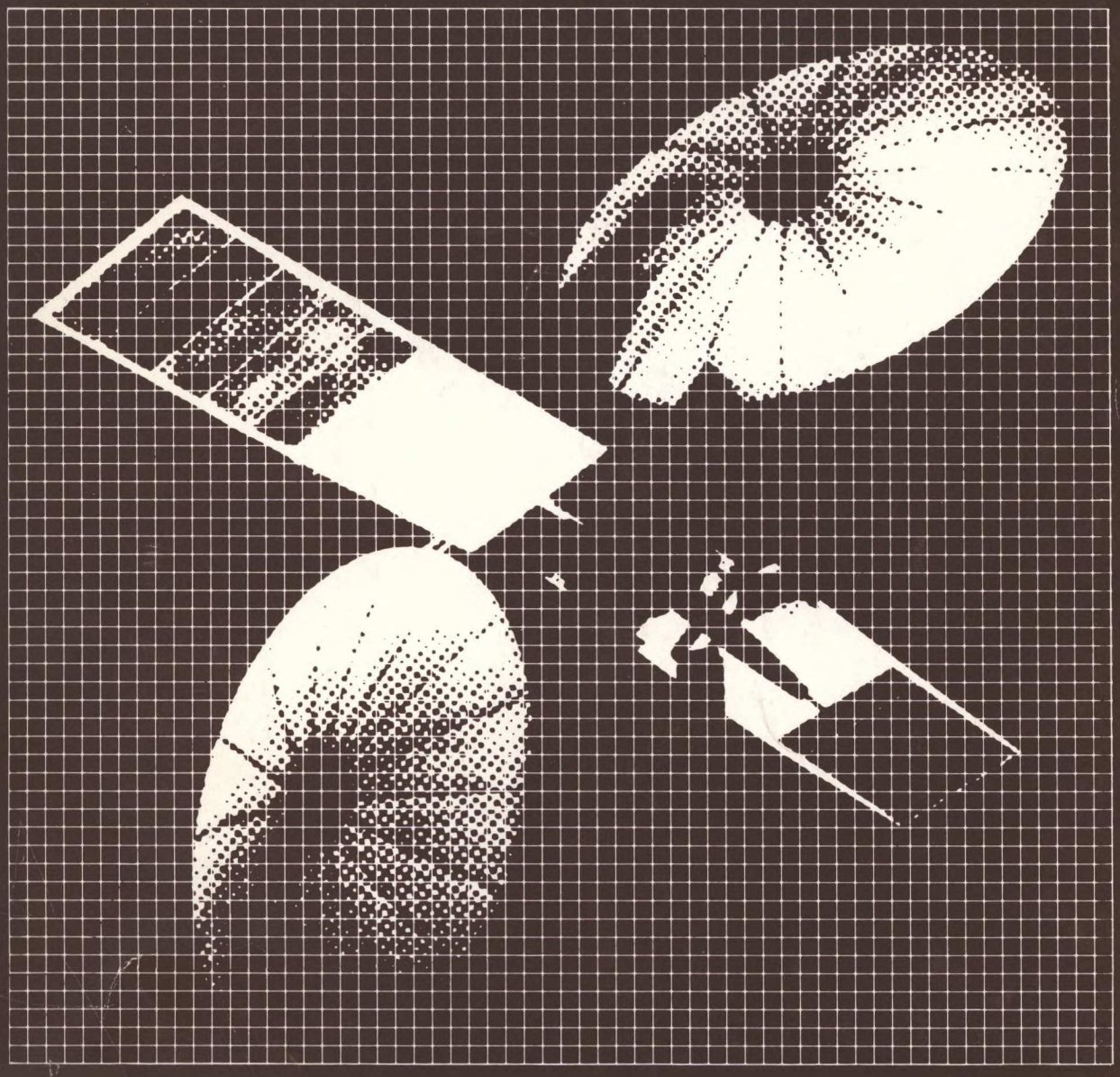
MSAT PHASE B

INDUSTRY BRIEFING

Government of Canada
Department of Communications

Gouvernement du Canada
Ministère des Communications

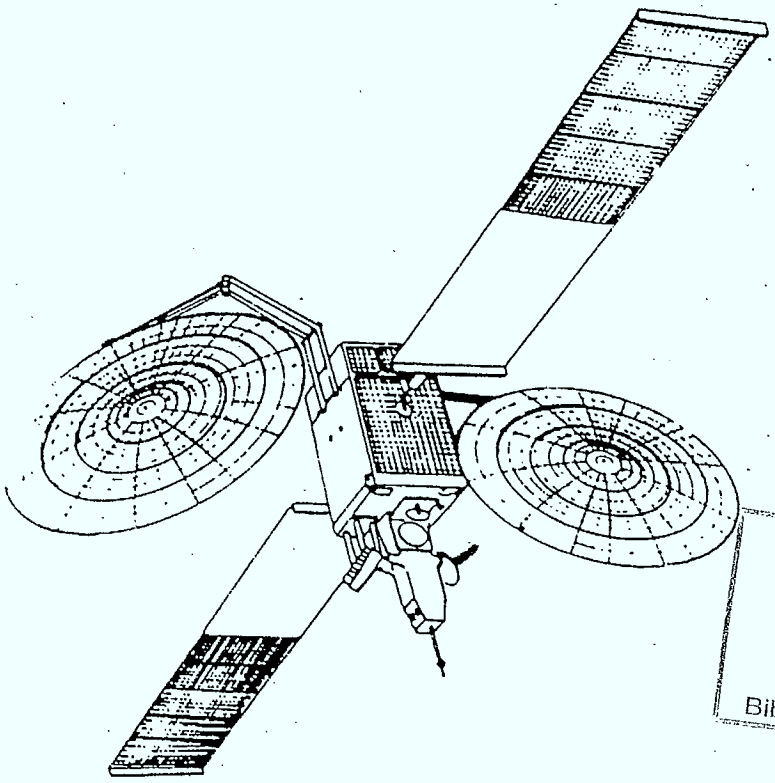


msat

Canada

MSAT PHASE B

INDUSTRY BRIEFING



SEPTEMBER 9 & 10, 1982

GOVERNMENT OF CANADA
DEPARTMENT OF COMMUNICATIONS

SPACE PROGRAM

GOUVERNMENT DU CANADA
MINISTÈRE DES COMMUNICATIONS

PROGRAMME SPATIAL

AGENDA

MSAT INDUSTRY BRIEFING - SEPTEMBER 9, 10, 1982

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395 WELLINGTON STREET, OTTAWA

CHAIRMAN - DR. R.W. BREITHAUPT

THURSDAY, SEPTEMBER 9

MORNING

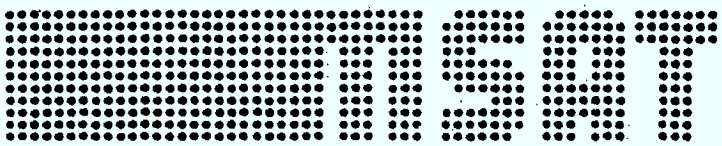
1.	WELCOME AND OPENING REMARKS	9:00	A. CURRAN (ASSISTANT DEPUTY MINISTER - SPACE PROGRAM)
2.	INTRODUCTION/ORGANIZATION	9:10	R.W. BREITHAUPT
3.	PROGRAM BACKGROUND AND OVERVIEW OF PHASE A RESULTS	9:20	P.M. BOUDREAU/J.L. MCNALLY
	COFFEE BREAK	10:20	
4.	MSAT SYSTEM CONCEPT	10:50	J.D.B. KENT
5.	DND SYSTEM REQUIREMENTS	11:20	LCOL R.R. COOPER/ A.R. ABERCROMBIE (DND)
	QUESTION PERIOD	11:30	
	BREAK FOR LUNCH	12:00	

AFTERNOON

6.	MSAT PHASE B WORK PLAN - INTRODUCTION	1:30	R.W. BREITHAUPT
7.	MSAT PROGRAM DEFINITION	1:40	P.M. BOUDREAU
8.	MSAT SYSTEM DEFINITION	2:15	J.L. MCNALLY
9.	SYSTEM STUDIES	2:20	J.D.B. KENT
	COFFEE BREAK	2:40	
10.	SPACE SEGMENT	3:00	H.R. RAINE
11.	GROUND SEGMENT	3:30	J.E. NICHOLSON
	QUESTION PERIOD	4:15	
	CLOSING REMARKS	4:30	R.W. BREITHAUPT

FRIDAY, SEPTEMBER 10

1.	PHASE A STUDIES - INTRODUCTION	9:00	R.W. BREITHAUPT
2.	MARKET STUDY	9:10	WOODS-GORDON
3.	COMMERCIAL VIABILITY STUDY	9:40	ADGA
	COFFEE BREAK	10:10	
4.	USER COST BENEFIT STUDY	10:30	SYSTEMHOUSE
5.	SPACE SEGMENT STUDIES	11:00	H.R. RAINE
6.	GROUND SEGMENT	11:30	J. SYDOR (DOC)/ADGA
	QUESTION PERIOD	12:00	



WELCOME

AND

OPENING REMARKS

A. CURRAN

AGENDA ITEM 1

AMSAT

INTRODUCTION

AND

ORGANIZATION

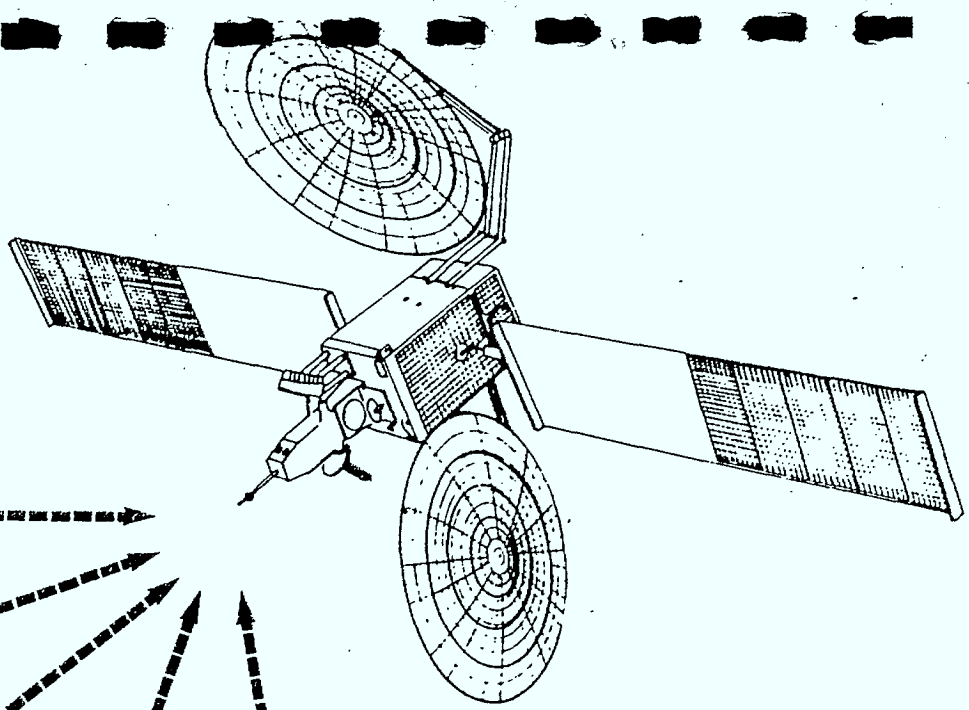
DR. R.W. BREITHAUPT

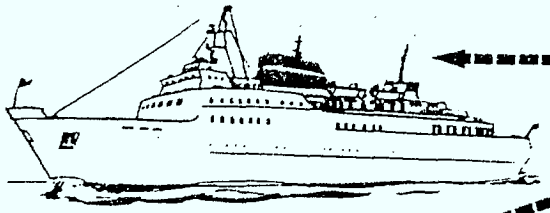
AGENDA ITEM 2

PURPOSE OF BRIEFING

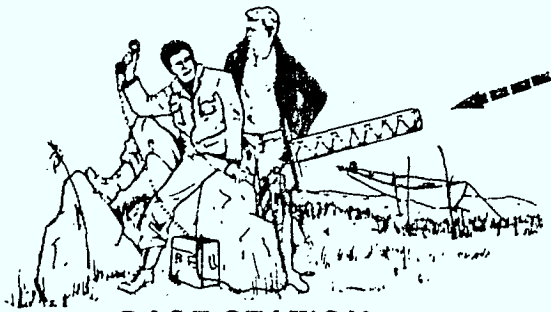
* UPDATE MSAT PROGRAM STATUS
* REVIEW PHASE A RESULTS
* DESCRIBE PHASE B WORK PLAN AND CONTRACTS
* OBTAIN FEEDBACK FROM INDUSTRY

M-SAT
SYSTEM CONCEPT

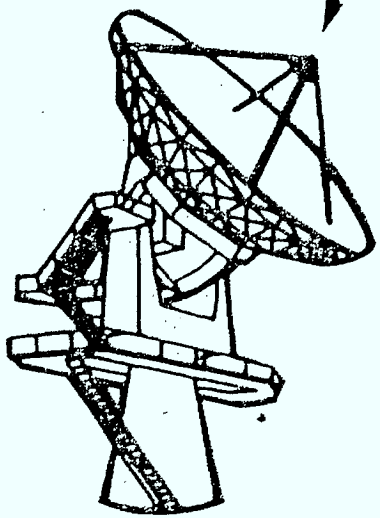




SEA MOBILES

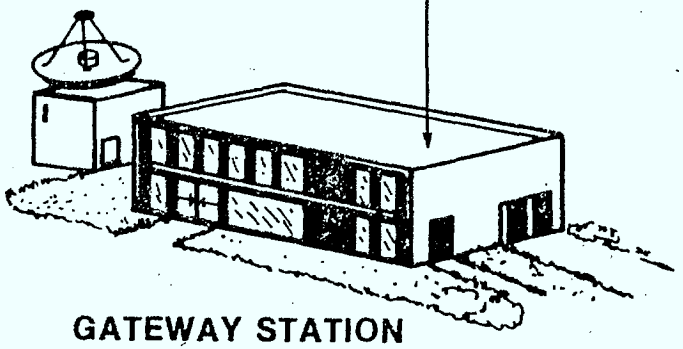


BASE STATION
OR
FIELD-PORTABLE STATION

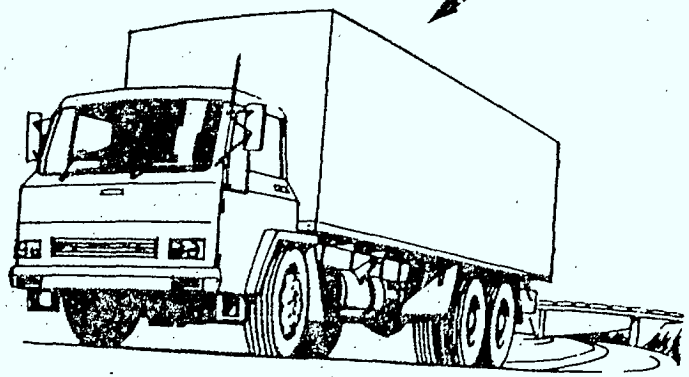


CENTRAL CONTROL
STATION

TELEPHONE
NETWORK



GATEWAY STATION



LAND MOBILES

GOVERNMENT OBJECTIVE OF THE MSAT PROGRAM

PRIMARY:

TO FOSTER THE DEVELOPMENT OF NEW MOBILE SATELLITE TELECOMMUNICATIONS SERVICES IN CANADA, WHICH SATISFY URGENT NATIONAL NEEDS FOR IMPROVED PUBLIC AND CIVIL GOVERNMENT MOBILE COMMUNICATIONS TO UNDERSERVED AREAS OF CANADA, AS WELL AS DND REQUIREMENTS FOR EXPERIMENTAL SATELLITE COMMUNICATIONS SERVICES.

SECONDARY:

TO FOSTER THE DEVELOPMENT OF SPACE SYSTEM TECHNOLOGY AND COMPETENCE IN THE PRIVATE SECTOR IN CANADA.

THROUGH

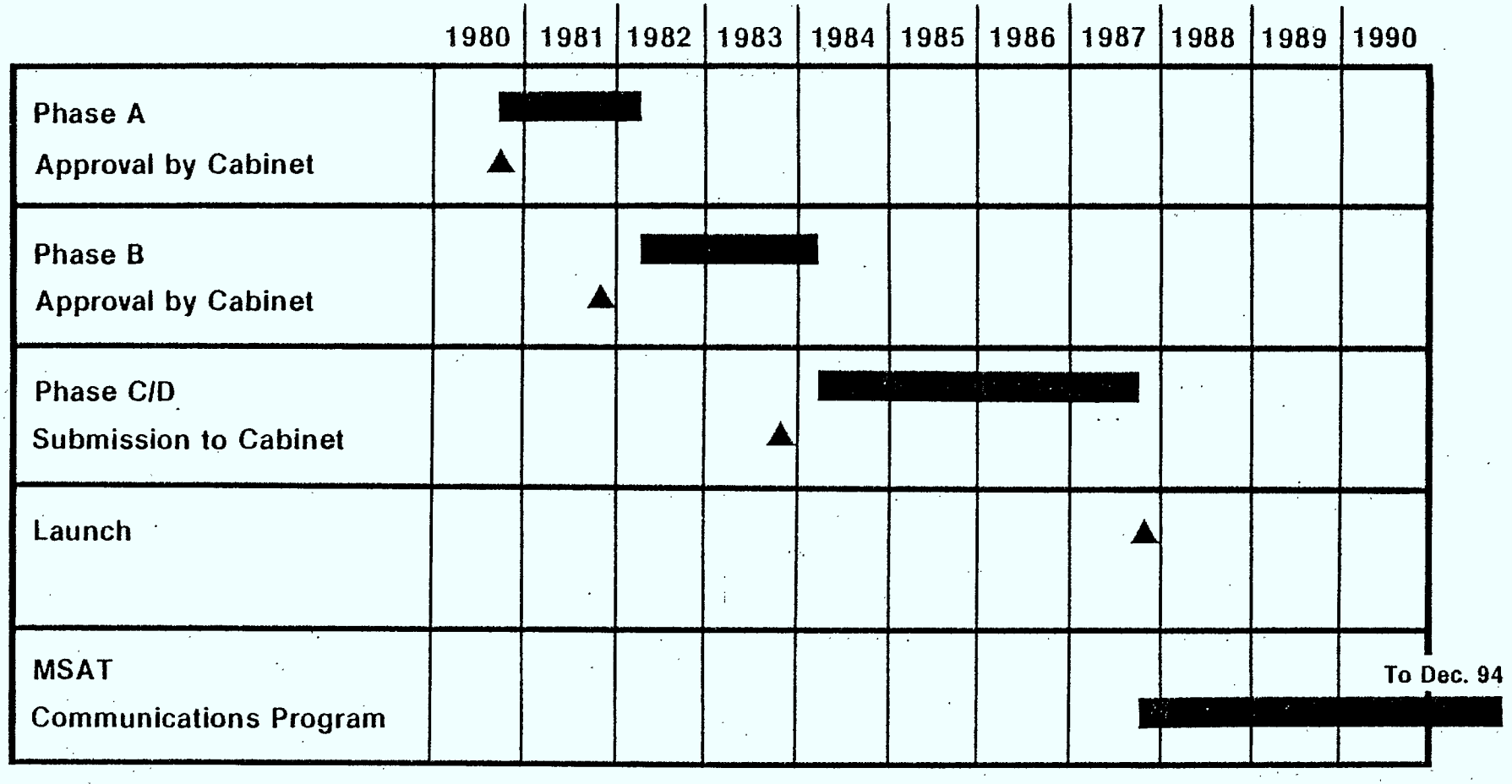
* DEVELOPMENT OF SYSTEM CONCEPTS, MARKET DEFINITION, TECHNOLOGY DEVELOPMENT

* DEFINITION AND IMPLEMENTATION OF A DEMONSTRATION/PREOPERATIONAL SYSTEM

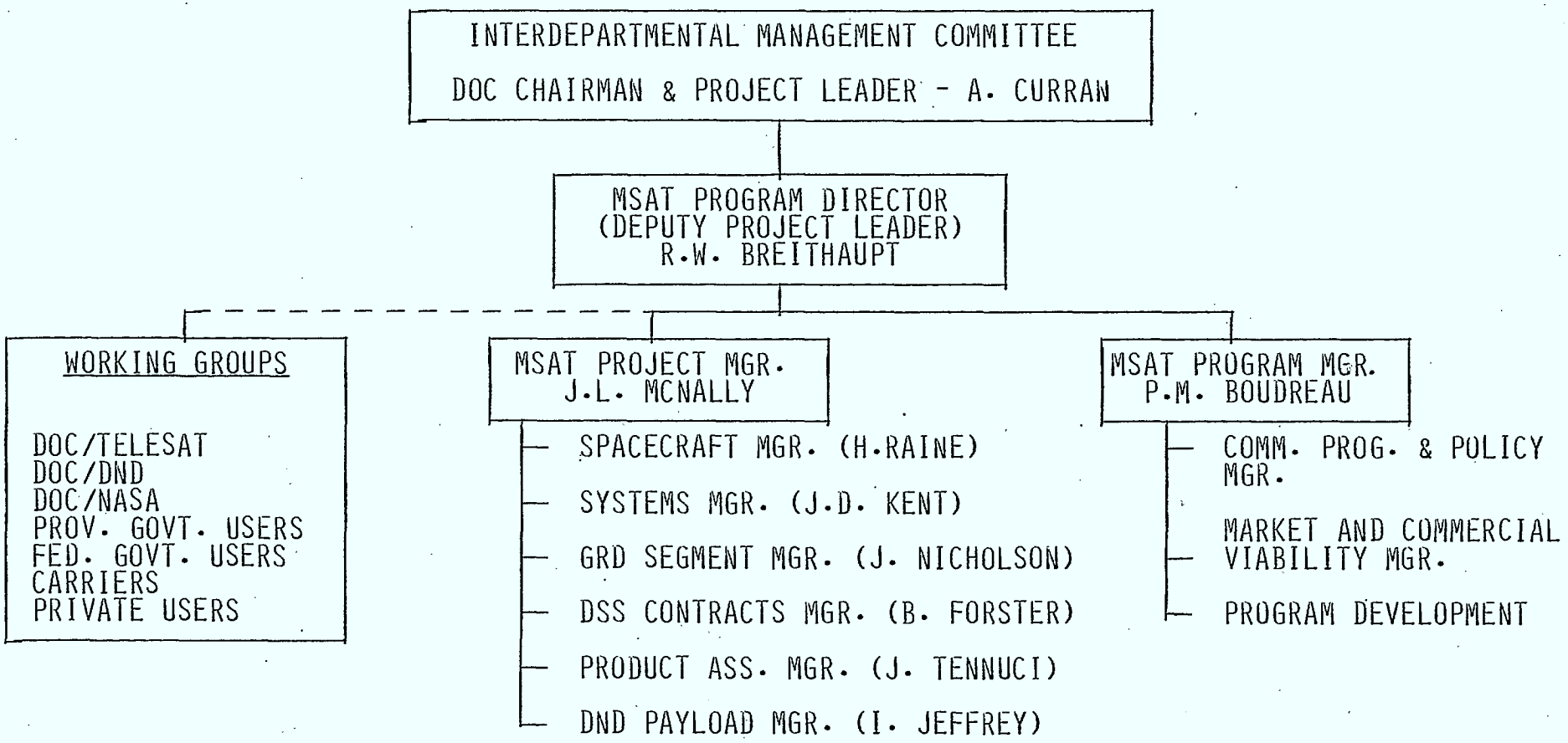
* RESOLUTION OF REGULATORY/POLICY QUESTIONS

* ENSURING A TRANSITION TO OPERATIONAL SERVICES

MSAT Program Schedule



MSAT PHASE B ORGANIZATION



PROGRAM BACKGROUND AND OVERVIEW

OF PHASE A RESULTS

AGENDA ITEM 3

OUTLINE

A. MSAT PROGRAM BACKGROUND

- MSAT SYSTEM
- SCHEDULE
- MAJOR MILESTONES
- LONG-RANGE PLAN
- TECHNOLOGY OBJECTIVES

B. MSAT SERVICES

C. MSAT PROGRAM COSTS AND BENEFITS

D. MSAT PHASE A (CONCEPT FEASIBILITY STUDIES)

- PHASE A OBJECTIVES
- LIST OF PHASE A CONTRACTS
- OVERVIEW OF PROGRAM STUDIES
- OVERVIEW OF TECHNICAL STUDIES

MSAT PROGRAM BACKGROUND

MSAT SYSTEM

- ONE SPACECRAFT IN GEOSTATIONARY ORBIT IN THE VICINITY OF 109^{o} WEST LONGITUDE
- ONE SPARE SPACECRAFT ON THE GROUND (PARTIALLY INTEGRATED)
- ONE SATELLITE GROUND CONTROL STATION; AND
- FAMILY OF GROUND COMMUNICATIONS TERMINALS FOR
  - LAND VEHICLES
  - SHIPS
  - AIRCRAFT
  - MAN-PACK
  - FIXED INSTALLATIONS

MSAT PROGRAM SCHEDULE

PHASE A	CONCEPT FEASIBILITY	OCTOBER 1980 TO APRIL 1982
PHASE B	PROJECT DEFINITION AND TECHNOLOGY DEVELOPMENT	APRIL 1982 TO APRIL 1984
IMPLEMENTATION DECISION		APRIL 1984
PHASE C/D	ENGINEERING DEVELOPMENT AND MANUFACTURING	APRIL 1984 TO OCTOBER 1987
	LAUNCH	
PHASE E	EXPERIMENTS, DEMONSTRATIONS, FIELD TRIALS, AND INTERIM OPERATIONAL SERVICE	1987 TO 1994

MAJOR MSAT PROGRAM MILESTONES

FEB./SEPT. 1980	JOINT DOC/NASA PLANNING AND FEASIBILITY STUDIES STUDIES FOR MOBILE-SATELLITE DEMONSTRATION PROGRAM
JULY/SEPT. 1980	CABINET SUBMISSION FOR PHASE A STUDIES
OCTOBER 1980	GOVERNMENT FUNDING APPROVAL AND START OF MSAT PHASE A STUDIES IN CANADA
OCTOBER 1981	MOSST SUBMISSION TO CABINET ON FUTURE SPACE PROGRAMS INCLUDING MSAT PHASE B
DECEMBER 1981	GOVERNMENT DECISION TO PROCEED WITH PHASE B OF MSAT PROGRAM
MARCH 1982	DND DECISION TO PARTICIPATE IN PHASE B
MARCH 1982	PHASE A COMPLETED
APRIL 1982	JOINT DOC/DND PHASE B TREASURY BOARD SUBMISSION
JULY 1982	GOVERNMENT FUNDING APPROVAL FOR PHASE B

PROPOSED LONG-RANGE PLAN FOR DEVELOPMENT OF COMMERCIAL MOBILE-SATELLITE SERVICES IN CANADA

	DEMONSTRATION MOBILE-SATELLITE COMMUNICATIONS PROGRAM	FOLLOW-ON COMMERCIAL MOBILE-SATELLITE SYSTEM
ROLE OF DOC	1980-82 • SPONSOR DEFINITION STUDIES 1980- • DEVELOP POLICY AND REGULATORY ASPECTS 1982-87 • SPONSOR DEVELOPMENT OF SPACECRAFT AND EARTH STATIONS 1987-94 • PROVIDE SATELLITE FACILITY FOR EXPERIMENTS, DEMONSTRATIONS AND FIELD TRIALS • PROVIDE SATELLITE FACILITY TO CARRIERS FOR INTERIM COMMERCIAL SERVICES	• PERFORM REGULATORY FUNCTIONS

PROPOSED LONG-RANGE PLAN FOR DEVELOPMENT OF COMMERCIAL MOBILE-SATELLITE SERVICES IN CANADA (CONTINUED)

	DEMONSTRATION MOBILE-SATELLITE COMMUNICATIONS PROGRAM	FOLLOW-ON COMMERCIAL MOBILE-SATELLITE SYSTEM
ROLE OF INDUSTRY (MANUFACTURING AND CARRIER) AND USERS	1980-82 • ADVISE DOC ON USER AND SYSTEM NEEDS, PLANS AND OBJECTIVES • PROVIDE TECHNICAL SUPPORT 1982-87 • DEVELOP AND BUILD SPACECRAFT • PROVIDE TECHNICAL SUPPORT 1987-94 • SPONSOR EXPERIMENTS, DEMONSTRATIONS AND FIELD TRIALS • PROVIDE INTERIM COMMERCIAL SERVICES	1987-90 • CONDUCT MARKET TRIALS AND PLANNING 1990 • MAKE DECISION ON FOLLOW-ON COMMERCIAL SYSTEM 1990-93 • PROCURE COMMERCIAL SYSTEM 1994 • START OF COMMERCIAL OPERATIONAL SERVICES

GENERAL TECHNOLOGY OBJECTIVES OF MSAT PROGRAM

- TO DEVELOP AND DEMONSTRATE AN 800 MHz SATELLITE SYSTEM FOR MOBILE RADIO AND TELEPHONE SERVICES WITH THE FOLLOWING FEATURES:
  - NATION-WIDE COVERAGE
  - NATION-WIDE COMPATIBLE SERVICE
  - TECHNOLOGY APPLICABLE TO FOLLOW-ON COMMERCIAL SYSTEM
  - TRANSPARENT TO MODULATION TECHNIQUE OF MOBILE TERMINALS

- TO DEVELOP AND DEMONSTRATE AN EXPERIMENTAL MILITARY EHF COMMUNICATIONS SYSTEM WITH TECHNOLOGY RELEVANT TO FUTURE MILITARY OPERATIONS IN THE EHF FREQUENCY BAND.

SPECIFIC TECHNOLOGY OBJECTIVES FOR 800 MHZ SYSTEM

- DEVELOPMENT OF 800 MHz SPACECRAFT TRANSPONDER AND ANTENNA ELEMENTS
- DEVELOPMENT OF LOW-COST MOBILE TERMINALS
  - COMPATIBLE WITH MSAT AND WITH FUTURE TERRESTRIAL SYSTEMS
  - POWER AND SPECTRUM EFFICIENT VOICE PROCESSING AND MODULATION TECHNIQUES
  - NEW TECHNICAL STANDARDS FOR MOBILE TERMINAL OPERATING IN AN INTEGRATED SATELLITE-TERRESTRIAL SYSTEM
- EVALUATION OF NETWORK CONTROL OF MOBILE TERMINALS
- EVALUATION OF SPACECRAFT PLATFORMS, DEPLOYMENT AND SATELLITE CONTROL
- EVALUATION OF PROPAGATION LOSSES

MSAT SERVICES

SATELLITE SERVICES TO BE PROVIDED ON MSAT

1. PUBLIC MOBILE TELEPHONE AND MOBILE RADIO SERVICES (806-890 MHz)

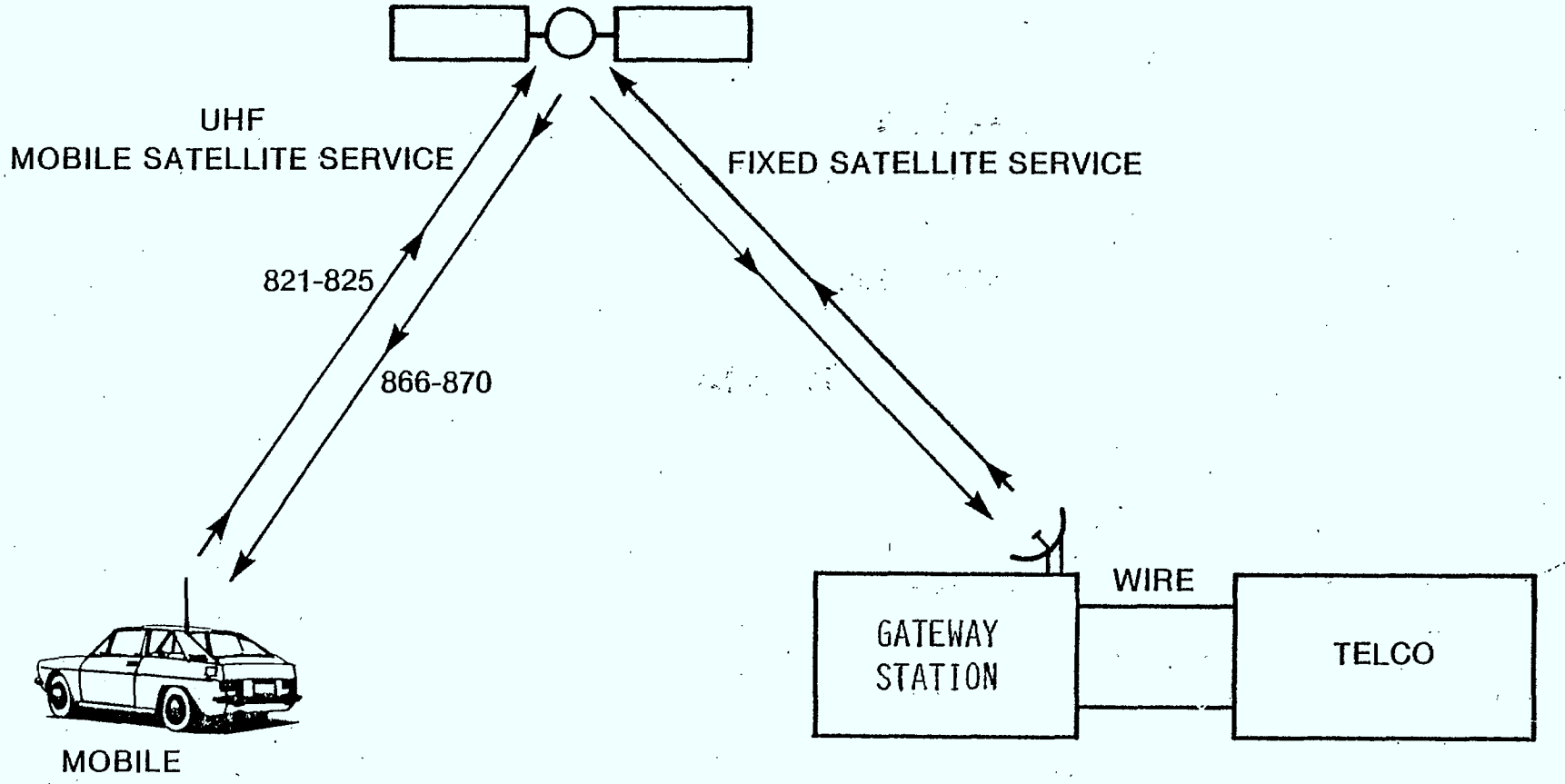
2. EXPERIMENTAL MILITARY EHF SERVICES (20/44 GHz)

3. DATA COLLECTION (401-403 MHz) (OPTION OF INTEREST TO DOE)

4. EMERGENCY BEACON MONITORING FOR SEARCH AND RESCUE (406.1 MHz) (OPTION OF INTEREST TO DOT)

COMMERCIAL UHF MOBILE-SATELLITE SERVICE

STATIONS	-	LAND VEHICLE, SHIPBORNE, PORTABLE, AND AIRCRAFT
SERVICE	-	FULL-DUPLEX MOBILE TELEPHONE, RADIO, DATA
AREA	-	CANADA AND COASTAL WATERS
FREQUENCY	-	SUB-BANDS WITHIN 806-890 MHz ALLOCATION
INTERCONNECTION	-	AMONG MOBILE STATIONS, TO TELEPHONE NETWORK OR TO BASE STATIONS



SYSTEM CONCEPT FOR MOBILE TELEPHONE SERVICE

DATA COLLECTION SERVICE (OPTION)

STATIONS	-	FIXED OR MOBILE DATA COLLECTION PLATFORMS
SERVICE	-	DATA COLLECTION FROM ENVIRONMENTAL SENSORS
TRIGGERING	-	TIME, EVENT, INTERROGATED
AREA	-	WHERE SATELLITE ELEVATION GREATER THAN 5 DEGREES
RATE	-	2.4 KPBS AT EIRP OF 13DBW, LOWER RATES AT LOWER EIRP
FREQUENCY	-	401-403 MHz
INTEROPERABILITY	-	GOES DATA COLLECTION PLATFORMS

EMERGENCY BEACON MONITORING SERVICE (OPTION)

FUNCTIONS	-	MONITORS EMERGENCY BEACON ON AIRCRAFT/SHIP/FIELD PARTIES AND NOTIFIES SEARCH AND RESCUE CENTRES OF EMERGENCIES
CAPABILITIES	-	CONTINOUS EARTH COVERAGE FROM GEOSTATIONARY ORBIT
	-	EARLY ALERTING CAPABILITY
	-	BEACON IDENTIFICATION
	-	COMPLEMENTARY TO SARSAT* CAPABILITY
FREQUENCY	-	406-406.1 MHz
BEACONS	-	UTILIZE SARSAT ELT** WITH IDENTIFICATION CODE UTILIZE EMERGENCY POSITION INDICATING RADIO BEACONS
INTEROPERABILITY	-	SARSAT

* SARSAT: SEARCH AND RESCUE SATELLITE SYSTEM TO BE PLACED IN POLAR ORBIT

** ELT: EMERGENCY LOCATOR TRANSMITTER

MSAT PROGRAM COSTS AND BENEFITS

MSAT PROGRAM COST ESTIMATES

1982 CANADIAN DOLLARS

	DOC	DND	TOTAL	
PHASE A	2.2		2.2	APPROVED
PHASE B	17.0	5.0	22.0	APPROVED
PHASE C/D/E (PREL. ESTIMATE)	365.8	55.0	420.8	NOT APPROVED
TOTAL	$385.0 M	$60.0 M	$445.0 M	

FINANCING

- DOC, DND AND OTHER CANADIAN PARTICIPANTS
- FOREIGN PARTICIPANTS
- COST RECOVERY FROM USERS

MSAT PROGRAM BENEFITS

TYPE		RECIPIENTS
SOCIAL	IMPROVED MOBILE SERVICES FOR CANADIANS	PUBLIC BEING SERVED INDUSTRY GOVERNMENTS BUSINESS
ECONOMIC	CANADIAN CONTENT JOB CREATION DOMESTIC SALES EXPORT SALES MORE EFFICIENT USER OPERATIONS	OVERALL CANADIAN ECONOMY MANUFACTURING INDUSTRY TELECOMMUNICATIONS INDUSTRY USERS
TECHNOLOGY	PATENTS SKILL DEVELOPMENT MANUFACTURING PROCESS NEW PRODUCTS AND SYSTEMS SPIN-OFFS	MANUFACTURING INDUSTRY
POLICY	IMPROVED COMMUNICATIONS SERVICES ECONOMIC DEVELOPMENT INCREASE R&D NATIONAL UNITY ACCESS TO ORBIT AND SPECTRUM RESOURCES	CANADA

MSAT PHASE A (CONCEPT FEASIBILITY STUDIES)

MSAT PHASE A OBJECTIVES

- TO EXPLORE THE USE OF SATELLITES TO IMPROVE MOBILE COMMUNICATIONS IN CANADA.

- TO DEFINE CONCEPTS AND PLANS FOR A DEMONSTRATION COMMUNICATIONS SATELLITE MSAT.

- TO PROVIDE MARKET, ECONOMIC, TECHNICAL, COST AND OTHER INFORMATION NEEDED FOR A DECISION ON WHETHER OR NOT TO PROCEED WITH PHASE B.

LIST OF PHASE A CONTRACTS

STUDY	CONTRACTORS	COST
1. MARKET AND ECONOMIC STUDIES		
MARKET STUDY	WOODS GORDON	$200K
COMMERCIAL VIABILITY STUDY	INTEL/TOUCHE ROSS	$200K
USER COST BENEFIT STUDY	SYSTEMHOUSE	$100K

LIST OF PHASE A CONTRACTS (CONTINUED)

STUDY	CONTRACTORS	COST
2. SPACE SEGMENT STUDIES		
SPACECRAFT CONFIGURATION STUDIES	SPAR	$825K
ANALYSIS OF ALTERNATIVE SYSTEMS	CAL	$240K*
SPACECRAFT MODELLING PROGRAM	CAL	$ 25K
MULTIBAND USE OF LARGE REFLECTOR	U. OF MANITOBA	$ 25K
SOFTWARE FOR MSAT STRUCTURAL CONFIGURATION	KENDALL	$ 20K

* JOINTLY FUNDED WITH DND

LIST OF PHASE A CONTRACTS (CONTINUED)

STUDY	CONTRACTORS	COST
3. GROUND SEGMENT AND SYSTEMS ENGINEERING		
CENTRAL CONTROL STATION	SED	$50K
GATEWAY STATION	SED	$30K
800 MHz TRANSPORTABLE MOBILE ANTENNA	ANDREW ANTENNA	$25K
800 MHz SHIP MOBILE ANTENNA	CAL	$25K
806-890 MHz MOBILE AND PORTABLE TERMINALS	ADGA	$50K
MISSION OPERATION AND AVAILABILITY ANALYSIS	TELESAT	$95K

LIST OF PHASE A CONTRACTS (CONTINUED)

STUDY	CONTRACTORS	COST
3. GROUND SEGMENT AND SYSTEMS ENGINEERING (CONTINUED)		
FREQUENCY INTERFERENCE	CAL	$25K
MULTIPLE ACCESS STUDY	MCS	$25K
SOFTWARE REQUIREMENTS	GASTOPS	$50K
APPLICATION DES SATELLITES AU DOMAINE DE LA RADIO MOBILE CANADIENNE (PHASE 1 ET PHASE 2)	UNIVERSITÉ DE SHERBROOKE	$60K

LIST OF PHASE A CONTRACTS

STUDY	CONTRACTORS	COST
4. TECHNOLOGY DEVELOPMENT		
SPACECRAFT FLEXIBILITY ASSESSMENT	DYNACON	$20K
SPACECRAFT THERMAL CONTROL	SPAR	$20K
REACTION CONTROL SYSTEMS	SPAR	$20K
SPACECRAFT DYNAMICS AND CONTROL	ANCON, SPAR	$60K
STRUCTURAL MODAL PARAMETERS	U. OF SHERBROOKE	$25K
VECTOR QUANTIZATION LPC	U. OF SHERBROOKE	$30K

OVERVIEW OF THE PHASE A MSAT MARKET STUDY

OBJECTIVE

TO IDENTIFY USER REQUIREMENTS
FOR A SATELLITE SYSTEM PROVIDING
MOBILE COMMUNICATION SERVICES
IN THE 806 - 890 MHz BAND

LICENCED MOBILE RADIOS IN CANADA
MARCH 1981

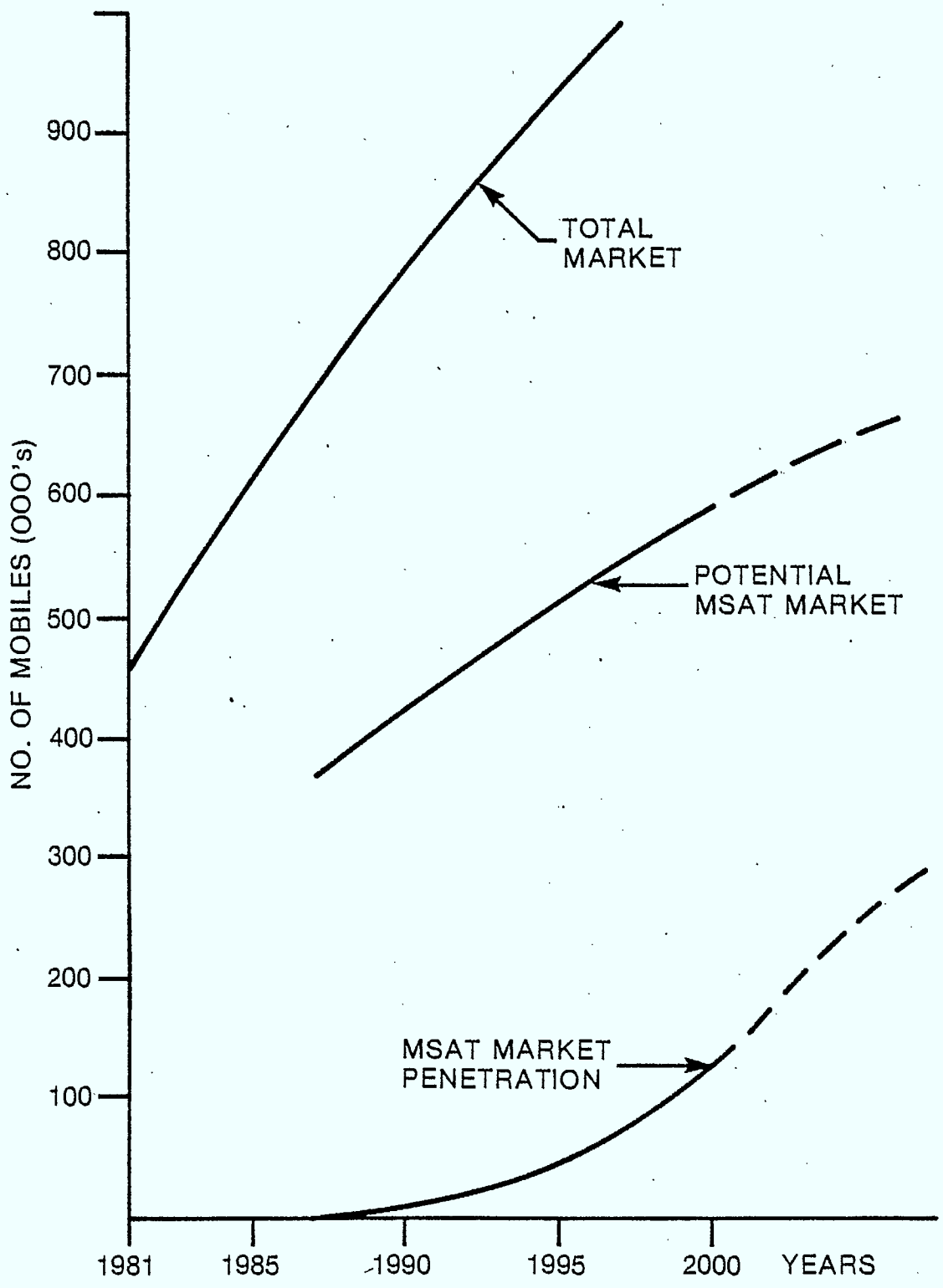
LAND – BASED	410,000
SHIPS	24,000
AIRCRAFT	17,000
TOTAL	451,000*

* INCLUDES ESTIMATED 49,000 MOBILE TELEPHONES

PROBLEM AREAS IDENTIFIED BY USERS IN NON-METROPOLITAN AREAS

	% OF RESPONSES
NOISE, INTERFERENCE AND DISTORTION	51%
INADEQUATE RANGE	41%
DELAY IN GETTING THROUGH	14%
NO LINK WITH ASSOCIATED SYSTEMS	11%

PROJECTED MOBILE COMMUNICATIONS MARKET



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Programme spatial

MSAT

OVERVIEW OF PHASE A MSAT USER COST BENEFIT STUDY

OBJECTIVE OF USER COST BENEFIT STUDY

TO DETERMINE IN QUANTATIVE TERMS THE BENEFITS MSAT USERS WILL EXPERIENCE VERSUS THE COST INCURRED BY USING AN OPERATIONAL MOBILE SATELLITE SYSTEM OPERATING IN 806-890 MHz BAND

USER COST BENEFIT STUDY

APPLICATION AREA	STUDY PARTICIPANTS
- MINERAL EXPLORATION	ESSO PETROCAN DOME GARNETT DRILLING
- FOREST INDUSTRIES	BC FOREST PRODUCTS
- RAILWAYS	CNR BC RAILWAYS CPR
- TRUCKING	CAN TRUCKING ASSOCIATION ONTARIO TRUCKING ASSOCIATION CP TRANSPORT

USER COST BENEFIT STUDY

APPLICATION AREA	STUDY PARTICIPANTS
- FOREST FIRE FIGHTING	ONTARIO MINISTRY OF NATURAL RESOURCES BC MINISTRY OF FORESTRY
- COASTAL FISHING	NATIONAL SEA PRODUCTS BC PACKERS
- EMERGENCY MEDICAL	NOVA-SCOTIA MINISTRY OF HEALTH ONTARIO MINISTRY OF HEALTH
- NETWORK, MAINTENANCE AND CONSTRUCTION	A.G.T. HYDRO QUEBEC
- LAW ENFORCEMENT	SQ RCMP OPP

CLASSES OF USER BENEFITS

- INCREASES BUSINESS AND PROFIT FOR USER
- USER COST SAVING
- TIME SAVING
- DAMAGE AVOIDED
- UNMEASURED BENEFIT
  - SAFETY
  - SECURITY
  - LIVES SAVED
  - LESS ISOLATION

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OVERVIEW OF THE PHASE A MSAT COMMERCIAL VIABILITY STUDY

OBJECTIVE

- EXAMINE THE FUTURE USE OF MOBILE-SATELLITE SYSTEMS TO COMPLEMENT TERRESTRIAL SYSTEMS FOR MOBILE SERVICES
- EXAMINE ALL-TERRESTRIAL COMPETITIVE SYSTEMS
- EXAMINE THE COMMERCIAL VIABILITY OF SUCH SYSTEMS

RESULTS OF COMMERCIAL VIABILITY STUDY

- PRELIMINARY PHASE A STUDY INDICATES THAT FOLLOW-ON COMMERCIAL MSAT SYSTEM WILL BE VIABLE

- SATELLITE SYSTEM IS ESTIMATED TO BE MORE COST EFFECTIVE THAN TERRESTRIAL SYSTEM FOR WIDE-AREA MOBILE COMMUNICATIONS

- LIST OF MAIN REPORTS FROM STUDY

  TRAFFIC MODEL
  FUNCTIONAL REQUIREMENTS
  TERRESTRIAL SYSTEMS
  ECONOMIC MODEL
  INTEGRATED SYSTEM CONCEPTS
  TERRESTRIAL SYSTEM CONCEPTS
  FINAL REPORT

Government of Canada
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Ministère des Communications
Programme spatial

PHASE A TECHNICAL STUDY RESULTS

INDUSTRY BRIEFING

SEPT. 9/10, 1982

PHASE "A" RESULTS WHICH DETERMINE DEMONSTRATION SYSTEM DESIGN

(1) STUDIES INDICATED COMMERCIAL VIABILITY RESULTS ESTIMATE 22,000 USERS BY 1994 WITH 140,000 USERS BY 2001.

(2) DEVELOPMENTAL APPROACH IS TO LAUNCH A DEMONSTRATION MODEL BASED ON AN AVAILABLE BUS DESIGN WITH A UHF PAYLOAD WHICH WILL ACCOMMODATE UP TO 22,000 USERS.

(3) ENGINEERING STUDIES INDICATE THAT REQUIREMENTS FOR A DEMONSTRATION MISSION CAN BE MET WITH 9.1 M. DIAMETER ANTENNAS.

(4) IT IS PLANNED TO DEMONSTRATE HIGHLY EFFICIENT MODULATION SYSTEMS SUCH AS, ACSB, RELPC, PELPC, AS WELL AS THE STANDARD N.B.F.M.

(5) EARLY DEVELOPMENT OF RELIABLE, LOW COST GROUND BASED EQUIPMENT IS ESSENTIAL.

PHASE "A" RESULTS

LIST OF REPORTS

PROGRAM STUDIES

1. "User Requirements for a Mobile Satellite System Operating in the 806-890 MHz Band", Vol. 1 - Report, Vol. II - Tables and Appendices, Woods Gordon Management Consultants, Toronto, Ont., September 1981, DOC-CR-SP-81-025.

2. "MSAT Commerical Viability Study", ADGA Consulting Group, Ottawa, Ont., March 1982, DOC-CR-SP-81-046.

3. "User Cost Benefit Study for a Mobile Satellite Radio System", Systemhouse Ltd., Ottawa, Ont. 3 Volumes, DOC-CR-SP-82-026, -027, 028.

4. "MSAT Phase B Project Plan", T.A. Eastland, Ottawa, Ont. October 1981.

SPACE SECTOR STUDIES

5. "MSAT Canadian Demonstration Spacecraft - Report and Baseline Performance Document", SPAR Aerospace, Ste. Anne-de-Bellevue, Quebec, November 1981, Vol. 1 Technical Description, Vol. 2 Appendix, DOC-CR-SP-81-047A.

6. "Executive Summary - MSAT Spacecraft Conceptual Design Studies - Commercial and Canadian Military Satellite Services", SPAR Aerospace, Ste. Anne-de-Bellevue, Quebec, November 1981, DOC-CR-SP-81-047B.

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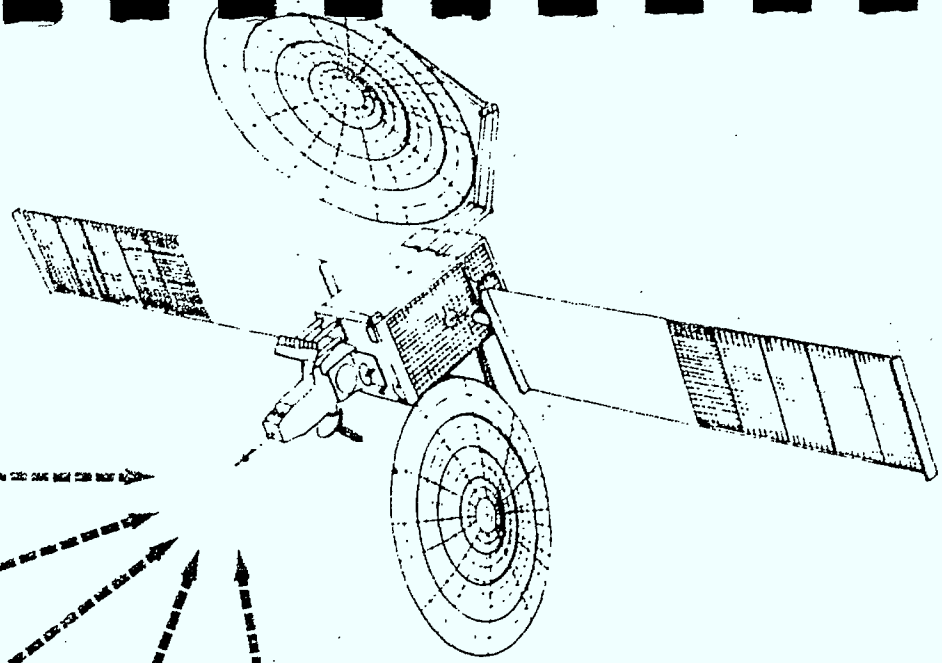
MSAT

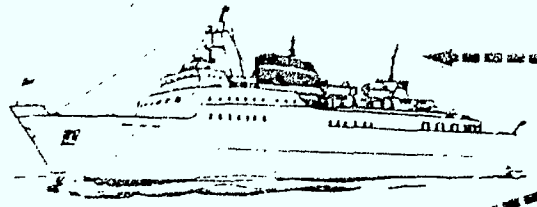
MSAT SYSTEM CONCEPT

J.D.B. KENT

AGENDA ITEM 4

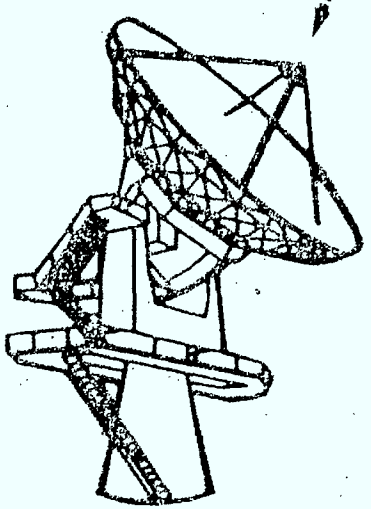
M-SAT
SYSTEM CONCEPT





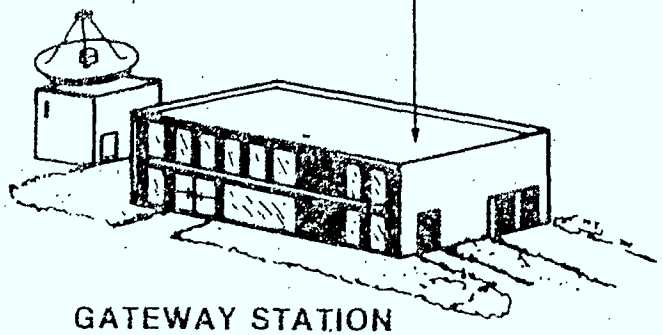
SEA MOBILES

BASE STATION
OR
FIELD-PORTABLE STATION

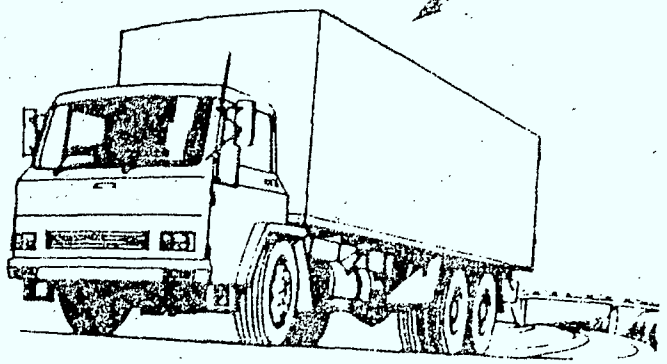


CENTRAL CONTROL
STATION

TELEPHONE
NETWORK



GATEWAY STATION



LAND MOBILES

MSAT

MSAT SYSTEM CONCEPT OUTLINE

- System Elements
- User Requirements
- Types of Service
- Community of Interest
- Channel Requirements
- Frequency Requirements
- System Coverage
- Link Budgets
- Space Segment

AMSAT

SYSTEM ELEMENTS

MOBILE RADIO TERMINALS - LIGHTWEIGHT, ROBUST, MULTICHANNEL RADIO SETS TRANSMITTING AT 821 - 825 MHZ AND RECEIVING AT 866 - 870 MHZ.

GATEWAYS - SHF RECEIVING AND TRANSMITTING TERMINALS WHICH PROVIDE CALL ROUTING, SWITCHING AND INTERFACE WITH THE TERRESTRIAL NETWORK.

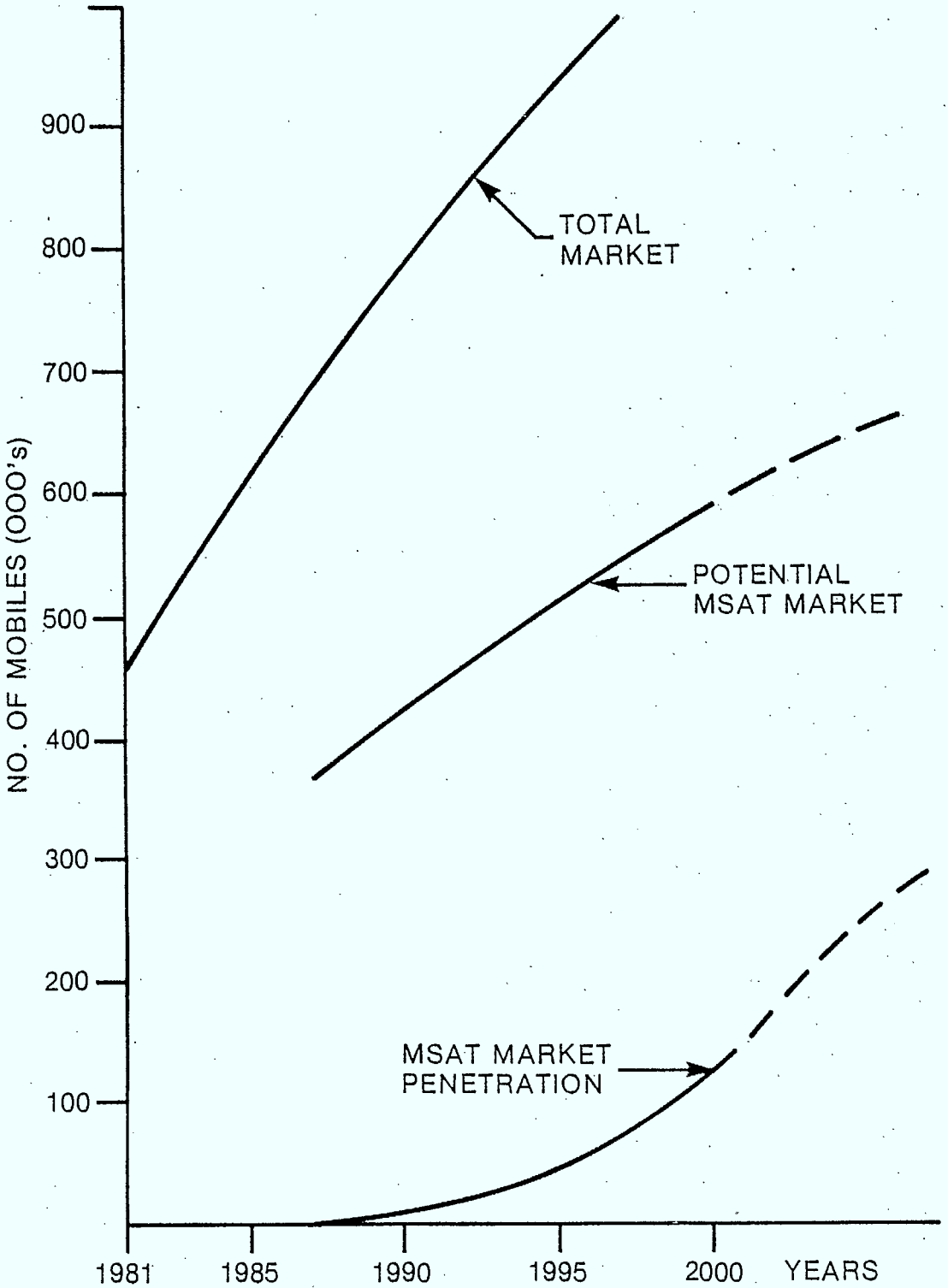
MASTER GATEWAY - A GATEWAY STATION THAT CONTROLS ALL OTHER GATEWAYS. IT MAY ALSO INCLUDE THE NETWORK MANAGEMENT FUNCTION.

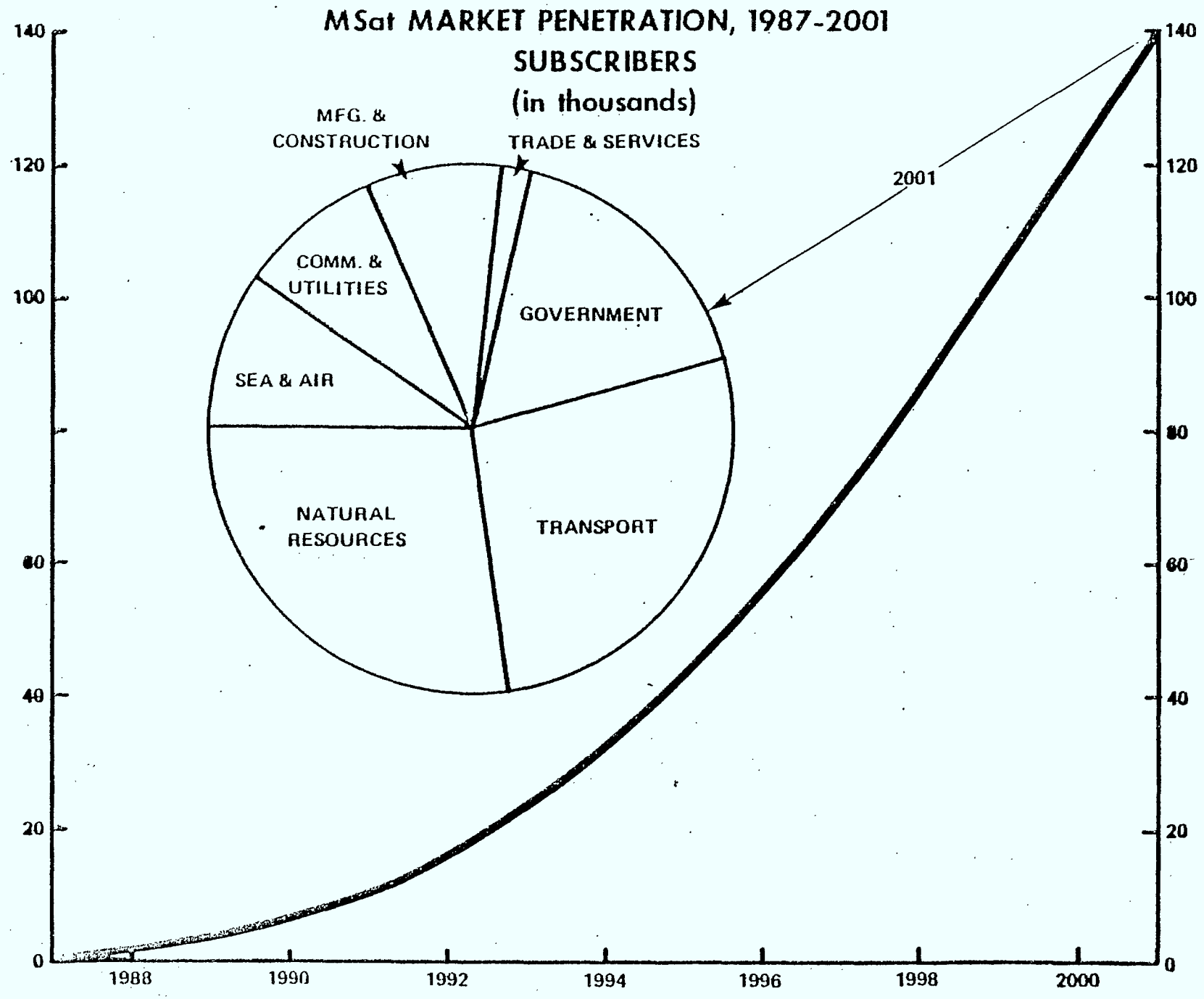
CENTRAL CONTROL STATION - A STATION THAT PERFORMS SATELLITE CONTROL, DIAGNOSTIC AND COMMAND. IT MAY ALSO INCLUDE THE NETWORK MANAGEMENT FUNCTION.

UHF - BASE STATIONS - FIXED TERMINALS TRANSMITTING AT 821 - 825 MHZ AND RECEIVING AT 866 - 870 MHZ. USES RELATIVELY HIGH GAIN ANTENNA.

SHF - BASE STATIONS - FIXED TERMINAL TRANSMITTING AT 7.975 - 8.025 GHZ AND RECEIVING AT 7.25 - 7.30 GHZ.

PROJECTED MOBILE COMMUNICATIONS MARKET




MSat MARKET PENETRATION, 1987-2001
SUBSCRIBERS
(in thousands)
MFG. & CONSTRUCTION
TRADE & SERVICES
COMM. & UTILITIES
GOVERNMENT
SEA & AIR
NATURAL RESOURCES
TRANSPORT
2001
140
120
100
80
60
40
20
0
1988
1990
1992
1994
1996
1998
2000

SARSAT

TYPES OF SERVICE

1. MOBILE RADIO SERVICE (MRS)

   - DIRECT VOICE COMMUNICATION BETWEEN MOBILE USERS, BASE STATIONS, GATEWAY STATIONS AND OTHER MOBILES
   - HIGH CALLING RATE WITH SHORT HOLDING TIME PER CALL
   - COMMUNICATION QUALITY
   - HALF DUPLEX AND VOICE ACTIVATED OR PUSH TO TALK

2. MOBILE TELEPHONE SERVICE (MTS)

   - DIRECT VOICE COMMUNICATION BETWEEN MOBILE USERS, GATEWAY STATIONS AND OTHER MOBILES
   - DIRECT ACCESS TO SWITCHED TELEPHONE NETWORK VIA GATEWAYS
   - CALLS CHARACTERIZED AS NORMAL MOBILE TELEPHONE
   - VOICE QUALITY ABOVE TOLL QUALITY IN ABSENCE OF FADES
   - FULL DUPLEX AND VOICE ACTIVATED

3. DATA SERVICE (DS)

   - PROVIDED TO MTS SUBSCRIBERS USING BASIC MTS TERMINALS
   - 4.8 KB/S DATA RATE, 1 IN 10^6 BER
   - 2400 BYTES OF DATA BUFFERING AT MOBILE TERMINAL

4. DATA COLLECTION PLATFORMS (DCP)

   - 401 - 403 MHZ UPLINK TO CCS VIA SHF BACKHAUL
   - DATA DISTRIBUTED TO SUBSCRIBERS VIA TERRESTRIAL NETWORK

5. EMERGENCY POSITION - INDICATING RADIO BEACONS (EPIRB)

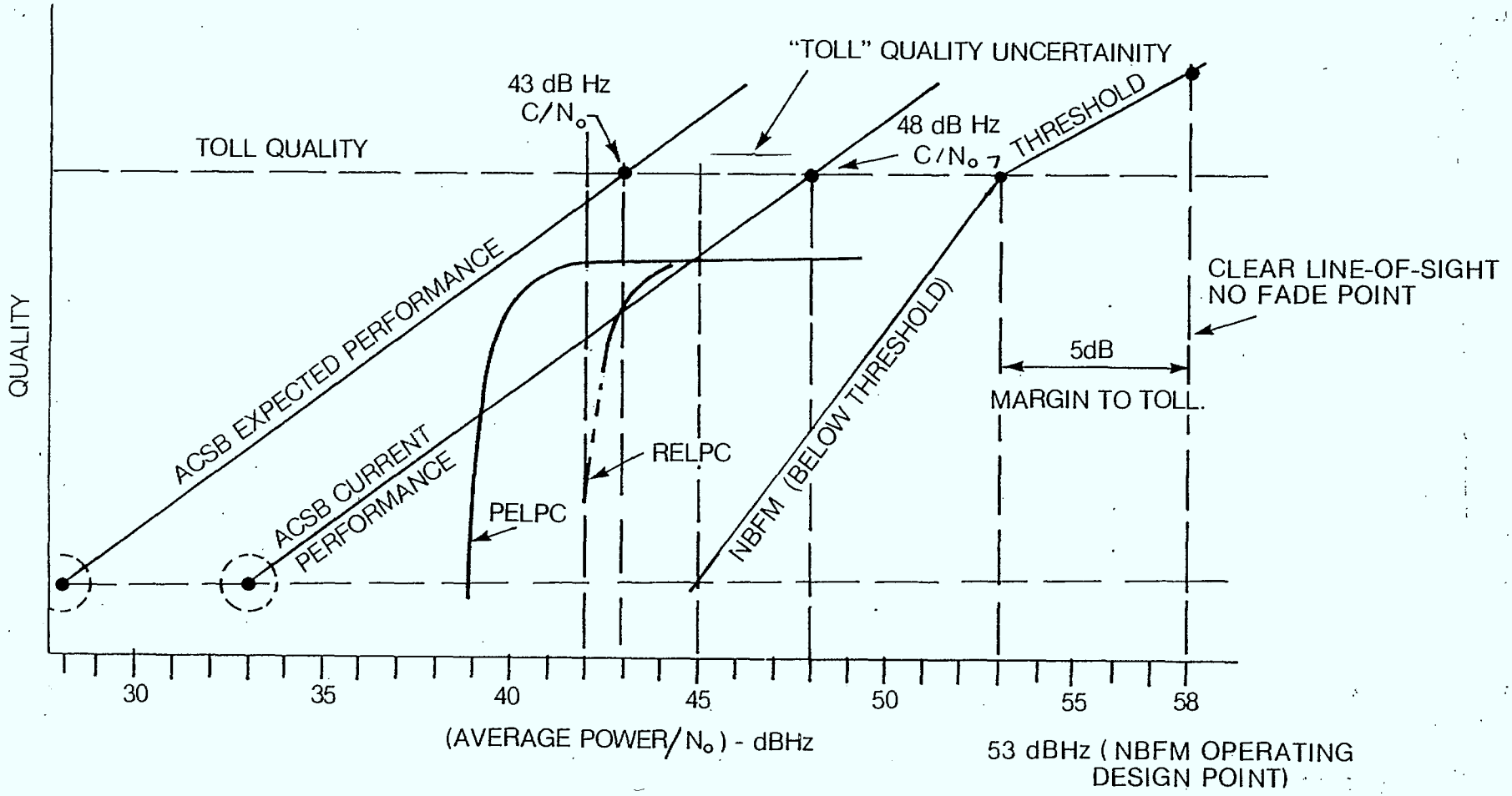
   - 406.1 MHZ UPLINK TO CCS VIA SHF BACKHAUL
   - INFORMATION FORWARDED TO SEARCH AND RESCUE CENTRES FOR PROCESSING
   - COMPLEMENTARY TO SARSAT SYSTEM

VOICE SERVICE CHARACTERISTICS

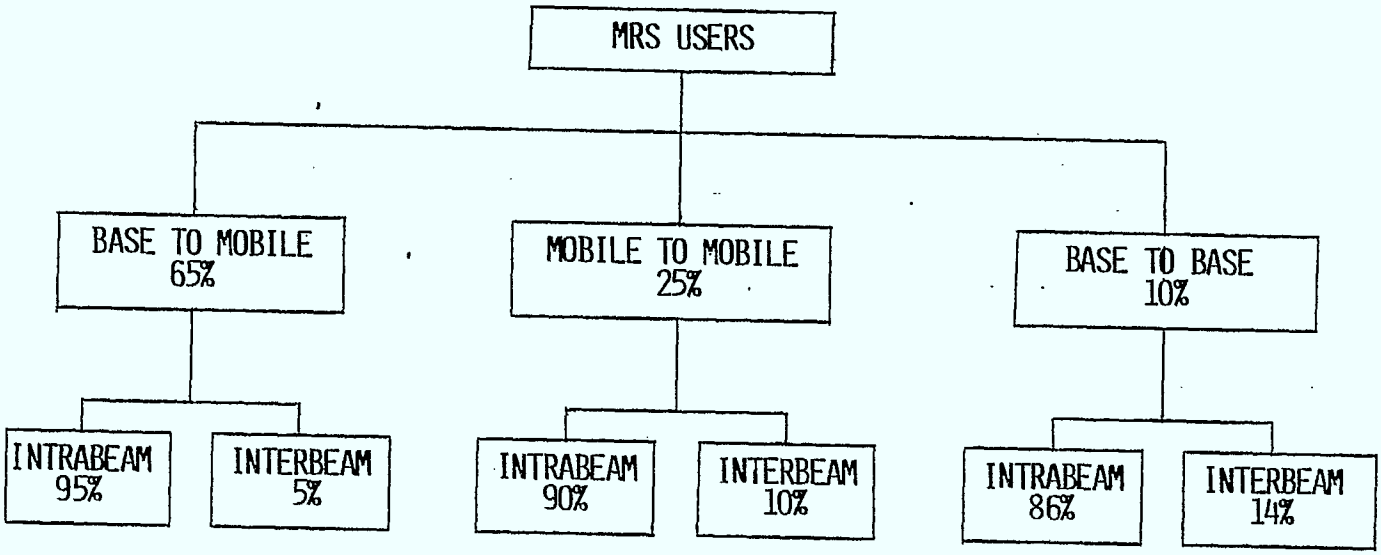
1. BUSY HOUR TRAFFIC INTENSITY PER USER — 0.0155 ERLANGS
2. SATELLITE END OF LIFE (EOL) GRADE OF SERVICE — P. 10
3. MINIMUM QUALITY WILL BE EXCEEDED — 99% OF TIME
4. VOICE QUALITY

	CARRIER TO NOISE SPECTRAL DENSITY C/No	
	FULL QUALITY	MINIMUM QUALITY (COMMUNICATION)
NBFM	53 dB-Hz	45 dB-Hz
PELPC	42 dB-Hz	39 dB-Hz
ACSB	48 dB-Hz	33 dB-Hz

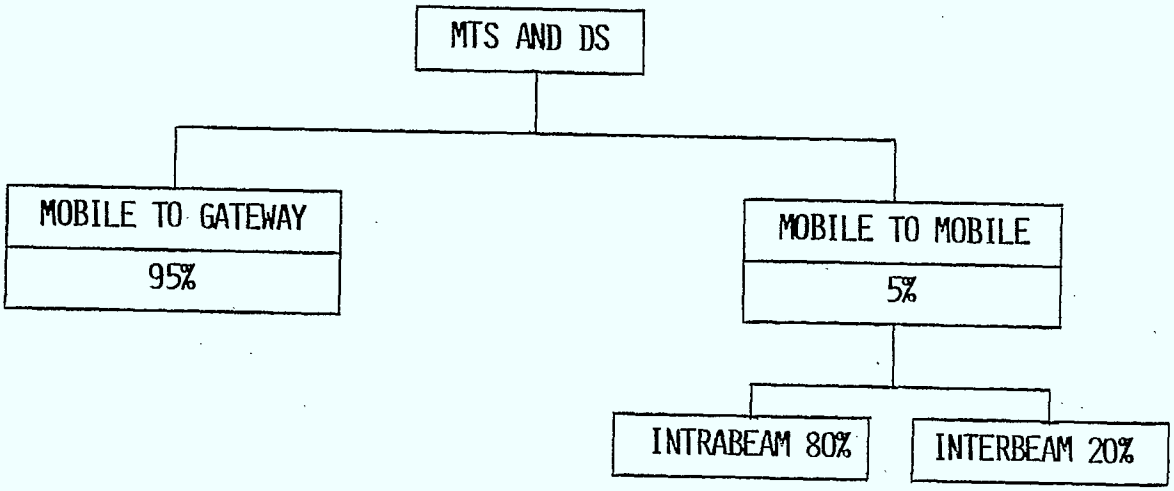
VARIATION IN SPEECH QUALITY



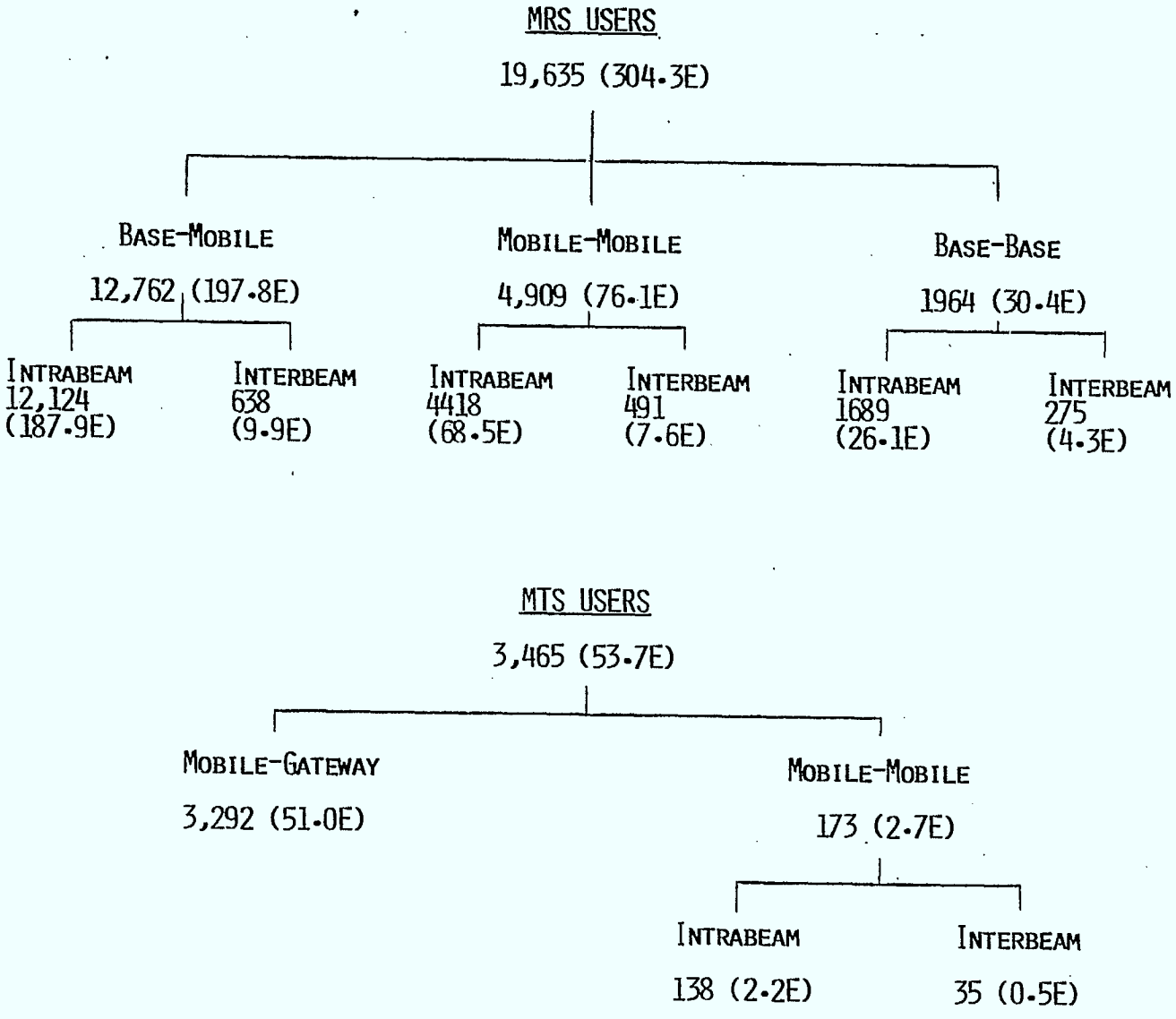
MRS COMMUNITY OF INTEREST



MTS AND DS COMMUNITY OF INTEREST



MSAT SATELLITE EOL PROJECTED NUMBER OF USERS AND COMMUNITY OF INTEREST



CHANNEL REQUIREMENTS

Basic Assumptions

MRS - All mobile - mobile and base - base intrabeam traffic and 50% of base - mobile intrabeam. traffic will be UHF/UHF routed. The remaining 50% base - mobile intrabeam traffic will be UHF/SHF routed via gateways or SHF base stations. All interbeam traffic will be double hop via a gateway.

MTS - All mobile to mobile traffic will be double hop via a gateway.

4 BEAM CANADA COVERAGE

EOL LOADING

	UHF-SHF		UHF-UHF	
SERVICE	Erlangs/beam	Channels/beam	Erlangs/beam	Channels/beam
MTS	14.1	17		
MRS	34.4	36	47.2	48

FREQUENCY PLAN

MOBILE RADIO SERVICE

UPLINK - 821 - 825 MHz
DOWNLINK - 866 - 870 MHz
5 kHz VOICE CHANNELS USING LINEAR PREDICTIVE CODING (LPC)

MOBILE TELEPHONE SERVICE

UPLINK - 821 - 825 MHz
DOWNLINK - 866 - 870 MHz
30 kHz VOICE CHANNELS USING
NARROW BAND FREQUENCY MODULATION (NBFM)

DATA COLLECTION SERVICE

UPLINK - 401 - 403 MHz
100 BPS DATA MESSAGE USING PHASE SHIFT KEYING

EMERGENCY SERVICE

UPLINK - 406.1 MHz
400 BPS DATA MESSAGE USING PHASE SHIFT KEYING

BACKHAUL

UPLINK - 7.975 - 8.025 GHz
DOWNLINK - 7.250 - 7.300 GHz

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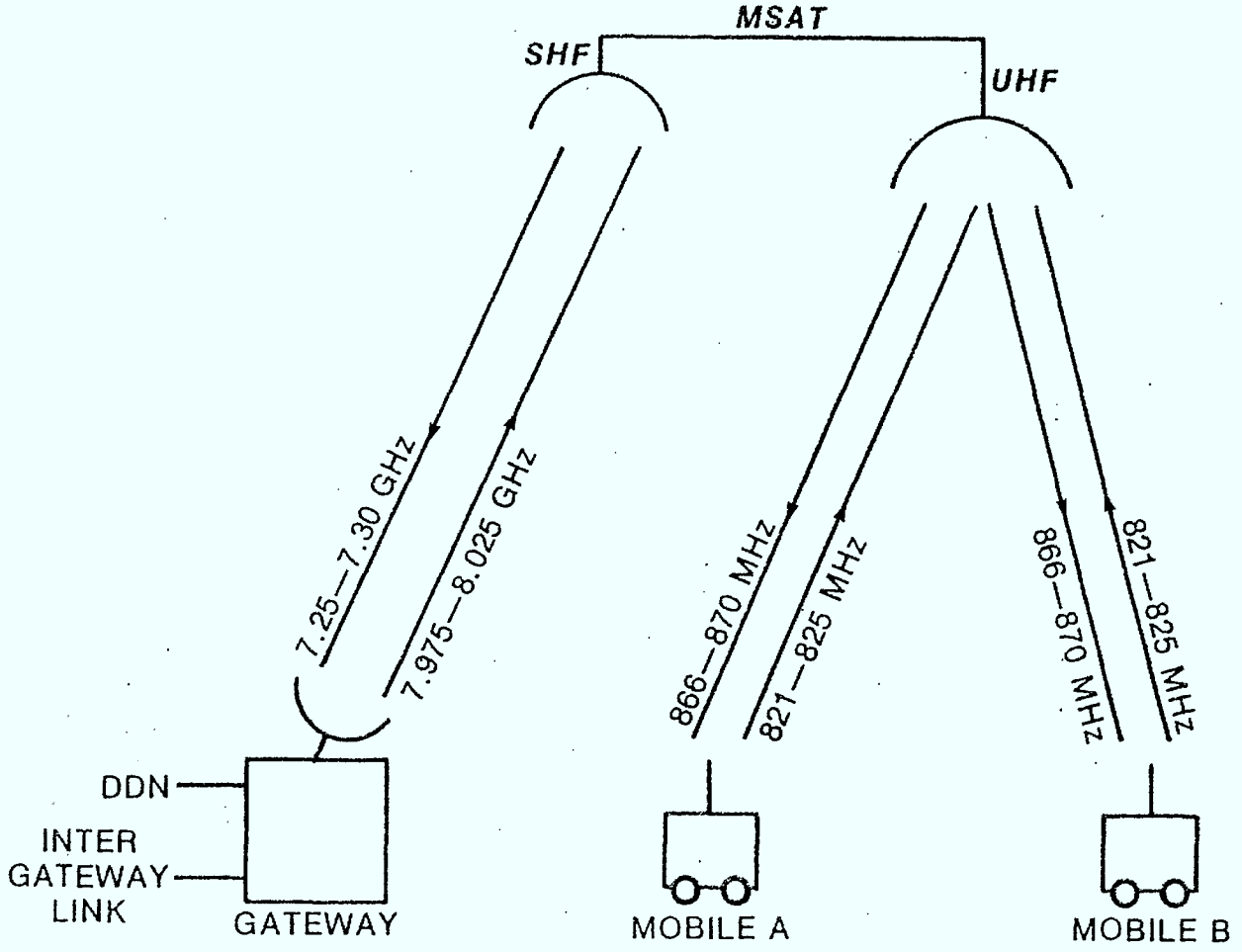
Programme spatial

MSAT

MOBILE TELEPHONE SERVICE



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Department of Communications
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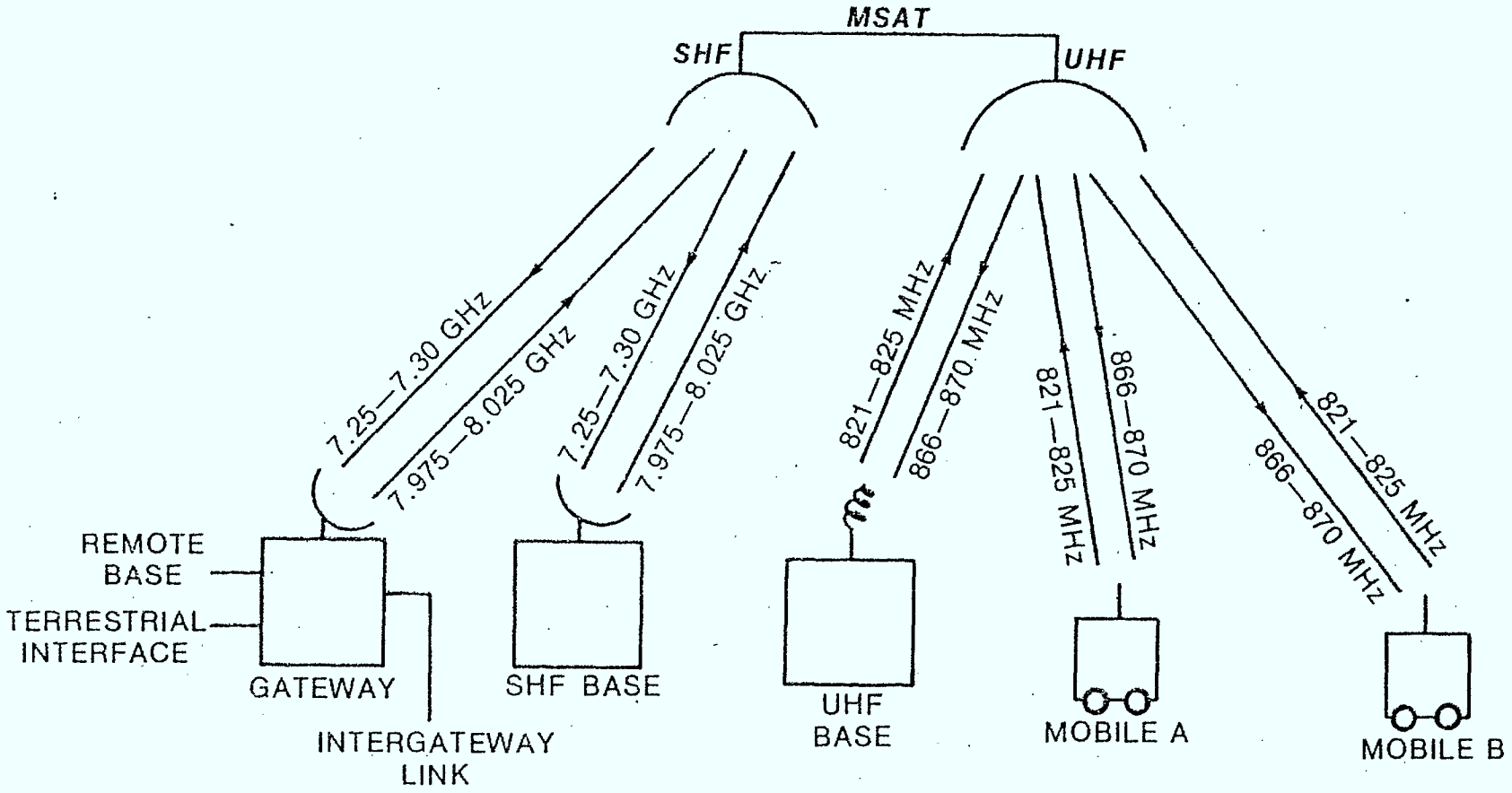
Ministère des Communications
Programme spatial

MSAT

MOBILE RADIO SERVICE



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Space Program

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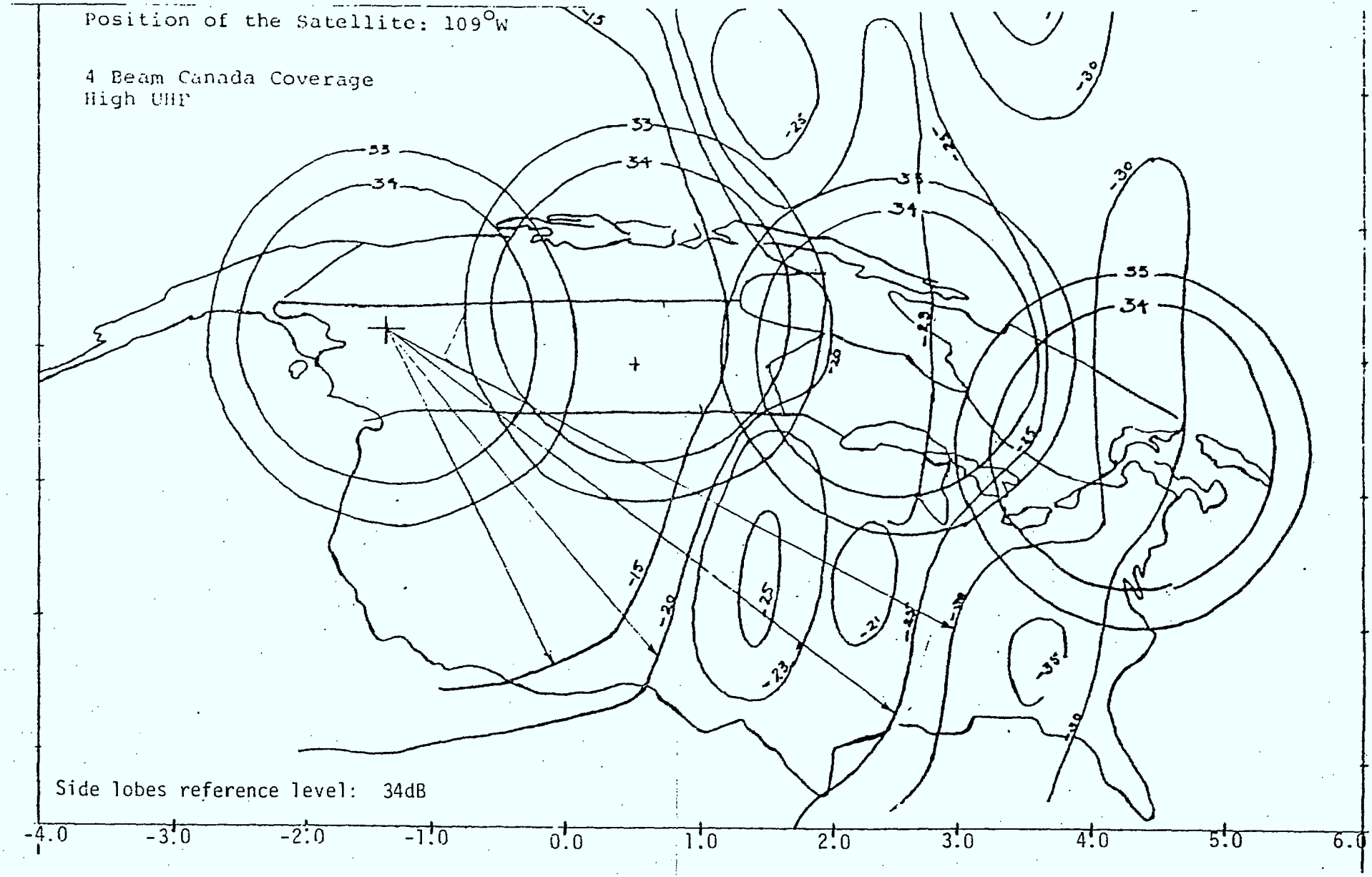
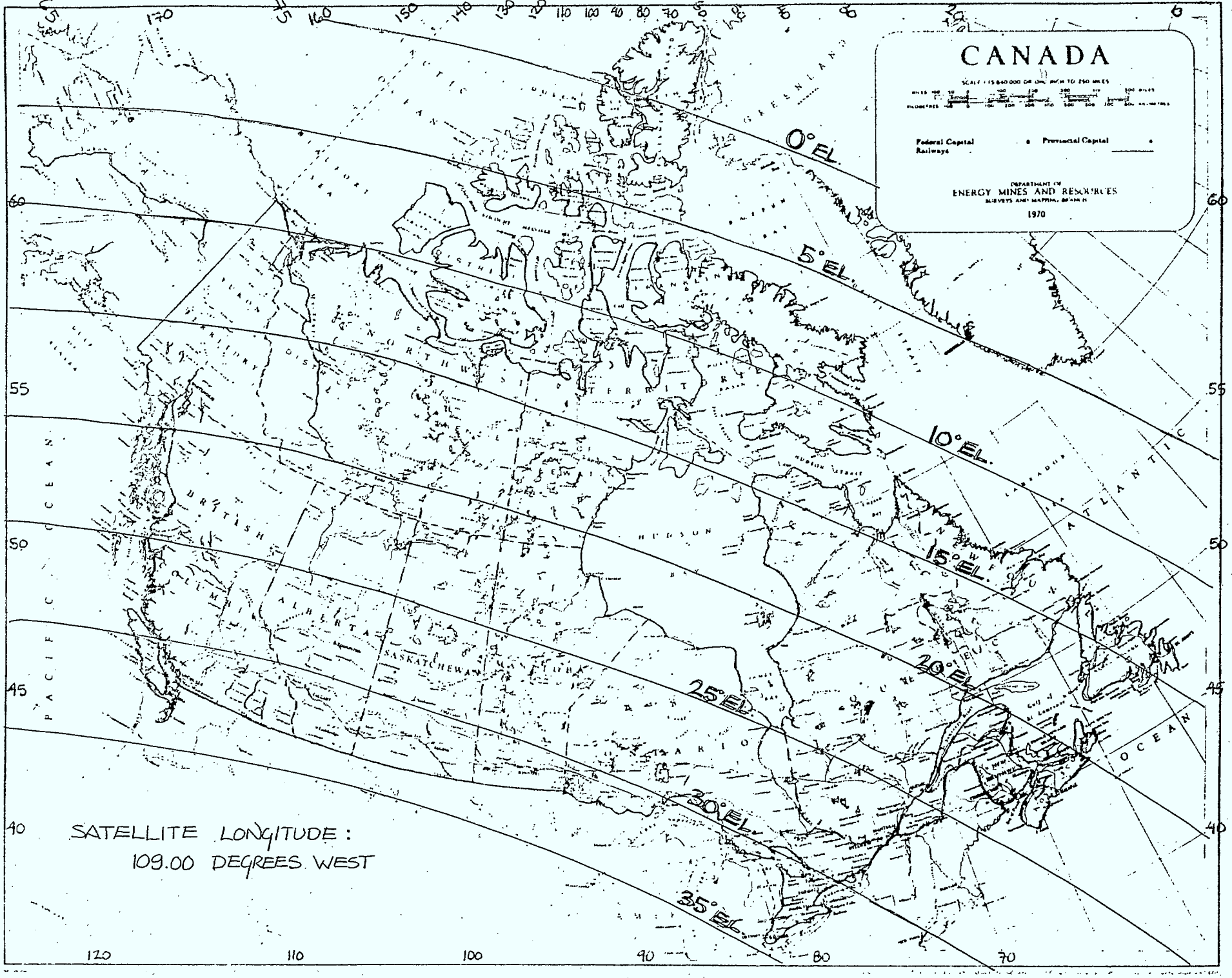
Ministère des Communications
Programme spatial

ANIK




CANADA
SCALE 1:5 840 000 OR ONE INCH TO 250 MILES
Federal Capital
Provincial Capital
Railways
DEPARTMENT OF
ENERGY MINES AND RESOURCES
SURVEYS AND MAPPING BRANCH
1970
0° EL.
5° EL.
10° EL.
15° EL.
20° EL.
25° EL.
30° EL.
35° EL.
SATELLITE LONGITUDE :
109.00 DEGREES WEST
PACIFIC OCEAN
ATLANTIC OCEAN
ARCTIC OCEAN
GREENLAND
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
HUDSON BAY
NORTHWEST TERRITORIES
60
55
50
45
40
120
110
100
90
80
70

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Department of Communications

Space Program

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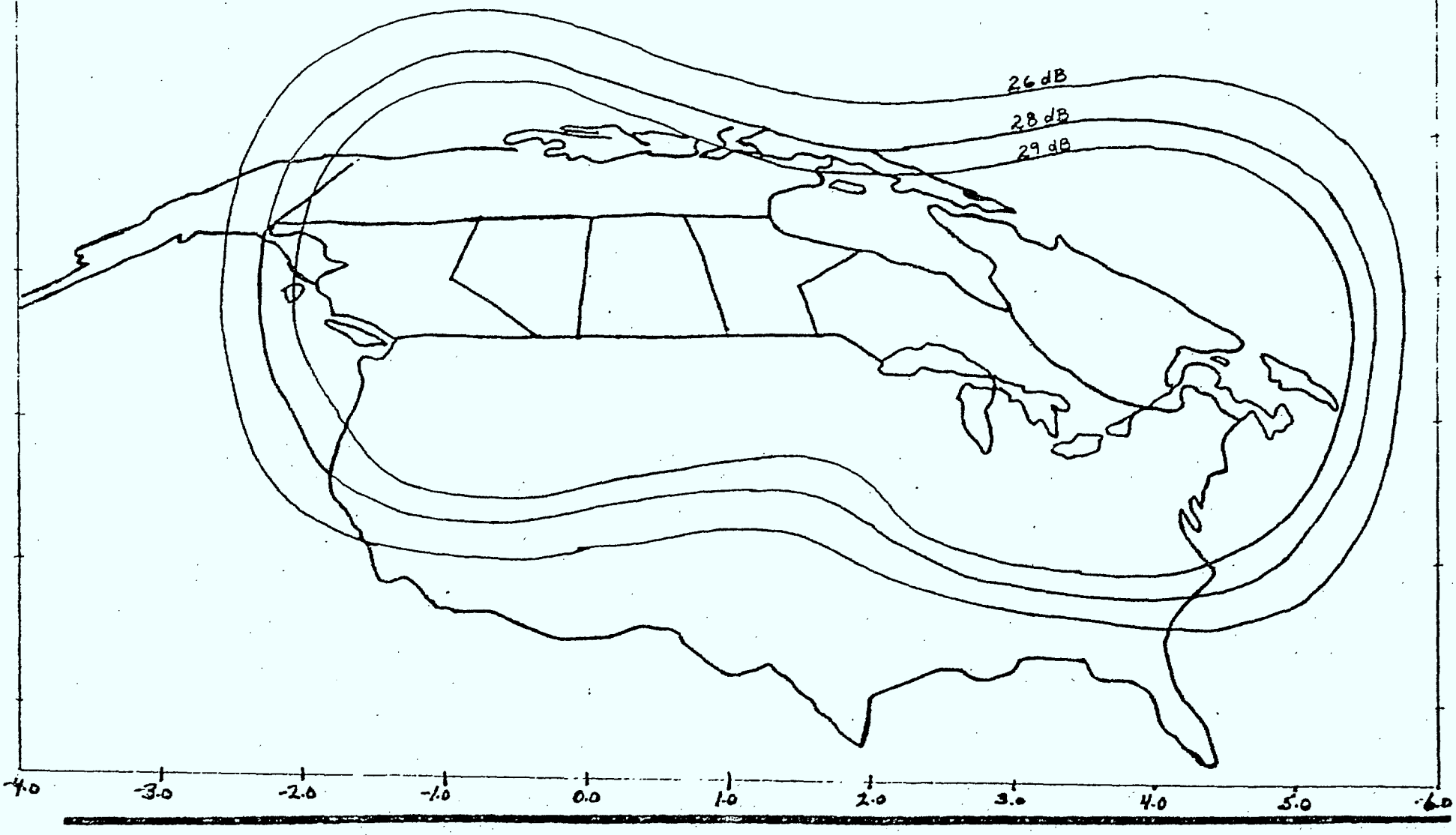
Ministère des Communications

Programme spatial

Position of the Satellite: 109°W

BACKHAUL 7.25 GHz



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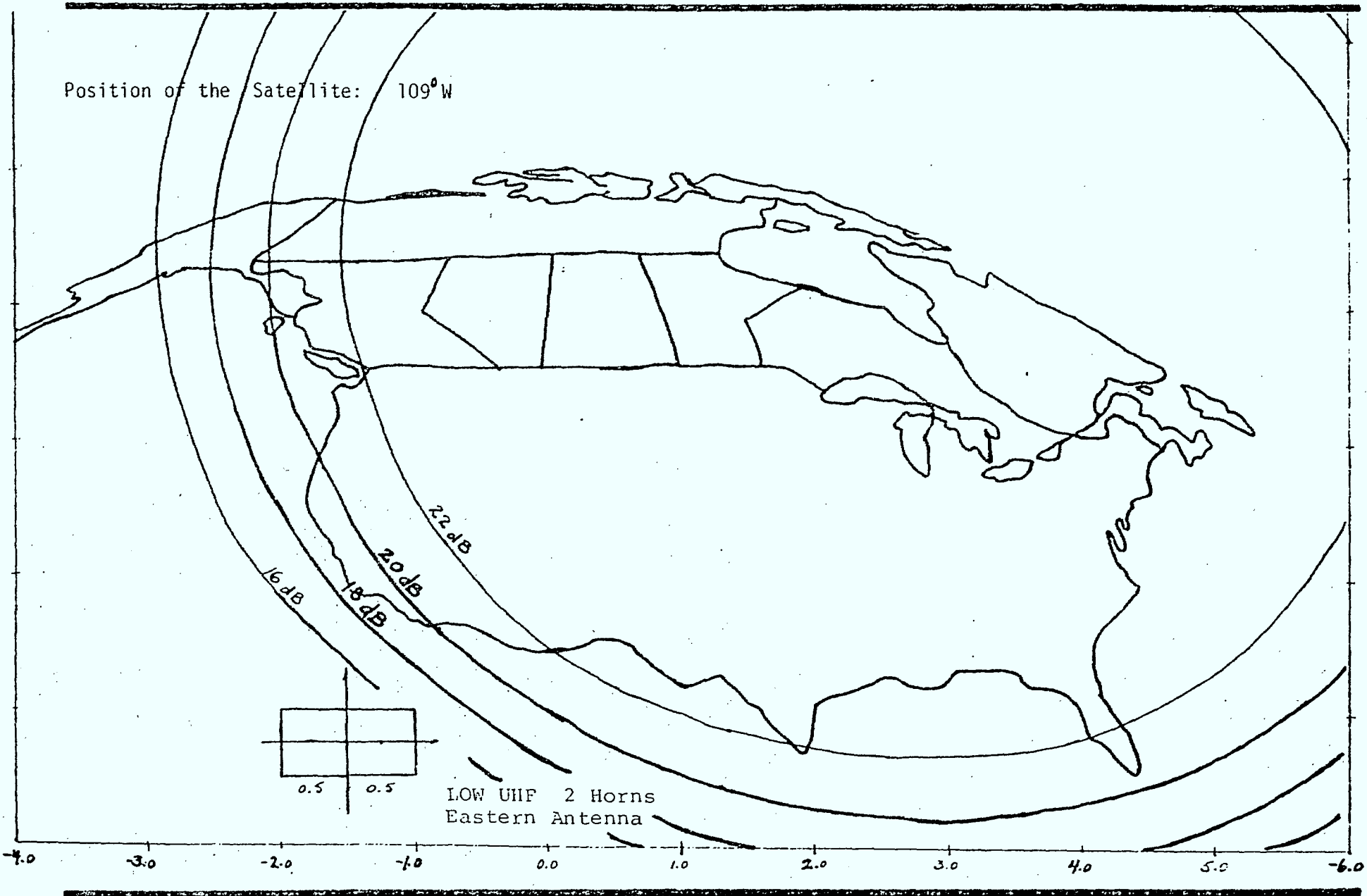
Programme spatial



8

MSAT LINK BUDGET

MOBILE TO SATELLITE

MODULATION NBFM; 30 kHz CHANNEL SPACING, 27 kHz IF BW
FREQUENCY 821-825 MHz

1.	TRANSMIT POWER			7.2 dBW
2.	TRANSMIT CIRCUIT LOSS			1.0 dB
3.	TRANSMIT EIRP			10.2 dBW
4.	LOSSES			199.3 dB
	A. FREE SPACE LOSS	182.8 dB		
	B. RECEIVE ANTENNA EOB LOSS	3.0 dB		
	C. MULTIPATH & SHADOWING LOSS	13.0 dB		
	D. POLARIZATION LOSS	0.5 dB		
5.	GAINS			39.7 dB
	A. TRANSMIT ANT. BORESIGHT GAIN	4.0 dB		
	B. RECEIVE ANT. BORESIGHT GAIN	35.7 dB		
6.	RECEIVED SIGNAL POWER/CHANNEL			-153.4 dBW
7.	RECEIVING CIRCUIT LOSS		2.3 dB	
	A. POLARIZER	0.2 dB		
	B. DUPLEXER	1.4 dB		
	C. CABLE	0.5 dB		
	D. REDUNDANCY SWITCH	0.2 dB		
8.	RECEIVING SYSTEM TEMPERATURE			27.9 dBK
	A. RECEIVER NF		1 dB	
	B. RECEIVER NOISE TEMPERATURE	$= 290\ (10^{0.1}-1) = 75°K$		
	C. LOSS ELEMENT TEMPERATURE	$= 290°K$		
	D. ANTENNA NOISE TEMPERATURE	$= 290°K$		
	E. SYSTEM NOISE TEMPERATURE	$= 290 + 290(10^{0.23}-1) + 10^{0.23} \times 75$		
		$= 620°K$		
9.	G/T			7.8 dB/°K
10.	BOLTZMANN'S CONSTANT			-228.6 dBW/Hz°K
11.	RECEIVE SYSTEM NOISE DENSITY			-200.7 dB-Hz
12.	$(C/N_0)_U$			47.3 dB-Hz
13.	C/I_0			54.6 dB-Hz
14.	$C/(N_{0U} + I_0)$			46.6 dB-Hz

MSAT LINK BUDGET

SATELLITE TO GATEWAY

MODULATION NBFM; 30 kHz CHANNEL SPACING, IF BW 27 kHz
FREQUENCY 7.25 - 7.30 GHz

1.	A. TRANSMIT POWER/CHANNEL (UNFADED UPLINK)		-14.2 dBW
	B. TRANSMIT POWER/CHANNEL (FADED UPLINK)		-27.2 dBW
2.	TRANSMIT CIRCUIT LOSS		1.3 dB
3.	A. TRANSMIT EIRP/CHANNEL (UNFADED UPLINK)		+16.5 dBW
	B. TRANSMIT EIRP/CHANNEL (FADED UPLINK)		+3.5 dBW
4.	LOSSES		219.5 dB
	A. TRANSMIT ANT. EOB	3.0 dB	
	B. TRANSMIT ANT. POINTING LOSS	0.5 dB	
	C. FREE SPACE LOSS	201.3 dB	
	D. RECEIVE ANT. POINTING LOSS	0.5 dB	
	E. ATMOSPHERIC LOSS	1.2 dB	
	F. UPLINK FADE	13.0 dB	
5.	GAINS		81.0 dB
	A. TRANSMIT ANTENNA BORESIGHT GAIN	32.0 dB	
	B. RECEIVE ANTENNA BORESIGHT GAIN	49.0 dB	
6.	RECEIVED SIGNAL POWER/CHANNEL		-154.0 dBW
7.	RECEIVING CIRCUIT LOSS	0.5 dB	
8.	RECEIVING SYSTEM TEMPERATURE		24.4 dBK
	A. RECEIVER NF	2.0 dB	
	B. RECEIVER NOISE TEMPERATURE = $290(10^{0.2}-1) = 170°K$		
	C. LOSS ELEMENT TEMPERATURE = $290°K$		
	D. ANTENNA NOISE TEMPERATURE = $50°K$		
	E. SYSTEM NOISE TEMPERATURE = $50 + 290(10^{0.05}-1)+10^{0.05}\times 170$ $= 276°K$		
9.	G/T		24.6 dB/°K
10.	BOLTZMANN'S CONSTANT		-228.6 dBW/Hz°K
11.	RECEIVE SYSTEM NOISE DENSITY		-204.2 dB-Hz
12.	$(C/N_0)_D$		50.2 dB-Hz
13.	$C/(N_{OU}+I_0)$		46.6 dB-Hz
14.	$C/(N_0)_T$		45.0 dB-Hz

MSAT LINK BUDGET

GATEWAY TO SATELLITE

MODULATION NBFM; 30 kHz CHANNEL SPACING, 27 kHz IF BW
FREQUENCY 7.975-8.025 GHz

1.	TRANSMIT POWER/CHANNEL		-10.0 dBW
2.	TRANSMIT CIRCUIT LOSS		0.5 dB
3.	EIRP/CHANNEL		39.0 dBW
4.	LOSSES		206.9 dB
	A. TRANSMIT ANTENNA POINTING LOSS	0.5 dB	
	B. FREE SPACE LOSS (8 GHz)	202.2 dB	
	C. RECEIVE ANTENNA EOB LOSS	3.0 dB	
	D. ATMOSPHERIC LOSS	1.2 dB	
5.	GAINS		81.5 dB
	A. TRANSMIT ANTENNA BORESIGHT GAIN	49.5 dB	
	B. RECEIVE ANTENNA BORESIGHT GAIN	32.0 dB	
6.	RECEIVED SIGNAL POWER/CHANNEL		-135.9 dBW
7.	RECEIVING CIRCUIT LOSS	1.5 dB	
8.	RECEIVING SYSTEM TEMPERATURE		30.1 dBK
	A. RECEIVER NF	4.0 dB	
	B. RECEIVER NOISE TEMPERATURE	$= 290(10^{0.4}-1) = 438°K$	
	C. LOSS ELEMENT TEMPERATURE	$= 290°K$	
	D. ANTENNA NOISE TEMPERATURE	$= 290°K$	
	E. SYSTEM NOISE TEMPERATURE	$= 290 + 290(10^{0.15}-1)+10^{0.15}\times 438$ $= 1028°K$	
9.	G/T		1.9 dB/°K
10.	BOLTZMANN'S CONSTANT		-228.6 dBW/Hz°K
11.	RECEIVE SYSTEM NOISE DENSITY		-198.5 dB-Hz
12.	$(C/N_0)_U$		62.6 dB-Hz
13.	C/I_0		62.6 dB-Hz
14.	$C/(N_{0U} + I_0)$		59.6 dB-Hz

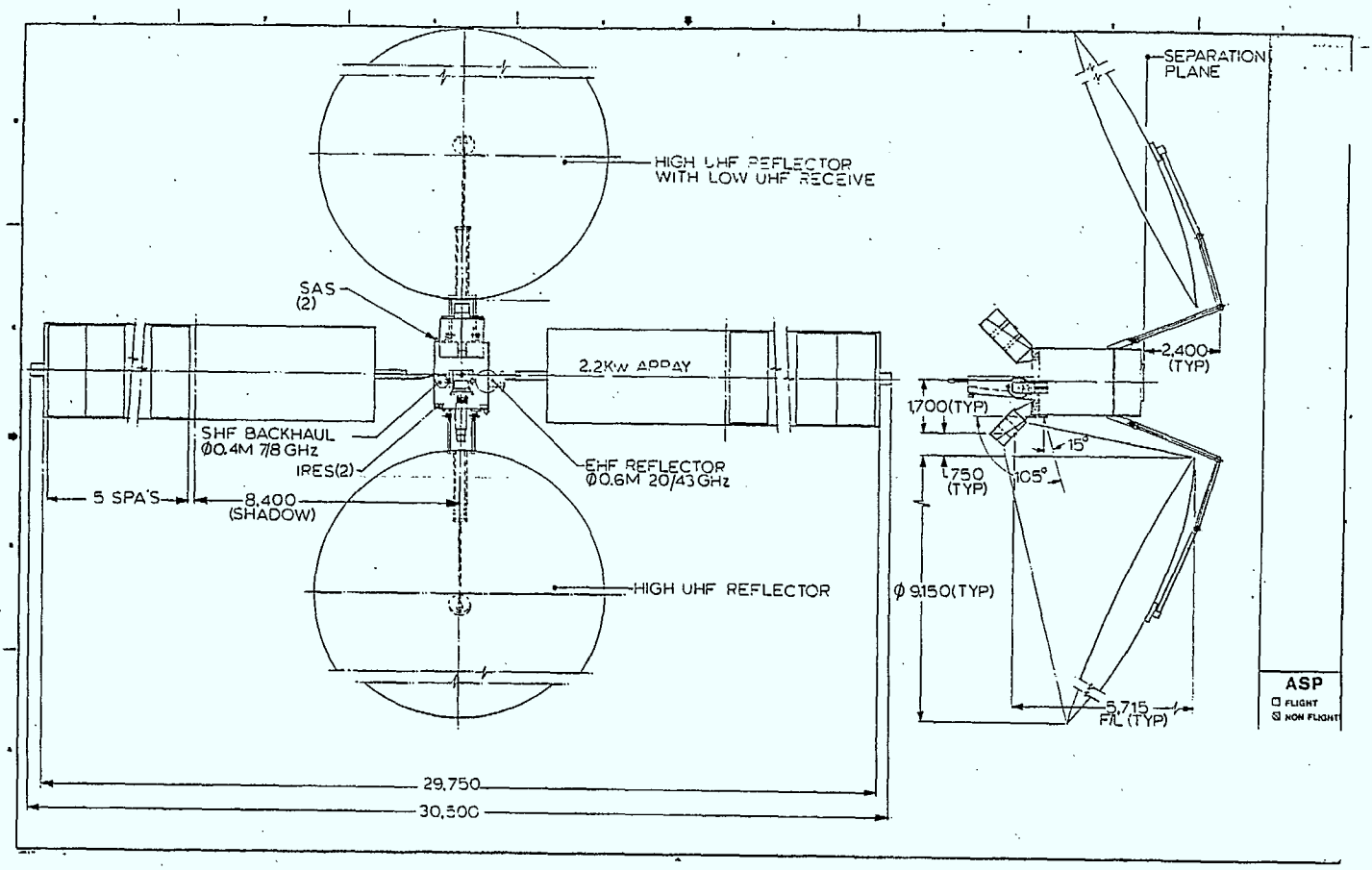
MSAT LINK BUDGET

SATELLITE TO MOBILE

MODULATION NBFM; 30 KHZ CHANNEL SPACING, IF BW 27 KHZ
FREQUENCY 866-870 MHZ

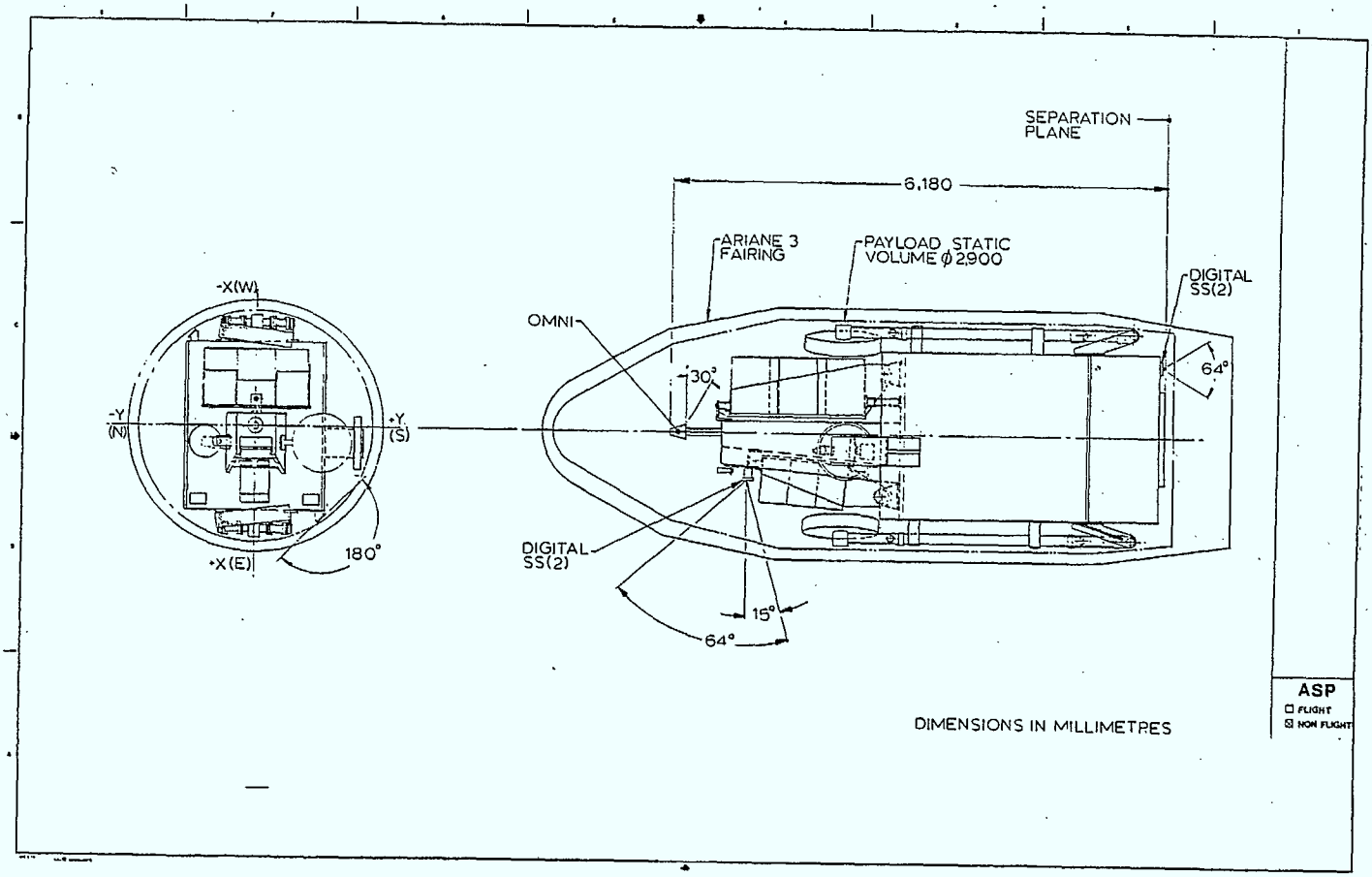
1.	TRANSMIT POWER		6.4 DBW
2.	TRANSMIT CIRCUIT LOSS		1.7 DB
	A. POLARIZER	0.2 DB	
	B. DUPLEXER	0.8 DB	
	C. CABLE	0.5 DB	
	D. REDUNDANCY SWITCH	0.2 DB	
3.	TRANSMIT EIRP		40.4 DBW
4.	LOSSES		191.8 DB
	A. TRANSMIT ANT. EOB	3.0 DB	
	B. FREE SPACE LOSS	183.3 DB	
	C. MULTIPATH FADE MARGIN	5.0 DB	
	D. POLARIZATION LOSS	0.5 DB	
5.	GAINS		39.7 DB
	A. TRANSMIT ANTENNA BORESIGHT GAIN	35.7 DB	
	B. RECEIVE ANTENNA BORESIGHT GAIN	4.0 DB	
6.	RECEIVED SIGNAL POWER/CHANNEL		-147.4 DBW
7.	RECEIVING CIRCUIT LOSS	1.0 DB	
8.	RECEIVING SYSTEM TEMPERATURE		27.1 DBK
	A. RECEIVER NF	2.0 DB	
	B. RECEIVER NOISE TEMPERATURE	$= 290(10^{0.2}-1) = 170°K$	
	C. LOSS ELEMENT TEMPERATURE	$= 290°K$	
	D. ANTENNA NOISE TEMPERATURE	$= 220°K$	
	E. SYSTEM NOISE TEMPERATURE	$= 220 + 290(10^{0.1}-1)+10^{0.1}\times 170$ $= 509°K$	
9.	G/T		-23.1 DB/°K
10.	BOLTZMANN'S CONSTANT		-228.6 DBW/HZ°K
11.	RECEIVE SYSTEM NOISE DENSITY		-201.5 DB-HZ
12.	$(C/N_O)_D$		54.1 DB-HZ
13.	$C/(N_{OU}+I_O)$		59.6 DB-HZ
14.	$C/(N_O)_T$		53.0 DB-HZ

DEMONSTRATION MSAT



ON STATION CONFIGURATION

DEMONSTRATION MSAT

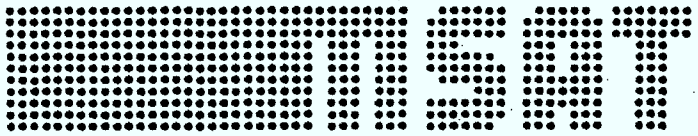


LAUNCH CONFIGURATION

MSAT

MSAT SUMMARY DATA

LAUNCHER	-	ARIANE OR STS
MASS IN TRANSFER ORBIT	-	2492 KG (ARIANE III)
POWER GENERATOR (AT 7 YEARS):		
SUNLIGHT	-	2800 W
ECLIPSE	-	2200 W
EQUIPMENT DESIGN LIFE	-	10 YEARS BUS, 7 YEARS PAYLOAD
MISSION LIFETIME (PROPELLANT LOADING)	-	7 YEARS
STATION	-	109° W
STATION-KEEPING	-	±0.1°
DIMENSIONS:		
BODY	-	2.1M x 1.75M x 3.5M
ARRAY SPAN TIP-TO-TIP		33M

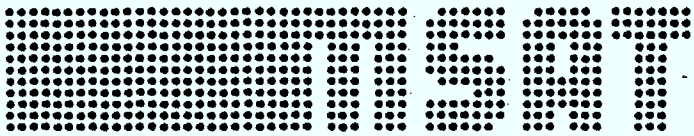


DND SYSTEM REQUIREMENTS

LCol. R.R. Cooper

A.R. Abercrombie

Agenda Item 5



INTRODUCTION

TO

MSAT PHASE B WORK PLAN

DR. R.W. BREITHAUPT

AGENDA ITEM 6

OUTLINE

A. PHASE B OBJECTIVES

B. PHASE B WORK BREAKDOWN STRUCTURE

C. PHASE B SCHEDULE

D. PHASE B BUDGET

E. KEY RESPONSIBILITIES

F. CONTRACTING PROCEDURES

Objectives of Phase B

Define and design MSAT demonstration system including bus selection

Develop technology for MSAT system

Prepare class B cost estimate for phase C/D

Prepare phase C/D performance specifications and schedule

Prepare plan for post launch mobile communications program

Refine assessment of market and commercial viability of follow-on operational systems

Objectives of Phase B (continued)

* Refine assessment of socio-economic benefits
* Develop co-operative arrangements and a cost recovery policy for program cost reduction
* Define marketing plan and promote MSAT services, products and technology
* Define and resolve communications regulatory and policy issues associated with MSAT
* Prepare project briet for phase C/D decision

MSAT PHASE B WORK BREAKDOWN STRUCTURE

WP 1. MANAGEMENT

2. MSAT PROGRAM DEFINITION

- WP 2.1 Program Management
- WP 2.2 Market Definition
- WP 2.3 Commercial Viability Studies
- WP 2.4 Post-Launch MSAT Communications Program Definition
- WP 2.5 Definition of Socio-Economics Benefits
- WP 2.6 Communications Policy Analysis and Definition
- WP 2.7 Frequency Coordination
- WP 2.8 Development of Cooperative Arrangements
- WP 2.9 Preparation of Program Submissions
- WP 2.10 Data Collection Platform Study
- WP 2.11 MSAT Working Groups
- WP 2.12 Public Information Plan

MSAT PHASE B WORK BREAKDOWN STRUCTURE (CONTINUED)

WP 3. MSAT SYSTEM DEFINITION

- WP 3.1 PROJECT MANAGEMENT
- WP 3.2 SYSTEM DEFINITION AND DESIGN
- WP 3.3 SPACE SEGMENT DEFINITION AND DESIGN
- WP 3.4 SPACE SEGMENT TECHNOLOGY DEVELOPMENT
- WP 3.5 LAUNCH DEFINITION
- WP 3.6 EARTH SEGMENT DEFINITION AND DESIGN
- WP 3.7 EARTH SEGMENT TECHNOLOGY DEVELOPMENT
- WP 3.8 COST ESTIMATE

KEY ROLES AND RESPONSIBILITIES FOR MSAT PHASE B

GOVERNMENT

DOC - LEAD MANAGEMENT AUTHORITY AND FOR OVERALL MSAT SYSTEM.

DND - MAJOR PARTICIPANT, RESPONSIBLE FOR DND REQUIREMENTS AND DND GROUND SEGMENT.

NASA - INTERNATIONAL PARTNER AND MAJOR EXPERIMENTER.

DSS - CONTRACT ADMINISTRATION

OTHER FEDERAL USERS - RCMP, DOT, DOE, DFO, HWC, DINA, EPC, COGLA.

OTHER DEPARTMENTS - MOSST, TBS, CEIC, DIC, DEA, MSED PARTICIPATE IN MSAT MANAGEMENT TO ASSURE IMPLEMENTATION OF GOVERNMENT POLICIES.

INDUSTRY

TELESAT - KEY PARTICIPANT IN DESIGN AND DEFINITION AND FOR ASSESSMENT OF MSAT COMMERCIAL VIABILITY.

SPAR - DESIGNATED SPACECRAFT PRIME CONTRACTOR.

CARRIER

MANUFACTURERS

MSAT PHASE B CONTRACT BUDGET OUTLINE

FY 82/83 AND 83/84

PROGRAM DEFINITION	1.7
SPACE SEGMENT AND LAUNCH	13.2
GROUND SEGMENT	1.8
SYSTEM STUDIES	1.2
	$17.9M

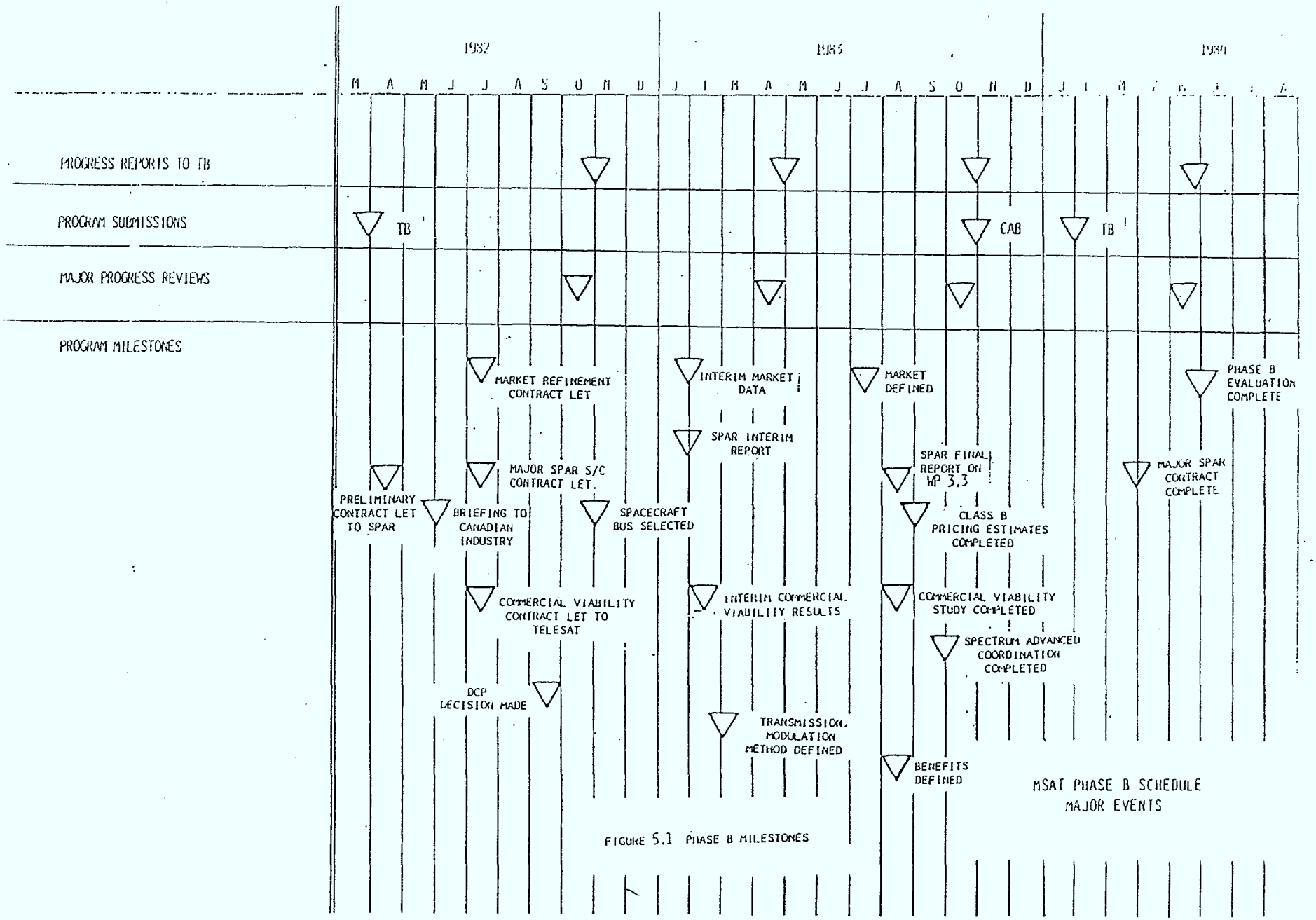


FIGURE 5.1 PHASE B MILESTONES

MSAT PROGRAM DEFINITION

AGENDA ITEM 7

OUTLINE

A. PHASE B WORK PACKAGES

B. DESCRIPTION OF PHASE B CONTRACTS

C. DESCRIPTION OF PHASE B IN-HOUSE TASKS

PHASE B PROGRAM DEFINITION WORK PACKAGES

	WORK PACKAGES	CONTRACT	IN-HOUSE
WP 2.1	PROGRAM MANAGEMENT		*
WP 2.2	MARKET DEFINITION STUDY	*	
WP 2.3	COMMERCIAL VIABILITY STUDY	*	
WP 2.4	POST-LAUNCH MSAT COMMUNICATIONS PROGRAM DEFINITION		*
WP 2.5	DEFINITION OF SOCIO-ECONOMIC BENEFITS	*	
WP 2.6	COMMUNICATIONS POLICY ANALYSIS AND DEFINITION		*
WP 2.7	FREQUENCY COORDINATION		*
WP 2.8	DEVELOPMENT OF COOPERATIVE ARRANGEMENTS		*
WP 2.9	PREPARATION OF PROGRAM SUBMISSIONS		*
WP 2.10	DATA COLLECTION PLATFORM STUDY		*
WP 2.11	MSAT WORKING GROUPS		*
WP 2.12	PUBLIC INFORMATION PLAN		*

PHASE B MARKET DEFINITION STUDY CONTRACT

OBJECTIVE

- TO REFINE THE MSAT PHASE A MARKET STUDY RESULTS
  - DEMOGRAPHICALLY
  - INDUSTRY CATEGORY
  - ELASTICITY TO PRICE
  - ELASTICITY TO QUALITY AND GRADE OF SERVICES
- TO UPDATE THE USER COST BENEFIT PROJECTIONS BASED ON PHASE B MARKET STUDY RESULTS

SCHEDULE

RELEASE OF DRAFT RFP	SEPT 82
ISSUE OF RFP	1 OCT 82
PROPOSALS DUE	14 OCT 82
CONTRACT AWARD	25 OCT 82
DATA PACKAGE ON MARKET RESEARCH	1 MAR 83
FINAL REPORT ON MARKET RESEARCH	30 APR 83
FINAL REPORT ON USER COST BENEFITS	30 JUNE 83

MSAT PHASE B COMMERCIAL VIABILITY STUDY CONTRACT

OBJECTIVE

- TO ASSESS THE VIABILITY OF A SATELLITE SYSTEM FOR PROVISION OF COMMERCIAL SERVICE TO MOBILE TERMINALS
- TO ASSESS THE POTENTIAL FOR MAXIMIZING COMMERCIAL EXPLOITATION OF THE MSAT TECHNOLOGY AND PRODUCTS

SCHEDULE

CONTRACT AWARD	3 NOV 82
FINAL REPORT	15 AUG 83

CONTRACTOR

CONTRACT DIRECTED TO TELESAT CANADA

MSAT PHASE B COMMERCIAL VIABILITY STUDY (CONTINUED)

INPUTS TO STUDY

RESULTS OF PHASE A STUDIES

RESULTS OF PHASE B STUDIES ON MARKET RESEARCH AND SYSTEM, SPACECRAFT AND TERMINAL DEFINITION

OUTPUTS OF STUDY

- FINAL ASSESSMENT OF MARKET POTENTIAL AND ROLE OF SATELLITE
- SATELLITE SYSTEM CONCEPTS TO MEET DIFFERENT MARKET DEMAND LEVELS
- SATELLITE SYSTEM COST MODELS
- FINANCIAL INVESTMENT ANALYSIS
- MARKETING APPROACH AND POLICY/REGULATORY REQUIREMENTS
- FEASIBILITY OF PAYBACK OF DEVELOPMENT COSTS
- RISK ASSESSMENT
- PLAN FOR TRANSITION FROM MSAT DEMO TO OPERATIONAL SYSTEM
- POTENTIAL FOR COMMERCIAL EXPLOITATION OF MSAT PRODUCTS AND TECHNOLOGY
- OVERALL ASSESSMENT OF COMMERCIAL VIABILITY

IMPACT STUDY OF MSAT ON MANUFACTURING INDUSTRY

OBJECTIVE

TO ASSESS THE IMPACT OF MSAT ON THE CANADIAN MANUFACTURING INDUSTRY

DELIVERABLES

- ESTIMATE OF WORLD MARKET FOR MSAT PRODUCTS
- FACTORS AFFECTING PENETRATION IN MARKET
- MARKET PENETRATION OBJECTIVE FOR CANADA
- CANADIAN CONTENT OBJECTIVES FOR MSAT PRODUCTS
- STRATEGIES FOR PRODUCT DEVELOPMENT AND MARKETING
- PROJECTED DOMESTIC AND EXPORT SALES TO YEAR 2000 AND CANADIAN CONTENT
- PROJECTED JOB CREATION IN MANUFACTURING INDUSTRY
- TECHNOLOGY SPIN-OFFS
- OVERALL ECONOMIC AND OTHER IMPACT ON CANADIAN INDUSTRY

SCHEDULE

RELEASE OF RFP	3 NOV 82
PROPOSALS DUE	3 DEC 82
CONTRACT AWARD	15 DEC 82
FINAL REPORT	31 AUG 83

IMPACT STUDY OF MSAT ON RADIO COMMON CARRIERS

OBJECTIVE

- TO EXAMINE INVOLVEMENT OF THE RCCs IN THE DELIVERY OF MSAT SERVICES
- TO IDENTIFY AND ASSESS ISSUES
- TO ASSESS ECONOMIC IMPACT OF MSAT ON RCCs

SCHEDULE

RELEASE OF RFP	3 NOV 82
PROPOSALS DUE	3 DEC 82
CONTRACT AWARD	15 DEC 82
FINAL REPORT	31 APRIL 83

STUDY TO BE DEFINED IN CONSULTATION WITH RCCA

IMPACT STUDY OF MSAT ON TELEPHONE COMPANIES

OBJECTIVE

- TO EXAMINE INVOLVEMENT OF THE TELEPHONE COMPANIES IN THE DELIVERY OF MSAT SERVICES
- TO IDENTIFY AND ASSESS ISSUES
- TO ASSESS ECONOMIC IMPACT OF MSAT ON THE TELEPHONE COMPANIES

SCHEDULE

- OCTOBER 82 TO MAY 83

STUDIES WILL BE COORDINATED THROUGH DOC-CARRIER WORKING GROUP

IMPACT STUDY OF MSAT ON LARGE MOBILE RADIO/TELEPHONE USERS

OBJECTIVE

TO ASSESS THE NEED, SYSTEM REQUIREMENTS, BENEFITS, COSTS AND OTHER ISSUES AFFECTING DECISION OF POTENTIAL LARGE USERS TO PARTICIPATE IN MSAT PROGRAM AND TO SUBSCRIBE TO MSAT SERVICES

SCHEDULE

- OCTOBER 82 TO MAY 83

STUDIES WILL BE COORDINATED THROUGH MSAT USER WORKING GROUPS

STUDY OF SOCIAL IMPACT OF MSAT

OBJECTIVE

TO IDENTIFY AND ASSESS THE SOCIAL BENEFITS/COSTS ASSOCIATED TO THE INTRODUCTION OF MOBILE-SATELLITE SERVICES IN CANADA

SCHEDULE

RELEASE OF RFP	15 DEC 82
PROPOSALS DUE	15 JAN 83
CONTRACT AWARD	15 FEB 83
FINAL REPORT	31 AUG 83

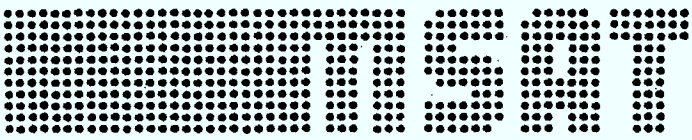
OVERALL SOCIO-ECONOMIC IMPACT STUDY

OBJECTIVE

- TO DEVELOP A SIMPLE SIMULATION MODEL INCLUDING THE MAIN SOCIO-ECONOMIC VARIABLES AND RELATIONSHIPS
- TO PROVIDE AN INTEGRATED ASSESSMENT OF THE SOCIO-ECONOMIC IMPACT OF MSAT E.G. OVERALL COST/BENEFIT, EMPLOYMENT
- TO EXAMINE SENSITIVITY OF RESULTS TO THE MAIN SOCIO-ECONOMIC VARIABLES SUCH AS MARKET DEMAND, EMPLOYMENT AND COSTS

SCHEDULE

RELEASE OF RFP	15 OCTOBER 1982
PROPOSALS DUE	15 NOVEMBER 1982
CONTRACT AWARD	6 DECEMBER 1982
FINAL REPORT	15 SEPTEMBER 1983



MSAT SYSTEM DEFINITION

J.L. McNALLY

AGENDA ITEM 8

Government of Canada
Department of Communications
Space Program

Gouvernment du Canada
Ministère des Communications
Programme spatial

MSAT SYSTEMS DEFINITION

INDUSTRY BRIEFING

SEPT. 9/10, 1982

MSAT PHASE "B" WORK BREAKDOWN STRUCTURE

- Project Management
- System Definition & Design
- Space Segment Definition & Design
- Space Segment Technology Development
- Launch Definition
- Earth Segment Definition & Design
- Earth Segment Technology Development
- Cost Estimates

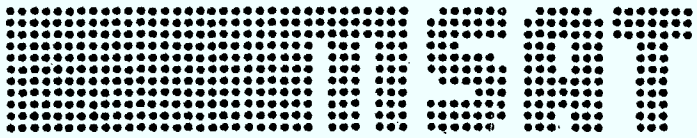
ITEMS REQUIRING CONTRACT ACTION

MSAT SYSTEMS DEFINITION

- System Study
- Space Segment Studies
- Ground Segment Studies
- Project Management Support

CONTRACT OUTPUTS

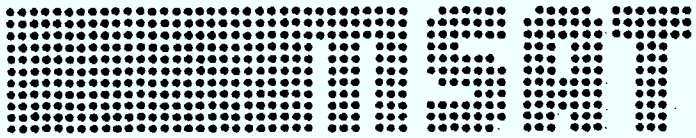
- Definition/Specification
- Technical Feasibility Reports
- Price Estimates
- Availability
- Implementation Plan
- Manpower Application
- Training Aspects



SYSTEM STUDIES

J.D.B. KENT

AGENDA ITEM 9



SYSTEMS STUDIES OUTLINE

- DAMA CONTROL CONCEPT & TERRESTRIAL INTERFACE STUDY
- NETWORK MANAGEMENT STUDY
- ADVANCED MODULATION TECHNIQUES
- INTERMODULATION ANALYSIS
- INTEGRATED MISSION & OPERATIONS ANALYSIS

DAMA CONTROL CONCEPT AND TERRESTRIAL INTERFACE STUDY

OBJECTIVE

To define a Demand Assignment Multiple Access (DAMA) concept for the MRS and MTS services and to specify the technical parameters for hardware and software for system operation and terrestrial service interface.

TASKS

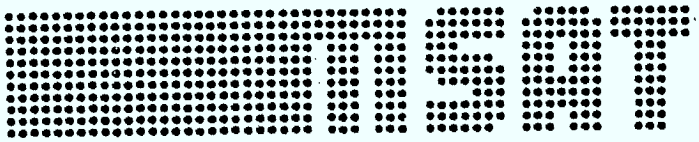
1. Based on the service concepts and channel allocation given in the MSAT concept document: to investigate different DAMA concepts that would meet system objectives. Select the system that optimizes satellite channel resources; and demonstrate in detail the reason for selecting this system.

2. Prepare a performance and technical specification for the selected system including the terrestrial interface and mobile radio. Include logic diagrams for user to user service and incomplete call attempts and estimate the storage requirements at terminals.

3. Develop Phase C/D cost estimates for the proposed system and indicate potential suppliers.

TIME FRAME

Start: October 1982
Finish: March 1983



NETWORK MANAGEMENT STUDY

OBJECTIVE

To define a network management system to: optimize system utilization, store and analyse network data, reconfigure the network for overload conditions or subsystem failures, and maintain a current network status log.

TASKS

1. Analyse the MSAT system concept and DAMA specification to determine the network management information available. Establish upper bounds on network performance and a set of alarms and corrective actions to be taken to counter system degradation.

2. Prepare a technical specification for a network management system including a breakdown of software requirements. Logic diagrams shall be included.

3. Prepare a Phase C/D cost estimate for the network management system and indicate where further development work is necessary. Prepare a list of potential system suppliers.

TIME FRAME

Start: February 1983
Finish: July 1983

ADVANCED MODUATION TECHNIQUES

OBJECTIVE

To develop advanced modulation techniques applicable to mobile satellite service that requires less spectrum and power per channel than NBFM.

TASKS

1. To continue development of PELPC, DMSK and ACSB modems for use at mobile terminals and gateway stations.

2. To provide comprehensive expected voice quality data for different received carrier to noise spectral density.

3. To provide Phase C/D cost estimates and source information on PELPC and ACSB modems.

TIME FRAME

Start: November 1982
Finish: July 1983

MSAT

INTERMODULATION ANALYSIS

OBJECTIVE

To carry out an intermodulation analysis of the MSAT UHF-UHF and UHF-SHF transponders for the different service modes and fade conditions.

TASKS

1. Based on the expected transponder characteristics to carry out intermodulation analyses for the different services and fading characteristics of the channel. This analysis should be suitable for inclusion in a system simulator.

2. To recommend frequency plan and guard bands (if necessary) for different services to maximize system performance.

3. Based on the intermodulation analysis to prepare an intermodulation, spurii and co-channel interference specification for the transponders.

TIME FRAME

Start: August 1983
Finish: November 1983

MARSAT

INTEGRATED MISSION AND OPERATIONS ANALYSIS

OBJECTIVE

To determine mission and operations requirements and perform integrated mission/operations planning.

TASKS

1. Determine the constraints on the mission profile, and on ground and spacecraft operations, and prepare a Mission/Operations Requirements Document.

2. Develop a plan, including estimated schedules and costs, for preparing during Phase C/D: a Mission Profile Description; an Integrated Mission/Operations Plan; Detailed Mission Test Procedures; and Detailed Operating Procedures.

3. Develop and implement procedures for optimising the mission profile, and prepare a preliminary Mission Profile Description Document.

4. Prepare a preliminary Integrated Mission/Operations Plan Document addressing requirements for:

   - mission compatibility tests, initial on-orbit checkout, and on-orbit communications tests;

   - housekeeping and communications operations during all phases of the mission, and operator training.

TIME FRAME

Start:	February 1983
Tasks 1 & 2 Complete:	August 1983
Finish:	August 1983

INMARSAT

SPACE SEGMENT

H.R. RAINE

AGENDA ITEM 10

MSAT

SPACE SEGMENT PHASES

A. CONCEPT FEASIBILITY

B. PROJECT DEFINITION

C. ENGINEERING DESIGN

D. SPACECRAFT PRODUCTION/LAUNCH

E. OPERATIONS

NASA MSAT

DEMONSTRATION MSAT SCHEDULE

ITEM	CY-80	CY-81	CY-82	CY-83	CY-84	CY-85	CY-86	CY-87	CY-88	CY-89	CY-90
PHASE A - STUDIES											
PHASE B - DEFINITION											
PHASE C - DESIGN											
PHASE D - BUILD, TEST, LAUNCH & ORBIT CHECKOUT											
PHASE E - OPERATIONS											→
TECHNOLOGY DEVELOPMENT											

SPACE SEGMENT

PHASE B OBJECTIVES

PRIMARY:

- DEFINE THE DEMONSTRATION SPACECRAFT
- DEVELOP AN IMPLEMENTATION PLAN
- PREPARE COST ESTIMATES

SUPPLEMENTARY:

- INITIATE LONG LEAD ITEMS
  - MAKE LAUNCH RESERVATIONS
  - BUY CRITICAL COMPONENTS
  - INITIATE CRITICAL DESIGN
  - BEGIN SOFTWARE DEVELOPMENT

MSAT

DEMONSTRATION MSAT PAYLOADS

- 800MHz Mobile Service
- 400MHz DCP/EPIRB Service
- Backhaul Service
- EHF Service

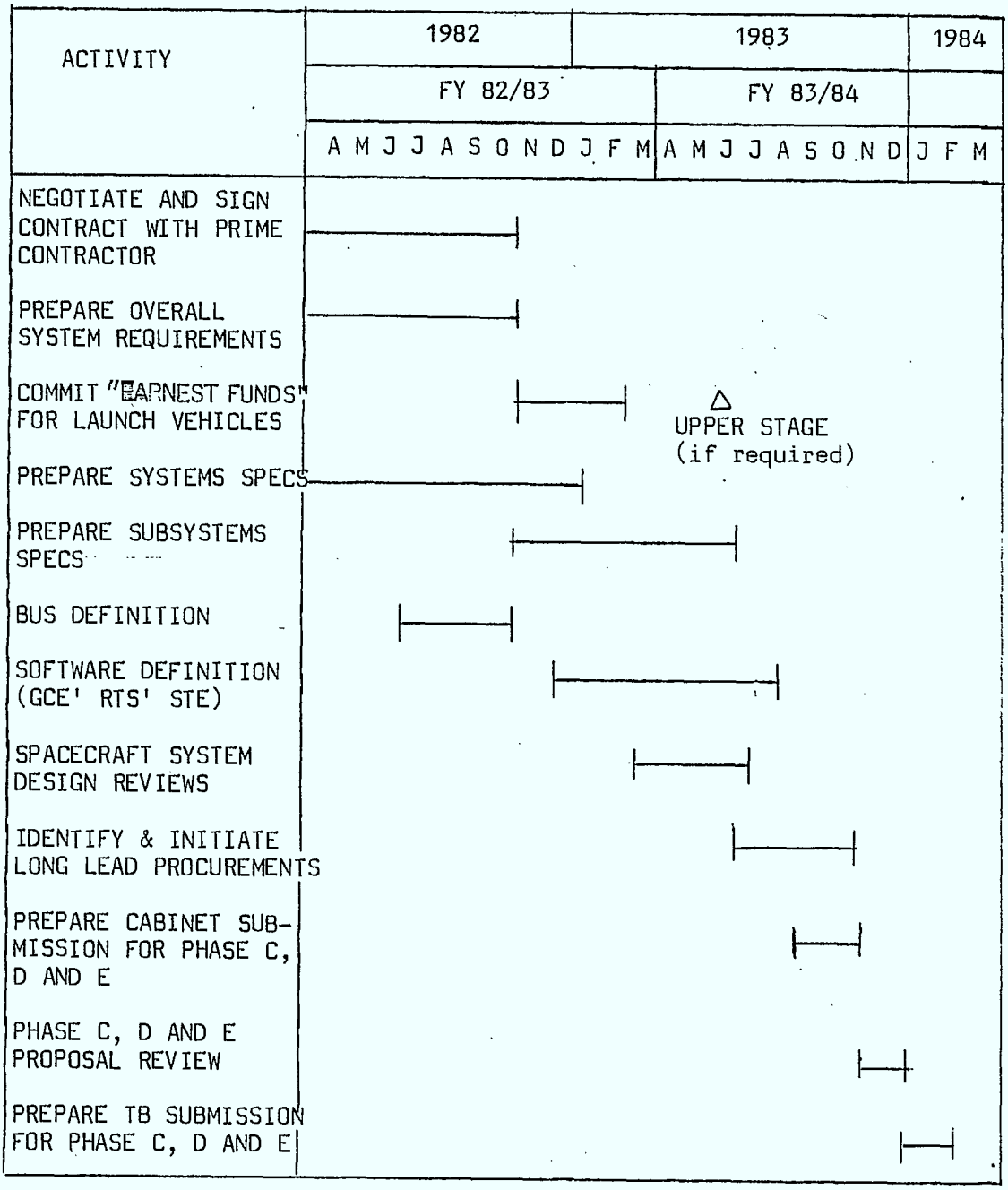
DEFINITION PHASE

SPACE SEGMENT ACTIVITIES

1. SPACECRAFT DEFINITION
2. OPERATIONS REQUIREMENTS DEFINITION
3. SOFTWARE REQUIREMENT DEFINITION
4. LAUNCH VEHICLE RESERVATION
5. UPPER STAGE SELECTION

MSAT PROJECT SCHEDULE - PHASE B

(SPACE SEGMENT)



MARISAT

SPACECRAFT DEFINITION

OBJECTIVE:

TO DEFINE THE SPACECRAFT SYSTEM, AND PERFORM CRITICAL TECHNOLOGY DEVELOPMENT NECESSARY FOR COST ESTIMATES OF THE IMPLEMENTATION AND OPERATIONS PHASES

DELIVERABLES:

SPACECRAFT SYTEM DEFINITION

- OPTIMIZATON OF PAYLOAD CONCEPTS
- SELECTION OF PLATFORM BASELINE

IMPLEMENTATION PLAN

- ORGANIZATIONAL PLANNING
- DEVELOPMENT PLAN
- PROCUREMENT PLAN
- MANUFACTURING PLAN
- INTEGRATION PLAN
- PERFORMANCE VERIFICATION PLAN
- LAUNCH AND CHECK-OUT STUDY
- SCHEDULE

IMPLEMENTATION COST ESTIMATES

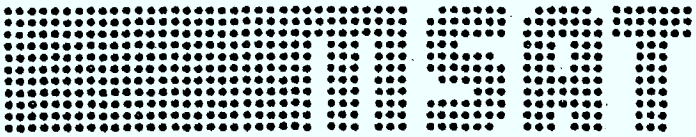
- MANAGEMENT/OVERHEAD COSTS
- LABOUR COSTS
- EQUIPMENT COSTS
- SUBCONTRACT COSTS

CRITICAL TECHNOLOGY DEVELOPMENT

- ESTABLISH DESIGN FEASIBILITY
- ENSURE CONTRACTOR CAPABILITY
- IDENTIFY AND DEVELOP SUPPORT REQUIREMENTS

SCHEDULE

1 APRIL 82 - MARCH 84



PRIMARY

TECHNOLOGY CHALLENGES

- MSAT SPACECRAFT -

- LARGE ANTENNA REFLECTORS & FEEDS
- 800 MHz P.A.
- FREQUENCY SOURCES
- EHF COMPONENTS
- ADVANCED CONTROLS

MARISAT

OPERATIONS REQUIREMENTS DEFINITION

OBJECTIVE:

To define the operations requirements, outline the implementation approach and produce cost estimates.

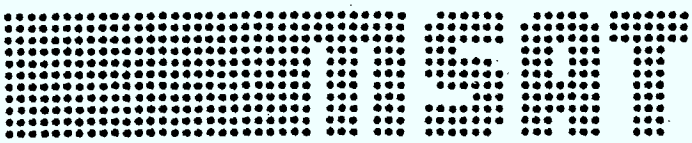
DELIVERABLES:

Activity Outline

- Planning Requirements
- Facilities/Equipment Requirements
- Support Requirements
- Capital & O&M Cost Estimate

SCHEDULE:

October 1982 - August 1983



SPACE SEGMENT

PHASE B CONTRACTS

SUBJECT: COMPUTATIONAL REQUIREMENTS

DELIVERABLES: STUDY REPORT ADDRESSING REQUIREMENTS AND COSTS FOR:

- GROUND CONTROL
- SIMULATION
- GROUND TESTING

TIME FRAME: OCTOBER 1982 - SEPTEMBER 1983

INMARSAT

SPACE SEGMENT

PHASE B CONTRACTS

SUBJECT: LAUNCH VEHICLE RESERVATIONS

DELIVERABLE: RESERVATION FOR LAUNCH ON CANDIDATE VEHICLES

SCHEDULE: OCTOBER. 1982 - MARCH 1983

MSAT

UPPER STAGE SELECTION STUDY

OBJECTIVE:

To review and document available and proposed upper stage options for an MSAT launch with the NASA STS.

DELIVERABLES: Study Report depicting the comparative capabilities, and electrical and mechanical MSAT/STS interfaces, together with estimated costs and schedules for the stage and any required modifications for MSAT

TIME FRAME: July 1982 - December 1983

GROUND SEGMENT

J.E. Nicholson

Agenda Item 11

GROUND SEGMENT OUTLINE

- CENTRAL CONTROL STATION
- GATEWAY STATION DEFINITION
- GROUND TERMINAL DEFINITION
- FREQUENCY CONTROL SYSTEM
- UHF TERMINAL ANTENNA DEFINITION

AMSAT

CENTRAL CONTROL STATION (CCS)

OBJECTIVE: To produce CCS
- Specifications
- Cost
- Implementation Schedule

SUBSYSTEMS:
- Spacecraft Operations and Control Hardware for TT&C
- Spacecraft Real Time Simulator Hardware
- Communications Operations and Control Hardware
- Station Monitor and Control Hardware & Software
- SHF Backhaul Communications
- Emergency Position Indicator Radio Beacon (EPIRB) Receiver
- Data Collection Platform (DCP) Receiver/Processor
- Antenna & RF
- Military Interface with TT&C and Backhaul if needed

SCHEDULE:

Contract Let	-	December 1982
Final Report	-	October 1983

GATEWAY STATION DEFINITION

OBJECTIVE: To produce gateway
- Specifications
- Cost
- Implementation schedule

SUBSYSTEMS:
- SHF Antenna & RF/IF
- Switched Telephone Network Interface Requirements will be provided
- Baseband Channel Electronics
- DAMA
- Frequency Control
- Colocated with TELCO
- Switching Matrix

SCHEDULE:
- Contract Let – December 1982
- Final Report – October 1983

MSAT

GROUND TERMINAL DEFINITION

OJBECITVE:

To produce
- specifications
- cost
- implementation schedule
- Dev. models

For the following MSAT ground terminals
- UHF Mobile
- UHF Transportable/Portable
- UHF Base
- SHF Base

CONSIDERATIONS:

- DAMA system to be provided
- Frequency control system to be provided
- Modulation technique characterization and development
- LNA & duplexer development
- Power amplifier development
- Terminal microprocessor controller development
- Minimum cost is essential

SCHEDULE:

Contract Let	- December 1982
Final Report	- October 1983
Preliminary Terminal Development	- December 1983

MSAT

FREQUENCY CONTROL SYSTEM

OBJECTIVE: TO DEFINE A FREQUENCY CONTROL SYSTEM FOR MSAT AND TO DEVELOP A FREQUENCY SYNTHESIZER FOR THE MOBILE TERMINALS.

CONSIDERATIONS:

- 5 KHZ CHANNEL SPACING
- DOPPLER
- DIFFERENT MODULATION TECHNIQUES
- DAMA
- DIFFERENT LINK MODES

SCHEDULE:

CONTRACT LET	-	NOVEMBER 1982
SYSTEM DEFINITION	-	FEBRUARY 1983
SYNTHESIZER DEVELOPMENT	-	JUNE 1983

MARISAT

UHF TERMINAL ANTENNA DEFINITION

OBJECTIVE:

- TO PRODUCE UHF ANTENNA
  - SPECIFICATIONS
  - COST
  - IMPLEMENTATION SCHEDULE

  FOR BASE, SHIP, MOBILE, AIRCRAFT AND TRANSPORTABLE STATIONS

- TO DEVELOP A UHF ANTENNA FOR MOBILE VEHICULAR APPLICATIONS

CONSIDERATIONS:

- 4 dBi GAIN FOR MOBILES
- POLARIZATION DISCRIMINATION
- LOW ANGLE MULTIPATH DISCRIMINATION
- PRACTICAL DESIGN FOR VEHICLES
- CIRCULAR POLARIZATION

SCHEDULE:

CONTRACT LET	- NOVEMBER 1982
FINAL REPORT	- OCTOBER 1983
MOBILE ANTENNA DEVELOPMENT	- DECEMBER 1983