



**NATIONAL AERONAUTICS
AND
SPACE ADMINISTRATION**



Space Operations Management Office

**JPL - PROJECT RADARSAT
Project Service Level Agreement**

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Section I ***Customer Information***

Mission Title: **RADARSAT**

Category/Sponsor: NASA U.S. Commercial
 NASA Cooperative Foreign Commercial
 Non-NASA Government Foreign Government
 DOD Other
(If Other, Describe)

Mission Objectives: This mission is designed to provide radar images of the Earth's surface. It will collect, process, and distribute synthetic aperture radar (SAR) data to all users, generate the first radar map of Antarctica, create daily sea ice maps over the Arctic, support crop forecasting, obtain periodic SAR data coverage of Antarctic sea ice distribution, collect global stereographic SAR images for mapping, and collect site and time specific data to support research and experimental applications.

Launch/Flight Information: Space Shuttle LV Aircraft RLV
 Expendable LV Other
Specify: Vehicle : Delta II Upper Stage: N/A
Launch/Operations Site: Vandenberg Air Force Base, CA
Trajectory Regime Description: Low Earth Orbiter
Launch/Flight Date(s): November 4, 1995

Orbit/Flight Path Data:: Aeroflight High-Earth Orbit
 Suborbital Deep Space
 Low-Earth Orbit Other

Orbital Parameters as Applicable:
Apogee: 812 km Perigee: 802 km Inclination: 98.6°
Other Trajectory Information: Sun synchronous _____

Key Mission Events and Dates: Since launch, November 4, 1995, all key mission events planned through the date of this PSLA have been successfully completed. The remaining key event is Modified Antarctic Mapping Mission II [MAMMII], tentatively planned for September through November 2000.

Approved Mission Start Date: 2/27/91 Phase C/D Start Date: 1993
Present Phase of Development: On-orbit Operations (Phase E)
Requirements Maturity Assessment: >80% >50% <50%
Funding Approval Status: Per NASA/CSA Agreement
Mission Duration: (mo/yr) Prime: 11/95-4/01 Extended: 3 years
Program Duration (mo/yr) - (mo/yr): _____
Other: Ref: MRR dated 30 August 1993
Ref: DMR (DSN 870-264, July 15, 1995)

Section II Customer Requirements and Standard Services

A. Mission Services - [All are Non-CSOC and Non-TMOD]

1. Mission Planning -- NO
 - 1.a. Customer Requirements
 - 1.b. Catalog Services

2. Mission Control -- NO
 - 2.a. Customer Requirements
 - 2.b. Catalog Services

3. Flight Dynamics -- NO
 - 3.a. Customer Requirements
 - 3.b. Catalog Services

4. Spacecraft Analysis -- NO
 - 4.a. Customer Requirements
 - 4.b. Catalog Services

5. Payload Analysis -- NO
 - 5.a. Customer Requirements
 - 5.b. Catalog Services

6. Science Data Processing -- NO
 - 6.a. Customer Requirements
 - 6.b. Catalog Services

7. Data Storage -- NO
 - 7.a. Customer Requirements
 - 7.b. Catalog Services

B. Data Services

1. Ground Network

1.a. Customer Requirements

Telemetry: Poker Flat and McMurdo will receive the downlink telemetry data on either the carrier or the 1024-kHz subcarrier. The real-time data of 500, 2000, 4000, and 32,000 bps can be placed on either the carrier or the subcarrier via MCS commands. The 128,000-bps data storage unit (DSU) recorded data can be placed only on the carrier. The Wallops Flight Facility shall ensure 95% or greater error-free telemetry reception and real-time data transmissions to the MCS from the Poker Flat and McMurdo stations. The station will demodulate the 1024-kHz subcarrier real-time data and will record, bit synchronize, and pack the data into NASCOM 4800-bit blocks in accordance with DSN 820-13, Module TLM-3-15C and send the data to the MCS. DSU 128,000-bps data will be received, recorded, bit synchronized, and packed into NASCOM 4800-bit blocks in accordance with TLM-3-15C and the data is sent to the MCS in real time. The WFF will retain all telemetry data for 30 days unless otherwise indicated by the MCS.

Command: The RADARSAT command rate is 2 kb/sec. Provide standard NASCOM DSN/GSFC Interface Block (DGIB) 4800 bit block interface to receive commands, from the MCS, and transmit command echoes to the MCS.

Tracking: Tracking data will be sent to the MCS and used by the MCS to determine the spacecraft trajectory. WFF will retain all tracking data for 30 days unless otherwise indicated by the MCS.

Non/Standard Services: [if applicable]

1.b. Catalog Services

- 1.b.1. GN Data Acquisition, Formatting and Transfer -- Per Standard Service
- 1.b.2. GN Command Handling and Transmission -- Per Standard Service
- 1.b.3. GN Tracking Data Generation -- Per Standard Service
- 1.b.4. GN Scheduling -- Per Standard Service
- 1.b.5. GN Real-Time Control and performance Data Monitoring -- Per Standard Service
- 1.b.6. GN Testing -- Per Standard Service
- 1.b.7. Summary Data -- Per Standard Service

The following tabular information is a summary of the ground network services requirements:

i. Low Earth Orbit/Launch Data Services - SPEC/Sub-Orbital

Ground Network

Basic Description of Support Required: [Including duration/passes per day]

RADARSAT support will be provided by the Wallops Flight Facility (WFF) stations located at Poker Flat (PKF), Alaska, and McMurdo (MGS), Antarctica. There will be pre-pass checkout of telemetry and command lines prior to all supports. Support will be provided by PKF for routine phase, the second Antarctic phase (and preparations for this), and, as requested, during emergencies. Support will be provided by MGS for the second Antarctic phase (and preparations for this). Support will consist of command, command echo, telemetry data and tracking data handling for approximately 1 pass per week (routine), 15 passes per week (second Antarctic phase), and 5 passes per week (pre-Antarctic).

Stations Required:

- | | | | | | |
|---|------------------------------|------------------------------|---------------------------------|--|------------------------------|
| <input type="checkbox"/> MIL | <input type="checkbox"/> PDL | <input type="checkbox"/> ASF | <input type="checkbox"/> WPS | <input checked="" type="checkbox"/> PKF | <input type="checkbox"/> AGO |
| <input checked="" type="checkbox"/> MGS | <input type="checkbox"/> SGS | <input type="checkbox"/> AGS | <input type="checkbox"/> Mobile | <input type="checkbox"/> Puerto Rico (LEO-T) | |

Telecommunications and Radio Metric Link Characteristics:

Uplink Frequency(s): 2053.458 MHz Bandwidth: 1.5 MHz
Downlink Frequency(s): 2230.0 MHz Bandwidth: 2.4 MHz
Number of R.F. Links: 1

Spacecraft Xmit Power, Watts, EIRP, per Link: 3 Watts; EIRP: 24 dBm (omni), 32 dBm (nadir)
Spacecraft Receiver G/T per Link: -50 dB/K minimum (omni 4 pi steradians, less holes)
Spacecraft Required Receive Power, dBm: -101 dBm minimum at the antenna
Radar EIRP and G/T Performance: N/A
Insitu Telecomm Relay Required: N/A
Link Analysis Attached: No

Data Type Requirements:

Telemetry Links	Data Rate Range	Format		Real Time	Recorded	% Data Return	Duration/Period
		CCSDS	Other				
1	0.5 to 128 kbps		DGIB	0.5 to 128 kbps	0.5 to 128 kbps	95	15 min

Command Links	Data Rates	Format		Real Time	Store Forward	Duration/Period
		CCSDS	Other			
1	2 kbps		Throughput	X		15 min

Tracking	Radio Metrics	Nav. Or Science	Accuracy	1, 2, 3-Way Mode	System Stability	Duration/Period
Range						
Range Rate		Nav	1 mm/sec	2-way		15 min
Angle/VLBI	Angle	Nav	0.05 deg			15 min
Other						
Radio Science Data Handling Reqs						

Coverage Requirements:

Phase [Define Phase and Period]	Routine	Antarctic (30 days)	Pre-Antarctic (90 days)
Passes/Month	5	60	20
Pass Length [min]	15	15	15

Standard Telemetry Requirements No. Of Links: 1 [If Non-standard, Explain Below]

Frequency	Bandwidth	Modulation	Coding	Subcarrier	Data Type	Format
2230 MHz	2.4 MHz	PCM/PM PCM/PSK/PM		1.024 MHz	BiPhase-L BiPhase-L	DGIB DGIB

Standard Command Requirements No. Of Links: 1 [If Non-standard, Explain Below]

Frequency	Bandwidth	Modulation	Subcarrier	EIRP	Format
2053.458 MHz	1.5 MHz	PCM/PSK/PM	16 kHz		Throughput

Standard Metrics Requirements Radar: [If Non-standard, Explain Below]

Ranging	Doppler	Angle	Optical	Special Data Handling
	Two-Way	Autotrack		

Special Data Links, Radio Metrics, or Optical Metrics, Destruct, Voice Communication:[Explain Below]

Special Communications Links to Other Facilities ; Special Data Handling:

Other Special Requirements:

Radar [Yes/No] _____ Beacon/Skin _____ No. Of Radars _____

Data Communication Requirements: See Section II B.4 Data Services.

Permission Support: None Required

Type, location, and duration of support: Normal command/telemetry/radio metric supports will be taken at the Poker Flat and McMurdo stations and will last approximately 8-15 minutes. No other special tracking or ranging supports are necessary.

Special Data Handling Requirements: None Required

Security Requirements: None Required

Command Guidance/Destruct Requirements: None Required

Radio Communication Requirements: None Required

Control Center Requirements: None Required

Real Time Data Display Requirements: None Required

Meteorological Requirements: None Required -- N/A

Optical Support Requirements: None Required

ii. Low Earth Orbit/Launch Data Services - SPEC/Sub-Orbital -- N/A

GSFC

Basic Description of Support Required: [Including duration/passes per day]

Radar [Yes/No] _____ **Beacon/Skin** _____ **No. Of Radars** _____

Data Communication Requirements:

Permission Support [P/L Checkout/Simulations/Compatibility]

Type, location, and duration of support:

Special Data Handling Requirements:

Security Requirements:

Command Guidance/Destruct Requirements:

Radio Communication Requirements:

Control Center Requirements:

Real Time Data Display Requirements:

Meteorological Requirements:

Optical Support Requirements:

iii. Low Earth Orbit/Launch Data Services - SPEC/Sub-Orbital -- N/A

Dryden

Description of Support Requirements:

	1998	1999	2000	2001	2002	2003	2004
Orbits/Flights per month							
Orbits/Flights per day							
Orbit or Flight duration							

Flight Test Locations:

Mission Control Center Requirements; Personnel, Console and Spectral Analysis Facility:

Real Time Data Display Requirements:

Special Data Handling Requirements:

Security Requirements:

Radar [Yes/No] _____ **Beacon/Skin** _____ **No. Of Radars** _____

Telemetry [Yes/No] _____ **Downlink Frequency(s)** _____ **Uplink Frequency** _____

Air-to-ground Video [Yes/No] _____ **Frequency(s)** _____

Flight Termination System [Yes/No]: _____ **Frequency** _____

Special Tone or Modulation Requirements: _____

Radio Communication Requirements: UHF Frequency(s) _____

VHF Frequency(s) _____ **HF Frequency(s)** _____

Special Communications Links to Other Facilities/NASA Centers:

Meteorological requirements:

Long Range Optical Support Requirements:

Video Distribution/Recording Requirements:

Mobile WATR Van Requirements/Location:

2. Space Network -- N/A

2.a. Customer Requirements

2.b. Catalog Services

2.b.1. SN Data Acquisition, Formatting and Transfer

2.b.2. SN Command Handling and Transmission

2.b.3. SN Tracking Data Generation

2.b.4. SN Scheduling

2.b.5. SN Real-Time Control and performance Data Monitoring

2.b.6. SN Testing

2.b.7. Summary Data

The following tabular information is a summary of the space network services requirements:

-- N/A

i. Low Earth Orbit/Launch Data Services - Space Network

i.a. Low Earth Orbit Spacecraft Data Services

Telecommunications and Tracking:

Forward Service	Contacts per Day	Minutes per Contact	Data Rate
MA			
KSA			
SSA			

SSA FWD Frequency

Data System Format: CCSDS TDM Other

Return Service	Contacts per Day	Minutes per Contact	Data Rate		Tracking Service	
			RT	PB	Range	Range Rate
MA					<input type="checkbox"/>	<input type="checkbox"/>
KSA					<input type="checkbox"/>	<input type="checkbox"/>
SSA					<input type="checkbox"/>	<input type="checkbox"/>

SSA RTN Frequency

Data System Format: CCSDS TDM Other

i.b. Launch Support Data Services -- N/A

	# of Contacts	Minutes/Contact	DataRate
MA			
SSA			
KSA			

i.c. Operations/Engineering Integration Services

- Link Analysis Pre-Acceptance Testing Documentation
 Loading Analysis Pre-Mission Testing

3. Deep Space Network

3.a. Customer Requirements

Telemetry: The DSN will receive the downlink telemetry data on either the carrier or the 1024-kHz subcarrier. The real-time data of 500, 2000, 4000, and 32000 bps can be placed on either the carrier or the subcarrier via MCS commands. The 128,000-bps data storage unit (DSU) recorded data can be placed only on the carrier. The DSN shall ensure 95% or greater error-free telemetry reception and real-time data transmissions to the MCS. The DSN will demodulate the 1024-kHz subcarrier real-time data and will record, bit synchronize, and pack the data into NASCOM 4800-bit blocks in accordance with DSN 820-13, Module TLM-3-15C and send the data to the MCS. DSU 128,000-bps data will be received, recorded, bit synchronized, and packed into NASCOM 4800-bit blocks in accordance with TLM-3-15C, and the data will be sent to the MCS in real time. The DSN will retain all telemetry data for 30 days unless otherwise indicated by the MCS.

Command: The RADARSAT command rate is 2 kb/sec. Provide standard NASCOM DSN/GSFC Interface Block (DGIB) 4800 bit block interface to receive commands, from the MCS, and transmit command echoes to the MCS.

Tracking: Tracking data will be sent to the MCS and used by the MCS to determine the spacecraft trajectory. The DSN will retain all tracking data for 30 days unless otherwise indicated by the MCS.

Modified Antarctic Mapping Mission II [MAMMII] S-Band Doppler

Requirement: Approximately forty-five (45) minutes of coherent S-Band Doppler Data from a high-latitude, southern hemisphere station, is required per day to be delivered to CSA in support of MAMMII. The DSN 26-m station at Canberra, Australia, (DSS-46) shall be used to meet this requirement. [Note - Other non-DSN stations, compatible with the CSA interface, may also be used to supplement the DSS-46 support to meet the forty-five (45) minute requirement.]

Note: As RADARSAT views vary between ~ 9 and ~15 minutes, this requirement may also be interpreted as three (3) passes per day.

In support of the generation of coherent doppler data, the Mission Control System (MCS) at CSA will require the delivery of telemetry and the capability to command the RADARSAT S/C in real-time. Existing interfaces, configurations and performance specifications, as detailed in the DSN's Network Operations Plan (NOP) for the RADARSAT S-Band Mission, shall be utilized to provide the telemetry and command services.

The CSA/MCS shall schedule DSS-46 in accordance with standard DSN scheduling interfaces.

The expected start date for MAMMII is September 4, 2000.

[Note: This S-Band Doppler Data Requirement is levied at the behest of the NASA X-Band Mission, and specifically *not* by the CSA S-Band Mission.]

3.b. Catalog Services

3.b.1. DSN Data Acquisition, Formatting and Transfer -- Per Standard Service

3.b.2. DSN Command Handling and Transmission -- Per Standard Service

- 3.b.3. DSN Tracking Data Generation -- Per Standard Service
- 3.b.4. DSN Scheduling -- Per Standard Service
- 3.b.5. DSN Real-Time Control and performance Data Monitoring -- Per Standard Service
- 3.b.6. DSN Testing -- Per Standard Service
- 3.b.7. Summary Data -- Per Standard Service

The following tabular information is a summary of the Deep Space Network services requirements:

Basic Description of Support Required:

RADARSAT support will be provided by the DSN stations located at Goldstone (GDS), California (DSS-16), Canberra (CAN), Australia (DSS-46), and Madrid (MAD), Spain (DSS-66). There will be pre-pass checkout of telemetry and command lines prior to all supports. Support will be provided by all three stations for routine phase, the MAMMII (and preparations for this), and, as requested, during emergencies. Support will consist of command, command echo, telemetry data and tracking data handling for approximately 4 passes per month (routine), and 90 passes per month (MAMMII).

Telecommunications and Radio Metric Link Characteristics:

Uplink Frequency(s): 2053.485 MHz Bandwidth: 1.5 MHz
 Downlink Frequency(s): 2230.0 MHz Bandwidth: 2.4 MHz
 Number of R.F. Links: 1
 Spacecraft Xmit Power, Watts, EIRP, per Link: 3 Watts EIRP 24 dBm (omni), 32 dBm (nadir)
 Spacecraft Receiver G/T per Link: -50 dB/K minimum (omni 4 pi steradians, less holes)
 Spacecraft Required Receive Power, dBm: -101 dBm minimum at the antenna
 Radar EIRP and G/T Performance: N/A
 Insitu Telecomm Relay Required: N/A
 Link Analysis Attached (If Available): NO

Data Type Requirements:

Telemetry Links	Data Rate Range	Format		Real Time	Recorded	% Data Return	Duration/Period
		CCSDS	Other				
1	0.5 to 128 kbps		DGIB	0.5 to 128 kbps	0.5 to 128 kbps	95	15 min

Command Links	Data Rates	Format		Real Time	Store Forward	Duration/Period
		CCSDS	Other			
1	2 kbps		Throughput	X		15 min

Tracking | Radio | Nav. or | | 1, 2, 3-Way | System | Duration/

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	Metrics	Science	Accuracy	Mode	Stability	Period
Range	Tone	Nav	2-5 m	2-way		15 Min
Range Rate		Nav	1 mm/sec	2-way		15 Min
Angle/VLBI	Angle	Nav	0.05 Degrees			15 Min
Other						
Radio Science Data Handling Reqs						

Coverage Requirements

Phase [Define Phase and Period]	Routine	MAMMII (90 days)
Passes/Month	4	90
Pass Length [minutes]	15	15
Antenna Expected [11, 26, 34, 70M]	26-m	26-m
Max Angle Rate [Near Earth]	0.6 deg/s	0.6 deg/s

Standard Telemetry Requirements **No. Of Links:** 1 [If Non-standard, Explain Below]

Frequency	Bandwidth	Modulation	Coding	Subcarrier	Data Type	Format
2230 MHz	2.4 MHz	PCM/PM PCM/PSK/PM		1.024 MHz	BiPhase-L BiPhase-L	DGIB DGIB

Standard Command Requirements **No. Of Links:** 1 [If Non-standard, Explain Below]

Frequency	Bandwidth	Modulation	Subcarrier	EIRP	Format
2053.458 MHz	1.5 MHz	PCM/PSK/PM	16 kHz		Throughput

Standard Metrics Requirements **Radar:** [If Non-standard, Explain Below]

Ranging	Doppler	Angle	Optical	Special Data Handling
Tone	Two-Way	Autotrack		

Deep Space/Lunar Trajectory Data for Pointing Information:

Geocentric Range, or Max Comm Range
 Declination/Right Ascension vs. Time (Submit Table)
 Applicable State Vector

Give brief description of services required in any or all of the following functional areas. Performance parameters are to be given on the previous page.

Radio Science (S, X or Ka Band service available) -- None Required

VLBI -- None Required

Radio Astronomy -- None Required

Radar Astronomy -- None Required

4. Data Distribution

4.a. Customer Requirements

Data Transport Facility Requirements:

Brief Data Transport Network Description: RADARSAT data from the ground stations will be routed through JPL to the Mission Control System in St. Hubert, Canada. All commands will be transmitted from the MCS through JPL to the ground stations for uplink.

Terminal Locations: The RADARSAT MCS is located at the Canadian Space Agency in St. Hubert (Montreal), Quebec, Canada. The JPL, GSFC, PKF, MGS, DSN, and MCS interface terminals already exist.

NISN Requirements: VOICE DATA VIDEO Miscellaneous

Highest Data Rate: 224 kbps

Other Distribution Services: All circuits are to be full service dedicated and are to be diversely routed.

Brief Narrative Description:

Standard Services: NISN will provide the voice and data communications circuits from the present through the operational life of the RADARSAT mission. The mission requires voice and data circuits between the MCS, JPL, GSFC, Poker Flat, McMurdo, and DSN ground stations.

See Attachment.

Non/Standard Services: None Required.

4.b. Catalog Services

5. Special Network Management Services

5.a. Customer Requirements

5.b. Catalog Services

6. Supporting Services

6.a. Customer Requirements

6.b. Catalog Services

6.b.1. spectrum licensing -- **Yes**

6.b.2. systems engineering -- **No**

6.b.3. end-to-end testing and mission readiness testing -- **Yes**

6.b.4. simulators -- **No**

6.b.5. service management {planning, scheduling, controlling, ...} -- **No**

6.b.6. other -- **No**

C. Center Unique Services

1. GSFC Unique Services

1.a. Customer Requirements

1.b. Catalog Services

2. JSC Unique Services

2.a. Customer Requirements

2.b. Catalog Services

3. KSC Unique Services

3.a. Customer Requirements

3.b. Catalog Services

Section III CUSTOMER REQUIREMENTS AND NON-STANDARD SERVICES

A. Non-CSOC SOMO Services

DSN Navigation will be available for emergency support during the life of the Mission. In addition, Navigation Services may be required during AMMII. Navigation Services will be required to assist the MCS Flight Dynamics (FD) Operation in performing the end-of-life analysis.

B. Non-NASA Services

C. PCD Requirements

Section IV Service Price, Metrics and Schedule Summary

Ent	Service ID	ServiceTitle	Unit						FY00	FY01	FY02	FY03	FY04
			Description	Units00	Units01	Units02	Units03	Units04					
Y	1.3.2.3.3	26m service	minute	0.00	0.00	0.00	0.00	0.00	-	-	-	-	-
Y	1.3.2.3.3.03	26M 3 contacts/wk	minute	9,400.00	0.00	0.00	9,400.00	0.00	85,701	-	-	111,612	-
Y	1.3.2.3.3.14	26M 14 contacts/wk	minute	0.00	11,200.00	11,200.00	0.00	0.00	-	189,648	234,155	-	-
Y	1.3.2.4.10.2.1	Mission Critical Routed Data Service < 56 Kbps-Domestic	circuit/year	1.00	1.00	1.00	1.00	1.00	6,226	5,568	4,455	4,050	3,797
Y	1.3.2.4.10.2.2	Mission Critical Routed Data Service < 256 Kbps-Domestic	circuit/year	1.00	1.00	1.00	1.00	1.00	16,815	15,038	12,030	10,937	10,253
Y	1.3.2.4.5.1	Dedicated Voice Service - Domestic (>25 miles)	voice-loop/yr	2.00	2.00	2.00	2.00	2.00	12,079	10,802	8,642	7,856	7,365
Y	GSFC-057	GSFC Mission Services (UPN-31580) RADARSAT	Lot	0.00	0.00	1.00	0.00	0.00	-	-	43,225	-	-
Radarsat I Total									120,821	221,057	302,507	134,454	21,415

The following caveats apply to this version of the PSLA:

1. DSN Data Service Minutes are an estimate only and generally valid at the time of the PSLA preparation. Actual track time is a factor of the Resource Allocation Process and will be different at the end of each fiscal year. Contacts/wk are an estimate only over a long period and actual weekly contacts will vary.

2. As DSN support to RADARSAT 1 is committed through the International Memorandum of Understanding (IMOU) for RADARSAT 1 between NASA and CSA, the latter is the top document governing, and takes precedence over any other document describing the nature of the CSA/NASA working relationship. Consequently, any conflict between the PSLA and the IMOU will be decided according to the IMOU, and any decisions which must be made will be taken by the International Steering Committee (ISC). The IMOU is set to expire in November 2000, and, although an extension is being discussed, it is presumed that the outcome will be consistent with the services and time frame described in the PSLA.

3. The DSS-46 S-Band Doppler Data Requirement for MAMMII is a requirement of the NASA X-Band Mission, and specifically *not* a requirement of the CSA S-Band Mission.

4. Finally, the CSA signature on the PSLA in no way commits CSA to pay any fees implicitly or explicitly identified in the document for the services described. The IMOU allows for no remuneration of any kind, as the full cost of DSN support to RADARSAT 1 is borne by NASA. In this regard, CSA recommends that its signature be countersigned or ratified by a representative of NASA HQ on behalf of NASA's participation in RADARSAT 1.

ATTACHMENT

Ground Communications and Data Transport

General Ground Communications Requirements

NASA will provide voice and data communications between the DSN and all tracking facilities. The communications requirement is for a single interface between the DSN and the MCS. The number and bandwidth of the required communications circuits are in the following table.

Ground communications will be required to support all phases of the mission. The Table provides the requirements for communications circuits for the NASA-provided resources to support RADARSAT.

Communications Circuit Requirements

Item No.	Communication End Points	Type of Communications Required	Bandwidth	Data Delivery	Service Date and Duration	Req. Class
1	JPL DSN – CSA MCS	TLM/CMD/CMD ECHO/TRK/ICV	224 kbps	Real Time	L-6 to EOM	1
2	JPL DSN – CSA MCS	TLM/CMD/CMD ECHO/TRK/ICV	56 kbps	Real Time	L-6 mo. to EOM	1
3	JPL DSN – CSA MCS	Voice	9.6 kbps AVD	Real Time	L-6 mo. to EOM	1
4	JPL DSN – CSA MCS	Voice	9.6 kbps AVD	Real Time	L-6 mo. to EOM	1
5	WFF Poker Flat/ McMurdo – NISN GSFC	TLM/CMD/CMD ECHO/TRK	224 kbps	Real Time	L-5 mo. to EOM	1
6	WFF Poker Flat/ McMurdo – NISN GSFC	Voice	9.6 kbps AVD	Real Time	L-5 mo. to EOM	1
7	JPL DSN – NISN GSFC	TLM/CMD/CMD ECHO/TRK	224 kbps	Real Time	L-5 mo. to EOM	1
8	JPL DSN – NISN GSFC	Voice	9.6 kbps AVD	Real Time	L-5 mo. to EOM	1
9	JPL DSN – NISN GSFC	Voice	9.6 kbps AVD	Real Time	L-5 mo. to EOM	1

The DSN shall request diversely routed communications circuits between the MCS and the DSN from NISN. The circuit configuration plan shall be that the 224-kbps duplex and one of the 9.6-kbps alternate voice/data (AVD) circuits to the MCS be diversely routed from the 56-kbps duplex and the second 9.6-kbps AVD circuit.