RFP 9F045-15-0292

Canadian Space Agency

ANNEX A

Statement of Work (SOW)
for a
Study on
Multi-Aperture SAR

Revision A

Canadian Space Agency | Agence Spatiale Canadienne

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1 INTRODUCTION

1.1 SCOPE

This Statement of Work (SOW) defines activities to investigate if multi-aperture technology could be proposed for the next generation Synthetic Aperture Radar (SAR) systems to be developed in Canada.

The study has three objectives:

- Perform detailed system analyses to evaluate the potential offered by multi-aperture technology in the context of a constellation of SAR satellites;
- Consult the Canadian User Team to select most interesting capabilities for follow-on systems;
- Identify inputs for CSA's SAR technology roadmap.

1.2 BACKGROUND

The first space-based SAR systems, like RADARSAT-1, ERS and ENVISAT used a single-aperture implementation. This means that even if the antenna is very large, all the received signals are summed up together at one point called the '*effective phase center'* of the antenna. Currently, there is considerable interest for SAR missions with multiple apertures. This interest is justified by the significant performance increase that multi-aperture SAR are capable of achieving. The ratio between the swath and the azimuth resolution of a conventional SAR is limited to ~ 20 km/m. RCM, for example, provides a 350 km mode with 50 m resolution, which equates to a ratio of 7 km/m, while RADARSAT-2 (RS2) wide mode offers a swath of up to 150 km with a single look azimuth resolution of 7.7 m for a ratio of 19.5 km/m. It is impossible to exceed this level of performance with a single-aperture instrument. However, if the antenna can be separated to receive in independent sections, similar to the 5 m mode of RS2 that uses the payload ability to split the antenna into two sections, swath sizes of 130 km can be achieved with resolutions of 5 m or better. This leads to a swath/azimuth resolution ratio of 26, which is significantly superior to any single-aperture mode available.

Without the use of multi-aperture, the coverage of a large area is more easily achieved using a large number of smaller satellites because the cost of a satellite increases significantly when its performance approaches the 20 km/m ratio. However, the optimal balance may shift towards a slightly more powerful satellite if this limitation can be relaxed using a multi-aperture satellite. This optimal balance point has not been well investigated to date.

During the RADARSAT Next Generation (RNG) Options Study that began in 2010, it was shown that many applications would benefit from a larger coverage area and more frequent revisit time than what is currently provided by RCM. A list of requirements was produced that is summarized in RD-5 and which will be used as an initial input to the multi-aperture study. The RNG study was focused on using a satellite design similar to the existing (single-aperture) RCM design to exploit the possibility of quickly launching additional satellites following the initial

RCM deployment. Under these constraints, the investigation led to a solution consisting of a constellation with a large number of satellites.

In the context of replacing the RCM satellites at the end of their planned service life in 2025, there is a need to investigate multi-aperture systems that were not considered in the RNG study. Multi-aperture systems may offer better solutions that can meet the requirements expressed in RD-5 using a smaller constellation and thus potentially reduce the overall mission cost. It is not planned to revisit the configurations evaluated during the RNG Options Study in this contract, although the same basic requirements will be used as a starting point to evaluate the potential of a multi-aperture system. This study will not only address the trade-off offered by multi-aperture systems with respect to the original RNG requirements but will also broaden the scope to identify the full range of benefits offered by a multi-aperture system.

Given the long timeframe required to implement a SAR mission, it is anticipated that a formal Phase 0 for a RCM follow-on system may be initiated in 2016. In this context, it is desirable that the main conclusions of the multi-aperture study are significantly advanced and detailed to support the Phase 0 definition activities although it is possible that one activity starts before the other is fully completed.

1.3 DOCUMENT CONVENTIONS

A number of the sections in this document describe controlled requirements and specifications and therefore the following verbs are used in the specific sense indicated below:

a) “Must” is used to indicate a mandatory requirement;

b) “Should” indicates a goal or preferred alternative. Such goals or alternatives must be treated as requirements on a best efforts basis, and verified as for other requirements. The actual performance achieved must be included in the appropriate verification report, whether or not the goal performance is achieved;

c) “May” indicates an option;

d) “Will” indicates a statement of intention or fact, as does the use of present indicative active verbs.

In the following, the term 'Contractor' is used to describe the team that will conduct the study, which could be a mixed team drawn from Canadian Industry, Universities or Research Institutes.

2 DOCUMENTS

2.1 REFERENCE DOCUMENTS

The following documents provide additional information or guidelines that either may clarify the contents or are pertinent to the history of this document.

TABLE 2-1: REFERENCE DOCUMENTS (RD)

RD No.	Document Number	Document Title	Rev. No.	Date
RD-1.	PMBOK Guide	A Guide to the Project Management Body of Knowledge	4th Ed.	2008
RD-2.	CSA-SE-STD-0001	CSA Systems Engineering Technical Reviews Standard	Rev. A	2008-11-7
RD-3.	CSA-ST-GDL-0001	CSA Technology Readiness Levels and Assessment Guidelines	I.R.	January 2009
RD-4.	RCM-RP-52-9274	RCM System Description	1.1	February 2010
RD-5.		Requirements Document for Multi-aperture SAR Study	I.R.	June 2015

3 REQUIREMENTS

The Contractor must manage the project to effectively achieve project performance, scope, quality, cost and schedule requirements of this SOW. The Contractor must provide the management, technical leadership, and support necessary to ensure effective and efficient performance of all project efforts and activities.

The Contractor must report project costs, schedule, technical, performance and risks issues as defined herein.

3.1 INITIAL TRADE-OFF AND CONSULTATION

3.1.1 Trade-off and Benefits study

The Contractor must review the requirements provided in RD-5. The Contractor must use these requirements as a starting point to define several potential configurations using multi-aperture techniques as well as a reference scenario utilizing the RCM design (or a design of very similar performance). The proposed options must be in C-band. The multi-aperture techniques investigated may range from simple dual-aperture systems similar to the RADARSAT-2 implementation up to a design that consists of a large number of independent receivers and transmitters in both the azimuth and range direction. The Contractor may also propose implementations that are not only based on phased arrays but also based on alternative antenna technologies. The Contractor must include as a minimum the following configurations:

- A system with 3-satellite RCM design (or with similar performance) for reference;
- A system with 3-satellite RCM design (or similar) with dual-aperture configuration;
- A system with 6-satellite RCM design (or similar) with dual-aperture configuration;
- A system with 3-satellite RCM design (or similar) with 4 or more sub-aperture configuration;
- A system with 6-satellite RCM design (or similar) with 4 or more sub-aperture configuration.

The Contractor may need to propose changes in the spacecraft design, antenna size, and/or transmit power to fully benefit from the multi-aperture configuration. The Contractor must investigate other configurations based on a requirements assessment and the Contractor's knowledge of the potential benefits and cost of these configurations.

The Contractor must be able to provide means of efficiently screening options that are of limited interest. The selected options must be presented to CSA at an Initial Option Review Meeting. The Contractor must then perform a more detailed trade-off between the selected configurations. In this trade-off, the Contractor must:

- Perform an initial evaluation of the performance of the system in terms of NESZ, swath, resolution, ambiguities, coverage, data rate and revisit performance.
- Evaluate compliance to the requirements provided in RD-5. Some of the requirements presented in the list require the use of other frequency bands, and in such cases full

compliance is not expected but the Contractor must provide an evaluation of the level of compliance to these requirements.

- Identify additional benefits of the proposed configuration in terms of:
    - New applications/services enabled by the proposed configuration.
    - Development of new markets for the system and/or subsystem benefiting the Canadian Aerospace Industry.
    - Cost savings with the use of the new system.
    - New/increased markets for value-added services providers.
    - Potential for development of new models/knowledge by Universities to provide benefits for Canada.
- Identify the improvement that will be offered by the proposed configuration in comparison to existing systems.
- Provide the relative costs and risks of each implementation.

The implementation of a multi-aperture configuration will enable new modes of operations. A few examples are:

- Improved wide-area monitoring (swath and/or resolution);
- Target velocity estimation;
- Improved high-resolution imaging;
- Medium-resolution monitoring mode and high-resolution mode operated in a ScanSAR fashion simultaneously to provide both wide-area monitoring and high-resolution imagery of critical areas, or to provide imagery to two different users if they have less demanding requirements;
- Wide-area monitoring at higher resolutions enabled by this mode of operation coupled with a larger aperture size may enable the provision of overlapping low- and high-incidence-angle imaging from one satellite to the next to provide near-instantaneous, multi-incidence imaging, which will allow the system to:
    - Provide high-incidence measurements for ship detection and low-incidence measurements for oil spill detection within a short time interval;
    - Provide low and high-incidence data to improve soil moisture estimates.

As part of the trade-off study, the Contractor must identify the suitable options (not limited to the list provided above), evaluate the benefits/value, and provide a first estimate of the relative cost and complexity of implementing each option.

In the course of the trade-off, it may be found that significant benefits can be achieved with the use of complementary sensors/technology. The Contractor must inform the Technical Authority (TA) of such possibilities. Upon approval from the TA, the Contractor may then incorporate these sensors/technology into the trade-off space.

The Contractor must provide a recommendation as to the most promising configuration and provide a conclusion concerning the trade-off between the number of satellites versus the complexity of each satellite. The Contractor must prepare a Trade-off and Benefits Analysis Document describing the work performed in this part of the study and the recommendations.

3.1.2 Consultation with the RCM User Team

The Contractor must present the results of the Trade-off and Benefits Analysis at a Trade-Off Review Meeting. Participants from the RCM User Team will be invited to review the work performed by the Contractor and provide their feedback on which options should continue forward for further study as well as whether any modifications/additions/removals of requirements are needed with respect to the initial requirements generated during the RNG Study. CSA will be responsible for all interactions and exchanges with the RCM User Team. A period of six weeks will be allocated for these discussions to be completed following the Trade-Off Review Meeting. During this period, the Contractor must provide answers to any questions and comments that users may have concerning the proposed options, which includes performing limited analysis on specific topics as required. The TA will provide the Contractor (as required) an updated list of requirements and a selection of up to three options that will be further investigated during the second part of the study.

3.2 OPTION REFINEMENT AND TECHNOLOGY DEVELOPMENT PLAN

3.2.1 Option Refinement

The Contractor must analyze the selected options in further detail. The Contractor must perform additional analyses to assess the impact of the requirements change (as necessary) that may have been agreed to during Task 3.1.2.

The Contractor must identify the key system and spacecraft requirements for each of the options and document the results in a Preliminary System Requirements Document. This document must be produced with the primary goal of establishing the impact of the proposed configuration on the various subsystems.

The Contractor must establish and validate models to provide an accurate estimation of the proposed satellite performance in terms of Noise Equivalent Sigma Zero (NESZ), range and azimuth ambiguities, resolution, etc. The algorithm used to compute the performance of these new modes of operation must be described in a Performance Model Document along with any assumption and/or limitation of the proposed model. A model/simulation of the proposed constellation must also be provided. The Contractor must provide the performance of the complete system in terms of coverage, revisit and coherent change detection interval, etc.

The Contractor must analyze the impact that each of the three options will have on the spacecraft and the ground segment. This analysis must include a detailed description of the impact as well as a potential implementation solution for the following subsystems:

- Antenna (size, structure, RF power generation and RF signal reception, etc.);
- Central Electronics (radar signal generation and reception);
- Spacecraft and Payload Control;
- Mass Memory Storage;
- Downlink Subsystem;
- DC Power Generation and Storage;
- Thermal Control;
- Orbit Determination and Control;
- Attitude Determination and Control;
- Order Handling Subsystem;
- Mission Planning and Control;
- Calibration;
- Product Generation;
- Product Distribution and Archiving.

Other subsystems must be considered if the proposed option requires significant changes to achieve performance beyond what is currently available. The key challenges, risks and required technology developments must be identified for each of the subsystems.

The Contractor must perform an in-depth assessment of the benefits of each options in term of compliance to the requirements agreed upon as part of the task described in Section 3.1.2. The assessment must also assess the benefits to other domains such as the aerospace industry, value-added service providers, new applications and services, improved models and understanding of the environment. The Contractor can include an estimate of the value of these benefits if enough information is available to substantiate it.

For each option, the Contractor must provide an estimate of the cost to implement the mission. This cost must be broken down between the non-recurring costs to develop the new system and the recurring costs of adding or replacing satellites. Along with the cost estimate, a detailed justification for those costs must be included. The justification must describe the type of analysis used (analogous, bottom-up, etc.), as well as the assumptions that were made. The Contractor must also provide an implementation schedule.

Potential for collaboration with an external entity, such as the Copernicus System, must be considered by the Contractor. The Contractor must analyze the opportunities for collaboration as well as the benefits of such collaboration for all three options. The results of all analyses performed in this section must be documented in a Mission Concept Option Analysis Document. The Contractor must provide a recommendation for the most promising option for further study.

3.2.2 Input to Technology Roadmap

The Contractor must provide a list of technologies required for each of the selected options. For each technology identified, the Contractor must provide:

- The list of activities required to bring the maturity of the technology to a Technology Readiness Level of 6;
- The cost and schedule estimate to perform these tasks;
- An evaluation of the urgency and criticality of each development activity;
- An evaluation of the main risks and challenges for the selected developments.

The Contractor must document this information in a Technology Development Plan.

3.2.3 Concept Review

The Contractor must present the main findings and recommendations in a Concept Review Meeting. During this review the Contractor must present:

- A technically and programmatically feasible concept with the main system parameters identified;
- The benefits of the proposed concept with respect to more conventional designs;
- The main development activities;
- A cost estimate;
- A preliminary schedule including necessary developments.

3.3 DELIVERABLES

The deliverables for the activity are listed in Table 3.3-1.

Reports and Documents	**Due Date**
Trade-off and Benefits Analysis	Trade-Off Review Meeting – 2 weeks
Preliminary System Requirements	Final Review – 2 weeks
Performance Model Document	Interim Review – 2 weeks
Mission Concept Options Analysis	I.R.: Interim Review – 1 weeks Final: Final Review – 2 weeks
Technology Development Plan	Final Review – 2 weeks
BIP and FIP Disclosure Report	Final Review – 2 weeks
Technical Notes	As required.
Minutes/ Presentations	
Kick-Off Meeting Presentations	ARO
Initial Option Review Meeting Presentation	Meeting Date – 1 week
Trade-Off Review Meeting Presentation	Meeting Date – 1 week
Interim Review Presentation	Meeting Date – 1 week
Final Review Presentation	Meeting Date – 1 week
Meeting Agenda	Meeting Date – 1 week
Minutes of Meetings	Meeting Date + 1 week
Action Item Log for Progress Review and Teleconference	Meeting Date + 1 day
Final Data Package	2 weeks before Contract End Date
Final Report	
Executive Report	
Project Management Deliverable	
Detailed Schedule	Initial at Kick-Off (updated as required by TA).
Monthly Report	Monthly

3.4 SCHEDULE

The work described in this SOW must be completed within 10 months.

3.5 MEETINGS

Table 3.5-1 lists the meetings with the Contractor planned for this activity.

Table 3.5-1

Meeting	**Date**	**Location**
Kick-Off	ARO + 2 week	Contractor
Initial Option Review Meeting	ARO + 4 weeks	CSA
Trade-Off Review Meeting	ARO + 3 months	Ottawa
Options Selection and Requirements Update Meeting	ARO + 4.5 months	Teleconference
Interim Review	ARO + 6 months	CSA
Concept Review	ARO + 9 months	CSA
Teleconference	As needed	Teleconference

3.6 DOCUMENTATION AND NAMING CONVENTION

Documentation, reporting and other deliverables must be according to instructions provided in Appendix B of this SOW, which also provides naming convention. Presentation material should be in Power Point format. Documents provided in Adobe PDF format must not be protected against copy of text and figures.

Documents must be delivered in the original software application format. One electronic copy of each deliverable document must be transferred to the CSA to the address and in the format specified in DID-0000, section 1.1. No paper copy is to be delivered.

All simulation scenarios that have been considered (e.g. with STK) must be delivered in CD-ROM or DVD-ROM format.

All documents must be provided 10 working days prior to the specified Review/Meeting unless otherwise indicated.

3.7 PROJECT MANAGEMENT REQUIREMENTS

The Contractor is responsible for establishing and maintaining a project management control system necessary meeting the requirements provided in the next sub-sections.

3.7.1 Team Organization

The Contractor must set up and maintain a project organization specific to this project. The Contractor must provide and maintain a current Project Organizational Chart showing personnel assignments by name and function, and showing subcontractor-reporting relationships.

The Contractor must nominate a Project Manager, who will be responsible for all aspects of the work carried out by the Contractor and will act as single point of contact within its project organization for communications between the Contractor and the Technical Authority (TA). In the absence of the single point of contact, the Contractor must designate an alternate to maintain continuity of communication between the Contractor and the TA.

The Contractor must also identify other key personnel who are considered essential to the performance of the contract. The Contractor must assign personnel with appropriate qualifications and experience to all posts within the project organization.

The Contractor must include, within its program management structure, the necessary leadership to effectively manage the performance of subcontractors in keeping with the project objectives.

3.7.2 Detailed Schedule and Critical Path

The Contractor must prepare and maintain a detailed schedule based on the CWBS for all the work to be performed under this contract.

The schedule must include all the milestones listed in section 3.5. The schedule must show dependencies between the activities to identify the critical path.

The schedule shall be updated at each major milestones.

3.7.3 Communications and Access

The Contractor must establish and maintain a close management and technical interface with CSA technical and project authorities to assure a coordinated program effort and monitoring of the total program cost, schedule and performance.

The Contractor must provide access to its plant and personnel, at mutually agreeable dates, by representatives of CSA or other organizations nominated by the CSA, for review of program status.

The Contractor must provide temporary accommodation and other facilities for the use of the CSA representatives (and the nominated attendees) visiting the Contractor's premises for reviews, meetings, audits, liaison, etc.

The accommodation must be adequate for the purposes of the visit and the facilities provided must include telephone, faxing, photocopying and Internet access.

All documentation and data generated by the Contractor for the project must be accessible to the TA for review.

3.7.4 Project Meetings

The Contractor must hold the meetings described in section 3.5. Some or all of these meetings may be attended by representatives of the CSA, and/or other organizations nominated by the CSA.

All meetings will be held between the Contractor and the TA at a mutually agreeable time. The Contractor must provide formal notification of the proposed meeting date to the TA no less than 10 working days before the meeting (with the exception of the KoM where the Contractor must provide formal notification no less than 5 working days before the meeting).

For meetings held at government venues, the Contractor must inform the TA of the names of Contractor and Subcontractor attendees no less than 10 working days before each meeting.

Additional teleconferences and face-to-face review meetings may be held if necessary when mutually agreed to by the Contractor and the CSA project manager.

Meetings can be alternatively replaced by videoconference or teleconferences for cost and/or time savings and when appropriate to support the scope of the meeting.

3.7.4.1 Kick-off Meeting

The Contractor must hold a Kick-off Meeting (KoM) After Contract Award (ACA).

This meeting will be chaired by the TA.

This meeting will be an opportunity for CSA to review the Contractor’s plans, the requirements of the work (SOW), schedules, deliverables, risks, and address issues.

All key participants under the contract, including one representative from each major subcontractor, must attend.

3.7.4.2 Technical Reviews

The Contractor must prepare, plan and conduct the meetings listed in section 3.5 in accordance with the requirements identified in CSA Technical Review Standard (RD-2). This document describes in detail the objectives, entry criteria, exit criteria and results of each review. These meetings may be attended by representatives of the CSA, or other organizations nominated by the TA.

The Contractor must submit the Review Data Packages 10 working days prior to each review; document versions must be as per the CDRL.

The Contractor's project manager, the systems engineer and all key Contractor participants, including at least one representative from each Subcontractor, must attend all Technical Reviews.

The TA may raise Review Item Discrepancies (RIDs) to identify issues. The Contractor must address all RIDs to the satisfaction of the TA. If RIDs cannot be fully addressed within 5 working days, the Contractor must provide, within 5 working days after receipt of the RID, an action plan to address the RID.

3.7.5 Agendas, Minutes and Action Item Log

The Contractor must provide a Meeting Agenda for all reviews and meetings including teleconferences and must deliver these to the TA no less than 5 working days before the meeting and must have it approved by the TA.

The Contractor must produce the minutes for all reviews and meetings including teleconferences and must deliver these to CSA. In the case of teleconferences, they must be delivered the next business day.

The Contractor must maintain a detailed Action Item Log (AIL) throughout the project to track actions resulting from all reviews and meetings including teleconferences using the following red-yellow-green stoplight method:

- 'Green' implying that the action item will be completed on-time.
- 'Yellow' implying that there exist an issue which will prevent meeting the deadline, and
- 'Red' implying that the action is past due.

Also, a chart indicating how many action items are open and how many are closed since the beginning of the project shall be produced for the monthly progress report and at the meetings. The AIL must be delivered with the Monthly Progress Report.

3.7.6 Project Reporting

3.7.6.1 Monthly Progress Reports

The Contractor must submit monthly Progress Reports.

The Monthly Progress Reports must be sent by e-mail to the TA and the Contracting Officer every month and no later than five working days after the end of the month.

3.7.7 Documents Deliverables

The Contractor must deliver all documentation listed in the CDRL tables (Appendix A) as a minimum. The format and content of the deliverables must be in accordance with the requirements specified in the Data Item Descriptions (DIDs) (Appendix B), both the specific DID identified in the CDRL and the General Preparation Instructions, DID-0000.

Except for the documents that will remain CSA documents, the Contractor may propose documents in a contractor's format provided the purpose, scope and content equal or exceed the DID requirements. Subject to CSA approval, the content of the contractor's document will replace the content of the document specified in the DID.

All documents must be delivered on CD-ROMs or DVD-ROMs (except Shipping Documents).

SI units must be used/supplied by the Contractor. Conversion factors must be supplied for all non-SI units used in the deliverable documents (including dates as YYYY-MM-DD).

The delivery schedule for all documentation must be as defined in the CDRL table.

The Contractor must obtain approval from the CSA for all CDRL Documents so indicated in the CDRL table (see Section 3.7.7.1).

3.7.7.1 Documents Delivered for Approval

The term “Approval” as used in this document and in other documents referred to herein, means written approval by CSA, of documents submitted by the Contractor. Once approved, the document is authorized for further use by CSA. The TA does not take responsibility for the validity of the data, or statements, and the Contractor is fully responsible for the content and secondary effects derived there from. The document may not be changed without the TA’s approval. No request or document for which approval is required must be acted upon or implemented by the Contractor until such approval is provided. Such requests and documents will be reviewed promptly by the TA and the necessary written approval or disapproval will be provided after their receipt by CSA. In the event of a failure by the TA to approve or disapprove the document within 30 calendar days, the documents may be deemed approved. In the event that a request or document is disapproved, the TA will advise the Contractor in writing as to the reasons for such disapproval and will define the additions, deletions or corrections that the TA deems necessary to render the request or document acceptable. Disapproved requests or documents that are subsequently amended by the Contractor and resubmitted for approval will be either approved or disapproved by the CSA.

3.7.7.2 Documents Delivered for Review

The term “Review” as used in this document and in all other documents referred to herein, means, unless specifically stated otherwise, a CSA review of the documents submitted for that purpose by the Contractor. The acceptance by the TA of a document for review shall imply that the document has been reviewed, commented on, revised as necessary, and has been determined to meet the requirements. The TA does not take responsibility for the validity of the data, or statements, and the Contractor is fully responsible for the content and secondary effects derived there from. In the event that the TA does not concur with a document submitted for review, the TA will so notify the Contractor. Such notification will include a full explanation of the reasons

for the lack of concurrence and will recommend the additions, deletions or corrections that the TA deems beneficial to the needs of the project.

The Contractor is obligated to consider implementation of the changes suggested by CSA insofar as the changes are in accordance with the relevant DID in Appendix D and this SOW. If written notification of concurrence is not provided by CSA within 30 calendar days of the receipt of the document, the document will be deemed to have been reviewed by the TA without comment.

3.7.8 Subcontract Management

The Contractor must be fully responsible for implementation and execution of all tasks, including those subcontracted to others. Whenever this is the case, the Contractor must prepare and maintain subcontract Statements of Work, technical requirements documents, etc., necessary to effectively manage the subcontractors' work. At the request of the TA, copies of subcontractor documentation must be delivered to the TA.

The Contractor must ensure that all of the relevant requirements of this Statement of Work are flowed down to the subcontract Statements of Work.

3.7.9 Product Assurance

There are no applicable product assurance requirements in this study.

4 GOVERNMENT FURNISHED EQUIPMENT AND INFORMATION

All the GFE hardware provided must be returned to the Crown at the conclusion of the Contract.

No GFE.

APPENDICES

APPENDIX A CONTRACT DATA REQUIREMENTS LIST (CDRL)

This Appendix defines the documentation to be delivered by the Contractor.

LEGEND:
A = Approval (in the Approval Category)
R = Review (in the Approval Category)

TABLE A-1: CDRL

Title	DID No.	Approval Category
Project Schedule	0002	A
Meeting Agenda	0004	A
Minutes of Meetings	0005	A
Action Items Log (AIL)	0006	A
Monthly Report	0003	A
Trade-off and Benefits Analysis	0200	A
Preliminary System Requirements	0210	A
Performance Model Document	0220	A
Mission Concept Option Analysis	0230	A
Technology Development Plan	0240	A
Executive Report	0250	A
Technical Notes	CF	X

APPENDIX B DATA ITEMS DESCRIPTIONS (DIDs)

DID-0000 - General Preparation Instructions

PURPOSE:

This DID describes the standard format for the preparation of deliverable project documentation. All documentation must be written in English and must be delivered in electronic format. Documentation must be prepared in the Contractor's format, however it must meet the requirements of this DID.

PREPARATION INSTRUCTIONS:

1. GENERAL INSTRUCTIONS

1.1. Electronic Copies

Electronic documents must be prepared using the most appropriate tool (Microsoft Word, Excel, MS Project, etc.); released versions must be delivered in electronic format and may be in PDF. Schedules must be submitted in Microsoft Project format. Documents must be delivered via e-mail or direct transfer (FTP). For direct transfer, a notification of the document's readiness and location on a contractor repository must be sent.

The electronic file name and the identification number written on the document itself must have the following format:

WXYZ-CDRL-NUM-CIE_ContractNumber_sent2007-03-30

where:

WXYZ:	A 4-8 letter acronym of the project
CDRL-NUM:	The CDRL Identifier
CIE:	Name of the Company (no space, no hyphen)
ContractNumber:	For example: _9F028-07-4200-03
_sentYEAR-MONTH-DAY:	Date Tracking Number

Electronic documents or notifications of their availability on contractor repositories must be sent to the e-mail address of the TA.

Emails are to contain the project/program acronym or equivalent identifier in the "Subject" line and include the CDRL identifier under which deliverable documents are being submitted. Hard copy and media deliverables are to be addressed to:

Attention:
Canadian Space Agency
6767, Route de l'Aéroport
Longueuil, QC, J3Y 8Y9
CANADA

The DVD-ROM label must present the following information:

a) Company Name
b) Document Title
c) Document Number and Revision Status
d) CDRL Number
e) Contract Number

1.2. Electronic Documents Format

Electronic copies of text documents must be formatted for printing on 8.5" x 11" paper.

1.2.1. Page Numbering

General format of documents should include page numbers and be formatted according to the contractor's normal standard. If the document is divided into volumes, each such volume must restart the page numbering sequence.

1.2.2. Document Numbers

All pages must contain the Document Number at the top of the page. Document Numbers must include revision status and volume identification as applicable.

2. DOCUMENT STRUCTURE AND CONTENT

2.1. Overall

Except as otherwise specified, all documents must have the overall structure as follows:

a) Cover/Title Page;
b) Table of Contents;
c) Scope;
d) Applicable and Reference Documents;
e) Body of Document; and
f) Appendices

2.2. Cover/Title Page

The title page must contain the following information:

- Document Number and date: Volume x of y (if multivolume)
- Rev. indicator / date of Rev.
- Document Title
- Project Name
- Contract No.
- CDRL Item No. or Nos., if one document responds to more than one CDRL, subject to prior approval from the TA.
- Prepared for: Canadian Space Agency
- Prepared by: Contractor name, CAGE Code, address, and phone number
- Product tree identifier, if applicable
- © HER MAJESTY THE QUEEN IN RIGHT OF CANADA [YEAR]

2.3. Table of Contents

The table of contents must list the title and page number of each titled paragraph and subparagraph, at least down to the third level inclusive. The table of contents must then list the title and page number of each figure, table, and appendix, in that order.

2.4. Scope

This section must be identified as section 1 and must, as a minimum, provide the following information:

a) Identification (number, title) of the system, hardware, or software to which the document applies;

b) A brief overview of the system to which the document applies; and

c) A summary of the purpose and content of the document.

The requirements specified in the following DIDs are the minimum expected. The Contractor must include in all documents all additional information required in order to ensure that the document provided will achieve its purpose as stated in the DID.

2.5. Applicable and Reference Documents

This section must list by Document Number and title, all applicable and reference documents. This section must also identify the source of all applicable and reference documents and the revision indicator.

2.6. Body of Document

The body of the document must be prepared in accordance with the content and format requirements defined in the specific Data Item Description.

2.7. Appendices

Appendices may be used to provide information published separately for convenience of document maintenance.

3. DOCUMENT REVISIONS

Changes in revised documents must be identified by a sidebar.

4. SUBMISSION OF DATA

Data must be submitted via Letter of Transmittal (or an electronic equivalent as mutually agreed by the TA and the Contractor), and acknowledged. The Letter of Transmittal will contain as a minimum, the Contract Serial Number, the CDRL Number and the Title. The Letter of Transmittal must be forwarded by the Contractor in two copies; one copy of acknowledgement to be signed and returned to the Contractor by the recipient.

DID-0002 – Project Schedule

PURPOSE:

To provide a schedule planning and control system for the project and to provide visibility to the CSA of the program progress and status.

PREPARATION INSTRUCTIONS:

The project schedule must be based on the WBS, in the form of a Gantt chart. The project schedule must be detailed enough to show each WBS task to be performed, and must provide the following information:

1) dependencies,
2) resource requirements,
3) the start and end date of each task,
4) task duration,
5) deadlines and milestones,
6) and Critical Path.

The schedule must show dependencies between the Contractor and other organizations.

The tasks related to deliverables must be limited to three months in the project schedule. When applicable, the Contractor must divide longer tasks into smaller significant tasks.

Tasks that are not related to any specific deliverable, such as Project Management activities, must be grouped separately from deliverables activities, and must be shown at the top of the chart. The schedule must be provided in its native tool format; MS project or Project Scheduler are the two accepted formats.

DID-0003 – Progress Report

PURPOSE:

The Progress Report records the status of the work in progress during the previous calendar period. The Progress Report is used by the Government to assess the Contractor's progress in performance of the work.

PREPARATION INSTRUCTIONS:

The monthly progress report must address the following:

1) a brief summary of the work performed in the current month;
2) a table of all milestones with actual and expected completion dates;
3) a table of all deliverables with the current percentage completion and the actual and expected completion dates;
4) a brief summary of the work planned for the following month;
5) a short narrative description of any tasks that are behind schedule, the impact on the overall program schedule, and what work-arounds are planned to achieve the overall program schedule;
6) a list of all problems and the proposed corrective action;
7) a table showing the current financial status (cash flow planned versus actual);
8) significant changes to the project organisation; and
9) any other items that the Contractor wants to bring to the attention of the Technical Authority.

The report must be concise and should not exceed 3 pages.

DID-0004 – Meeting Agenda

PURPOSE:

To clarify the purpose, content and timings of a meeting.

PREPARATION INSTRUCTIONS:

The meeting agendas must contain the following information, as a minimum.

1) **DOCUMENT HEADER:**
   a) Title;
   b) Type of meeting;
   c) Project title, project number, and contract number;
   d) Date, time, and place;
   e) Chairperson; and
   f) Expected duration.
2) **DOCUMENT BODY:**
   a) Introduction;
   b) Opening Remarks: CSA;
   c) Opening Remarks: Contractor;
   d) Review of previous minutes and all open action items;
   e) Project technical issues;
   f) Project management issues;
   g) Other topics;
   h) Review of any action items as a result of the current meeting and
   i) Set or confirm dates of future meetings.

DID-0005 – Minutes of Meetings

PURPOSE:

The minutes of reviews or meetings provide a record of decisions and agreements reached during reviews/meetings.

PREPARATION INSTRUCTIONS:

Minutes of meeting must be prepared for each formal review or meeting and must include the following information, as a minimum:

1) Title page containing the following:
    a) Title, type of meeting and date,
    b) Project title, project number, and contract number,
    c) Space for signatures of the designated representatives of the Contractor and the CSA,
    d) Name and address of the Contractor;
2) Purpose and objective of the meeting;
3) Location;
4) Agenda;
5) Summary of the discussions, assumptions, decisions and agreements reached;
6) List of the attendees by name, position, phone numbers and e-mail addresses as appropriate;
7) Listing of open action items and responsibility for each action to be implemented as a result of the review;
8) Other data and information as mutually agreed; and
9) The minutes must include the following statement:

"All parties involved in contractual obligations concerning the project acknowledge that minutes of a review/meeting do not modify, subtract from, or add to the obligations of the parties, as defined in the contract."

The list of action items must include the following information:

1) the action item number;
2) a description of the action required;
3) the date the action item was opened;
4) the person responsible for ensuring that the action is carried out;
5) the due date for the action;
6) the status of the action (open or closed); and

7) any comments or remarks relevant to the action.

Once an action item is closed, the action item list should also indicate the date the action was complete.

DID-0006 – Action Items Log

PURPOSE:

The Action Item Log (AIL) lists, in chronological order, all items on which some action is required, allows tracking of the action, and in the end provides a permanent record of those Action Items (AI).

PREPARATION INSTRUCTIONS:

The AIL must be in a tabular form, with the following headings in this order:

1) Item Number;
2) Red, yellow, green stoplight
3) Item Title;
4) Open Date;
5) Source of AI (e.g. MCR meeting, RID, etc.);
6) Originator;
7) Office of Prime Interest;
8) Person responsible (for taking action);
9) Target/Actual Date of Resolution;
10) Status (Open or Closed);
11) Remarks; and
12) Chart of graphical representation of open, closed, and total action items.

The date in column 8 will be the target date as long as the item is open, and the actual date once the item is closed.

DID-0200 – Trade-off and Benefits Analysis

PURPOSE:

To provide a summary of the work accomplished during the Trade-Off analysis

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PREPARATION INSTRUCTIONS:

The document must include the following items:

1) An introduction including the scope, the purpose and a list of assumptions (if any);
2) A list of applicable and reference documents (if any);
3) A list of the different configurations investigated and the rationale/criteria/methodology used to filter solutions determined to have no, or very low, chance of achieving the study objectives;
4) Initial evaluation of the performance of the system in term of NESZ, swath, resolution, ambiguity, coverage and revisit performance for the selected configuration;
    a) A list of the assumptions/models/simplifications used to perform this evaluation;
5) Compliance to the requirements provided in RD-5;
6) A list of the identified additional benefits of the proposed configuration in terms of:
    a) New applications/services enabled by the proposed configuration;
    b) Development of new markets for the systems and/or subsystems benefiting the Canadian Aerospace Industry;
    c) Cost savings provided through the use of the new systems;
    d) New/increased market for value-added services providers;
    e) Potential for development of new models/knowledge by Universities that provide benefits for Canada.
7) Identify the improvement that will be offered by the proposed configuration in comparison to existing systems:
    a) Technology Required;
    b) Mass;
    c) Power;
    d) Complexity;
    e) Other pertinent parameters.
8) Other parameters or assumptions used by the contractor to perform the trade-off.
9) Provide the relative costs and risks of each implementation.

10) A recommendation on the best configuration(s) to retain for further study.

DID-0210 – System Requirements Document

PURPOSE:

To capture the mission requirements to identify impacts on sub-systems.

PREPARATION INSTRUCTIONS:

The document must include the following:

1) An introduction including the scope, the purpose and a list of assumptions (if any);
2) A list of applicable and reference documents (if any);
3) A short description of the mission including the mission objectives, the constellation, the spacecraft, the payloads and the ground segment architecture;
4) A list of all mission requirements to respond to known and/or anticipated user requirements including explanatory notes when required;
5) A list of any mission goals that would enhance the mission objectives if implemented including explanatory notes when required;
6) Any appendices required to provide detailed information pertinent to the mission requirements that is not suitable to be contained in the main document as explanatory notes.

DID-0220 – Performance Model Document

PURPOSE:

To capture the model used to generate the performance of Multi-Aperture System .

PREPARATION INSTRUCTIONS:

The document must include the following:

1) An introduction including the scope, the purpose and a list of assumptions (if any);
2) A list of applicable and reference documents (if any);
3) A description of the assumption used in the model and any reference coordinates, definitions, etc.;
4) a description of the model used to estimate the performance of the Spacecraft in terms of NESZ, range and azimuth ambiguity, resolution, etc. ;
5) A description of the limitation of the model;
6) A list of recommendations for improvement to the model.

DID-0230 – Mission Concept Option Analysis

PURPOSE:

To capture the results of the investigation of the multi-aperture configuration evaluated.

PREPARATION INSTRUCTIONS:

The document must include the following:

1) An introduction including the scope, the purpose and a list of assumptions (if any);
2) A list of applicable and reference documents (if any);
3) A description of the concepts with appropriate illustrations;
4) A summary of the concept performance;
5) A description of the impact of the analysis/simulation modelling performed for the three concepts;
6) A description of the impact on the subsystems and potential implementation solutions;
7) A list of the key challenges and risks;
8) An evaluation of the benefits of each concept with an estimated value when possible;
9) A preliminary development schedule and a cost estimate (may be provided separately) divided between recurring and non-recurring cost along with the assumptions used;
10) An evaluation of the potential for collaboration and the benefits of such cooperation;
11) A recommendation on the best concept.

DID-0240 – Technology Development Plan

PURPOSE:

To capture the technology development required to implement multi-aperture SAR satellites.

PREPARATION INSTRUCTIONS:

The document must include the following:

1) An introduction including the scope, the purpose and a list of assumptions (if any);
2) A list of applicable and reference documents (if any);
3) The list of activities required to bring the maturity of the technology to a Technology Readiness Level of 6;
4) The cost and schedule estimate to perform these tasks;
5) An evaluation of the urgency and criticality of each development activity;
6) An evaluation of the main risks and challenges for the selected developments.

DID-0250 – Executive Report

PURPOSE:

To provide a summary of the work accomplished during the contract.

PREPARATION INSTRUCTIONS:

The Executive Report will be placed in the public domain (e.g. CSA's library, publication and/or website).

The report should not exceed ten (10) pages.

The Contractor should submit an electronic copy plus one (1) hard copy of the Executive Report in the Final Data Package. The structure for the Executive Report is as follows:

1) Introduction;
2) Project Objectives;
3) Approach / Project Tasks;
4) Accomplishments;
5) Science/Technology:
    a) Innovative Aspects;
    b) Application Fields;
6) Business Potential, Benefit and Impact on the organisation;
7) Ownership of Intellectual Property; and
8) Publications / References.

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APPENDIX C ACRONYMS AND ABBREVIATIONS

ACA	After Contract Award
AD	Applicable Document
AI	Action Items
AIL	Action Items Log
AIS	Automated Identification System
AIS-C	AIS Constellation
BIP	Background Intellectual Property
CA	Contract Authority
CADM	Configuration and Data Management
CCB	Configuration Control Board
CM	Configuration Management
COTS	Commercial Off-The-Shelf
CRB	Configuration Review Board
CSA	Canadian Space Agency
CWBS	Contract Work Breakdown Structure
DID	Data Item Description
EEE	Electrical, Electronic and Electro-mechanical
EGSE	Electrical Ground Support Equipment
ELV	Expendable Launch Vehicle
FIP	Foreground Intellectual Property
GFE	Government Furnished Equipment
GS	Ground Segment
GSE	Ground Support Equipment
IP	Intellectual Property
KoM	Kick-off Meeting
LEOP	Launch and Early Operations
LV	Launch Vehicle
OGD	Other Government Departments
RD	Reference Document
RID	Review Items Discrepancy
RCM	RADARSAT Constellation Mission
RNG	RADARSAT Next Generation
SAR	Synthetic Aperture Radar

SOW	Statement Of Work
TA	Technical Authority
TBC	To Be Confirmed
TBD	To Be Determined
TN	Technical Note
TRA	Technology Readiness Assessment
TRL	Technology Readiness Level
TT&C	Tracking, Telemetry and Command
WBS	Work Breakdown Structure
WPD	Work Package Description