



CSA-DSTOP-SOW-0001

Canadian Space Agency

Annex "A"

Post-ISS Human Spaceflight Contributions – Deep Space Telecommunications (DST) Optical (OP) Concept Study

Statement of Work (SOW)

Initial Release

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TABLE OF CONTENTS

1	INTRODUCTION.....	1
1.1	BACKGROUND.....	1
1.2	OBJECTIVE	1
1.3	CONVENTION	2
1.4	RESPONSIBILITIES	2
1.5	SCOPE	2
2	REFERENCE DOCUMENTS	3
3	TECHNICAL DESCRIPTION	4
3.1	PRELIMINARY OPCC ASSESSMENT.....	5
3.2	OPCC CONCEPT.....	6
3.2.1	<i>Concept of Operations</i>	6
3.2.2	<i>Mission Requirements</i>	7
3.2.3	<i>Preliminary System Requirements</i>	7
3.2.4	<i>Conceptual Design</i>	7
3.2.5	<i>Development, Manufacturing and Qualification Approach</i>	8
4	TECHNOLOGY DESCRIPTION	9
5	BUSINESS AND MANAGEMENT ASSESSMENT.....	10
5.1	BUSINESS ASSESSMENT	10
5.1.1	<i>Strategic Assessment</i>	10
5.1.2	<i>Collaboration</i>	10
5.1.3	<i>Canadian Capabilities Development</i>	10
5.1.4	<i>Commercialization Plan</i>	11
5.2	MANAGEMENT REPORT.....	11
5.2.1	<i>Cost</i>	11
5.2.2	<i>Schedule</i>	12
5.2.3	<i>Risk Assessment</i>	13
5.3	CONCEPT ANIMATION	13
5.4	INTELLECTUAL PROPERTY MANAGEMENT	14
5.5	EXECUTIVE SUMMARY	14
6	CONTRACT MEETINGS AND DELIVERABLES	15
6.1	CONTRACT MEETINGS	15
6.2	DOCUMENTATION, REPORTING AND OTHER DELIVERABLES	16
7	LIST OF ACRONYMS.....	19
	APPENDICES.....	20
A	DOCUMENT NAMING CONVENTIONS	21
B	DATA ITEM DESCRIPTION (DID)	22
	DID-0003 – CONCEPT ASSESSMENT MEETING PRESENTATION	23
	DID-0004 – MID-TERM REVIEW MEETING PRESENTATION	24
	DID-0005 – FINAL REVIEW MEETING PRESENTATION	25
	DID-0007 – MONTHLY PROGRESS REPORT	26
	DID-0008 – TECHNICAL REPORT, CONCEPT ASSESSMENT	27
	DID-0009 – TECHNICAL REPORT, CONCEPT DOCUMENT	28
	DID-0010 – MANAGEMENT REPORT	29
	DID-0011 – CONTRACTOR DISCLOSURE OF INTELLECTUAL PROPERTY	30
	DID-0013 – FINAL DATA PACKAGE	31

DID-0016 – TECHNOLOGY REPORT	32
DID-0017 – SCHEDULE	33
DID-0018 – ANIMATION	34
DID-0019 – BUSINESS ASSESSMENT	35
DID-108 – KICK-OFF MEETING PRESENTATION	36
DID-110 – MEETING AGENDA	37
DID-111 – MINUTES OF MEETING	38
DID-112 – ACTION ITEMS LOG	39
DID-115 – EXECUTIVE REPORT	40
DID-116 – CONTRACTOR PERFORMANCE EVALUATION	41

LIST OF TABLES

TABLE	PAGE
TABLE 2-1: REFERENCE DOCUMENTS	3
TABLE 5-1: COST BREAKDOWN	12
TABLE 6-1: MEETING SCHEDULE	15
TABLE 6-2: CDRL	18

1 INTRODUCTION

1.1 BACKGROUND

The exploration of space is a highly visible endeavour, a powerful driver for scientific and technical innovation, a magnet for world-class talent, and an incentive for young Canadians to pursue careers in science and technology. This study is part of the implementation of the Space Policy Framework of Canada (RD-01) in which the Government commits to: ensuring that Canada is a sought-after partner in the international space exploration Missions that serve Canada's national interests; and continuing to invest in the development of Canadian contributions in the form of advanced systems and scientific instruments as part of major international endeavours.

The CSA is continuing its collaboration with international partners to define concepts for collaborative Missions Beyond Low Earth Orbit (BLEO), as presented in the Global Exploration Roadmap (RD-02). The goals are to expand international partnerships, develop human exploration technologies and capabilities, synergize human and robotic capabilities, foster commercial industry and economic development, and advance scientific knowledge.

1.2 OBJECTIVE

This statement of work (SOW) is for the study of initial concept for potential future Canadian BLEO space exploration opportunities in global partnerships with other space agencies in the area of communications. This Concept Study, which will be limited to the topic of Optical Communication Contribution (OPCC) will allow Canada to take its place among the top innovators of space and allow Canadians to take full advantage of the benefits space has to offer. From the results of this concept study, Canada may propose a contribution to a potential exploration missions Beyond Low Earth Orbit. In this SOW the word contribution or concept is used to identify proposed investment in possible future space exploration project.

The initial phase for a possible contribution is the concept definition and feasibility assessment studies. As it provides an opportunity for exploring truly innovative ideas, this concepts study is of high importance to the Canadian Space Agency in encouraging the growth and development of an internationally competitive Canadian space community and the advancement of new ideas.

1.3 CONVENTION

The following verbs, as used in this document, have specific meaning as indicated below:

- “must” indicates a mandatory requirement
- “should” indicates a preferred but not mandatory alternative.
- “will” indicates a statement of intention or fact.

In the following, the term 'Contractor' is used to describe the team that will conduct the study.

1.4 RESPONSIBILITIES

The Canadian Space Agency (CSA) is the customer for this study. As such, the Agency has the authority on all matters concerning this study. The Contractor must perform the tasks as outlined in this SOW and must deliver the end items defined by this SOW.

1.5 SCOPE

The Contractor must provide the facilities, personnel, materials, and services required to perform this concept study. It should be made clear to the Contractor that this SOW is a description of the expanse of the work that the contractor will have to perform and will result in a Final Review presentation to the CSA.

The nature and scope of this concept study requires an interdisciplinary team to address all aspects of this concepts study, including technology, space operations, financial, and future applications of this type of technology. This SOW also provides the requirements and deliverables list and will enable the CSA to recommend options to the government and international partners for informed decision-making about potential future investments in BLEO exploration missions in the timeframe of the next decade.

2 REFERENCE DOCUMENTS

The documents identified in Table 2-1 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

MRD No.	Document Number	Document Title	Rev. No.	Date
RD-01		Canada's Space Policy Framework http://www.asc-csa.gc.ca/eng/publications/space-policy/default.asp		Feb 7, 2014
RD-02		The Global Exploration Roadmap http://www.globalspaceexploration.org/wordpress/wp-content/uploads/2013/10/GER_2013.pdf	2	2013
RD-03		Project Management Book of Knowledge (PMBok)	5 th Edition or latest edition	2013

3 TECHNICAL DESCRIPTION

Free-space optical communication technology is emerging as a new tool to deliver data from space in the context of future Earth Observation, Planetary Exploration, and Deep Space Missions. Traditionally, radio waves are used to communicate with satellites and deep space probes. This technology has become mature and extremely reliable. However, radio frequency communications started to reach their physical limits in keeping up with the growing demand for amount of data that needs to be transferred by satellites. In order to overcome these limits optical communications have started to be deployed offering Gigabit data rates comparable with those used within terrestrial fiber optic networks. Optical communication has been demonstrated in space in various scenarios, such as, LEO to Ground, GEO to Ground and Moon orbit to Ground communications. Optical communications have become a part of future planetary exploration mission concepts. Thus naturally, the vision for BLEO exploration includes optical communication elements as parts of its telecommunication architecture. It includes communications between the following:

1. Earth and a space vehicle
 - a. in orbit around the Moon,
 - b. traveling to and from Mars, its moons, and other deep space destinations,
2. Earth and elements remaining on the Moon, Mars, and other deep space destinations,
3. Space vehicle and elements
 - a. remaining on the Moon, Mars, and other deep space destination,
 - b. in the proximity of space vehicle such as an Extra Vehicular Activity crewmember or resupply vehicles, and
4. Element to element on surface of Moon, Mars, and other deep space destinations.

While RF communication elements benefit from their maturity, optical technology may become important in some parts of this architecture by offering larger data throughput capability with low mass/volume/power envelope of the communication devices.

The study under this SOW aims at developing specific mission scenarios for BLEO communication contribution based on optical technology, assessment of its feasibility, and defining system architecture based on technology option trade-offs. The term “Optical Communication Contribution” (OPCC) is used here to represent a self-contained device or a pair of devices that provide communication functionality.

The Contractor must propose a concept based upon the previous work that meets the high level user requirements described in this SOW or show how existing concepts can be adapted to meet these requirements.

The Contractor must plan to coordinate and must be able to adjust the OPCC concept with the stakeholders' needs and vision, including CSA and its international partners involved in BLEO mission concept development. It is anticipated that the Contractor will be provided Government Furnished Information (GFI) at the beginning and throughout the contract to guide the concept development and synchronise it with the efforts of the International BLEO working group.

3.1 PRELIMINARY OPCC ASSESSMENT

Within the context of BLEO exploration vision, CSA sees the need to focus the study on the one of the (or several) following high data-rate communication scenarios by means of optical technology.

Scenario (1) Earth to Space Vehicle.

Option (a). Communication from a Space Vehicle orbit around the Moon to Earth (return link) and vice versa (forward link). The following three potential orbits around moon will be considered: Lissajous orbit around EML2; Halo orbit around EML2; Near-rectilinear orbit around the Moon. The proposed OPCC must allow data rates in the range of 100-500 Mbps on the return link and in the range 50-100 Mbps on the forward link.

Option (b) Communication from a Space Vehicle on excursion to Mars (fly-around from Moon Near-rectilinear orbit) to Earth (return link) and vice versa (forward link). A circular 200 km to 500 km altitude Mars orbit will be considered as a baseline for the purpose of this assessment. The proposed OPCC must allow data rates in the range of 30-150 Mbps on the return link and in the range of 15-40 Mbps on the forward link.

The Contractor must consider NASA and ESA Optical Ground Station capabilities (current and in development) as baseline assumption when assessing the options of this scenario.

Scenario (2) Surface Element (rover or lander) to Space Vehicle or Earth.

Option (a) Communication from a Surface Elements on the Moon (e.g. rover) (return link) to a Space Vehicle around the Moon and vice versa (forward link).

Option (b) Communication from a Surface Elements on Mars (e.g. rover) (return link) to a Space Vehicle around Mars and vice versa (forward link).

Option (c) Communication from Surface Elements on Moon or Mars (e.g. rover) (return link) to Earth and vice versa (forward link). The Contractor must consider NASA and ESA Optical Ground Station capabilities (current and in development) as baseline assumption when assessing this option.

The OPCC must allow data rates of minimum 25 Mbps on the return link and minimum 10 Mbps on the forward link for each of the three options. The orbital parameters to be considered in this scenario are as per scenario 1. The transportation volume and mass of the deployed communication assembly on the Moon and Mars surface must be minimized.

Scenario (3) Element to Element on Surface of Moon & Mars (and other Deep Space Destinations).

Communication to and from a surface element and other surface elements on the Moon & Mars. The OPCC must allow data rates of minimum 100 Mbps to and from elements separated by a maximum distance of 10 km. The transportation volume and mass of the deployed communication assembly on the Moon and Mars surface must be minimized.

At this stage, the data rates, identified above are indicative. It will be possible to propose alternative specifications with technical explanation for the alternative and with related rationale.

For the preliminary assessment the Contractor must elaborate on the proposed concept in regard to how the concept best fits the technology capability of the industrial team, meets user needs and presents the best benefit for Canada. The Contractor must define key baseline mission requirements and system specifications, and must define a system architecture for OPCC. The Contractor must substantiate OPCC's performance characteristics based on performance model.

The level of details of the OPCC assessment must be sufficient for efficient and effective decision making for the OPCC Concept Assessment review. The Contractor must prepare technical report per CDRL 0008 (DID-0008 – Technical Report, Concept Assessment). The assessment for OPCC must be presented to CSA at Milestone 1 (Concept Assessment Review).

Upon concept assessment review with CSA, the Contractor must develop a full concept of the OPCC as described in the following sections.

3.2 OPCC CONCEPT

The Contractor must develop a full concept of OPCC and deliver the technical report per CDRL 0009 (DID-0009 – Technical Report, Concept Document). The draft concept with a focus on key driving elements of all aspects described below must be presented at the Milestone 2 (Mid-term Review Meeting). The Contractor must deliver the final document and present the full concept at the Milestone 3 (Final Review Meeting).

3.2.1 Concept of Operations

The Contractor must produce a Preliminary Concept of Operations that demonstrates the feasibility of routine operations, autonomous controls, data acquisitions throughputs, communications coverage, components operations, maintenance concepts, and ground operations. System operation throughout different mission phases as well as various modes of operation must be defined.

3.2.2 Mission Requirements

The Contractor must further elaborate mission requirements initially defined for the OPCC assessment. The mission requirements must reflect detailed understanding of the mission needs, functional, performance, environment, resource budgets and reliability aspects.

3.2.3 Preliminary System Requirements

Starting with the Mission Requirements, the Contractor must derive preliminary system requirements for the OPCC in the form of requirement verification matrix. The Contractor must provide the requirements verification matrix as an attachment to the Technical Report (DID-0009).

The preliminary system requirements must include the functional requirements (including spacecraft interface requirements, operational requirements description and substantiation), the performance (data rates, link distance, link availability, bit error rate), resource budgets (volume, mass, power), specific safety requirements associated with human flights (laser safety), and preliminary environmental requirements.

The Contractor must define separate system requirements for two sides of the communication system. In some cases, the Contractor may rely on an international partnerships to provide one side of the communication system, in this case, applicable interface conditions have to be defined to ensure compatibility of both parts of the system.

The preliminary requirements must also include the main functional and performance requirements for the relevant subsystems; typically these subsystems will include the following:

- a. The detector assembly,
- b. The acquisition, tracking and pointing assembly,
- c. The laser transmitter assembly,
- d. Digital data processing electronics and software,
- e. Optical antenna.

3.2.4 Conceptual Design

The Contractor must develop a conceptual design of the OPCC at system level with an emphasis on the degree of innovation and any critical aspects. The conceptual design must further describe the approach through a preliminary payload definition based on Preliminary System Requirements, the identification of related OPCC subsystems, and subsystem trade-offs. The conceptual design must be documented in the Technical Report (DID-0009).

The Contractor must base the concept on the optical free-space communication protocols already demonstrated in space or accepted for future missions in the field of optical communication in space that includes the choice of wavelengths, types of modulation, link budget and pointing accuracy considerations, as well as coding and synchronization aspects. The Contractor must assess the compatibility of the potential Canadian OPCC with other OPCCs considered for planetary exploration missions by partner Agencies.

The Contractor must provide a functional block diagram of the OPCC payload. The Contractor must provide a list of key items indicating possible suppliers and known space heritage.

The Contractor must produce an assessment of impact of the mission environment on the concept in all aspects, including but not limited to: thermal, mechanical, radiation, vacuum, contamination.

The Contractor must provide the mechanical concept in the form of CAD drawings that represent the integrated optical component and showing integration of all subsystems. The CAD drawings must have the level of details sufficient to assess the required volume, external interfaces of the OPCC and its configuration and don't need to go into fine details of each sub-system. The CAD model must be provided in the STEP format as an attachment to the Technical Report.

The Contractor must provide the electrical architecture and diagrams identifying all circuits, their functionalities and interconnections.

The Contractor must provide the software architecture and diagrams identifying all its components, their functionalities and interconnections.

The Contractor must provide the optical concept in the form of optical design files developed using Zemax software with the level of details sufficient to assess the driving factors in optical performance and configuration. The Zemax design files must be provided in its native format as an attachment to the Technical Report.

The Contractor must provide engineering assessment spreadsheets covering at minimum such budgets as mass, volume, power, data, link, pointing, and an assessment of the projected bit error rate. The engineering spreadsheets must be provided either within the Technical Report or as an attachment to it using a conventional format (for example, Microsoft Excel or Comma Separated Value files).

3.2.5 Development, Manufacturing and Qualification Approach

The Contractor must provide an overview of the development approach, key subcontractors, and the general strategy best suited for this approach. The Contractor must also list the major tasks required in the development and manufacturing cycles and identify the potential long lead items. The Contractor must provide the preliminary verification plan, qualification approach, and assumptions made.

4 TECHNOLOGY DESCRIPTION

The Contractor must prepare a Technology description report to document the concept technology status. The technology description report describes in a systematic and objective fashion the technological readiness level of the concept for a particular spaceflight mission.

The technology description of the proposed concept must be divided in its main elements with a product breakdown structure (PBS) in a table format.

The Technology Readiness Level (TRL) of each main elements of the concept must be based on NASA 9 point scale. For each main elements, the contractor must provide the actual TRL of the element with explanation to provide a summary of the actual maturity of the technologies. For each main elements, the contractor must provide a description of the changes required to bring the maturity of the element to the level required. The intent is to measure the technology heritage of each main elements of the concept. For element that requires technology improvement, the contractor must describe the activities planned to mature the element and the technology development risks of the work. A main element is a technology element (hardware or software) that is critical for the proposed technology.

The Contractor must produce a Technology description Report per the CDRL 0016.

5 BUSINESS AND MANAGEMENT ASSESSMENT

The following subsections describe the work that is expected for the management and business assessment.

5.1 BUSINESS ASSESSMENT

The business assessment must be delivered per CDRL 0019 (DID-0010 – Management Report Assessment) the first version at the Concept Assessment review and the final version at the mid-term review.

The Contractor must provide a business assessment to explain the potential socio-economic benefits of an investment for a mission beyond low Earth orbit.

5.1.1 Strategic Assessment

The contractor must provide information which demonstrates how the investment aligns with the following strategic considerations.

1. Technology contributions must be considered as critical and valuable by international partners and enhance Canada's international reputation as a sought after partner for exploration missions.
2. Technology contributions must be highly visible, brand Canada as an innovative nation and inspire Canadians.
3. Technology contributions must strengthen and sustain leadership of Canadian industry and advance Canadian science and expertise.
4. Technology contributions must drive innovation with tangible applications on Earth to improve the quality of life of Canadians.

5.1.2 Collaboration

The Contractor must identify potential partners/stakeholders at the national/international level, state the benefits of their participation in such a mission and provide a preliminary assessment of roles and responsibilities. The basis and process of stakeholder analysis is described in the Project Management Book of Knowledge (PMBoK) (RD-03).

5.1.3 Canadian Capabilities Development

This report must provide an estimate of the anticipated percentage of Canadian content relative to the overall cost of the proposed flight project, what options could be undertaken to maximize the Canadian content and their corresponding impacts and benefits. The contractor must include information on the Canadian supply chain involved in this possible OPCC project and expected to be involved in subsequent phases.

The report must also provide an overview of the Contractor's strategy to develop and maintain Canadian capabilities. If the overall approach of the Contractor implies technology transfer and partnership with foreign entities to develop the Canadian capabilities, the Contractor must specify teaming arrangements, Intellectual Property (IP) ownership issues, licensing, royalties and opportunities that this partnership would open.

5.1.4 Commercialization Plan

The Contractor must provide information on the minimum business in the field required to maintain the necessary expertise in the long run.

The Contractor must provide a commercialization plan to explain the potential economic benefits of an investment in such a mission. This plan must include a description of potential products and spin-offs (space and non-space) that can be commercialized, and analysis of the competitors (national and international) for the potential products. The Contractor must include an estimate of the potential market for their products as well as specify companies/market segments/export markets that would purchase their products. The Contractor must describe and explain their overall/general business model for any potential new business.

5.2 MANAGEMENT REPORT

The management report must be delivered per CDRL 0010 (DID-0010 – Management Report): the first version at the Mid-term review and the final version at the final review.

5.2.1 Cost

The Contractor must provide cost estimates, for all phases leading to the development, qualification, implementation, launch, operations and disposal of the hardware/software resulting from the concept. Each cost estimate must be substantiated by providing a basis for each (e.g., bottom-up, analogous, parametric, etc.) and any assumptions made for the derivation. The cost estimates must include planned activities required to mature the technologies. The cost estimate must be presented in the management report (CDRL 0010).

The contractor must present the cost breakdown of the proposed flight concept per the following table.

TABLE 5-1: COST BREAKDOWN

		Pre-phase A	Phase A	Phase B	Phase C	Phase D
Labour	Duration (months)					
	Management					
	Technical					
	Software					
	Product assurance					
	Others					
	Total Labour					
Non-Labour	Hardware					
	Tools, Equipment & Facilities					
	Subcontract					
	T&L					
	Others					
	Overhead					
	Total Non-Labour					
Risk	Risk Contingency					
Total per phase						
Total all Phases						

Use a separate table of similar format to present the cost of each particular technology development demonstration required to mature element of the proposed concept. In addition, the contractor must present in a separate table the same cost information with the calendar year for each column (instead of phase).

5.2.2 Schedule

The Contractor must prepare a schedule relative to the overall life cycle of the flight Concept. The schedule must include key milestones corresponding to, for instance, Preliminary Design Review (PDR), Critical Design Review (CDR), Acceptance Review (AR).

The schedule must include planned activities for the proposed flight concept and also, for each particular technology development demonstration with link to the flight concept tasks (as required).

The project schedule prepared by the Contractor must provide a graphical representation of predicted tasks, milestones, dependencies, task duration. The project's master schedule must inter-relate all tasks on a common time scale and be in the form of a Gantt chart. The project schedule must be detailed enough to show tasks to be performed, the start and end date of each task, the deliverables, the long lead items, the expected duration of the task.

The flight project schedule must be presented in the management report (CDRL 0010) with a Gantt Chart and with a table with all significant milestone dates. A start date of April 1, 2019 is suggested for the phase A contract award. The native file in MS project must be delivered per CDRL 0017. The schedule section of the management report must describe the schedule starting from the concept through all phases of the components, including correlated sequence of development milestones from contract start date through to completion of design, implementation, integration, verification, certification, and delivery.

5.2.3 Risk Assessment

The Contractor must provide a preliminary technical and programmatic risks assessment in the management report (CDRL 0010). For each risk identified, the Contractor must identify the phase to which the risk applies, the likelihood of occurrence, the impact if the risk occur, and any possible mitigation actions that may be taken to decrease either the likelihood or the impact. Specific mitigation actions must be identified for high risks at this time. Contingency plans (i.e., identifying alternative strategies) must also be developed for high risks, or when it is uncertain that mitigation plan will be effective. This general risk assessment must also consider access to information issues, like Export Control (International Traffic in Arms Regulations (ITAR)) and others as potential risks.

The Contractor must integrate and present the top risks in a 5x5 Risk Assessment Matrix.

5.3 CONCEPT ANIMATION

The Contractor must produce and deliver to CSA an animation (CDRL 0018) of the proposed concept that will allow to better appreciate and understand it. The animation must demonstrate main elements of the concept covering the scenario, operation, technology and benefits. The animation must be bilingual. The duration of the animation must be 2 minutes as a minimum and must not exceed 5 minutes.

5.4 INTELLECTUAL PROPERTY MANAGEMENT

The Contractor must complete the Contractor Disclosure of Intellectual Property per CDRL 0011 (DID-0011 – Contractor Disclosure of Intellectual Property), identifying the BIP and FIP that will be generated in this contract, the owners of the BIP and how it will be managed and coordinated among the various collaborators and entities involved.

5.5 EXECUTIVE SUMMARY

Provide an executive summary (high level) that captures only the essential technical elements of the proposed concept and essential element of the business assessment. Include the most pertinent facts in a clear, concise, and strategic overview per CDRL 0012 (DID-115 – Executive Report).

6 CONTRACT MEETINGS AND DELIVERABLES

This section reviews and describes the contract meetings and deliverables.

6.1 CONTRACT MEETINGS

The Contractor must organize the meetings listed in the table below and deliver presentation for each meeting per the specific CDRL. For monthly progress review, presentation is not required, the monthly report (CDRL 0007) will be reviewed.

TABLE 6-1: MEETING SCHEDULE

Meeting	Date	Location
Kick-off Meeting	No later than 2 weeks After Contract Award	CSA
Concept Assessment Review (Milestone 1)	No later than 8 weeks After Contract Award	CSA
Mid-term Review Meeting (Milestone 2)	No later than 16 weeks After Contract Award	CSA or teleconference
Final Review Meeting (Milestone 3)	End of contract (24 weeks after Contract Award)	CSA
Progress Reviews	Monthly	Teleconference

Key participants under the contract must attend all the meetings. This can be done in person or via teleconference. The exact date and time of the review meeting will be mutually agreed to by the PA, and the Contractor. The contractor must deliver meeting agenda per CDRL 0001, meeting minutes per CDRL 0006 and Action items log per CDRL 0015.

The contractor must support a KOM (CDRL 0002) at the CSA in the first 2-weeks after Contract award. The purpose of the KOM is to introduce the Contractor and CSA teams, review the scope of work, the schedule, the basis of payment and discuss any other topics as required. All key participants under the contract, including representatives from each major subcontractor, must attend. Attendance of some team members by teleconference is acceptable.

The Concept Assessment Review (CDRL 0003) will analyze the proposed concept, scenario and options with the goal of confirming the overall concept as the go-forward plan.

The Mid-term Review (CDRL 0004) will analyze the preliminary concept with the goal of confirming the conceptual approach. The technology description will be reviewed at this milestone. Furthermore, the scope of the management analysis will be reviewed and validated by CSA.

The specific intent of the Final Review Meeting (CDRL 0005) will be to discuss, in detail, the results obtained and the proposed follow-on activities. This meeting is intended to provide an opportunity for the Contractor, the Project Authority (PA), and other invited attendees to review and discuss the proposed project with the selected option as described in the management report. Key Contractor personnel involved in the work under review must attend the meeting. The contractor must deliver a final data package per CDRL 0013 and the contractor performance evaluation per CDRL 0014.

The Contractor may request Ad-hoc Meetings with the CSA whenever required to resolve unforeseen and urgent issues. The CSA may also request such Ad-hoc Meetings with the Contractor. The selection of participants will depend on the nature of the issue.

6.2 DOCUMENTATION, REPORTING AND OTHER DELIVERABLES

The Contractor must submit the documentation as defined and at the date stipulated in the Contract Data Requirements List (CDRL), Table 6-2, to the PA, or using the contractor format (CF) when indicated. All diagrams must be clearly drawn and labelled.

The Contractor must provide the PA with an electronic copy in a format acceptable to the CSA. Both the PDF and original version, e.g. Microsoft Word , PowerPoint, or MS Project files, must be provided to CSA. Original versions of any figures or tables that are part of these documents must also be provided to CSA, e.g. Visio file of a figure created in Microsoft Visio, or pictures, or graphs, etc., separately if so requested. Instructions on how to name electronic documents are provided in Appendix A.

The cover page of each document must include the following text:

© CANADIAN SPACE AGENCY yyyy (insert year)

“RESTRICTION ON USE, PUBLICATION OR DISCLOSURE OF PROPRIETARY INFORMATION

This document is a deliverable under contract no. _____. This document contains information proprietary to Canada, or to a third party to which Canada may have legal obligation to protect such information from unauthorized disclosure, use or duplication. Any disclosure, use or duplication of this document or any of the information contained herein for other than the specific purpose for which it was disclosed is expressly prohibited except as Canada may otherwise determine.”

Then, on all internal pages, each document must include the following text:

“Use, duplication or disclosure of this document or any of the information contained herein is subject to the Proprietary Notice at the front of this document.”

The Contractor must not publish, nor discuss verbally in public (i.e. conferences), nor have published any information contained within this, without the prior written approval of the CSA.

All documents must identify the organisation's name, contract number, title and document name and must be structured in accordance with the Data Item Description (DID) referenced in the CDRL.

TABLE 6-2: CDRL

CDRL No.	Deliverable	Due Date	Version	DID No.
1.	Meeting Agendas	Meeting – 1 week	Final	0110
2.	Kick-off Meeting Presentation	Meeting	Final	0108
3.	Concept Assessment Review Meeting Presentation	Meeting	Final	0003
4.	Mid-term Review Meeting Presentation	Meeting	Final	0004
5.	Final Review Meeting Presentation	Meeting	Final	0005
6.	Meeting Minutes	Meeting + 1 week	Final	0111
7.	Monthly Progress Reports	Monthly	Final	0007
8.	Technical Report, Concept Assessment	Milestone 1	Final	0008
9.	Technical Report, Concept Document	Milestone 2 Final milestone	Draft Final	0009
10.	Management Report	Milestone 2 Final milestone	Draft Final	0010
11.	Intellectual Property (FIP) Disclosure	Final milestone	Final	0011
12.	Executive Report	Final milestone	Final	0115
13.	Final Data Package	End of contract	Final	0013
14.	Contractor Performance Evaluation	Final milestone	Final	0116
15.	Action Items Log (AIL)	Meeting + 1 week	Final	0112
16.	Technology Report	Milestone 2 Final milestone	Baseline Final	0016
17.	Schedule	Milestone 2 Final milestone	Draft Final	0017, native format
18.	Animation	Final milestone	Final	0018
19.	Business Assessment	Milestone 1 Milestone 2	Draft Final	0019

7 LIST OF ACRONYMS

AD	Applicable Document
CDRL	Contract Data Requirements List
CF	Contractor Format
CSA	Canadian Space Agency
CTE	Critical Technology Element
DID	Data Item Description
DTO	development test objective
FIP	Foreground Intellectual Property
FRM	Final Review Meeting
FTP	File Transfer Protocol
GoC	Government of Canada
IP	Intellectual Property
LCC	Life Cycle Cost
LOE	Level of Effort
MTR	Mid-term Review
OPCC	Optical Communication Contribution
RFP	Request For Proposal
ROM	Rough Order of Magnitude
TBC	To Be Confirmed
TBD	To Be Determined
TRL	Technology Readiness Level

APPENDICES

A DOCUMENT NAMING CONVENTIONS

Context

This appendix presents the naming convention to follow for any documentation generated under any resulting contract.

Documents must contain 3 main components:

1. Project identifier
2. Contract Number
3. Document title
 - revision number or letter
4. Date Tracking number

WXYZ-TYPE-NUM-CIE_ContractNumber document title rev no._sent **2015-03-30**

1. Project Identifier

The project identifier must contain:

- **WXYZ**: A 4-8 letter acronym of the project
- **TYPE**: A 2 letter acronym according to the table below.

Acronym	Description
AG	Agenda
ER	Executive Report
MN	Minutes of meeting
PR	Progress Report
PT	Presentation
TN	Technical Note
MM	Animation/Multimedia

- **NUM**: A three digits sequential number (e.g. 001, 002, etc.)
- **CIE**: Name of Company (no space, no hyphen)

2. Contract Number

- For example: _9F028-07-4200-03

3. Date Tracking Number

- _sentYEAR-MONTH-DAY_draft

The *_draft* mentioned should be removed on the final version of the document once approved by CSA.

B DATA ITEM DESCRIPTION (DID)

DID-0003 – CONCEPT ASSESSMENT MEETING PRESENTATION.....	23
DID-0004 – MID-TERM REVIEW MEETING PRESENTATION.....	24
DID-0005 – FINAL REVIEW MEETING PRESENTATION	25
DID-0007 – MONTHLY PROGRESS REPORT	26
DID-0008 – TECHNICAL REPORT, CONCEPT ASSESSMENT.....	27
DID-0009 – TECHNICAL REPORT, CONCEPT DOCUMENT.....	28
DID-0010 – MANAGEMENT REPORT.....	29
DID-0011 – CONTRACTOR DISCLOSURE OF INTELLECTUAL PROPERTY.....	30
DID-0013 – FINAL DATA PACKAGE	31
DID-0016 – TECHNOLOGY REPORT	32
DID-0017 – SCHEDULE	33
DID-0018 – ANIMATION	34
DID-0019 –BUSINESS ASSESSMENT.....	35
DID-108 – KICK-OFF MEETING PRESENTATION	36
DID-110 – MEETING AGENDA	37
DID-111 – MINUTES OF MEETING.....	38
DID-112 – ACTION ITEMS LOG	39
DID-115 – EXECUTIVE REPORT	40
DID-116 – CONTRACTOR PERFORMANCE EVALUATION.....	41

DID-0003 – Concept Assessment Meeting Presentation

PURPOSE:

To present the results of the work done to date in the contract. The Concept Assessment meeting should discuss the options analysis in terms of the technical, financial, and programmatic issues affecting the components success.

PREPARATION INSTRUCTIONS:

The Presentation must contain the following information, as a minimum:

- 1) Review of contract deliverables;
- 2) Review of concept, scenario, options and selection;
- 3) Review of Business Assessment ;
- 4) Review of the way forward toward mid-term review;
- 5) Presentation to include the required copyrights and IP disclosure;
- 6) Other items as deemed appropriate

DID-0004 – Mid-Term Review Meeting Presentation

PURPOSE:

To present the results of the work done to date in the contract, and in particular since the previous meeting. The mid-term review should discuss the technical, financial, and programmatic issues affecting the investment success.

PREPARATION INSTRUCTIONS:

The Presentation must contain the following information, as a minimum:

- 1) Review current status of the work, discuss orientation and results;
- 2) Present concept in detail;
- 3) Proposed preliminary project definition as if the project gets approved.
- 4) Technical and programmatic issues if any;
- 5) Review of contract deliverables;
- 6) Work requirements, work status and schedule;
- 7) FIP and BIP;
- 8) Licensing issues if any;
- 9) Other items as deemed appropriate;
- 10) Presentation's slides to include the required copyrights and intellectual property disclosure

DID-0005 – Final Review Meeting Presentation

PURPOSE:

To present the overall results of the work done under the contract. In essence, show in detail that the recommended concept will be capable of achieving the mission requirements.

PREPARATION INSTRUCTIONS:

The Presentation must contain the following information, as a minimum:

- 1) Detailed presentation of the work conducted (presentation of the content of the technical report, concept, design, interface, feasibility, etc.);
- 2) Elements of a components goals, components concept, operational concept, LCC estimates, etc.;
- 3) Technical and programmatic issues if any, constraints and assumptions;
- 4) Contract deliverables;
- 5) FIP and BIP;
- 6) Licensing issues if any;
- 7) Other items as deemed appropriate;
- 8) Presentation slides to include the required copyrights and intellectual property disclosure

DID-0007 – Monthly Progress Report

PURPOSE:

To record the status of the work in progress during the previous calendar month. 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 list each deliverable and contain the following information, as a minimum:

- 1) Planned and actual milestone completion dates
- 2) Brief summary of the work performed in the current month
- 3) The work planned for the following month
- 4) A highlight of problems, if any, and the proposed corrective approach
- 5) Any other relevant information deemed necessary.

Based on the above, the Monthly Progress Report should not exceed 3 pages.

This report is required even in the case of a fixed firm price contract.

DID-0008 – Technical Report, Concept Assessment

PURPOSE:

To describe the concept, explain rationale, technical benefits, objectives, and approaches. (The author may define and organize additional sub-sections as deemed appropriate to present the comprehensive results of the study).

PREPARATION INSTRUCTIONS:

The information must be provided to allow assessment of the Concept .

- 1) Concept and scenario selection rationale
- 2) Driving user needs and requirements
 - a) Driving mission requirements associated with the concept
 - b) Main assumptions on concept of operation
 - c) Key system specifications
- 3) Concept Description
 - a) Components/Payload system description
 - b) Preliminary description of system performance and functionality
 - c) Technical approach and possible concepts to meet technical and mission objectives
 - d) Provide breakdown of systems to illustrate/assess the Canadian niche capabilities
 - e) Concept success criteria (what would be the conditions for full and minimum success)

DID-0009 – Technical Report, Concept Document

PURPOSE:

To fully describe the concept as required by this SOW, explain rationale, benefits, objectives, and approaches. Presents the viable options and technology trade-offs for the concept and associated benefits that will undergo detailed analysis. (The author may define and organize additional sub-sections as deemed appropriate to present the comprehensive results of the study).

PREPARATION INSTRUCTIONS:

The information must be provided to allow efficient and effective decision making on proceeding or not further with the proposed concept. The advantages and risks (with supporting evidence) of the described concept should be fully explored.

- 1) Concept summary
- 2) User needs
- 3) Concept of operations
- 4) Mission requirements
- 5) Preliminary system requirements
- 6) Conceptual Design
- 7) Development, Manufacturing and Qualification Approach

DID-0010 – Management Report

PURPOSE:

To fully document the management of the flight project and the technology development.

PREPARATION INSTRUCTIONS:

The information must be provided to allow efficient and effective decision making on proceeding or not further with the proposed concept into a flight project.

The Management Report must contain the following sections, and content as a minimum;

- 1) Executive summary (10 – 15 sentences) Include objectives, implementation approach and results of the concept study
- 2) Concept Summary, a general description for management (focus on how the concept meets mission and business requirements)
- 3) Cost
 - a) The cost breakdown must be delivered in the native file format, Excel spreadsheet , broken down by phases, by years, and by major assemblies or components.
- 4) Schedule, including all major milestones
- 5) Risk assessment
- 6) The advantages and disadvantages of the proposed concept.
- 7) Verify alignment with strategic objectives
- 8) Verify alignment with proposed commercialisation plan
- 9) Explain what are the constraints of the options and any assumptions used.
- 10) Recommendations for follow-on activities & conclusion

DID-0011 – Contractor Disclosure of Intellectual Property

PURPOSE:

To list all Foreground and Background Intellectual Property related to the project, to be reviewed at the Final Review Meeting.

PREPARATION INSTRUCTIONS:

The Disclosure must address the questions listed the document

- CONTRACTOR DISCLOSURE OF INTELLECTUAL PROPERTY that can be found at: <ftp://ftp.asc-csa.gc.ca/users/GPITT-IPMTT/pub/>.

DID-0013 – Final Data Package

PURPOSE:

The Final Data Package is a collection of all documents to be presented by the Contractor at the end of the contract.

PREPARATION INSTRUCTIONS:

The Final Data Package must consist of the final/revised version of all deliverables requested under the present contract (electronic copy). For example, with no limitation, the final data package should include presentations, minutes, monthly progress reports and other required deliverables in their final revision. It must also include the contractor disclosure of intellectual property and project evaluation sheet.

DID-0016 – Technology Report

PURPOSE:

The Technology Description Report describes in a systematic and objective fashion the technological readiness of a concept for a particular spaceflight mission.

PREPARATION INSTRUCTIONS:

The Report must contain the following information, as a minimum:

1. Introduction
 - 1.1. Purpose of Document
 - 1.2. Concept Description.
2. Mission/Project Objectives
 - 2.1. overview of the mission/project
 - 2.2. concept key requirements
 - 2.3. concept constraints & assumptions.
3. Technology Description

Description in detail of the proposed concept with a product breakdown structure that contains each main element of the proposed concept for a particular spaceflight. This section must describe in detail the proposed capability of the proposed contribution.
4. Technology Capability

This section must describe the contractor technology development activities planned to mature the proposed concept from the actual performance to the new performance. The contractor is required to identify the need for breadboard, or prototype or other units to mature the technology to reduce the risk for the proposed flight concept.
5. Summary

This section summarizes the information of previous sections is a few paragraph for non-technical people to understand the proposed technology.

DID-0017 – Schedule

PURPOSE:

To provide a level 3 schedule for the flight project in native format.

PREPARATION INSTRUCTIONS:

The flight project schedule must be in the form of a Gantt chart. Level 1 is the complete roll-up. Level 2 is each phase of the project. Level 3 must present the significant main activities to perform the Flight project.

The project schedule must be detailed enough to show majors tasks to be performed, and must provide the following information:

- 1) dependencies,
- 2) the start and end date of each task,
- 3) task duration,
- 4) deadlines and milestones.

The schedule must show dependencies between the Contractor and other organizations. The schedule must be divided by typical flight projects phases (A,B,C,D).

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.

DID-0018 – Animation

PURPOSE:

This animation will be used to present the proposed mission to better appreciate and understand it.

PREPARATION INSTRUCTIONS:

The animation must identify Contractor's name, contract number and title as well as CSA copyright statement as follows.

© CANADIAN SPACE AGENCY yyyy (insert year)

The animation must be bilingual, the text and voice must be duplicated in both official languages, English and French. The animation must be delivered in a common digital video format. The contractor must include only information and graphic material that can be released to the public and does not contain any IP or material that belongs to a third party without written authorization.

DID-0019 –Business Assessment

PURPOSE:

To provide information related to the expected socio-economic benefits for Canada of the proposed investment.

PREPARATION INSTRUCTIONS:

The Business Assessment Report must contain the following sections, as a minimum;

- 1) Executive summary. A public statement about the advantages of investing in the proposed project.
- 2) A description of Strategic Assessment;
- 3) A description of potential collaborations;
- 4) A description of the proposed Canadian capabilities development strategy; and
- 5) A description of the proposed commercialisation plan.

DID-108 – Kick-off Meeting Presentation

PURPOSE:

To present the Contractor's plan for carrying out the project and to address all significant issues.

PREPARATION INSTRUCTIONS:

The Presentation must contain the following information, as a minimum:

- 1) Review major assumptions for the study;
- 2) Review of contract deliverables;
- 3) Work requirements and schedule;
- 4) FIP and BIP;
- 5) Licensing issues if any;
- 6) Project's funding and expected cash-flow;
- 7) Presentation to include the required copyrights and IP disclosure;
- 8) Other items as deemed appropriate

DID-110 – Meeting Agenda

PURPOSE:

The Meeting Agenda specifies the purpose and content of a meeting.

PREPARATION INSTRUCTIONS:

The Meeting Agenda 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;
- f) Mandatory and desirable attendance; and
- g) Expected duration.

2. DOCUMENT BODY:

- a) Introduction, purpose, objective;
- 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 newly created/closed action items, decisions, agreements and minutes; and
- i) Set or confirm dates of future meetings.

DID-111 – Minutes of Meeting

PURPOSE:

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

PREPARATION INSTRUCTIONS:

The Meeting Minutes must contain 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, the CSA and the Public Works and Government Services Canada (PWGSC), and
 - d) Name and address of the Contractor;
- 2) Purpose and objective of the meeting;
- 3) Location;
- 4) Agenda;
- 5) Summary of the discussions, 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, numbered per the AIL;
- 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.”

DID-112 – 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 Action Item Log (AIL) must be in a tabular form, with the following headings in this order:

- 1) Item Number;
- 2) Item Title;
- 3) Open Date;
- 4) Source of AI (e.g. PDR meeting, RID, etc.);
- 5) Originator;
- 6) Office of Prime Interest (OPI);
- 7) Person responsible (for taking action);
- 8) Target/Actual Date of Resolution;
- 9) Status (Open or Closed); and
- 10) Remarks.

Note: 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-115 – Executive Report

PURPOSE:

To fully describe the entire concept study for dissemination in the public domain.

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 Executive Report must contain the following information, as a minimum:

1) Introduction (~2 pages);

Presentation of overall concept and main objectives. Illustrative picture(s) should be included.

2) Concept Overview (2-3 pages);

Discussion on main user/components requirements, feasibility and compatibility with target components.

3) Technology (~1 page);

Description of the innovative technologies requiring development and summary of the application fields.

4) Business Assessment (~1 page);

Collaboration, Canadian capabilities development, and commercialization plan.

Note that Canada and the Contractor, or others designated by them, have the right to unrestricted reproduction and distribution of the Executive Report. The report must include the following proprietary notice:

© CANADIAN SPACE AGENCY, yyyy (insert year)

Permission is granted to reproduce this document provided that written acknowledgement to the Canadian Space Agency is made.

DID-116 – Contractor Performance Evaluation

PURPOSE:

To provide an evaluation of the overall success of the project.

PREPARATION INSTRUCTIONS:

The Contractor Performance Evaluation must contain the following information, as a minimum:

- 1) Was the project completed on schedule (list deliverables with planned and actual delivery date)?
- 2) How many man-hours of highly qualified personnel (by category) did this work create or maintain?
- 3) What new opportunities created by the work conducted under the study ?