



CSA-DSTRF-SOW-0001

Canadian Space Agency

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

Statement of Work (SOW)

**Initial Release
April 06, 2017**

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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 Beyond Low Earth Orbit (BLEO) Missions, 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 Canadian BLEO communication systems to be used in future space exploration opportunities in global partnerships with other space agencies. These communication systems may be considered as Canadian contributions to future BLEO missions.

The initial phase consists of concept definition and feasibility assessment studies. It provides an opportunity for exploring truly innovative ideas. This concept 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. This concept study is limited to Radio Frequency Communication Technologies (later referred as RFCT) applicable to future space exploration projects. As such, the Canadian government is interested in innovative concepts which could integrate new ground breaking technologies such as artificial intelligence, internet of things, mesh, star network or some sort of BLEO internet network. For instance the proposed architecture or design could include intelligent network control which would facilitate the network exchanges or another example would be a communication system which could be reused to communicate with different entities by using reconfigurable radios and antennas, etc. It is also in the interest of the Canadian contractor to propose innovative concepts as it has more likelihood to stand-out along-side worldwide competition in the space telecom industry.

In this SOW, the word contribution or concept or system is used to identify proposed investment in potential future space exploration projects. The initial phase of the investment is the concept definition and feasibility assessment.

1.3 HIGH-LEVEL DESCRIPTION OF THE BLEO CONCEPT

1.3.1 BLEO Notional Architecture

The BLEO communication architecture comprises the following links between the elements:

- 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 EVA crewmember or resupply vehicles, and
- 4) Element to element on surface of Moon, Mars and other deep space destinations.

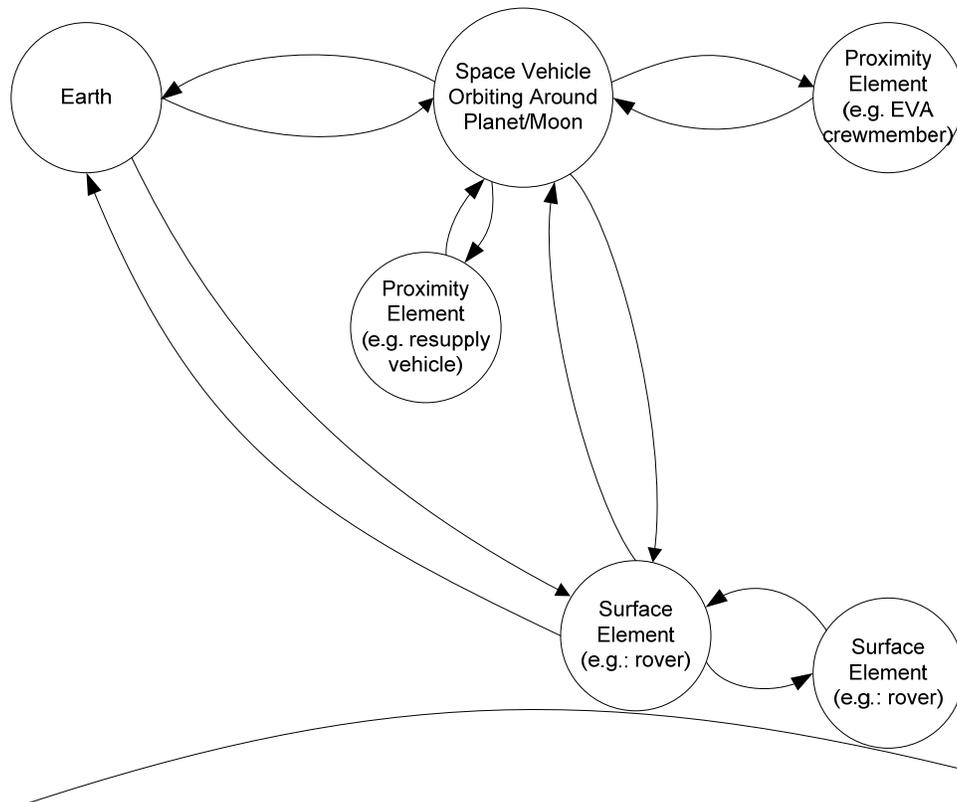


FIGURE 1-1: NOTIONAL ARCHITECTURE OF THE BLEO COMMUNICATION SYSTEM

Figure 1-1 shows the communication links (arrows) between different entities. A subsystem is a complete communication system located within one of these entities. A component is an element of a subsystem.

The notional performances or characteristic of the different communication links are given in the following sub-sections.

1.3.2 Earth Communication Infrastructure

The Earth communication networks to be considered in this study are the existing ground networks currently available and compatible with the BLEO missions that is the DNS network, TDRS, NEN network, and any other suitable one.

1.3.3 Moon Orbit Concepts

The three potential space vehicle orbits around the moon are the following:

- a. Lissajous orbit around EML2
- b. Halo orbit around EML2
- c. Near-rectilinear orbit around the Moon

1.3.4 Mars Orbit Concepts

The space vehicle orbit around Mars is currently undefined. The concept studied here must be flexible enough to alleviate any dependencies on the selected Mars orbit. The contractor will be responsible for choosing a realistic orbit as a baseline scenario.

1.4 COMMUNICATION NEEDS

1.4.1 Generic Communication Requirements

[USER-GENE-0010] Communication Standards. The communication system must be compliant with any relevant CCSDS or IEEE standards.

[USER-GENE-0010] Note.1: a partial list of CCSDS standards is given in the Reference document section.

[USER-GENE-0020] Communication Classes. The system must support two classes of communication: near real-time (e.g.; telecommand, telemetry, voice, video, etc.) and highly reliable (disruption tolerant) channel.

[USER-GENE-0030] Communication Latency Between Entities. For near real-time communication channel, the maximum latency of the communication system to process and forward information must be less than 0.1 second (time of flight of the information is excluded here).

[USER-GENE-0040] Communication Latency Between Entities. For highly reliable communication, the communication system must have a Disruption Tolerant Networking mechanism (DTN) (e.g.: local data storage, etc.).

[USER-GENE-0050] Navigation Capability – Space Vehicle And Proximity Elements. The communication system must support navigation (e.g. ranging) for the space vehicle and for proximity elements.

[USER-GENE-0060] Navigation Capability – Surface Elements - Goal. The communication system should support navigation (e.g. ranging) for surface elements.

[USER-GENE-0070] Communication between nodes. Any node must be able to communicate with any node either directly or via another node.

1.4.2 Earth to Space Vehicle (Communication Nearby the Moon)

The Communication system from a Space Vehicle orbit around the Moon to Earth (return link) and vice versa (forward link) must have the following performances (considering the worst case distance between the two elements):

[USER-ESMO-0010] Frequency Bands – Earth to Moon Space Vehicle - Downlink. The downlink communication system must use Ka-band and X-band.

[USER-ESMO-0020] Frequency Bands – Earth to Moon Space Vehicle - Uplink. The uplink communication system must use X-band.

[USER-ESMO-0030] Earth to Moon Space Vehicle Link - Information Data Rate. The information data rates must be at least 100 Mbps on the return link and 50 Mbps on the forward link.

[USER-ESMO-0040] Earth to Moon Space Vehicle Link - Information Data Rate - Goal. The information data rates should be at least 500 Mbps on the return link and 100 Mbps on the forward link.

[USER-ESMO-0050] Earth to Moon Space Vehicle Link - Availability. For near real time communication, the overall availability should be of at least 95% and have no outage greater than for 1 consecutive hour.

[USER-ESMO-0050]Note.1: The outage only considers environmental effects (such as RF propagation impairment but no eclipse) and physical hardware failure or anomalies.

[USER-ESMO-0050]Note.2: This requirement is stated as a goal at this time because it will be revisited later.

1.4.3 Earth to Space Vehicle while in Excursion to Mars (and other Deep Space Destinations)

The Communication system of a Space Vehicle on excursion to Mars communicating back to Earth (return link) and vice versa (forward link) must have the following performances (considering the worst case distance between the two elements):

[USER-ESMA-0010] Frequency Bands – Earth to Mars Space Vehicle – Uplink. The exact frequencies bands of this link are currently unspecified. The chosen frequencies must be compatible with the existing ground infrastructure.

[USER-ESMA-0020] Frequency Bands – Earth to Mars Space Vehicle – Downlink. The exact frequencies bands of this link are currently unspecified. The chosen frequencies must be compatible with the existing ground infrastructure.

[USER-ESMA-0030] Earth to Mars Space Vehicle Link Information Data Rate. The communication system must have an information data rate of at least 30 Mbps on the return link and 15 Mbps on the forward link.

[USER-ESMA-0040] Earth to Mars Space Vehicle Link - Information Data Rate - Goal. The communication system and service should allow information data rates of at least 150 Mbps on the return link and 40 Mbps on the forward link.

[USER-ESMA-0050] Earth to Mars Space Vehicle Link Availability. For near real time communication, the communication system should have an overall availability of at least 95% and have no outage higher than 1 consecutive hour.

[USER-ESMA-0050]Note.1: The outage only considers environmental effects (such as RF propagation impairment but no eclipse) and physical hardware failure or anomalies.

[USER-ESMA-0050]Note.2: This requirement is stated as a goal at this time because it will be revisited later.

1.4.4 Space Vehicle to Moon & Mars Surface Elements (and other Deep Space Destinations)

The Communication system from a Space Vehicle around/ the Moon or Mars to respective Surface Elements (e.g. rover) (return link) and vice versa (forward link) must have the following performances (considering the worst case distance between the two elements):

[USER-SVSE-0010] Frequency Bands –Space Vehicle to Surface Elements– Uplink. The exact frequencies bands of this link are currently unspecified.

[USER-SVSE-0010]Note.1: however as a reminder, the communication system must be compatible with the existing CCSDS or IEEE standards.

[USER-SVSE-0020] Frequency Bands –Space Vehicle to Surface Elements– Downlink. The exact frequencies bands of this link are currently unspecified.

[USER-SVSE-0020]Note.1: however as a reminder, the communication system must be compatible with the existing CCSDS or IEEE standards.

[USER-SVSE-0030] Space Vehicle Around The Moon or Mars to Respective Surface Elements - information data rate. The communication system must have an information data rate of minimum 25 Mbps on the return link and minimum 10 Mbps on the forward link.

[USER-SVSE-0040] Space Vehicle Around The Moon or Mars to Respective Surface Elements link availability. When the space vehicle is above the horizon of the surface elements, for near real time communication, the communication system should have an overall availability of 95% and outage should be less than for 1 consecutive hour.

[USER-SVSE-0040]Note.1: The outage only considers environmental effects (such as RF propagation impairment but no eclipse or loss of line-of-sight) and physical hardware failure or anomalies.

[USER-SVSE-0040]Note.2: This requirement is stated as a goal at this time because it will be revisited later.

[USER-SVSE-0050] Space Vehicle Around The Moon or Mars to Respective Surface Elements link - blockage. Link budget must accommodate for partial blockage or multipath issues (e.g.: rock on the moon surface, blockage due to antenna positioning).

[USER-SVSE-0060] Space Vehicle Around The Moon or Mars to Respective Surface Elements - communication system volume and mass - Goal. The transportation volume and mass of the deployed communication assembly on the Moon and Mars surface should be minimized.

[USER-SVSE-0060]Note.1: For example, the antenna size should not exceed 1 meter in diameter unless it can be packaged for transportation in an equivalent volume (e.g., a collapsible antenna).

1.4.5 Element to Element on Surface of Moon & Mars (and other Deep Space Destinations)

The Communication system from one element on the planet surface to another element (e.g. rover) (return link) and vice versa (forward link) assuming direct line-of-sight must have the following performances (considering the worst case distance between the two elements):

[USER-ELEL-0010] Intra-Surface Element Frequency Bands. The exact frequencies bands of this link are currently unspecified.

[USER-ELEL-0010]Note.1: however as a reminder, the communication system must be compatible with the existing CCSDS or IEEE standards.

[USER-ELEL-0020] Intra-Surface Elements Information Data Rate. The communication system must have an information data rate of minimum 20 Mbps in each direction when in direct line-of-sight.

[USER-ELEL-0040] Intra-Surface Elements Link Availability. The communication system should have an overall availability of 99%.

[USER-ELEL-0040]Note.1: The outage only considers environmental effects (such as RF propagation impairment but no eclipse or loss of line-of-sight) and physical hardware failure or anomalies.

[USER-ELEL-0040]Note.2: This requirement is stated as a goal at this time because it will be revisited later.

[USER-ELEL-0050] Intra-Surface Element - Communication System Volume And Mass. The transportation volume and mass of the deployed communication assembly on the Moon and Mars surface should be minimized.

[USER-ELEL-0050]Note.1: Although there is currently no requirement concerning this aspect, the design should put the emphasis on portability of the system.

1.4.6 Earth to Element on Surface of Moon & Mars (and other Deep Space Destinations)

[USER-EAEL-0010] Earth to Element – Information Data Rate. The communication system should have an information data rate of at least 256 kbps on the return link and 16 kbps on the forward link.

[USER-EAEL-0010]Note.1: These requirements are notional and thus set as a goal. These requirements should not compromise the feasibility of the system or concept.

1.4.7 Space Vehicle and Element in Proximity of Space Vehicle such as a Resupply Vehicle or EVA Crewmember

The Communication system from Space Vehicle to the element in proximity (defined as a maximum of 50 km) of the space vehicle (return link) and vice versa (forward link) assuming direct-line-of-sight must have the following performances (considering the worst case distance between the two elements):

[USER- SVPR-0010] Space Vehicle to Element Frequency Bands. The exact frequencies bands of this link are currently unspecified.

[USER-SVPR-0010]Note.1: however as a reminder, the communication system must be compatible with the existing CCSDS or IEEE standards.

[USER-SVPR-0020] Space Vehicle to Element Link – Information Data Rate. The communication system must have an information data rate of at least 10 Mbps on the return link and 1 Mbps on the forward link.

[USER-SVPR-0030] Space Vehicle to Element Link – Availability. For near real time communication, The communication system must have an overall availability of 98%.

[USER-SVPR-0040] Space Vehicle to Element Link – Availability. The outage duration must be less than 50-120 seconds (separation range dependent) during proximity operations.

1.5 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.

1.6 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.

1.7 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 concept 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 for informed decision-making about potential future investments in 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	GER	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)		2013
RD-04	450 SNUG	Space Network User's Guide	10	2012
RD-05	453-NENUG	Near Earth Network User's Guide	2	February 2016
RD-06	CCSDS 131.0-B-2	TM Synchronization and Channel Coding	2	August 2011
RD-07	CCSDS 732.0.B-3	AOS Space Data Link Protocol	3	September 2015
RD-08	CCSDS 133.1-B-3	Encapsulation Service	2	October 2009
RD-09	CCSDS 702.1-B-1	IP Over CCSDS Space Links	1	September 2012
RD-10	CCSDS 727.0-B-4	CCSDS File Delivery Protocol (CFDP) – Recommended Standard	4	January 2007
RD-11	CCSDS 911.2-B-3	Space Link Extension – Return Channel Frames Service Specification	3	August 2016
RD-12	CCSDS 912.1-B-4	Enhanced Forward Command Link Transmission Unit (CLTU) Services	4	August 2016
RD-13	CCSDS 913.1-B-2	Space Link Extension – Internet Protocol for Transfer Services	2	September 2015

3 TECHNICAL DELIVERABLES

The following list of activities define the technical deliverables of this concept study.

The deliverables must contain the following elements:

- 1) A communication architecture & concept of operation;
- 2) A preliminary system requirements;
- 3) A system selection analysis;
- 4) A system design.

3.1 BLEO COMMUNICATION ARCHITECTURE & CONCEPT OF OPERATION

This deliverable must include the following elements:

- 1) Verification of the requirements;
- 2) Description of the architecture.

Since the future space infrastructures (i.e.: space vehicle, surface element or proximity element) are currently undefined, the architecture of the systems will define the nodes and will comprise the main high-level characteristics of each system (for example, but not limited to, frequencies, modulation, data rates, communication performances, limitations, pointing requirements, mass, power, envelopes, electrical interfaces, assumptions of the physical location of the system onto the infrastructure, etc.).

- 3) Description of the concept of operation
 - a. How is the communication system being used during the different mission phases (i.e. transit and operational) and different mission operational activities.
 - b. Description of the innovation with respect to a traditional architecture/concept of operation;
- 4) Any operational constraints (for example due to physical outage, maintenance, eclipses, etc);
- 5) List of users and other stakeholders and any assumptions on third-parties' existing equipment or infrastructure;
- 6) Preliminary System Health and Safety Requirements.

This deliverable must be presented in the communication architecture & concept of operation document (CDRL 0008).

3.2 PRELIMINARY SYSTEM REQUIREMENTS

This deliverable must include the high-level preliminary system requirements including the functional, performance and physical requirements for each communication entity identified above (exempted for Earth entities) based upon the architecture, concept of operation and constraints identified in the previous section. Since the interfaces with the future space infrastructures (i.e.: space vehicle, surface element or proximity element) are currently undefined, some assumptions will have to be made on where the systems will be exactly located and how the different systems will connect to other systems. For both space and Earth entities, the deliverable must include which network will be used and list any assumptions on its future capabilities.

This deliverable must be presented in the Preliminary system requirements document (CDRL 0009).

3.3 SYSTEM SELECTION ANALYSIS

This deliverable must include the following elements based upon the preliminary system requirements:

- 1) top-level technical performance measures of the communication systems;
- 2) List of viable and innovative communication systems within the communication architecture;
- 3) Trade-off analyses on these viable options;
- 4) Preliminary design of the viable options;
- 5) A list of communication systems or components which Canada could potentially contribute in (i.e.: for the space vehicle and/or for nearby elements to the space vehicle and/or for planet surface element, etc)

This deliverable must be presented in the System selection analysis document (CDRL 0010).

3.4 SYSTEM DESIGN

Based upon the outcome of the system selection analysis, one or several viable systems or components must be analyzed in greater detail in this deliverable.

As mentioned in the Introduction section 1, the Canadian government is interested in innovative concepts (e.g.: related to artificial intelligence, mesh, star network or some sort of BLEO internet network). Thus we are encouraging the industry to propose innovative ideas and as such this deliverable must clearly identify the innovative aspects of the proposed system.

This deliverable must include the following elements:

- 1) The system level architecture of the selected communication systems;
- 2) Detailed preliminary system requirements document including the following elements:
 - a. Functional requirements;
 - b. Performance requirements;
 - c. External interfaces requirements (if applicable);
 - d. Reliability requirements;
 - e. Environmental requirements including if applicable the following sub-elements:
 - i. Mechanical Environment;
 - ii. Thermal Environment;
 - iii. Electromagnetic Environment;
 - iv. Moon or Mars Atmospheric Environment;
 - v. Space Radiation Environment;
 - vi. Meteoroid Environment;
 - vii. Cleanliness and Contamination Requirements.
- 3) A performance assessment of the selected communication systems;
- 4) Verification compliance matrix of both system requirements and user requirements as well as traceability matrix
- 5) Description of the innovation with respect to a traditional equipment;
- 6) Development plan of the selected communication systems.

This deliverable must be presented in the System design document (CDRL 0011).

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 contractors 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 elements that require technological improvements, 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 0018.

5 BUSINESS AND MANAGEMENT ASSESSMENT

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

5.1 BUSINESS ASSESSMENT

The business assessment must be delivered per CDRL 0021, the first version at the Mid-term 2 review (M2) and the final version at the final review(M3).

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 business assessment 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 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 0012, 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 0012).

The contractor must present the cost breakdown of the proposed flight concept per Table 5-1. The cost breakdown must be provided per phase and at the sub-system level.

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 0012) 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 0019. 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 0012). 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 0020) 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 0013, 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 report (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 0014.

5.6 MONTHLY REPORT

The contractor must write and deliver a monthly report per CDRL 0007. The report must summarize the work accomplished during the completed month and briefly mention the work planned for the following month.

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 Table 6-1 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 (KOM)	No later than 2 weeks After Contract Award	CSA
Progress Review Meeting (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
Monthly 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 0017.

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 Progress Review Meeting (Milestone 1) (CDRL 0003) will examine the communication architecture and the concept of operation. The contractor will present the preliminary system requirements and the proposed system selection analysis will be discussed.

The Mid-term Review Meeting (Milestone 2) (CDRL 0004) will examine the proposed system for a potential flight mission. The technology description will be reviewed at this milestone. Furthermore, the Business assessment report and the management report will be evaluated and commented 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 flight 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 0015 and the contractor performance evaluation per CDRL 0016.

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	0001
2	Kick-off Meeting Presentation	Meeting	Final	0108
3	Progress Review Meeting Presentation (M1)	Meeting	Final	0003
4	Mid-term review Meeting Presentation (M2)	Meeting	Final	0004
5	Final Review Meeting Presentation (M3)	Meeting	Final	0005
6	Meeting Minutes	Meeting + 1 week	Final	0006
7	Monthly Progress Reports	End of month + 1 week	Final	0007
8	Cislunar communication architecture & concept of operation	KOM Milestone 1 Milestone 2	Draft Update Final	0008
9	Preliminary System Requirements	Milestone 1 Milestone 2	Draft Final	0009
10	System Selection Analysis	Milestone 2 Milestone 3	Draft Final	0010
11	System Design Document	Milestone 2 Milestone 3	Draft Final	0011
12	Management Report	Milestone 2 Milestone 3	Draft Final	0012
13	Intellectual Property (FIP) Disclosure	Milestone 3	Final	0013
14	Executive Report	Milestone 3	Final	0014
15	Final Data Package	Milestone 3	Final	0015
16	Contractor Performance Evaluation	Milestone 3	Final	0016
17	Action Items Log (AIL)	Meeting + 1 week	Final	0017

CDRL No.	Deliverable	Due Date	Version	DID No.
18	Technology description report	Milestone 2 Milestone 3	Baseline Final	0018
19	Schedule	Milestone 2 Milestone 3	Draft Final	0019, native format
20	Animation	Milestone 3	Final	0020
21	Business Assessment	Milestone 2 Milestone 3	Draft Final	0021

7 LIST OF ACRONYMS

BLEO	Beyond Low Earth Orbit
CCSDS	Consultative Committee for Space Data Systems
CDRL	Contract Data Requirements List
CSA	Canadian Space Agency
CTE	Critical Technology Element
DID	Data Item Description
DNS	Domain Name Server
DST	Daylight Saving Time
DTN	Disruption Tolerant Networking
EML2	Earth Moon Lagrange 2
EVA	Extravehicular Activity
FIP	Foreground Intellectual Property
FTP	File Transfer Protocol
GER	Global Exploration Roadmap
GoC	Government of Canada
IEEE	Institute of electrical and electronics Engineers
IP	Intellectual Property
LCC	Life Cycle Cost
LOE	Level of Effort
Mbps	Megabits per second
NEN	Near Earth Network
PBS	Product Breakdown Structure
RD	Reference Document
RF	Radio frequency
SOW	Statement of work
TDRS	Tracking and Data relay Satellite
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-0001 – MEETING AGENDA	28
DID-0002 – KICK-OFF MEETING PRESENTATION	29
DID-0003 – PROGRESS REVIEW MEETING PRESENTATION	30
DID-0004 – MID-TERM REVIEW MEETING PRESENTATION	31
DID-0005 – FINAL REVIEW MEETING PRESENTATION	32
DID-0006 – MEETING MINUTES	33
DID-0007 – MONTHLY PROGRESS REPORT	34
DID-0008 – COMMUNICATION ARCHITECTURE & CONCEPT OF OPERATION	35
DID-0009 –PRELIMINARY SYSTEM REQUIREMENTS.....	36
DID-0010 – SYSTEM SELECTION ANALYSIS.....	37
DID-0011 – SYSTEM DESIGN DOCUMENT	38
DID-0012 – MANAGEMENT REPORT.....	40
DID-0013– CONTRACTOR DISCLOSURE OF INTELLECTUAL PROPERTY	41
DID-0014– EXECUTIVE REPORT	42
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DID-0017 – ACTION ITEMS LOG	45
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DID-0020 – ANIMATION	48
DID-0021 –BUSINESS ASSESSMENT	49

DID-0001 – 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-0002 – Kick-off Meeting Presentation

PURPOSE:

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

To present the needed deliverable.

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) Required items as per Table 6-2 : CDRL
- 4) Work requirements and schedule;
- 5) FIP and BIP;
- 6) Licensing issues if any;
- 7) Project's funding and expected cash-flow;
- 8) Presentation to include the required copyrights and IP disclosure;

DID-0003 – Progress Review Meeting Presentation

PURPOSE:

To present the results of the work done to date in the contract.

PREPARATION INSTRUCTIONS:

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

- 1) Review of contract deliverables;
- 2) Review of industrial capabilities;
- 3) Required Items as per Table 6-2 : CDRL
- 4) Review of the way forward toward mid-term review;
- 5) Presentation to include the required copyrights and IP disclosure;

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 components 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) Required Items as per Table 6-2 : CDRL
- 3) Technical and programmatic issues if any;
- 4) Review of contract deliverables;
- 5) Work requirements, work status and schedule;
- 6) FIP and BIP;
- 7) Licensing issues if any;
- 8) Other items as deemed appropriate;
- 9) 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 option will be capable of achieving the components requirements.

PREPARATION INSTRUCTIONS:

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

- 1) Required Items as per Table 6-2 : CDRL
- 2) LCC estimates;
- 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-0006 – Meeting Minutes

PURPOSE:

To 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-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 – Communication Architecture & Concept of Operation

PURPOSE:

To describe the preliminary concept, explain rationale, benefits, objectives, and approaches. Presents the architecture, concept of operation, constraints, stakeholders, etc.

PREPARATION INSTRUCTIONS:

This deliverable must include the following elements:

- 1) Verification of the requirements. The contractor must understand every requirement, flag any inconsistencies and propose a way forward in case of discrepancy.
- 2) Description of the Architecture. The architecture must describe the different communication components of the entire mission, how to integrate them within the different modules and how they communicate with one another.
- 3) Description of the communication concept of operation. The communication concept of operation must describe how the communication system is being used during the different mission phases and different mission operational activities;
- 4) Main assumptions on concept of operation and architecture;
- 5) Any operational constraints;
- 6) List of users and other stakeholders and any assumptions on third-parties' existing equipment or infrastructure;
- 7) Preliminary system health and safety requirements.

DID-0009 –Preliminary System Requirements

PURPOSE:

To define the functional, performance, environmental and other requirements for a given system, subsystem, unit, module or assembly and to provide the basis on which the requirements specification will be developed.

PREPARATION INSTRUCTIONS:

The preliminary system requirement document must define the requirements on the subject item (either system or a subsystem, etc.) as a whole and must not contain specific requirements on sub-items. All requirements must be verifiable on the item as integrated.

The document must address all of the following requirement areas, as a minimum:

- 1) functional requirements;
- 2) performance requirements;
- 3) physical (mass, volume, location constraints of the equipment);
- 4) External stowage and deployment requirements, if any.
- 5) Assumptions on the communication network (ground and space) which will be used and its future capabilities.

Requirements documents must cite applicable standards and parent requirements (e.g. requirements from manufacturers), and must make clear the priority sequence of the applicable documents.

DID-0010 – System Selection Analysis

PURPOSE:

- To establish a list of selection criterion for choosing the viable systems or components;
 - To provide a list of viable communication systems compatible with BLEO;
 - To perform trade-off analyses on these viable options;
 - To evaluate the fitness level within the BLEO mission of the proposed communication systems;
 - To evaluate the pertinence for Canada to contribute to the mission with the proposed system(s).
-

PREPARATION INSTRUCTIONS:

This deliverable must include the following elements:

- 1) Top-level technical performance measures of the communication systems. This item must contains every criterion used to compare options in the trade-off analysis. Moreover any assumptions and any constraints must be listed too.
- 2) List of viable communication systems within the communication architecture. Viable means systems that fulfill the needs of the mission and at the same time that the required technological developments are within reach given the mission timeframe.
- 3) Trade-off analyses on these viable options. The trade space could be frequency, power, power efficiency, mass, volume, robustness, TRL level, information data rate capabilities, etc.. The trade-off must include quantitative assessment of the performances.
- 4) Preliminary design of the viable options.
- 5) A list of communication systems or components which Canada could contribute (i.e.: for the space vehicle and/or for nearby elements to the space vehicle and/or for planet surface element, etc).

DID-0011 – System Design Document

PURPOSE:

- To provide the system level architecture of the selected communication systems based upon the system selection analysis.
 - To define the functional, performance, environmental and other requirements for a given system, subsystem, unit, module or assembly and to provide the basis on which the requirements specification will be developed.
 - To perform performance assessment of the selected communication systems;
 - To propose an innovative solution that presents clear advantages over a traditional communication system.
 - To present a development plan of the selected communication systems.
-

PREPARATION INSTRUCTIONS:

The document must address all of the following requirement areas, as a minimum:

- 1) Description of the System level architecture;
 - 2) System Requirements:
 - a) Functional requirements;
 - b) Performance requirements;
 - c) External interface requirements (if applicable);
 - d) Reliability requirements;
 - e) Environmental requirements including if applicable the following sub-elements:
 - i. Mechanical Environment;
 - ii. Thermal Environment;
 - iii. Electromagnetic Environment;
 - iv. Moon or Mars Atmospheric Environment;
 - v. Space Radiation Environment;
 - vi. Meteoroid Environment;
 - vii. Cleanliness and Contamination Requirements.
 - f) External stowage and deployment requirements, if any.
 - 3) Performance assessment;
 - 4) Verification compliance matrix of both system requirements and user requirements as well as traceability matrix
 - 5) Description of the innovation over traditional equipment.
-

6) A development plan of the selected communication systems.

Requirements documents must cite applicable standards and parent requirements (e.g. requirements from manufacturers), and must make clear the priority sequence of the applicable documents.

DID-0012 – 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 advantages and risks of the described concept should be fully explored and evaluated in terms of the following:

- Ability to contribute toward the desired business outcomes and benefits;
- Extent to which technical requirements and mission needs are addressed;
- Estimates of the full costs; and
- Risks associated with the concept.

The Management Report must contain the following information, 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) Business potential
- 4) 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.
- 5) Schedule
- 6) Risk assessment
- 7) Recommendations et conclusion

DID-0013– 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 in the document CONTRACTOR DISCLOSURE OF INTELLECTUAL PROPERTY that can be found at:

- <ftp://ftp.asc-csa.gc.ca/users/GPITT-IPMTT/pub/>.

DID-0014– 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 Potential (~1 page);
Business potential, Canadian capabilities development

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-0015 – 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 – 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) New opportunities created by the work conducted under the study.

DID-0017 – 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) Bureau de première responsabilité;
- 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-0018 – Technology Description 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-0019 – 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-0020 – 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-0021 –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.