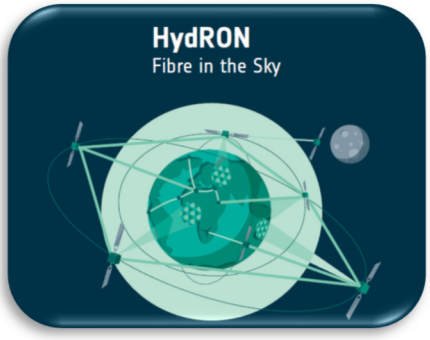
HIGH THROUGHPUT OPTICAL NETWORK DEMONSTRATION SYSTEM (HYDRON-DS)



HYDRON-DS PHASE B2/C/D/E THEMATIC CALL GUIDELINES

Prepared by	HydRON Implementation Manager
Document Type	Announcement of Opportunity
Reference	ESA-CSC-T-AO-0001
Issue/Revision	1.0
Date of Issue	19/07/2023
Status	Approved

APPROVAL

Title	Thematic Call Guidelines for HydRON-DS Phase B2/C/D/E		
Issue Number	1	Revision Number	1
Author	HydRON Implementation Manager	Date	19/07/2023
Approved By	ScyLight Strategic Programme Line Manager	Date of Approval	19/07/2023

CHANGE LOG

Thematic Call Guidelines for HydRON-DS Phase B2/C/D/E	Issue Nr	Revision Number	Date
New document	1	0	19/07/2023

CHANGE RECORD

Issue Number	1	Revision Number	1	
Reason for change		Date	Pages	Paragraph(s)
New document		19/07/2023	All	All

DISTRIBUTION

Name/Organisational Unit

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1. INTRODUCTION

1.1. Document Scope

As part of the HydRON-DS Project (High thRoughput Optical Network Demonstration System), this document provides the guidelines of the "Thematic Call for HydRON-DS Phase B2/C/D/E" that will be issued by the European Space Agency (hereafter referred to as the Agency).

1.2. Applicable Documents

AD. 1	Mission Assumptions and Technical Requirements (MATER) for HydRON-DS Phase B2/C/D/E, ESA-CSC-T-SP-0002, Issue 1, Rev 0
AD. 2	ARTES 4.0 Standard Call for Propoposal, CfP/4-40001/23/NL/AF

1.3. Reference Documents

RD. 1	ESA Specification for Terabit/sec Optical Links (ESTOL) – ESA-CSC-T-SP-0001 Issue 1 Rev 0

1.4. Abbreviations

AC	Adjudication Committee
CfP	Call for Proposals
CMIN	Council at Ministerial level
ESTOL	ESA Specification for Terabit/sec Optical Links
GEO	Geostationary Orbit
HydRON	High thRoughput Optical Network
HydRON-DS	HydRON Demonstration System
IPC	Industrial Policy Committee
ITT	Invitation to Tender
JCB	Joint Board on Communication Satellite Programmes
LEO	Low Earth Orbit

MATER	Mission Assumptions and Technical Requirements
MEO	Medium Earth Orbit

2. BACKGROUND

HydRON (High thRoughput Optical Network) is a project within the ScyLight programme, first presented at the Ministerial Council in November 2019 (CM19). The HydRON Project is implemented as part of the ARTES Strategic Programme Line “Optical and Quantum Communication – ScyLight”.

HydRON aims to demonstrate the world’s first (all) optical multi-orbit transport network at terabit/sec capacity in space, extending terrestrial fibre-based networks seamlessly into space – in other words HydRON will demonstrate the “Fibre in the Sky” and extend the "Internet beyond Cloud(s)".

The initiative is to enable the development and validation of required technologies by European and Canadian industries. The project will support the next generation of institutional and commercial space telecom missions, requiring advanced communication capabilities which are currently unavailable.

2.1. HydRON Vision

HydRON is the vision for a high throughput optical space network that will address and master the challenges of bringing connectivity to multiple users across different orbits and applications to showcase the capabilities of optical communication technology in end-to-end system implementations (Figure 1). The targeted capacity performance of HydRON is orders of magnitude greater compared to today’s SatCom systems (terabit/sec in contrast to gigabit/sec), which has the potential to trigger a true revolution of applications, services and connectivity provided by SatCom. The seamless inter-operability of the optical space network with terrestrial systems is one of the key aspects of HydRON to provide a perceived integrated infrastructure.

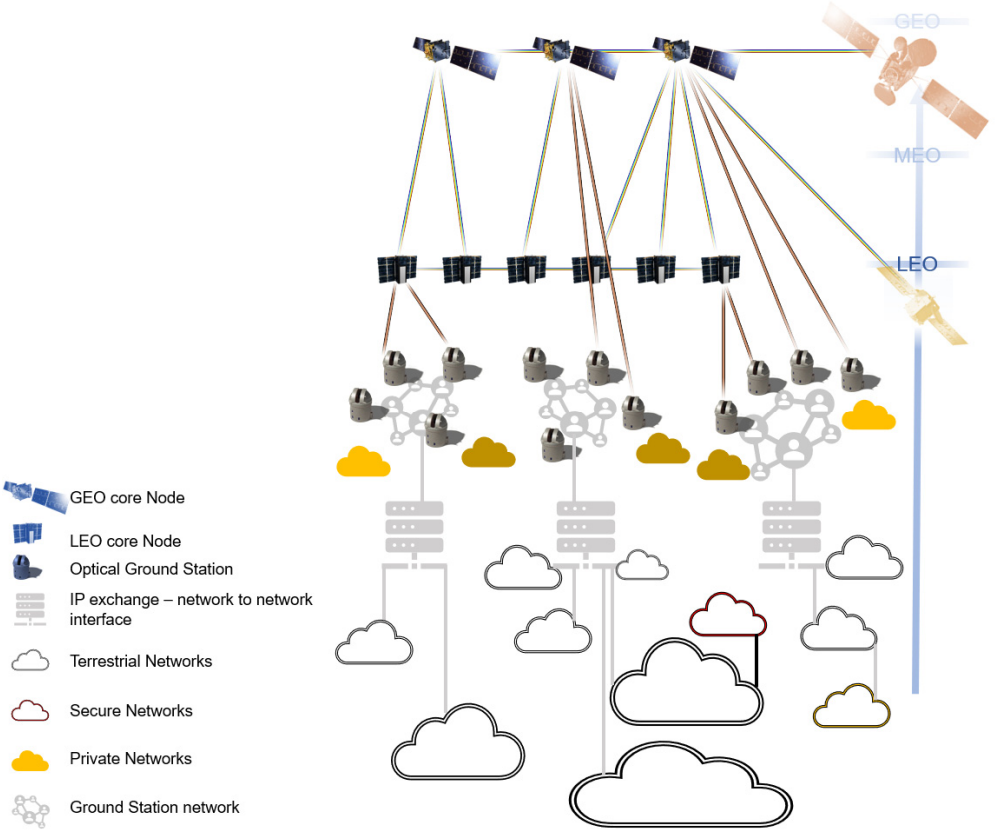


Figure 1 Vision of a high throughput optical space network bringing high data rate terrestrial connectivity to multiple space users across different orbits (e.g., LEO, MEO, GEO) and to ground users located in remote areas with no available broadband access.

2.2. HydRON Demo System

The implementation of the full HydRON concept (i.e., Vision) is considered beyond the scope of the (ESA) HydRON Project, considering estimated financial envelope and effort. Instead, the objective of the (ESA) HydRON Project is to define, develop and validate a representative HydRON Demonstration System (HydRON-DS) reducing the complexity of a full system to key elements (Figure 2).

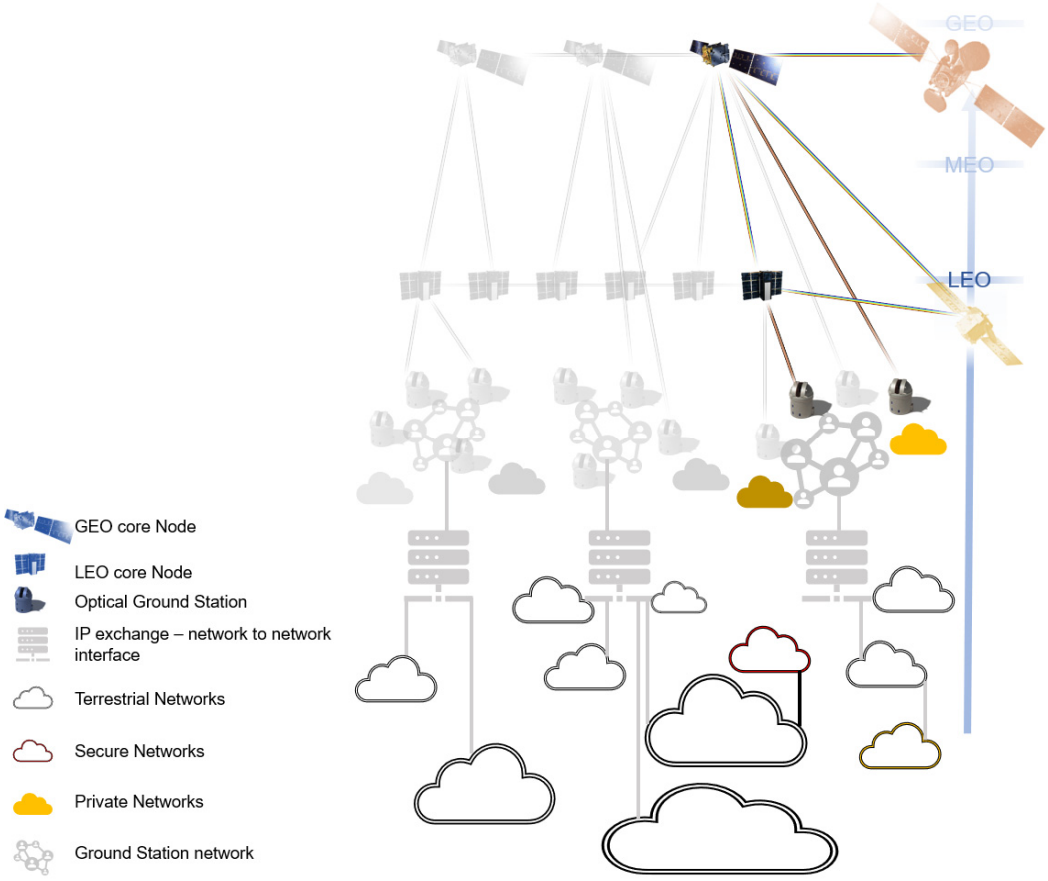


Figure 2 Demo System mission of a downscaled high throughput optical space network (i.e., HydRON-DS), demonstrating key optical / digital technologies and validating operational concepts required for the HydRON vision.

2.3. HydRON Project

The HydRON Project targets the implementation (i.e., development, deployment, in-orbit testing and demonstration) of the HydRON Demonstration System (i.e., HydRON-DS). The HydRON-DS (Figure 2) will be composed of the minimum number of elements (in space and on ground) necessary to demonstrate high-capacity data transport and flexible network capabilities to assets / users located both in space and on ground.

The Phase A/B1 of the HydRON-DS was initiated in 2022 and will be completed by 4th quarter 2023. Two parallel competitive contracts were awarded to industrial teams led by TAS (Italy) and ADS (Germany) respectively. Both consortia are executing the preparatory activities planned in the Phase A/B1 studies, including the consolidation of potential technical baseline(s) (and associated programmatics and cost estimations).

In parallel, the Agency organized a HydRON Operators Workshop in May 2023, where several industry-initiated proposals were presented by Satellite Operators / Service Providers / Primes. Further discussions involving Delegations took place in May / June 2023 timeframe. As a result, additional commercially driven scenarios boosted by means of HydRON technologies are under assessment by the consortia of the Phase A/B1 studies, in close collaboration with the proposal initiators (i.e., Satellite Operators / Service Providers / Primes).

The Agency is now planning to initiate and implement the Phase B2/C/D/E of the HydRON-DS. The Phase B2/C/D/E activity is intended to be performed through close cooperation and interaction between the “to-be-selected” HydRON-DS Industrial Consortium and the Agency. Given the received commercial interests, in general, the Agency largely encourages cooperation with Satellite Operators / Service Providers offering flight opportunities and / or utilization of the HydRON-DS for commercial exploitation (or other sorts of co-investment).

3. COOPERATION OPPORTUNITY DESCRIPTION

The Thematic Call for HydRON-DS looks for industry-initiated ideas to reconcile the goals of ESAs HydRON-DS Technology Demonstration mission with visionary concepts of e.g., Satellite Operators / Service providers / Primes in response to upcoming business opportunities in the satcom market.

The present call aims at collecting Outline Proposals from Industry (followed by Agency's invitation to submit Full Proposals) to implement the next Phase B2/C/D/E of the HydRON-DS.

The present call aims at collecting Outline Proposals from Industry describing their plan to implement the next Phase B2/C/D/E of the HydRON-DS. It is planned that the Agency will invite the responders to this thematic call to hand in the detailed Full Proposal.

The Thematic Call for HydRON-DS is addressed to Service Providers, Operators and Primes, complemented by relevant sub-contractors and suppliers. The Thematic Call is open for all European and Canadian industry from the Participating States of the ScyLight programme / HydRON project to submit their own ideas to boost their business opportunities by leading the definition, development and in-orbit demonstration of the HydRON-DS.

For that purpose, the industrial proposals shall contain the necessary information including co-funding levels, which will be the basis for exchanges with the Participating States of the ScyLight programme / HydRON project to consolidate, and finally approve, the required level of funding while fulfilling the geographical return constraints. The Outline Proposal shall provide technical, management, implementation / cooperation, financial and as well business case information.

Detailed information of the potential cooperation between Industry (i.e., Service Providers, Operators and Primes) and the Agency shall be described in the proposal response, including flight opportunities and / or utilization plans of the HydRON-DS for commercial exploitation (or other sorts of co-investement).

4. GUIDELINE OF THE PROCESS

The steps of the present Thematic Call for HydRON-DS Phase B2/C/D/E are summarized as follow:

- Step-1: Solicitation of Outline Proposals
- Step-2: Clarification discussions (bi-laterals with Industry and Delegations)
- Step-3: Invitation to submit Full Proposals
- Step-4: Proposal evaluation and Board recommendation
- Step-5: Contract negotiation

In more detail:

- Step-1 will make use of the existing ARTES 4.0 Open Call for Proposals | ESA TIA for ScyLight. The deadline for the submission of the Outline Proposals is 4/9/2023.
- In Step-2, the Industrial partners who have responded to Step-1 will invite all ScyLight Participating States to the "HydRON Workshop with Delegations" to explain their plans in order to ensure the best coverage of the final Full Proposal. The "HydRON Workshop with Delegations" will take place on 11/9/2023 and 12/9/2023.
- In Step-3, the Agency will invite the submission of the Full Proposals through esa-star (under preparation). The release[1] will be given short after the HydRON Workshop with Delegations. The deadline for the submission of the Full Proposals will be 8 weeks (TBC).
- Step-4 is planned in November / December 2023. The outcome will be the list of recommended proposal(s) for implementation by the HydRON Project.
- Step-5 is intended to be accomplished in 2nd quarter 2024 after financial approval of the updated HydRON-DS Project Proposal by the Joint Board on Communication Satellite Programmes (JCB) and the approval of the Contract

[1] Full proposal submission must be preceded first by Step-1 ("Call for Outline proposals") and Step-2 ("HydRON Workshop with Delegations"). Go-ahead must be given by ESA for submission of the Full Proposal.

Proposal by the Adjudication Committee (AC) and the Industrial Policy Committee (IPC).

The overall process of the Call for Proposals for the HydRON-DS Phase B2/C/D/E is detailed in Table 1 (steps, content, tools, templates, timeline) and depicted in Figure 5 (flowchart) of the Annex B - Detailed Process of the Thematic Call.

Step #	Title	Content	Tool / Templates	Date
Step-1	Solicitation of Outline Proposals	Preparation and submission of the Outline Proposals, including preliminary financial information (total cost, private funding level, geographical distribution)	Existing ARTES 4.0 Open Call for Proposals | ESA TIA for ScyLight in esa-star Annex C – Response Template and Content	Release 21/7/2023 Submission deadline 4/9/2023
Step-2	Clarification discussions	Bi-laterals with Industry and Delegations	"HydRON Workshop with Delegations"	11/9/2023 and 12/9/2023 at ESTEC
Step-3	Invitation to submit Full Proposals	Preparation and submission of the Full Proposals, including final committing financial information (total cost, private funding level, geographical distribution) and Authorisation of Funding notification from the relevant National Delegations	esa-star	Release 15/9/2023 (TBC) Submission deadline (8 weeks (TBC))

Step-4	Proposal evaluation and Board recommendation	List of recommended proposal(s) for implementation by the HydRON Project	esa-star	November / December 2023
Step-5	Contract negotiation	Contract(s) negotiation for the HydRON-DS Phase B2/C/D/E	esap	2nd quarter 2024

Table 1. Summary of the steps of the Call for Proposals for the HydRON-DS Phase B2/C/D/E.

5. PROGRAMMATIC CONSIDERATIONS

5.1. Geographical Return

The current list of Participating States to the HydRON Project is: Canada, Germany, Hungary, Italy, Netherlands, Poland, Romania, Switzerland and United Kingdom.

The indicative total availability for industrial commitments currently available is 48.0 MEuro (at current e.c.), split according to Table 2.

HydRON Participating State	Indicative Availability for Industrial Commitments [MEuro]
Canada	1.7
Germany	4.9
Hungary	0.8
Italy	31.5
Netherlands	2.4
Poland	1.6
Romania	2.1
Switzerland	2.9
United Kingdom	0.0
Total	**48.0**

Table 2. Current indicative availability for industrial commitments to the HydRON Project.

The HydRON Project is implemented within the “Optical and Quantum Communication – ScyLight ARTES Strategic Programme Line”. The current list of Participating States

to the ScyLight Programme is[2]: *Austria, Belgium, Czech Republic, Estonia, France*, Germany, *Greece,* Hungary, *Ireland,* Italy, *Luxemburg,* Netherlands, Poland, *Portugal,* Romania, *Spain, Sweden,* Switzerland, United Kingdom, Canada and *Lithuania.*

For the geographical return assessment, the Tenderer should first identify industrial entities belonging to the list of Participating States already subscribed to the HydRON Project.

Industrial entities from the list of Participating States to the ScyLight Programme could also be considered, but it will require discussions with the relevant Delegation(s) to agree on the mechanism for the needed financial support (e.g., transfer of funding from the ScyLight Programme to the HydRON Project).

5.2. Schedule

The schedule details of the present Thematic Call for HydRON-DS Phase B2/C/D/E are given in Table 1 and in Annex B - Detailed Process of the Thematic Call. Indicated dates in Figure 5 are planned dates (TBC). The Agency reserves the right to modify, extend or shorten such timeline.

The targeted timeframe for the deployment of the HydRON-DS is launch and In-Orbit Test (Phase E1) in 2026, followed by the In-Orbit Demonstration (Phase E2) in 2026-2028, as shown in Figure 3. The HydRON Project schedule may be adjusted based on the outcome of the Thematic Call for HydRON-DS Phase B2/C/D/E. The option exists to select an Operator / Service Provider to start the exploitation of the HydRON-DS infrastructure in parallel or after successful completion of the Phase E2.

[2] The Participating States that are presently not part of the HydRON Project are *highlighted in italic.*

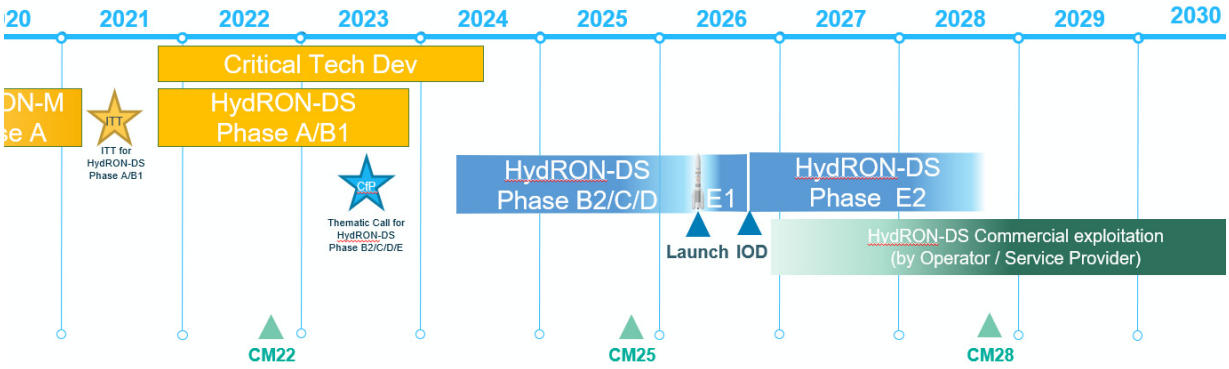


Figure 3. Targeted HydRON Project Schedule.

5.3. Co-funding levels

The maximum co-funding levels for the public investment part are detailed in TABLE B of AD. 2, and copied in Figure 4 for the sake of clarity and completeness. For detail explanations please refer to section 6 of AD. 2.

Development Phase	***Funding level up to***		***Funding level for Universities or Research Institutes with no commercial Interest in the Product up to***
	Non-SME	***SME***	
Definition Phase	75%[1]	80%	100%
Technology Phase	75%	80%	100%
Product Phase	75%[1]	80%	100%
Demonstration Phase	75%[1]	80%	50%

Figure 4. Maximum funding levels for ARTES strategic programme line Optical and Quantum Communication – ScyLight (extracted from TABLE B in section 6 of AD. 2).

Please note that National Delegations may support different funding levels up to the maximum specified in TABLE B of AD. 2.

The effective level of funding within the ESA-funded percentage will be defined by the relevant National Delegation(s) and indicated in the Authorisation of Funding notification. The remainder has to be financed by the Tenderer through private sector co-financing, excluding co-financing from third-party public funds[3].

[3] Third-party public funds would reduce the ESA co-funding part such that the overall public co-funding does not exceed the maximum co-funding levels defined in TABLE B of AD. 2.

6. ANNEX A – HYDRON-DS MISSION OBJECTIVES

The HydRON Mission Statement is:

“Fibre in the Sky” technology integrated in terrestrial networks at Terabit capacity demonstrated by European and Canadian Industries”

HydRON-DS ambition is to demonstrate the seamless integration of SatCom systems and the connectivity of space assets into terrestrial networks by providing low-latency and / or high-capacity data transport capabilities (eventually services).

The HydRON-DS has two main mission objectives:

- ✓ Mission Objective #1: technology verification in an end-to-end system demonstration.
- ✓ Mission Objective #2: validation of operational concepts in support of Service Demonstration.

and one mission goal:

- ✓ Mission Objective #3 (goal): provision of Service Demonstration in support of future Service (i.e., commercial exploitation after successful completion of the In-Orbit Demonstration phase E2)

7. ANNEX B – DETAILED PROCESS OF THE THEMATIC CALL

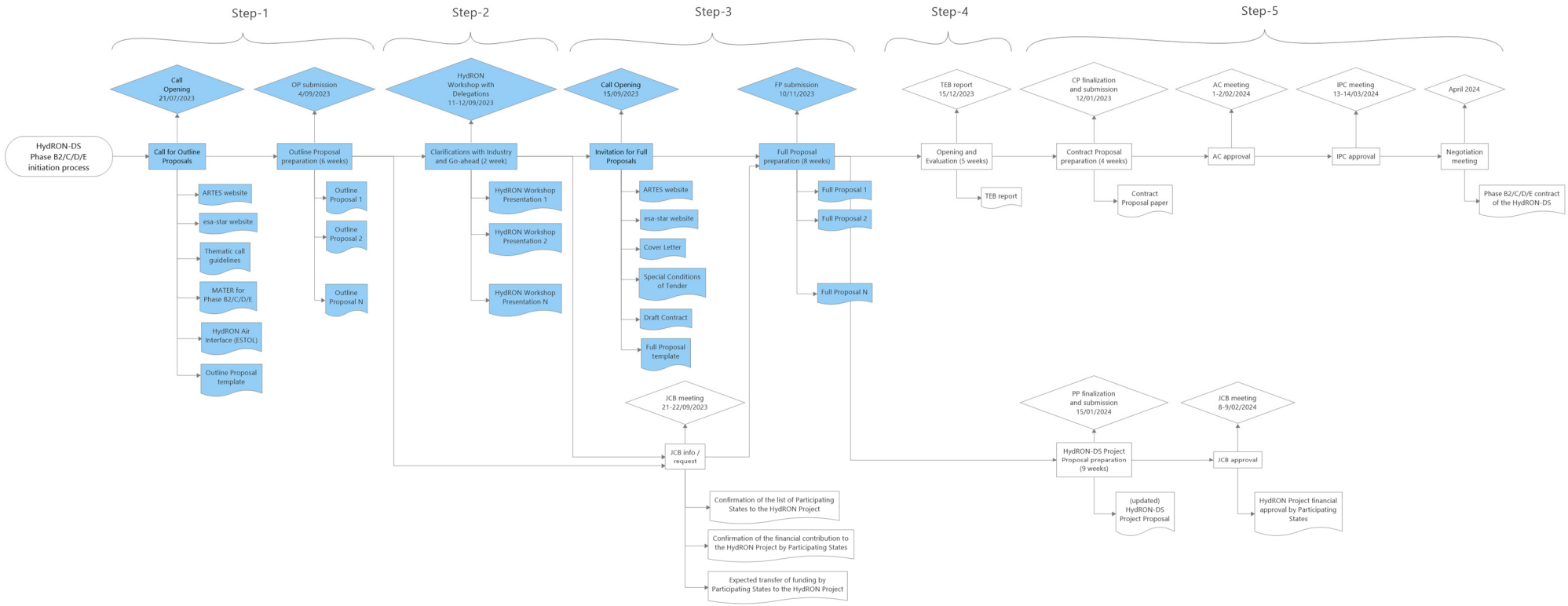


Figure 5. Flowchart of the Call for Proposals for the HydRON-DS Phase B2/C/D/E. Indicated dates are planned dates (TBC).

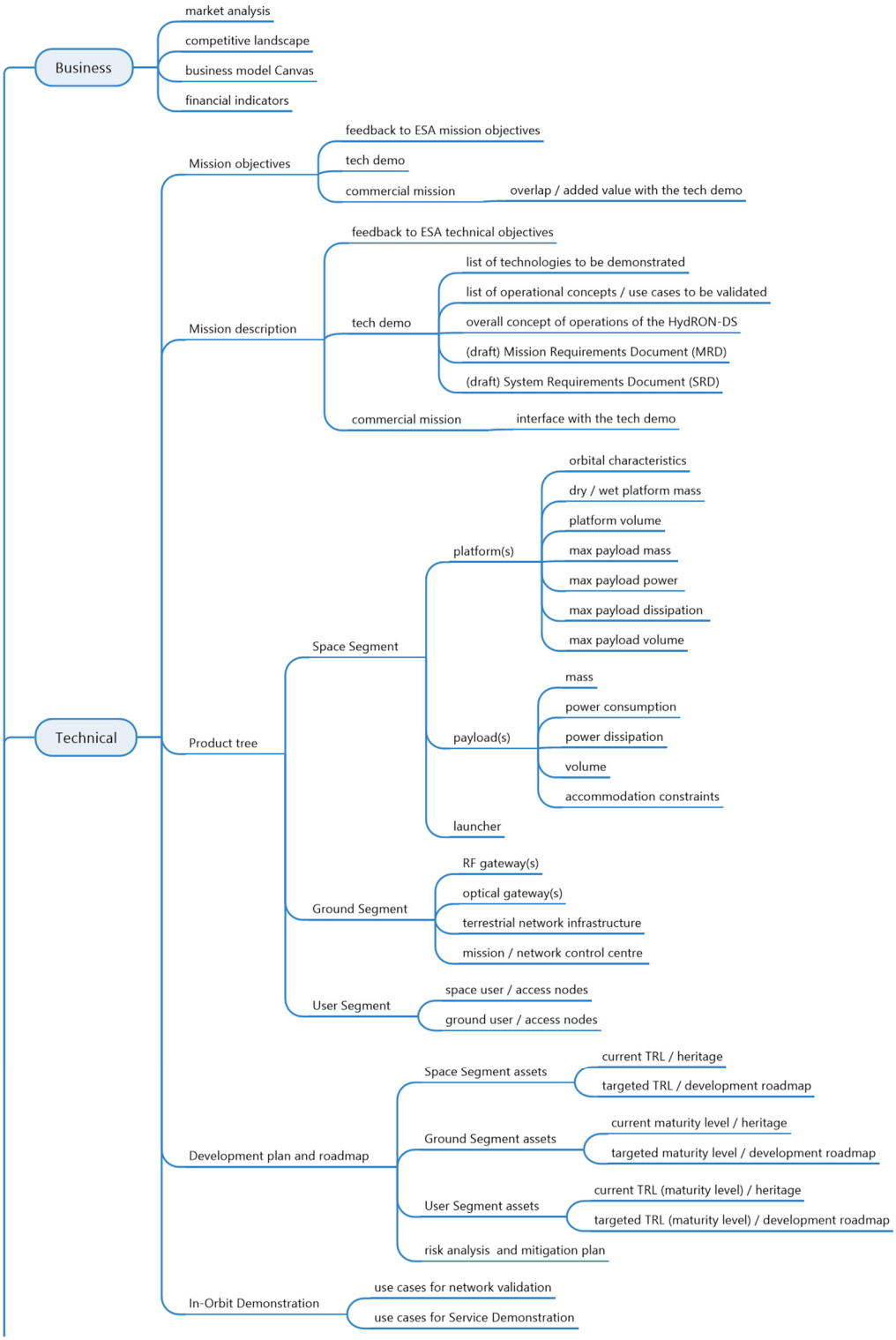
8. ANNEX C – RESPONSE TEMPLATE AND CONTENT

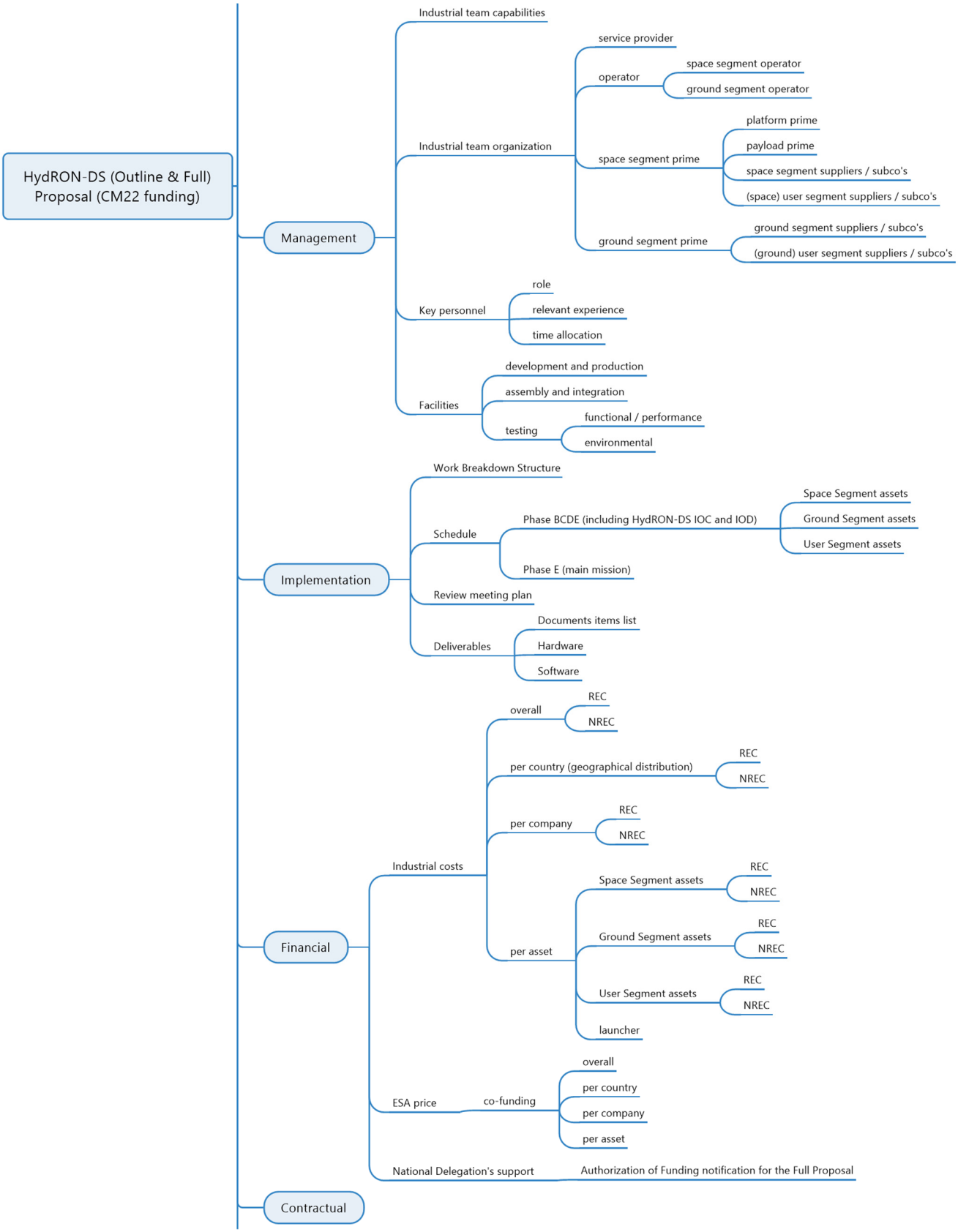
The Outline Proposal will be prepared using the template available on the ARTES website - https://artes.esa.int/documents.

The length of the Outline Proposal shall be kept to the necessary minimum number of pages (max 50), enough to efficiently provide the required information. Please be direct and avoid superfluous content.

Following a successful Outline Proposal, the Agency will invite the Tenderer to submit a Full Proposal. The templates for the Full Proposal will be made available in Step-3.

The Tenderer, in preparing the business / technical / management / implementation / financial content of the Outline Proposal (and the Full Proposal), shall provide the preliminary / first iteration (and the detailed / full iteration) of the subjets listed in the tree shown in Figure 6. The given list of subjects may be tailored by the Tenderer to best match the needs of its proposal content.


Business
market analysis
competitive landscape
business model Canvas
financial indicators
Technical
Mission objectives
feedback to ESA mission objectives
tech demo
commercial mission
overlap / added value with the tech demo
Mission description
feedback to ESA technical objectives
tech demo
list of technologies to be demonstrated
list of operational concepts / use cases to be validated
overall concept of operations of the HydRON-DS
(draft) Mission Requirements Document (MRD)
(draft) System Requirements Document (SRD)
commercial mission
interface with the tech demo
Product tree
Space Segment
platform(s)
orbital characteristics
dry / wet platform mass
platform volume
max payload mass
max payload power
max payload dissipation
max payload volume
payload(s)
mass
power consumption
power dissipation
volume
accommodation constraints
launcher
Ground Segment
RF gateway(s)
optical gateway(s)
terrestrial network infrastructure
mission / network control centre
User Segment
space user / access nodes
ground user / access nodes
Development plan and roadmap
Space Segment assets
current TRL / heritage
targeted TRL / development roadmap
Ground Segment assets
current maturity level / heritage
targeted maturity level / development roadmap
User Segment assets
current TRL (maturity level) / heritage
targeted TRL (maturity level) / development roadmap
risk analysis and mitigation plan
In-Orbit Demonstration
use cases for network validation
use cases for Service Demonstration


HydRON-DS (Outline & Full) Proposal (CM22 funding)
Management
Industrial team capabilities
Industrial team organization
service provider
operator
space segment operator
ground segment operator
space segment prime
platform prime
payload prime
space segment suppliers / subco's
(space) user segment suppliers / subco's
ground segment prime
ground segment suppliers / subco's
(ground) user segment suppliers / subco's
Key personnel
role
relevant experience
time allocation
Facilities
development and production
assembly and integration
testing
functional / performance
environmental
Implementation
Work Breakdown Structure
Schedule
Phase BCDE (including HydRON-DS IOC and IOD)
Space Segment assets
Ground Segment assets
User Segment assets
Phase E (main mission)
Review meeting plan
Deliverables
Documents items list
Hardware
Software
Financial
Industrial costs
overall
REC
NREC
per country (geographical distribution)
REC
NREC
per company
REC
NREC
per asset
Space Segment assets
REC
NREC
Ground Segment assets
REC
NREC
User Segment assets
REC
NREC
launcher
ESA price
co-funding
overall
per country
per company
per asset
National Delegation's support
Authorization of Funding notification for the Full Proposal
Contractual

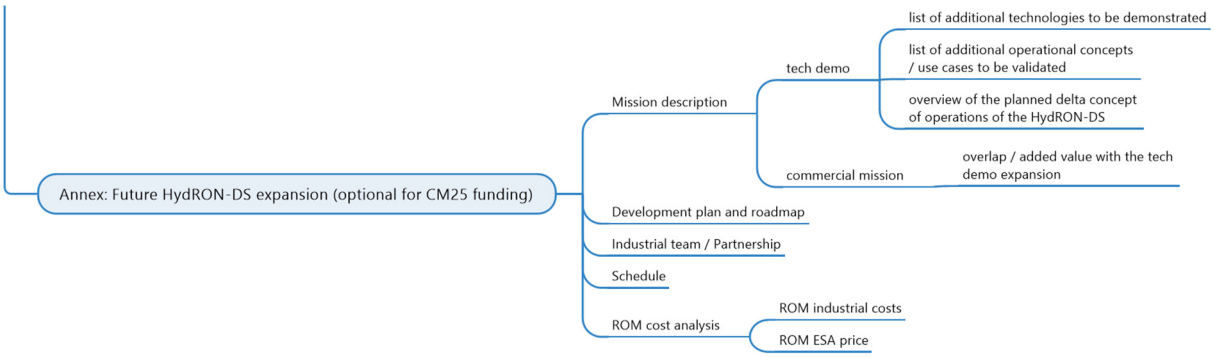


Figure 6. List of subjects to be addressed in the Outline Proposal (first preliminary iteration) and in the Full Proposal (detailed iteration).

9. ANNEX D – EVALUATION CRITERIA

The Outline Proposal will be evaluated using the following criteria:

1. Service Provider / Operator participation, key selling points and credibility of the business plan. Relevance to the HydRON-DS objectives and scope, including the added value of HydRON-DS assets to the commercial mission.
2. Quality and completeness of technical proposal, suitability of the proposed technical solution vs. HydRON-DS mission / technical objectives, evaluation of the technical risks and credibility of the risk mitigation actions.
3. Industrial consortium experience and competence, completeness of the team in all areas required.
4. Planning and costing, value for money, assessment of financial risk versus company resources, geographical distribution and co-funding capability.

The evaluation criteria for the Full Proposal will be provided in Step-3.