Connecting Land and Sea for Global Awareness

Federated Marine Spatial Data Infrastructure Pilot 2023

Open Geospatial Consortium

OGC Federated Marine Spatial Data Infrastructure Pilot 2023 - Connecting Land and Sea for Global Awareness

Call for Participation (CFP)

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Chapter 1. Introduction

The Open Geospatial Consortium (OGC) is releasing this Call for Participation (CFP) to solicit proposals for the OGC Federated Marine Spatial Data Infrastructure Pilot 2023 (FMSDI Pilot Phase 4). This CFP consists of technical overview, objectives, deliverable documents, components, capabilities, a master schedule, project management artifacts, Sponsor requirements, stakeholder role descriptions, proposal submission instructions and evaluation criteria, and an initiative architecture.

The responses to this CFP should include the proposing organization's technical solution, cost-sharing requests for funding, and proposed in-kind contributions to the initiative. Responses should also include plans for activities to involve stakeholder representatives in technical solution development and testing. Participants may apply for any of the three threads or cross thread activities as listed in Section 3.

Once the original CFP has been published, ongoing authoritative updates and answers to questions can be tracked by monitoring the CFP Corrigenda Table and the CFP Clarifications Table.

1.1. Overview

Globally, we are currently facing many rapidly changing environments such as climate, computing, space commercialization, economics, to name a few. One of the significantly important aspects of these environments is our changing oceans and coasts, and correspondingly the diverse data associated with them, such as the sharing and exchange of data between land and sea systems, changing ports and shipping lanes, coastal changes due to storms, sea level rise, and many more. To better understand, adapt, manage, mitigate, and prepare for all these coastal and marine changes, OGC is calling for participation in the Federated Marine Spatial Data Infrastructure (FMSDI) Pilot Project that spans science, economics, logistics, and geospatial solutions while promoting the principles of Finding, Accessing, Interoperating, and Reusing (FAIR).

The Singapore Land Authority (SLA) and the Maritime and Port Authority of Singapore (MPA), also supported by National Oceanic and Atmospheric Administration (NOAA) are interested in advancing spatial data integration to create future Digital Twins of Singapore's coastal and marine environments. One of the compelling challenges of this work is to overcome the disparity between marine and terrestrial data systems and formats to enable interoperable and integrable systems and services towards digital twin development that will enable the creation of what-if scenarios and scientific and societal questions. 30% of Singapore's land mass is less than 5m above sea level, hence the need for accurate, variational data that can address long and near-term decision making, experimental evaluation using digital twins and across diverse situations. This work will focus on storm surge, coastal flooding, and land areas including port infrastructure anywhere in Singapore. See Section 2.1 Digital Twin of Land and Sea Interfaces - Singapore for further details on this challenge.

Satellite imagery illustrates the dramatic loss of sea ice over the last several decades as air and water temperatures in the Arctic have warmed – one of many documented changes being tracked and reported annually. The loss of sea ice in the Arctic has led to accelerated ocean warming, stronger winds and currents, and accelerated shoreline erosion in Arctic communities (Moon et al. 2019). Ecosystems are adapted to the climate in certain areas, and climate change will therefore influence ecosystems. As an example, marine mammals and other marine species (e.g., Arctic seabirds) rely on the year-round or seasonal presence of sea ice. Other species (e.g., humpback, fin,

and gray whales) migrate to the Arctic from more temperate regions to feed during the summer months. These species follow the receding sea ice edge and take advantage of the region's immense summer biological productivity. This challenge is focused on the Arctic and development of geospatial data integration concepts that form the future of an integrated "Digital Arctic": an integrated ecosystem allowing access, sharing, and use of any geospatial information set relevant for decision making in the Arctic region. Efforts through this work will contribute to the fundamental understanding of efficient and powerful spatio-temporal data integration and processing platforms through such concepts as Digital Twins, land-sea data integration, and climate change scenarios, among others. Please see Section 2.2 Digital Arctic Connecting Land and Sea for more details on this challenge.

In addition, we are challenging our Participants to demonstrate new uses of navigation data to advance the "Blue Economy": the sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and ocean ecosystem health. What are the possibilities of fully exploiting land-marine geospatial information and how suitable is navigational data for use with other types of data? Shipping is rapidly adopting and advancing digital innovations, optimizing data solutions, and looking towards the next generation of navigation. What new uses and innovative capabilities could come from integration of all this navigation data and improved connectivity at sea? This challenge will concentrate on a Caribbean-based scenario but can certainly be coordinated with the other scenarios and challenges within this call. Refer to Section 2.3 Various Use Cases to Integrate Land & Sea in the Caribbean for more details.

Note: While this call for participation is separated into three distinct areas of interest we encourage cross-cutting solutions where applicable and desired. The deliverables from cross-cutting solutions would include a single Engineering Report (ER), video, and demo describing the work, not multiples of the deliverables for each study region.

1.2. Previous Initiatives

Since the areas of land and water are traditionally separated organizationally, the integration of data for the respective areas or their interface poses a particular challenge. On the one hand, this is due to different areas of responsibility and the resulting different data content and formats. On the other hand, the requirements for the factual characteristics of data and the location concepts on which they are based differ. As an example, while land-based objects are usually modeled using a local spatial reference system to define their height above ground, sea-based objects use both mean sea level and maximum tide height to define dispersion areas. These differences can play an important role in the modeling of floodplains and associated urban and land development.

This initiative is based on the result of the OGC FMSDI Pilot Phase 3 and Phase 1 & 2 which started in September 2021 until January 2023. These pilots again built on the works of prior OGC Collaborative Solutions and Innovation (COSI) Program initiatives, such as the Marine Spatial Data Infrastructure Concept Development Study, the Maritime Limits and Boundaries Pilot, and the Arctic Spatial Data Pilot.

1.3. Objectives

The goal of this Pilot is to advance the FMSDI concept to facilitate improved land-sea data systems, explore Digital Twin concepts related to coastal management, and imagine where interoperable land-sea, coastal, and navigational data can improve: climate change and impact understanding; disaster and storm mitigation and response; economic and land preservation; and might enhance

the "Blue Economy".

The overarching goal of the scenario development and exploration work is both to demonstrate interoperability with state-of-the-art concepts and technologies, and to develop design, setup, and maintenance guidelines for senior decision makers in particular. Demonstrations of information products will be made available persistently and individual components of the demonstration will be made accessible in the form of deployable software containers, as much as possible while respecting data and software licensing requirements.

It is widely recognized that standards play an essential role for data integration and processing. The Findable, Accessible, Interoperable, and Reusable (FAIR) principles are key to integrate data from multiple sources and owners into analytical environments. This pilot shall explore how we can combine geospatial data at standardized interfaces with tabular data and live spatial data feeds. These data feeds, e.g. ocean monitoring buoys, weather sensors, and land systems represent key dimensions of integrated land-sea systems and related Digital Twins. How can we protect our coastal cities and lands, preserve our coastal food sources and port systems, and track changes over time from the Arctic, to Singapore, to the Caribbean? Vast amounts of data in the marine environment have been produced with navigation as the primary goal. Is that data fit for other purposes, such as search & rescue, environment, economics? What are the new purposes and use cases we can build with the data we have available?

OGC is exploring standards-based software architectures for marine environments as well as the land-marine interface as part of the FMSDI Pilot series. Previous initiatives of the FMSDI series conducted in 2021 and 2022 explored the capabilities of International Hydrographic Organization (IHO) and OGC standards for marine data discovery, access, integration, and reuse. The corresponding use cases from the past Pilot series included marine protected areas and vessel routes in the Arctic, the Baltic Sea, and the North Sea.

Chapter 2. Technical Overview and Architecture

Bidders are invited to describe ideas for crosscutting scenarios or individual scenarios specific to a region within their proposals. The final scenario will be mutually agreed upon by Sponsors and Participants during the execution phase of the pilot.

The scenarios that are developed by each Participant individually can address any aspect of the changing landscapes. Potential activities may include:

- Demonstrating interoperability between land and marine data that is necessary to understand coastal environments and land-sea interactions.

- General sensitivity to climate change.

- Storm surge and disaster related impacts.

This initiative has three different threads that are designed separately; however, they are interconnected in the concept of an FMSDI model for land and sea. The connection can be seen in various fields such as architecture design, scenario definition, data analysis tools and component development. In this section, three different threads are described:

1) Digital Twin of Land and Sea Interfaces in Singapore;

2) Digital Arctic Connecting Land and Sea in Canada;

3) Integrating Land & Sea for Various Use Cases in Caribbean.

These three design elements are designed to meet the requirements of the Sponsors who are concerned about integrating land and sea for various use cases. The design of each thread influences the design of the others, and they must work together to create a functional, efficient, more sustainable and reusable FMSDI for connecting land and sea environments.
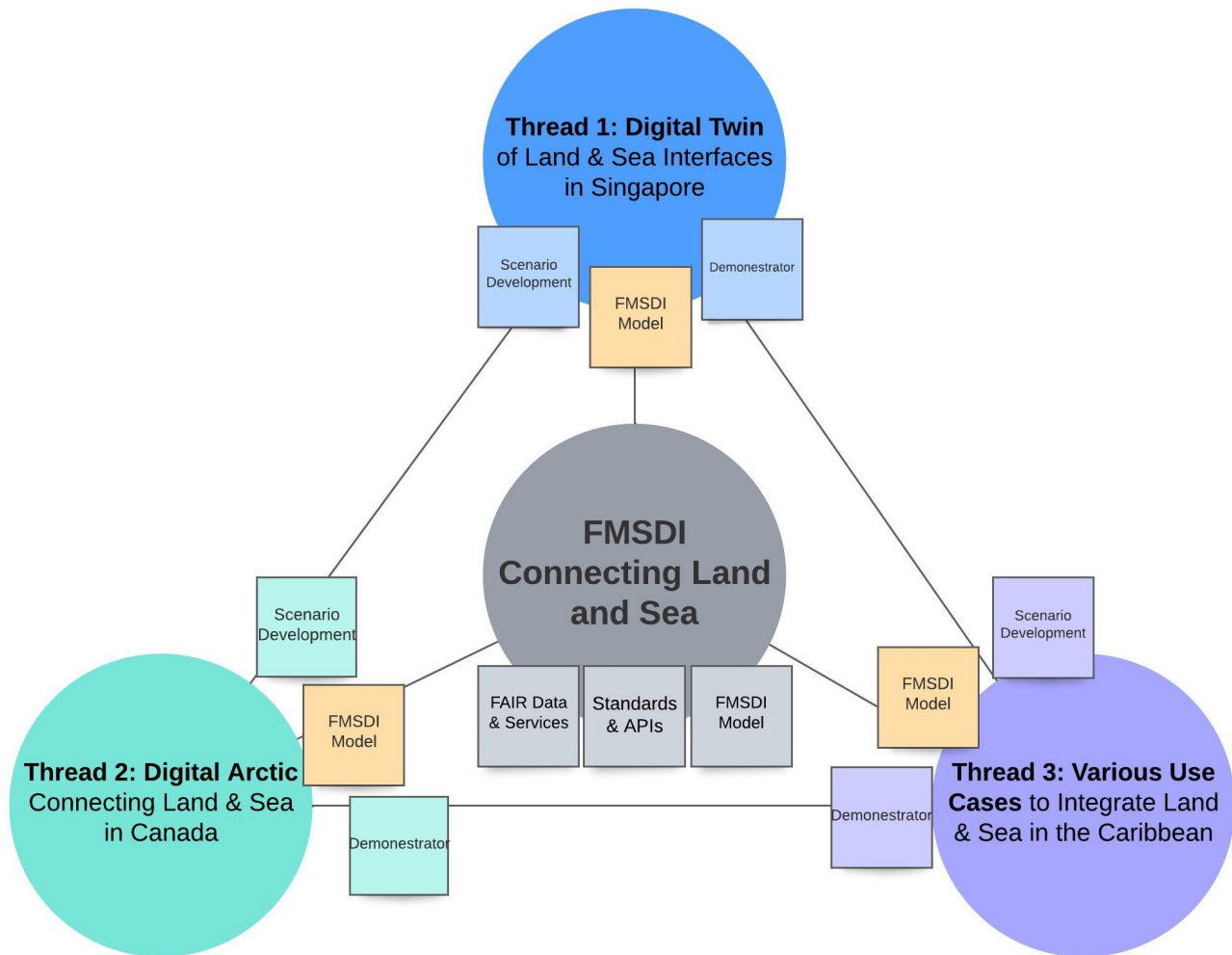
Figure 1. Left: Technical Architecture of the FMSDI Pilot (three threads and their cross relationships)

2.1. Digital Twin of Land and Sea Interfaces - Singapore

Digital Twin Challenge: Integration of Land and Marine data for Coastal Protection Planning, Critical Infrastructure Protection, and Resilience.

Geospatial data and interface standards are a foundational element of data integration and analysis.

These standards act as a catalyst toward achieving a Digital Twin of the land-sea interface. Since the areas of land and water are traditionally separated organizationally, the primary objective is to demonstrate how geospatial standards can better support interoperability of land and marine geospatial data. The work shall develop a proof-of-concept design that can be extended to an operational implementation by any jurisdiction. The proof-of-concept shall be structured such that it can be extended in future to cover more diverse scenarios with minimal modification.

This will be achieved through the investigation, development, and implementation of standards that can enable solutions for geospatial information discovery, access, management, sharing, predictive analytics, and use required to support decision making by diverse stakeholders. The project focuses on the use case of coastal vulnerability to storm surges. Both storm surge data and consequences on the harbor and land side will be evaluated. The main focus is on the integrability of data concerning the land as well as the seaside. It will be considered to what extent these data fit together in terms of content, modeling approaches, encoding details, spatial and temporal resolution, and accuracy. The results will serve as the basis for a variety of activities and analyses

that require integration of land and ocean geospatial information. The exact characteristics of the use case will be defined within the first month of this project.

This effort will specifically explore the development and use of modern geospatial standards frameworks, such as OGC API, and relevant IHO and ISO standards, to facilitate land and marine geospatial data integration. Work will evaluate if existing modern standards frameworks are sufficient to support Singapore's requirements related to land-marine geospatial data integration and, if found to be sufficient, demonstrate implementation within the context of the project use case. If current standards approaches are determined to not be sufficient, the project will outline recommended standards-development activities.

2.1.1. Scenario

As the impacts of climate change continue to increase in Singapore, a multi-dimensional Digital Singapore to address challenges around the discovery, access, integration and reuse of land and marine geospatial information is critical and must be resolved. This challenge will explore how geospatial standards can be leveraged to help and eliminate/reduce such challenges and identify potential opportunities for coastal communities, ecosystems, and economic activities in Singapore.

2.1.2. Detailed Requirements

This scenario shall address the following requirements:

Application Scenario and Use case - This scenario will explore a storm surge event incorporating the detailed requirements as well as the corresponding research questions listed in this section. The storm surge leads to flooding of coastal zones and land areas, including port infrastructure. Continued climate change may even lead to inundation, where rising sea levels lead to currently dry land areas to be permanently submerged. In order to achieve a visualization as close to reality as possible, 3D or even better 4-dimensional data (3D + time) should be integrated.

The scenario can be located at any location in Singapore and will follow recommendations by the Sponsor. The scenario may be extended or modified based on input from participating organizations.

Other requirements are described below:

- Challenge the OGC community to explore the practicalities related to the 3D/4D Digital Twin Concept. Practicalities may include aspects such as multi-vendor data discovery and integration of data over space and time, expressivity of metadata concepts for data and services, common patterns for API design and data modeling, stability of link-systems for linked resources and other aspects of daily multi-user shared data environments.

- Test implementations of both OGC APIs and IHO S.1xx standards interoperability with other S-100 product specifications and land data models, such as International Organization for Standardization (ISO) Land Administration Domain Model (LADM).

- Demonstration of software and standards capabilities using deployed service instances and client applications.

- Influence the standards development communities in IHO, OGC, and ISO to ensure fit for purpose curation/development of standards.

- Support the IHO-Singapore Innovation and Technology Laboratory and continued work by IHO, OGC, United Nations Committee of Experts on Global Geospatial Information Management (UN-

GGIM), and ISO.

- The demonstration scenario shall include aspects such as possible:
  - data acquisition gaps in nearshore areas.
  - data integration challenges due to horizontal and vertical object misalignments.
  - data integration challenges due to conflicting data models and characteristics.
- Gain immediate insight into the potential of existing modern geospatial standards frameworks for supporting diverse activities requiring land and marine geospatial data and sensor information.
- Identify potential improvements to, or the creation of, new geospatial standards to better enable land-marine geospatial data integration for activities within Singapore and internationally.
- Identify and demonstrate (where reasonable) strategies to improve Singapore's ability to support discovery, accessibility, sharing, and use of land and marine geospatial information.
- Understand how modern geospatial standards frameworks can improve Singapore's ability to collaborate with key partners domestically and internationally in support of land and marine activities.
- Include the ability to demonstrate the standards interoperability at the application level. **Note:** There can be access to some data sets, or simulated data if necessary, as required by the scenario.

2.1.3. Research Questions

The following research questions complement the requirement listed above and serve as guiding principles for the performance of the Pilot initiative. They serve as a basis for the definition of the scenario, although depending on the scenario characteristics and level of detail, it may not be possible to fully answer all research questions.

- What experiences have been made while working with data for coastal environmental areas and built environments?
- What data is needed to generate a complete scenario? Were all these data available and could be integrated successfully?
- How can live sensor feeds or sensor hardware be integrated into the scenario?
- How can Artificial Intelligence (AI) and Machine Learning (ML) be used for data integration and data analytics? What role can AI/ML play in these types of multi-source scenario evaluation projects?
- Which areas have been identified as particularly vulnerable to storm surges and rising sea levels? Where are most people affected?
- What is the best way to visualize the land and sea components? How can the temporal component be considered?
- How easy is it to connect to existing platforms (e.g., OneMap, GeoSpace-Sea)?
- How to connect to BIM/CityGML and existing urban digital twins? Are there any data and/or interoperability gaps?

- Which OGC APIs standards (e.g., Features, Maps), IHO standards (e.g., S-122, S-412) and ISO standards (LADM Part 3: Marine Georegulation) should be included?

- How does this work help refine the concept of a digital twin for Land and Sea in the context of Singapore and internationally?

2.1.4. Deliverables

Appendix A includes the list of all deliverables and more details on each one of them. For more information on the "Pilot organization", please refer to Section 4; and, for more details on "Results and Outcomes", please see Section 4.6.

Table 1. List of Deliverables for the Singapore Thread

ID	Component Name	Description
D001	**Pilot Summary ER**	The Engineering Report (ER) will capture all results and experiences from this project. It shall respond to all requirements listed above. The ER shall contain a plain language executive summary to clearly outline the motivations, goals, and critical outcomes of this initiative and briefly describe the requirement, planning, and execution of the Pilot. The ER will be published by OGC at the end of the project.
D100	**Persistent Demonstration - Singapore**	Demonstration of the Pilot scenario as implemented by Participant. The demonstration will be delivered in the form of a live demonstration with corresponding screen captured video with voice-over. Services and web-based clients implemented during the project will be made available to the Sponsor, including persistent demonstration capabilities. A final, self-produced summary video based on the screen capture material delivered by the Participants and including a summary of the work accomplished is required by the OGC Singapore Member Meeting the week of September 25th, 2023. For more information on this see Section 4.6.5.

2.2. Digital Arctic Connecting Land and Sea - Canada

Satellite imagery illustrates the dramatic loss of sea ice over the last several decades as air and water temperatures in the Arctic have warmed. The loss of sea ice in the Arctic has led to accelerated ocean warming, stronger winds and currents, and accelerated shoreline erosion in Arctic communities (Moon et al. 2019). Ecosystems are adapted to the climate in certain areas, and climate change will therefore influence ecosystems. As an example, marine mammals and other marine species (e.g., Arctic seabirds) rely on the year-round or seasonal presence of sea ice. Other species (e.g., humpback, fin, and gray whales) migrate to the Arctic from more temperate regions to feed during the summer months. These species follow the receding sea ice edge and take advantage

of the region's immense summer biological productivity.

As the impacts of climate change continue to increase, a multi-dimensional Digital Arctic to address challenges around the integration and use of land and marine geospatial information is critical. This project will explore how geospatial standards can be leveraged to help and eliminate/reduce such challenges and identify potential opportunities for coastal communities, ecosystems, and economic activities in the Arctic environment.

The primary objective is to demonstrate how geospatial standards can better support the interoperability of land and marine geospatial data for a Digital Arctic. The work shall develop a proof-of-concept design that can be extended to an operational implementation by any jurisdiction. The proof-of-concept shall be structured such that it can be extended in future to cover more diverse scenarios with minimal modification.

This will be achieved through the investigation, development, and implementation of standards that can enable solutions for geospatial information discovery, access, management, sharing, predictive analytics, and use required to support decision-making by diverse stakeholders. To limit the scope of this effort the project will focus on a coastal sensitivity to climate change use case in the Arctic; however, outcomes will inform approaches for a variety of activities requiring integration of land and marine geospatial information.

In particular, the development and use of modern geospatial standards, such as OGC API standards, will be explored to facilitate the integration of land and marine geospatial data within the Digital Arctic. Work will evaluate if existing modern standards frameworks are sufficient to support Canada's requirements related to Digital Arctic geospatial data integration and, if found to be sufficient, demonstrate implementation within the context of the project use case. If current standards approaches are determined to not be sufficient, the project will outline recommended standards-development activities.

2.2.1. Scenario

Climate change has severe consequences on the Arctic environment such as increased sea levels, accelerated warming through shorter sea and land ice periods, thawing permafrost, etc. The overarching goal of the scenario development and exploration work is both to demonstrate interoperability with state-of-the-art concepts and technologies, and to develop design, setup, and maintenance guidelines for a Digital Arctic.

Participants are invited to develop demonstration scenarios that show how data can be discovered, accessed, used, and reused, shared, processed, analyzed, and visualized. Each Participant should propose a scenario based on the corresponding research questions and requirements listed below in a climate change scenario in the Arctic with emphasis on coastal sensitivity.

Under the leadership of the OGC, the scenario will be developed in close collaboration between the Participants and the Sponsor (Natural Resources Canada). The Sponsor is invited to include additional stakeholders (e.g., from other groups within Natural Resources Canada or other public administration units) to participate in the scenario definition process. The scenario may be extended or modified based on input from Participants.

The scenario will drive the proof-of-concept of modern geospatial standards implementation whose framework can be operationally used by the Sponsor and Arctic stakeholders to enable streamlined geospatial information discovery, access, availability and cataloging for land and marine geospatial information. To support this requirement, the scenario may be broken into multiple sub-scenarios, all serving and contributing to the primary objective of a comprehensive proof-of-concept study.

- **Area of Interest:** The area of the interest for this thread is any location in the Canadian Arctic

and/or Circumpolar Arctic. All scenarios shall be located in the Arctic.

- **Data Sources and Services:** The scenario will include aspects such as the discovery and integration of land and marine geospatial information from multiple sources, explore integration challenges with existing services with a particular focus on the current paradigm change from all-purpose Web services to modern, customer-focused Web APIs, and may explore new integration concepts such as Discrete Global Grid Systems (DGGS).
  With respect to data, the scenario will include data from a wide range of suppliers, such as:

  - Sentinel, Landsat, WorldView, RADARSAT, etc.

  - Weather and climate data - e.g., Environment and Climate Change Canada's Canadian Ice Service and GeoMet Weather Service

  - Argo oceanographic data

  - Arctic Spatial Data Infrastructure (Arctic SDI) data and services

  - Arctic Data Committee services

  - Canada Centre for Mapping and Earth Observation (CCMEO) sensor data

  - European Space Agency Polar Thematic Exploitation Platform (PolarTEP)

Details about data will be agreed upon between Sponsor, Participants, and OGC. In any case, several satellite data, in-situ sensors, and analytical sources will be part of the scenario. Automated and manual data discovery will enable the integration of data. The applied processes will take multi-lingual interfaces and metadata into account and cover a wide spectrum of statistical to spatiotemporal analysis services. To further advance dynamic discovery processes and semantic interoperability, the scenario will include linked-data concepts and principles. The goal is to better understand and demonstrate how linked data mechanisms can help design and operate services that foster the consumption of related data from corresponding environments, such as marine, climate, weather, and land data.

Though the state-of-the-art paradigm to serve data is in the form of Web APIs, the scenario needs to support various sources and interfaces. As such, it will align Web APIs with Government of Canada Standards on APIs, existing sources such as Arctic SDI and other platforms, and explore the usability of directly accessible cloud-native resources.

Participants shall support loading data to the service instance to make it available in a format supported by the OGC client instances. Alternatively, the server instances may proxy existing, non-standard compliant data services to provide a standards-based API.

- **Data Client:** The scenario will be demonstrated with client applications that demonstrate the integration concepts and applied analytics. These clients will be compliant with the Web Content Accessibility Guidelines (WCAG) version 2.1. Ideally, demonstration clients support a variety of platforms, such as in-browser clients, desktop applications, or mobile applications. The clients serve as integration points for all elements that are part of the scenario.

- **Persistent Demonstrator:** The demonstration itself will be made available persistently in the form of demonstration material. Individual components of the demonstration will be made available in the form of deployable software containers as much as possible, though are subject to further discussions between the OGC and the Sponsor to respect data and software licensing aspects that are outside of OGC's control.

- **Scenario Requirements:** Each scenario shall demonstrate what is currently possible and what

gaps are experienced with the resources that can be discovered on the Internet. In the context of the scenario developments, the following questions shall be answered by each Participant:

1. What data do I need for my scenario (ideally)?

2. Can I find all the data I need?

3. Was sufficient metadata provided that helped during the discovery phase (include metadata for the services as well as for the data as such)?

4. From what I found, can I access the data directly or are there any obstacles to data access?

5. Can I access the subset of data that I am interested in?

6. Can data or analytical services be streamed via a known standard or specification?

7. Is it possible to process the data online, or do I need to download and process locally?

8. What standards are used for data discovery, access, and processing interfaces?

9. What data formats are offered?

10. How complete is the data, e.g. with regard to spatial or temporal extent?

11. How difficult is it to integrate the data into an analysis and visualization environment?

12. What is my overall experience developing the scenario?

13. How would this be packaged for a senior executive?

14. How may communities with very low bandwidth participate?

During the course of the pilot, all Participants will work together to integrate their individual scenarios. All experiences made during the development and implementation phase of the scenario(s) will be captured in a single ER. All Participants will contribute their text material that includes sub-scenario documentation as well as experiences made and lessons learned during all phases of scenario development.

2.2.2. Detailed Requirements

This Pilot initiative shall address the following requirements for the **Digital Arctic concept:**

- Challenging the OGC community to explore the practicalities related to the Digital Arctic concept.

- Testing implementations of both OGC APIs and IHO S.1xx standards for a climate change scenario located in the Arctic.

- Demonstration of software and standards capabilities using deployed service instances and client applications.

- Influencing the standards development communities in IHO, OGC, and ISO to ensure fit for purpose curation/development of standards.

- Supporting continued overall work by IHO, OGC, UN-GGIM, and ISO.

- The demonstration scenario shall include aspects such as:

  ◦ data acquisition gaps in the land-sea interface or transition areas.

  ◦ data integration challenges due to horizontal and vertical object misalignments.

- data integration challenges due to conflicting data models and characteristics.

- Gain immediate insight into the potential of existing modern geospatial standards frameworks for supporting diverse activities requiring land and marine geospatial data and sensor information.

- Identify potential improvements to or the creation of new geospatial standards to better enable land-marine geospatial data integration for activities within Canada and internationally.

- Identify and demonstrate (where reasonable) strategies to improve Canada's ability to support discovery, accessibility, sharing, and use of land and marine geospatial information.

- Demonstrate how the developed proof-of-concept can be implemented in different operational environments (e.g., CCMEO, Arctic SDI), including temporal and analytical functionalities.

- Understand how modern geospatial standards frameworks can improve Canada's ability to collaborate with key partners domestically and internationally in support of land and marine activities.

- Demonstrate the standards interoperability at the application level.

- Explore how to sustain catalog(s) after the completion of the project.

- Demonstrate the effects of climate change and a changing Arctic environment on inundation, coastal flooding, infrastructure (ice roads), wildlife migration corridors through time: land-sea ice-island (e.g., caribou) and oceans (e.g., marine mammals), food security, and ocean conditions (currents and salinity levels).

- Mapping of coastal sensitivity to climate change and the impacts on local communities.

- Investigating the role of vector tiles and style sheets across the land-marine interface.

- Explore the role and value of heterogeneous data fusion using the emerging OGC Discrete Global Grid System API

- Evaluate various Arctic Discrete Global Grid Systems for 3D data aggregation and integration

2.2.3. Research Questions

The following research questions complement the requirement listed above and serve as guiding principles for the execution of the Pilot initiative. They serve as a basis for the definition of the Digital Arctic scenario, although depending on the scenario characteristics and level of detail, it may not be possible to fully answer all research questions comprehensively.

- What experiences have been made while working with data for sea, coastal, and land environments?

- What data is needed to generate a complete scenario in the context of climate change and its impact on the Arctic? Were all these data readily available and could be integrated successfully? If not, which data sets were missing?

- How much effort is it to serve additional data that is currently not directly accessible at a standards-based Web interface but may exist in some other form (e.g., download service at a Web portal, files accessible via FTP (File Transfer Protocol), cloud native data?

- How can live sensor feeds or sensor hardware be integrated into the scenario?

- What is the best way to visualize the land and sea components? How can the temporal

component be considered?

- How easy is it to connect to existing platforms (e.g., Arctic SDI, others)?

- What additional effort is it to support multiple languages in the scenario?

- How to connect to other emerging digital twins, for example, those for the oceans? Are there any data and /or interoperability gaps with these digital twins or other existing platforms?

- Which OGC API standards, IHO standards, and ISO Standards should be included?

- How does this work help refine the concept of a Digital Arctic in the context of Canada and internationally?

2.2.4. Deliverables

Appendix A includes the list of all deliverables and more details on each one of them. For more information on the "Pilot organization", please refer to Section 4; and, for more details on "Results and Outcomes", please see Section 4.6.

Table 2. List of Deliverables for for the Canadian Digital Arctic Thread

ID	Component Name	Description
D001	**Pilot Summary ER**	The ER may include one or more volumes of a project report describing the requirement, planning, execution, and outcomes of the Pilot to be published by OGC at the end of the project.
D101	**Methodology for discovery and integration of land and marine geospatial information for Arctic**	Develop a standards-based methodology to enable the discovery and integration of land and marine geospatial information within the Arctic context of the project. For more description of this deliverable please refer to Appendix A, D101.
D102	**Persistent Demonstration on Digital Arctic**	This component will demonstrate the Digital Arctic concept of the FMSDI Pilot, scenario as implemented by Participant. The outputs of this deliverable are a summary video with voice-over, a persistent demonstrator, and contributions to the ER. For more description of this deliverable please refer to Section 4.6.5.

2.3. Integrating Land & Sea for Various Use Cases - Caribbean

To effectively oversee and manage the marine areas (e.g., lakes, rivers, deltas, seas, and oceans) as well as their resources, a federated marine SDI is needed to integrate marine geospatial information into broader digital information systems. This integration is vital for creating evidence-based policies and making informed decisions in various use cases. An integrated and well managed marine SDI will meet the requirements of governance, planning, managing and

coordinating resources, transportation, coastal resilience, recreation, and other aspects of the blue economy.

Shipping is making great strides towards a future characterized by digital innovations, improved connectivity at sea, and optimized data solutions. These not only herald the next generation of navigation, but also enable multiple uses of data beyond their original reason for collection through new data integration capabilities. Together with other national hydrographic offices and the IHO, the UKHO works to set and raise global standards of hydrography, cartography and navigation. Current use cases for integrating marine data in the Caribbean include supplying defense and the commercial shipping industry, ensuring Safety of Life at Sea (SOLAS), protecting the marine environment and supporting the efficiency of global trade using digital charts (e.g., UKHO's portfolio of ADMIRALTY Standard Nautical Charts (SNCs) and Thematic Charts).

With this in mind, this pilot looks at the use and integration of digital data in various application scenarios that focus on unlocking the value of non-navigational data and information. The pilot aims at integrating marine SDI into the global geospatial information infrastructure ecosystem to find out what pitfalls exist in the use of marine and marine-related data, what integration problems are evident, how they can be solved, and what possible pathways exist to enable a data-driven Blue Economy.

This will be achieved through the investigation, development, and implementation of standards that can enable solutions for geospatial information discovery, access, management, sharing, predictive analytics, and use required to support decision making by diverse stakeholders in the Caribbean. The main focus of the pilot is on the integrability of data. It will be considered to what extent these data fit together in terms of content, modeling approaches, encoding details, spatial and temporal resolution, and accuracy. This effort will specifically explore the development and use of modern geospatial standards frameworks, such as OGC API standards to facilitate oceanographic geospatial data integration. Work will evaluate if existing modern standards frameworks are sufficient to support all requirements related to geospatial data integration and use. If current standards approaches are determined to not be sufficient, the project will outline recommended standards-development activities.

Preferred islands of interest are:

- Anguilla, British Virgin Islands (BVI), Cayman Islands, and Turks and Caicos Islands;

Any of these islands are acceptable as well:

- Antigua & Barbuda, Bahamas, Barbados, Bermuda, Dominica, Grenada, Jamaica, Montserrat, Saint Lucia, St Kitts & Nevis, St Vincent & The Grenadines, Trinidad and Tobago;

2.3.1. Scenario

The scenario shall be located in the Caribbean using one, or a subset of the islands listed. The exact area of interest will be mutually agreed upon during the initial pilot development phase. The scenario will include identification of the area of interest in the Caribbean and definition of an application scenario (e.g., a hurricane) to provide the necessary umbrella for data integration assessments and experiments. Building on a scenario localized in the Caribbean, it is important to focus on one or more small island states with limited socioeconomic and technical capabilities.

Various use cases can be considered to address issues, challenges, and opportunities in the oceans and seas, coastal zones, deltas, tributaries, and internal waters and water bodies:

- Nautical Charting and Transportation
- The Blue Economy tourism;
- Marine Resource Management and spatial planning;
- Emergency/disaster management and response;
- Integrated Marine Cadastral Systems;
- Energy and Environmental Protection;
- Coastal Resilience;
- Climate Change;
- Maritime limits, regulation and administration;
- Scientific Research, etc.

2.3.2. Detailed Requirements

This Pilot initiative shall address the following requirements:

- Testing the Integrated Geospatial Information Framework Marine (IGIF-M) Marine SDI Maturity Assessment and optionally the Operational Framework for Integrated Marine Geospatial Management (IGIF-H) in the context of the Pilot scenario;
- Analysis of existing IHO S-100 series data and other data for the area of interest;
- Analysis of existing data access options and extension of these to OGC APIs within the demonstration scenario;
- Analysis of the existing data regarding their data models, attribute definitions, and quality aspects;
- Analysis of integration effort for other data with existing S-100 series data, in particular digital geospatial products designed to enhance situational awareness in the marine environment;
- Analysis of the value of S-100 series data beyond navigation purposes;
- Demonstration of the role of standards and the capabilities of standards-based web services within a scenario;
- Testing implementations of both OGC APIs and IHO S.1xx standards via demonstrating results;
- Influencing the standards development communities in IHO, OGC and ISO to ensure fit for purpose curation/development of standards;
- Supporting continued overall work by IHO, OGC, and UN-GGIM;
- Assessment of relevant existing and under development ISO standards (e.g., ISO 19152:2012: LADM, Integrated Marine Transport, etc.).

2.3.3. Research Questions

The following research questions complement the requirement listed above and serve as guiding principles for the execution of the Pilot initiative. Building on a scenario localized in the Caribbean, this pilot will specifically discuss and, where possible, illustrate through practical demonstrations the following issues:

- What are the possibilities for fully exploiting the value of data produced for navigation purposes?

- How suitable is navigation data in scenarios that go beyond actual navigation? How do the IHO S-100 standards perform in these scenarios?

- Are the S-100 standards sufficiently future-proof, or do necessary extensions or modifications become apparent in the context of complex scenarios?

- What opportunities do digital, standards-based data open up with regard to the development of new markets and use cases?

- What model for future federations can we envision?

- What efforts are recommended to further enhance the user experiences for the various elements in the scenario? The Pilot will develop a proof-of-concept that accomplishes two tasks: On the one hand, satisfy all the requirements and answers to the above questions. Second, components are to be created that can be used beyond the pilot and ideally support sustainable use of ocean resources for economic growth while preserving the health of ocean ecosystems (Blue Economy).

2.3.4. Deliverables

Appendix A includes the list of all deliverables and more details on each one of them. For more information on the "Pilot organization", please refer to Section 4; and, for more details on "Results and Outcomes", please see Section 4.6.

Table 3. List of Deliverables for the Caribbean Thread

ID	Component Name	Description
D001	**Pilot Engineering Report (Thread 3: Integrating Land & Sea in the Caribbean for Various Use Cases)**	The ER may include one or more volumes of a project report describing the requirement, planning, execution, and outcomes of the Pilot to be published by OGC at the end of the project. This ER captures the outcomes of the Pilot's three threads and an RFI report on the Caribbean area.
D103	**Persistent Demonstration - Caribbean**	Demonstration of the Pilot scenario as implemented by Participant. The demonstration will be delivered in the form of a live demonstration with corresponding screen captured video with voice-over. Services and web-based clients implemented during the project will be made available to the Sponsor and include persistent demonstrator capabilities. For more description of this deliverable please refer to section 4.6.5.

Chapter 3. Master Schedule

The following table details the major Initiative milestones and events.

Table 4. Master Schedule

Milestone	Date	Event
M01	Mar 3, 2023	Release of Call for Participation
M02	March 23 at 00:00 UTC and again on March 24 at 14:00 UTC	Bidders Q&A Webinar to be held 10:00-11:00 EST (Registration Link)
M03	**April 14, 2023**	**Close of Call for Participation and Responses Due (Proposal Submission Website)**
M04	April 21, 2023	Proposal Evaluation and all Participation Agreements Signed.
M05	Apr 24, 2023	Kick-off Workshop (virtual)
M06	May 1- Aug 30 , 2023	**Implementation Period:** Technology Integration Experiment (TIE) Testing, Draft ER and Initial Demonstration
M07	May 7, 2023	Initial ER Due
M08	May 30 - June 2, 2023	**Intermediate Virtual Workshop** (Initial ER and Demonstration) to develop a shared implementation plan (Outreach activity: Presenting Draft ER in the OGC Member Meeting June 5-9, Huntsville, AL
M09	Sep 15, 2023	Final Demo Videos Due
M10	Sep 29, 2023	Final Engineering Report Due
M11	Sep 25-29, 2023	Outreach activity: Presenting Final ER and Demos in the OGC Member Meeting (Singapore Sep 25)
M12	Oct 2023	**Final In-person Workshop in Canada** (Demonstration of ER and Demo Videos) to ensure sustainability of project results.

Chapter 4. Pilot Organization and Execution

All bidders are invited to suggest scenario elements or modifications to this overall scenario. At the kick-off meeting, Participants together with sponsoring organizations and OGC staff will further refine the high level scenario.

During the pilot execution phase, each Participant will evaluate the applicable research questions stated above. These aid in a thorough execution of all phases of data discovery, access, integration, analysis, and visualization. Participants are invited to collaborate as much as possible and support each other with data, processing capacities, and visualization tools. The overarching goal is to learn more about current capabilities and shortcomings of marine data services offered by all Marine Spatial Data Infrastructures, Web portals, and directly accessible cloud native data.

4.1. Initiative Policies and Procedures

This initiative will be conducted under the following OGC Policies and Procedures.

- This Initiative will be conducted in accordance with OGC Innovation Program Policies and Procedures.

- OGC Principles of Conduct will govern all personal and public Initiative interactions.

- Participants drafting documents for the Initiative are required to allow OGC to copyright and publish documents following the OGC Intellectual Property Rights Policy.

4.2. Initiative Roles

The roles generally played in any OGC Innovation initiative include Sponsors, Bidders, Participants, Observers, Stakeholders, and the Innovation Team ("COSI Team"). Explanations of the roles are provided in Tips for New Bidders.

The COSI Team for this Initiative will include an Initiative Director and an Initiative Architect. Unless otherwise stated, the Initiative Director will serve as the primary point of contact (POC) for the OGC.

The Initiative Architect will work with Participants and Sponsors to ensure that Initiative activities and deliverables are properly assigned and performed. The Initiative Architect is responsible for scope and schedule control and will provide timely escalation to the Initiative Director regarding any severe issues or risks that happen to arise.

4.3. Kick-off

The Kickoff is a meeting (using GoToMeeting) where Participants, guided by the Initiative Architect, will refine the Initiative architecture and settle upon specific use cases and interface models to be used as a baseline for prototype component interoperability. Participants will be required to attend the Kickoff, including breakout sessions, and will be expected to use these breakouts to collaborate with other Participants and confirm Component API agreements in order to facilitate potential data sharing and component interchange.

4.4. Regular Teleconference and Interim Meetings

After the Kickoff, Participants will meet on a frequent basis (weekly) remotely via web meetings and teleconferences.

4.5. Workshop events and Outreach

In the course of Pilot execution, two workshops will be held to foster interchange and collaboration with stakeholders, including Sponsors, supporters, Participants, responsible government agency representatives, and inter- / non-governmental relief organizations. Participants will be required to participate in workshops, in person is compulsory for at least the first workshop.

Each Participant will work with OGC Marketing and Promotions (MAP) and Innovation staff to provide reasonable support for outreach and communication activities such as stakeholder engagements, workshops, webinars, blogs, and social media posts to provide public visibility for Pilot activities and accomplishments.

4.6. Results and Outcomes

All activities in this Pilot will result in a Deliverable. These Deliverables can take the form of documents, implementations, demonstrations, and videos, as well as other collaboration and outreach activities.

Each Participant is free to choose the type of software used for data integration, analysis, and visualization. It's possible to offer a software solution, but delivering a software product will not be necessary. Instead, delivery is provided in the form of live demonstrations of the scenario during video conferences that will be recorded and used for future outreach activities. In total, this pilot is expected to fund a total of ten organizations. Each Participant shall demonstrate a sub-scenario and contribute a dedicated component to the overarching scenario.

Each deliverable shall include the definition and implementation of the scenario; the role it plays as part of the overarching scenario, and the documentation of all results, experiences made, and lessons learned as stated above. The documentation is delivered as a contribution to the initiative results ER.

Demonstration of the Pilot scenario will be delivered in the form of a live demonstration with corresponding screen captured summary video with voice-over, and explanation of value of outcomes. Services and web-based clients implemented during the project will be made available to the Sponsors. For persistent demonstrators, project demonstration components will be maintained on an ongoing basis for one year by the Participant to showcase the concept of Digital Twins and the capability of an integrated - interoperable operational system. This will allow project stakeholders to interact with technical project outcomes over the long-term.

All results will be discussed with OGC working groups to ensure close alignment and continuous information of OGC Domain Working Groups. Standards-related aspects will be introduced to OGC Standard Working Groups for further consideration.

Please Refer to Appendix A for a full deliverables table covering all three topic areas.

4.6.1. Scenario Development

The following list provides a first overview of topics that will be part of the scenario description and evaluation report:

- Experiences and lessons learned with respect to the data research questions stated above.

- What role do standards play?

- Which standards have been used? What is missing?

- How will the integration/federation work?

- What model for future federations can we envision?

- What efforts are recommended to further enhance the user experiences for the various elements in the scenario?

- How might this scenario work within a Digital Twin concept (if applicable)

- How will 3D/4D visualization capabilities be applied (if applicable)

Development of ERs, Change Requests (CRs), videos, and other documentary deliverables will commence during or immediately after Kickoff.

Under the Participation Agreement (PA) contracts to be executed with selected Bidders, ALL Participants will be responsible for contributing content to project documents and videos, but the document Editors will assume the duty of being the primary document authors and coordinators.

4.6.2. ER and CR

ERs, Guides, and CRs will be prepared in accordance with OGC published templates. ERs are to be delivered by posting on the (members-only) OGC Pending directory when complete and the document has achieved a satisfactory level of consensus among interested Participants, contributors, and editors. ERs are the formal mechanism used to deliver results of the Innovation Program to Sponsors and to the OGC Standards Program for consideration by way of Standards Working Groups and Domain Working Groups.

4.6.3. Final Summary Reports, Demonstration Events, and Other Stakeholder Meetings

Participant Final Summary Reports will constitute the close of the funded activity. Further development work might take place to prepare and refine assets to be shown at the Demonstration Event and other stakeholder meetings.

4.6.4. Implementations

Services, Clients, Datasets, Schemas, API documentation, and Tools will be provided by methods suitable to each type and stated requirements. For example, services and components (e.g., an EDR API instance) are delivered by deployment of the service or component for use in the Initiative via an accessible Uniform Resource Locator (URL). A Client software application or component may be used during the Initiative to exercise services and components to test and demonstrate interoperability; however, the client software is most often not delivered licensed for follow-on usage. Implementations of services, clients, and data instances will be developed and deployed in all activities for integration and interoperability testing to support the agreed-up activity scenario(s) and technical architecture. The services, clients, and tools may be invoked for cross-activity scenarios in demonstration events.

4.6.5. Persistent Demonstrators

Workflows and applications will be made available in the form of persistent and/or easily deployable demonstrators accessible to stakeholder users for outreach, testing, and experimentation purposes. Workflow components (data access, processing, user application, etc.) provided by Participants are required to be made available for deployment in containerized form to a common cloud computing environment for persistent demonstration and interchange experiment purposes for at least 12 months from the completion of the pilot project. This requirement is waived for already deployed common data sources and services such as Copernicus which are considered openly available for use in any workflow.

4.6.6. Assurance of Demonstrator Availability

Participants selected to implement workflows are expected to maintain the deployability of supporting components and datasets for a period of no less than six months after the Participant Final Summary Reports milestone.

4.6.7. Videos

Each Participant shall develop and deliver or participate in the production of a short video that can be used in outreach activities on a royalty-free basis. The videos will be free and clear to be placed on the OGC YouTube Channel and Project page with no restrictions. The video shall identify the requirement(s) for the development (why the work was done), illustrate the initial challenge(s) and demonstrate the developed solutions. The video can be done using screen-capturing of clients or slides with (English) voice-over. Participants shall cooperate with OGC in the translation of videos to additional languages (e.g. French, Spanish) as needed, as well as incorporation in Sponsor-produced summary videos. Good examples of videos are available from previous initiatives, such as Arctic Spatial Data Pilot (video 1, video 2), Vector Tiles Pilot (video), or Testbed-13 (video 1, video 2).

4.7. Business Reporting

Initiative Participant business/contract representatives are required (per the terms in the Participation Agreement contract) to report the progress and status of the Participant's work. Detailed requirements for this reporting will be provided during contract negotiation. Initiative accounting requirements (e.g., invoicing) will also be described in the contract.

The COSI Team will provide progress reports to Sponsors. Ad hoc notifications may also occasionally be provided for urgent matters. To support this reporting, each Pilot Participant must submit (1) a Technical Progress Report and (2) a Business Progress Report. Both reports shall be delivered every second month by the first working day on or after the 4th of that month. Templates for both of these report types will be provided and must be followed.

The purpose of the Business Progress Report is to provide initiative management with a quick indicator of project health from the perspective of each Pilot Participant. The COSI Team will review action item status on a weekly basis with the Initiative Participants assigned to complete those actions. Initiative Participants must be available for these contacts to be made.

Chapter 5. Proposal Evaluation and Submission

Proposals are expected to be short and precisely address the work items a bidder is interested in. The proposal evaluation process and criteria are described below and proposal submission guideline in the next section.

5.1. Evaluation Process & Criteria

Proposals will be evaluated according to criteria based on three areas: management, technical, and cost. Each review will commence by analyzing the proposed deliverables in the context of the Sponsor priorities, examining viability in light of the requirements and assessing feasibility against the use cases.

The review team will then create a draft Initiative System Architecture from tentatively selected proposals. This architecture will include the proposed components and relate them to available hardware, software, and data. Any candidate interface and protocol specification received from a Bidder will be included.

At the Technical Evaluation Meeting (TEM), the COSI Team will present Sponsors with draft versions of the initiative system architecture and program management approach. The team will also present draft recommendations regarding which parts of which proposals should be offered cost-sharing funding (and at what level). Sponsors will decide whether and how the draft recommendations in all these areas should be modified.

Immediately following TEM, the COSI Team will begin to notify Bidders of their selection to enter negotiations for potentially becoming initiative Participants. The COSI Team will develop for each selected bidder a Participant Agreement (PA) and a Statement of Work (SOW).

5.1.1. Management Criteria

- Adequate, concise descriptions of all proposed activities, including how each activity contributes to the achievement of particular requirements and deliverables. To the extent possible, it is recommended that Bidders utilize the language from the CFP itself to help trace these descriptions back to requirements and deliverables.

- Willingness to share information and work in a collaborative environment.

- Contribution toward Sponsor goals of enhancing the availability of standards-based offerings in the marketplace.

5.1.2. Technical Criteria

- How well applicable requirements in this CFP are addressed by the proposed solution.

- Proposed solutions can be executed within available resources.

- Proposed solutions support and promote the initiative system architecture and demonstration concept.

- Where applicable, proposed solutions are OGC-compliant.

5.1.3. Cost Criteria

- Cost-share compensation request is reasonable for the proposed effort. All Participants are required to provide at least some level of in-kind contribution (i.e., activities or deliverables offered that do not request cost-share compensation). As a rough guideline, a proposal should include at least one dollar of in-kind contribution for every dollar of cost-sharing compensation requested. All else being equal, higher levels of in-kind contributions will be considered more favorably during evaluation. Participation may be fully in-kind.

5.2. Proposal Submission Guidelines

This section presents general guidelines for submitting a CFP proposal. Detailed instructions for submitting a response proposal using the *Bid Submission Form* web page can be found in the Step-by-Step Instructions below.

IMPORTANT	Please note that the content of the "Proposed Contribution" text box in the Bid Submission Form will be accessible to all Stakeholders and should contain **no confidential information** such as labor rates.
	Similarly, no sensitive information should be included in the Attached Document of Explanation.

Proposals must be submitted before the deadline indicated in the Master Schedule, **14 April 2023**.

Bidders responding to this CFP must be organizational OGC members familiar with the OGC mission, organization, and process.

Proposals from non-members or individual members will be considered *provided that* a completed application for organizational membership (or a letter of intent) is submitted prior to or with the proposal.

TIP	Non-members or individual members should make a note regarding their intent to join OGC on the ***Organizational Background*** page of the *Bid Submission Form* and include their actual ***Letter of Intent*** as part of an Attached Document of Explanation.

The following screenshot shows the ***Organizational Background*** page:

Figure 2. Sample Organizational Background Page

Information submitted in response to this CFP will be accessible to OGC and Sponsor staff members. This information will remain in the control of these stakeholders and will not be used for other purposes without prior written consent of the Bidder. Once a Bidder has agreed to become a Participant, they will be required to release proposal content (excluding financial information) to all initiative stakeholders. Sensitive information other than labor-hour and cost-share estimates should not be submitted.

Bidders will be selected for cost share funds on the basis of adherence to the CFP requirements and the overall proposal quality. A general initiative objective is to inform future OGC standards development, implementation, and adoption with findings and recommendations. Each proposed deliverable should formulate a path for (1) producing executable interoperable prototype implementations meeting the stated CFP requirements and (2) documenting the associated findings and recommendations. Bidders not selected for cost share funds may still request to participate on a purely in-kind basis.

Bidders should avoid attempts to use the initiative as a platform for introducing new requirements not included in the Technical Architecture. Any additional in-kind scope should be offered outside the formal bidding process, where an independent determination can be made as to whether it should be included in initiative scope or not. Out-of-scope items could potentially be included in another OGC IP initiative.

Each selected Participant (even one not requesting any funding) will be required to enter into a

Participation Agreement contract ("PA") with the OGC. The reason this requirement applies to purely in-kind Participants is that other Participants will likely be relying upon their delivery. Each PA will include a Statement of Work ("SOW") identifying specific Participant roles and responsibilities.

5.3. Questions and Clarifications

Once the original CFP has been published, ongoing updates and answers to questions can be tracked by monitoring the CFP Corrigenda Table and the CFP Clarifications Table

Bidders may submit questions using the *Additional Message* textbox in the OGC Innovation Program Contact Form. Question submitters will remain anonymous, and answers will be regularly compiled and published in the CFP clarifications.

Two Bidders Q&A Webinars will be held (as listed in the Master Schedule). The webinar is open to the public, but anyone wishing to attend must register using the provided link. Questions will be due prior to the Q&A Webinar.

5.4. Proposal Submission Procedures

The process for a Bidder to complete a proposal is essentially embodied in the online Bid Submission Form. Once this site is fully prepared to receive submissions (soon after the CFP release), it will include a series of web forms, one for each deliverable of interest. A summary is provided here for the reader's convenience.

For any individual who has not used this form in the past, a new account will need to be created first. The user will be taken to a home page indicating the "Status of Your Proposal." If any defects in the form are discovered, this page includes a link for notifying OGC. The user can return to this page at any time by clicking the *OGC logo* in the upper left corner.

Any submitted bids will be treated as earnest submissions, even those submitted well before the response deadline. Be certain that you intend to submit your proposal before you click the *Submit* button on the *Review* page.

IMPORTANT	Because the *Bid Submission Form* is still relatively new, it might contain some areas that are still brittle or in need of repair. Please notify OGC of any discovered defects. Periodic updates will be provided as needed.
	Please consider making **local backup copies** of all inputs in case any need to be re-entered.

5.4.1. High-Level Overview

Clicking on the *Propose* link will navigate to the Bid Submission Form. The first time through, the user should provide organizational information on the Organizational Background Page and click *Update and Continue*.

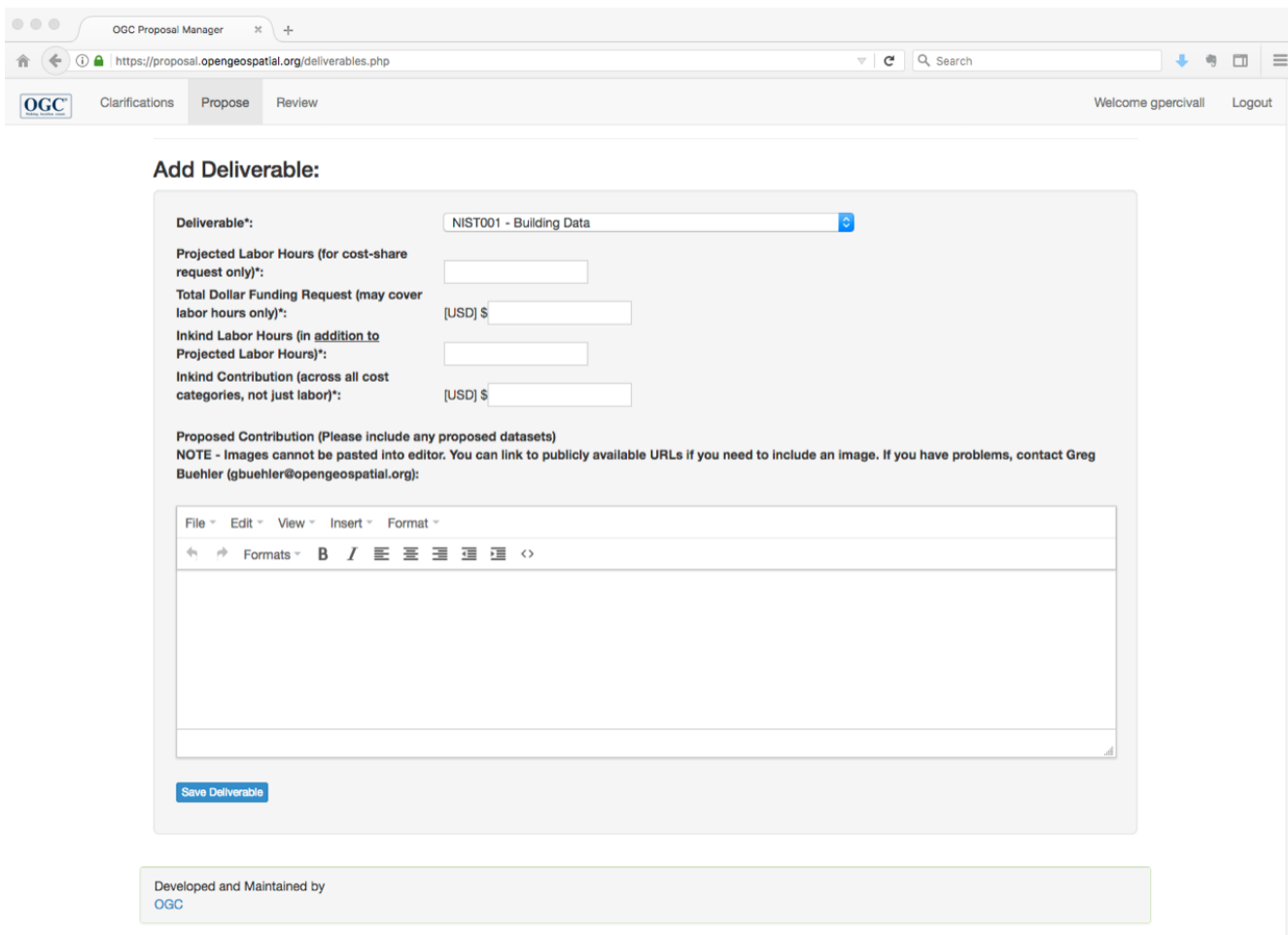This will navigate to an "Add Deliverable" page that will resemble the following:

Figure 3. Sample "Add Deliverables" Page

The user should complete this form for **each** proposed deliverable.

TIP	For component implementations having multiple identical instances of the same deliverable, the bidder only needs to propose just one instance. For simplicity, each bidder should just submit against the lowest-numbered deliverable ID. OGC will assign a unique deliverable ID to each selected Participant later (during negotiations).

On the far right, the *Review* link navigates to a page summarizing all the deliverables the Bidder is proposing. This Review tab won't appear until the user has actually submitted at least one deliverable under the *Propose* tab first.

TIP	Consider regularly creating printed output copies of this *Review* page at various points during proposal creation.

Once the *Submit* button is clicked, the user will receive an immediate confirmation on the website that their proposal has been received. The system will also send an email to the bidder and to OGC staff.

TIP	In general, up until the time that the user clicks this *Submit* button, the proposal may be edited as many times as the user wishes. However, this initial version of the form contains no "undo" capability, so please use caution in over-writing existing information.

The user is afforded an opportunity under *Done Adding Deliverables* at the bottom of this page to attach an optional *Attached Document of Explanation*.

Figure 4. Sample Dialog for an "Attached Document of Explanation"

IMPORTANT	No sensitive information (such as labor rates) should be included in the *Attached Document of Explanation*.

If this attachment is provided, it is limited to one per proposal and must be **less than 5Mb**.

This document could conceivably contain any specialized information that wasn't suitable for entry into a *Proposed Contribution* field under an individual deliverable. It should be noted, however, that this additional documentation will only be read on a **best-effort basis**. There is no guarantee it will be used during evaluation to make selection decisions; rather, it could optionally be examined if the evaluation team feels that it might help in understanding any specialized (and particularly promising) contributions.

5.4.2. Step-by-Step Instructions

The *Propose* link takes the user to the first page of the proposal entry form. This form contains fields to be completed once per proposal such as names and contact information.

It also contains an optional *Organizational Background* field where Bidders (particularly those with no experience participating in an OGC initiative) may provide a description of their organization. It also contains a click-through check box where each Bidder will be required (before entering any data for individual deliverables) to acknowledge its understanding and acceptance of the requirements described in this appendix.

Clicking the *Update and Continue* button then navigates to the form for submitting deliverable-by-deliverable bids. On this page, existing deliverable bids can be modified or deleted by clicking the appropriate icon next to the deliverable name. Any attempt to delete a proposed deliverable will require scrolling down to click a *Confirm Deletion* button.

To add a new deliverable, the user would scroll down to the *Add Deliverable* section and click the *Deliverable* drop-down list to select the particular item.

The user would then enter the required information for each of the following fields (*for this deliverable only*). Required fields are indicated by an asterisk ("*"):

- Estimated *Projected Labor Hours** for this deliverable,

- *Funding Request**: total U.S. dollar cost-share amount being requested for this deliverable (to cover burdened labor only),

- Estimated *In-kind Labor Hours** to be contributed for this deliverable, and

- Estimated *In-Kind Contribution*: total U.S. dollar estimate of the in-kind amount to be contributed for this deliverable (including all cost categories).

TIP	There's no separate text box to enter a global in-kind contribution. Instead, please provide an approximate estimate on a per-deliverable basis.

Cost-sharing funds may **only** be used for the purpose of offsetting burdened labor costs of development, engineering, documentation, and demonstration related to the Participant's assigned deliverables. By contrast, the costs used to formulate the Bidder's in-kind contribution may be much broader, including supporting labor, travel, software licenses, data, IT infrastructure, and so on.

Theoretically there is no limit on the size of the *Proposed Contribution* for each deliverable (beyond the raw capacity of the underlying hardware and software). But bidders are encouraged to incorporate content by reference where possible (rather than inline copying and pasting) to avoid overloading the amount of material to be read in each proposal. There is also a textbox on a separate page of the submission form for inclusion of *Organizational Background* information, so there is no need to repeat this information for each deliverable.

IMPORTANT	A breakdown (by cost category) of the "Inkind Contribution" may be included in the *Proposed Contribution* text box for each deliverable. However, please note that the content of this text box will be accessible to all Stakeholders and should contain **no confidential information** such as labor rates. Similarly, no sensitive information should be included in the Attached Document of Explanation.

This field *Proposed Contribution (Please include any proposed datasets)* should also be used to provide a succinct description of what the Bidder intends to deliver for this work item to meet the requirements expressed in the Technical Architecture. This language could potentially include a brief elaboration on how the proposed deliverable will contribute to advancing the OGC standards baseline, or how implementations enabled by the specification embodied in this deliverable could add specific value to end-user experiences.

A Bidder proposing to deliver a *Service Component Implementation* can also use this field to identify what suitable **datasets** would be contributed (or what data should be acquired from another identified source) to support the proposed service.

In general, please try to limit the length of each *Proposed Contribution* to about one text page per deliverable.

Note that images cannot be pasted into the field *Proposed Contribution* textbox. Bidders should instead provide a link to a publicly available image.

A single bid may propose deliverables arising from any number of threads or tasks. To ensure that the full set of sponsored deliverables are made, OGC might negotiate with individual Bidders to drop and/or add selected deliverables from their proposals.

5.5. General Requirements

The following requirements apply to the proposal development process and activities.

- Participants selected to implement component deliverables will be expected to participate in the full course of interface and component development, Technical Interoperability Experiments, and demonstration support activities throughout Initiative execution.

- In general, a proposed component deliverable based on a product that has earned OGC Certification will be evaluated more favorably than one which has not.

- Participants selected as Editors will also be expected to participate in the full course of activities throughout the Initiative, documenting implementation findings and recommendations and ensuring document delivery.

- Participants should remain aware of the fact that the Initiative components will be developed across many organizations. To maintain interoperability, each Participant should diligently adhere to the latest technical specifications so that other Participants may rely on the anticipated interfaces during the Technology Integration / Technical Interoperability Experiments (TIEs).

- All Selected Participants (both cost-share and pure in-kind) must attend with at least one technical representative to the Kickoff. Participants are also encouraged to attend with at least with one technical representative to Workshop, Outreach, and Demonstration Events.

- No work facilities will be provided by OGC. Each Participant will be required to perform its PA obligations at its own provided facilities and to interact remotely with other Initiative stakeholders.

5.6. Tips for new bidders

Bidders who are new to OGC initiatives are encouraged to review the following tips:

- In general, the term "activity" is used as a verb describing work to be performed in an initiative, and the term "deliverable" is used as a noun describing artifacts to be developed and delivered for inspection and use.

- The roles generally played in any OGC Innovation Program initiative are defined in the OGC Innovation Program Policies and Procedures, from which the following definitions are derived and extended:

  ◦ Sponsors are OGC member organizations that contribute financial resources to steer

Initiative requirements toward rapid development and delivery of proven candidate specifications to the OGC Standards Program. These requirements take the form of the deliverables described herein. Sponsors representatives help serve as "customers" during Initiative execution, helping ensure that requirements are being addressed and broader OGC interests are being served.

- Bidders are organizations who submit proposals in response to this CFP. A Bidder selected to participate will become a Participant through the execution of a Participation Agreement contract with OGC. Most Bidders are expected to propose a combination of cost-sharing requests and in-kind contributions (though solely in-kind contributions are also welcomed).

- Participants are selected OGC member organizations that generate empirical information through the definition of interfaces, implementation of prototype components, and documentation of all related findings and recommendations in Engineering Reports, Change Requests and other artifacts. They might be receiving cost-share funding, but they can also make purely in-kind contributions. Participants assign business and technical representatives to represent their interests throughout Initiative execution.

- Observers are individuals from OGC member organizations that have agreed to OGC intellectual property requirements in exchange for the privilege to access Initiative communications and intermediate work products. They may contribute recommendations and comments, but the IP Team has the authority to table any of these contributions if there's a risk of interfering with any primary Initiative activities.

- The OGC Collaborative Solutions and Innovation Team (COSI Team) is the management team that will oversee and coordinate the Initiative. This team is comprised of OGC staff, representatives from member organizations, and OGC consultants. The COSI Team communicates with Participants and other stakeholders during Initiative execution, provides Initiative scope and schedule control, and assists stakeholders in understanding OGC policies and procedures.

- The term Stakeholders is a generic label that encompasses all Initiative actors, including representatives of Sponsors, Participants, and Observers, as well as the COSI Team. Initiative wide email broadcasts will often be addressed to "Stakeholders".

- Suppliers are organizations (not necessarily OGC members) that have offered to supply specialized resources such as capital or cloud credits. OGCs role is to assist in identifying an initial alignment of interests and performing introductions of potential consumers to these suppliers. Subsequent discussions would then take place directly between the parties.

- Non-OGC member organizations must become members in order to be selected as Participants. Non-members are welcome to submit proposals as long as the proposal is complemented by a letter of intent to become a member if selected for participation.

- Any individual wishing to gain access to the Initiative's intermediate work products in the restricted area of the Portal (or attend private working meetings and telecons) must be a member-approved user of the OGC Portal system. Intermediate work products that are intended to be shared publicly will be made available as draft ER content in a public GitHub repository.

- Individuals from any OGC member organization that does not become an Initiative Sponsor or Participant may still (as a benefit of membership) quietly observe all Initiative activities by registering as an Observer.

- Prior initiative participation is not a direct bid evaluation criterion. However, prior

participation could accelerate and deepen a Bidder's understanding of the information presented in the CFP.

- All else being equal, preference will be given to proposals that include a larger proportion of in-kind contribution.

- All else being equal, preference will be given to proposed components that are certified OGC-compliant.

- All else being equal, a proposal addressing all of a deliverable's requirements will be favored over one addressing only a subset. Each Bidder is at liberty to control its own proposal, of course. But if it does choose to propose only a subset for any particular deliverable, it might help if the Bidder prominently and unambiguously states precisely what subset of the deliverable requirements are being proposed.

- The Sponsor(s) will be given an opportunity to review selection results and offer advice, but ultimately the Participation Agreement (PA) contracts will be formed bilaterally between OGC and each Participant organization. No multilateral contracts will be formed. Beyond this, there are no restrictions regarding how a Participant chooses to accomplish its deliverable obligations so long as the Participant's obligations are met in a timely manner (e.g., with or without contributions from third-party subParticipants).

- In general, only one organization will be selected to receive cost-share funding per deliverable, and that organization will become the Assigned Participant upon which other Participants will rely for delivery. Optional in-kind contributions may be made provided that they don't disrupt delivery of the required, reliable contributions from Assigned Participants.

- A Bidder may propose against any or all deliverables. Participants in past initiatives have often been assigned to make only a single deliverable. At the other extreme, it's theoretically possible that a single organization could be selected to make all available deliverables.

- Results of other recent OGC initiatives can be found in the OGC Public Engineering Report Repository.

- A Bidders Q&A Webinar will likely be conducted soon after CFP issuance. The webinar will be open to the public, but prior registration will be required.

Appendix A: Deliverables Summary & Funding Status

The following table summarizes the full set of deliverables. It is expected that cost-share funding will be available for all work items.

The following includes deliverables details and a complete deliverables table for all threads. Please refer to Section 4 for further detail on pilot execution or Section 4.6 for expected results and outcomes of each task.

A.1. D001 - Pilot Summary ER:

The ER may include one or more volumes of a project report describing the requirement, planning, execution, and outcomes of the Pilot to be published by OGC at the end of the pilot. The ER (D001) will summarize the FMSDI pilot results and outcomes and if applicable:

- three volumes/sections related to each thread

- the RFI results for the Caribbean Area. The OGC team will be responsible for the development of a Request for Information (RFI) to assess basic data availability, interfaces, and data formats in the Caribbean area. After that the ER (D001) editor will capture the results in the ER.
  The ER shall contain a plain language executive summary to clearly outline the motivations, goals, and critical outcomes of this initiative. The report will be made available to the public.
  The ER may result in the development of new geospatial standards, as well as insights into future standards development activities that will benefit geospatial information sharing and use for Arctic land and marine applications. As such, the ER will:

  - Document the geospatial standards-based approaches developed as part of the pilot.

  - Outline the steps required to formally incorporate these approaches into international geospatial standards, such as those published by the OGC.

  - Describe recommended future standards-development activities to meet identified requirements and challenges that cannot be resolved within the pilot's scope. The ER will be developed in a Github Repo using a Metanorma template based on OGC guidelines.

A.2. D100 - Persistent Demonstration - Singapore:

Participants will complete an end-to-end demonstration of a proposed application scenario implementation in the area of interest in Singapore. This demonstration will show how geospatial data/information can be used in an operational context satisfying all the requirements in section 2.1.2. Each scenario shall demonstrate what is currently possible and what gaps are experienced with the resources that can be discovered on the Internet. Scenario developments should include various data sources, metadata, access process to the online data, and various standards used for data discovery, access, and processing interfaces. Participants will propose a scenario, data sources and services, and load data to the service instance to make it available in a format supported by the standard client instances. The server shall provide an OGC compliant API that supports discovery and access to marine or land data in the Singapore scenario. The client instance will be delivered in

the form of a live demonstration that illustrates all elements of the different scenarios. Ideally, the client shall make use of all Caribbean server instances. Demonstration should cover a wide range of analysis types supported (e.g., statistical, topological, buffering, etc.). Other forms of desired analysis may be identified during pilot completion. Depending on technological developments as well as changes to existing services included in the demonstration, both the nature and scope of the demonstration may need to be adjusted over time. Demonstration of the Pilot scenario will be delivered in the form of a live demonstration with corresponding screen captured video with voice-over. Services and clients implemented during the pilot will be made available, including persistent demonstration capabilities for at least 1 year. Each deliverable shall document the definition and implementation of the scenario; the role it plays, and the documentation of all results, experiences made, and lessons learned as stated above. The documentation is delivered as a contribution to the initiative summary ER (D001).

A.3. D101 - Methodology for discovery and integration of land and marine geospatial information for the Arctic:

This deliverable will explore the development and use of geospatial standards-based approaches to create a methodology that will streamline satellite, land/marine sensor, and analytical service discovery and integration. The developed methodology shall support the following:

- Use of manual and automated techniques for discovery.

- Availability and discovery of key geospatial datasets (e.g., satellite imagery) for Arctic coastal erosion applications.

- Access and use of metadata to enable geospatial dataset discovery and access. Multilingual requirements for metadata shall be considered (English and French at a minimum).

- Leverage of discovery information through a range of tools (e.g., Government of Canadahttps://open.canada.ca/en/open-maps[Open Maps]/https://open.canada.ca/en/open-data[Open Data], catalogs, online dashboards, etc.). Multilingual user requirements shall be considered (English and French at a minimum).

- Integration of satellite, land/marine sensor, and analytical service information sources in the context of the pilot's Arctic climate change coastal sensitivity use case. The methodology shall be designed such that it can be applied to common types of unclassified satellite imagery and land/marine sensor data provided by a wide range of suppliers:

- Sentinel, Landsat, WorldView, RADARSAT, etc.

- Weather and climate data - e.g., Environment and Climate Change Canada's Canadian Ice Service and GeoMet Weather Service

- Argo oceanographic data

- Arctic SDI data and services

- Arctic Data Committee services

- CCMEO's sensor data

- European Space Agency Polar Thematic Exploitation Platform (PolarTEP)

The thread will support at least three information sources: one declassified satellite imagery dataset, one land/marine-based sensor dataset, and one analytical service. The final selection of the geospatial information types will be completed during the pilot.

This task shall also explore the use of modern geospatial standards approaches to enable the addition of spatial elements to link land and marine data. The goal is to demonstrate how linked data can be spatially enabled and support integration with other forms of geospatial data.

Outcomes from this task shall demonstrate how Canada can design standards-based methods that support discovery and integration of land/marine geospatial information. Outputs from this task will include an application methodology documented in the ER that will be enabled in the next Deliverable.

A.4. D102 - Persistent Demonstration on Digital Arctic:

Leveraging the methodology created in D101, Participants will complete an end-to-end demonstration scenario implementation of the developed methodology. This demonstration will show how geospatial data/information can be used in an operational context within the parameters of the Arctic coastal sensitivity to climate change use case through modern geospatial standards approaches.

This task will leverage Arctic SDI efforts to create a seamless multidimensional "Digital Arctic" that will link the land, atmosphere, and marine Arctic domains within an integrated platform. The concept of a Digital Arctic occurs over multiple dimensions of space and time. The dimensions will comprise location (X, Y, or other coordinates), elevation/bathymetry/altitude, time, and flows to measure pathways and directions (e.g., currents, migration, icebergs, ice flows, etc.). This work relates to other ongoing emerging initiatives (metaverse, digital twin). The Digital Arctic demonstration will include:

- Theme and methodology aspects

  ◦ Demonstration of the application of geospatial analysis processes in the context of the Arctic coastal sensitivity to climate change use case.

  ◦ Demonstration that D101 methodology supports analysis in unclassified cloud computing environments.

- Analytics

  ◦ Demonstration that a wide range of analysis types are supported (e.g., statistical, topological, buffering, etc.). Other forms of desired analysis may be identified during pilot completion.

- Visualization

  ◦ Demonstrate visualization of analysis results through desktop, web, and mobile application-based approaches. The web and mobile application-based approaches will implement Map Markup Language (MapML) where appropriate.

  ◦ Visualizations that are shareable between desktop, web, and mobile approaches to the greatest degree possible.

  ◦ Demonstrate that common visualization functions can be supported (e.g., zoom, pan, queries, layer ordering, etc.).

  ◦ Flexible visualization functions between the desktop, web, and mobile approaches, allowing for a range of design potential (e.g., having very similar functions between all approaches to

developing tailored functionality for mobile approaches given specific user requirements).

- Transferability

  ◦ Demonstrate how the approach can enable analysis and visualization for different types of activities beyond the project's Arctic coastal sensitivity to climate change use case.

- Multilingualism

  ◦ Demonstrate that visualizations support multilingualism requirements where necessary (English and French at a minimum).

- Linked Data

  ◦ Demonstrate the ability of modern geospatial standards to spatially-enable at least one linked land and marine dataset.

  ◦ Demonstrate the integration of at least one form of spatially-enabled linked land or marine dataset with at least one geospatial land or marine dataset.

  ◦ Explore the use of modern geospatial standards approaches to enable the addition of spatial elements to land and marine data that exists in a non-spatial data format. The goal is to demonstrate how such linked data can be spatially enabled and support integration with other forms of geospatial data.

- Federation

  ◦ The inclusion of at least three components that work together to demonstrate a proof-of-concept for a federated Digital Arctic.

Participants will propose a scenario, data sources and services, and load data to the service instance to make it available in a format supported by the standard client instances. The server shall provide an OGC compliant API that supports discovery and access to marine or land data in the Arctic scenario. The client instance will be delivered in the form of a live demonstration that illustrates all elements of the different scenarios. Ideally, the client shall make use of all Arctic server instances.

Demonstration of the Pilot scenario will be delivered in the form of a live demonstration with corresponding screen captured video with voice-over. Services and clients implemented during the pilot will be made available to the Sponsors for at least 1 year. For persistent demonstrators, pilot demonstration components will be maintained on an ongoing basis for one year for deployment in containerized form to a common cloud computing environment for persistent demonstration of a Digital Arctic concept and interchange experiment purposes. This will allow project stakeholders to interact with technical outcomes over the long-term. Depending on technological developments as well as changes to existing services included in the demonstration, both the nature and scope of the demonstration may need to be adjusted over time.

Each deliverable shall document the definition and implementation of the scenario; the role it plays, and the documentation of all results, experiences made, and lessons learned as stated above. The documentation is delivered as a contribution to the initiative results ER.

Demonstration dependencies: The Digital Arctic demonstration will be presented independently from any other activities undertaken to avoid confusion with other initiatives. Specifics regarding permanent aspects of the Digital Arctic demonstration are to be determined by OGC.

Coordination with other OGC activities: The results of this pilot will be coordinated with the activities of the OGC Quality of Service and Experience and Climate Resilience Domain working groups.

The following table lists all the deliverables for this thread. Please refer to Section 4 for more detail on pilot execution or Section 4.6 for output and results of each task.

A.5. D103 - Participant Demonstration - Caribbean:

Participants will complete an end-to-end demonstration of a proposed application scenario implementation in the area of interest in the Caribbean. This demonstration will show how geospatial data/information can be used in an operational context satisfying all the requirements in section 2.3.2.
Scenarios will use at least one of the islands of interest listed.

Preferred islands of interest are:

- Anguilla, British Virgin Islands (BVI), Cayman Islands, and Turks and Caicos Islands;

Any of these islands are acceptable as well:

- Antigua & Barbuda, Bahamas, Barbados, Bermuda, Dominica, Grenada, Jamaica, Montserrat, Saint Lucia, St Kitts & Nevis, St Vincent & The Grenadines, Trinidad and Tobago;

Each scenario shall demonstrate what is currently possible and what gaps are experienced with the resources that can be discovered on the Internet. Scenario developments should include various data sources, metadata, access process to the online data, and various standards used for data discovery, access, and processing interfaces.
Participants will propose a scenario, data sources and services, and load data to the service instance to make it available in a format supported by the standard client instances. The server shall provide an OGC compliant API that supports discovery and access to marine or land data in the Arctic scenario. The client instance will be delivered in the form of a live demonstration that illustrates all elements of the different scenarios. Ideally, the client shall make use of all Arctic server instances.
Demonstration should cover a wide range of analysis types supported (e.g., statistical, topological, buffering, etc.). Other forms of desired analysis may be identified during pilot completion. Depending on technological developments as well as changes to existing services included in the demonstration, both the nature and scope of the demonstration may need to be adjusted over time.
Demonstration of the Pilot scenario will be delivered in the form of a live demonstration with corresponding screen captured video with voice-over. Services and clients implemented during the pilot will be made available to the Sponsors for at least 1 year.
Each deliverable shall document the definition and implementation of the scenario; the role it plays, and the documentation of all results, experiences made, and lessons learned as stated above. The documentation is delivered as a contribution to the initiative summary ER (D001).

A.6. Full Deliverables Table

The following table covers all deliverables from each of the threads, Singapore, Canada, & Caribbean.

Table 5. Summary of Deliverables

ID	Component Name	Description
D001	**Pilot Summary Engineering Report (ER)**	The ER may include one or more volumes of a project report describing the requirement, planning, execution, and outcomes of the Pilot to be published by OGC at the end of the pilot. This ER captures the outcomes of the Pilot's three threads and an RFI report on the Caribbean area.
D100: Digital Twin of Land and Sea Interfaces - Singapore	**Persistent Demonstration - Singapore (multiple instances)**	Demonstration of the Pilot scenario as implemented by Participant. The demonstration will be delivered in the form of a live demonstration with corresponding screen captured video with voice-over. Services and web-based clients implemented during the pilot will be made available to the Sponsor, including persistent demonstration capabilities. A final, self-produced summary video based on the screen capture material delivered by the Participants and including a summary of the work accomplished is required. For more information on this see Section 4.6.5.
D101: Digital Arctic Connecting Land and Sea - Canada	**Methodology for discovery and integration of land and marine geospatial information for Digital Arctic**	Develop a standards-based methodology to enable the discovery and integration of land and marine geospatial information within the Arctic context of the pilot. For more description of this deliverable please refer to Appendix A, D101.
D102: Digital Arctic Connecting Land and Sea - Canada	**Persistent Demonstration on Digital Arctic (multiple instances)**	This component will demonstrate the Digital Arctic concept of the FMSDI Pilot, scenario as implemented by Participant. The outputs of this deliverable are a summary video with voice-over, a persistent demonstrator, and contributions to the ER. For more description of this deliverable please refer to Section 4.6.5.
D103: Integrating Land & Sea for Various Use Cases - Caribbean	**Persistent Demonstration - Caribbean (multiple instances)**	Demonstration of the Caribbean scenario as implemented by Participant. The demonstration will be delivered in the form of a live demonstration with corresponding screen captured video with voice-over. Services and web-based clients implemented during the pilot will be made available to the Sponsor and include persistent demonstrator capabilities. For more description of this deliverable please refer to section 4.6.5.

Appendix B: Abbreviations

The following table lists all abbreviations used in this CFP.

AI	Artificial Intelligence
API	Application Programming Interface
Arctic SDI	Arctic Spatial Data Infrastructure
AWS	Amazon Web Services
BVI	British Virgin Islands
CCMEO	Canada Centre for Mapping and Earth Observation
CFP	Call for Participation
CR	Change Request
COSI	Collaborative Solutions and Innovation
DGGS	Discrete Global Grid Systems
DWG	Domain Working Group
EDR	Environmental Data Retrieval
ER	Engineering Report
EO	Earth Observation
FAIR	Findable, Accessible, Interoperable, Reusable
FMSDI	Federated Marine Spatial Data Infrastructure
IHO	International Hydrographic Organization
IoT	Internet of Things
ISO	International Organization for Standardization
IT	Information Technology
JSON	JavaScript Object Notation
LADM	Land Administration Domain Model
ML	Machine Learning
MPA	Maritime and Port Authority of Singapore
ODC	Other Direct Costs
OGC	Open Geospatial Consortium
PA	Participant Agreement
PDF	Portable Document Format
POC	Point of Contact
Q&A	Questions and Answers

SDI	Spatial Data Infrastructure
SLA	Singapore Land Authority
SOW	Statement of Work
SWG	Standards Working Group
TC	OGC Technical Committee
TEM	Technical Evaluation Meeting
TIE	Technology Integration / Technical Interoperability Experiment
UN-GGIM	United Nations Committee of Experts on Global Geospatial Information Management
URL	Uniform Resource Locator
WCAG	Web Content Accessibility Guidelines
WG	Working Group (SWG or DWG)
XML	Extensible Markup Language

Appendix C: Corrigenda & Clarifications

The following table identifies all corrections that have been applied to this CFP compared to the original release. Minor editorial changes (spelling, grammar, etc.) are not included.

Section	Description

The following table identifies all clarifications that have been provided in response to questions received from organizations interested in this CFP.

Question	Clarification
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(*end of document*)