Request for Information on Arctic Spatial Data

Architecture, Data, Services, Requirements & Constraints in North America's Arctic

RFI Issuance Date: February 24, 2016
Response Due Date: March 18, 2016

Abstract

The Arctic SDI[*] (Arctic Spatial Data Infrastructure) helps stakeholders to gain new perspectives into social, economic, and environmental issues by providing an online network of resources that improves the sharing, use and integration of information tied to geographic locations in the North. The Arctic SDI further allows pan-Arctic science, monitoring, and societal, economic, and environmental decision support.

This Request for Information (RFI) is part of an OGC Interoperability Program project "Arctic Spatial Data Pilot". Sponsored by Natural Resources Canada and US Geological Survey, the goal of the Arctic Spatial Data Pilot is to demonstrate the diversity, richness and value of Spatial Data Infrastructure (SDI) Web services to Arctic SDI stakeholders.

The motivation to issue this RFI is to better understand the Arctic SDI. What is it exactly? What data and Web services are available and what needed data and Web services are missing? What are the data sharing and data integration requirements of the different Arctic communities? What is the ideal architecture for Arctic SDI? What key stakeholders need to contribute to the development process? What scenarios and use cases should be considered as part of this OGC Pilot? Readers of this RFI are encouraged to respond with recommendations for procedures, technology, data, and open standards that should be considered to be included in a recommended practice for Arctic SDI.

Results of the RFI responses will be analyzed and documented in a report that will serve as the basis for the development of a subsequent Request for Quotation (RFQ). The RFQ will invite technology providers to describe work they offer to do to address those Arctic SDI interoperability requirements. RFI respondents will be considered in future Open Geospatial Consortium, Natural Resources Canada, United States Geological Survey, Academic funding bodies, or other opportunities. All RFI responses will contribute to Arctic SDI considerations moving forward.

Responses to the RFI are requested by March 18, 2016. This RFI includes instructions on how organizations can respond and submit questions about the RFI.

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[*] For clarification on the various flavors and interpretations of the term *Arctic SDI*, please see section 2.

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1 Introduction

1.1 RFI purpose and scope

This Request for Information (RFI) is part of the Arctic Spatial Data Pilot. The RFI is a process to assess the current state of the Arctic SDI and to understand its future optimal setup and design.

The Arctic Spatial Data Pilot is organized in two phases. This first phase collects input on an SDI for the Arctic region in general. The second phase, which will be more strongly connected to the OGC Testbed-12 activity, will focus on a geographic extent in North America, though the interaction with the Testbed will be used to test interoperability of data services and tools from across the Arctic. Specifically, phase 1 of the Arctic Spatial Data Pilot will result in the development of an inventory of available geospatial Web services across the Arctic with the intent to capture a wide range of thematic data layers. The second activity in phase 1 will focus on the delineation of core components that best defines Arctic SDI architecture. These outputs, combined with a detailed plan for phase 2 will drive the activities for the second phase of the Arctic Spatial Data Pilot. Phase 2 will be based on the detailed plan developed in phase 1 (including the development of a Request for Quotation (RFQ)/Call for Participation (CFP) and video presentations), the proposed technical architecture to be implemented and the suggested scenarios and use cases to be considered in this pilot.

The pilot is sponsored by Natural Resources Canada and the United States Geological Survey (USGS). It supports the expansion of the Canadian Geospatial Data Infrastructure and National Spatial Data Infrastructure into the Arctic (i.e. Canadian Territories, Northern Quebec, Northern Labrador and Alaska). To be successful, the Arctic Spatial Data Pilot has to take particular requirements into account, including responding to priorities of Northerners and Aboriginal Communities, working in zero/low bandwidth regions and considering the realities of frontier economies.

The following figure illustrates some key aspects of Spatial Data Infrastructures. It applies to all SDIs and is used in slightly modified versions for the various types of SDIs from local to regional to global.
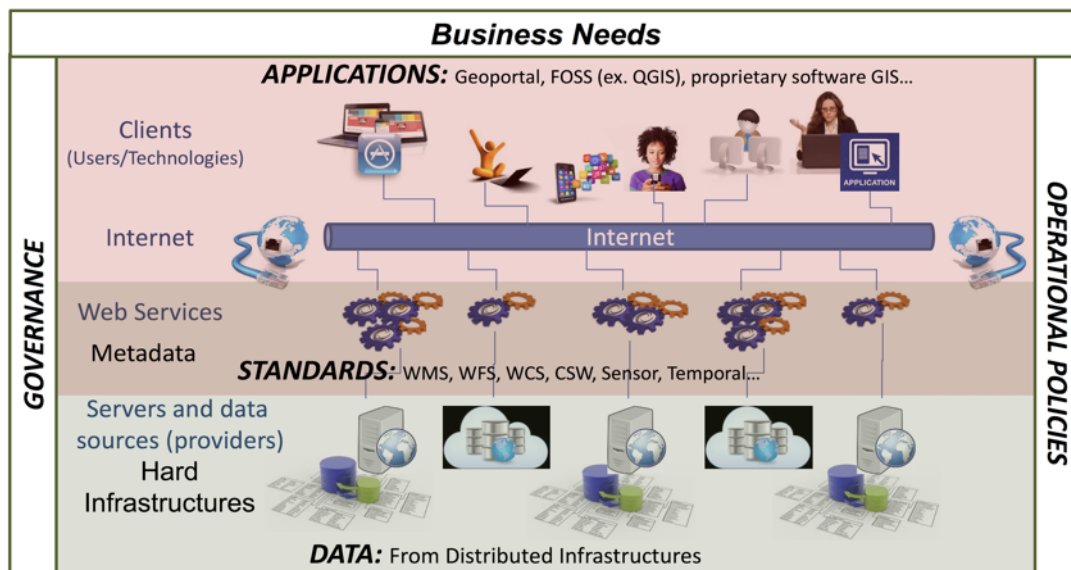
Figure 1: The aspects of an SDI are shown above. Arctic Spatial Data Pilot aspects of primary interest are shaded. The other aspects are examined but in less details in the Pilot. Source: NRCan.

Requirements and business needs shape type and functionality of software applications made available to SDI consumers. The requirements are analyzed in Phase 1 of the Arctic Spatial Data Pilot. Clients (including both humans and machines) use software applications to access data via standardized interfaces and communication protocols that include standardized data information models and encodings. Shared governance and policies are important and orthogonal aspects to a SDI. The focus of this specific pilot - in particular in its next phase - is on the boxes shaded in orange, brown and green, though others shall be addressed as part of the concept development study that this RFI supports.

Being part of a multi-year pilot activity that includes development and implementation phases, it serves as a baseline investigation step that helps understanding institutional, administrative, and industrial perspectives on the following aspects:

- **Business Needs & Stakeholders**
    - How to get more stakeholders involved and better served?
    - Who are the stakeholders of the Arctic SDI? (includes producers, providers, policy makers, broker, value added reseller, and end users)
    - What are the particular business needs of Arctic SDI stakeholders?
- **Requirements & Constraints**
    - What additional constraints should be taken into account for future Arctic SDI developments?
    - What are the requirements of the Arctic SDI that need to be considered during future design and development phases?
    - What are the business requirements that apply to an Arctic SDI?
- **Governance**
    - How to implement an effective governance of Arctic SDI? What are the development goals that should be met, which should be prioritized?
- **Architecture**
    - What should be the key components of the Arctic SDI?

- o What is the ideal Arctic SDI architecture?
- o How to implement an effective governance structure as part of the architecture?
- **Data**
  - o What data sets are available and should become part of the Arctic SDI?
  - o What data are currently missing and should be developed?
- **Standards**
  - o What standards should be used for Arctic SDI data, data exchange, and metadata?
  - o What additional standards are necessary for orthogonal aspects such as governance?
- **Applications**
  - o What are the current applications used in the Arctic?
  - o What type of services should be available as part of the Arctic SDI?
  - o What type of applications shall be developed that make use of Arctic SDI or become integral part of it?
- **Operational Policies**
  - o What guidelines, best practices, directives, procedures and manuals exist that address topics related to the lifecycle of geospatial information (i.e., collection, management, dissemination, and use) relevant to Arctic SDI?
- **Scenarios and Use Cases**
  - o What scenarios and use cases shall be implemented or at least considered as part of this pilot activity?
  - o What applications need to be connected to the Arctic SDI? What applications are using the Arctic SDI?
  - o Is there anything missing to connect specific applications with the Arctic SDI?

Readers of this RFI are encouraged to respond with recommendations for the aspects listed above or any additional procedures, technology, data, or open standards issue that should be considered to be included in a recommended practice for Arctic SDI.

1.2 Organizations supporting this RFI

Organization managing the RFI:
The **Open Geospatial Consortium** (**OGC**) is an international consortium of more than 500 companies, government agencies, research organizations, and universities participating in a consensus process to develop publicly available geospatial standards. OGC standards support interoperable solutions that "geo-enable" the Web, wireless and location-based services, and mainstream IT. OGC standards empower technology developers to make geospatial information and services accessible and useful with any application that needs to be geospatially enabled.

Sponsors:
Natural Resources Canada (**NRCan**) seeks to enhance the responsible development and use of Canada's natural resources and the competitiveness of Canada's natural resources

products. We are an established leader in science and technology in the fields of energy, forests, and minerals and metals and use our expertise in earth sciences to build and maintain an up-to-date knowledge base of our landmass. NRCan develops policies and programs that enhance the contribution of the natural resources sector to the economy and improve the quality of life for all Canadians.

As the largest water, earth, and biological science and civilian mapping agency of the United States, the **U.S. Geological Survey** (**USGS**) collects, monitors, and analyzes data and information, and provides scientific understanding about natural resource conditions, issues, and problems. The diversity of its scientific expertise enables USGS to carry out large-scale, multi-disciplinary investigations and provide impartial scientific information to resource managers, planners, and other customers.

2 Arctic SDI: CGDI, NSDI and Arctic-SDI.org Linkages

There are a number of SDI initiatives addressing the Arctic region, such as the US National Spatial Data Infrastructure (NSDI) or the Canadian Geospatial Data Infrastructure (CGDI). Other initiatives, such as Arctic-SDI.org address the entire Arctic region based on a cooperation between the mapping agencies of the eight bordering states. From a Canadian perspective, Arctic SDI addresses all SDI elements of the Canadian Geospatial Data Infrastructure primarily north of 60 degrees latitude (i.e. Canadian Territories, Northern Quebec and Northern Labrador), which assist regional, national and international SDIs. The US definition addresses the compatibility of USGS and the FGDC role in supporting national and international SDIs. Both the NSDI and CGDI are contributing to the development and sustainability of Arctic-SDI.org.

For this RFI, the term Arctic SDI is used for an SDI of several flavors. It is part of national SDIs that address the Arctic region and it is a cooperation between 8 national mapping agencies with their internet platform featuring an Arctic data portal and Web services. Thus, it combines the various perspectives based on the rationale that there is a reciprocal influencing and dependency process between national (and even sub-national) and international initiatives addressing the Arctic region.

In a reciprocal process, developing the Arctic SDI helps to generate a better understanding of how the national spatial data infrastructures can be developed and applied to support Arctic priorities. By implementing consistent means to share geographic data among all users, costs for collecting and using data can be significantly reduced while decision-making is enhanced.

2.1 National Spatial Data Infrastructure (NSDI)

"The NSDI has come to be seen as the technology, policies, criteria, standards and people necessary to promote geospatial data sharing throughout all levels of government, the private and non-profit sectors, and academia. It provides a base or structure of practices and relationships among data producers and users that facilitates data sharing and use. It is a set of actions and new ways of accessing, sharing and using geographic data that enables far

more comprehensive analysis of data to help decision-makers choose the best course(s) of action." ([FGDC](#))

The vision of the NSDI is to leverage investments in people, technology, data, and procedures to create and provide the geospatial knowledge required to understand, protect, and promote national and global interests.

According to the *[National Spatial Data Infrastructure Strategic Plan 2014-2016](#)*, the Arctic Spatial Data Pilot addresses a number of desires the NSDI shall fulfill in the near future:

- Provide government, businesses, and citizens with a way to visualize and explore data to derive information and knowledge.
- Create a network of resources and services for the seamless integration of location-based information into broader information assets to serve the needs of government, the business community, and citizens.
- Serve as an enabling resource for discovery, access, integration, and application of location information for a growing body of users.
- Leverage shared and open standards-based services and focus on applied information for improved decision-making.
- Promote place-based business intelligence and smart, shared applications.
- Include a core set of information layers that interface with other non-spatial data being generated.
- Use real-time data feeds and sensor webs for improved monitoring, control, situational awareness, and decision-making.
- Facilitate access to and use of multi-temporal information linked to place.
- Integrate and use advanced technologies and their associated standards and best practices.
- Facilitate use of community-driven open standards with multiple implementations.

2.2 Canadian Geospatial Data Infrastructure (CGDI)

The Government of Canada creates an environment for the development of the Canadian Geospatial Data Infrastructure (CGDI). Natural Resources Canada's responsibility is to foster an environment for the development and use of spatial data infrastructures (SDI) both within Canada and internationally. Spatial data infrastructures are highly distributed components that allow data integration based on international standards, industry consortia, operational policies, governance mechanisms and application development.

The CGDI is an on-line network of resources that improves the sharing, use and integration of information tied to geographic locations in Canada. It helps decision-makers from all levels of government, the private sector, non–government organizations and academia make better decisions on social, economic and environmental priorities. The infrastructure itself consists of data, standards, policies, technologies and partnerships that are in place to allow the sharing and visualization of information on the Internet. Primarily north of 60 degrees latitude, the CGDI is referred as the Arctic Spatial Data Infrastructure (Arctic SDI).

Governance of geospatial information management in Canada is based on a cooperative approach between the federal, provincial and territorial governments, industry, academia and

the public. Numerous committees and organisations support the evolution of the CGDI including the Federal Committee on Geomatics and Earth Observations, Canadian Council on Geomatics and GeoAlliance.

The Arctic Spatial Data Pilot will contribute to realize key actions listed in the Canadian Geospatial Data Infrastructure Vision, Mission and Roadmap - The Way Forward and the GeoAlliance Canada Strategy and Action Plan:

- "Communicate and promote the benefits of open data sharing.
- Improve mechanisms for active collaboration.
- Develop mechanisms that acknowledge the contribution of data.
- Build collaboration tools to create, maintain and improve the quality of geospatial data
- Establish tools related to volunteered geographic information (VGI), cloud computing and data sharing.
- Establish mechanisms to make standards and policy processes easily and widely communicated.
- Continue to promote open data, with an emphasis on efficiency of data accessibility.
- Foster standards and operational policies that will facilitate and increase the use, sharing and non-duplication of geospatial data." Source: CGDI Vision, Mission and Roadmap - The Way Forward

The Arctic Spatial Data Pilot is sponsored by Natural Resources Canada and the United States Geological Survey (USGS) with a North American focus, yet is scalable to the circumpolar community. It supports the expansion of the Canadian Geospatial Data Infrastructure and National Spatial Data Infrastructure into the Arctic (i.e. Canadian Territories, Northern Quebec, Northern Labrador and Alaska). To be successful, the Arctic Spatial Data Pilot has to take particular requirements into account, including responding to priorities of Northerners and Aboriginal Communities, working in zero/low bandwidth regions and considering the realities of frontier economies.

The Arctic SDI will play a key role in a range of complex issues where geospatial data are necessary, such as responsible resource development, environmental management and assessment, regulatory reviews, and safety and security. The Arctic SDI aims to make geospatial information available in a coherent way to the public, academic institutions, the private sector and others who are involved in to conducting research or produce value-added products and applications, driving innovation and stimulating economic development. Geospatial data, services and applications accessed through Arctic SDI will help agencies understand the impact of climate change and human activities in the Arctic, facilitating monitoring, management, emergency preparedness and decision making. Moreover, Arctic SDI will support Canadian research on climate change and enable decision-makers to take effective decisions and implement mitigation strategies.

2.3 Arctic-SDI.org

"The Arctic-SD.org is a cooperation between eight Arctic National Mapping Agencies whose Board includes the Mapping Directors of those Agencies. The purpose of the Arctic Spatial

Data Infrastructure is to support the Arctic Council and other relevant stakeholders in meeting their goals and objectives by using reliable and interoperable geospatial reference data of the Arctic, accessible via the Arctic SDI Geoportal." (Arctic Council, 2015). The Arctic SDI geoportal is available online at http://geoportal.arctic-sdi.org.

One goal of this pilot is to evaluate its ease of use and to complement it with additional clients, tools, and applications that allow efficient use of Arctic SDI data and processing resources.

2.4 Relationship of Arctic SDI and the Arctic Spatial Data Pilot Activity

The goal of the Arctic Spatial Data Pilot is to make the Arctic SDI better known and more attractive to its various stakeholders. As part of the pilot, communication with existing stakeholders will be intensified and new stakeholders will be approached. The pilot supports future Arctic SDI development by
- gathering requirements on the Arctic SDI,
- explaining the Arctic SDI concept, technology and its application to new stakeholders (video(s))
- developing additional components of the Arctic SDI and making more data available

3 Arctic Spatial Data Pilot Activity

The Arctic Spatial Data Pilot Activity is sponsored by US Geological Survey and Natural Resources Canada. Kicked-off on December 3, 2015, the goal is to demonstrate the diversity, richness and value of Spatial Data Infrastructure (SDI) Web services to Arctic SDI stakeholders. The diversity of Arctic data available via OGC specifications shall be assessed within the context of domestic, continental and international requirements.

The project is being executed in **two phases**:
- The first phase is organized as an OGC concept development study.
- The second phase will be an OGC pilot initiative with active involvement of a number of OGC member organizations. Funding will be made available for this purpose. The second phase is further split into phase 2a and 2b, indicating two consecutive pilot activities.

The concept is illustrated in Figure 3 below. Phase 1 activities are shaded in light orange, phase 2 activities in blue, and Testbed-12 activities in green.
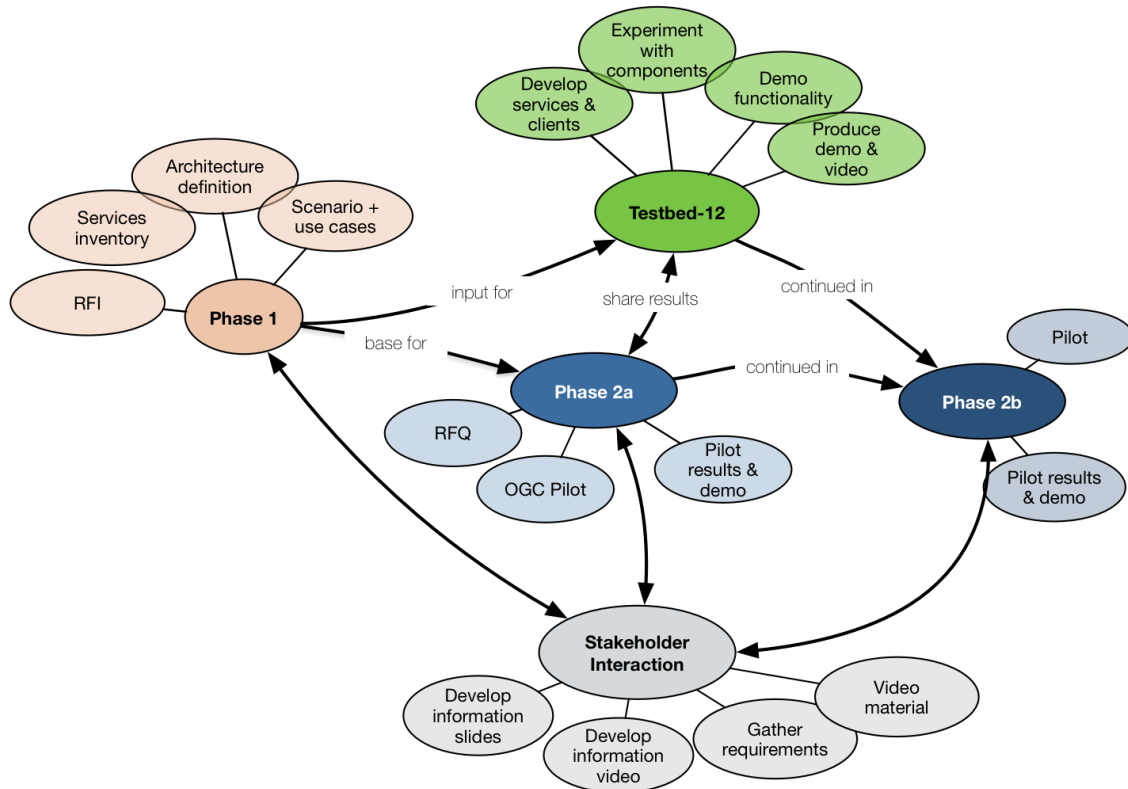
Figure 3: Overview of the two Arctic Spatial Data Pilot phases and major work items

The OGC Concept Development Study and Pilot initiatives are both part of the OGC Interoperability Program, a collaborative effort that applies the OGC Technical Baseline and other (non-OGC) technologies to Sponsor scenarios. Phase one develops an inventory of available geospatial Web services across the Arctic, defines the core components of the Arctic SDI architecture, and defines use-cases and scenarios for future implementations as part of phase two. These activities are complemented by this request for information (RFI) in order to capture the various perspectives, requirements, and opinions by Arctic SDI stakeholders and contributors. Further beyond, the Arctic Spatial Data Pilot phase one serves as direct input for the large-scale interoperability program initiative Testbed-12, where additional support may be made available to test and further develop components identified by the Arctic Spatial Data Pilot.

The goal of Phase 2 is to articulate the value of interoperability and to demonstrate the usefulness of standards. This will be done by implementing the recommended Arctic SDI architecture and developing a video that will tell the story of the scenario(s) and showcase incorporation of the services into Arctic SDI Geoportal and other applications. Phase 2 consists of two consecutive OGC Interoperability Pilots. Funding will be made available as part of phase 2.

3.1 Relationship between Arctic Spatial Data Pilot and OGC Testbed-12

The Arctic Spatial Data Pilot and concept study runs in parallel to the OGC Testbed-12 activity as illustrated in figure 4. Testbed-12 is an OGC activity where sponsors have defined requirements on selected topics. The OGC has released an RFQ to solicit participants'

interest to implement and explore the various components and work items. Further details about Testbed-12 can be found [online](#).

Both the Testbed-12 as well as the Arctic Spatial Data Pilot have components identified that play a role for Arctic SDI. The Arctic Spatial Data Pilot defines the scenarios and use cases and further implements Arctic SDI components to elaborate and demonstrate the usefulness and value of the Arctic SDI. By definition, Testbeds explore components with a lower level of component maturity and experiment with new technologies. Testbeds identify work items that need further exploration, which then could be explored in OGC pilot activities such as the Arctic Spatial Data Pilot.

3.2 Temporal Sequence of Arctic Spatial Data Pilot & Testbed

The following figure illustrates the temporal sequence of Arctic Spatial Data Pilot and Testbed-12 activities. Pilot activities are shaded in light yellow (phase one) and blue (phase two); testbed activities in red.
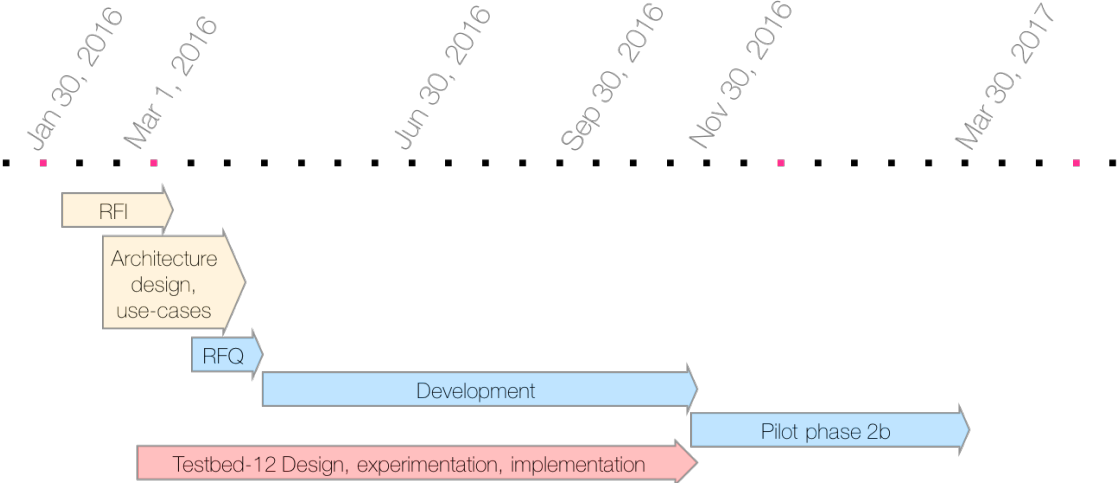

Figure 4: Timing of OGC Arctic Spatial Data Pilot and Testbed-12 activities (Dec 2015 - Mar 2017)

The results from this RFI will form the basis for architecture, design, and use-case definitions of the future Arctic Spatial Data Pilot Phase 2. Simultaneously, requirements and evaluation experiments will be derived that will be further explored as part of Testbed-12. Both initiatives will demonstrate their results toward the end of November, early December 2016. The pilot phase 2b will then continue and implement outstanding work items until the final demonstration in March 2017. Extended exploration in future testbeds or pilots is likely to occur.

4 Responding to this RFI

4.1 Who can apply
This RFI is open to the general public. It is open to all organizations with an interest in the arctic. Responding organizations may have an interest in developing the Arctic SDI architecture, develop spatial data infrastructure components, or provide or consume data relevant for the arctic.

4.2 General terms and conditions
Responses to this RFI are due by the date listed in the Master Schedule (see Section 4.7). Responses will be distributed to members of the organizations listed in section 1.2. Submissions will remain in the control of this group and will used for the purposes identified in this RFI. A summary of the RFI Responses may be made public. If your wish to submit proprietary information, contact (techdesk@opengeospatial.org) in advance of sending the response.

4.3 How to transmit a response
Send your response in electronic version to the OGC Technology Desk (techdesk@opengeospatial.org) by the submission deadline. Microsoft® Word format is preferred, however, Rich Text Format, or Adobe Portable Document Format® (PDF) are acceptable.

4.4 RFI response outline
A response to this RFI shall respond to as many aspects defined in section 1.1 as possible. No particular format is required, but any response should be structured in a way that allows understanding of the respondents' position on key aspects as listed in Section 1.1: Stakeholders, architecture, data, scenarios & use cases, requirements & constraints, operation & organization, and applications & technologies. Respondents are free to add any additional topic as they think appropriate.

4.5 Questions and clarifications
Questions and requests for clarification should be sent to techdesk@opengeospatial.org. Questions received as well as clarifications from the RFI developers will be posted publicly at the OGC Arctic Spatial Data Pilot web site:
http://www.opengeospatial.org/projects/initiatives/arcticsdp

4.6 Reimbursements
The organizations issuing this RFI will not reimburse submitters for any costs incurred in connection with preparing responses to this RFI. Cost share opportunities will arise from the Request for Quotation described in the abstract of this document.

4.7 Master Schedule

The following table details the major events associated with this RFI.

Activity/Milestone	Date
RFI issued	February 24, 2016
RFI responses due	March 18, 2016
RFI result publication	April 7, 2016