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**Concept Development Study Proposal
Defining the Future for the
Marine Spatial Data Infrastructure (MSDI)**

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Contents

Concept Development Initiative: Defining the Future of Marine Spatial Data Infrastructure

1. Purpose:

This proposal presents the Open Geospatial Consortium's (OGC) approach for evaluating the current state and defining the potential future of Marine Spatial Data Infrastructures (MSDIs). The initiative will emphasize on the rapid evolution of technologies and methodologies for generating non-navigational location-based information of value to a broad range of users.

2. Background:

Today's Hydrographic Offices have advanced a global coverage of navigational charts and associated electronic data to support safety of navigation. At the same time, our global society is experiencing rapid advancement of technologies to support littoral, coastal and deep water bathymetric collection as well as a broadening base of authoritative, corporate and citizen sources of hydrographic location information of value to ocean science, energy exploration, sustainable development and many other topics. Examples of emerging capabilities and integrative opportunities include, but are not limited to:

- Crowd-sourced bathymetric data collection
- Autonomous surface and submerged vehicle data collection
- Real time buoy observations
- Satellite / airborne imaging for shallow water bathymetric collection
- Shipboard active bathymetric data collection and navigation
- Explosion of Internet of Things (IoT) devices and their potential application
- Automatic Data Identification (AIS) traffic monitoring and Analytic services
- Big data analytics

Further, the MSDI must be defined such that it is compatible with other SDIs to allow support for integration of other data holdings, including the ability to address topics such as the land / water interface. There is a wealth of marine information not currently managed by Hydrographic Offices, however this information has relevance to a wide variety of non-navigation marine uses, and may also enrich navigational information. What shall be the extent of coverage of the MSDI, and what information assets shall it maintain and reference?

Supporting interoperability of emerging technologies, new information sources and with other SDIs is the underpinning role of open standards and the OGC. Open standards make possible agile sharing and exchange of hydrographic information, along with the ability to rapidly and efficiently extend IT systems to ingest and process new data especially from new technology sources. The International Hydrographic Organization (IHO), the Open Geospatial Consortium (OGC), and ISO/TC 211 are a few of the major Standards Development Organizations (SDO) that are providing core open standards to enable the MSDI.

While a core framework of standards to support MSDI are in place, solutions to major and emerging challenges are required from standards community. One such challenge focuses on identifying and implementing a more efficient and effective mechanisms to organize, retrieve and apply the exploding volume of data being collected by a myriad of devices over the globe.   A Discrete Global Grid System (DGGS) effort is underway in the OGC to support the massive and growing body of location-based information being collected and processed by individuals, governments, businesses, researchers and citizens alike. Other challenges include the need for automated methods for determining the uncertainty associated with and integration of potential sources of data such as crowd-sourced or volunteered geospatial information.

The MSDI is also important to addressing the goals of the United Nations 2030 Agenda on sustainable development and its 17 Sustainable Development Goals (SDG), many of which have a direct need for spatial information and supporting decision support technologies to address these goals. SDG 14 regarding Oceans, Seas and Marine Resources will benefit greatly from a globally consistent MSDI with a level of standards based interoperability that allows rapid mobilization of new and emerging data sources and technologies to address marine topics at local, regional and global level.   OGC is directly contributing to the goals of the 2030 Agenda through its participation in the United Nations Global Geospatial Information Management (UN-GGIM) program, and through its role as a Participating Organization in the Group on Earth Observations.

Further, ongoing and recent OGC interoperability initiatives have bearing on the definition of an MSDI. In addition to engaging the marine community, the OGC will leverage outcomes of prior testbeds and pilots to assist in shaping a MSDI interoperability reference architecture. Such projects include the recently completed Arctic Spatial Data Pilot (Arctic SDP), the International Oil and Gas Producers (IOGP) / IPIECA Oil Spill Response Common Operational Picture Study, and SDI and related Cross Community Information Sharing requirements addressed in OGC's previous interoperability Testbeds.

3. Proposal Objectives:

The goal of this proposal is to evaluate the current state and define the potential future of Marine Spatial Data Infrastructures (MSDIs). It has the following objectives:

- Document the current state of MSDIs
- Document the needs for a MSDI based on current emerging technologies
- Document strategies to interoperate with other Spatial Data Infrastructures
- Develop a common interoperability reference architecture
- Engage with experts from across the user community as well as from the community of technology / information and services providers, including hydrographic offices, industry, government, research, and other SDOs.

4. About the Open Geospatial Consortium:

 The Open Geospatial Consortium, Inc. (OGC) is an international voluntary Standards Development Organization (SDO) that provides a broad interface with over 500 industry, government, academia and

research organizations engaged in advancing standards to improve geospatial interoperability. OGC's standards are implemented in hundreds of products in the global technology marketplace, and are implemented in user community solutions to improve the discovery, sharing, access, fusion and application of geospatial / location based information; and to rapidly mobilize new technologies and information sources.

OGC is comprised of a range of industry, government, NGO, academic and research organizations representing a variety of markets and domains of use – working collectively to advance interoperable best practices and standards to enable rapid mobilization of geospatial technology services, technologies and information. Organizations representing domains such as meteorology and oceans, emergency management, response and recovery; defense and intelligence; urban planning and management are active in OGC. These organizations benefit from coordinating with others in their market or domain of interest. More importantly, members benefit greatly from their ability to advance solutions to address the complex challenge of cross-domain information sharing and processing to address increasingly complex issues such as climate change, and alternative energy planning.

In addition to its proven consensus process for advancing and adopting open standards for implementation and use worldwide, OGC emphasizes an [Innovation Program](#) of fast paced Concept Development Initiatives, Testbeds, Pilot initiatives and Interoperability Experiments. These initiatives allow OGC members to rapidly conceptualize and develop candidate standards and best practice interoperability recommendations in an environment where these standards can be actively and rapidly developed, tested, validated and demonstrated in the context of real world business scenarios.

Since its inception, OGC has been a major enabler of Spatial Data Infrastructure (SDI) programs worldwide to advance a common set of standards to enable the publishing, discovery, access, fusion and application of geospatial / location information for improved decision making.
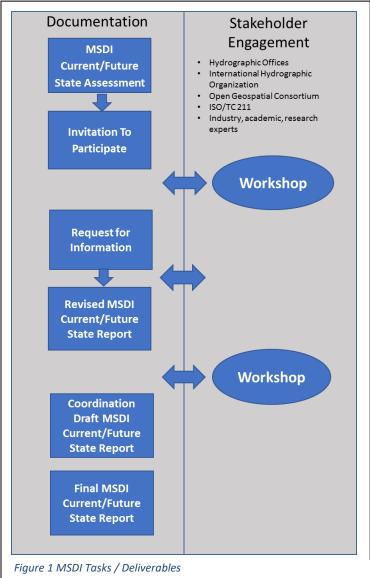
Furthermore, the OGC has a solid track record of partnering with the broader standards community such as with ISO Technical Committee 211 (Geographic Information / Geomatics) and the International Hydrographic Organization, OASIS, OMG, IETF, ITU and the W3C to support cooperative standards and best practice development. One example of this cooperative support includes the successful collaboration between ISO/TC 211, IHO and OGC to develop a set of guides to articulate the value of open geospatial standards and to provide guidance on the implementation and adoption of geospatial standards by the user community. These documents can be downloaded for review at: http://ggim.un.org/ggim_committee.html.

5. Tasks:

The OGC will leverage the proven processes of its successful Innovation Program to organize a Concept Development Study (CDS) Initiative to engage the marine community in assessing current MSDI capabilities and architecture. The CDS will also identify potential MSDI future states based on a range of factors including the rapid evolution of technologies and the broadening base of potential contributors of

useful hydrographic information. The CDS will engage the hydrographic community, SDO membership and other experts from industry, government, academia and research in the cooperative definition of a current and future state MSDI. Major tasks will include:

1. Conduct **initial assessment of MSDI** by researching available documentation and by interviewing experts. The study will present the current state of MSDI, future needs based on the emerging technologies, and an Interoperability Reference Architecture describing the standards framework for the MSDI.

2. Release of an **Invitation to Participate** in a MSDI Current / Future State Workshop to review and refine the draft MSDI Current / Future State report.

3. Convene a one day MSDI Current / Future State workshop in a location agreed upon with the Sponsors, with remote connectivity for invited participants who are unable to attend in person.

4. From the results of the initial Workshop, develop and issue a global **Request For Information** to contribute to the definition of the current MSDI and a future state MSDI that takes into account the implications emerging technologies, new methods of collection and processing, recommendations on extent and content of the MSDI, and the interoperability / standards framework needed to enable MSDI agility to change and growth.

Figure 1 MSDI Tasks / Deliverables

5. Review and consolidate responses to the RFI along with input from the initial workshop and initial assessment into a draft **MSDI Current / Future State Report**

6. Convene a follow-on one day workshop to discuss and **finalize the MSDI Current / Future State Report**.

7. Prepare ***formal coordination draft of the MSDI Current / Future State report***, to include a presentation summarizing the report and its findings, and issue to participants for final review and approval.

8. Perform a final revision based on coordination feedback and ***release the final MSDI Current / Future State Report*** to sponsors and public.

9. Propose a potential follow on OGC ***innovation pilot project or testbed,*** with a focus on key use cases identified in the final report, such as but not limited to cross community bathymetric information sharing for the Arctic.

6. Deliverables and Schedule

Task	Week																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Initial MSDI Assessment and Report		■	■	■	■	■																					
Invitation to Participate in MSDI Workshop				■	■	■	■																				
MSDI Current / Future State Workshop											■																
Request for Information												■	■	■	■	■	■										
Revised MSDI Current / Future State Report																	■	■	■								
Workshop to review and finalize MSDI Current / Future State Report																				■							
Coordination Draft of MSDI Current / Future State Report																					■	■	■				
Release Final approved version of MSDI Current / Future State Report																									■		
Proposed follow on Innovation Pilot or Testbed Recommendation																									■		

7. Cost

The following is a breakdown of OGC's cost proposal submitted as a firm fixed price project:

OGC Cost Proposal Summary		Project
Reference		MSDI CDS
Duration (Weeks)		30
Type of Proposal		Firm Fixed Price
OGC Staff Extended DL Burdened w/Fee		Dollars
1. Management	$	6,812.48
2. Initial MSDI Assessment Current / Future State Report	$	14,404.96
3. Invitation to Participate in Workshops	$	985.53
4. Workshops	$	10,845.48
5. Request for Information	$	2,061.94
6. Initial Draft MSDI Current/Future State Report	$	16,019.60
7 Coordination Draft MSDI Report	$	16,019.60
8. Final MSDI Report	$	4,066.48
9. Pilot Initiative Recommendation	$	5,360.56
Total Direct Labor	$	76,576.63
Other Direct Costs exc. G&A + Fee		Dollars
Travel	$	3,600.00
Total Other Direct Costs	$	3,600.00
Total Price before Adjustment	$	80,176.63
Adjustment	$	(176.63)
Total Price after Adjustment	$	80,000.00

8. Other Considerations.

8.1 Workshop Facilities:

OGC assumes that facilities for the workshops discussed in this proposal will be arranged and provided by Sponsoring organizations at no cost to the OGC. OGC will provide net meeting services as required to support remote participation by participants unable to travel. If desired, OGC will assist sponsors in identifying potential meeting locations by working with its member representatives, who may have facilities and interest in hosting workshop events.

Persons invited to attend workshops in person are expected to cover their own travel costs.

9. Key Personnel

Dr. Luis Bermudez

Dr. Luis Bermudez is the Executive Director of the OGC Innovation program. He has a Ph.D. and M.S. in Environmental Informatics from Drexel University. Dr. Bermudez has more than 20 years of experience in the information and technology industry including geospatial, sensor web, semantic web and legal information. On the last 5 years while working for OGC, he has led numerous initiatives of OGC's Innovation Program and has played the role of system architect on OGC Testbeds.

Prior to joining the OGC in 2010, he was the Technical Manager for the SURA Coastal Ocean Observing and Prediction Program and Technical Lead of the Marine Metadata Interoperability project at the Monterey Bay Aquarium Research Institute (MBARI). In both positions, he advanced solutions implanted world-wide to support management and sharing of coastal data, including numerical models and ocean observing systems. In Colombia (1996-1999), he developed CRM and legal information systems, and provided consulting on strategic planning and technology implementation for Latin America companies.

Mr. Bermudez is an adjunct faculty member in the Master of Professional Studies in Geographic Information Systems program at the University of Maryland, where he teaches topics on GIS, databases, NoSQL, cloud computing and cartographic modeling.

Mr. Lew Leinenweber

Mr. Lew Leinenweber brings significant experience as a Project Manager and Software Engineer, which has been focused on developing systems and capabilities incorporating geospatial technologies. As Director of Innovation Programs, Mr. Leinenweber is responsible for planning, managing and developing architectures for interoperability initiatives such as testbeds, pilots, interoperability experiments.

Since 2005, Mr. Leinenweber has served as Initiative Architect or Initiative Manager for Innovation Program testbeds including OGC Web Services Phase 3 (OWS-3) through OWS-6, and served as Initiative Manager for the OWS-4 testbed. As an OGC member company representative, he served as Chairman of the Emergency & Disaster Management (EDM) Domain Working Group (DWG). During this period, he also served as a member of the Emergency Management Technical Committee in OASIS supporting the development of Emergency Data Exchange Language (EDXL) message standards. Previously, he led software development projects including database migrations and software process improvement initiatives in accordance with the Software Engineering Institute's Capability Maturity Models (CMM and CMMI).

Mr. Leinenweber holds a BS in Physics from University of North Carolina at Chapel Hill and an MS in Computer Science from The Johns Hopkins University in Baltimore, Maryland.

Mr Trevor Taylor

Mr. Trevor Taylor has over twenty-five years of experience in the international Earth Observation community. With a background in Geography (Carleton University, Canada), Mr. Taylor has worked with the Canada Centre for Remote Sensing, Dipix Technologies, Interra (now InterMap) Technologies and PCI Geomatics. Currently, Mr. Taylor is Director, Member Services, Asia and the Americas with OGC.

Mr. Taylor has significant global experience in a wide variety of technical, client services, project, business and strategic planning activities. Example completed project work relevant to standards and the marine domain include Coastal Mapping (near shore, Western Africa), FP-5 GETIS, Participant lead (sample scenario: Marine Vessel Safety, European Union), Cyclone Monitoring (India, Thailand, Vietnam), SAR and Detection of Land/Water boundaries (Canada, Malaysia), Known Depth Analysis, Port and Port approaches charting (Middle East), plus numerous other projects containing a geospatial standards element.

Mr. Taylor has been involved in OGC for fifteen years both as member representative at the technical, principal, principal plus and strategic levels, with a focus on South America, India, China and Western Europe and as OGC staff.