Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences

C S A S | ***S C C S***

Canadian Science Advisory Secretariat | **Secrétariat canadien de consultation scientifique**

Proceedings Series 2006/024 | **Série des comptes rendus 2006/024**

National DFO Workshop on Service-Oriented Architecture (SOA) and Interoperability.

Maurice Lamontagne Institute
Mont-Joli, Québec

March 28 – 30, 2006

P. Lafond*, J. Hamel, S. Hurtubise and T. Evangelatos*

Atelier national du MPO sur l'architecture orientée service (*SOA - Service Oriented Architecture*) et l'interopérabilité.

Institut Maurice-Lamontagne
Mont-Joli, Québec

28 au 30 mars, 2006

P. Lafond*, J. Hamel, S. Hurtubise et T. Evangelatos*

Fisheries and Oceans Canada | Pêches et Océans Canada
Maurice Lamontagne Institute | Institut Maurice-Lamontagne
850 Route de la mer, Mont-Joli, QC, G5H 3Z4 Canada

* Holonics Inc. 200 Montcalm R-9,
Gatineau, QC, J8Y 3B5 Canada

March 2006 | **Mars 2006**

Canada

Foreword

This workshop was not carried out under the coordination of the Canadian Science Advisory Secretariat (CSAS). However, it is being documented in the CSAS Proceedings series as it presents key topics related to the management, use, access and dissemination of scientific data which are of high relevance for the DFO Science Sector. The purpose of these proceedings is to archive the activities, discussions and recommendations of the meeting.

Avant-propos

Cet atelier n'a pas été tenu dans le cadre du Processus consultatif scientifique coordonné par le Secrétariat canadien de consultation scientifique (SCCS). Il est toutefois documenté dans la série des Comptes rendus du SCCS, car il couvre des sujets clés liés à la gestion, l'utilisation, l'accès et la diffusion de données scientifiques qui sont d'une grande pertinence pour le secteur des Sciences du MPO. Le présent compte rendu fait état des activités, des discussions et des recommandations qui ont eu lieu lors de l'atelier.

National DFO Workshop on Service-Oriented Architecture (SOA) and Interoperability.

Maurice Lamontagne Institute
Mont-Joli, Québec

March 28 – 30, 2006

P. Lafond*, J. Hamel, S. Hurtubise and T. Evangelatos*

Atelier national du MPO sur l'architecture orientée service (*SOA - Service Oriented Architecture*) et l'interopérabilité.

Institut Maurice-Lamontagne
Mont-Joli, Québec

28 au 30 mars, 2006

P. Lafond*, J. Hamel, S. Hurtubise et T. Evangelatos*

Fisheries and Oceans Canada | Pêches et Océans Canada
Maurice Lamontagne Institute | Institut Maurice-Lamontagne
850 Route de la mer, Mont-Joli, QC, G5H 3Z4 Canada

* Holonics Inc. 200 Montcalm R-9,
Gatineau, QC, J8Y 3B5 Canada

March 2006

Mars 2006

ISSN 1701-1272 (Printed / Imprimé)

Published and available free from:
Une publication gratuite de :

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Science Advisory Secretariat / Secrétariat canadien de consultation scientifique
200, rue Kent Street
Ottawa, Ontario
K1A 0E6

http://www.dfo-mpo.gc.ca/csas/

CSAS@DFO-MPO.GC.CA

La version française est disponible à l'adresse ci-dessus.

Printed on recycled paper.
Imprimé sur papier recyclé.

Correct citation for this publication:
On doit citer cette publication comme suit :

DFO, 2006. National DFO Workshop on Service-Oriented Architecture (SOA) & Interoperability; March 28 – 30, 2006. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2006/024.

TABLE OF CONTENTS

SUMMARY

Over the past years, several DFO data access initiatives have been undertaken but the lack of a common strategy has resulted in DFO having invested into the development of many data and information systems that are not necessarily able to access one another.

In an era where global integrated systems (ex: GEOSS[1], GoMOOS[2]) are a major component of key scientific programs and action plans (ex: OAP[3], COIN[4]) and where each organisation is expected to readily contribute its knowledge to the community, it is essential that an internal strategy be developed in order for DFO to build up the integrated access to its own assets and to be able to interconnect with its external partners' systems.

To supply a common framework in order to deal with these issues it is felt necessary to develop a strategy and guidelines for the implementation of a service-oriented architecture (SOA) to support DFO scientific data management and accessibility while building on existing regional and national initiatives and respecting their technological specificity and orientations. To achieve this, three steps are being taken. These are:

1. The definition of a model SOA including services and system specifications
2. A pilot project to develop a basic set of tools and demonstrate the SOA approach
3. National Workshop with the following objectives:
   i. A training and discussion session on: SOA and interoperability
   ii. The presentation and discussion of pilot project results
   iii. Discussions on issues and ways ahead for integrated access to DFO scientific data
   iv. Theme sessions

A National Workshop was hosted by MLI on March 28 - 30, 2006 with the following objectives:

- To get a clearer understanding of principles and applications of SOA and by sharing knowledge of what it may mean for DFO Science.
- To define a path for DFO Science for the adoption of SOA and interoperability
- To create synergy that will carry on for follow-on steps to be discussed at this workshop.

Even though the half-day seminar on Service-Oriented Architecture could not be held, the goals proposed for the workshop were successfully achieved. The background knowledge expected to be gained from the seminar was compensated for by the sharing of knowledge between the participants and at the same time those discussions yielded a good understanding of what the implementation of an SOA may mean for DFO Science.

Data used in the science sector cover broad areas of information requiring the need for a wide range of national and international specifications or standards, many of which were discussed during the workshop. Fortunately there is a trend, internationally, towards the harmonization of these standards which will help DFO in its efforts to create an SOA. It was recognized that the implementation of an SOA is a large task but one that is

1 GEOOS : Global Earth Observation System of Systems

2 GoMOOS: Gulf of Maine Ocean Observation System

3 OAP : Oceans Action Plan

4 COIN : Coastal and Ocean Information Network

necessary if the Science Sector is to achieve maximum use of its data archives. It was beyond the scope of this workshop to prepare a detailed long term plan for the implementation of an SOA, but it was successful in specifying a one year plan and getting national commitment to it. The new work builds upon the pilot project executed last year and makes it possible to maintain a high level of enthusiasm and provide the synergy needed for such an important undertaking.

SOMMAIRE

Au cours des dernières années, le MPO a entrepris plusieurs projets d'accès aux données, mais en raison de l'absence d'une stratégie globale, le Ministère a investi dans le développement de nombreux systèmes de données et d'information qui ne peuvent pas toujours communiquer entre eux.

À notre époque où les systèmes globaux intégrés (p. ex. : le système de systèmes mondiaux d'observation terrestre [GEOSS[5]] et le système d'observation océanique du golfe du Maine [GoMOOS[6]]) constituent un élément important de programmes scientifiques clés (p. ex : PAO[7], COIN[8]), et où l'on s'attend à ce que chaque organisation partage volontiers son savoir avec la collectivité, il est essentiel de mettre au point une stratégie interne pour permettre au MPO de structurer l'accès intégré à ses propres systèmes et de se connecter aux systèmes de ses partenaires extérieurs.

Afin d'élaborer un cadre commun pour y parvenir, il est nécessaire de développer une stratégie et des lignes directrices de mise en œuvre d'une architecture orientée service (SOA) en appui à la gestion des données scientifiques du MPO et à leur accessibilité, tout en tablant sur les initiatives régionales et nationales, et tout en respectant leurs particularités technologiques et leur propre orientation. Trois étapes sous-tendent ce processus:

1. La définition d'une SOA modèle, y compris les services et les spécifications du système.
2. Un projet pilote visant à mettre au point un ensemble d'outils de base et à éprouver l'approche en matière de SOA.
3. Un atelier national comportant les objectifs suivants :
   i. une séance de formation et de discussion sur la SOA et l'interopérabilité;
   ii. la présentation et l'examen des résultats du projet pilote;
   iii. l'examen des enjeux et des avenues possibles dans l'avenir pour un accès intégré aux données scientifiques du MPO;
   iv. la tenue de séances thématiques.

Un atelier national a eu lieu à l'Institut Maurice-Lamontagne (IML) du 28 au 30 mars 2006. Les objectifs étaient les suivants :

- Obtenir une vision plus claire des principes et des applications de la SOA et, par l'échange de connaissances, d'en circonscrire les répercussions possibles sur le secteur des sciences du MPO.
- Définir la voie que doit suivre le secteur des sciences du MPO en vue de l'adoption de la SOA et de l'interopérabilité.
- Créer la synergie nécessaire à l'exécution des étapes ultérieures de suivi, selon les discussions de cet atelier.

Bien que la conférence d'une demi-journée sur l'architecture orientée service n'ait pu avoir lieu, les objectifs fixés pour l'atelier ont été atteints avec succès. Le partage de connaissances entre les participants a compensé cette lacune en ce qui a trait au savoir contextuel que la tenue de la conférence devait combler. Les discussions ont en outre

5 GEOOS : Système de systèmes mondiaux d'observation terrestre – Global Earth Observation System of Systems

6 GoMOOS: Système d'observation océanique du golfe du Maine – Gulf of Maine Ocean Observing System

7 POA : Plan d'action pour les océans

8 COIN: Coastal and Ocean Information Network

permis de mieux comprendre les répercussions que la mise en œuvre de la SOA pourrait avoir sur le secteur des sciences du MPO.

Les données utilisées dans le secteur scientifique recouvrent de vastes domaines d'information exigeant un large éventail de spécifications et de normes nationales et internationales qui ont, pour bon nombre d'entre elles, fait l'objet de discussions au cours de l'atelier. Heureusement, on assiste à une tendance vers l'harmonisation de ces normes à l'échelle internationale, ce qui aidera le MPO dans ses efforts de création d'une SOA. On a reconnu que la mise en œuvre d'une SOA constitue une tâche d'envergure, mais qu'elle s'avère essentielle si l'on veut maximiser l'utilisation des archives de données au sein du secteur scientifique. Il n'entrait pas dans le cadre de cet atelier de préparer un plan détaillé à long terme de mise en œuvre d'une SOA, mais on est parvenu à définir un plan sur une année et à obtenir un engagement envers ce plan à l'échelle nationale. Le travail en cours est fondé sur le projet pilote réalisé l'année dernière, ce qui permet de nourrir l'enthousiasme et de tabler sur la synergie nécessaire pour entreprendre un projet de cette importance.

National DFO Workshop on
Service-Oriented Architecture (SOA) & Interoperability

1. Introduction and Objectives

A service-oriented architecture (SOA) allows for the integrated access to distributed data and information from various data sources and information systems through the use of common communication protocols, information technologies and standards. A common approach to developing SOA-type services will take existing systems to a level of interoperability that will result in a wider and more efficient access to DFO's diverse data holdings[9].

Data accessibility not only relies on having database management processes in place and on developing Web applications according to client/user needs but it also requires implementing an architecture based on services and on system interoperability.

Over the past years, several DFO data access initiatives have been undertaken throughout the country. The lack of a common strategy has resulted in DFO having invested into the development of many data and information systems that are not necessarily able to access one another and an initial project is underway to begin to deal with these issues on a national basis. Phase I of this project consists of three deliverables

1. The definition of a model SOA including services and system specifications
2. A pilot project to develop a basic set of tools and to demonstrate the value of the SOA approach
3. National Workshop with the following objectives:
    i. A training and discussion session on: SOA and interoperability
    ii. The presentation and discussion of pilot project results
    iii. Discussions on issues and ways ahead for : integrated access to DFO scientific data
    iv. Theme sessions

2. Workshop Summary

As many as forty-two individuals from all regions of DFO participated in this bilingual workshop which included managers and system specialists from the three sectors of Science, Oceans and Information Management, and Technical Services (IMTS). The workshop agenda is presented in Appendix 1 and the list of participants is provided in Appendix 2.

Unfortunately it was necessary to cancel the seminar on Service Oriented Architectures (SOA) but the other presentations and the discussions helped compensate for this loss and a very successful workshop was nevertheless achieved.

By organizing the workshop around four thematic sessions, each with a well defined list of questions to be discussed, it was possible for the facilitator to initiate discussions on key issues to a level of detail that enabled participants to understand, prioritize, and make a number of important recommendations and decisions that should enable DFO Science to progress with implementing its national strategy for more efficient

9 DFO National Science Data Management Project Proposal

management and accessibility of DFO scientific assets, and to begin the implementation of a national SOA that will foster interoperability of DFO's diverse information systems. These sessions were:

Thematic Session 1: Types of scientific data services
Thematic Session 2: Interoperability Standards
Thematic Session 3: System Development Approach and National Strategy
Thematic Session 4: Follow-on steps to Pilot project

Highlights of the discussions and results of each of these sessions are provided and at the end of the report a summary of all the recommendations and conclusions is provided.

3. Opening Remarks and Introduction to Workshop

Ariane Plourde, Regional Director, Science Branch and Director of the Maurice Lamontagne Institute, gave participants a warm welcome. She was pleased to see representation from every region of DFO and felt that the discussion on the Service-Oriented Architecture (SOA) was very timely and seemed to provide a good approach to solving the difficulties with the discovery, access, use, and distribution of scientific information on a national basis. She enthusiastically supported the investigation and application of the SOA to the sector and wished the group a successful and enjoyable workshop.

Sylvain Hurtubise, the Quebec region representative on the National Science Data Management Committee (NSDMC), also welcomed delegates to the institute and outlined the background for the workshop. He was especially looking forward to presenting the results of the SOA Pilot Project and as mentioned by Ariane Plourde, the SOA provides the technology that the workshop will focus upon for solving some of the issues in obtaining the horizontal integration of science data. After noting that participants are free to use language of their choice he introduced the workshop facilitator, Pierre Lafond and the note taker, Tim Evangelatos.

After noting a few changes to the agenda, Pierre Lafond reiterated the three main workshop objectives as:

- To get a clearer understanding of principles and applications of SOA and by sharing our knowledge of what it may mean for DFO Science.
- To define a path for DFO Science for the adoption of SOA and interoperability
- To create synergy that will carry on for follow-on steps to be discussed at this workshop.

4. Seminar: SOA & interoperability: principles and applications

Unfortunately Invite Dr Abdel Obaid became ill at the last moment and was unable to attend the workshop and present the seminar. However it is hoped to that some mechanism can be found to present the seminar in the near future, possibly by video conference

To compensate for this loss Joanne Hamel provided a brief introduction to Service Oriented Architecture, focusing on the benefits and basic principles of SOA concept. A

glossary was also distributed to participants in order to help with selected SOA related acronyms, concepts and definitions.

5. Pilot Project Overview

1. **Pilot Project Background.** Joanne Hamel used this project to introduce the concept and basic principles of an SOA and also to introduce some of the core technologies upon which this architecture can be built. These technologies are:

   - XML : eXtensible Markup Language
   - SOAP: Simple Object Access Protocol
   - WSDL: Web Service Description Language
   - UDDI: Universal Description, Discovery and Integration

   Joanne described the benefits of using the SOA approach and explained how the vision to test the SOA concept evolved. She also placed SOA and interoperability concepts in the context of the growing need for data exchange both internally and with external partners. The Pilot project was funded by the NSDMC to explore and help develop a strategy for the implementation of a service-oriented architecture (SOA) for DFO Science. In addition, it has delivered a generic toolkit for developers and the linking to four DFO data services to get temperature and salinity data which are described later. The tools included a Web Data Service (WDS) browser and a client data access interface.

2. **SOA Framework and Data Service Development.** Alain Desmeules described the SOA concept in more detail and illustrated how tight coupling between systems produces greater dependencies and can make interoperability more difficult, costly and highly inefficient. He also described the WDS, which can be described as an easy to use connector that defines a series of access methods (or functions) and their behaviour. WDS is a Web service built upon the SOAP technology that allows systems to explore data and can meet most conventional data access needs. By using the WDS, it was possible to access temperature and salinity data from four different sources in different locations. These were:

   - On-line Scientific Buoy Network : real-time data : every 15 min
   - CHS SINECO Water Level Information Network: real-time data : 3 and 15 min
   - BIO TS Climate Database: 33 million observations of water temperature and salinity
   - ODMS – Oceanographic Data Management System : 22 million observations of water temperature and salinity

3. **Interoperability Tests.** Using some simple coding examples, André Gosselin discussed the rather extensive knowledge and effort that would normally be required by a system developer who did not use the approach illustrated by the WDS. Furthermore, without this technology, developers would be on their own and would be less able to make use of other people's code or share the code that they write.

4. **WDS Browser and Data Application.** The WDS browser may be entered at http://www.osl.gc.ca/wds-browser/ . Alain Desmeules introduced participants to the

various functionalities including metadata and data descriptions, data selection (by date, spatial coordinates, depth, etc), and data visualisation (graphical and tabular). Bernard Pelchat demonstrated how a client interface was developed based upon the use of the WDS Browser in order to tap into DFO data sets and extract the desired data. The application allowed participants to access temperature data stored in various databases. It was noted that with appropriate agreements it will also be possible to access external databases. Bernard emphasized the benefits of this approach for sharing data, expertise, and technologies, thereby making integrated access more efficient for the end users. This approach could be applied across DFO to foster cooperation and reduce the inter-regional silo effects and DFO could increase its capacity to distribute all scientific data.

5. **Cookbook and Documentation.** The URL http://www.osl.gc.ca/wds/cookbook/en/ provides a link to a WDS Cookbook and a Java Toolkit developed in the project and which Alain Desmeules briefly described. This information and tools can help others to readily implement other WDS data links. It was noted that the current Cookbook has yet to be translated to English and that it will be useful to explore options for funding the eventual translation costs.

6. **Results and Possibilities.** Alain Desmeules concluded the Pilot project overview by itemizing how this approach improves the efficiency of data access. His points were:

   - Data transport completely handled by HTTP (Internet)
   - Client systems do not require knowledge of database structures anymore
   - Services and client applications can be independent from technologies (types of processors, software, operating systems, programming languages, etc)
   - No specific component required, need only SOAP for data transport
   - Simplicity and accessibility from the viewpoint of service development and access by systems
   - Improved development and maintenance
   - Code can be reused: develop once, reuse many times.

   Alain also noted some aspects of system performance:

   - Level of interoperability provided by SOAP affects performance
   - A certain loss of performance is related to data transport mechanisms and can be translated into milliseconds (buoy database: adds 0.5 seconds when accessing 1000 records). This loss can be compensated by possible compression on the HTTP protocol
   - WDS specification uses a database exploring methodology that prevents overexploiting data sets

   Alain concluded the presentation and set the stage for the discussion of the project by talking about development possibilities including additional WDS to be deployed, the production of profile graphs, maps and WMS, data service aggregation (cascading), toolkits for various programming languages and the need for a service cataloguing approach,

7. **Discussion on the Pilot project:** Pierre Lafond led the discussion by asking the following basic question:

   What did you find interesting (good or bad) about the pilot project?

Paul Bellemare noted that the long held dream to build interoperable systems was no longer just a dream and could now be realized. Others agreed that the technology was no longer an issue but to move forward it was now necessary to deal with organizational issues such as:

- Need for various groups to develop MOU's in order to connect "outside"
- Further, it was not clear how difficult it would be to obtain those MOU's
- Need to promote access and exchange through the Web

Bob Keeley noted that SOA provides a technological solution that was missing in the past. There are organizational issues of resolving the many outstanding differences in managing data across regions. Without an increased level of cooperation across regions, SOA will not be successful.

For some, dealing with "intellectual property" was perceived as a barrier to distributing any data. For example, with regard to BIOCHEM data, a common problem was the loss of control when the data is made available. Others noted that studies have been done that provide prescriptions on how to quote a database for dissemination in the public domain. Further, many organizations are now dealing with the management of the "Digital Rights" within messages provided with the data.

There were also some concern with the overlap between the WDS and the WFS and the future evolution of such similar Web services, and the requirement to also make "gridded" data available though such Web services. The SOAP specification is one of the basic foundations of SOA and for building of the WDS and Alain expects that SOAP will be widely adopted over the next few years. Questions on the future of OGC specification such as WFS and WMS and if they might be rebuilt using SOAP could not be answered but it was recommended that the relationship of WDS, WFS and WMS be clarified.

In response to questions on the quality of the on-line data accessed in the Pilot Project, Alain Desmeules noted that the system will recognize erroneous data if it is flagged as such and reject it. Also with regard to providing more secure access (e.g. passwords) it is expected that some other service would deal with that aspect.

6. Thematic Session 1: Types of scientific data services

The purpose of this session was to define the types of scientific data services that support DFO strategic objectives and enhance decision-making processes in the context of major outcomes such as:

- Safe and accessible waterways
- Healthy and Productive Aquatic Ecosystems
- Sustainable Fisheries and Aquaculture

Group Session 1: Consumers of DFO Data:

The following list describes the organizations and applications that participants identified were users of scientific data collected and archived by DFO.

Summary List of Users and Applications Employing DFO Scientific Data:

1. **Public**

   NGO's, e.g. Wildlife organizations
   ECO Groups
   Recreational (Boating and Fishing)
   Promoters
   Media (Popularizing science)
   Lawyers and Legal System (Domestic and International)

2. **DFO Managers, Scientists and staff**

   Stock/ Resource Assessment
   Canadian Coast Guard
   Oceans
   Habitat
   Fisheries management

3. **Educational Services (Museums, ECO Groups)**

   Academia
   Researchers (university, students, scientists)

4. **Habitat Classification/ Assessment**

   Environment Consulting

5. **Other Government Organisations (OGD's) (e.g DND, EC, SC, HC, provinces, etc.)**

   Scientists and staff (Internal, Federal, provincial, municipal)
   Environnent Canada
   - Marine mammal sample data
   - Fisheries closure
   - Satellite imagery

6. **Industry**

   Transportation
   Fishing Industry
   Aquaculture Industry
   Shipping/Commerce
   Insurance
   Oil and Gas
   Engineering
   Ports
   - Harbour Authorities
   - Water levels
   - Channel depth

7. **Operational Systems (Weather, Ice, Ocean Forecasting)**

   VDC (Virtual Data Centre)

Mapster[10]
Port Information Systems (Navigation and Planning)
Electronic navigation Systems
Weather Network
Multi-Hazard Systems (Tsunami, Wind, Wave, Storm Surge, SAR)
GeoPortal
Data Modeling System (Forecasting)
Ocean Observing Systems (e.g. GoMOOS, SCOOP, COIN)

8. **First Nations**

9. **North Atlantic Fisheries Organization (NAFO)[11]**

10. **International Polar Year[12]**

11. **Emergency Measure Organizations**

12. **Special Interest (Environmental Groups)**

Group Session 2: Interoperable Web Services:

After completing a fairly comprehensive list of its users, a list of the potential Web-based services was developed for use in distributing DFO's scientific data holdings.

List of Possible Services Identified by Workshop Participants:

1. **Remote Access to Databases:** Wireless, read/write service to obtain GPS based data from the field as well as to provide data to satisfy operation requirements
2. **Real-Time (Raw) Data Web Service:** Includes unprocessed but error corrected data (e.g. Tides, temperature, etc.)
3. **Forecasting Web Services**: To cover tides, currents, etc
4. **Environmental Warning Web Service**
5. **Statistical Analysis Web Service**
6. **Database Updating Service**: Links to others to feed data up
7. **Chart Services**: Downloading, and Product updates
8. **Water Level Service**: Includes position, time and water level. Examples were provided in the WDS presentation, SINECO[13] also provides an active Web service.
9. **Habitats' Capacity of Production (Analysis) Web Service**
10. **Bathymetric Surfaces Web Service:** Must employ source data.
11. **Species at Risk Web Service:** In one example this could provide information for construction along water ways. User enters position and radius and gets any species at risk identified. Invasive species could also be covered by this service.
12. **Multi-Species Distribution Web Service:** Includes locations and times.
13. **Interpolation Web services**: From a distribution of readings generate and deliver a grid.
14. **Contouring Services**: For example, may use the grid from the previous service to generate zones or areas of interest.
15. **Vessel Monitoring System (VMS):** One use is to check the accuracy of fishers log books.

[10] http://www-heb.pac.dfo-mpo.gc.ca/maps/maps-data_e.htm
[11] http://www.nafo.ca/
[12] http://www.ipy.org/
13 Système d'Information sur le Niveau des Eaux Côtières et Océaniques – Coastal and Ocean Water Level Information System

16. **Biological Tracking System**: Track acoustic tags attached to various species.
17. **General Monitoring System**: Returns the status of any monitoring item. For example for buoys, this would include the calibration and operational status.
18. **Vertical Referencing System Conversion Web Service;** Convert between various datum's.
19. **Animal Health Surveillance System**: Query zones for different species and disease.
20. **Pulp Finder Tracking System:** Ability to locate storage and movement of pulp wood in rivers
21. **Data Format Conversion Web Service**
22. **Bottom Type Classification Web Service:** An aid to the fishing industry.
23. **Oceanographic Data Web Service:** Generalization of the variables.
24. **Stock Assessment Data Web Service:** For example**,** data released to industry to help preparing for the regional/zonal/national assessment processes.
25. **Sea Surface Temperatures:** For a given area and time period it provides the average temperature.
26. **Web Mapping Service**: Integrate map/charts and remove any overlaps.
27. **Geoprocessing Web Service**: Many applications but must distinguish between application and Web Service.
28. **Biological Samples Catalogue Service**
29. **Common Computational Service**: Example includes observation validation, unit conversion, quality control, etc.
30. **Metadata Catalogue Services**
31. **Geospatial Ontology Service**: To improve catalogue searches and should be multi-lingual.
32. **Bathymetry Source Data Web Service**

Pierre Lafond concluded this exercise by leading a review of the types of services identified above in relation to the data consumers previously identified.

Summary of Day 1

Pierre Lafond quickly summarized the day's activities. This included a review of the Web Data Service Pilot Project with a discussion of what was accomplished in the project followed with a discussion of the pros and cons of that approach. Although it was not exhaustive, the group identified and documented the key consumers of DFO Science data and the possible Web Services that could be built to support those consumers.

The participants agreed that the exercises were a very good learning exercise and set a good foundation for the next phase of the workshop discussions. It was also agreed that organization issues are now the key barriers to implementing an SOA and of developing nationally interoperable systems.

7. Thematic Session 2: Interoperability Standards

The purpose of this session was to identify which interoperability standards and specifications are currently in use within DFO and which ones should be considered for adoption.

Pierre Lafond asked participants to identify what metadata specifications (standards) are being used in each region to describe data. The replies are summarized in the following table:

Summary of Data Access Specifications (Standards) in use in Each Region:

Maritimes Region:

1. Minimum profile of the FGDC[14] specification
2. Looking at GCMD[15] Keywords
3. Potential implementation of ISO19115
4. ESRI products
5. Integrated Taxonomic Information System (ITIS)
6. Potential use of Z39.50 Protocol or service oriented approach in ArcIMS 9.x

Gulf Region:

1. List of regional Keywords.

Quebec Region:

1. Uses own metadata specification but have plans to use ISO 19115
2. CHSDIR (proprietary but being moved to ISO 19115) - while CHSDIR was only mentioned by the Quebec Region it is used by all CHS regional offices and headquarters.
3. Codes and data from sites in Ottawa
4. In-house Oceanography Specification

Ottawa:

1. GCMD
2. Minimum profile of the FGDC specification
3. Data Dictionary – Variable names from across the regions and the beginning of a mapping of these names. Names may correspond to those used by the international community but the latter is a de-facto standard and is not formally endorsed by anyone.
4. Ship Coding scheme used internationally and which is maintained by the US.
5. Similar situation for country codes.
6. Integrated Taxonomic Information System (ITIS)[16]
7. Computational Routines for depth and temperature
8. Ottawa is using the Metadata tool M^{3}Cat in conjunction with the GeoPortal to handle the national catalogues for MEDS.

Burlington

1. Integrated Taxonomic Information System (ITIS)
2. ISO Specification for publishing Units (e.g. temperature)

Winnipeg:

1. No official Metadata Specification.
2. Peer reviews
3. Some scientists follow international standards

Pacific:

1. Ocean Habitat Catalogue (Based upon FGDC)
2. Z39.50 Protocol[17]
3. Spatial Holdings organized under ISO Categories
4. ESRI Products
   a. IHO – S57 for nautical charts (Used nationally and internationally). - while this was only mentioned by the Pacific Region it is used by all CHS regional offices and headquarters.

[14] http://www.fgdc.gov/
[15] http://gcmd.nasa.gov/Resources/valids/keyword_list.html
[16] http://www.itis.usda.gov/
[17] http://www.cni.org/pub/NISO/docs/Z39.50-1992/

Following a brief discussion and concurrence that any search capability must support both French and English, the group recommended that DFO Science should explore the following metadata specifications before adopting any specific one:

Metadata Specifications to be assessed (Standards) for DFO Science
1. FGDC Specification until the ISO 19115 is approved 2. ISO 19115 including: a. NA Profile (Canadian contact is Jean Brodeur (brodeur@nrcan.gc.ca)) b. ISO Meteorological Profile (Contact is Steve Foreman (steve.foreman@metoffice.gov.uk)) c. ISO Oceanographic Profile d. FGDC Biological Profile 3. OGC Catalogue Specifications (Formally harmonized with ISO) 4. Controlled Vocabulary: (e.g. for the Science Data Dictionary and harmonized with GCMD) 5. IOC / IODE Ocean Portal[18] Controlled List of Keywords / Categories 6. Dublin Core Metadata Initiative[19] (A Treasury Board requirement for common look and feel)

It was recommended that the Metadata workshop, that is to be held in June 2006, addresses those and formally makes recommendations at the end of the meeting.

To provide leadership and create momentum for the harmonization of the oceanographic metadata, internationally and well as nationally, DFO should complete and publish an internally approved specification which can then be presented to IOC for wider consideration in the international community. In addition it is important to monitor the activities of the Marine Metadata Interoperability Project (MMI)[20] which covers many of the areas of interest.

Pierre Lafond asked participants to identify what services and standards are being used in each region to catalogue and register data. The replies are summarized in the following table:

[18] http://ioc.unesco.org/oceanportal/power_search.php
[19] http://dublincore.org/
[20] http://marinemetadata.org/

Summary of Catalogue/Registry Specifications (Tools and Services) in use:
Maritimes Region: 1. Looked at a number of technologies 2. Some issues with M^{3}cat and using MetaManager from Compusult 3. License for ESRI ARC IMS – Z39.50 connector but nothing is implemented yet
Gulf Region 1. FGDC with Z39.50 is used for Traditional Fishing Data.
Quebec Region: 1. GeoPortal Links 2. Z39.50 3. MetaManager 4. The Discovery Portal describes some of the region's data. At issue is how to handle the region's many small catalogues and also take advantage of what CGDI has to offer.
Ottawa: 1. Discovery Portal 2. M^{3}Cat with FGDC
Burlington No Catalogue
Winnipeg: No catalogue
Pacific: 1. Publish own Webpage using local Metadata Catalogue 2. ESRI ARC Catalogue 3. Produce own metadata for publishing 4. Z39.50 which is very slow

Z39.50 is an older specification intended particularly for use by systems supporting information retrieval services for organizations such as libraries, information utilities, and catalogue centers. It is slow and it was recommended to replace Z39.50 with the OGC Catalogue services.

The discussion on a national strategy to manage data catalogues ranged from the two perspectives of having a decentralized approach provided the catalogues can be found and searched, to a centralized depository. Some felt that although a decentralized approach was feasible in theory, it imposed too much compromise in its implementation.

Bob Keeley noted that DFO Science has a policy for the completion of the national data inventory and is committed to a national catalogue that can be searched through the Web. How it will be implemented, whether centralized or distributed, will depend upon the state of the technology and the bandwidth available between the regions. Its design and governance will be through the National Science Data Management Committee (NSDMC).

In concluding the discussion on catalogues and metadata, Pierre Lafond raised the question of how DFO Science would register their data catalogues and deploy specific data services. As nothing is in place yet, two possibilities were discussed: the OGC Catalogue Service and the Universal Description, Discovery and Integration (UDDI) protocol[21]. It was recommended that these two specifications be evaluated, in terms of

[21] http://www.uddi.org/

the acceptance by clients and technology providers and their readiness to be deployed to meet DFO's catalogue needs.

Pierre Lafond then asked participants to identify what Web services specifications are being used in each region to deploy data access. The replies are summarized in the following table.

Summary of Web Services in use in the Regions			
Web Service	**WMS**	**WFS**	**Others**
Region			
Maritimes	Yes	Yes	SLD also used
Gulf	No	No	No Web Services
Quebec	Yes	Yes	WDS (Internally) and other non-standard on-line services)
Ottawa	Yes	Yes	
Burlington	No	No	
Winnipeg	Yes	No	
Pacific	Yes	Yes	SLD also used

Pierre Lafond asked participants to identify which additional relevant specifications and standards are required for SOA infrastructure components (service definition, communication protocols, security, orchestration, etc)?

Dwight McCullough suggested that we require XML and possibly its specialization for geospatial data, namely GML[22]. However to use GML a new schema for oceanographic data would have to be developed and its performance in handling large volumes of data would have to be investigated. Other formats requiring support for scientific data are the following two from World Meteorological Organization (WMO):

- GRIdded Binary (WMO (GRIB))[23]
- Binary Universal Format Representation (BUFR)[24]

Other specifications that were discussed included:

- Web Services Description Language (WSDL)[25] for encoding data in XML
- RSS[26].format for automatic broadcasting of data must be considered.
- Web Coverage Service (WCS)[27] from the Open Geospatial Consortium
- CGDI Web Services (Appendix 7)
- Hierarchical Data Format (HDF)[28]
- Common Data Format (CDF)[29] for multi-dimensional data
- Ontology Service

Robert Nowlan also identified a requirement for dealing with other types of media such as video.

[22] http://opengis.net/gml/
[23] http://www.wmo.ch/web/www/WDM/Guides/Guide-binary-2.html
[24] http://www.wmo.ch/web/www/WDM/Guides/Guide-binary-1A.html
[25] http://www.w3.org/TR/wsdl
[26] http://www.xml.com/pub/a/2002/12/18/dive-into-xml.html
[27] http://www.opengeospatial.org/specs/?page=specs
[28] http://hdf.ncsa.uiuc.edu/whatishdf.html
[29] http://cdf.gsfc.nasa.gov/

Interoperability, the SOA, and Security Concerns

DFO, led by IMTS, is upgrading its security protocols to meet new Treasury Board guidelines and these will have an impact on how computer networking is carried out in the department. However it was felt that the following items must also be taken into consideration:

- Treasury Board Guidelines
- Distributed Systems for data
- HTTPS use
- Simple Object Access Protocol (SOAP)[30] Version 2
- Distributed Access Control System (DACS)[31]
- Interoperability and copyright
- Unanswered Questions Covered:
  - How to define roles on an enterprise level?
  - How do we migrate from existing security to the new SOA architecture?
  - What levels of encryption do we use?
- For Transactions Consider:
  - Business Process Execution Language (BPEL)[32]
  - Enterprise Service Bus (ESB)[33]
  - Simple Object Access Protocol (SOAP)·link with OGC
  - Web Services Description Language (WSDL)[34]

Recommendation: Study what IMTS is doing and also discuss security issues and direction with them.

Recommendation: Adopt SOAP Version 2.

8. Thematic Session 3: National Strategy for SOA Development

The purpose of this session was to define a common approach to data access system development and outline the elements of a national strategy for DFO Science in the context of SOA and interoperability,

Pierre Lafond asked participants to consider what should be included into the strategy in terms of the perceived benefits, architectural level, issues to be dealt with, how it should be implemented, and what barriers and challenges may to be faced. The orchestration of the SOA development is crucial and it is also important to identify who will coordinate the work and who will lead the various aspects. The following bullets summarize the conclusions of the discussion.

1. Summary of Benefits of the SOA Identified by Participants

- Improves efficiency of finding and accessing data
- Improves accessibility to data on a national scale
- Simplifies development of the computer systems and their use
- Enables greater reuse of software tools
- More flexible system development and provides platform independence
- Current approach to enterprise systems

[30] http://ws.apache.org/soap/
[31] http://www.geoconnections.org/CGDI.cfm/fuseaction/geoInnovations.details/id/414/pgm_id/1/gcs.cfm
[32] http://www-128.ibm.com/developerworks/library/specification/ws-bpel/
[33] http://www-306.ibm.com/software/info1/websphere/index.jsp?tab=integration/esb
[34] http://www.w3.org/TR/wsdl

- Helps reduce the “SILO” effect
- Facilitates system interoperability
- Allows organization to rise to a higher level of service
- Reduces system coupling while proving a better level of service
- Helps organization make better use of their expertise
- Allows greater deployment of “open systems”, a TB directive.
- Cost Avoidance by:
    - Re-use of developed services
    - Re-use of existing hardware and services
    - Development can benefit others
    - Reduced cost to respond to data requirements
    - Ease of operation and maintenance (less involvement of data experts)

Pierre Lafond then asked the participants what would happen if it was found out after a year that SOA is not the way to go. What have we gained and what have we lost?

The participants answered:

- Costs After 1 year not too high
- Increased level of cooperation among regions
- Major incentive for national cooperation and standardization
- Software components developed and available for everyone to use
- Reduces risks of not being able to access data if other methods are not in place

2. Risk Mitigation

- Start small
- Make something available for users

3. User Considerations

- Find champions
- Employ collective knowledge of the National Science Data Management Committee
- End users must be part of the overall strategy development and this can be done through consultations and engaging the users directly (e.g. in person). End users should have representation on the project team, and should be formally recognized with a position on the project organizational chart.
- Engage the users as early as possible in the project and conduct appropriate user surveys and make sure they are not overlooked.

4. Concerns/Challenges/Barriers and Weaknesses of Implementing the SOA

- Leading Edge technology
    - How close do we want to be to the leading edge?
    - Quickly changing standards, protocols and practices
    - Need for up-to-date knowledge
- Impact on performance has to be determined
- Approval process by NSDMC for SOA development, to ensure that service development is coordinated across regions
- Will effort be adopted by others?
- Demands a greater degree of cooperation between regions
- Complexity of making functional changes to existing services and related dependencies

- Redundant data is a problem
- The impact of software updates on systems and user
- System analysis requirements to identify dependencies
- Managing/documenting and adding new components
- 3-year plan hard to prepare

5. Risks

- Finding resources
- Local implementations may not satisfy department wide needs
- Keeping software up-to-date
- Setting expectations too high (Need to balance expectations with reality)
- Return on investment?

6. Unresolved Issues

- Whether to approach users from a national or local perspective, and
- Similarly, how to deal with education and training across the sector.

7. Vision Statement and Project Charter to be developed

- Governance Structure and Project Charter
- Roles and responsibilities
    - Business experts
    - Technical experts

Following extensive discussion on all of the above topics the following strategic direction for the next fiscal year was agreed upon and which was used the following day to develop an action plan for 2006/07.

Strategic Direction for 2006/07

1. Educating people on the concept and benefits of implementing an SOA
2. Involve end-users in any proposed project
3. Identify a Test Case (Service) and implement it
4. Expand Pilot Project to include oceanography/biochemistry
5. Utilize survey conducted by the CHS to determine bathymetry requirements
6. Conduct market research to determine priorities for services for users
7. Save time and effort to find data by implementing catalogue of the Science archives and determine if the catalogue should be implemented as a Web service
8. Prioritize and create the metadata needed to complete the archive catalogue
9. For document management look at links to EKME or create a library
10. Exercise care with respect to what is promised

Summary of Day 2:

Pierre Lafond acknowledged the breath and depth of the discussions and the wide range of views that had been expressed but felt they would serve as a good basis for developing a plan and specific defining actions for the next steps of evolving to an SOA in DFO Science.

9. Thematic Session 4: Follow-on Steps to Pilot project

The purpose of this session was to identify follow-on steps to Interoperability Pilot Project for 2006/2007.

Based upon the strategic decisions of the previous session specific plans and national actions were identified and agree on. **Volunteers were sought to prepare specific proposals to go to NSDMC.**

Work Plan for 2006/07

1. Extend WDS Pilot Project to other regions. Consider extensions for:

    - Biochemistry;

    - Water levels; and

    - Conduct a high risk test by providing access to a high volume non-database (i.e. non-SQL) data. This will test the SOA concept of providing access to large and non-DB compliant data. To experiment such high volume SOA a prototype for a bathymetry web service was proposed.

    - Joanne Hamel (IML) volunteered to lead the proposal for an extension of the pilot project and proposed to include an access to the MEDS archives as a test involving national, high volume and complex data sets. That should help demonstrate and obtain acceptance of the SOA concept. Data stored in different formats (e.g. database-based, file-based) can be used and MEDS must be involved in the project and where feasible, other regions offered to participate.

2. Build a national Catalogue Service with Bob Keeley (MEDS) as proposal leader.

3. Develop a Guide on Implementing Web Services in DFO Science with Sylvain Hurtubise as the proposal leader. Educational material from GeoConnections[35] should provide a basis for this effort.

4. Build a network of “Experts”. To collect and help share information Bob Keeley suggested that a virtual Centre of Expertise be established. In the Maritimes Region, “Data Management” is a priority and they are preparing a report on that topic which should be available by mid-April 2006. Further Doug Gregory has developed background material on national inventories (Attachment 7). Similar reports on related topics such as standards in DFO Science (Attachment 5) and access to data in DFO Science are also available (Attachment 6).

5. Develop a program to educate staff and users on SOA. This should include a seminar on the SOA as had been originally planned

[35] http://www.geoconnections.org/publications/training_manual/e/

Proposed SOA Development 2006/07 – Summary of Regional Participation				
Region	**WDS Extension**	**Catalogue Service**	**Education:** SOA Video Conf. Virtual Centre of Exp. Action Plan	**Comments**
IML	Project Lead	Yes	Strong interest	Broad local participation
Maritimes		To be determined	"	Part of regional objectives and a report on regional plans will be issued next week.
Moncton	If feasible	If feasible	"	
Ottawa	Yes	Project Lead	"	MEDS to discuss with reg. representatives (ISDM)
Burlington	No	Provide DB link	"	
Winnipeg	No	No	"	No resources
Pacific	To be determined	To be determined	"	Possible resource from Science Sector

Bob Keeley noted that the NSDMC will soon be issuing a call for project proposals and he feels that the workshop has provided a good forum for discussion, recommendations, and setting of priorities on what we want to do in the domain of SOA. He would now like to see teams coalesce around the various topics and submits proposals.

10. Workshop Wrap-up

As time was short, Pierre Lafond did not attempt to review all of the accomplishments achieved in the workshop but he asked each participant to comments on their experience.

Participants Comments on the Workshop:

Joanne Hamel: I am very happy with the workshop, the turnout and the level of participation. The bilingual aspect was also excellent and helped to encourage discussion.

Pierre Bélanger: The pilot project has generated a lot of new ideas and although we have big plans but we have made a good start..

Marc Journault: The discussions were good and useful, and the workshop objectives were met.

Paul Couture: A very interesting workshop and it was good to meet colleagues from other parts of Canada.

Dwight McCullough: We have been addressing a long-standing problem in the department and the workshop was a great start but it will be important to bring the end-users into these discussions. Also it was very good to meet everybody.

Tania Trivedi: I was able to gather a lot of information and have a new understanding and appreciation of the issues.

Denis Bernier: I agree with the previous comments and I was pleased that we did not get ground up in a lot of technical jargon.

Blair Dunn: Enjoyed the discussions and I agree with the other comments.

Patrick Dupont: The workshop provided a good start into democratizing the department's data and as an information integrator this effort will help me to meet the needs of my clients. I found it to be a very good workshop.

André Gosselin: From the perspective of a data manager, this was a very good exercise and useful in bringing us down to earth.

Alain Desmeules: A good exercise and I agree with the other comments**.**

David Gauthier: I now have a better understanding of the SOA and I look forward to seeing the report on the workshop.

Pierre Pineau: As a developer I found the workshop very interesting, thank you.

Peter Wills: For me this was a good exposure to the SOA and I return to IOS with a greater interest.

Tobias Spear: This was my first experience with a real-time bilingual workshop and it was very good for me. In my region this workshop will give me more leverage to deal with operational issues.

Patrice Cousineau: In the workshop I saw some new things**.** Also the DFO enterprise is a business and we have the knowledge and desire to make the department function in a business-like manner**.**

Robert Nowlan: I am happy to know that we will see a series of proposals that will emerge from this workshop. I see that the SOA can provide the technology to provide accessibility to our data, to foster greater interoperability, cooperative development, and bring on the demise of the "silo" era.

Bob Keeley: We needed to have this discussion on the SOA which as we saw is the technological vehicle upon which we can develop national systems. I am pleased with the work that we were able to accomplish and our success in addressing basic issues and to make the department face them. I would also like to thank IML for suggesting the idea of an SOA for leading the Pilot Project, and for hosting this workshop.

Sylvain Hurtubise: I am very happy with the results of the workshop and pleased to see the cooperation between regions, sectors and managers. I am also pleased that we were able to agree on a number of important actions and to develop a national plan

– a major accomplishment with the elements required for success. Pleased to see the positive reception to the pilot project by other regions.

Several of the participants simple echoed the views that had been expressed by others.

Sylvain Hurtubise closed the workshop by thanking the facilitator, Pierre Lafond, for his energy and ability to lead a very dynamic workshop. He expressed appreciation to the note-taker, Tim Evangelatos, for contributing his knowledge and experience, and to the interpreters, Brian and Gabriel, for their excellent efforts and thanked Diane Bélanger for taking care of all the logistics required for the workshop.

11. Summary of Workshop Recommendations

1. Invite Dr Abdel Obaid or identify another expert to present a seminar on “Service-Oriented Architectures and Interoperability: Principles and Applications” through a national video conference.
2. Study what IMTS is doing. and also discuss security issues and direction with them
3. Adopt SOAP Version 2.
4. For the introduction of SOA technology, start small and make something available to users.
5. Find champions to support the SOA on both local and national basis.
6. Employ the collective knowledge of the Science Data Management Working Group. Consider creating a virtual “Centre of Expertise”.
7. Conduct appropriate user surveys as one way to get the users involved in the SOA initiative.
8. Educate data managers and data collectors so that there data will be discoverable and accessible.
9. Don’t let expectations exceed our ability to deliver.
10. Exercise care with respect to what is promised.
11. Clarify the relationship and evolution of WDS with the OGC’s WFS and WMS.
12. Establish environment/culture of software re-use rather re-invention.
13. Approach the IOC to lead the harmonization of oceanographic metadata.
14. The Metadata workshop, that is to be held in June 2006, will address metadata specifications for DFO Science and will formally make recommendations at the end of the meeting.

Specific Tasks Recommended for 2006/07:

1. Develop a program to educate staff and users on SOA Involve people in any proposed project.
2. Identify a Test Case (Service) and implement it.
3. Extend WDS Pilot Project to other regions.
4. Expand Pilot Project to include oceanography/biochemistry and bathymetry.
5. Utilize survey conducted by the CHS to determine bathymetry requirements.
6. Look at market research to determine priorities for services for users.
7. Build a national Catalogue Service.
8. Prioritize and create the metadata needed to complete the archive catalogue.
9. For document management look at links to EKME or create a library.
10. Develop a Guide on Implementing Web Services in DFO Science.
11. Implement a virtual Centre of Expertise.
12. Build a network.

12. Workshop Conclusions

Even though the seminar on the Service-Oriented Architecture was not held, the workshop was able to successfully achieve the goals proposed for the workshop. The background knowledge expected to be gained from the seminar was compensated for by the sharing of knowledge between the participants and at the same time those discussions yielded a good understanding of what the implementation of an SOA may mean for DFO Science.

Data used in the science sector cover broad areas of information requiring the need for a wide range of national and international specifications or standards, many of which were mentioned during the workshop. Fortunately there is a trend, internationally, towards the harmonization of these standards which will help DFO in its efforts to create an SOA. It was recognized that the implementation of an SOA is a large task but one that is necessary if the Science Sector is to achieve the maximum use of its data archives. It was beyond the scope of this workshop to prepare a detailed long term plan for the implementation of an SOA, but it was successful in specifying a one year plan and getting national commitment to it. The new work builds upon the pilot project executed last year and makes it possible to maintain a high level of enthusiasm and to provide the synergy needed for such an important undertaking.

Appendix 1. Workshop Agenda

DFO National Workshop on Service-Oriented Architecture (SOA) & Interoperability

Maurice Lamontagne Institute, Mont-Joli, QC
Estelle Laberge Auditorium
March 28-30, 2006

Revised Agenda

DAY 1 Tuesday, March 28

08h00-08h30 ▸ Registration
08h30-08h45 ▸ Opening remarks
08h45-09h00 ▸ Introduction, workshop objectives
09h00-12h00 ▸ Seminar: « SOA & Interoperability: principles and applications » by Prof. A. Obaïd, UQÀM[36]

12h00-13h00 ▸ LUNCH

13h00-13h45 ▸ Pilot project overview
13h45-14h45 ▸ Results
14h45-15h00 ▸ Recommendations

15h00-15h30 ▸ BREAK

15h30-16h30 ▸ Discussions, round table
16h30-17h00 ▸ Day 1 wrap-up
17h00-19h00 ▸ Ice-breaker / Networking

DAY 2 Wednesday, March 29

Theme Session 1: Defining the types of scientific data services that support DFO strategic objectives and enhance our decision-making processes in the context of the main outcomes:

- Safe and Accessible Waterways
- Healthy and Productive Aquatic Ecosystems
- Sustainable Fisheries and Aquaculture.

09h00-09h15 ▸ Introduction
09h15-11h45 ▸ Discussions:
Breakout groups and general discussions about DFO data services (existing or to be developed) and service consumers (systems/applications/end-users), both internal and external.

11h45-12h00 ▸ Wrap-up

12h00-13h00 ▸ LUNCH

[36] Dr Abdel Obaid is a professor and director of the Department of Computer Science at the University of Quebec in Montréal (UQÀM), and also a researcher at LATECE. Prof. Obaid holds a "Doctorat 3ème cycle" from the Université de Bordeaux (1982) and a PhD in computer science from the University of Ottawa (1991). Dr Obaid has been with the computer science department of UQÀM since 1996. His research interests are in distributed systems and advanced telecommunications services, with applications to m-business (mobile business).

Theme Session 2: Identifying interoperability standards and specifications currently in use within DFO and ones that should be considered for adoption.

13h00-13h10 ▸ Introduction
13h10-15h00 ▸ Discussions:
Breakout groups and general discussions about recognized standards in areas such as metadata, cataloguing, communication protocols, security, data dictionaries, etc.

15h00-15h30 ▸ BREAK

15h30-16h30 ▸ Discussions
16h20-16h30 ▸ Day2 wrap-up

DAY 3 Thursday, March 30

Theme Session 3: Defining a common approach to data access system development and the elements of a national strategy in the context of SOA and interoperability.

09h00-09h10 ▸ Introduction
09h10-11h50 ▸ Discussions:
Breakout groups and general discussions: identifying key elements of a national strategy, strengths, benefits and challenges.

11h50-12h00 ▸ Wrap-up
12h00-13h00 ▸ LUNCH

Theme session 4: Taking the Interoperability Pilot Project further in the context of the National Science Data Management Committee (NSDMC) national approach to Data Accessibility.

13h00-13h20 ▸ Introduction
13h20-15h00 ▸ Discussions:
Breakout groups and general discussions: identifying next steps, priorities and scope.

15h00-15h15 ▸ BREAK

15h15-16h00 ▸ Workshop review, roundtable and conclusion.

Appendix 2. List of Participants

Participant	Organization	Day 1	Day 2	Day 3
LAFOND, Pierre	Holonics Inc.	1	1	1
DUNN, Blair	MPO/DFO-C&A	1	1	1
TRIVEDI, Tanya	MPO/DFO-C&A	1	1	1
BÉLANGER, Pierre	MPO/DFO-GLF	1	1	1
NOWLAN, Robert	MPO/DFO-GLF	1	1	1
SPEARS, Tobias	MPO/DFO-MAR	1	1	1
COUSINEAU, Patrice	MPO/DFO-NCR	1	1	1
MCCULLOUGH, Dwight	MPO/DFO-PAC	1	1	1
WILLS, Pete	MPO/DFO-PAC	1	1	1
BUSSIÈRES, Martin	MPO/DFO-QUE	1		
LEBLOND, Andrée	MPO/DFO-QUE	1		
PROULX, Jean-François	MPO/DFO-QUE	1		
LOIGNON, Sylvain	Innovation Maritime	1		
CAVEEN, James	ISMER, Université du Québec à Rimouski	1		
LAPOINTE, Martin	CIDCO, Centre Interdisciplinaire de dévelop. de la cartographie des océans	1		
CAUGHIE, Robert	Seaquest Technologies	1		
KEELEY, Robert	MPO/DFO-NCR	1	1	1
PLOURDE, Ariane	MPO/DFO-QUE	1		
GOSSELIN, Serge	MPO/DFO-QUE	1	1	1
HURTUBISE, Sylvain	MPO/DFO-QUE	1	1	1
DESMEULES, Alain	MPO/DFO-QUE	1	1	1
HAMEL, Joanne	MPO/DFO-QUE	1	1	1
PELCHAT, Bernard	MPO/DFO-QUE	1	1	1
DUPONT, Patrick	MPO/DFO-QUE	1	1	1
JOURNAULT, Marc	MPO/DFO-QUE	1	1	1
GOSSELIN, André	MPO/DFO-QUE	1	1	1
LEFRANÇOIS, Carl	MPO/DFO-QUE	1		
RATTÉ, Keven	MPO/DFO-QUE	1		
PROULX, James	MPO/DFO-QUE	1		
PINEAU, Pierre	MPO/DFO-QUE	1	1	1
BELLEMARE, Paul	MPO/DFO-QUE	1		1
FORTIN, Gilles	MPO/DFO-QUE	1	1	1
BARIL, Daniel	MPO/DFO-QUE	1	1	1
BERNIER, Denis	MPO/DFO-QUE	1	1	1
GAUTHIER, David	MPO/DFO-QUE	1	1	1
DEVINE, Laure	MPO/DFO-QUE	1	1	1
LAFLEUR, Caroline	MPO/DFO-QUE	1	1	1
SAINT-PIERRE, Isabelle	MPO/DFO-QUE	1		
LAVOIE, Fred	MPO/DFO-QUE	1	1	1
COUTURE, Paul	MPO/DFO-QUE	1	1	1
LAPIERRE, Jean-Phillip	MPO/DFO-QUE	1	1	1
EVANGELATOS, Tim	Holonics Inc.	1	1	1
Total		**42**	**29**	**30**

Appendix 3. Questions for Participants

Thematic Session 1: Types of scientific data services

Purpose To define the types of scientific data services that support DFO strategic objectives and enhance our decision-making processes in the context of the major outcomes:

- Safe and accessible waterways
- Healthy and Productive Aquatic Ecosystems
- Sustainable Fisheries and Aquaculture

1. Who are the external end-users that are consumers of DFO scientific data?
2. Who are the internal end-users that are consumers of DFO scientific data?
3. Which external systems/applications could be a direct consumer of DFO scientific data?
4. Which internal systems/applications could be a direct consumer of DFO scientific data?
5. What existing services/programs could be deployed as interoperable web services to meet the needs of data consumers? What data is required for these services?
6. What new/additional service could be offered with existing scientific data to meet the needs of data consumers? What data is required for these services?

Thematic Session 2: Interoperability Standards

Purpose To identify which interoperability standards and specifications are currently in use within DFO and which ones should be considered for adoption

1. Which standards are currently in use across the department for metadata?
2. Which standards need to be supported?
3. How could we define a minimum metadata profile that would satisfy all interoperability standards to be supported?
4. Which catalogue/registry services are currently in use in the department? How are you cataloguing metadata about data and services?
5. Which standards should be adopted / supported to maximize dissemination of metadata on DFO scientific data holdings and services to multiple national and international communities?
6. What key reference entities (e.g. species, countries, sampling gear, etc) should be standardized across DFO for scientific data interoperability?
7. Which national/international standards could apply to them?
8. Which standards are currently in use by regions to deploy specific data access services?
9. Which standards should be adopted / supported to maximize use of DFO scientific data holdings and services internally and externally by multiple national and international communities?

10. Which additional relevant specifications and standards are required for SOA infrastructure components (service definition, communication protocols, security, orchestration, etc)?

Thematic Session 3: System Development Approach and National Strategy

Purpose To define a common approach to data access system development and elements of a national strategy in the context of SOA and interoperability

1. What are the key elements of a national SOA-based data access system development strategy?
2. What are the strengths and benefits of a national SOA-based data access system development strategy?
3. What are the barriers to implementation and challenges of a national SOA-based data access system development strategy? (cost, people, performance, security of access, time/schedule, privacy, etc.)

Thematic Session 4: Follow-on steps to Pilot project

Purpose To identify follow-on steps to Interoperability Pilot Project for 2006-2007

1. From the list of services identified which ones should be tested and deployed in a follow-on project to the Pilot Project? Should existing pilot services be deployed horizontally across all regions? Should new services be deployed?
2. Which standards should be tested/deployed in the follow-on project?
3. What additional activities should be undertaken to evolve the SOA infrastructure?

Appendix 4. Pilot Project – Executive Summary

Development of a strategy for the implementation of a Service-Oriented Architecture (SOA) supporting efficient management and accessibility of DFO scientific data assets and ensuring interoperability of information systems.

Pilot Project
Executive Summary

Context

Data accessibility not only relies on having database management processes in place and on developing Web applications according to client/user needs but it also requires implementing an architecture based on services and on system interoperability. Such services include data services, Web services, computing services, etc. They could be described as interfaces between systems.

A service-oriented architecture (SOA) allows for the integrated access to distributed data and information from various data sources and information systems through the use of common communication protocols, information technologies and standards. A common approach to developing SOA-type services will take existing systems to a level of interoperability that will result in a wider and more efficient access to DFO data holdings.

Rationale

Over the past years, several DFO data access initiatives have been undertaken throughout the country. The lack of a common strategy has resulted in DFO having invested into the development of many data and information systems that are not necessarily able to access one another.

In an era where global integrated systems (ex: GEOSS[37], GoMOOS[38]) are a major component of key scientific programs and action plans (ex: OAP[39], COIN[40]) and where each organisation is expected to readily contribute its knowledge to the community, it is essential that an internal strategy be developed in order for DFO to build up the integrated access to its own assets and to be able to interconnect with its external partner's systems.

Objectives

This research and development project will focus on the following:

- **Common Framework**:
  to develop a strategy and guidelines for the implementation of a service-oriented architecture (SOA) to support DFO scientific data management and accessibility while building on existing regional and national initiatives and respecting their technological specificity and orientations. The framework will include:

  - a definition of the requirements and specifications for standard SOA services to achieve system connectivity both internally (intra- and inter-

[37] GEOSS : Global Earth Observation System of Systems
[38] GoMOOS: Gulf of Maine Ocean Observation System
[39] OAP : Oceans Action Plan
[40] COIN : Coastal Ocean Information Network

sectoral exchanges) and externally (DFO and partners) e.g. how to create a service, what are the service specifications, what are the exchange protocols and standards involved, etc.
    - a generic tool kit for developers and documentation.

- **Interoperability Implementation**:
  to implement the strategy by taking into consideration the results of a pilot Service-Oriented Architecture in the Quebec region by:
    - using the developer tools to create SOA services for selected systems
    - making recommendations to NSDMC.

Appendix 5. Pilot Project Coordination Working Group

member	*title*	*sector*	*region*
Desmeules, Alain	Senior System Analyst, OSL	SC	Quebec
Hamel, Joanne	Scientific Coordinator, OSL	SC	Quebec
Hurtubise, Sylvain	Head, Fisheries Science Data Management and NSDMC member	SC	Quebec
Journault, Marc	Head, CHS Data Management	SC	Quebec
Dupont, Patrick	Chief, Fish Habitat and Coastal Data Management	O&H	Quebec
Pelchat, Bernard	Head, Ocean Science Data Management	SC	Quebec
Leblond, Andrée	Acting Chief, Information Management and Information Systems	IMTS	Quebec
Proulx, Jean-François	Data Analyst, Information Management and Information Systems	IMTS	Quebec
Gregory, Doug	Head, Ocean Science Data Management	SC	Maritimes
McCullough, Dwight	GIS Coordinator, Oceans/Watershed Planning and Restoration	OH&E	Pacific

Appendix 6. Acronyms Used in the Workshop

ACIP	Atlantic Coastal Information Portal
BUFR	Binary Universal Format Representation
CAWG	CGDI Architecture Working Group
CCG	Canadian Coast Guard
CGDI	Canadian Geospatial Data Infrastructure
CHS	Canadian Hydrographic Service
COIN	Coastal and Ocean Information Network
CDF	Common Data Format
DACS	Distributed Access Control System
ECO's	Environment and Conservation Organizations
FGDC	Federal Geographic Data Committee (US)
GCMD	Global Change Master Directory
GEOSS	Global Earth Observation System of Systems
GML	Geographic Markup Language
GoMoos	Gulf of Maine Ocean Observing System
GRIB	GRIdded Binary (World Meteorological Organization)
HDF	Hierarchal Data Format
HTML	Hyper Text Markup Language
HTTP	Hyper Text Transfer Protocol
IODE	International Oceanographic Data and Information Exchange
IMTS	Information Management and Technology Services
IHO	International Hydrographic Organization
IMII	Integrated Marine Information Infrastructure
IOC	Intergovernmental Oceanographic Commission
IOS	Institute of Ocean Science
ISO	International Standards Organization
MEDS	Marine Environmental Data Service
MGDI	Marine Geospatial Data Infrastructure
MMI	Marine Meta Data
NAFO	North Atlantic Fisheries Organization
NGDB	National Geochemical Database (US)
NGO's	Non-Government Organizations
NSDI	National Science Data Inventory

NSDMC	National Science Data Management Committee
O&H	Oceans and Habitat Sector
OAP	Oceans Action Plan
OBIS	Ocean Biogeographic Information System
ODMS	Oceanographic Data Management System
OGC	Open Geospatial Consortium
OH&E	Oceans, Habitat and Enhancement Branch
OSL	St. Lawrence Observatory
SAR	Search and Rescue
SC	Science Sector
SCOOP	The SURA Coastal Ocean Observing and Prediction Program
SINECO	Coastal Ocean Water Level System
SLD	Style Layer Descriptor
SOA	Service-Oriented Architecture
SOAP	Simple Object Access Protocol
SVG	Scalable Vector Graphics
UDDI	Universal Description, Discovery and Integration protocol
URL	Uniform Resource Locator
VDC	Virtual Data Centre
WDS	Web Data Service
W3C	World Wide Web Consortium
WCS	Web Coverage Service
WebCGM	Web Computer graphic Metafile
WFS	Web Feature Service
WMO	World Meteorological Organization
WMS	Web Mapping Service
WSDL	Web Services Description Language
XML	Extensile Markup Language