



RELATION TO STANDARDS - M12

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DOCUMENT HISTORY

| Version ¹ | Issue Date | Stage | Content and Changes |
|----------------------|--------------------------------|-------|--|
| 0.8 | 17 th November 2013 | | Initial draft report submitted to MOSS for their input |
| 0.9 | 25 th November 2013 | | Content from MOSS integrated into the document |
| 1.0 | 25 th November 2013 | | Version to be submitted to the Project Officer |

¹ Integers correspond to submitted versions

EXECUTIVE SUMMARY

IQmulus maintains a regular checkpoint with de jure and de facto standards bodies throughout the project. The focus of this initiative is standards for data representation and packaging. This has two objectives. First is to ensure that IQmulus does not re-invent standards by building on what communities are already achieving. Second is to allow the experience of IQmulus to contribute to standardisation action activities and accelerate consensus and deployment of new standards. At the proposal stage a number of standards initiatives were identified as particularly relevant; these include Open Geospatial Consortium and ISO. In addition communities implementing standards were considered such as the EC INSPIRE Directive implementation.

The summary of interactions at M12 is given in the table below

| Community | IQmulus |
|-----------|---|
| ISO | Limited work on ISO19123 over the last 12 months, which is the main standard for coverages. Domain communities are beginning to ask questions about standards for LIDAR data, however, this is as much about data capture as it is about data representation. |
| OGC | Participation in the further development of CityGML via the Special Interest Group 3D (SIG 3D). |
| OpenMI | OpenMI looks at standards for numerical models. Initial discussion with this community due to interaction on the EC DRIHM Project (HR Wallingford and IMATI are partners). |
| INSPIRE | Ongoing tracking of INSPIRE developments. HR Wallingford and MOSS are both involved with the technical development of INSPIRE and have registered as part of the standards maintenance programme. |
| Hadoop | Identification of players involved with the application of Hadoop technology to geospatial data. |

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1 INTRODUCTION

As part of its development IQmulus will need to establish encodings for many ISO 19123 coverage classes. Whilst such encodings presently exist, there has been little effort to try and standardise them for any formal process and furthermore there exist few de-facto standards. As part of its activities IQmulus will engage with the Open Geospatial Consortium (OGC) as a recognised body with a strong interest in geospatial data standards. Fraunhofer and HR Wallingford are active members of the OGC and HR Wallingford is currently working on the integration of the open modelling standard “OpenMI” into the OGC standards process. Fraunhofer is working on 3D Information Models Thematic Working Group in the OGC and is leading the Web 3D Service standardisation effort.

1.1 SCOPE OF THE DOCUMENT

Each section of this document presents a standards related initiative IQmulus has engaged with. It outlines the scope of the initiative, the relevance to IQmulus and the specific activities IQmulus has undertaken.

1.2 MONTH 12 SUMMARY

At month 12 we have continued our work interacting with ISO, OGC, OpenMI and INSPIRE. For these initiatives there has been little development of relevance to IQmulus, and as IQmulus is only in its first year, little for IQmulus to put forward for standardisation. In addition we have begun a dialogue with the Hadoop community. Hadoop is becoming an implementation standard for big data processing and recently parts of this community are starting to consider how Hadoop can be used for geospatial data. Regular interaction with this community has now been included for year 2 of IQmulus.

2 ISO (INTERNATIONAL ORGANISATION FOR STANDARDISATION)

2.1 ROLE AND REMIT

ISO is a de jure standards bodies and technically it is the only body that can legitimately call its outputs ‘standards’. ISO is an umbrella organisation for national standardisation initiatives and has scope far exceeding standards related to point cloud data sets. ISO 9001 (Quality Management) and ISO 14001 (Environmental Management) are two well-used standards developed by ISO.

Work developing ISO standards is undertaken by a series of committees at national level who cooperate in virtual teams with their counterparts in other countries. There are also regular face to face meetings. The process for developing standards is also governed by its own standards that stipulate revision cycles for existing standards, proposals for new standards and the sign off and acceptance procedure for any changes to standards.

2.2 RELEVANCE TO IQMULUS

2.2.1 X3D76

Although current visualization systems are often highly specialized and rather sophisticated, they still utilize proprietary formats and methods that are neither compatible in their concepts of operation nor in their supported data formats. On the one hand this prevents a harmonization of data from different sources and thereby hinders its distribution and utilization. On the other hand this also leads to parallel developments of incompatible and isolated technologies. In this context, the ISO standard X3D76 is the only standardized 3D deployment format and differs from other formats like Collada in that it also includes the scene's runtime behaviour. The proposed visualization component therefore aims at the exchange and interactive exploration of volumetric data and at industrial applications that use X3D as interchange format, but can link to proprietary databases and hardware.

As mentioned, with surface, volume, and geo-spatial components X3D thereby provides a solid foundation and is a good starting point for further standardization efforts. Here, using standardized techniques and services enable an automated connection of existing data with the atmospheric, oceanographic, or geological data to be visualized. Hence, this consortium will have a pro-active participation in several standardization bodies (OGC, W3C, Khronos Group) to prevent parallel developments of isolated components.

2.2.2 ISO 19000

The ISO 19000 range of standards covers geospatial information. Around 50 different aspects of geospatial data are standardised under the ISO 19000 range of standards. Of most relevance to IQmulus is ISO 19123 that describes geospatial coverages (grids, meshes, points). What does not exist at present are standard (or widely adopted) ways of encoding all of these coverages. Also of relevance to IQmulus are:

- ISO19156 Observation and Measurements that detail how the data set has been created
- ISO 19115 Generic metadata for geospatial data sets
- ISO 19119 Generic metadata for services
- ISO 19139 XML encoding of 19115/19

2.3 ACTIVITIES

HR Wallingford is a member of IST36, the British Standards committee responsible for ISO 19000. Standards committee meetings have been attended over the last year, as well as email dialogue. There has been little of relevance to IQmulus in the activities of IST36, similarly there has been nothing of significance to IQmulus that could be put forward as a new work item for standardisation.

3 OGC (OPEN GEOSPATIAL CONSORTIUM)

3.1 ROLE AND REMIT

The Open Geospatial Consortium (OGC) is an international industry consortium of 474 companies, government agencies and universities participating in a consensus process to

develop publicly available interface standards. [OGC® Standards](#) support interoperable solutions that "geo-enable" the Web, wireless and location-based services and mainstream IT. The standards empower technology developers to make complex spatial information and services accessible and useful with all kinds of applications.

3.2 RELEVANCE TO IQMULUS

3.2.1 Web Coverage Service (WCS)

A service for open, flexible, and scalable access to and processing of Earth data is the OGC Web Coverage Service (WCS) 2.0 Standard, which now allows providing a comprehensive portion of Earth science data categories through one coherent and implementation-independent interface. The coverage model of WCS 2.0 transcends pure raster data and includes almost all relevant categories, such as irregular and curvilinear grids, general meshes, trajectories, surfaces, solids, and point clouds. In this regard, the open ISO standard X3D also incorporates basic means for point rendering, as well as a geospatial component. Since most geo-referenced data are provided in a geodetic or projective spatial reference frame, X3D therefore provides support for a number of nodes that can use spatial reference frames for modeling purposes. However, there are still several drawbacks like the lack of well-defined terrain rendering. In addition, with the X3D Earth working group there is a strong collaboration of the Web3D Consortium with the Open GeoSpatial Consortium (OGC).

3.2.2 City Geography Markup Language (CityGML)

CityGML is an exchange format as well as an XML schema for representing city structures in a 3 dimensional way. CityGML was originally developed by the Special Interest Group 3D (SIG 3D) and became an OGC standard in the year 2008. The current version is 2.0 though work towards the next version is already being conducted. Interesting topics for the further improvement are a modified Level of Detail (LOD) concept, the ability to handle metadata, the representation of data without a spatial representation in CityGML, like e.g. measurement values, interactions, persons and – last but not least – the provision of an UML-model of CityGML for enterprise architects on which upon everybody can agree.

3.3 ACTIVITIES

MOSS is involved in the standardisation process of CityGML via the work conducted within the SIG 3D. Experiences and requirements for the improvement of CityGML are gained in the development work of the 3DCityDB, as a producer of CityGML for most of the German federal states and in research projects like IQmulus. MOSS participates in the SIG3D meetings, namely:

- SIG3D meeting at the Technical University Munich, June 2013
- SIG3D modelling meeting in Frankfurt, August 2013
- Diverse teleconferences of the modelling group of SIG3D

Upon agreement on a shared goal the SIG3D prepares recommendations which are presented to the OGC.

4 INSPIRE

4.1 ROLE AND REMIT

The INSPIRE directive came into force on 15 May 2007 and will be implemented in various stages, with full implementation required by 2019. The INSPIRE directive aims to create a European Union (EU) spatial data infrastructure. This will enable the sharing of environmental spatial information among public sector organisations and better facilitate public access to spatial information across Europe. A European Spatial Data Infrastructure will assist in policy-making across boundaries. Therefore the spatial information considered under the directive is extensive and includes a great variety of topical and technical themes.

4.2 RELEVANCE TO IQMULUS

INSPIRE provides reference models and implementations of a range of data standards. Included amongst these are implementations of coverage classes for elevation models and simulation models. Not all the encoding models for INSPIRE coverages have been standardised; mainly due to a lack of resources to address this issue.

4.3 ACTIVITIES

HR Wallingford was the facilitator of the INSPIRE themes 'Oceanographic Geographic Features' (OF) and 'Sea Regions' (SR). Now the Annex III data specifications have been published, HR Wallingford is involved in the update and management of the standards.

MOSS was the editor of the INSPIRE theme 'Environmental Monitoring Facilities' (EF). Now the Annex III data specification has been published. MOSS is involved in the update and maintenance of the standard as experts in the expert team.

5 OPENMI (OPEN MODEL INTERFACE)

5.1 ROLE AND REMIT

OpenMI defines a standard for numerical simulations to communicate to one another. It was developed to enable simulations to be developed in a modular way such that users can combine the best simulations for a given location. A combination of simulations is referred to as a composition and this can include several interacting models. Communication between models is on a time-step by time-step process and allows for each model to modify shared parameters. For example a rainfall-runoff model modifies water depth, which in turn modifies the rate of rainfall run-off. OpenMI was the result of the FP5 project Harmon-IT and has subsequently been updated and maintained by a consortium of European hydraulic laboratories.

5.2 RELEVANCE TO IQMULUS

This could be used as part of either the IQMULUS DSL (Domain Specific Language) or to actually implement workflows, based on the OpenMI implementations that exist. This standard has also been used in the EC DRIHM project to underpin workflows that link hydrological models with

flood forecasting models. Currently we are considering how IQMULUS could process point clouds to deliver elevation models (DEM and DTM) for use in DRIHM.

5.3 ACTIVITIES

HR Wallingford and CNR-IMATI are part of the EC DRIHM project and HR Wallingford is part of the technical board for OPEN-MI.

6 HADOOP

6.1 ROLE AND REMIT

Apache™ Hadoop® is an open source software project that enables the distributed processing of large data sets across clusters of commodity servers. It is designed to scale up from a single server to thousands of machines, with a very high degree of fault tolerance. Rather than relying on high-end hardware, the resiliency of these clusters comes from the software's ability to detect and handle failures at the application layer. Apache Hadoop has two main subprojects:

- MapReduce - The framework that understands and assigns work to the nodes in a cluster.
- HDFS - A file system that spans all the nodes in a Hadoop cluster for data storage. It links together the file systems on many local nodes to make them into one big file system. HDFS assumes nodes will fail, so it achieves reliability by replicating data across multiple nodes.

Hadoop is supplemented by an ecosystem of Apache projects, such as Pig, Hive and Zookeeper that extend the value of Hadoop and improve its usability.

6.2 RELEVANCE TO IQMULUS

The work on WP2 identified Hadoop as a suite of technologies that can be used in the IQmulus architecture. Hadoop is widely used for storing and processing big data and so needs consideration for IQmulus.

6.3 ACTIVITIES

Hadoop has been recognised in other user communities as having limitations with respect to geospatial data. In Year 1 of IQmulus we identified a number of projects exploring the use of Hadoop for 'big geospatial data'. Liaising with these initiatives is a key action for Year 2 of IQmulus and specific liaison activities have been scheduled. One area we need to explore is the extent to which geospatial coverages (ISO19123) have been considered in these tools for Hadoop as most of the work to date has focussed on indexing by coordinates. See

<https://wiki.umi.acs.umd.edu/csc/images/8/8f/CLuE-Rishe.pdf>

<http://esri.github.io/gis-tools-for-hadoop/>

<http://proceedings.esri.com/library/userconf/devsummit13/papers/devsummit-194.pdf>

<https://uspatial.umn.edu/node/414>

<http://www.vldb.org/pvldb/vol6/p1009-aji.pdf>

<http://www.cs.odu.edu/~mukka/cs775s11/Presentations/papers/cary.pdf>

<http://www.youtube.com/watch?v=A3Q2XlGvYcU>