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Discussion Paper
OGC Standard for Moving Features; Requirements

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Contents

i. Abstract

Applications using moving feature data, typically on vehicles and pedestrians, have recently been rapidly increasing. Innovative applications are expected to require the overlay and integration of moving feature data from different sources to create more social and business values. Efforts in this direction should be encouraged by ensuring smoother data exchange because handling and integrating moving feature data will broaden the market for geo-spatial information. This discussion paper provides an overview of some actual and potential geo-spatial applications using moving feature data and the existing international standards or specifications on moving feature data handling. It also summarizes the requirements set on the standards for moving feature data, and finally proposes the development of a new OGC standard for moving features.

ii. Keywords

Requirements, Implementation Specifications, Moving Features

iii. Preface

This is an OGC discussion paper for review by the OGC members and other interested parties. It is a working report on the requirements for the implementation standards set on moving feature data. The document may be updated or replaced by other documents at any time. It is inappropriate to use OGC Discussion Papers as reference materials or to cite them as other than "work in progress." This is a work in progress and does not imply endorsement by the OGC membership.

iv. Submitting organizations

The following organizations submitted this discussion paper to the Open Geospatial Consortium Inc.

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b) Hitachi Ltd., Central Research Laboratory

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vi. Revision history

Date	Release	Author	Paragraph modified	Description
2012-09-07	0.1	Ryosuke Shibasaki	All	Initial Draft

vii. Changes to the OGC® Abstract Specification

The OGC® Abstract Specifications do not require changes to accommodate this OGC® standard.

OGC Standards for Moving Features — Requirements

1 Scope

This discussion paper provides an overview of some actual and potential geo-spatial applications using moving feature data and the existing international standards or specifications on moving feature data handling. It summarizes the requirements set on the standards for moving feature data, and finally proposes starting the development of a new OGC standard for moving features.

2 Why is an OGC standard on moving features necessary?

2.1 Market demand

Demand is very rapidly increasing recently for better handling of moving feature data with GIS. Example applications using moving feature data include traffic congestion information services using probe cars or taxis equipped with GPS to measure the travel time of each road link, tracking systems on auto-trucks for logistics management, and agent-based road traffic simulation systems for forecasting traffic situations. Systems relying on single-source moving feature data are now evolving into more integrated systems. Integration of moving feature data from different sources is a key to developing more innovative and advanced applications. The following are examples of such efforts.

a) **Integrated simulation for disaster risk management**: Moving feature data is collected/integrated from different simulation systems such as people evacuation simulations, road vehicle simulations including emergency vehicles, and tsunami simulations. Many of them, except the tsunami simulations, are agent-based simulation systems that explicitly output the trajectories of individual agents, i.e., pedestrians and vehicles. A concrete example is described in Section 4. Real-time simulation and integration may be needed in support of an evacuation.

b) **Traffic information services**: Traffic congestion and the trafficability of roads can be estimated to provide guidance information to road users from real-time vehicle trajectory data collected from probe cars. Sources are becoming diversified from a fleet of taxis with GPS belonging to a single company to the mixture of auto-trucks, buses, and navigation system users. This trend makes it more necessary to integrate data using different models and formats. Figure 1 shows how the trajectory data from car navigation system users were integrated to identify the trafficability of road segments after the Great Earthquake of East Japan in 2011.

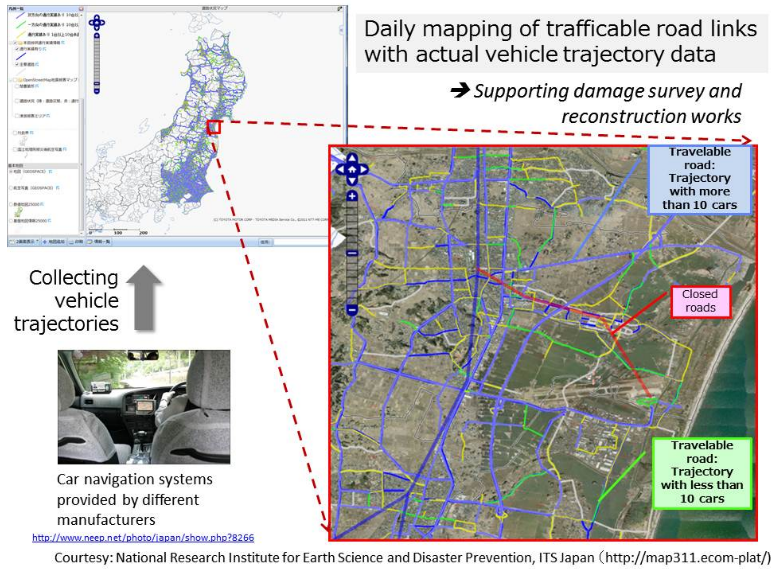

Figure 1. Identifying trafficability of road segments by aggregating vehicle trajectory data from car navigation systems.

Integrated data have recently been used to identify traffic accident hot spots by analyzing a large amount of data on vehicle trajectories and velocity/acceleration changes. The ITS community (ISO/CEN and ETSI) is drafting standards on the “Local Dynamic Map”, a platform for integrating the trajectories of many moving features, such as pedestrians and moving vehicles, to reduce the number of traffic accidents around intersections (ISO/DTS 17931(WG3), ETSI TR 102 863 V1.1.1 (2011-06)) (Figure 2).

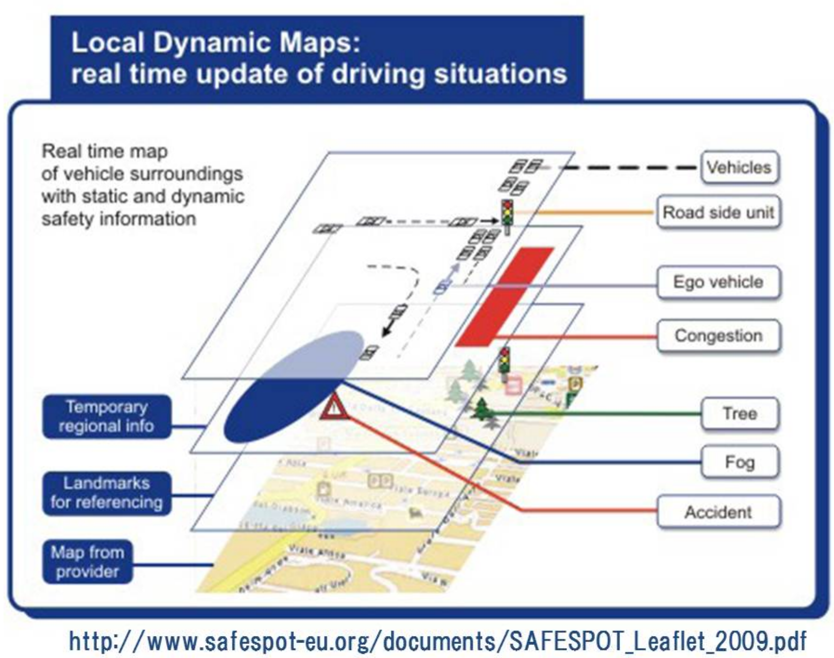

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Figure 2. Local Dynamic Map (LDM)

c) **Security services**: This service requires the generation and sharing of situational information as a common picture by integrating and visualizing data on pedestrian and vehicle movements collected from heterogeneous sensors like surveillance cameras, GPSs, and mobile phones.

d) **Navigation for Robots**: Robots are expected to guide and help in the movement of elderly or handicapped people in public spaces like shopping malls (Shiomi et al., 2009). Since robots can identify only near-by obstacles and moving features with laser range and/or vision sensors, they may require situational information on a larger scale, and this requires integration of the trajectory data from the moving features collected through sensor networks. Figure 3 shows a conceptual example of moving feature data integration for guiding robots.

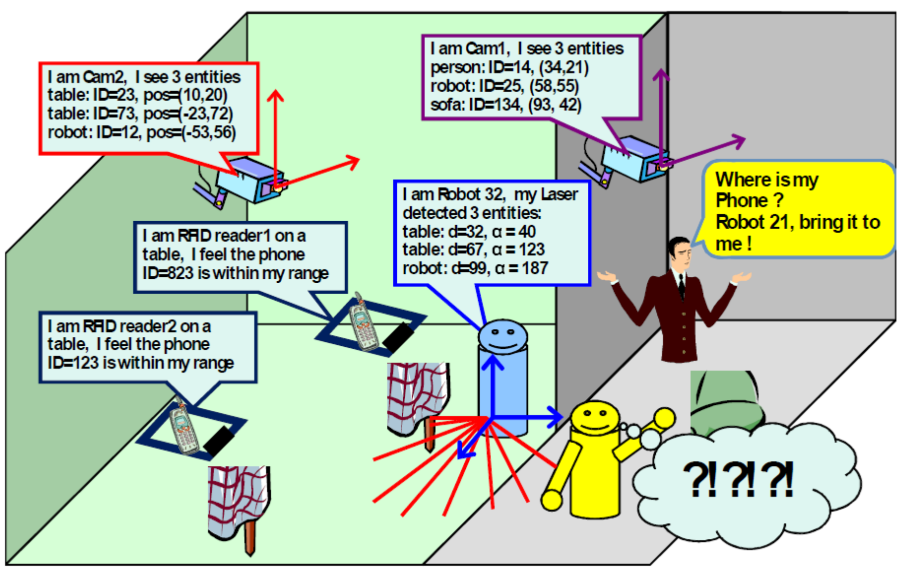


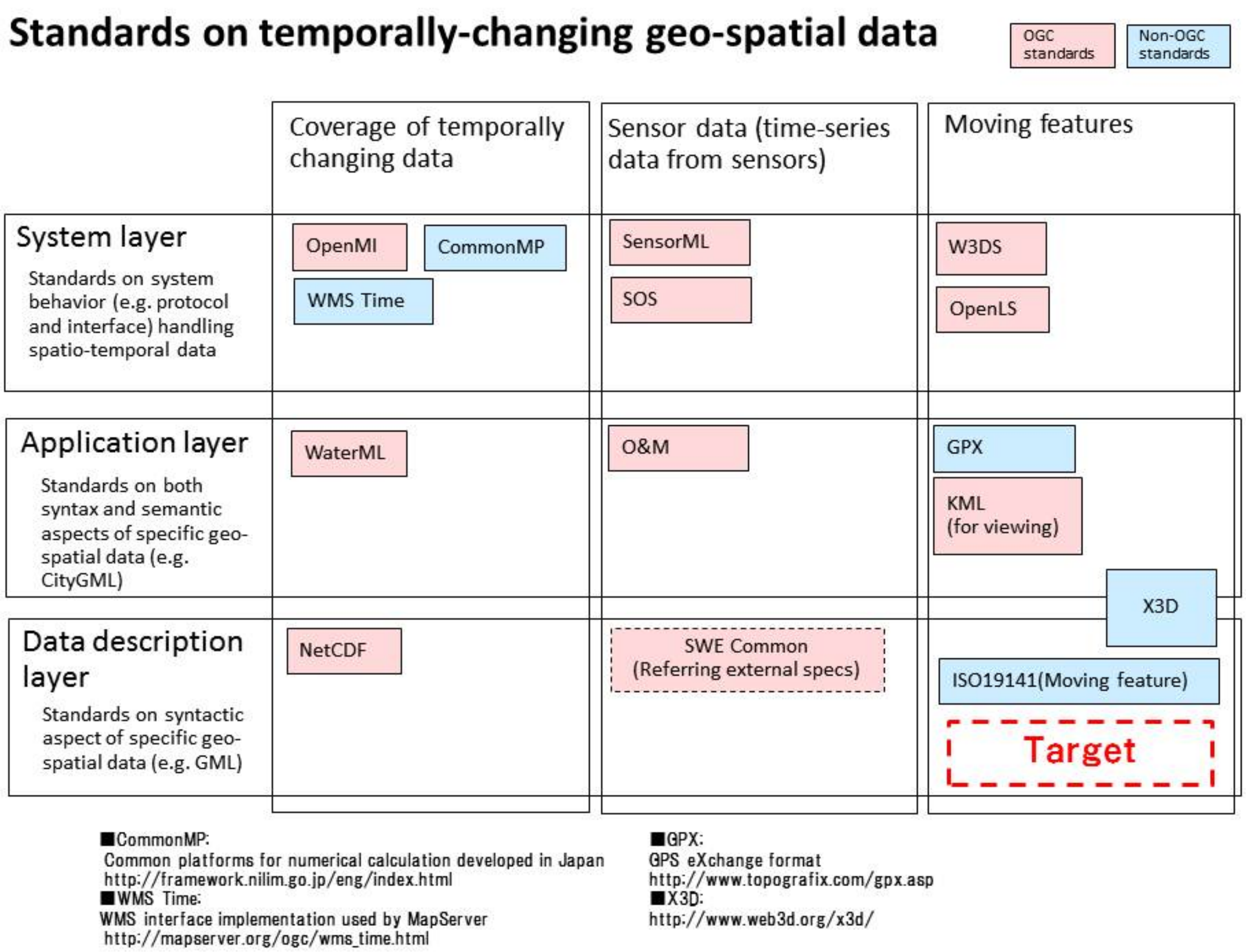
Figure 3. Example of typical robotic service situation requiring localization of entity (Robotic Localization Service (RLS) Version 1.1, August 2012, http://www.omg.org/spec/RLS/1.1)

Moreover, the growth of smart phones in the market makes it much easier to acquire large amounts of data on user trajectories reflecting the movement of people and vehicles on a global scale and in real-time. This will create an enormous market for geo-spatial applications that requires the integration of moving feature data from many heterogeneous sources with a GIS platform.

2.2 Existing Standards for a Moving Feature

The standards for moving features, however, are insufficient. Different converters still need to be developed whenever connecting system A with system B in order to exchange moving feature data between systems. Table 1 summarizes the existing standards associated with temporally-changing geo-spatial data including moving feature data. ISO/TC211 published a standard (ISO 19141, 2008) on moving features. However, it is an abstract standard rather than an implementation specification more directly relevant for system development. OGC implementation specifications need to be developed based on ISO 19141 as indicated by “Target” in the table. The other associated standards include X3D for the visualization of moving features and GPX for describing trajectories using GPS. In addition, some of the OGC standards may be associated with moving feature data. Overlaps and consistency should be taken into account in the process of developing the OGC standards for moving features.

Table 1. Standards on temporally-changing geo-spatial data



3 Requirements for Standards on Moving Features

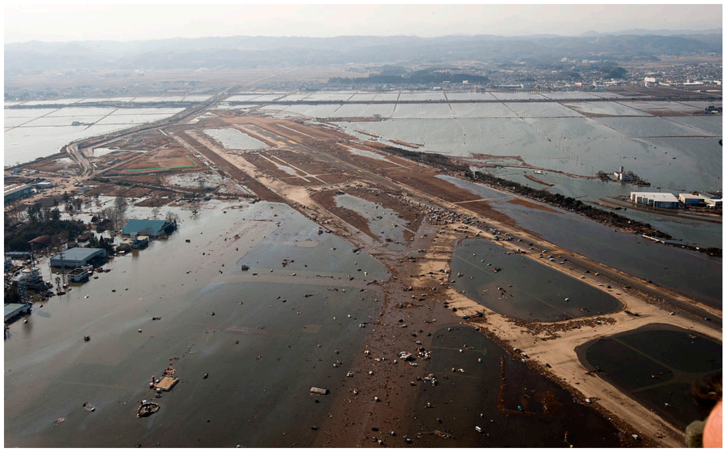
The requirements for standards on moving features are summarized below.

1) "Schema for Moving Features (ISO19141, 2008)" should be referred to as the conceptual framework for this development. A standard data model should describe the movement of zero to three-dimensional geometric features including changes in attitude or rotation along with the movement.
2) The implementation specifications on moving features should be prioritized, which more directly contributes to the system development because moving feature data is becoming more popular with the very rapid growth of smart phone users worldwide, and this is strongly pushing system developers towards the integration of moving feature data rather than using the moving feature data from a single source. Implementation specifications on simple features could be a starting point. The scope of the standardization should be expanded incrementally through communication and discussions with system developers and potential users.
3) Methods specific to moving feature data handling, such as the detection of collisions, could be standardized after data model development arrives at certain level of maturity, based on further analysis of the technology and market trends.
4) Visualization and spatio-temporal interpolation of geometric features are already supported by popular standards such as X3D (http://www.web3d.org/x3d/). Unnecessary overlaps should be avoided, while popular standards should be referred to in developing a new specification on the moving features.

4 Example Prospective Application using Standard on Moving Features

As an example of the prospective applications, i.e., simulation system for tsunami evacuation, this section describes an estimation system of tsunami damage partly implemented by the authors.

A tsunami is a very large wave generated by a sudden up-thrust or sinking of the sea bed in association with an undersea earthquake, and causes serious damage along the coastal regions. Huge tsunamis have recently caused serious damage in Sumatra, Indonesia in 2004 and Tohoku, Japan in 2011 (Figure 4). In order to reduce the amount of damage from tsunamis, measures and policies are required, such as the construction of breakwaters, the designation of evacuation areas, and the provision of evacuation guidance. A simulation for tsunami evacuation is helpful for creating measures and formulating policies.



(http://upload.wikimedia.org/wikipedia/commons/thumb/5/54/SendaiAirportMarch16.jpg
/1024px-SendaiAirportMarch16.jpg)

Figure 4 Sendai airport inundated by tsunami

The simulation system for tsunami evacuation facilitates well-informed decision making for the appropriate allocation of tsunami evacuation buildings (figure 5) by integrating tsunami simulations and people flow or evacuation simulations. Tsunami simulations precisely estimate the flooding areas when a tsunami hits the coastal area based on the topography of the sea bed and land. The people flow or evacuation simulation estimates the location of individuals when earthquakes happen and computes the evacuation movements to the nearest tsunami evacuation building. The system computes how many people could successfully evacuate from a tsunami under different scenarios to evaluate the effectiveness of the evacuation guidance, tsunami warning services, location/capacity of tsunami evacuation buildings among others (Figure 6). The system requires the functionality of exchanging temporally-changing inundation area/depth and moving features in a three-dimensional space.

Symbol of tsunami evacuation building

Metropolitan office building, Minami-ward, Nagoya city, Japan

www.city.nagoya.jp/shobo/page/0000025607.html

Figure 5 Tsunami evacuation building in Nagoya city, Japan

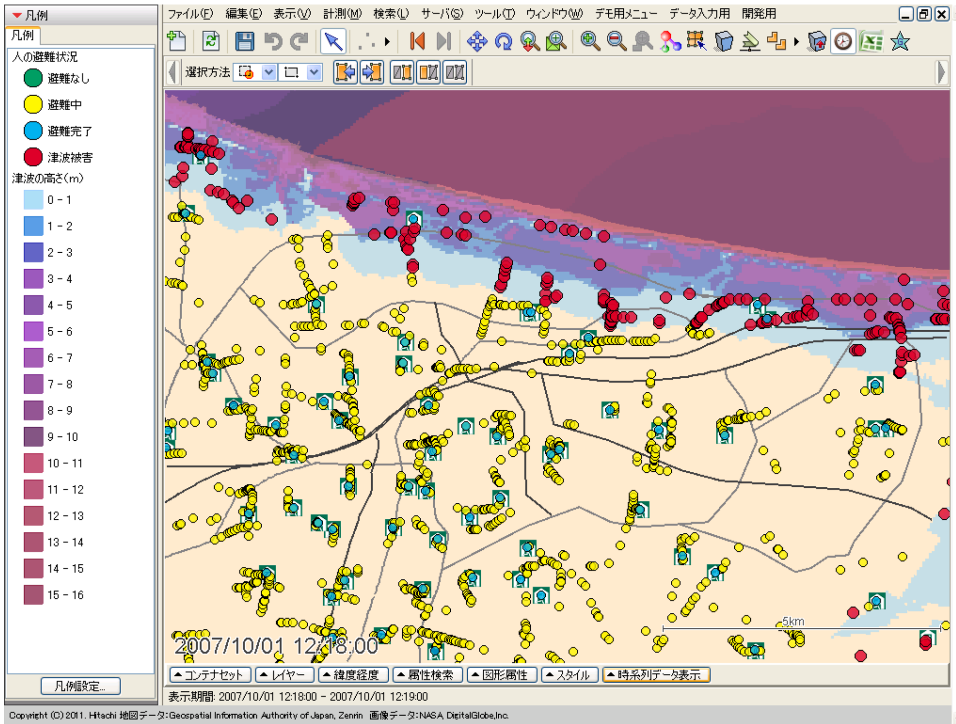


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Figure 6. Example of Simulation of Evacuation from Tsunami for Coastal City with population of 600,000. The blue to purple color gradation indicates the height of the simulated tsunami. Each point denotes residents (a point for 50 people). The yellow points are evacuating people, while the red ones are people who could not escape. The green squares are tsunami evacuation buildings.

5 Next Steps

The development will start by examining the relevant standards, i.e., ISO 19141 Schema of Moving Features (2008) and OGC Implementation Specifications on Simple Features. Development could be made by an existing SWG or by a new SWG. The next steps will be defined through discussions between the members and chairpersons of the SWGs who may be interested in this development.

6 References

1. ISO 19141 Schema of Moving Features (2008)

2. ETSI TR 102 863 V1.1.1 (2011-06) DTR/ITS-0010006 Intelligent Transport Systems (ITS);Vehicular Communications; Basic Set of Applications; Local Dynamic Map (LDM); Rationale for and guidance on standardization
3. ISO/DTS 17931 (WG3) Intelligent transport systems -- Extension of map database specifications for Local Dynamic Map for applications of Cooperative ITS
4. Masahiro Shiomi, Takayuki Kanda, Dylan F. Glas, Satoru Satake, Hiroshi Ishiguro, and Norihiro Hagita, Field Trial of Networked Social Robots in a Shopping Mall, IEEE/RSJ International Conference on Intelligent Robots and Systems, 2009.
5. OGC Implementation Specification on Simple Feature (OpenGIS Implementation Specification for Geographic information - Simple feature access - Part 1: Common architecture).
6. Robotic Localization Service (RLS) Version 1.1 August 2012, http://robotics.omg.org/

Annex A
(informative)

List of related OGC standards and documents

List of related OGC standards and documents

標準名	文献名
KML	07-147r2 OGC® KML version 2.2.0 08-125r1 KML Standard Development Best Practices 07-124r2 OWS-5 KML Engineering Report
NetCDF	10-090r3 OGC® Network Common Data Form (NetCDF) Core Encoding Standard version 1.0 10-092r3 NetCDF Binary Encoding Extension Standard: NetCDF Classic and 64-bit Offset Format (1.0) 10-091r3 CF-netCDF Core and Extensions Primer
O&M	10-025r1 OGC® Observations and Measurements - XML Implementation 10-157r3 Earth Observation Metadata profile of Observations & Measurements (1.0) 10-004r3 Topic 20: Observations and Measurements
OpenLS	07-074 OpenGIS Location Service (OpenLS) Implementation Specification: Core Services 08-028r7 OpenGIS Location Services (OpenLS): Part 6 - Navigation Service 06-024r4 OGC Location Services (OpenLS): Tracking Service Interface Standard
SensorML	07-000 OpenGIS Sensor Model Language (SensorML) version 1.0.0 07-122r2 OpenGIS SensorML Encoding Standard v 1.0 Schema Corregendum 1 (1.01) 08-127 GML 3.2 implementation of XML schemas in 07-000 (1.0.1) 09-163r2 sensorML Extension Package for ebRIM Application Profile 09-033 OWS-6 SensorML Profile for Discovery Engineering Report
Simple Features	06-103r4 OpenGIS Implementation Specification for Geographic information - Simple feature access - Part 1: Common architecture version 1.2.1
SOS	12-006 OGC® Sensor Observation Service Interface Standard 06-009r6 OpenGIS Sensor Observation Service
SWE Common	08-094r1 OGC® SWE Common Data Model Encoding Standard
W3DS	09-075r1 OWS-6 3D Flythrough (W3DS) Engineering Report 09-104r1 Draft for Candidate OpenGIS Web 3D Service Interface Standard
WaterML	10-126r3 OGC® WaterML 2.0: Part 1- Timeseries 12-031r2 WaterML 2.0 – Timeseries – NetCDF Discussion Paper

Other documents

標準名	文献名
OpenMI	OpenMI Standard 2 Specification for the OpenMI (Version 2.0)