Health Spatial Information Framework White Paper

Table of Contents

Publication Date: YYYY-MM-DD

Approval Date: YYYY-MM-DD

Posted Date: YYYY-MM-DD

Reference number of this document: OGC XX-XXX

Reference URL for this document: http://www.opengis.net/doc/PER/t13-ID

Category: Public Engineering Report

Editor: Eddie Oldfield, Luis Bermudez

Title: Health Spatial Information Framework White Paper

OGC White Paper

LICENSE AGREEMENT

Permission is hereby granted by the Open Geospatial Consortium, ("Licensor"), free of charge and subject to the terms set forth below, to any person obtaining a copy of this Intellectual Property and any associated documentation, to deal in the Intellectual Property without restriction (except as set forth below), including without limitation the rights to implement, use, copy, modify, merge, publish, distribute, and/or sublicense copies of the Intellectual Property, and to permit persons to whom the Intellectual Property is furnished to do so, provided that all copyright notices on the intellectual property are retained intact and that each person to whom the Intellectual Property is furnished agrees to the terms of this Agreement.

If you modify the Intellectual Property, all copies of the modified Intellectual Property must include, in addition to the above copyright notice, a notice that the Intellectual Property includes modifications that have not been approved or adopted by LICENSOR.

THIS LICENSE IS A COPYRIGHT LICENSE ONLY, AND DOES NOT CONVEY ANY RIGHTS UNDER ANY PATENTS THAT MAY BE IN FORCE ANYWHERE IN THE WORLD. THE INTELLECTUAL PROPERTY IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NONINFRINGEMENT OF THIRD PARTY RIGHTS. THE COPYRIGHT HOLDER OR HOLDERS INCLUDED IN THIS NOTICE DO NOT WARRANT THAT THE FUNCTIONS CONTAINED IN THE INTELLECTUAL PROPERTY WILL MEET YOUR REQUIREMENTS OR THAT THE OPERATION OF THE INTELLECTUAL PROPERTY WILL BE UNINTERRUPTED OR ERROR FREE. ANY USE OF THE INTELLECTUAL PROPERTY SHALL BE MADE ENTIRELY AT THE USER'S OWN RISK. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR ANY CONTRIBUTOR OF INTELLECTUAL PROPERTY RIGHTS TO THE INTELLECTUAL PROPERTY BE LIABLE FOR ANY CLAIM, OR ANY DIRECT, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, OR ANY DAMAGES WHATSOEVER RESULTING FROM ANY ALLEGED INFRINGEMENT OR ANY LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR UNDER ANY OTHER LEGAL THEORY, ARISING OUT OF OR IN CONNECTION WITH THE IMPLEMENTATION, USE, COMMERCIALIZATION OR PERFORMANCE OF THIS INTELLECTUAL PROPERTY.

This license is effective until terminated. You may terminate it at any time by destroying the Intellectual Property together with all copies in any form. The license will also terminate if you fail to comply with any term or condition of this Agreement. Except as provided in the following sentence, no such termination of this license shall require the termination of any third party end-user sublicense to the Intellectual Property which is in force as of the date of notice of such termination. In addition, should the Intellectual Property, or the operation of the Intellectual Property, infringe, or in LICENSOR's sole opinion be likely to infringe, any patent, copyright, trademark or other right of a third

party, you agree that LICENSOR, in its sole discretion, may terminate this license without any compensation or liability to you, your licensees or any other party. You agree upon termination of any kind to destroy or cause to be destroyed the Intellectual Property together with all copies in any form, whether held by you or by any third party.

Except as contained in this notice, the name of LICENSOR or of any other holder of a copyright in all or part of the Intellectual Property shall not be used in advertising or otherwise to promote the sale, use or other dealings in this Intellectual Property without prior written authorization of LICENSOR or such copyright holder. LICENSOR is and shall at all times be the sole entity that may authorize you or any third party to use certification marks, trademarks or other special designations to indicate compliance with any LICENSOR standards or specifications.

This Agreement is governed by the laws of the Commonwealth of Massachusetts. The application to this Agreement of the United Nations Convention on Contracts for the International Sale of Goods is hereby expressly excluded. In the event any provision of this Agreement shall be deemed unenforceable, void or invalid, such provision shall be modified so as to make it valid and enforceable, and as so modified the entire Agreement shall remain in full force and effect. No decision, action or inaction by LICENSOR shall be construed to be a waiver of any rights or remedies available to it.

None of the Intellectual Property or underlying information or technology may be downloaded or otherwise exported or reexported in violation of U.S. export laws and regulations. In addition, you are responsible for complying with any local laws in your jurisdiction which may impact your right to import, export or use the Intellectual Property, and you represent that you have complied with any regulations or registration procedures required by applicable law to make this license enforceable.

Chapter 1. Summary

The Health Spatial Information Framework provides a discussion about the exchange, integration, analysis, and visualization of health and non-health data to support health applications. It will identify opportunities to advance the OGC Standards towards building a framework to support Health Spatial Data Infrastructures (SDI).

Chapter 2. Motivation

Providing the design of a Health Spatial Information Framework based on open standards will help stakeholders and users of health data as follows:

- **Service Providers** - to understand market needs and add value to services.
- **Market Participants** - to understand where OGC standards can be applied to support improved health outcomes.
- **Government and Institutes** - to understand market priorities and to design health-oriented Spatial Data Infrastructures (SDI).
- **Standard Organizations** - to understand opportunities to develop or improved standards to support health applications.
- **Researchers** - to have a foundation of elements for advancing research on SDI and Health related applications using OGC Standards.

2.1. Document contributor contact points

All questions regarding this document should be directed to the editor or the contributors:

Name	Organization
Luis Bermudez	OGC
Eddie Oldfield	Spatial Quest

Table 1. Contacts

2.2. Foreword

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium shall not be held responsible for identifying any or all such patent rights.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

Chapter 3. Overview

This document provides an overview of OGC Standards in support of health application areas identified in the market. It builds on contributions from OGC Health DWG members, is informed by OGC Health DWG sessions from 2012-2017, including a Summit in 2016 and 2017. This paper concludes with recommendations for advancing the standards in areas of need / or areas for further research and separate documentation.

Health is a very broad domain, with many distinct fields and information requirements. Thus, only a few key application areas can be explored here, as a way to present essential elements of a health Spatial Information Framework, to guide the development of SDI Spatial Data Infrastructure and applications using OGC Standards.

Four key areas emerged through consultation of the OGC Health DWG, including:

- Climate-Health
- Healthy Ageing
- Global Indicators
- Health in the Smart City

Together, these key application areas cover a good scope of market requirements and functional areas, that may be supported with OGC Standards.

Chapter 4. Introduction

One hundred and fifty years ago, John Snow demonstrated the value of spatial relationships, by combining cholera death and water pump locations to predict the development of infectious disease outbreaks. Today, GIS, computing, modelling, statistics, sensors, geospatial data and OGC web service standards, are enabling powerful spatial analysis to support health and epidemiological research. However there is not a documented framework that provides an architecture and interfaces to support a health spatial data infrastructure.

This white paper will present background activities related to this paper, discuss key application areas and proposed a framework to support a Health Spatial Data Infrastructure. The resulting framework will serve as the basis for developing a pilot for futher refinement of the system.

Chapter 5. Background

The framework discussion was advanced at the OGC Health Domain Working Group (Health DWG) held at the Health Summit in Dublin, during the OGC TC in June 2016. Participants on the climate-health panel coalesced around the need to improve interoperability of geospatial data and web services to facilitate more sophisticated climate-health applications. Participants in the healthy-ageing panel coalesced around the ability of sensor networks to support active and healthy ageing, connecting indoor sensors and devices to support clinical records and the wellbeing of patients with cognitive impairments (as an example) - this culminated in the creation of an Active and Healthy Ageing Observation and Measurement (AHA O&M) Profile. Participants in the healthy urban environments panel coalesced around the need for well-defined protocols for using health information in mapping applications while protecting privacy, to better understand interaction between disease and health determinants (including built environment).

A second health summit is to take place at the OGC TC meeting in St, Jones in June 2017. At this meeting this white paper wil be discussed as well as potential future activities to advance the framework.

Through interviews and discussion, participants indicated that a future state of a Spatial Data Infrastructure would include: implementation of wider-accepted interoperable (OGC) standard based technologies and services, improved privacy and security best practices and common vocabularies.

Since the Summit in 2016, interest continues to be expressed in the potential for OGC standards to support health domain requirements, helping to solve interoperability challenges for integrating health data with non-health data (e.g. environmental determinants of health), but disparities remain in the adoption of standards and frameworks to collect, process, store, integrate, visualize, and protect information, especially with complex Big Data scenarios. Health professionals rarely have access to or are not able to use climate and weather data for diagnosing, treating, monitoring, or advising a patient; or to take informed action based on environment and health data mashups, or to determine causal relationships over various spatial and temporal scales. The data challenge includes several aspects: quantity of data, distributed nature of data, the heterogeneity and diversity of the data, the lack of data sharing due to both policy and technology limitations, and difficulties to share across disciplines, organisations, and geographic boundaries.

Furthermore it is important to look at how geospatial standards are used to support indicators on a spatio-temporal basis to help determine current state and plan for action related to global disparities for health impacts from disasters and climate change. Challenges still remain on spatial-temporal understanding of health impacts (e.g. injury, illness, death) from climate change and environmental health determinants, population vulnerabilities and adaptive capacity, and other possible complex exposures (diets,

lifestyles, etc).

Chapter 6. Application Areas and Methodology

Development of an Information framework requires understanding of the applications that the framework should support. The following application areas are documented in this document:

- Climate-Health
- Healthy Ageing
- Global Indicators
- Health in the Smart City

For each area the following methodology was undertaken:

1. Introduction explaining the application area
2. Use Case Scenarios
3. Data Requirements (Health and Non-Health Data)
4. Relevant OGC and Non-OGC Standards

For the data requirements the following types of data are assumed:

- **Vector**: Data that can be represented as point lines or polygons. Tabular data can be represented in vector format if there is a column that provides the geospatial coordinates.
- **Coverages**: Usually gridded data including raster and model outputs that has a grid as a reference.
- **Sensor**: Data is more dynamic in nature than vector and coverages, usually a time series of a sensor in particular location

6.1. Climate-Health

6.1.1. Introduction

Climate variability and related impacts pose significant threats to human health and well-being. These climate impacts come from higher temperatures, increased extreme weather events, wildfire, decreased air quality, threats to mental health, and illnesses transmitted by food, water, and disease carriers such as mosquitoes and ticks. Extreme storms and temperatures can disrupt the delivery of health services and damage hospitals, clinics, wastewater treatment plants, and other facilities. Climate also impacts economic sectors

that support health, such as energy, transportation, and agriculture. Health organizations are increasingly interested to develop ways to monitor, prevent, and respond to climate impacts on human health. Steps taken to prepare for climate impacts can improve health and provide other societal benefits, such as sustainable development, disaster risk reduction, and improvements in quality of life.

Relying on a Health Spatial Information Framework , health authorities could publish up-to-date maps showing various dimensions of disease, population health, environment, and statistics. The economy of scale is present when epidemiological research and health planning communities utilize a system to address inequalities in health care provision, access, and promotion, which can be scaled up for sophisticated climate-health scenarios, during health emergencies and for pandemic response efforts [1, 2].

6.1.2. Use Case Scenarios

6.1.3. Project XYZ

initiatives.pdf

6.1.4. Data Requirements

Type	Description	Type
Population and Socio-Economic Statistics	Statistics data from ground surveys (e.g. household surveys), census and economic sectors	Vector
Discharge Data and Health Outcomes		Vector
Weather		Coverage
Social Vulnerability Indices		Vector
Land Use	Building Codes	Infrastructure
	Vector	Climate Data
Predictive Models		Coverage
Disaster Loss Data		Vector
Remotely Sensed Data		Coverage
Sensor Data		Sensor

WARNING

A column that explains the standard should be added to the table. Standards include:

- OASIS EDXL HAVE
- HL7 SDMX-HD
- IoT

Appendix A: Revision History

Date	Release	Editor	Primary clauses modified	Descriptions
April, 2017	Eddie Oldfield	.1	all	initial version
May 12 2017	Luis Bermudez	.2	all	formatted in asciidocs, overall edits and restructuring

Table 2. Revision History

Appendix B: Bibliography

1. M. N. K. Boulos, “Towards evidence-based, GIS-driven national spatial health information infrastructure and surveillance services in the United Kingdom,” *International Journal of Health Geographics*, vol. 3, no. 1, 2004.
2. T. W. Tam, “Preparing for influenza epidemics and pandemics in the new millennium,” *Can J Public Health*, 1999.