




# Dr. Knut Jetlund

Convenor

ISO/TC 211 Harmonized Model Maintenance Group (HMMG)

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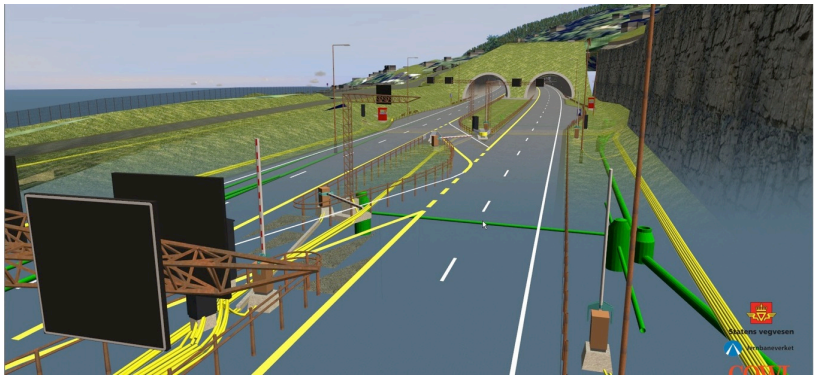
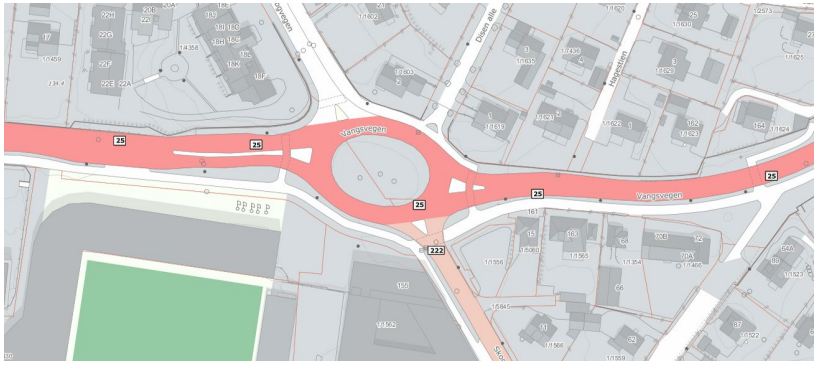
# Introduction

ISO/TC 211 have used UML for the development and implementation of standards since 1998

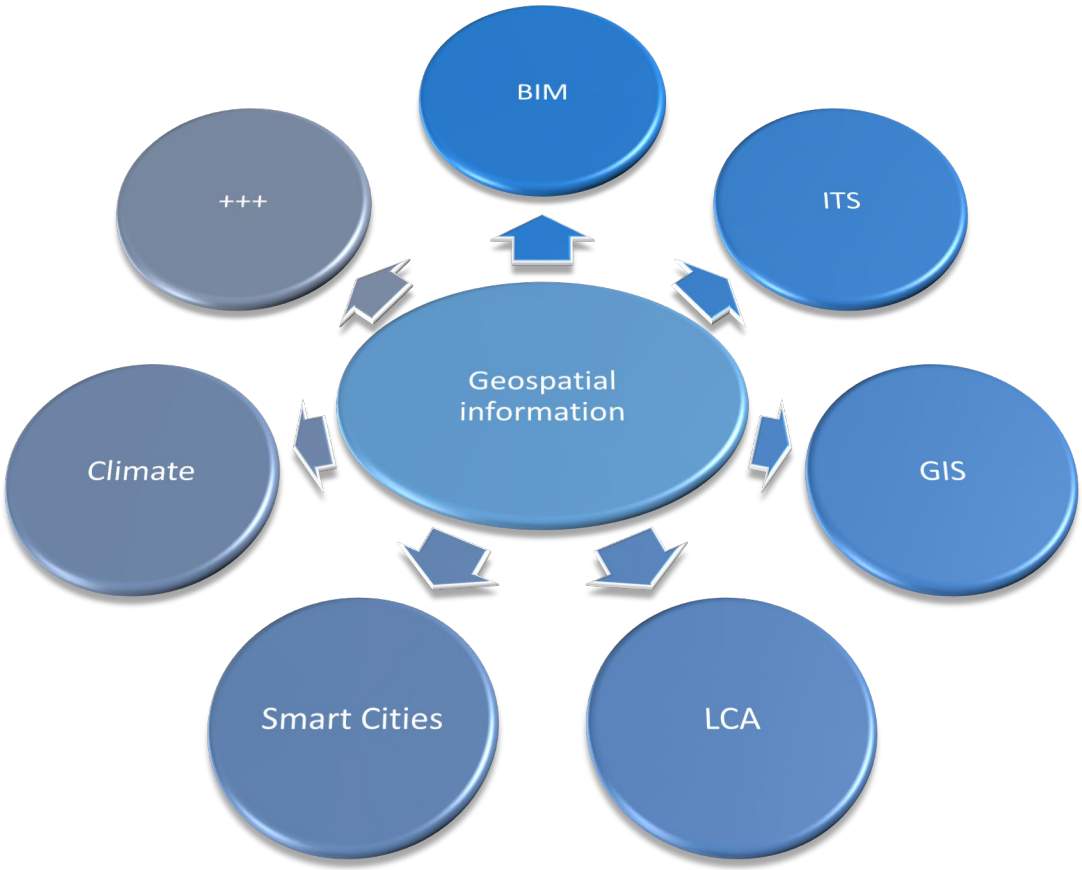
Agenda:

- About ISO/TC 211  and the HMMG
- How ISO/TC 211 use UML and MDA
- How we store and work with the models
- Implementation and documentation
- Example models
- Improvements in progress





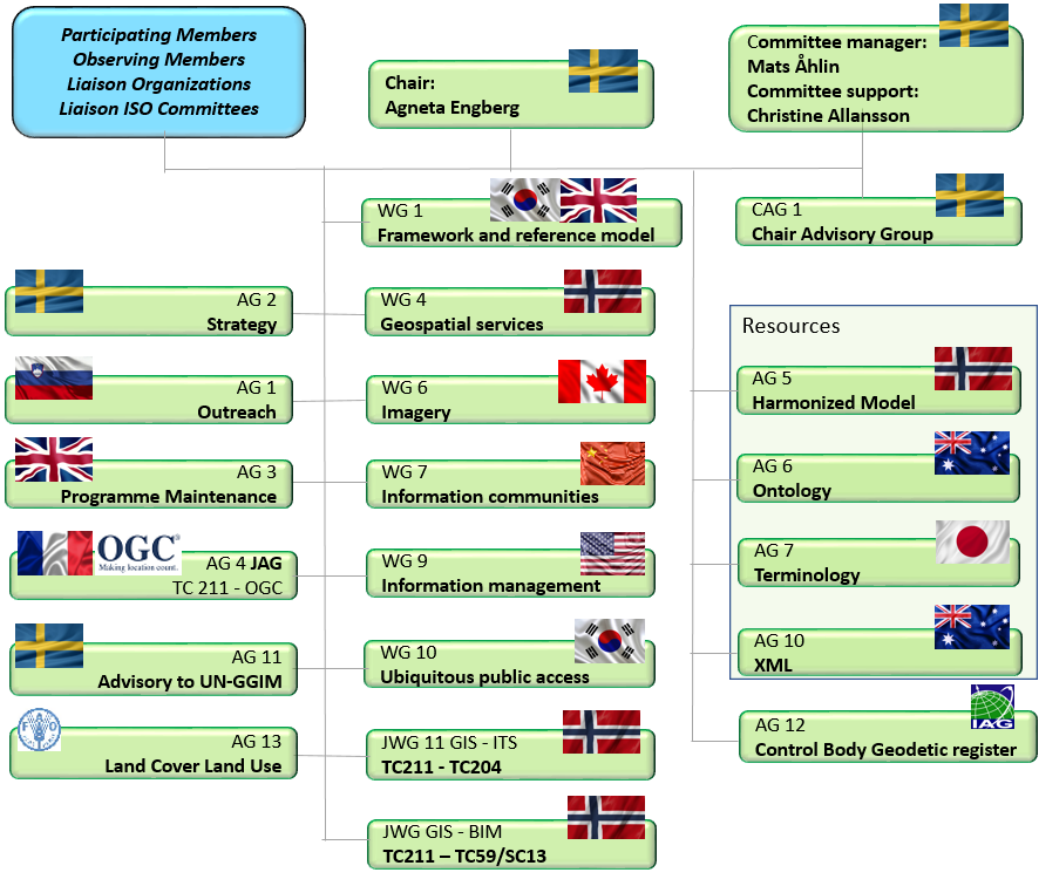
# Everything happens somewhere




78% of German Wikipedia articles in 2013 were found to be either directly or indirectly related to geospatial location references.

Source: Hahmann, S., Burghardt, D., How much information is geospatially referenced? Networks and cognition. *International Journal of Geographical Information Science* **2013**, *27(6)*, p. 1171-1189,DOI: 10.1080/13658816.2012.743664.

# ISO/TC 211 Geographic Information/Geomatics




## Scope

Standardization in the field of digital geographic information.

This work aims to establish a structured set of standards for information concerning objects or phenomena that are directly or indirectly associated with a location relative to the Earth.

These standards may specify, for geographic information, methods, tools and services for data management (including definition and description), acquiring, processing, analyzing, accessing, presenting and transferring such data in digital/electronic form between different users, systems and locations.

The work shall link to appropriate standards for information technology and data where possible, and provide a framework for the development of sector-specific applications using geographic data.

# UN Sustainable Development Goals

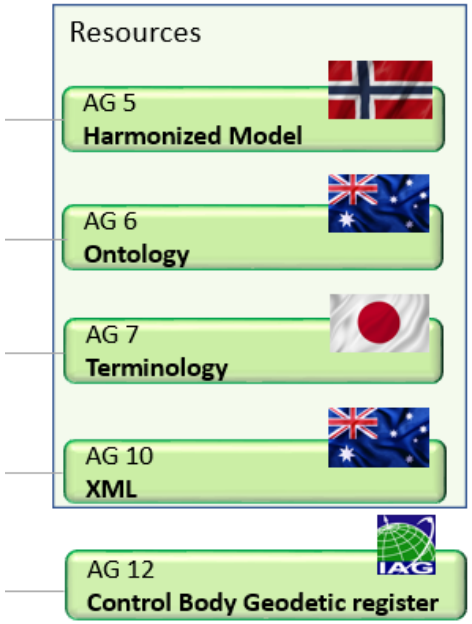
- ISO/TC 211 contributes with over 100 standards supporting the UN Sustainable Development Goals
- UN-GGIM: Committee of Experts on Global Geospatial Information Management
  - @UNGGIM

# History

- 1994
  - 1st ISO TC/211 Plenary. Oslo, Norway
- 1997
  - OMT Object Model as a graphical language, EXPRESS and CORBA IDL as lexical languages
- 1998
  - UML was selected as the conceptual schema language
- 2002
  - The Harmonized Model Maintenance Group (HMMG)

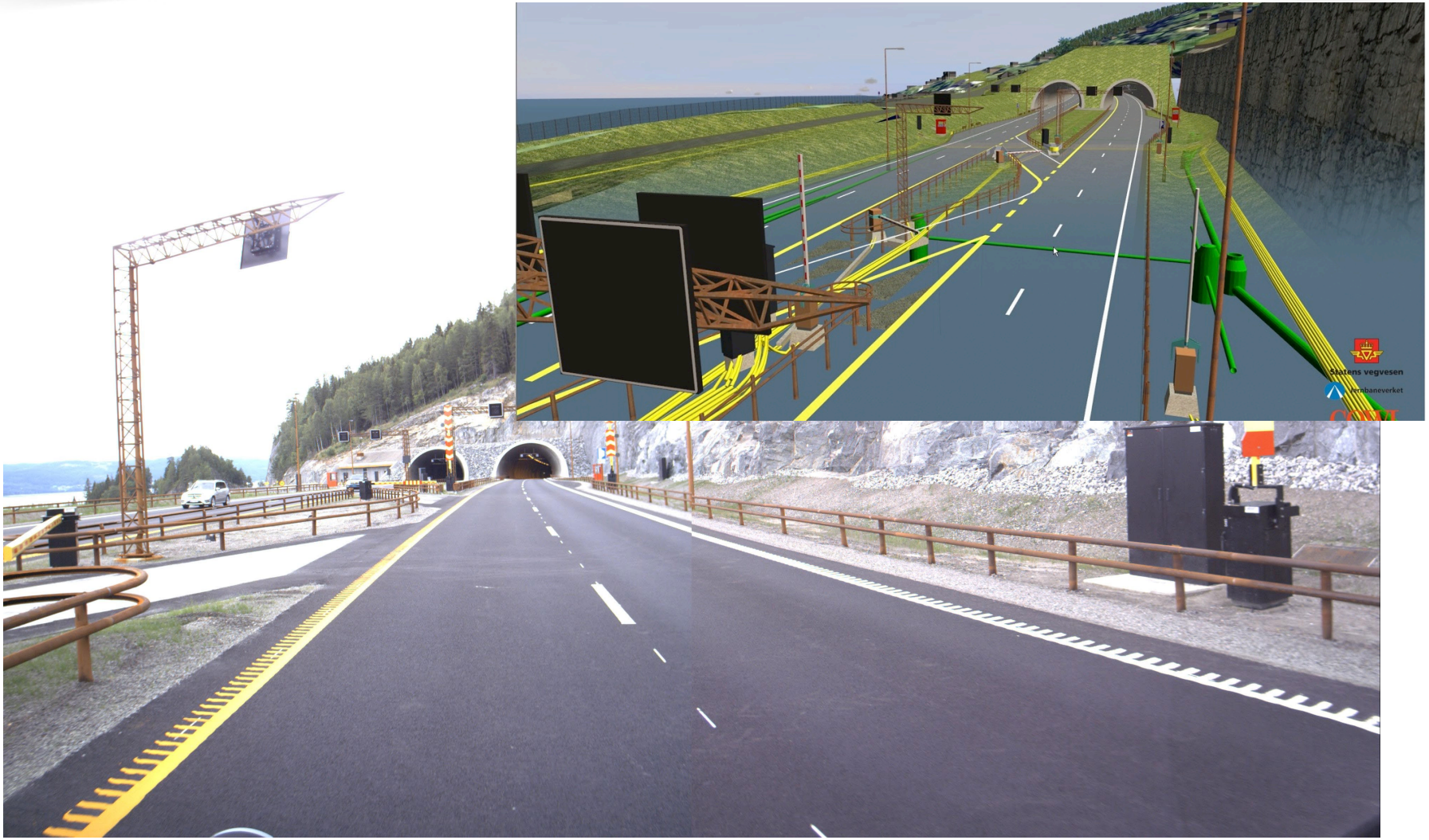
# The Harmonized Model Maintenance Group

- Convenor: Dr. Knut Jetlund, Norway
- Core responsibility:
  - *Ensure that UML models and derived resources for implementation are maintained and made accessible.*
- Establish, maintain and make available the **Harmonized UML Model**
- Coordinate the use of UML
- Coordinate the work on resources for implementation
  - Close cooperation with the XML Maintenance Group (**XMG**), the Group of Ontology Management (**GOM**) and the Terminology Maintenance Group (**TMG**)



# Information modelling: There is a real world out there

# Geospatial information is more than maps



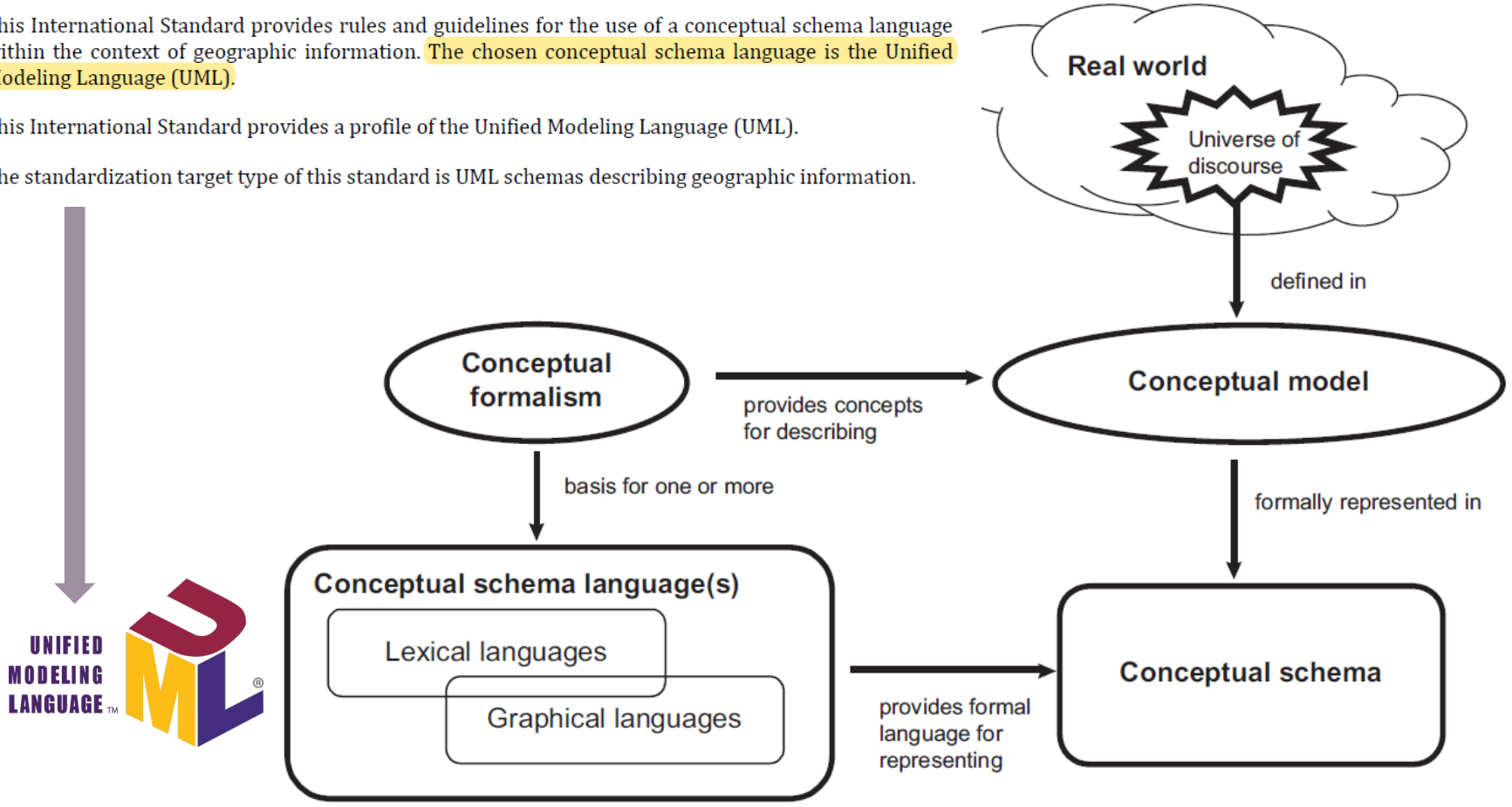
# ISO/TC 211 Information modelling concepts

**ISO 19103:2015 Geographic information — Conceptual schema language**

This International Standard provides rules and guidelines for the use of a conceptual schema language within the context of geographic information. The chosen conceptual schema language is the Unified Modeling Language (UML).

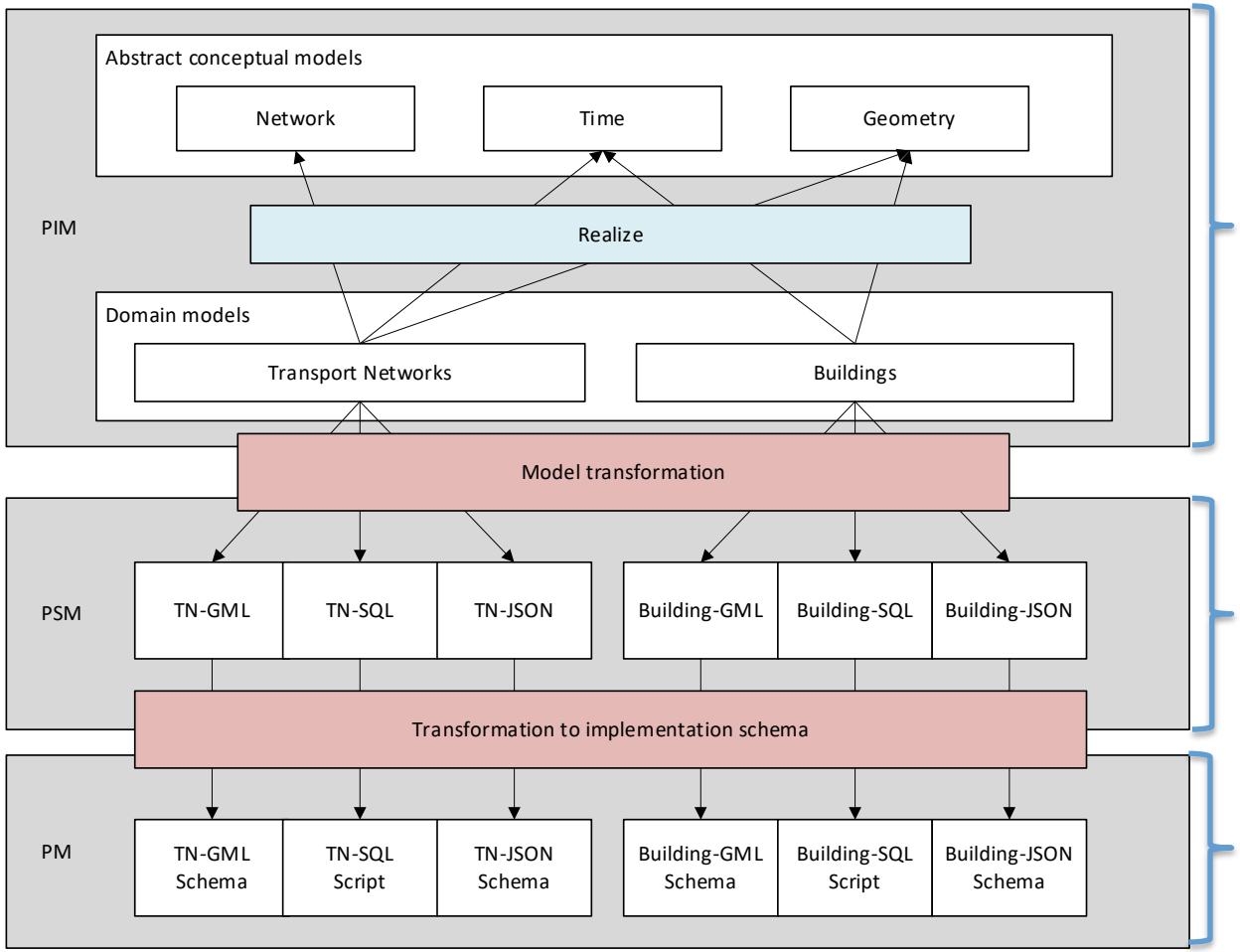
This International Standard provides a profile of the Unified Modeling Language (UML).

The standardization target type of this standard is UML schemas describing geographic information.




**ISO 19101:2013 Geographic information — Reference model (Figure E.1)**

# Model Driven Architecture (MDA)



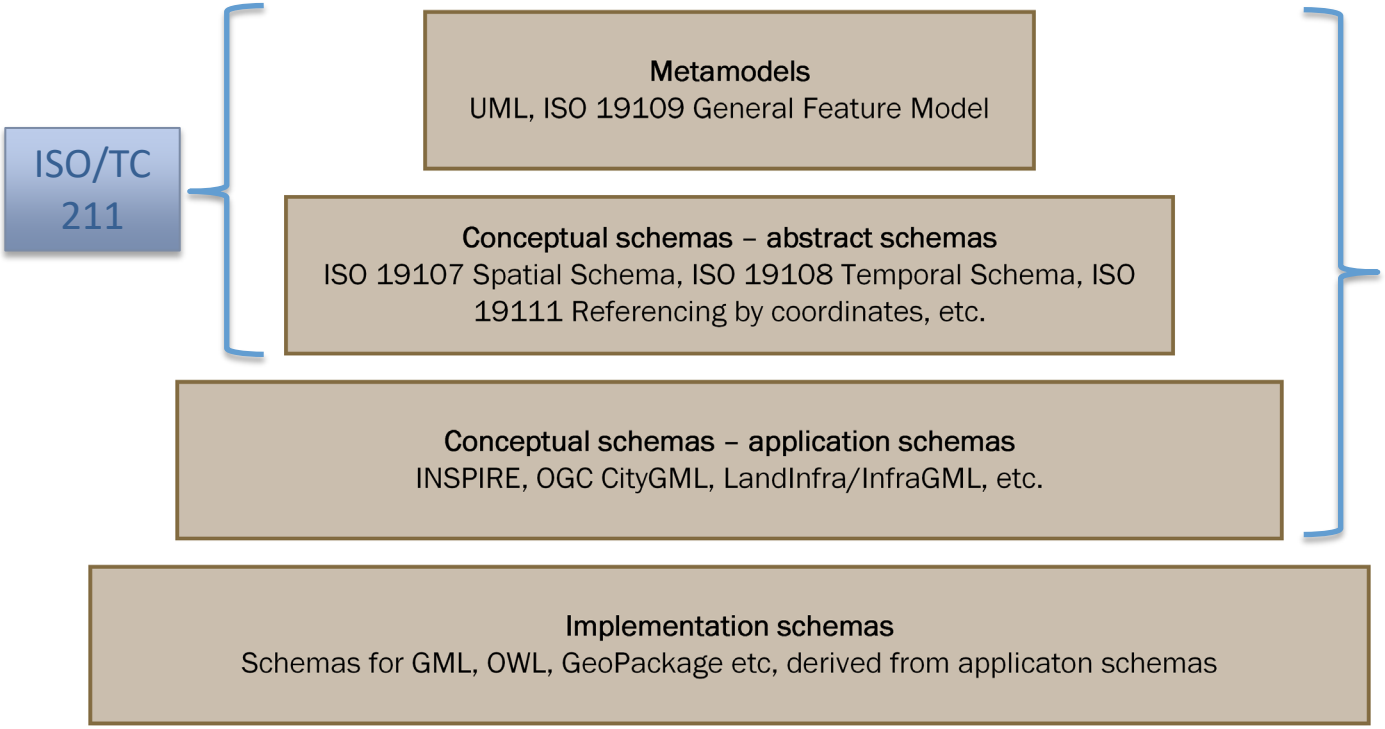

Platform Independent Models

Platform Specific Models

Platform Models

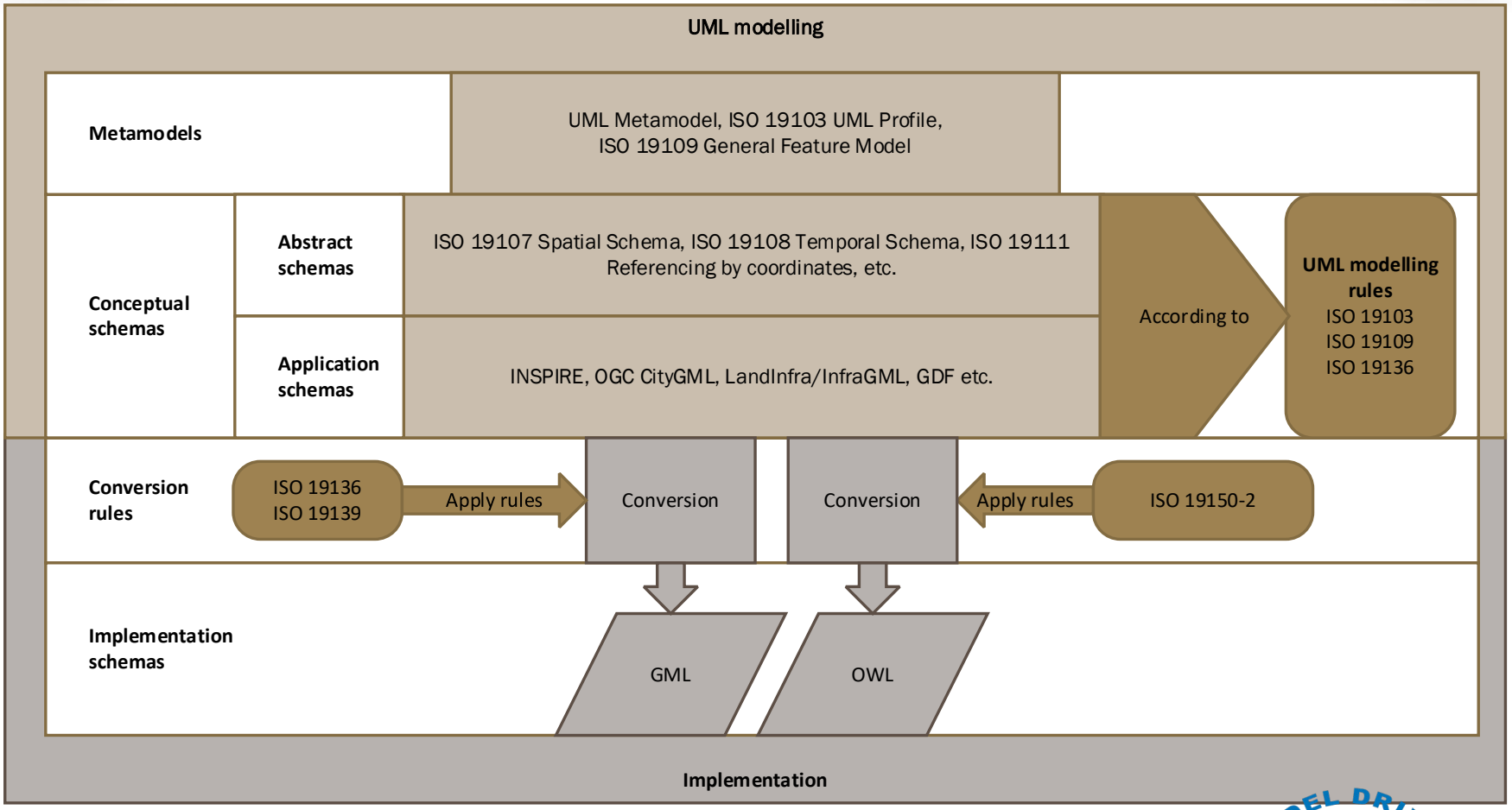
Source: Jetlund, K., Harmonizing and linking conceptual models of geospatial information, in Faculty of Engineering, Department of Manufacturing and Civil Engineering. 2021, Norwegian University of Science and Technology. p. 207.

# ISO/TC 211 MDA – levels of abstraction




Source: Jetlund, K., Onstein, E., Huang, L., Information Exchange between GIS and Geospatial ITS Databases Based on a Generic Model. Isprs International Journal of Geo-Information 2019, 8(3), p. 141,DOI: ARTN 141 10.3390/ijgi8030141.

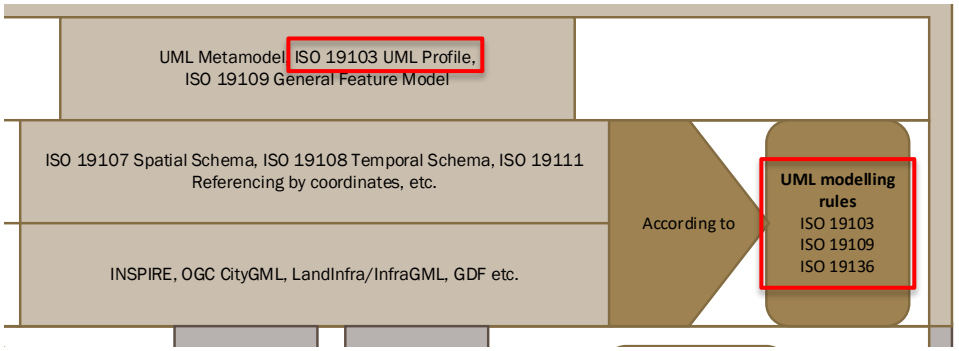
# ISO/TC 211 MDA Framework

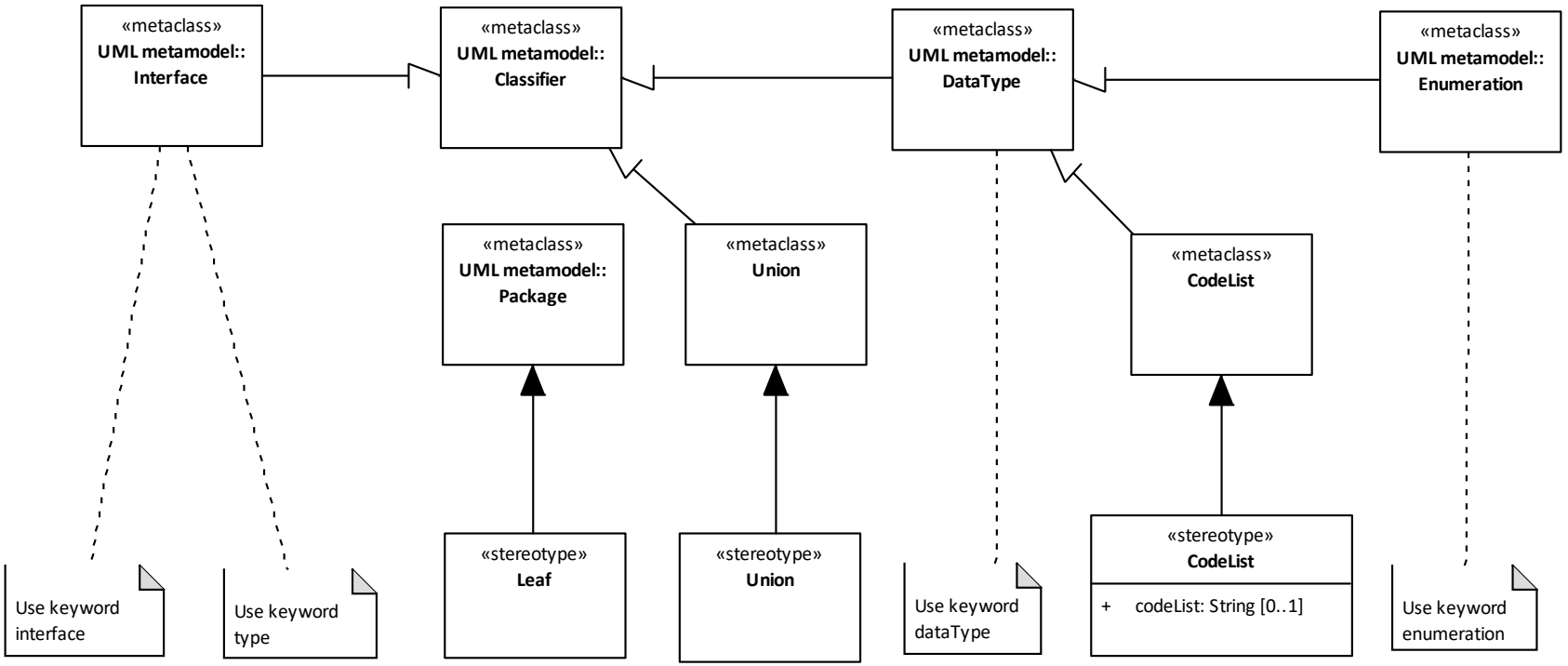



Source: Jetlund, K., E. Onstein, and L. Huang, Adapted Rules for UML Modelling of Geospatial Information for Model-Driven Implementation as OWL Ontologies. ISPRS International Journal of Geo-Information, 2019. 8(9): p. 365.

# Modelling rules: ISO 19103 UML Profile

## Classes and packages

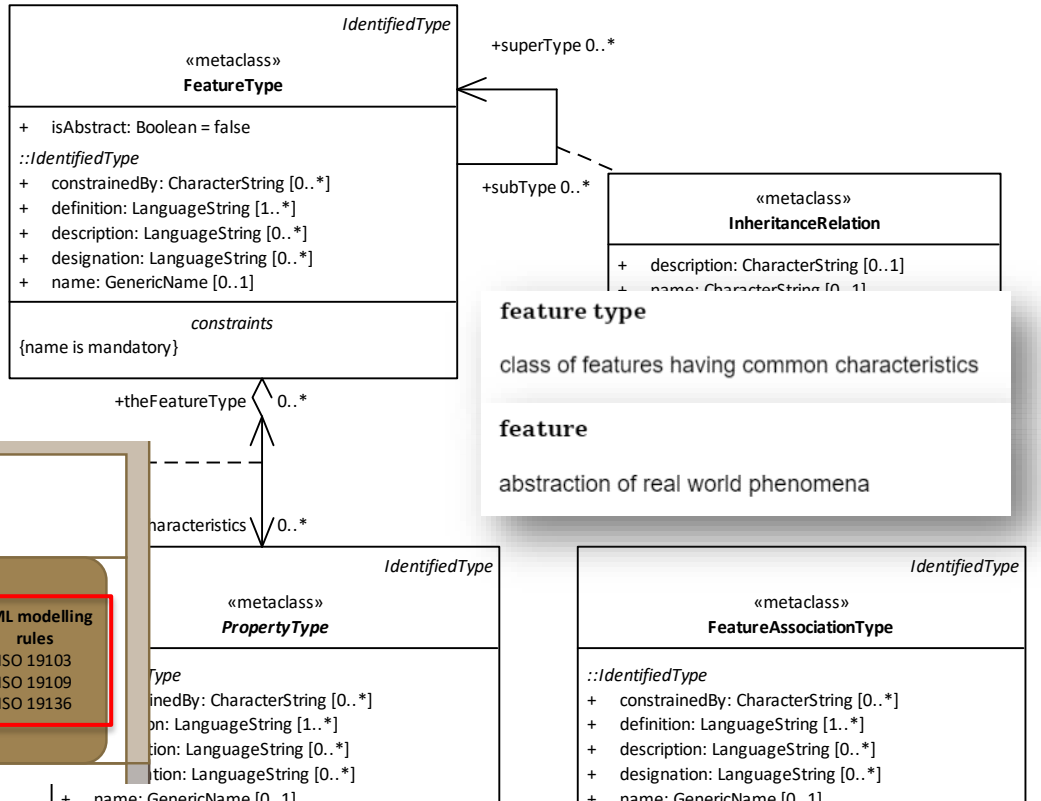



**ISO 19103:2015 Geographic information — Conceptual schema language (Figure D.29)**

# Modelling rules: ISO 19109

## The General Feature Model (GFM)




**ISO 19109:2015 Geographic information — Rules for application schemas (Figure 5)**

# UML Best Practices

https://github.com/ISO-TC211/UML-Best-Practices/wiki

**Welcome to the ISO/TC211 Wiki on best practices for modelling geographic information in UML**

The purpose of this wiki is to collect and present best practices for modelling geographic information in UML, and to make the models understandable for both machines and humans.
See also related wikis for ISO/TC211 XMG and ISO/TC211-GOM.

Pages 39

Find a Page...

## Introduction

- Basic UML
- Level of abstraction
- Reference material

## Best practices

- Relevant requirements and recommendations
- Best practices for modelling
- Best practices for designing class diagrams
- Best practices to help implementation

## Model documentation

- Automated documentation of models
- Versions
- Exporting diagrams to image files

## Tools, scripts and searches

- Scripts in Enterprise Architect - Sample scripts
- Model searches in Enterprise Architect
- ShapeChange plugin
- Creating XML Schemas From the Harmonized Model Using ShapeChange

## Best practices for diagram design

Tobias Spears edited this page on 24 Mar 2020 · 29 revisions

Home

**A *class diagram* is just a view of a part of a model, and might not show all aspects. But it is an important illustration for human understanding of the model. This page contains best practices for creating clean and consistent *class diagrams* that are easier to understand.**

### Required diagrams

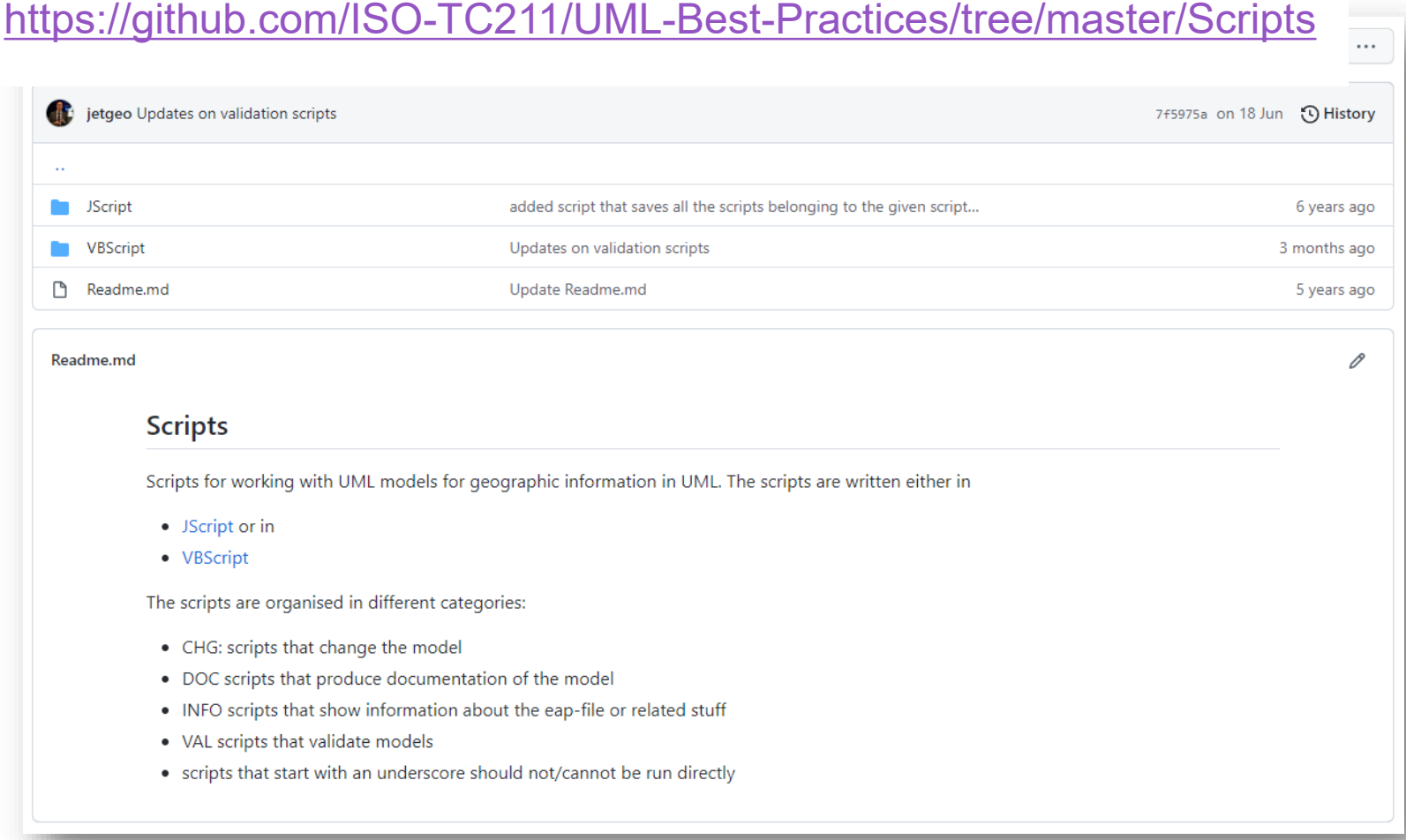
ISO19103 - Conceptual Schema Language have rules and recommendations for documentation of models, including which diagrams that should be a part of the documentation.

### Designing class diagrams

- Use of colours and fonts in UML diagrams.
- Less is more - few elements and few perspectives for one diagram
- Orthogonality - arrange elements and connectors orthogonally
- Illustrate classes from other standards
- Avoid crossing lines
- Parent elements above child elements
- Harmonize sizes
- Illustrating constraints

# GitHub Script repository

- Sample scripts for working with UML models based on ISO/TC 211 standards
  - https://github.com/ISO-TC211/UML-Best-Practices/tree/master/Scripts



jetgeo Updates on validation scripts — 7f5975a on 18 Jun — History

| | | |
|---|---|---|
| JScript | added script that saves all the scripts belonging to the given script... | 6 years ago |
| VBScript | Updates on validation scripts | 3 months ago |
| Readme.md | Update Readme.md | 5 years ago |

Readme.md

## Scripts

Scripts for working with UML models for geographic information in UML. The scripts are written either in

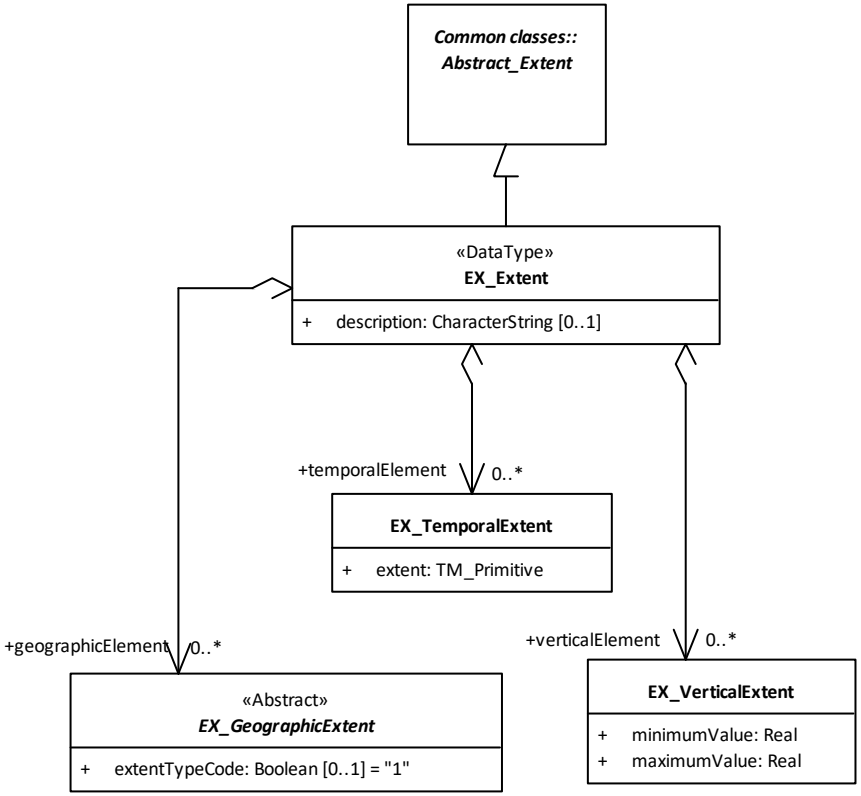
- JScript or in
- VBScript

The scripts are organised in different categories:

- CHG: scripts that change the model
- DOC scripts that produce documentation of the model
- INFO scripts that show information about the eap-file or related stuff
- VAL scripts that validate models
- scripts that start with an underscore should not/cannot be run directly

# The UML models are the standards!

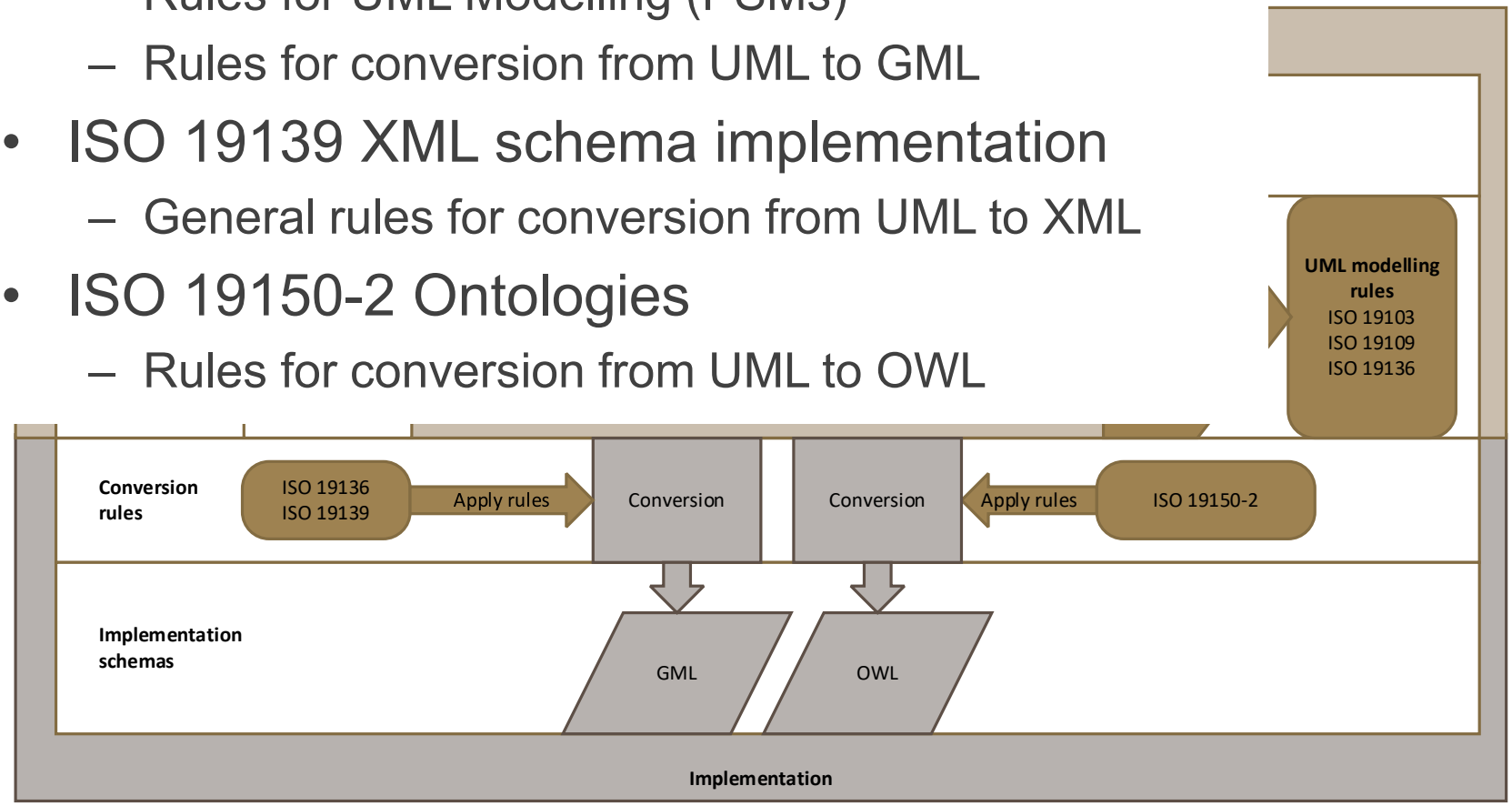
- *The standard documents are the formal representations of the models as text and figures…*
- *…and add normative statements, conformance classes and conformance tests…*
- **…but the UML models are the originals!**




**ISO 19115:2014 Geographic information — Metadata – Part 1: Fundamentals**

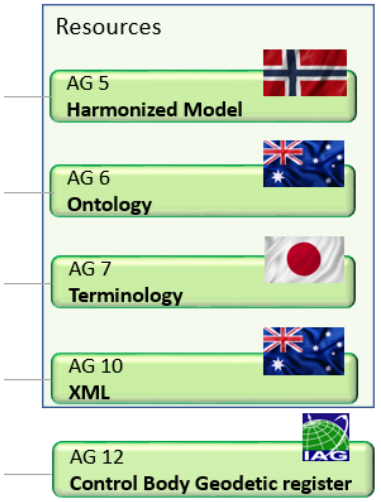
# Standardized Model-driven implementation

- ISO 19136 Geography Markup Language
  - XML for geospatial information
  - Rules for UML Modelling (PSMs)
  - Rules for conversion from UML to GML
- ISO 19139 XML schema implementation
  - General rules for conversion from UML to XML
- ISO 19150-2 Ontologies
  - Rules for conversion from UML to OWL



# Standardized Implementation Schemas

- Derived from The Harmonized UML Model:
  - XML Schemas https://schemas.isotc211.org
  - OWL Ontologies https://def.isotc211.org




ISO TC 211 Geographic information/Geomatics

XML schema representations of geographic technology standards

BROWSE ALL SCHEMAS AND ASSOCIATED RESOURCES

LOCATE A SPECIFIC

Standard number:

For example, 19115

ISO TC 211 Geographic information/Geomatics

Ontology representations of geographic technology standards

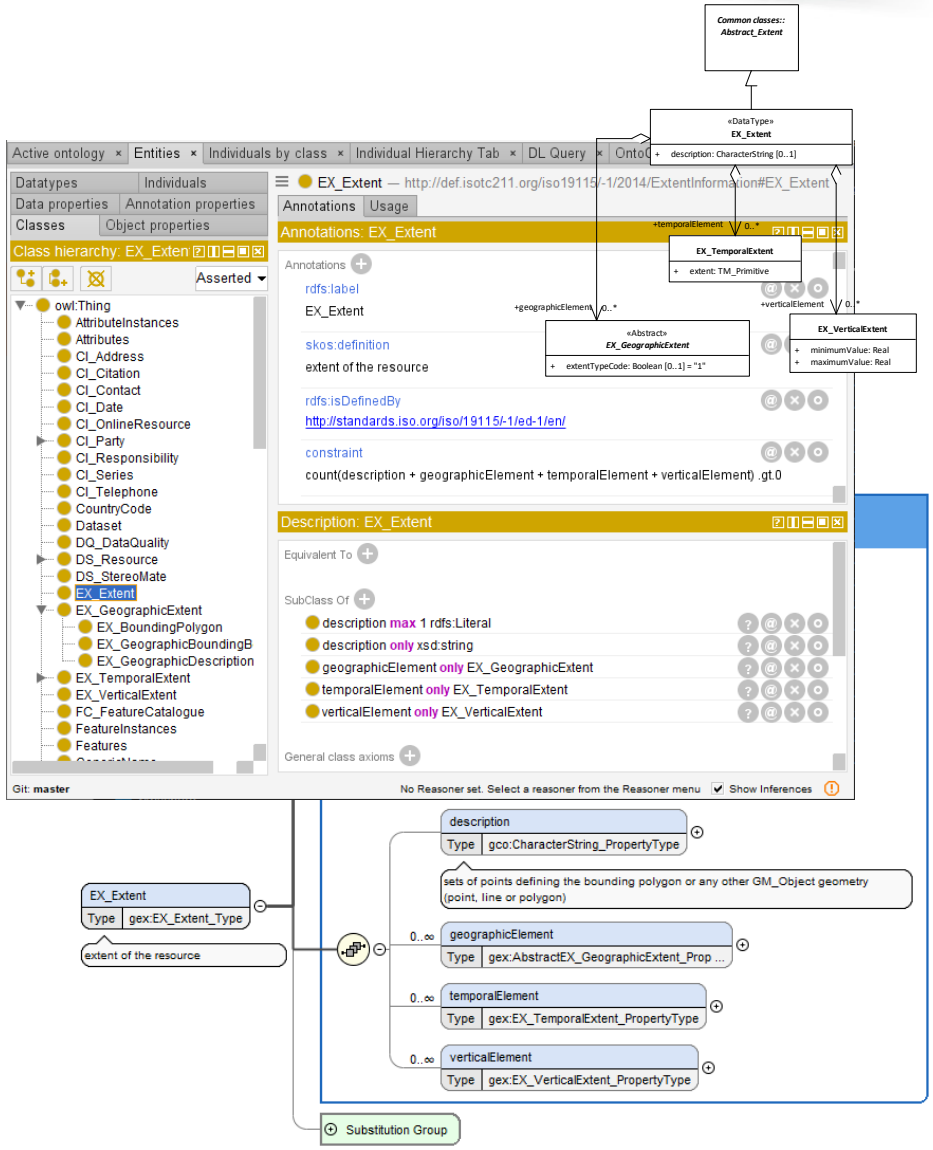
BROWSE ALL ONTOLOGIES

LOCATING ONTOLOGIES

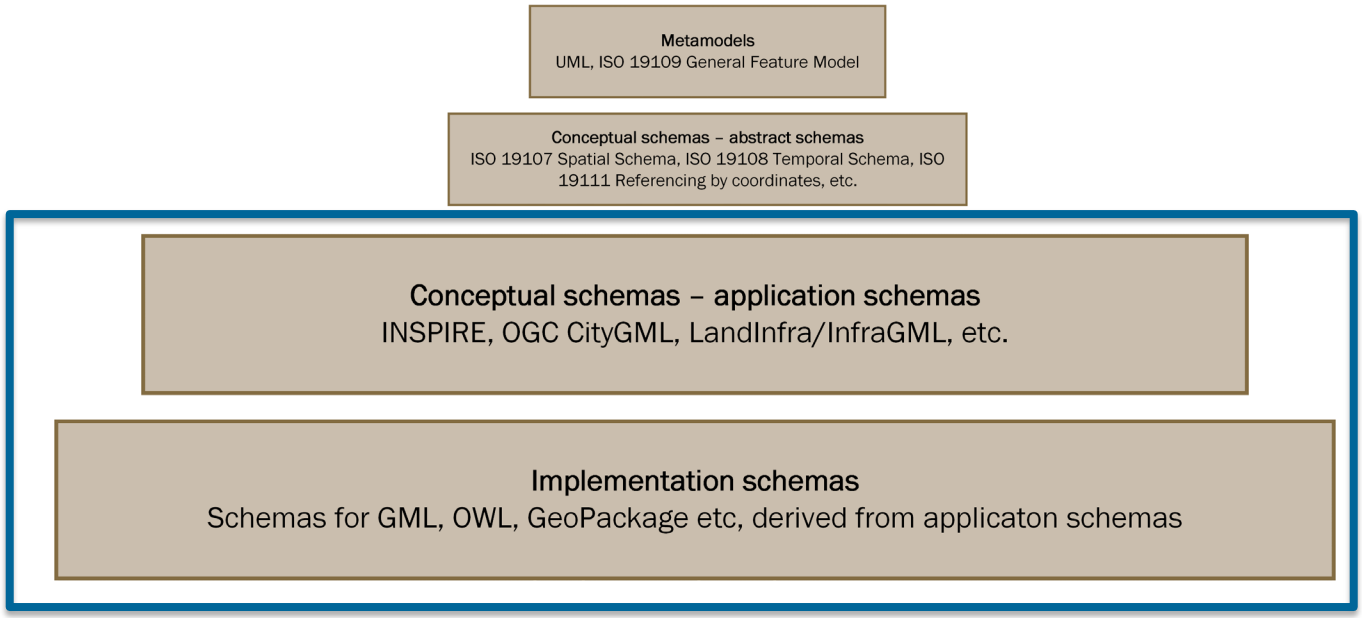
| Standard number: | Part number: | Year: | Version: | |
|---|---|---|---|---|
| For example, 19101 | 2 | 2008 | catalog-v001.xml | Locate ontology |

# The schemas are the resources for implementation!

- *The standard documents present the models as text and figures…*
- *…and add normative statments, conformance classes and conformance tests…*
- *…the UML models are the originals…*
- **…but the schemas are the resource needed for implementation!**



# Application schemas and implementation schemas




MODEL DRIVEN ARCHITECTURE®

UNIFIED MODELING LANGUAGE™ UML®

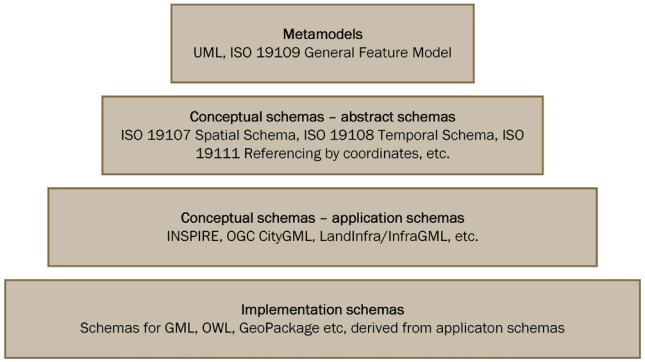
<GML>

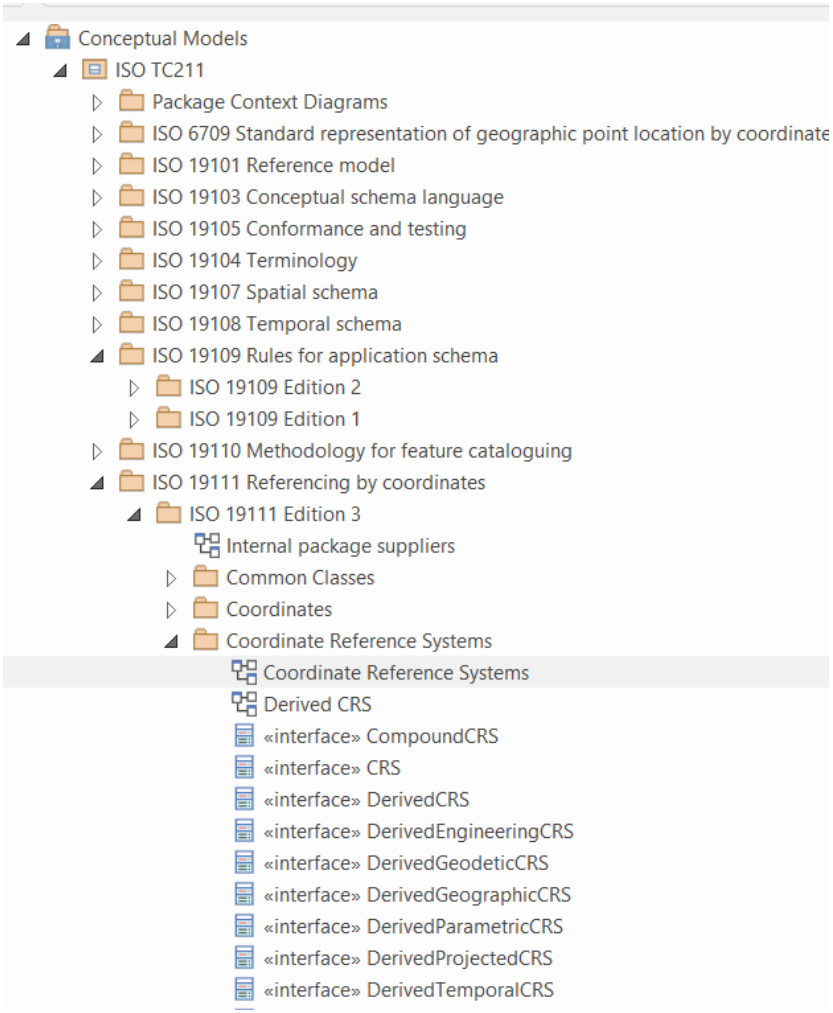
W3C OWL

| Global | Regional | National |
|---|---|---|
| OGC® Making location count. | INSPIRE · Infrastructure for Spatial Information in Europe | GEONOVUM |
| IHO International Hydrographic Organization | | Kartverket |

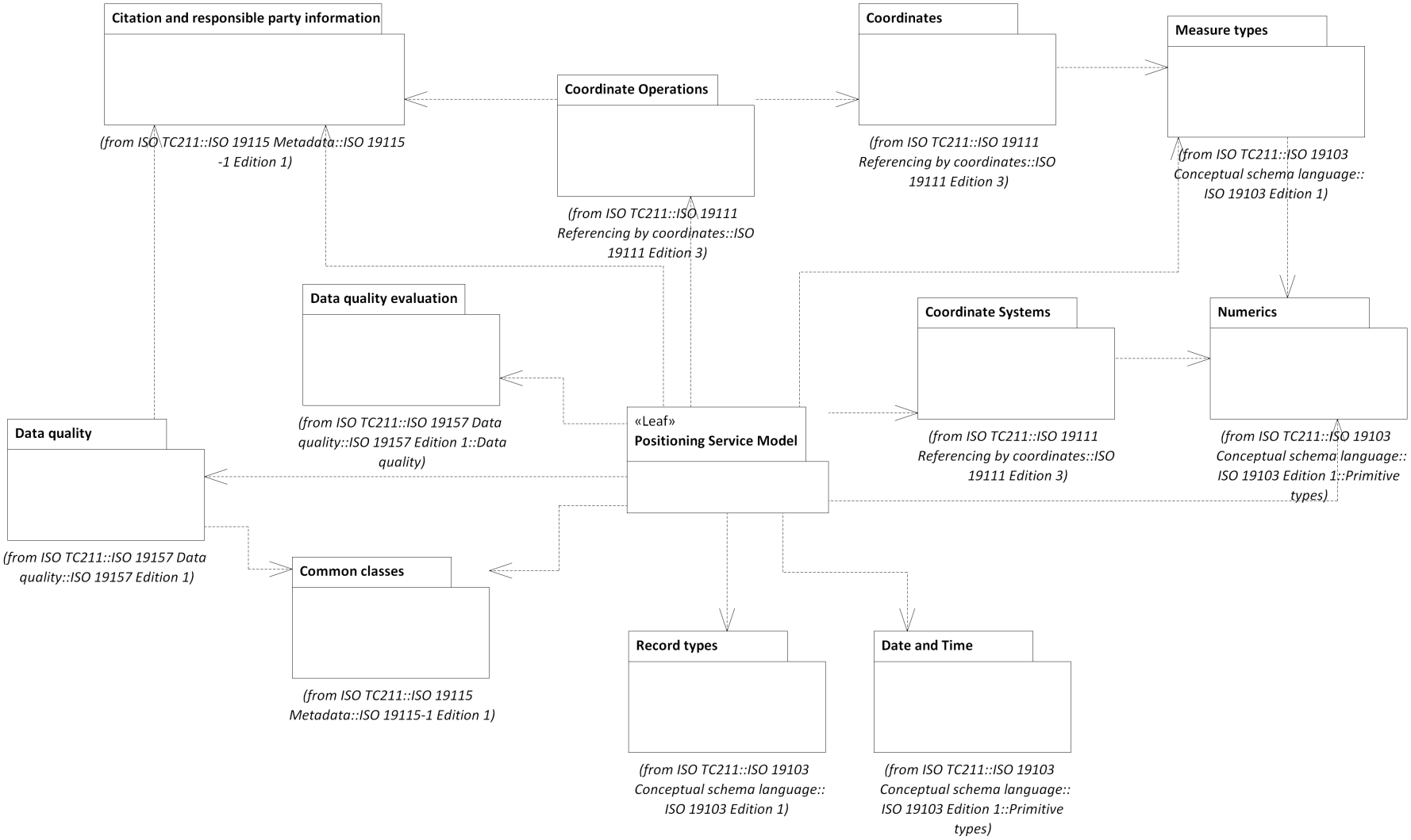
# The Harmonized UML Model

- All UML models in one repository
- Maintained by the HMMG
- Reuse of elements
  - Internally in ISO/TC 211 standards
  - Externally: OGC, INSPIRE, Domain models, National models



# Example internal dependencies: ISO 19116




**ISO 19116:2019 Geographic information — Positioning services**

# Ways of accessing and working with the HM

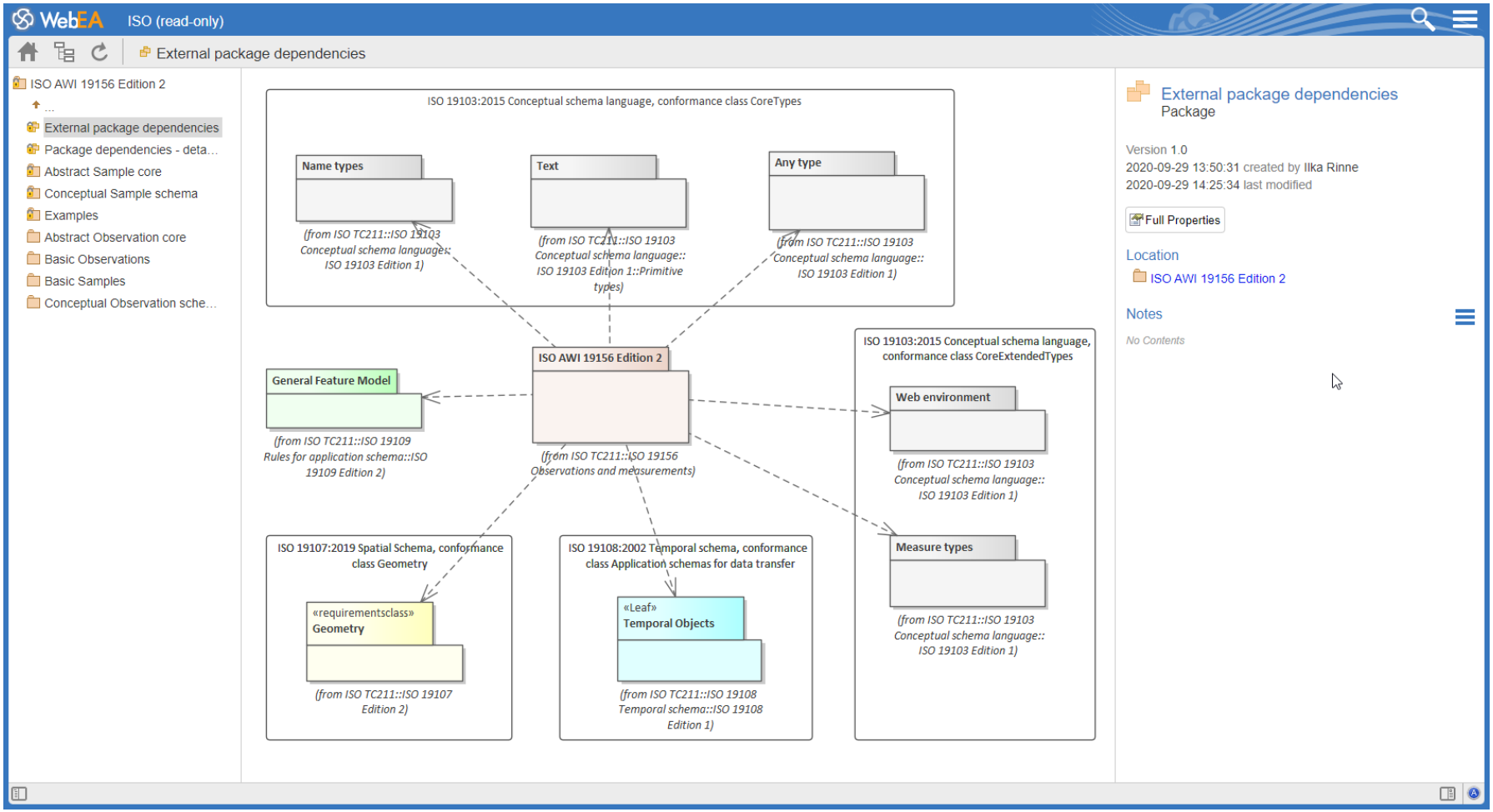
https://github.com/ISO-TC211/HMMG/wiki#accessing-the-isotc-211-harmonized-uml-model

- HM cloud repository (read/write access, for editors)
  - Cloud based, latest versions of all approved changes for all models
- Sparx ProCloud Web (open for anyone)
  - http://iso.sparxcloud.com/index.php
- Sparx ProCloud Reusable Asset Service (RAS)
  - Read access - download **published versions** of individual model packages directly into any EA project
- GitHub resources:
  - Standalone 'Official' EA project – **periodically synchronized** with ProCloud
  - Standalone 'Editorial' EA project – **periodically synchronized** with 'Official' EA project + merge of 'Editorial' XMIs

- ProCloud and RAS is the primary repository
- EA projects on GitHub are provided for convenience

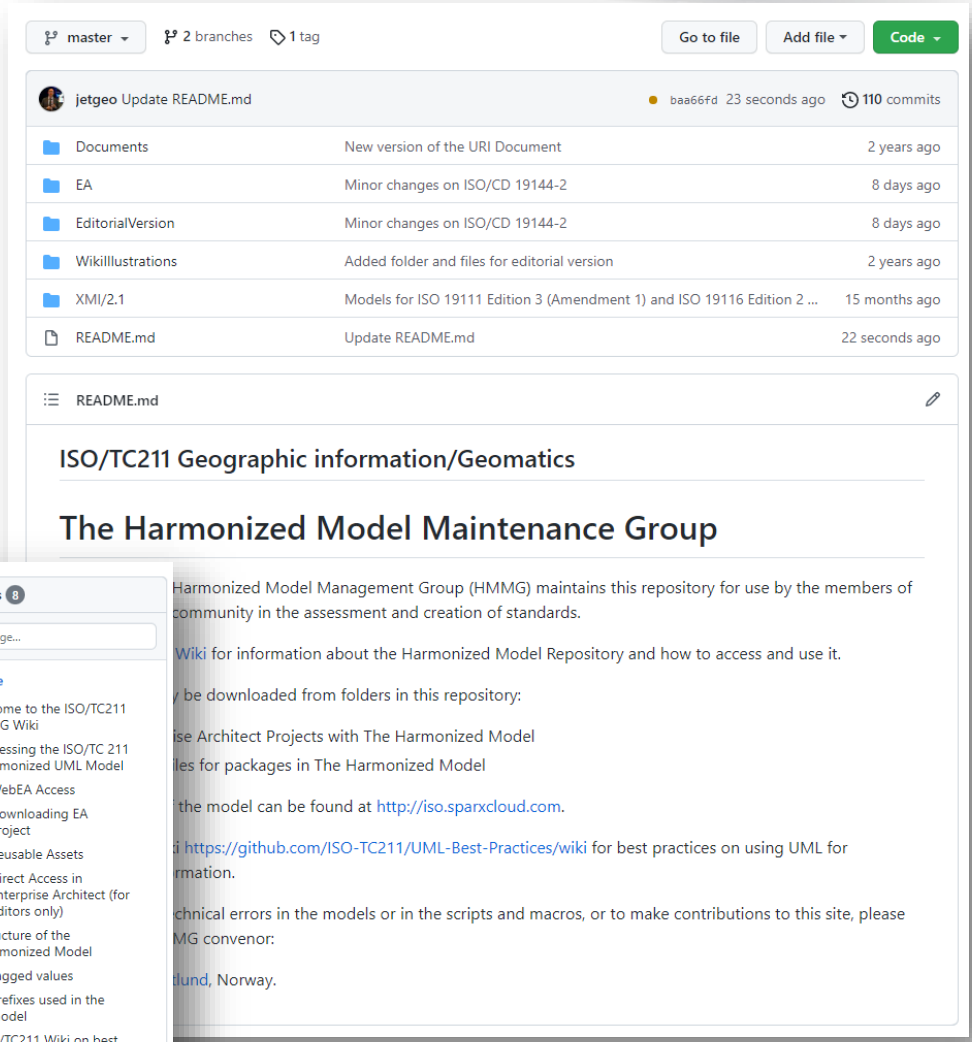
# Sparx ProCloud Web

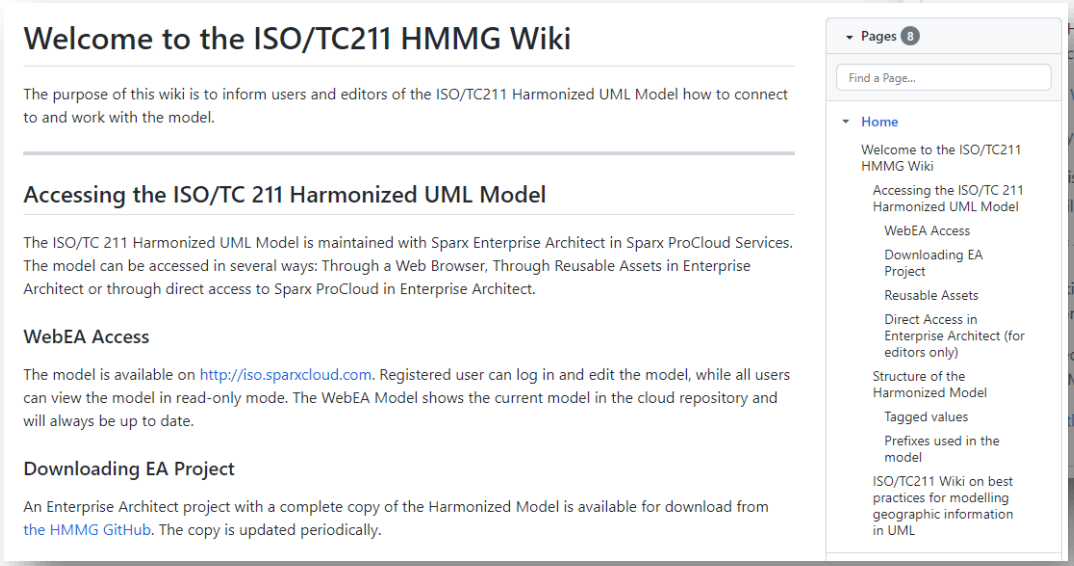
- http://iso.sparxcloud.com/index.php



# https://github.com/ISO-TC211/HMMG

- EA UML Projects
- XMI Files
- Wiki



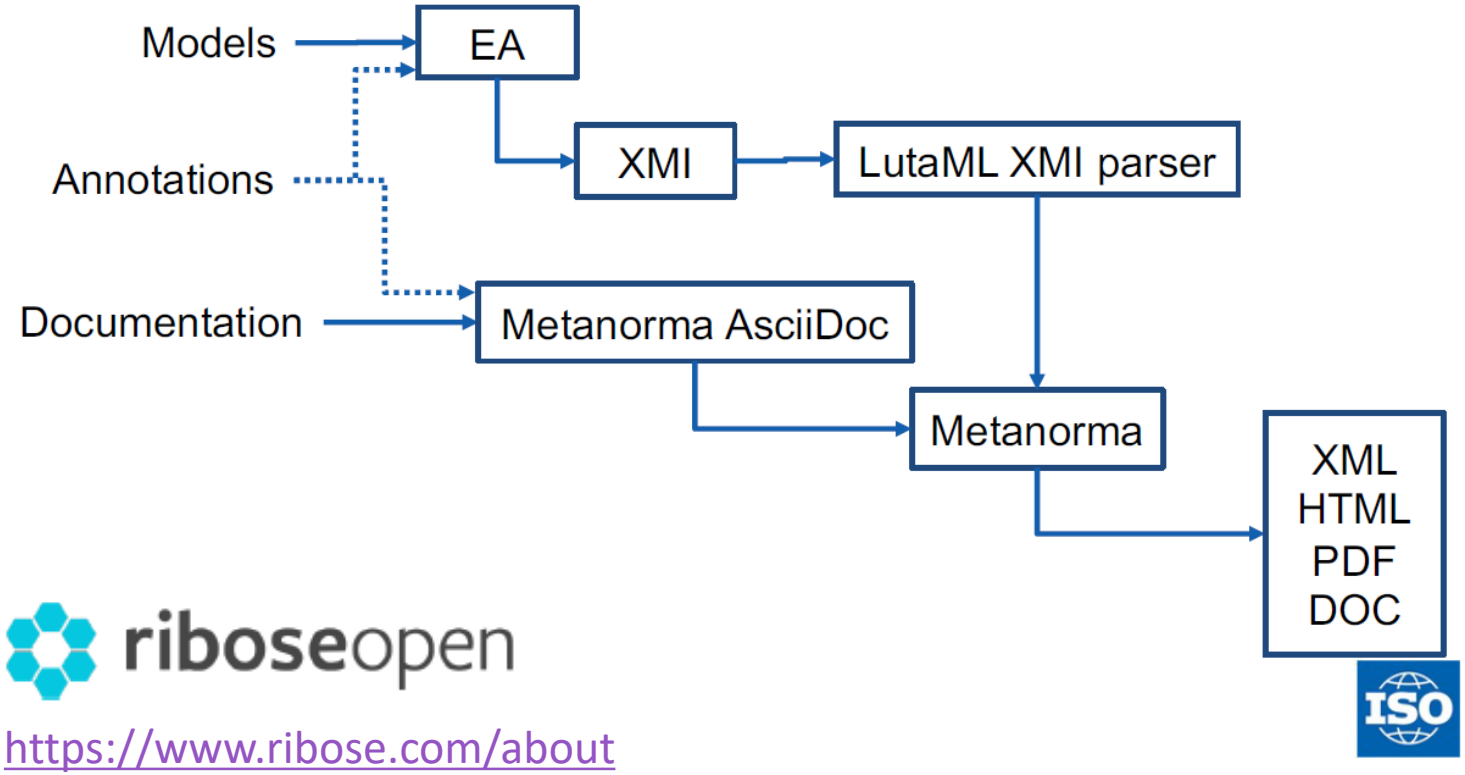



# Experiences

- Project teams need to work with the HM in different ways
  - Depending on technical restrictions and possibilities set by governments and employers...
- The cloud repository
  - \+ Direct update with the latest version
  - – Lack of version control
  - – Response time challenges – geographic differences (!)
- In local projects
  - \+ XMI file version control on GitHub
    - Manual XMI export/import – by Project team or HMMG
  - – Need manual XMI import into the cloud repository and official offline projects – by HMMG

# Automated documentation

Model-based authoring data flow with Metanorma

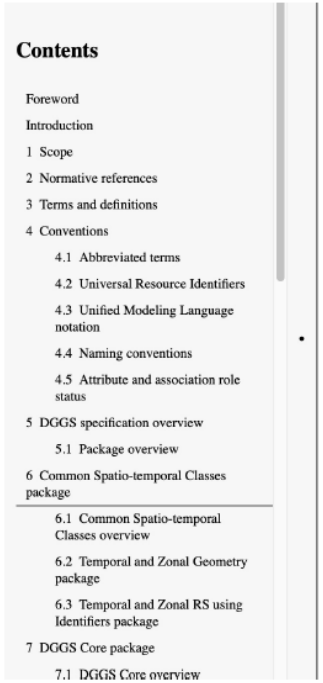



riboseopen

https://www.ribose.com/about

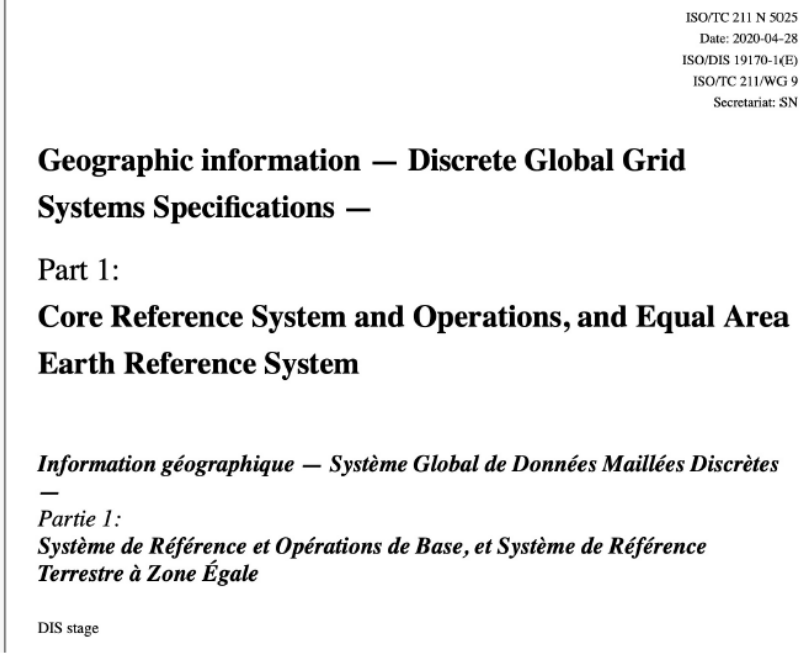
# Automated documentation

ISO 19170-1 fully generated via EA model (90%)



**Contents**






ISO/TC 211 N 5025
Date: 2020-04-28
ISO/DIS 19170-1(E)
ISO/TC 211/WG 9
Secretariat: SN


**Geographic information — Discrete Global Grid Systems Specifications —**

Part 1:

**Core Reference System and Operations, and Equal Area Earth Reference System**

***Information géographique — Système Global de Données Maillées Discrètes —***

*Partie 1:*

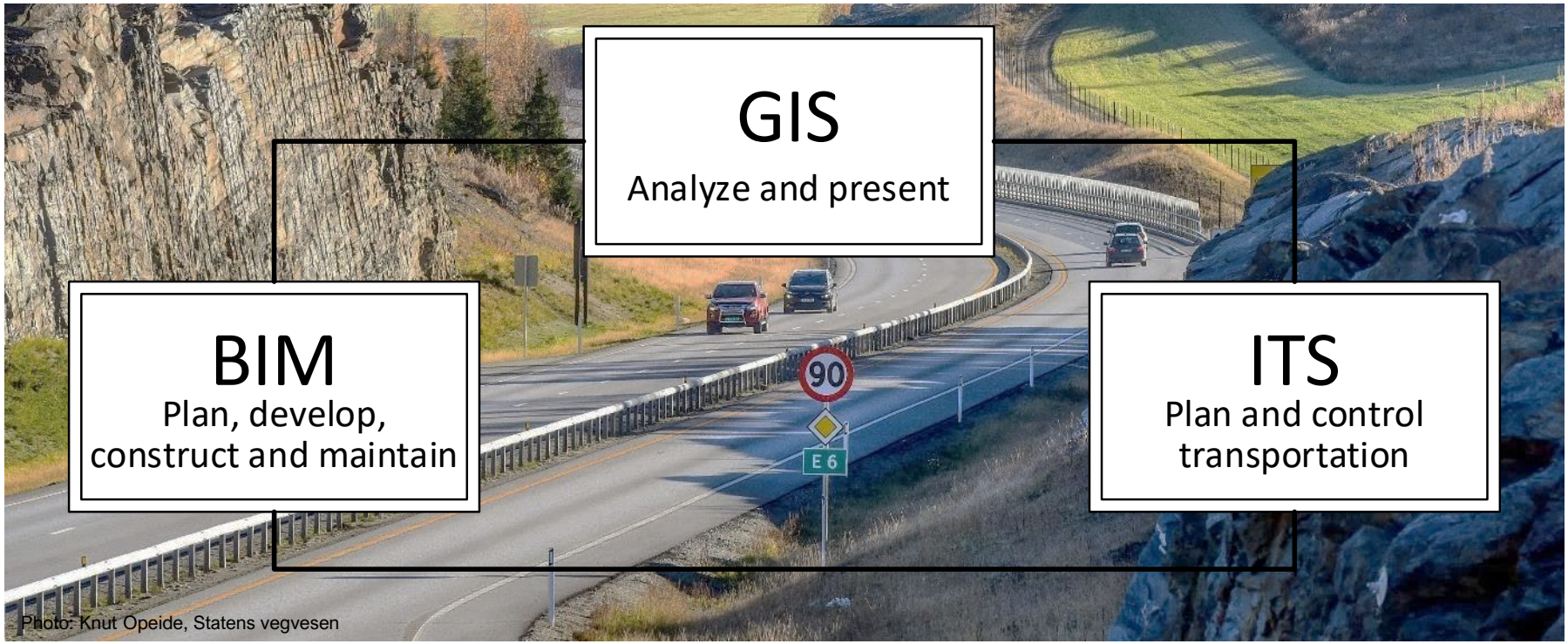
***Système de Référence et Opérations de Base, et Système de Référence Terrestre à Zone Égale***

DIS stage

riboseopen

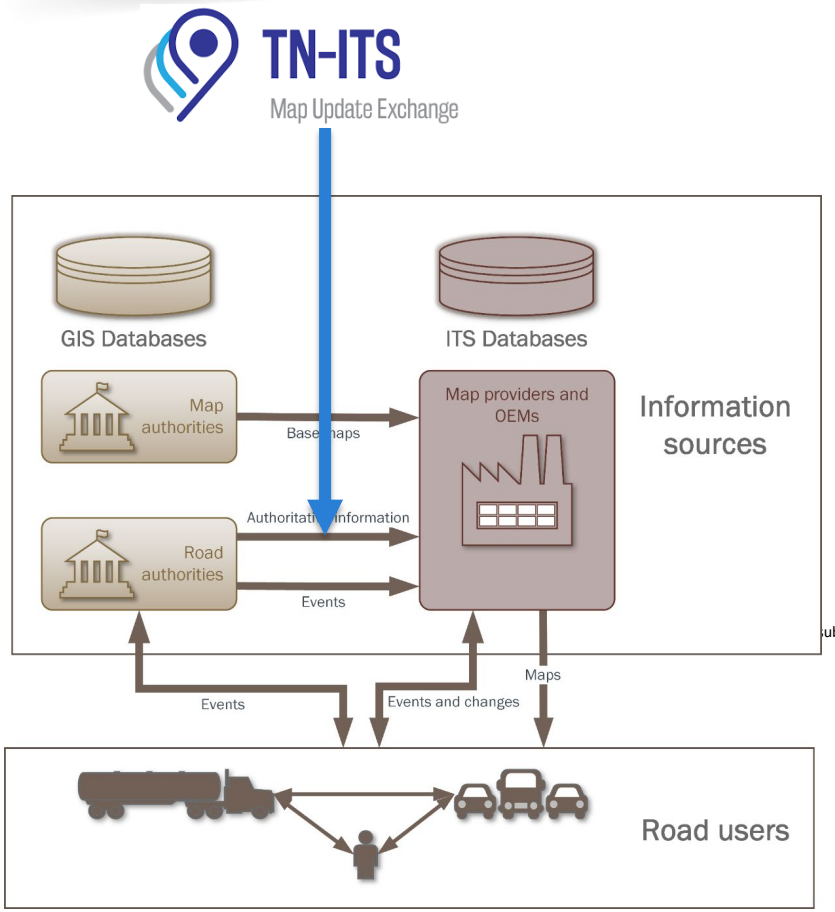
https://www.ribose.com/about

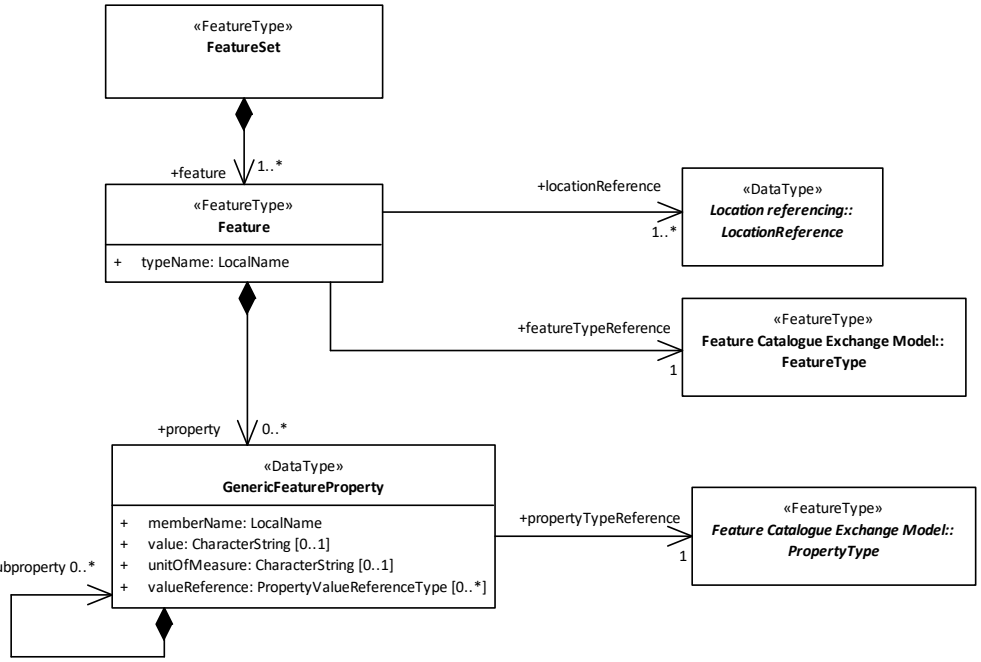
# Examples: Three domains, one real world




…and one approach for modelling geospatial information?

# Example: Intelligent Transport Systems (ITS)



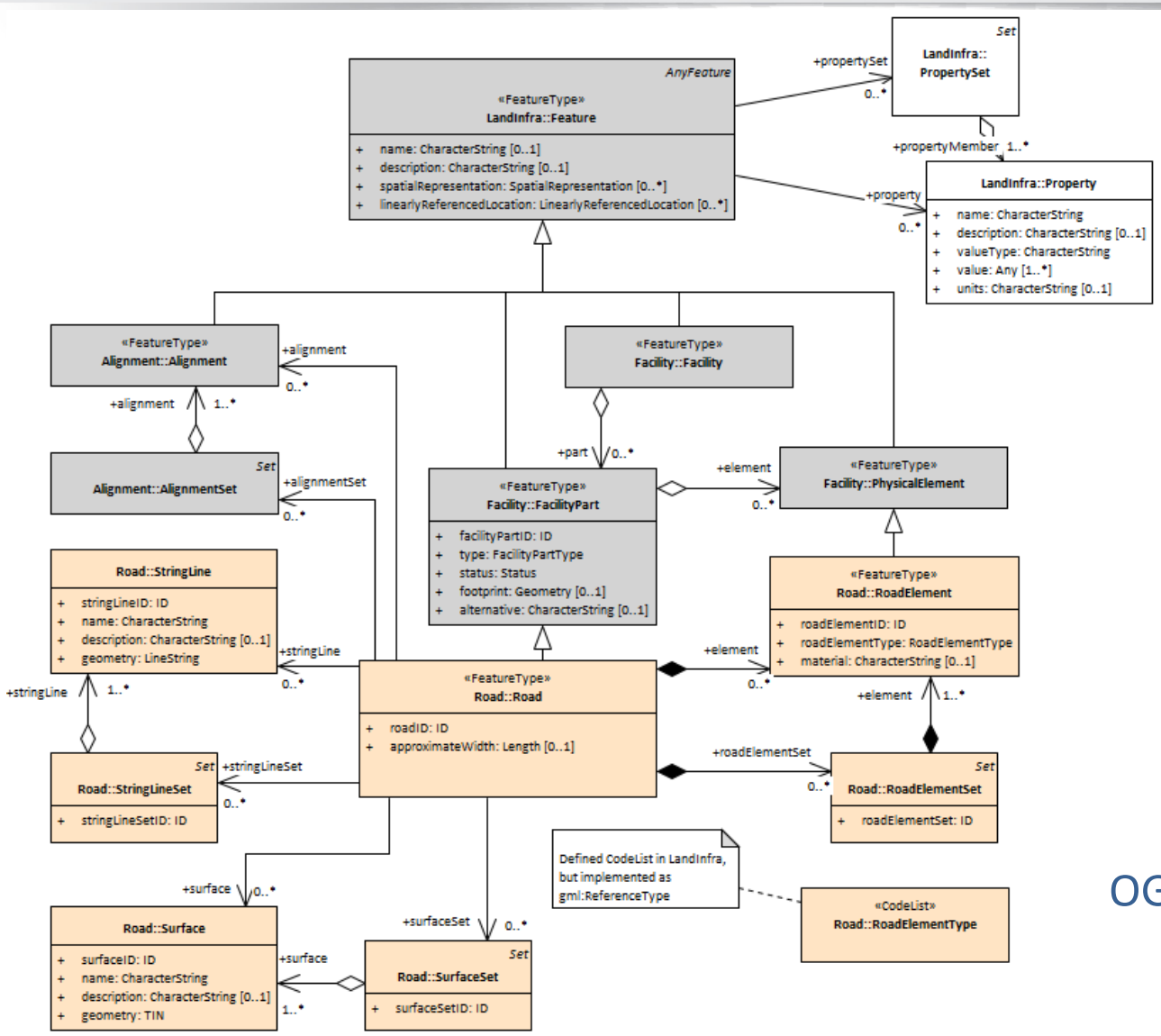




## Implementation schemas:

<GML> W3C OWL

Source: Jetlund, K., Onstein, E., Huang, L., Information Exchange between GIS and Geospatial ITS Databases Based on a Generic Model. Isprs International Journal of Geo-Information 2019, 8(3), p. 141,DOI: ARTN 141 10.3390/ijgi8030141.

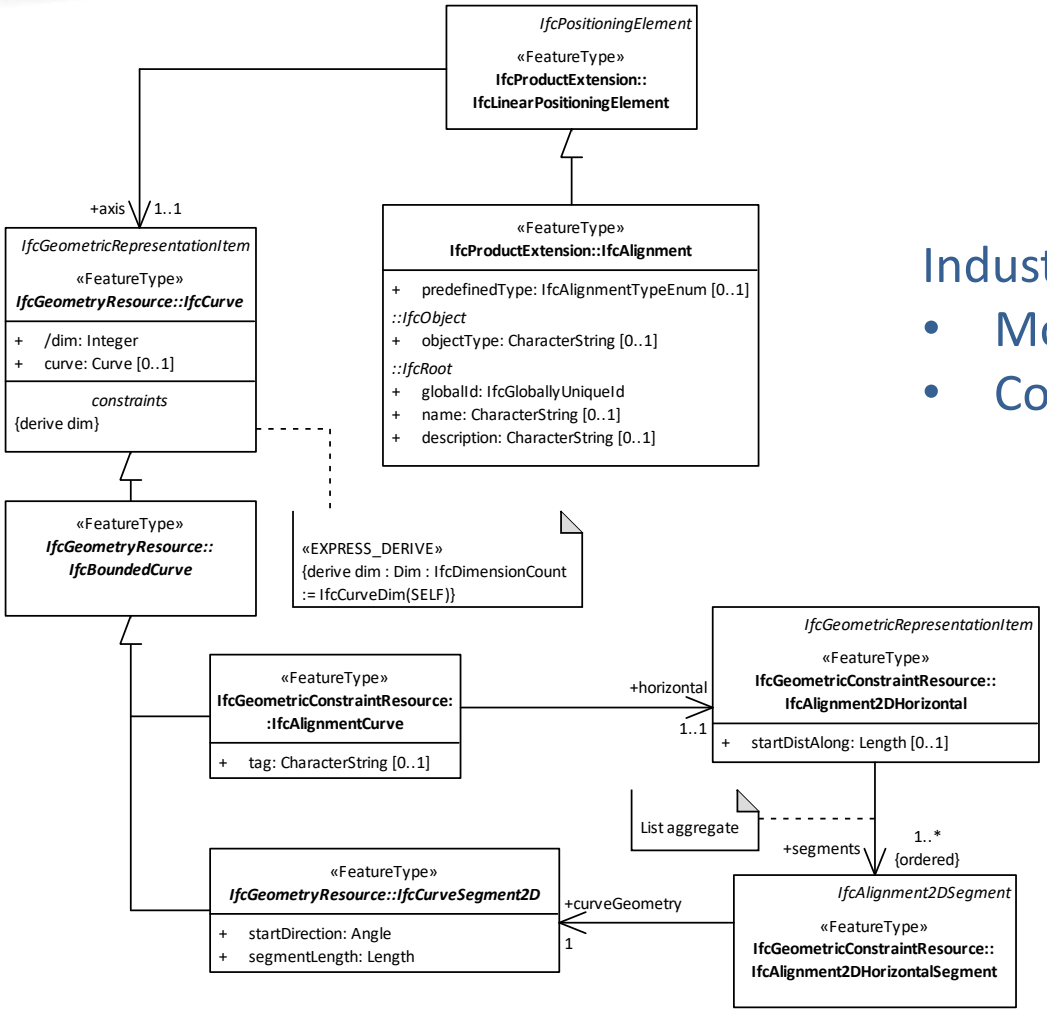
# Example: Road infrastructure construction




OGC®
Making location count.

OGC LandInfra/InfraGML

# Example: Building Information Modelling (BIM)




Source: Jetlund, K., E. Onstein, and L. Huang, IFC Schemas in ISO/TC 211 compliant UML for improved interoperability between BIM and GIS. ISPRS International Journal of Geo-Information, 2020. 9(4).

## Industry Foundation Classes – IFC

- Modelled in EXPRESS
- Converted to ISO/TC 211 UML

## Implementation schemas:

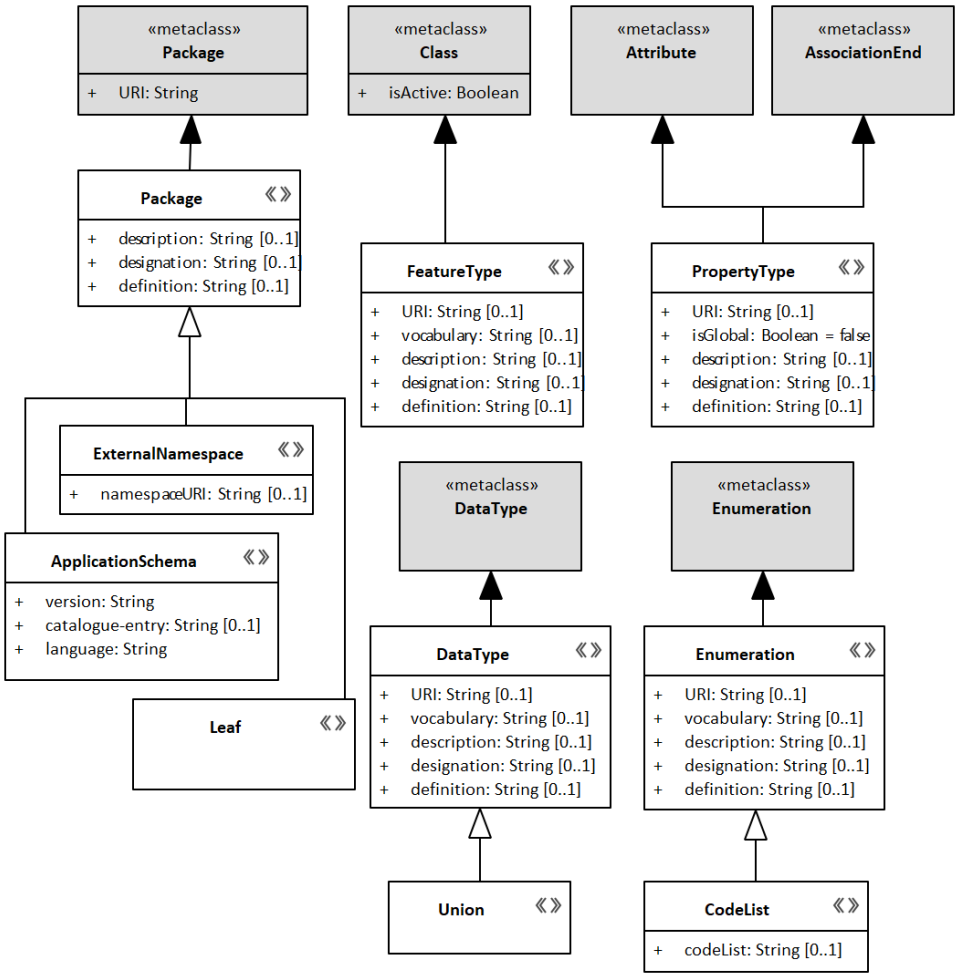
<GML> EXPRESS

# Improvements in progress: The UML Profile

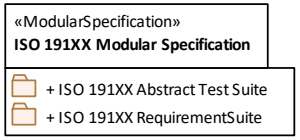
**ISO 19103:202X**
**Geographic information — Conceptual schema language**

- Better conformance to the UML Specification
- Better structure of UML profiles
- Semantics for improved implementation in OWL
- Reaching out towards Top-level Ontologies according to ISO 21831-1.

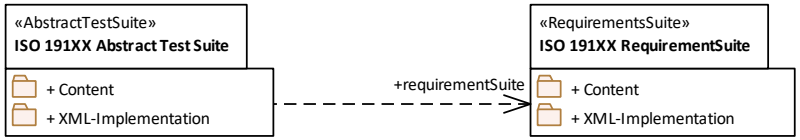
- Create MDG Technologies



# Improvements in progress: Modular specifications

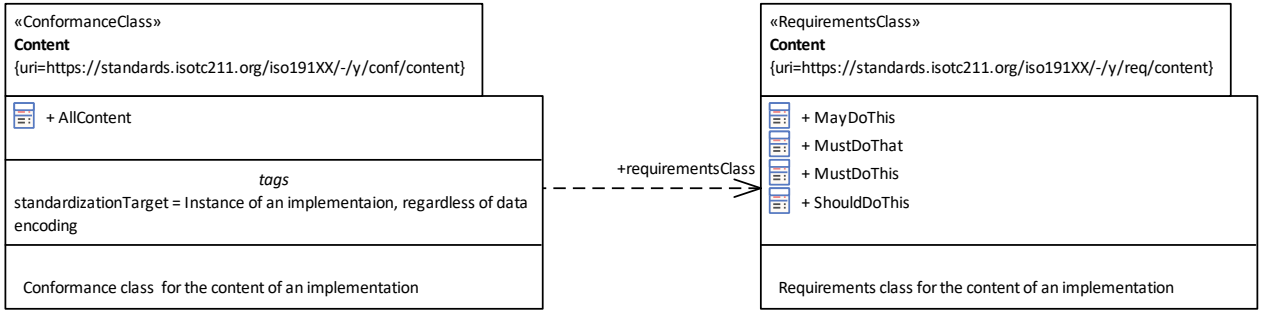



*(from Modular Specification Template)*

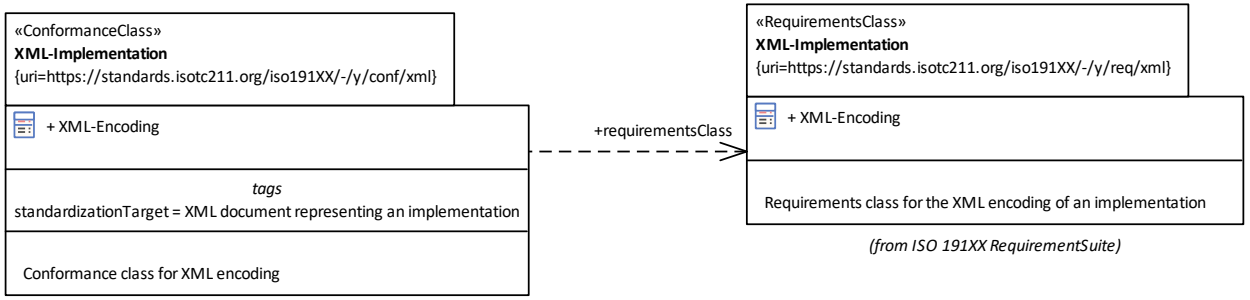



## Conceptual model and UML Profile

### Extending ISO 19105 – Conformance and Testing

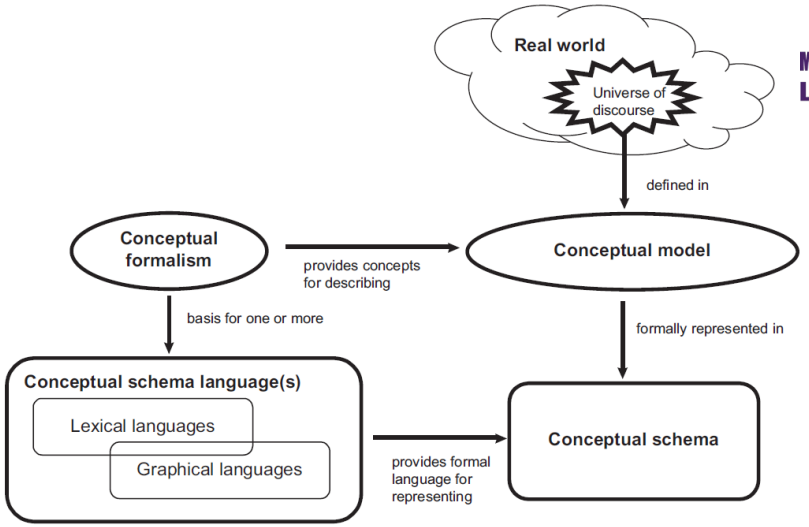



*(from ISO 191XX Abstract Test Suite)* *(from ISO 191XX RequirementSuite)*

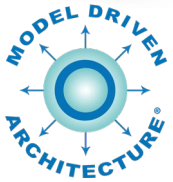


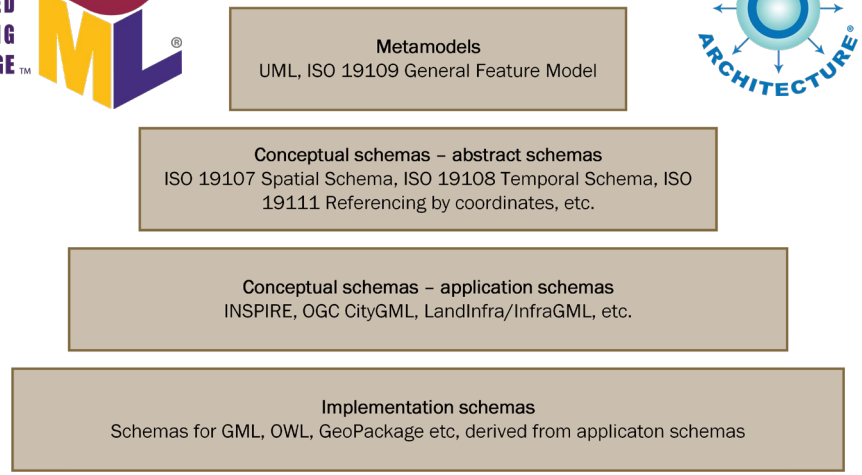

*(from ISO 191XX Abstract Test Suite)* *(from ISO 191XX RequirementSuite)*

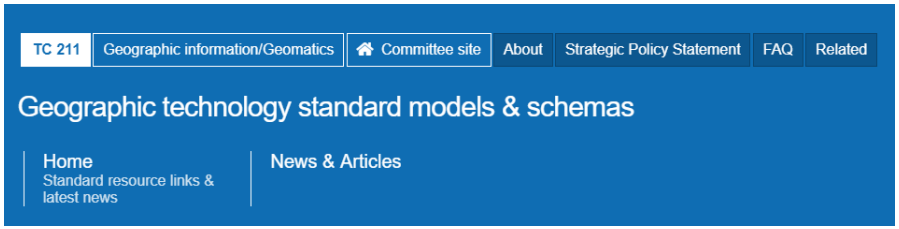
# Summary





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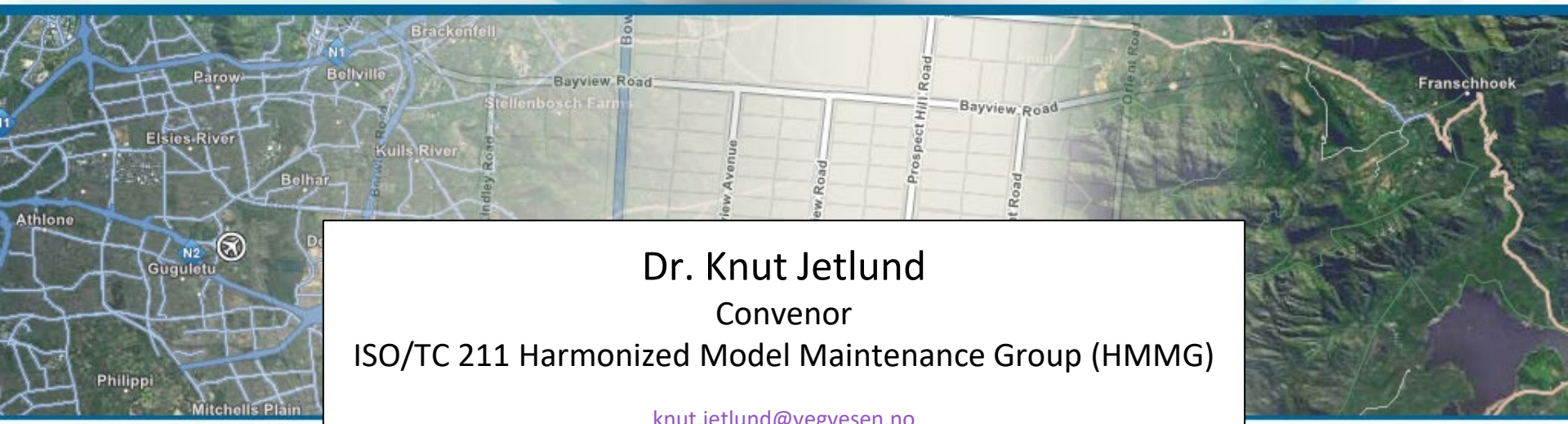
- UML models are the standards!
- Implementation Schemas are needed for implementation
- Documents are needed for normative statements, conformance classes and tests


# Thank you for listening !

## - Questions, comments, concerns?





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