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

How we work with UML and MDA in our Harmonized UML Model, and how the models are implemented in tools for geospatial information.

Speaker



Knut Jetlund
Statens vegvesen

Event Time & Date

PDT 10.00 - Sep 10

CEST 19.00 - Sep 10

AEST 03.00 - Sep 11

Duration

60 Min

Collaborate with Knut
post session at teams



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Prolaborate

Dr. Knut Jetlund
Convenor
ISO/TC 211 Harmonized Model Maintenance Group (HMMG)

knut.jetlund@vegvesen.no

Twitter: [@Jetgeo](https://twitter.com/Jetgeo)

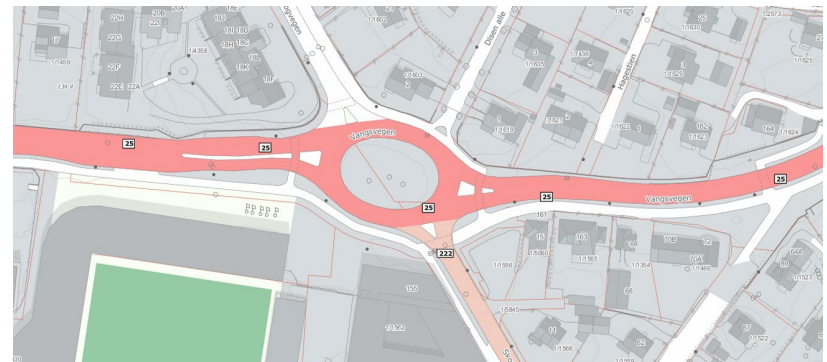
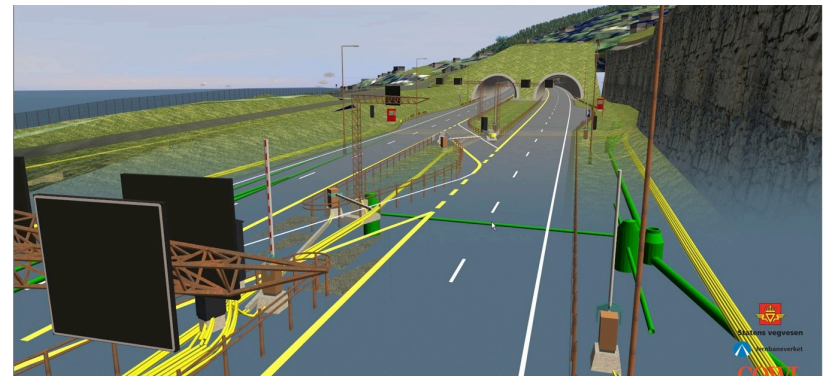
LinkedIn: <https://www.linkedin.com/in/knut-jetlund/>

Introduction

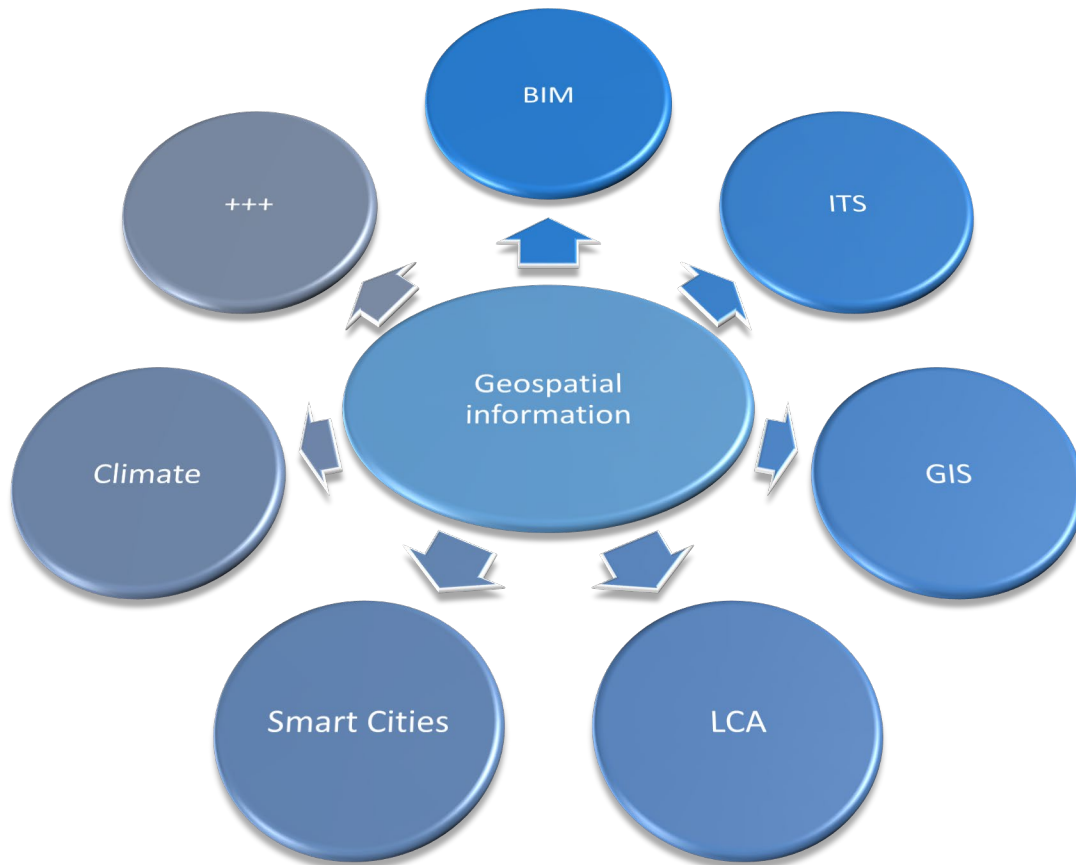
ISO/TC 211 have used UML for the development and implementation of standards since 1998

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



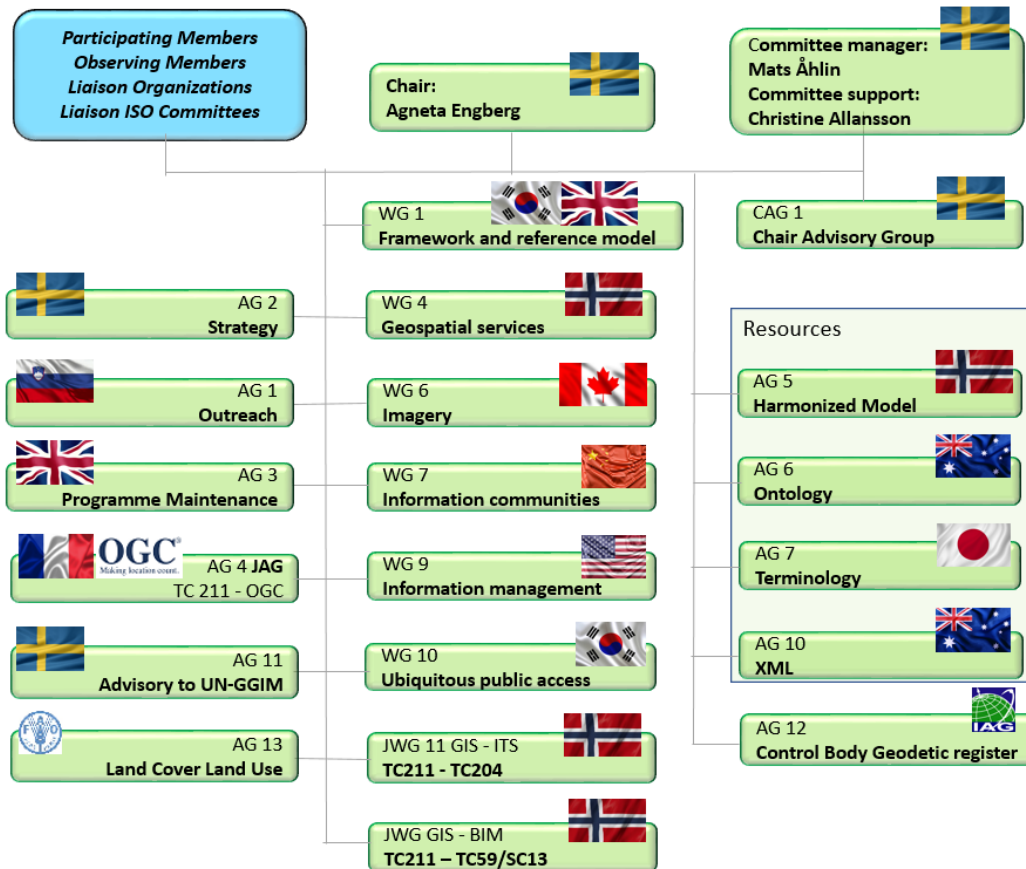
Everything happens somewhere



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](#)

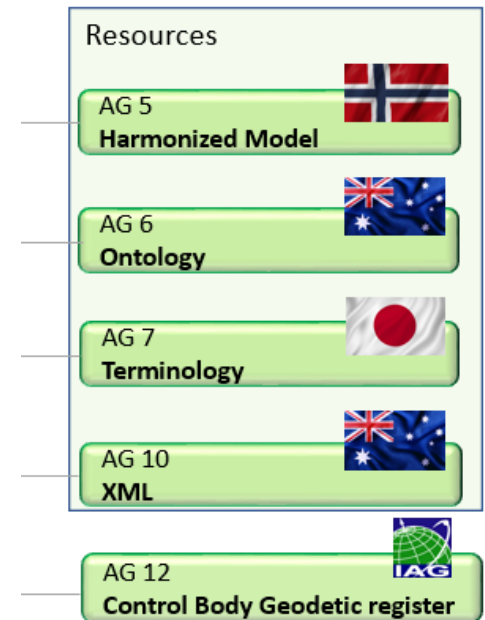


History

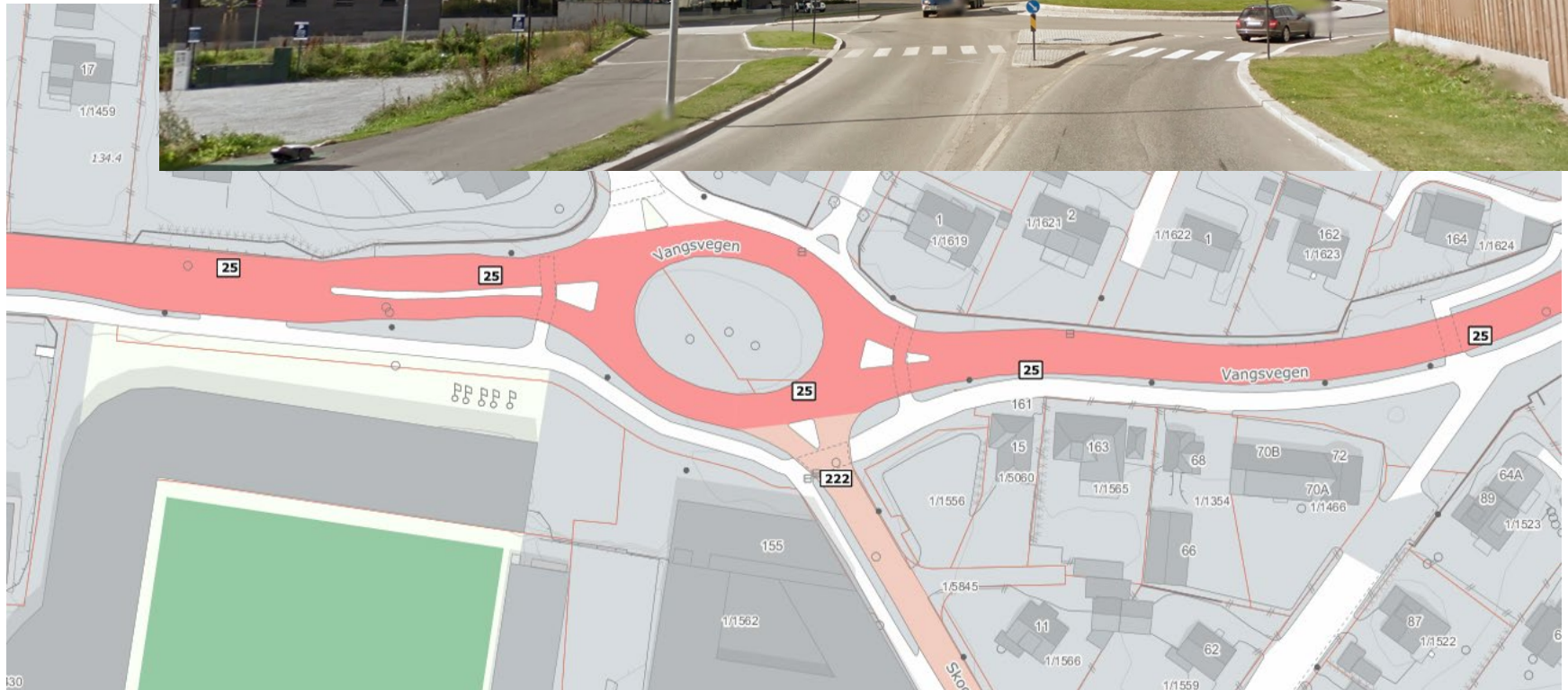
- 1994
 - 1st ISO TC/211 Plenary. Oslo, Norway
- 1997
 - OMT Object Model as a graphical language, EXPRESS and CORBA IDL as lexical languages
- 1998
 - UML was selected as the conceptual schema language
- 2002
 - The Harmonized Model Maintenance Group (HMMG)

The Harmonized Model Maintenance Group

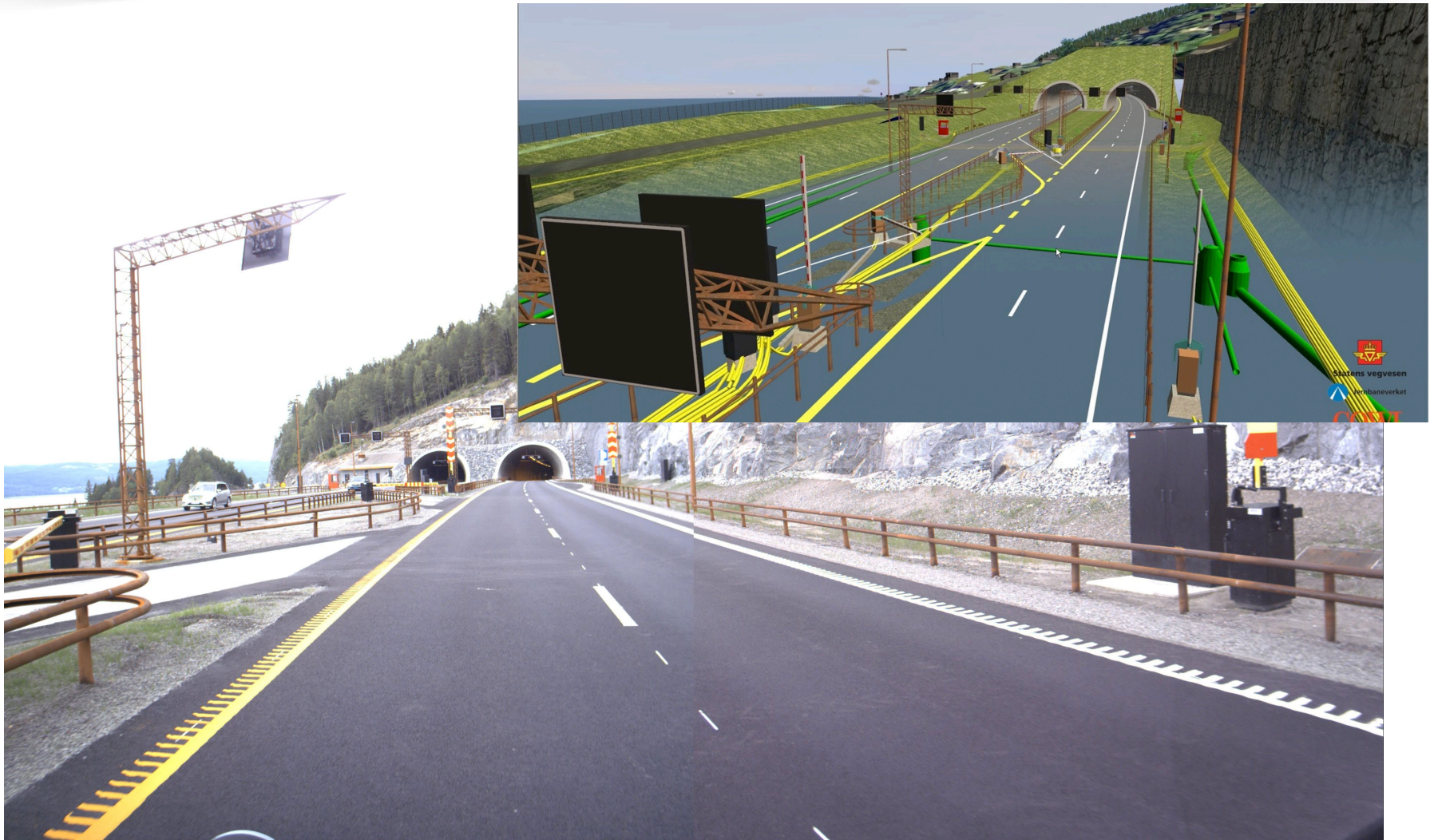
- Convenor: Dr. Knut Jetlund, Norway
- Core responsibility:
 - *Ensure that UML models and derived resources for implementation are maintained and made accessible.*
- Establish, maintain and make available the **Harmonized UML Model**
- Coordinate the use of UML
- Coordinate the work on resources for 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



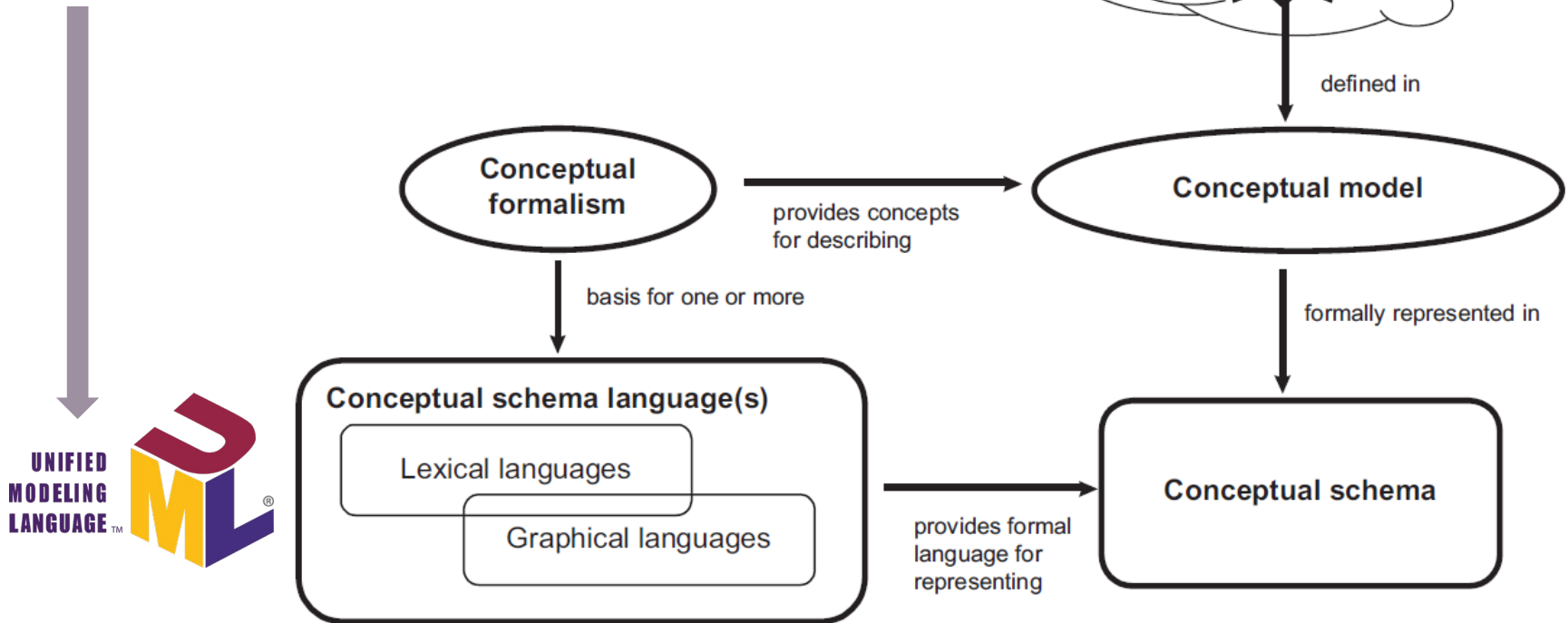
ISO/TC 211 Information modelling concepts

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).

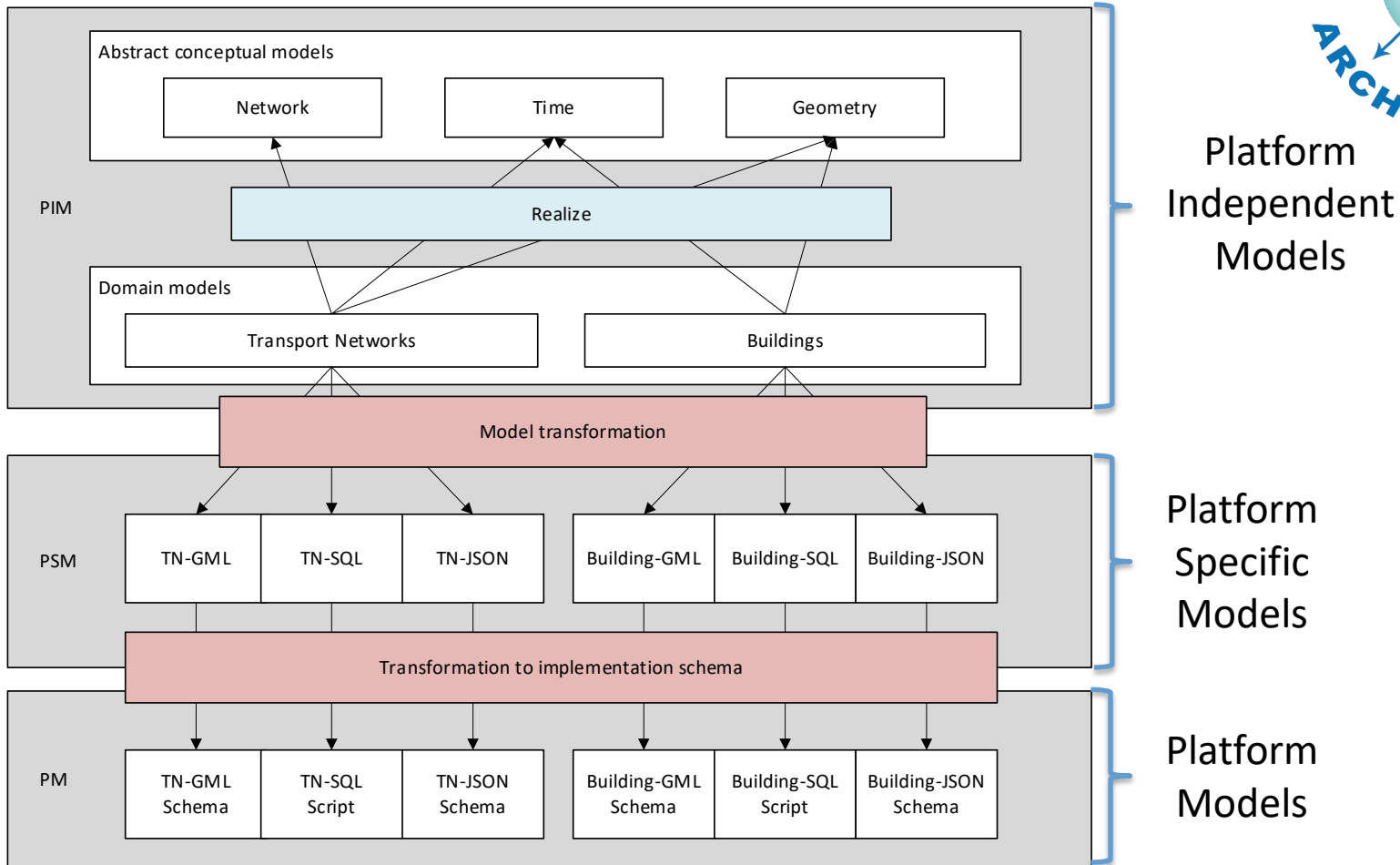
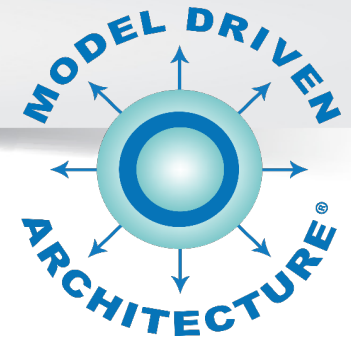
This International Standard provides a profile of the Unified Modeling Language (UML).

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



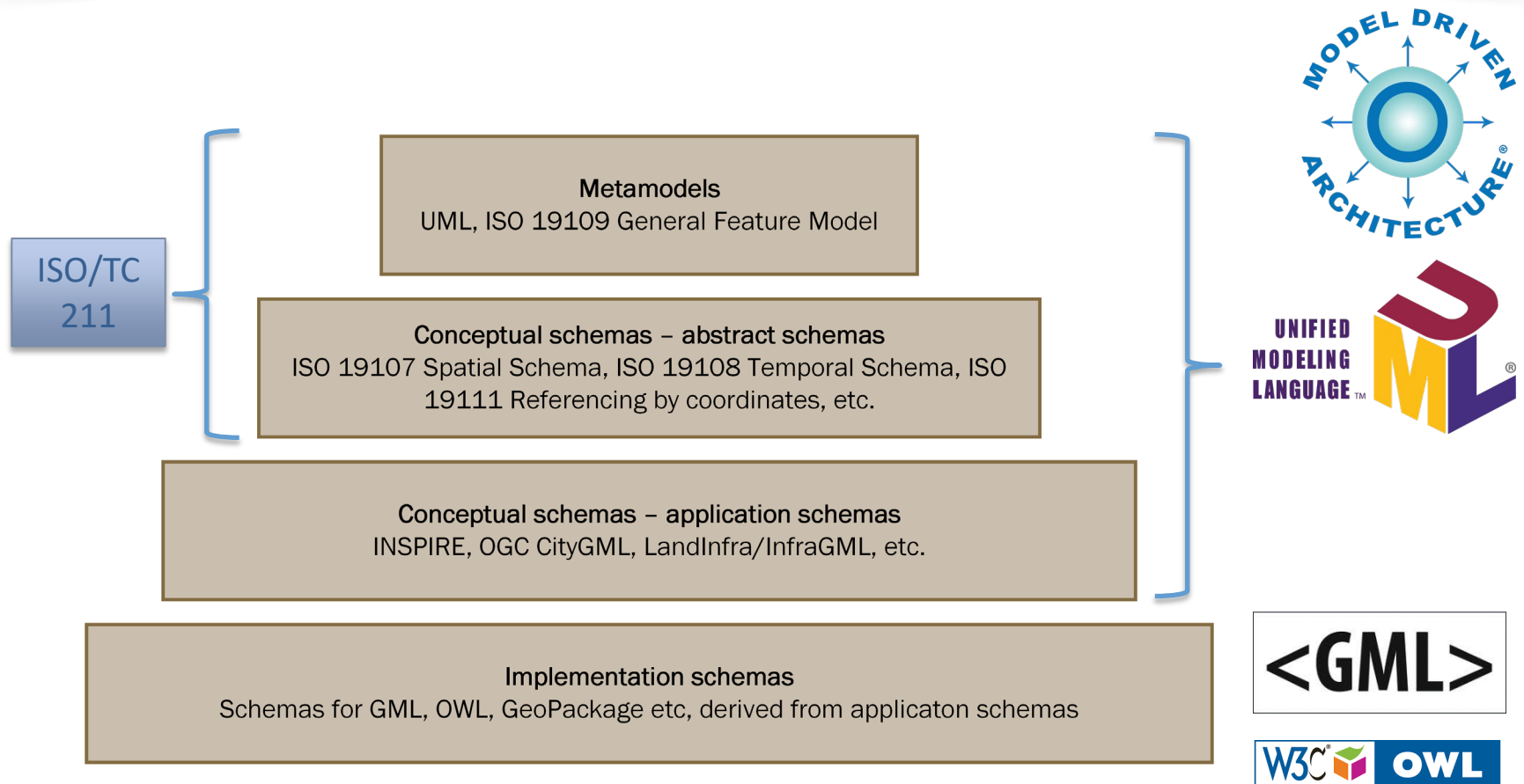
ISO 19101:2013 Geographic information — Reference model (Figure E.1)

Model Driven Architecture (MDA)



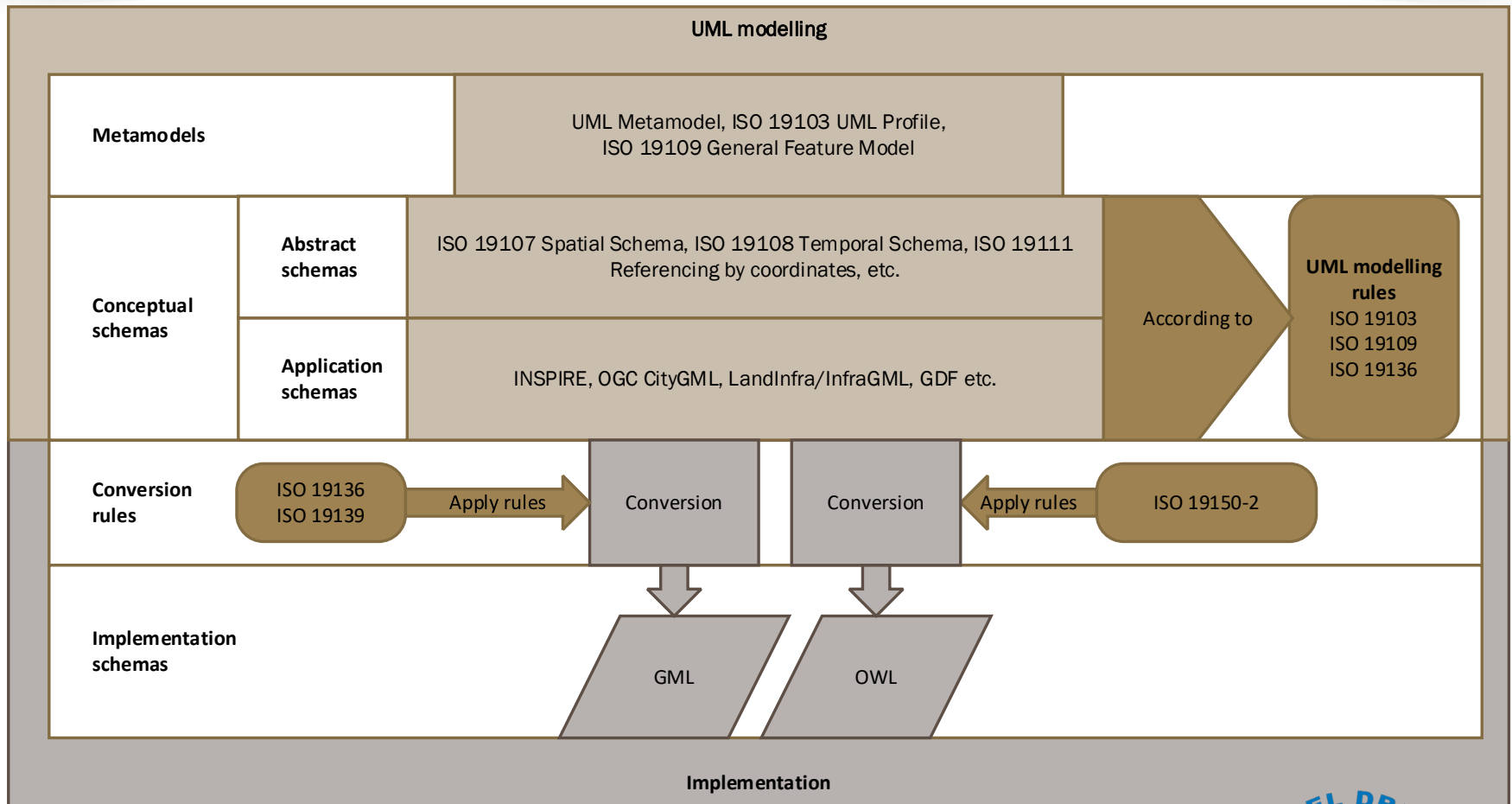
Source: Jetlund, K., Harmonizing and linking conceptual models of geospatial information, in Faculty of Engineering, Department of Manufacturing and Civil Engineering. 2021, Norwegian University of Science and Technology. p. 207.

ISO/TC 211 MDA – levels of abstraction

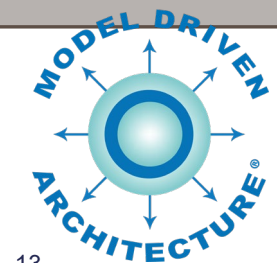


Source: Jetlund, K., Onstein, E., Huang, L., Information Exchange between GIS and Geospatial ITS Databases Based on a Generic Model. *Isprs International Journal of Geo-Information* 2019, 8(3), p. 141, DOI: ARTN 141 10.3390/ijgi8030141.

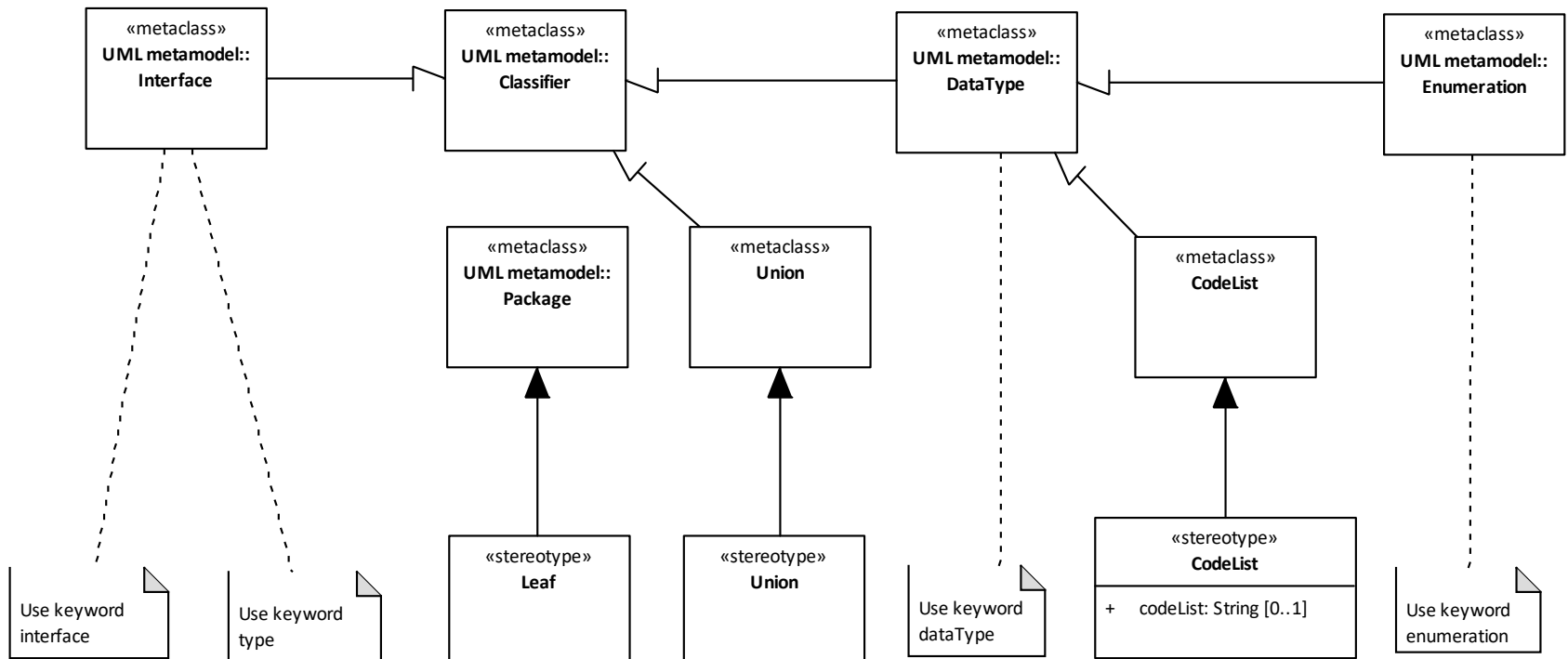
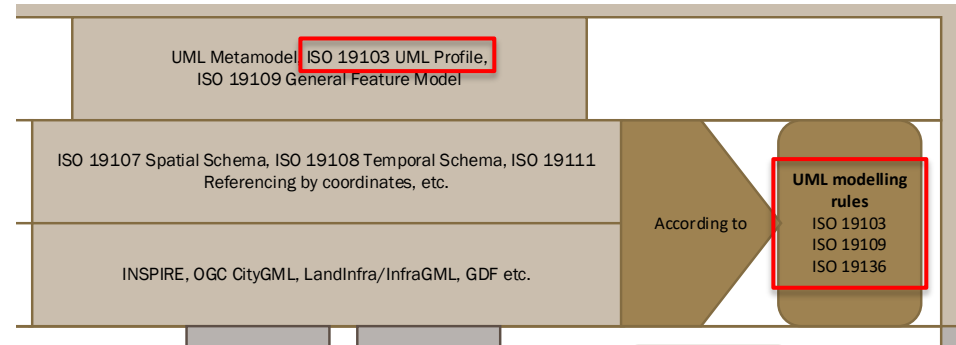
ISO/TC 211 MDA Framework



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.

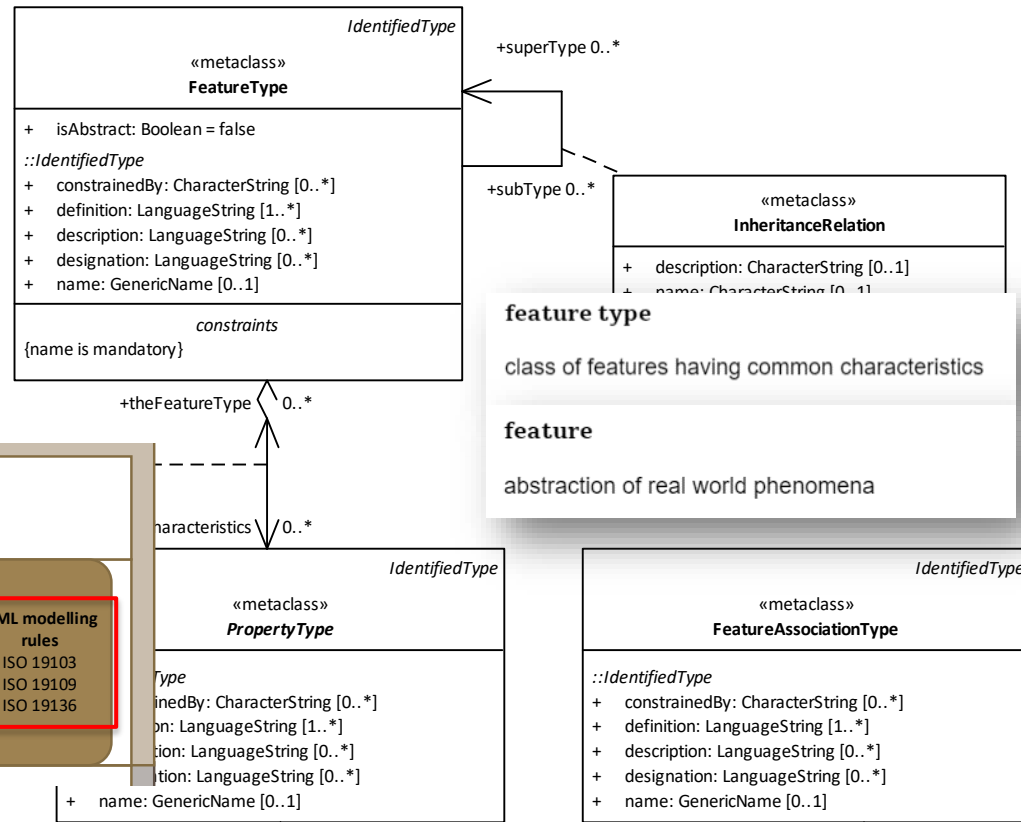


Modelling rules: ISO 19103 UML Profile Classes and packages



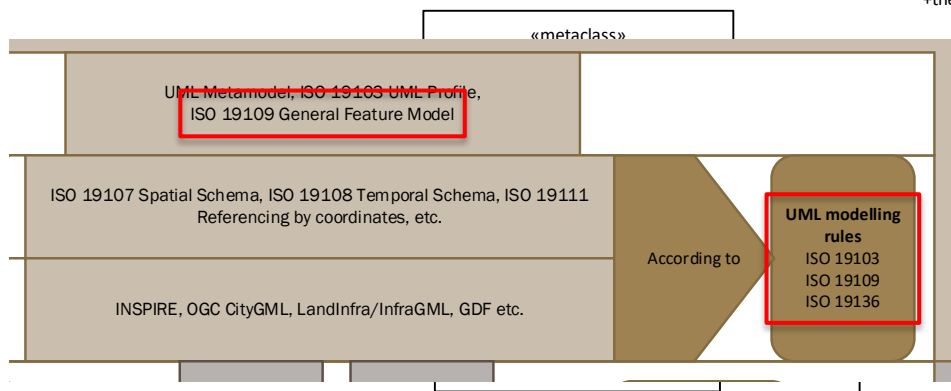
ISO 19103:2015 Geographic information — Conceptual schema language (Figure D.29)

Modelling rules: ISO 19109 The General Feature Model (GFM)

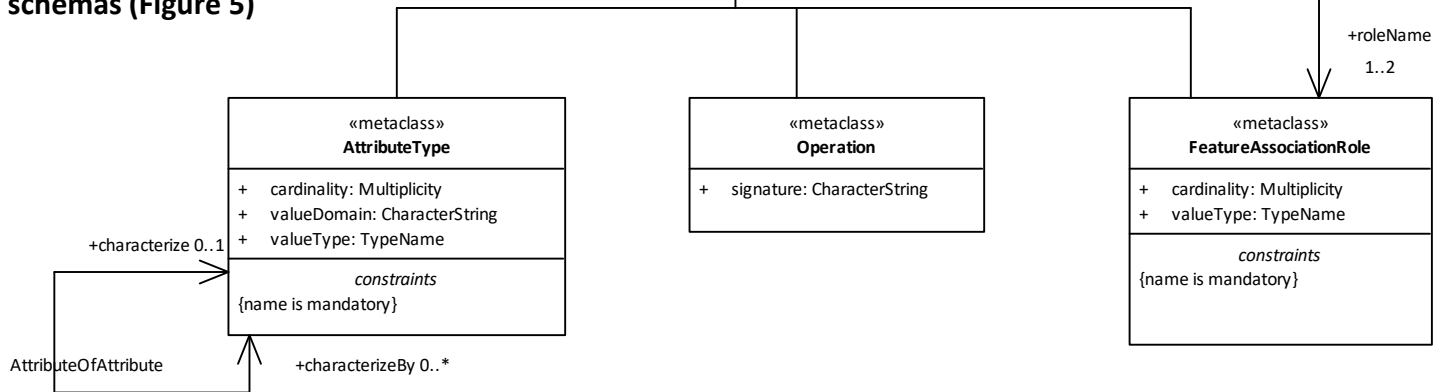


feature type
class of features having common characteristics

feature
abstraction of real world phenomena



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](#).

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](#)

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Find a Page...

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

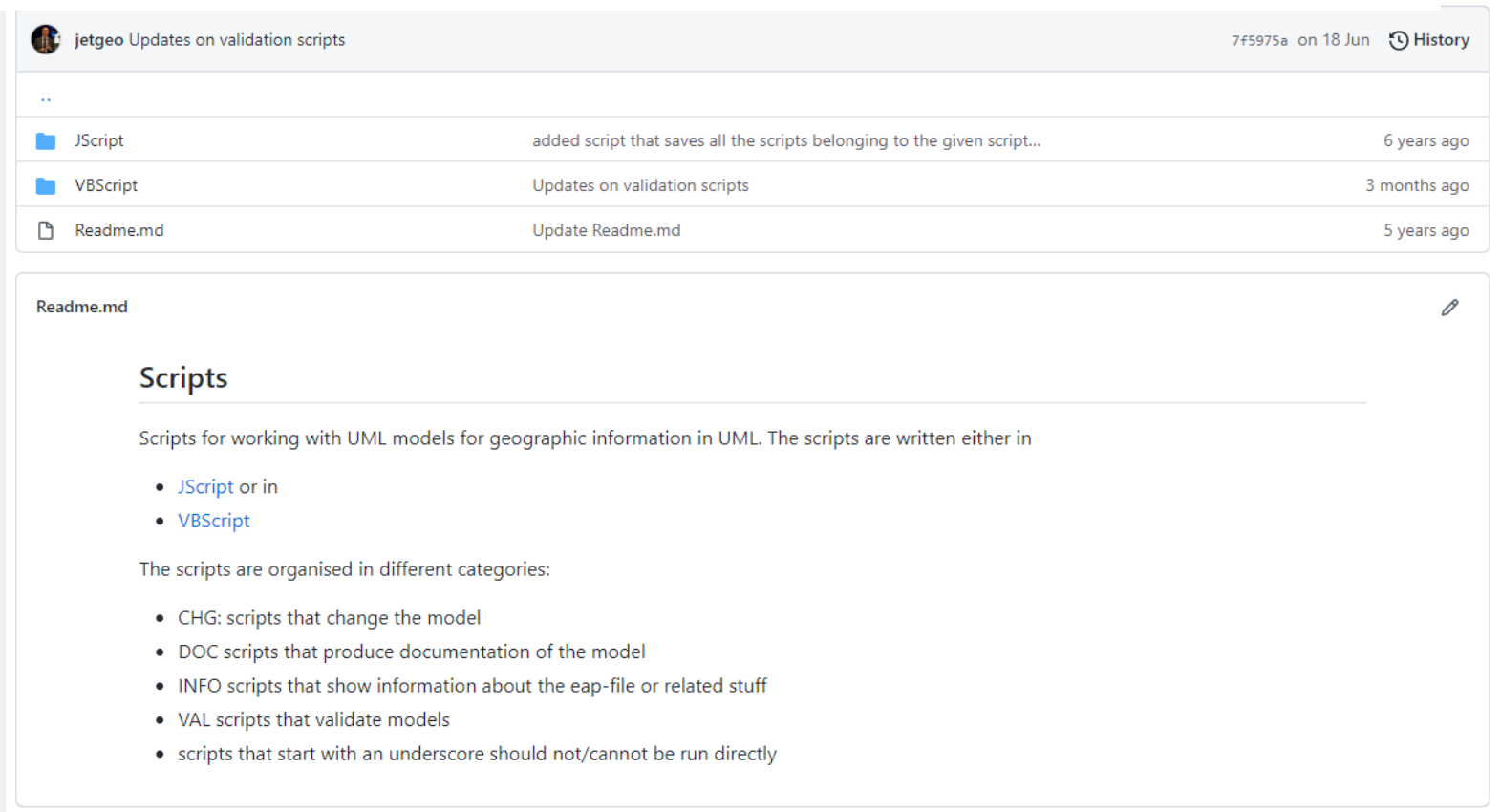
ISO19103 - Conceptual Schema Language have rules and recommendations for documentation of models, including [which diagrams that should be a part of the documentation](#).

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>



The screenshot shows a GitHub repository page for the 'Scripts' directory. At the top, it displays the repository name 'jetgeo Updates on validation scripts' and the commit hash '7f5975a on 18 Jun' with a 'History' link. Below this is a table of recent commits:

File	Commit Message	Time Ago
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

Below the commit list is the content of the 'Readme.md' file. It features a section titled 'Scripts' with a horizontal line underneath. The text describes the scripts as being for working with UML models for geographic information and lists the languages used: JScript and VBScript. It also provides a list of script categories: CHG (change model), DOC (documentation), INFO (information), VAL (validation), and a note that scripts starting with an underscore should not be run directly.

Readme.md

Scripts

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

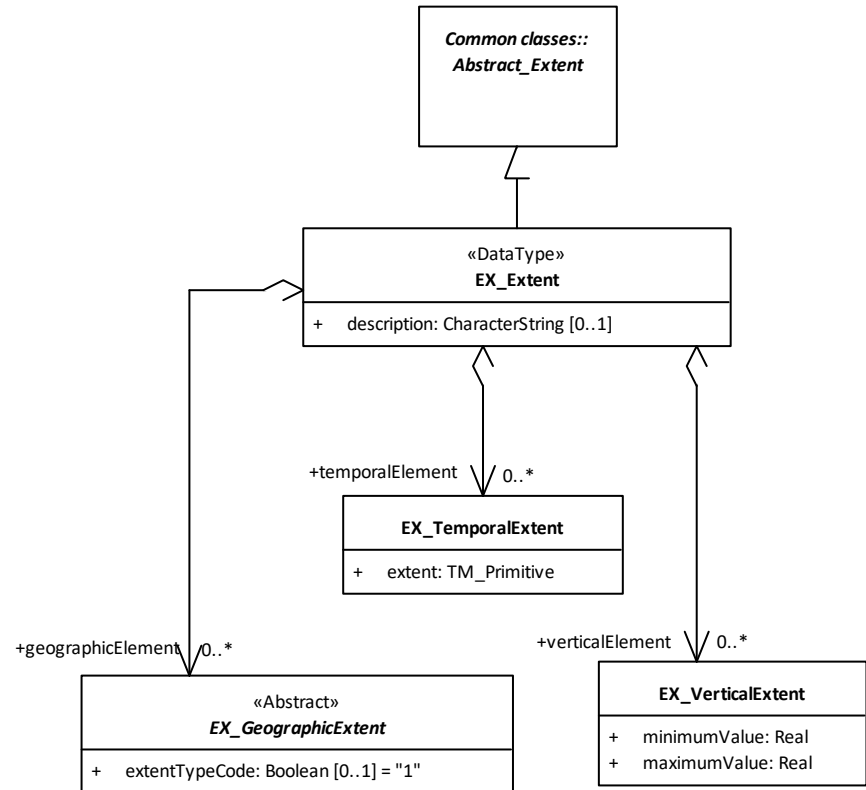
- [JScript](#) or in
- [VBScript](#)

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!

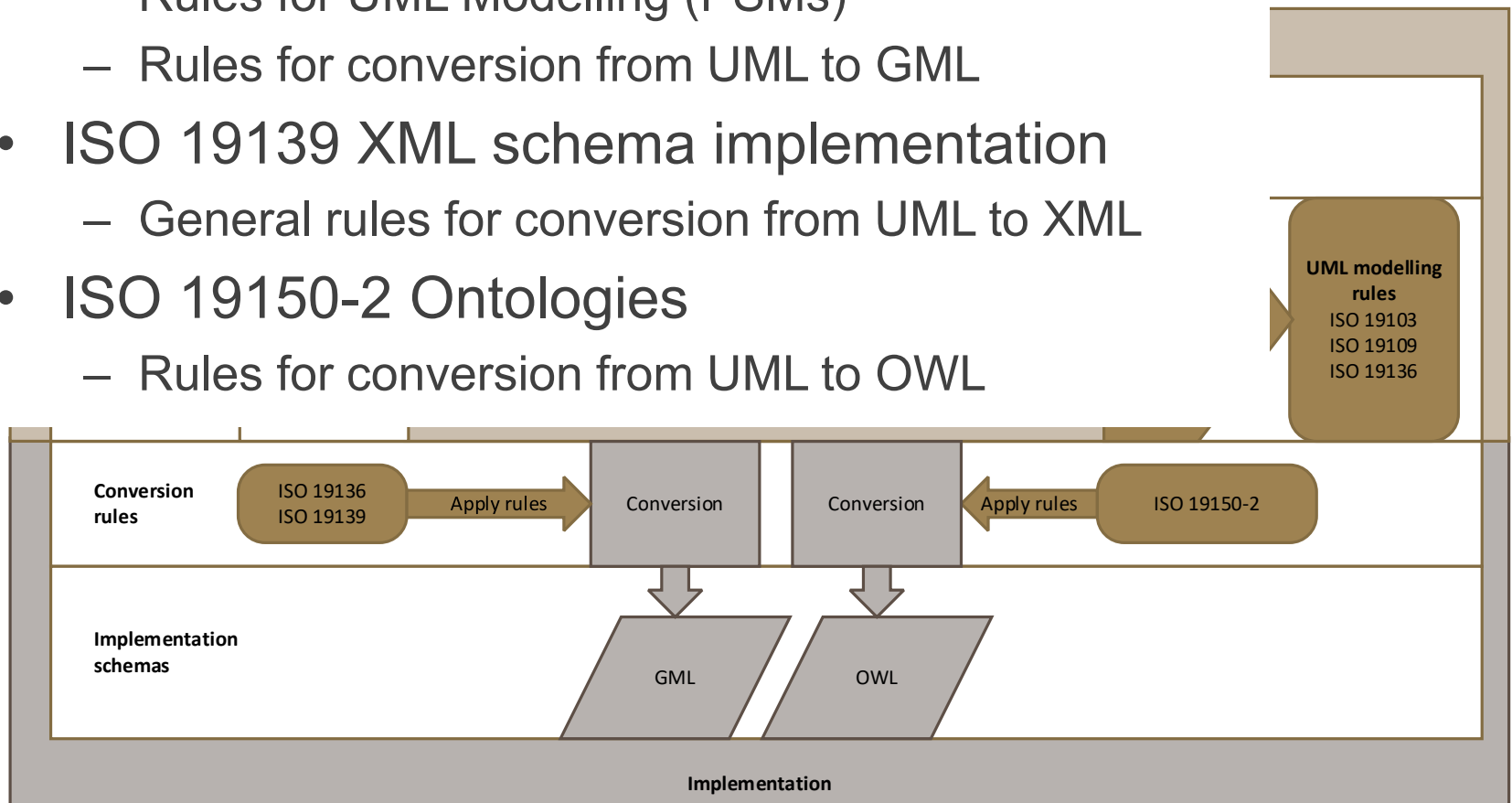
- *The standard documents are the formal representations of the models as text and figures...*
- *...and add normative statements, conformance classes and conformance tests...*
- **...but the UML models are the originals!**



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

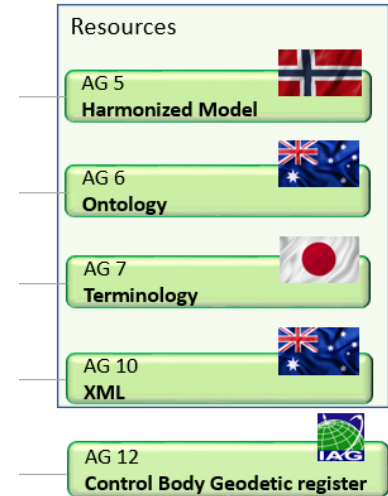
Standardized Model-driven implementation

- 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>



XML schema representations of geographic technology standards

[BROWSE ALL SCHEMAS AND ASSOCIATED RESOURCES](#)

LOCATE A SPECIFIC

Standard number:

For example, 19115



TC 211 Geographic information/Geomatics

Ontology representations of geographic technology standards

[BROWSE ALL ONTOLOGIES](#)

LOCATING ONTOLOGIES

Standard number:

For example, 19101

Part number:

2

Year:

2008

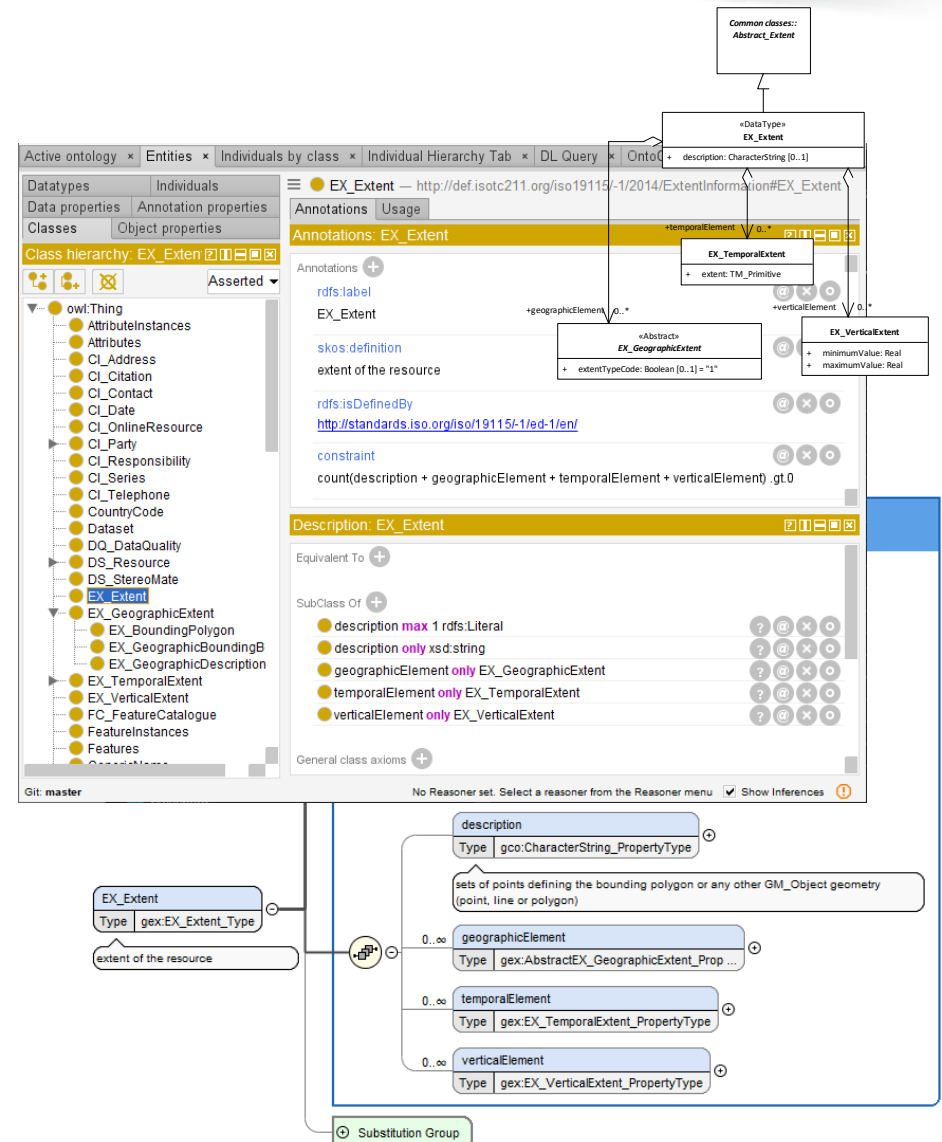
Version:

catalog-v001.xml

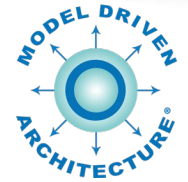
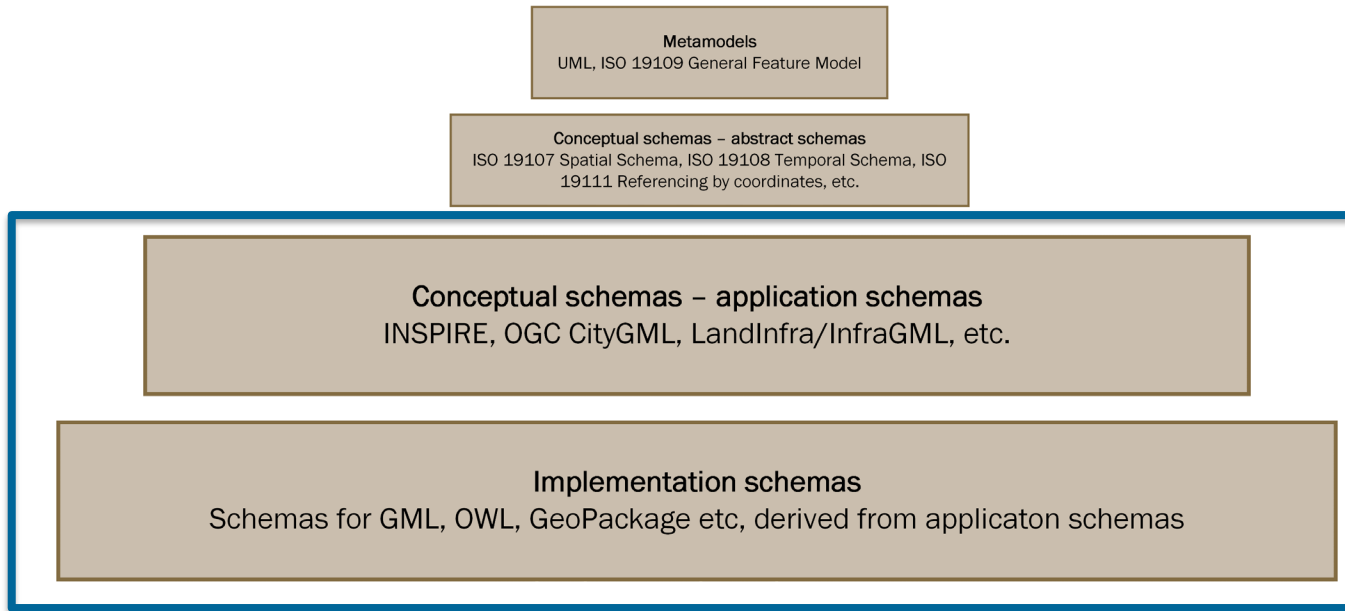
Locate ontology

The schemas are the resources for implementation!

- *The standard documents present the models as text and figures...*
- *...and add normative statements, 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



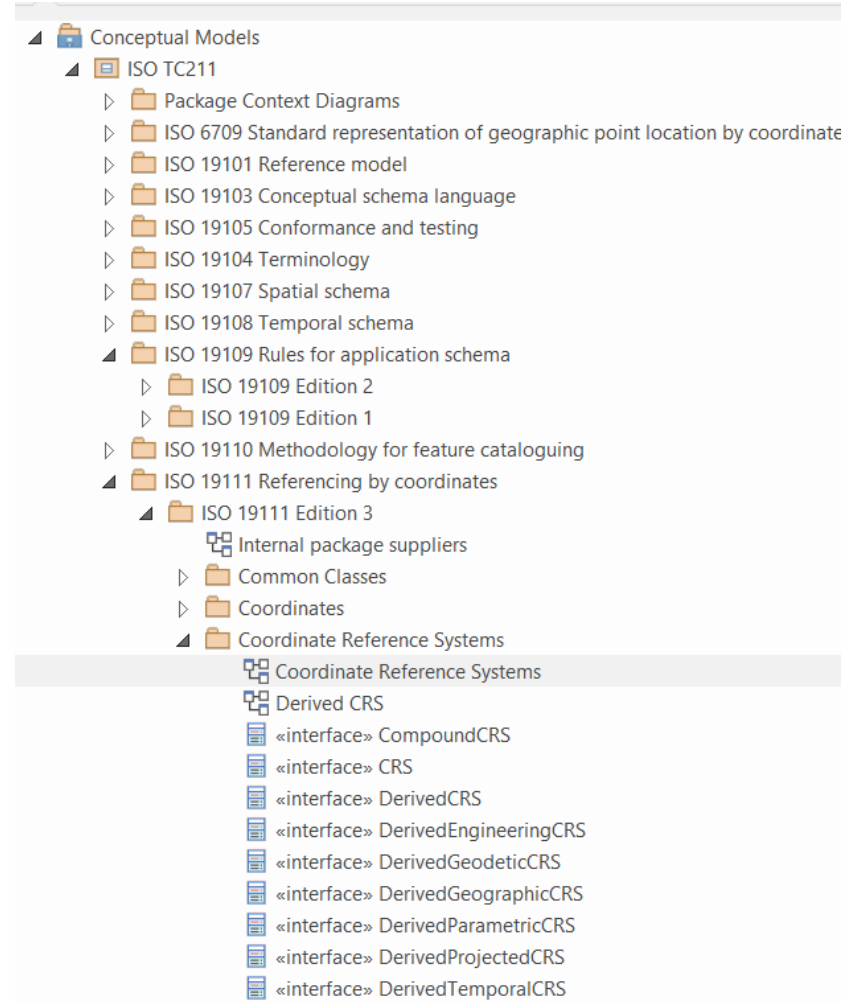
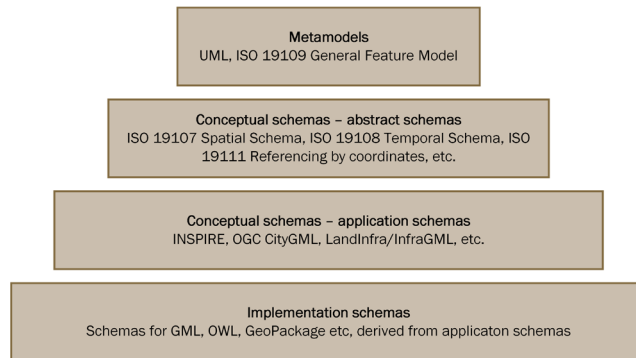
Global

Regional

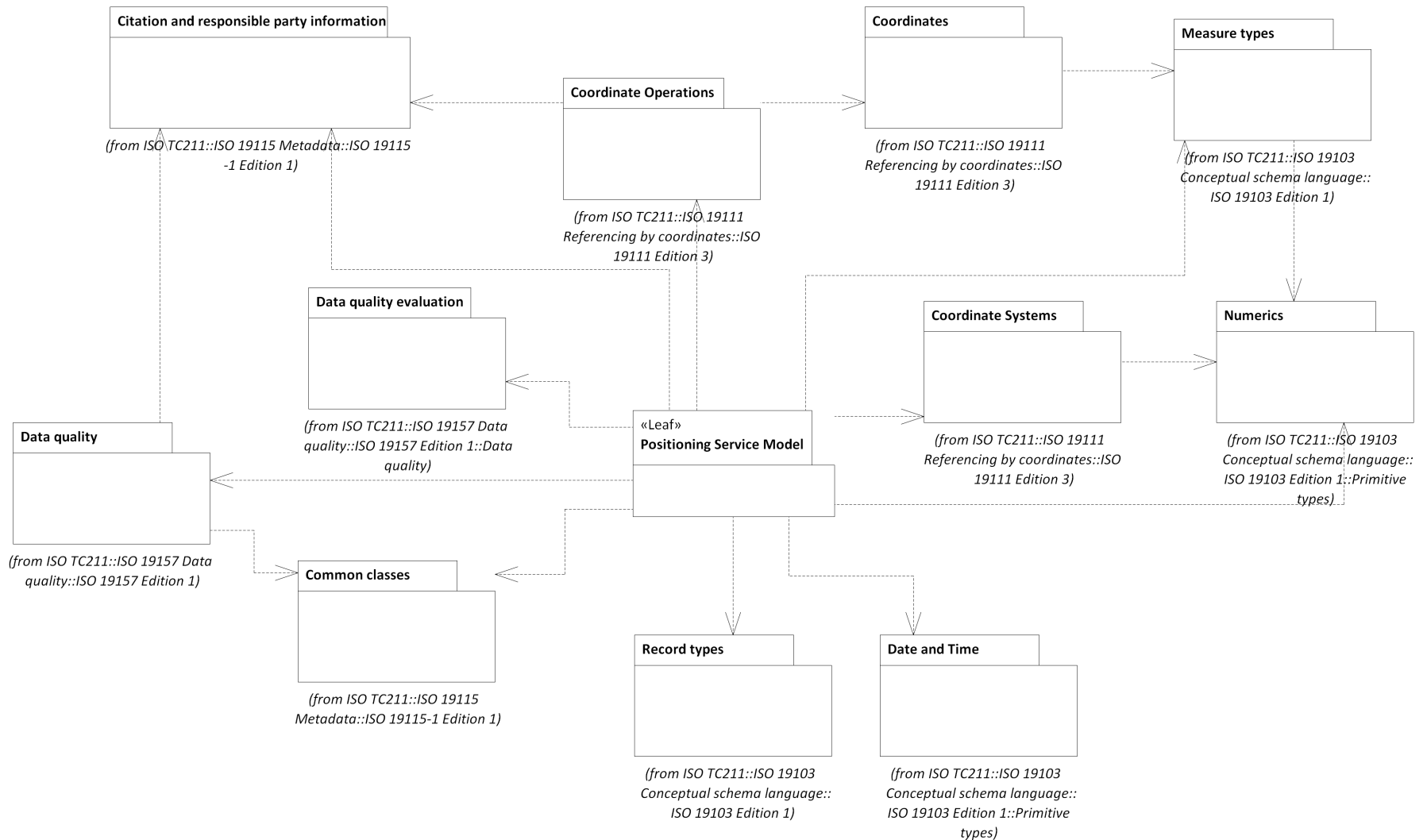
National

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



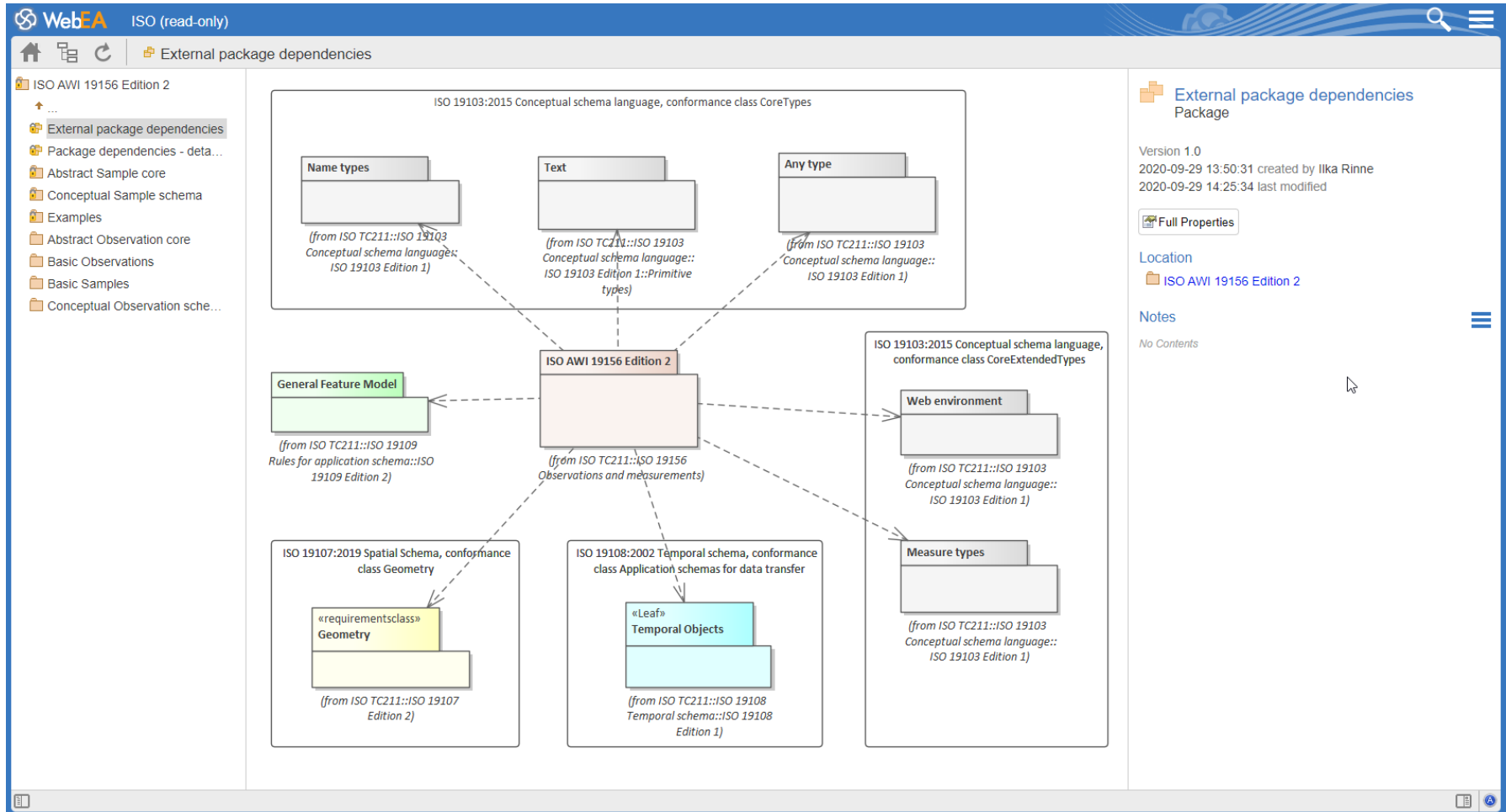
Ways of accessing and working with the HM

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

Sparx ProCloud Web

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



- [EA UML Projects](#)
- [XMI Files](#)
- [Wiki](#)

master 2 branches 1 tag

Go to file Add file Code

jetgeo Update README.md baa6efd 23 seconds ago 110 commits

Documents	New version of the URI Document	2 years ago
EA	Minor changes on ISO/CD 19144-2	8 days ago
EditorialVersion	Minor changes on ISO/CD 19144-2	8 days ago
Wikillustrations	Added folder and files for editorial version	2 years ago
XMI/2.1	Models for ISO 19111 Edition 3 (Amendment 1) and ISO 19116 Edition 2 ...	15 months ago
README.md	Update README.md	22 seconds ago

README.md

ISO/TC211 Geographic information/Geomatics

The Harmonized Model Maintenance Group

Welcome to the ISO/TC211 HMMG Wiki

The purpose of this wiki is to inform users and editors of the ISO/TC211 Harmonized UML Model how to connect to and work with the model.

Accessing the ISO/TC 211 Harmonized UML Model

The ISO/TC 211 Harmonized UML Model is maintained with Sparx Enterprise Architect in Sparx ProCloud Services. The model can be accessed in several ways: Through a Web Browser, Through Reusable Assets in Enterprise Architect or through direct access to Sparx ProCloud in Enterprise Architect.

WebEA Access

The model is available on <http://iso.sparxcloud.com>. Registered user can log in and edit the model, while all users can view the model in read-only mode. The WebEA Model shows the current model in the cloud repository and will always be up to date.

Downloading EA Project

An Enterprise Architect project with a complete copy of the Harmonized Model is available for download from the [HMMG GitHub](#). The copy is updated periodically.

Pages 8

Home

- Welcome to the ISO/TC211 HMMG Wiki
- Accessing the ISO/TC 211 Harmonized UML Model
 - WebEA Access
 - Downloading EA Project
 - Reusable Assets
 - Direct Access in Enterprise Architect (for editors only)
- Structure of the Harmonized Model
 - Tagged values
 - Prefixes used in the model
- ISO/TC211 Wiki on best practices for modelling geographic information in UML

Harmonized Model Management Group (HMMG) maintains this repository for use by the members of community in the assessment and creation of standards.

Wiki for information about the Harmonized Model Repository and how to access and use it.

be downloaded from folders in this repository:

ise Architect Projects with The Harmonized Model

les for packages in The Harmonized Model

the model can be found at <http://iso.sparxcloud.com>.

i <https://github.com/ISO-TC211/UML-Best-Practices/wiki> for best practices on using UML for rmination.

chnical errors in the models or in the scripts and macros, or to make contributions to this site, please MG convenor:

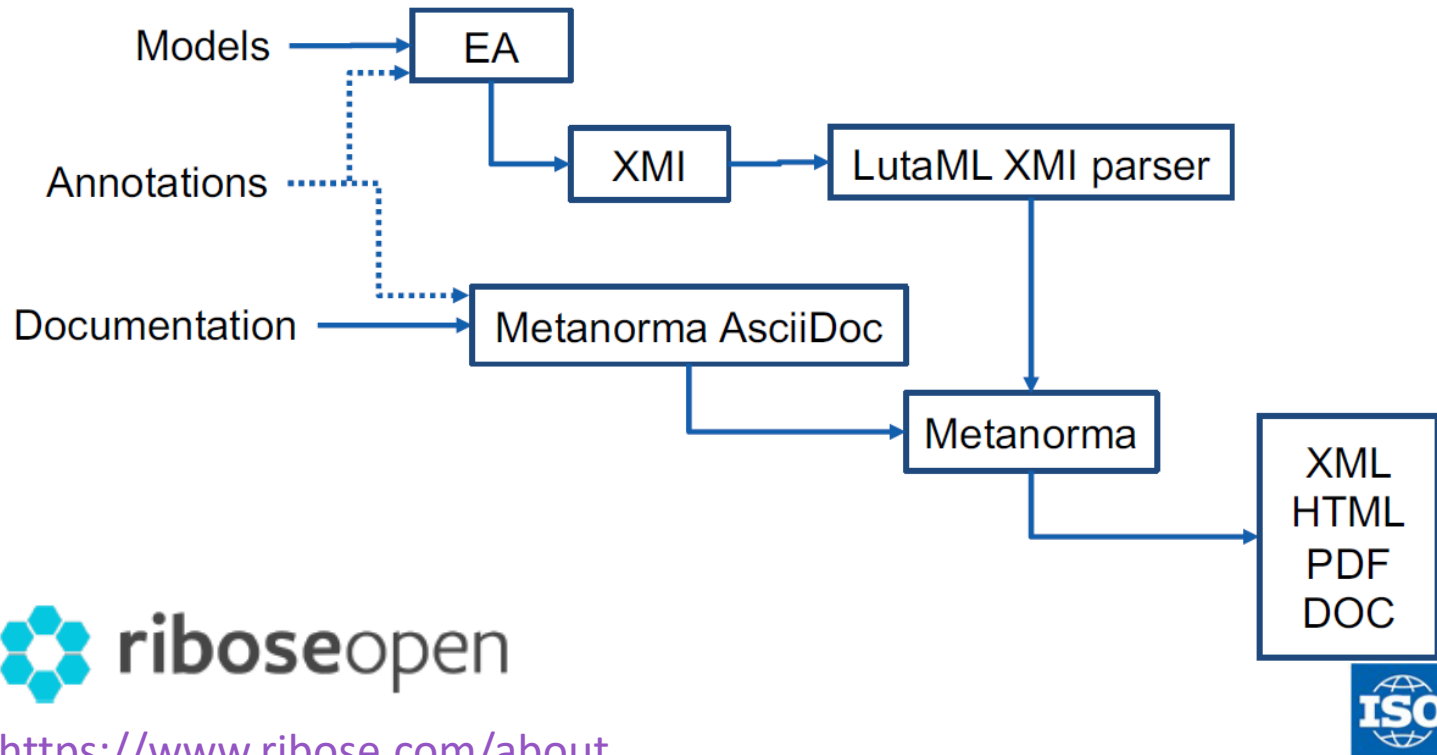
lund, Norway.

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



<https://www.ribose.com/about>

Automated documentation

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

Contents

- Foreword
- Introduction
- 1 Scope
- 2 Normative references
- 3 Terms and definitions
- 4 Conventions
 - 4.1 Abbreviated terms
 - 4.2 Universal Resource Identifiers
 - 4.3 Unified Modeling Language notation
 - 4.4 Naming conventions
 - 4.5 Attribute and association role status
- 5 DGGs specification overview
 - 5.1 Package overview
- 6 Common Spatio-temporal Classes package
 - 6.1 Common Spatio-temporal Classes overview
 - 6.2 Temporal and Zonal Geometry package
 - 6.3 Temporal and Zonal RS using Identifiers package
- 7 DGGs Core package
 - 7.1 DGGs Core overview

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:

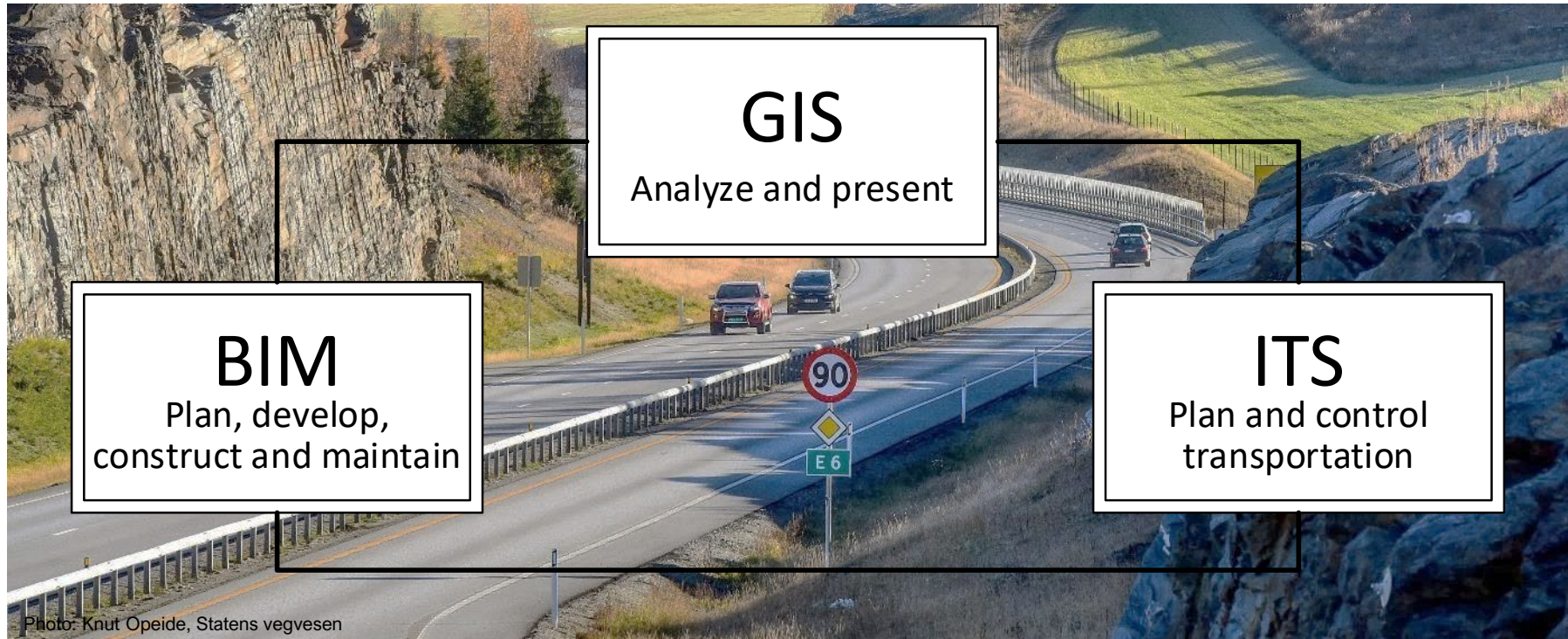
*Système de Référence et Opérations de Base, et Système de Référence
Terrestre à Zone Égale*

DIS stage



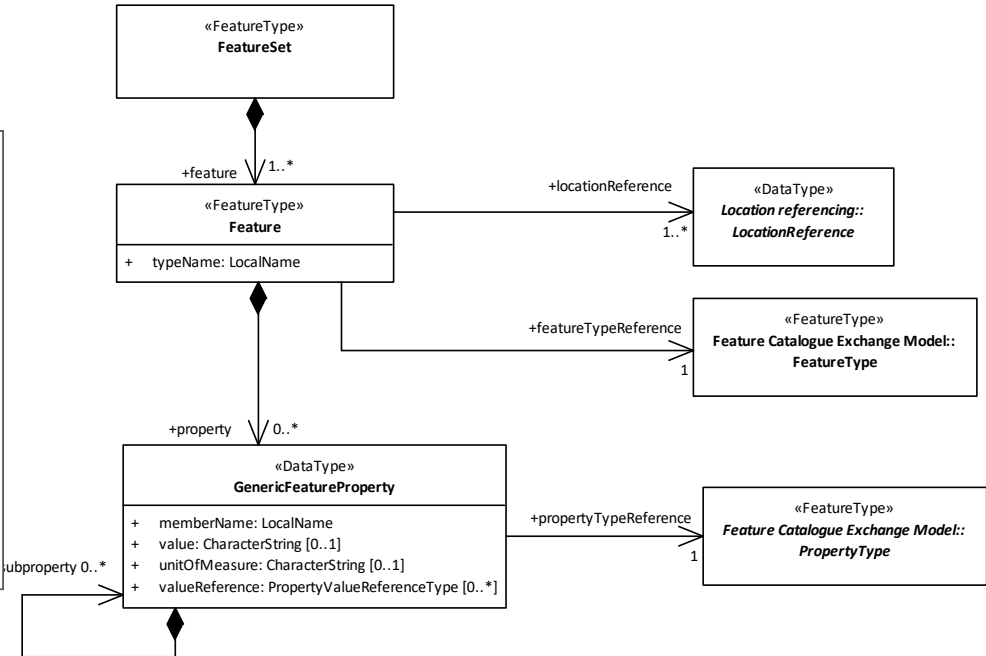
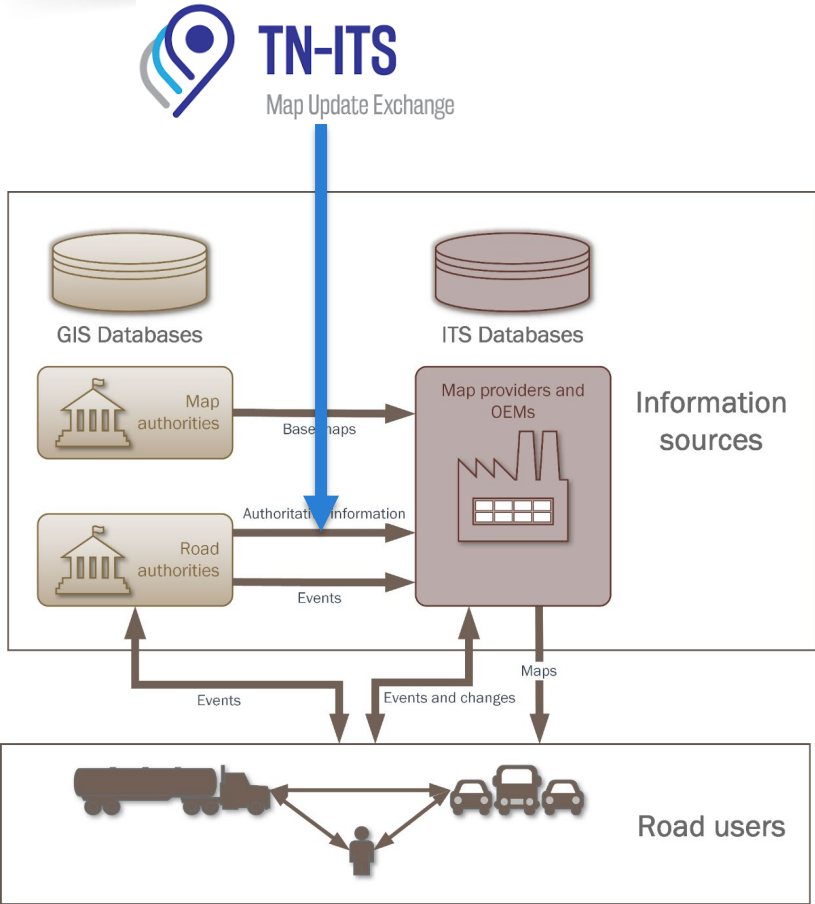
<https://www.ribose.com/about>

Examples: Three domains, one real world



...and one approach for modelling geospatial information?

Example: Intelligent Transport Systems (ITS)

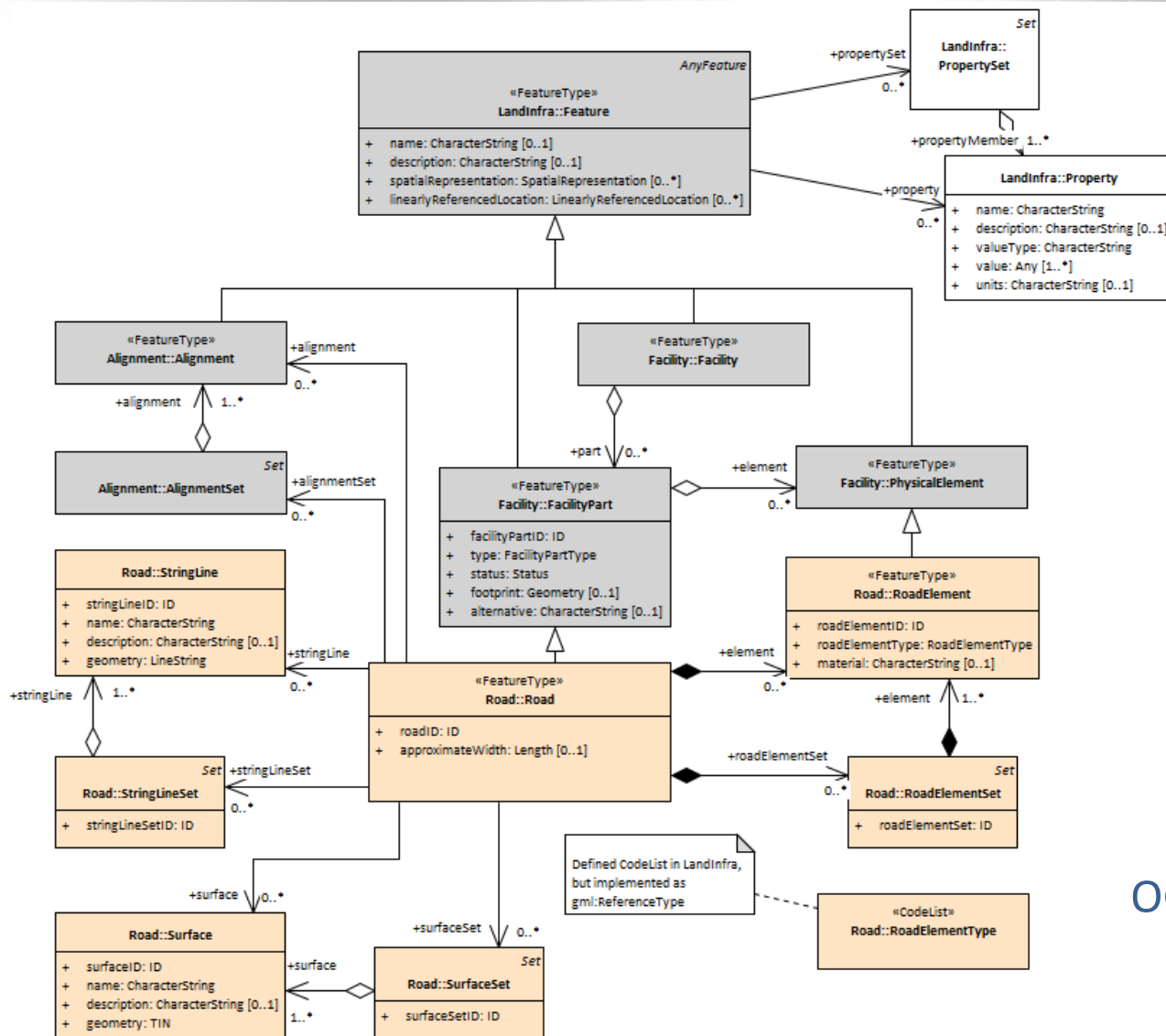


Implementation schemas:



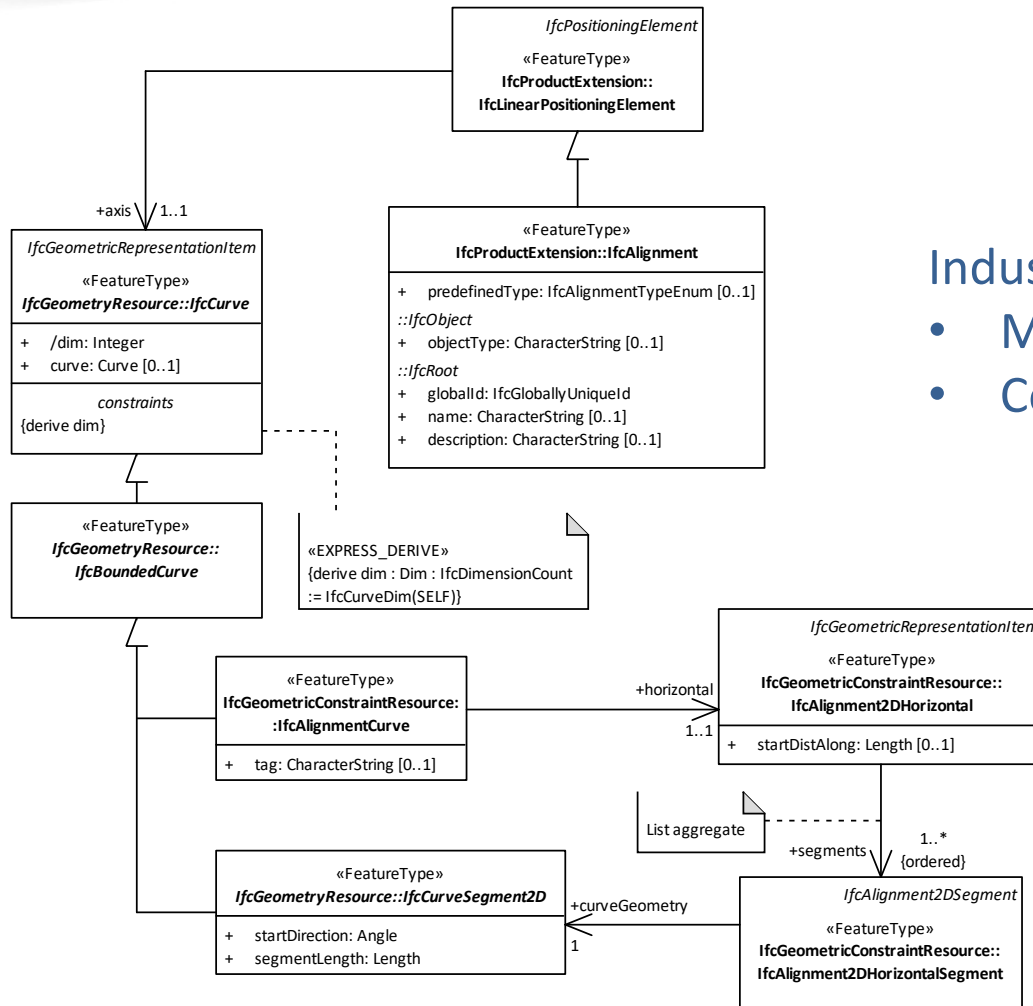
Source: Jetlund, K., Onstein, E., Huang, L., Information Exchange between GIS and Geospatial ITS Databases Based on a Generic Model. Isprs International Journal of Geo-Information 2019, 8(3), p. 141, DOI: ARTN 141 10.3390/ijgi8030141.

Example: Road infrastructure construction



OGC LandInfra/InfraGML

Example: Building Information Modelling (BIM)



Industry Foundation Classes – IFC

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

Implementation schemas:



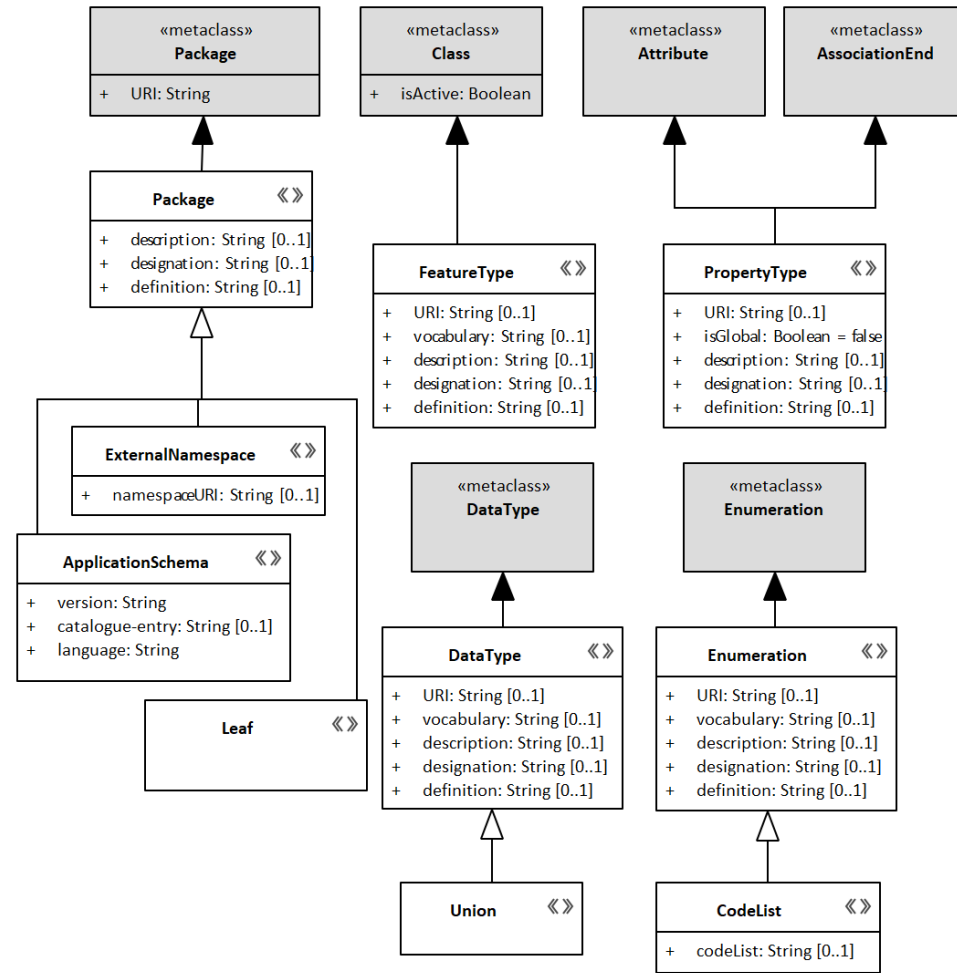
Source: Jetlund, K., E. Onstein, and L. Huang, IFC Schemas in ISO/TC 211 compliant UML for improved interoperability between BIM and GIS. ISPRS International Journal of Geo-Information, 2020. 9(4).

Improvements in progress: The UML Profile

ISO 19103:202X

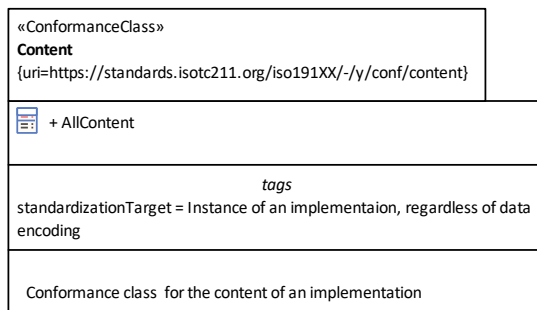
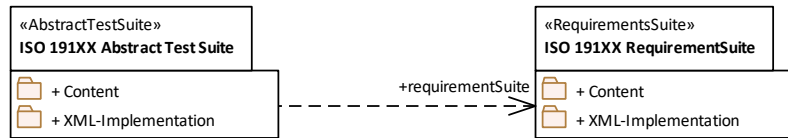
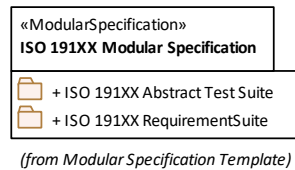
Geographic information — Conceptual schema language

- 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

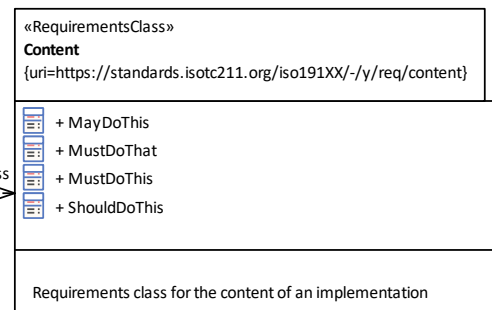


Improvements in progress: Modular specifications

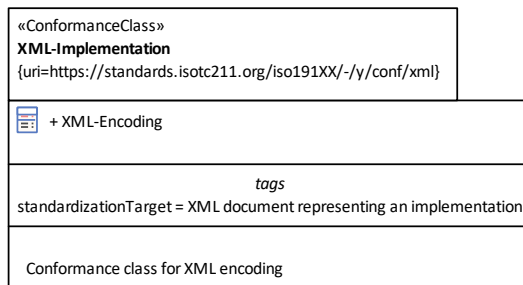
Conceptual model and UML Profile Extending ISO 19105 – Conformance and Testing



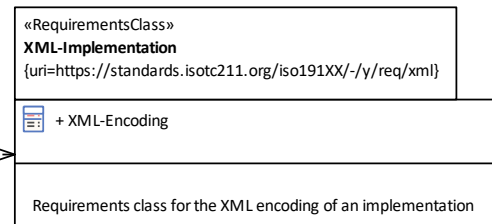
(from ISO 191XX Abstract Test Suite)



(from ISO 191XX RequirementSuite)

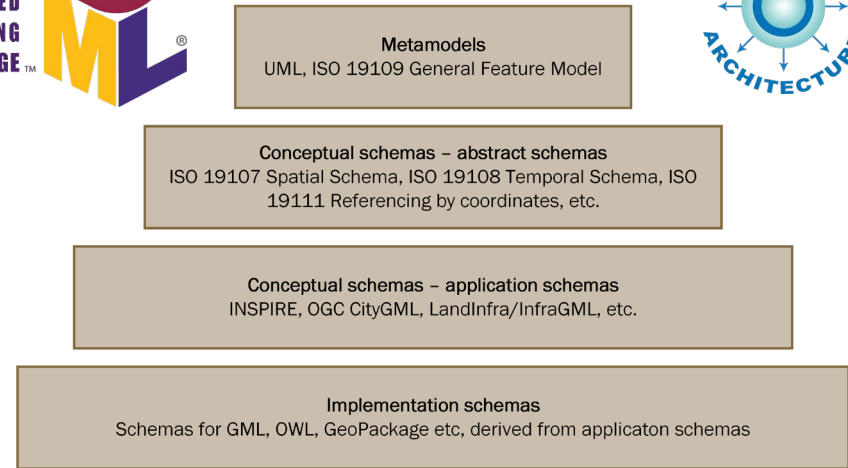
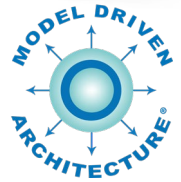
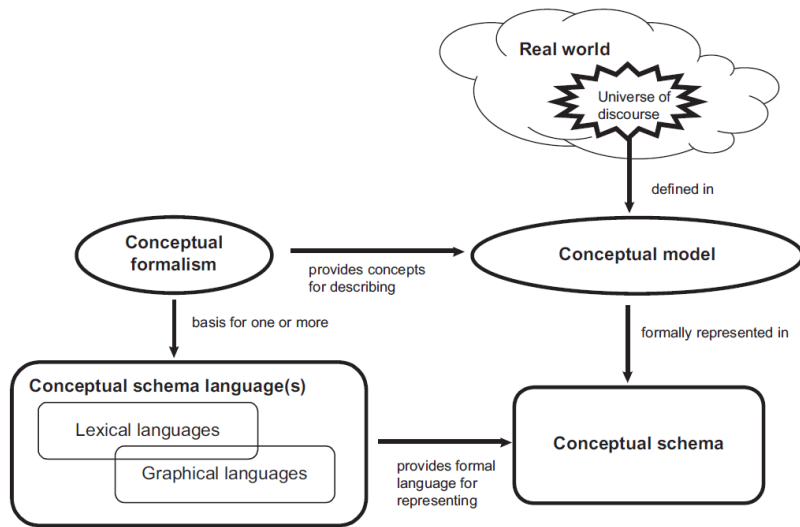


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Summary



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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

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ISO/TC 211 have used UML for the development and implementation of standards since 1998.
How we work with UML and MDA in our Harmonized UML Model and how the models are implemented in tools for geospatial information.

Speaker:  **Knut Jetlund**
Statens vegvesen

Event Time & Date
PDT 10:00 - Sep 10
CEST 19:00 - Sep 10
AEST 03:00 - Sep 11

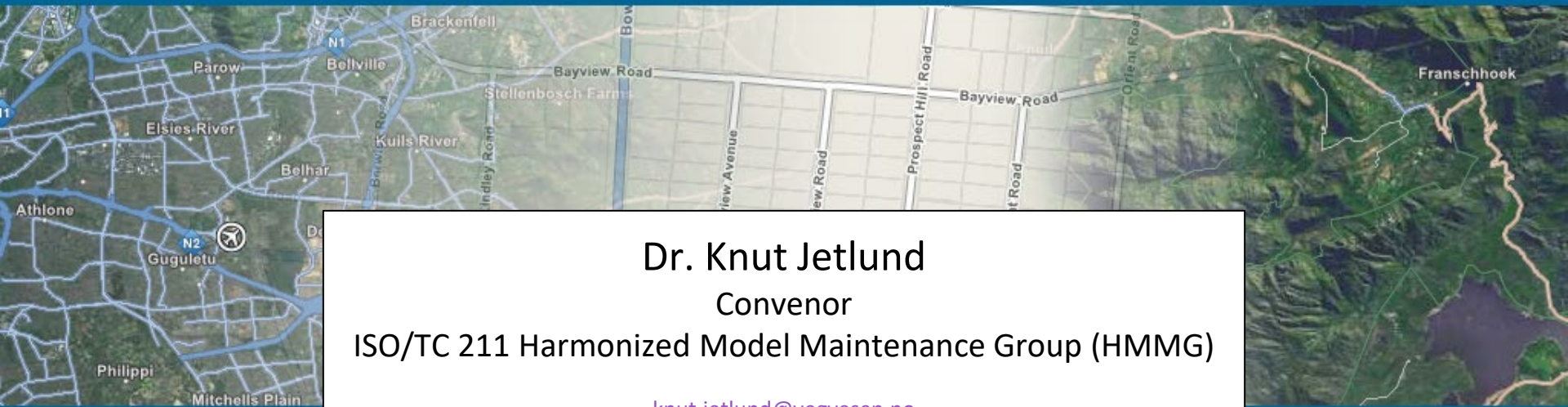
Duration
60 Min

Collaborate with Knut post session at teams

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**Thank you for listening !
- Questions, comments, concerns?**



Dr. Knut Jetlund
Convenor
ISO/TC 211 Harmonized Model Maintenance Group (HMMG)

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