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Modellering av geografisk informasjon basert på ISO/TC 211-standarder

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ISO/TC 211 – Geographic information/Geomatics

Opprettet i Oslo i 1994

Sekretariat

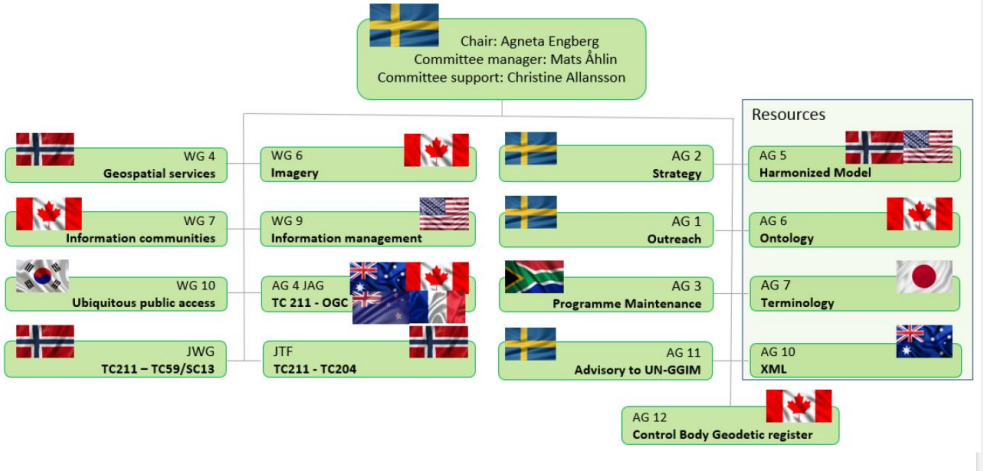
- 1994-2017: Standard Norge
- Fra 2017 : SIS (Swedish Standards Institute)

Leder (Chairman):

- 1994-2017: Olaf Østensen, Kartverket
- 2017-2018: Christina Wasström, Lantmäteriet
- Fra 2018 : Agneta Engberg, Lantmäteriet

Tung norsk og nordisk deltakelse

Stor utbredelse av de sentrale ISO/TC 211-standardene innen GIS-domenet



OGC- Open Geospatial Consortium

Samarbeidsforum mellom programvareleverandører, universiteter, offentlige etater mm

Etablert 1994

- 8 medlemmer 1994
- 500+ medlemmer nå
- ESRI, Intergraph, Norkart, Kartverket
- UCB, NMBU

Kjente standarder:

- WMS, WFS, GML
- CityGML, InfraGML, IndoorGML

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Samarbeid

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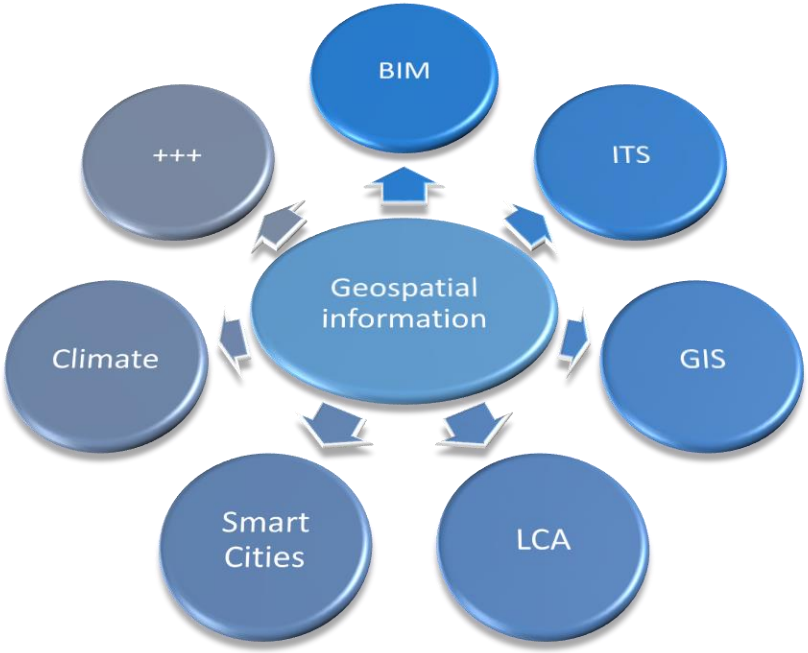
- ISO/TC 211 har adoptert flere av OGC sine standarder, blant annet WMS, WFS og GML
- Flere standarder utvikles og revideres i samarbeid i ISO/TC 211 og OGC, med parallelle høringer, for eksempel:
  - ISO 19136 GML
  - ISO 19107 Spatial schema
  - ISO 19111 Referencing by coordinates
  - ISO 19148 Linear referencing
  - ISO 19156 Observations and measurements
- Flere medlemmer er aktive i både OGC og ISO/TC 211
- OGC-standarder er basert på grunnleggende ISO/TC 211-standarder

ISO/TC 211

OGC

Geografisk informasjon er sentralt for mange domener



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.

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Standarder vs åpne spesifikasjoner

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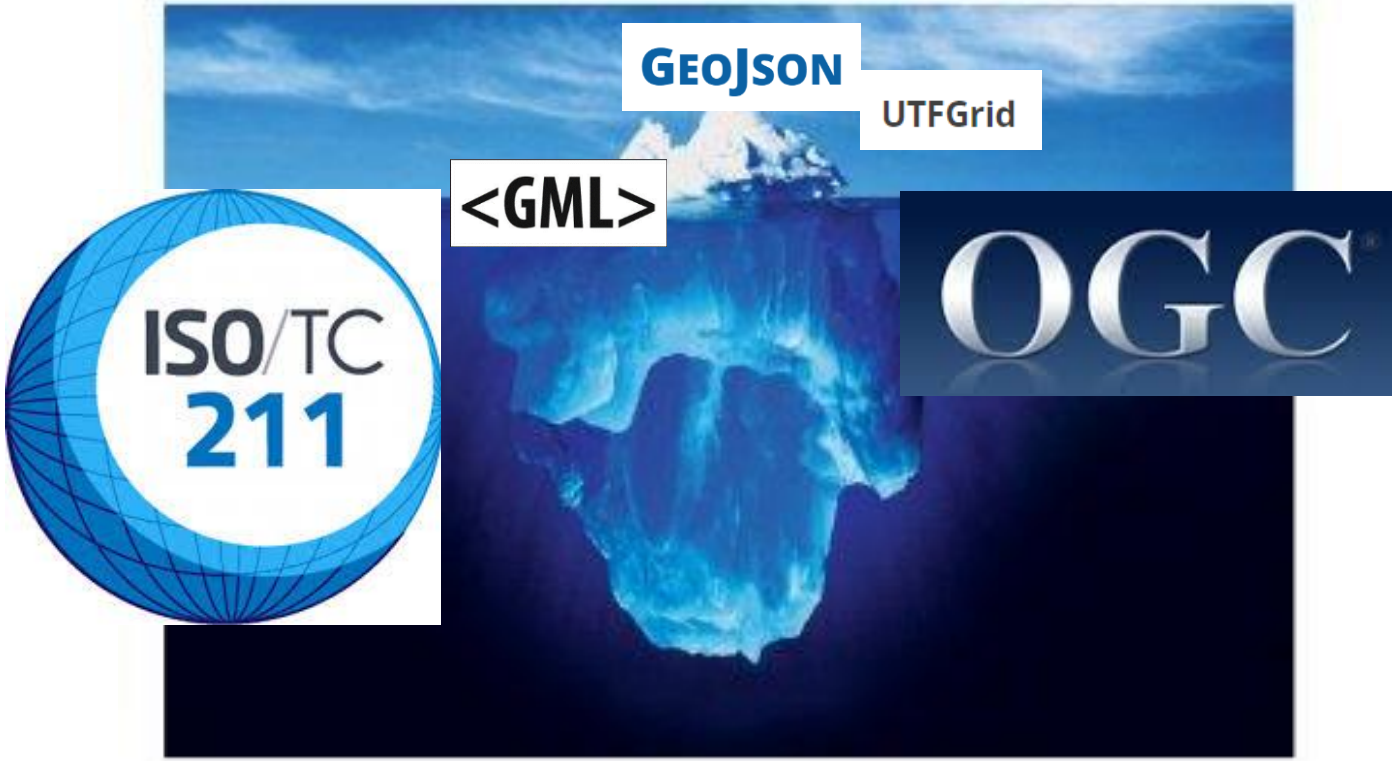
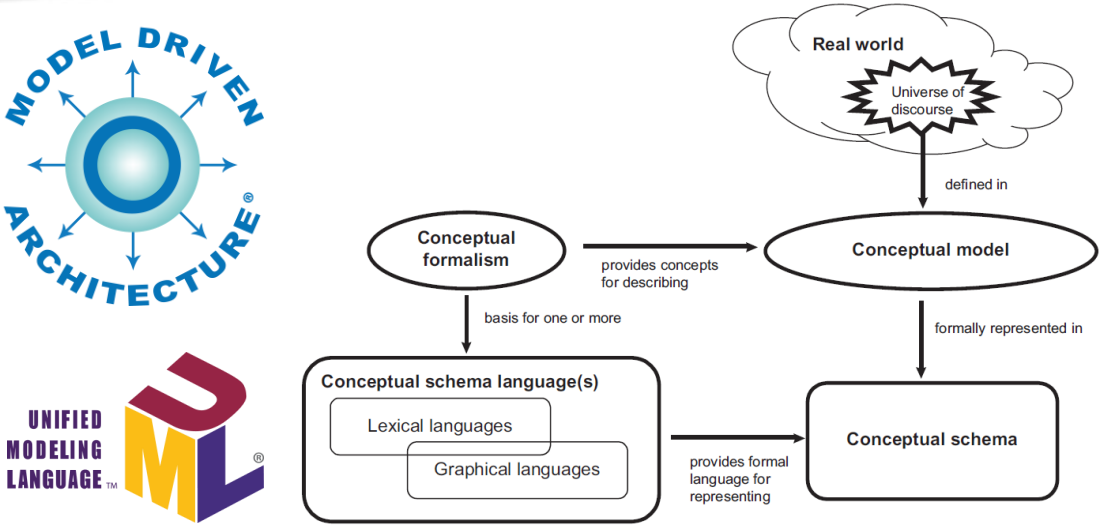


ISO/TC 211 Information modelling concepts



Source: ISO 19103:2015

Resolutions ISO/TC 211 by correspondence 1998-05-12 (N0524, N0525)

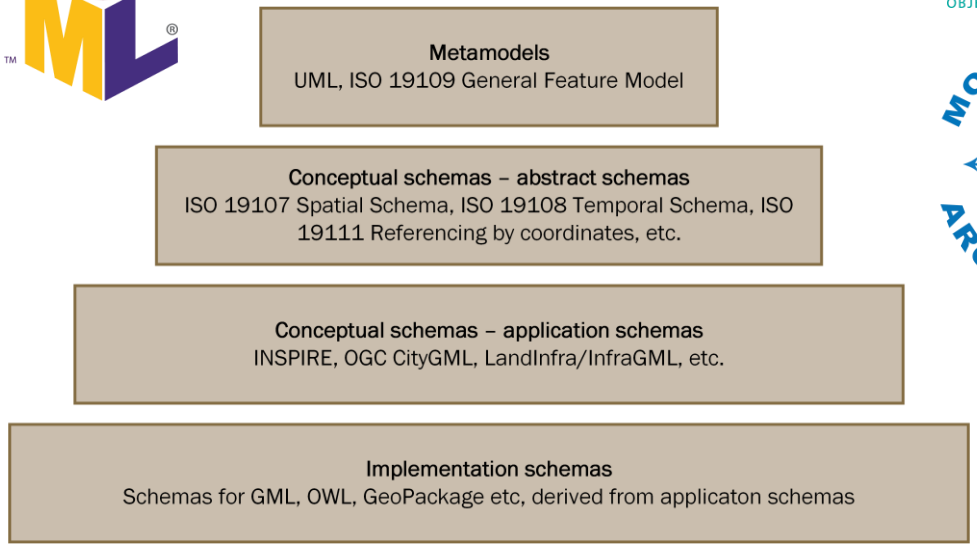
Resolution 68 Conceptual schema language for specifying ISO 15046

ISO/TC211 shall use the Unified Modelling Language (UML) static structure diagram with the ISO Interface Definition Language (IDL) basic type definitions and the UML Object Constraint Language (OCL) as the conceptual schema language for specification of the normative parts of ISO 15046. This requirement shall be implemented prior to submission of the parts for CD and DIS.

Justification:

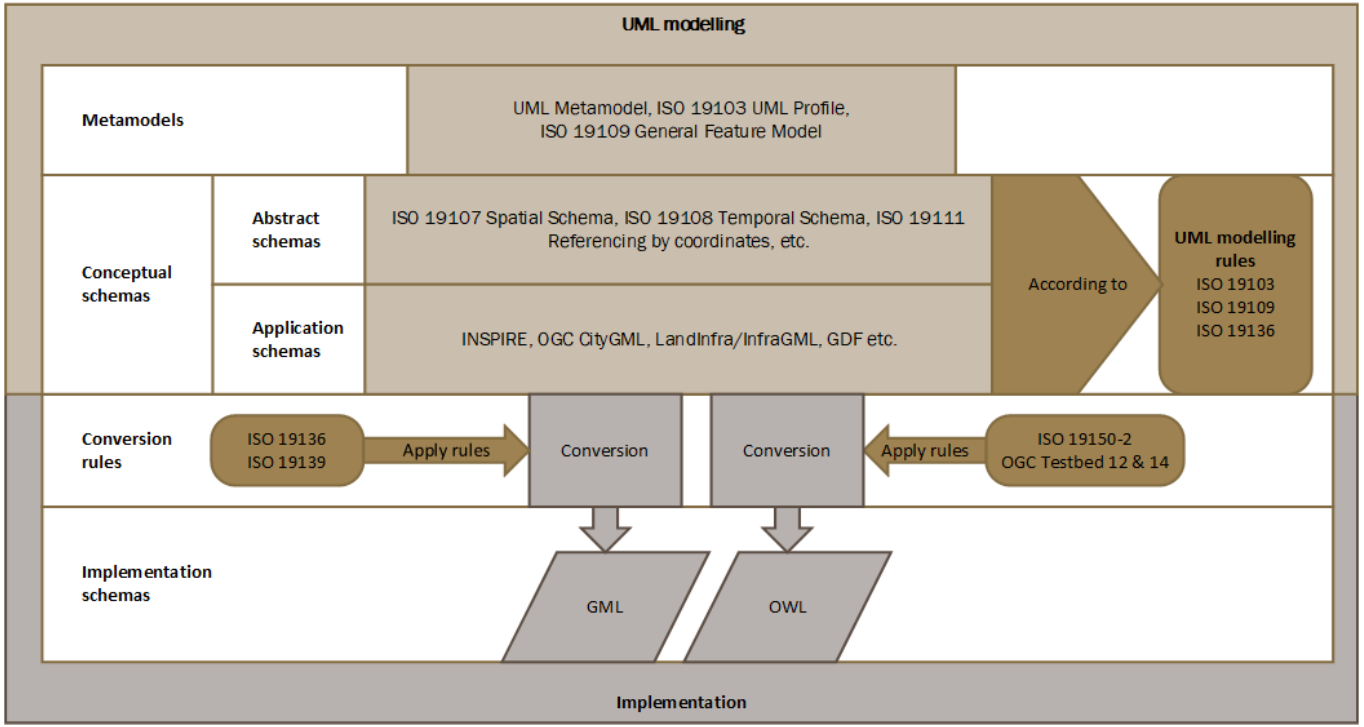
The reason for this decision is that the goal of ISO/TC 211 is to create a framework to enable syntactic interoperability and to support semantic interoperability, while supporting multiple interchange formats and multiple service implementations. UML is selected as the conceptual schema language for producing specifications that can support the creation of such a framework.

Model Driven Architecture – 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.

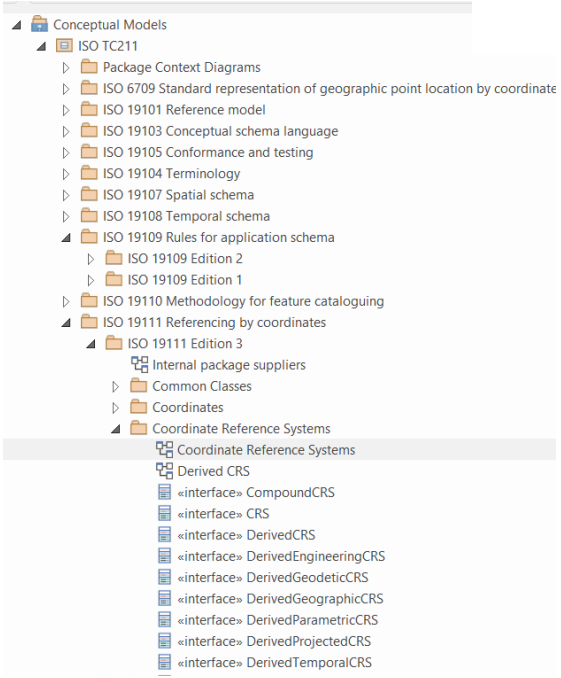
Model Driven Architecture



Source:
Jetlund, K., Onstein, E., Huang, L., 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.

The Harmonized UML Model

- All UML models in one repository
  - Subversion repository run by JRC
  - Will be moved to Sparx Pro Cloud
- Maintained by The Harmonized Model Maintenance Group (HMMG)
- Resue of concepts
  - Internally in ISO/TC 211 standards
  - Externally: OGC, INSPIRE, Domain models, National models
- Model-driven implementation



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UNIFIED MODELING LANGUAGE

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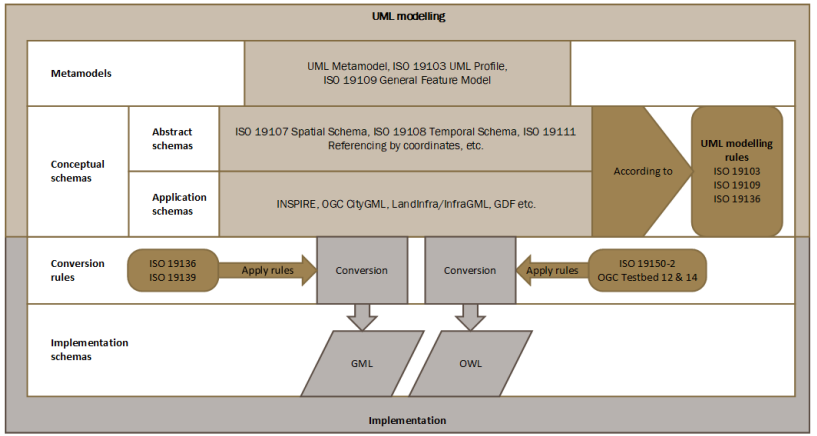
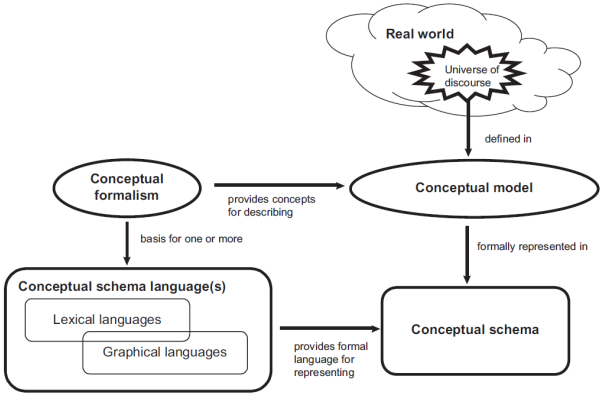
ENTERPRISE ARCHITECT

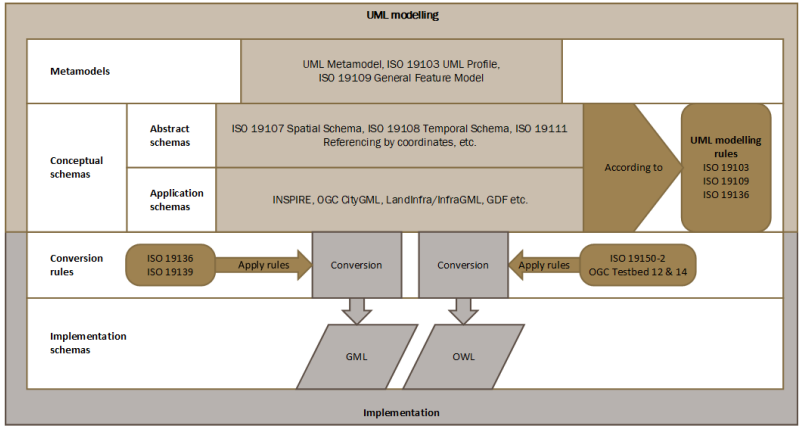
Standardized Model-driven implementation

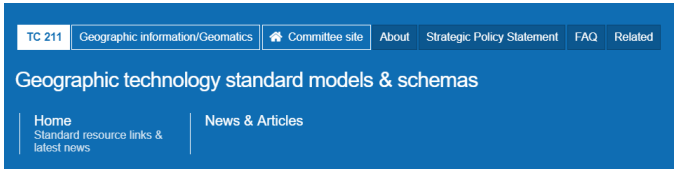
- ISO 19136 Geography Markup Language
  - XML for geospatial information
  - Rules for UML Modelling
  - Rules for conversion from UML to GML
- ISO 19139 XML schema implementation
  - General rules for conversion from UML to XML
- ISO 19150-2 Ontologies
  - Rules for conversion from UML to OWL



Oppsummering



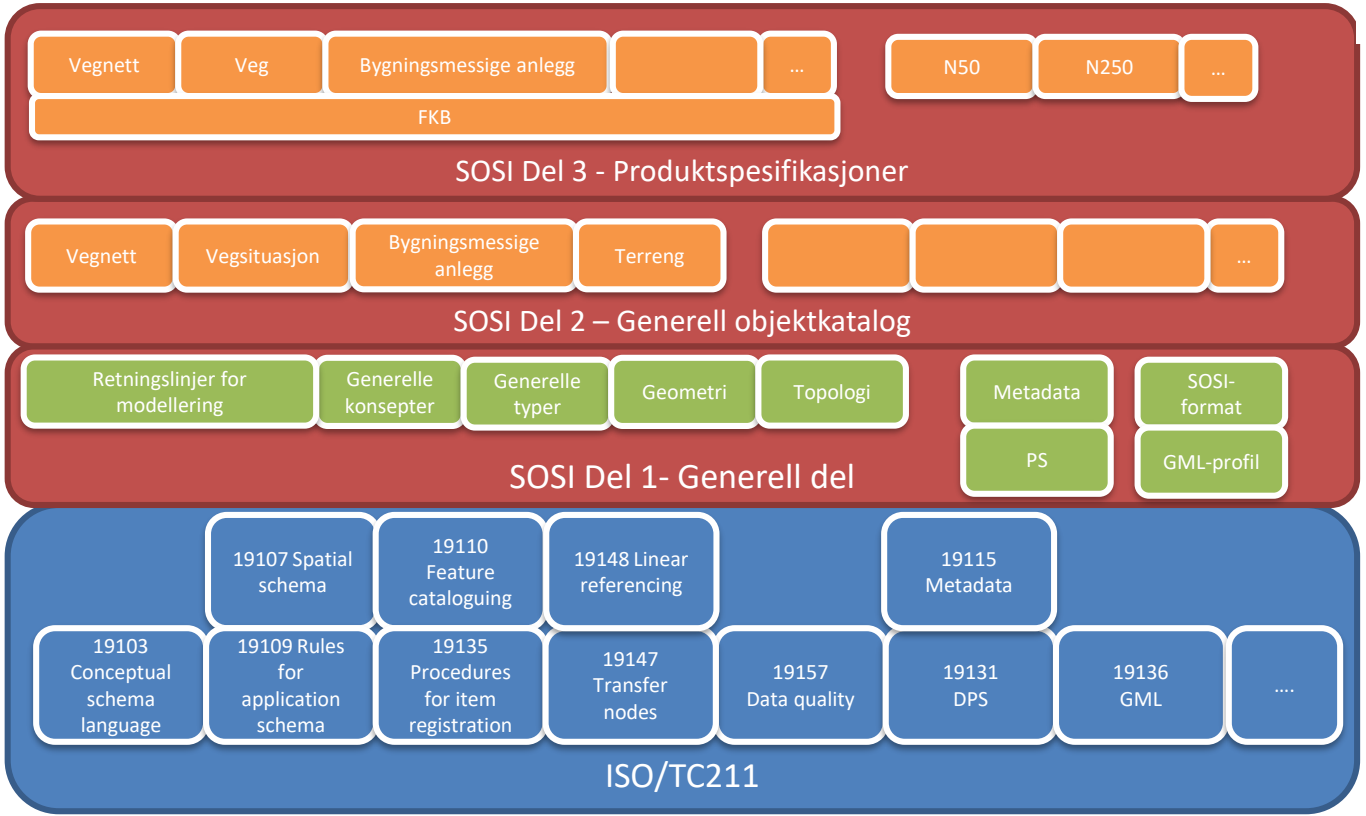




isotc211.org

- UML-modellene er standardene
- Implementasjonsskjema avledes fra modellene
- Applikasjonsskjema lages av andre enn ISO/TC 211
- MDA krever at modeller er lagd i henhold til regler

ISO/TC211 og SOSI



NVDB Datakatalogen

Statens vegvesen
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- Restriksjoner
  - Fartsgrenser, bruksklasser, svingerestriksjoner…
- Andre egenskaper
  - Trafikkmengde, vegbredder…
- Objekter langs vegen
  - Skilt, stikkrenner, rekkverk…
- Hendelser
  - Ulykker, skred…

- Totalt ca 370 ulike objekttyper
  - NVDB Datakatalogen

NVDB Datakatalogen

Statens vegvesen
Norwegian Public Roads Administration

- https://datakatalogen.vegdata.no/

Nasjonal vegdatabank
Datakatalog

Sorter listen etter ◉ Navn ○ Nummer

A

Antenne 470
Armeringsnett 609
Artsrik vegkant 517
ATK-punkt 162
ATK, influensstrekning 775
Avkjørsel 46
Avkjørsel, holdningsklasse 815
Avrettingslag 791
Avstandsmåling 335

B

Basseng/Magasin 208
Belysningspunkt 87
Belysningsstrekning 86
Beredskapsveg 923
Bergrom 147
Bergsikring 72
Betongutstøping 71
Blomsterbeplantning 274

Gravetillatelse 938
Grøft, åpen 80
Grøfteklasse 832
Grøntanlegg 508
GSV langs annen vegkategori 949
Gågate 813

H

Hastighetssone GeoSUM (test) 944
Holdeplassutrustning 487
Hydrant 209
Hydraveg 82
Høydebegrensning 591
Høydehinder 610
Høydemåler 462
Høydemåling 113
Høyttaler 937
Høyttalersystem 936

I

Plastring/Erosjonssikring 144
PMS-parsell 603
Politidistrikt 579
Port/Dør 13
Pumpe 85
Pumpestasjon 210

R

Radar 483
Radioanlegg 472
Rapportdefinisjon 760
Rasteplass 39
Referansepunkt 627
Referansestolpe 98
Referansestrekning 808
Region 534
Reisetidsregistreringspunkt 862
Rekkverk 5
Rekkverksende 14
Rekkverksskjøt 543
Renovasjon 27

Tilstandsgrad, kum 879
Tilstandsgrad, rekkverk 947
Tilstandsgrad, sidegrøft dyp 877
Tilstandsgrad, skjerm 899
Tilstandsgrad, stikkrenne/kulvert 878
Toalettanlegg 243
Trafikanttilbud 527
Trafikkberedskapsklasse 887
Trafikkdata i tellepunkt 708
Trafikkdeler 172
Trafikkindeks 707
Trafikklomme 47
Trafikkmengde 540
Trafikkmengde, kjørefelt 798
Trafikkregistreringsstasjon 482
Trafikkreguleringer 856
Trafikkspeil 342
Trafikkstasjon 638
Trafikkulykke 570
Trafikkøy 49
Trafo 466

NVDB Datakatalogen

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Antenne 470

Ledning eller system av ledninger som en bruker til å sende ut eller ta imot elektromagnetiske bølger med (5). I tilknytning til vegtrafikk benyttes f.eks radio- og mobiltelefonantenner i tunneler.

Antall vegobjekter 922

Hent statistikk Se detaljer

Egenskapstyper

Type 3779
Radio 4822
Strålekabel 4823
Mobiltelefon 4821

Høyde 3874
<Tall>

Etableringsår 4072
<Tall>

Driftsmerking 11446
<Tekst>

SCADA-merking 11733
<Tekst>

Foreldre

Tunnelløp 67

Barn

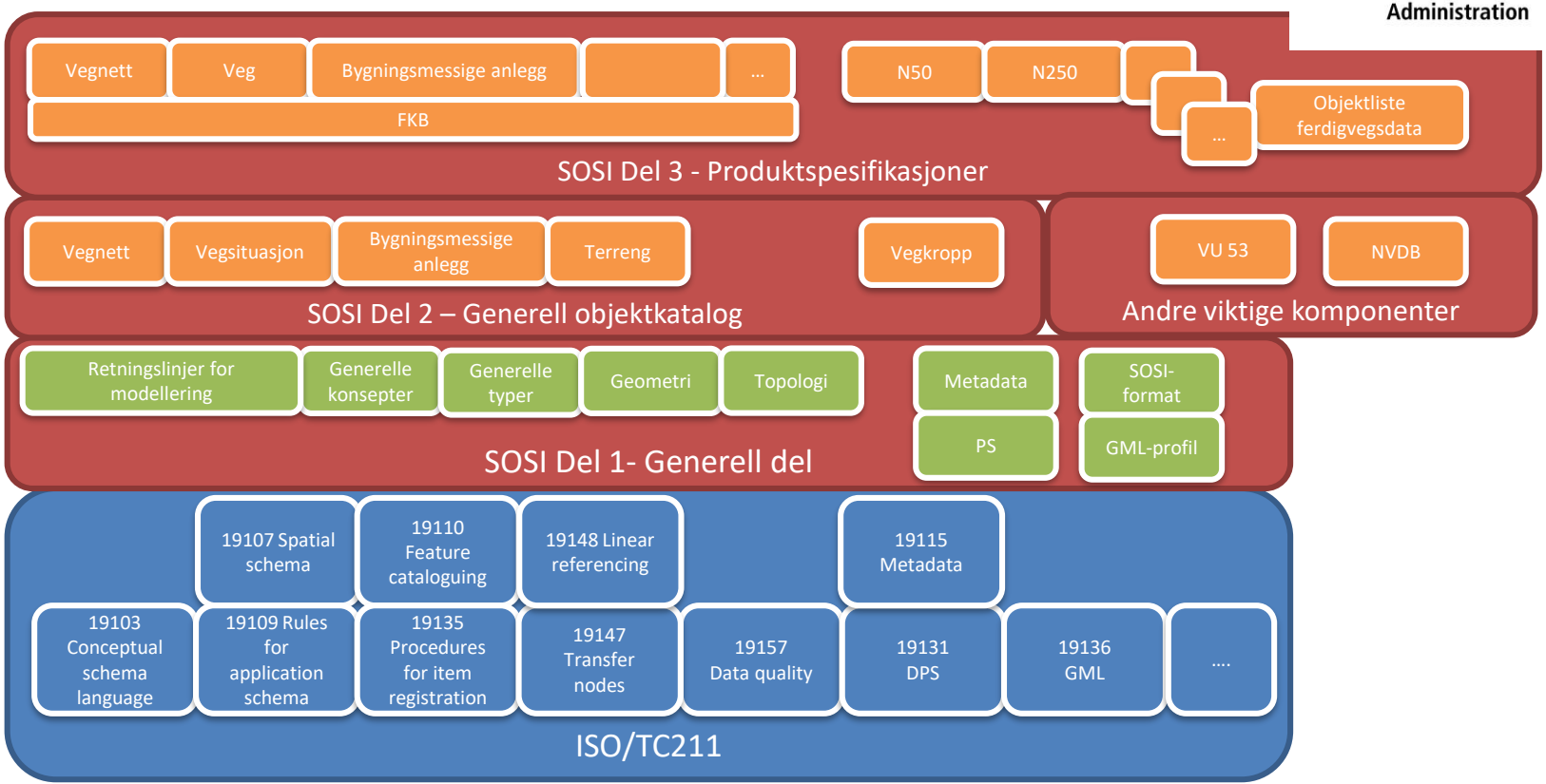
Dokumentasjon 446
Systemobjekt 794
Tilstand/skade FU, punkt 762
Tilstand/skade, punkt 761

Mer informasjon

Stedfesting PUNKT
Sorteringsnummer 5780
Sosinvdbnavn Antenne_470

https://datakatalogen.vegdata.no/470-Antenne

ISO/TC211, SOSI og NVDB



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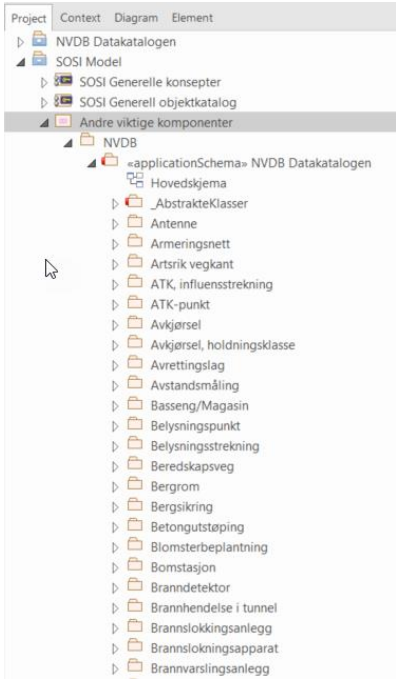
NVDB Datakatalogen i SOSI



AbstraktAntenne

«featureType»
Antenne

- type: Type [0..1]
- høyde: Real [0..1]
- etableringsår: Integer [0..1]
- driftsmerking: CharacterString [0..1]
- SCADA_Merking: CharacterString [0..1]
- produsent: CharacterString [0..1]
- produktnavn: CharacterString [0..1]
- tilleggsinformasjon: CharacterString [0..1]
- arkivreferanse: CharacterString [0..1]
- prosjektreferanse: CharacterString [0..1]
- eier: Eier [0..1]
- vedlikeholdsansvarlig: Vedlikeholdsansvarlig [0..1]
- vedlikeholdsansvarlig_Navn: CharacterString [0..1]
- posisjon: Punkt [0..1]
- senterlinje: Kurve [0..1]
- lineærPosisjon: LineærPosisjonPunkt [0..*]

«codeList»
Type

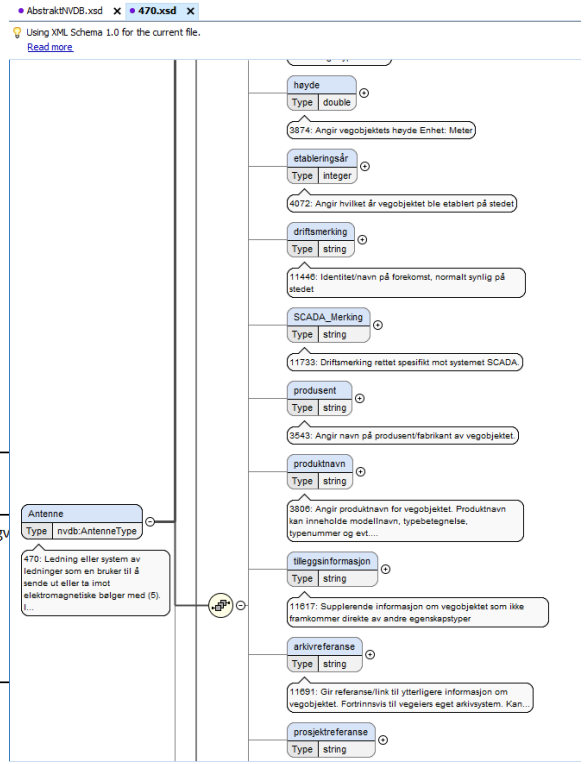
- radio
- strålekabel
- mobiltelefon

«codeList»
Vedlikeholdsansvarlig

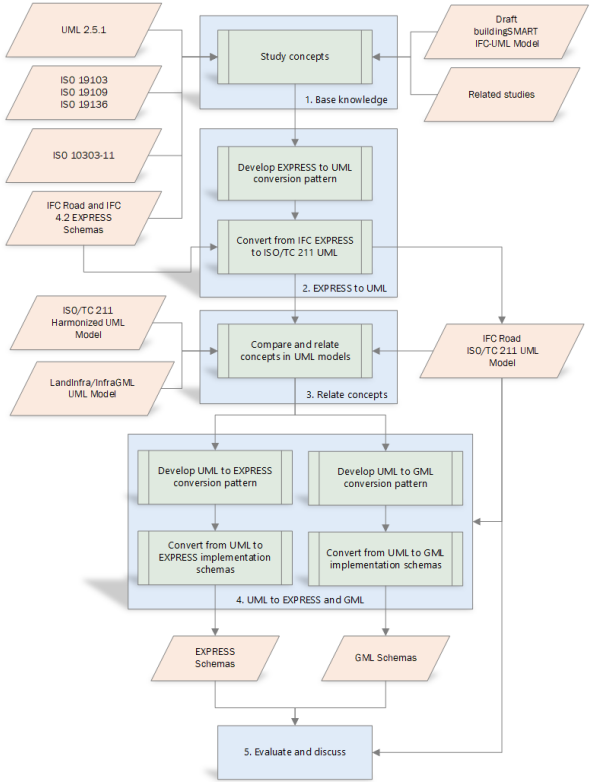
- statensVegvesen
- nyeVeier
- fylkeskommune
- OPS
- kommune
- privat
- uavklart

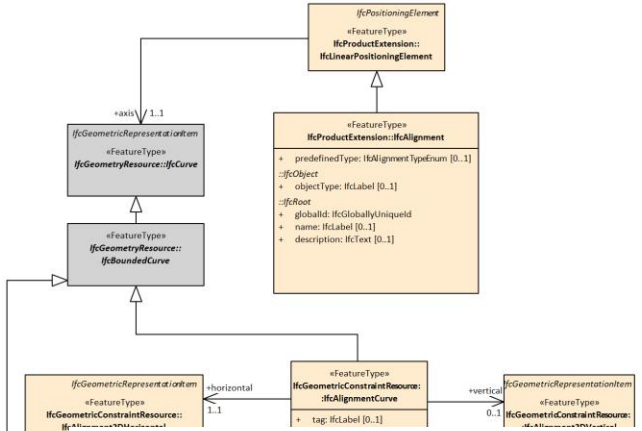
«codeList»
Eier

- stat_StatensVegv
- stat_NyeVeier
- fylkeskommune
- privat_Telenor
- privat_Ice
- privat_Telia
- uavklart



IFC i UML basert på ISO/TC 211






```
<ifc:IfcSite>                                                    [36 lines]
<ifc:IfcAlignment gml:id="vegvesen.no.nvdb.88263528">
 <ifc:globalId>30ce2eac-48f8-494f-b556-e35fd683687d</ifc:globalId>
 <ifc:name>Alignment_88263528</ifc:name>
 <ifc:description>Example alignment feature</ifc:description>
 <ifc:axis>
  <ifc:IfcAlignmentCurve>
   <ifc:dim>3</ifc:dim>
   <ifc:curve>
    <gml:LineString srsName="EPSG:6150" srsDimension="3">
     <gml:posList>133189.363 1313776.627 135.218 133289.351 1313747.742 142.1
                  133364.851 1313764.775 146.8 133543.175 1313888.363 154.8
                  133679.496 1314048.563 157.3 133839.121 1314127.771 163
                  134048.109 1314279.143 179.9 135091.153 1314562.761 205.954</gml:posList>
    </gml:LineString>
   </ifc:curve>
   <ifc:horizontal xlink:href="IfcAlignmentExample.gml#vegvesen.no.nvdb.88263528_0_H"/>
  </ifc:IfcAlignmentCurve>
 </ifc:axis>
</ifc:IfcAlignment>
<ifc:IfcAlignment2DHorizontal gml:id="vegvesen.no.nvdb.88263528_0_H">  [64 lines]
```

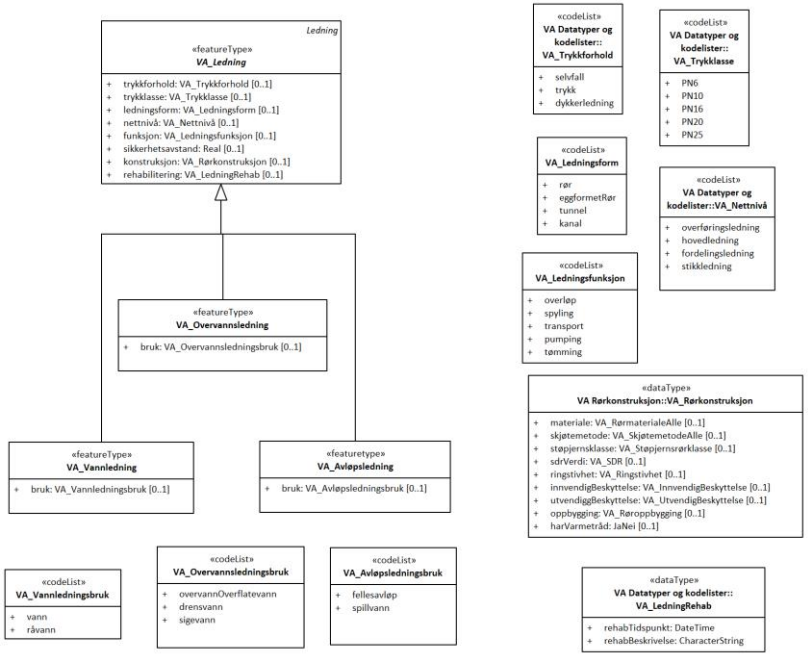
https://www.mdpi.com/2220-9964/9/4/278

Hva er en svane, hvilken farge har den?

From http://www.millennialplanners.com

- Open World Assumption (OWA)
  - More information may show up, and may deviate from the model.
- Closed World Assumption (CWA)
  - The information model is complete in the given context
  - Additional or deviating information is wrong

Tradisjonell UML-modellering (og EXPRESS)



«Alle svaner er hvite»

Semantisk Web - OWL

«Det finnes svaner. Noen kan være hvite.»

The real world changes

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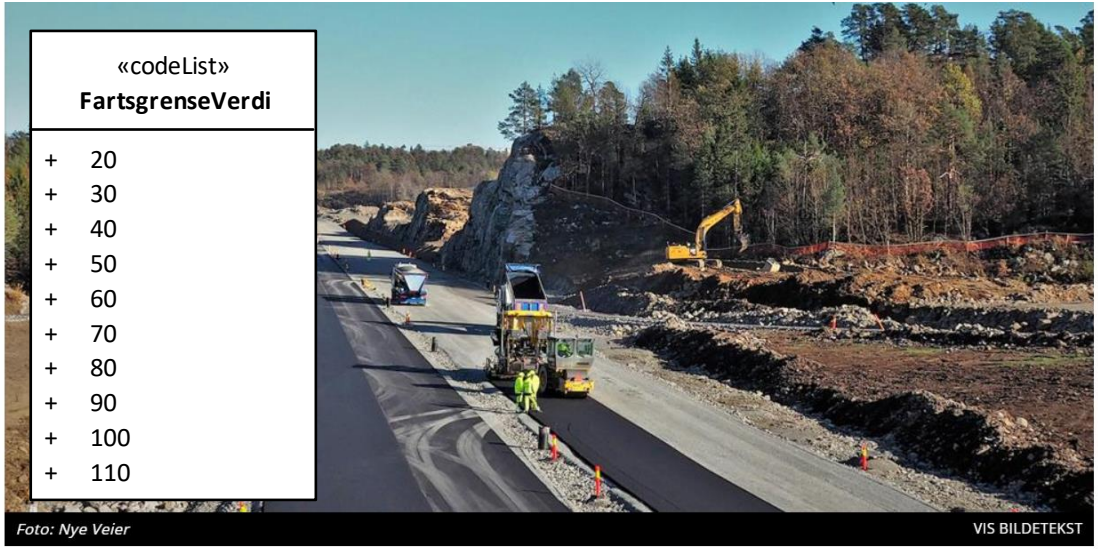


Vurderer 120 kilometer i timen

120 kilometer i timen? Vegdirektoratet vurderer nå dette på oppdrag fra Samferdselsdepartementet.

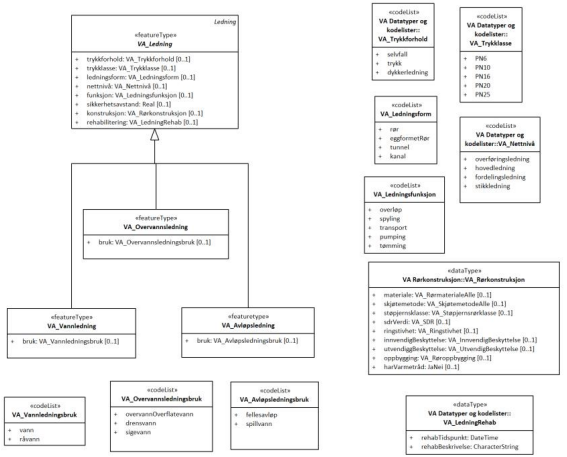
Hvor mye kan og bør standardiseres?

«Mest mulig»

Men:

- Verden utvikler seg kontinuerlig
- Det vil alltid dukke opp nye behov

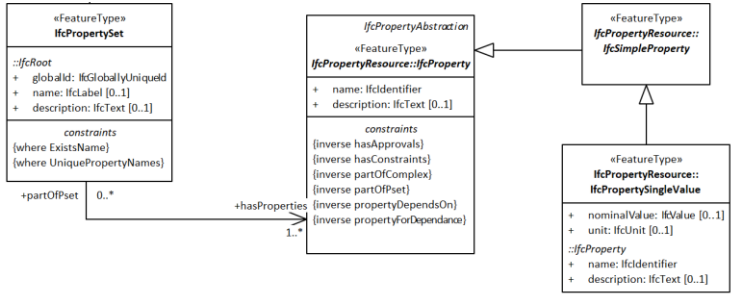
Hvordan kan vi knytte informasjon på en mer fleksibel måte til de statiske modellene?



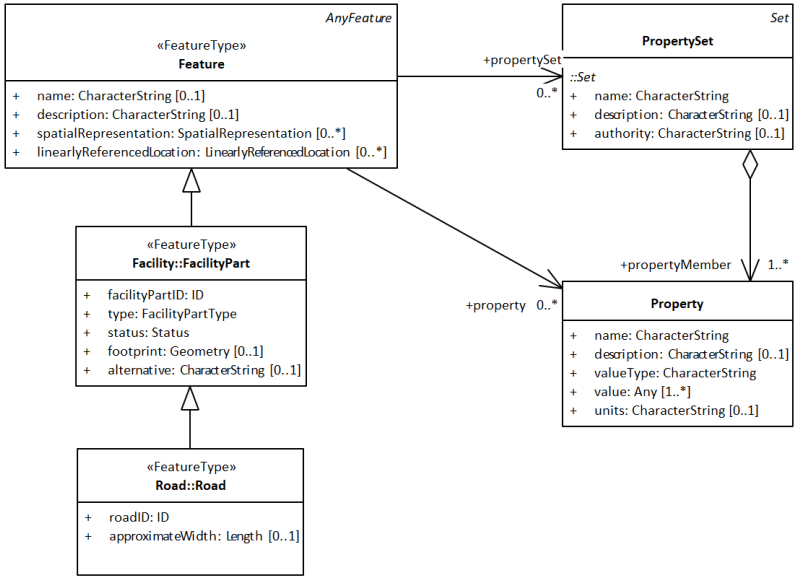
IFC: PropertySets

PsetName	Properties			
Pset_WindowCommon	Template	PropertyName	Value	Reference
	Single Value	Reference	IfcIdentifier	
	Single Value	AcousticRating	IfcLabel	
	Single Value	FireRating	IfcLabel	
			IfcLabel	
			IfcBoolean	
			IfcVolumetricFlowRateMeasure	
		nce	IfcThermalTransmittanceMeasure	
		on	IfcPositiveRatioMeasure	
			IfcBoolean	
			IfcBoolean	
			IfcBoolean	
			IfcBoolean	
			IfcBoolean	
		ting	IfcLabel	
		ating	IfcLabel	
			IfcLabel	
			IfcLabel	

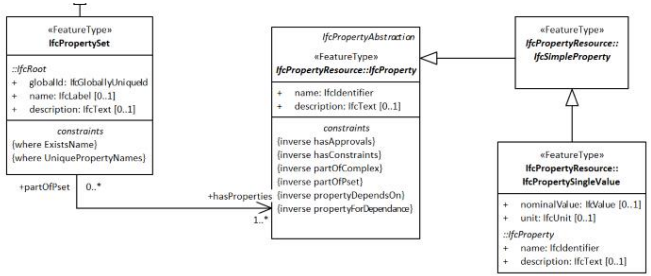
```
#1382333= IFCWINDOW('0ettZiqmL4NgBBj3nY6Lph',#30,'UV-t 02','','',#1382270,#1382329,'28DF78EC-D305-445E-A2CB-B43C62195CEB',1760.,2610.);

#1382270= IFCLOCALPLACEMENT(#1382110,#1382269);
#1382329= IFCPRODUCTDEFINITIONSHAPE($,$,(#1382276,#1382327));

#1382352= IFCRELDEFINESBYPROPERTIES('1pBAjI6Q_6v1DaZhf5GA$g',#30,$,$,(#1382333),#1382350);
#1382359= IFCRELDEFINESBYPROPERTIES('0p6QCW0pG_eFvV9yCLK$_S',#30,$,$,(#1382333),#1382357);
#1382365= IFCRELDEFINESBYPROPERTIES('21zwfWmXja_CVxS4ghHAJI',#30,$,$,(#1382333),#1382363);
#1382372= IFCRELDEFINESBYPROPERTIES('2R5LdcbXBPLLWeLpvIlqyZ',#30,$,$,(#1382333),#1382370);
#1382378= IFCRELDEFINESBYPROPERTIES('1kltZIOhR2syTxW2SLAgkn',#30,$,$,(#1382333),#1382376);
#1382390= IFCRELDEFINESBYPROPERTIES('38jJRuEp1apVEnhchgVXPG',#30,$,$,(#1382333),#1382388);

#1382341= IFCPROPERTYSINGLEVALUE('Infiltration',$,IFCVOLUMETRICFLOWRATEMEASURE(0.),$);
#1382342= IFCPROPERTYSINGLEVALUE('Reference',$,IFCIDENTIFIER(''),$);
#1382343= IFCPROPERTYSINGLEVALUE('SecurityRating',$,IFCLABEL(''),$);
#1382344= IFCPROPERTYSINGLEVALUE('SmokeStop',$,IFCBOOLEAN(.F.),$);
#1382345= IFCPROPERTYSINGLEVALUE('FireRating',$,IFCLABEL('-'),$);
#1382346= IFCPROPERTYSINGLEVALUE('AcousticRating',$,IFCLABEL('30 dB'),$);
#1382347= IFCPROPERTYSINGLEVALUE('ThermalTransmittance',$,IFCTHERMALTRANSMITTANCEMEASURE(0.8),$);
#1382348= IFCPROPERTYSINGLEVALUE('GlazingAreaFraction',$,IFCPOSITIVERATIOMEASURE(0.),$);
#1382349= IFCPROPERTYSINGLEVALUE('IsExternal',$,IFCBOOLEAN(.T.),$);
#1382350= IFCPROPERTYSET('0QVO8265mIzOgfBDaB4qah',#30,'Pset_WindowCommon',$,(#1382341,#1382342,#1382343,#1382344,#1382345,#1382346,#1382347,#1382348,#1382349));
```



InfraGML: PropertySets



Relativt lik modell som IFC



IFC PropertySets i InfraGML

I GML-fila er propertysettet knytta til objektet gjennom relasjonen "propertySet":

```
<li:feature>
    <li:Feature>
        <gml:identifier codeSpace="Local">ExampleFeature</gml:identifier>
        <gml:name>Example generic feature</gml:name>
        <li:spatialRepresentation> [85 lines]
        <li:propertySet
            xlink:href="IfcPropertySetTest.gml#Pset_WindowCommon.0QVO8265mIzOgfBDaB4qah"/>
    </li:Feature>
</li:feature>
```

Egenskapene er definert i et PropertySet med referanse til PSD-XML-en for beskrivelser:

```
<li:abstractData>
    <li:PropertySet gml:id="Pset_WindowCommon.0QVO8265mIzOgfBDaB4qah">
        <gml:descriptionReference
            xlink:href="https://standards.buildingsmart.org/IFC/DEV/IFC4_3/RC1/HTML/psd/Pset_WindowCommon.xml"/>
        <gml:identifier codeSpace="IFC">0QVO8265mIzOgfBDaB4qah</gml:identifier>
        <gml:name>Pset_WindowCommon</gml:name>
        <li:authority>buildingSMART International</li:authority>
        <li:propertyMember>
            <li:Property>
                <gml:descriptionReference
                    xlink:href="https://standards.buildingsmart.org/IFC/DEV/IFC4_3/RC1/HTML/psd/Pset_WindowCommon.xml#AcousticRating"/>
                <gml:name>AcousticRating</gml:name>
                <li:valueType>gml:MeasureType</li:valueType>
                <li:value gml:uom="dB">30</li:value>
            </li:Property>
        </li:propertyMember>
        <li:propertyMember>
            <li:Property>
                <gml:descriptionReference
                    xlink:href="https://standards.buildingsmart.org/IFC/DEV/IFC4_3/RC1/HTML/psd/Pset_WindowCommon.xml#IsExternal"/>
                <gml:name>IsExternal</gml:name>
                <li:valueType>xsd:boolean</li:valueType>
                <li:value>True</li:value>
            </li:Property>
        </li:propertyMember>
        <li:propertyMember> [8 lines]
        <li:propertyMember> [8 lines]
    </li:PropertySet>
</li:abstractData>
```

SOSI Vegkropp er basert på InfraGML

→ PropertySets kan brukes i SOSI Vegkropp

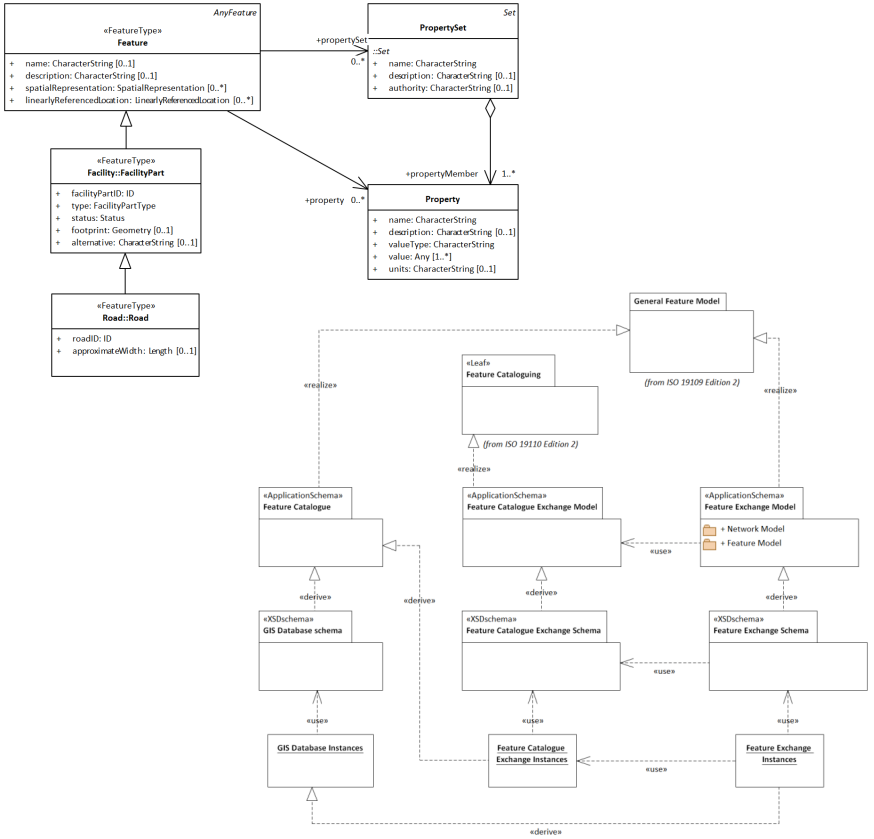
Hvor mye kan og bør standardiseres?

«Mest mulig»

Men:

- Verden utvikler seg kontinuerlig
- Det vil alltid dukke opp nye behov

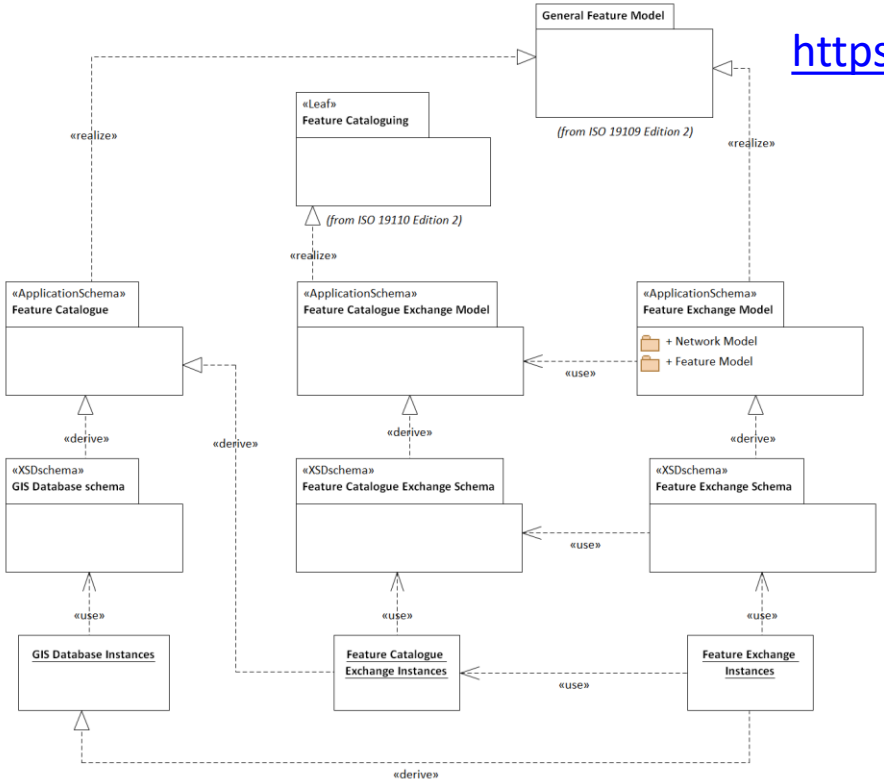
Vi trenger standardiserte metoder for å knytte fleksible modeller til de statiske modellene

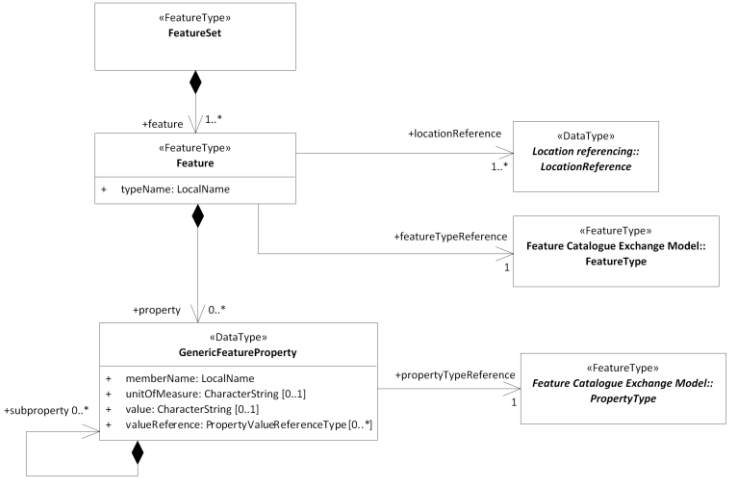


Ytterste konsekvens: Helt generisk modell

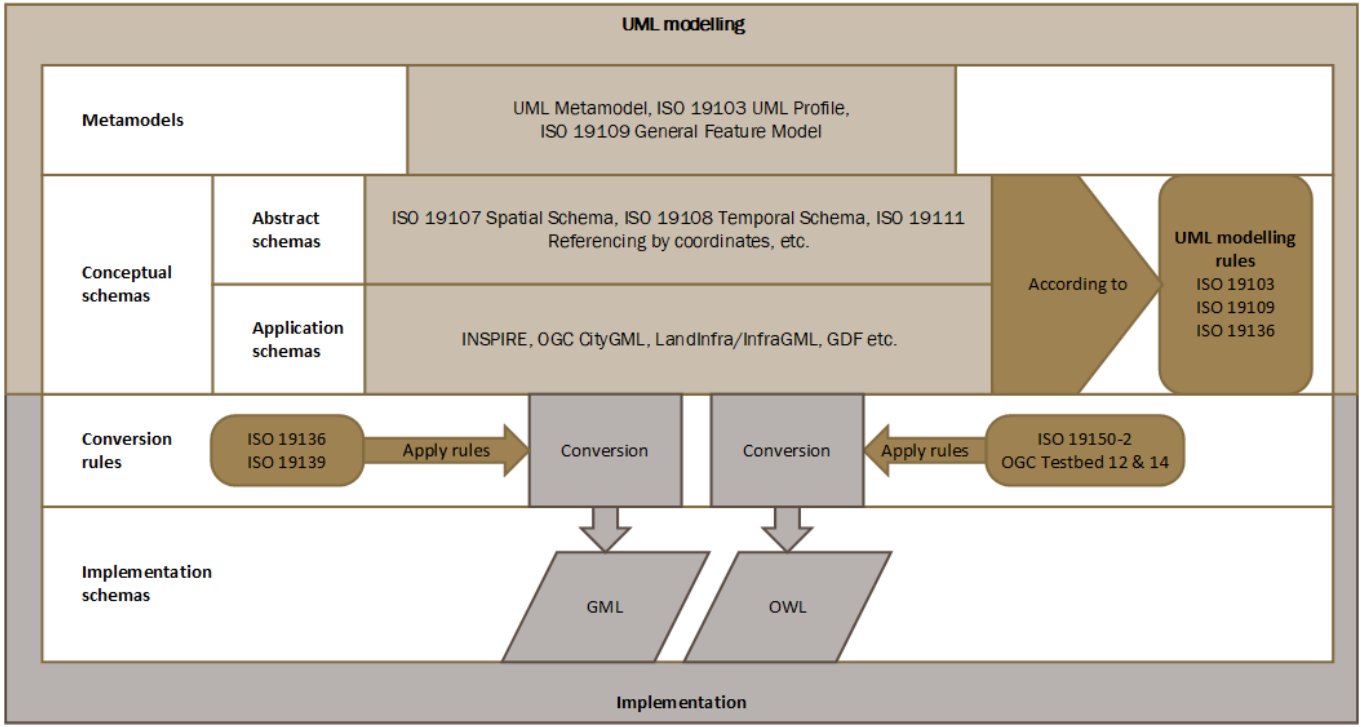
Statens vegvesen
Norwegian Public Roads Administration

https://www.mdpi.com/2220-9964/8/3/141





Model Driven Architecture

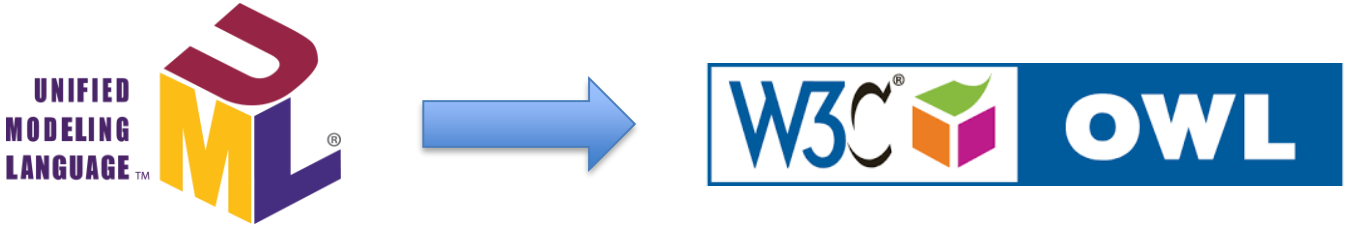


Source:
Jetlund, K., Onstein, E., Huang, L., Adapted Rules for UML Modelling of Geospatial Information for Model-Driven Implementation as OWL Ontologies. ISPRS International Journal of Geo-Information 2019, 8(9), p. 365.

Scopes of derived geospatial ontologies

Three possible levels of information flow:

A. Use in Semantic Web technology and applications only.
B. Unidirectional information exchange from GIS applications to the Semantic Web.
C. Bidirectional information exchange between GIS applications and the Semantic Web.



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Improvements of derived geospatial ontologies

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- https://www.mdpi.com/2220-9964/8/9/365
- Global properties
- Reuse of external concepts
- Conversion of UML abstract classes, unions, compositions and code lists

NTNU

Norwegian University of Science and Technology

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Questions and discussion…

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