



WXXM to WXS: A FullMoon Experience

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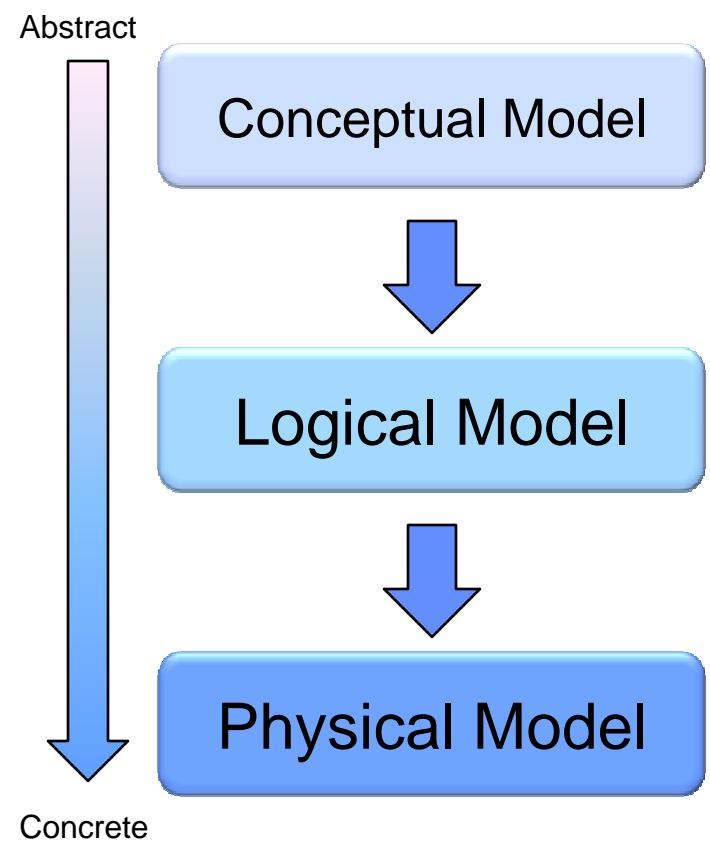
Outline



- **Model Driven Architecture**
- **FullMoon Overview**
- **NNEW Enhancements**
- **Summary**



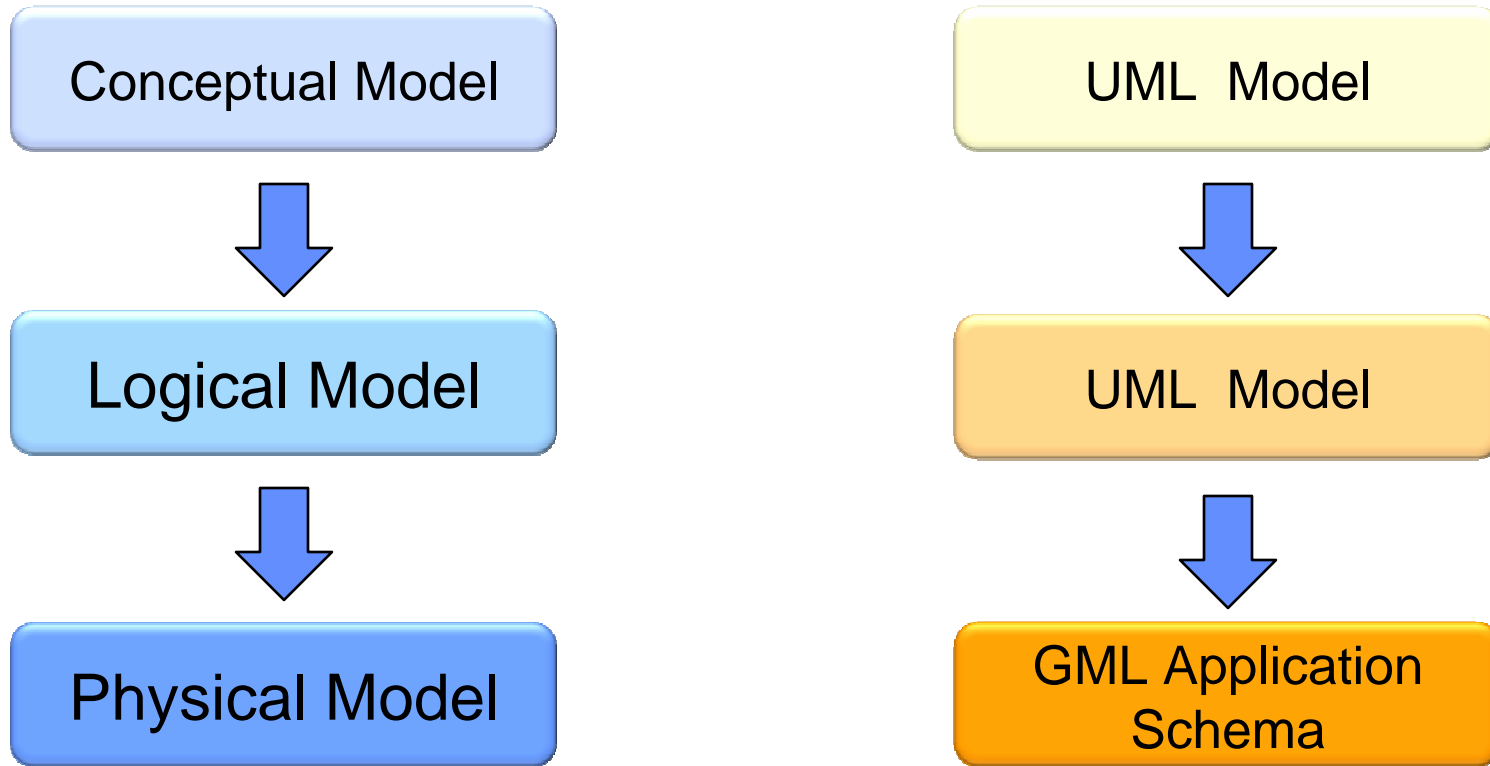
The Models



- *High level view of “customer” requirements.*
- *Formalized view conforming to rules of information science.*
- *One specific instantiation of the “logical” model*



OGC/ISO Model Driven Design





ISO/ TC 211 Process



UML Model

- Also called *Information Model*
- Must be developed in UML
- Must conform to a strict UML profile
 - Patterns, stereotypes, tagged values

Keys to Geographic Information Interoperability :

- UML application model: describes the feature types for a domain
- XML-based transfer encoding using Geography Markup Language (GML)

GML Application Schema

- Physical Representation must be an XML schema
 - Must be a GML Application Schema
- Must conform to rules defined in ISO 19136



Motivation



- **OGC/ISO uses “Model Driven Architecture” for design**
- **Community semantics are formalized (in part) as “application schemas” in UML**
 - ➔ **the UML representation is the “reference implementation” of a domain model**
- **Issues:**
 - **Application/Processing requires concrete physical models (XML, relational)**
 - Example: OGC services (e.g. WFS) require XML (GML)
 - **Logical and Physical models must be kept “in sync”**
 - **Must ensure conformance to ISO 19136 Annex E rules**
- **Challenge:**
 - **Conversion of the design to conformant application schema is non-trivial**
 - Customized scripts? Tool? Manual?



Outline



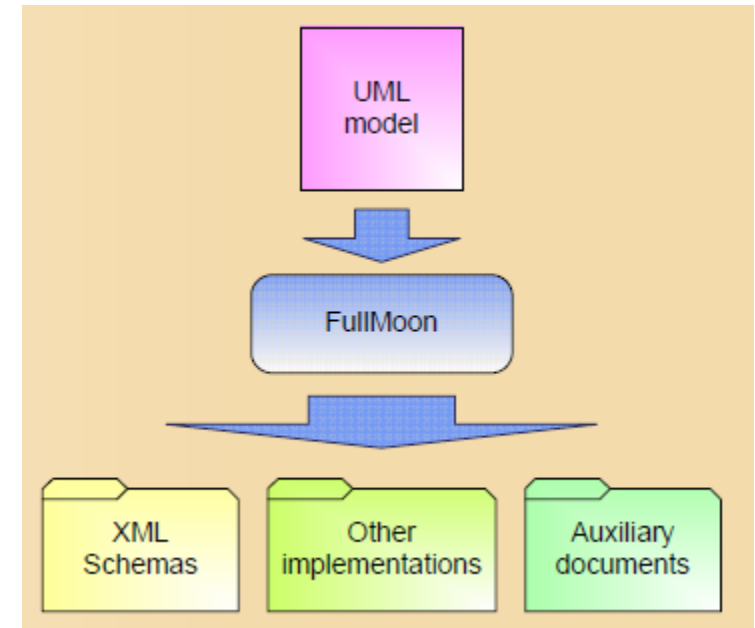
- Model Driven Architecture
- **FullMoon Overview**
- **NNEW Enhancements**
- **Summary**



FullMoon Overview



- Developed by:
 - Nick Ardlie, Geoscience Australia
 - Paval Golodoniuc, CSIRO, AuScope
 - Simon Cox
- Flexible, Scalable framework
- Supports conversion of “logical” model to “physical model”
 - Translates UML model to GML Application Schema
 - Generates documentation from UML model



FullMoon is released under GPL. For more information, see <https://www.seegrid.csiro.au/twiki/bin/view/AppSchemas/FullMoon>

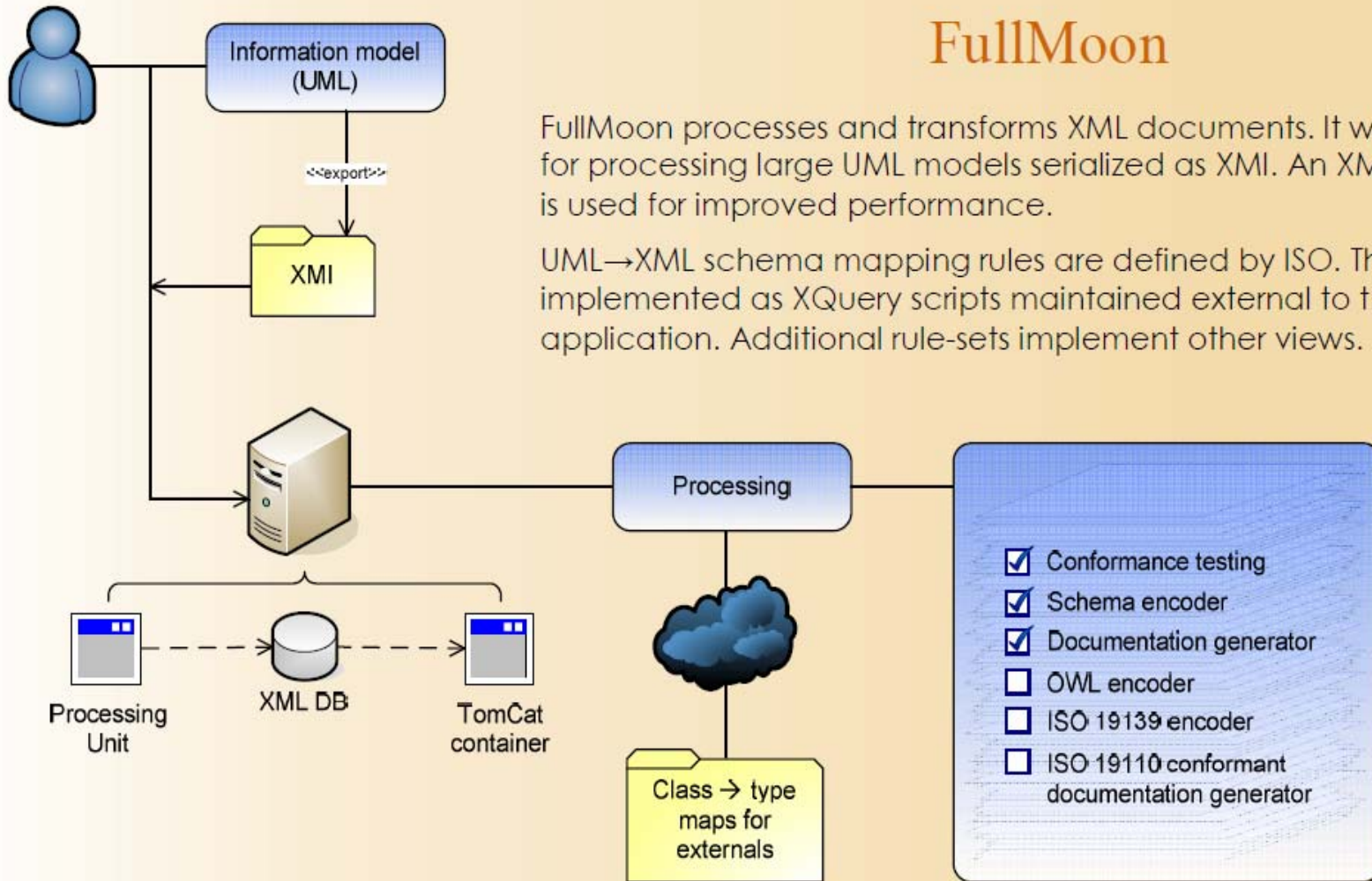


FullMoon Flow

FullMoon

FullMoon processes and transforms XML documents. It was designed for processing large UML models serialized as XMI. An XML DB (eXist) is used for improved performance.

UML→XML schema mapping rules are defined by ISO. The rules are implemented as XQuery scripts maintained external to the application. Additional rule-sets implement other views.





FullMoon Highlights



- **XMI → various implementations**
 - GML application schema
 - HTML documentation (frameset)
 - ...
 - UML Profile validation
- **Each rule-set externalized as a set of XQuery documents**
 - New rule-sets added easily
 - Rules applied sequentially
 - E.g. enhancements to ISO 19136 rules added as an extra layer
- **Modular configuration of external dependencies**
 - Subscribe to independently governed packages/canonical schemas
 - e.g. GML, O&M
 - Currently via “back-pocket registers” ...



FullMoon Outcomes



Conformance test

Reports on the validity of your model and its conformance to the standards. Non-conformities are located in UML model, to support the debugging process.

Complete model documentation

Comprehensive HTML documentation for the model is generated from the XMI. Scope-notes must be provided in the model for all components. The UML representation of the domain model is the only artefact maintained.

XML Schema

XML Schemas (XSD) are the most important output from the framework. GML-conformant schemas define XML representations for transfer using standard SOA interfaces, such as OGC's WFS.

Need more?

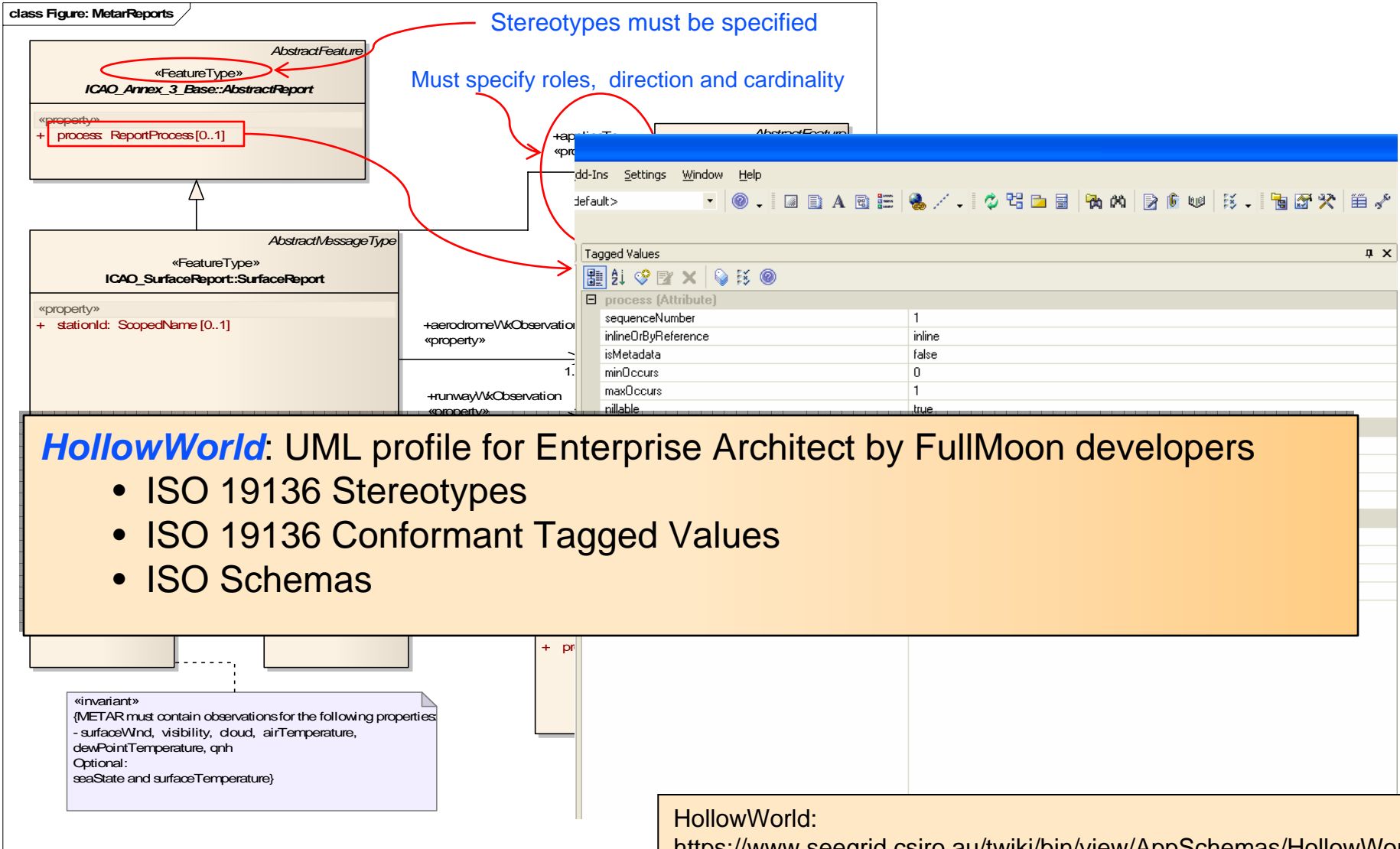
Since FullMoon is designed as "rules-driven" framework it's easy to enhance existing rule-sets or introduce new ones...



Step 1: WXXM



Get your UML Model with UML Profile Right!



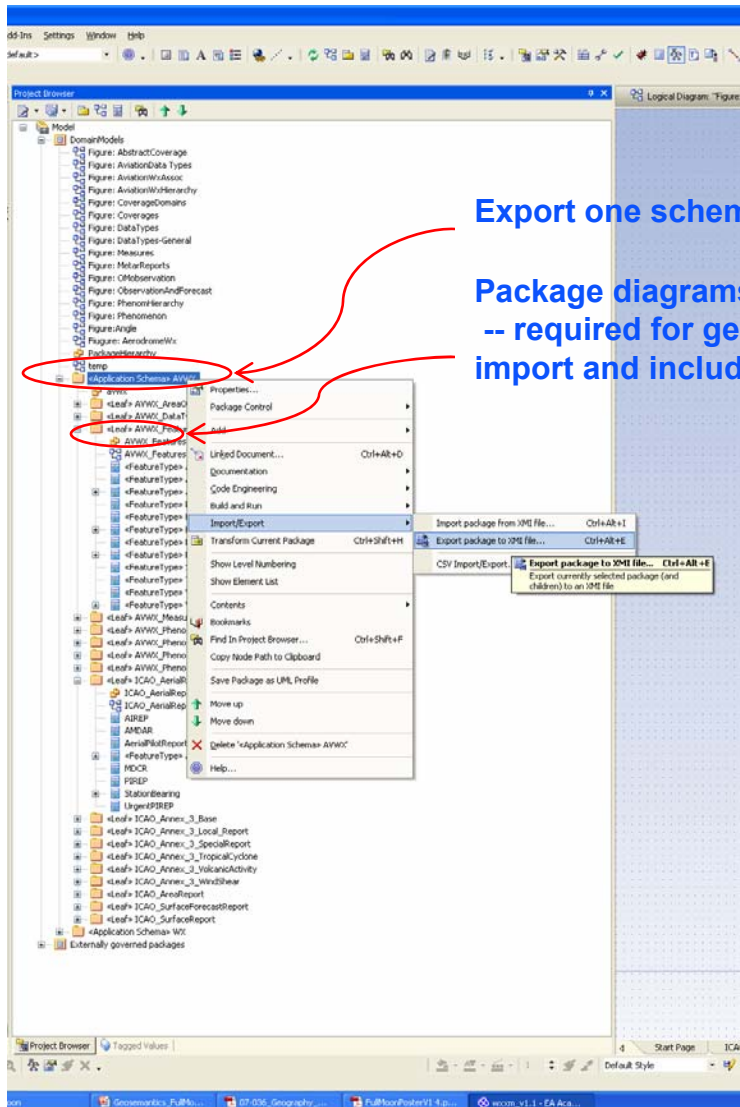
HollowWorld: UML profile for Enterprise Architect by FullMoon developers

- ISO 19136 Stereotypes
- ISO 19136 Conformant Tagged Values
- ISO Schemas

HollowWorld:
<https://www.seegrid.csiro.au/twiki/bin/view/AppSchemas/HollowWorld>



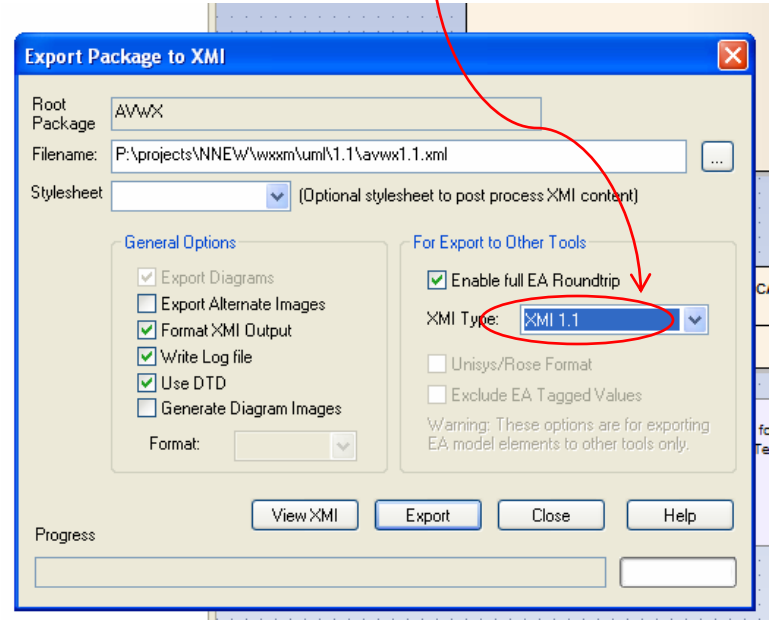
Step 2: Export Your Model



Export one schema at a time!

Package diagrams are essential!
-- required for generating correct import and include statements

FullMoon can handle XMI 1.1 exports only





Step 3: Model Conformance

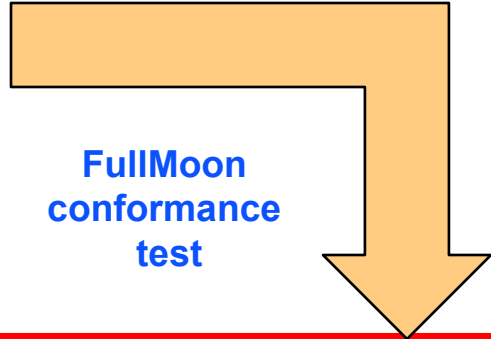


XMI

```

ClassifierRole name="ICA0_SurfaceReport" xmi.id="EAID_0F4735E2_6A61_4cf6_90"
<UML:ModelElement.stereotype>
<UML:Stereotype name="Leaf"/>
</UML:ModelElement.stereotype>
<UML:ModelElement.taggedValue>
<UML:TaggedValue tag="isSpecification" value="false"/>
<UML:TaggedValue tag="ea_stype" value="Package"/>
<UML:TaggedValue tag="ea_n_type" value="0"/>
<UML:TaggedValue tag="version" value="1.0"/>
<UML:TaggedValue tag="package" value="EAPK_6DD91FC7_3447_4961_8499_A7CA0"
<UML:TaggedValue tag="date_created" value="2009-03-17 16:09:20"/>
<UML:TaggedValue tag="date_modified" value="2010-03-18 20:53:54"/>
<UML:TaggedValue tag="gentype" value="Java"/>
<UML:TaggedValue tag="tagged" value="0"/>
<UML:TaggedValue tag="package2" value="EAID_0F4735E2_6A61_4cf6_909A_E94"
<UML:TaggedValue tag="package_name" value="AVWX"/>
<UML:TaggedValue tag="phase" value="1.0"/>
<UML:TaggedValue tag="author" value="claypool"/>
<UML:TaggedValue tag="complexity" value="1"/>
<UML:TaggedValue tag="status" value="Proposed"/>
<UML:TaggedValue tag="stereotype" value="Leaf"/>
<UML:TaggedValue tag="tpos" value="0"/>
<UML:TaggedValue tag="ea_localid" value="-285660146"/>
<UML:TaggedValue tag="ea_eleType" value="package"/>
<UML:TaggedValue tag="style" value="BackColor=-1;BorderColor=-1;BorderW"
<UML:TaggedValue tag="$fea_xref_property" value="$XREFPROP=$XID={6AECAB49
</UML:ModelElement.taggedValue>
</UML:ClassifierRole>
<UML:ClassifierRole name="AVWX_Measures" xmi.id="EAID_3C6C89

```



```

59 <cr:result xmlns:cr="urn:tdb:xmlns:TBD:FullMoon:conftest-results:1.0">
60   <cr:test number="10"/>
61   External packages and/or classes within the model do not have corresponding records in registry or type-mapping
62   FAILED
63   External dependency package "Measures" does NOT have a corresponding record in the dependency register.</cr:message>
64   External dependency package "Units" does NOT have a corresponding record in the dependency register.</cr:message>
65   External dependency package "Base" does NOT have a corresponding record in the dependency register.</cr:message>
66   External dependency class "TM_Object" does NOT have a corresponding record in a ClassMap found through a register
67   External dependency class "CircleByCenterPoint" does NOT have a corresponding record in a ClassMap found through
68   External dependency class "Polygon" does NOT have a corresponding record in a ClassMap found through a register
69   </cr:messages>
70 </cr:result>
71 <cr:result xmlns:cr="urn:tdb:xmlns:TBD:FullMoon:conftest-results:1.0">
72   attribute and navigable association-end does have a "sequenceNumber" tagged value.</cr:passed>
73 </cr:result>
74 </cr:result>
75 <cr:result xmlns:cr="urn:tdb:xmlns:TBD:FullMoon:conftest-results:1.0">
76   <cr:test number="12"/>
77   Each "sequenceNumber" tagged value is unique in the scope of the class owning the property.</cr:passed>
78 </cr:result>

```

All tests should pass!



Step 4: Schema Generation (finally!)

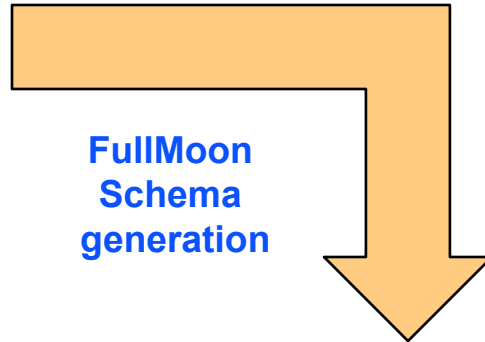


XMI

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<UML:ModelElement.taggedValue>
<UML:TaggedValue tag="isSpecification" value="false"/>
<UML:TaggedValue tag="ea_stype" value="Package"/>
<UML:TaggedValue tag="ea_n_type" value="0"/>
<UML:TaggedValue tag="version" value="1.0"/>
<UML:TaggedValue tag="package" value="EAPK_6DD91FC7_3447_4961_8499_A7CA01"/>
<UML:TaggedValue tag="date_created" value="2009-03-17 16:09:20"/>
<UML:TaggedValue tag="date_modified" value="2010-03-18 20:53:54"/>
<UML:TaggedValue tag="genType" value="Java"/>
<UML:TaggedValue tag="tagged" value="0"/>
<UML:TaggedValue tag="package2" value="EAID_0F4735E2_6A61_4cf6_909A_E941"/>
<UML:TaggedValue tag="package_name" value="AVWX"/>
<UML:TaggedValue tag="phase" value="1.0"/>
<UML:TaggedValue tag="author" value="claypool"/>
<UML:TaggedValue tag="complexity" value="1"/>
<UML:TaggedValue tag="status" value="Proposed"/>
<UML:TaggedValue tag="stereotype" value="Leaf"/>
<UML:TaggedValue tag="tpos" value="0"/>
<UML:TaggedValue tag="ea_localid" value="-285660146"/>
<UML:TaggedValue tag="ea_eleType" value="package"/>
<UML:TaggedValue tag="style" value="BackColor=-1;BorderColor=-1;BorderWidth=-1;BorderStyle=-1;CalloutColor=-1;CalloutType=-1;DiagramColor=-1;DiagramStyle=-1;FillColor=-1;FillStyle=-1;FontColor=-1;FontStyle=-1;IconColor=-1;IconStyle=-1;ImageColor=-1;ImageStyle=-1;LineColor=-1;LineStyle=-1;ProcessColor=-1;ProcessStyle=-1;TextColor=-1;TextStyle=-1;ZoomFactor=-1;ZoomOrigin=-1;ZoomPosition=-1;ZoomSize=-1;ZoomType=-1"/>
<UML:TaggedValue tag="$ea_xref_property" value="$XREFPROP=$XID={6AECAB49
...
</UML:ModelElement.taggedValue>
</UML:ClassifierRole>
<UML:ClassifierRole name="AVWX_Measures" xmi.id="EAID_3C60
...

```



```

<complexType name="AerialReportType">
  <complexContent>
    <extension base="avwx:AbstractReportType">
      <sequence>
        <element maxOccurs="1" minOccurs="0" name="airspaceWxObservation">
          <complexType>
            <sequence>
              <element ref="om:Observation"/>
            </sequence>
          </complexType>
        </element>
        <element maxOccurs="1" minOccurs="0" name="aircraftId" type="gml:CodeWithAuthorityType"/>
        <element maxOccurs="1" minOccurs="0" name="airframeId" type="gml:CodeWithAuthorityType"/>
        <element maxOccurs="1" minOccurs="0" name="flightId" type="gml:CodeWithAuthorityType"/>
      </sequence>
    </extension>
  </complexContent>
</complexType>
<complexType name="AerialReportPropertyType">
  <sequence minOccurs="0">
    <element ref="avwx:AerialReport"/>
  </sequence>
  <attributeGroup ref="gml:AssociationAttributeGroup"/>
  <attributeGroup ref="gml:OwnershipAttributeGroup"/>
</complexType>

```



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FullMoon Issues



- **Rule-sets are incomplete**
 - **UML Profile validation**
- **Encoding rules**
 - **Not all tagged values are supported**
 - **Some rules are encoded for one stereotype but not all**
 - **Some rule sets are not implemented**
 - **Unions were not referenced properly**
- **Class Maps (registers) are not complete**



NNEW Enhancements



- **NNEW Enhancements:**
 - **Added additional support for some of the tag values**
InlineOrByReference now works for attributes and associations
 - **Provide more uniform encoding of rules across stereotypes**
Enumeration and CodeLists work similarly for FeatureTypes and Types
Added Union handling for feature types and types
 - **Added new rules**
Deal with simple types and simple types with complex content
 - **Enhanced schematron rules for handling “restrictions”**



Summary



- **FullMoon feels a niche in Model Driven Design development**
 - Growth fueled by community needs
 - Not mature as yet
- **NNEW Enhancements**
 - Several enhancements fueled by the needs of our project
 - Reviewing changes and will feed them back to FullMoon



Lessons Learned



- **Be patient!**
 - It takes many iterations specially when you are new to it!
 - FullMoon is a great start and would benefit from community support!
- **Sequence numbers are important**
 - They affect the order of the XML elements
- **Attributes are implemented as property types**
 - For simple types, an association produces the desired result
- **Package diagrams are important**
 - Only way FullMoon knows what to import and include
- **Have a decent amount of memory**
 - XMI's are pretty large!
- **Buy your office-mates headphones 😊**



Acknowledgements



CSIRO Exploration and Mining
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 Dr Simon Cox
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MITRE



Aaron Braeckel
 Kelly Moran
 Oliver Newell

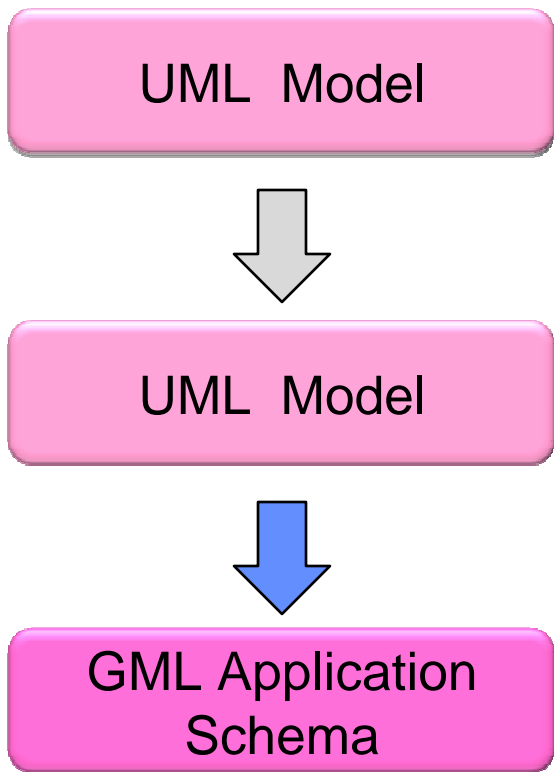
 **Questions??**

My ever patient officemates:
 William Pughe
 Ai-Hoa Sanh





ISO/ TC 211 Process



- Also called *Information Model*
- Must be developed in UML
- Must conform to a strict UML profile
 - Patterns, stereotypes, tagged values
- Must be dependent on ISO packages for common elements
 - Geometry, time, spatial functions

UML Profile

UML Stereotype	Scope	Use
<<Application Schema>>	Package	Complete Application Schema
<<Feature Type>>	Class	Feature Type
<<Type>>	Class	Objects (other than features) that can be referenced
<<Data Type>>	Class	Structured Data Types
<<Union>>	Class	Arbitrary set of alternative classes
<<CodeList>>	Class	Extensible enumeration
<<Enumeration>>	Class	Fixed Enumeration