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OGC Web Services (OWS) 3 UGAS Tool

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iii. Revision history

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2005-10-24	0.0.2	CP		Final Draft
2006-04-25	0.0.3	C. Reed	Various	Copyright, general edits.

iv. Changes to the OpenGIS[®] Abstract Specification

The OpenGIS[®] Abstract Specification **does not require** changes to accommodate the technical contents of this document.

Foreword

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Introduction

This document contains a description of the UGAS (UML Application Schema to GML ApplicationSchema conversion) tool development in the decision support services thread (GeoDSS) during the OWS-3 initiative.

Geo Decision Support Services (GeoDSS) — UGAS Tool

1 Scope

This OpenGIS® document describes the UGAS (UML Application Schema to GML ApplicationSchema conversion) Tool used in the GeoDSS thread of the OWS-3 initiative to derive GML Application Schemas from ISO 19109 Application Schemas in UML.

The tool used in the process is the ShapeChange tool and this document specifies the tool as used in the initiative.

2 Conformance

Not required for an IP IPR, DIPR, or Discussion Paper.

3 Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this **document**. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this **document** are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

OWS-3 Schema Maintenance and Tailoring IPR

4 Terms and definitions

Not applicable

5 Conventions

5.1 Symbols (and abbreviated terms)

ISO International Organization for Standardization

OGC Open Geospatial Consortium

GML	Geography Markup Language
UML	Unified Modeling Language
XML	eXtended Markup Language
NGA	National Geospatial Intelligence Agency

6 The ShapeChange tool

The ShapeChange tool is described by two documents (attached to this document):

- ShapeChange.pdf: ShapeChange installation, architecture and user guide
- UGAS-Guidelines-and-Encoding-Rules.pdf: Rules for the use of UML and a description of the XML Schema encoding rules

7 Changes to support the OWS-3 requirements

The changes to address OWS-3 requirements include:

- Support for schema metadata encoding
- Rewrite of the web interface including a WRS client
- Support for new NGA schema requirements (including DFDD)
- Bugfixes

At the same time, a number of additional, non OWS-3 related enhancements are part of the change from version 0.2 to 0.3 including experimental support for the UML tool Enterprise Architect.



Mapping UML to GML Application Schemas ShapeChange - Architecture and Description

Version: 0.3

Date: 24.10.2005

Status: Draft

Filename: ShapeChange.doc

Path: <http://www.interactive-instruments.de/ugas/ShapeChange.pdf>

Author: C. Portele

interactive instruments GmbH

Version	Date	Changes	Editor
0.1-a	11.01.2003	First Draft	C. Portele
0.1-b	08.05.2003	Document updated	C. Portele
0.1.1	04.07.2003	Configuration of servlet changed	C. Portele
0.1.2	04.10.2003	Bug fixes	C. Portele
0.2	28.10.2004	Document updated for new version	C. Portele
0.3	24.10.2005	Draft update, includes CS-W client	C. Portele R. Renkert

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The source code of ShapeChange is available under the GNU Public License (GPL).

interactive instruments also provides commercial licenses for users who want to use ShapeChange in commercial products. For more information send email to ShapeChange@interactive-instruments.de.

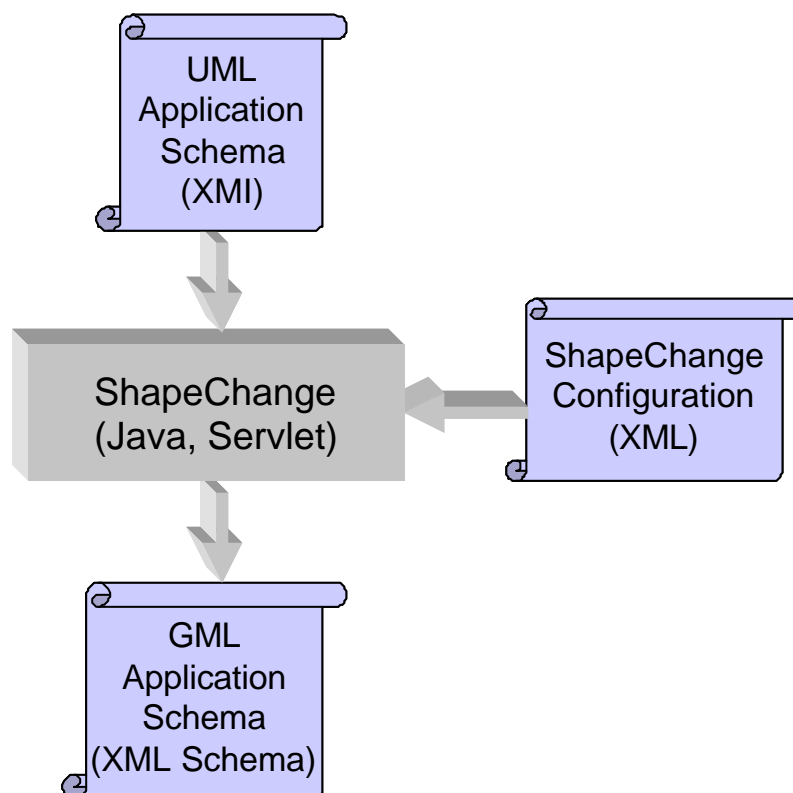


1 Basic Information about ShapeChange

1.1 Scope

The following technical requirements are supported by ShapeChange, an UML to GML Application Schema tool (UGAS):

- ShapeChange is a software capability that can generate a valid GML Application Schema when provided an UML model that follows a well-defined set of guidelines. These guidelines are described in a separate document, "Guidelines and Encoding Rules".
- ShapeChange accepts UML models as input in XMI 1.0 format. Details are given in the document "Guidelines and Encoding Rules", too.
- ShapeChange recognizes and generates diagnostic error messages for incorrectly constructed UML models and XMI files. See chapter 4.
- ShapeChange generates valid GML 2.1.2, 3.0.1 or GML 3.1.1 application schemas, given correctly constructed input. Again, details of the mapping are part of the document "Guidelines and Encoding Rules".
- ShapeChange can be run from the command line or via a web interface.
- ShapeChange can query Web Registry Services for existing XMI documents provided that the schema metadata conforms to the ShapeChange requirements.
- ShapeChange is a partial encoding service in the sense of ISO 19118:2005 chapter 9 and implements the "generateXMLSchema" operation.





1.2 Status

The current version of the tool is 0.3.

It is based on the following documents of ISO/TC 211 (<http://www.isotc211.org/>) and the Open Geospatial Consortium Inc (<http://www.opengeospatial.org/>):

- GML 3.0, GML 3.1 (ISO/CD 19136), GML 3.2 (ISO/DIS 19136)
- ISO 19118:2005
- ISO/TS 19103:2005
- ISO 19109:2005.

Knowledge of these documents is required to understand this document.



2 Installation and Configuration

2.1 Contents of the ShapeChange distribution

The tool is distributed in a ZIP archive (filename "ShapeChange-v0.3.zip") and contains the following files:

ShapeChangeConfiguration.xml	Configuration file for the maps of pre-defined types, see section 2.2
ShapeChangeConfiguration.xsd	Schema description of the configuration file
ShapeChangeSystemConfiguration.xml	Configuration file for the repositories and registry services, see section 2.4
ShapeChangeResult.xsd	Schema description of the log file created during the execution of
index.html	Web page redirecting to the web interface
run.bat	Example batch file for a command line execution of ShapeChange
documentation	Directory for documentation related to ShapeChange
----- UGAS-Guidelines-and-Encoding-Rules.pdf	White paper on the guidelines and encoding rules supported by ShapeChange
----- ShapeChange.pdf	This document
Images	Directory for images used by ShapeChange web pages
----- (gifs)	
HTML	Directory for help web pages
----- (htmls)	
Out	Directory used by the web interface to store the XSDs and logfiles; for every execution a new directory is created
----- index.html	Auxiliary web page redirecting to the main page
WEB-INF	Directory containing the files required to run the servlet
----- web.xml	Description of the servlet (web application)
----- classes	
----- ShapeChange.jar	JAR file of the ShapeChange classes
----- make.bat	Batch file that can be used to compile the



	source code and update the JAR file
----- de	
----- interactive_instruments	
----- ShapeChange	
----- (class files)	
----- Converter.java	Core module of ShapeChange
----- ConverterServlet.java	Servlet / web interface
----- COPYING.txt	Text of the GNU Public License
----- Main.java	Command line interface
----- MainClass.txt	
Xmi	Directory that can be used for XMI input files
----- UML13.dtd	DTD all XMI files (UML models) must validate against
----- UML13X.dtd	Alternative DTD used by some UML tools
XSLT	Directory for XSL templates for XML-to-HTML translation in ShapeChange
----- (xsl stylesheets)	

2.2 Configuration file

2.2.1 Overview

The configuration file contains the following information:

- Aliases for well-known stereotypes
- Namespaces
- Map entries for well-known classes to XML Schema elements and types

2.2.2 Stereotype aliases

A **StereotypeAlias** element specifies a stereotype that is an alias (XML attribute "alias") to a well-known stereotype (XML attribute "wellknown").

Example:

```
<StereotypeAlias wellknown="FeatureType" alias="Feature"/>
```

The well-known stereotypes are:

- (no stereotype)
- Abstract
- DataType
- FeatureType
- Enumeration
- CodeList
- Union



- BasicType
- Interface
- Type
- Union
- Application Schema
- Leaf
- import
- disjoint

2.2.3 Namespace identifiers

A **Namespace** element specifies namespaces (XML Attribute "ns"), their abbreviations (XML Attribute "nsabr") , the corresponding GML version (XML Attribute "gmlVersion"), and the location of the corresponding XML Schema document (XML Attribute "location").

Examples:

```
<Namespace nsabr="xlink" ns="http://www.w3.org/1999/xlink" gmlVersion="3.1"
location="http://schemas.opengis.net/gml/3.1.1/xlink/xlinks.xsd"/>
```

```
<Namespace nsabr="gml" ns="http://www.opengis.net/gml" gmlVersion="3.1"
location="http://schemas.opengis.net/gml/3.1.1/base/gml.xsd"/>
```

2.2.4 Map entries

The configuration file contains map entries for three maps:

- The **type map** maps types of UML attributes and UML association roles to types of the corresponding GML property elements. For simple types this is the (pre-defined) type itself, for complex types this is in general a property type following the association pattern as described in the GML model and syntax (GML 3.00, section 7.2). The <TypeMapEntry> element has the following attributes:
 - "type" specifies the UML class name of the type.
 - "gmlVersion" restricts the entry to a specific version of GML. "*" is a wildcard for all versions, otherwise "2.1.2", "3.0" or "3.1" can be used.
 - "rule" can be either "direct" (in this case the type specified in "mapTo" is used directly) or "propertyType" (in which case an anonymous property type encapsulating or referencing the type specified in "mapTo" is used).
 - "mapTo" specifies the type name of the XML Schema simple or complex type to be used in the property element.
 - "ns" has to be set, if the type in "mapTo" is not in the XML Schema namespace. Use "gml" for GML types and "smXML"/"scXML" for ISO 19139 types.
- The **element map** maps UML types to global XML elements (usually GML objects). The <ElementMapEntry> element has the following attributes:
 - "type" specifies the UML class name of the type.
 - "gmlVersion" restricts the entry to a specific version of GML. "*" is a wildcard for all versions, otherwise "2.1.2", "3.0" or "3.1" can be used.
 - "rule" must be "direct".
 - "mapTo" specifies the element name of object.
 - "ns" has to be set, if the element in "mapTo" is not in the XML Schema namespace. Use "gml" for GML elements and "smXML"/"scXML" for ISO 19139 elements.



- The **base map** maps UML types to named XML complex types, this is used to map inheritance relationships from the UML to the GML application schema. The <BaseMapEntry> element has the following attributes:
 - "type" specifies the UML class name of the type.
 - "gmlVersion" restricts the entry to a specific version of GML. "*" is a wildcard for all versions, otherwise "2.1.2", "3.0" or "3.1" can be used.
 - "rule" must be "direct".
 - "mapTo" specifies the type name of complex type.
 - "ns" has to be set, if the type in "mapTo" is not in the XML Schema namespace. Use "gml" for GML types and "smXML"/"scXML" for ISO 19139 types.

The current configuration file is listed below¹. This file can be customized to support additional pre-defined conceptual UML classes, existing XML grammars and UML stereotypes.

```
<?xml version="1.0" encoding="UTF-8"?>
<ShapeChangeConfiguration xmlns:sc="http://www.interactive-instruments.de/ShapeChange"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.interactive-
instruments.de/ShapeChange ShapeChangeConfiguration.xsd" >
  <stereotypeAliases >
    <StereotypeAlias wellknown="DataType" alias="Request"/>
    <StereotypeAlias wellknown="DataType" alias="Response"/>
    <StereotypeAlias wellknown="FeatureType" alias="Feature"/>
  </stereotypeAliases >
  <namespaces >
    <Namespace nsabr="sc" ns="http://www.interactive-instruments.de/ShapeChange" gmlVersion="*"
location="http://www.interactive-instruments.de/ShapeChange/ShapeChangeAppinfo.xsd"/>
    <Namespace nsabr="xlink" ns="http://www.w3.org/1999/xlink" gmlVersion="2.1"
location="http://schemas.opengis.net/gml/2.1.2/xlinks.xsd"/>
    <Namespace nsabr="gml" ns="http://www.opengis.net/gml" gmlVersion="2.1"
location="http://schemas.opengis.net/gml/2.1.2/feature.xsd"/>
    <Namespace nsabr="xlink" ns="http://www.w3.org/1999/xlink" gmlVersion="3.0"
location="http://schemas.opengis.net/gml/3.0.1/xlink/xlinks.xsd"/>
    <Namespace nsabr="gml" ns="http://www.opengis.net/gml" gmlVersion="3.0"
location="http://schemas.opengis.net/gml/3.0.1/base/gml.xsd"/>
    <Namespace nsabr="xlink" ns="http://www.w3.org/1999/xlink" gmlVersion="3.1"
location="http://schemas.opengis.net/gml/3.1.1/xlink/xlinks.xsd"/>
    <Namespace nsabr="gml" ns="http://www.opengis.net/gml" gmlVersion="3.1"
location="http://schemas.opengis.net/gml/3.1.1/base/gml.xsd"/>
    <Namespace nsabr="scXML" ns="http://www.isotc211.org/scXML" gmlVersion="3.1"
location="http://www.isotc211.org/scXML/scXMLbase.xsd"/>
    <Namespace nsabr="smXML" ns="http://www.isotc211.org/smXML" gmlVersion="3.1"
location="http://www.isotc211.org/smXML/metadataEntity.xsd"/>
  </namespaces >
  <mapEntries >
    <!-- ISO/TS 19103 -->
    <BaseMapEntry type="Record" gmlVersion="*" rule="direct" mapTo="Record_Type" nsabr="scXML"/>
    <BaseMapEntry type="RecordType" gmlVersion="*" rule="direct" mapTo="RecordType_Type"
nsabr="scXML"/>
    <ElementMapEntry type="Record" gmlVersion="*" rule="direct" mapTo="Record" nsabr="scXML"/>
    <ElementMapEntry type="RecordType" gmlVersion="*" rule="direct" mapTo="RecordType"
nsabr="scXML"/>
    <TypeMapEntry type="Angle" gmlVersion="3.0" rule="direct" mapTo="AngleType" nsabr="gml"/>
    <TypeMapEntry type="Angle" gmlVersion="3.1" rule="direct" mapTo="AngleType" nsabr="gml"/>
    <TypeMapEntry type="Area" gmlVersion="3.0" rule="direct" mapTo="AreaType" nsabr="gml"/>
    <TypeMapEntry type="Area" gmlVersion="3.1" rule="direct" mapTo="AreaType" nsabr="gml"/>
    <TypeMapEntry type="Boolean" gmlVersion="*" rule="direct" mapTo="boolean"/>
  </mapEntries >
</ShapeChangeConfiguration >
```

¹ GML 3.2.0 = ISO/DIS 19136 and ISO/DTS 19139 will be supported as soon as the documents have been submitted to ISO Central Secretariat.



```
<TypeMapEntry type="CharacterString" gmlVersion="*" rule="direct" mapTo="string"/>
<TypeMapEntry type="Date" gmlVersion="*" rule="direct" mapTo="date"/>
<TypeMapEntry type="DateTime" gmlVersion="*" rule="direct" mapTo="dateTime"/>
<TypeMapEntry type="Decimal" gmlVersion="*" rule="direct" mapTo="double"/>
<TypeMapEntry type="Distance" gmlVersion="3.0" rule="direct" mapTo="LengthType" nsabr="gml"/>
<TypeMapEntry type="Distance" gmlVersion="3.1" rule="direct" mapTo="LengthType" nsabr="gml"/>
<TypeMapEntry type="GenericName" gmlVersion="2.1.2" rule="direct" mapTo="string"/>
<TypeMapEntry type="GenericName" gmlVersion="3.0" rule="direct" mapTo="CodeType" nsabr="gml"/>
<TypeMapEntry type="GenericName" gmlVersion="3.1" rule="direct" mapTo="CodeType" nsabr="gml"/>
<TypeMapEntry type="Integer" gmlVersion="*" rule="direct" mapTo="integer"/>
<TypeMapEntry type="Length" gmlVersion="3.0" rule="direct" mapTo="LengthType" nsabr="gml"/>
<TypeMapEntry type="Length" gmlVersion="3.1" rule="direct" mapTo="LengthType" nsabr="gml"/>
<TypeMapEntry type="LocalName" gmlVersion="2.1.2" rule="direct" mapTo="string"/>
<TypeMapEntry type="LocalName" gmlVersion="3.0" rule="direct" mapTo="CodeType" nsabr="gml"/>
<TypeMapEntry type="LocalName" gmlVersion="3.1" rule="direct" mapTo="CodeType" nsabr="gml"/>
<TypeMapEntry type="Measure" gmlVersion="3.0" rule="direct" mapTo="MeasureType" nsabr="gml"/>
<TypeMapEntry type="Measure" gmlVersion="3.1" rule="direct" mapTo="MeasureType" nsabr="gml"/>
<TypeMapEntry type="Number" gmlVersion="*" rule="direct" mapTo="double"/>
<TypeMapEntry type="Real" gmlVersion="*" rule="direct" mapTo="double"/>
<TypeMapEntry type="Record" gmlVersion="*" rule="propertyType" mapTo="Record" nsabr="scXML"/>
<TypeMapEntry type="RecordType" gmlVersion="*" rule="propertyType" mapTo="RecordType"
nsabr="scXML"/>
<TypeMapEntry type="Scale" gmlVersion="3.0" rule="direct" mapTo="ScaleType" nsabr="gml"/>
<TypeMapEntry type="Scale" gmlVersion="3.1" rule="direct" mapTo="ScaleType" nsabr="gml"/>
<TypeMapEntry type="ScopedName" gmlVersion="3.0" rule="direct" mapTo="CodeType" nsabr="gml"/>
<TypeMapEntry type="ScopedName" gmlVersion="3.1" rule="direct" mapTo="CodeType" nsabr="gml"/>
<TypeMapEntry type="Time" gmlVersion="*" rule="direct" mapTo="time"/>
<TypeMapEntry type="UnitOfMeasure" gmlVersion="3.0" rule="direct" mapTo="UnitOfMeasureType"
nsabr="gml"/>
<TypeMapEntry type="UnitOfMeasure" gmlVersion="3.1" rule="direct" mapTo="UnitOfMeasureType"
nsabr="gml"/>
<TypeMapEntry type="Vector" gmlVersion="2.1.2" rule="direct" mapTo="CoordinatesType" nsabr="gml"/>
<TypeMapEntry type="Vector" gmlVersion="3.0" rule="direct" mapTo="VectorType" nsabr="gml"/>
<TypeMapEntry type="Vector" gmlVersion="3.1" rule="direct" mapTo="VectorType" nsabr="gml"/>
<TypeMapEntry type="Velocity" gmlVersion="3.0" rule="direct" mapTo="VelocityType" nsabr="gml"/>
<TypeMapEntry type="Velocity" gmlVersion="3.1" rule="direct" mapTo="SpeedType" nsabr="gml"/>
<TypeMapEntry type="Volume" gmlVersion="3.0" rule="direct" mapTo="VolumeType" nsabr="gml"/>
<TypeMapEntry type="Volume" gmlVersion="3.1" rule="direct" mapTo="VolumeType" nsabr="gml"/>
<TypeMapEntry type="Year" gmlVersion="*" rule="direct" mapTo="gYear"/>
<!-- ISO 19107 Geometry -->
<BaseMapEntry type="GM_Aggregate" gmlVersion="2.1.2" rule="direct" mapTo="MultiGeometryType"
nsabr="gml"/>
<BaseMapEntry type="GM_Aggregate" gmlVersion="3.0" rule="direct" mapTo="MultiGeometryType"
nsabr="gml"/>
<BaseMapEntry type="GM_Aggregate" gmlVersion="3.1" rule="direct" mapTo="MultiGeometryType"
nsabr="gml"/>
<BaseMapEntry type="GM_Complex" gmlVersion="3.0" rule="direct" mapTo="GeometricComplexType"
nsabr="gml"/>
<BaseMapEntry type="GM_Complex" gmlVersion="3.1" rule="direct" mapTo="GeometricComplexType"
nsabr="gml"/>
<BaseMapEntry type="GM_CompositeCurve" gmlVersion="3.0" rule="direct" mapTo="CompositeCurve"
nsabr="gml"/>
<BaseMapEntry type="GM_CompositeCurve" gmlVersion="3.1" rule="direct" mapTo="CompositeCurve"
nsabr="gml"/>
<BaseMapEntry type="GM_CompositePoint" gmlVersion="3.0" rule="direct" mapTo="PointType"
nsabr="gml"/>
<BaseMapEntry type="GM_CompositePoint" gmlVersion="3.1" rule="direct" mapTo="PointType"
nsabr="gml"/>
<BaseMapEntry type="GM_CompositeSolid" gmlVersion="3.0" rule="direct" mapTo="CompositeSolid"
nsabr="gml"/>
<BaseMapEntry type="GM_CompositeSolid" gmlVersion="3.1" rule="direct" mapTo="CompositeSolid"
nsabr="gml"/>
<BaseMapEntry type="GM_CompositeSurface" gmlVersion="3.0" rule="direct" mapTo="CompositeSurface"
nsabr="gml"/>
<BaseMapEntry type="GM_CompositeSurface" gmlVersion="3.1" rule="direct" mapTo="CompositeSurface"
nsabr="gml"/>
<BaseMapEntry type="GM_Curve" gmlVersion="2.1.2" rule="direct" mapTo="LineStringType" nsabr="gml"/>
```



```
<BaseMapEntry type="GM_Curve" gmlVersion="3.0" rule="direct" mapTo="AbstractCurveType"
nsabr="gml"/>
<BaseMapEntry type="GM_Curve" gmlVersion="3.1" rule="direct" mapTo="AbstractCurveType"
nsabr="gml"/>
<BaseMapEntry type="GM_Envelope" gmlVersion="3.0" rule="direct" mapTo="Envelope" nsabr="gml"/>
<BaseMapEntry type="GM_Envelope" gmlVersion="3.1" rule="direct" mapTo="Envelope" nsabr="gml"/>
<BaseMapEntry type="GM_MultiCurve" gmlVersion="2.1.2" rule="direct" mapTo="MultiLineStringType"
nsabr="gml"/>
<BaseMapEntry type="GM_MultiCurve" gmlVersion="3.0" rule="direct" mapTo="MultiCurveType"
nsabr="gml"/>
<BaseMapEntry type="GM_MultiCurve" gmlVersion="3.1" rule="direct" mapTo="MultiCurveType"
nsabr="gml"/>
<BaseMapEntry type="GM_MultiPoint" gmlVersion="2.1.2" rule="direct" mapTo="MultiPointType"
nsabr="gml"/>
<BaseMapEntry type="GM_MultiPoint" gmlVersion="3.0" rule="direct" mapTo="MultiPointType"
nsabr="gml"/>
<BaseMapEntry type="GM_MultiPoint" gmlVersion="3.1" rule="direct" mapTo="MultiPointType"
nsabr="gml"/>
<BaseMapEntry type="GM_MultiPrimitive" gmlVersion="2.1.2" rule="direct" mapTo="MultiGeometryType"
nsabr="gml"/>
<BaseMapEntry type="GM_MultiPrimitive" gmlVersion="3.0" rule="direct" mapTo="MultiGeometryType"
nsabr="gml"/>
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nsabr="gml"/>
<BaseMapEntry type="GM_MultiSolid" gmlVersion="3.0" rule="direct" mapTo="MultiSolidType"
nsabr="gml"/>
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nsabr="gml"/>
<BaseMapEntry type="GM_MultiSurface" gmlVersion="2.1.2" rule="direct" mapTo="MultiPolygonType"
nsabr="gml"/>
<BaseMapEntry type="GM_MultiSurface" gmlVersion="3.0" rule="direct" mapTo="MultiSurfaceType"
nsabr="gml"/>
<BaseMapEntry type="GM_MultiSurface" gmlVersion="3.1" rule="direct" mapTo="MultiSurfaceType"
nsabr="gml"/>
<BaseMapEntry type="GM_Object" gmlVersion="2.1.2" rule="direct" mapTo="AbstractGeometryType"
nsabr="gml"/>
<BaseMapEntry type="GM_Object" gmlVersion="3.0" rule="direct" mapTo="AbstractGeometryType"
nsabr="gml"/>
<BaseMapEntry type="GM_Object" gmlVersion="3.1" rule="direct" mapTo="AbstractGeometryType"
nsabr="gml"/>
<BaseMapEntry type="GM_OrientableCurve" gmlVersion="3.0" rule="direct" mapTo="AbstractCurveType"
nsabr="gml"/>
<BaseMapEntry type="GM_OrientableCurve" gmlVersion="3.1" rule="direct" mapTo="AbstractCurveType"
nsabr="gml"/>
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mapTo="AbstractSurfaceType" nsabr="gml"/>
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mapTo="AbstractSurfaceType" nsabr="gml"/>
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<BaseMapEntry type="GM_Point" gmlVersion="3.0" rule="direct" mapTo="PointType" nsabr="gml"/>
<BaseMapEntry type="GM_Point" gmlVersion="3.1" rule="direct" mapTo="PointType" nsabr="gml"/>
<BaseMapEntry type="GM_Primitive" gmlVersion="2.1.2" rule="direct" mapTo="AbstractGeometryType"
nsabr="gml"/>
<BaseMapEntry type="GM_Primitive" gmlVersion="3.0" rule="direct"
mapTo="AbstractGeometricPrimitiveType" nsabr="gml"/>
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<TypeMapEntry type="CV_DiscretePointCoverage" gmlVersion="3.1" rule="propertyType"
mapTo="MultiPointCoverage" nsabr="gml"/>
<TypeMapEntry type="CV_DiscreteSurfaceCoverage" gmlVersion="3.1" rule="propertyType"
mapTo="MultiSurfaceCoverage" nsabr="gml"/>
```




```
<!-- ISO 19115 + ISO/TS 19139 -->
<BaseMapEntry type="CI_Address" gmlVersion="*" rule="direct" mapTo="CI_Address_Type"
nsabr="smXML"/>
<BaseMapEntry type="CI_Citation" gmlVersion="*" rule="direct" mapTo="CI_Citation_Type"
nsabr="smXML"/>
<BaseMapEntry type="CI_Contact" gmlVersion="*" rule="direct" mapTo="CI_Contact_Type"
nsabr="smXML"/>
<BaseMapEntry type="CI_ResponsibleParty" gmlVersion="*" rule="direct"
mapTo="CI_ResponsibleParty_Type" nsabr="smXML"/>
<BaseMapEntry type="CI_Telephone" gmlVersion="*" rule="direct" mapTo="CI_Telephone_Type"
nsabr="smXML"/>
<BaseMapEntry type="EX_Extent" gmlVersion="*" rule="direct" mapTo="EX_Extent_Type"
nsabr="smXML"/>
<BaseMapEntry type="MD_Metadata" gmlVersion="*" rule="direct" mapTo="MD_Metadata_Type"
nsabr="smXML"/>
<BaseMapEntry type="RS_Identifier" gmlVersion="*" rule="direct" mapTo="RS_Identifier_Type"
nsabr="smXML"/>
<ElementMapEntry type="CI_Address" gmlVersion="*" rule="direct" mapTo="CI_Address" nsabr="smXML"/>
<ElementMapEntry type="CI_Citation" gmlVersion="*" rule="direct" mapTo="CI_Citation" nsabr="smXML"/>
<ElementMapEntry type="CI_Contact" gmlVersion="*" rule="direct" mapTo="CI_Contact" nsabr="smXML"/>
<ElementMapEntry type="CI_ResponsibleParty" gmlVersion="*" rule="direct" mapTo="CI_ResponsibleParty"
nsabr="smXML"/>
<ElementMapEntry type="CI_Series" gmlVersion="*" rule="direct" mapTo="CI_Series" nsabr="smXML"/>
<ElementMapEntry type="CI_Telephone" gmlVersion="*" rule="direct" mapTo="CI_Telephone"
nsabr="smXML"/>
<ElementMapEntry type="DQ_DataQuality" gmlVersion="*" rule="direct" mapTo="DQ_DataQuality"
nsabr="smXML"/>
<ElementMapEntry type="DQ_PositionalAccuracy" gmlVersion="*" rule="direct"
mapTo="_DQ_PositionalAccuracy" nsabr="smXML"/>
<ElementMapEntry type="DQ_QuantitativeResult" gmlVersion="*" rule="direct"
mapTo="DQ_QuantitativeResult" nsabr="smXML"/>
<ElementMapEntry type="EX_Extent" gmlVersion="*" rule="direct" mapTo="EX_Extent" nsabr="smXML"/>
<ElementMapEntry type="MD_BrowseGraphic" gmlVersion="*" rule="direct" mapTo="MD_BrowseGraphic"
nsabr="smXML"/>
<ElementMapEntry type="MD_ClassificationCode" gmlVersion="*" rule="direct"
mapTo="MD_ClassificationCode" nsabr="smXML"/>
<ElementMapEntry type="MD_Format" gmlVersion="*" rule="direct" mapTo="MD_Format"
nsabr="smXML"/>
<ElementMapEntry type="MD_Identifier" gmlVersion="*" rule="direct" mapTo="MD_Identifier"
nsabr="smXML"/>
<ElementMapEntry type="MD_ImagingConditionCode" gmlVersion="*" rule="direct"
mapTo="MD_ImagingConditionCode" nsabr="smXML"/>
<ElementMapEntry type="MD_MediumNameCode" gmlVersion="*" rule="direct"
mapTo="MD_MediumNameCode" nsabr="smXML"/>
<ElementMapEntry type="MD_Metadata" gmlVersion="*" rule="direct" mapTo="MD_Metadata"
nsabr="smXML"/>
<ElementMapEntry type="RS_Identifier" gmlVersion="*" rule="direct" mapTo="RS_Identifier"
nsabr="smXML"/>
<TypeMapEntry type="CI_Address" gmlVersion="*" rule="propertyType" mapTo="CI_Address"
nsabr="smXML"/>
<TypeMapEntry type="CI_Citation" gmlVersion="*" rule="propertyType" mapTo="CI_Citation"
nsabr="smXML"/>
<TypeMapEntry type="CI_Contact" gmlVersion="*" rule="propertyType" mapTo="CI_Contact"
nsabr="smXML"/>
<TypeMapEntry type="CI_ResponsibleParty" gmlVersion="*" rule="propertyType"
mapTo="CI_ResponsibleParty" nsabr="smXML"/>
<TypeMapEntry type="CI_Series" gmlVersion="*" rule="propertyType" mapTo="CI_Series"
nsabr="smXML"/>
<TypeMapEntry type="CI_Telephone" gmlVersion="*" rule="propertyType" mapTo="CI_Telephone"
nsabr="smXML"/>
<TypeMapEntry type="DQ_DataQuality" gmlVersion="*" rule="propertyType" mapTo="DQ_DataQuality"
nsabr="smXML"/>
<TypeMapEntry type="DQ_PositionalAccuracy" gmlVersion="*" rule="propertyType"
mapTo="_DQ_PositionalAccuracy" nsabr="smXML"/>
<TypeMapEntry type="DQ_QuantitativeResult" gmlVersion="*" rule="propertyType"
mapTo="DQ_QuantitativeResult" nsabr="smXML"/>
```



```
<TypeMapEntry type="EX_Extent" gmlVersion="*" rule="propertyType" mapTo="EX_Extent"
nsabr="smXML"/>
<TypeMapEntry type="MD_BrowseGraphic" gmlVersion="*" rule="propertyType"
mapTo="MD_BrowseGraphic" nsabr="smXML"/>
<TypeMapEntry type="MD_ClassificationCode" gmlVersion="*" rule="propertyType"
mapTo="MD_ClassificationCode" nsabr="smXML"/>
<TypeMapEntry type="MD_Format" gmlVersion="*" rule="propertyType" mapTo="MD_Format"
nsabr="smXML"/>
<TypeMapEntry type="MD_Identifier" gmlVersion="*" rule="propertyType" mapTo="MD_Identifier"
nsabr="smXML"/>
<TypeMapEntry type="MD_ImagingConditionCode" gmlVersion="*" rule="propertyType"
mapTo="MD_ImagingConditionCode" nsabr="smXML"/>
<TypeMapEntry type="MD_MediumNameCode" gmlVersion="*" rule="propertyType"
mapTo="MD_MediumNameCode" nsabr="smXML"/>
<TypeMapEntry type="MD_Metadata" gmlVersion="*" rule="propertyType" mapTo="MD_Metadata"
nsabr="smXML"/>
<TypeMapEntry type="RS_Identifier" gmlVersion="*" rule="propertyType" mapTo="RS_Identifier"
nsabr="smXML"/>
<!-- Others -->
<ElementMapEntry type="TopoCurve" gmlVersion="3.1" rule="direct" mapTo="TopoCurve" nsabr="gml"/>
<ElementMapEntry type="TopoPoint" gmlVersion="3.1" rule="direct" mapTo="TopoPoint" nsabr="gml"/>
<ElementMapEntry type="TopoSurface" gmlVersion="3.1" rule="direct" mapTo="TopoSurface"
nsabr="gml"/>
<TypeMapEntry type="TopoCurve" gmlVersion="3.1" rule="direct" mapTo="TopoCurvePropertyType"
nsabr="gml"/>
<TypeMapEntry type="TopoPoint" gmlVersion="3.1" rule="direct" mapTo="TopoPointPropertyType"
nsabr="gml"/>
<TypeMapEntry type="TopoSurface" gmlVersion="3.1" rule="direct" mapTo="TopoSurfacePropertyType"
nsabr="gml"/>
<TypeMapEntry type="Set<TP_DirectedEdge>" gmlVersion="3.1" rule="direct"
mapTo="TopoCurvePropertyType" nsabr="gml"/>
<TypeMapEntry type="Set<TP_DirectedNode>" gmlVersion="3.1" rule="direct"
mapTo="TopoPointPropertyType" nsabr="gml"/>
<TypeMapEntry type="Set<TP_DirectedFace>" gmlVersion="3.1" rule="direct"
mapTo="TopoSurfacePropertyType" nsabr="gml"/>
<TypeMapEntry type="Set<GM_Object>" gmlVersion="3.1" rule="direct"
mapTo="GeometryPropertyType" nsabr="gml"/>
<TypeMapEntry type="URI" gmlVersion="*" rule="direct" mapTo="anyURI"/>
<TypeMapEntry type="URL" gmlVersion="*" rule="direct" mapTo="anyURI"/>
</mapEntries >
</ShapeChangeConfiguration >
```

2.3 Configuration of the web interface

The following assumes an existing and running Tomcat installation including the Tomcat Web Application Manager (ShapeChange has been tested with Tomcat version 5.5.9). In case of large XML files, the memory allocations of Tomcat may need to be increased, e.g. by using the 'Java Options' "-Xms128m -Xmx1024m" or by configuring the 'memory pool' in the Tomcat Monitor. Furthermore, Xerces-J must have been installed (the installation of Xerces in a tomcat environment is not covered in this document, this installation is explained in several resources on the web).

- Unpack the ShapeChange zip archive. The root directory of the files in the archive is called ShapeChange with a trailing version number, e.g. "ShapeChange-v0.3". Remove the version number from the name, i.e. rename it to "ShapeChange".
- Move (or copy) this directory directly under the "webapps" directory of Tomcat.
- Update the two init-params in the "web.xml" file.
 - *configFile*: Pointer to the configuration file, e.g.
"http://services.interactive-instruments.de/ShapeChange/ShapeChangeConfiguration.xml"
 - *systemConfigFile*: Pointer to the system configuration file, e.g.
"http://services.interactive-instruments.de/ShapeChange/ShapeChangeSystemConfiguration.xml"



- There are other parameters used in ShapeChange that can be configured in the "web.xml" file.
 - *reportLevel*: The level for the output of diagnostic messages, e.g. "WARNING" further levels are " INFO", "ERROR", "FATAL ERROR" (see also chapter 4)
 - *maxSizeOfRequest*: maximum in bytes for data being processed to deny DoS attack, e.g. "20000"
 - *session-timeout*: time in minutes a session will be valid, e.g. "180"

Then the web.xml file may look like the following:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE web-app PUBLIC "-//Sun Microsystems, Inc.//DTD Web Application 2.3/EN"
"http://java.sun.com/dtd/web-app_2_3.dtd">
<web-app>
  <display-name>ShapeChange</display-name>
  <description>UML Application Schema to GML Application Schema Converter</description>
  <servlet>
    <servlet-name>ConverterServlet</servlet-name>
    <servlet-class>de.interactive_instruments.ShapeChange.ConverterServlet</servlet-class>
    <init-param>
      <param-name>configFile</param-name>
      <param-value>
        http://services.interactive-instruments.de/ShapeChange/ShapeChangeConfiguration.xml
      </param-value>
    </init-param>
    <init-param>
      <param-name>systemConfigFile</param-name>
      <param-value>
        http://services.interactive-instruments.de/ShapeChange/ShapeChangeSystemConfiguration.xml
      </param-value>
    </init-param>
    <init-param>
      <param-name>reportLevel</param-name>
      <param-value>WARNING</param-value>
    </init-param>
    <init-param>
      <param-name>maxSizeOfRequest</param-name>
      <param-value>20000</param-value>
    </init-param>
  </servlet>
  <servlet-mapping>
    <servlet-name>ConverterServlet</servlet-name>
    <url-pattern>/servlet/*</url-pattern>
  </servlet-mapping>
  <session-config>
    <session-timeout>180</session-timeout>
  </session-config>
  <mime-mapping>
    <extension>java</extension>
    <mime-type>text/plain</mime-type>
  </mime-mapping>
  <mime-mapping>
    <extension>class</extension>
    <mime-type>application/java</mime-type>
  </mime-mapping>
</web-app>
```

- Restart Tomcat (you may also use the Tomcat Web Application Manager to control the web application).



2.4 Configuration of the repository and registry for the web interface

In order to use repositories and registries with ShapeChange, these services have to be listed in the system configuration file "ShapeChangeSystemConfiguration.xml" (its path is specified in the "web.xml" file).

- Update the parameters for the repository. A repository must be write-accessible via ftp and read accessible via http.
 - *name*: label that is used in the web interface, e.g.
"interactive instruments"
 - *urlFtp*: access path of the FTP (to store the results in), e.g.
"ftp.interactive-instruments.de"
 - *urlHttp*: URL for the HTTP access of the FTP server, e.g.
"http://www.interactive-instruments.de/ows3/repository/out/"
 - *userName*: name of a user that has write-access to the FTP server
 - *password*: password belonging to *userName* to access the FTP server

Notes: The *userName* and *password* are kept in clear text and are not encrypted in ShapeChange at this time.

- Update the parameters for the registry.
 - *name*: label that is used in the web interface, e.g.
"CubeWerx"
 - *urlPost*: Post URL of the WRS to post the request, e.g.
"http://demo.cubewerx.com/ows3/catalog/cwwrs.cgi"
 - *urlGet*: Get URL of the WRS, e.g.
"http://demo.cubewerx.com/ows3/catalog/cwwrs.cgi?"

After configuration the "ShapeChangeSystemConfiguration.xml" file may look like the following:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<ShapeChangeSystemConfig>
<!-- for further ftp or wrs entries please use/copy the templates -->
<!-- set the correct serial id ... -->
  <ftpConfig>
    <ftp id="ftp1">
      <name>interactive instruments</name>
      <urlFtp>ftp.interactive-instruments.de</urlFtp>
      <urlHttp>http://www.interactive-instruments.de/ows3/repository/out/</urlHttp>
      <userName>theUserName</userName>
      <password>thePassword</password>
    </ftp>
    <ftp id="ftp2">
      <name>secondEntry</name>
      <urlFtp>ftp.secondEntry.com</urlFtp>
      <urlHttp>http://www.secondEntry.com/repository/</urlHttp>
      <userName>myUserName</userName>
      <password>myPassword</password>
    </ftp>
  </ftpConfig>
```



```
<wrsConfig>
  <wrs id="wrs1">
    <name>CubeWerx</name>
    <urlPost>http://demo.cubewerx.com/ows3/catalog/cwwrs.cgi</urlPost>
    <urlGet>http://demo.cubewerx.com/ows3/catalog/cwwrs.cgi?</urlGet>
  </wrs>
  <wrs id="wrs2">
    <name>secondEntry</name>
    <urlPost>http://secondEntry.com/catalog/cwwrs.cgi</urlPost>
    <urlGet>http://secondEntry.com/catalog/cwwrs.cgi?</urlGet>
  </wrs>
</wrsConfig>
</ShapeChangeSystemConfig>
```

For additional repositories or registry services, copy the according element set (`<ftp id="ftp1"> ... </ftp>` or `<wrs id="wrs1"> ... </wrs>`) and add it under the last specified entry in the list. Update the elements ID with the next sequential/serial number and insert the new parameter values.

- Restart Tomcat (you may also use the Tomcat Web Application Manager to control the web application).

2.5 Required software

In order to run ShapeChange from the command line, the following components must be installed

- Java (tested with version 1.5 [<http://java.sun.com/j2se/1.5/index.jsp>])
- Xerces2-J (tested with version 2.6.2 and 2.7.1 [<http://xml.apache.org/xerces2-j/>])
- Xalan-J (tested with version 2.6.0 and 2.7.0 [<http://xml.apache.org/xalan-j/>])

The Web Interface has been tested with Apache Tomcat (version 5.5.9). It also requires the following component:

- Jakarta Commons Net API (tested with version 1.4.0 [http://jakarta.apache.org/site/downloads/downloads_commons-net.cgi], JAR installed in the Java Runtime Environment)

Notes:

- The Xerces and Xalan JAR files **must** be installed in the "endorsed" directory of the Java Runtime Environment (e.g. in `C:\Programs\Java\jdk-1.5.0\lib\endorsed`), otherwise they will not be used by the Java VM even if they are in the Java CLASSPATH.
- If you want to recompile all the java classes you also need the `servlet.jar` archive in your classpath. In this case you also may want to put the directory that contains the `java`, `javac` and `jar` executables in your predefined path where the operating system searches for executables.



3 Running the UGAS Tool

3.1 Command Line Interface

The UGAS Tool is a Java Application. The application accepts a number of parameters that influence the encoding rules from the UML metamodel to the GML Application Schema documents. These parameters are:

-p (default), -P	"-p" is appropriate for application schemas that will be used for data encodings that are shared across application boundaries: i.e., only elements with public visibility will be mapped. Otherwise ("-P") visibility is assumed to be irrelevant for the mapping process and even private elements will be represented in the GML Application Schema.
-m <i>name</i>	Name of the application schema package that shall be converted. If the option is missing, all application schemas in the model will be converted. If no package has a stereotype <<Application Schema>>, ShapeChange will abort.
-u (default), -U	"-u" includes documentation in annotation elements in the XML Schema files, "-U" surpresses this.
-h	Information about these options.
-t, -T (default)	"-t" maps <<Type>> classes to GML objects, "-T" to GML features.
-g (default), -G	-g maps a <<Union>> class to a complexType, -G to a group.
-x (default), -X	-x maps a property to a local elements, -X to a global group (required for restrictions). Using -X is not recommended.
-c (default), -C	-c adds property types for all complexTypes, -C surpresses the property types.
-d (default), -D	-d adds property-by-value types for all complexTypes, -D surpresses them.
-e (default), -E	-e maps an <<Enumeration>> class to a named simpleType, -E to anonymous simpleTypes.
-l (default), -L	-l maps an <<CodeList>> class to an extendable enumeration, -L to a GML Dictionary.
-N	-N disables the use of the abstract GML base types which are used by default. (Experimental)
-R	-R activates support for the restriction (redefinition) of properties. Use with caution. (Experimental)
-V <i>tvalues</i>	Comma seperated list of tagged values to include in the GML Application Schema. The default is "".
-s, -S (default)	-s adds support for parameterized types Set<T> and Sequence<T>. -S disables the support.
-f (default), -F	-f maps only those packages to an XML Schema that carry a tagged value 'xsdDocument'. -F maps all packages to a document.
-M <i>style</i>	Metadata encoding style. Currently one of NONE or OWS3 (Experimental). Default is NONE. OWS3 creates schema metadata following the DDMS



schema as specified during the OWS-3 initiative.

<i>-r level</i>	Verbosity of the log file, one of DEBUG, INFO, WARNING, ERROR. Default is WARNING.
<i>-v version</i>	Determines the target version of GML, i.e. 2.1.2, 3.0 or 3.1. Default is 3.1.
<i>-o outputdir</i>	The local directory where the output files are created (the xsd files and the log file). Default is the working directory.
<i>Xmifile</i>	The URI of the XMI document containing the UML model.

The result of the mapping process is documented in a file ShapeChangeResult.xml in the output directory. This includes a sequence of Messages (fatal errors, errors, warnings, informational messages; see also chapter 4) and a list of XML Schema files that were created by the tool.

Note that all elements must be entered into the UML case tool in a way so that the XMI export function of the tool maps every element to the appropriate construct in terms of the UML 1.3 metamodel (and in turn during the XMI export process to the XMI 1.0 constructs).

In case of large XMI files, the memory allocations may need to be increased, e.g. by using the options "-Xms128m -Xmx1024m".

Example of a ShapeChange invocation:

```
java -Xms128m -Xmx1024m -jar "WEB-INF\classes\ShapeChange.jar" -D -o "out"
"xml\myBigAS.xml"
```

3.2 Web Interface

A web interface to the tool is part of the distribution (a Java Servlet tested under Tomcat), so that it can be accessed over the internet/intranet without installation of the software at the user's side.

JavaScript must be enabled in the web browser. ShapeChange uses pop-up windows, so pop-up blockers must be configured to allow pop-ups for ShapeChange.

Compared with the command line interface (see 3.1), the web interface provides several further features for the user:

- Search Web Registry Services (WRS) for appropriate schemas
- Select a UML model found in the WRS for conversion
- Choose the conversion settings
- Store the conversion result files in a repository
- Download the result files from the repository
- Register the conversion result in one or more WRS for publication



3.2.1 Home page



The upper part of the home page enables the user to select a UML Application Schema (respectively the URL to a Schema) for the conversion process. On the one hand a known URL to a Schema can be provided directly in the 'Enter URL' dialogue, on the other hand it can be searched in a Web Registry Service (WRS), choosing the 'Search in Schema Registry' dialogue.

The web interface provides a selection of the conversion parameters available at the command line. There are components to choose whether only public or all elements to be mapped, to include the UML models documentation in the result schema and to select the target GML version. The parameters are set to reasonable default values. For more information about the conversion parameters see section 3.1.

An additional parameter for the web interface is the 'GML Application Schema Repository'. The selected repository will be the target for the result files generated by the conversion process. Default is a FTP-server at interactive instruments.

Once the source URL is chosen and the parameters are set as required, the conversion process can be started by clicking on 'Convert UML application schema to GML'. This process may last some time, dependent on the servers capacity and the model size. Instead of the home page, a new page will appear to show the result and provide further options. See 3.2.5 [Conversion results](#) for details.

3.2.2 Search Schema Registry

WRS have the ability to publish and search descriptive information (metadata) of data, services and related information objects that can be stored in its catalogue.

In order to find an appropriate schema, a convenient way is to search for one using a catalogue/registry. ShapeChange can connect to an external WRS to search for schemas provided



that the schema metadata follows basic rules described below. ShapeChange can search, show information and directly import the URL of a suitable schemas found.

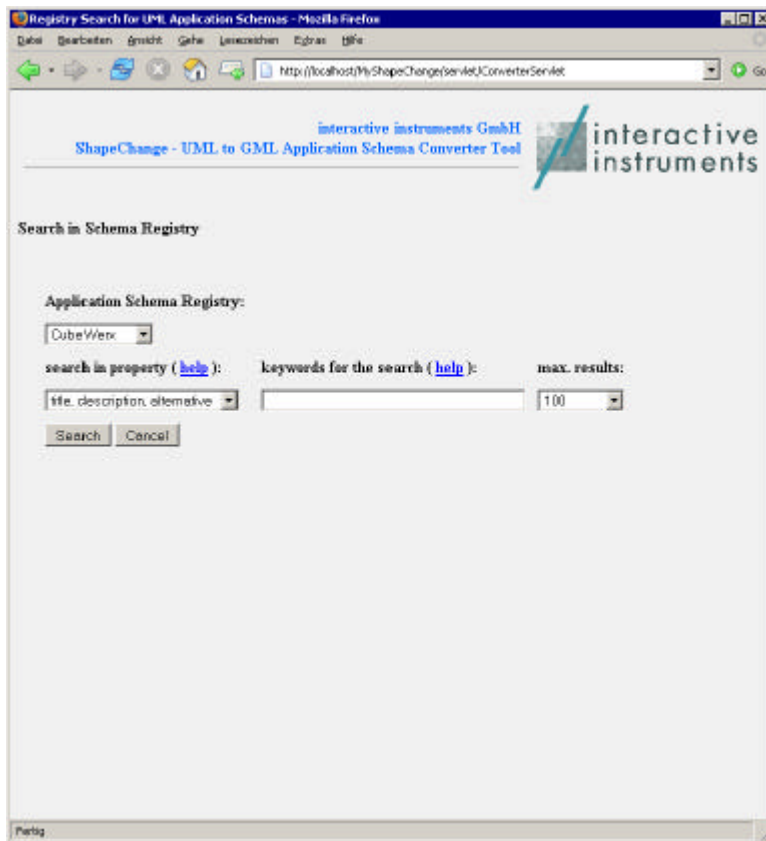
The metadata for application schemas is defined in the paper 'OWS-3 Schema Tailoring and Maintenance' as part of the OGC Web Services Phase 3 initiative. As this paper is currently not publicly available, an example metadata set shall illustrate a brief response of information returned from a WRS.

The WRS will return the metadata encoded as Dublin Core metadata elements, for example:

```
<dc:alternative>Version 0.4_2005-04-01</dc:alternative>
<dc:created>2005-07-27</dc:created>
<dc:creator>interactive instruments GmbH+49-228-91410-70ShapeChange@interactive-
instruments.de</dc:creator>
<dc:description>MSD Level 3 application schema. Automatically created from the NGA Access
Databases (FACC/DFDD, NGA Feature Catalogue and Mission Specific
Data).</dc:description>
<dc:format>digital</dc:format>
<dc:format>text/xml; subtype="xmi/1.0/iso 19109"</dc:format>
<dc:identifier>c03321f1-8129-404f-9d2c-e1ebc2cc34bc</dc:identifier>
<dc:language>en</dc:language>
<dc:publisher>NGA</dc:publisher>
<dc:relation>dependsOn urn:uuid:75cbe865-0453-4989-8aa0-91504fa4116d</dc:relation>
<dc:relation>resource http://interactive-
instruments.de/ows3/repository/xmi/msd3.xml</dc:relation>
<dc:rights>>true</dc:rights>
<dc:title>MSD Level 3</dc:title>
<dc:type>Schema</dc:type>
```

Metadata properties used by ShapeChange:

- *alternative*, *description* and *title* are vital information for the user that are provides e.g. in the 'basic information' and search result table
- *identifier* for registry requests of known record datasets as, e.g., for 'More Information'
- *relation* for information of relationships between the datasets (e.g. 'partOfApplicationSchema' for selection of a FeatureTypes parent schema)
- *relation* with the 'resource' information that provides the URL to the resource
- *type* for identification of the records type



To get best record matches the search can be limited to certain metadata properties that can be selected from a list. The properties are grouped to search more than one property at once. For more information please see the online help on the 'Search Schema Registry' page.



The keywords text field is the central element of the search. It is allowed to use several keywords in one search request. To improve the search request special characters are used as wildcards. For more information and examples on this, please see the online help. To limit the output of search results, the maximum number of records to show can be selected from a list.

The page can be left undone by clicking the 'Cancel' button. It will return to the home page of ShapeChange.



3.2.3 Search results

	no.	title	type	alternative	description	
More Info	1.	PZD019	FeatureType	Version 0.4_2005-04-01	General Miscellaneous Feature: Any feature deemed important for a particular mission or user and which is not covered by any other feature coding in this catalog	Show parent Schema
More Info	2.	PAT045	FeatureType	Version 0.4_2005-04-01	Radar Transmitter: A device for transmitting and receiving radar emissions.	Show parent Schema
More Info	3.	AZD019	FeatureType	Version 0.4_2005-04-01	General Miscellaneous Feature: Any feature deemed important for a particular mission or user and which is not covered by any other feature coding in this catalog.	Show parent Schema
More Info	4.	LED019	FeatureType	Version 0.4_2005-04-01	General Miscellaneous Feature: Any feature deemed important for a particular mission or user and which is not covered by any other feature coding in this catalog.	Show parent Schema
More Info	5.	MSD Level 3	Schema	Version 0.4_2005-04-01	MSD Level 3 application schema. Automatically created from the NGA Access Databases (FAOCYDFDD, NGA Feature Catalogue and Mission Specific Data)	Select
More Info	6.	AEC040	FeatureType	Version 0.4_2005-04-01	US-Cleared Way/Cut Line/Firebreak UK-Cleared Way/Firebreak: A man-made clearing in a cultural area or through a stand of trees, designed to provide access for a road, railroad, pipeline, or power transmission line, or for boundary demarcation, survey line-of-sight, or to impede the progress of forest fires.	Show parent Schema
More Info	7.	LAT030	FeatureType	Version 0.4_2005-04-01	Power Transmission Line: A system of above ground wires including their supports, which transmits electricity over distance. (See also AT005, AT006 and AT060)	Show parent Schema

[New Search](#) [Cancel](#)

For a successful search ShapeChange provides a page with basic information of the metadata record sets in a table. More details can be fetched via the 'More Info' button. The full metadata for the record set will be displayed in a pop-up window.

If one result set seems to be adequate for the actual purpose, the schema can be accepted via 'Select' button. The URL will be posted to the home page, which will show basic information and provide the URL for the conversion.

If the result set is a FeatureType and, therefore, only part of a schema, the button 'Show parent Schema' appears. Execution will show information about the parent schema the FeatureType is part of in a separate page ('Show parent Schema'). From this page the schema can be selected to post it to the home page, where basic information will be shown. The URL will be shown on the home page, too.

In case of no match the 'Search results' page will not display any table. The top of the page will inform about the fact that no match was found; as it will display the number of matches for every successful search. Another inherent part of the pages is the button set 'New Search' and 'Cancel' that will restart the 'Search Schema Registry' page respectively go back to the home page.



More information pop-up window



Show parent Schema



Extract of home page with selected URL and basic information

UML Application Schema:

Source:

Basic info:

title: MSD Level 3

abstract: Version 0.4_2005-04-01

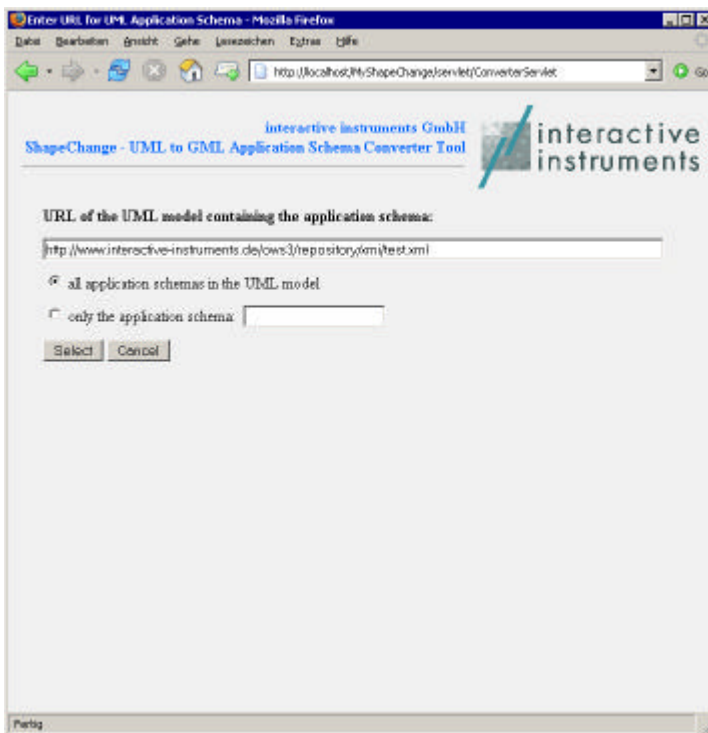
description: MSD Level 3 application schema. Automatically created from the NGA Access Databases (FAO/DFDD, NGA Feature Catalogue and Mission Specific Data).

Name of the Application Schema UML package:

A selected URL is shown at the top of the home page. For schemas that were selected from the search result, basic information about the schema is displayed. By clicking the 'Remove schema' button, the URL and associated information are removed; the home page is in its initial state again.

Note that the referenced resource must be accessible to ShapeChange.

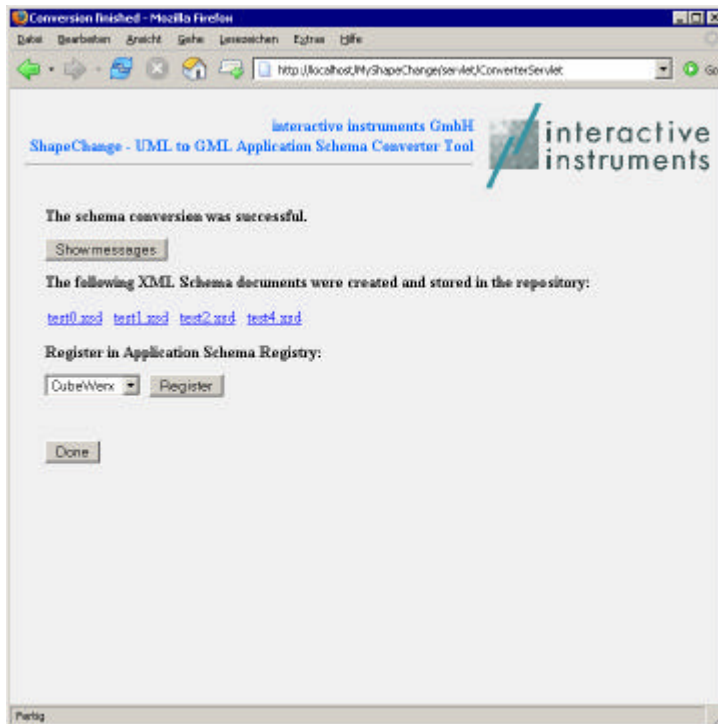
3.2.4 Enter URL



To manually enter a source URL identifying a UML model, this page provides a text field. It is also possible to select just one single application schema out of the model. The default is to select all application schemas in the UML model; otherwise it is necessary to provide the name of the application schema in the second text field. The 'Select' button passes the entered information to the home page, where they are displayed again. 'Cancel' leaves to the home page without selection.



3.2.5 Conversion result



After the conversion, the ShapeChange web interface shows the result. It informs about success or failure of the conversion. In a pop-up window that is loaded automatically, the file 'ShapeChangeResult.xml' displays detailed message information concerning the conversion process. Clicking the button 'Show messages' provides some of these information in a pop-up window in an easier to read text format.

The resulting XML Schema files are automatically stored in the repository selected in the home page. From this repository they are available for download through links in the result page².

Another feature of ShapeChange is the registration of the newly created schemas in a WRS. It is only available for schemas that were converted with the option 'OWS-3 schema metadata (DDMS)'. The result files can be inserted into ('harvested by') a WRS directly from the repository where they were saved in, by using the button 'Register'. Feedback from the selected WRS will be reported in a new pop-up window for information purpose. A successful registration makes the result available to users of the WRS.

This feature requires the WRS to support the Schema Metadata as created by ShapeChange. For more information see the internal OGC document 05-054 (ebRIM-OWS Catalog Profile), created as part of OGC Web Services Initiative, Phase 3.

The result pages button 'Done' will finally call the initial state of the home page.

² Downloading the result file(s) via right mouse click and "Save as..." in Microsoft Internet Explorer may change the file extension. The correct file extension is *.xsd.



Registration result

The screenshot shows a browser window titled "result messages - Mozilla Firefox". The main content area displays the following information:

registration result

ID	object type
um:uid:45645c5-e48b-4d78-b72d-9d870a0d11de	Schema
um:uid:ecbc2c3e-b1c2-4f7b-a1c9-ac66694364a5	Schema
um:uid:ba0b0913-0030-49df-a528-4faae-b3c7f7a	Schema

3 conversion results registered.

At the bottom of the browser window, the text "Partiq" is visible in the status bar.



4 Diagnostic messages

This chapter lists the diagnostic messages produced by the tool. Text in square brackets are placeholders.

4.1 Fatal Errors

- XML parser was unable to be configured for the creation of an XML Schema file.
- XML Parser was unable to be configured.
- Invalid configuration file.
- System error. Stereotype of class [name] is not an allowed value: [stereotype].
- Unable to get a document builder factory.
- XMI version must be 1.0, found: [version].
- Exactly only element <XMI> expected.
- Metamodel must be UML, found: [model].
- The UML version must be 1.3, found: [version].
- Exactly one element <XMI.metamodel> expected.
- No application schema found in the UML model.
- Application schema [appSchemaName] not found in the UML model.
- Unable to get a document builder factory.
- Invalid XMI file.

4.2 Errors

- The package with ID [id] has no name. The ID is used instead.
- The class with ID [id] has no name. The ID is used instead.
- The attribute with ID [id] has no name. The ID is used instead.
- The association with name [name] and ID [id] does not have 2 connections: [n] connections. All Roles will be ignored.
- The type [name] is neither part of the UML application schema nor does a mapping to a predefined type exist.
- The type of a property with the name [name] with ID [id] was not found.
- The type [name] is not a valid base type. Only feature and data types are supported.
- The type [name] is neither part of the UML application schema nor does a mapping to a predefined type exist.
- The type with ID [id] was not found.
- The element [name] is not valid as a head of a substitution group. Only feature and data types are supported.
- The element [name] is not undefined. Only feature and data types are supported.
- The type [name] is neither part of the UML application schema nor does a mapping to a predefined type exist.
- The supertypes of class [name] are of different categories. This is not supported, the class is ignored.
- The restriction of UML attribute [name] in class [name] is not legal. The lower multiplicity limit is smaller than in the supertype [name]. The minOccurs value has been adjusted.



- The restriction of the predefined GML property 'name' in class [name] is not legal. Its type is not a specialization of the type in AbstractFeatureType.
- The restriction of UML attribute [name] in class [name] is not legal. The upper multiplicity limit is higher than in the supertype [name]. The maxOccurs value has been adjusted.
- The restriction of UML attribute [name] in class [name] is not legal. Its type is not a specialization of the type in the supertype [name]. The type has been adjusted.
- The restriction of the predefined GML property [name] in class [name] is not legal. The upper multiplicity limit is higher than in the supertype [name]. The maxOccurs value has been adjusted.
- The restriction of the predefined GML property 'description' in class [name] is not legal. Its type is not a specialization of the type in AbstractFeatureType.
- The class [name] is modeled as an interface, but has supertypes that are instantiable. The supertype relationships are ignored.
- The class [name] is modeled as a feature or data type, but has at least one supertype of a different category. The class is ignored.
- The class [name] is modeled as a feature or data type, but has more than one supertype of the same kind. All but one (arbitrary) supertypes are ignored.
- The class [name] is an enumeration. Generalization relationships are not supported for these classes. All such relationships are ignored.
- The class [name] is a code list. Generalization relationships are not supported for these classes. All such relationships are ignored.

4.3 Warnings

- Stereotype <<[stereotype]>> not supported for UML model elements of type [name]. The [name] will be ignored.
- The discriminator for the UML generalization with ID [id] is not blank. This generalization is ignored.
- The restriction of the predefined GML property [name] in class [name] is currently not supported. The attribute will be defined in the local namespace.

4.4 Informational Messages

- Restriction of property [name] in class [name] from supertype [name].
- Restriction of property [name] in class [name] from gml:AbstractFeatureType.

4.5 Other Messages

In addition, Xerces and Java Runtime error messages may be reported by the tool, for example if the XMI file does not validate against the UML13.dtd.



Mapping UML to GML Application Schemas Guidelines and Encoding Rules

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1 Introduction

This document describes a mapping from an UML Application Schema into a GML Application Schema via an XMI representation of the UML Application Schema. The UML Application Schema must be conformant to ISO 19109:2005 and follow some additional modeling guidelines described in this document.

This document describes work in progress and the rules have been so far tested in several projects. It is based on the definitions of GML 3.1, ISO 19118:2005, ISO/TS 19103, ISO 19109:2005 as well as drafts documents of ISO 19136 and ISO/TS 19139. Knowledge of these documents is required to understand this document.



2 Guidelines for UML Application Schemas

2.1 Guidelines with respect to the use of UML

To be a valid input into the mapping the UML Application Schema should conform to GML 3.1 (ISO/CD 19136) Annex E. In some cases, experimental modelling elements are supported, too, but must be activated using non-standard switches.

NOTE Since GML 3.2 (ISO/DIS 19136) has recently been published for review, support for this version will be added in the near future, too.

2.2 Guidelines with respect to XMI

To be valid input into the mapping process, the XMI representation of the UML Application Schema must conform to the following:

- The UML model containing the application schema and all other required model elements shall be stored in a single XMI document.
- The XMI document shall be well-formed.
- The XMI document shall conform with XMI version 1.0.
- The XMI document shall be valid, i.e. contain a DOCTYPE declaration and the document must validate against this document type definition. This DTD must be the normative DTD that is part of UML 1.3.
- Only the contents of the <XMI.header> and the <XMI.content> elements are be used by the UGAS Tool. All other elements will be ignored.

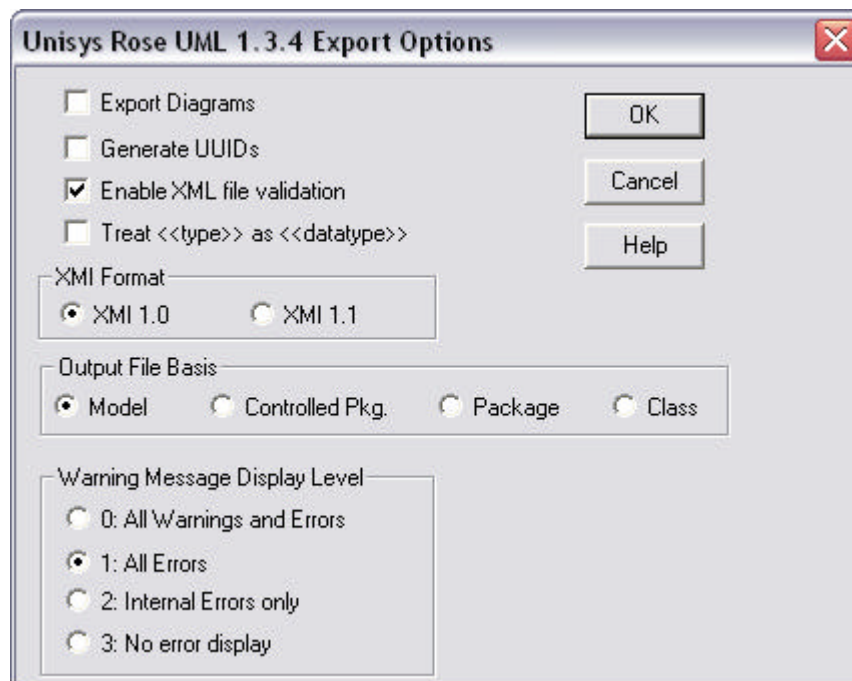


Figure 1 – Export options with the Unisys XMI export tool for Rational Rose



3 Encoding Rules

3.1 General Remarks

The mapping from an ISO 19109 conformant UML Application Schema to the corresponding GML Application Schema is based on a set of encoding rules. These encoding rules are identical with those specified in GML 3.1 (ISO/CD 19136) Annex E plus experimental extensions. Only the deviations from GML 3.1 and experimental extensions are specified in this document.

The schema encoding rules are based on the general idea that the class definitions in the application schema are mapped to type and element declarations in XML Schema, so that the objects in the instance model can be mapped to corresponding element structures in the XML document.

The target version of GML is by default 3.1.1.

3.2 Encoding Rules

3.2.1 General encoding requirements

3.2.1.1 Application schema

The input Application Schema shall be defined in XMI 1.0 (UML 1.3 DTD) according to the guidelines specified in the previous chapter.

3.2.1.2 Character repertoire and languages

"UTF-8" will be used as the character encoding of the XML Schema files (with the associated character repertoire) in accordance with the XML specification.

3.2.1.3 Exchange metadata

n/a

3.2.1.4 Dataset and object identification

n/a

3.2.1.5 Update mechanism

n/a

3.2.2 Input data structure

n/a

3.2.3 Output data structure

n/a

3.2.4 Conversion rules

The schema conversion rules define how to produce XML Schema documents (XSDs) according to an ISO 19109 application schema expressed in UML.

In addition to the rules specified in GML 3.1 (ISO/CD 19136) the following rules exist:

- All tagged values that are implicitly or explicitly associated with ShapeChange are mapped to appinfo elements of the corresponding model element.

Example:

```
<complexType name="PAA010Type">
  <annotation>
    <documentation>Mine: An excavation made in the earth for the purpose
of extracting natural deposits.</documentation>
  <appinfo>
```



```
<sc:taggedValue tag="name">Mine</sc:taggedValue>
<sc:taggedValue tag="code">PAA010</sc:taggedValue>
</appinfo>
</annotation>
...
</complexType>
```

In addition, the following, often experimental, options exist:

- It can be selected whether documentation elements are included in annotation elements in the XML Schema files.
- <<Type>> classes may be mapped to GML objects or features.
- <<Union>> classes may be mapped to a complexType with a choice or to a group containing a choice.
- Properties may be mapped to local elements or global groups (to support restrictions across namespaces - not recommended).
- Property types for all complexTypes may be added or not.
- Property-by-value types for all complexTypes may be added or not.
- <<Enumeration>> classes may be mapped to a named simpleType or to an anonymous simpleType.
- <<CodeList>> classes may be mapped to an extendable enumeration or to a GML Dictionary
- Restrictions redefining properties may be allowed or prohibited (recommended).
- Parameterized types Set<T> and Sequence<T> may be supported.
- Either only packages carrying a tagged value 'xsdDocument' are mapped to an XML Schema document or all packages are mapped to an XML Schema document.
- Schema metadata may be added in an appinfo element of the <xs:schema> element. Currently only the experimental schema metadata of the OWS-3 initiative is supported (using the DDMS schema).