

# AIXM is GML

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AIXM Class | **2007**

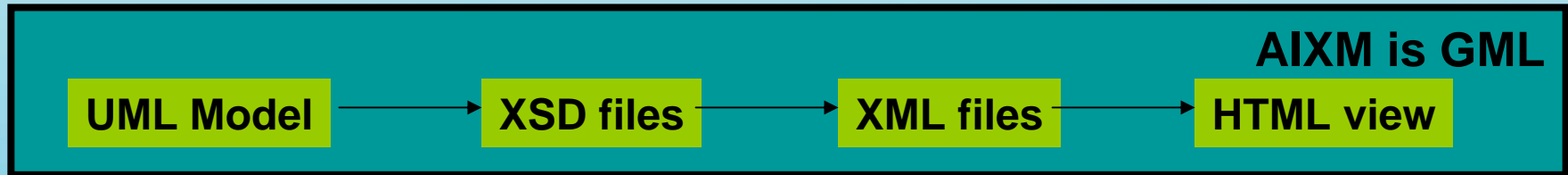
AIXM 5 RC2



# Topics

- GML is defined using XSDL
- AIXM XSDL is defined based on constraints from GML
- Additional XSDL concepts for GML
- GML definitions referenced by AIXM

# General Scheme



- AIXM is modelled using UML
  - UML Features are GML Objects
  - UML Objects are GML Objects
- Scripts within the UML model are used to generate XSD files. These files act as schema definitions for the AIXM data
  - The AIXM-AbstractGML-ObjectTypes.xsd, gml4aixm.xsd, and xlink.xsd files encode XML to be validated using the GML namespace.
- The AIXM data is defined as XML files
  - GML data
- Software (Java, XSLT, etc) is used to transform the XML data to HTML to be viewed by a browser

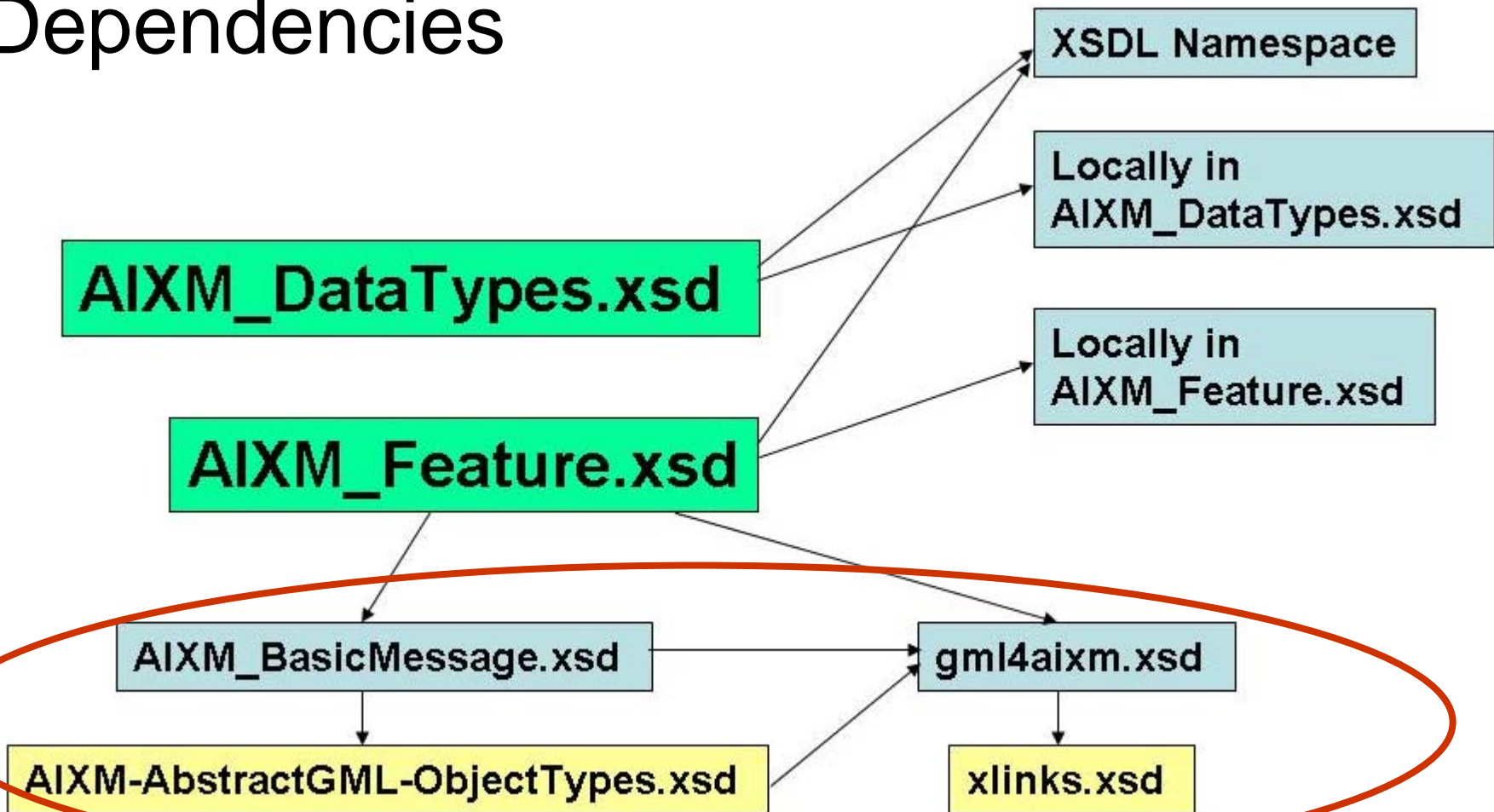
**AIXM**

Aeronautical Information Exchange Model

EXCHANGE MODEL

# AIXM 5 Release Candidate 2 (RC2) xsd files

## Dependencies



# GML Basics

- Consists of 28 core XSD schemas
- AIXM uses:
  - xlink.xsd (as is)
  - A compilation of GML definitions from the other GML core schemas in two files:
    - AIXM-AbstractGML-ObjectTypes.xsd
    - gml4aixm.xsd

# Object Property Model

- No GML object may be the immediate child of a GML object - no element may be both a GML object and a GML property
- An association between two features (or a feature and an object) is implemented over a property of the feature, e.g.
  - `<AirportHeliport> <!-- feature -->`  
`<hasReferencePoint> <!-- property -->`  
`<ElevatedPoint> <!-- object -->`

# GML Basics

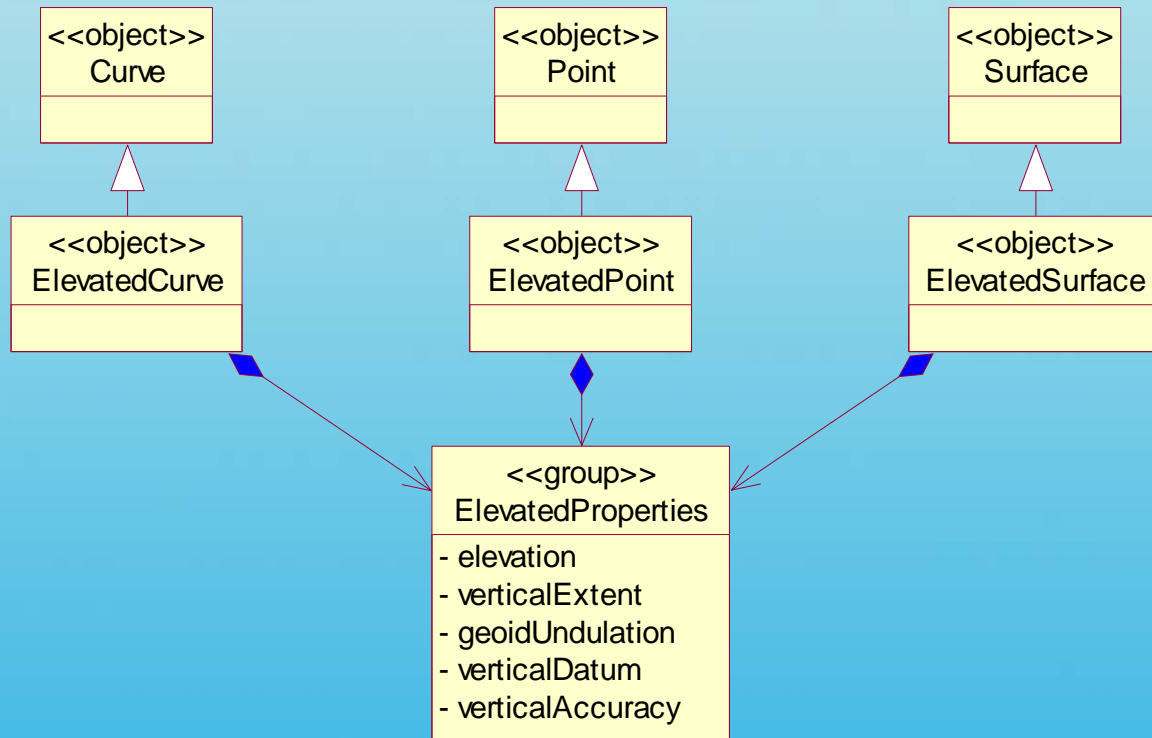
- Configured using the object-property model
- A GML object corresponds to an AIXM Feature
  - Modelled as UML objects and features and as XSDL elements
- A GML property corresponds to AIXM Feature Attributes
  - Modelled as UML attributes and as XSDL elements
- A GML association between an object and a property corresponds to an association between two AIXM Features
  - Modelled as UML associations and as XSDL elements

# XSDL components used to encode AIXM as GML

- **Elements**
  - AIXM Features and Objects
  - AIXM UML relationships
- **Attributes**
  - In AIXM datatypes
- **Named Model Groups (for elements; <group/>)**
  - Groups of elements
- **Attribute Groups (within an XSDL ComplexType with a reference to a GML <attributeGroup/>)**
  - Groups of attributes referenced from AIXM datatypes
- **Substitution Groups (as an element with a reference to a GML <substitutionGroup/>)**
  - Groups of element substitutions



# GML Geometry in AIXM



- AIXM uses a 2.5D representation of the GML geometry model

Property	Definition	Value Domain
Elevation	The vertical distance to the highest point on the geometry from Mean Sea Level.	Vertical Distance with Unit of Measurement (FT, M)
verticalExtent	The height of the geometry measured from the highest point on the geometry to the lowest point on the geometry.	Vertical Distance with Unit of Measurement (FT, M)
geoidUndulation	A distance separating the geoid and the ellipsoid at that position. In respect of WGS-84 geodetic datum, the difference between the WGS-84 ellipsoidal height and geoidal height represents geoidal undulation.	Vertical Distance with Unit of Measurement (FT, M)
verticalDatum	Attribute to take the "Vertical Datum" (viz. the tide gauge to determine MSL - for example, "AMSTERDAM GAUGE", "NEWLYN" etc.).	Text value of vertical datum
verticalAccuracy	The vertical distance from the stated elevation within which there is a defined confidence of the true position falling	Vertical Distance with Unit of Measurement (FT, M)

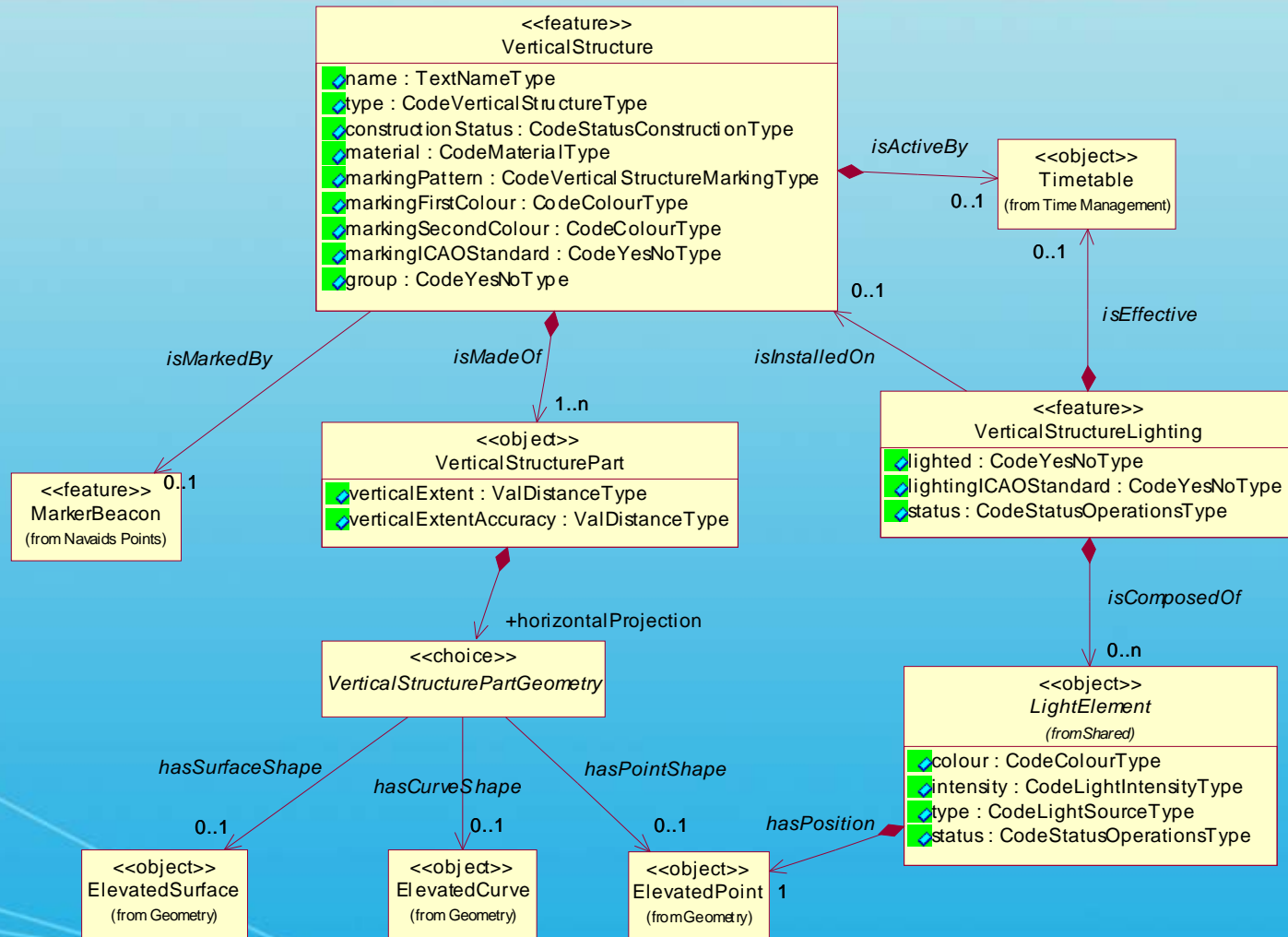
# Rules for the design of GML schemas

- Declare a target namespace
- Import core schemas from GML
- GML properties declared as
  - Global elements
  - Local elements within object content model
- GML objects follow rules extension and restriction of base types in the GML specification (consistent with XSDL)

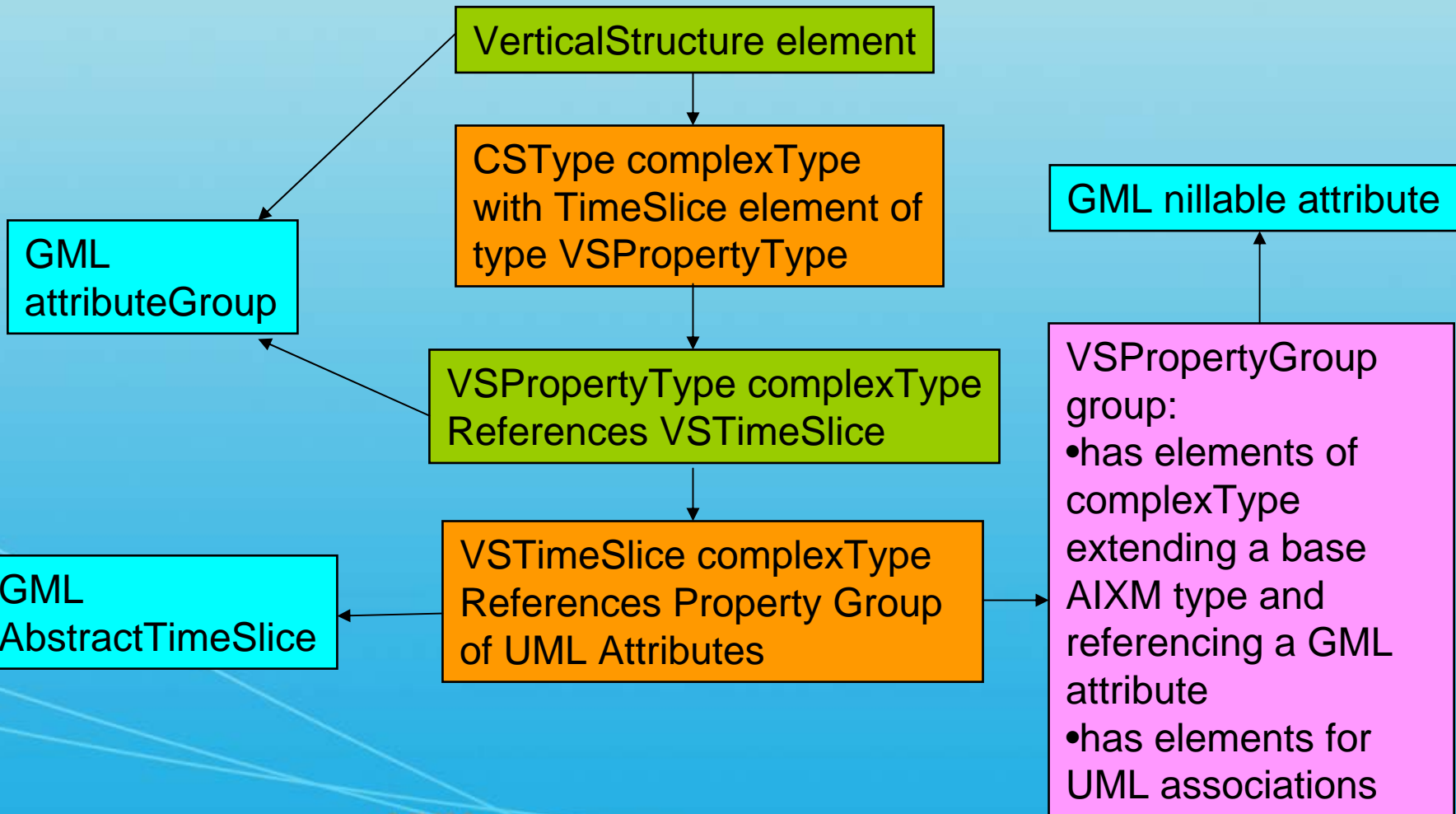
# Rules for the design of GML schemas

- Abstract features are used to distinguish XSDL elements defining AIXM UML features from those used for other aspects of AIXM (e.g. UML associations)
  - GML objects derive from abstract type
  - GML object collections derive from abstract collections

# VerticalStructure includes Obstacles



# VerticalStructure XSD



# VerticalStructure XSD

- `<element name="VerticalStructure ... AIXM VStype ... GML substitutionGroup">`
- `<complexType name="VStype">`
  - `<element name="TimeSlice" AIXM VSPROPERTY type">`
- `<complexType name="VSPROPERTYType">`
  - `<element ref="VSTimeSlice"`
  - `<attributeGroup ref="a GML attributeGroup"/>`
- `<element name="VSTimeSlice" AIXM "VSTimeSlice type ... GML substitutionGroup">`
- `<complexType name="VSTimeSliceType">`
  - `<group ref="VSPROPERTYGroup"/>`
  - `<element ref="AbstractVSExtension"/>`
  - `<attributeGroup ref="a GML attributeGroup"/>`

# VerticalStructure XSD

- `<group ref="VSPropertyGroup"/>`
  - `<element name="UML Attribute" minOccurs="0" {maxOccurs default is 1}>`
    - `<complexType>`
      - Extension of a base AIXM type
      - Attribute name="nilReason" type from GML
  - ....repeated format for all UML attributes in this UML class
  - Element declarations for UML associations using minOccurs and maxOccurs to define UML multiplicity



# VerticalStructureTimeSlicePropertyType references a GML attributeGroup

```
<complexType name="VerticalStructureTimeSlicePropertyType">  
  <sequence>  
    <element ref="aixm:VerticalStructureTimeSlice"/>  
  </sequence>  
  <attributeGroup ref="gml:OwnershipAttributeGroup"/>  
</complexType>
```

# gml:OwnershipAttributeGroup

```
<xsd:attributeGroup name="OwnershipAttributeGroup">  
  <xsd:annotation>  
    <xsd:documentation>Encoding a GML property inline vs. by-reference  
    shall not imply anything about the “ownership” of the contained or  
    referenced GML Object, i.e. the encoding style shall not imply any “deep-  
    copy” or “deep-delete” semantics. To express ownership over the  
    contained or referenced GML Object, the gml:OwnershipAttributeGroup  
    attribute group may be added to object-valued property elements. If the  
    attribute group is not part of the content model of such a property element,  
    then the value may not be “owned”.the value of the owns attribute is  
    “true”, the existence of inline or referenced object(s) depends upon the  
    existence of the parent object.  
    </xsd:documentation>  
  </xsd:annotation>  
  <xsd:attribute name="owns" type="boolean" default="false"/>  
</xsd:attributeGroup>
```

# VerticalStructurePropertyGroup references GML NilReasonEnumeration

```
<group name="VerticalStructurePropertyGroup">
  <sequence>
    <element name="name" nillable="true" minOccurs="0">
      <annotation>
        <documentation>The name of the vertical structure, if
        applicable,</documentation>
      </annotation>
      <complexType>
        <simpleContent>
          <extension base="aixm:TextNameType">
            <attribute name="nilReason"
            type="gml:NilReasonEnumeration"/>
          </extension>
        </simpleContent>
      </complexType>
    </element>
    {Additional XSDL elements used to define AIXM UML attributes}
    <element name="isActiveBy" type="aixm:TimetablePropertyType"
    minOccurs="0"/>
    {Additional XSDL elements used to define AIXM UML associations}
  </sequence>
</group>
```

# gml:NilReasonEnumeration union simpleType

```
<xsd:simpleType name="NilReasonEnumeration">  
  <xsd:union>  
    <xsd:simpleType>  
      <xsd:restriction base="string">  
        <xsd:enumeration value="inapplicable"/>  
        <xsd:enumeration value="missing"/>  
        <xsd:enumeration value="template"/>  
        <xsd:enumeration value="unknown"/>  
        <xsd:enumeration value="withheld"/>  
      </xsd:restriction>  
    </xsd:simpleType>  
    <xsd:simpleType>  
      <xsd:restriction base="string">  
        <xsd:pattern value="other:\w{2,}"/>  
      </xsd:restriction>  
    </xsd:simpleType>  
  </xsd:union>  
</xsd:simpleType>
```

# gml:AbstractTimeSlice

```
<xsd:element name="AbstractTimeSlice" type="gml:AbstractTimeSliceType"
abstract="true" substitutionGroup="gml:AbstractGML">
```

```
<xsd:annotation>
```

```
<xsd:documentation>To describe an event — an action that occurs at an
instant or over an interval of time — GML provides the
gml:AbstractTimeSlice element. A timeslice encapsulates the time-varying
properties of a dynamic feature -- it shall be extended to represent a time
stamped projection of a specific feature. The gml:dataSource property
describes how the temporal data was acquired.gml:AbstractTimeSlice
instance is a GML object that encapsulates updates of the dynamic—or
volatile—properties that reflect some change event; it thus includes only
those feature properties that have actually changed due to some
process.:AbstractTimeSlice basically provides a facility for attribute-level
time stamping, in contrast to the object-level time stamping of dynamic
feature instances. time slice can thus be viewed as event or process-
oriented, whereas a snapshot is more state or structure-oriented. A
timeslice has richer causality, whereas a snapshot merely portrays the
status of the whole.
```

```
</xsd:documentation>
```

```
</xsd:annotation>
```

```
</xsd:element>
```

# gml:AbstractTimeSliceType

```
<xsd:complexType name="AbstractTimeSliceType" abstract="true">
  <xsd:complexContent>
    <xsd:extension base="gml:AbstractGMLType">
      <xsd:sequence>
        <xsd:element ref="gml:validTime"/>
        <xsd:element ref="gml:dataSource" minOccurs="0"/>
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>

<xsd:element name="dataSource" type="gml:StringOrRefType">
  <xsd:annotation>
    <xsd:documentation>Evidence is represented by a simple gml:dataSource
    or gml:dataSourceReference property that indicates the source of the
    temporal data. The remote link attributes of the gml:dataSource element
    have been deprecated along with its current type.</xsd:documentation>
  </xsd:annotation>
</xsd:element>
```

# In-line versus external references in GML

- GML allows for two types of definitions for properties (UML attributes):
  - In-line; i.e. internal definition
  - External, using xlink
- The use of xlink requires that a property have a unique identifier
- In AIXM, all GML properties require this identifier

# gml:AbstractObject

```
<xsd:element name="AbstractGML" type="gml:AbstractGMLType" abstract="true"
substitutionGroup="gml:AbstractObject">
  <xsd:annotation>
    <xsd:documentation>The abstract element gml:AbstractGML is “any
GML object having identity”. It acts as the head of an XML Schema
substitution group, which may include any element which is a GML
feature, or other object, with identity. This is used as a variable in content
models in GML core and application schemas. It is effectively an abstract
superclass for all GML objects.
</xsd:documentation>
  </xsd:annotation>
</xsd:element>

<xsd:complexType name="AbstractGMLType" abstract="true">
  <xsd:sequence>
    <xsd:group ref="gml:StandardObjectProperties"/>
  </xsd:sequence>
  <xsd:attribute ref="gml:id" use="required"/>
</xsd:complexType>
```



# Use of XSDL anyType in GML/AIXM

```
<xsd:element name="AbstractObject" abstract="true">  
  <xsd:annotation>  
    <xsd:documentation>This element has no type defined, and is therefore  
    implicitly (according to the rules of W3C XML Schema) an XML Schema  
    anyType. It is used as the head of an XML Schema substitution group  
    which unifies complex content and certain simple content elements used  
    for datatypes in GML, including the gml:AbstractGML substitution  
    group.</xsd:documentation>  
  </xsd:annotation>  
</xsd:element>
```

By not declaring the type for this element, it can be defined as simpleType or complexType

# gml:AbstractGMLType

```
<xsd:complexType name="AbstractGMLType" abstract="true">
  <xsd:sequence>
    <xsd:group ref="gml:StandardObjectProperties"/>
  </xsd:sequence>
  <xsd:attribute ref="gml:id" use="required"/>
</xsd:complexType>

<xsd:group name="StandardObjectProperties">
  <xsd:sequence>
    <xsd:element ref="gml:metaDataProperty" minOccurs="0"
      maxOccurs="unbounded"/>
    <xsd:element ref="gml:description" minOccurs="0"/>
    <xsd:element ref="gml:descriptionReference" minOccurs="0"/>
    <xsd:element ref="gml:identifier" minOccurs="0"/>
    <xsd:element ref="gml:name" minOccurs="0"
      maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:group>
```

# Xlink

- A member of the XML family of languages
- Used to link xml documents
- Allows for
  - Simple links
    - similar to HTML links
  - Extended links
    - Allow bidirectional linking
    - not used by GML/AIXM

# XSDL Identity Constraints

- Xlink is implemented in GML using identity constraints
  - Unique identification of an xml tag
  - Enable connection to external resources
  - Can be used only for XSDL attributes (not XSDL elements)

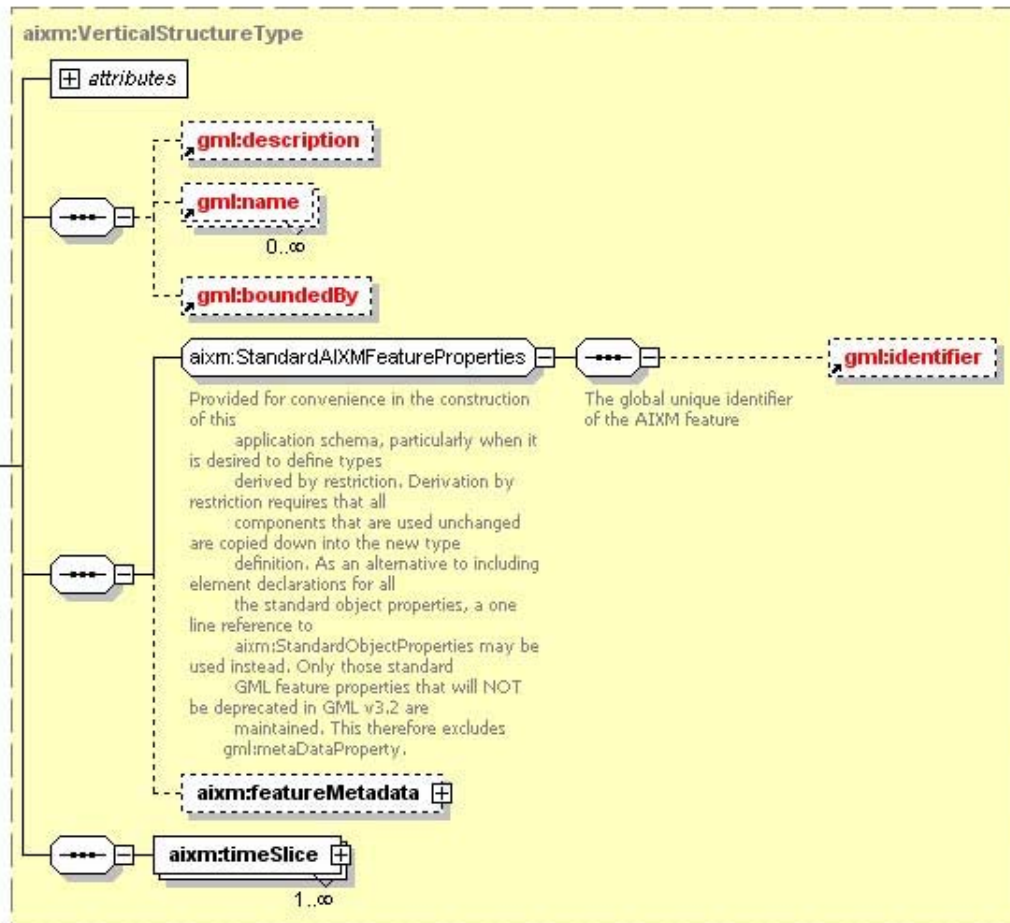
- An example in a notional instance document:
  - <Runway gml:id="A1">
    - <gml:CenterPoint xlink:href="#L1"/>
    - {or xlink:href="http somewhere on the web"}
  - </Runway>

```
<attributeGroup name="simpleLink">  
  <attribute name="type" type="string" fixed="simple" form="qualified"/>  
  <attribute ref="xlink:href" use="optional"/>  
  <attribute ref="xlink:role" use="optional"/>  
  <attribute ref="xlink:arcrole" use="optional"/>  
  <attribute ref="xlink:title" use="optional"/>  
  <attribute ref="xlink:show" use="optional"/>  
  <attribute ref="xlink:actuate" use="optional"/>  
</attributeGroup>
```

# VerticalStructure XSD

## VerticalStructure

All fixed (whether temporary or permanent) and mobile objects, or parts thereof that extend above the surface of the Earth. Those vertical structures that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight are considered obstacles.



# References

- UML 2 for Dummies, Chonoles and Schardt
  - Part II (Chapters 3 to 7)
- Definitive XML Schema, Priscilla Walmsley, PH-PTR
  - Whole book is very useful
- GML: Foundation for the Geo-Web, Ron Lake et al. Wiley
  - Chapters 10 and 11 for schema
  - The rest of the book for GML instances

# Technology Relationships

UML	GML	XSD
Feature	Object	Element
Object	Object	Element
Choice	Object	Element
Datatype	Object	Datatype
Enumeration	Object	Datatype
Codelist	Object	Datatype
Attribute	Property	Datatype
Relationship	Property	Element