Temporal ADE for CityGML

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CityGML, WP06
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For several months, we've worked on the temporal representation of data in 3D city models and participated to several works on the modification of CityGML to improve its modelisation of the city's history.

- M. Morel : "tags" and "states"

  Adding a tag and a state to a CityObject to represent a change at a given date

  Morel M. and Gesquière G., “Managing Temporal Change of Cities with CityGML”. In Eurographics Workshop on Urban Data Modelling and Visualisation, 2014.

  This implementation is effective

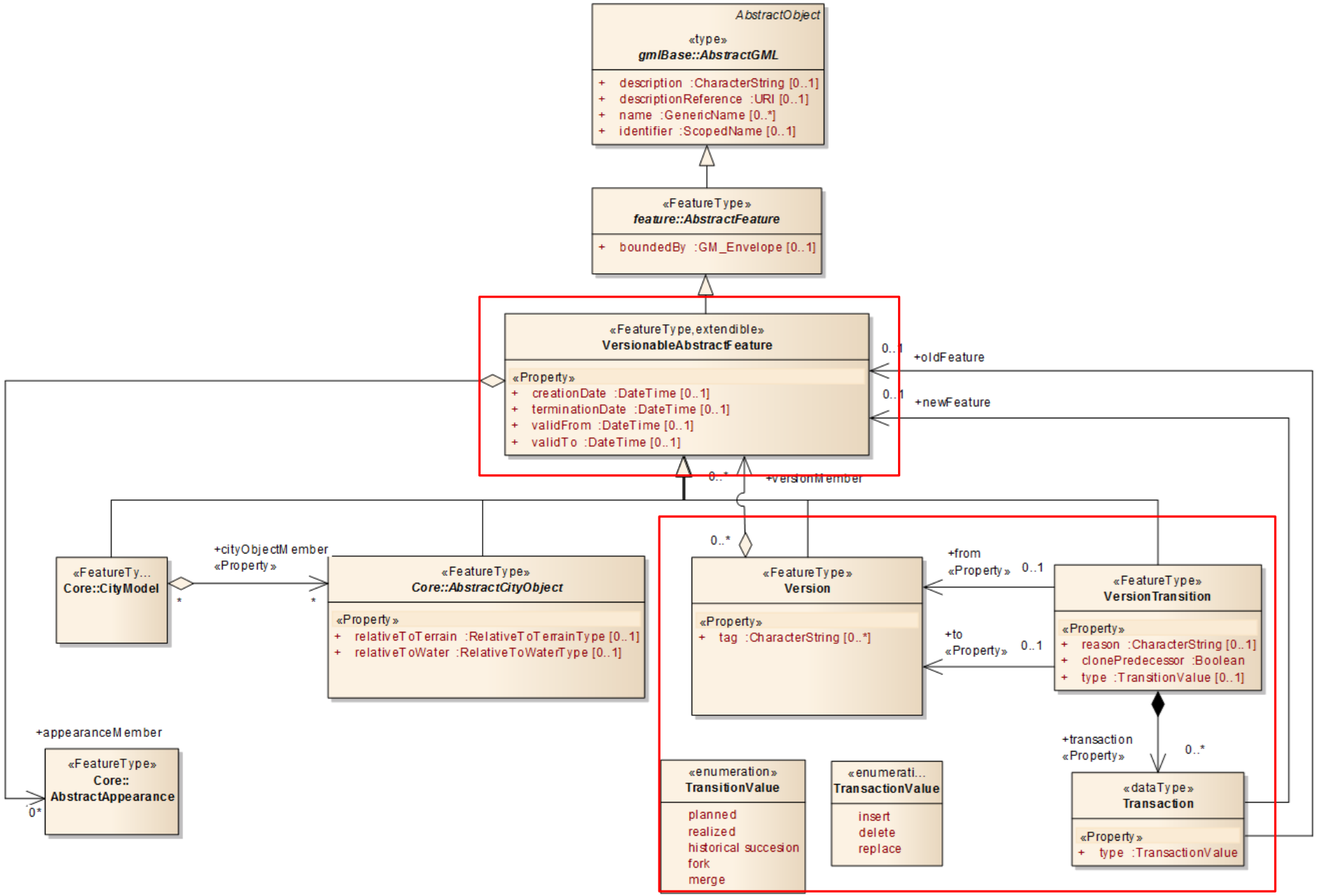
- K. Chaturvedi : history and version managing

  Versions of the city model or its elements, planned alternatives

  Chaturvedi K., Smyth C. S., Gesquière G., Kutzner T. and Kolbe T. H., "Managing versions and history within semantically enriched 3D city models". 3D Geoinfo 2015, to appear

  My goal:

  Implement this work as an Application Domain Extension

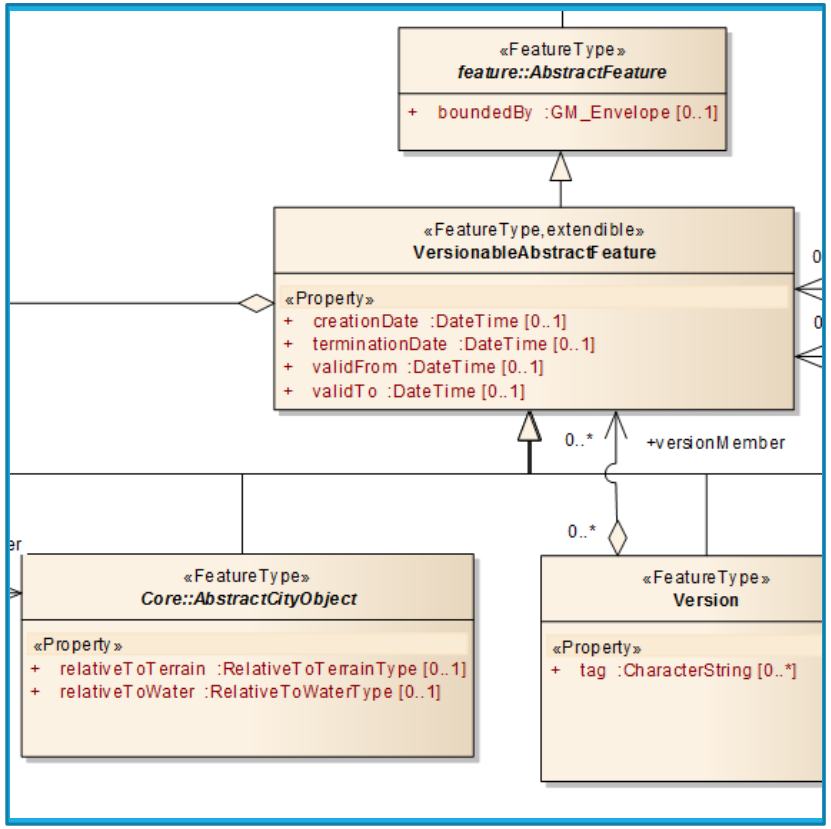

AbstractObject
«type»
gmlBase::AbstractGML
+ description :CharacterString [0..1]
+ descriptionReference :URI [0..1]
+ name :GenericName [0..*]
+ identifier :ScopedName [0..1]
«FeatureType»
feature::AbstractFeature
+ boundedBy :GM_Envelope [0..1]
«FeatureType, extendible»
VersionableAbstractFeature
«Property»
+ creationDate :DateTime [0..1]
+ terminationDate :DateTime [0..1]
+ validFrom :DateTime [0..1]
+ validTo :DateTime [0..1]
0..1
+oldFeature
0..1
+newFeature
0..*
+versionMember
«FeatureTy...
Core::CityModel
+cityObjectMember
«Property»
«FeatureType»
Core::AbstractCityObject
«Property»
+ relativeToTerrain :RelativeToTerrainType [0..1]
+ relativeToWater :RelativeToWaterType [0..1]
0..*
«FeatureType»
Version
«Property»
+ tag :CharacterString [0..*]
+from
«Property»
0..1
+to
«Property»
0..1
«FeatureType»
VersionTransition
«Property»
+ reason :CharacterString [0..1]
+ clonePredecessor :Boolean
+ type :TransitionValue [0..1]
+transaction
«Property»
0..*
«dataType»
Transaction
«Property»
+ type :TransactionValue
«enumeration»
TransitionValue
planned
realized
historical succesion
fork
merge
«enumerati...
TransactionValue
insert
delete
replace
+appearanceMember
«FeatureType»
Core::
AbstractAppearance
0*

Problem:
Impossible to replace the relationship between AbstractFeature and AbstractCityObject with an ADE

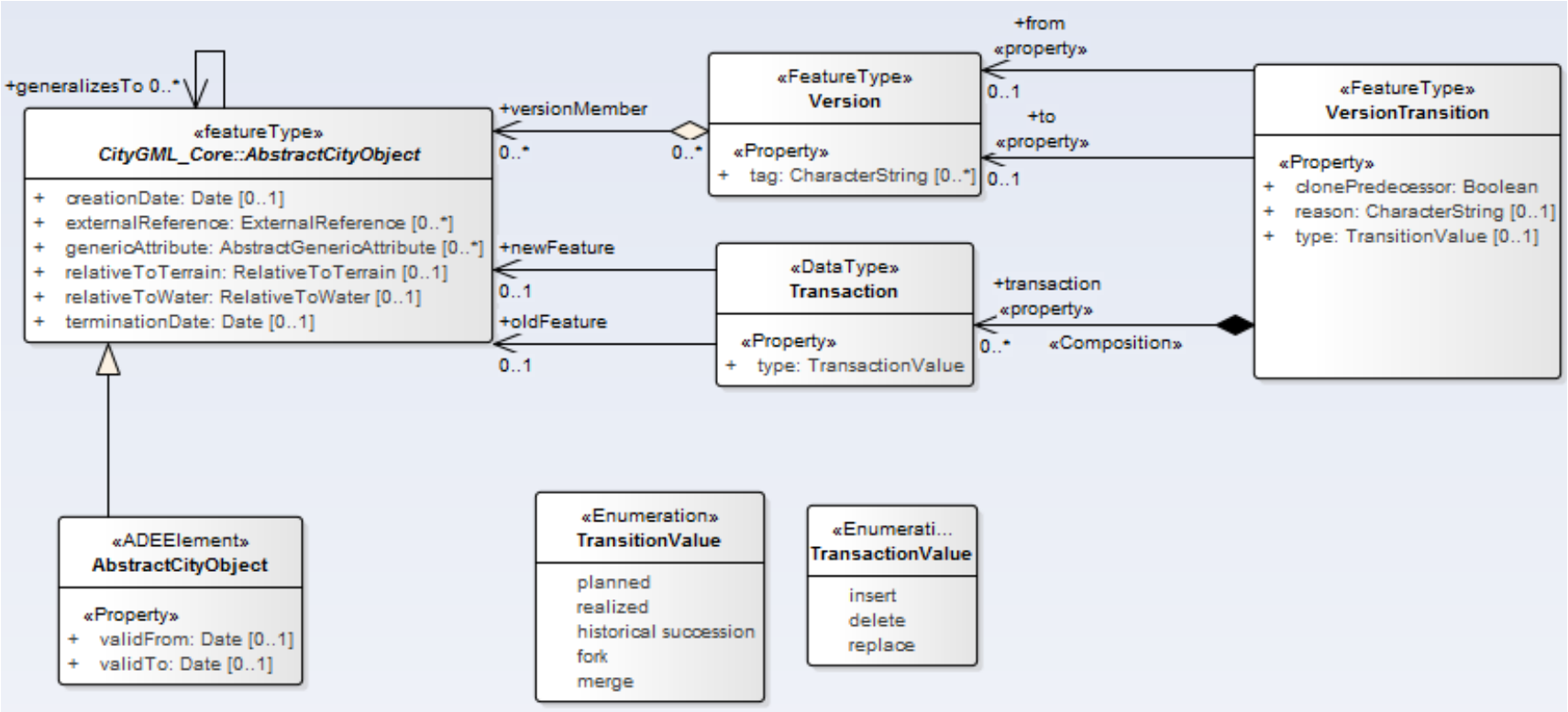
Workaround (discussed with Munich team):

- Inject the required properties into AbstractCityObject using the ADE hooks
- Change the type of the members of Version and Transaction from VersionableAbstractFeature to AbstractCityObject

This only makes the AbstractCityObject and derived classes versionable, instead of all the model.



Designed ADE Model:



Realized with the help of Tatjana Kutzner

Tools used:
Enterprise Architect for the UML diagram, XSD file generated with ShapeChange

Providing a reference implementation

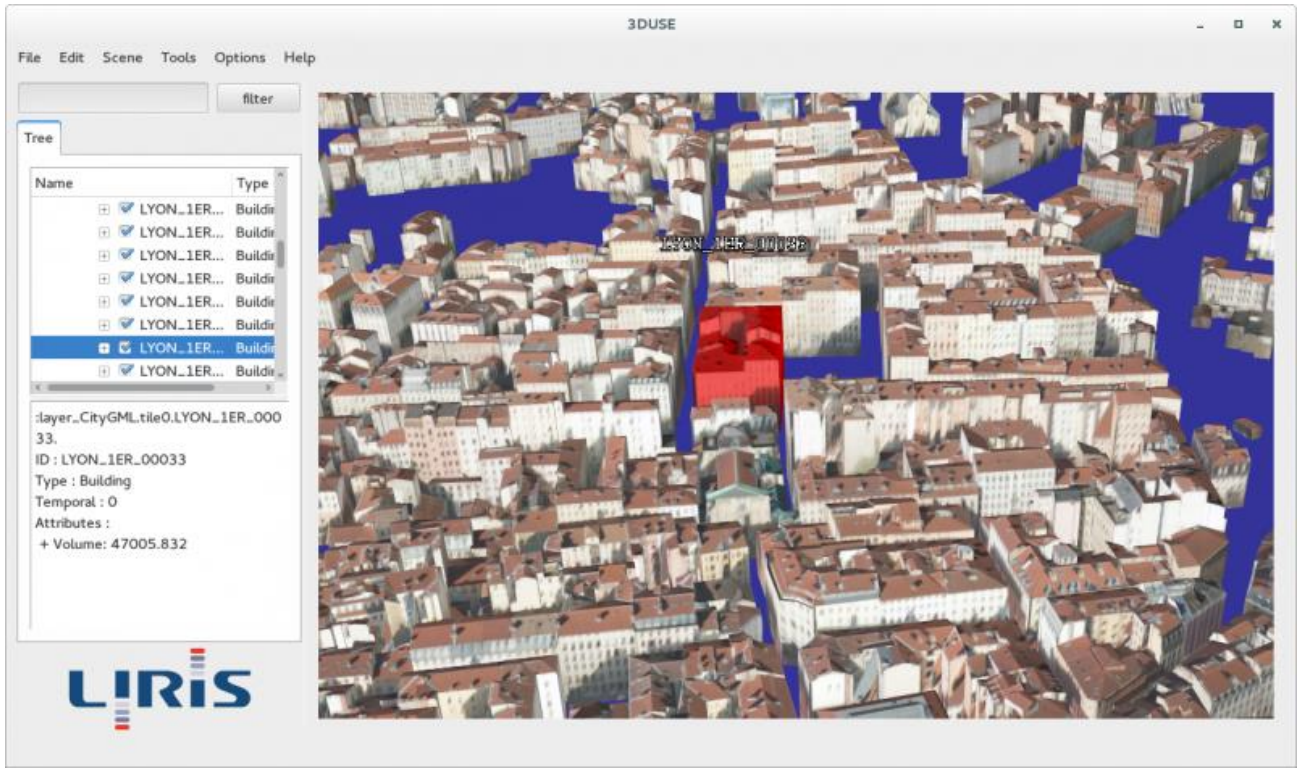
3D-USE :

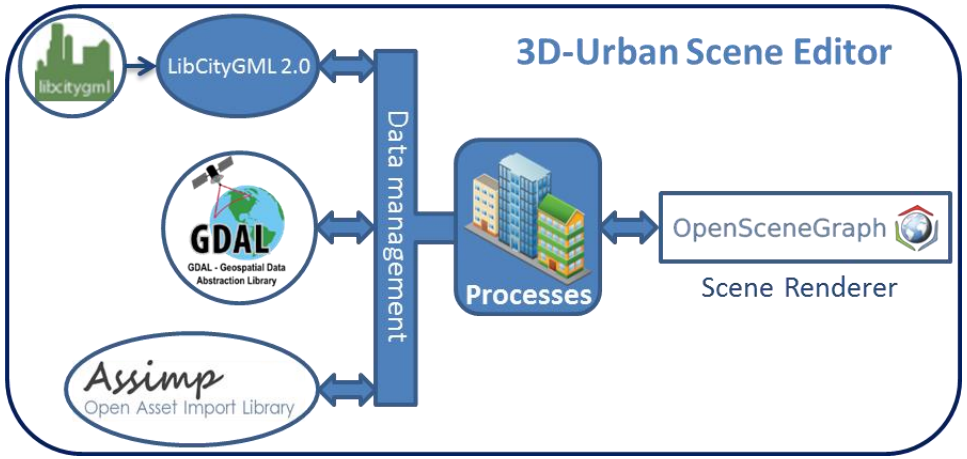
Our tool for elaborating and validating new processes on city models.

3D-Use can open many file formats like CityGML, 3ds, obj or Shapefile.

It provides 3D visualization of data coming from these files.

http://liris.cnrs.fr/vcity/wiki/doku.php?id=3duse_en





Modifying the 3D-USE CityGML parser

- Based on the C++ libraries libcitygml and libxml2
- Parses the XML elements one by one (SAX parser)

- Creates a tree data structure with the City Model as the root

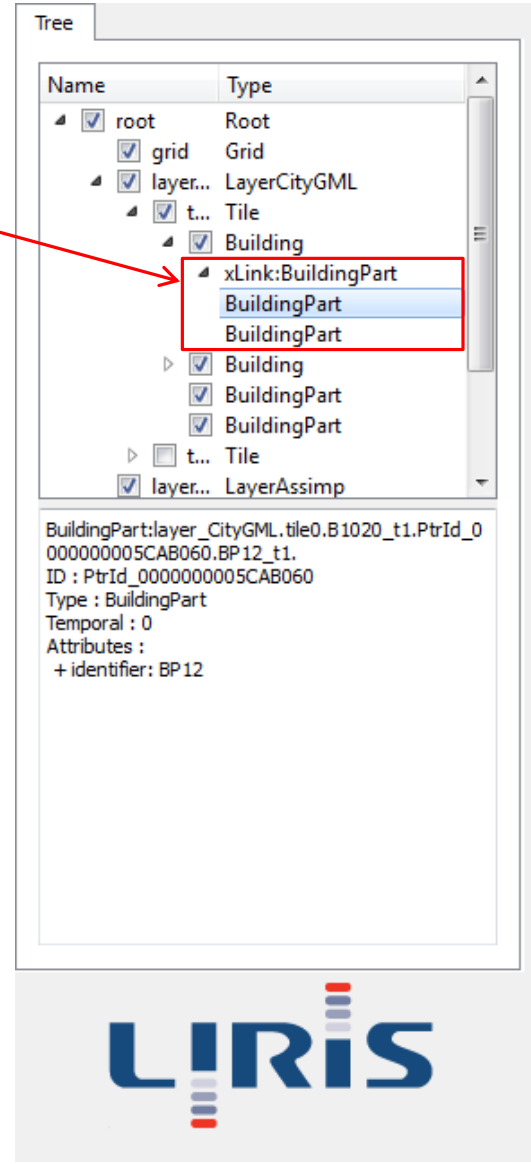
Required modifications:

- XLink-XPath support
- Version, VersionTransition and Transaction classes
- validFrom and validTo dates

Realisations so far:

- validFrom and validTo dates can be parsed
- Support for the XLink (still in testing)
  - Added a new attribute to the C++ CityObject class that describes if the object is a XLink
  - When the parser encounters a gml:identifier, it adds an entry in a map of identifiers
  - At the end of the document, we explore the newly built city model. Each time we meet a CityObject described as a XLink, we search in the map all the Objects corresponding to the identifier and add them to the model as children of the XLink object

```
<cityObjectMember>
    <Building gml:id="B1020_t1">
        <identifier>B1020</identifier>
        <consistsOfBuildingPart>
            <BuildingPart xlink:href="//identifier[text()='BP12']"/>
        </consistsOfBuildingPart>
        <creationDate>2012-08-02</creationDate>
        <terminationDate>2013-10-09</terminationDate>
        <function>Office</function>
    </Building>
</cityObjectMember>
<cityObjectMember>
    <Building gml:id="B1020_t2">
        <identifier>B1020</identifier>
        <consistsOfBuildingPart>
            <BuildingPart xlink:href="//identifier[text()='BP12']"/>
        </consistsOfBuildingPart>
        <creationDate>2013-10-09</creationDate>
        <function>Living</function>
    </Building>
</cityObjectMember>
<cityObjectMember>
    <BuildingPart gml:id="BP12_t1">
        <identifier>BP12</identifier>
        <creationDate>2012-08-02</creationDate>
        <terminationDate>2014-06-03</terminationDate>
        <roofType>Flat</roofType>
    </BuildingPart>
</cityObjectMember>
<cityObjectMember>
    <BuildingPart gml:id="BP12_t3">
        <identifier>BP12</identifier>
        <creationDate>2014-06-03</creationDate>
        <roofType>Saddle</roofType>
     </BuildingPart>
</cityObjectMember>
```



Work in progress:

- Version management
  - Has not been anticipated in libcitygml or 3D-USE, so it might need a lot of work to add it to the data structure

- Modification of the "Export CityGML" functions

Current questions:

- What namespace for the ADE?

- Does the XLink need to be defined in the XSD file?