buildingSMART International and Open Geospatial Consortium Framework for Collaboration on BIM-GIS Interoperability

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• buildingSMART International (bSI) and the Open Geospatial Consortium (OGC)
• Cooperating on BIM-GIS interoperability since 2006

• Today’s topic
  – Focused effort on joint conceptual model for infrastructure data has resulted in an OGC standard
  – Success of this effort has led to the creation of a joint Integrated Digital Built Environment (IDBE) Working Group
Who?

- bSI Infra Room
- OGC Land and Infrastructure Domain and Standards Working Groups (LandInfra DWG and LandInfra SWG)
- Joint meetings hosted by both organizations
Result: Land and Infrastructure (LandInfra)

• Land and Infrastructure Conceptual Model Standard (LandInfra)
  – It’s all about the land upon which infrastructure facilities are built
  – and the infrastructure facility improvements themselves
  – including the surveying necessary for the construction and
    recording of the facilities and land interests
• “use case driven subset of LandXML functionality, but … supported by a UML (Unified Modeling Language)
  conceptual model”
• LandInfra is a Conceptual Model, specified as an OGC
  Standard (OGC 15-111r1), independent of
  implementations but whose target is encoding standards
• InfraGML is one of those LandInfra encodings
LandInfra / InfraGML
http://www.opengeospatial.org/standards/landinfra

Land Features
Core
Railway
Roads
Facilities
Alignment
Survey
Projects
Land Division
Condominiums
InfraGML Encoding Standards

- InfraGML marks a significant, pragmatic realization in the often idealized integration of GIS/CAD/BIM
- Based on the LandInfra consensus concepts developed by OGC and bSi
- Follows the OGC Modular Specification for extensibility
- Builds upon and extends GML3.2 and 3.3 foundation for features, data types, spatial schema, coordinate and linear referencing, and observation and measurement
- Provides a framework for addressing the full facility life cycle
- Capitalizes on the numerous extensions to the OGC baseline that have been added since “GIS” Simple Features
- Parallels extensions by bSi beyond just “buildings”
Flexibility of LandInfra Requirements Classes (RCs)
Extendable InfraGML: a Multi-Part Standard

0. Core

1. LandFeatures
2. Facilities and Projects
3. Alignments
6. Survey
7. LandDivision

8. Site
4. Roads
5. Railways
9. Wet Infrastructure
10. Utilities
InfraGML

• Part 0 is the (concrete) Core RC which shall be supported by all conforming applications

• Then an application can select from
  – Part 1 Land Features
  – Part 2 Facilities (with optional Projects)
  – Part 3 Alignments
  – Part 6 Survey (with optional Equipment, Observations, and SurveyResults)
  – Part 7 Land Division (with optional Condominiums)
  – or any combination of these

• If Land Features and Facilities are supported, an application can then also include Part 4 Roads (with optional Road Cross Sections)

• If Facilities are supported, an application can then also include Part 5 Railway
LandInfra RC (InfraGML Core)

- Core (mandatory) RC
- The root class, LandInfraDataset:
  - specifies the Land and Infrastructure dataset
  - attributes provide header information
- The dataset may contain any number of:
  - features (facility, land feature, land division, document, survey mark) having featureID, name, description, spatialRepresentation, linearlyReferencedLocation, property, and propertySet
  - plus: surveys, sets, and feature associations
- The RC contains other classes and data types common across other RCs
LandFeature RC

• LandFeatures include:
  – topographic Features of the land, e.g., naturally occurring water features and vegetation
  – surfaces, modelled as TINs, including the top ground terrain surface and any subterranean surfaces which separate the underground into layers
  – layers of homogeneous material of type SolidLayer, SurfacesLayer, or LinearLayer

• SolidLayers are spatially represented as Polyface Mesh Solids; SurfacesLayer as top and bottom LandSurfaces (TINs); and LinearLayers as a series of ordered cross sectional areas
Facility RC

- Facilities include buildings and civil engineering works and their associated siteworks.
- A Facility has a life cycle, including planning, design, construction, maintenance, operation, and removal phases.
- Facilities may be broken down into FacilityParts, based on type.
- FacilityPart is a logical collection of physical elements representing manufactured or constructed parts or virtual elements used to locate, align, or organize physical elements.

Facility is dependent upon the LandInfra core.
A Project is an activity related to the improvement of a facility, including design and/or construction.

A Project may be for the creation, modification, or elimination of the entire facility or a part of the facility.

Projects can have multiple parts, termed ProjectParts which relate to a single facility type (road, railway, etc.).

Project is dependent upon Facility.
Alignment RC

- An alignment provides a Linear Referencing System for locating physical elements; defined
  - as a 3D or simple 2D linestring representation (in any CRS)
  - as a horizontal alignment: that is, a 2D projection onto a horizontal plane of a Cartesian local engineering reference system
  - as a horizontal alignment with an accompanying 2D vertical long section taken along the horizontal alignment
  - with a 3D linestring generated from the horizontal and vertical
- The Alignment RC Conceptual Model was jointly developed with bSI so that it can function as a link between OGC GML and bSI IFC
Road Element

Surface

String Line

Cross Section

Multiple Representation Schemes
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xmlns:gml="http://www.opengis.net/gml/3.2"
gml:id="ds1"
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xmlns:li="http://www.opengis.net/infragml/core/1.0"
xmlns:lia="http://www.opengis.net/infragml/alignment/1.0"
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xmlns:gmllro="http://www.opengis.net/gml/3.3/lro"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
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    <identifier>DS3</identifier>
    <scope>OGC LandInfraSWG</scope>
  </datasetID>
  <name>Sample Part3 Dataset</name>
  <description>LandInfra dataset to test all possible content for Part3 Alignment</description>
  <dateTime>2016-11-02T10:00:00</dateTime>
  <datasetVersion>1.0</datasetVersion>
  <application>manual</application>
  <author>Paul Scarponcini, Bentley Systems, Inc.</author>
  <infraVersion>1.0</infraVersion>
  <language>English</language>
  <defaultCRS xlink:href="crs1"/>
  <feature>
    <lia:Alignment xlink:id="a1">
      <gml:description>sample alignment definition</gml:description>
      <gml:name>Road 1 alignment</gml:name>
      <lia:alignmentID>
        <lia:identifier>Alignment1</lia:identifier>
        <lia:scope>OGC LandInfraSWG</lia:scope>
      </lia:alignmentID>
      <lia:purpose>roadway centerline</lia:purpose>
      <lia:designAlternative>DesignA</lia:designAlternative>
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        <gml:pos>0 1100</gml:pos>
      </lia:linestring2DRepresentation>
    </lia:Alignment>
  </feature>
</LandInfraDataset>
Road RC

• For exchanging the output of a design with someone who is likely to use the design for purposes other than completing the road design.

• Road specifies that part of a Facility which is a single segment of road that is continuous, non-overlapping, and non-branching (though it may contain intersections with other roads)

• Road can be represented with RoadElements, 3D StringLines, or 3D surfaces and layers, or sets of each of these

• Road is dependent upon Facility and LandFeature

OGC®
RoadCrossSection RC

- Extends the Road Requirements Class by adding the 2D CrossSection alternative way of representing a design.
- A CrossSection describes how a Road looks (or will look), in a 2D cross section view, at some specific location along its length.
- CrossSections can have CrossSectionElements and/or Areas, defined by CrossSectionPoints.
- RoadCrossSection is dependent upon Road.
Railway RC

• For exchanging the output of a design with someone who is likely to use the design for purposes other than completing railway design.

• Railway is a Feature that specifies that part of a Facility which is a single segment of railway that is continuous, non-overlapping, and non-branching (though it may contain intersections with other railways)

• CantSpecification is a collection of CantEvents which mark locations along the railway where an applied cant value (difference in elevation between the two rails) changes

• Railway is dependent upon Facility
Survey RC

- Surveys cover the acquisition of points, lines, surfaces and properties of features of interest. The primary focus is recording and reprocessing the observations of the acquired objects.
- The Survey class contains header information for the surveys.
- Survey is divided in sub-packages because of the number of classes in the Observations, SurveyResults and Equipment packages.
- Survey is dependent upon the LandInfra core.
LandDivision and Condominium RCs
LandInfra Phase II

- Planning has begun by the LandInfraDWG
- Possible candidates so far:
  - “wet” infrastructure
  - utilities
  - site / landscape architecture
  - environmental
  - road design?