CITYGML RESTFUL WEB SERVICE:
AUTOMATIC RETRIEVAL OF CITYGML DATA BASED
ON THEIR SEMANTICS. PRINCIPLES, GUIDELINES AND BLDG CONCEPTUAL DESIGN

Our Motivation

Semantics aspect of citygml
SOAP vs. REST

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3D GEOINFO CONFERENCE
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Ioannis Pispidikis, NTUA, Greece
Efi Dimopoulou, NTUA, Greece
3D City Models

CityGML

Interoperability

Web Services
OGC 3D Web Services

W3DS (Web 3D Service)
WVS (Web View Service)

representation of data (Scene, image)

Not Suitable!!
Related work

WFS (Web Feature Service)
real data based on
GEOMETRY

CityGML
SEMANTIC
Our Motivation

🌟 Semantic aspect of CityGML

SOAP vs REST

CityGML RESTful Web Service
GENERAL OVERVIEW AND PRINCIPLES

- HATEOAS (Hypermedia AS The Engine Of Application State)
- ROA (ReSource-Oriented Architecture)

Architecture of the CityGML

main resources

namespace prefix of CityGML

5 components
Name of the main resources

<table>
<thead>
<tr>
<th>Resource Name</th>
<th>URI</th>
<th>CityGML Modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>bldg</td>
<td>../bldg</td>
<td>Buildings</td>
</tr>
<tr>
<td>wtr</td>
<td>../wtr</td>
<td>Waterbodies</td>
</tr>
<tr>
<td>dems</td>
<td>../dem</td>
<td>reliefs</td>
</tr>
<tr>
<td>veg</td>
<td>../veg</td>
<td>Vegetation</td>
</tr>
<tr>
<td>luse</td>
<td>../luse</td>
<td>LandUses</td>
</tr>
<tr>
<td>fnr</td>
<td>../fnr</td>
<td>CityFurniture</td>
</tr>
<tr>
<td>tran</td>
<td>../tran</td>
<td>Transportations</td>
</tr>
<tr>
<td>brids</td>
<td>../brid</td>
<td>Bridges</td>
</tr>
<tr>
<td>tun</td>
<td>../tun</td>
<td>Tunnels</td>
</tr>
<tr>
<td>grp</td>
<td>../grp</td>
<td>CityObjectGroups</td>
</tr>
</tbody>
</table>

General filters of Main Thematic resources

<table>
<thead>
<tr>
<th>Filter</th>
<th>URI (Example for bldg resource)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>../bldg?function=3020</td>
</tr>
<tr>
<td>Usage</td>
<td>../bldg?usage=1010</td>
</tr>
<tr>
<td>Class</td>
<td>../bldg?class=1000</td>
</tr>
<tr>
<td>BBox</td>
<td>../bldg?BBox=334433.0,4455667.0,445677.0,5566556.0</td>
</tr>
<tr>
<td>Lod</td>
<td>../bldg?lod=2</td>
</tr>
</tbody>
</table>

../CityModels  ➔ Overview of the available thematic models grouped by thematic category model
CityModels ReSource Schema

```json
{
    "type": "object",
    "properties": {
        "thematic": {"type": "string"},
        "counts": {"type": "number"},
        "links": {
            "type": "object",
            "properties": {
                "link": {"type": "string"},
                "rel": {"type": "string"}
            }
        }
    }
}
```
Bldg re:Source
LoD 2 bldg sub-resources

list of the available semantic feature based on respective sub resource

../bldg links / {gmlid}

list of the available buildings

specific building

/walls
/grounds
/roofs
/ceiling
/floors
/installations

links

links

/ {gmlid}

Specific Semantic feature

../bldg/1/walls?lod=2 (All LoD 2 walls for building 1)
Resources + Properties + Filters

- **Applications**
  - CityGML, RESTful Web Services
  - buildings (list of available buildings)
  - buildings (specific building)
    - properties: building information, geometry, generic, address, gmlid, lod, buildingPart, link
    - filter: lod, generic
  - floors (list of floors)
    - properties: gmlid, lod, generic, appearance, geometry, links
    - filter: lod
  - ceilings (list of ceilings)
    - properties: gmlid, lod, generic, appearance, geometry, links
    - filter: lod
  - roofs (list of roofs)
    - properties: gmlid, lod, generic, appearance, geometry, links
    - filter: lod
  - walls (list of walls)
    - properties: gmlid, lod, generic, appearance, geometry, links
    - filter: lod
  - roofs (list of roofs)
    - properties: gmlid, lod, generic, appearance, geometry, links
    - filter: lod
  - grounds (list of grounds)
    - properties: gmlid, lod, generic, appearance, geometry, links
    - filter: lod
  - ground surfaces (specific ground surface)
    - properties: gmlid, lod, generic, appearance, geometry, links
    - filter: lod
  - walls (specific wall)
    - properties: gmlid, lod, generic, appearance, geometry, links
    - filter: lod
  - roofs (specific roof)
    - properties: gmlid, lod, generic, appearance, geometry, links
    - filter: lod
  - ceilings (specific ceiling)
    - properties: gmlid, lod, generic, appearance, geometry, links
    - filter: lod
  - outer floors (specific outer floor)
    - properties: gmlid, lod, generic, appearance, geometry, links
    - filter: lod

- **Resources**
  - installations (list of building installations)
    - properties: usage, function, class, gmlid, generic, type, appearance, geometry, links
    - filter: usage, function, class, type
LoD3 bldg Sub-resources

../bldg/{gmlid} links /walls/ /roofs/ links {gmlid}

/INSTALLATIONS/ links {gmlid} LoD3 Sub-resources

links /windows/ /doors/ links {gmlid}

../bldg/1/walls/3/windows (All windows of wall 3 for building 1)
LoD4 bldg sub-resources

../bldg/ {gmlid}

/rooms

/ceiling

/floors

/installations

/interior

/installations

/walls

/links {gmlid}

/ceiling

/links {gmlid}

/floors

/installations

/links {gmlid}

/furniture

/links /windows/

/doors/

/links {gmlid}

/interior installations

../bldg/1/installations?type=interior (interior installations)
the retrieval information

**Information based and NOT geometry based**

<table>
<thead>
<tr>
<th>Information</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>lod</td>
<td>Number</td>
<td>LoD value</td>
</tr>
<tr>
<td>bldgPart</td>
<td>Boolean</td>
<td>True or False</td>
</tr>
<tr>
<td>bldgInformation</td>
<td>Object</td>
<td>List of key value pairs based on building module</td>
</tr>
<tr>
<td>geometry</td>
<td>Object</td>
<td>Geometry object based on GeoJSON specification</td>
</tr>
<tr>
<td>generic</td>
<td>Object</td>
<td>Ad hoc list of key value pairs based on generic module</td>
</tr>
<tr>
<td>address</td>
<td>Object</td>
<td>List of key value pairs based on xAL specification</td>
</tr>
<tr>
<td>links</td>
<td>Object</td>
<td>List of key value pairs regarding links to the parent and child resources</td>
</tr>
<tr>
<td>gmlid</td>
<td>String</td>
<td>Gmlid value</td>
</tr>
<tr>
<td>terrain</td>
<td>String</td>
<td></td>
</tr>
</tbody>
</table>
Case Studies

- simple requests
- advanced requests
- requests + JavaScript

RESULTS
- New approach for retrieving CityGML data incrementally
- Easy to use web service (RESTful)
- Geometry information - GeoJSON specification and not the GML
- Information based

CityGML
Samples of simple requests

1) radiators of room 3 for building 2

.. /bldg/2/rooms/3/installations?usage=1010

2) furniture of room 3 for building 4

.. /bldg/4/rooms/3/furniture
installations (list of installations)

properties: class, usage, function, gmlid, generic, appearance, geometry, links

Filter: class, usage, function, gmlid
Samples of simple requests

1) radiators of room 3 for building 2

`../bldg/2/rooms/3/installations?usage=1010`

2) furniture of room 3 for building 4

`../bldg/4/rooms/3/furniture`
Sample of advanced requests

Doors of the toilet for building 2

1 \rightarrow .../bldg/2/rooms?function=1050 \quad \text{(get the toilet: e.g. 2)}

\text{link}

2 \rightarrow .../bldg/2/rooms/2/doors \quad \text{(get the doors)}
Sample of requests with JavaScript

Number of burned out lamps in the living room for the building with gmlid 2

1. \text{./bldg/2/rooms?function=1000 (get the living room: e.g 3)}

2. \text{./bldg/2/rooms/3/installations?function=3010 (get the lamps of living room)}

```javascript
var Count=0;
response.forEach ( function ( installations ) {
    if ( installations.generic.burned==true )
        Count++;
}
```

RESULTS

New approach for retrieving CityGML data semantically

- Easy to use web service (RESTful)
- Geometry information $\rightarrow$ GeoJSON specification and not the GML
- Information based
future work

Conceptual design of rest main resources

Logical & physical design
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