



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



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Our Motivation



Case Studies

- Simple requests
- Advanced requests
- Requests - Abstraction



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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

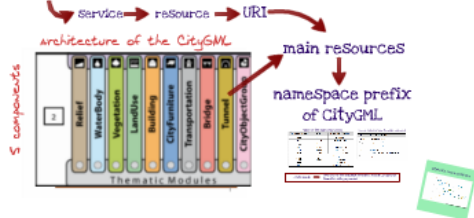
SOAP vs REST

semantically

CityGML RESTful Web Service

GENERAL OVERVIEW AND PRINCIPLES

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



Bldg reSource



the retrieval information
information based and NOT geometry based

Information	Type	Description
Id	Number	1:1D value
BldgPart	Boolean	True or False
BldgInformation	Object	List of key value pairs based on building module
geometry	Object	Geometry object based on GML/3DM specification
generic	Object	Ad hoc list of key value pairs based on generic module
address	Object	List of key value pairs based on IALA specification
links	Object	List of key value pairs providing links to the parent and child resources
guid	String	GUID value
terrain	String	

Bldg resource

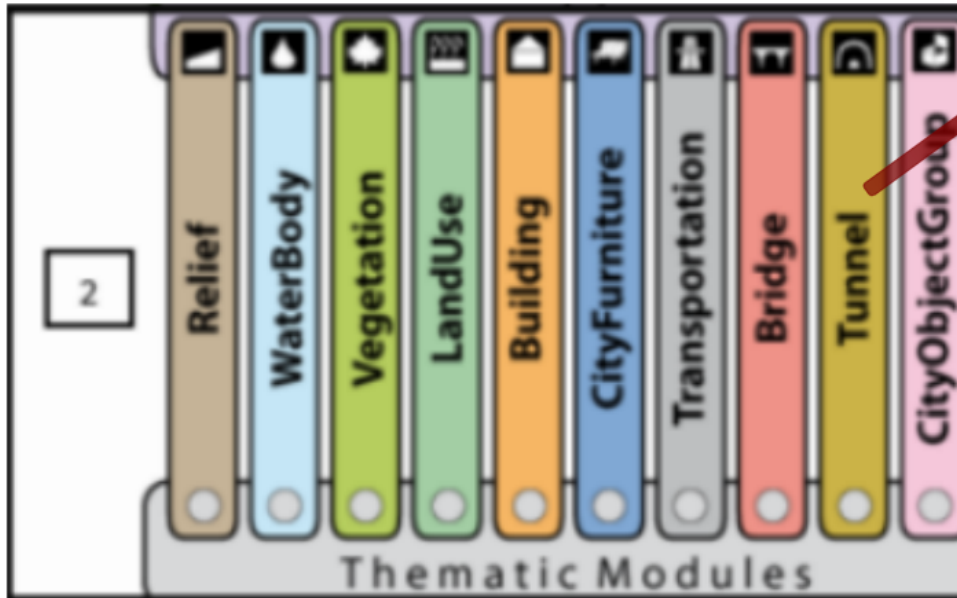
GENERAL OVERVIEW AND PRINCIPLES

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



Architecture of the CityGML

5 components



main reSources

nameSpace prefix of CityGML

Name of the main reSources			General filters of Main Thematic resources	
Resource Name	URI	CityGML Modules	Filter	URI of sample file resources
bldg	/bldg	Buildings	Year	http://www.citygml.org/2008/09/01/
str	/str	Water bodies	Year	http://www.citygml.org/2008/09/01/
dem	/dem	reliefs	City	http://www.citygml.org/2008/09/01/
veg	/veg	Vegetation	Year	http://www.citygml.org/2008/09/01/
luse	/luse	LandUses	Year	http://www.citygml.org/2008/09/01/
fn	/fn	CityFurniture	Year	http://www.citygml.org/2008/09/01/
tran	/tran	Transportations	Year	http://www.citygml.org/2008/09/01/
brdg	/brdg	Bridges	Year	http://www.citygml.org/2008/09/01/
tun	/tun	Tunnels	Year	http://www.citygml.org/2008/09/01/
grp	/grp	CityObjectGroups	Year	http://www.citygml.org/2008/09/01/

./CityModels → Overview of the available thematic models grouped by thematic category model



of CityGML

Name of the main resources

Resource Name	URI	CityGML Modules
bldg	../ bldg	Buildings
wtr	../ wtr	Waterbodies
dems	../ dem	reliefs
veg	../ veg	Vegetation
luse	../ luse	LandUses
frn	../ frn	CityFurniture
tran	../ tran	Transportations
brids	../ brid	Bridges
tun	../ tun	Tunnels
grp	../ grp	CityObjectGroups

General filters of Main Thematic resources

Filter	URI (Example for bldg resource)
Function	../bldg?function=3020
Usage	../ bldg?usage=1010
Class	../ bldg?class =1000
BBox	../ bldg?BBox= 334433.0,4455667.0,445677.0,5566556.0
Lod	/bldg?lod=2

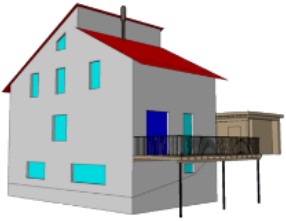
../CityModels



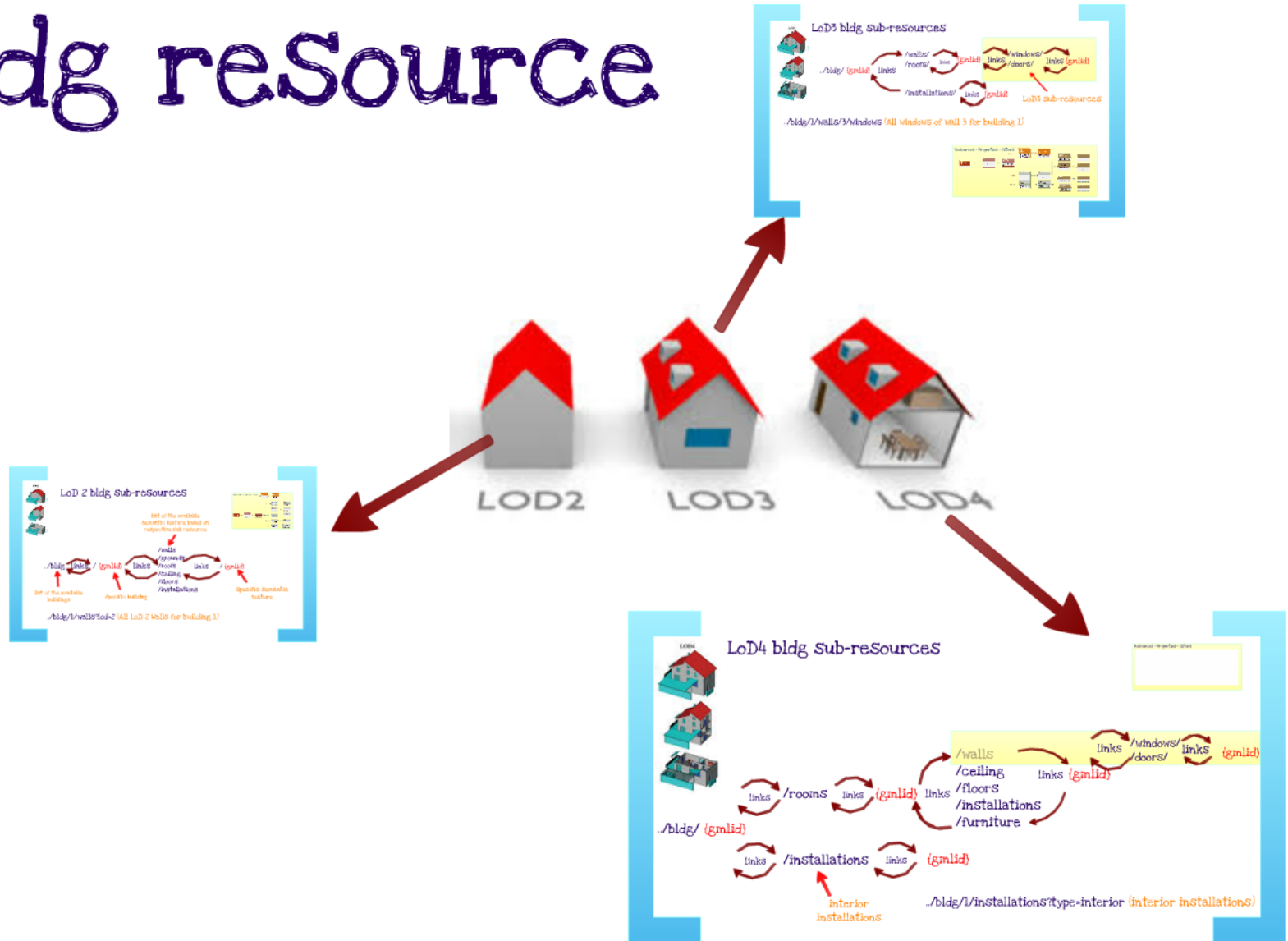
Overview of the available thematic models grouped by thematic category model

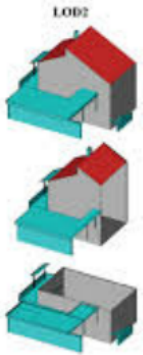
CityModels Resource Schema

```
{
  "type": "object",
  "properties": {
    "thematic": {"type": "string"},
    "counts": {"type": "number"},
    "links": {
      "type": "object",
      "properties": {
        "link": {"type": "string"},
        "rel": {"type": "string"}
      }
    }
  }
}
```

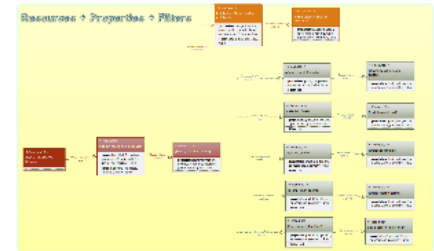


Bldg resource

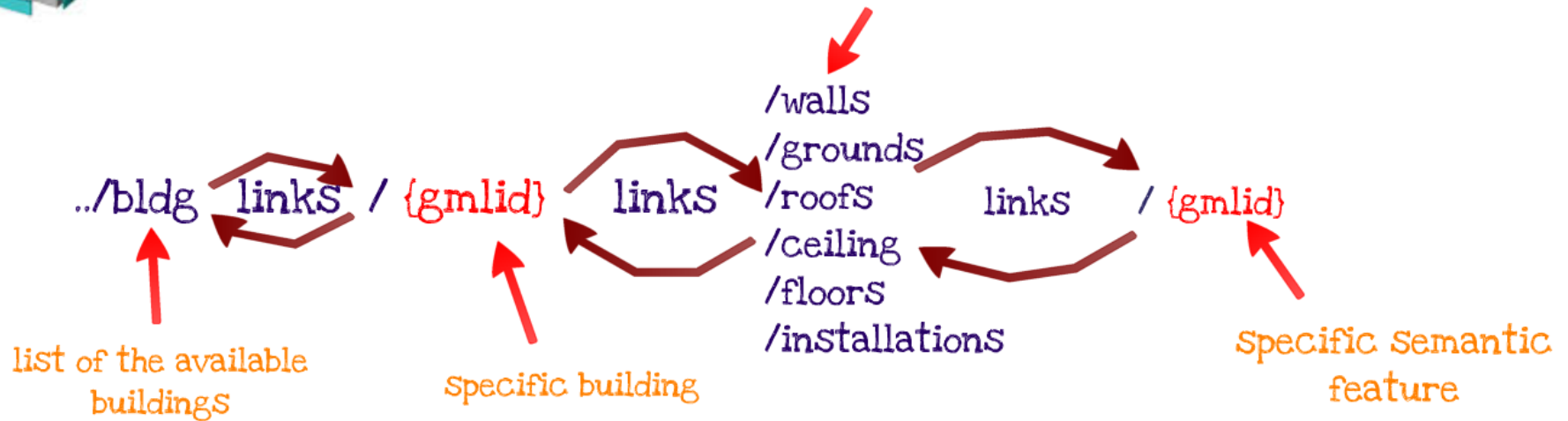




LoD 2 bldg sub-reSources

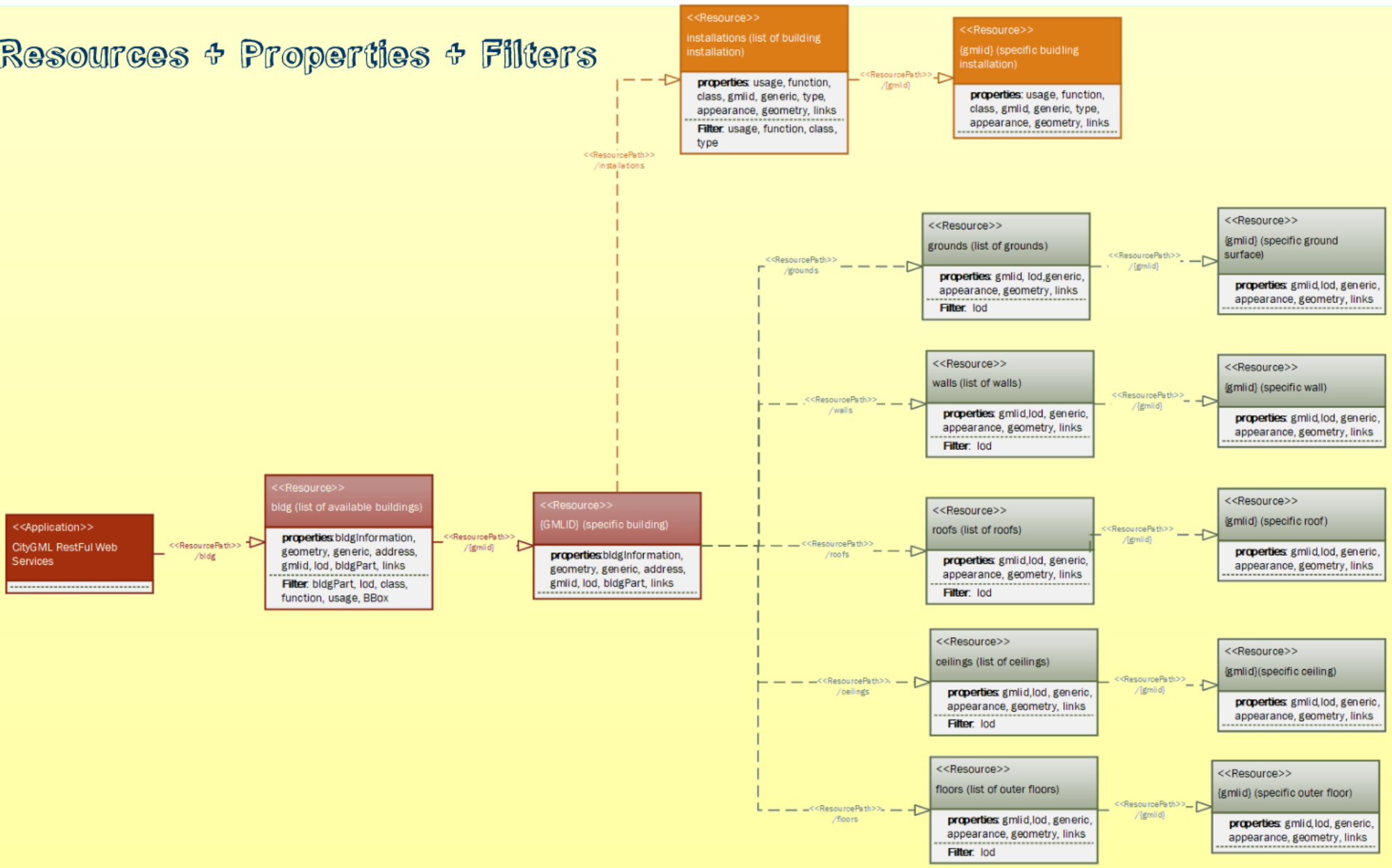


list of the available
semantic feature based on
respective sub resource



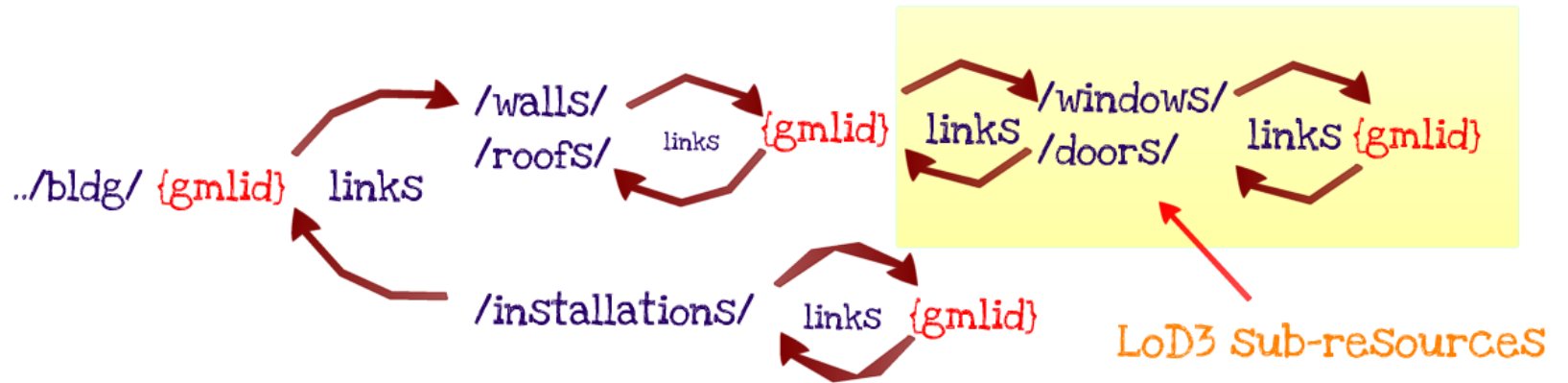
../bldg/1/walls?lod=2 (All LoD 2 walls for building 1)

Resources + Properties + Filters

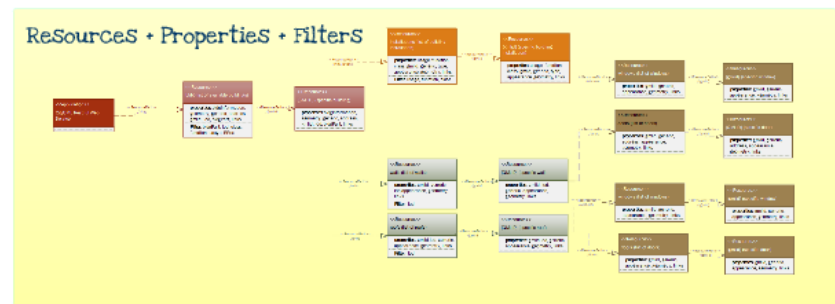




LoD3 bldg sub-resources

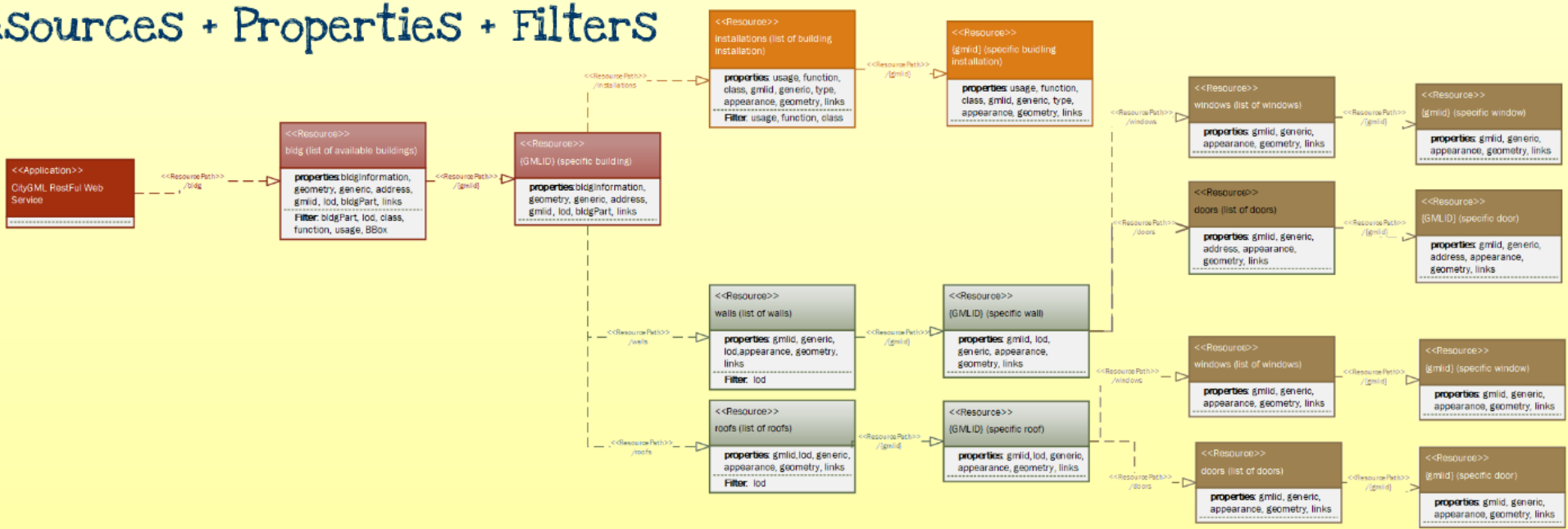


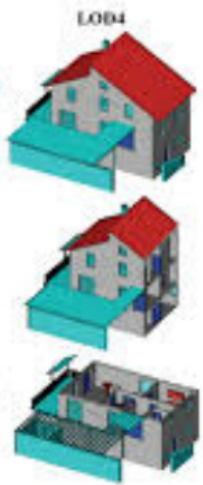
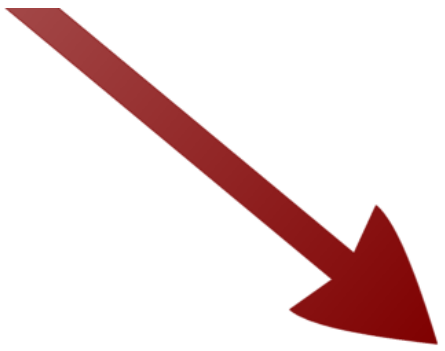
../bldg/1/walls/3/windows (All windows of wall 3 for building 1)



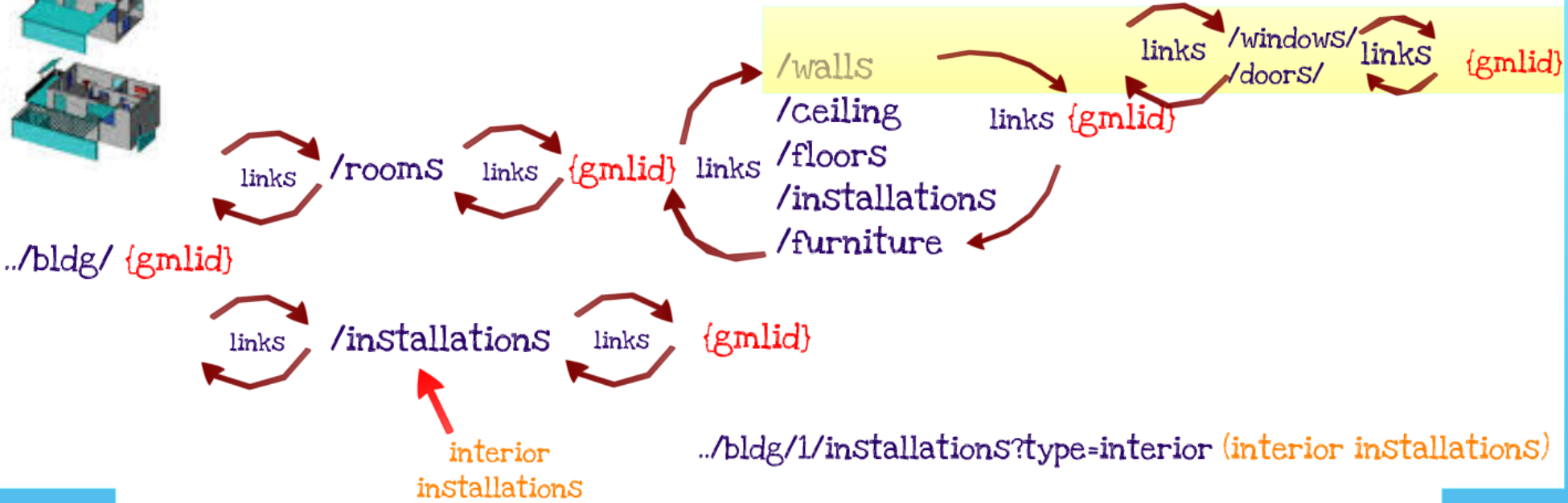
All 3 for building 1)

ReSources + Properties + Filters





LoD4 bldg sub-reSourceS



Wait!



the retrieval information

Information based and NOT geometry based

bldg resource

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

Case Studies

- ▶ simple requests
- ▶ advanced requests
- ▶ requests + JavaScript



RESULTS

New approach for retrieving CityGML data **semantically**



- ▶ Easy to use web service (RESTful)
- ▶ Geometry information → GeoJSON specification and not the GML
- ▶ Information based

CityGML

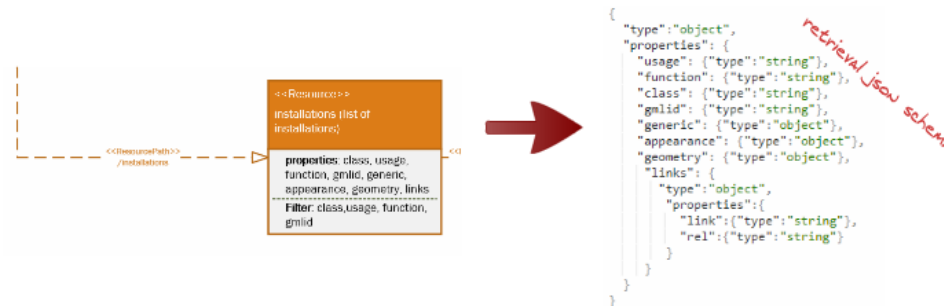


3

Samples of simple requests

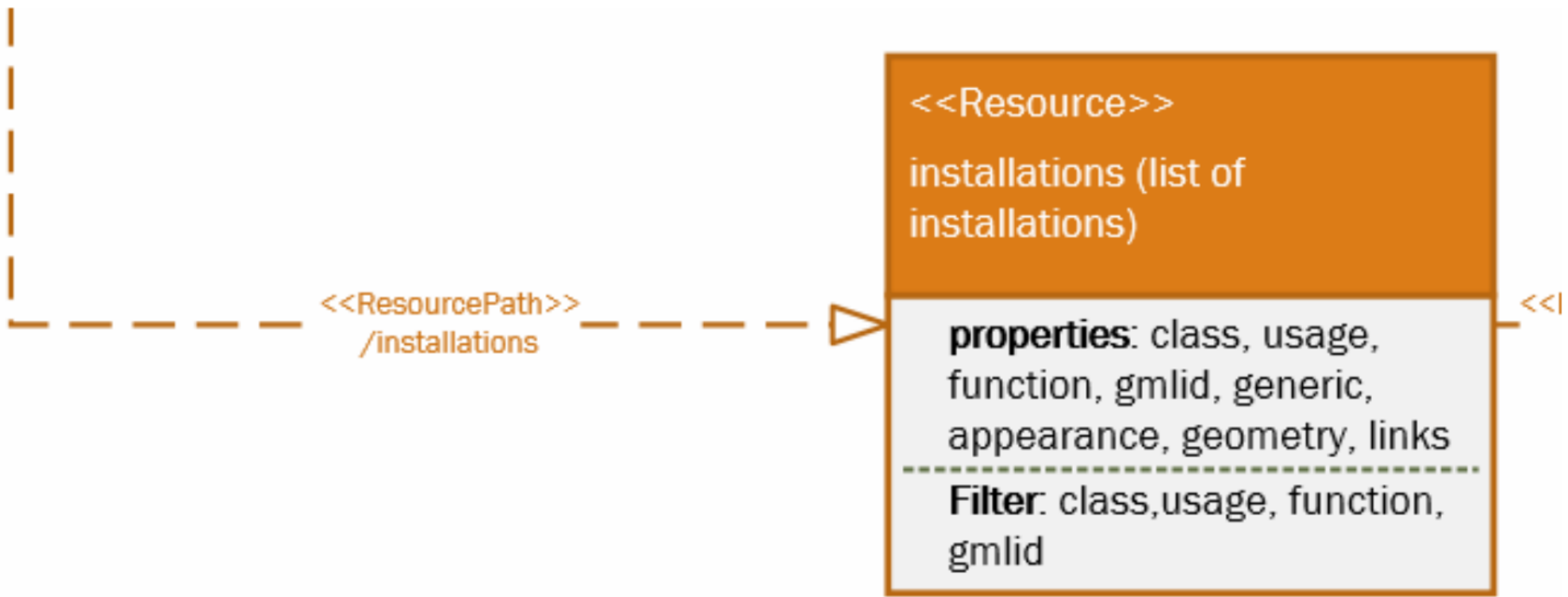
1) radiators of room 3 for building 2

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



2) furniture of room 3 for building 4

../bldg/4/rooms/3/furniture



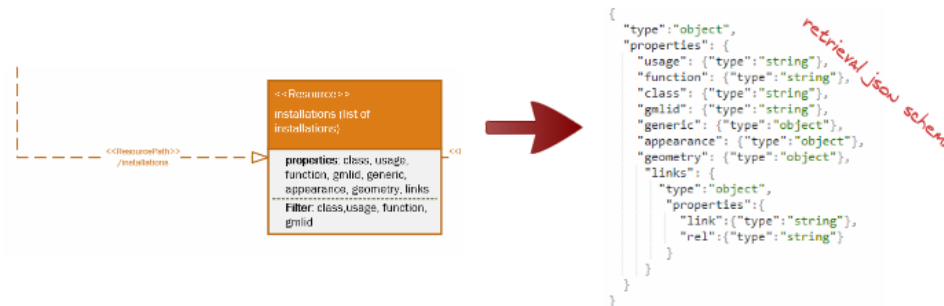
```
{
  "type": "object",
  "properties": {
    "usage": {"type": "string"},
    "function": {"type": "string"},
    "class": {"type": "string"},
    "gmlid": {"type": "string"},
    "generic": {"type": "object"},
    "appearance": {"type": "object"},
    "geometry": {"type": "object"},
    "links": {
      "type": "object",
      "properties": {
        "link": {"type": "string"},
        "rel": {"type": "string"}
      }
    }
  }
}
```

retrieval json schema

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 → .../bldg/2/rooms?function=1050 (get the toilet: e.g 2)

↓ link


2 → .../bldg/2/rooms/2/doors (get the doors)

Sample of requests with JavaScript

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

1 → `.../bldg/2/rooms?function=1000` (get the living room: e.g 3)

2 → `../bldg/2/rooms/3/installations?function=3010`
(get the lamps of living room)



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

JavaScript

RESULTS

New approach
for retrieving CityGML data **Semantically**



- ▶ Easy to use web service (RESTful)
- ▶ Geometry information --> GeoJSON Specification and not the GML
- ▶ Information based

future work

- ▷ Conceptual design of
rest main resources
- ▷ Logical & physical design



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