V3ct3D

Structuring project

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1 From BDTopo to a 3DTile server

In this part, we will focus on how to extract the relevant data from the building set in BDTopo and deal with missing information. The final goal is to fill all the required fields in a 3D Tile.

1.0.1 Description of BDTopo "Bati"

> **Source** : the BDTopo extract that we have used as a basis for our study is freely available at IGN, along with a 200pp document describing the source of data and the meaning of each data attributes.

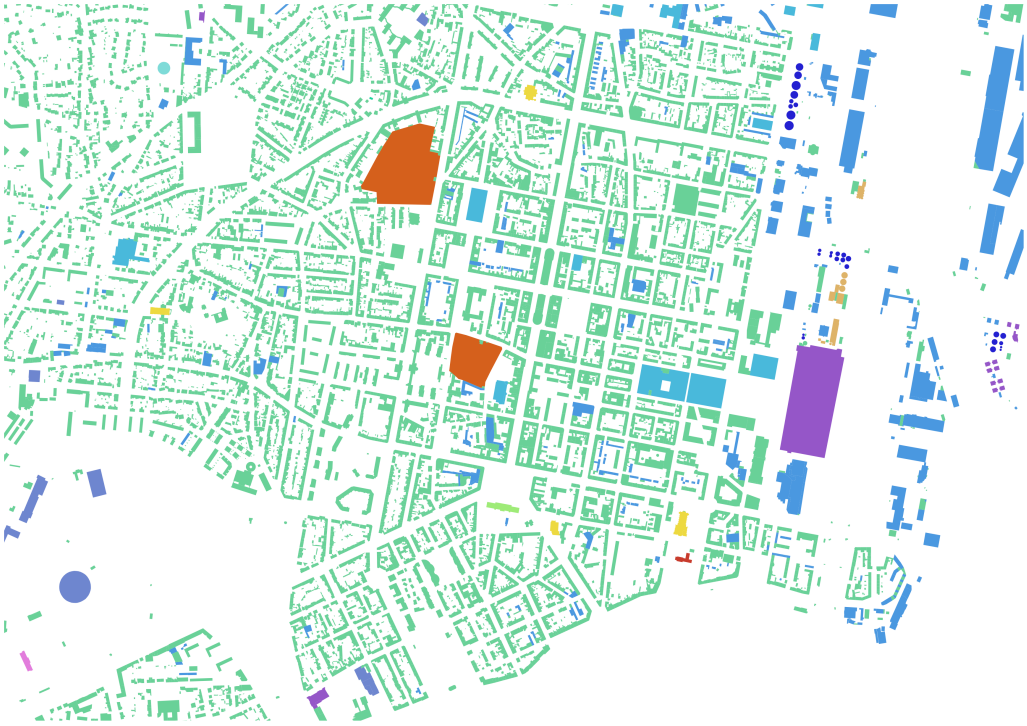
The **"E_BATI"** dataset contains 12 types of buildings (from "industrial" to "graveyard"). They all have the same set of attributes but, for simplicity we only focused on a few buildings. These are : **"BATI_INDUSTRIEL"**, **"BATI_REMARQUABLE"**, **"BATI_INDIFFERENCIE"**, **"CIMETIERE"**, **"LEGERE"**, **"RESERVOIR"**, **"TERRAIN_SPORT"**.

Definition of the attributes : - **ID** : unique id - **PREC_PLANI** and **PREC_ALTI** : respectfully for the precision in positionning and the precision in altitude. The latter depends on the data source (*cadastre* or other) - **ORIGIN_BAT** : the origin of the data (example : *cadastre*) - **HAUTEUR** : height of the building - **Z_MIN** and **Z_MAX** : minimum and maximum height at the gutter level (basically at the base of the roof). For "TERRAIN_SPORT", these fields are replaced by **"Z_MOYEN"**.

> **Note** : The data imported from the *casdastre* has better 2D description and is more detailed than the other data (which have better 3D description and positionning) - *see p82 of BDTOPO_description manual version 2.2*

In addition to those fields, the BDTopo extract that we have provides a geometry : - **wkt_geom** : MultiPolygonZM data with (x,y) in the metric system (Lambert93), and z as the height of the building from sea-level. It provides a full description of the bounding upper surface of the object.

The illustration shows all the data available (from the subset of “E_BATI”)



1.0.2 What is a 3DTile ?

> **Note** : A thorough study of the strengh and current status of Cesium’s proposal regarding 3D Tile as a standard can be found in annex (see document : Summary of Cesium 3D tiles standard proposal). It also provides links to relevant Cesium webpages.

3DTile is an open source specification built on top of glTF (GL Transmission format). glTF is a very efficient way for transmitting and loading 3D content (as a binary stream). More information can be found in annex : Description of glTF.

3D Tile adds, among other things, spatial information and a hierarchy between objects.

In 3D Tiles, a **tileset** is a set of **tiles** organized in a spatial data structure, the **tree**. A tile references a **feature** or set of features, such as 3D models. The **metadata** for each tile - not the actual contents - are defined in JSON, as well as the tileset.

In summary, one tile description includes : - a tile.json with a bounding box definition, information necessary to handle a Hierarchical Level of Detail (HLOD). - a binary file with the description of the object and possibly some textures.

Among the possibilities, **Batched 3D Models** is the best way to describe a building. This format is described in annex : Desciption of B3DM.

1.1 Use case diagrams

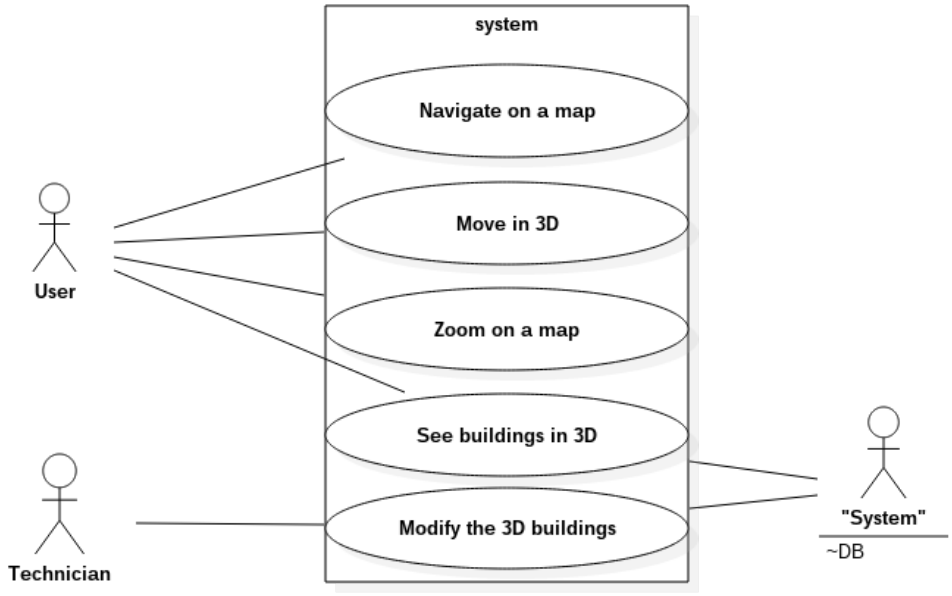
We identify two users for our application : * The general users * The technicians

Our application interacts with an external database that contains the 3DTiles

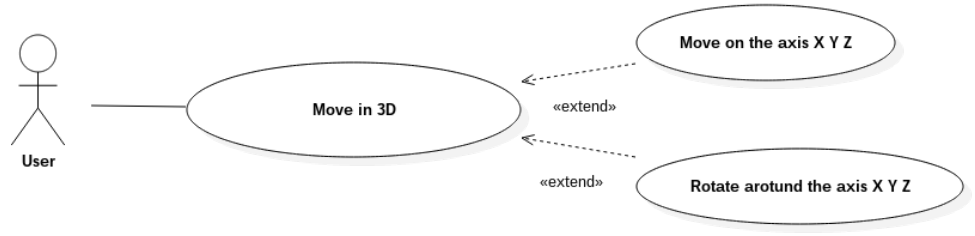
A user can navigate on a map, move in 3D, zoom on a map, see buildings in 3D.

A technician can modify the buildings.

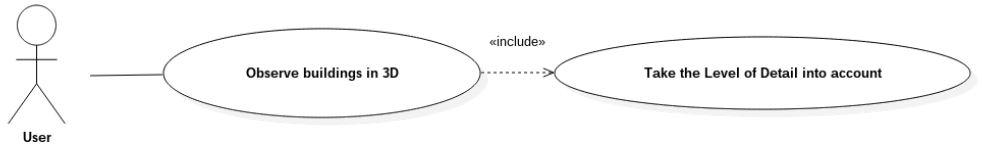
You can find this information in our use case diagram :



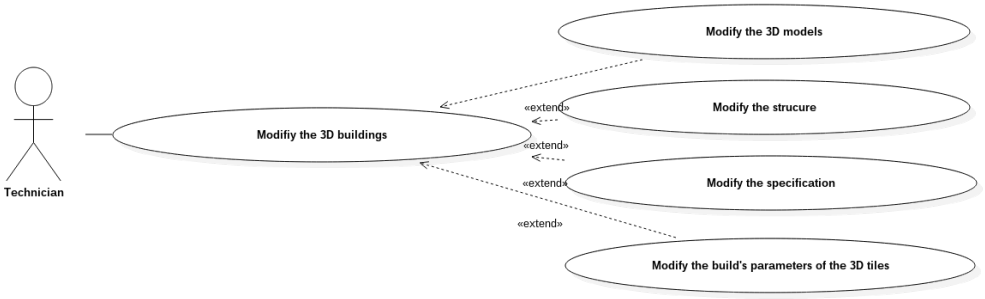
To move in 3D, the user can translate on the axis X,Y,Z and rotate around these axis :



To see buildings in 3D, the system takes the Level of Details in account :



When the technician modifies a building, he can modify the 3D models , the structure, the specification of the building and the build's paramters of the 3D tiles :



You can see our complete use case diagram in the annexes.

1.2 Visualization

In this section, we will describe the process and different parameters used in the visualization of 3d vector tiles. ###Itowns Oslandia had announced the first release of iTowns, a new 3D geospatial data visualization web framework developed by the iTowns project, including people from French IGN, Oslandia and AtolCD .

iTowns is a web framework written in Javascript/WebGL for visualisation of 3D geographic data, allowing precise measurements in 3D. Its first purpose is the visualisation of street view images and terrestrial lidar point clouds, though it now supports much more data types.

1.2.0.1 Technical basis :

- JavaScript
- WebGL
- THREE.JS
- Shaders

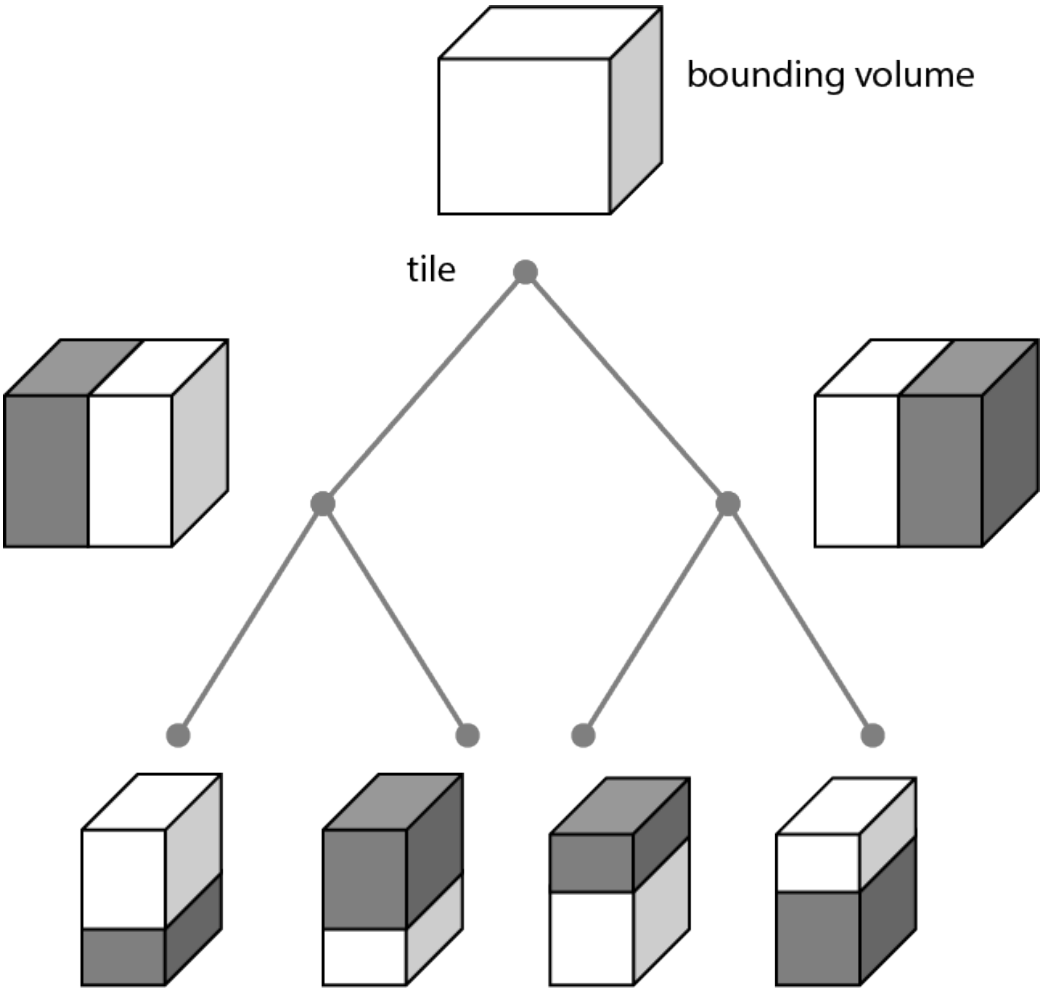
→ iTowns : client-side only

Oslandia is working on iTowns to support the GLTF format for 3d data display. Itowns uses a Javascript 3d library called THREE.JS which serves to load glTF format.

1.2.1 Tileset

Taken from : Tileset

A tileset is a set of tiles organized in a spatial data structure, the tree. Each tile has a bounding volume completely enclosing its contents. The tree has spatial coherence ; the content for child tiles are completely inside the parent's bounding volume. To allow flexibility, the tree can be any spatial data structure with spatial coherence, including k-d trees, quadtrees, octrees, and grids.



1.2.2 LOD

In client side, Level of detail involves decreasing the complexity of a 3D model representation as it moves away from the viewer or according to other metrics such as object importance, viewpoint-relative speed or position. Level of detail techniques increase the efficiency of rendering by decreasing the workload on graphics pipeline stages, usually vertex transformations.

Level Of Details

LOD 01

LOD 02

LOD 03

LOD 04

Tile structures

3D Building

- Roofing
  - Texture
    - 3D Object

Required Data

2D frame contour

LOD 01 + Orthophoto HD

LOD 02 + oblique pictures + Detail of facades

LOD 03 + Architect Plans + Field surveys

Optional Data

Textured DMT

Textured DMT

Textured DMT + Breaking lines

Textured DMT + Breaking lines

Applications

Departement : 3D simple - Map of the noises - Flood Map

Agglomeration : Facilities - Modelization - Simulation

City : Urbanism - Communication - Tourism

City Heart : Immersion - Networks - Security

1.2.3 Process

When the user launches iTowns, The view is initialized by a global tileset. The zoom level determines a bounding box of a tileset.

Each tileset is characterized by an identifier which is included in the request with the level of detail LOD.

The response to the request is a 3dtiles format which contains a gltf file that is required for display and can be loaded using the three.js library : GLTFLoader.js

The cache contains a copy of the original data when it is expensive to retrieve compared to cache access time. Once some 3d vector tiles are stored in the

cache, the client can access them directly through the cache rather than retrieving them by requests, which reduces the access time.