

Virtual Leodium : une tentative de modélisation spatio-temporelle 3D de l'information historique relative à l'urbanisme liégeois

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Plan de la présentation

- Introduction
- VL : genèse et réalisation
- VL : modèle de données
- Perspectives : temporalité
- Perspectives : évènement
- Perspectives : identité
- Perspectives : modèle simple
- Conclusions

INTRODUCTION

- La géomatique à Liège
- Les liens avec l'archéologie

La géomatique

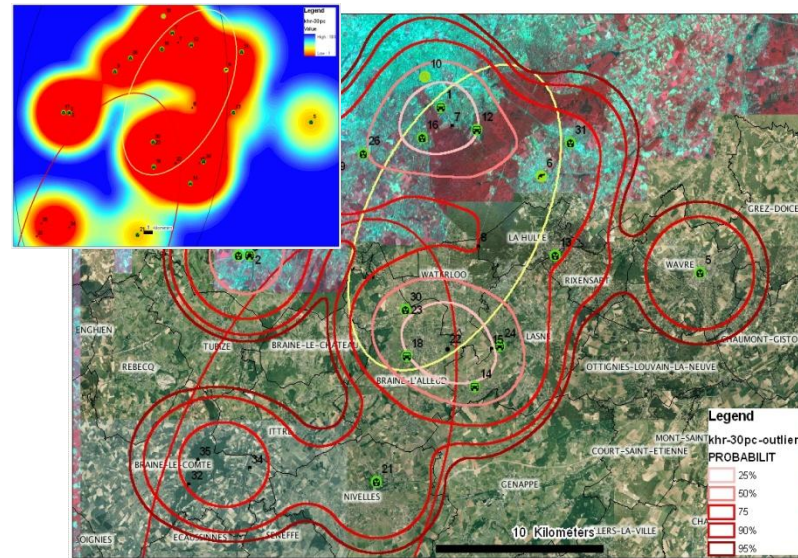
- La géomatique est une discipline ayant pour objet la **gestion des données à référence spatiale**. Elle fait appel aux sciences et technologies liées à leur acquisition, leur stockage, leur traitement et leur diffusion.
- La géomatique repose principalement sur des disciplines comme la topométrie, la cartographie, la géodésie, la photogrammétrie, la télédétection et l'informatique

La géomatique à l'ULg

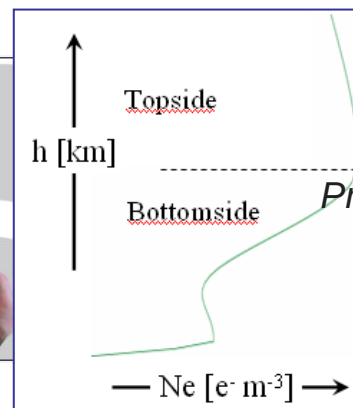
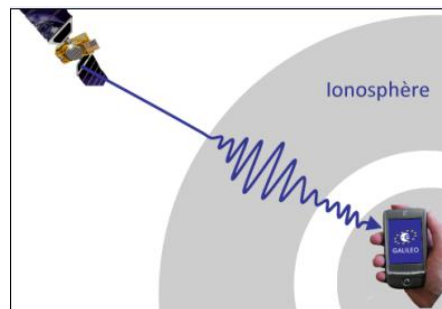
- ▶ 4 académiques (SIG / Topo / GNSS / Télédé)
- ▶ 15 chercheurs
 - ▶ Contrats communautaires, régionaux et européens
- ▶ Nombreuses publications internationales
- ▶ Matériels spécifiques (enseignement et recherche)



Classification des bâtiments
extraits d'images
satellitaires
stéréo à très haute
résolution



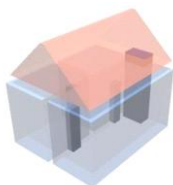
Analyse densimétrique d'activités criminelles
(« Tueurs du Brabant »)



Profil de densité électronique affectant
la propagation des signaux GNSS



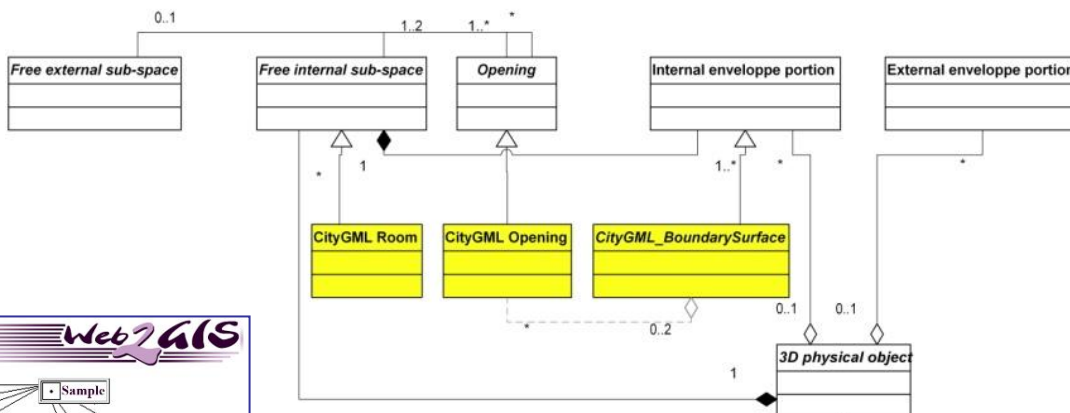
Indoor LoD 1



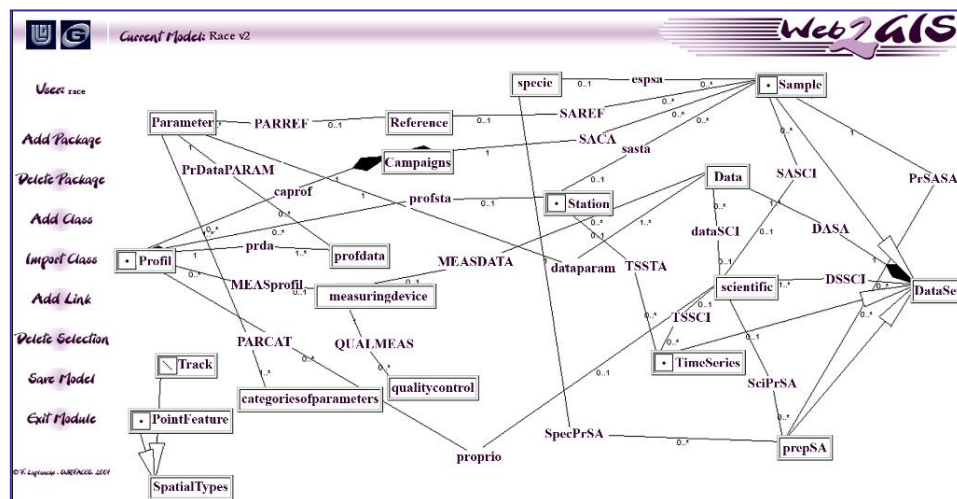
Indoor LoD 2



Indoor LoD 3

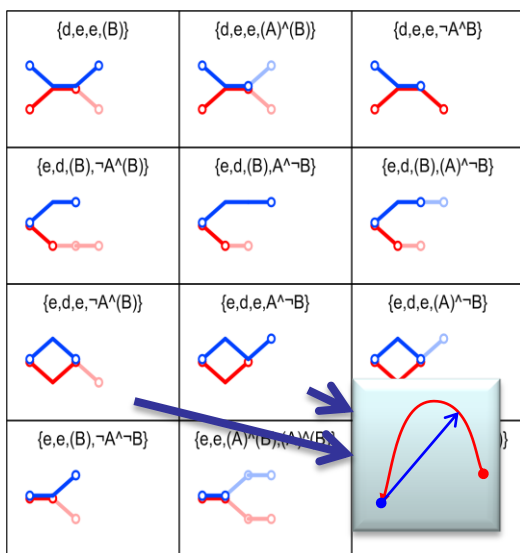


Modélisation 3D
utilisant CityGML
enrichi

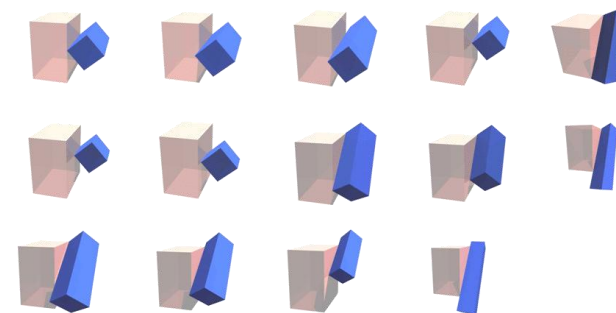
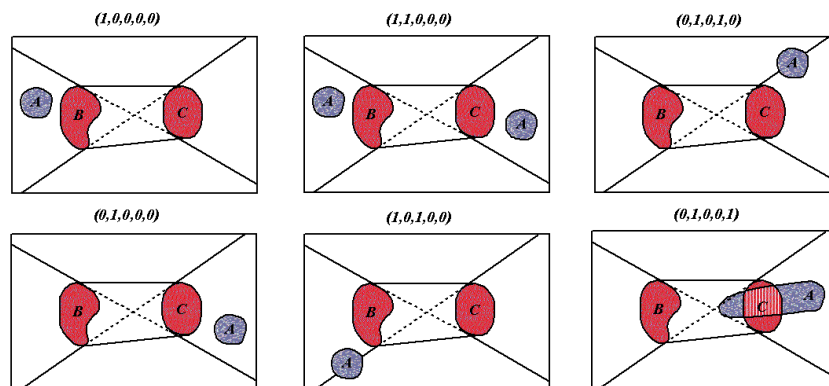


Logiciel Web2GIS (ULg) de conception et gestion de SIG

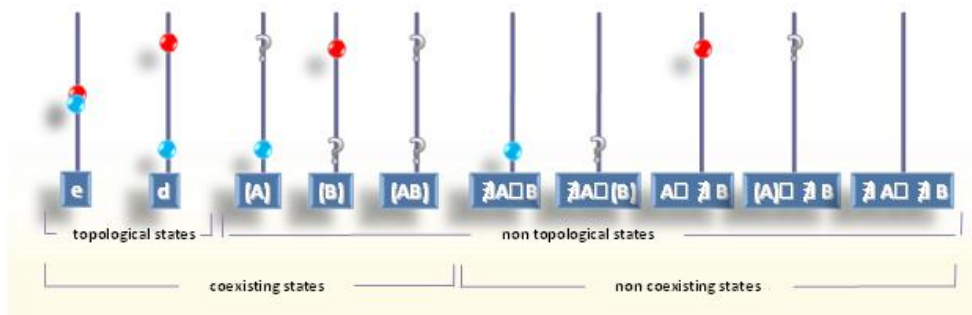
Modèle basé sur la notion d'état spatio-temporel

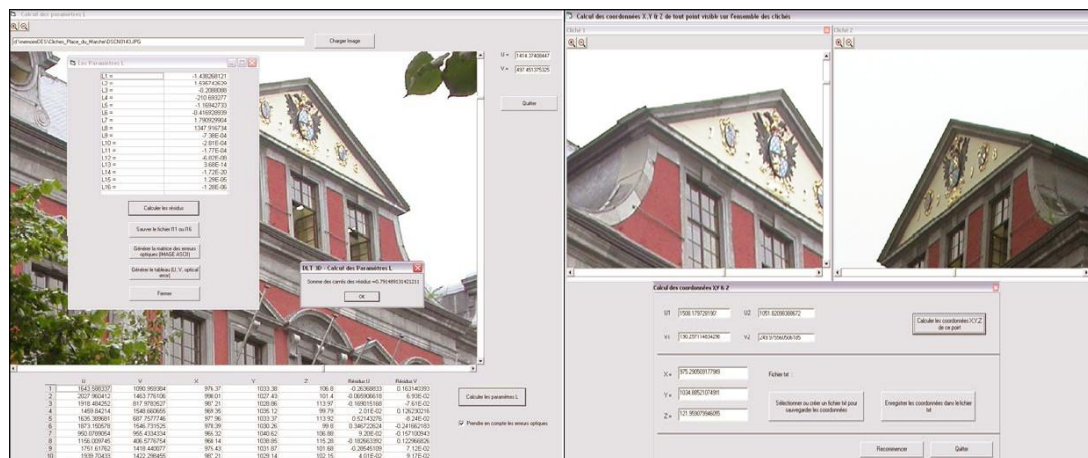


Modèle de relations projectives ternaires



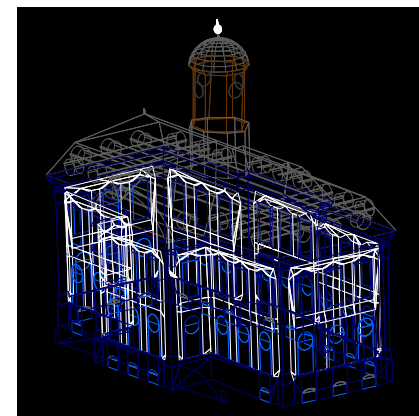
Modèle de relations topologiques 3D





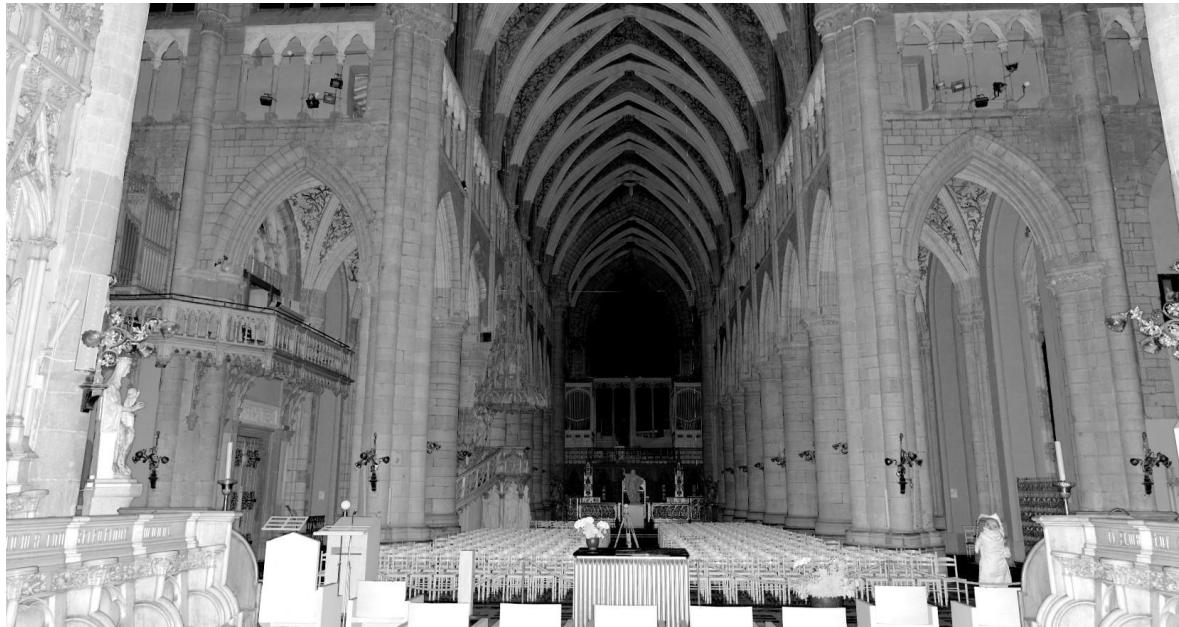
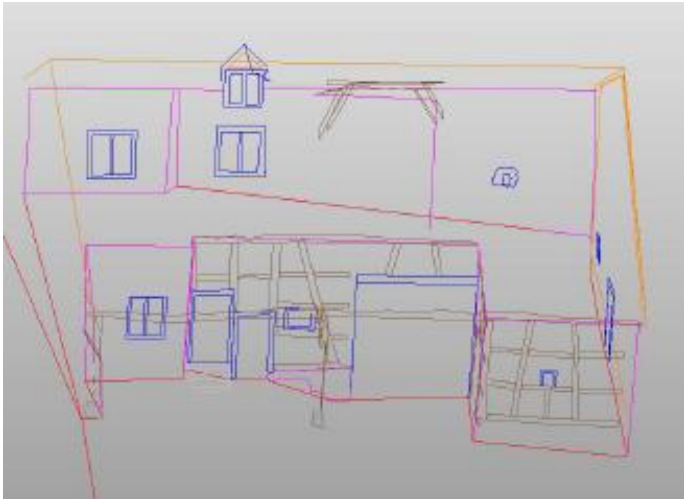
Logiciel (ULg) de levé rapide topo-photographique

Reconstitution 3D par photogrammétrie terrestre



Reconstitution 3D par Lasergrammétrie terrestre



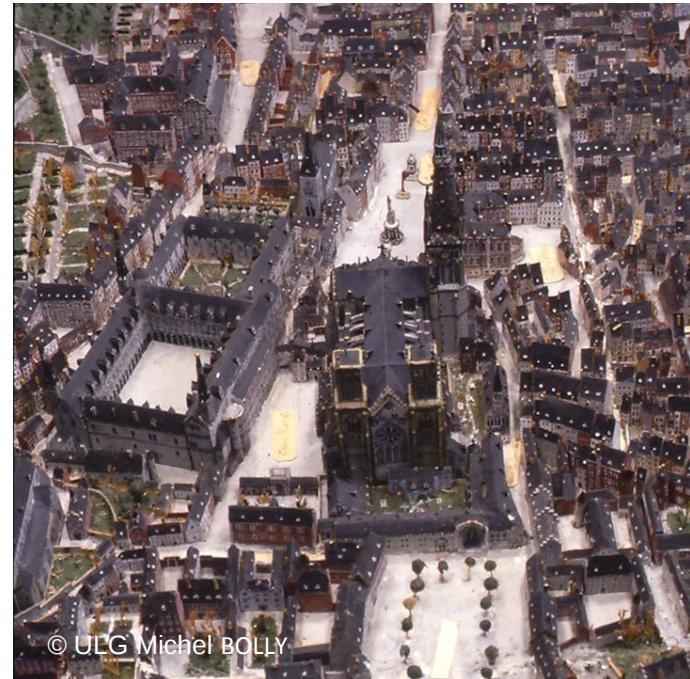
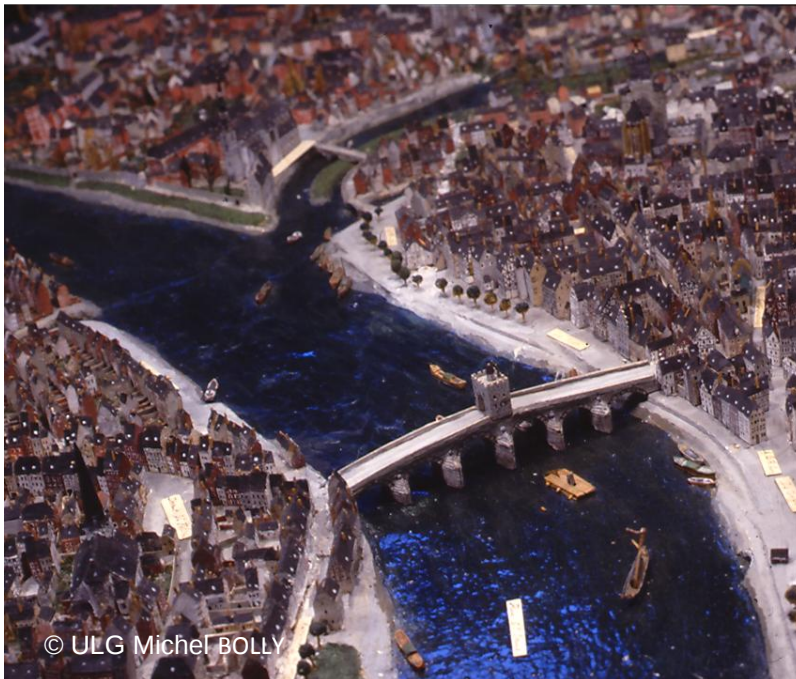


VL : GENÈSE ET RÉALISATION

- La maquette
- L'acquisition de données
- La chaîne de production
- Un projet similaire : « Nantes 1900 »

Virtual Leodium

- The ***Artistic Collections of the University of Liège*** host a wonderful model which was built by Gustave Ruhl-Hauzeur : « *La cité de Liège vers 1730* »
- It represents the central part of the city of Liège (scale 1/1200) in the eighteenth century.

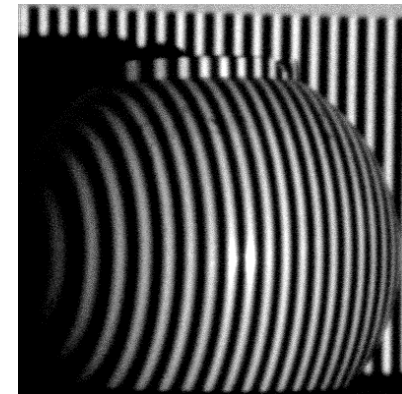
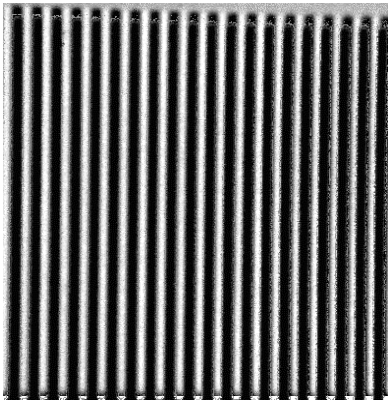


Virtual Leodium

- The project consists in creating two models out of the Ruhl master piece:
 - a digital surface model combining geometry and chromatic information (texture)
 - a geo-info model (or geographical information model) composed of 3D vectors objects on which semantic information can be added.
- Objectives
 - to increase and improve accessibility to the historical model
 - to offer conservation advantages
 - to provide new archaeological scientific discoveries
 - to improve laserscanning methodology
 - to study semantical enrichment of 3D urban models

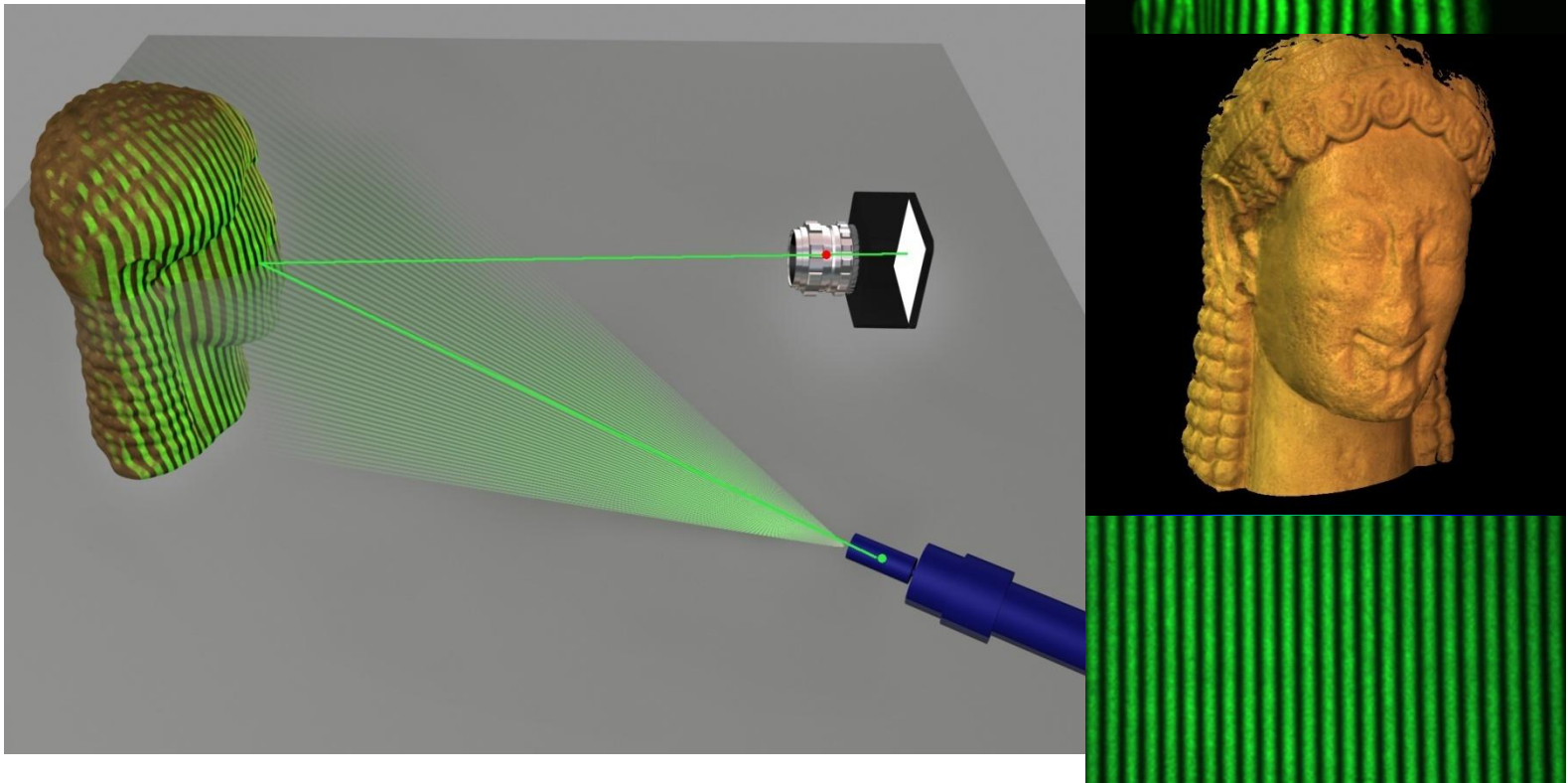
Virtual Leodium

- *Fringe-pattern 3D scanner built at the University of Liège*
(Renotte *et al.*)
- In order to obtain a digital surface model, a specific technique called projected-fringes is used
 - Optical Moiré technique



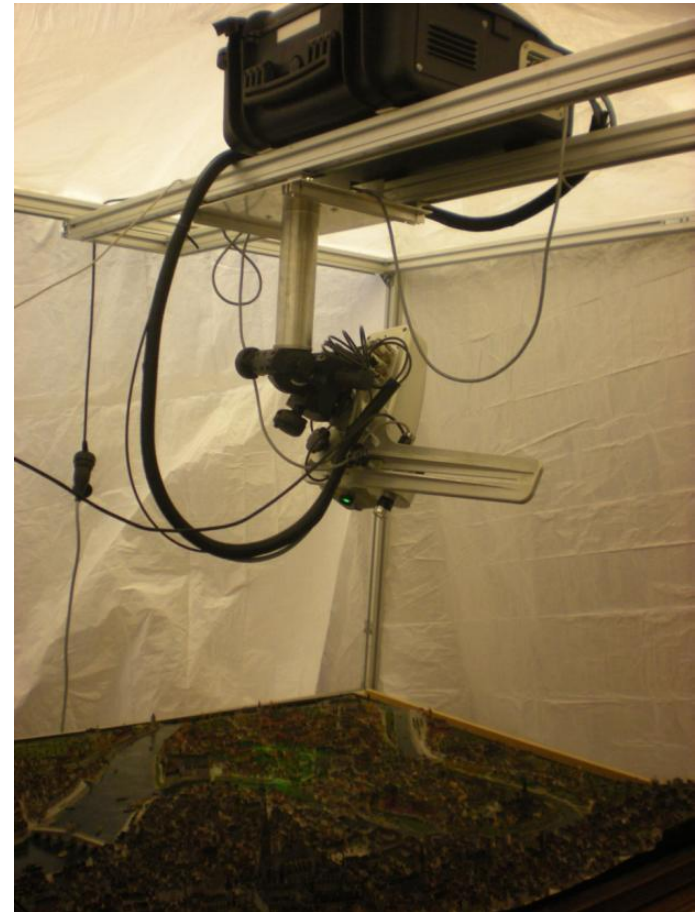
Virtual Leodium

- Whole-field triangulation technique



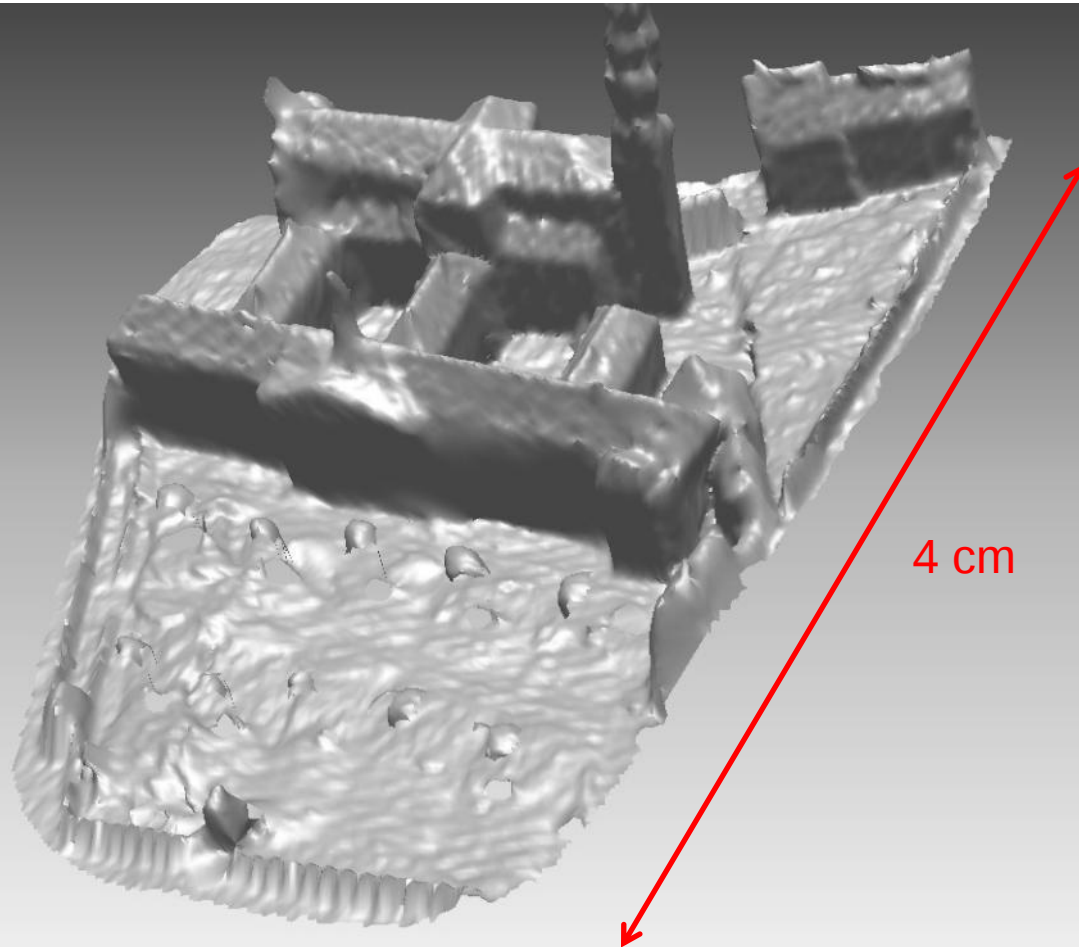
Virtual Leodium

The whole model has been scanned in several pieces and through several positions (vertical, front, back, left side, right side). The result is more than 650 individual scans which then need to be cleaned and merged.



Virtual Leodium

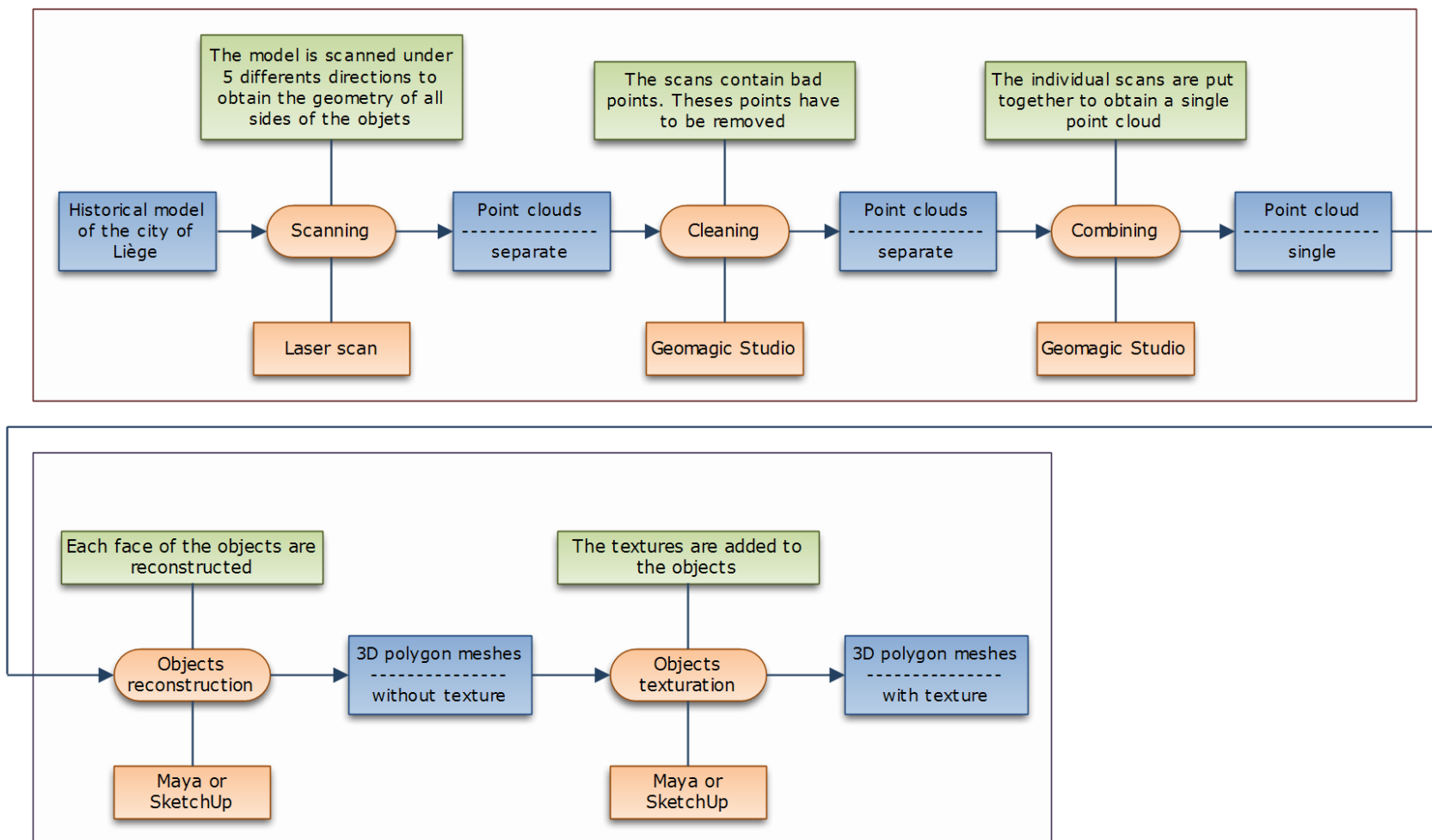
Perspective



Virtual Leodium

- From the digital surface model and pictures of the Rhul's model, we derive 3D geo-objects
 - A 3D geo-database is created following the CityGML format (OpenGIS consortium standard)
 - The application is developed in Java. It relies on ArcGIS 10 for storing our geometries and the semantic data. It also takes benefits from the ArcScene API available in Java for displaying and navigating in the 3D scene.
 - Our motivations:
 - Interoperability
 - Geo-object will be the container of archaeological information
- towards an archaeological information system

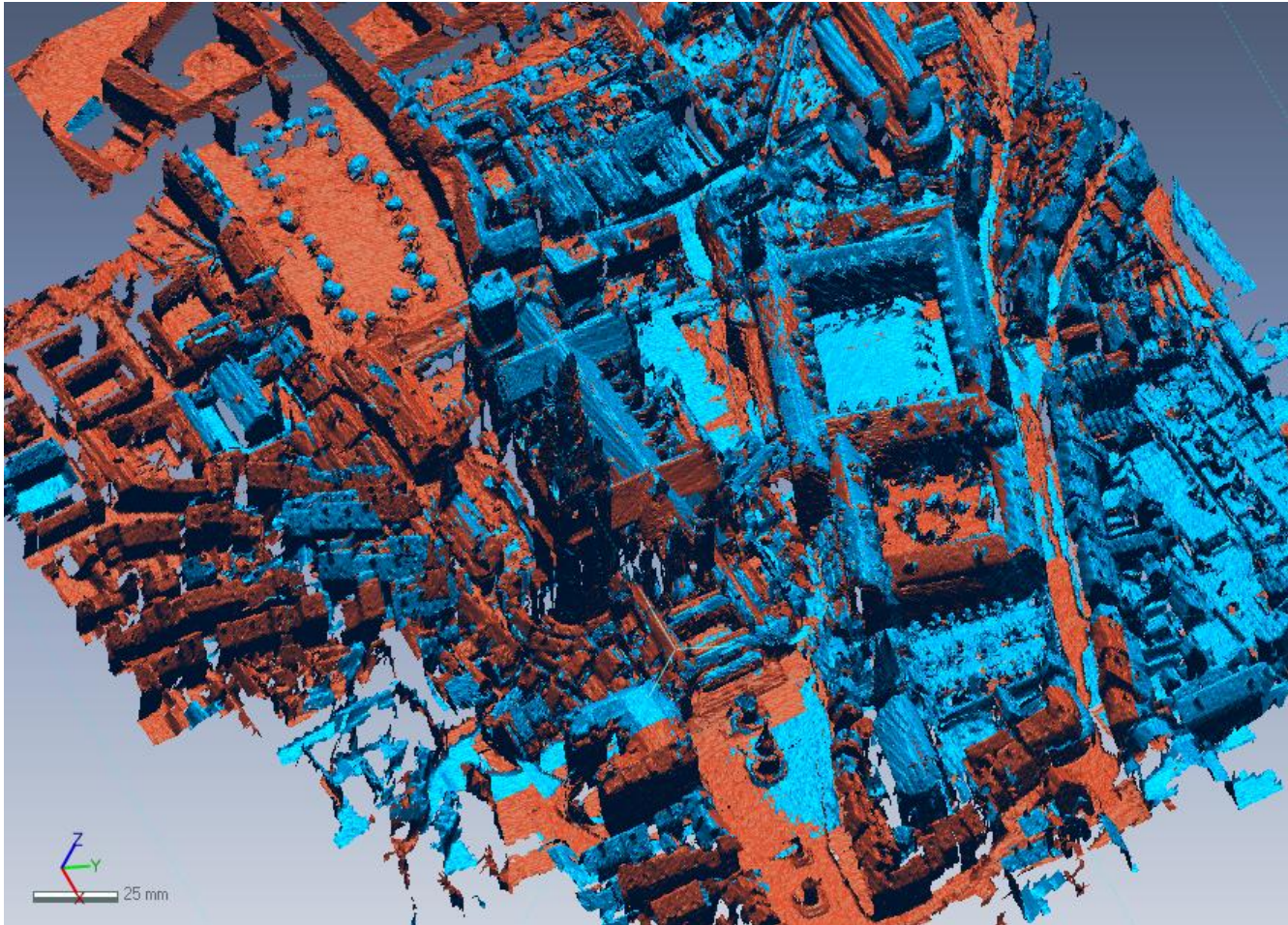
Virtual Leodium



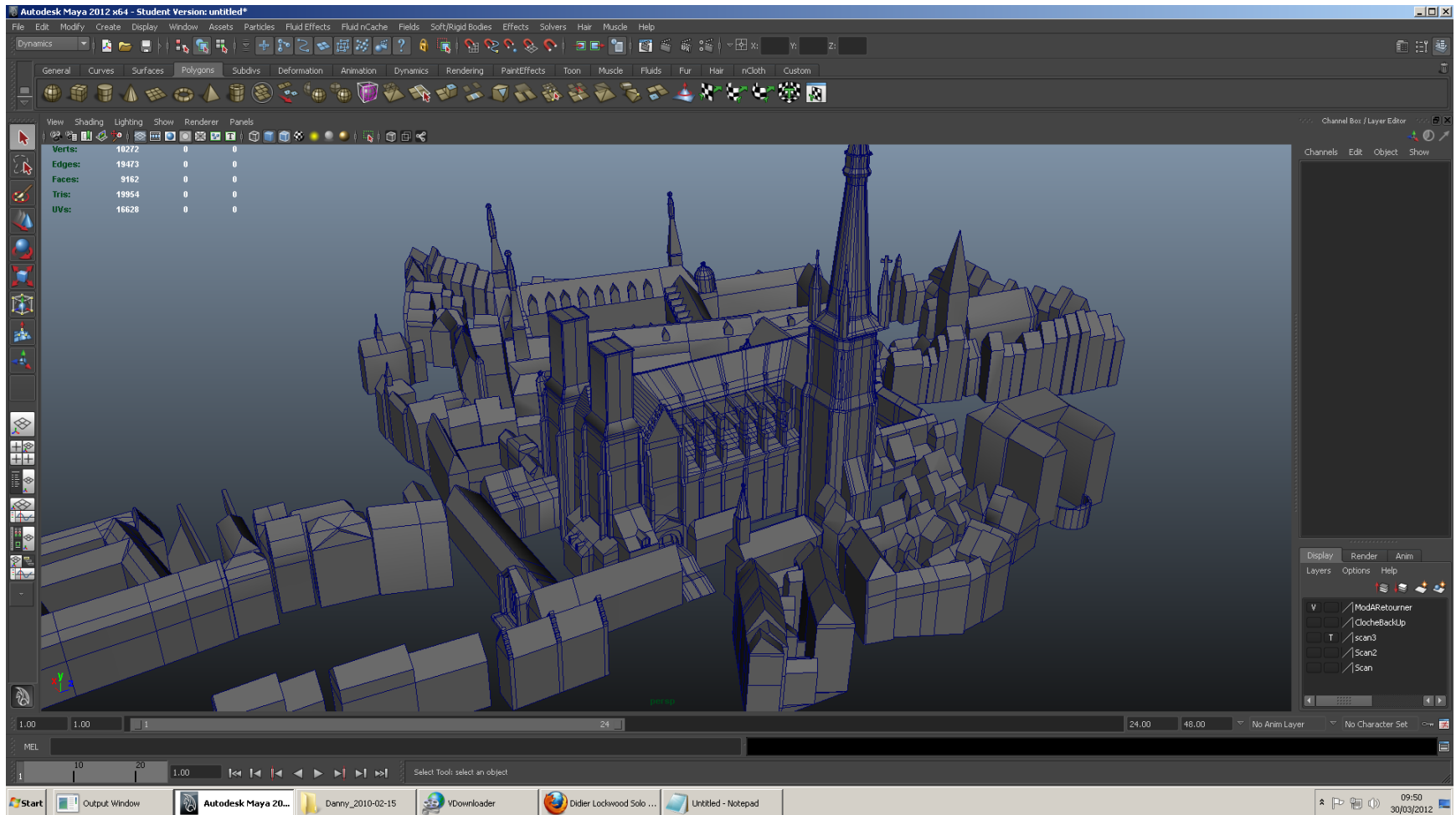
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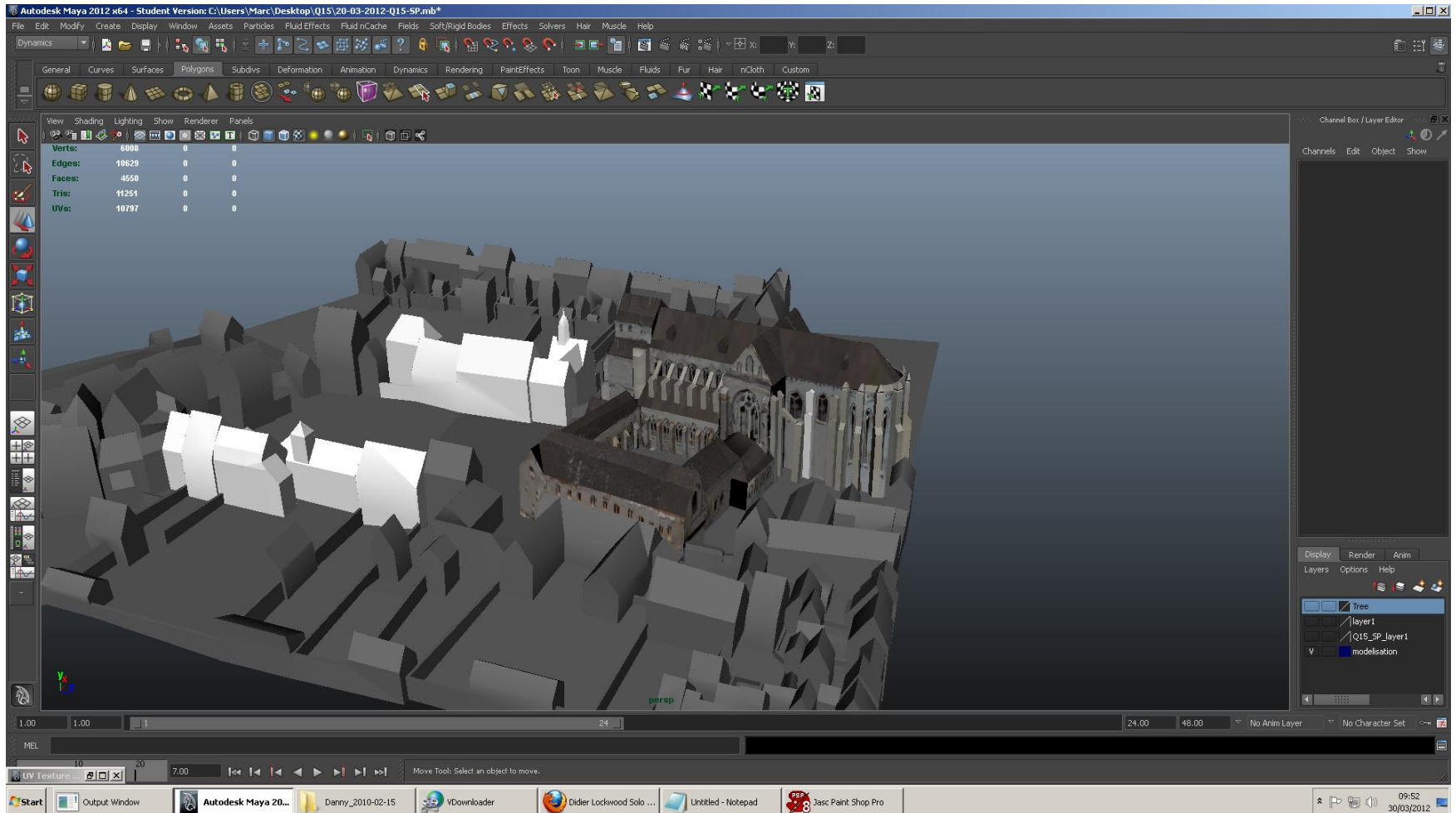
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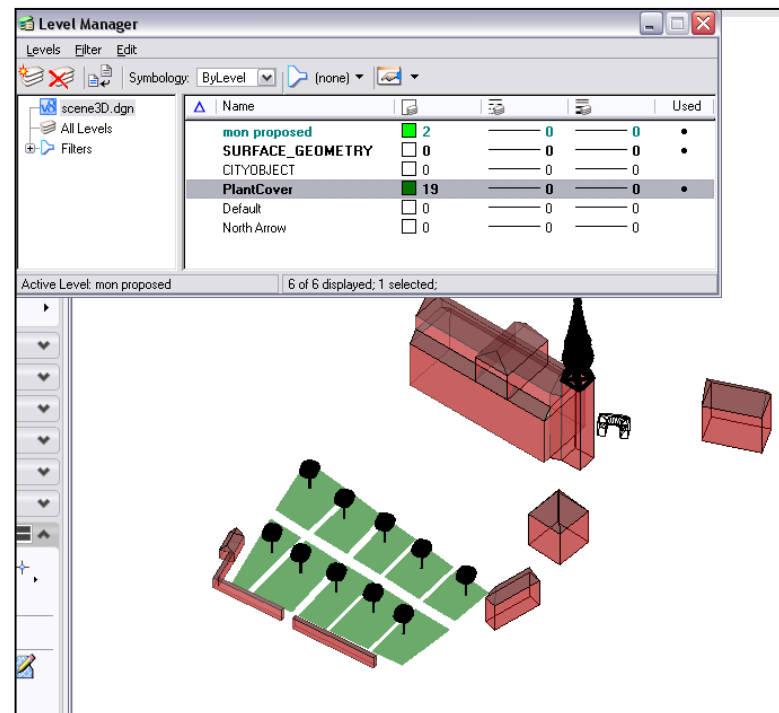
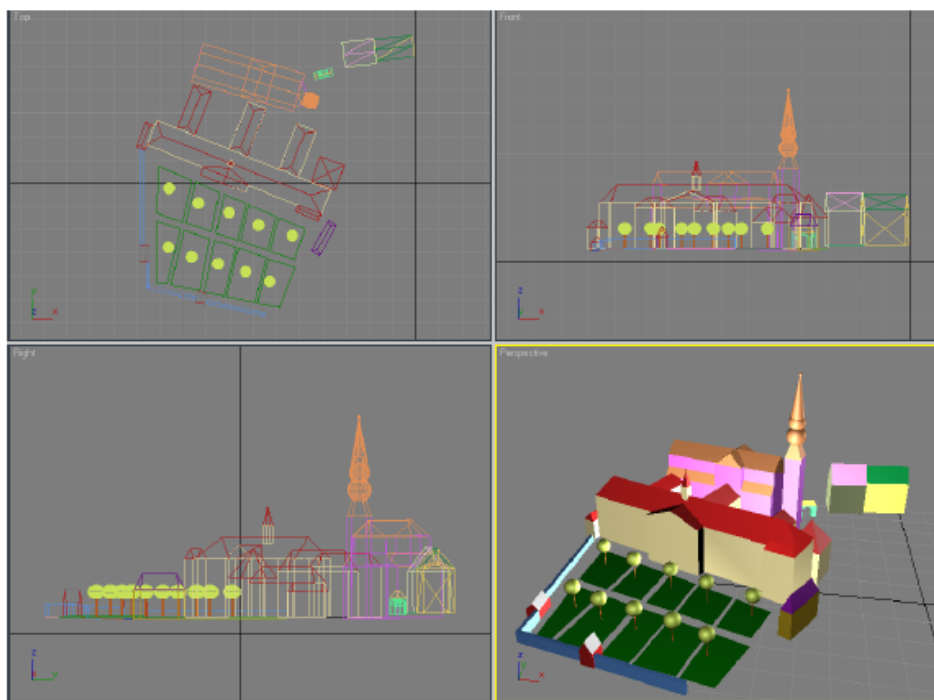
Virtual Leodium



Virtual Leodium



Virtual Leodium



Nantes1900 project

A scientific and pedagogical project with a great Museum

physical mock-up of Nantes harbour built in 1899 (9.20 meters long and 1.85 meters wide - scale approximately 1/500)



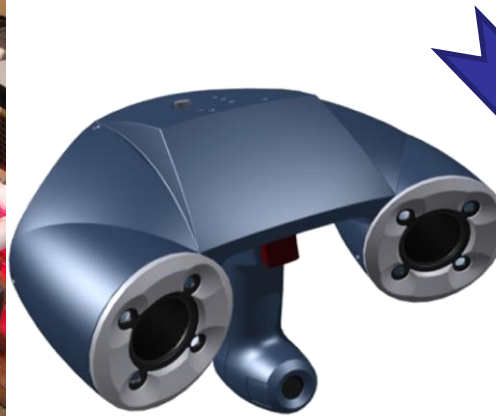
Polytech Nantes

Centre François Viète
Épistémologie et histoire
des sciences et des techniques
Université de Nantes



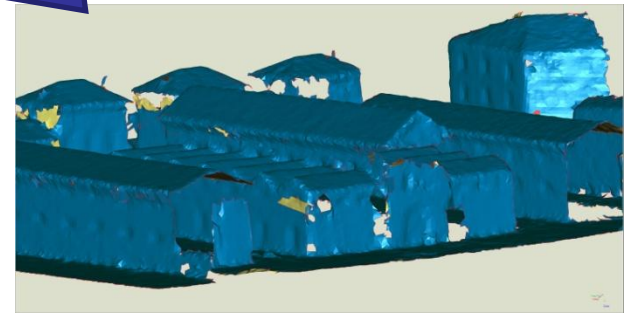
UMR CNRS 6597

Nantes 1900



HandyScan

STL cloud of points

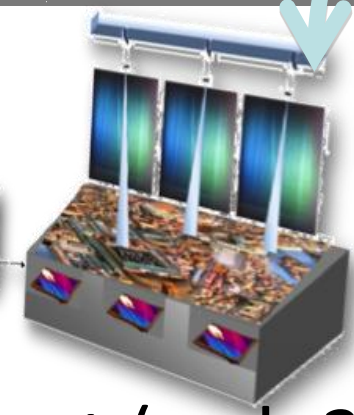
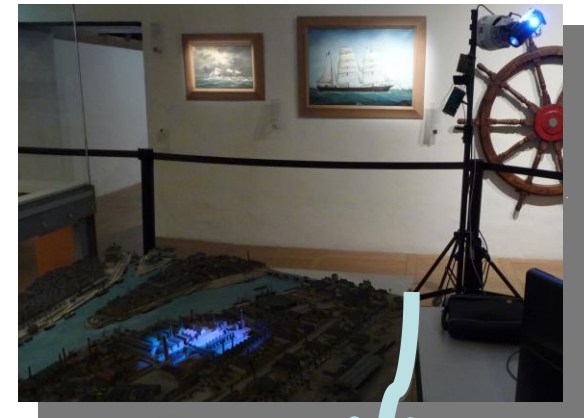
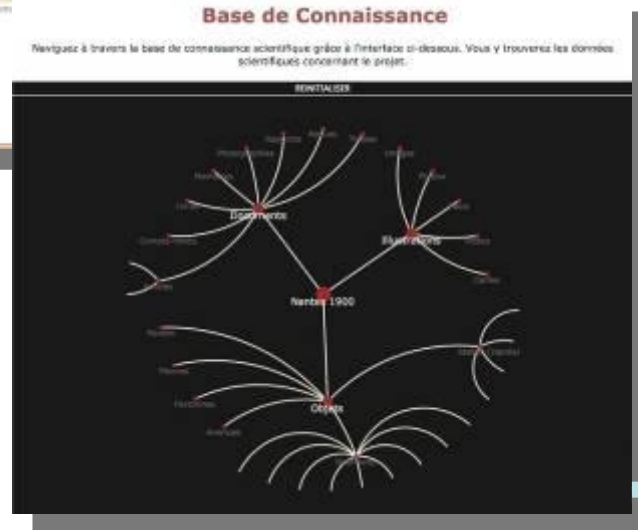


Nantes 1900

Create interaction between real object and virtual artifact



User (web or visitor) can chose himself the deepness of information.



Knowledge database / Semantic request (web 3.0)

VL : MODÈLE DE DONNÉES

- Le modèle géo – inspiré par CityGML
- Le modèle « archéo »
- La problématique globale – croiser l'info sur le milieu urbain

The geo-info model

- From the digital surface model and pictures of the Rhul's model, we will derive 3D geo-objects
 - A 3D geo-database will be created following the CityGML format (OpenGIS consortium standard)
 - Our motivations:
 - Interoperability
 - Geo-object will be the container of archaeological information
- towards an archaeological information system

The geo-info model

- CityGML

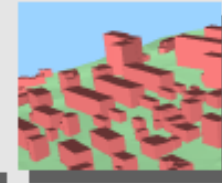
LOD 0 – Regional model

- ▶ 2.5D Digital Terrain Model



LOD 1 – City / Site model

- ▶ “block model” w/o roof structures



LOD 2 – City / Site model

- ▶ textured, differentiated roof structures



LOD 3 – City / Site model

- ▶ detailed architecture model



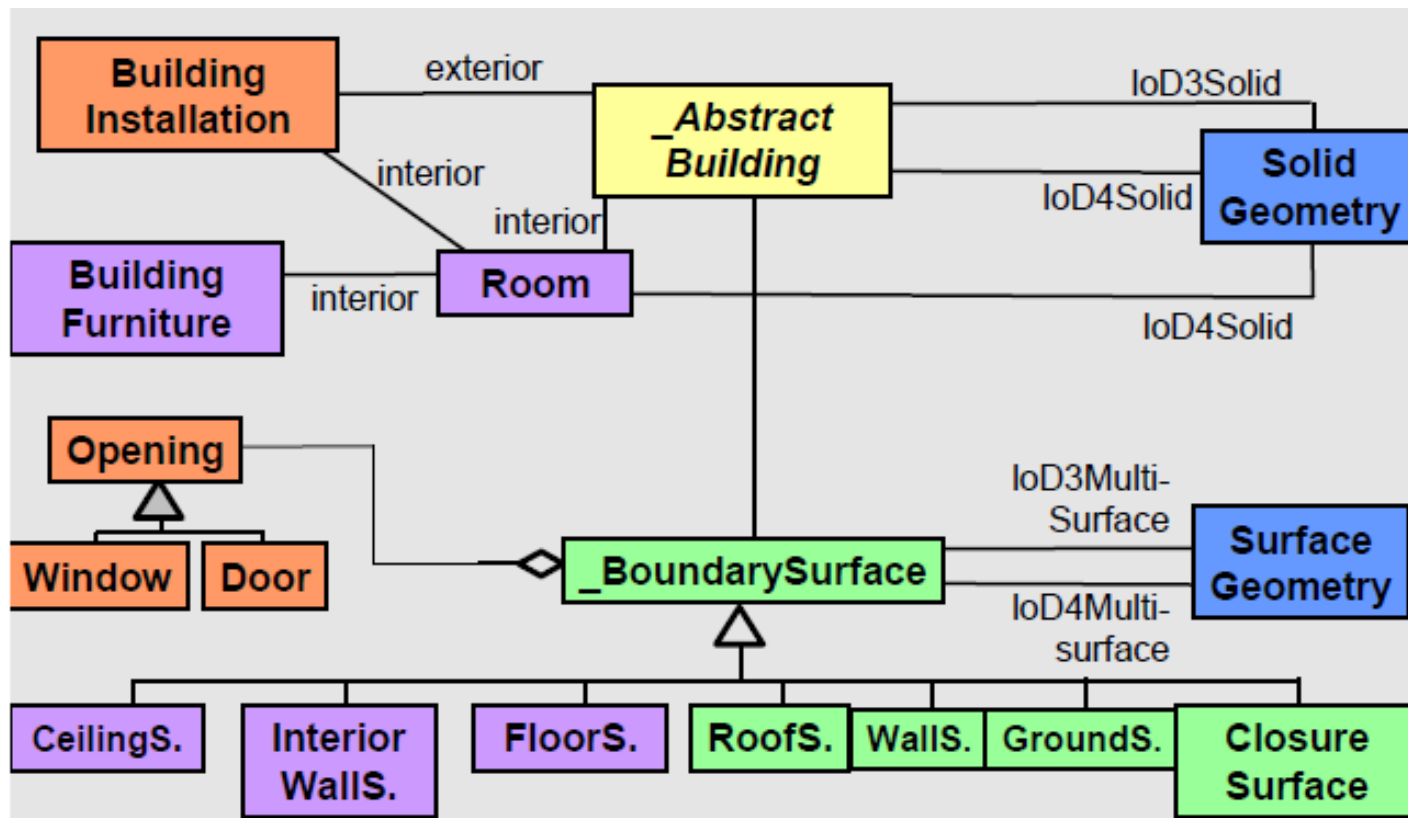
LOD 4 – Interior model

- ▶ “walkable” architecture models



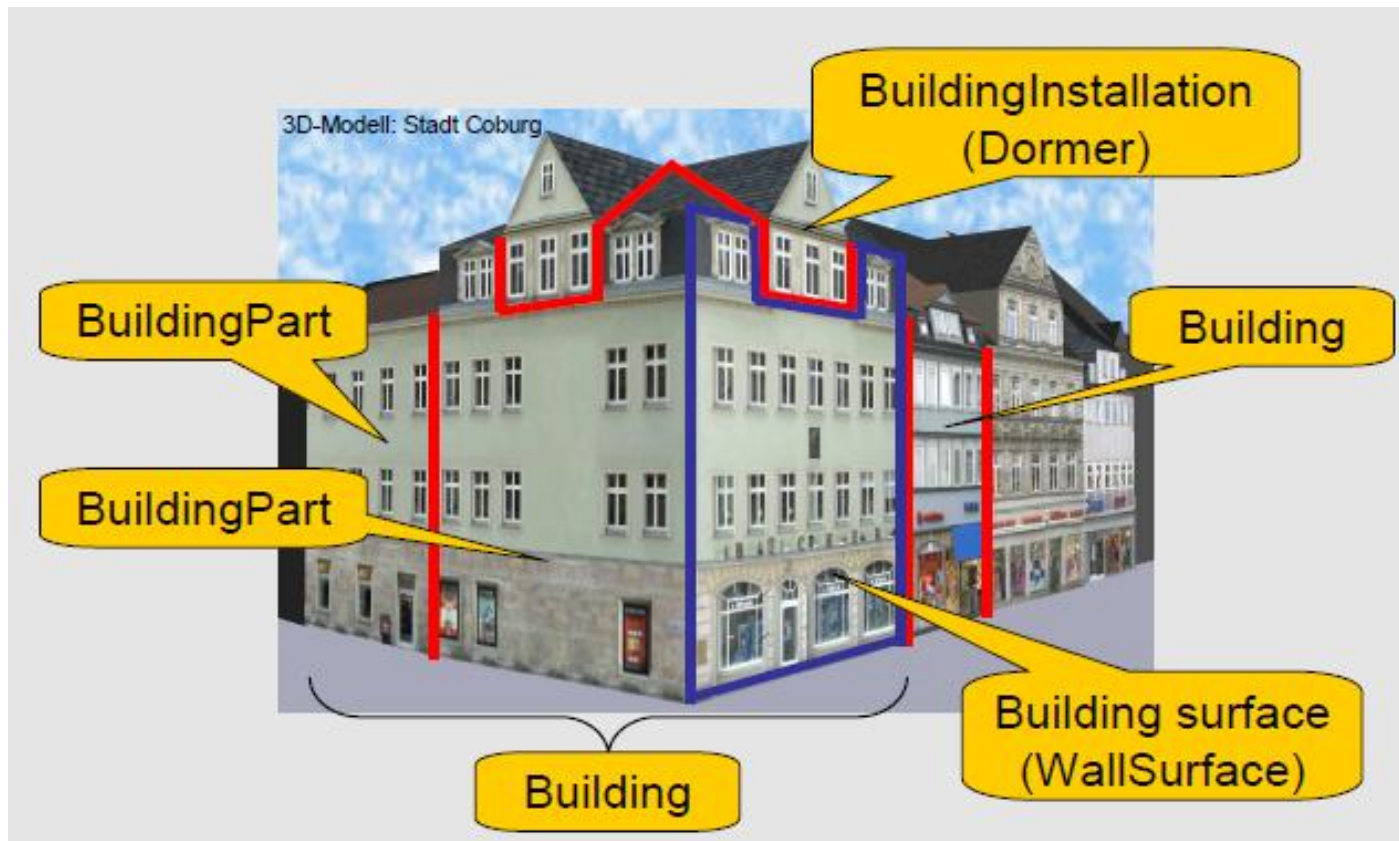
The geo-info model

- CityGML

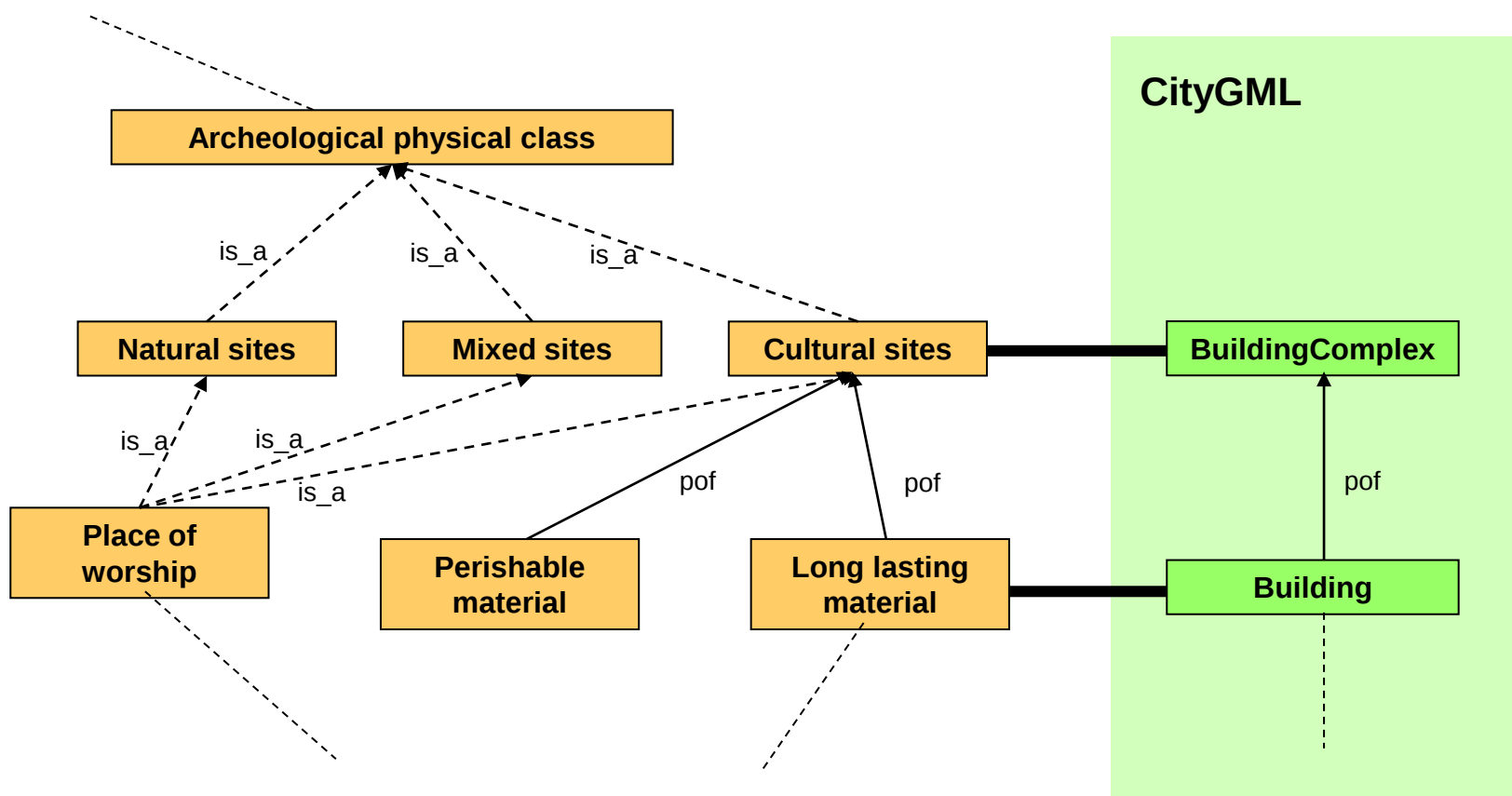


The geo-info model

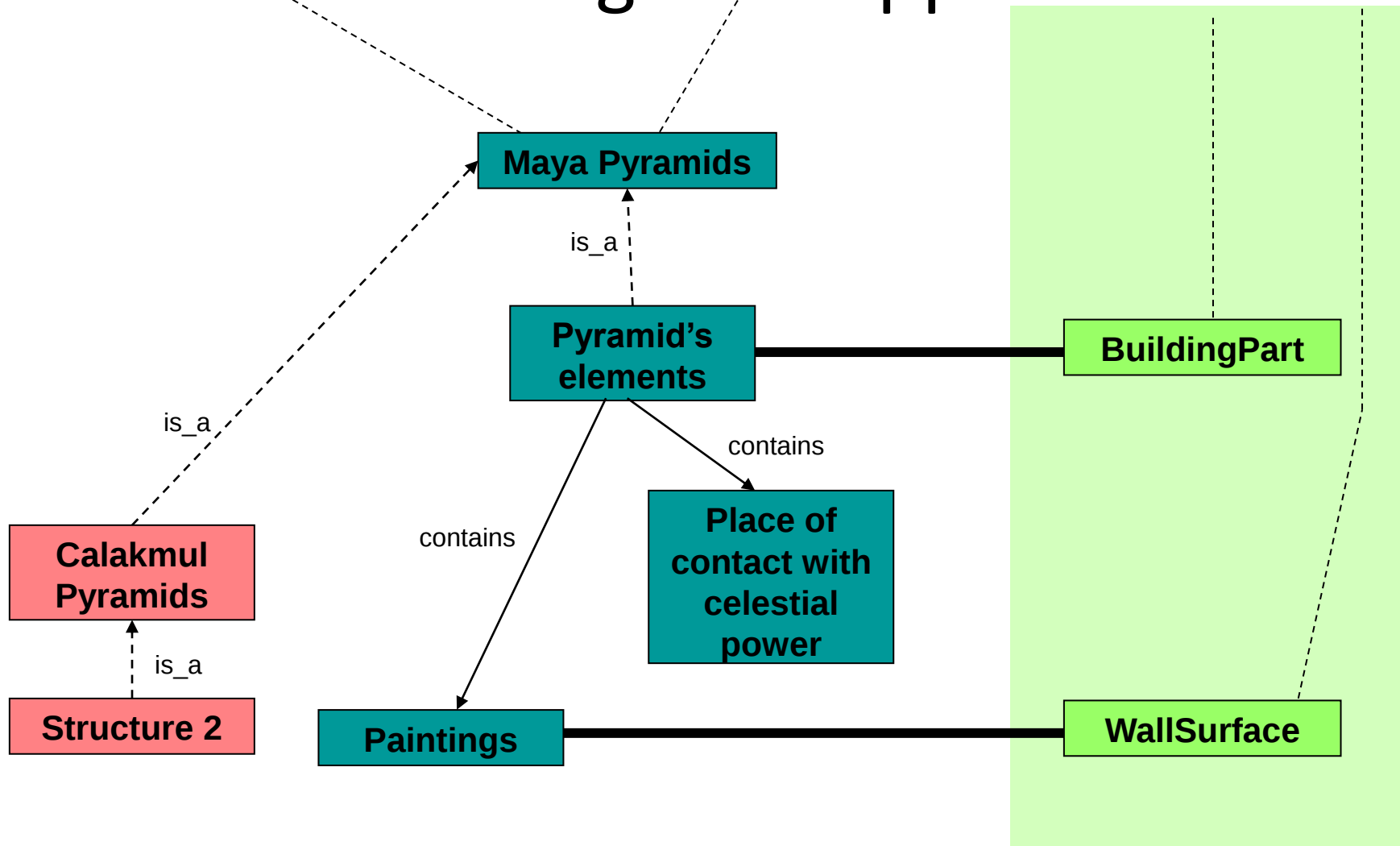
- CityGML



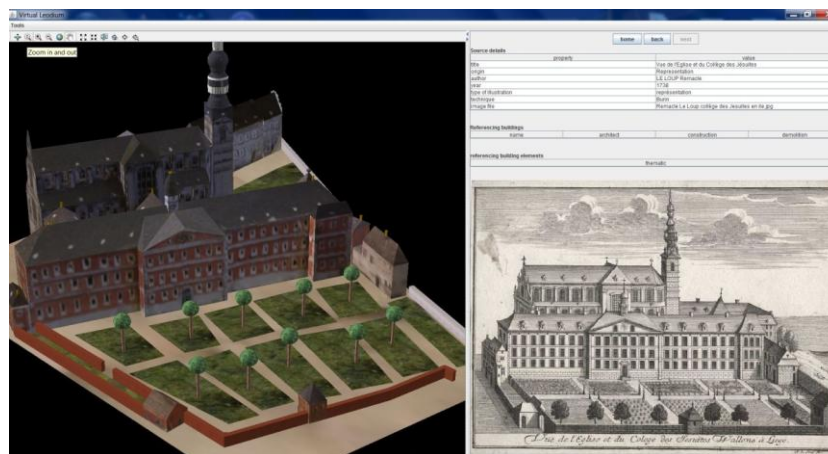
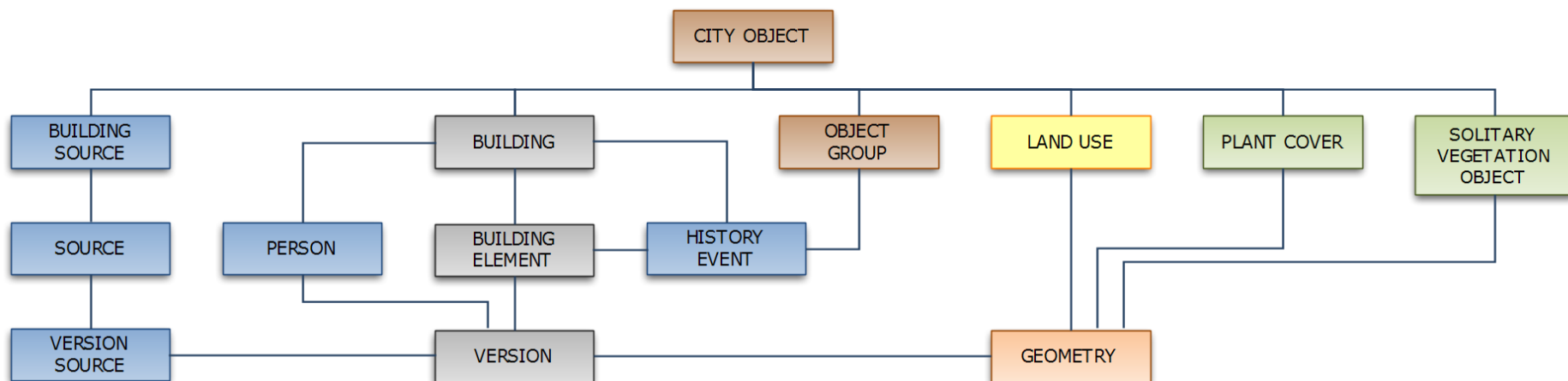
An « ontological » approach



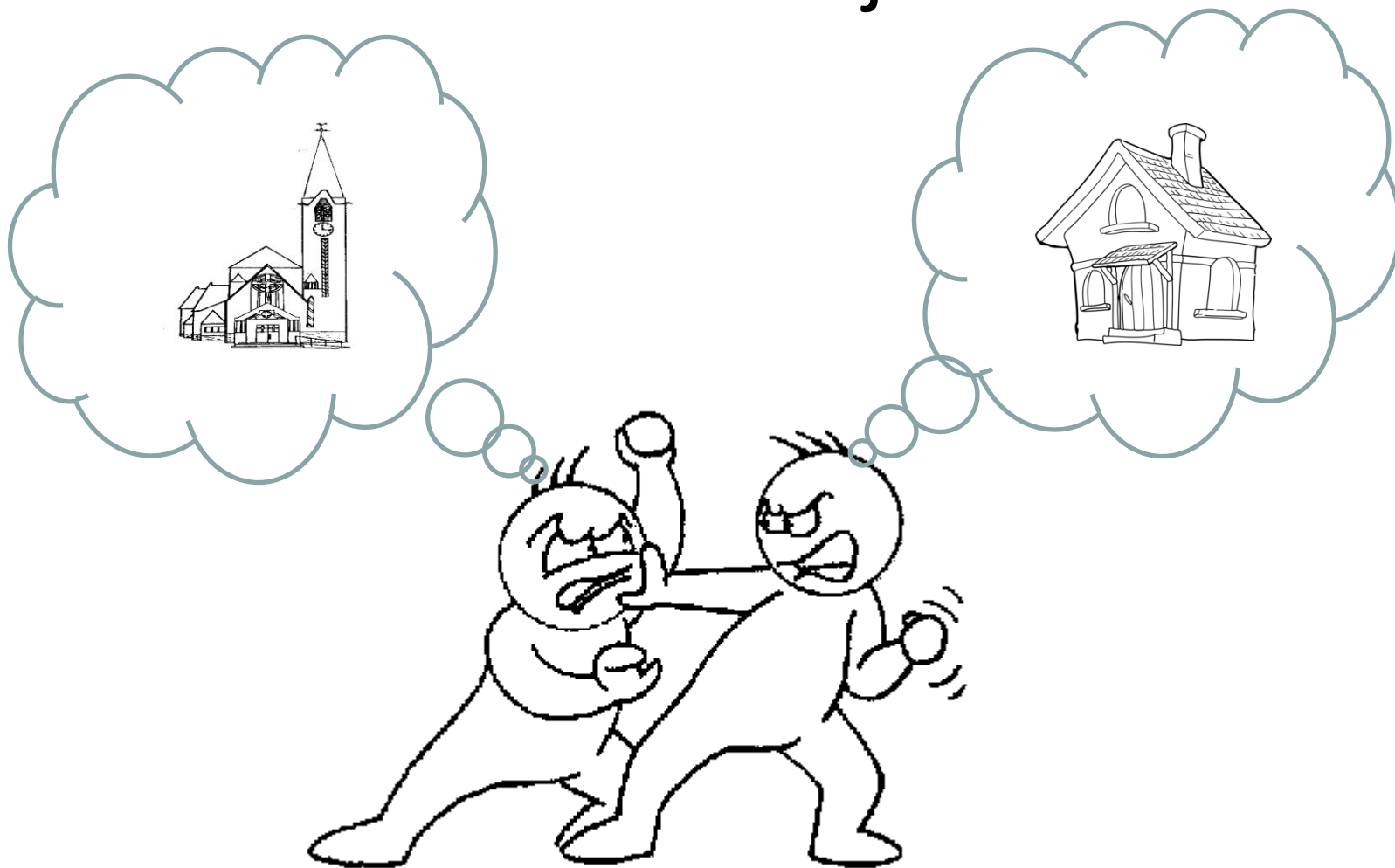
An « ontological » approach



Virtual Leodium



A «version » object



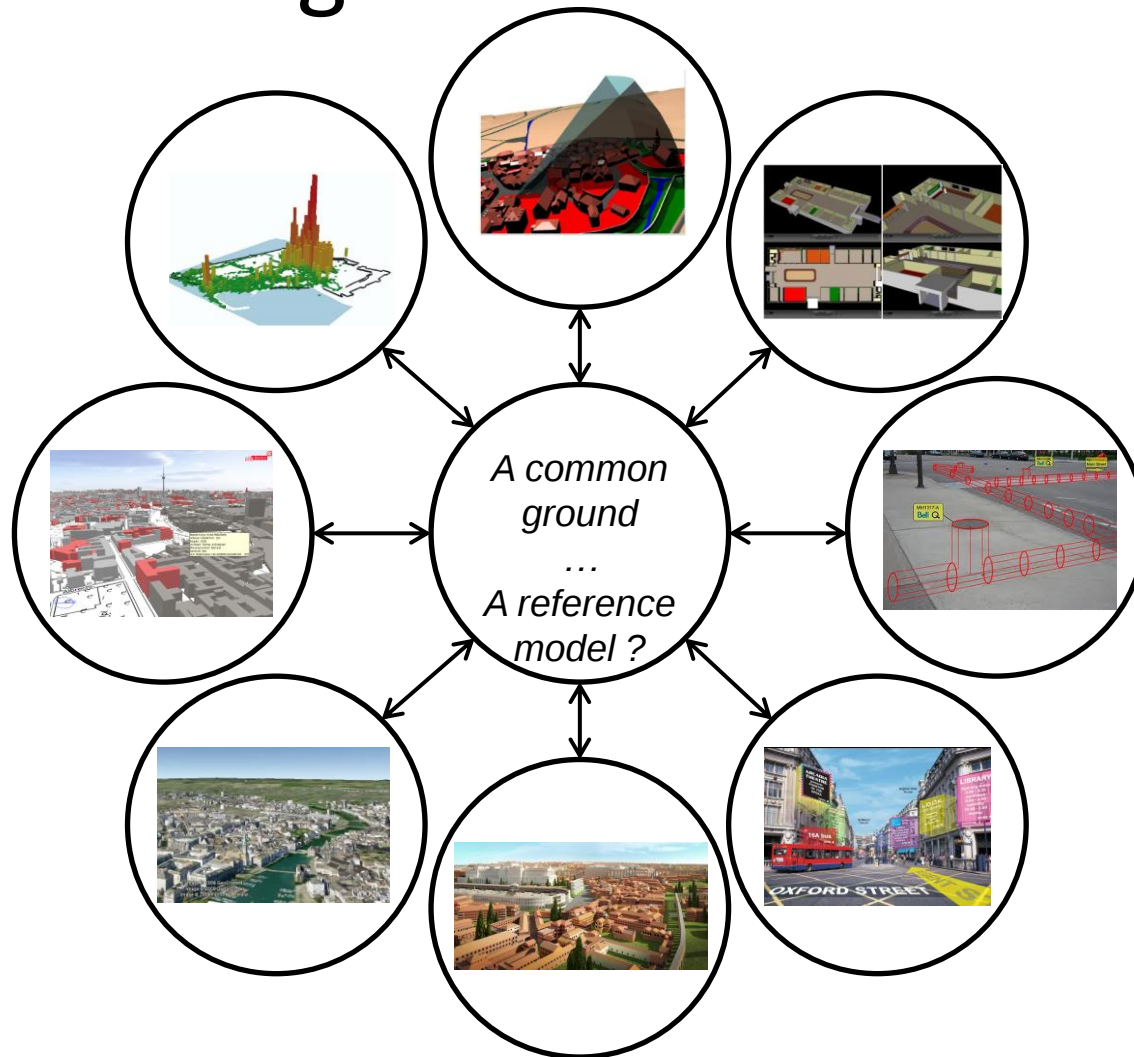
A «version » object



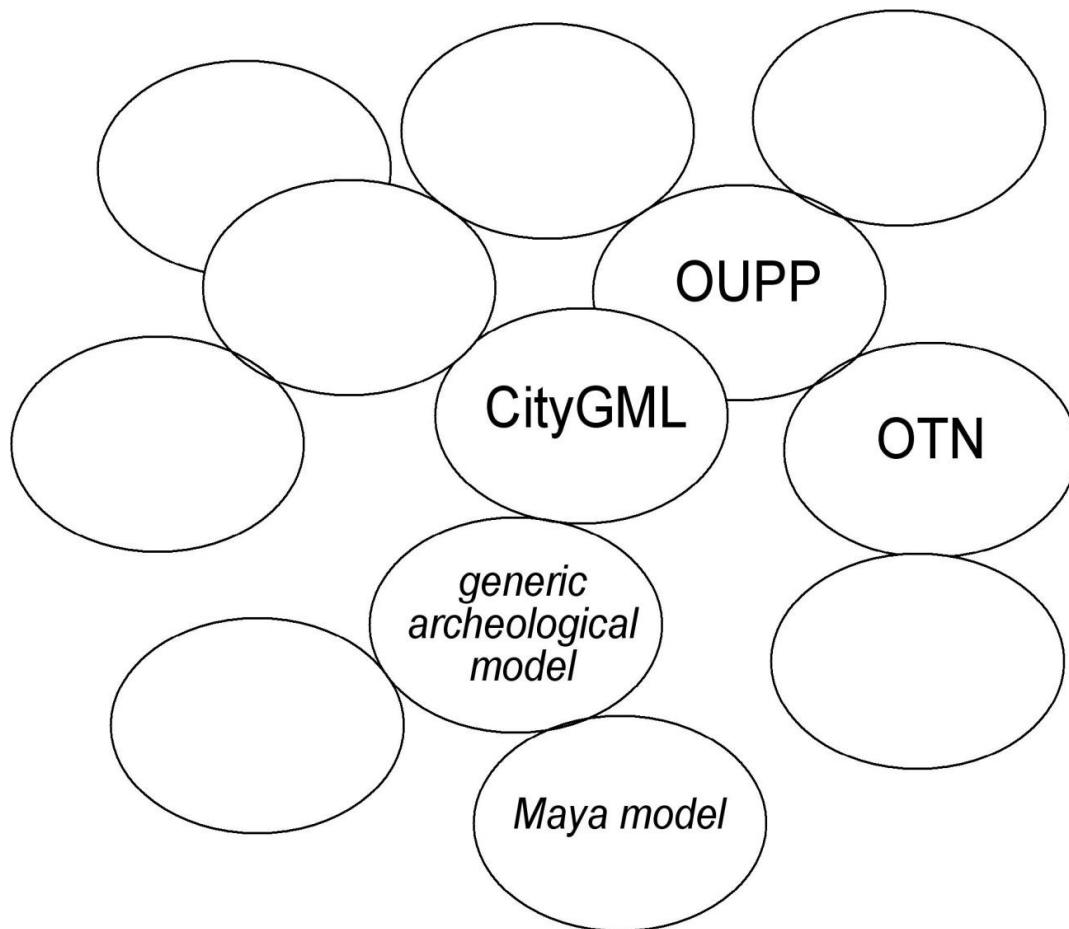
Sharing urban information

- Urban reality perception is diverse and multiple
 - It is impossible to have a unique universal urban model
 - ... developing isolated models for each application is unconceivable
- A solution is to interconnect
 - it implies that models should conform to existing standards and should provide detailed semantic description of modelled objects

Sharing urban information

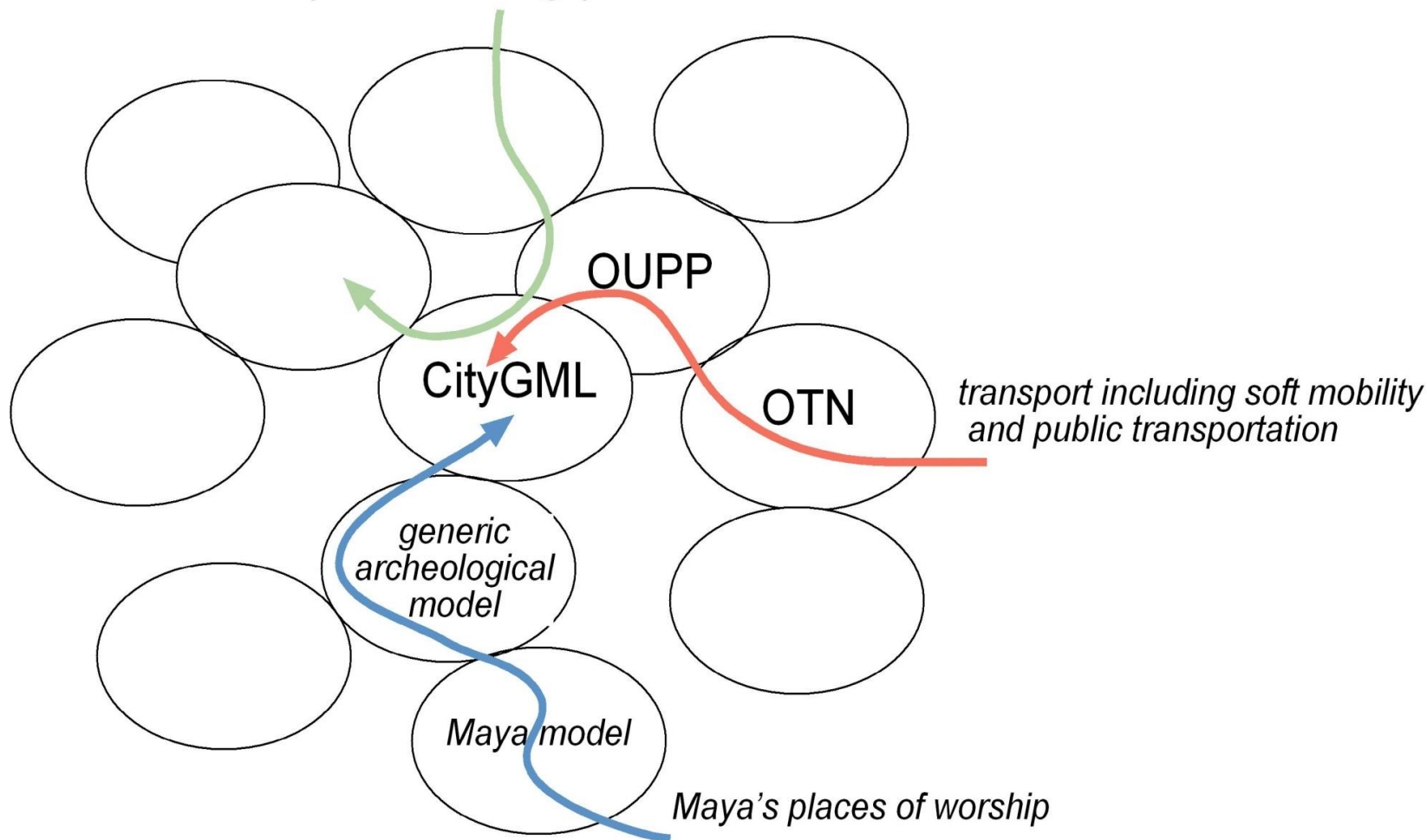


Sharing urban information



Sharing urban information

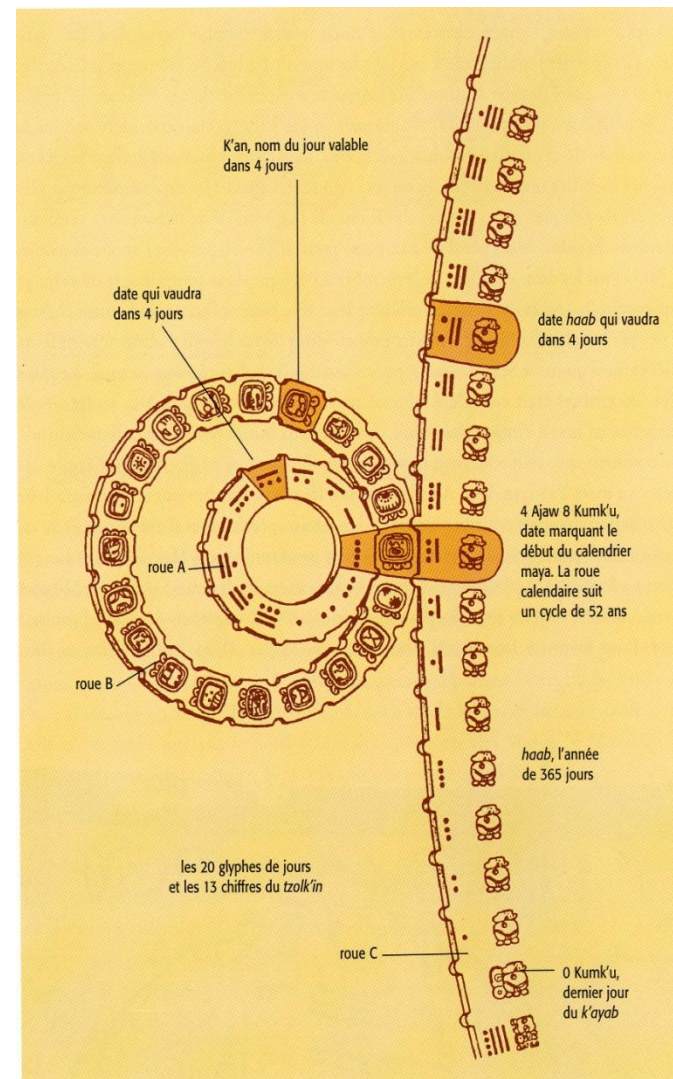
specific modelling question A



PROTOTYPE

- Zone test enrichie en information historique

PERSPECTIVES : TEMPORALITÉ



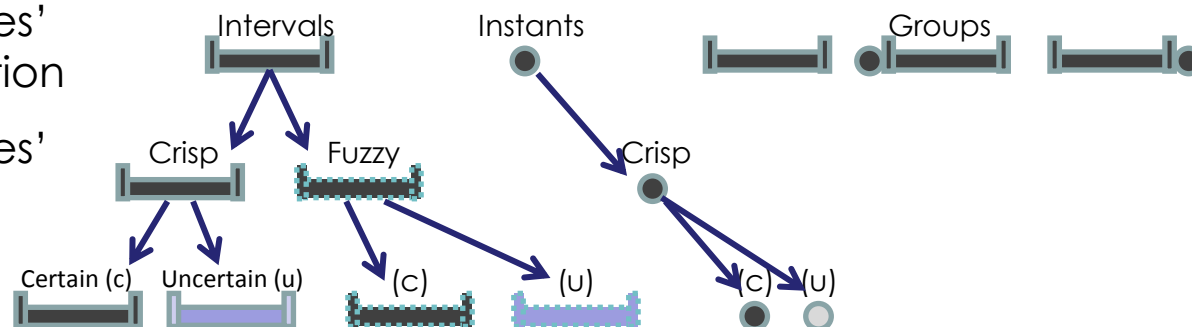


La temporalité nous amène à gérer des informations incomplètes, floues, incertaines ...

Temporalities' representation

Temporalities' natures

Level of certainty



For intervals: 4 possibilities:

Crisp and certain: + 584 → + 628
Crisp and uncertain: maybe + 584 → + 628
fuzzy and certain: + 584 (± 20 years) → + 628
fuzzy and uncertain: maybe + 584 (± 20 years) → + 628 (± 10 years)

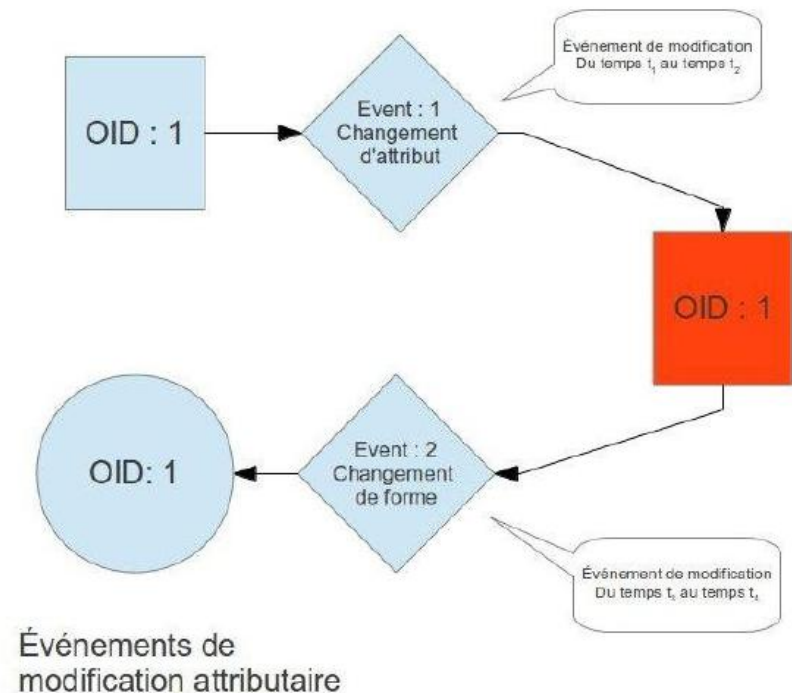
For Instants: 2 possibilities:

Crisp and certain: + 584
Crisp and uncertain: maybe + 584

PERSPECTIVES : ÉVÈNEMENT

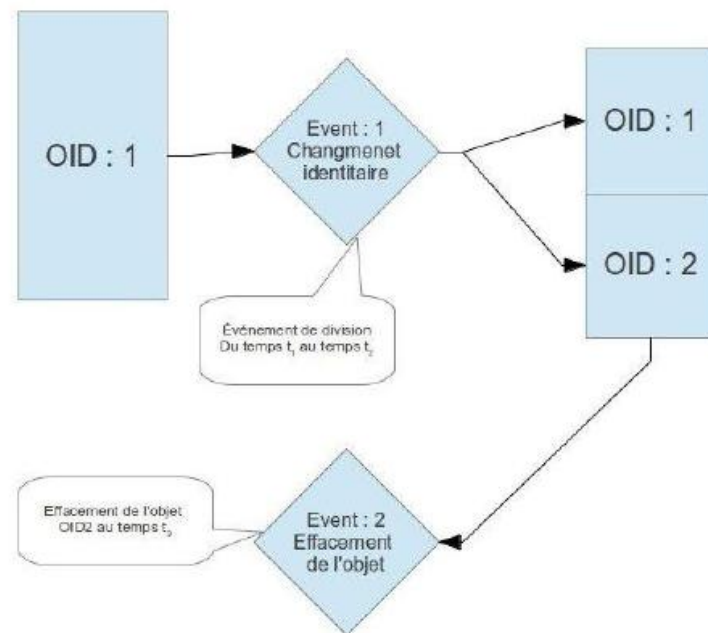
Gestion événementielle de l'IG

- Événement de modification attributaire
- Proche de la gestion par versionning



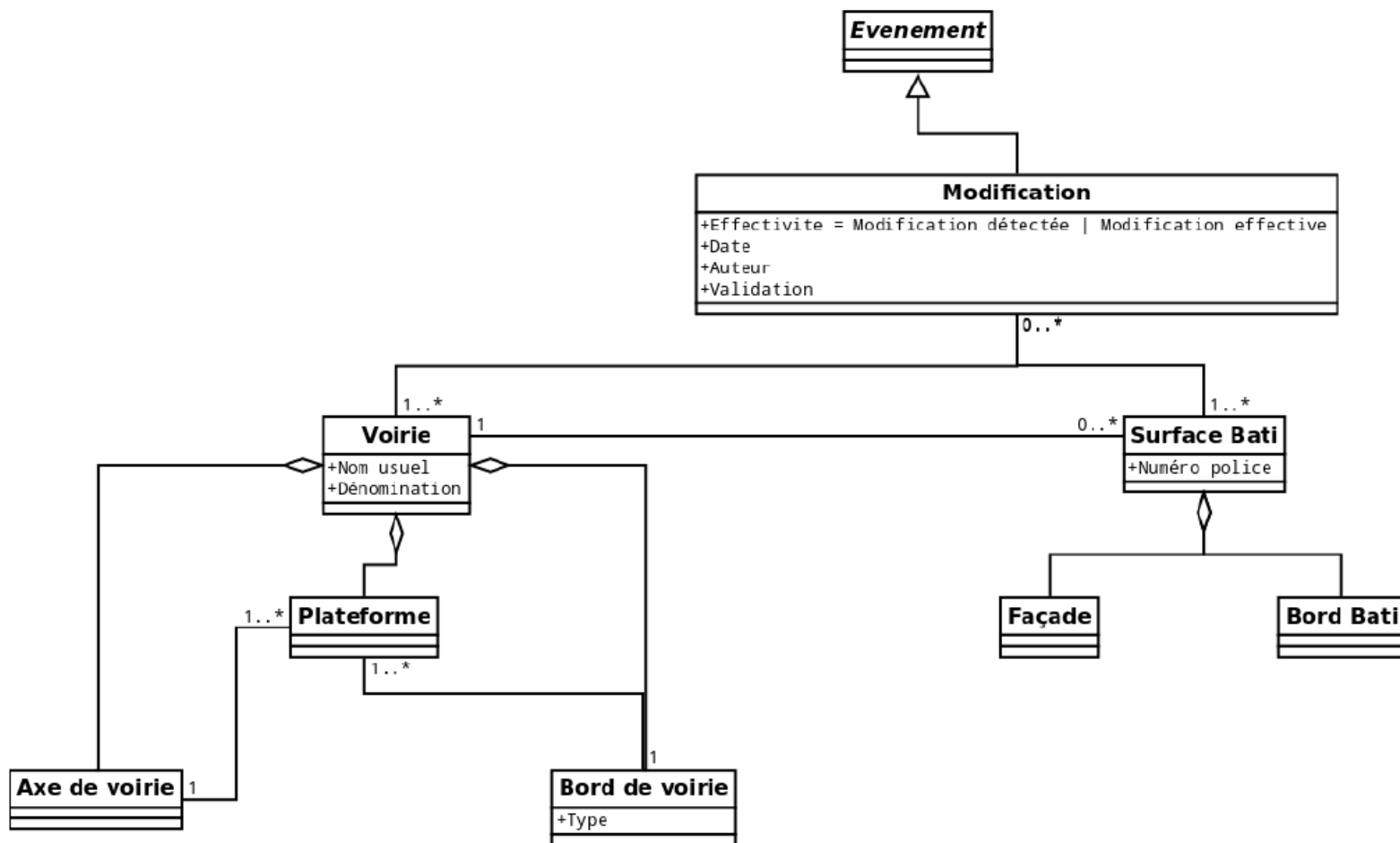
Gestion évènementielle de l'IG

- Événement de modification identitaire
- Événement de modification identitaire (impossible en versionning)

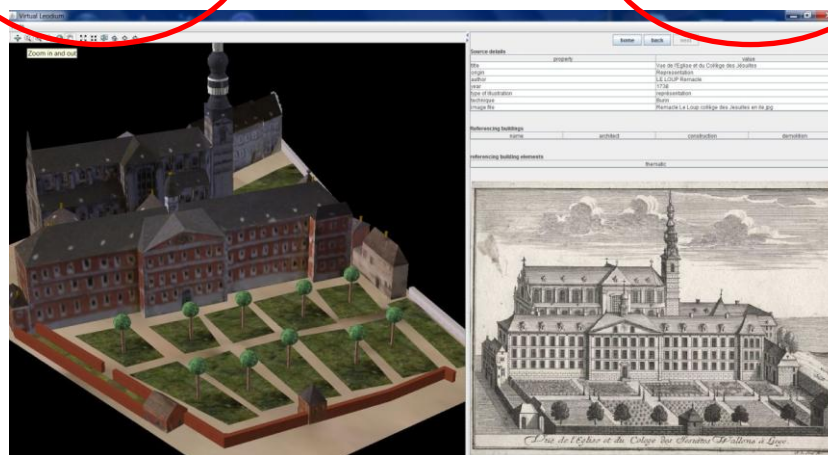
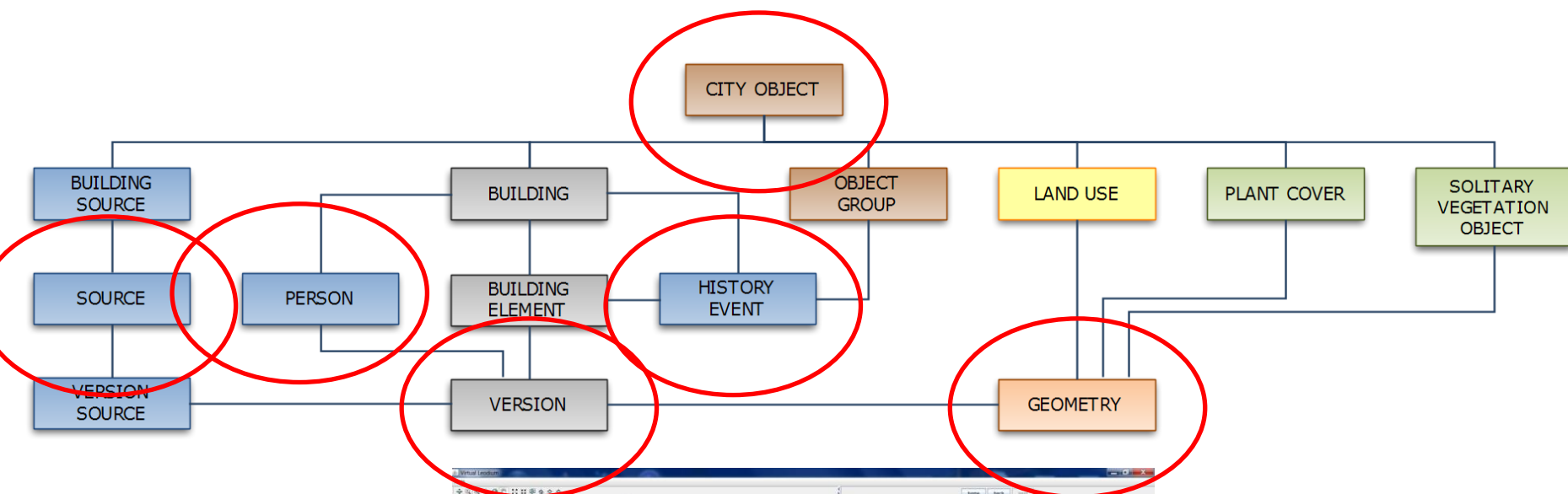


Événements de modification identitaire

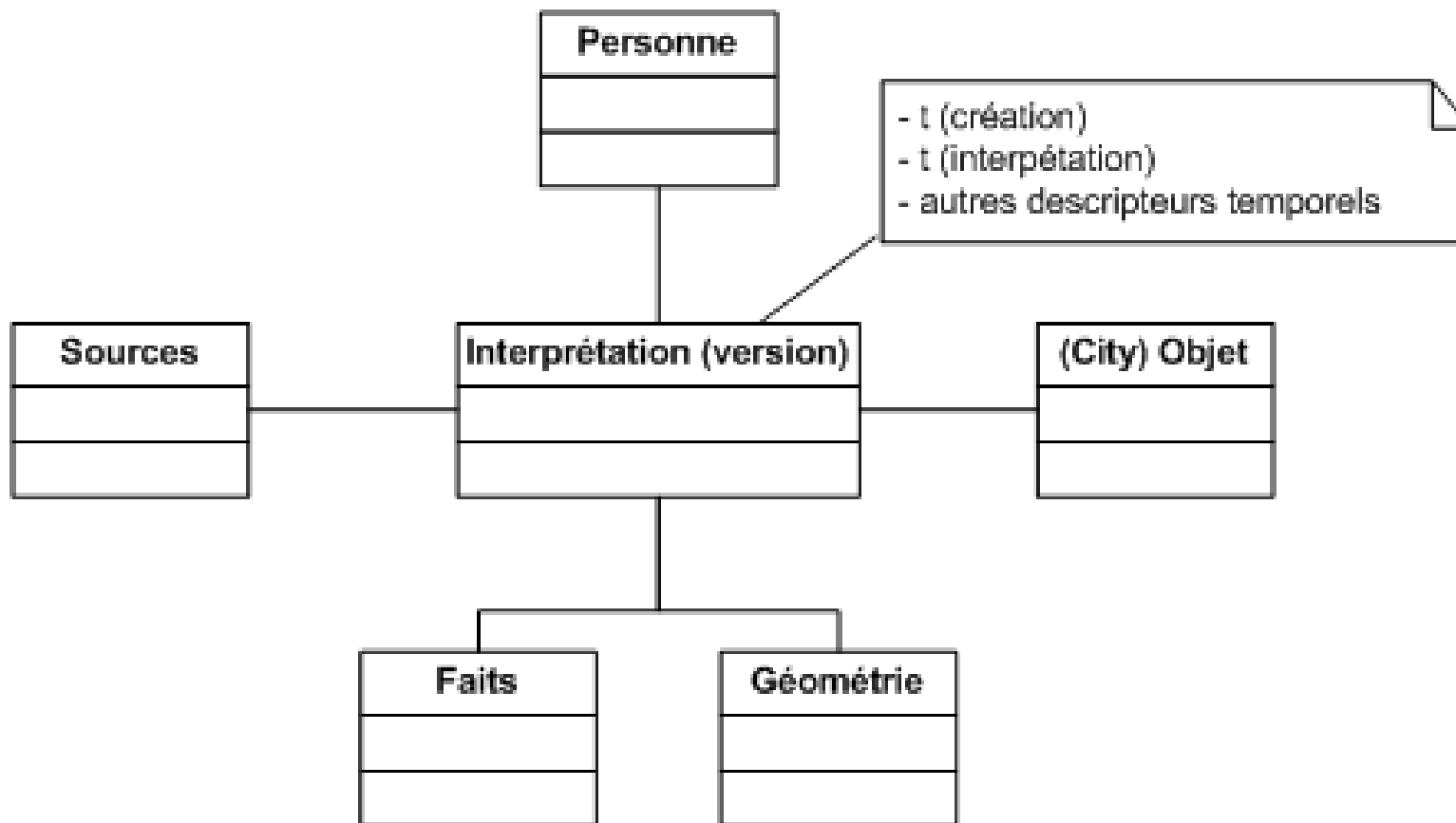
Gestion évènementielle de l'IG



Virtual Leodium



Vers un nouveau modèle VL



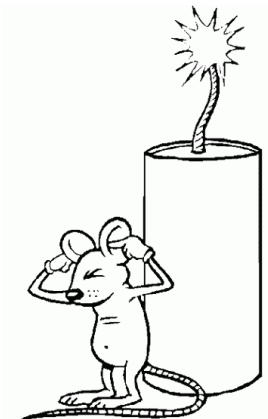
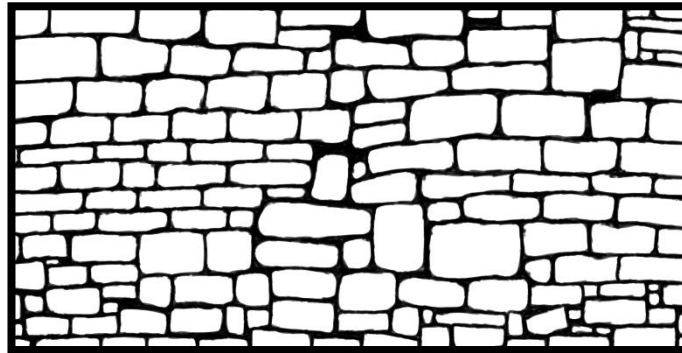
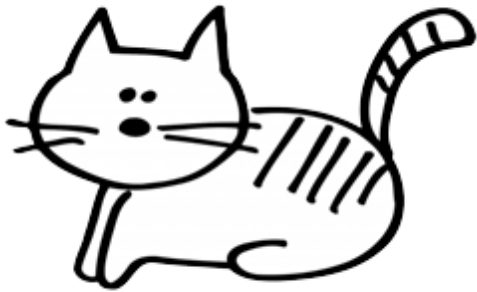
PERSPECTIVES : IDENTITÉ

L'identité à travers l'espace et le temps

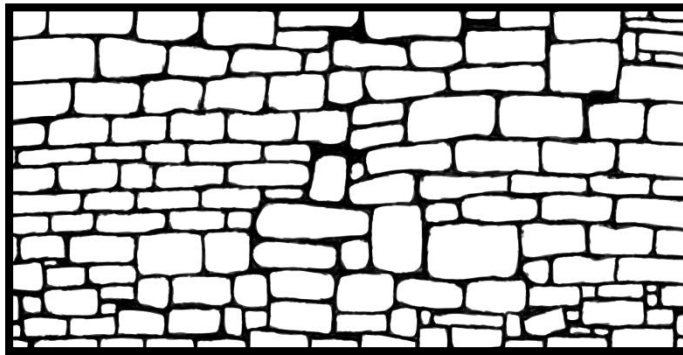
Vers une définition de l'identité
et des relations spatio-temporelles
entre objets géographiques

PhD presentation
Pierre Hallot - 26th of March 2012

Let's take a cat, a wall and a firecracker...

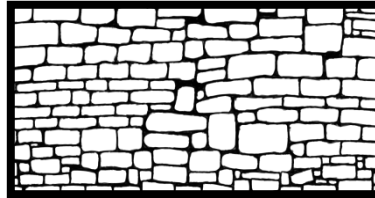


What happens if...

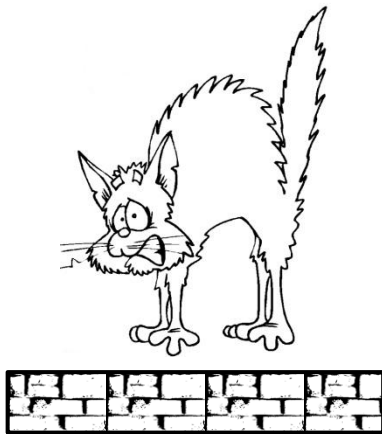


BOUM!

What is the cat's state?



For our point of view,
the cat is hidden...



The cat exits



The cat does not exist anymore

More about the cat⁺

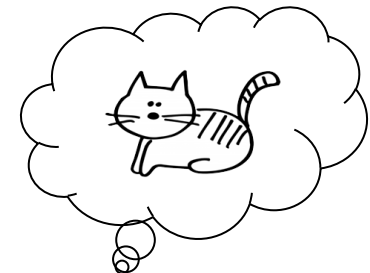
- Till when will the cat exist ?



- Does the cat's non-presence destroy its identity ?

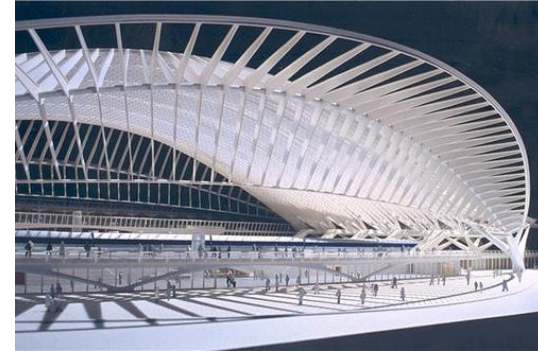


- If we remember the cat, is this relation sufficient to maintain its identity over time ?



What about a geographical object ?

- Does an object exist before its physical realisation ?

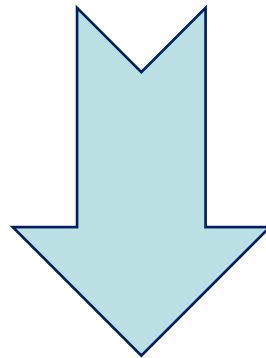


- Does an objet exist after its physical destruction?

- What about the identity of an object which only appears once a while ?

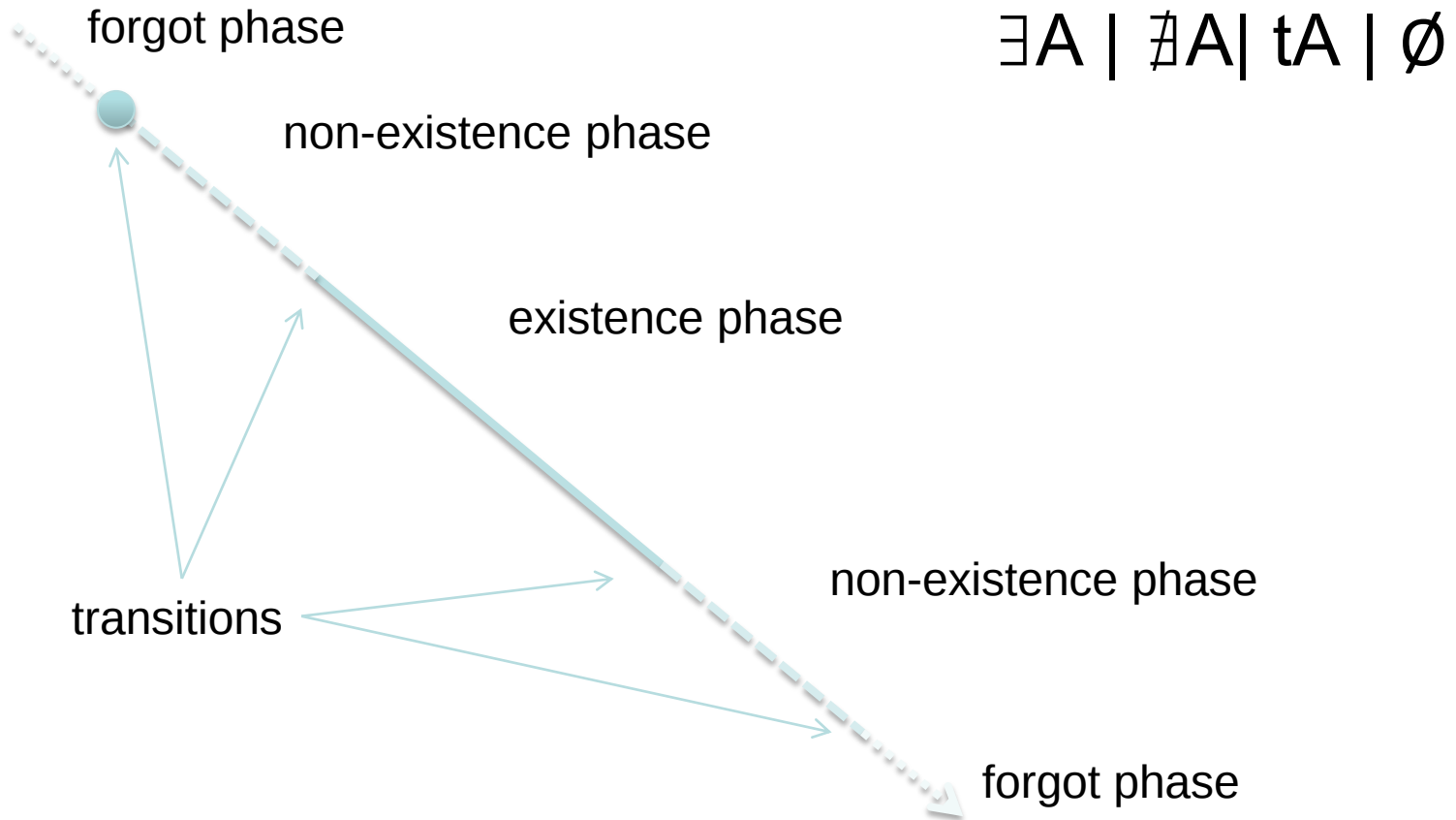


Does a geographical object may exist
before | after
its physical
realisation | destruction?

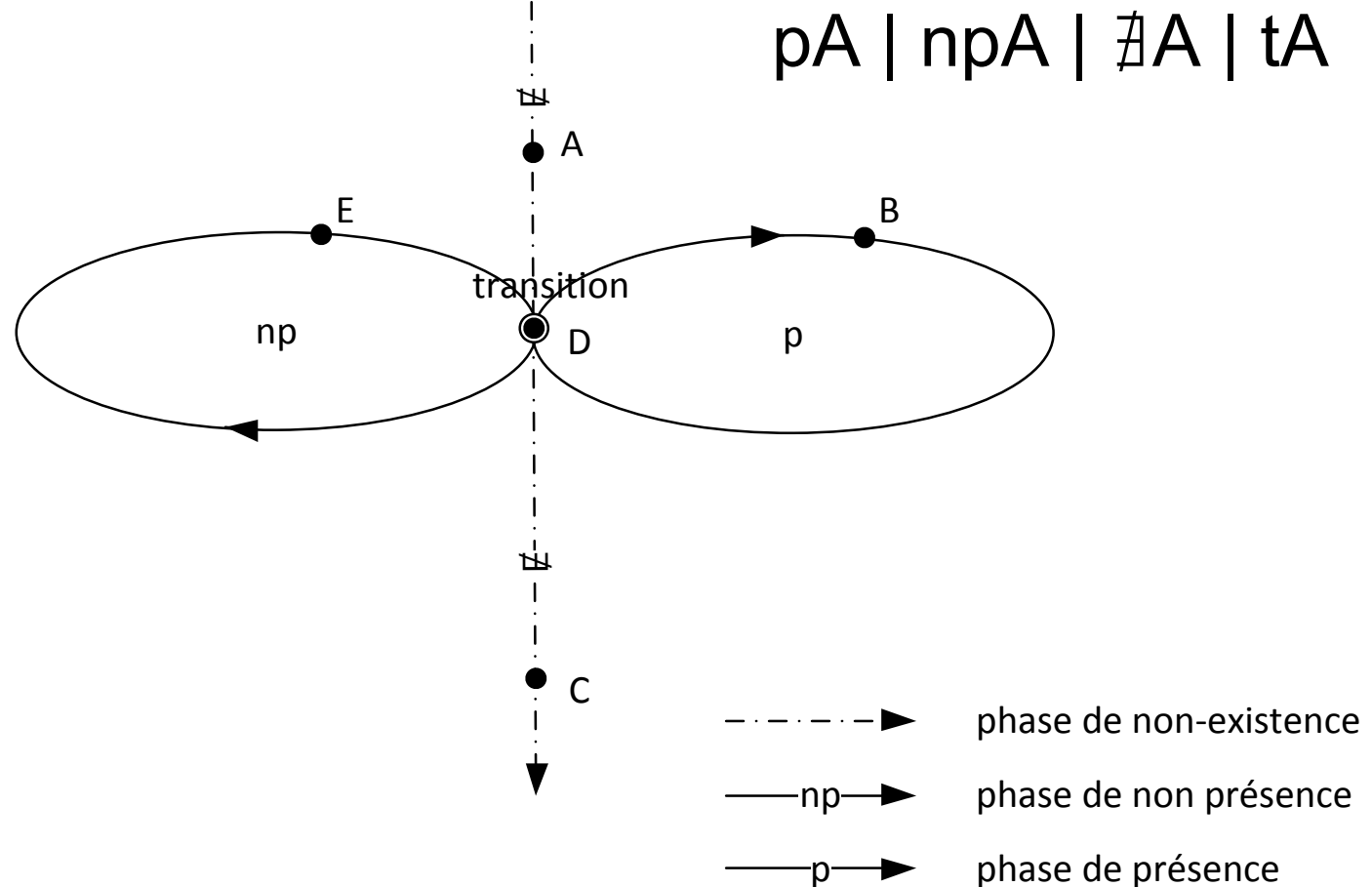


Study of identity across space and time

Conceptual representation

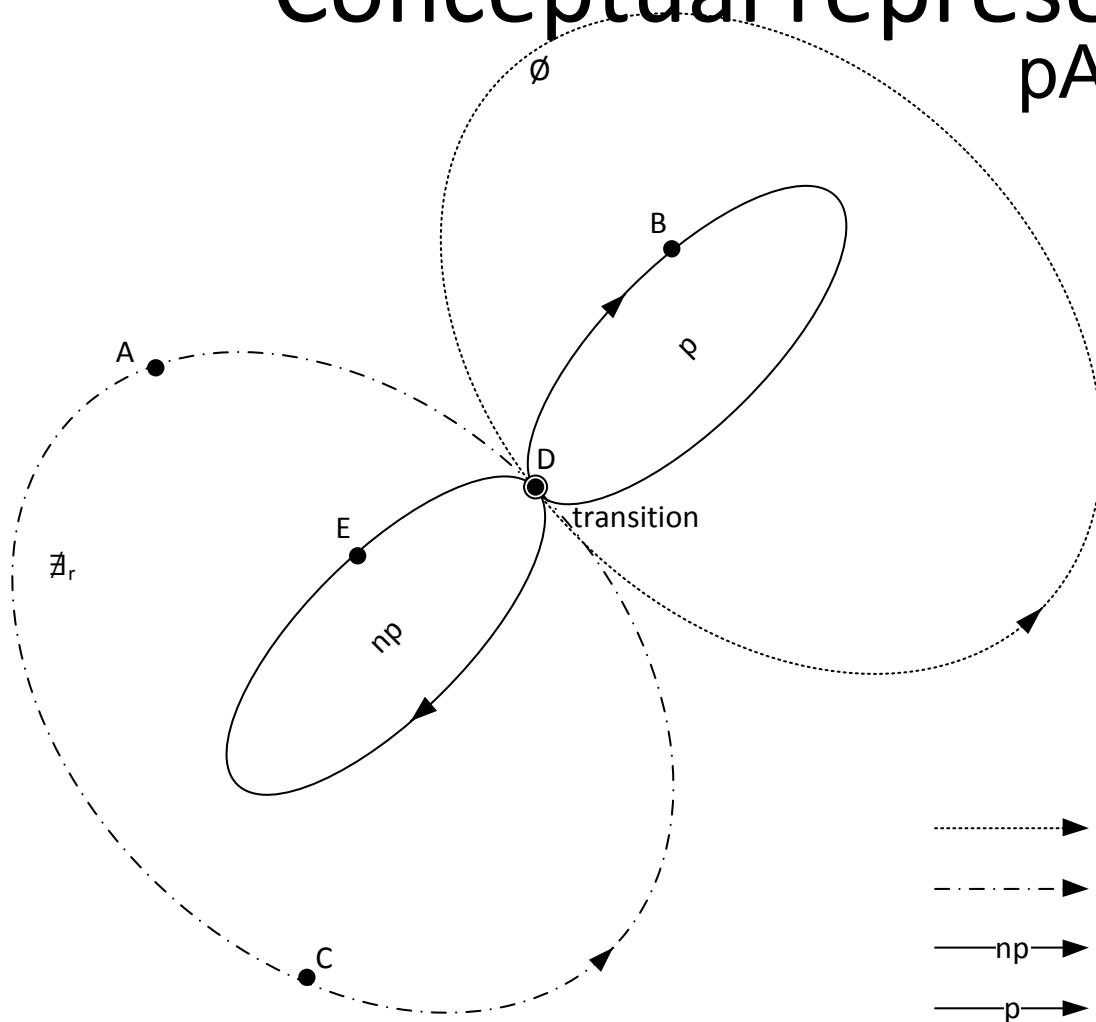


Conceptual representation



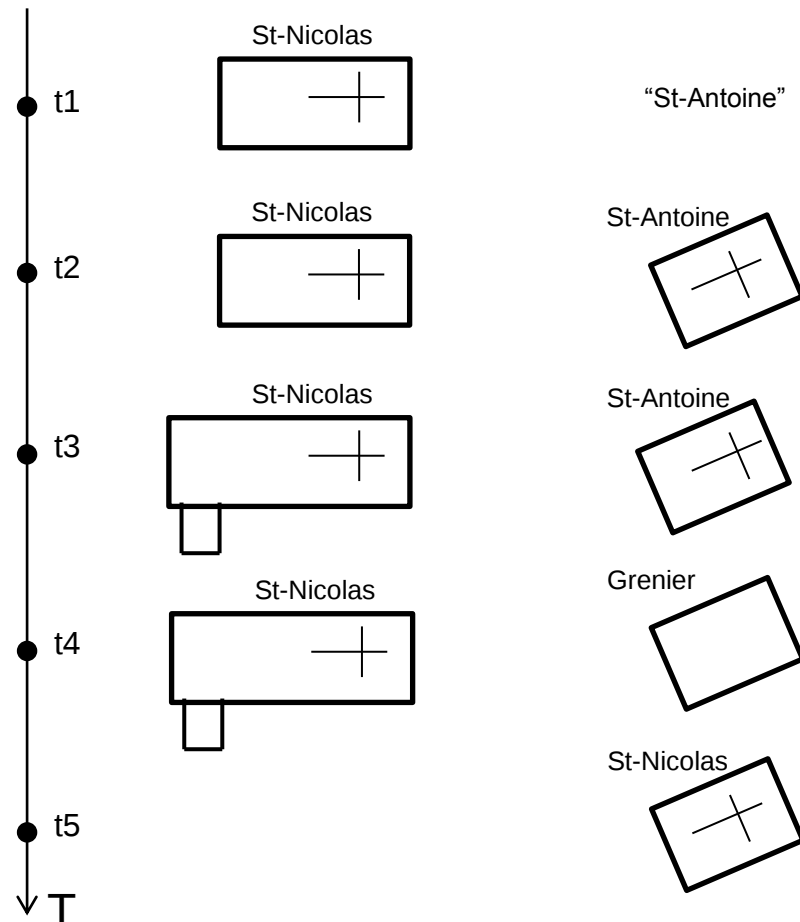
Conceptual representation

$pA \mid npA \mid \nexists A \mid tA \mid \emptyset$



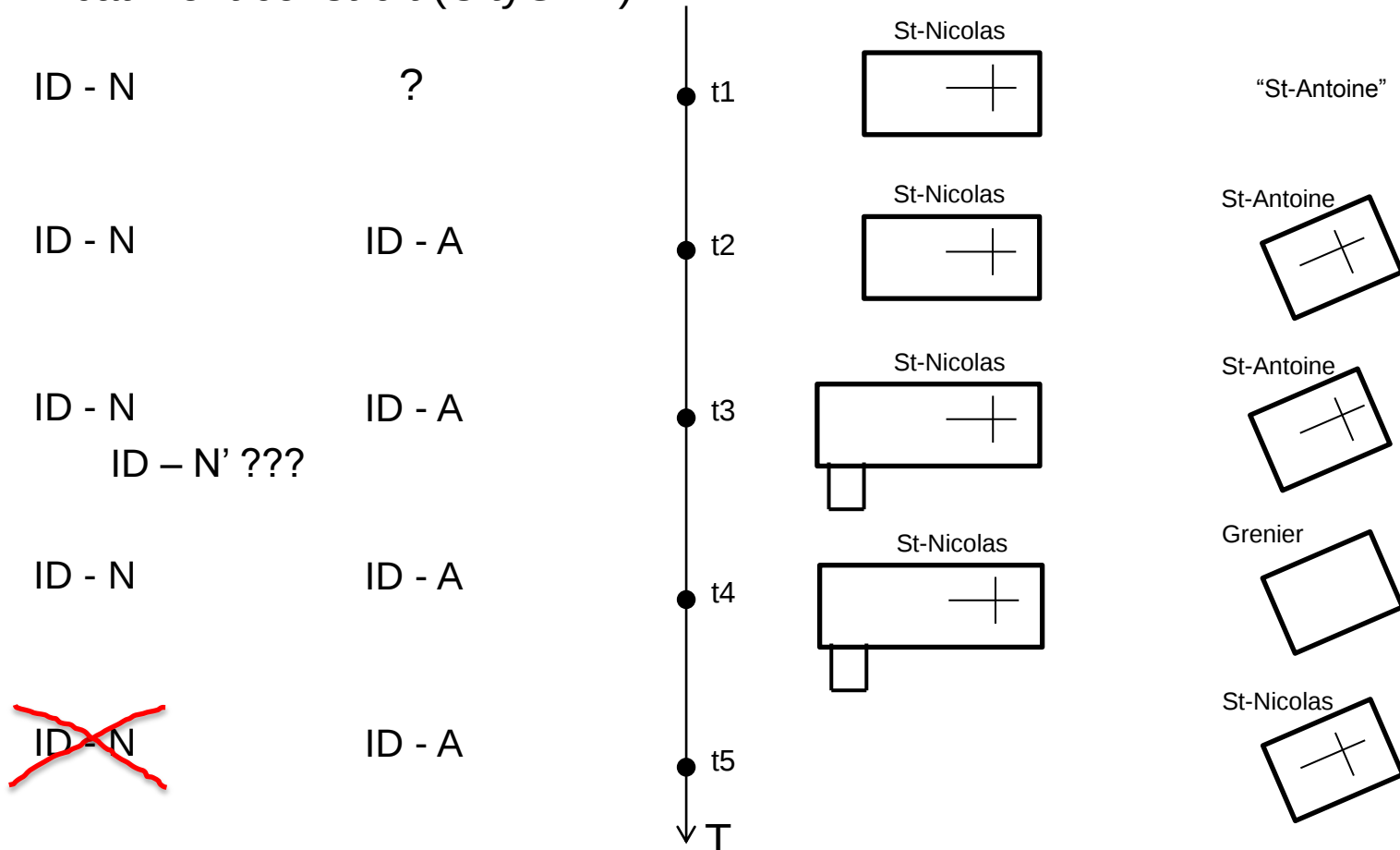
-→ phase d'oubli
- - - - -→ phase de non-existence
- np——→ phase de non présence
- p——→ phase de présence

Et dans notre projet VL



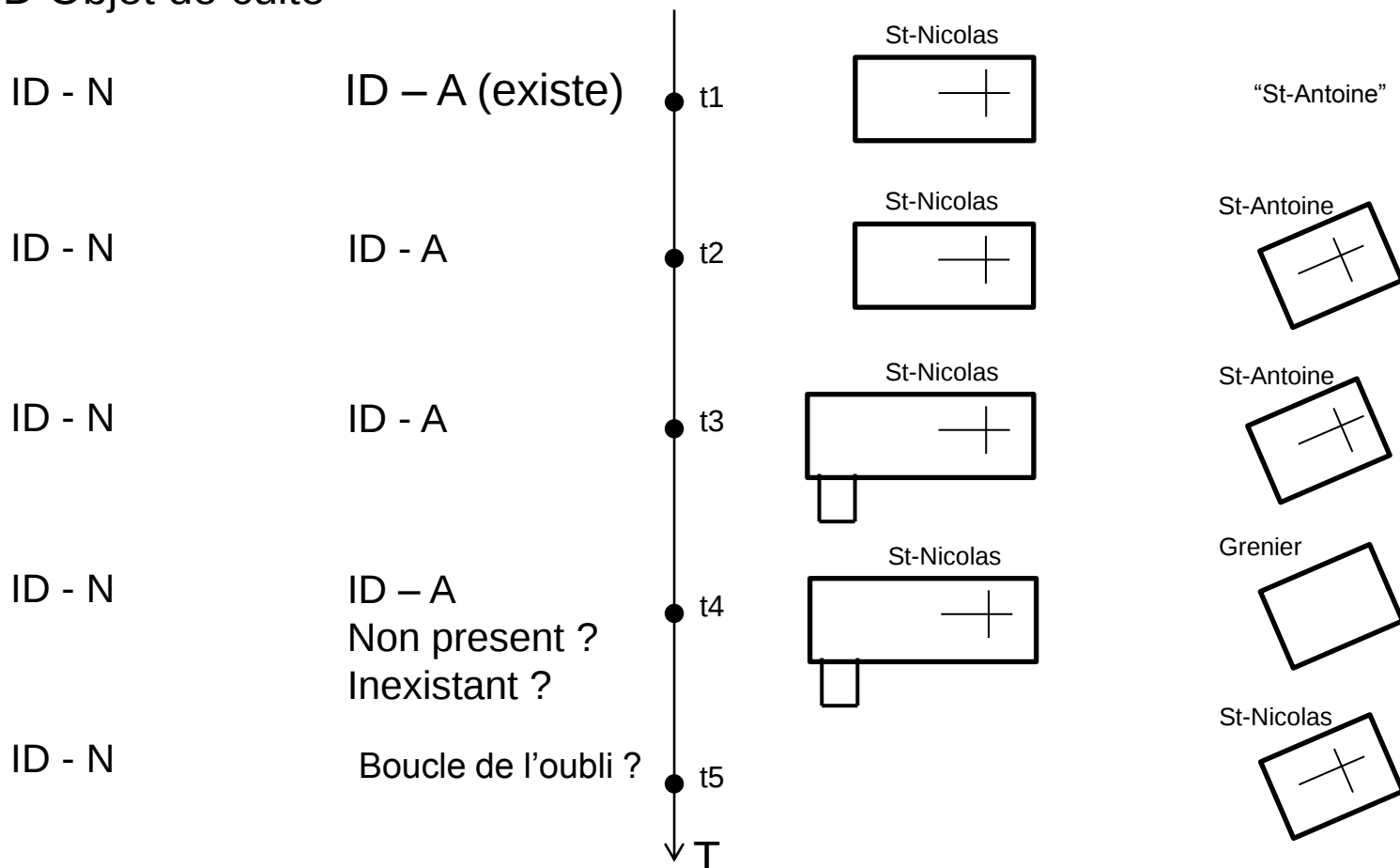
Et dans notre projet VL

ID bâtiment construit (CityGML)



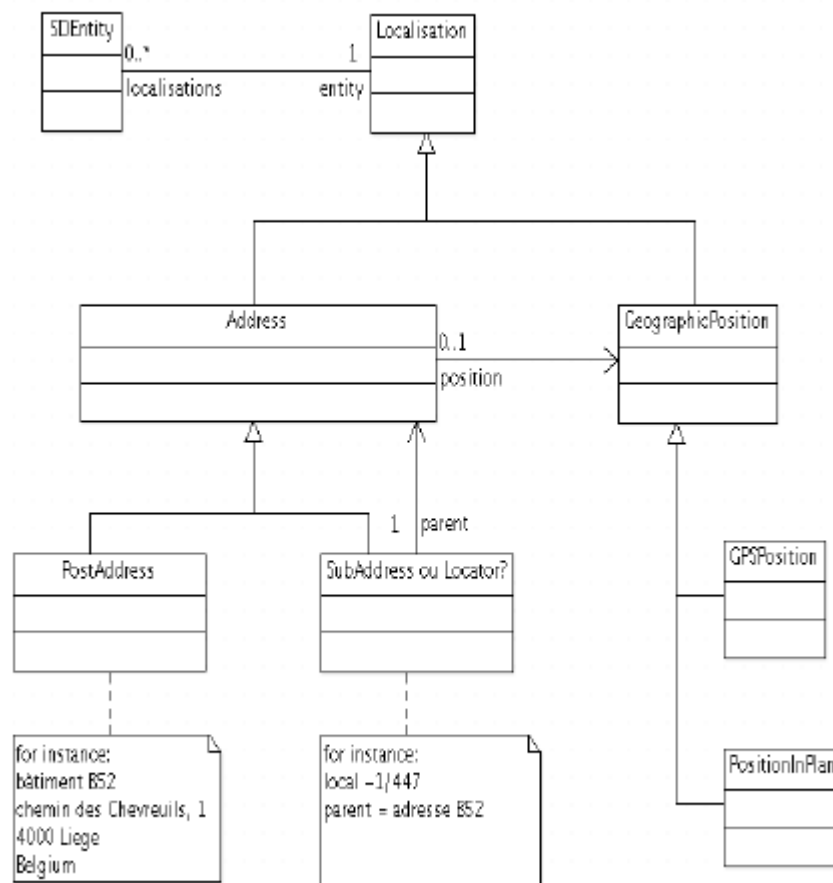
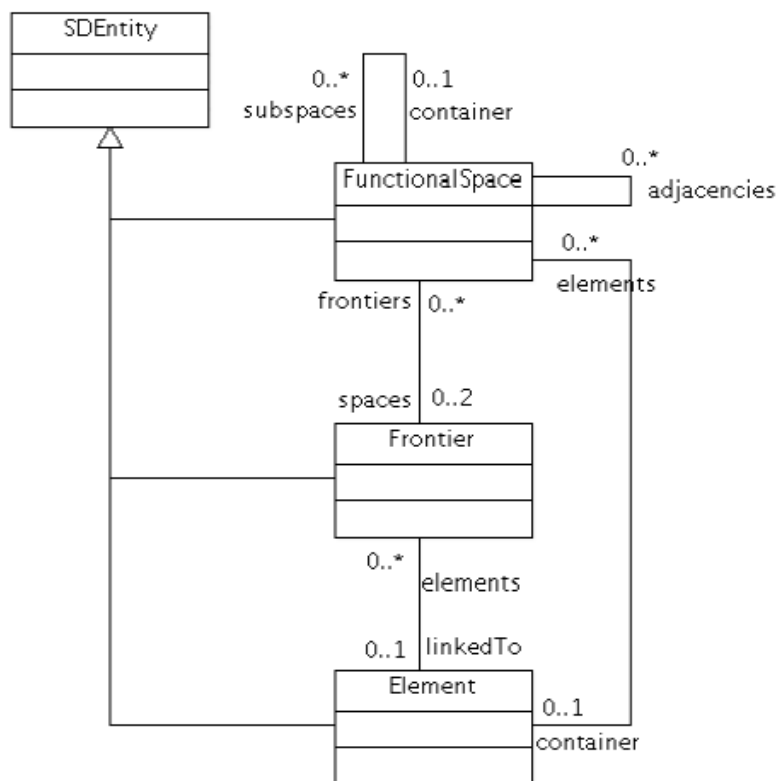
Et dans notre projet VL

ID Objet de culte



PERSPECTIVES : MODÈLE SIMPLE

Le projet Spatiodata



Conclusions

- Le projet Virtual Leodium nous permet de tester de nombreuses hypothèses de modélisation et est un lieu de rencontre entre historiens / archéologues et géomaticiens
- La première démarche a été de respecter une approche géomatique « rigoureuse » en terme de modèle de données (standard)
- Une certaine touche « historique » a été apportée (version) et a permis d'aboutir à un prototype SIA.
- Les perspectives d'amélioration englobent la prise en compte plus explicite de la temporalité des objets et de leurs attributs, une modélisation plus affinée de la notion d'interprétation / version et une réflexion sur l'évolution identitaire des objets
- Dans les autres perspectives, citons la possibilité d'utiliser des modèles de référencement plus souples ... mais par conséquent moins interopérable avec d'autres modèles d'informations urbaines
- Toutes ces réflexions s'appliquent en modélisation géographique en général