Smart City Digital Twin

Multidata City Model for Analyses and Simulations

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https://www.disit.org, https://www.snap4city.org

Casablanca Smart City – 8th Edition
From the Smart Citizen to the Smart Metropolis
Circle 3 – Smart Citizen Services
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Introduction

- A digital twin is a **virtual replica** of a **real entity**
- Born in the aerospace industry, they have been progressively adopted in different fields (e.g., manufacturing and construction)
- More recently the concept of digital twins **has been adopted in the context of Smart Cities**

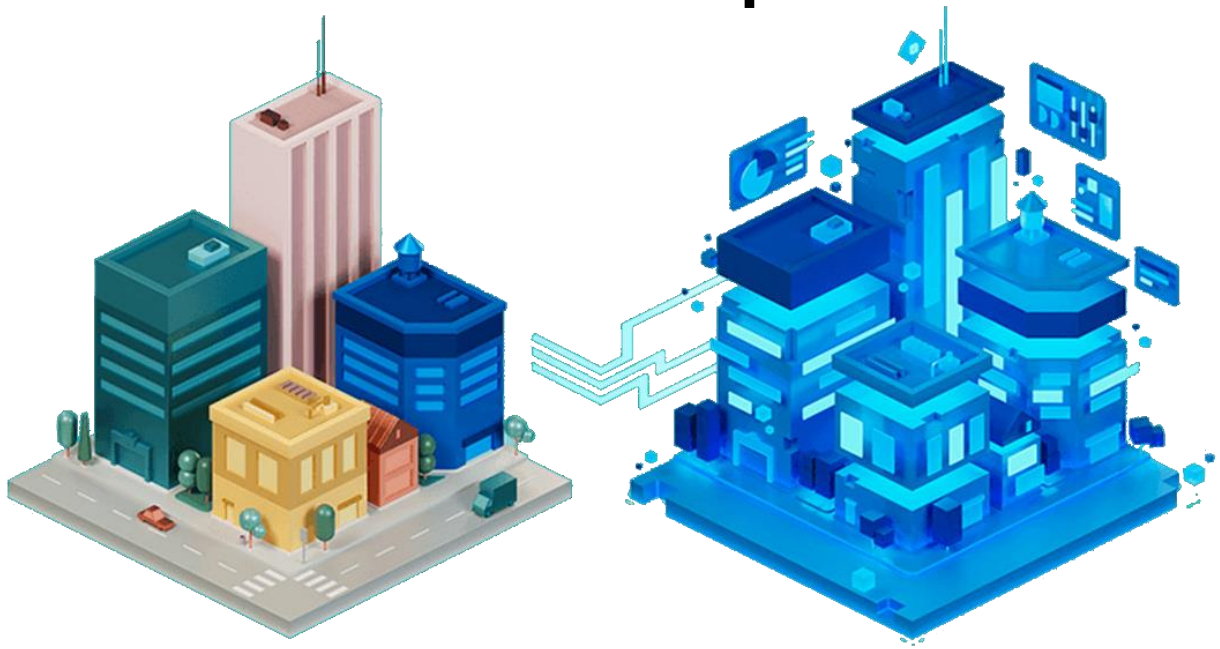


Image credit: https://www.12dsynergy.com/innovation-showcase/digital-twins-explained/

Introduction

- Exploiting **big data** and **Internet of Things/Internet of Everything** technologies is possible to build a faithful replica of the urban environment
- Digital twin technology can undoubtfully help to **face future urban developments** in several domains
  - Mobility
  - Environment
  - Energy
  - Urban planning
  - …

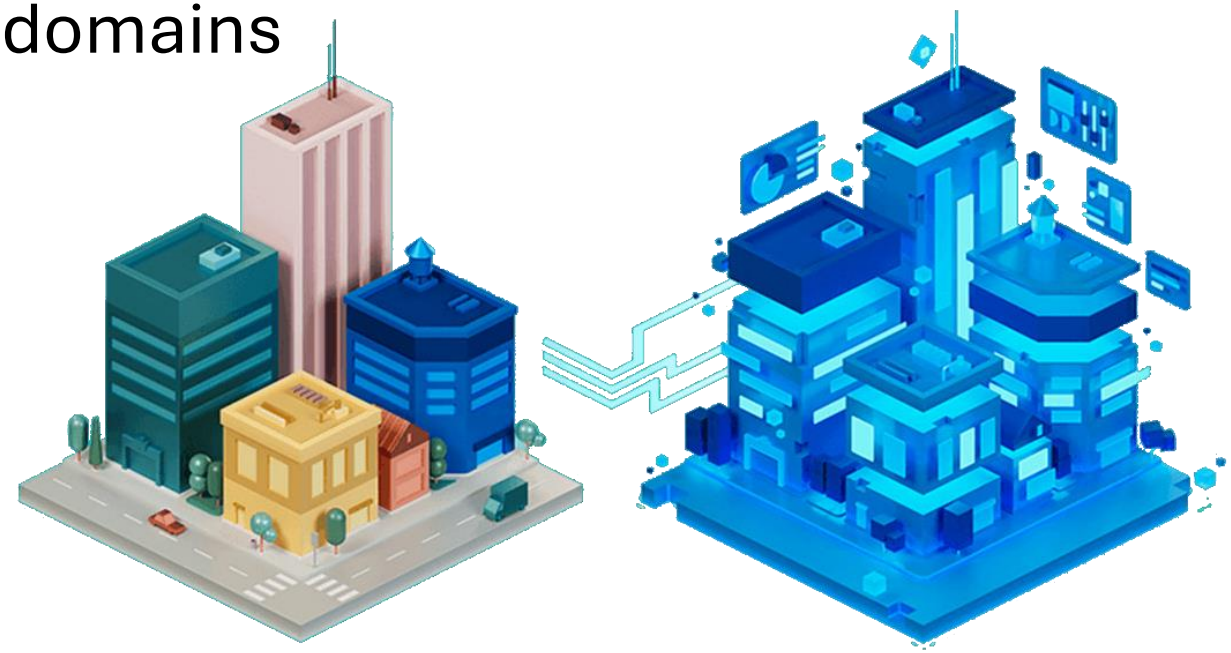


Image credit: https://www.12dsynergy.com/innovation-showcase/digital-twins-explained/

Challenges

Building an urban digital twin is not an easy task

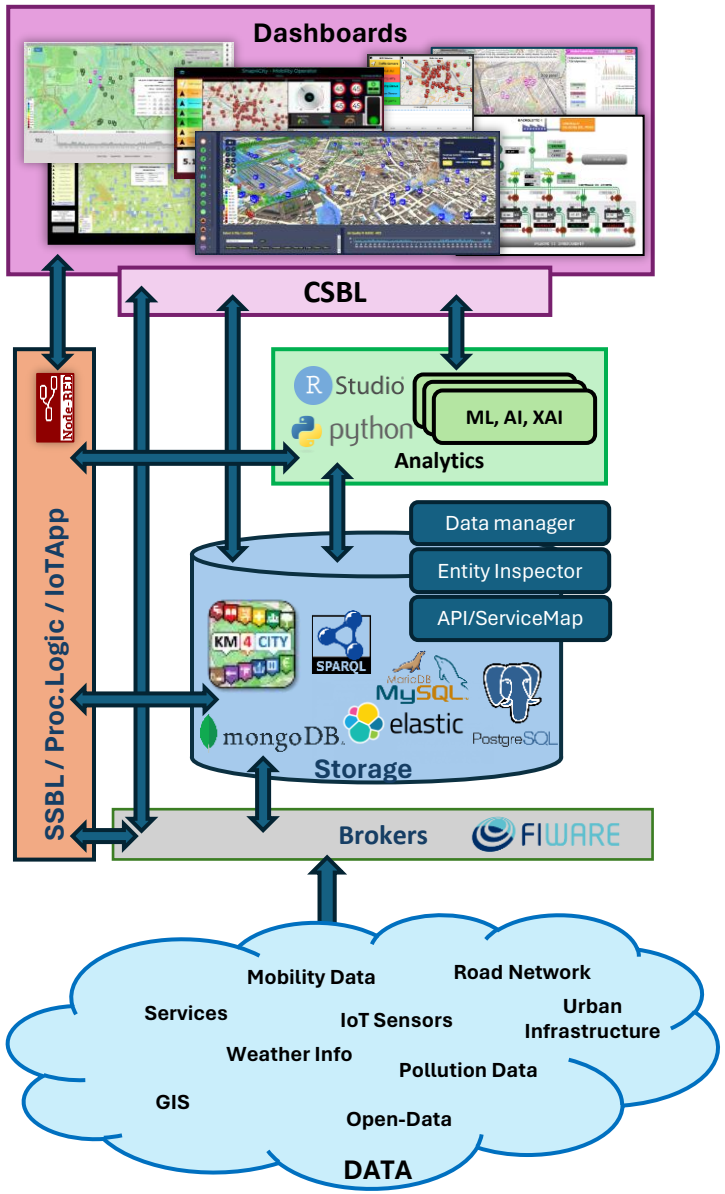
- **Heterogeneous data** must be acquired to create the so-called **City Information Model**

- **Analytics** for analyses, reconstructions, and simulations must be developed exploiting also **machine learning** and **artificial intelligence** solutions

- **Accessible interactive interfaces** are required to let decision-makers work on the digital twin and **promote citizen** engagement in the urban development

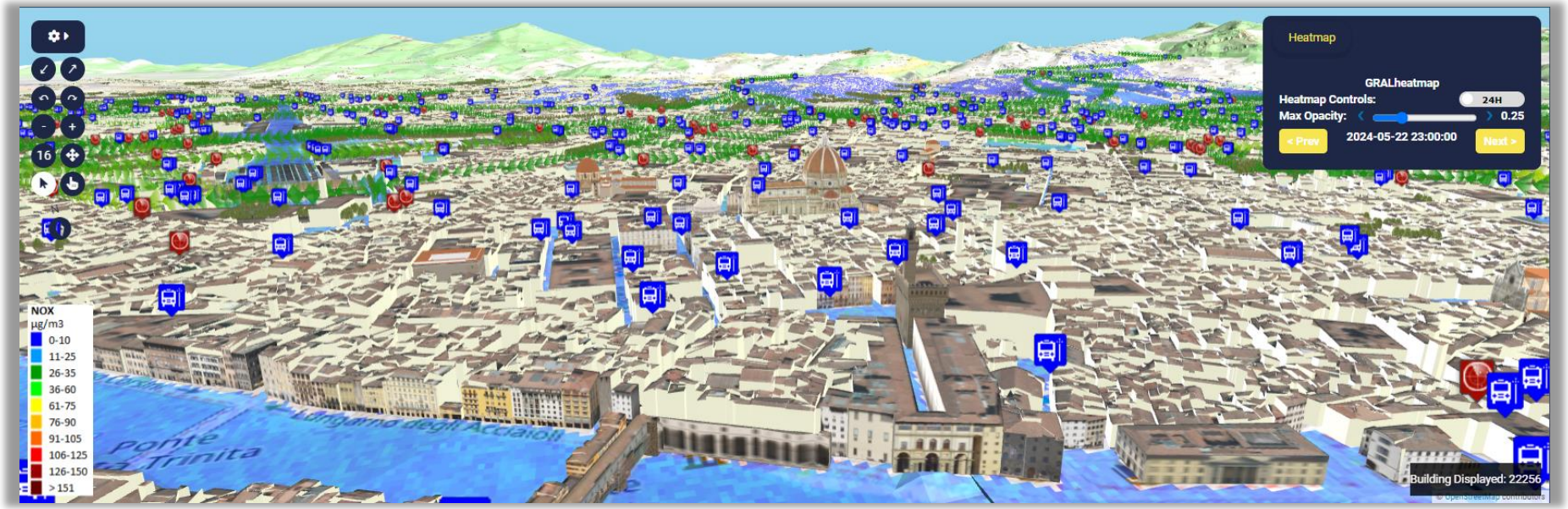
Snap4City platform

- Snap4City is an **open-source IoT platform based on a microservice architecture** developed at DISIT Lab of the University of Florence
- The platform handles **heterogeneous data sources** (IoT devices, Open Data, external services, etc.) exploiting multiple storages with semantic enrichment
- Data are retrieved with **dedicated APIs** and exploited by **data analytic processes** and **IoT applications**
- **2D and 3D dashboards** can be built using a large number of widgets



Interactive 3D Interface

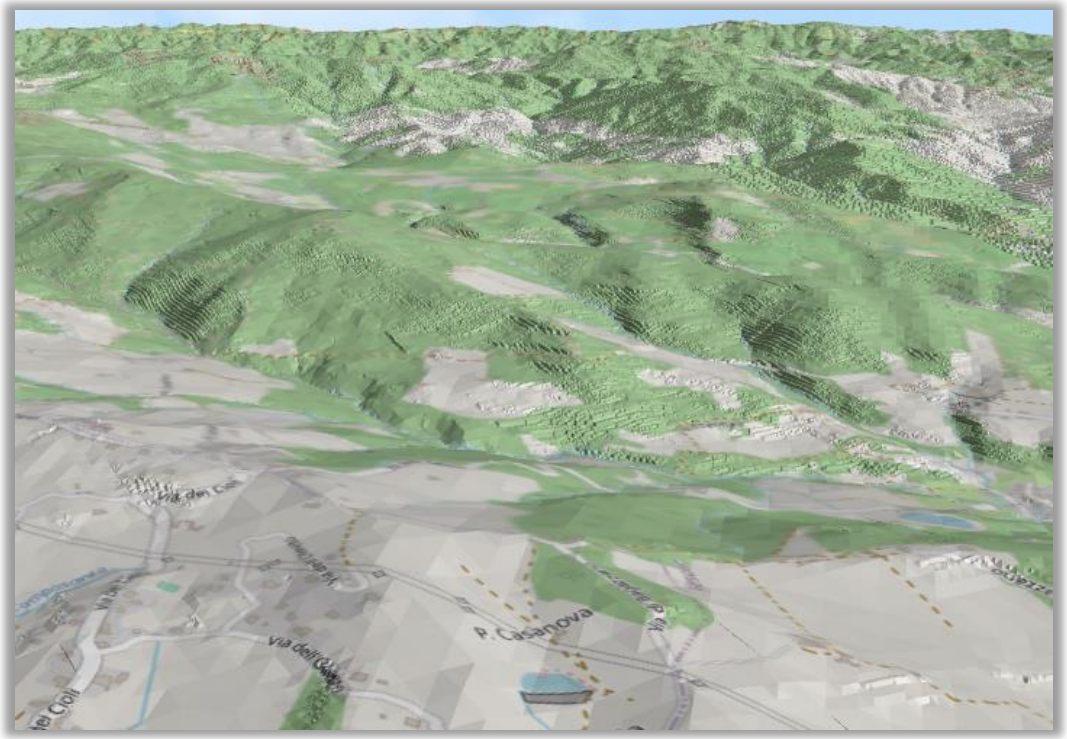
- On top of the Snap4City platform, we build **a web-based interactive 3D interface**



Florence demo accessible from https://digitaltwin.snap4city.org

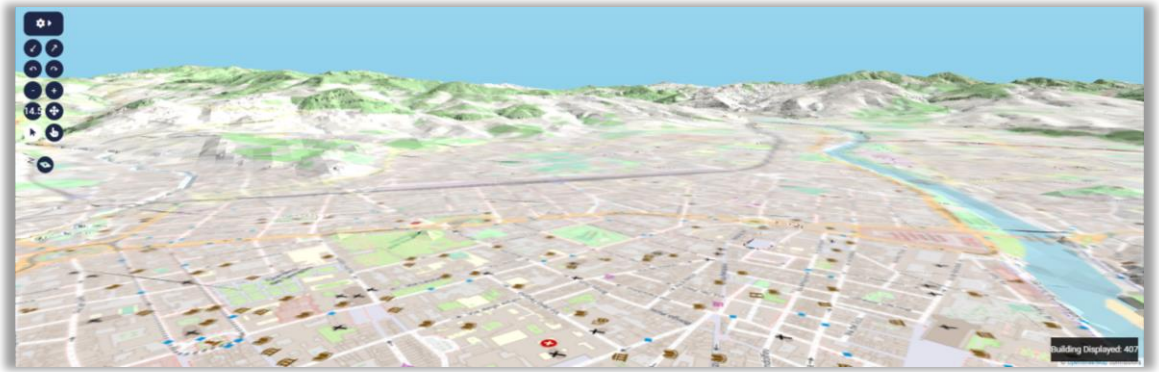
Snap4City Digital Twin Features

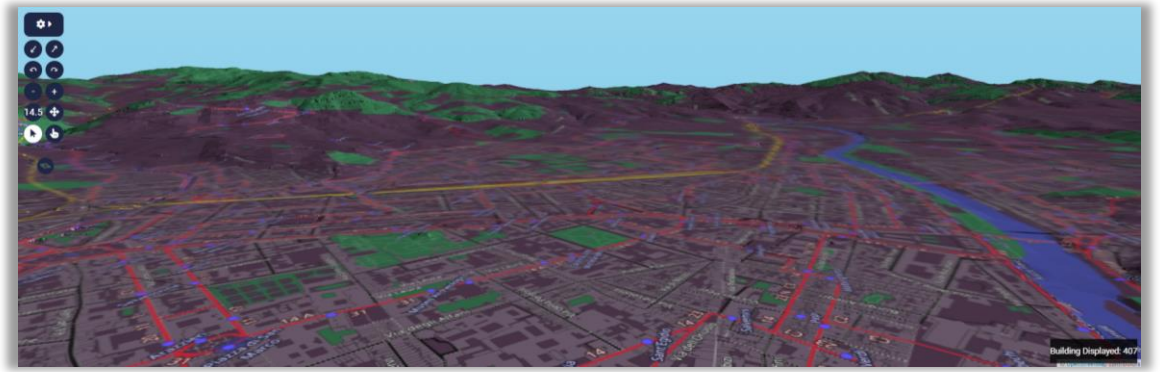
- Accurate **3D terrain model**

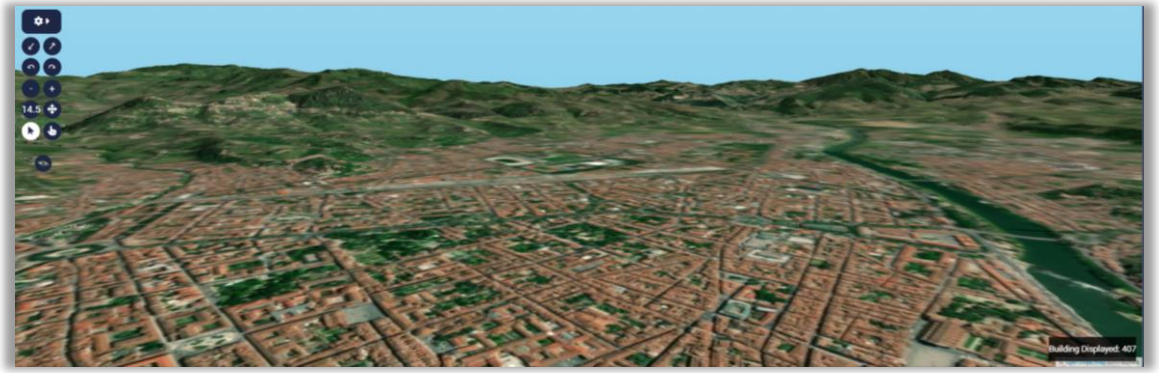


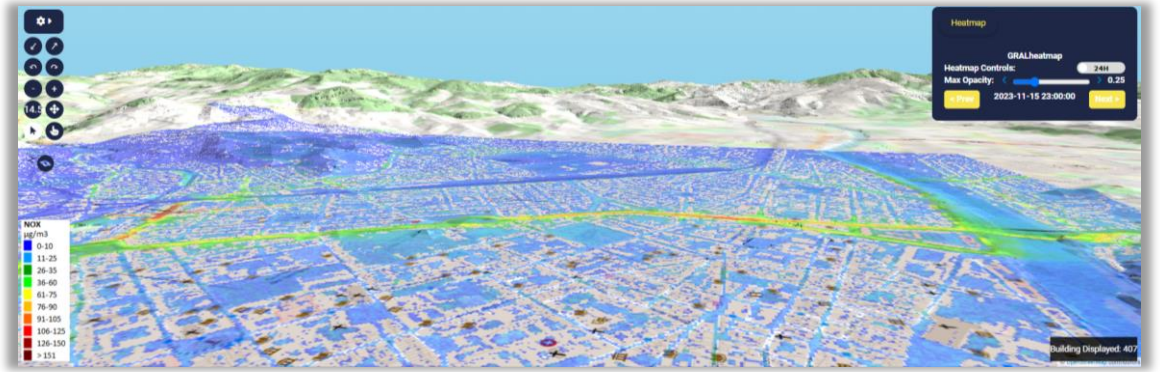
Snap4City Digital Twin Features

- Multiple **ground maps** and **heatmaps**







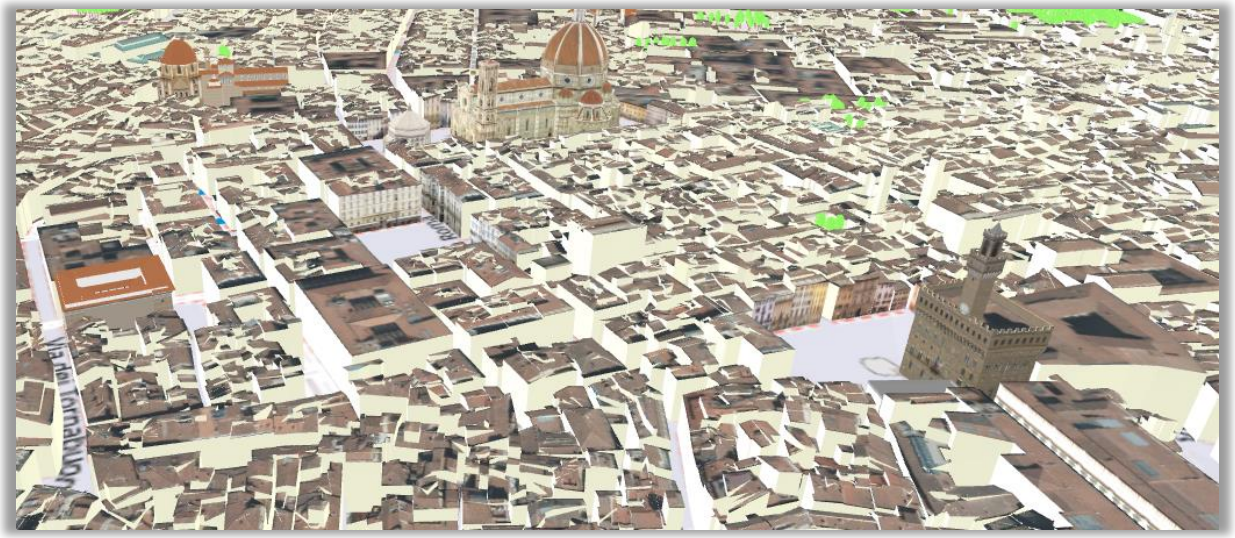


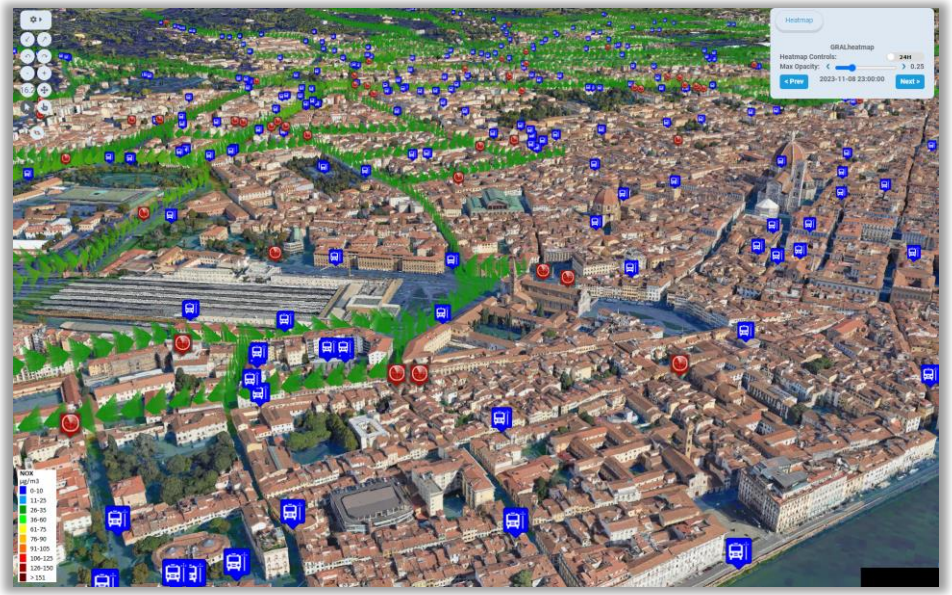
Snap4City Digital Twin Features

- PINs to represent **IoT devices**, **services**, **bus stops**, **points of interest**, etc.
- Each PIN can be clicked to access to **additional information** and **real-time and historic** data

Snap4City Digital Twin Features

- Different kinds of 3D building models
  - Simple box-like 3D representations
  - Accurate 3D reconstructions
  - 3D Tiles (e.g., Google Photorealistic 3D Tiles)



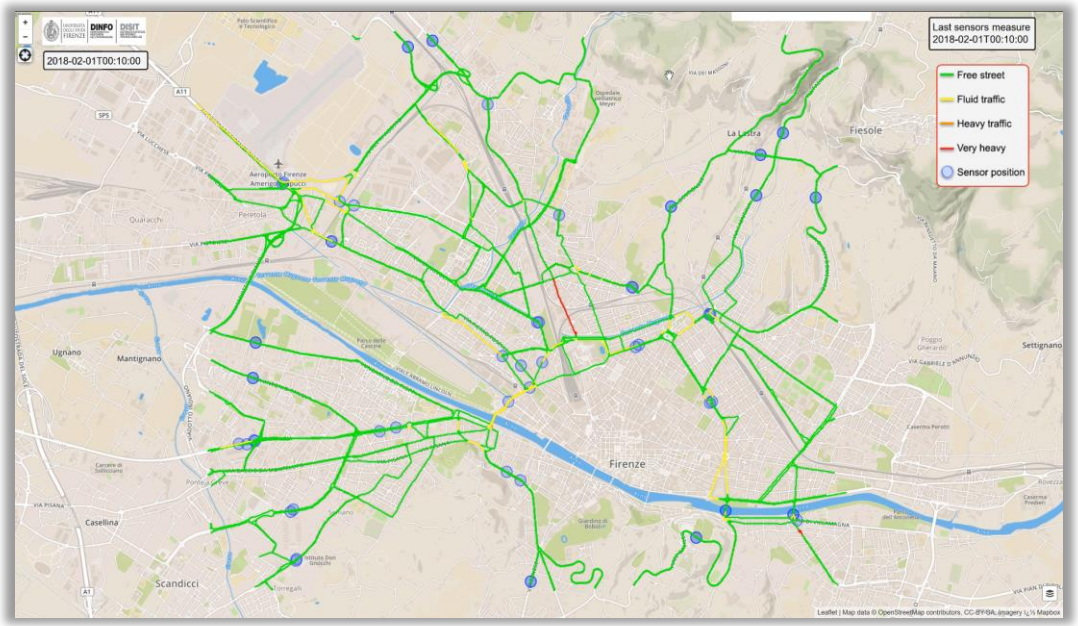


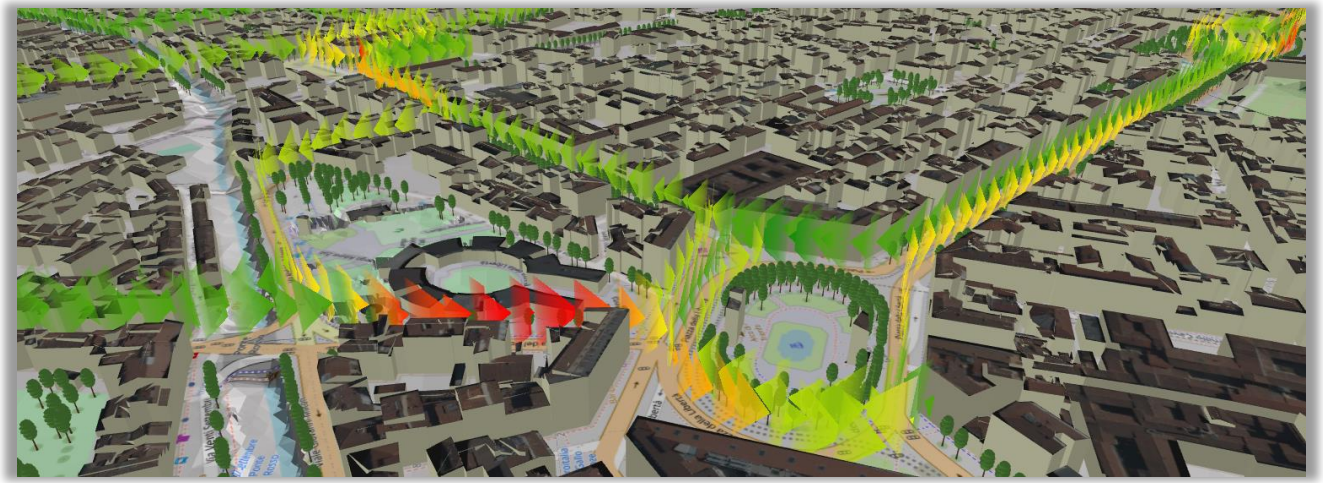
Snap4City Digital Twin Features

- Buildings can be **changed in real-time**, and BIMs can be integrated when available

Snap4City Digital Twin Features

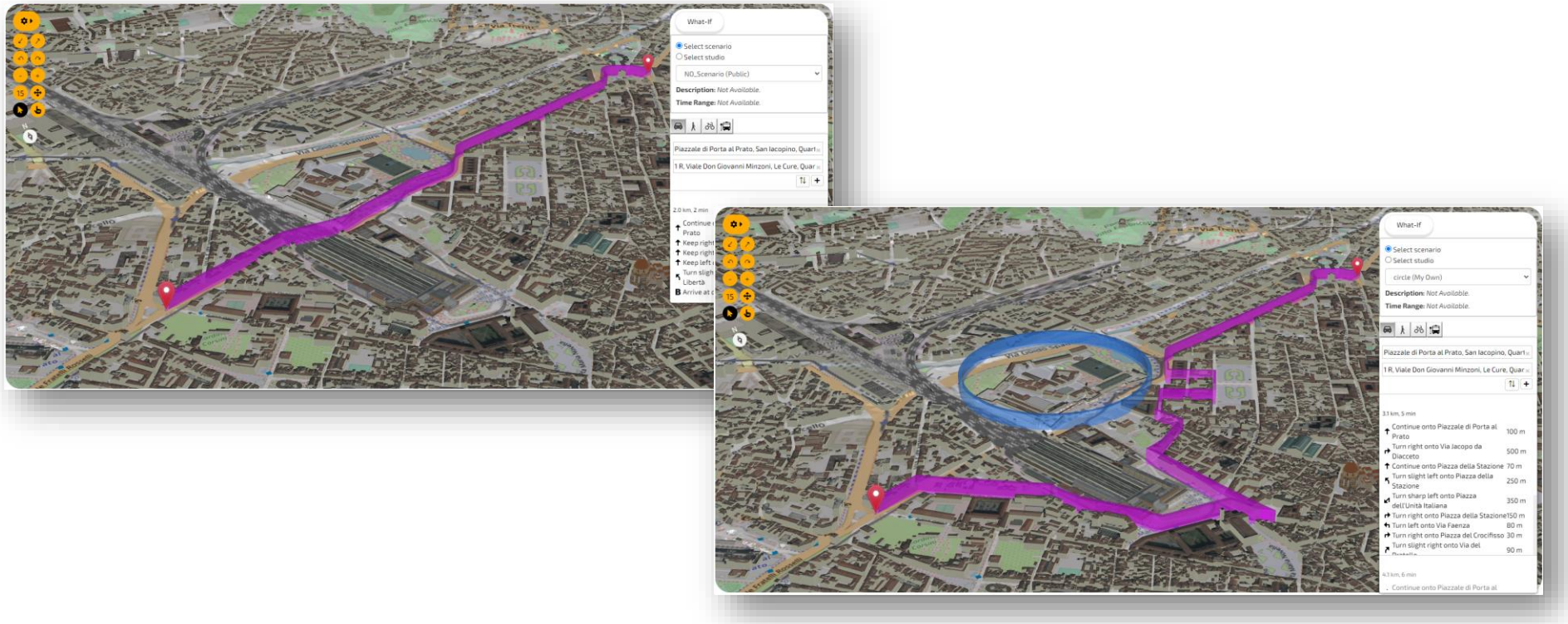
- **Traffic flow reconstructions** can be visualized with animated 3D arrows





Snap4City Digital Twin Features

- **What-if analysis** can be carried out, for example to observe routing changes due to temporary areas blocked to traffic



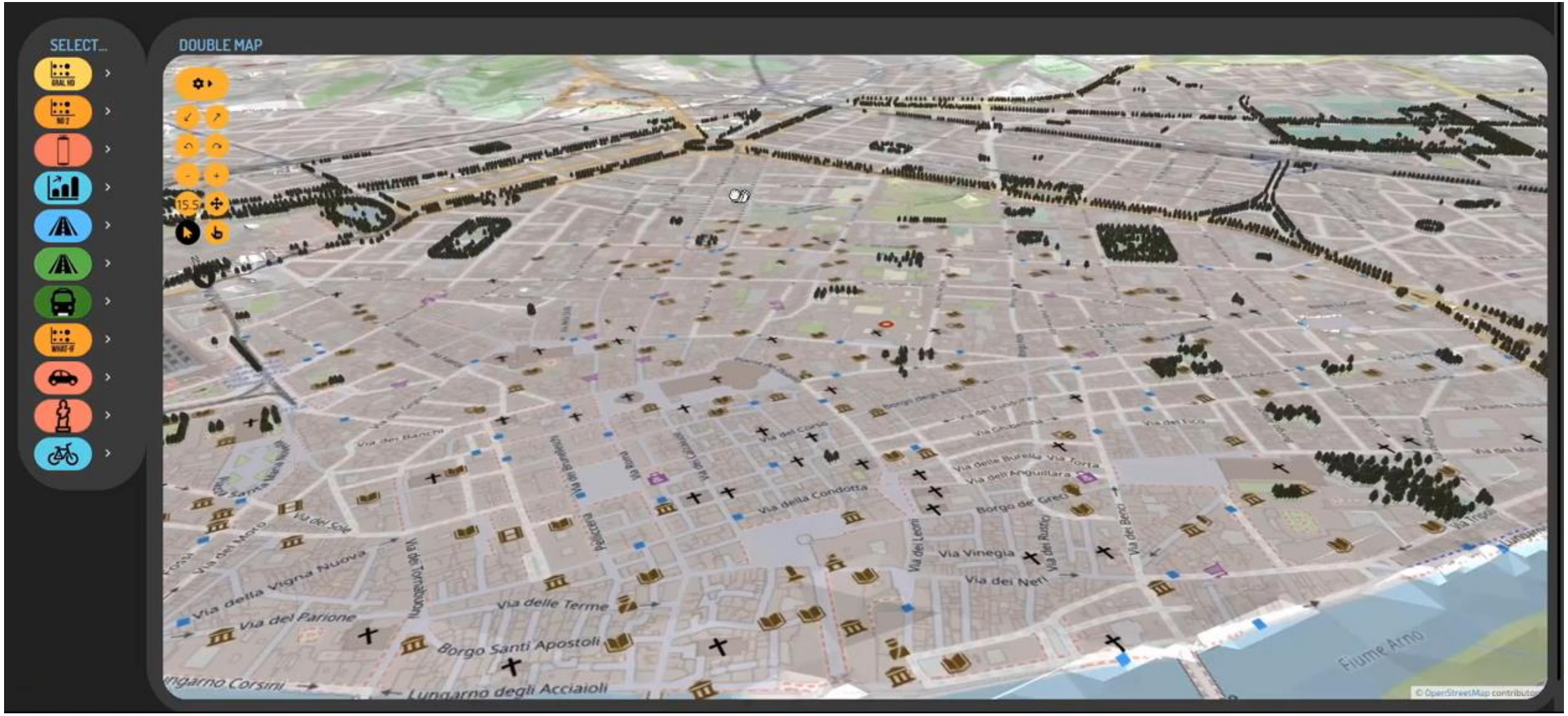
Snap4City Digital Twin Features

- Many other features are available:
  - Road description
  - Public transport routes and scheduling
  - Available cycling paths
  - …

- For a complete description, see
  - Snap4City Digital Twin (https://digitaltwin.snap4city.org/)
  - L. Adreani, P. Bellini, M. Fanfani, P. Nesi and G. Pantaleo, "***Smart City Digital Twin Framework for Real-Time Multi-Data Integration and Wide Public Distribution***," in IEEE Access, 2024, doi: 10.1109/ACCESS.2024.3406795. https://ieeexplore.ieee.org/document/10540577

Conclusions

- Smart City Digital Twin are fundamental tool to **inspect the urban environment** and **perform analyses and simulations**
- Such tools can help city officers and decision-makers to address **problems spanning in several fields** (mobility, environmental, urban planning, etc.) as **support decision systems**
- Thanks to accessible web interfaces, **citizen can better comprehend** the urban environment and **actively participate** in the development of their cities
- **Further works are still required** on data accessibility, on analytics for simulations and what-if analysis, and on interfaces


SELECT...
DOUBLE MAP
Via della Condotta
Via Vinegia
Via dei Neri
Via delle Terme
Borgo Santi Apostoli
Via della Vigna Nuova
Via del Parione
Lungarno degli Acciaioli
Fiume Arno
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Thanks for your attention

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