

**Be smart in a SNAP!**

***A Framework for  
rapid implementation of  
- Sustainable Smart Solutions  
- Decision Support Systems  
as a no-coding, low-coding***

Sept. 2023, Course  
Part 1: overview

**SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES**



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

DINFO  
DIPARTIMENTO DI  
TECNOLOGIE DELL'INFORMAZIONE

DISIT  
DISTRIBUTED SYSTEMS  
AND INFRASTRUCTURE  
TECHNOLOGICAL LAB



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**DINFO**  
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INGEGNERIA  
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**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB



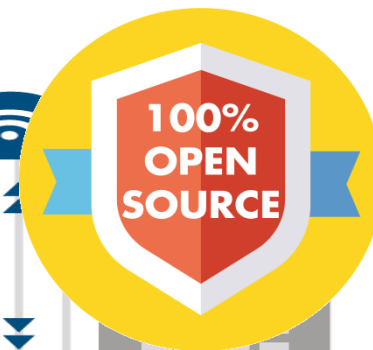
# SNAP4CITY



Powered by

## *scalable Smart aNalytic APplication builder for sentient Cities: for Living Lab and co-working with Stakeholders*

<https://www.Snap4City.org>



Sept. 2023, Course, Part 1

<https://www.snap4city.org/944>

<https://www.snap4city.org/577>

Paolo Nesi, [paolo.nesi@unifi.it](mailto:paolo.nesi@unifi.it)

<https://www.Km4City.org>

<https://www.disit.org>



# Today Agenda

- Needs of the Operators vs platform
- Platform Overview: from data to interactive tools
- Data Analytics, AI
- Some Cases by Domains: solutions vs analytics

– *Coffee Break*

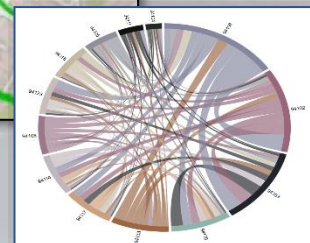
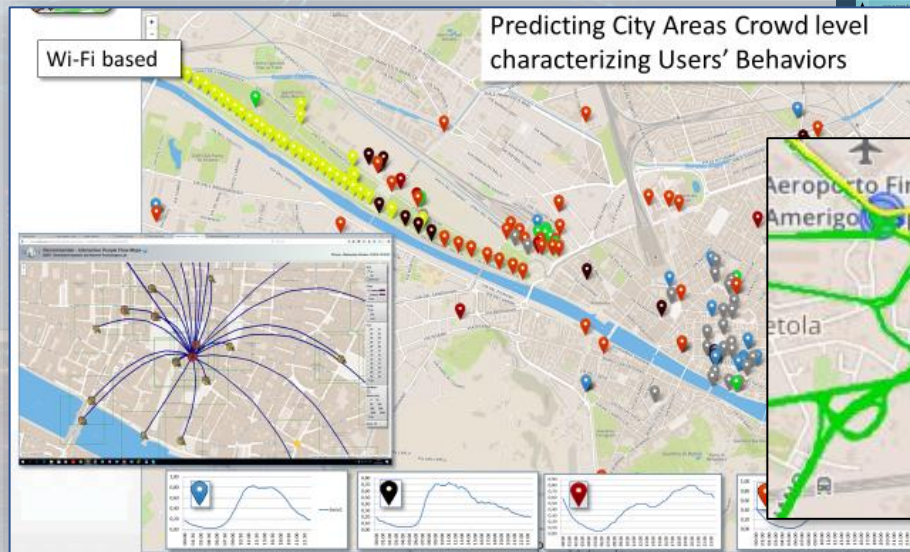
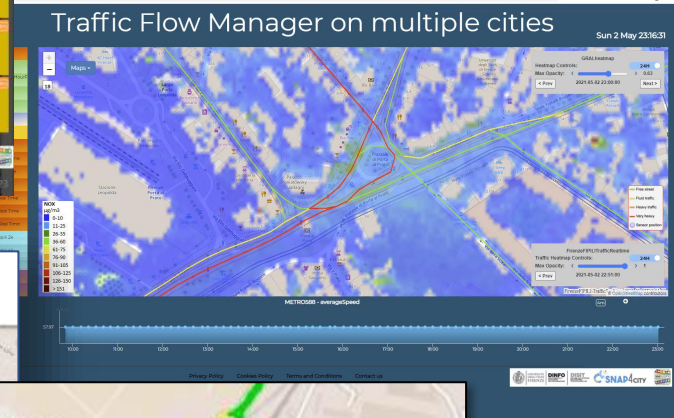
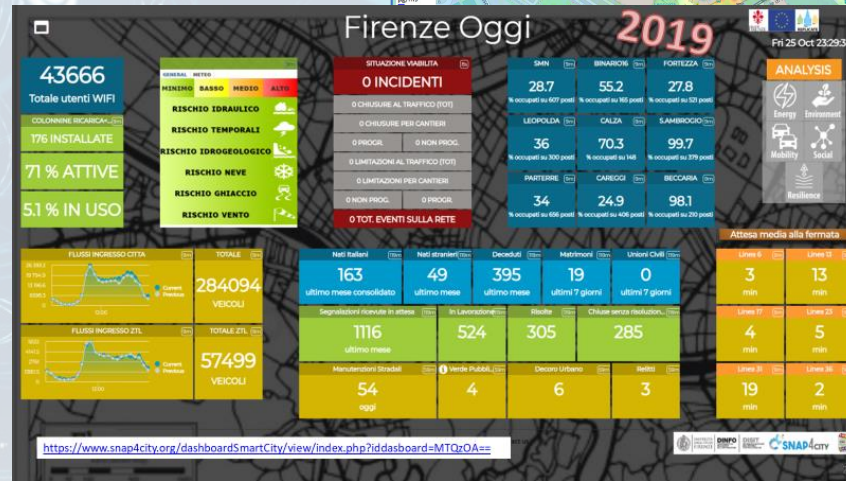
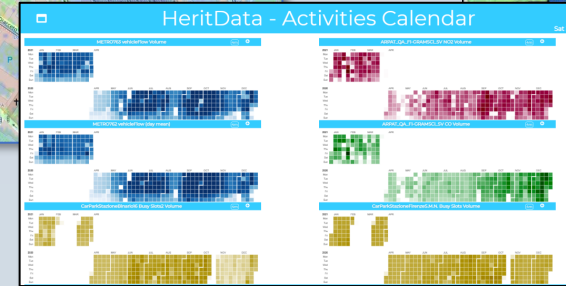
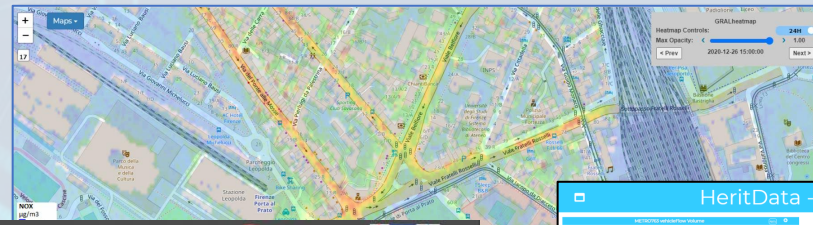
- Other Cases and scenarios
- Overview of the next parts of the Course
- References to other material

# We know the Problem

- **Systems are becoming complex CyberPhysical**
  - Delay in making decisions is a cost!
  - Missed early warning is a cost!
  - Lack of precision is a cost!
  - Lack of decisions & strategies and/or forecast is a cost!
  - KPI computation is a cost:
    - SDG, PUMS, SUMI, 15 Min City Index, etc.
- ***Making Decisions Process* is less effective when it is:**
  - not fully supported by data?
  - not performed in time?
  - not possible from remote?
- **Huge amount of data are or could be exploited to make the right decision in time.** The always listened reasons:
  - complexity, formats, integration, competence, licensing,
  - costs, processing, accessibility, discovery, production, ..
  - volume, velocity, value, update, ...

# Domains

- Smart City, control room
  - Mobility and transport
  - Environment, pollutant, waste, water, ..
  - Green Deal, smart light, ..
  - Energy , Industry
  - Tourism and People
- 
- Big Data
  - Artificial Intelligence
  - Public and private data





# SUSTAINABLE DEVELOPMENT GOALS

<b>1</b> NO POVERTY 	<b>2</b> ZERO HUNGER 	<b>3</b> GOOD HEALTH AND WELL-BEING 	<b>4</b> QUALITY EDUCATION 	<b>5</b> GENDER EQUALITY 	<b>6</b> CLEAN WATER AND SANITATION 
<b>7</b> AFFORDABLE AND CLEAN ENERGY 	<b>8</b> DECENT WORK AND ECONOMIC GROWTH 	<b>9</b> INDUSTRY, INNOVATION AND INFRASTRUCTURE 	<b>10</b> REDUCED INEQUALITIES 	<b>11</b> SUSTAINABLE CITIES AND COMMUNITIES 	<b>12</b> RESPONSIBLE CONSUMPTION AND PRODUCTION 
<b>13</b> CLIMATE ACTION 	<b>14</b> LIFE BELOW WATER 	<b>15</b> LIFE ON LAND 	<b>16</b> PEACE, JUSTICE AND STRONG INSTITUTIONS 	<b>17</b> PARTNERSHIPS FOR THE GOALS 	 <b>SUSTAINABLE DEVELOPMENT GOALS</b>

# indicators



- **United Nations Sustainable Development Goals, SDGs** (for which cities can do more to achieve some of the 17 SDGs, <https://sdgs.un.org/goals>);
- **15 minutes cities** (where primary services must be accessible within 15 minutes on foot);
- **objectives of the European Commission** in terms of pollutant emissions for: NO<sub>2</sub>, PM<sub>10</sub>, PM<sub>2.5</sub> ([https://environment.ec.europa.eu/topic/air\\_en](https://environment.ec.europa.eu/topic/air_en));
- **PUMS: mobility and transport vs wnv**
- **SUMI: mobility and transport vs env**
- **ISO indicators: city smartness, digitization. Tech level**
- ....

Global  
Vs  
Local



Pollutant	Averaging period	Objective and legal nature and concentration	Comments	WHO guidelines	
				Concentration	Comments
PM <sub>2.5</sub>	One day			25 µg/m <sup>3</sup> (*)	99 <sup>th</sup> percentile (3 days/year)
PM <sub>2.5</sub>	Calendar year	Target value, 25 µg/m <sup>3</sup>	The target value has become a limit value since 1 January 2015	10 µg/m <sup>3</sup>	
PM <sub>10</sub>	One day	Limit value, 50 µg/m <sup>3</sup>	Not to be exceeded on more than 35 days per year.	50 µg/m <sup>3</sup> (*)	99 <sup>th</sup> percentile (3 days/year)
PM <sub>10</sub>	Calendar year	Limit value, 40 µg/m <sup>3</sup> (*)		20 µg/m <sup>3</sup>	
O <sub>3</sub>	Maximum daily 8-hour mean	Target value, 120 µg/m <sup>3</sup>	Not to be exceeded on more than 25 days per year, averaged over three years	100 µg/m <sup>3</sup>	
NO <sub>2</sub>	One hour	Limit value, 200 µg/m <sup>3</sup> (*)	Not to be exceeded more than 18 times a calendar year	200 µg/m <sup>3</sup> (*)	
NO <sub>2</sub>	Calendar year	Limit value, 40 µg/m <sup>3</sup>		40 µg/m <sup>3</sup>	



• **15 Minute City Index:**

- 13 subindexes: energy, slow mobility, fast mobility, housing, economy education, culture and cults, health, entertainment, gov, food, security...



- Monitoring and Prediction of energy consumption
- Stimulating: Bike sharing, e-bikes, car charge, etc.
- Community of Energy, planning energy plant



- Industry 4.0 integrated solutions
- Decisions Support Systems
- Process optimization, control
- Predictive maintenance



- Smart City infrastructure: monitoring and resilience, long terms predictions
- Effective and Low cost smart solutions
- What-if analysis, Simulations
- Origin Destination matrices computation



- business intelligence tools for decision makers
- Reduction production costs
- Monitoring resource consumption
- Optimization of Waste Collection



- Monitoring and Predicting: NO<sub>2</sub>, NO<sub>x</sub>, CO<sub>2</sub>, Traffic flow, pollutant, landslide, waste, etc.
- Traffic flow reconstruction
- Demand vs Offer of Mobility analysis



- Shortening justice time
- Anonymization and indexing legal docs.
- Prediction of mediation proneness
- Ethical Explainable Artificial Intelligence



# 15MinCityIndex

**What would support my neighborhood to become a 15-Minute City?**

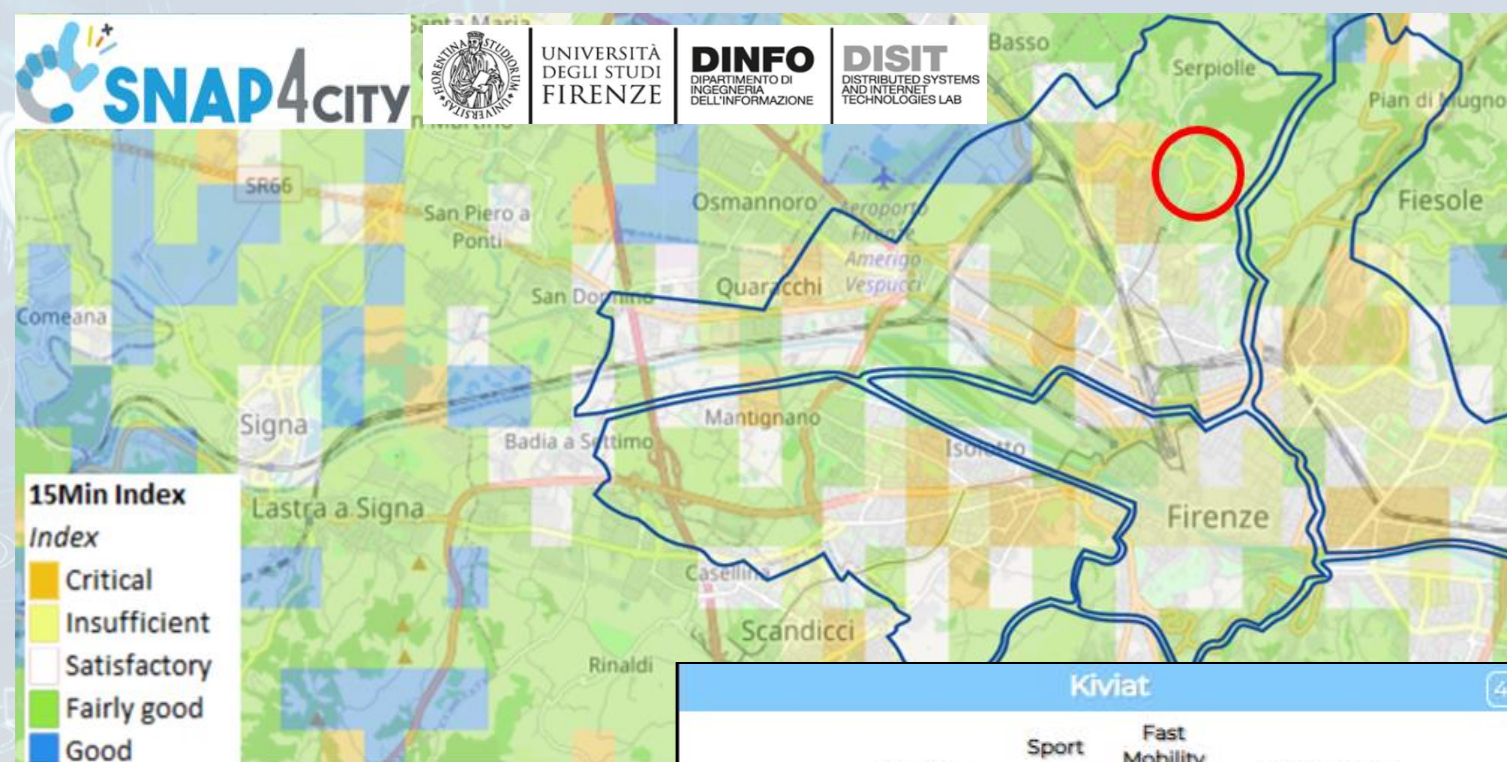
## Using the Open Data:

We developed a data analytic tool based on municipal and national open data to assess services adequacy for people living in each 15 minutes areas of the city.

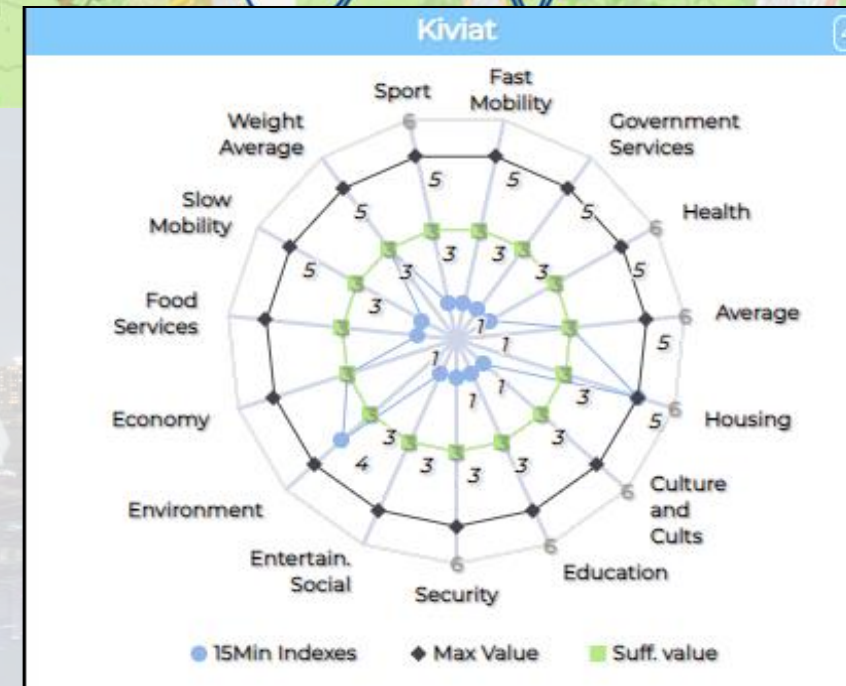
Good public transport services: bus, new tram line, train stations, cycle paths.



Careggi/Rifredi is a relevant district in Florence because of hosting the main Florence/Tuscany hospitals Careggi and Meyer, but also university headquarters and many other workplaces.



The tool supports the becoming of a 15-Minute city evaluating the service level in various domains.



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MjkzOA==>

# 15MinCityIndex on Bologna

Ciao roottooladmin!

Tue 3 May 20:14:59

## 15 MINUTI INDEX BOLOGNA CITTÀ METROPOLITANA - NEWGUI

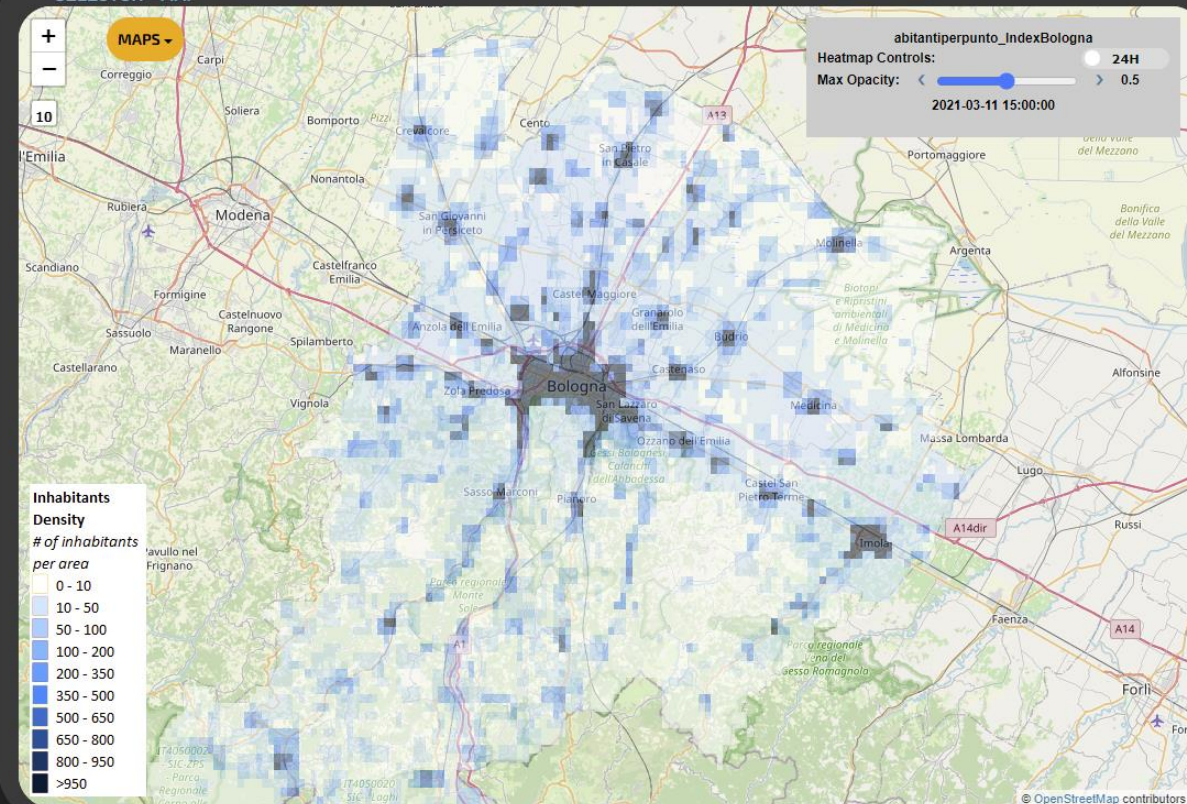
- # of Inhabitants >
- Green factor >
- Civil factor >
- Industrialization factor >
- Environment Index >
- 15Min Economy Index >
- 15Min Housing Index >
- 15Min Health Index >
- 15Min Food Index >
- 15Min Education Index >
- 15Min Slow Mob Index >

### THE PICKED POINT

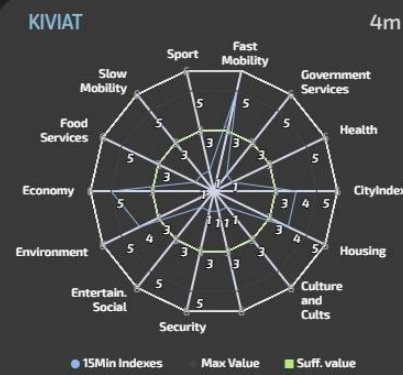
9m

City: Argelato  
Address: Via Casadio N. 1  
lat,lon: 44.61882,11.35437

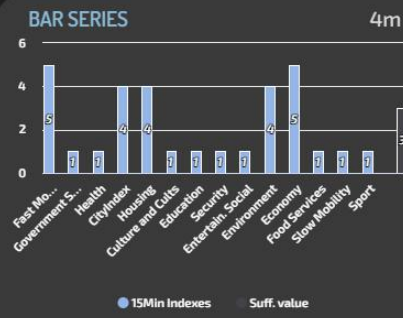
### SELECTOR - MAP



### KIVIAT



### BAR SERIES



- 1 NO POVERTY**
- 2 ZERO HUNGER**
- 3 GOOD HEALTH AND WELL-BEING**
- 4 QUALITY EDUCATION**
- 7 AFFORDABLE AND CLEAN ENERGY**
- 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE**
- 11 SUSTAINABLE CITIES AND COMMUNITIES**
- 12 RESPONSIBLE CONSUMPTION AND PRODUCTION**
- 13 CLIMATE ACTION**
- 15 LIFE ON LAND**

# Control Room



# Mobility and Environment What-IF Analysis

This dashboard contains data derived from actual sensors and predictive values under validation

Wed 20 Nov 15:43:00

- ✓ Air Quality Sensors
  - ✓ Weather Sensors
  - ▲ PM10 Heatmap
  - ▲ PM2.5 Heatmap
  - ▲ CO Heatmap
  - ▲ CO2 Heatmap
  - ▲ NO2 Heatmap
  - ▲ Europ. AQI Heatmap
  - ▲ Air Humidity Heatmap
  - ▲ Air Temp. Heatmap
  - ▲ Wind Speed Heatmap
  - ✓ Cral Pred. HM NOx (3m)
  - ▲ Cral Pred. HM NOx (6m)
  - ✓ Traffic Sensors
  - ✓ Traffic Flow
  - ▲ Cycling Paths
  - ▲ Accident Heatmap
  - ▲ Only HRes Anym. Gra
  - ▲ Scenarios
  - ▲ What-if analysis
- Firenze Oggi
- Air Temperat... (m)



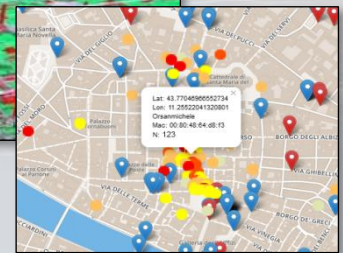
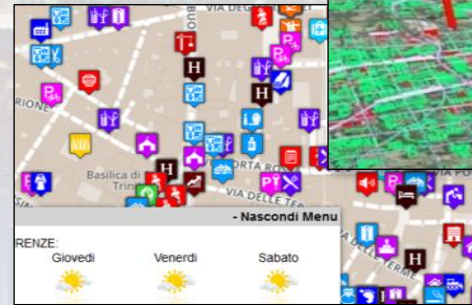
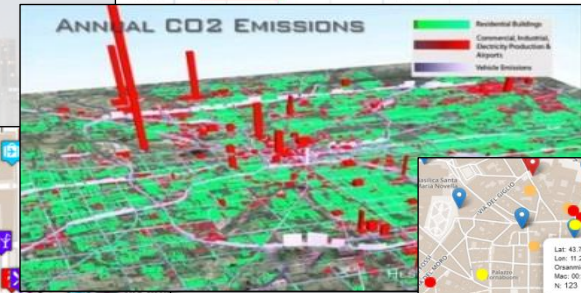
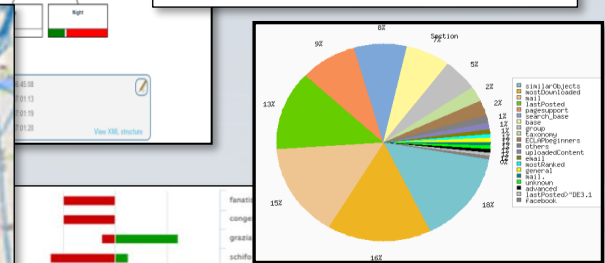
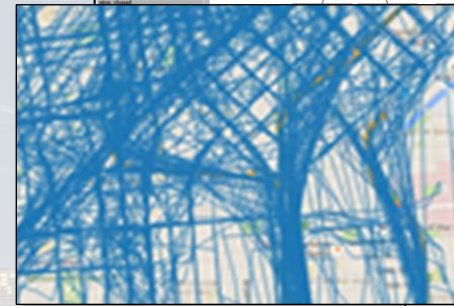
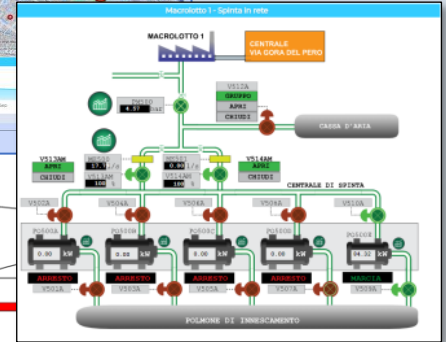
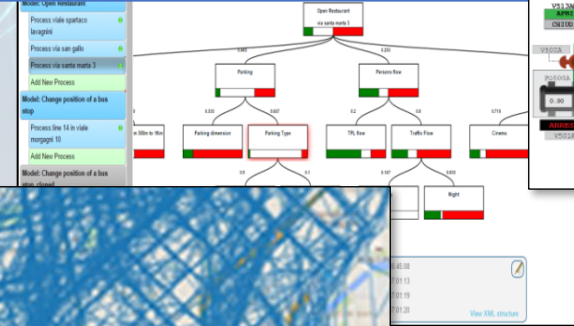
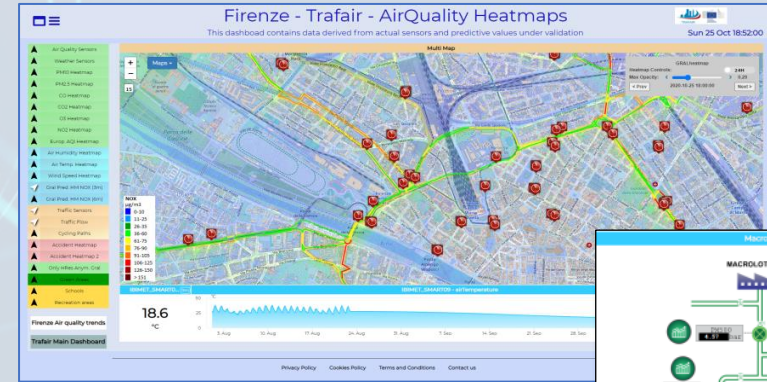
<https://www.snap4city.org/511>

ADVANCED SMART  
DATA ANALYTICS

# Data Driven Decision Support



- Decision Support system
- Assessment / Strategies
- Data Rendering,
  - visual analytics, business intel..
- Data Analytics, ML, AI
- Data aggregation, Storage, indexing
- Data Ingestion



# Challenges vs Technologies

- **DSS, Decision Support Systems**, with multiple objectives:
  - **Quality of life** for citizens, improvements of services, cost reduction, innovation, attractiveness for tourists and/or industries and/or commercial activities, etc.
- **provide the decision-making process with simulation tools integrated with short-, long- and very long-term prediction algorithms**  
 → *what-if analysis*
  - Analyse *incipient events* to cope with events;
  - Analyse future situations for structural planning: tactics/strategic.
- **Opportunities and needs**
  - exploit **huge amounts of heterogeneous data (Big Data)** that come from the territory, from the structures and services of the city and from the stakeholders;
  - **flexible, dynamic and interoperable models and analysis tools;**
  - **accessible for:**
    - Operators, decision-makers, stakeholders;
    - In some measure also for citizens: as a tool for illustrating and discussing possible solutions and development plans with them: *cowork*



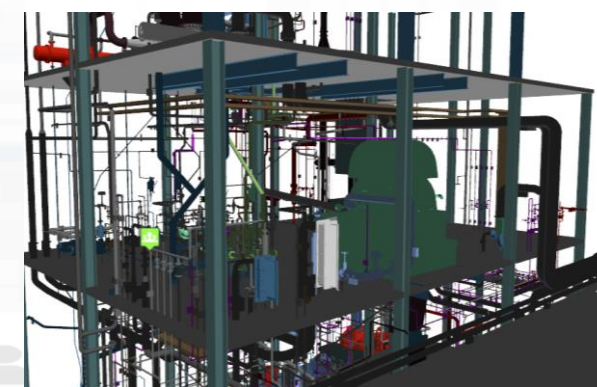
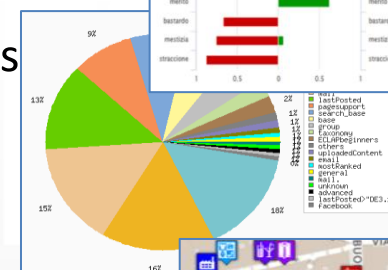
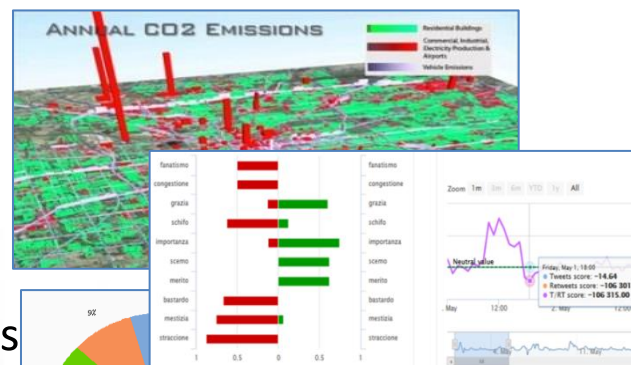
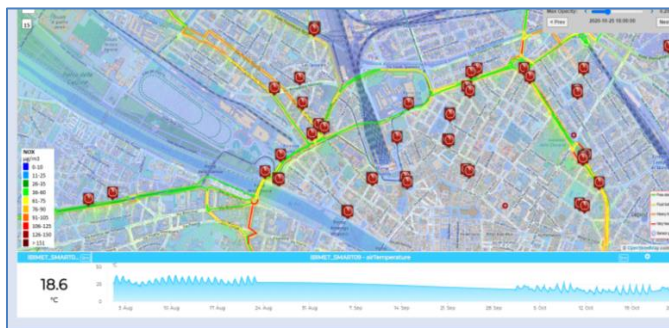
# Digital Twin

- **Digital Twin**

- **Connected** with real systems
- **Modelling** aspects: structural, visual, informative, real time data sensors (context), POI, functional, resources, etc.
- **Integration:** AI/XAI techniques, simulations, users' needs, etc.

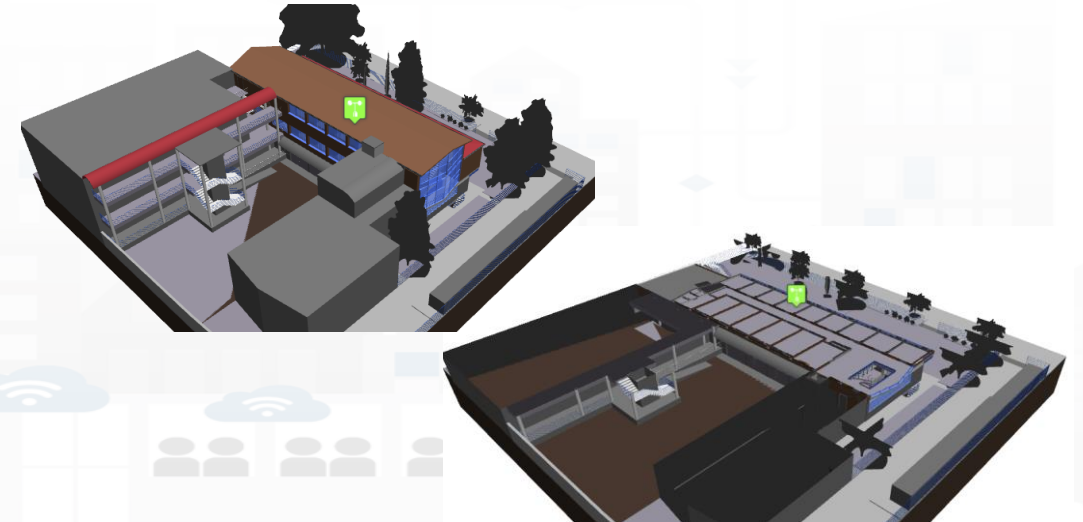
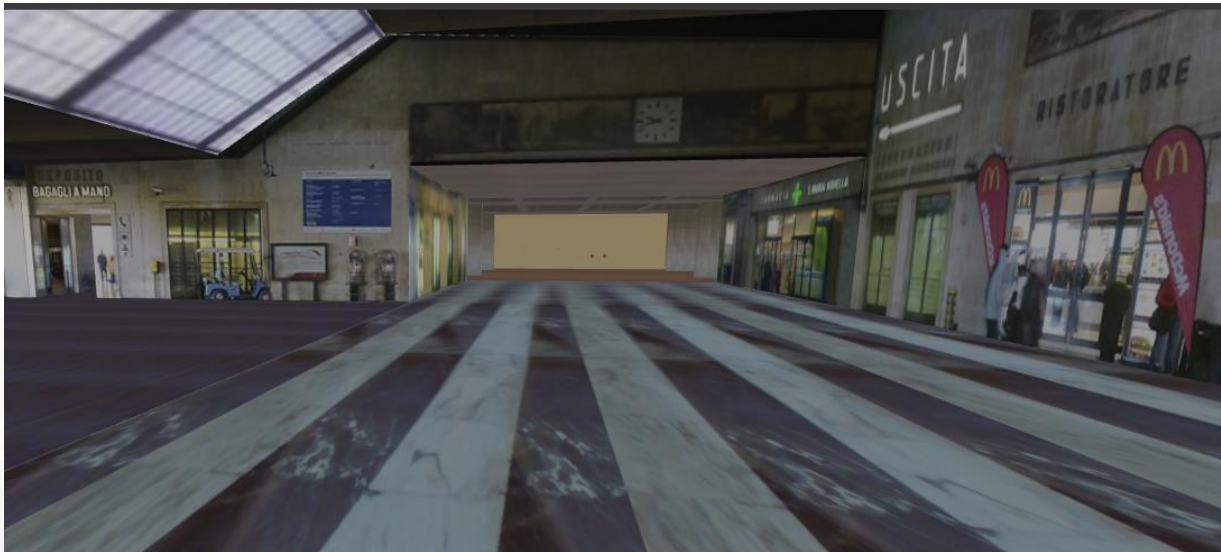
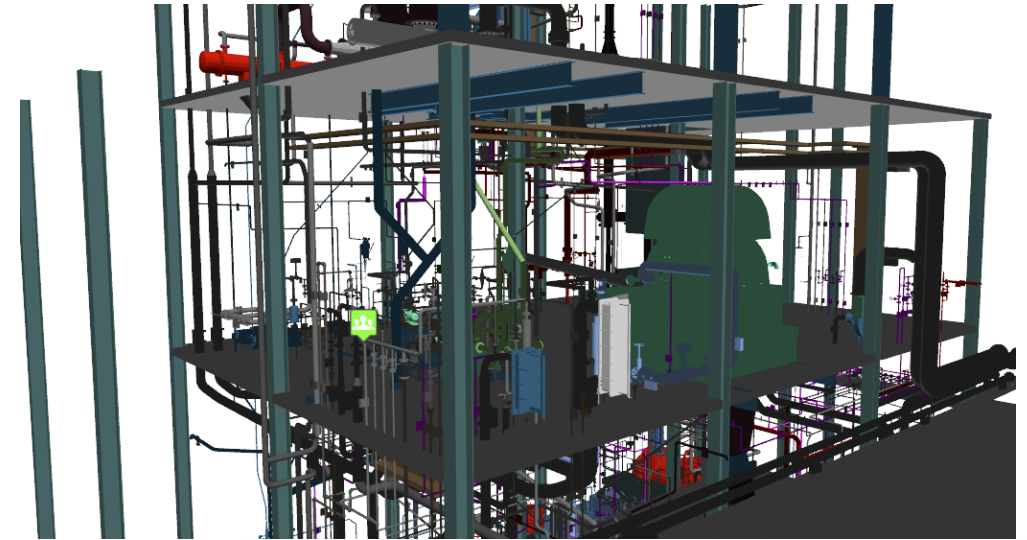
- **Utility to**

- Experiment via simulations and analysis by case
  - Reduction of costs to experiments new solutions
  - Share the possibilities with city users
- Virtual Representation
  - Easier to understand the context, review from multiple points of view
- Who
  - Discussion with city users, decision makers
  - Support: decision makers, proposers of solutions



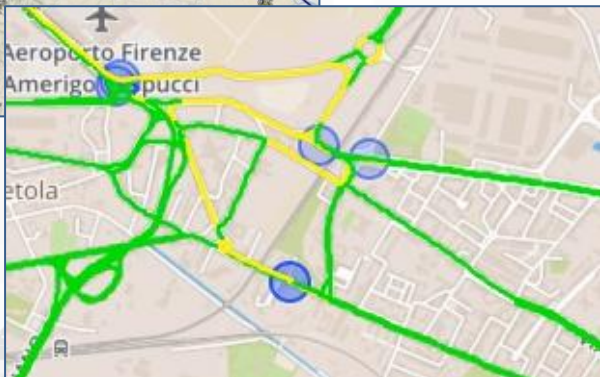
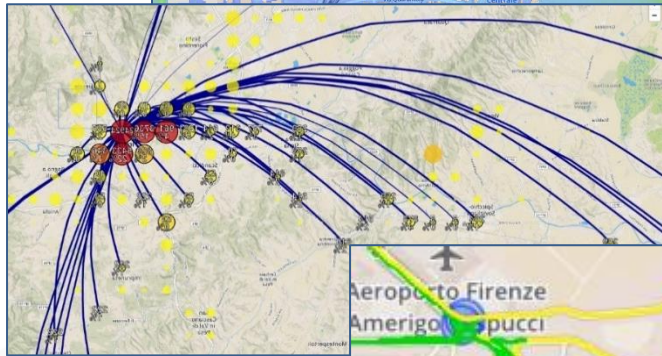
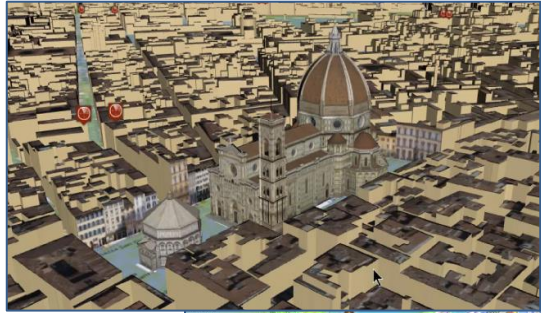
# Digital Twin

## Global vs Local





# Global Digital Twin



## 3D representation of the city with...

- geomorphological, hydrogeological aspects,
- private and public transport networks,
- waste recovery systems,
- weather conditions, climate and microclimate,
- events, emergencies, ..., parking, sharing, ...
- tourist and city user flows, origin destination matrices,
- commercial activities, urban decorum, public lighting,
- green areas, cleanliness, safety on the road and in pedestrian areas,
- places for entertainment events, cultural activities, attraction and aggregation points of the city,

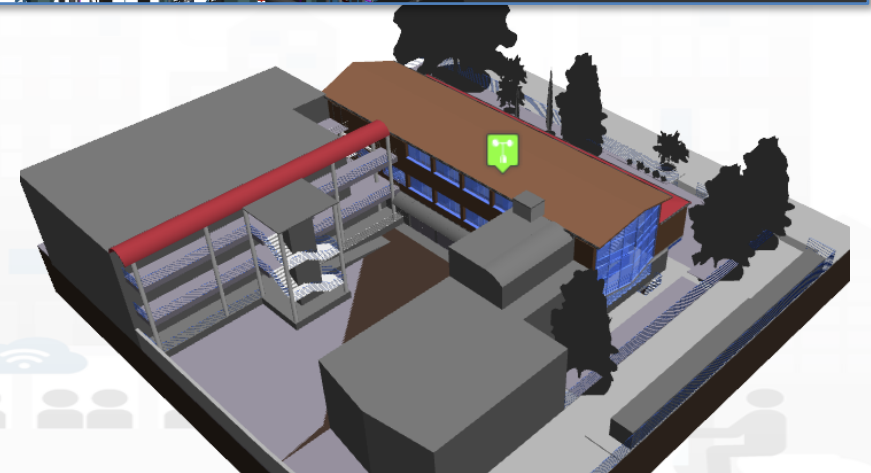
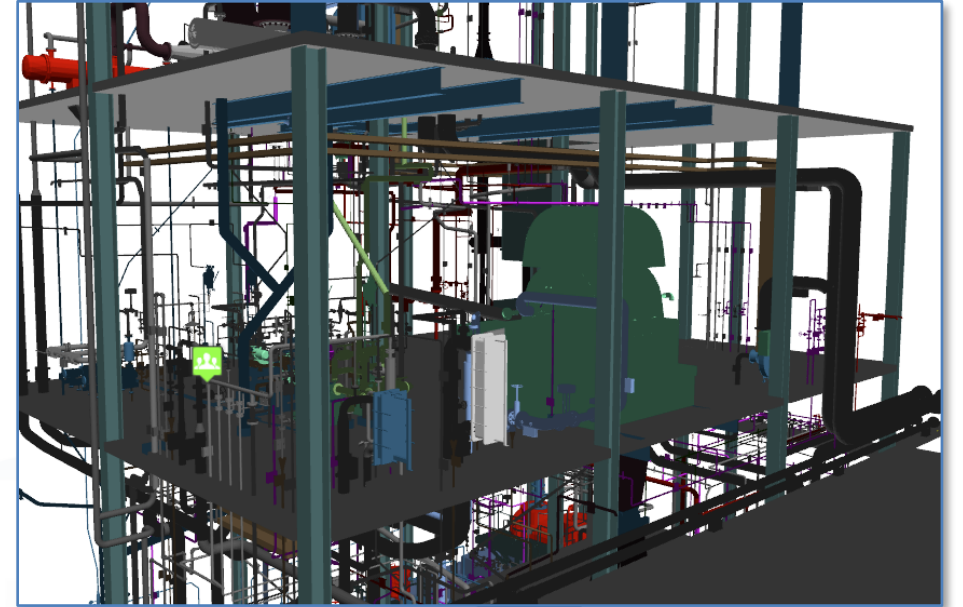
**Complex and heterogeneous information**, structured and unstructured, historical series and in real time data, public/private and sensitive data for security aspects.

### ○ → Reuse of legacy systems

- GIS (Geographical Information System),
- ITS (Intelligent Transportation System),
- AVM (Automatic vehicle monitoring),
- from IoT (Internet of Thing) systems and networks.

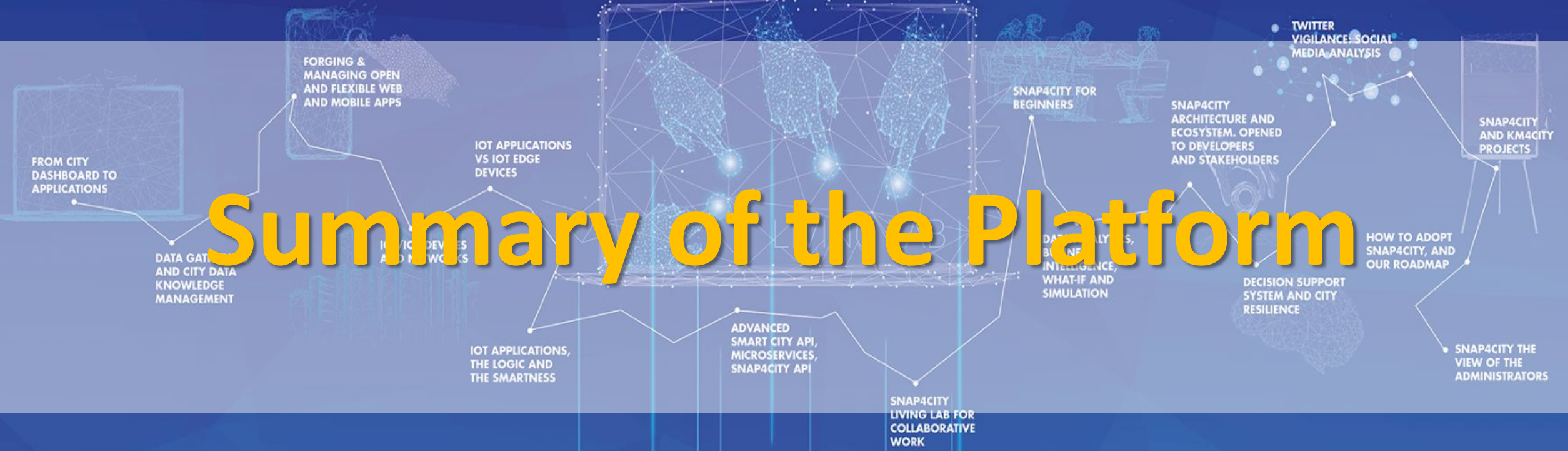
# The Local Digital Twin

- **Digital Twin:**
  - From a single sub-system (**Local Digital Twin**) to
  - A whole city or apart of it (**Global Digital Twin**)
- To model various data kind and to keep them connected to each other and to its counterparts in physical world:
  - a **building with its BIM** (Building Information Modeling) model with details of the floors, plumbing, electrical subsystems, services, construction materials, etc.;
  - **control systems** with their real-time data (data from the IoT world): boilers, air conditioners, electrical systems, sensors, network connection, etc.;
  - **events and the evolution of their status;**
  - **functional and structural aspects;**
  - **How they are used;**
  - **microclimatic aspects,**
  - etc.

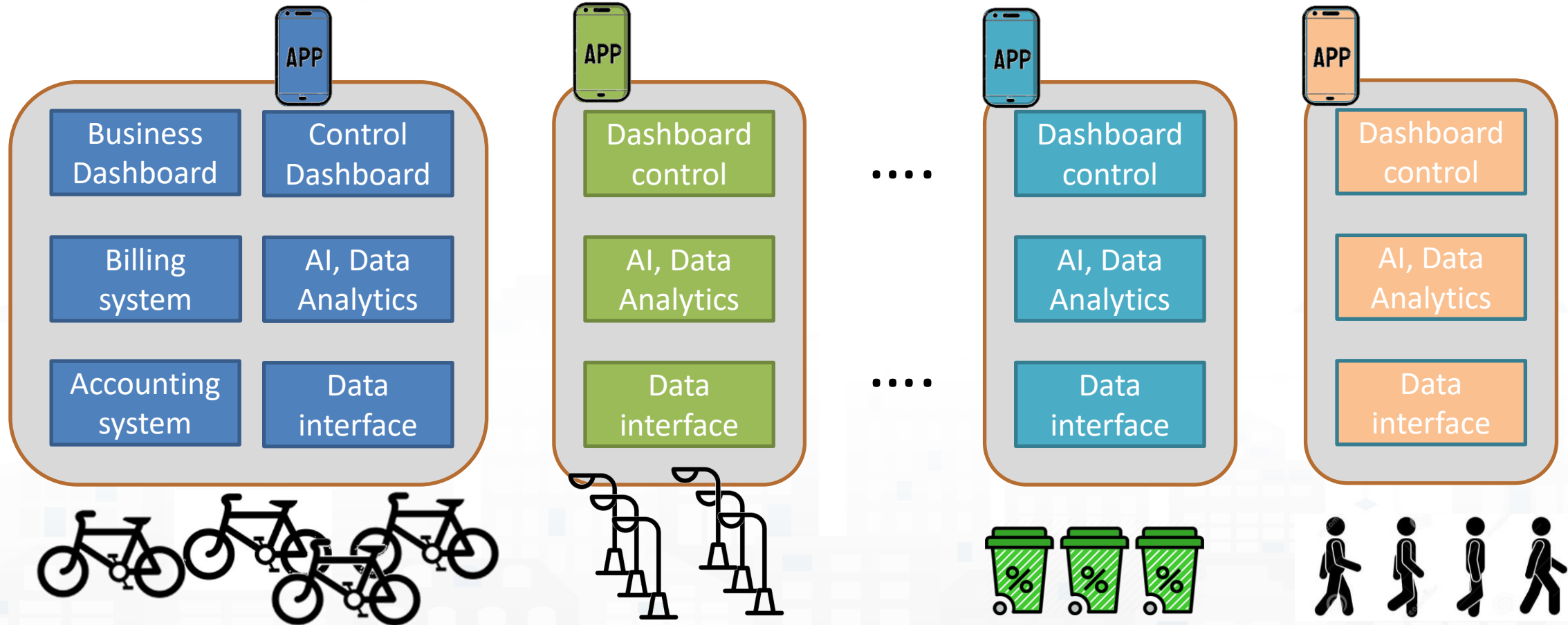




# Summary of the Platform



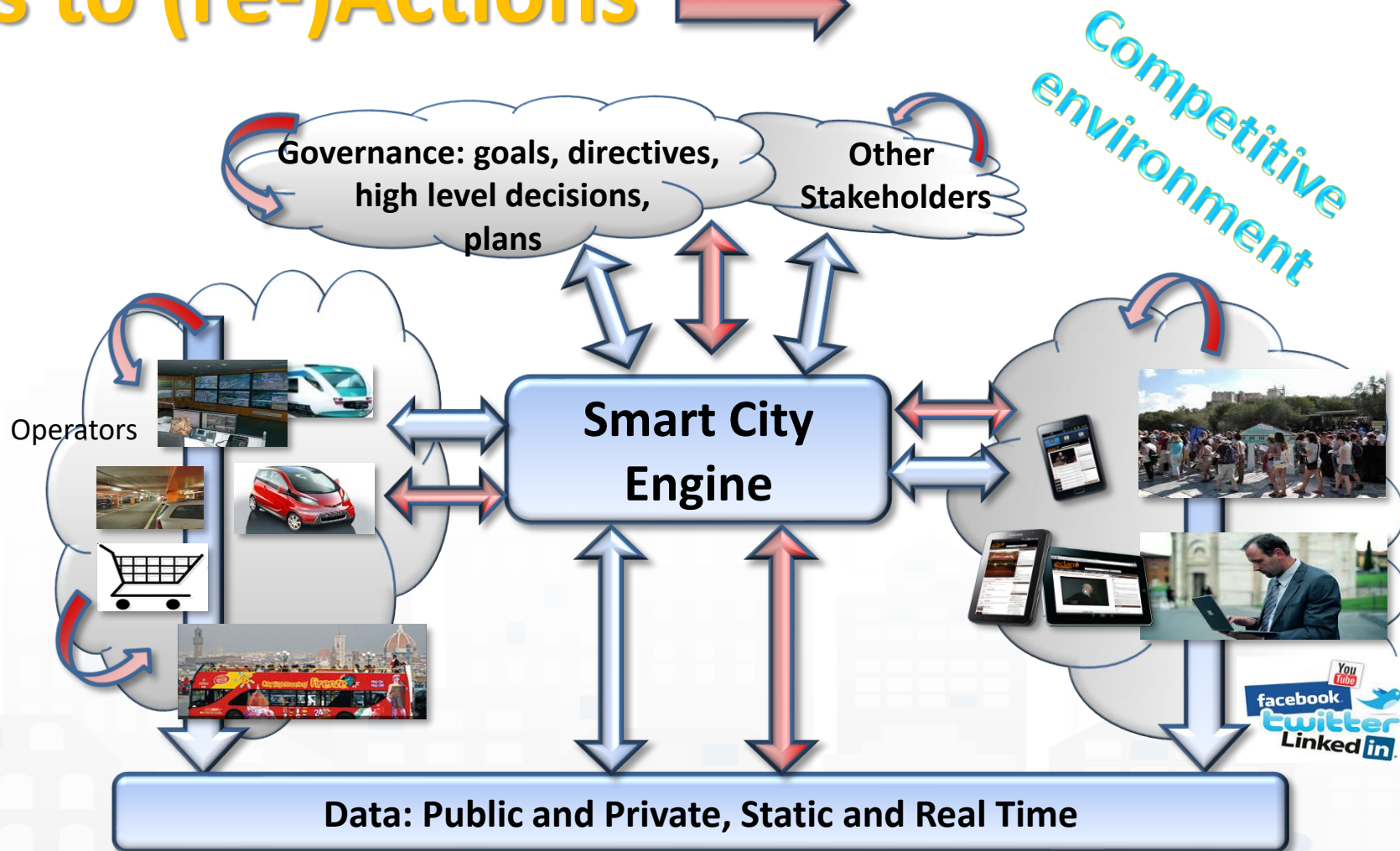
# Avoiding to have a collection of verticals



*Simplifying the development and integration of verticals*

# From Strategies to (re-)Actions

- Analyze
- Alerting, Early Warning
- Support Decision makers
- Plans
- Prescriptions
- Inform
- Suggest
- Engage
- Research





# SMART SOLUTIONS AND DECISION SUPPORT SYSTEMS

CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - BUSINESS INTELLIGENCE - SIMULATIONS - SMART APPLICATIONS



DASHBOARDS - VISUAL ANALYTICS - SYNOPTICS - DIGITAL TWIN - GRAPHICAL WIDGETS - ANALYTICS - GUI CUSTOM STYLES - VISUAL PROGRAMMING

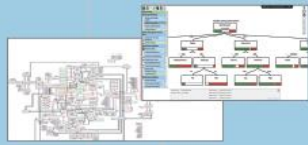


DASHBOARDS, WIDGETS  
TEMPLATES

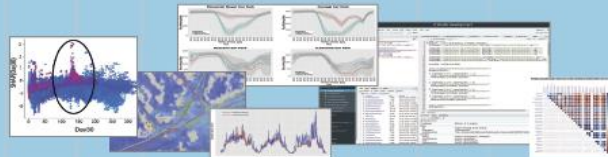
PREDICTION - ANOMALY DETECTION - CLUSTERING - ROUTING - SENTIMENT NLP - TRAFFIC FLOW  
PEOPLE FLOWS - SDG - 15 MIN CITY INDEX - KPI - HEATMAPS - ORIGIN DESTINATION - ETC...

API - MICROSERVICES - GIS - BPM  
VIDEO - REPORTS - MAPS - 3D ...

ANY: DATA, BROKER, NETWORK AND VERTICAL



EXPERT SYSTEM, KNOWLEDGE BASE  
SEMANTIC REASONING  
SMART DATA MODEL  
IOT DEVICE MODELS, STORAGE



BIG DATA ANALYTICS, ARTIFICIAL INTELLIGENCE  
EXPLAINABLE AI, MACHINE LEARNING  
OPERATIVE RESEARCH, STATISTICS



VISUAL PROGRAMMING, ADAPTERS  
DATA FLOWS, WORKFLOWS  
PARALLEL DISTRIBUTED PROCESSING  
DATA DRIVEN

- Native and External Applications**
- Smart Parking
  - Smart Light
  - Smart Waste
  - Smart Energy
  - Social Media Analysis
  - ...



METHODOLOGIES  
LIVING LABS  
COURSES AND COMMUNITY  
DEVELOPMENT TOOLS



Powered by  
**FIWARE**

FREE  
TRIAL

PEN Test  
Passed

EU GDPR  
COMPLIANT

SNAP4  
Appliances and Dockers  
Installations

EUROPEAN OPEN  
SCIENCE CLOUD

Node-RED

JS Foundation

E015  
digital ecosystem

NVIDIA



# Smart Solutions and Decision Support Systems

Powered by **FIWARE**

**FREE TRIAL**

**PEN Test Passed**

**EU GDPR COMPLIANT**

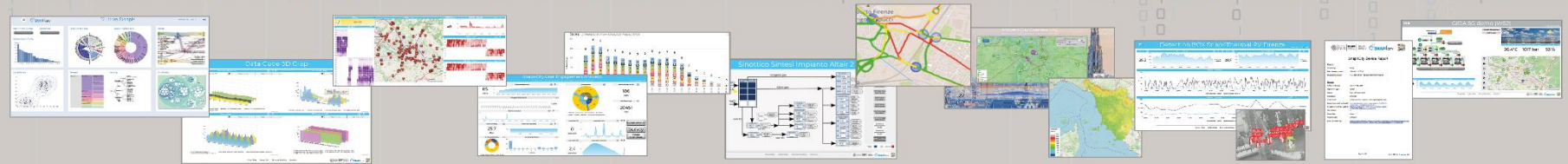
**Appliances and Dockers Installations**

**E015**  
digital ecosystem

## CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - BUSINESS INTELLIGENCE - SIMULATIONS - SMART APPLICATIONS



## DASHBOARDS - VISUAL ANALYTICS - SYNOPTICS - DIGITAL TWIN - GRAPHICAL WIDGETS - ANALYTICS - GUI CUSTOM STYLES - VISUAL PROGRAMMING



DASHBOARDS, WIDGETS  
TEMPLATES

PREDICTION - ANOMALY DETECTION - CLUSTERING - ROUTING - SENTIMENT NLP - TRAFFIC FLOW  
PEOPLE FLOWS - SDG - 15 MIN CITY INDEX - KPI - HEATMAPS - ORIGIN DESTINATION - ETC...

API - MICROSERVICES - GIS - BPM  
VIDEO - REPORTS - MAPS - 3D ...

## ANY: DATA, BROKER, NETWORK AND VERTICAL

**EXPERT SYSTEM, KNOWLEDGE BASE  
SEMANTIC REASONING  
SMART DATA MODEL  
IOT DEVICE MODELS, STORAGE**

**BIG DATA ANALYTICS, ARTIFICIAL INTELLIGENCE  
EXPLAINABLE AI, MACHINE LEARNING  
OPERATIVE RESEARCH, STATISTICS**

**VISUAL PROGRAMMING, ADAPTERS  
DATA FLOWS, WORKFLOWS  
PARALLEL DISTRIBUTED PROCESSING  
DATA DRIVEN**

**METHODOLOGIES  
LIVING LABS  
COURSES AND COMMUNITY  
DEVELOPMENT TOOLS**



CONTROL ROOM  
ADMIN

MAINTENANCE

SERVER

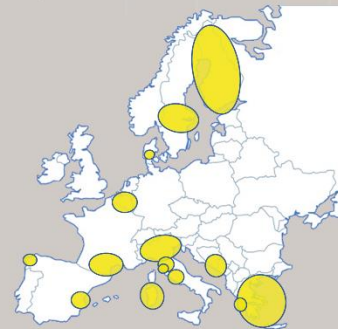
DCS/SCADA

LOGISTICS

DRONES

ENERGY

ENVIRONMENT



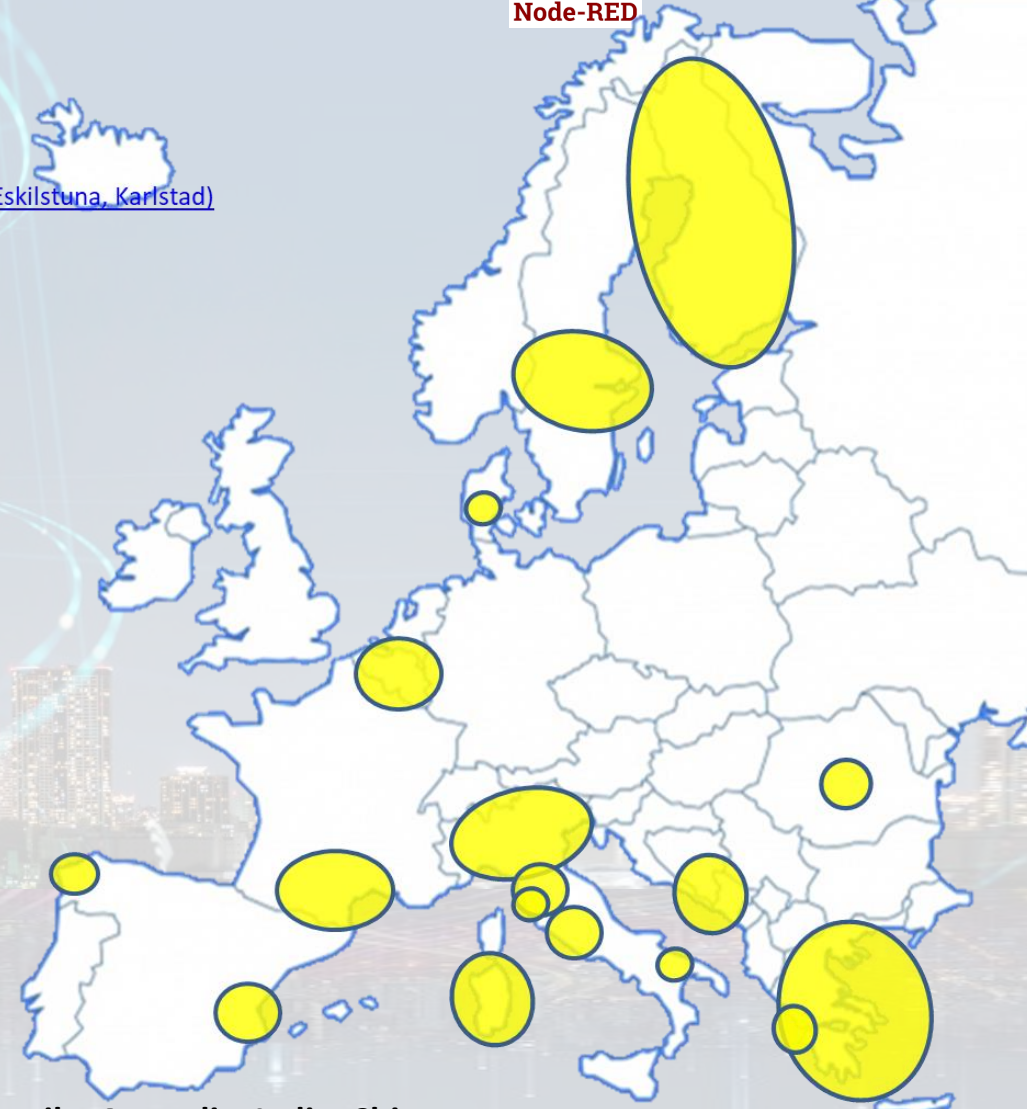


- 11 running installations in Europe
  - Snap4.city.org, Greece, Merano, ...
  - Toscana, Pisa, Sweden, ISPRA, Snap4.eu,
  - Altair, Italmatic, Sweden, Romania, ....
- 16 projects, 12 pilots on 10 Countries
  - >40 cities/area
- **Widest MULTI-tenant deploy has**
  - 19 Organizations / tenant
  - > 8000 users on
  - > 1600 Dashboards
  - > 16 mobile Apps
  - > **2.2 Million of structured data per day**
  - > 520 IoT Applications/node-RED
  - > 700 web pages with training
  - > 70 videos, training videos

#### Main Organizations/areas

- [Antwerp area \(Be\)](#)
- [Bologna \(I\)](#)
- Brasov (Ro)
- [Capelon \(Sweden: Västerås, Eskilstuna, Karlstad\)](#)
- [DISIT demo \(multiple\)](#)
- [Dubrovnik, Croatia](#)
- [Firenze area \(I\)](#)
- [Garda Lake area \(I\)](#)
- [Greece \(Gr\)](#)
- [Helsinki area \(Fin\)](#)
- [Livorno area \(I\)](#)
- [Lonato del Garda \(I\)](#)
- Merano (I)
- [Modena \(I\)](#)
- [Mostar, Bosnia-Herzegovina](#)
- [Oslo & Padova \(Impetus\)](#)
- [Pisa area \(I\)](#)
- [Pistoia \(I\)](#)
- [Pont du Gard, Occitanie \(Fr\)](#)
- [Prato \(I\)](#)
- [Roma \(I\)](#)
- [Santiago de Compostela \(S\)](#)
- [Sardegna Region \(I\)](#)
- [Siena \(I\)](#)
- SmartBed (multiple)
- [Toscana Region \(I\), SM](#)
- [Valencia \(S\)](#)
- [Venezia area \(I\)](#)
- [WestGreece area \(Gr\)](#)

- + Israel, Colombia, Brasile, Australia, India, China, etc.

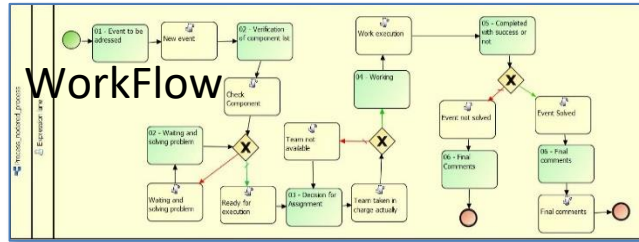




# Concept



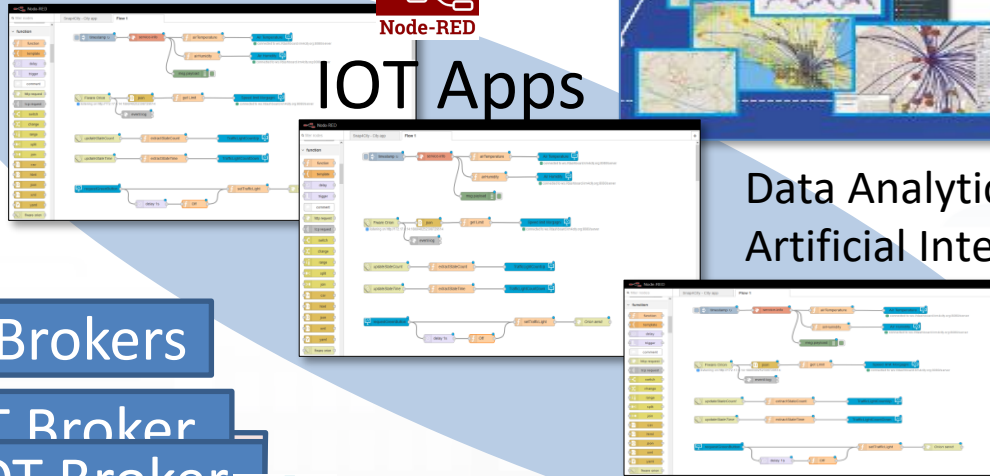
KPI, POI, MyKPI, ...  
API, External Services  
Web Scraping



Artwerp City Overview - AS  
GIDA 5G demo  
13.7 °C 1019 bar 77 %  
Air Quality  
My Data Dashboard Kibana  
7,642,593



## IOT Apps



### Data Analytics, Artificial Intelligence



IOT Brokers  
IOT Broker  
IOT Broker



## Dashboards and Apps



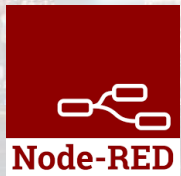
# Standards and Interoperability (6/2023)



## Compliant with:

- **IoT:** NGSI V2/LD, LoRa, LoRaWan, MQTT, AMQP, COAP, OneM2M, TheThingsNetwork, SigFOX, Libelium, IBIMET/IBE, Enocean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Protocol Buffer, KNX, OBD2, Proximus, ..
- **IoT model:** FIWARE Smart Data Model, Snap4City IoT Device Models
- **General:** HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, SOAP, WSDL, FTP, FTPS, WebSocket, WebSocket Secure, GML, WFS, WMS, RTSP, ONVIF, AXIS TVCam, CISCO Meraki, OSM, Copernicus, The Weather Channel, Open Weather, OLAP, VMS, ....
- **Formats:** JSON, GeoJSON, XML, CSV, GeoTIFF, OWL, WKT, KML, SHP, db, XLS, XLSX, TXT, HTML, CSS, SVG, IFC, XPDL, OSM, Enfuser FMI, Lidar, gITF, GLB, DTM, GDAL, Satellite, D3 JSON, ...
- **Database:** Open Search, MySQL, Mongo, HBASE, SOLR, SPARQL, ODBC, JDBC, Elastic Search, Phoenix, PostGres, MS Azure, ..
- **Industry:** OPC/OPC-UA, OLAP, ModBUS, RS485, RS232,..
- **Mobility:** DATEX, GTFS, Transmodel, ETSI, NeTEx, ..
- **Social:** Twitter, FaceBook, Telegram, ..
- **Events:** SMS, EMAIL, CAP, RSS Feed, ..
- **OS:** Linux, Windows, Android, Raspberry Pi, Local File System, AXIS, ESP32, etc.

<https://www.snap4city.org/65>

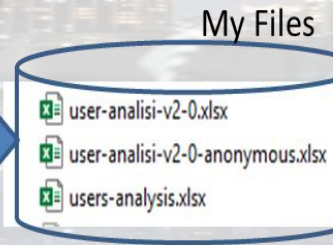
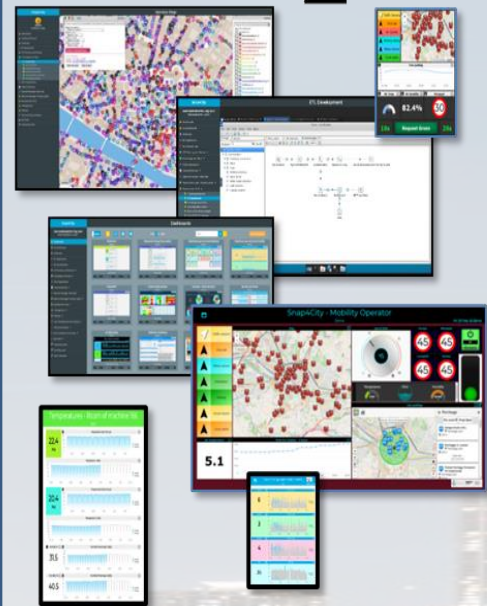
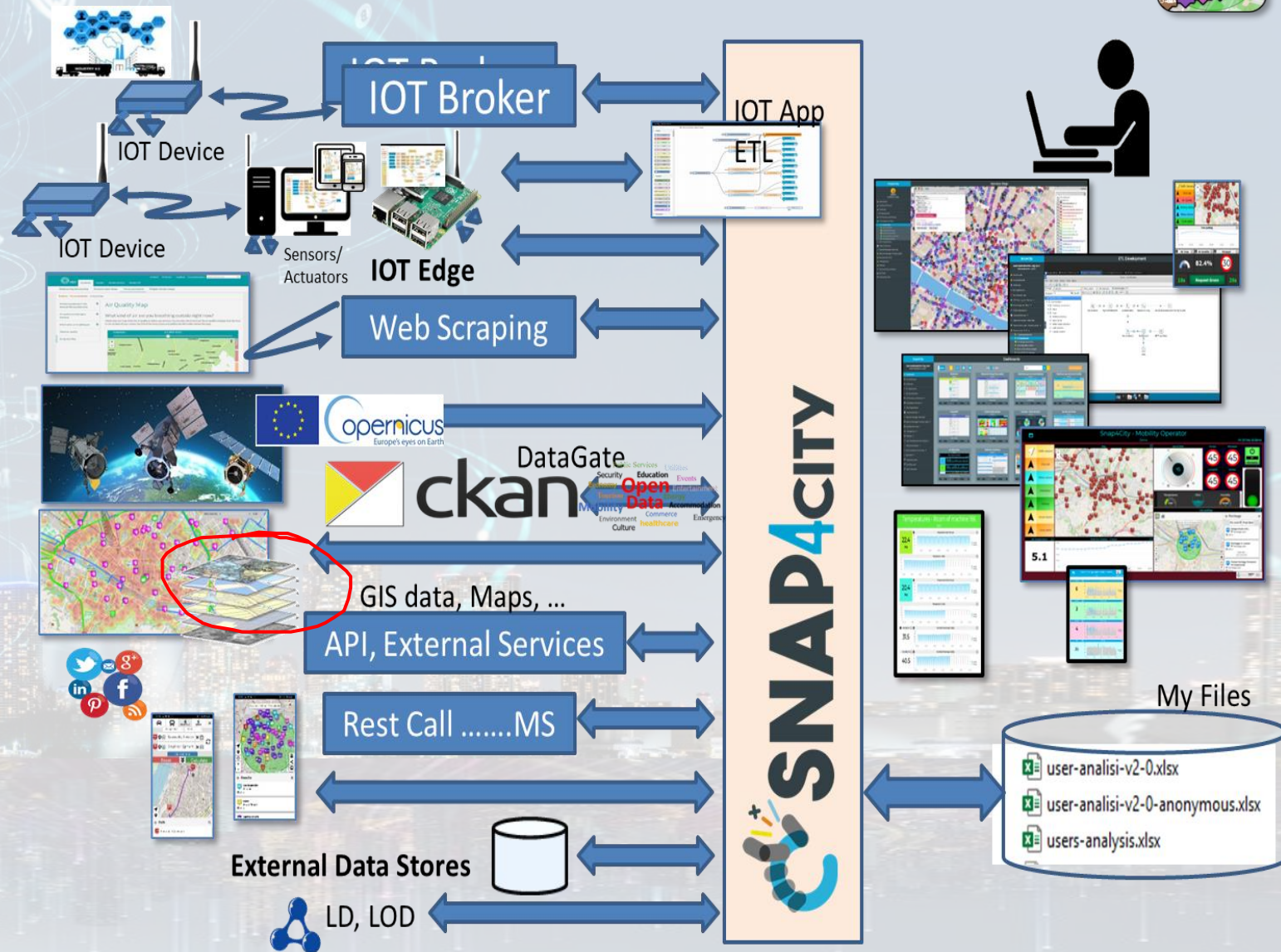


# Ingestion, agg. → exploitation

- **Snap4City** efficient tools for

- Bidirectional data channels
- Any format, any channel, any data, any broker, any protocol, ...

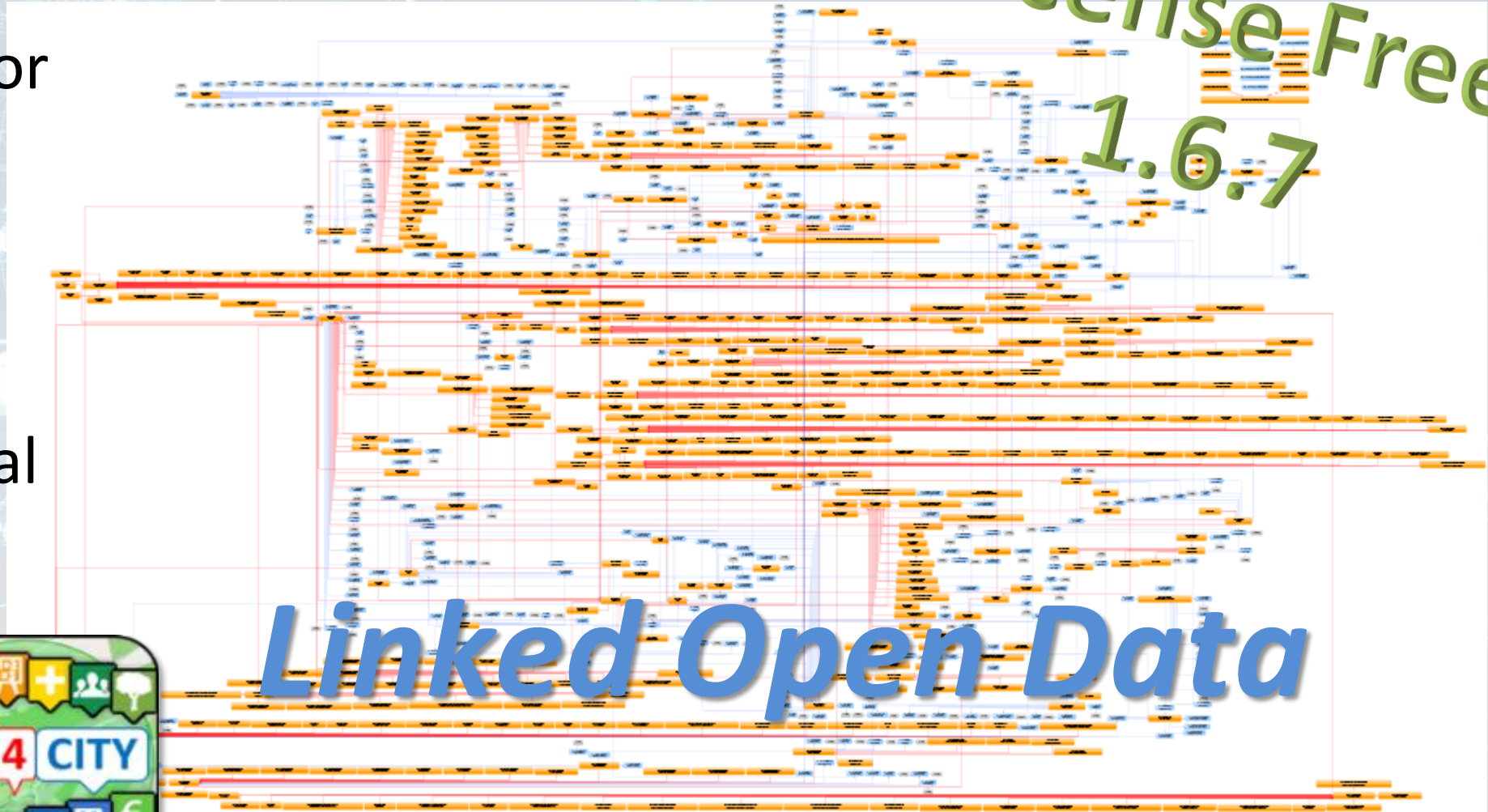
- **Km4City** Knowledge base Ontology reasoning on geo, space, time, relationships



# Expert System *semantic queries*



- **via:**
- **Smart City API** for Apps and third party
- **MicroServices** data driven develop via visual language Node-RED



*License Free*  
*1.6.7*

*Linked Open Data*

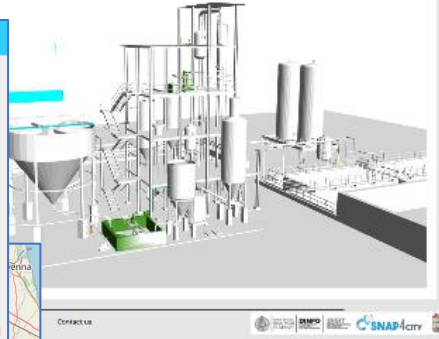
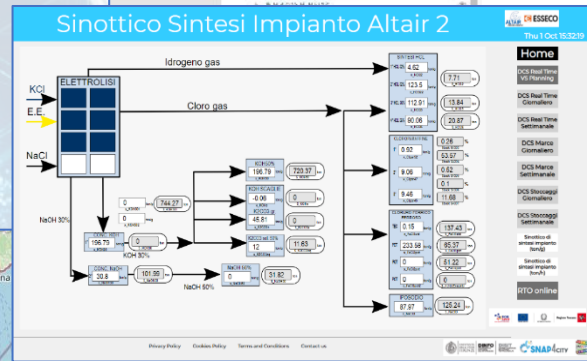
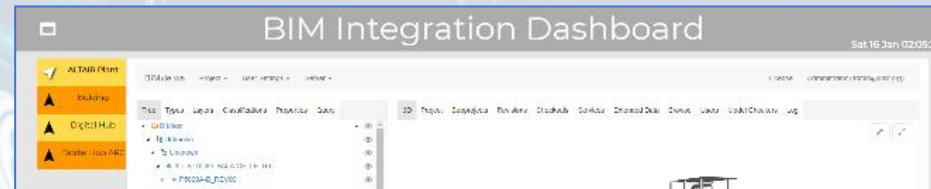


<https://www.snap4city.org/19>

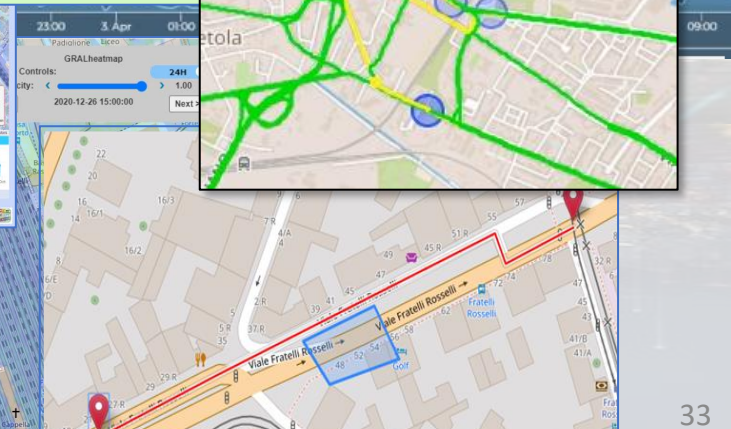
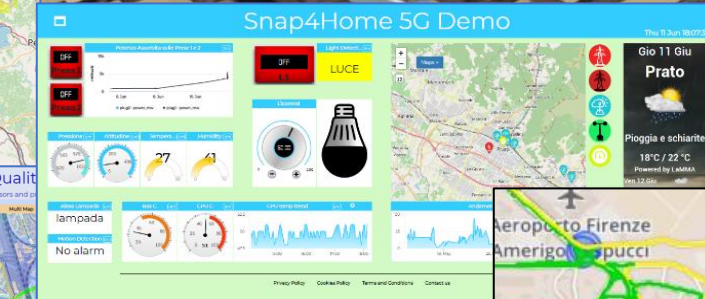
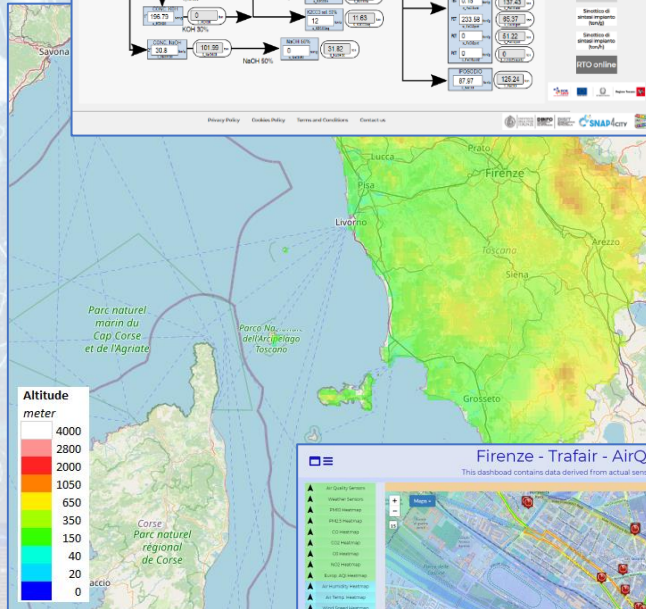
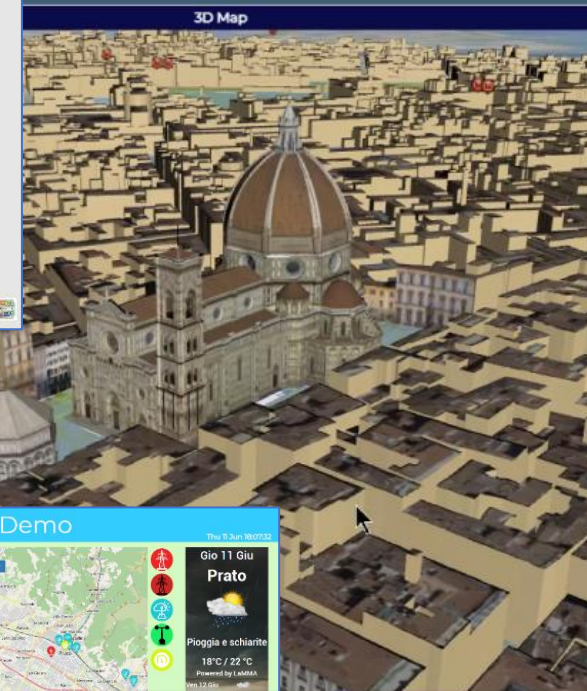
# High Level Types

Snap4City (C), September 2023

- POI, IOT Devices, shapes, ...
  - FIWARE Smart Data Models,
  - IoT Device Models
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ...
- Satellite data, ...
- traffic flow, typical trends, ...
- trajectories, events, Workflow, ...
- 3D Models, BIM, Digital Twins, ...
- OD Matrices of several kinds, ...
- Dynamic icons/pins, ...
- Synoptics, animations, ...
- KPI, personal KPI, ...
- social media data, TV Stream, ...
- routing, multimodal, constraints, ...
- decision scenarios, ....
- etc.



**SNAP4CITY**  
- Digital Twin Global - Fire  
demonstrator



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**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB



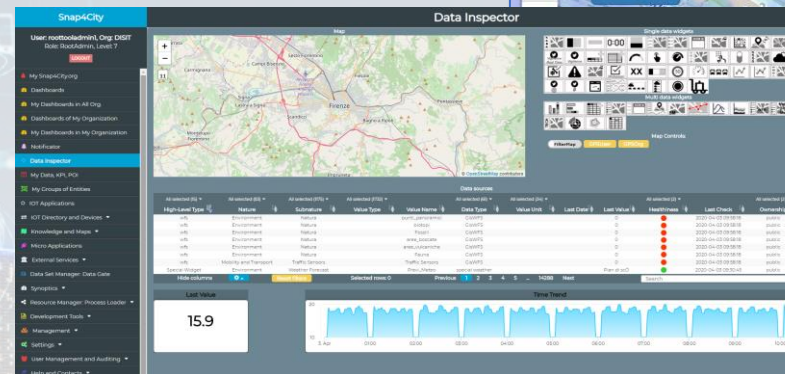
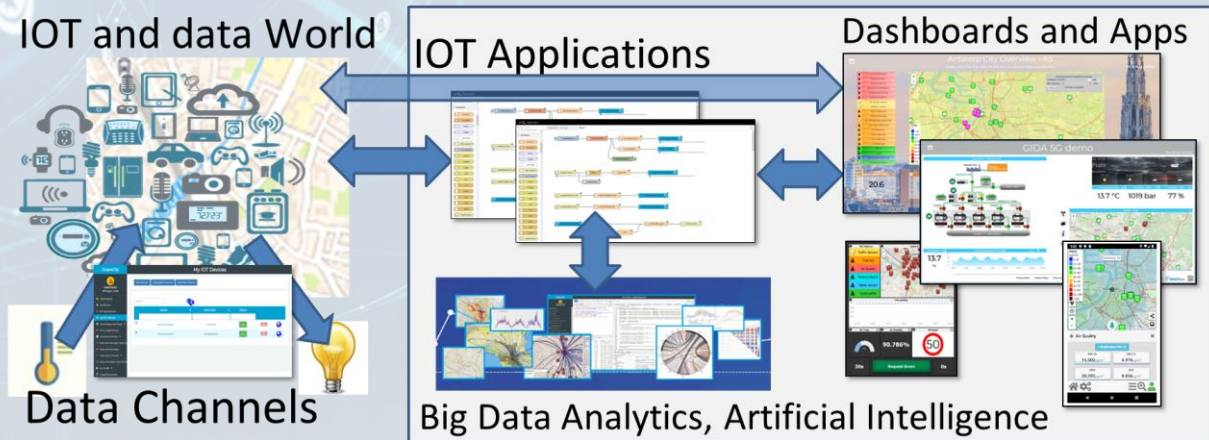
# Solutions: reliable, secure and fast to realize

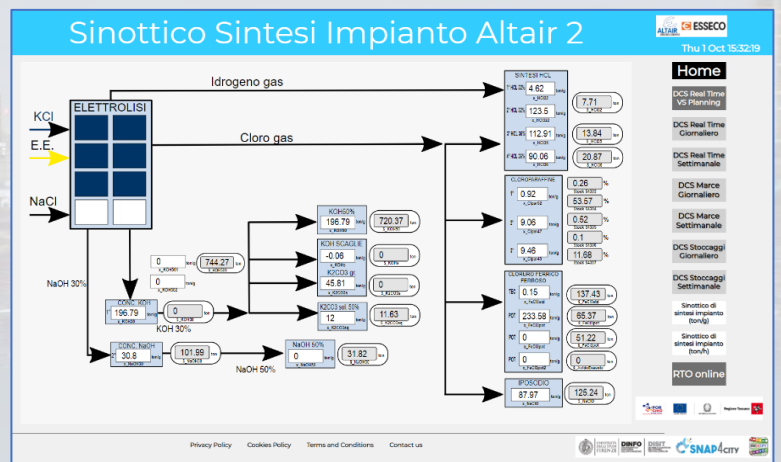
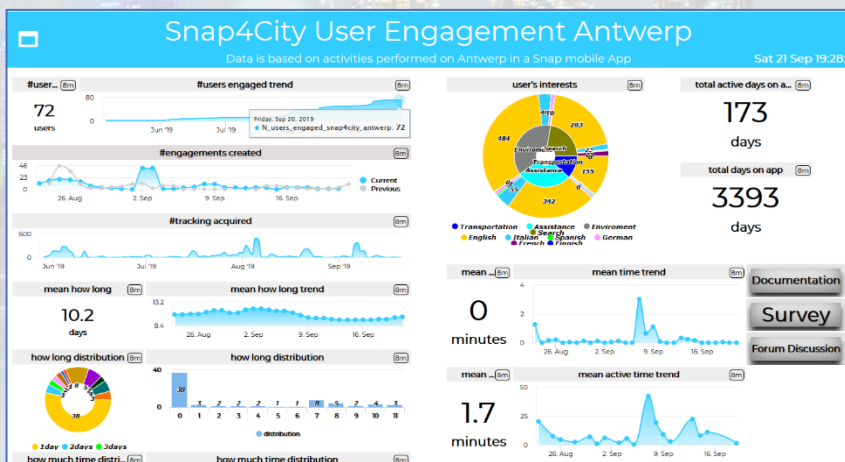
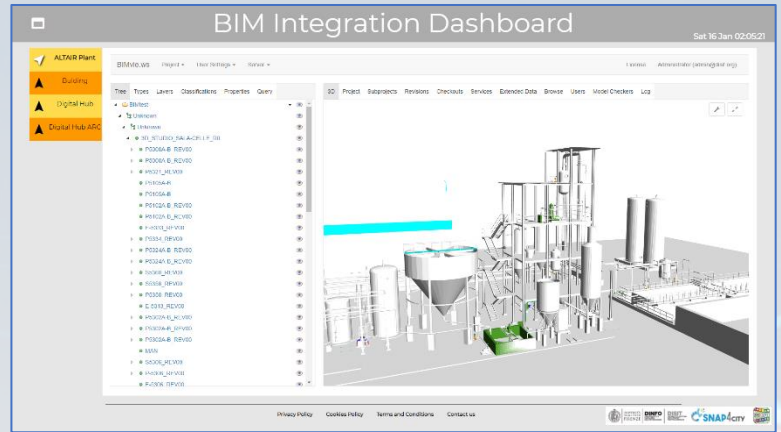
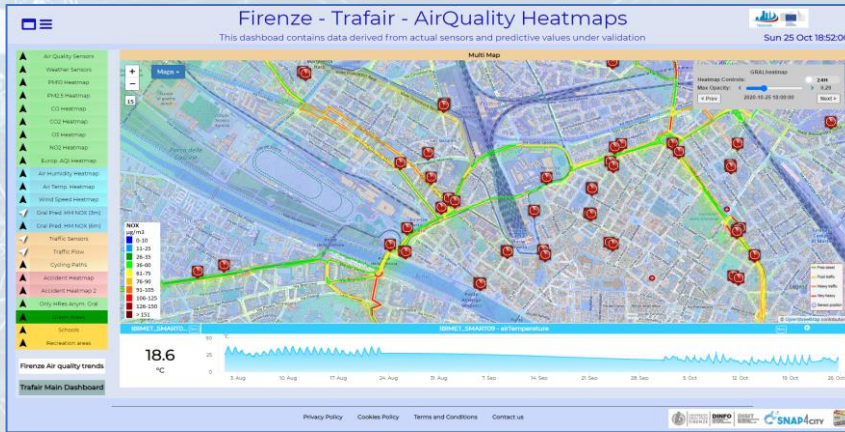
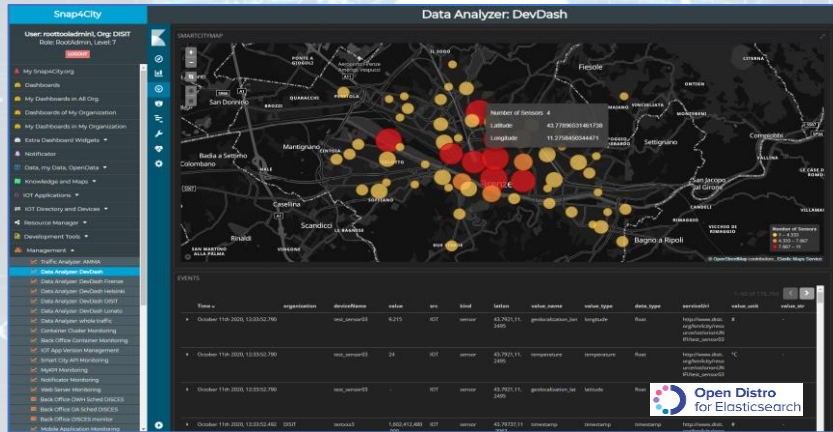
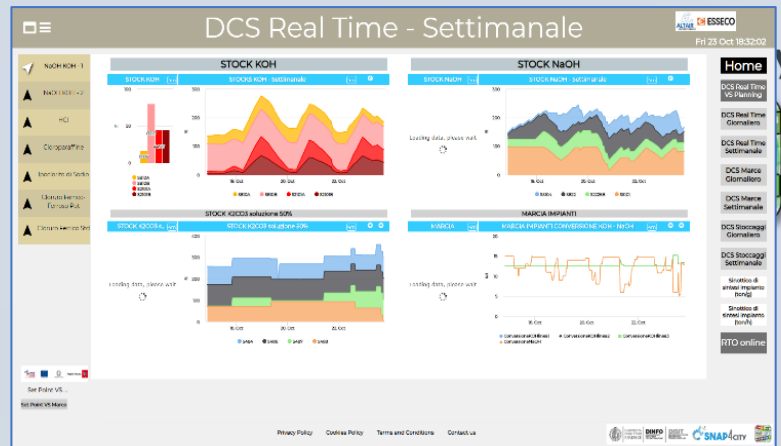
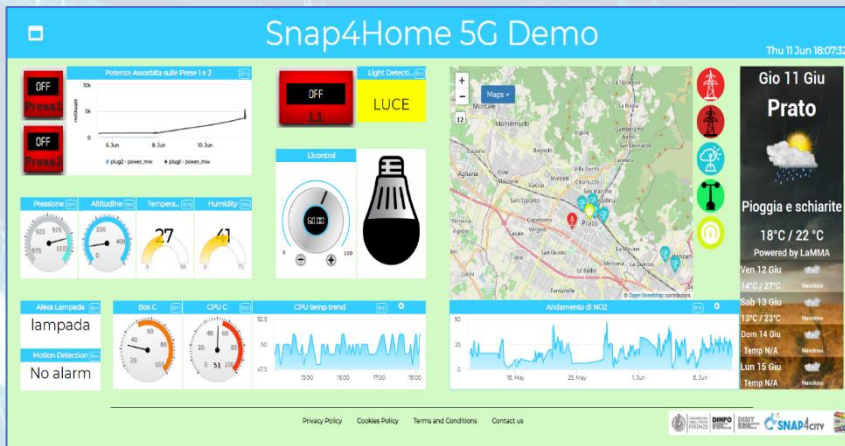
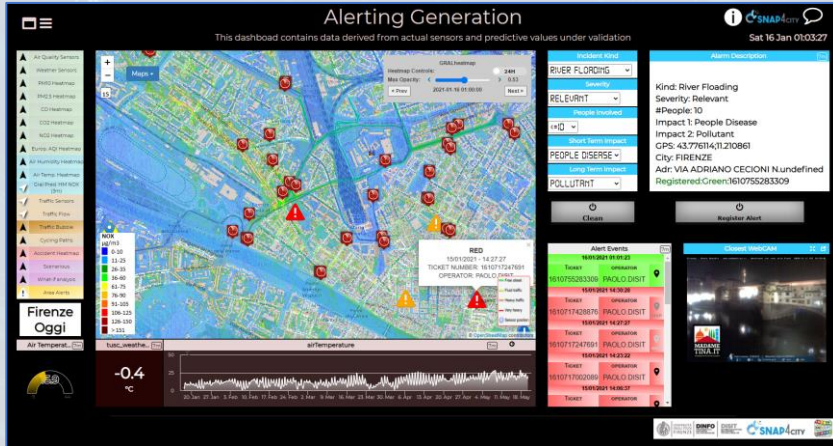
- Via Snap4City tools

- Dashboard Wizard
- Dashboard Builder
- Data/Visual Analytic

- Smart Solutions results to be

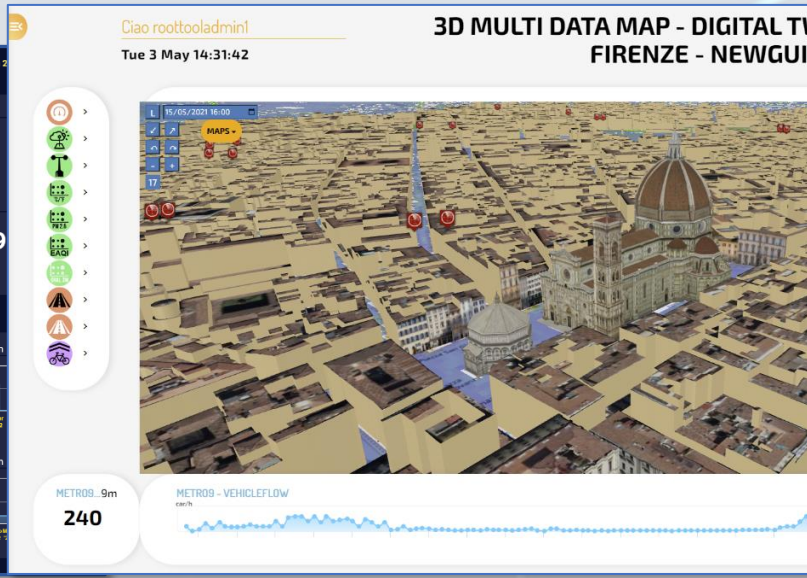
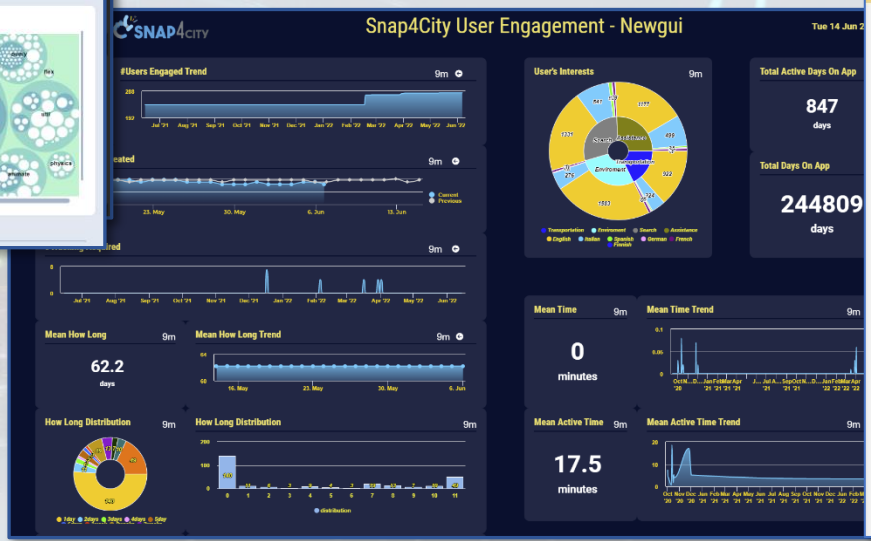
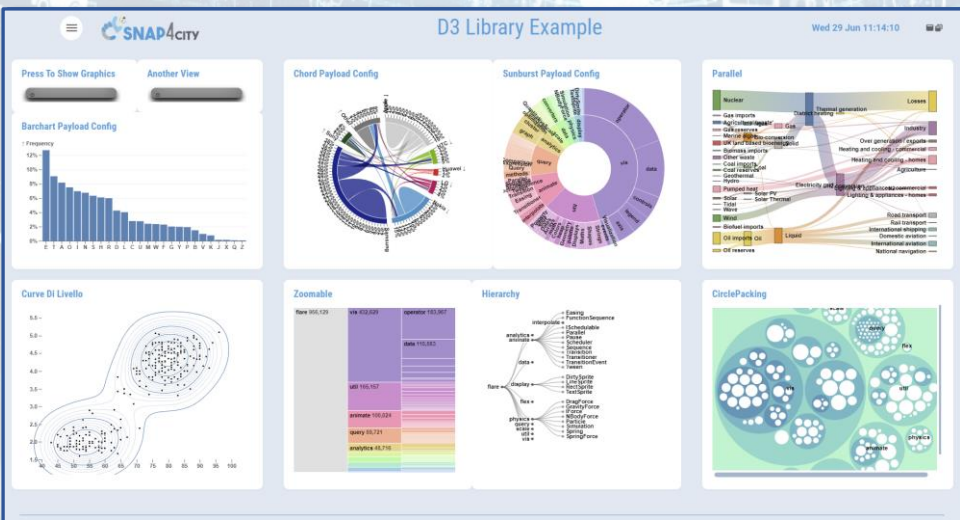
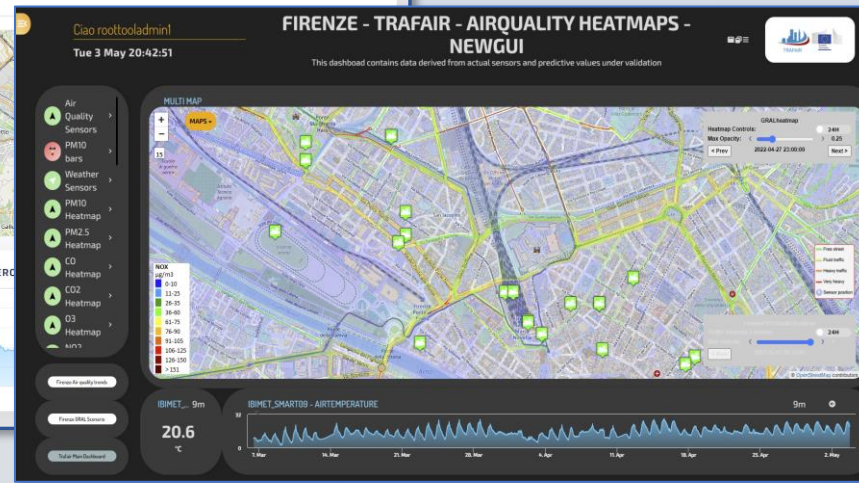
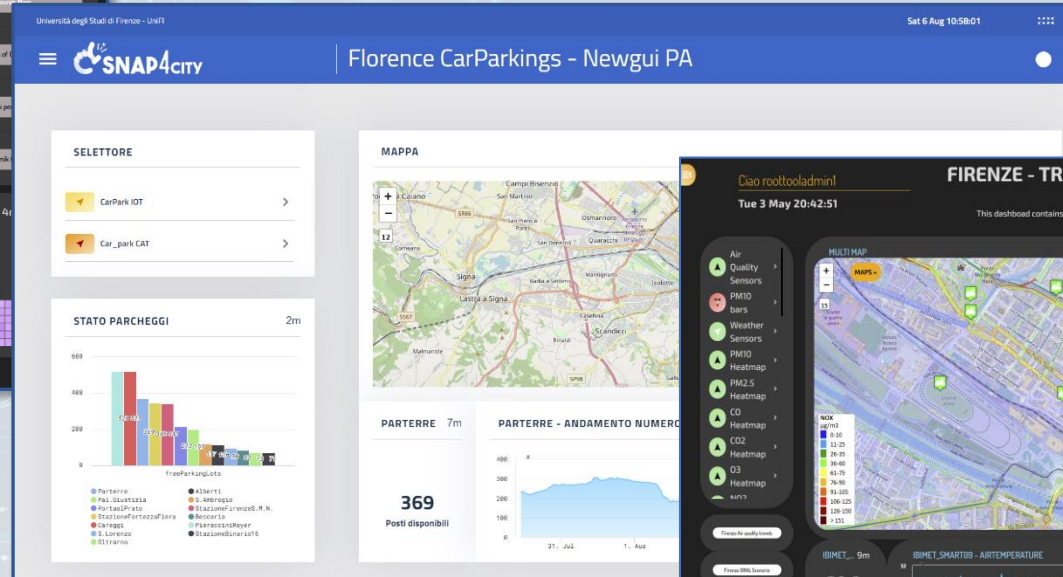
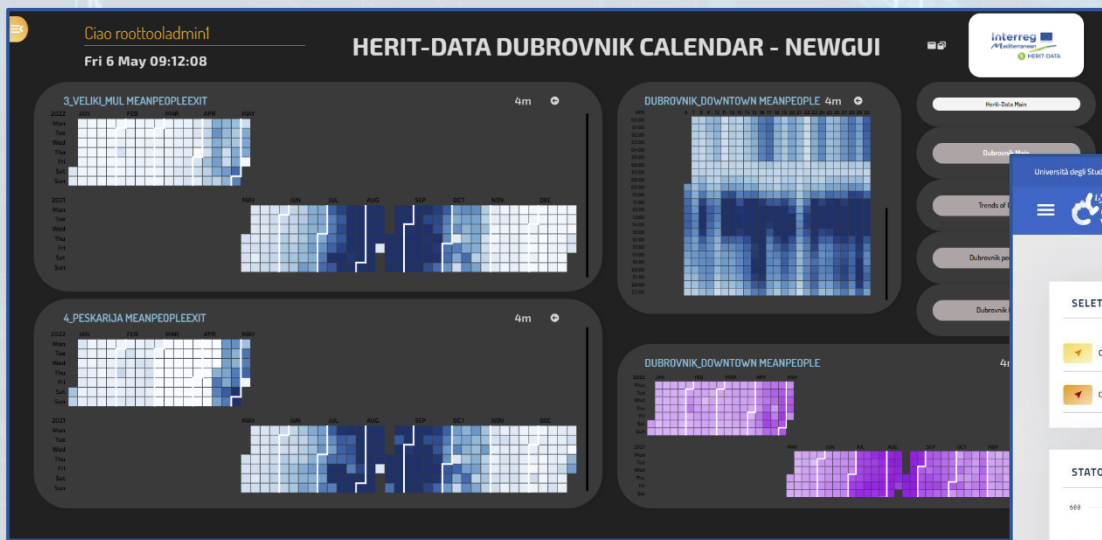
- Real time data drive
- Secure end-to-end
- GDPR compliant
- Reliable, interoperable
- Auditable, marketable







# Different Themes



New styles/themes can be developed by specializing a few files from open source

<https://www.snap4city.org/793>

TOP

# Data Analytic Artificial Intelligence, XAI, Machine and Deep Learning

FROM CITY DASHBOARD TO APPLICATIONS

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

IoT APPLICATIONS VS IoT EDGE DEVICES

SNAP4CITY FOR BUSINESS

SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS AND STAKEHOLDERS

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

SNAP4CITY AND KM4CITY PROJECTS

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

IoT DEVICES AND NETWORKS

DATA ANALYTICS: INTELLIGENCE, WHAT-IF AND SIMULATION

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

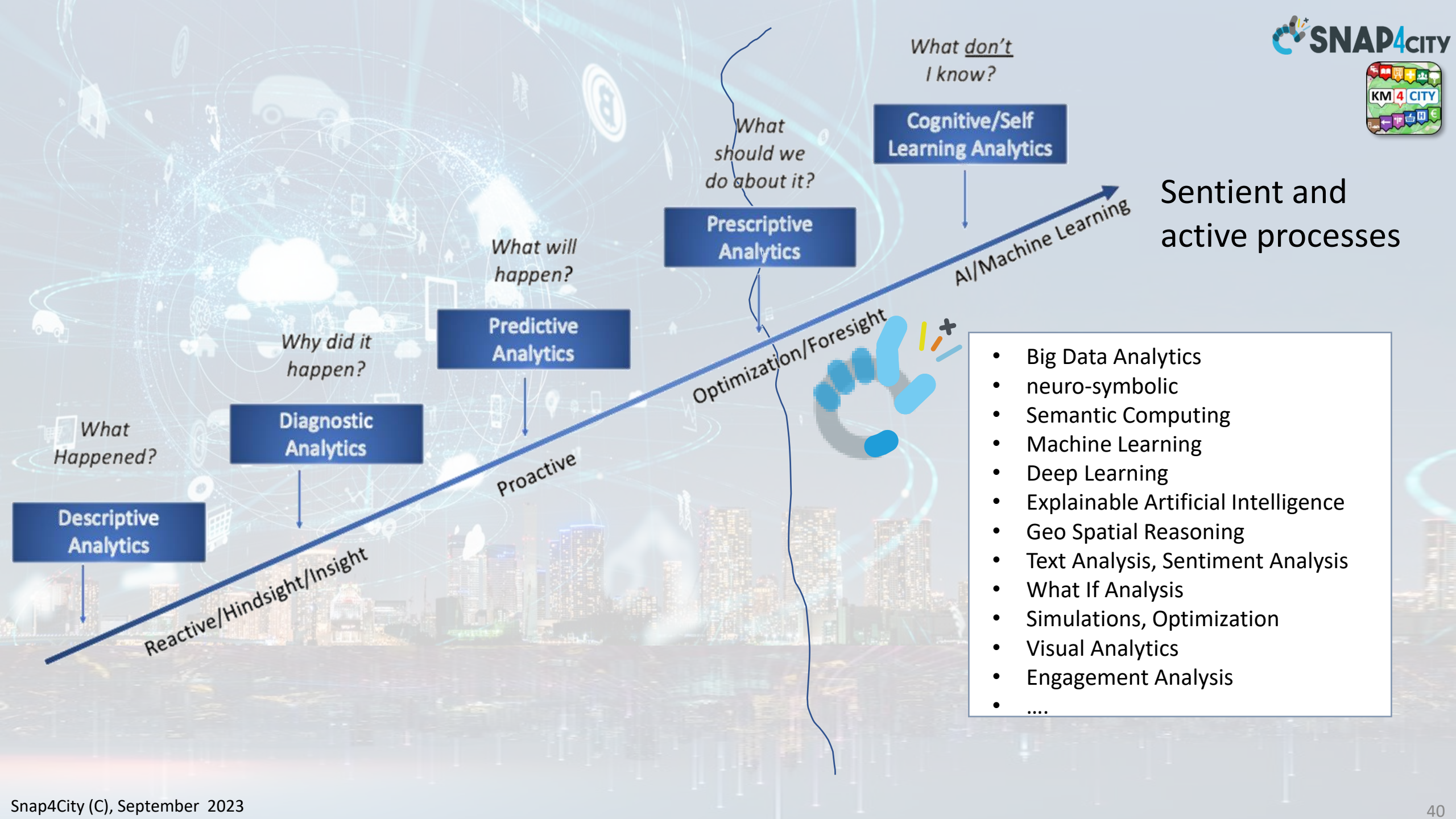
SNAP4CITY THE VIEW OF THE ADMINISTRATORS

APPLICATIONS LOGIC AND PARTNERSHIP

ADVANCED SMART CITY AND MICRO-SERVICE SNAP4CITY

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK





What Happened?

**Descriptive Analytics**

Reactive/Hindsight/Insight

Why did it happen?

**Diagnostic Analytics**

What will happen?

**Predictive Analytics**

Proactive

What should we do about it?

**Prescriptive Analytics**

Optimization/Foresight

What *don't* I know?

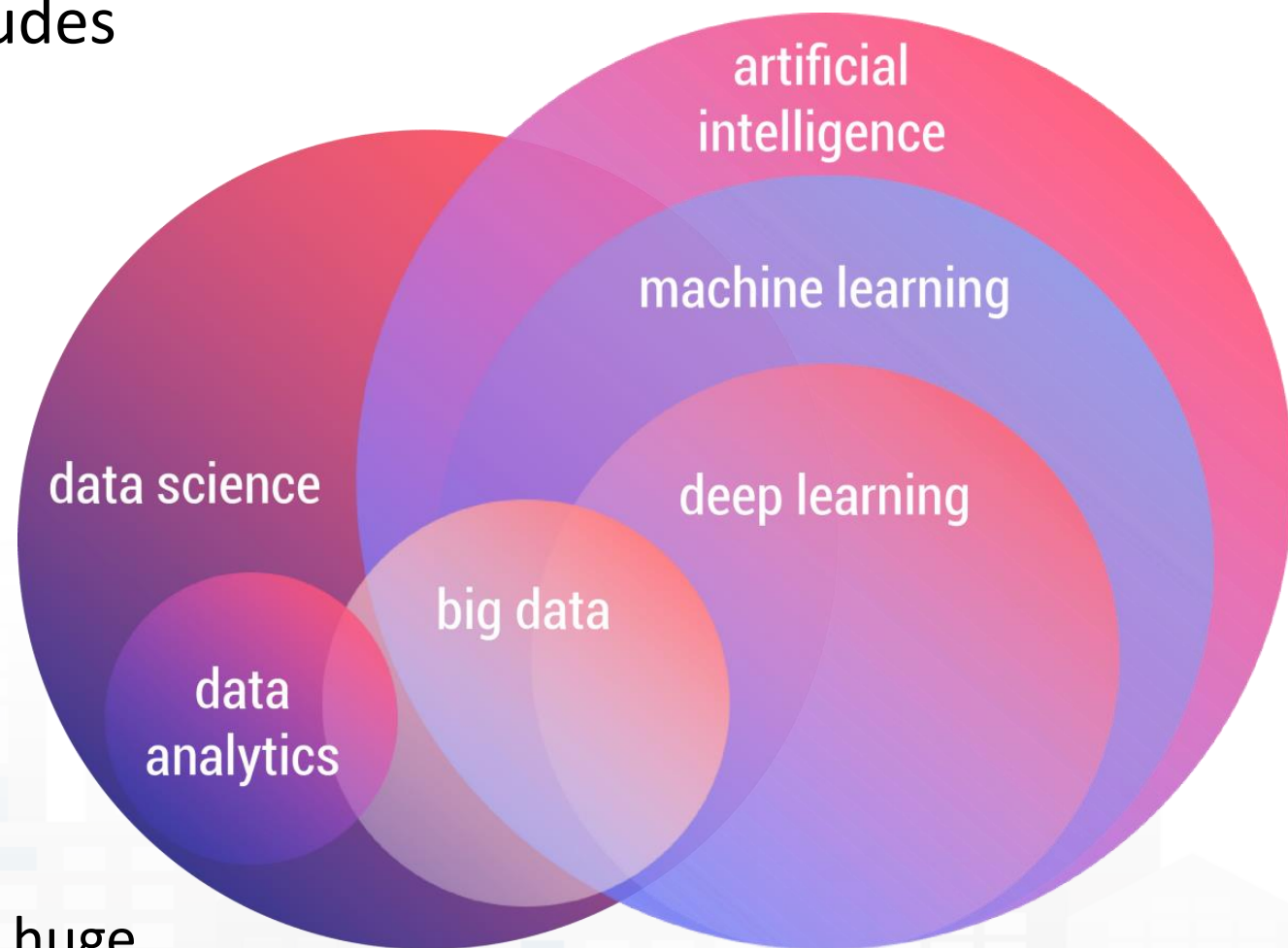
**Cognitive/Self Learning Analytics**

AI/Machine Learning

Sentient and active processes

- Big Data Analytics
- neuro-symbolic
- Semantic Computing
- Machine Learning
- Deep Learning
- Explainable Artificial Intelligence
- Geo Spatial Reasoning
- Text Analysis, Sentiment Analysis
- What If Analysis
- Simulations, Optimization
- Visual Analytics
- Engagement Analysis
- ....

- **Artificial Intelligence** usually also includes
  - Code, learn and reasoning
  - Semantic computing, Knowledge Bases
  - Neuro-symbolic reasoning
  - Decision Support Systems
  - Problem solving
- **Machine Learning** usually includes
  - Learn without coding
  - Predictions, decisions (classifications)
  - Supervised or not
  - NLP, vision, pattern recognition
- **Deep Learning** usually includes
  - Capability to learn complex patterns on huge amount of data
  - Specialized ML solutions



# Big Data Analytics + Artificial Intelligence



- **Decision support**

- Early warning, City Indexes, etc.
- What-IF analysis (simulation + AI + data)

- **Predictions**

- **Short and Long terms predictive models on:**

- traffic, parking, people flow, maintenance, land sliding, NO2

- **3D Flow prediction:** Pollutant (NOX, NO2, ...)

- **Suggestions and recommendations**

- **Modeling, simulation, routing**

- Traffic Flow reconstruction
- Constrained Routing

## AI & XAI:

- RF, XGBoost, BRNN, RNN, SVR, DNN, LSTM, CNN-LSTM, Autoencoders, neuro-symbolic..
- Clustering: K-means, K-Medoid, ...
- Semantic Reasoning, ..
- XAI: Shap, variations, Lime, gradients, ...

## Representations, animated

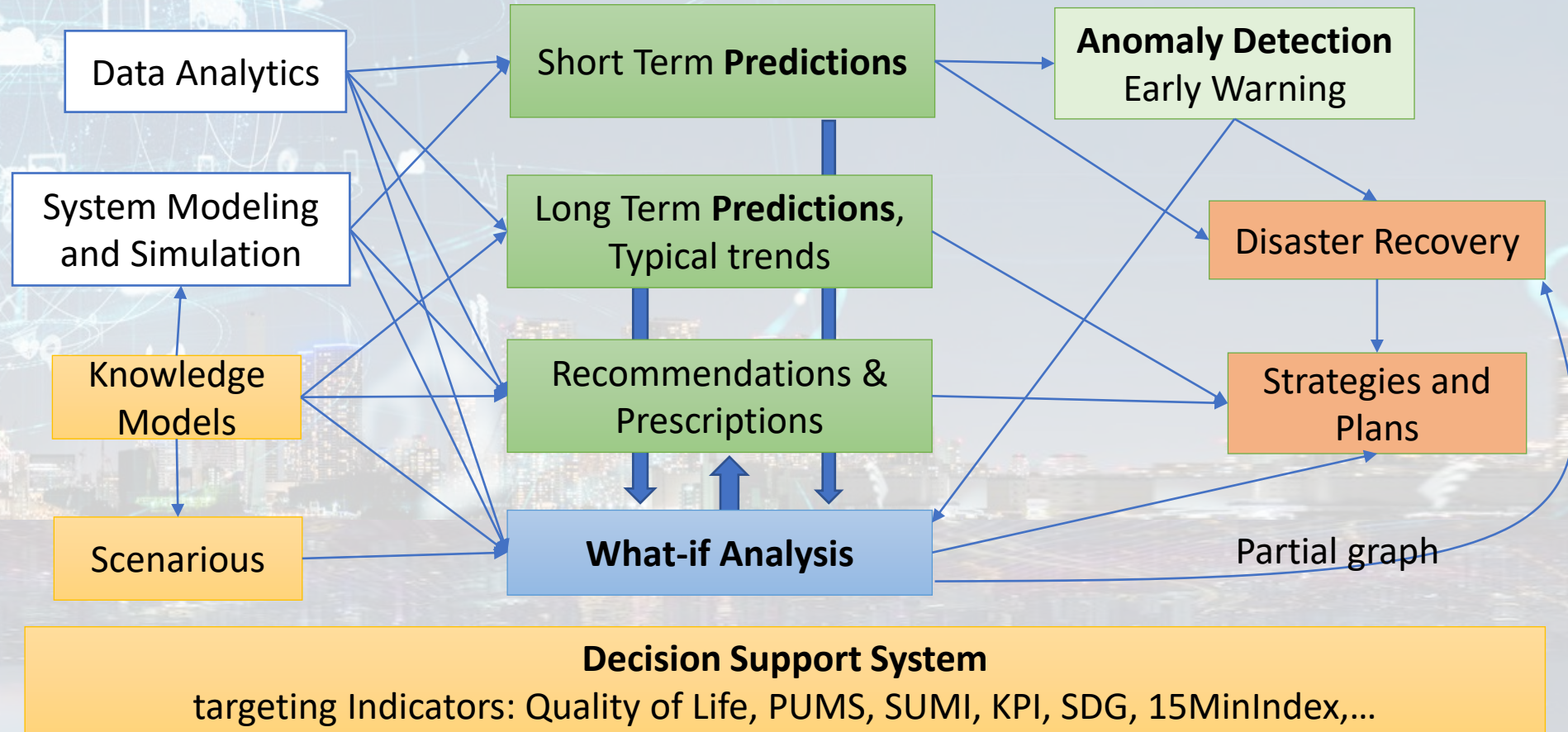
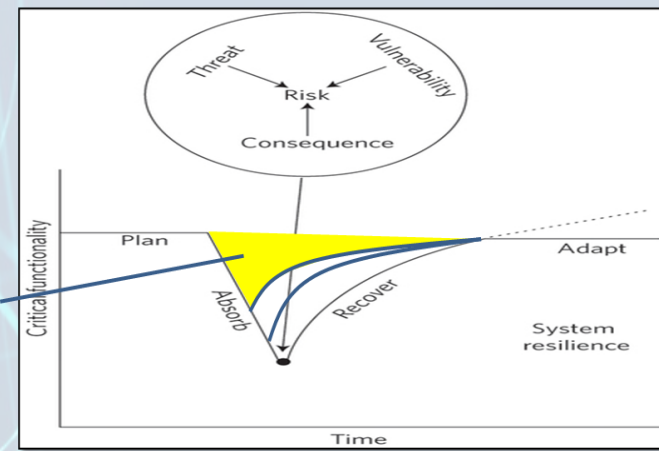
- Heatmaps, Traffic, Flows, ..
- Trajectories, OD matrices,
- 3D Rendering
- Typical Time Trends, etc.

<https://www.snap4city.org/download/video/course/da/>

# Snap4City Analytics

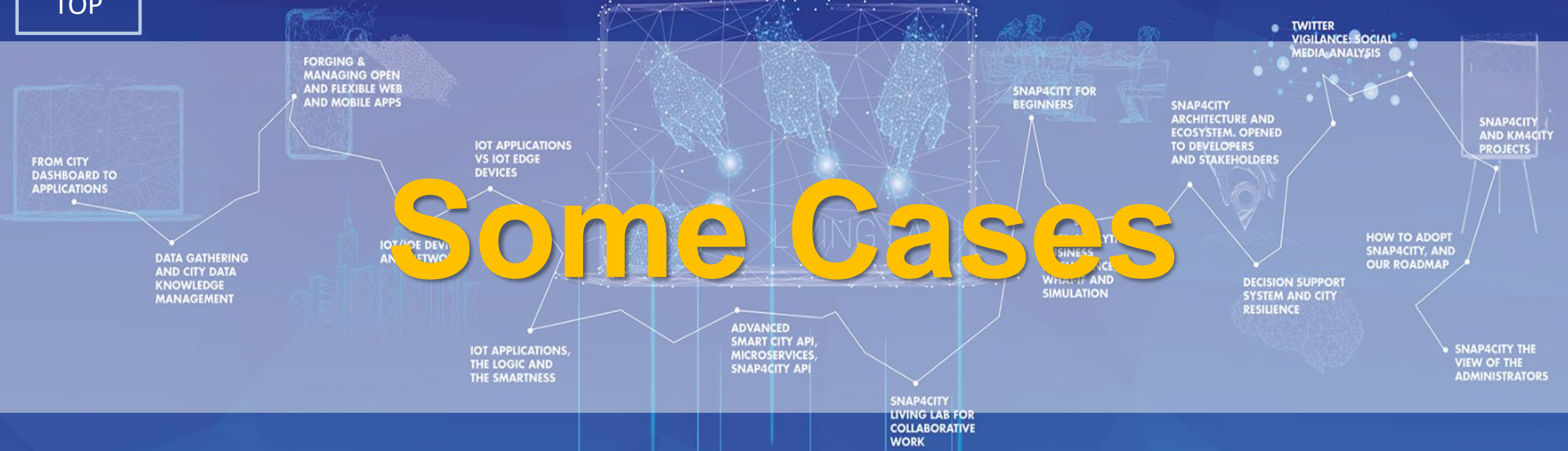
- Decision support systems
- Improvement of life quality
- Sustainable Solutions
- Reduction of costs
- Risk Assessment
- Resilience

**P**repare  
**A**bsorb  
**R**ecover  
**A**dapt



TOP

# Some Cases



# Florence



<b>1</b> NO POVERTY 	<b>2</b> ZERO HUNGER 	<b>3</b> GOOD HEALTH AND WELL-BEING 	<b>4</b> QUALITY EDUCATION 	<b>7</b> AFFORDABLE AND CLEAN ENERGY 
<b>9</b> INDUSTRY, INNOVATION AND INFRASTRUCTURE 	<b>11</b> SUSTAINABLE CITIES AND COMMUNITIES 	<b>12</b> RESPONSIBLE CONSUMPTION AND PRODUCTION 	<b>13</b> CLIMATE ACTION 	<b>15</b> LIFE ON LAND 



# Tuscany Region

<https://www.snap4city.org/760>

Firenze, Pisa, Livorno, Prato,  
Siena, Arezzo, etc.



<https://www.snap4city.org/746>



<https://www.snap4city.org/758>



<https://www.snap4city.org/751>



# Smart City Control Room

## Florence Metropolitan City



reference



### • Multiple Domain Data

- Thousands of Open/Private data, POI, IOT, etc.
- **mobility and transport:** accidents, public transport, parking, traffic flow, Traffic Reconstruction, KPI, ...
- **AND:** environment, civil protection, gov KPI, covid-19, social & social media, people flow, tourism, energy, culture, ...

### • Multiple dash/tool Levels & Decision Makers

- Real Time monitoring, Alerting, quality assess.
- Predictions, KPI, DSS, what-if analysis

### • Historical and Real Time data

- Billions of Data

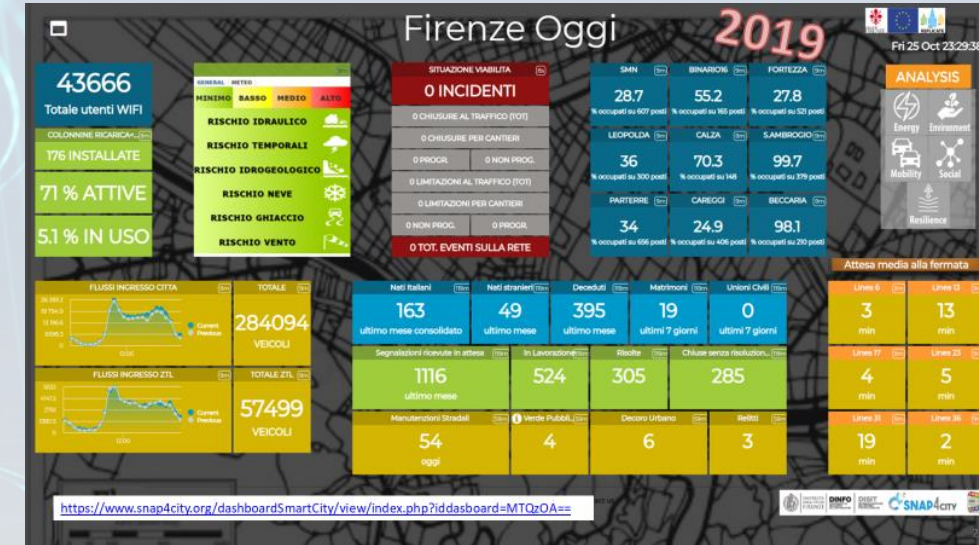
### • Services Exploited on:

- Multiple Levels, Mobile Apps, API

### • Since 2017



<https://www.snap4city.org/747>



# Firenze Oggi

Mon 16 May 12:59:27

**20991**  
 float

**COLONNINE**  
 COLONNINE  
 82% ACTIVE  
 3 K/W CSD  
 24% NOW ACTIVE

**GENERAL** **RETE**

MONITORING: BASSO MEDIO

- RISCHIO IDRAULICO
- RISCHIO TEMPORALI
- RISCHIO IDROGEOLOGICO
- RISCHIO NEVE
- RISCHIO GRANDINE
- RISCHIO VENTO

**SITUAZIONE VIABILITÀ**  
 0 INCIDENTI

- 0 CHIUSURE AL TRAFFICO (TOT)
- 0 CHIUSURE PER CANTIERI
- 0 PROGR. 0 NON PROC.
- 0 LIMITAZIONI AL TRAFFICO (TOT)
- 0 LIMITAZIONI PER CANTIERI
- 0 NON PROC. 0 PROGR.
- 0 TOT. EVENTI SULLA RETE

<b>SMN</b> 42.2	<b>BINA.</b> 54.5	<b>FORT.</b> 23.2
<b>LEOP.</b> 37.3	<b>CALZA</b> 48	<b>S.AM.</b> 58.6
<b>PART.</b> 55	<b>CARE.</b> 13.8	<b>BECC.</b> 77.6

**ANALYSIS**

- Energy
- Environment
- Mobility
- Social
- Resilience

**FLUSSI INGRESSO CIT.** **TOTA.**  
 92207  
 VEICOLI

**FLUSSI INGRESSO ZTL** **TOTA.**  
 15964  
 VEICOLI

<b>Nati Italiani</b> 175	<b>Nati s.</b> 48	<b>Dece.</b> 499	<b>Matri.</b> 72	<b>Unio.</b> 2
<b>Manutenzioni Strad.</b> 19	<b>Verif.</b> 18	<b>Decoro Urba.</b> 3	<b>Reint.</b> 5	

**Indicatore Rt per la provincia di** **Pt**  
 0.94

Linea... Linea...  
 Linea... Linea...  
 Linea... Linea...

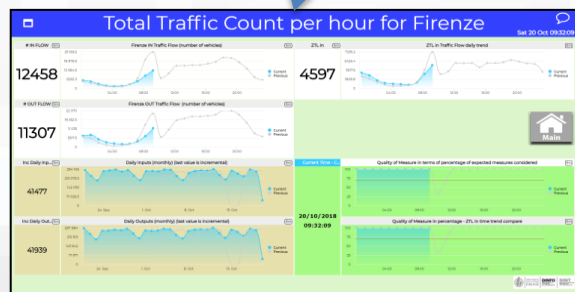
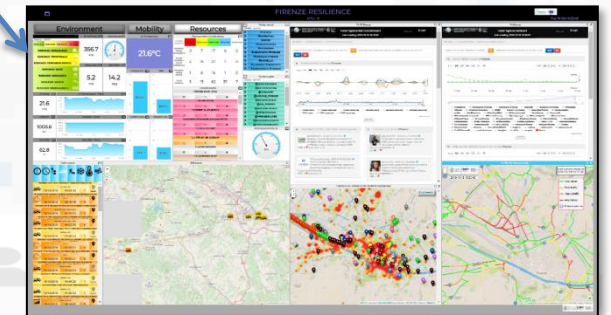
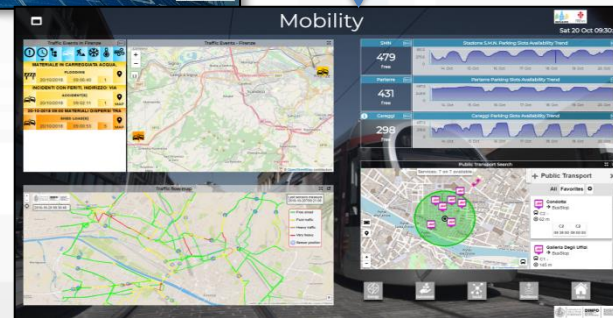
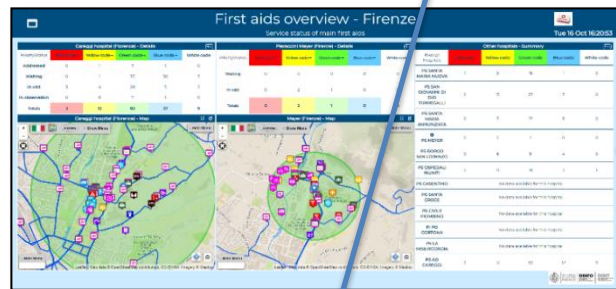
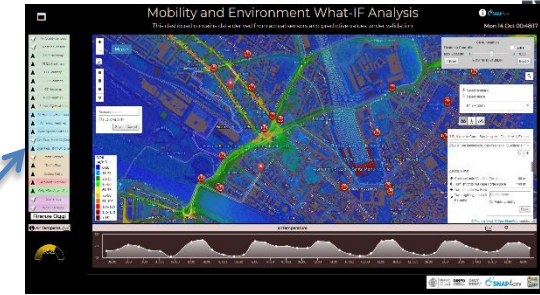
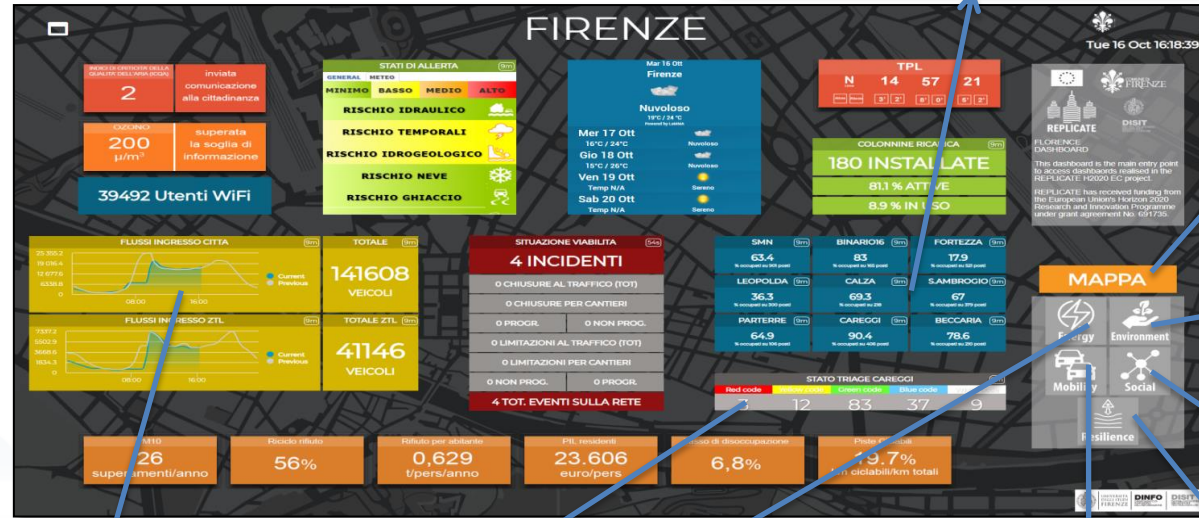




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DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

**DISIT**  
DISTRIBUTED SYSTEMS AND  
INTERNET TECHNOLOGIES LAB  
DISTRIBUTED DATA INTELLIGENCE  
AND TECHNOLOGIES LAB

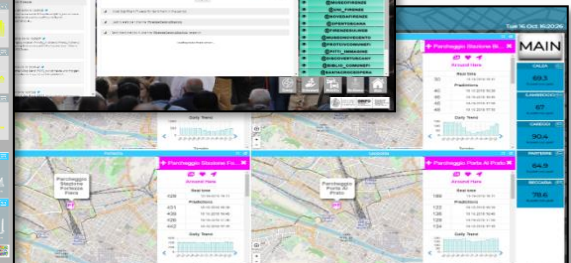
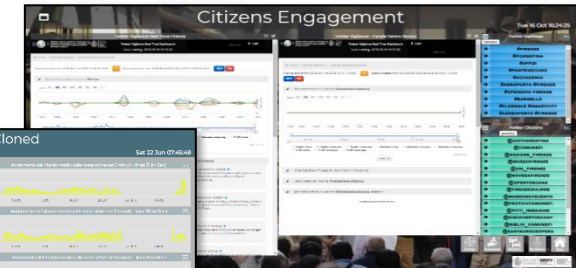
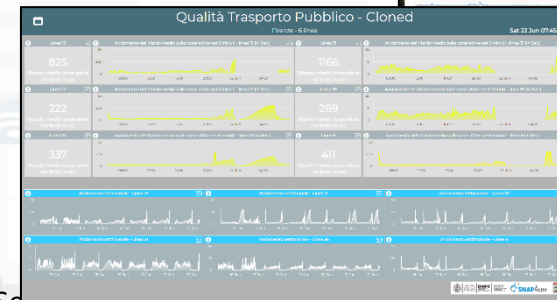
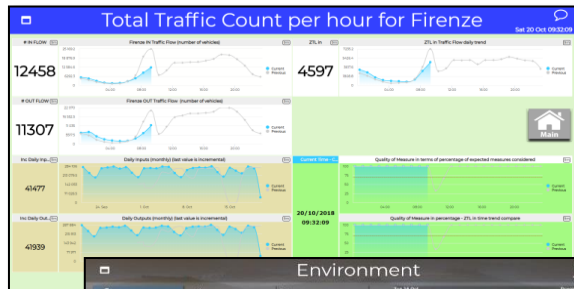


# Florence Case

- **Smart City Control Room**
- **Dashboards and Services**
- **Mobile App: Firenze Where What**

- **Mobility:**
  - quality of public transportation service (mean delay on bus-stops)
  - public transport operators schedule and paths, routing, multimodal routing
  - traffic flow reconstruction
  - Smart parking: predictions
  - Accidents and events, Log, heatmaps
- **Environment:**
  - smart irrigators
  - smart waste
  - Sensors: PM10, PM2.5,.....
  - Heatmaps: PM10, PM2.5, ...
  - NOX predictions
- **Energy:**
  - recharging stations (fast and reg.)
  - consumption meters (smart info)
  - smart light, street lights
- **Weather**
  - Forecast and actual

- **Social:**
    - smart benches
    - Twitter monitoring, Sentiment analysis, NLP text
    - TV camera streams
  - **People Flows:**
    - Wi-Fi, people flow
    - Origin destination matrices
  - **Governmental and Communications:**
    - KPI of the City
    - Digital Signage
    - Civil protection, Resilience (Resolute)
  - **Tourism and Culture:**
    - POI, etc.
- Analysis:**
- **what-if routing, scenarios,**
  - **traffic flow, environmental predictions**



# Valutazione Trasporto Pubblico

Firenze - 6 linee

Tue 5 Nov 17:49:00



# Firenze



# Estimation of the mean waiting time at bus stops

### Snap4City

User: rootooladmin1, Org: DISIT  
Role: RootAdmin, Level: 7  
[Logout](#)

- My Snap4City.org
- Dashboards
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- Notificator
- Data Inspector
- My Data, KPI, POI
- IOT Applications**
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management

### BusLinesWaitTimeToDash

Node-RED

Flow 1

Input: inject, catch, status, link, mqtt, http, websocket, tcp, udp, cron, amqp, amqp2, stomp

Processors: f (function)

Output: Save on Tempo\_medioattesa\_linea6, Save on Tempo\_medioattesa\_linea13, Save on Tempo\_medioattesa\_linea17, Save on Tempo\_medioattesa\_linea23, Save on Tempo\_medioattesa\_linea31, Save on Tempo\_medioattesa\_linea36



### 3D Map



Traffic

FirenzeTrafficRealtime

Traffic Controls: 24H

Max Opacity:

< Prev 2023-05-22 08:01:00

- Free street
- Fluid traffic
- Heavy traffic
- Very heavy
- Sensor position

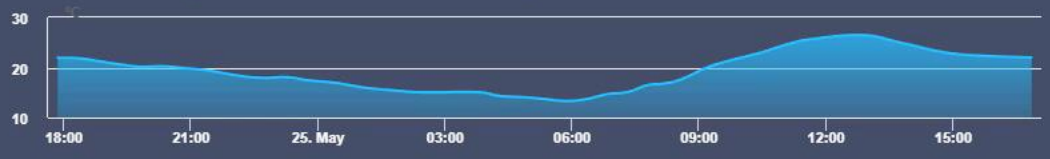
### Air Quality FI-BASSI - NO2

6m



### Weather\_sensor\_Open Weather 3176959 - Air Temperature

6m



<https://youtu.be/JLzT9k3Xbc0>



Ciao

Sun 2 Jul 12:58:18

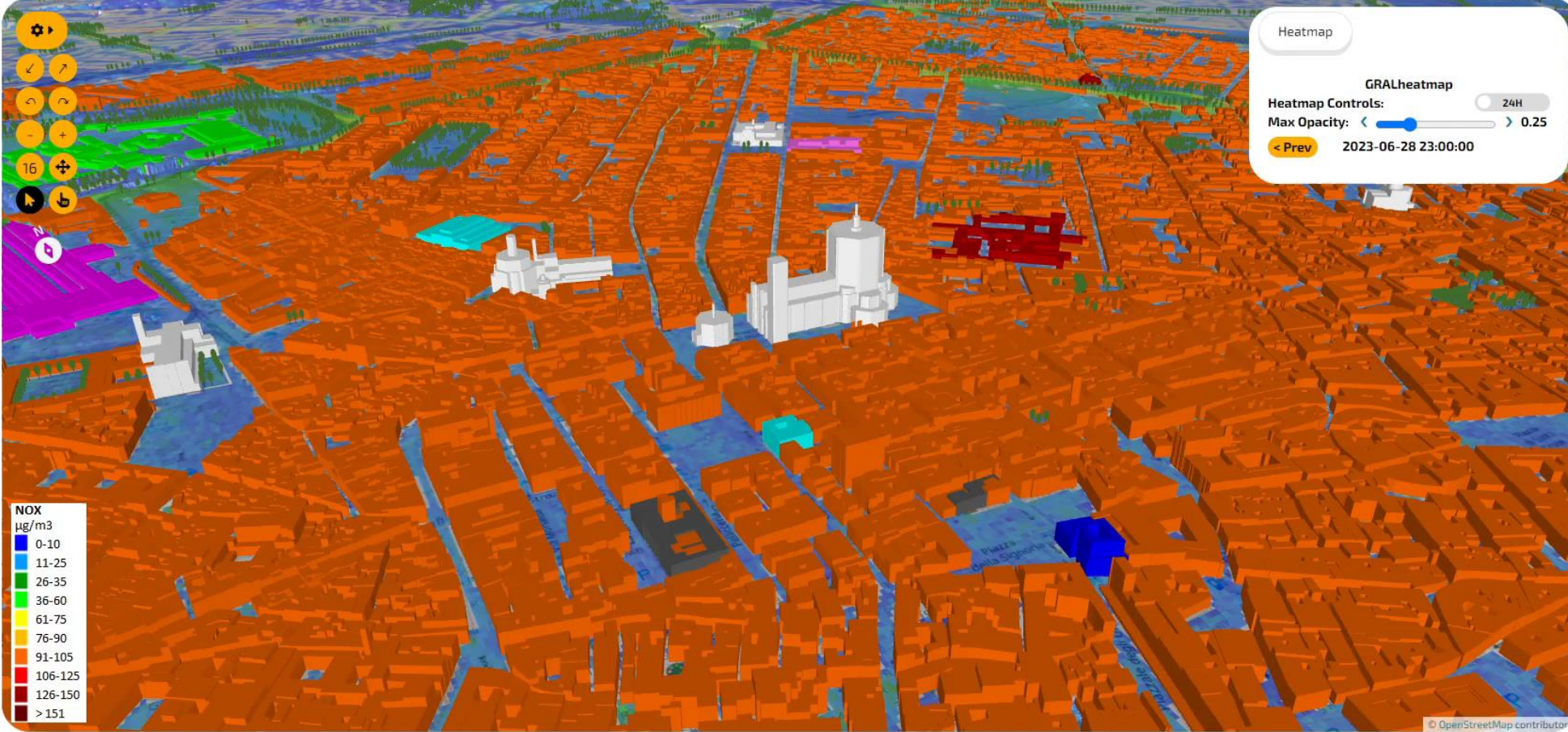
# FLORENCE SCDT



SELECT...

-  >
-  >
-  >
-  >
-  >
-  >
-  >
-  >
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-  >
-  >

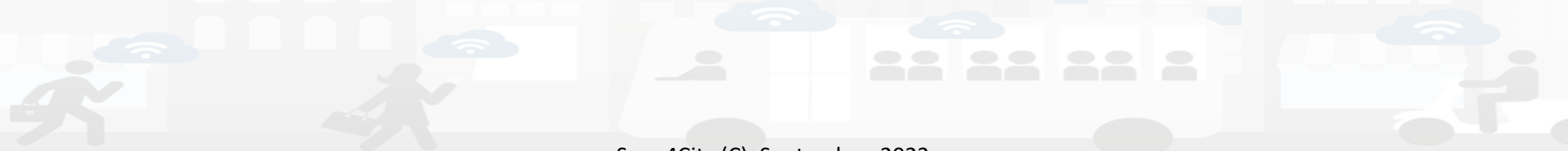
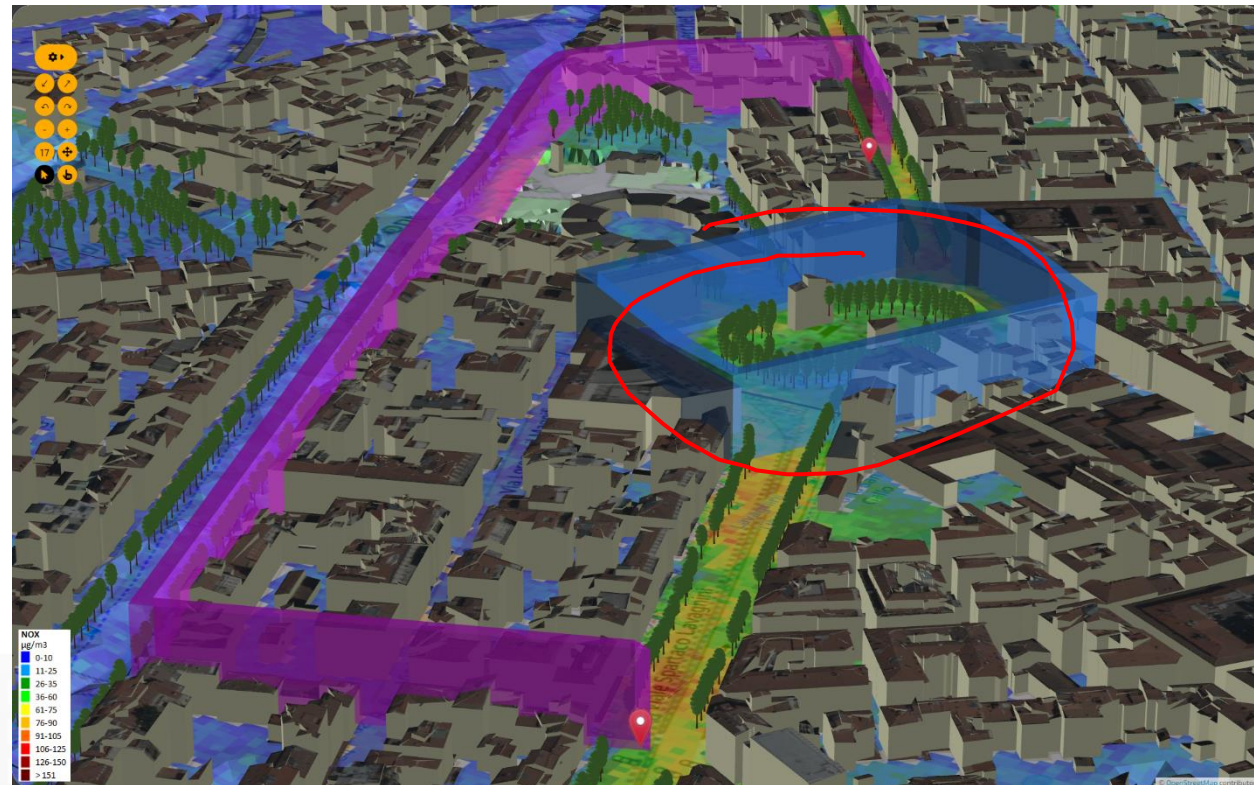
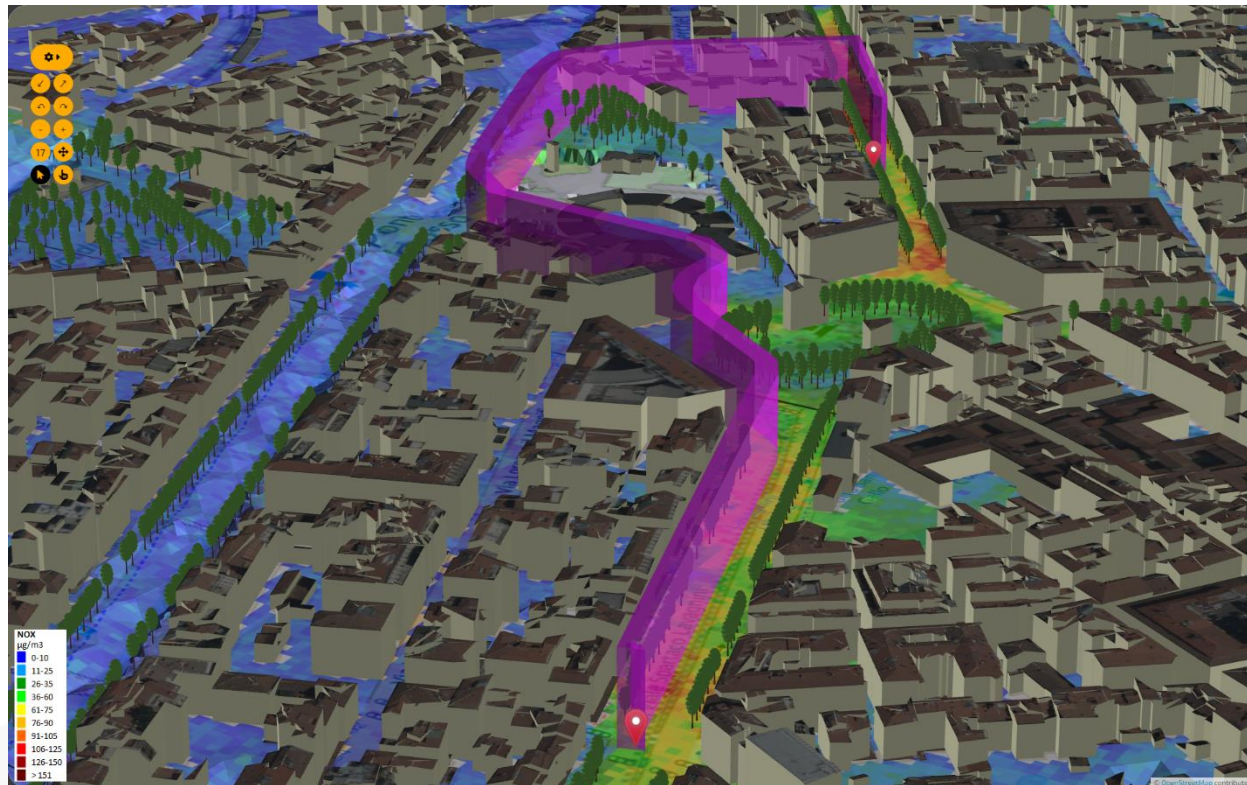
DOUBLE MAP



© OpenStreetMap contributor



# Dyamic Routing in 3D space





UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

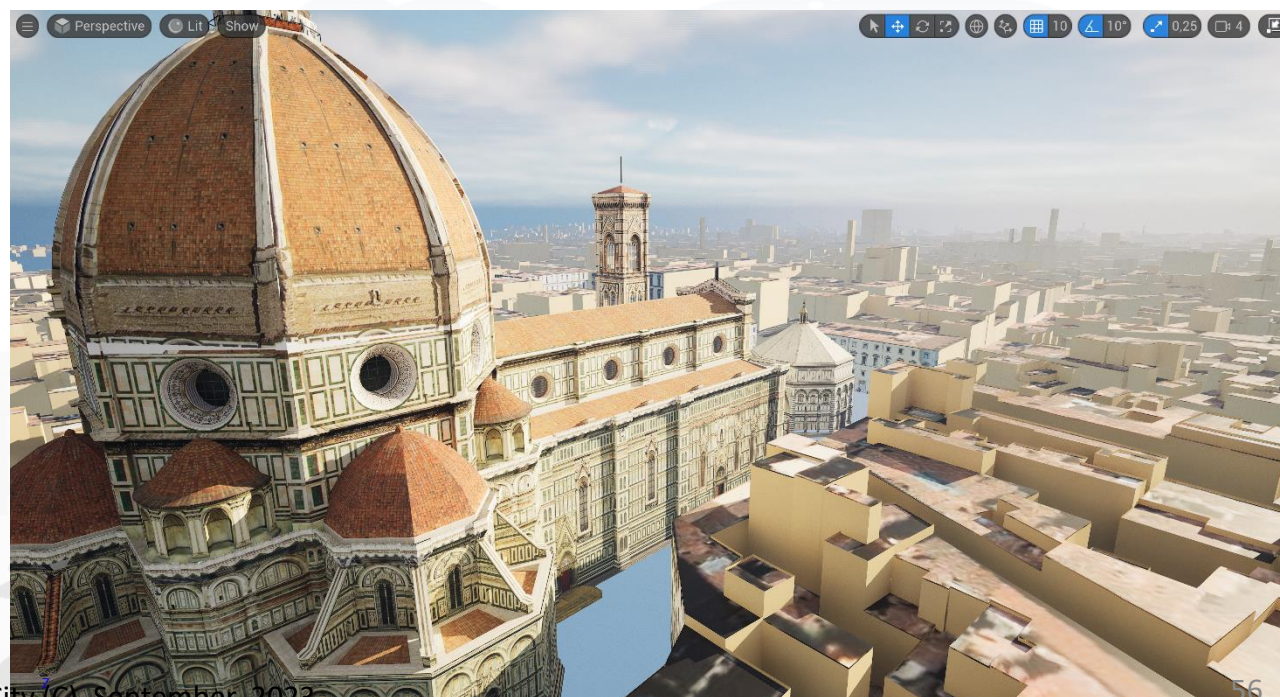
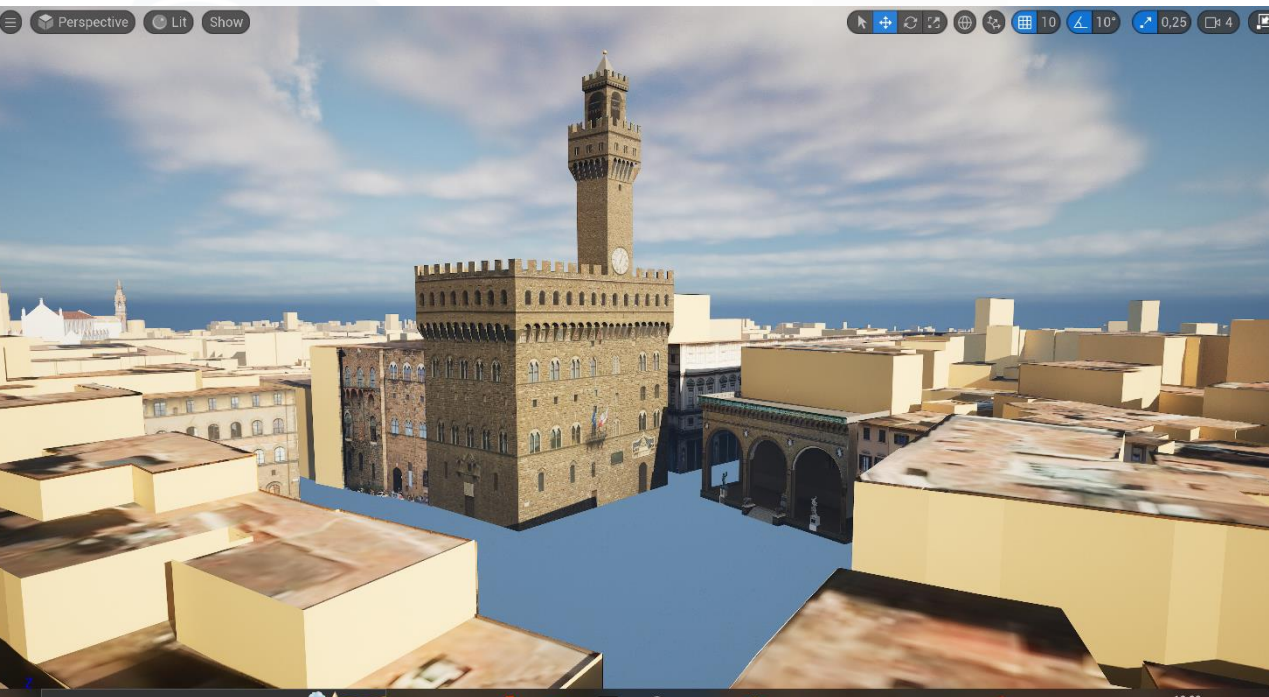
**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB

 **SNAP4CITY**



# OCULUS



City (C) September 2023



Switch To New Layout (Beta)

User: nicolaroot, Org: DISIT  
Role: RootAdmin, Level: 7

LOGOUT

- My Snap4City.org
- Tour Again
- www.snap4solutions.org
- ダッシュボード
- Dashboards (Public)
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- My Data Dashboard Dev Kibana
- My Data Dashboard Kibana
- Extra Dashboard Widgets
- Notificator
- Data Management, HLT
- Knowledge and Maps
- Processing Logics / IOT App
- Entity Directory and Devices
- Resource Manager
- Development Tools
- Management
- Decision Support Systems
- Deploy and Installation



Home / Snap4City: Smart aNalytic APp builder for sentient Cities and IOT

# Snap4City: Smart aNalytic APp builder for sentient Cities and IOT

You can't delete this newsletter because it has not been sent to all its subscribers.

Username: nicolaroot

## Search



Training on Tools and Platform

Powered by www.km4city.org

FIWARE Node-RED

Sii-Mobility

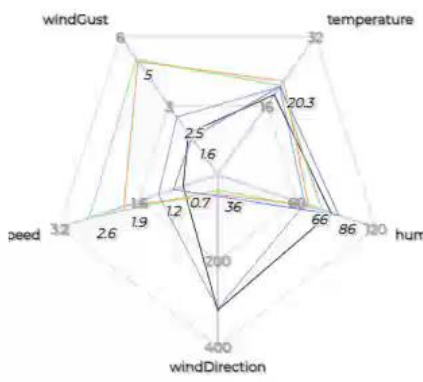
Who's online

# BIM Airport

Thu 25 May 18:16:22

- Select the view of interest
- Airport Building 1
  - Airport Heatmap dash
  - Terminal Heatmap

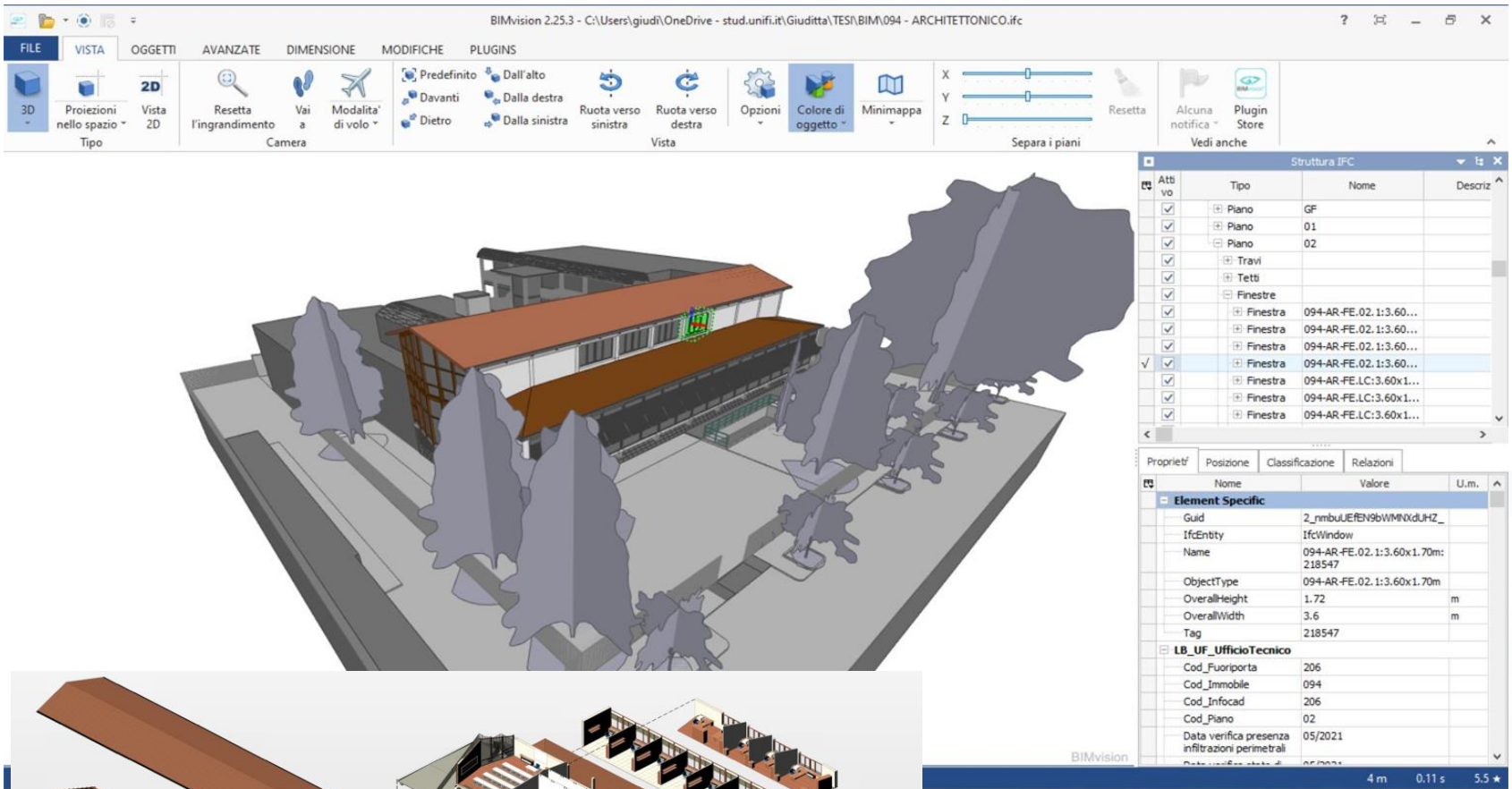
Sensor Data 4m



- Sensor\_TOS926
- Sensor\_TOS1096
- Sensor\_TOS1215
- Sensor\_TOS811
- Sensor\_TOS1205



Last Value	Time Trend Chart
No data	



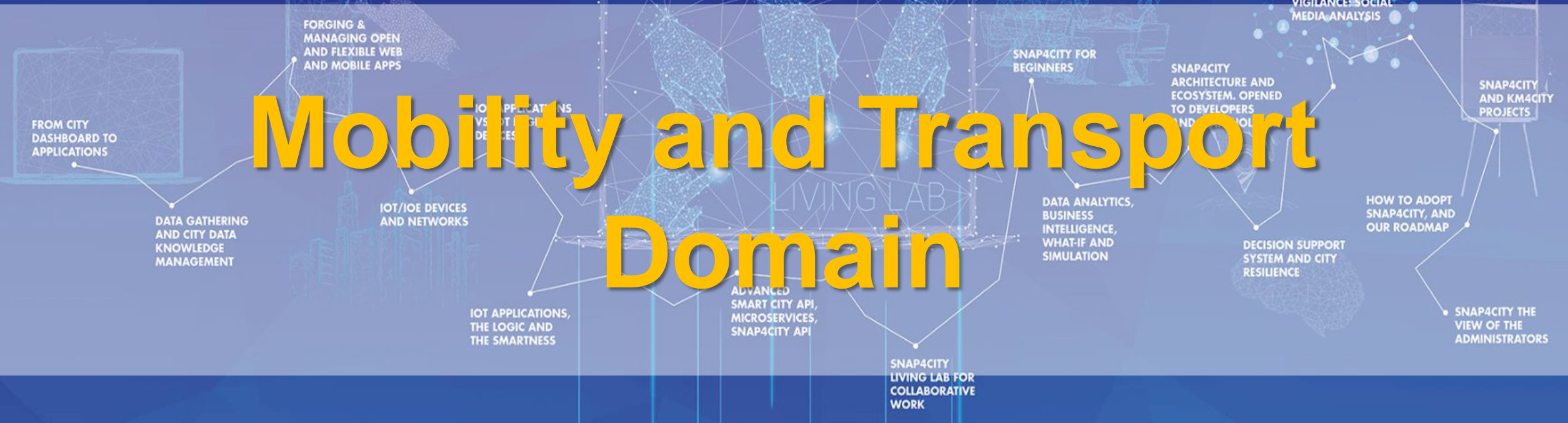
.IFC

Nome	Valore	U.m.
<b>LB_UF_UfficioTecnico</b>		
Cod_Fuoriporta	122	
Cod_Immobile	094	
Cod_Infocad	122	
Cod_Piano	01	
Data verifica presenza infiltrazioni perimetrali	05/2021	
Data verifica stato di conservazione, fissaggio, funzionalità, stabilità e tenuta di superfici vetrate	05/2021	
Descrizione	Facciata continua con telaio in legno, finestre apribili e avvolgibili	
Immagine	Immagine raster: IMG_7428.JPG	
Immagine tipo	Immagine raster: IMG_7428.JPG	
Periodicità verifica presenza infiltrazioni perimetrali	A chiamata	
Periodicità verifica stato di conservazione, fissaggio, funzionalità, stabilità e tenuta di superfici vetrate	A chiamata	
Verifica presenza infiltrazioni perimetrali	Si	
Verifica stato di conservazione, fissaggio, funzionalità, stabilità e tenuta di superfici vetrate	Si	



TOP

# Mobility and Transport Domain

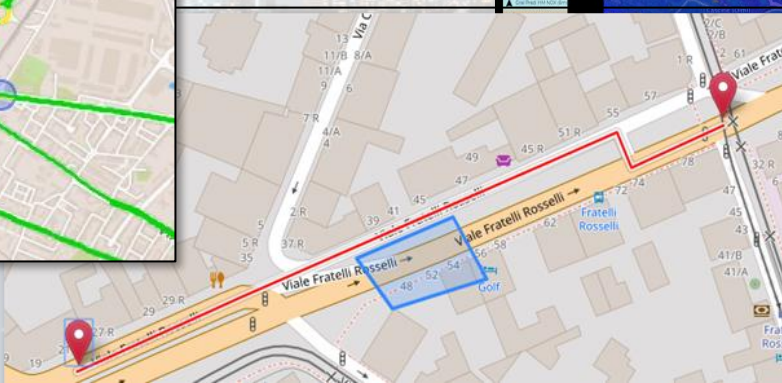
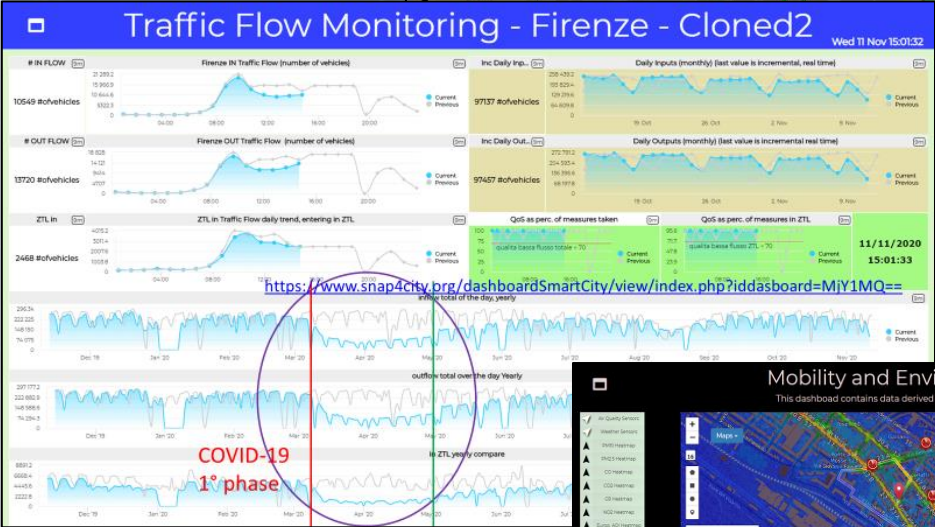


# Mobility and Transport Traffic Flow Analysis

Cities: Firenze, Pisa, Livorno, Modena, Santiago di Compostela



- **Multiple Domain Data**
  - Traffic Flow sensors, city structure, weather
- **Decision Makers Multiple Locations**
  - Real time Monitoring, predictions
  - Traffic Flow Predictions,
  - Traffic Reconstructions, routing
  - Dashboards, What-IF analysis
  - Mobile App, people flows
- **Historical and Real Time data**
- **Services Exploited on:**
  - Dashboards, Mobile App
- **Since 2017, 2019**





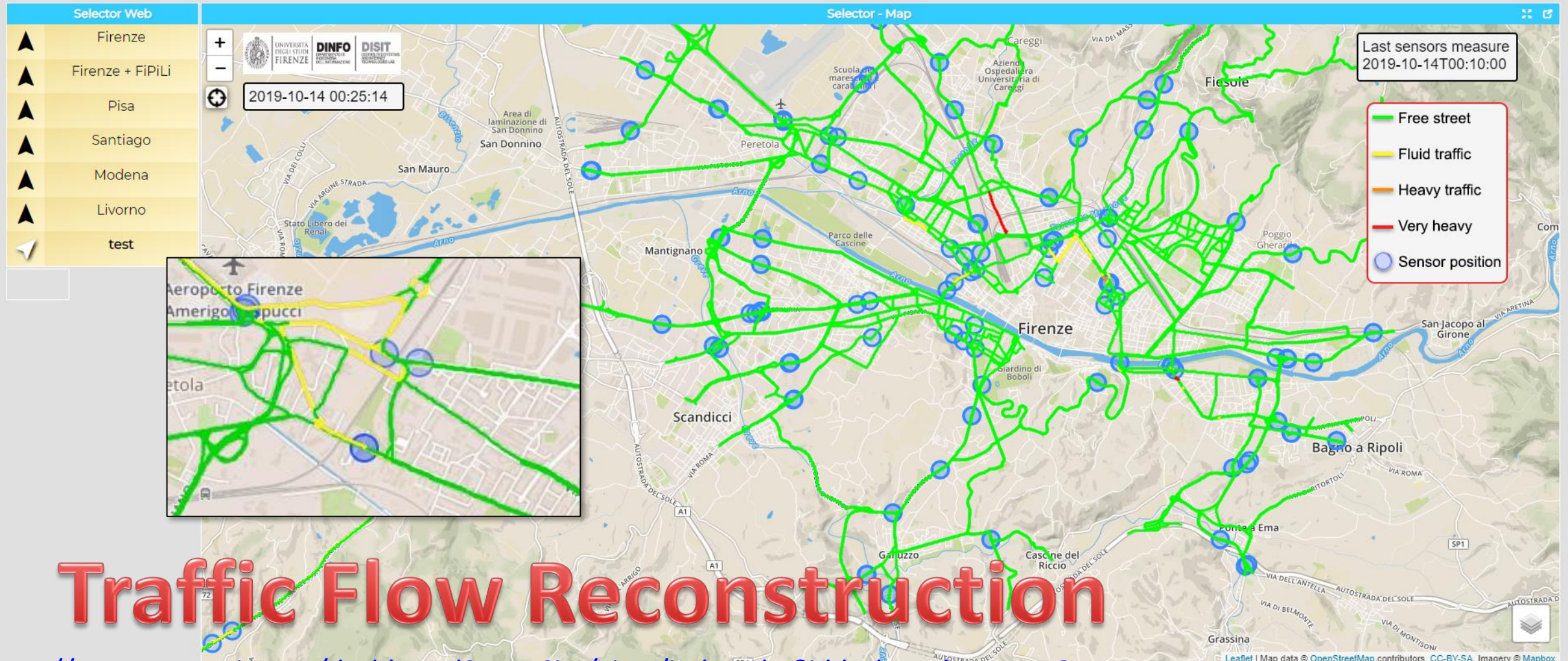
# Mobility and Transport

- **Public Transportation:** Ingestion and modelling of GTFS, Transmodel, etc. (DP)
  - Analysis of the **demand mobility vs offer transport** of according to public transportation and multiple data sources (Simulation)
  - Assessing **quality of public transportation** (analysis)
- **Accidents** heatmaps, anomaly detection (analysis, ML)
- **Predictions** for: traffic flow, smart parking, smart bike sharing, people flows, etc. (ML, DL)
- **What if analysis:** routing, traffic flow, demand vs offer, pollutant, etc. (Simulation + ML)
- **Traffic flow reconstruction** from sensors and other sources (simulation + ML)
- **Tracking fleets**, people, via devices: OBU, OBD2, mobile apps, etc. (DP)
- **Routing** and multimodal routing (multistop travel planning), constrained routing, dynamic routing (DA)
- Computing **Origin Destination Matrices** from different kind of data (analysis, DP, DP)
- Computing **typical trajectories** on the basis of tracks (analysis, ML)
- Computing Messages for Connected drive (DP)
- Slow and Fast Mobility **15 Minute City Indexes** (analysis, DP, ...ML)
- Computing and comparing traffic flow on devices and at the city border (analysis)
- **Typical time trends** for traffic flow and IoT Time series. (analysis, ML)
- **Impact of COVID-19** on mobility and transport
- Computing **SUMI, PUMS**, etc. (mainly DP)
- Etc.

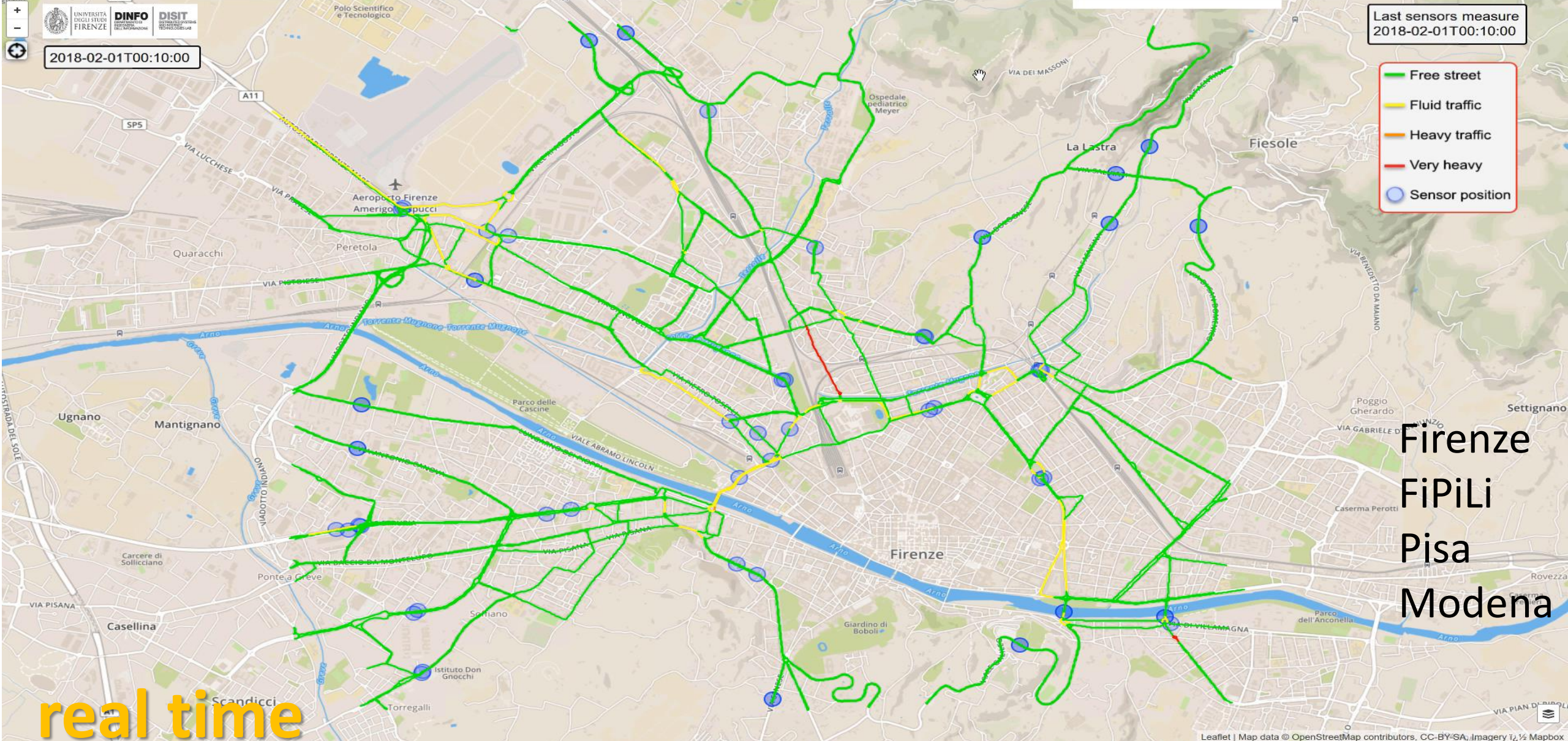


# Traffic Flow Reconstruction for the cities

Mon 14 Oct 00:25:15



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTc5NQ==>



Last sensors measure  
2018-02-01T00:10:00

2018-02-01T00:10:00

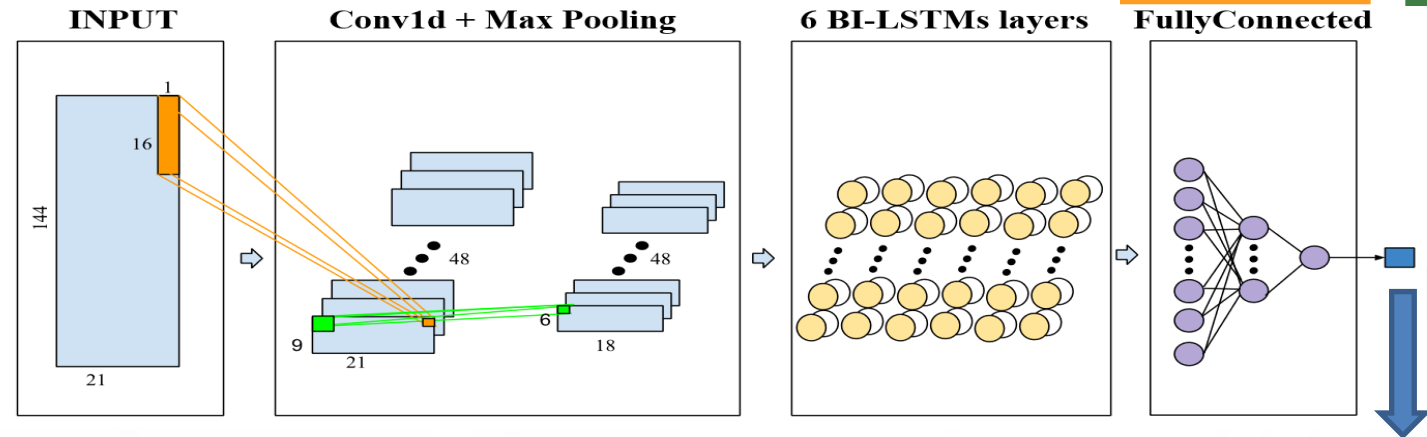
- Free street
- Fluid traffic
- Heavy traffic
- Very heavy
- Sensor position

real time

Firenze  
FiPiLi  
Pisa  
Modena

# Traffic Flow Reconstruction

# Short-Term Prediction of City Traffic Flow via Convolutional Deep Learning



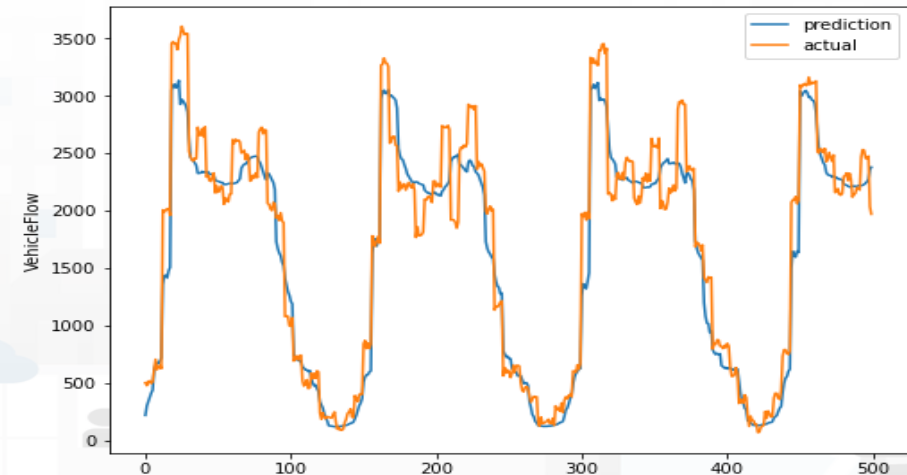
Urban data:

- Date-time
- Traffic
- Temporal
- Seasonality
- Pollution
- Weather

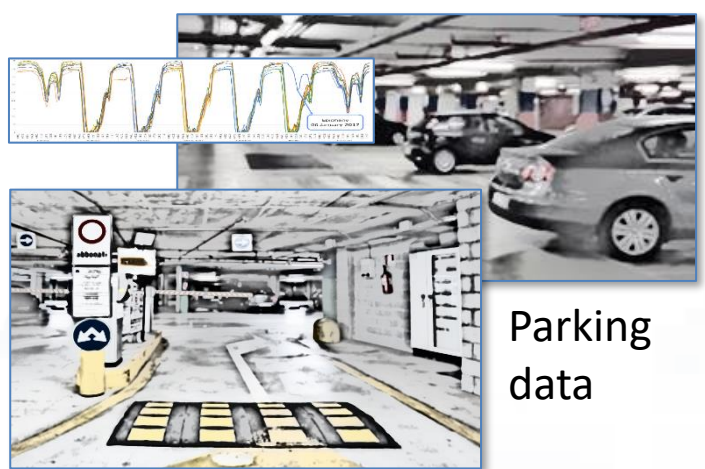


- RF
- XGBOOST
- DNN
- LSTM
- BI-LSTM
- Autoencoder BI-LSTM
- Attention CONV-LSTM
- CONV-BI-LSTM

CONV-BI-LSTM



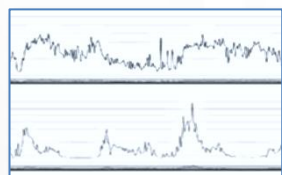
# Deep Learning AI to surely Park!



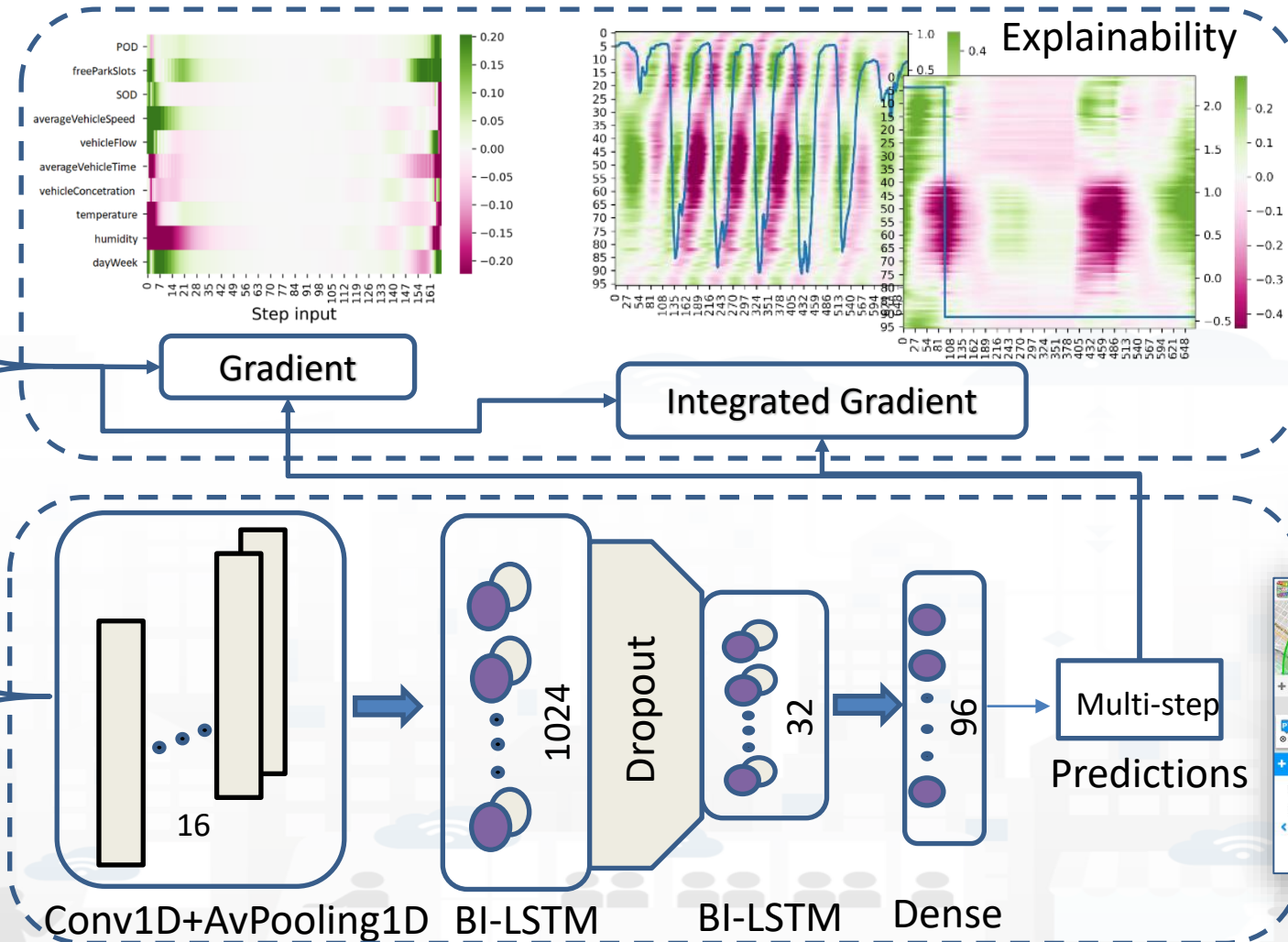
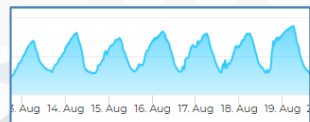
Parking data



Traffic sensors data



Weather Features



# Smart City / Smart Parking + Environment

## Reverberi, Lonato del Garda



reference

- **Multiple Domain Data**

- Smart Parking, Environment, Wi-Fi

- **Multiple Decision Makers**

- City Officer, operators
- Data monitoring, alerting
- analytics

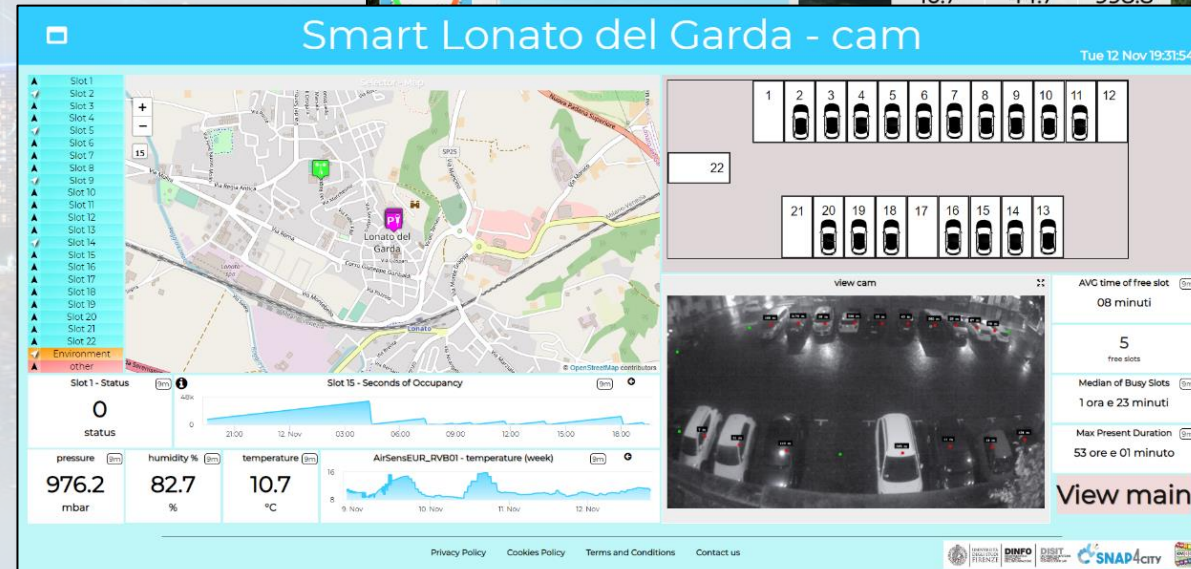
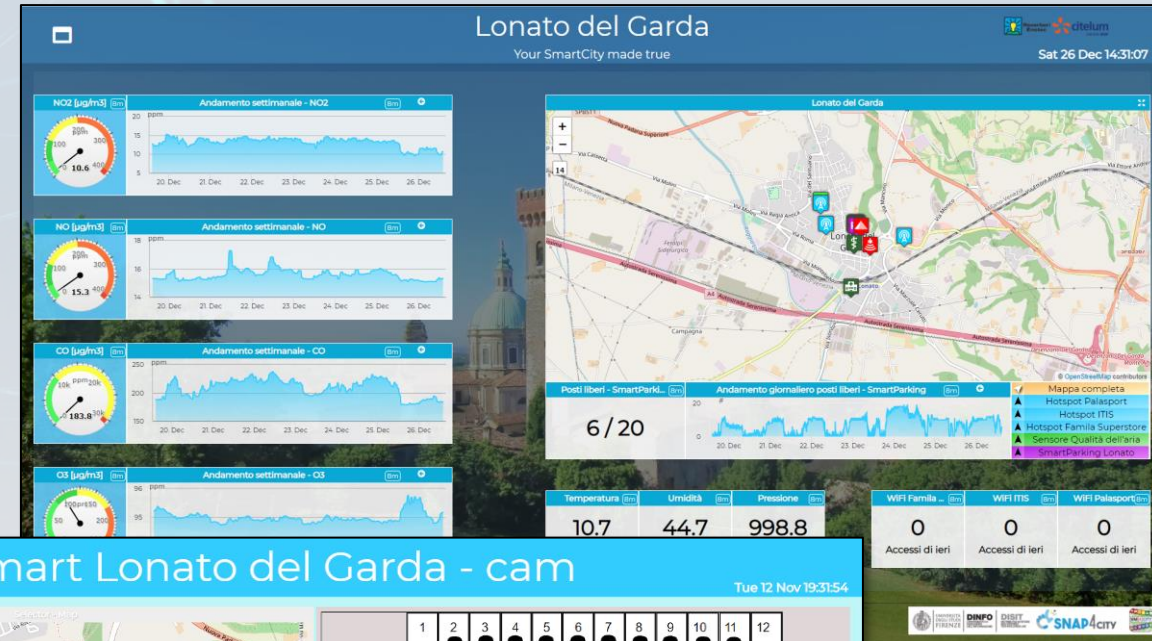
- **Historical and Real Time data**

- Dashboards

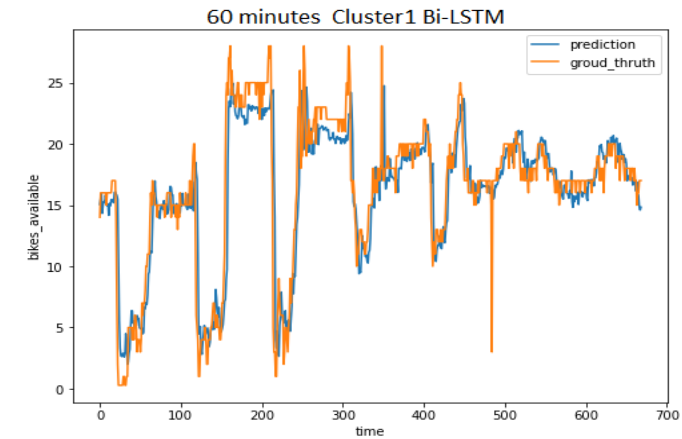
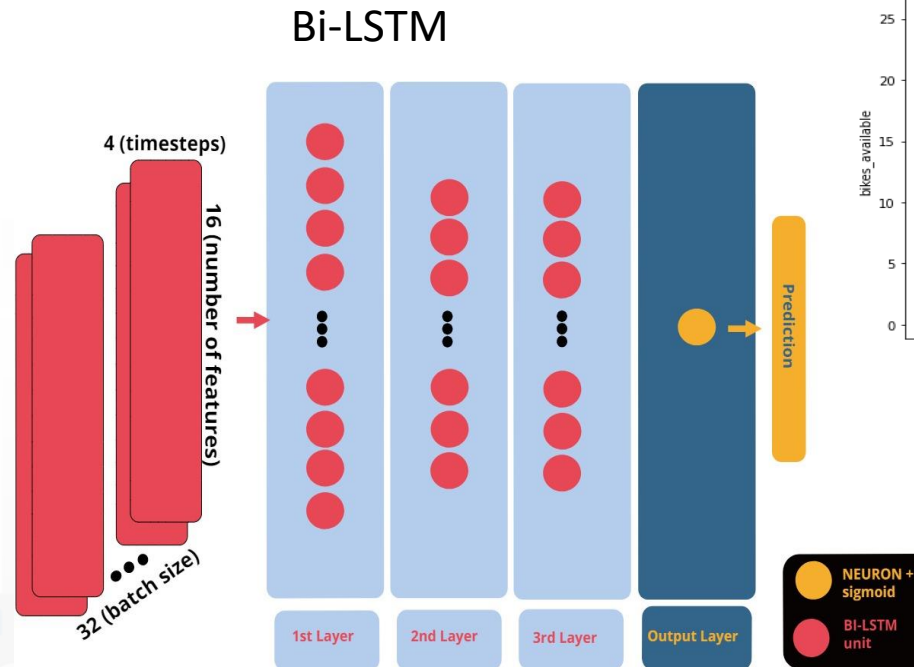
- **Services Exploited on:**

- Dashboards, API

- **Since 2019**



# Deep Learning for Short-Term Prediction of Available Bikes on Bike-Sharing Stations



E. Collini, P. Nesi and G. Pantaleo, "Deep Learning for Short-Term Prediction of Available Bikes on Bike-Sharing Stations," in *IEEE Access*, vol. 9, pp. 124337-124347, 2021, doi: 10.1109/ACCESS.2021.3110794.  
<https://ieeexplore.ieee.org/abstract/document/9530580>

# What-if Analysis on Pub Transport



- Definition of scenarious impact on
  - Traffic, Pollutant, parking, public transport, private flows, etc.
  - KPI analysis

## Public Services

Welcome to DORAM powered by SNAP4CITY. Services: 36 on 36 available. The public transportation system has been analyzed in the City, considering the service offer vs. mobility demand. The top-thirty most crowded stops are presented on the right panel and on the map. Please, select your desired scenarios or a stop on the map to perform other analysis.

Type the stop name... Search

Stop panel

Scenario Selector

Choose a scenario: Actual scenario

Actual scenario: Describes the current status of the public transportation network. (More Info)

Daily Individual Trips > 52000  
 Stops > 1900  
 Residential Buildings > 31000  
 Service Providers > 32000  
 Mobility Operators > 10  
 Transport Modes = 3

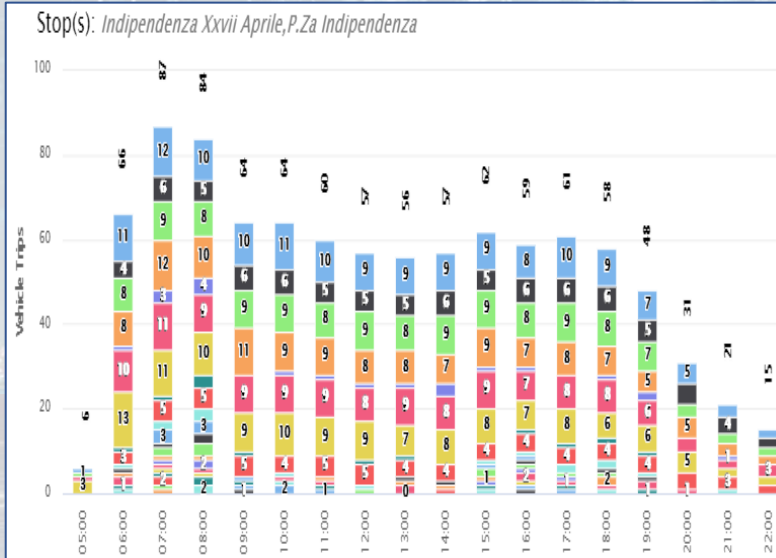
**The Most Crowded Stops** Select a time slot: 05:00 to 01:59 Search

**Indipendenza Xxvii Aprile**  
P.Za Indipendenza

Daily Pick-ups: 377  
 Daily Drop-offs: 407  
 Daily Vehicle Trips: 979

**Stazione Nazionale**

Daily Pick-ups: 321  
 Daily Drop-offs: 358  
 Daily Vehicle Trips: [unlabeled]

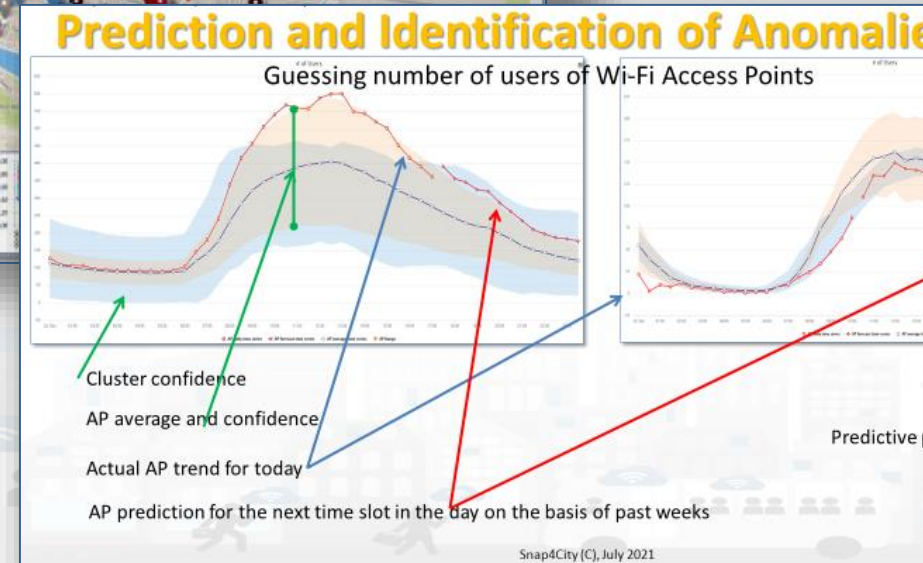
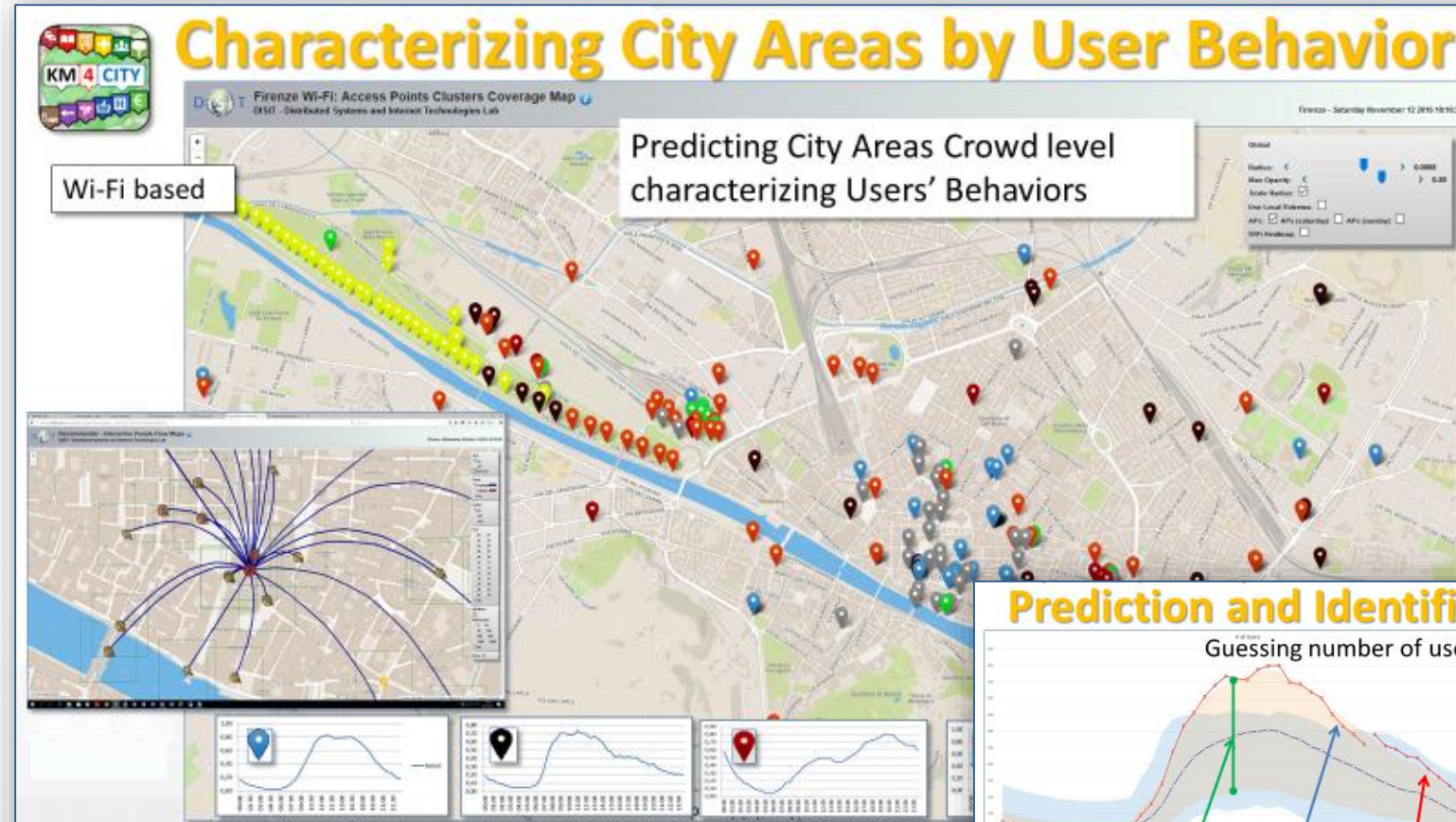




# City Users Behavior and Social Analysis

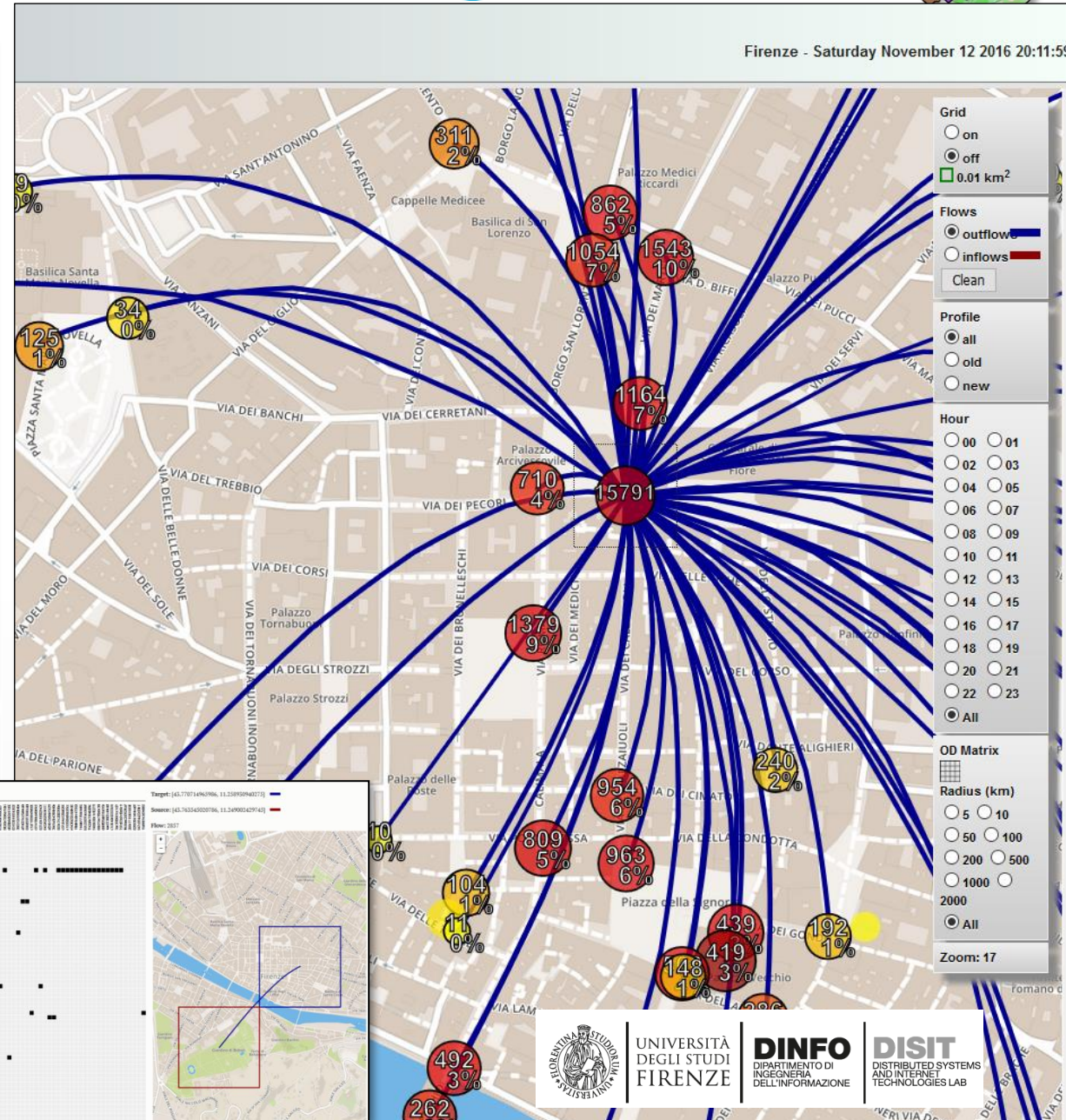
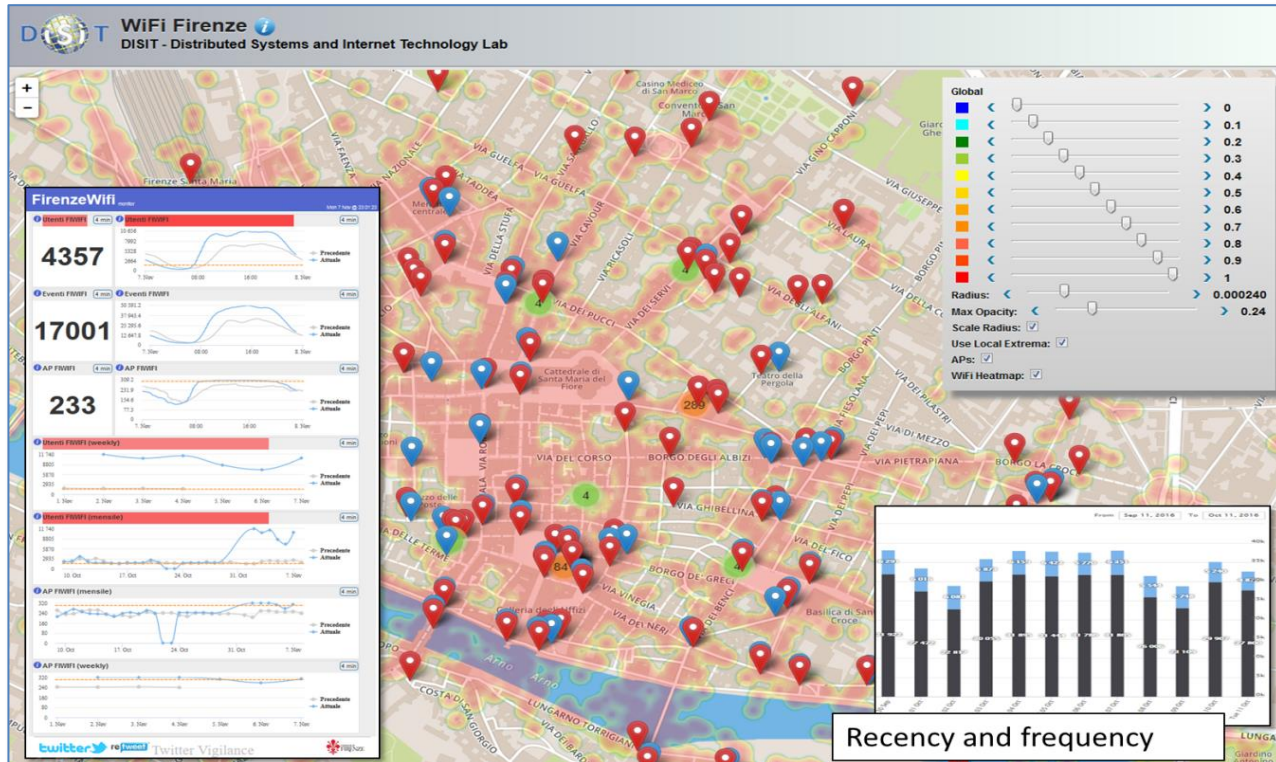
- **People detection and classification:** persona, strollers, bikes, etc. (ML, DL)
- **people counting** and tracking, head counting (via thermal cameras, ML, DL)
- **People flows prediction** and reconstruction, (ML, DL)
  - Wi-Fi data, mobile apps data, Mobile Data, etc.
- **User's behaviour analysis, People flow analysis** from PAX Counters and heterogenous data sources (ML, AI)
  - origin destination matrices, hot places, time schedule,
  - Recency and frequency, permanence, typical trajectory, etc.
- **Computing User engagement and suggestions** for sustainable mobility (Rule Based, ML)
- **Social media analysis** on specific channel, specific keywords: see Twitter Vigilance,
  - Reputation, service assessment: MultiLingual NLP and Sentiment Analysis, SA
  - Tweet proneness, retweet-ability of tweets, impact guessing
  - Audience predictions on TV channels and physical events, locations
  - Prediction of attendance of events and on attractions
- **Virtual Assistant construction, LLM, NLP, Sentiment Analysis (DL, NLP)**
- **15 Minute City Index** , etc. (modeling and computability)
- Computing SDG, etc., (DP)
- Etc.

- **Prediction of people flows** on the basis of Wi-Fi data
- **Anomaly detection**
- **Resolute H2020**
- **Classification of city areas**



# Origin Destination Matrix Estimation

Firenze - Saturday November 12 2016 20:11:59



Recommender - Interactive People Flow Maps  
 DISIT - Distributed Systems and Internet Technologies Lab



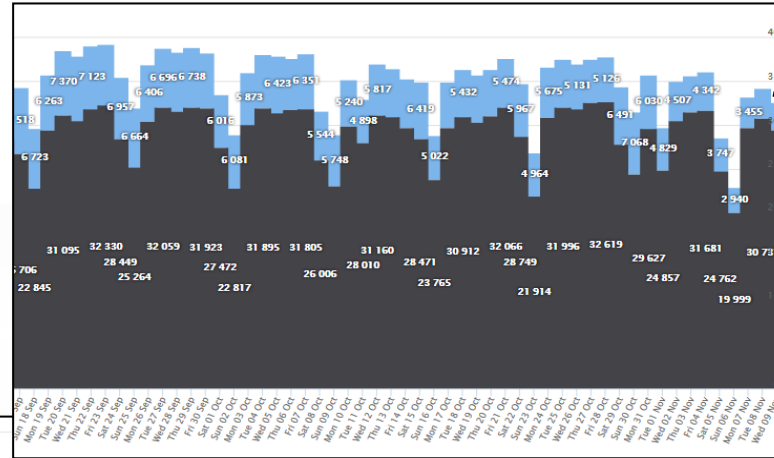
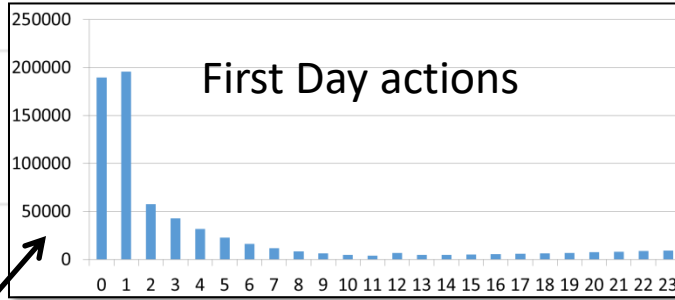
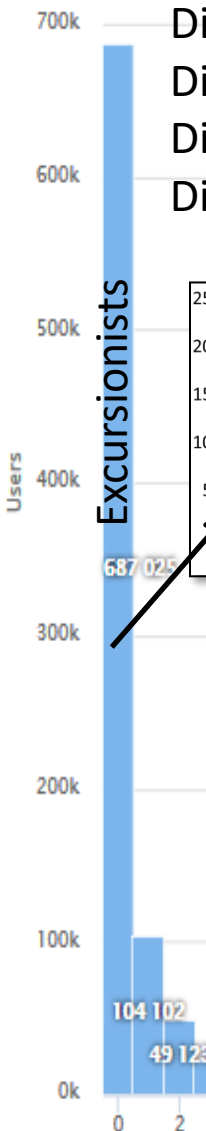
Wi-Fi based



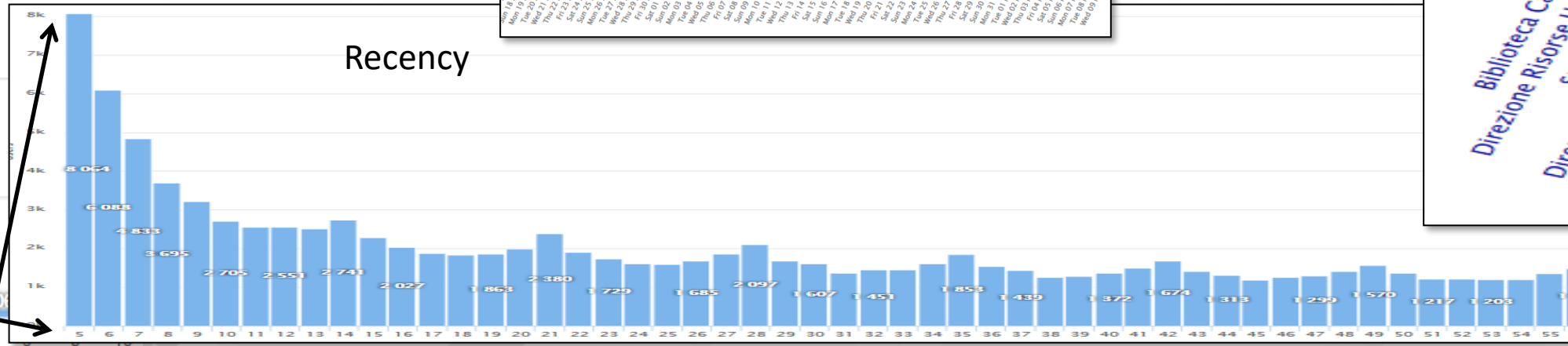
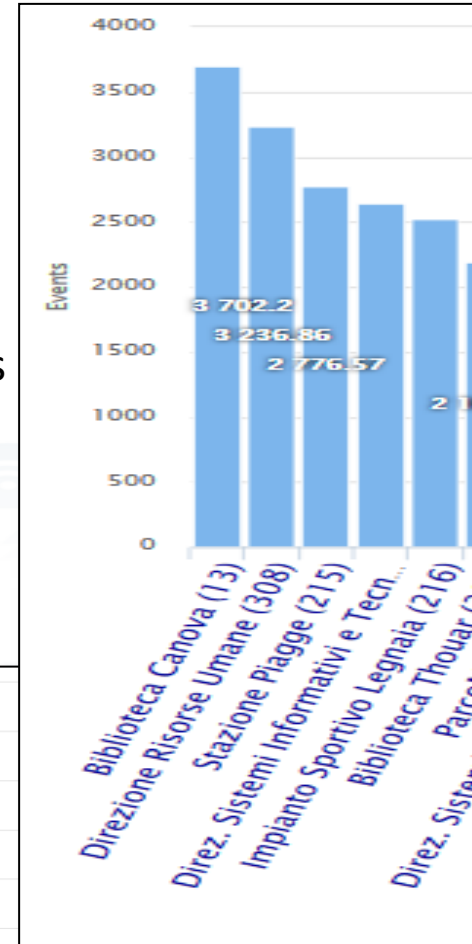
# User Behaviour Analysis

Where

Distinct APs: 343  
 Distinct APs (last 24 hours): 311  
 Distinct Users (last 180 days): 1102098  
 Distinct Excursionists (last 180 days, < 24 h): 687025



New City Users  
VS  
Returning



# Tuscany Region

## • Dashboards & Services:

- **Mobility:** public transport operators schedule and paths, traffic Fi-Pi-Li main road, parking status and predictions, traffic sensors, Origin Destination matrix, routing, multimodal routing, etc.

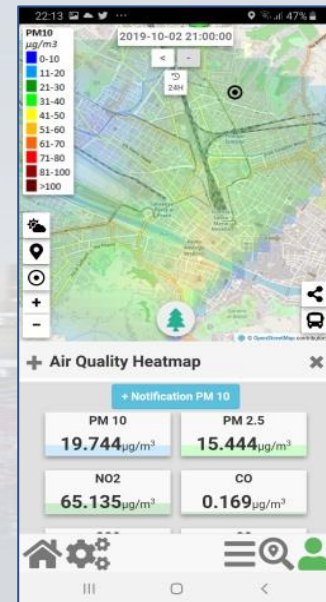
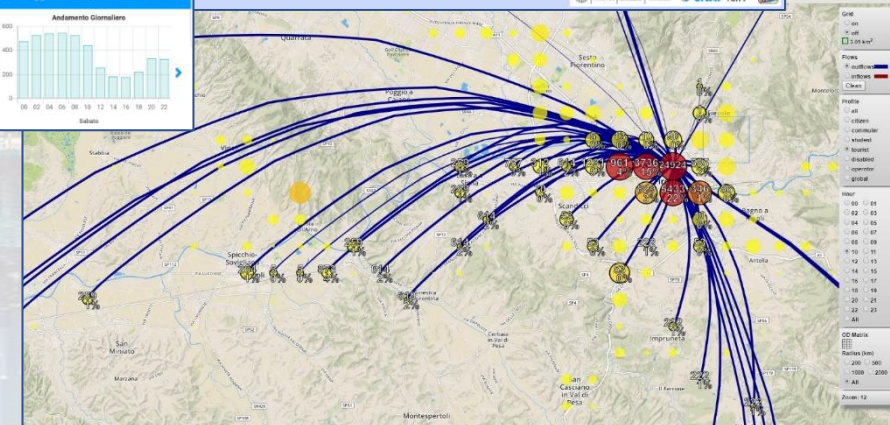
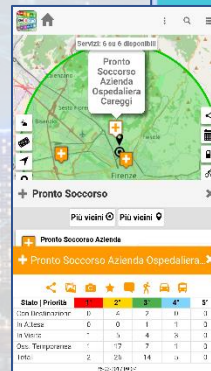
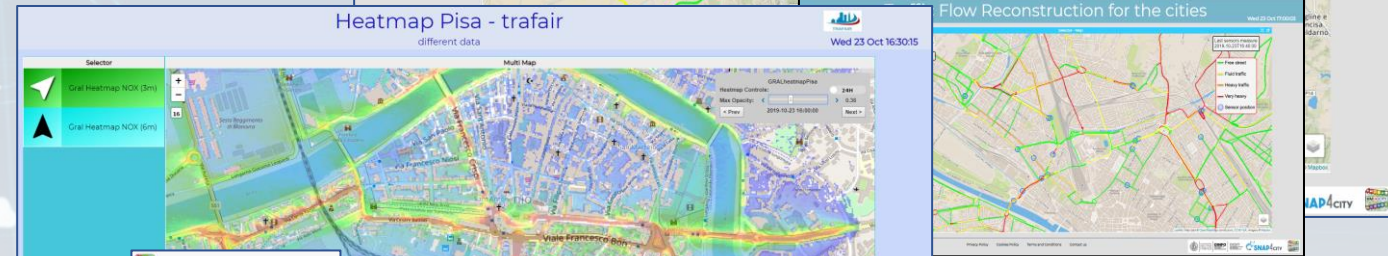
- **Social:** Hospitals and triage, etc.
- **Environment:** sensors, heatmaps, alerting,
  - **Pollution Forecast:** NOX, NO2
  - **Weather Forecast,**
- **Culture and Tourism**
- Etc.

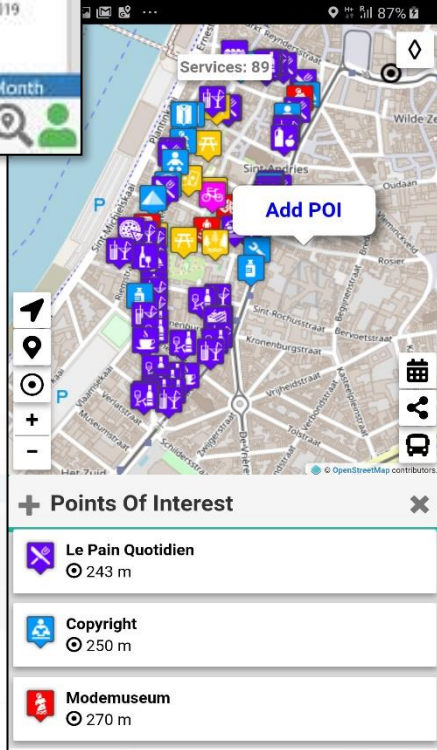
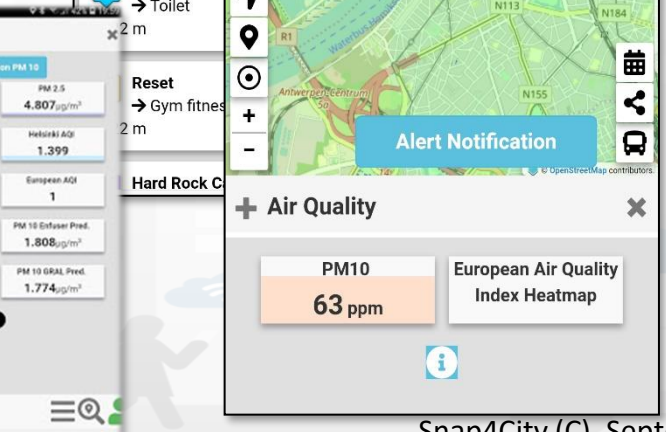
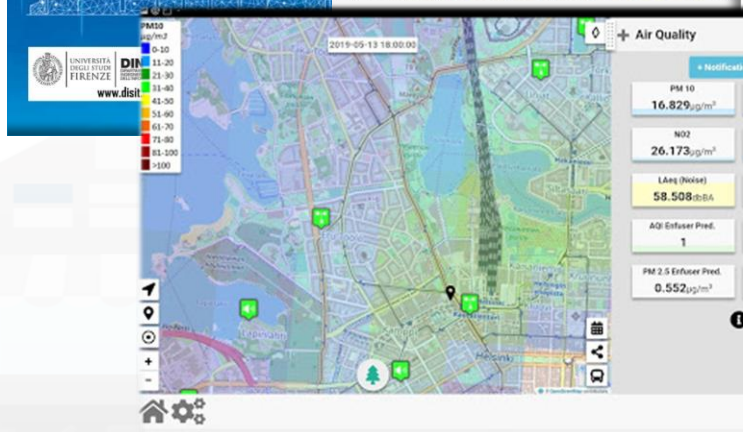
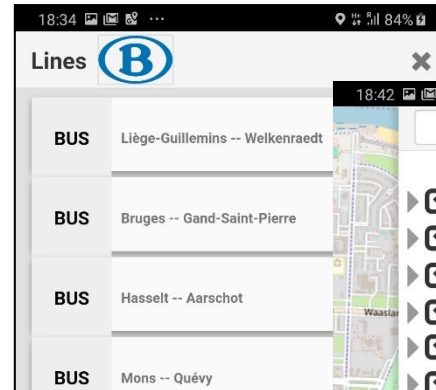
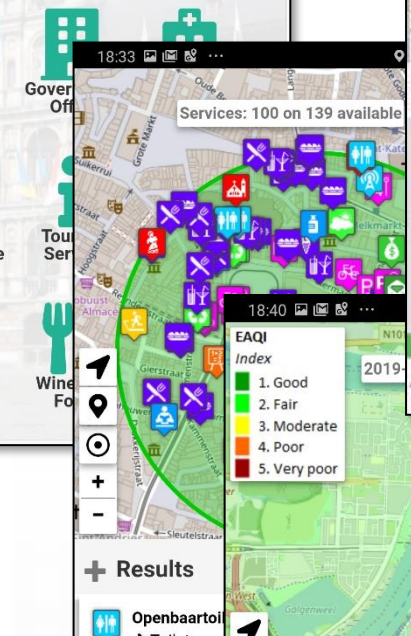
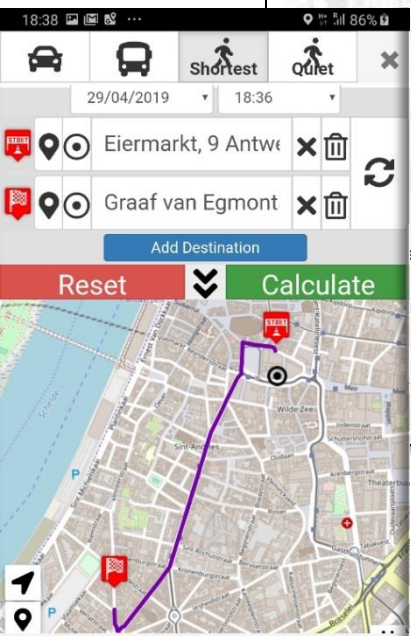
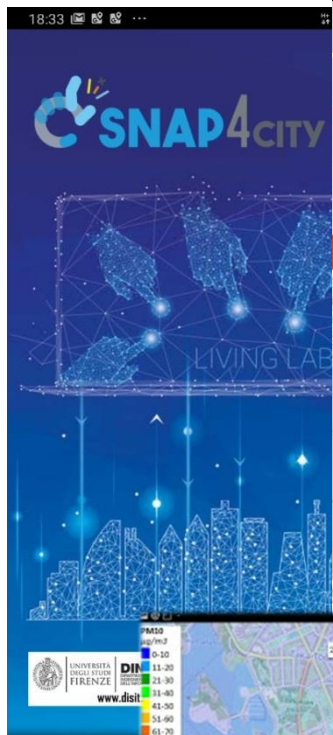
## • Mobile App and MicroApplications:

- Tuscany in a Snap (all stores)
- Tuscany where what... km4city (all stores)

## • Numbers: 1.5 M complex events per day

Snap4City (C), September 2023





# The App is a Bidirectional Device

- GPS Positions
- Selections on menus
- Views of POI
- Access to Dashboards
- searched information
- Routing
- Ranks, votes
- Comments
- Images
- Subscriptions to notifications
- ....

## Produced information

- Viewed ?
- Accepted ?
- Performed ?
- ...

Users



## Derived information

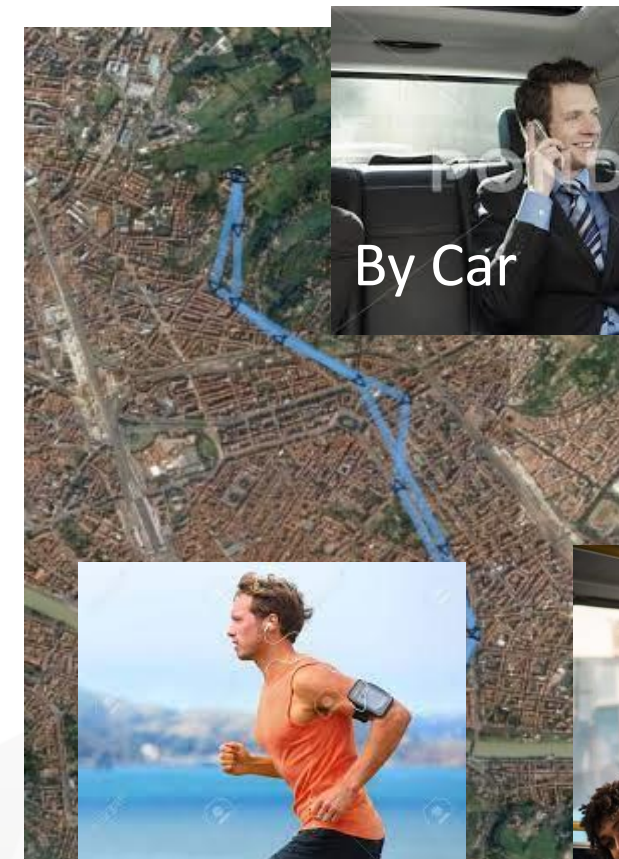
- Trajectories
- Hot Places by click and by move
- Origin destination matrices
- Most interested topics
- Most interested POI
- Delegation and relationships
- Accesses to Dashboards
- **Cumulated Scores from Actions**
- Requested information
- Routing performed
- .....

## Produced information

- Suggestions
- Engagements
- Notifications
- ...

System

# To propose suggestions and Engage city user we need to know how they are moving



By Car



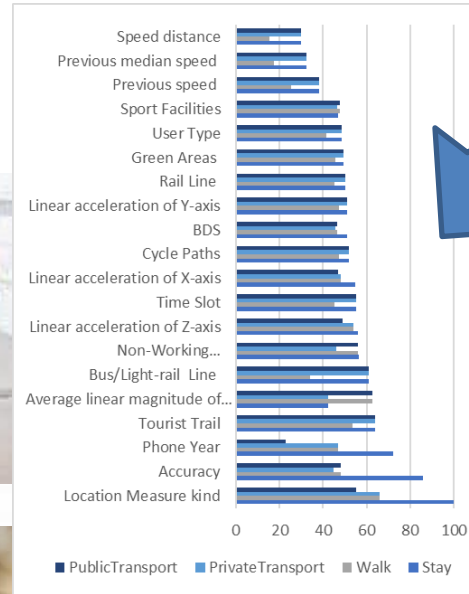
Walk



By BUS

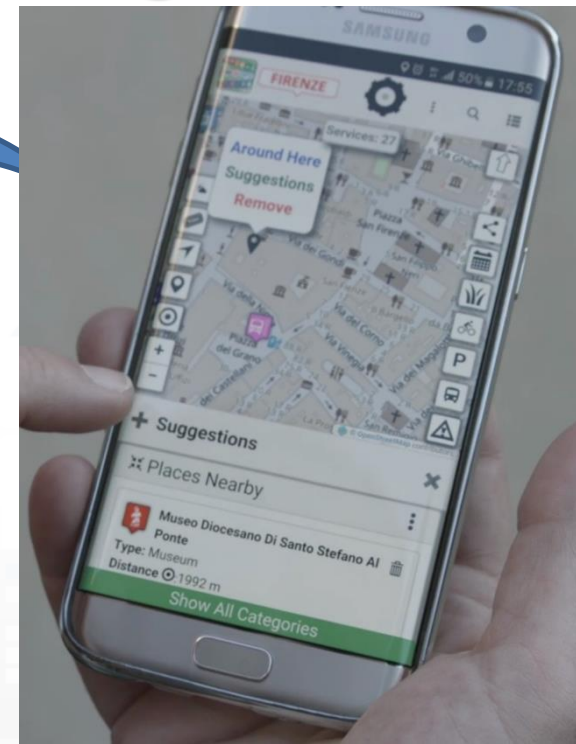


Run



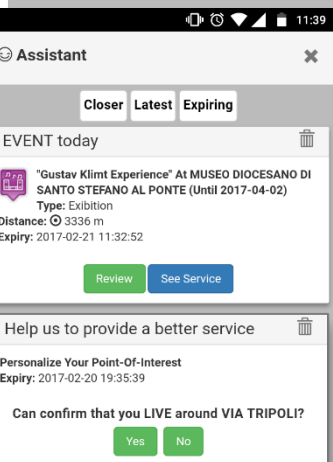
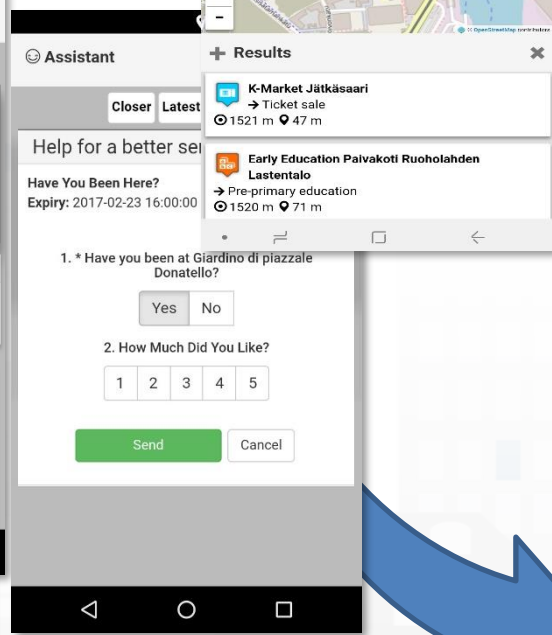
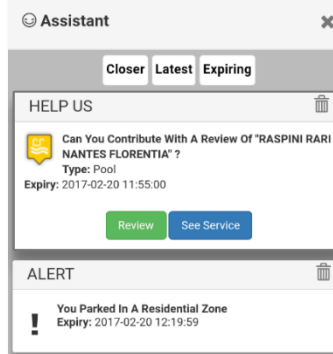
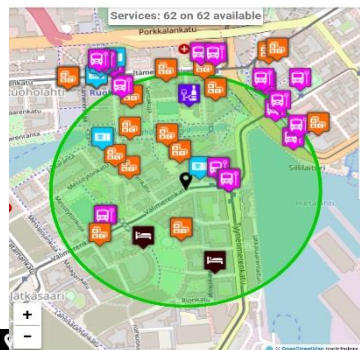
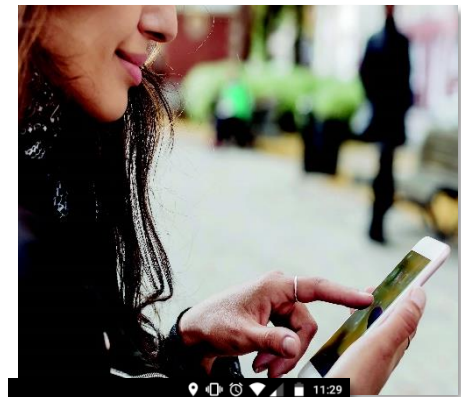
Artificial Intelligence  
Classification

Suggestions

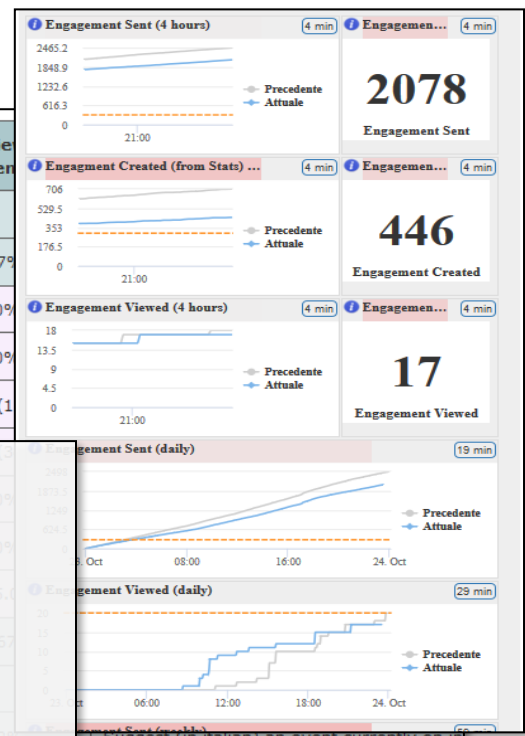




# Users' Engagement



Rule name	Type	#sent	#viewed	#viewed / #sent
daily_event_de	ENGAGEMENT	1 (0%)	0 (0%)	0%
daily_event_en	ENGAGEMENT	1720 (2.12%)	70 (7.1%)	4.07%
- commuter		5 (0.29%)	0 (0%)	0 (0%)
- student		14 (0.81%)	0 (0%)	0 (0%)
- tourist		1462 (85%)	25 (35.71%)	25 (17.1%)



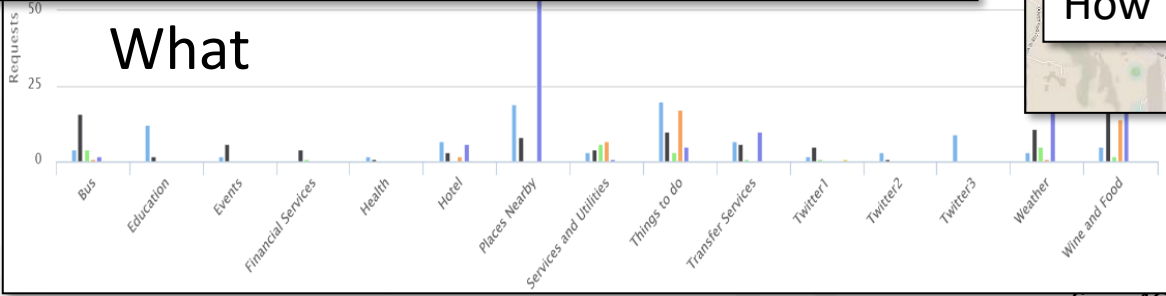
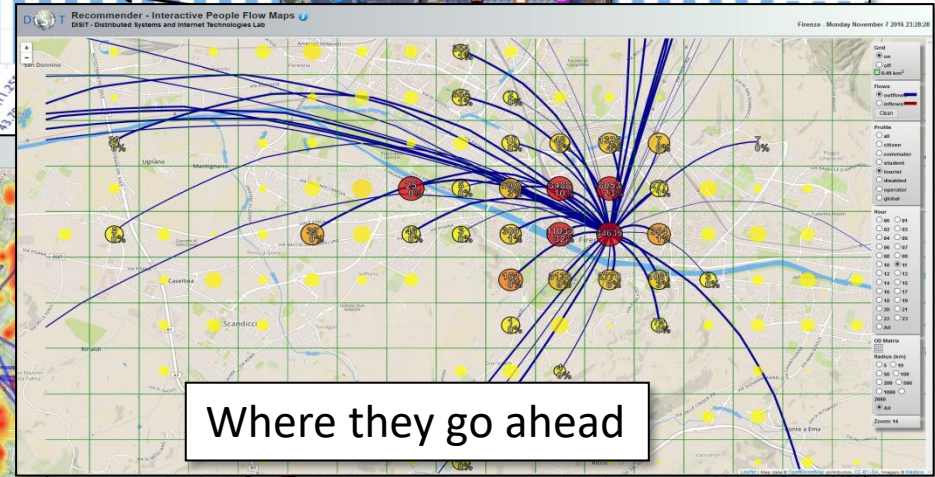
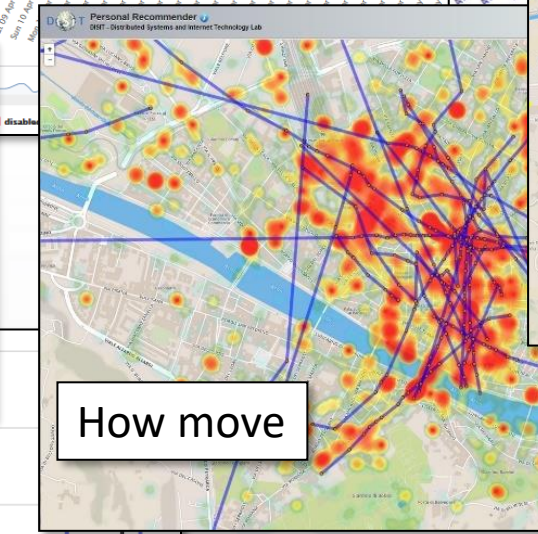
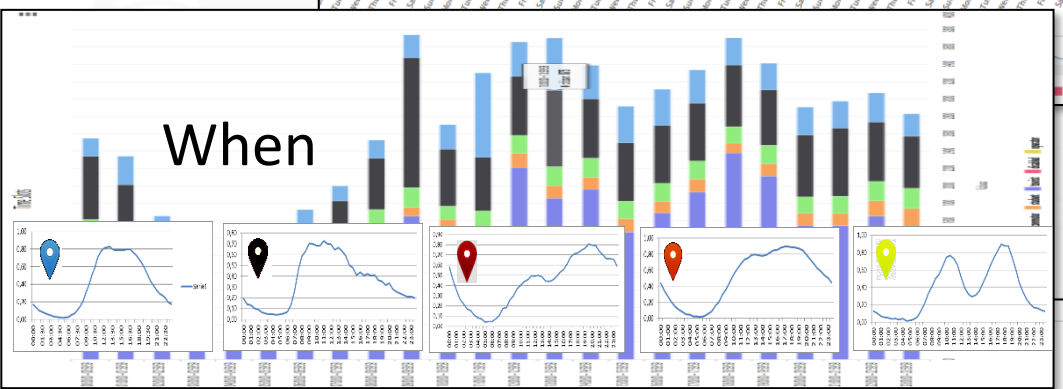
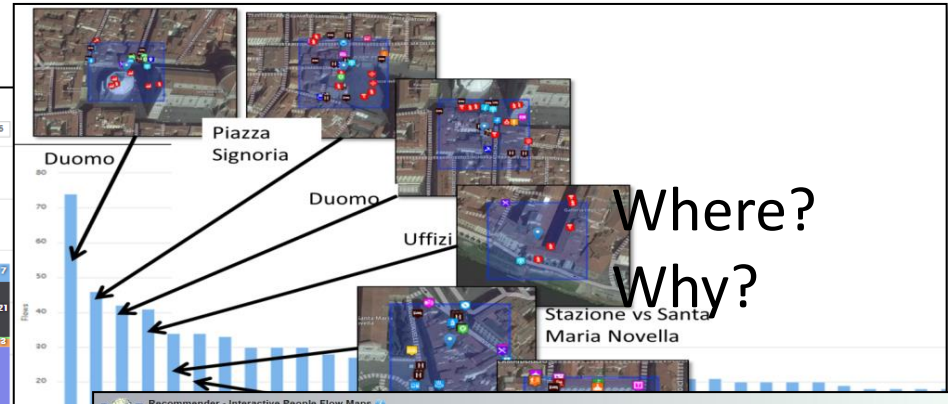
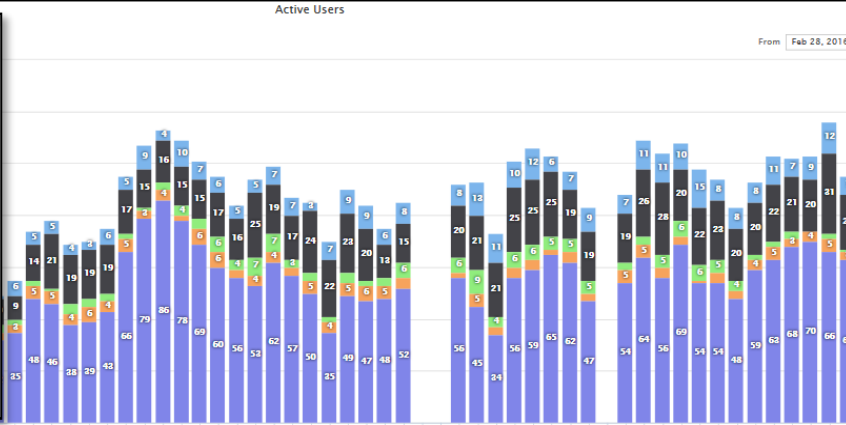
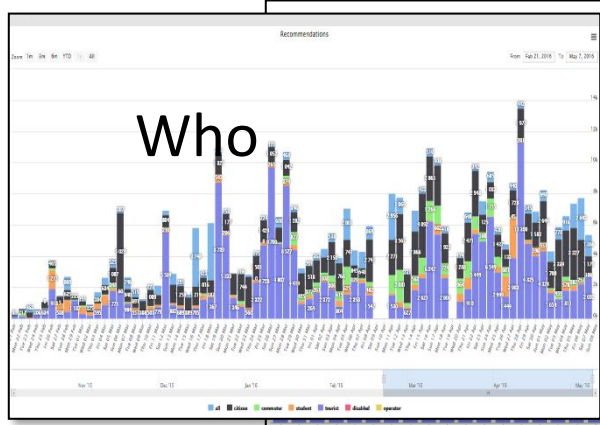
- Inform**
  - Air Quality forecast is not very nice
  - You have parked out of your residential parking zone
  - The Road cleaning is this night
  - The waste in S.Andreas Road is full
- Engage**
  - Provide a comment, a score, etc.
- Stimulate / recommend**
  - Events in the city, services you may be interested, etc..
- Provide Bonus, rewards if needed**
  - you get a bonus since you parked here
  - We suggest: leave the car out of the city, this bonus can be used to buy a bus ticket

User context

City context

Rules

# User Behavior Analyser for Collective Profiling



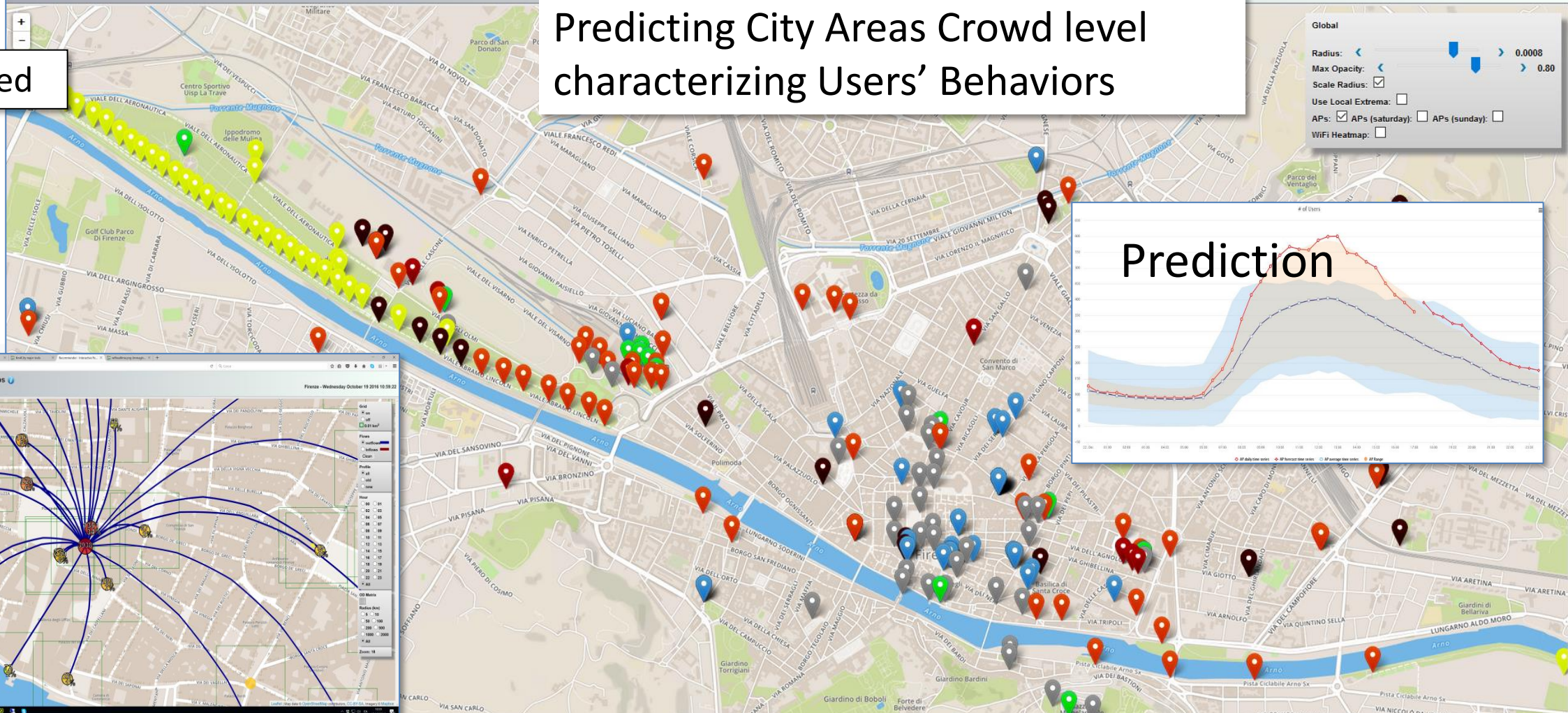
# Characterizing City Areas

DISIT Firenze Wi-Fi: Access Points Clusters Coverage Map  
DISIT - Distributed Systems and Internet Technologies Lab

Firenze - Saturday November 12 2016 19:16:33

Wi-Fi based

Predicting City Areas Crowd level characterizing Users' Behaviors



Global

Radius: < 0.0008 >

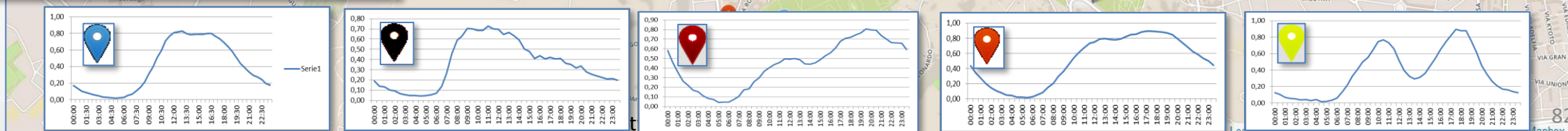
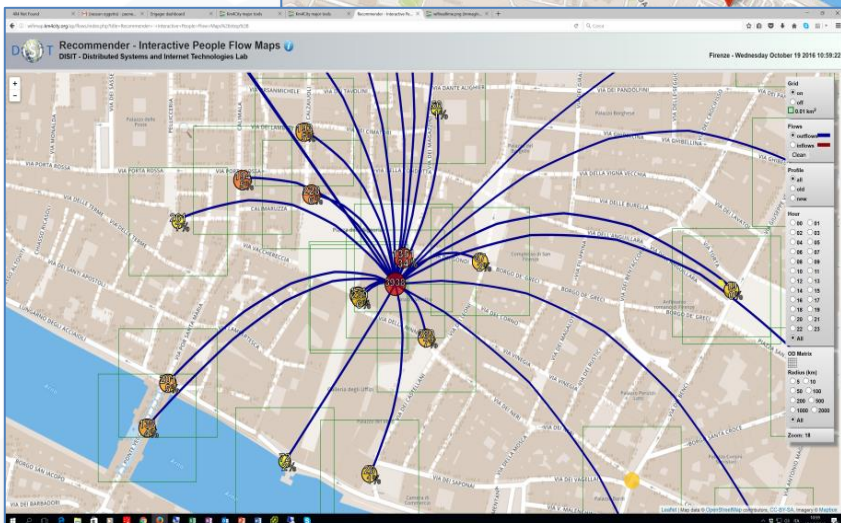
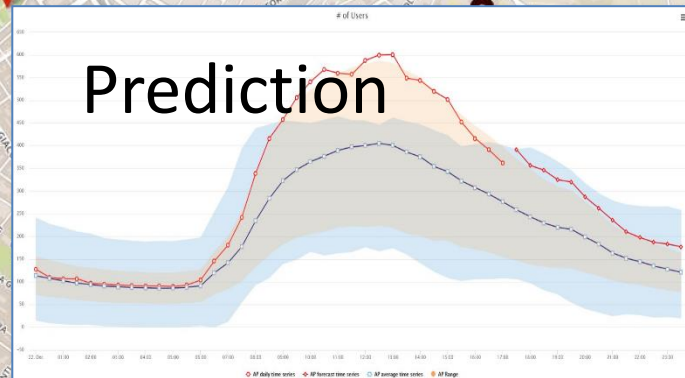
Max Opacity: < > 0.80

Scale Radius:

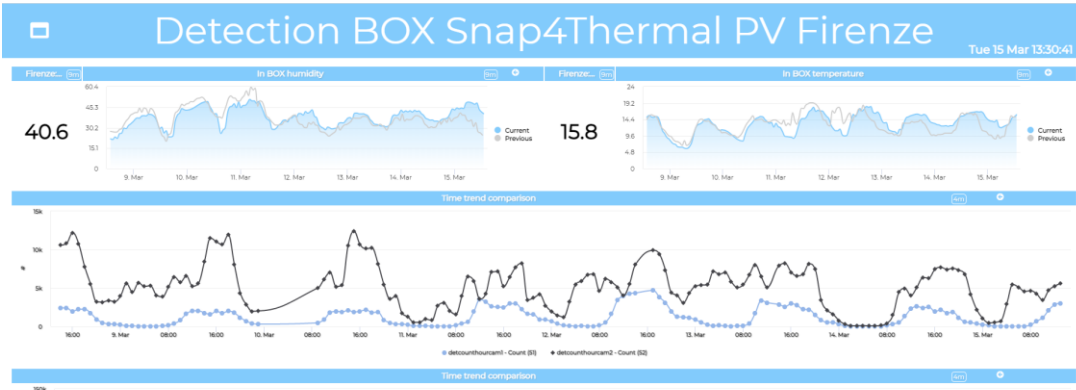
Use Local Extrema:

APs:  APs (saturday)  APs (sunday)

WiFi Heatmap:



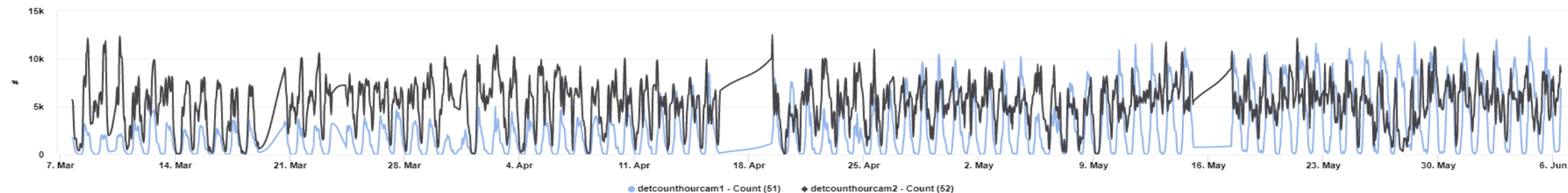
# A view and data from the Thermal Camera



<https://www.snap4city.org/dashboardSmartCity/view/Gea.php?iddashboard=MzM3Ng==>

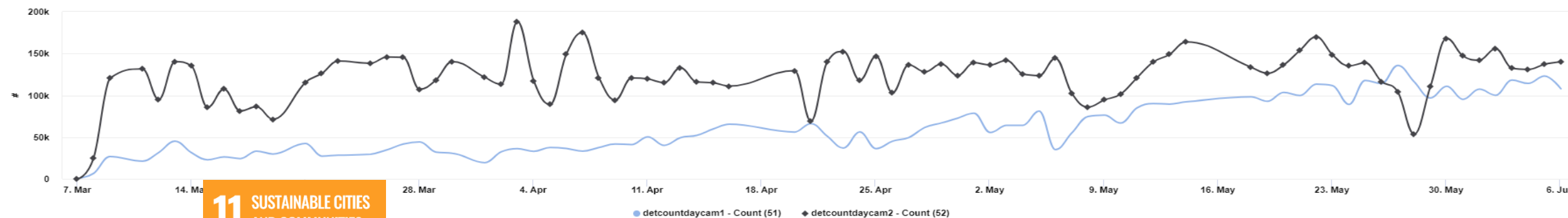
## Time Trend Comparison

4m



## Time Trend Comparison

4m



**11 SUSTAINABLE CITIES AND COMMUNITIES**

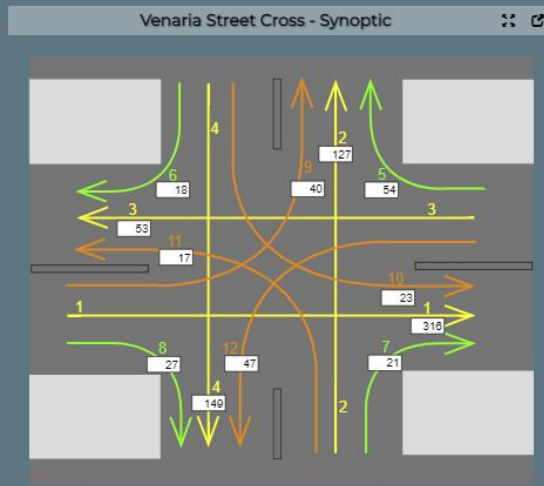
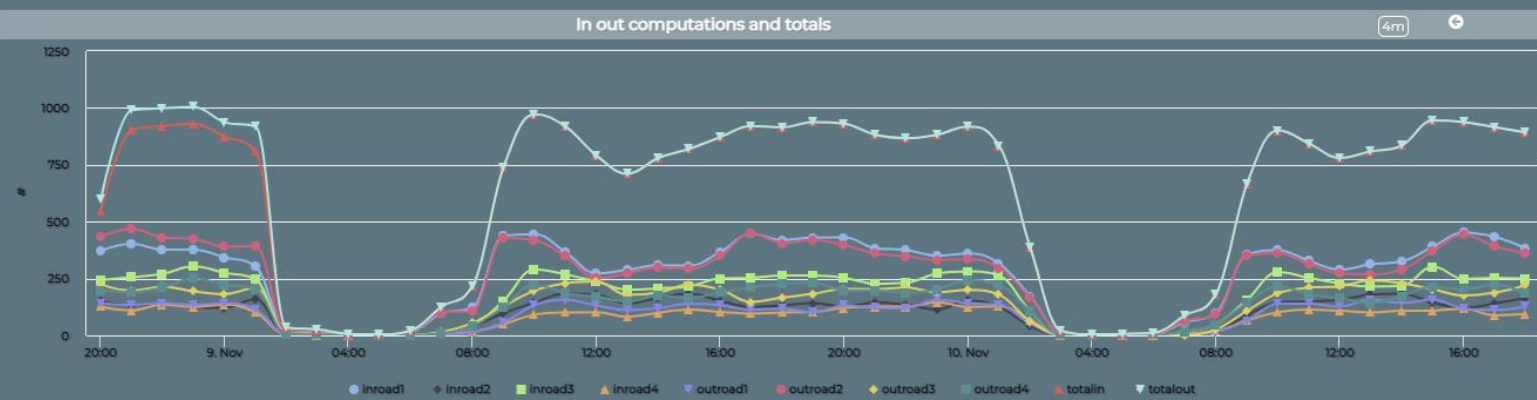
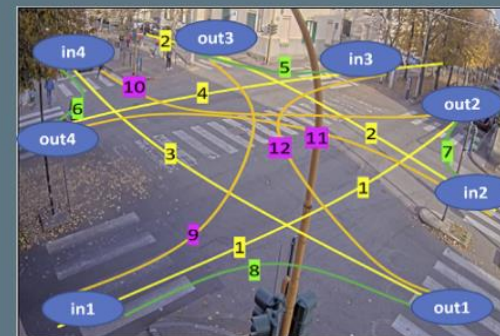
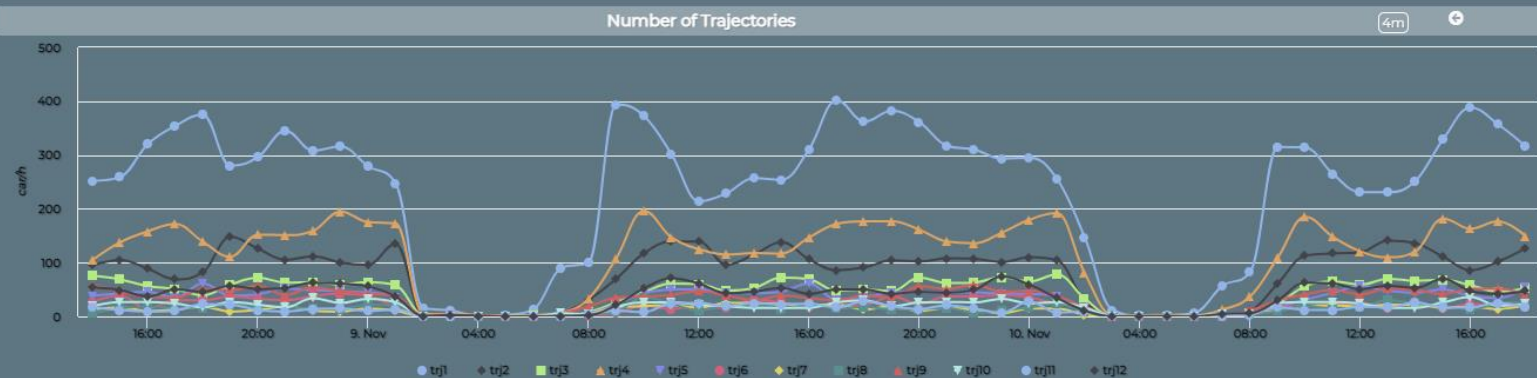
# Barc 2022





## Monitoring Cross Road Venaria - (AXIS Camera)

Wed 10 Nov 18:50:53



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MzI5Ng==>





# Environment and Quality of Life

## Air Quality Predictions

Cities of:  
Firenze, Pisa, Livorno



- **Multiple Domain Data**

- Traffic Flow data, Pollutant: NOX, CO2, PM10, PM2.5, O3, ....
- 3D City structure, weather, ...

- **Multiple Decision Makers**

- Pollutant Predictions: NOX, NO2, ..
- City officers, energy industries
- Dashboards, What-IF analysis
- Traffic Flow Reconstruction

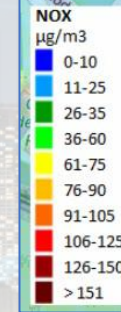
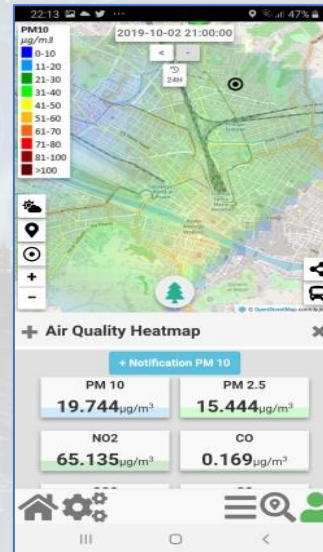
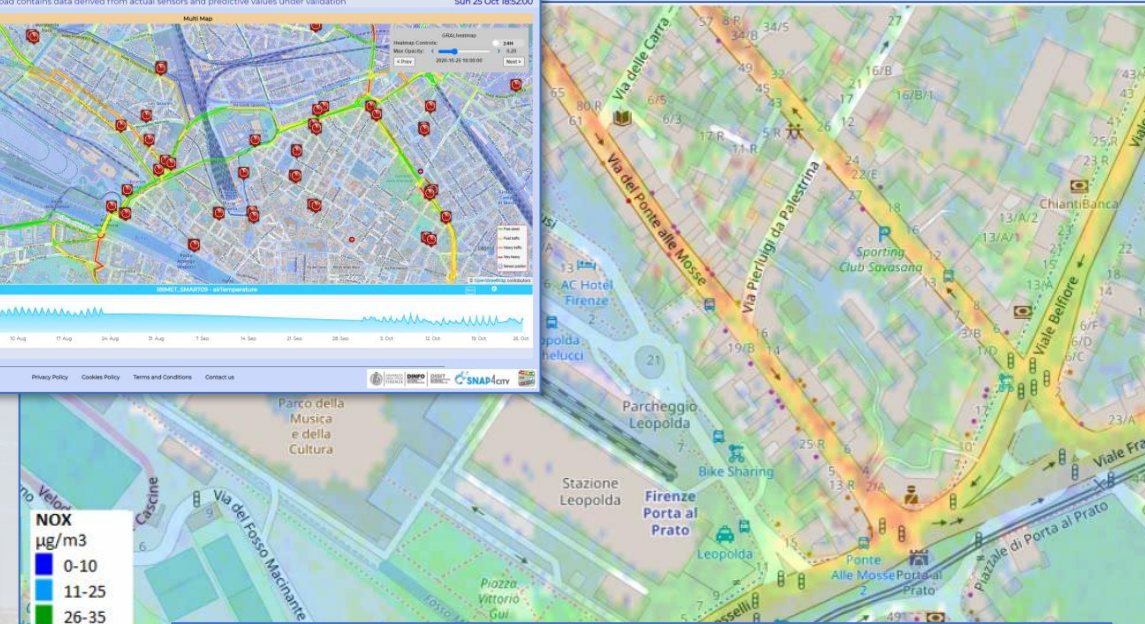
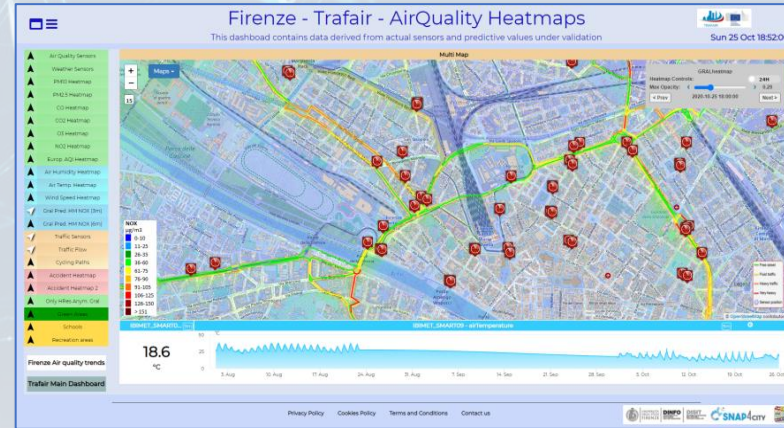
- **Historical and Real Time data**

- Billions of Data

- **Services Exploited on:**

- Dashboards, Mobile App

- **Since 2020**



Pollutant	Averaging period	Air Quality Directive		WHO guidelines	
		Objective and legal nature and concentration	Comments	Concentration	Comments
PM <sub>2.5</sub>	One day			25 µg/m <sup>3</sup> (*)	99 <sup>th</sup> percentile (3 days/year)
PM <sub>2.5</sub>	Calendar year	Target value, 25 µg/m <sup>3</sup>	The target value should become a limit value by 2015	10 µg/m <sup>3</sup>	
PM <sub>10</sub>	One day	Limit value, 50 µg/m <sup>3</sup>	Not to be exceeded on more than 35 days per year.	50 µg/m <sup>3</sup> (*)	99 <sup>th</sup> percentile (3 days/year)
PM <sub>10</sub>	Calendar year	Limit value, 40 µg/m <sup>3</sup> (*)		20 µg/m <sup>3</sup>	
O <sub>3</sub>	Maximum daily 8-hour mean	Target value, 120 µg/m <sup>3</sup>	Not to be exceeded on more than 25 days per year, averaged over three years	100 µg/m <sup>3</sup>	
NO <sub>2</sub>	One hour	Limit value, 200 µg/m <sup>3</sup> (*)	Not to be exceeded more than 18 times a calendar year	200 µg/m <sup>3</sup> (*)	
NO <sub>2</sub>	Calendar year	Limit value, 40 µg/m <sup>3</sup>		40 µg/m <sup>3</sup>	

KPI of EC

# Environment and Weather

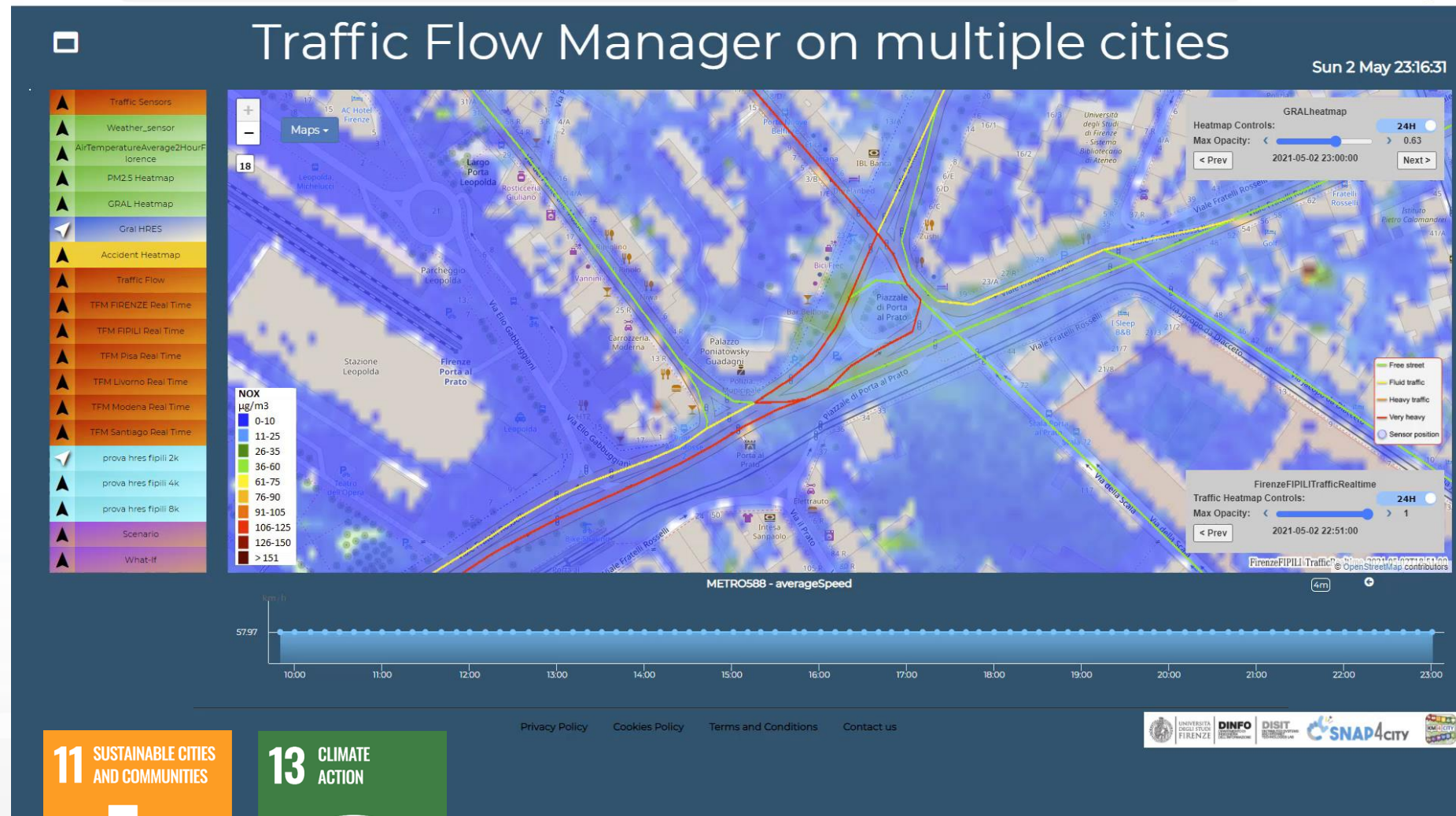
- **Pollutant Predictions: short, long and very long term** European Commission KPIs
  - NOX, PM10 pollution on the basis of traffic flow, 48 hours (ML, AI, DL)
  - Cumulated NO2 average value over the year, ..... (ML, AI, DL)
- **Computation of CO2** on the basis of traffic flows (DP), computing emission factor (DA)
  - each road for each time slot of the day
- **Prediction of MicroClimate** conditions for diffusion (ML, AI)
  - NO2, PM10, PM2.5, etc.
- **Prediction of landslides**, 24 hours in advance (AI, DL)
- **Heatmaps production**, dense data interpolation (DP) for
  - Weather conditions: temperature, humidity, wind, DEW
  - Pollutants and Aerosol: NO, NO2, CO2, PM10, PM2.5, etc.
- **Impact of COVID-19** on Environmental aspects (DP)
- Optimisation of **waste collection** schedule and paths (DP, ML)
- Computing **SDG, SUMI, PUMS**, .. (mainly DP)
- Etc.

- **Prediction**

- **NOX Pollutant** diffusion on the basis of Traffic Flow (prediction), weather and 3D structure
- **NO2 progressive average** (Long term)

- **Project:**

- **Trafair CEF EC**
- Mixed solutions of Fluidinamics modeling and AI



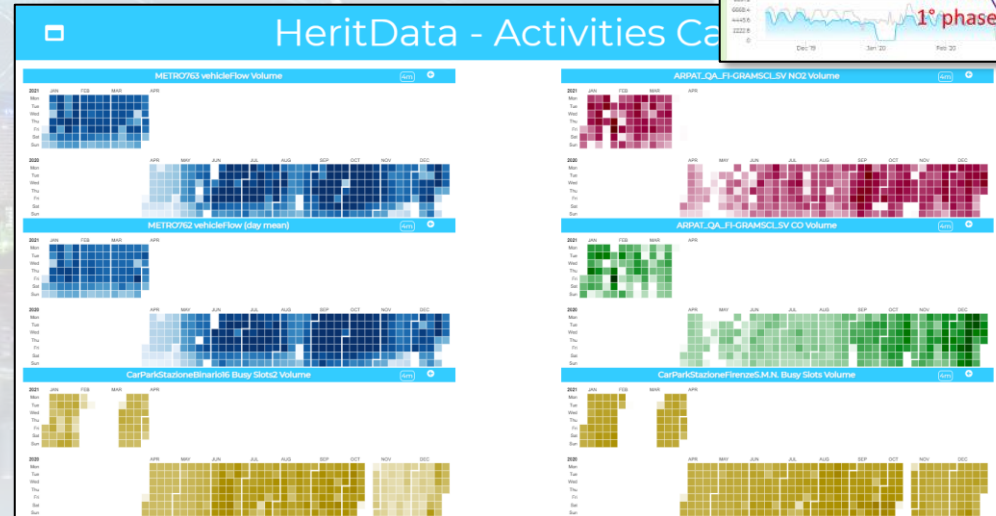
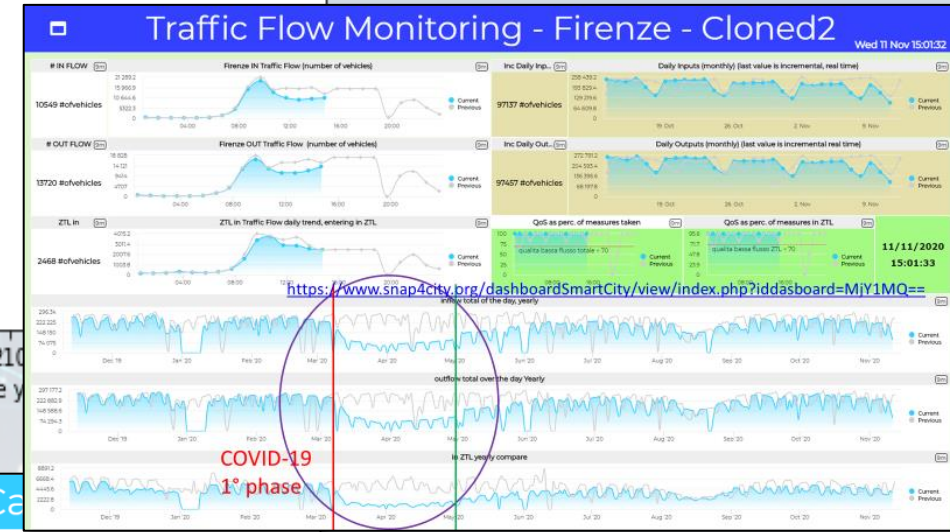
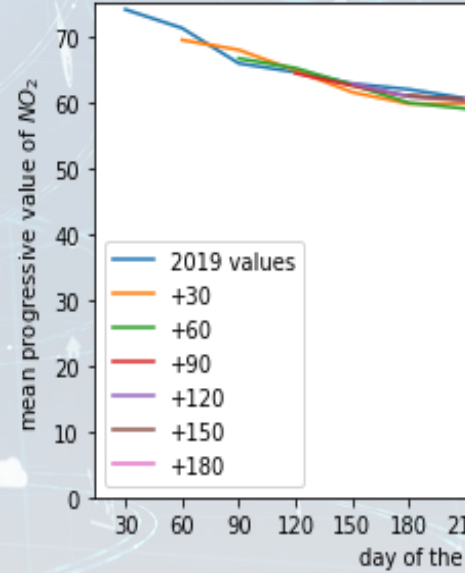
# Impact of COVID-19

Cities: Firenze, Pisa, Livorno, Toscana



- **Multiple Domains Data**
  - Traffic, environment, People, parking, stock options, Twitter, tc.
- **Decision Makers Multiple Locations**
  - NO2 long term predictions
  - Twitter analysis
- **Historical and Real Time data**
- **Services Exploited on:**
  - Dashboards
  - Social media,
  - Sentiment Analysis
- **Since 2019, 2020**

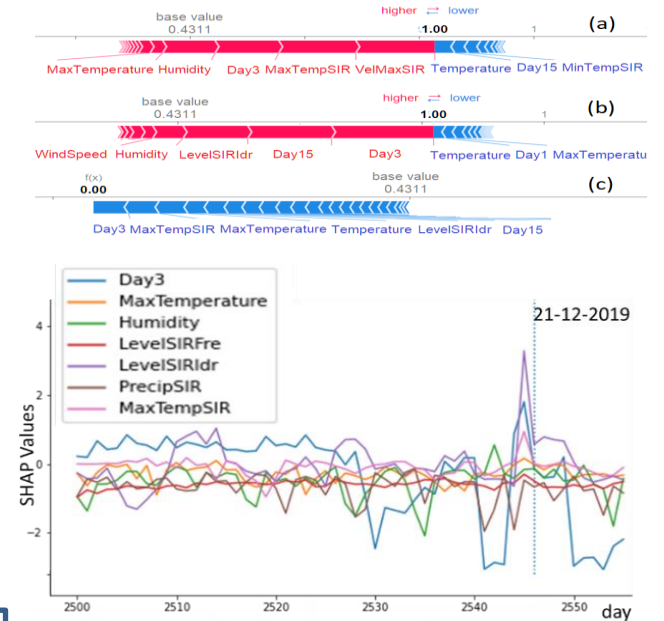
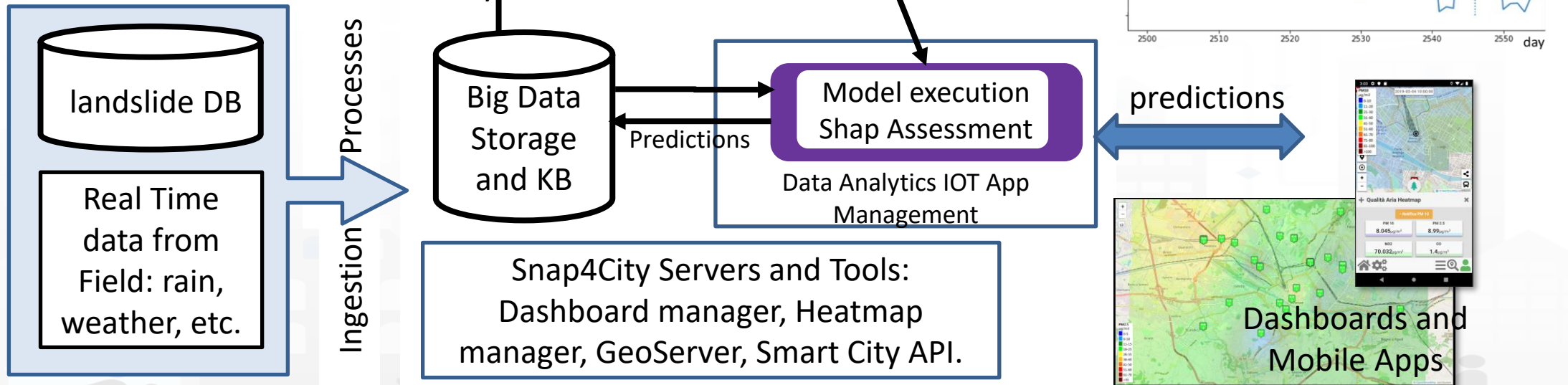
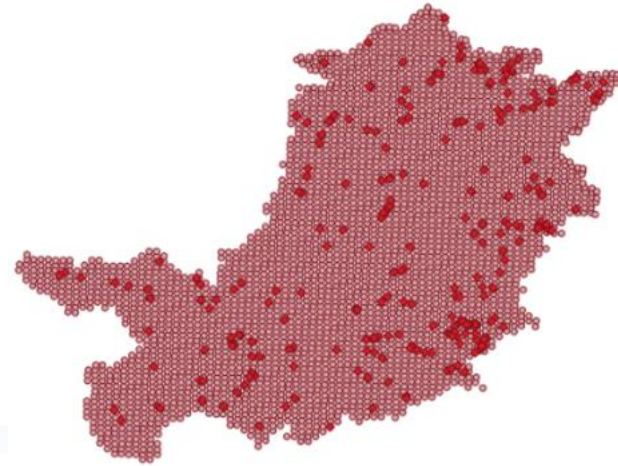
mean progressive NO<sub>2</sub> of 2019



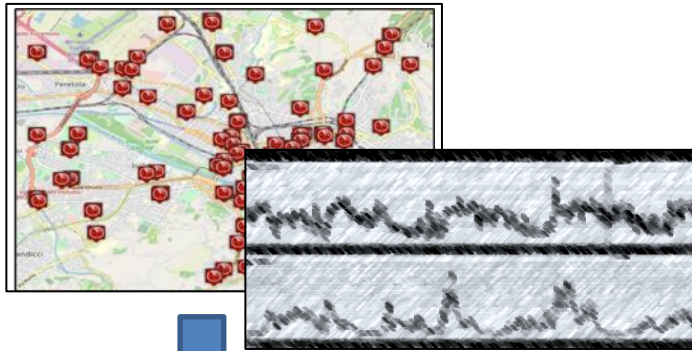
metric	model30	model60	model90	model120	model150	model180
MAE	1.21	1.31	1.52	2.04	2.31	2.37
RMSE	2.16	2.61	4.18	6.77	7.83	7.93
MAPE	1.99	2.20	2.65	3.57	4.07	4.18
R2	0.91	0.83	0.80	0.54	0.45	0.14

Table 4. Assessment of the predictive models with respect to the actual values of the 2019.

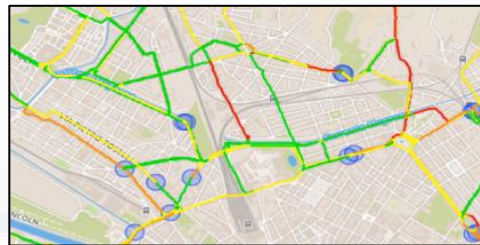
# Predicting Land slides



# Estimating City Local CO2 from Traffic Flow Data



Computing Traffic Flow  
into CO2 sensor area



Traffic Flow data

- Traffic Flow is one the main source of CO2
  - K1: Fluid Flow
  - K2: Stop and Go
- **Dense estimation of CO2 into the city** is very useful to know to target EC's KPIs

Computing CO2 on the basis of  
traffic flow data



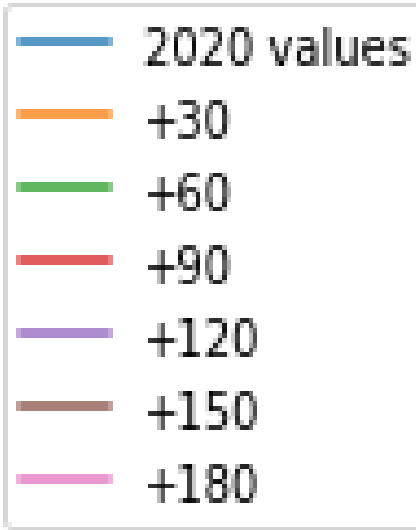
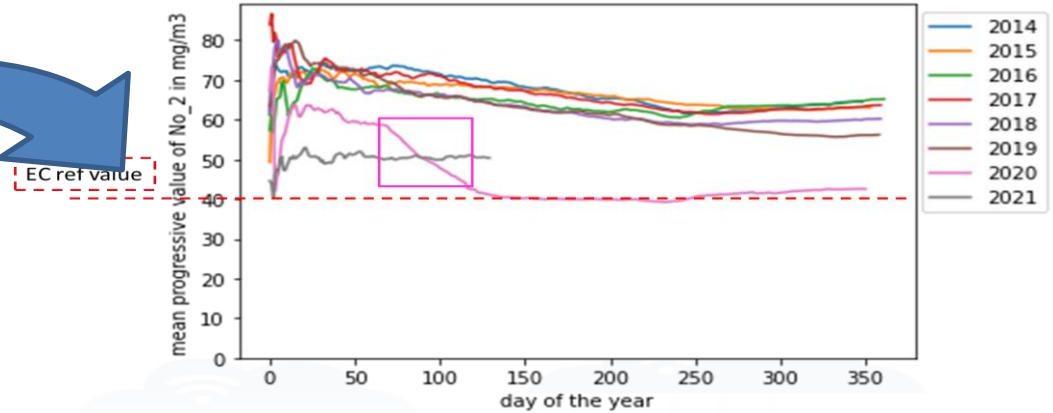
CO2 estimation



S. Bilotta, P. Nesi, "Estimating CO2 Emissions from IoT Traffic Flow Sensors and Reconstruction", Sensors, MDPI, 2022. <https://www.mdpi.com/1424-8220/22/9/3382/>

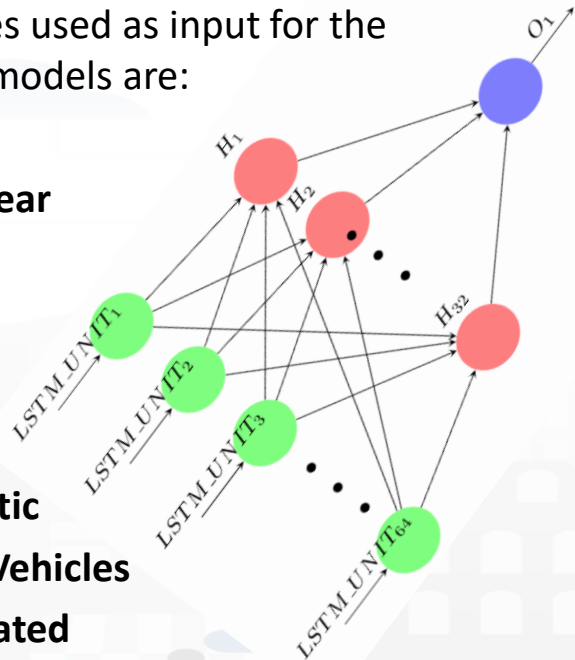
# Predicting EC's KPI on NO2 months in advance

Deep Learning Long Terms Predictions of NO2 mean values, From 30 to 180 days in advance



The features used as input for the predictive models are:

- **Month**
- **dayOfTheYear**
- **NO2**
- **Tmean**
- **Humidity**
- **windMean**
- **NoxDomestic**
- **numberOfVehicles**
- **NO2cumulated**
- **NO2progesseveMean**
- **numberOfVehiclesCumulated**



Pollutant	Averaging period	Air Quality Directive		WHOguidelines	
		Objective and legal nature and concentration	Comments	Concentration	Comments
PM <sub>2.5</sub>	One day			25 µg/m <sup>3</sup> (*)	99 <sup>th</sup> percentile (3 days/year)
PM <sub>2.5</sub>	Calendar year	Target value, 25 µg/m <sup>3</sup>	The target value has become a limit value since 1 January 2015	10 µg/m <sup>3</sup>	
PM <sub>10</sub>	One day	Limit value, 50 µg/m <sup>3</sup>	Not to be exceeded on more than 35 days per year.	50 µg/m <sup>3</sup> (*)	99 <sup>th</sup> percentile (3 days/year)
PM <sub>10</sub>	Calendar year	Limit value, 40 µg/m <sup>3</sup> (*)		20 µg/m <sup>3</sup>	
O <sub>3</sub>	Maximum daily 8-hour mean	Target value, 120 µg/m <sup>3</sup>	Not to be exceeded on more than 25 days per year, averaged over three years	100 µg/m <sup>3</sup>	
NO <sub>2</sub>	One hour	Limit value, 200 µg/m <sup>3</sup> (*)	Not to be exceeded more than 18 times a calendar year	200 µg/m <sup>3</sup> (*)	
NO <sub>2</sub>	Calendar year	Limit value, 40 µg/m <sup>3</sup>		40 µg/m <sup>3</sup>	



# Smart Waste – Map view



Thu 5 May 11:14:28

Select the bins Kind, Fullness and Status from the dropdown below and press SUBMIT to see the results on the map.

Kind: Group | Status: All

Fullness: All

**Submit**

Address: via dei medici

Group ID: F167898

**Table view**

VALUE NAME: F167898

DESCRIPTION	VALUE	Buttons
dateObserved	2022-02-28T12:46:12.899Z	Last value 4 hours 24 hour 7 days 30 days 6 month 1 year
generic	[SURI id]	Last value 4 hours 24 hour 7 days 30 days 6 month 1 year
glass	[SURI id]	Last value 4 hours 24 hour 7 days 30 days 6 month 1 year
metal	[SURI id]	Last value 4 hours 24 hour 7 days 30 days 6 month 1 year
organic	[SURI id]	Last value 4 hours 24 hour 7 days 30 days 6 month 1 year
paper	[SURI id]	Last value 4 hours 24 hour 7 days 30 days 6 month 1 year
plastic	[SURI id]	Last value 4 hours 24 hour 7 days 30 days 6 month 1 year

Smart waste bins status

ORGANIC	PAPER	METAL	PLASTIC	GLASS	GENERIC
89%	100%	100%	62%	83%	65%

Via\_DeL\_Medic: ORGANIC fullness

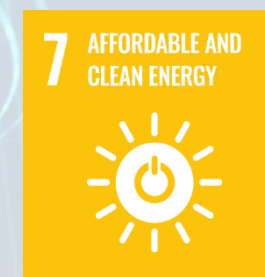
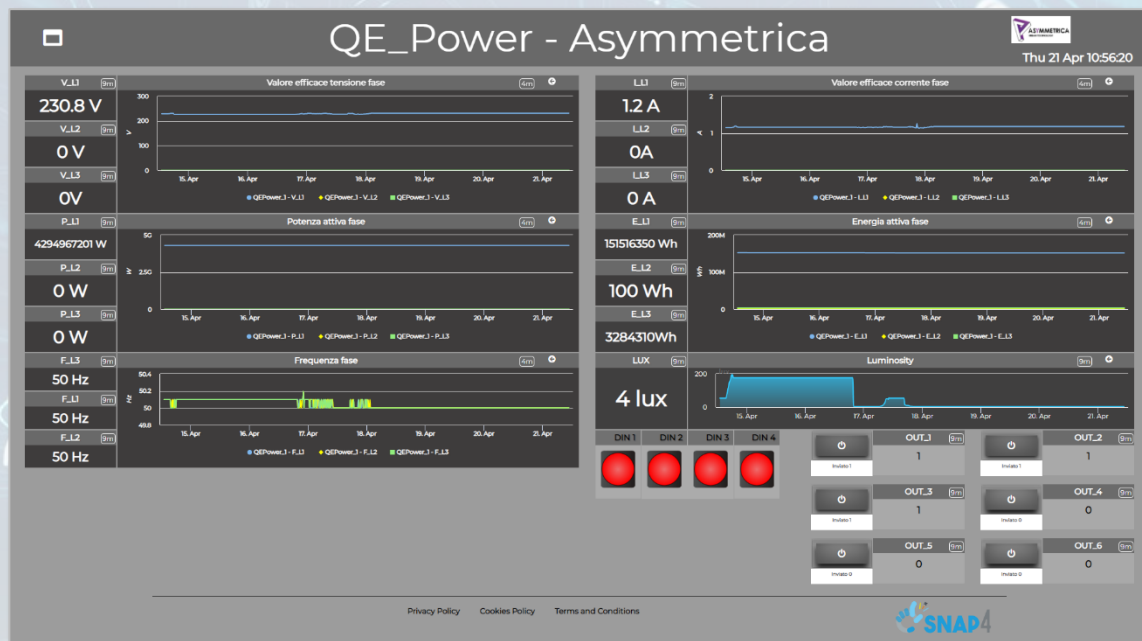
Privacy Policy | Cookies Policy | Terms and Conditions

Search bins on map by filtering per:

- **Kind** (All, generic, plastic, paper, glass, metal, organic)
- **Status** (Active, Not Active)
- **Fullness** (Full, Half-full, Empty)
- **Address**
- **Group of bins** (by GroupID)

- Refine a search by using the filters on the left side
- Click on a waste bin pin on the map:
- A popup with real time data is shown
- The fullness status of the selected group of bins is shown in the synoptic below the map
- Specific fullness weekly trends are shown below the map
- Click on the «Table view» button to access the other dashboard





- Environmental data
- Power meter Data
- Smart Light data are coming (in collaboration with a multinational company)

**Asymmetrica Alarms**  
Thu 21 Apr 10:56:49

Alarms

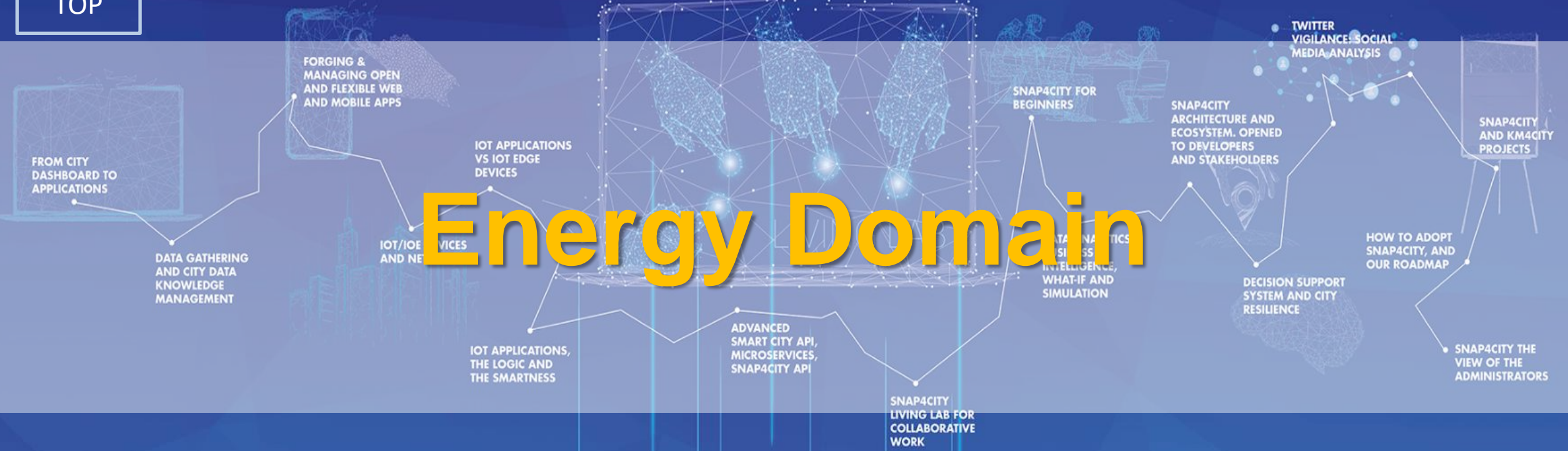
Variable	Status	Device	Date and Time
DIN_4	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:24:40
DIN_3	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:24:38
DIN_2	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:24:35
DIN_2	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:22:20
DIN_4	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:19:39
DIN_3	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:19:38
DIN_2	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:19:37
DIN_4	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:17:10
DIN_3	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:17:07
DIN_2	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:17:05
DIN_4	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:14:40
DIN_3	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:14:38
DIN_2	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:14:36
DIN_4	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:12:09
DIN_3	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:12:08
DIN_2	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:12:05
DIN_4	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:09:39
DIN_3	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:09:38
DIN_2	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:09:37
DIN_4	ALERT_H	DIGITAL_IN_Alarm_1	18/04/2022 3:07:10

Showing 1 to 20 of 3,392 entries

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TOP

# Energy Domain





reference

# Smart Light Control of **CAPÉLON**

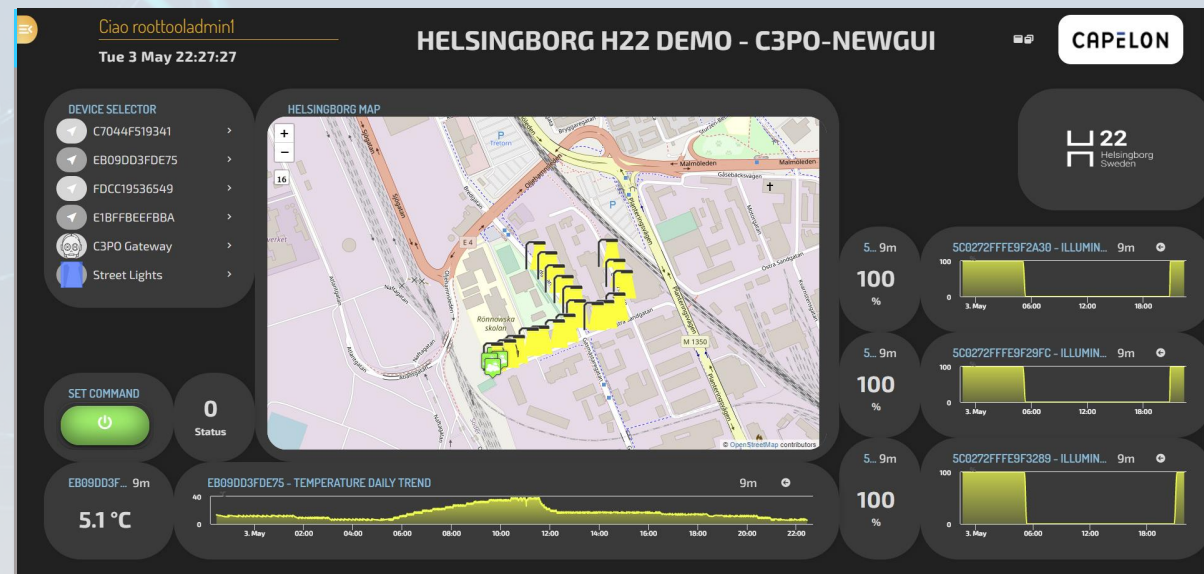
## • Energy Domain

- Smart Light, MQTT, ....
- IoT Orion Broker FIWARE



## • Dashboards

- Map coverage on Sweden
- Monitoring and real time control
- Energy control, analytics
- Direct control

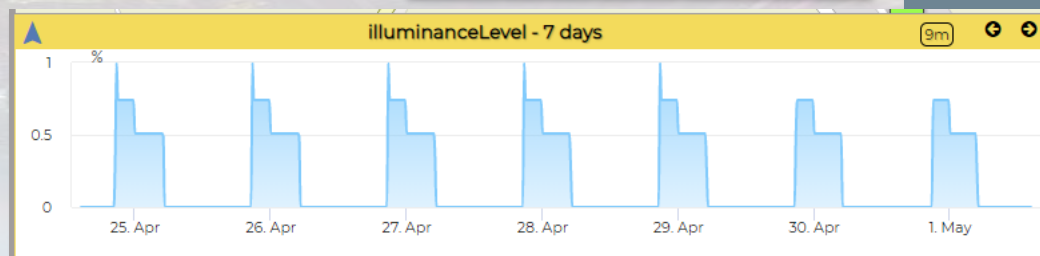
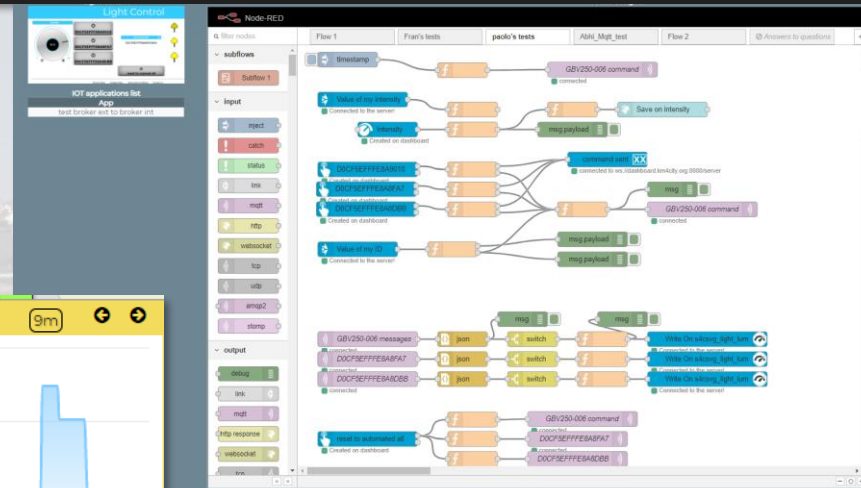
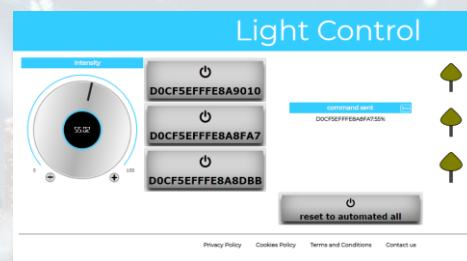


## • Historical and Real Time data

## • Services Exploited on:

- Multiple Levels, API
- Dashboards

## • Since 2020





Ciao roottooladmin!

Tue 3 May 22:27:27

## HELSINGBORG H22 DEMO - C3PO-NEWGUI

HELSINGBORG H22 DEMO - C3PO-NEWGUI

### DEVICE SELECTOR

- C7044F519341 >
- EB09DD3FDE75 >
- FDCC19536549 >
- E1BFFBEEFBBA >
- C3PO Gateway >
- Street Lights >

### SET COMMAND



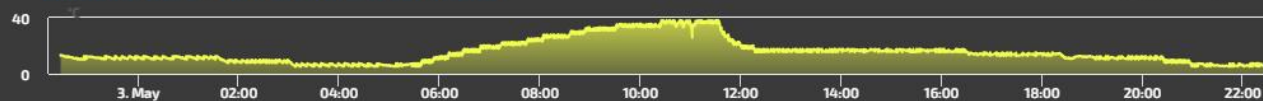
0

Status

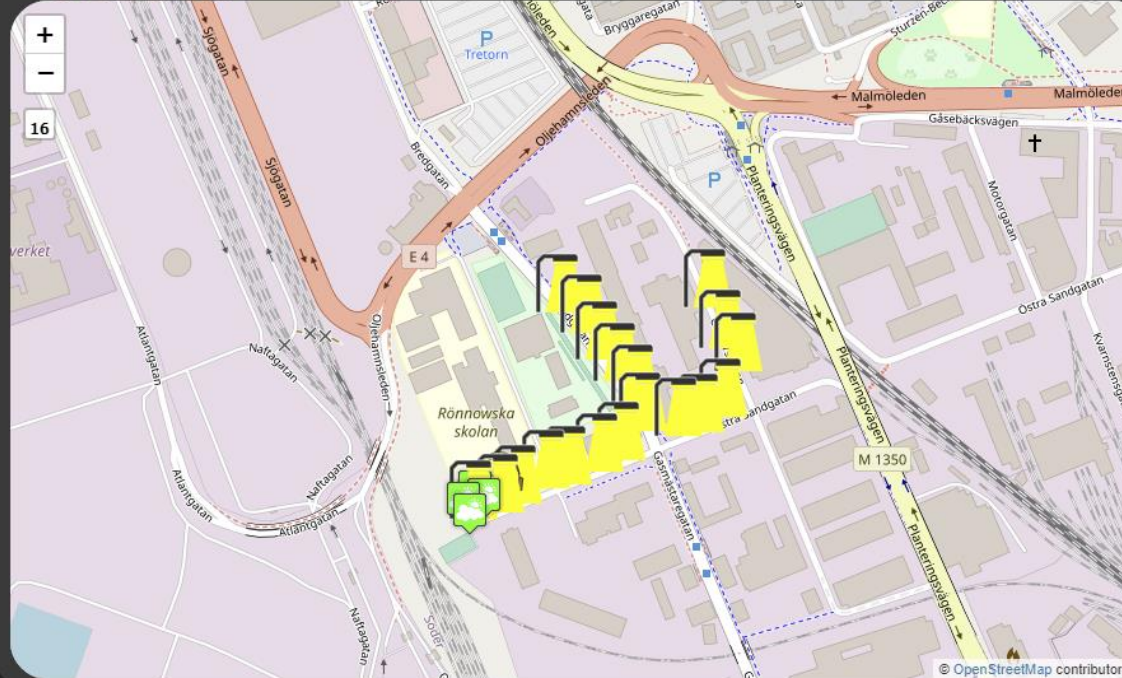
EB09DD3F... 9m

5.1 °C

EB09DD3FDE75 - TEMPERATURE DAILY TREND



### HELSINGBORG MAP

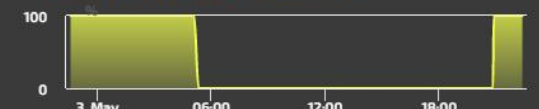


HELSINGBORG H22 DEMO - C3PO-NEWGUI

5... 9m

100 %

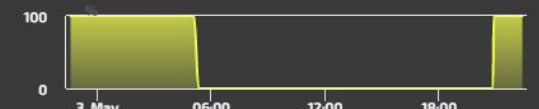
5C0272FFFE9F2A30 - ILLUMIN... 9m



5... 9m

100 %

5C0272FFFE9F29FC - ILLUMIN... 9m



5... 9m

100 %

5C0272FFFE9F3289 - ILLUMIN... 9m



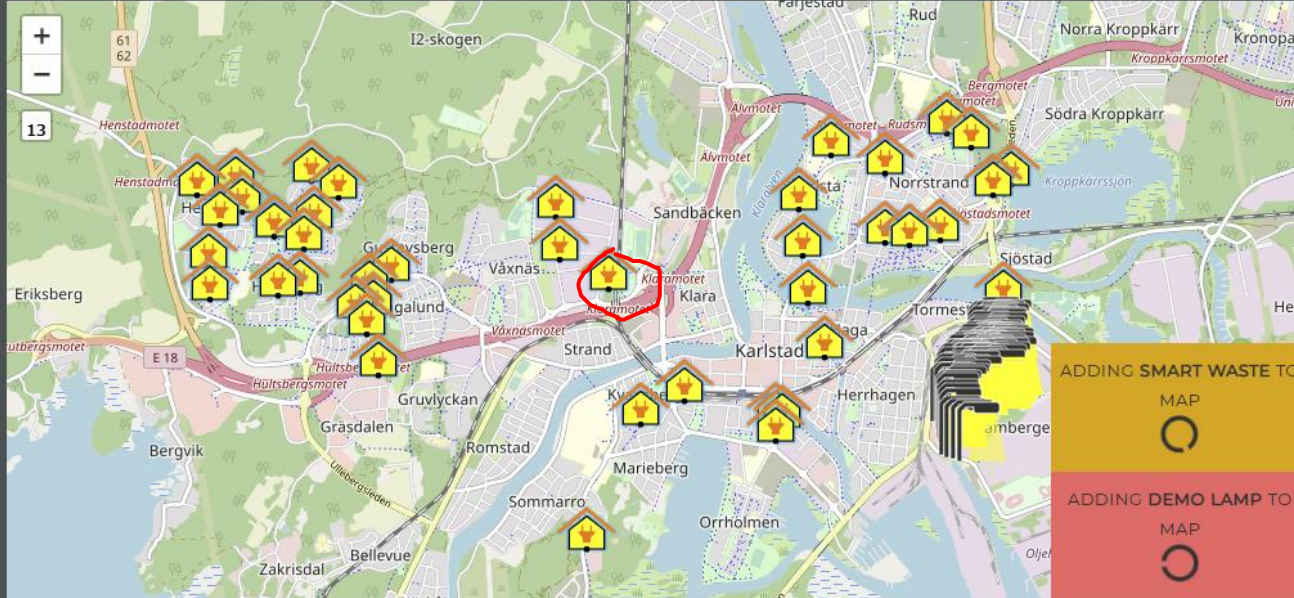


## Karlstad - Capelon

CAPELON

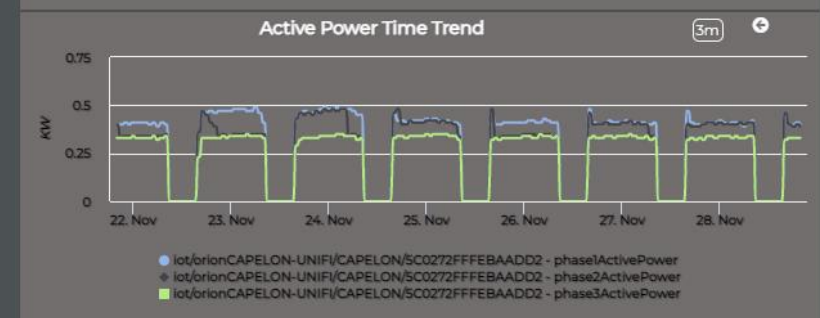
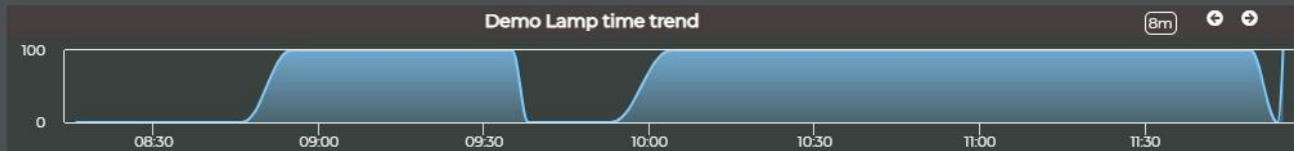
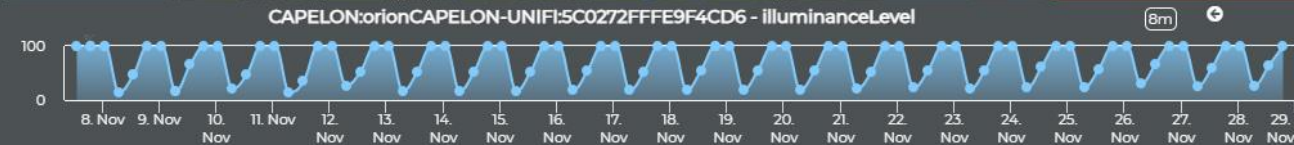
Sun 28 Nov 20:02:16

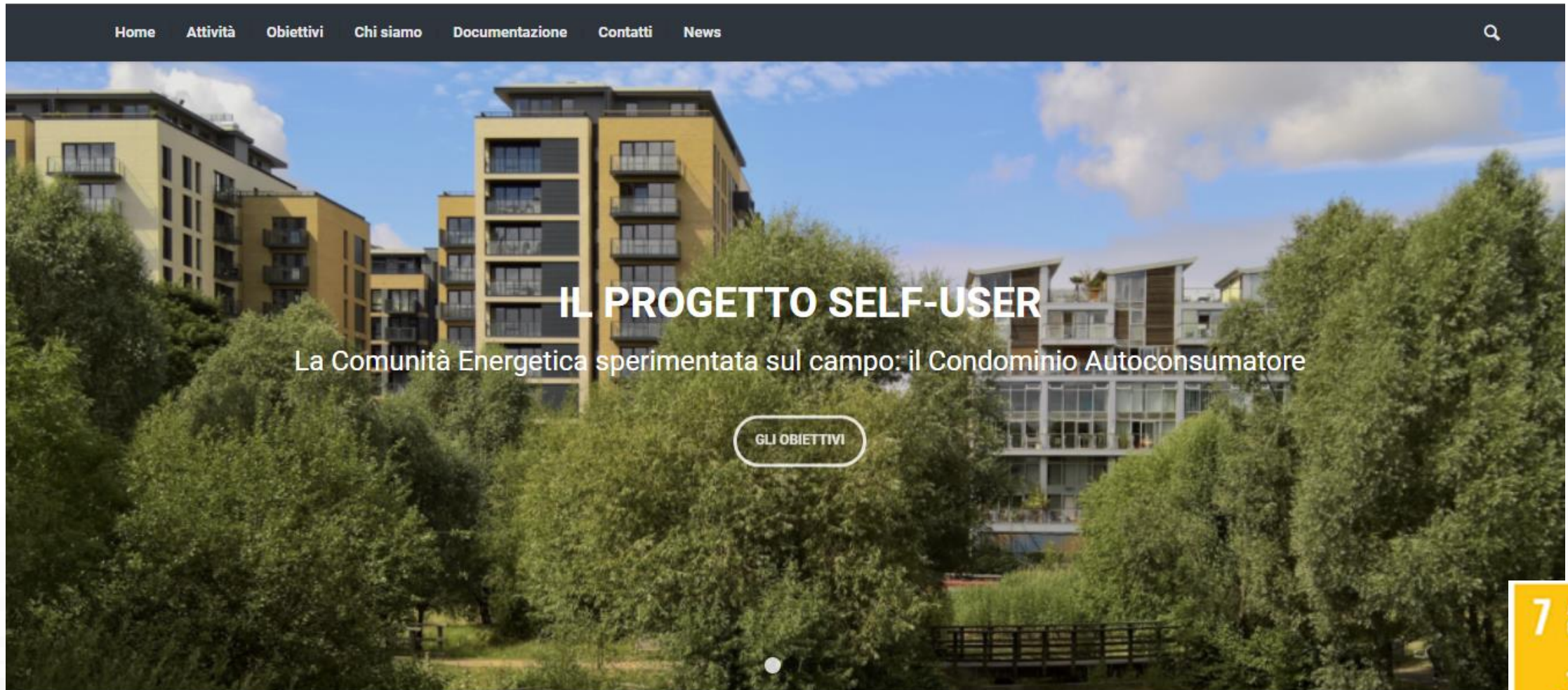
- Cabinet
- Smart Light
- Demo Lamp
- Smart Waste



Lamp ON

Lamp OFF





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## IL PROGETTO SELF-USER

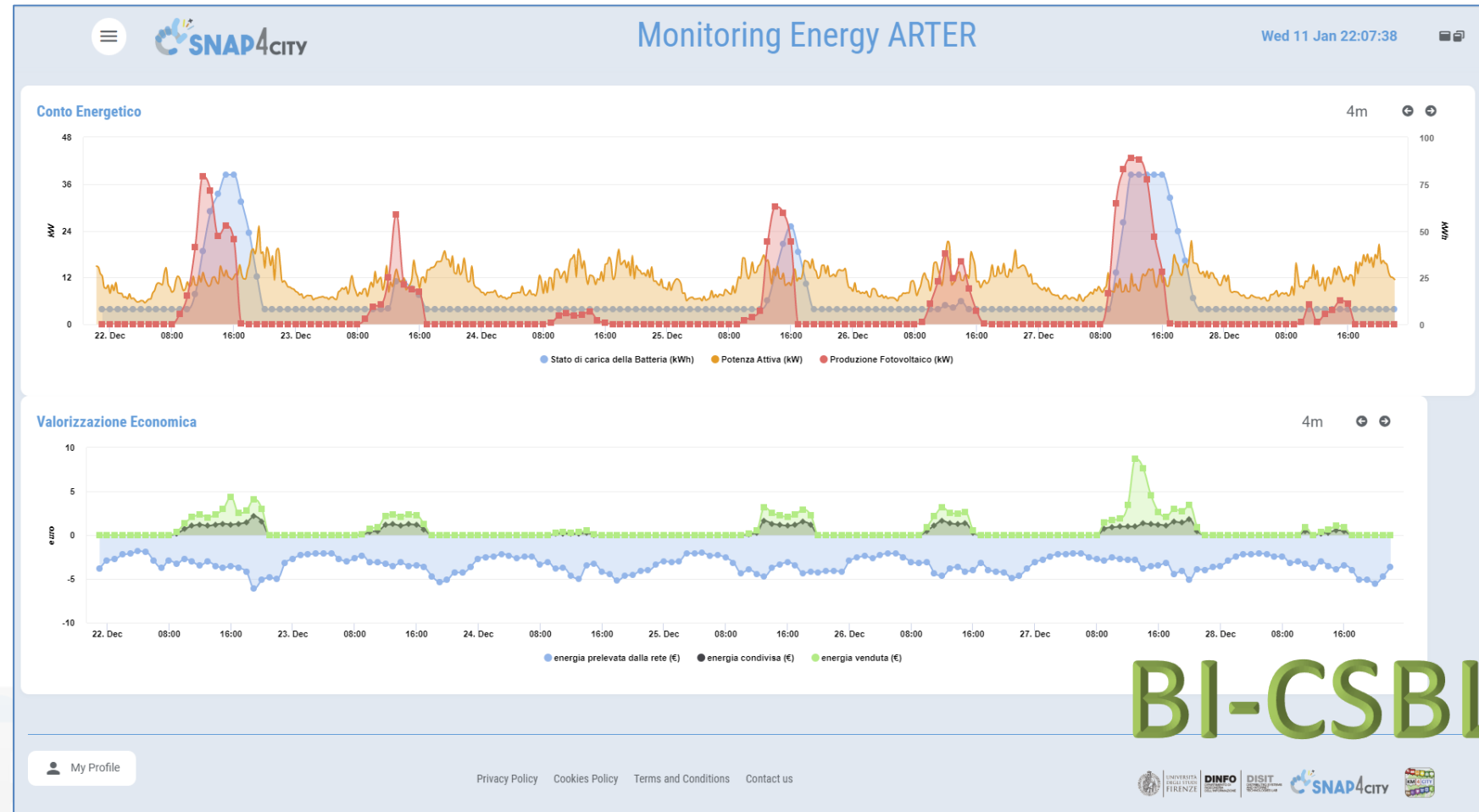
La Comunità Energetica sperimentata sul campo: il Condominio Autoconsumatore

GLI OBIETTIVI



I DATI DI MONITORAGGIO IN TEMPO REALE

- **Field-tested energy community: the self-consumer condominium**
- The Self User project creates in the pilot condominium, through the collection and analysis of data, a model for calculating and enhancing the impact of an energy community on a community of people, with a view to actions to combat energy poverty



BI-CSBL

<https://www.selfuser.it>





# SELF USER

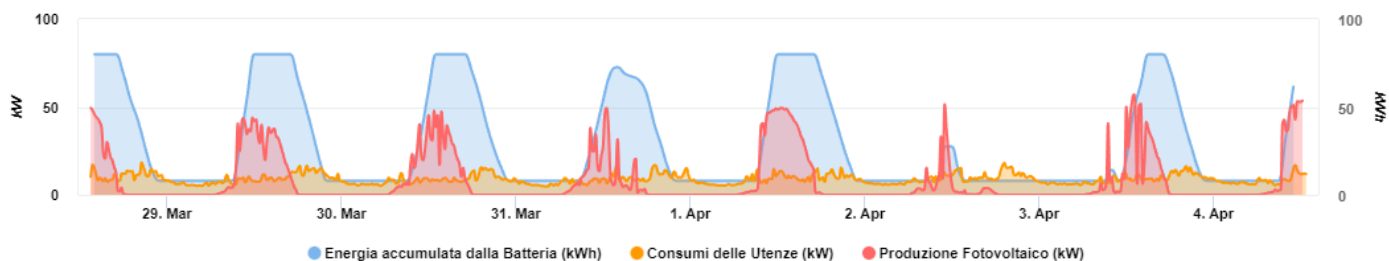
Tue 4 Apr 13:20:04



Monitoraggio in tempo reale della comunità energetica condominiale

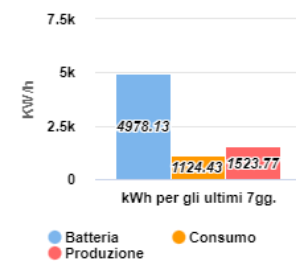
## Conto Energetico

4m



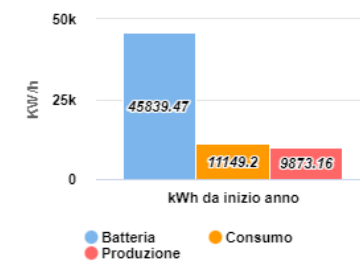
## KWh Ultimi 7 Gg.

4m



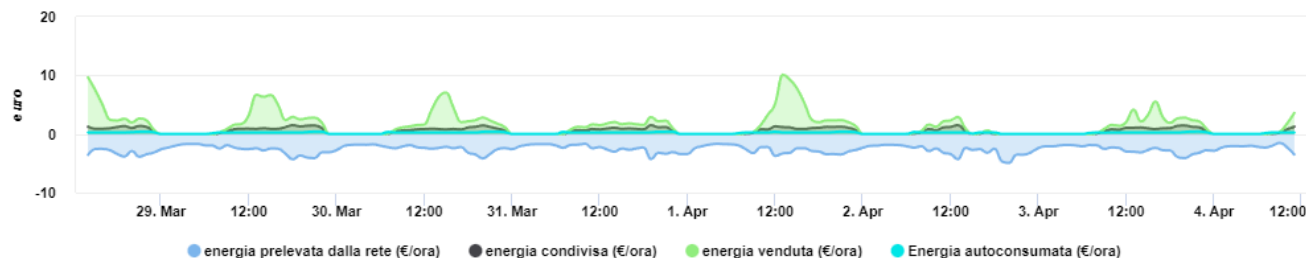
## KWh Da Inizio Anno

4m



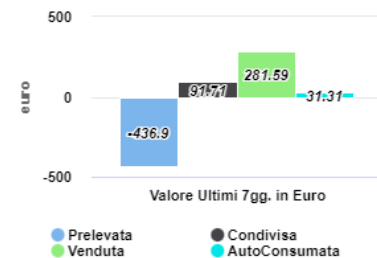
## Valorizzazione Economica

4m



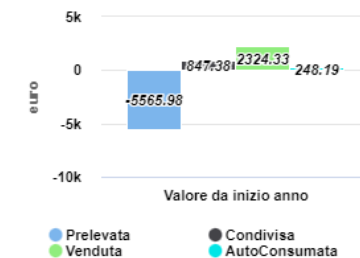
## Valore Ultimi 7gg.

4m



## Valore Da Inizio Anno

4m



<https://www.snap4city.org/dashboardSmartCity/view/Baloon.php?iddashboard=MzcwNw==>

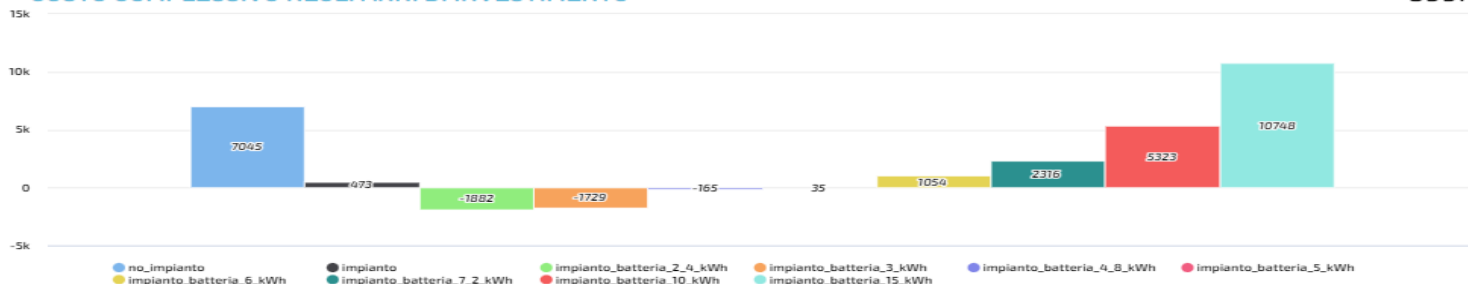
Ciao roottooladmin1

Tue 4 Apr 13:15:34

## SIMULATORE IMPIANTO FOTOVOLTAICO

### COSTO COMPLESSIVO NEGLI ANNI DI INVESTIMENTO

599m



Manuale Utente

English Version

### PARAMETRI DELL'IMPIANTO

Ti consigliamo un impianto con batteria da 2,4 kWh

Gruppo di Consumo Annuale

Prezzo Energia Vendita (€/kWh)

Prezzo Energia Acquisto (€/kWh)

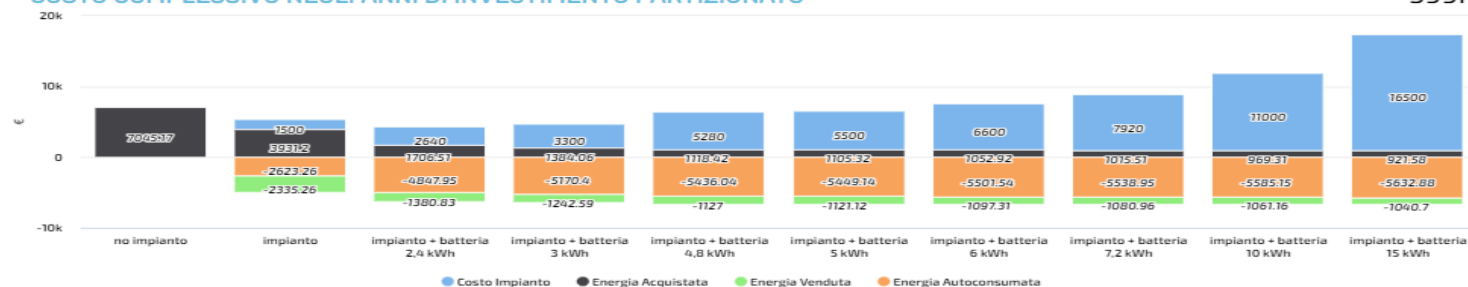
Anni di Investimento

Mese da simulare

Invia

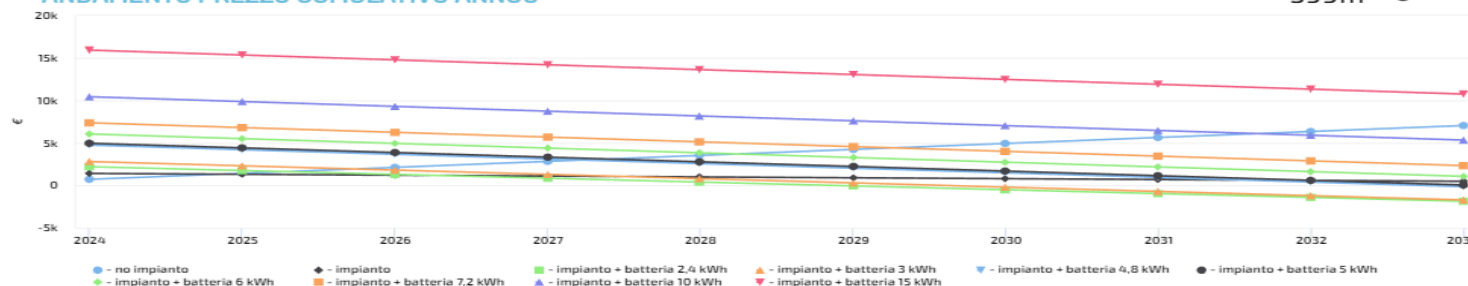
### COSTO COMPLESSIVO NEGLI ANNI DI INVESTIMENTO PARTIZIONATO

599m



### ANDAMENTO PREZZO CUMULATIVO ANNUO

599m



Ciao roottooladmin!

Tue 3 May 14:37:14

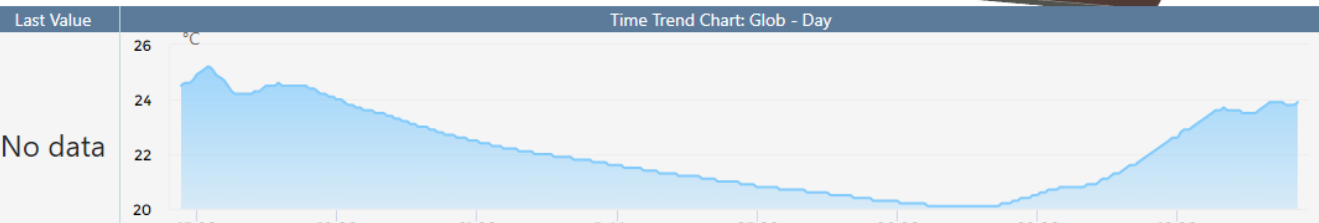
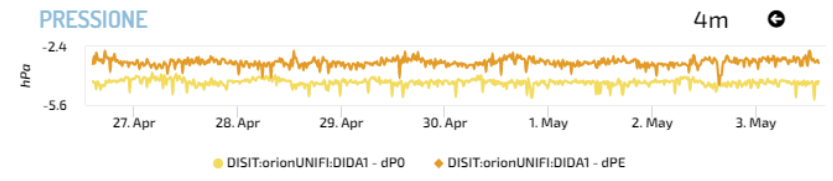
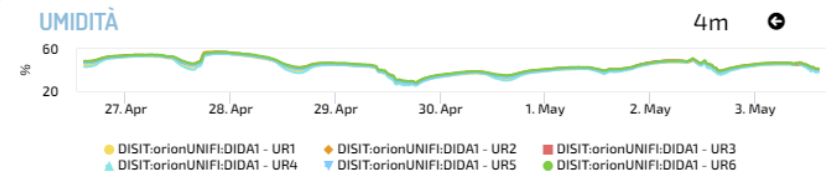
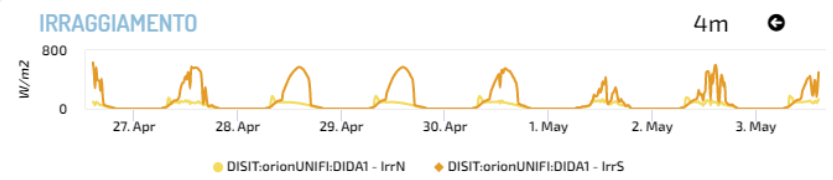
## DIDA DATA 2 - NEWGUI

7 AFFORDABLE AND CLEAN ENERGY

11 SUSTAINABLE CITIES AND COMMUNITIES

to see BIM log as user: info@disit.org, passwd: guest

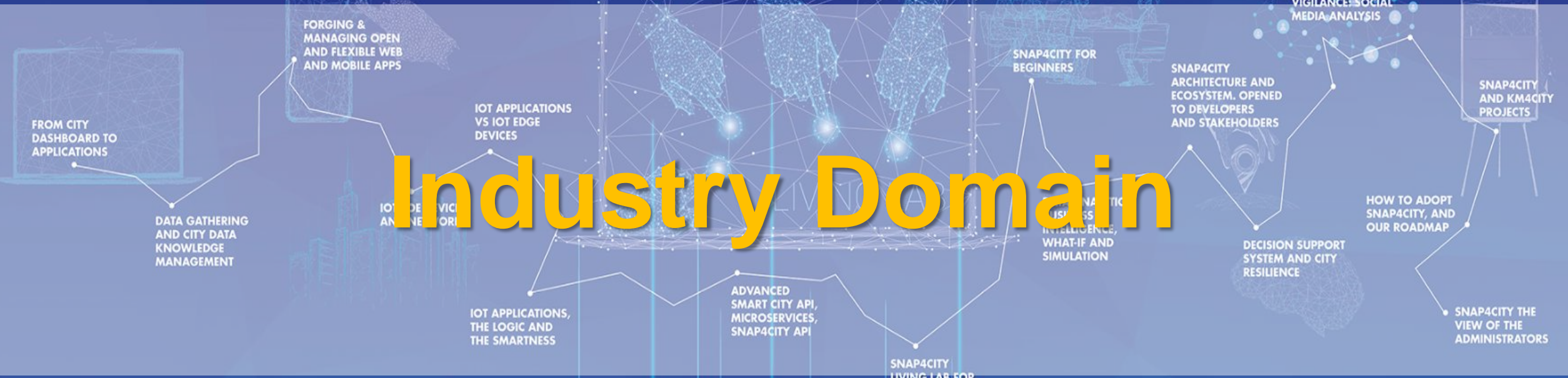
### BIM SANTA VERDIANA



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MzI4OA==>

TOP

# Industry Domain





9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

The icon for Sustainable Development Goal 9, 'Industry, Innovation and Infrastructure', consists of three interlocking cubes in white and orange.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

The icon for Sustainable Development Goal 12, 'Responsible Consumption and Production', is a white circular arrow symbol on a gold background.

# *Altair Chemical (Italy, Saline di Volterra)*

# Industry Plant Supervision and Maintenance



## Aims

- **Control Room: Higher level supervision and monitoring (since 2020)**
  - Management of Production Plan *Optimization*
  - Control of Perimeter with drone and sensors
- **Maintenance ticketing (since 2017)**
  - *predictive* (in development)
  - 3D Digital Twin (in development)
- **Monitoring production process quality**
  - Alerting
  - Decision making

# Snap4Altair Decision Support supervision and control, Industry 4.0



reference

- **Multiple Domain Data**

- Distributed Control System: energy, flows, storage, chemical data, settings, ..
- Cost of energy, Orders, Production Parameters
- Maintenance data

- **Multiple Levels & Decision Makers**

- Optimized planning on chemical model
- Business Intelligence on Maintenance data

- **Historical and Real Time data**

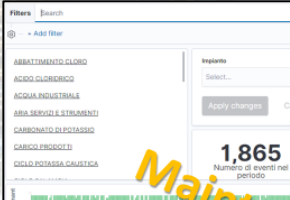
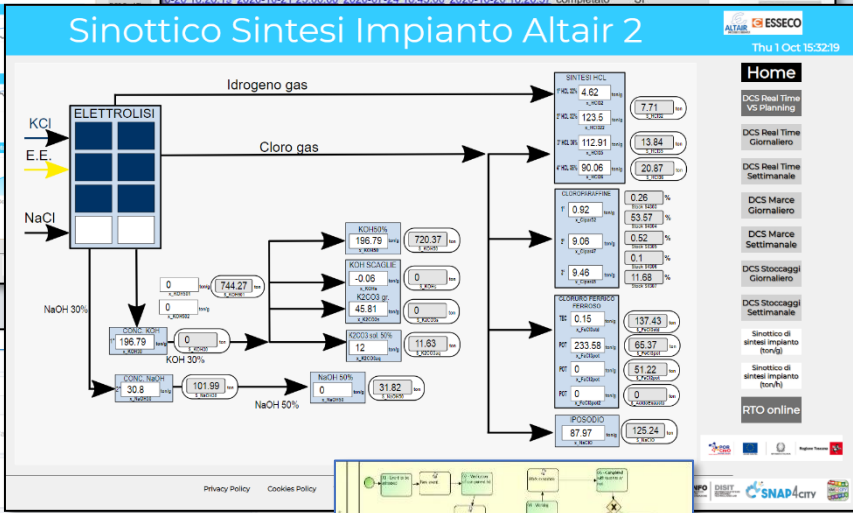
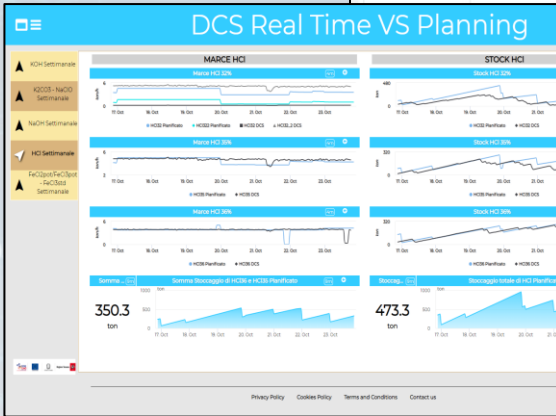
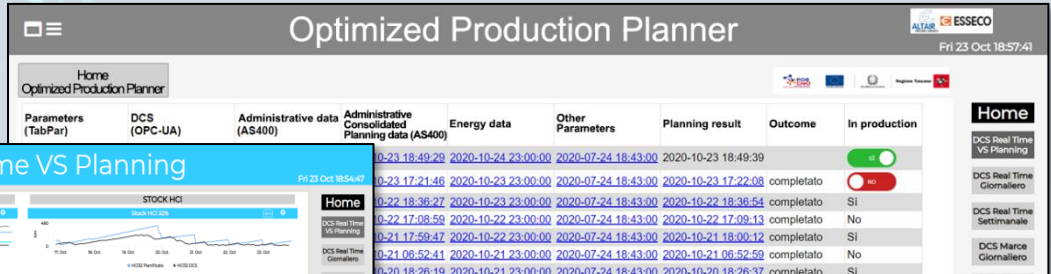
- Billions of Data

- **Services Exploited on:**

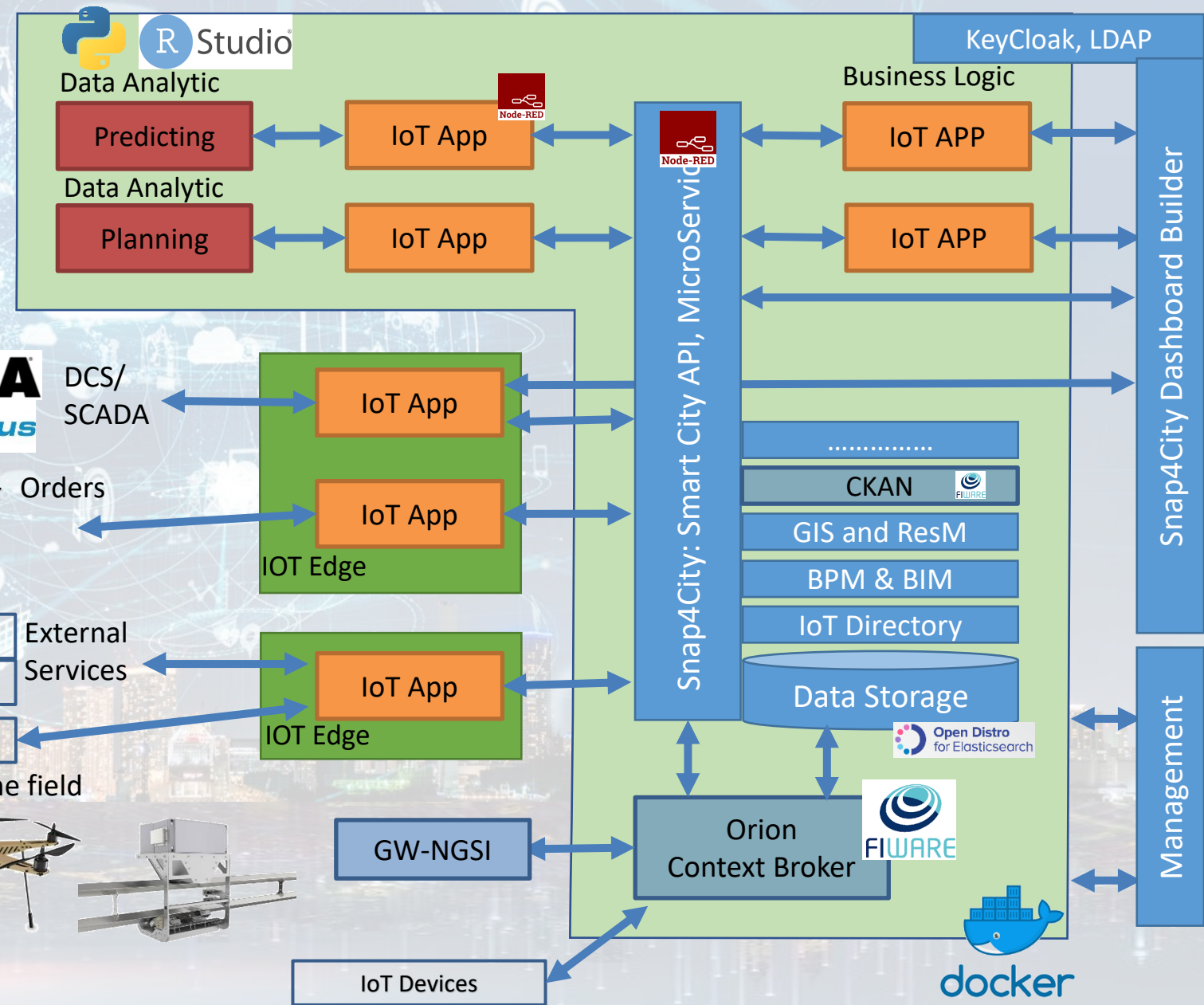
- Multiple Levels, Mobile Apps, API

- **Since 2020**

Snap4City (C), September 2023

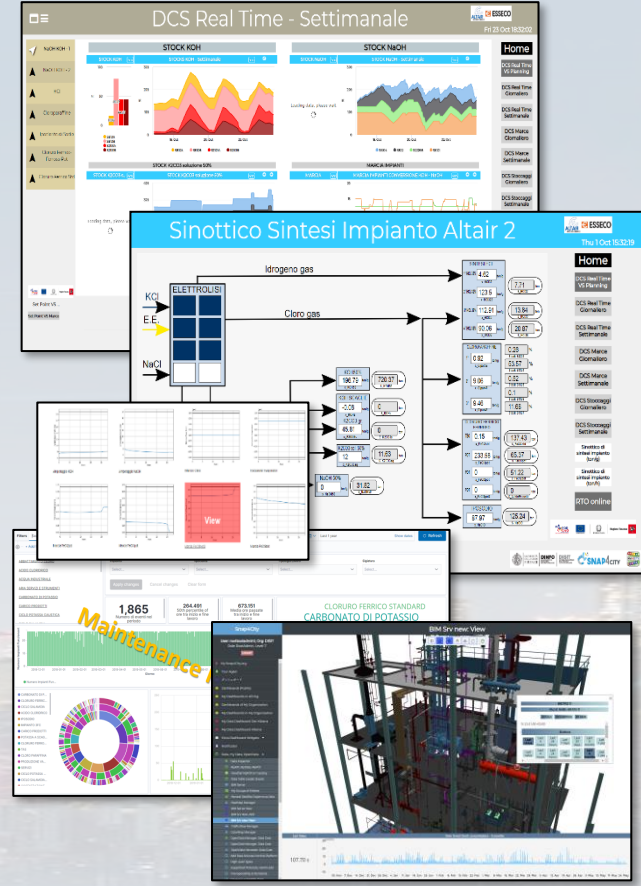


# Snap4City/Industry Detailed Architecture



Production Parameters

Dashboards, Visual Analytics, Synoptics, 3D, Maps







# Some Altair Flows



**Snap4Altair**

User: userrootadmin, Org: Organization  
Role: RootAdmin, Level: **Logout**

IoT Application nodered2

**Snap4Altair**

User: userareamanager, Org: Organization  
Role: AreaManager, Level: **Logout**

IoT Application nodered2

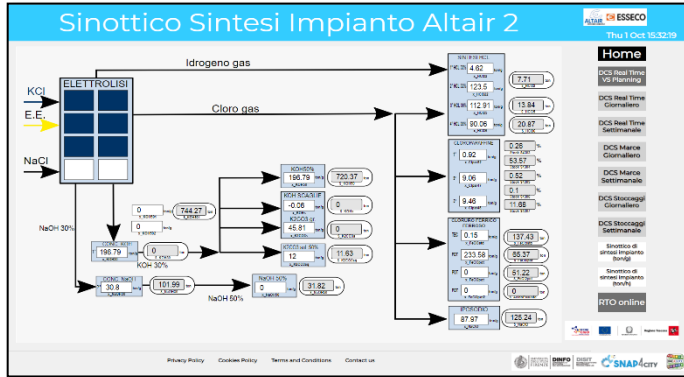
**Snap4Altair**

User: userrootadmin, Org: Organization  
Role: RootAdmin, Level: **Logout**

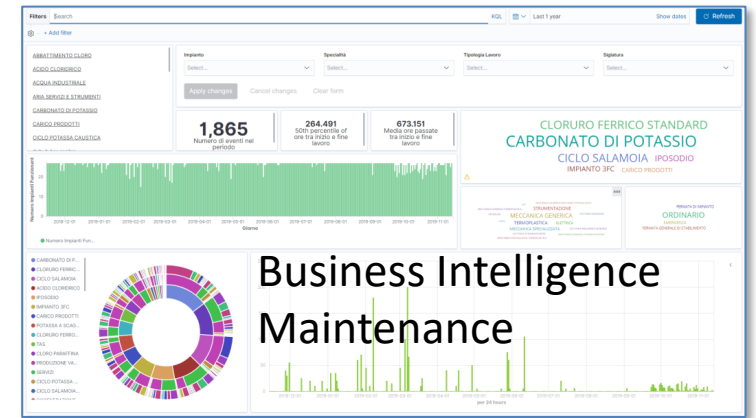
IoT Application nodered2



# Workflow for Ticket management



Consumptions/productions

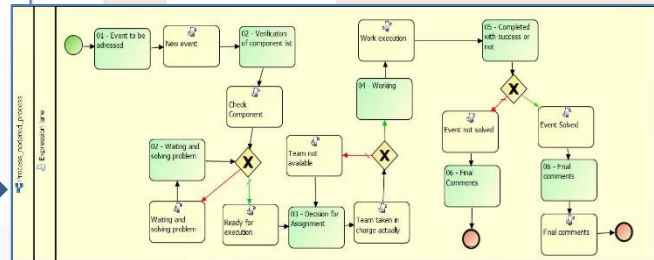


Events/actions

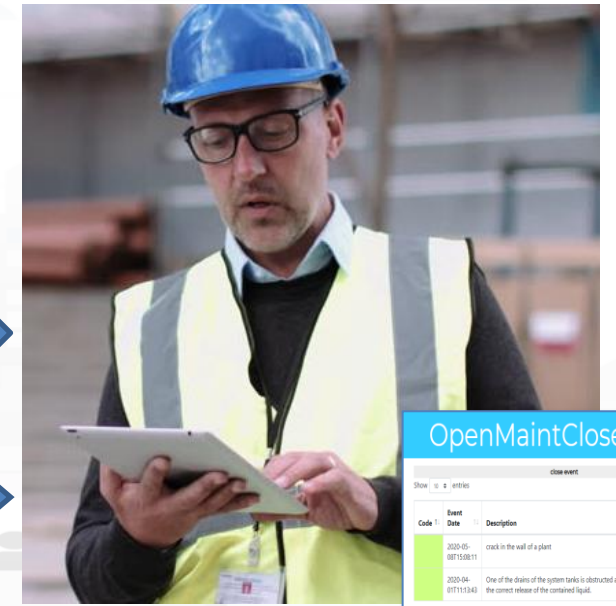
Business Intelligence  
Maintenance

Dashboards and actions

OpenMaint: BPM Workflow  
management, team assignment,  
material control, ...



IOT App, Data  
event firing,  
event detection  
and firing  
Critical event  
management



# Digital Twin Local, 3D vs Real Time Data



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB

Tue 8 Jun 11:04:55

## BIM Integration for Digital Twin



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UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

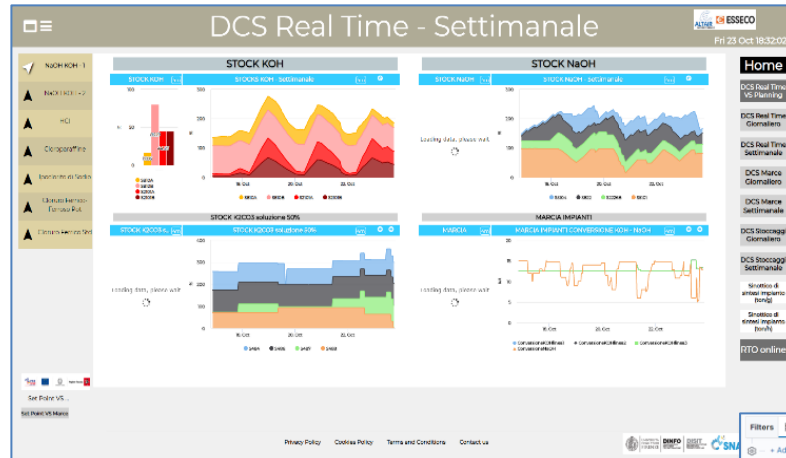
**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB

**SNAP4CITY**



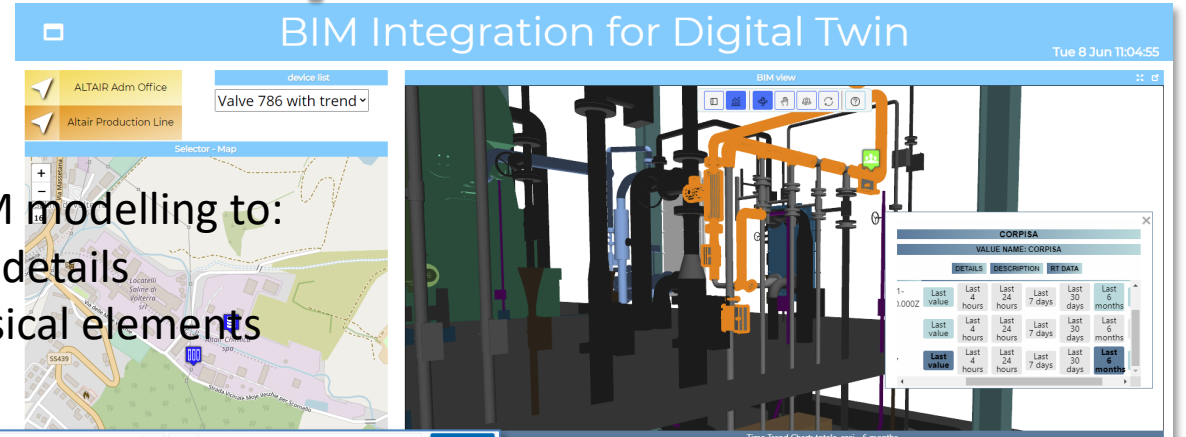
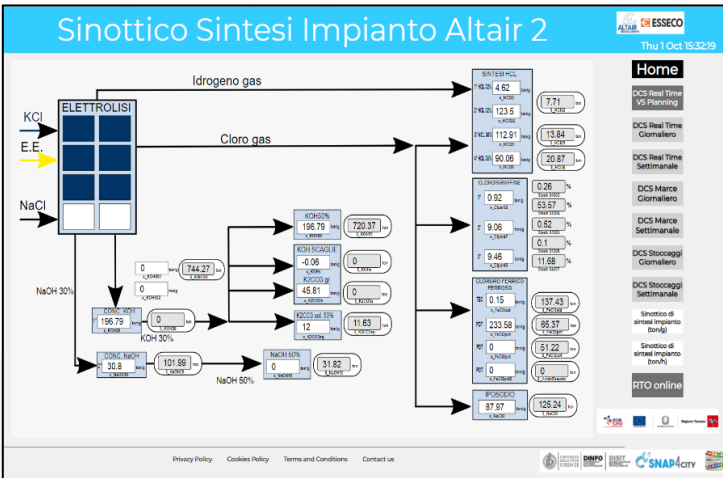


# Closing the loop

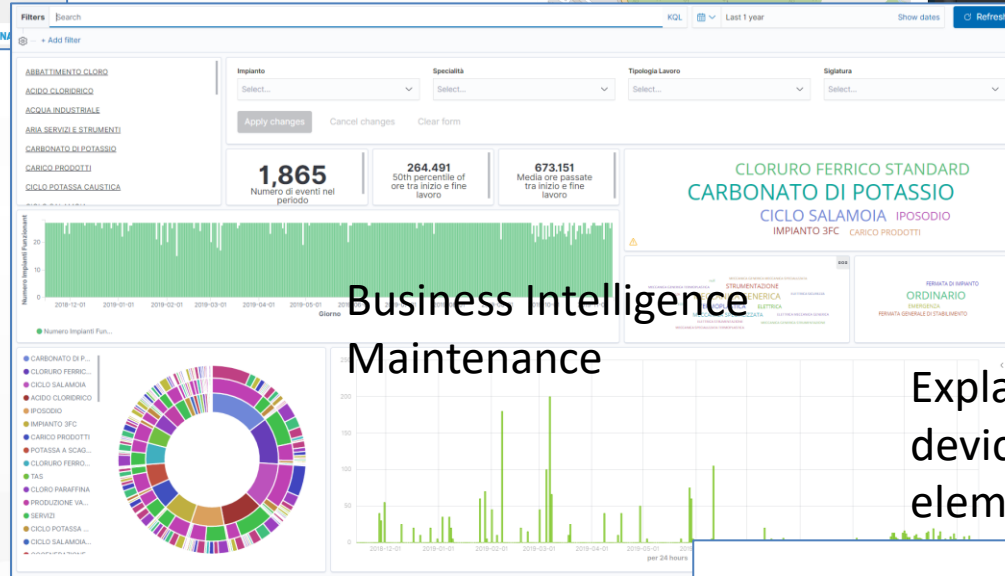


Historical and Real Time Data

Synoptics for real time monitoring

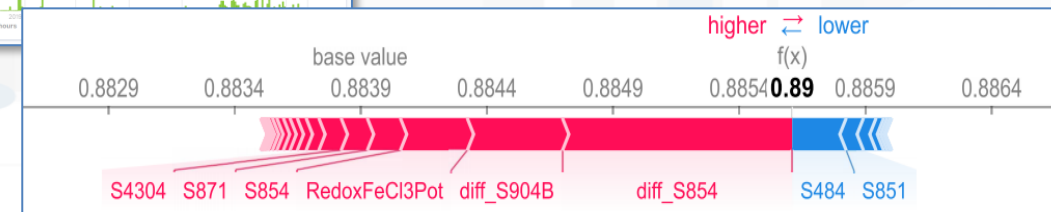


Map and 3D BIM modelling to:  
-- represent the details  
-- associate physical elements with data



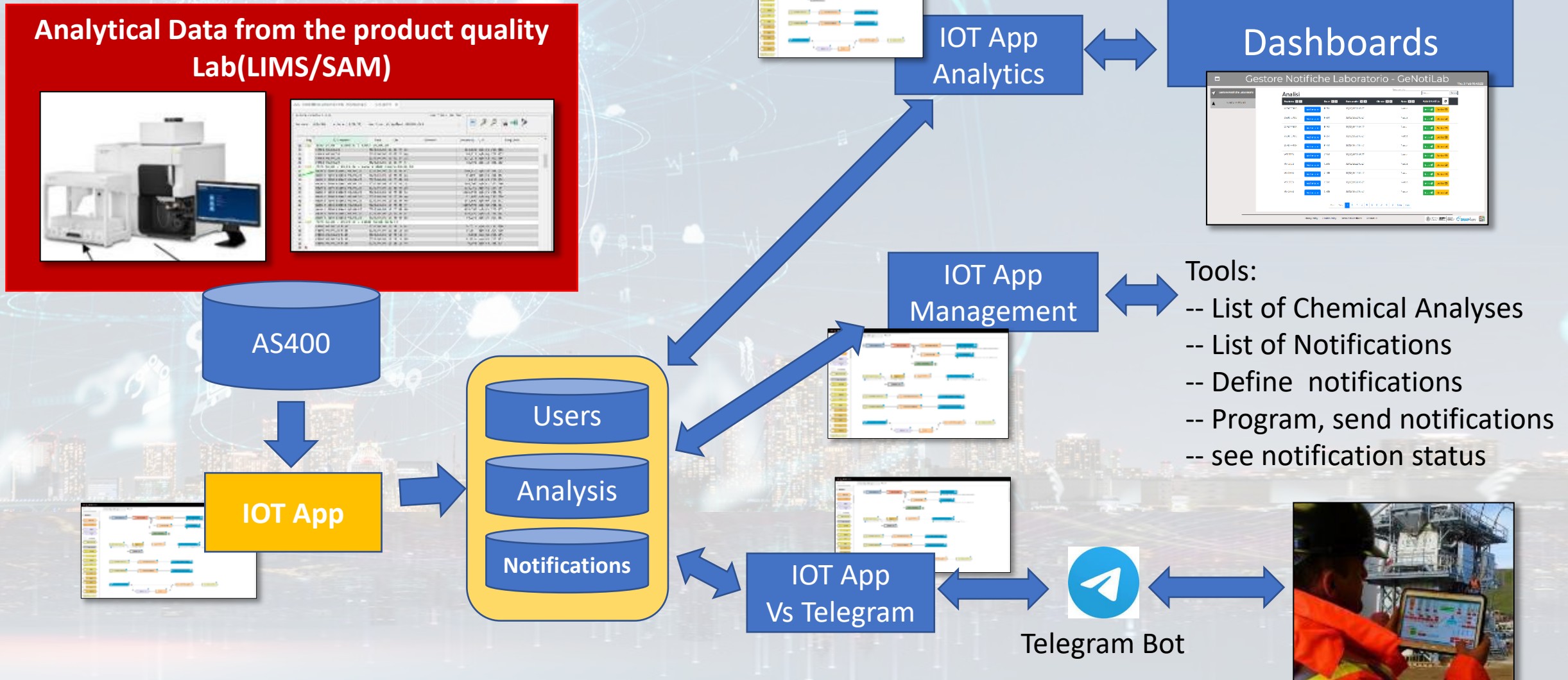
Business Intelligence Maintenance

Explainable AI to map critical values of devices and detection to physical elements in the plant



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MzA1NA==>

# GeNotiLab Architecture for ALTAIR



## Sinottico Impianto Presse - Autoclave

**Stato Presse**

**Select Pressa**  
PRESSA 6

Press to update the list

**Status**  
NO STATUS

**Tempo Vulcanizzazione Pressa**

**Tempo Preriscaldamento Pressa**

**Temperatura Settore Pressa**

**Pressione Pressa**

**Temperatura Piani Pressa**

**Stato autoclave**

USCITA\_PRESSIONE: 100 %  
INGRESSO\_VAPORE: 0 %

TEMP\_MOTORE\_VENT: 27.1 °C

Internal pressure: 0.027999997 BAR

Air Temp.: 28.666666 °C  
Hitc Temp.: 27 °C  
Lotc Temp.: 27 °C  
SP Air Temp.: 0 °C

Motor: 0 A, 0 rpm, 0 kW

TEMP\_RAFFREDDAMENTO: 27.7 °C

NOME RICETTA: Cilindri ebanite aria calda

- Main Dashbaord
- Autoclave db - Weekly
- Autoclave KPI - Weekly
- Impianto Presse - Weekly
- OpcUaValues - Weekly
- OpcUaValues and rison

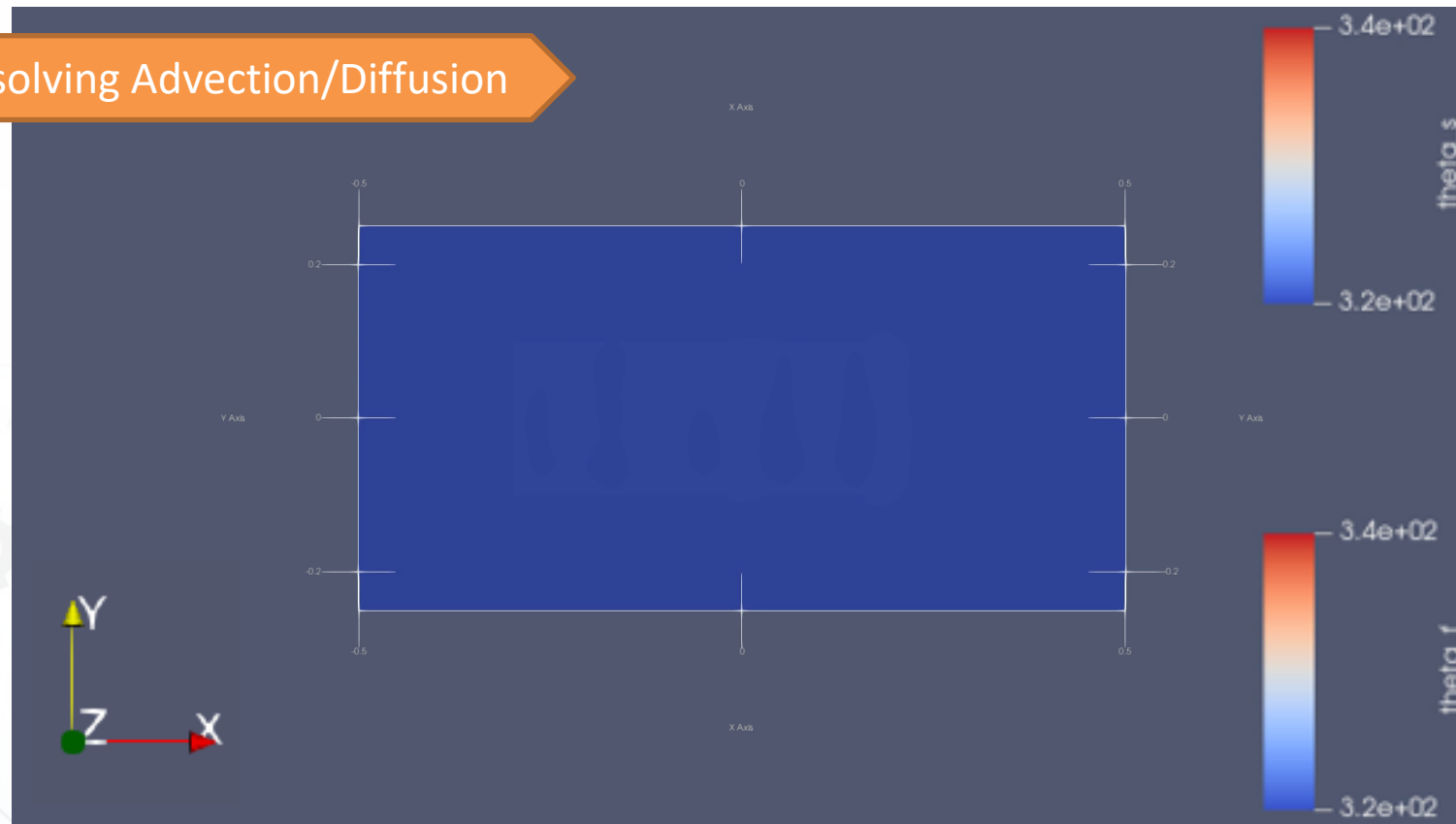
<http://dashboard/dashboardSmartCity/view/index.php?iddashboard=MTk=>



# Physics-informed neural networks (PINN)

Solve complex fluid-dynamic problems based on **partial differential equation (PDE)** using neural networks

Thermal transfer solving Advection/Diffusion





# COFFEE BREAK



TOP

# A Selection of Other Cases



# <https://www.snap4city.org/4>

- [Scenario: SnapBot: Real Time Smart City services via Telegram](#)
- [Scenario: Copernicus Satellite Data](#)
- [Scenario: SmartBed, Materasso Intelligente](#)
- [MicroServices Suite for Smart City Applications](#)
- [Scenario: MODBUS for Snap4Industry Snap4City Applications](#)
- [Scenario: MOBIMART Interreg: MOBilità Intelligente MARE Terra](#)
- [Scenario: City of Roma case, mobility and environmental data](#)
- [Scenario: Herit-Data video and aims](#)
- [Scenario: Control Room vs Video Wall](#)
- [Scenario: Snap4Home the case of: Alexa, Philips, Sonoff, TP-link, etc. \(Italiano\)](#)
- [Scenario: how to manage maintenance and accidents workflows](#)
- [Scenario: Snap4Home, how to exploit Snap4City solution on home automation](#)
- [Scenario: Energy Monitoring](#)
- [Scenario: Multipurpose User Engagement Tools](#)
- [Scenario: 5G Enabled Water Cleaning Control \(smart city, industry 4.0\)](#)
- [Scenario: High Level Control of Industrial Plant \(industry 4.0\)](#)
- [Scenario: Vehicle Monitoring via OBD2](#)
- [Scenario: Events and Museums Monitoring in Antwerp](#)
- [Scenario: High Resolution Prediction of Environmental Data](#)
- [Scenario: Mobility and Transport Analyses in multiple cities](#)
- [Scenario: People Flow Analysis via Wi-Fi](#)
- [Scenario: Antwerp Pilot on Environmental Data](#)
- [Scenario: Helsinki Pilot on Environmental Data](#)
- [Scenario: Firenze Smart City Control Room](#)
- [Scenario: Mobile & Web App: Toscana Where What ... Km4City, Toscana in a Snap](#)
- [Scenario: Helsinki Pilot on User Behaviour](#)
- [Scenario: Antwerp Pilot on User Behaviour](#)



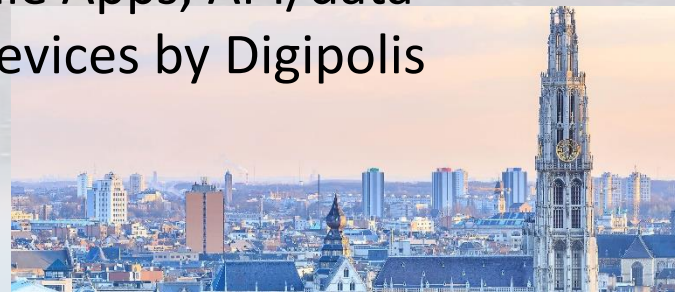
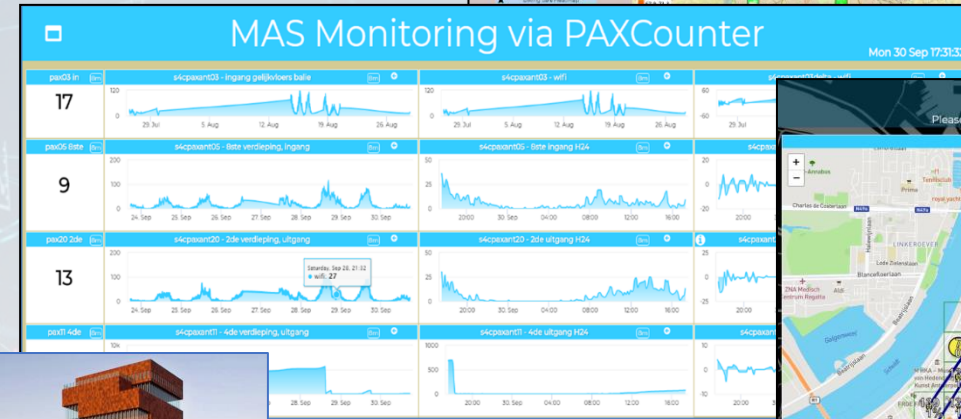
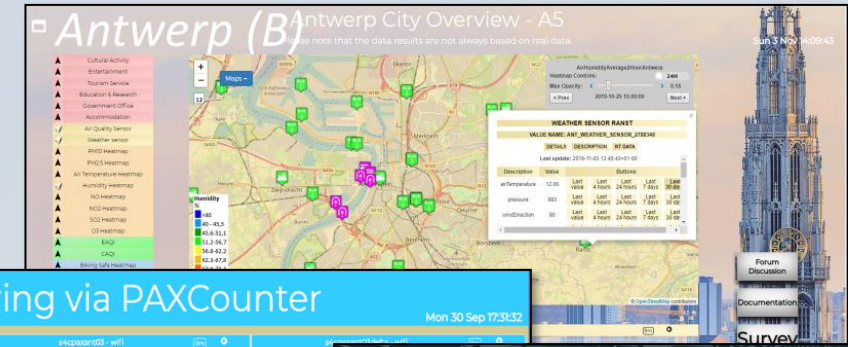
## Scenariious

- [Data Analytic: Origin Destination Matrices, Algorithms and tools](#)
- [Data Analytic: Traffic Flow Reconstruction](#)
- [Data Analytic: in general, and the cases of Antwerp and Helsinki](#)
- [Data Analytic: Predicting Air Quality](#)
- [Data Analytic: Analyzing Public Transportation Offer wrt Mobility Demand](#)

# People Monitoring on Pub Services DIGIPOLIS Antwerp



- **Multiple Domain Data**
  - PAX Counters: museum, pub services, COVID-19
- **Multiple Levels & Decision Makers**
  - Business Intelligence Dashboards
  - People flow, OD flows
  - Detection of critical conditions
- **Historical and Real Time data**
  - 20 fixed PaxCounters
  - 2 Mobile PaxCounters
- **Services Exploited on:**
  - Dashboards, Mobile Apps, API/data
  - Fully Controlled Devices by Digipolis
- **Since 2019**



# Pont du Gard

- **Tourism Domain**

- KPIs
- Social Media
- People Flows
- Bike Flows

- **Dashboards**

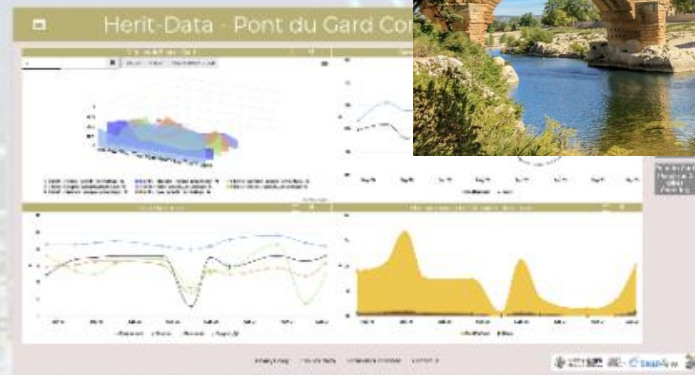
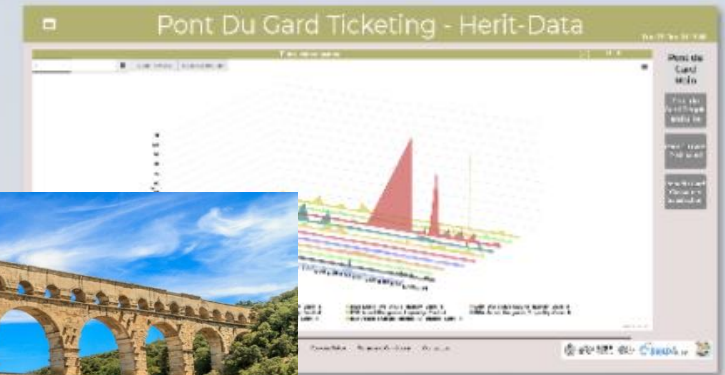
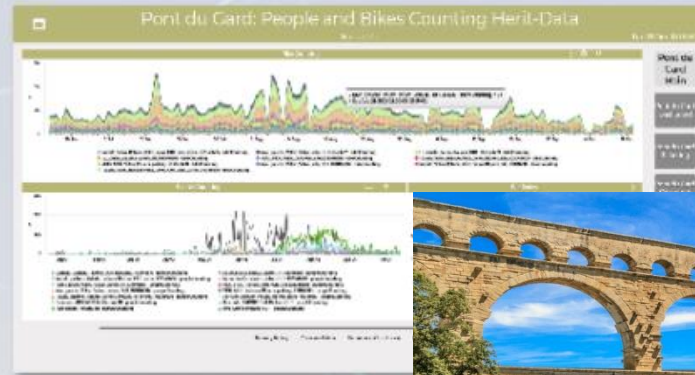
- Monitoring KPI
- People and bikes flows
- Twitter Vigilance

- **Historical and updated data**

- **Services Exploited on:**

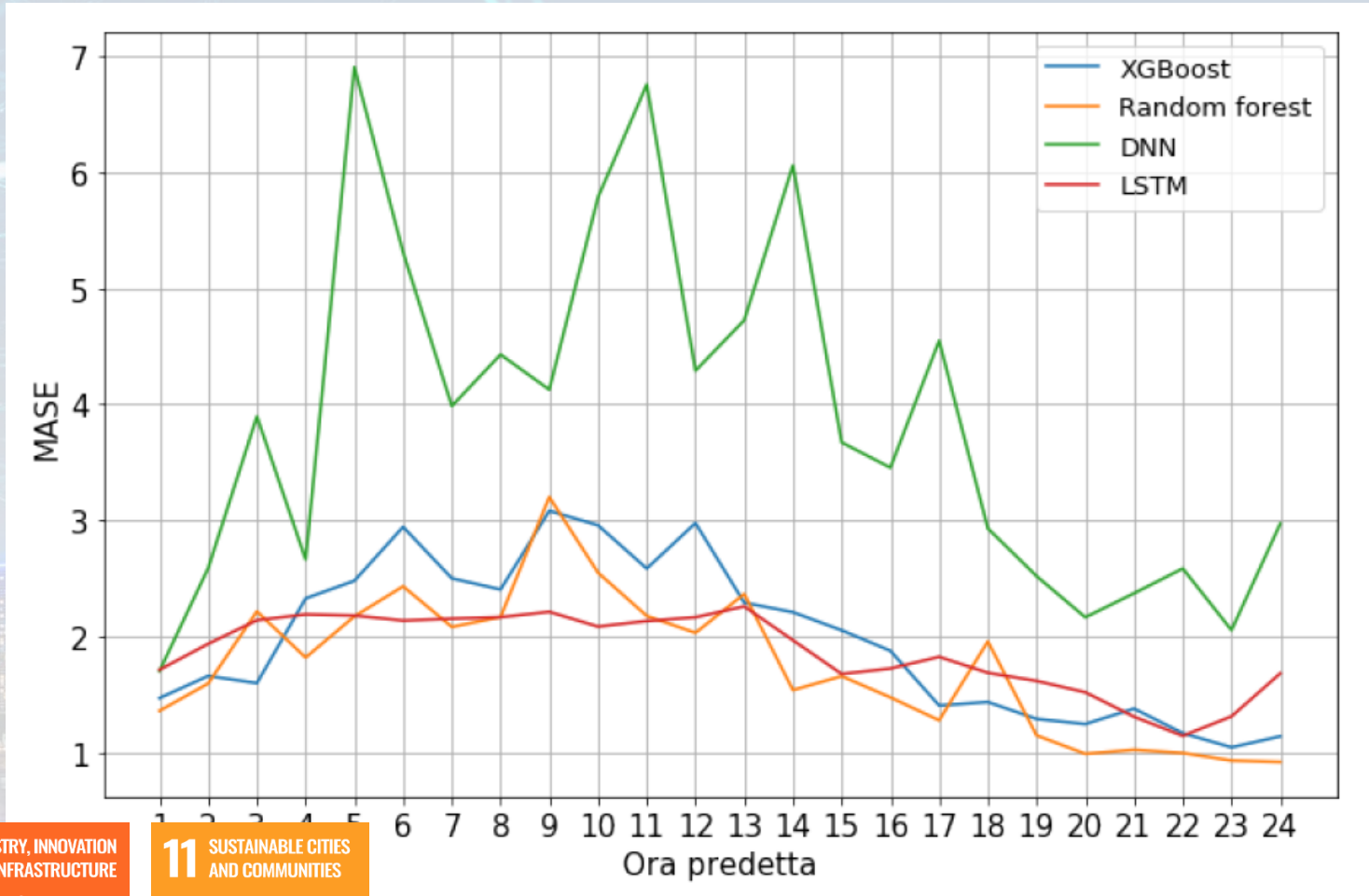
- Dashboard

- **Since 2020**



# Pont du Gard: data analytics

- Prediction of the number of sold tickets 24 hours in advance
- Using:
  - Historical data
  - Weather conditions
  - Social Media



**Twitter Vigilance**

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



11 SUSTAINABLE CITIES AND COMMUNITIES



# Dubrovnik

- **Tourism Domain**

- Counting People
- TV Cameras and WiFi
- Social Media

- **Dashboards**

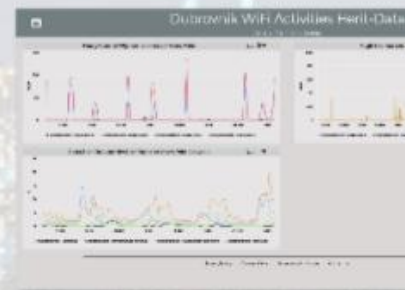
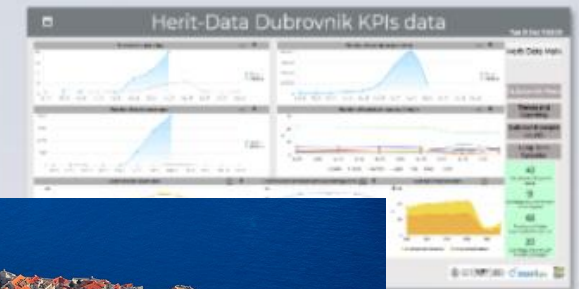
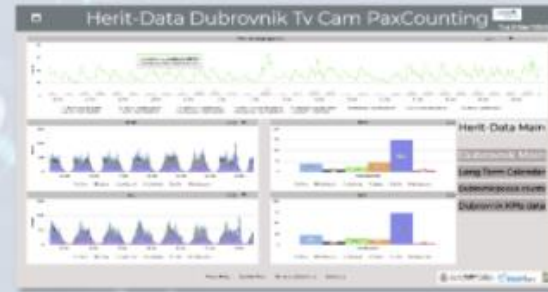
- Monitoring and real time control
- People flow
- Twitter Vigilance

- **Historical and Real Time data**

- **Services Exploited on:**

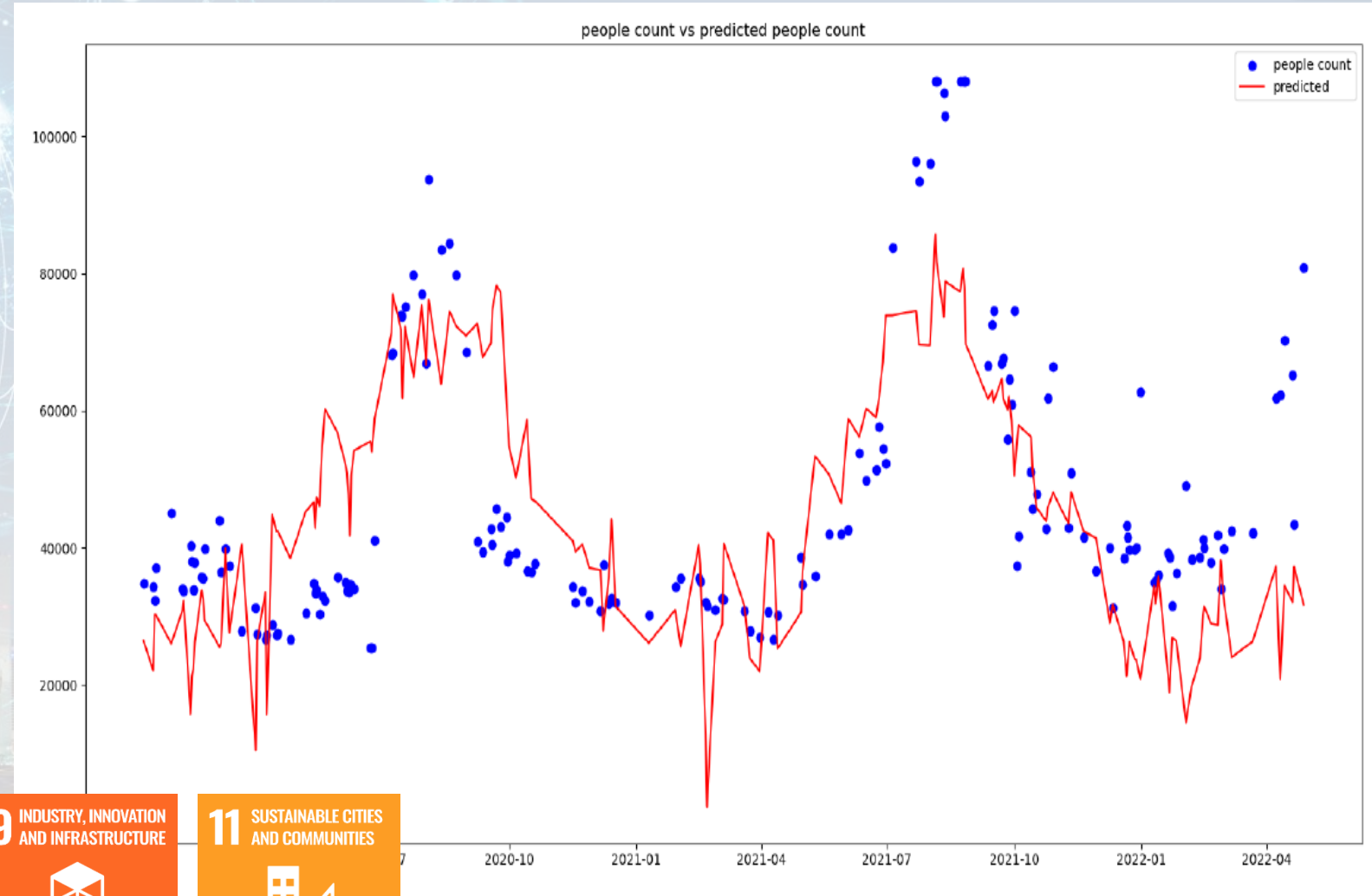
- Dashboard

- **Since 2020**



# Dubrovnik: Data Analytics

- Assessing impact of advertising
- Prediction of presences on the basis of
  - Social Media Twitter Vigilance
  - weather conditions
  - Historical data



**Twitter Vigilance**

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

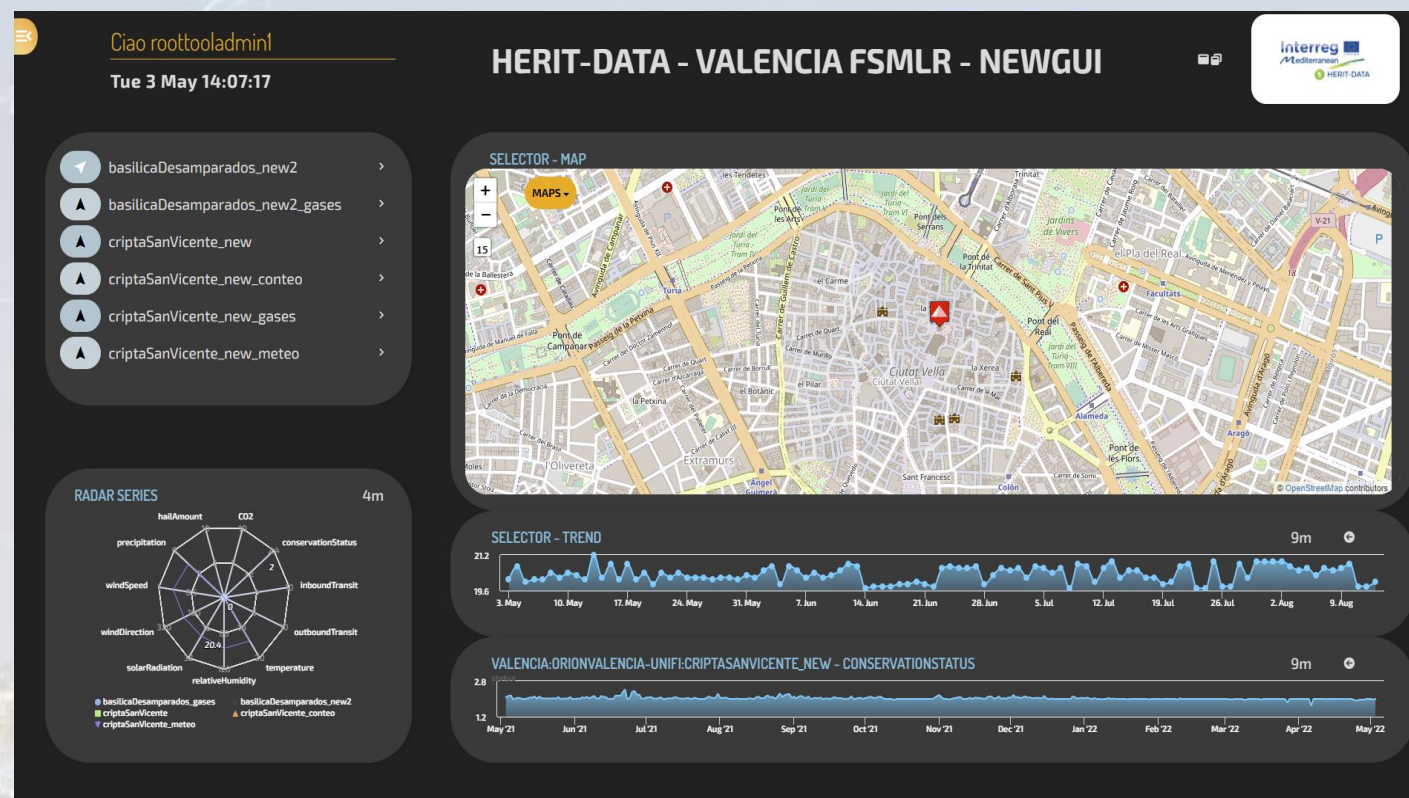


11 SUSTAINABLE CITIES AND COMMUNITIES



# Valencia, FSMLR

- **Tourism Domain**
  - Counting People
  - Environmental data
  - Social Media
- **Dashboards**
  - Monitoring and real time control
  - People flow
  - Twitter Vigilance
- **Historical and Real Time data**
- **Services Exploited on:**
  - Dashboard
- **Since 2020**

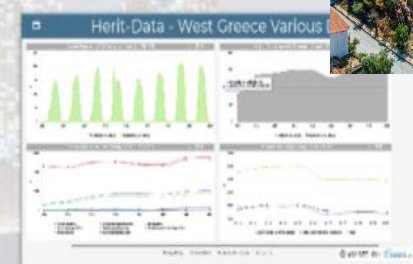
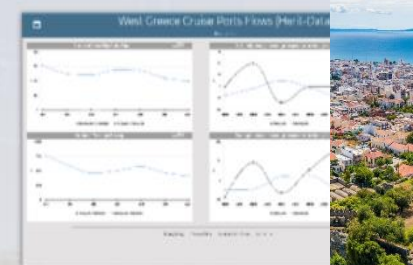
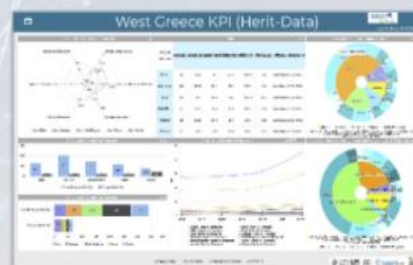
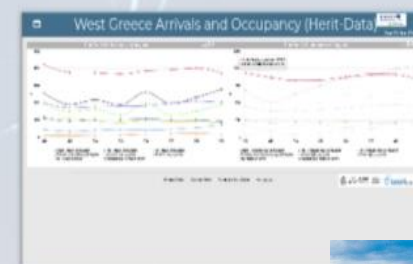
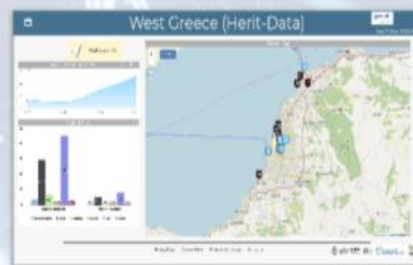


<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MzE1MA==>



# West Greece

- **Tourism Domain**
  - KPIs: ODM, Flows, ...
  - Social Media
  - People Flows
- **Dashboards**
  - Monitoring KPI
  - People flows
  - Twitter Vigilance
- **Historical and updated data**
- **Services Exploited on:**
  - Dashboard
- **Since 2020**



# Helsinki, Finland



## • Dashboards & Services:

### • Environment & Weather, PM10, PM2.5, NO, SO2, CO, noise, etc.

- Sensors values, Heatmap & Alerts on critical
- FMI Enfuser prediction: PM10, PM2.5, ..
- GRAL predictions PM10, validations
- Private sensors in Jätkäsaari area (personal dashboards)

### • Mobility: Traffic Sensors, Operators, routing, multimodal routing, whatif

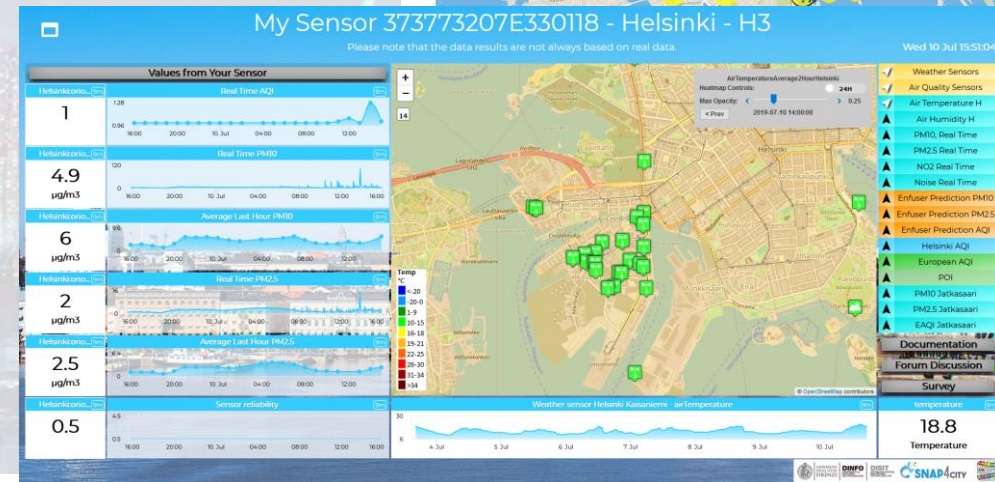
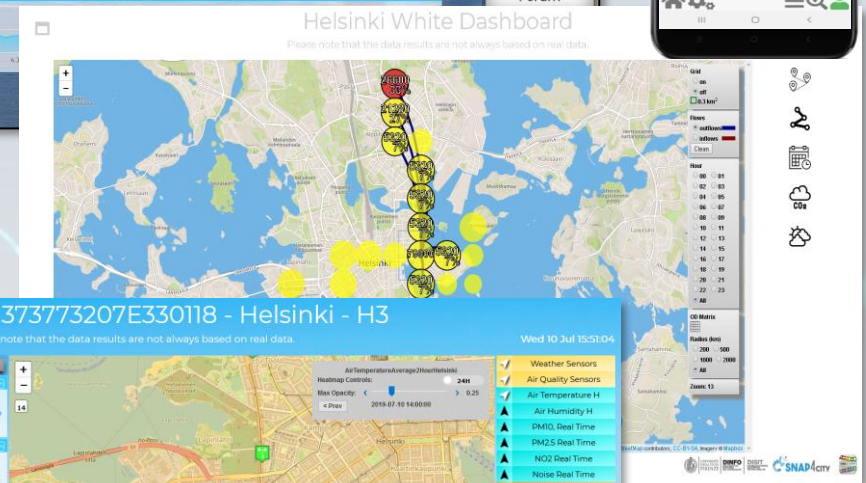
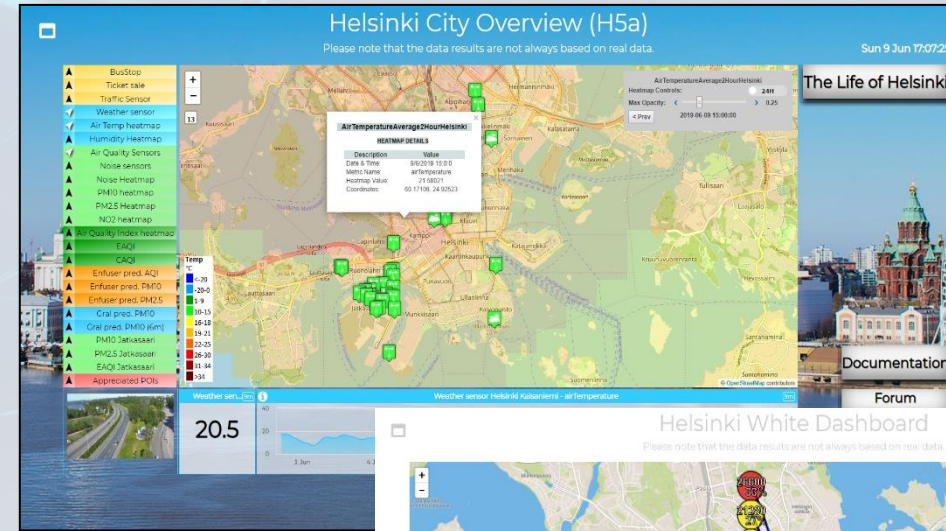
### • Social: Twitter Vigilance, early warning

### • Life in Helsinki: OD matrix people flow, Twitter Vigilance SA, hot places, etc.

### • Tourism and Culture

## • Mobile App and MicroApplications:

- Helsinki in a Snap (all stores)



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTQwNg==>

terso  
territorisostenibili

Con **terso**  
monitori **qualità** e **mobilità** del tuo territorio,  
decidi strategie di **sviluppo sostenibile**,  
coinvolgi i cittadini in nuovi **stili di vita**.



Lavagno



terso è un servizio di  
**Smartea**  
sostenibilità smart

[Privacy Policy](#) [Cookies Policy](#) [Terms and Conditions](#)

**Smartea**  
sostenibilità smart



11 SUSTAINABLE CITIES  
AND COMMUNITIES



13 CLIMATE  
ACTION



15 LIFE  
ON LAND



## Progetto Terso - Lavagno

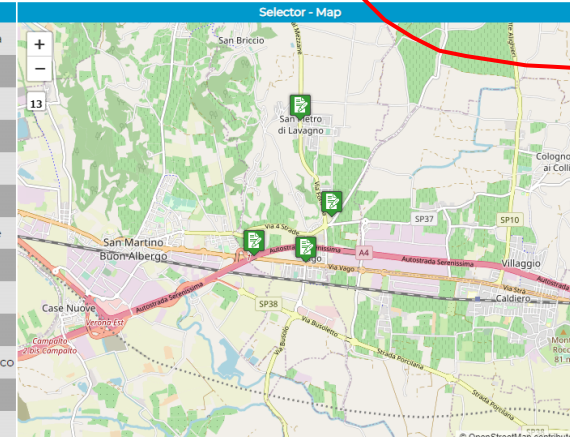
Terzo punto servizio di  
**Smartea**  
sostenibilità smart

Thu 21 Apr 10:59:49

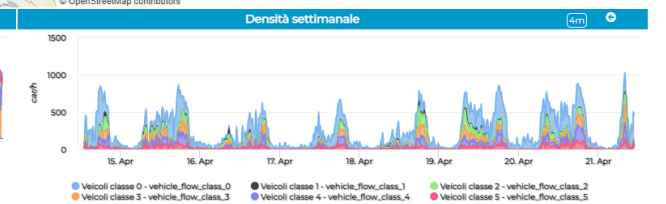
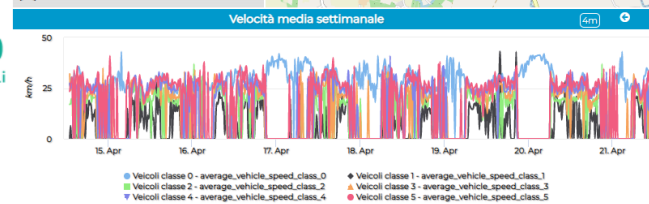
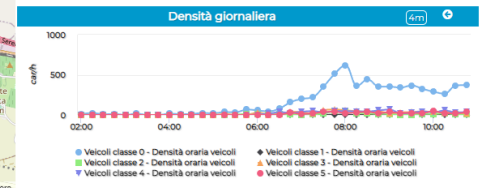
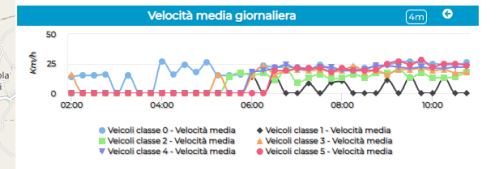


Lavagno

Selector
Via Roma - Verso Rimembranza
Via Roma - Verso centro paese
Via Roma - Verso Migross
Via Roma - Da Migross
Via Osteria - Da SP37
Via Osteria - Verso SP37
Via Osteria - Verso centro paese
Via Osteria - Da centro paese
Via Copernico - Verso Ovest
Via Copernico - Verso Est
Via Copernico - Verso Via San Rocco
Viale Volta - Verso paese
Viale Volta - Verso tangenziale



Seleziona la data: mm / dd / yyyy  
Seleziona sonda: [dropdown]  
Invia 2169



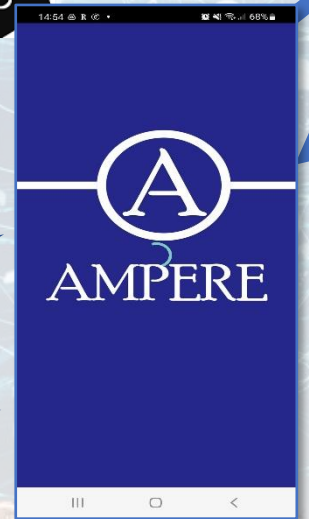
terso  
territorisostenibili

[Privacy Policy](#) [Cookies Policy](#) [Terms and Conditions](#)



- Traffic Data
- Environmental Data
- People counting (pedestrian)

# Jewel Alarms AMPERE



Click on  
Jewel



### Ampere user list

Fri 15 Apr 14:49:19

Filters: Filter by Age, Filter by Status, Filter by Language

Name	Surname	Ethnicity	Language	Age	Status	DateObserved
Daniele	Bologna	European	Italiano	33	not_active	2022-04-06T14:19:41.050Z
Email: dbologna120@gmail.com Phone: 3381122333 Controls: <b>Link</b>						
Hidkdbdb	ididij		Italiano		not_active	2022-04-10T09:43:45.016Z
Francesco	Vini		Italiano		not_active	2022-04-14T13:47:56.708Z
Mini Long	Mini Long		English	28	not_active	2022-04-14T18:56:49.203Z

Map: Selector - Map

Link to "Ampere User Management"

### Ampere User Management

Fri 15 Apr 12:09:11

**Anagraphic data:**

- Name: Mini Long Mini Long
- phone number: 125066585
- Day of birth: 1994-11-11
- Address: {}
- City: {}
- Locality: {}
- Gender: male
- Language: English
- Ethnicity:
- Height:
- Weight:

**Healthcare data:**

- Medications:
- Vision Impaired: false
- Wheel Chair User: false
- Allergies: No

**Contacts:**

- Contact name: S Longo Longo
- Phone number: 458865536

**User Metadata**

Map: Selector - Map

List of user event's

Status	Description	Try
Called: Longo Longo		Pin Action
Called: Longo Longo		Pin Action
Called: 118		Pin Action
alert:		Pin Action

Show 10

Data Observed	DeviceId	Status	Description	Try
2022-04-11T13:56:29.952Z	Operator	Called: S Sev		
2022-04-11T14:37:52.656Z	APP	alert		Pin Action
2022-04-11T14:38:24.112Z	Operator	Called: 118		
2022-04-12T08:16:46.076Z	APP	alert		Pin Action
2022-04-13T12:07:27.586Z	Operator	Called: 118		
2022-04-13T15:16:45.987Z	Operator	Called: Daniele Bologna	test_description	
2022-04-14T13:00:15.680Z	Operator	Called: 115	new action	
2022-04-14T13:19:18.118Z	Operator	Called: 115	test new action	
2022-4-11T15:18:47.000Z	Operator	Called: M Bol		
2022-4-11T15:21:6.000Z	Operator	Called: 112		

### Operator Actions

Call User: Daniele Bologna (3381122333)

Call Contacts: OM Bol (057123693966), OS Sev (255249146)

ER Numbers: Call 115, Call 112, Call 118

Description:

Cancel Confirm

<https://www.snap4city.org/577>



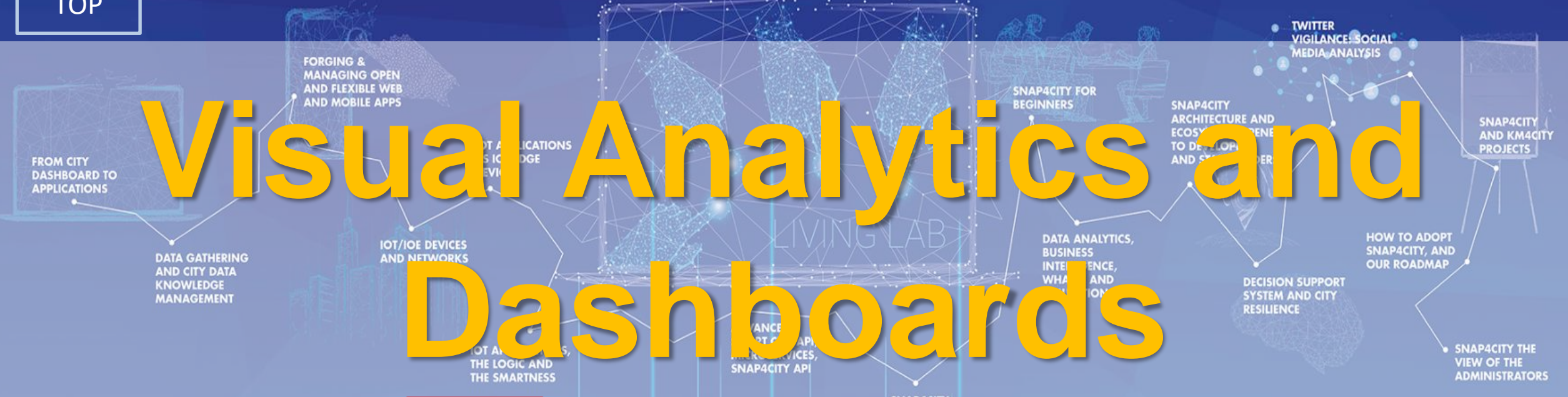
*On Line Training Material (free of charge)*

	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
What	Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								

Video1								
Video2								
Video3								
Video4				none		none	none	none

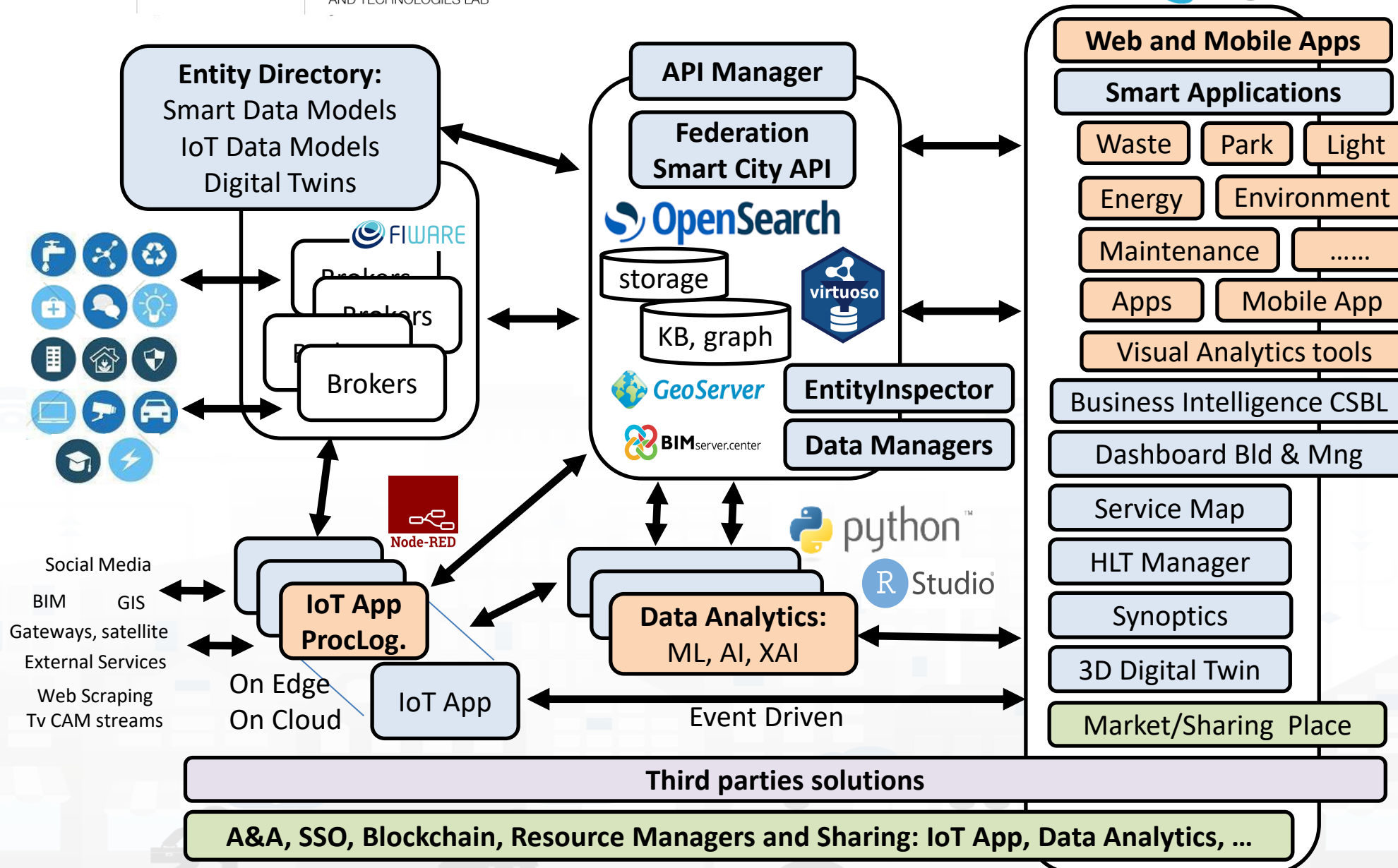
TOP

# Visual Analytics and Dashboards



	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
what	Overview	Dashboards	IoT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								

# Tech Arch



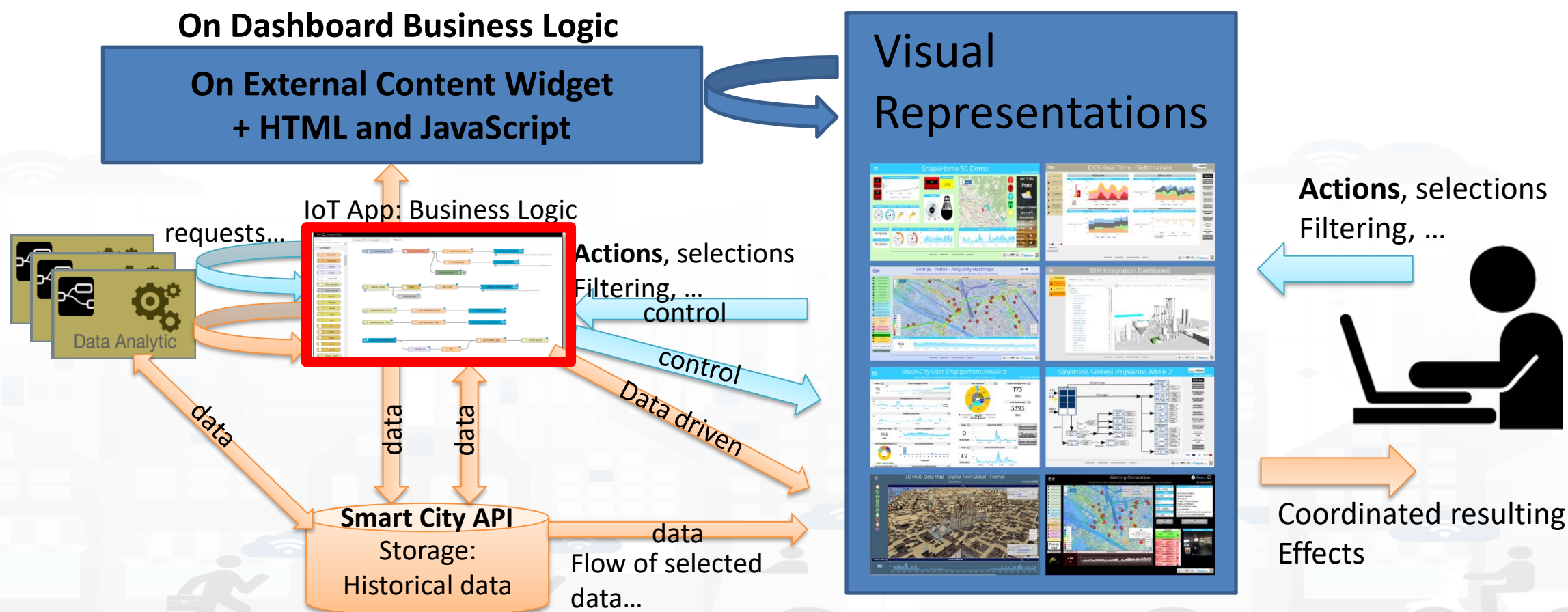
# Agenda of second part

- Recall on Snap4City Architecture
- Snap4City Dashboards Purposes and Uses
  - Snap4City Dashboards vs Technical data monitoring dashboards
  - Snap4City Dashboards main concepts
- Main Data Kinds: data vs representations
- Snap4City DASHBOARDS: Main Concepts and simple Widgets
- Creating a Snap4City Dashboard
- Snap4City Multi Data Map Widget
- Snap4City High Level Types
  - Video Streams from TV Cameras
  - External Services (integration of) your or third party web pages
  - Synoptics, Custom Widgets as External Services
- Selector for the Multi Data Map Widget
- Data Inspector vs Data Processes Details
- Dashboard Management
- Training Material

<https://www.snap4city.org/944>



- implementing sophisticated **Business Intelligence Tools**
- Open to receive a range of possible Actions, to produce a large combination of results in terms of data and representations.



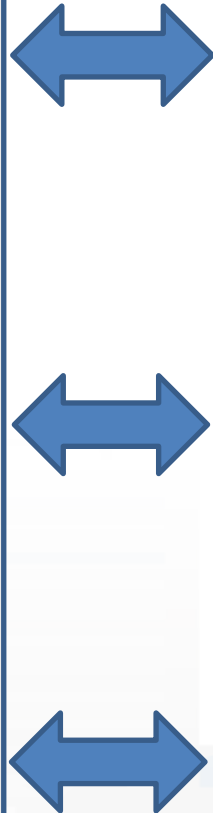
# Dashboard Builder: Development

Data Transformation  
Business Logic

IOT Applications

Knowledge Base,  
Km4City

Knowledge and Storage  
Data from the Field and  
City + MyKPI ++

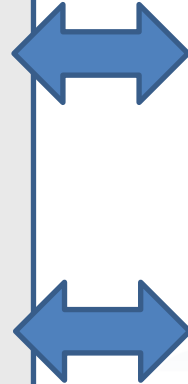


Widget Collection

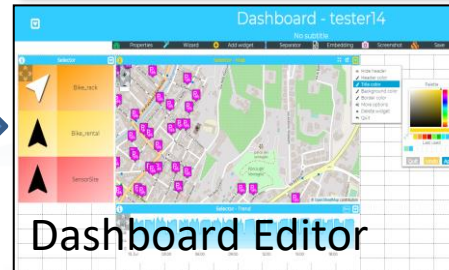
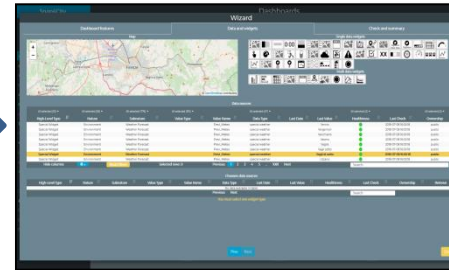
Micro Applications

External Services

Custom Widgets/  
Synoptics

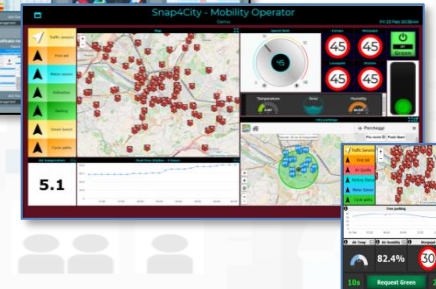


Dashboard Wizard



Public  
Dashboard  
Collection

Create, save, load,  
delegate, grant access,  
change ownership



My Own Dash/App



SNAP4City Dashboards Wizard

Dashboard features | Data and widgets | Check and summary

Map

Single data widgets

Multi data widgets

Data sources

High-Level Type	Nature	Subnature	Value Type	Value Name	Last Date	Last Value	Healthiness	Last Check	Ownership
Special Widget	Environment	Weather Forecast	Prevl_Meteo	special weather	Vernio		●	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Prevl_Meteo	special weather	Vergemoli		●	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Prevl_Meteo	special weather	Vecchiano		●	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Prevl_Meteo	special weather	Valano		●	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Prevl_Meteo	special weather	Vaglia		●	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Prevl_Meteo	special weather	Vagli sotto		●	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Prevl_Meteo	special weather	Vagli di sotto		●	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Prevl_Meteo	special weather	Uzzano		●	2018-07-08 16:00:18	public

Hide columns | Filters | Selected rows: 0 | Previous | 1 | 2 | 3 | 4 | 5 | ... | 1081 | Next

Chosen data sources

No data available in table

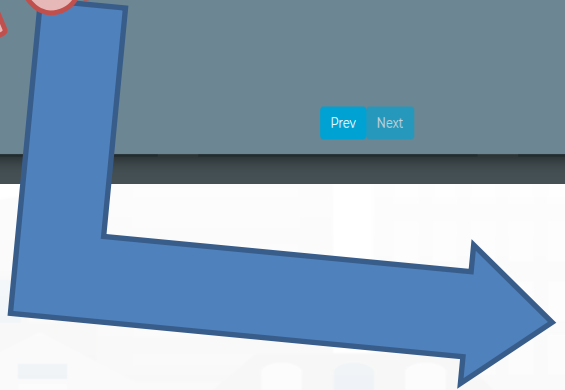
You must select one widget type

Prev Next



# Dashboard Wizard

**Wizard**



Università degli Studi di Firenze - UniFI


SNAP4city Florence CarParkings - Newgui PA

Sat 6 Aug 10:58:01

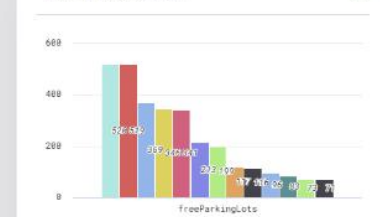
SELETTORE

- CarPark IOT
- Car\_park CAT

MAPPA




STATO PARCHEGGI 2m



PARTERRE 7m

369 Posti disponibili

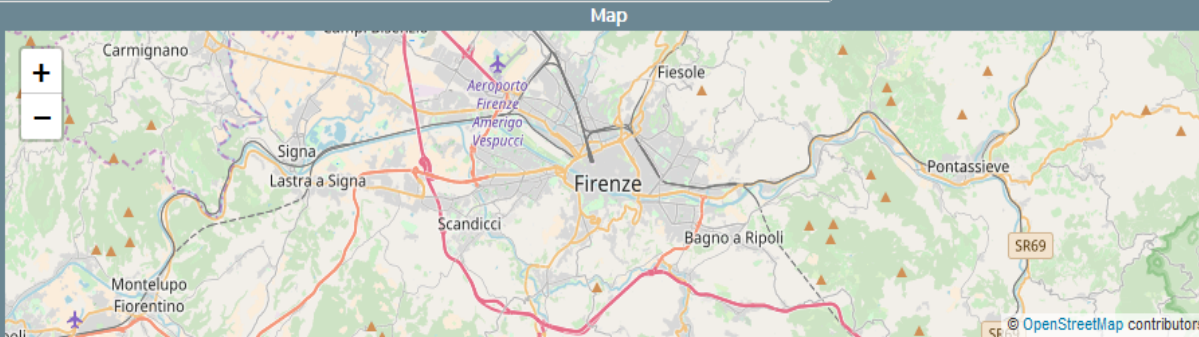
PARTERRE - ANDAMENTO NUMERO POSTI LIBERI 7m



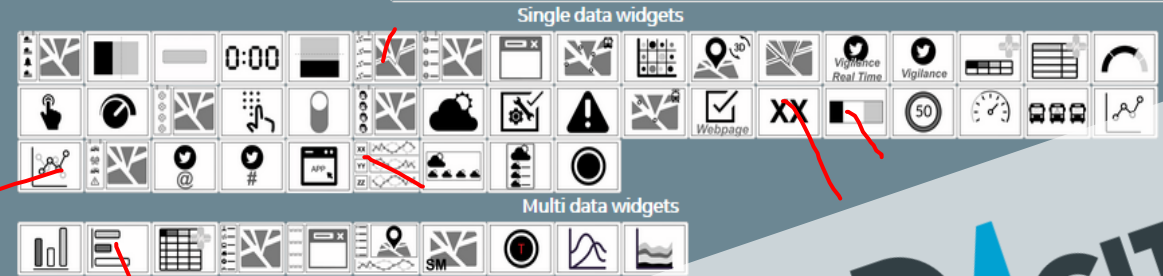
The Wizard help you in selecting only possible combination of data vs graphic representation

## Wizard

## Dashboard features



## Data and widgets



## Check and summary

## Data sources

High-Level Type	Nature	Subnature	Value Type	Value Name	Data Type	Last Date	Healthiness	Last Check	Ownership
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather	Vigilance	2018-07-08 16:00:18	public		
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather	Vergemoli	2018-07-08 16:00:18	public		
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather	Vecchiano	2018-07-08 16:00:18	public		
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather	Valiano	2018-07-08 16:00:18	public		
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather	Vaglia	2018-07-08 16:00:18	public		
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather	Vagli sotto	2018-07-08 16:00:18	public		
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather	Vagli di sotto	2018-07-08 16:00:18	public		
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather	Uzzano	2018-07-08 16:00:18	public		

- Select the area of your interest: panning and zooming

- Select the

- graphic aspect of your interest, or
- High Level Type of your interest, or
- Make a search if you have a precise idea or
- Act on filters: nature, subnature, type, name, value, date, health, owner, ...
- Combine them as you like

- Select the lines of your interest
- Then click on Next and get the Dashboard by wizard

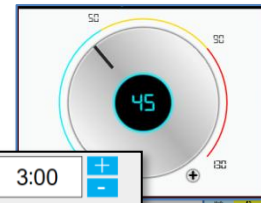
Close

# Dashboard Widgets: List and Editor



Begin 3:00

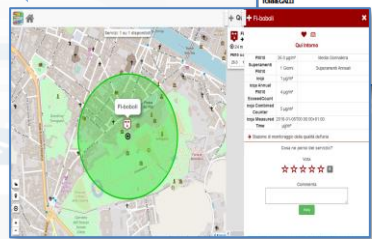
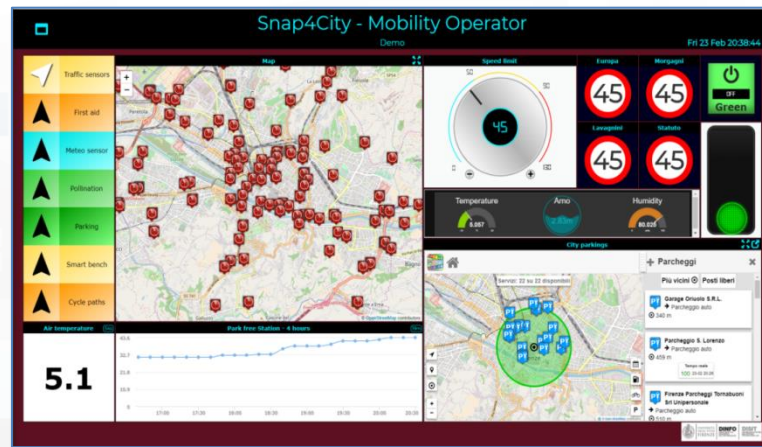
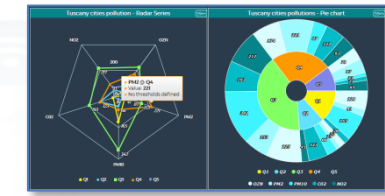
Finish 5:30



Tempo	Temperatura (°C)	Umidità (%)	Velocità (km/h)	Pressione (hPa)
7	19	71	1	922
16	15	57	1	876
1	4	72	3	1022
5	6	0	0	855
11	8	72	23	913
18	0	3	33	957



CRID	2018-090530	S.P.N. 73 DI MARMITILE	ISTITUZIONE	TEMPORARY TRAFFIC LIGHTS
16/03/2018	00:00:00	5		
CRID	2018-090531	S.P.N. 105 DI TORRANCIPOLI	ISTITUZIONE	TEMPORARY TRAFFIC LIGHTS
12/03/2018	00:00:00	5		



Florence main first aid status

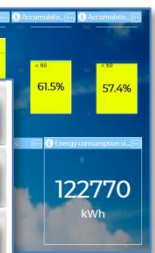
Red code	Yellow code	Green code	Blue code	White code
7	9	43	25	0
1	6	20	6	0

Antwerp Helsinki Florence Current Blue

PeopleNumber

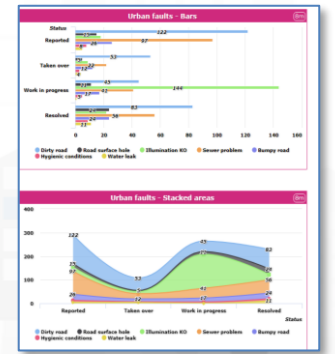
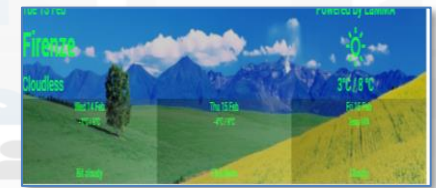
7	8	9
4	5	6
1	2	3
0	.	Cancel

Confirm



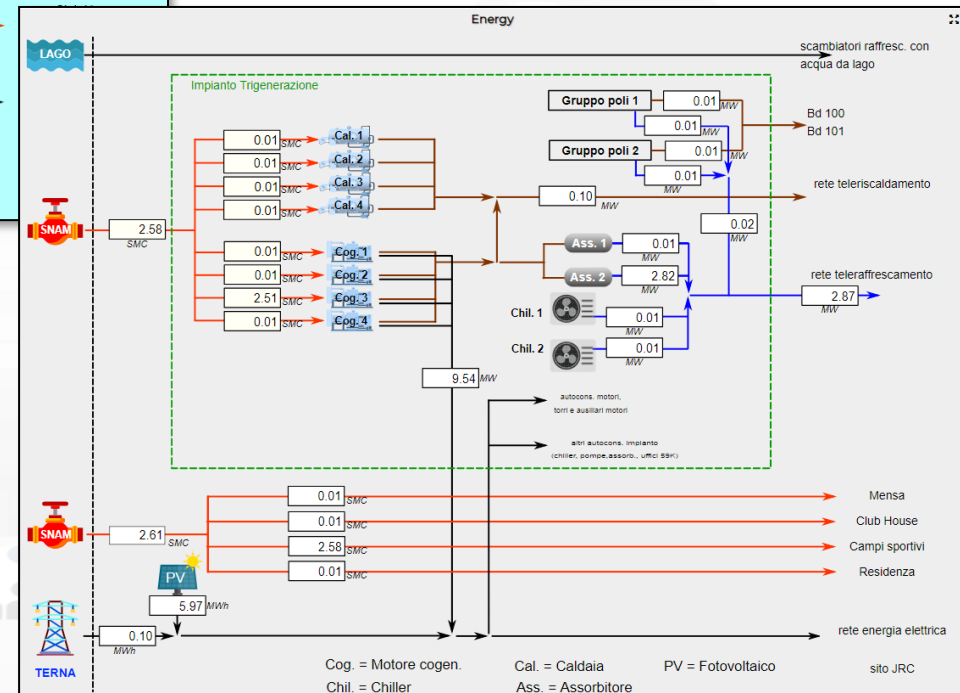
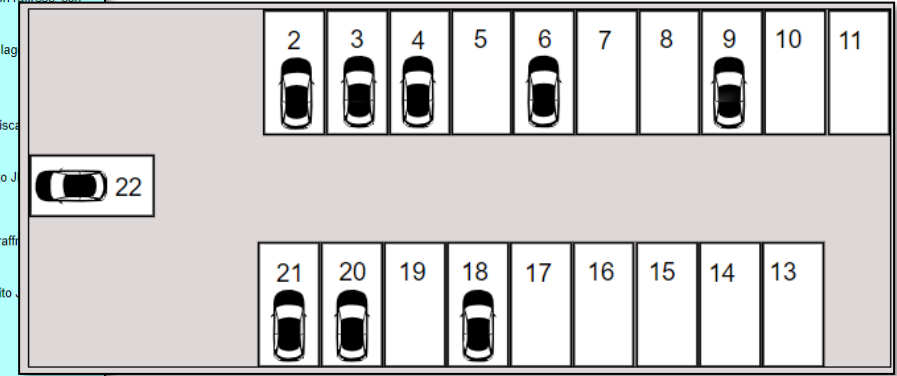
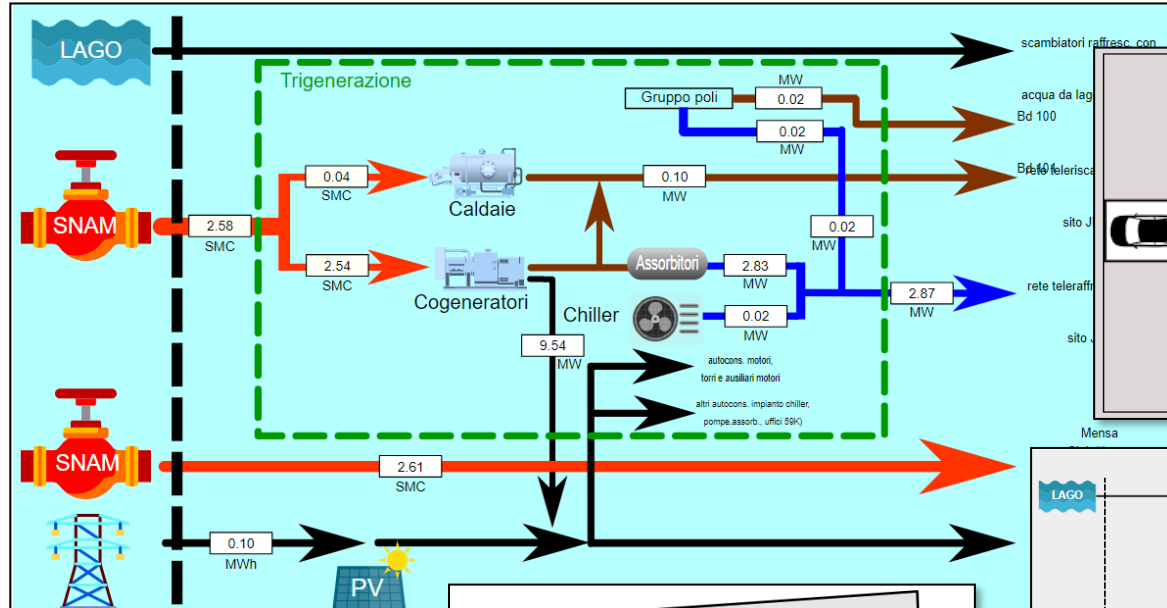
Europa Morgagni

Lavagnini Statuto



# Special Custom Widgets

- Smart parking
- Smart Energy
- Smart Light
- Smart ....
- Energy View
- Custom Controls

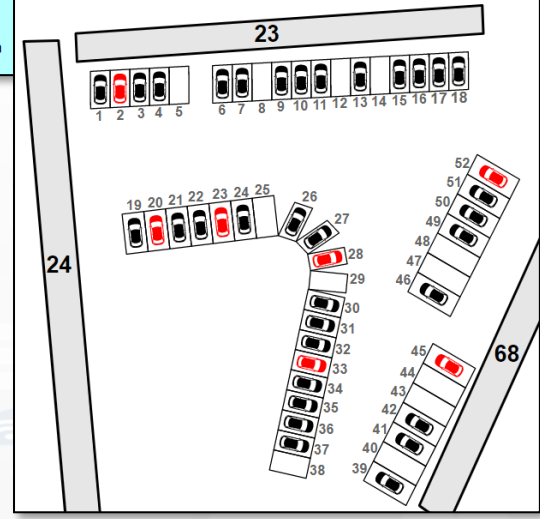


Widget showing a feedback system with 5 smiley faces (from -2 to 2) and two data boxes:

- Total clicks: 6
- Mean rate value: 0.00

Widget showing a control panel with a time range and feedback smiley faces:

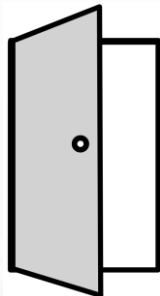
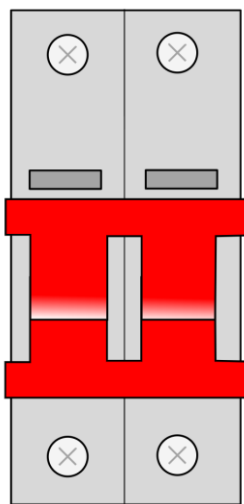
- Begin: 17:00
- Finish: 4:00



# Other examples

## Virtual Actuators (sensor-actuator)

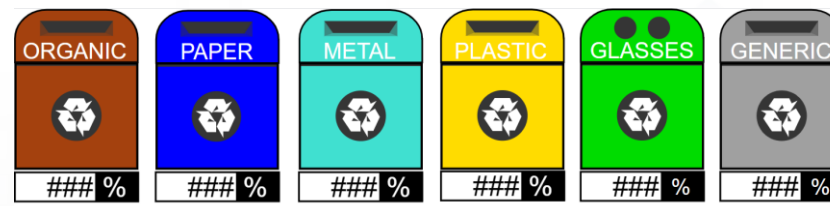
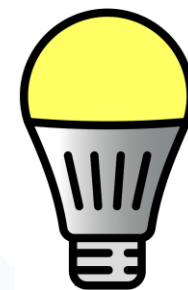
- From: Dashboard
- To: IOT App, MyKPI, other Synoptics



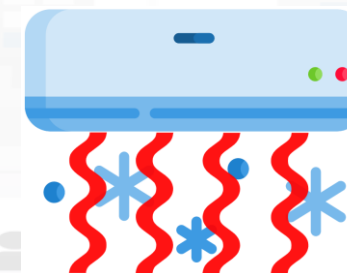
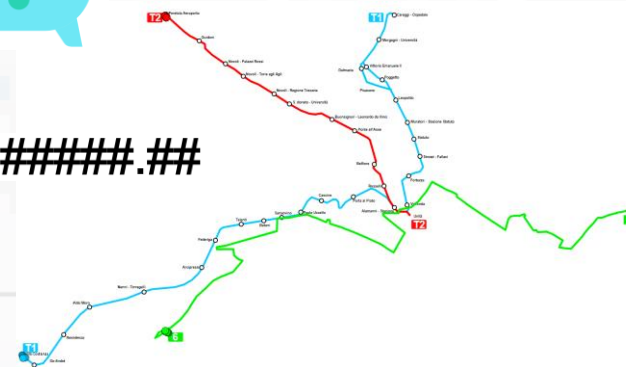
## Virtual Sensors



- From: MyKPI, Sensors, IOT App, other Synoptics
- To: Dashboards



#####.##





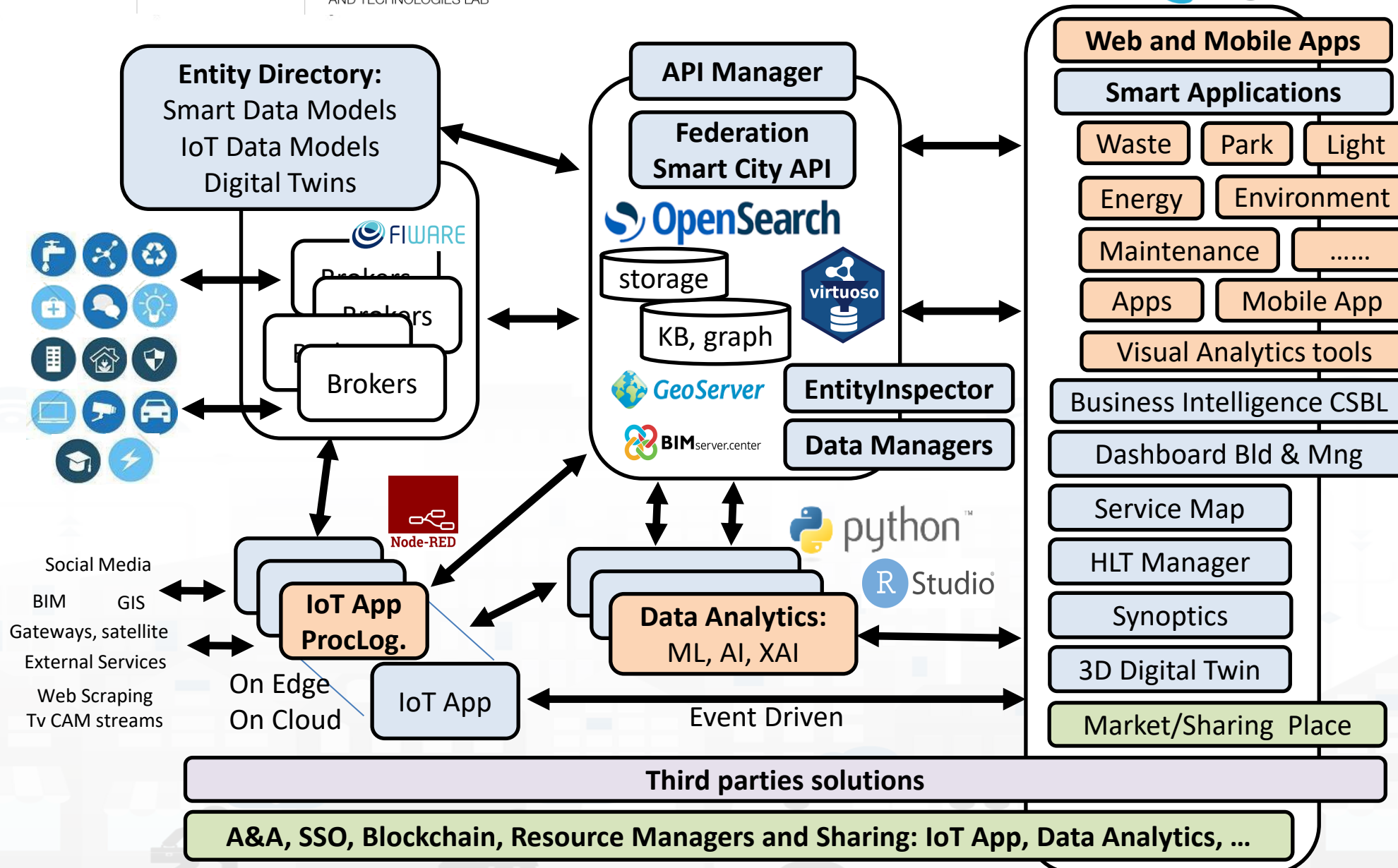


TOP

# IoT Application Development smartening the solutions



	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
what	Overview	Dashboards	IoT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								



# Agenda of third part

- Recall on Snap4City Architecture
- Node-RED
- IOT App = Node-RED + Snap4City
  - IoT App === Proc.Logic
- Examples of IOT App for Smartening Solutions
- Exploiting/Generating data by using: IoT App/Proc.Logic
- External Service  $\leftrightarrow$  IoT App/Proc.Logic
- Dashboards  $\leftrightarrow$  IoT App/Proc.Logic
  - Server Side Business Logic

# IoT App / Proc.Logic Agenda

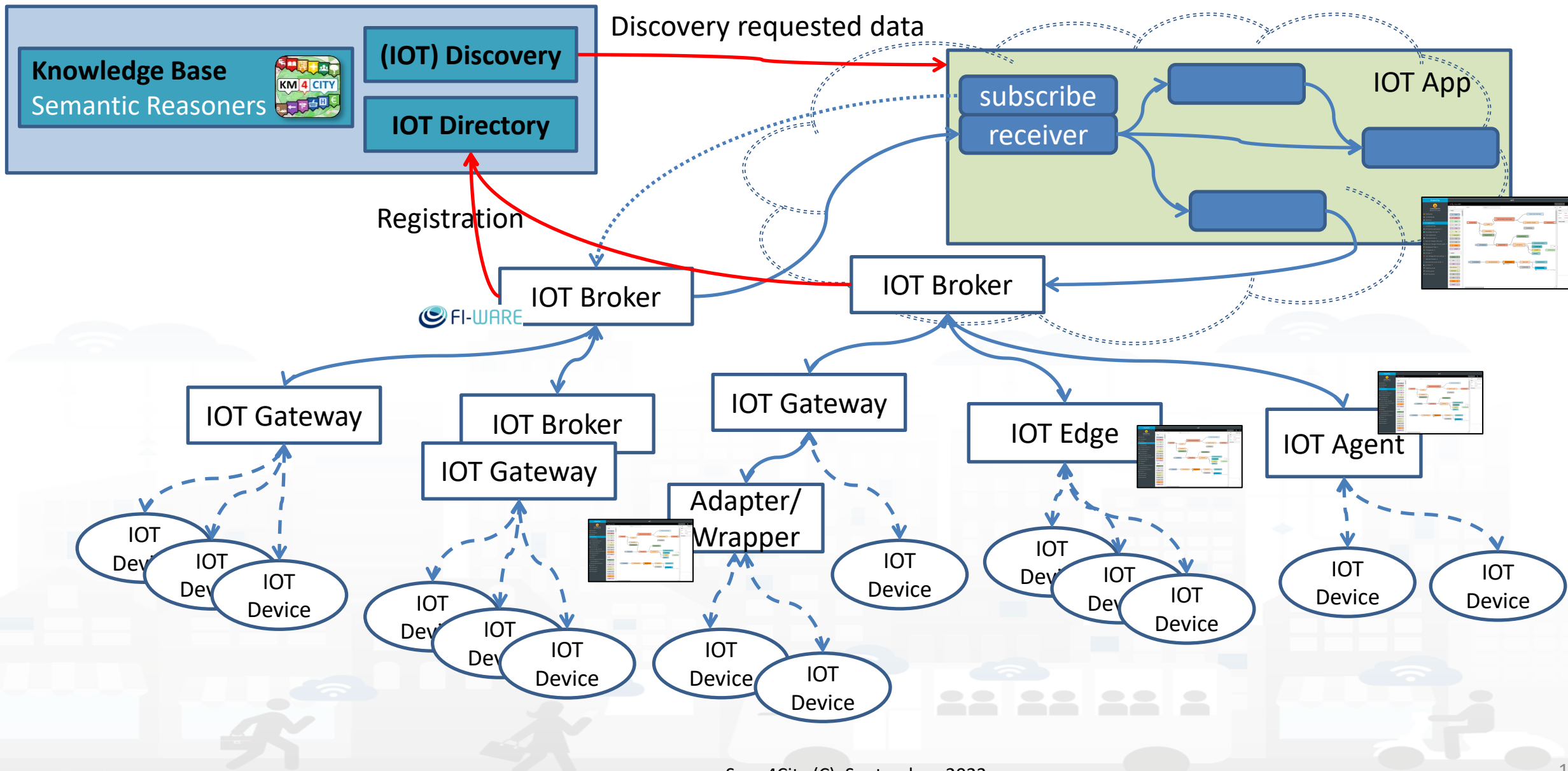
- **Creating IOT Applications with Node-RED**
- **IOT App = Node-RED + Snap4City**
- **Integration of External Services into IOT Applications**
- **IOT App Smartening Dashboards and Solutions: server side business logic**
- **IOT Network Management and Control**
- **IOT Devices hardware-software integration**
- **Using Data Models: FIWARE Smart Data Models, Snap4City IoT Device Models**
- **IOT end-2-end Secure Stack, IOT  $\leftrightarrow$  Dashboards**
- **Data Exchange and Distributed, computing on multiple Snap4City Domains**
- **Managing IOT Applications and Containers all**

# *IOT Interoperability*

**Compliant with:** AMQP, COAP, MQTT, OneM2M, HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, NGSI, LoRa, LoRaWan, TheThingsNetwork, SigFOX, DATEX II, Telegram, SMS, WebSocket, WebSocket Secure, ModBUS, OPC, GML, RS485, RS232, XML, JSON, CSV, GeoJSON, ESP32, Libelium, IBIMET/IBE, OBD2, XLS, XLSX, KNX, Enocean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Protocol Buffer, VMS, etc.



# IoT Network



IOT Device

# What About IoT Devices, Time Series



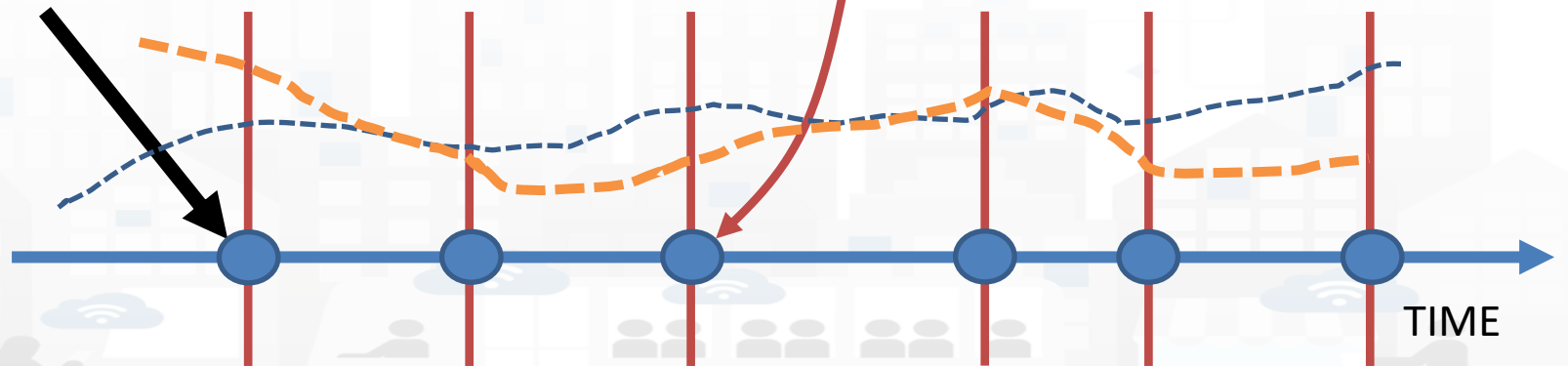
IOT Device

Sends a  
message

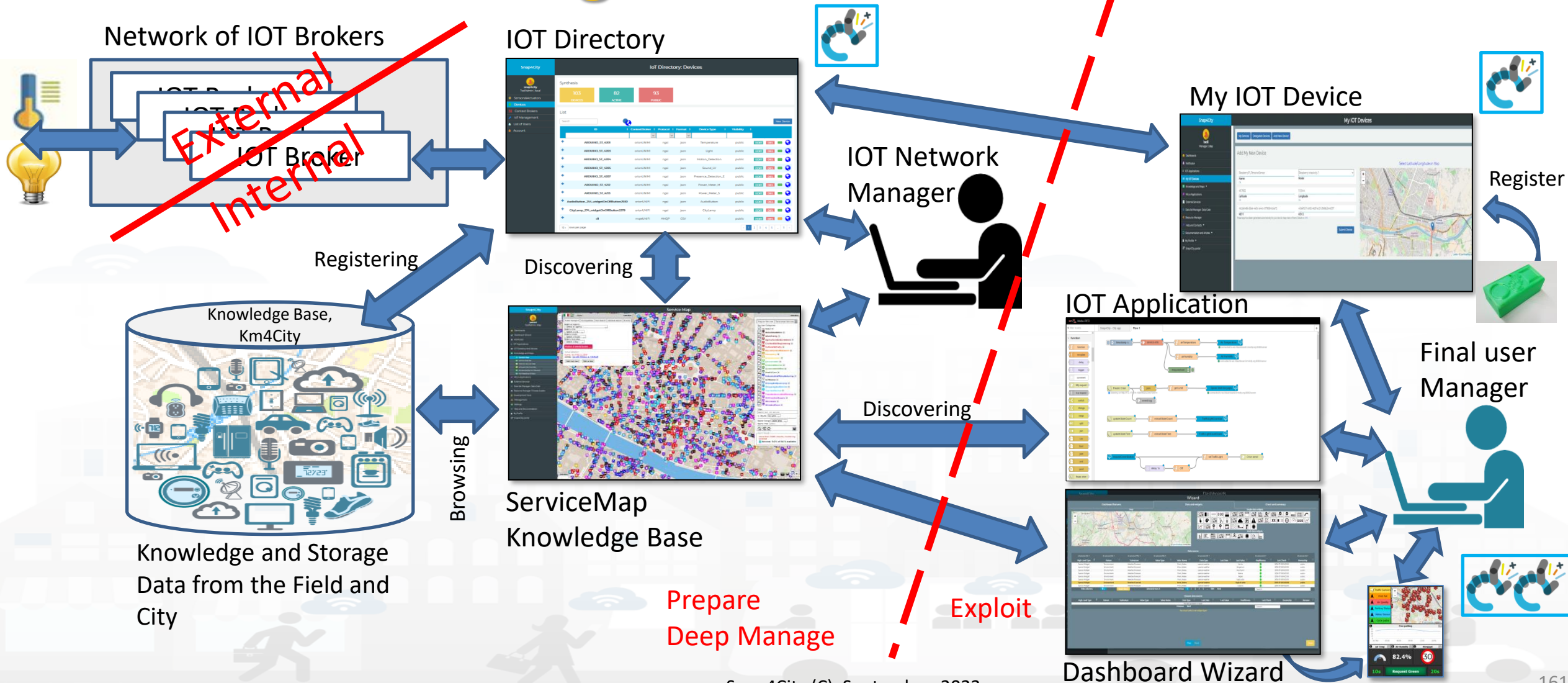
Message (  
timestamp: 02-04-2020 at 10:30,  
Temperature: 29.34,  
Humidity: 35  
)

- A set of data coming from an IoT Device with multiple sensor become a time series of values for devices.
  - For example: taking a new measure every 10 minutes (**Red Lines**)
  - Non regular rates can be valid data as well.
- Each new measure in Snap4City is conventionally time located in «**dateObserved**», which has to be **Unique**.
  - **Only one message per dateObserved is allowed**

dateObserved	Temp	Humidity
02-04-2020 10:30	34.5	23
02-04-2020 10:40	36.5	24
02-04-2020 10:50	36.0	22.5



# IOT Network Manager vs Final User





# Create/instantiate IOT Devices

**Snap4City** IOT Devices

User: paolodisti, Org: DISIT  
Role: AreaManager, Level: 3

Show: 10 entries

Device Identifier	IOT Broker	Device Type	Model	Ownership	Status	Edit	Delete	Location
adminDev1	orionUNIFI	Ambiental		PUBLIC	active			
angelo-prova780	orionUNIFI	Ambiental	Raspberry snap4city 1	PUBLIC	active			
ARDUINO_ST_4204	orionUNIMI	Motion_Detection	custom	PUBLIC	active			
ARDUINO_ST_4205	orionUNIMI	Sound_LV	custom	PUBLIC	active			
ARDUINO_ST_4207	orionUNIMI	Presence_Detection_E	custom	PUBLIC	active			
ARDUINO_ST_4212	orionUNIMI	Power_Meter_M	custom	PUBLIC	active			
ARDUINO_ST_4213	orionUNIMI	Power_Meter_S	custom	PUBLIC	active			
AudioButton_254_widgetOnOffButton2930	orionUNIFI	AudioButton		PUBLIC	active			
CityLamp_Z74_widgetOnOffButton3379	orionUNIFI	CityLamp		PUBLIC	active			
corarezzo	orionUNIFI	misura	statuscorregione	MYOWNPUBLIC	active	EDIT	DELETE	

Showing 1 to 10 of 170 entries

**A)**

**Snap4City** IOT Devices

User: paolodisti, Org: DISIT  
Role: AreaManager, Level: 3

Show: 10 entries

**Add new device**

IOT Broker: ContextBroker  
Info: sensor  
Position: Kind: Ok  
Static Attributes: Protocol: Device protocol is mandatory  
Values: Format: Device format is mandatory

Service/Tenant: ServicePath

Cancel Confirm

**New IOT Device From Scratch or from IOT Dev Model**

**Snap4City** My IOT Sensors and Actuators

User: paolodisti, Org: DISIT  
Role: AreaManager, Level: 3

Show: 10 entries

Device Identifier	Value Type	Device Type	Ownership	Status	Location
corarezzo	status	misura	MYOWNPUBLIC	active	
corarezzo	timestamp	misura	MYOWNPUBLIC	active	
corarezzo	people_count	misura	MYOWNPUBLIC	active	
corarezzo	status	misura	MYOWNPUBLIC	active	
corarezzo	people_count	misura	MYOWNPUBLIC	active	
corarezzo	people_count	misura	MYOWNPUBLIC	active	
corarezzo	people_count	misura	MYOWNPUBLIC	active	
corarezzo	people_count	misura	MYOWNPUBLIC	active	
corarezzo	people_count	misura	MYOWNPUBLIC	active	
corarezzo	people_count	misura	MYOWNPUBLIC	active	

Showing 1 to 10 of 476 entries

**B)**

**Snap4City** My IOT Sensors and Actuators

User: paolodisti, Org: DISIT  
Role: AreaManager, Level: 3

Show: 10 entries

**Add My New Device**

Device Identifier: ProvaSVGrmodel  
Model: Ok  
Latitude: 43.77605  
Longitude: 11.26099

KEY1: ccb23... KEY2: ccb23...

Submit Device

**New IOT Device (simplified creation) from IOT Device Model**



User: roottooladmin1, Org: DISIT  
Role: RootAdmin, Level: 7



Prev 1 2 3 ... 9 Next

Filter

- Dashboards
- My Dashboards
- Notificator
- IOT Applications**
- My Personal Data
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management
- Settings
- User Management and Auditing
- Help and Contacts
- Documentation and Articles
- My Profile
- Snap4City portal
- Km4City portal
- DISIT Lab portal

● 2018-09-14T04:44

IOT Edge App

owner: badii

● 2018-09-21T03:19

IOT Edge App

owner: panesi

● 2018-10-19T16:07

IOT Edge App

owner: pb3

● 2018-10-19T17:17

IOT Edge App

owner: pb3

● 2018-10-22T11:57

IOT Edge App

owner: semolarudy

● application

IOT Application

owner: tester5

● Bib APP

IOT Application

owner: semolarudy

● ChargingStations

IOT Application

owner: comunedashres

● Deprecated - SiIMobilityControlRoom

IOT Application

owner: badii

● SamsungGalaxyS4Barcode

IOT Edge App

owner: badii

● esercitazione

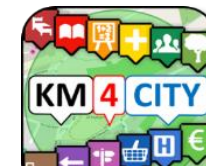
IOT Application

owner: tester2

● Iot-App

IOT Application

owner: tester14



# Proc.Logic / IoT App



User: paolo.disit, Org: DISIT  
Role: AreaManager, Level: 3  
[LOGOUT](#)



[Switch to Legacy Layout](#)

[CREATE NEW](#)

Dashboards (Public)



My Snap4City.org



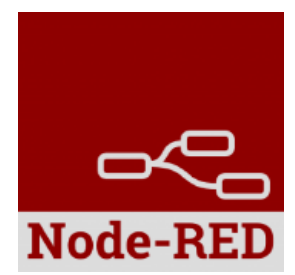
Tour Again

Sort icons: ↕, ↕, Prev 1 2 3 Next, Filter, Search, Close

- www.snap4solutions.org
- Dashboards of My Organization
- My Dashboards in My Organization
- My Data Dashboard Dev Kibana
- Extra Dashboard Widgets
- Data Management, HLT
- Knowledge and Maps
- Processing Logics / IOT App
  - Processing Logics / IOT App
  - MicroServices for Proc.Logic/IoT Apps
  - MicroServices from DataAnalytic
  - IOT MicroServices for Final Users
  - IOT MicroServices for Developers
  - DOC: Processing Logic/IOT App

<p>● 2020-07-28T10:20</p> <p>My own</p> <p>Management</p>	<p>● 2020-07-28T12:32</p> <p>My own</p> <p>Management</p>	<p>● 2020-08-18T08:38</p> <p>My own</p> <p>Management</p>	<p>● 2021-01-19T16:25</p> <p>My own</p> <p>Management</p>	<p>● 2021-08-21T13:26</p> <p>My own</p> <p>Management</p>
<p>● 2022-05-28T14:50</p> <p>My own</p> <p>Management</p>	<p>● actionurltest</p> <p>My own</p> <p>Management</p>	<p>● Alarm Management</p> <p>My own</p> <p>Management</p>	<p>● corona1</p> <p>My own</p> <p>Management</p>	<p>● coronaR</p> <p>My own</p> <p>Management</p>

The image shows a Node-RED interface within the Snap4City environment. The main workspace displays a flow named 'flow1' with several nodes connected in a sequence. The flow starts with a 'world map' node, followed by a 'point' function node, then a 'service-search-near-marker' node. This is followed by a 'transform results' function node, which connects to another 'world map' node. There are also 'event-log' and 'msg.payload' nodes. Below this, a 'timestamp' node connects to a 'service-info' node, which then connects to a 'vehicleFlow' function node. The 'vehicleFlow' node has multiple outputs, including 'vehicle flow (car/h)', 'worldmap', 'switch', and 'sensor abc'. Another 'timestamp' node connects to a 'last temperature' function node, which then connects to a 'Dashboard' node. The 'Dashboard' node is connected to a 'get v' function node, which in turn connects to an 'event-log' node and a 'Temperature' node. The right-hand panel shows flow information for 'flow1', including its name, ID, and status.



Data Adaption  
 Transformation, Conversion  
 Integration  
 Business Logic vs Dashboards

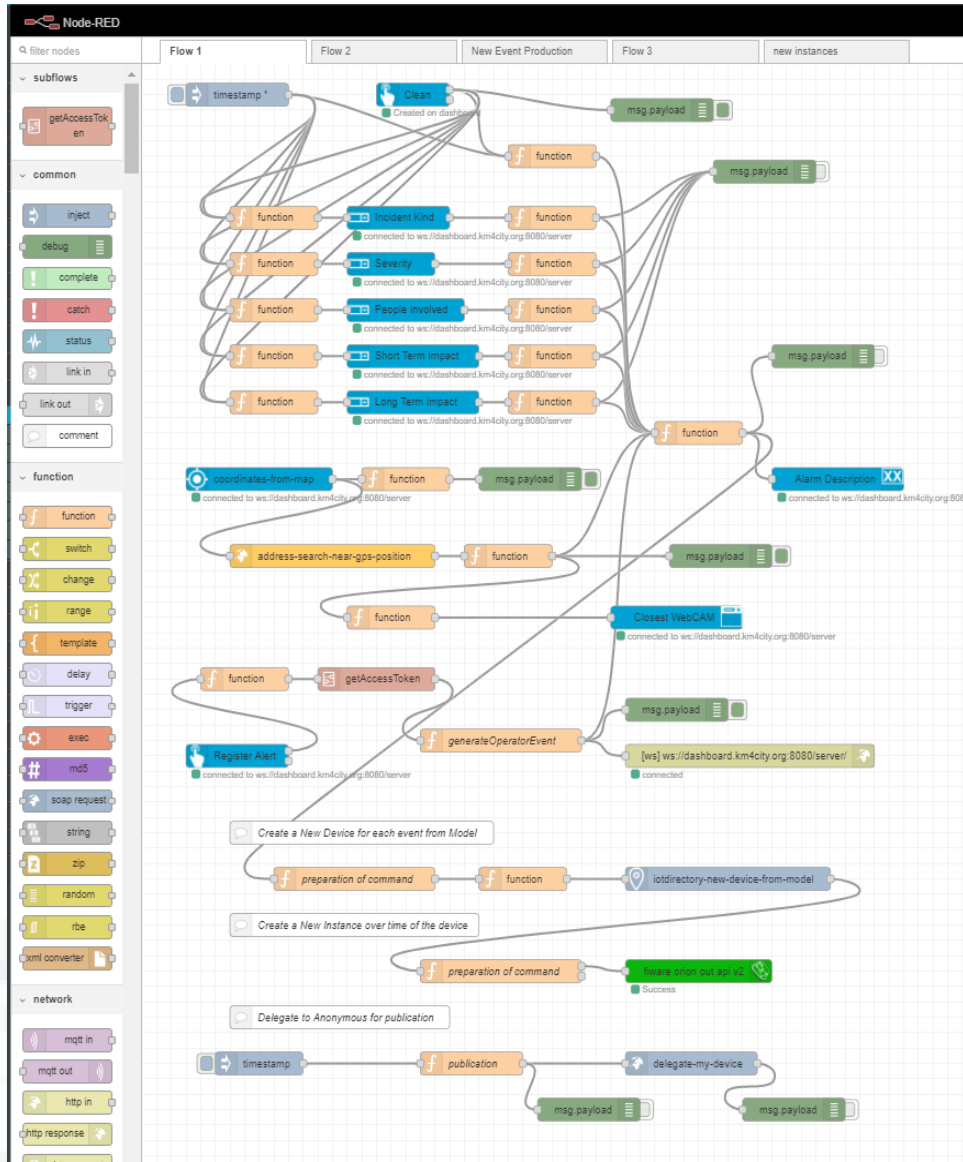
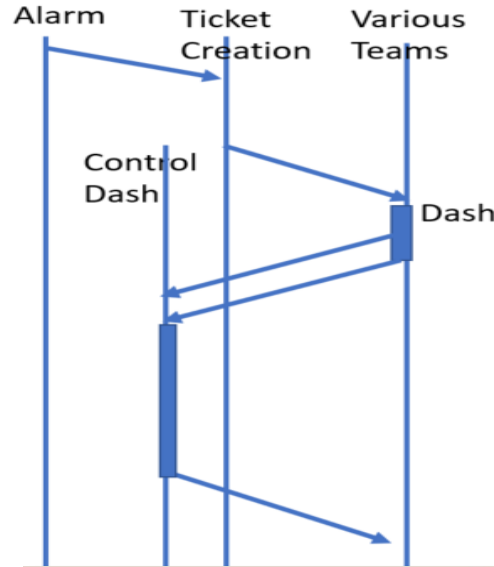
Editing IOT Applications

Data Analytics control

Everywhere: Cloud, on IoT Edge Devices



# Flow Mng



## Change Alert Color Status

Refresh List of events

Active Events

Change Color

**Alarm Description**

Ticket id: alert\_1610717428876  
 Last Color Code: Red  
 Date Time: 2021-01-15T15:17:30.800Z  
 Last data time: 2021-01-15T16:17:30.800+01:00  
 Kind: Fire  
 Severity: Low  
 #People: 100  
 Impact 1: Pollutant  
 Impact 2: Noise  
 GPS: 43.775494;11.222878

## Florence: Events in the city

Social Events, Traffic Events and Critical Events

**Traffic Events**

INTERESSATA AL PROVVEDIMENTO (CON PARTICOLARE RIFERIMENTO AGLI ACCESSI LATERALI ED AI PASSI CARRABILI E SULLE DIRETTICI DI ACCESSO E DI USCITA ALL'AREA.

**DIVERSION IN OPERATION**

18/01/2021 09:00:00 10

**ORDINANZA N.44/2021 - ISTITUZIONE DI DIVIETO DI TRANSITO A TUTTI I VEICOLI (FG. 0.46 ART. 119) ECCEZIO MEZZI DI SOCCORSO DIRETTI ALL'AREA INTERDETTA E VEICOLI IN INGRESSO E USCITA DAI PASSI CARRABILI E FRONTISTI.**

**CLOSED AHEAD**

18/01/2021 07:00:00 10

**ORDINANZA N.24/2021 - STRADA INTERDETTA ALL'ALTEZZA DEL CANTIERE: ISTITUZIONE DI DIVIETO DI TRANSITO A TUTTI I VEICOLI (FG. 0.46 ART. 119) ECCEZIO MEZZI DI SOCCORSO DIRETTI ALL'AREA INTERDETTA E VEICOLI IN INGRESSO E USCITA DAI PASSI CARRABILI I VEICOLI AUTORIZZATI, IL CUI TITOLARIO DEVE NECESSARIAMENTE INTERESSARE IL TRATTO DI STRADA IN OGGETTO, DOTTRANO CIRCOLO ASE**

**Operator Events**

TICKET	OPERATOR
1610755283309	PAOLO DISIT
15/01/2021 14:39:28	
1610717428876	PAOLO DISIT
15/01/2021 14:27:27	
161074972614	PAOLO DISIT

**Florence Events**

FIRENZE, DOVE, COSA

Free

1 WEBINAR DI CONOSCI FIRENZE

JAMES LEVINE

INCONTRI CON LA CITTÀ 2020-2021 - IN STREAMING

NAPULE '70

LAVAY SHANI

**Parking Free Spaces: S. Lorenzo**

**Parking Free Spaces: S.M.N. Station**

<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MjM1Ng==>

TOP

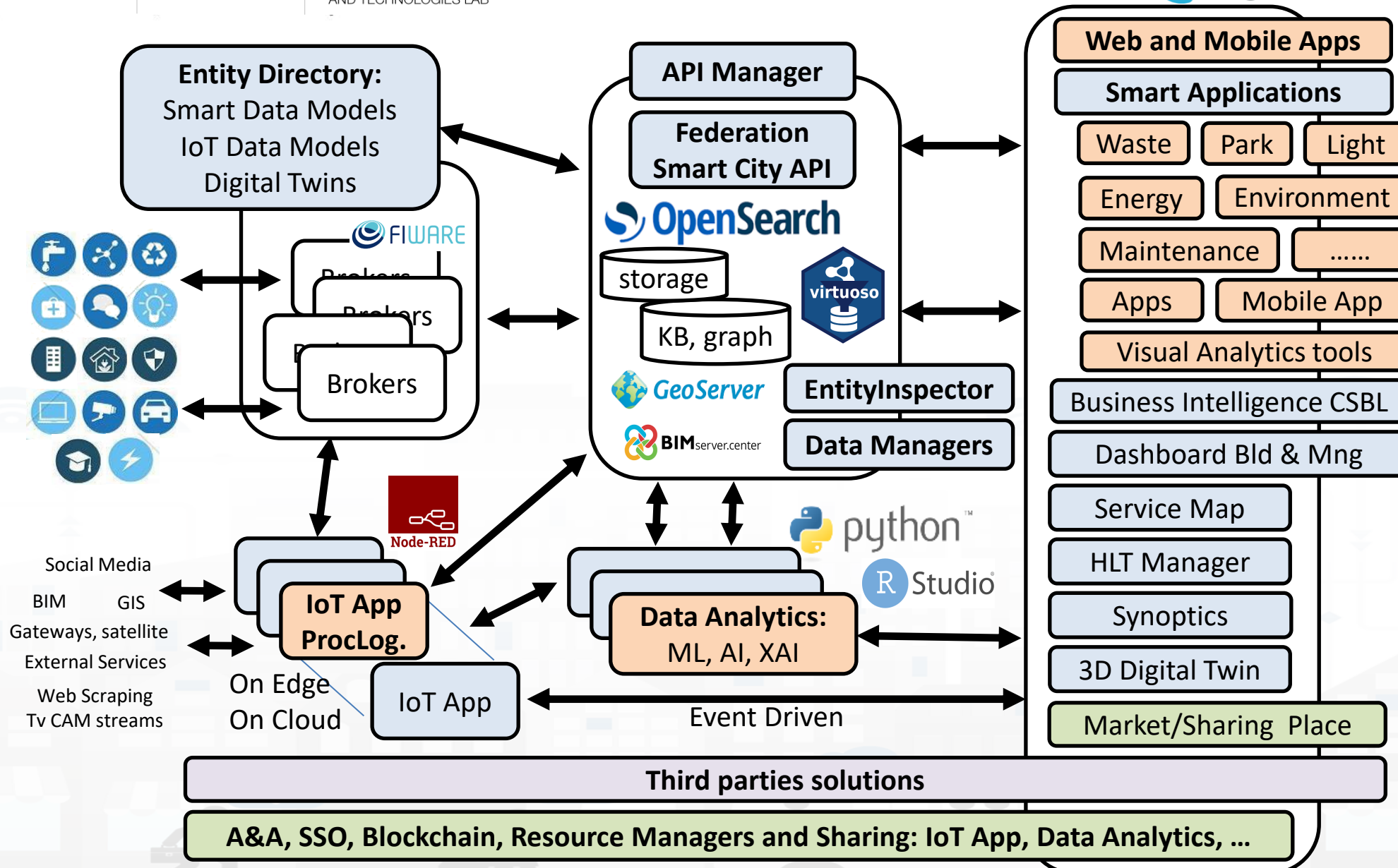
# Data Analytics and Artificial Intelligence



	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
what	Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								



# Tech Arch



# Agenda of forth part

- Why and Where use DA, AI and XAI ? General Life Cycle
- Data Processing
- What is Data Analytics, DA and Artificial Intelligence, AI
- List of the most relevant available DA and AI Solutions
- Predictions and Anomaly detections
- Computing: Higher Level Types Data and their representations
- How AI/XAI, and Life Cycle
- Using DA, AI, XAI in Snap4City infrastructures
  - Data Analytics  $\leftrightarrow$  IoT App / Proc.Logic
- Decision Support Systems and What-If Analysis
- Routing, Multimodal Routing, Dynamic Routing
- Business Intelligence and Visual Analytics
- Training Material

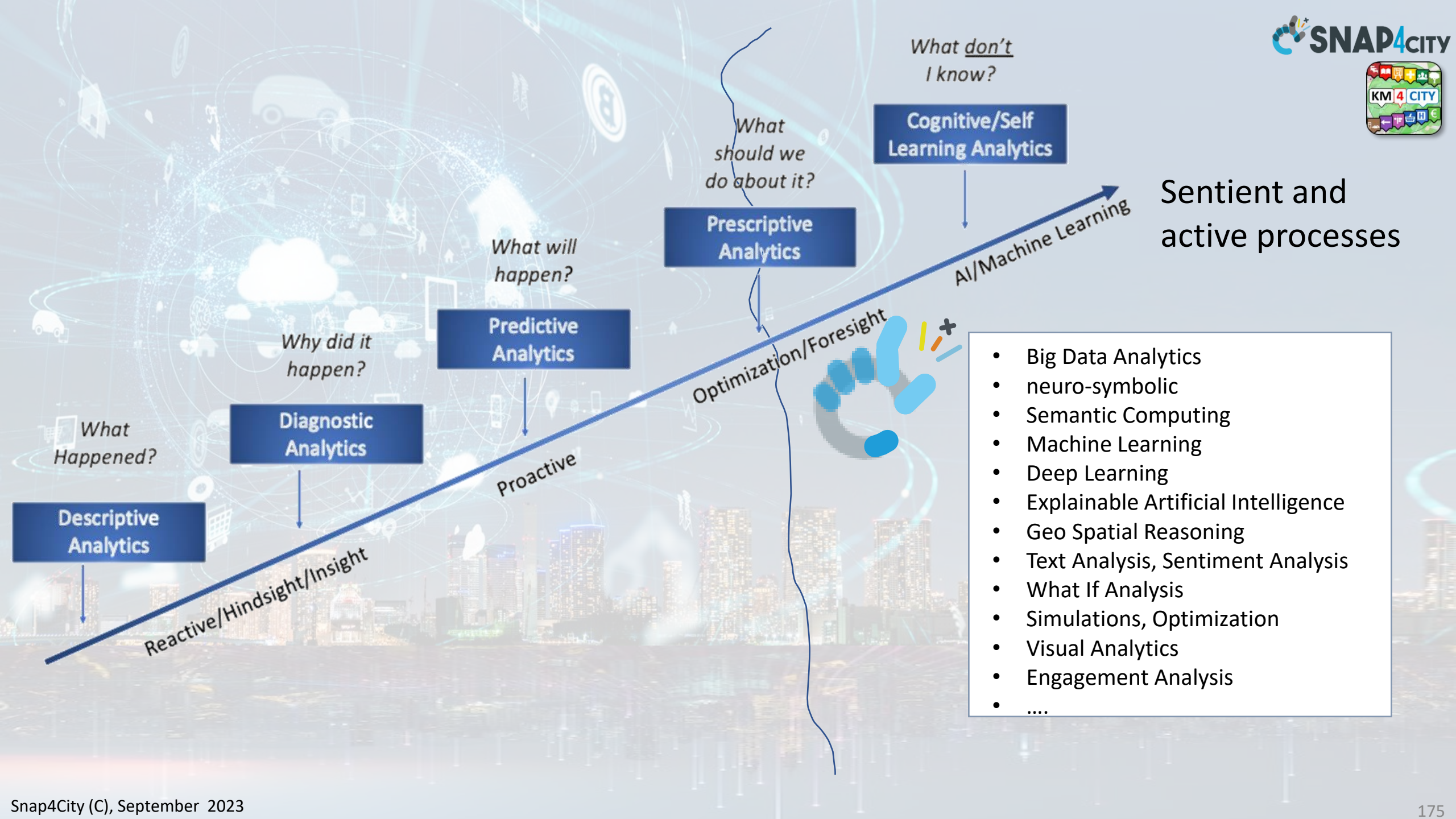
# Available DA / AI Solutions on Snap4City

- **Mobility and Transport**
- **Environment, Weather, Waste, Water**
- **City Users Behaviour and Social analysis**
- **Energy and Control, Security, .....**
- **High Level Decision Support Solutions**
  - **Management Strategies**
  - **Resilience and Risks Analysis**
- **Low level Techniques**

<https://www.snap4city.org/download/video/course/da/>



[https://www.snap4city.org/download/video/DPL\\_SNAP4SOLU.pdf](https://www.snap4city.org/download/video/DPL_SNAP4SOLU.pdf)



What *don't* I know?

Cognitive/Self Learning Analytics

What should we do about it?

Prescriptive Analytics

What will happen?

Predictive Analytics

Why did it happen?

Diagnostic Analytics

What Happened?

Descriptive Analytics

Reactive/Hindsight/Insight

Proactive

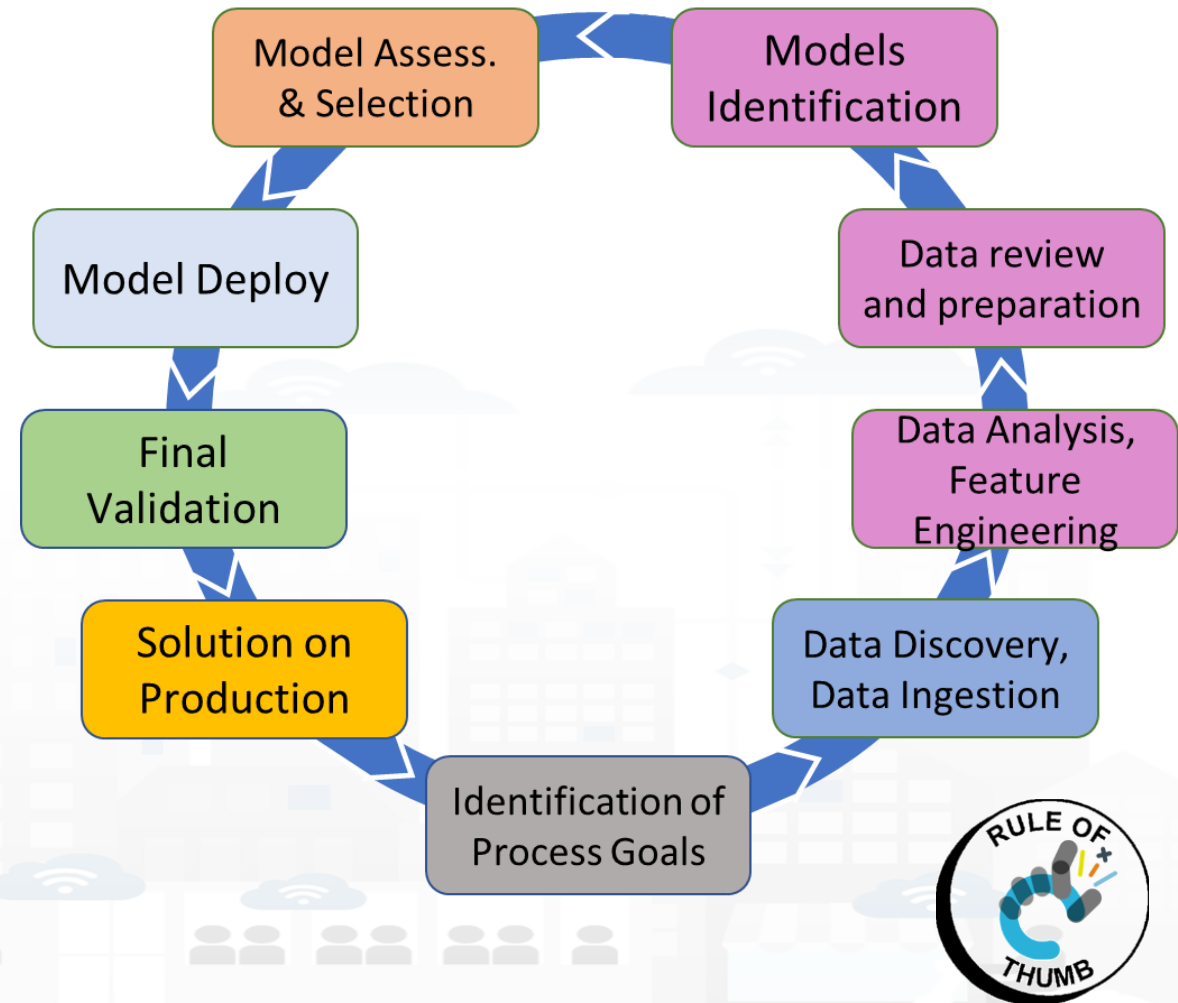
Optimization/Foresight

Sentient and active processes

- Big Data Analytics
- neuro-symbolic
- Semantic Computing
- Machine Learning
- Deep Learning
- Explainable Artificial Intelligence
- Geo Spatial Reasoning
- Text Analysis, Sentiment Analysis
- What If Analysis
- Simulations, Optimization
- Visual Analytics
- Engagement Analysis
- ....

# Model/Technique Development/testing

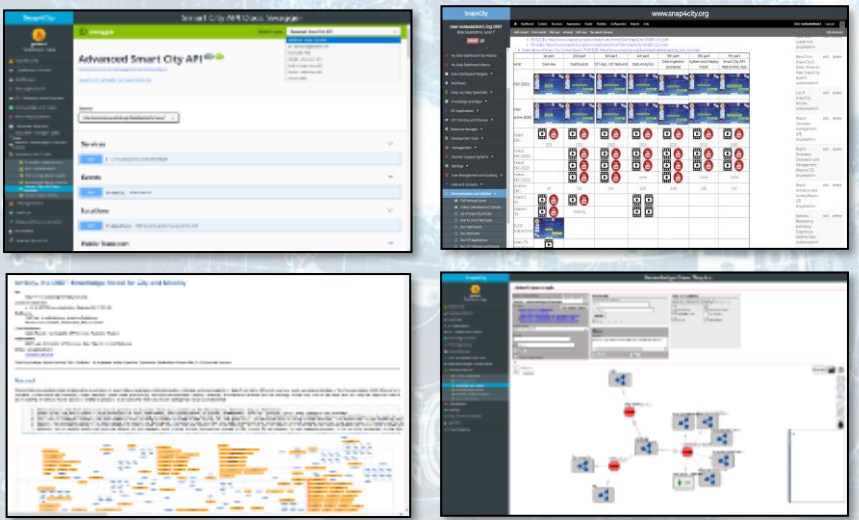
- **Identification of Process goals and Planning**
  - Which goals
  - How to compute, which language
  - Which environment, which libraries
- **Data Discovery and Ingestion (from the general life cycle)**
- **Data Analysis: feature engineering, feature selection**
- **Data review and preparation for the model**
- **Model Identification and building: ML, AI, etc....**
  - Training
  - Tuning hyperparameters when possible
- **Model Assessment and Selection**
  - Validation in testing
  - Assessment on a set of metrics depending on the goals: global relevant and feature assessment
  - Assessing computational costs
  - Impact Assessment, Ethic Assessment and incidental findings
  - Global and Local Explanation via Explainable AI techniques
- **Model Deploy and Final Validation**
  - Optimisation of computation cost for features, if needed reiterate
- **Solution on Production (security, scalability, etc.)**



# Data Analytics on Snap4City platform



Swagger

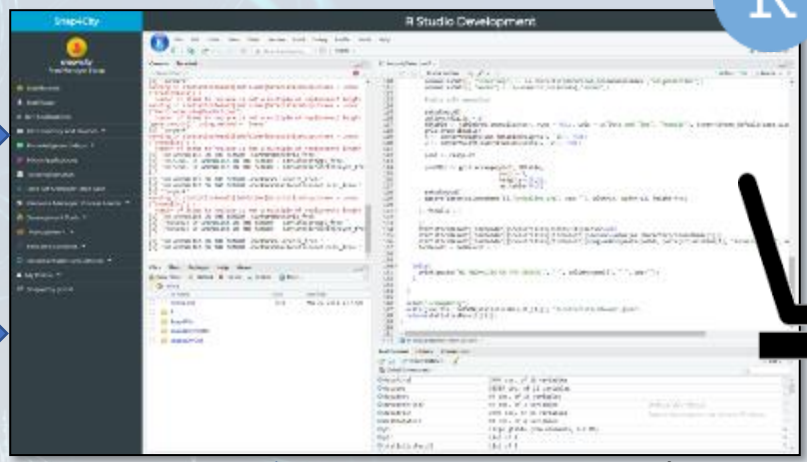


Ontology Schema

LOG.disit.org



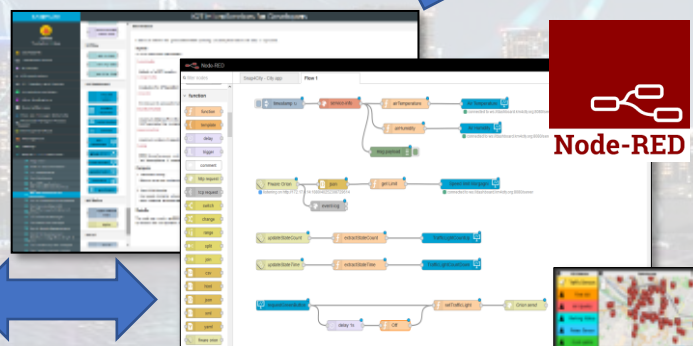
Smart City API from Knowledge Base and other tools



Creating MicroServices



Saving / Sharing reusing



Using them into IOT Applications



Resource Manager

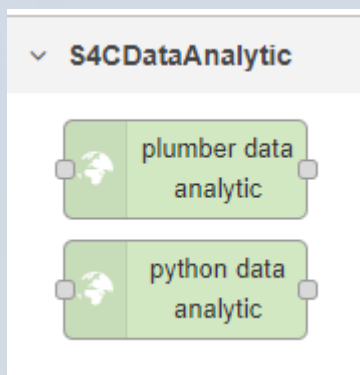
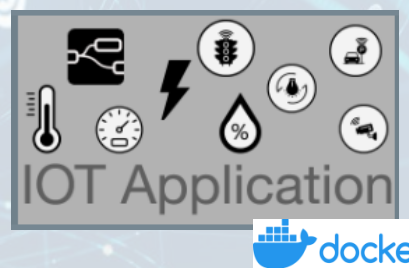




# Data Analytic Container



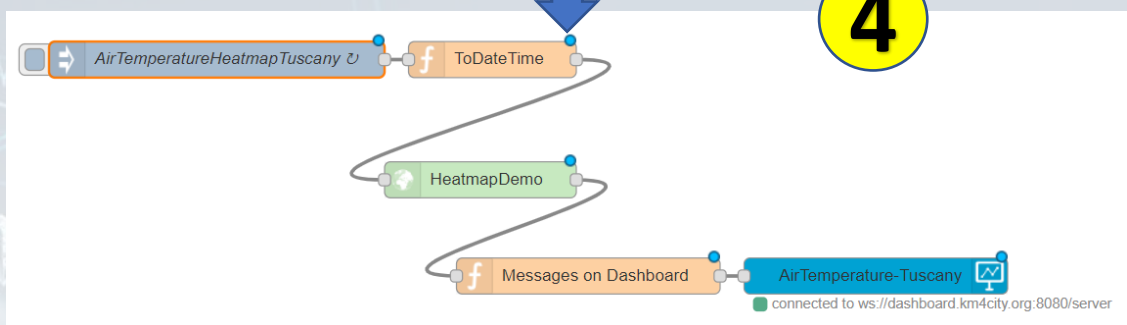
**2** Open an Advanced IoT App / Node-RED



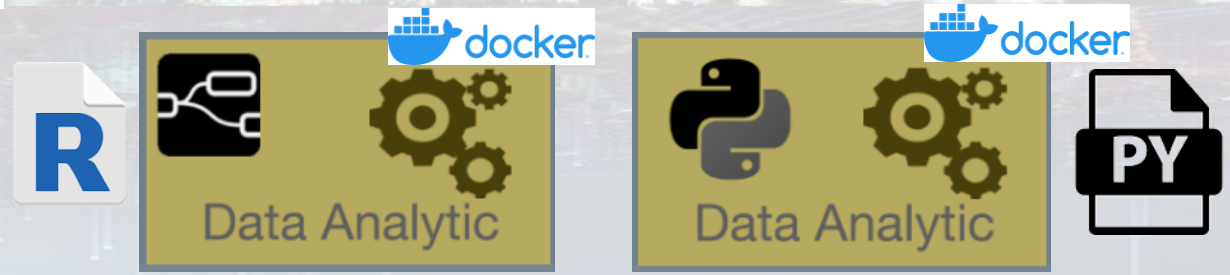
**3** Use Snap4City Data Analytic Node, and load in the code you developed.

**1** Develop .py or .r program on (i) Snap4City platform online, or (ii) your Development Machine.

The code has to respect the guidelines provided for creating API.  
The API are called as a MicroService  
For example see:  
<https://www.snap4city.org/641>  
<https://www.snap4city.org/645>



**4** Deploy the IoT App → Snap4City Container Manager based on Marathon/Mesos is creating a Container for your Data Analytic code



TOP

# Data Model, Ingestion and Management



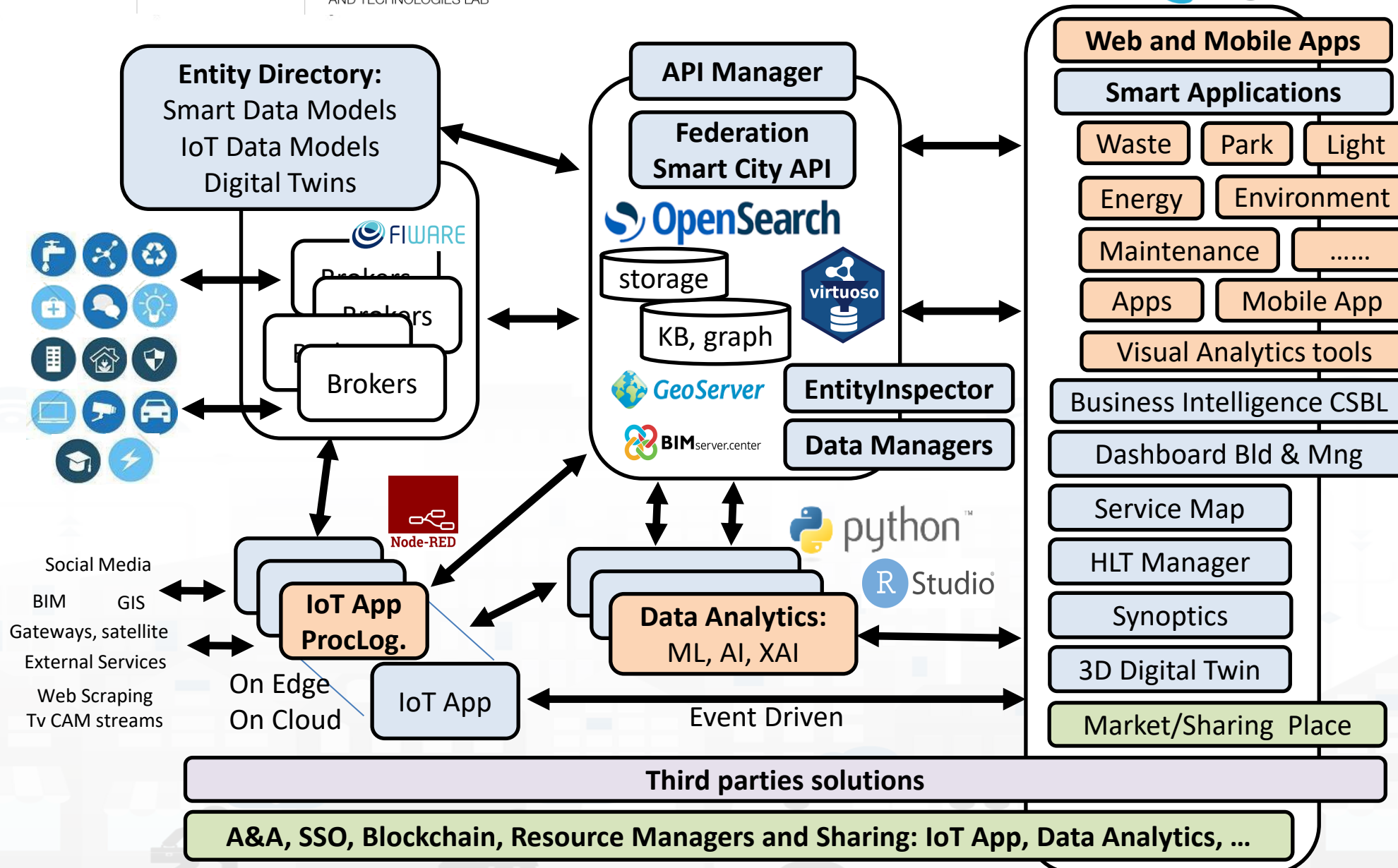
	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
what	Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								



# Data Ingestion Agenda

- Data Types
- Data Ingestion Capabilities and Architecture
- Data Ingestion Strategy and Tools
- Data Inspector tool
- Connecting devices, external servers, any network
- Interoperability, smart data models. satellite
- Data Ingestion in Python

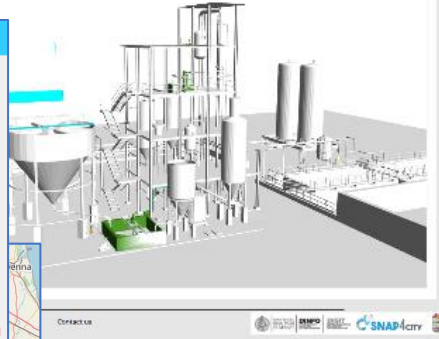
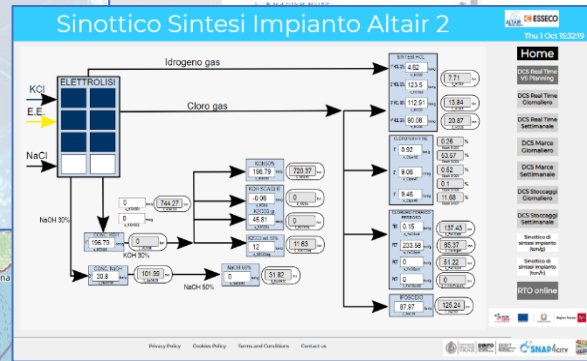
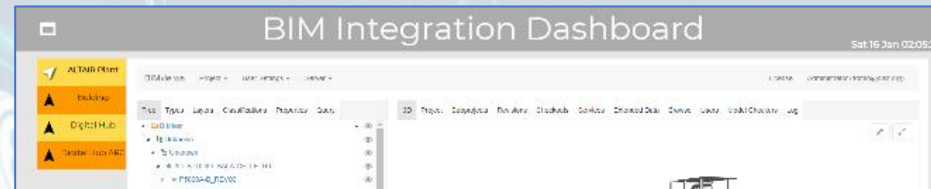
# Tech Arch



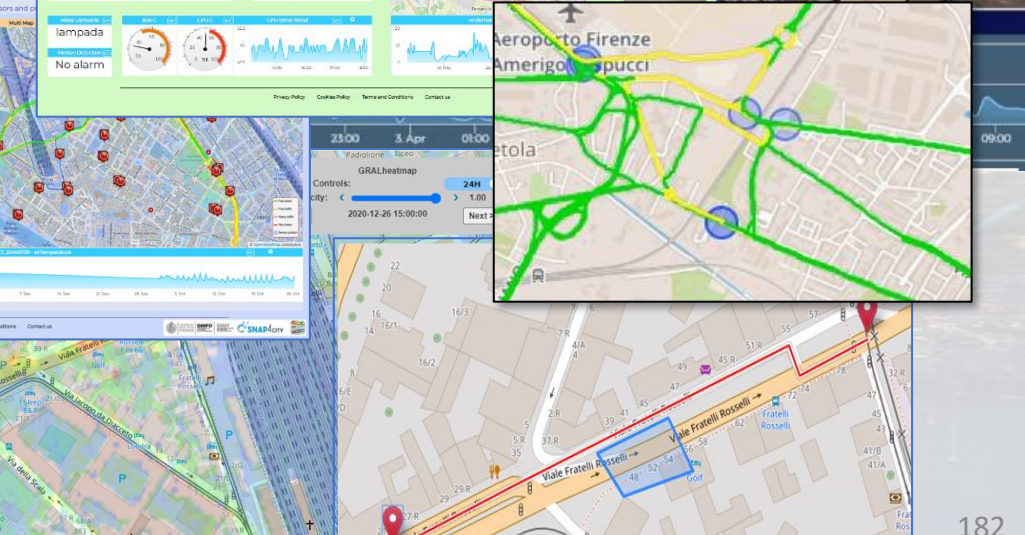
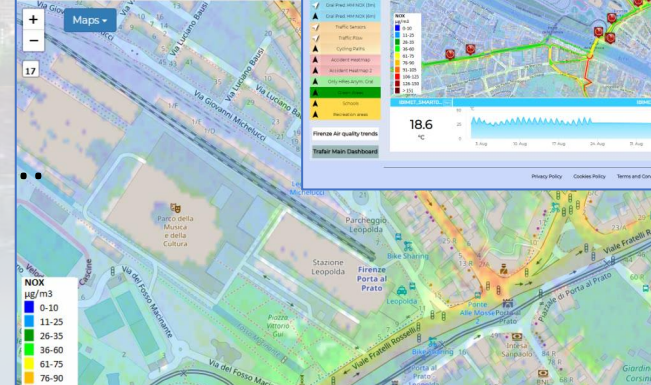
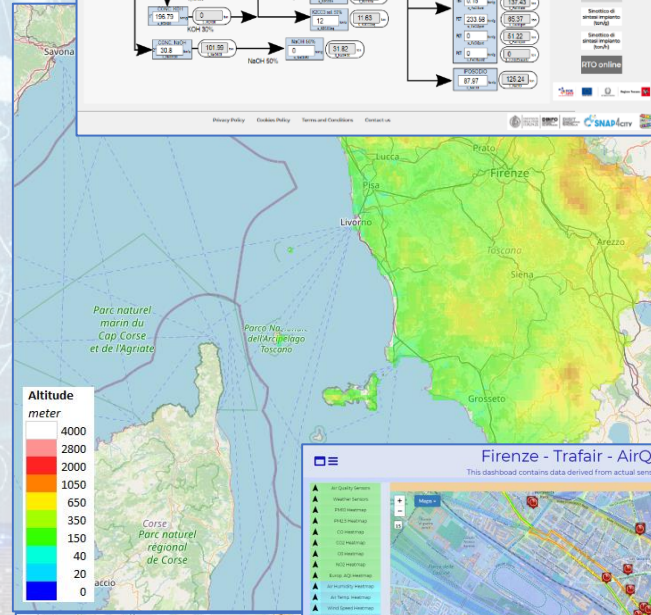
# High Level Types

Snap4City (C), September 2023

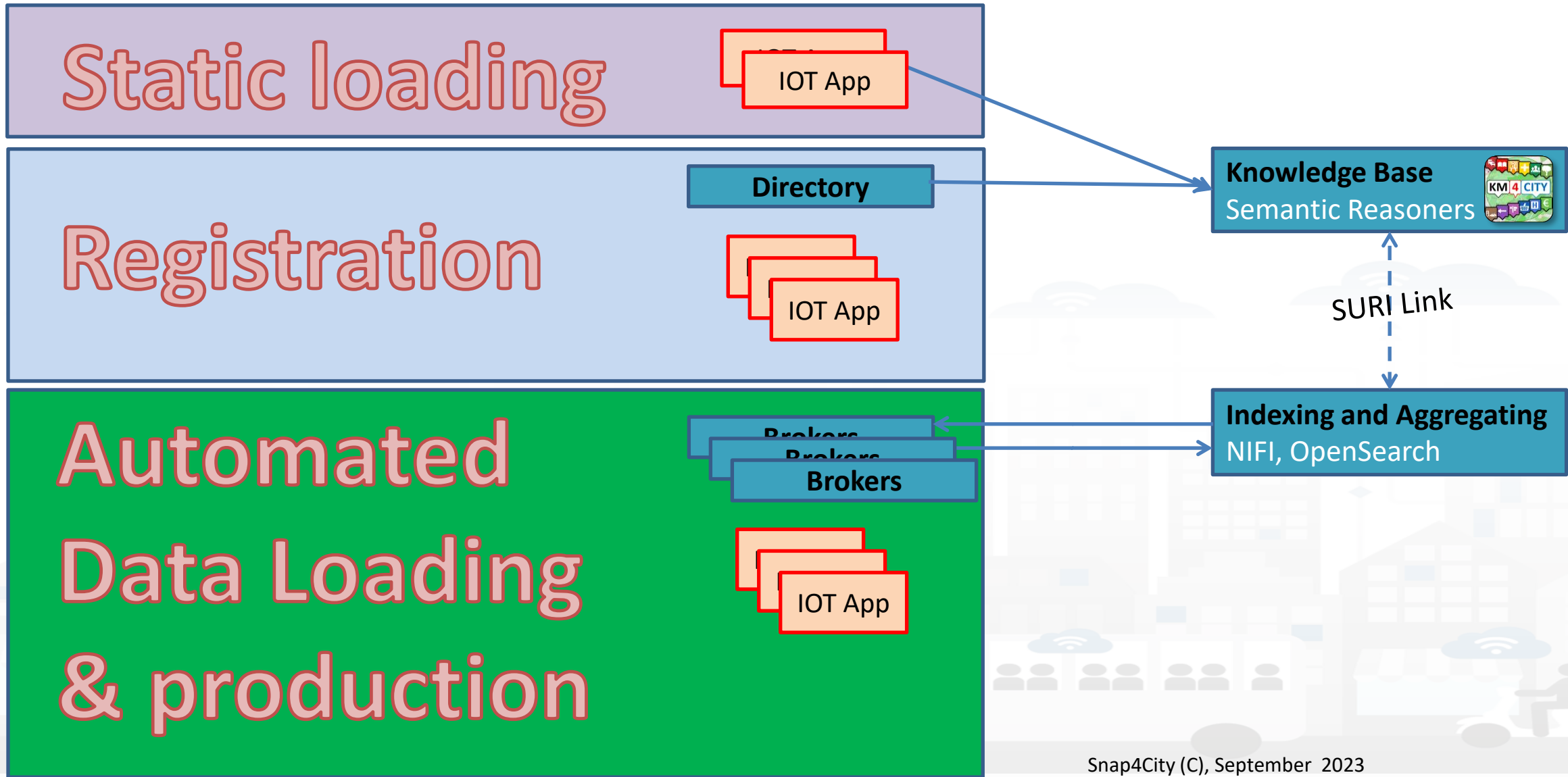
- POI, IOT Devices, shapes, ...
  - FIWARE Smart Data Models,
  - IoT Device Models
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ...
- Satellite data, ...
- traffic flow, typical trends, ...
- trajectories, events, Workflow, ...
- 3D Models, BIM, Digital Twins, ...
- OD Matrices of several kinds, ...
- Dynamic icons/pins, ...
- Synoptics, animations, ...
- KPI, personal KPI, ...
- social media data, TV Stream,
- routing, multimodal, constraints, ...
- decision scenarios, ....
- etc.



**SNAP4CITY**  
- Digital Twin Global - Fire  
demonstrator



# Snap4city Data Ingestion Flow Diagram

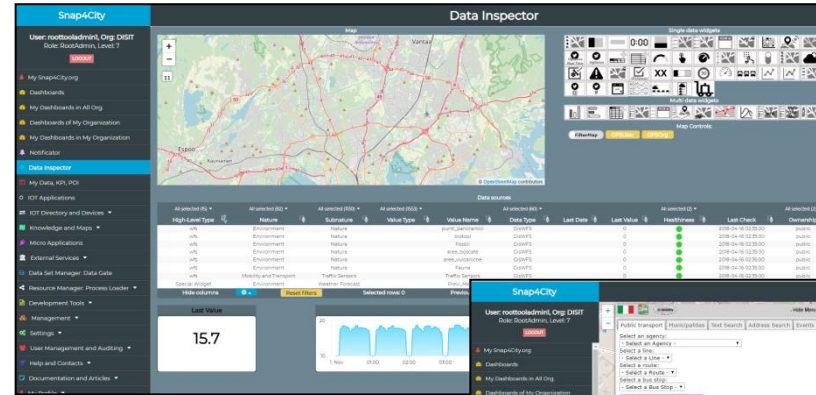


# Checking data ingestion results

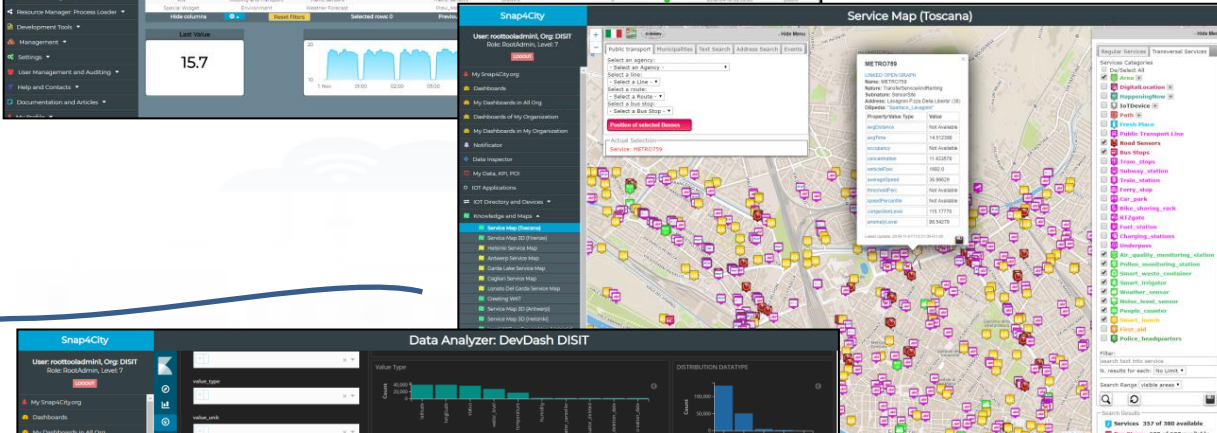
Knowledge base  
Semantic reasoners



- **Data Inspector**
- **ServiceMap, SCAPI**
  - LOG / LOD viewer
  - Super Service Map
- IOT Directory
- SCAPI: Swagger
- IOT Broker



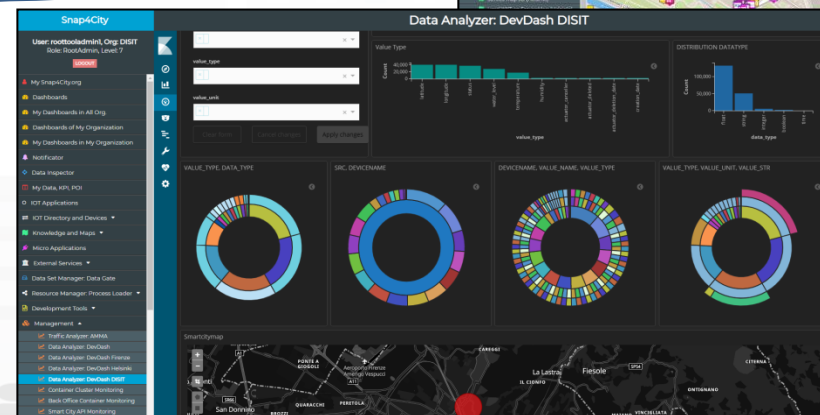
Data Inspector  
Digital Twin view



ServiceMap

Indexing and aggregating  
NIFI, OpenSearch

- **Data Inspector**
- **ServiceMap, SCAPI**
- **My Data Dashboard (Kibana), DevDash**
- **Open Distro (ElasticSearch)**



My Data Dashboard  
DevDash



**Snap4City**

User: roottooladmini, Org: DISIT  
Role: RootAdmin, Level: 7

[LOGOUT](#)

- My Snap4City.org
- Dashboards
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- Notificator
- Data Inspector**
- My Data, KPI, POI
- IOT Applications
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management
- Settings
- User Management and Auditing
- Help and Contacts
- Documentation and Articles

**Data Inspector**

Map

Single data widgets  
Multi data widgets

Map Controls:  
[FilterMap](#) [GPSUser](#) [GPSOrg](#)

Data sources

Sensor	All selected (7)
High-Level Type	Nature
Sensor	Environment
Sensor	Environment
Sensor	Environment
Sensor	Environment
Sensor	Environment
Sensor	Environment
Sensor	Environment

Last Value: **14.9**

Data sources Details

Device	Values	Healthiness	Process	Image	Licensing	User
GPS Coordinates:	42.642033, 18.1122					
High-Level Type:	Sensor					
Nature:	From IOT Device to KB					
Subnature:	IoTSensor					
Value Name:	DubrovnikorionDubrovnik-UNIFI:camera_Dubrovnik_1_Ploce					
Device ServiceURI or Data ID:	http://www.disit.org/km4city/resource/iot/orionDubrovnik-UNIFI/Dubrovnik/camera_Du					
Sensor ServiceURI or Data ID:	http://www.disit.org/km4city/resource/iot/orionDubrovnik-UNIFI/Dubrovnik/camera_Du					
Datasource:	IoT					
Ownership:	private					
Organizations:	Dubrovnik					

[Link to Service Map](#) [Link to IoT Device](#)

Healthiness table:

Healthiness	Check	Ownership
●	2019-08-13 07:18:30	public
●	2019-08-13 07:18:30	public
●	2019-08-13 07:18:30	public
●	2019-08-13 07:18:30	public
●	2019-08-13 07:18:30	public
●	2019-08-13 07:18:30	public
●	2019-08-13 07:17:27	public
●	2019-08-13 07:17:27	public



- Click with the mouse on it

**HLT: Sensor**

Knowledge Base view

Knowledge base entry details:

- Name: orionDubrovnik-UNIFI:camera\_Dubrovnik\_1\_Ploce
- High-Level Type: Sensor
- Nature: From IOT Device to KB
- Subnature: IoTSensor
- Value Name: DubrovnikorionDubrovnik-UNIFI:camera\_Dubrovnik\_1\_Ploce
- Device ServiceURI or Data ID: http://www.disit.org/km4city/resource/iot/orionDubrovnik-UNIFI/Dubrovnik/camera\_Du
- Sensor ServiceURI or Data ID: http://www.disit.org/km4city/resource/iot/orionDubrovnik-UNIFI/Dubrovnik/camera\_Du
- Datasource: IoT
- Ownership: private
- Organizations: Dubrovnik

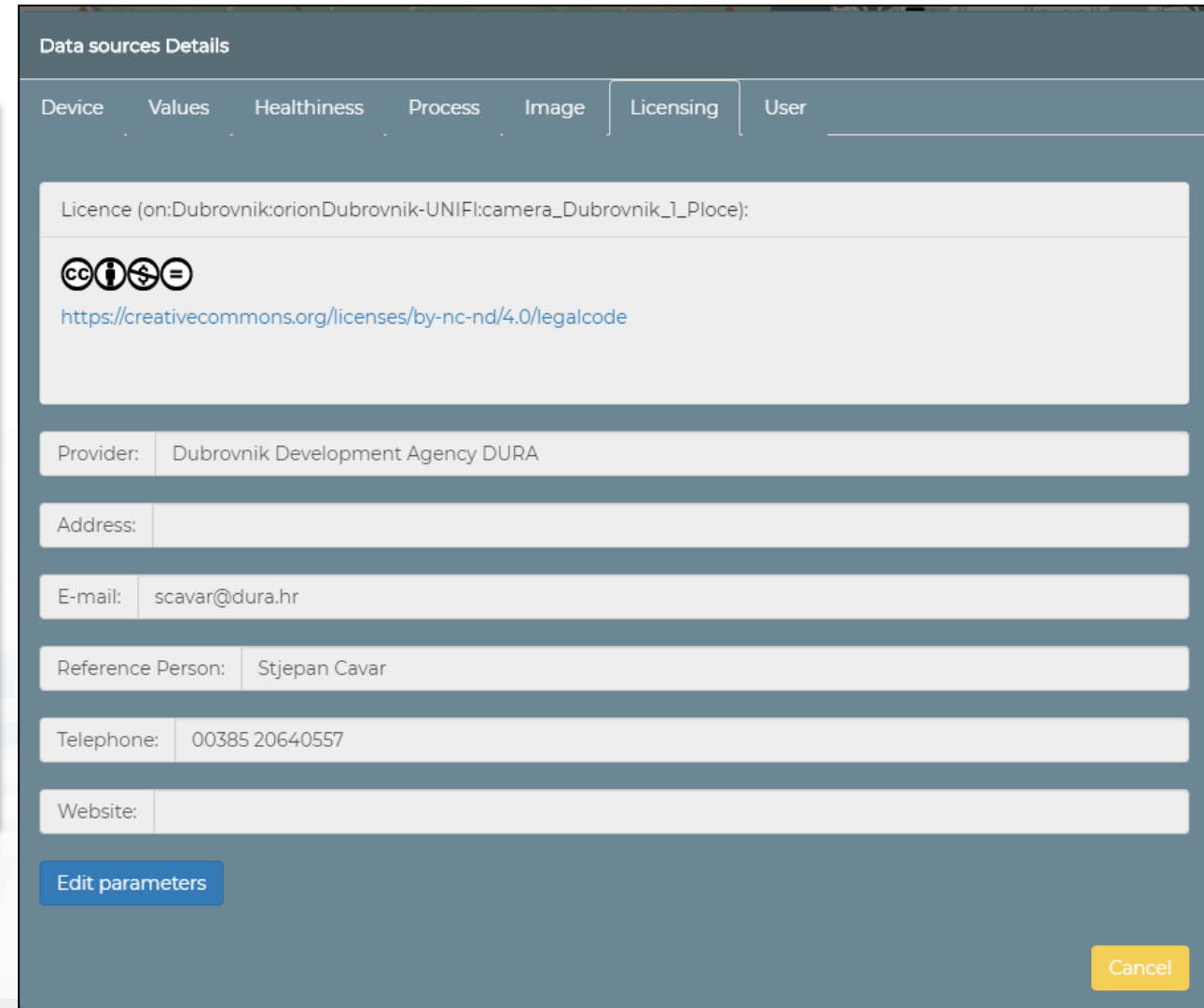
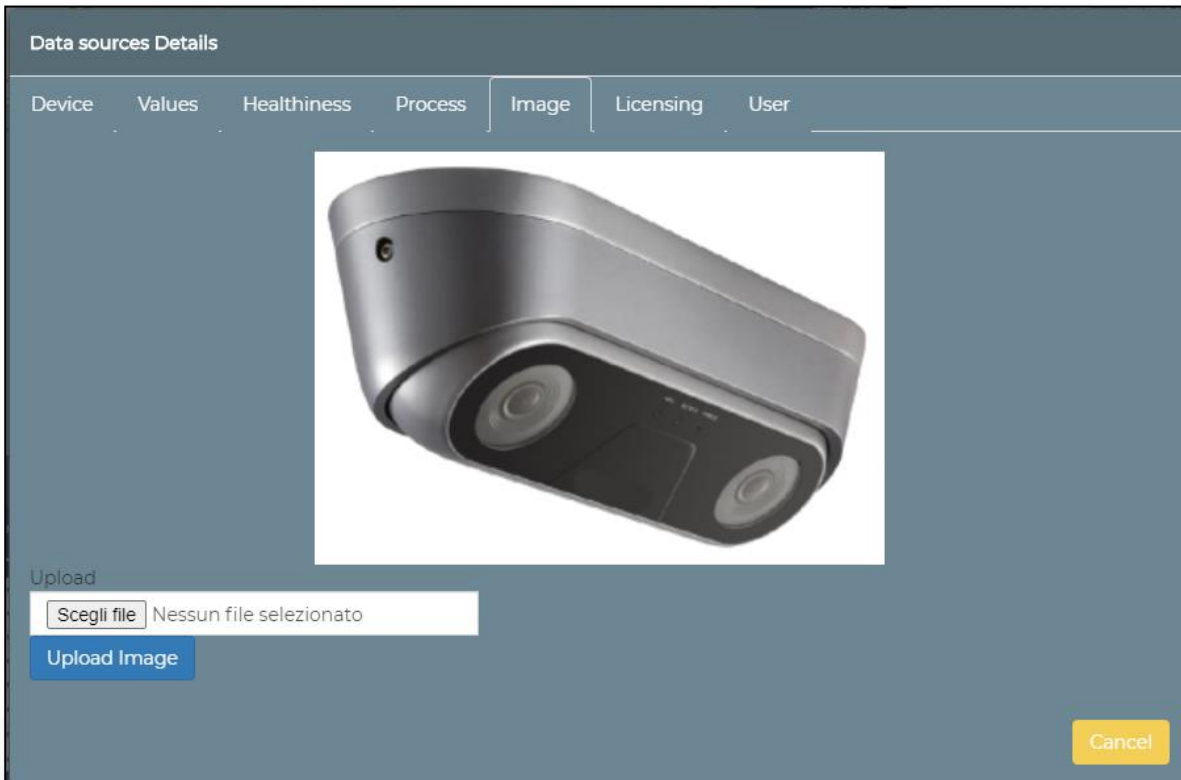
**IOT Devices**

IOT Device	IOT Broker	Device Type	Model	Ownership	Status	Soft	Delete	Location
AccessPoint1_FerniaSuperstore	orionLonatoDeCarda-UNIFI	AccessPointSensor	AccessPointLonato	DELEGATED	active	EDIT	DELETE	
AccessPoint2_ITIS	orionLonatoDeCarda-UNIFI	AccessPointSensor	AccessPointLonato	DELEGATED	active	EDIT	DELETE	
AccessPoint3_Datareport	orionLonatoDeCarda-UNIFI	AccessPointSensor	AccessPointLonato	DELEGATED	active	EDIT	DELETE	
adminDev1	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	
AdminDevice001	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	
AdminDevice002	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	
AdminDevice004	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	
AdminDevice005	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	
AdminTest005	orionUNIFI	Ambiental		MYOWNPRIVATE	active	EDIT	DELETE	

Showing 1 to 10 of 370 entries

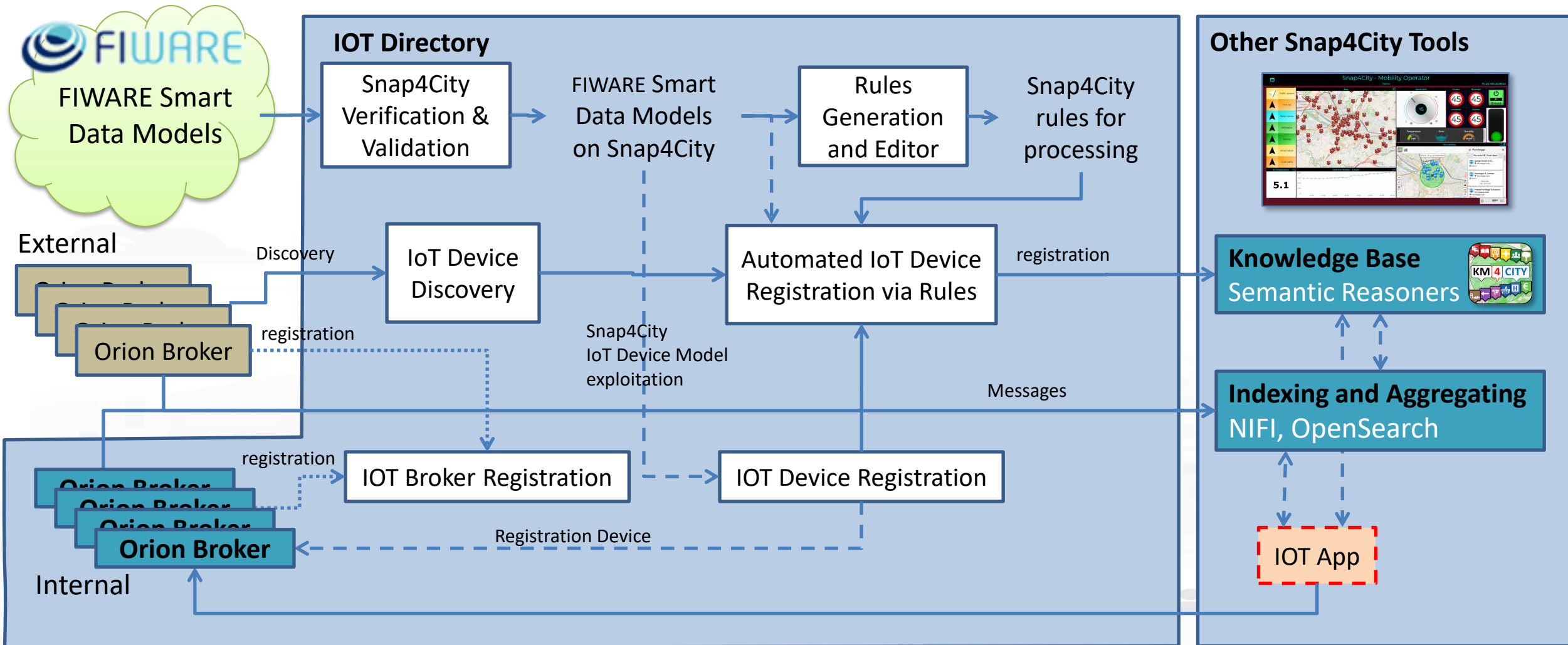
Some functionalities are limited to certain roles

## Image of the Devices and Licensing



*Some functionalities are limited to certain roles*

# Exploiting FIWARE Smart Data Models





TOP

# Smart City API and Federation Mobile & Web App SDK

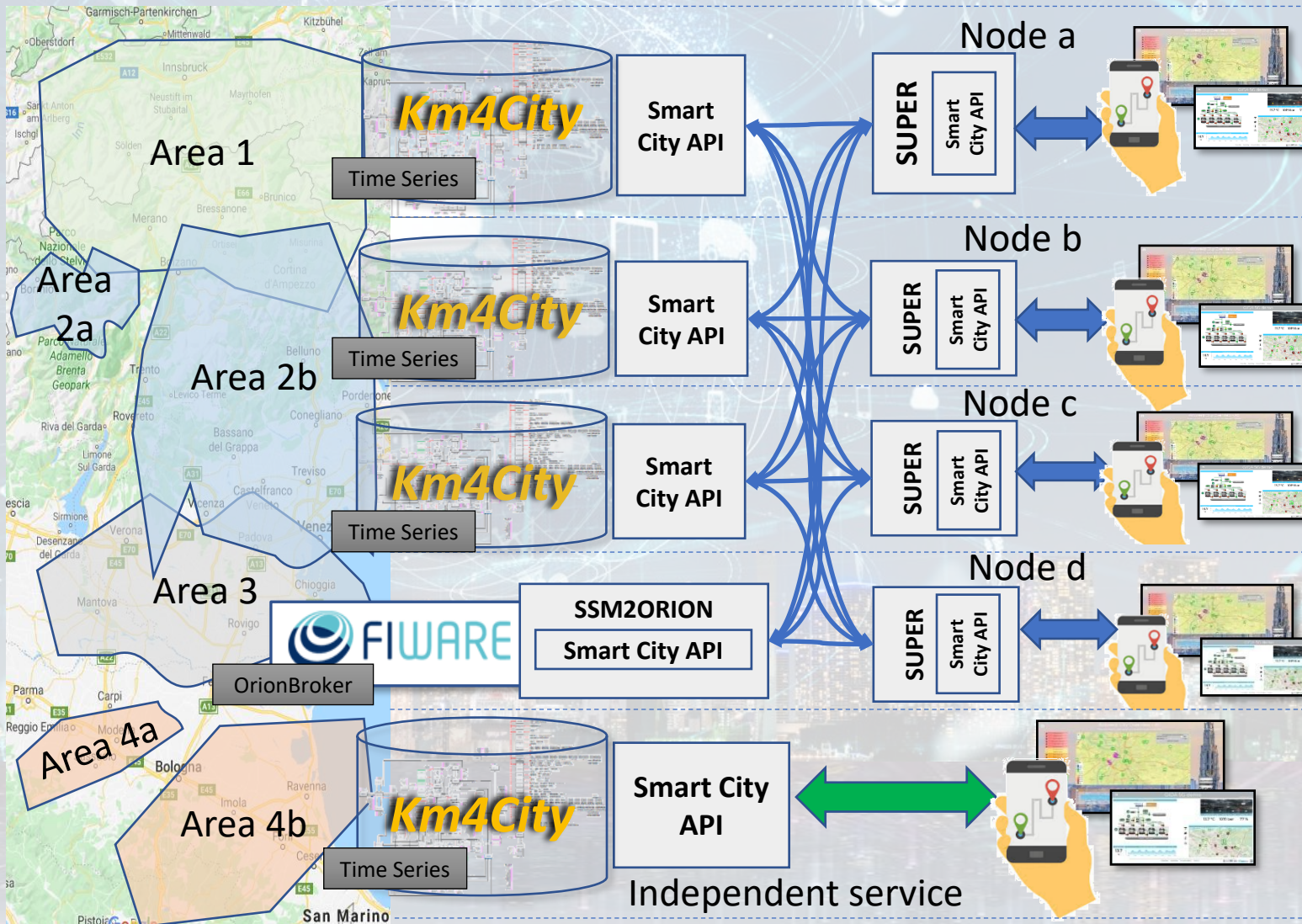


	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part ✓	8th
what	Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deployment Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								

# Interoperability via API

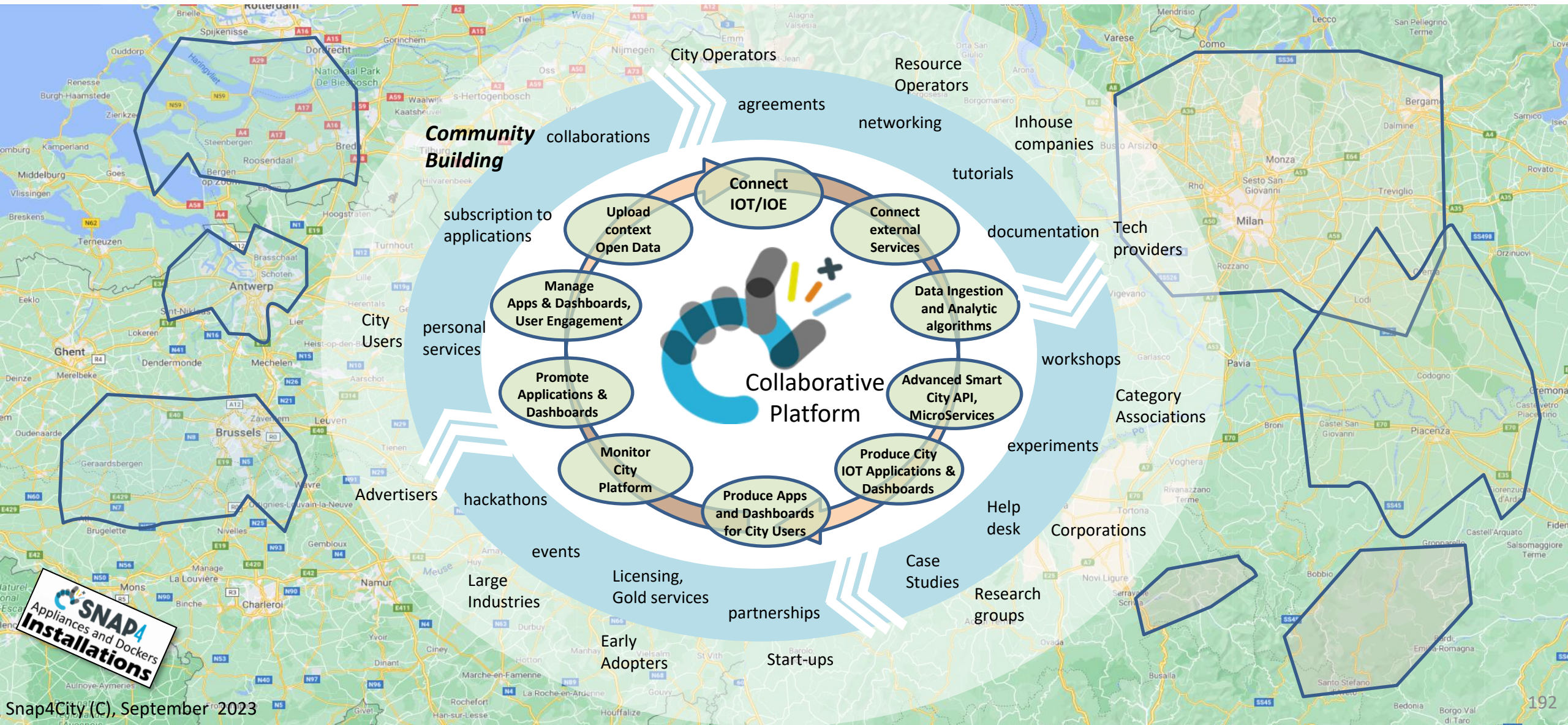
- Smart City API: Internal and External
- Advanced Smart City API, MicroServices, Snap4City API
- Federated Knowledge Base and Smart City API
- Mobile App Development Kit

# Federation of Smart City Services



- **Km4City Semantic Reasoner**
- **ServiceMap interoperability**
- **Seamless for multiple Mobile Apps**
- **Smart City API**
- **Super:**
  - distributed access and sharing services
  - Each city control its own data
  - Final user can pass from one city / area to another in seamless manner: without changing the mobile Apps

# One Snap4City Platform may serve Multiple Cities



**SNAP4**  
Appliances and Dockers  
Installations

# External Smart City API

Smart City API Docs: Swagger

User: roottooladmin1, Org: DISIT  
Role: RootAdmin, Level: 7  
LOGOUT

External Services

Data Set Manager: Data Gate

Resource Manager: Process Loader

Development Tools

- Web Scraping Tool
- Web Scraping Tool (0n)
- Web Scraping Tool (6l)
- R Studio Development
- R Studio Development 0.11
- R Studio Development 0.116
- R Studio Development TF
- R Studio Development GFF
- R Studio Development Gral
- MicroServices from DataAnalytic
- ETL Development
- ETL Development 1
- ETL Development 2
- Knowledge Base Graphs
- Knowledge Base Queries
- Smart City API Docs: Swagger**
- Internal API Docs: Swagger
- Testing API by Postman
- Source Code Access

Management

Settings

User Management and Auditing

Help and Contacts

Documentation and Articles

My Profile

Select a spec: Advanced Smart City API

- Advanced Smart City API
- Km4city Web App API
- Orion Broker K1-K2 Authentication API
- Heatmap API

Advanced Smart City API <sup>1.0.0</sup> <sup>OAS3</sup>  
<https://www.km4city.org/swagger/external/ascapi-openapi3.json>  
SMART CITY API WEB DOCUMENTATION

Servers

Services

- GET / Service discovery and information

Events

- GET /events/ Event search

Locations

- GET /location/ Address and geometry search by GPS

Public Transport

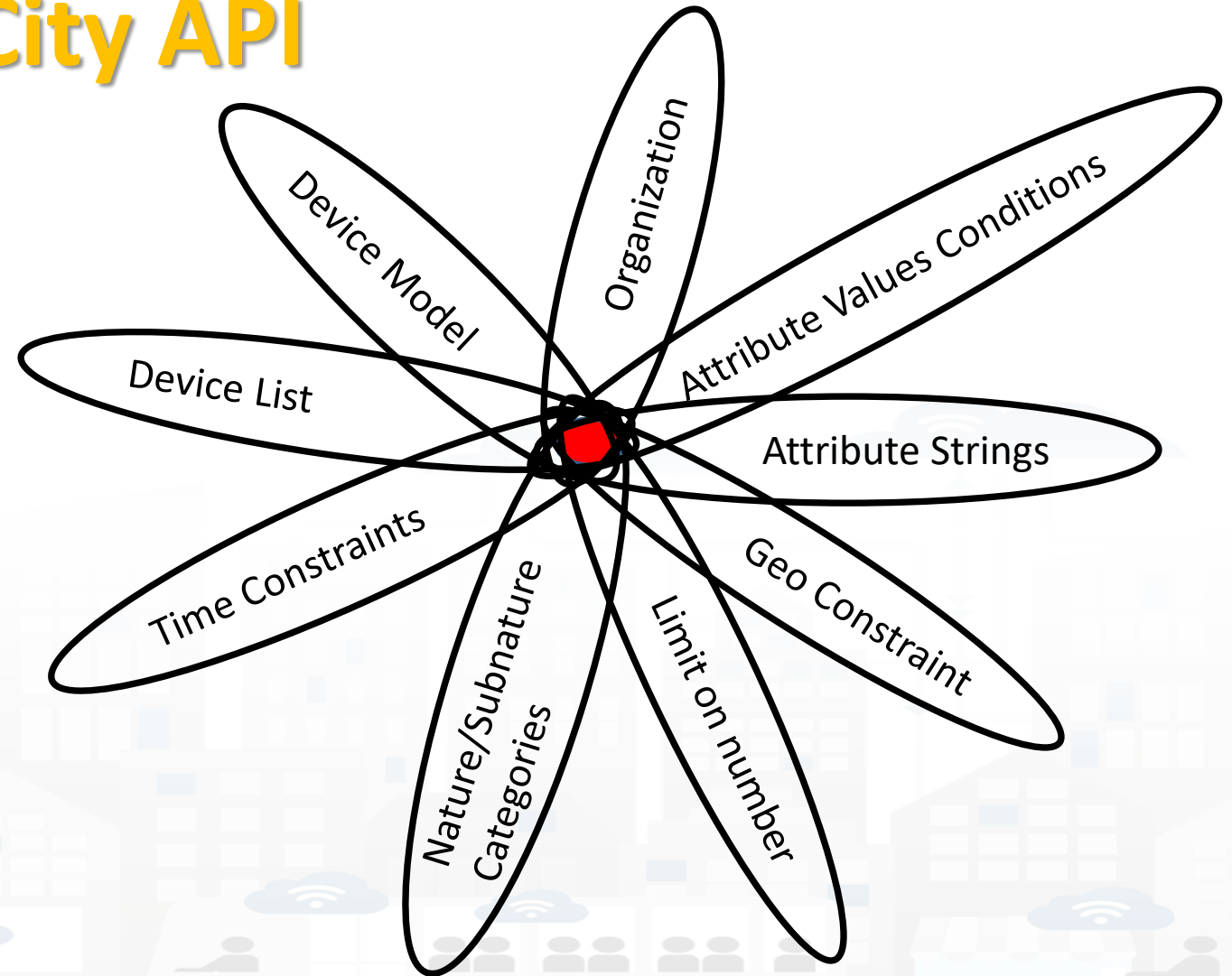
- GET /tpl/agencies/ Agency list
- GET /tpl/bus-lines/ (Bus) Lines list
- GET /tpl/bus-routes/ (Bus) Routes list

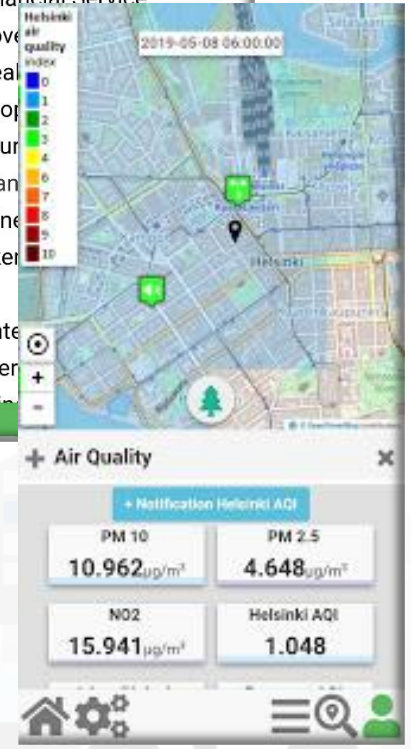
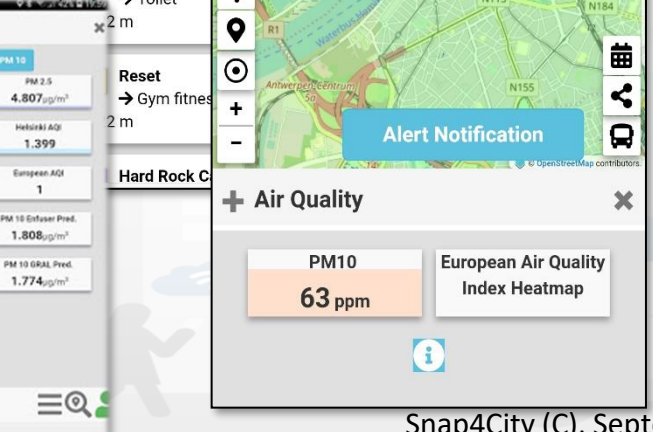
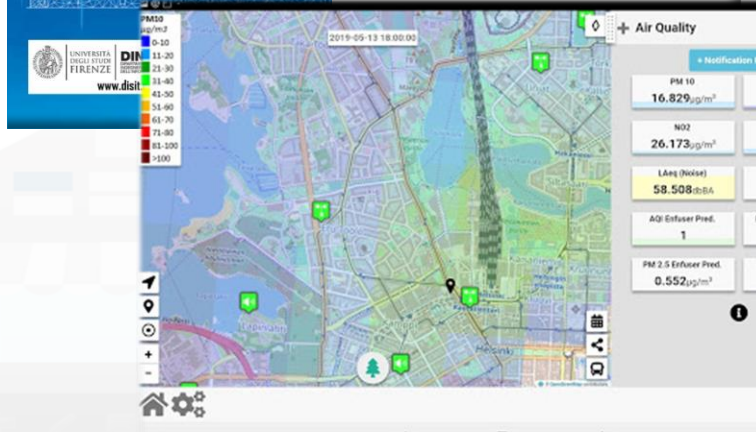
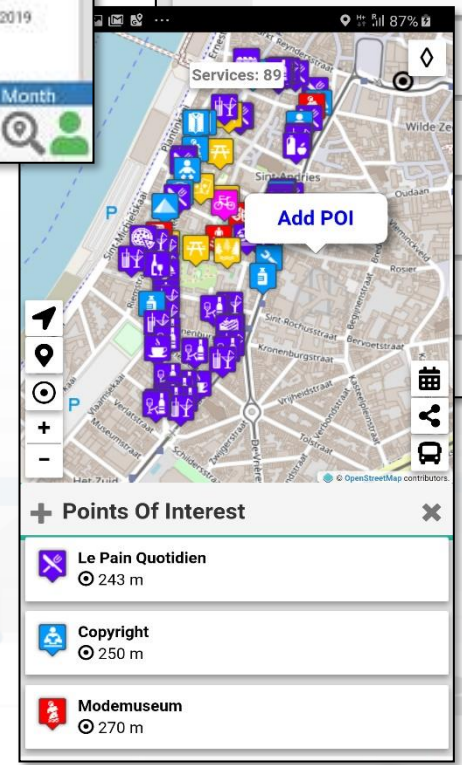
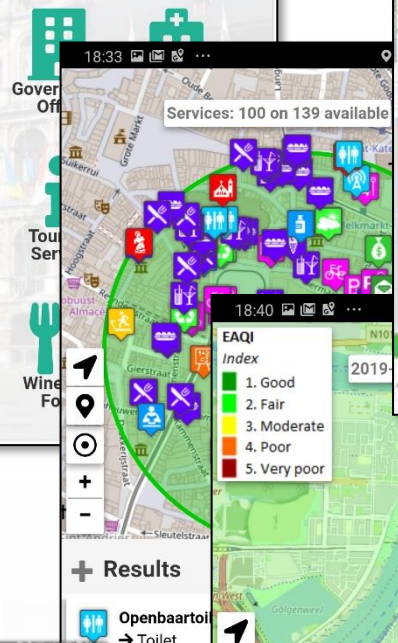
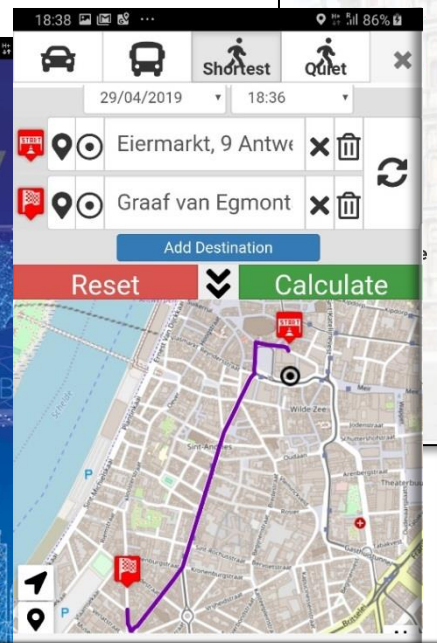
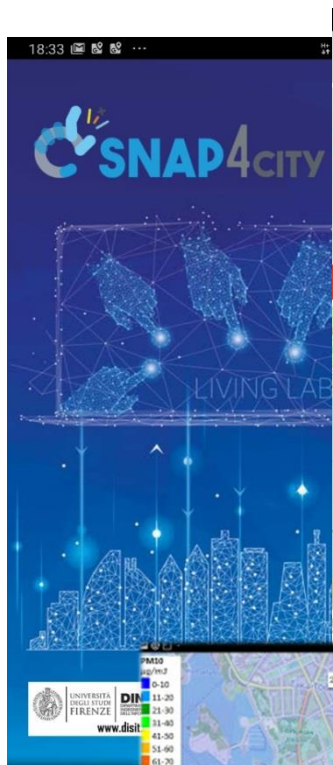
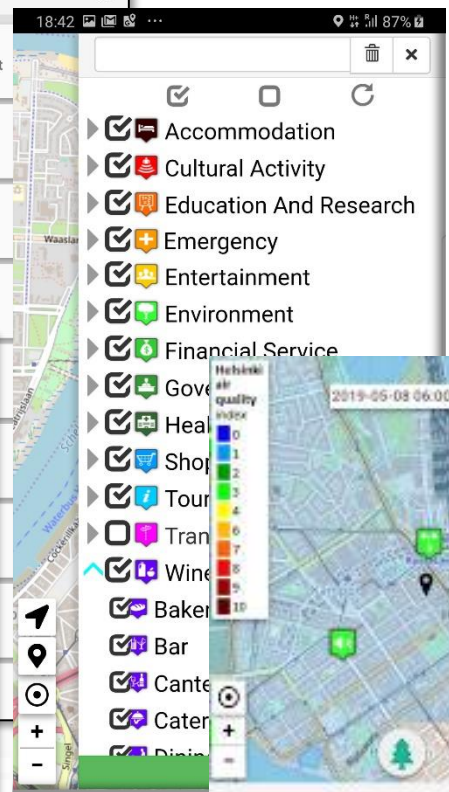
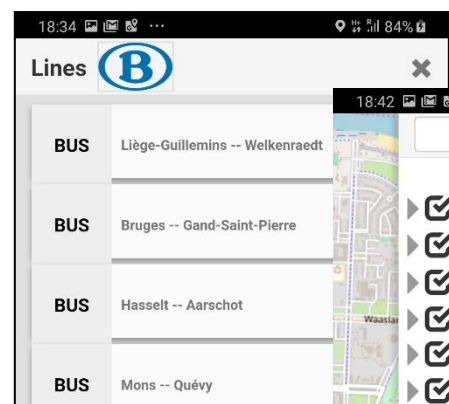
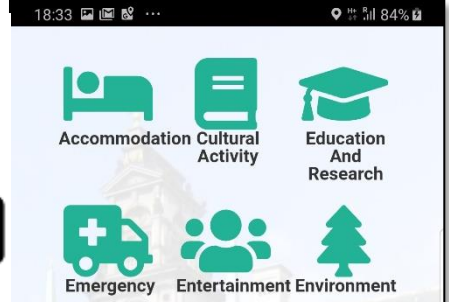
API ITA N

<https://www.km4city.org/swagger/external/index.html>

# Selection on Smart City API

- Combining different filters for selecting entities from Smart City APIs
- **Be care:** filtering too much may lead to empty set 😊





TOP

# Development of Solutions



	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th part
what	Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								



# Development

<https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf>



## Development Life-Cycle

<https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle-v1-1.pdf>

### From Snap4City:

- We suggest you to read the **TECHNICAL OVERVIEW**:
  - <https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf>
- <https://www.snap4city.org>
- <https://www.snap4solutions.org>
- <https://www.snap4industry.org>
- <https://twitter.com/snap4city>
- <https://www.facebook.com/snap4city>
- <https://www.youtube.com/channel/UC3tAO09EbNba8f2-u4vandg>

**Coordinator:** Paolo Nesi, [Paolo.nesi@unifi.it](mailto:Paolo.nesi@unifi.it)

DISIT Lab, <https://www.disit.org>  
DINFO dept of University of Florence,  
Via S. Marta 3, 50139, Firenze, Italy  
Phone: +39-335-5668674

**Access Level:** public

**Date:** 21-10-2022

**Version:** 1.4



## Development Life-Cycle

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- <https://www.snap4city.org>
- <https://www.snap4solutions.org>
- <https://www.snap4industry.org>
- <https://twitter.com/snap4city>
- <https://www.facebook.com/snap4city>
- <https://www.youtube.com/channel/UC3tAO09EbNba8f2-u4vandg>

**Coordinator:** Paolo Nesi, [Paolo.nesi@unifi.it](mailto:Paolo.nesi@unifi.it)

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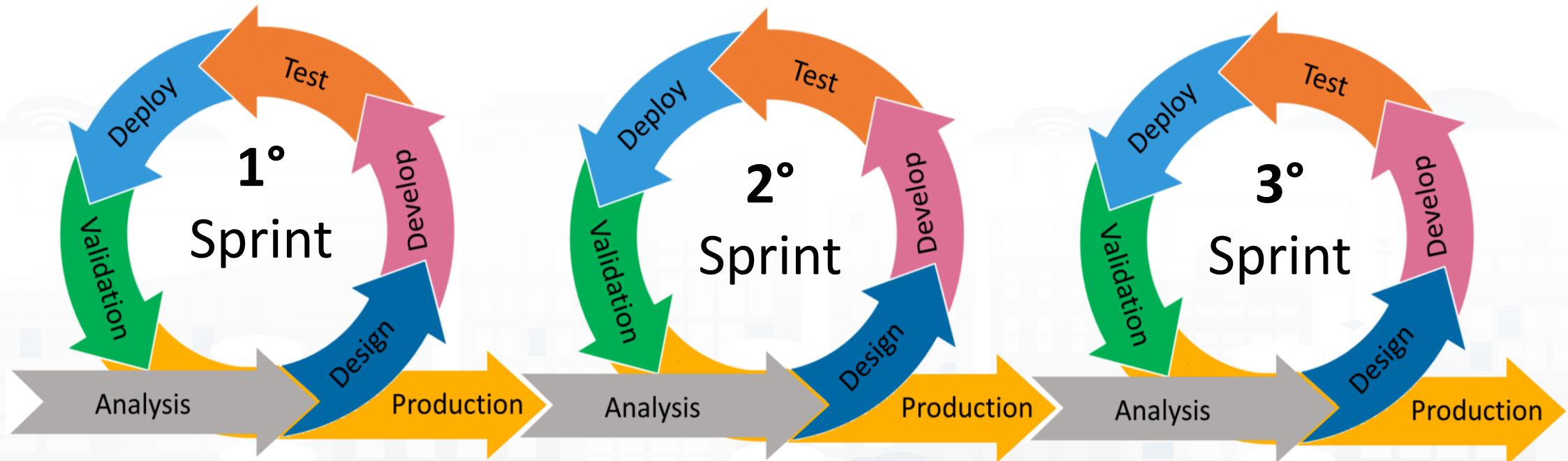


<https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf>

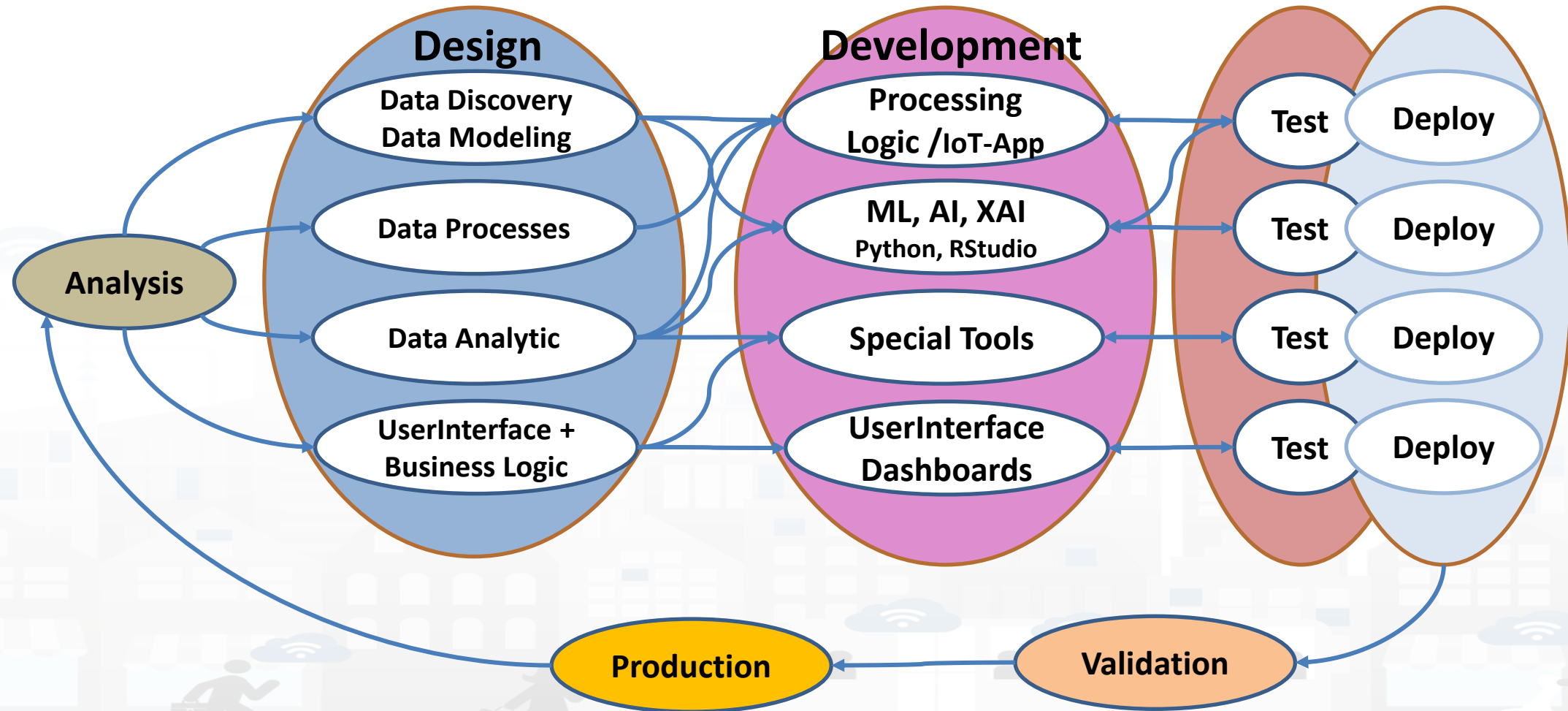




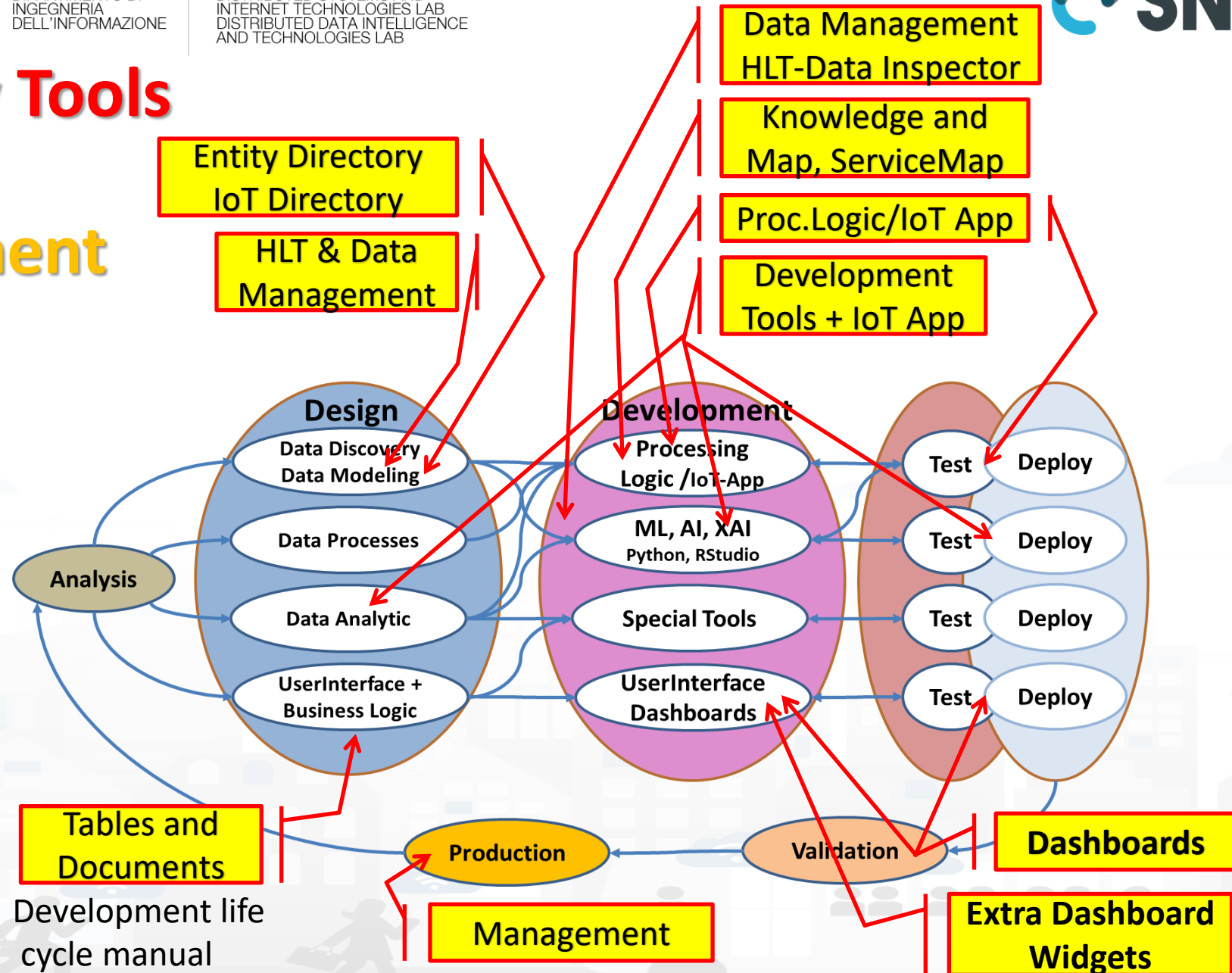
# Development Life Cycle Smart Solutions



# Development Life Cycle Smart Solutions



# Snap4City Tools vs Development Life Cycle



Development life cycle manual

# BI-CSBL

TOP

# Smart Application Business Intelligence

FROM CITY DASHBOARD TO APPLICATIONS

DATA GATHERING AND KNOWLEDGE MANAGEMENT

PLANNING & MAINTAINING OPEN AND FLEXIBLE OBJECTS

IOT APPLICATIONS VS IOT EDGE DEVICES

IOT/IIOT DEVICES AND NETWORKS

IOT APPLICATIONS, THE LOGIC AND

ADVANCED SMART CITY API, MICROSERVICES,

DATA ANALYTICS BUSINESS INTELLIGENCE AND WHAT SIMULATION

SNAP4CITY ARCHITECTURE AND OPENING UP TO DEVELOPERS AND STAKEHOLDERS

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

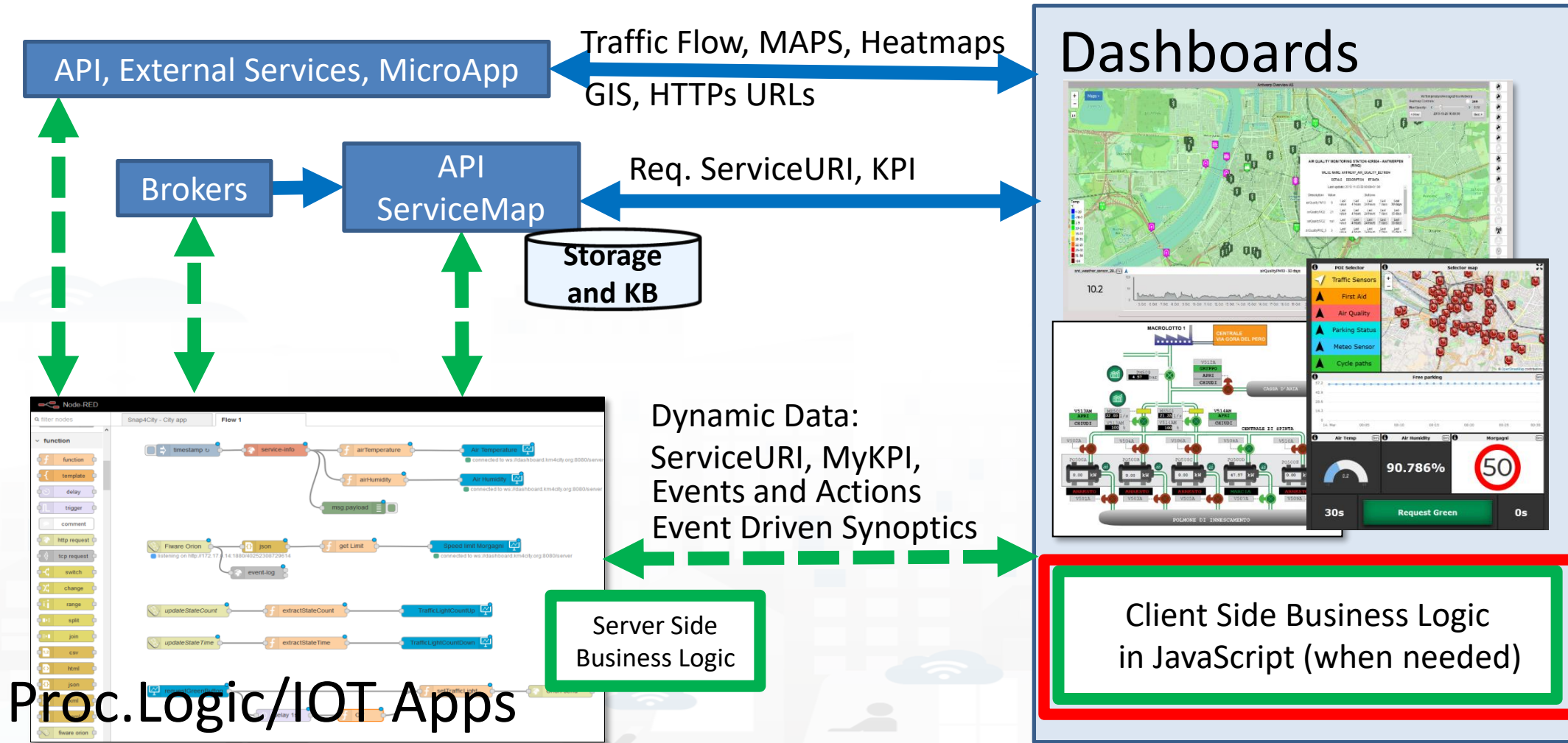
SNAP4CITY AND KM4CITY PROJECTS

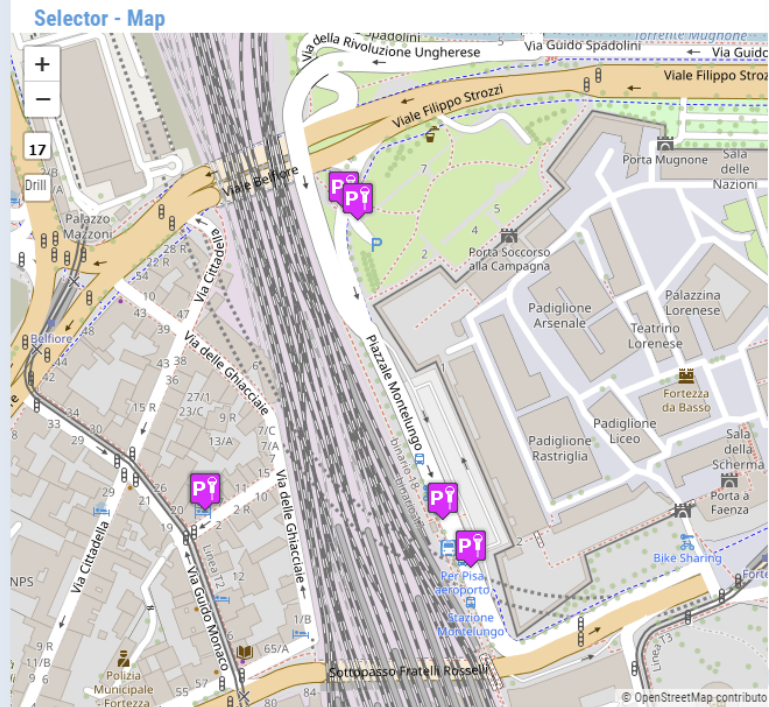
HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

SNAP4CITY THE VIEW OF THE ADMINISTRATORS

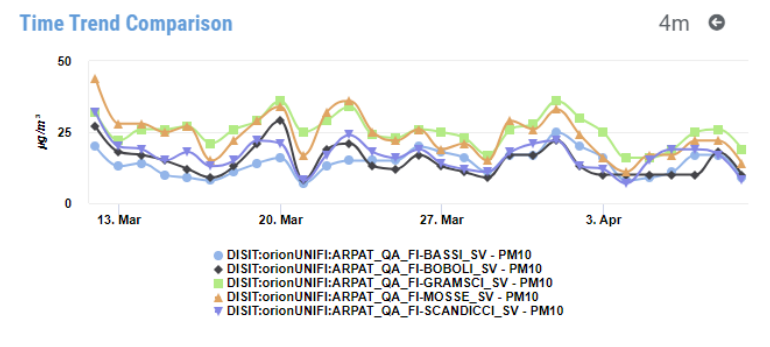
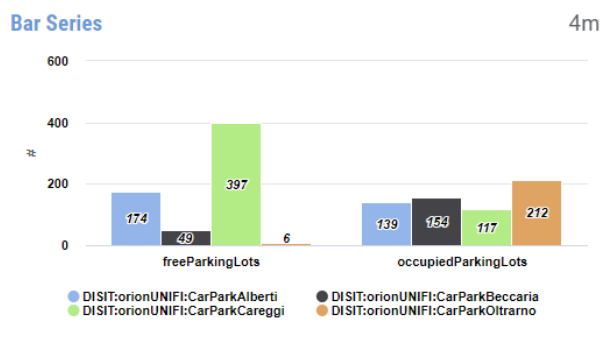
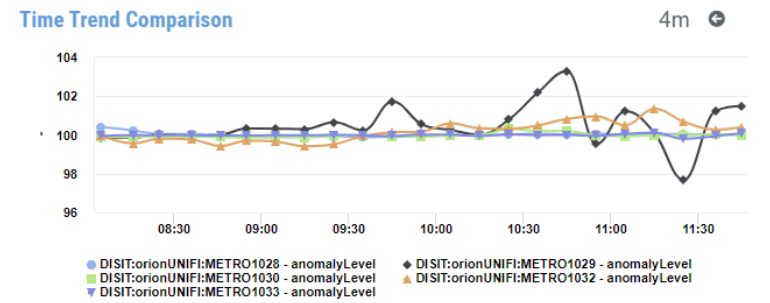
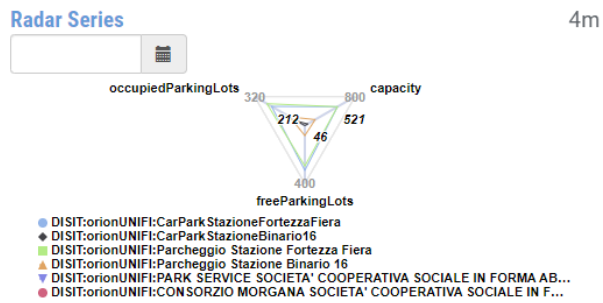
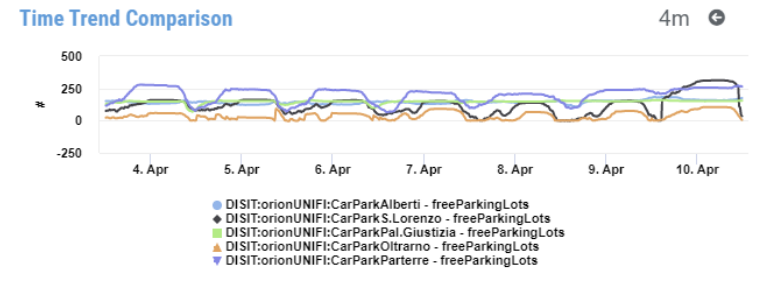
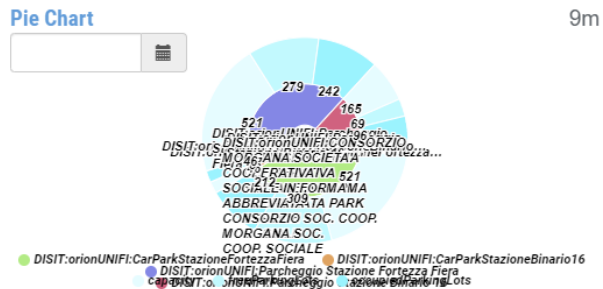
	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
what	Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								

# How the Dashboards exchange data





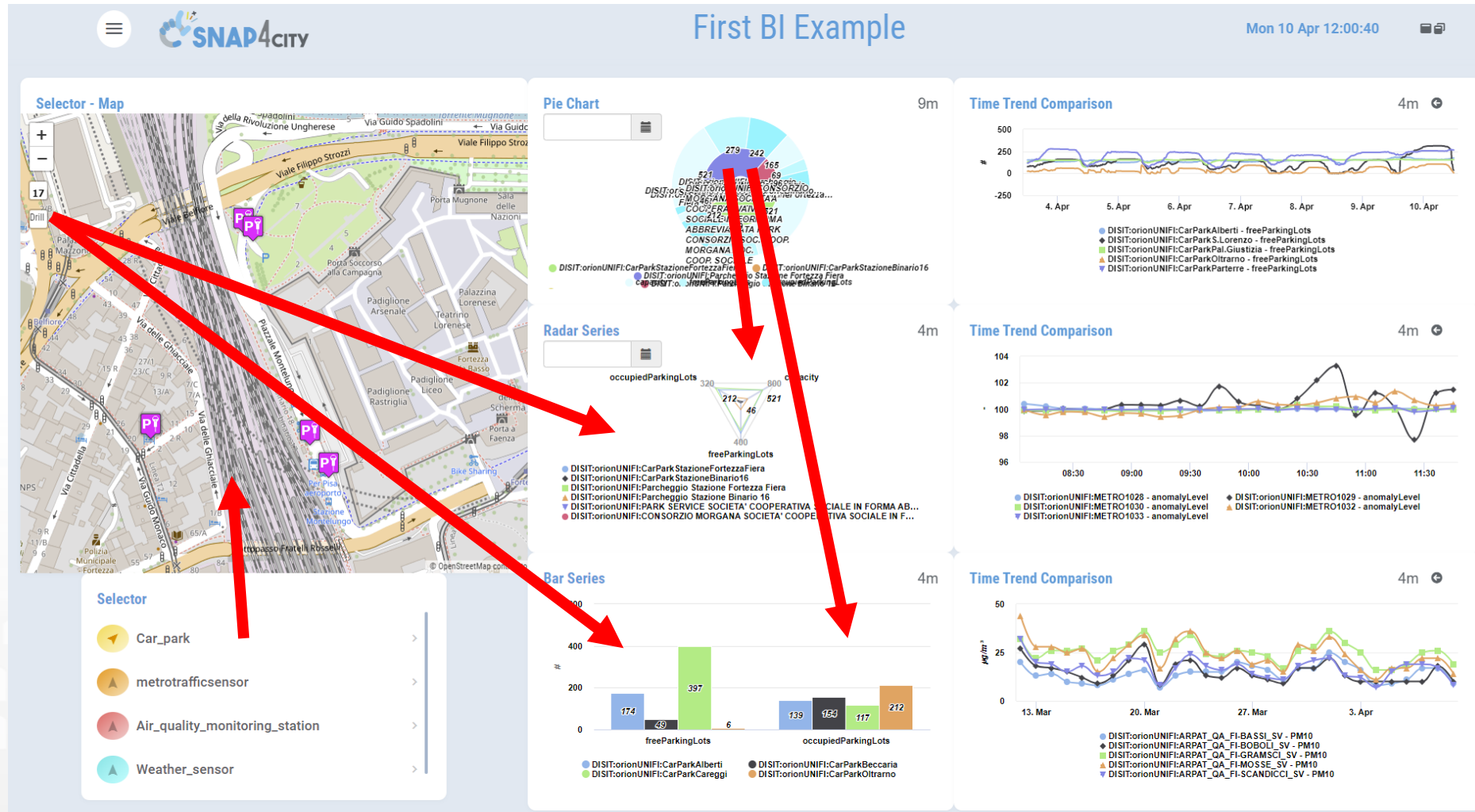
- ### Selector
- ▶ Car\_park
  - ▶ metrotrafficsensor
  - ▶ Air\_quality\_monitoring\_station
  - ▶ Weather\_sensor





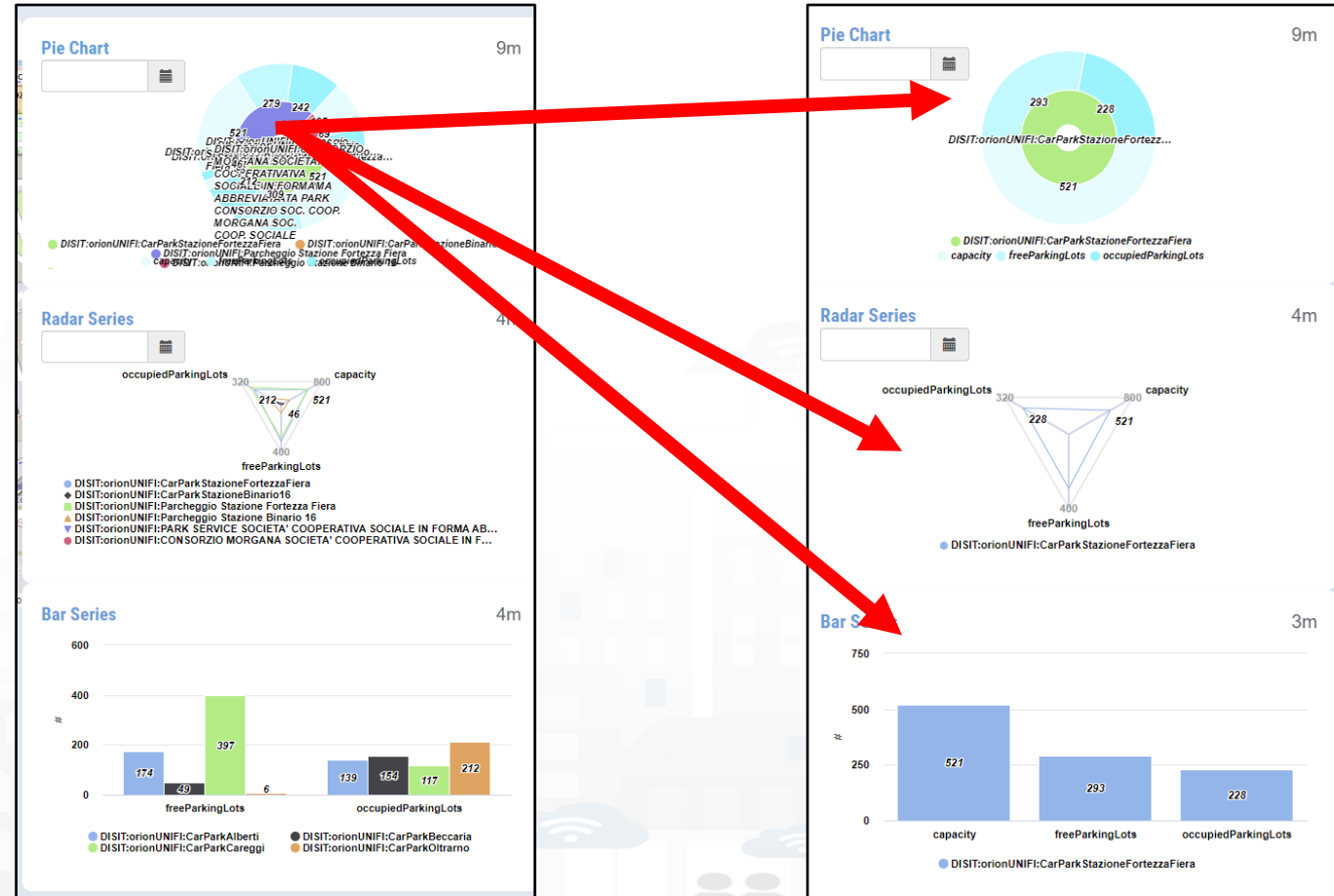
# Example: From Map to Graphs (spatial drill down)

- 1) Select the area of interest on map
- 2) Select the sensors kind of interest
- 3) Drill down on map
- 4) The JavaScript CSBL on Map will send data to the programmed Widgets. In this case, arrowed in RED



# Example: From Data Graphs to Graphs (drill down)

- 1) Click on the Donut element
- 2) The JavaScript CSBL on the Donut Widget will send commands to the programmed Widgets to focus on selection, as highlighted by the red arrows



1) Click on the Legend of Bar Series

2) The JavaScript CSBL on the Bar Series will send commands to the programmed Widgets to remove the unselected devices, as highlighted by the red arrows



# Client Side Business Logic

<https://www.snap4city.org/download/video/ClientSideBusinessLogic-WidgetManual.pdf>

## Client-Side Business Logic Widget Manual

### From Snap4City:

- We suggest you read <https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf>
- We suggest you read the TECHNICAL OVERVIEW:
  - <https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf>
- slides go to <https://www.snap4city.org/577>
- <https://www.snap4city.org>
- <https://www.snap4solutions.org>
- <https://www.snap4industry.org>
- <https://twitter.com/snap4city>
- <https://www.facebook.com/snap4city>
- <https://www.youtube.com/channel/UC3tAQ09EbNba8f2-u4vanda>

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TOP



FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

IOT APPLICATIONS VS IOT EDGE DEVICES

SNAP4CITY FOR BEGINNERS

SNAP4CITY ARCHITECTURE ECOSYSTEM, OPENED TO DEVELOPERS AND STAKEHOLDERS

**SNAP4**  
Appliances and Dockers  
**Installations**

AND KM4CITY PROJECTS

# Installing Snap4City

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT-IF AND SIMULATION

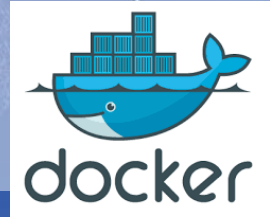
HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

IOT APPLICATIONS, THE LOGIC AND THE SMARTNESS

ADVANCED SMART CITY API, MICROSERVICES, SNAP4CITY API

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK



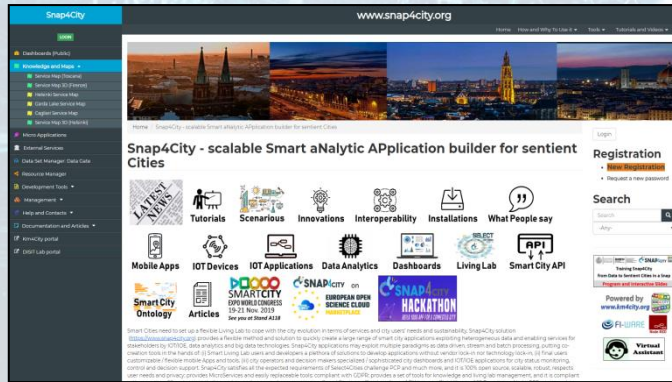
**Installations**

<https://www.snap4city.org/471> for VM

<https://www.snap4city.org/738> for container

To get an updated version read it!

# How to adopt Snap4City



## Smart City as a Service

- Supporting Org
- 100% Open Source Platform: Github
- Further developments
- Publishing Appliances and Docker
- Training courses, docs
- Consulting
- Forums
- Etc.



## On your premise



## Installation on your premise

- Virtual Machines or Docker
- Different configurations
  - From small to scalable
  - Exploiting your legacy tools
  - Interoperable with any tool
- No vendor lock-in, No tech lock-in
- **Mixed solutions! For example:**
  - Start on Cloud as Smart City as a Service
    - Migrate on premise on the fly
  - Start on Cloud into a sand box
    - Pass to install on premise what you need



# Using from Cloud or Installing on Premise

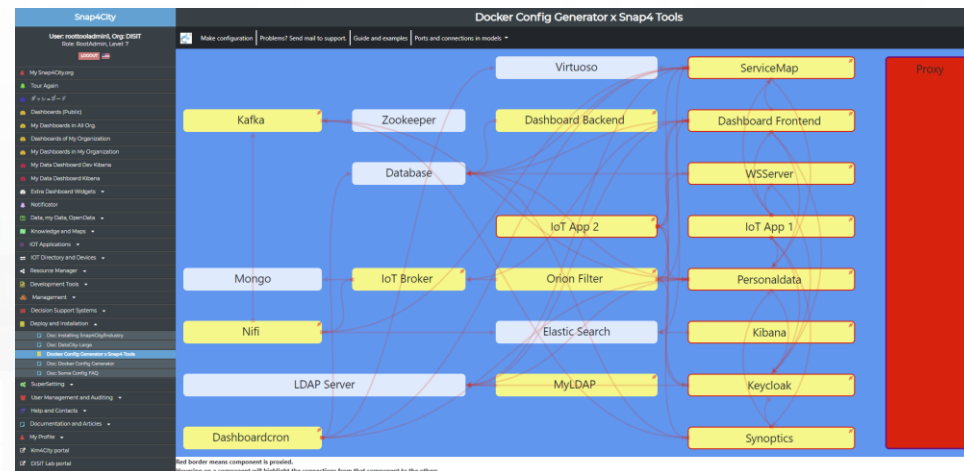
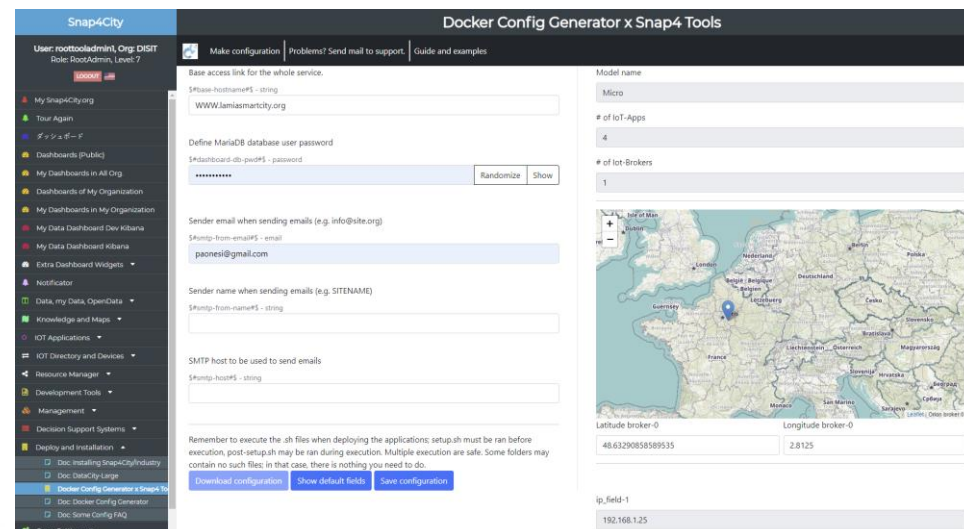
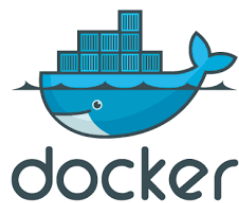
- **Cloud «as a service»:** a number of installations are in place
  - The largest <https://www.snap4city.org>
    - 20 tenants/organizations, Billions of data
    - 1 hour deploy new organization, devices, data, dashboards
- **Installations on public or private cloud, or on private servers**
  - A number of ready to use configurations from 1VM to multiple scalable solutions: <https://www.snap4city.org/471>
    - VM: Appliances ready to use
    - Docker compose, Tool for generating and downloading the docker compose files
      - Micro X version can be installed and tested in 2 hours. <https://www.snap4city.org/738>



[https://www.snap4city.org/docker-generator/selecting\\_model](https://www.snap4city.org/docker-generator/selecting_model)

# Installations, different models a TOOL to get them

- **Micro X:**
  - 1 VM of dockers
- **Normal X,Y:**
  - 2 VM of dockers
- **Small X,Y:** scalable
  - 4 VM of dockers
- **DataCitySmall X,Y,Z:** scalable
  - 6 VM of dockers
- **DataCityMid X,Y,Z,T:** scalable
  - # VM + X/70 VM + Y/3 VM + Z VM + T VM of dockers
- **DataCityLarge:** scalable
  - depending on your needs
- **Kubernetes**
  - Beta local and AWS

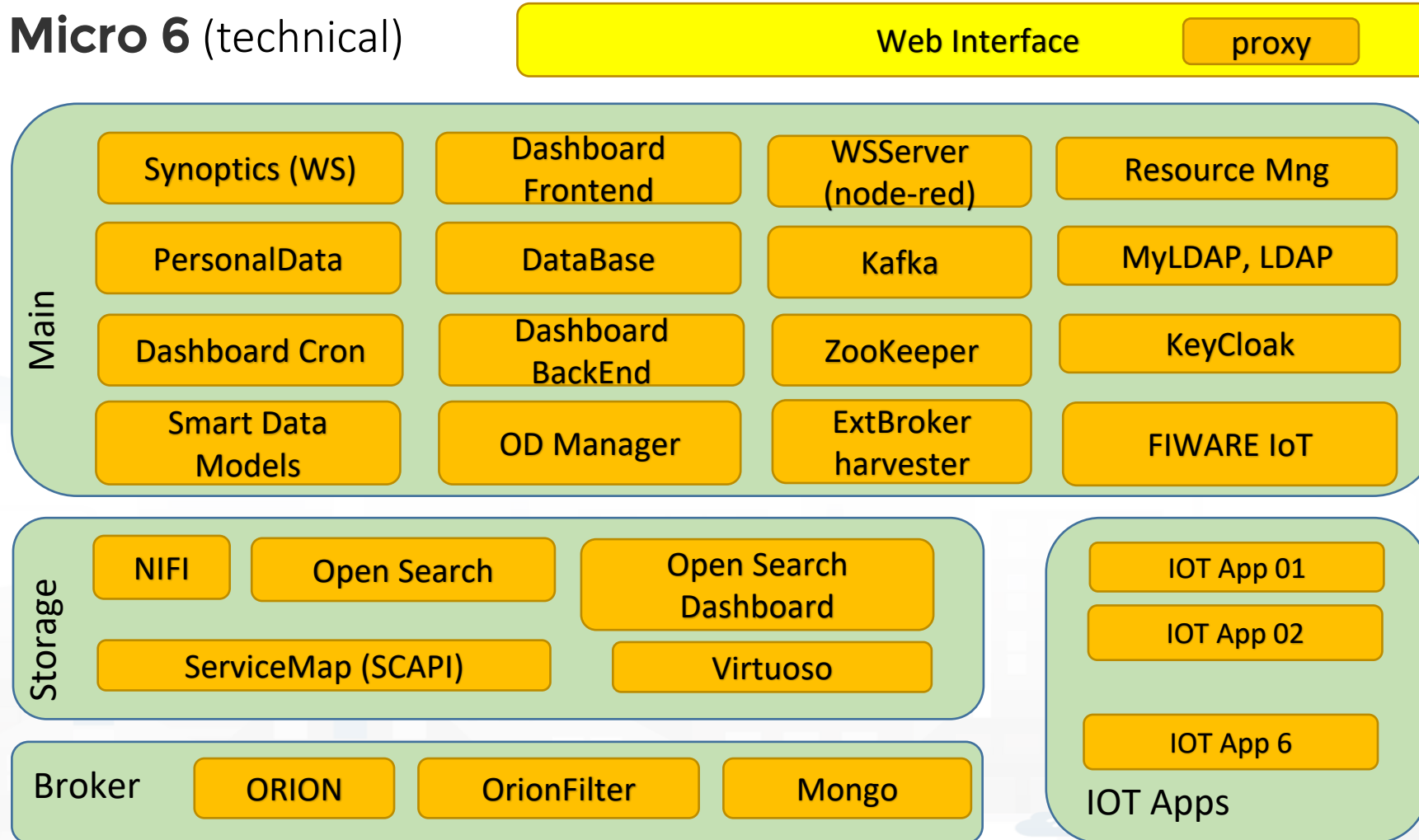


[https://www.snap4city.org/docker-generator/selecting\\_model](https://www.snap4city.org/docker-generator/selecting_model)



# Micro 6 model

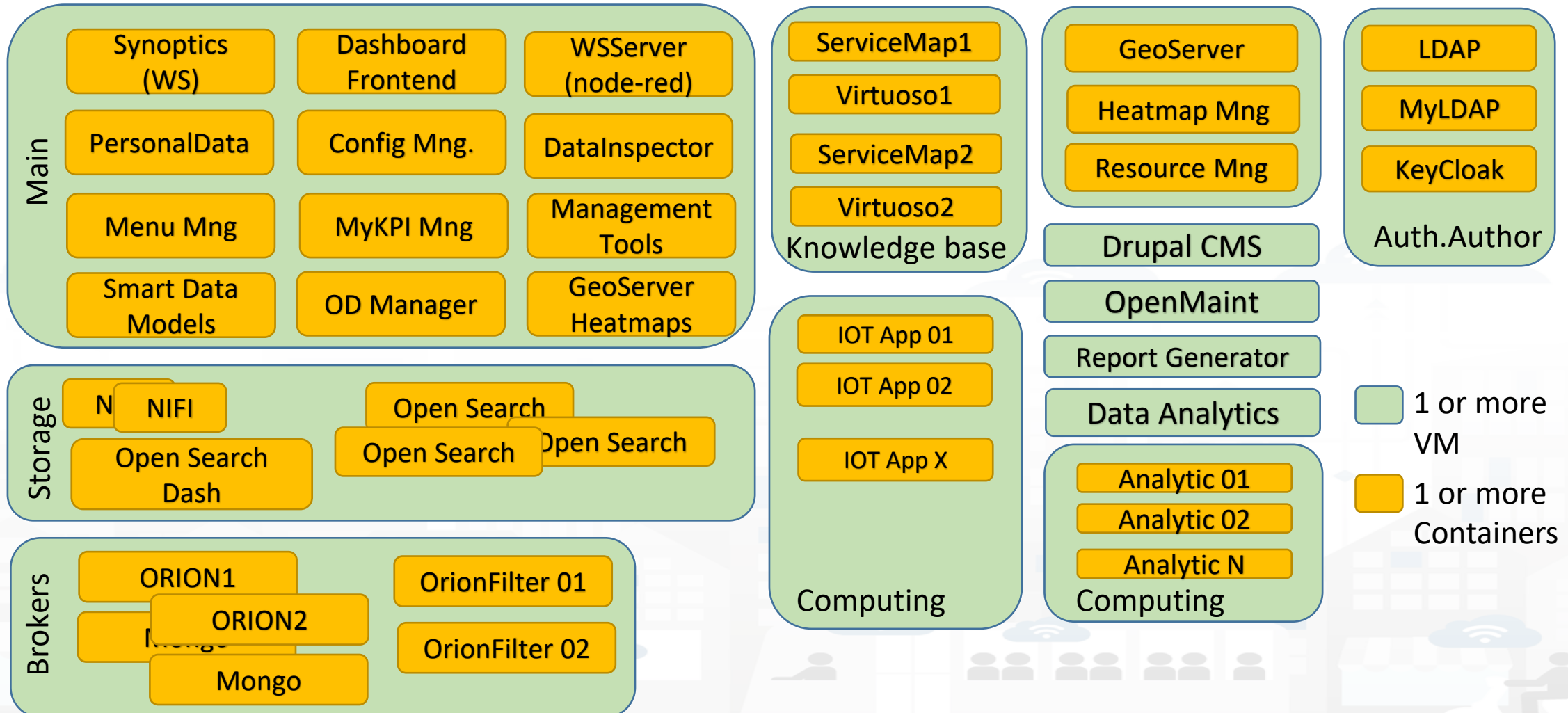
## Micro 6 (technical)



1Hour  
installation  
and  
ready to use

# DataCitySmall X-2-2

## Web Interfaces



- **SLA:**
  - Including: Direct Contact, POC; Help Desk
    - may be an Organization on our cloud to test new tools, and work with the community, this is typically 5-12Keuro first 2years and 1-2keuro for each successive year depending on the feature and number of users you are placing.
  - Similar to: <https://www.snap4city.org/497> with some adaptation on the basis of your deploy and critical conditions, if any
    - Updates, help desk, etc.
- **Our support can be valued on:**
  - The basis of the complexity of your solution: 10% of the cost
    - Or
  - Block of: 16 hours, for 3000 euro / 50 hours, for 6000 euro
    - larger packages can be negotiated
- **Support can be provided by:** Snap4, DISIT Lab, and other companies
- **Customizations can be assessed separately**

- **The solution is 100% open source**
  - Licensing cost is 0 (zero) euro
- **Recurrent costs are**
  - **HighCharts**
    - Proprietary for commercial, Free of use for non-profit organizations.
    - Perpetual licence is about 5350Euro for 10 developer, then 171 euro for each developer for the successive years.
  - **Eventual SLA with us for**
    - Corrective maintenance
    - Updates when performed by us
- **Services:** customisation, development of data analytics, development of IoT Apps.

Platform Management: Proc. Logic / IoT Applications Data Flow Logic

**Presentation:** Control Room, Widgets, Mobile Apps, Visual Analytics Applications, Telegram Bot, ...

Dashboard Builder    Dashboard Mng    Synoptics    3D Digital Twin

Dashboard Wizard    Data Inspector    Scenario Editor    CSBL

**External Interoperability:** Smart City API, Federated, API Accounting/Billing

Super    ASCAPI    kafka    WebSocket

**Operation:**

What-if    Simulation    Event Reporting    File Mng    Heatmap Mng    Traffic Flows Mng    ODM Mng    TVCam Mng    BIM Mng    ....

R Studio    python    KPI, Indicator Analysis    WorkFlow Tickets BPM    Sentiment Analysis    SUMO    Tipyc. Time Trend    ....    Open to any module and system

docker    Data Processing    Predictions    Anomaly detection    Statistics    Artificial Intelligence    Routing    Internal GIS    GeoServer    ckan    openMAINT    BIMserver.center    ....

**Internal Interoperability:** API, MicroServices

Snap4City Node-red Libraries    ASCAPI    WebSocket    FIWARE

**Data Storage and Reasoning:** data storage, noSQL, aggregation, semantic modeling, city entities, normalization, knowledge base

Service Map    LOGraph    OpenSearch    virtuoso

SuperServiceMap    DevDash    nifi

NGSI V1, V2, LD    FIWARE    Linked Data triples

**Data Collection:** data mining, harvesting, integration, transformation, data models, ...

Directory    Blockchain    Brokers    Brokers

Harvester    Data Manager    FIWARE    Node-RED

**Connectivity:** wired, wireless (Lora, 5G, 4G, 3G, Wi-Fi, etc...), IoT Edge, etc.

Any protocol and format    Any protocol and format    Any protocol and format    Any protocol and format

Device Layer:

External Third Party Services: GIS    BIM    OSM    Gateways    External Services    Web Scraping    Social Media

Authentication and Authorization: KEYCLOAK, OpenLDAP, SNAP4CITY, GDPR compliant

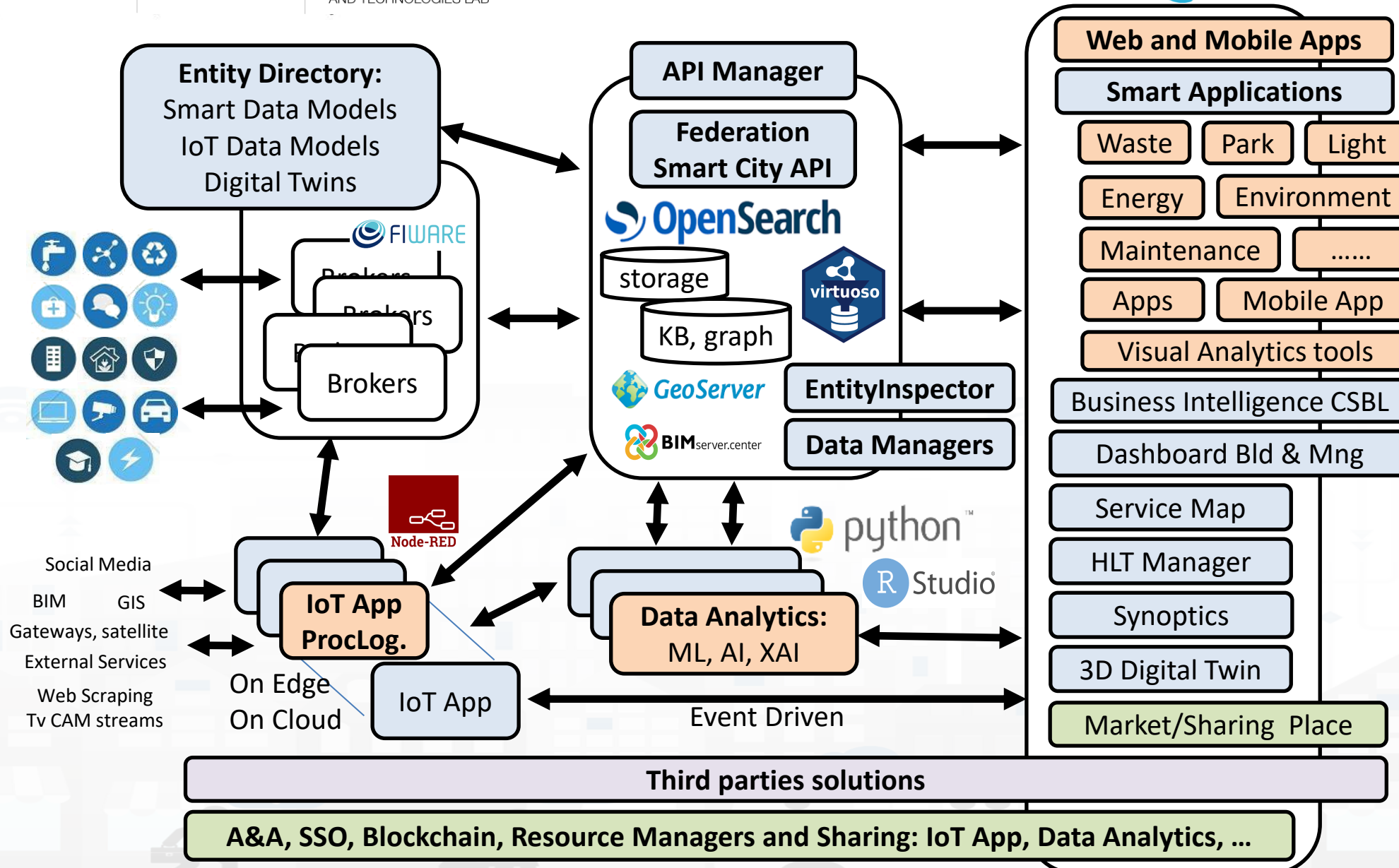
Partecipatori and Living Lab Supports

TOP

# Platform Administration



	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
what	Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								



# Roles in Snap4City/Industry solutions

- **RootAdmin**
  - The gods of the specific installation, access to all tools for all Organizations
- **ToolAdmin**
  - The administrators of an Organization with some capabilities on single tools
- **AreaManager (developers)**
  - access to development tools, access to a wider number of resources, IOT with both basic and advanced, IOT Models, etc.
- **Manager (final users)**
  - limited access to development, IOT App development with Basic library.
- **Users of any Role** have full control on their own resources: data, devices, dashboards, IOT App, etc., which may control according to GDPR rules,
  - providing access, revoking, etc.
- **All users start as Manager roles**
  - All users have also a Level (numeric). A score about what they have exploited in the platform. Higher scores correspond to wider exploitation of capabilities.
- **RootAdmin users may**
  - pass Users to higher roles. Ask to [snap4city@disit.org](mailto:snap4city@disit.org) to become an AreaManager for testing
  - Provide/grant specific authorizations to data access on Tool usage
- In the Installation onPremise, you become the RootAdmin of it, you decide ALL.



# Management by Organization

- **Organizations /Tenant** may have
  - name, ID, GPS center, a number of Groups on Snap4City.org (living lab support Drupal)
  - users of different kinds and may impose early bounds on the resourced used by users (IOT Dev, IOT App, Dash)
  - on cloud user kinds up to level of Tool Administrator
  - One or more ServiceMap and boundaries for the federation
- **ToolAdmin** users (requested by Organizations) may
  - control processes, consumption of resources, healthiness, etc.
  - manage tools exploited in your configuration
- **24H/7D Help Desk and Assistance**

The screenshot shows the Snap4City user interface. At the top, the user is identified as 'User: panesi, Org: DISIT' with the role 'ToolAdmin, Level: 6'. A red circle highlights the 'LOGOUT' button. The sidebar menu includes the following items: My Snap4City.org, Dashboards (Public), My Dashboards in All Org., Dashboards of My Organization, My Dashboards in My Organization, Extra Dashboard Widgets, Notificator, Data, my Data, OpenData, Knowledge and Maps, IOT Applications, IOT Directory and Devices, Resource Manager, Development Tools, Management, Decision Support Systems, Settings, User Management and Auditing, Help and Contacts, Documentation and Articles, My Profile, Km4City portal, and DISIT Lab portal.

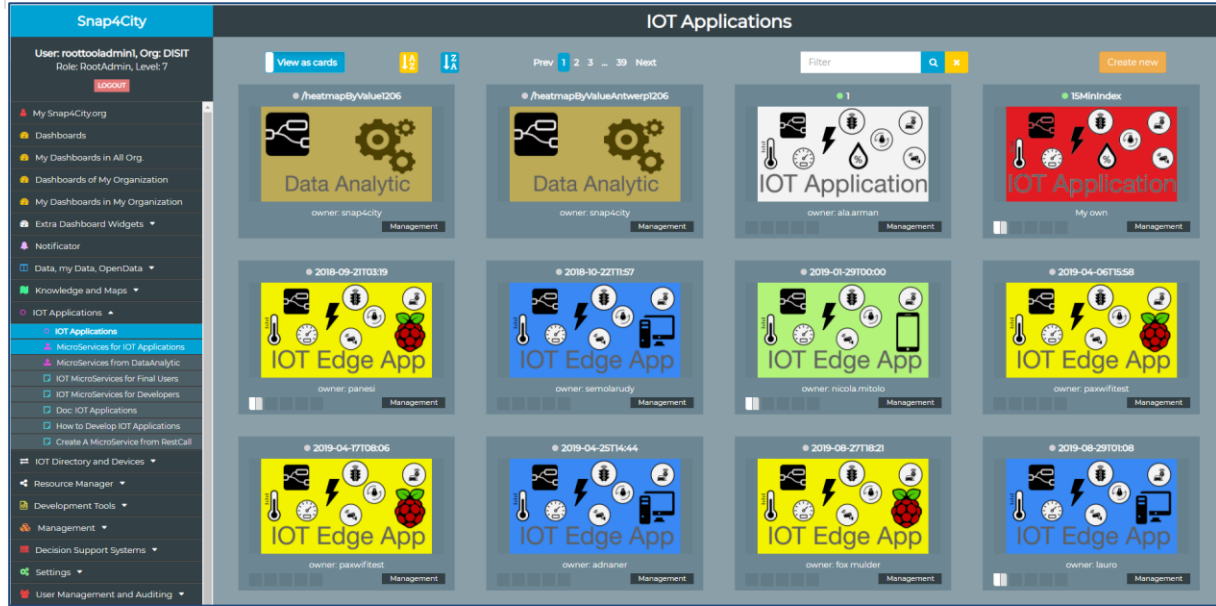
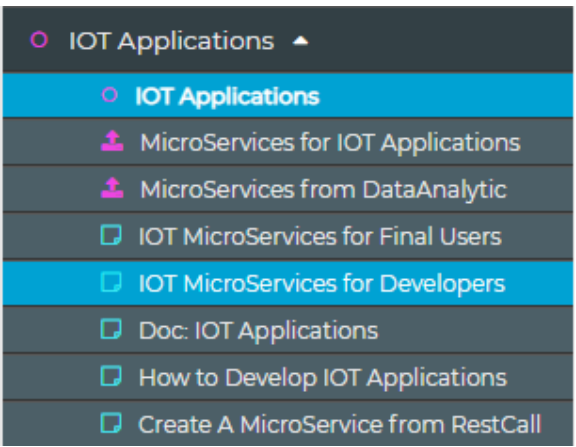
- RootAdmin on Snap4City.org has a very large set of tools
  - My Snap4City, ....Tour, etc.
  - Dashboards
  - **My Data Dashboard (Kibana)**
  - **Extra Dashboard Widgets**
  - Notificator
  - **Data, My Data, OpenData**
  - **Knowledge and Maps**
  - **IOT Applications**
  - **IOT Directory and Devices**
  - **Resource Manager**
  - **Development Tools**
  - **Management**
  - **Decision Support Systems**
  - **Settings**
  - **User Management and Auditing**
  - Help and Contacts
  - Documentation and Articles
  - .....

*In this section  
of the slides,  
those market  
in bold are  
presented.*

User: roottooladmin1, Org: DISIT  
Role: RootAdmin, Level: 7

LOGOUT

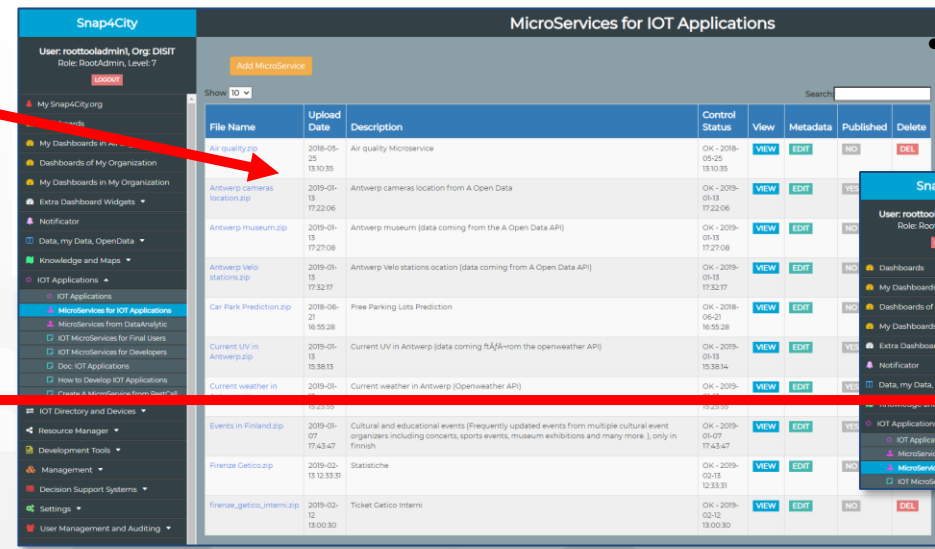
- My Snap4City.org
- Tour Again
- ダッシュボード
- Dashboards (Public)
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- My Data Dashboard Dev Kibana
- My Data Dashboard Kibana
- Extra Dashboard Widgets
- Notificator
- Data, my Data, OpenData
- Knowledge and Maps
- IOT Applications
- IOT Directory and Devices
- Resource Manager
- Development Tools
- Management
- Decision Support Systems
- Settings
- User Management and Auditing
- Help and Contacts
- Documentation and Articles
- My Profile
- Km4City portal



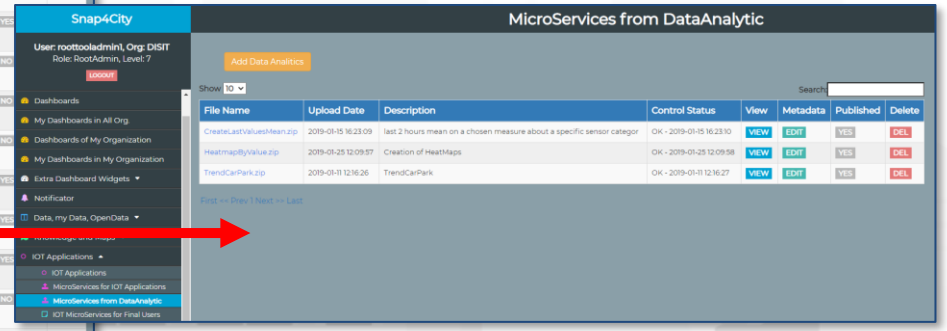
- **IOT Applications:** a view to manage Containers / IOT Edge Apps: IOT Apps, Data Analytics (R and Python), WebScraping, IOT edge, etc.

Managing also

- **MicroServices for IOT App exploiting REST Call**
- **MicroServices from DataAnalytics**



For non admin tools see Training parts 3 and 5: <https://www.snap4city.org/577>



# IOT Directory and Devices

- IOT Directory and Devices
- My IOT Sensors and Actuators
- IOT Sensors and Actuators
- IOT Devices
- IOT Devices Management
- IOT Brokers
- IOT Device Models
- IOT Devices Bulk Registration
- IOT Broker Periodic Update setting
- IOT Orion Broker Mapping Rules
- Doc: IOT Directory and Devices
- Create an IOT Device Instance
- Create an IOT Device Model
- Add an IOT Device into Snap4City

**Snap4City**

User: rootooladmin, Org: DISIT  
Role: RootAdmin, Level: 7  
[Logout](#)

- My Snap4City.org
- Dashboards
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- Extra Dashboard Widgets
- Notifier
- Data, my Data, OpenData
- Knowledge and Maps

**IOT Devices Management**

1739 DEVICES | 1728 ACTIVE | 495 PUBLIC | 1212 PRIVATE

Show 5 entries

IOT Device	IOT Broker	Device Type	Model	Ownership	Organization	Owner	Status	Edit	Delete	Location
ISEP2ZT2AA15000022	orionFinzen-UNIFI	ChargingStation	ChargingStationModel	PUBLIC	Firenze	michela_firenze	active	EDIT	DELETE	
373773207E330100	orionFinland	AirQualityObserved	custom	PUBLIC	Helsinki	iottdirectory/helsinki	active	EDIT	DELETE	
373773207E330101	orionFinland	AirQualityObserved	custom	PUBLIC	Helsinki	iottdirectory/helsinki	active	EDIT	DELETE	
373773207E330103	orionFinland	AirQualityObserved	custom	PUBLIC	Helsinki	iottdirectory/helsinki	active	EDIT	DELETE	
373773207E330104	orionFinland	AirQualityObserved	custom	PUBLIC	Helsinki	iottdirectory/helsinki	active	EDIT	DELETE	

Previous 1 2 3 4 5 ... 337 Next

IOT Device Models and Instances

**IOT Devices Bulk Registration**

0 VALID DEVICES | 0 INVALID DEVICES

no file is selected yet

IOT Broker: Antwerp | Device Model: Raspberry snap4city1

Edge-Gateway Type: | Edge-Gateway URI: | [upload](#)

**Massive management of IOT Devices**

IOT Device	IOT Broker	Protocol	Format	Device Type	Status	Edit	Delete	Location
No data available in table								

Showing 0 to 0 of 0 entries

[Insert Valid Devices](#) [Update Values](#)

**IOT Broker Periodic Update setting**

0 VALID DEVICES | 0 INVALID DEVICES

Contact broker: rabbitUNIM

Model: AccessPointLonato

Edge-Gateway Type: | Edge-Gateway URI: |

[Suggest Modifications](#) [Show active brokers](#) [Retrieves devices](#)

IOT Device	IOT Broker	Protocol	Format	Device Type	Status	Edit	Delete	Location
No data available in table								

Showing 0 to 0 of 0 entries

[Delete All](#) [Update Devices](#) [Update Values](#) [Insert Valid Devices](#)

**IOT Orion Broker Mapping Rules**

134 TOTAL RULES

Name	IOT Broker	Selector	Format	Kind	Edit	Delete
address	Antwerp	["param":{"\$":"\$address","type":"JSON"}]	json	property	EDIT	DELETE
address	orionFinland	["param":{"\$":"\$address","type":"JSON"}]	json	value	EDIT	DELETE
BC	Antwerp	["param":{"\$":"BC","type":"JSON"}]	json	value	EDIT	DELETE
charging_level	Antwerp	["param":{"\$":"\$charging_level","type":"JSON"}]	json	property	EDIT	DELETE
dateObserved	Antwerp	["param":{"\$":"\$dateObserved","type":"JSON"}]	json	value	EDIT	DELETE
dateObserved	orionFinland	["param":{"\$":"\$dateObserved","type":"JSON"}]	json	value	EDIT	DELETE
dateObservedFrom	orionFinland	["param":{"\$":"\$dateObservedFrom","type":"JSON"}]	json	value	EDIT	DELETE
dateObservedTo	orionFinland	["param":{"\$":"\$dateObservedTo","type":"JSON"}]	json	value	EDIT	DELETE
description	Antwerp	["param":{"\$":"\$description","type":"JSON"}]	json	value	EDIT	DELETE
devicetype	orionFinland	["param":{"\$":"\$type","type":"JSON"}]	json	property	EDIT	DELETE

Showing 1 to 10 of 134 entries

Previous 1 2 3 4 5 ... 14 Next

Automated NGSI V2 brokers harvesting and registration

IOT Directory manages multiple internal and external IoT Context Brokers

- For non admin tools see Training parts 3 and 5: <https://www.snap4city.org/577>

Development Tools ▾
Web Scraping Tool
Jupyter Hub - Python
Web Scraping Tool (0n)
Web Scraping Tool (6l)
R Studio Development
R Studio Development 0.11
R Studio Development 0.116
R Studio Development TF
R Studio Development GFF
R Studio Development Gral
ETL Development
ETL Development 1
ETL Development 2
Knowledge Base Graphs
Knowledge Base Queries
Smart City API Docs: Swagger
Internal API Docs: Swagger
Testing API by Postman
Source Code Access
How to Develop Smart Applications

- *All these tools are well described into Training parts:*  
<https://www.snap4city.org/577>
- *The Administrators may*
  - *access to all instances of them*
  - *Grant access to them at specific AreaManager users*
- **API and Swagger documentation**
- **Model Knowledge Base Graphs (LOG.disit.org)**
- **Python online dev. Environment**
- **R Studio Online dev. Environment**
- WebScraping tool
- SPARQL Editor and tools (custom FLINT)
- ETL OnLine dev. Environment (deprecated)

# User Management and Auditing

- All that the RootAdmin needs to manage:
  - **User Management: for managing**
    - accounts and profiles
    - limits of the users in exploiting resources
    - Accesses and providing special authorization
    - Organization vs Groups of users
    - Users vs Organizations
  - **Users vs Web and Mobile Applications**
    - Engaging and monitoring users on platform and devices
  - **Users on Chats room of Dashboards**
    - Managing Users on Chats of Dashboards
  - **Auditing of the data and resource accesses**
    - Auditing all the activities on the platform (see next section)
    - Personal auditing

## User Management and Auditing ▾

User Management

User Limits Management

User Engagement

User Engagement Dash

User Role Management via LDAP

Manage Resource Ownership

User Chats Management

Auditing Data Access Try-out

Auditing Elements vs Ownership

Auditing Personal Data

Auditing Accesses Authentication

Auditing User Activities

Auditing Activities on Queries

Auditing Activities on Articles

Auditing IOT Directory Data

Dashboard Builder Local Users

Organizations vs Groups

Users vs Organizations

# Training Material



	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
what	Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								





**SMARTCITY**  
EXPO WORLD CONGRESS

**15 - 17 NOV 2022**  
**BARCELONA & ONLINE**

**Visit our stand:**  
**Pavillon 2, stand B86**





<https://www.snap4city.org/577>



*On Line Training Material (free of charge)*


<https://www.snap4city.org/944>

	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
What	Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								

Video1								
Video2								
Video3								
Video4				none		none	none	none

# Note on Training Material

- **Course 2023:** <https://www.snap4city.org/944>
  - Introductionary course to Snap4City technology
- **Course** <https://www.snap4city.org/577>
  - Full training course with much more details on mechanisms and a wider set of cases/solutions of the Snap4City Technology
- **Documentation** includes a deeper round of details
  - Snap4City Platform Overview:
    - <https://www.snap4city.org/drupal/sites/default/files/files/Snap4City-PlatformOverview.pdf>
  - Development Life Cycle:
    - <https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf>
  - Client Side Business Logic:
    - <https://www.snap4city.org/download/video/ClientSideBusinessLogic-WidgetManual.pdf>
- **On line cases and documentation:**
  - <https://www.snap4city.org/108>
  - <https://www.snap4city.org/78>
  - <https://www.snap4city.org/426>

[Switch To New Layout \(Beta\)](#)User: paolo.disit, Org: DISIT  
Role: AreaManager, Level: 3[LOGOUT](#) [Home](#) / [Tutorials and Videos](#) / Welcome: how to start using Snap4City for beginners

## Welcome: how to start using Snap4City for beginners






### We suggest you:

Congratulations! You have really contributed to Snap4City and successfully passed all first levels!

You have reached a level in which you can contribute with competence to the city improvement and smartness. We hope you interested in helping other users in conquering higher levels on the city smartness ranking, and provising of smart services to all city users!

So that we could be interested in engaging and elevating your role in the Snap4City community as coordinator of thematic groups, for example on **Mobile APP development**, **Dashboard on Mobility**, **IOT Application Development**, etc., according to your preferences.

Please contact [paonesi@gmail.com](mailto:paonesi@gmail.com) !

[Share / Save](#)    ...[Add to your favorites](#)

Innovations



Interoperability



Installations



What People say



Mobile Apps



IOT Devices



IOT Applications



Data Analytics



Dashboards



Living Lab



Smart City API



Smart City Ontology



Work with Us



Articles



SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE



SNAP4CITY HACKATHON



INDUSTRY 4.0



Snap4Industry



Snap4Home

- TECHNICAL OVERVIEW: <https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf>
- Development Life Cycle: <https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf>
- Client-Side Business Logic Widget Manual: <https://www.snap4city.org/download/video/ClientSideBusinessLogic-WidgetManual.pdf>
- Booklet Data Analytics, Snap4Solutions: [https://www.snap4city.org/download/video/DPL\\_SNAP4SOLU.pdf](https://www.snap4city.org/download/video/DPL_SNAP4SOLU.pdf)

Please start a fully guided training cases:

- [HOW TO: create a Dashboard in Snap4City](#)
- [HOW TO: add a device to the Snap4City Platform](#)
- [HOW TO: add data sources to the Snap4City Platform](#)

Username: paolo.disit

## Search

**Training on Tools and Platform**Powered by [www.km4city.org](http://www.km4city.org)

## Organization Groups

DISIT

- Developer
- Operativo

## Updates on Tools

Training Course Snap4City - 2023 Edition **new**  
drupaladminSnap4City Newsletter of April 2023 **new**  
roottooladmin1[My Snap4City.org](#)[Tour Again](#)[www.snap4solutions.org](#)[Dashboards \(Public\)](#)[Dashboards of My Organization](#)[My Dashboards in My Organization](#)[My Data Dashboard Dev Kibana](#)[Extra Dashboard Widgets](#)[Data Management, HLT](#)[Knowledge and Maps](#)[Processing Logics / IOT App](#)[Entity Directory and Devices](#)[Resource Manager](#)[Development Tools](#)[Management](#)[Decision Support Systems](#)[Deploy and Installation](#)[Help and Contacts](#)[Documentation and Articles](#)[My Profile](#)[Km4City portal](#)[DISIT Lab portal](#)

Dashboards (Public)



www.snap4solutions.org

Dashboards of My Organization

My Dashboards in My Organization

My Data Dashboard Dev Kibana

Extra Dashboard Widgets

Data Management, HLT

Knowledge and Maps

Processing Logics / IOT App

Entity Directory and Devices

Resource Manager

Development Tools

Management

Decision Support Systems

Deploy and Installation

Help and Contacts

Documentation and Articles



Home / Snap4City: Smart aNalytic APp builder for sentient Cities and IOT

# Snap4City: Smart aNalytic APp builder for sentient Cities and IOT

You can't delete this newsletter because it has not been sent to all its subscribers.

Username: paolo.disit

## Search

Search input field with dropdown menu showing '-Any-'

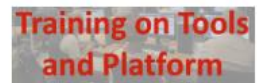
WHAT IS Snap4City | LATEST NEWS | SELECT for CITIES 1° Place award to SNAP4CITY | Snap4City Training on Tools and Platform | Tutorials | Scenarios | Organizations

SMARTCITY EXPO WORLD CONGRESS 15 - 17 NOVEMBER 2022 BARCELONA & ONLINE GET YOUR PASS

Flyer | DATA ANALYTICS ARTIFICIAL INTELLIGENCE | Innovations | Interoperability | Installations

What People say | Mobile Apps | IOT Devices | IOT Applications | Data Analytics | Dashboards | Living Lab | Smart City API | Ontology | Work with Us

Articles | SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE | SNAP4CITY HACKATHON | INDUSTRY 4.0 | Snap4Industry | Snap4Home



## Organization Groups

- DISIT
  - Developer
  - Operativo

- TECHNICAL OVERVIEW: <https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf>
- Development Life Cycle: <https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf>
- Client-Side Business Logic Widget Manual: <https://www.snap4city.org/download/video/ClientSideBusinessLogic-WidgetManual.pdf>
- Booklet Data Analytics, Snap4Solutions: [https://www.snap4city.org/download/video/DBL\\_SNAP4SOLUTION.pdf](https://www.snap4city.org/download/video/DBL_SNAP4SOLUTION.pdf)

# 2022 booklets

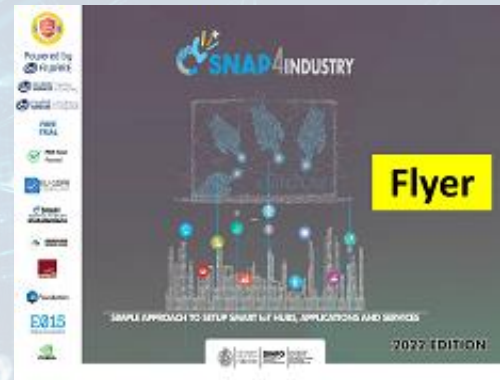


- Snap4City



[https://www.snap4city.org/download/video/DPL\\_SNAP4CITY\\_2022-v02.pdf](https://www.snap4city.org/download/video/DPL_SNAP4CITY_2022-v02.pdf)

- Snap4Industry



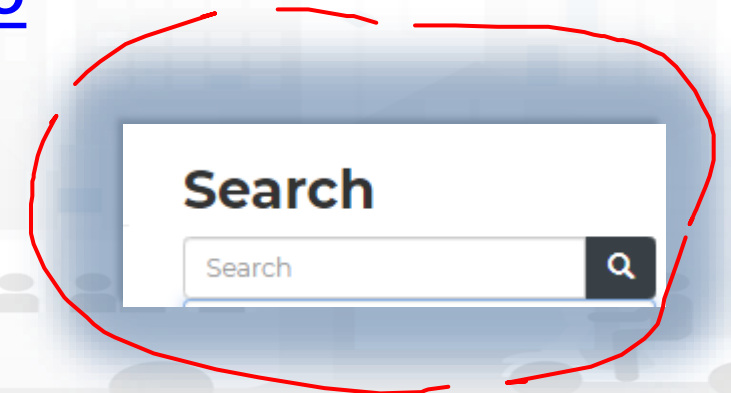
[https://www.snap4city.org/download/video/DPL\\_SNAP4INDUSTRY\\_2022-v03.pdf](https://www.snap4city.org/download/video/DPL_SNAP4INDUSTRY_2022-v03.pdf)

- Solutions
- Data Analytics



[https://www.snap4city.org/download/video/DPL\\_SNAP4SOLU.pdf](https://www.snap4city.org/download/video/DPL_SNAP4SOLU.pdf)

- **Free Registration on Snap4City.org**
  - Please select DISIT ORG to be sure to access at the examples
  - Most of the cities / tenant are private and they do not left much visible
- **What you get** is probably the 10% of what is on the platform 😊
- **Training:** <https://www.snap4city.org/577>
- **Scenarious:** <https://www.snap4city.org/4>
- **Publications:** <https://www.snap4city.org/426>
- **WEB pages:** <https://www.snap4city.org/78>
- ***SEARCH on the right side***



# Tech Overview

- <https://www.snap4city.org/drupal/sites/default/files/files/Snap4City-PlatformOverview.pdf>



### Technical Overview

From: DINFO dept of University of Florence, with its  
DISIT Lab, <https://www.disit.org> with its Snap4City solution

Snap4City:

- Web page: <https://www.snap4city.org>
- <https://twitter.com/snap4city>
- <https://www.facebook.com/snap4city>

Contact Person: Paolo Nesi, [Paolo.nesi@unifi.it](mailto:Paolo.nesi@unifi.it)

- o Phone: +39-335-5668674
- o LinkedIn: <https://www.linkedin.com/in/paolo-nesi-849ba51/>
- o Twitter: <https://twitter.com/paolonesi>
- o FaceBook: <https://www.facebook.com/paolo.nesi2>

# Development

<https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf>



## Development Life-Cycle

<https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle-v1-1.pdf>

### From Snap4City:

- We suggest you to read the **TECHNICAL OVERVIEW**:
  - <https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf>
- <https://www.snap4city.org>
- <https://www.snap4solutions.org>
- <https://www.snap4industry.org>
- <https://twitter.com/snap4city>
- <https://www.facebook.com/snap4city>
- <https://www.youtube.com/channel/UC3tAO09EbNba8f2-u4vandq>

**Coordinator:** Paolo Nesi, [Paolo.nesi@unifi.it](mailto:Paolo.nesi@unifi.it)

DISIT Lab, <https://www.disit.org>  
DINFO dept of University of Florence,  
Via S. Marta 3, 50139, Firenze, Italy  
Phone: +39-335-5668674



# Client Side Business Logic

<https://www.snap4city.org/download/video/ClientSideBusinessLogic-WidgetManual.pdf>



Powered by  
 **SNAP4Tech**

## Client-Side Business Logic Widget Manual

### From Snap4City:

- We suggest you read <https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf>
- We suggest you read the TECHNICAL OVERVIEW:
  - <https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf>
- slides go to <https://www.snap4city.org/577>
- <https://www.snap4city.org>
- <https://www.snap4solutions.org>
- <https://www.snap4industry.org>
- <https://twitter.com/snap4city>
- <https://www.facebook.com/snap4city>
- <https://www.youtube.com/channel/UC3tAQ09EbNba8f2-u4vanda>

Coordinator: Paolo Nesi, [Paolo.nesi@unifi.it](mailto:Paolo.nesi@unifi.it)  
DISIT Lab, <https://www.disit.org>  
DINFO dept of University of Florence,  
Via S. Marta 3, 50139, Firenze, Italy  
Phone: +39-335-5668674



SMART CITIES AND SMART INDUSTRY

**Snap4City:**  
**FIWARE** powered smart app  
builder for sentient cities

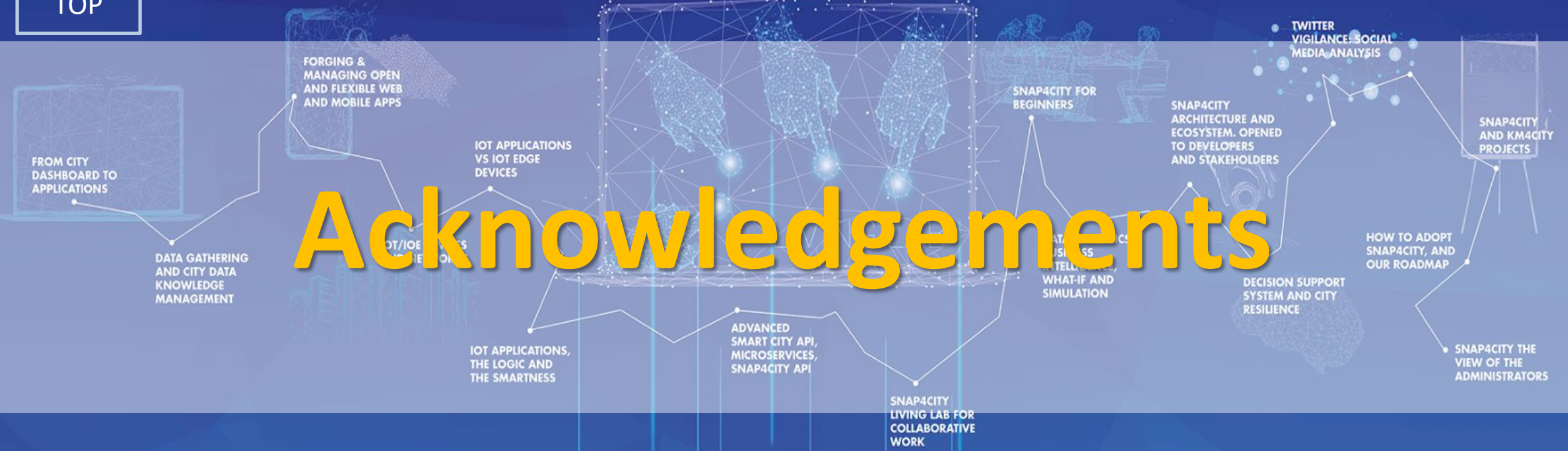
With the contribution of

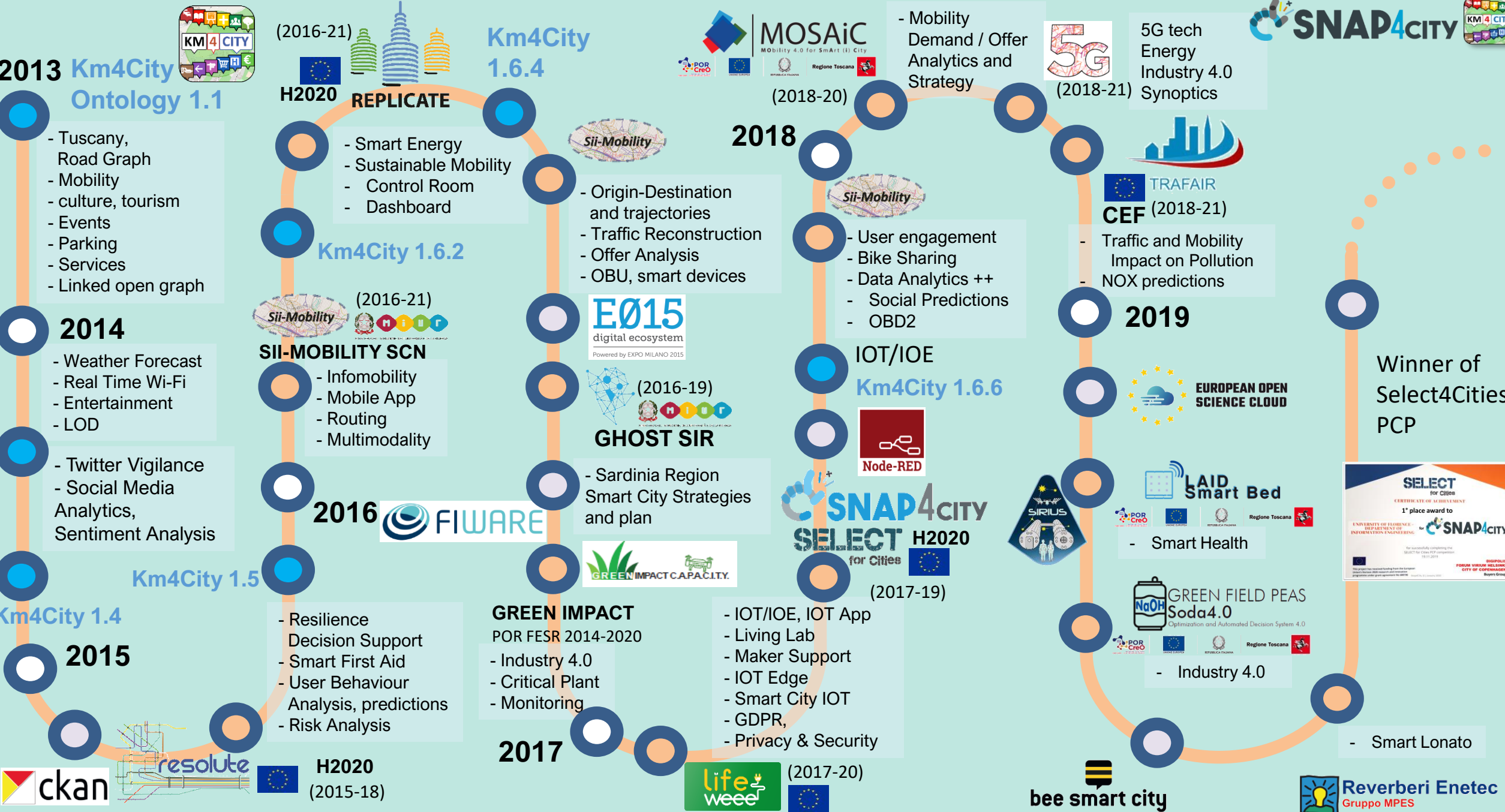


- <https://fiware-foundation.medium.com/snap4city-fiware-powered-smart-app-builder-for-sentient-cities-acfe24df49d5>
- [https://www.snap4city.org/download/sites/default/files/files/FF\\_ImpactStories\\_Snap4City.pdf](https://www.snap4city.org/download/sites/default/files/files/FF_ImpactStories_Snap4City.pdf)

TOP

# Acknowledgements





## 2013 Km4City Ontology 1.1

- Tuscany, Road Graph
- Mobility
- culture, tourism
- Events
- Parking
- Services
- Linked open graph

## 2014

- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- LOD

- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

## Km4City 1.4

## 2015

- Resilience Decision Support
- Smart First Aid
- User Behaviour Analysis, predictions
- Risk Analysis



## (2016-21) H2020 REPLICATE Km4City 1.6.4

- Smart Energy
- Sustainable Mobility
- Control Room
- Dashboard

## Km4City 1.6.2



- ### SII-MOBILITY SCN
- Infomobility
  - Mobile App
  - Routing
  - Multimodality



## Km4City 1.5

- ### GREEN IMPACT
- POR FESR 2014-2020
- Industry 4.0
  - Critical Plant
  - Monitoring

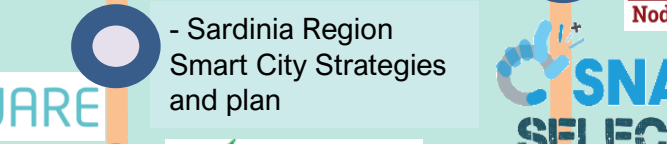


## (2018-20) MOSAIC Mobility 4.0 for Smart (II) City

- ### 2018
- Origin-Destination and trajectories
  - Traffic Reconstruction
  - Offer Analysis
  - OBU, smart devices



- ### GHOST SIR
- (2016-19)
- Sardinia Region Smart City Strategies and plan



## (2017-19) H2020

- IOT/IOE, IOT App
- Living Lab
- Maker Support
- IOT Edge
- Smart City IOT
- GDPR, Privacy & Security



## (2018-21) 5G tech Energy Industry 4.0 Synoptics

- Mobility Demand / Offer Analytics and Strategy
- User engagement
- Bike Sharing
- Data Analytics ++
- Social Predictions
- OBD2

## IOT/IOE Km4City 1.6.6



## (2017-19) H2020

- Smart Health



## SNAP4CITY

- ### 2019
- Traffic and Mobility Impact on Pollution
  - NOX predictions



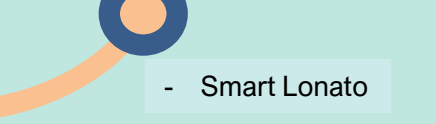
Winner of Select4Cities PCP



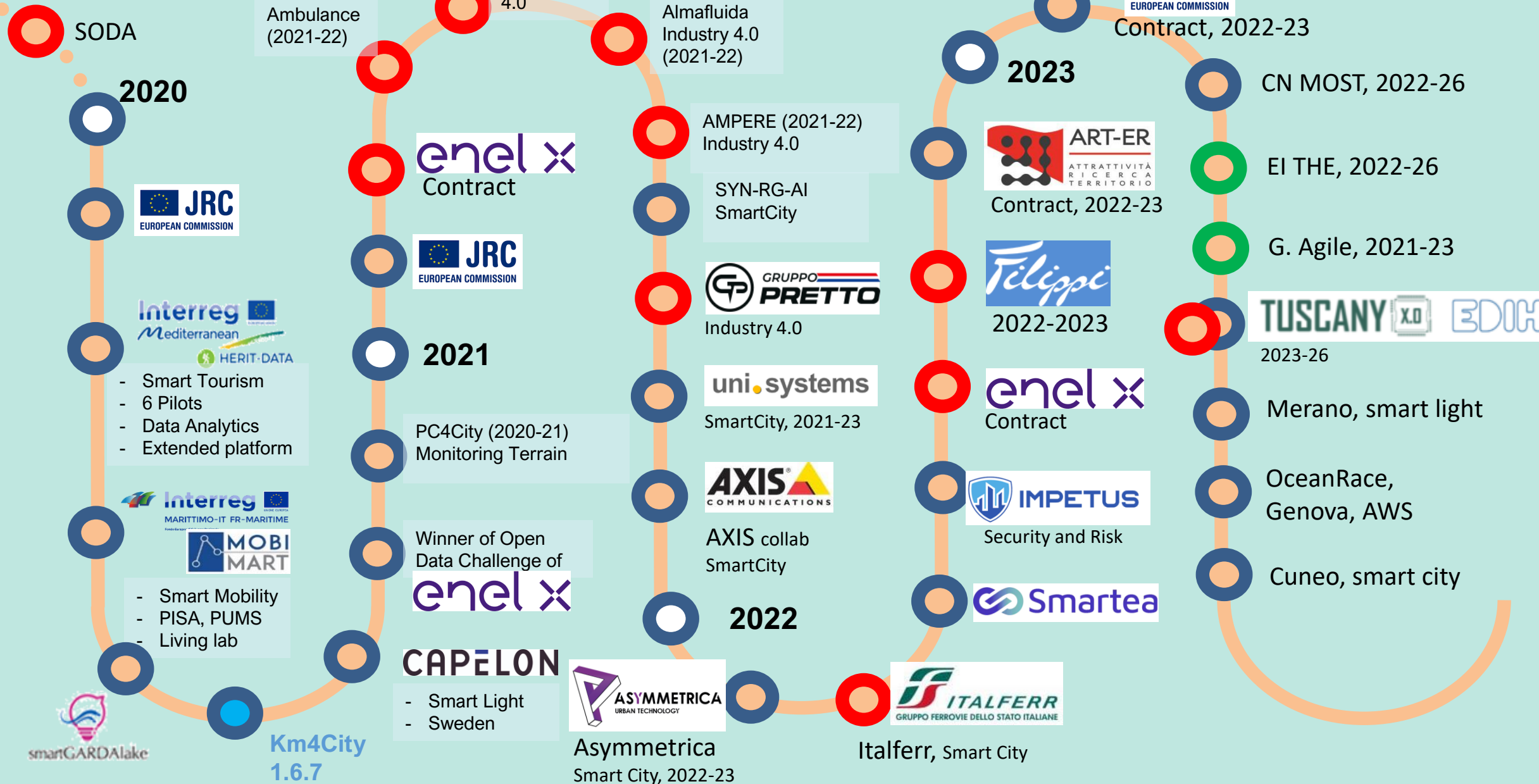
## GREEN FIELD PEAS Soda4.0

Optimization and Automated Decision System 4.0

- Industry 4.0



DISIT lab roadmap vs model and tools' usage



**2020**



- Smart Tourism
- 6 Pilots
- Data Analytics
- Extended platform



- Smart Mobility
- PISA, PUMS
- Living lab



**Km4City 1.6.7**



**2021**

PC4City (2020-21)  
Monitoring Terrain



**CAPELON**  
- Smart Light  
- Sweden



**Asymmetrica**  
Smart City, 2022-23

**uni.systems**  
SmartCity, 2021-23



AXIS collab  
SmartCity

**2022**



**Italferr, Smart City**

AMPERE (2021-22)  
Industry 4.0

SYN-RG-AI  
SmartCity



Industry 4.0

uni.systems  
SmartCity, 2021-23



AXIS collab  
SmartCity

**2022**



**Italferr, Smart City**

Almafluida  
Industry 4.0  
(2021-22)

Enterprise  
(2021-22)  
Industry  
4.0

Smart  
Ambulance  
(2021-22)

**JRC**  
EUROPEAN COMMISSION  
Contract, 2022-23

**2023**



CN MOST, 2022-26

EI THE, 2022-26

G. Agile, 2021-23



Merano, smart light

OceanRace,  
Genova, AWS

Cuneo, smart city

TOP



*Be smart in a SNAP!*



**SMARTCITY**

EXPO WORLD CONGRESS

7-9 November 2023, Barcelona, Spain

Visit Snap4City in Hall 1

## CONTACT

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