



[www.snap4city.org](http://www.snap4city.org)  
[www.snap4solutions.org](http://www.snap4solutions.org)



[www.km4city.org](http://www.km4city.org)

# Overview for Adopters, Cities, Regions, Integrators, Decision Makers

Sept. 2024, Course  
Part 1: overview

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DIGITAL TWIN SOLUTIONS TO SETUP SUSTAINABLE DECISION SUPPORT SYSTEMS AND BUSINESS INTELLIGENCE



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

DINFO  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

DISIT  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB



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<https://www.Km4City.org>  
<https://www.disit.org>



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



**Be smart in a SNAP!**

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

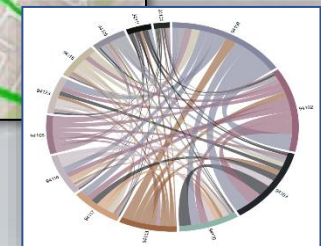
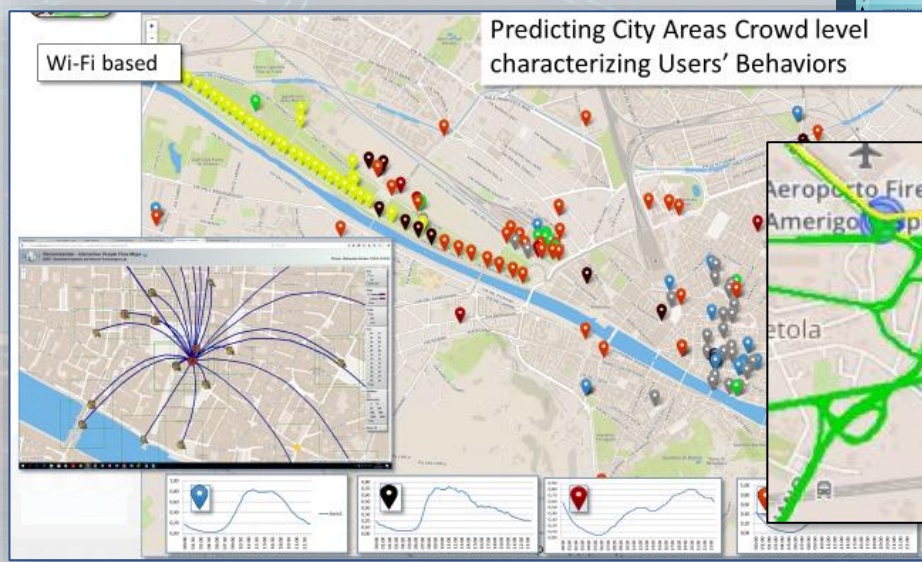
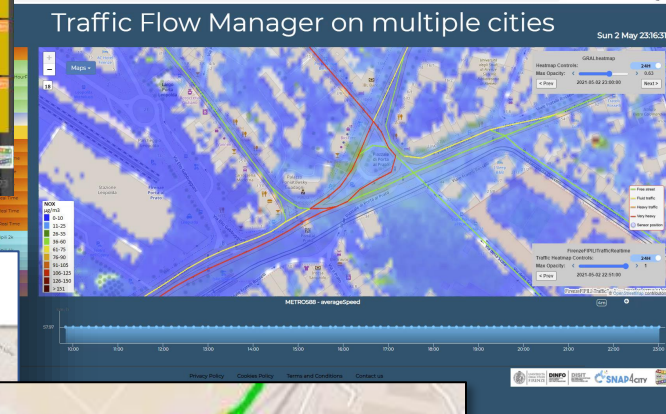
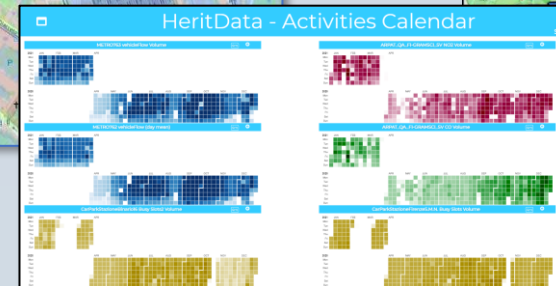
Sept. 2024, Course, Part 1  
<https://www.snap4city.org/944>  
<https://www.snap4city.org/577>

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



# Domains

- Smart City, control room
- Mobility and transport
- Environment, pollutant, waste, water, green, ..
- Energy, light, recharge
- Tourism and People
- Asset management
- Security and Safety
- Social Media
  
- Big Data, AI/XAI
- Public and private data



# Key Performance Indicators, KPI



- **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: NO2, PM10, PM2.5 ([https://environment.ec.europa.eu/topics/air\\_en](https://environment.ec.europa.eu/topics/air_en));
- **SUMI: mobility and transport vs env**
  - <https://www.snap4city.org/951>
- **SUMP/PUMS: mobility and transport vs env.**
- **ISO indicators:** city smartness, digitization, tech level.
- **Low Level/Real Time:** global traffic, quality of service, betweenness, centrality, queue, time to travel, etc.

Global  
&  
Local  
  
Periodic  
&  
Realtime

Air Quality Directive				WHO guidelines	
Pollutant	Averaging period	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>	



• **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?**

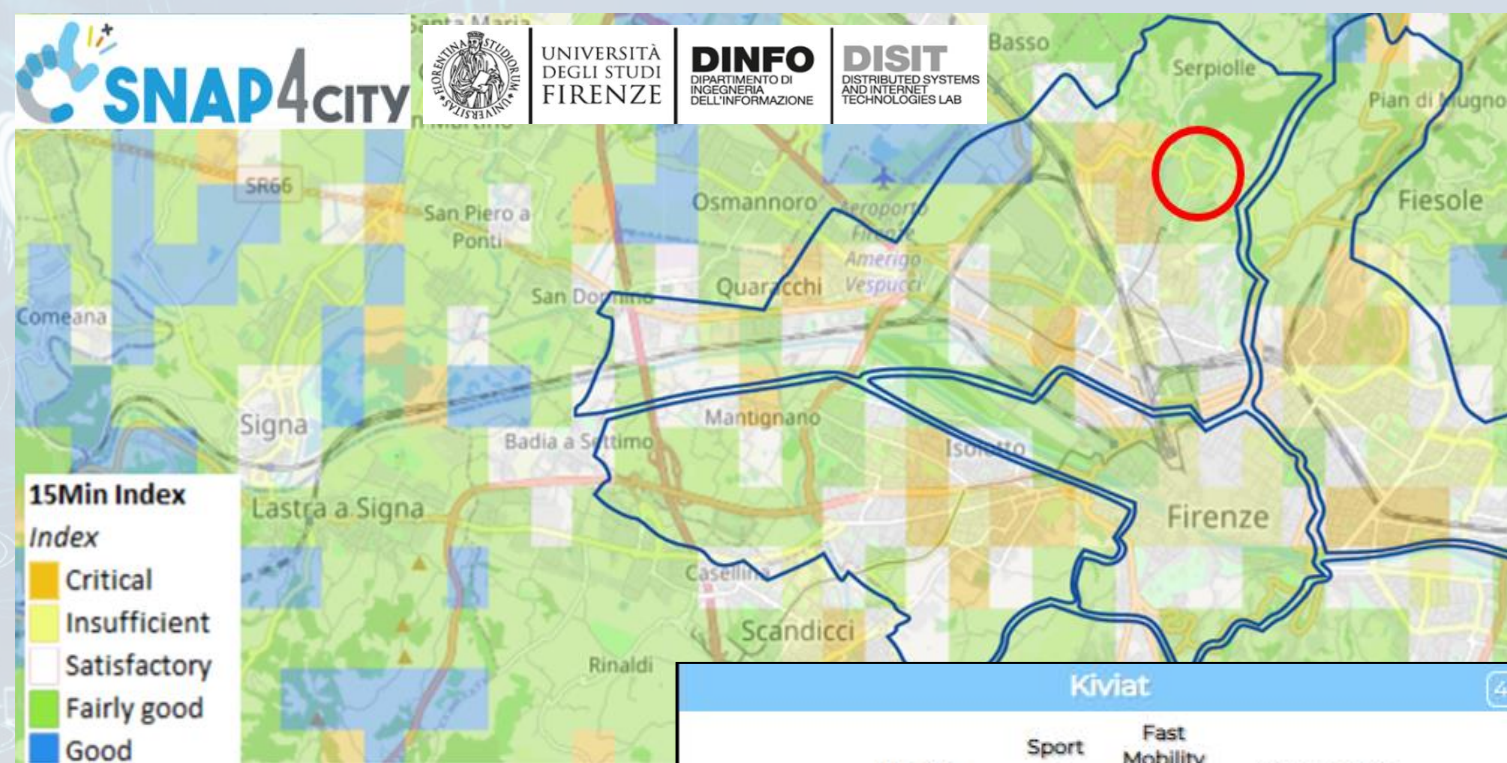
## Using the Open Data:

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.

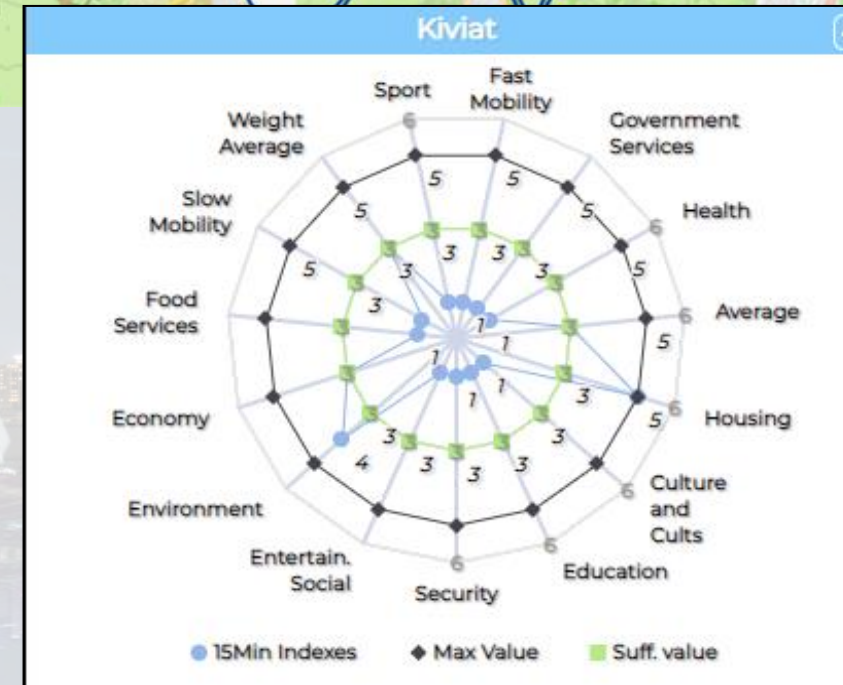
Good public transport services: bus, new tram line, train stations, cycle paths.



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

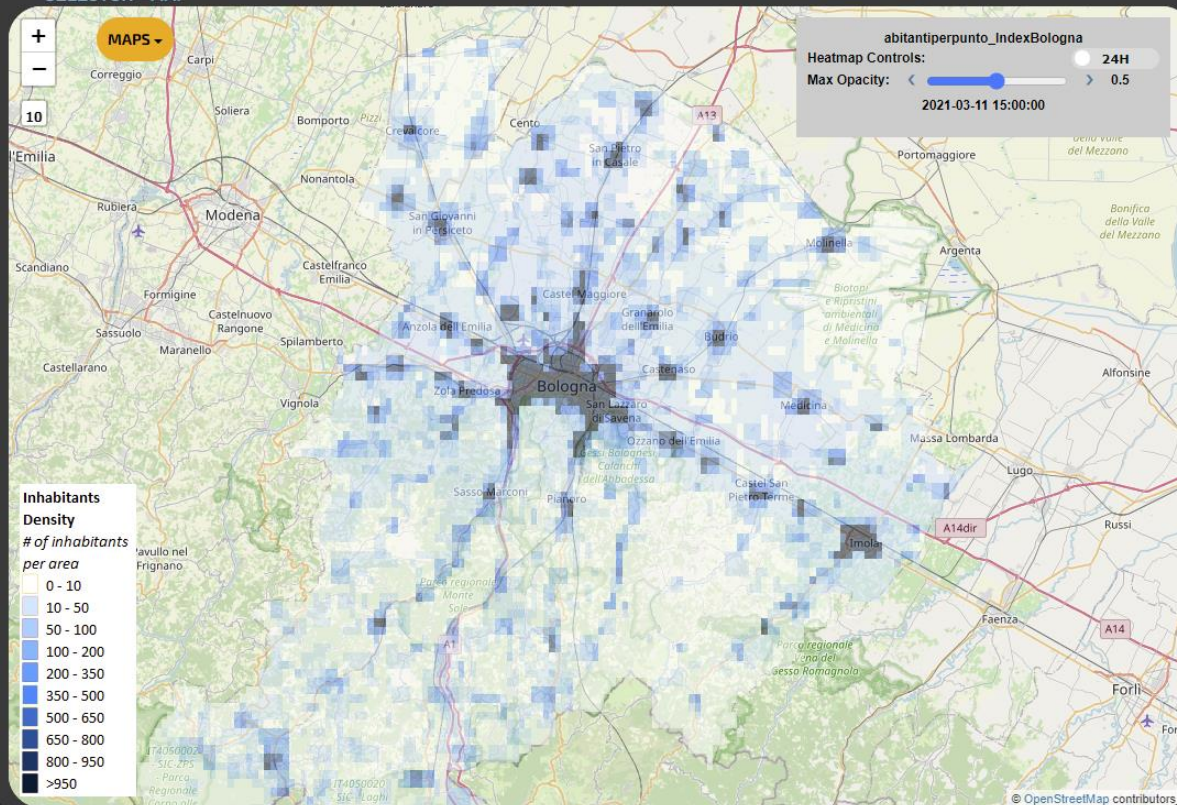
- # of Inhabitants
- Green factor
- Civil factor
- Industrialization factor
- Environment Index
- 15Min Economy Index
- 15Min Housing Index
- 15Min Health Index
- 15Min Food Index
- 15Min Education Index
- 15Min Slow Mob Index

### THE PICKED POINT

9m

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

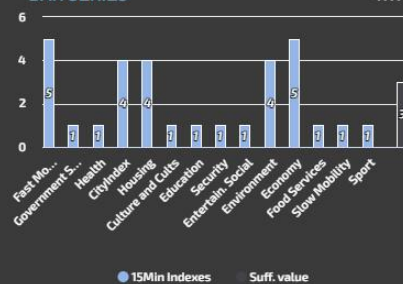
### SELECTOR - MAP



### 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





# Public Spaces as Critical Infrastructures

- The City is a system of systems for city users
  - Cascading effects
- **Transport** networks
  - Main means for rescue teams, food, water, etc.
- **Communication**, ICT infrastructure
  - TV cam, switches, cyber,
- **Energy** networks
  - power supply for health, cyber systems, etc.
- **Hospitals** networks
- Aggregation areas



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

# Mobility and Environment What-IF Analysis

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

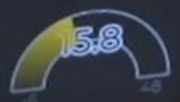
Wed 20 Nov 15:43:00

- ✓ 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)

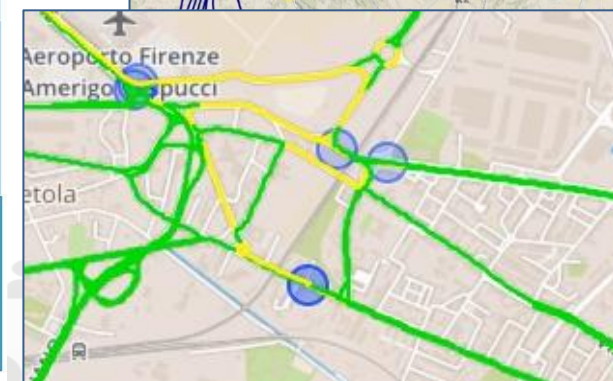
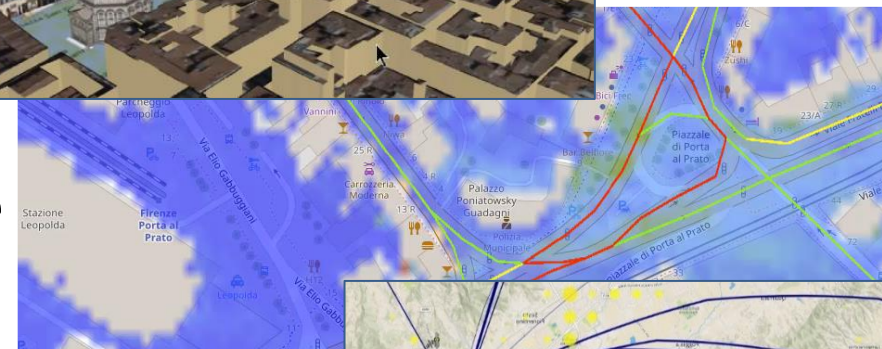


<https://www.snap4city.org/511>

ADVANCED SMART  
DATA ANALYTICS

# Main Tasks

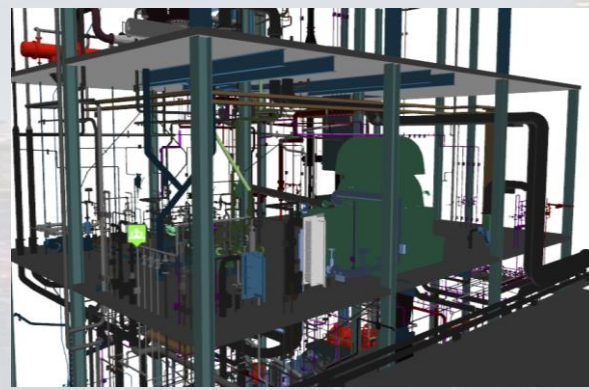
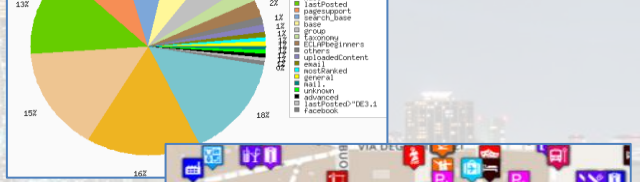
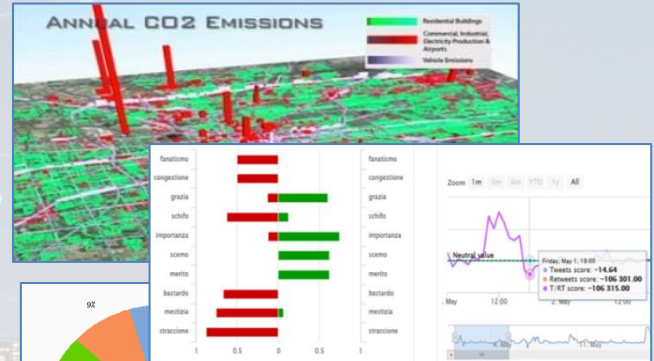
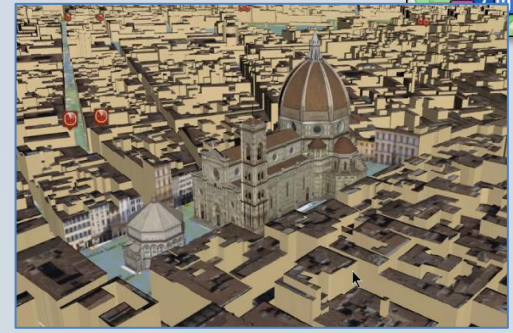
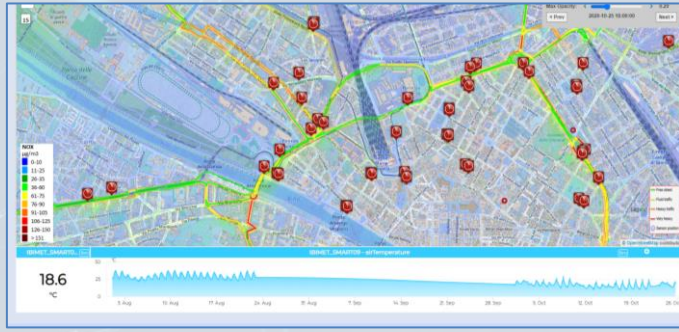
- **Controlling Status:** management, and operational
  - Monitoring via KPI
  - Computing predictions data from the field and KPI
  - Anomaly detection
  - Early warning on critical conditions
- **Making plan: tactic and strategic, medium and long range**
  - Optimisation: Prescriptions, suggestions
  - Risk assessment
  - What-if analysis on scenarios
    - Simulation and predictions
  - Resilience
- **Be ready for Unexpected Unknowns**



# Digital Twin

## Digital Twin

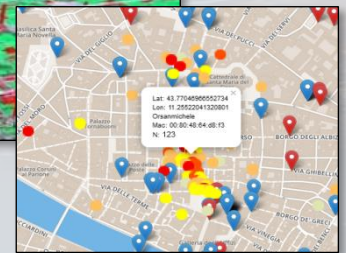
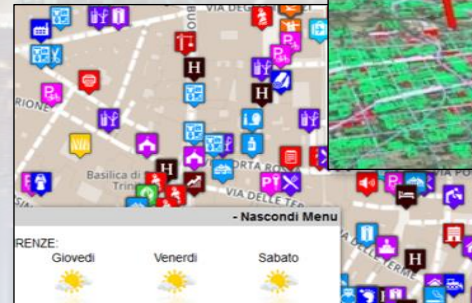
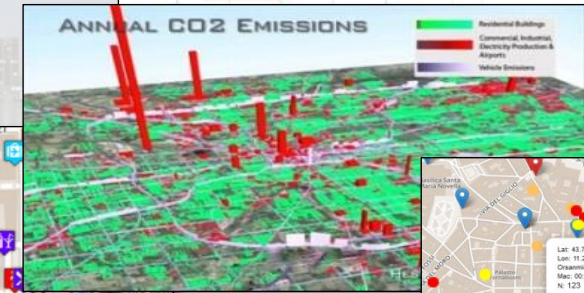
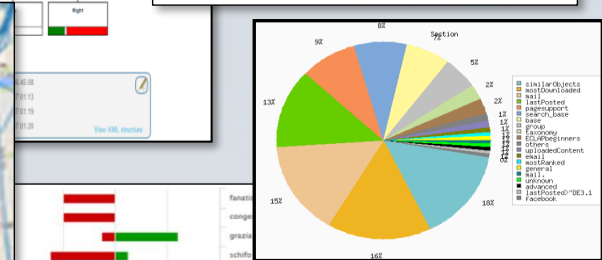
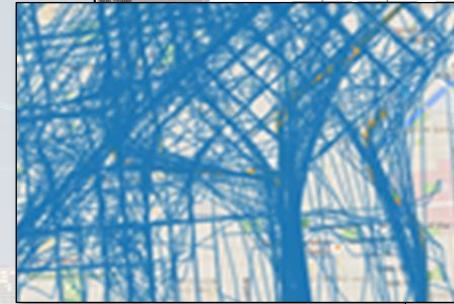
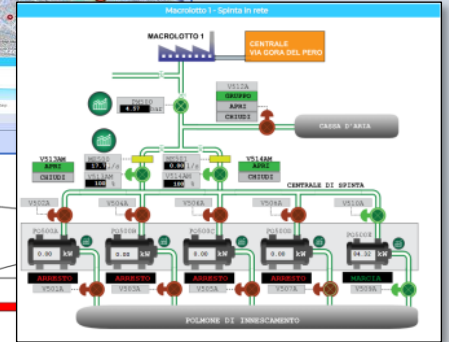
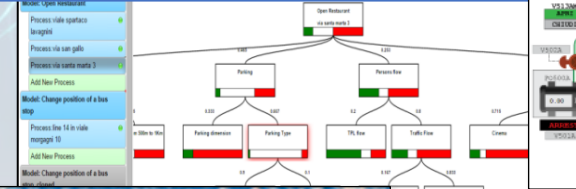
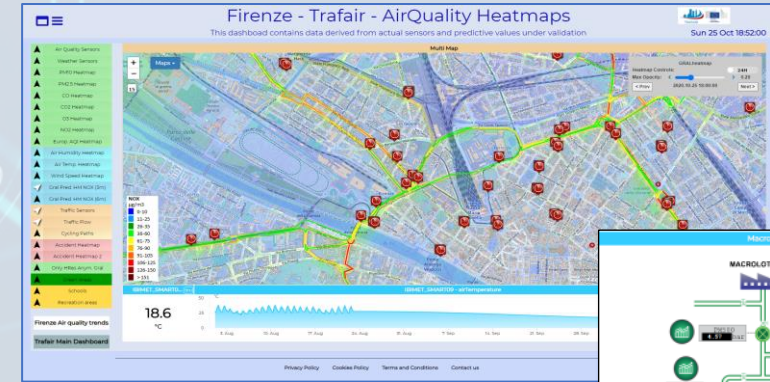
- **Connected** with real systems
  - **Modelling** aspects: structural, visual, informative, real time data sensors (context), POI, functional, resources, etc.
  - **Analytics:** AI/XAI techniques, simulations, users' needs, etc.
- **Easier to understand the context, review from multiple points of view**
- **Useful to perform**
    - Discussion with city users
    - Support decision makers
    - By Case Experiments for analysing
      - New solutions, impact of disaster (natural and provoked)
      - Reduction of costs in the analysis, in reduction of mistakes



# 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

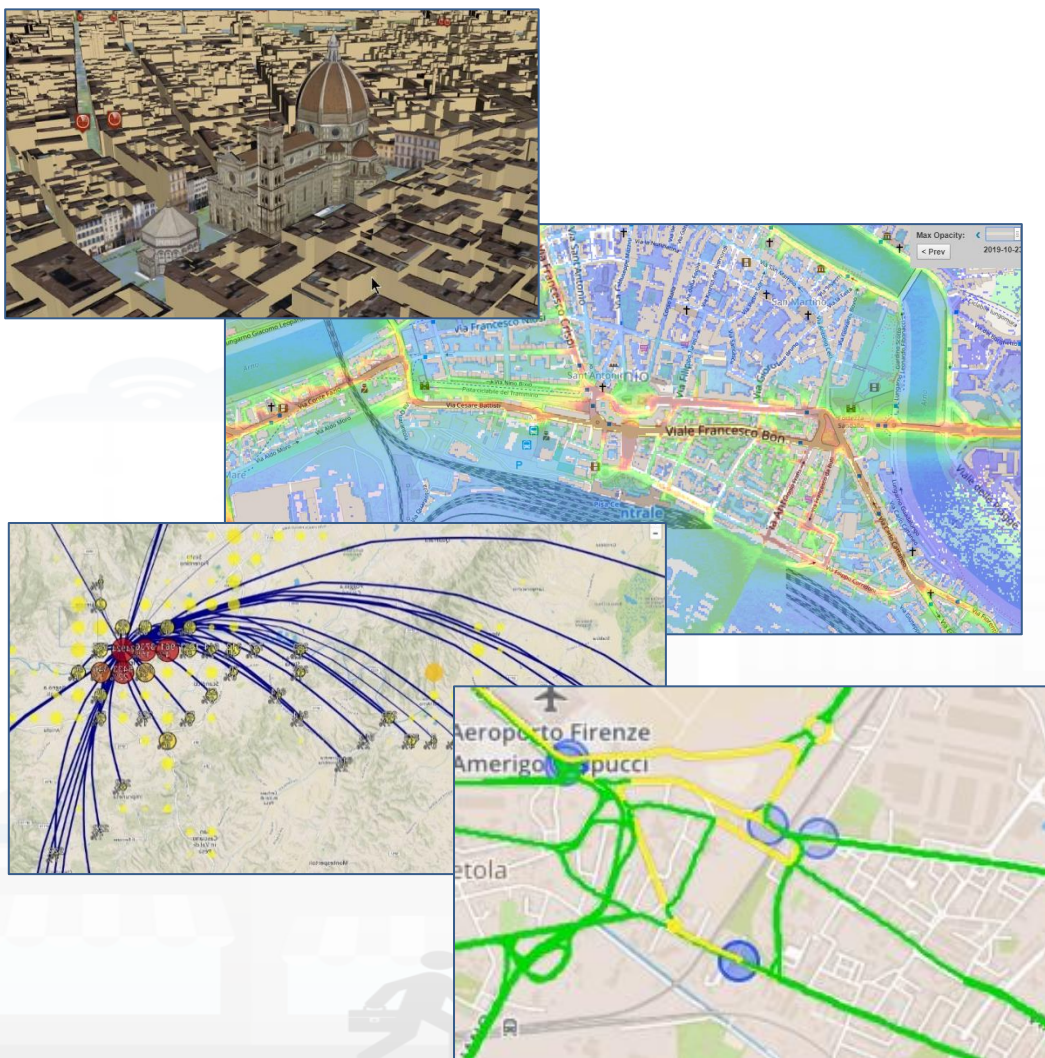


# Challenges vs Technologies

- **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*



# Smart City Digital Twin City Digital Model with...



## City Digital Model with...

- Intuitive platform
- Any Data TYPE, any data source, any protocol
- Data storage seamless
- Data analytics → artificial intelligence, AI/XAI
- Data Ethics, AI Ethics, GDPR
- **Interactive** Data Representation, any kind
- Key Performance Indicators, any kind
- What-IF analysis – Simulation, prediction, 2D/3D
- Micro, Meso e macro scales
- Operation, planning tactic and strategic
- Collaborative and shared representation
- Sustainable, shared, open source 100%



## Complex and heterogeneous information, interoperability

- GIS, ITS, AVM, IoT, BIM, CKAN, etc.
- Satellite services
- MaaS, last-mile delivery HUBs
- etc.



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INTERNET TECHNOLOGIES LAB  
DISTRIBUTED DATA INTELLIGENCE  
AND TECHNOLOGIES LAB



# Application: eSharing and Pooling



FROM CITY  
DASHBOARD TO  
APPLICATIONS

DATA AND  
KNOWLEDGE  
MANAGEMENT

SNAP4CITY  
AND KM4CITY  
PROJECTS

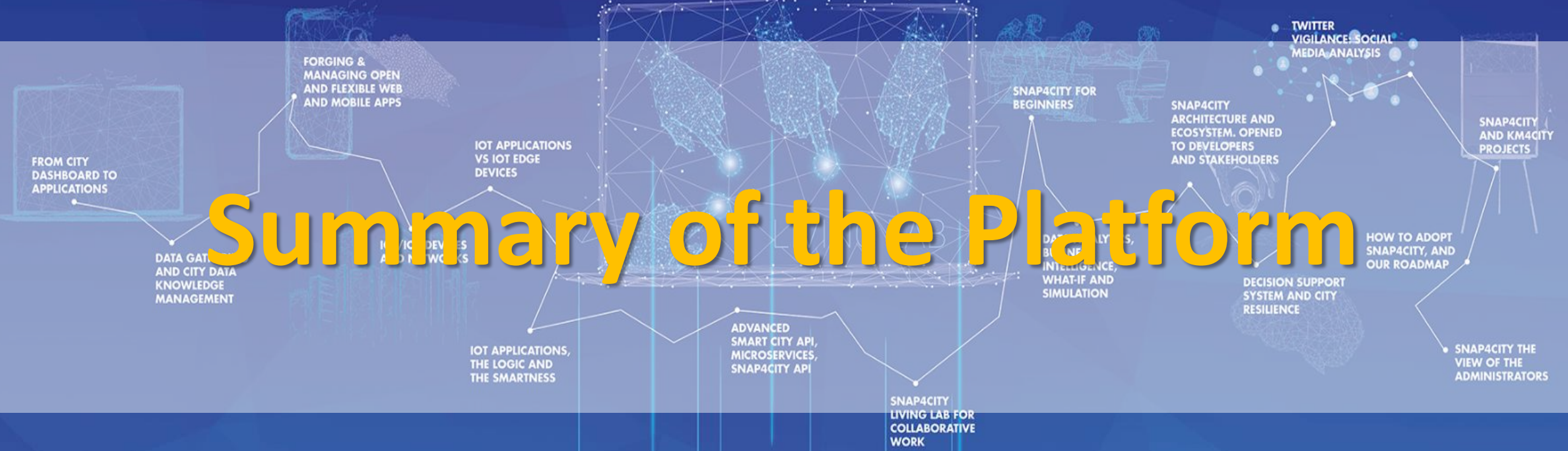
HOW TO ADOPT  
SNAP4CITY, AND  
THE ROADMAP

SNAP4CITY THE  
VIEW OF THE  
ADMINISTRATORS





# Summary of the Platform

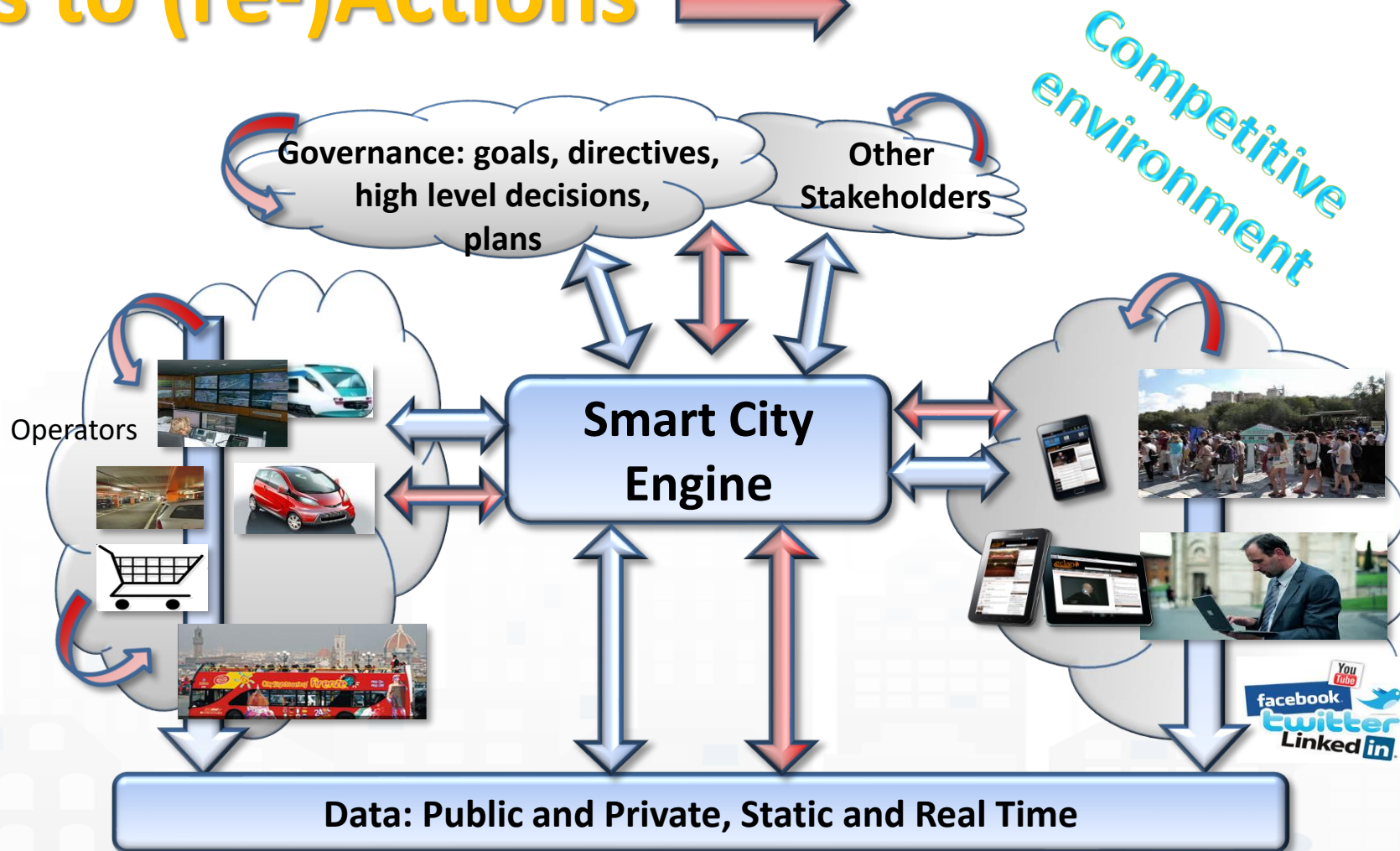


# Snap4City



# From Strategies to (re-)Actions

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





# Digital Twin Solutions for Sustainability

OPERATION AND PLAN - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - OPTIMIZATION - APPLICATIONS

### CONTROL AND PLAN

### MOBILITY AND TRANSPORT

### SMART ENERGY AND SMART BUILDING

### ENVIRONMENT AND WASTE MANAGEMENT

### CITY USER'S SERVICES AND TOURISM MANAGEMENT

- DEVELOPMENT ENVIRONMENT AND METHODOLOGY
- VISUAL PROGRAMMING, ML, AI, HPC
- TRAINING COURSES
- LIVING LABS
- GUI CUSTOM STYLES
- FULL APPLICATIONS, DASHBOARDS AND VIEWS
- MOBILE APPS



## VISUAL ANALYTICS - SYNOPTICS - GRAPHICAL WIDGETS - ANALYTICS - BUSINESS INTELLIGENCE - SIMULATIONS

**DASHBOARDS, WIDGETS TEMPLATES**

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

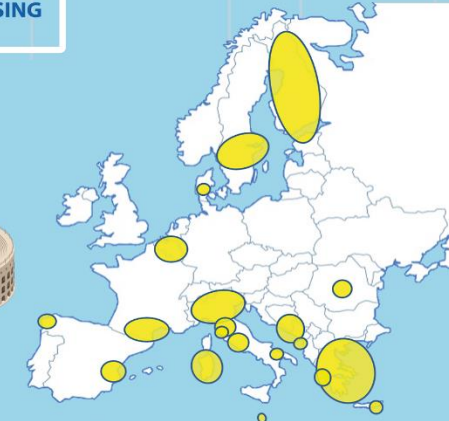
**API - MICROSERVICES - GIS - BPM**  
VIDEO - REPORTS - MAPS - 3D ...

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

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

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

FULL INTEROPERABILITY, ANY: DATA, BROKERS, NETWORKS AND VERTICALS



Powered by **FIWARE**

FREE TRIAL

PEN Test Passed

EU GDPR COMPLIANT

SNAP4 Appliances and Dockers Installations

EUROPEAN OPEN SCIENCE CLOUD

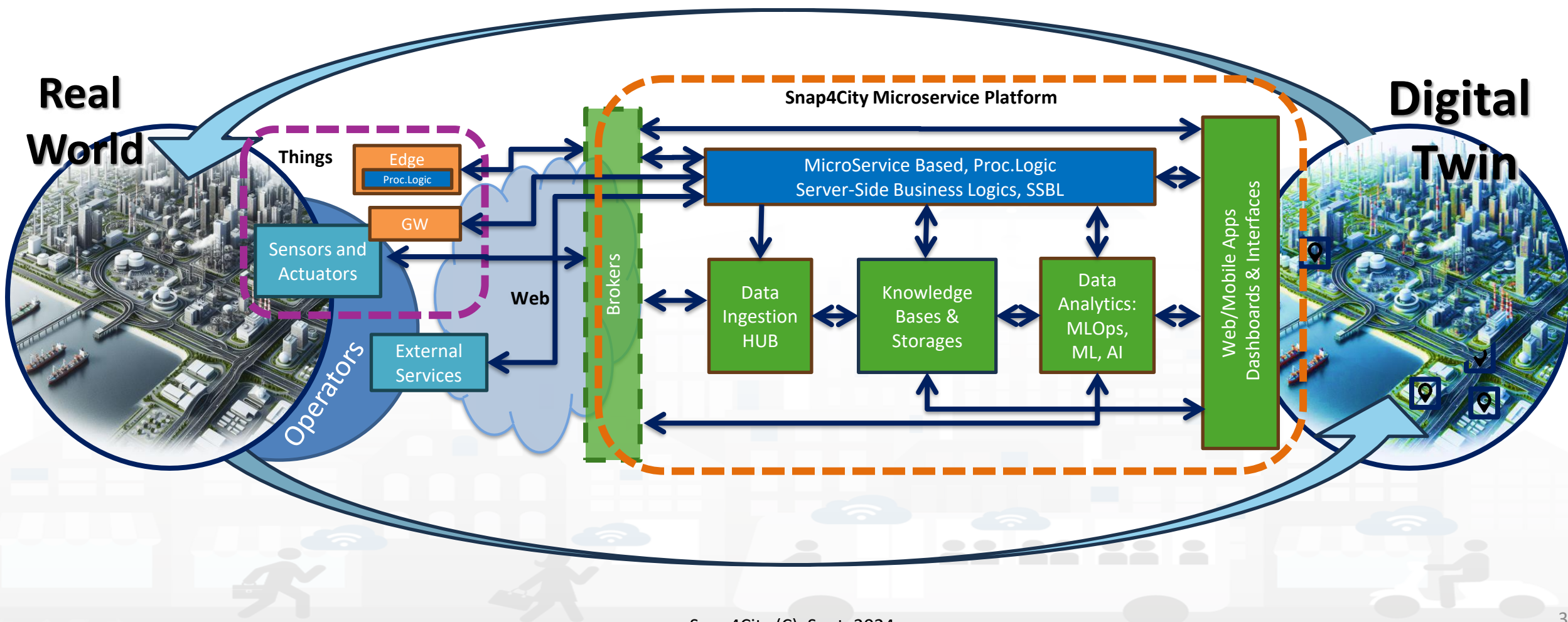
Node-RED

JS Foundation

E015 digital ecosystem

NVIDIA

# Digital Twin Development Platform





# Smart Solutions and Decision Support Systems

Powered by **FIWARE**

**FREE TRIAL**

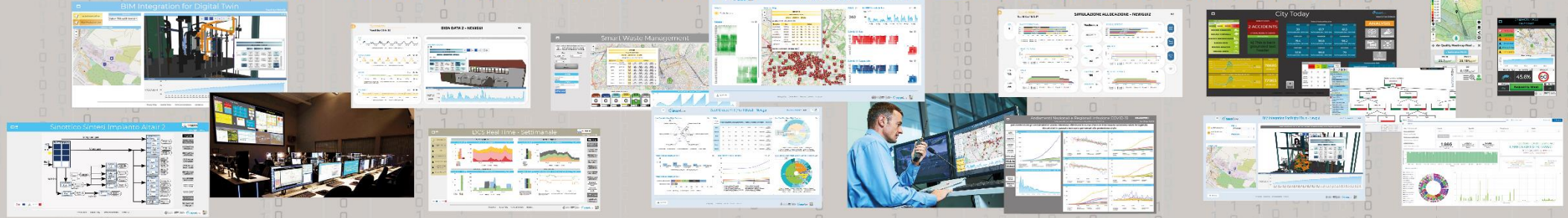
**PEN Test Passed**

**EU GDPR COMPLIANT**

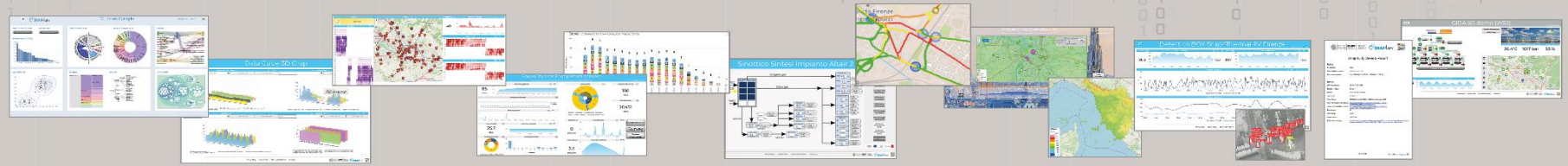
**Appliances and Dockers Installations**

**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  
PLC**

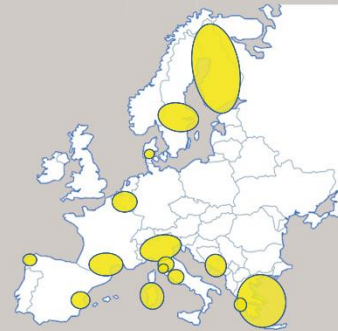
**DCS/SCADA**

**LOGISTICS  
MES**

**WASTE  
DRONES**

**ENERGY**

**ENVIRONMENT  
CO2**

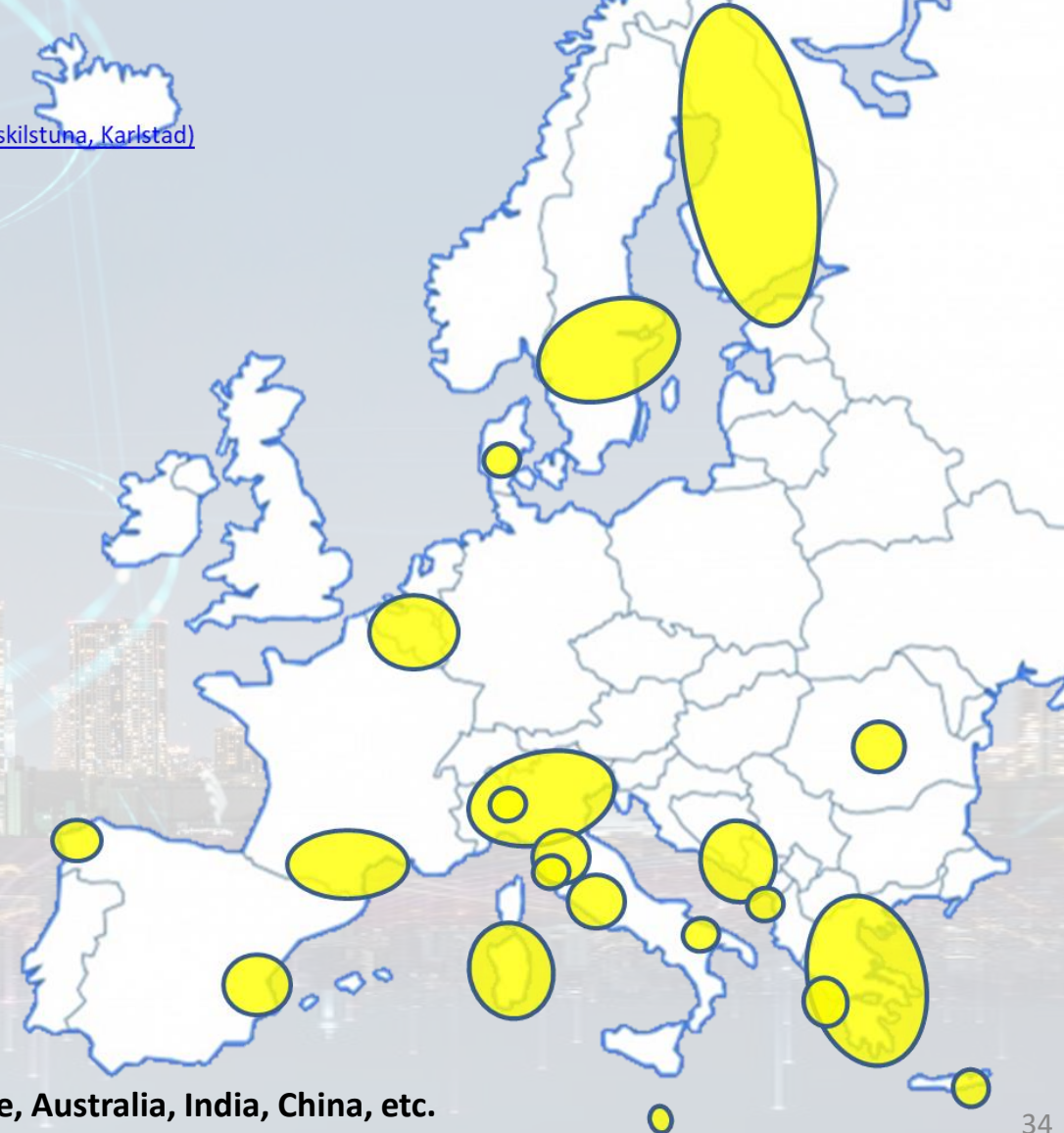




PEN Test  
Passed



EU GDPR  
COMPLIANT



#### Main Organizations/areas

- [Antwerp area \(Be\)](#)
- [Bari \(I\)](#)
- [Bisevo, Croatia](#)
- [Bologna \(I\)](#)
- Brasov (Ro)
- [Capelon \(Sweden: Västerås, Eskilstuna, Karlstad\)](#)
- [Cuneo \(I\)](#)
- [DISIT demo \(multiple\)](#)
- [Dubrovnik, Croatia](#)
- [Firenze area \(I\)](#)
- [Garda Lake area \(I\)](#)
- [Greece \(Gr\)](#)
- [Helsinki area \(Fin\)](#)
- [Limassol \(Cy\)](#)
- [Livorno area \(I\)](#)
- [Lonato del Garda \(I\)](#)
- Malta (Malta)
- Merano (I)
- [Modena \(I\)](#)
- [Mostar, Bosnia-Herzegovina](#)
- [Oslo & Padova \(Impetus\)](#)
- [Pisa area \(I\)](#)
- [Pistoia \(I\)](#)
- [Pont du Gard, Occitanie \(Fr\)](#)
- [Prato \(I\)](#)
- [Rhodes \(Gr\)](#)
- [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.

- 11 running installations in Europe
  - Snap4.city.org, Greece, Merano, Cuneo, ...
  - Toscana, Pisa, Sweden, ISPRA, Snap4.eu,
  - Altair, Italmatic, Romania, ....
- 16 projects, 12 pilots on 10 Countries
  - >40 cities/area
- **Widest MULTI-tenant deploy has**
  - 24 Organizations / tenant
  - > 8850 users on
  - > 1800 Dashboards
  - > 17 mobile Apps
  - > **2.2 Million of structured data per day**
  - > 580 IoT Applications/node-RED
  - > 750 web pages with training
  - > 75 videos, training videos

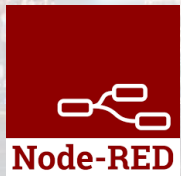
# Standards and Interoperability (6/2023)



## 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>





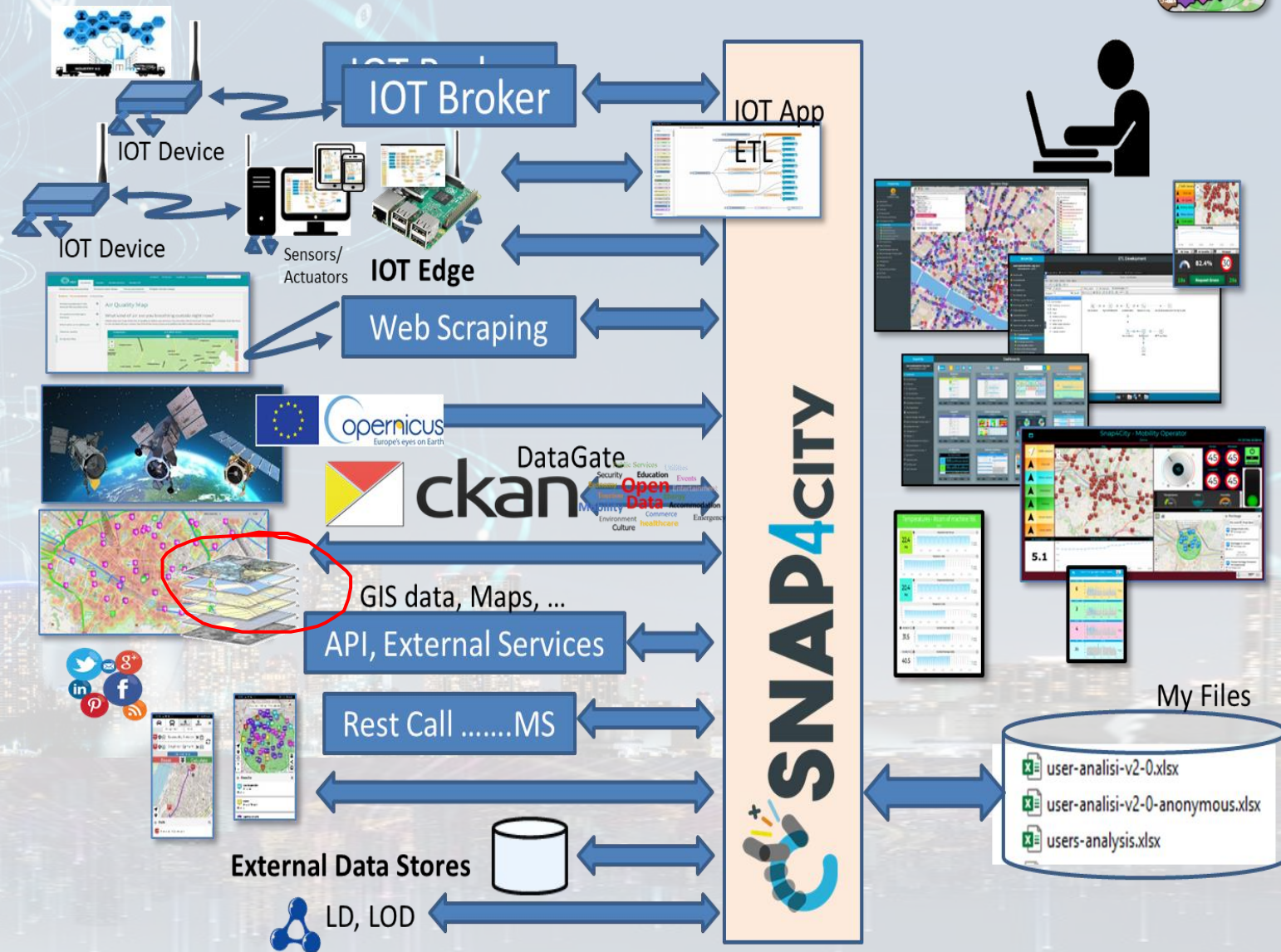
# Ingestion, agg. → exploitation



- **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*



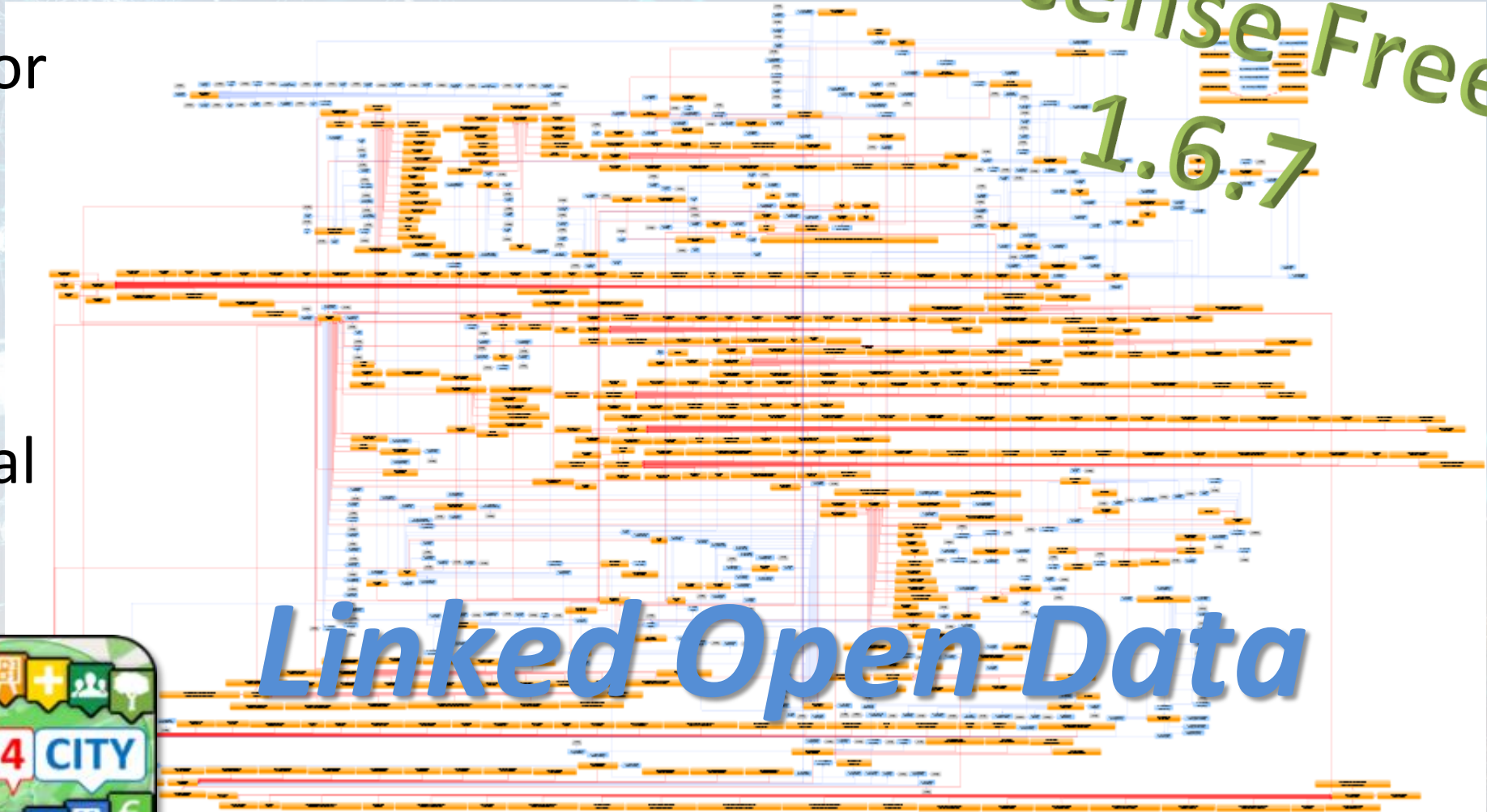
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DINFO  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

DISIT  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB



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

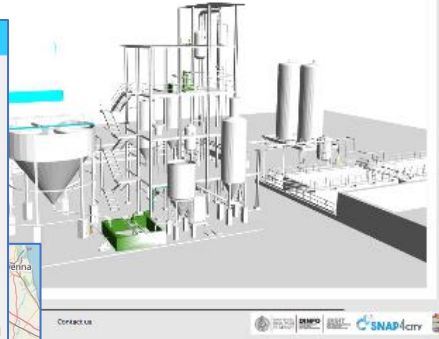
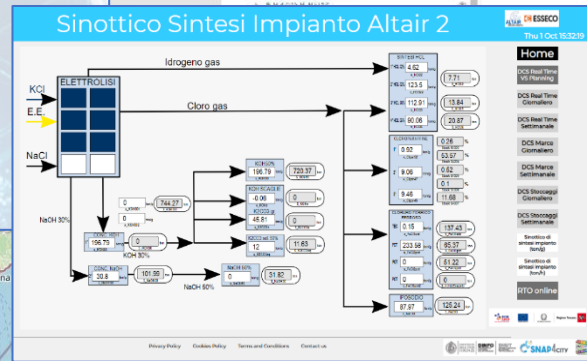
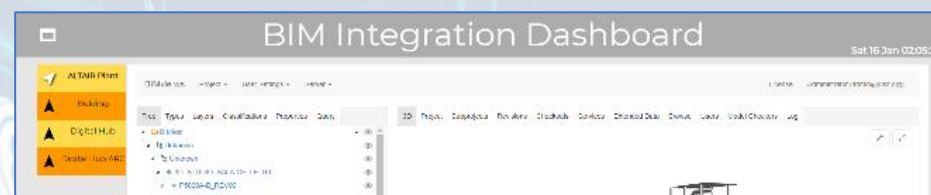


<https://www.snap4city.org/19>

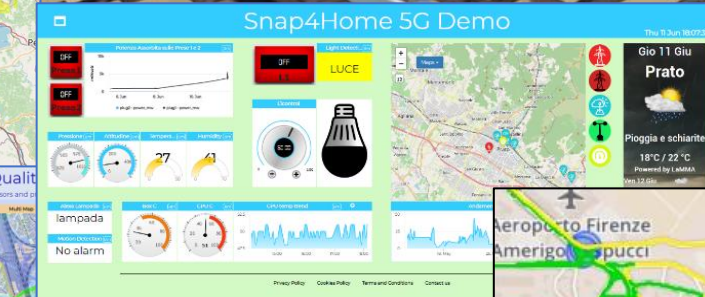
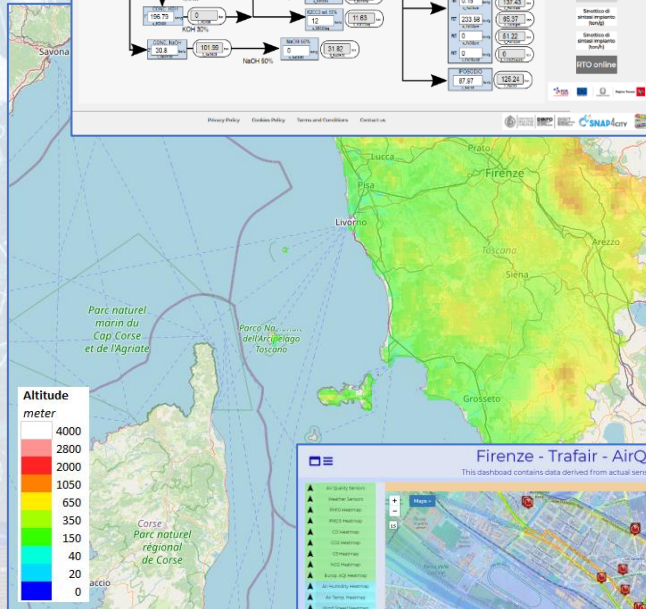
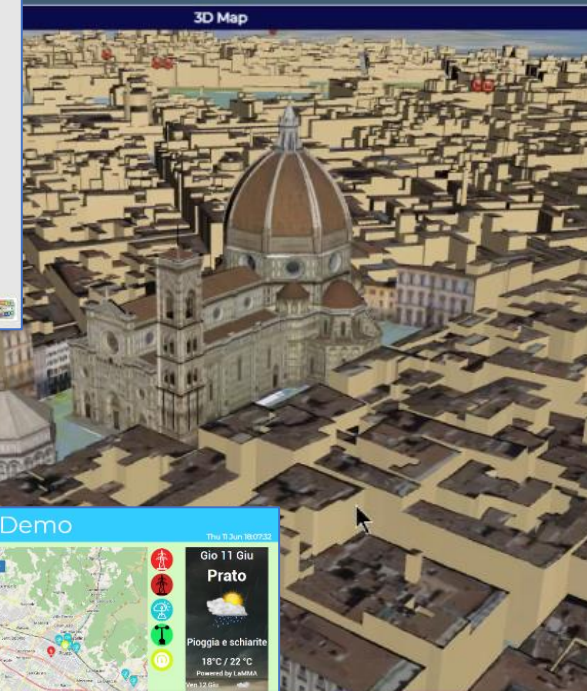
# High Level Types

Snap4City (C), Sept. 2024

- POI, IOT Devices, shapes, ...
  - FIWARE Smart Data Models,
  - IoT Device Models
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ..
- Satellite data, any kind..
- 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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FIRENZE

**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

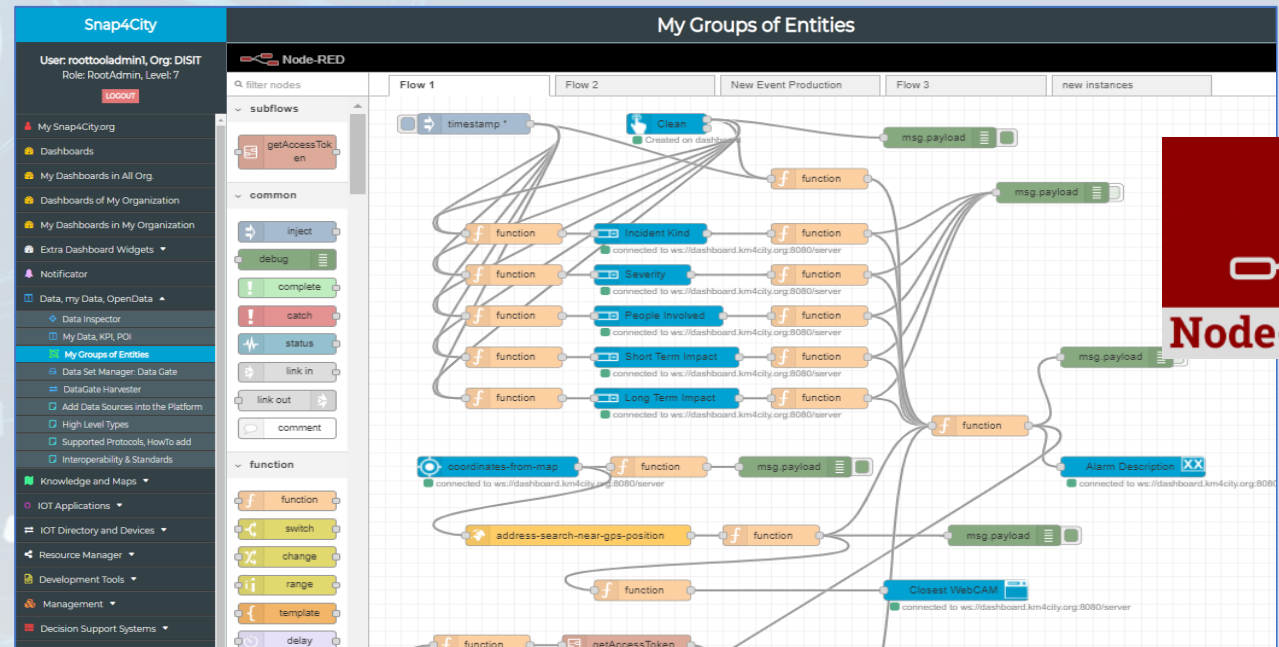
**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB

# Ingestion, aggreg. → exploitation



## • IoT App Visual Programming, no coding

- Data transformation
- Integration, Interoperab.
- Scripting Data Analytics
- Data ingestion
- Business logic Server side



## • Edge and Cloud

## • MicroServices data driven develop via visual language Node-RED

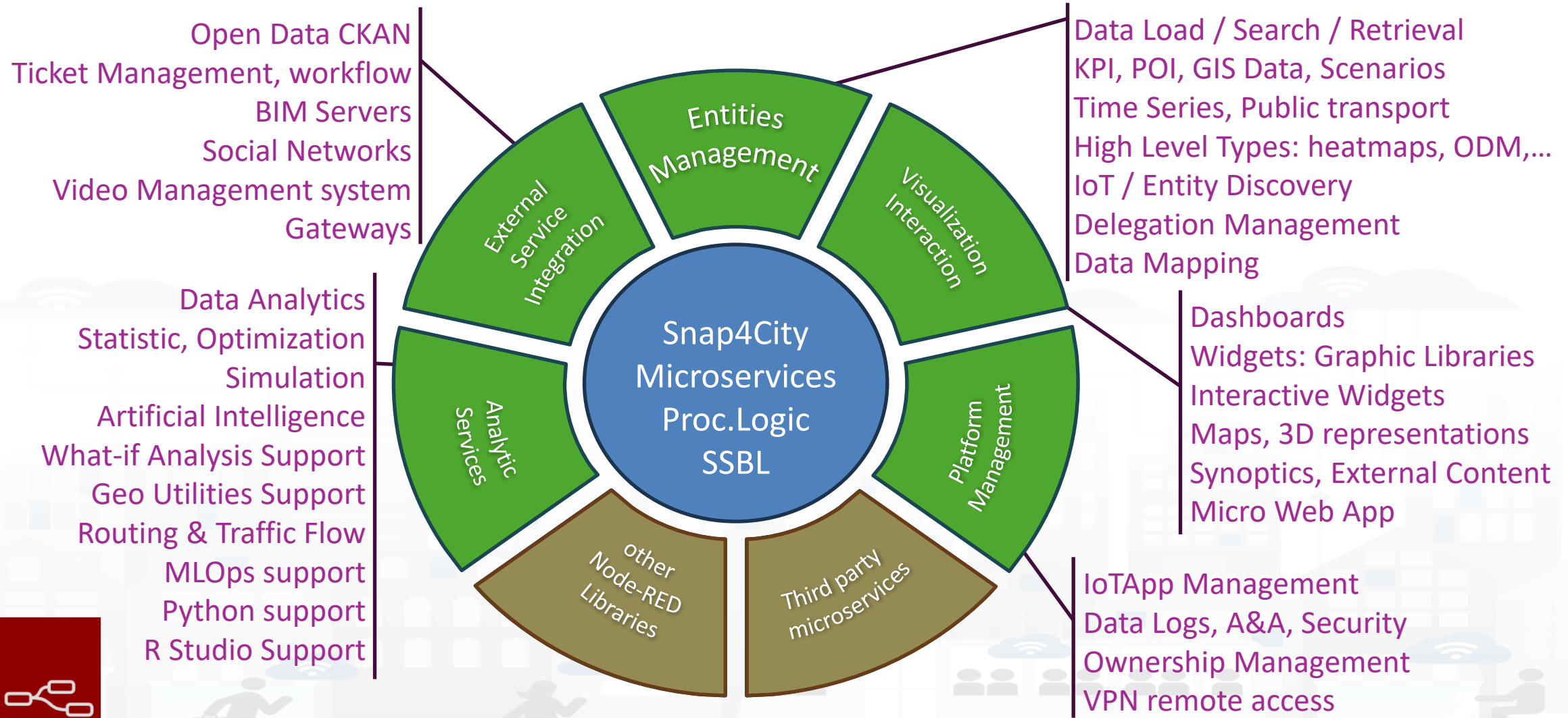
<https://flows.nodered.org/search?term=snap4city>

We suggest also to install:

- NGSI
- social
- AND: From Resource Manager
- UserCreated
- S4CioT
- S4CLogDev
- S4CView
- S4CSocial
- S4CSigfox
- S4CioTApp
- S4CData
- S4COpenMaint
- S4COpenDev
- S4CLogDev
- S4CView
- S4CSocial
- S4CSigfox
- S4CioTApp
- S4CData
- S4COpenMaint
- S4COpenDev

Snap4City(C), May 2021

## Areas



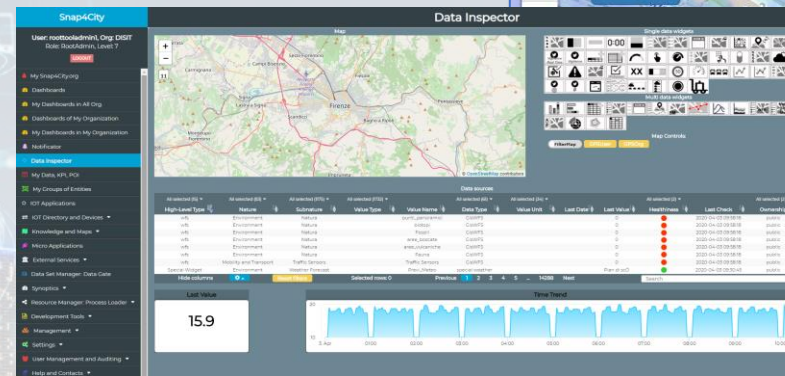
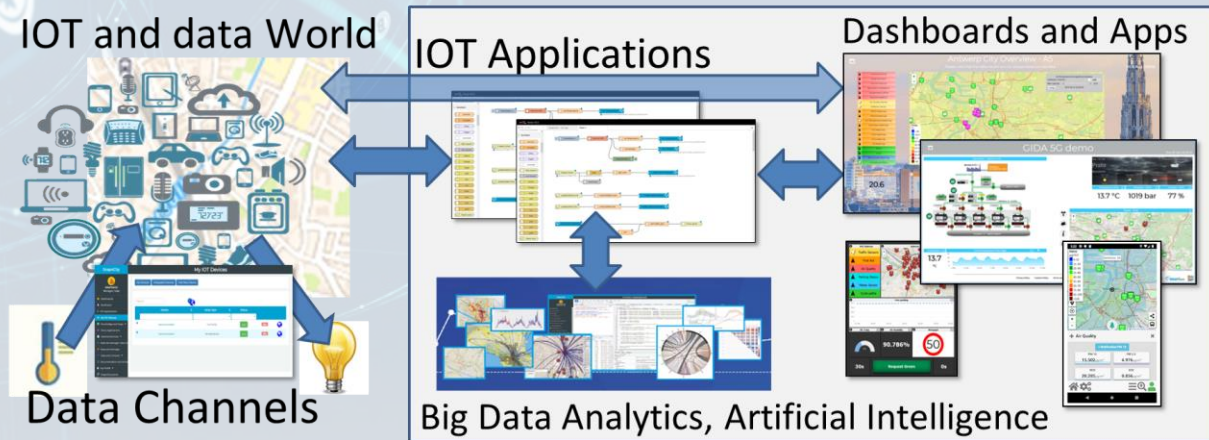
# Solutions: reliable, secure and fast to realize

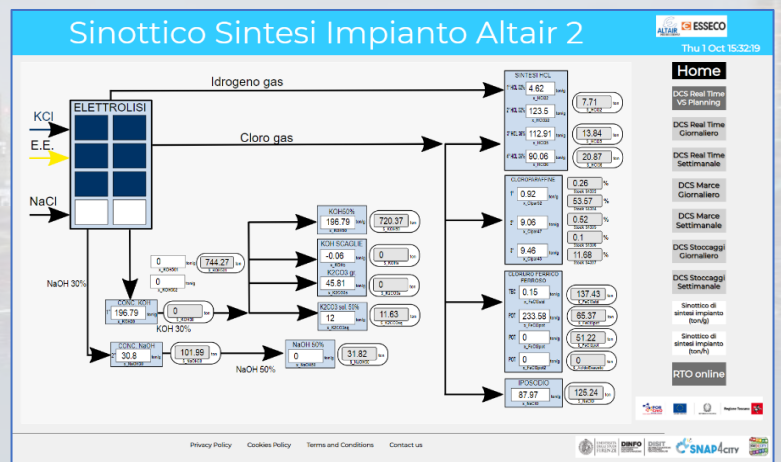
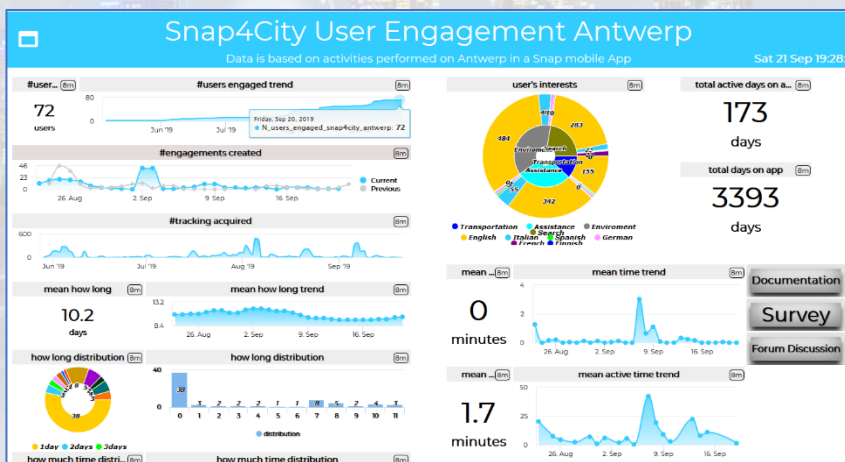
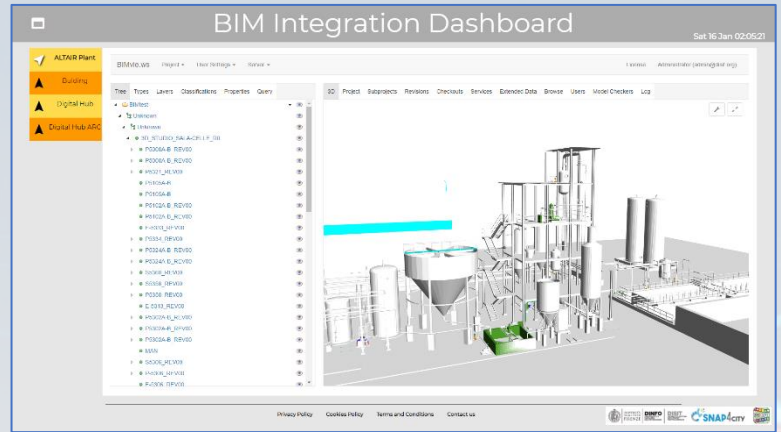
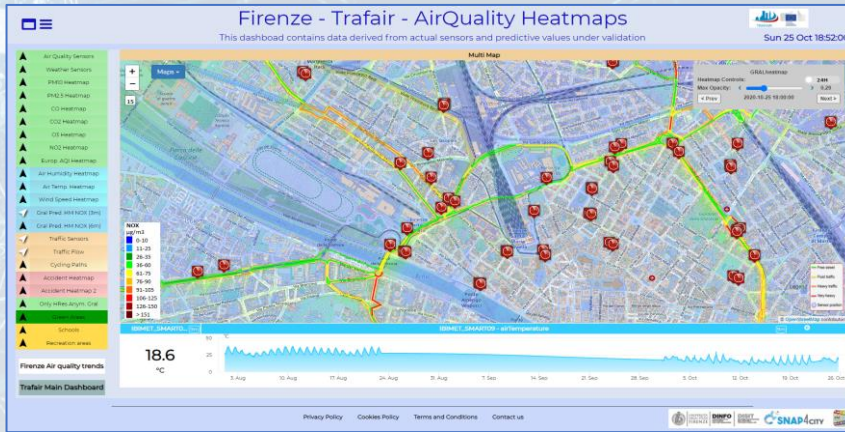
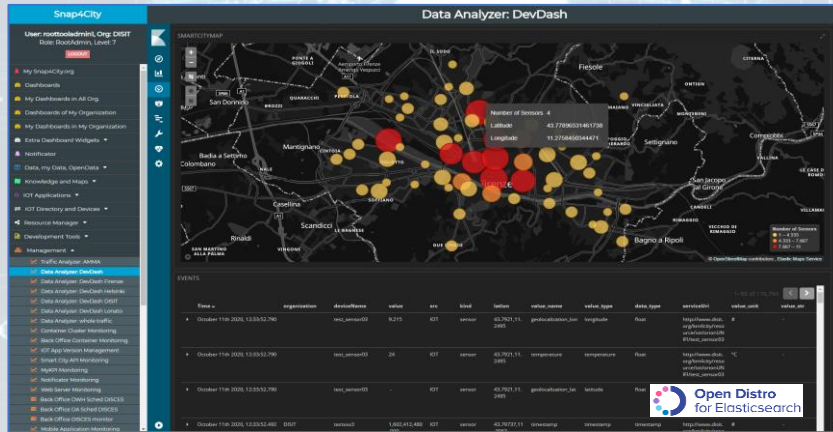
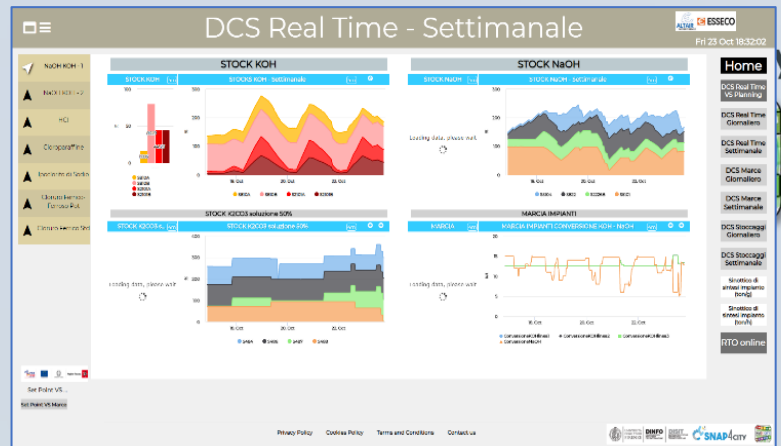
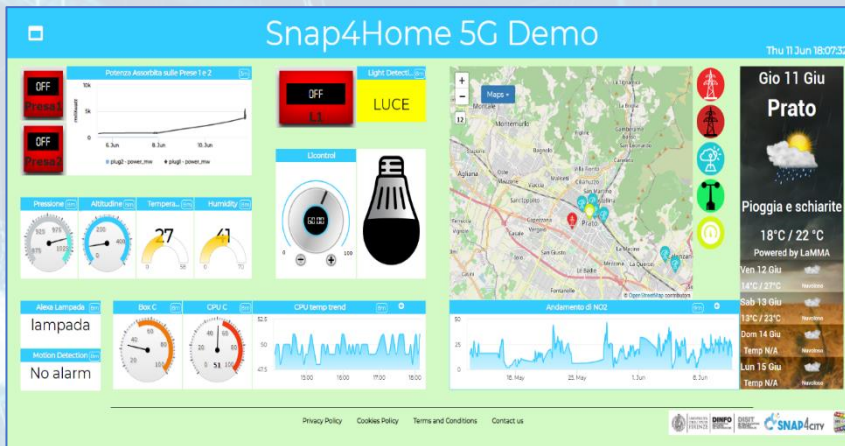
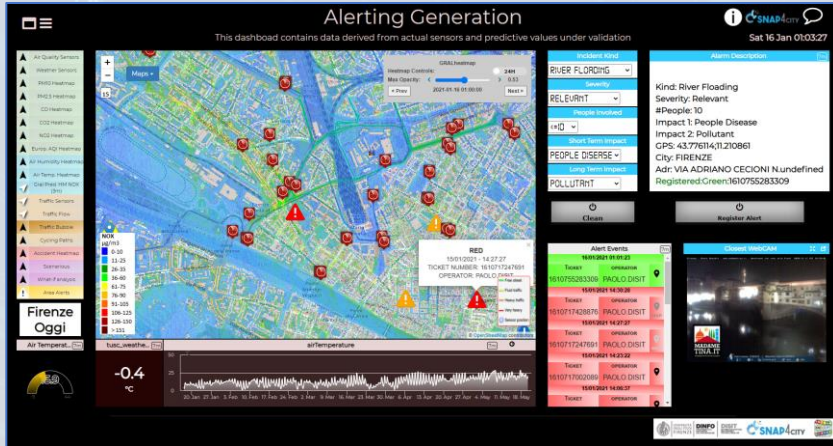
- Via Snap4City tools

- Dashboard Wizard
- Dashboard Builder
- Data/Visual Analytic

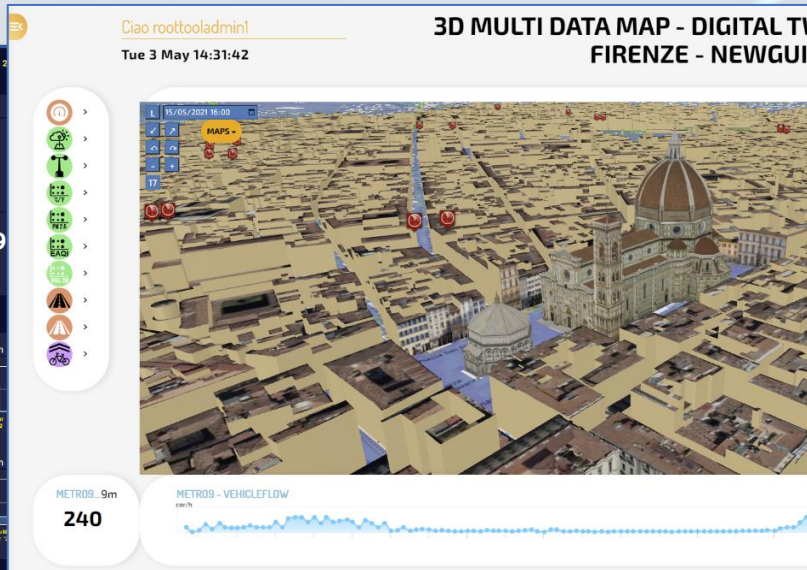
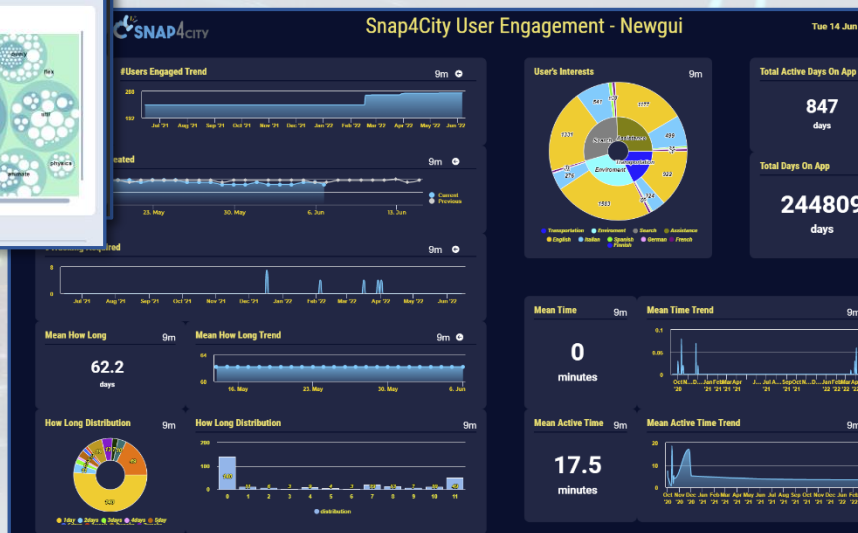
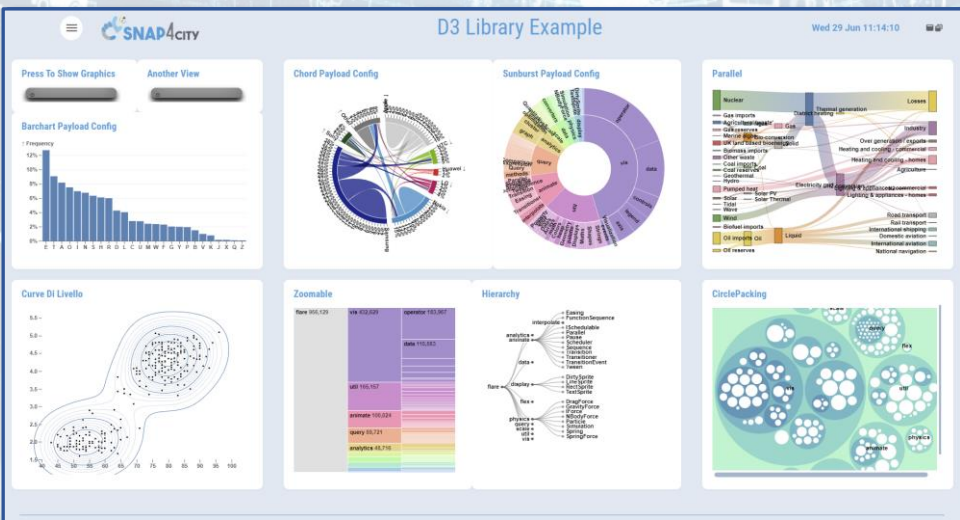
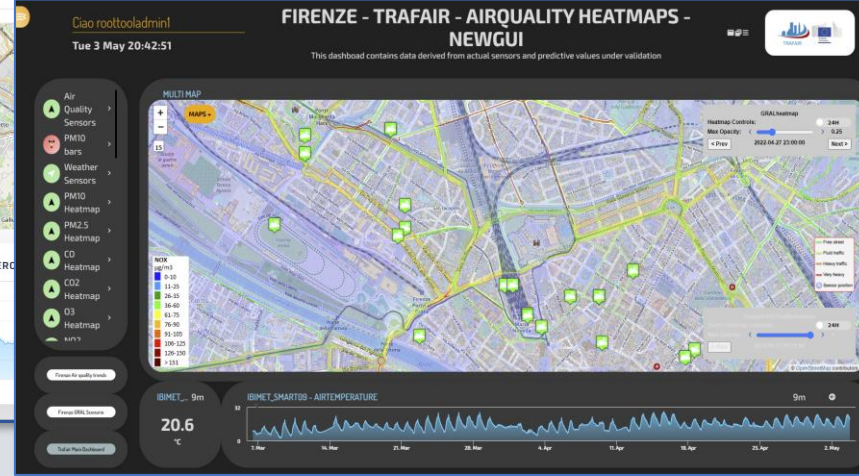
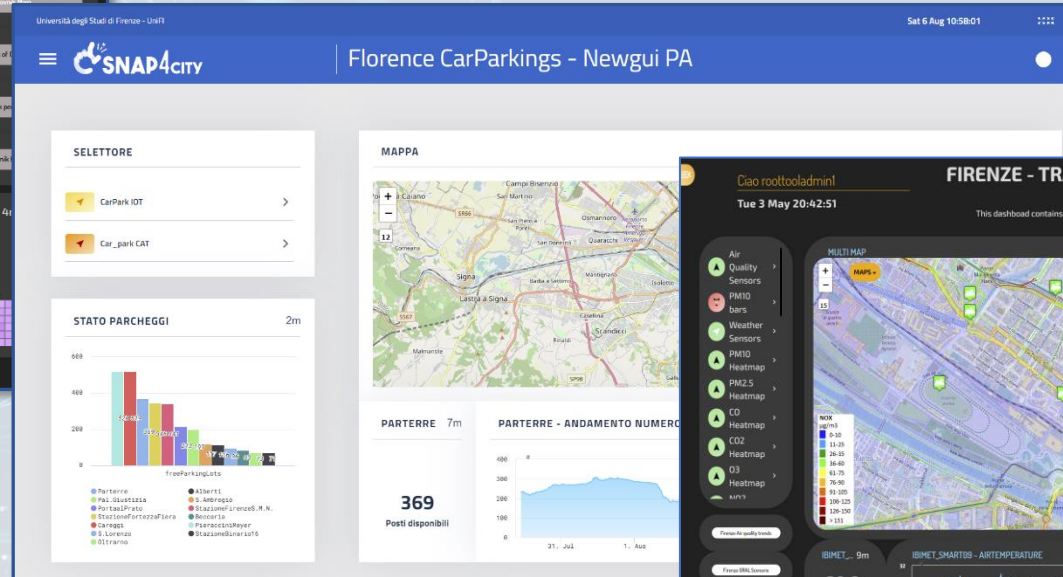
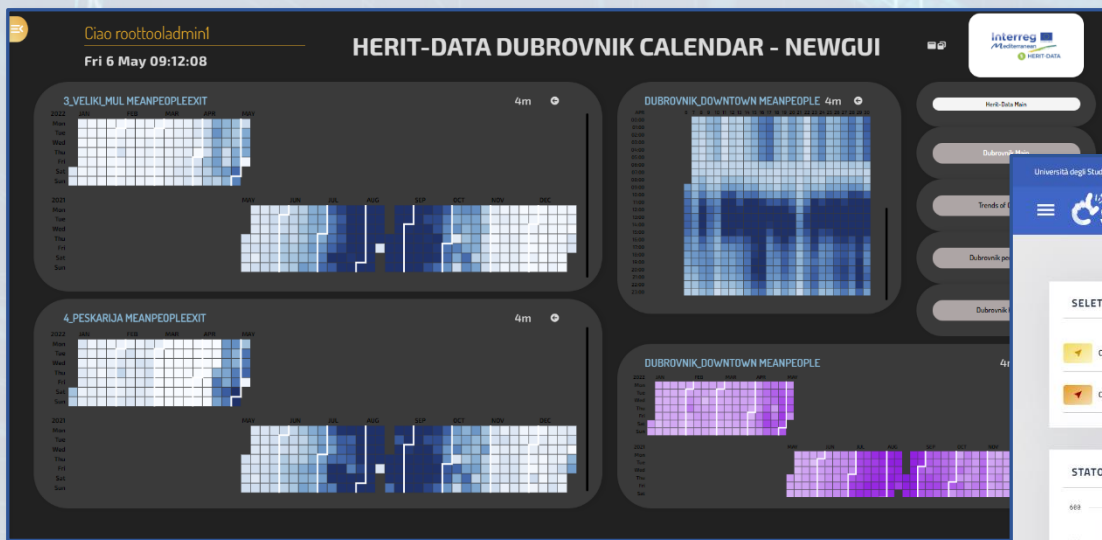
- Smart Solutions results to be

- 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>



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

FORGING &  
MANAGING OPEN  
AND FLEXIBLE WEB  
AND MOBILE APPS

FROM CITY  
DASHBOARD TO  
APPLICATIONS

SNAP4CITY FOR  
BEGINNERS

SNAP4CITY  
ARCHITECTURE AND  
ECOSYSTEM, GUIDED  
TO DEVELOPERS  
AND STAKEHOLDERS

SNAP4CITY  
AND KM4CITY  
PROJECTS

TWITTER  
VIGILANCE: SOCIAL  
MEDIA ANALYSIS

IOT/IIOT DEVICES  
AND NETWORKS

DATA ANALYTICS,  
BUSINESS  
INTELLIGENCE  
WHAT-IF  
SCENARIO TO

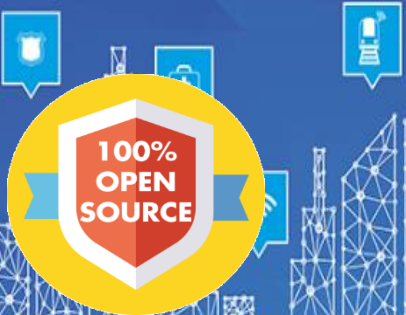
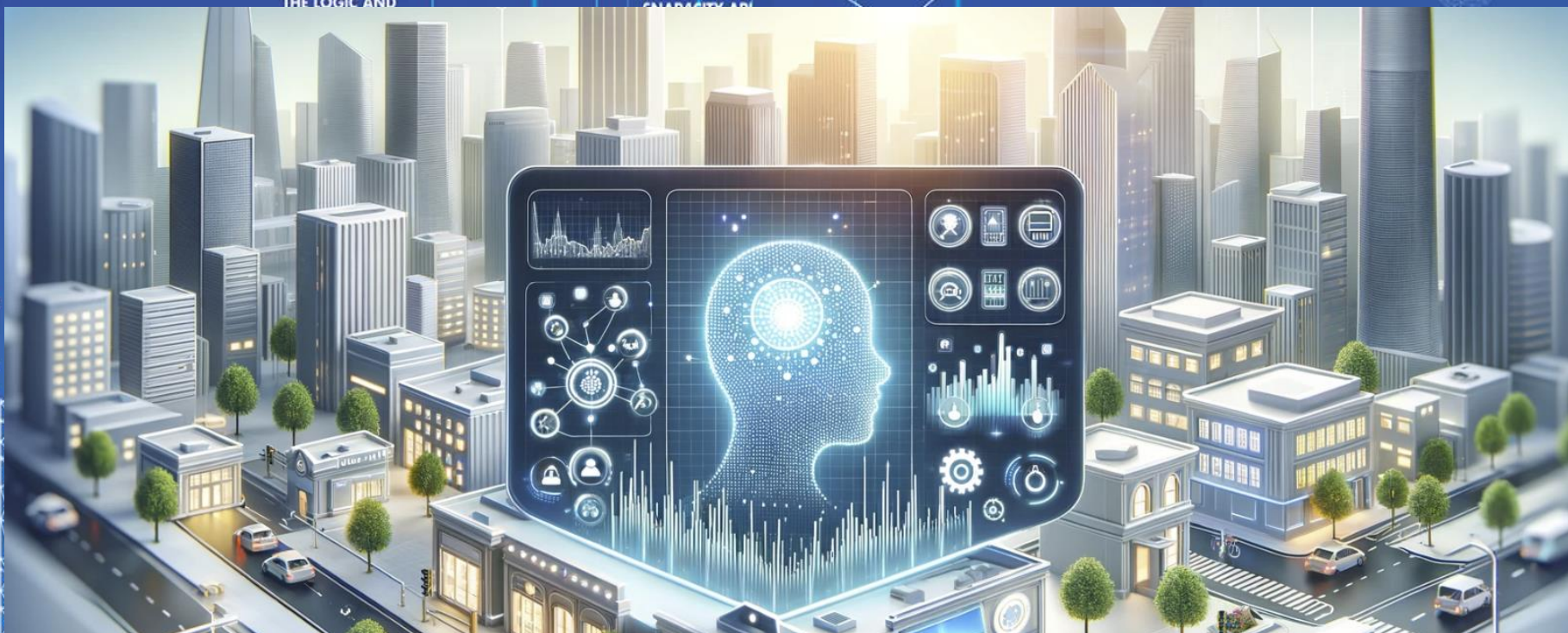
HOW TO ADOPT  
SNAP4CITY AND  
FOR ADIAP

DECISION SUPPORT  
SYSTEMS AND CITY  
RESILIENCE

IOT APPLICATIONS,  
THE LOGIC AND

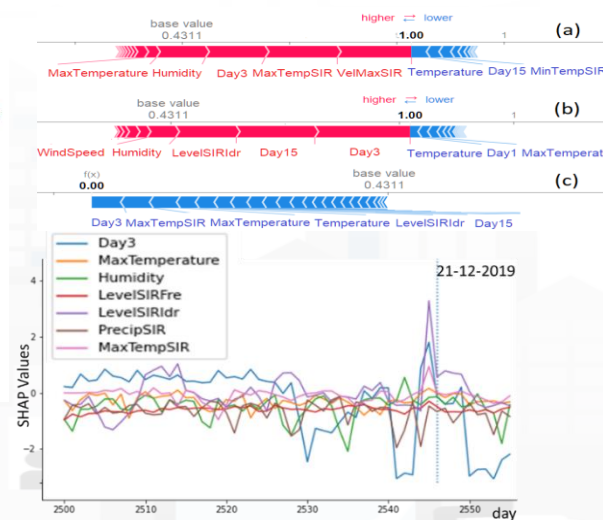
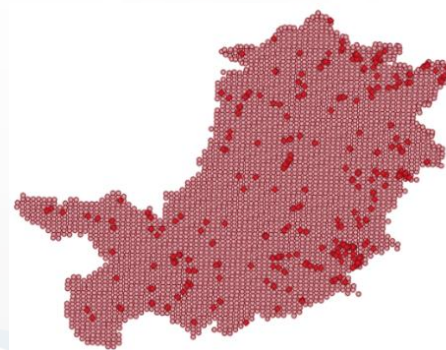
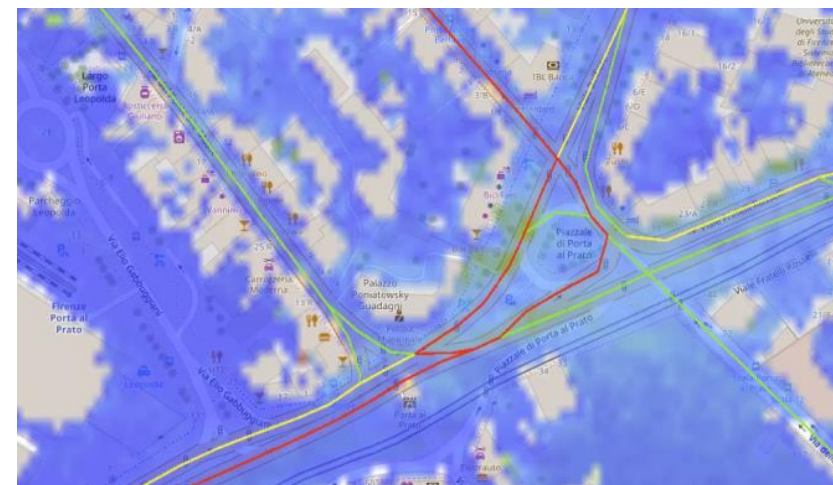
ADVANCED  
SMART CITY API,  
MICROSERVICES,  
SNAP4CITY API

SNAP4CITY THE  
VIEW OF THE  
ADMINISTRATORS



# The difference is on computational models

- **Simulation models,**
- **statistics and operations research techniques**
- Machine Learning and Artificial Intelligence techniques
  - exploitation of heterogeneous data, **BIG DATA**
    - Predictions, Early Warning, Anomaly Detection, ...
    - **What-If Analysis** integrating predictive models and simulations
  - **Explainable AI, XAI, providing to the decision-maker**
    - **detailed explanations** on the motivations behind the suggestions provided, so that the decision maker can understand the process and the motivations
    - **evidence of compliance with ethical aspects with confidence**
  - *To be able to use the systems as a trusted expert system.*



# 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/p4/>



# Available AI Solutions on Snap4City

<https://www.snap4city.org/997>

More than 80 Available Solutions & 300 AI applic.

- Mobility and Transport
- Environment, Weather, Waste, Water
- City Users Behaviour and Social analysis
- Energy and Control
- Tourism and People
- Security and Safety
- High Level Decision Support Solutions
  - Asset management
  - Resilience and Risks Analysis
- Low level Techniques



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

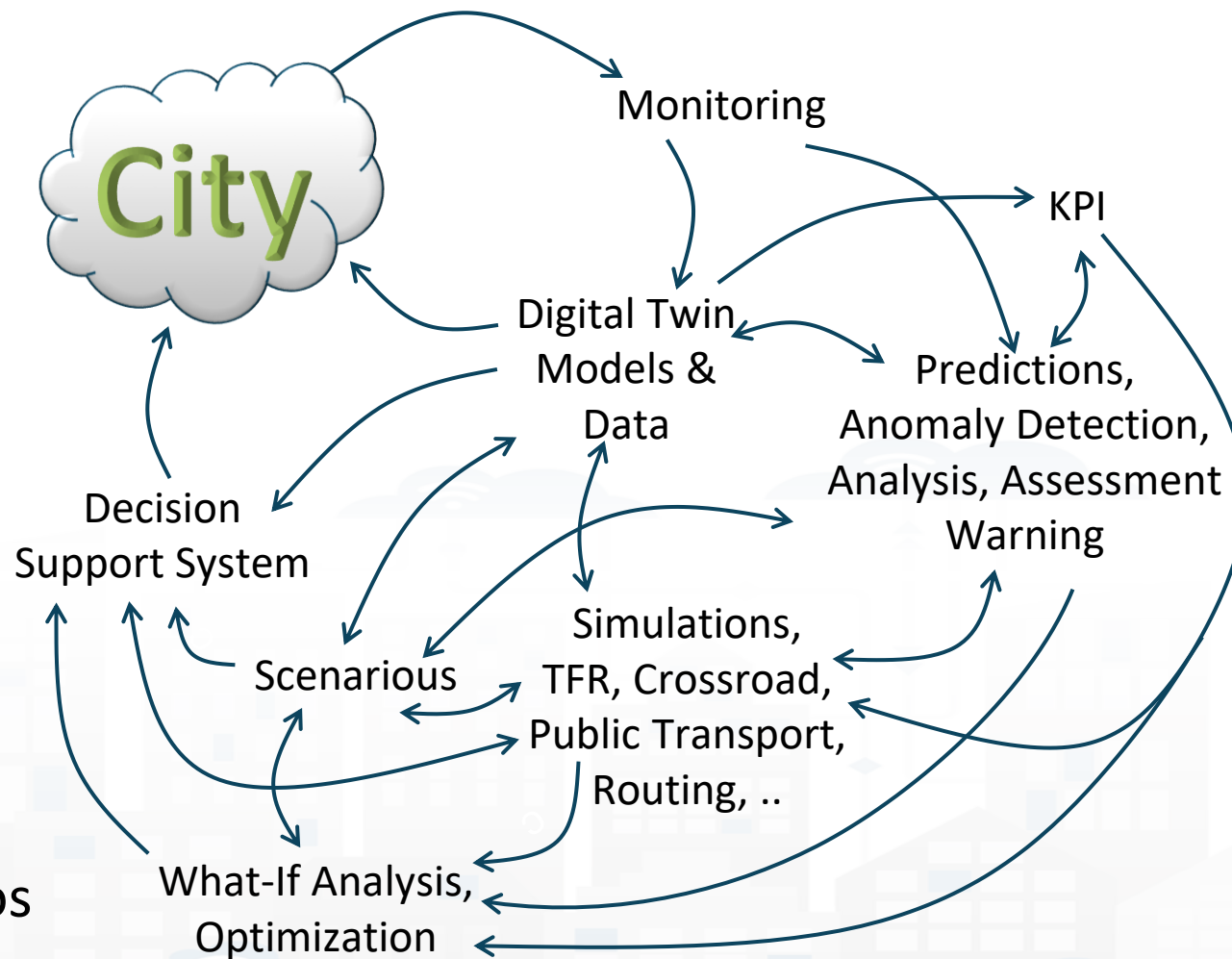
<https://www.snap4city.org/download/video/course/p4/>

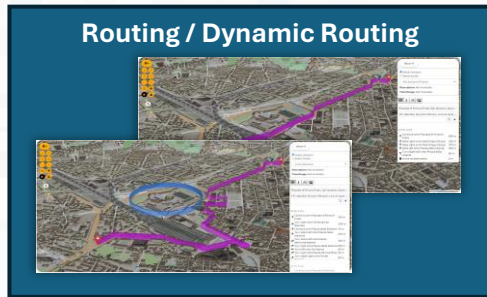
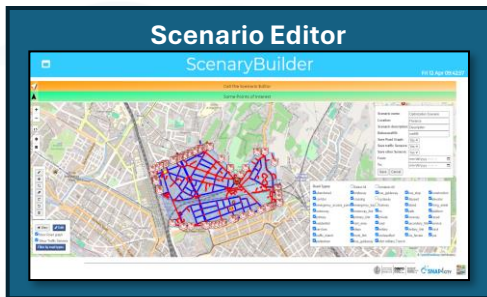
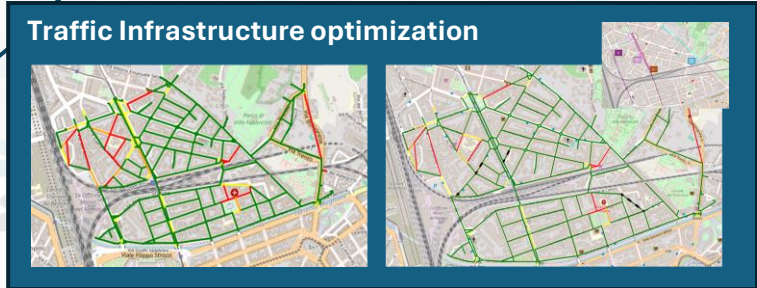
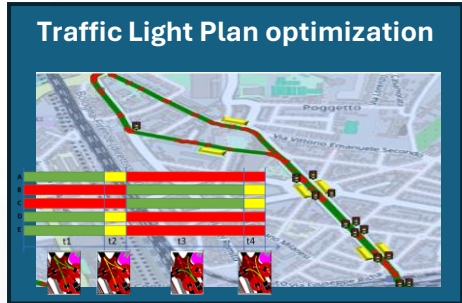
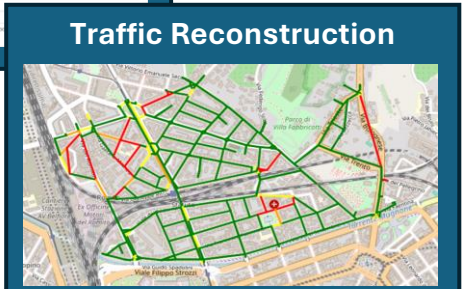
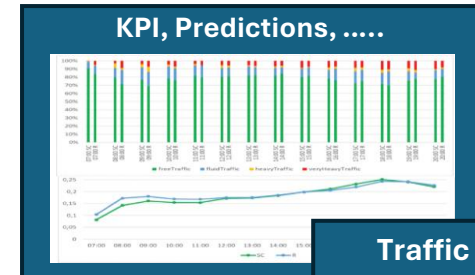
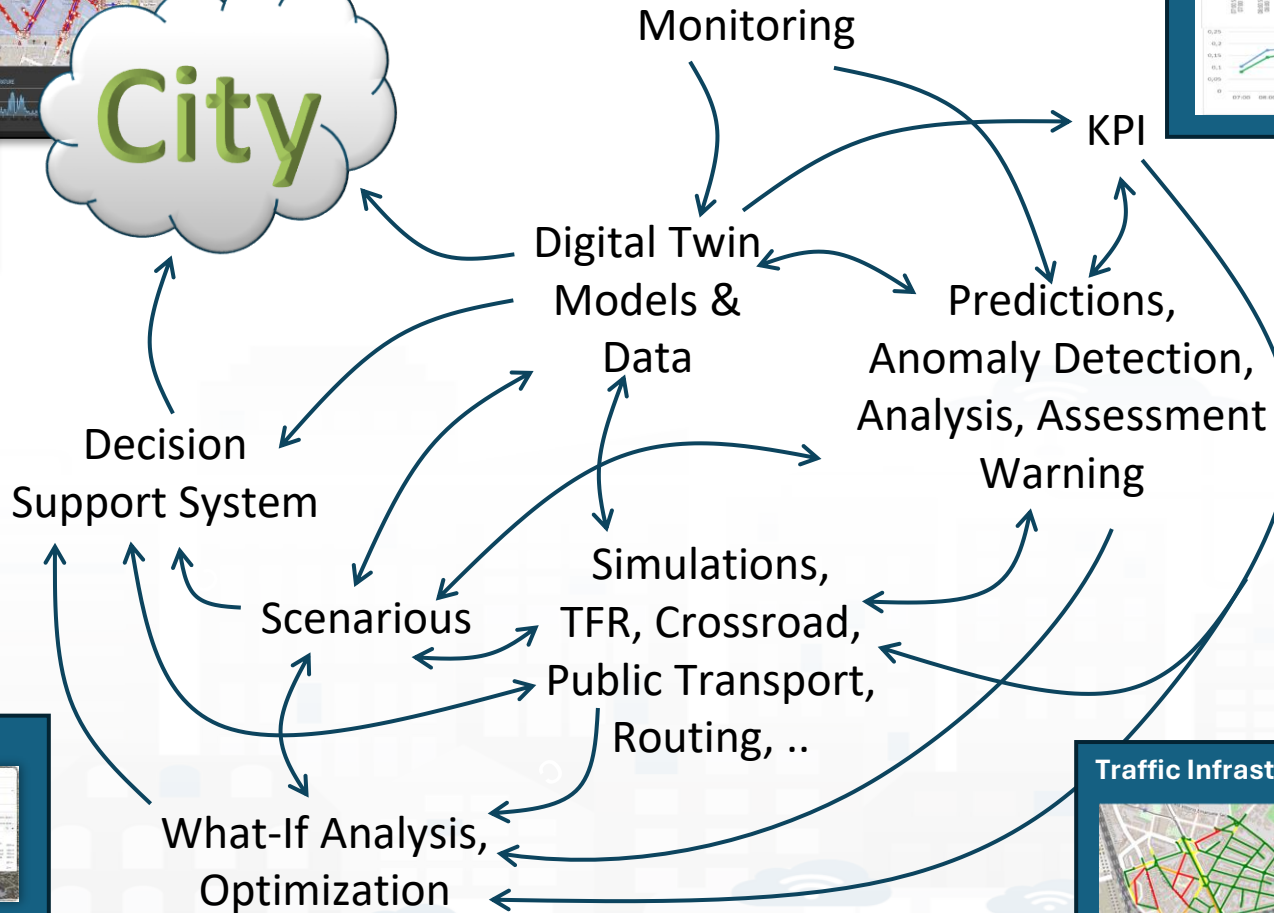
- **Controlling Status:** management, and operational

- Monitoring via KPI
- Predictions vs KPI
- Anomaly detection
- Neuro-Symbolic analysis
- Risk assessment
- Early warning on critical conditions

- **Making plan:** tactic and strategic, medium and long range, micro/macro

- Simulation & optimization
- Generative AI Prescriptions, scenarios
- Resilience to Unexpected unknowns
- What-if analysis wrt scenarios



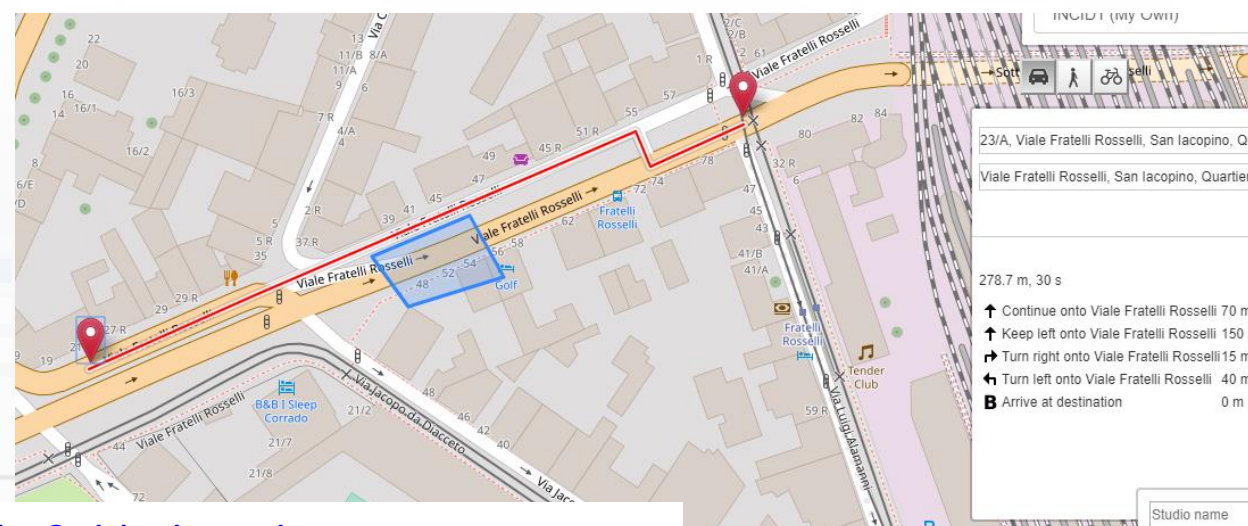
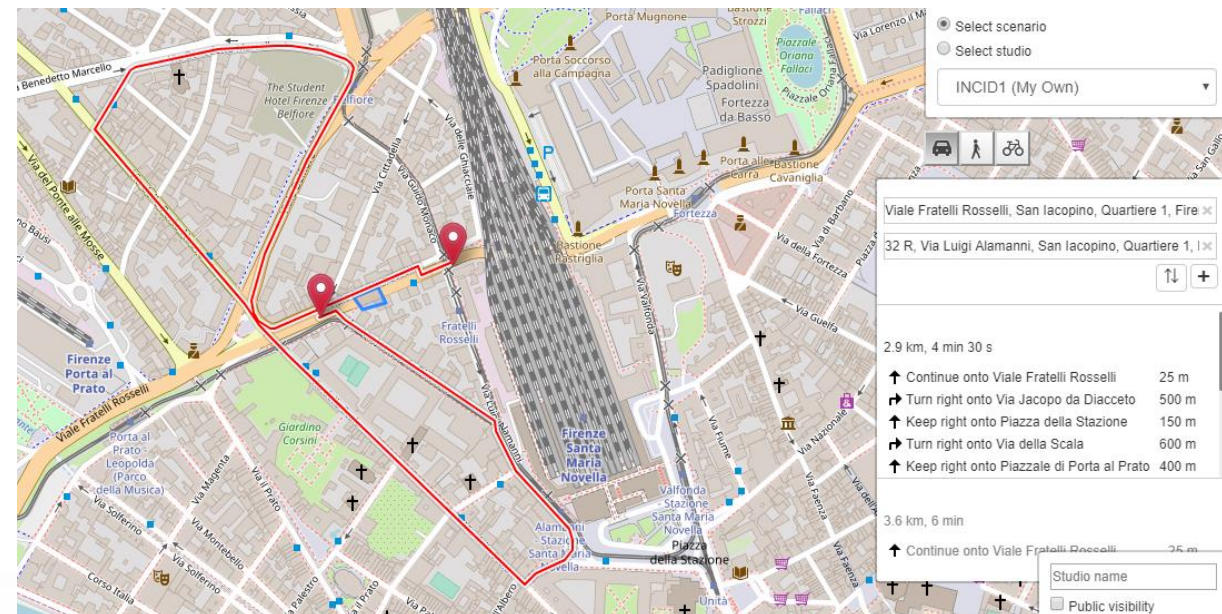


Accidents and elements blocking Points and Shapes taken into account for:

- Routing
- Traffic Flow reconstruction
- Evacuation paths
- Rescue team paths

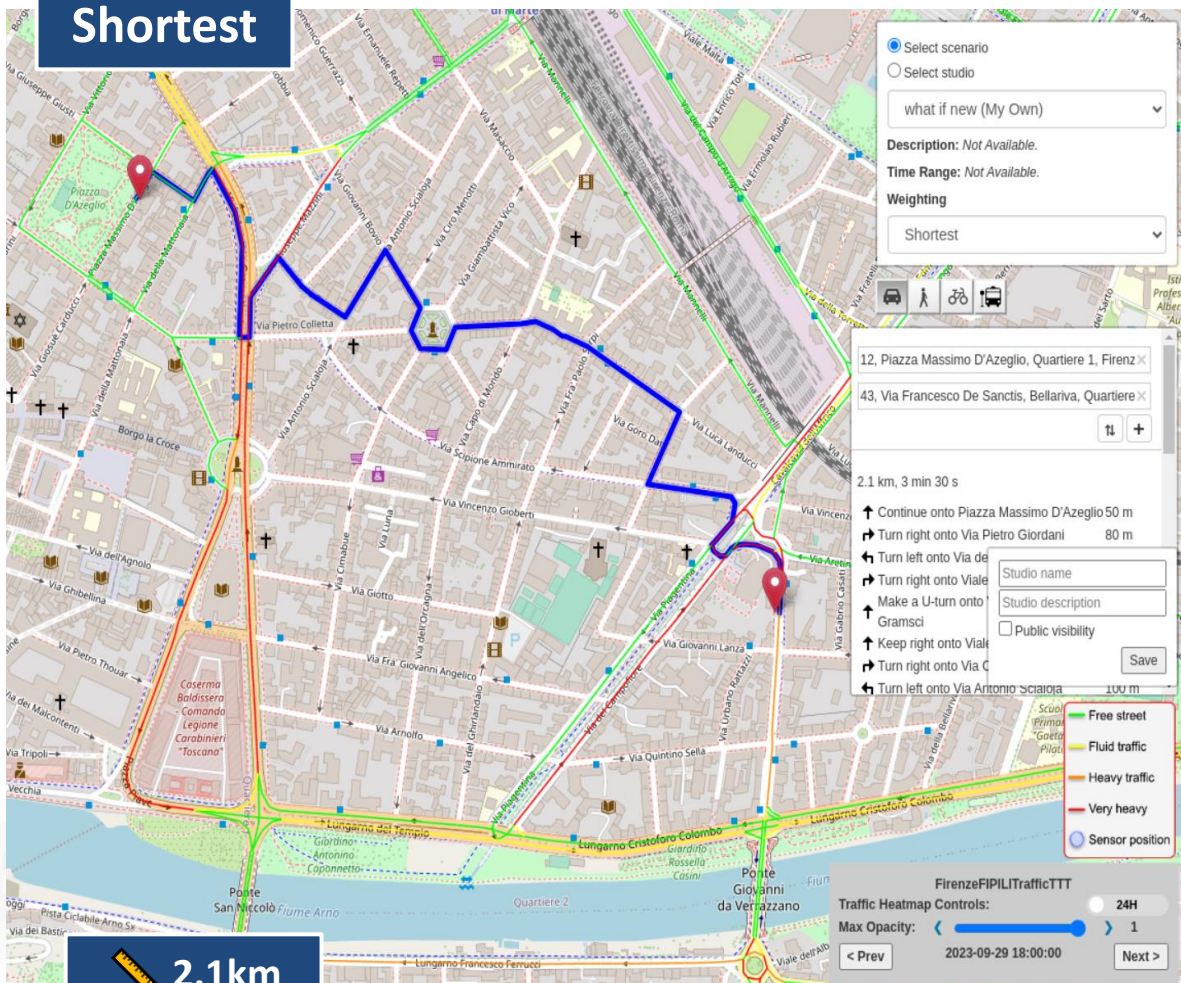
Assessment on the basis of changes:

- Mobility demand assessment
- Mobility Offer assessment

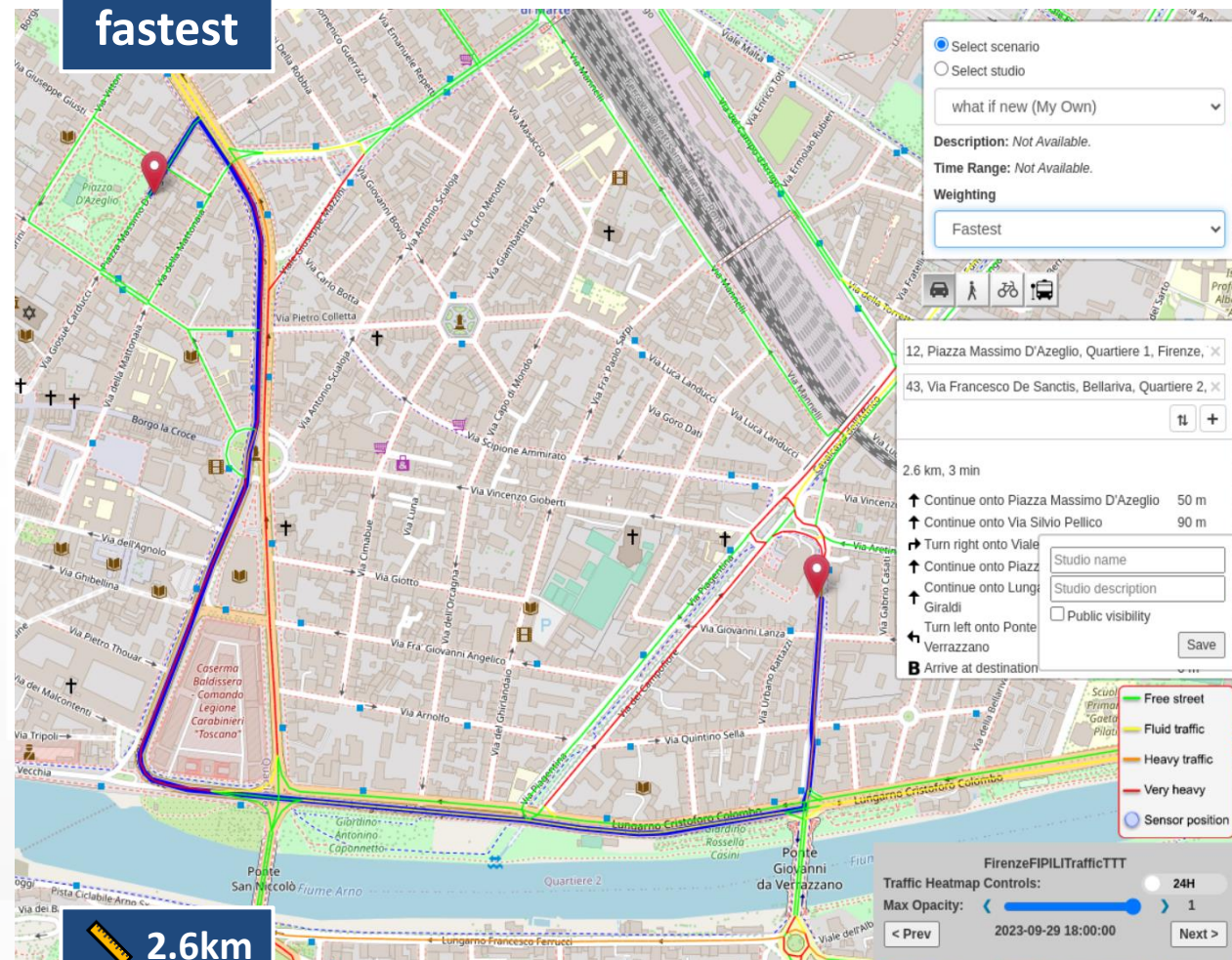


# Constrained Dynamic Routing: Traffic Flow

Shortest



fastest



2.1km

3min 30s

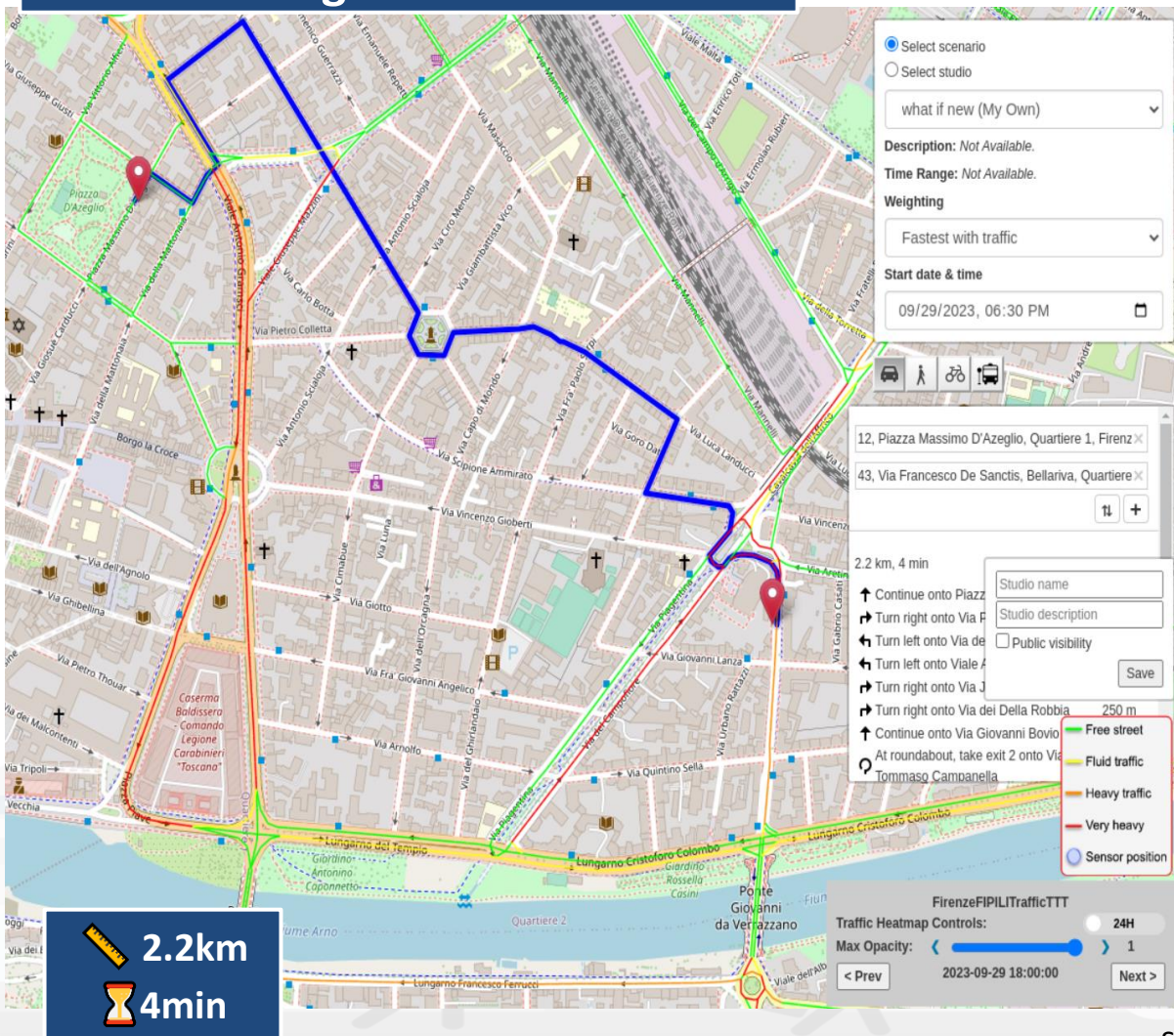
2.6km

3min

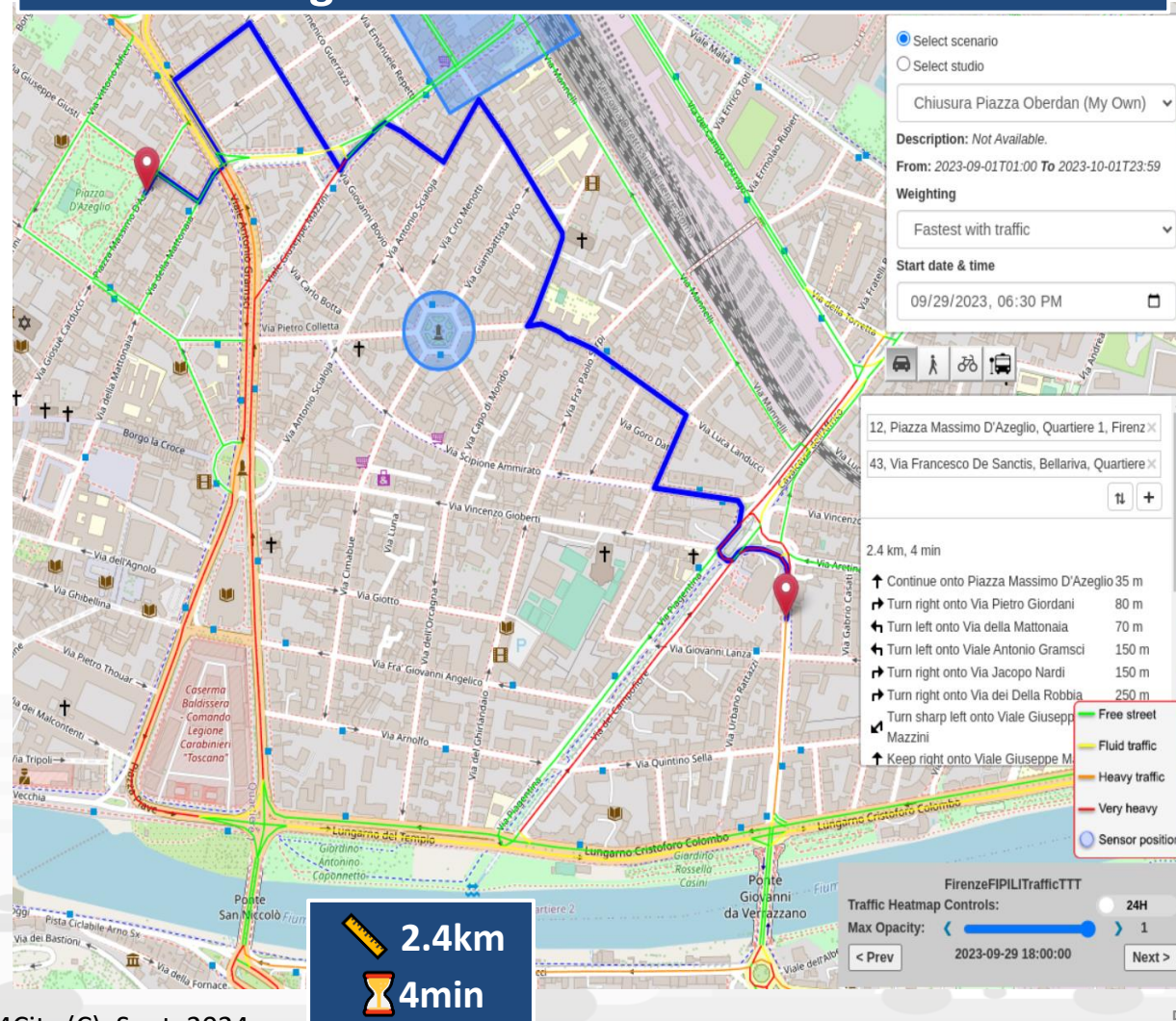


# Constrained Dynamic Routing: Traffic Flow

## Fastest taking into account traffic

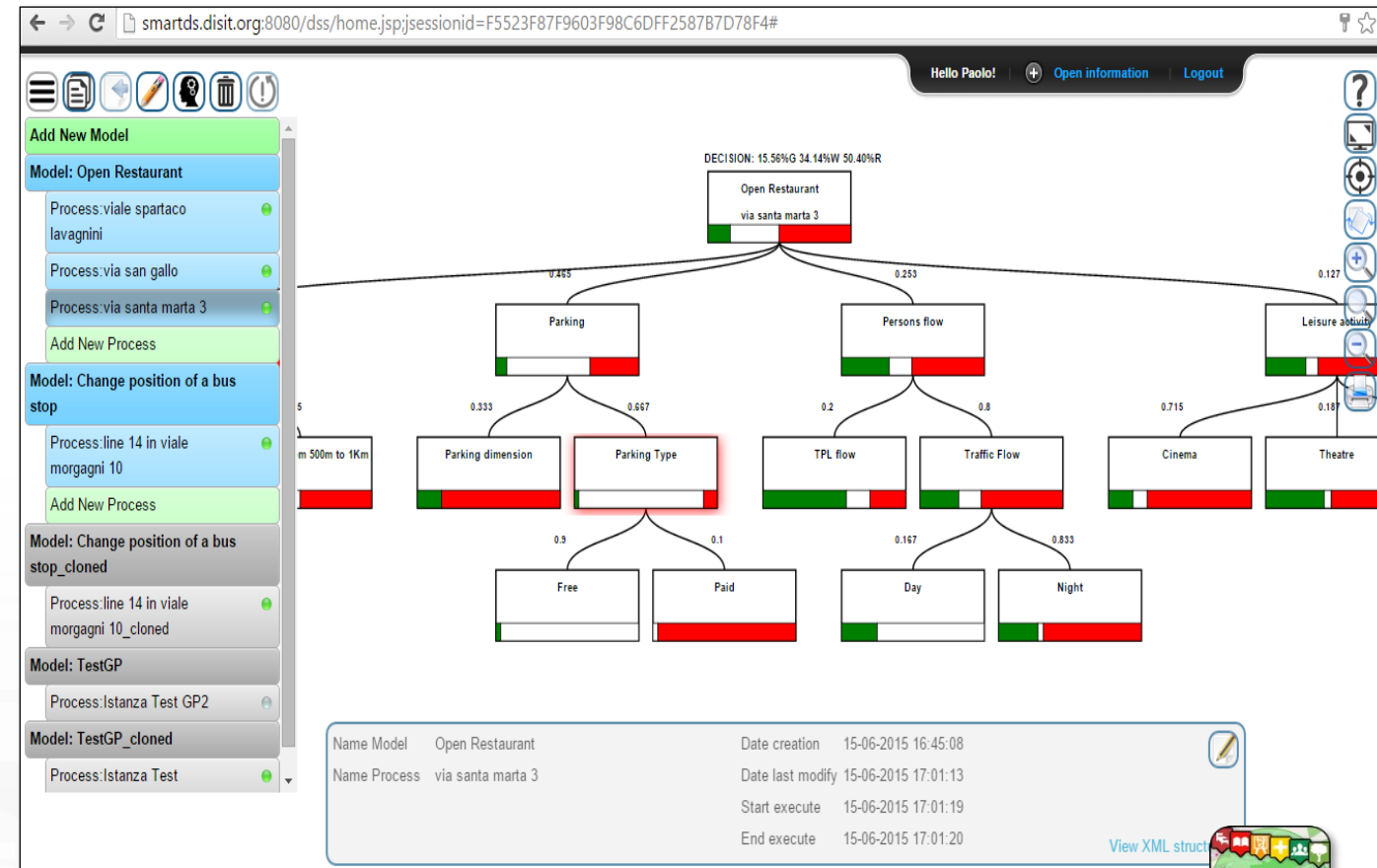


## Fastest taking into account traffic and blocked areas



# Smart Decision Support , system thinking

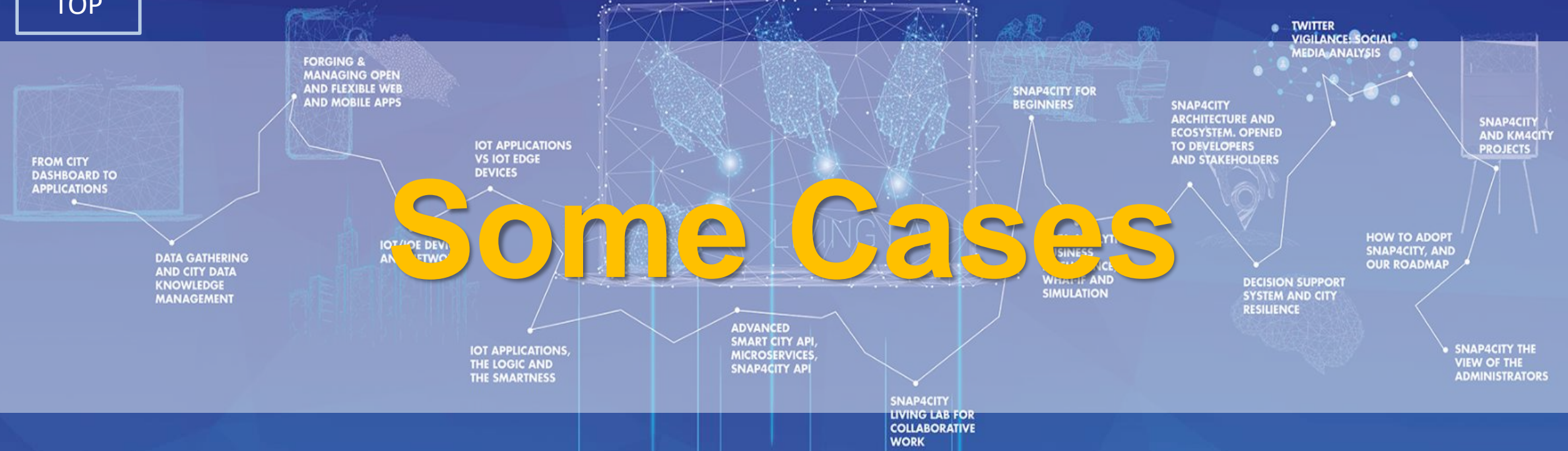
- **Smart Decision Support System** based on System Thinking plus
- Actions to city reaction, resilience, smartness, ...
- Enforcing Mathematical model for propagation of decision confidence..
- Collaborative work, ...
- Processes connected to city data: DB, RDF Store, Twitter, etc.
- Production of alerts/alarms
- Data analytics process
- Twitter Processes
- reuse, copy past, ...



<http://smartds.km4city.org>

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.



- **Goals:**
  - Increasing quality of Life, quality of services,
  - Decongestion, Decarbonization, Sustainability
  - increase efficiency and production optimization
  - Improve accessibility to services: citizens, Tourists, commuters, etc.
  - Improve security/Safety of city users, risk reduction
  - Costs reduction of services, energy consumption reduction
  - Reduction of emissions and EC taxations
- **Horizontal homogeneous platform Uniform Technology for**
  - **Any Vertical operation/plan:** mobility, energy, environment, security, tourism, infrastructure and assets control, buildings, etc.
  - **AI Solutions:** early warning, predictions, simulations, what-if, optimization; Deep Learning, ML, BERT, LLM, XAI (Shap/Lime),
  - **Development Environment for any vertical, Digital Twin:** City Global and Local, IoT, VR, Visual Programming, business intelligence, CSBL, SSBL, etc.
  - **Interoperability:** any format, any protocol, any video management system, any sensor, any device, etc.
- **KPI:** multidomain KPI, general management, early warning, early detection of critical conditions, 15 Min City Index, SDG
- **Mobile App:** modular applications, operators' modules, multiple cities, etc.
- **Participatory:** problem reporting, ticketing, etc.
- **Integration of any kind**



# 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

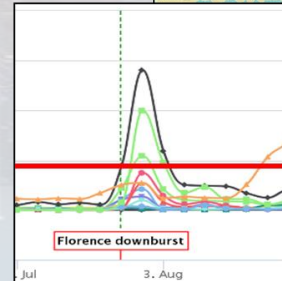
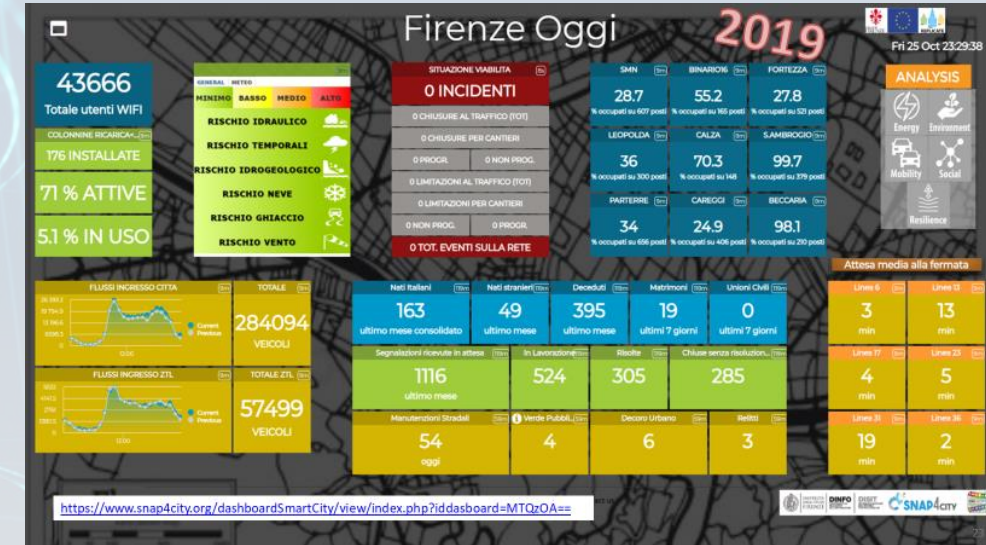
## • Services Exploited on:

- Multiple Levels, Mobile Apps, API

## • Since 2017



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



# Firenze Oggi

Mon 16 May 12:59:27

**20991**  
 fluit

**COLONNINE**  
 COLONNINE  
 42% ATTIVE  
 3 K/W CND  
 24% NON ATTIVE

**GENERAL** **RETE**

MONITORING: BASSO MEDIO ALTO

- RISCHIO IDRAULICO
- RISCHIO TEMPORALI
- RISCHIO IDROGEOLOGICO
- RISCHIO NEVE
- RISCHIO GHIACCIO
- 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...







### FIRENZE

Tue 16 Oct 16:18:39

**2** incidenti comunicati alla cittadinanza

**200**  $\mu\text{m}^3$  superata la soglia di informazione

**39492** Utenti WiFi

**STATI DI ALLERTA**

MINIMO BASSO MEDIO ALTO

**RISCHIO IDRAULICO**

**RISCHIO IDROGEOLOGICO**

**RISCHIO NEVE**

**RISCHIO GHIACCIO**

**Mar 16 Ott**  
Firenze

**Nuvoloso**

Mer 17 Ott 16°C / 24°C  
Gio 18 Ott 18°C / 24°C  
Ven 19 Ott Temp N/A  
Sab 20 Ott Temp N/A

**TPL**

N 14 57 21

**COLONNINE RICARICA**

**180** INSTALLATE

81.1% ATTIVE  
8.9% IN USO

**REPLICATE DASHBOARD**

REPLICATE has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 601725.

**FLUSSI INGRESSO CITTÀ**

TOTALE **141608** VEICOLI

**FLUSSI INGRESSO ZTL**

TOTALE ZTL **41146** VEICOLI

**SITUAZIONE VIABILITÀ**

**4** INCIDENTI

0 CHIUSURE AL TRAFFICO (TOT)

0 CHIUSURE PER CANTIERI

0 PROG. / 0 NON PROG.

0 LIMITAZIONI AL TRAFFICO (TOT)

0 PROG. / 0 NON PROG.

**4** TOT. EVENTI SULLA RETE

SMN	63.4	BINARIO6	83	FORTEZZA	17.9
LEOPOLDA	36.3	GALZA	69.3	SAMBERGIO	67
PARTERRE	64.9	CAREGGI	90.4	BECCARIA	78.6

**STATO TRAFFICO CAREGGI**

Red Code	12	83	37	9
----------	----	----	----	---

**MAPPA**

Energy Environment

Mobility Social

Resilience

### Parcheggi Firenze App

### Mobility and Environment What-If Analysis

### Environment

Air quality Weather sensors Pollen monitoring

### Citizens Engagement

### First aids overview - Firenze

Service status of main first aids

### Energy

Per charging stations

### Mobility

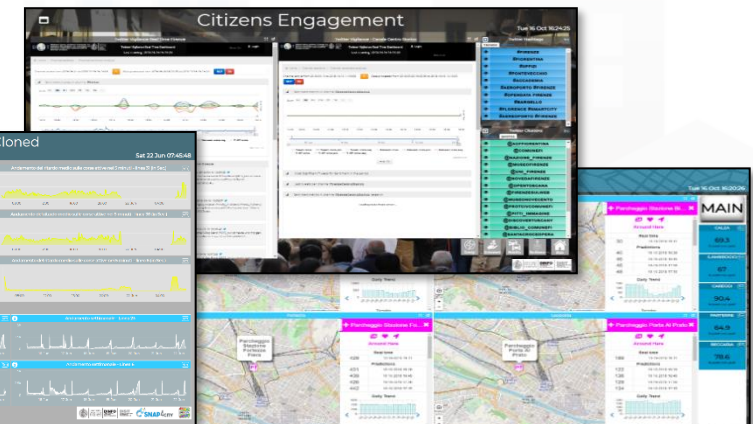
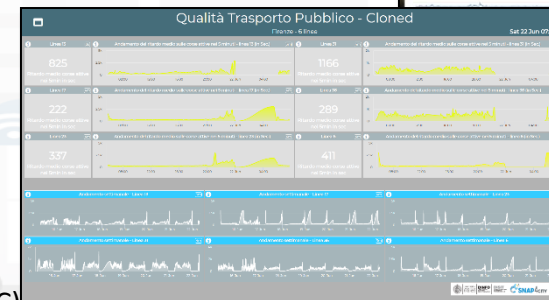
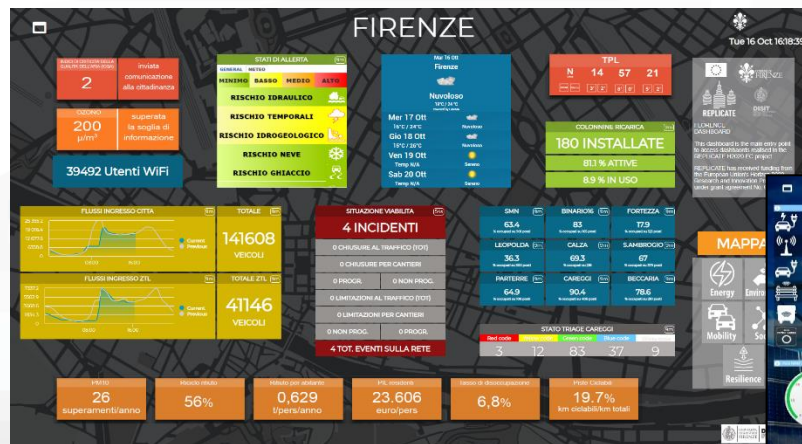
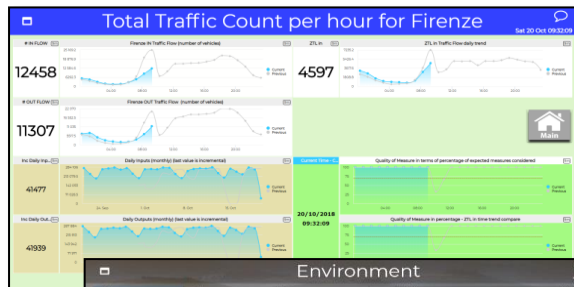
### FIRENZE RESILIENCE

### Total Traffic Count per hour for Firenze

- **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



# 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

**Node-RED**

TempiAttesaLinea | TempNegativiNoServizio | TempAttesaLineaDestinazi | Flow 1

input

- inject
- catch
- status
- link
- mqtt
- http
- websocket
- tcp
- udp
- cron
- amqp
- amqp2
- stomp

output

timestamp

Value of my Tempo\_medio\_linea6

Value of my Tempo\_medio\_linea13

Value of my Tempo\_medio\_linea17

Value of my Tempo\_medio\_linea23

Value of my Tempo\_medio\_linea31

Value of my Tempo\_medio\_linea36

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

msg.payload



Ciao roottooladmin!

Fri 2 Sep 19:13:07

## 3D MAP GLOBAL DIGITAL TWIN - NEWGUI



3D MAP

Enable Lights

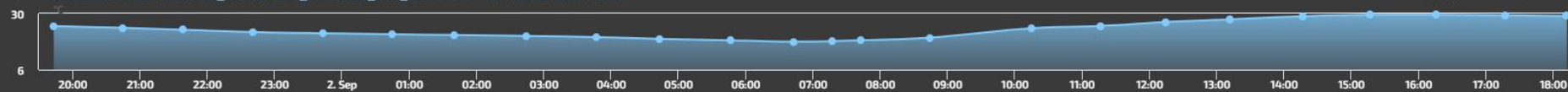
Datetime: 02/08/2022 10:11

Enable dynamic shadows (experimental)

Free street  
Fluid traffic  
Heavy traffic  
Very heavy  
Sensor position

FirenzeFIPILITrafficRealtime  
Traffic Heatmap Controls: 24H  
Max Opacity: 1  
< Prev 2022-09-02 18:56:00

DISIT:ORIONUNIFI:TUSC\_WEATHER\_SENSOR\_OW\_3176959 - AIRTEMPERATURE



Ciao

Fri 13 Oct 18:29:18

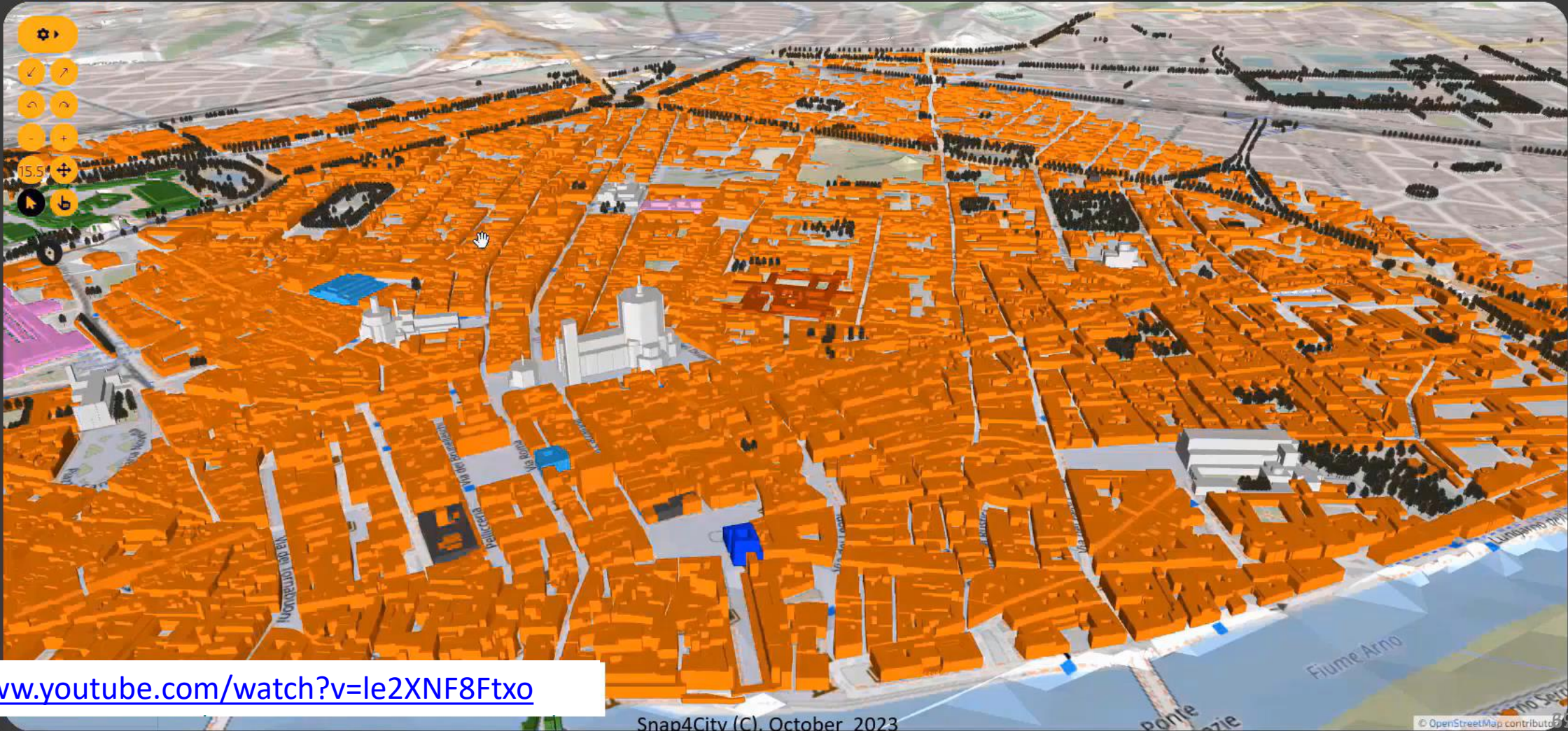
# FLORENCE SCDT

SELECT...

- GRAL HD
- NO 2
- Mobile
- Bar chart
- Highway
- Highway
- Bus
- WHAT-IF
- Car
- Person
- Bicycle

DOUBLE MAP

- Settings
- Home
- Navigation
- Layers
- 15.5
- Play
- Reset



<https://www.youtube.com/watch?v=le2XNF8Ftxo>



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

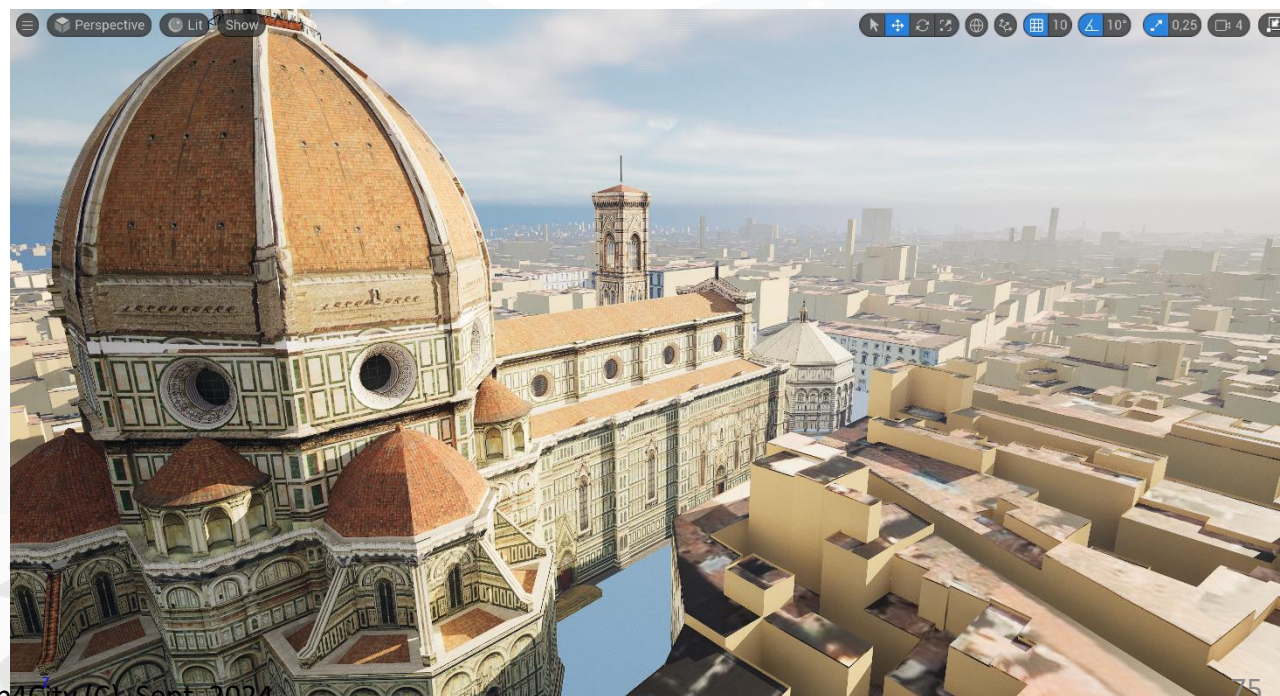
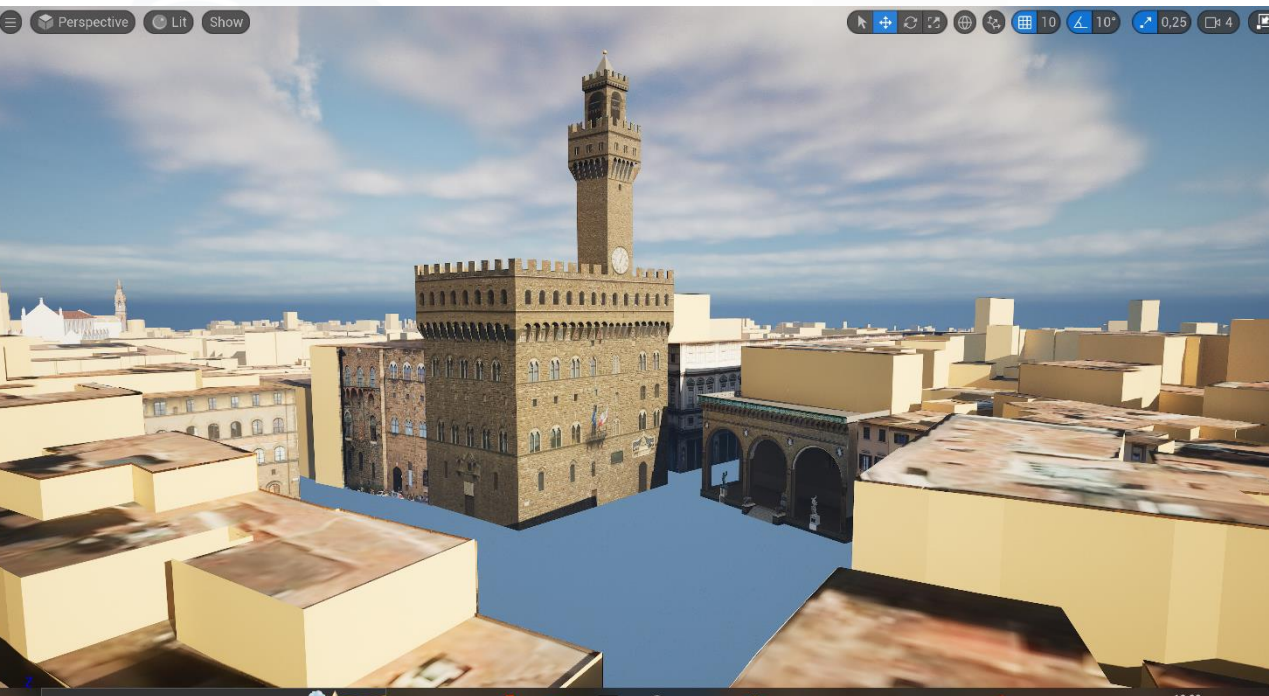
**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB

 **SNAP4CITY**



# OCULUS



4City (C), Sept. 2024



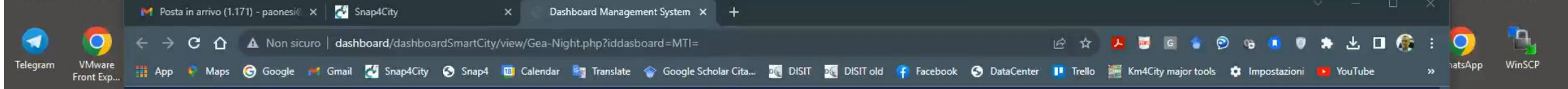
# Exploiting Google API with Snap4City engine

- Select any city/locality and see if 3D Representation of your city is Available
- Snap4City re-rendering and distribution engine allows to
  - Optimize distribution of data
  - Integrate any kind of data on Digital Twin with 3D tileds of Google
    - PIN, IoT Data
    - Traffic Flows
    - Cycling paths
    - 3D shapes superimposed
    - Etc.



# Snap4City Digital Twin Engine and data + 3D Google Data





## Florence Testing

Mon 18 Sep 17:40:57

**Selector**

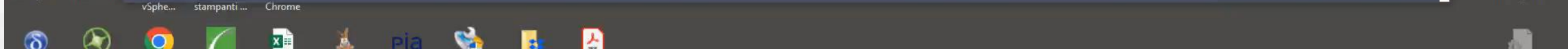
- >
- >
- >
- >
- >
- >
- >
- >
- >
- >
- >
- >

**Double Map**

**OBS è già in esecuzione**

OBS è già in esecuzione! A meno che non si intendeva effettuare questa operazione, chiudere tutte le istanze esistenti di OBS prima di provare a eseguirne una nuova. Se avete OBS impostato per minimizzarsi nell'area di notifica, si prega di controllare per vedere se è ancora in esecuzione.

Avvia comunque    Annulla



SELECT...

- 100-30
- NO 2
- Bar chart
- Line graph
- Bus
- WHAT-IF
- Car
- Statue
- Bicycle



Snap4CityDocker | Dashboard Management System | Genoa - Google Maps

Non sicuro | dashboard/dashboardSmartCity/view/Baloon-Dark.php?iddashboard=MTY=

App | Maps | Google | Gmail | Snap4City | Snap4 | Calendar | Translate | Google Scholar Cita... | DISIT | DISIT old | Facebook | DataCenter | Trello | Km4City major tools | Impostazioni | YouTube | Google Forms | News | Qnap15sek7gyfe

Ciao

Mon 18 Sep 18:32:23

## GOOGLE TEST

SELECT...

- SELECT...
- NO 2
- Bar chart
- Map
- 15
- What-if
- Car
- Person
- Bicycle

DOUBLE MAP

© OpenStreetMap contributors

Ciao

Mon 16 Oct 14:09:10

## GOOGLE TEST

SELECT

- Home
- Map
- NO2
- Bar chart
- Highway
- Highway
- Bus
- WHAT?
- Car
- Person
- Bicycle

DOUBLE MAP

NOX  
µg/m3

0-10
11-25
26-35
36-60
61-75
76-90
91-105
106-125
126-150
> 151

Heatmap

GRALheatmap

Heatmap Controls: 24H

Max Opacity: 0.25

< Prev 2023-10-11 23:00:00 Next >

Snap4City (C), Sept. 2024

Snap4CityDocker | Dashboard Management System

Non sicuro | dashboard/dashboardSmartCity/view/Baloon-Dark.php?idashboard=MTY=

App | Maps | Google | Gmail | Snap4City | Snap4 | Calendar | Translate | Google Scholar Cita... | DISIT | DISIT old | Facebook | DataCenter | Trello | Km4City major tools | Impostazioni | YouTube | Google Forms | News | Qnap15sek7gyfe

Ciao  
Tue 19 Sep 10:02:15

## GOOGLE TEST

SELECT...

- SMALL
- NO2
- PM10
- PM2.5
- NOX
- WIND-W
- TEMP
- REL-HUM
- CO2
- CO
- SO2
- NO
- PM1
- PM4
- PM10
- PM2.5
- PM0.1
- PM0.4
- PM0.6
- PM0.9
- PM1.2
- PM1.6
- PM2.0
- PM2.5
- PM3.0
- PM3.5
- PM4.0
- PM4.5
- PM5.0
- PM5.5
- PM6.0
- PM6.5
- PM7.0
- PM7.5
- PM8.0
- PM8.5
- PM9.0
- PM9.5
- PM10.0

DOUBLE MAP

Heatmap

GRALheatmap

Heatmap Controls: 24H

Max Opacity: 0.25

< Prev 2023-09-13 23:00:00 Next >

NOX  
µg/m3

0-10
11-25
26-35
36-60
61-75
76-90
91-105
106-125
126-150
> 151

Snap4City (C), Sept. 2024

© OpenStreetMap contributors

# Local Digital Twin vs BIM

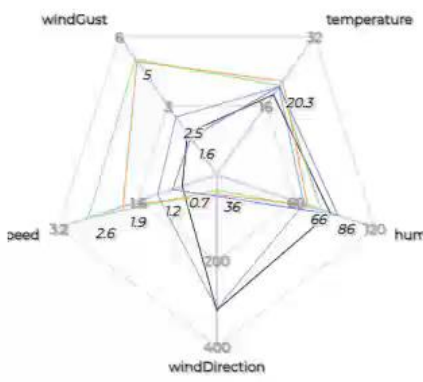


# BIM Airport

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	



Left sidebar navigation menu for Snap4City, including options like 'Switch To New Layout (Beta)', user profile 'User: nicolaroot', and various dashboard and tool categories.



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

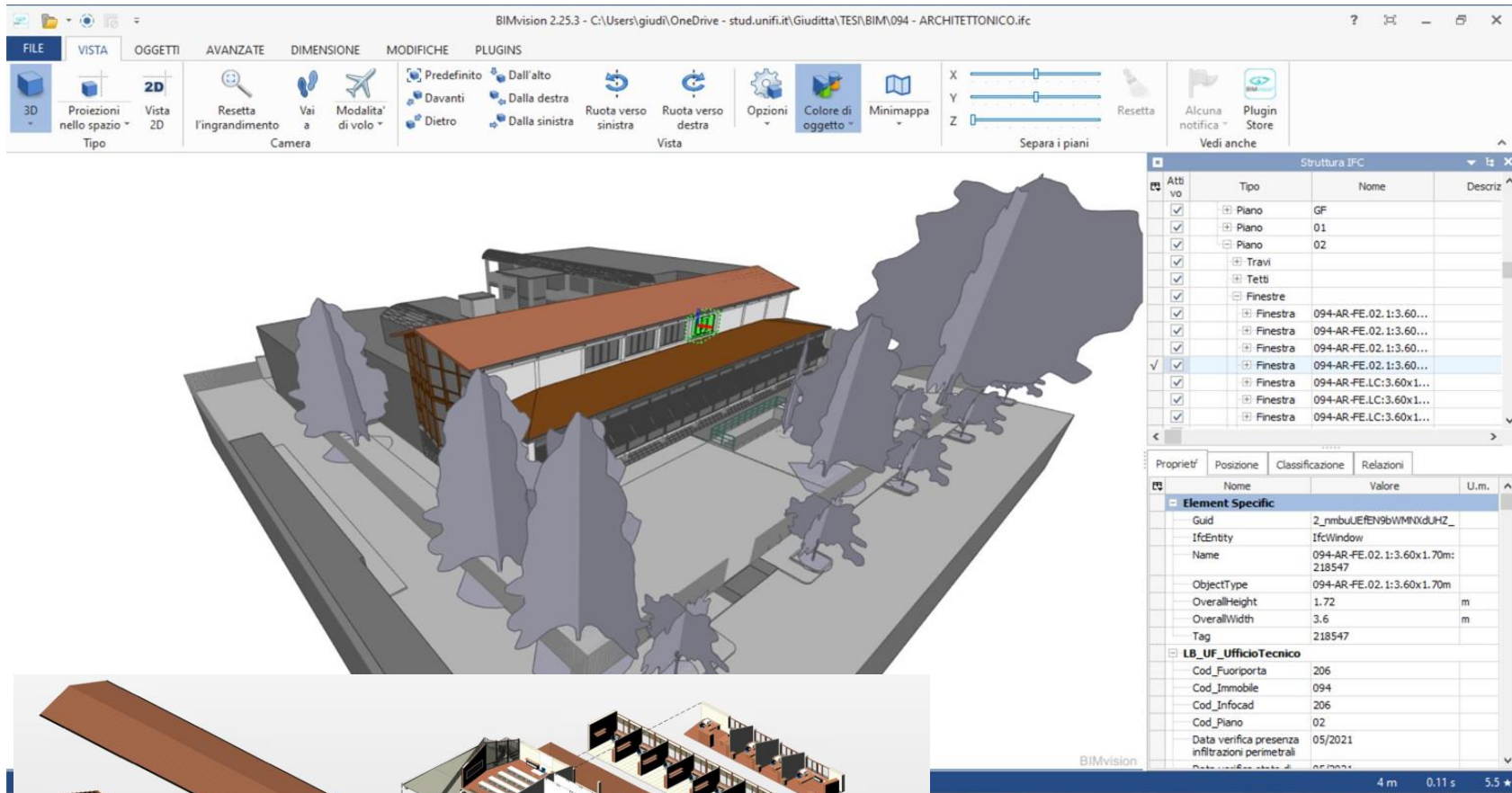
# Snap4City: Smart aNalytic APp builder for sentient Cities and IOT

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

User profile section: Username: nicolaroot, Search bar with '-Any-' dropdown.

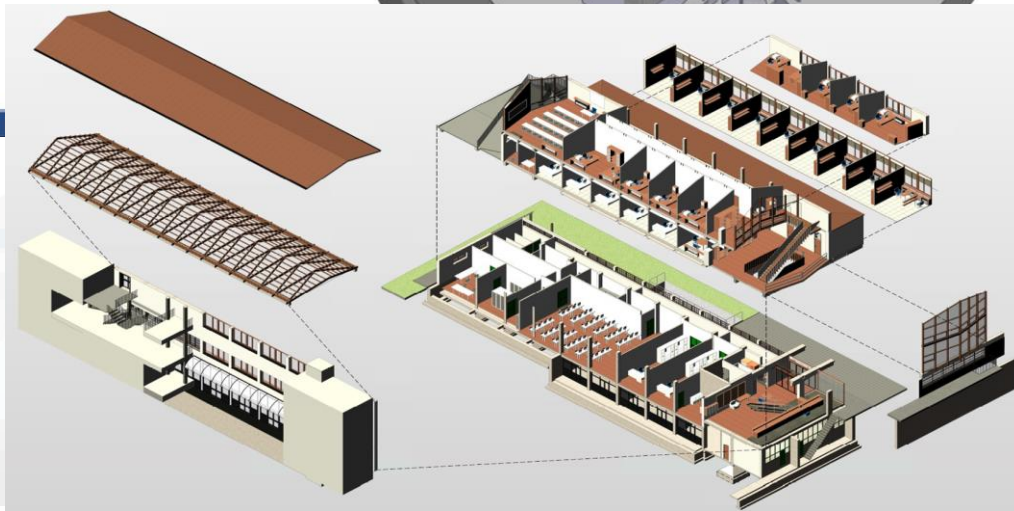
Main content area featuring various promotional tiles: 'WHAT IS Snap4City', 'LATEST NEWS', 'SELECT for CITIES 1st Place award to SNAP4CITY', 'Snap4City Training on Tools and Platform', 'Tutorials Scenarious Organizations', 'SMARTCITY EXPO WORLD CONGRESS 15 - 17 NOVEMBER 2022 BARCELONA & ONLINE GET YOUR 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', 'SNAP4CITY on', 'INDUSTRY 4.0'.

Right sidebar content: 'Training on Tools and Platform', 'Powered by www.km4city.org', 'FIWARE', 'Node-RED', 'Sii-Mobility', 'Who's online'.



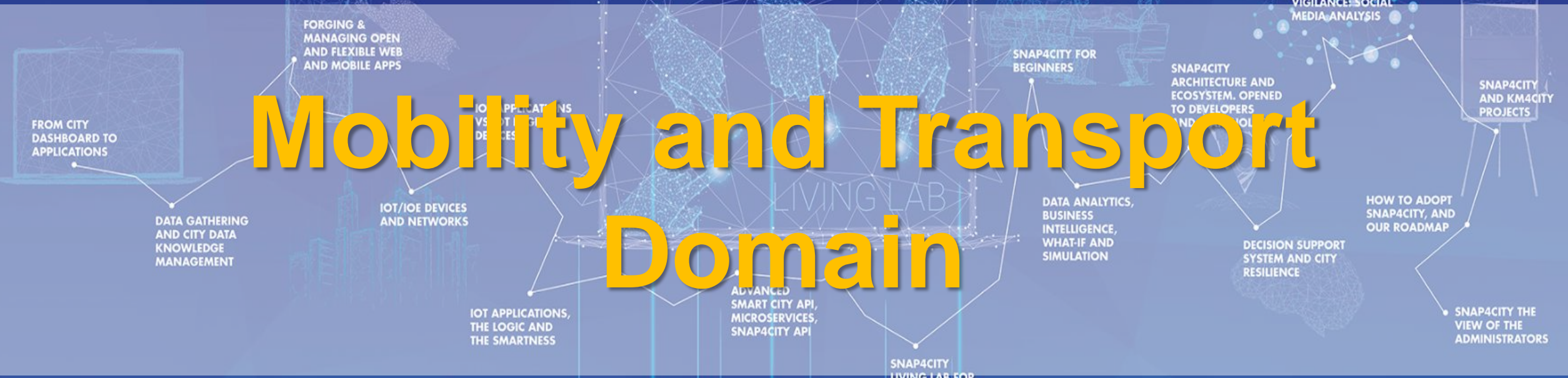
.IFC

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	



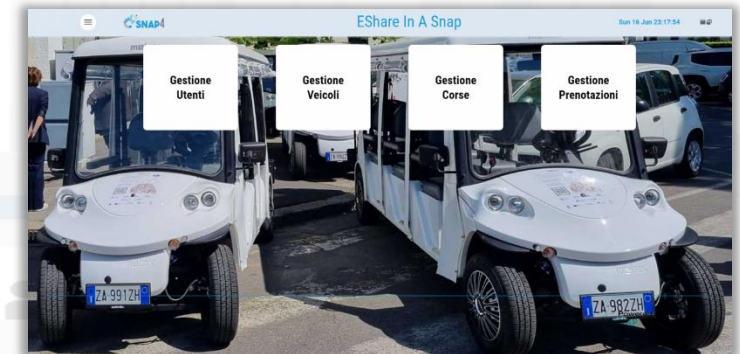
TOP

# Mobility and Transport Domain



# Mobility

- **Goals:**
  - Decongestion, Decarbonization, costs reductions
  - Improve Accessibility to services
  - Improve Security/Safety of city users
- **Operation and Plan:**
  - Traffic monitoring, prediction, reconstruction, identification of critical conditions (early warning), fleet management, dynamic routing, multimodal routing, city user behaviour analysis
- **Optimization and what-if analysis traffic light, infrastructure Reduction:** travel time, waiting time, stops, CO2 emissions, consume fuel, travel time for tramways
- **Public Transport:** analysis of Mobility Demand vs Offer of Transportation
- **Parking Management:** monitoring, prediction, any payments, on/off-road
- **Sharing / Pooling Management:** eShare and mobile app, bikesharing, smart bike, fleet management
- **KPI:** SUMI/SUMP, travel time, emissions, traffic status, accessibility, ..
- **Mobile App:** final users and operators
  - Info Mobility, traffic reconstruction, charging, participation,
  - Parking, payments, overparking, fine reporting, ..
- **Participatory:** problem reporting, ticketing, etc.
- **Data Integration of any kind:** env, weather. Tickets, presences, POI, sat, etc.

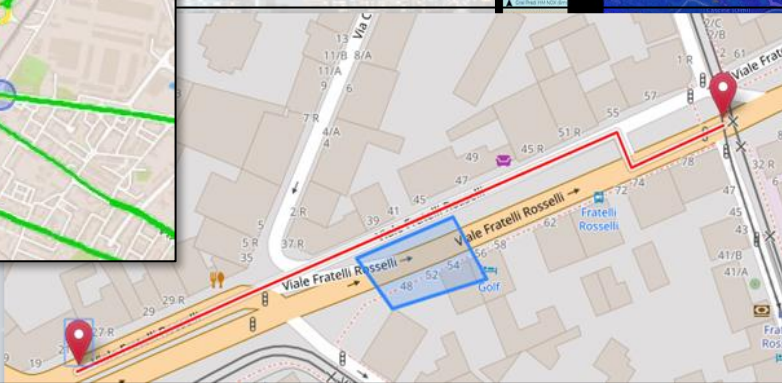
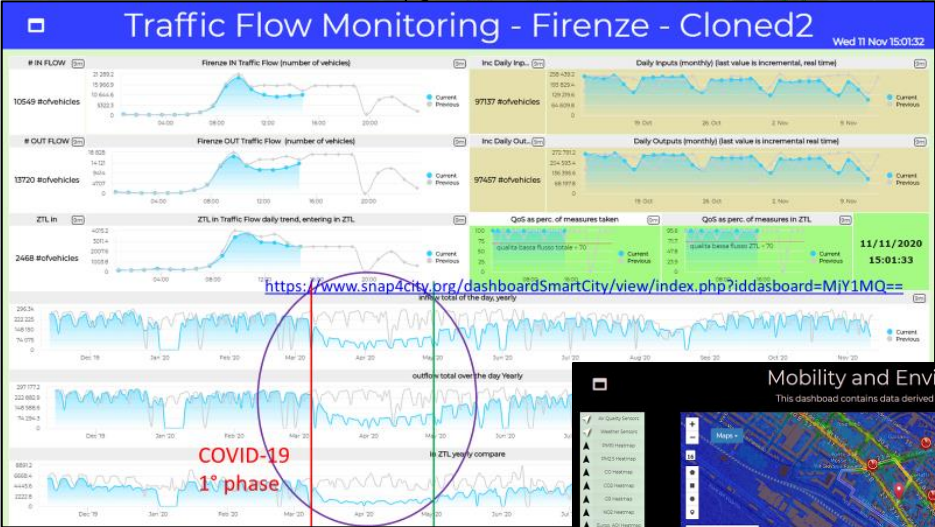


# Mobility and Transport Traffic Flow Analysis

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 Domain (2024/8)

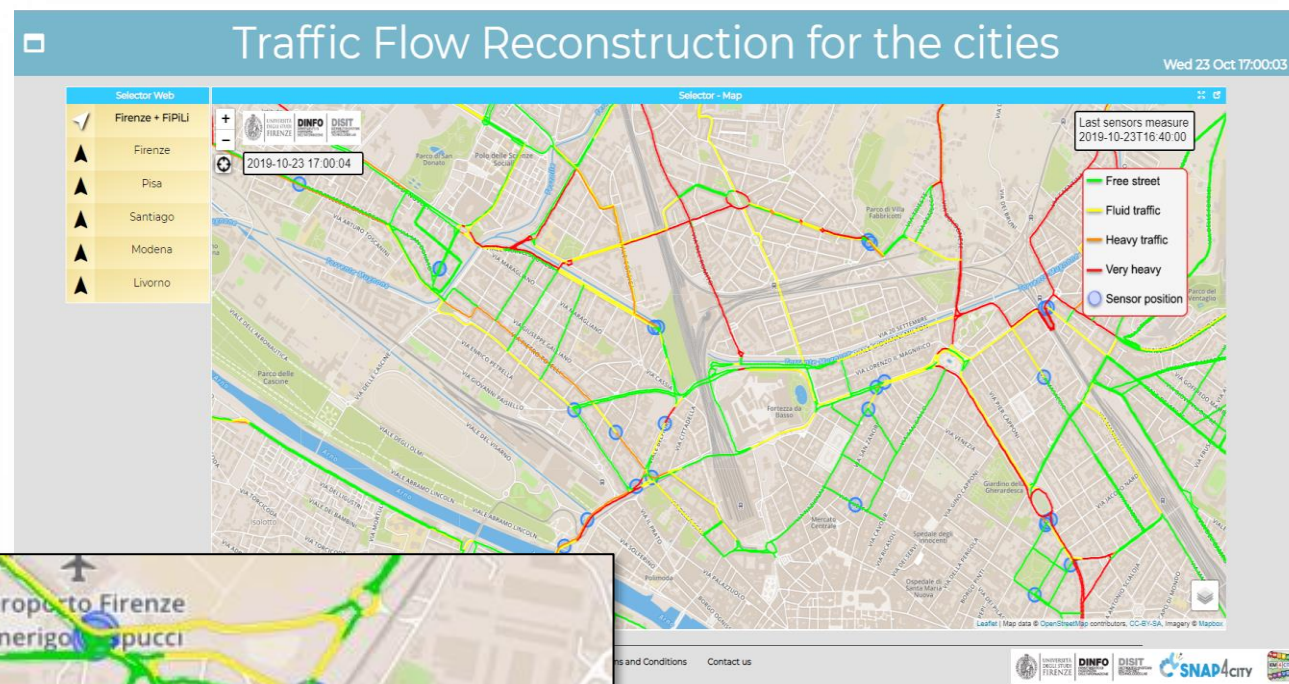
- **Goals:**
  - Decongestion
  - Decarbonization
  - Accessibility to services
  - Security/Safety of city users
- **Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)**
  - Monitoring traffic, parking, people flow, services, boats, ports, beaches, etc.
  - Early detection/warning of critical conditions: traffic, congestion, security/safety
  - Managing Smart Parking, transportation services, fines, etc.
  - Managing fleets: personal, sharing, waste collection, maintenance, etc.
  - Managing E-sharing, pooling services, MaaS, etc.
  - Managing entrances in city areas: restricted areas, touristic busses, etc.
  - Production of suggestions, recommendations, nudging
  - Computing predictions of any kind
- **Solutions for Planning (optimization and what-if analysis)**
  - Reduction of traffic congestion, via optimization: traffic light plans, viability, routing
  - Reduction of Pollutant Emissions, via optimization: traffic light plans, viability
  - Optimization of transportation offers wrt multimodal mobility demand
- **Algorithms and computational solutions, see next slide**

# Tools for Mobility and Transport (2024/8)

- Optimisation of viability of an area for reducing congestion, waiting time, stops
- Optimisation of Traffic Light Plans, synchronization, in an area for reducing congestion, waiting time, stops
- 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)
- Public Transportation: Ingestion and modelling of GTFS, Transmodel, NeTEx, 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)
- Road light controlled by traffic conditions
- 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)
- Fleet management, monitoring, booking, allocation, maintenance
- 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)
- **Definition of Scenarios**: traffic, road graph, conditions, etc.
- Etc.

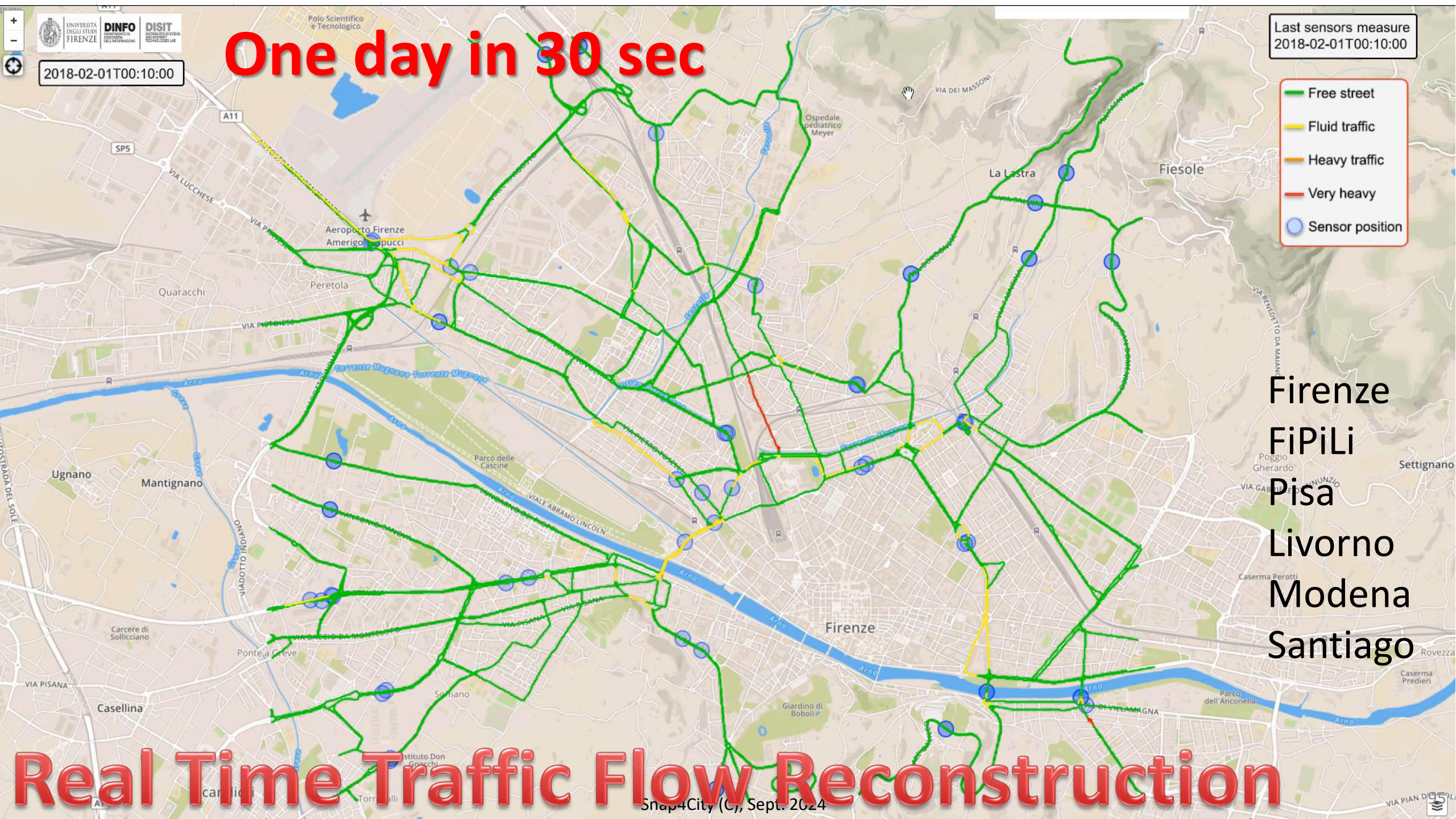
# Why Dense Traffic Flow Reconstruction ?

- Making decision on mobility and transport solutions → what if analysis
- Controlling pollution
- Dynamic Routing for Firebrigade, Ambulances, general public
- Planning Public Transportation routing



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





2018-02-01T00:10:00

# One day in 30 sec

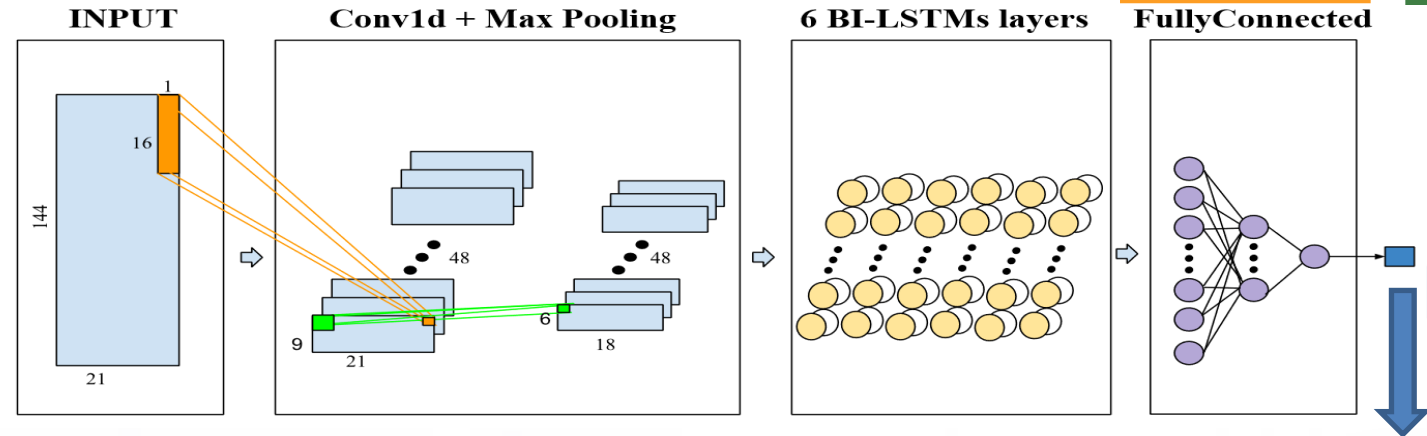
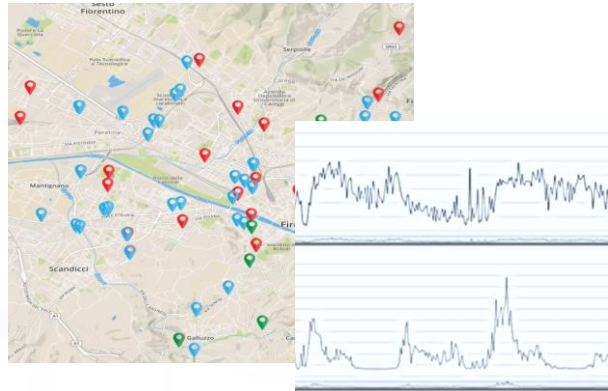
Last sensors measure  
2018-02-01T00:10:00

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

Firenze  
FiPiLi  
Pisa  
Livorno  
Modena  
Santiago

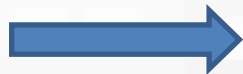
# Real Time Traffic Flow Reconstruction

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



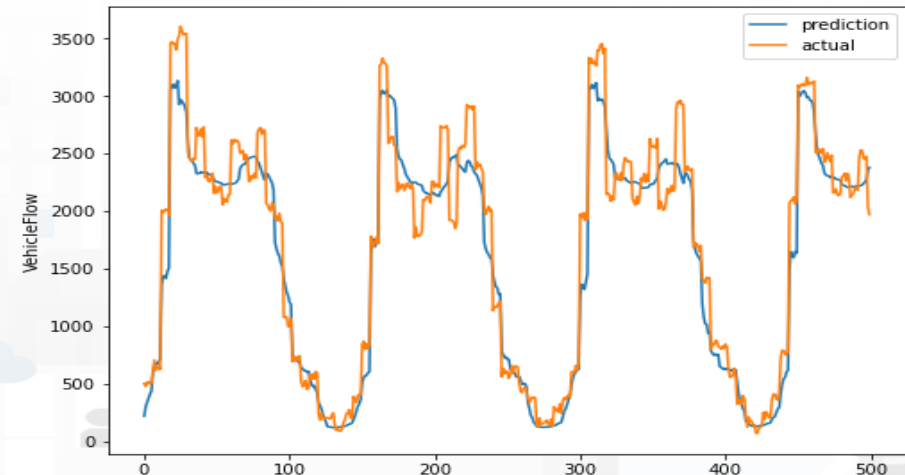
Urban data:

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

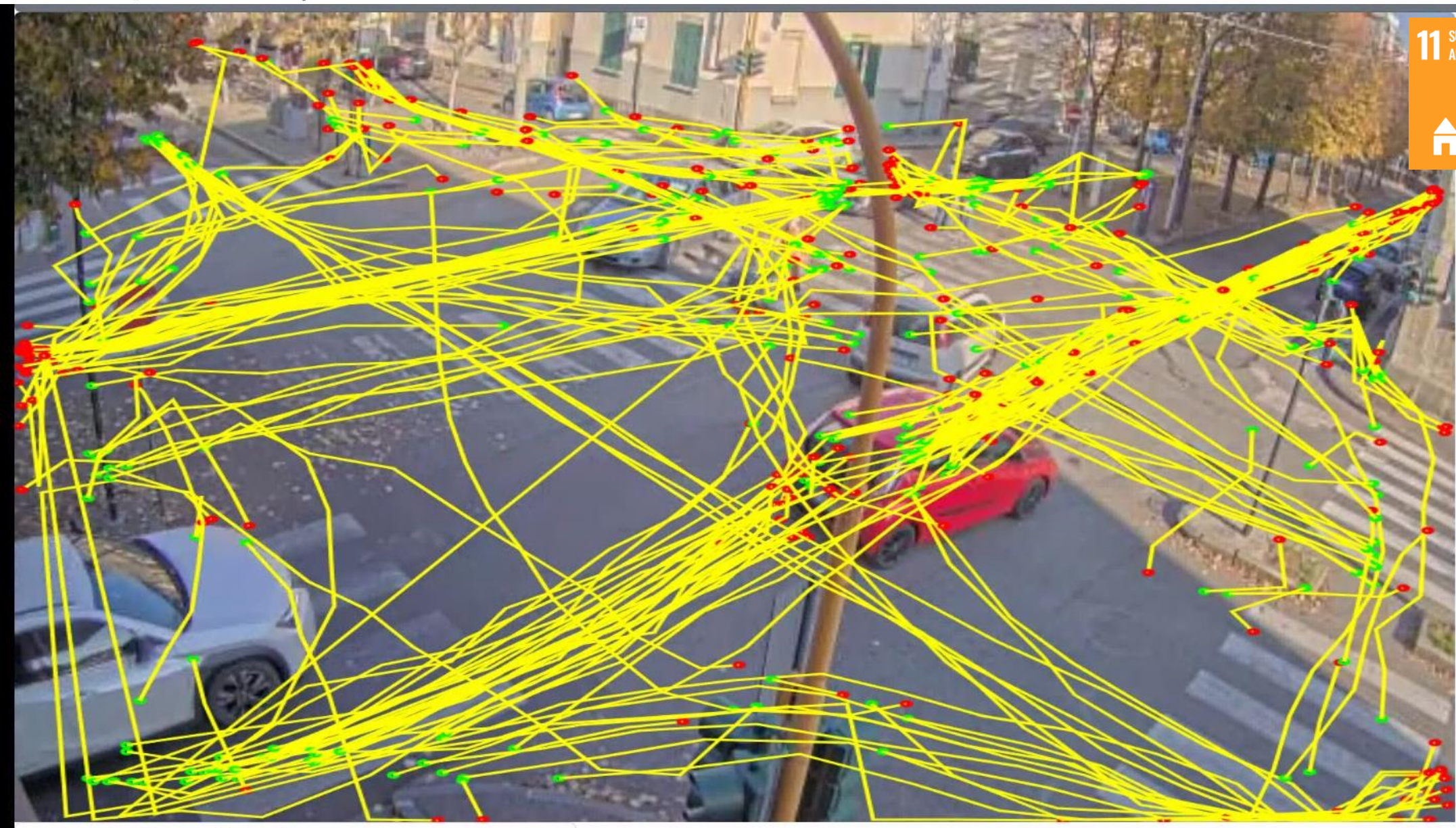


- RF
- XGBOOST
- DNN
- LSTM
- BI-LSTM
- Autoencoder BI-LSTM
- Attention CONV-LSTM
- CONV-BI-LSTM

CONV-BI-LSTM

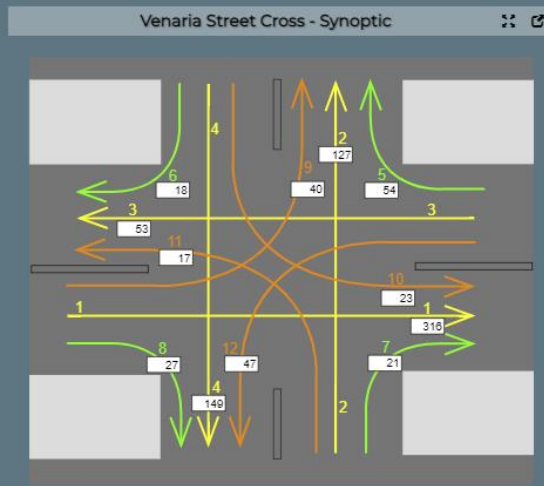
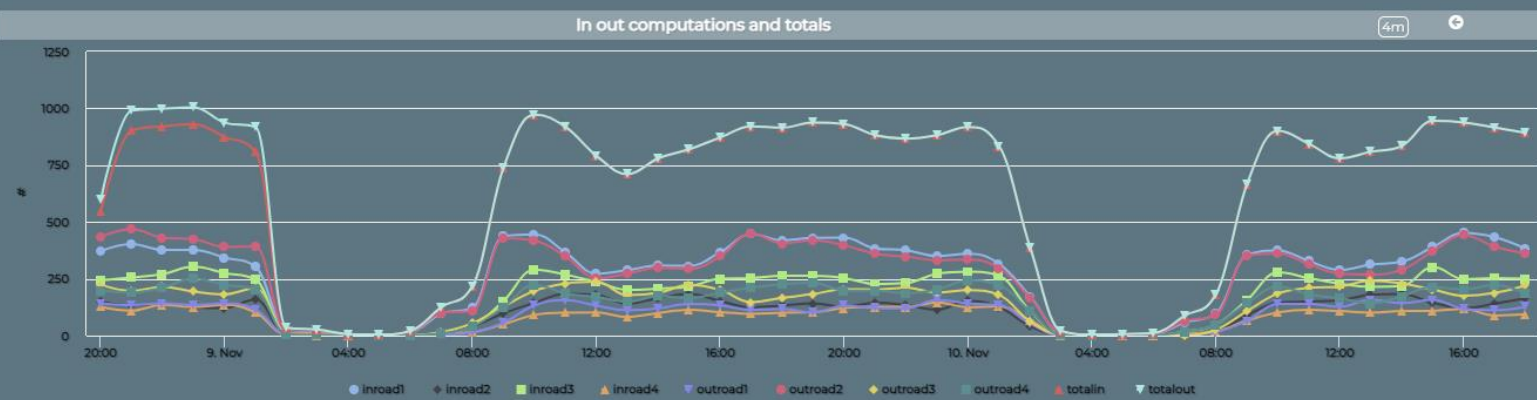
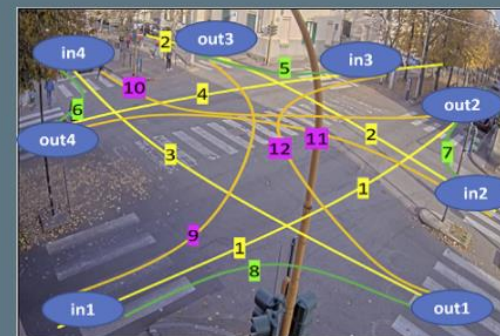
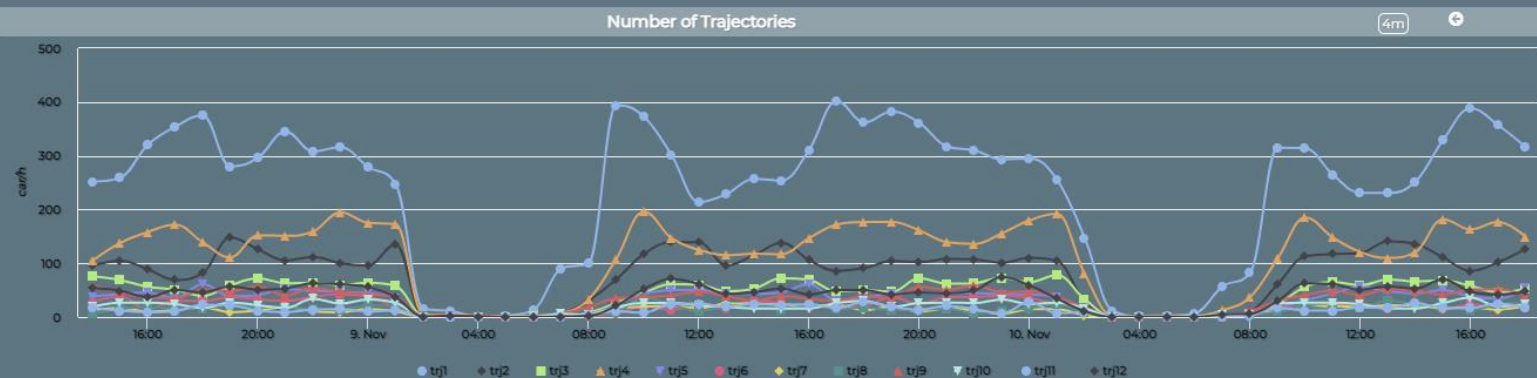


11 SUSTAINABLE CITIES  
AND COMMUNITIES



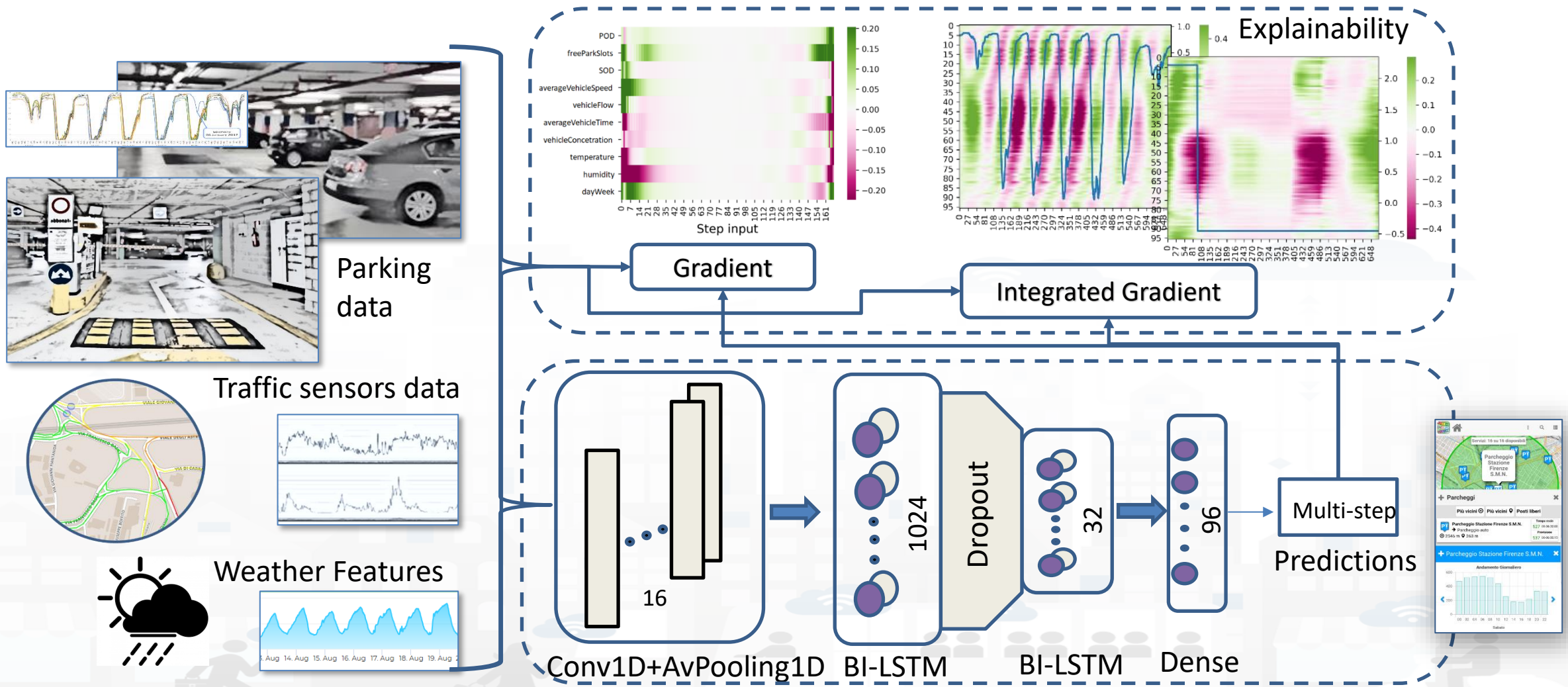
## Monitoring Cross Road Venaria - (AXIS Camera)

Wed 10 Nov 18:50:53



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

# Deep Learning AI to surely Park!



# Traffic Light Plan Optimization

FROM CITY  
DASHBOARD TO  
APPLICATIONS



**11 SUSTAINABLE CITIES AND COMMUNITIES**



**MOST**  
CENTRO NAZIONALE PER LA MOBILITÀ SOSTENIBILE

<https://www.snap4city.org/1015>

# Traffic Light Plan Optimisation, Digital Twin

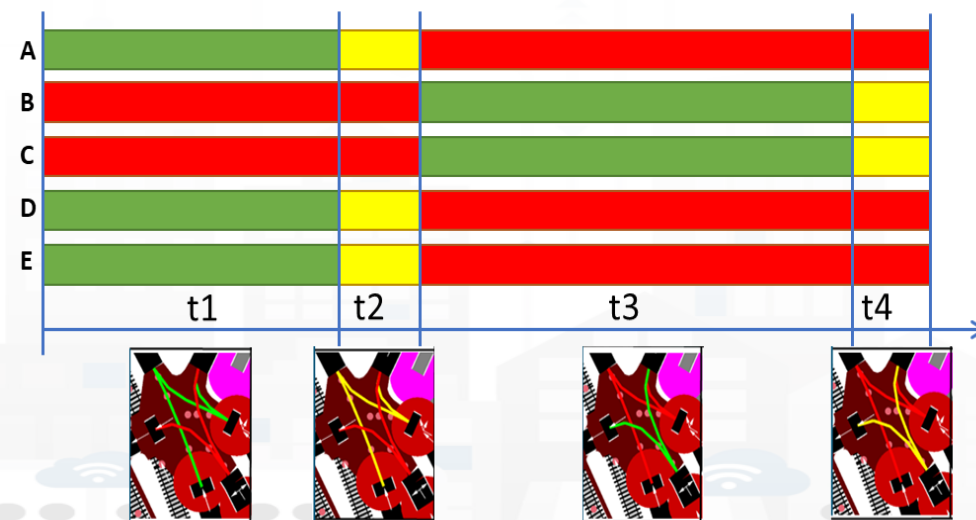
- **Match Multiple Objectives and Synchronization:**

- public and private traffic, tramway priority
- Micro and Macro Scales
- **AI: Genetic Algorithms, Reinforced Learning**
  - Fixed and Actuated Cycles
  - Adjusted on Demand

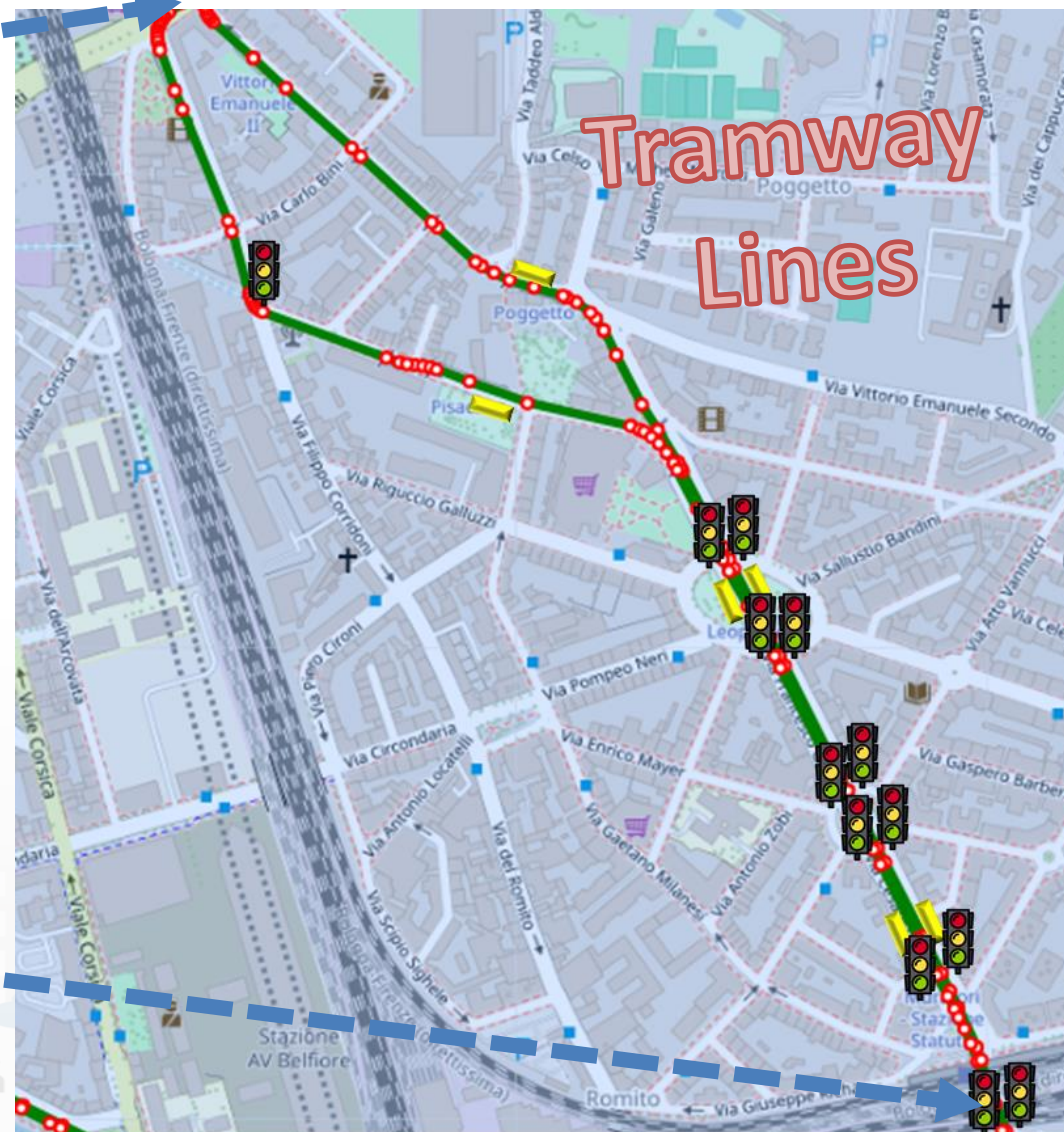
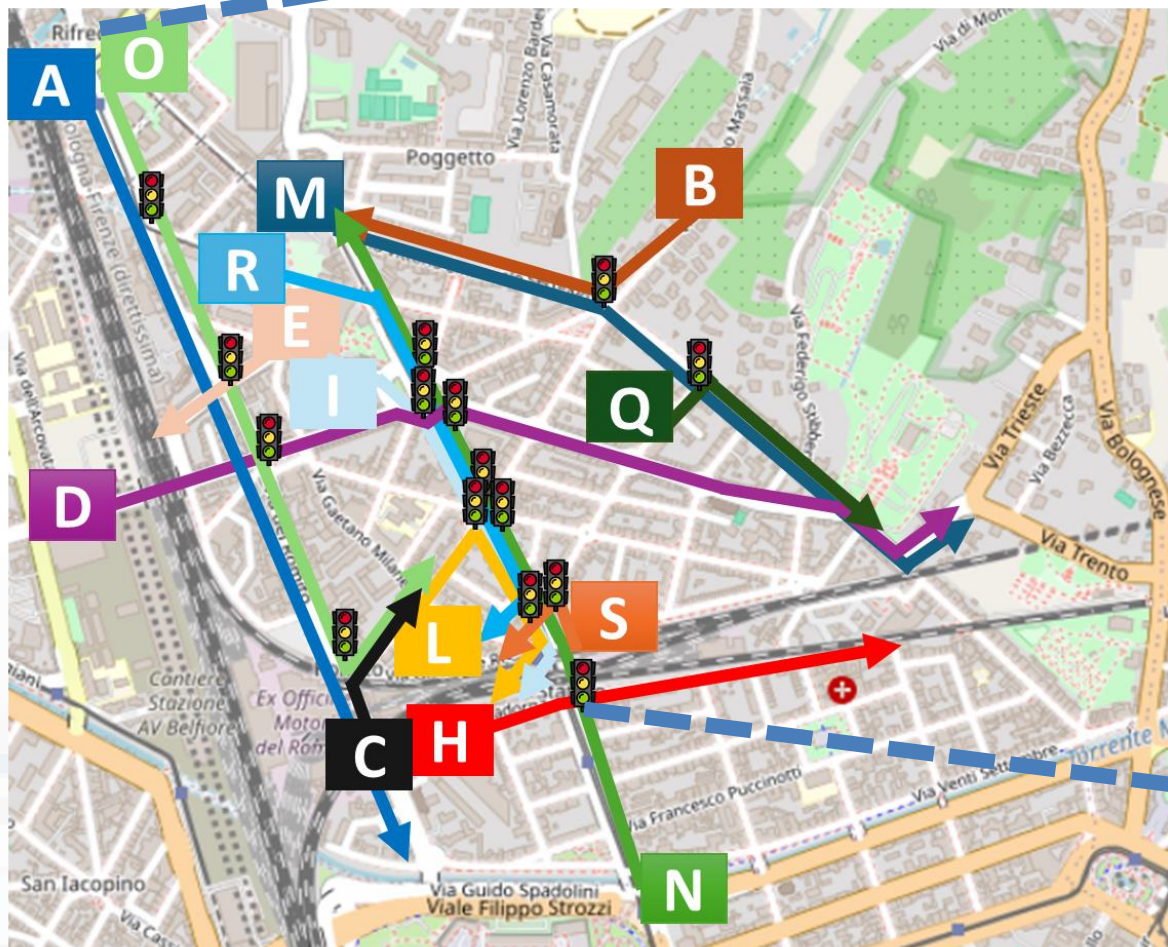
- **Validation/integ.** with *SUMO* simulation

- Travel Time, waiting time, waiting count, specific travel time on directions, CO2 emissions, etc.

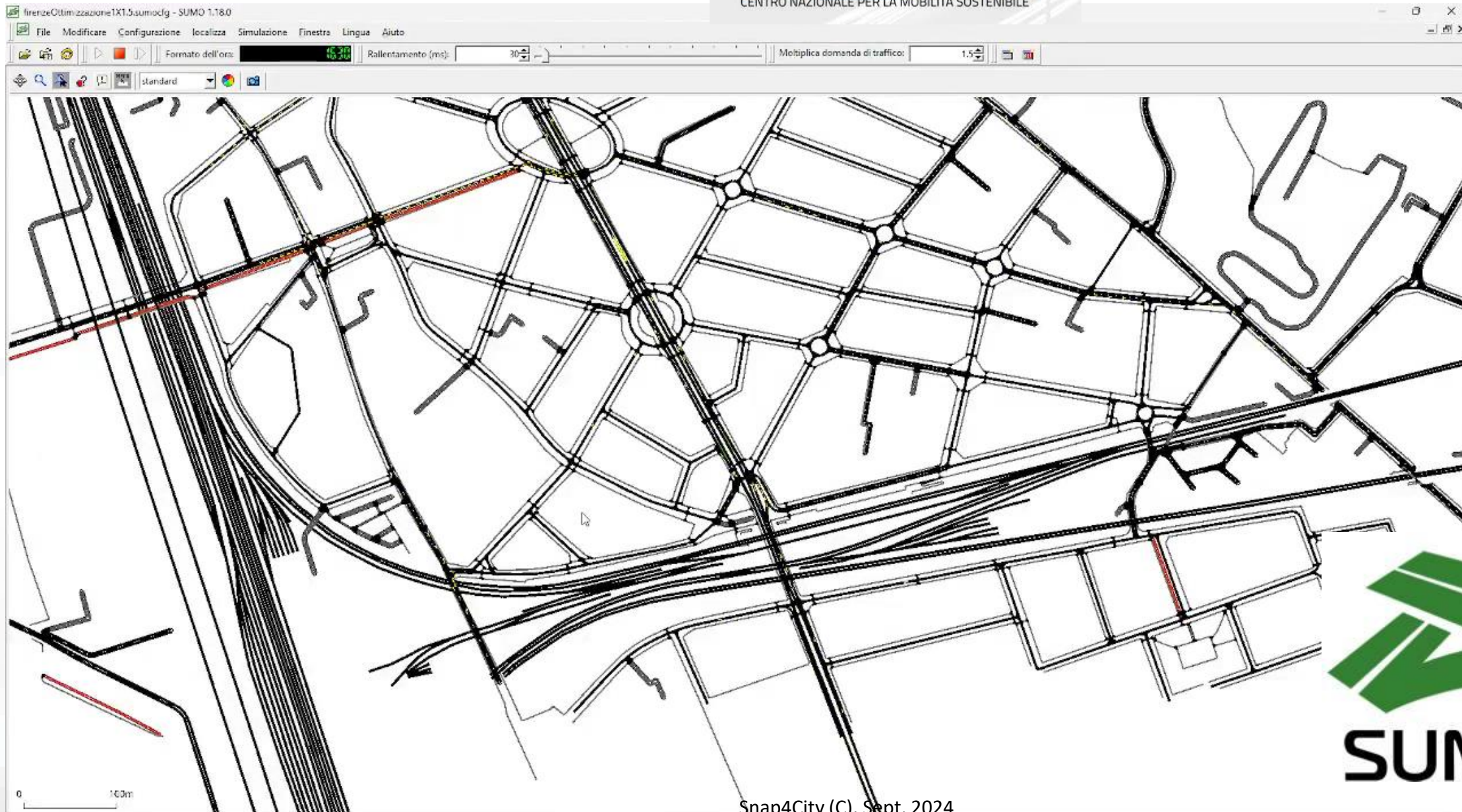
- **Reductions from 5% to 15%**



# Example, main paths







# Traffic Infrastructure Optimization

FROM CITY  
DASHBOARD TO  
APPLICATIONS

DATA GATHERING  
AND CITY  
KNOWLEDGE  
MANAGEMENT

11 SUSTAINABLE CITIES  
AND COMMUNITIES



# MOST

CENTRO NAZIONALE PER LA MOBILITÀ SOSTENIBILE

TO ADOPT  
CITY, AND  
ROADMAP

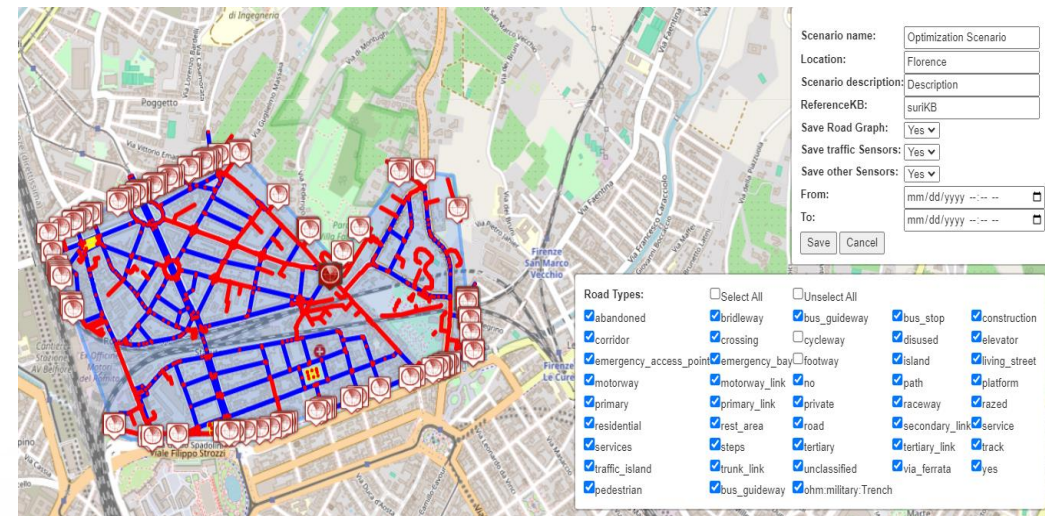
• SNAP4CITY THE  
VIEW OF THE  
ADMINISTRATORS

<https://www.snap4city.org/1014>

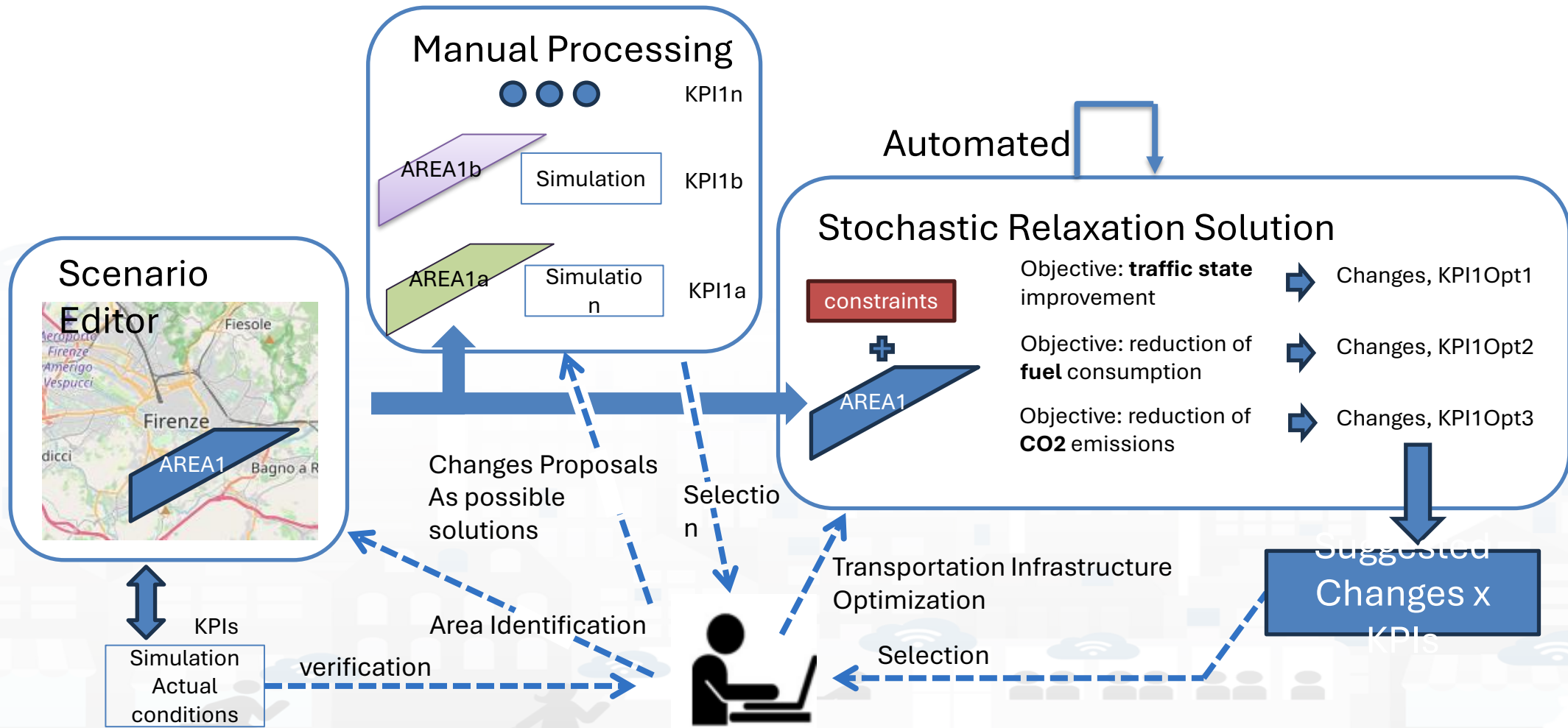


# Traffic Infrastructure Optimisation, Digital Twin

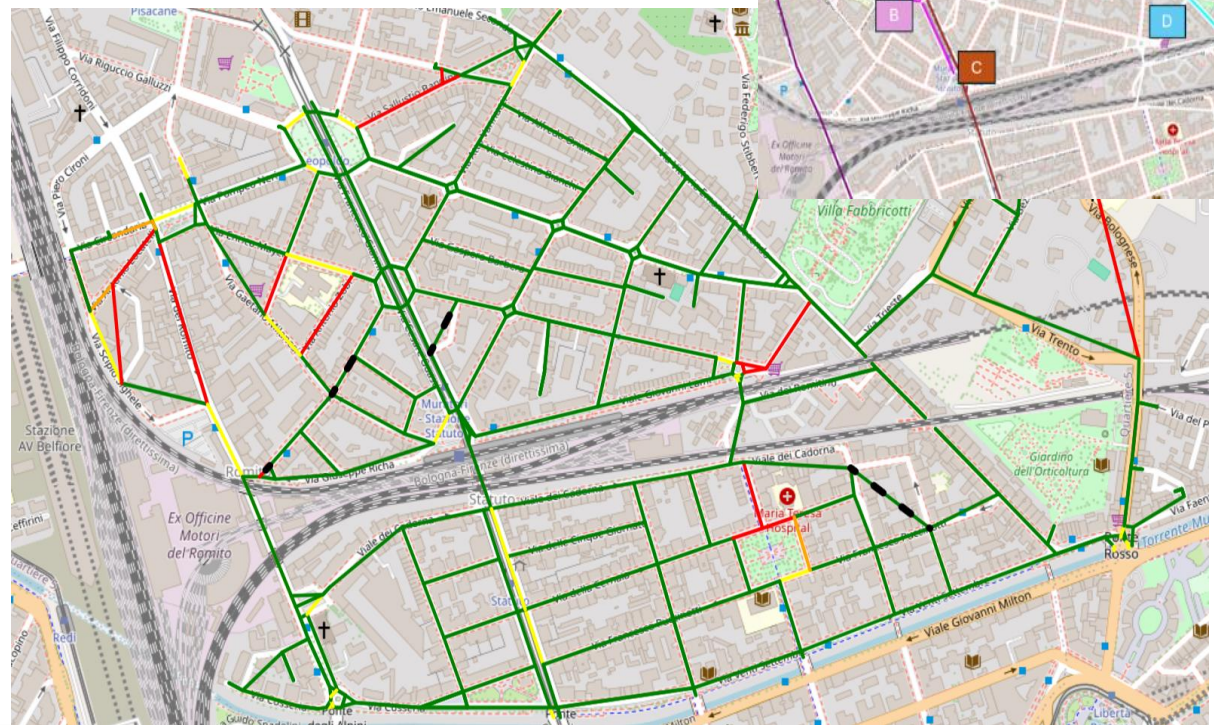
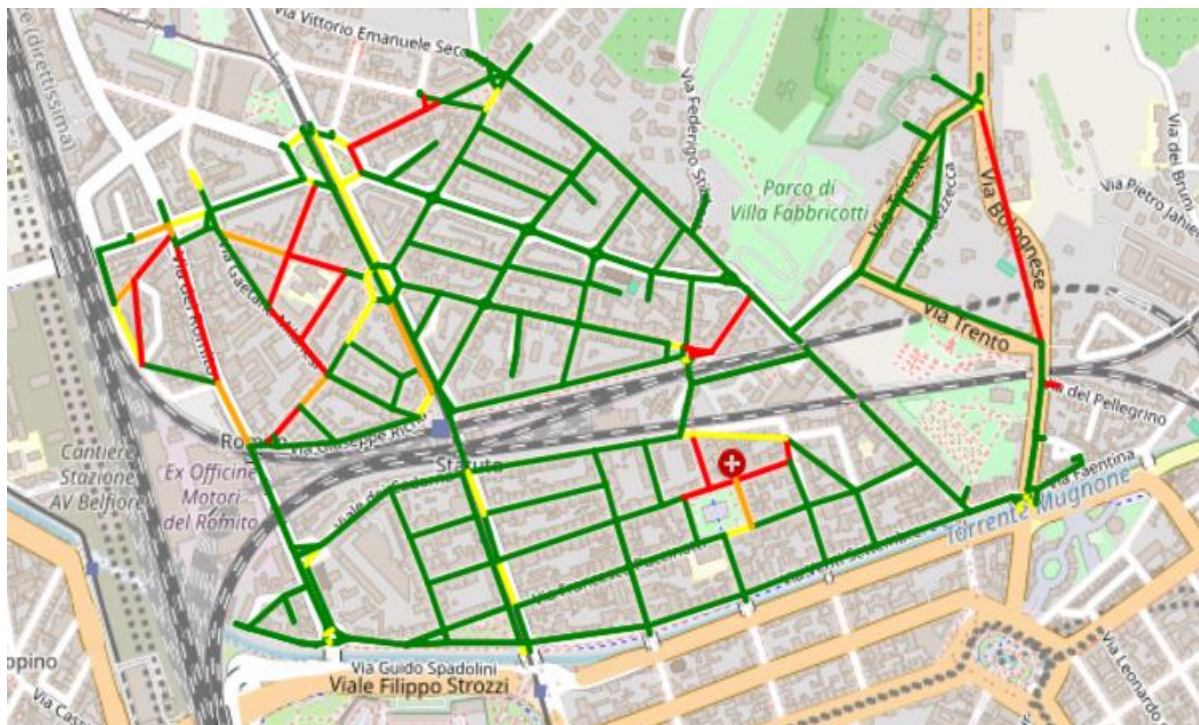
- **Identification of Scenario**  
(Scenario Editor), any changes
  - Definition of traffic loads by flows
- **What-if or Automated Optimisation**
- **Automated Optimisation:**
  - Stochastic Relaxation, Simulated Annealing, Traffic Flow Reconstruction
  - Multiple objectives targeting
    - Travel time, emissions, fuel consumption, traffic status
  - Limiting the number of changes



# Traffic Infrastructure Optimisation



# Optimization Results



<i>Case max 4 changes</i>	<i>KPI estimation on the best solution</i>		
	<i>Traffic State</i>	<i>Fuel</i>	<i>CO2</i>
<i>Optim 4 Traffic State</i>	<b>91.341</b>	17.964	128536
<i>Optim 5 Fuel</i>	91.514	<b>16.633</b>	128227
<i>Optim 6 CO2</i>	92.859	19.192	<b>127876</b>
<i>Original</i>	115.475	25.680	165822

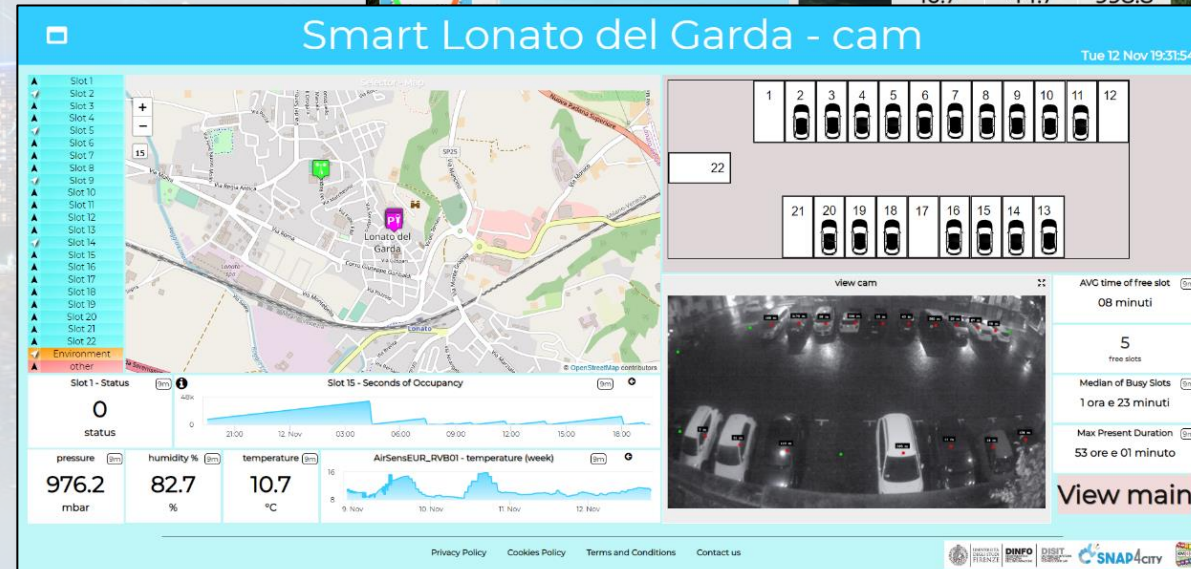
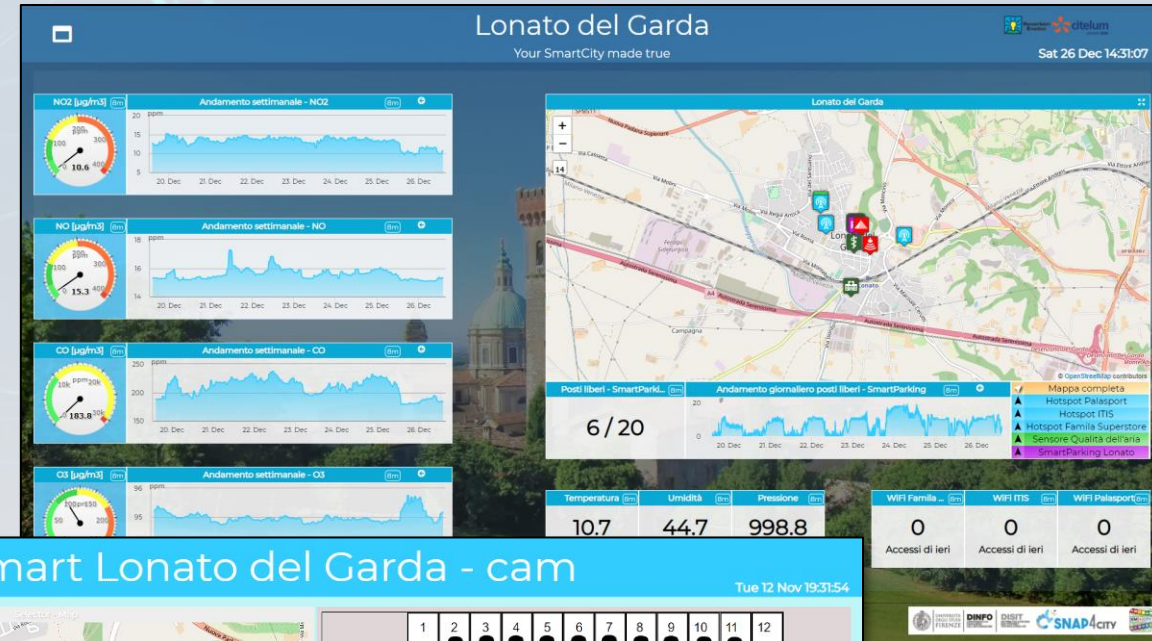
<i>Travel Time [s]</i>	<i>Path A</i>	<i>Path B</i>	<i>Path C</i>	<i>Path D</i>	<i>Total Time</i>
<i>Original Scenario</i>	183.2	59.6	80.9	132.5	456.4
<i>Optim 4 Traffic State</i>	93.2	60.0	63.7	<b>96.0</b>	313.1
<i>Optim 5 Fuel</i>	89.6	<b>51.2</b>	59.7	96.4	<b>296.9</b>
<i>Optim 6 CO2</i>	<b>89.5</b>	53.2	<b>58.4</b>	100.1	301.3

# Smart City / Smart Parking + Environment Reverberi, Lonato del Garda

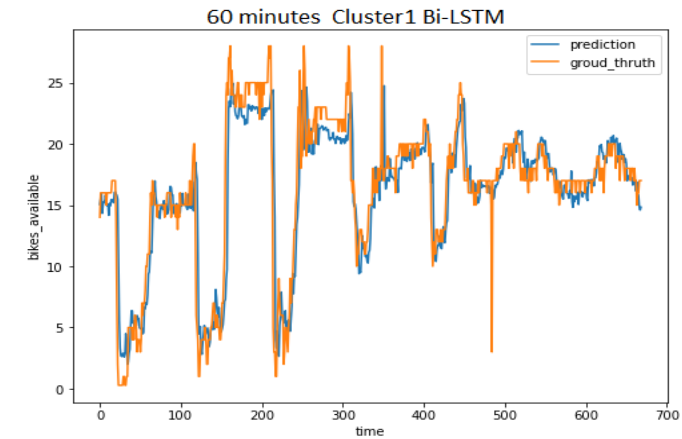
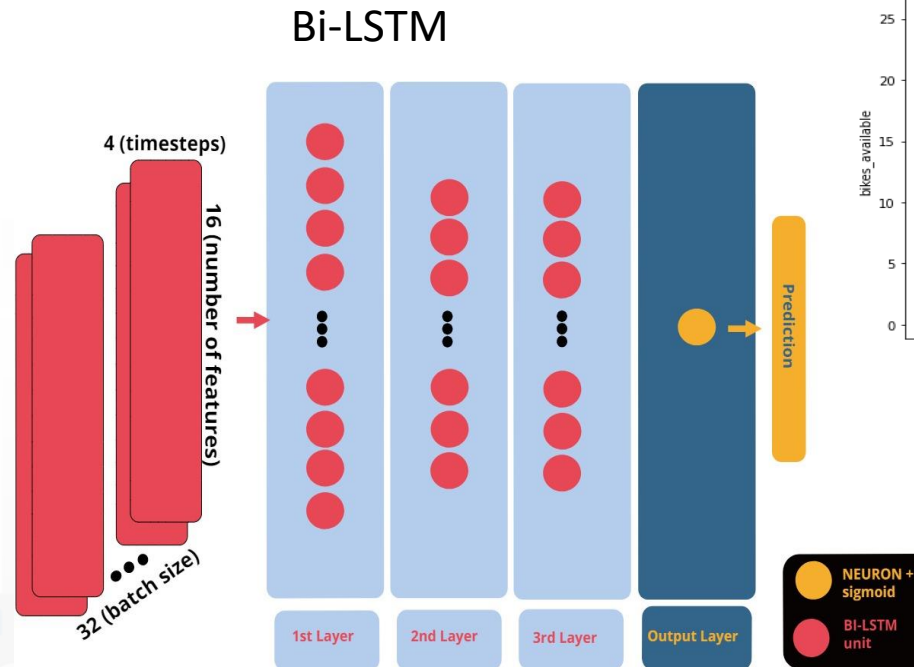


reference

- **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

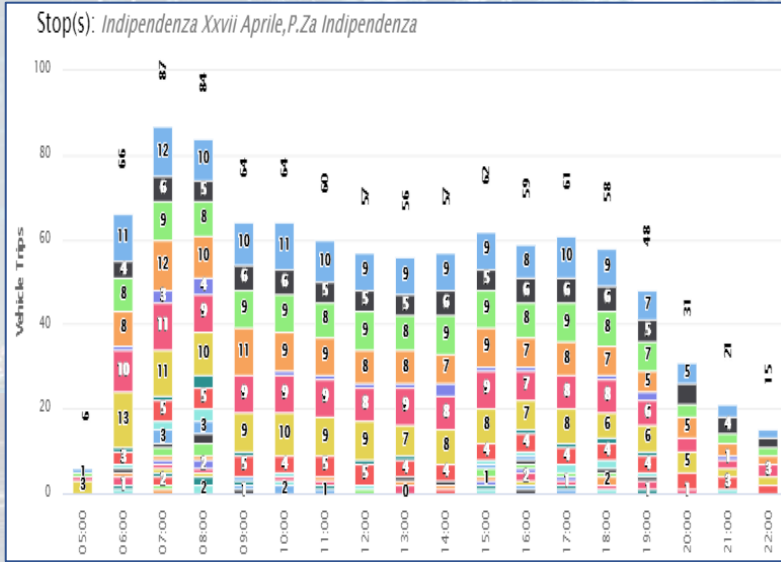


# What-if Analysis on Pub Transport



- 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 Load

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]



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

**Stop(s): Indipendenza Xxvii Aprile, P.Za Indipendenza**

Hour	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
Total Trips	6	66	87	84	64	64	60	57	56	57	62	59	61	58

**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

**Vehicle Arrival**

Pick-ups/Vehicle Arrival (Green)

Drop-offs/Vehicle Arrival (Red)

**Scenario Selector**

Choose a scenario: Actual scenario Load

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

<https://www.snap4city.org/odanalyzer/#b>

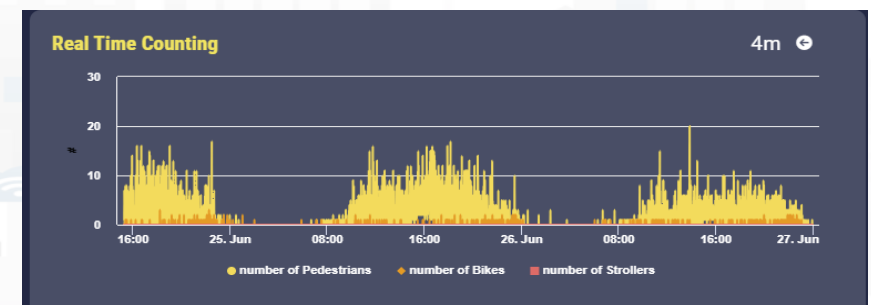
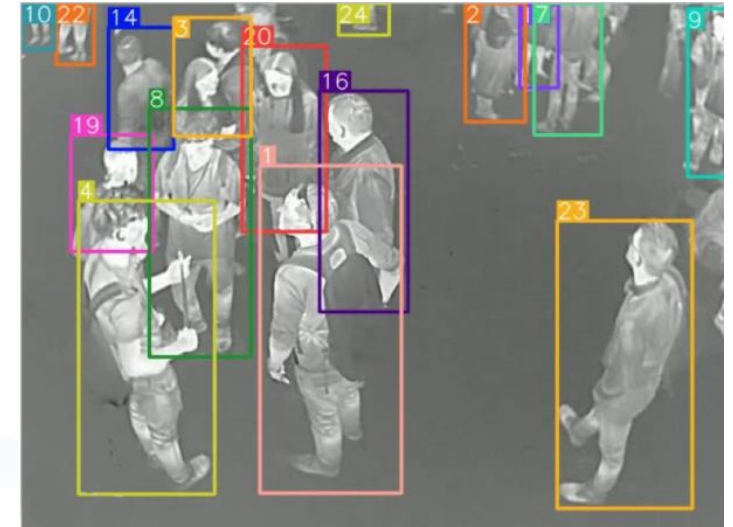
TOP

# Behaviour understanding and User Engagement Security and Safety



# City User Behaviour/services, Tourism and Safety

- **Goals:**
  - Improve Quality of Life and quality of services,
  - Over tourism mitigation, sustainability
  - Costs reduction of services
  - Improve accessibility to services: citizens, Tourists, commuters, etc.
  - Improve Security/Safety of city users
- **People Flow Analysis / Management:** in/out-door, retail, attractions
  - Counting, tracking, Flows, ODM, sentiment, etc.,
  - multiple sources: thermal & TV cameras, radar sensors, PAX sniffers, mobile data, ...
  - Data and/or OD matrices from: Wi-Fi, traffic data, mobile phone data
  - **Suggestions:** info Tourism, digital signages, engagement, ..
- **Tourists Flows & Retail Management:** predictions of presences, services' reputations, suggestions on second offer, over-tourism, notifications, early warning,
- **KPI:** 15 MinCityIndex, energy vs people, over-tourism, accepted suggestions, precision
- **Mobile App:** final users services/informing and operators
  - Info Tourism, people flows, info mobility, sharing, ...
  - Participation, engagement, ..
- **Participatory:** problem reporting, ticketing, etc.
- **Integration of any kind:** env/weather, mobility, ticketing, presences, POI, ..



# City User Behaviour/services, Tourism and Safety (2024/8)

- **Goals:**
  - Quality of Life, quality of services, over tourism mitigation, sustainability
  - Costs reduction of services
  - Accessibility to services: citizens, Tourists, commuters, etc.
  - Security/Safety of city users
- **Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)**
  - Monitoring services: tickets, reputation, usages, areas, etc.
  - Monitoring user behaviour (counting, trajectories): indoor/outdoor, hot places/services, ports, beaches,
  - Computing: origin destination, trajectories, travel means, etc.
  - Early detection/warning of critical conditions, connection with Video Management Systems
  - Managing entrances in city areas: restricted areas, touristic busses, etc.
  - Production of info-tourism, recommendations, nudging to city users and operators, second offer promotion
  - Providing Virtual Assistants for City Services, Tourist Offices, etc.
  - Monitoring reputation of services via: social media, blogs, etc.
  - Collecting complains, requests, participations from City users via mobile apps
  - Computing predictions of any kind
- **Solutions for Planning (optimization and what-if analysis)**
  - Reduction of Pollutant Emissions, via optimization
  - Optimization plan to distribution of workload on multiple touristic offers/services, area cleaning, etc.
  - Predicting reputation of services, touristic and operative
- **Algorithms and computational solutions, see next slide**

# City Users Behaviour, Safety, Security and Social Analysis (2024/8)

- **People detection and classification:** persona, strollers, bikes, etc. (ML, DL)
- **people counting and tracking,** head counting, people trajectories (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)**
- **Video management System integration for security**
- **15 Minute City Index** , etc. (modeling and computability)
- Computing **SDG**, etc., (DP)
- Etc.

# Tuscany Region

## Dashboards & Services:

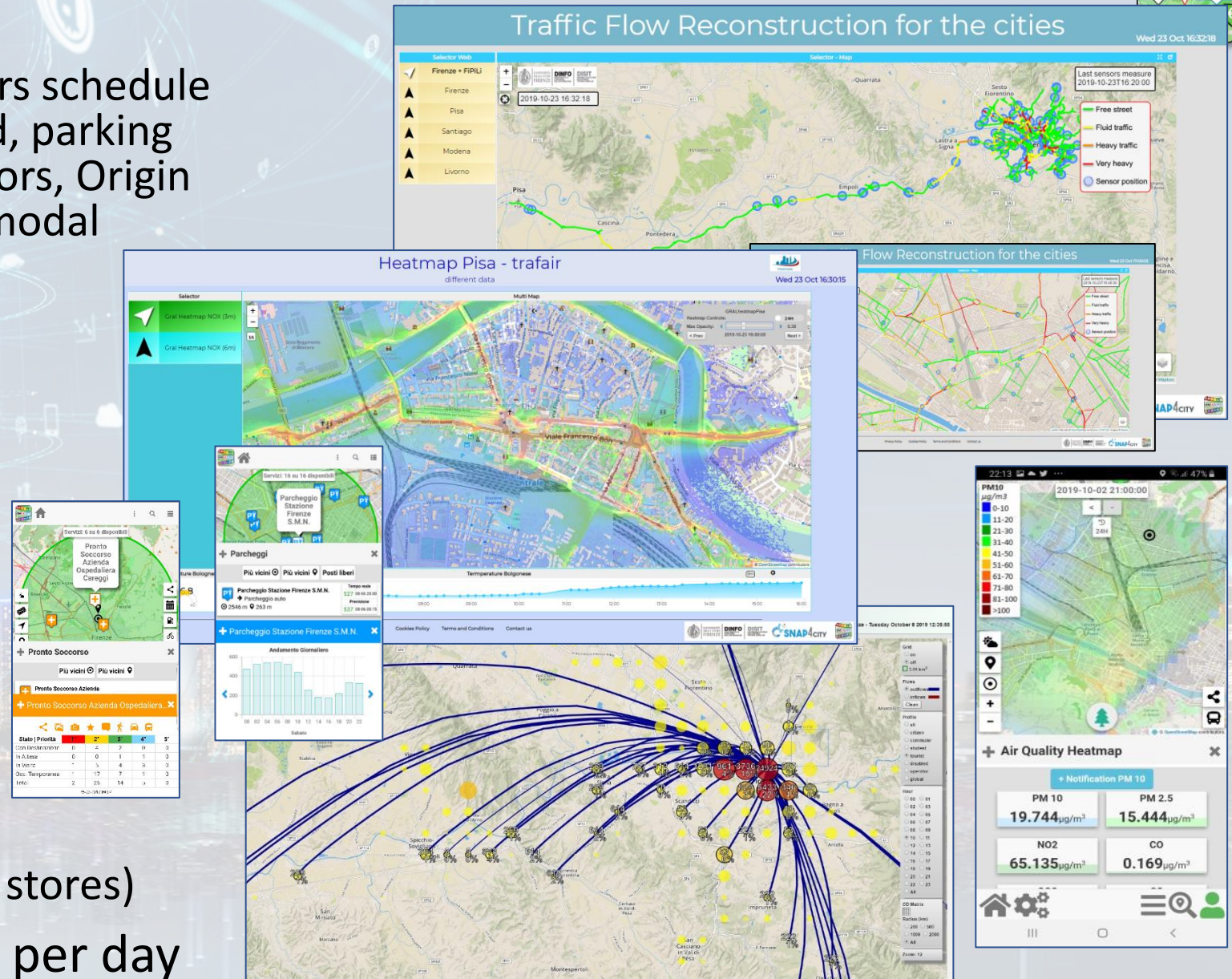
- Mobility:** public transport operators schedule and paths, traffic Fi-Pi-Li main road, parking status and predictions, traffic sensors, Origin Destination matrix, routing, multimodal routing, etc.
- Social:** Hospitals and triage, etc.
- Environment:** sensors, heatmaps, alerting,
  - Pollution Forecast:** NOX, NO2
  - Weather Forecast,**
- Culture and Tourisms**
- Etc.**

## Mobile App and MicroApplications:

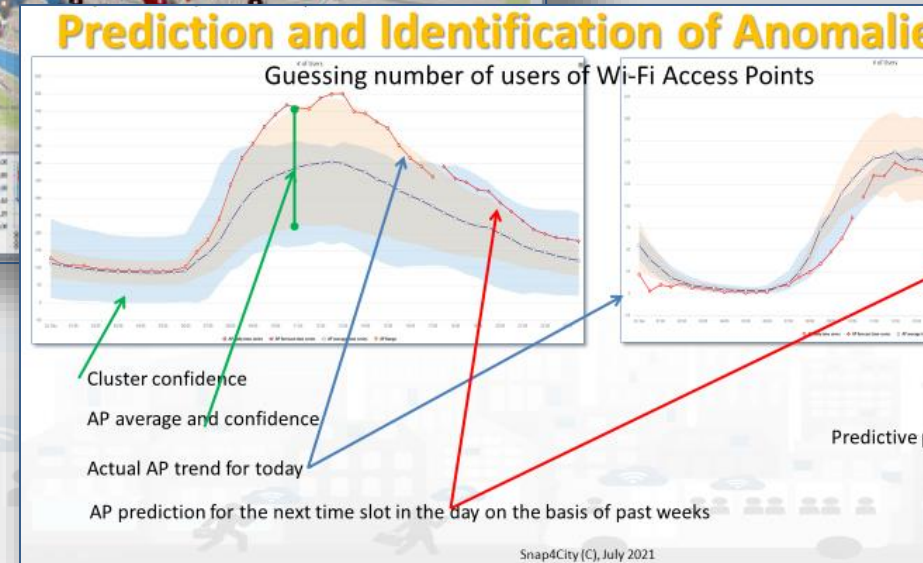
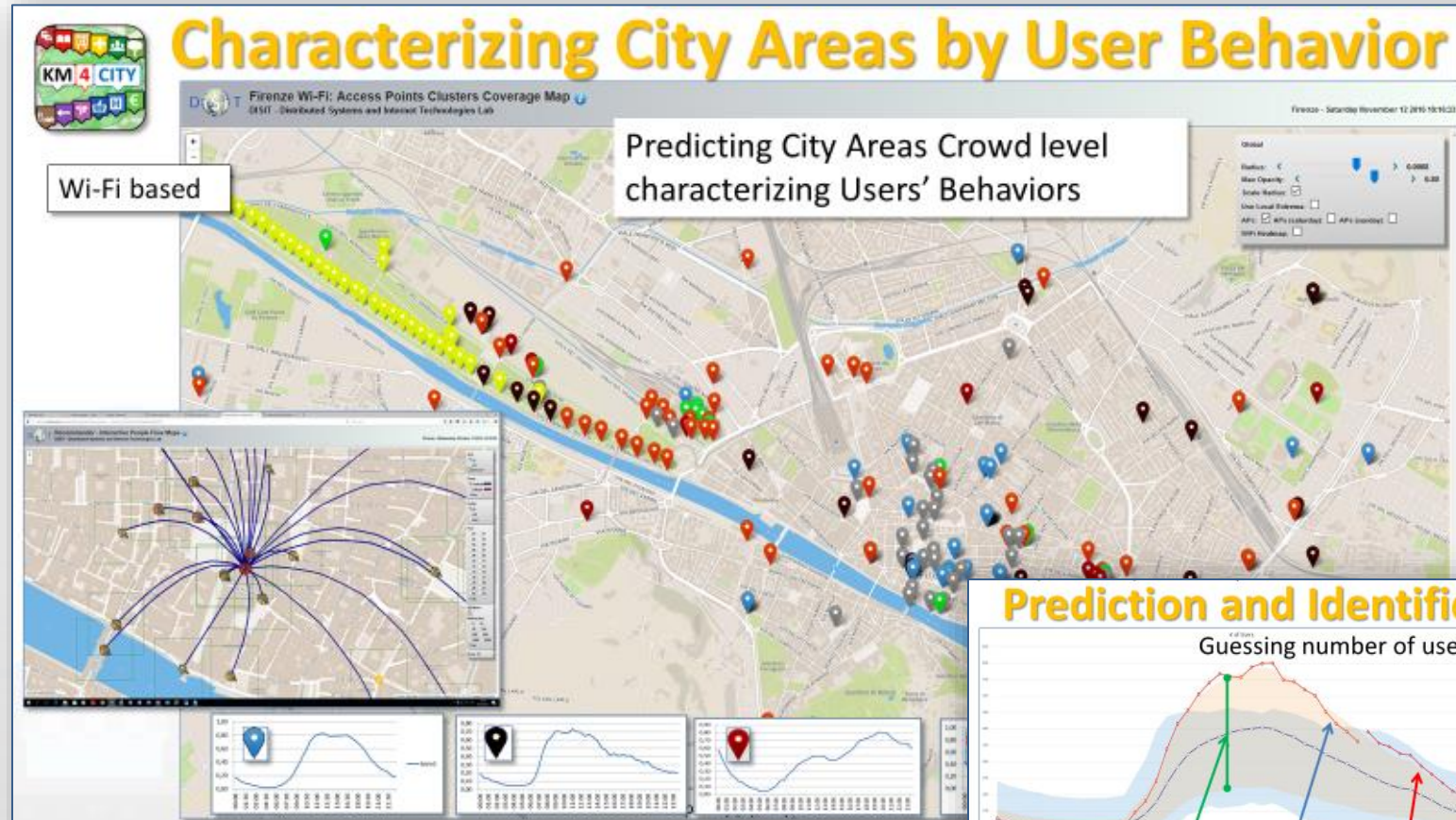
- Tuscany in a Snap (all stores)
- Tuscany where what... km4city (all stores)

## Numbers: 1.5 M complex events per day

Snap4City (C), Sept. 2024

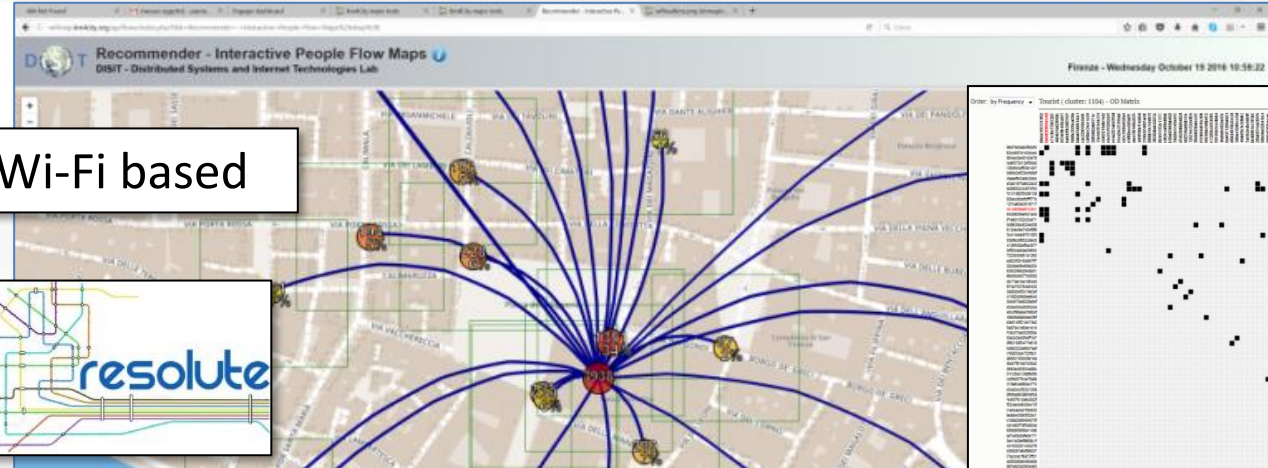
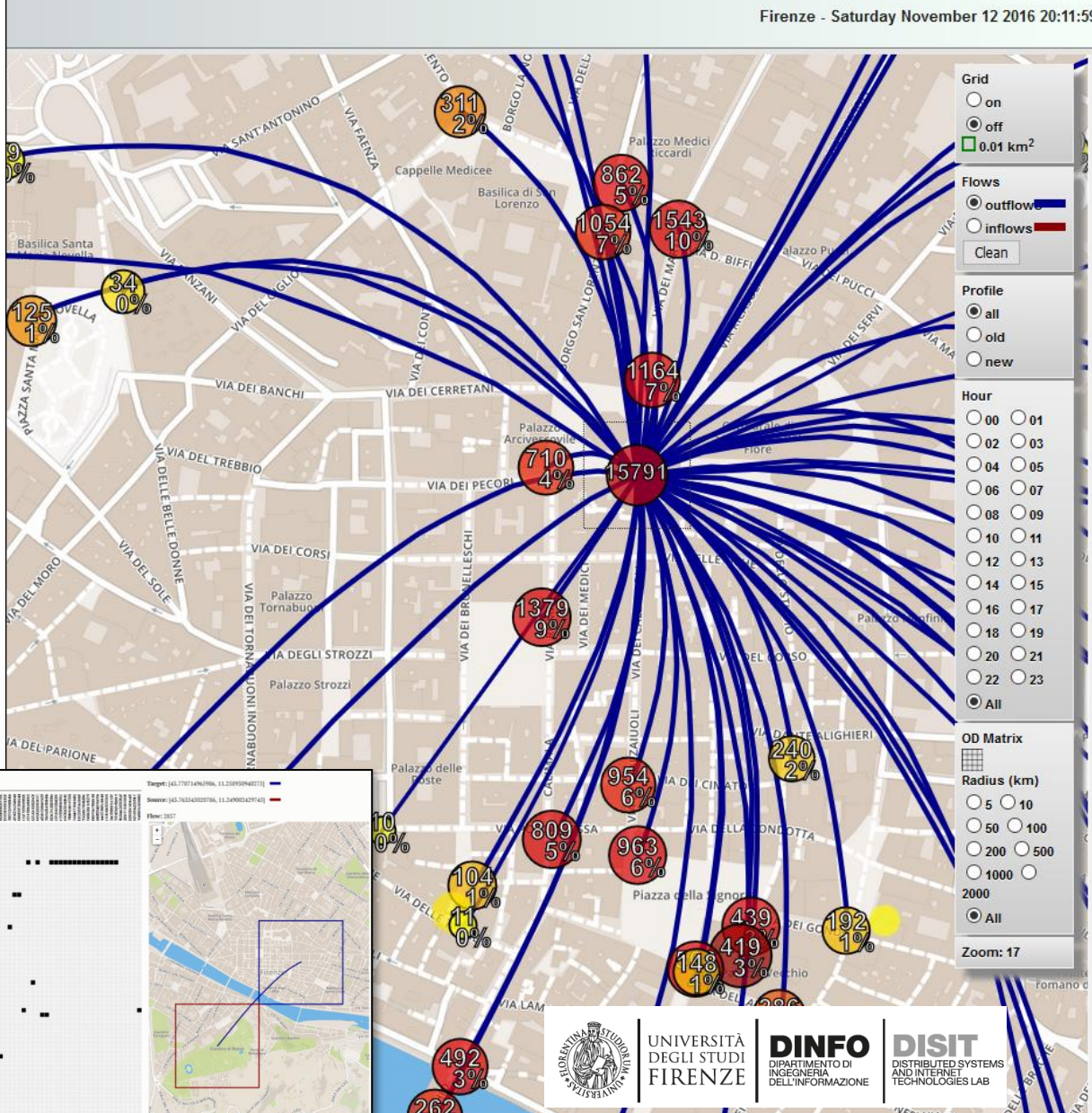
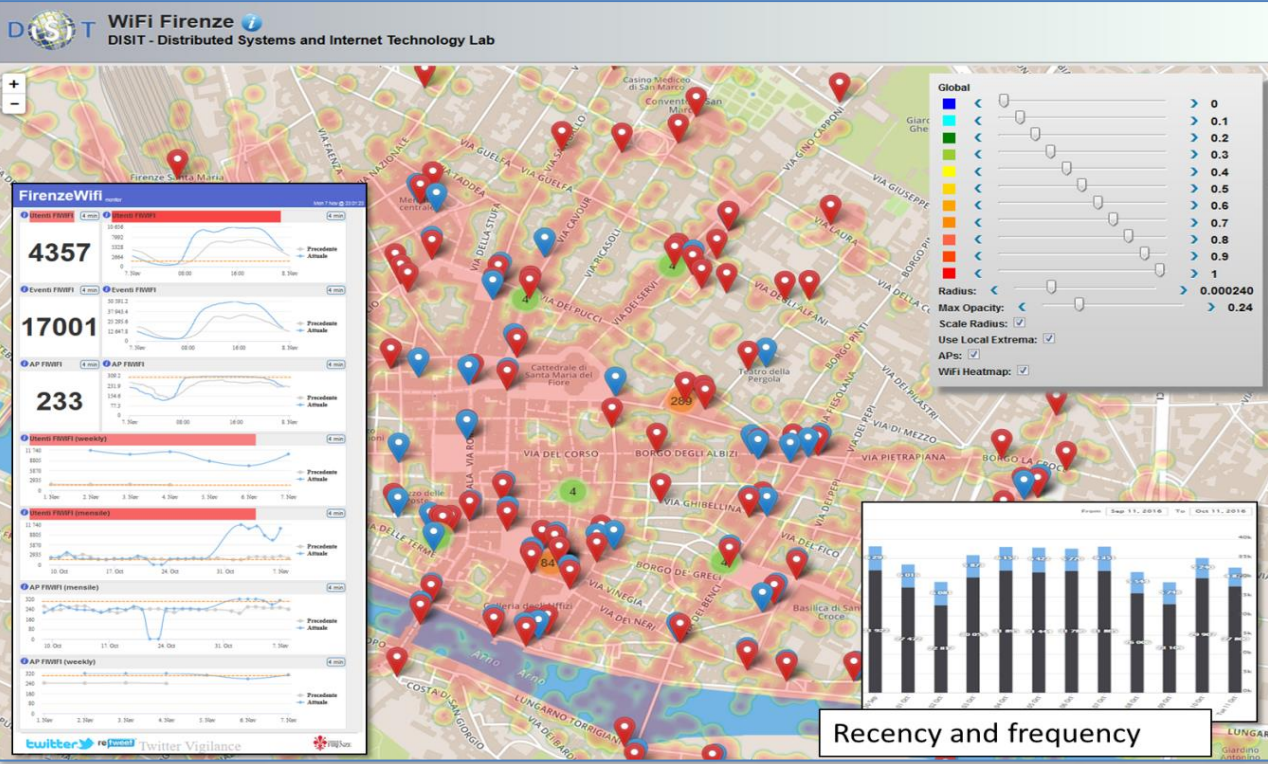


- **Prediction of people flows** on the basis of Wi-Fi data
- **Anomaly detection**
- **Resolute H2020**
- **Classification of city areas**



# Origin Destination Matrix Estimation

Firenze - Saturday November 12 2016 20:11:59

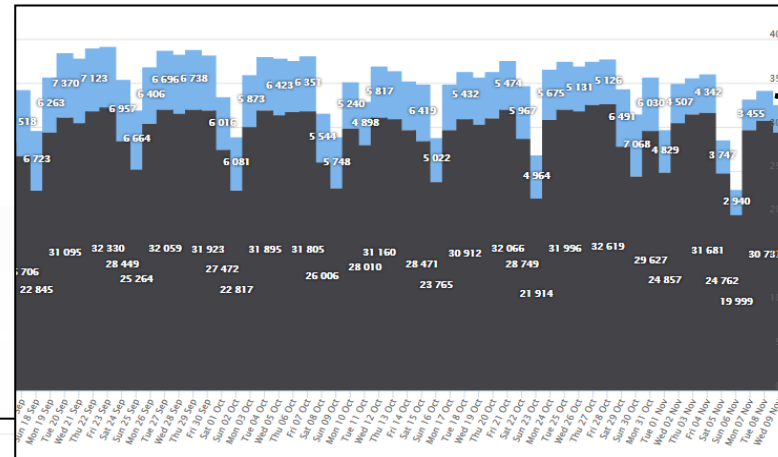
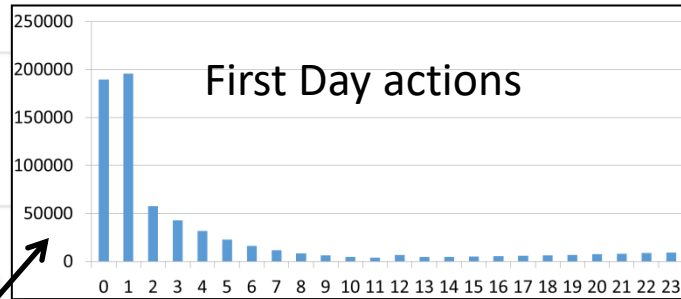
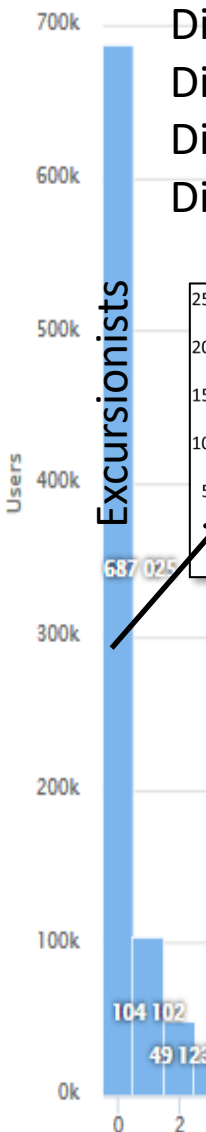




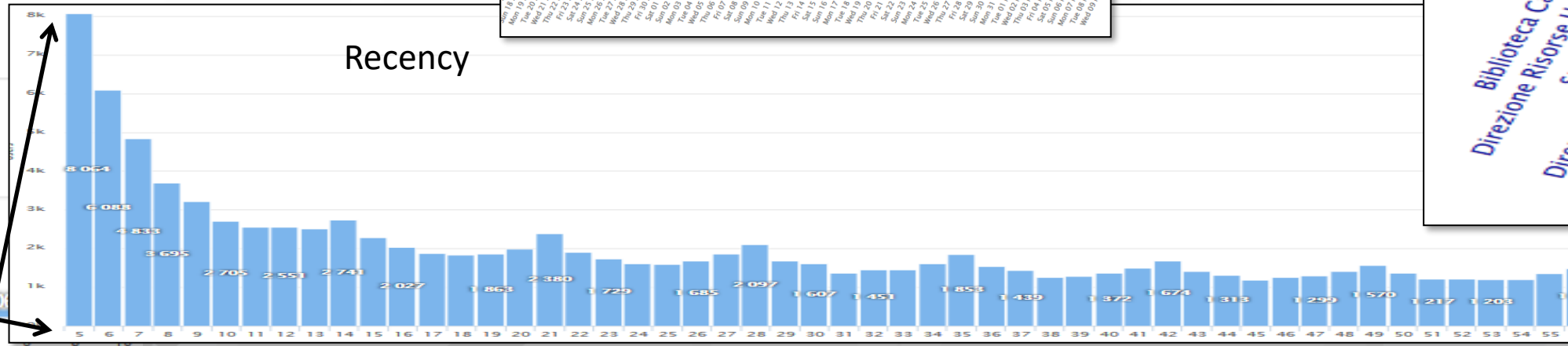
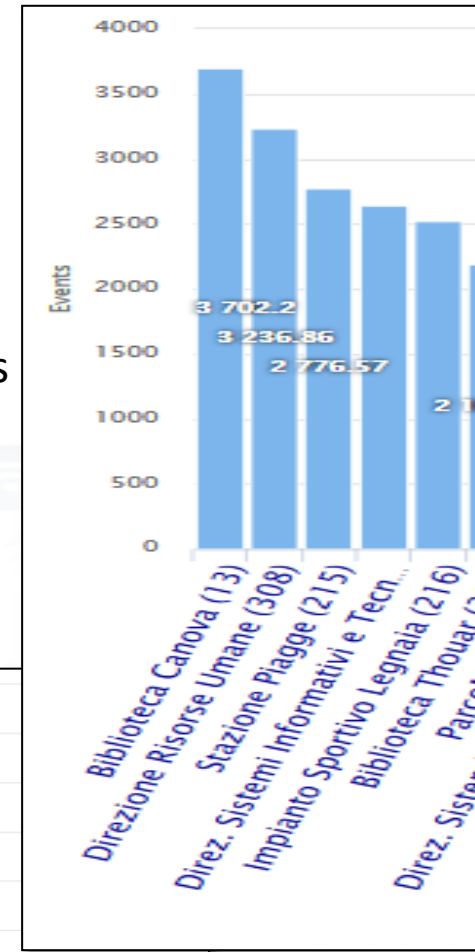
# User Behaviour Analysis

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



# 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

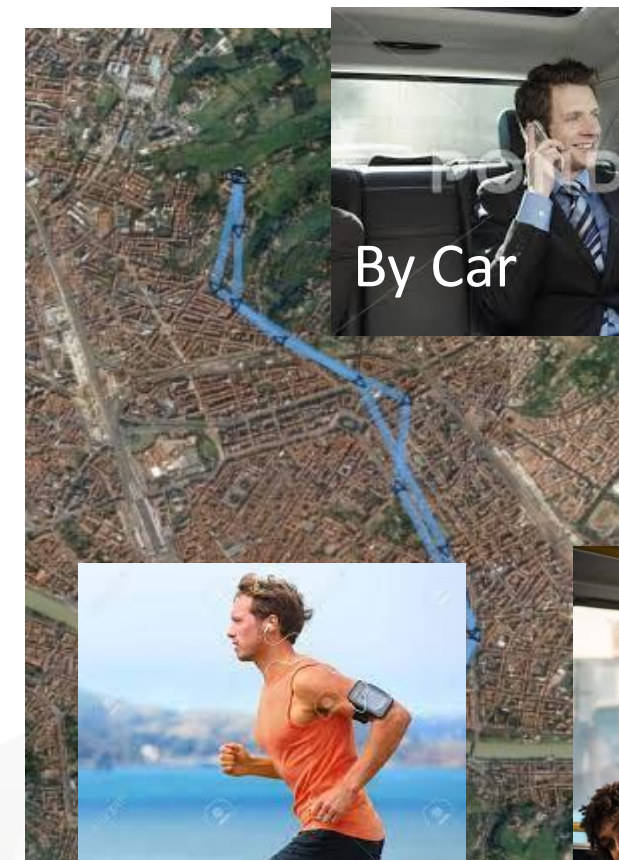
- Trajectories
- Hot Places by click and by move
- Origin destination matrices
- Most interested topics
- Most interested POI
- Delegation and relationships
- Accesses to Dashboards
- **Cumulated Scores from Actions**
- Requested information
- Routing performed
- .....

## Produced information

- Suggestions
- Engagements
- Notifications
- ...

System

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



By Car



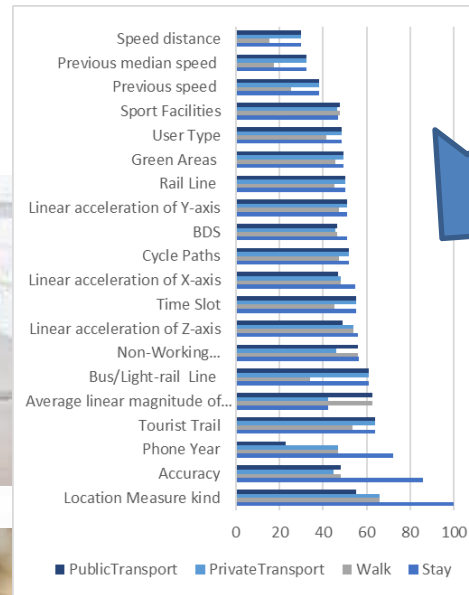
Walk



By BUS

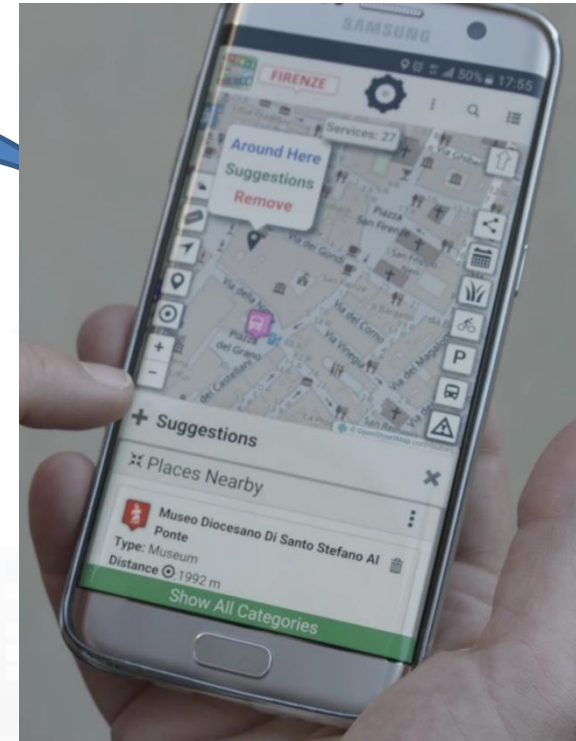


Run

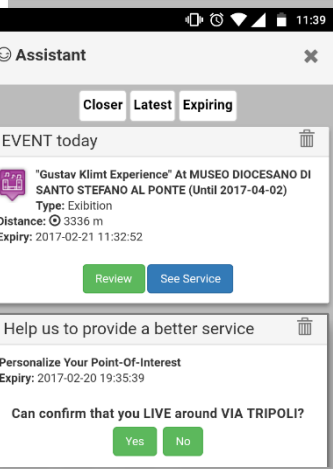
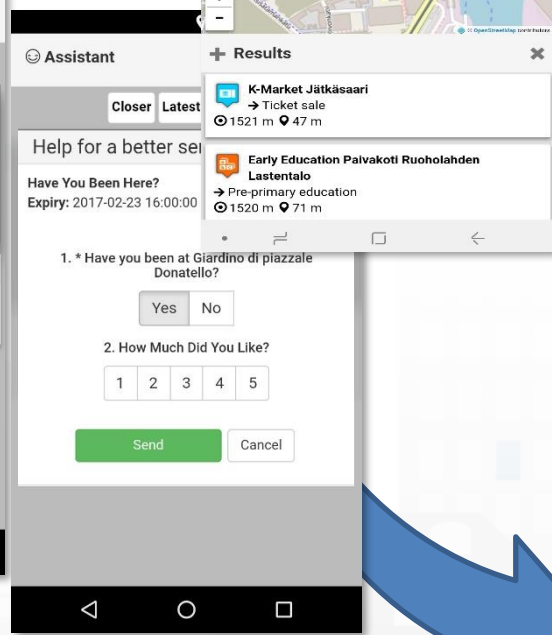
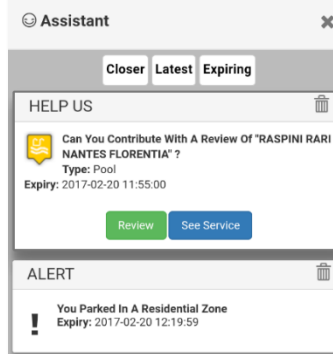
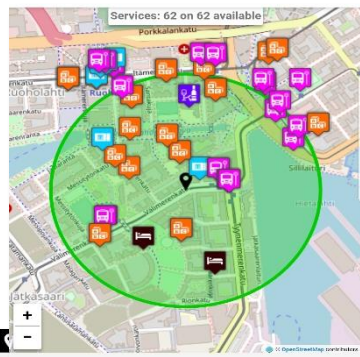
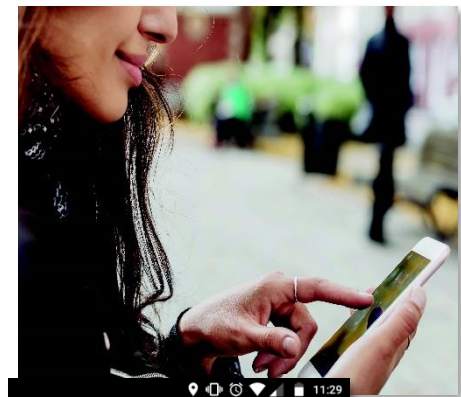


Artificial Intelligence  
Classification

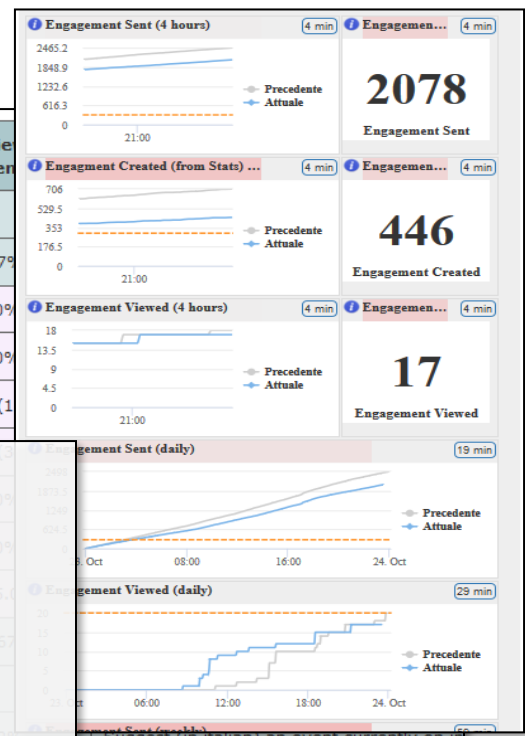
Suggestions



# 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.

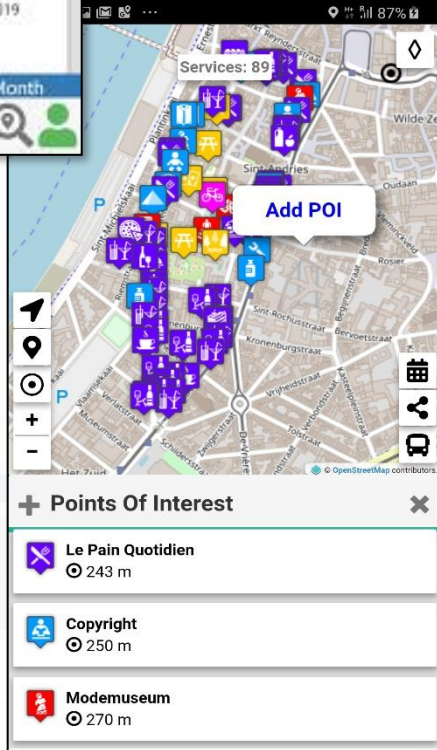
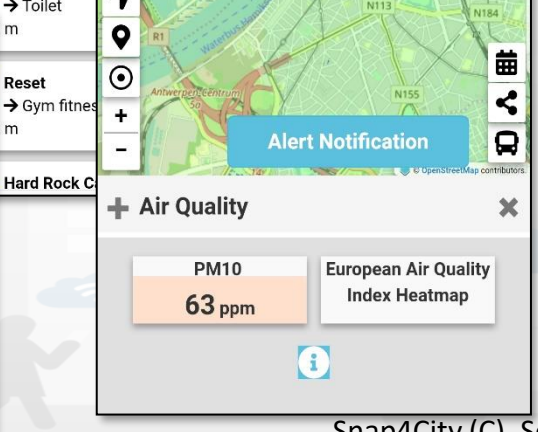
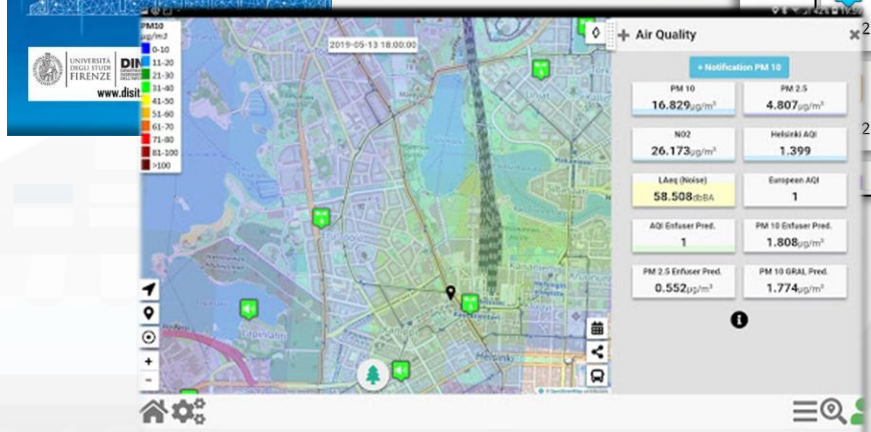
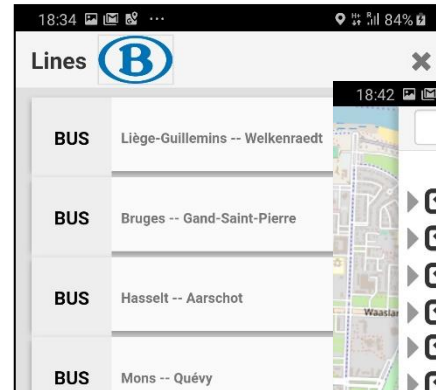
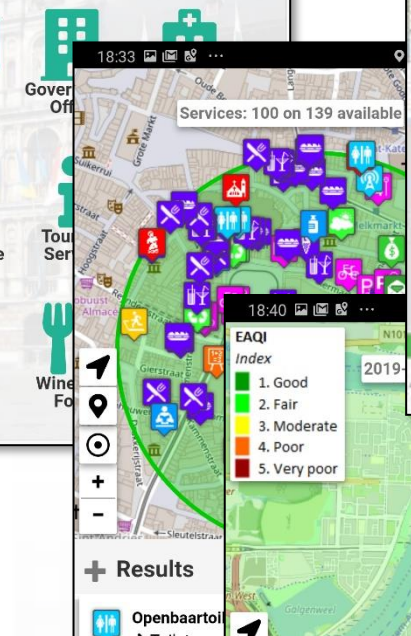
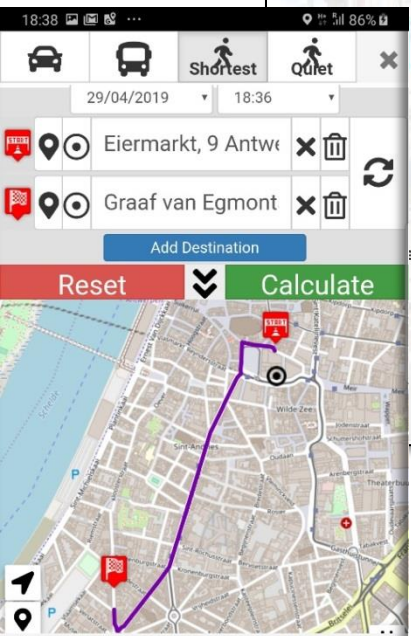
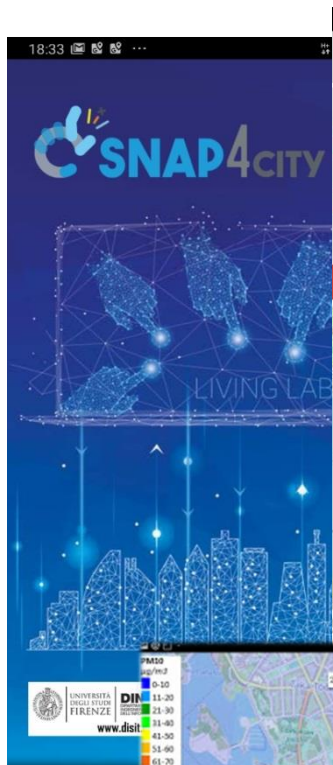
**Stimulate / recommend**  
Events in the city, services you may be interested, etc..

**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

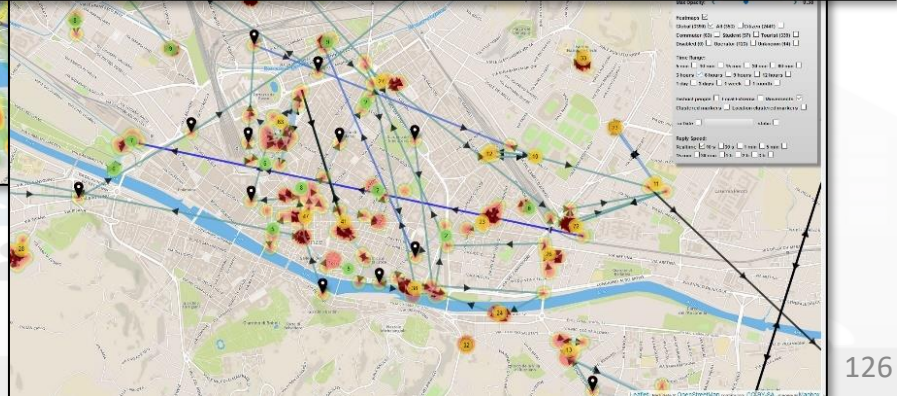
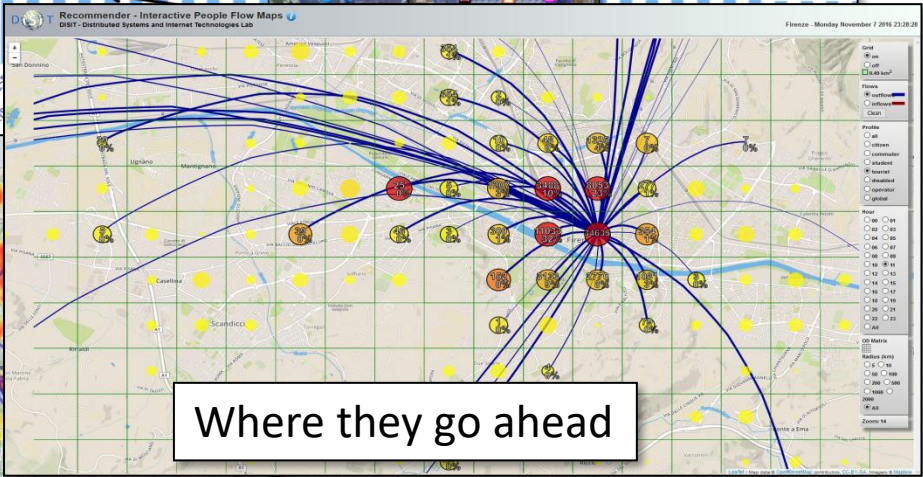
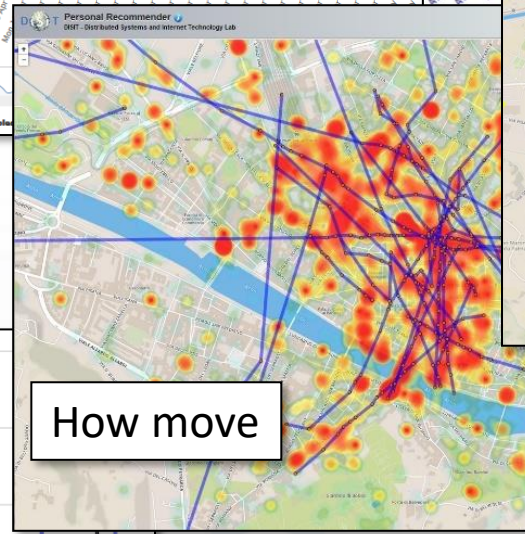
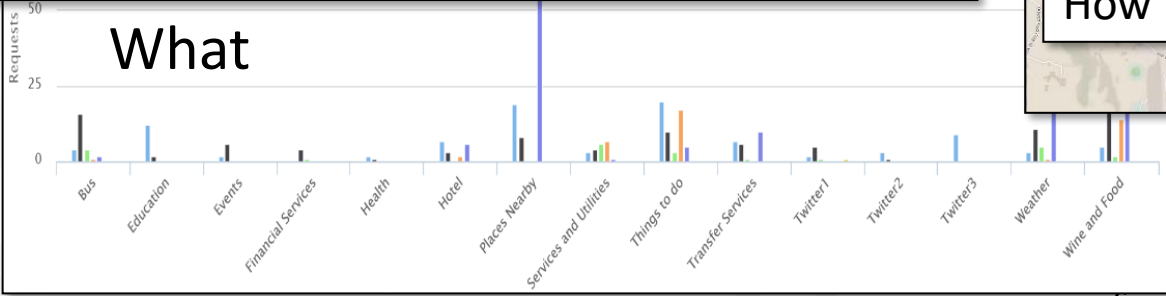
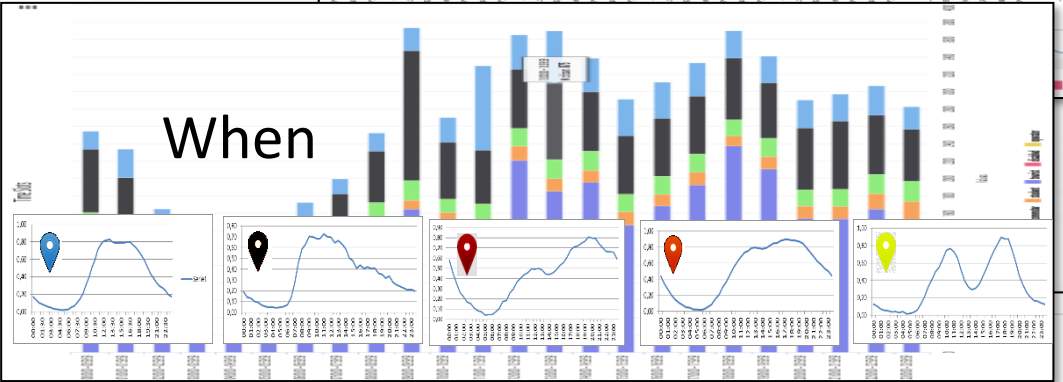
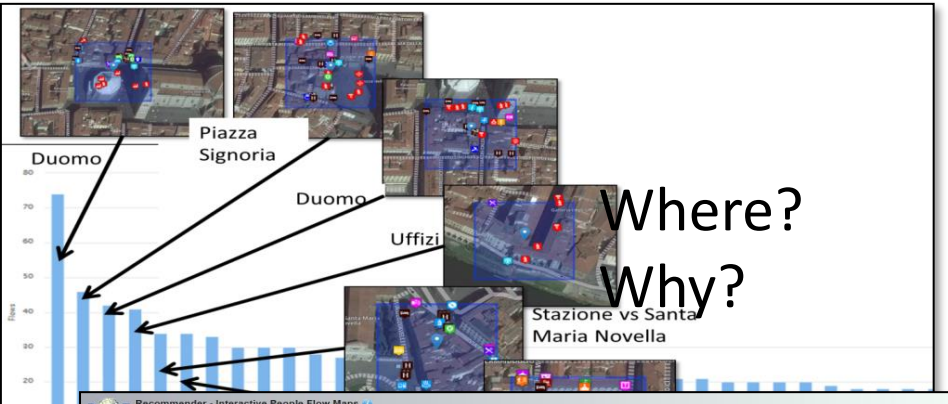
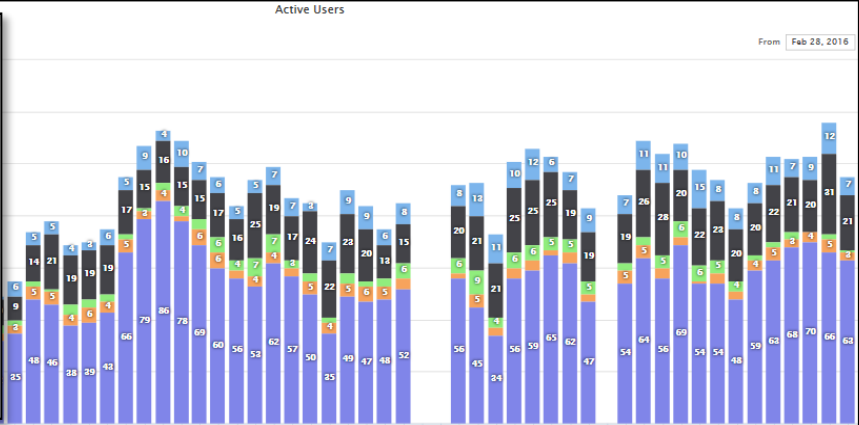
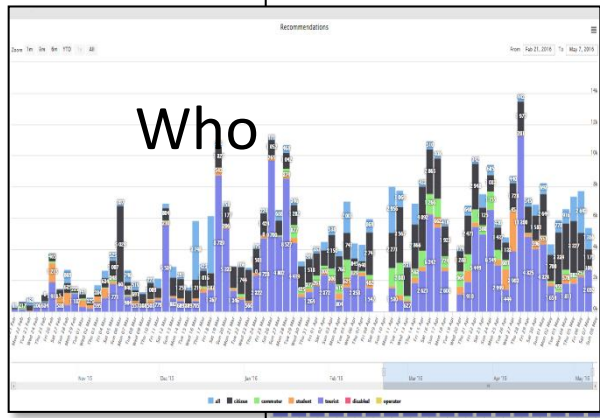
User context

City context

Rules



# User Behavior Analyser for Collective Profiling



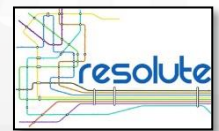
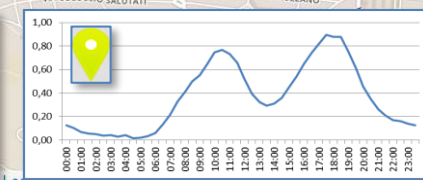
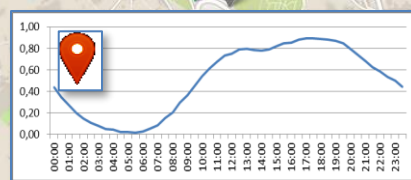
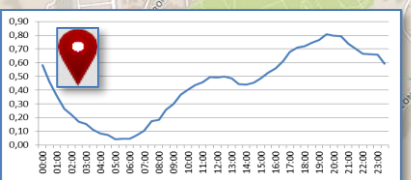
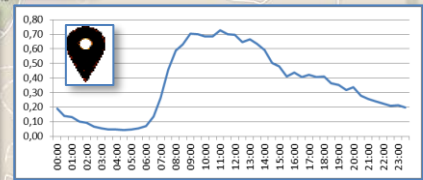
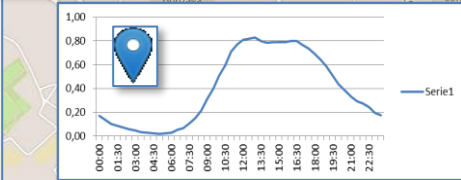
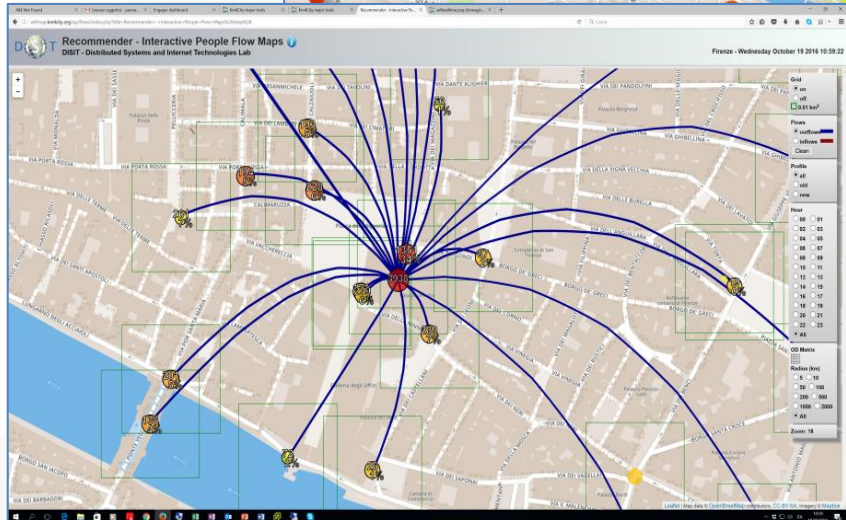
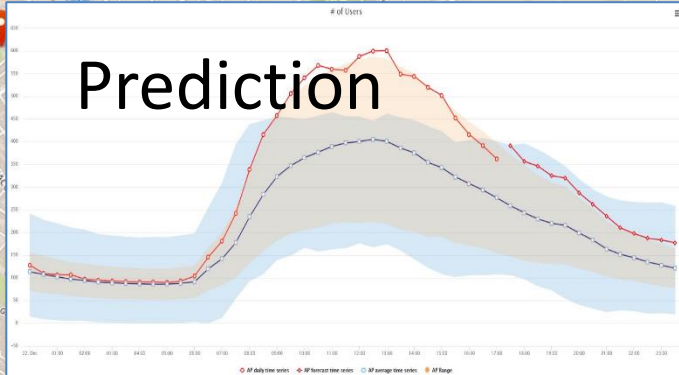
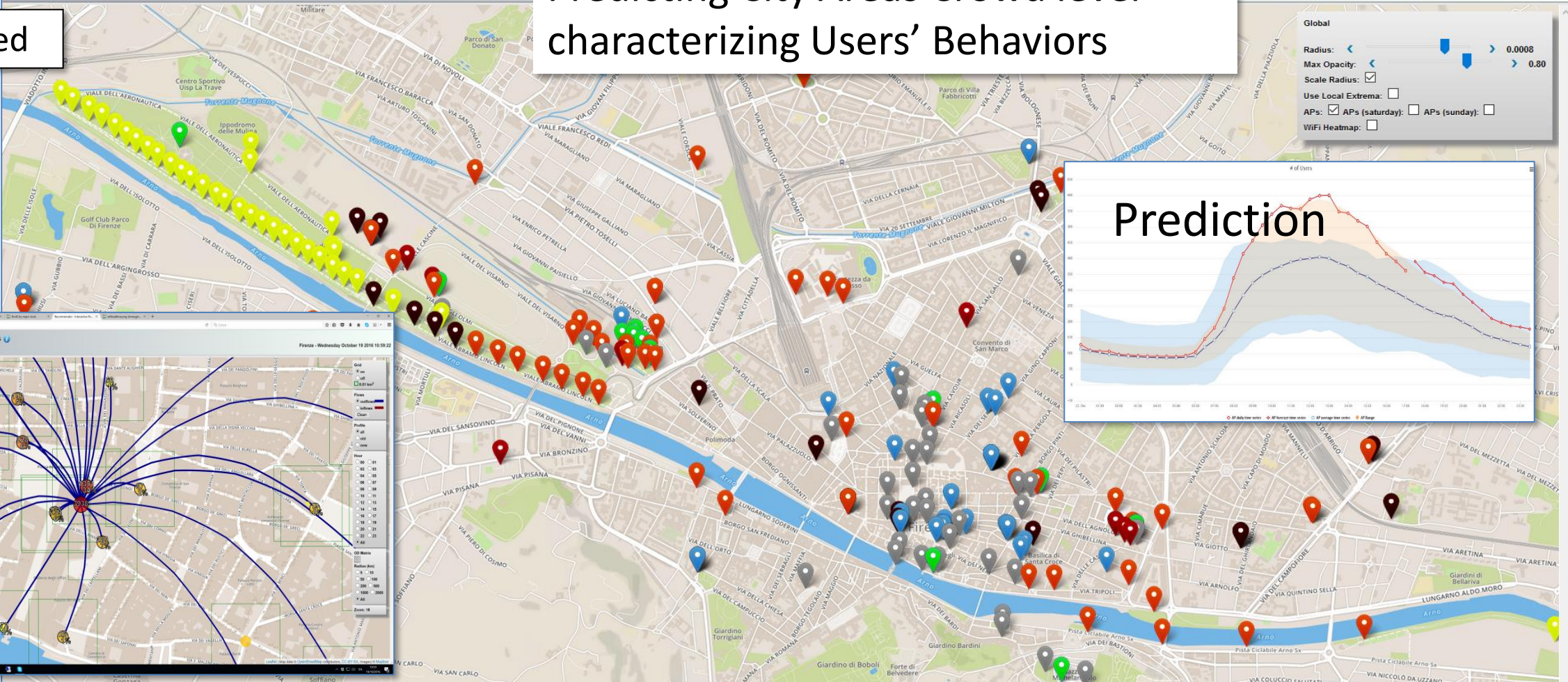
# Characterizing City Areas

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

Wi-Fi based

## Predicting City Areas Crowd level characterizing Users' Behaviors

Firenze - Saturday November 12 2016 19:16:33



# A view and data from the Thermal Camera



## Detection BOX Snap4Thermal PV Firenze Tue 15 Mar 13:30:41

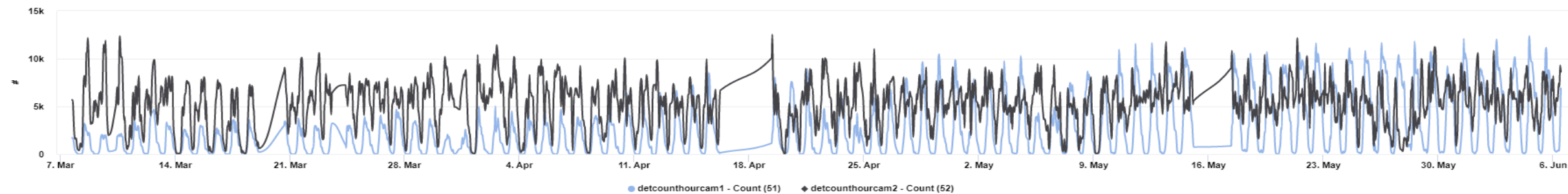




<https://www.snap4city.org/dashboardSmartCity/view/Gea.php?iddashboard=MzM3Ng==>

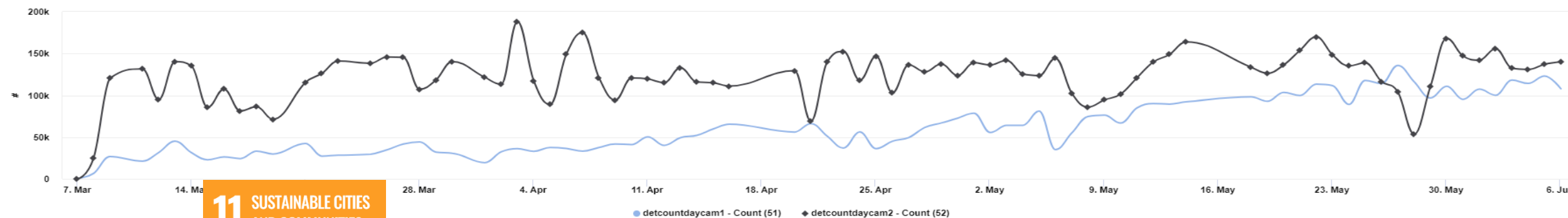
### Time Trend Comparison

4m



### Time Trend Comparison

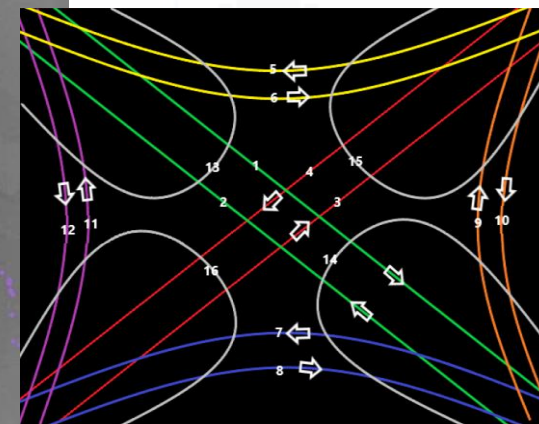
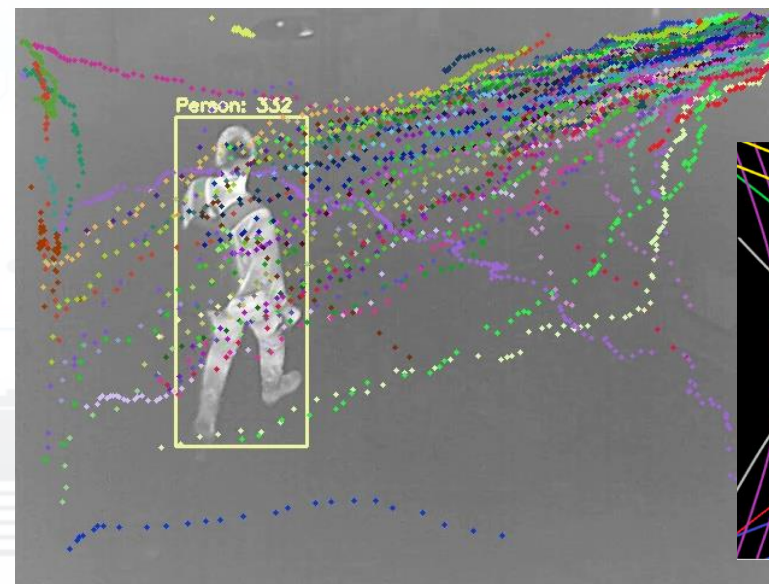
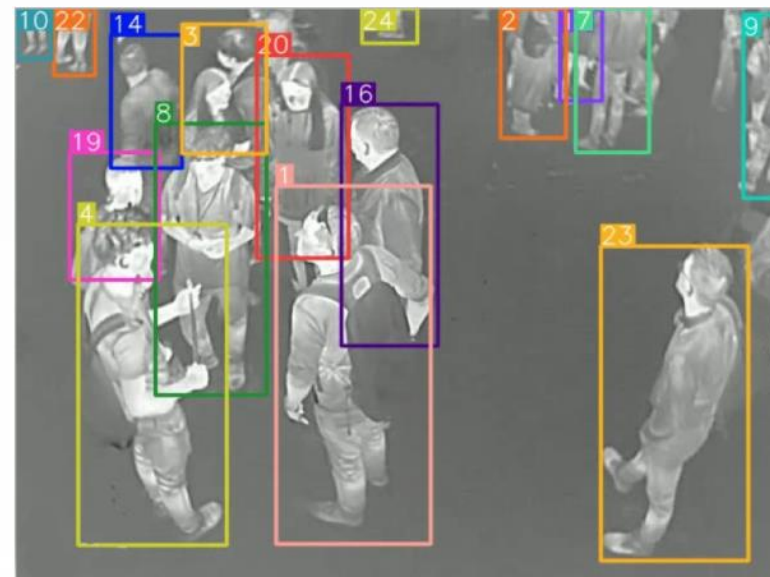
4m



**11** SUSTAINABLE CITIES  
AND COMMUNITIES



# People Counting and Tracking



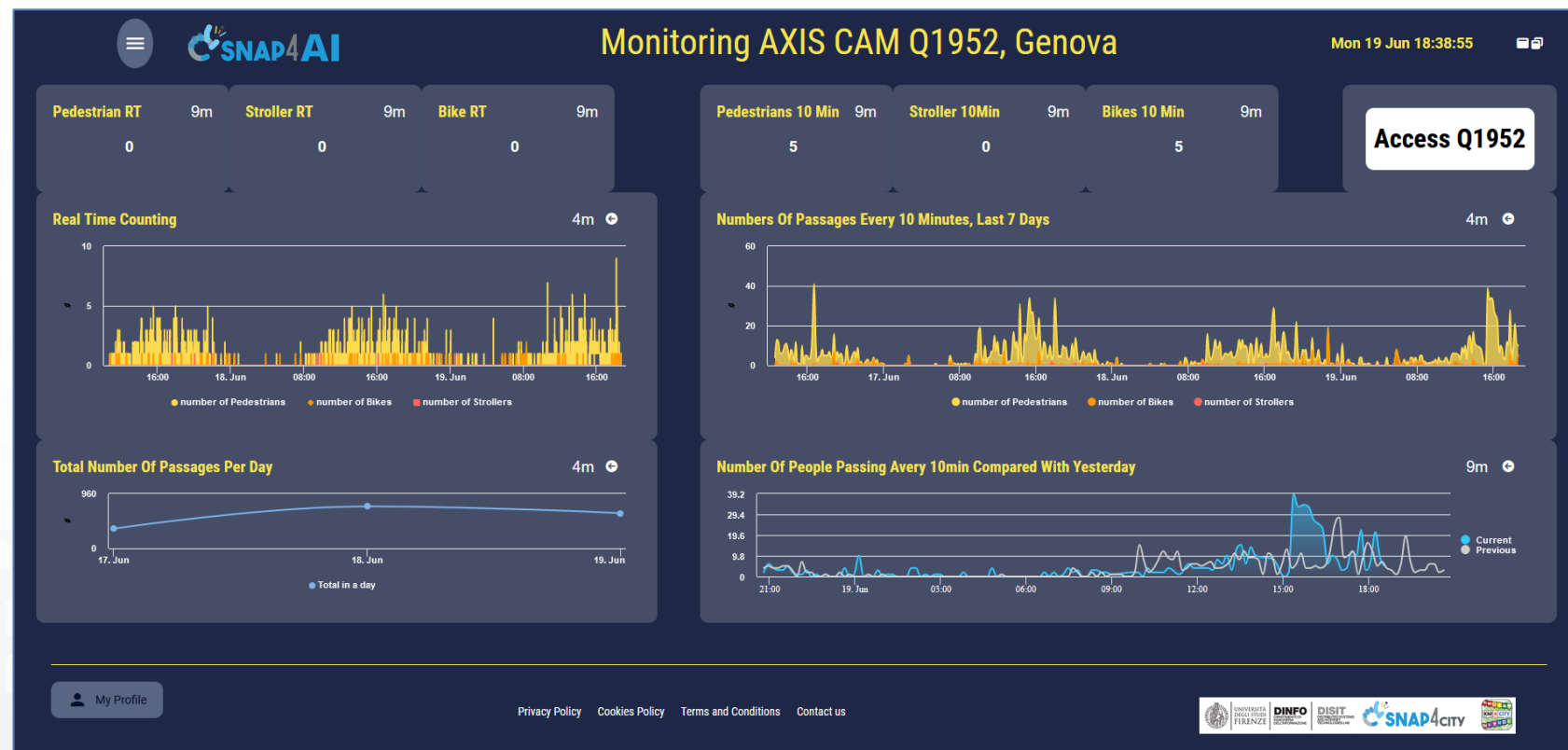
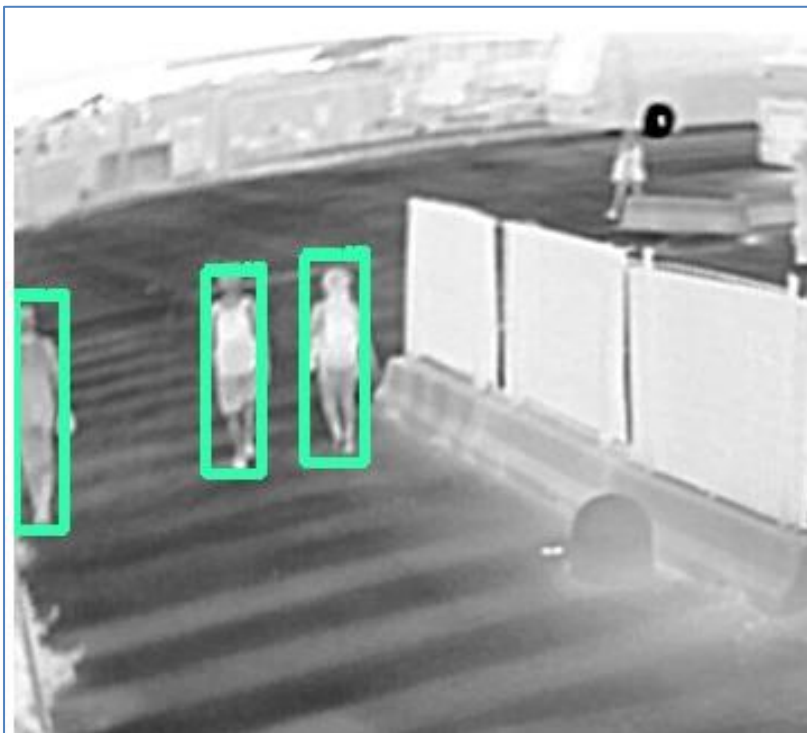
**11** SUSTAINABLE CITIES  
AND COMMUNITIES

**3X**



# Monitoring Passages AXIS Q1952

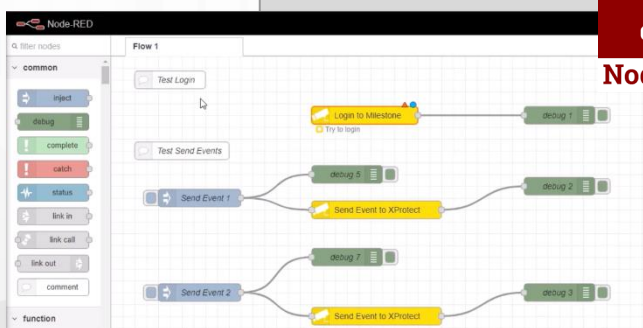
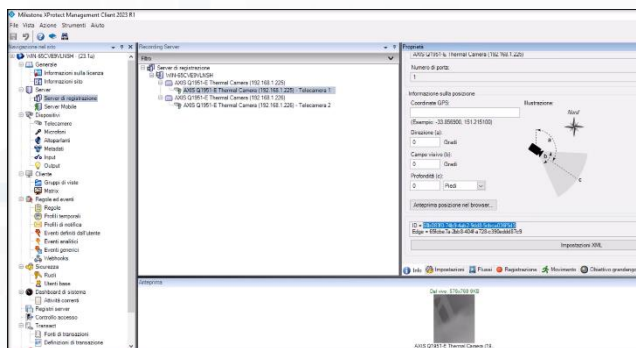
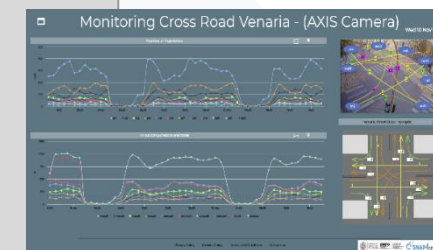
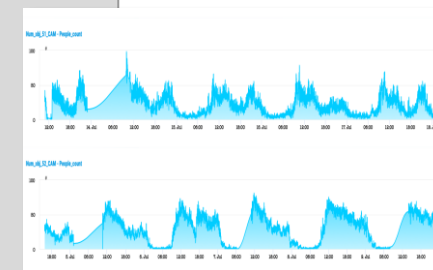
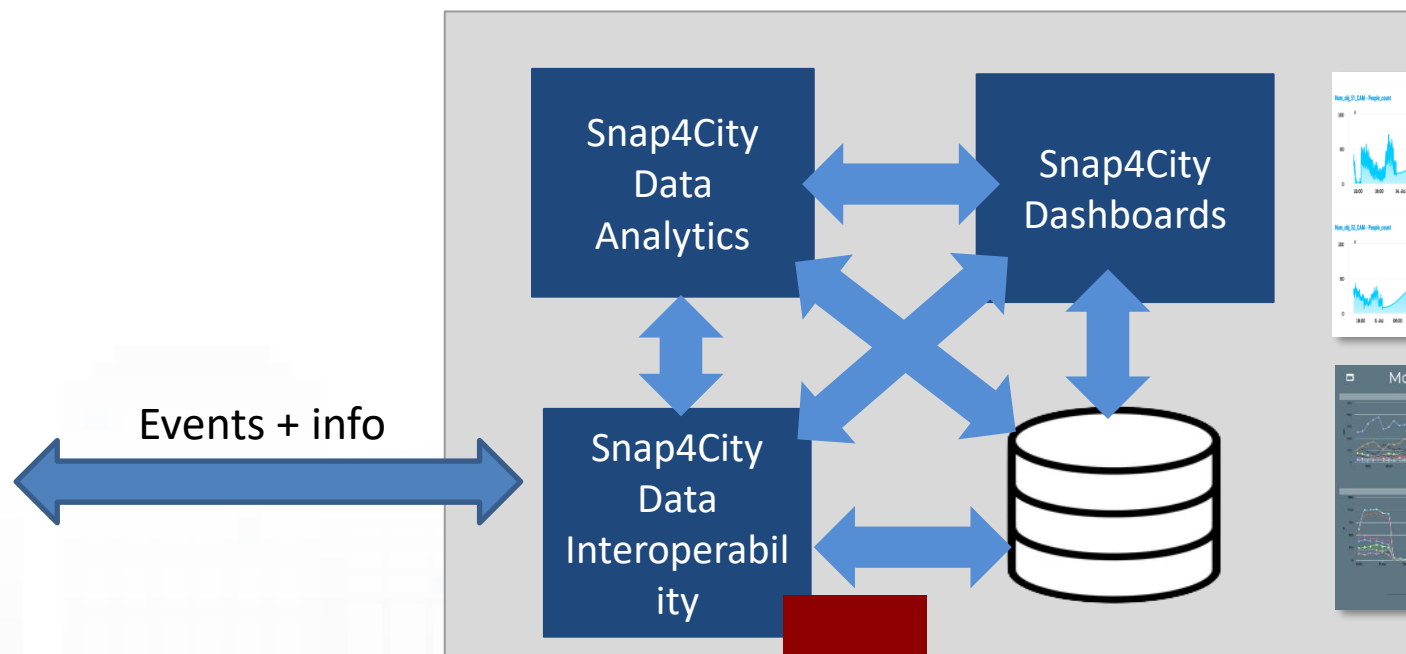
- Genova: Ocean Race, 2023



11 SUSTAINABLE CITIES  
AND COMMUNITIES



# VMS vs Snap4City: sending and getting events, AI solutions



# Event Management

App Maps Google Gmail Snap4City Snap4 Calendar Translate Google Scholar Cita... DISIT DISIT old Facebook DataCenter Trello Km4City major tools Impostazioni YouTube Google Forms News Tutti i preferiti

**Event Registration** Tue 31 Oct 23:14:19

**Severity**

**Status**

[Reset](#) [Reset Map](#) [Filter](#)

---

[Cameras](#) >

[Hospital](#) >

[Traffic Flow](#) >

[Weather](#) >

---

**EventWebCam**

**Insert Alarm Data**

**Name**

**Kind**

**Severity**

**People Involved**

**Impact**

**Description**

Event Description

[Clear](#) [Register Event](#) [Refresh](#)

**Creating Event**

**Show**  **Search:**

First << Prev 1 2 3 ... Next >> Last

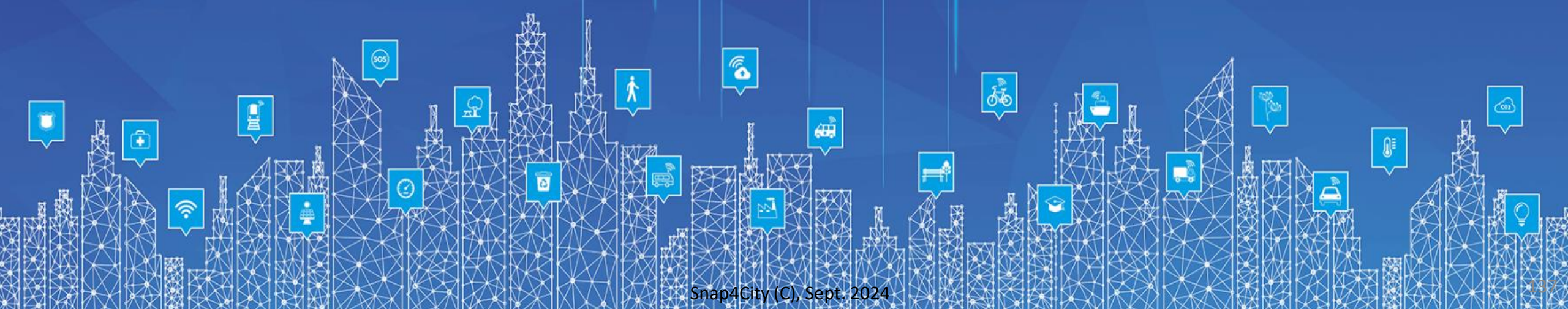
device	Severity	dateObserved	status	Actions
fireonplazgardon20231031T221304273Z	Yellow	2023-10-31T22:13:04.273Z	init	
Telecamera4_22320231031T14213584Z	Yellow	2023-10-31T14:21:35.84Z	init	
CarCrash20231031T134436250Z	Orange	2023-10-31T13:44:36.250Z	init	
CriticalTrafficJam20231031T132718888Z	Red	2023-10-31T13:27:18.888Z	init	
FloodedRoad20231031T132309212Z	White	2023-10-31T13:23:09.212Z	init	

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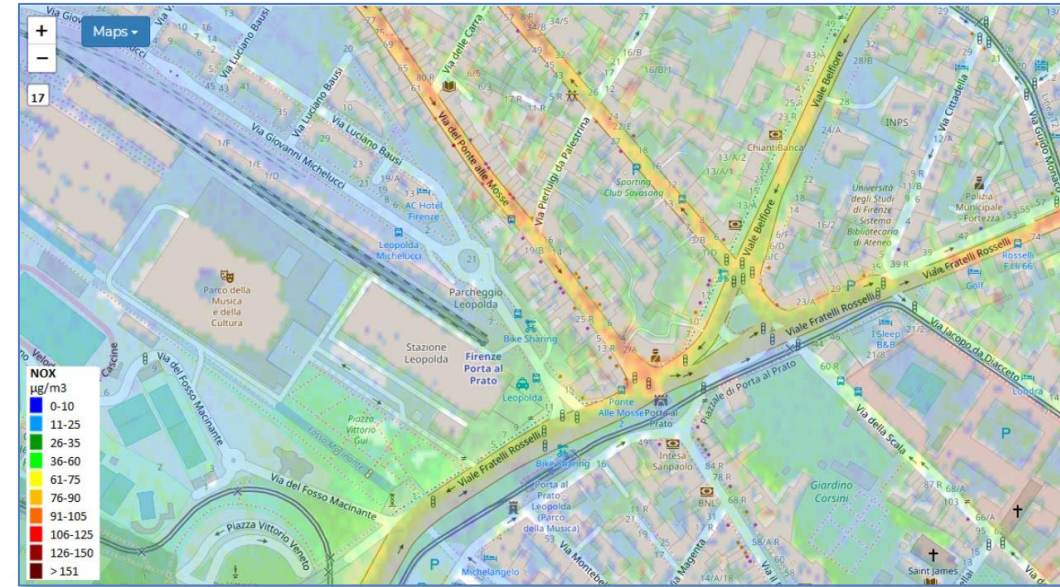
TOP

# Environment Domain



# Environment and Waste

- **Goals:**
  - Reduction of emissions and EC taxations
  - Cost reduction for waste collection,
  - reduction of waste collection impact on mobility
- **Environment Management producing prescriptions:**
  - Monitoring and long and short-term predictions, warning for:
    - GHG, emissions, pollutants, aerosol, chemical plants analysis
    - land slide, coastal erosion (blue economy)
  - Traffic Flow impact emissions, predictions
- **Waste Management and Optimisation:**
  - costs reduction, optimal routing production, pay as you throw,
  - avoiding out of bins, predictions of waste production on bins, alarms
- **KPI:** SDG, 15MinCityIndex, QOS, costs, Km, collecting time, EC KPI, emissions
- **Mobile App:** final users services/informing and operators
  - Info Waste for operators, participation, informing, optimal routing, RAEE Collection, ..
- **Participatory:** problem reporting, ticketing, etc.
- **Integration of any kind: env/weather, mobility, ticketing, presences, POI, ..**



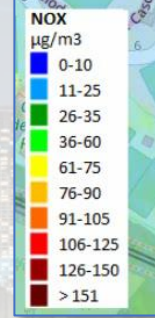
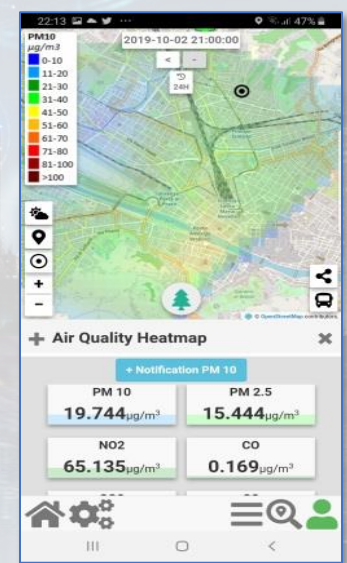
# Environment and Quality of Life

## 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, waste, land, etc., Domain (2024)

- **Goals:**
  - Reduction of pollutant emissions and EC taxations
  - Cost Reduction for waste collection, reduction of waste collection impact on mobility
- **Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)**
  - Monitoring emissions, weather, waste, water, etc.: sensors, traffic, flows, ....
  - Early detection/warning of critical conditions on *emissions, weather, waste, water, fire, animals, ...*
  - Early detection/warning of critical conditions for *landslides, water flooding, beach*
  - Managing Smart Waste: bins/lockers, waste collection daily plan, pay as you throw, PAYT, etc.
  - Short terms prediction of emissions: CO<sub>2</sub>, NO<sub>2</sub>, etc.
  - Production of suggestions, nudging
  - Computing and predicting long terms KPI indicators of the European Commission
- **Solutions for Planning (optimization and what-if analysis)**
  - Identification of main CO<sub>2</sub>/NO<sub>2</sub> emission locations in the city, total production from traffic
  - Reduction of Pollutant Emissions, via optimization: semaphore cycles, viability
- **Algorithms and computational solutions, see next slide**

# Tools: Environment and Weather (2024)

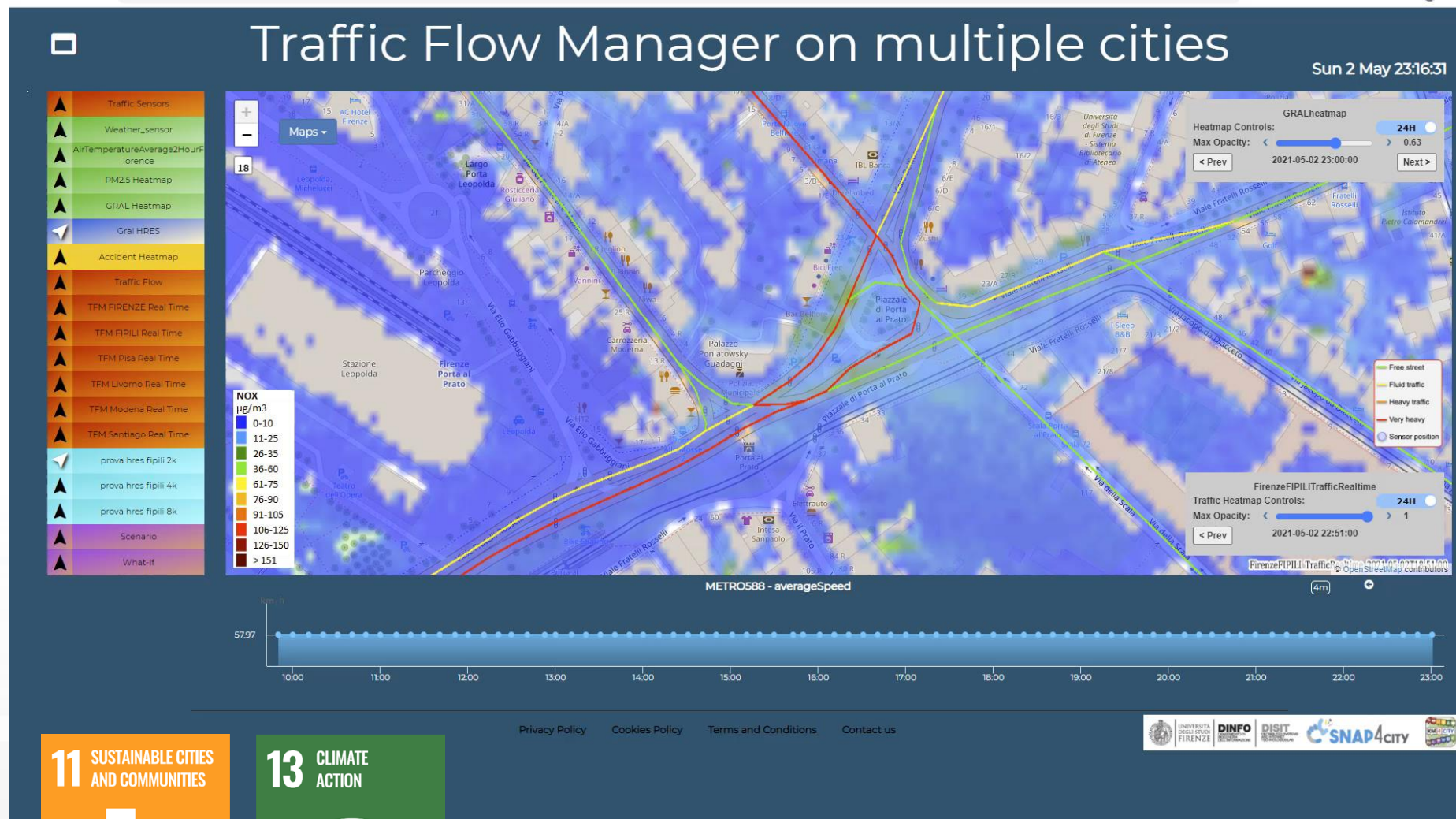
- **Pollutant Predictions: short, long and very long term** European Commission KPIs
  - NOX, PM10 pollution on the basis of traffic flow, 48 hours (ML, AI, DL)
  - Cumulated NO2 average value over the year, ..... (ML, AI, DL)
- **Computation of CO2** on the basis of traffic flows (DP), computing emission 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

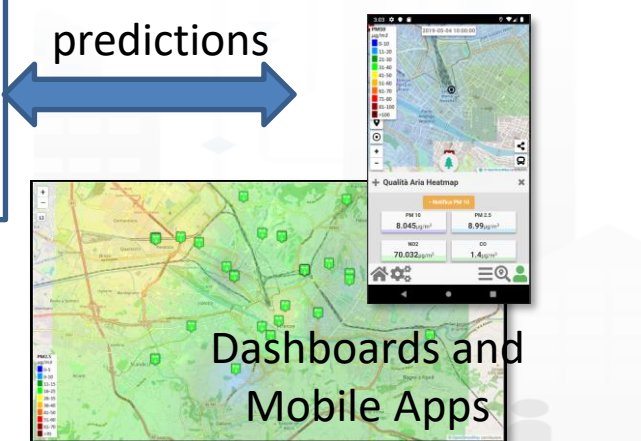
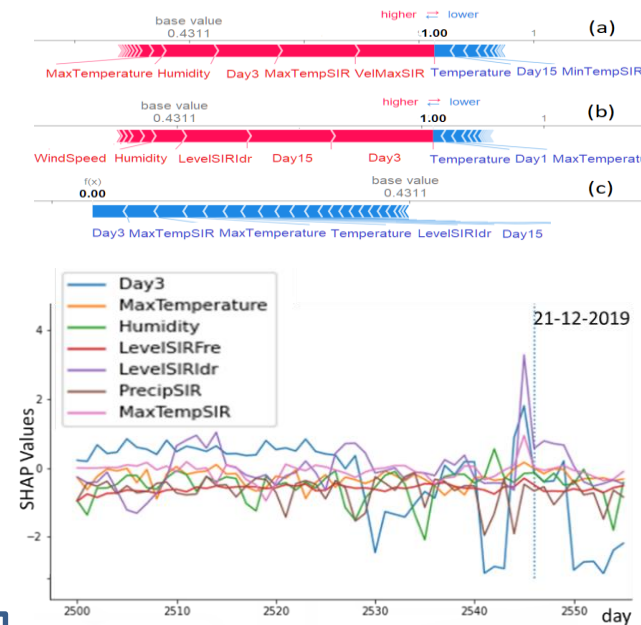
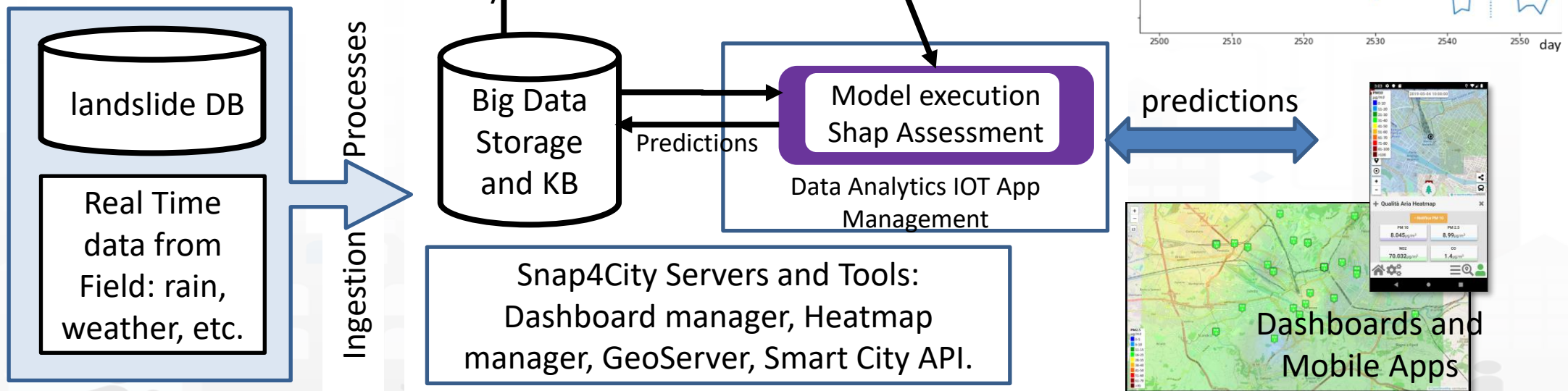
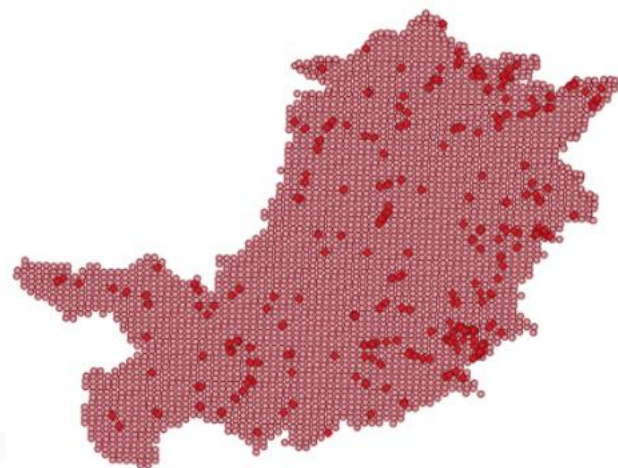
- **NOX Pollutant** diffusion on the basis of Traffic Flow (prediction), weather and 3D structure
- **NO2 progressive average** (Long term)

## • Project:

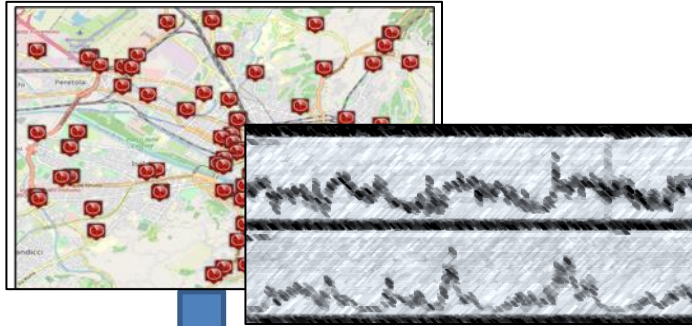
- **Trafair CEF EC**
- Mixed solutions of Fluidinamics modeling and AI



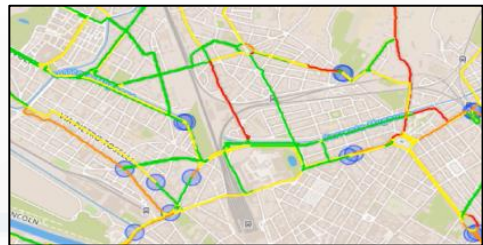
# Predicting Land slides



# 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



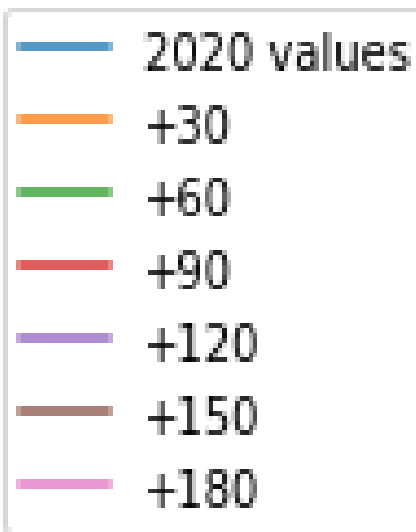
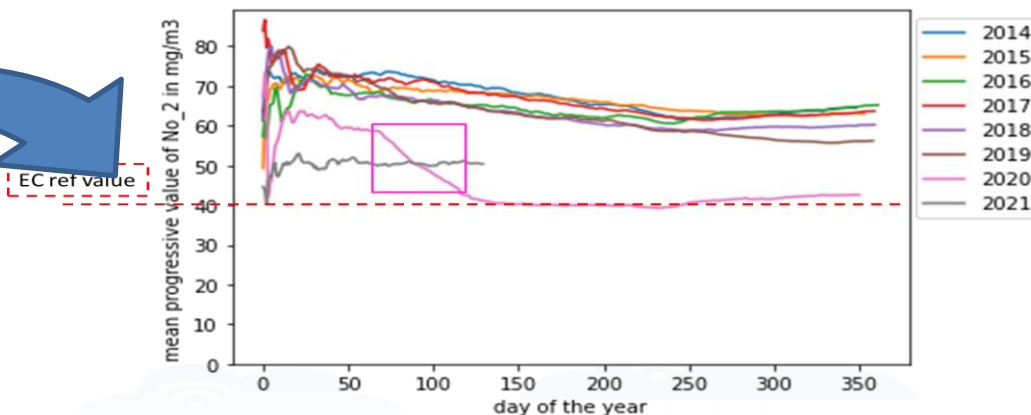
CO2 estimation



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/>

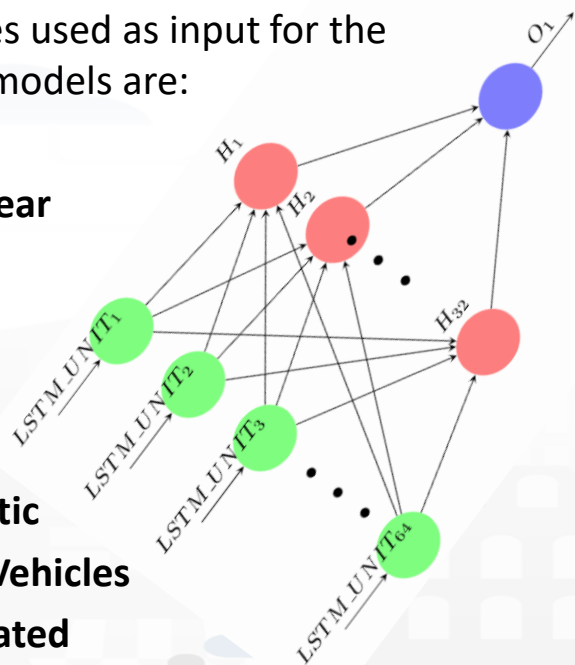
# Predicting EC's KPI on NO2 months in advance

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**
- **NO2progresseveMean**
- **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

## Smart Waste Management

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

Kind:  Status:

Fullness:

Address:

Group ID:

VALUE NAME: F167898

DETAILS DESCRIPTION RT DATA

Last update: 2022-02-28 12:46:12.899Z

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

Smart waste bins status

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

Via\_DeI\_Medici: 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)

- Reduction of costs for waste collection
  - Optimization of waste collection for the next day, forecast
  - Production of rides and paths for the drivers on waste collection
- Operator:
  - 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





**Trajectorywaste2** Fri 17 May 18:34:15

Selector - Map

DISIT:orionUNIFI:113043.960\_485172.926-Rest

Please select a date: 02/09/2020

Please select a ride among: 3

DISIT-OrionUNIFI:114985.283\_488088.814-Rest - Weight 8m

**Trajectorywaste2** Fri 17 May 18:34:37

Selector - Map

DISIT:orionUNIFI:113043.960\_485172.926-Rest

Please select a date: 02/09/2020

Please select a ride among: 3

DISIT-OrionUNIFI:114985.283\_488088.814-Rest - Weight 7m

AMSTERDAM  
DIMPO  
DISIT  
SNAP4CITY

**Trajectorywaste2** Fri 17 May 18:30:58

Selector - Map

DISIT:orionUNIFI:113043.960\_485172.926-Rest

Please select a date: gg/mm/yyyy

Please select a ride among: 3

**116977.080\_488279.962-REST**

VALUE NAME: 116977.080\_488279.962-REST

DETAILS DESCRIPTION RT DATA

Last update: 2021-12-04 10:10:34.000+01:00

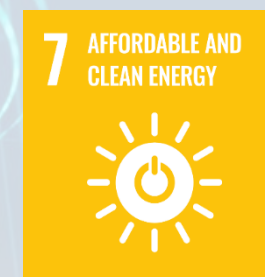
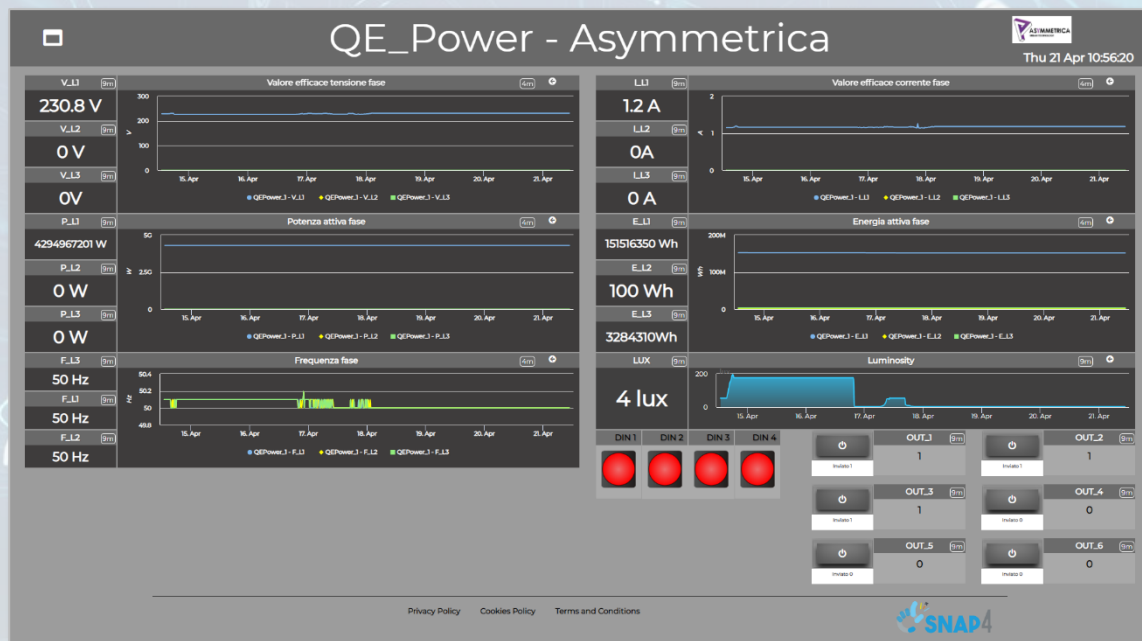
Description	Value	Buttons
dateObserved	2021-12-04T09:10:34.000Z	Last 4h 24h 7d 30d 6m 1y 2y 10y
weight	215	Last 4h 24h 7d 30d 6m 1y 2y 10y

Keep data on target widget(s) after popup close:

Weight - 10 Year 9m







- 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

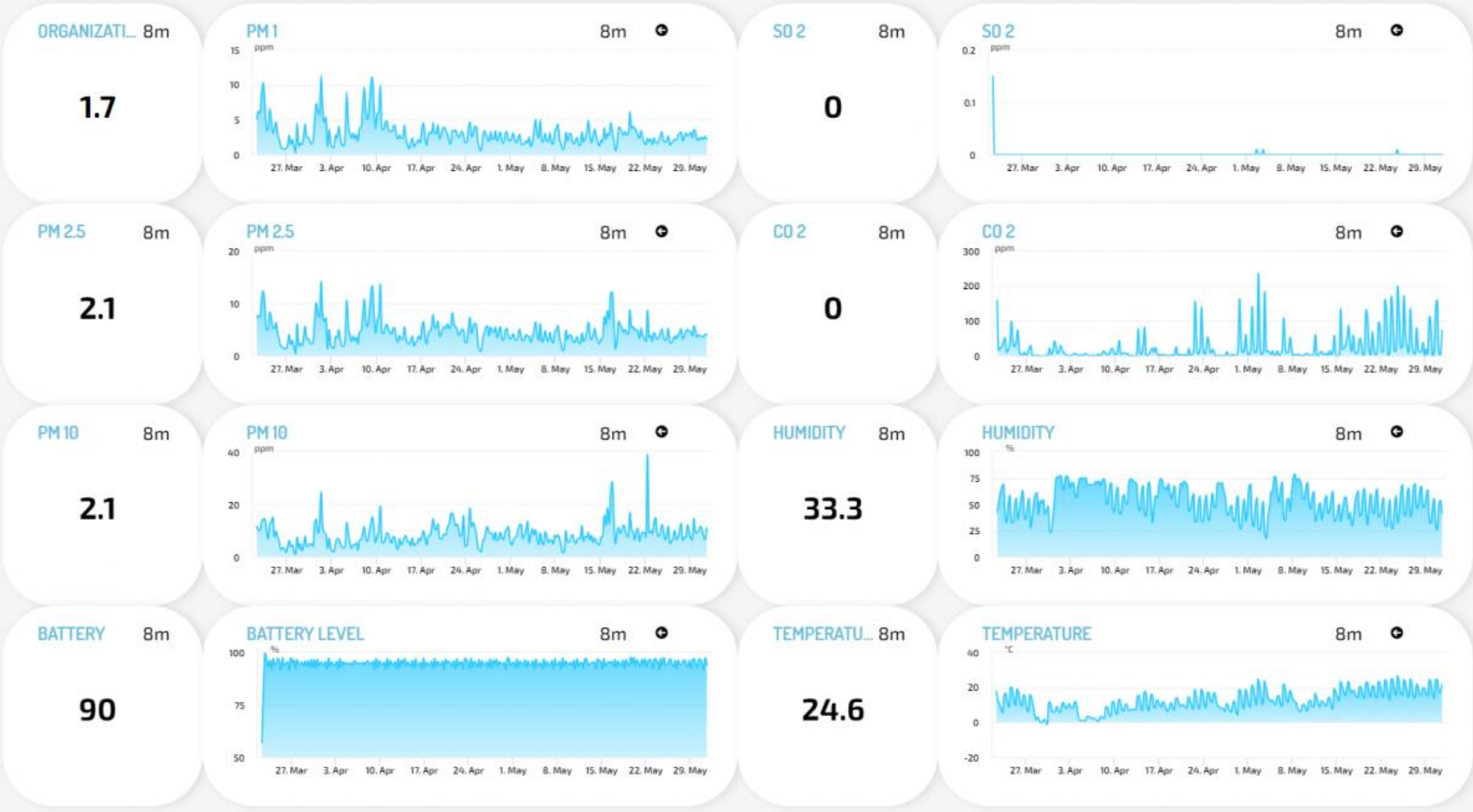
Showing 1 to 20 of 3,392 entries

# TheLab.City LivingLab by ICEBERG, Romania



Ciao  
Wed 31 May 16:11:04

## ICEBERG AIR QUALITY AND PMX



- Airquality
- Urban planning
- Parking
- Waste
- Etc.

<https://thelab.city/>

# Smart Energy

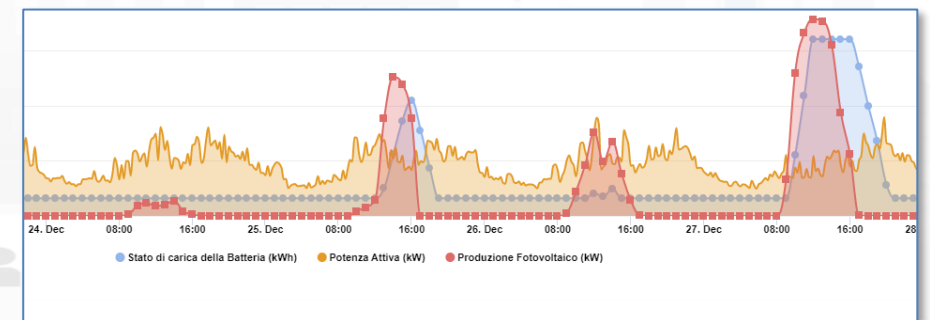
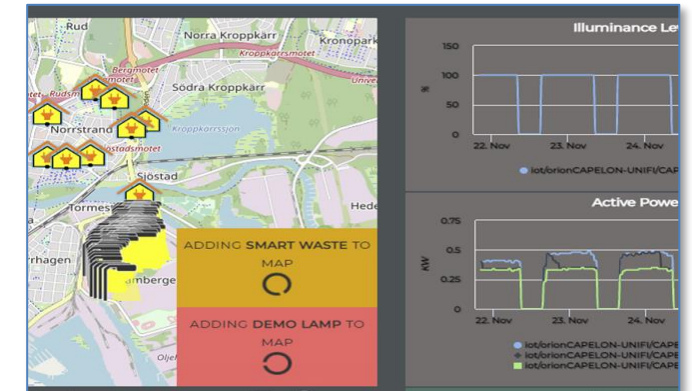
FROM CITY DASHBOARD TO APPLICATIONS

DATA AND KNOWLEDGE



# City Energy and Buildings

- **Goals:**
  - Energy consumption reduction, increment of efficiency,
  - Areas and building sustainability
  - Improve accessibility to services, security and safety
- **Energy Monitoring:** Building, floors, rooms, recharging poles, cabinets, Community of Energy, Data centers, Energy for Hot / cold, air condition, energy vs temperature and usage, etc.
- **Energy Management:** Predictions, early warning, identification of critical conditions
- **Smart Light Management:** LED/mixt, cabinets, lights vs traffic, lights vs security, energy saving, .luminaries profiling, group management.
- **Smart Building Management:** consumption, number of people, etc.
  - Communities of Energy, Photovoltaic plants, sustainability
- **KPI: Energy consumption, efficiency, pros/cons**
  - Light profiling and adaptation
  - Autoclave industrial plants simulation, Photovoltaic plant simulation
  - consumption / usage, energy vs temperature
- **Mobile App:** monitoring, info-recharge, eSharing, booking, ..
- **Participatory:** problem reporting, ticketing, etc.
- **Integration of any kind**



# Energy Domain (2024/8)

- **Goals:**
  - Energy consumption reduction, increment of efficiency, sustainability
  - accessibility to services
- **Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)**
  - Monitoring energy consumption (heating, cooling, prod.,...), conditions, charging stations, etc.
  - **Managing Smart Light** for city: dimmering, programming, traffic control, controllers, legacy, etc.
  - Early detection/warning, alarm, of critical conditions
  - Managing smart services: cabinets, lockers, etc.
  - Production of suggestions, nudging
  - Global and local 3D/2D representations of area and buildings
  - Managing Communities of Energy, certification via Blockchain
  - Computing predictions of any kind
- **Solutions for Planning (optimization and what-if analysis)**
  - Reduction of energy costs, via optimization
  - Identification of roofs with better orientation
  - Optimization of battery storage size for PV plants
  - Community of Energy planning and viability
- **Algorithms and computational solutions, see next slide**

# Tools: Energy Domain (2024/8)

- Monitoring Energy Consumption in single building, area and per zone
- Smart Light management, unicast and multi cast management, smart light controlled by traffic flow data
- Monitoring Energy provisioning on recharging station
- Matching Energy consumption with respect to the actual usage
- Computing Roof orientation for Photovoltaic installations
- Optimisation of Photovoltaic installations to identify the best parameters of size and storage
- Collecting and managing Communities of Energy
- Computing KPI
- Etc.



reference

# Smart Light Control of **CAPÉLON**

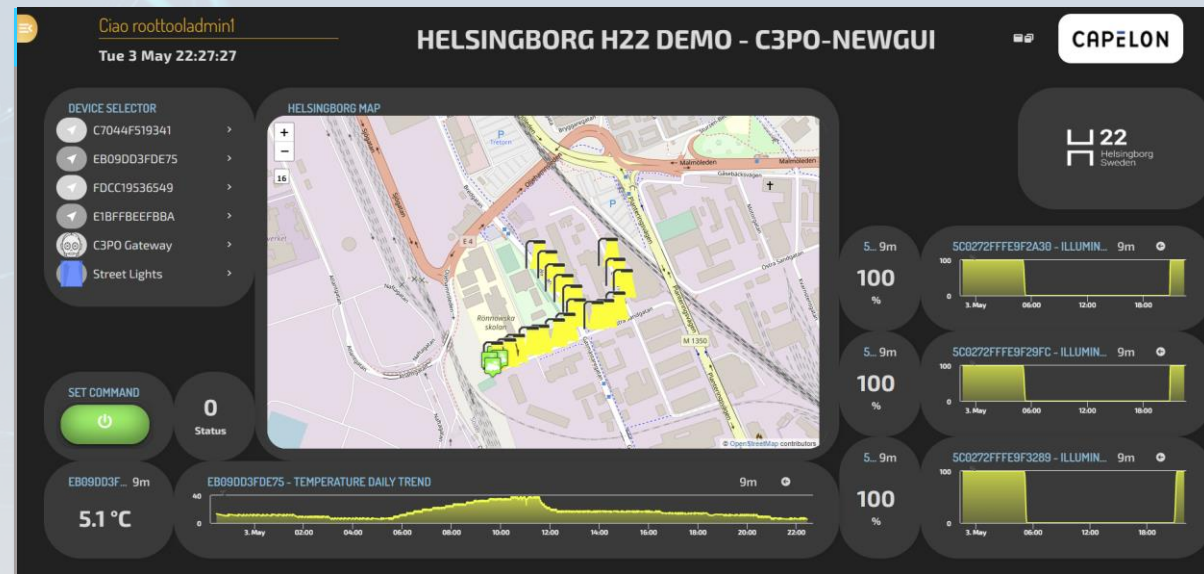
## • Energy Domain

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



## • Dashboards

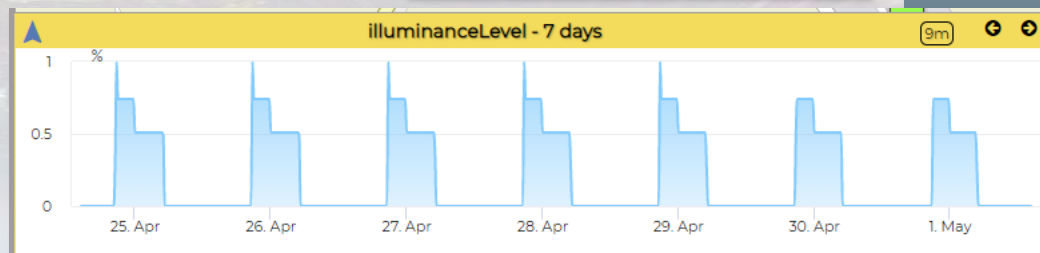
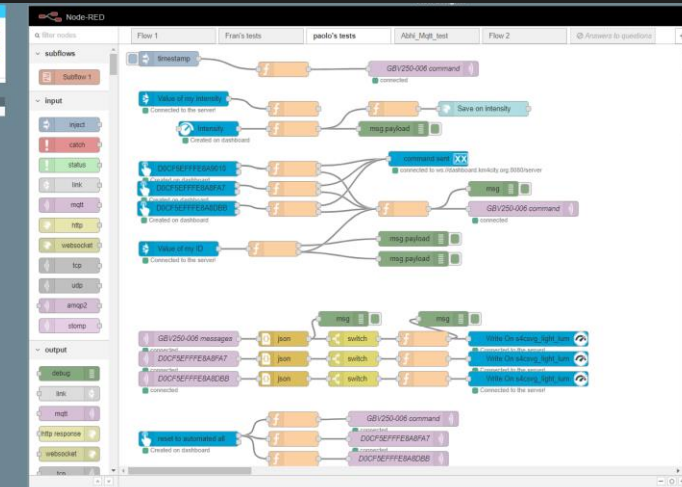
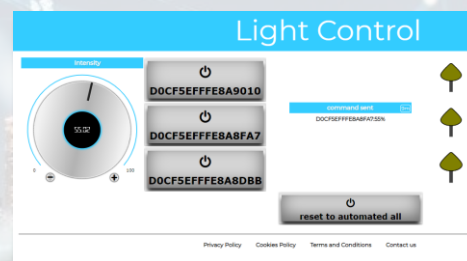
- Map coverage on Sweden
- Monitoring and real time control
- Energy control, analytics
- Direct control



## • Historical and Real Time data

## • Services Exploited on:

- Multiple Levels, API
- Dashboards



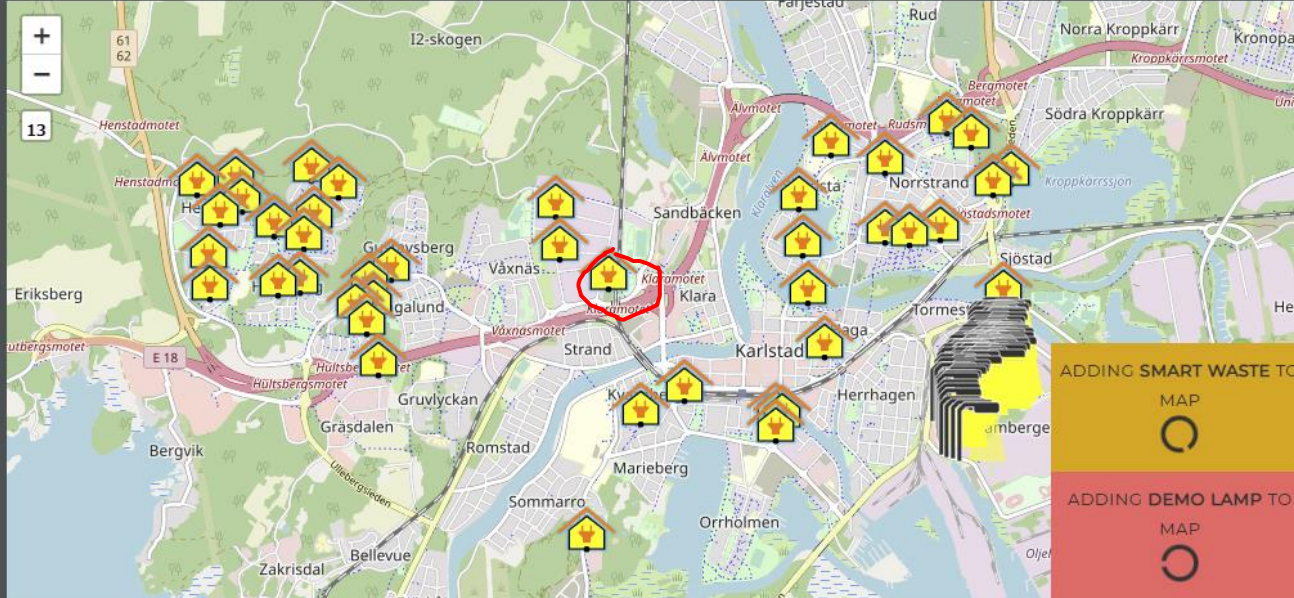


## Karlstad - Capelon

CAPELON

Sun 28 Nov 20:02:16

- Cabinet
- Smart Light
- Demo Lamp
- Smart Waste

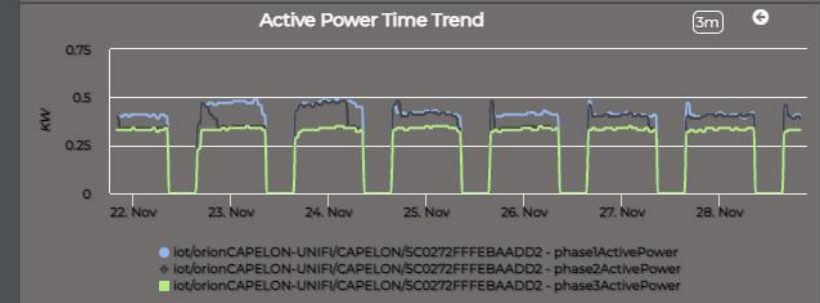
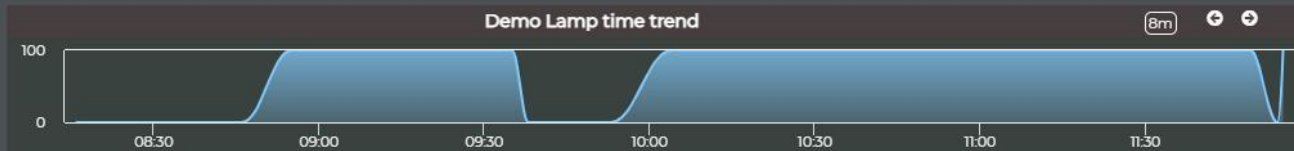
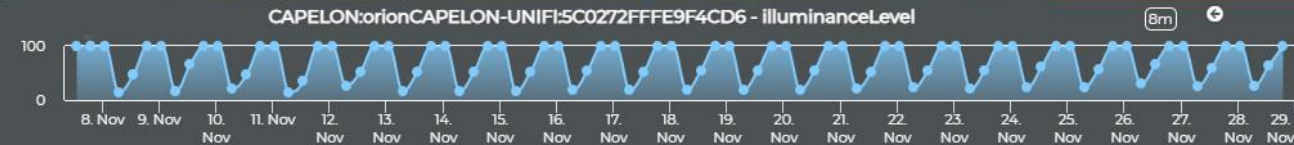


ADDING SMART WASTE TO MAP

ADDING DEMO LAMP TO MAP

Lamp ON

Lamp OFF

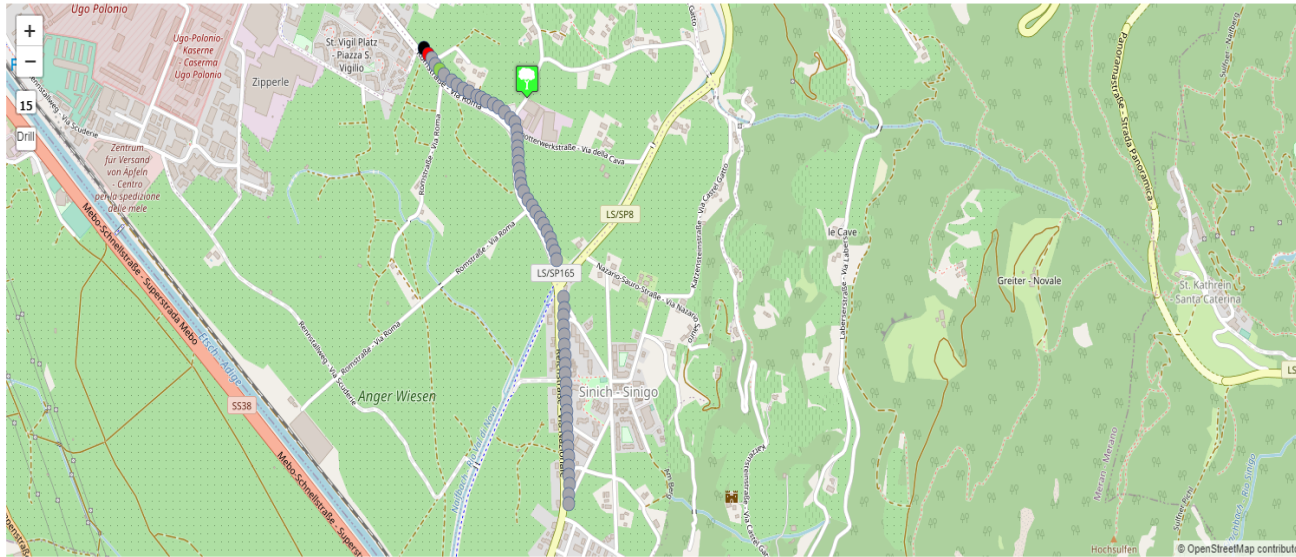




# Smart Light Management in Merano



All lamps Data visualization Event logs Graph Settings



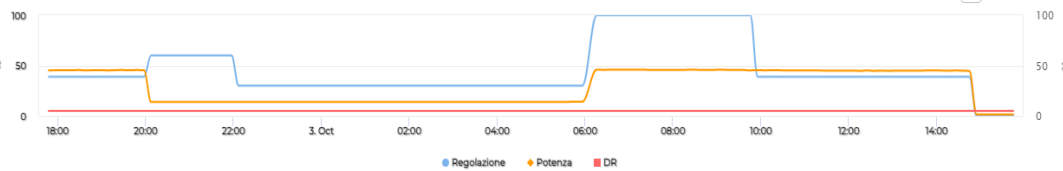
N. Punto Luce	11251
DevEui	70b3d5bf100085DB
Via	Romstraße
Regolazione	100
Ore di servizio	1440
Conta energia	28709
Potenza attuale	24
Stato	ON
Nome errore	INF DALLI LAMPON
RSSI	-42
SNR	10.5
Data	03/10/2023 15:42:43

ON

OFF

- DALI\_NTC\_MISSING
- INF\_AUX\_TRIGGER
- DALI\_FADE\_TIME\_DISABLE
- DALI\_BALAST\_NOT\_CONFIG
- ERR\_DALI\_THERMAL\_SHUTDOWN
- ERR\_DALI\_THERMAL\_DERATING
- ERR\_DALI\_POWER\_LIM
- ERR\_DALI\_OVERALL
- INF\_POWER\_FAIL
- INF\_BUSS\_POWERED\_BY\_FRE

- Managing DALI 2 devices FlashNet via LoraWan
- programming SmartLight via UniCast and MultiCast
- Controlling devices
- Automation of Smart Light on the basis of Traffic Flow



Non Attivo  
Stato Linea verso Merano Centro

Non Attivo  
Stato Linea verso Sinigo



All lamps Data visualization Event logs Graph Settings

## Add device to multicast

DevEui:

Multicast address:

Multicast network session key:

Multicast application session key:

Salva

DevEui	Action
70b3d5bf100085db	Remove
70b3d5bf100085dd	Remove
70b3d5bf100085dv	Remove
70b3d5bf100085dp	Remove
70b3d5bf100085d0	Remove
70b3d5bf100085d5	Remove
70b3d5bf100085dk	Remove

## Multicast configuration

Multicast2:

Set UTC timestamp

Set cpPush

Set configuration

Salva

<https://www.snap4city.org/968>



Show 500 entries

Data	Numero punto luce	DevEui Lorawan	Via	Eventi e messaggi d'errore
30/09/2023 23:51:59	11710	70B3D5BF100085E8	RomStraße	INF LL CHANGED, INF DALI LAMPON
30/09/2023 23:42:28	9	70B3D5BF100085F9	RomStraße	INF LL CHANGED, INF DALI LAMPON
30/09/2023 23:42:23	22	70B3D5BF100085ED	RomStraße	INF LL CHANGED, INF DALI LAMPON
30/09/2023 23:42:22	11261	70B3D5BF100085E2	RomStraße	INF LL CHANGED, INF DALI LAMPON
30/09/2023 23:22:38	10974	70B3D5BF10008610	ReichStraße	INF LL CHANGED, INF DALI LAMPON
30/09/2023 23:22:35	28	70B3D5BF100085F7	RomStraße	INF LL CHANGED, INF DALI LAMPON
30/09/2023 23:22:28	16421	70B3D5BF10008601	ReichStraße	INF LL CHANGED, INF DALI LAMPON
30/09/2023 23:12:34	16423	70B3D5BF10008603	R	
30/09/2023 23:02:40	10968	70B3D5BF1000860A	R	
30/09/2023 23:02:38	16427	70B3D5BF10008607	R	
30/09/2023 23:02:38	16422	70B3D5BF10008602	R	
30/09/2023 23:02:32	16425	70B3D5BF10008605	R	
30/09/2023 23:02:31	17	70B3D5BF100085F0	R	
30/09/2023 23:02:31	9	70B3D5BF100085F9	R	
30/09/2023 23:02:26	16417	70B3D5BF100085FD	D	
30/09/2023 23:02:26	16426	70B3D5BF10008606	R	
30/09/2023 23:02:25	11352	70B3D5BF100085DA	R	
30/09/2023 23:02:25	20	70B3D5BF100085EB	R	
30/09/2023 23:02:13	29	70B3D5BF100085F5	R	
30/09/2023 22:52:36	28	70B3D5BF100085F7	R	
30/09/2023 22:52:34	10313	70B3D5BF100085FB	R	
30/09/2023 22:42:31	16421	70B3D5BF10008601	R	
30/09/2023 22:42:27	16416	70B3D5BF100085FC	R	
30/09/2023 22:42:26	11261	70B3D5BF100085E2	R	
30/09/2023 22:42:20	10972	70B3D5BF1000860D	R	

All lamps
Data visualization
Event logs
Graph
Settings

**70B3D5BF100085DB**

VALUE NAME: 70B3D5BF100085DB

DETAILS DESCRIPTION RT DATA

Last update: 2023-10-03 13:42:43.881Z

Description	Value	Buttons
DR	5	Last 4h 24h 7d 30d 6m 1y 2y 1i
RSSI	-42	Last 4h 24h 7d 30d 6m 1y 2y 1i
SNR	10.5	Last 4h 24h 7d 30d 6m 1y 2y 1i
check_nuovo_evento	NO	Last 4h 24h 7d 30d 6m 1y 2y 1i
conta_energia	28709	Last 4h 24h 7d 30d 6m 1y 2y 1i
dateObserved	2023-10-03T13:42:43.881Z	Last 4h 24h 7d 30d 6m 1y 2y 1i
gatewayId	7276M002e08044c	Last 4h 24h 7d 30d 6m 1y 2y 1i
messaggio_errore_evento	INF DALI LAMPON	Last 4h 24h 7d 30d 6m 1y 2y 1i
numero_punto_luce	11251	Last 4h 24h 7d 30d 6m 1y 2y 1i

**QUADROFRATTA**

VALUE NAME: QUADROFRATTA

DETAILS DESCRIPTION RT DATA

Last update: 2023-10-03 13:00:00.008Z

Description	Value	Buttons
dateObserved	2023-10-03T13:00:00.008Z	Last 4h 24h 7d 30d 6m 1y 2y 10y
offTime	07:07	Last 4h 24h 7d 30d 6m 1y 2y 10y
onTime	19:06	Last 4h 24h 7d 30d 6m 1y 2y 10y
statoLinea_1	Non Attivo	Last 4h 24h 7d 30d 6m 1y 2y 10y
statoLinea_2	Non Attivo	Last 4h 24h 7d 30d 6m 1y 2y 10y
statoLinea_3	Non Attivo	Last 4h 24h 7d 30d 6m 1y 2y 10y
statoLinea_4	Non Attivo	Last 4h 24h 7d 30d 6m 1y 2y 10y
statoLinea_5	Non Attivo	Last 4h 24h 7d 30d 6m 1y 2y 10y

Keep data on target widget(s) after popup close:

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

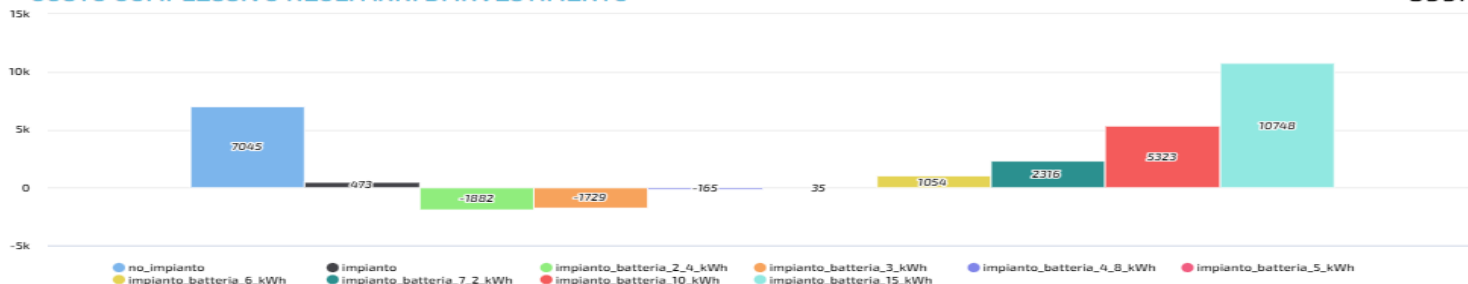
Ciao roottooladmin1

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

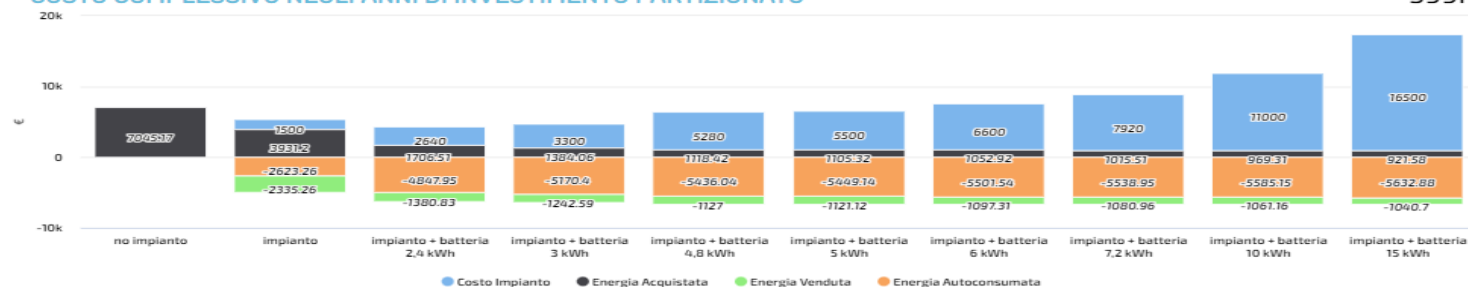
Invia

7 AFFORDABLE AND CLEAN ENERGY



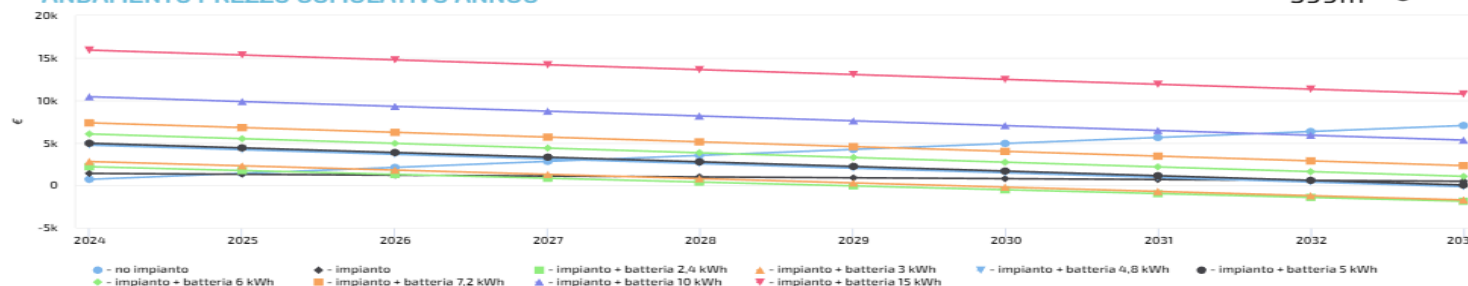
### COSTO COMPLESSIVO NEGLI ANNI DI INVESTIMENTO PARTIZIONATO

599m

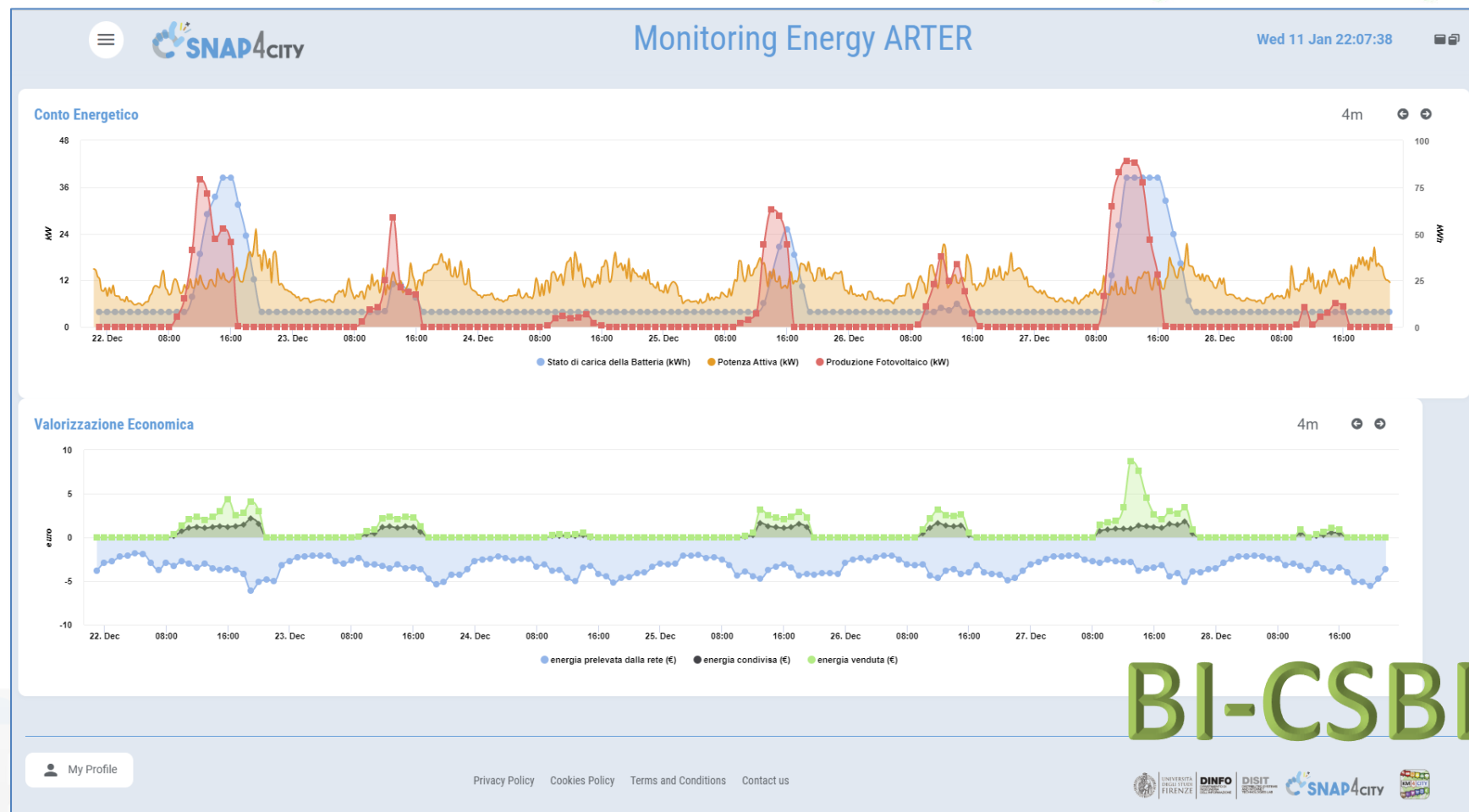


### ANDAMENTO PREZZO CUMULATIVO ANNUO

599m



- **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**

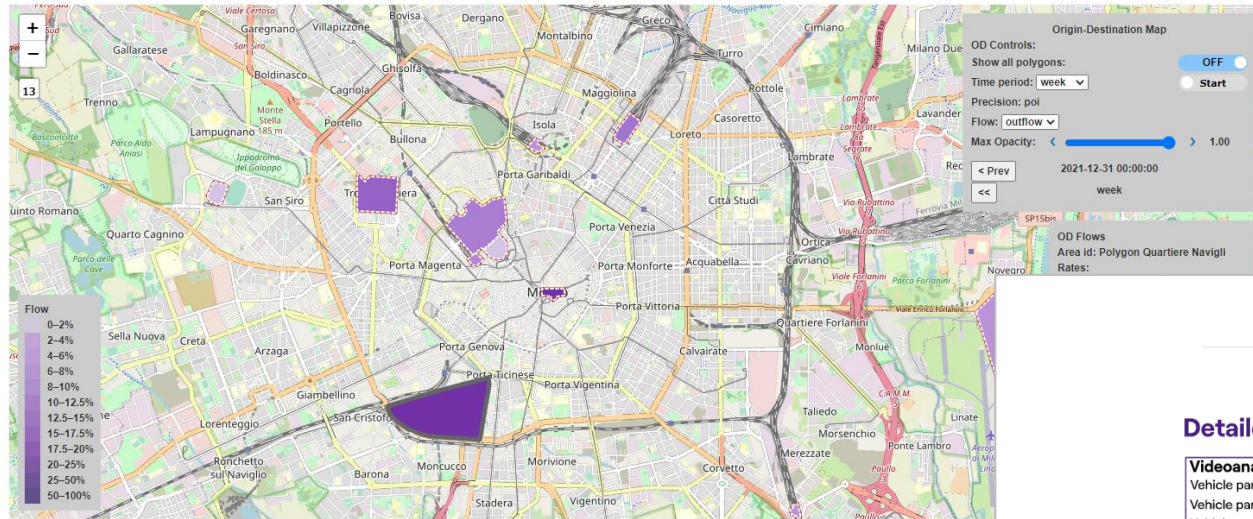
<https://www.selfuser.it>

# Energy monitoring and business intelligence

## Green and Data Driven District

Aggregated KPI JuicePark SmartPole CityAnalytics

POI - OD POI - PRESENZE POI - PRESENZE (TS) ACE - PRESENZE ACE - PRESENZE (TS)



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## Green and Data Driven District

Aggregated KPI JuicePark SmartPole CityAnalytics

### Detailed KPIs

#### Videoanalysis

People counted daily: 0

People counted to date: 0

People aggregation daily: 0

People aggregation to date: 0

Vehicle counted daily: 0

Vehicle counted to date: 21

#### Power meter

Daily energy consumed: 9.024 kWh

Energy consumed to date: 27.341 kWh

Daily energy produced: 1.409 kWh

Energy produced to date: 4.252 kWh

#### WiFi

Max number of connected devices in the last day: 0

Hourly average connected devices: #####

#### eBike

Daily number of sessions: 0

Number of sessions to date: 0

Total Energy consumed: 0

Average energy consumed: 0

Last charger session: 17/05/2022 11:25

#### Emergency

SOS requests to date: 0

SOS request daily: 0

AED requests to date: 0

AED requests to daily: 0

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## Green and Data Driven District

Aggregated KPI JuicePark SmartPole CityAnalytics

### Detailed KPIs

#### Videoanalysis

Vehicle parked daily: 8

Vehicle parked to date: 87

Vehicle count daily: 24

Vehicle count to date: 520

#### Power meter

Energy consumed daily: 0 kWh

Energy consumed to date: 0 kWh

Energy produced daily: 0 kWh

Energy produced to date: 0 kWh

#### WiFi

Max number of connected devices in the last day: 0

Hourly average connected devices: #####

#### Emergency

SOS Requests to date: 0

SOS request daily: 0

#### EV charged

Number of sessions daily: 0

Number of sessions to date: 0

Total Energy consumed: 0

Average energy consumed: 0

Last charger session: 0

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7 AFFORDABLE AND CLEAN ENERGY



11 SUSTAINABLE CITIES AND COMMUNITIES





UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

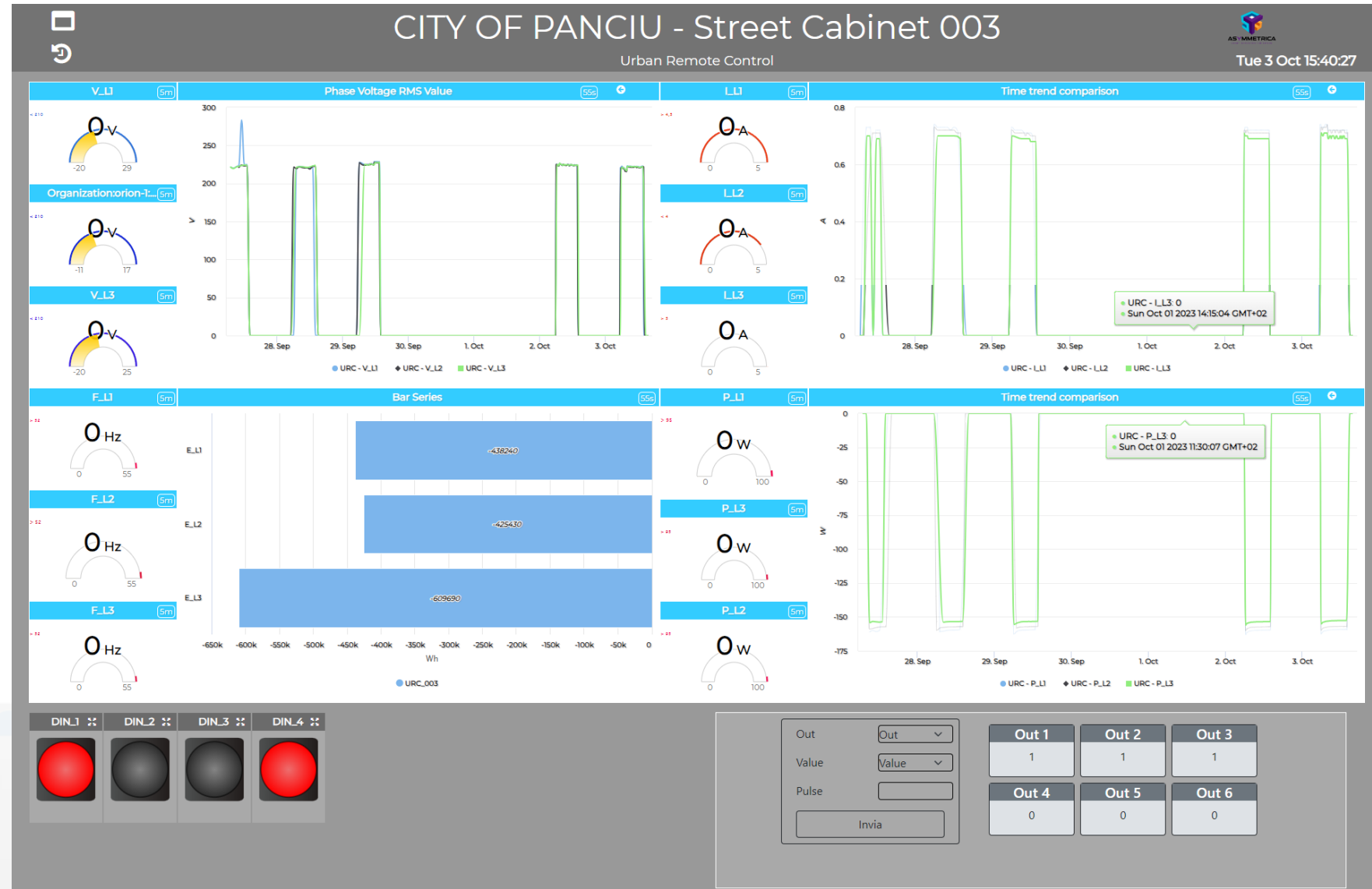
**DISIT**  
DISTRIBUTED SYSTEMS AND  
INTERNET TECHNOLOGIES LAB  
DISTRIBUTED DATA INTELLIGENCE  
AND TECHNOLOGIES LAB

**SNAP4CITY**



# City of Panciu in Romania

By  
**Asymmetrica**  
and Snap4



TOP

# Building and Infrastructure management Domain

FROM CITY DASHBOARD TO APPLICATIONS

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

IOT APPLICATIONS VS. SMART DEVICES

SNAP4CITY FOR BEGINNERS

SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS AND PARTNERS

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

SNAP4CITY AND KM4CITY PROJECTS

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

IOT/IOE DEVICES AND NETWORKS

DATA ANALYTICS, BUSINESS INTELLIGENCE, AND WEATHER

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

# management Domain

IOT APPLICATIONS, THE LOGIC AND THE SMARTNESS

ADVANCED SMART CITY API, MICROSERVICES, SNAP4CITY API

TECHNICAL SUPPORT SYSTEMS AND CITY RESILIENCE

SNAP4CITY THE VIEW OF THE ADMINISTRATORS

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK



# Snap4Building Domain (2024/8)

- **Goals:**
  - increase efficiency, cost reduction, sustainability
  - Accessibility to services
  - Security/Safety
- **Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)**
  - Monitoring: usage, energy, environmental conditions, people flows, services, etc.
  - Early detection/warning, alarm, of critical conditions, notifications, decision support
  - Production of suggestions/prescriptions, nudging
  - Managing smart services: cabinets, dispenser, lockers, etc.
  - Global and local 3D/2D representations of area and buildings
  - Integration with Video Management Systems
  - Computing predictions of any kind
- **Solutions for Planning (optimization and what-if analysis)**
  - Reduction of energy costs via optimization
- **Algorithms and computational solutions, see next slide**

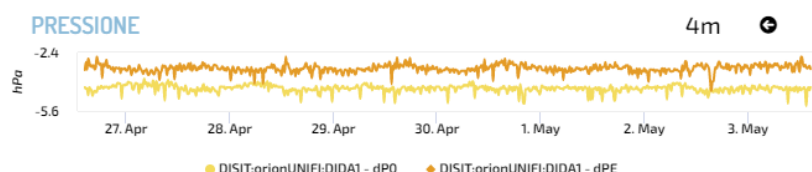
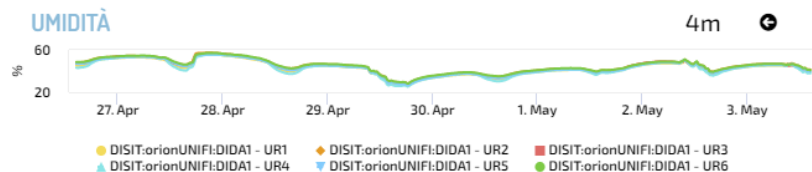
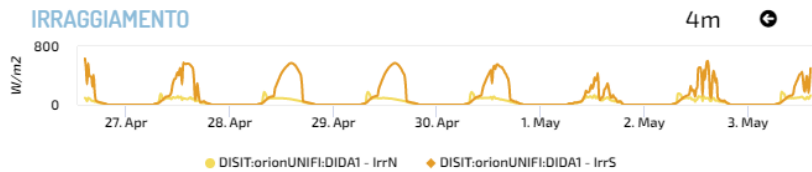
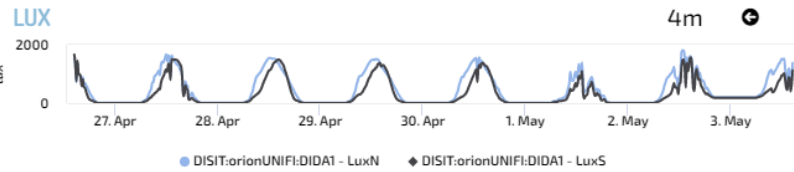


# Smart Buildings, Snap4Building (2024/8)

- **Digital Twin for monitor, control and manage distributed infrastructures**
  - 2D/3D representations of the whole set of buildings, BIM modeling
  - Entities (building, floors, rooms, parking, charging stations, gates, etc.) with their shapes and descriptors, and data monitoring the allocation to office, meeting, cafeteria, storage, stairs, elevator, etc.
- **Monitoring and computing KPIs on real time for**
  - **energy** consumed or produced (hot/cold), **parking, logistic, presences, cleaning, air quality, departments, subareas, maintenance, etc.**
  - **allocation/designation**, dispositions, heating, cooling, temperature, equipment, etc.
  - **grouped in Zones**

Ciao roottooladmin!

Tue 3 May 14:37:14



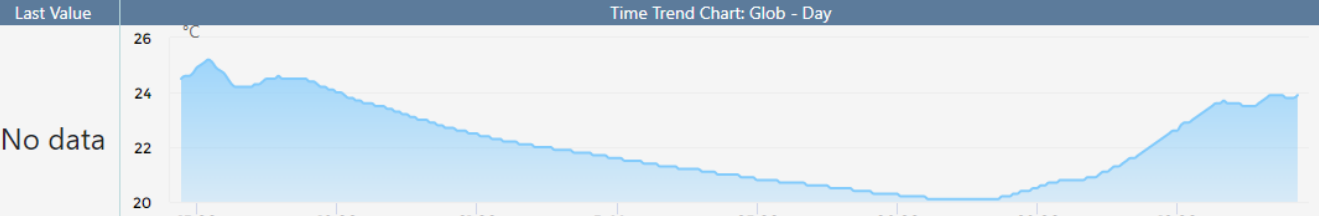
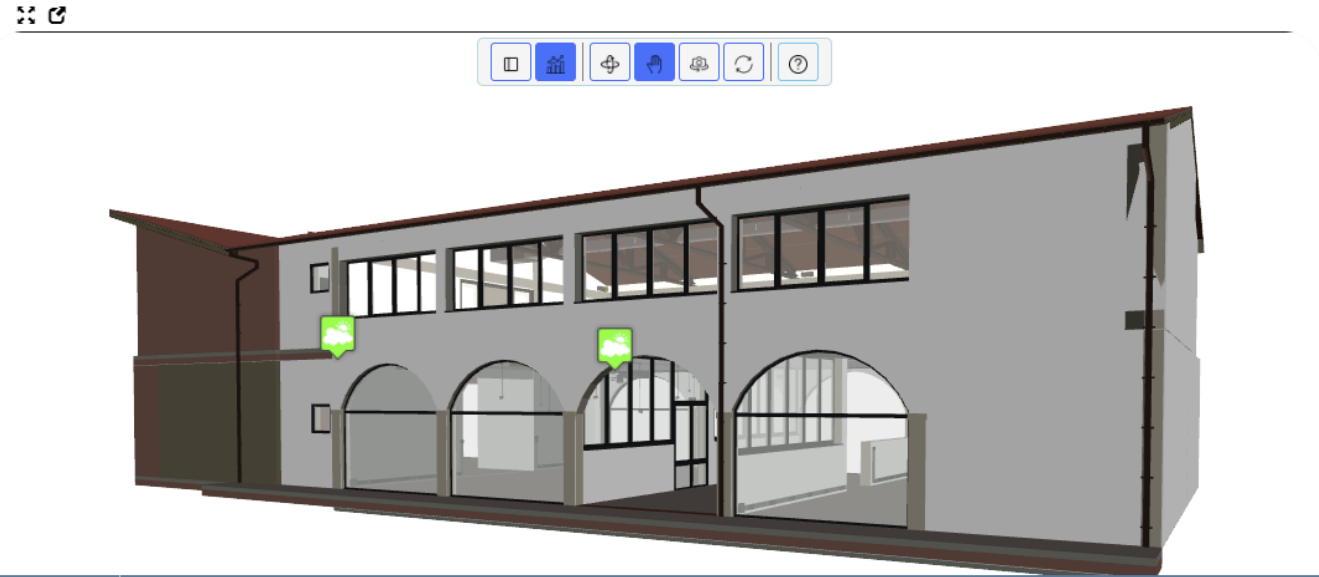
## DIDA DATA 2 - NEWGUI

**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==>

# Objectives of the Snap4ISPRA POC

- **Set up a Snap4Ispra demonstration to:**
  - Enable the analysis at level of building, floors/zones for Zones' Occupancy vs Energy consumption
  - Enable the analysis of parking areas
  - Conformance with EU Login
  - Exploiting heterogenous data coming from multiple sources

Building / Floor / Parking:

Building

All / Single Building:

All

Variable:

occupancy

Popup on Shape Click

Add To Map



Ispra - Occupancy 8m

883

Ispra - Occupancy



ISPRA Site



- Date Observed: 10/23/2023, 12:30:01 PM
- Capacity: 2936 #
- Allocation: 1995 #
- Occupancy: 883 #
  - DAC: -941 #
  - DOA: -1112 #
  - DOC: -2053 #
  - PAC: 67.95 %
  - POA: 44.26 %
  - POC: 30.07 %
- Energy Hot: 4473978 kWh
- Energy Cold: 916361 kWh
- Power Hot: 36 kW
- Power Cold: 0 kW
- Outdoor Temperature: 14.07 °C
- Total Number of Buildings: 76 of 304 #
- Total Number of Floors: 104 #
- Total Number of Zones: 139 #
- Total Number of Parking Areas: 4 #

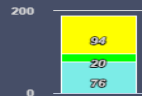
See Trends

Parking Overview

person My Profile

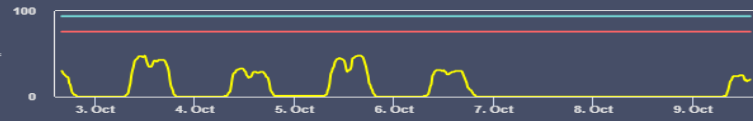


### Actual 4m



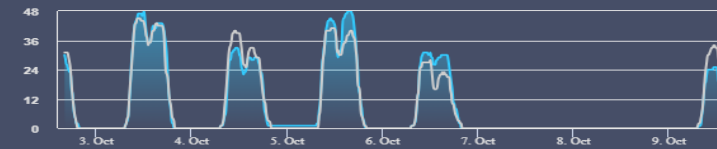
● Capacity  
● Occupancy  
● Allocation

### Capacity - Allocation - Occupancy 4m



● capacity ● occupancy ● allocation

### Occupancy Weekly Time Trend Compare 9m



● Current  
● Previous

### Office Mq 9m

803.9 m<sup>2</sup>

### Temp. 9m

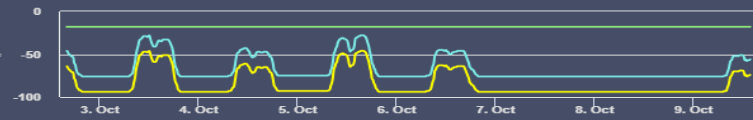
20.6 °C

### Difference 4m



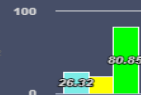
● DOA  
● DOC  
● DAC

### DOA - DOC - DAC 4m



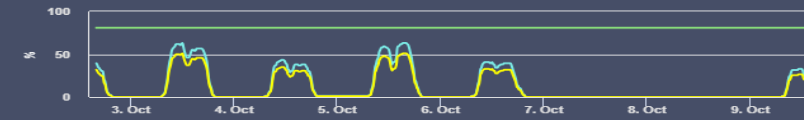
● DOA ● DOC ● DAC

### Percentage 4m



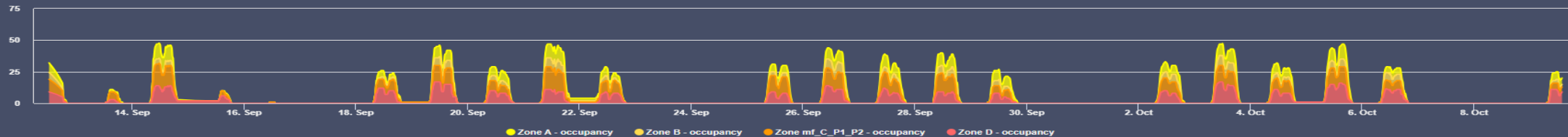
● POA  
● POC  
● PAC

### POA - POC - PAC 4m



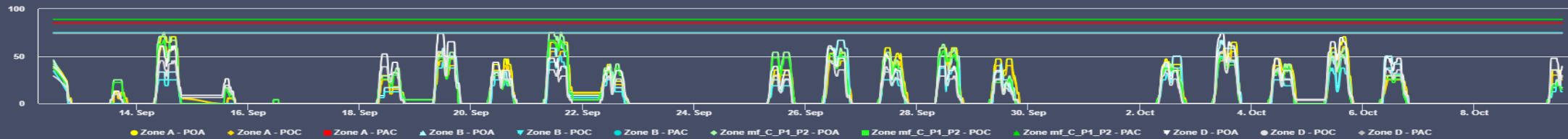
● POA ● POC ● PAC

### Occupancy Per Zones - Monthly Time Trend Comparison Stacked 4m



● Zone A - occupancy ● Zone B - occupancy ● Zone mf\_C\_P1\_P2 - occupancy ● Zone D - occupancy

### Percentage Per Zones - Monthly Time Trend Comparison 4m



● Zone A - POA ● Zone A - POC ● Zone A - PAC ● Zone B - POA ● Zone B - POC ● Zone B - PAC ● Zone mf\_C\_P1\_P2 - POA ● Zone mf\_C\_P1\_P2 - POC ● Zone mf\_C\_P1\_P2 - PAC ● Zone D - POA ● Zone D - POC ● Zone D - PAC

### Heat Power 9m

0 kW

### Heat Energy 9m

1931279 kWh

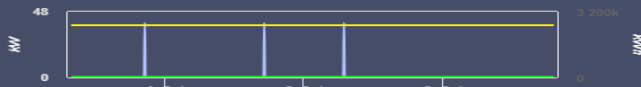
### Cold Power 9m

0 kW

### Cold Energy 9m

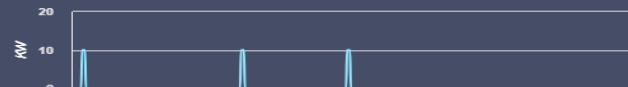
888311 kWh

### Energy Trends 4m



● Heat Power (kW) ● Cold Power (kW) ● Heat Energy (kWh)

### Average Hourly Power 4m



● Heat power ● Cold power

### En./Mq 9m

0 kWh

### En./Pax 9m

0 kWh

## Ispra Floor, Zone And Room Details

Fri 6 Oct 18:41:54

**Allocation Number**

- >50
- 25-50
- 13-25
- 5-13
- 0-5

### Floor PT of Building 58A

- Date Observed: 10/6/2023, 6:30:02 PM
- Capacity: 37
- Allocation: 31
- Occupancy: 1
  - DAC: -6 #
  - DOA: -30 #
  - DOC: -36 #
  - PAC: 83.78 %
  - POA: 3.23 %
  - POC: 2.7 %

[See Trends](#)

Select a Zone metric: Allocation

### Room 017

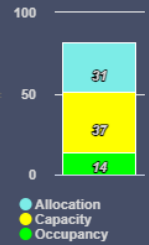
- Date Observed: 10/6/2023, 12:01:00 PM
- Zone Id: 58A\_PT\_B
- Capacity: 1
- Allocation: 0
- mq: 12.16
- Average hourly temp. Xi: 24.07°C
- Average hourly temp. Xs: 20.92°C
- Average hourly temp. Xt: 6.00°C
- Heat Start temp.: 17.92°C
- Cold Start temp: 23.92°C

[See Trends](#)

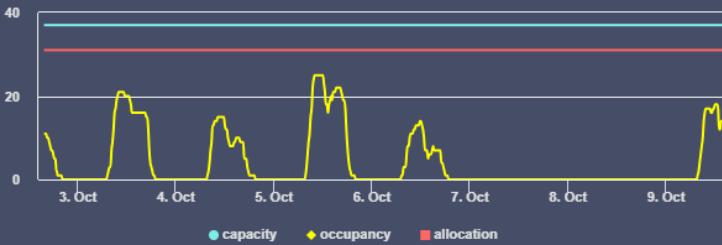
# Building 58A PT Trends

Mon 9 Oct 13:51:30

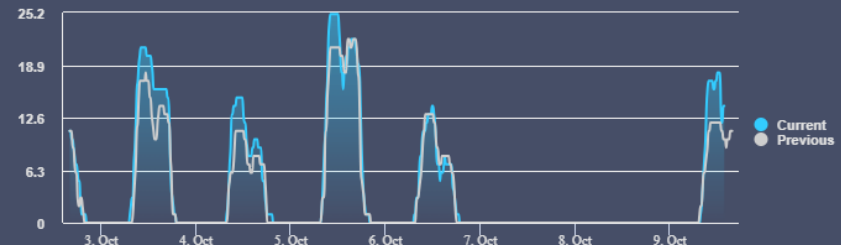
## Actual 4m



## Capacity - Allocation - Occupancy 4m



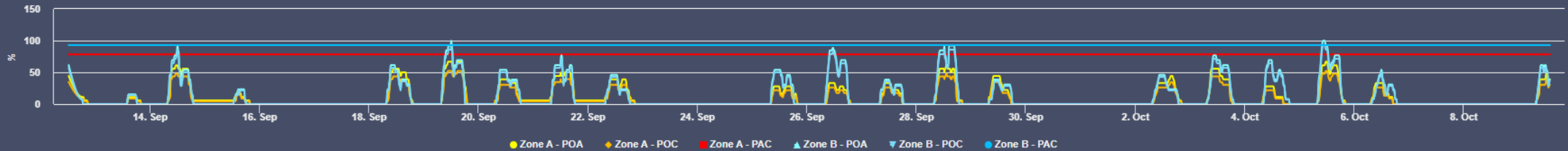
## Organization: Orion-1: Floor2\_58A\_PT - Occupancy 9m



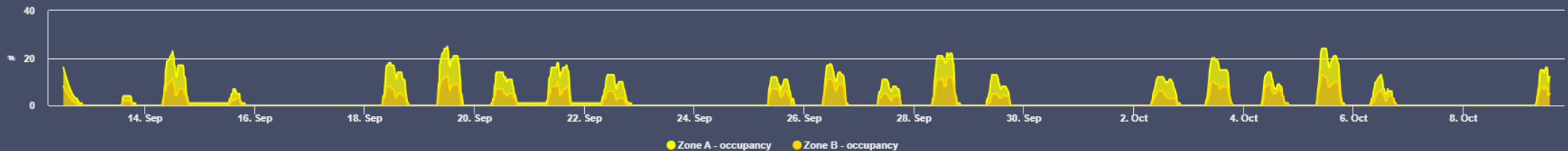
## Temp. 9m

21.7 °C

## Percentage Per Zones - Monthly Time Trend Comparison 4m



## Occupancy Per Zones - Monthly Time Trend Comparison Stacked 4m



# Parking

## Parking 58C

Fri 6 Oct 18:33:41

A1_1	A1_2	A1_3	A1_4	A1_5	A1_6	A1_7	A1_8	A1_9	A1_10	A1_11	A1_12	A1_13	A1_14	A1_15	A1_16	A1_17	A1_18	A1_19	A1_20	A1_21	A1_22	A1_23	A1_24	A1_25	A1_26	A1_27	A1_28	A1_29	A1_30	A1_31	A1_32	A1_33	A1_34	A1_35	A1_36	A1_37	A1_38	A1_39	A1_40	A1_41	A1_42	A1_43	A1_44	A1_45	A1_46	A1_47	A1_48	A1_49	A1_50	A1_51	A1_52	A1_53	A1_54	A1_55	A1_56	A1_57	A1_58	A1_59	A1_60	A1_61	A1_62	A1_63	A1_64	A1_65	A1_66	A1_76	A1_77	A1_78	A1_79	A1_80	A1_81	A1_82	A1_83	A1_84	A1_85	A1_67	A1_68	A1_69	A1_70	A1_71	A1_72	A1_73	A1_74	A1_75
------	------	------	------	------	------	------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

**Capacity** 9m **Free Slots** 9m **Occupanc...** 9m

85# 74# 12.9%

**OverparkingSlots** 9m **Unknown State Slots** 9m

0# 3#

**Free Slots Weekly Time Trend Compare** 9m

**Percentage Of Occupancy Daily Time Trend Com...** 9m

**Overparking Weekly Time Trend Compare** 9m

**Time Trend Comparison** 4m



TOP

# Assets Management & Control



# Assets Control Domain (2024/8)

- **Goals:**
  - Costs reduction, increase service availability, risk reduction
  - Quality Level
- **Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)**
  - **Monitoring :**
    - **Assets:** switches, Wi-Fi, servers, UPS, sensors, building, TV Cams, etc.
    - **Energy:** consumption, operative conditions, UPS continuity, etc.
    - **Production:** continuous serviceability analysis
    - Etc.
  - Early detection/warning, alarm, of critical conditions
    - **Multichannel** Event reporting, notifications: email, Telegram, mobile apps, SMS, etc.
  - Managing maintenance operation, predictive maintenance
  - Computing predictions of any kind
- **Solutions for Planning (optimization and what-if analysis)**
  - Reduction maintenance costs, reduction of critical SLA conditions, improve service level
- **Algorithms and computational solutions, see next slide**

# Cuneo Assets' Monitoring, Safety



Monitoraggio Generale
Thu 4 Jan 18:13:19

- ▶ CameraModelP1448-LE
- ▶ UpsModelRiello
- ▶ UpsModelSeltec
- ▶ SwitchModelMicrosense
- ▶ SwitchModelNetonix

**Legenda**

Valore	Significato	Simbolo
0	Buono stato	<span style="color: green;">●</span>
1	Non raggiungibile	<span style="color: gray;">●</span>
2	Raggiungibile, dati non disponibili	<span style="color: yellow;">●</span>
3	Identificata anomalia	<span style="color: red;">●</span>

**SWITCH015**

VALUE NAME: 1721615250

DETAILS DESCRIPTION RT DATA

Last update: 2024-01-04 13:34:24.334Z

Description	Value	Buttons
dateObserved	01/04/24, 02:34:24 PM	Last 4h 24h 7d 30d 6m 1y 2y 10y
fanSpeed	4985	Last 4h 24h 7d 30d 6m 1y 2y 10y
generalStatus	0	Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue1	48	Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue10	0	Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue11	0	Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue12	0	Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue13	0	Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue14	0	Last 4h 24h 7d 30d 6m 1y 2y 10y

TempValu... 9m

49

TempValue1 - 7 Days

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Monitoraggio Dettagliato
Thu 4 Jan 18:05:15

**Tabella Device**

Cerca per Indirizzo, ID o device...

Camera UPS Switch ● ● ● ●

ID	Stato	Tipo device	Indirizzo	IP	Azioni
TC010182	<span style="color: green;">●</span>	Camera	Cuneo Sud Palo Angolo Parco Giochi	172.16.12.185	📍
TC010178	<span style="color: green;">●</span>	Camera	Cuneo Sud Palo Alto verso Asilo	172.16.12.181	📍
TC010181	<span style="color: green;">●</span>	Camera	Cuneo Sud Palo davanti Biblioteca	172.16.12.184	📍
TC010179	<span style="color: green;">●</span>	Camera	Biblioteca Cuneo Sud Esterna Sopra Ingresso	172.16.12.182	📍
TC010184	<span style="color: green;">●</span>	Camera	Cuneo Sud Angolo verso Parco Giochi	172.16.12.187	📍
TC010185	<span style="color: green;">●</span>	Camera	Cuneo Sud Angolo verso Bar	172.16.12.188	📍
TC010183	<span style="color: green;">●</span>	Camera	Cuneo Sud Angolo davanti Megafresco	172.16.12.186	📍
TC010203	<span style="color: green;">●</span>	Camera	Rotonda Corso Francia Croce Rossa	172.16.12.203	📍
TC010204	<span style="color: green;">●</span>	Camera	Rotonda Corso Francia Distributore	172.16.12.204	📍
SWITCH041	<span style="color: green;">●</span>	Switch	Rotonda Corso Francia Croce Rossa	172.16.15.222	📍
TC010202	<span style="color: green;">●</span>	Camera	Rotonda Corso Francia Tabaccaio	172.16.12.202	📍
SWITCH040	<span style="color: gray;">●</span>	Switch	Rotonda Corso Francia Croce Rossa	172.16.15.223	📍

**Tabella Dettaglio**

**TC010185**

dateObserved	04/01/2024, 14:34
generalStatus	<span style="color: green;">●</span>
tempStatus1	1

**TEMP STATUS**

Valore	Significato
1	Buono stato
2	Letture dato fallita

**Legenda**

● 115 ● 13 ● 22 ● 4

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# Cuneo Assets' Monitoring, Safety

### Cruscotto Videosorveglianza

Legenda - Filtro: ● 93 ● 9 ● 22 ● 0

Buono stato

Selector - Map

Description	Value
dateObserved	01/04/24, 02:34:24
generalStatus	0
tempStatus1	1

Last update: 2024-01-04 13:34:24.307Z

### Dashboard Varchi

Thu 4 Jan 18:04:12

name: TC010016\_varco  
transiti: 76  
measuredTime: 2024-01-04T16:51:49.927Z

TC010047 - Transiti 9m

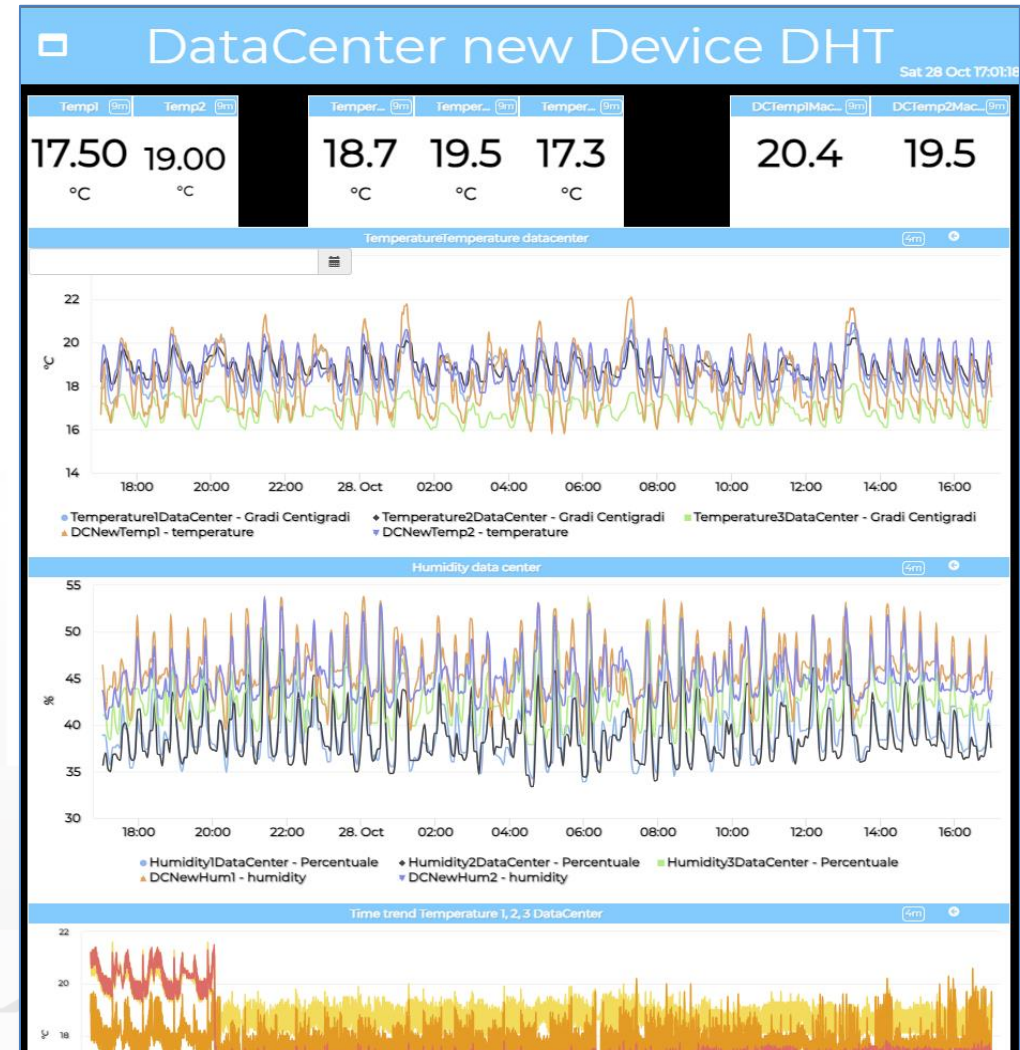
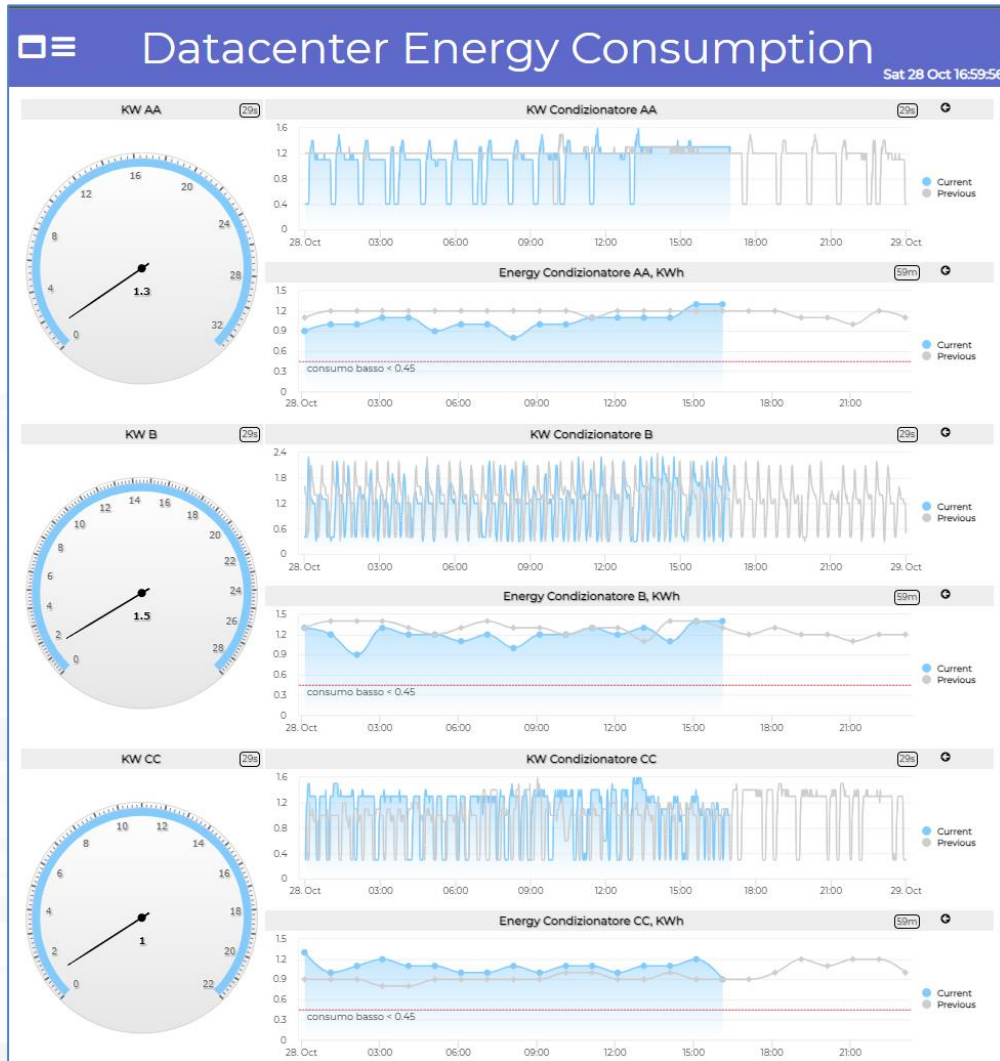
## 152

TC010047 - # Transiti Nei 10 Minuti

9m

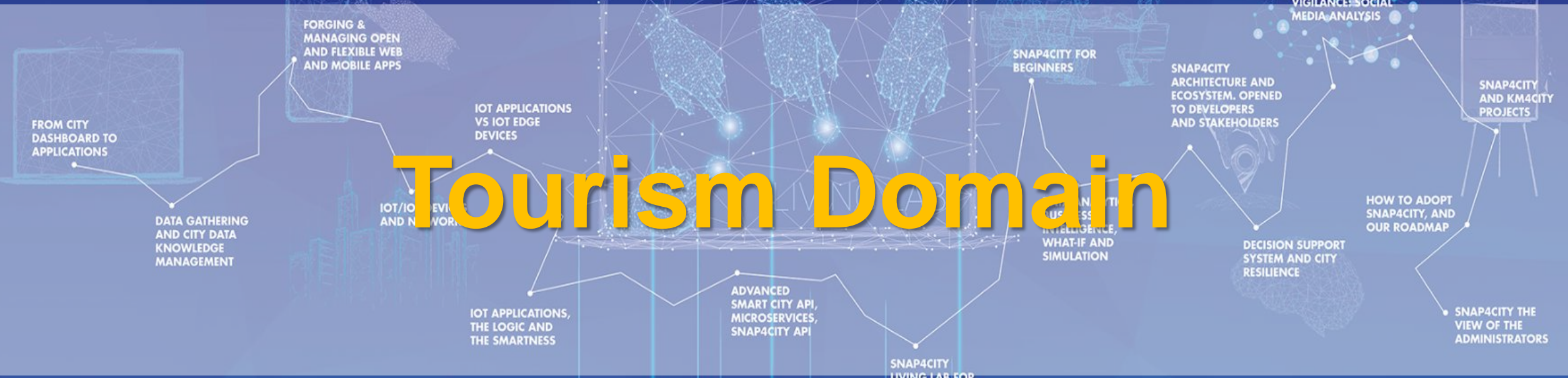


# Data Center monitoring



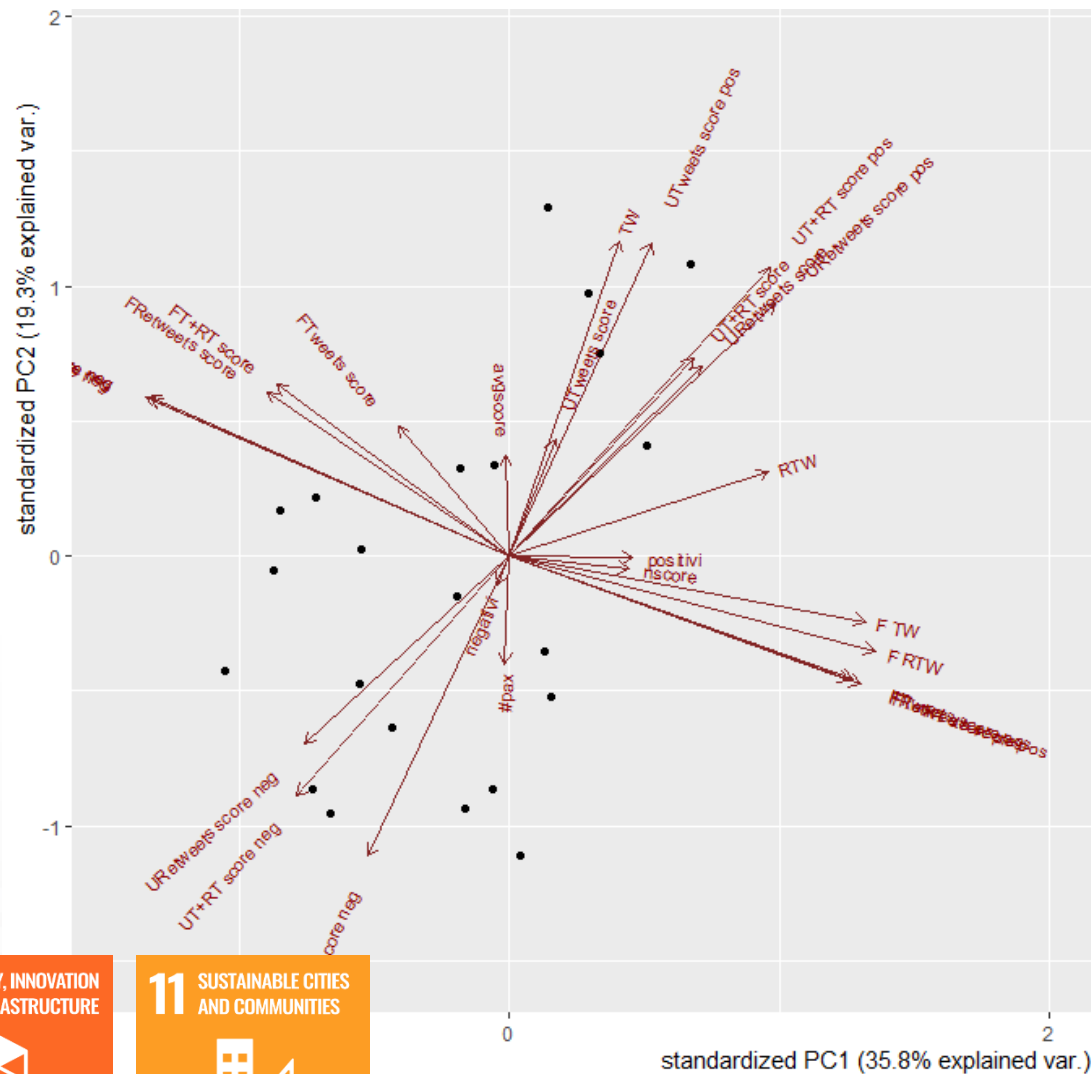
TOP

# Tourism Domain



# Reputation

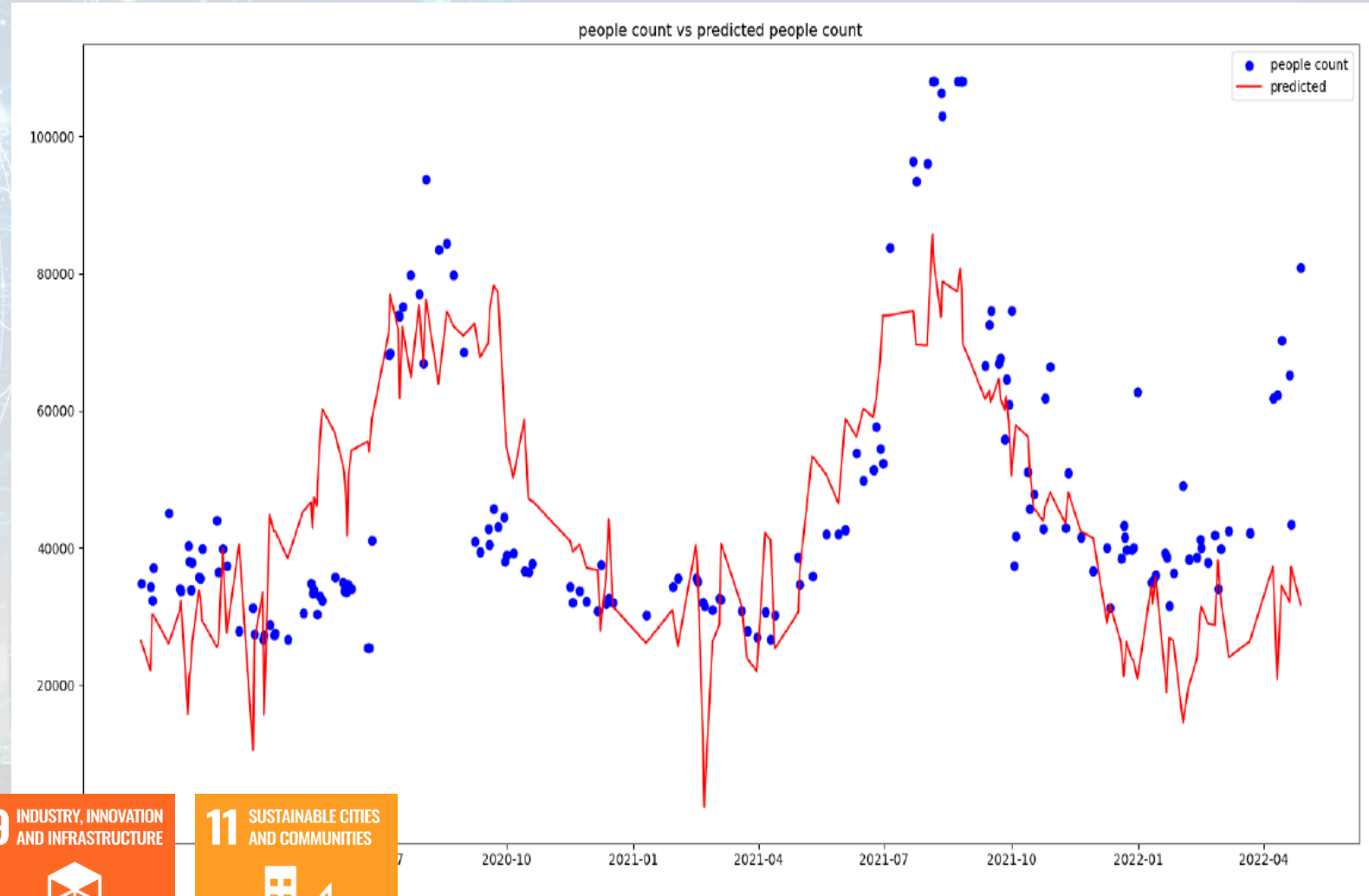
- Prediction/estimation of **Average Score of Trip Advisor** as a function of *Twitter Vigilance Metrics + other information*
- Prediction/estimation of **Negative Scores on specific Museum or service** as a function of *Twitter Vigilance Metrics + other information*



**Twitter Vigilance**

# 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



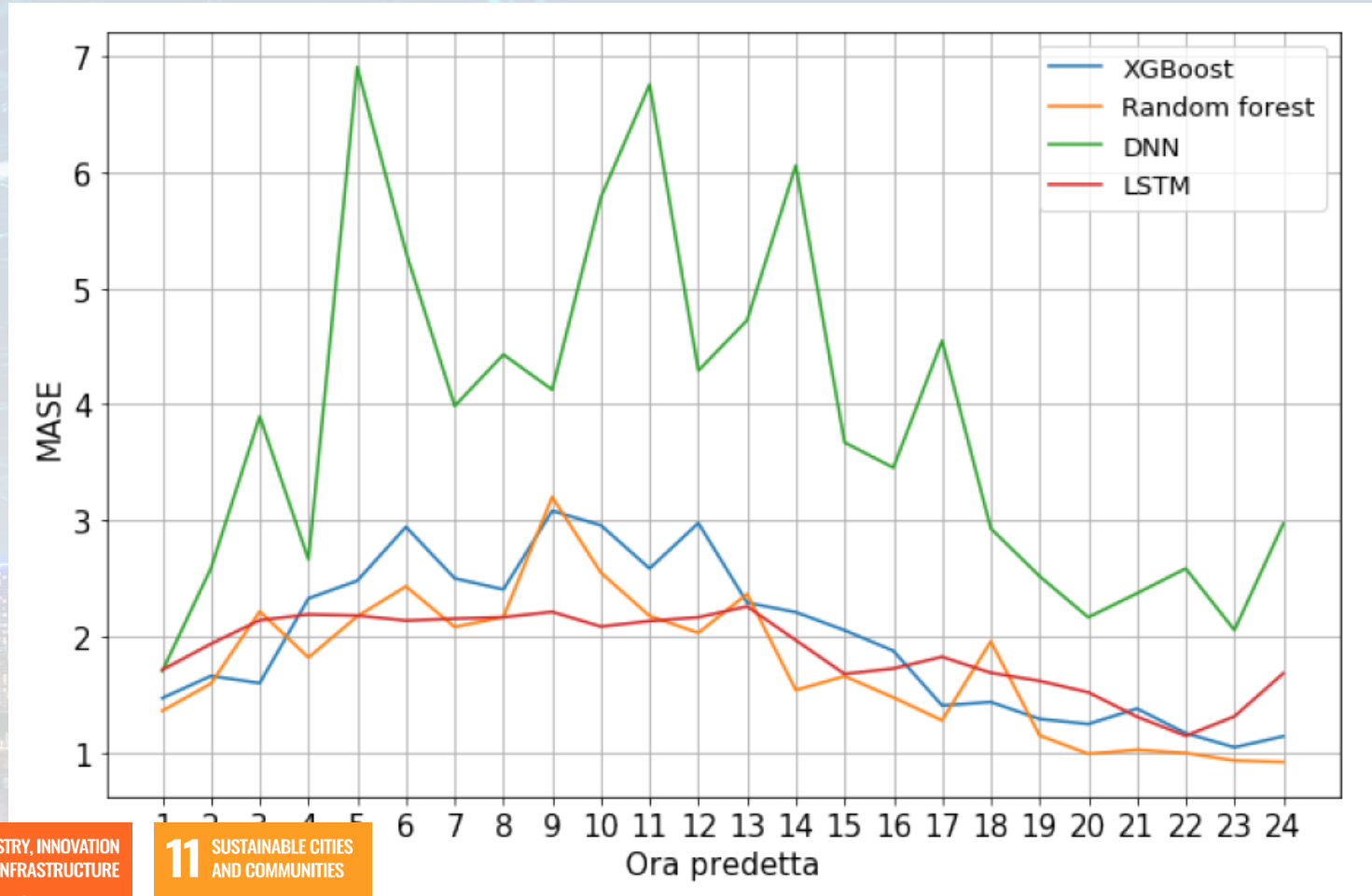
11 SUSTAINABLE CITIES AND COMMUNITIES





# 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



TOP

# Industry Domain predictive maintenance



# Industry production Domain (2024/8)

- **Goals:**
  - Cost reduction, increase control on production
  - Production optimisation
  - Quality Level
- **Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)**
  - Monitoring KPI: administration, production, commercial, faults, etc.
  - Early detection/warning, alarm, of critical conditions
    - **Multichannel** Event reporting: email, Telegram, mobile apps, SMS, etc.
  - Managing maintenance operation
  - Computing predictions on KPI
  - Computing predictive maintenance
- **Solutions for Planning (optimization and what-if analysis)**
  - Generative AI and predictive AI for production plan optimisation
  - Reduction maintenance costs, reduction of critical SLA conditions, improving quality level
- **Algorithms and computational solutions, see next slide**

# 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**

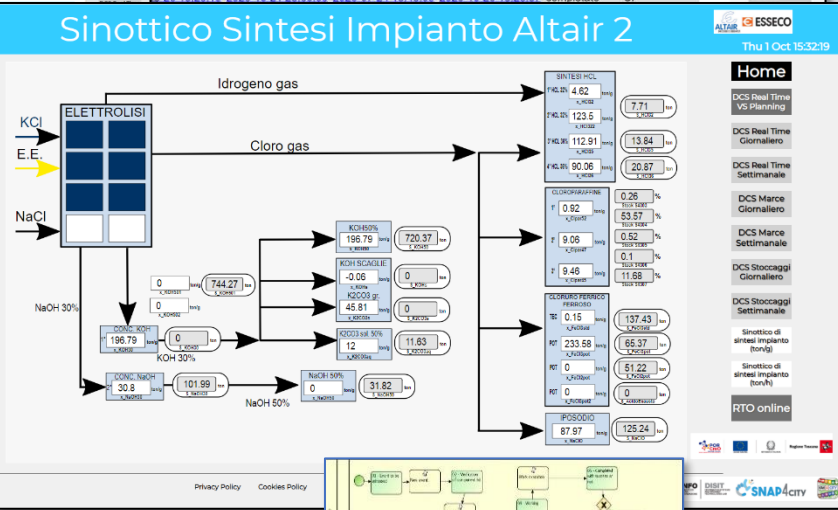
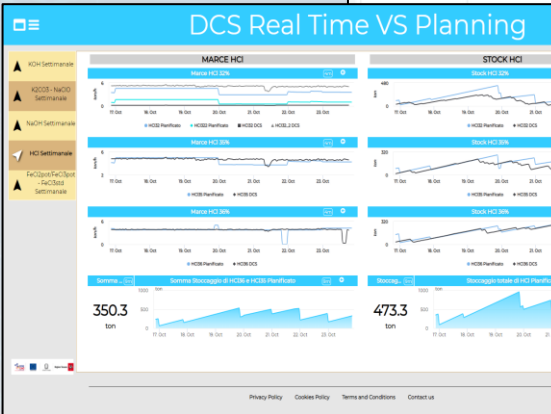
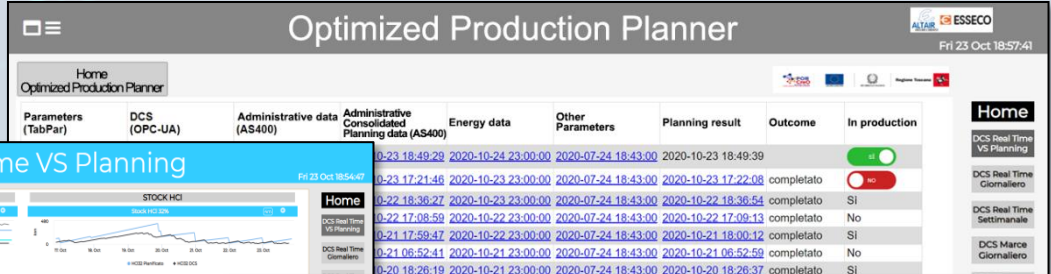
- Billions of Data

- **Services Exploited on:**

- Multiple Levels, Mobile Apps, API

- **Since 2020**

Snap4City (C), Sept. 2024



# Workflow for Ticket management

Consumptions/productions

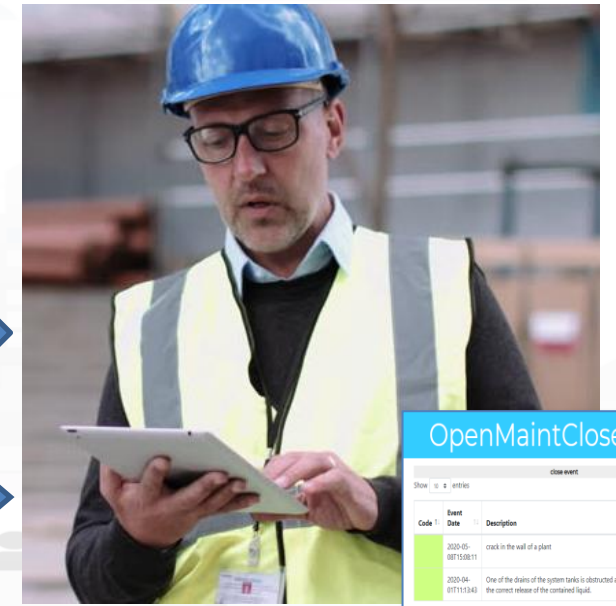
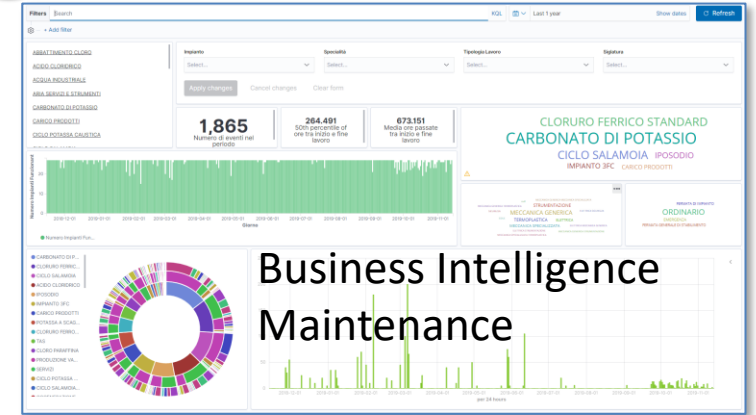
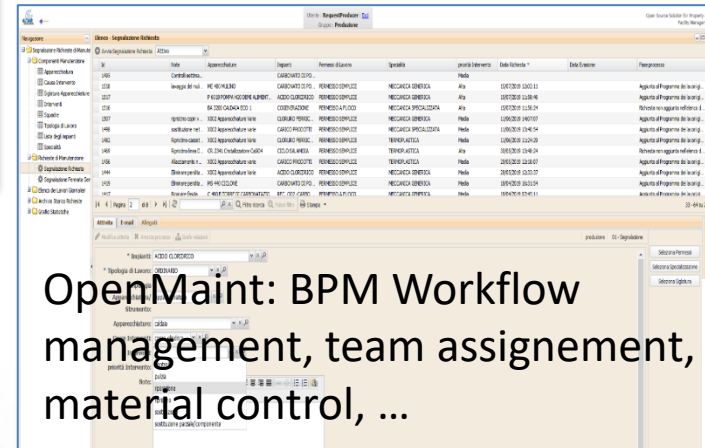
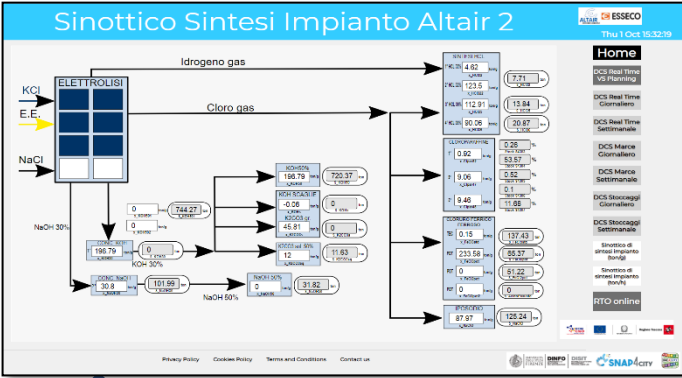
Events/actions

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



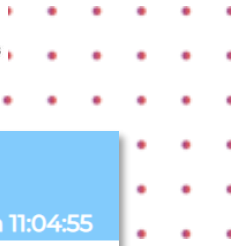
# Digital Twin Local, 3D vs Real Time Data



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB



## BIM Integration for Digital Twin

Tue 8 Jun 11:04:55

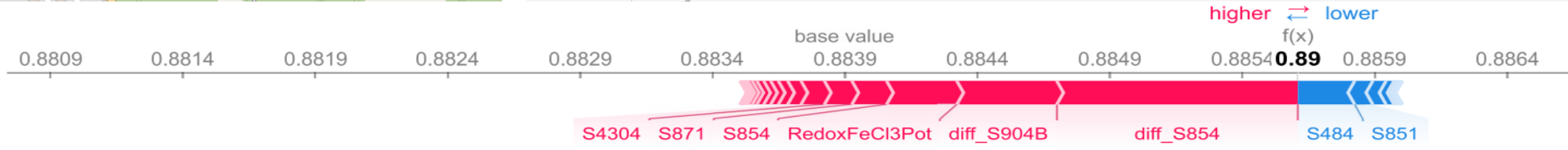
device list  
Valve 786 with trend ▾

Selector - Map

BIM view

Time Trend Chart: totale\_casi - 6 months

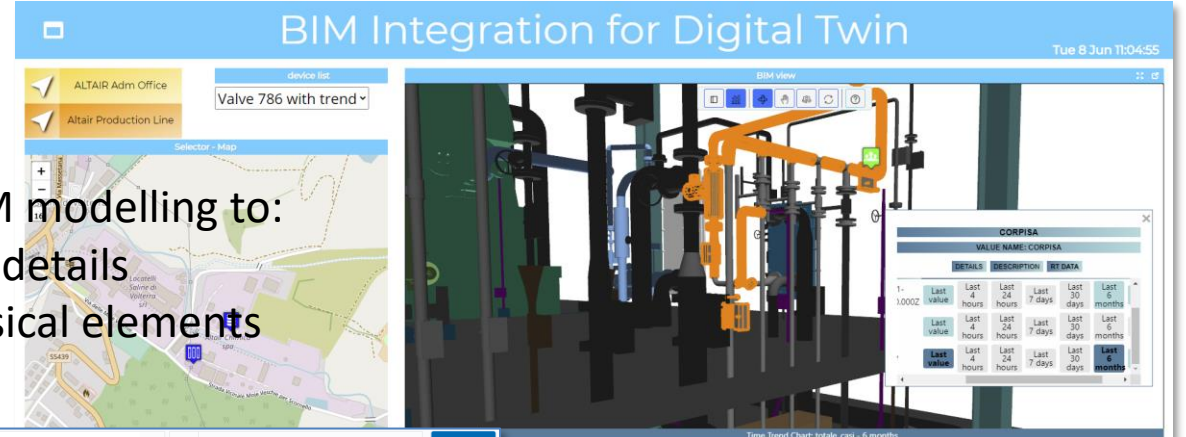
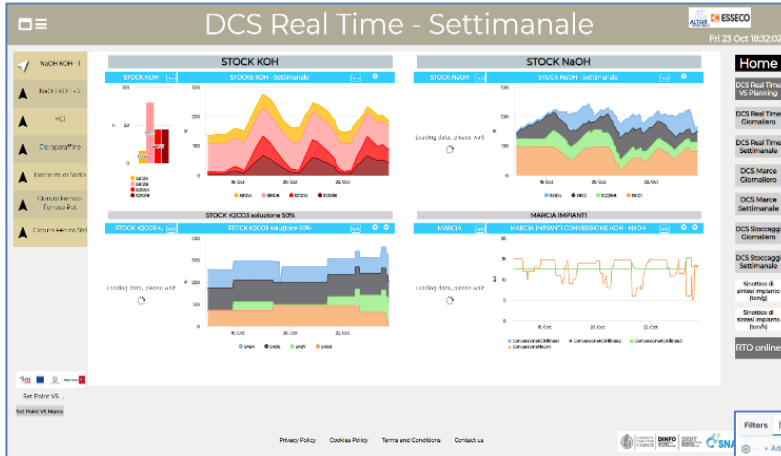
CORPISA					
VALUE NAME: CORPISA					
	DETAILS	DESCRIPTION	RT DATA		
1-0,000Z	Last value	Last 4 hours	Last 24 hours	Last 7 days	Last 30 days
	Last value	Last 4 hours	Last 24 hours	Last 7 days	Last 30 days
	Last value	Last 4 hours	Last 24 hours	Last 7 days	Last 30 days



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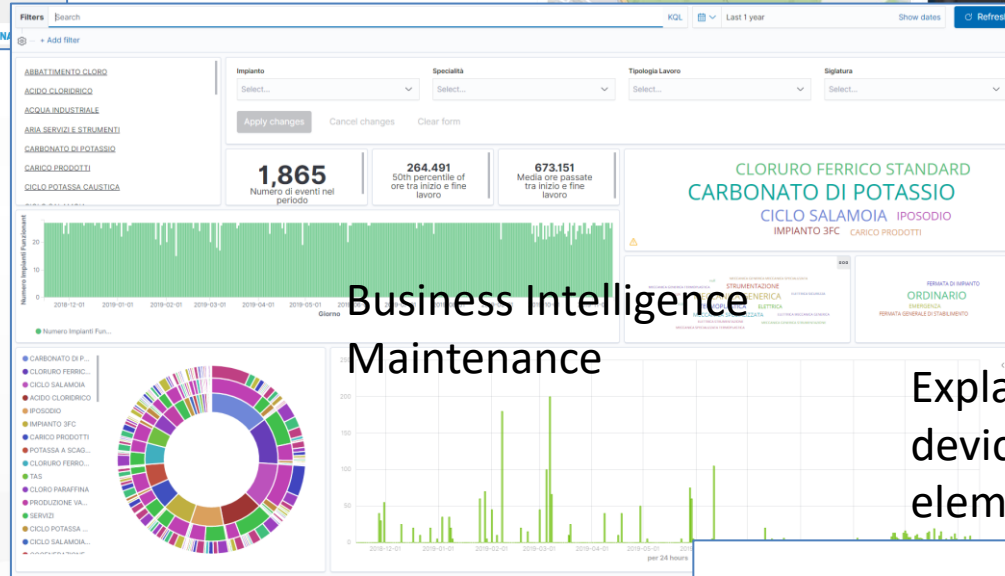
# Closing the loop



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

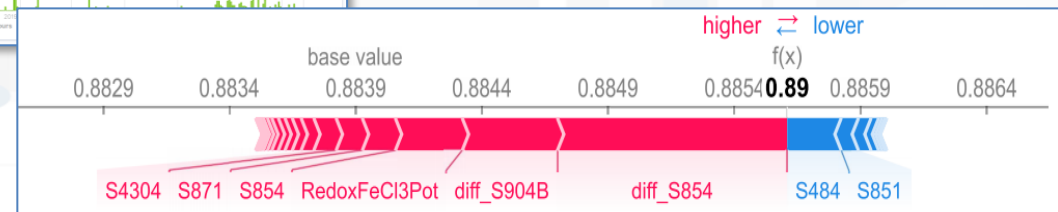
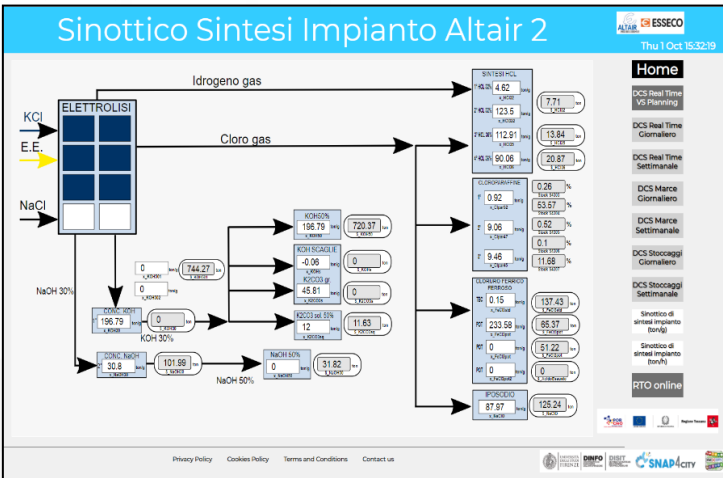
Historical and Real Time Data

Synoptics for real time monitoring



Business Intelligence  
Maintenance

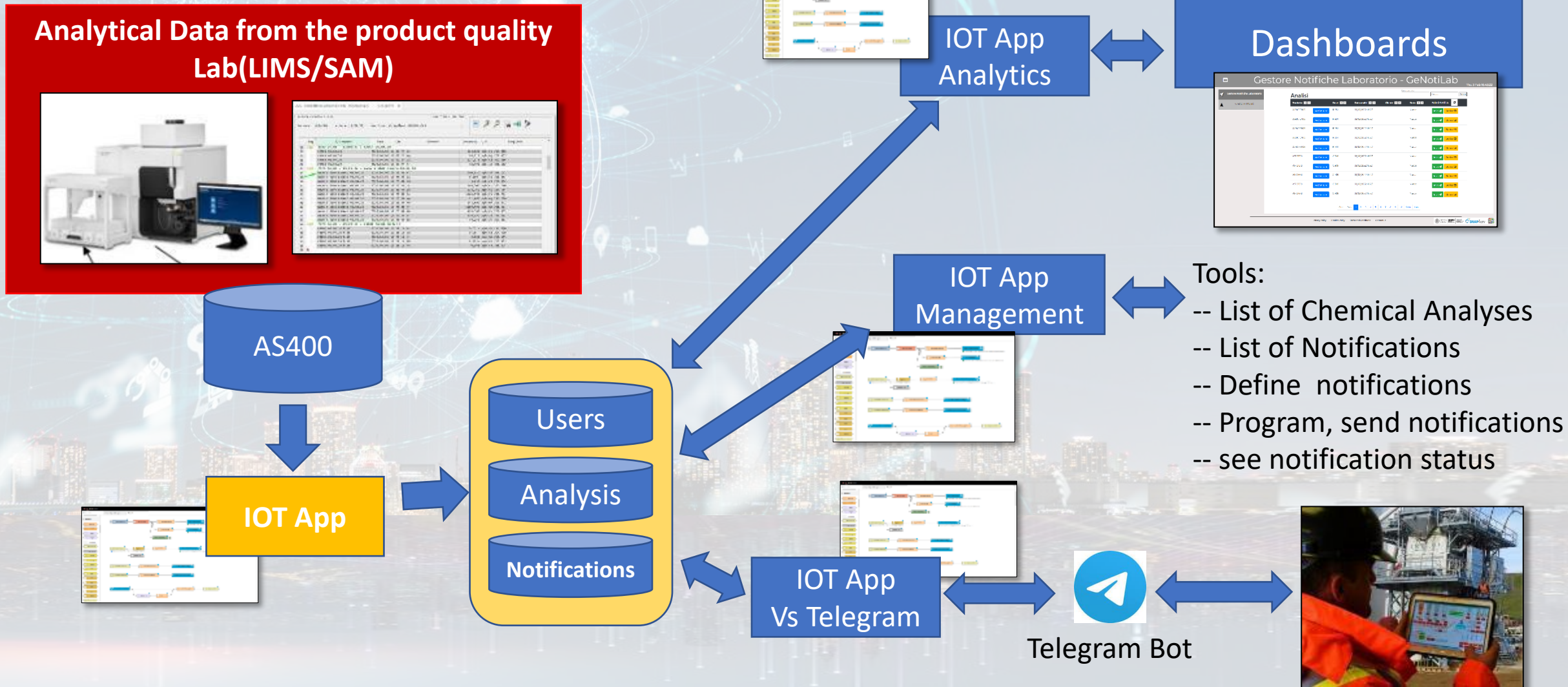
Explainable AI to map critical values of devices and detection to physical elements in the plant



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

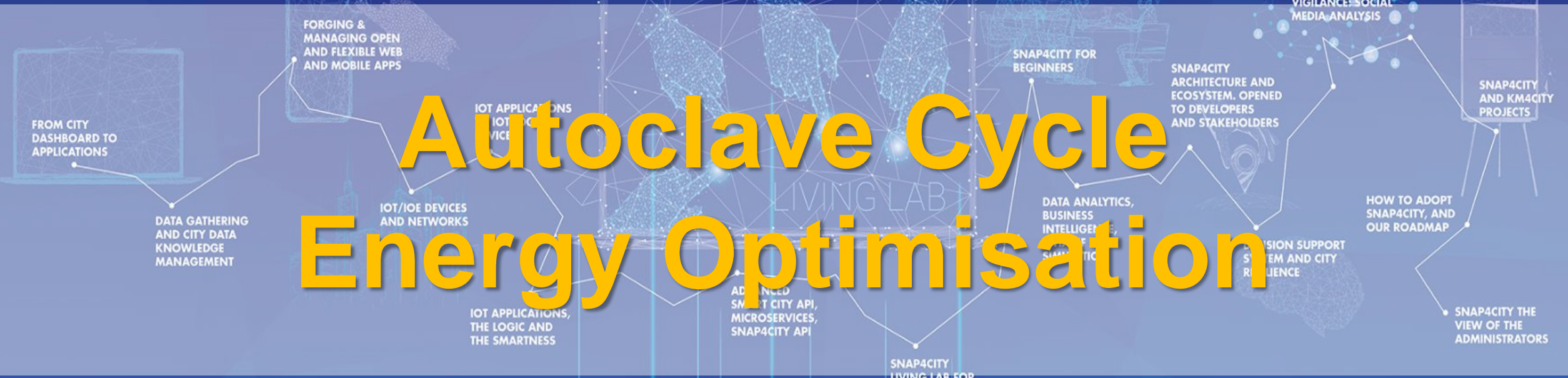


# GeNotiLab Architecture for ALTAIR



TOP

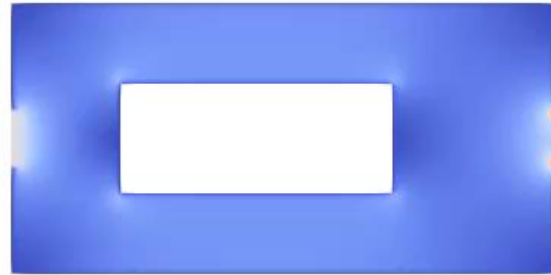
# Autoclave Cycle Energy Optimisation



# PINN: Physically Informed Neural Networks Models

- **Solving Navier-Stokes PDE** (partial differential equations) equation, **via PINN** approach
  - Reduction of computing costs for simulating load effect into the autoclaves curing process
  - Validation wrt Open Foam
  - Precision on steady and transitory cases
  - Definition of Transfer Learning techniques
- Videos on <https://www.snap4city.org/1010>

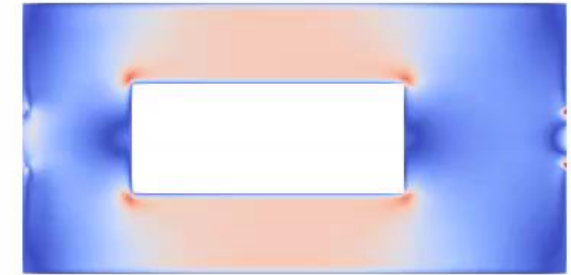
# Comparison of PINN vs OpenFoam and error



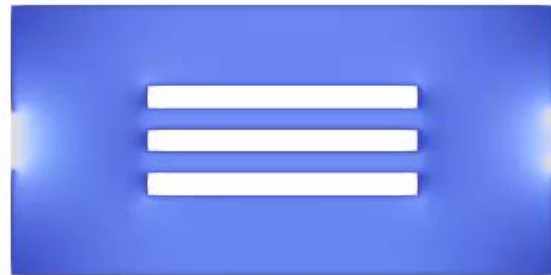
OpenFoam  
0.000 2.000



MFN-PINN (512)  
0.000 2.000



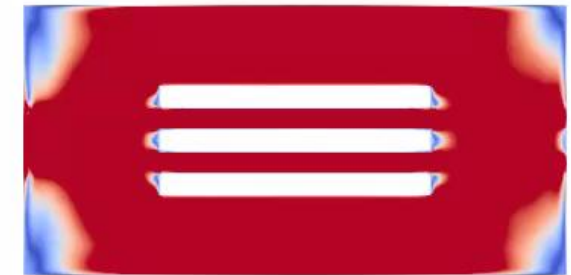
Absolute Error  
0.000 0.250 0.500



OpenFoam  
0.000 2.000



MFN-PINN  
0.000 2.000



Absolute Error  
0.000 0.050 0.100

## 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 %

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\_MOTORE\_VENT: 27.1 °C

TEMP\_RAFFREDDAMENTO: 27.7 °C

NOME RICETTA: Cilindri ebanite aria calda

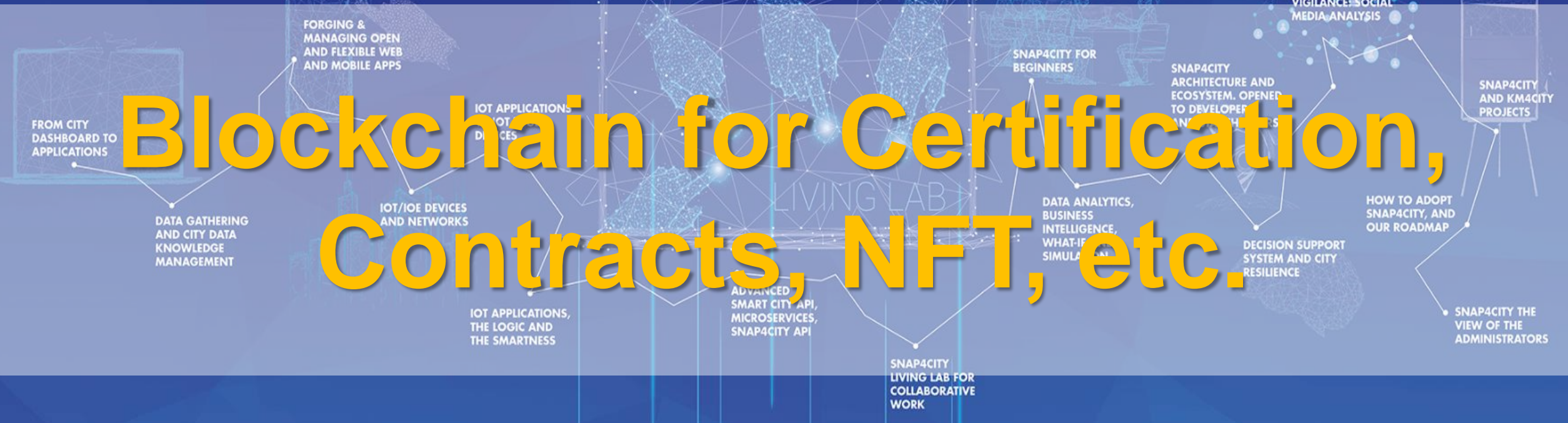
- Main Dashboard
- Autoclave db - Weekly
- Autoclave KPI - Weekly
- Impianto Presse - Weekly
- OpcUaValues - Weekly
- OpcUaValues and Historian



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

TOP

# Blockchain for Certification, Contracts, NFT, etc.

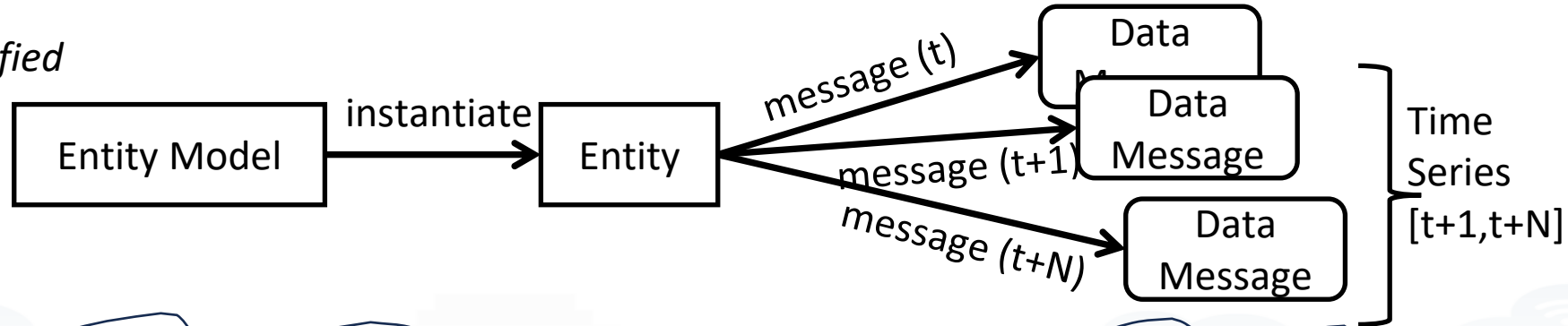


# BlockChain vs Snap4City

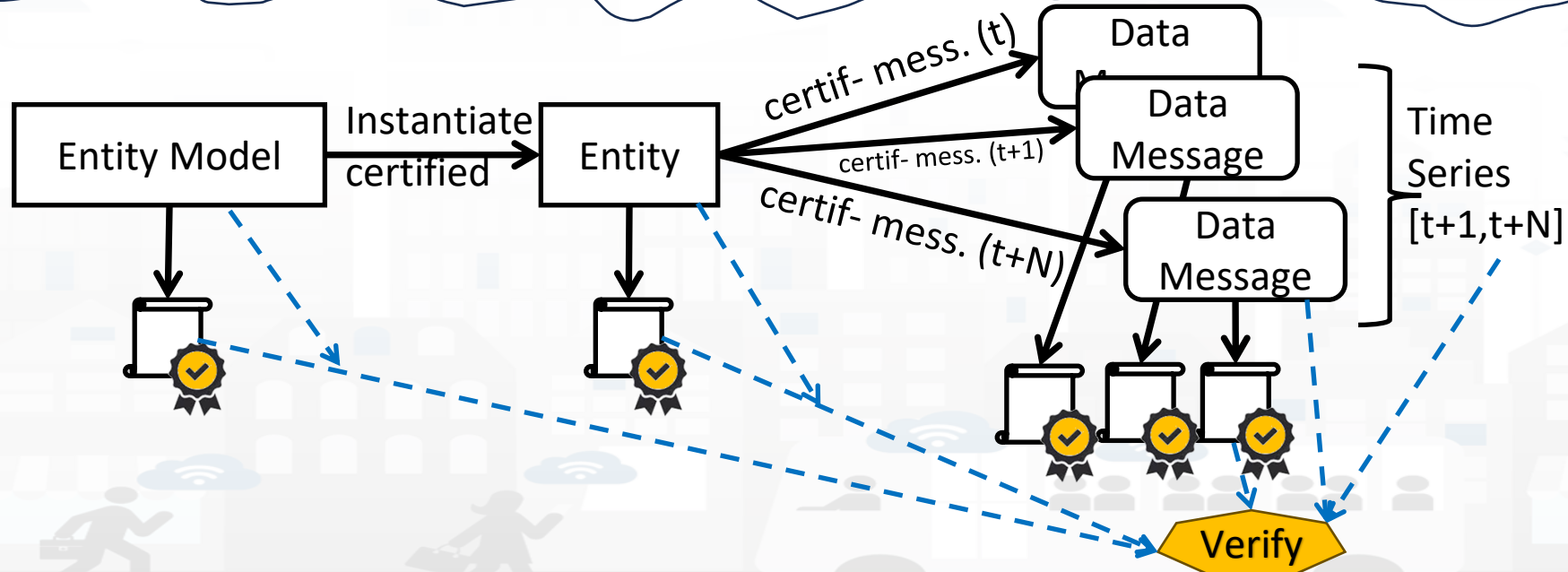
- A feature optionally installed and optimally used to certify locally or in federation with other installations.
- Blockchain technology on Snap4City can be used for:
  - Certification of Data Messages →
    - Time Series, NFT with history of transactions, cold chains, transactions chains
    - MaaS, Waste collection Pay as you Throw (PAYT), etc.
  - Certification of Devices/Entities →
    - Contracts, transaction, micro-transactions
  - Certification of IoT Devices/Entities Models
    - Usage of Standard models and templates

# Cerified and non certified entities

*Fully non certified*

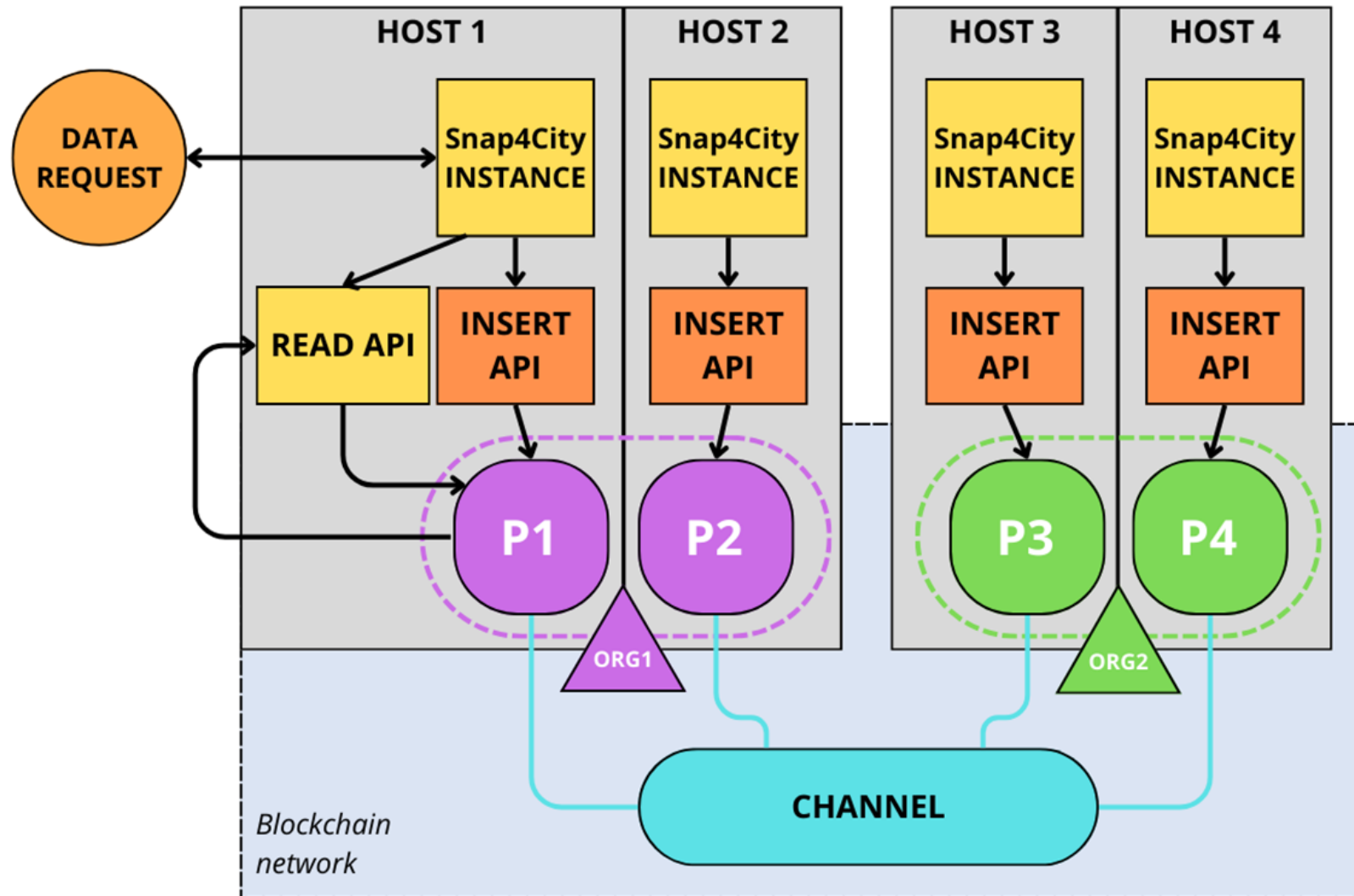


*Fully certified*





# Snap4City with Blockchain





Devices blockchain verification

1 PENDING   0 IN EXECUTION   0 FAILED   35 COMPLETED

Show  entries   Search:

Device Identifier	From date	To date	Owner	Request Status	Report	Check Performed	missing data
traffic_9001	1179-01-01T00:00:00	1179-01-21T00:00:00		completed	DOWNLOAD REPORT	1000	0
traffic_9001	1179-01-01T00:00:00	1179-01-11T00:00:00		completed	DOWNLOAD REPORT	528	0
traffic_9001	1179-01-01T00:00:00	1179-01-15T00:00:00		completed	DOWNLOAD REPORT	720	2
traffic_9001	1179-01-01T00:00:00	1179-01-06T00:00:00		completed	DOWNLOAD REPORT		
traffic_9001	1179-01-01T00:00:00	1179-01-02T00:00:00		completed	DOWNLOAD REPORT		
traffic_9001	1179-01-01T00:00:00	1179-01-01T00:00:00		completed	DOWNLOAD REPORT		
traffic_1002	2024-04-03T00:00:00	2024-04-26T00:00:00	tochange	pending	DOWNLOAD REPORT		

Showing 31 to 37 of 37 entries

Devices blockchain verification

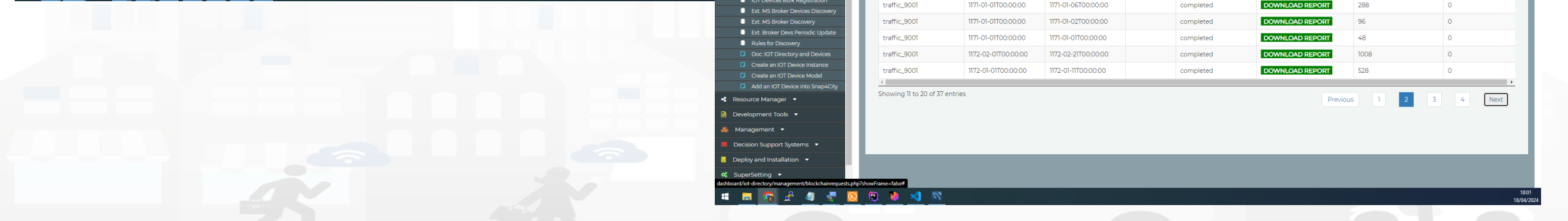
1 PENDING   0 IN EXECUTION   0 FAILED   35 COMPLETED

Show  entries   Search:

Device Identifier	From date	To date	Owner	Request Status	Report	Check Performed	missing data
traffic_9001	1170-01-01T00:00:00	1170-01-02T00:00:00		completed	DOWNLOAD REPORT	96	0
traffic_9001	1170-01-01T00:00:00	1170-01-01T00:00:00		completed	DOWNLOAD REPORT	48	0
traffic_9001	1171-01-01T00:00:00	1171-01-21T00:00:00		error	DOWNLOAD REPORT	1008	0
traffic_9001	1171-01-01T00:00:00	1171-01-11T00:00:00		completed	DOWNLOAD REPORT	528	0
traffic_9001	1171-01-01T00:00:00	1171-01-15T00:00:00		completed	DOWNLOAD REPORT	720	0
traffic_9001	1171-01-01T00:00:00	1171-01-06T00:00:00		completed	DOWNLOAD REPORT	288	0
traffic_9001	1171-01-01T00:00:00	1171-01-02T00:00:00		completed	DOWNLOAD REPORT	96	0
traffic_9001	1171-01-01T00:00:00	1171-01-01T00:00:00		completed	DOWNLOAD REPORT	48	0
traffic_9001	1172-02-01T00:00:00	1172-02-21T00:00:00		completed	DOWNLOAD REPORT	1008	0
traffic_9001	1172-01-01T00:00:00	1172-01-11T00:00:00		completed	DOWNLOAD REPORT	528	0

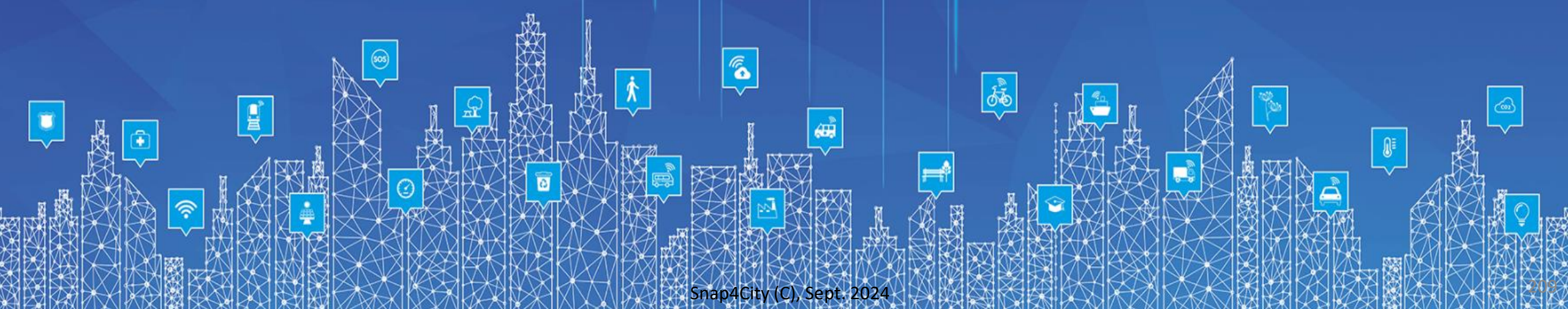
Showing 11 to 20 of 37 entries

Previous 1 2 3 4 Next



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](#)



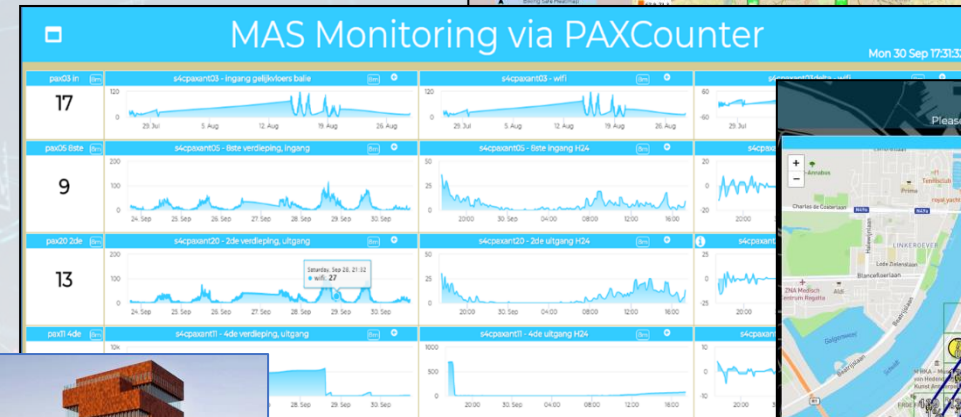
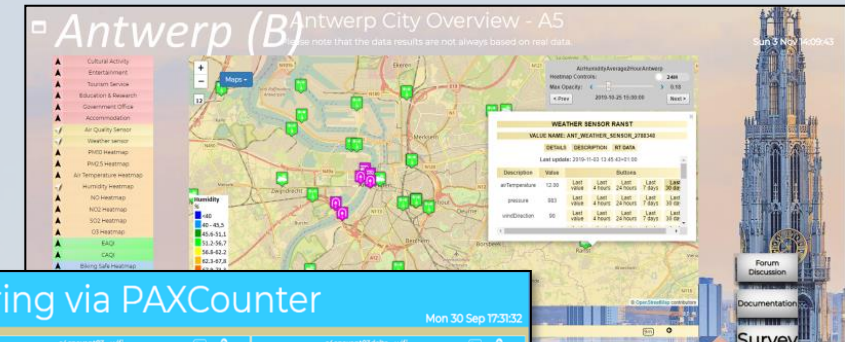
## Scenariious

- [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**



# Valencia, FSMLR

- **Tourism Domain**

- Counting People
- Environmental data
- Social Media

- **Dashboards**

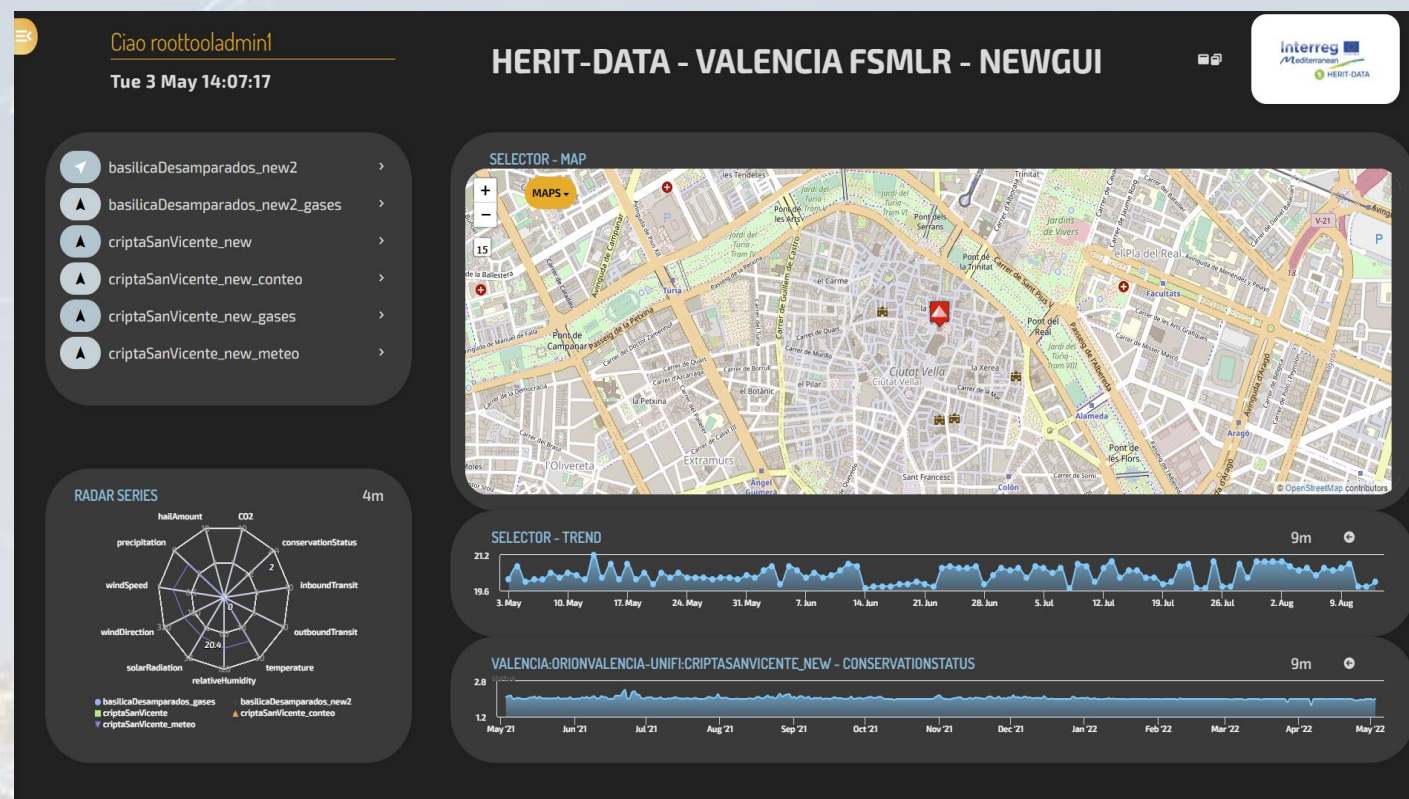
- Monitoring and real time control
- People flow
- Twitter Vigilance

- **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**

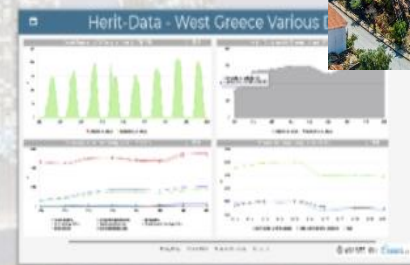
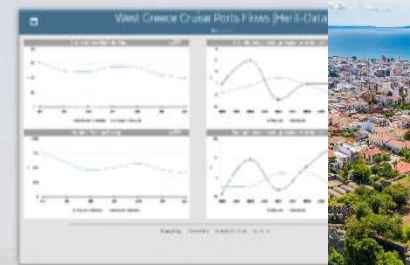
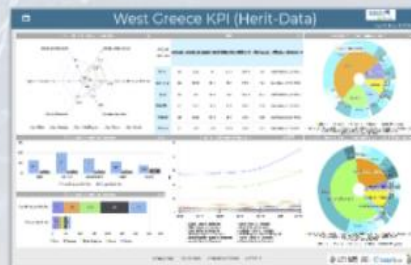
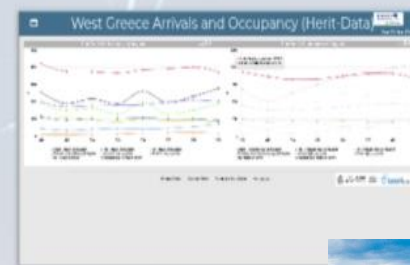
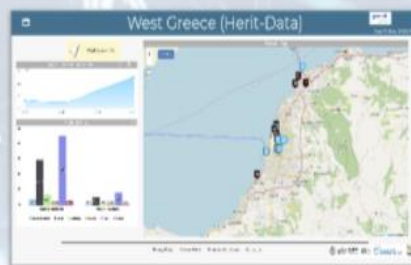
- Monitoring KPI
- People flows
- Twitter Vigilance

- **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

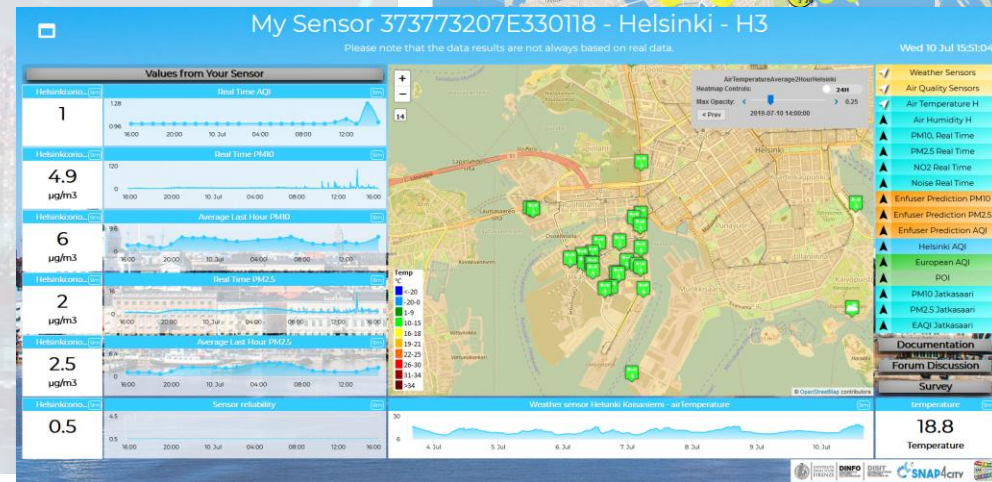
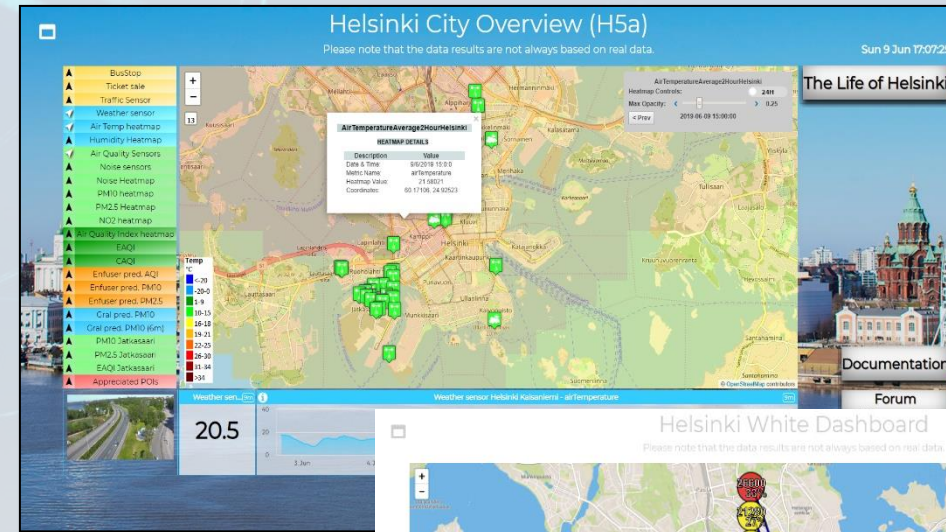
### • Social: Twitter Vigilance, early warning

### • 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



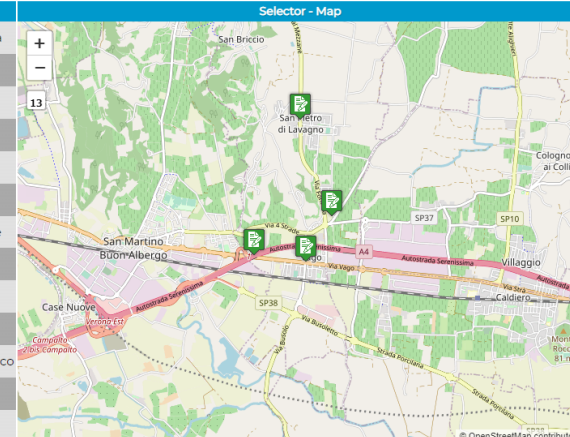
## Progetto Terso - Lavagno

Smartea

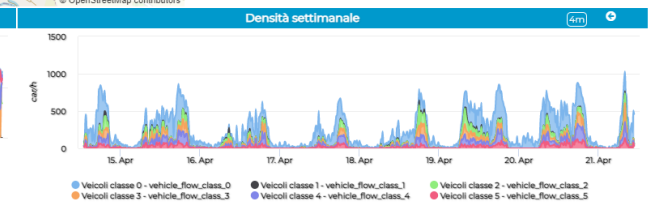
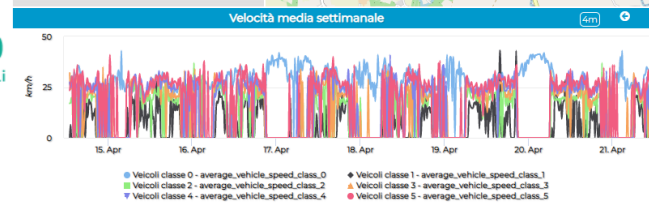
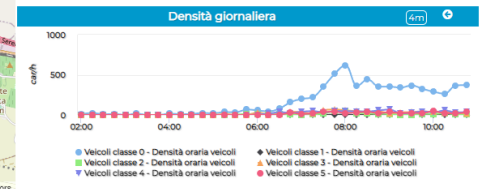
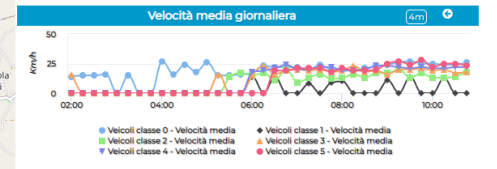
Thu 21 Apr 10:59:49



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



Privacy Policy Cookies Policy Terms and Conditions



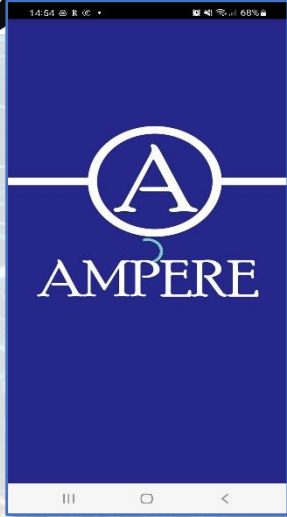
- Traffic Data
- Environmental Data
- People counting (pedestrian)

terso  
territorisostenibili

# Jewel Alarms AMPERE



BLE



### 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>Pin</b>						
Hidkdbdb	sdjldj		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: 1250666385
- 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

**Emergency number:**

- Call 112: false
- Call 115: true
- Call 118: true

**Contacts:**

- Contact name: S Longo Longo
- Phone number: 4588665536

User Metadata

List of user event's

Status	Description	Try
Called: Longo Longo		<b>Pin</b> <b>Action</b>
Called: Longo Longo		<b>Pin</b> <b>Action</b>
Called: 118		<b>Pin</b> <b>Action</b>
alert:		<b>Pin</b> <b>Action</b>

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		<b>Pin</b> <b>Action</b>
2022-04-11T14:38:24.112Z	Operator	Called: 118		
2022-04-12T08:16:46.076Z	APP	alert		<b>Pin</b> <b>Action</b>
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**

Click on Jewel



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

*On Line Training Material (free of charge)*



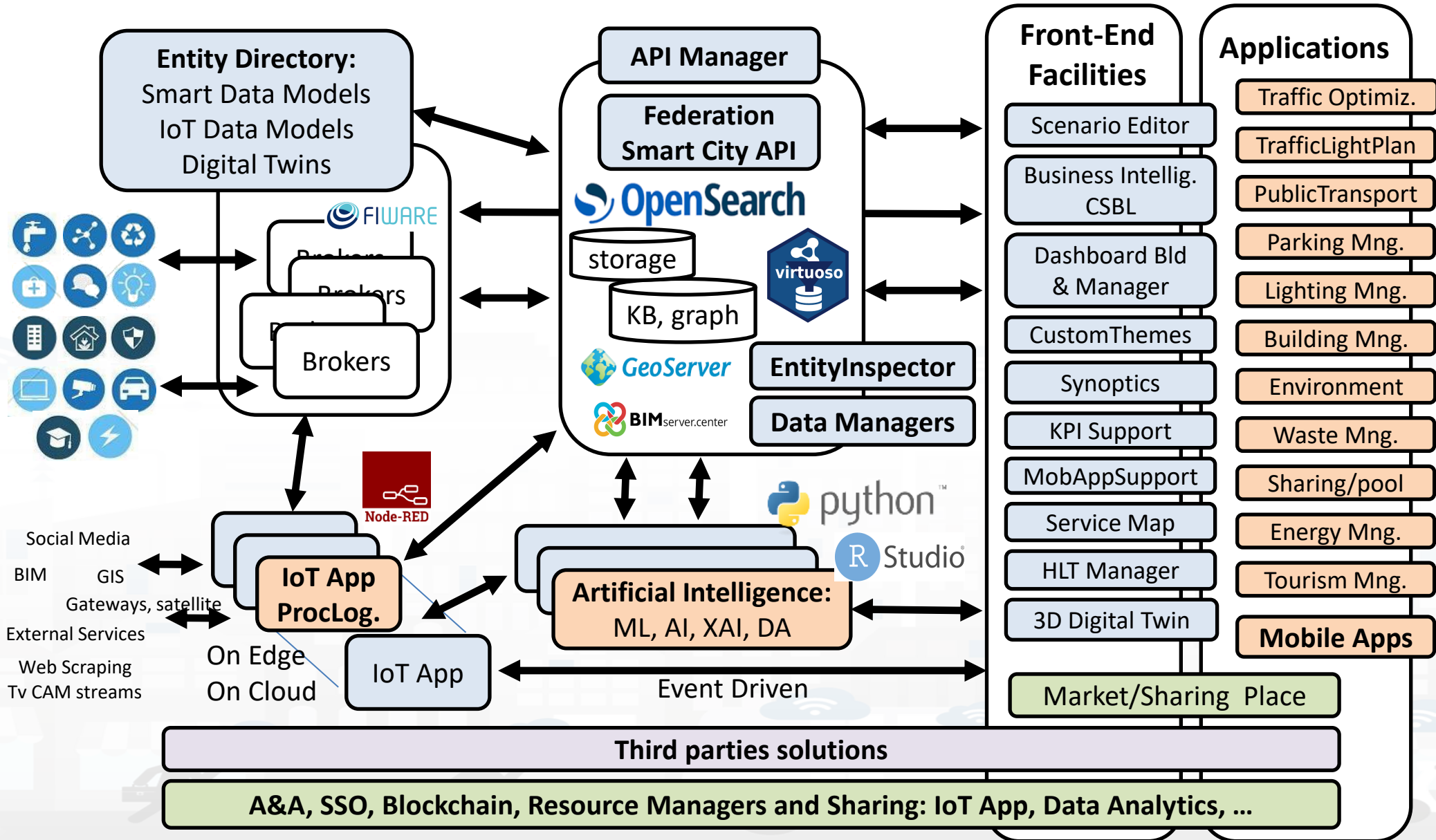
1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions


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								



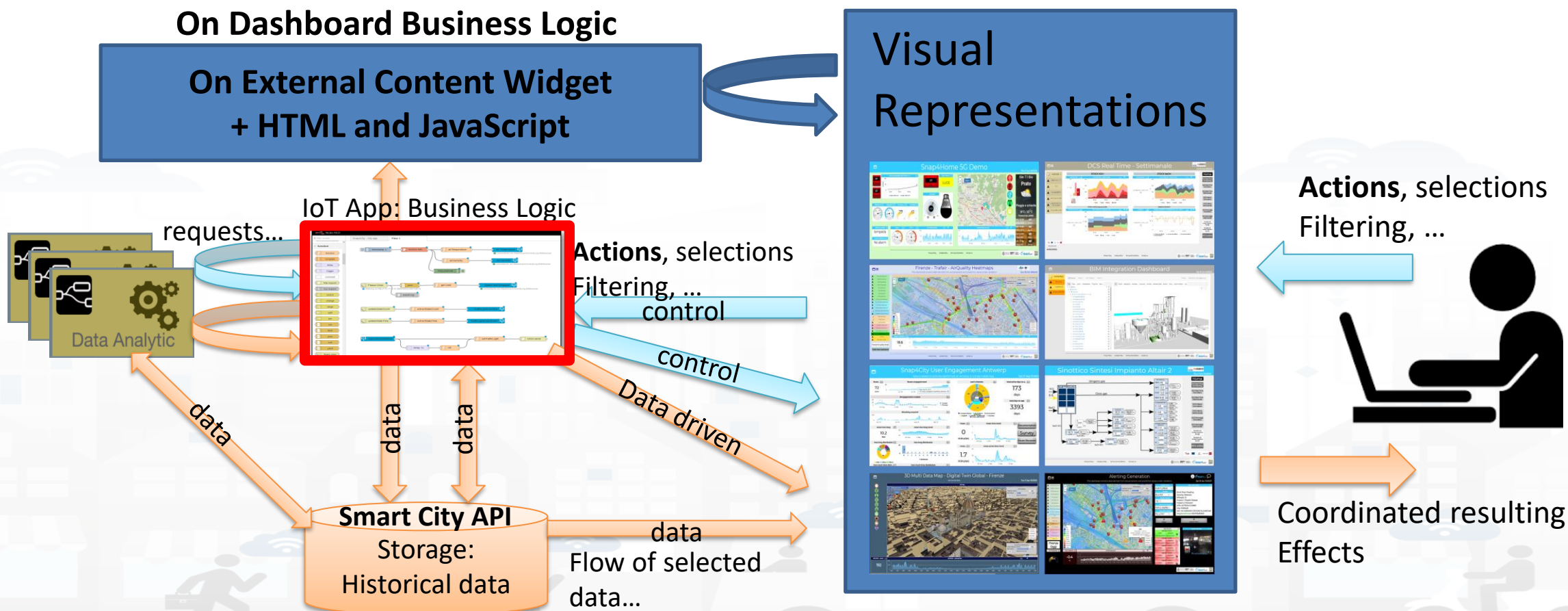
# Agenda of second part

- 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.



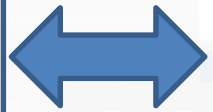
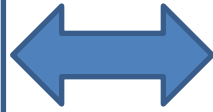
# Dashboard Builder: Development

Data Transformation  
Business Logic

IOT Applications

Knowledge Base,  
Km4City

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

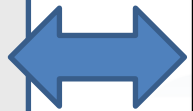


Widget Collection

Micro Applications

External Services

Custom Widgets/  
Synoptics



Dashboard Wizard

Dashboard Editor

Public Dashboard Collection

My Own Dash/App

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





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

High-Level Type | Subnature | Value Type | Value Name | Data Type | Last Date | Last Value

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

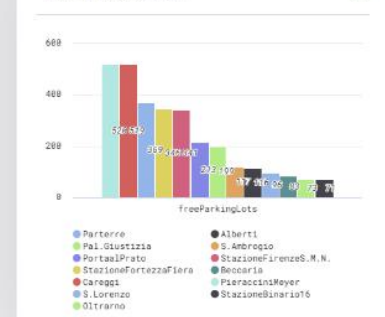
SELETORE

- CarPark IOT
- Car\_park CAT

MAPPA



STATO PARCHEGGI 2m




freeParkingLots

- Parterre
- Pal. Giustizia
- Porta al Prato
- Stazione Fortezza Fiera
- Careggi
- S. Lorenzo
- Oltarno
- Alberti
- S. Ambrogio
- Stazione Firenze S. M. N.
- Beccaria
- Pieraccini Meyer
- Stazione Binario 76

PARTERRE 7m

369 Posti disponibili

PARTERRE - ANDAMENTO NUMERO POSTI LIBERI 7m

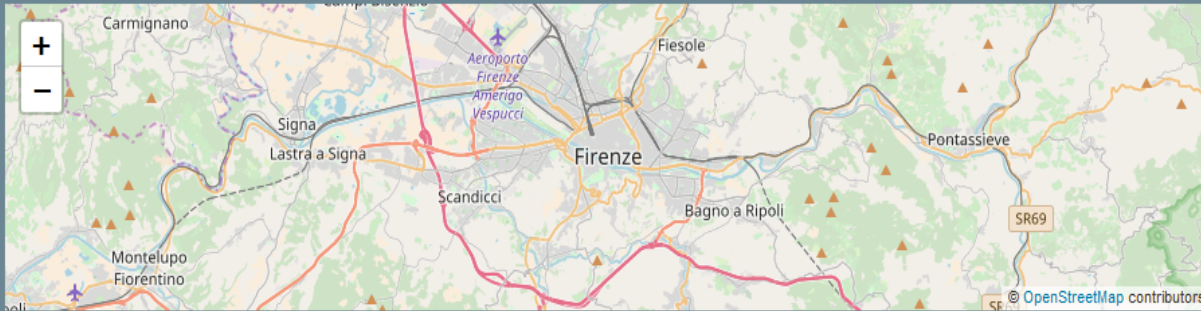


The Wizard help you in selecting only possible combination of data vs graphic representation

## Wizard

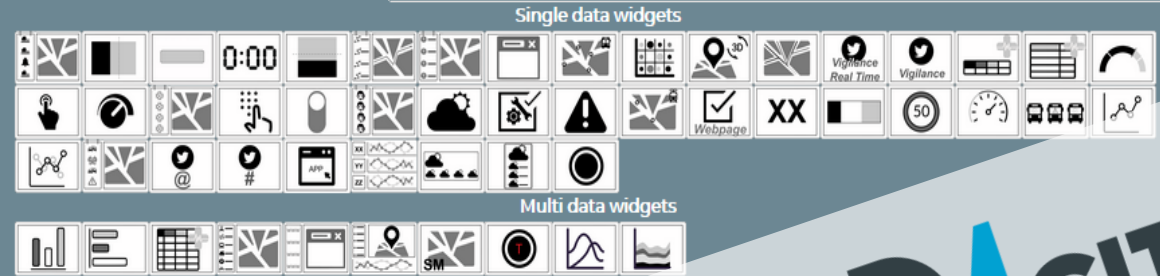
## Dashboard features

## Map



## 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				2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather				2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather				2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather				2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather				2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather				2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather				2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather				2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast	Previ_Meteo	special weather				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

# New Data Inspector/Wizard

New Wizard

Data Inspector BETA OS

The interface includes a map of Florence, a dashboard with various widgets, a table of data sources, and a time-series visualization. A large red watermark 'New Wizard' is overlaid on the top left.

Level	Type	Nature	Subnature	Device	Model	Broker	Value Name	Value Type	Data Type	Value Unit	Last Date	Last Value	Healthiness	Last Check	Ownership
DT	EM Devi...	Environment	Weather	DIDA1		Santa Verdiana ...	Mio sensore	webpage	webpage		2021-11-23 13:44...		●	2023-07-18 16:0...	public
DT	EM Devi...	TransferService...	SensorSite	METRO11		Altair-soda	Altair Valve State	webpage	webpage		2021-06-05 00:00...		●	2024-01-10 01:3...	public
DT	EM Devi...	IndustryAndMa...	Computer	AltairStatoPom...		Altair-soda	Altair Pump St...	webpage	webpage		2021-05-20 13:51...		●	2024-01-10 01:3...	public
DT	EM Devi...	Environment	Air	IBIMET_SMART...		Altair-soda	Altair pump 43...	webpage	webpage		2021-06-07 17:3...		●	2024-01-10 01:3...	public
DT	EM Devi...	Environment	Air	ARPAT_QA_FI...		Altair-soda	Altair valve 541	webpage	webpage		2021-06-07 17:3...		●	2024-01-10 01:3...	public
DT	EM Devi...	TransferService...	SensorSite	METRO514		Altair-soda	Altair Pump 4321	webpage	webpage		2021-06-07 00:00...		●	2024-01-10 01:3...	public
DT	EM Devi...	TransferService...	SensorSite	SI052032F5990...		Altair-soda	Altair Stock sta...	webpage	webpage		2021-06-07 00:00...		●	2024-01-10 01:3...	public
DT	EM Devi...	TransferService...	SensorSite	METRO831		Altair-soda	Altair Pump 92...	webpage	webpage		2021-06-07 00:00...		●	2024-01-10 01:3...	public

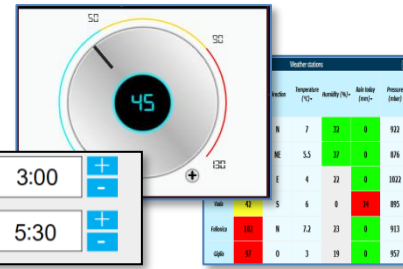
- Filtering/Searching for individual fields (even for some fields not displayed as geographic coordinates)
- Geographic Filtering
- Text Search on all fields
- Menu for choosing the fields to display in the table
- View on Map(via PREVIEW)
- Data and Trend visualization
- Opening Digital Twin
- Pass to Synoptic mode
- Select the graph representation

# Dashboard Widgets: List and Editor



Begin 3:00

Finish 5:30



CRID: 2018-000530 - S.P.N. 73 DI MARMANTILE - ISTITUZIONE TEMPORARY TRAFFIC LIGHTS

16/03/2018 00:00:00 5

CRID: 2018-000531 - S.P.N. 105 DI TORRANCI - ISTITUZIONE DI TEMPORARY TRAFFIC LIGHTS

12/03/2018 00:00:00 5

**INCIDENTI SOLO DANNI**

11/03/2018 10:06:12 1

**INCIDENTI CON FERTI**

11/03/2018 05:30:23 1

**INCIDENTI SOLO DANNI**

11/03/2018 05:58:48 1

**INCIDENTI CON FERTI**

11/03/2018 05:38:41 1



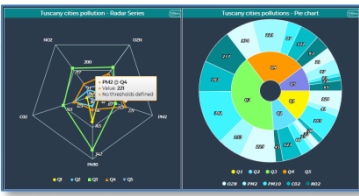
Cam Firenze 1 Cam Firenze 2

Antwerp Helsinki Florence Current Blue

**PeopleNumber**

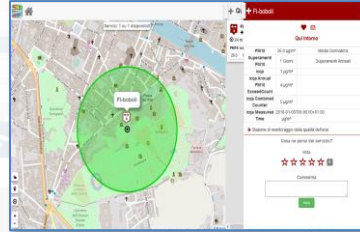
7	8	9
4	5	6
1	2	3
0	.	Cancel

Confirm



Snap4City - Mobility Operator

5.1

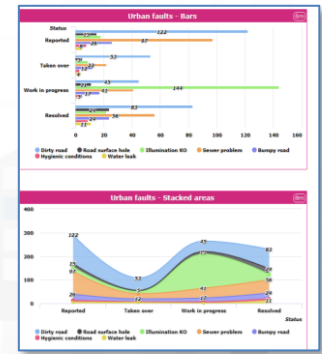
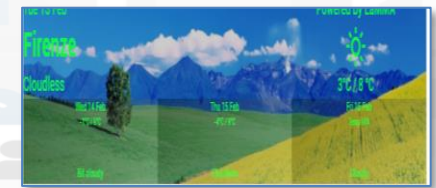


Europa Montepagni

45 45

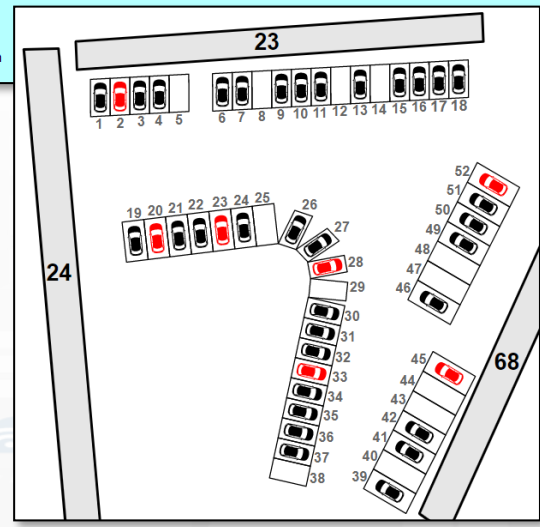
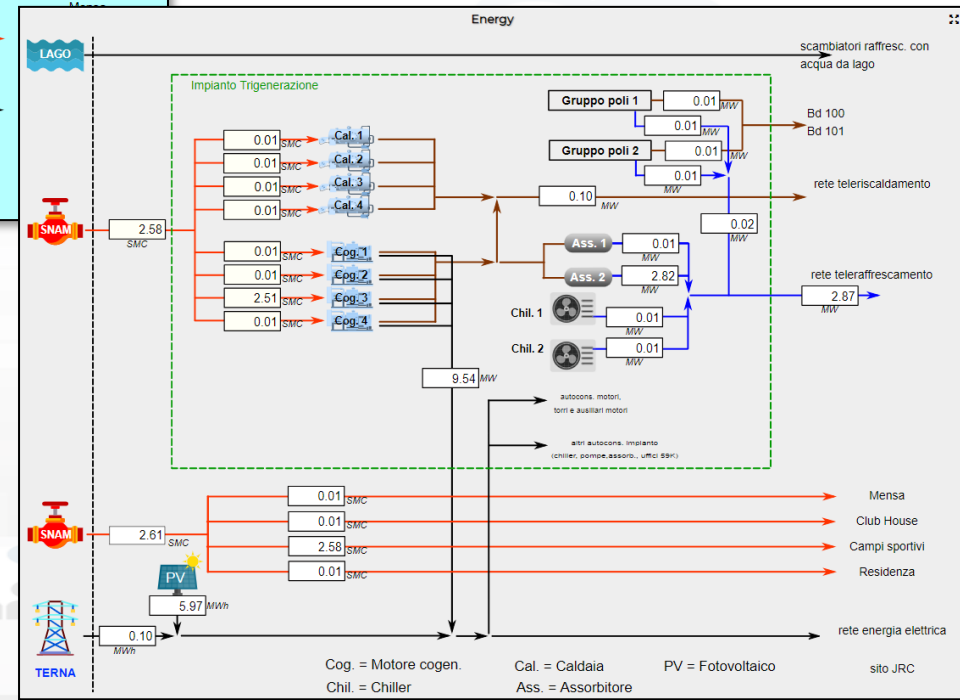
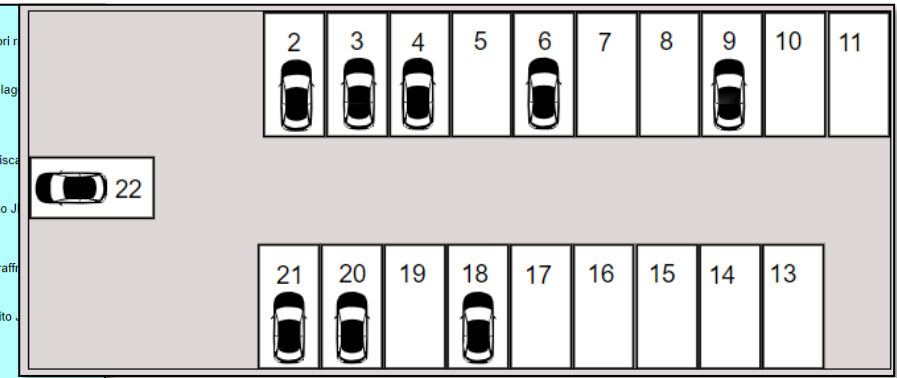
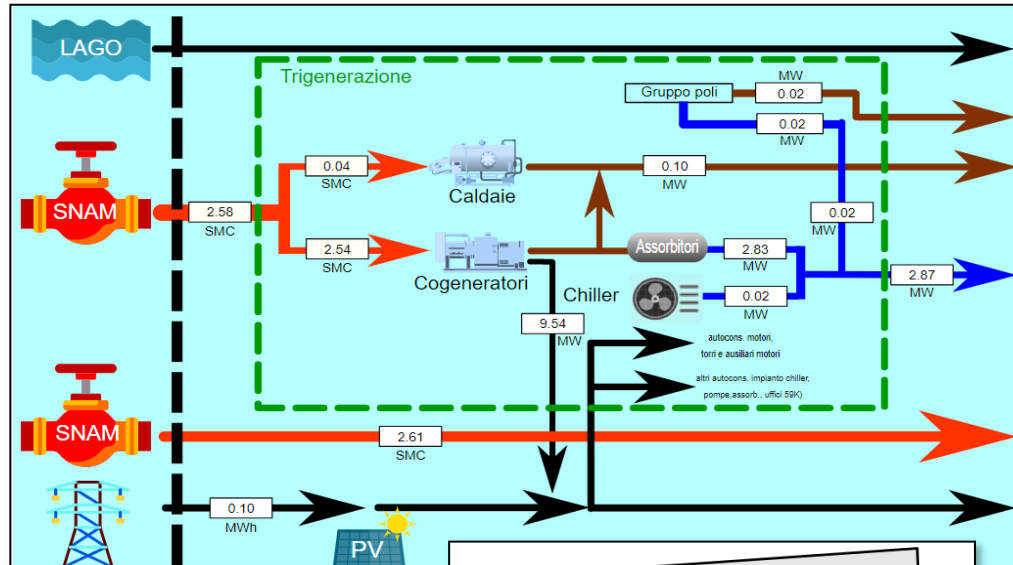
Lavagnini Statuto

45 45



# Special Custom Widgets

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



-2 -1 0 1 2

Total clicks 6    Mean rate value 0.00

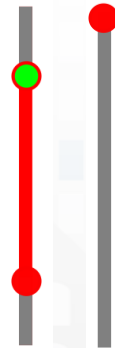
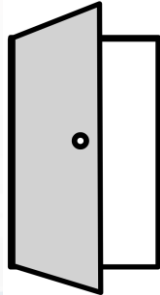
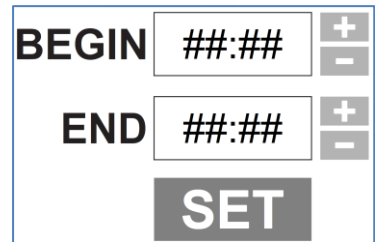
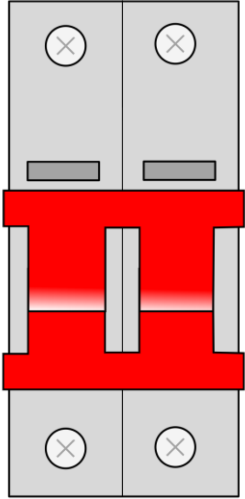
Begin 17:00 + -

Finish 4:00 + -

# Other examples

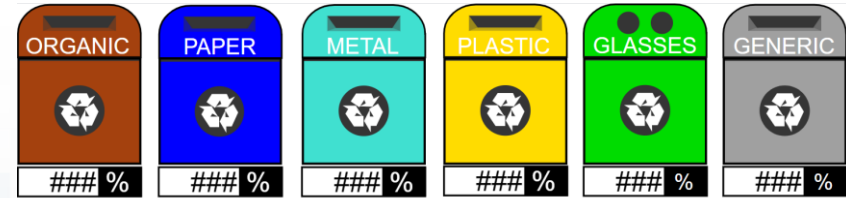
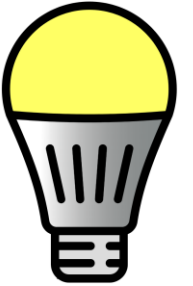
## • Virtual Actuators (sensor-actuator)

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

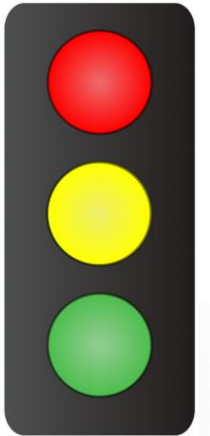
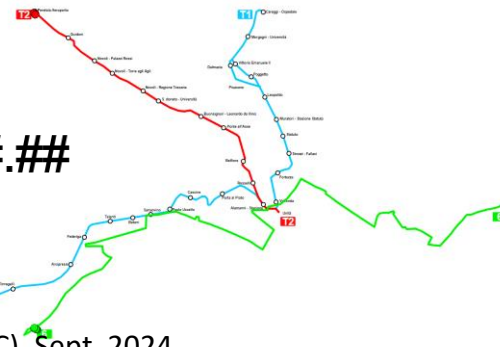


## • Virtual Sensors

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

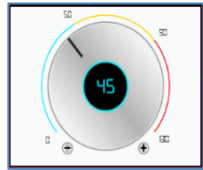


#####.##



# Business Logic on Dashboards

PeopleNumber		
Time	Last confirmed	
	None	
7	8	9
4	5	6
1	2	3
0	-	Cancl
Confirm		



IoTDevice Data

enter text

enter number

enter email

enter password

enter check

enter check2

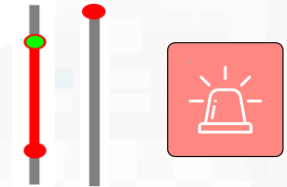
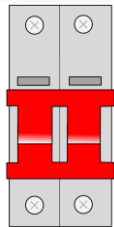
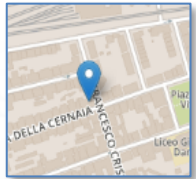
enter switch

enter switch2

enter date gg/mm/aaaa

enter time

Submit



- impulse button
- numeric keyboard
- switch button
- dimmer
- geolocator
- dropdown
- form
- coordinates from map
- event driven my kpi
- synoptic read
- synoptic subscribe
- dashboard - map

**IOT Application**

- gauge chart
- single content
- speedometer
- horizontal single bar
- vertical single bar
- web content
- time trend
- bar series
- radar series
- pie chart
- curved line series
- table content
- calendar
- speak synthesis
- synoptic write
- Selector - Map
- dashboard - map

20.3°C

SNAP4CITY Dashboard Widgets:

- Map with speedometer overlay
- Temperature gauge (20.3°C)
- Line chart (Temperature)
- Bar chart (Temperature)
- Table (Temperature)
- Calendar
- Map with lightbulb icon
- Map with route
- Energy meter (CENTRALE DI SPINTA)
- Recycling bins (METAL, PLASTIC, GLASSES, GENERIC)

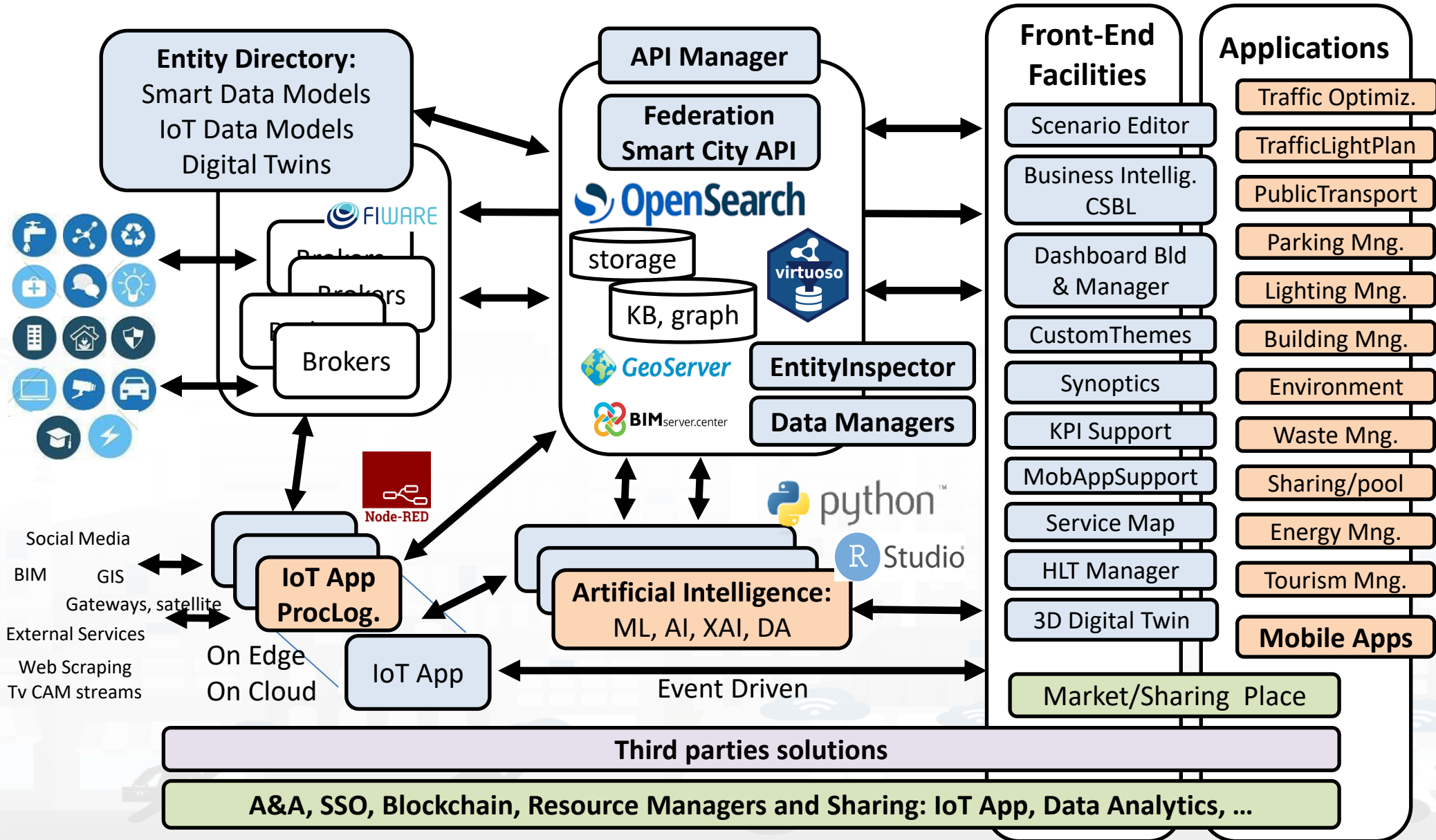
TOP

# IoT Application Development smartening the solutions

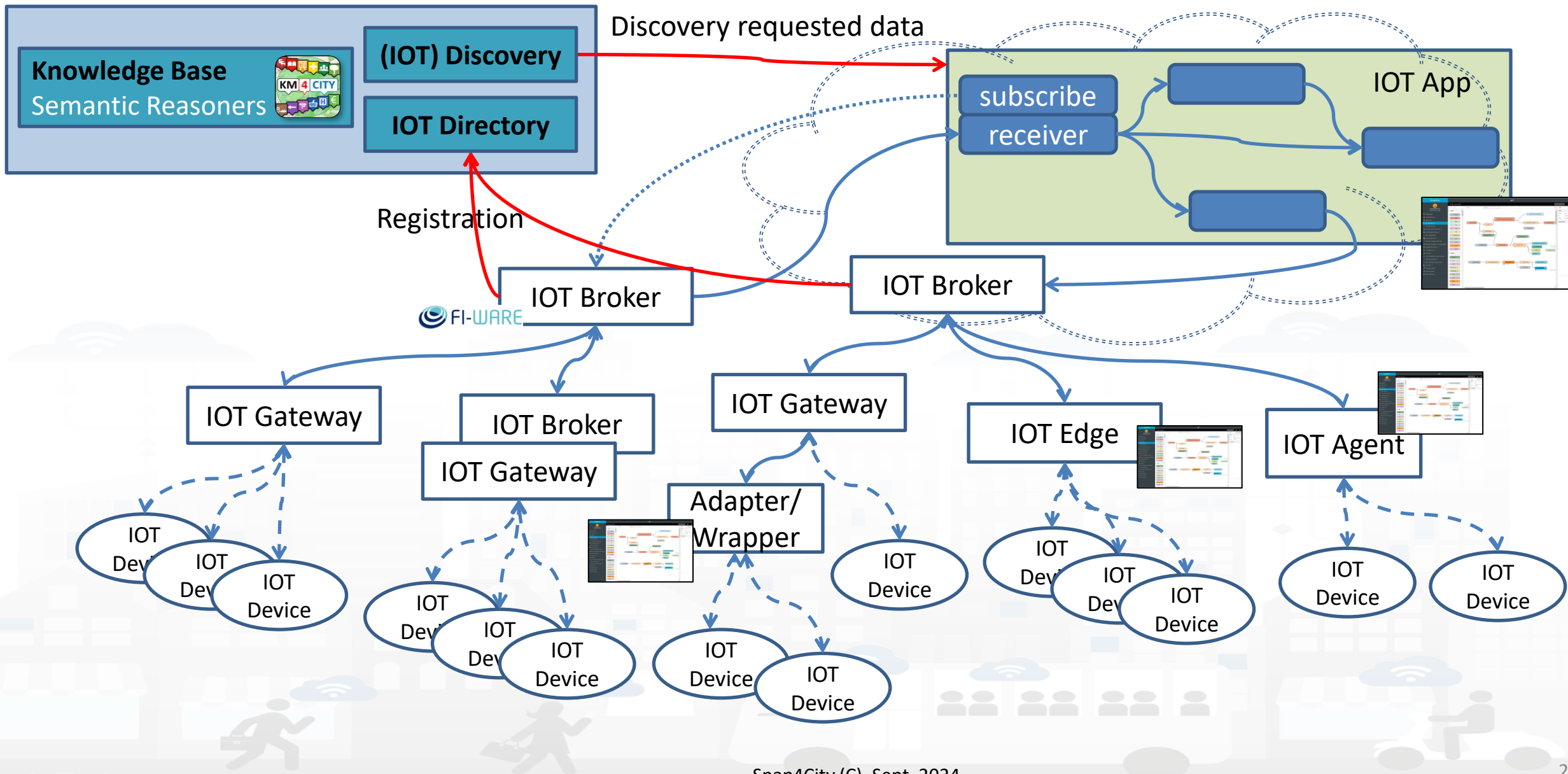


	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
what	Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								





# IoT Network

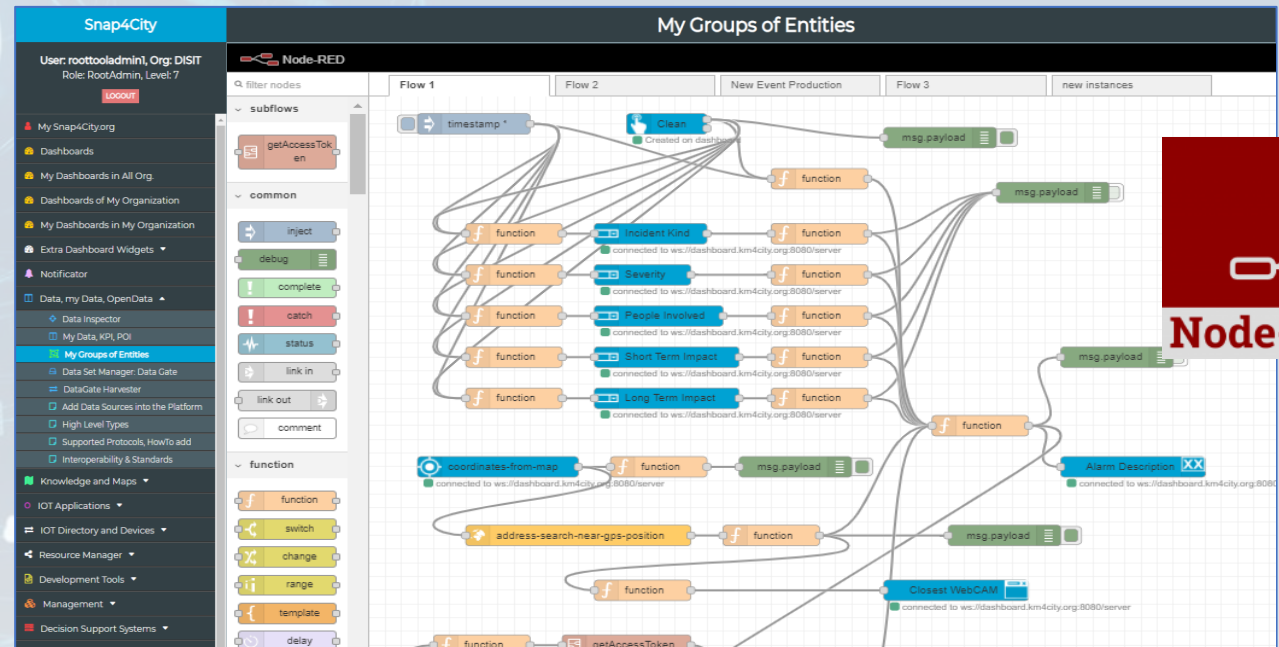


# Ingestion, aggreg. → exploitation



## IoT App Visual Programming, no coding

- Data transformation
- Integration, Interoperab.
- Scripting Data Analytics
- Data ingestion
- Business logic



## Edge and Cloud

## MicroServices data driven develop via visual language Node-RED

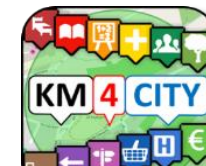
<https://flows.nodered.org/search?term=snap4city>

AND: From Resource Manager

We suggest also to install:

- NGSI Entity
- NGSI Dataset
- NGSI Update
- NGSI Subscription
- NGSI Context
- Twitter Heart Data
- Twitter Heart Data Twitter Channel
- Twitter Heart Data Twitter Channel Search
- Twitter Heart Data Twitter Channel Search
- Twitter Heart Data Twitter Channel Search
- Twitter Heart Data Twitter Channel Search
- Twitter Heart Data Twitter Channel Search

Snap4City(C), May 2021



# 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



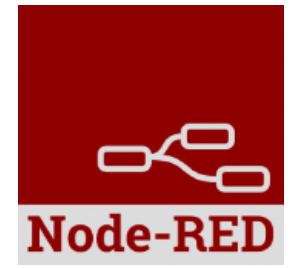
Tour Again

Sort icons: ↓↑, ↓↑  
Prev 1 2 3 Next  
Filter

- 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' node, another 'world map' node, and an 'event-log' node. A 'timestamp' node feeds into a 'service-info' node, which then connects to a 'vehicleFlow' node. The 'vehicleFlow' node has multiple outputs, including 'vehicle flow (car/h)', 'worldmap', 'switch', and 'sensor abc'. Another 'timestamp' node feeds into a 'last temperature' function node, which connects to a 'Dashboard' node. The 'Dashboard' node is connected to a 'get v' node, which then 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

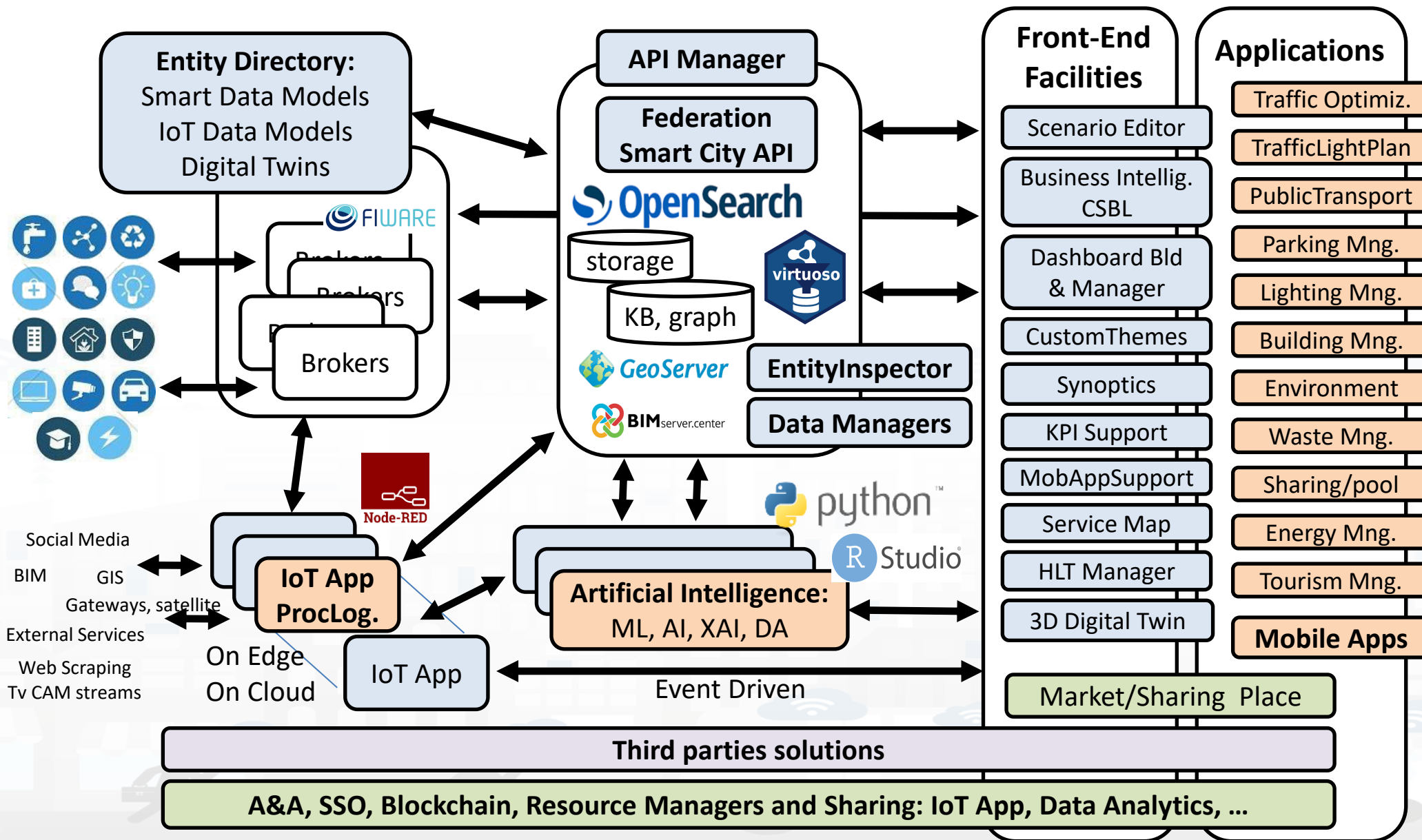
Everywhere: Cloud, on IoT Edge Devices

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								





# Available AI Solutions on Snap4City

<https://www.snap4city.org/997>

More than 80 Available Solutions & 300 AI applic.

- Mobility and Transport
- Environment, Weather, Waste, Water
- City Users Behaviour and Social analysis
- Energy and Control
- Tourism and People
- Security and Safety
- High Level Decision Support Solutions
  - Asset management
  - Resilience and Risks Analysis
- Low level Techniques



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

<https://www.snap4city.org/download/video/course/p4/>



Ciao roottooladmin!

Wed 14 Feb 22:40:02

## FIRENZE - TRAFAIR - AIRQUALITY HEATMAPS - NEWGUI

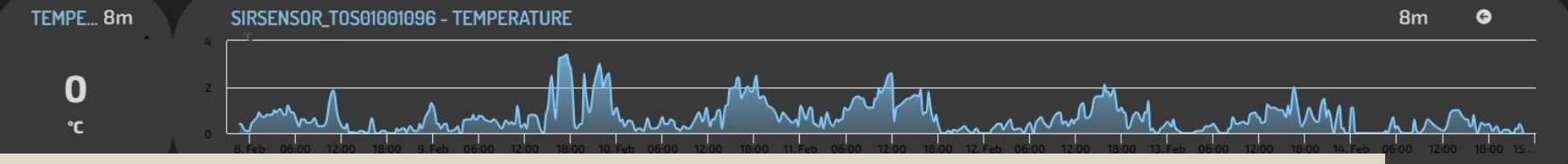
This dashboard contains data derived from actual sensors and predictive values under validation



- U3 Heatmap
- NO2 Heatmap
- Europ. AQI Heatmap
- Air Humidity Heatmap
- Air Temp. Heatmap
- Wind Speed Heatmap
- Gral Pred. HM NOX (3m)
- Gral Pred. HM NOX (6m)
- Traffic Sensors
- Traffic Flow



- Firenze Air quality trends
- Firenze GRAL Scenario
- TraFair Main Dashboard



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

Select map

Zoom

The interface includes a map with various road segments (blue, green, red) and arrows indicating direction. On the left, there are zoom controls (+, -, 20) and a home button. Below the map is a toolbar with icons for editing (pencil, plus, eraser, split/join, delete, undo, redo) and a 'Filter by road types' button. A 'View/Edit' panel at the bottom left has 'Show Road graph' and 'Show Traffic Sensors' checked. A 'Road Types' panel at the bottom center lists various road categories with checkboxes. On the right, there are two configuration panels: 'Edit Road Segment' and 'Category Street'.

Scenario name:

Location:

Scenario description:

ReferenceKB:

Save Road Graph:

Save traffic Sensors:

Save other Sensors:

From:

To:

Edit Road Segment

Category Street:

Nr.Lanes:

Speed Limit (km/h):

Direction:

Restrictions:

- Road Types:
- |  |   |  |  |   |
|--|---|--|--|---|
| <input checked="" type="checkbox"/> abandoned              | <input checked="" type="checkbox"/> brideway      | <input checked="" type="checkbox"/> bus_guideway | <input checked="" type="checkbox"/> bus_stop       | <input checked="" type="checkbox"/> construction        |
| <input checked="" type="checkbox"/> corridor               | <input checked="" type="checkbox"/> crossing      | <input checked="" type="checkbox"/> cycleway     | <input checked="" type="checkbox"/> disused        | <input checked="" type="checkbox"/> elevator            |
| <input checked="" type="checkbox"/> emergency_access_point | <input checked="" type="checkbox"/> emergency_bay | <input checked="" type="checkbox"/> footway      | <input checked="" type="checkbox"/> island         | <input checked="" type="checkbox"/> living_street       |
| <input checked="" type="checkbox"/> motorway               | <input checked="" type="checkbox"/> motorway_link | <input checked="" type="checkbox"/> no           | <input checked="" type="checkbox"/> path           | <input checked="" type="checkbox"/> platform            |
| <input checked="" type="checkbox"/> primary                | <input checked="" type="checkbox"/> primary_link  | <input checked="" type="checkbox"/> private      | <input checked="" type="checkbox"/> raceway        | <input checked="" type="checkbox"/> razed               |
| <input checked="" type="checkbox"/> residential            | <input checked="" type="checkbox"/> rest_area     | <input checked="" type="checkbox"/> road         | <input checked="" type="checkbox"/> secondary_link | <input checked="" type="checkbox"/> service             |
| <input checked="" type="checkbox"/> services               | <input checked="" type="checkbox"/> steps         | <input checked="" type="checkbox"/> tertiary     | <input checked="" type="checkbox"/> tertiary_link  | <input checked="" type="checkbox"/> track               |
| <input checked="" type="checkbox"/> traffic_island         | <input checked="" type="checkbox"/> tram          | <input checked="" type="checkbox"/> trunk_link   | <input checked="" type="checkbox"/> unclassified   | <input checked="" type="checkbox"/> via_ferrata         |
| <input checked="" type="checkbox"/> secondary              | <input checked="" type="checkbox"/> yes           | <input checked="" type="checkbox"/> pedestrian   | <input checked="" type="checkbox"/> bus_guideway   | <input checked="" type="checkbox"/> ohm:military:Trench |

- identifier
- composition
- elemLocation
- elementClass
- elementType
- length
- operatingStatus
- speedLimit
- trafficDir
- width
- highwayType
- route

New Scenario

Editing

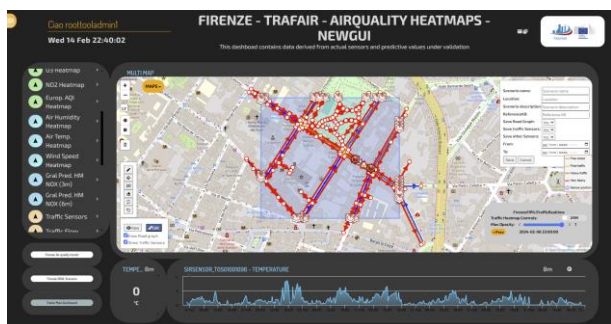
Drag & drop

Split & Join

Delete

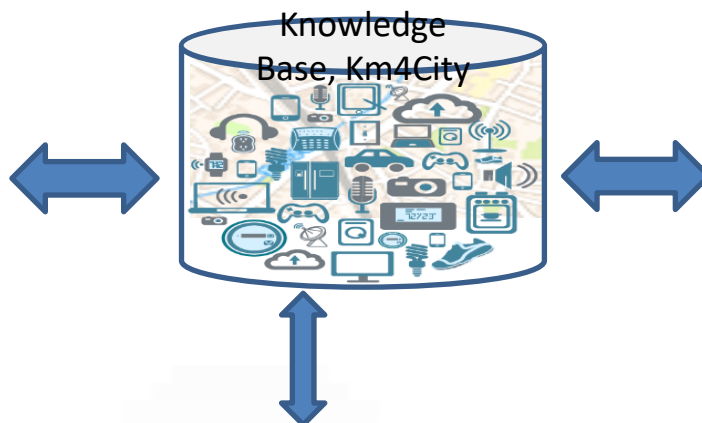
Do and Undo

# The actual Scenario Exploitation



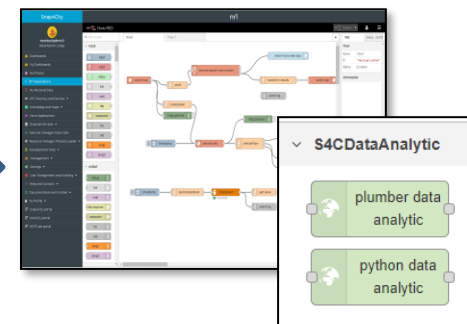
Defining Context via Editing Scenario:

- Select area and data
- Editing roads, POI, IoT entities, ..
- Save/load, share
- Change status



A Scenario includes:

- Metadata
- Status and versions, date time
- Period of validity
- Road graphs, cycling, pedestrian seg.
- List of data, sensors
- Etc.



Computing in the Scenario Context as:

- KPI, Metrics, SUMI, SUMP, 15MinCity Index
- Heatmaps
- OD Matrices
- Traffic Flow reconstructions
- Predictions
- Routing, constrained routing
- Early Warnings
- Etc.

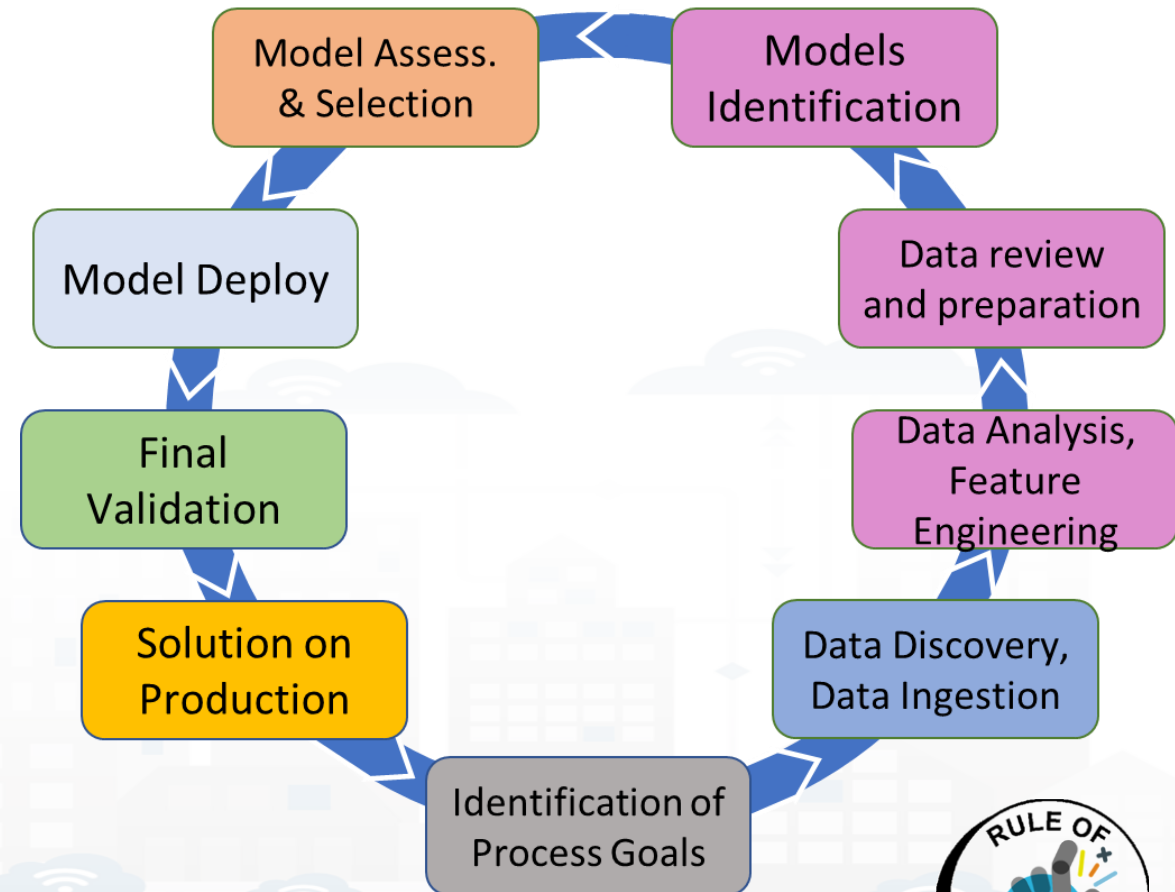
ReLoading Scenario in JavaScript

- Evolve Scenarios
- Use Scenario to context the Data Analytics: R Studio, Python for computing



# Model/Technique Development/testing

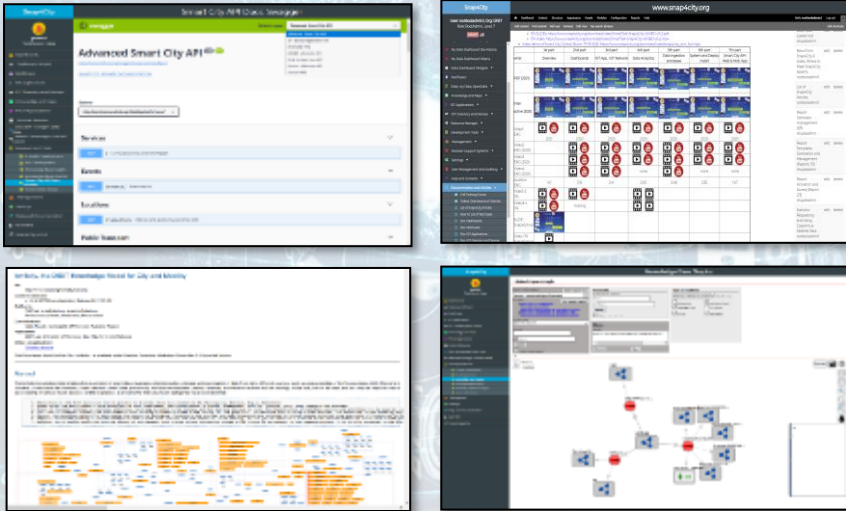
- **Identification of Process goals and Planning**
  - Which goals
  - How to compute, which language
  - Which environment, which libraries
- **Data Discovery and Ingestion (from the general life cycle)**
- **Data Analysis: feature engineering, feature selection**
- **Data review and preparation for 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

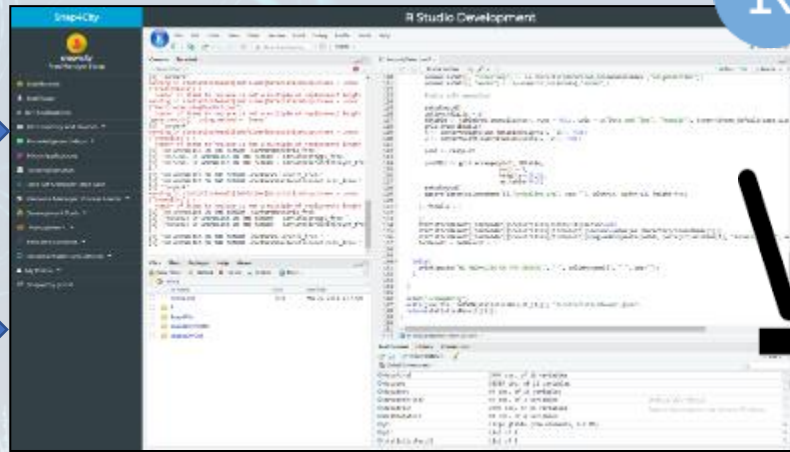


Ontology Schema

LOG.disit.org



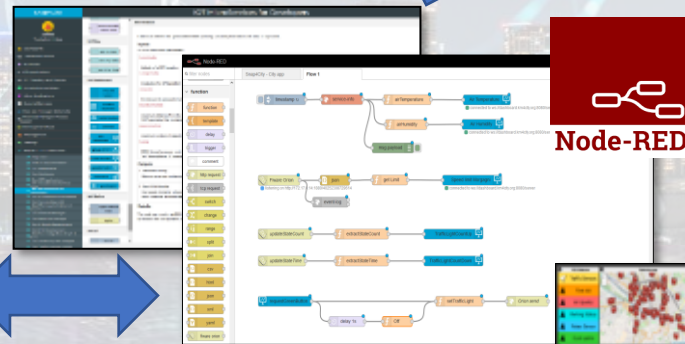
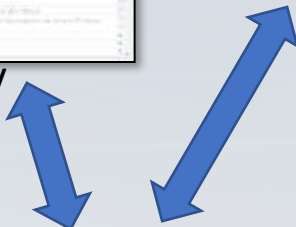
Smart City API from Knowledge Base and other tools



Creating MicroServices

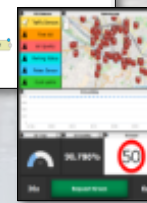


Saving / Sharing reusing



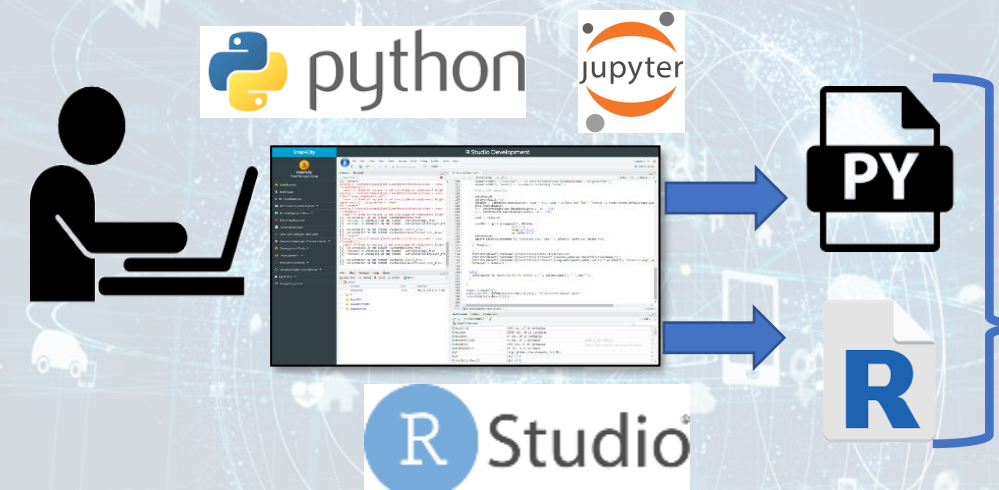
Resource Manager

Using them into IOT Applications

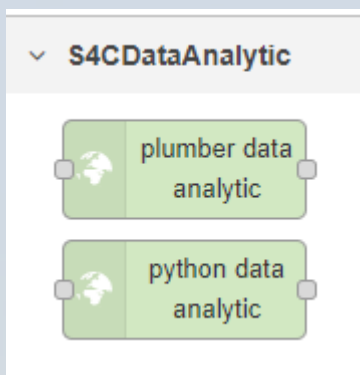
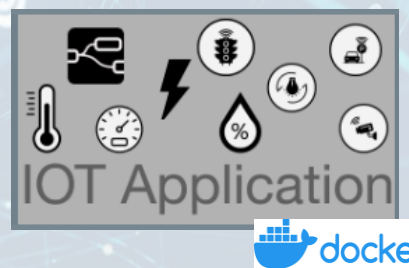




# Data Analytic Container



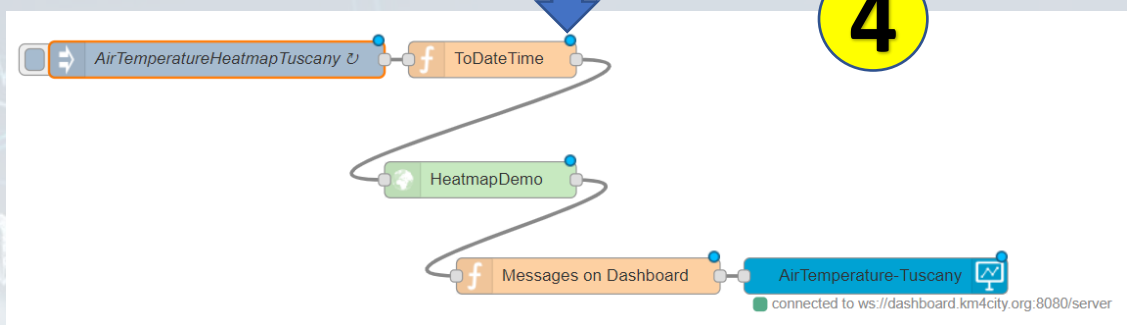
**2** Open an Advanced IoT App / Node-RED



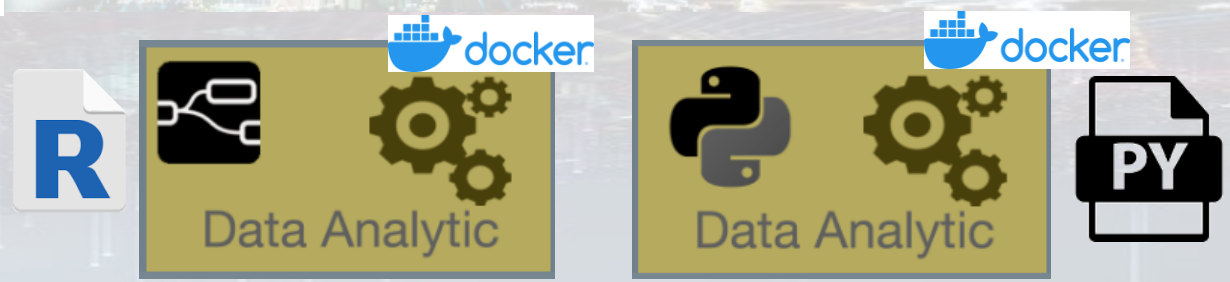
**3** Use Snap4City Data Analytic Node, and load in the code you developed.

**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>



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

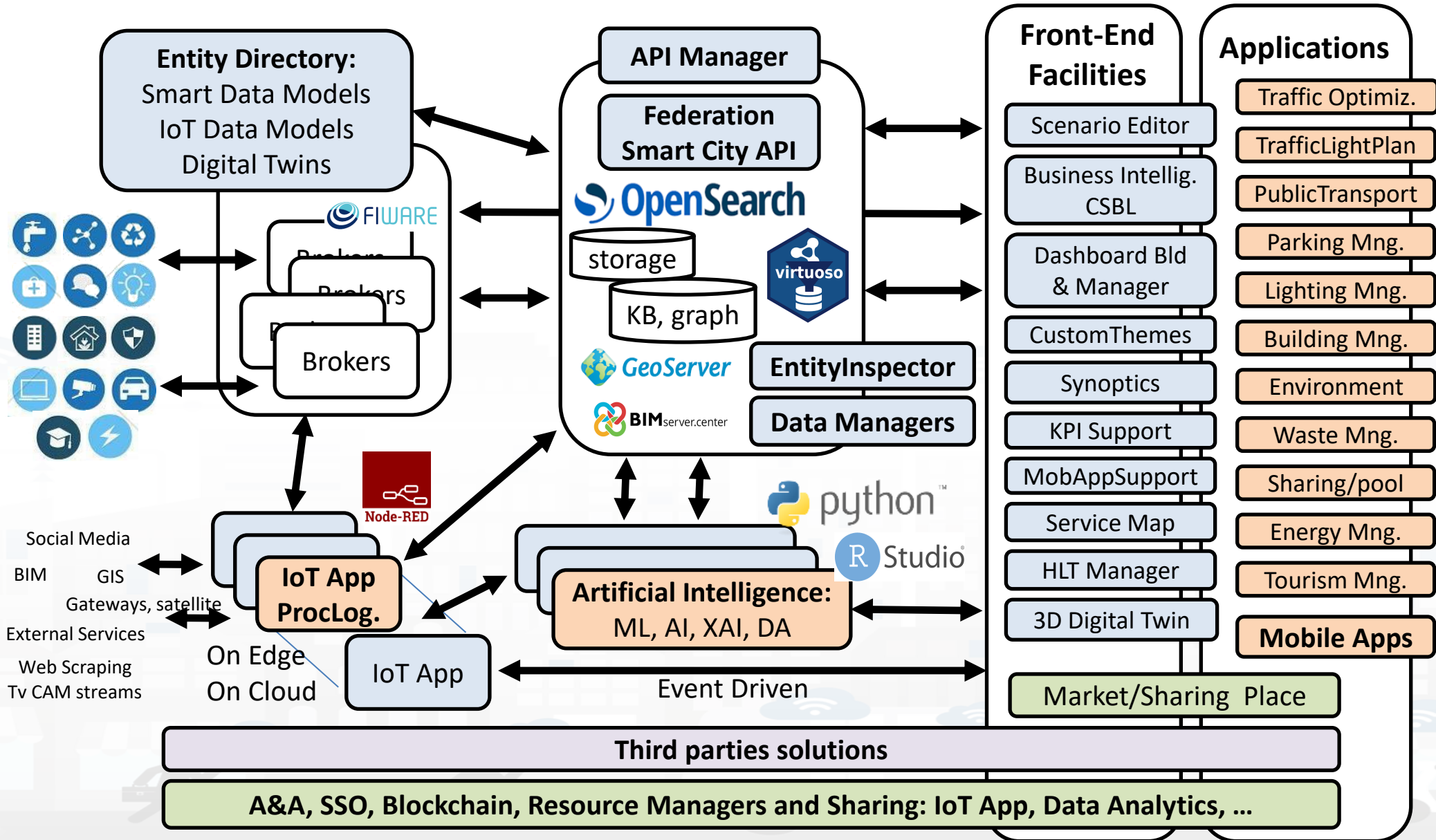


TOP

# 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								

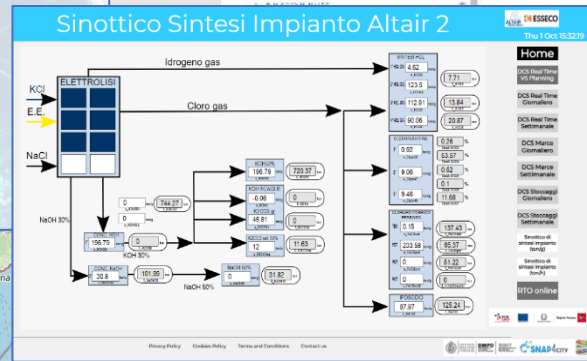
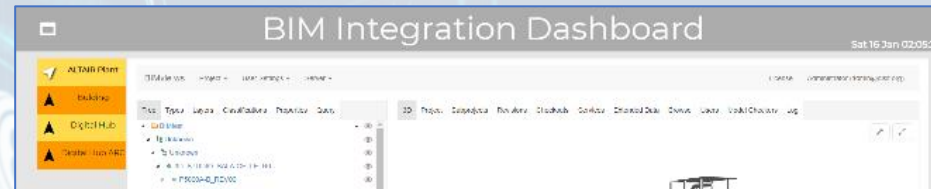




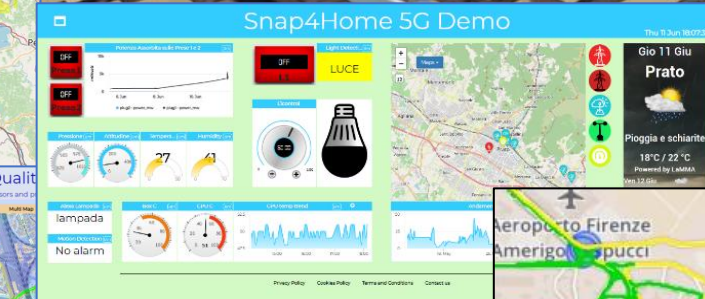
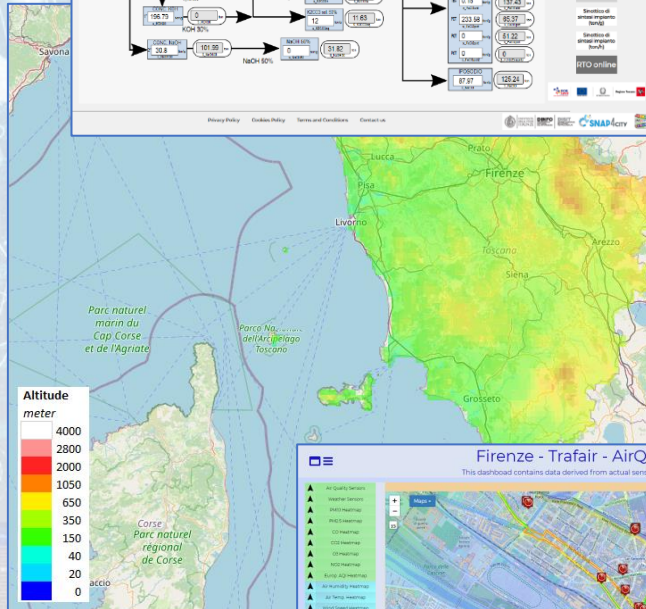
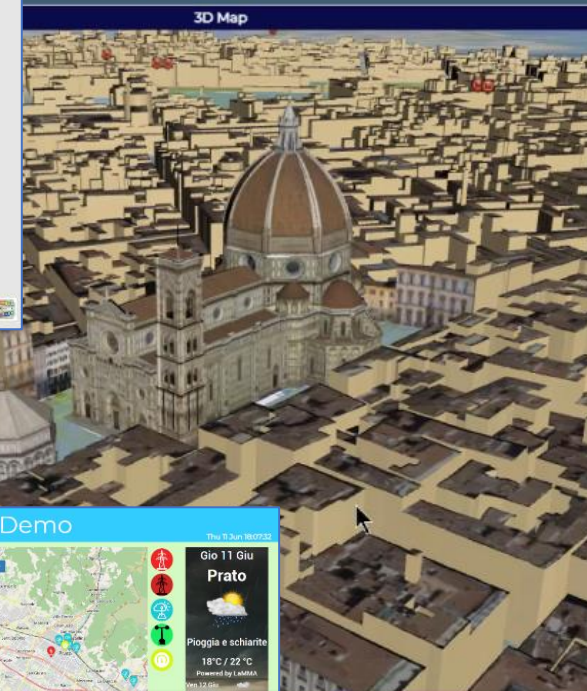
# High Level Types

Snap4City (C), Sept. 2024

- 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

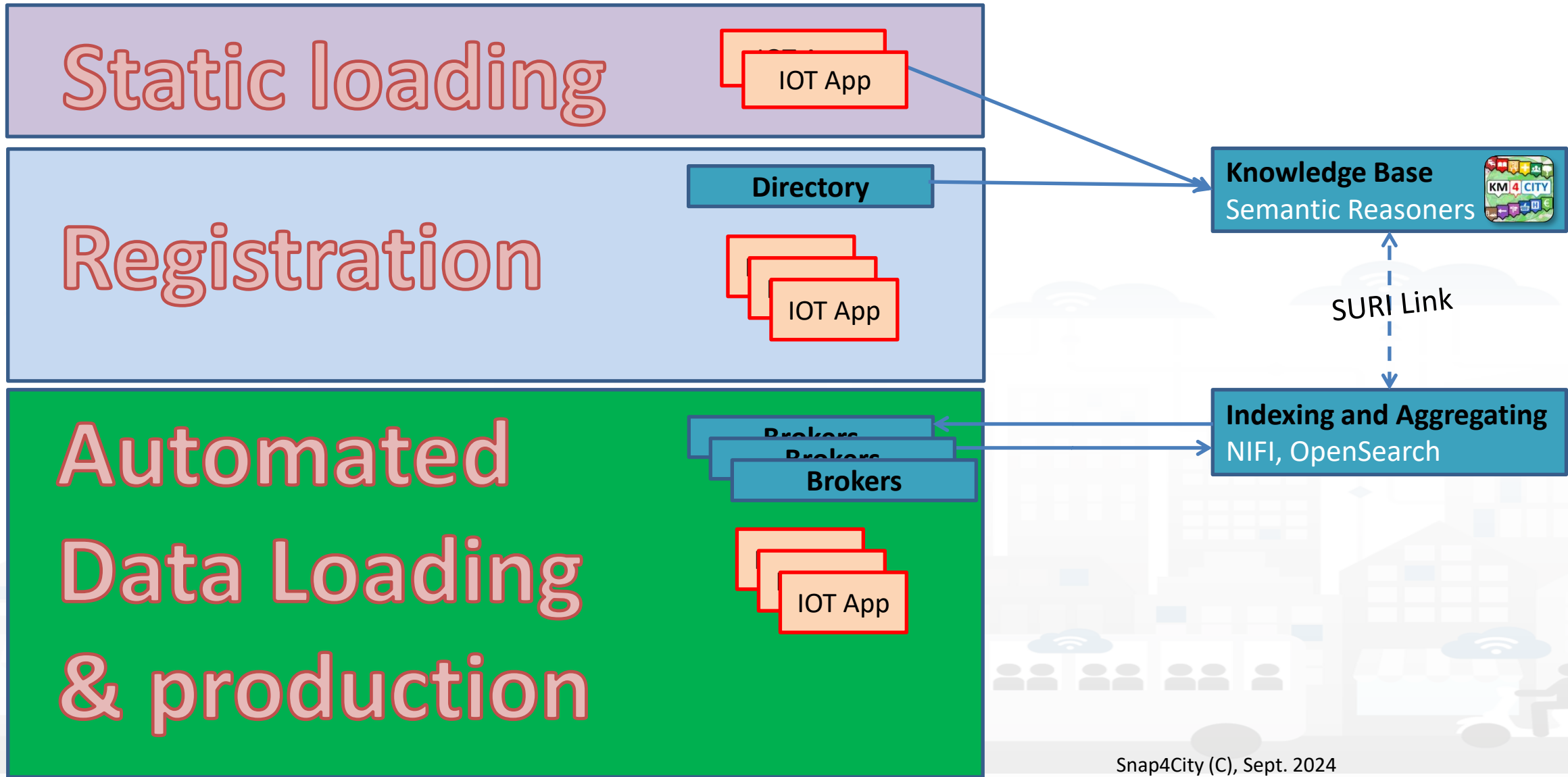


UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB

# Snap4city Data Ingestion Flow Diagram



# Checking data/Entity ingestion results

## Knowledge base Semantic reasoners

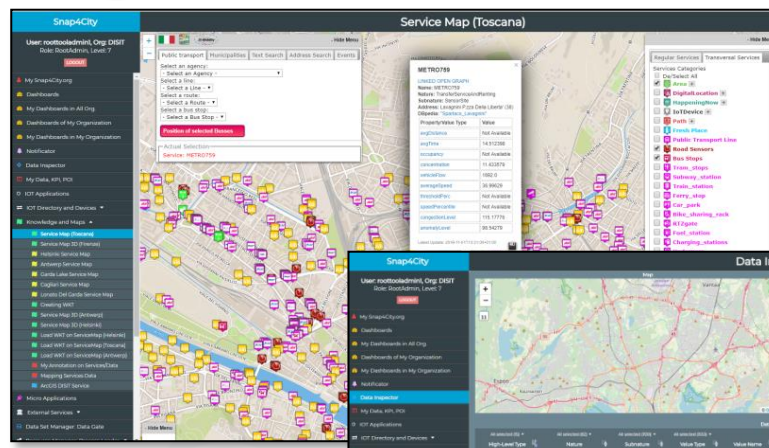


- All searches
- Metata
- Structure
- Last values of IoT Dev
- GTFS
- Only public IoT Dev

## Indexing and aggregating NIFI, OpenSearch

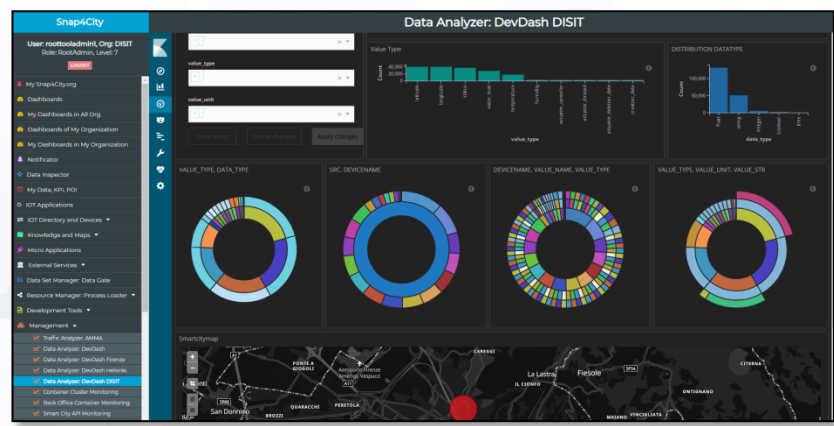
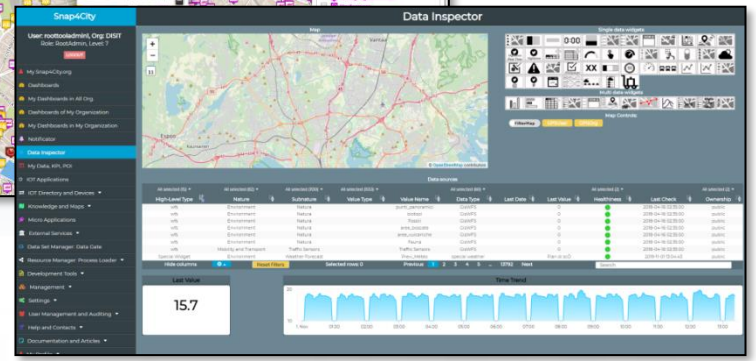
- Faceted search
- Geo search
- Time Series
- Private and Public

- **ServiceMap, SCAPI, SuperSM**
  - LOG / LOD viewer
  - Super Service Map
  - SCAPI: Swagger
  - Last data
- **Data Inspector (last data)**
- IoT/Entity Directory
  - IoT Brokers
- **ServiceMap, SCAPI (last data), SuperSM**
- **My Data Dashboard, OpenSearchDash**
- **Data Inspector (last data)**



ServiceMap or Super ServiceMap

Data Inspector  
Digital Twin view



My Data Dashboard  
**DevDash**

# New Data Inspector/Wizard

**New Wizard**

**Data Inspector BETA OS**

The interface includes a map of Florence, a dashboard with various widgets, a table of data sources, and a time-series visualization. A large red watermark 'New Wizard' is overlaid on the top left.

Level	Type	Nature	Subnature	Device	Model	Broker	Value Name	Value Type	Data Type	Value Unit	Last Date	Last Value	Healthiness	Last Check	Ownership
DT	EM Devi...	Environment	Weather	DIDA1		Santa Verdiana ...	Mio sensore	webpage			2021-11-23 13:44...		●	2023-07-18 16:0...	public
DT	EM Devi...	TransferService...	SensorSite	METRO11		Altair-soda	Altair Valve State	webpage			2021-06-05 00:00...		●	2024-01-10 01:3...	public
DT	EM Devi...	IndustryAndMa...	Computer	AltairStatoPom...		Altair-soda	Altair Pump St...	webpage			2021-05-20 13:51...		●	2024-01-10 01:3...	public
DT	EM Devi...	Environment	Air	IBIMET_SMART...		Altair-soda	Altair pump 43...	webpage			2021-06-07 17:3...		●	2024-01-10 01:3...	public
DT	EM Devi...	Environment	Air	ARPAT_QA_FI...		Altair-soda	Altair valve 541	webpage			2021-06-07 17:3...		●	2024-01-10 01:3...	public
DT	EM Devi...	TransferService...	SensorSite	METRO514		Altair-soda	Altair Pump 4321	webpage			2021-06-07 00:00...		●	2024-01-10 01:3...	public
DT	EM Devi...	TransferService...	SensorSite	SI052032F5990...		Altair-soda	Altair Stock sta...	webpage			2021-06-07 00:00...		●	2024-01-10 01:3...	public
DT	EM Devi...	TransferService...	SensorSite	METRO831		Altair-soda	Altair Pump 92...	webpage			2021-06-07 00:00...		●	2024-01-10 01:3...	public

- Filtering/Searching for individual fields (even for some fields not displayed as geographic coordinates)
- Geographic Filtering
- Text Search on all fields
- Menu for choosing the fields to display in the table
- View on Map(via PREVIEW)
- Data and Trend visualization
- Opening Digital Twin
- Pass to Synoptic mode
- Select the graph representation



**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					

Healthiness: 100% (green dot)

Ownership: public

18:00 20:00 22:00



- Click with the mouse on it

**HLT: Sensor**

Knowledge Base view

Link to Service Map

Link to IoT Device

**Snap4City**

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

[LOGOUT](#)

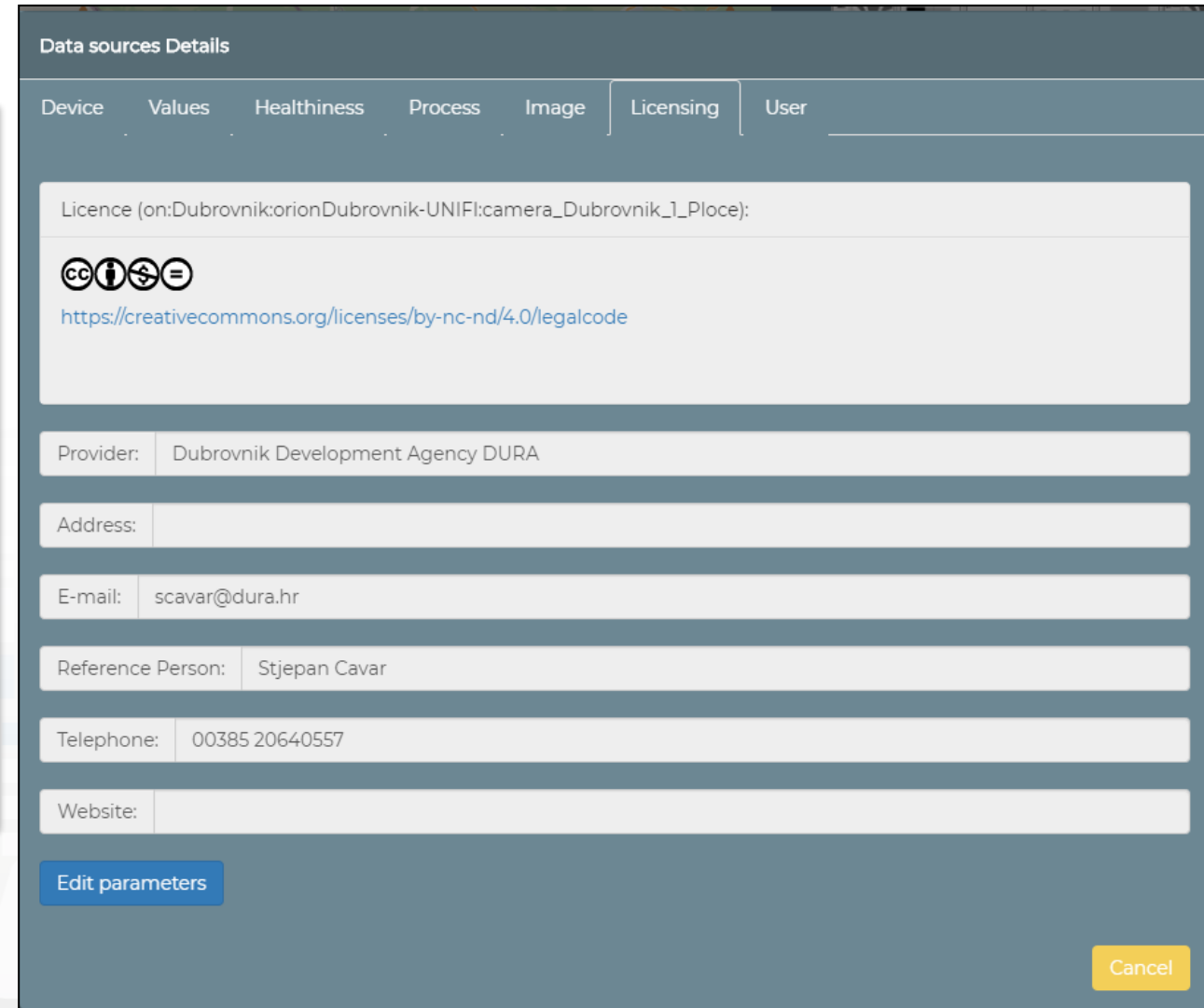
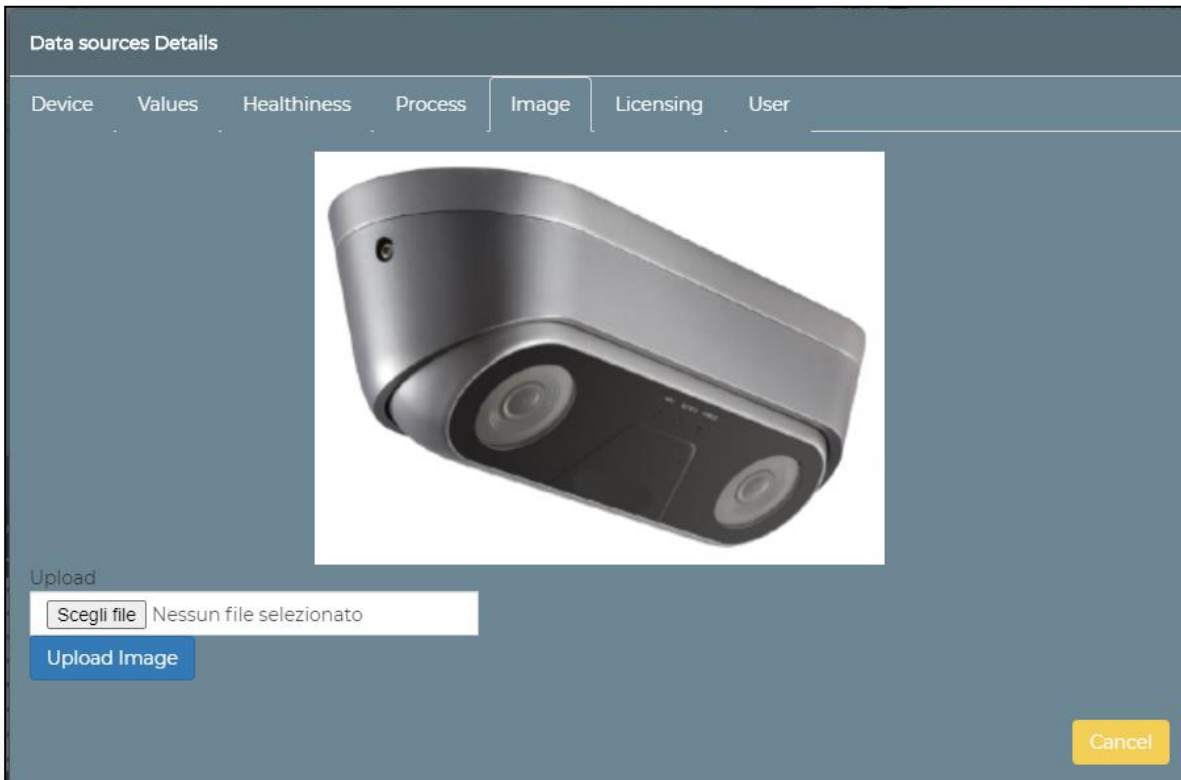
IOT Devices

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

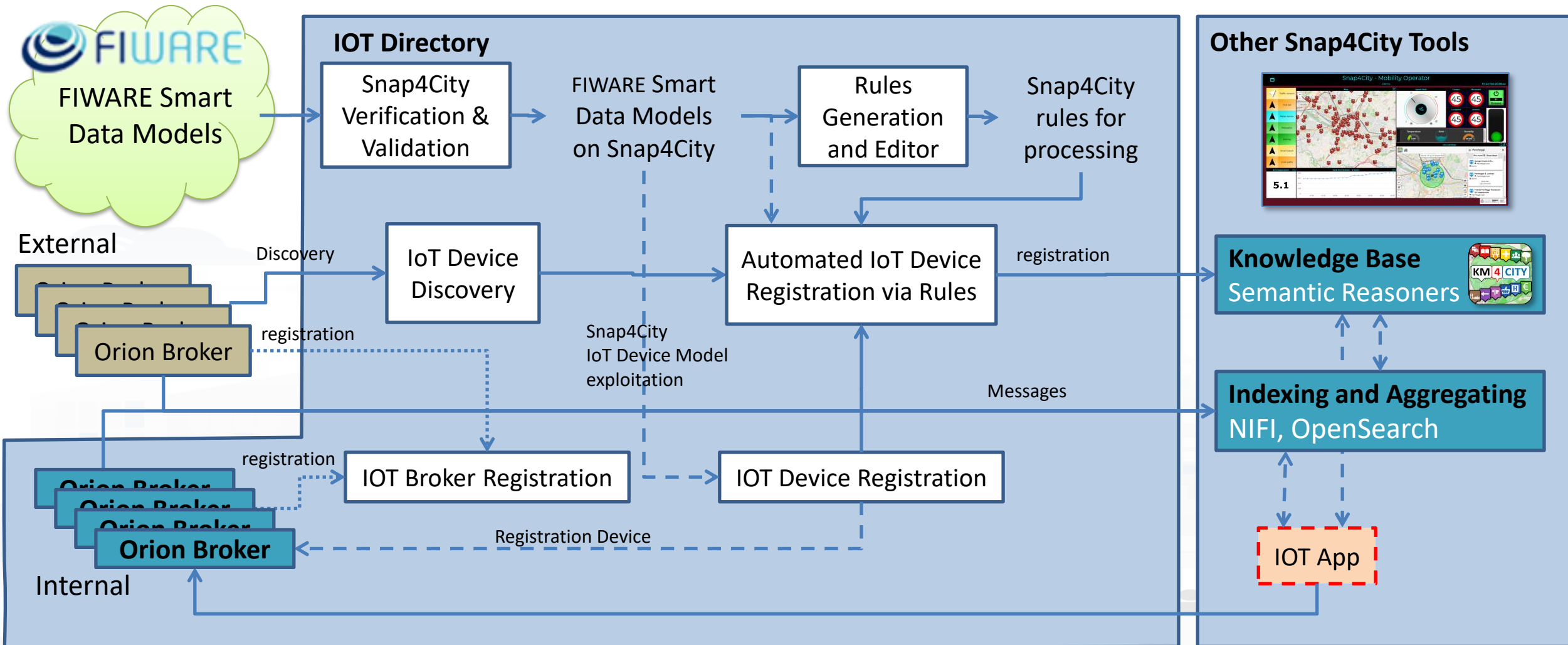
Some functionalities are limited to certain roles

## Image of the Devices and Licensing



*Some functionalities are limited to certain roles*

# Exploiting FIWARE Smart Data Models



TOP

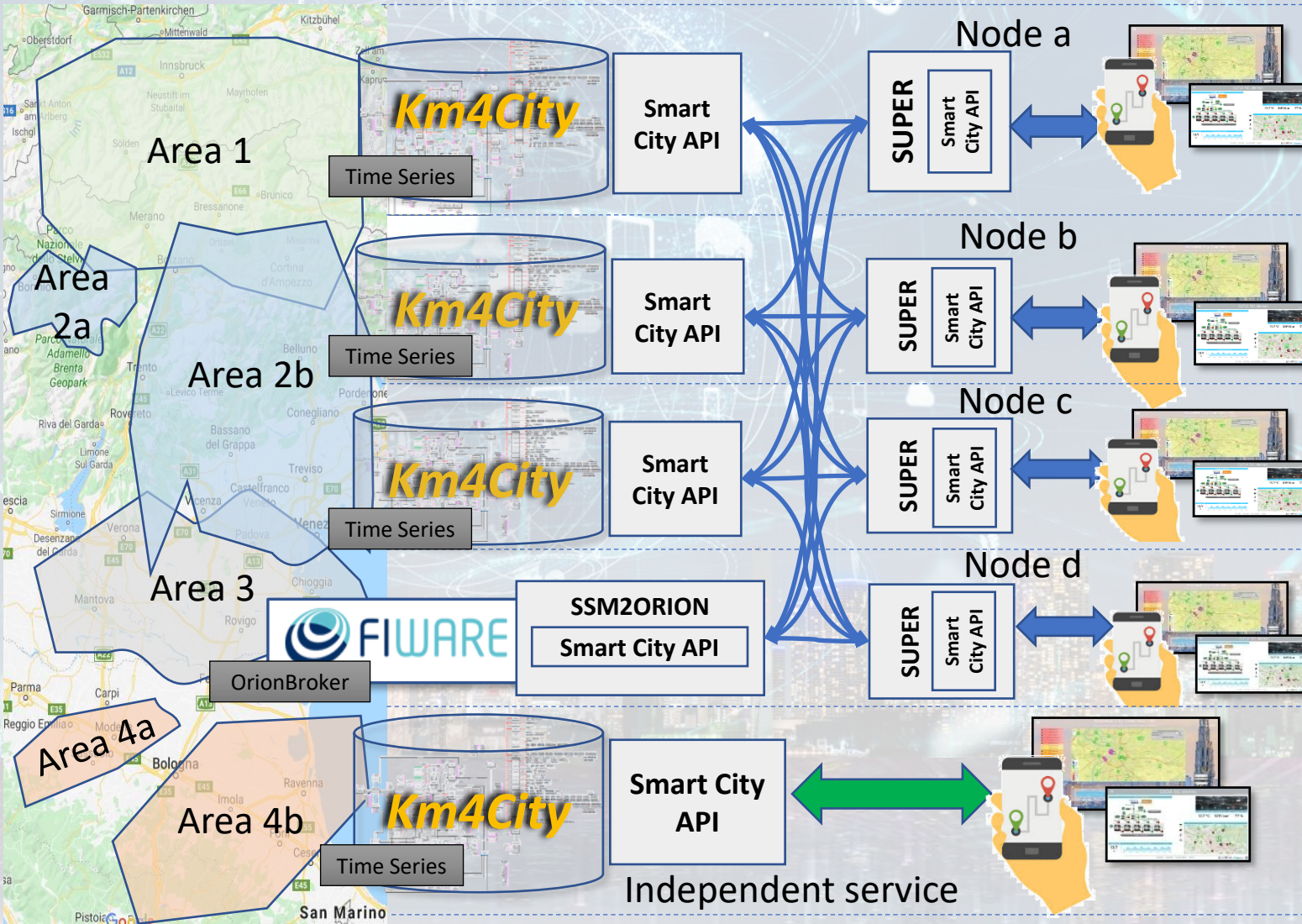
# Smart City API and Federation Mobile & Web App SDK



	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 Development Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								



# 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

The screenshot displays the Swagger UI for the Snap4City Smart City API. The interface is divided into a sidebar on the left and a main content area on the right. The sidebar contains navigation options such as 'External Services', 'Data Set Manager: Data Gate', 'Resource Manager: Process Loader', 'Development Tools', 'MicroServices from DataAnalytic', 'ETL Development', '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', and 'My Profile'. The main content area shows the 'Advanced Smart City API' documentation, including a dropdown menu for selecting a specification, a 'Servers' dropdown, and a list of services with their respective endpoints and methods.

**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

swagger 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** 1.0.0 OAS3

<https://www.km4city.org/swagger/external/ascapi-openapi3.json>

SMART CITY API WEB DOCUMENTATION

Servers

<https://servicemap.disit.org/WebAppGrafo/api/v1>

**Services**

GET / Service discovery and information

**Events**

GET /events/ Event search

**Locations**

GET /location/ Address and geometry search by GPS

**Public Transport**

GET /tp1/agencies/ Agency list

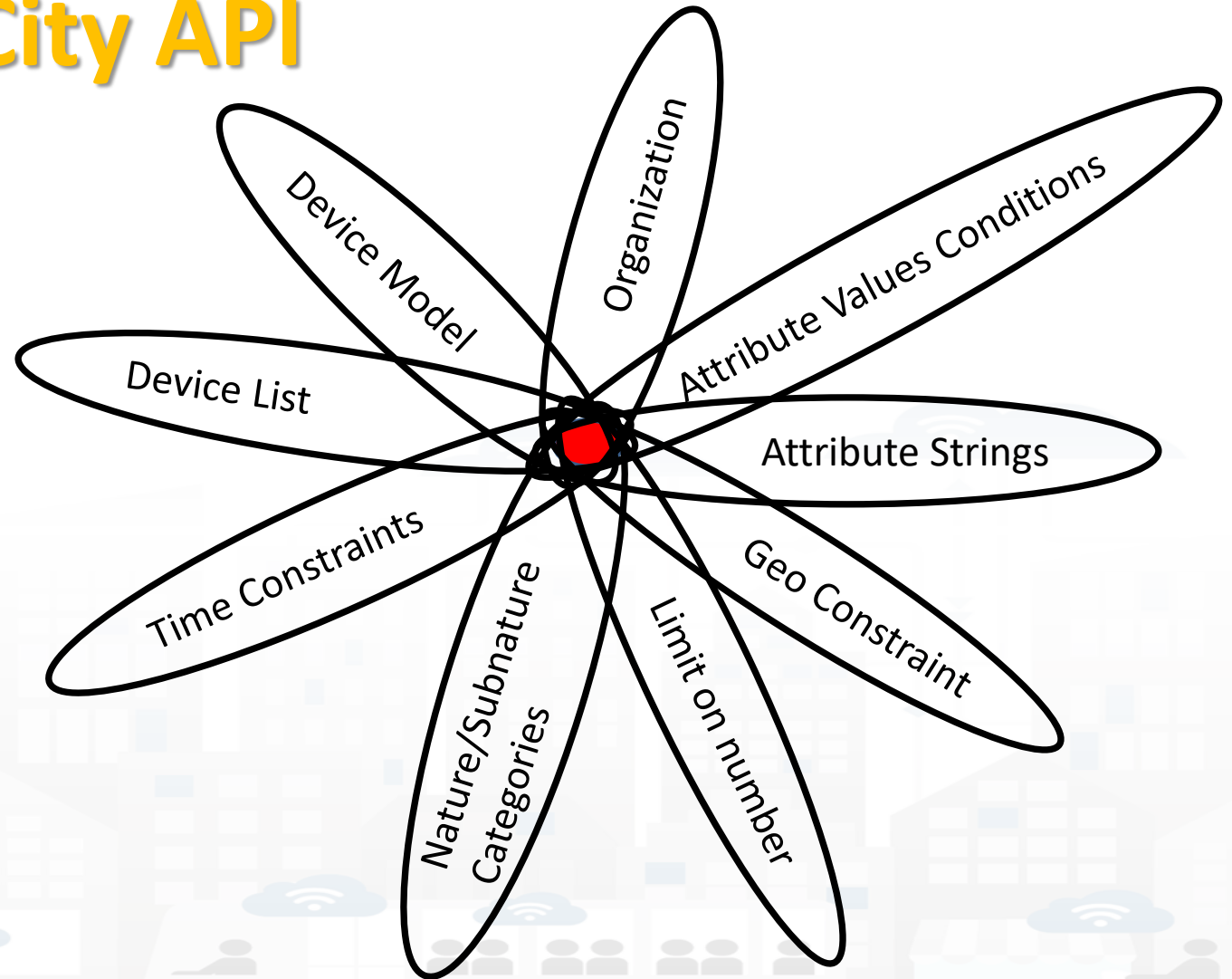
GET /tp1/bus-lines/ (Bus) Lines list

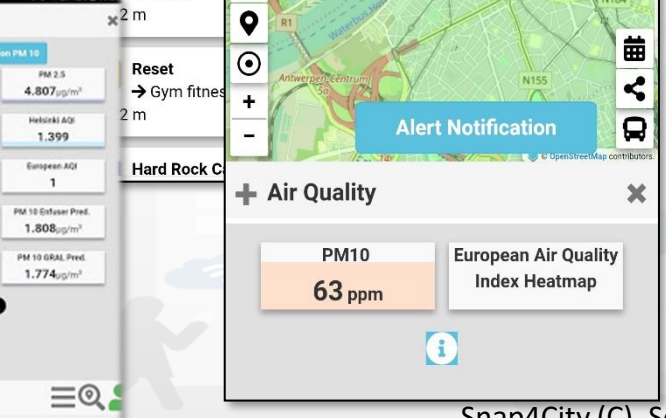
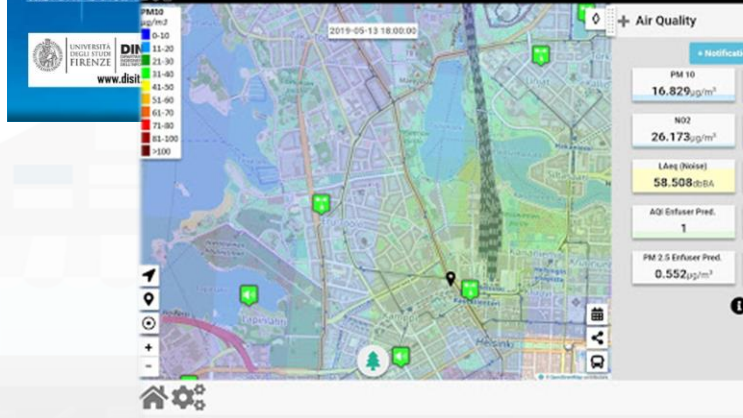
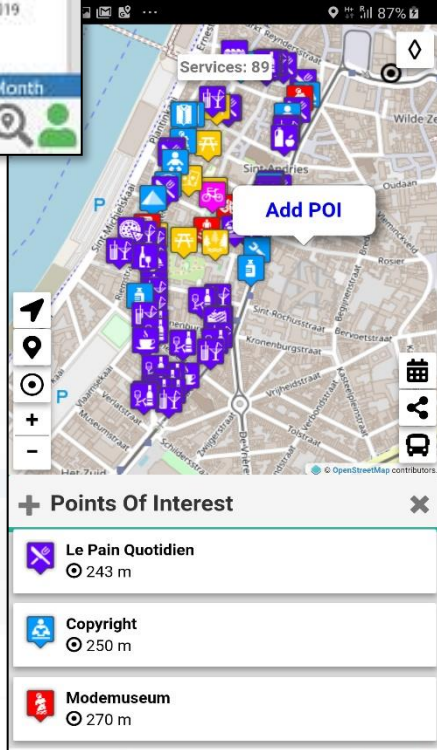
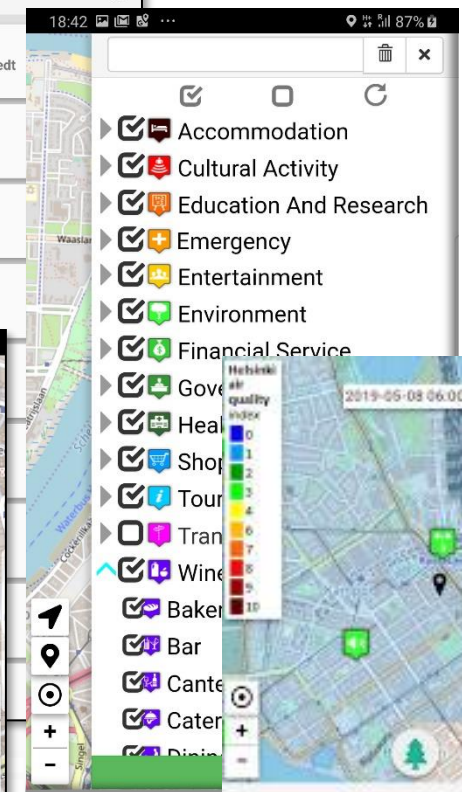
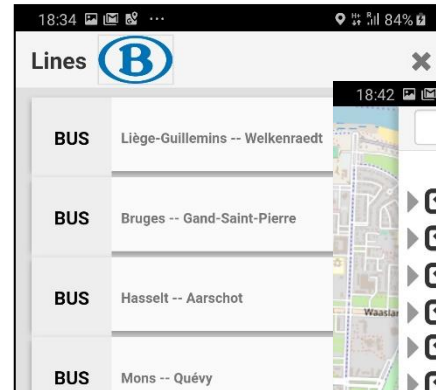
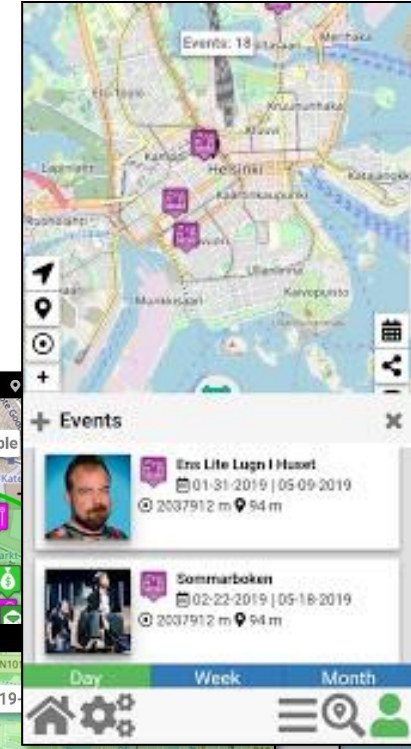
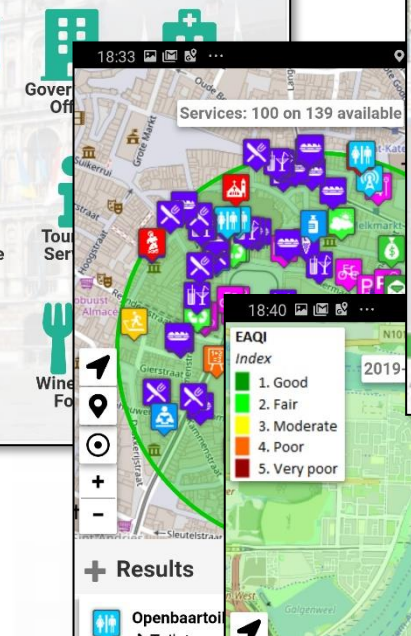
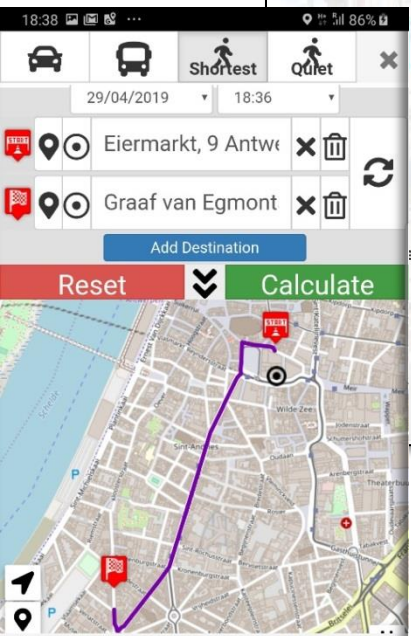
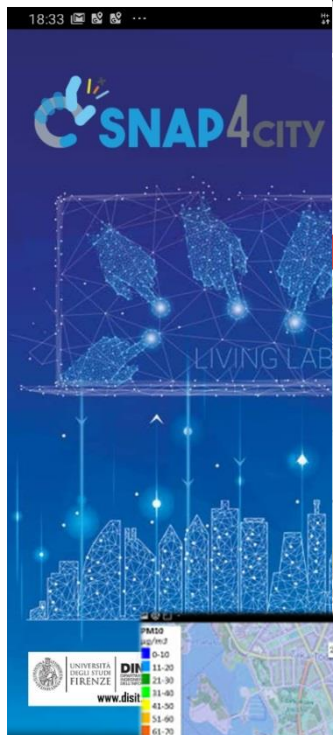
GET /tp1/bus-routes/ (Bus) Routes list

<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
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

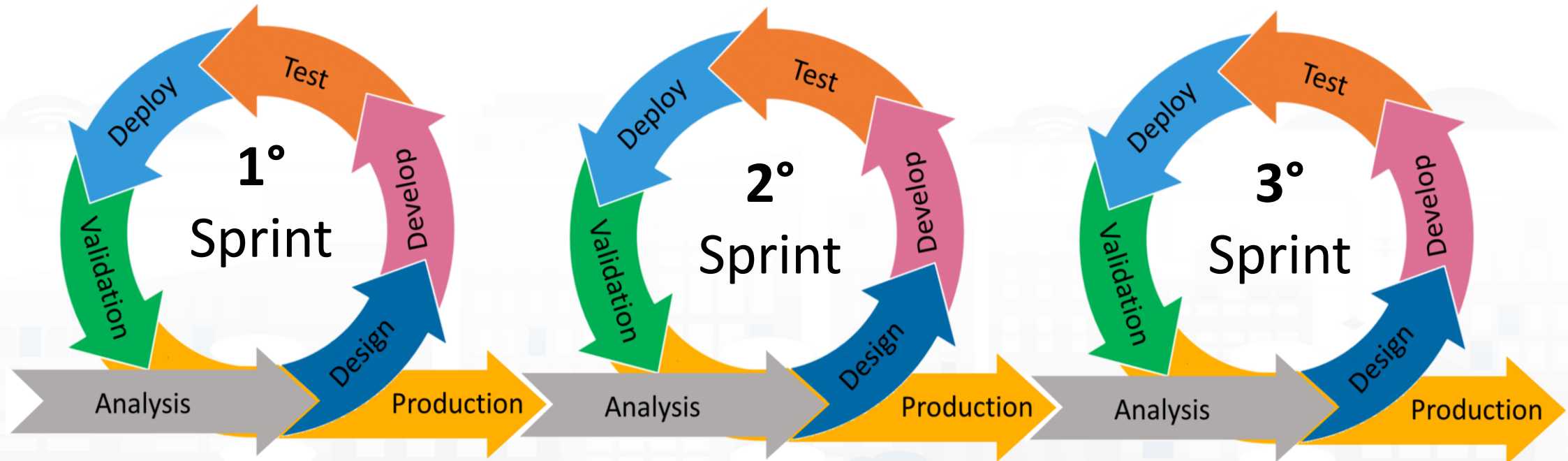
**Access Level:** public

**Date:** 21-10-2022

**Version:** 1.4

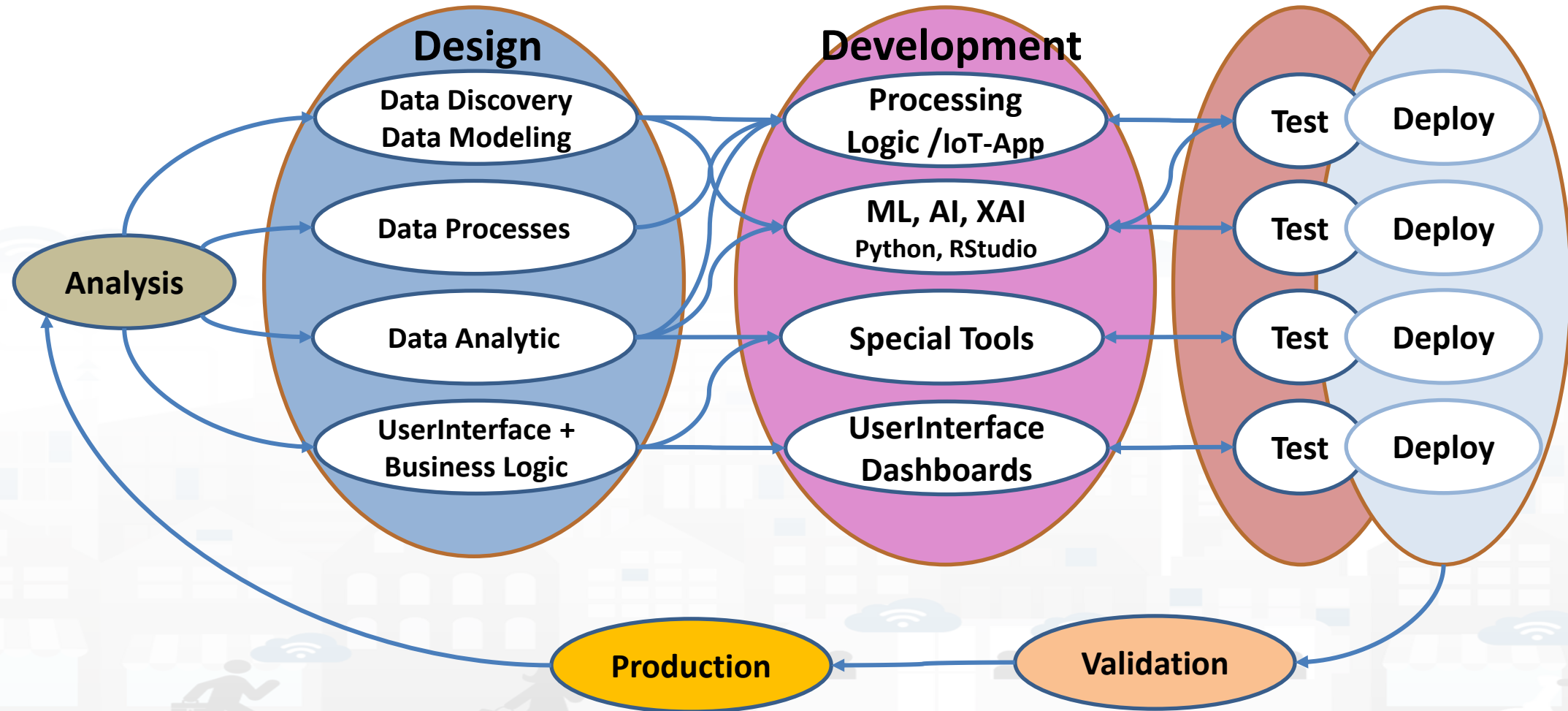


# Development Life Cycle Smart Solutions





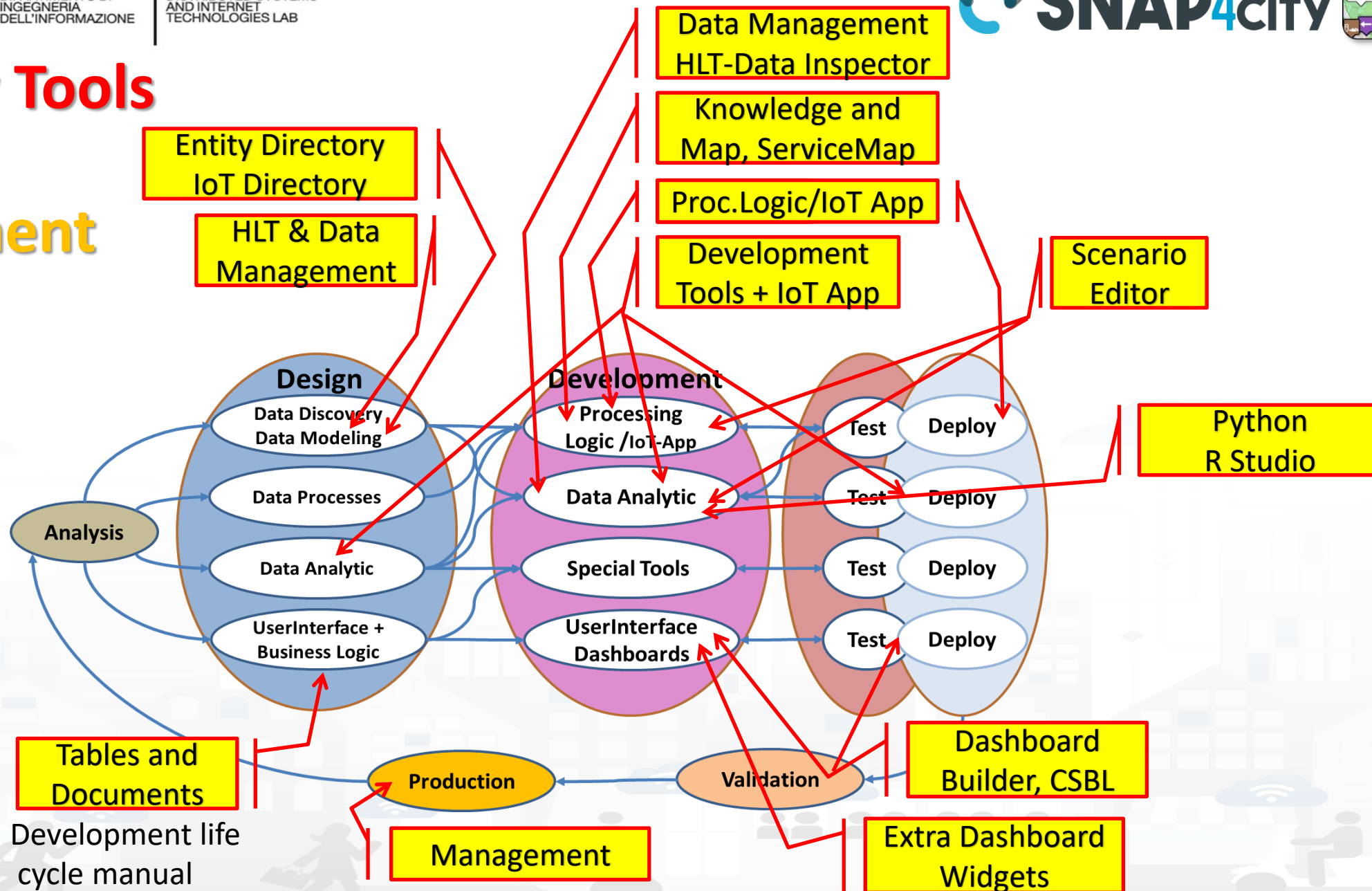
# Development Life Cycle Smart Solutions

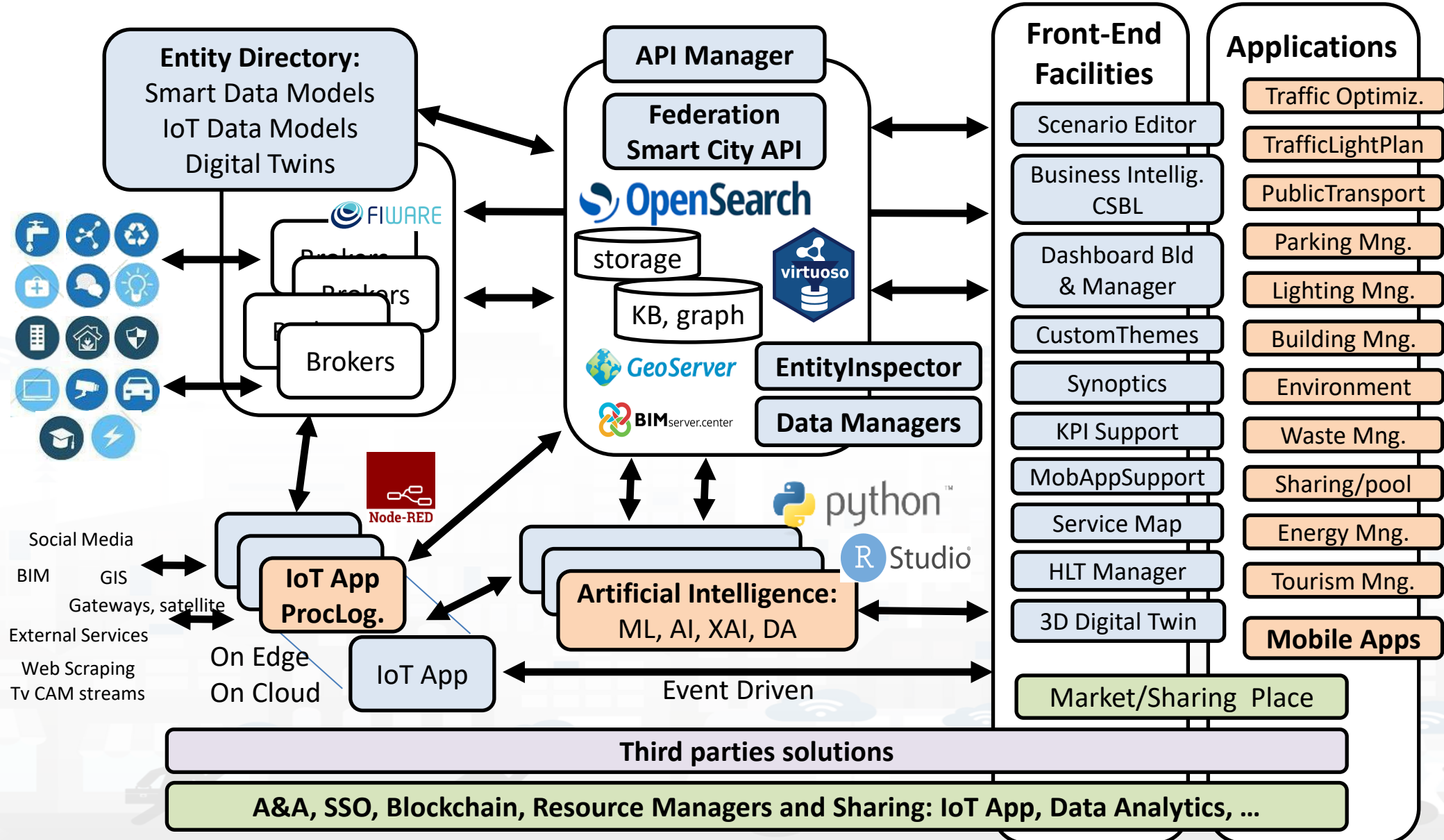


# Snap4City Tools

vs

# Development Life Cycle





# 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 WHEN SIMULATION

SNAP4CITY ARCHITECTURE AND OPEN TO DEVELOPERS AND STAKEHOLDERS

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

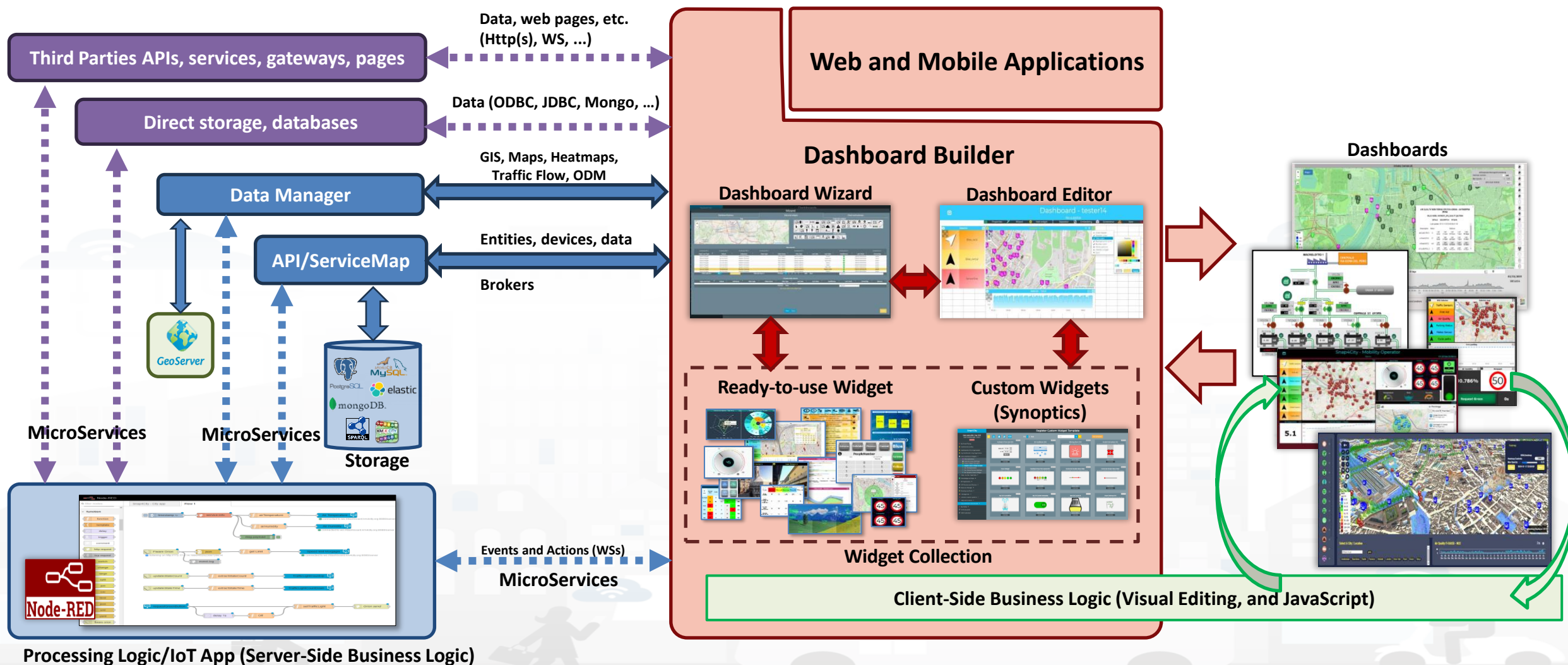
SNAP4CITY AND KM4CITY PROJECTS

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

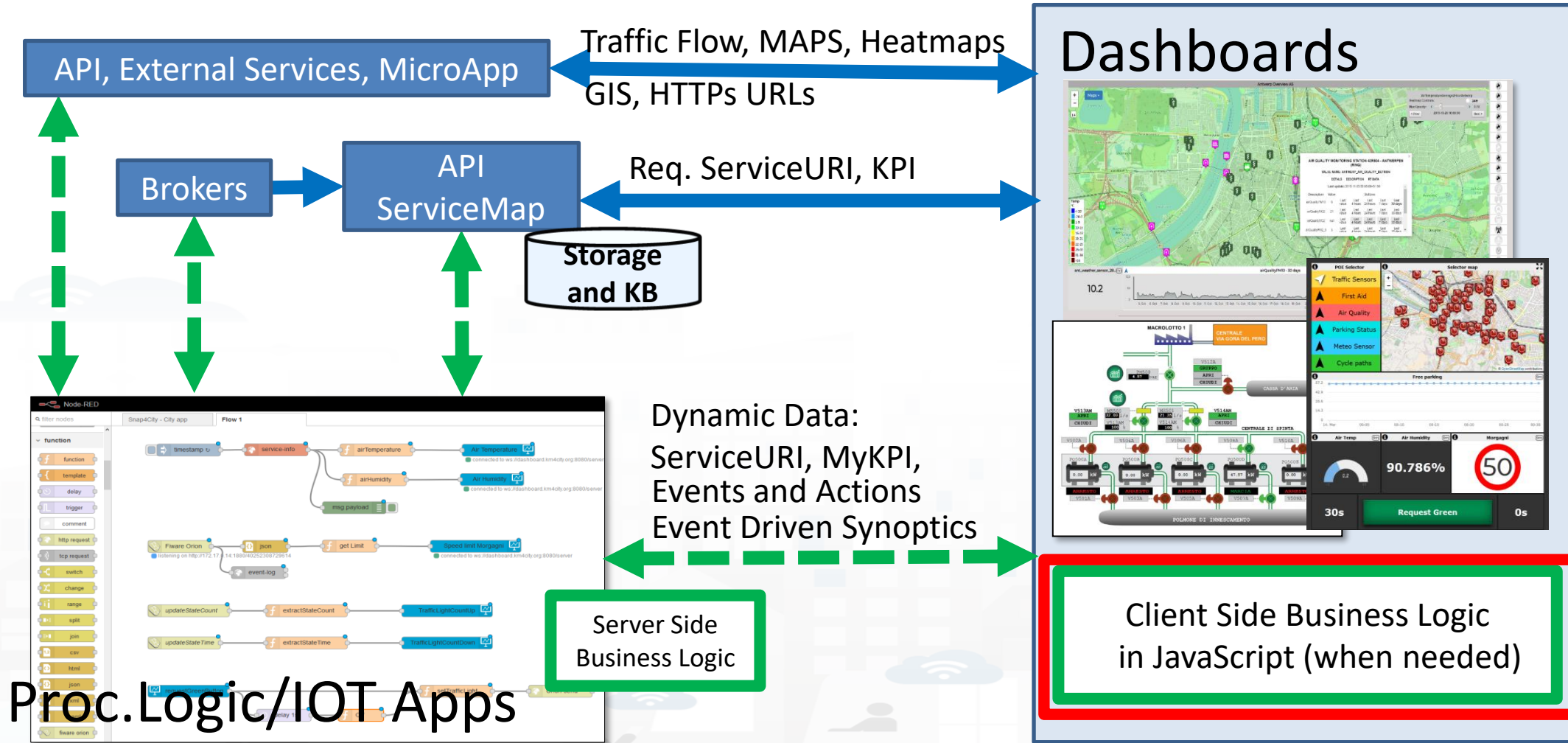
SNAP4CITY THE VIEW OF THE ADMINISTRATORS

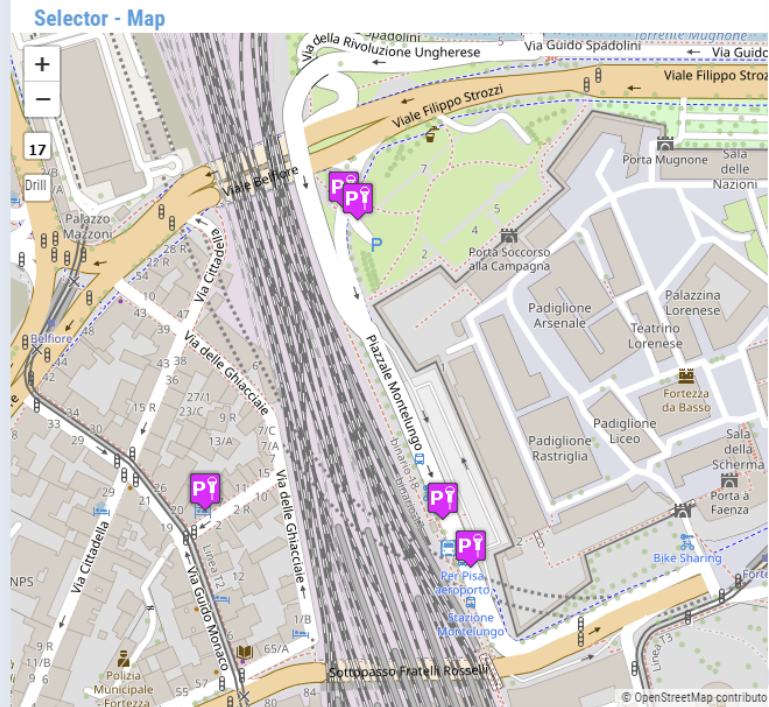
	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
what	Overview	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								

# How the Dashboards / Apps Exchange data (2024/8)

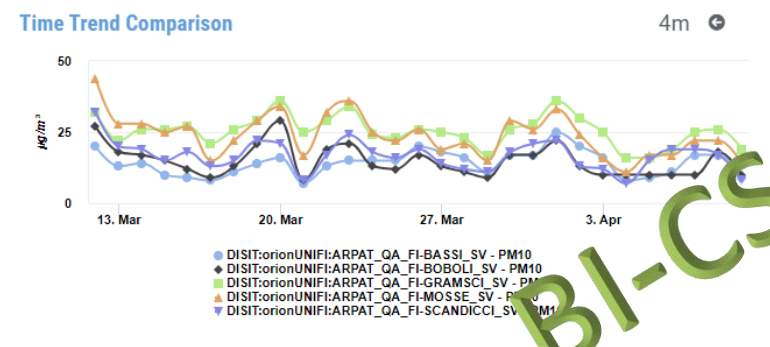
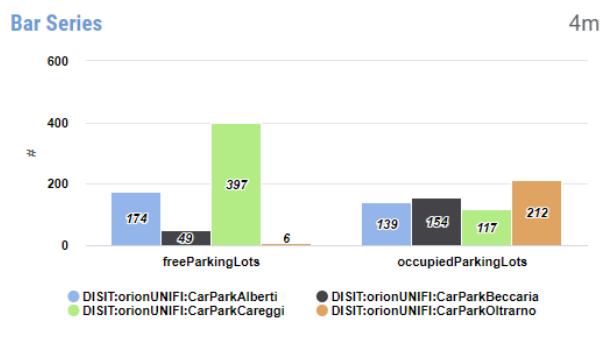
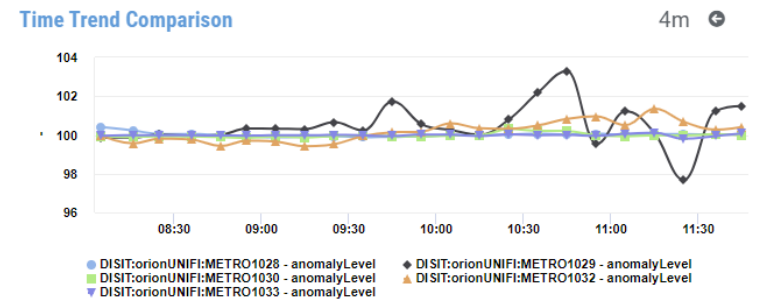
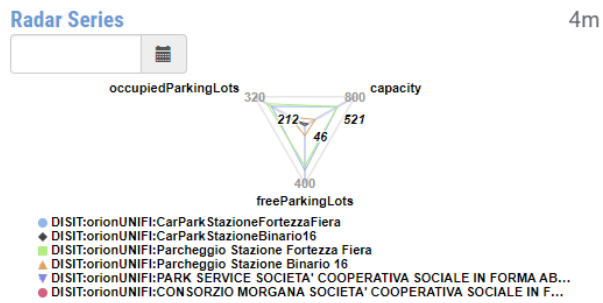
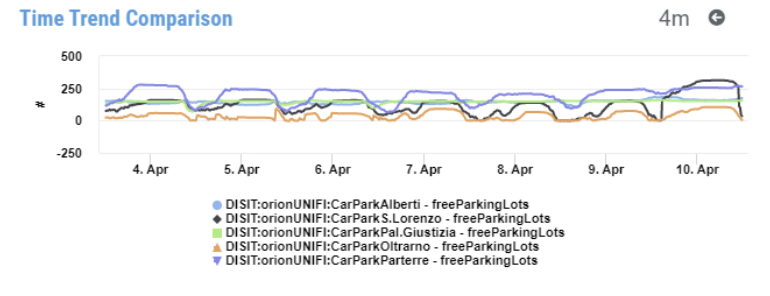
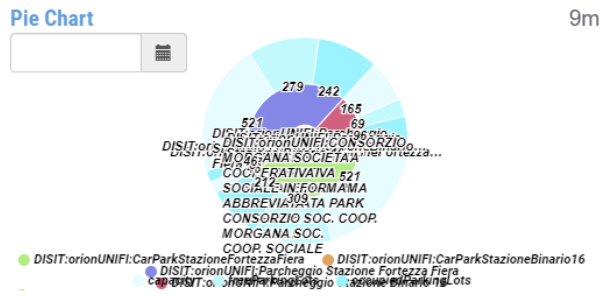


# How the Dashboards exchange data





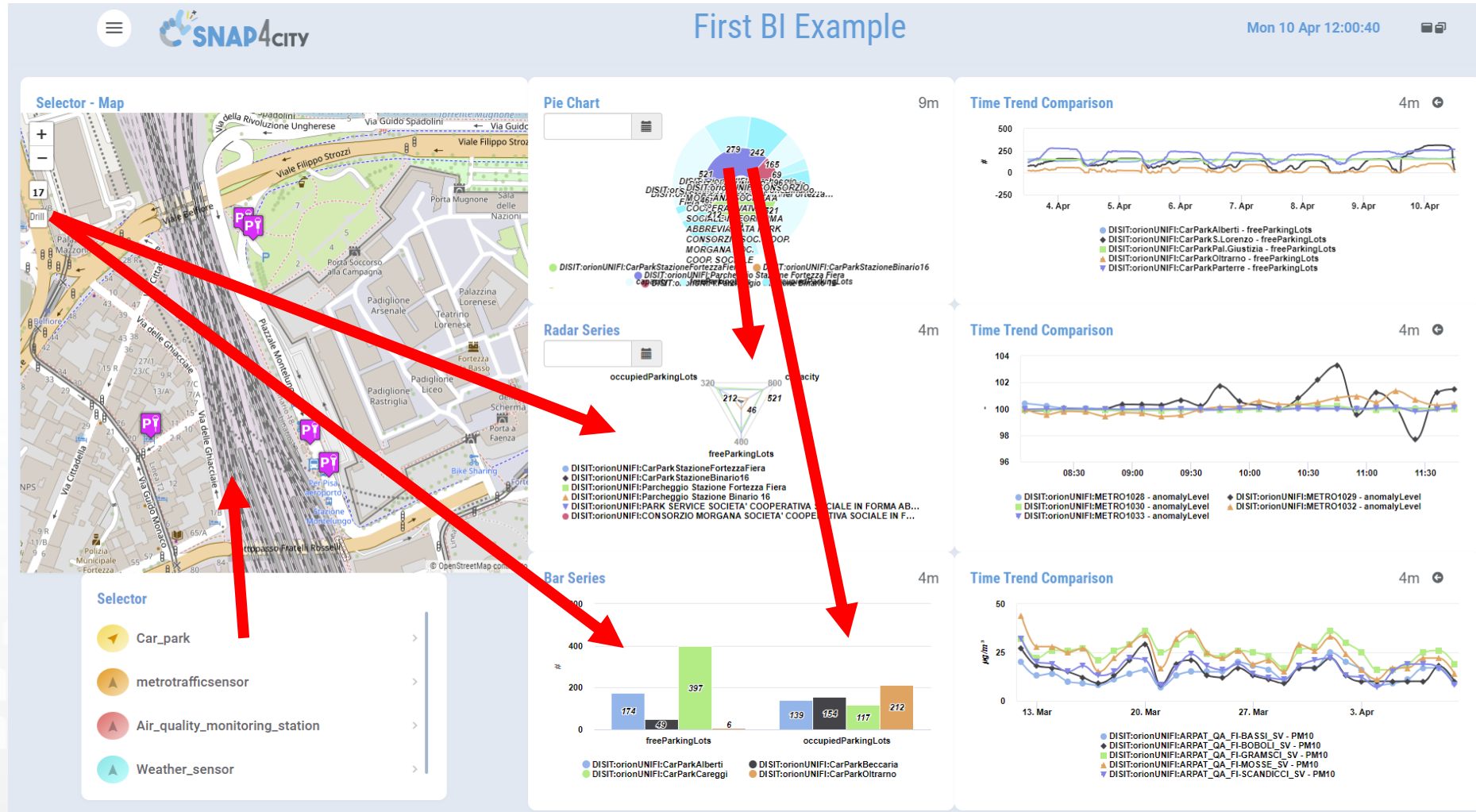
- ### Selector
- ▶ Car\_park
  - ▶ metrotrafficsensor
  - ▶ Air\_quality\_monitoring\_station
  - ▶ Weather\_sensor



BI-CSBL

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

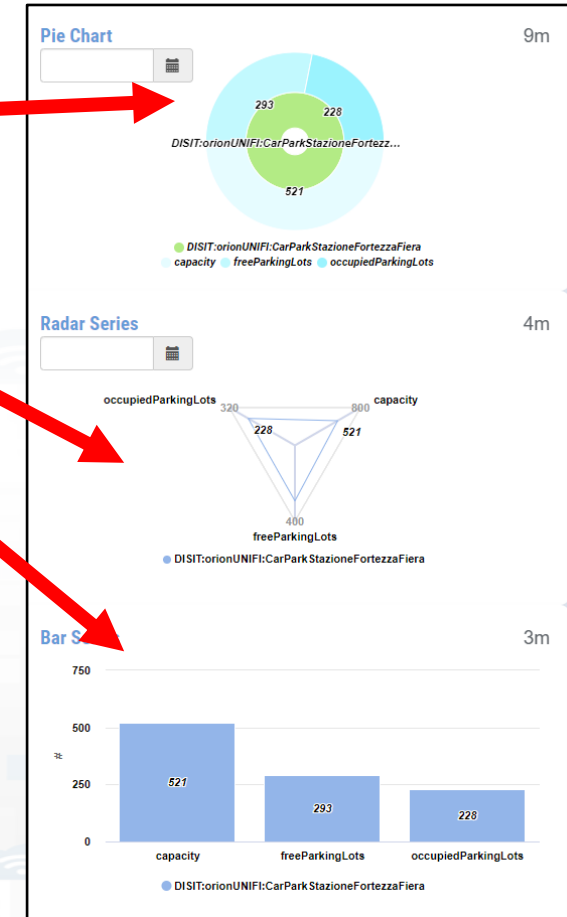
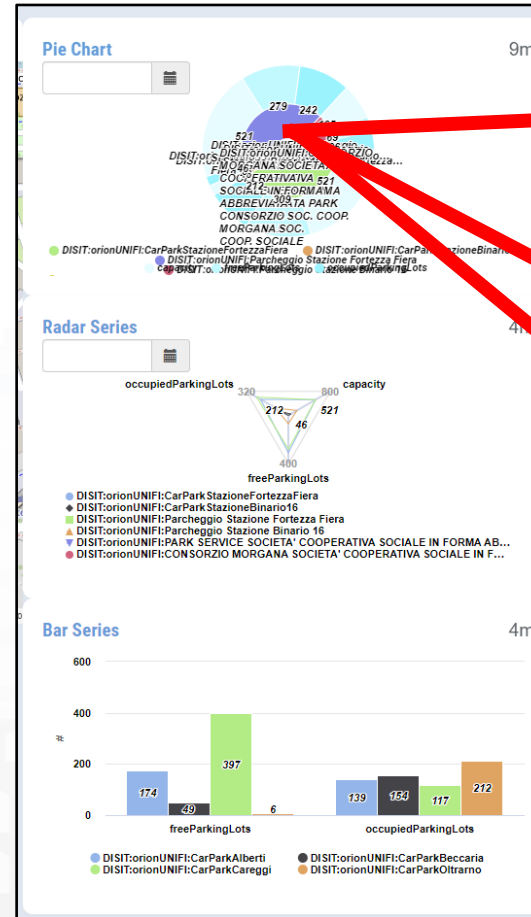
- 1) Select the area of interest on map
- 2) Select the sensors kind of interest
- 3) Drill down on map
- 4) The JavaScript CSBL on Map will send data to the programmed Widgets. In this case, arrowed in RED





# 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



# BI-CSBL

- 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>



Powered by  
**SNAP4Tech**

## Client-Side Business Logic Widget Manual

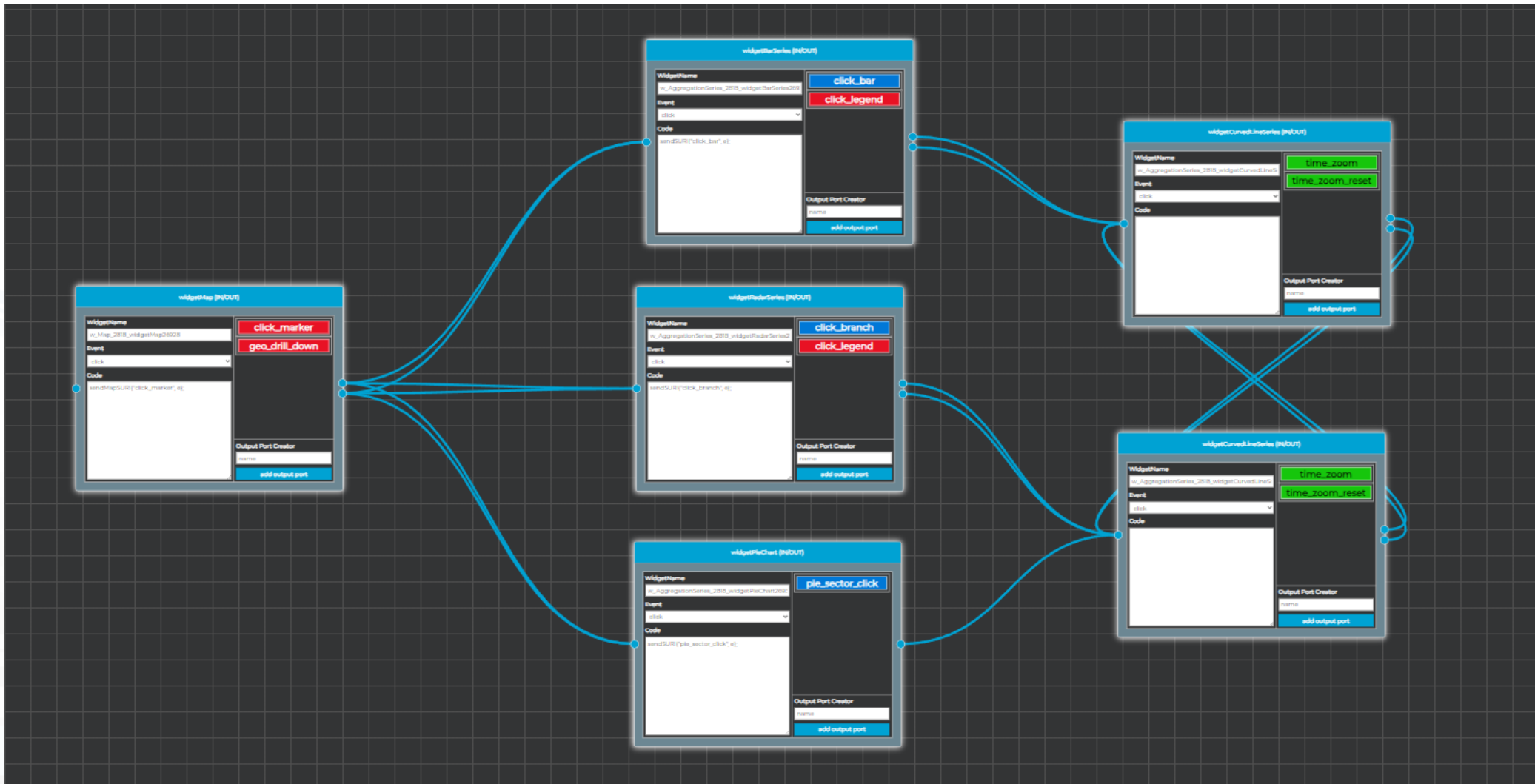
### From Snap4City:

- 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/UC3TAO09EbNba8f2-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



# Visual programming for CSBL, accessible in beta



# Context and Life Cycle and Living Lab support

FORGING &  
MANAGING OPEN  
AND FLEXIBLE WEB  
AND MOBILE APPS

STARTUP OF  
BUSINESS

SNAP4CITY  
ARCHITECTURE AND

TWITTER  
VIGILANCE SOCIAL  
MEDIA ANALYSIS

SNAP4CITY

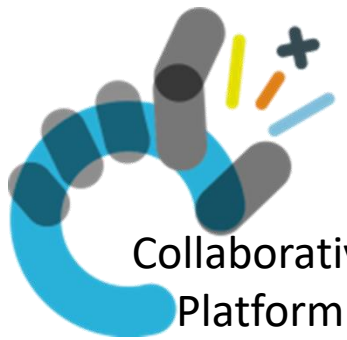
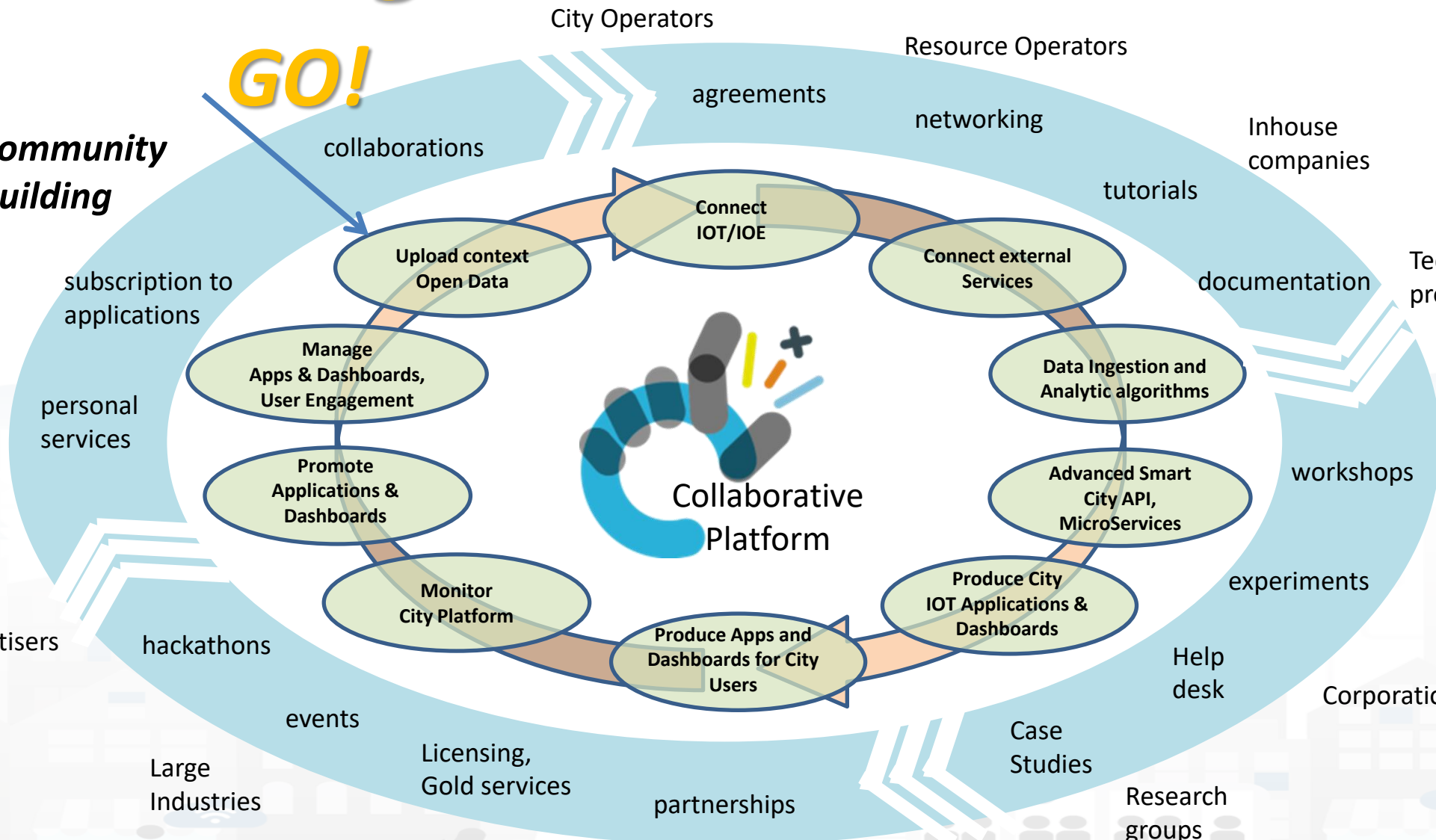


# Accelerating



**GO!**

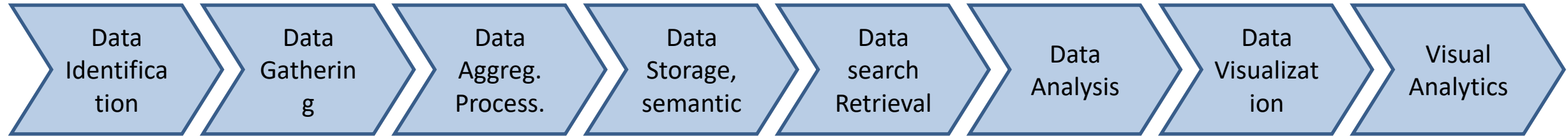
**Community Building**



**Collaborative Platform**



# Phases' Coverage



what	Identifi- cation	Gatheri- ng	Comple- x data types	Aggrega- tion	Storage (seman- tic)	Efficient Retrieval	Semantic Modeling, query	Data Analytics (micro, marco)	Scenarios context	Artificial Intelligen- ce	Data renderin- g	Real Time Dashboar- d	Event Driven data rendering
GeoServer					(x)						(x)	(x)	
GIS			(x)					(micro)			x		
PowerBI						x		(x)			x	x	
Tableau					x	x		(x)			x	x	
....													
Snap4City	x	x	x	x	x	x	x	x	x	x	x	x	x

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

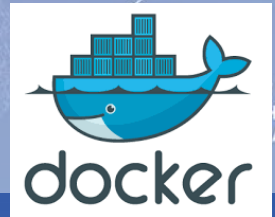
HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

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**

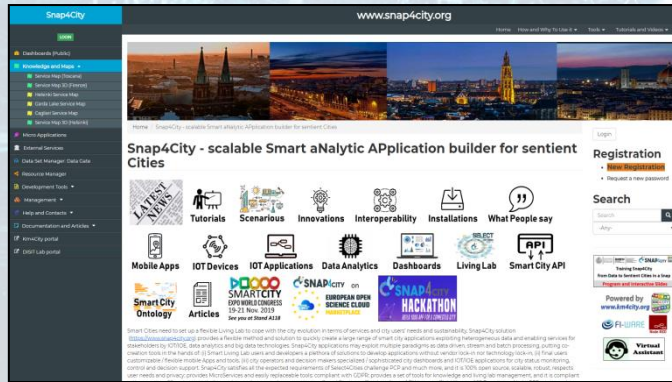
<https://www.snap4city.org/471> for VM

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

To get an updated version read it!



# How to adopt Snap4City



## On your premise



### Smart City as a Service

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

**Download and deploy**



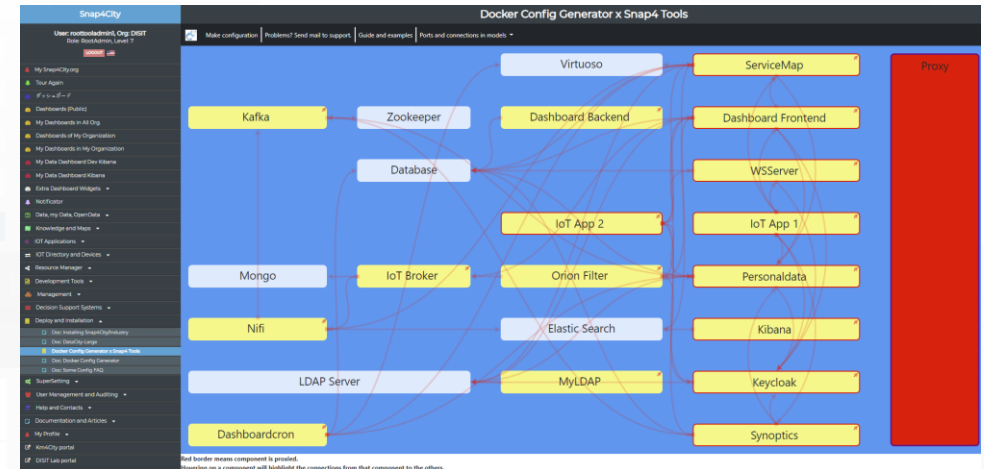
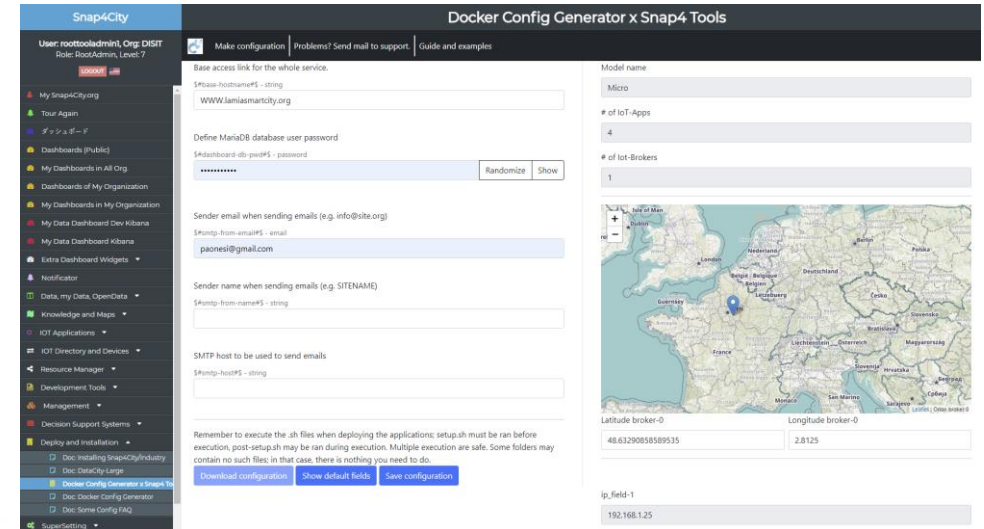
### Installation on your premise

- Virtual Machines or Dockers
- 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



# Installations, different models a TOOL to get them

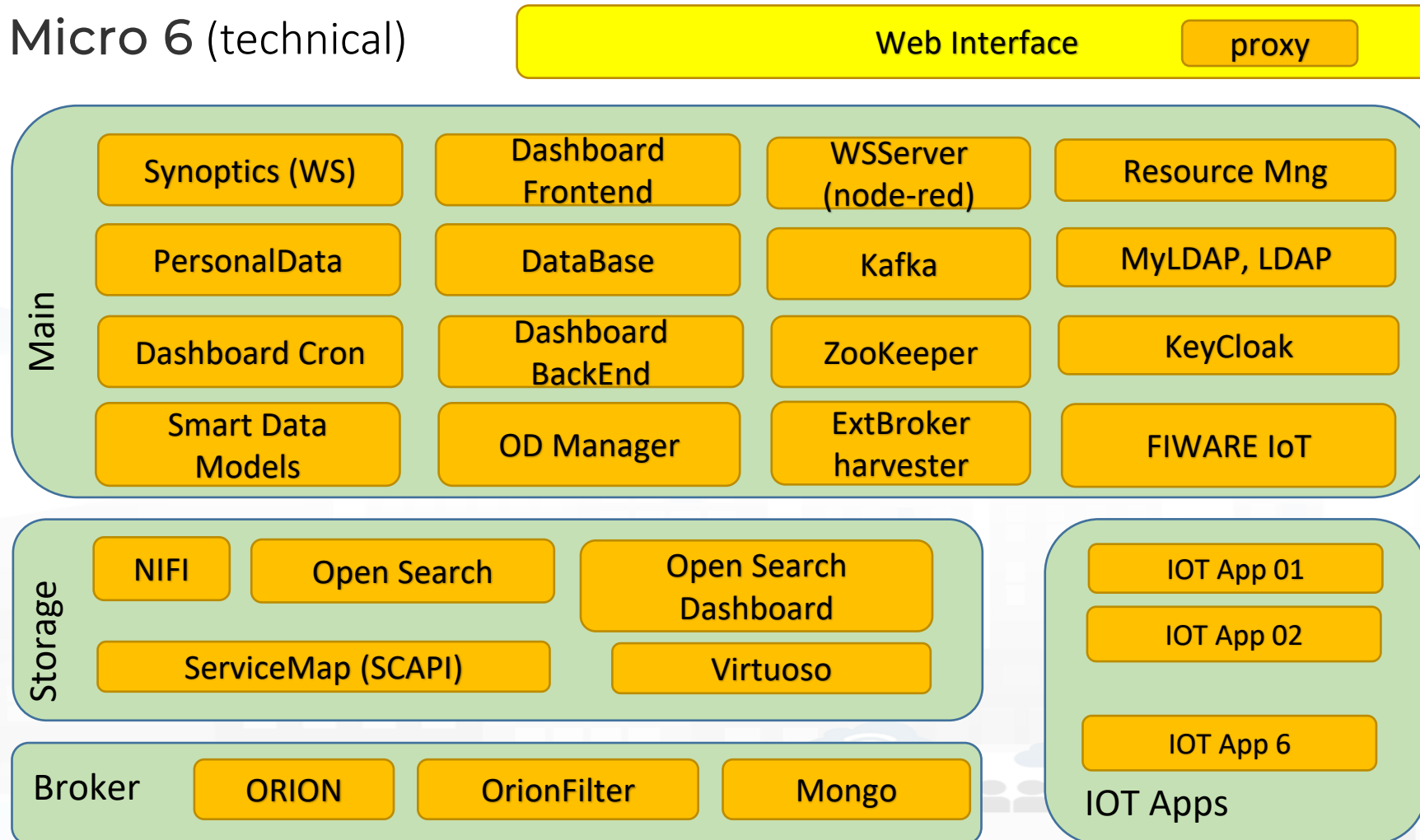
- **Micro X:**
  - 1 VM of dockers
- **Normal X,Y:**
  - 2 VM of dockers
- **Small X,Y:** scalable
  - 4 VM of dockers
- **DataCitySmall X,Y,Z:** scalable
  - 6 VM of dockers
- **DataCityMid X,Y,Z,T:** scalable
  - # VM + X/70 VM + Y/3 VM + Z VM + T VM of dockers
- **DataCityLarge:** scalable
  - depending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



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

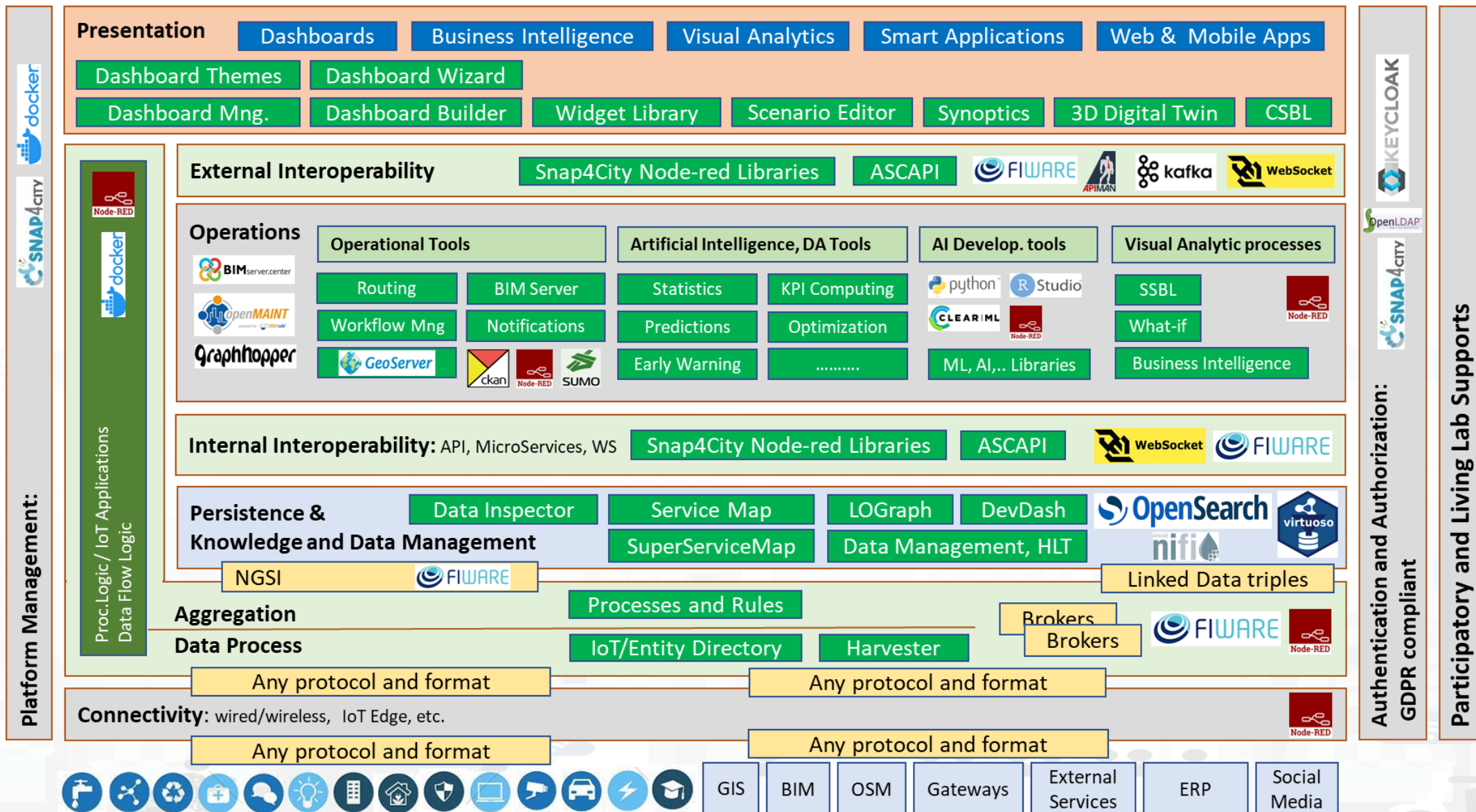
# Micro 6 model

Micro 6 (technical)



1Hour  
installation  
and  
ready to use

- **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**



TOP

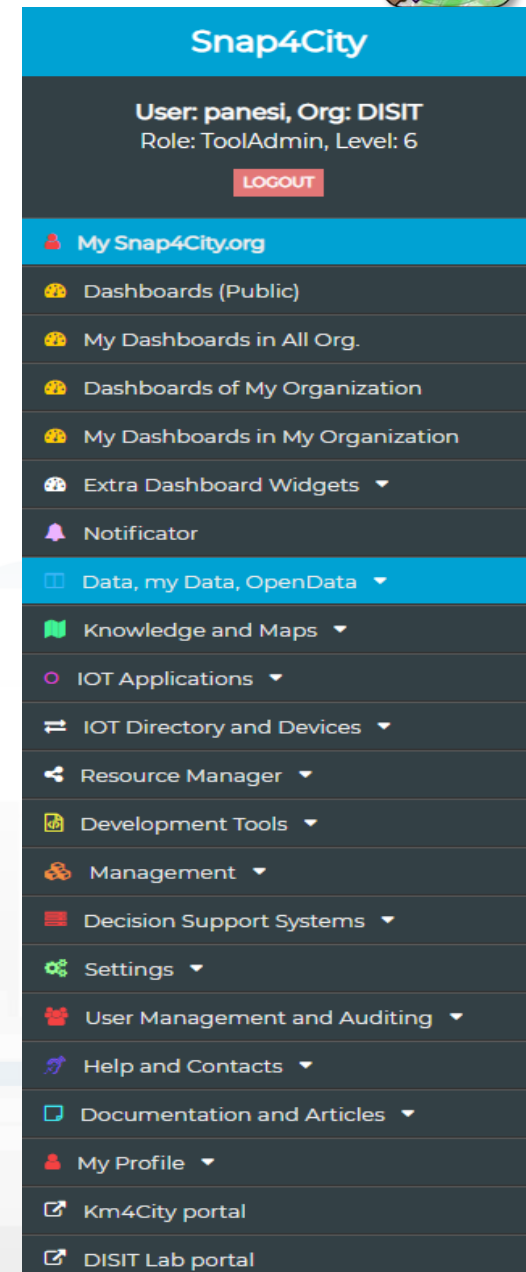
# Platform Administration



	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								

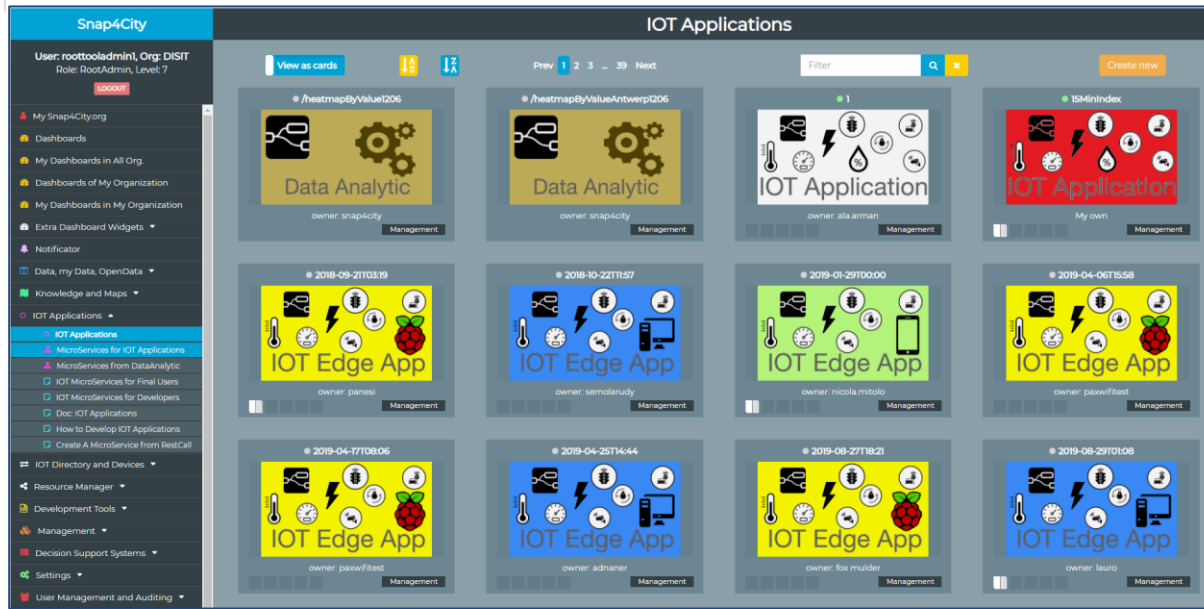
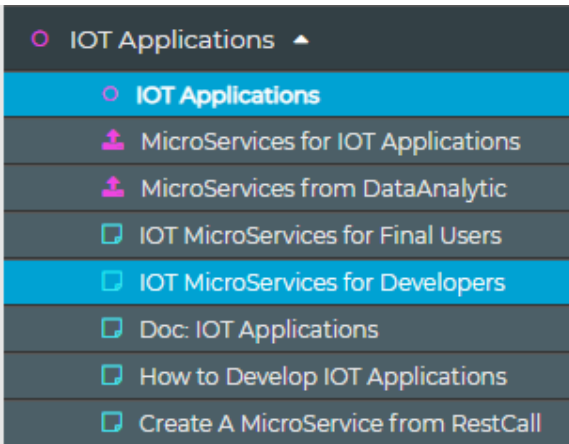
# Management by Organization

- **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, it displays the user's name 'panesi', organization 'DISIT', and role 'ToolAdmin, Level: 6'. A 'LOGOUT' button is visible. The main menu includes the following items:

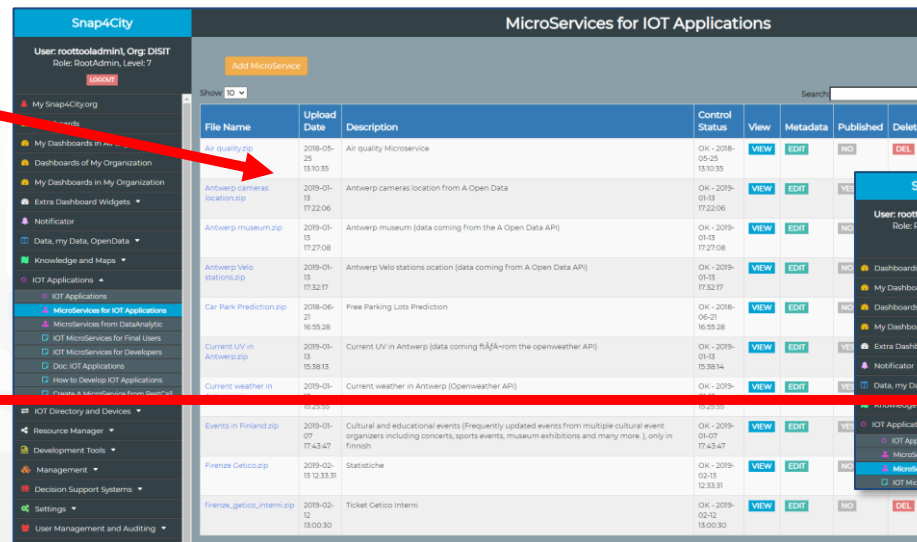
- My Snap4City.org
- Dashboards (Public)
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- Extra Dashboard Widgets
- Notificator
- Data, my Data, OpenData**
- Knowledge and Maps
- IOT Applications
- IOT Directory and Devices
- Resource Manager
- Development Tools
- Management
- Decision Support Systems
- Settings
- User Management and Auditing
- Help and Contacts
- Documentation and Articles
- My Profile
- Km4City portal
- DISIT Lab portal



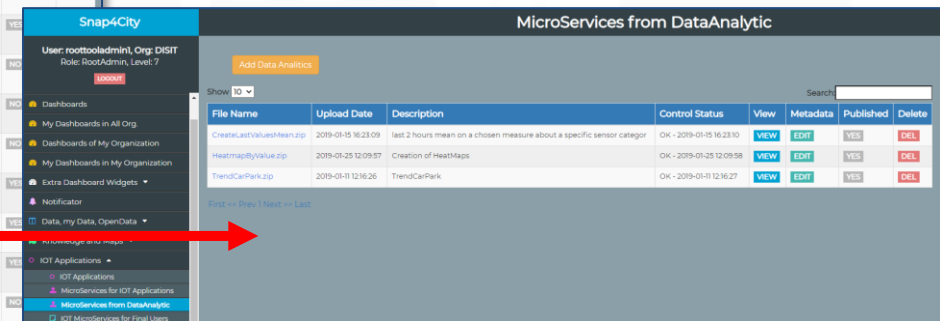
- **IOT Applications:** a view to manage Containers / IOT Edge Apps: IOT Apps, Data Analytics (R and Python), WebScraping, IOT edge, etc.

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
15EP2ZT2AA15000022	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	
330103	orionFinland	AirQualityObserved	custom	PUBLIC	Helsinki	iottdirectory/helsinki	active	EDIT	DELETE	
330104	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 snap4city 1

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

Context broker: rabbitUNIM

Model: AccessPointLorato

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":{"\$chargingLevel","\$"},"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	Antwerp	["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

- *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)

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

# 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



	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								

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




*On Line Training Material (free of charge)*

1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
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


# 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 BUILD YOUR APP FOR A CONNECTED CITY



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-'

- 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\\_SNAP4SOLL.pdf](https://www.snap4city.org/download/video/DBL_SNAP4SOLL.pdf)

## Organization Groups

- DISIT
- Developer
  - Operativo

## Updates on



# 2023 booklets



- Smart City



[https://www.snap4city.org/download/video/DPL\\_SNAP4CITY.pdf](https://www.snap4city.org/download/video/DPL_SNAP4CITY.pdf)

- Industry



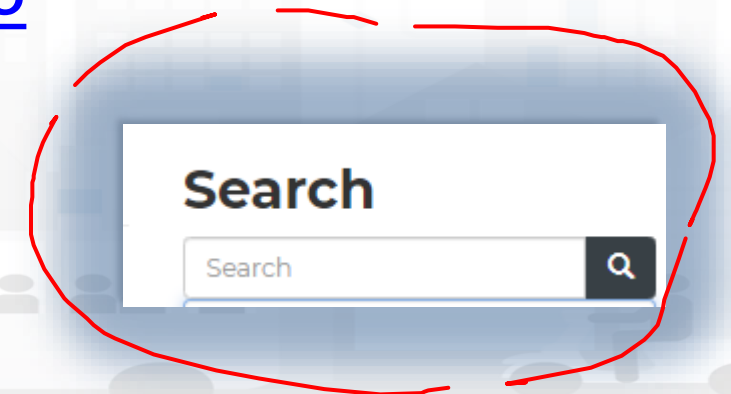
[https://www.snap4city.org/download/video/DPL\\_SNAP4INDUSTRY.pdf](https://www.snap4city.org/download/video/DPL_SNAP4INDUSTRY.pdf)

- Artificial Intelligence



[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)

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- 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>



## 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)  
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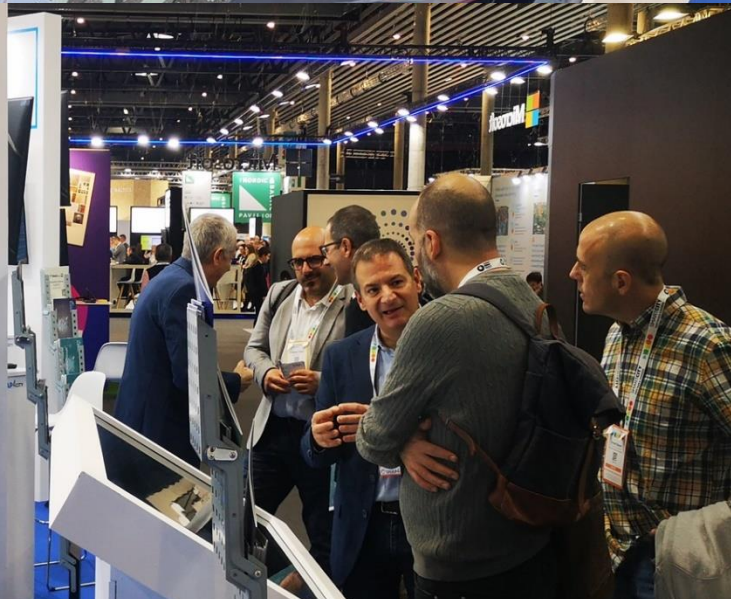
SMART CITIES AND SMART INDUSTRY

**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/drupal/sites/default/files/files/FF\\_ImpactStories\\_Snap4City.pdf](https://www.snap4city.org/drupal/sites/default/files/files/FF_ImpactStories_Snap4City.pdf)



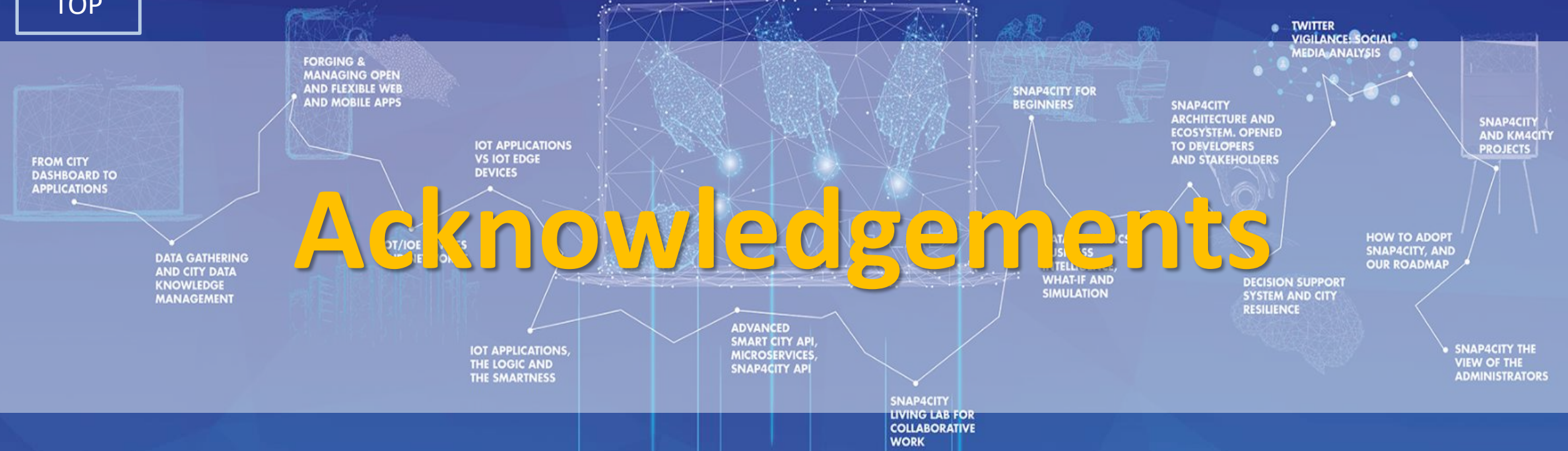
**SMARTCITY**  
 EXPO WORLD CONGRESS  
 7 - 9 NOVEMBER 2023



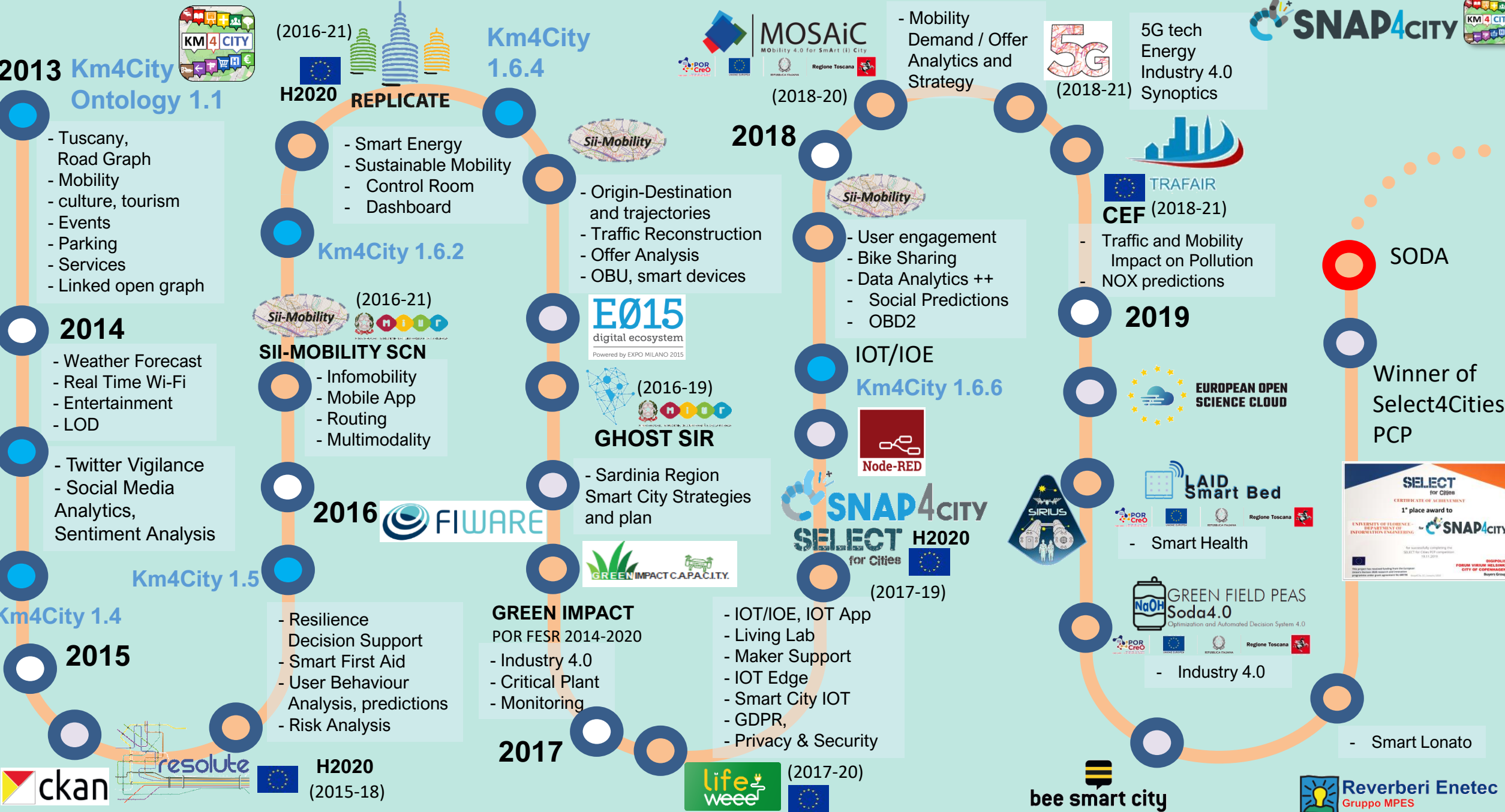
PAVILLON 1 - STAND D 100

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# 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

(2016-21) Sii-Mobility

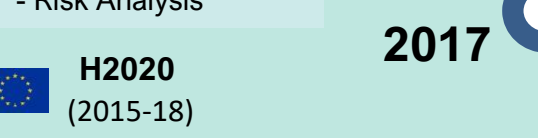
### SII-MOBILITY SCN

- Infomobility
- Mobile App
- Routing
- Multimodality

## 2016 FIWARE

## Km4City 1.5

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



## MOSAiC (2018-20) - Mobility Demand / Offer Analytics and Strategy

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

E015 digital ecosystem Powered by EXPO MILANO 2015

(2016-19) GHOST SIR

- Sardinia Region Smart City Strategies and plan

SNAP4CITY SELECT for Cities H2020 (2017-19)

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

bee smart city

- Smart Waste

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

- User engagement
- Bike Sharing
- Data Analytics ++
- Social Predictions
- OBD2

## IOT/IOE Km4City 1.6.6

Node-RED

LAID Smart Bed

- Smart Health

GREEN FIELD PEAS Soda4.0 Optimization and Automated Decision System 4.0

- Industry 4.0

Reverberi Enetec Gruppo MPES

- Smart Lonato

## SNAP4CITY

TRAFAIR CEF (2018-21)

- Traffic and Mobility Impact on Pollution
- NOX predictions

## SODA

Winner of Select4Cities PCP

SELECT for Cities CERTIFICATE OF MERIT 1st place award to SNAP4CITY

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**

Smart Ambulance (2021-22)

Enterprise (2021-22)  
Industry 4.0



Contract

**2021**

PC4City (2020-21)  
Monitoring Terrain

Winner of Open Data Challenge of  
**enel x**

**CAPELON**

- Smart Light
- Sweden

Almafluida Industry 4.0 (2021-22)

AMPERE (2021-22)  
Industry 4.0

SYN-RG-AI  
SmartCity



Industry 4.0

**uni.systems**

SmartCity, 2021-23



AXIS collab  
SmartCity

**2022**



Asymmetrica Smart City, 2022-23

Contract, 2022-23



**2023**



Contract, 2022-23



2022-2023



Security and Risk



Italferr, Smart City

CN MOST, 2022-26



EI THE, 2022-26



G. Agile, 2021-23



2023-26



Merano, smart light

OceanRace, Genova, AWS

Cuneo, smart city

**2024**

TOURISMO



Co-funded by the European Union



ELLIE IA 2025-2027



Contract, 2024-25

CAI4DSA



OPTIFaaS



SASUAM

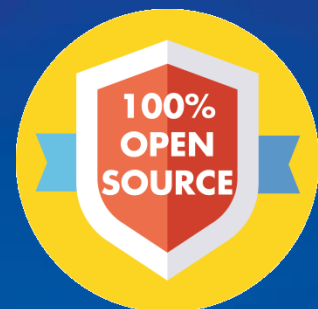


Rhodes, smart city

eShare UNIFI TUSS

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*Be smart in a SNAP!*



**SMARTCITY**  
EXPO WORLD CONGRESS

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DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

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DISTRIBUTED SYSTEMS  
AND NETWORK  
TECHNOLOGIES LAB