SNAP4CITY

www.snap4city.org
www.snap4solutions.org

KM4CITY

www.km4city.org

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

June 2024, Course
Part 1: overview

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

UNIVERSITÀ DEGLI STUDI FIRENZE
DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE
DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

Paolo Nesi, paolo.nesi@unifi.it
https://www.Km4City.org
https://www.disit.org

SNAP4CITY

KM4CITY

SNAP4 Appliances and Dockers Installations

100% OPEN SOURCE

EU GDPR COMPLIANT

PEN Test Passed

Powered by FIWARE

SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

Node-RED

Be smart in a SNAP!

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

June 2024, Course, Part 1
https://www.snap4city.org/944
https://www.snap4city.org/577

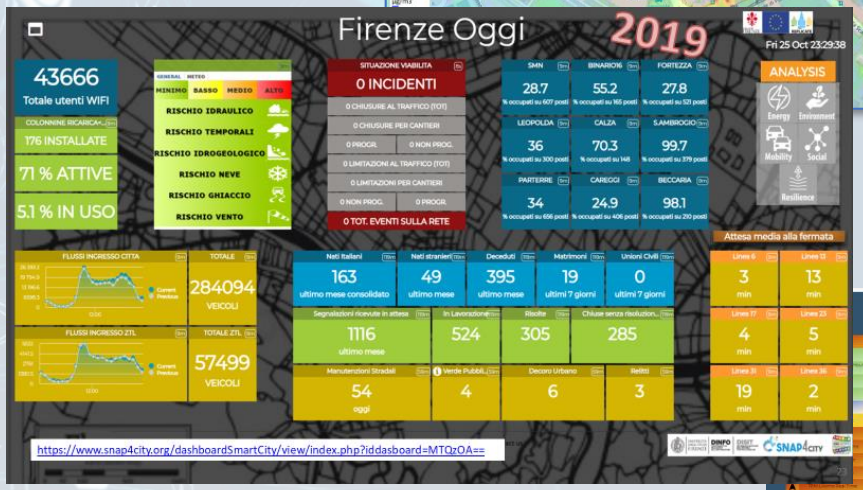
SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES

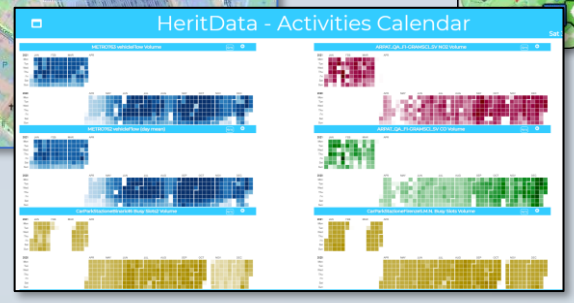
UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO | DISIT

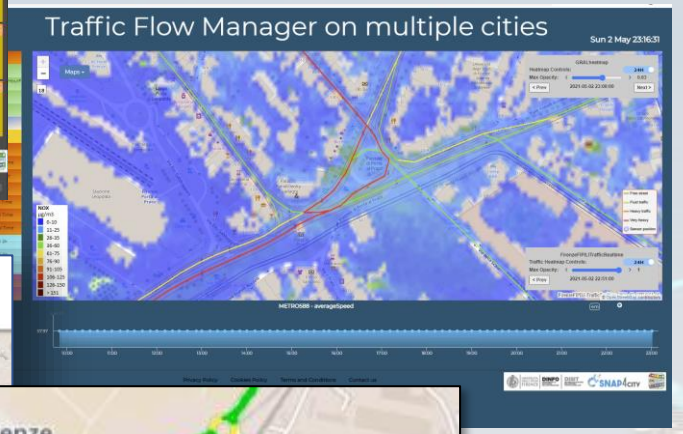
Domains

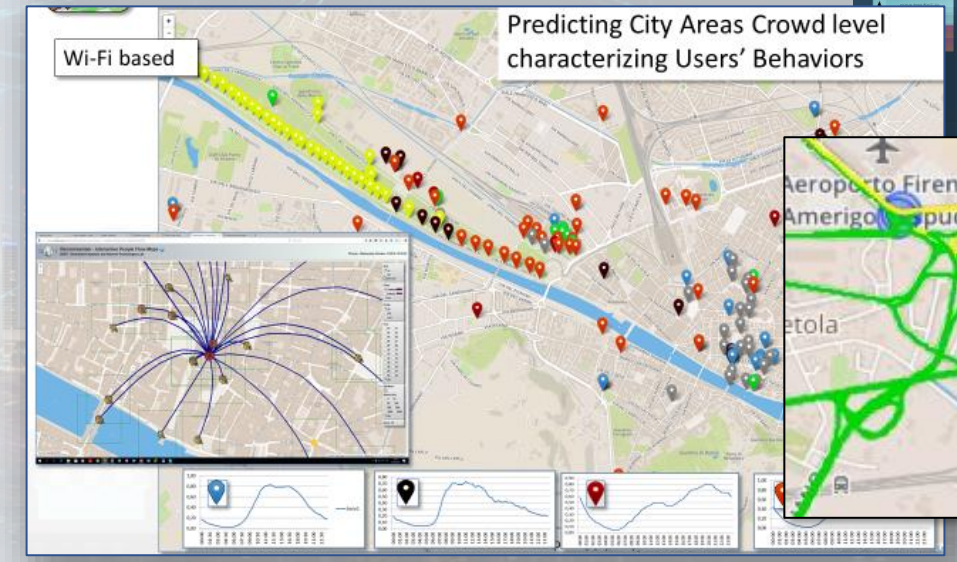
- Smart City, control room
- Mobility and transport
- Environment, pollutant, waste, water, green, ..
- Energy, light, recharge
- Tourism and People
- Asset management
- Security and Safety
- Social Media

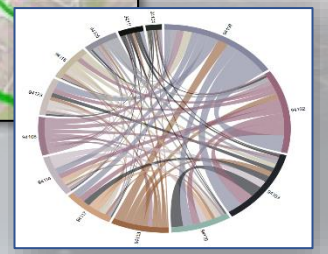
- Big Data, AI/XAI
- Public and private data











Publications http://www.disit.org/5487

Key Performance Indicators, KPI

	Air Quality Directive			WHO guidelines	
Pollutant	Averaging period	Objective and legal nature and concentration	Comments	Concentration	Comments
$PM_{2.5}$	One day			25 µg/m³ (*)	99th percentile (3 days/year)
$PM_{2.5}$	Calendar year	Target value, 25 µg/m³	The target value has become a limit value since 1 January 2015	10 µg/m³	
PM_{10}	One day	Limit value, 50 µg/m³	Not to be exceeded on more than 35 days per year.	50 µg/m³ (*)	99th percentile (3 days/year)
PM_{10}	Calendar year	Limit value, 40 µg/m³ (*)		20 µg/m³	
O_3	Maximum daily 8-hour mean	Target value, 120 µg/m³	Not to be exceeded on more than 25 days per year, averaged over three years	100 µg/m³	
NO_2	One hour	Limit value, 200 µg/m³ (*)	Not to be exceeded more than 18 times a calendar year	200 µg/m³ (*)	
NO_2	Calendar year	Limit value, 40 µg/m³		40 µg/m³	

- **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);
- **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

- ***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

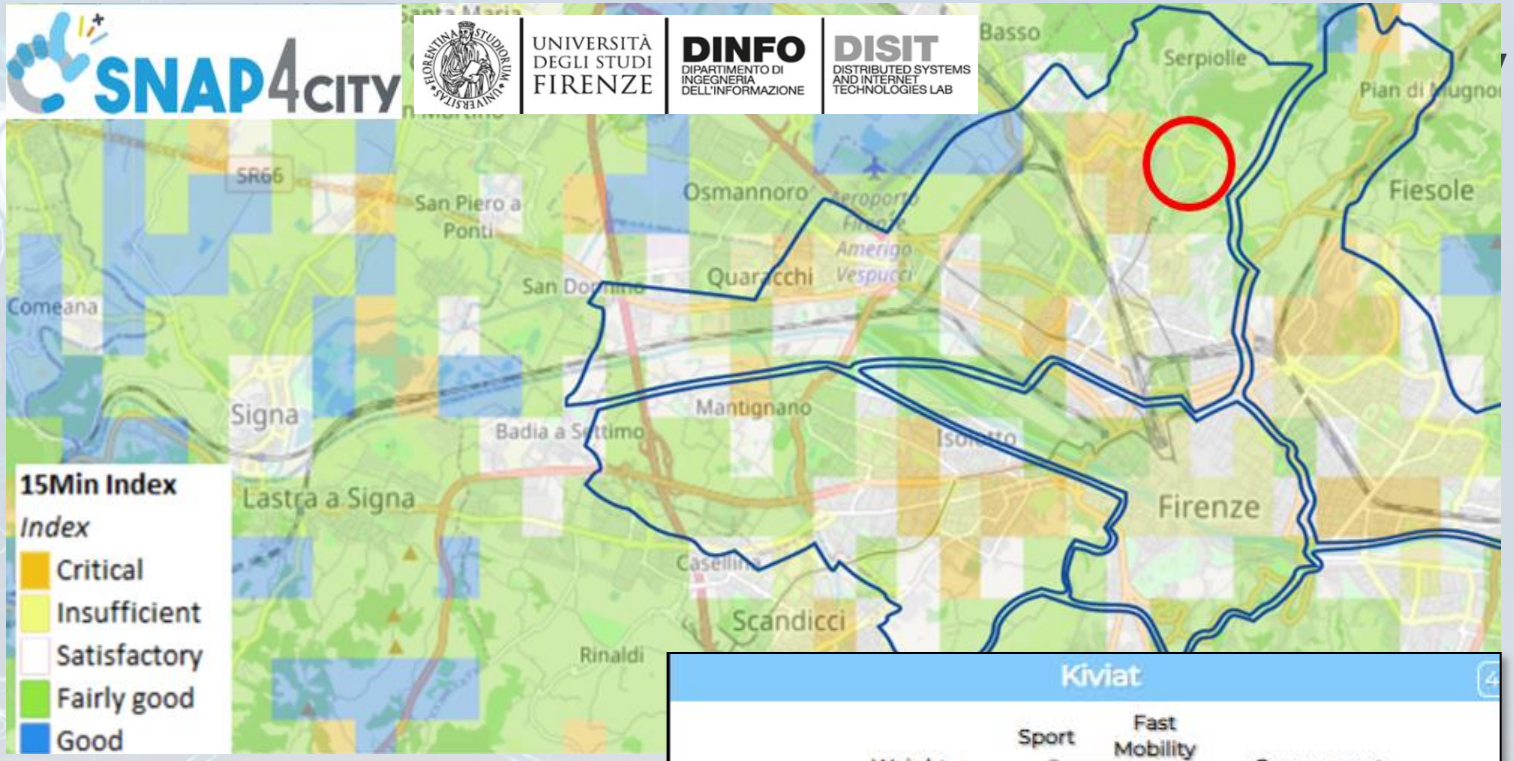
- Monitoring and Predicting: NO2, NOX, CO2, Traffic flow, pollutant, landslide, waste, etc.
- Traffic flow reconstruction
- Demand vs Offer of Mobility analysis

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

15MinCityIndex

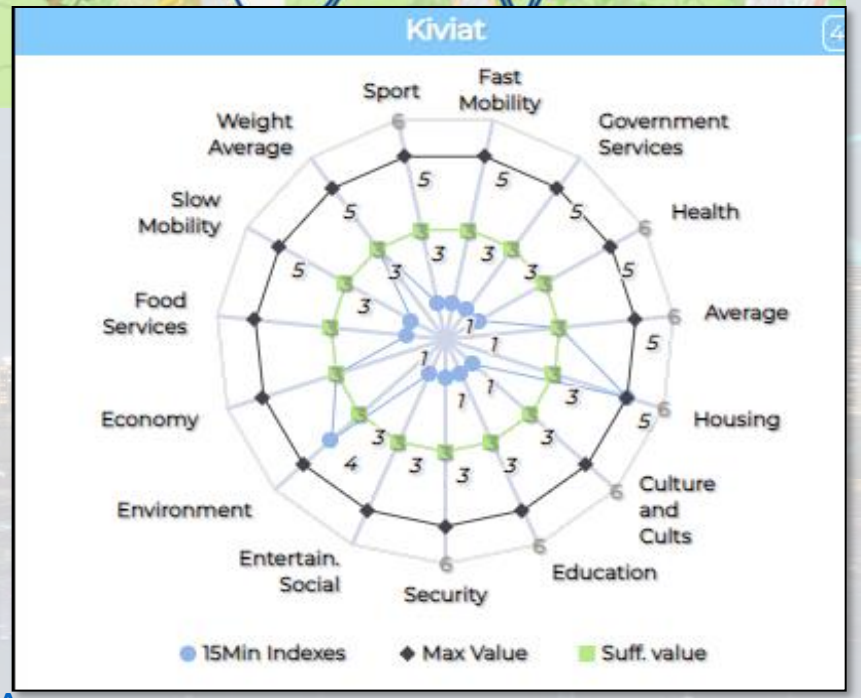
What would support my neighborhood to become a 15-Minute City?

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.

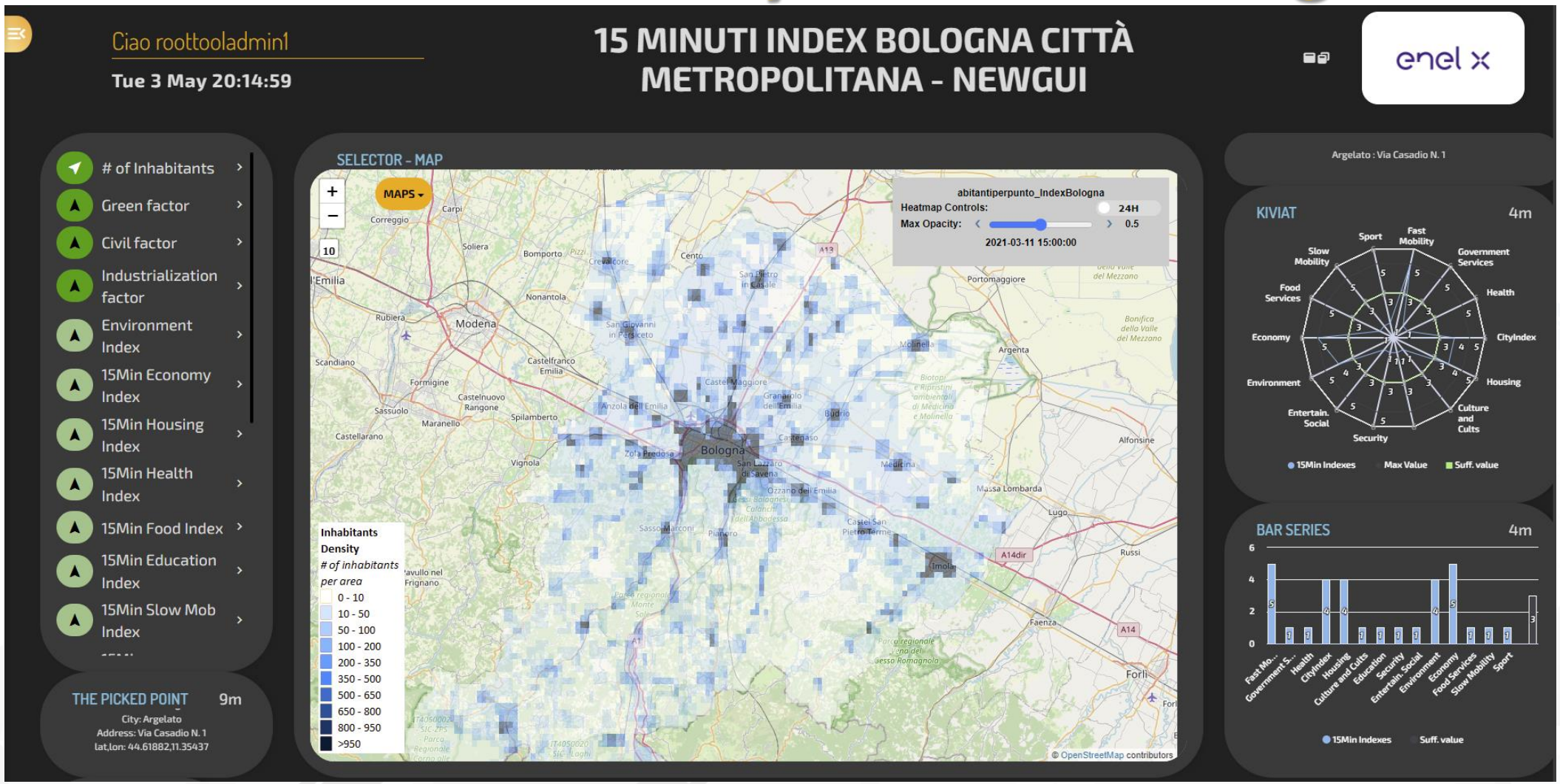
The tool supports the becoming of a 15-Minute city evaluating the service level in various domains.



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.

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjkzOA==

15MinCityIndex on Bologna



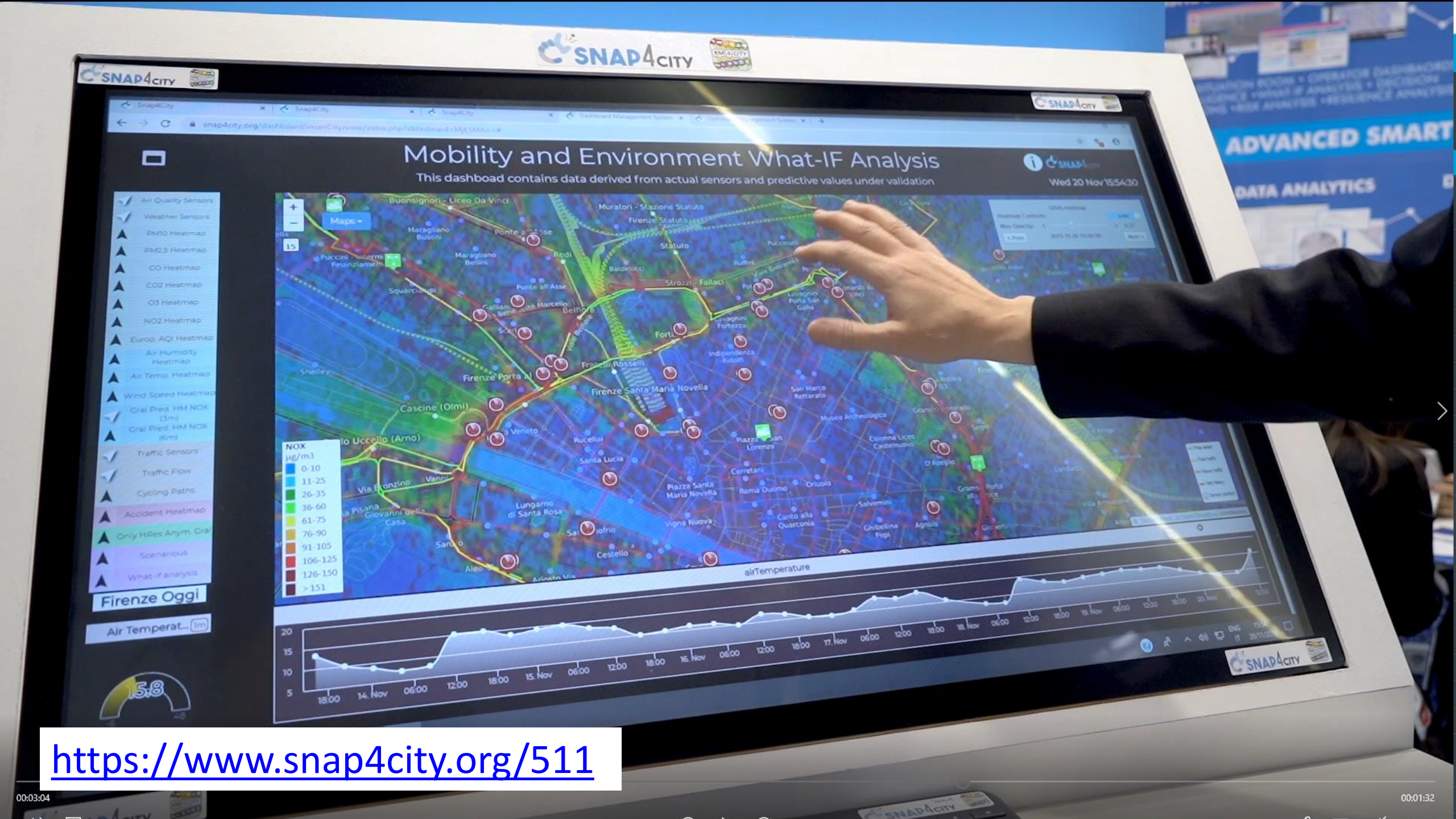
https://www.snap4city.org/dashboardSmartCity/view/Baloon-Dark.php?iddasboard=MzQxMg==

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/511

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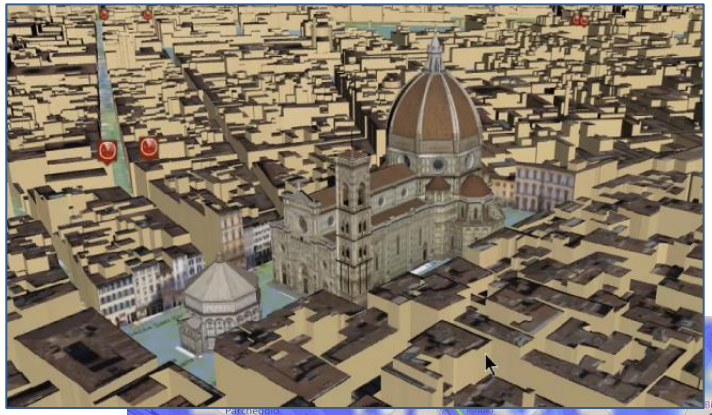
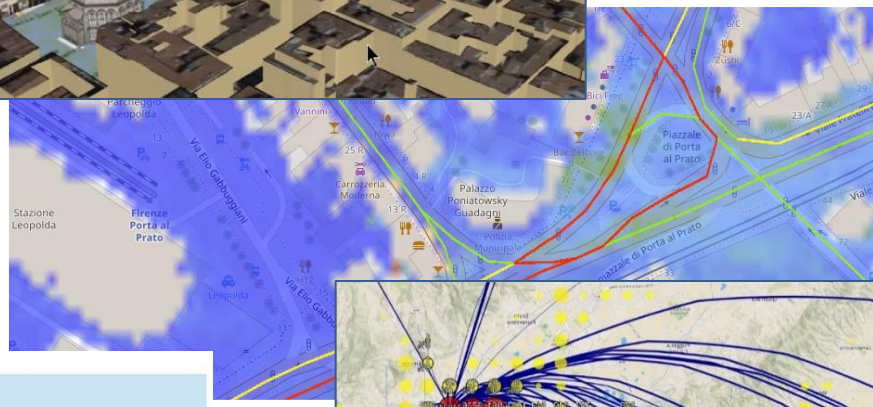
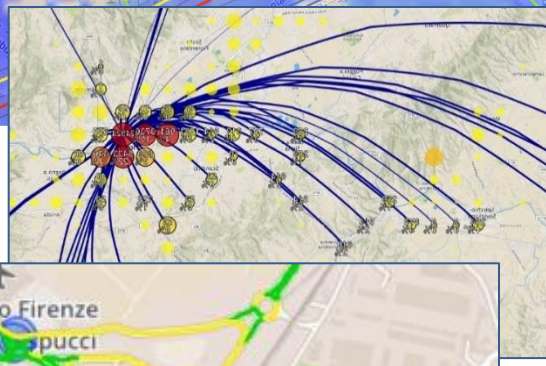
Main Tasks

- **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 Unknows**

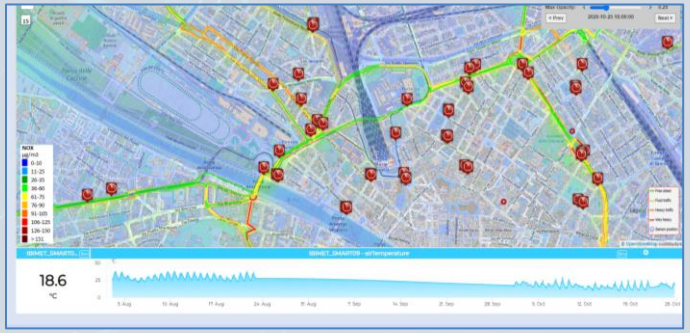


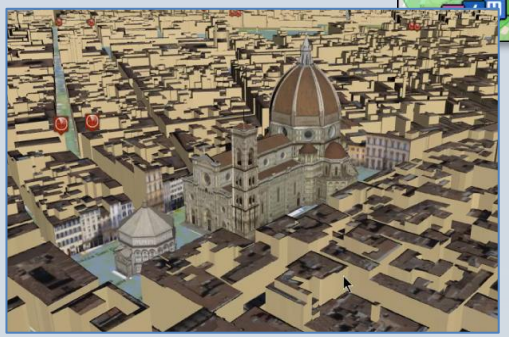


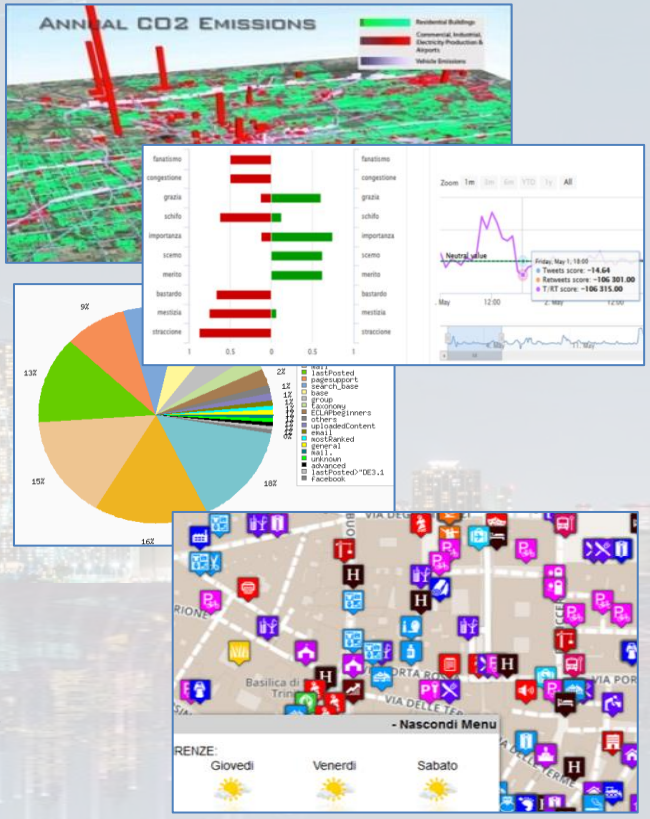


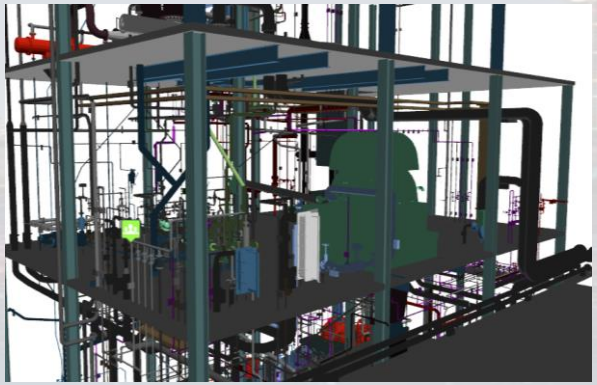
Digital Twin

- **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



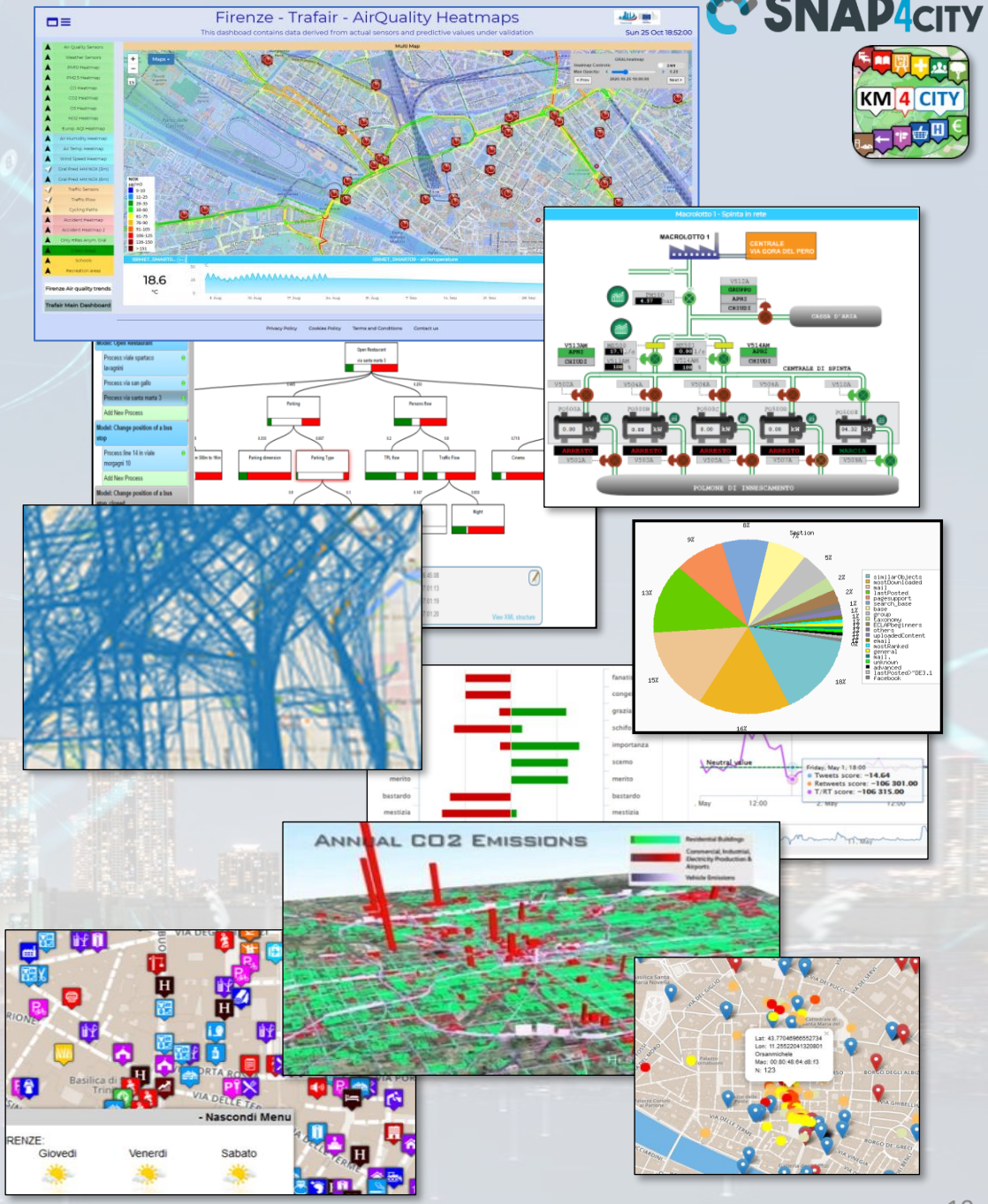






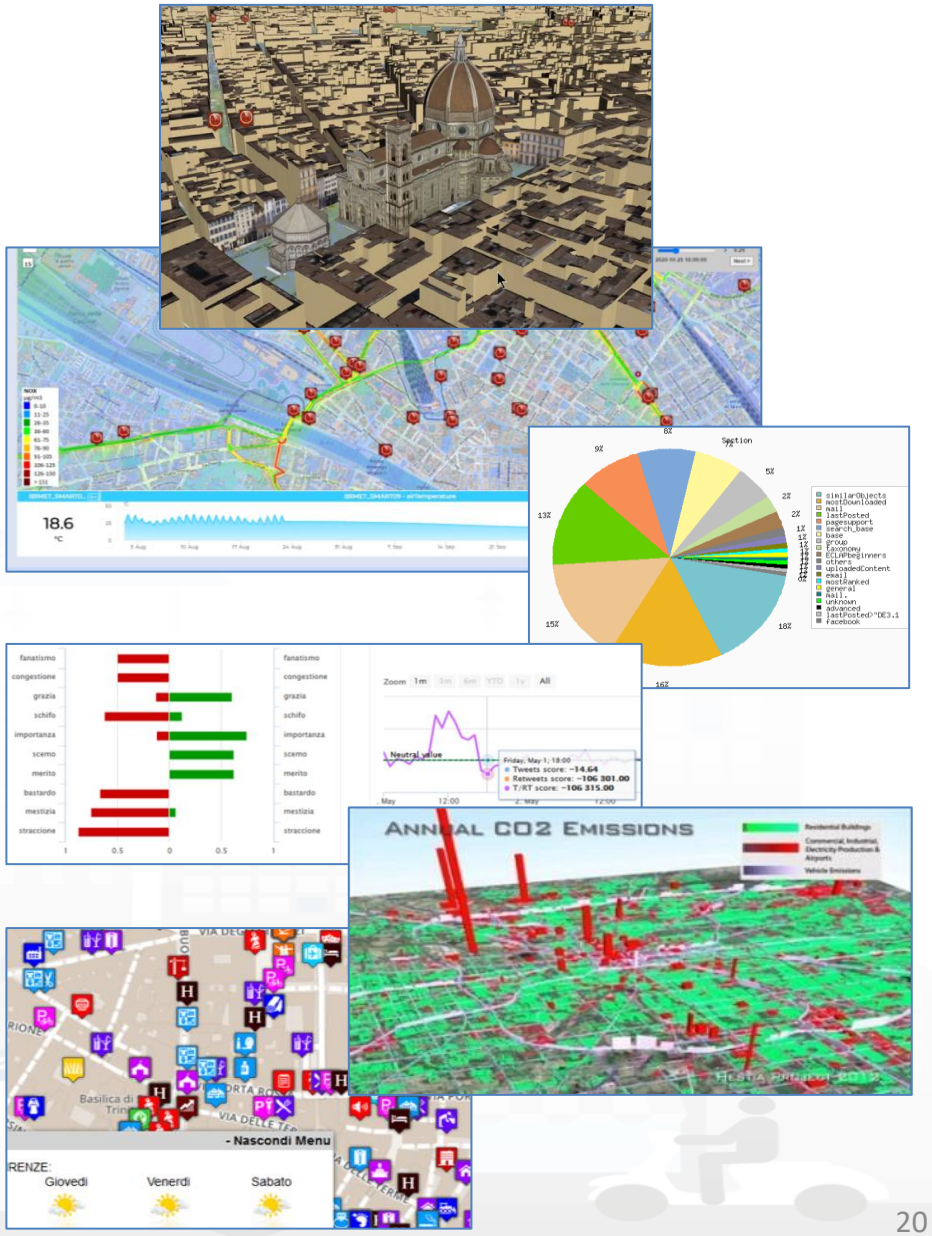
Data Driven Decision Support

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

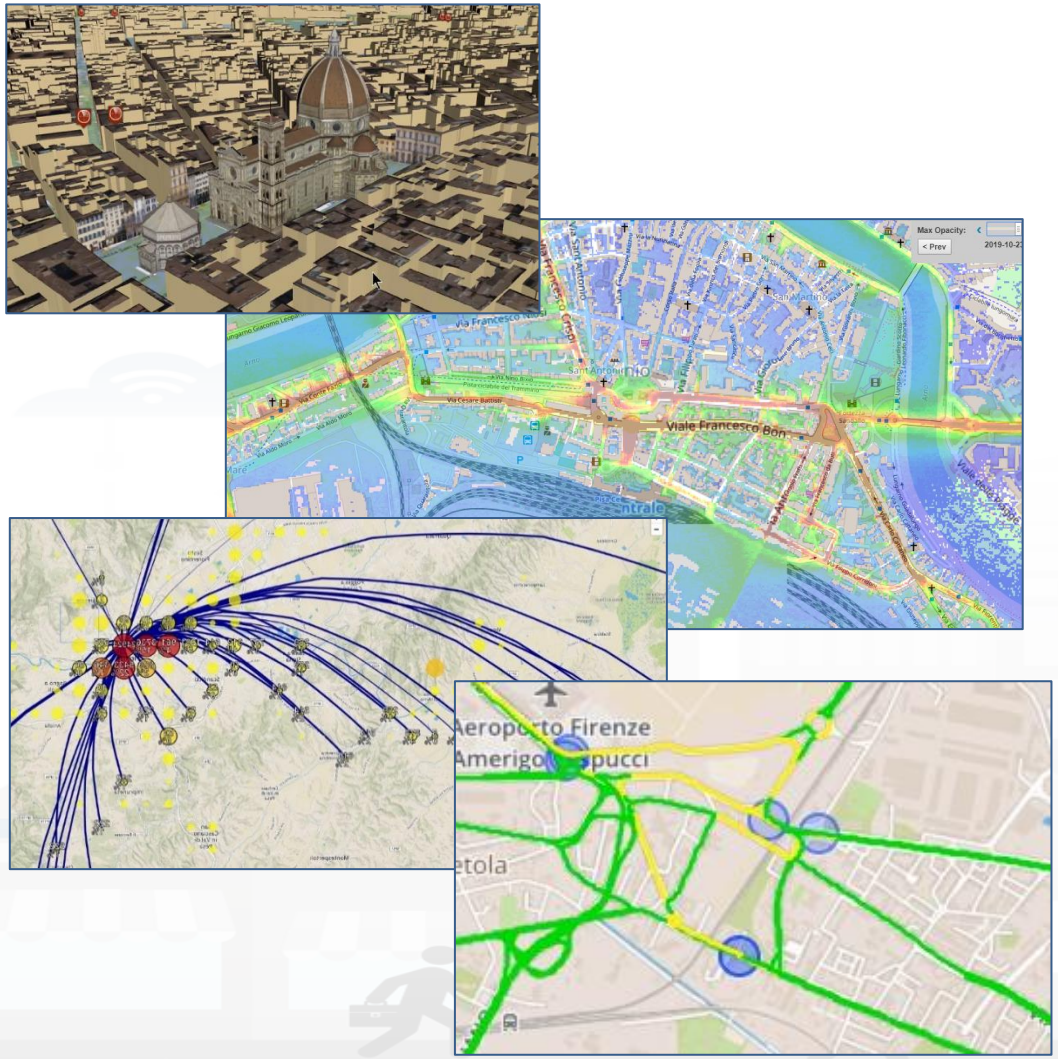


Challenges vs Technologies

- **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



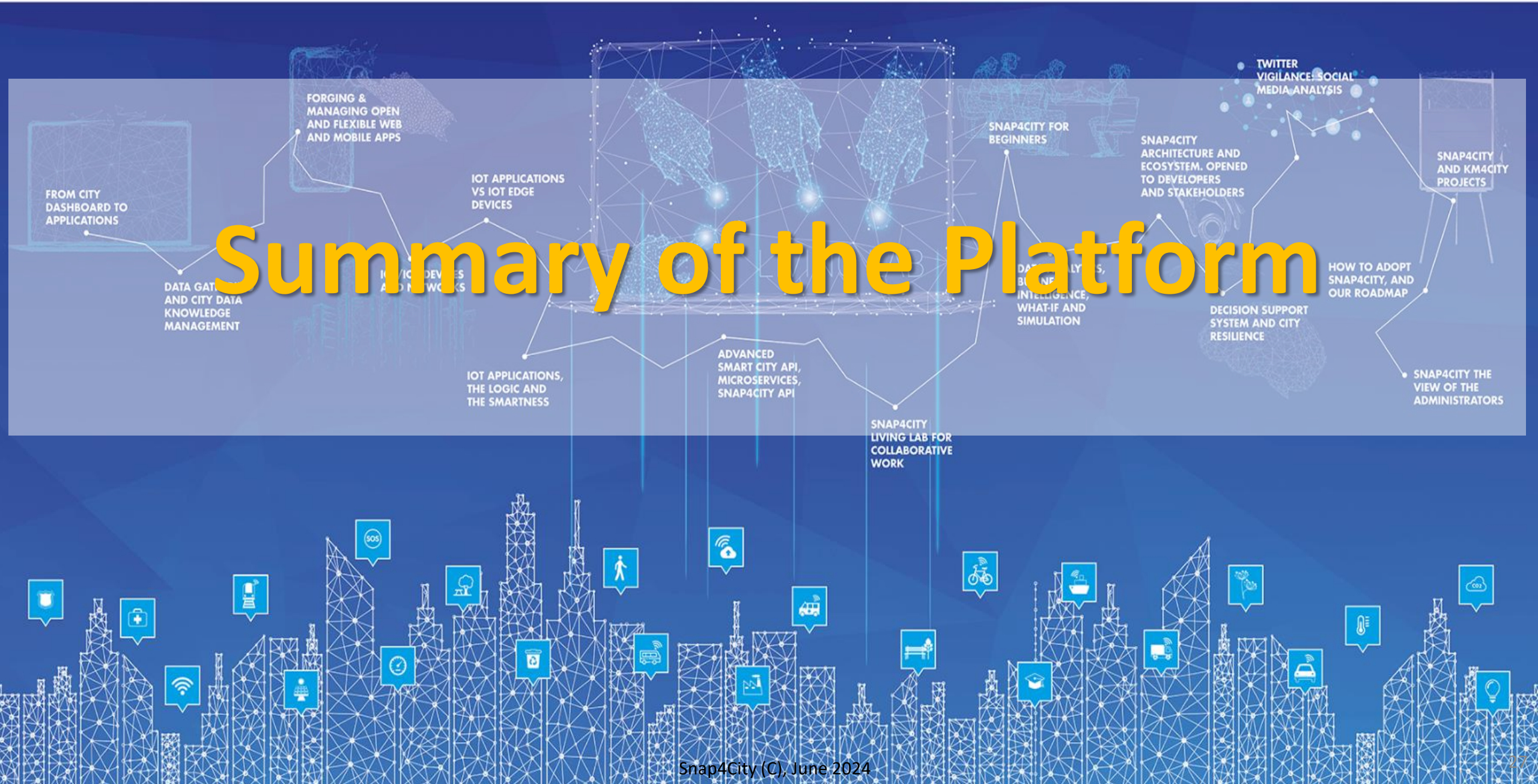
City Digital Model with…

- 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.

Application: eSharing and Pooling

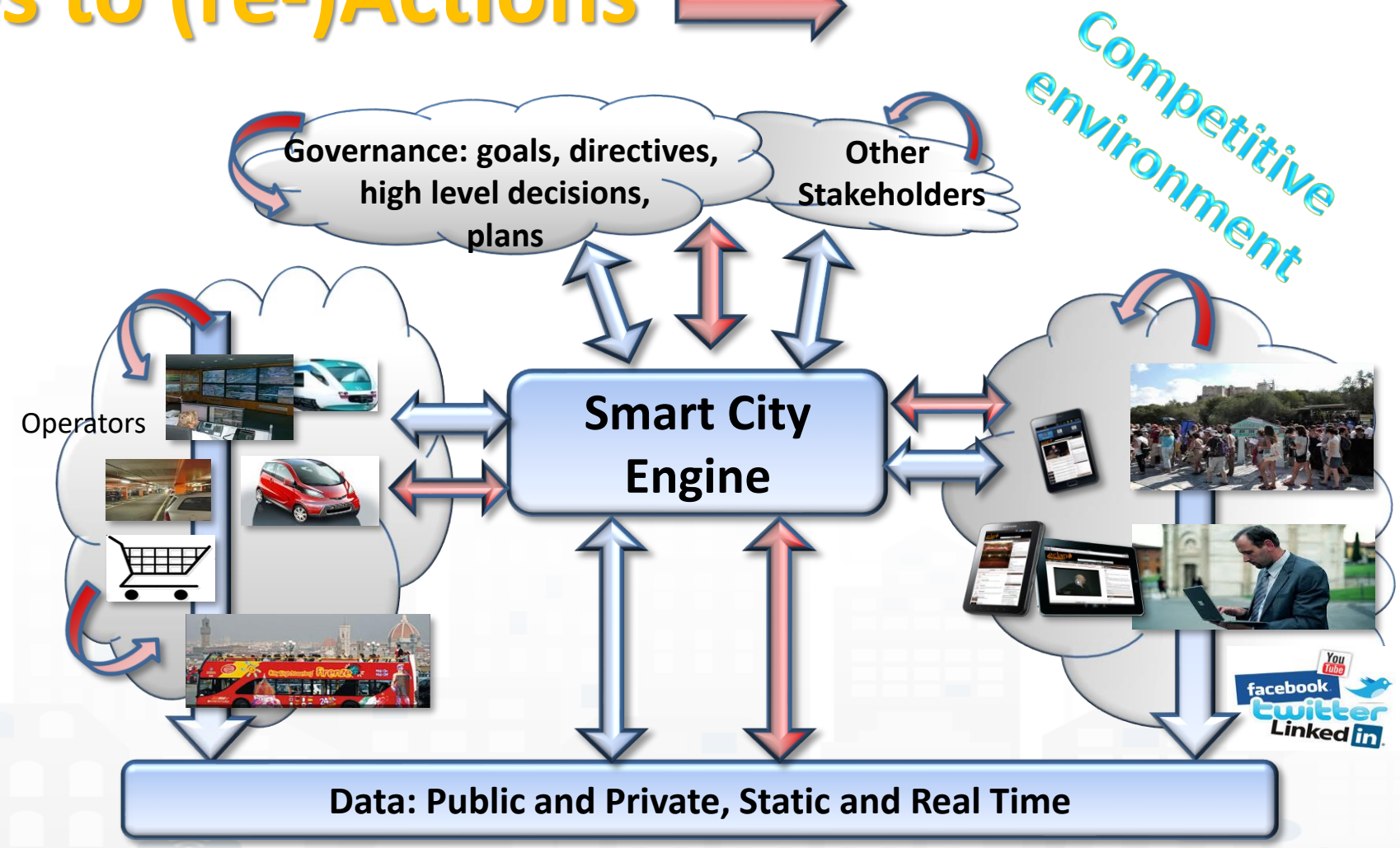


Summary of the Platform

Snap4City

From Strategies to (re-)Actions

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



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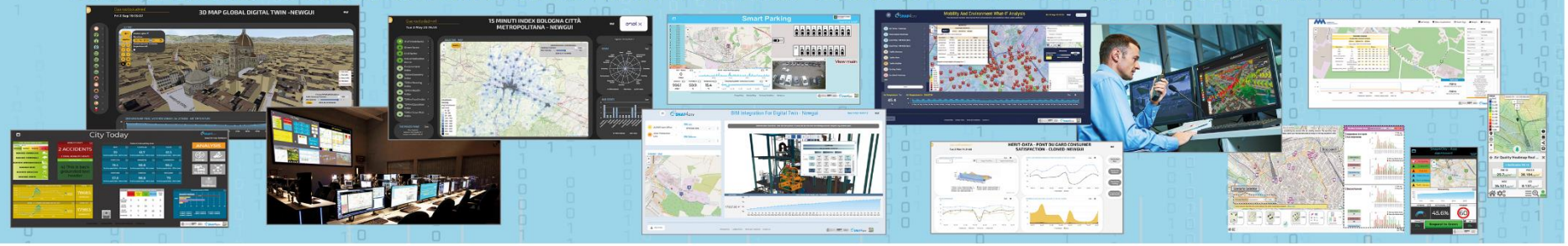
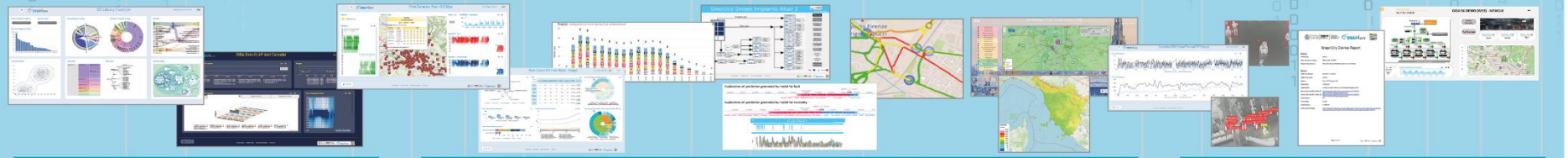


DASHBOARDS - VISUAL ANALYTICS - SYNOPTICS - DIGITAL TWIN - GRAPHICAL WIDGETS - ANALYTICS - GUI CUSTOM STYLES - VISUAL PROGRAMMING

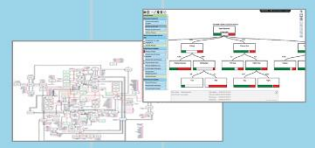


DASHBOARDS, WIDGETS
TEMPLATES

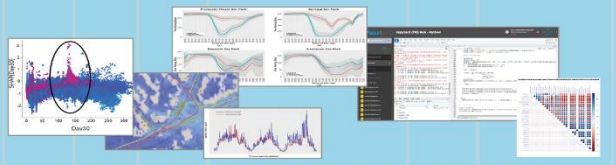
PREDICTION - ANOMALY DETECTION - CLUSTERING - ROUTING - SENTIMENT NLP - TRAFFIC FLOW
PEOPLE FLOWS - SDG - 15 MIN CITY INDEX - KPI - HEATMAPS - ORIGIN DESTINATION - ETC...

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

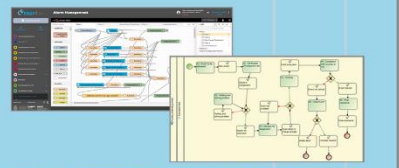
ANY: DATA, BROKER, NETWORK AND VERTICAL



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
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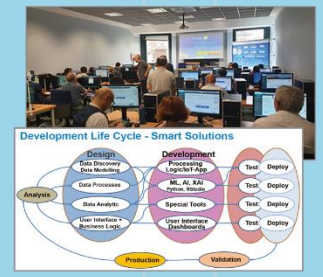
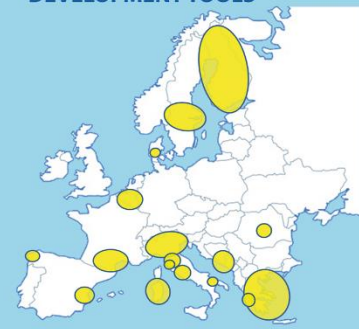
Native and External Smart Applications

- Mobility & Transport
- Light & Energy
- Waste | Environment
- Building | Tourism
- Asset Management
- Security and Safety
- Social Media

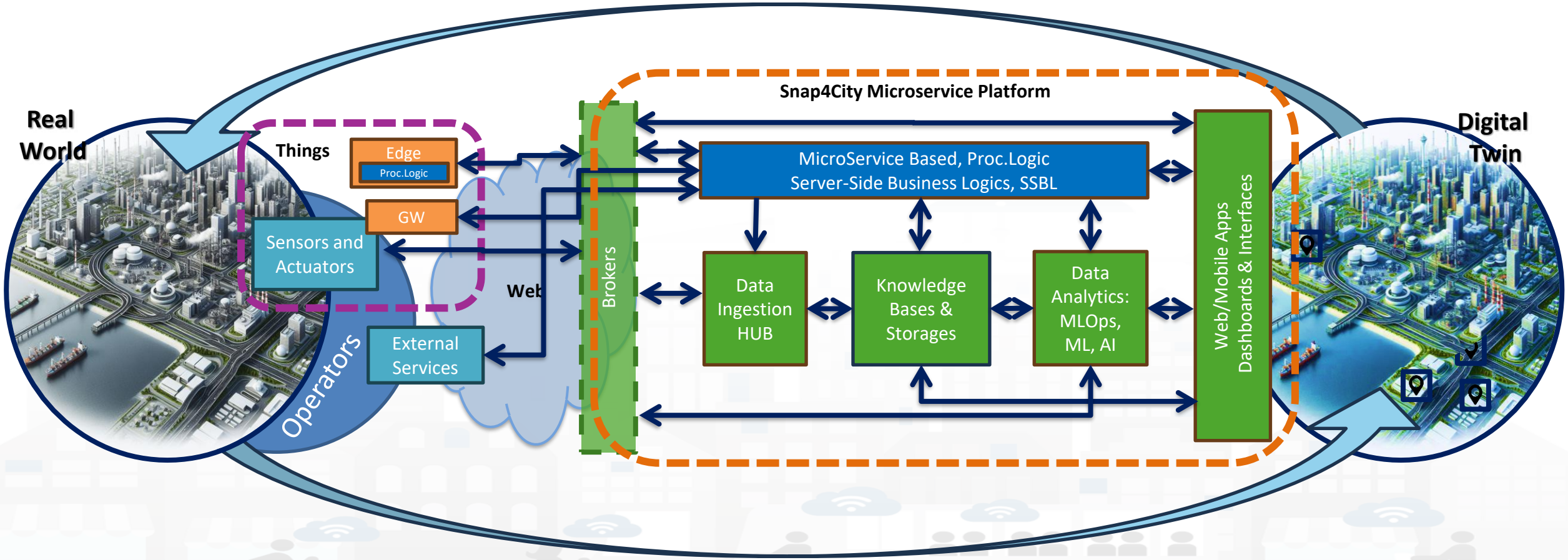
...



METHODOLOGIES
LIVING LABS
COURSES AND COMMUNITY
DEVELOPMENT TOOLS



Digital Twin Development Platform



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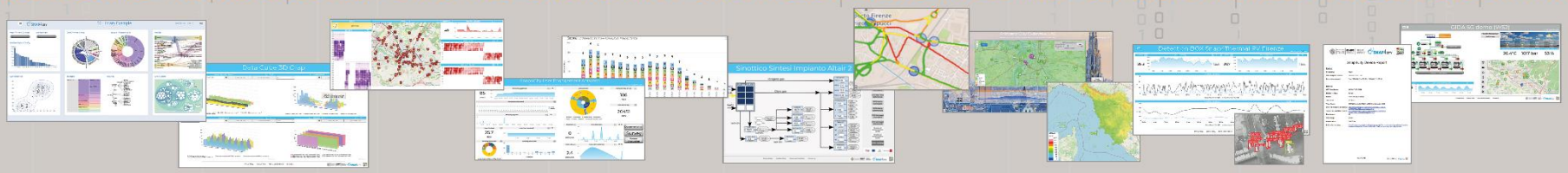

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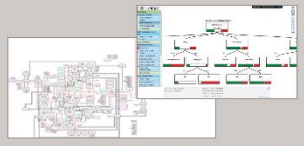

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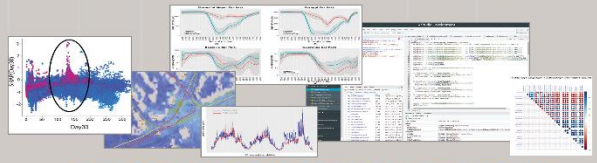

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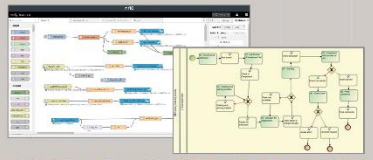

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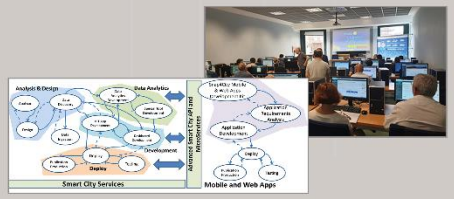

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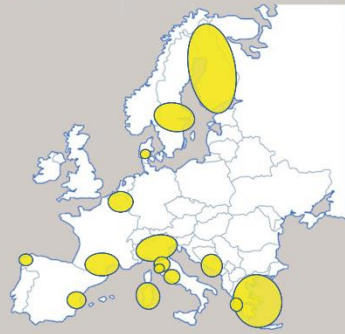
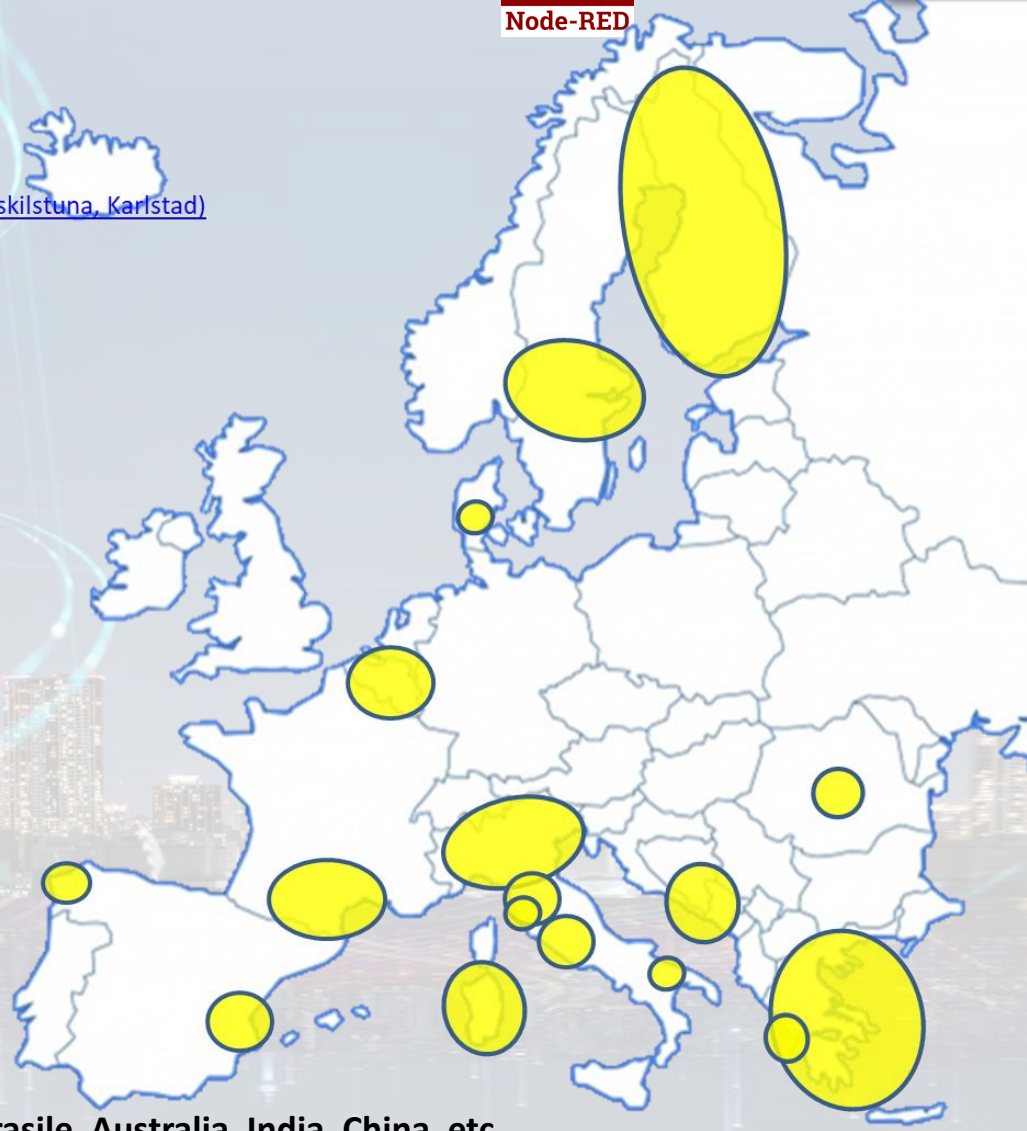


https://www.Snap4City.org

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

Main Organizations/areas

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



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

Standards and Interoperability (6/2023)

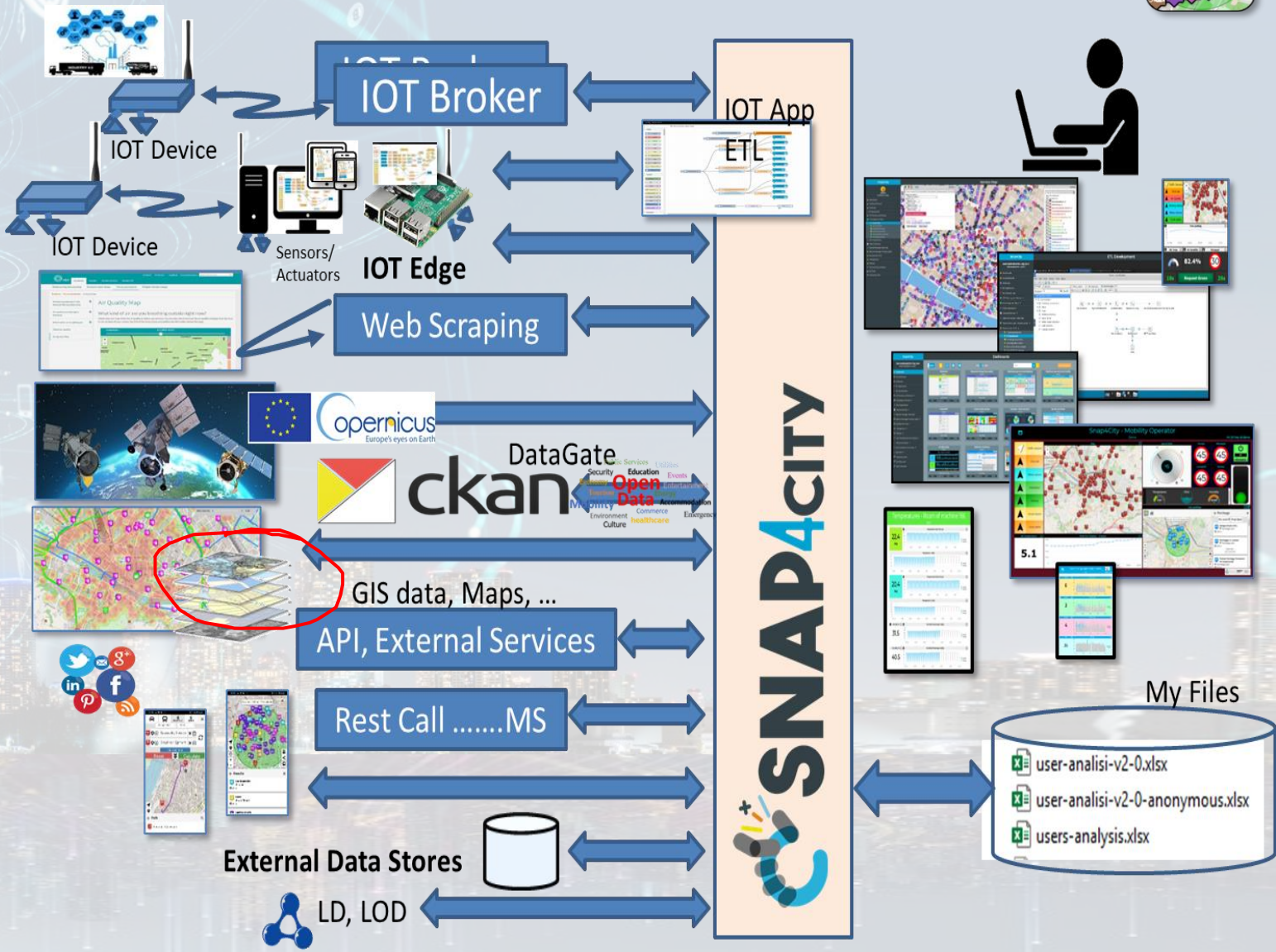
Compliant with:

- **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, glTF, GLB, DTM, GDAL, Satellite, D3 JSON, …
- **Database**: Open Search, MySQL, Mongo, HBASE, SOLR, SPARQL, ODBC, JDBC, Elastic Search, Phoenix, PostGres, MS Azure, ..
- **Industry**: OPC/OPC-UA, OLAP, ModBUS, RS485, RS232,..
- **Mobility**: DATEX, GTFS, Transmodel, ETSI, NeTEx, ..
- **Social**:Twitter, FaceBook, Telegram, ..
- **Events**: SMS, EMAIL, CAP, RSS Feed, ..
- **OS**: Linux, Windows, Android, Raspberry Pi, Local File System, AXIS, ESP32, etc.

https://www.snap4city.org/65

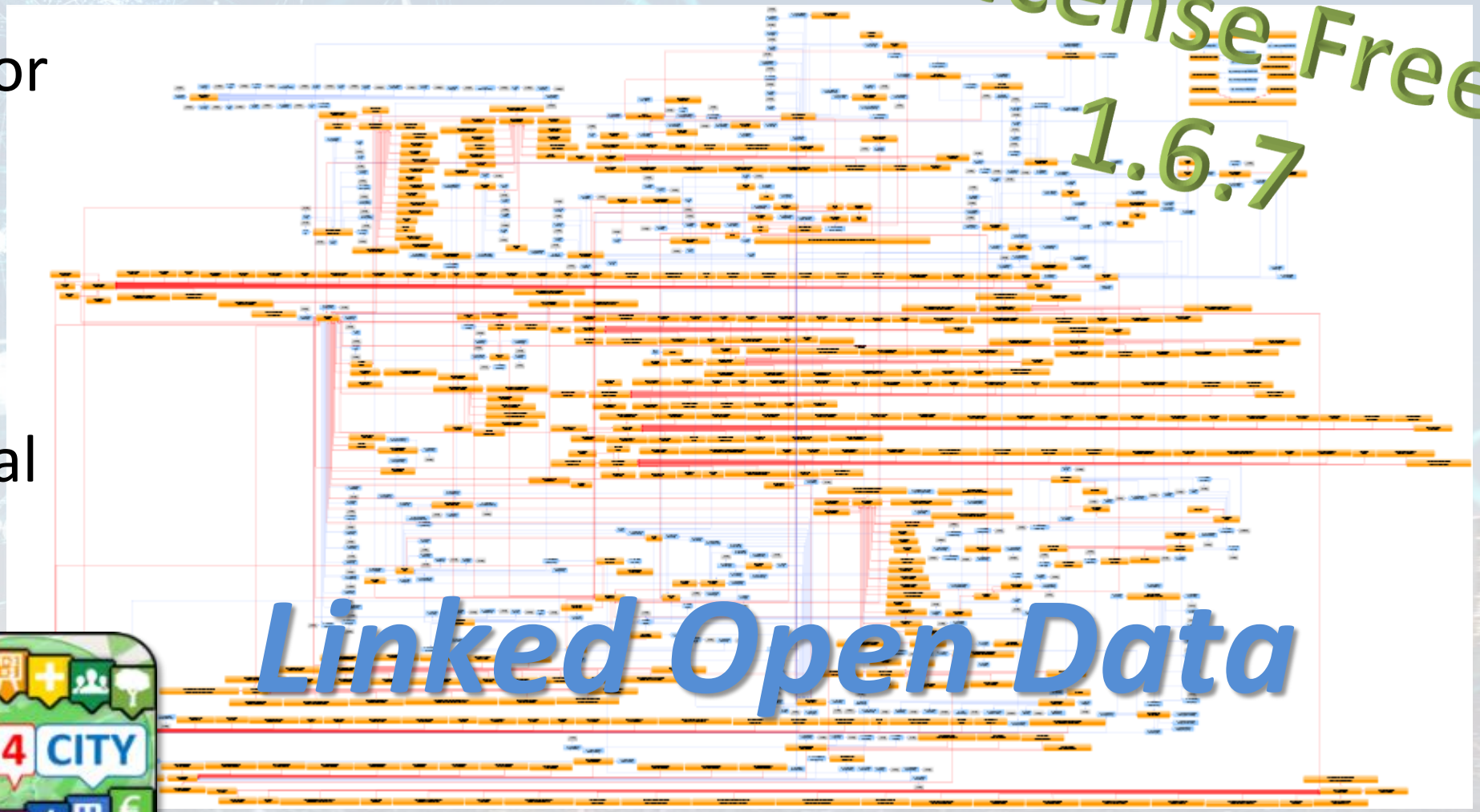
Ingestion, agg. → exploitation

- **Snap4City efficient tools for**
  - Bidirectional data channels
  - Any format, any channel, any data, any broker, any protocol, …
  - **Km4City** Knowledge base Ontology reasoning on geo, space, time, relationships



Expert System semantic queries

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

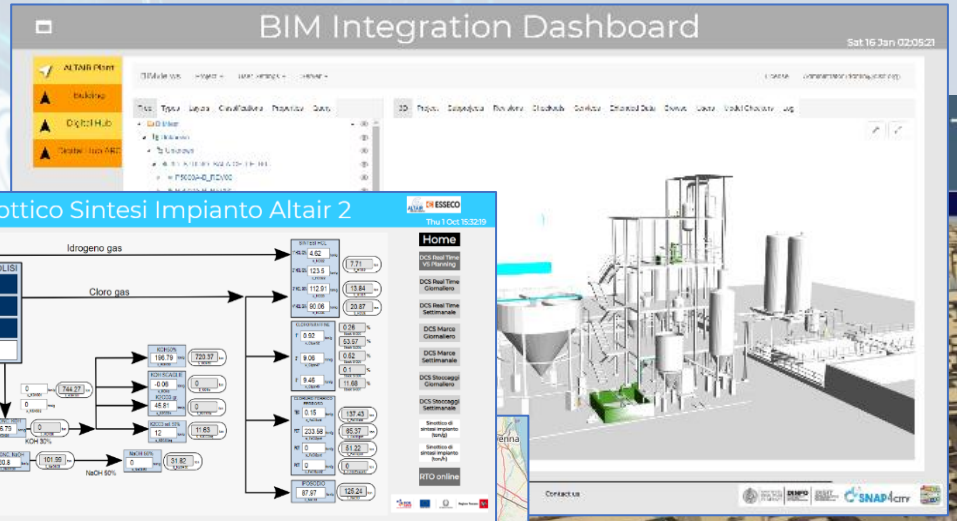


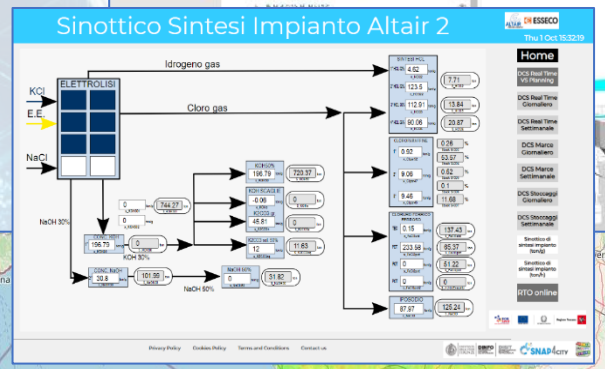
https://www.snap4city.org/19

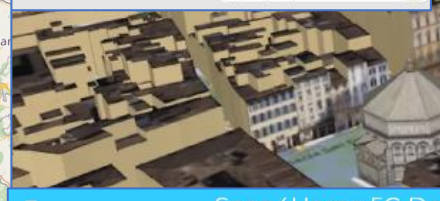
High Level Types

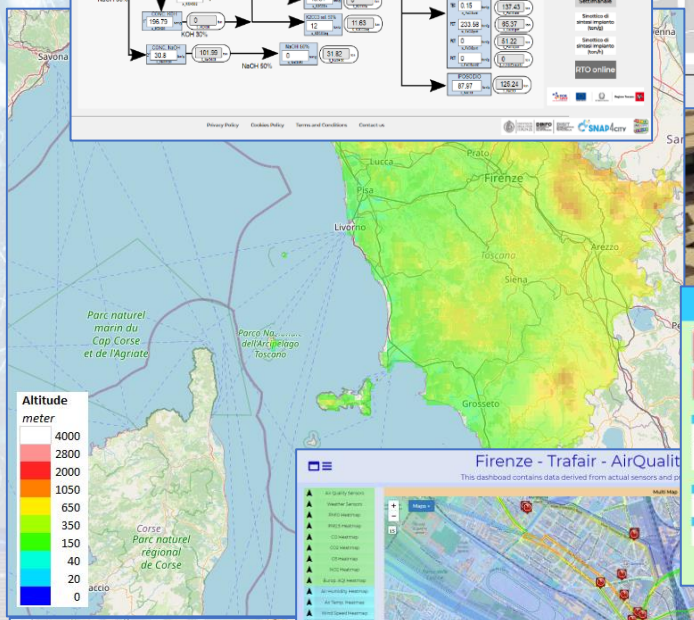
Snap4City (C), June 2024

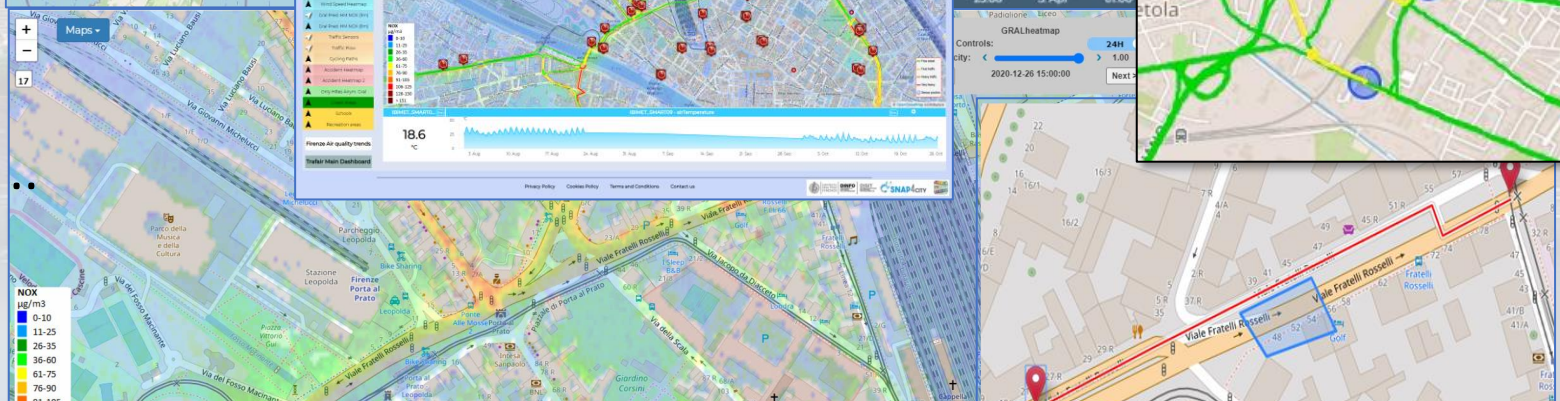
- POI, IOT Devices, shapes,..
  - FIWARE Smart Data Models,
  - IoT Device Models
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ..
- Satellite data, any kind..
- traffic flow, typical trends, ..
- trajectories, events, Workflow, ..
- 3D Models, BIM, Digital Twins, ..
- OD Matrices of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





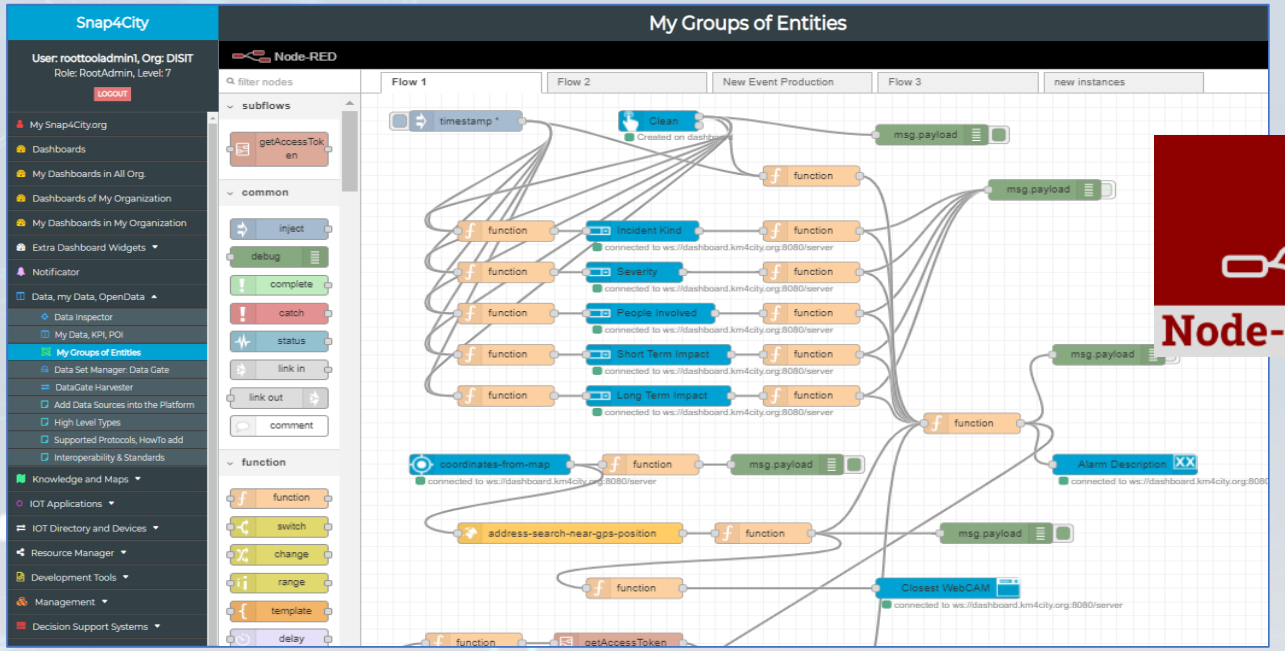


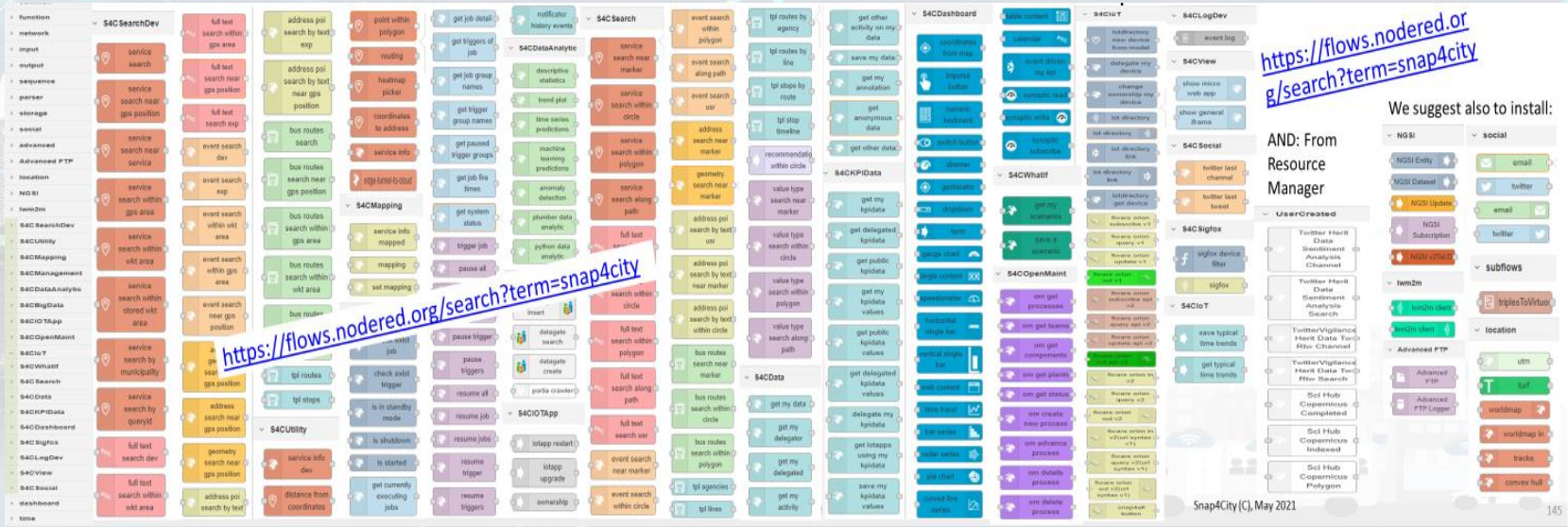




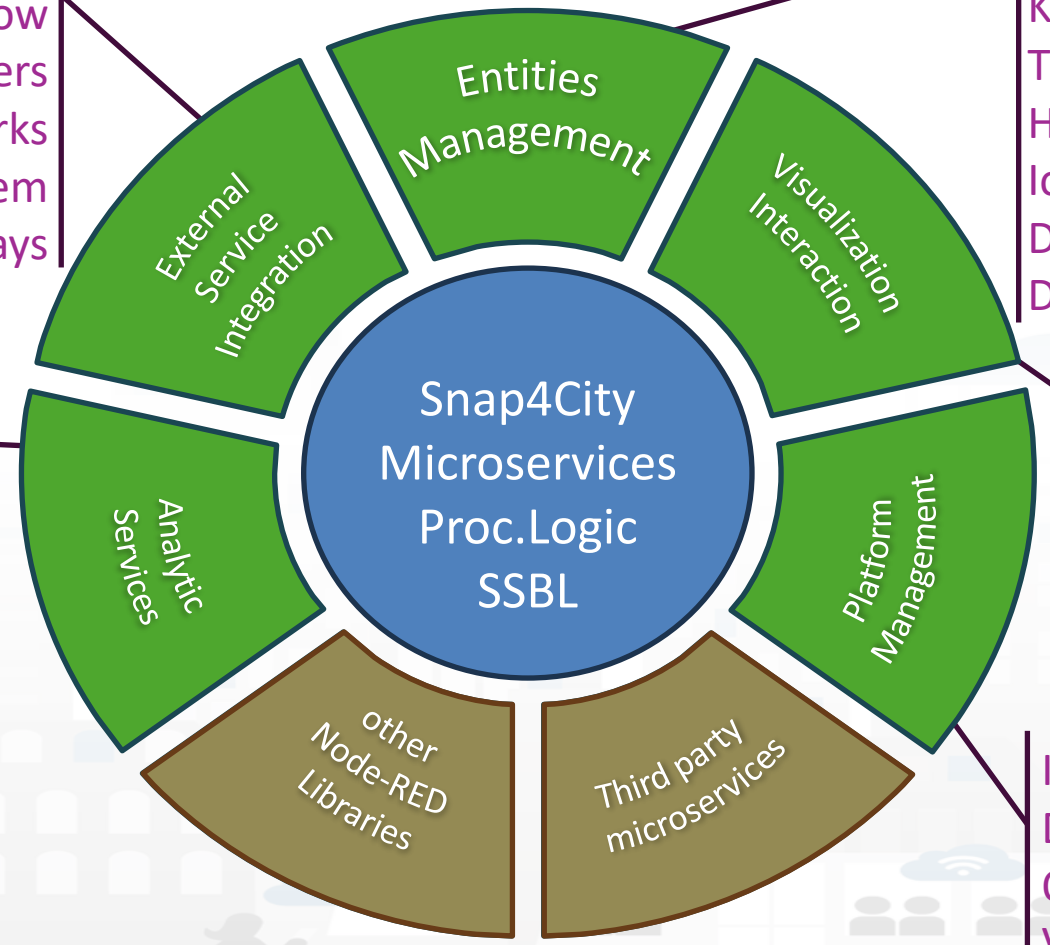
Ingestion, aggreg. → exploitation

- **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





MicroServices Areas



Open Data CKAN
Ticket Management, workflow
BIM Servers
Social Networks
Video Management system
Gateways

Data Load / Search / Retrieval
KPI, POI, GIS Data, Scenarios
Time Series, Public transport
High Level Types: heatmaps, ODM,…
IoT / Entity Discovery
Delegation Management
Data Mapping

Data Analytics
Statistic, Optimization
Simulation
Artificial Intelligence
What-if Analysis Support
Geo Utilities Support
Routing & Traffic Flow
MLOps support
Python support
R Studio Support

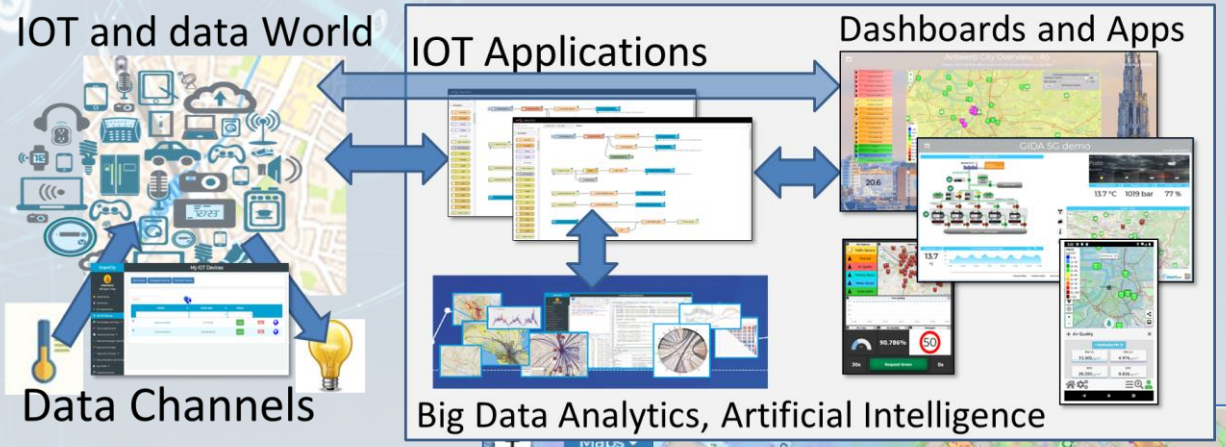
Dashboards
Widgets: Graphic Libraries
Interactive Widgets
Maps, 3D representations
Synoptics, External Content
Micro Web App

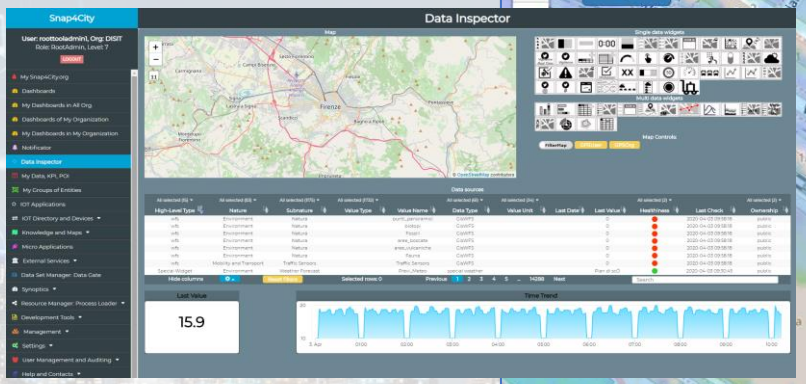
IoTApp Management
Data Logs, A&A, Security
Ownership Management
VPN remote access

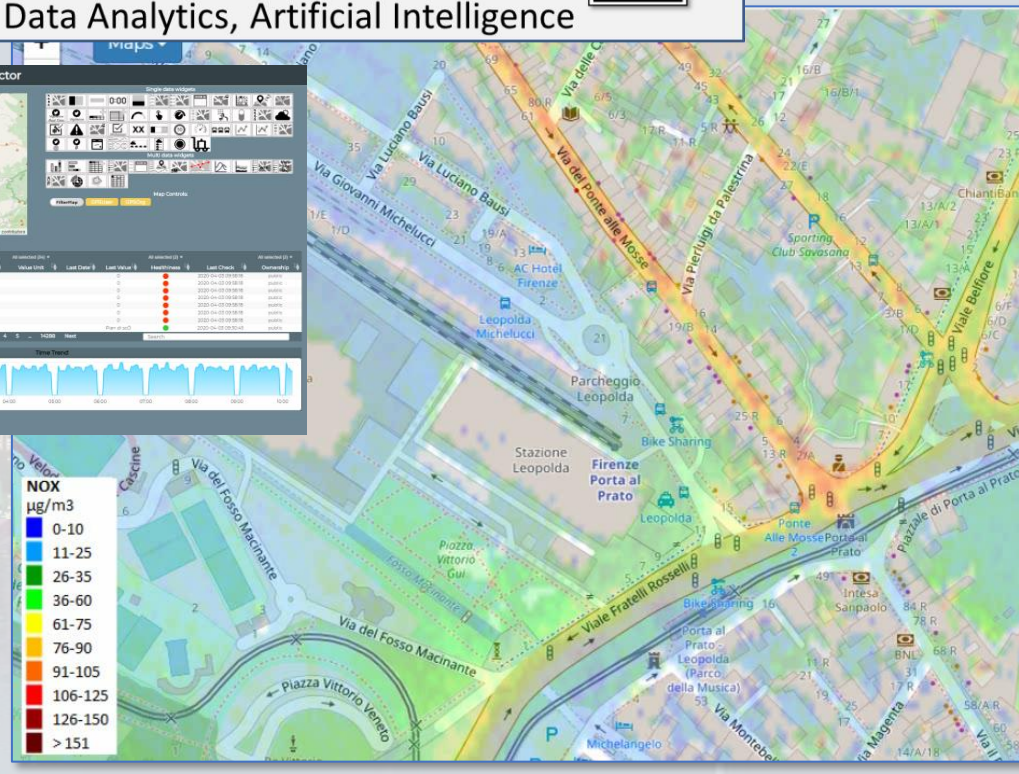
Solutions: reliable, secure and fast to realize

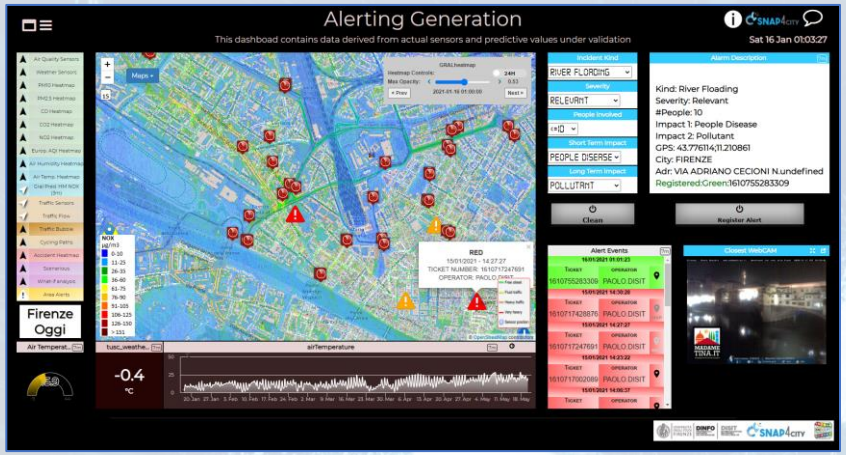
- **Via Snap4City tools**
  - **Dashboard Wizard**
  - **Dashboard Builder**
  - **Data/Visual Analytic**

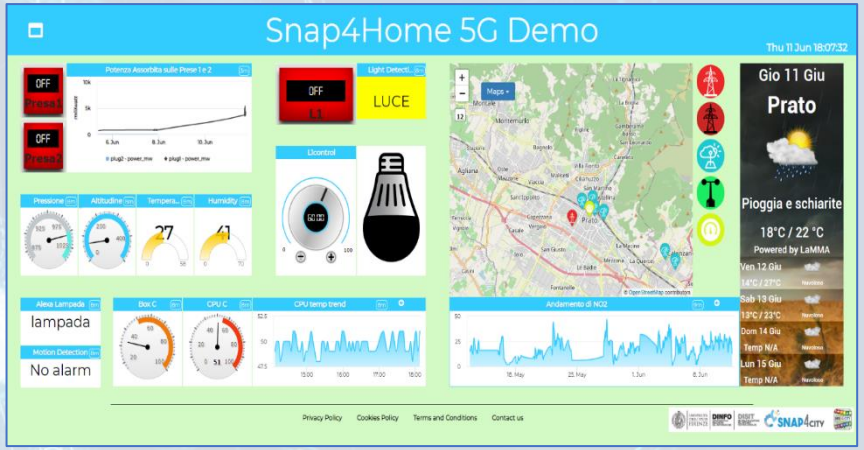
- **Smart Solutions results to be**
  - **Real time data drive**
  - **Secure end-to-end**
  - **GDPR compliant**
  - **Reliable, interoperable**
  - **Auditable, marketable**

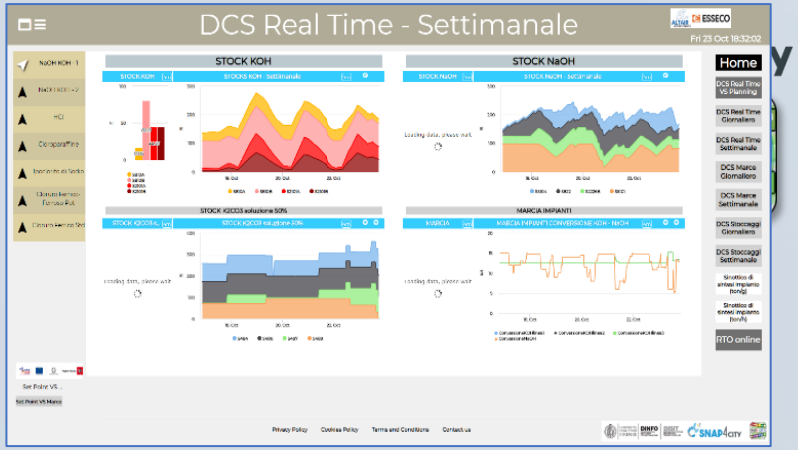


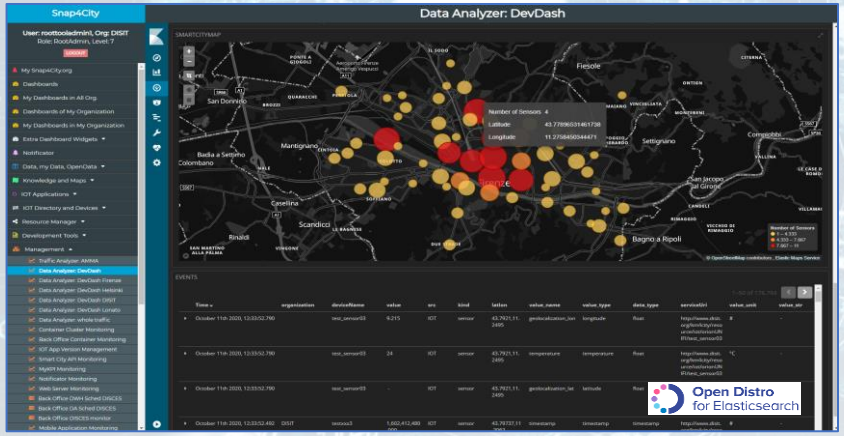


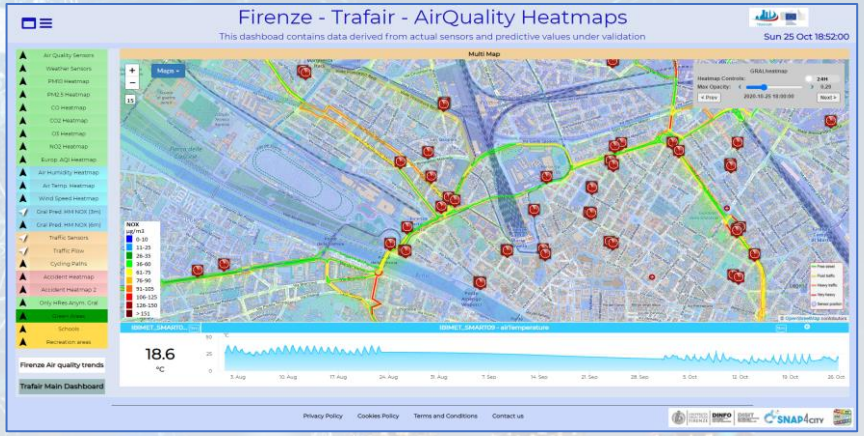


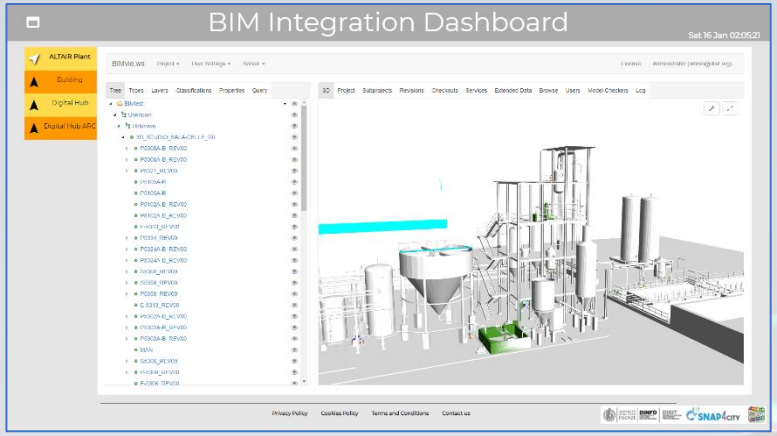

Alerting Generation
This dashboad contains data derived from actual sensors and predictive values under validation
Sat 16 Jan 01:03:27
Firenze Oggi
-0.4


Snap4Home 5G Demo
Thu 11 Jun 18:07:32
LUCE
lampada
No alarm
Gio 11 Giu
Prato
Pioggia e schiarite
18°C / 22 °C
Powered by LaMMA

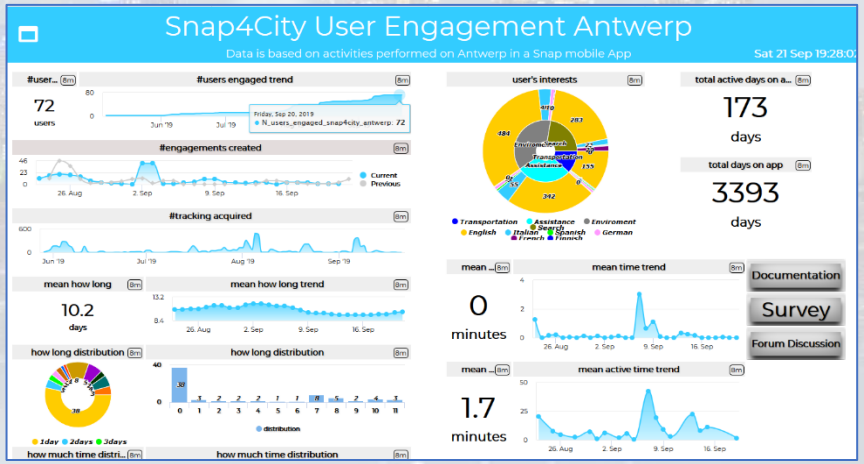

DCS Real Time - Settimanale
Fri 23 Oct 18:32:02
STOCK KOH
STOCK NaOH
Home

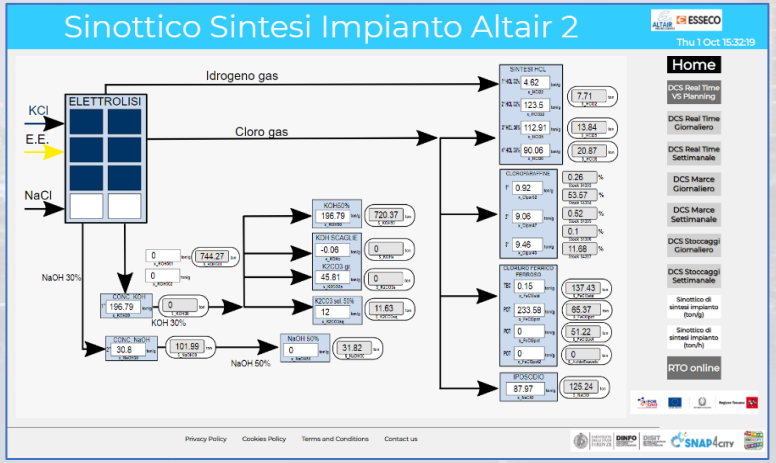

Snap4City
Data Analyzer: DevDash
Open Distro
for Elasticsearch


Firenze - Trafair - AirQuality Heatmaps
This dashboad contains data derived from actual sensors and predictive values under validation
Sun 25 Oct 18:52:00
18.6

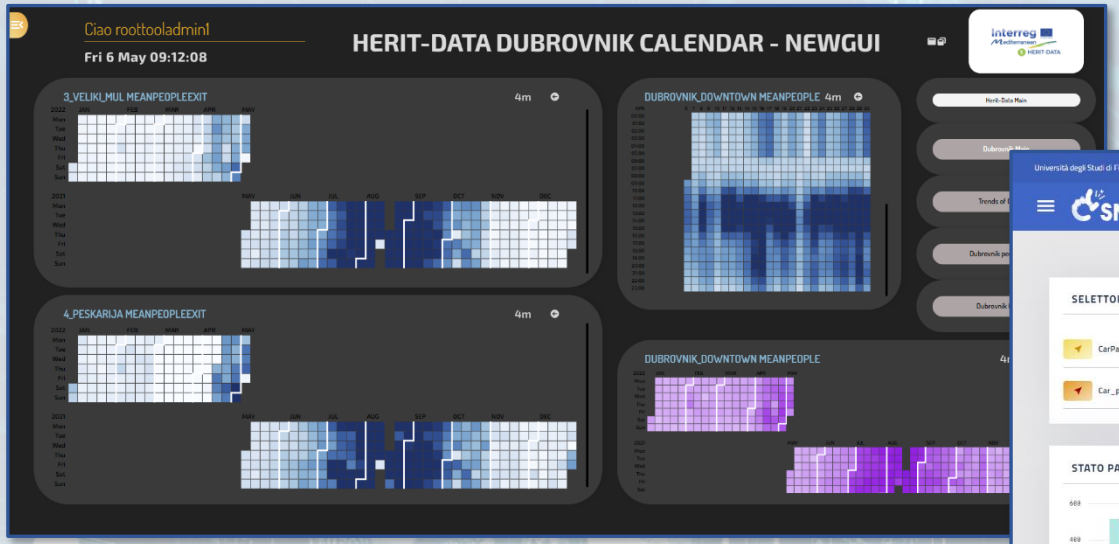

BIM Integration Dashboard
Sat 16 Jan 02:05:21

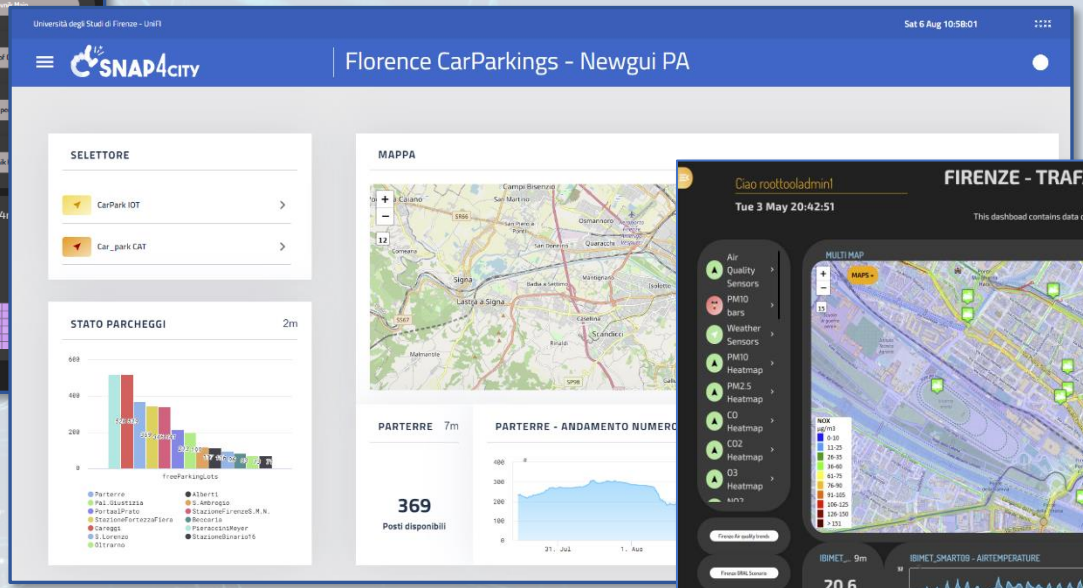

3D Multi Data Map - Digital Twin Global - Firenze
demonstrator
Sun 3 Apr 16:03:52
192

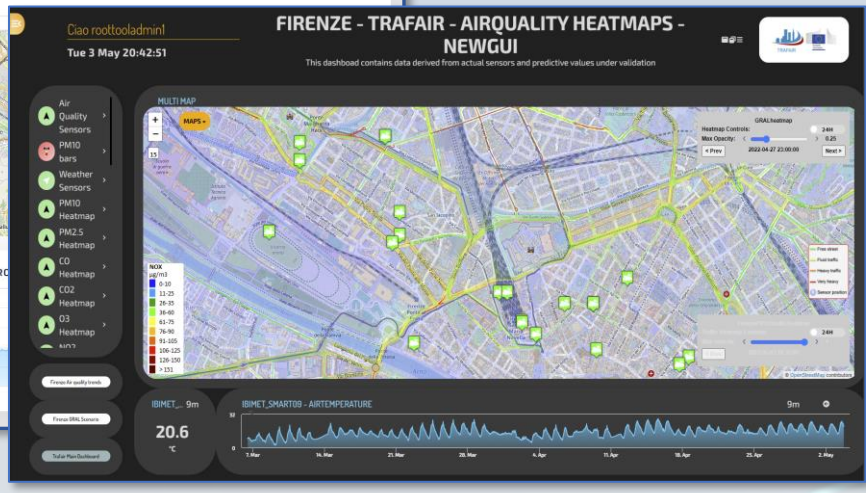

Snap4City User Engagement Antwerp
Data is based on activities performed on Antwerp in a Snap mobile App
Sat 21 Sep 19:28:0
72
users
10.2
days
0
minutes
1.7
minutes
173
days
3393
days
Documentation
Survey
Forum Discussion

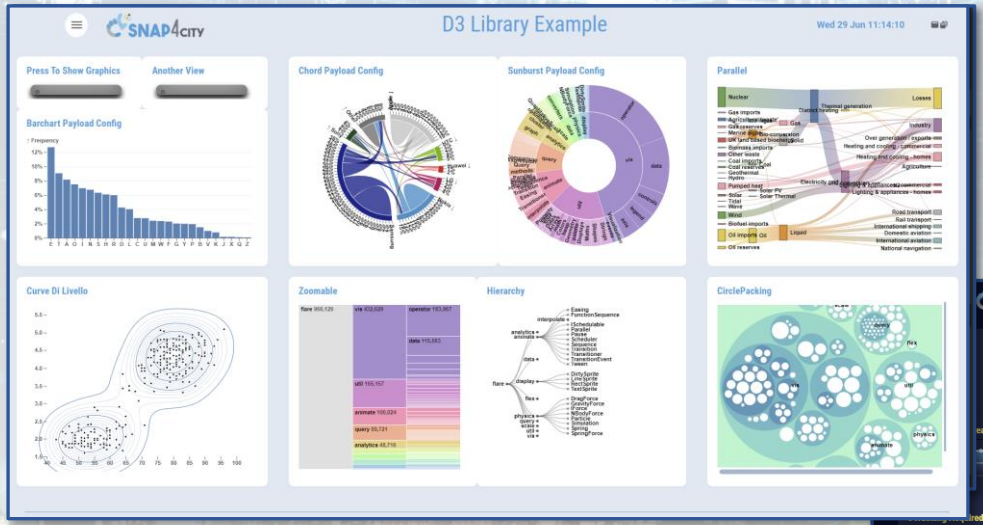

Sinottico Sintesi Impianto Altair 2
Thu 1 Oct 15:32:19
Home
ELETTROLISI
Idrogeno gas
Cloro gas
KCl
E.E.
NaCl
NaOH 30%
KOH 30%
NaOH 50%

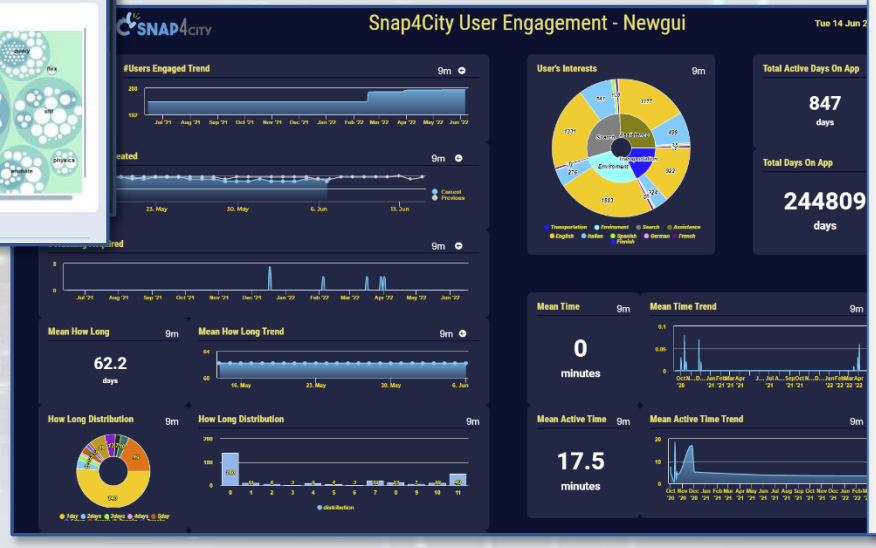
Different Themes

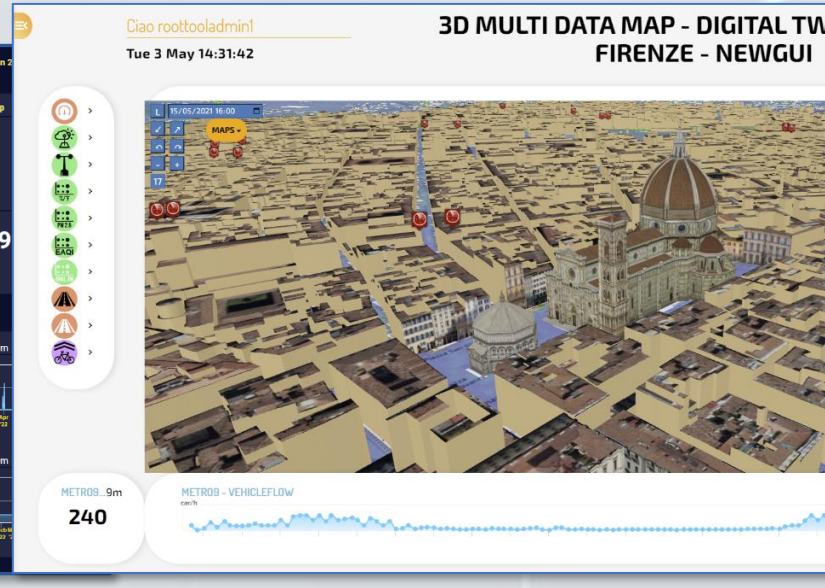








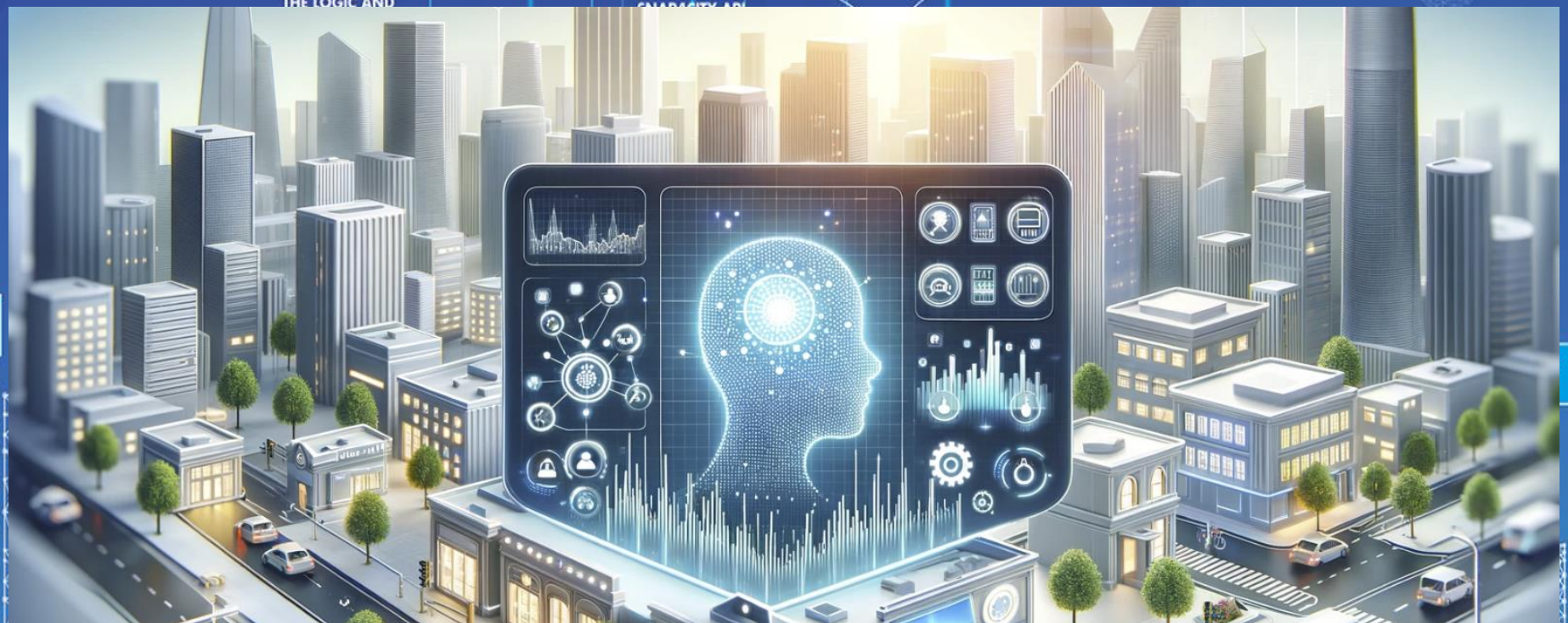




New styles/themes can be developed by specializing a few files from open source

https://www.snap4city.org/793

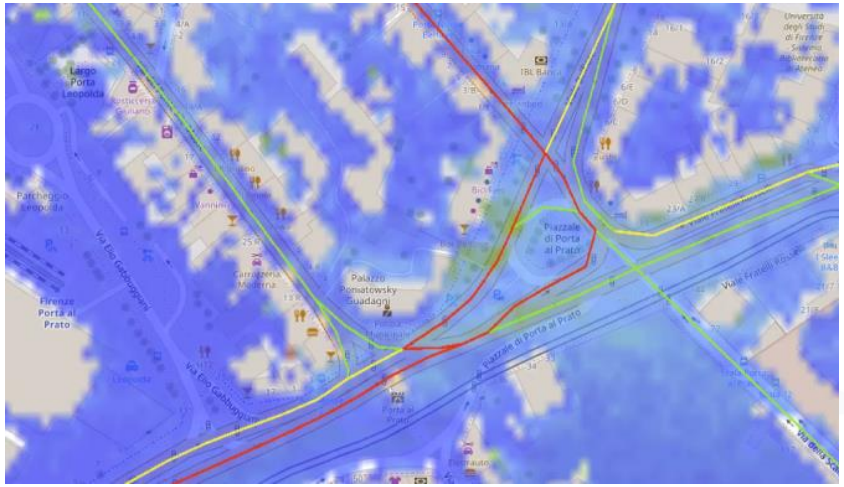
Data Analytic Artificial Intelligence, XAI, Machine and Deep Learning

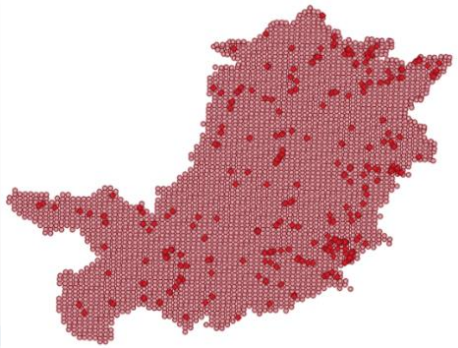


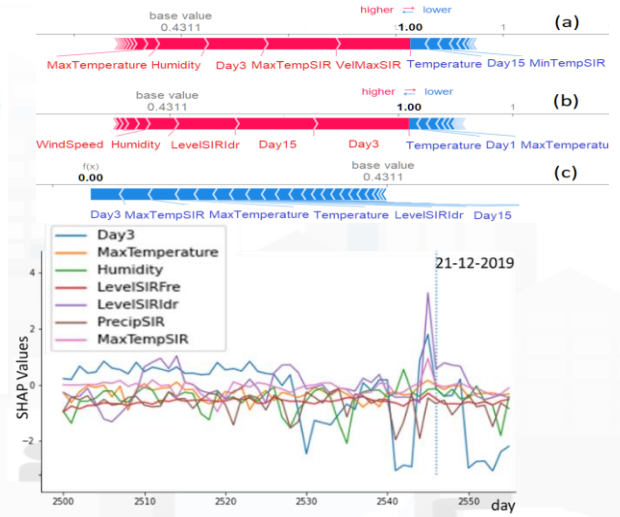
100% OPEN SOURCE

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.

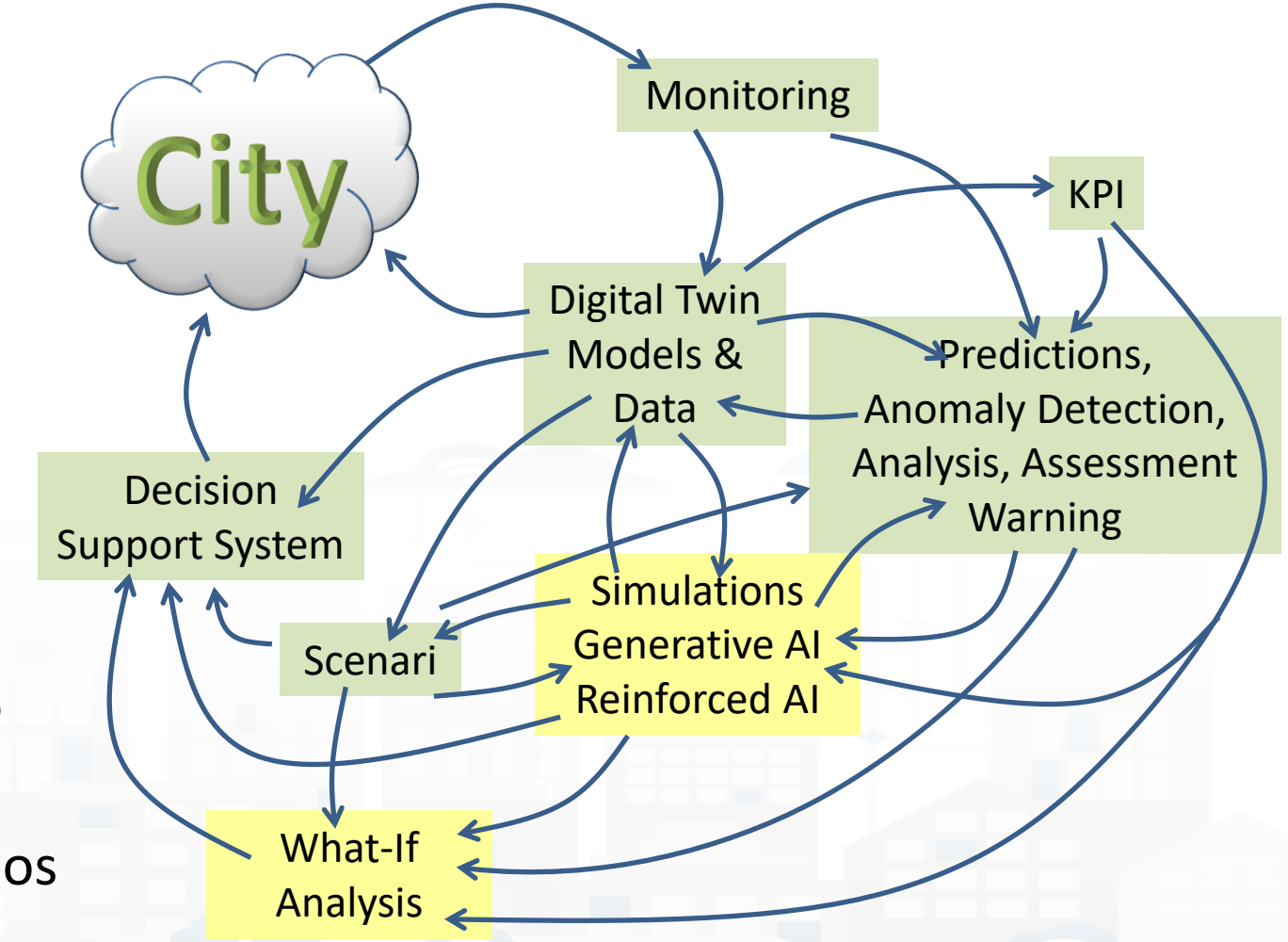
- **Mobility and Transport**
- **Environment, Weather, Waste, Water**
- **City Users Behaviour and Social analysis**
- **Energy and Control**
- **Tourism and People**
- **Security and Safety**
- **High Level Decision Support Solutions**
  - **Asset management**
  - **Resilience and Risks Analysis**
-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

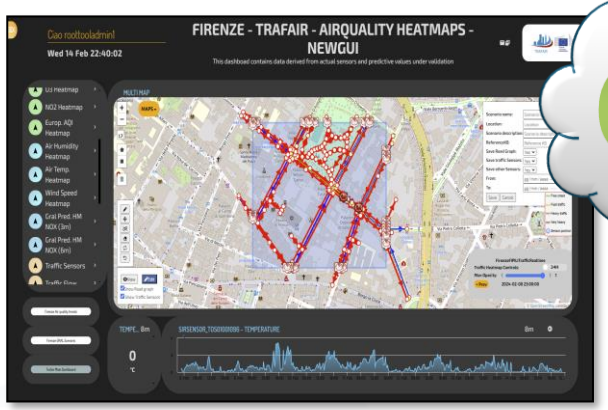
https://www.snap4city.org/download/video/DPL_SNAP4SOLU.pdf

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

Main tasks

- **Controlling Status: management, and operational**
  - Monitoring via KPI
  - Computing 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 & predictions
  - Generative AI Prescriptions, scenarios
  - Resilience to Unexpected unknows
  - What-if analysis wrt scenarios





City

Monitoring

KPI

Digital Twin
Models &
Data

Predictions,
Anomaly Detection,
Analysis, Assessment
Warning

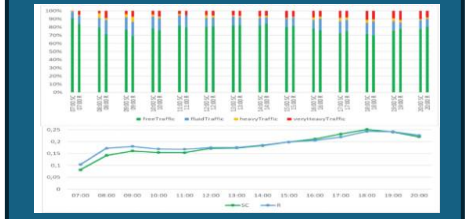
Decision
Support System

Scenarious

Simulations,
TFR, Crossroad,
Public Transport,
Routing, ..

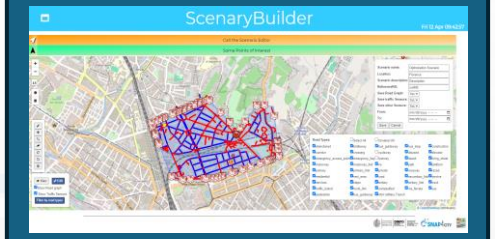
What-If Analysis,
Optimization

KPI



Traffic Lights plan optimization

Scenario Editor

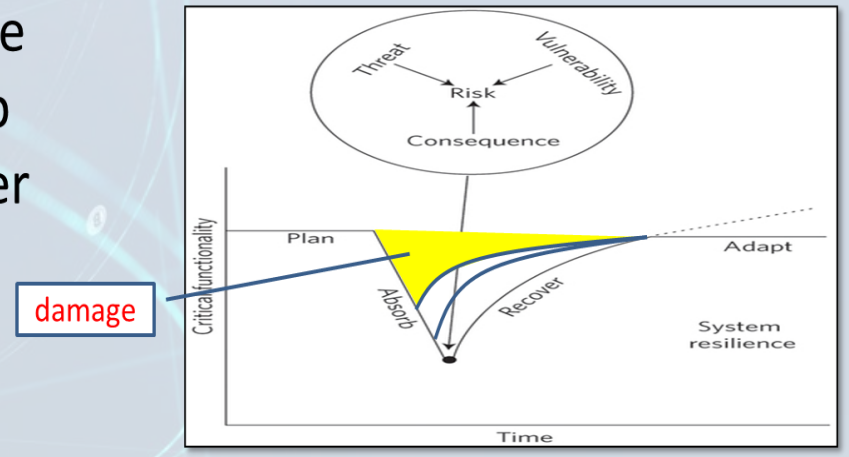


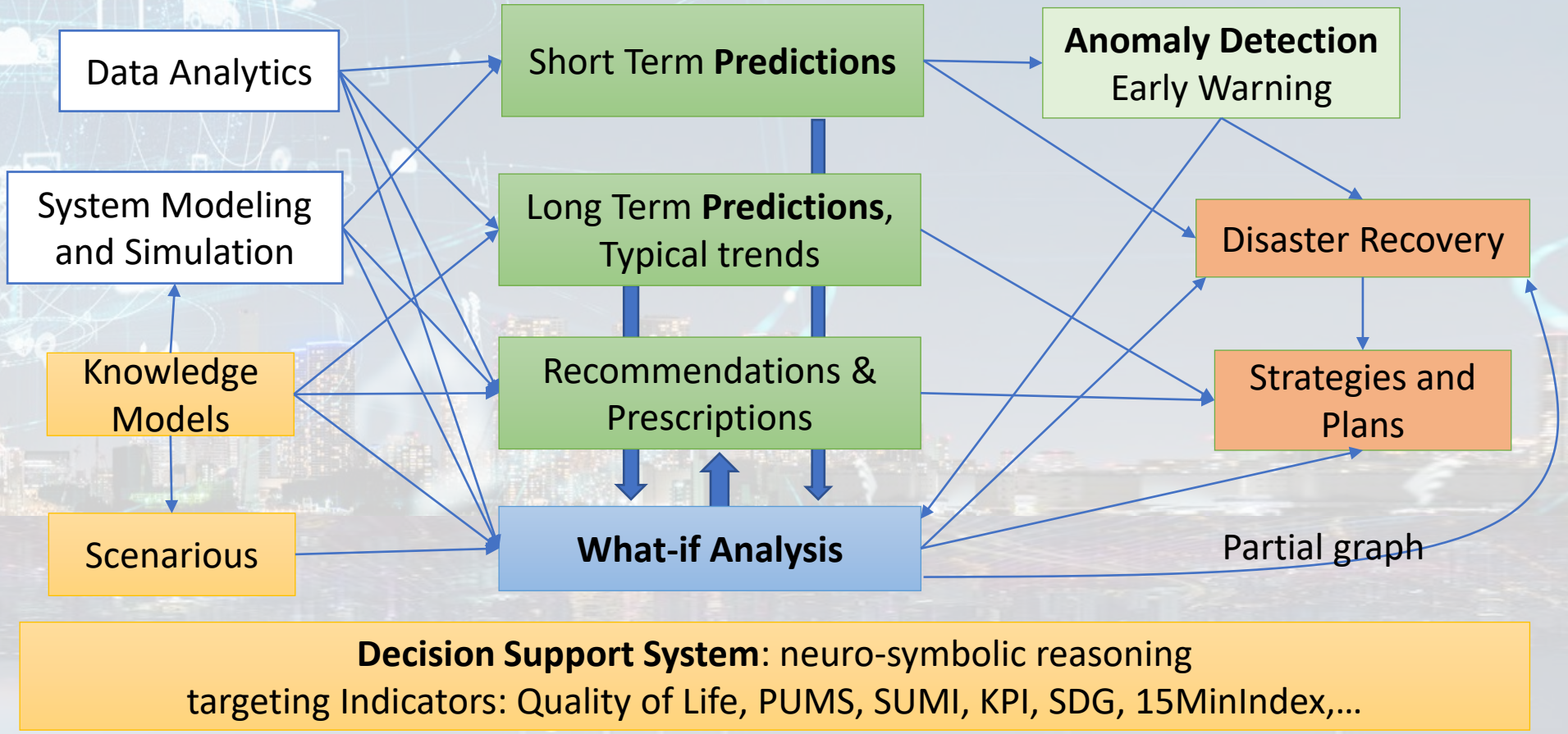
Traffic Reconstruction

Snap4City Analytics

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

Prepare
Absorb
Recover
Adapt





Decision Support System: neuro-symbolic reasoning
targeting Indicators: Quality of Life, PUMS, SUMI, KPI, SDG, 15MinIndex,…

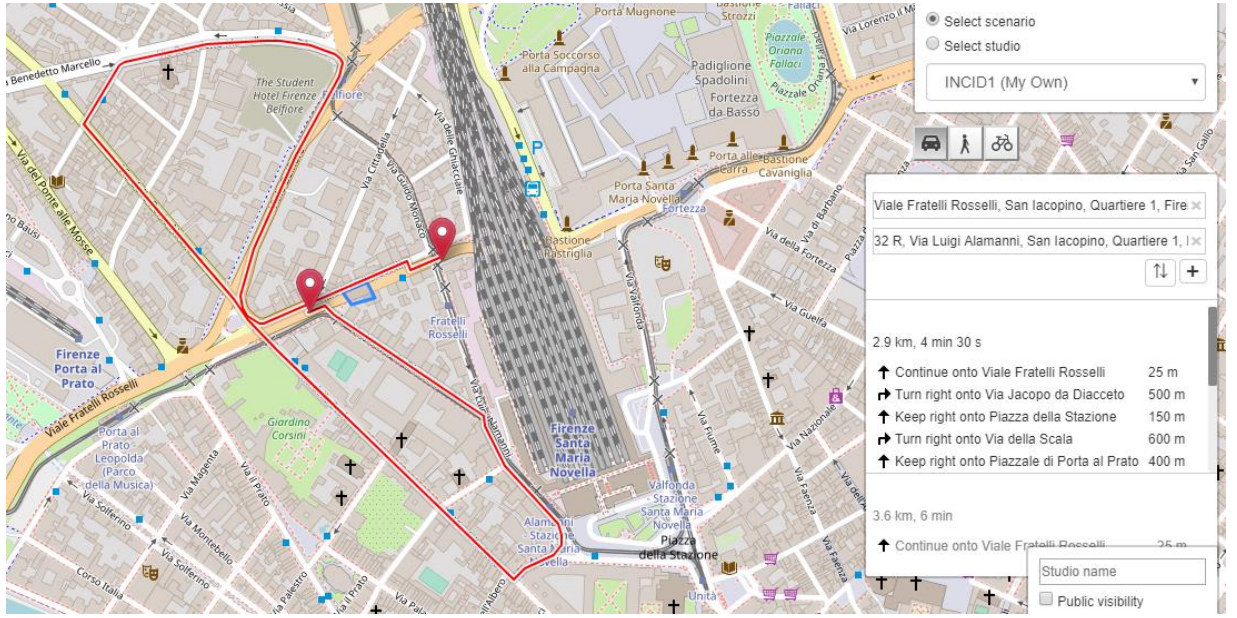
What-If Analysis

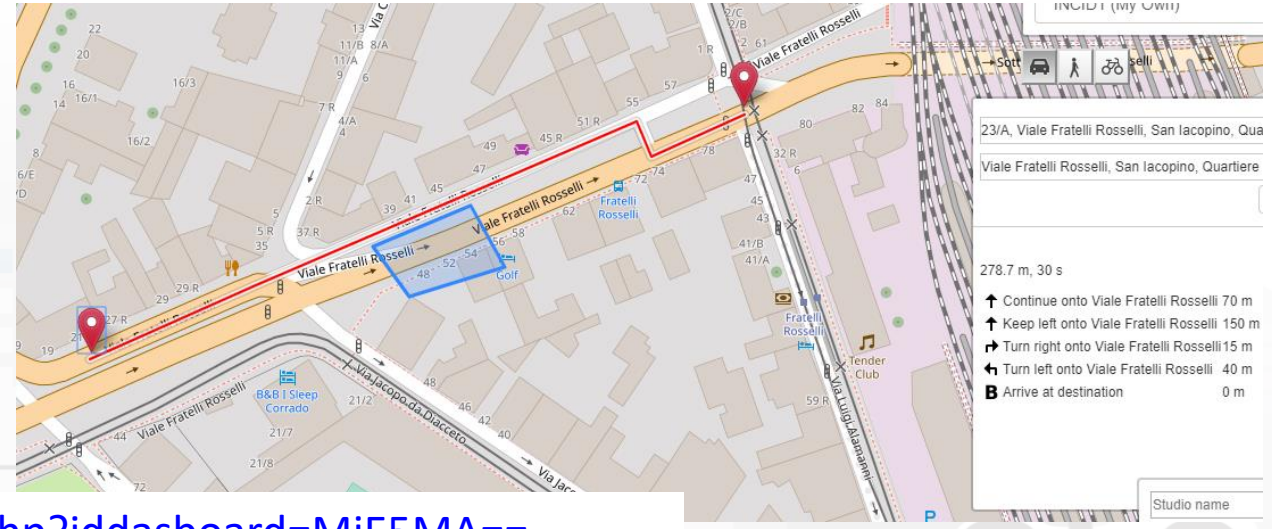
Accidents and elements blocking Points and Shapes taken into account for:

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

Assessment on the basis of changes:

- Mobility demand assessment
- Mobility Offer assessment

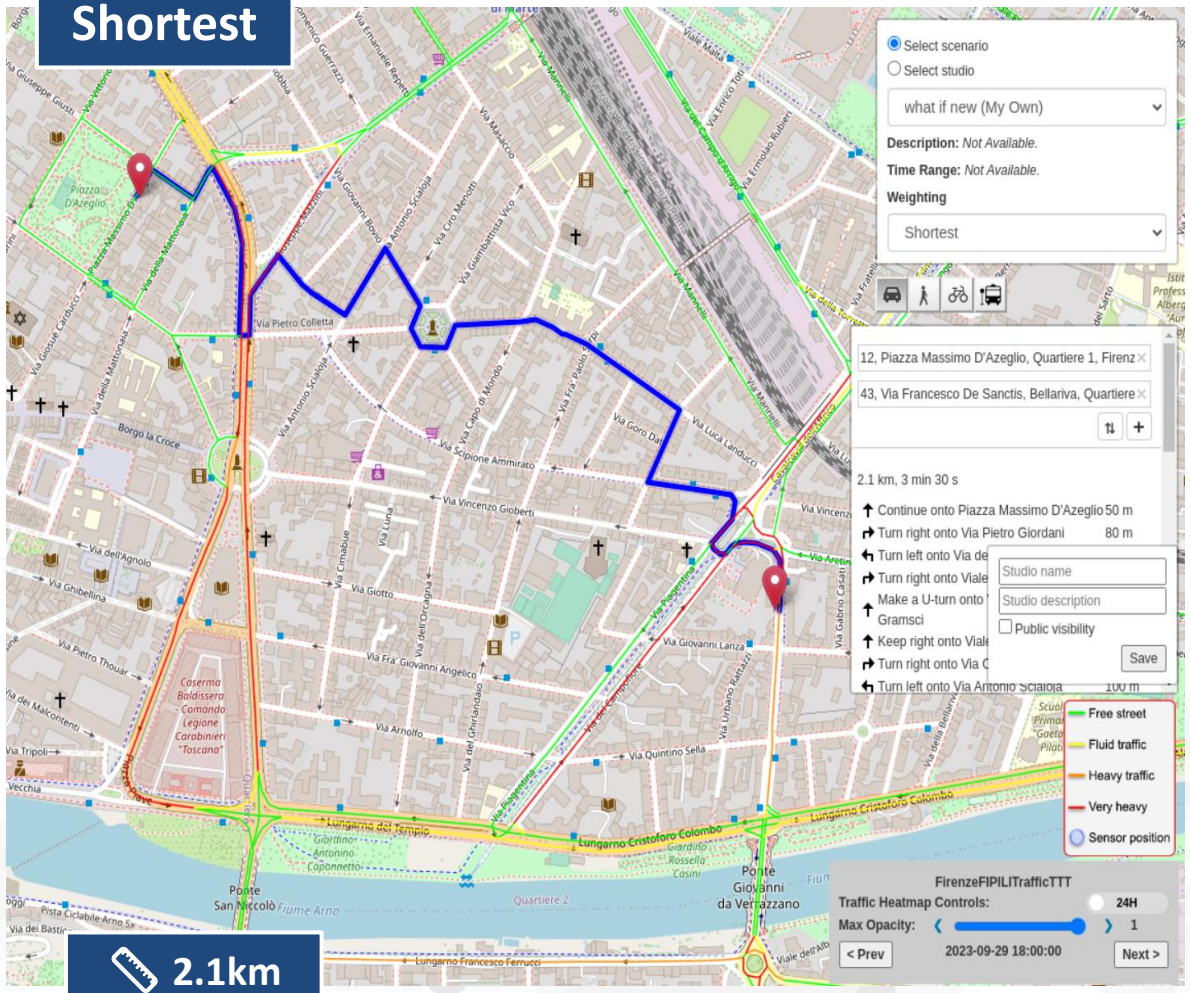




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

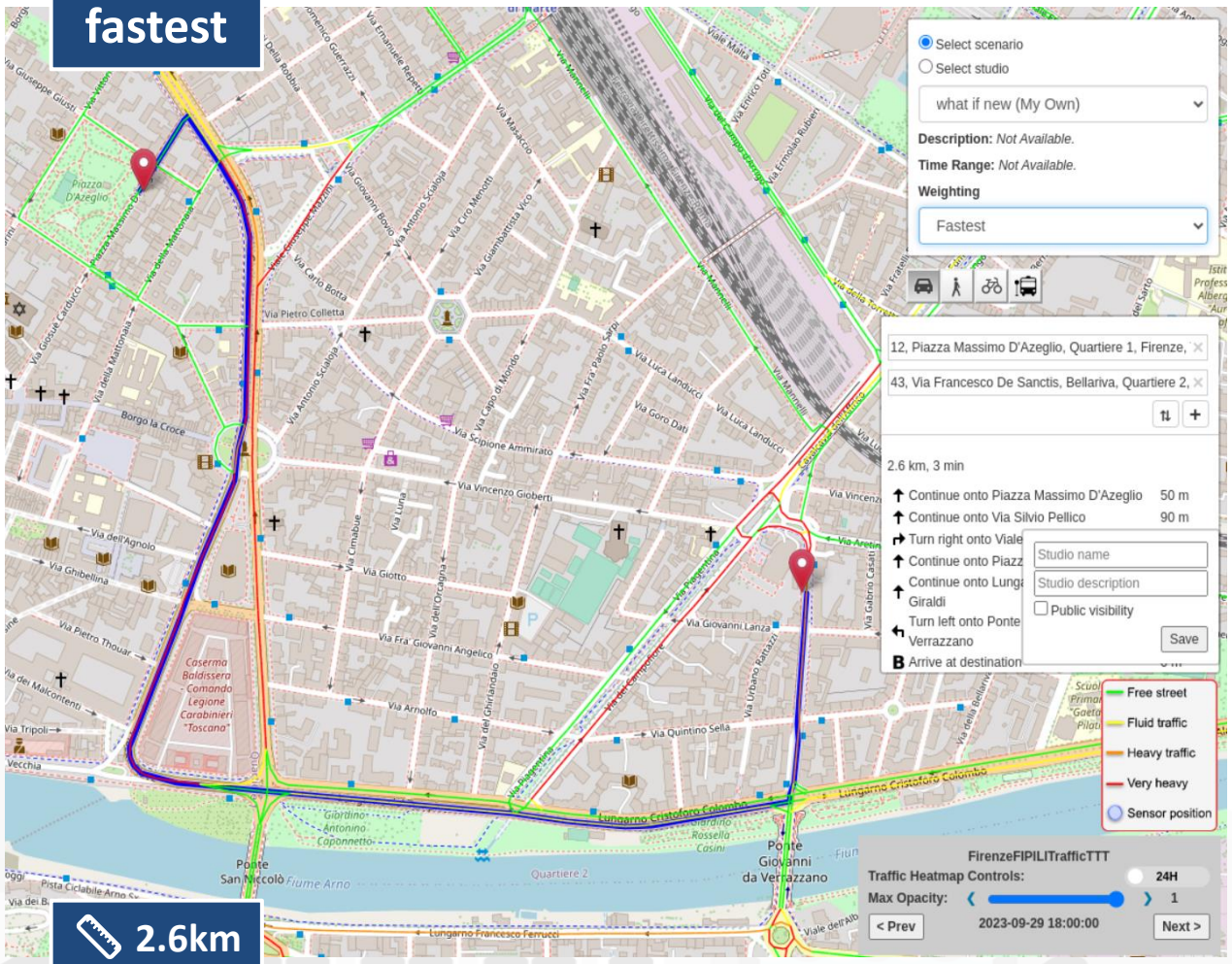
Constrained Dynamic Routing: Traffic Flow

Shortest



2.1km
3min 30s

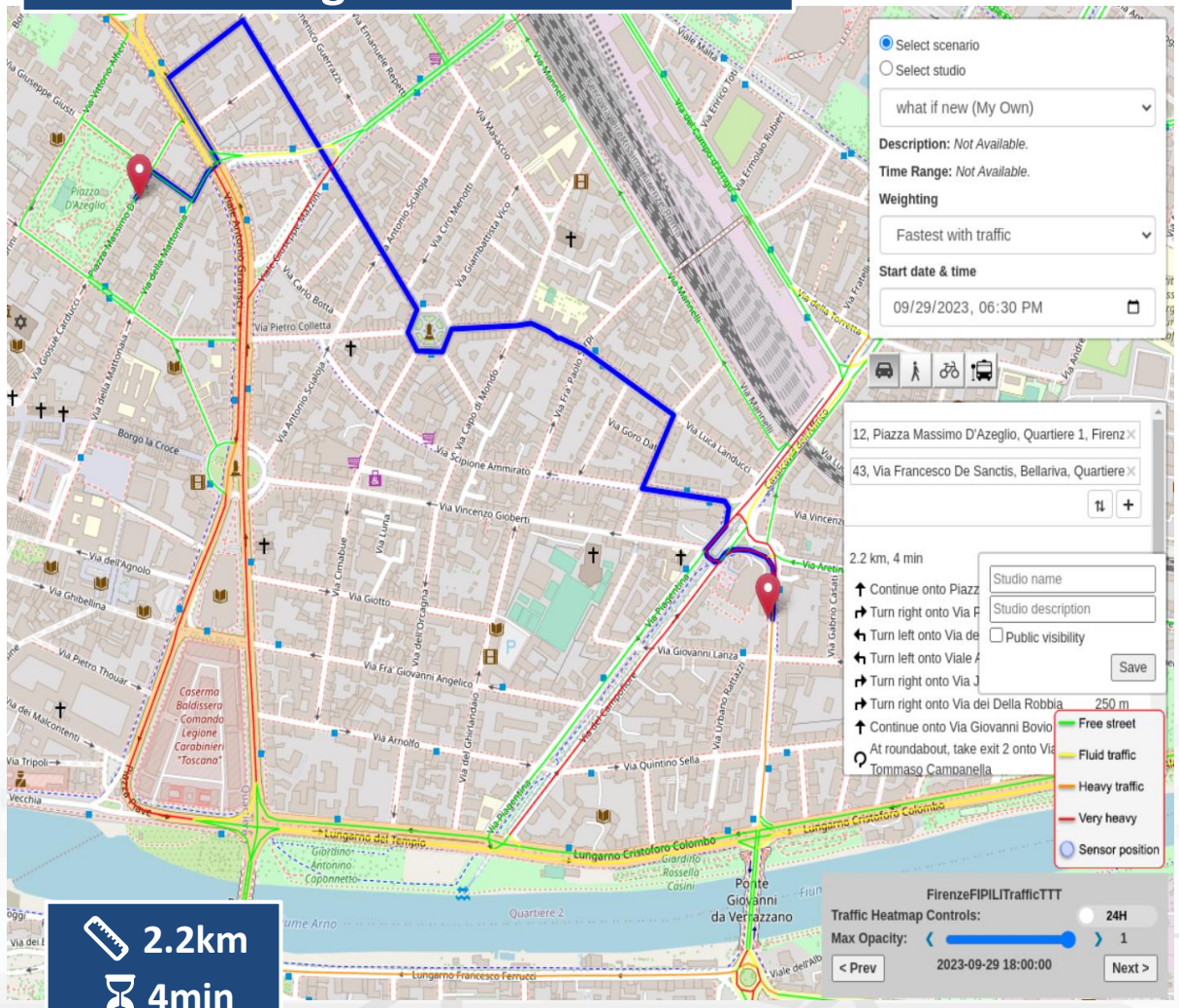
fastest



2.6km
3min

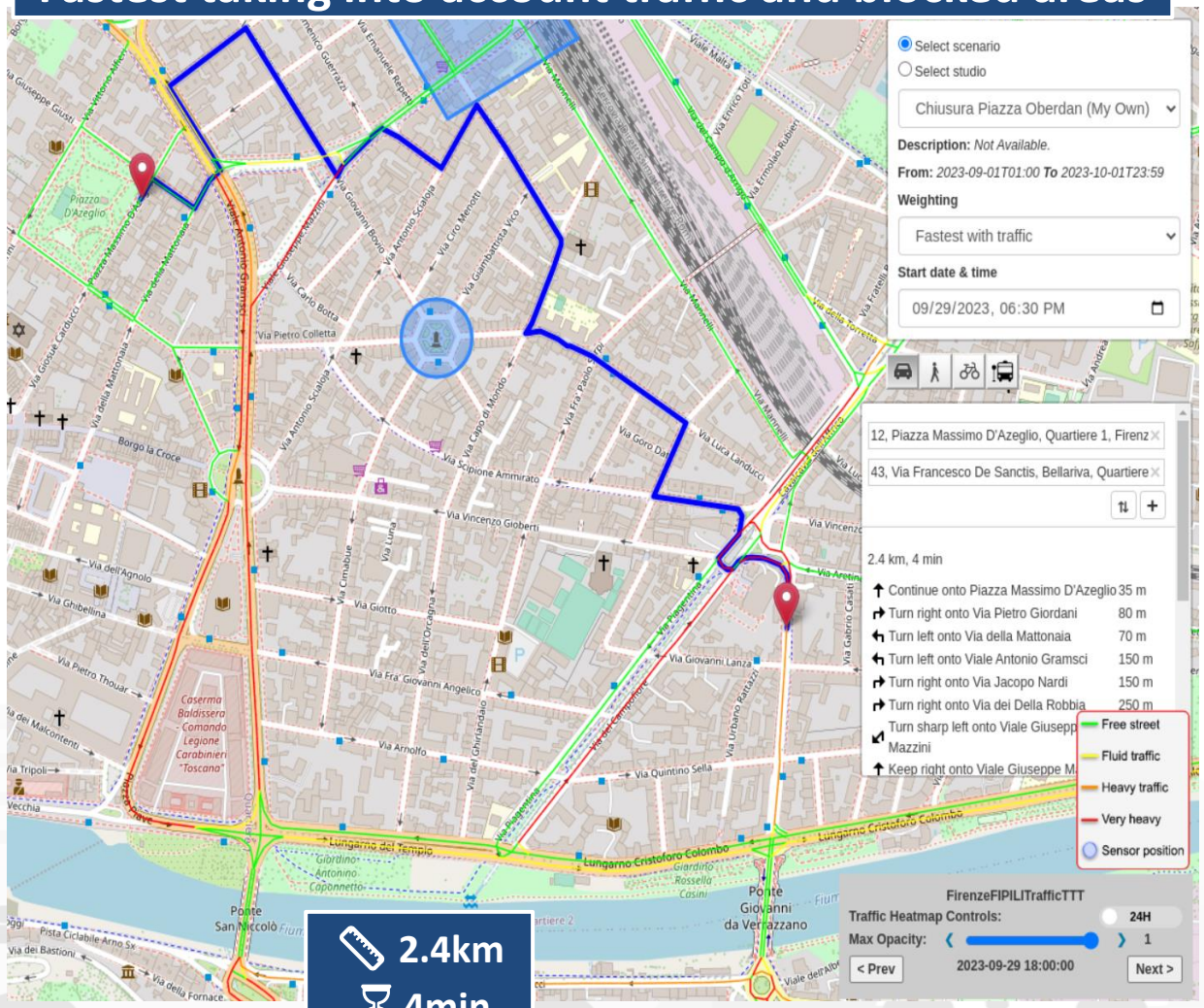
Constrained Dynamic Routing: Traffic Flow

Fastest taking into account traffic



2.2km
4min

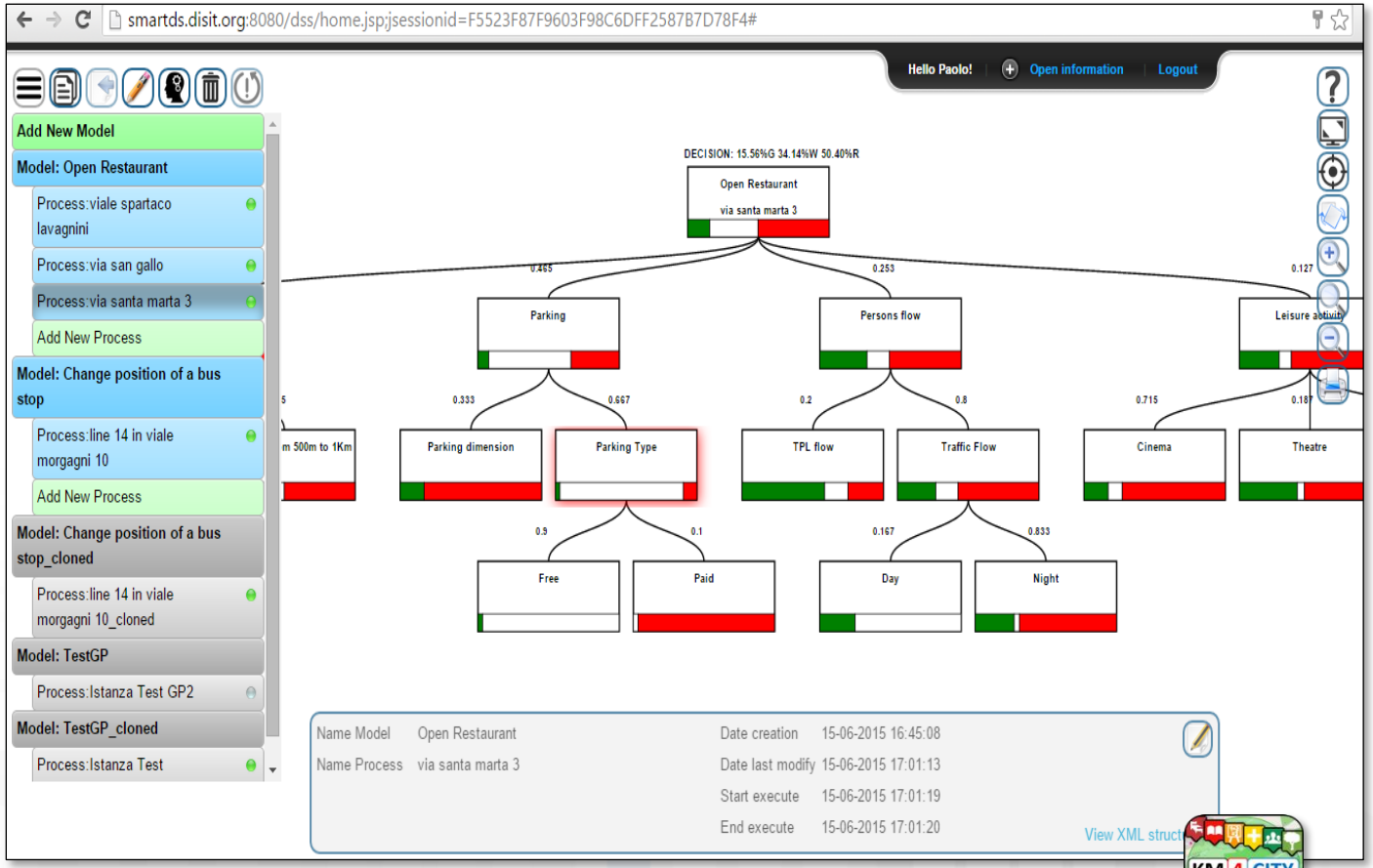
Fastest taking into account traffic and blocked areas



2.4km
4min

Smart Decision Support , system thinking

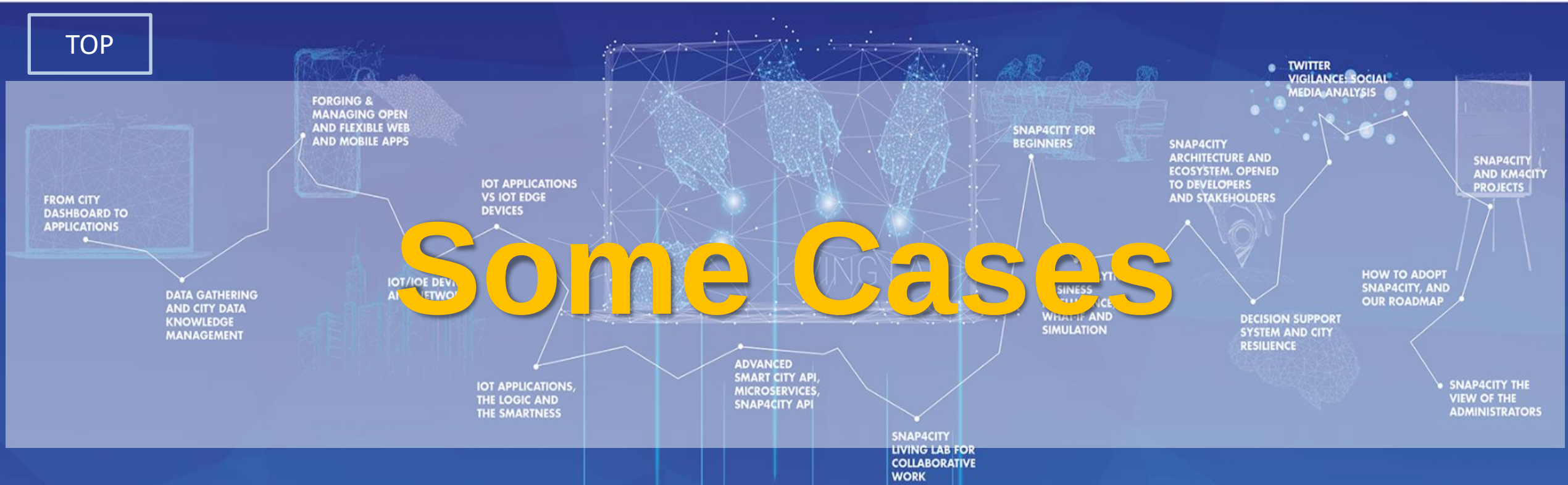
- **Smart Decision Support System** based on System Thinking plus
- Actions to city reaction, resilience, smartness, …
- Enforcing Mathematical model for propagation of decision confidence..
- Collaborative work, …
- Processes connected to city data: DB, RDF Store, Twitter, etc.
- Production of alerts/alarms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



http://smartds.km4city.org

TOP

Some Cases



100% OPEN SOURCE

SNAP4 Appliances and Dockers **Installations**

Florence


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

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

https://www.snap4city.org/760

https://www.snap4city.org/746

https://www.snap4city.org/758

https://www.snap4city.org/751

Smart City Control Room
Florence Metropolitan City

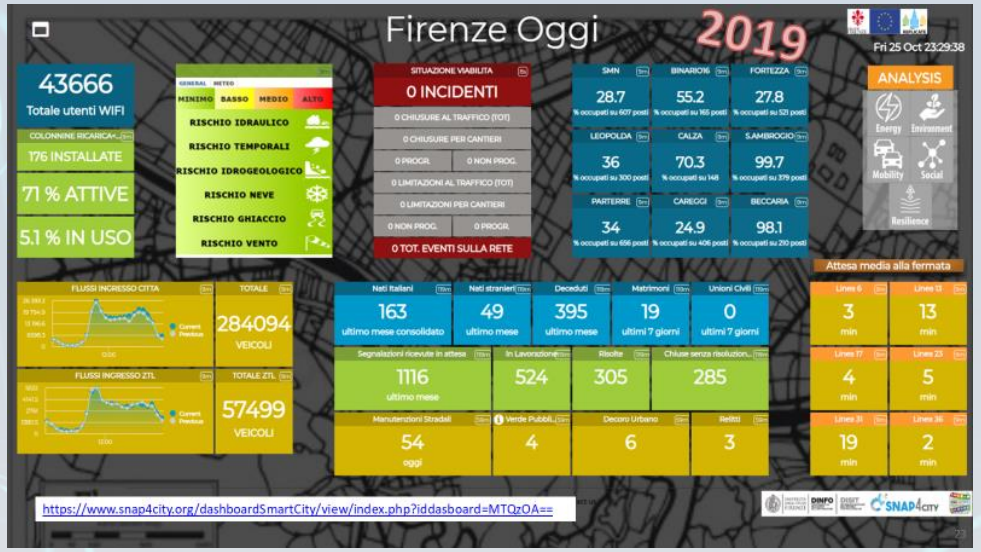
COMUNE DI FIRENZE

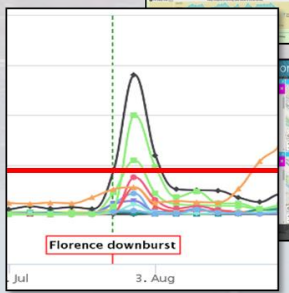
reference

SNAP4CITY

KM 4 CITY

- **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


Snap4City
Dashboard Management Syst
Dashboard Management Syst
Nuova scheda
snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQzOA==
Ospite
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CALZA...
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CARE...
13.8
BECC...
77.6
ANALYSIS
Energy
Environment
Mobility
Social
Resilience
FLUSSI INGRESSO CIT
TOTA...
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FLUSSI INGRESSO ZTL
TOTA...
15964
Nati italiani
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Nati s...
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Matri...
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Unio...
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Manutenzioni Strad...
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Verd...
18
Decoro Urba...
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Reiti...
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Indicatore Rt per la provincia di
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The European House
Ambrosetti

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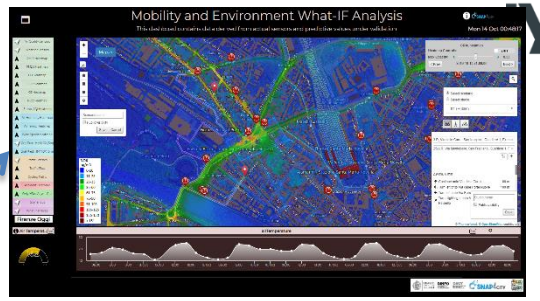
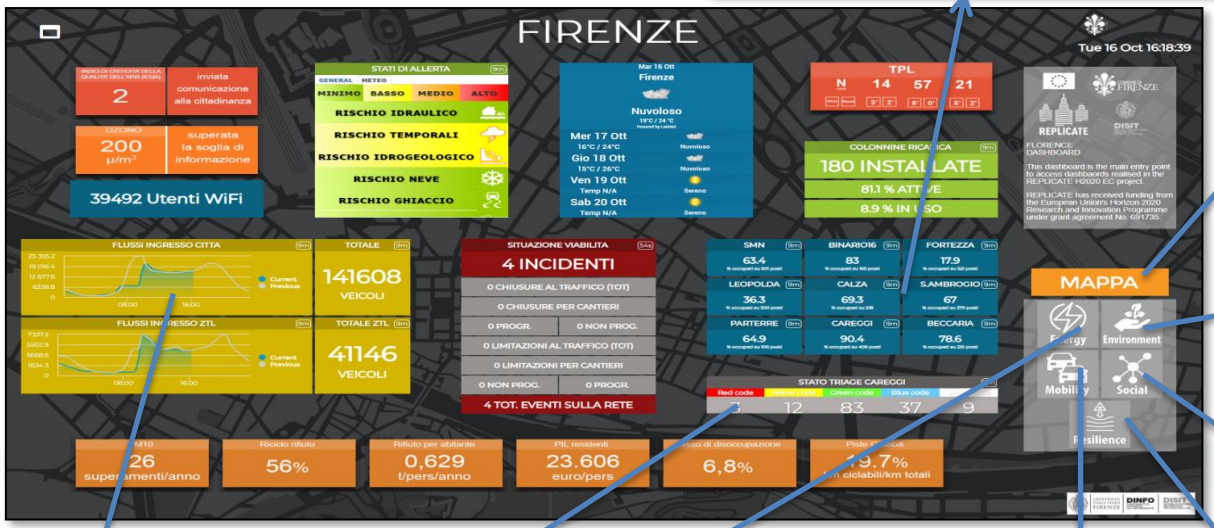
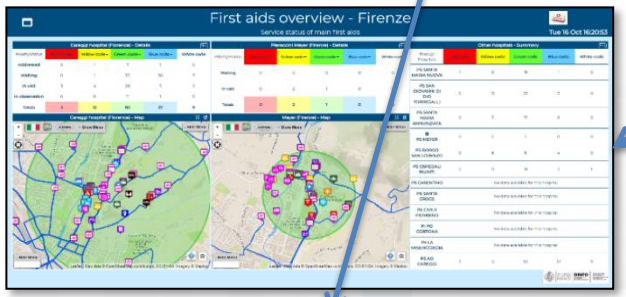
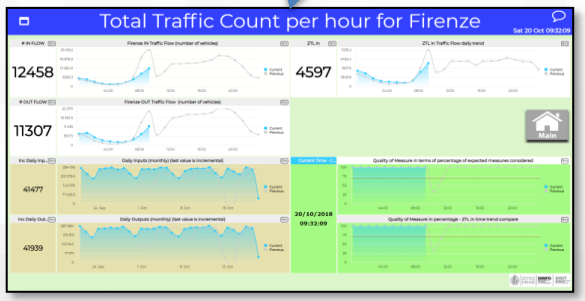
REPLICATE

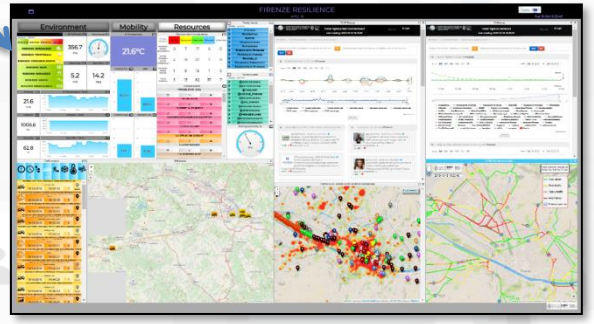
KM4CITY











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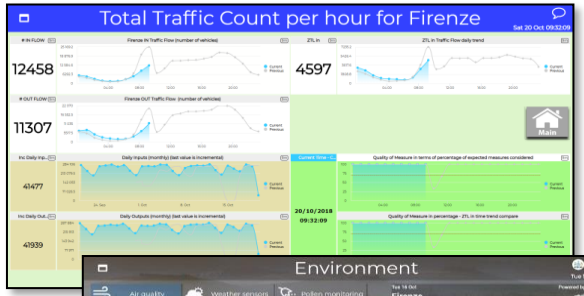
Florence Case

SNAP4CITY | KM4CITY

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

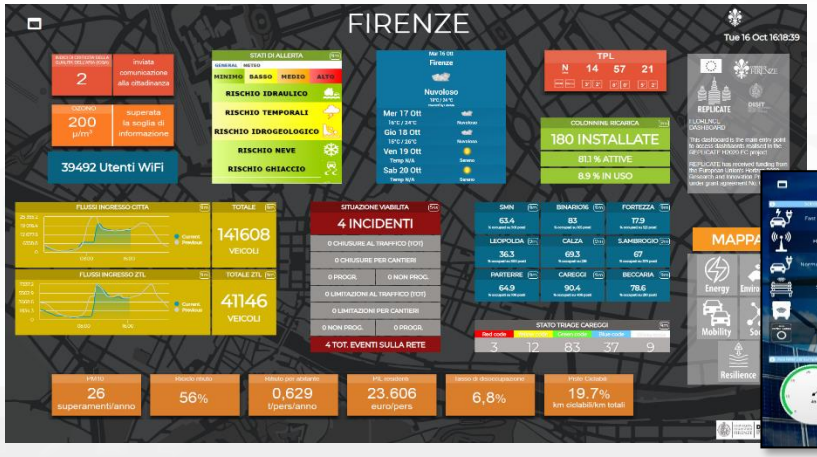


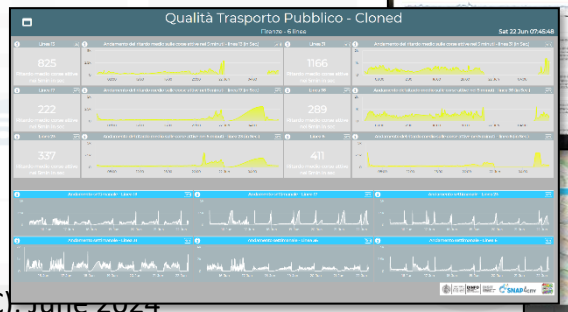
- **Mobility**:
  - quality of public transportation service (mean delay on bus-stops)
  - public transport operators schedule and paths, routing, multimodal routing
  - traffic flow reconstruction
  - Smart parking: predictions
  - Accidents and events, Log, heatmaps
- **Environment**:
  - smart irrigators
  - 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

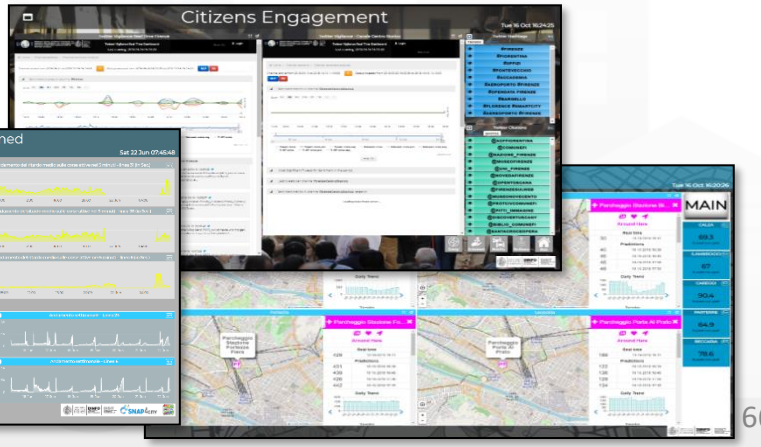
- **Social**:
  - smart benches
  - Twitter monitoring, Sentiment analysis, NLP text
  - TV camera streams
- **People Flows**:
  - Wi-Fi, people flow
  - Origin destination matrices
- **Governmental and Communications**:
  - KPI of the City
  - Digital Signage
  - Civil protection, Resilience (Resolute)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

Analysis:

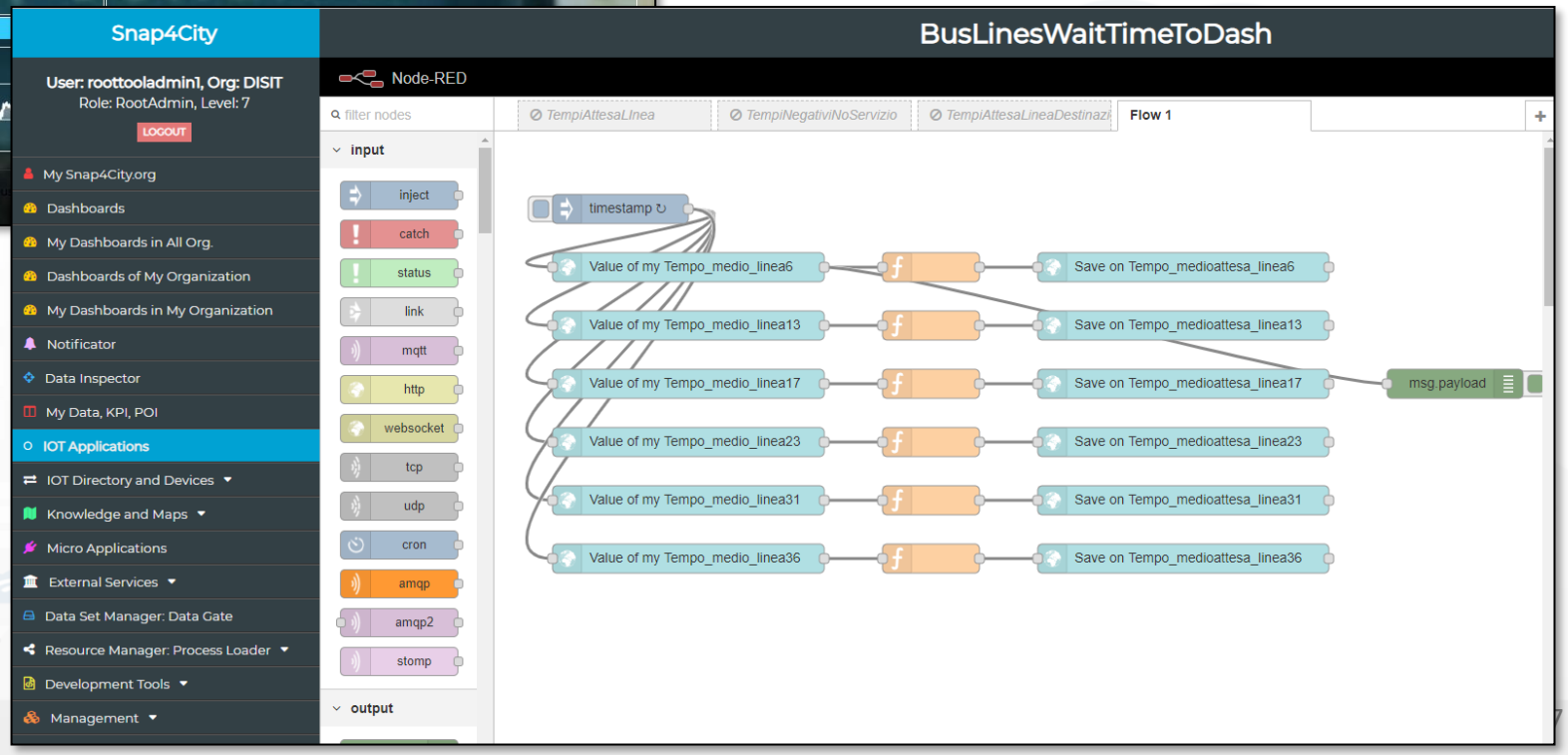
- **what-if routing, scenarios,**
- **traffic flow, environmental predictions**



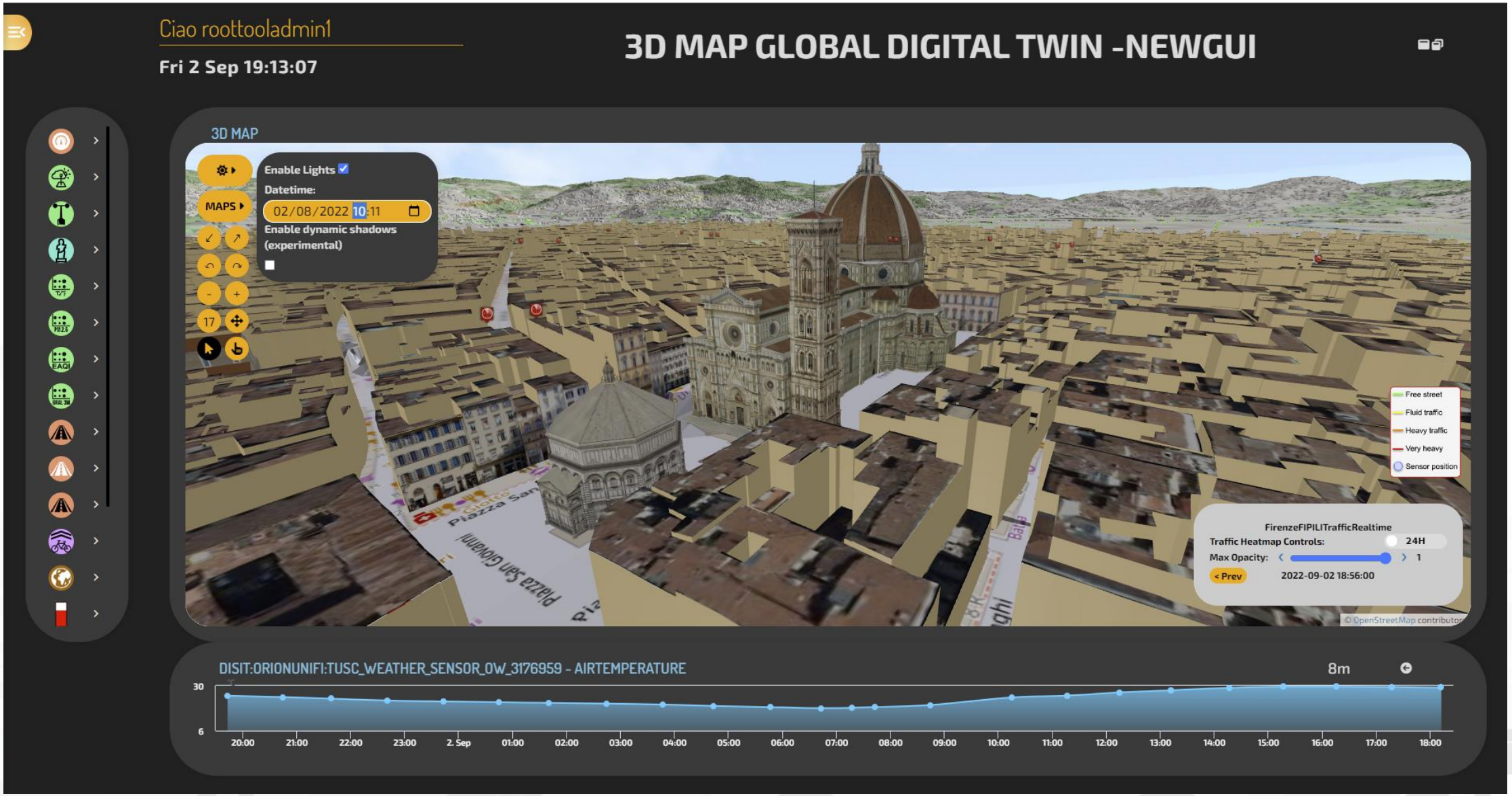


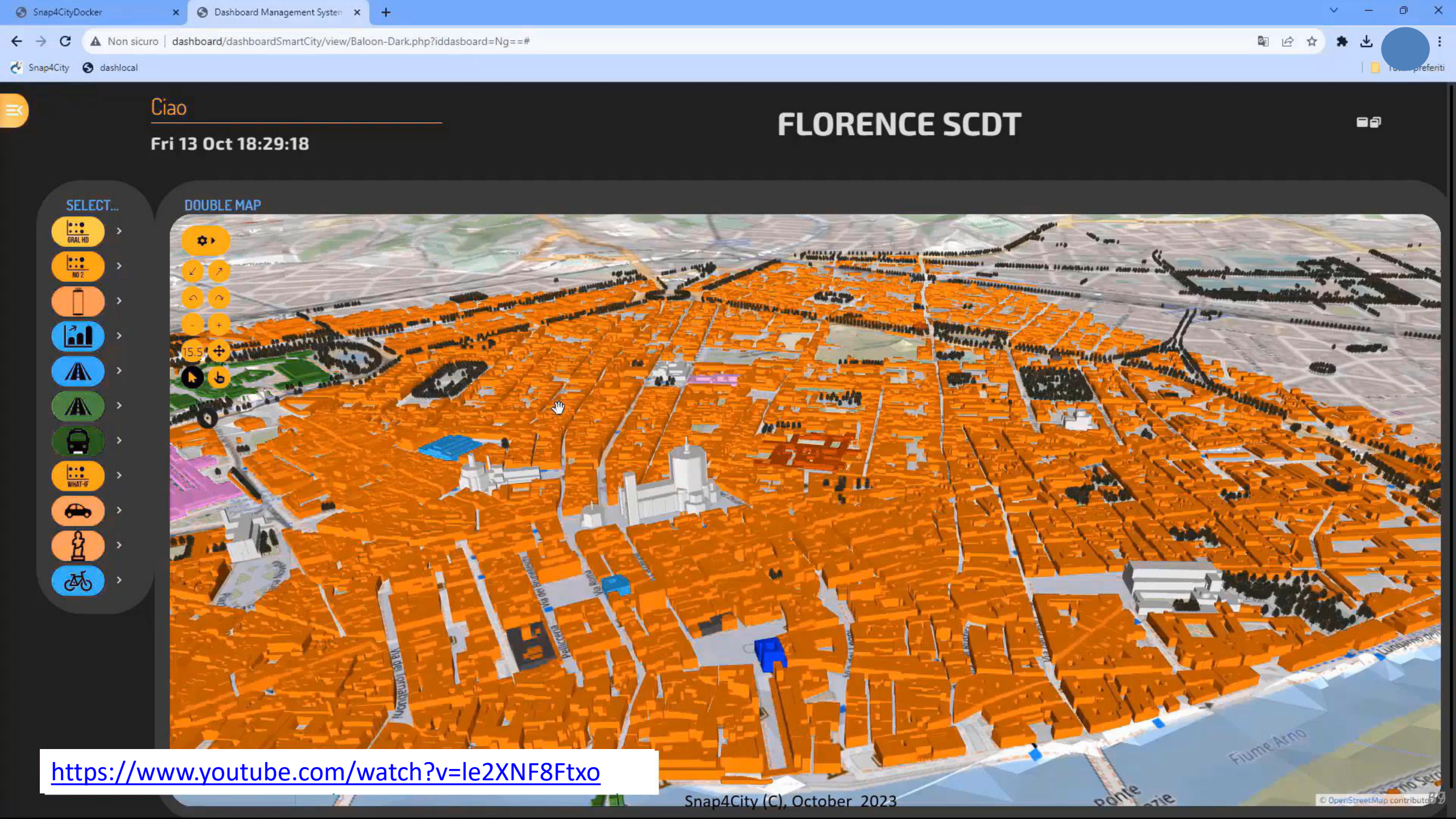


Estimation of the mean waiting time at bus stops



3D Digital Twin




Snap4CityDocker
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Snap4City
dashlocal
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Fri 13 Oct 18:29:18
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DOUBLE MAP
GRAL HD
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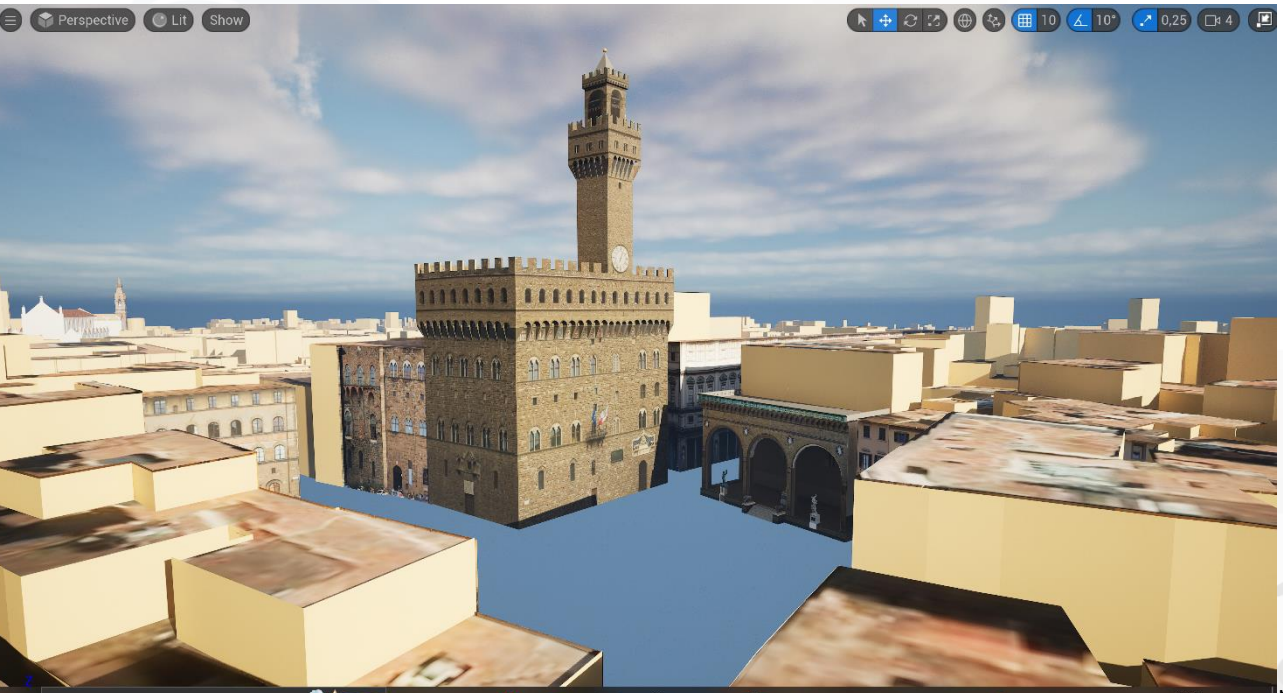
WHAT-IF
Fiume Arno
Snap4City (C), October 2023
https://www.youtube.com/watch?v=le2XNF8Ftxo

OCULUS


Perspective
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6°C
19:09
30/11/2022


Perspective
Lit
Show

OCULUS

https://www.youtube.com/watch?v=Rcf_B2_GOio

Exploiting Google API with Snap4City engine

- Select any city/locality and see if 3D Representation of your city is Available
- Snap4City redendering 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

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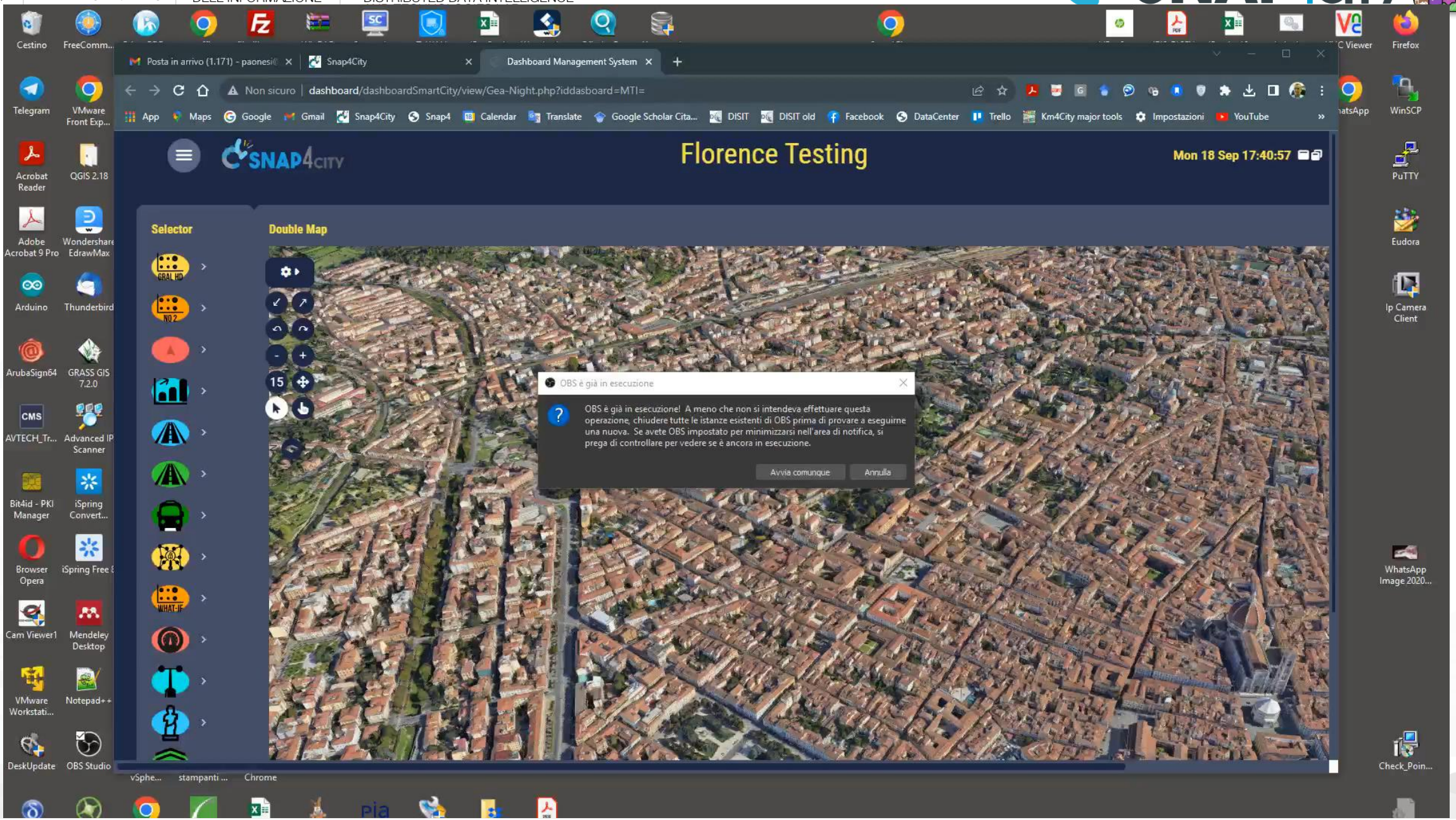
Firenze

SNAP4CITY

KM4CITY



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Prato

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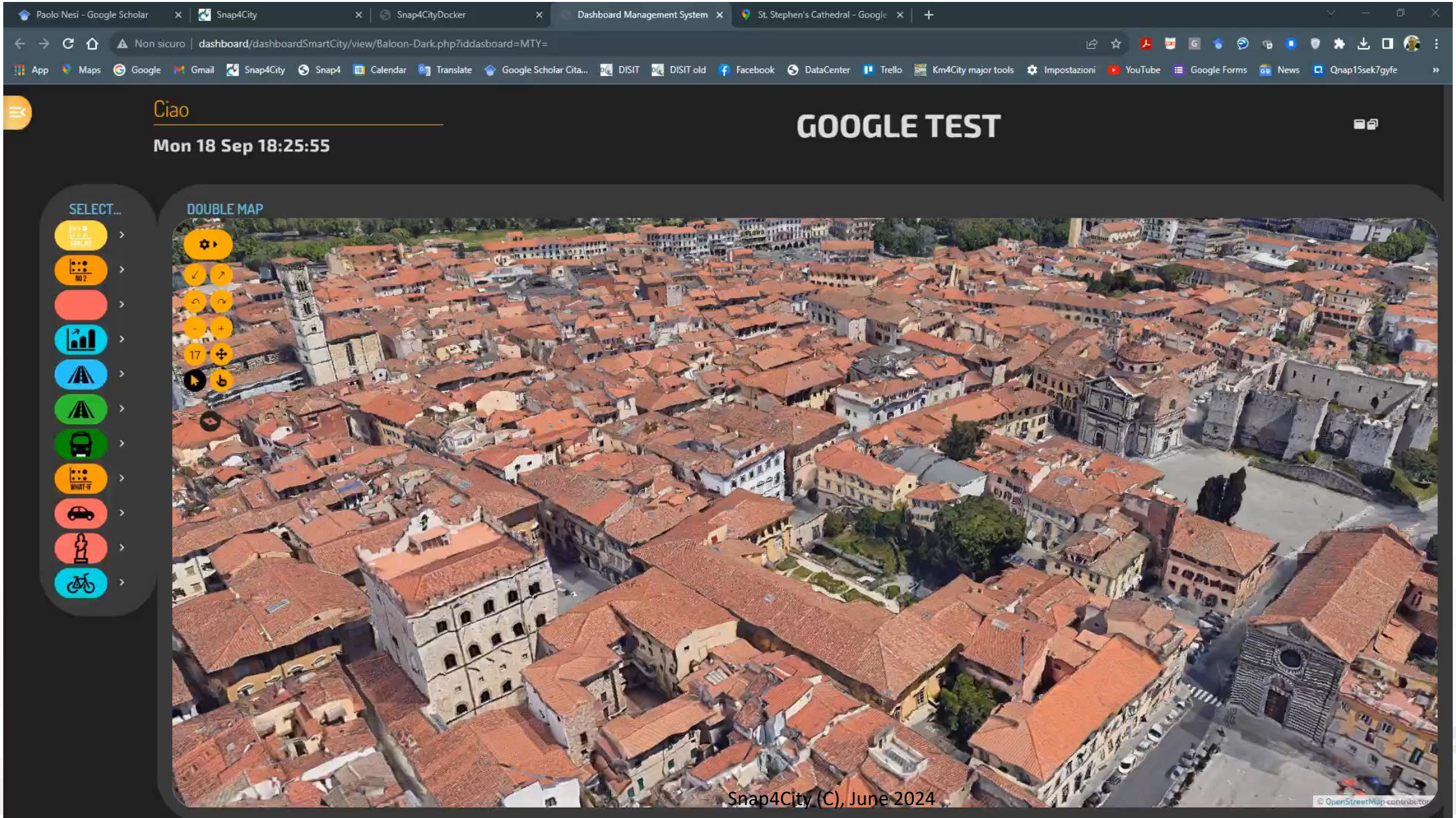
KM4CITY



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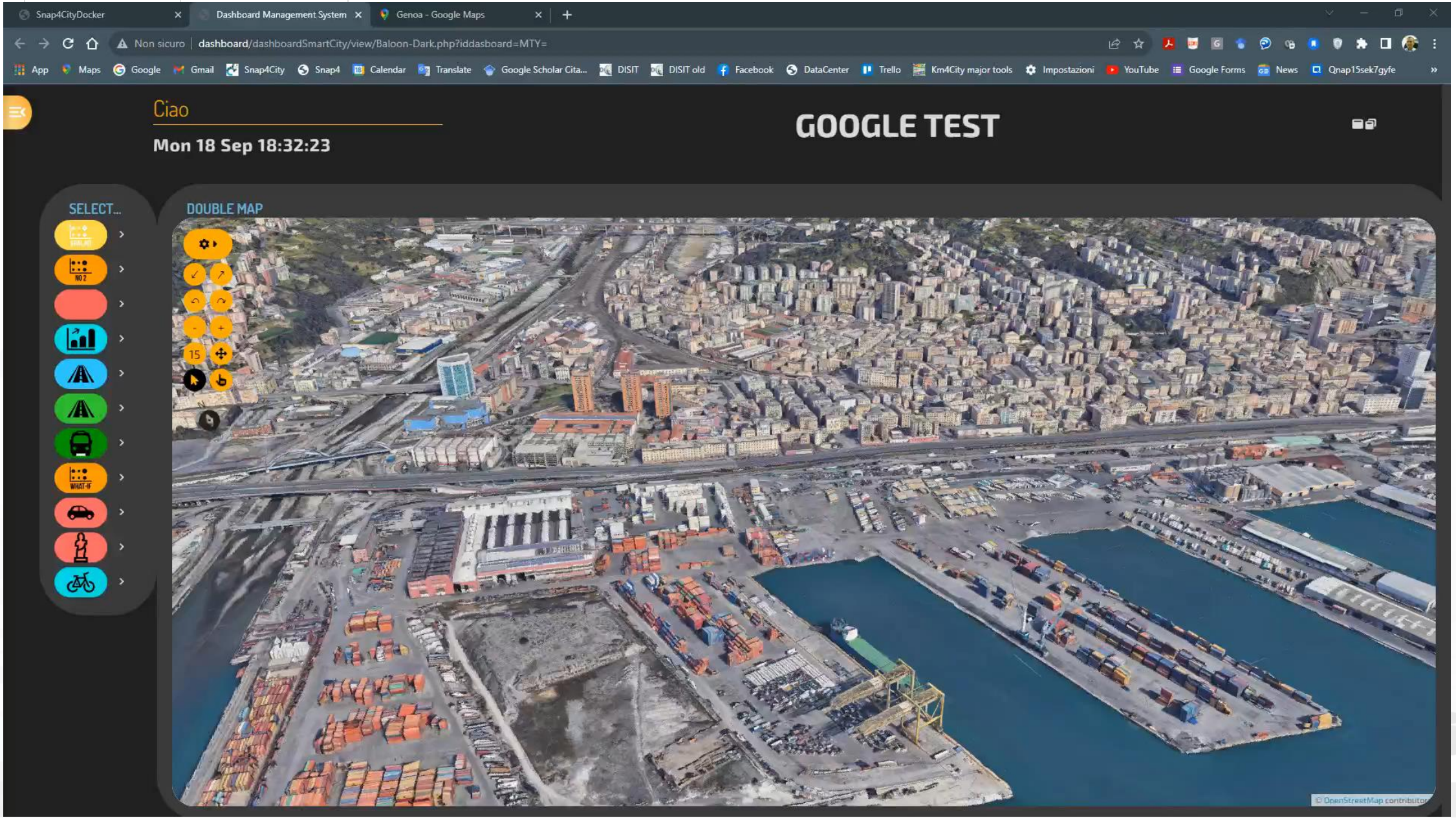
Genova

SNAP4CITY

KM4CITY



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Bologna

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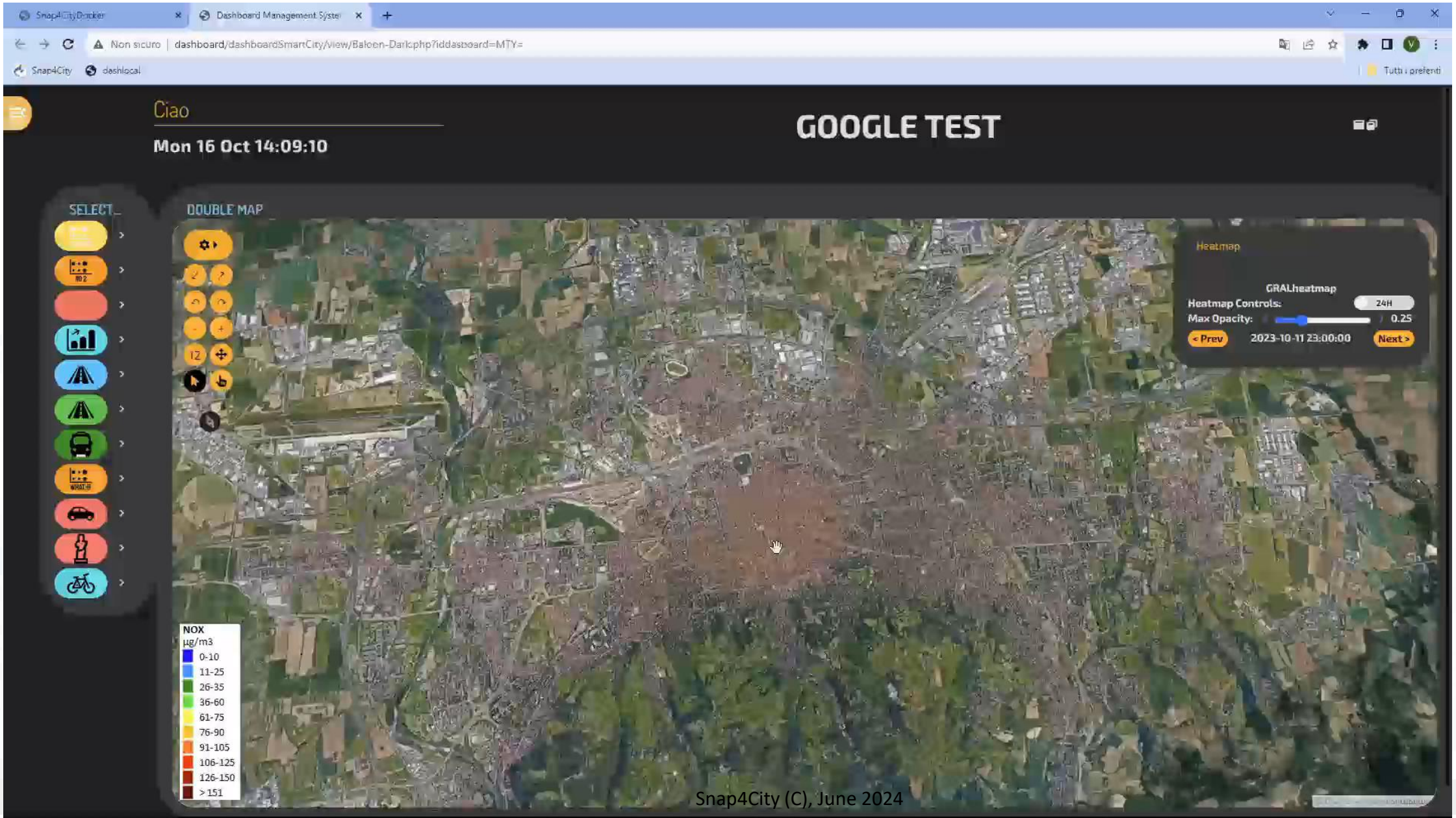

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Torino

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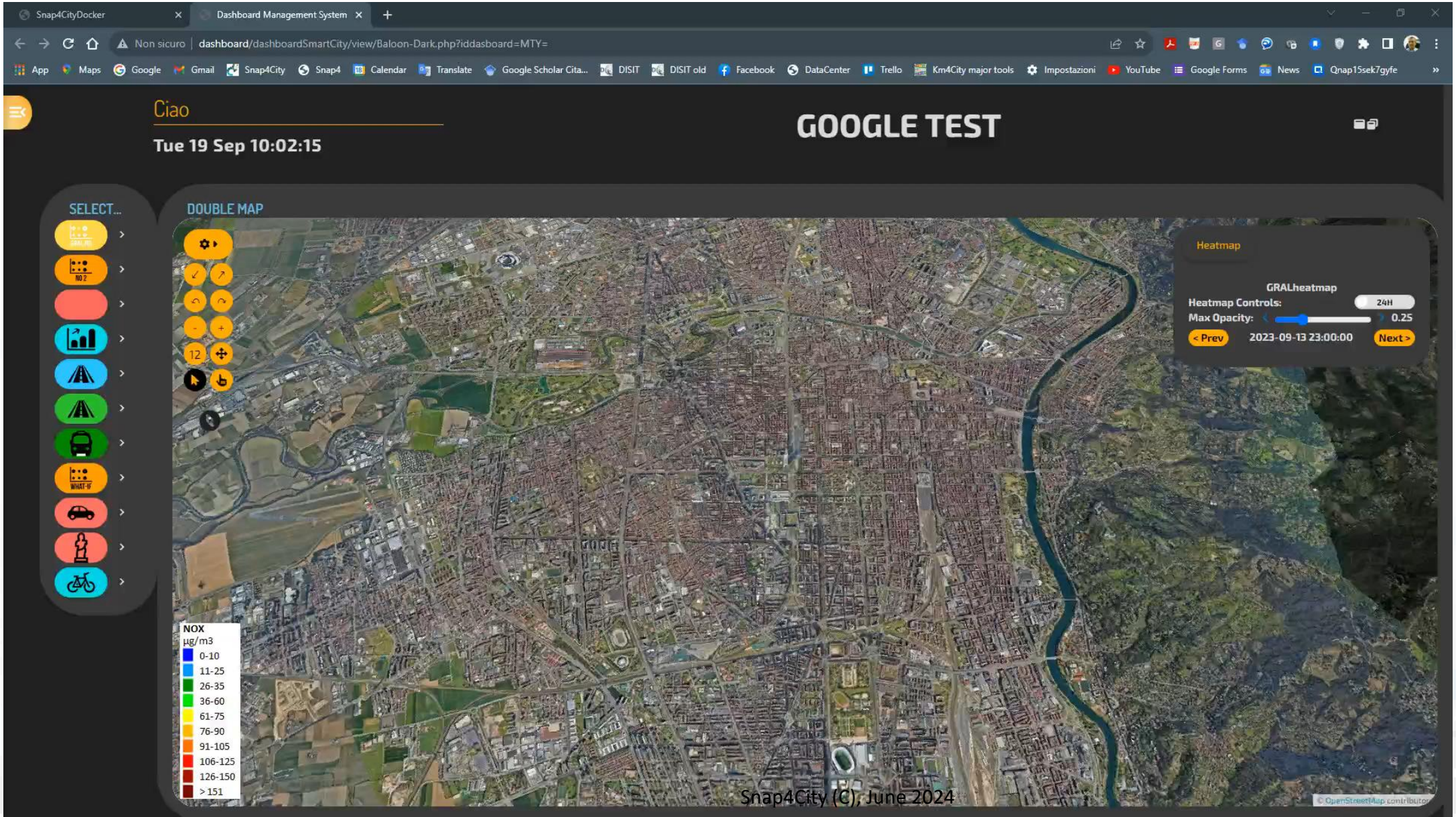

Local Digital Twin vs BIM

Snap4City | Dashboard Management System | Nuova scheda

snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mzg0NA==

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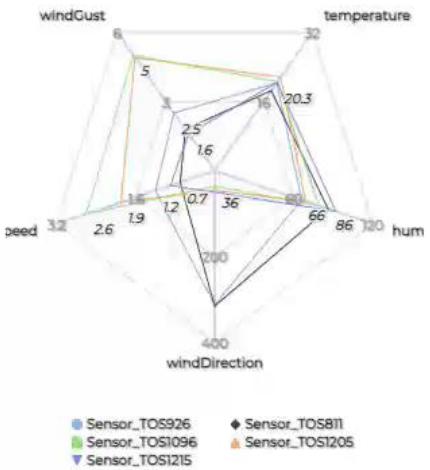
BIM Airport

Thu 25 May 18:16:22

Select the view of interest

- Airport Building 1
- Airport Heatmap dash
- Terminal Heatmap

Sensor Data 4m



Last Value	Time Trend Chart
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www.snap4solutions.org
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Dashboards (Public)
My Dashboards in All Org.
Dashboards of My Organization
My Dashboards in My Organization
My Data Dashboard Dev Kibana
My Data Dashboard Kibana
Extra Dashboard Widgets
Notificator
Data Management, HLT
Knowledge and Maps
Processing Logics / IOT App
Entity Directory and Devices
Resource Manager
Development Tools
Management
Decision Support Systems
Deploy and Installation

Snap4City: Smart aNalytic APp builder for sentient Cities and IOT

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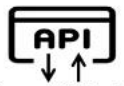

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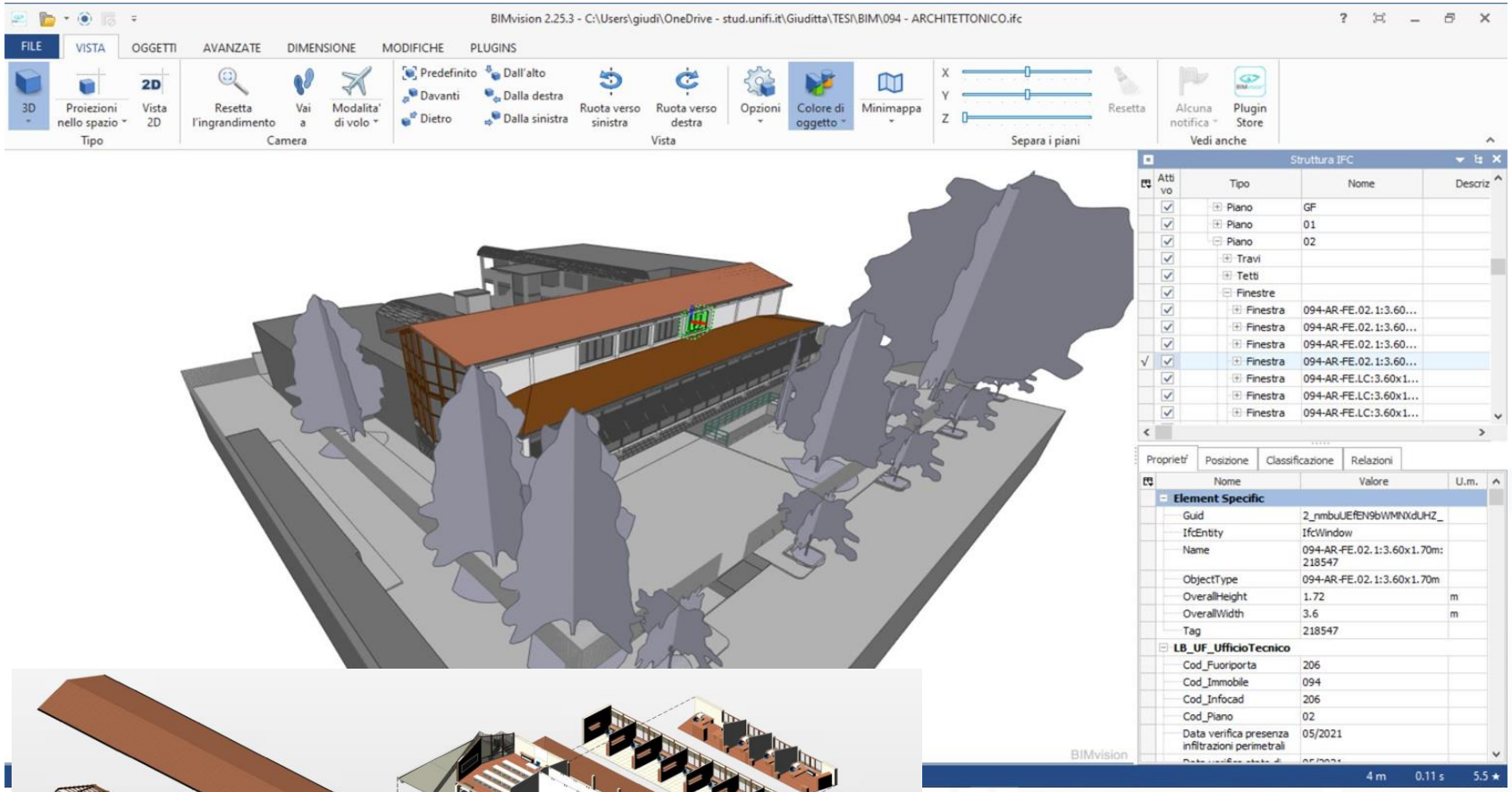
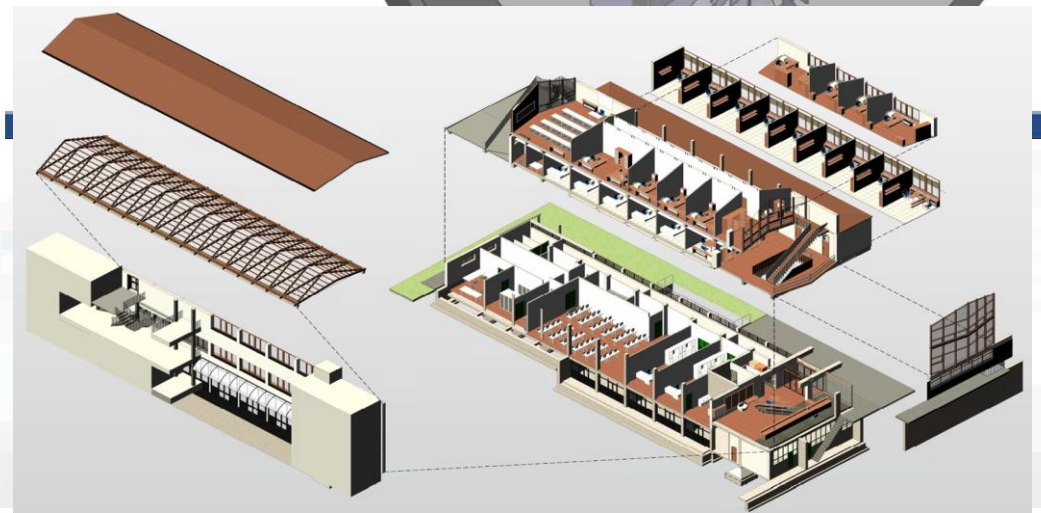
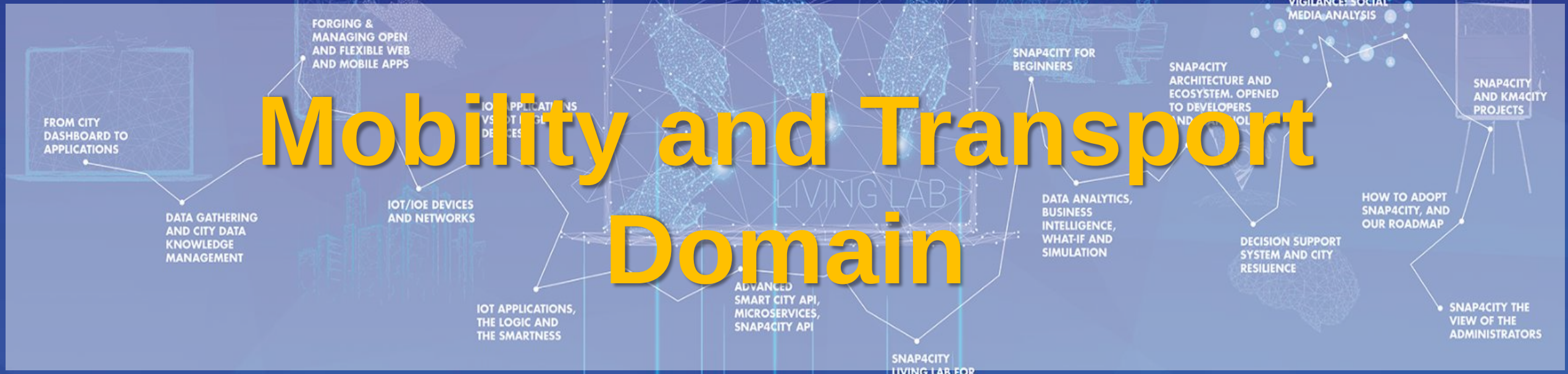


Nome	Valore	U.m.
LB_UF_UfficioTecnico		
Cod_Fuoriporta	122	
Cod_Immobile	094	
Cod_Infocad	122	
Cod_Piano	01	
Data verifica presenza infiltrazioni perimetrali	05/2021	
Data verifica stato di conservazione, fissaggio, funzionalità, stabilità e tenuta superfici vetrate	05/2021	
Descrizione	Facciata continua 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



100% OPEN SOURCE

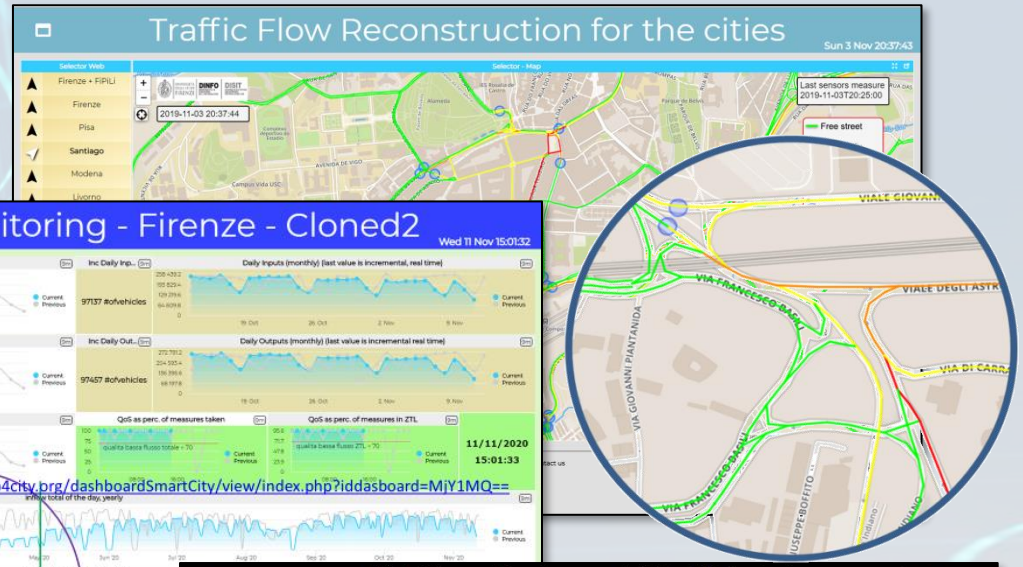
SNAP4 Appliances and Dockers **Installations**

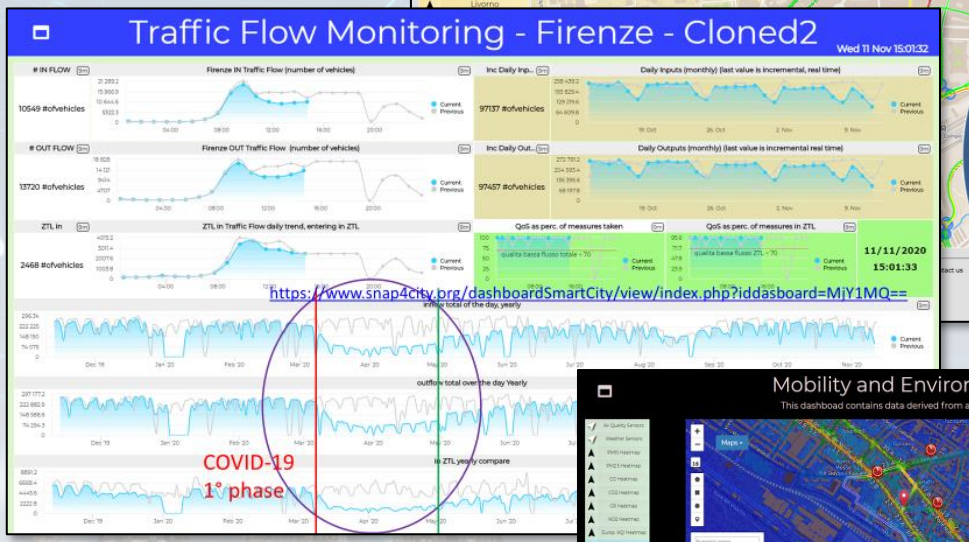
Mobility and Transport Traffic Flow Analysis

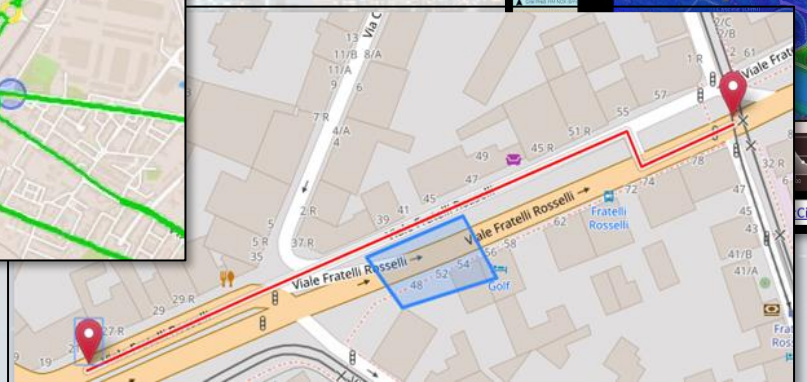
Cities: Firenze, Pisa, Livorno, Modena, Santiago di Compostela

reference

- **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)

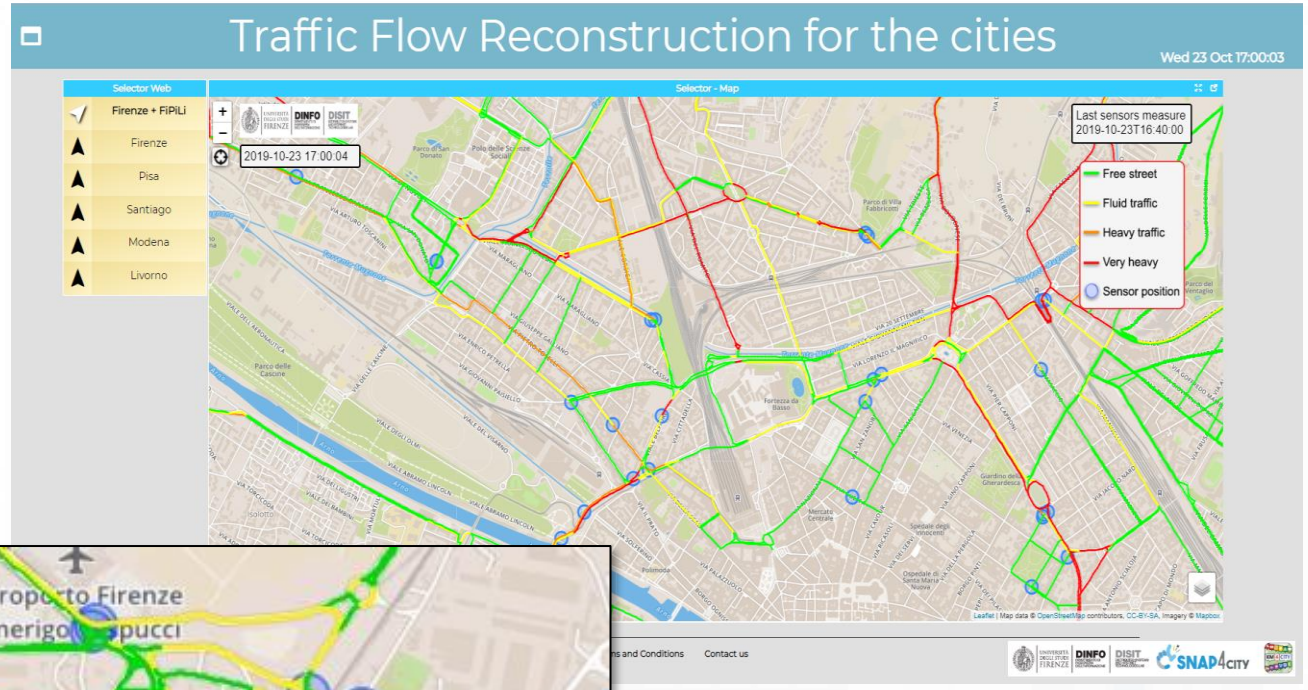
- Goals:
  - Decongestion
  - Decarbonization
  - Accessibility to services
  - Security/Safety of city users
- Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)
  - Monitoring traffic, parking, people flow, services, boats, ports, beaches, etc.
  - Early detection/warning 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, resommendations, nudging
  - Computing predictions of any kind
- Solutions for Planning (optimization and what-if analysis)
  - Reduction of traffic congestion, via optimization: semaphore cycles, viability, routing
  - Reduction of Pollutant Emissions, via optimization: semaphore cycles, viability
  - Optimization of transportation offers wrt multimodal mobility demand
- Algorithms and computational solutions, see next slide

Tools for Mobility and Transport (2024)

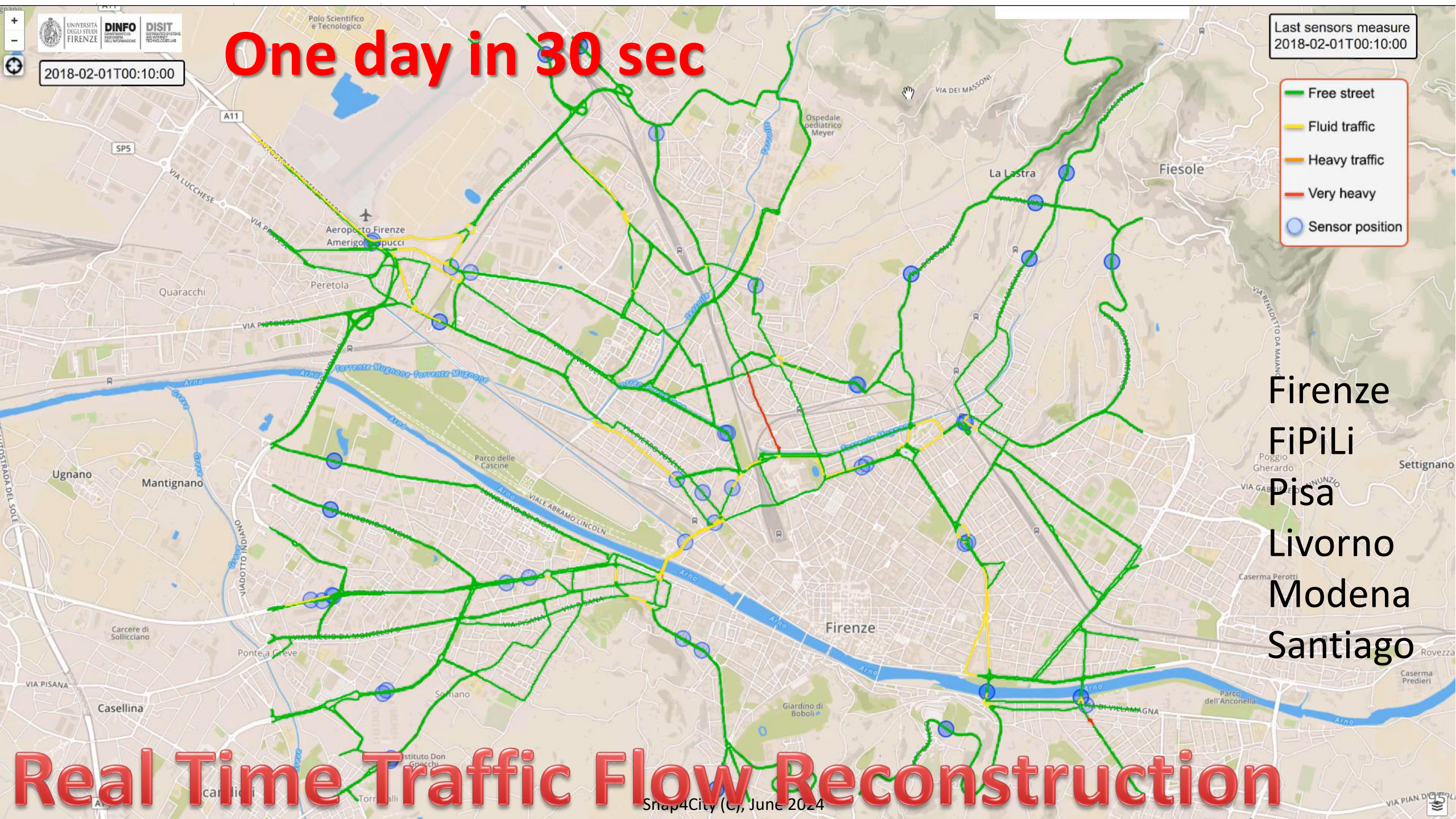
- Optimisation of viability of an area for reducing congestion, waiting time, stops
- Optimisation of semaphores time cycles, synchronization, in an area for reducing congestion, waiting time, stops
- Predictions for: traffic flow, smart parking, smart bike sharing, people flows, etc. (ML, DL)
- What 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 ?

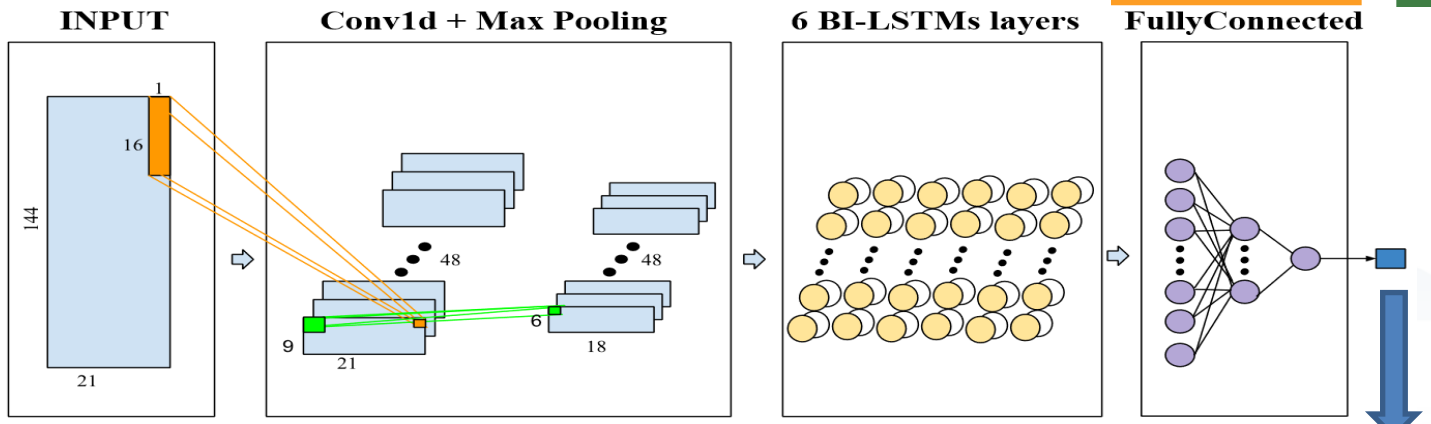
- Making decision on mobility and transport solutions → what if analysis
- Controlling pollution
- Dynamic Routing for Firebrigade, Ambulances, general public
- Planning Public Transportation routing



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc5NQ==


One day in 30 sec
2018-02-01T00:10:00
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

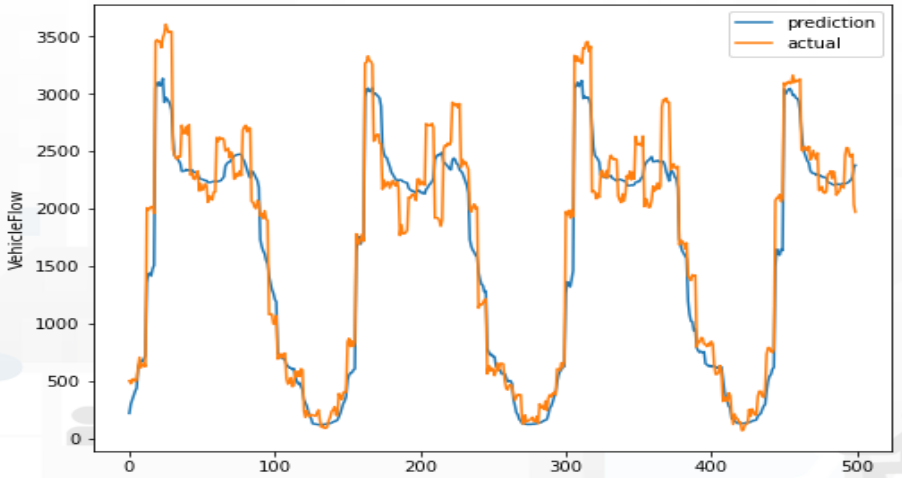


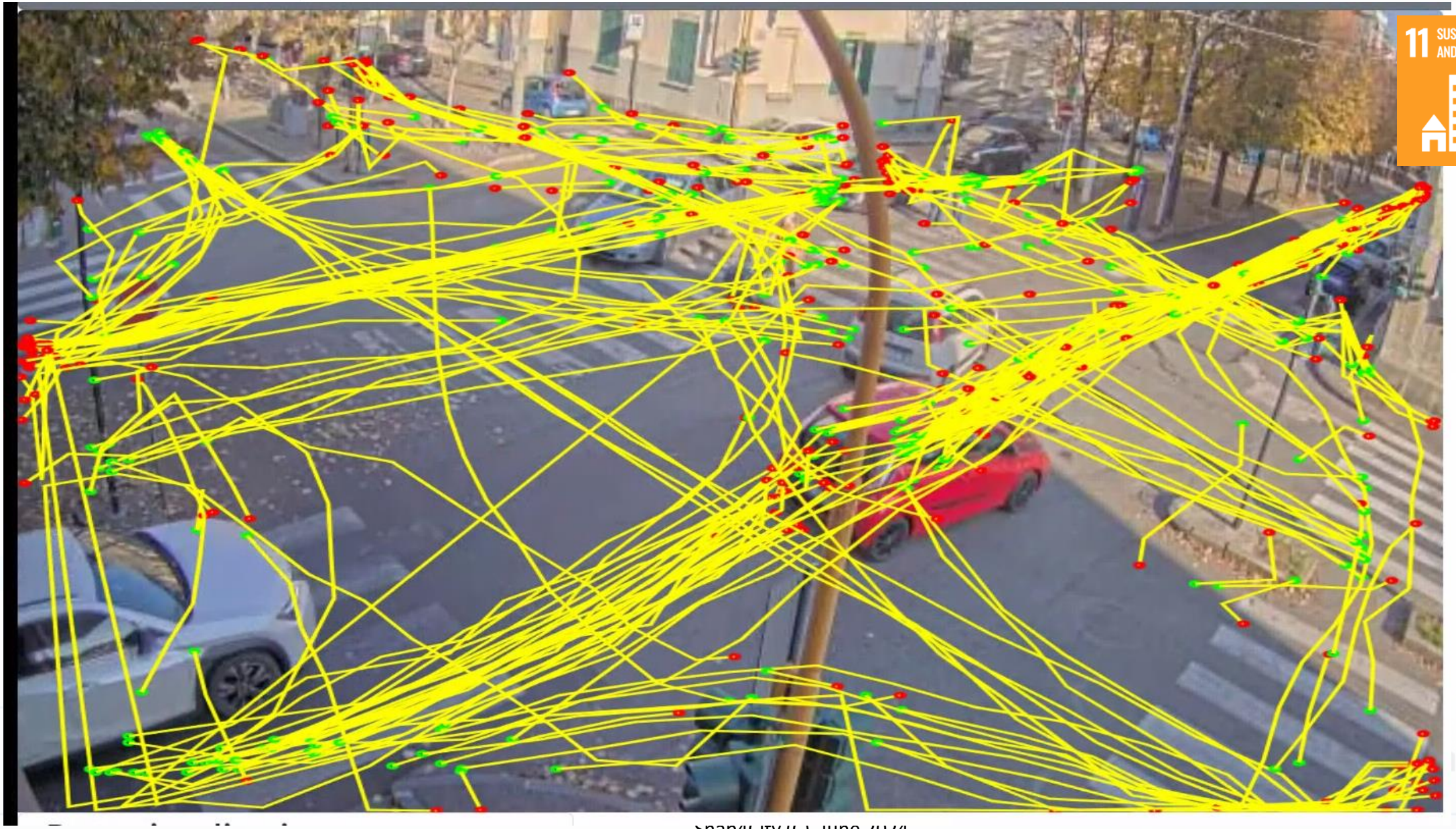
Urban data:

- 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

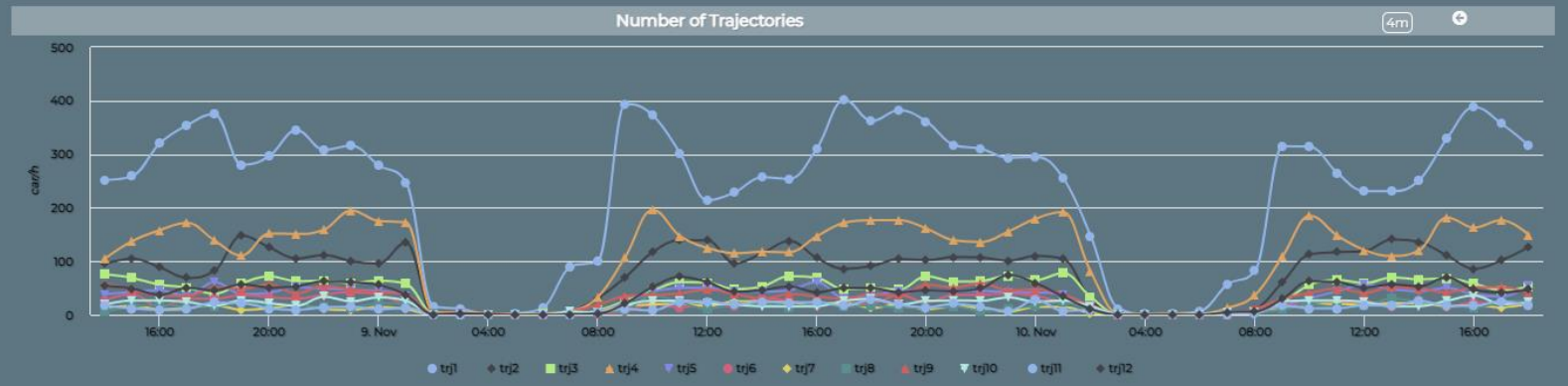


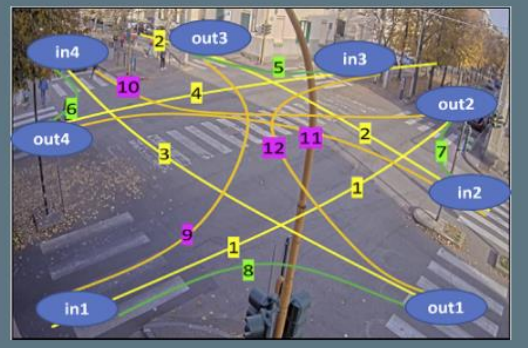


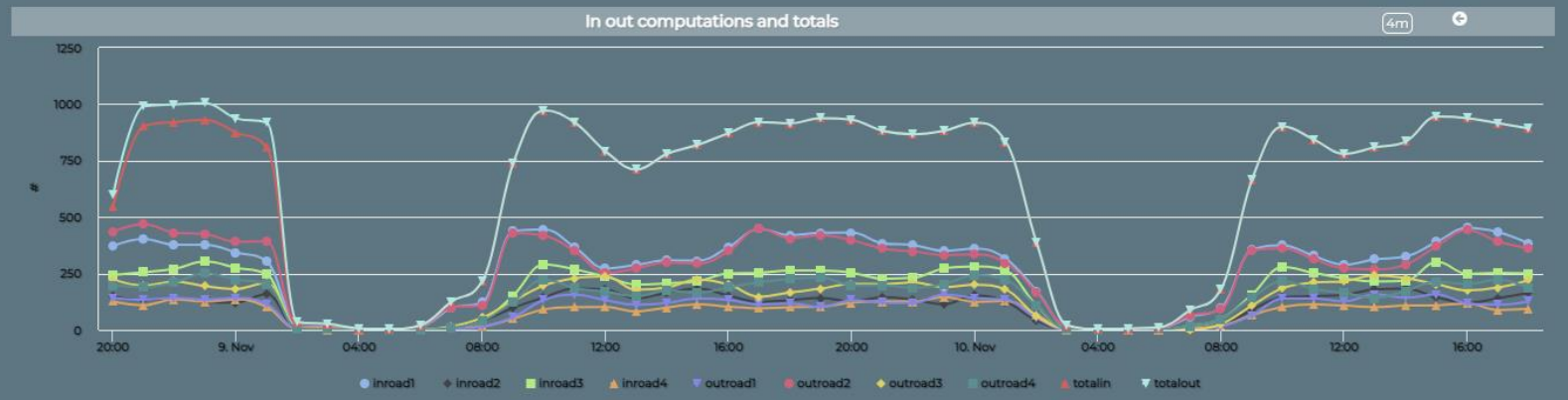
Venaria Reale

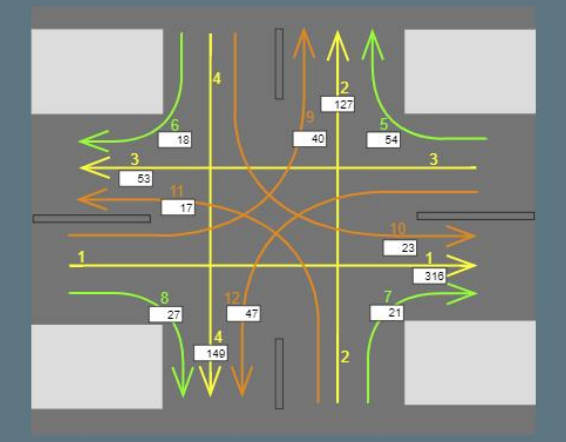
Monitoring Cross Road Venaria - (AXIS Camera)

Wed 10 Nov 18:50:53









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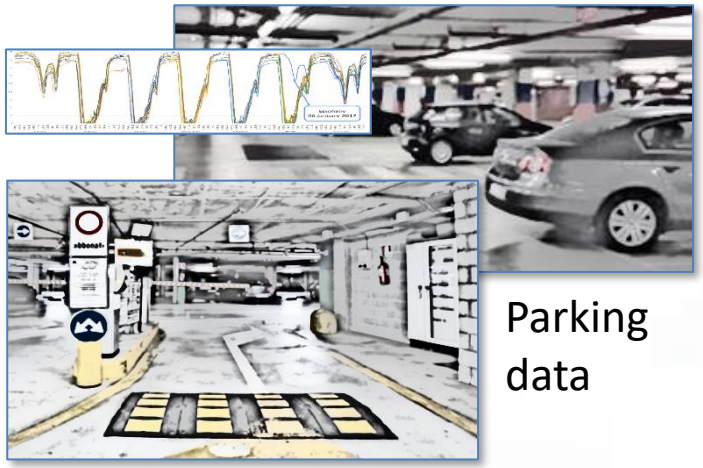
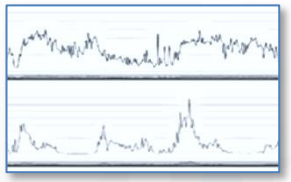
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzI5Ng==

Deep Learning AI to surely Park!

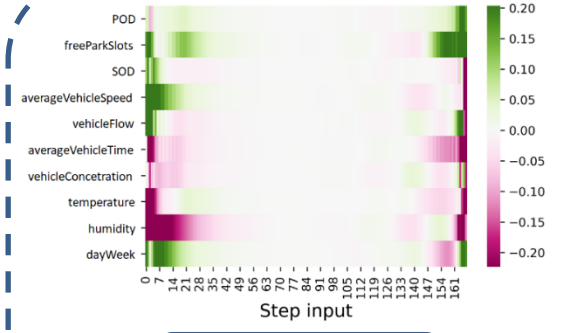


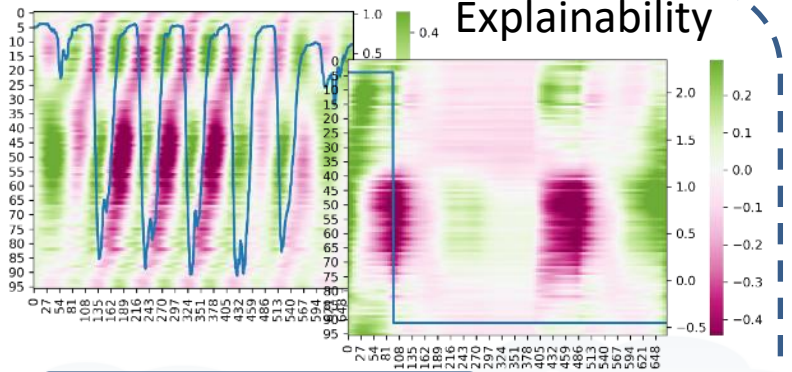
Parking data

Traffic sensors data



Weather Features

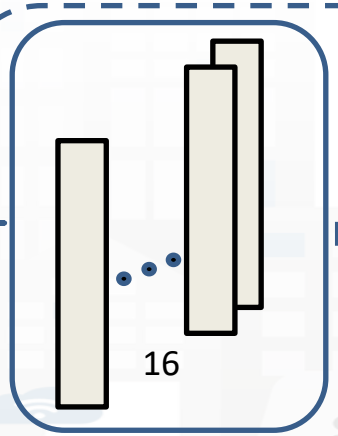


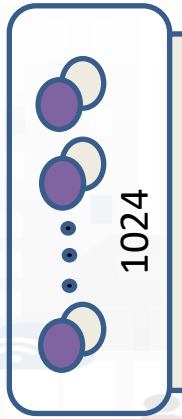


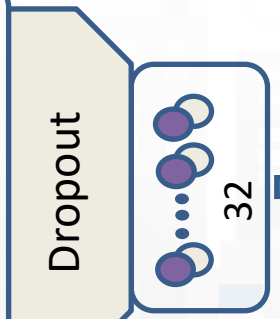
Explainability

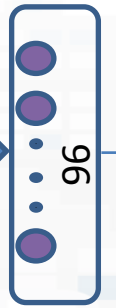
Gradient

Integrated Gradient

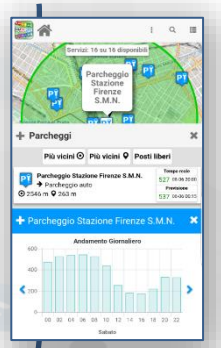








Multi-step Predictions

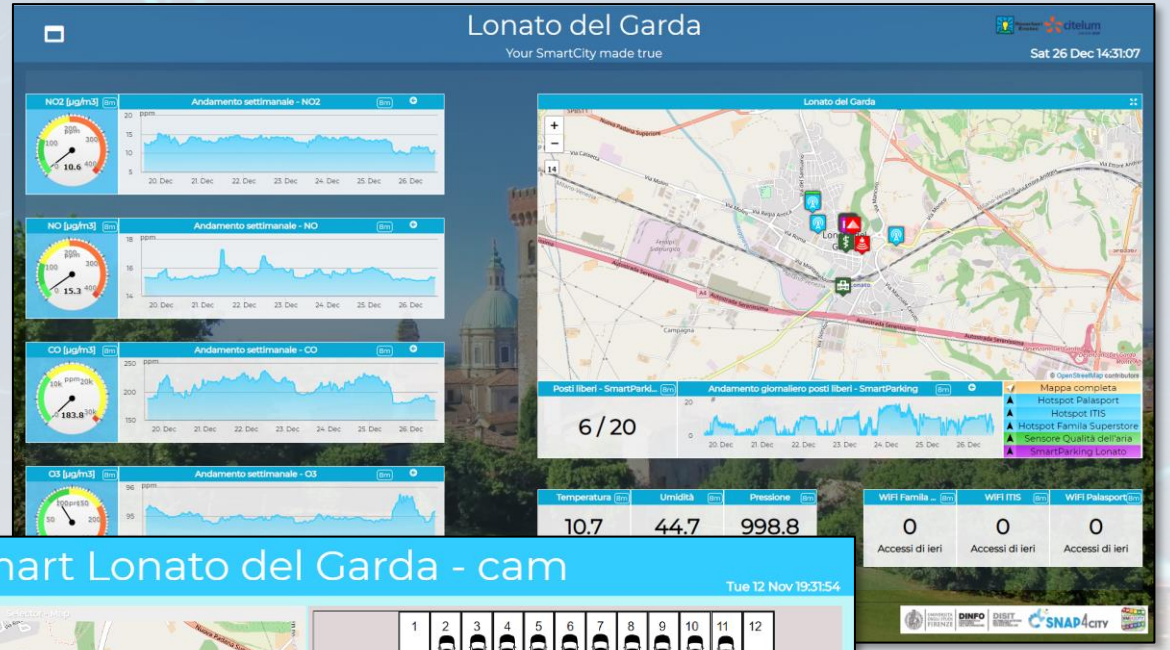


Conv1D+AvPooling1D BI-LSTM BI-LSTM Dense

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

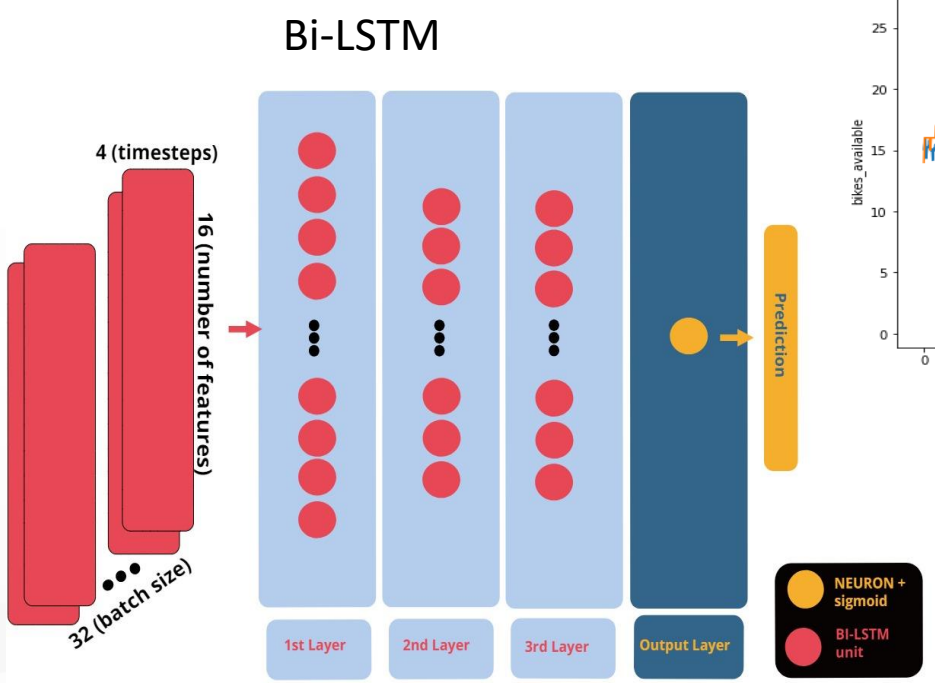
reference

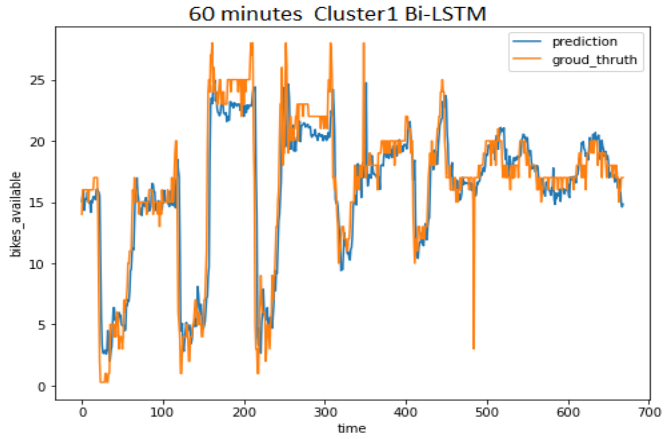
- **Multiple Domain Data**
  - Smart Parking, Environment, Wi-Fi
- **Multiple Decision Makers**
  - City Officer, operators
  - Data monitoring, alerting
  - analytics
- **Historical and Real Time data**
  - Dashboards
- **Services Exploited on:**
  - Dashboards, API
- **Since 2019**



11 SUSTAINABLE CITIES AND COMMUNITIES

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



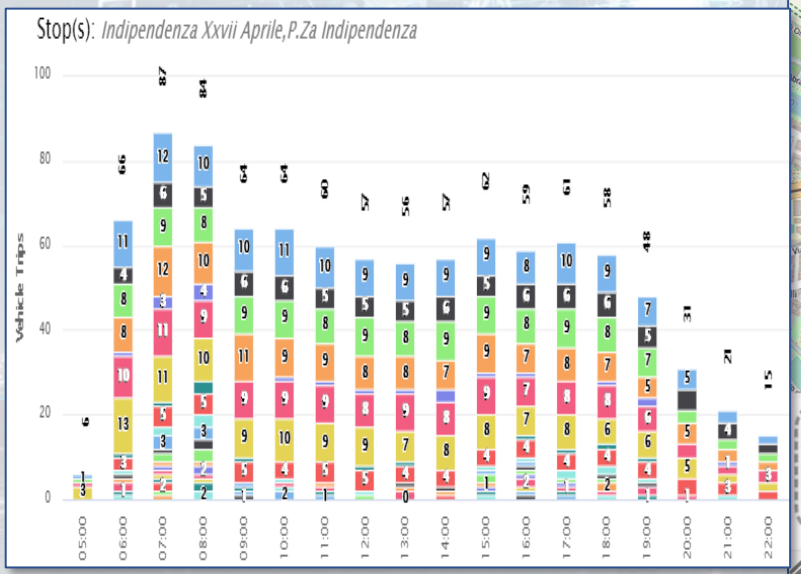


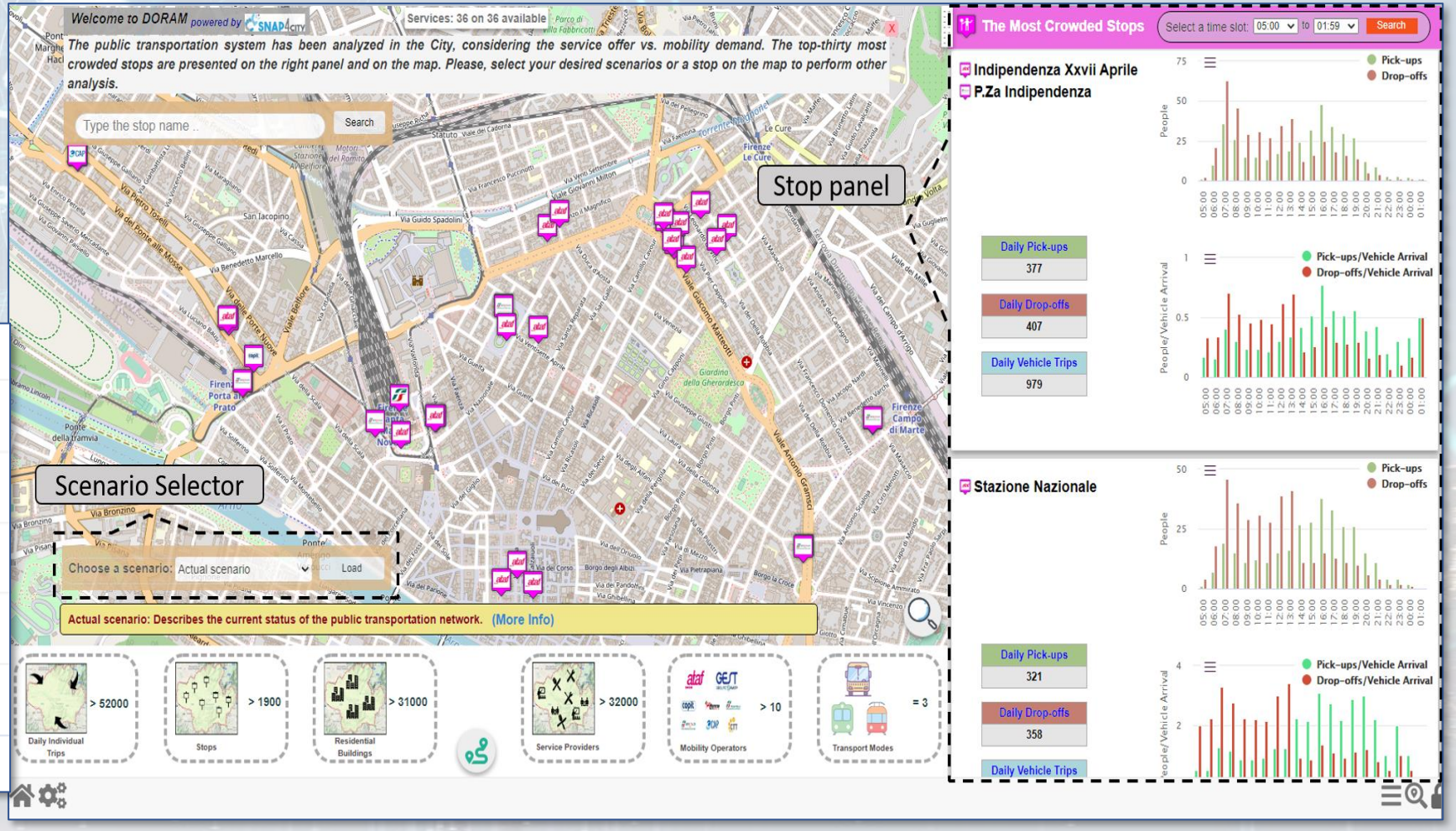
E. Collini, P. Nesi and G. Pantaleo, "Deep Learning for Short-Term Prediction of Available Bikes on Bike-Sharing Stations," in *IEEE Access*, vol. 9, pp. 124337-124347, 2021, doi: 10.1109/ACCESS.2021.3110794.
https://ieeexplore.ieee.org/abstract/document/9530580

What-if Analysis on Pub Transport

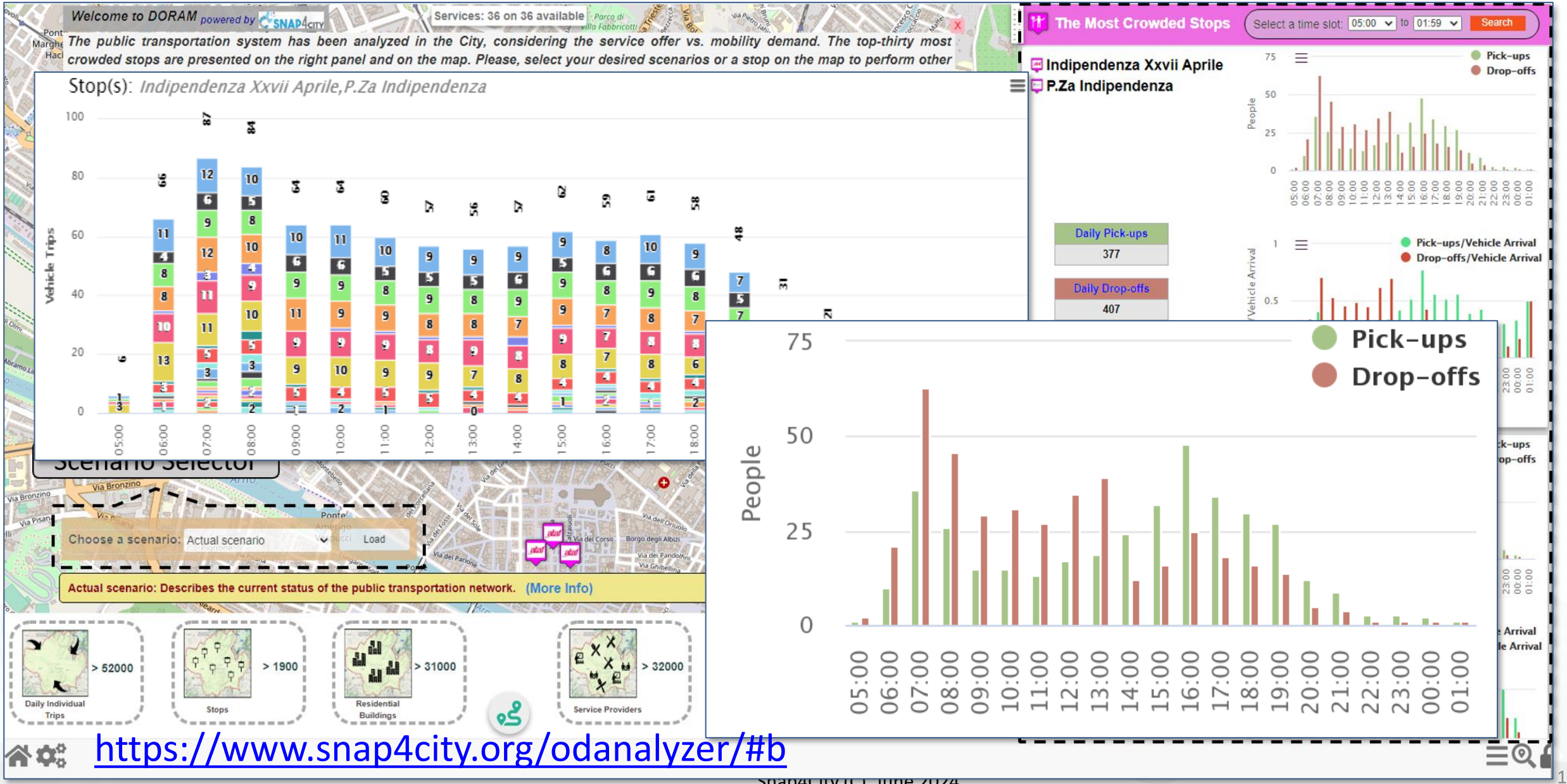
- Definition of scenarious impact on
  - Traffic, Pollutant, parking, public transport, private flows, etc.
  - KPI analysis

Public Services





DORAM



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

TOP

Behaviour understanding and User Engagement Security and Safety

100% OPEN SOURCE

SNAP4 Appliances and Dockers **Installations**

City Users Domain (2024)

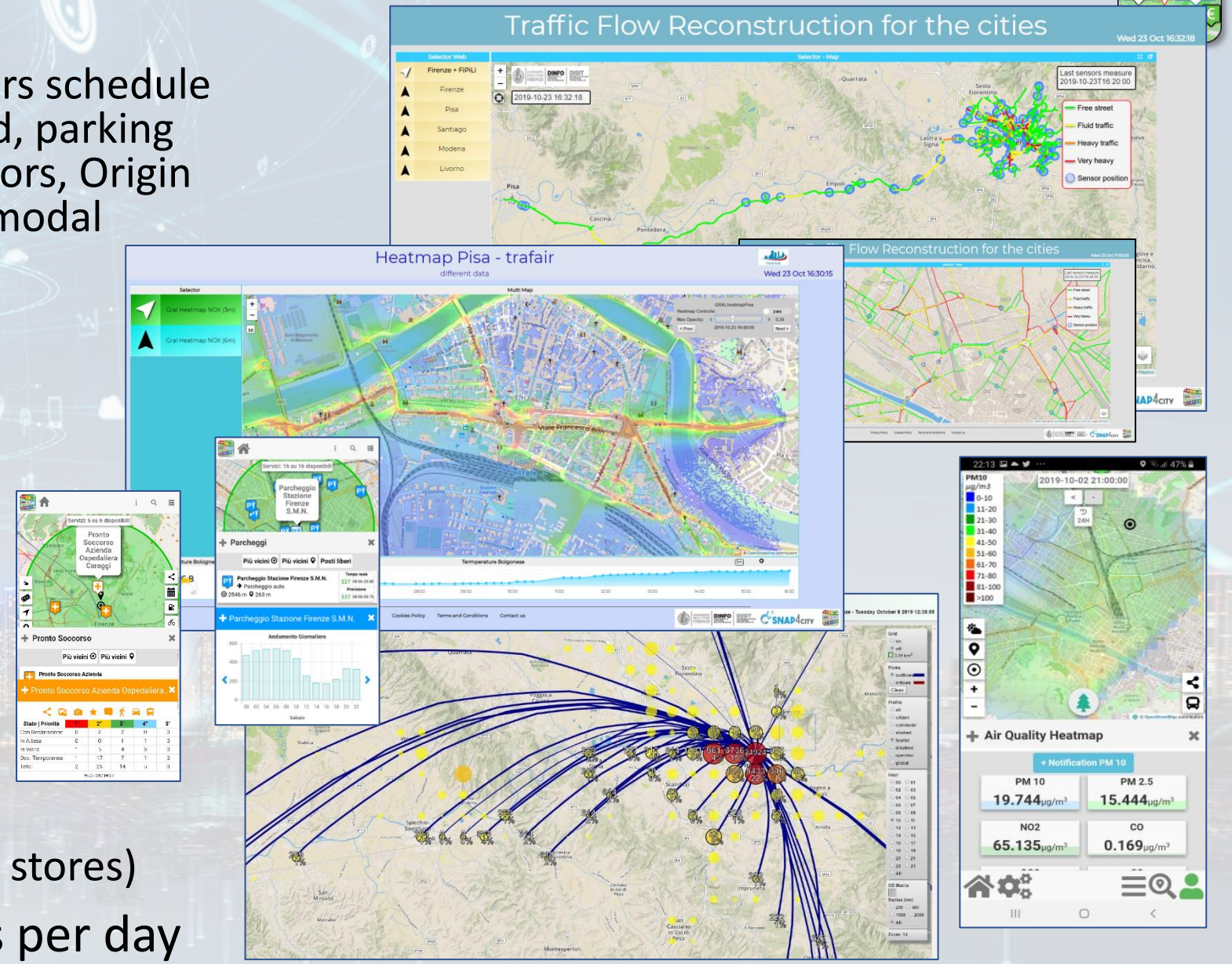
- Goals:
  - Quality of Life, quality of services
  - Costs reduction of services
  - Accessibility to services: citizens, Tourists, commuters, etc.
  - Security/Safety of city users
- Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)
  - Monitoring services: tickets, reputation, usages, areas, etc.
  - Monitoring user behaviour: 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 suggestions, recommendations, nudging to city users and operators
  - 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

- **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

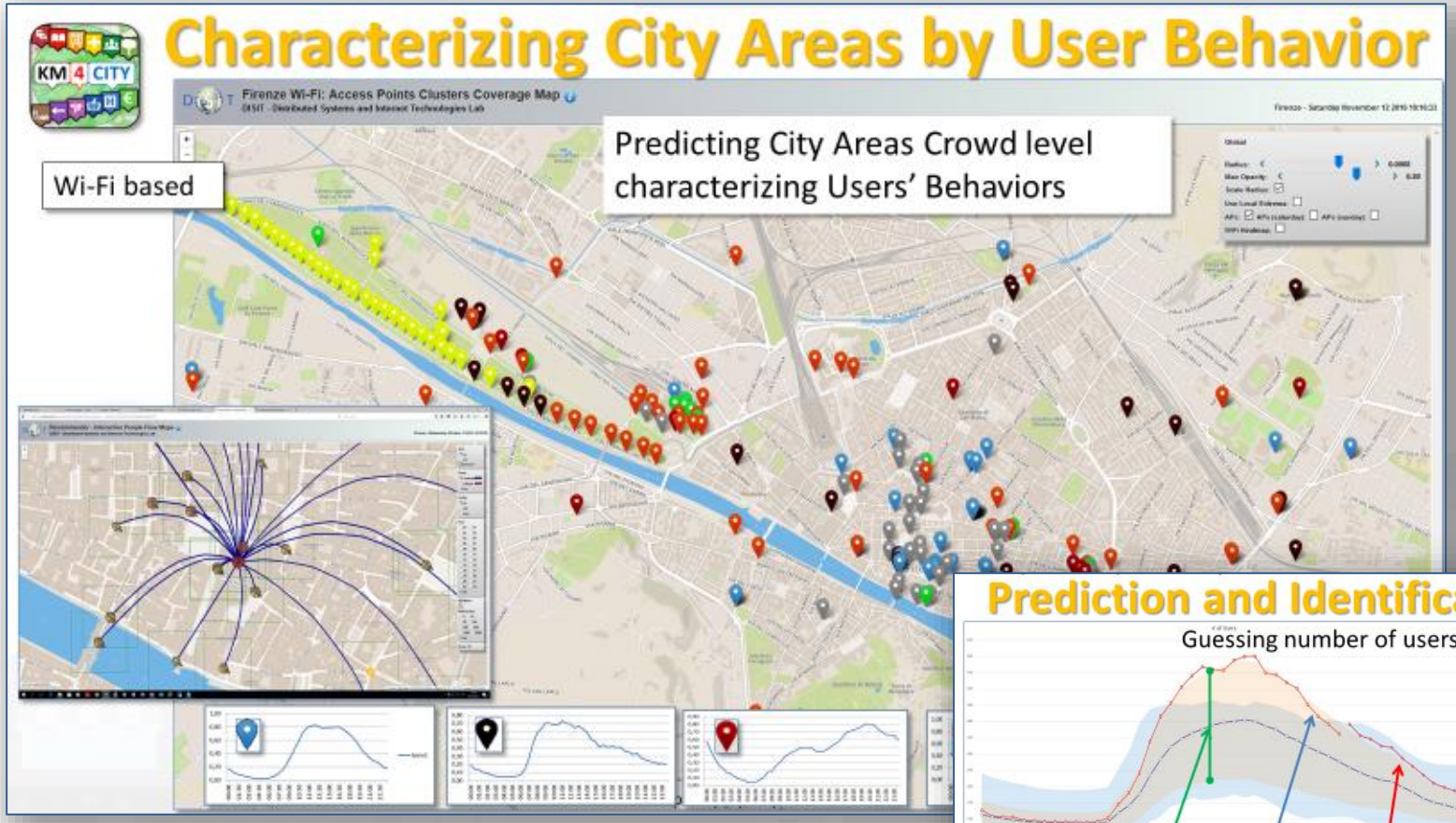
- **Dashboards & Services**:
  - **Mobility**: public transport operators schedule and paths, traffic Fi-Pi-Li main road, parking status and predictions, traffic sensors, Origin Destination matrix, routing, multimodal routing, etc.
  - **Social**: Hospitals and triage, etc.
  - **Environment**: sensors,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



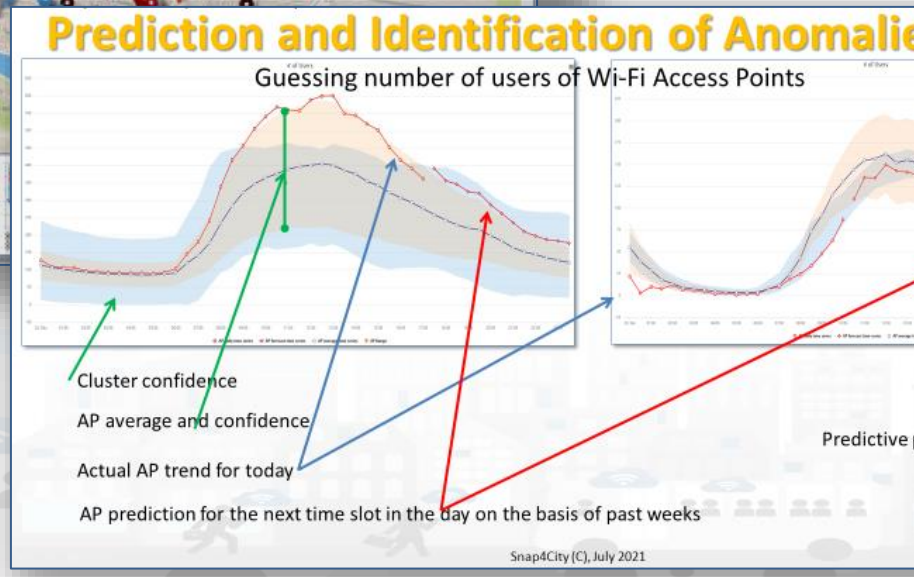
People Flows

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

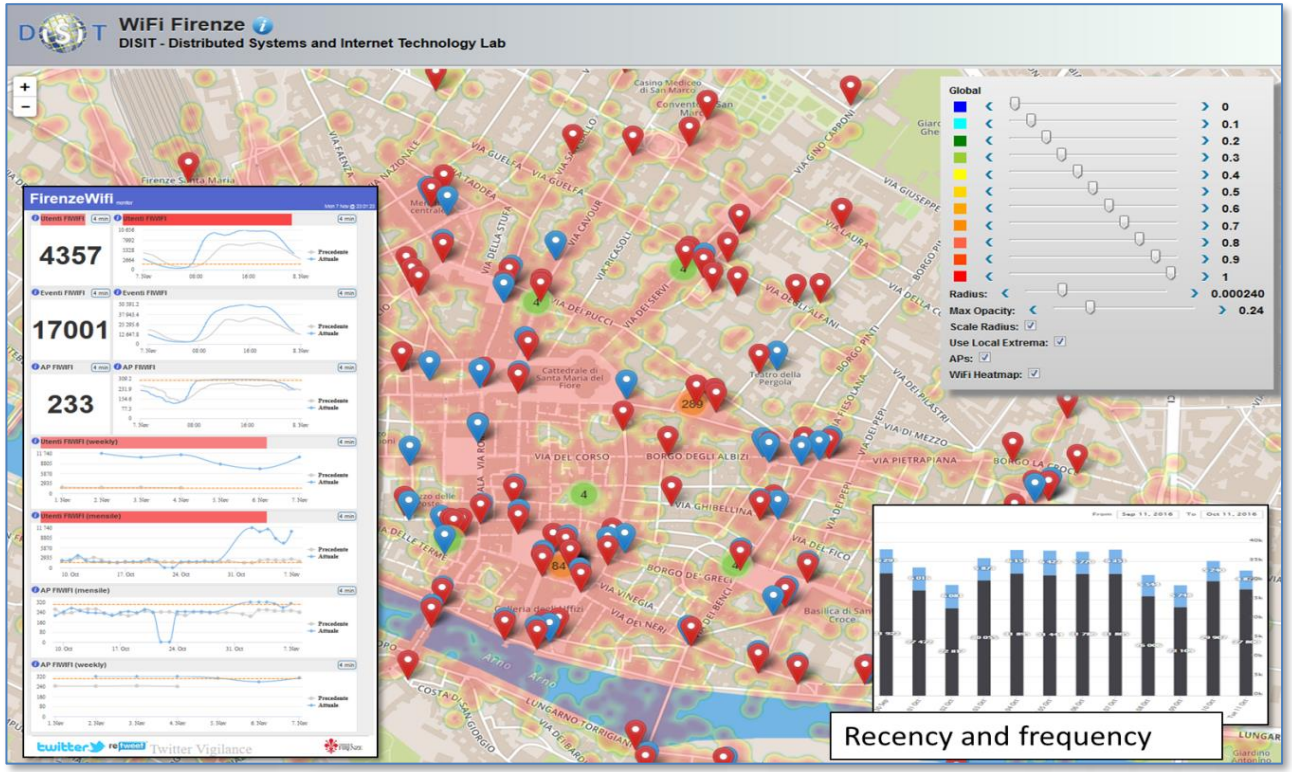
Characterizing City Areas by User Behavior

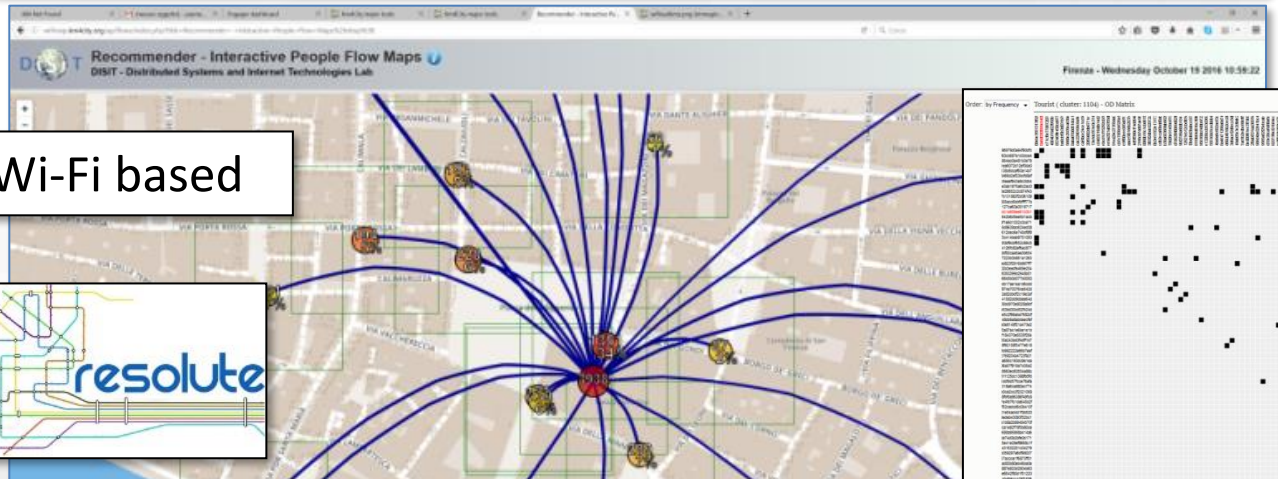


11 SUSTAINABLE CITIES AND COMMUNITIES

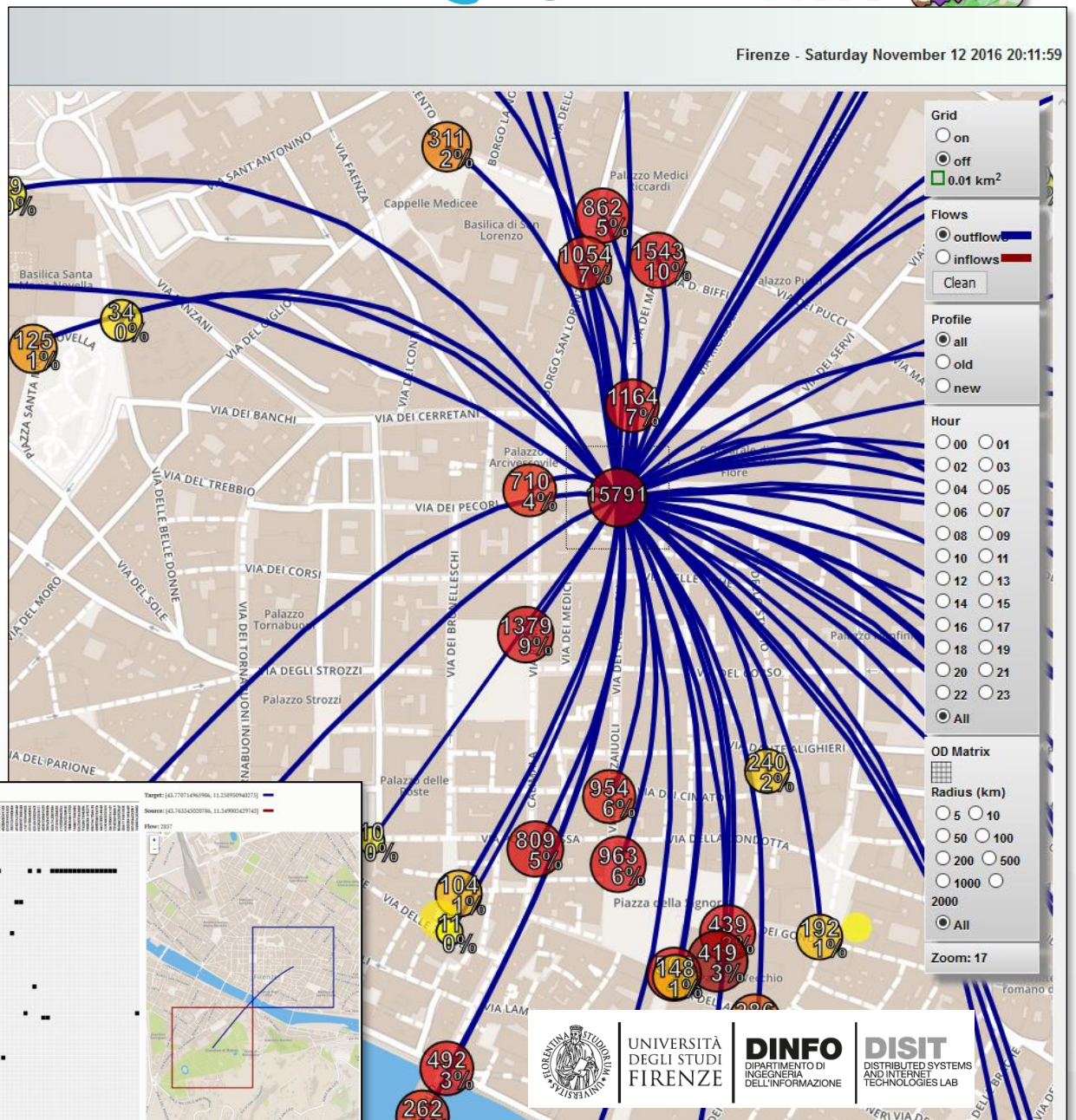


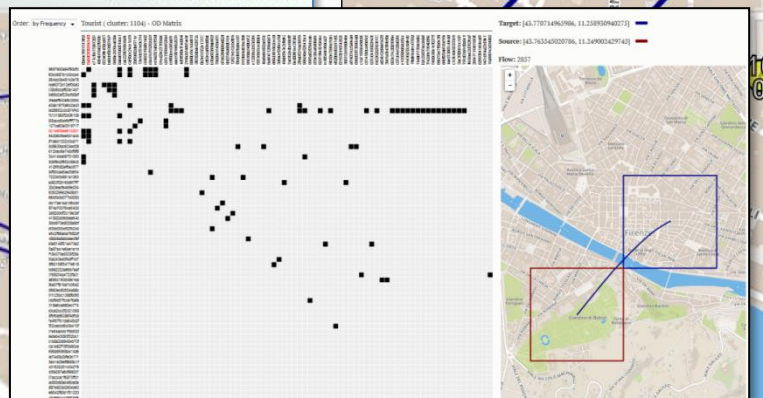
Origin Destination Matrix Estimation





Wi-Fi based





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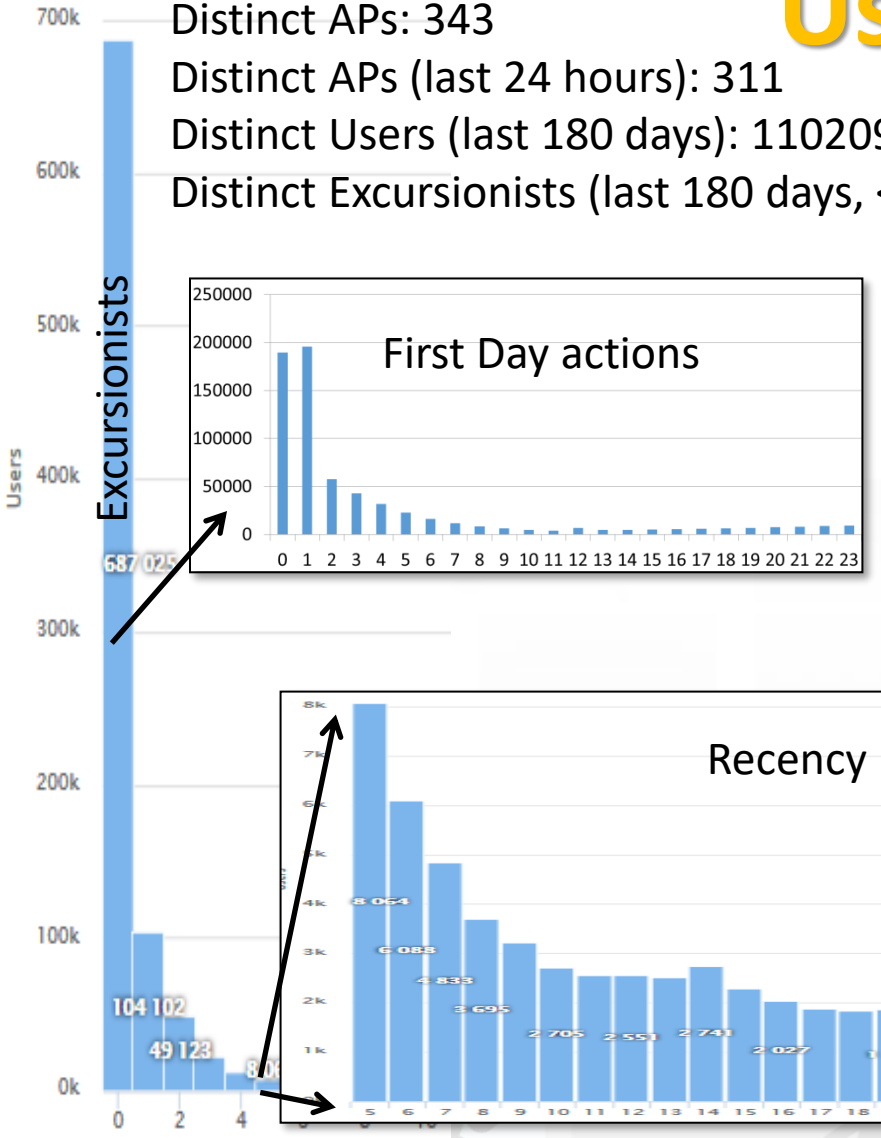
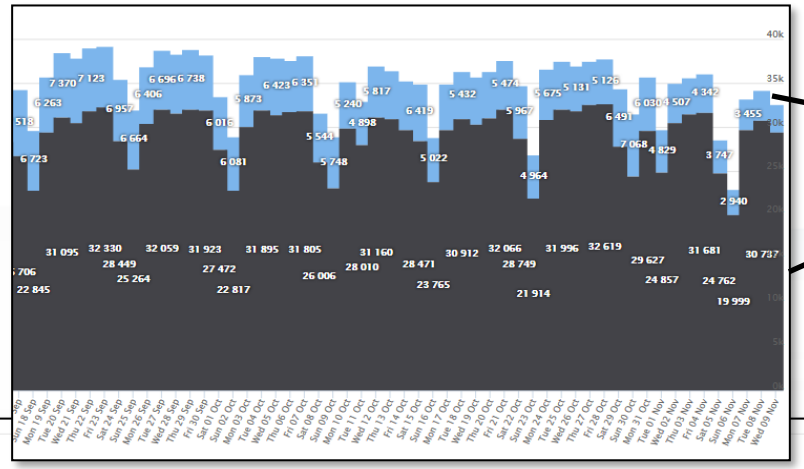
User Behaviour Analysis

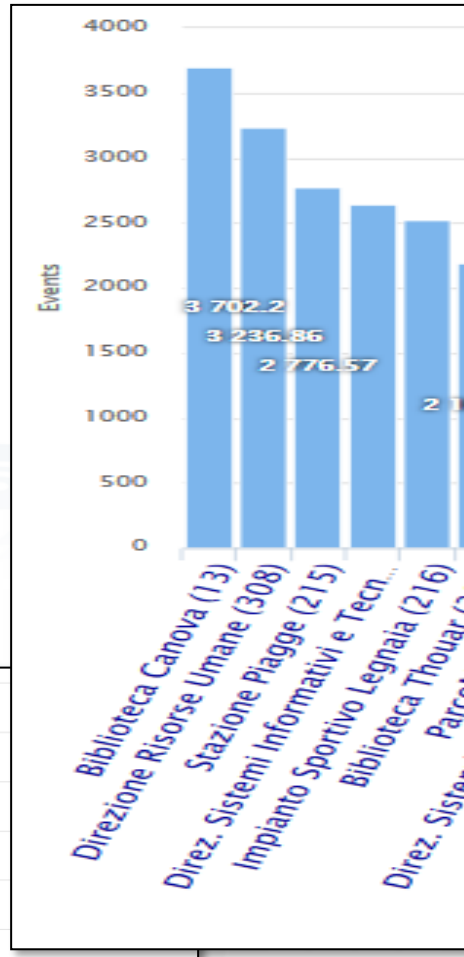
Distinct APs: 343
Distinct APs (last 24 hours): 311
Distinct Users (last 180 days): 1102098
Distinct Excursionists (last 180 days, < 24 h): 687025



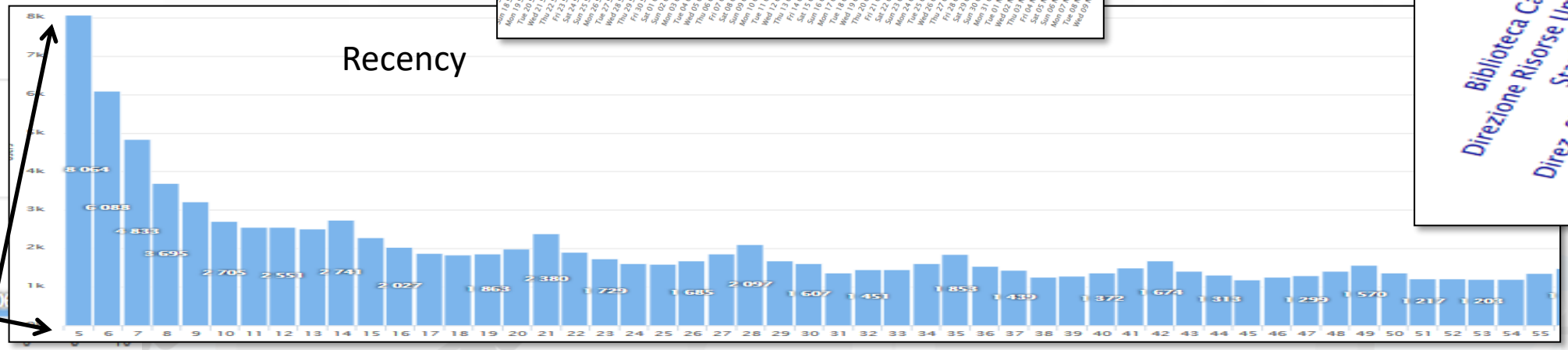


New City Users
VS
Returning

Where



Recency



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
- …..

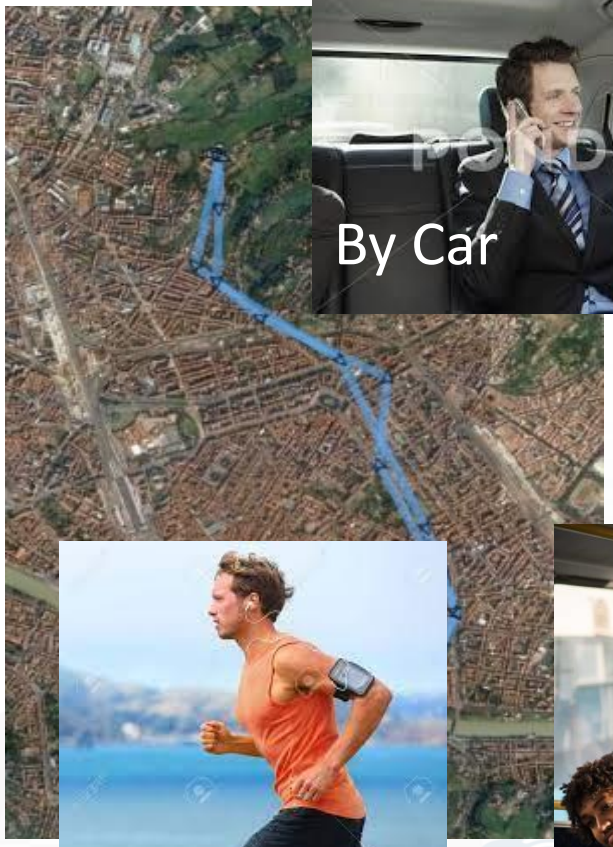
Produced information

- Suggestions
- Engagements
- Notifications
- …

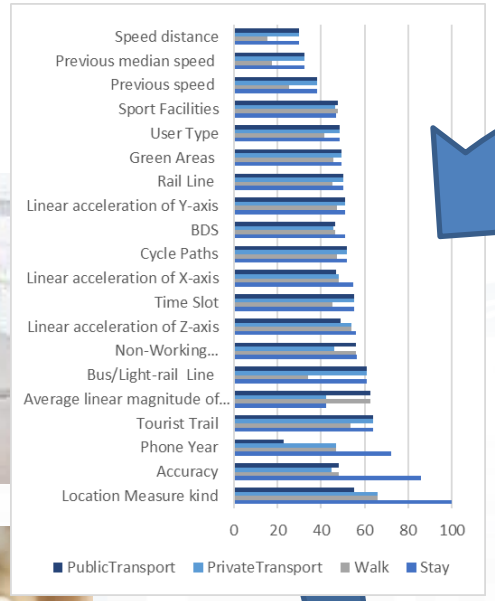
System

To propose suggestions and Engage city user

we need to know how they are moving

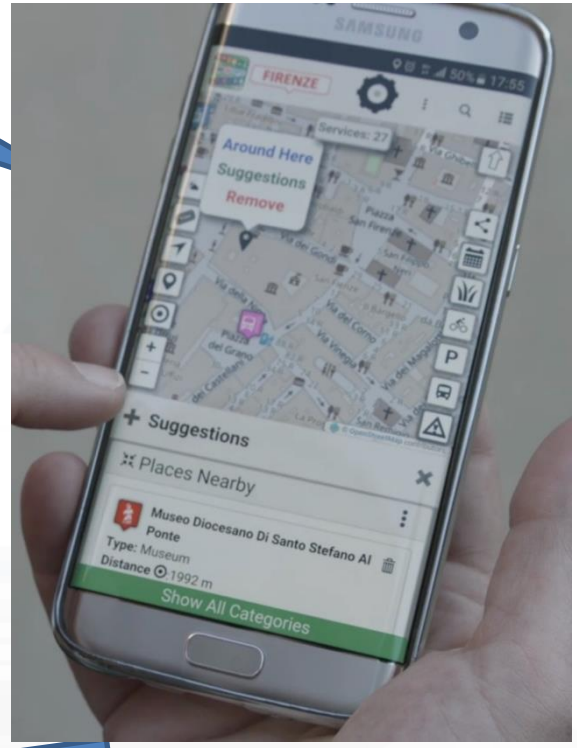


Walk

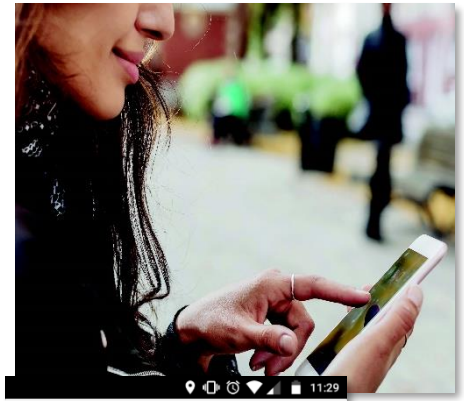


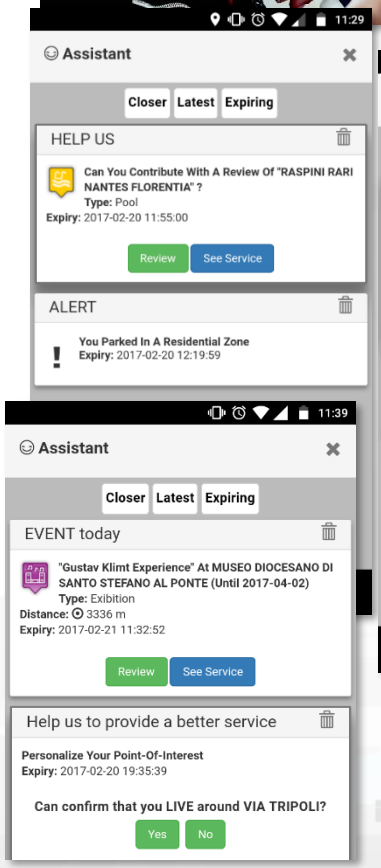
Artificial Intelligence Classification

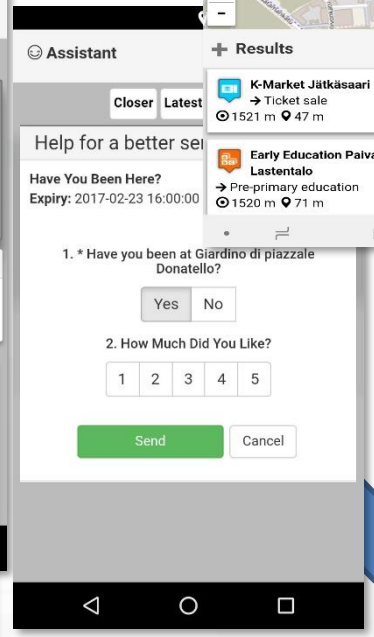
Suggestions

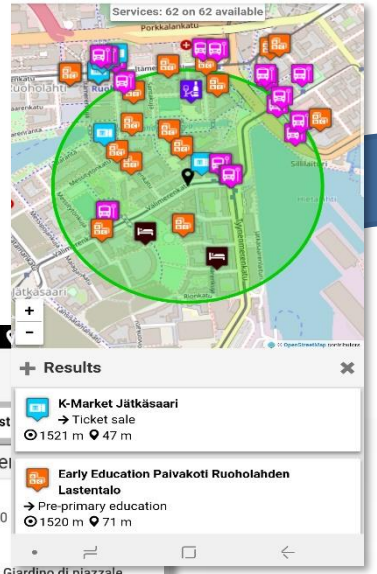


Users' Engagement

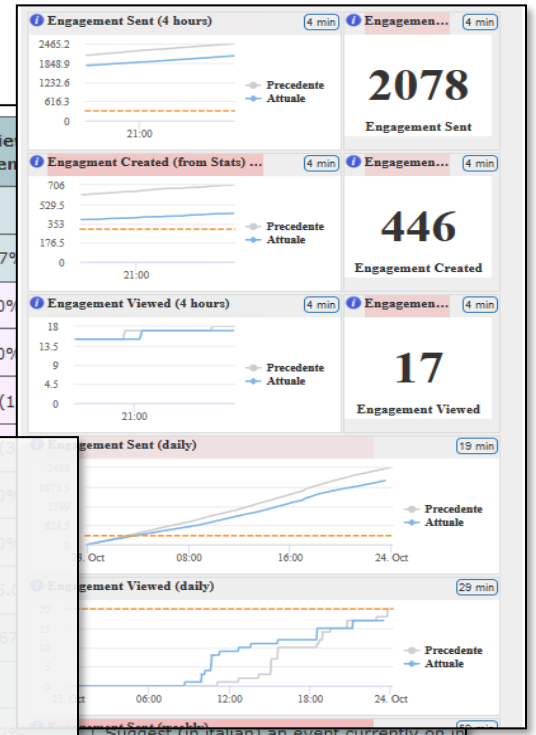


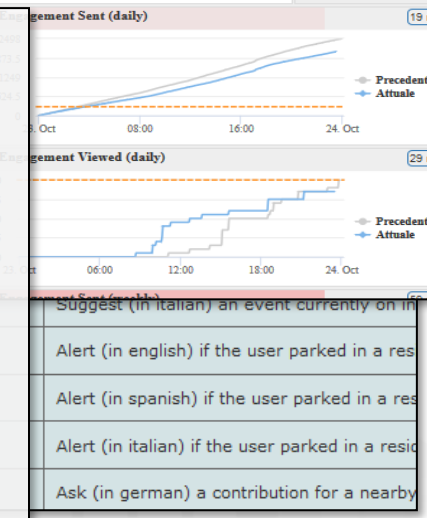






Rule name	Type	#sent	#viewed	#vie #sen
daily_event_de	ENGAGEMENT	1 (0%)	0 (0%)	0%
daily_event_en	ENGAGEMENT	1720 (2.12%)	70 (7.1%)	4.07%
	- commuter	5 (0.29%)	0 (0%)	0 (0%
	- student	14 (0.81%)	0 (0%)	0 (0%
	- tourist	1462 (85%)	25 (35.71%)	25 (1





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.

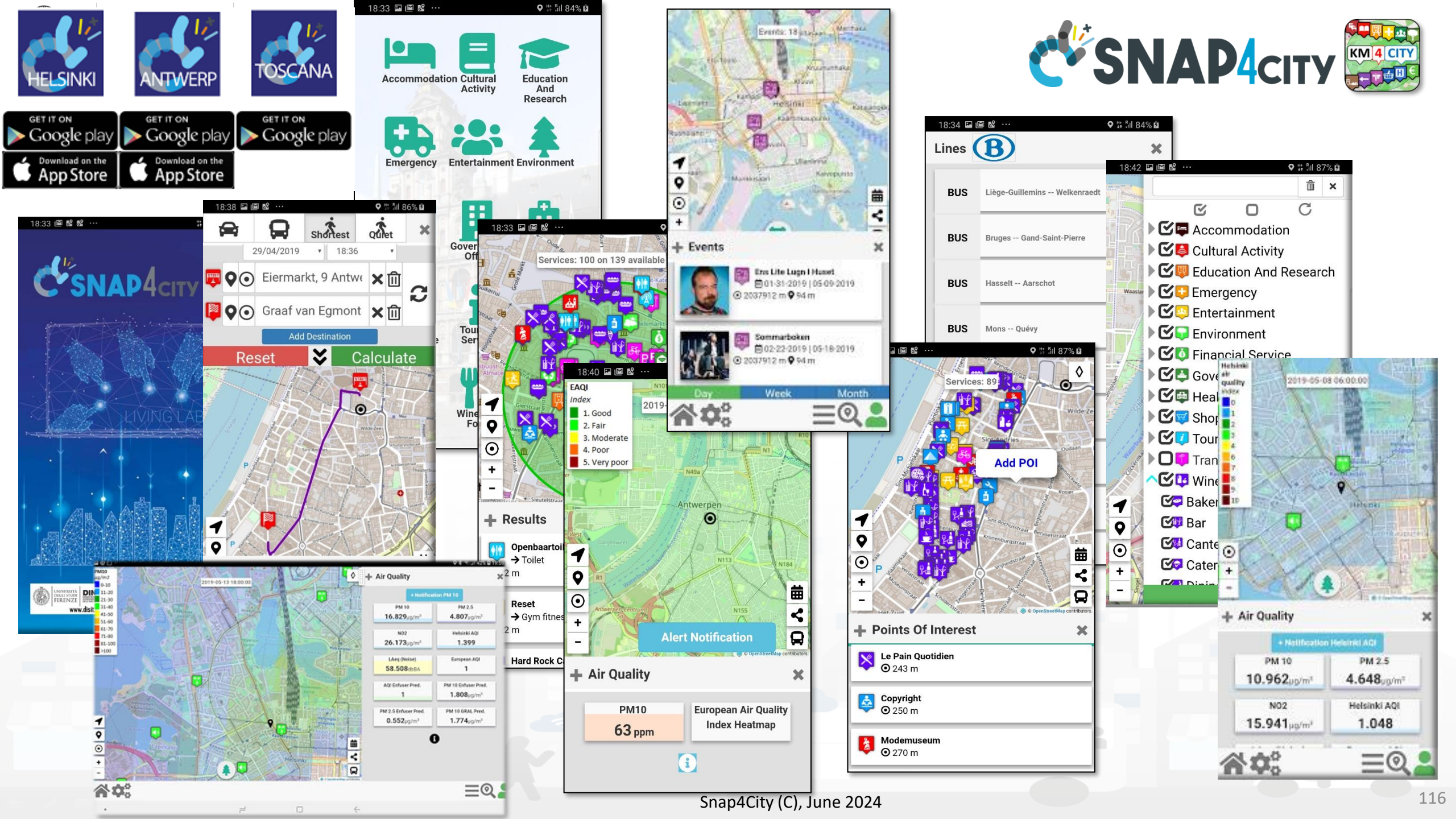
Stimulate / recommend
- Events in the city, services you may be interested, etc..

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

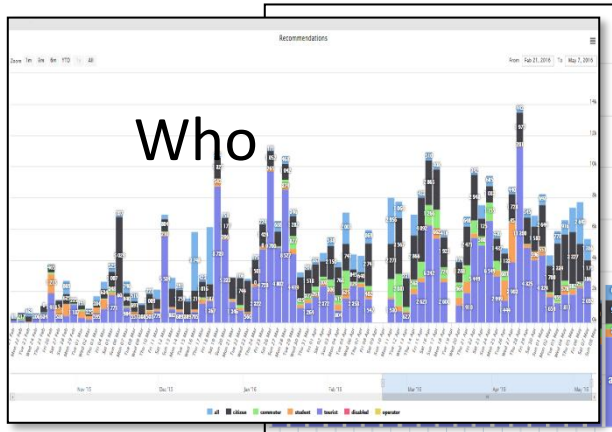
User context

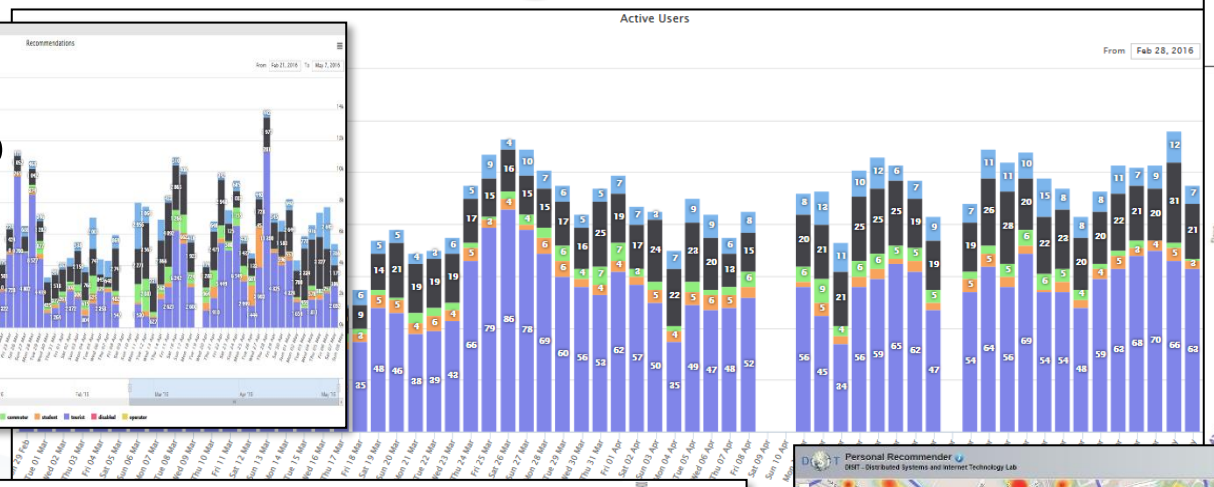
Rules

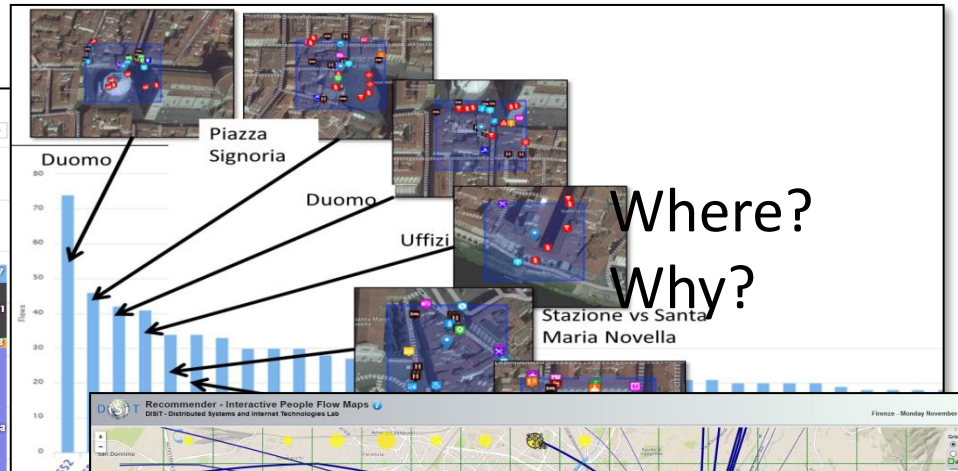
City context

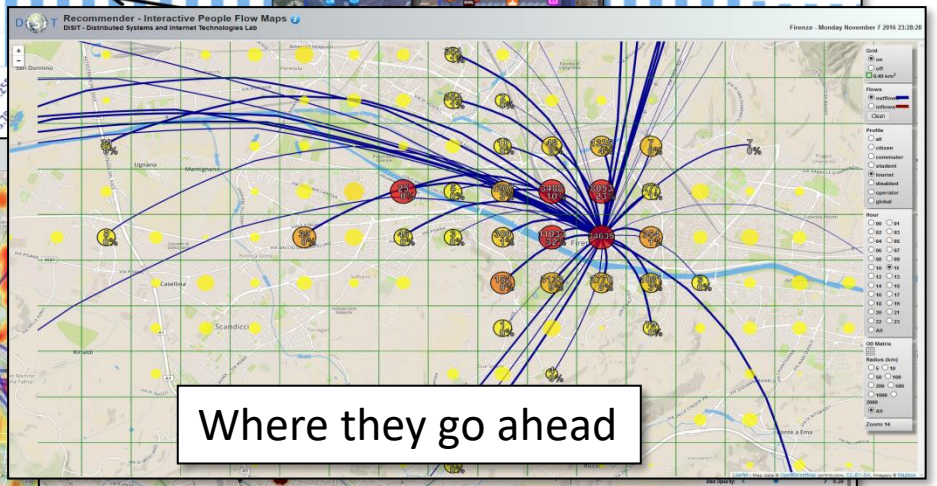

HELSINKI
ANTWERP
TOSCANA
GET IT ON Google play
Download on the App Store
SNAP4CITY
KM 4 CITY
Accommodation
Cultural Activity
Education And Research
Emergency
Entertainment
Environment
Shortest
Quiet
Add Destination
Reset
Calculate
Events
Day
Week
Month
Services: 100 on 139 available
EAQI Index
1. Good
2. Fair
3. Moderate
4. Poor
5. Very poor
Results
Air Quality
PM10
63 ppm
European Air Quality Index Heatmap
Alert Notification
Lines
BUS
Liège-Guillemins -- Welkenraedt
Bruges -- Gand-Saint-Pierre
Hasselt -- Aarschot
Mons -- Quévy
Add POI
Points Of Interest
Le Pain Quotidien
243 m
Copyright
250 m
Modemuseum
270 m
Financial Service
Bar
Air Quality
PM 10
10.962
PM 2.5
4.648
NO2
15.941
Helsinki AQI
1.048

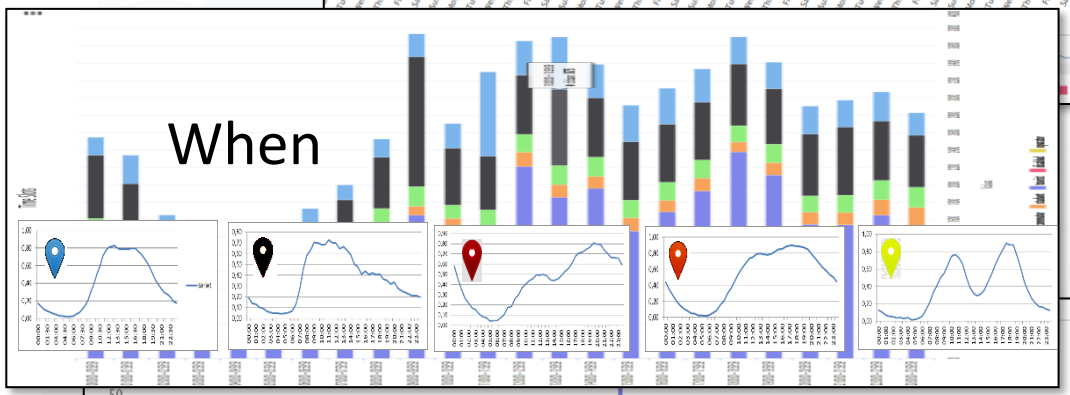
User Behavior Analyser for Collective Profiling

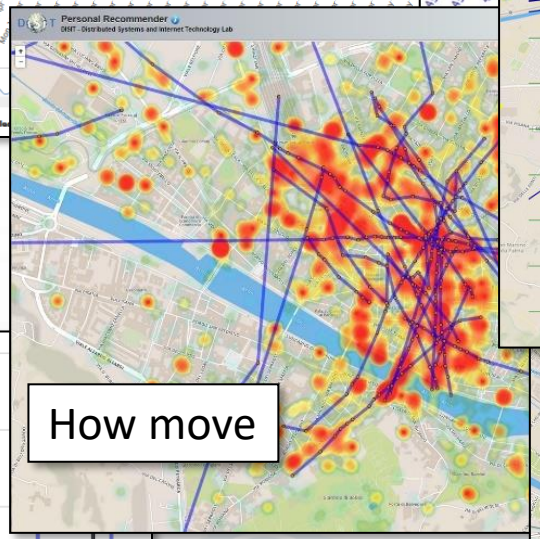


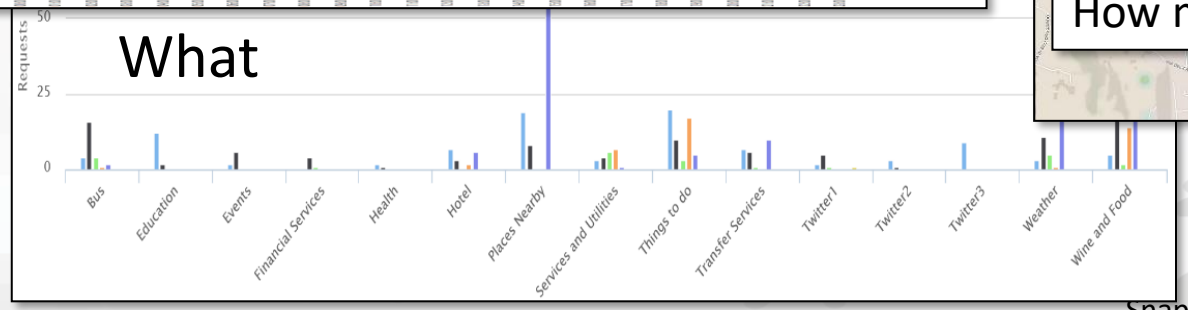


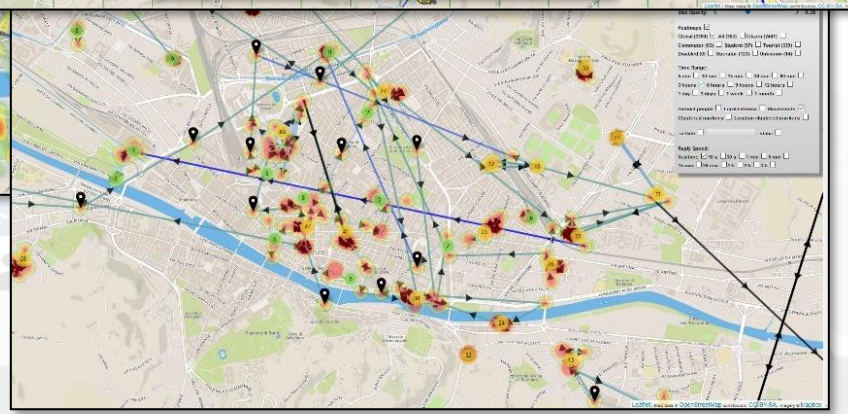








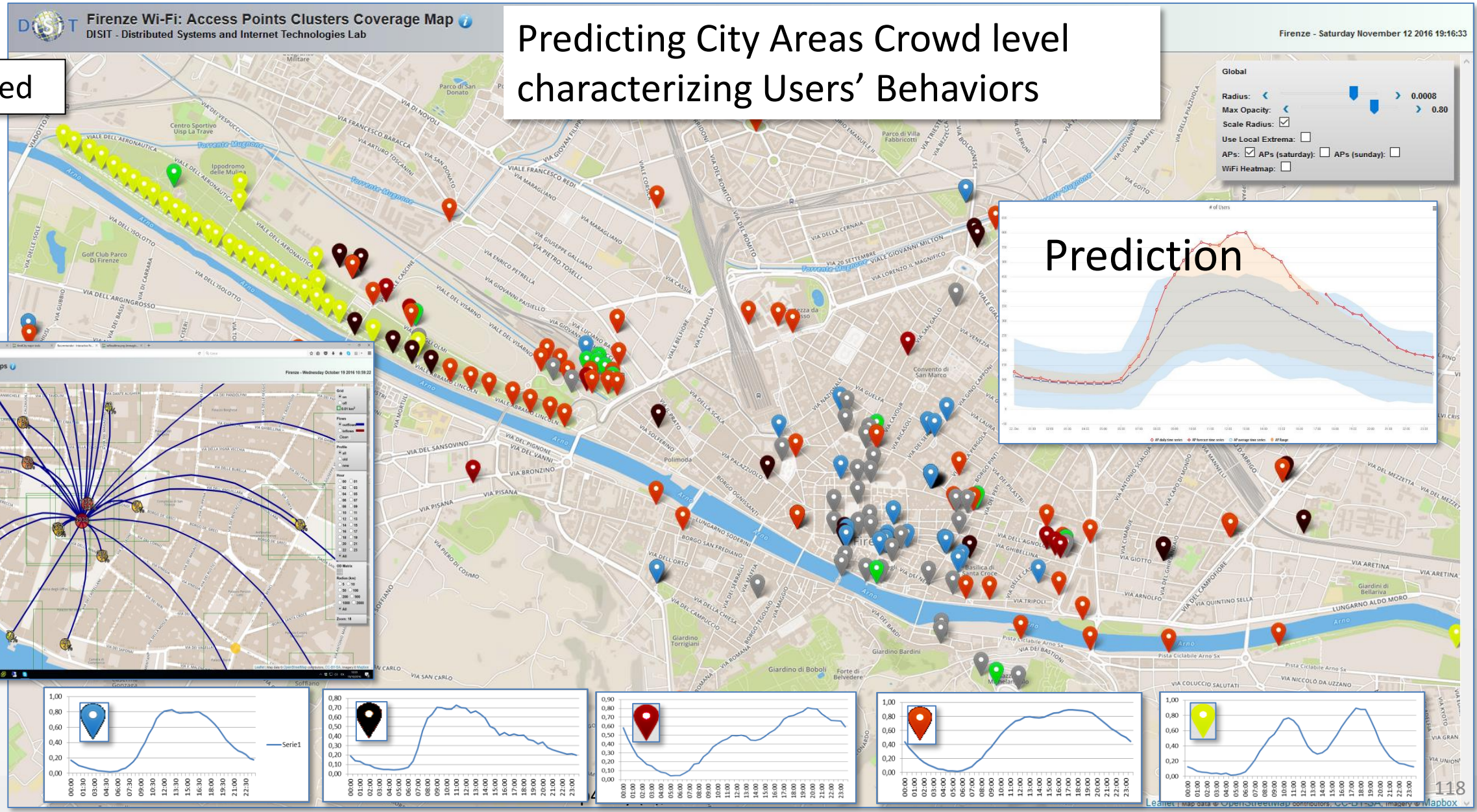




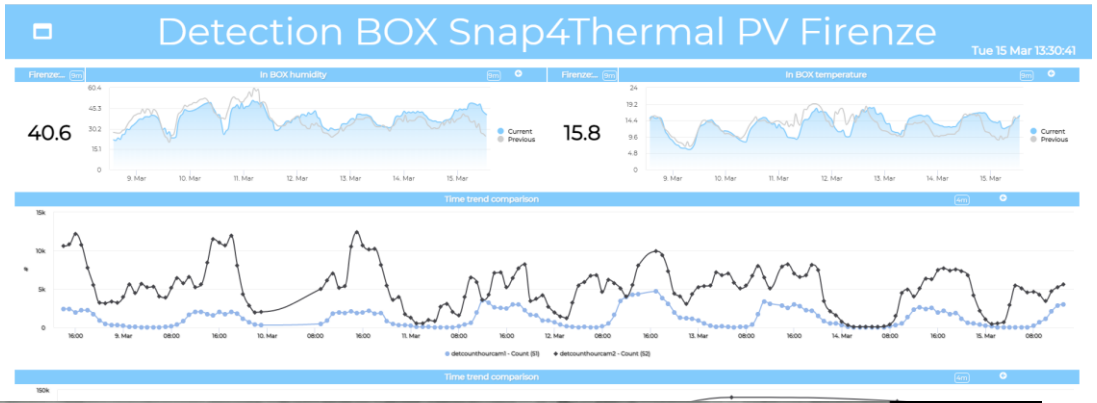
Characterizing City Areas

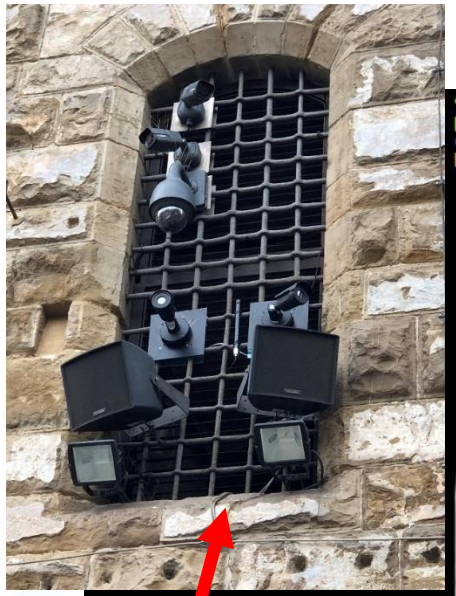
Wi-Fi based

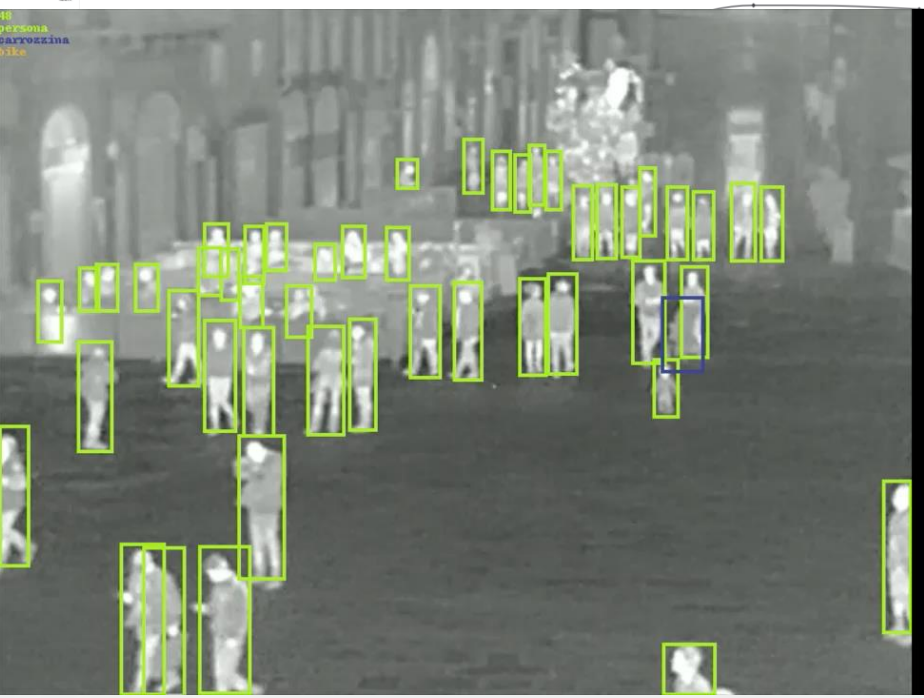
Predicting City Areas Crowd level characterizing Users' Behaviors

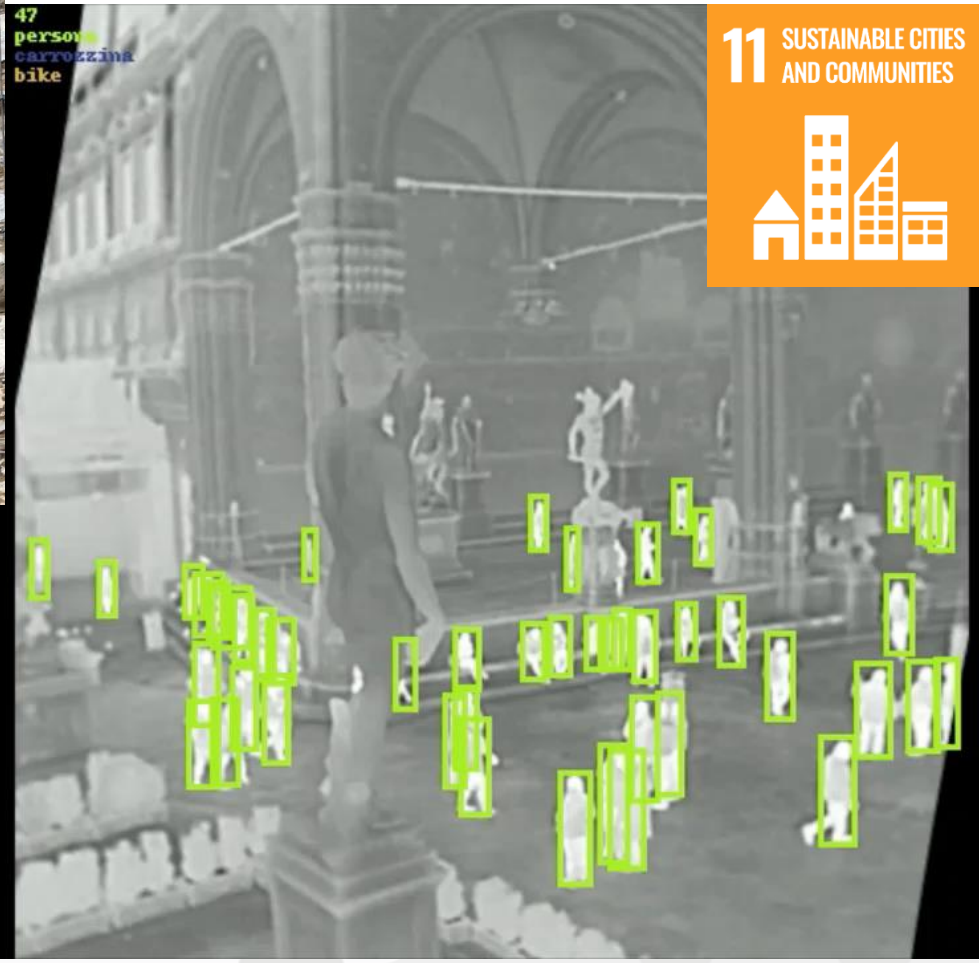


A view and data from the Thermal Camera









11 SUSTAINABLE CITIES AND COMMUNITIES

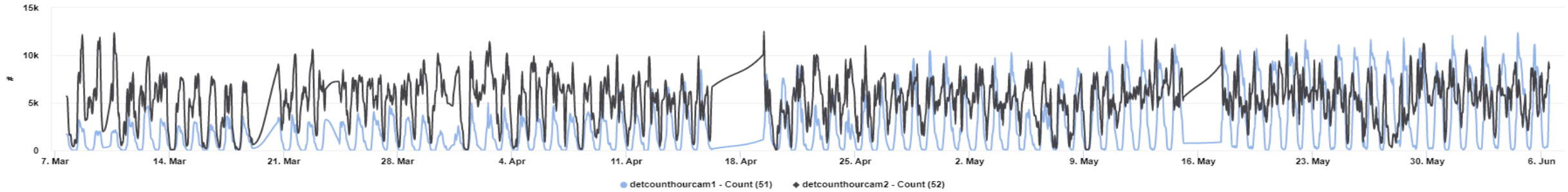
People Counting

https://www.snap4city.org/dashboardSmartCity/view/Gea.php?iddasboard=MzM3Ng==

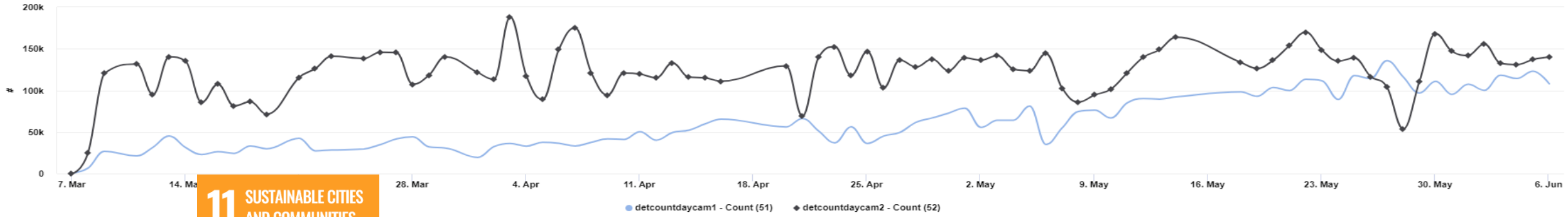
Detection BOX Snap4Thermal PV Firenze

Thu 30 Mar 23:55:16

Time Trend Comparison



Time Trend Comparison



11 SUSTAINABLE CITIES AND COMMUNITIES

My Profile

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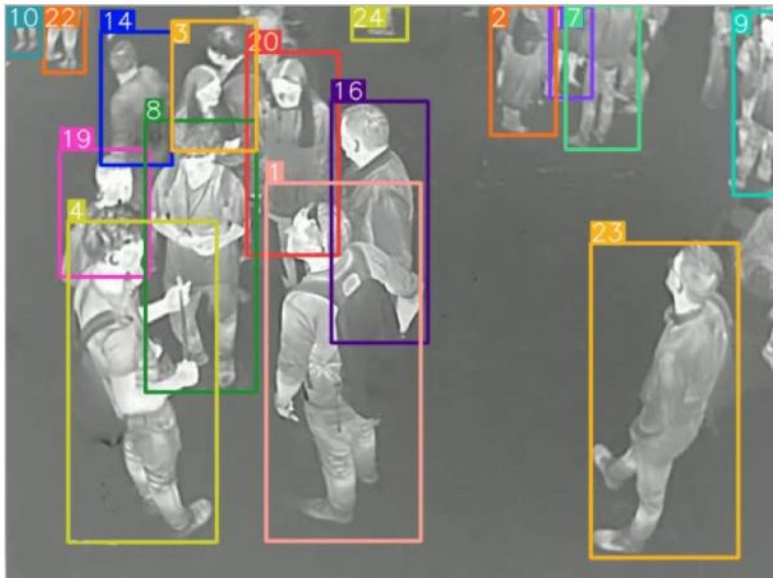
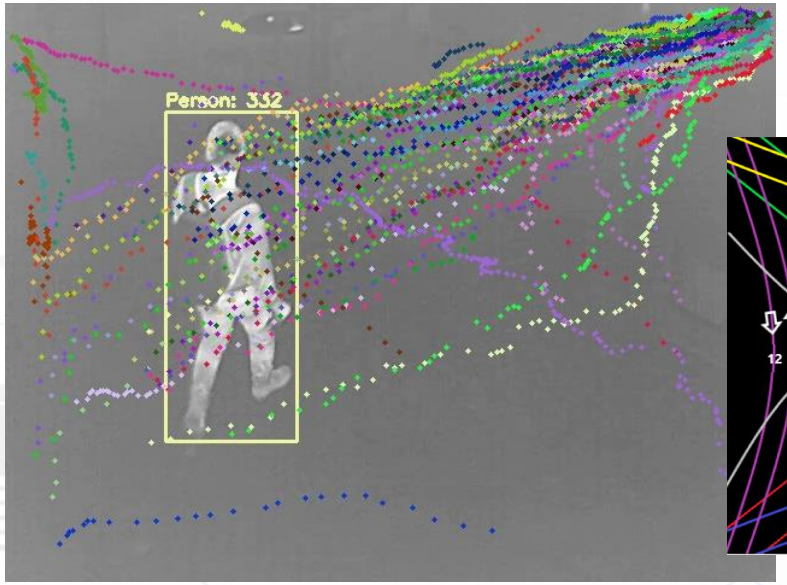
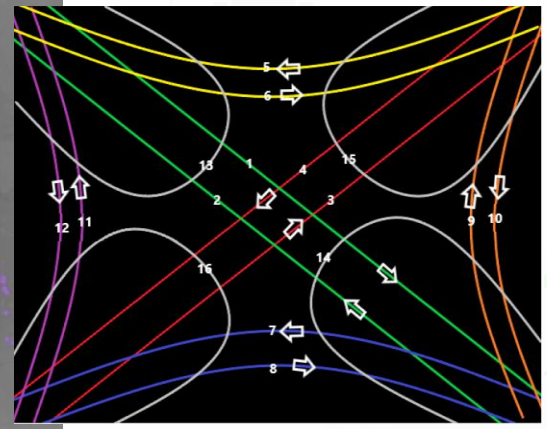
People Counting and Tracking

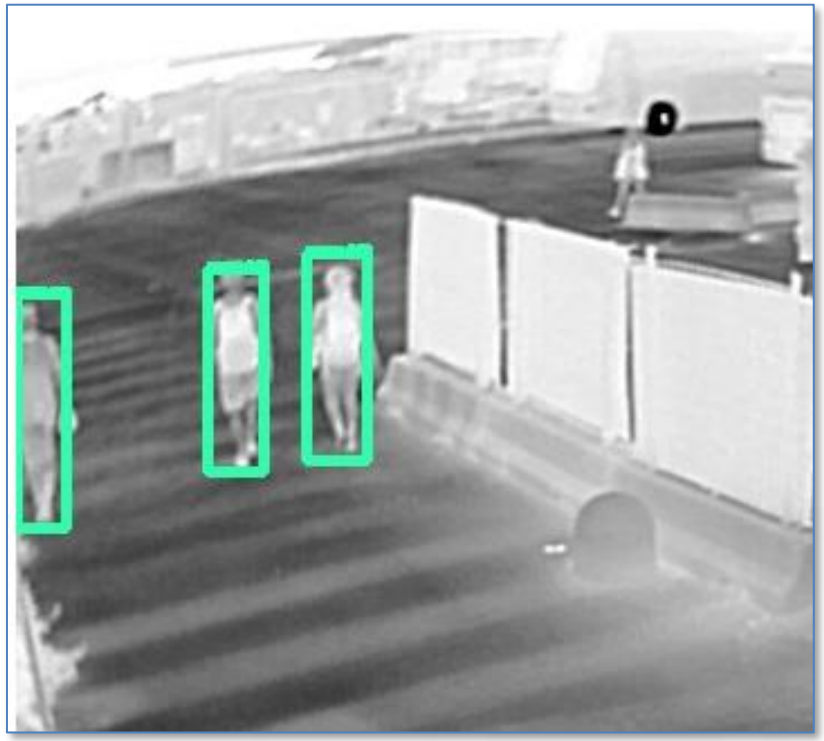






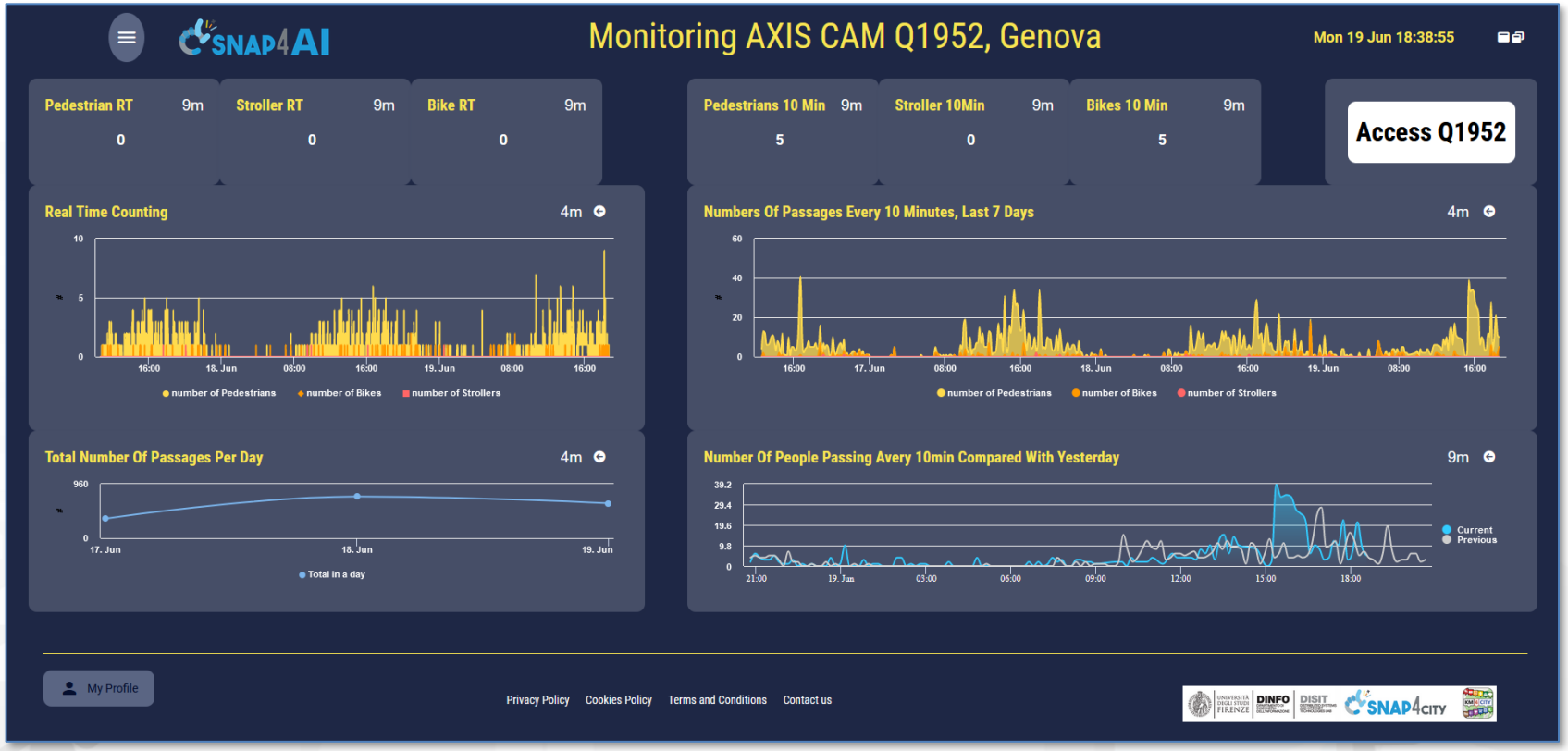
11 SUSTAINABLE CITIES AND COMMUNITIES

3X



Monitoring Passages AXIS Q1952

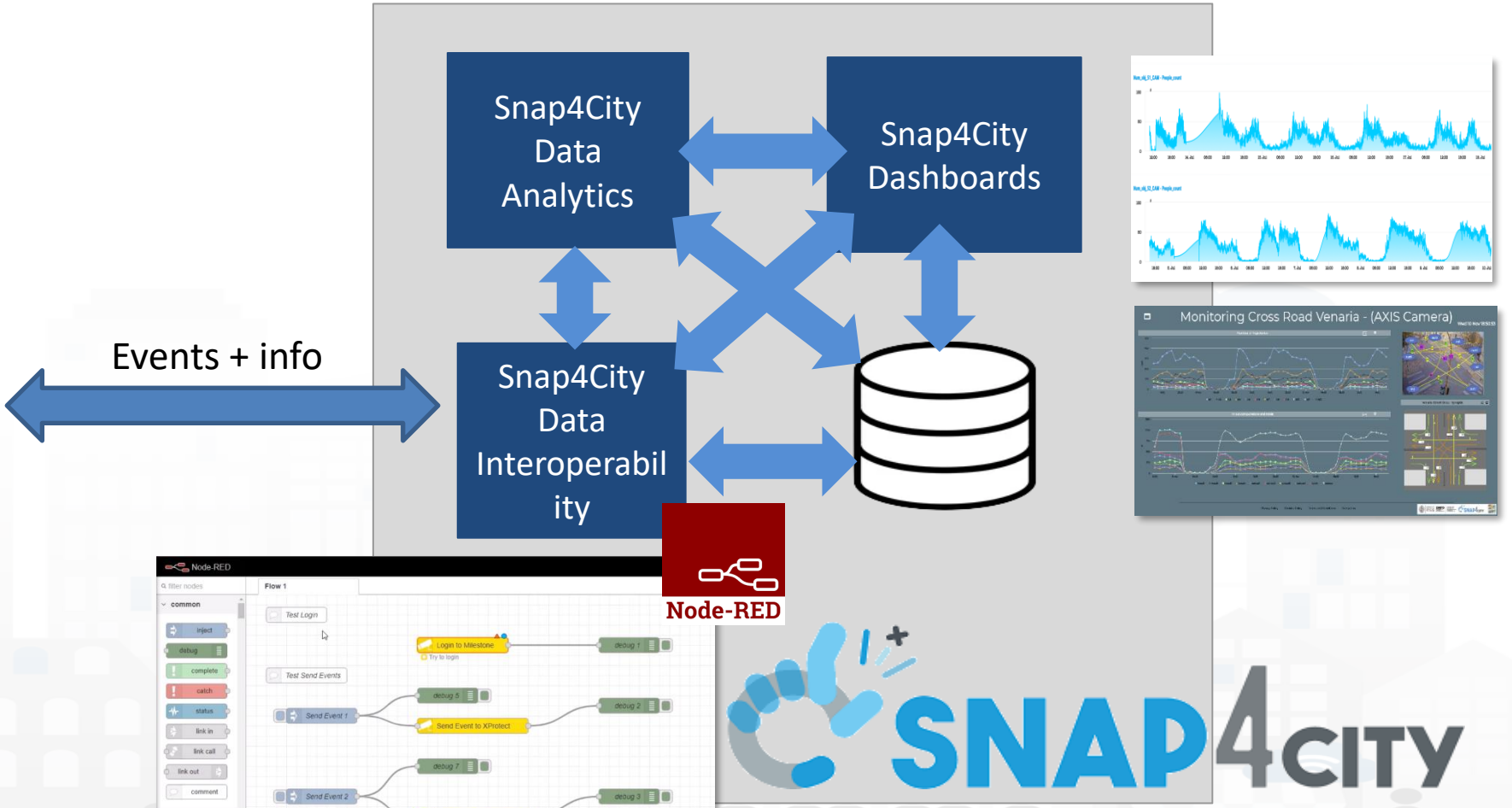
- Genova: Ocean Race, 2023

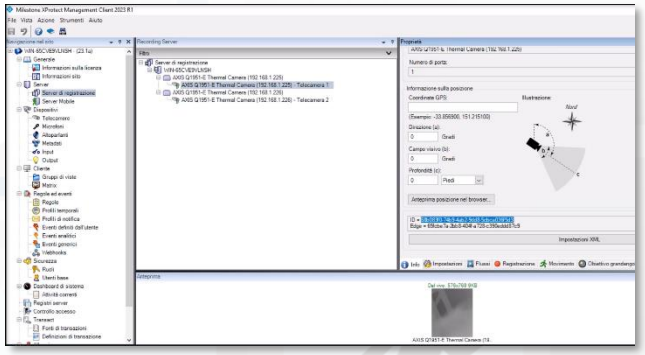


11 SUSTAINABLE CITIES AND COMMUNITIES

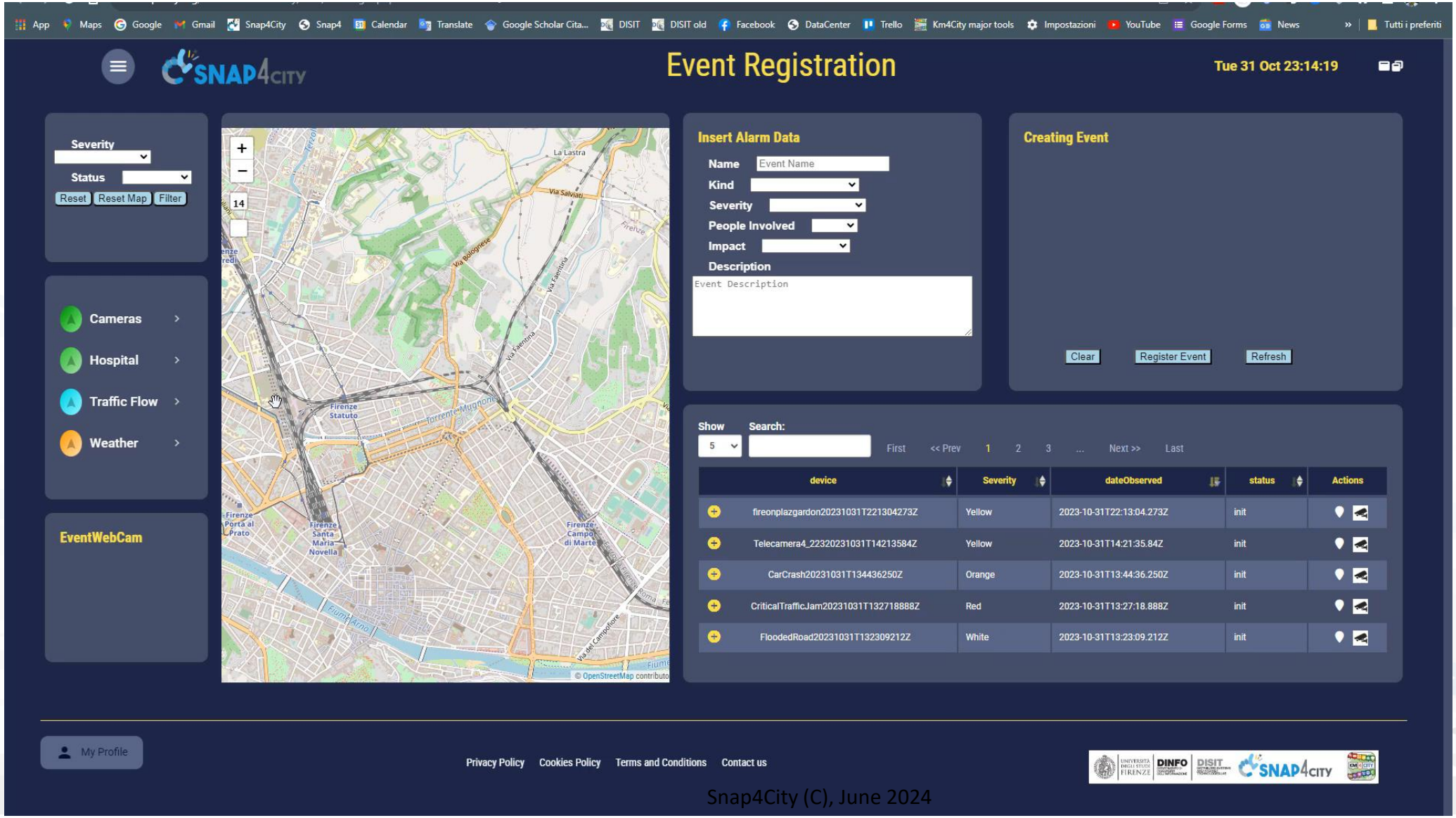
VMS vs Snap4City: sending and getting events, AI solutions

Events + info



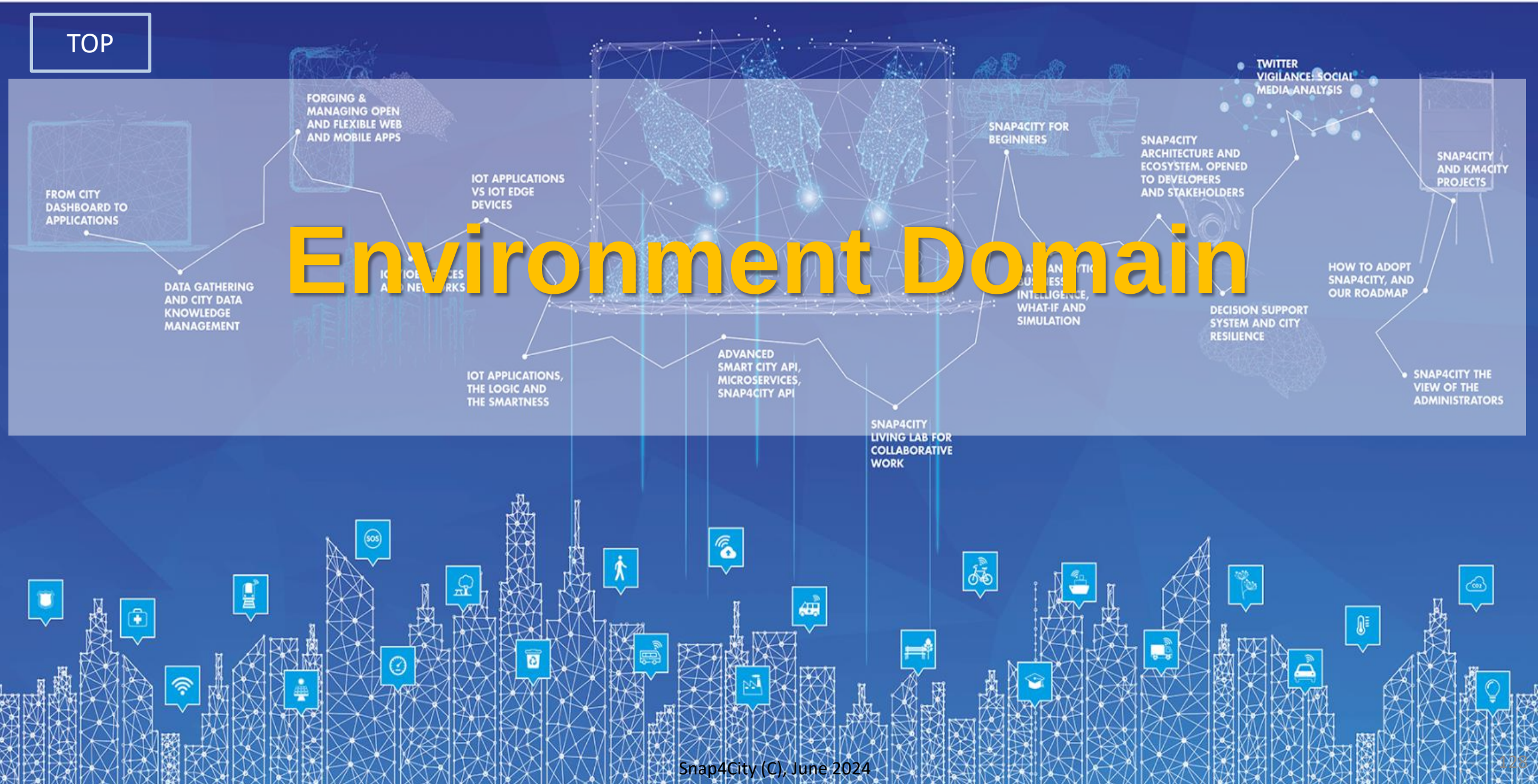


Event Management



TOP

Environment Domain

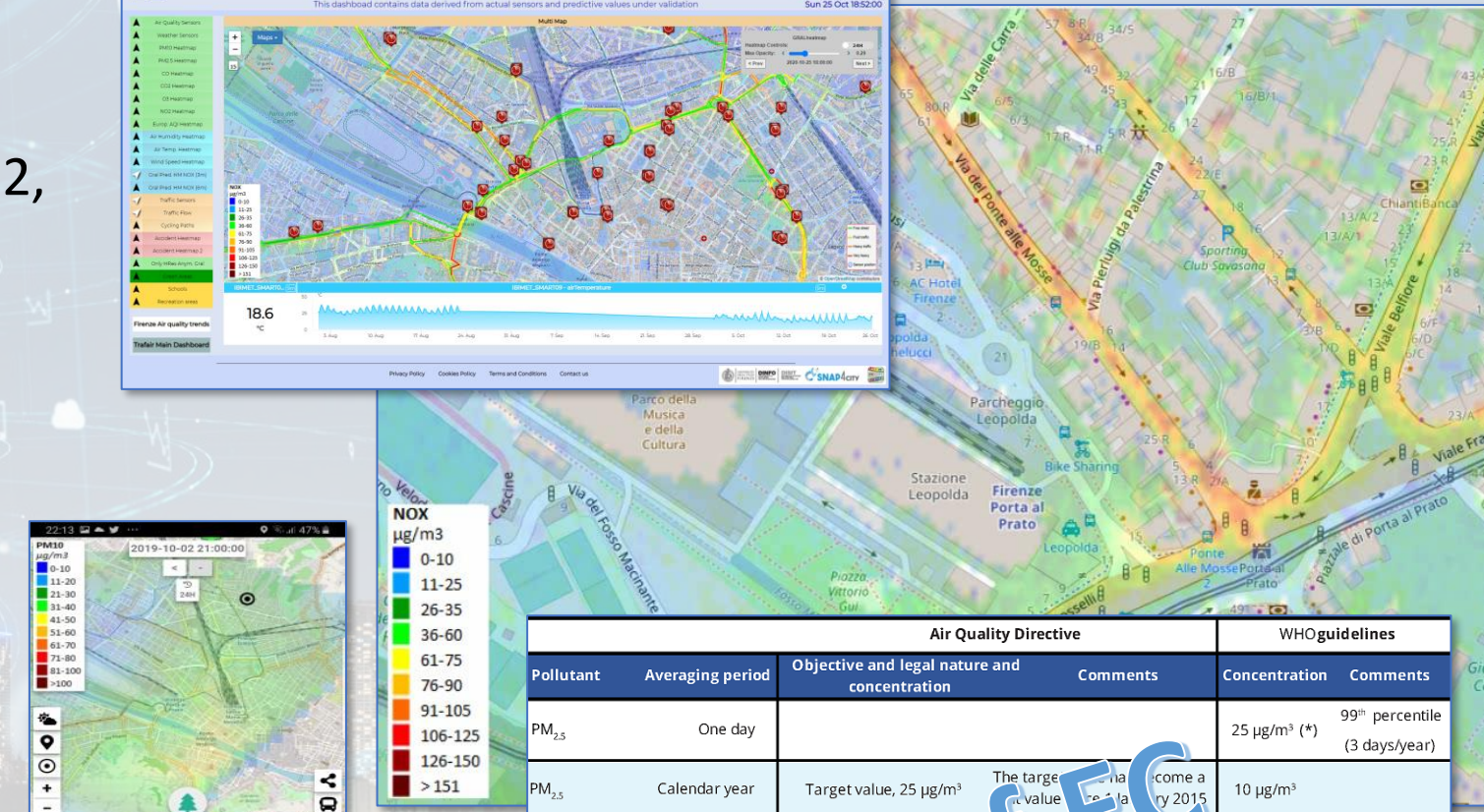


Environment and Quality of Life
Air Quality Predictions

Cities of: Firenze, Pisa, Livorno

reference

- **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**



	Air Quality Directive			WHO guidelines	
Pollutant	Averaging period	Objective and legal nature and concentration	Comments	Concentration	Comments
$PM_{2.5}$	One day			25 µg/m³ (*)	99th percentile (3 days/year)
$PM_{2.5}$	Calendar year	Target value, 25 µg/m³	The targe… …come a …value …ry 2015	10 µg/m³	
PM_{10}	One day	Limit …e, 50 µ…	…t to be e…ed on more …han 35 d…s per year.	50 µg/m³ (*)	99th percentile (3 days/year)
PM_{10}	Calend…	…t va… 40 µg/m… (*)		20 µg/m³	
O_3	Maximum …ly 8-hour m…n	Target value, 120 µg/m³	Not to be exceeded on more than 25 days per year, averaged over three years	100 µg/m³	
NO_2	One hour	Limit value, 200 µg/m³ (*)	Not to be exceeded more than 18 times a calendar year	200 µg/m³ (*)	
NO_2	Calendar year	Limit value, 40 µg/m³		40 µg/m³	

KPI of EC

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

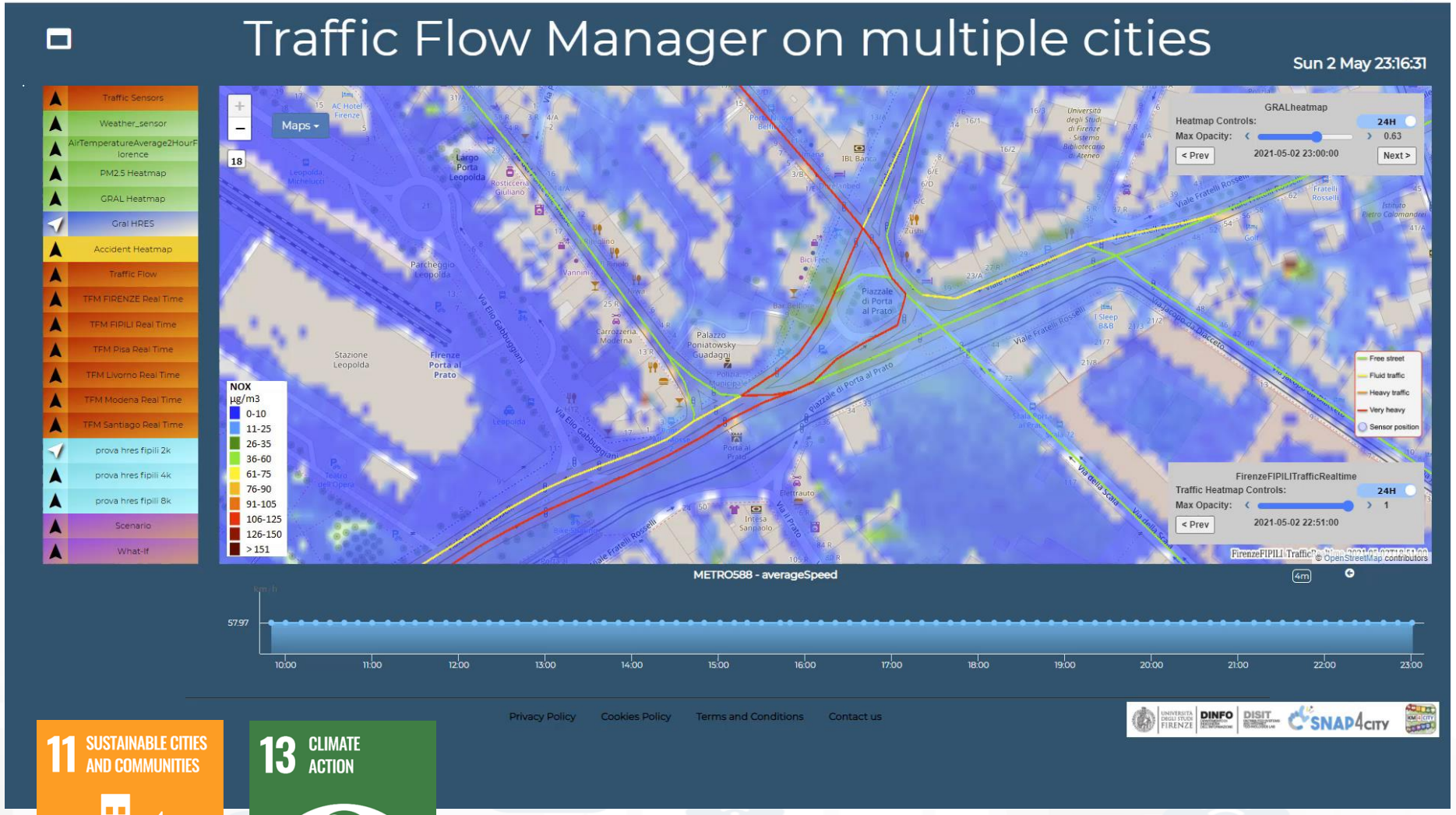
- Goals:
  - Reduction of pollutant emissions and EC taxations
  - Cost Reduction for waste collection, reduction of waste collection impact on mobility
- Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)
  - Monitoring emissions, weather, waste, water, etc.: 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: CO2, NO2, 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 CO2/NO2 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)

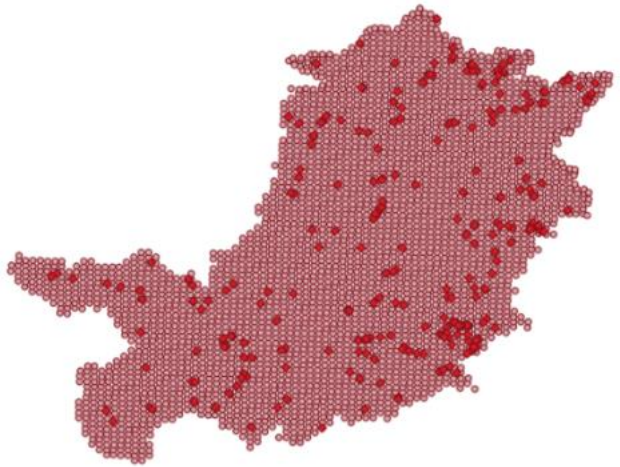
- **Pollutant Predictions: short, long and very long term** European Commission KPIs
  - NOX, PM10 pollution on the basis of traffic flow, 48 hours (ML, AI, DL)
  - Cumulated NO2 average value over the year, ……. (ML, AI, DL)
- **Computation of CO2** on the basis of traffic flows (DP), computing emission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

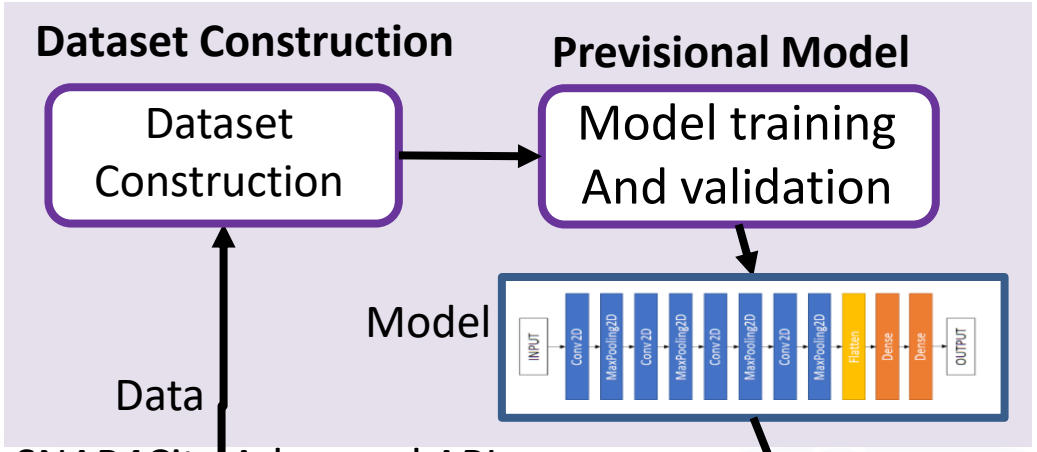
Environment

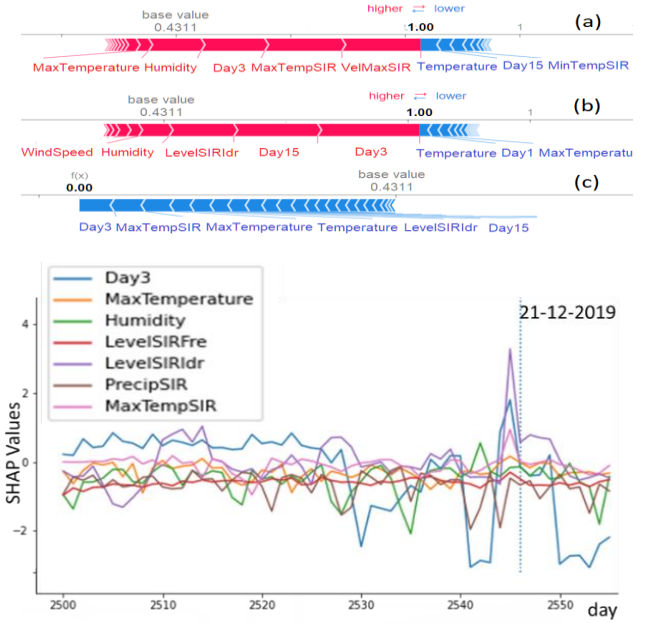
- **Prediction**
  - **NOX Pollutant** diffusion on the basis of Traffic Flow (prediction), weather and 3D structure
  - **NO2 progressive average** (Long term)
- **Project:**
  - **Trafair** CEF EC
  - Mixed solutions of Fluidinamics modeling and AI

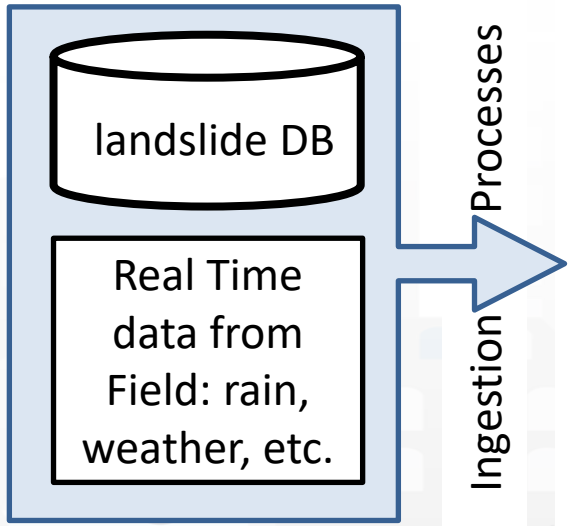


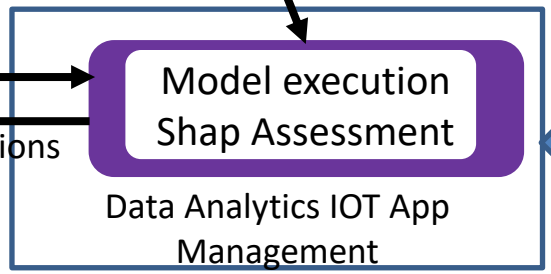
Predicting Land slides

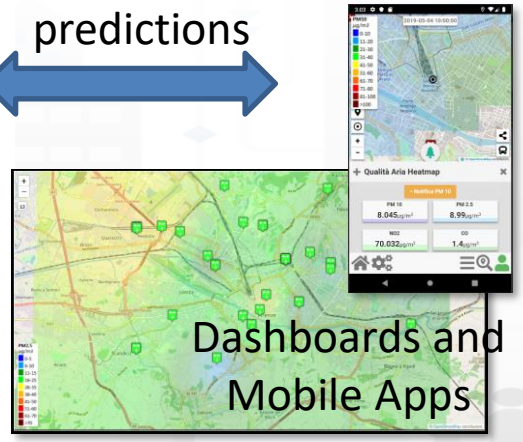








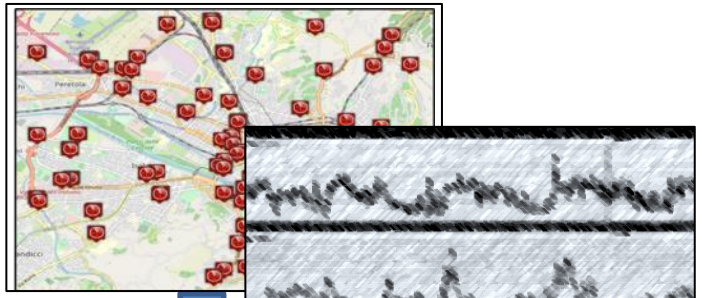




Snap4City Servers and Tools: Dashboard manager, Heatmap manager, GeoServer, Smart City API.

E. Collini, L. A. I. Palesi, P. Nesi, G. Pantaleo, N. Nocentini and A. Rosi, "Predicting and Understanding Landslide Events with Explainable AI," in *IEEE Access*, doi: 10.1109/ACCESS.2022.3158328.
https://ieeexplore.ieee.org/abstract/document/9732490

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

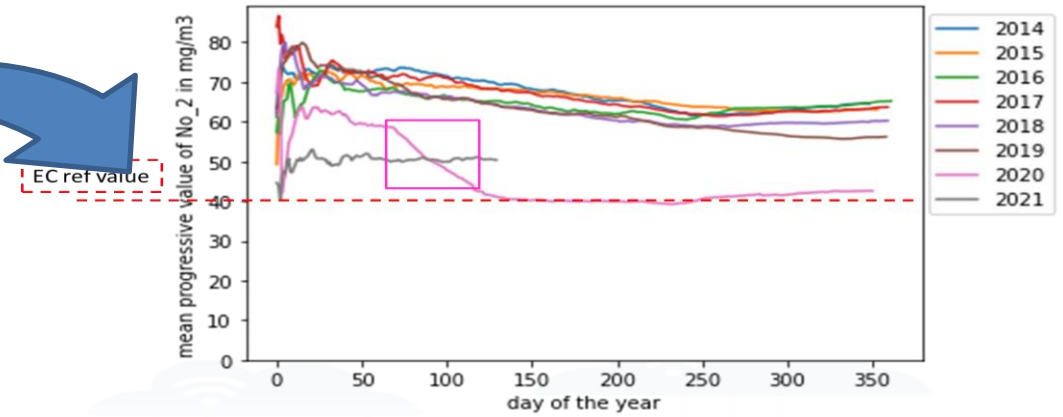
Computing CO2 on the basis of traffic flow data

CO2 estimation

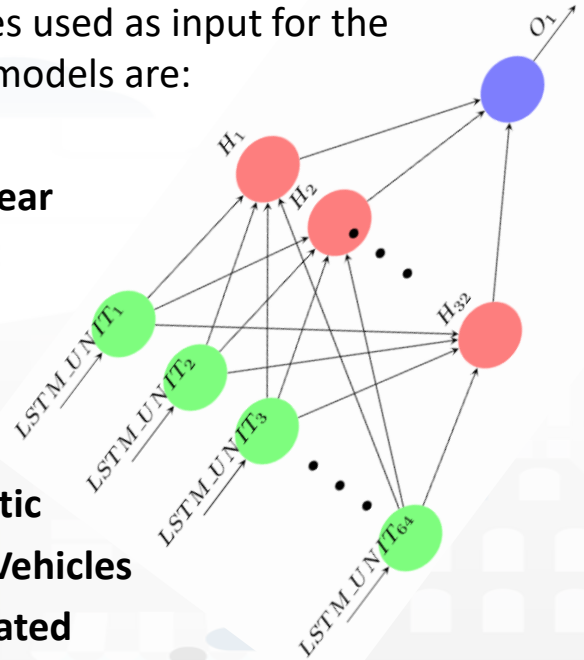
S. Bilotta, P. Nesi, "Estimating CO2 Emissions from IoT Traffic Flow Sensors and Reconstruction", Sensors, MDPI, 2022. https://www.mdpi.com/1424-8220/22/9/3382/

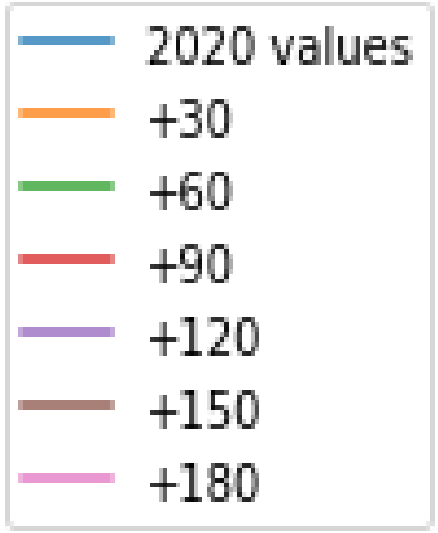
Predicting EC's KPI on NO2 months in advance

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**





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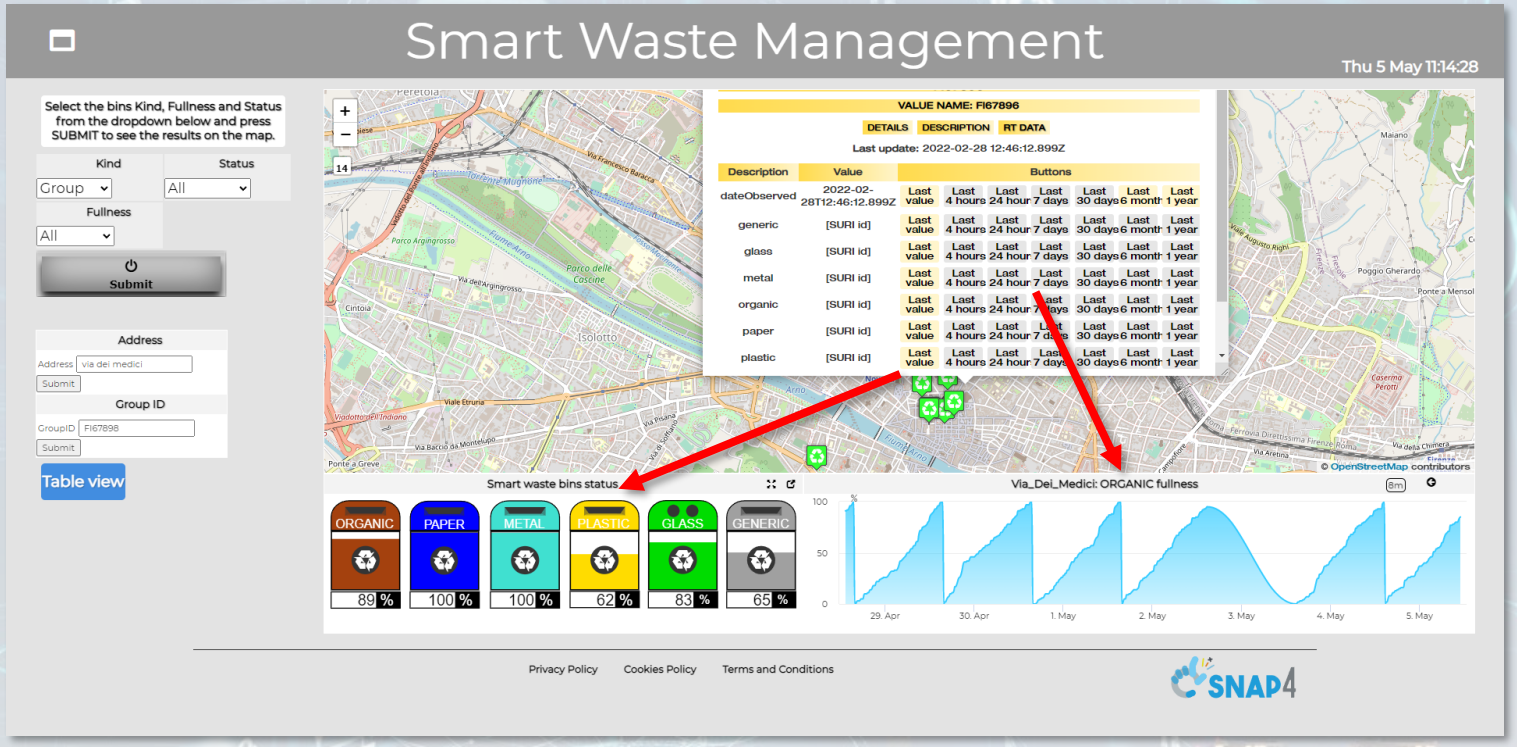
$PM_{2.5}$	Calendar year	Target value, 25 µg/m³	The target value has become a limit value since 1 January 2015	10 µg/m³	
PM_{10}	One day	Limit value, 50 µg/m³	Not to be exceeded on more than 35 days per year.	50 µg/m³ (*)	99th percentile (3 days/year)
PM_{10}	Calendar year	Limit value, 40 µg/m³ (*)		20 µg/m³	
O_3	Maximum daily 8-hour mean	Target value, 120 µg/m³	Not to be exceeded on more than 25 days per year, averaged over three years	100 µg/m³	
NO_2	One hour	Limit value, 200 µg/m³ (*)	Not to be exceeded more than 18 times a calendar year	200 µg/m³ (*)	
NO_2	Calendar year	Limit value, 40 µg/m³		40 µg/m³	

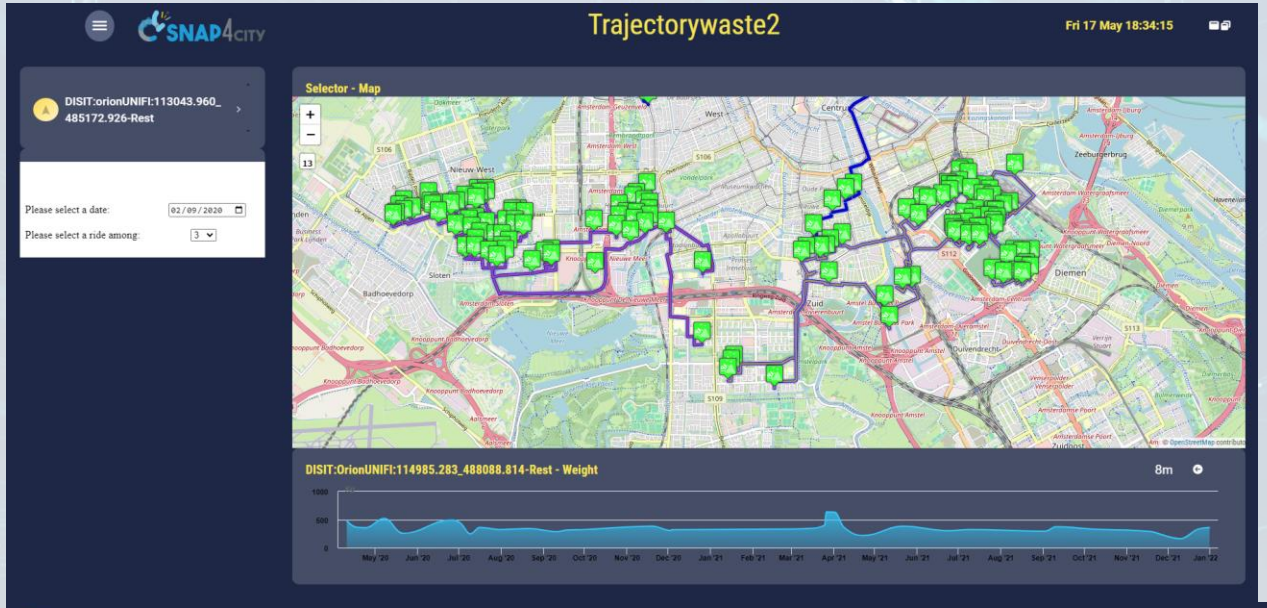
Smart Waste – Map view

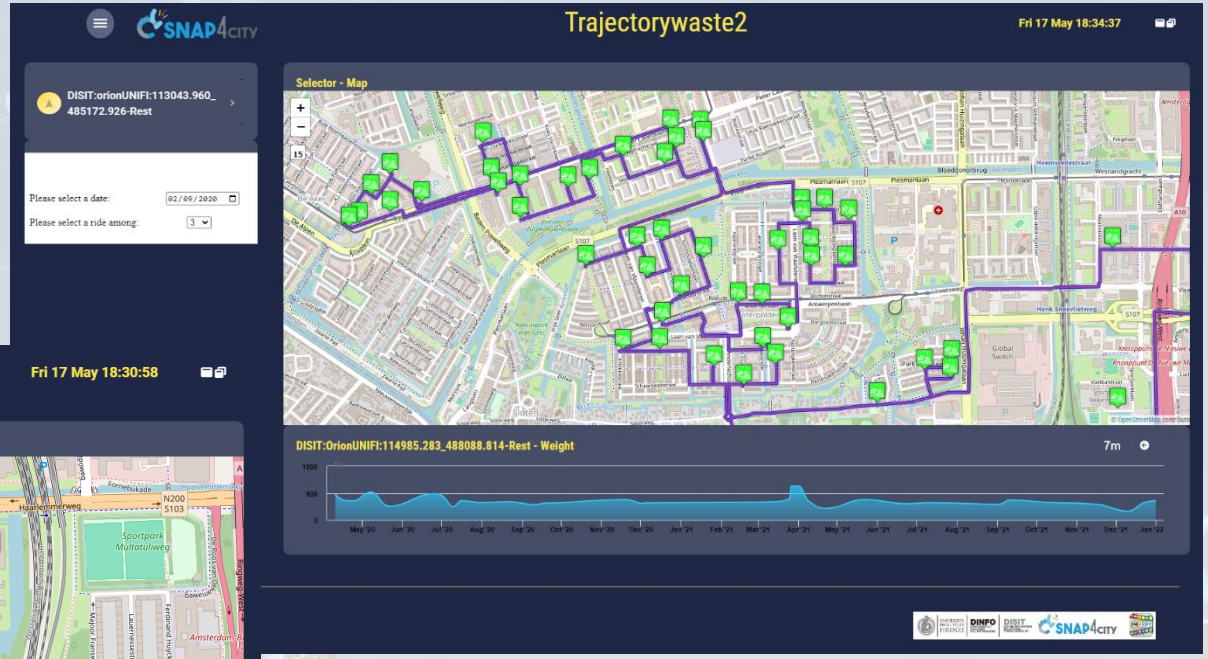


Search bins on map by filtering per:

- **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
  - Chick on the «Table view» button to access the other dashboard


Trajectorywaste2
Fri 17 May 18:34:15
DISIT:orionUNIFI:113043.960_485172.926-Rest
Please select a date:
02/09/2020
Please select a ride among:
3
Selector - Map
DISIT:OrionUNIFI:114985.283_488088.814-Rest - Weight
8m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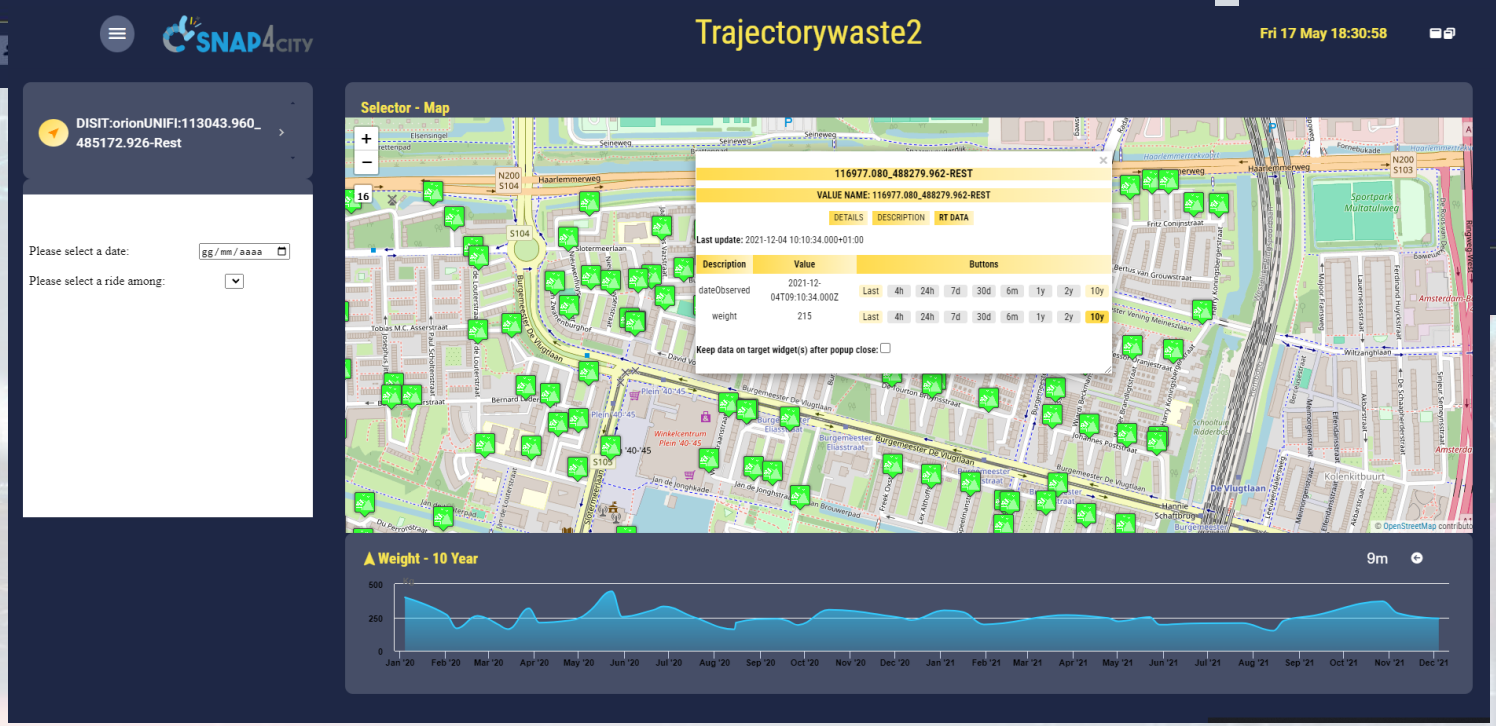
Please select a ride among:
3
Selector - Map
DISIT:OrionUNIFI:114985.283_488088.814-Rest - Weight
7m


Trajectorywaste2
Fri 17 May 18:30:58
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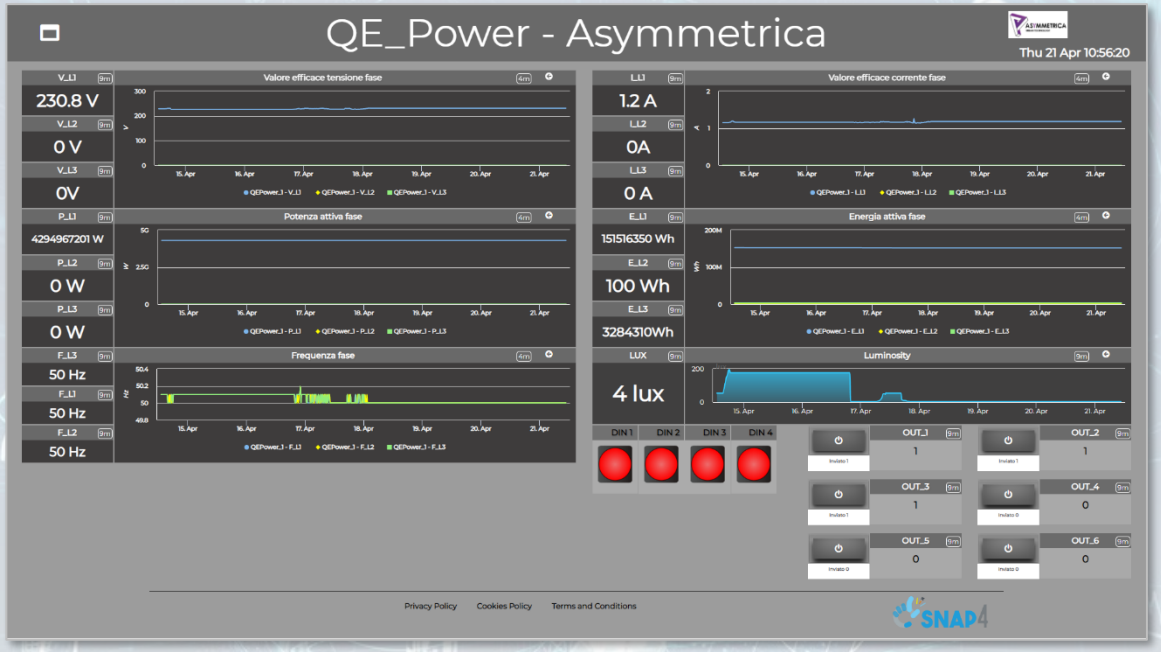
Please select a date:
gg/mm/aaaa
Please select a ride among:
Selector - Map
116977.080_488279.962-REST
VALUE NAME: 116977.080_488279.962-REST
DETAILS
DESCRIPTION
RT DATA
Last update: 2021-12-04 10:10:34.000+01:00
Description
Value
Buttons
dateObserved
2021-12-04T09:10:34.000Z
weight
215
Keep data on target widget(s) after popup close:
Weight - 10 Year
9m


11
SUSTAINABLE CITIES AND COMMUNITIES


3
GOOD HEALTH AND WELL-BEING



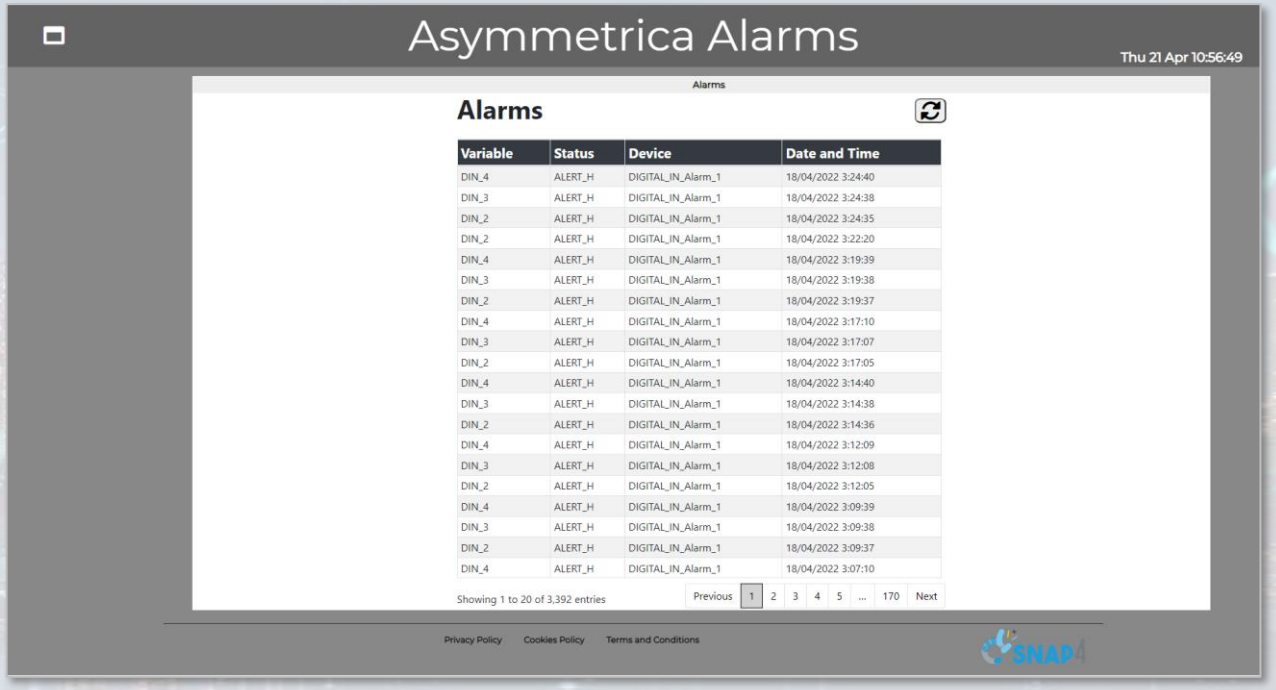
ASYMMETRICA
URBAN TECHNOLOGY

SNAP4

7 AFFORDABLE AND CLEAN ENERGY

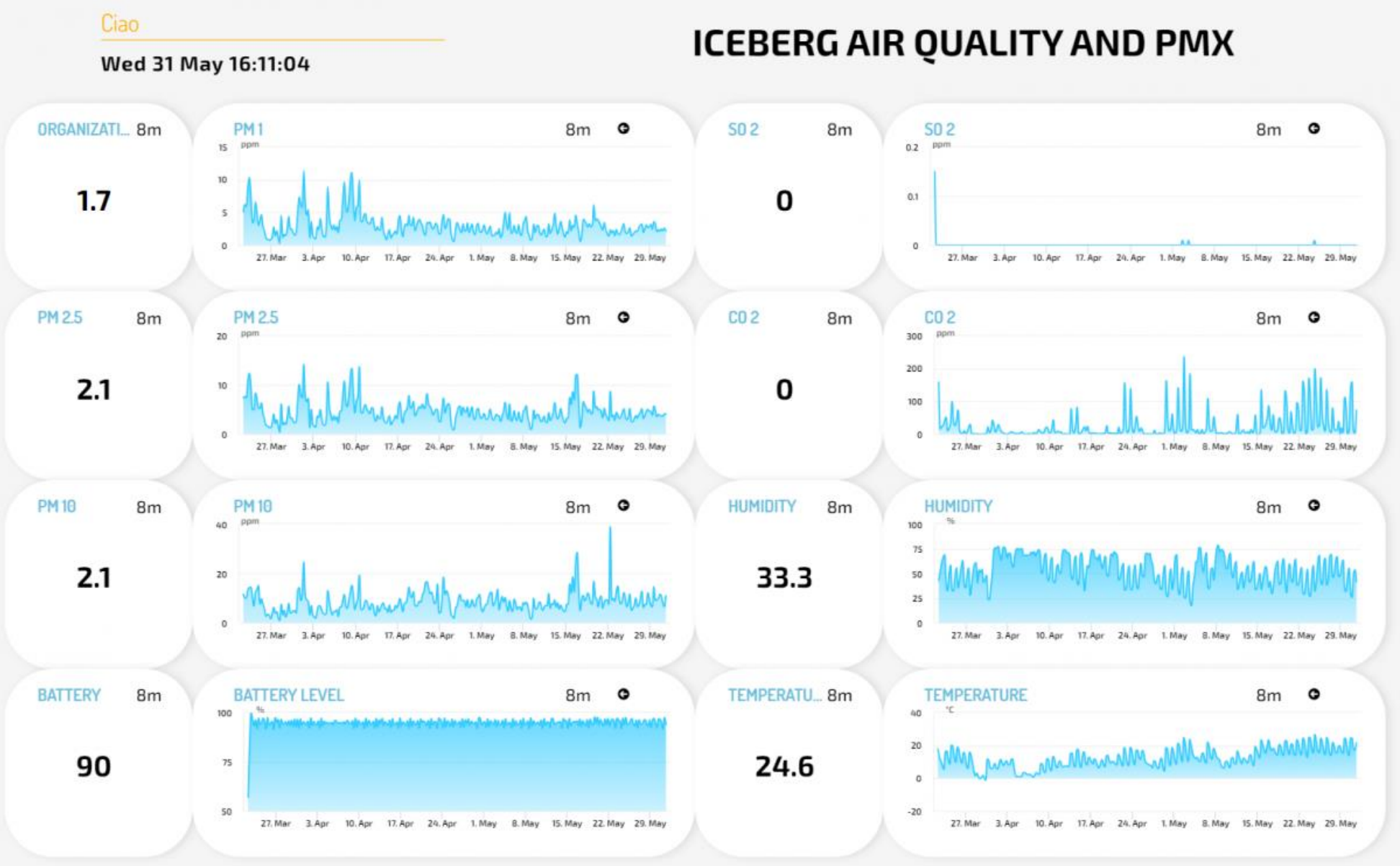
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

13 CLIMATE ACTION



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

TheLab.City LivingLab by ICEBERG, Romania

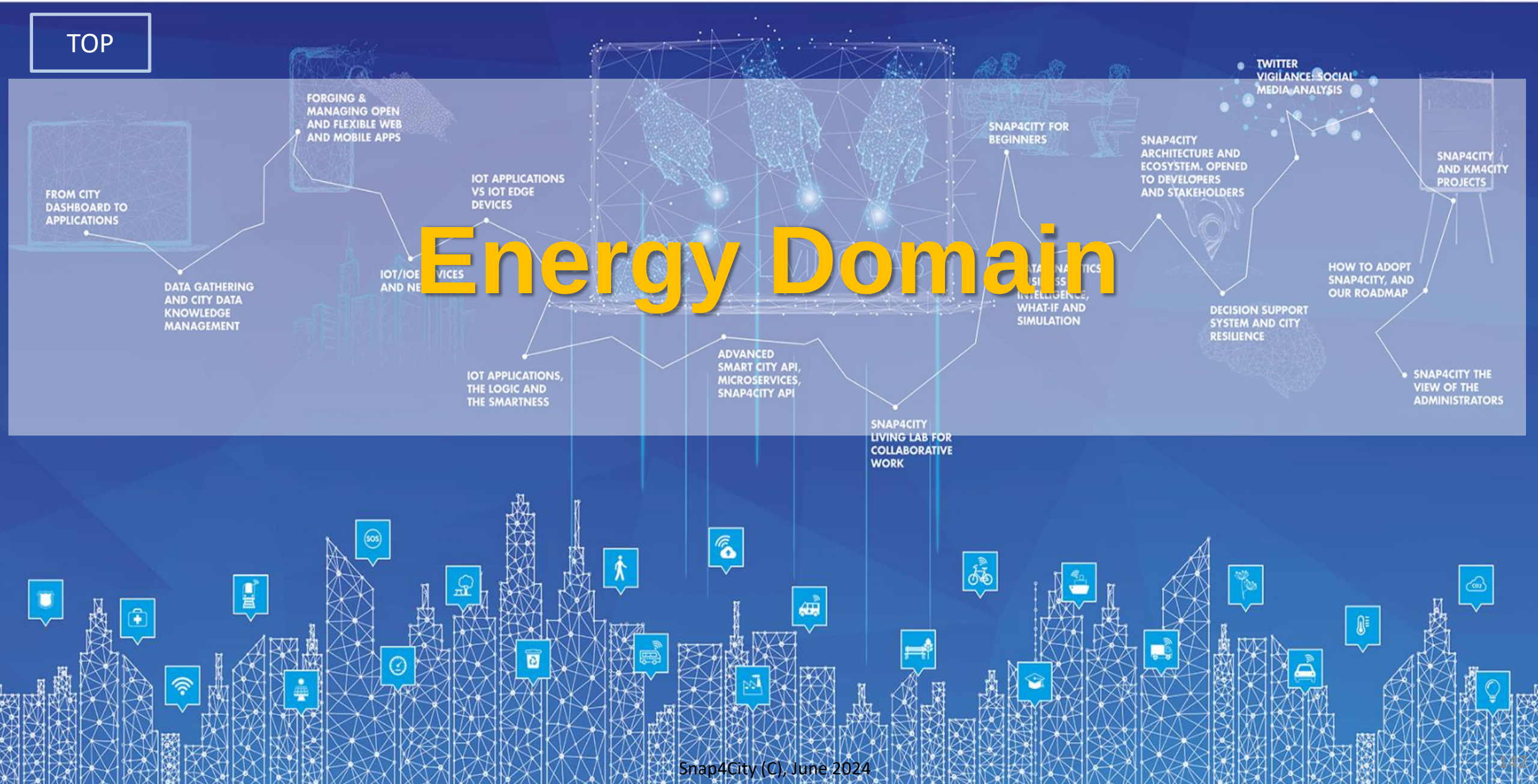


- Airquality
- Urban planning
- Parking
- Waste
- Etc.

https://thelab.city/

TOP

Energy Domain



Energy Domain (2024)

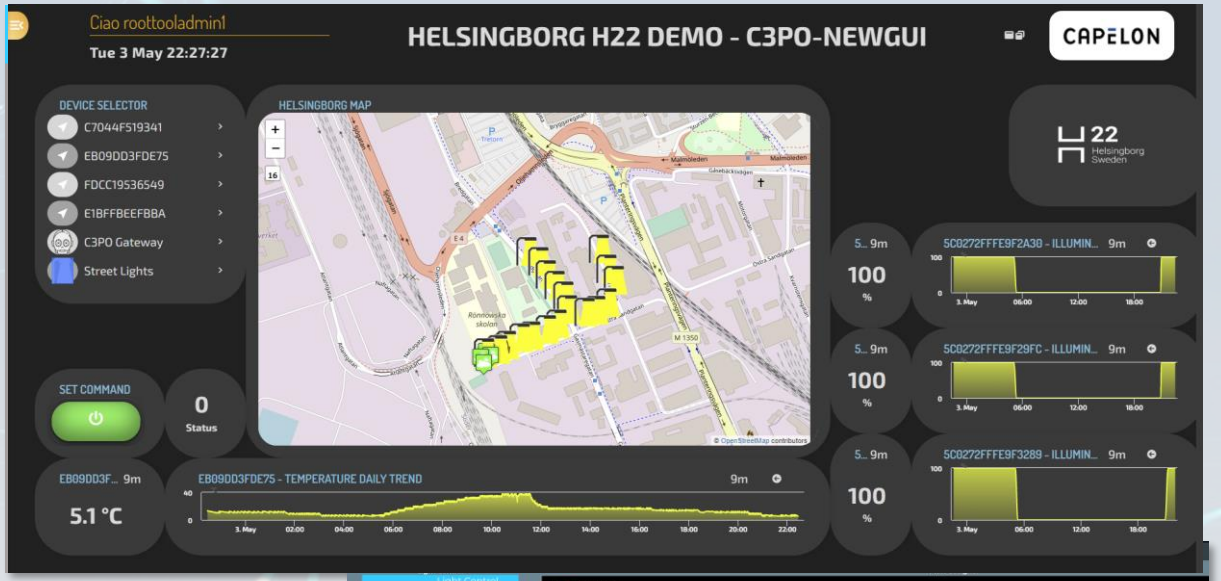
- Goals:
  - Efficiency, costs
  - Accessibility to services
- Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)
  - Monitoring energy consumption (heating, cooling, prod.,..), conditions, charging stations, etc.
  - Managing Smart Light for city: dimering, 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

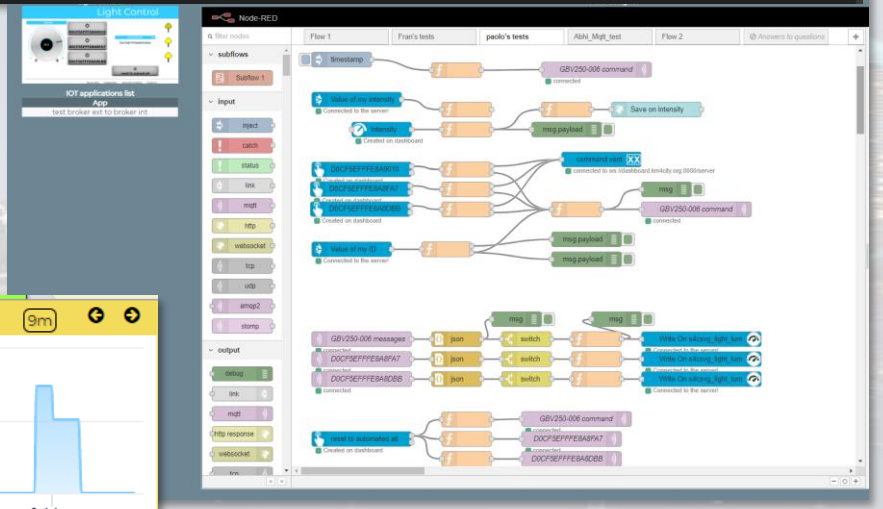
Tools: Energy Domain (2024)

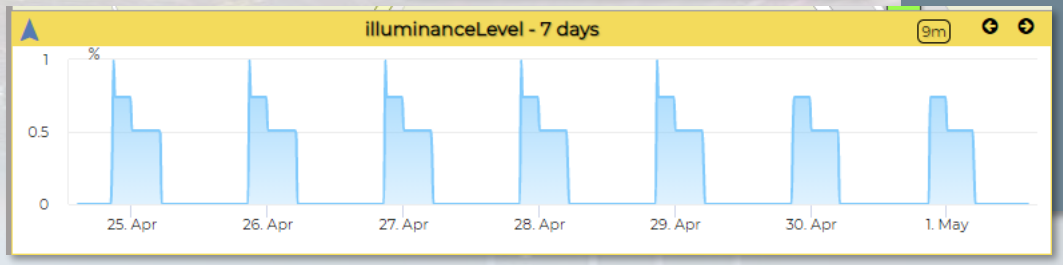
- Monitoring Energy Consumption in single building, area and per zone
- Matching Energy consumption with respect to the actual usage
- Computing Roof orientation for Photovoltaic installations
- Optimisation of Photovoltaicc installations to identify the best parameters of size and storage
- Smart Light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

Smart Light Control of CAPELON *reference*

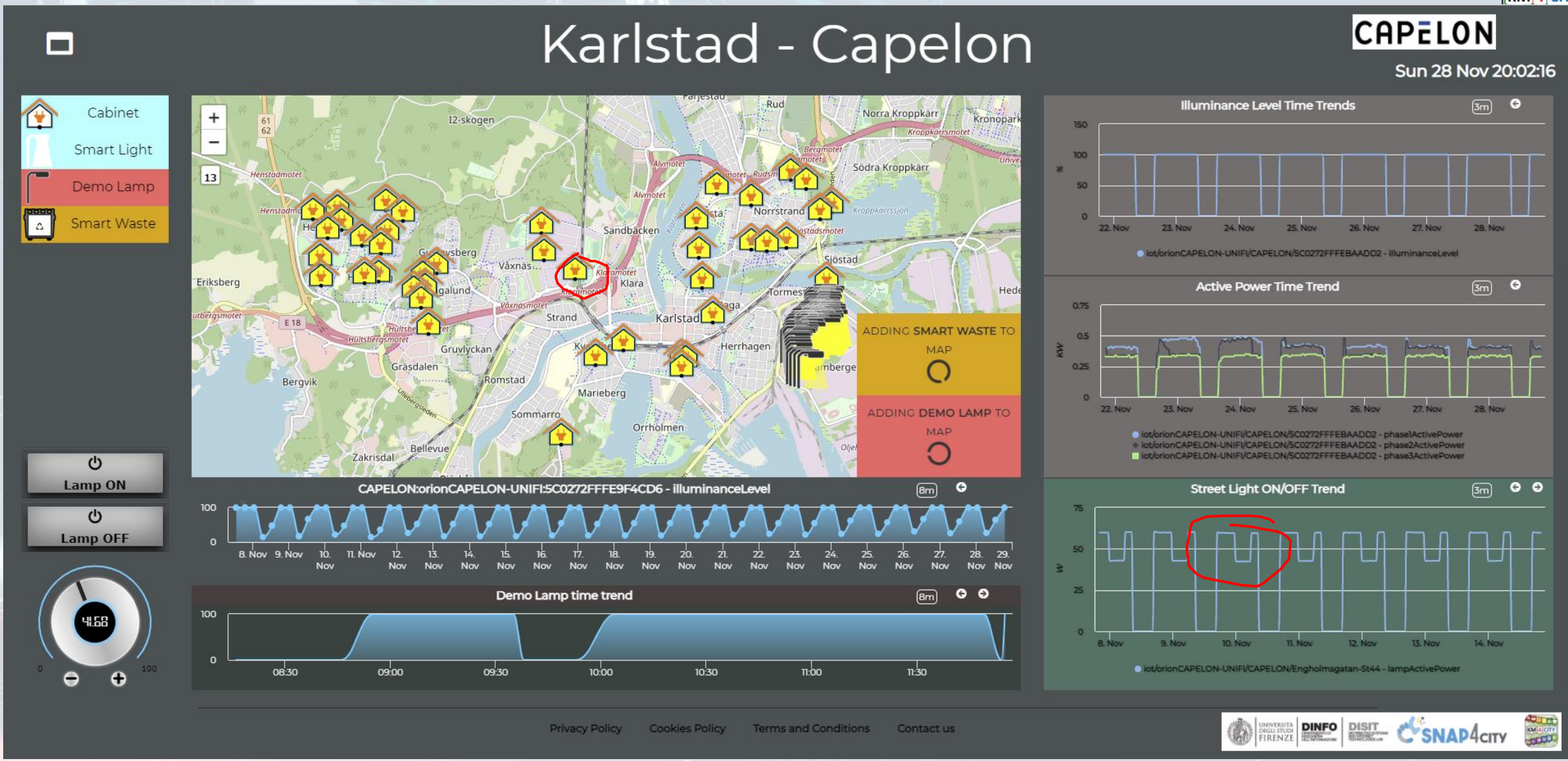
- **Energy Domain**
  - Smart Light, MQTT, ….
  - IoT Orion Broker FIWARE
- **Dashboards**
  - Map coverage on Sweden
  - Monitoring and real time control
  - Energy control, analytics
  - Direct control
- **Historical and Real Time data**
- **Services Exploited on:**
  - Multiple Levels, API
  - Dashboards
- **Since 2020**





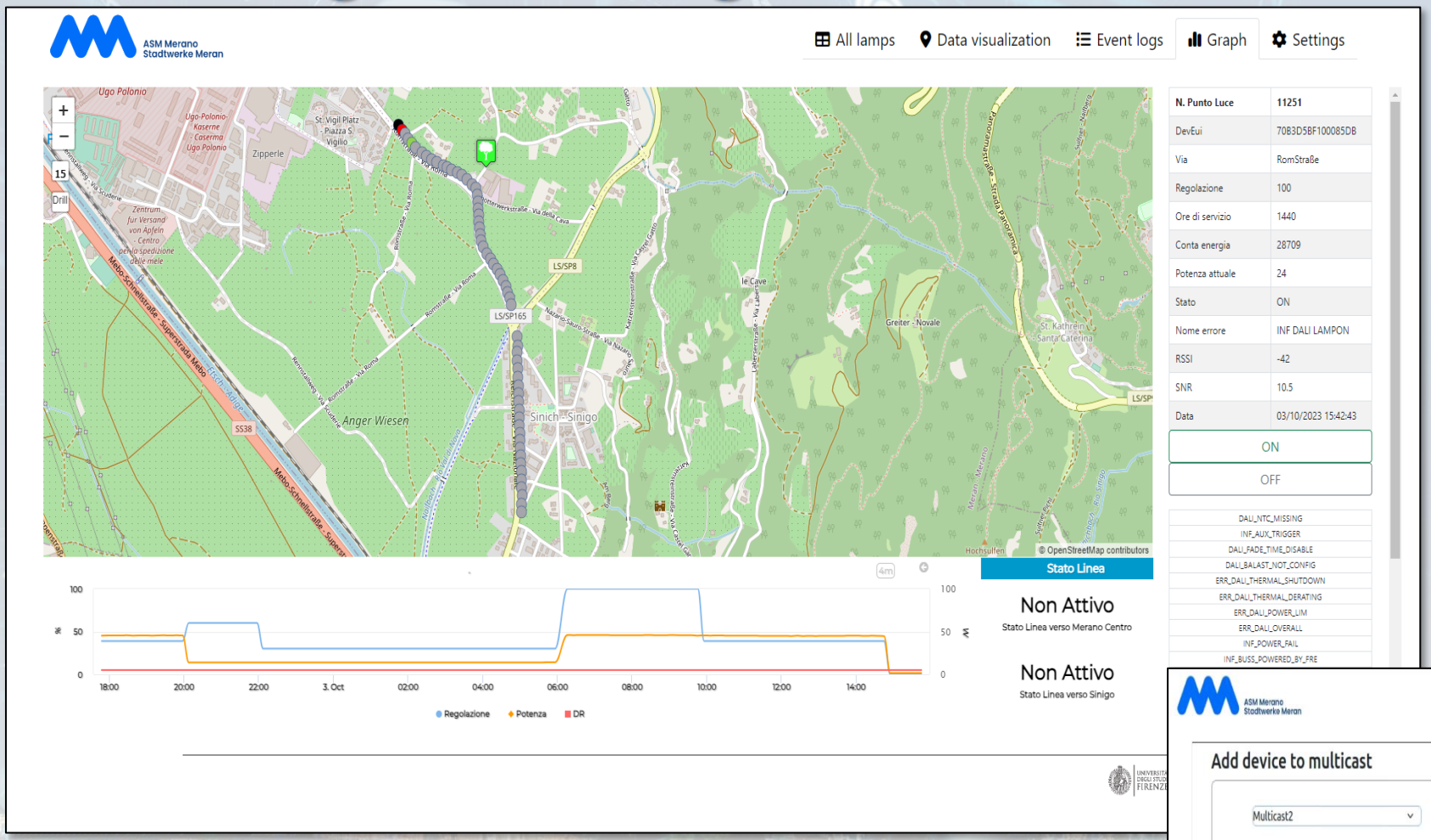


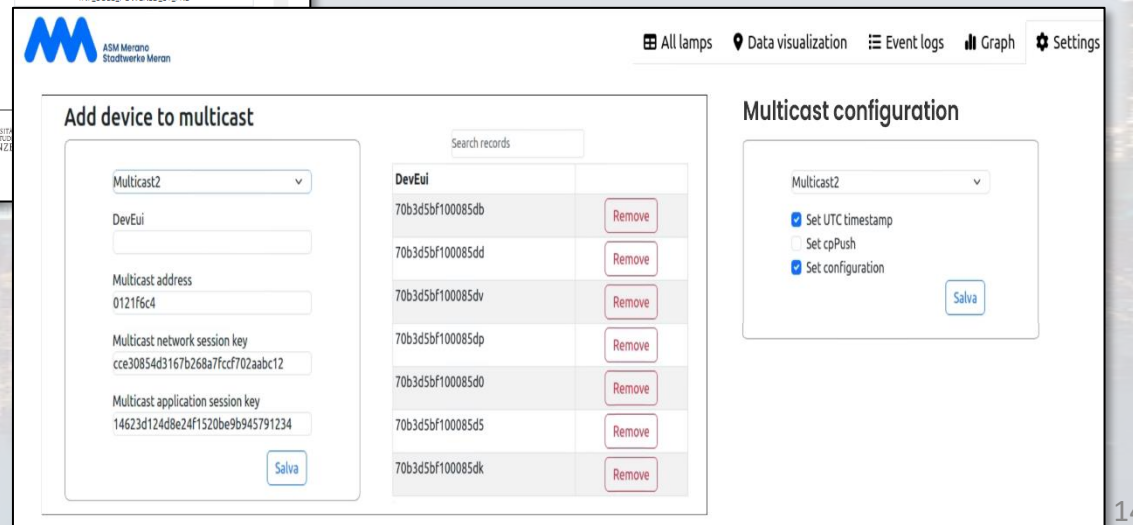
Karlstad Street Lights



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzI5NQ==

Smart Light Management in Merano





- 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

https://www.snap4city.org/968

ASM Merano Stadtwerke Meran

All lamps | Data visualization | Event logs | Graph | Settings

SNAP4CITY

KM 4 CITY

Show 500 entries

Data	Numero punto luce	DevEui Lorawan	Via	Eventi e messaggi d'errore
	Punto Luce x			Search.. x
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	
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30/09/2023 22:42:26	11261	70B3D5BF100085E2	R	
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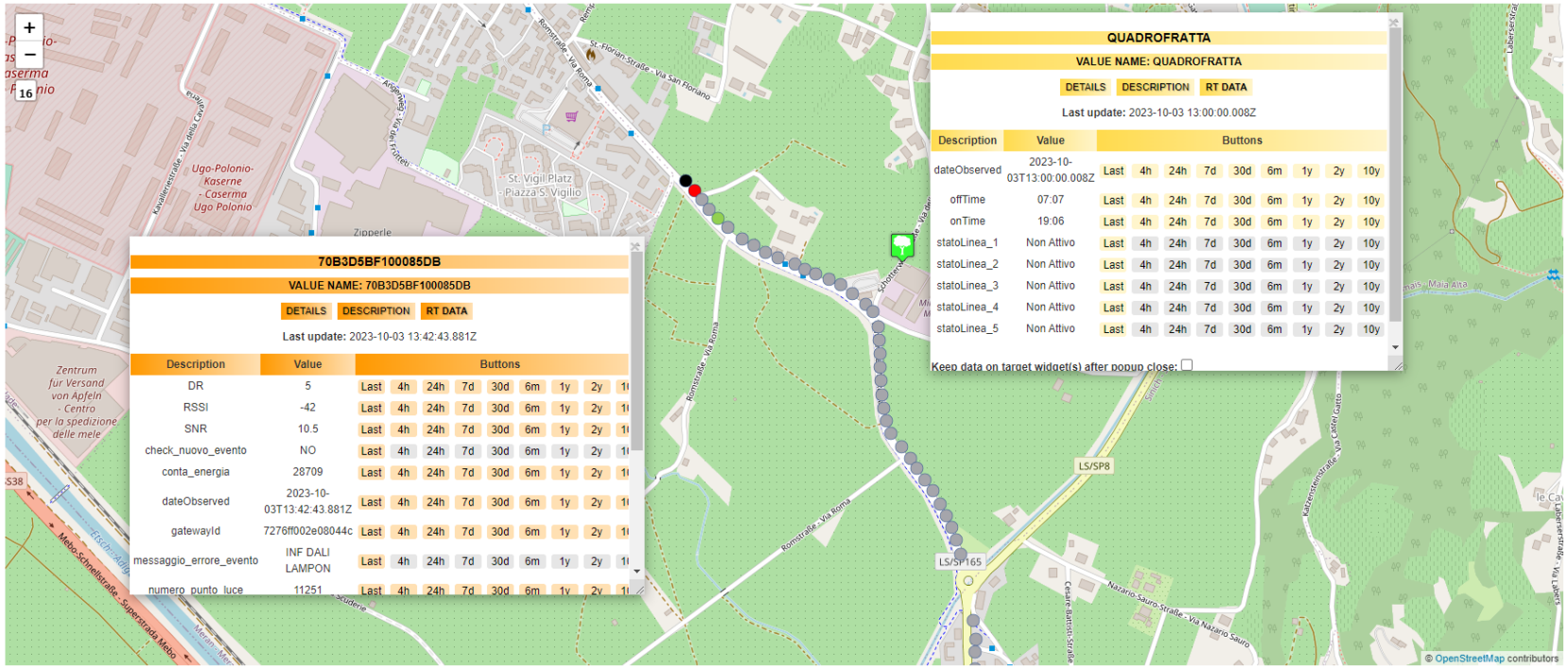
ASM Merano Stadtwerke Meran

All lamps | Data visualization | Event logs | Graph | Settings



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SNAP4CITY | KM4CITY

https://www.snap4city.org/dashboardSmartCity/view/Baloon.php?iddasboard=MzcxNw==

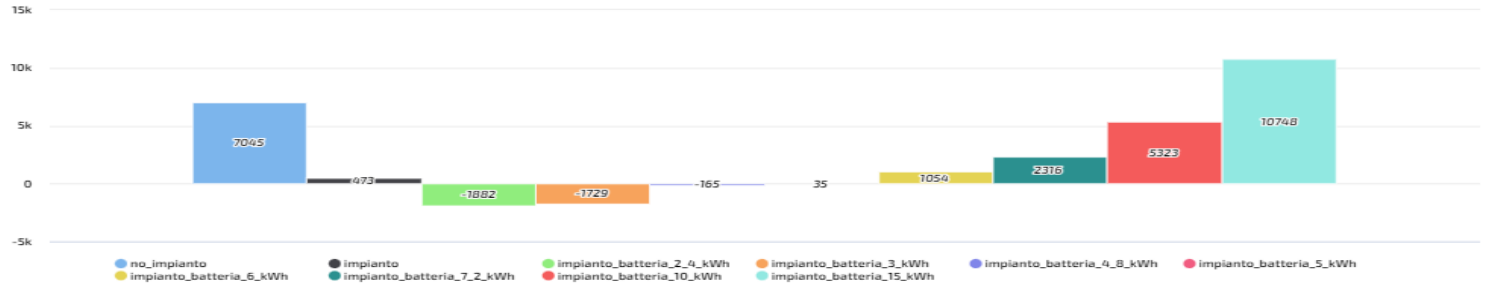
Ciao roottooladmin1

Tue 4 Apr 13:15:34

SIMULATORE IMPIANTO FOTOVOLTAICO

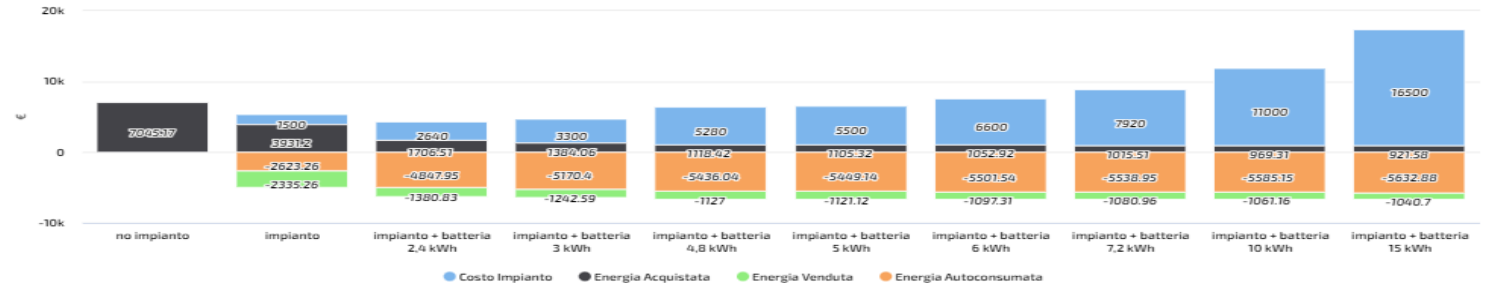
COSTO COMPLESSIVO NEGLI ANNI DI INVESTIMENTO

599m



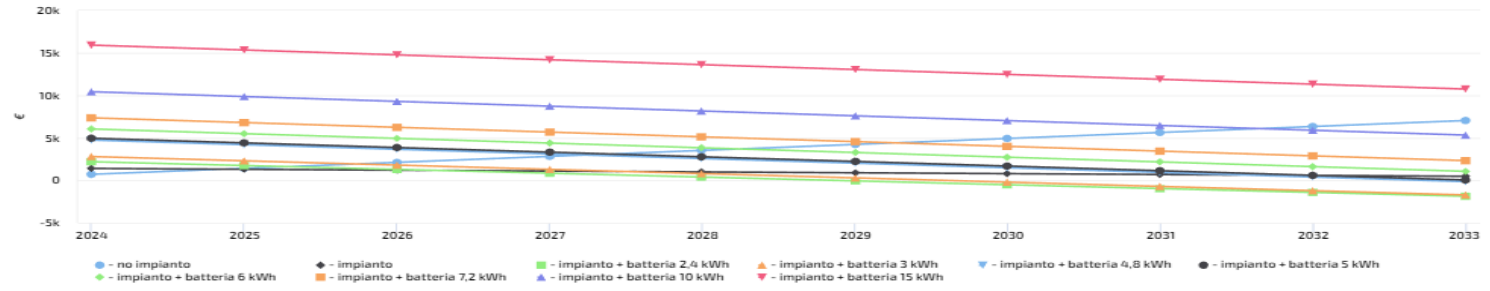
COSTO COMPLESSIVO NEGLI ANNI DI INVESTIMENTO PARTIZIONATO

599m



ANDAMENTO PREZZO CUMULATIVO ANNUO

599m



Manuale Utente

English Version

PARAMETRI DELL'IMPIANTO

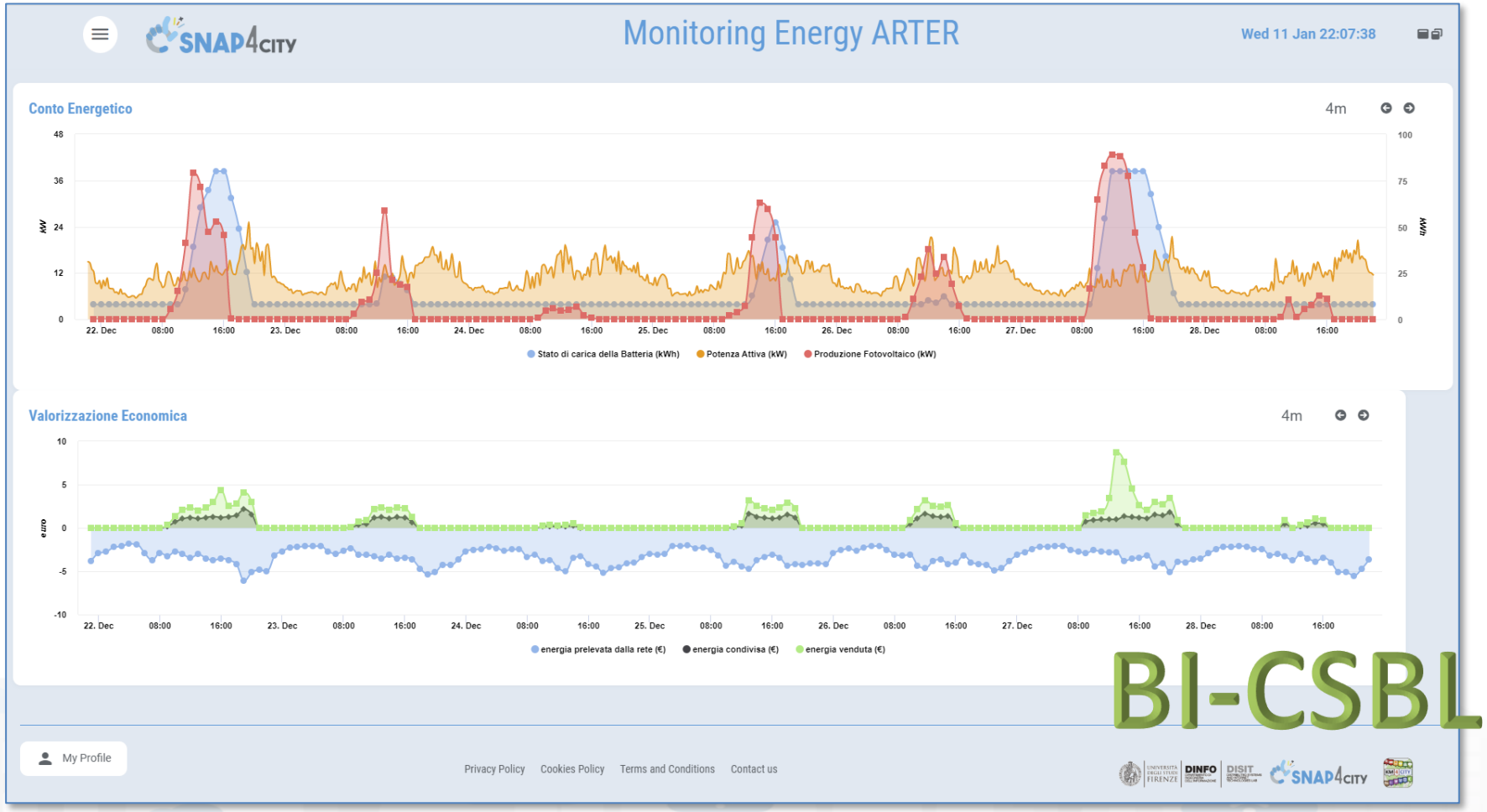
Ti consigliamo un impianto con batteria da 2,4 kWh

Gruppo di Consumo Annuale	2000 kWh
Prezzo Energia Vendita (€/kWh)	0,15
Prezzo Energia Acquisto (€/kWh)	0,35
Anni di Investimento	10
Mese da simulare	Gennaio

Invia

7 AFFORDABLE AND CLEAN ENERGY

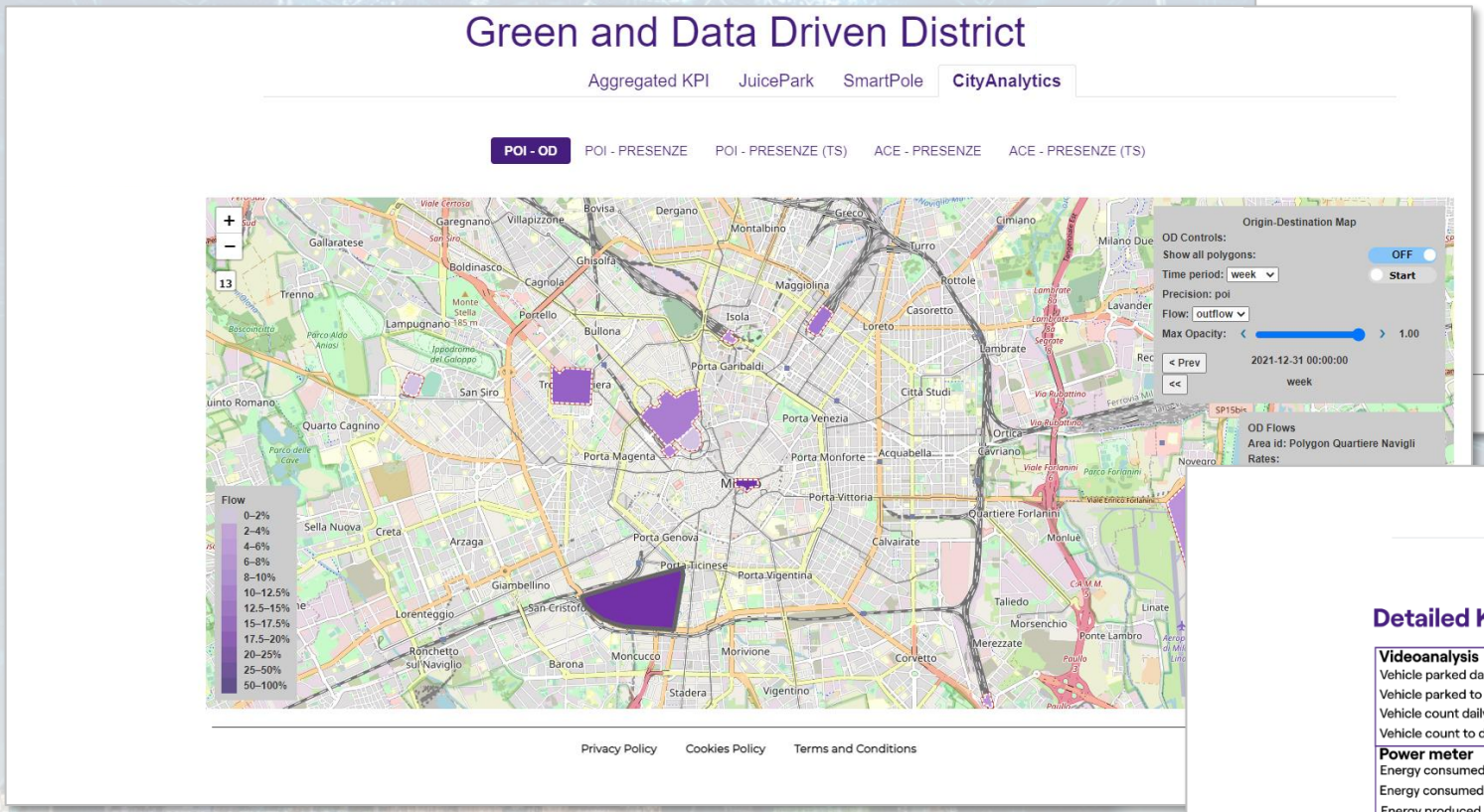
- **Field-tested energy community: the self-consumer condominium**
- The Self User project creates in the pilot condominium, through the collection and analysis of data, a model for calculating and enhancing the impact of an energy community on a community of people, with a view to actions to combat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

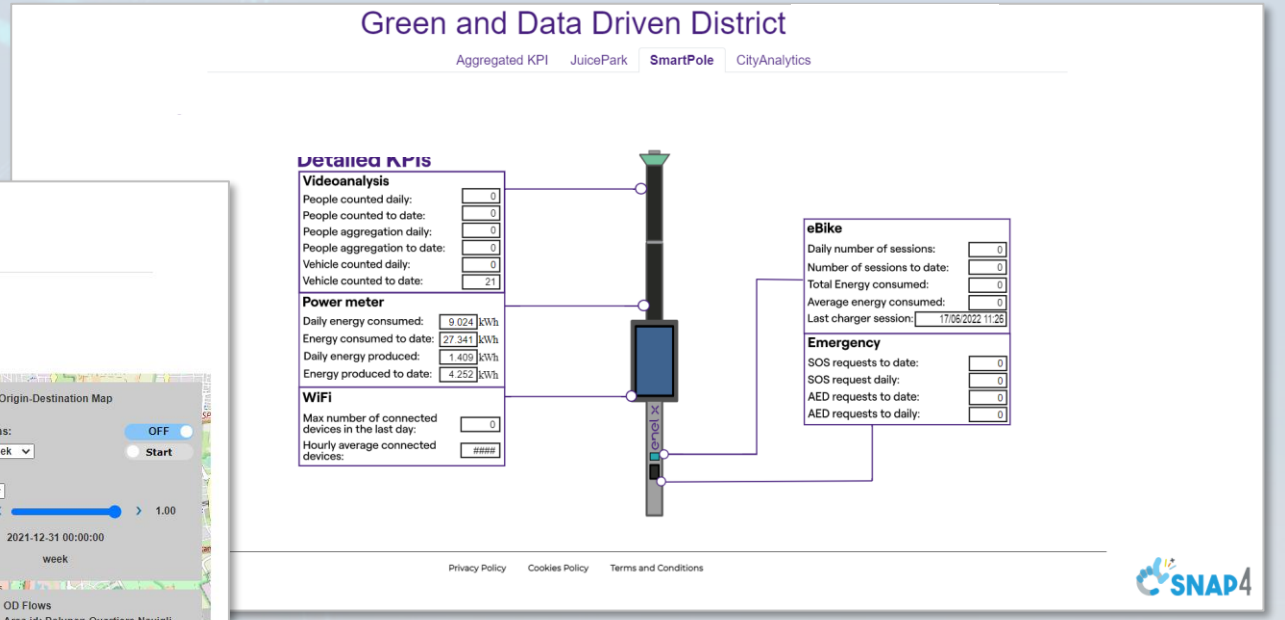


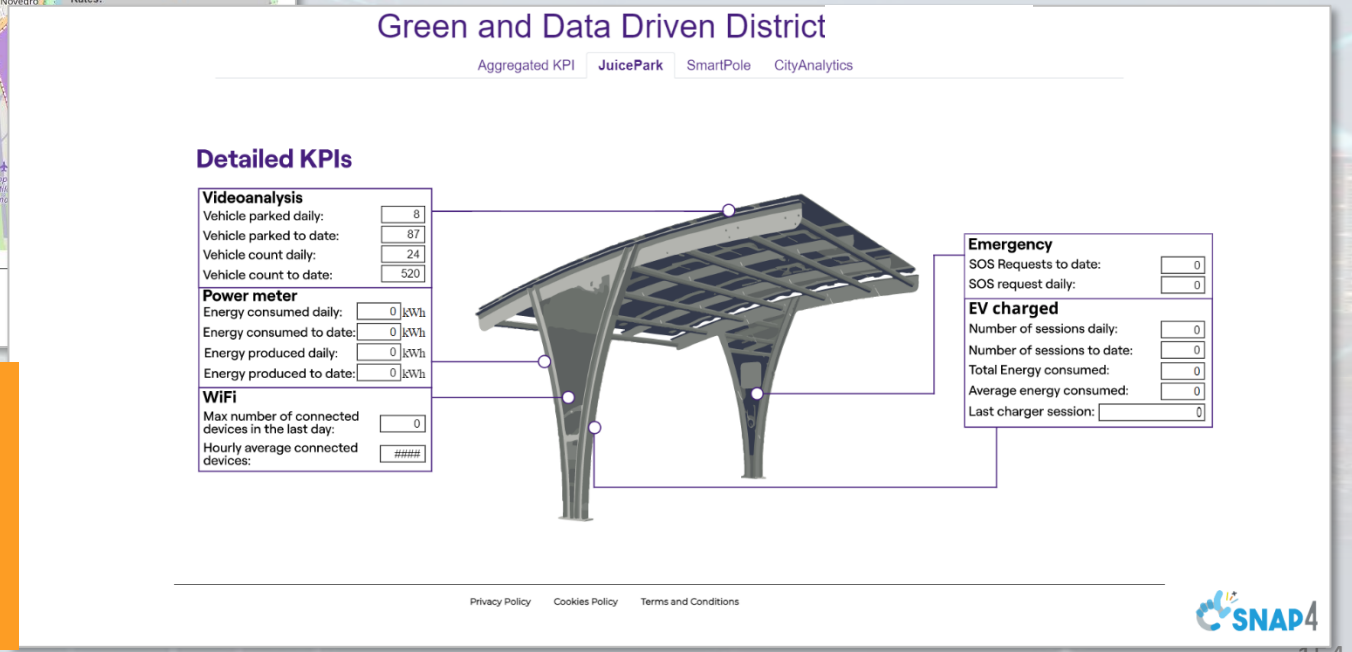
BI-CSBL

https://www.selfuser.it

Energy monitoring and business intelligence







7 AFFORDABLE AND CLEAN ENERGY

11 SUSTAINABLE CITIES AND COMMUNITIES

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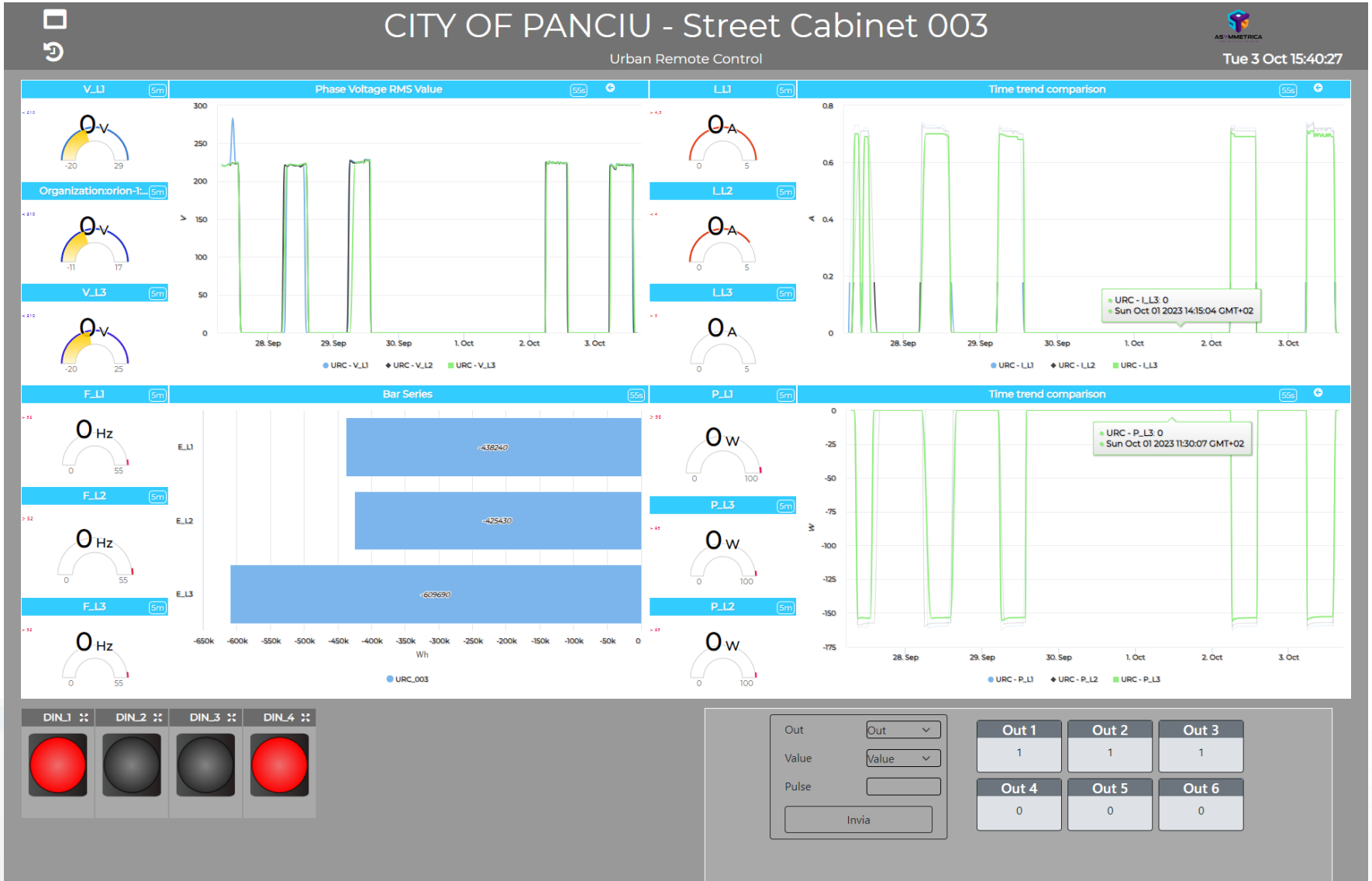
DISTRIBUTED DATA INTELLIGENCE AND TECHNOLOGIES LAB

SNAP4CITY KM4CITY

City of Panciu in Romania

By Asymmetrica and Snap4



Powered by SNAP4Tech

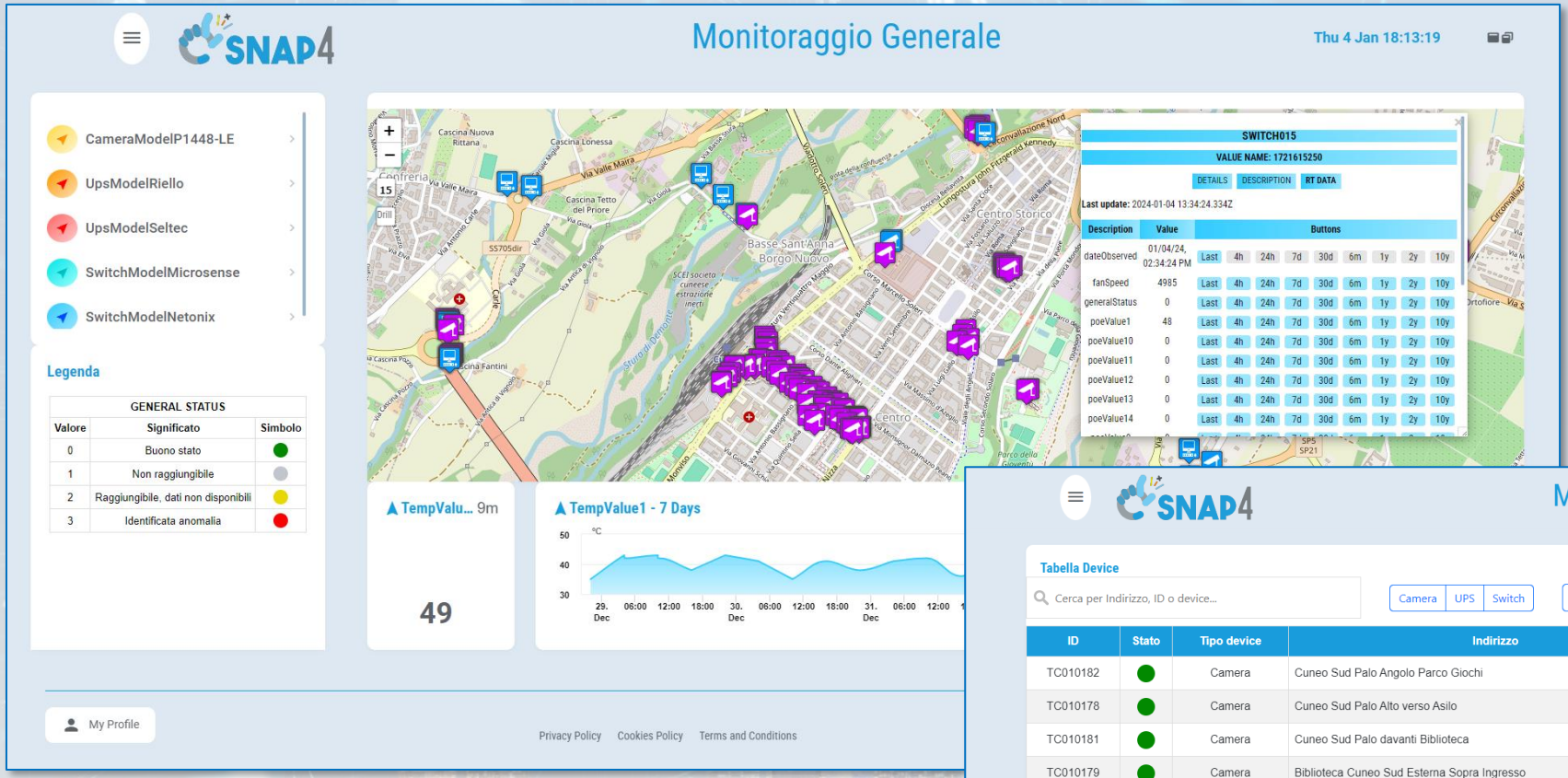
TOP

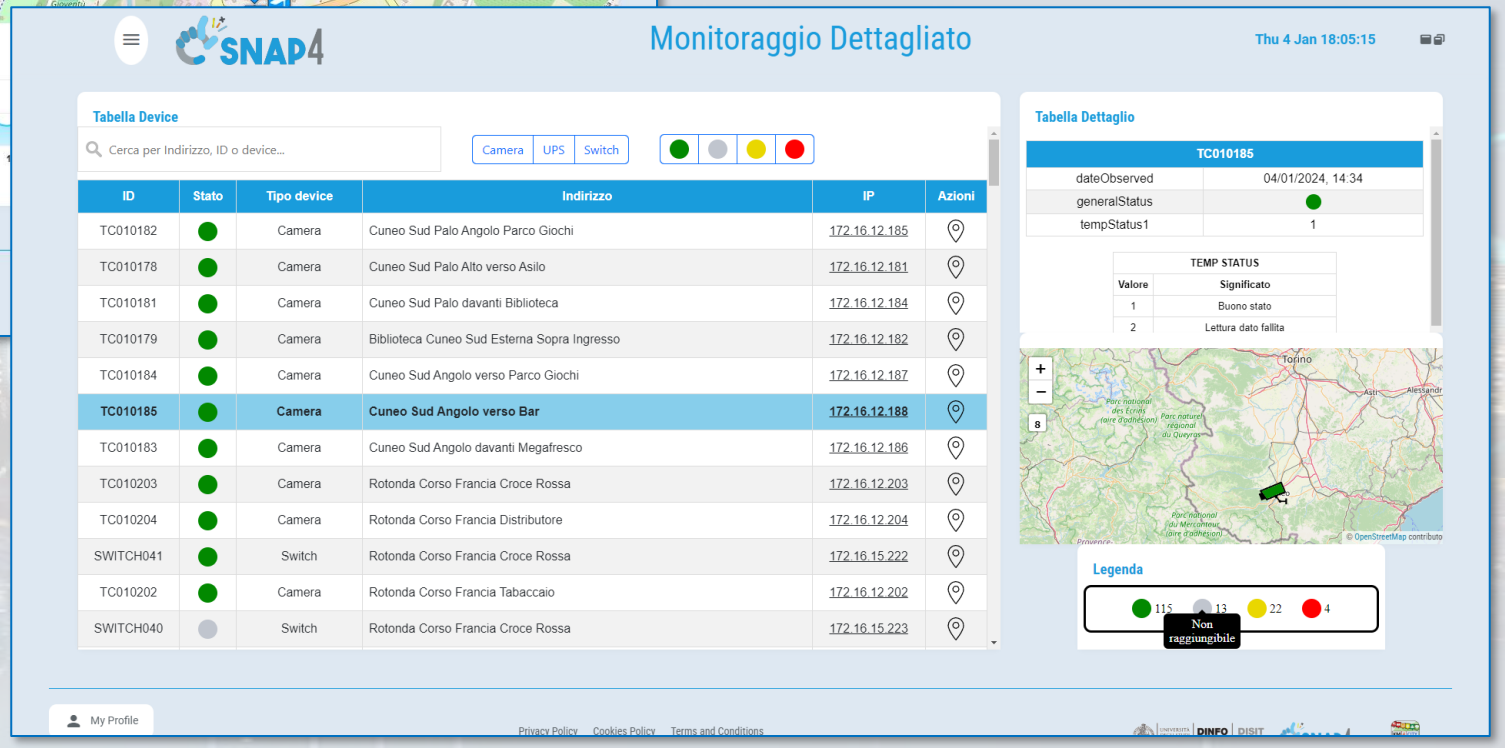
Assets Management & Control

Assets Quality Control Domain (2024)

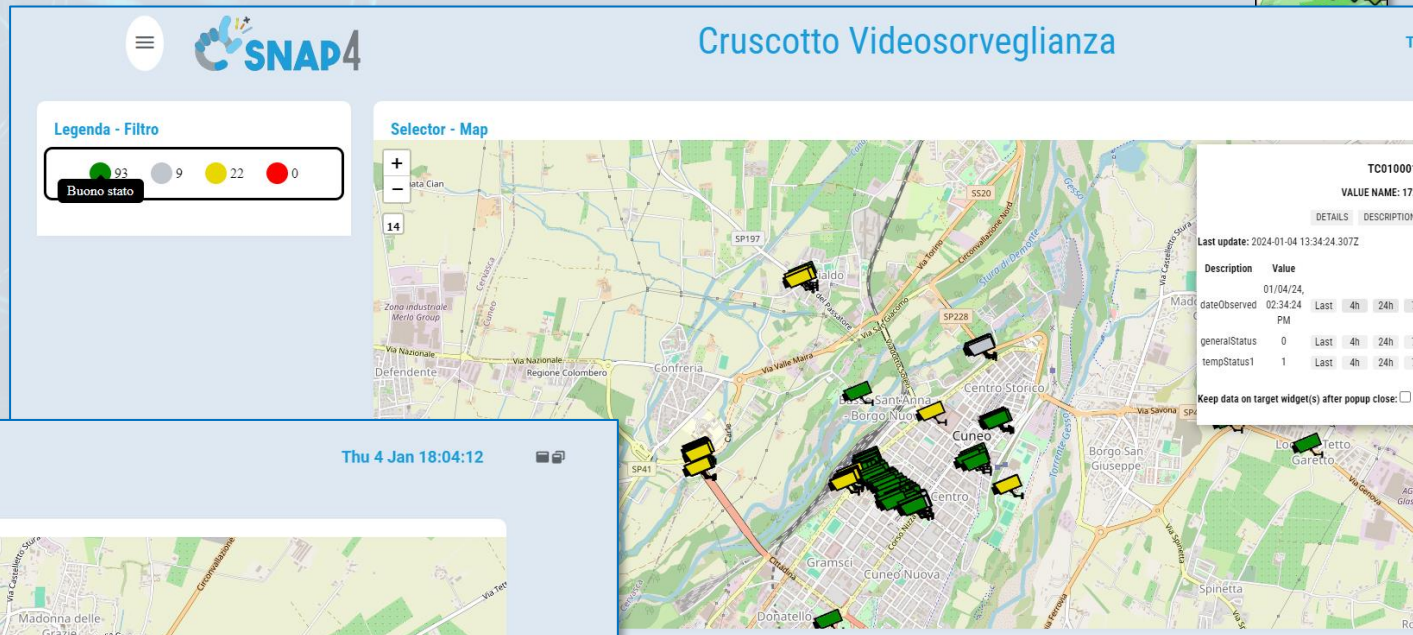
- Goals:
  - Efficiency, costs
  - Quality Level
- Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)
  - Monitoring :
    - **Assets**: switches, Wi-Fi, servers, UPS, sensors, building, TV Cams, etc.
    - **Energy**: consumption, operative conditions, etc.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

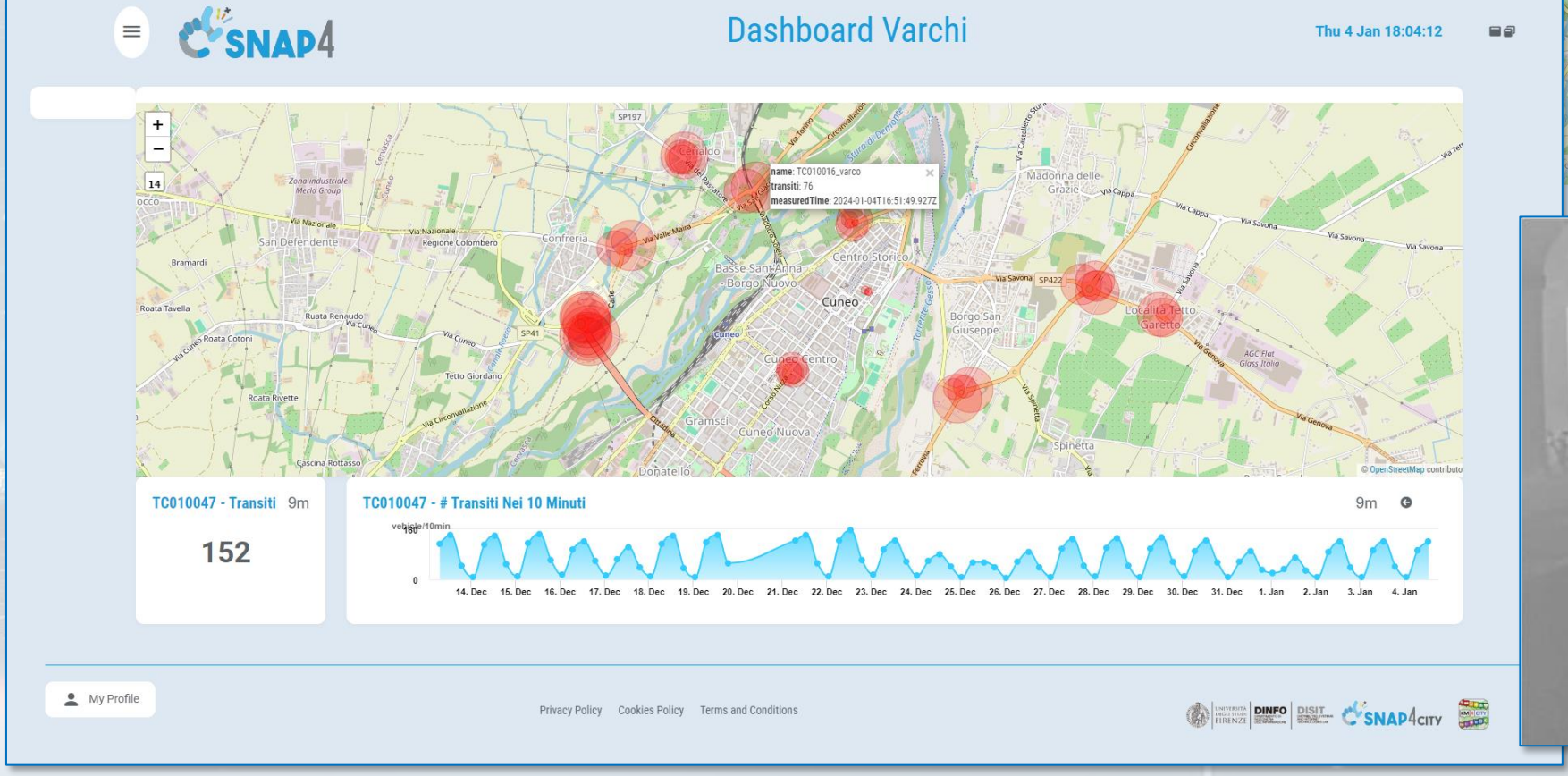
Cuneo Assets' Monitoring, Safety



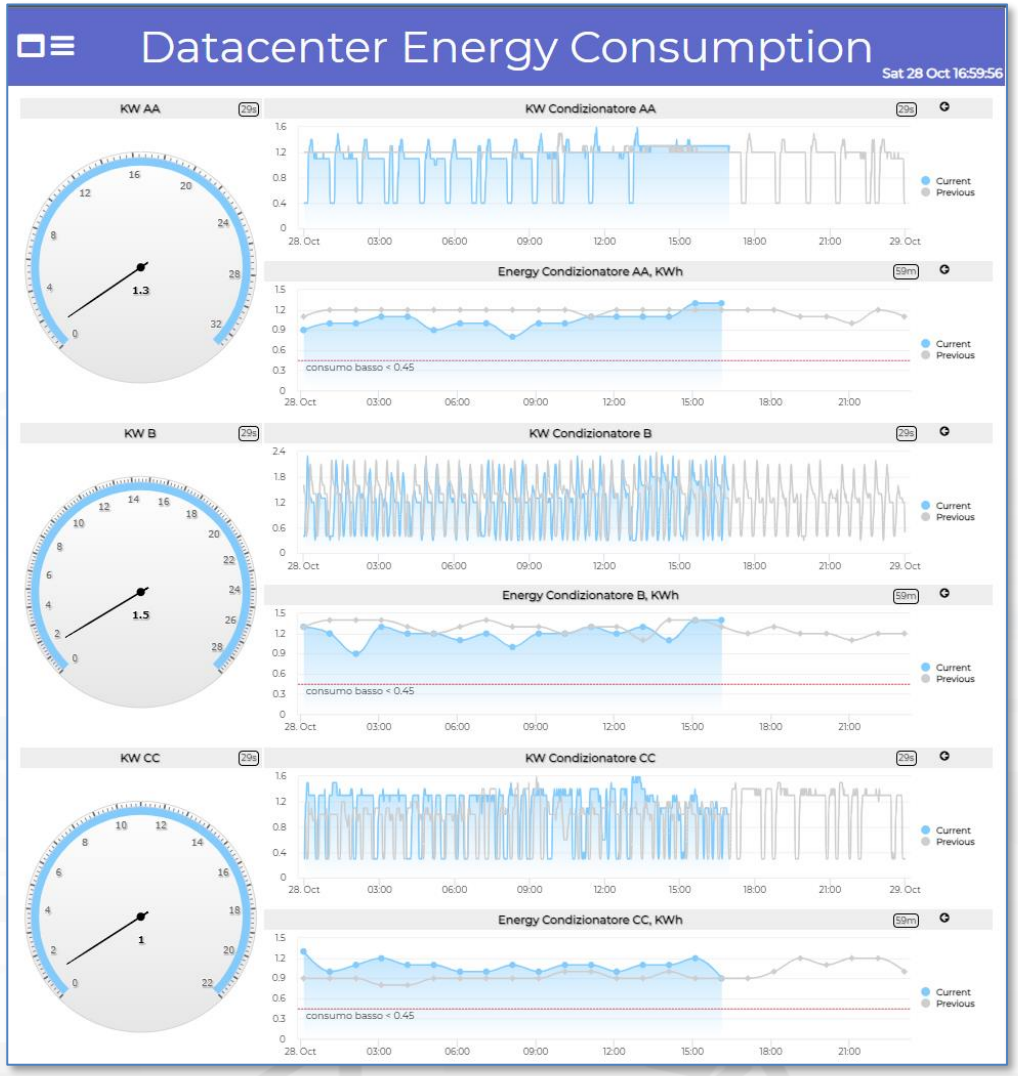


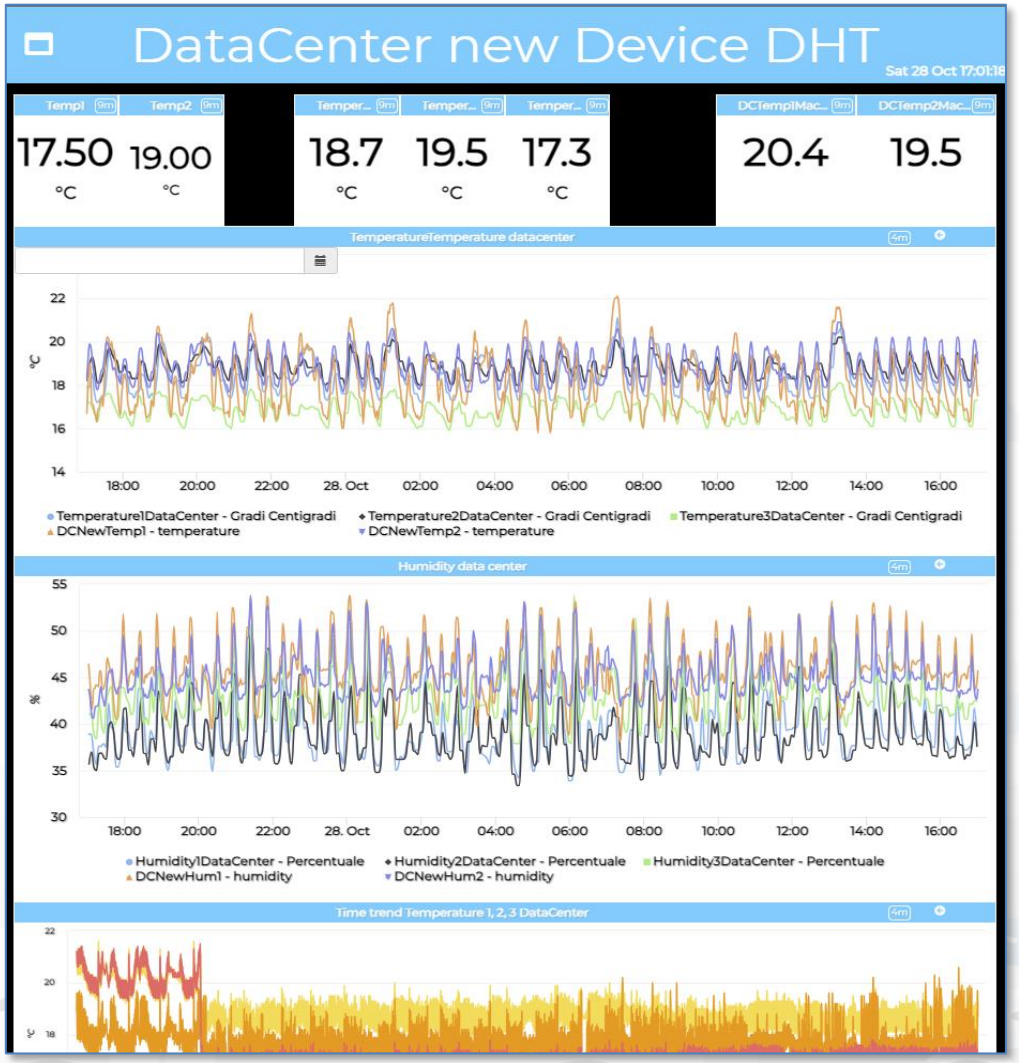
Cuneo Assets' Monitoring, Safety





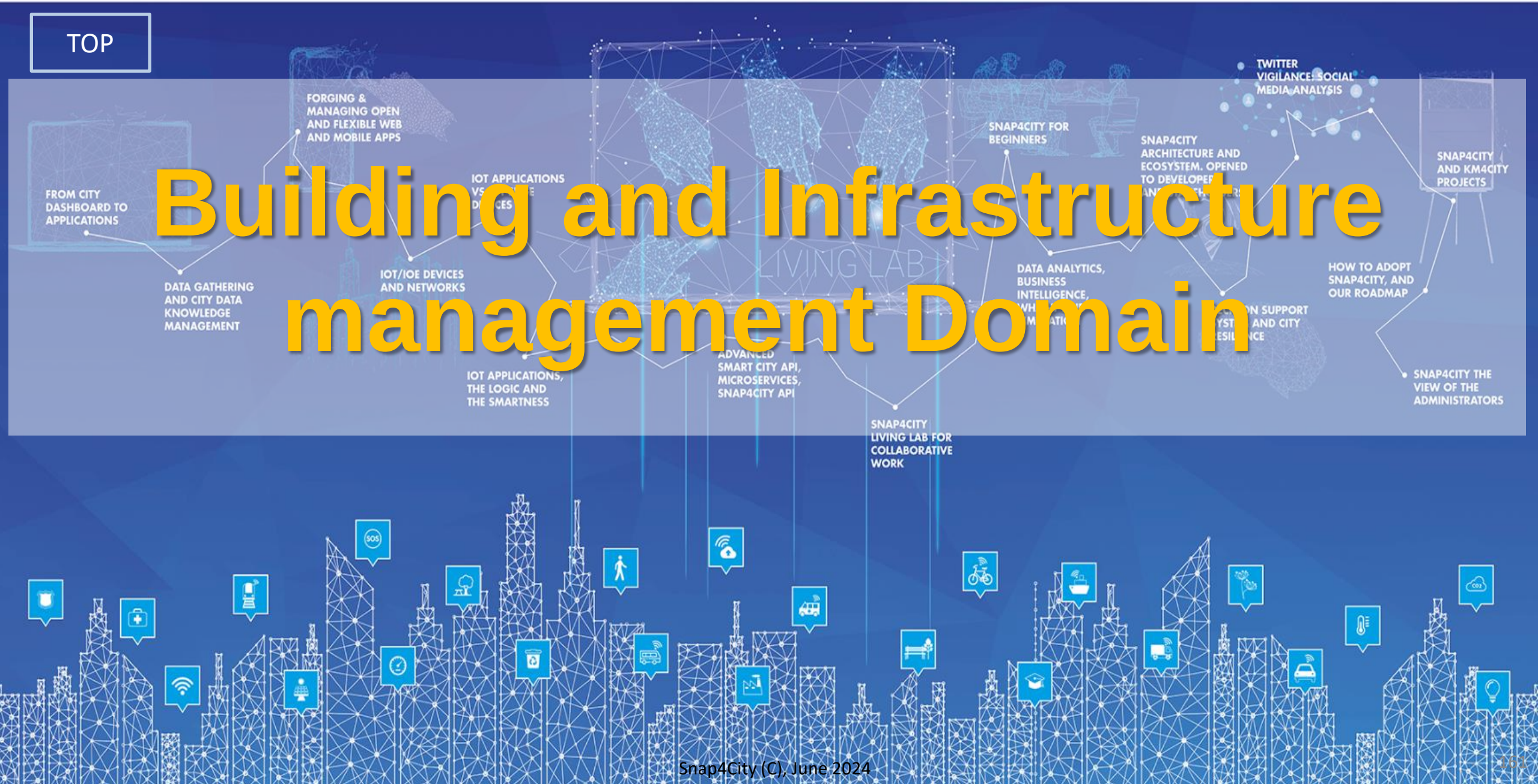
Data Center monitoring





TOP

Building and Infrastructure management Domain



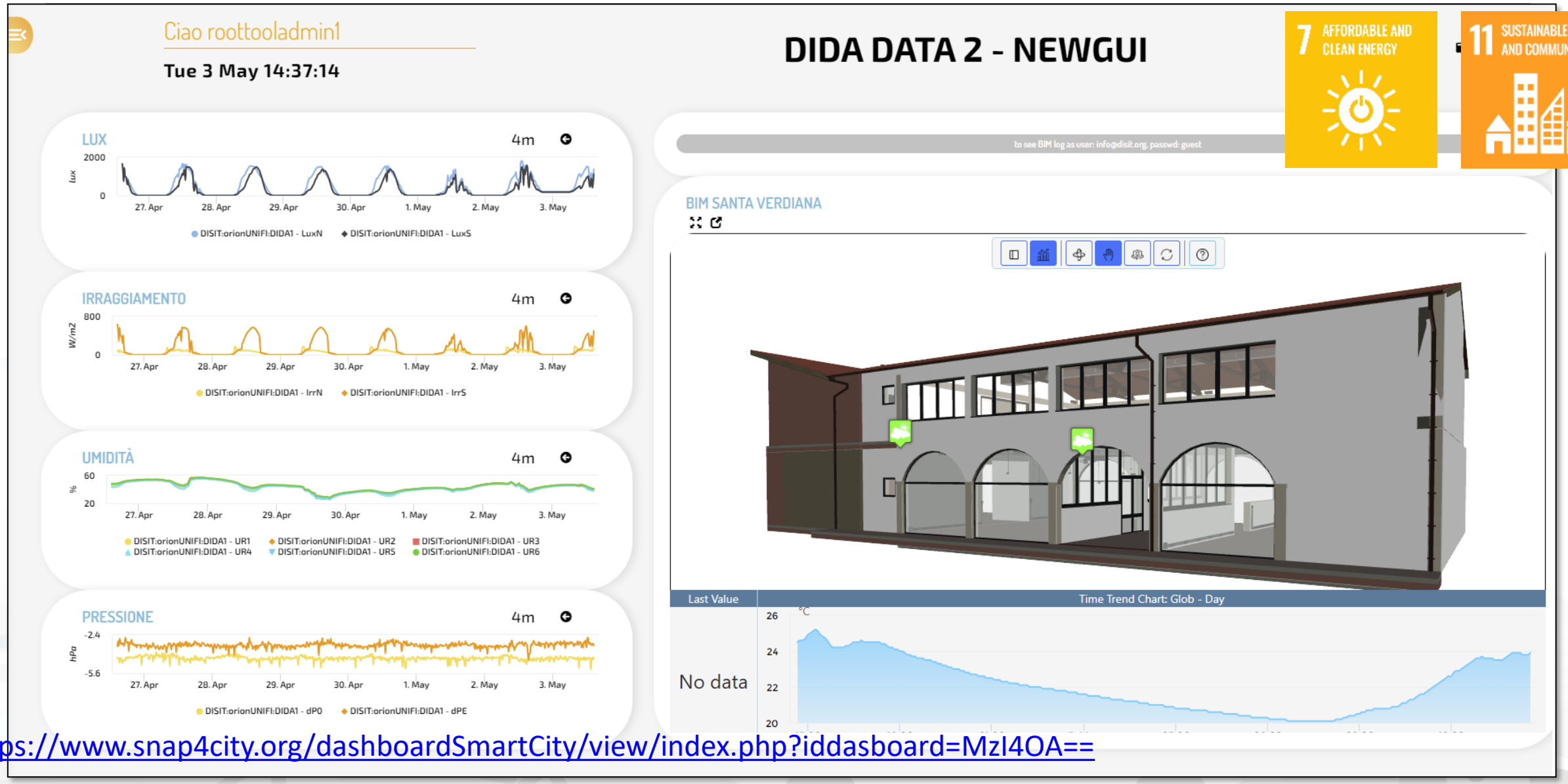
Snap4Building Domain (2024)

- Goals:
  - Efficiency, costs
  - Accessibility to services
  - Security/Safety
- Solutions for Operation (monitoring, managing, mobile apps, digital signages, control rooms)
  - Monitoring usage, energy consumption, environmental conditions, people flows, services, etc.
  - Early detection/warning, alarm, of critical conditions
  - Production of suggestions, 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

Tools: Smart Buildings, Snap4Building (2024)

- **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 KPI 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**

Smart Building

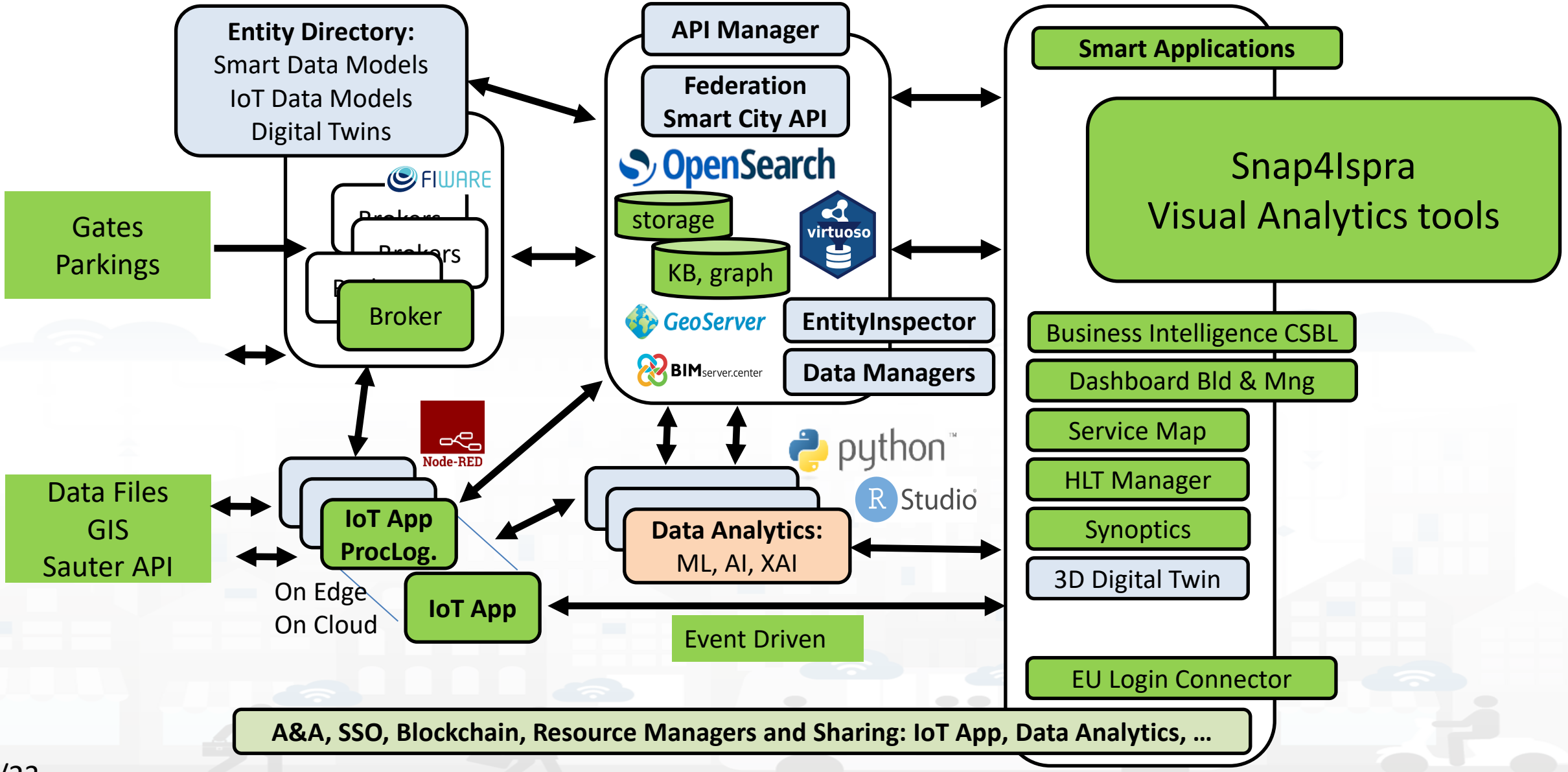


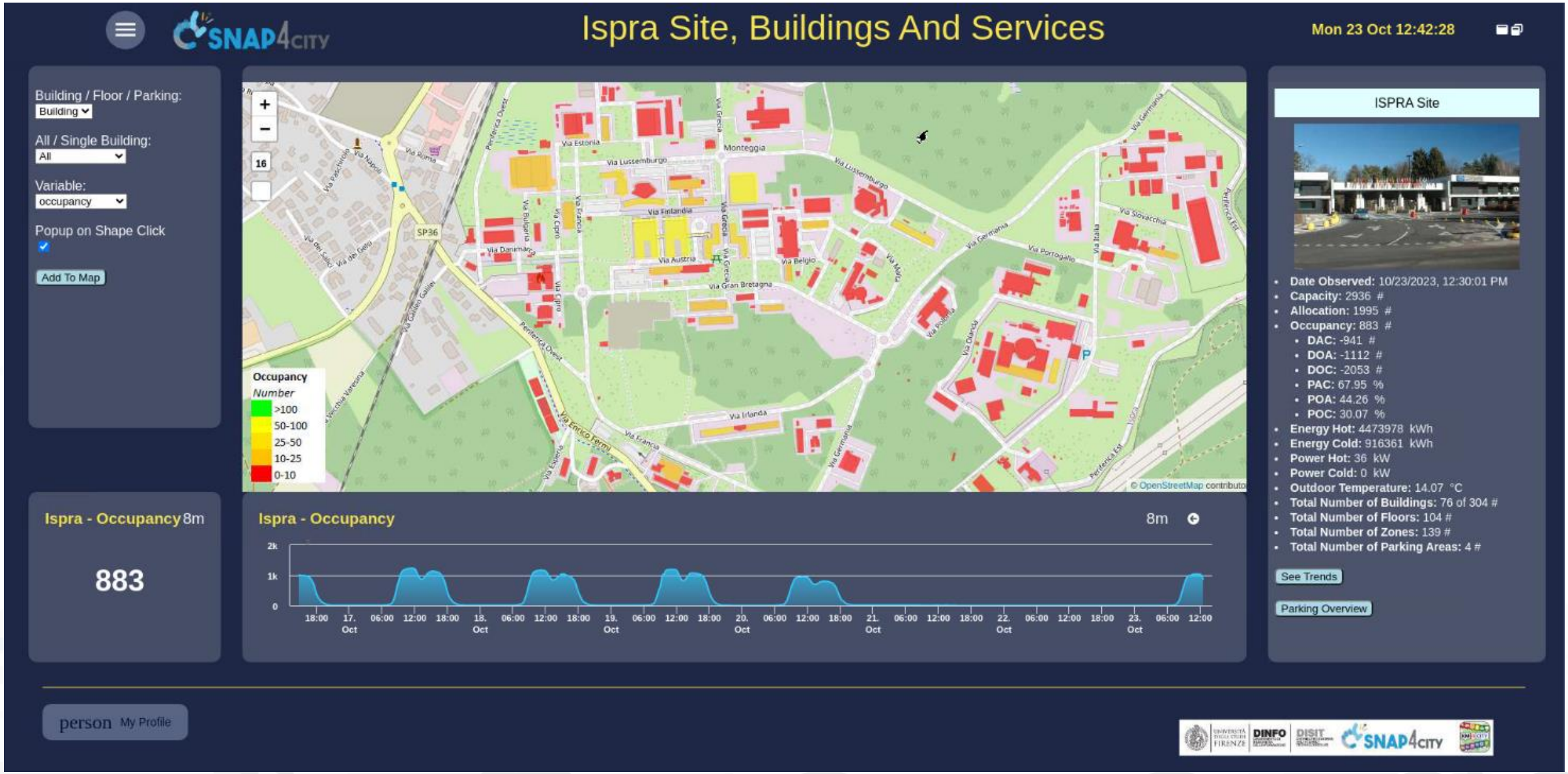
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzI4OA==

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

Tech Arch

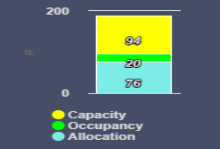

Entity Directory:
Smart Data Models
IoT Data Models
Digital Twins
FIWARE
Brokers
Broker
Gates
Parkings
Data Files
GIS
Sauter API
Node-RED
IoT App
ProcLog.
On Edge
On Cloud
IoT App
API Manager
Federation
Smart City API
OpenSearch
storage
KB, graph
virtuoso
GeoServer
BIMserver.center
EntityInspector
Data Managers
python
RStudio
Data Analytics:
ML, AI, XAI
Event Driven
Smart Applications
Snap4Ispra
Visual Analytics tools
Business Intelligence CSBL
Dashboard Bld & Mng
Service Map
HLT Manager
Synoptics
3D Digital Twin
EU Login Connector
A&A, SSO, Blockchain, Resource Managers and Sharing: IoT App, Data Analytics, …


SNAP4CITY
Ispra Site, Buildings And Services
Mon 23 Oct 12:42:28
Building / Floor / Parking:
Building
All / Single Building:
All
Variable:
occupancy
Popup on Shape Click
Add To Map
Occupancy
Number
>100
50-100
25-50
10-25
0-10
© OpenStreetMap contributo
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
Ispra - Occupancy 8m
883
Ispra - Occupancy
8m
2k
1k
0
18:00 17. Oct 06:00 12:00 18:00 18. Oct 06:00 12:00 18:00 19. Oct 06:00 12:00 18:00 20. Oct 06:00 12:00 18:00 21. Oct 06:00 12:00 18:00 22. Oct 06:00 12:00 18:00 23. Oct 06:00 12:00
person My Profile

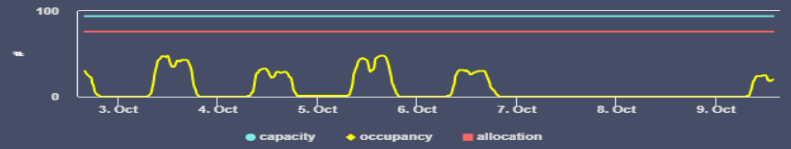
Building 27B Trends

Mon 9 Oct 13:47:14

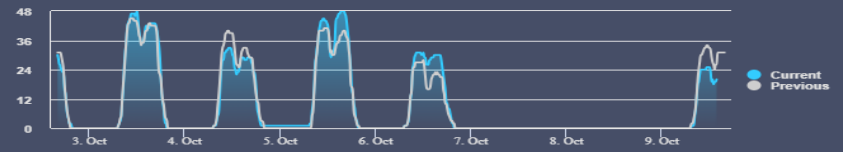
Actual 4m



Capacity - Allocation - Occupancy 4m



Occupancy Weekly Time Trend Compare 9m



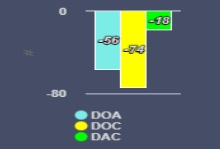
Office Mq 9m

803.9 m2

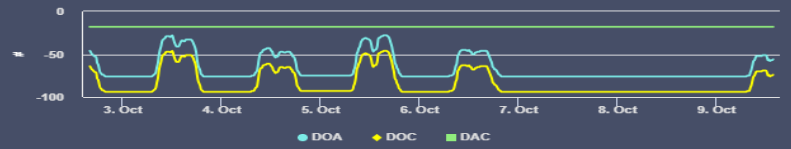
Temp. 9m

20.6 °C

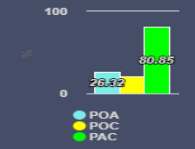
Difference 4m



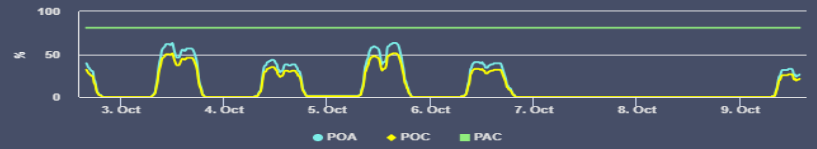
DOA - DOC - DAC 4m



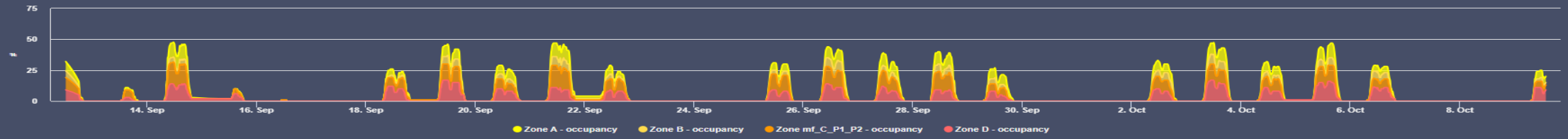
Percentage 4m



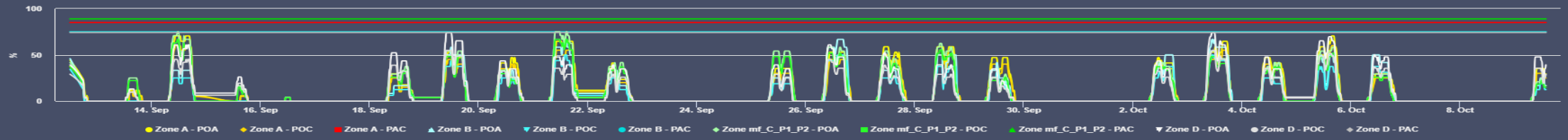
POA - POC - PAC 4m



Occupancy Per Zones - Monthly Time Trend Comparison Stacked 4m



Percentage Per Zones - Monthly Time Trend Comparison 4m



Heat Power 9m

0 kW

Heat Energy 9m

1931279 kWh

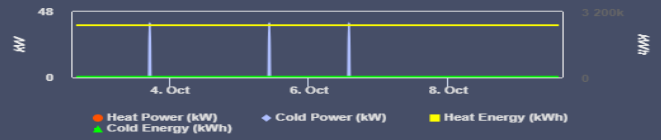
Cold Power 9m

0 kW

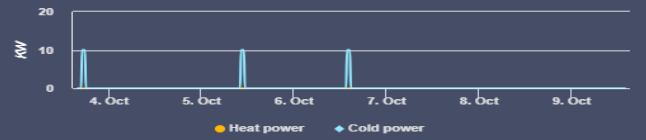
Cold Energy 9m

888311 kWh

Energy Trends 4m



Average Hourly Power 4m



En./Mq 9m

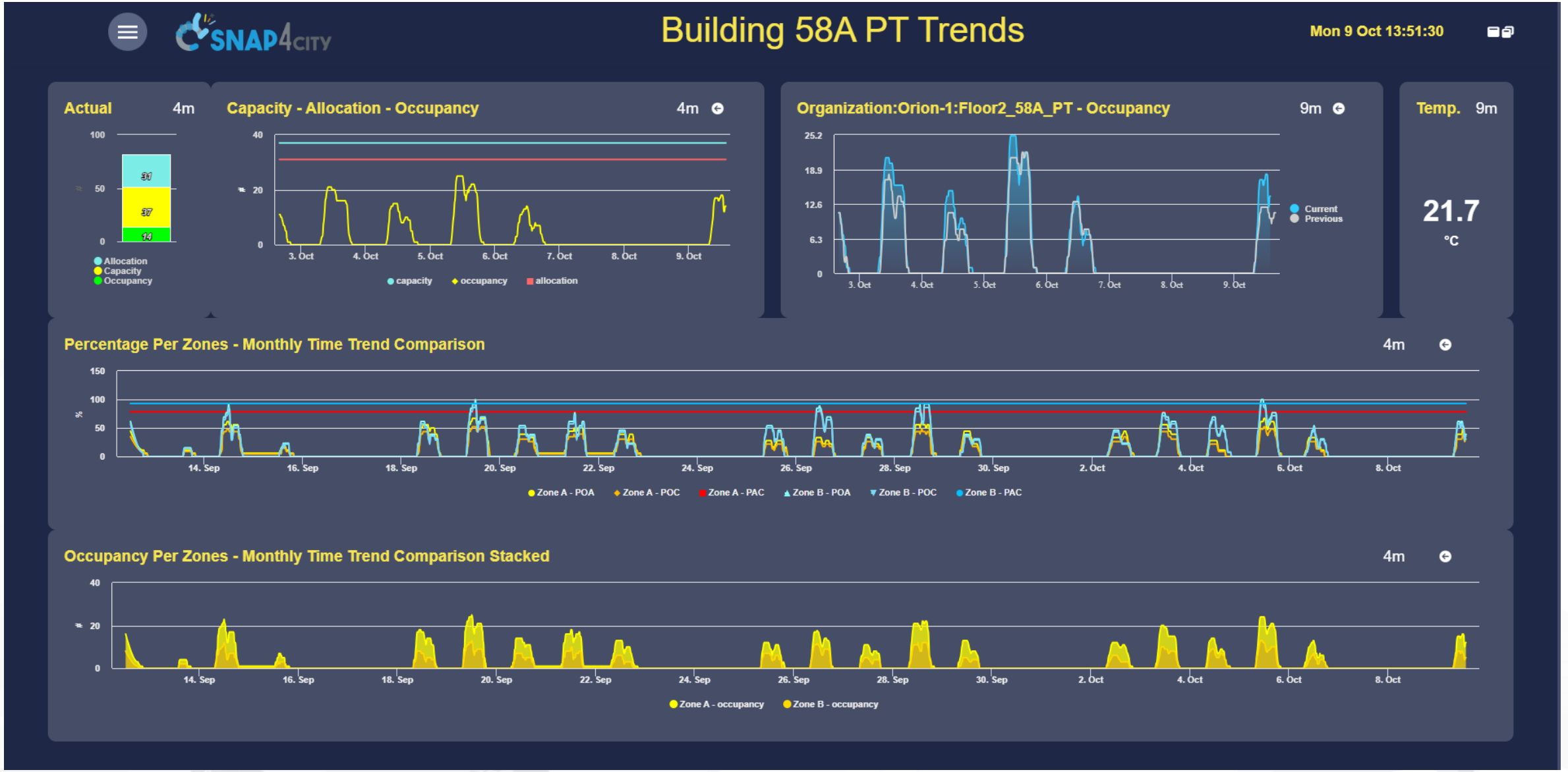
0 kWh

En./Pax 9m

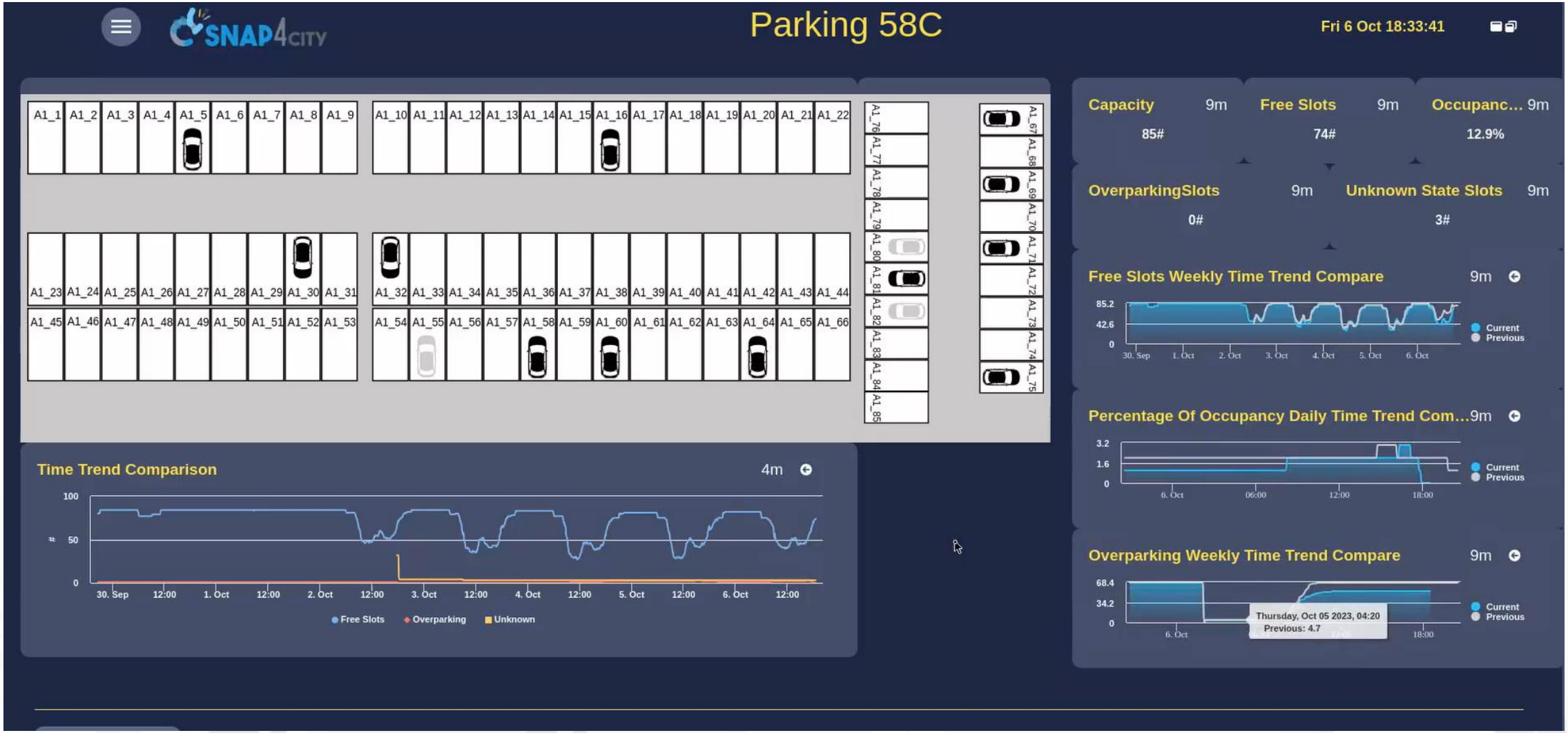
0 kWh

person My Profile

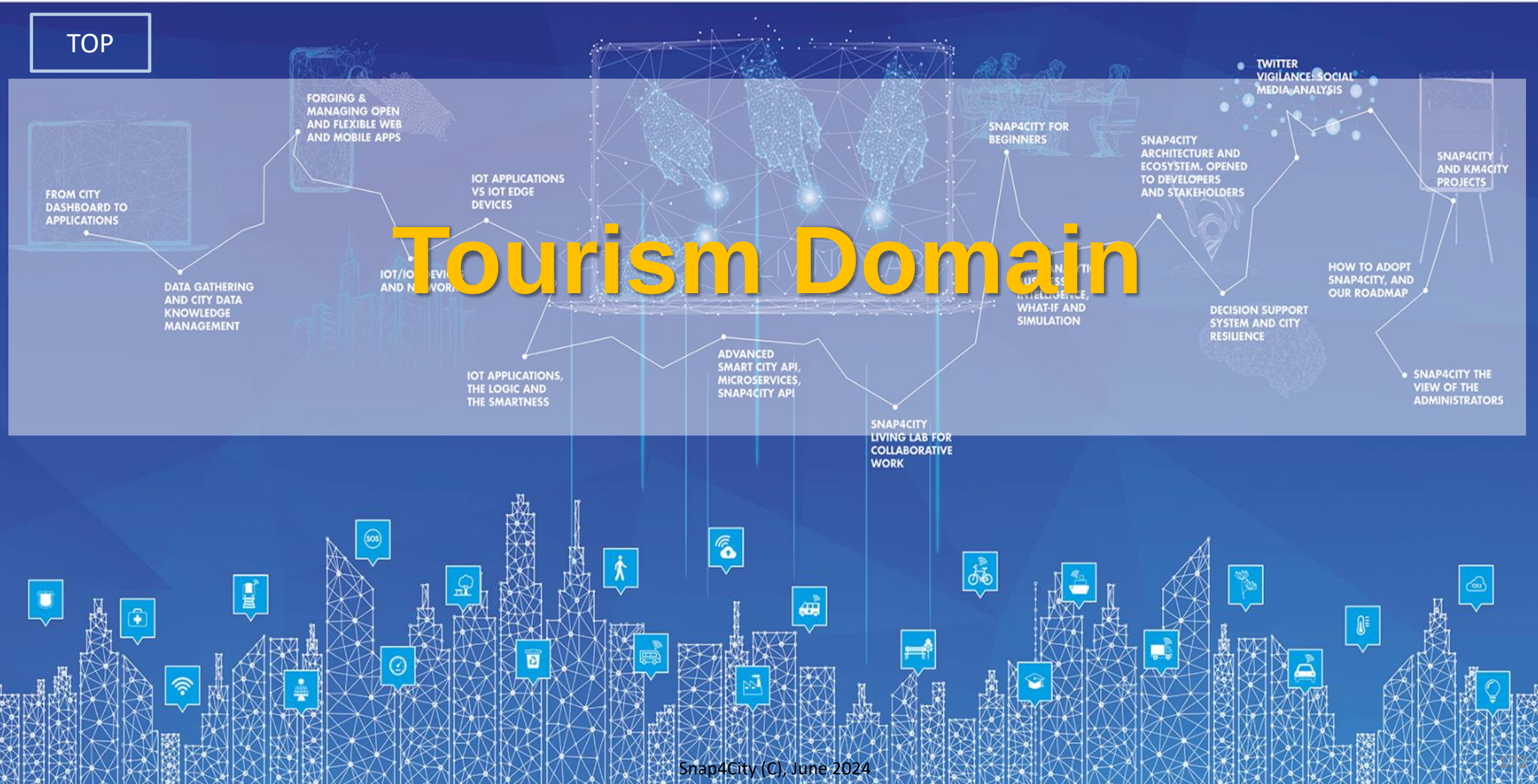
Floor Details


Building 58A PT Trends
Mon 9 Oct 13:51:30
Actual 4m
Allocation
Capacity
Occupancy
Capacity - Allocation - Occupancy 4m
capacity
occupancy
allocation
Organization:Orion-1:Floor2_58A_PT - Occupancy 9m
Current
Previous
Temp. 9m
21.7
°C
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
Occupancy Per Zones - Monthly Time Trend Comparison Stacked 4m
Zone A - occupancy
Zone B - occupancy

Parking


Parking 58C
Fri 6 Oct 18:33:41
Capacity 9m
85#
Free Slots 9m
74#
Occupanc... 9m
12.9%
OverparkingSlots 9m
0#
Unknown State Slots 9m
3#
Free Slots Weekly Time Trend Compare 9m
Current
Previous
Percentage Of Occupancy Daily Time Trend Com... 9m
Overparking Weekly Time Trend Compare 9m
Thursday, Oct 05 2023, 04:20
Previous: 4.7
Time Trend Comparison 4m
Free Slots
Overparking
Unknown

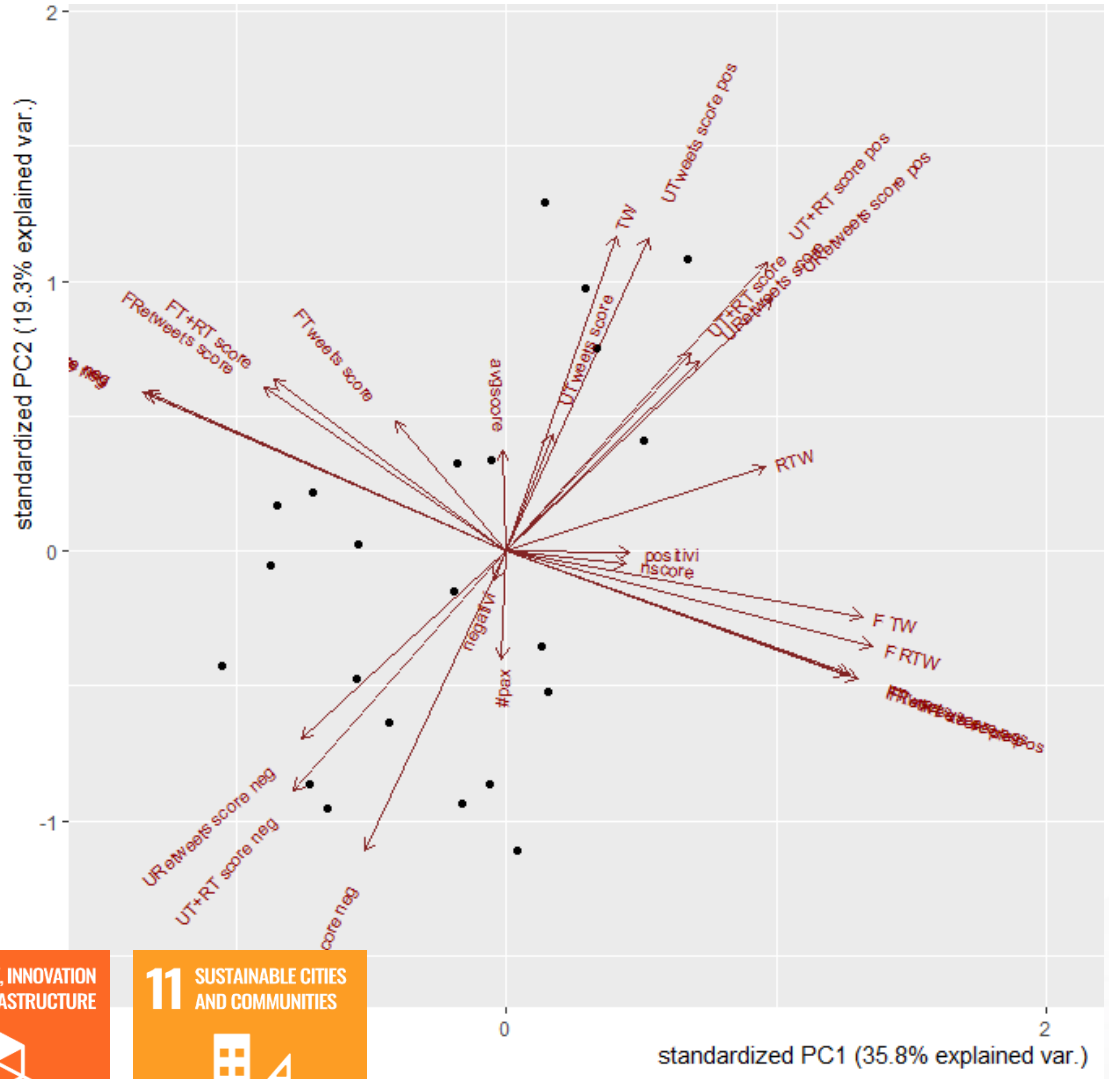
TOP



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*



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

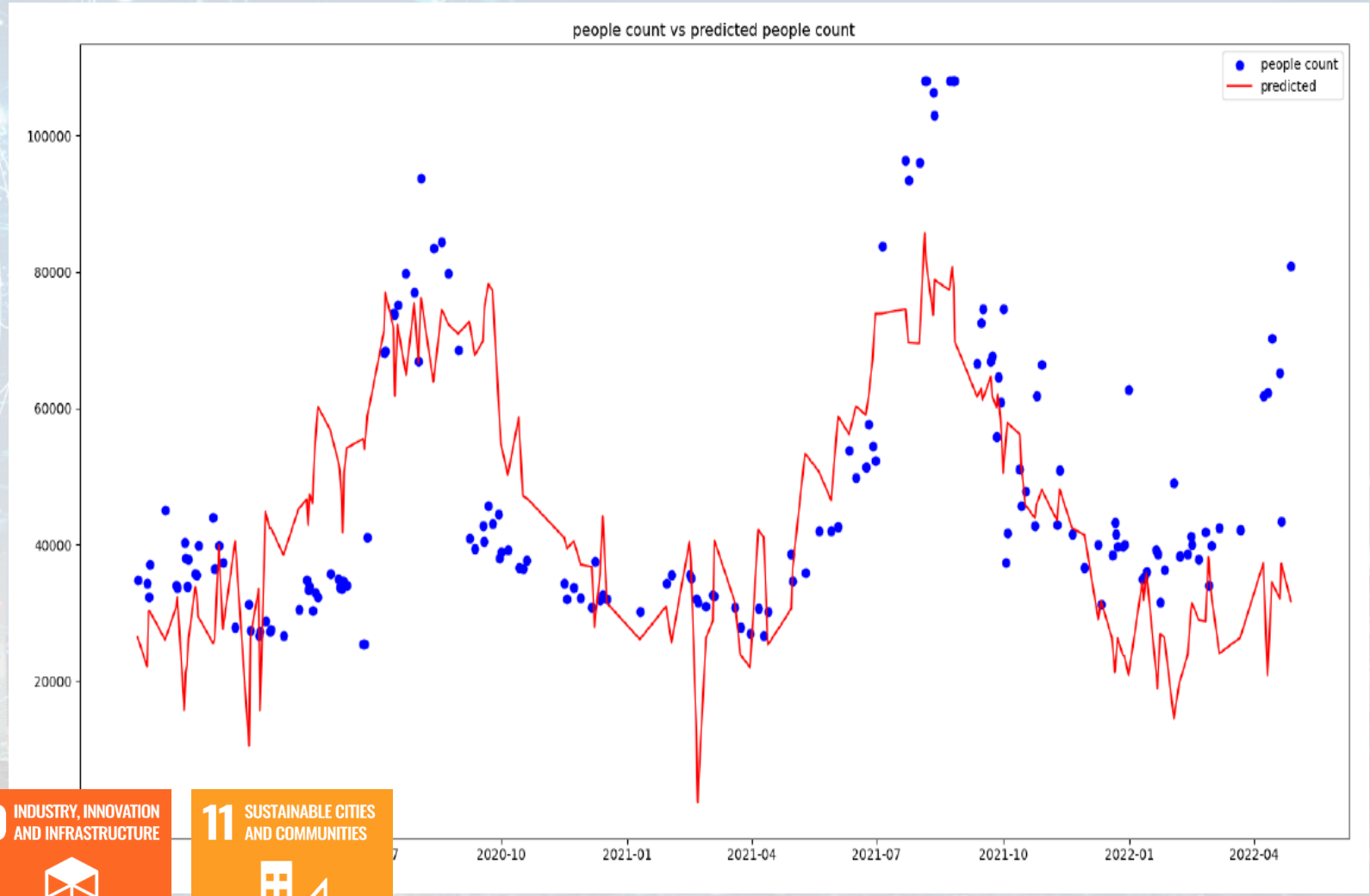
11 SUSTAINABLE CITIES AND COMMUNITIES

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

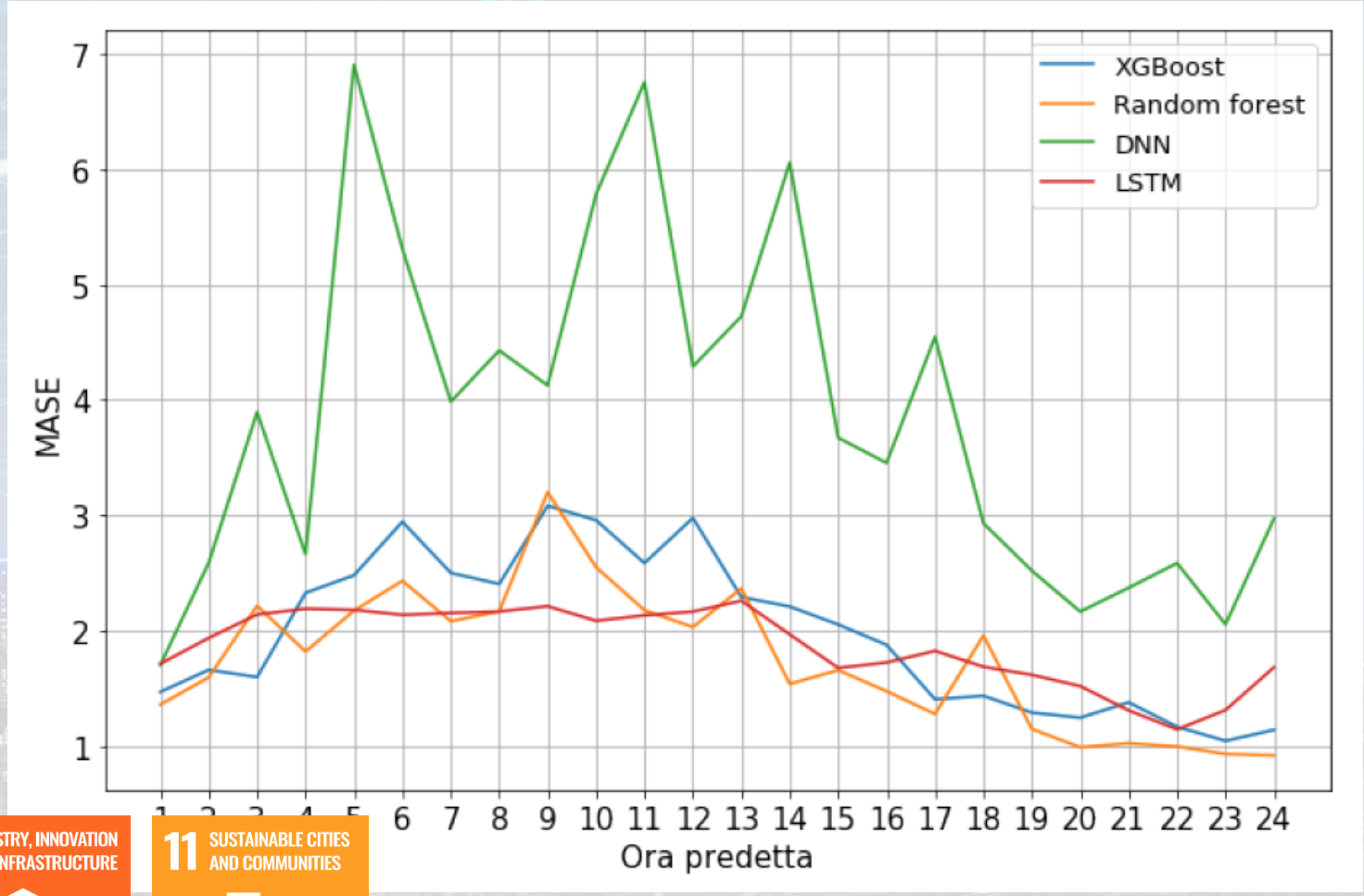
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

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



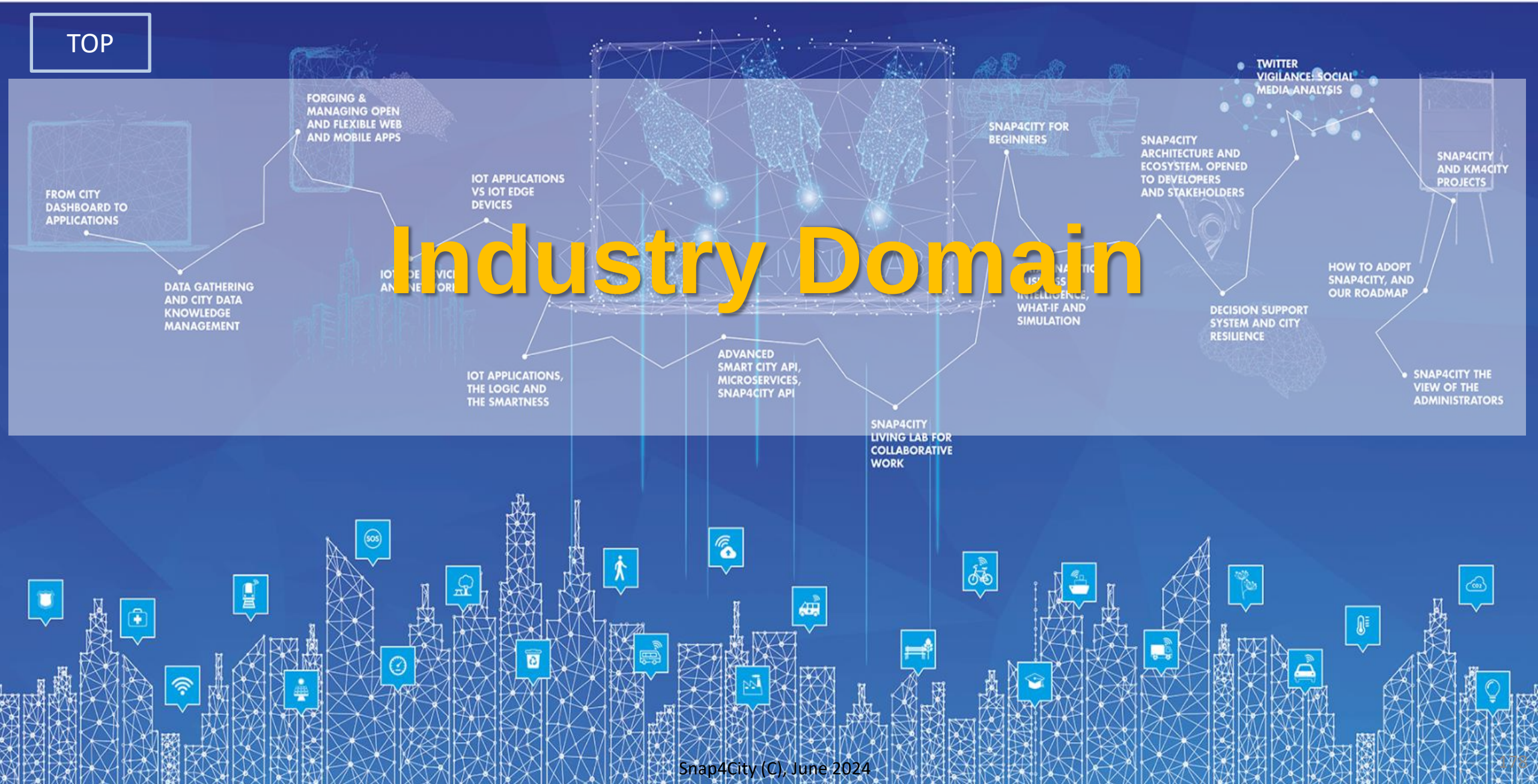
Twitter Vigilance

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

11 SUSTAINABLE CITIES AND COMMUNITIES

TOP

Industry Domain



Industry production Domain (2024)

- Goals:
  - Efficiency, costs
  - 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

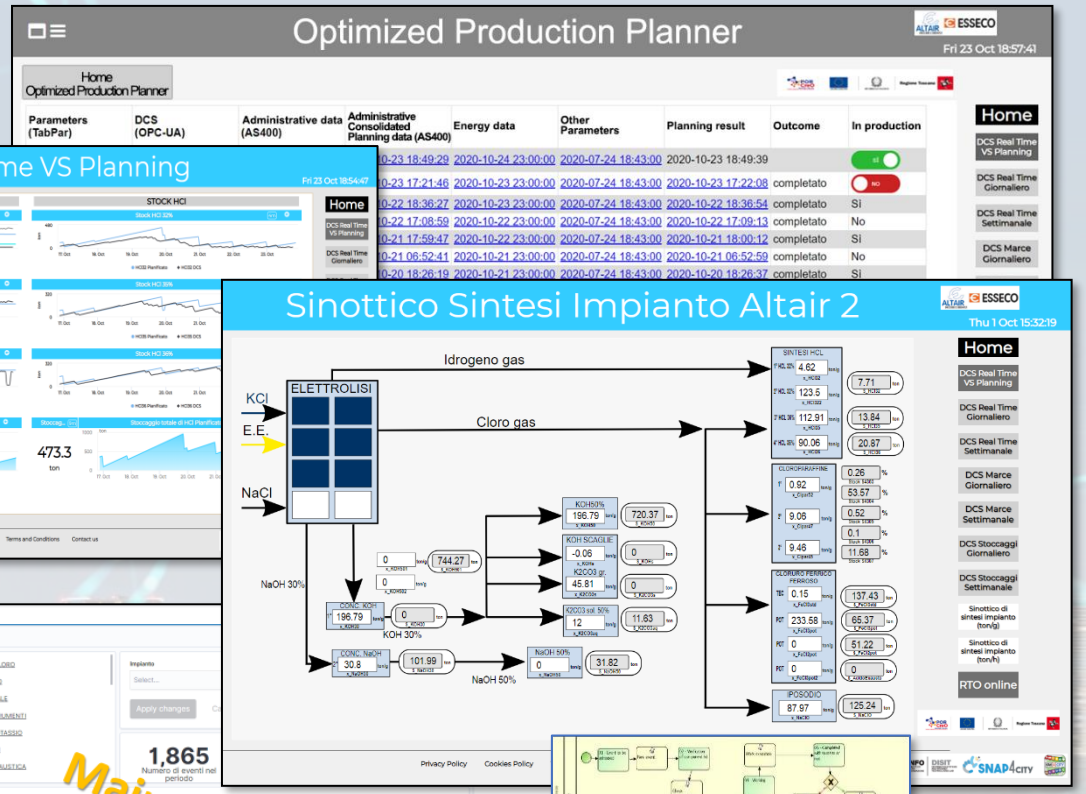
Aims

- **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**



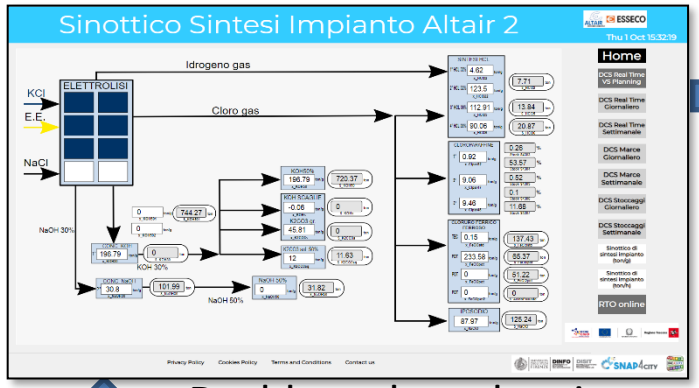
UNIVERSITÀ DEGLI STUDI FIRENZE

DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

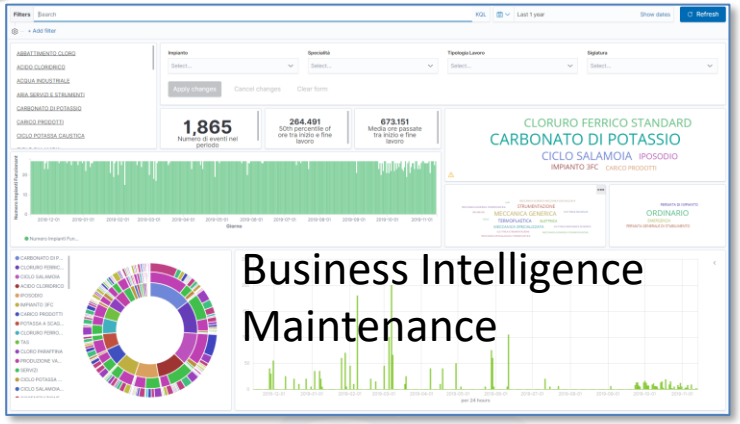
DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB
DISTRIBUTED DATA INTELLIGENCE AND TECHNOLOGIES LAB

SNAP4CITY KM4CITY

Workflow for Ticket management



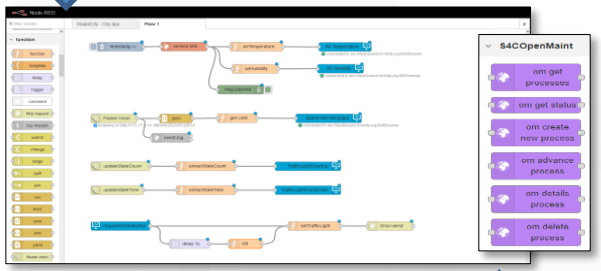
Consumptions/productions

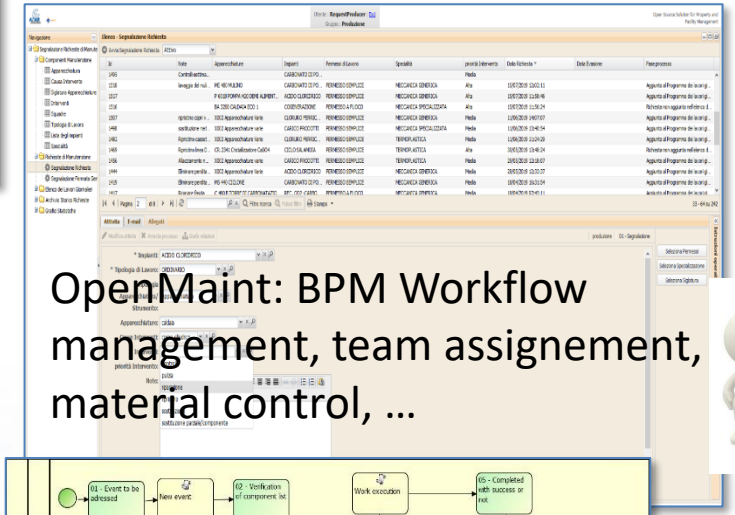


Events/actions

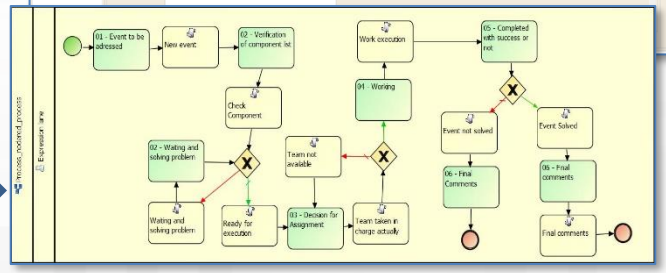
Business Intelligence
Maintenance

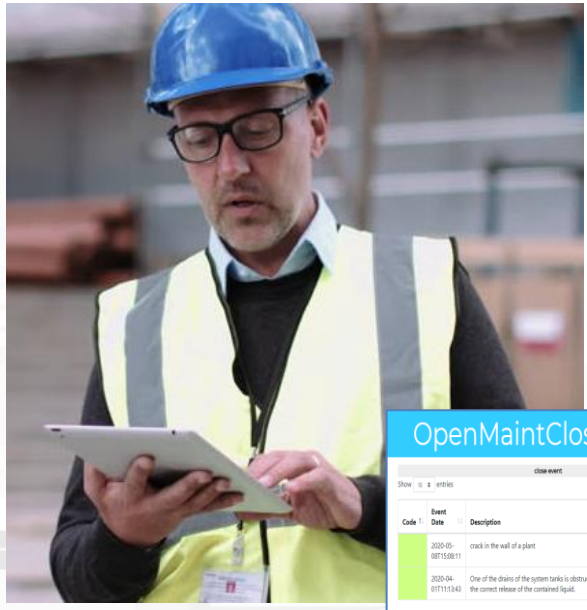
Dashboards and actions

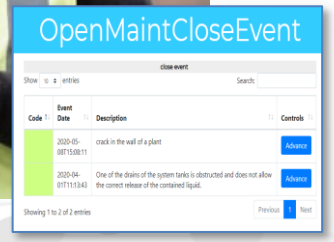




OpenMaint: BPM Workflow management, team assignement, material control, …

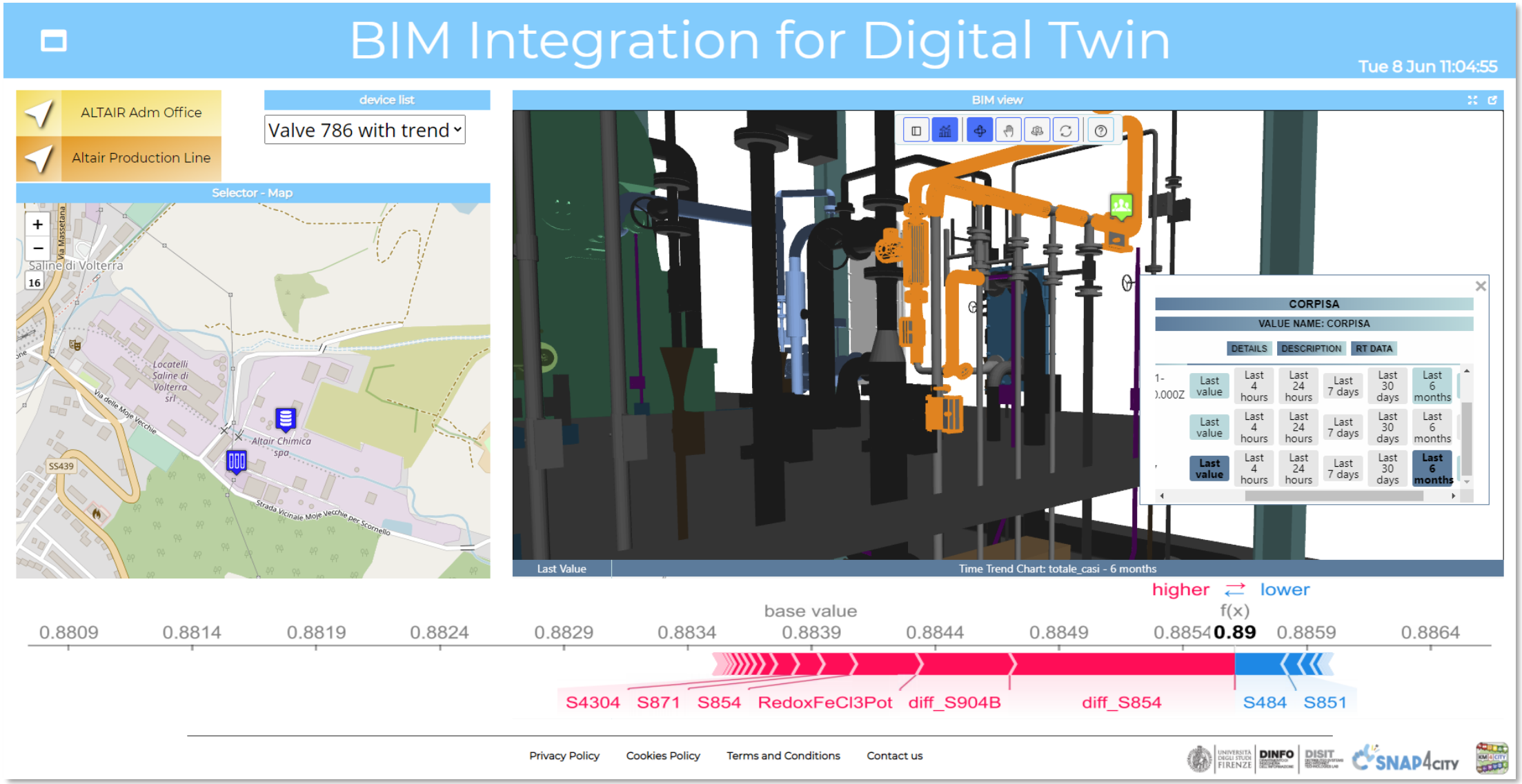






IOT App, Data event firing, event detection and firing Critical event management

Digital Twin Local, 3D vs Real Time Data



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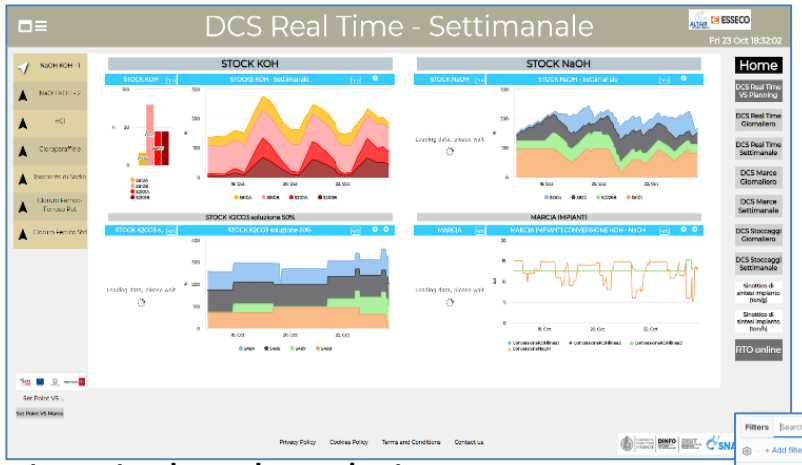
DISTRIBUTED DATA INTELLIGENCE AND TECHNOLOGIES LAB

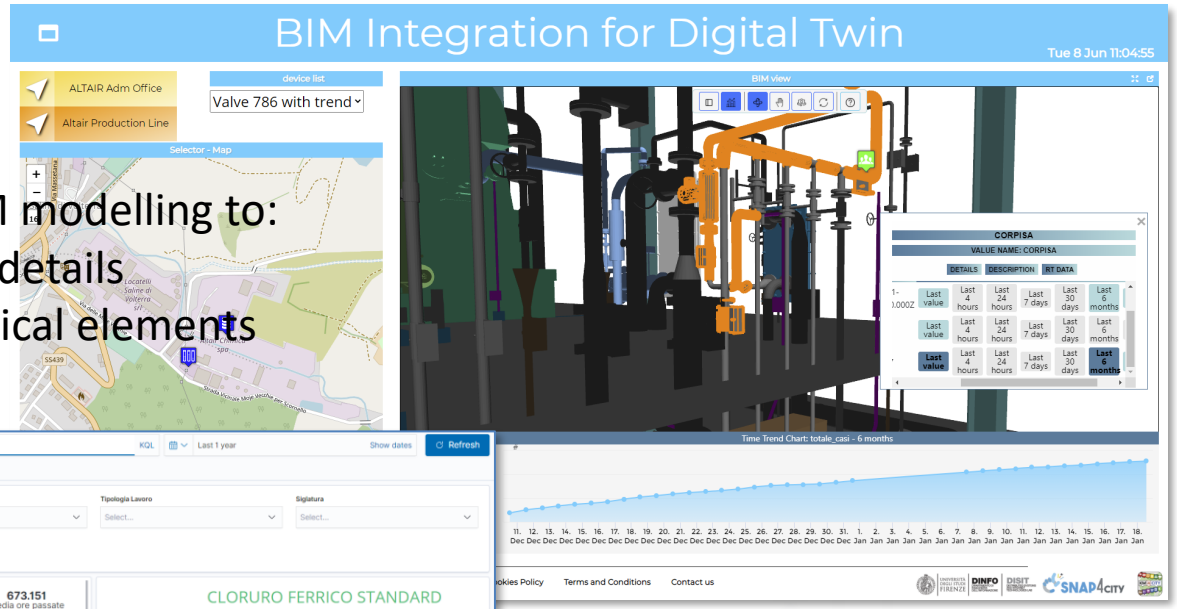
Closing the loop

SNAP4CITY KM4CITY

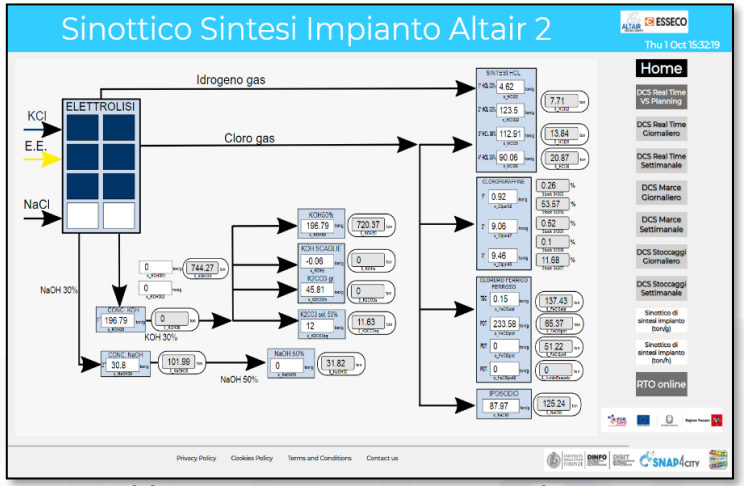


Historical and Real Time Data

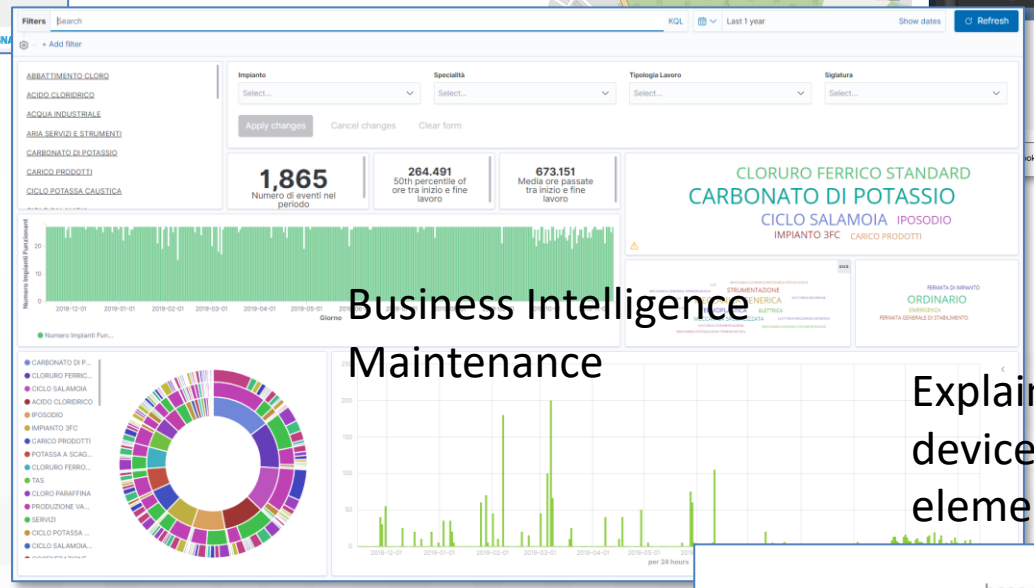
Map and 3D BIM modelling to:
-- represent the details
-- associate physical elements with data



Synoptics for real time monitoring

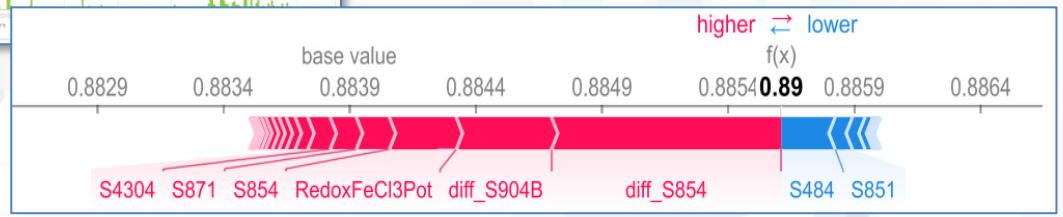


https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA1NA==



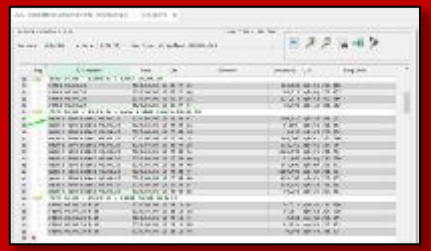
Business Intelligence Maintenance

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



GeNotiLab Architecture for ALTAIR

Analytical Data from the product quality Lab(LIMS/SAM)



AS400

IOT App

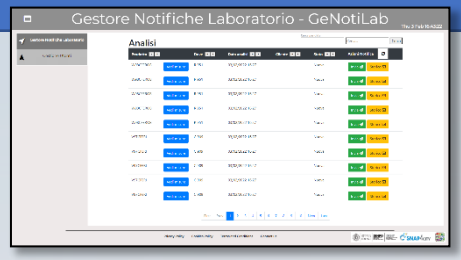
Users

Analysis

Notifications

IOT App Analytics

Dashboards



IOT App Management

Tools:
-- List of Chemical Analyses
-- List of Notifications
-- Define notifications
-- Program, send notifications
-- see notification status

IOT App Vs Telegram

Telegram Bot

Sinottico Impianto

Sinottico Impianto Presse - Autoclave

Mon 4 Oct 15:34:59

Stato Presse

OFF 1	OFF 2	OFF 3	OFF 4	OFF 5	ON 6
OFF 7	OFF 8	OFF 9	OFF 10	ON 11	OFF 12
OFF 13	ON 14	OFF 15	OFF 16	OFF 17	OFF 18
OFF 19	OFF 20	OFF 21	OFF 22	OFF 23	

Select Pressa

PRESSA 6

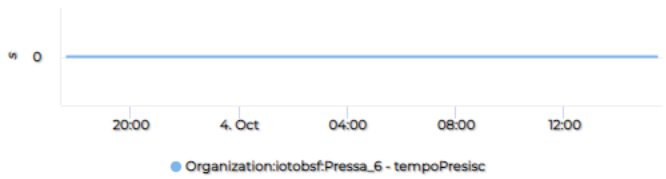
Press to update the list

Status

NO STATUS

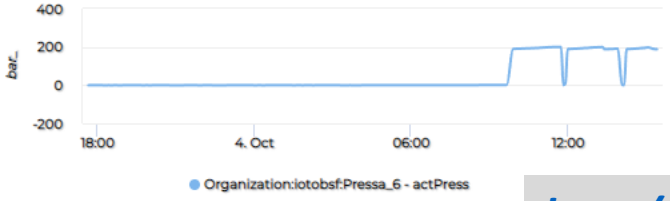
Tempo Vulcanizzione Pressa

Tempo Preriscaldo Pressa



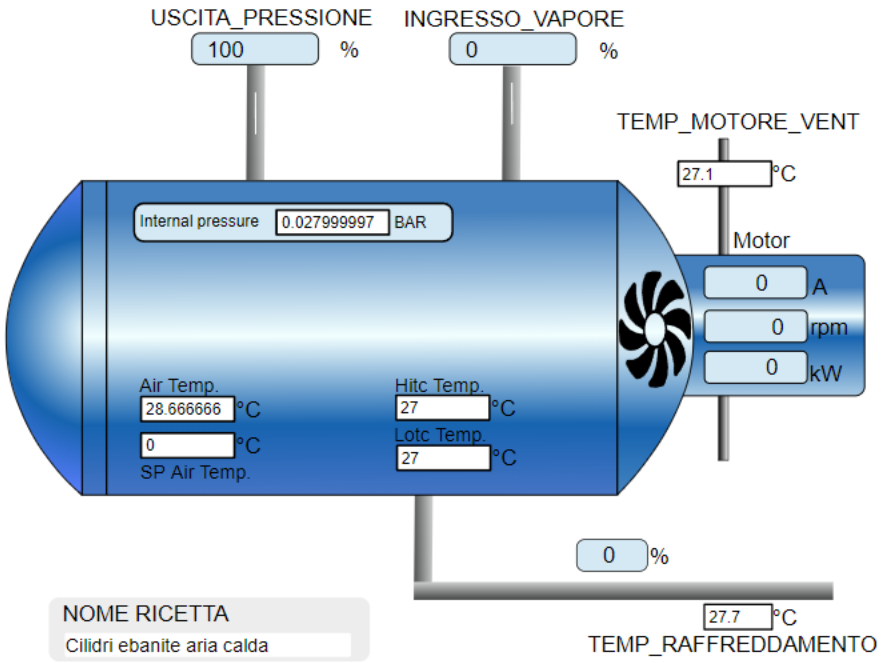
Temperatura Settore Pressa

Pressione Pressa



Temperatura Piani Pressa

Stato autoclave



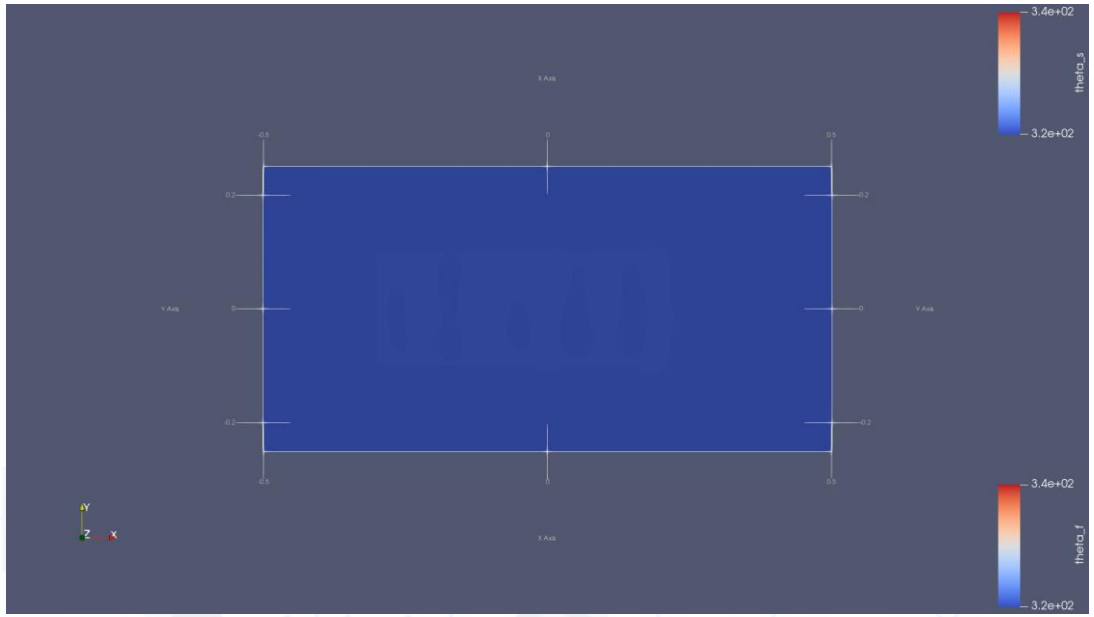
- Main Dashbaord
- Autoclave db - Weekly
- Autoclave KPI - Weekly
- Impianto Presse - Weekly
- OpcUaValues - Weekly
- OpcUaValues ... rison

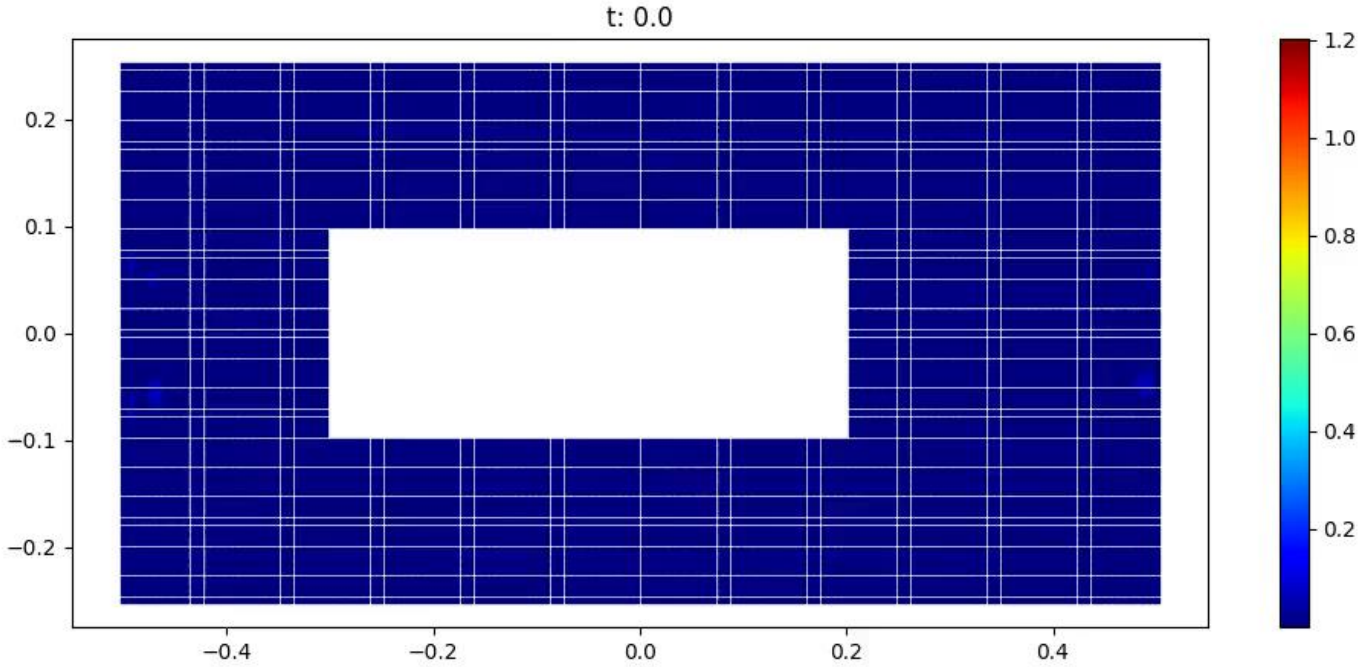
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

http://dashboard/dashboardSmartCity/view/index.php?iddasboard=MTk=

Physics-informed neural networks (PINN)

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





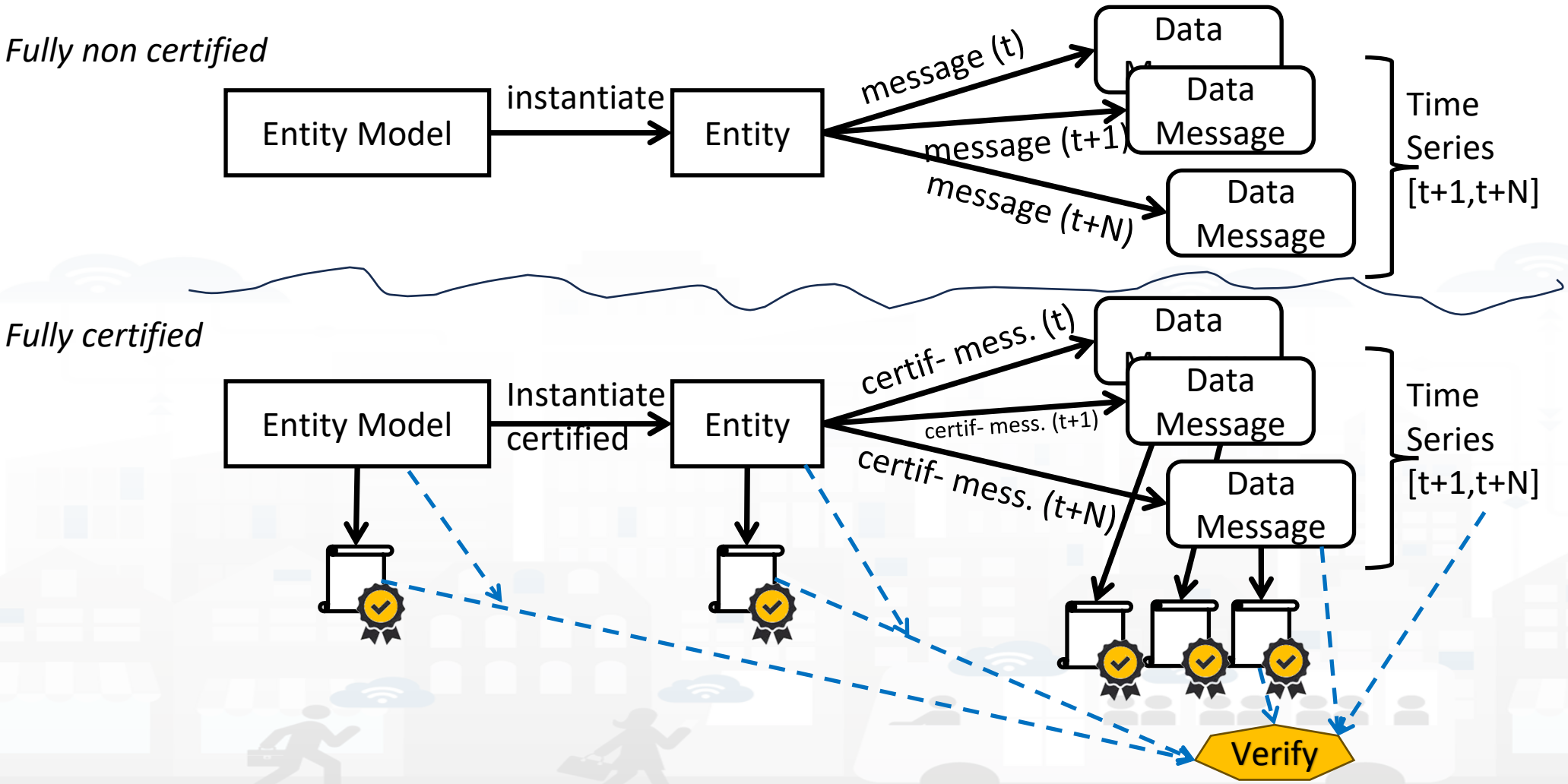
TOP

Blockchain for Certification, Contracts, NFT, etc.

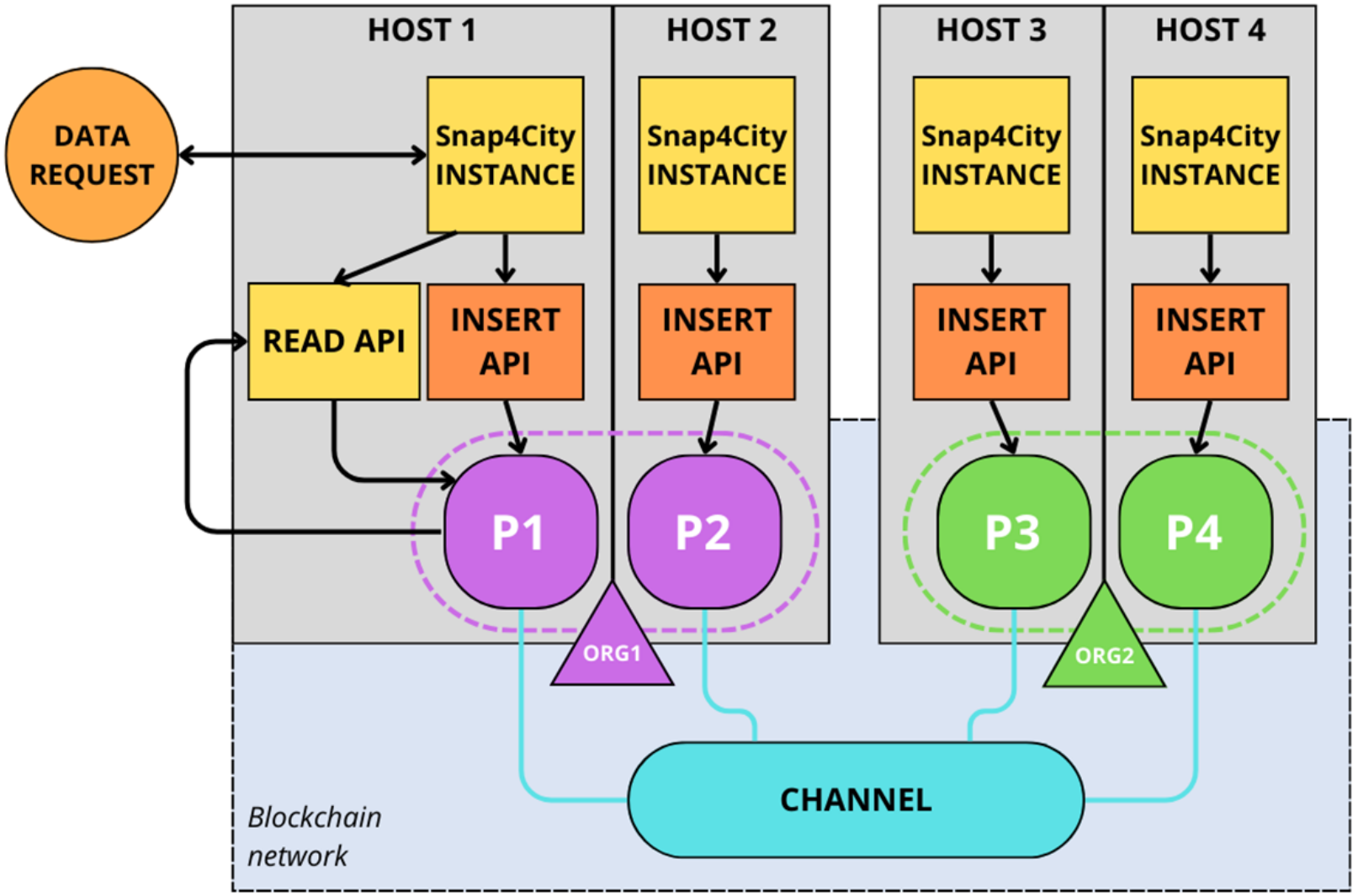
BlockChain vs Snap4City

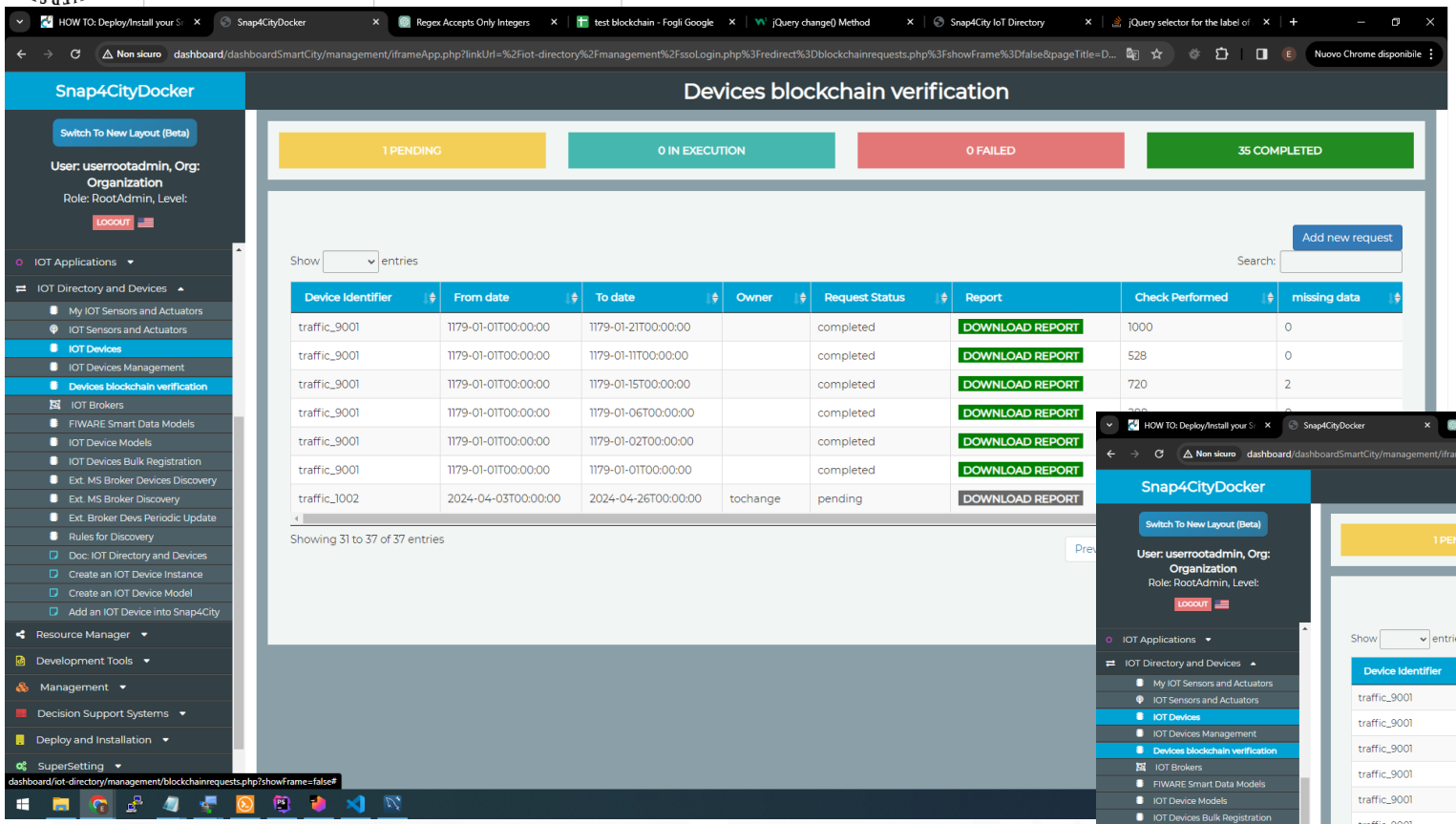
- A feature optionally installed and optimally used to certify locally or in federation with other installations.
- Blockchain technology on Snap4City can be used for:
  - Certification of Data Messages →
    - Time Series, NFT with history of transactions, cold chains, transactions chains
    - MaaS, 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

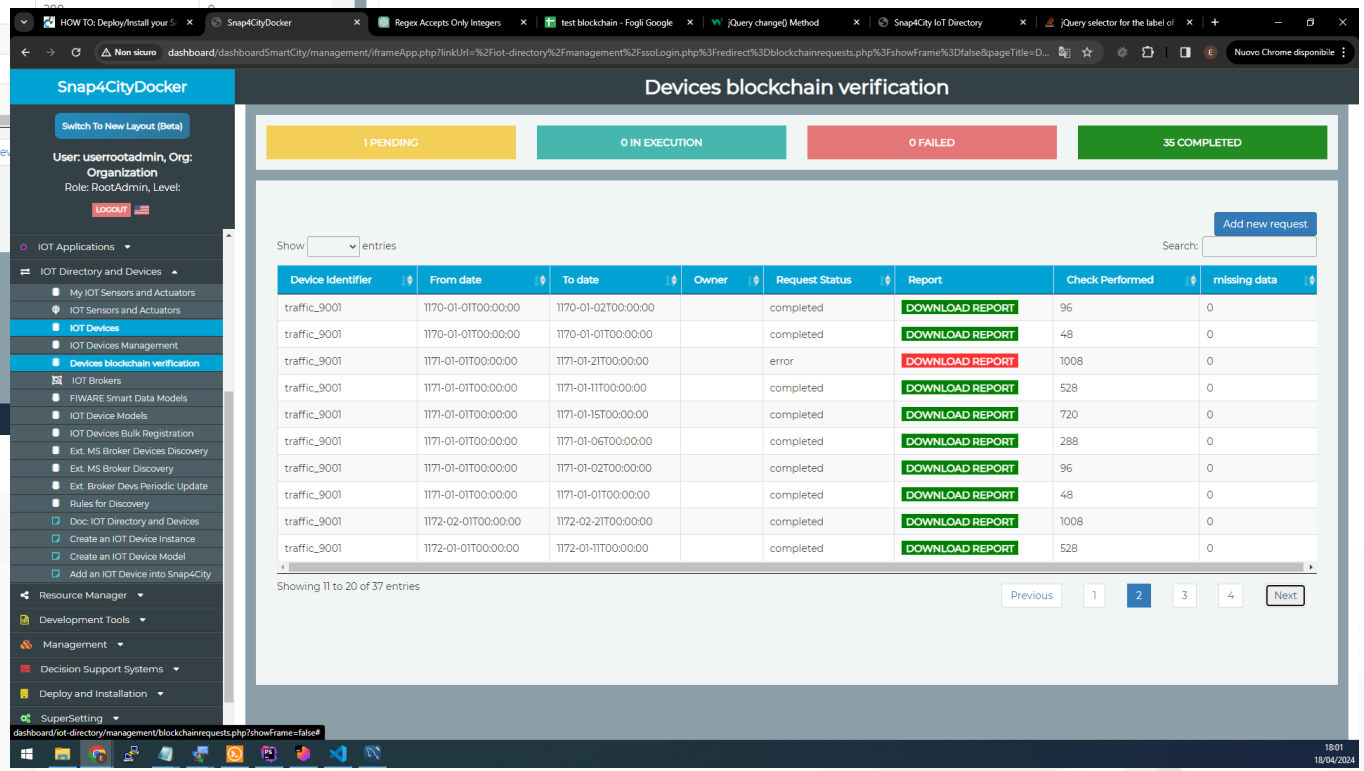
Cerified and non certified entities



Snap4City with Blockchain

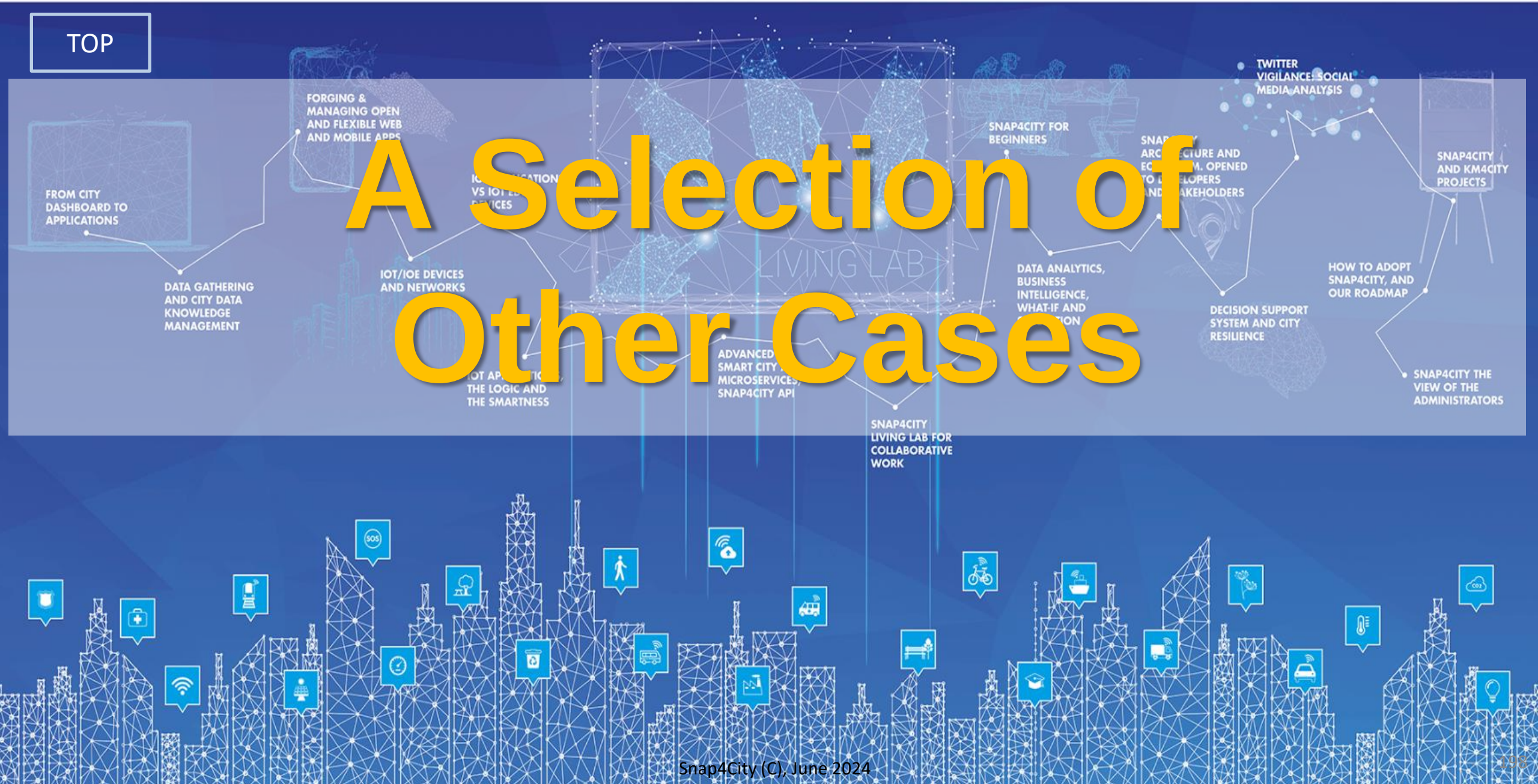



Snap4CityDocker
Devices blockchain verification
Switch To New Layout (Beta)
User: userrootadmin, Org: Organization
Role: RootAdmin, Level:
LOGOUT
1 PENDING
0 IN EXECUTION
0 FAILED
35 COMPLETED
Add new request
Show entries
Search:
Device Identifier | From date | To date | Owner | Request Status | Report | 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
IOT Applications
IOT Directory and Devices
My IOT Sensors and Actuators
IOT Sensors and Actuators
IOT Devices
IOT Devices Management
Devices blockchain verification
IOT Brokers
FIWARE Smart Data Models
IOT Device Models
IOT Devices Bulk Registration
Ext. MS Broker Devices Discovery
Ext. MS Broker Discovery
Ext. Broker Devs Periodic Update
Rules for Discovery
Doc: IOT Directory and Devices
Create an IOT Device Instance
Create an IOT Device Model
Add an IOT Device into Snap4City
Resource Manager
Development Tools
Management
Decision Support Systems
Deploy and Installation
SuperSetting


Snap4CityDocker
Devices blockchain verification
Switch To New Layout (Beta)
User: userrootadmin, Org: Organization
Role: RootAdmin, Level:
LOGOUT
1 PENDING
0 IN EXECUTION
0 FAILED
35 COMPLETED
Add new request
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

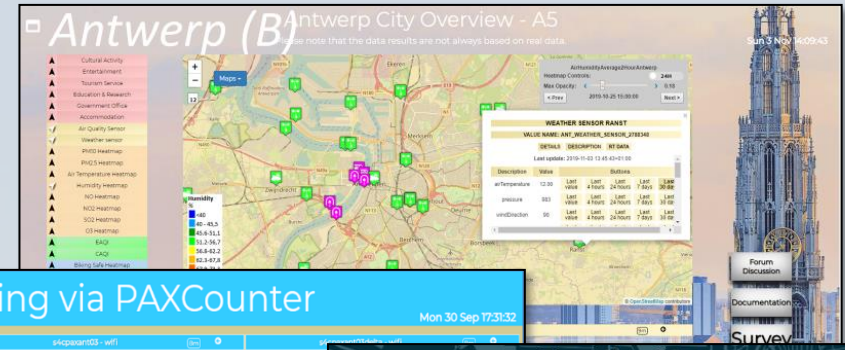
- Scenario: SnapBot: Real Time Smart City services via Telegram
- Scenario: Copernicus Satellite Data
- Scenario: SmartBed, Materasso Intelligente
- MicroServices Suite for Smart City Applications
- Scenario: MODBUS for Snap4Industry Snap4City Applications
- Scenario: MOBIMART Interreg: MOBilità Intelligente 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

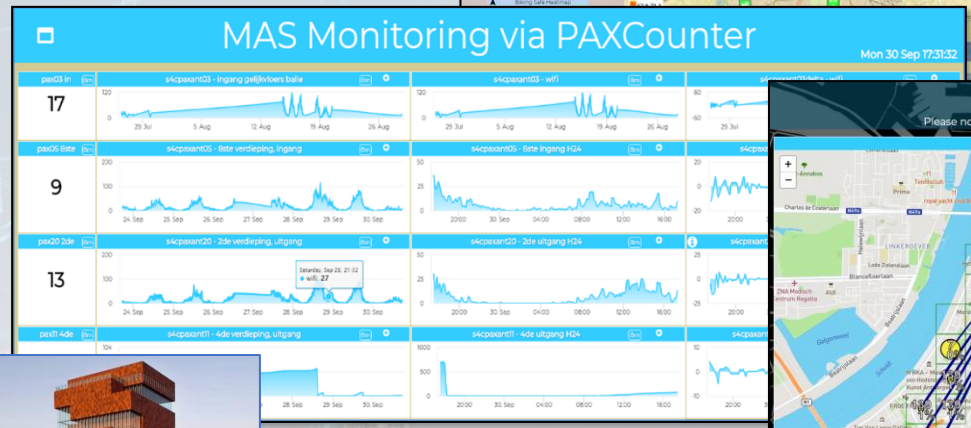
- Data Analytic: Origin Destination Matrices, Algorithms and tools
- Data Analytic: Traffic Flow Reconstruction
- Data Analytic: in general, and the cases of Antwerp and Helsinki
- Data Analytic: Predicting Air Quality
- Data Analytic: Analyzing Public Transportation Offer wrt Mobility Demand

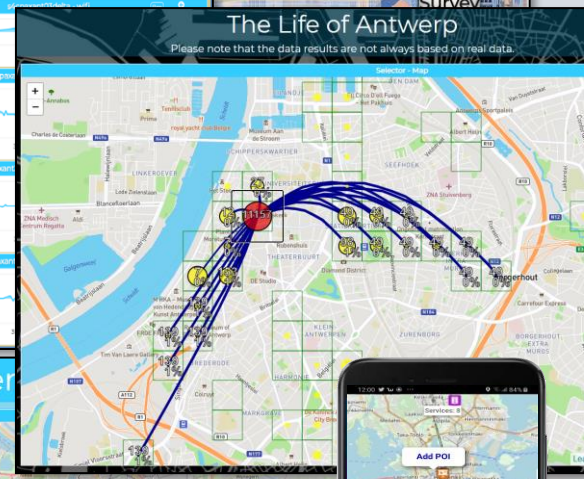
People Monitoring on Pub Services DIGIPOLIS Antwerp

reference

- **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**

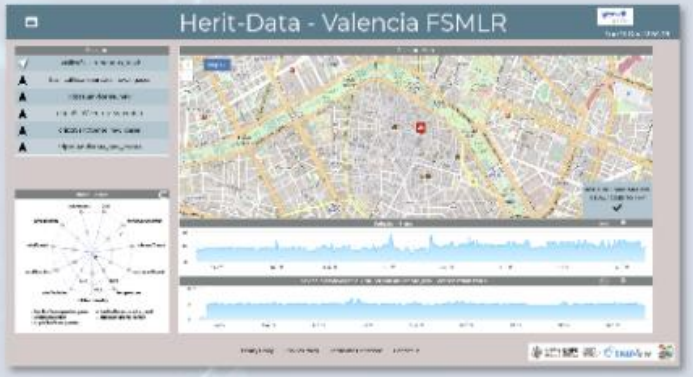


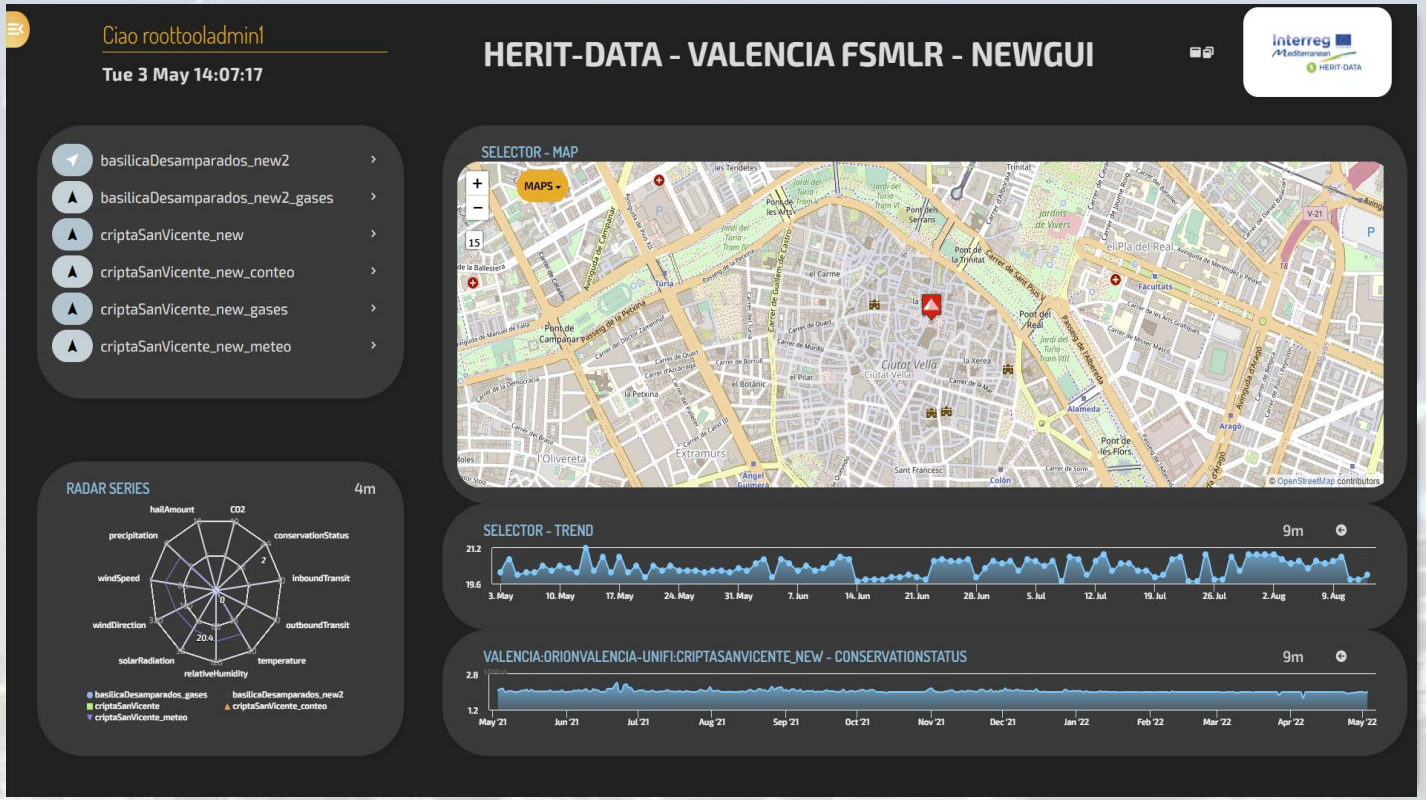




Valencia, FSMLR

- **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**

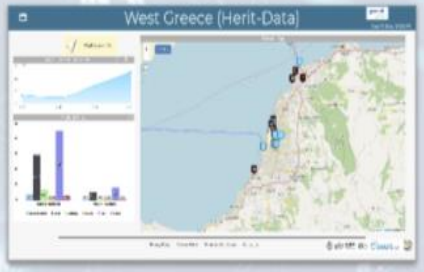


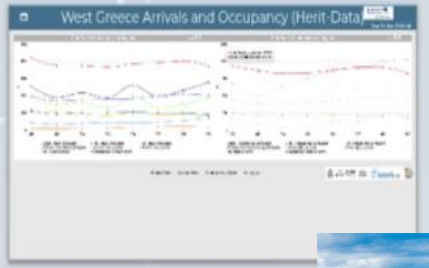


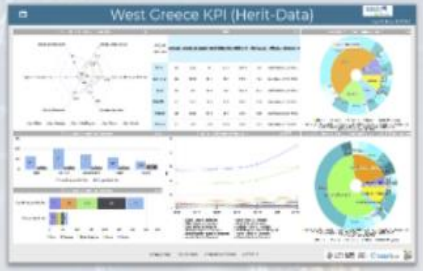
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzE1MA==

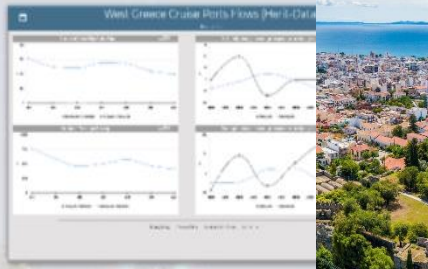
West Greece

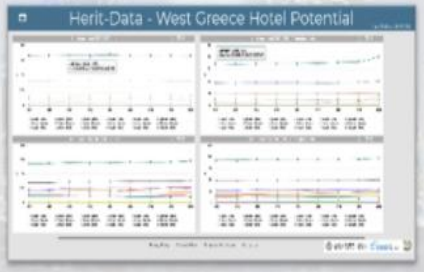
- **Tourism Domain**
  - KPIs: ODM, Flows, …
  - Social Media
  - People Flows
- **Dashboards**
  - Monitoring KPI
  - People flows
  - Twitter Vigilance
- **Historical and updated data**
- **Services Exploited on:**
  - Dashboard
- **Since 2020**







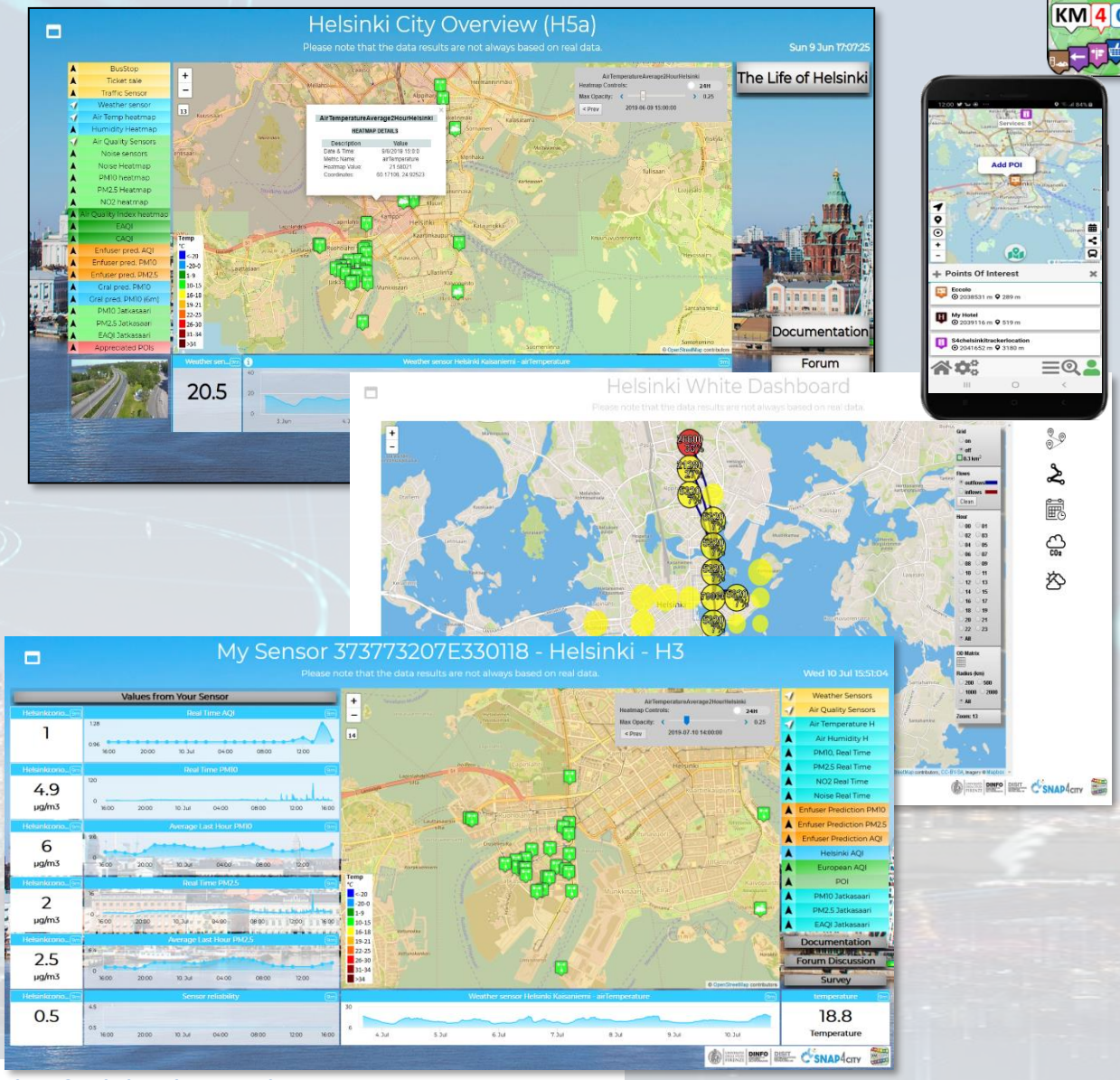




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzE1NA==

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?iddasboard=MTQwNg==

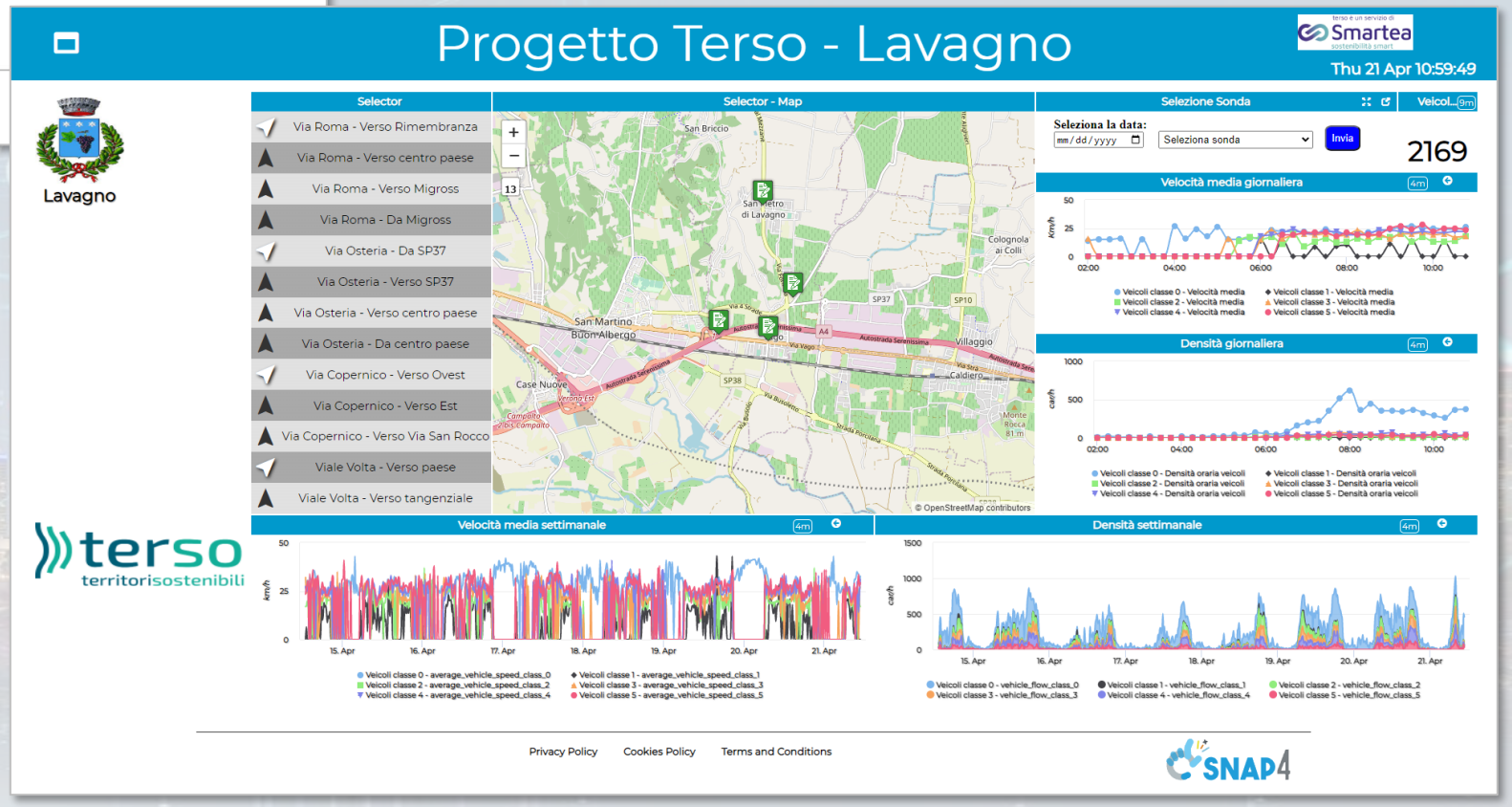
Smartea
sostenibilità smart

SNAP4

11 SUSTAINABLE CITIES AND COMMUNITIES

13 CLIMATE ACTION

15 LIFE ON LAND

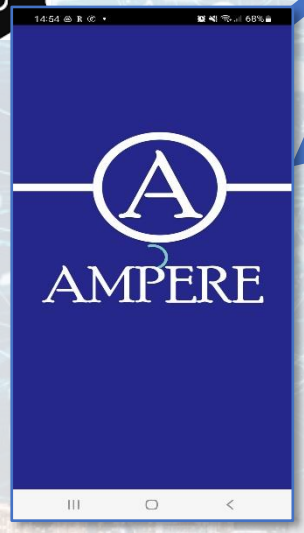


- Traffic Data
- Environmental Data
- People counting (pedestrian)

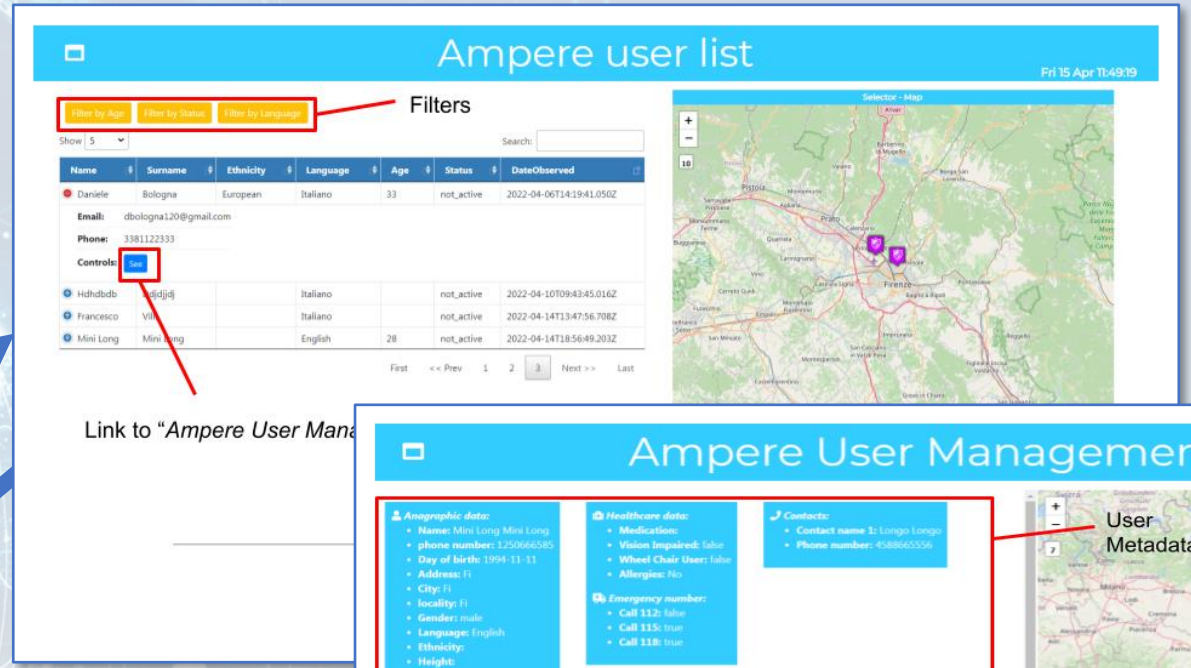
Jewel Alarms AMPERE

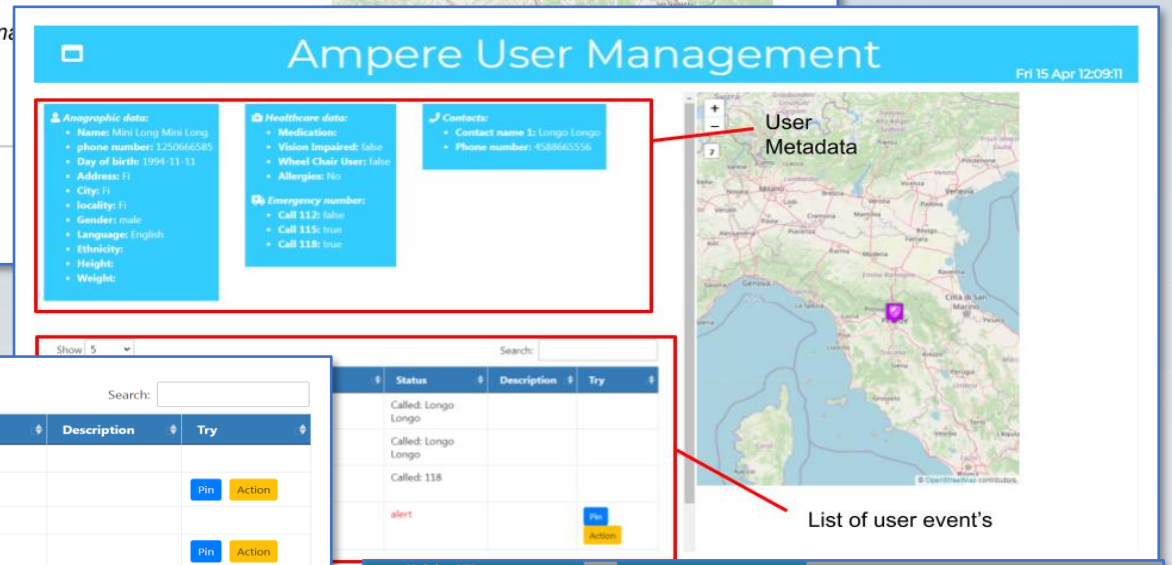
NFC

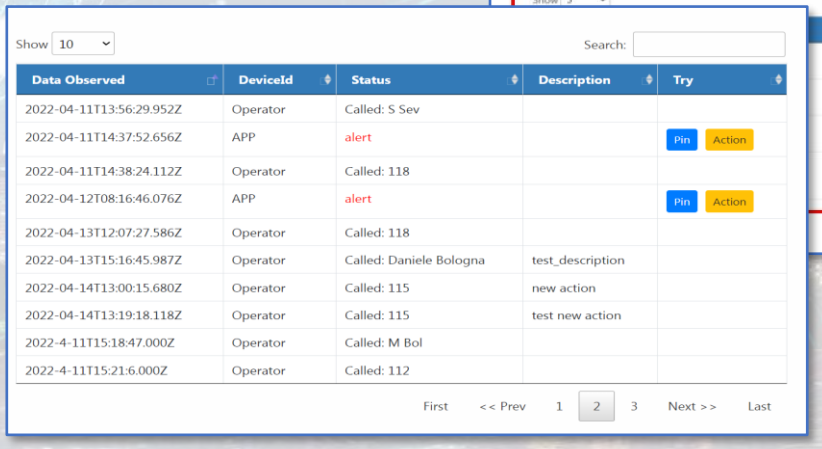
BLE



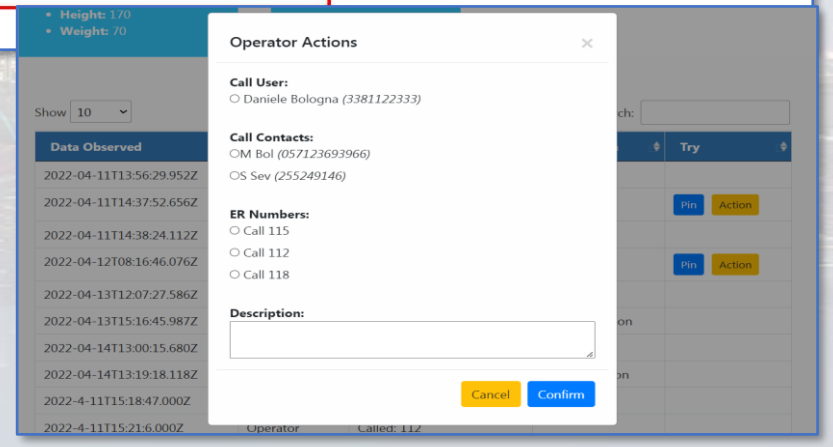
Click on Jewel







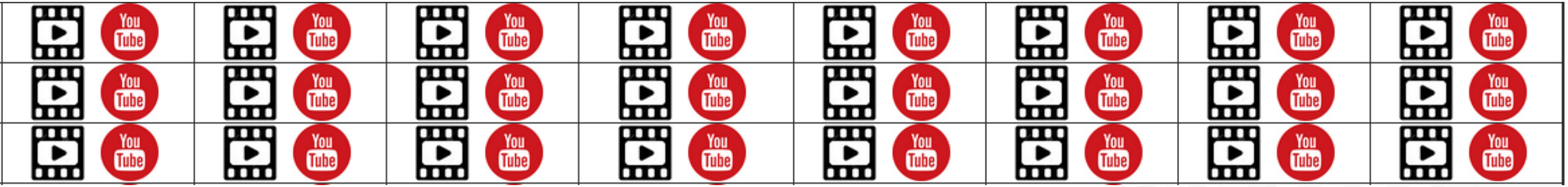
Data Observed	DeviceId	Status	Description	Try
2022-04-11T13:56:29.952Z	Operator	Called: S Sev		
2022-04-11T14:37:52.656Z	APP	alert		Pin Action
2022-04-11T14:38:24.112Z	Operator	Called: 118		
2022-04-12T08:16:46.076Z	APP	alert		Pin Action
2022-04-13T12:07:27.586Z	Operator	Called: 118		
2022-04-13T15:16:45.987Z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



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
							
							

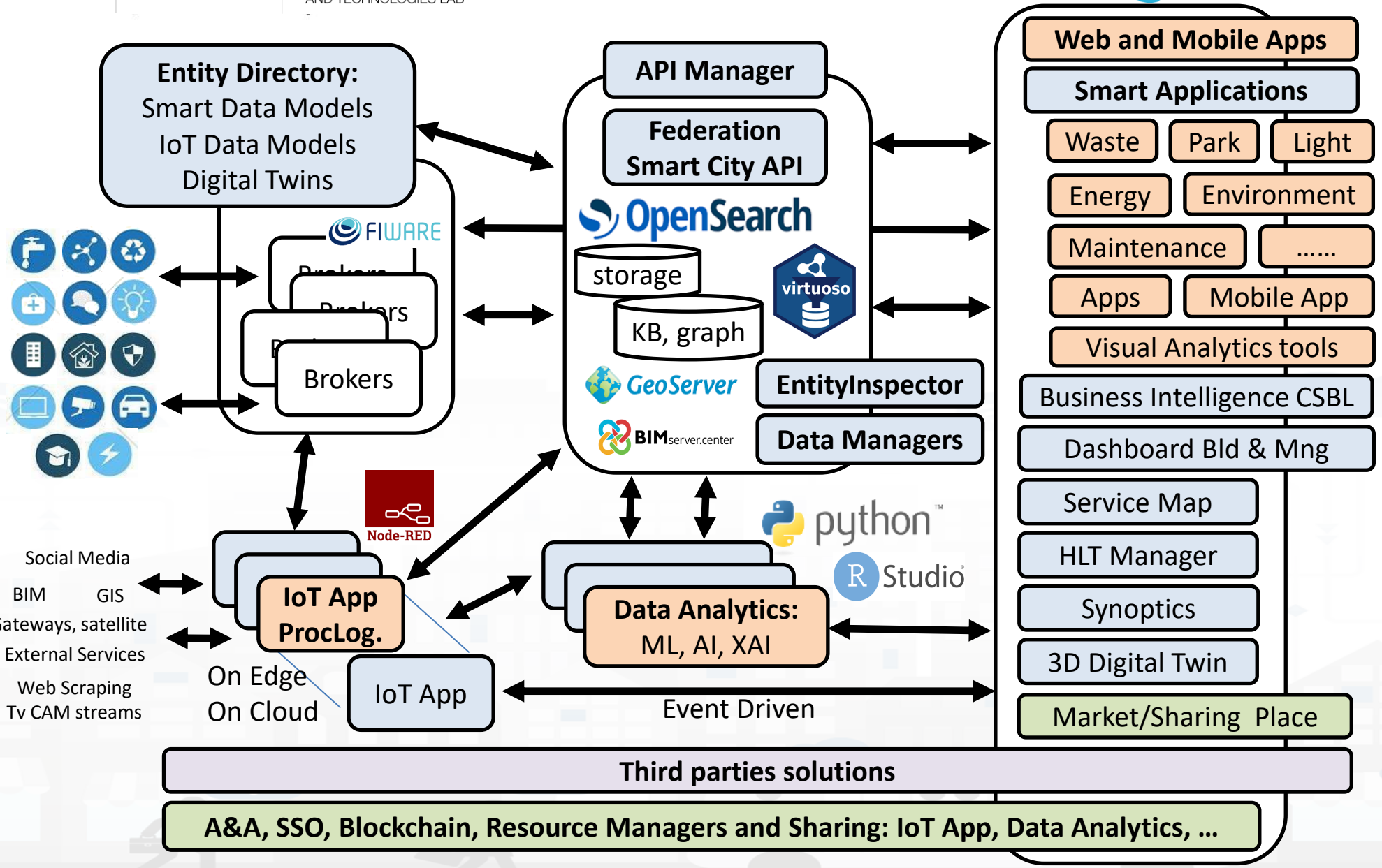


TOP

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								

Tech Arch


Entity Directory:
Smart Data Models
IoT Data Models
Digital Twins
FIWARE
Brokers
Brokers
Brokers
API Manager
Federation
Smart City API
OpenSearch
storage
KB, graph
virtuoso
GeoServer
EntityInspector
BIMserver.center
Data Managers
Node-RED
python
RStudio
Social Media
BIM
GIS
Gateways, satellite
External Services
Web Scraping
Tv CAM streams
IoT App
ProcLog.
On Edge
On Cloud
IoT App
Data Analytics:
ML, AI, XAI
Event Driven
Web and Mobile Apps
Smart Applications
Waste
Park
Light
Energy
Environment
Maintenance
……
Apps
Mobile App
Visual Analytics tools
Business Intelligence CSBL
Dashboard Bld & Mng
Service Map
HLT Manager
Synoptics
3D Digital Twin
Market/Sharing Place
Third parties solutions
A&A, SSO, Blockchain, Resource Managers and Sharing: IoT App, Data Analytics, …

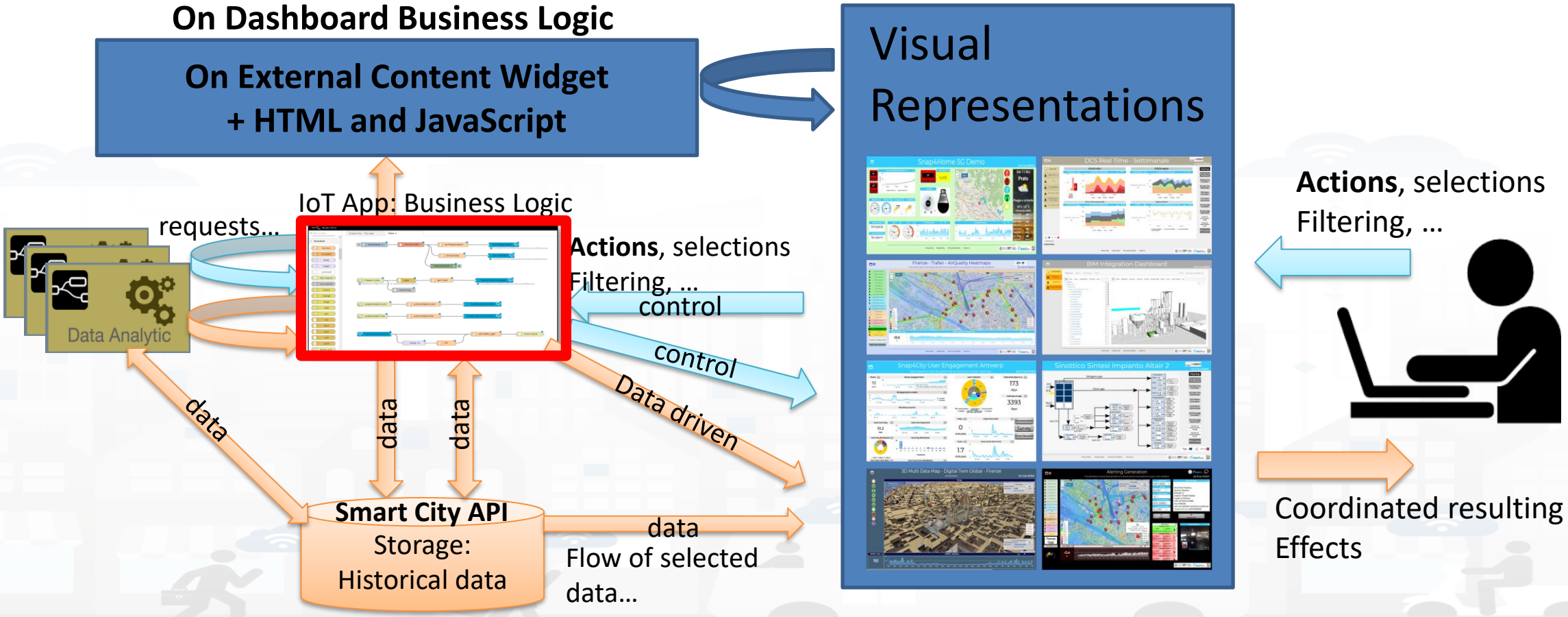
Agenda of second part

- 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

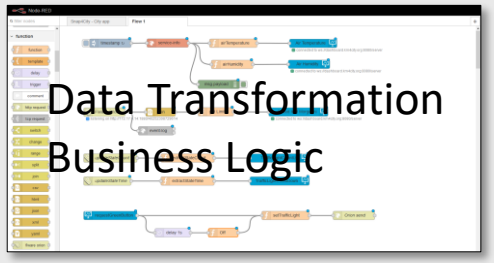
https://www.snap4city.org/944

Visual Analytics

- 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



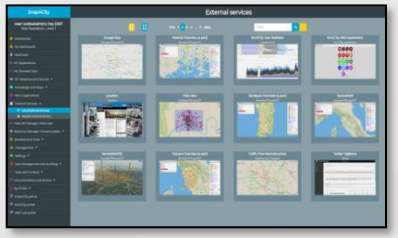
Data Transformation
Business Logic

IOT Applications

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

Widget Collection

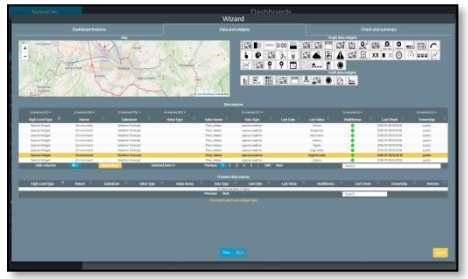
Micro
Applicat
ions



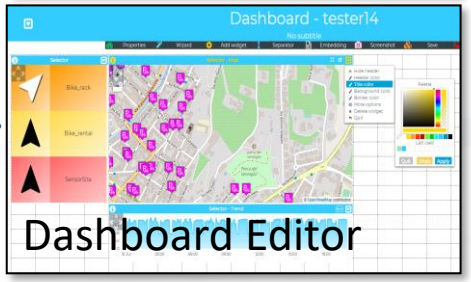
External
Services

Custom
Widgets/
Synoptics

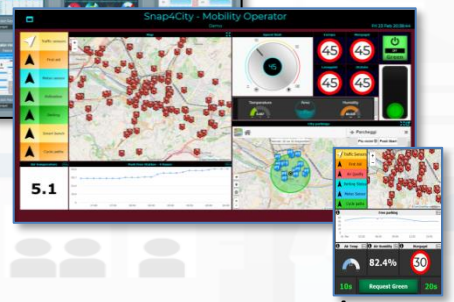
Dashboard Wizard



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



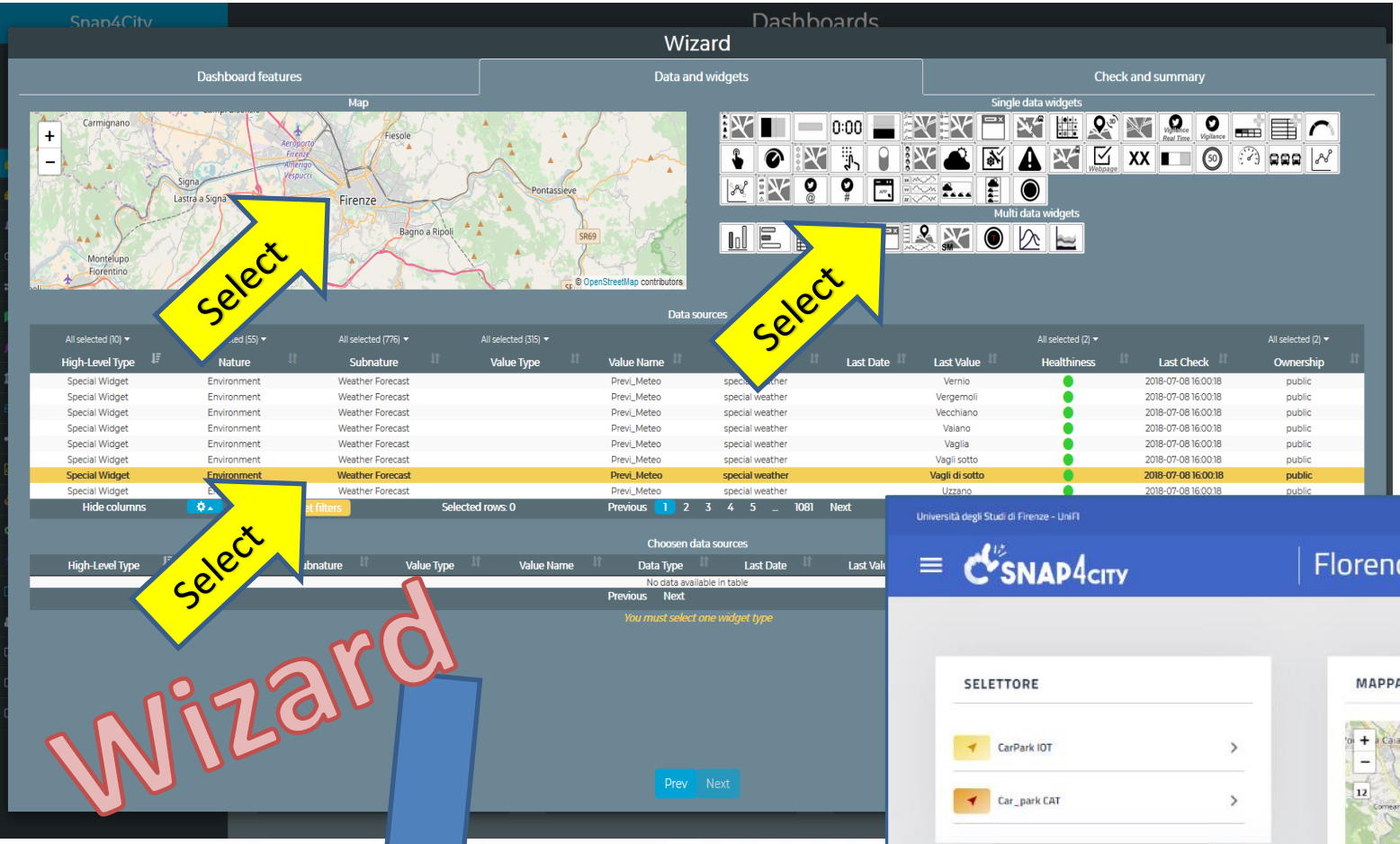
Dashboard Editor

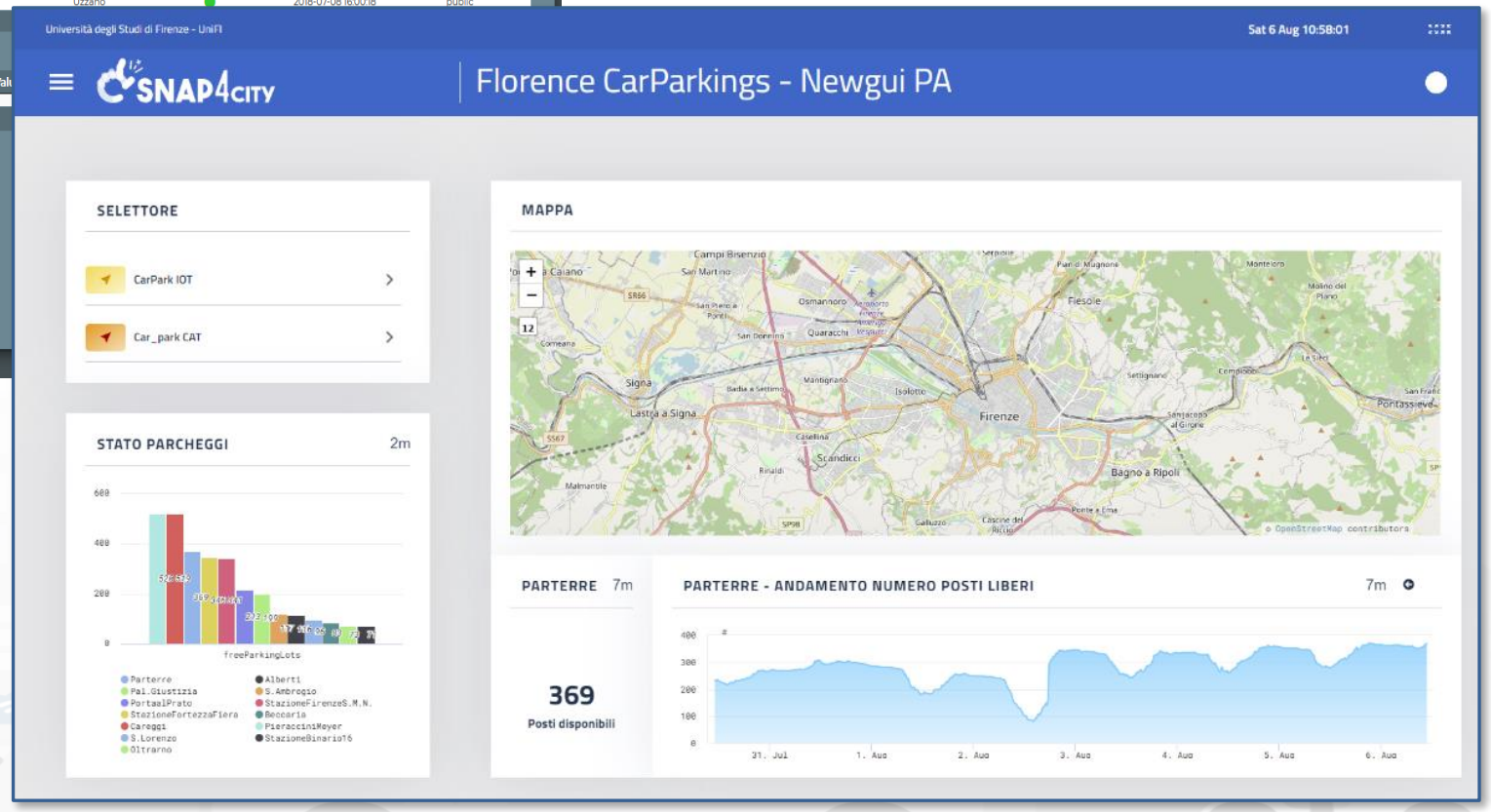


Public
Dashboard
Collection

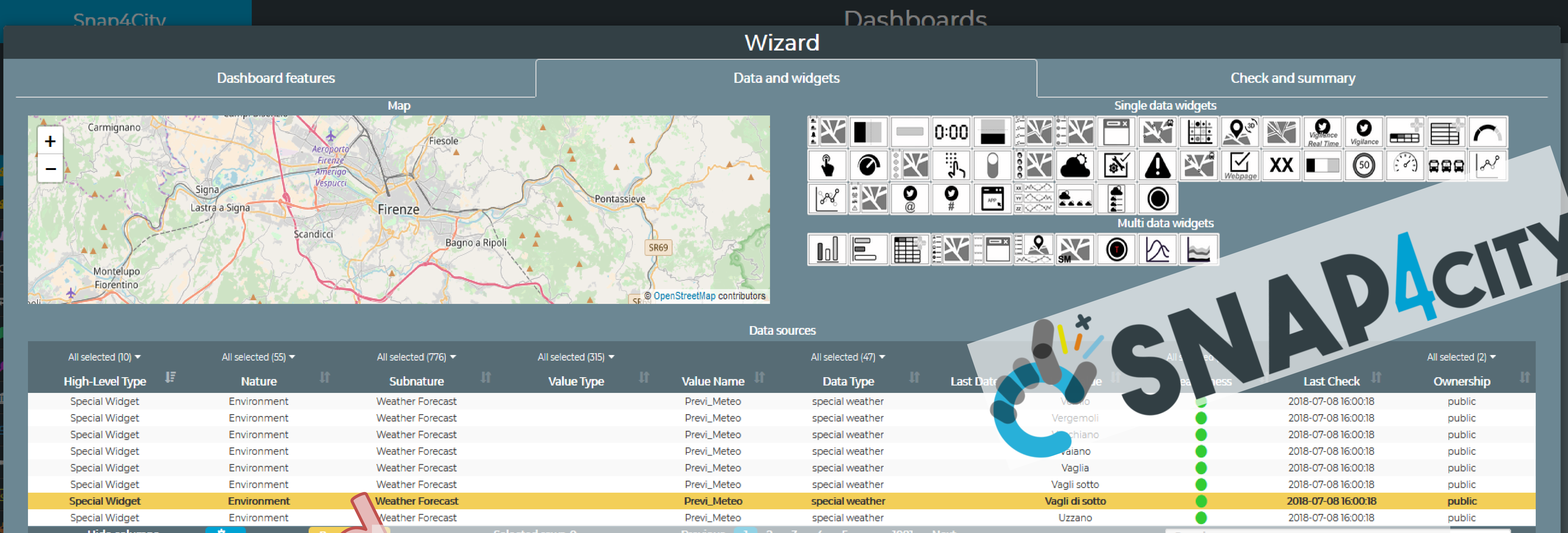
My Own Dash/App

Dashboard Wizard



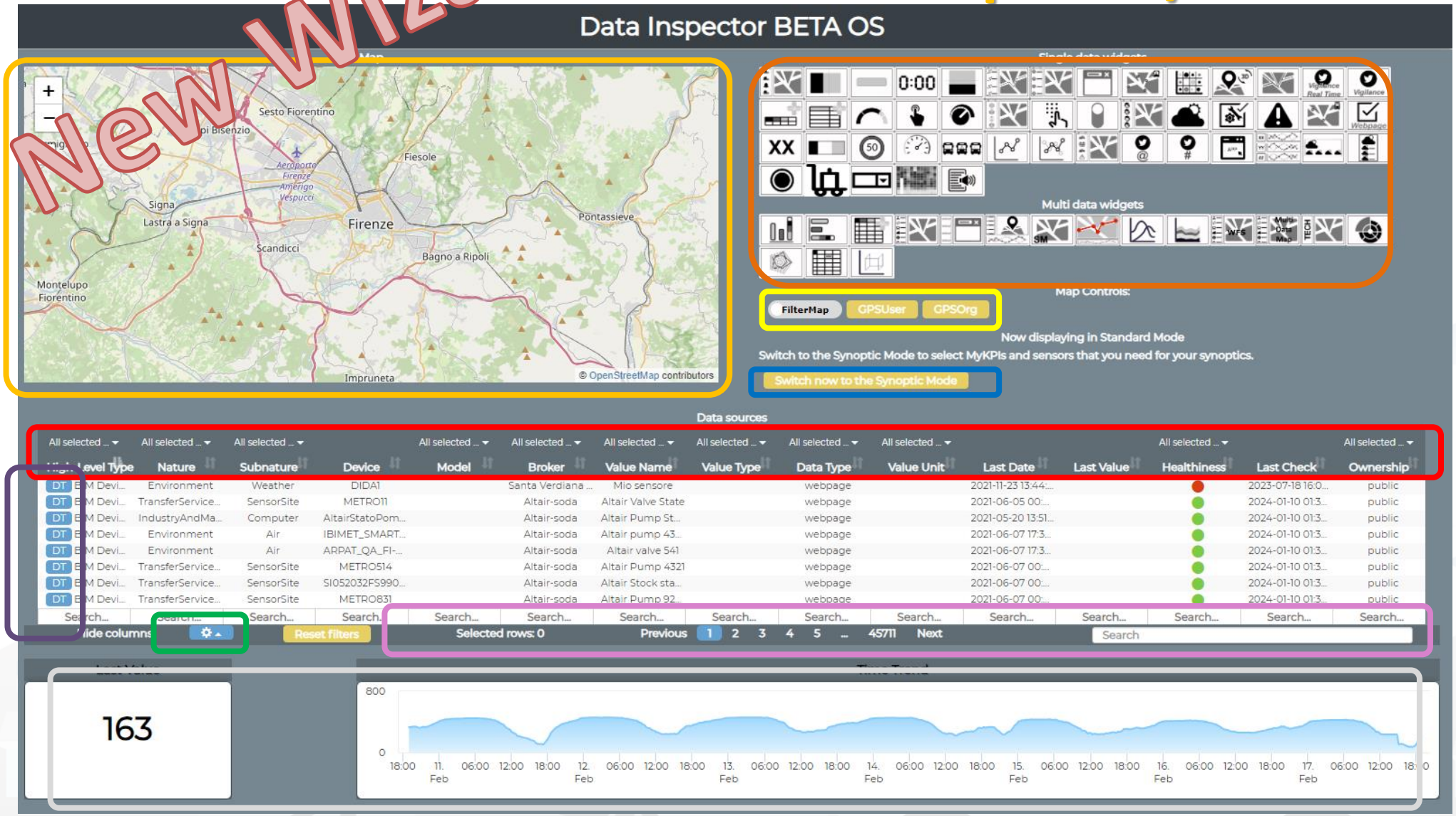


The Wizard help you in selecting only possible combination of data vs graphic representation



- 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 a 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

New Data Inspector/Wizard



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)

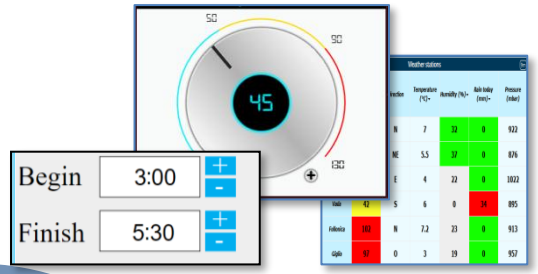
Data and Trend visualization

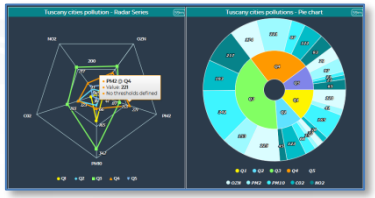
Opening Digital Twin

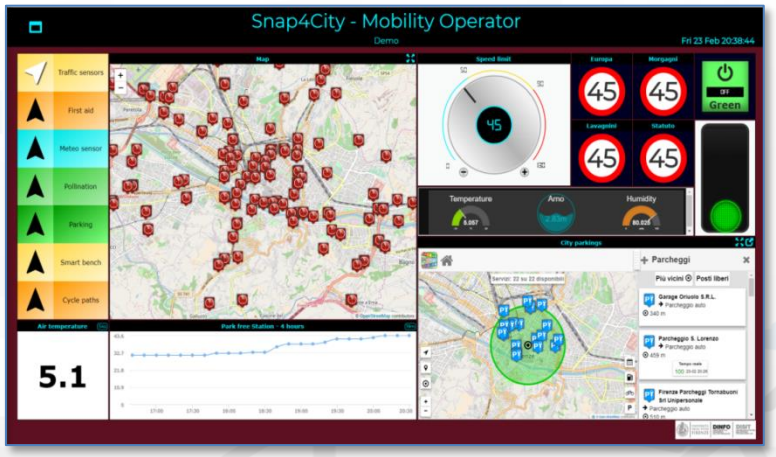
Pass to Synoptic mode

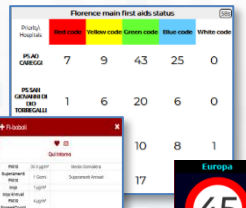
Select the graph representation

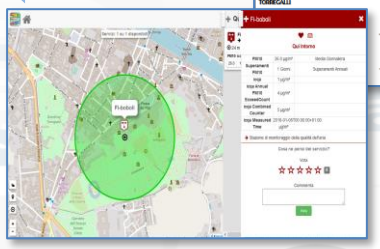
Dashboard Widgets: List and Editor

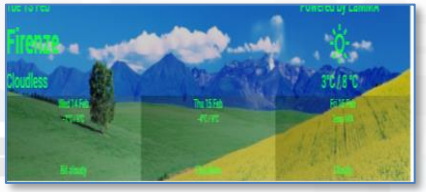


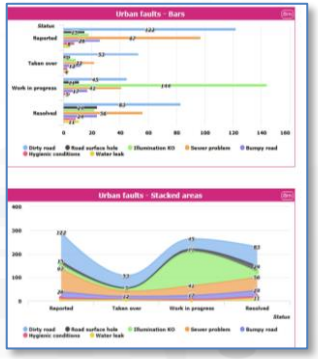






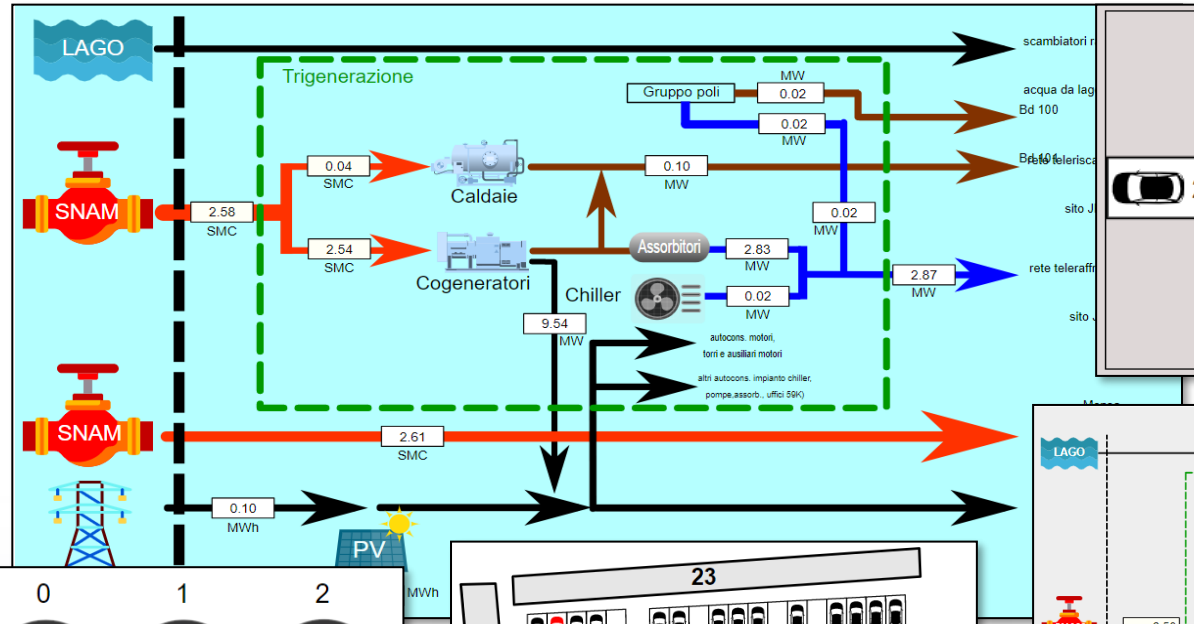


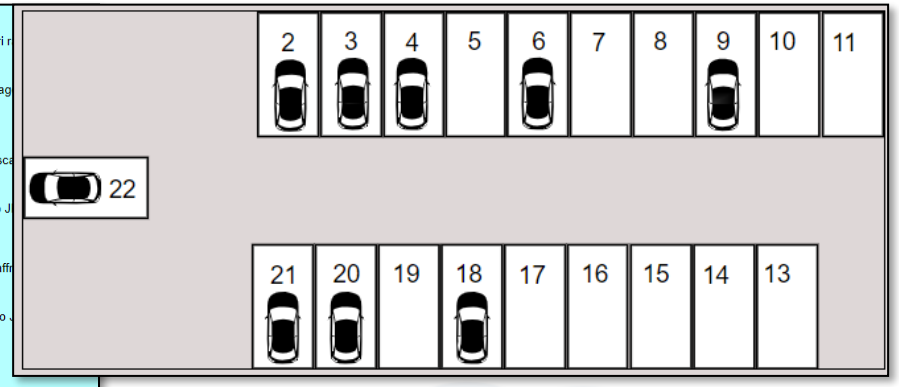


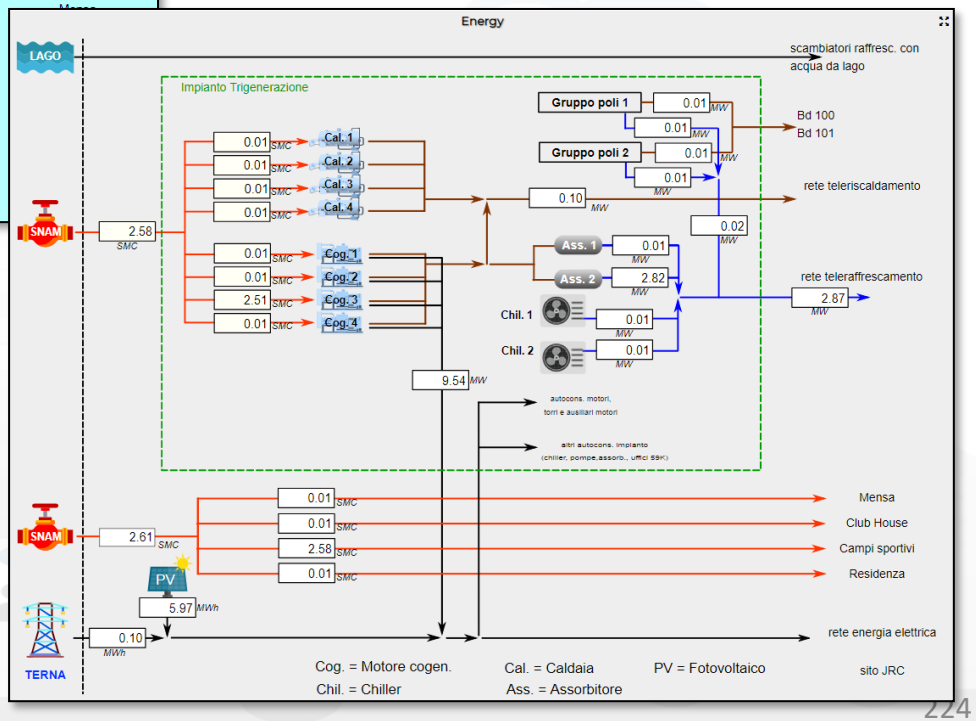


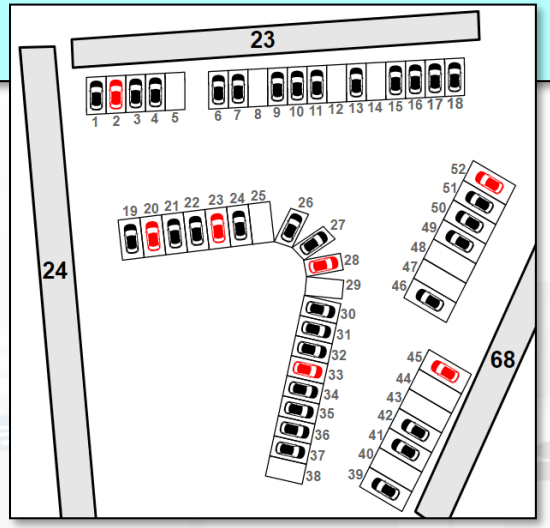
Special Custom Widgets

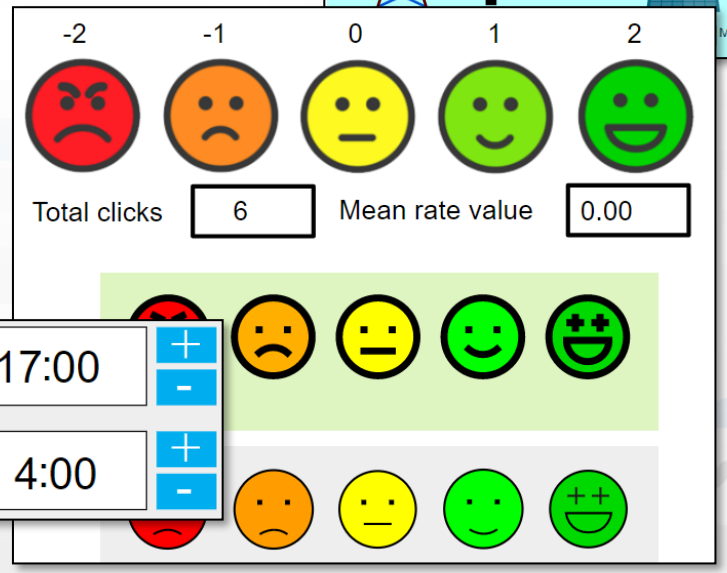
- Smart parking
- Smart Energy
- Smart Light
- Smart ….
- Energy View
- Custom Controls

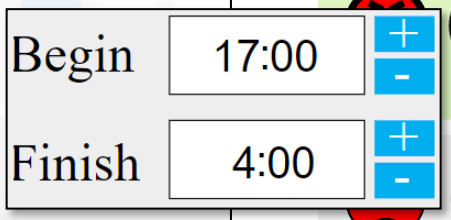




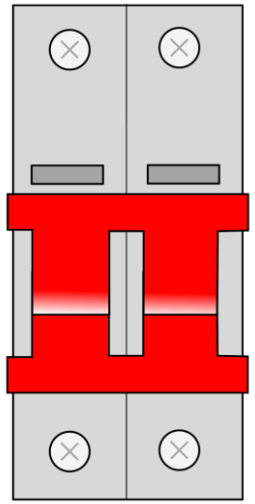




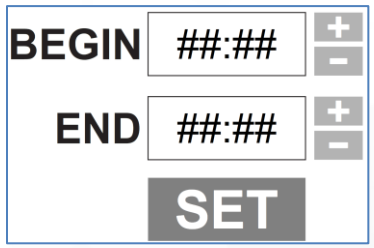


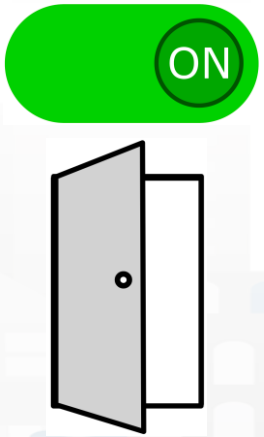


Other examples

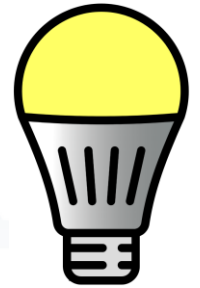


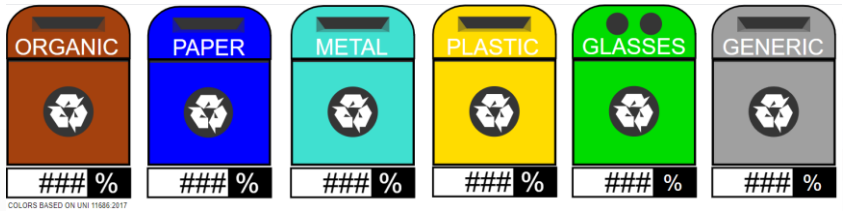
- **Virtual Actuators (sensor-actuator)**
  - From: Dashboard
  - To: IOT App, MyKPI, other Synoptics

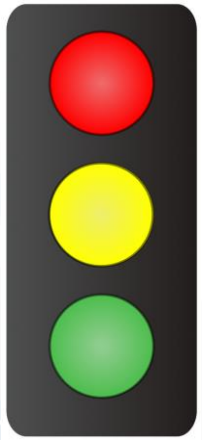


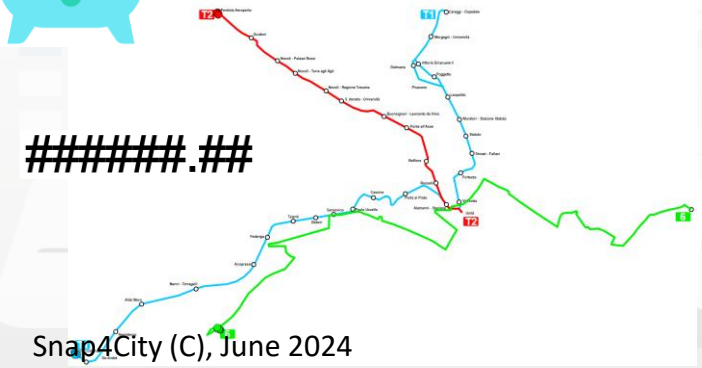


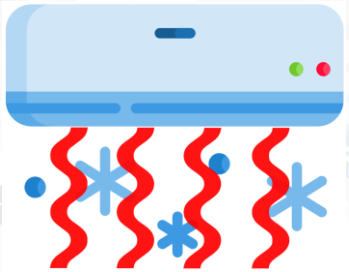
- **Virtual Sensors**
  - From: MyKPI, Sensors, IOT App, other Synoptics
  - To: Dashboards



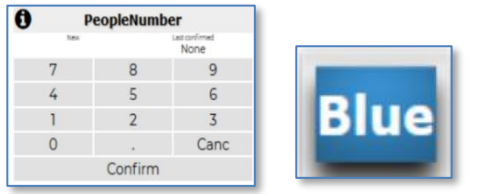


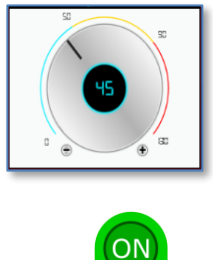


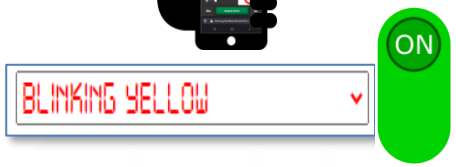


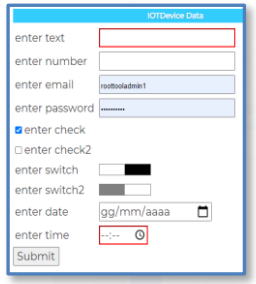


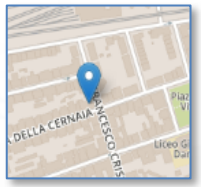
Business Logic on Dashboards

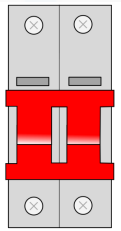


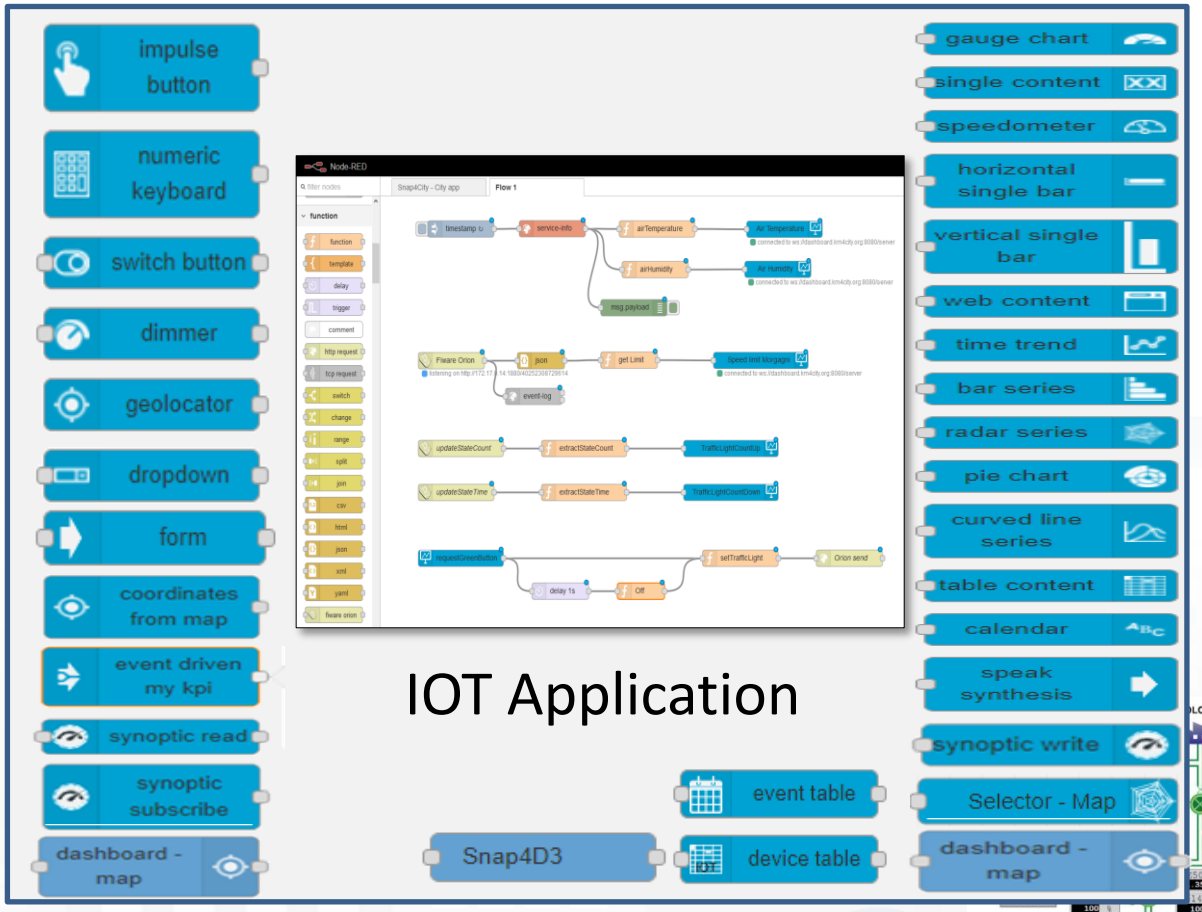


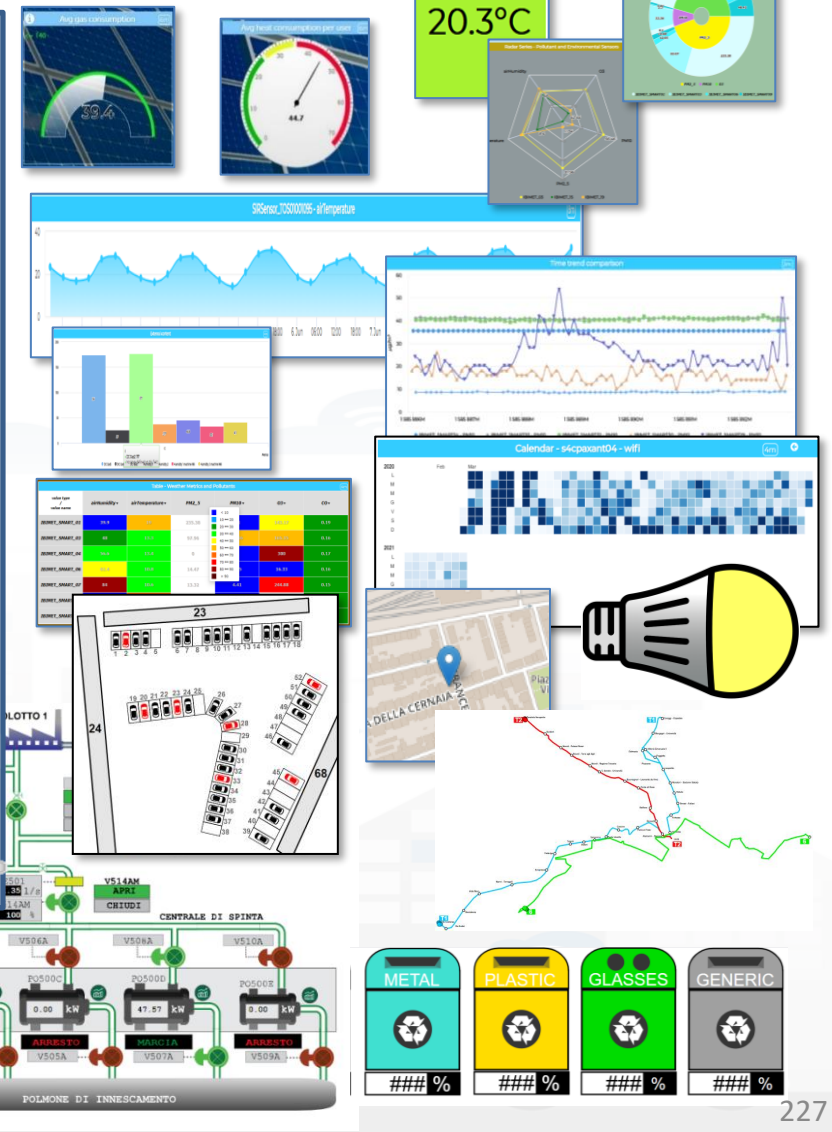










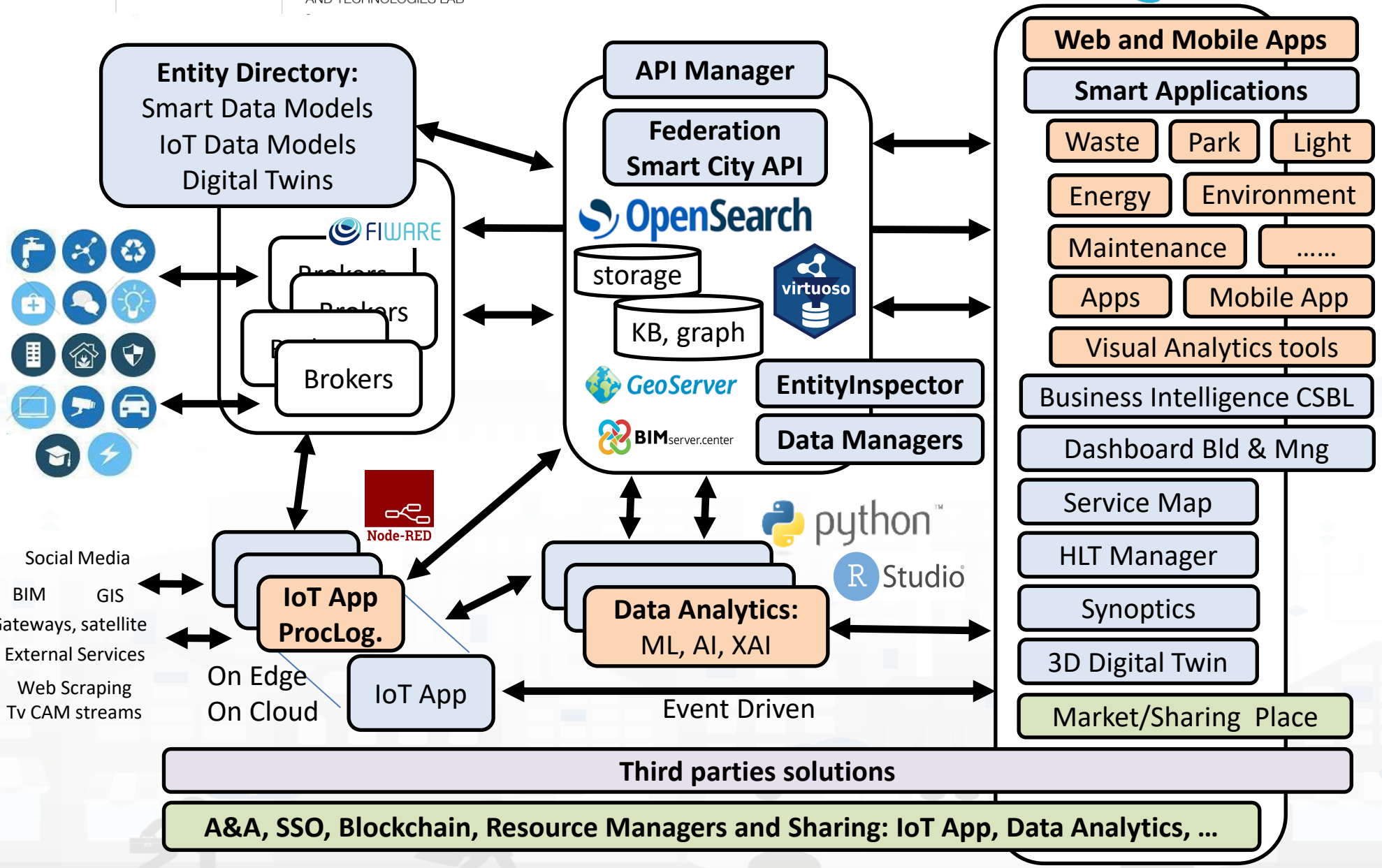


TOP

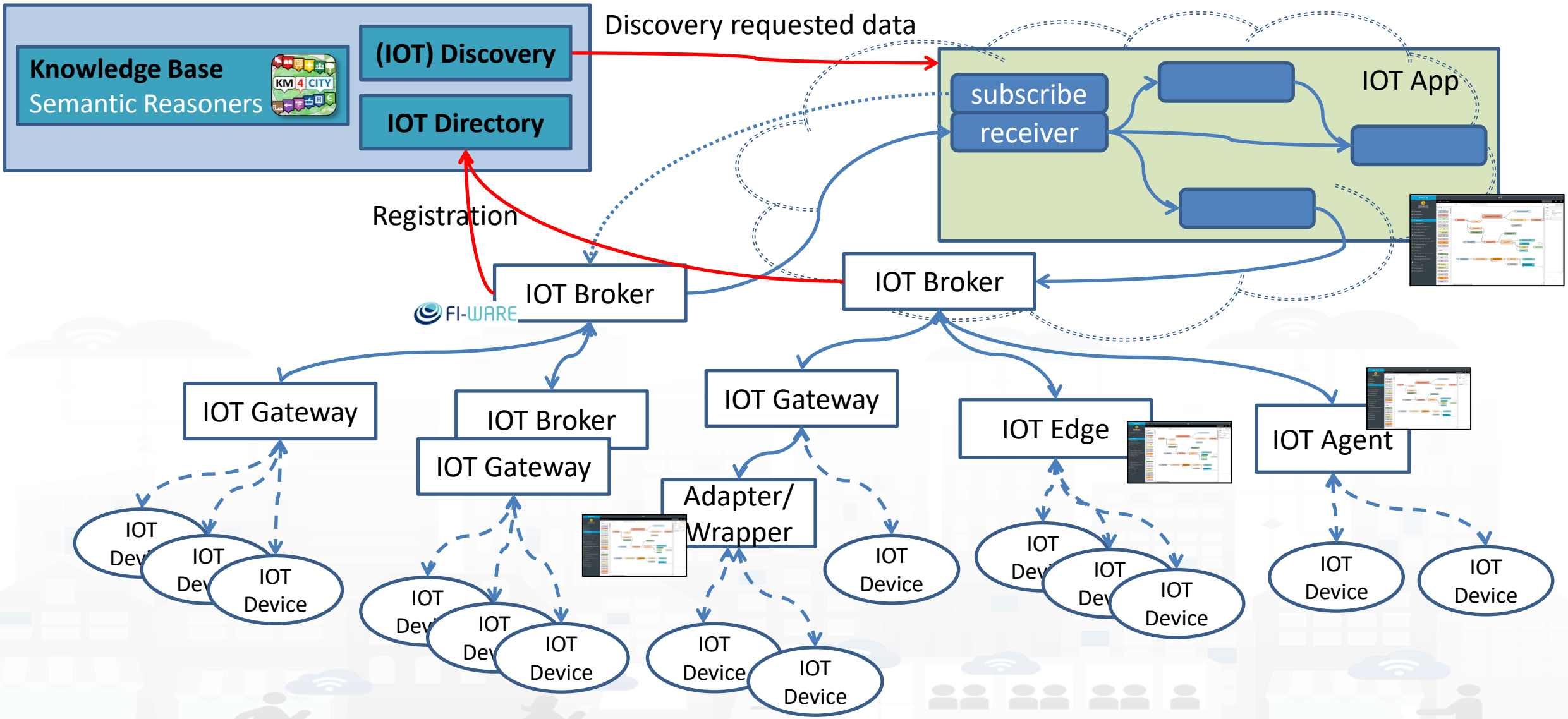
IoT Application Development smartening the solutions

	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								

Tech Arch

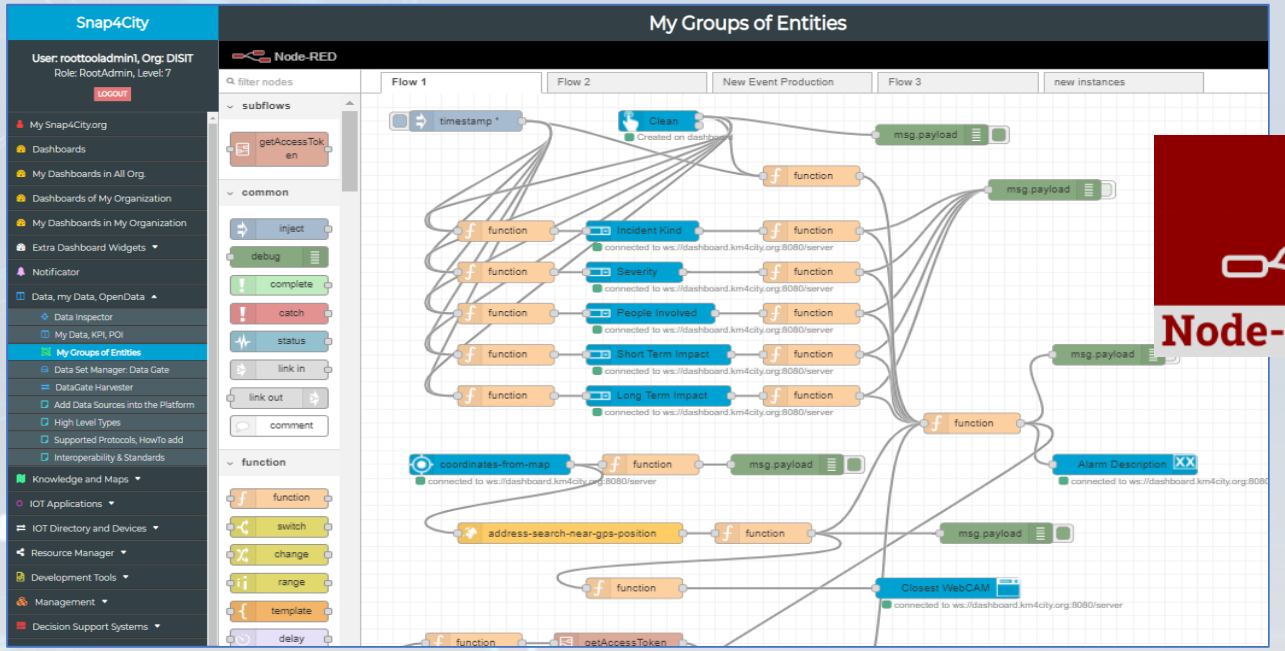

Entity Directory:
Smart Data Models
IoT Data Models
Digital Twins
FIWARE
Brokers
Brokers
Brokers
API Manager
Federation
Smart City API
OpenSearch
storage
KB, graph
virtuoso
GeoServer
EntityInspector
BIMserver.center
Data Managers
Node-RED
python
RStudio
Social Media
BIM
GIS
Gateways, satellite
External Services
Web Scraping
Tv CAM streams
IoT App
ProcLog.
On Edge
On Cloud
IoT App
Data Analytics:
ML, AI, XAI
Event Driven
Web and Mobile Apps
Smart Applications
Waste
Park
Light
Energy
Environment
Maintenance
……
Apps
Mobile App
Visual Analytics tools
Business Intelligence CSBL
Dashboard Bld & Mng
Service Map
HLT Manager
Synoptics
3D Digital Twin
Market/Sharing Place
Third parties solutions
A&A, SSO, Blockchain, Resource Managers and Sharing: IoT App, Data Analytics, …

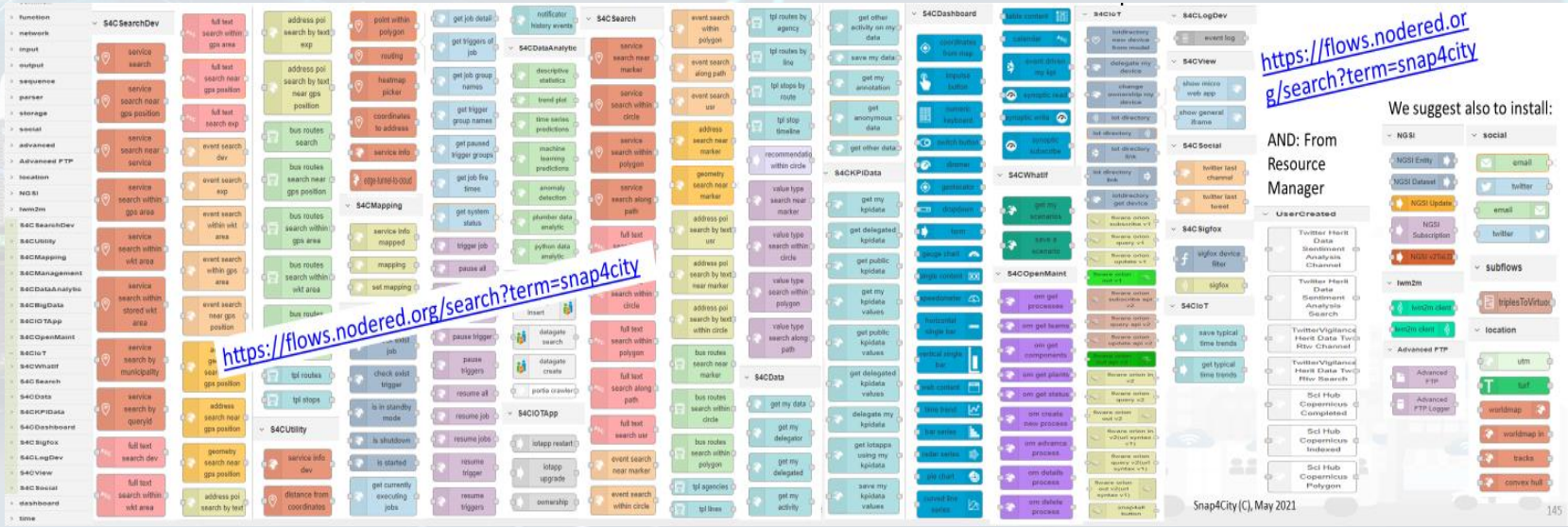
IoT Network

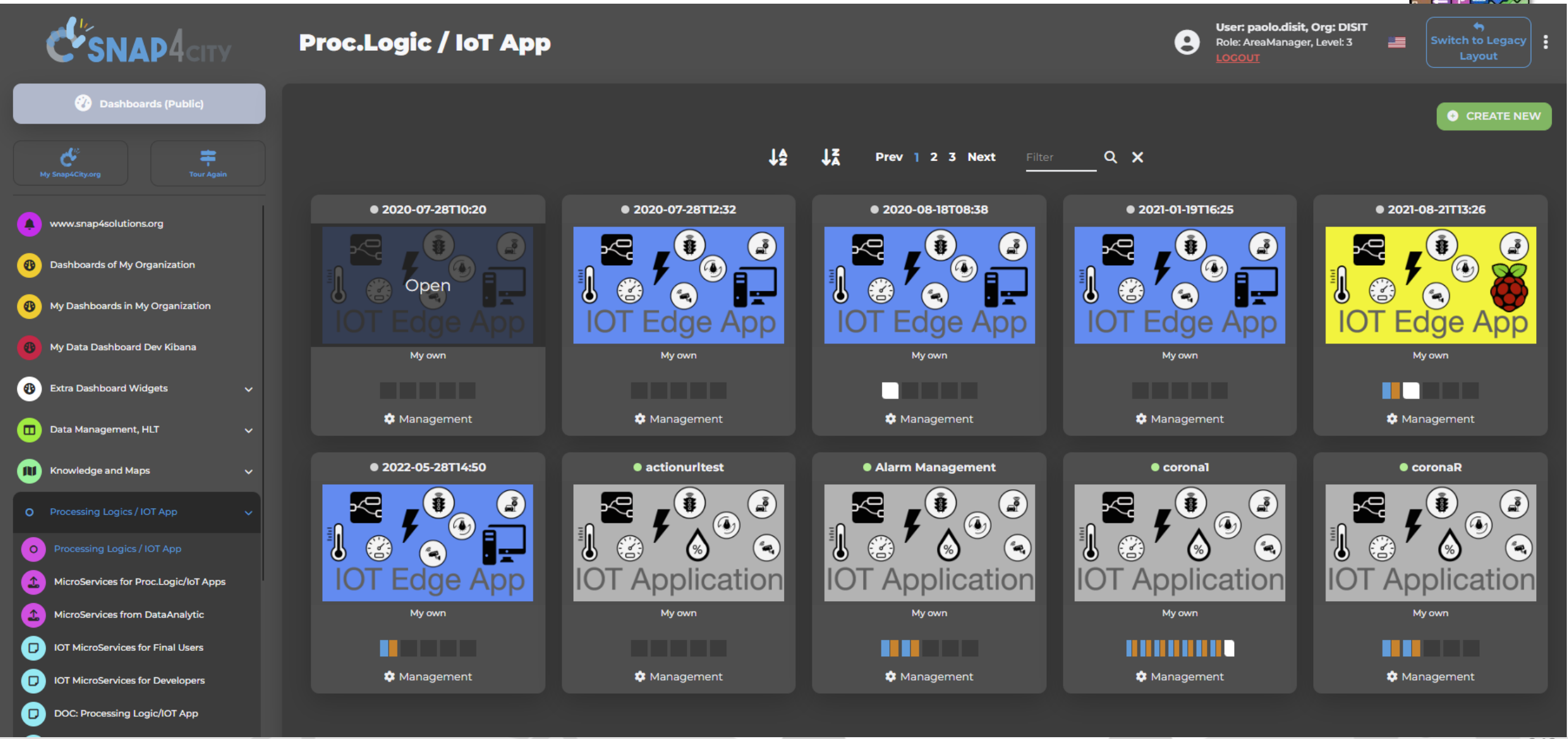

Knowledge Base
Semantic Reasoners
(IOT) Discovery
IOT Directory
Discovery requested data
Registration
subscribe
receiver
IOT App
FI-WARE
IOT Broker
IOT Broker
IOT Gateway
IOT Broker
IOT Gateway
IOT Gateway
Adapter/
Wrapper
IOT Edge
IOT Agent
IOT Device

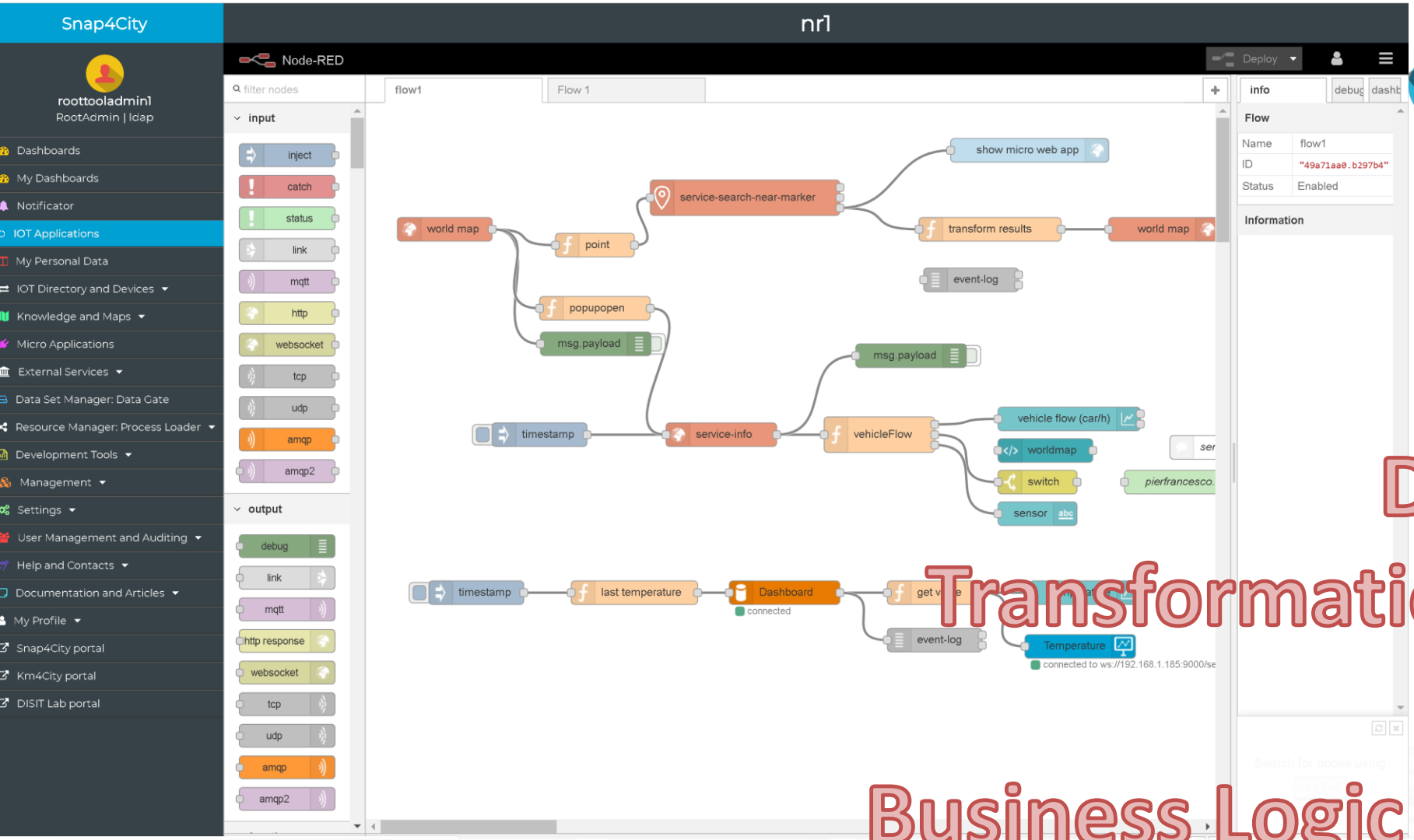
Ingestion, aggreg. → exploitation

- **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






SNAP4CITY
Proc.Logic / IoT App
User: paolo.disit, Org: DISIT
Role: AreaManager, Level: 3
LOGOUT
Switch to Legacy Layout
Dashboards (Public)
My Snap4City.org
Tour Again
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
CREATE NEW
Prev 1 2 3 Next
Filter
2020-07-28T10:20
Open
IOT Edge App
My own
Management
2020-07-28T12:32
IOT Edge App
My own
Management
2020-08-18T08:38
IOT Edge App
My own
Management
2021-01-19T16:25
IOT Edge App
My own
Management
2021-08-21T13:26
IOT Edge App
My own
Management
2022-05-28T14:50
IOT Edge App
My own
Management
actionurltest
IOT Application
My own
Management
Alarm Management
IOT Application
My own
Management
corona1
IOT Application
My own
Management
coronaR
IOT Application
My own
Management



Editing IOT Applications

Data Adapation

Transformation, Conversion

Integration

Business Logic vs Dashboards

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 Netwo	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
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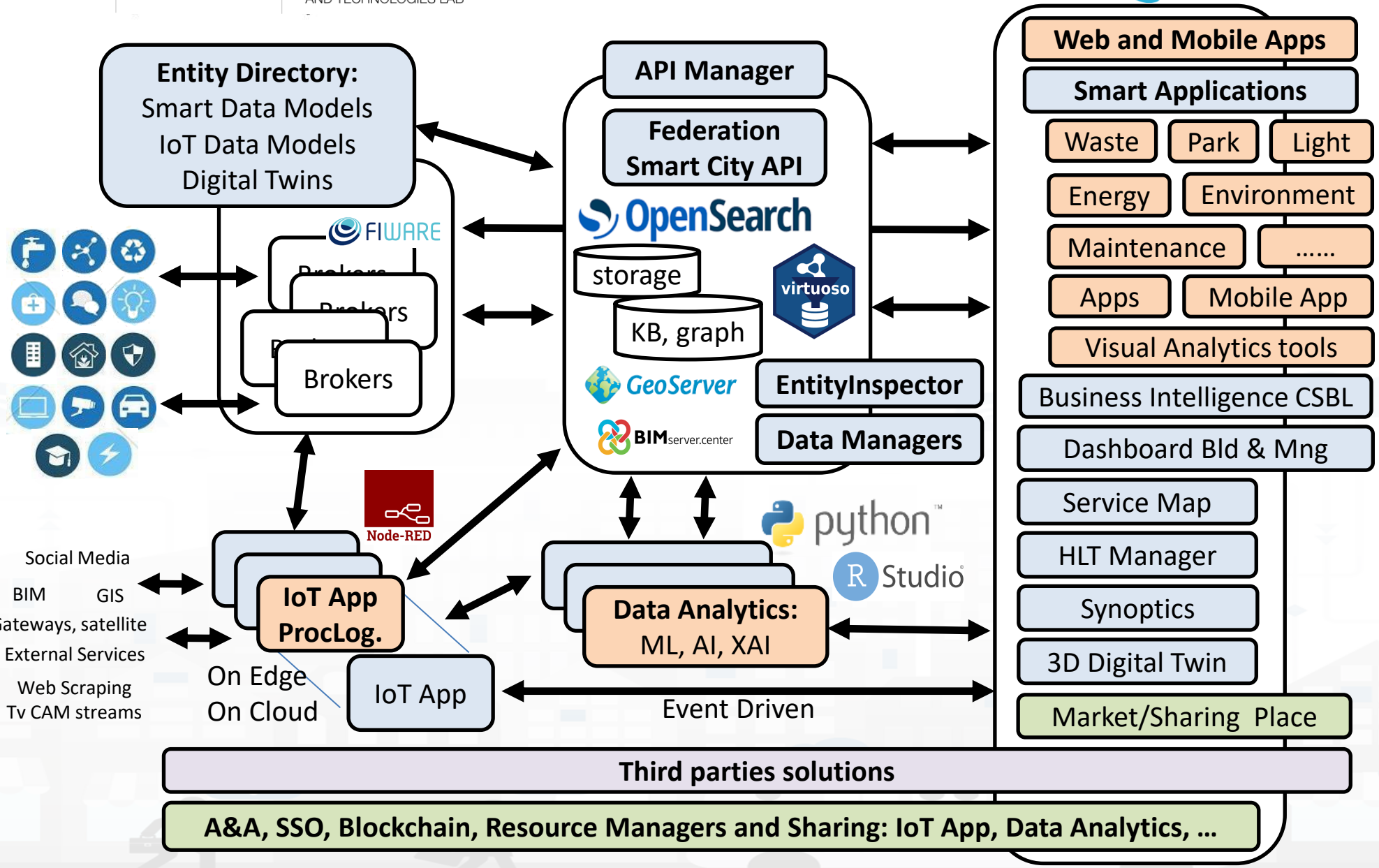
Tech Arch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API Manager
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OpenSearch
storage
KB, graph
virtuoso
GeoServer
EntityInspector
BIMserver.center
Data Managers
Node-RED
python
RStudio
Social Media
BIM
GIS
Gateways, satellite
External Services
Web Scraping
Tv CAM streams
IoT App
ProcLog.
On Edge
On Cloud
IoT App
Data Analytics:
ML, AI, XAI
Event Driven
Web and Mobile Apps
Smart Applications
Waste
Park
Light
Energy
Environment
Maintenance
……
Apps
Mobile App
Visual Analytics tools
Business Intelligence CSBL
Dashboard Bld & Mng
Service Map
HLT Manager
Synoptics
3D Digital Twin
Market/Sharing Place
Third parties solutions
A&A, SSO, Blockchain, Resource Managers and Sharing: IoT App, Data Analytics, …

Available AI Solutions on Snap4City

https://www.snap4city.org/997

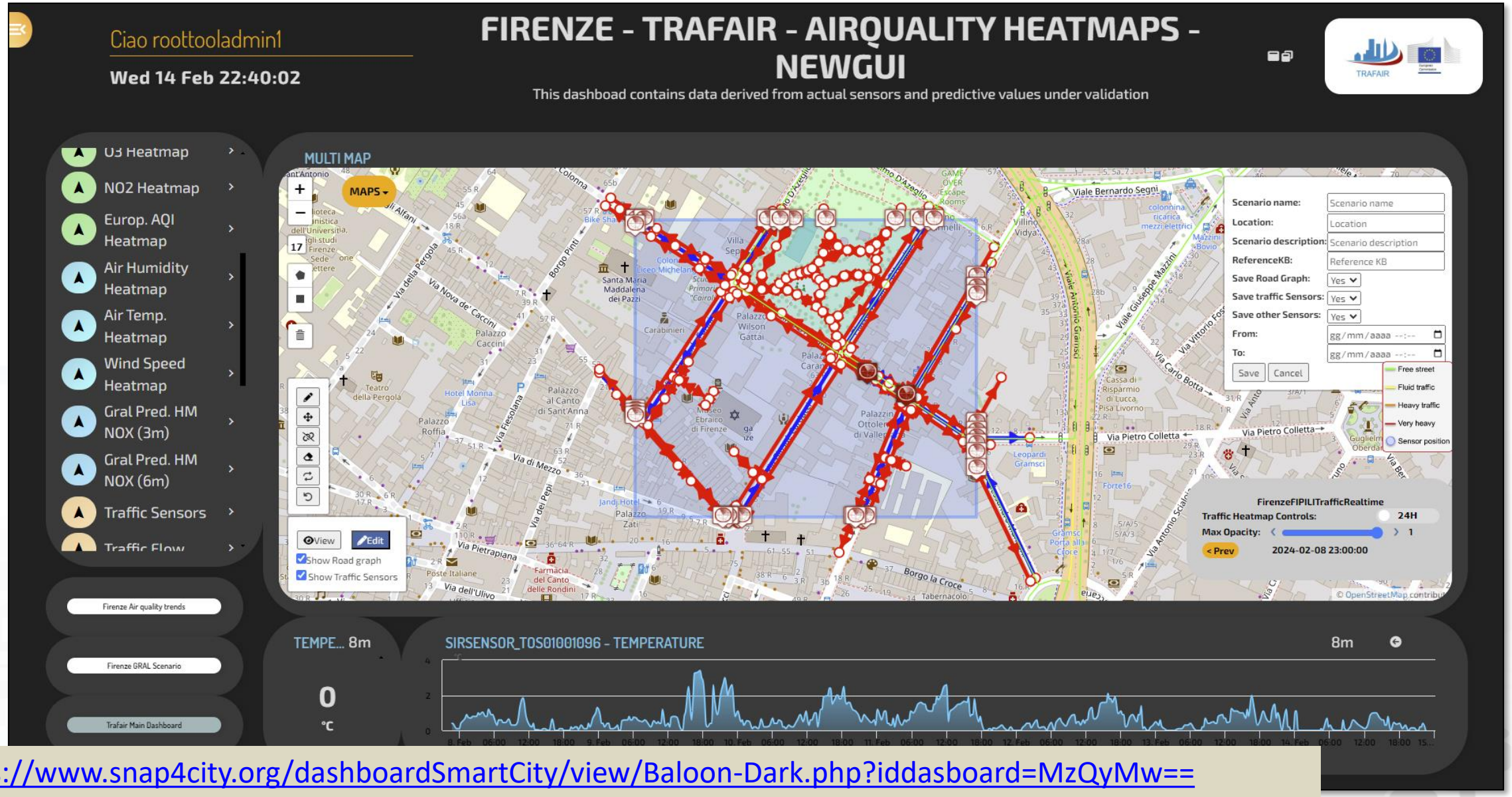
More than 80 Available Solutions & 300 AI applic.

- **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/course/p4/

Trial:



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

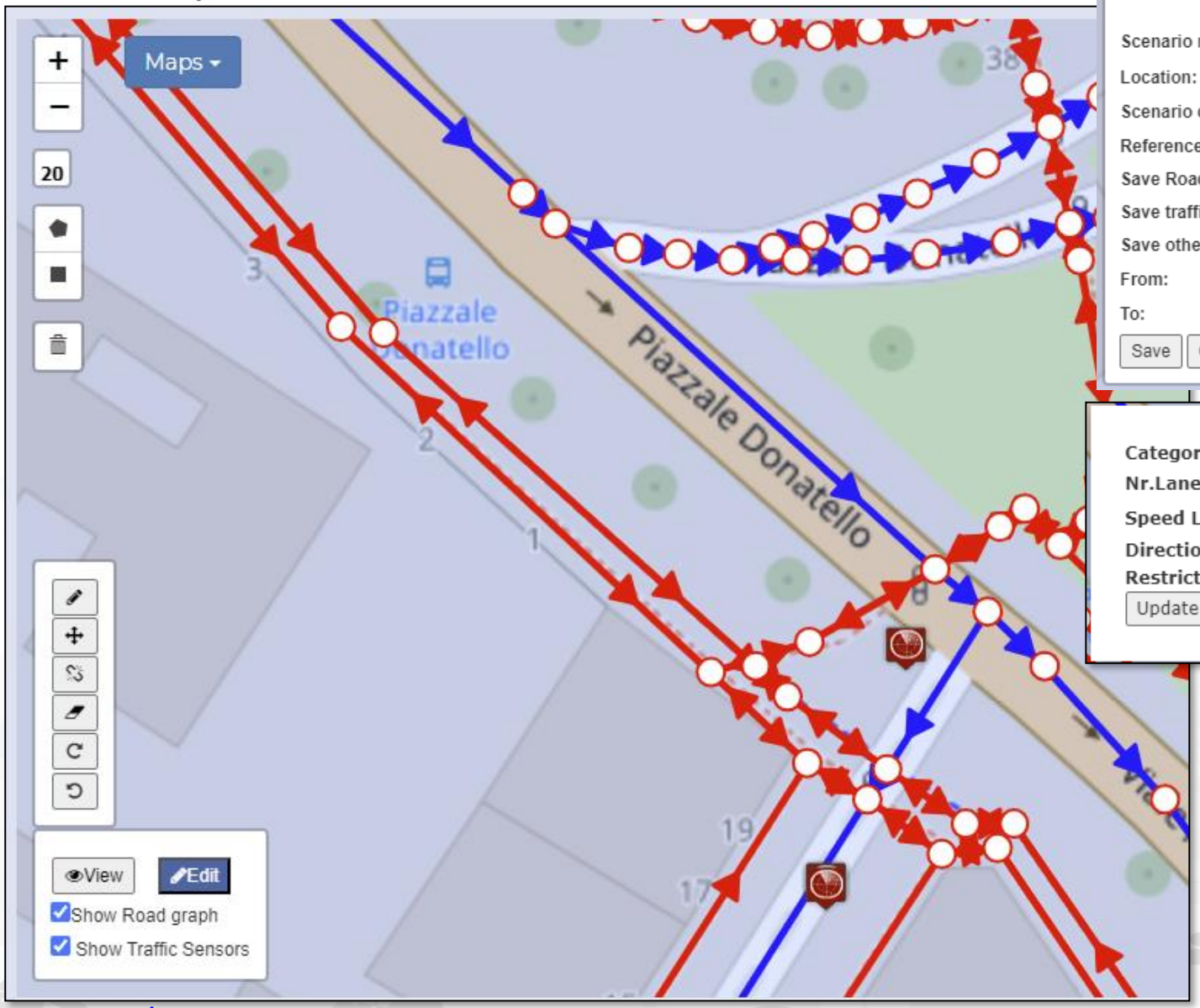
For example:

Select map

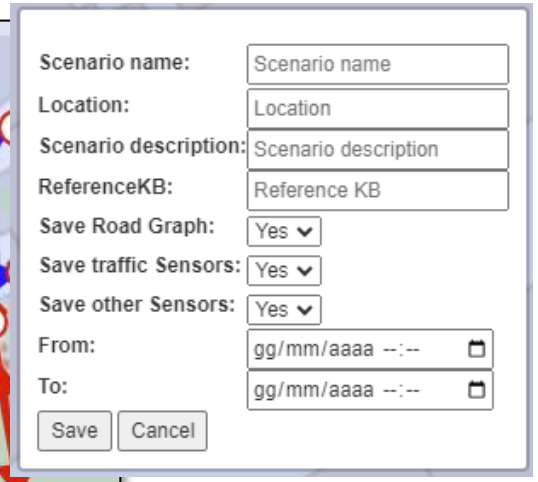
Zoom

New Scenario

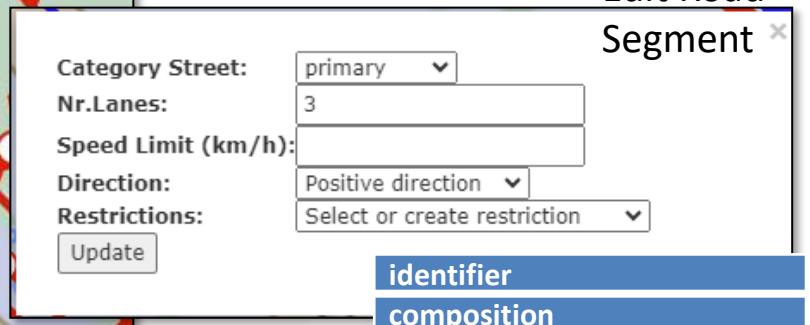
Editing
Drag & drop
Split & Join
Delete
Do and Undo



Save



Edit Road Segment

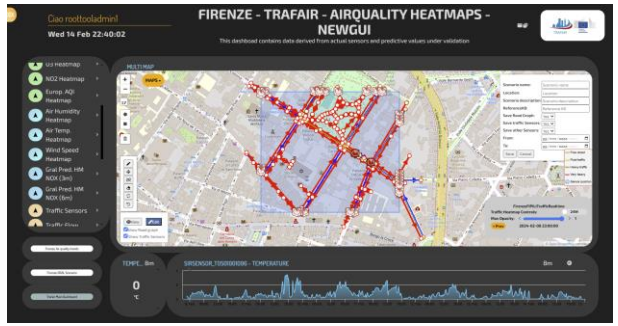


- identifier
- composition
- elemLocation
- elementClass
- elementType
- length
- operatingStatus
- speedLimit
- trafficDir
- width
- highwayType
- route

Properties of Road Elements

https://www.snap4city.org/976

The actual Scenario Exploitation

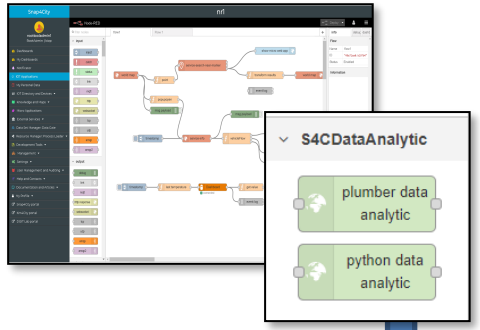


Defining Context via Editing Scenario:

- 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.

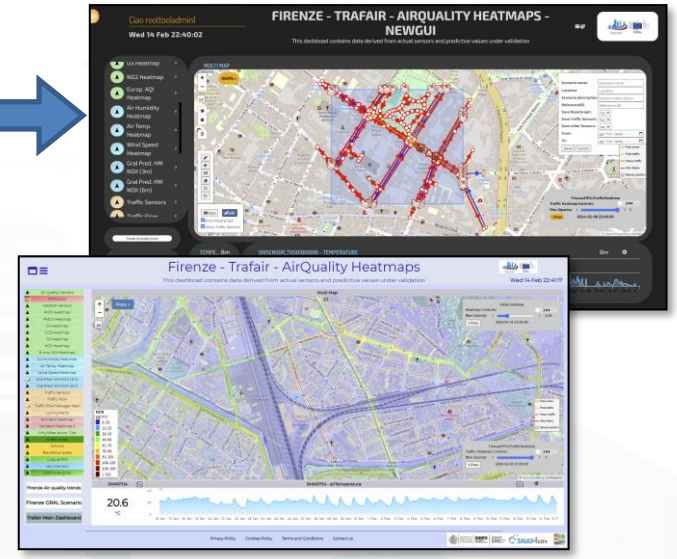


Computing in the Scenario Context as:

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

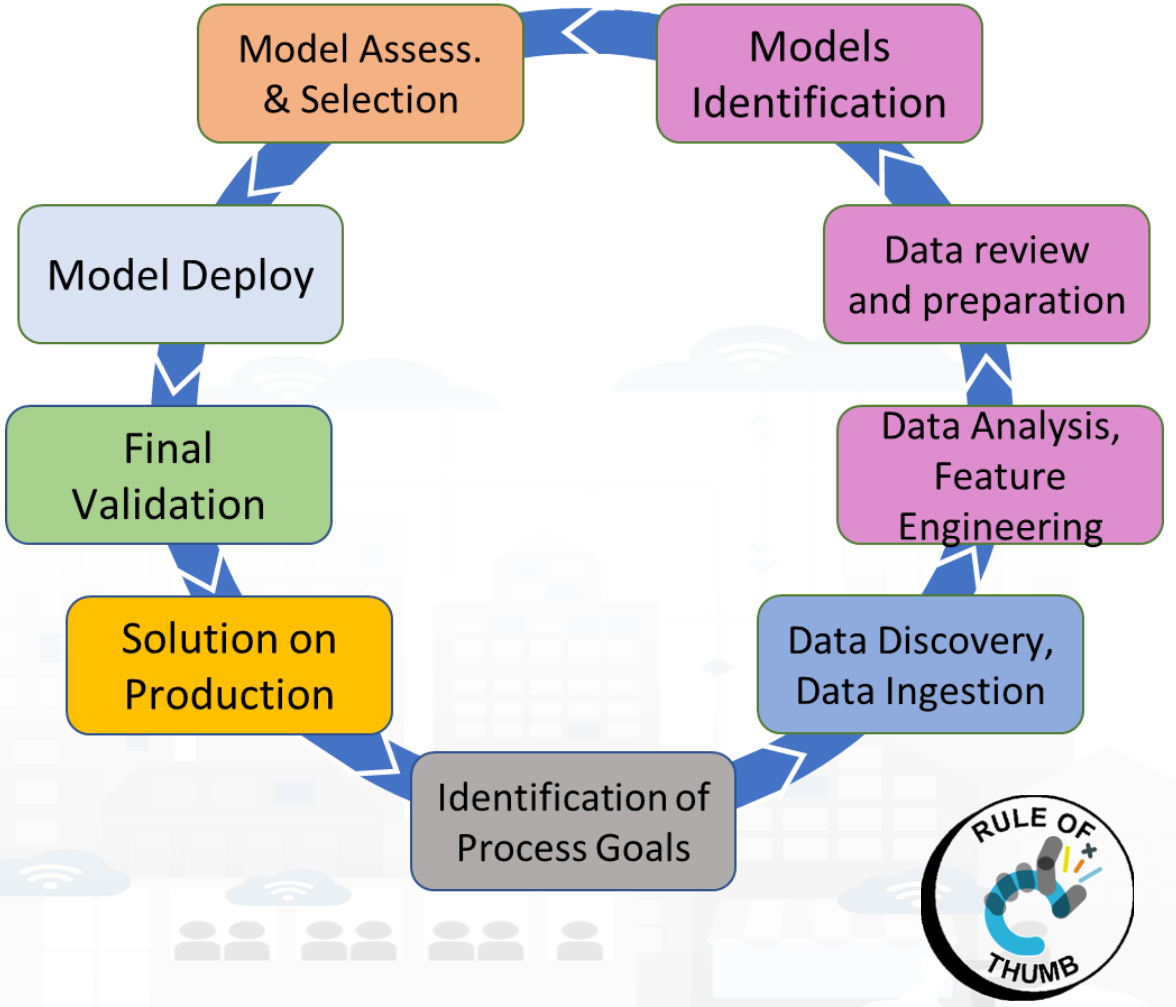
ReLoading Scenario in JavaScript

- 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

Knowledge Base, Km4City

Big Data Store Facility

Smart City API from Knowledge Base and other tools

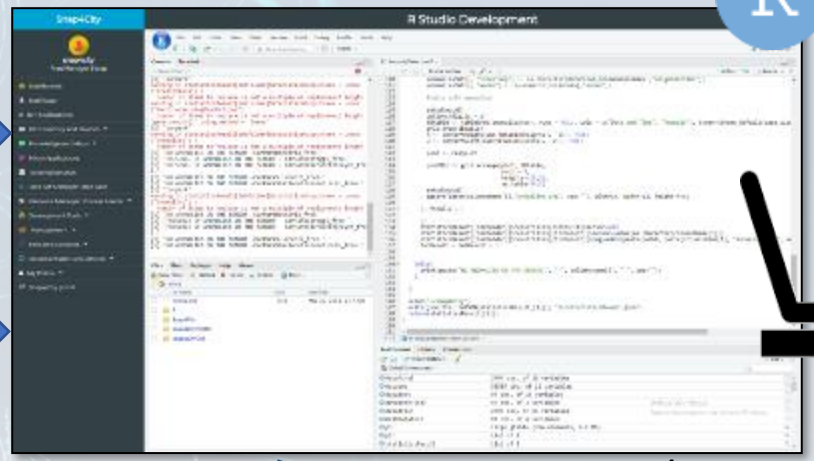
TensorFlow

NVIDIA CUDA

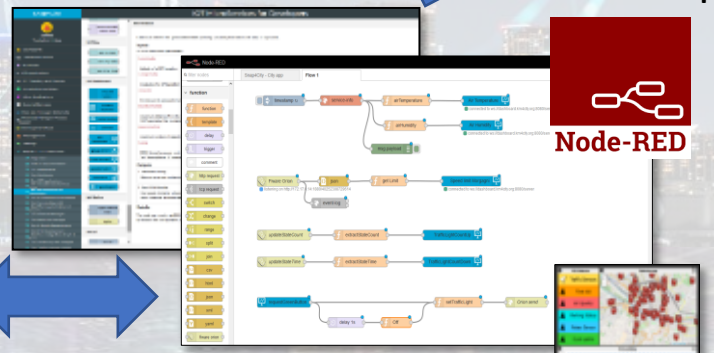
python

jupyter

R Studio



Creating MicroServices

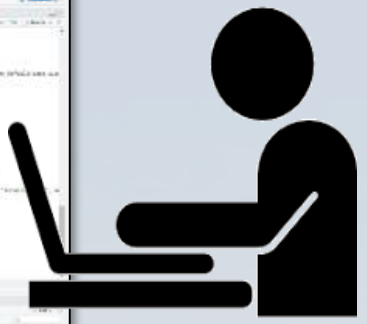


Node-RED

Using them into IOT Applications

Saving / Sharing reusing

Resource Manager

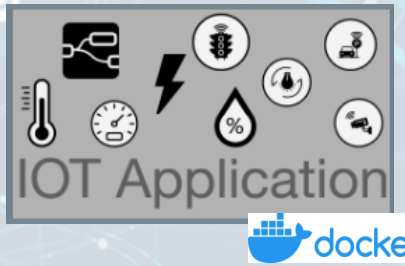


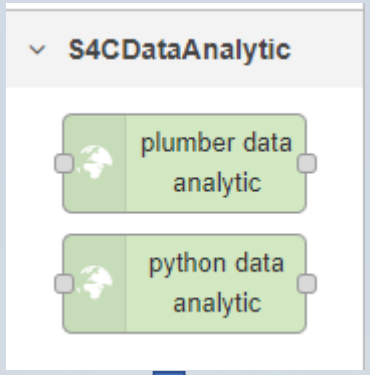
Data Analytic Container

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

2 Open an Advanced IoT App / Node-RED

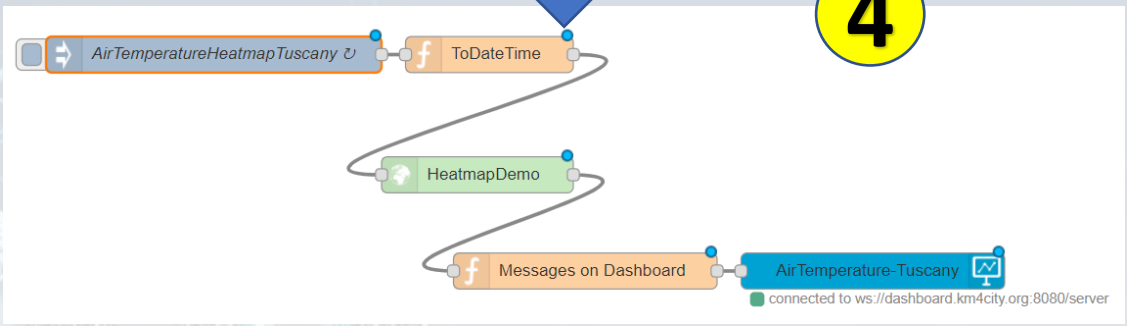




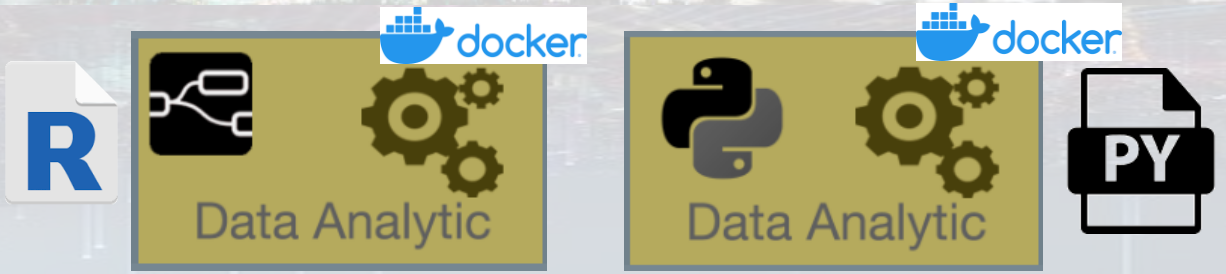
3

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

4



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

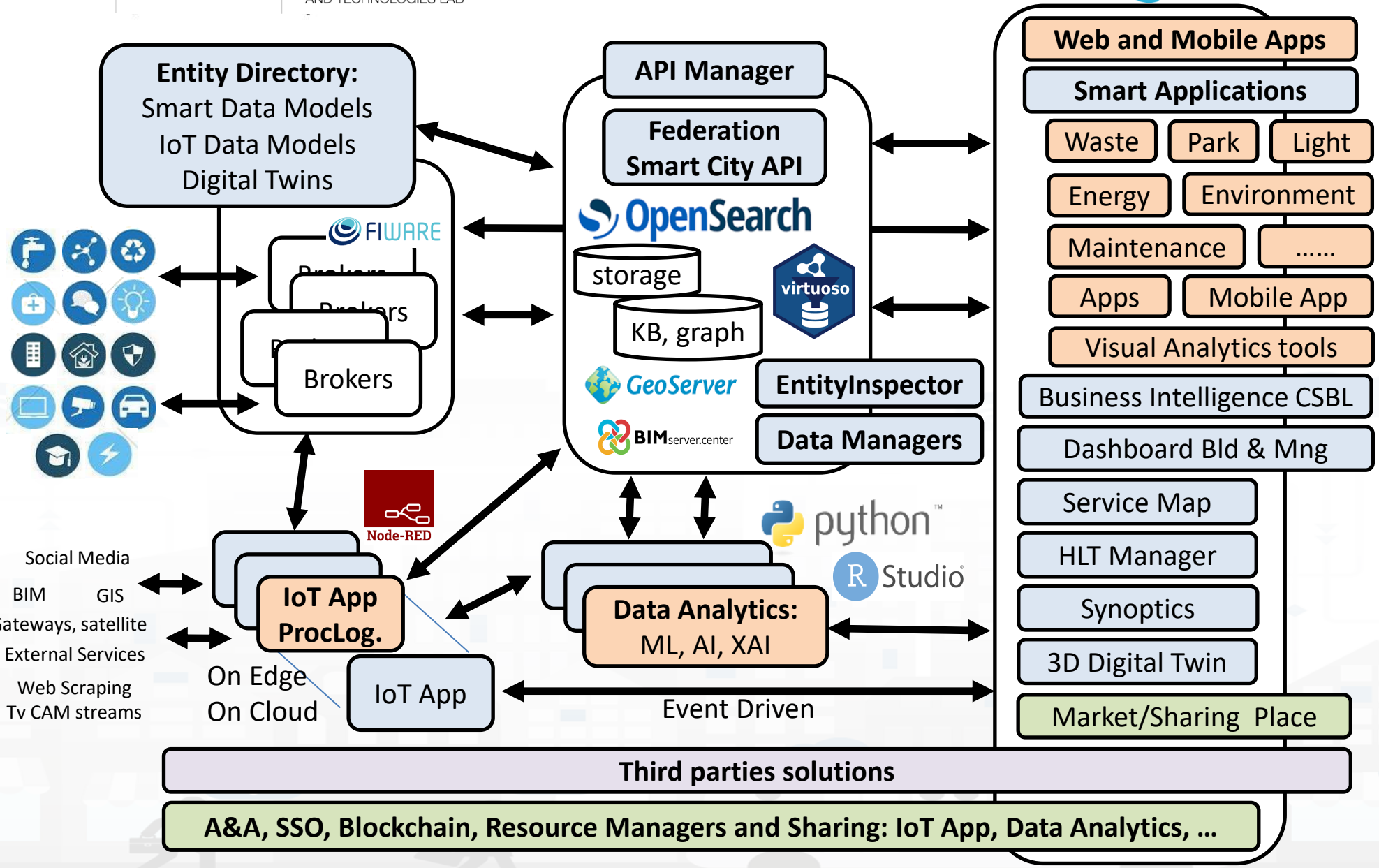


TOP

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	ystem and Deploy Install	Smart City API: Web & Mob. App	Design and Develop Smart Solutions
PDF 2022								
Interactive (2022) with video and animations								

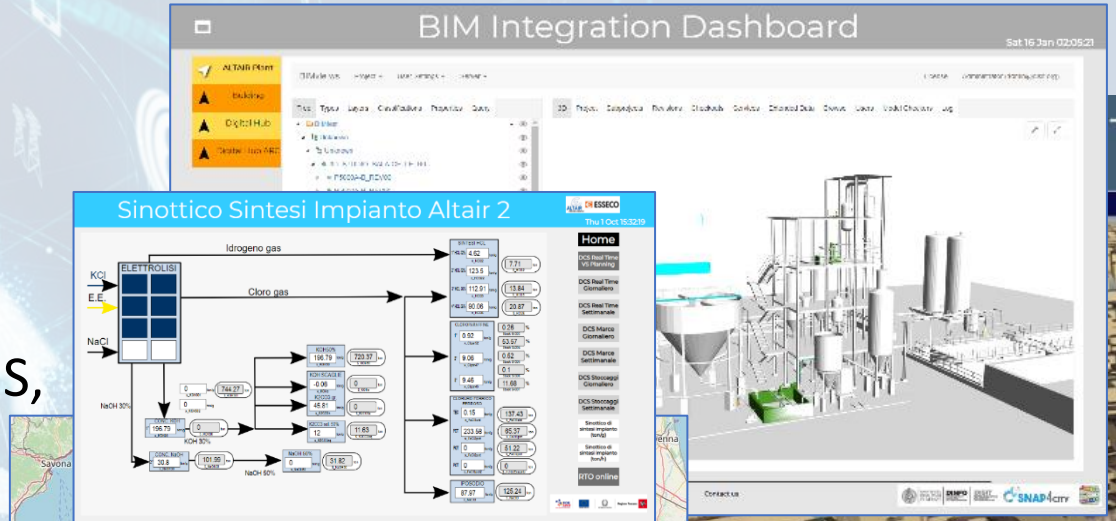
Tech Arch

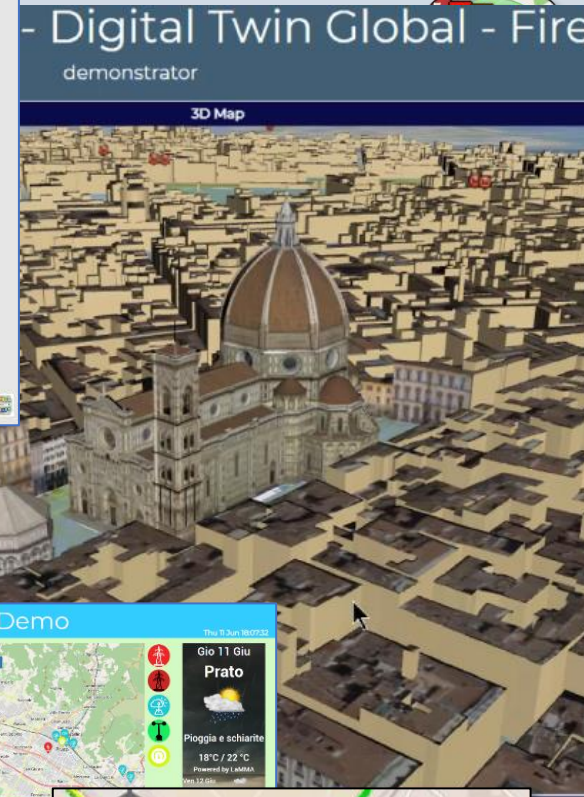

Entity Directory:
Smart Data Models
IoT Data Models
Digital Twins
FIWARE
Brokers
Brokers
Brokers
API Manager
Federation
Smart City API
OpenSearch
storage
KB, graph
virtuoso
GeoServer
EntityInspector
BIMserver.center
Data Managers
Node-RED
python
RStudio
Social Media
BIM
GIS
Gateways, satellite
External Services
Web Scraping
Tv CAM streams
IoT App
ProcLog.
On Edge
On Cloud
IoT App
Data Analytics:
ML, AI, XAI
Event Driven
Web and Mobile Apps
Smart Applications
Waste
Park
Light
Energy
Environment
Maintenance
……
Apps
Mobile App
Visual Analytics tools
Business Intelligence CSBL
Dashboard Bld & Mng
Service Map
HLT Manager
Synoptics
3D Digital Twin
Market/Sharing Place
Third parties solutions
A&A, SSO, Blockchain, Resource Managers and Sharing: IoT App, Data Analytics, …

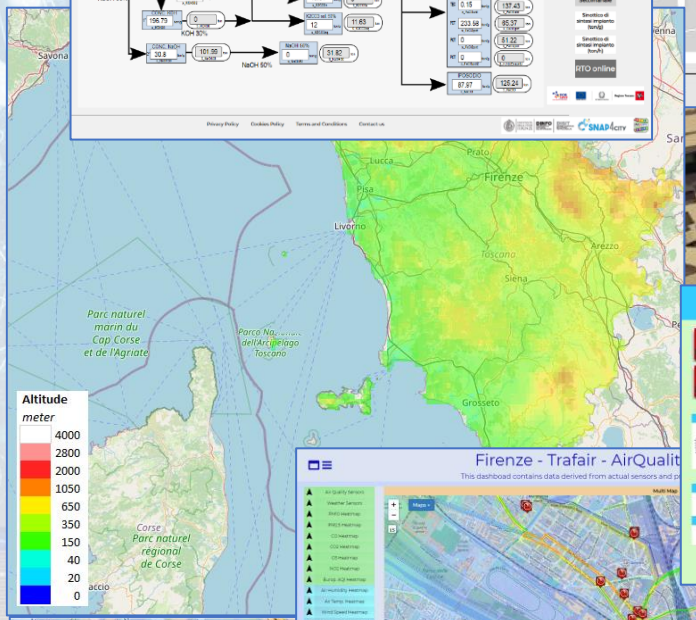
High Level Types

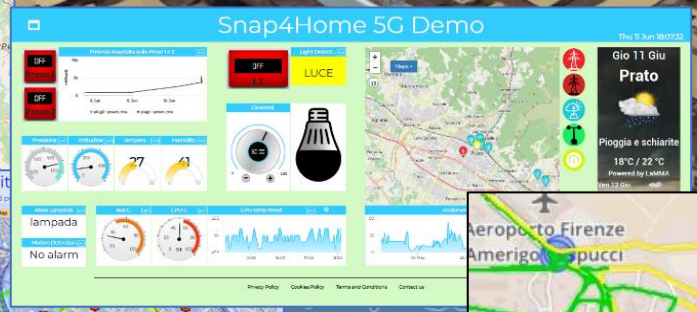
Snap4City (C), June 2024

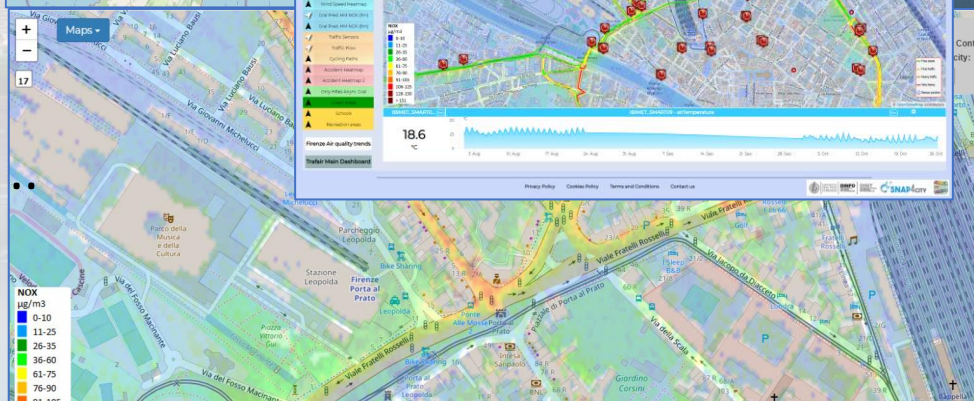
- POI, IOT Devices, shapes,..
  - FIWARE Smart Data Models,
  - IoT Device Models
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ..
- Satellite data, ..
- traffic flow, typical trends, ..
- trajectories, events, Workflow, ..
- 3D Models, BIM, Digital Twins, ..
- OD Matrices of several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

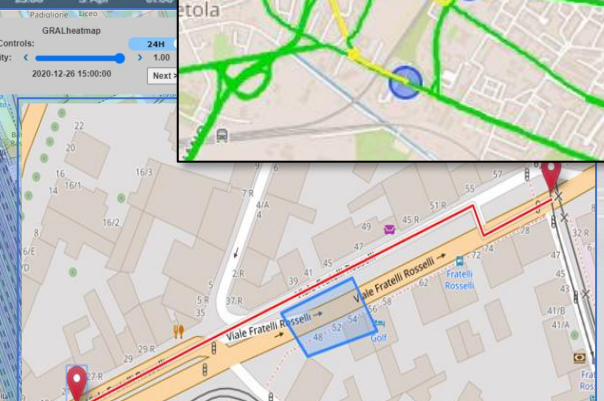




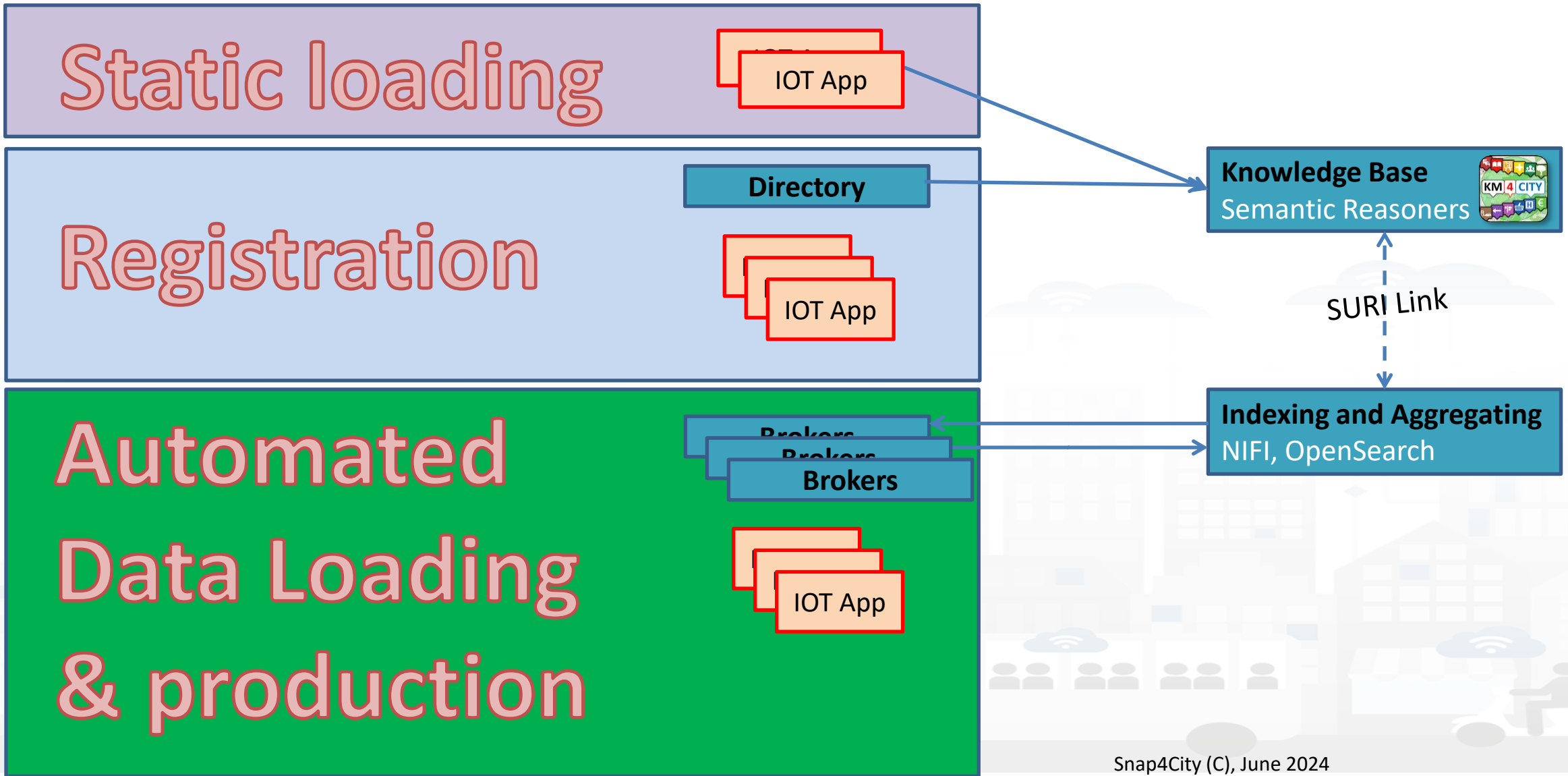








Snap4city Data Ingestion Flow Diagram

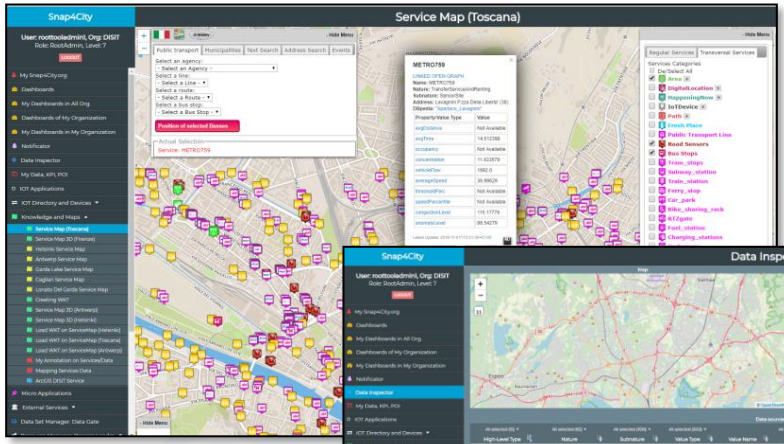


Checking data/Entity ingestion results

Knowledge base
Semantic reasoners

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

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



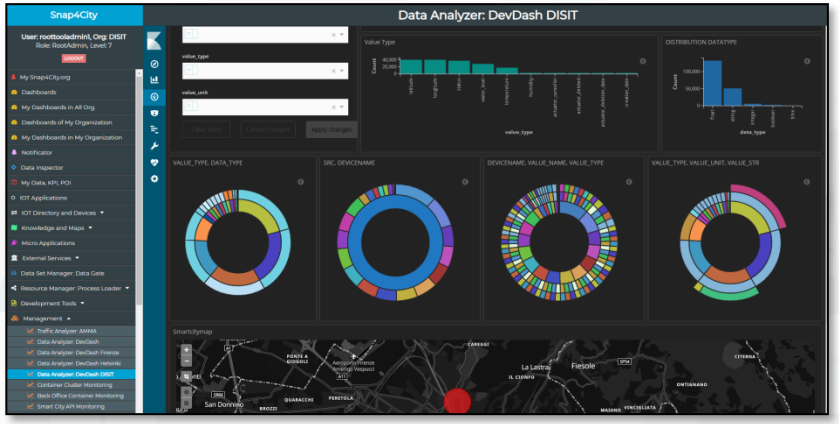
ServiceMap or
Super ServiceMap

Data Inspector
Digital Twin view

Indexing and aggregating
NIFI, OpenSearch

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

- **ServiceMap**, SCAPI (last data), **SuperSM**
- **My Data Dashboard,** OpenSearchDash
- **Data Inspector (last data)**

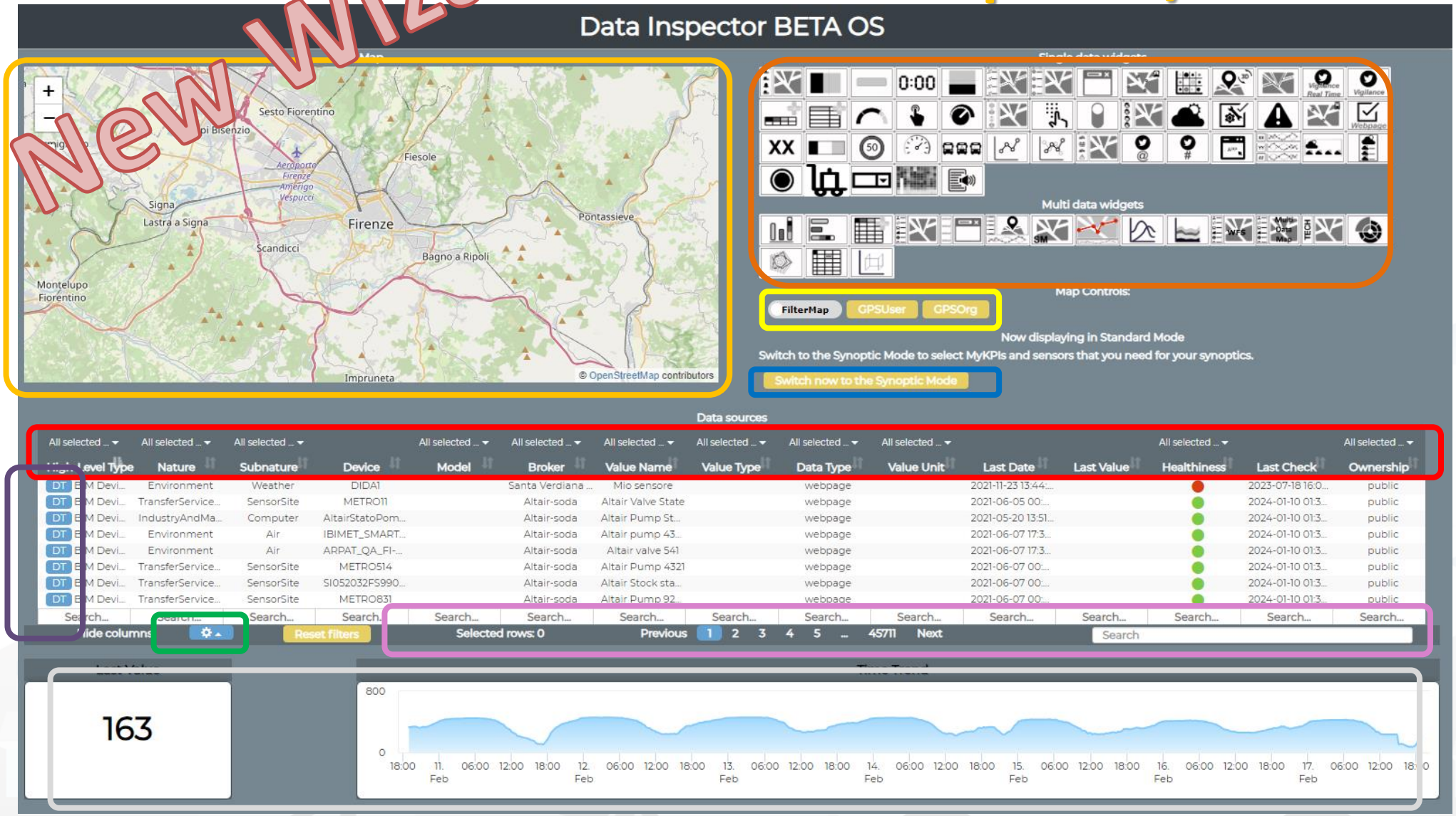


My Data Dashboard

DevDash

Some functionalities are limited to certain roles

New Data Inspector/Wizard



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

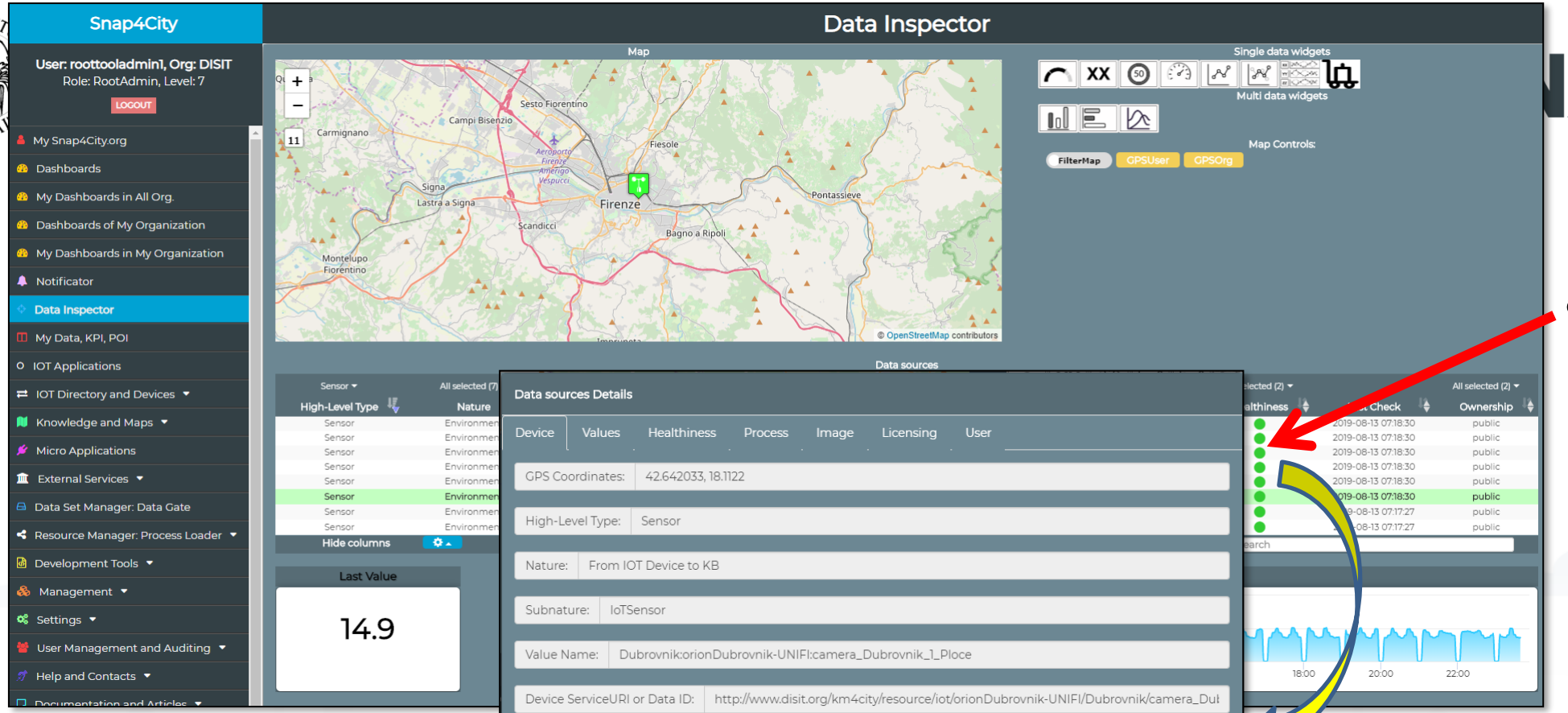
View on Map(via PREVIEW)

Data and Trend visualization

Opening Digital Twin

Pass to Synoptic mode

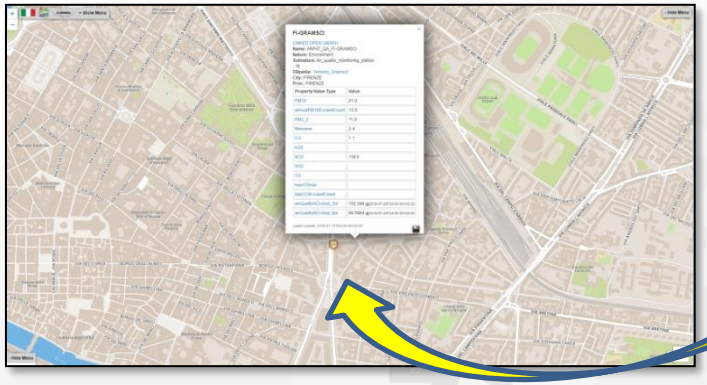
Select the graph representation

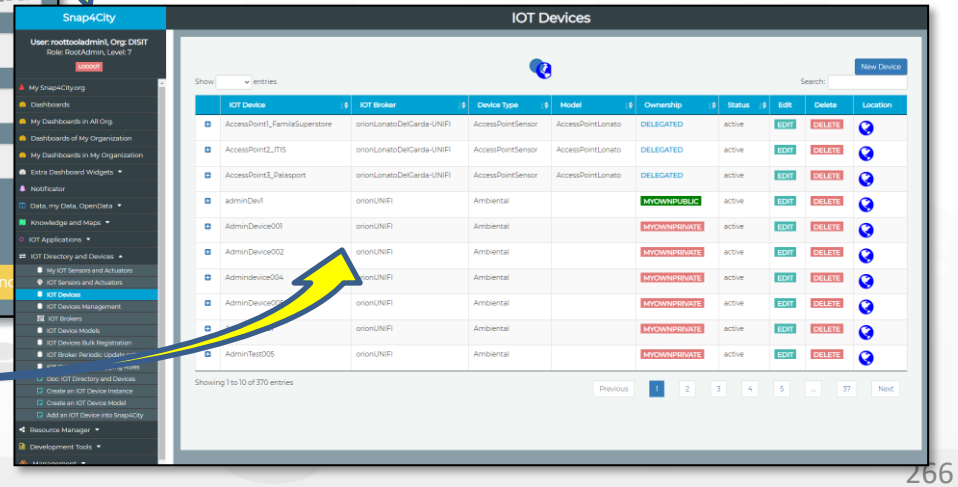


Knowledge Base view

- Click with the mouse on it

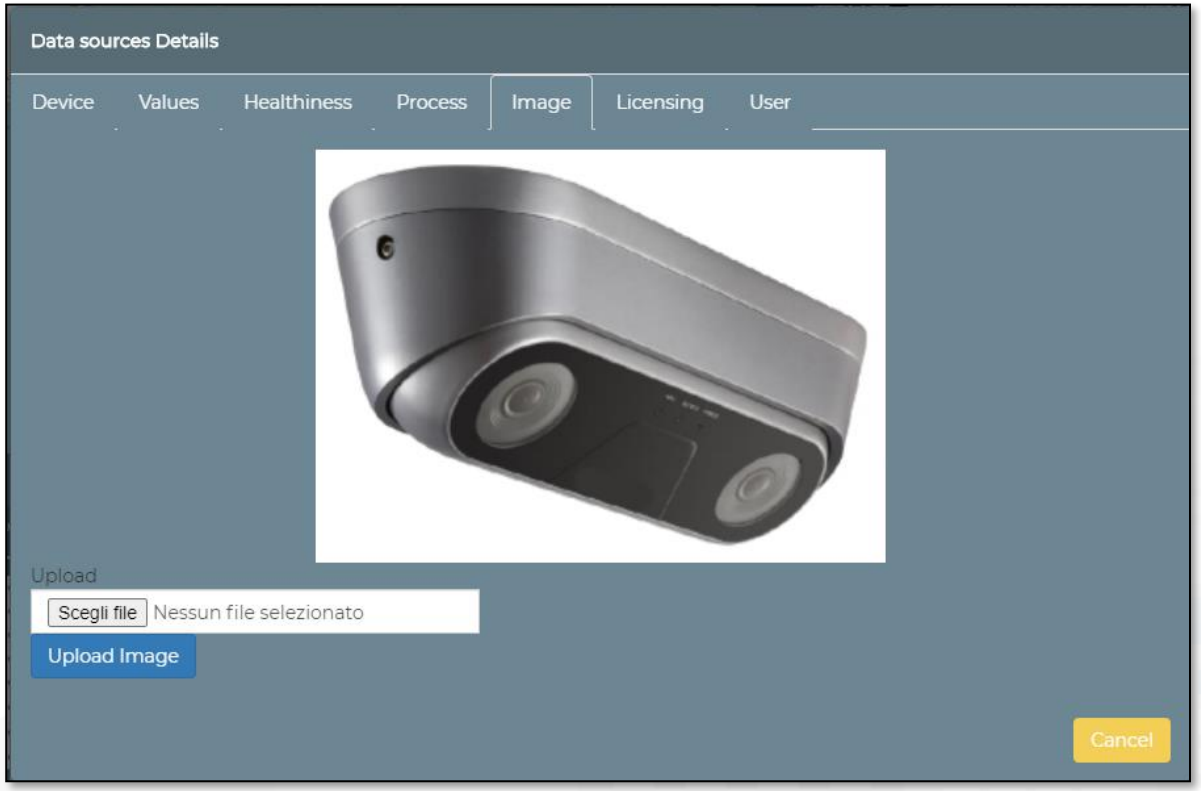
HLT: Sensor

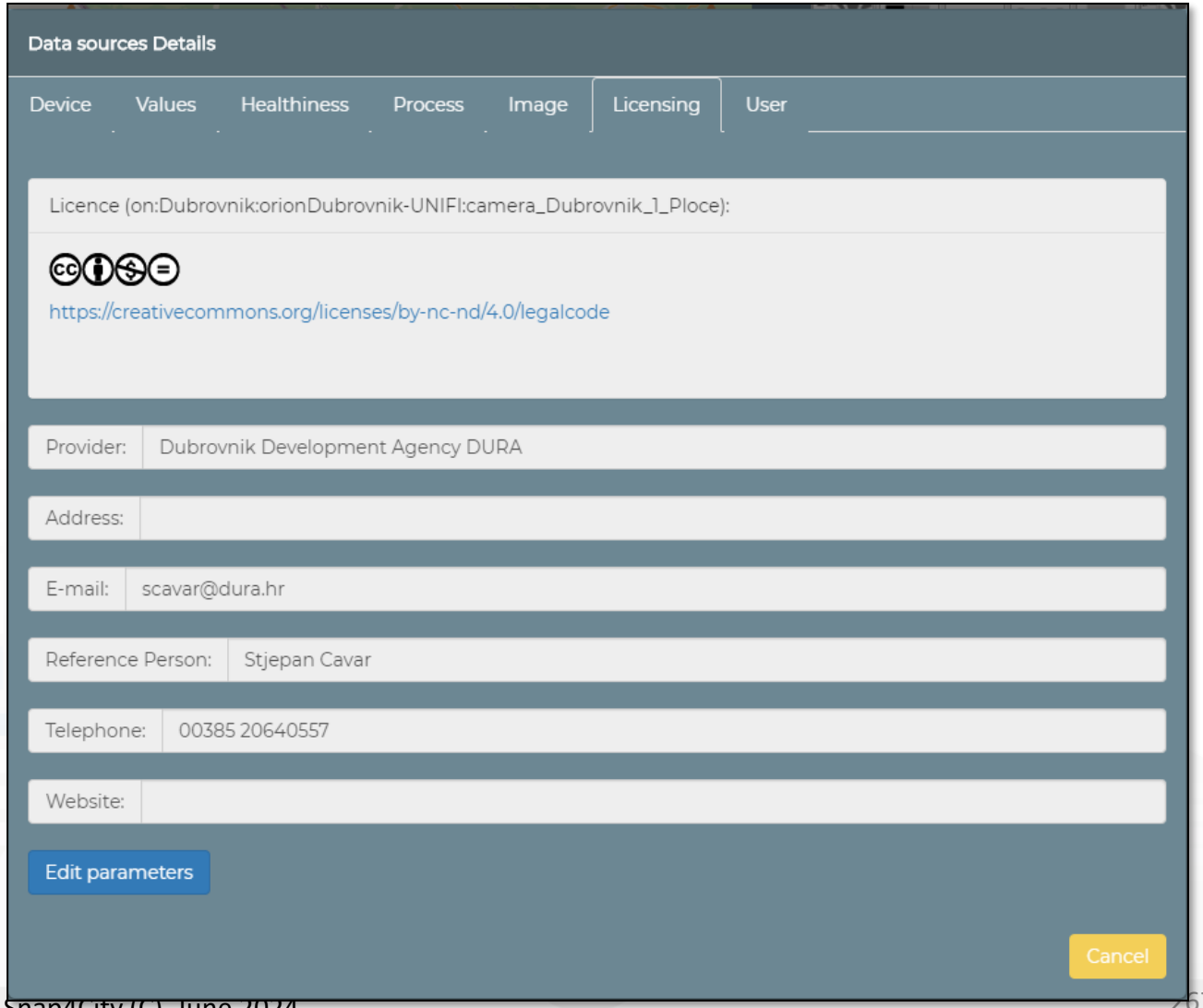




Some functionalities are limited to certain roles

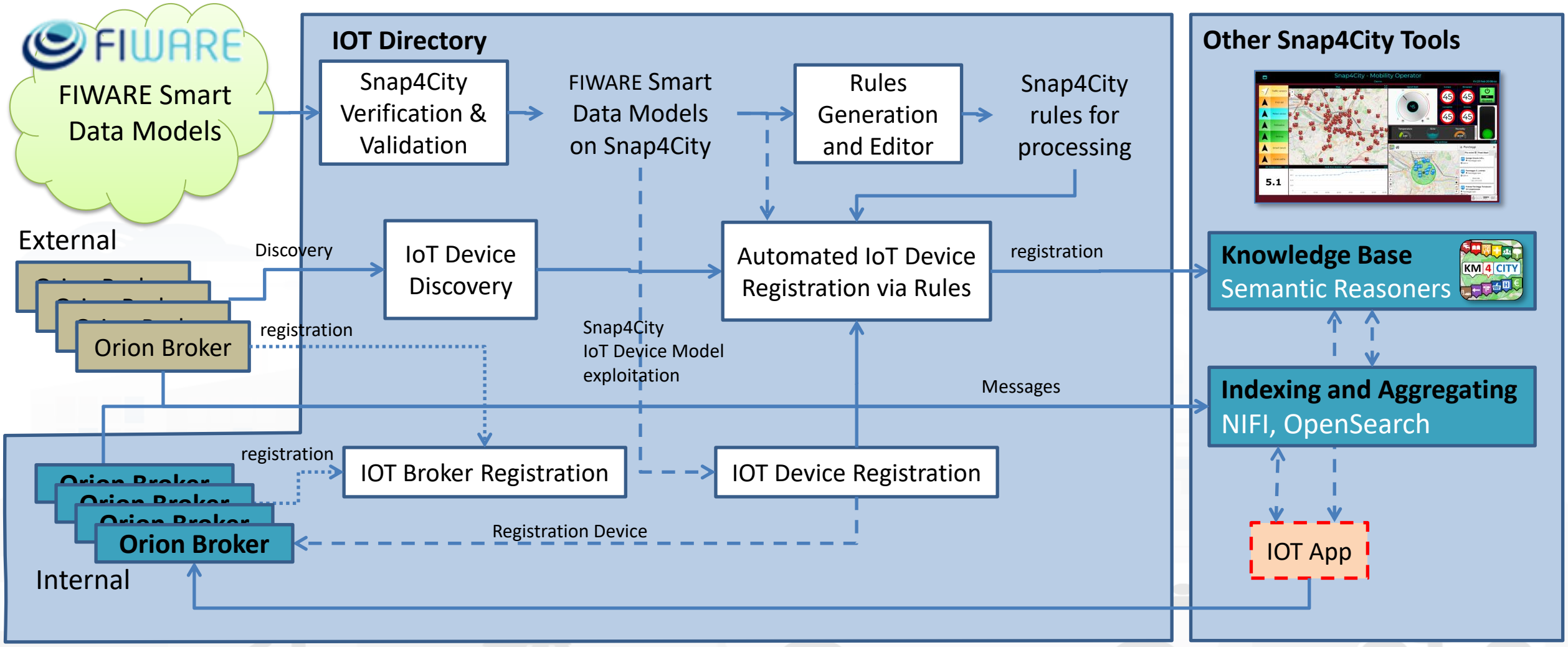
Image of the Devices and Licensing





Some functionalities are limited to certain roles

Exploiting FIWARE Smart Data Models

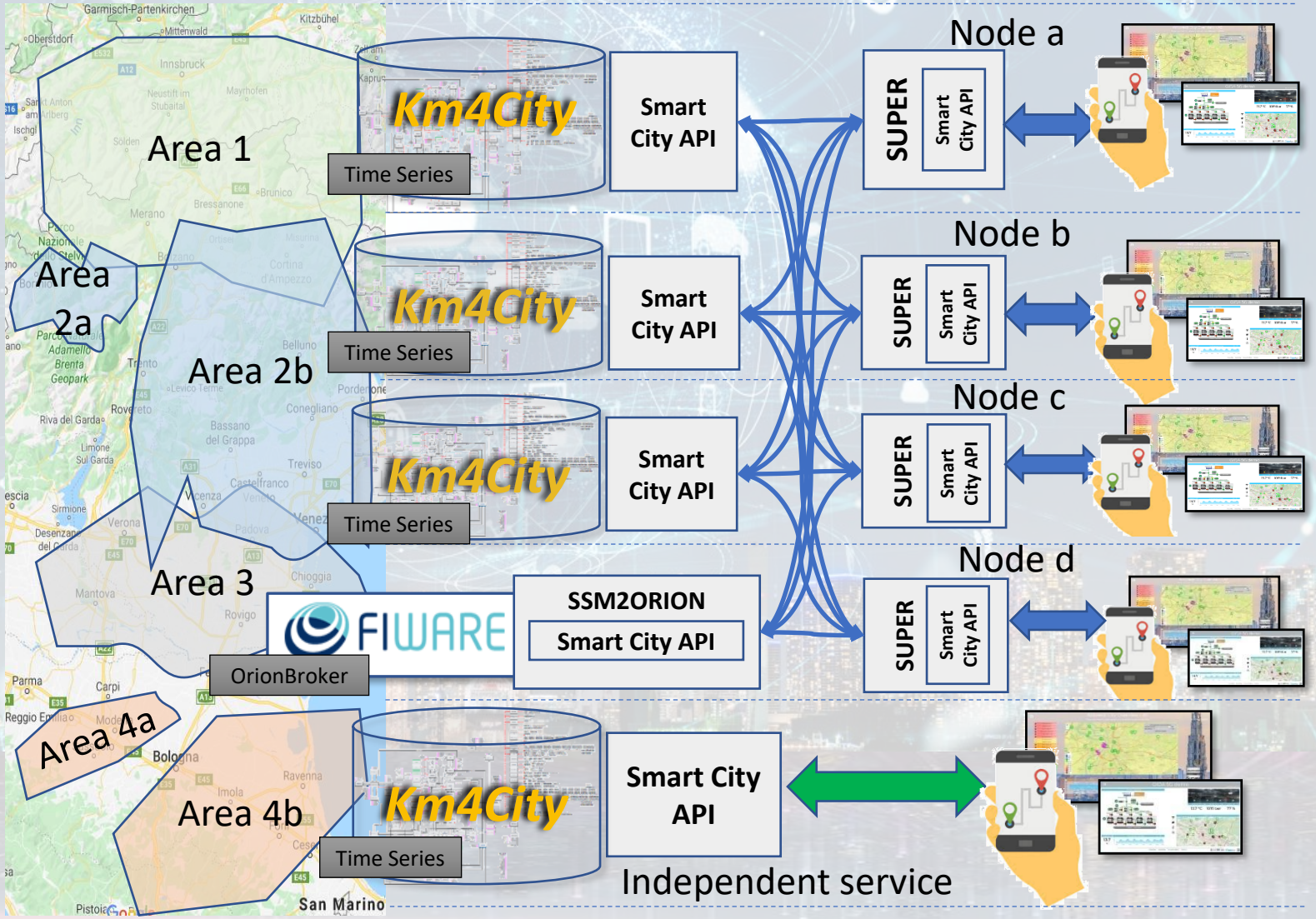


TOP

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 Deplo Install	Smart City API: Web & Mob. App	Design and Develop 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

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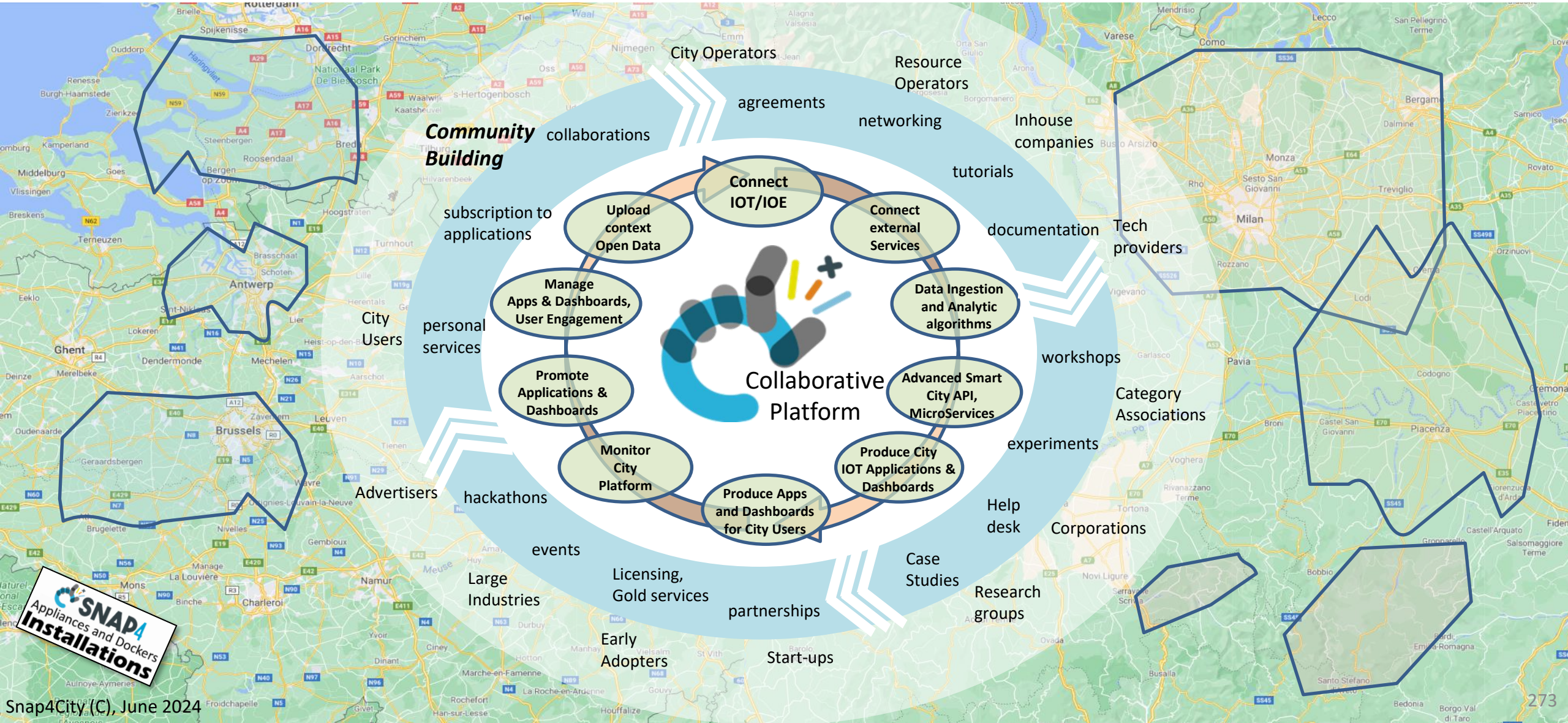
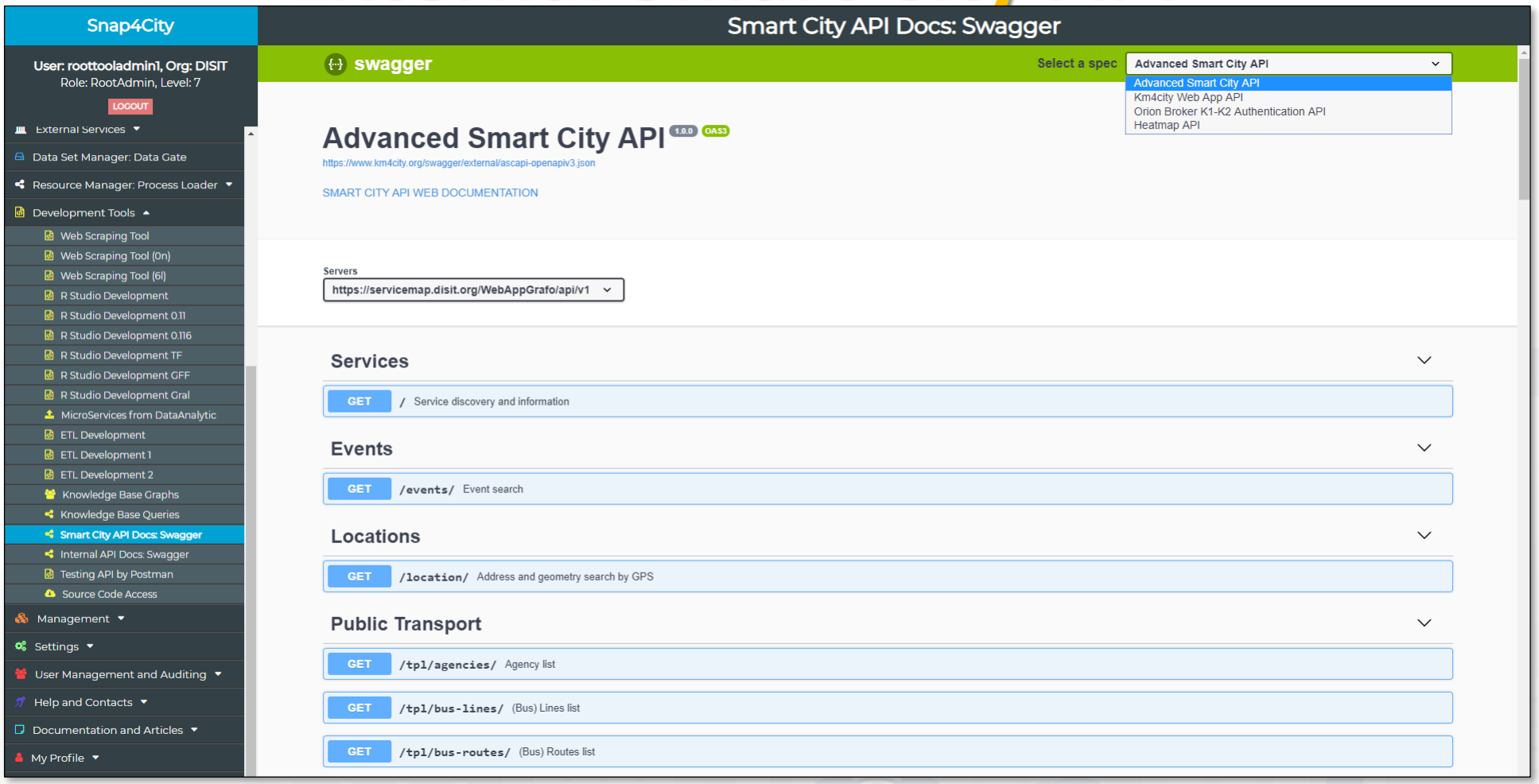
SNAP4CITY KM4CITY

One Snap4City Platform may serve Multiple Cities



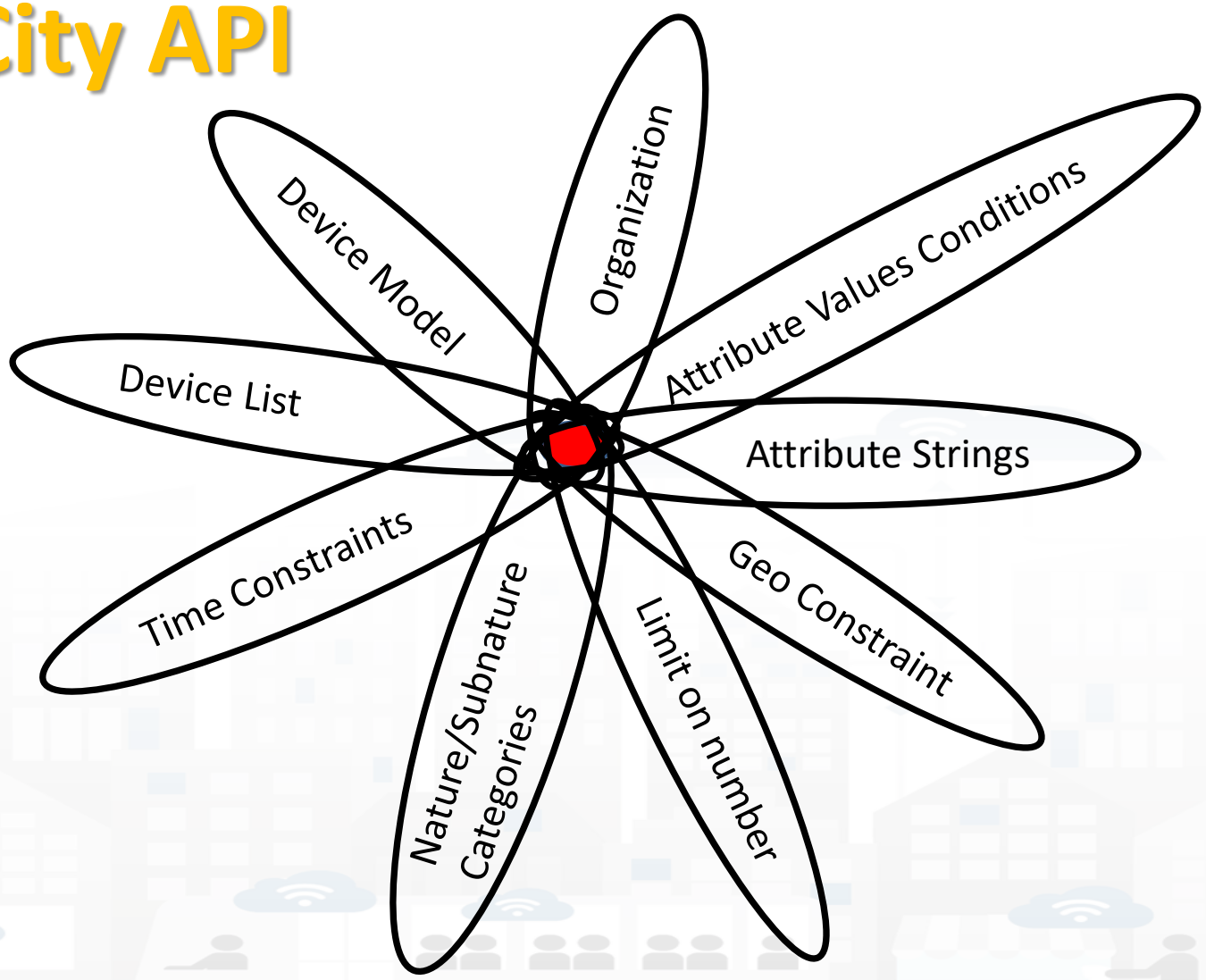
External Smart City API

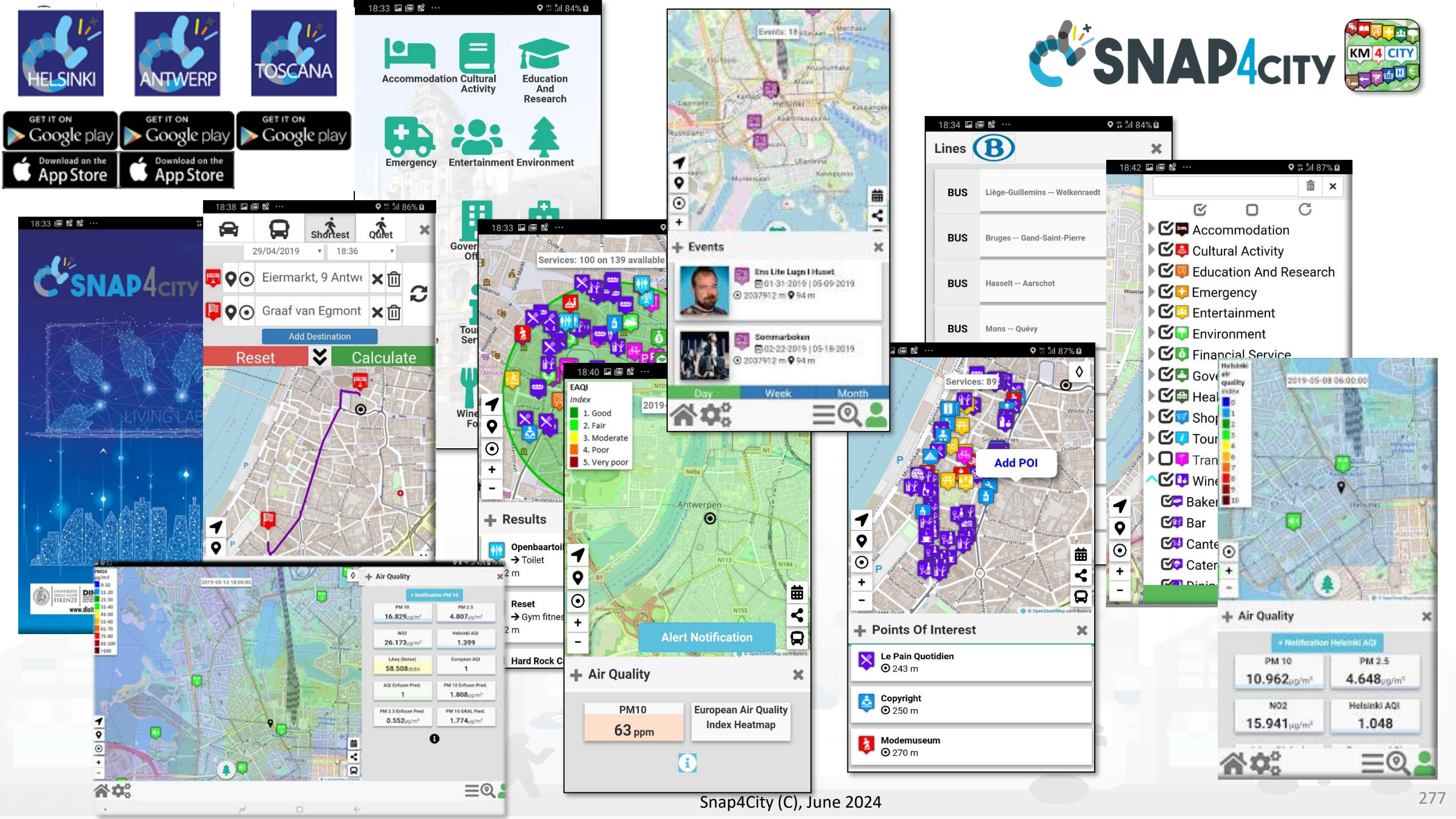


https://www.km4city.org/swagger/external/index.html

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 ☺

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ANTWERP
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KM 4 CITY
Accommodation
Cultural Activity
Education And Research
Emergency
Entertainment
Environment
Shortest
Quiet
Add Destination
Reset
Calculate
Events
Day
Week
Month
Lines
BUS
Liège-Guillemins -- Welkenraedt
Bruges -- Gand-Saint-Pierre
Hasselt -- Aarschot
Mons -- Quévy
Services: 100 on 139 available
EAQI
Index
1. Good
2. Fair
3. Moderate
4. Poor
5. Very poor
Results
Alert Notification
Air Quality
PM10
63 ppm
European Air Quality Index Heatmap
Add POI
Points Of Interest
Le Pain Quotidien
243 m
Copyright
250 m
Modemuseum
270 m
Financial Service
Bar
Air Quality
PM 10
10.962
PM 2.5
4.648
NO2
15.941
Helsinki AQI
1.048

TOP

Development of Solutions

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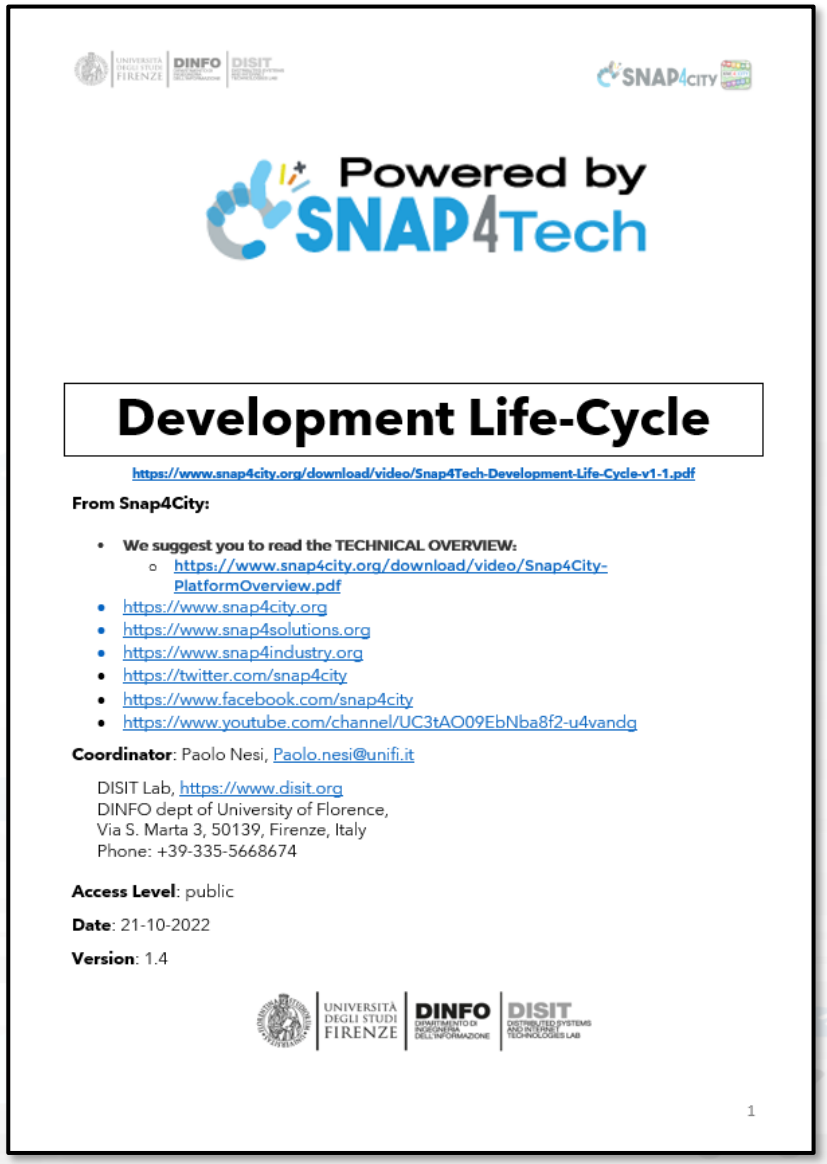
Development

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



Powered by SNAP4Tech

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

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Access Level: public

Date: 21-10-2022

Version: 1.4

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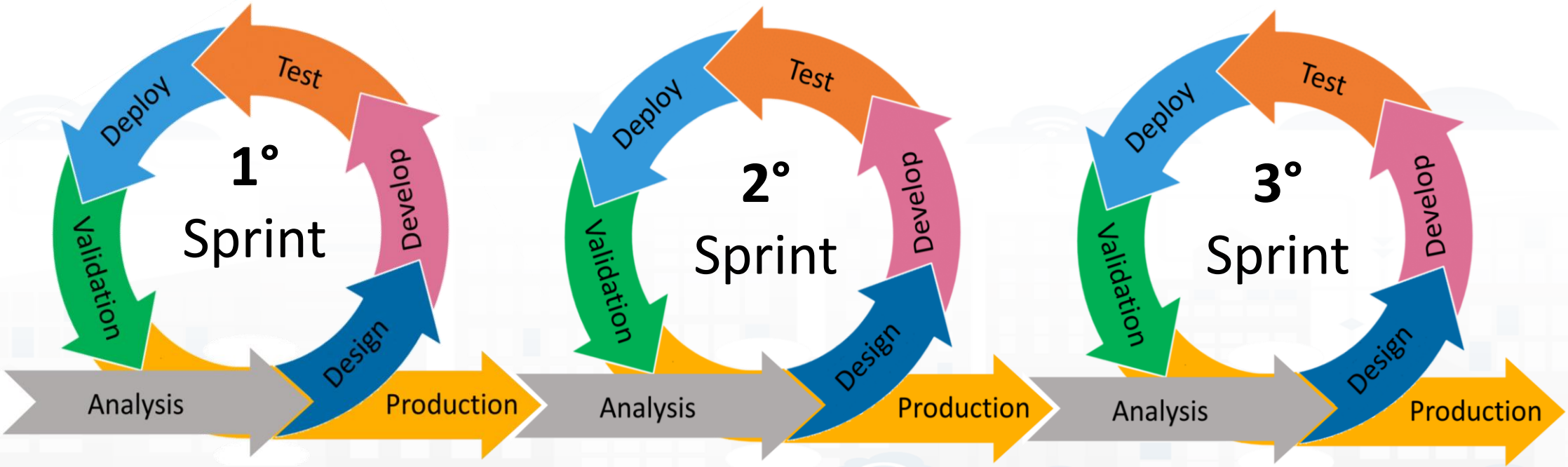
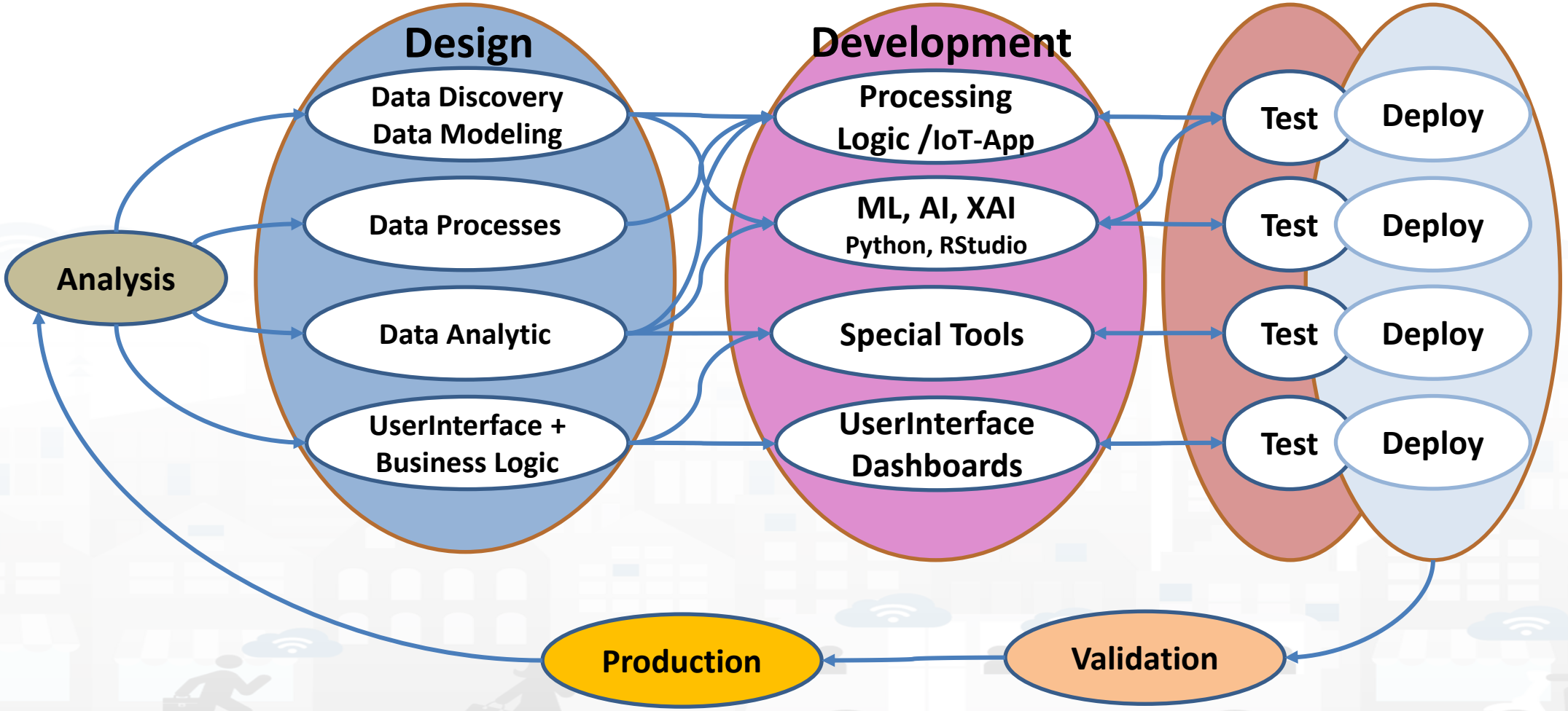
1

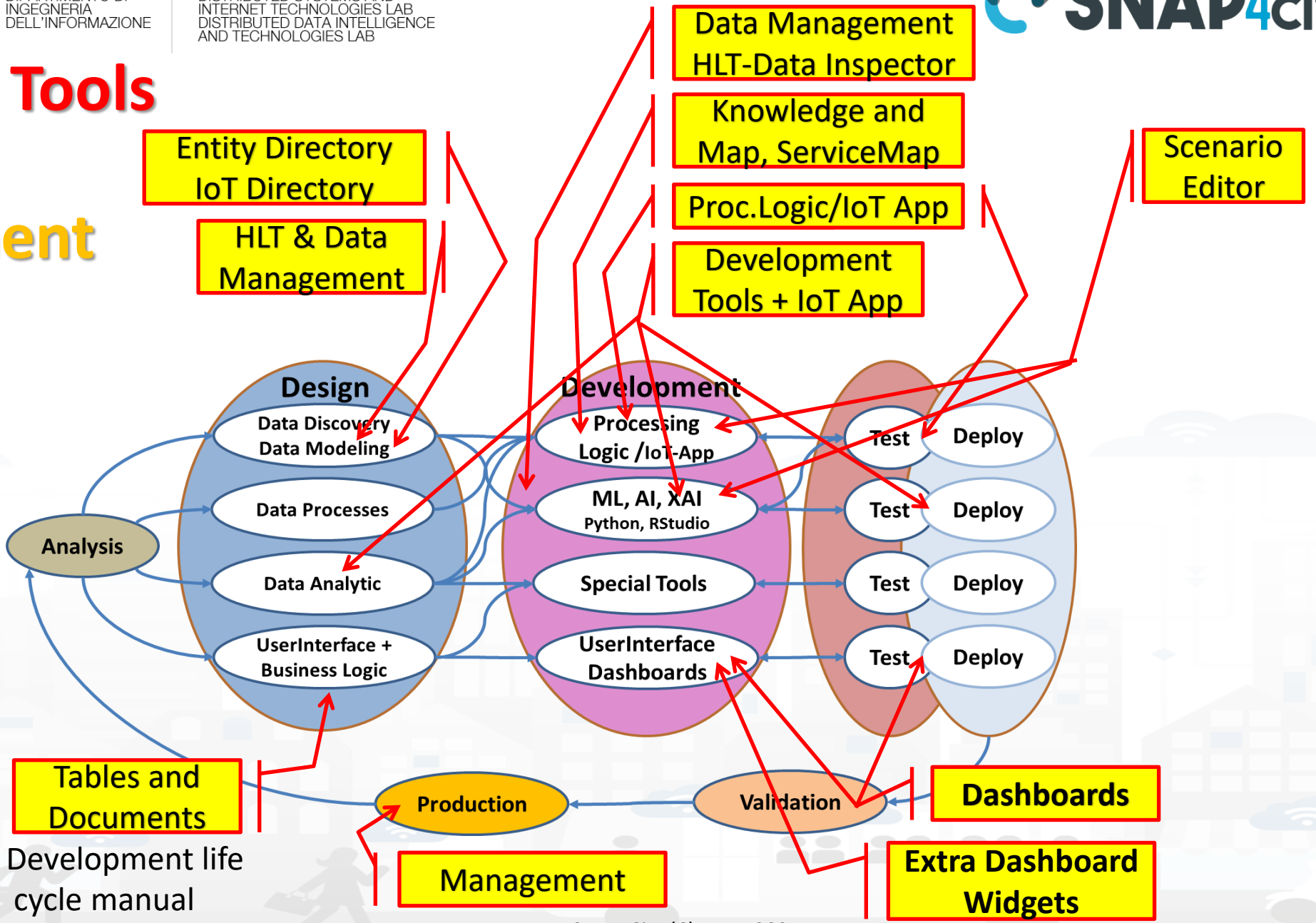
Development Life Cycle Smart Solutions



Development Life Cycle Smart Solutions

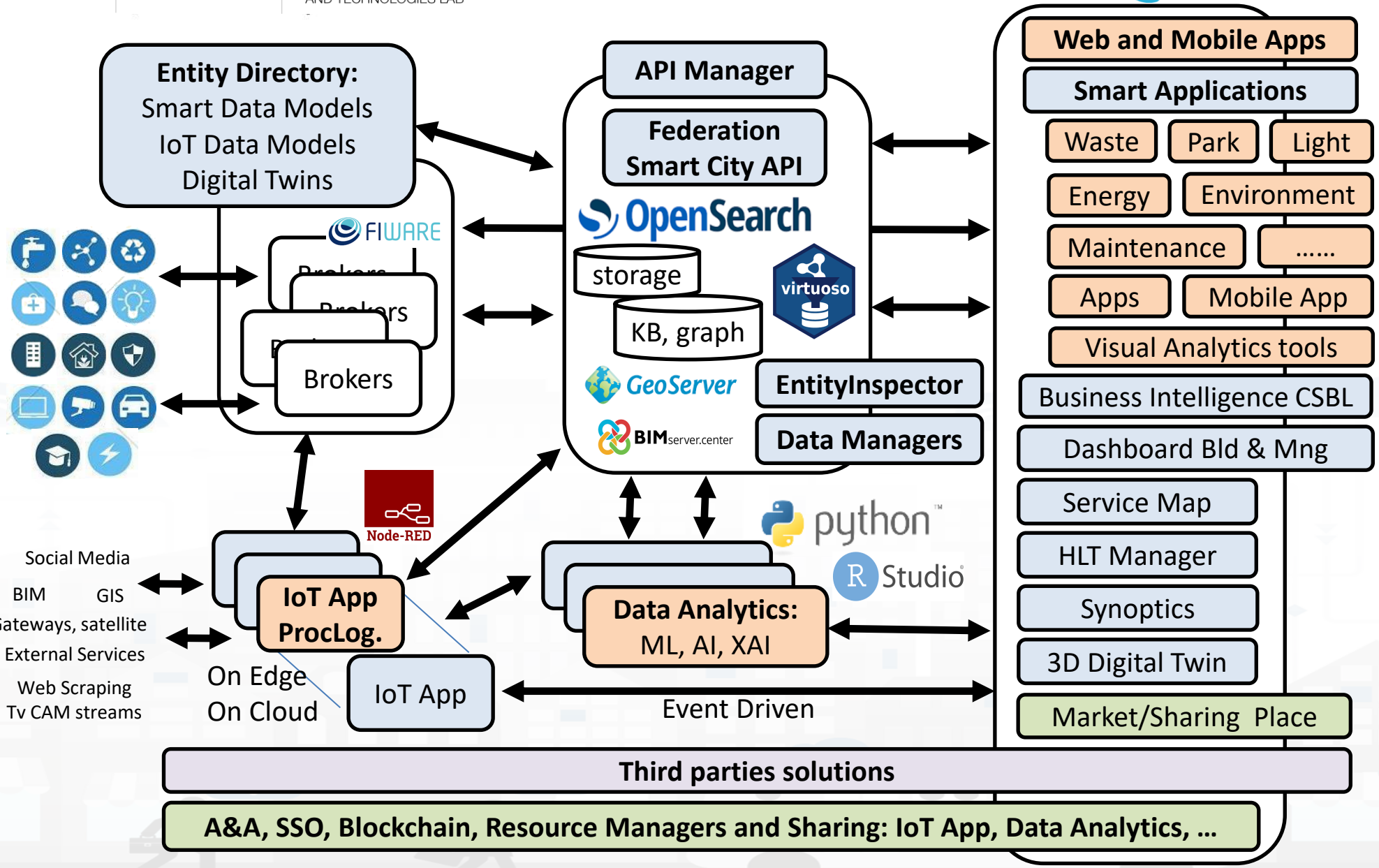


Snap4City Tools vs Development Life Cycle



Development life cycle manual

Tech Arch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Node-RED
python
RStudio
Social Media
BIM
GIS
Gateways, satellite
External Services
Web Scraping
Tv CAM streams
IoT App
ProcLog.
On Edge
On Cloud
IoT App
Data Analytics:
ML, AI, XAI
Event Driven
Web and Mobile Apps
Smart Applications
Waste
Park
Light
Energy
Environment
Maintenance
……
Apps
Mobile App
Visual Analytics tools
Business Intelligence CSBL
Dashboard Bld & Mng
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Tech Arch

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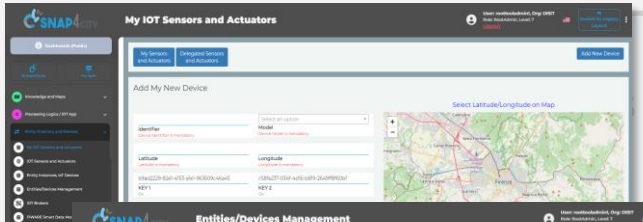
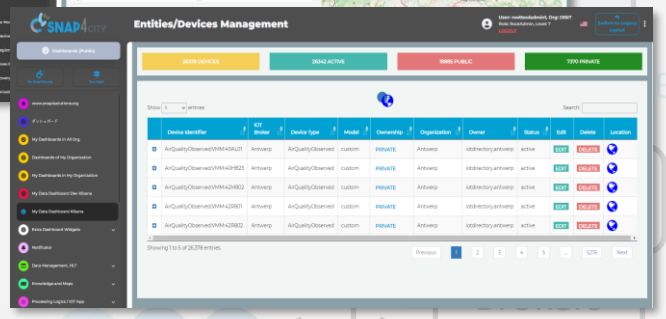
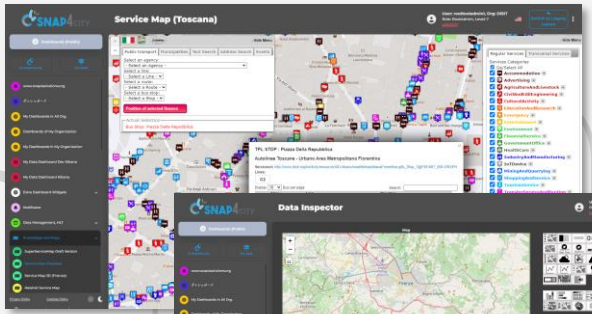
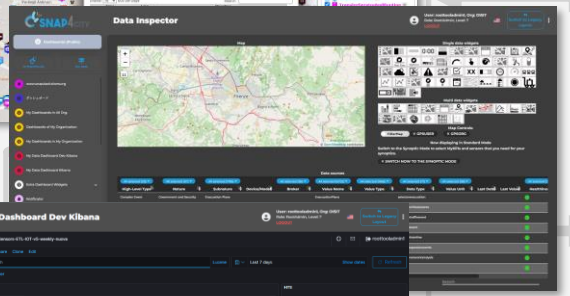
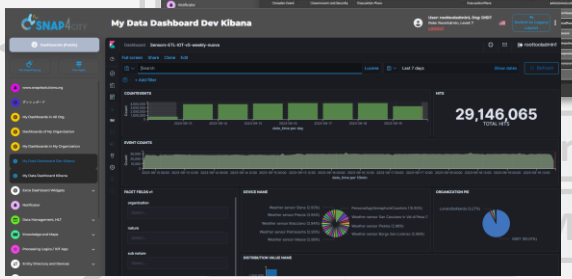
KM4CITY

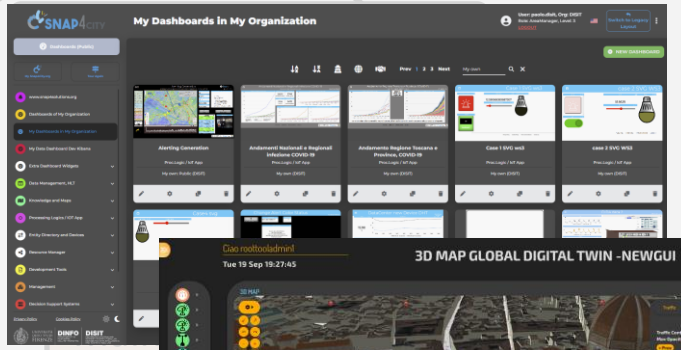


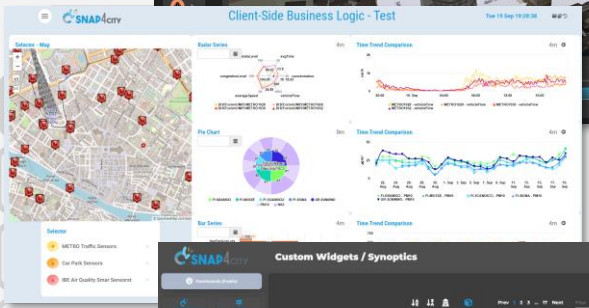


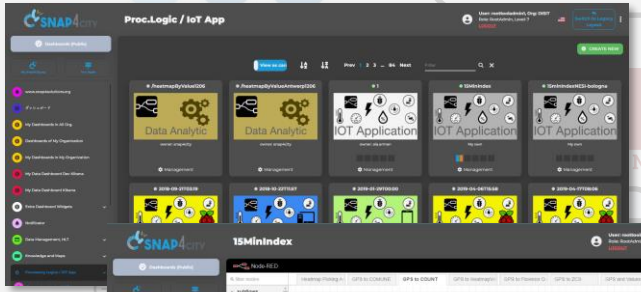


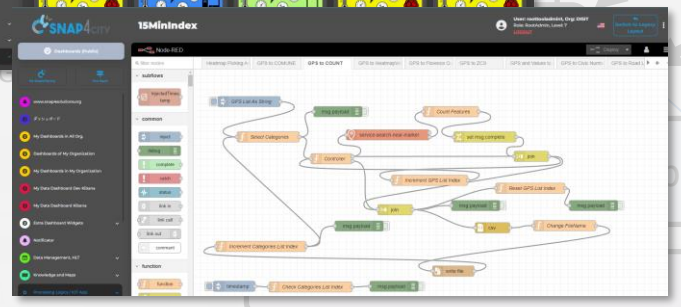


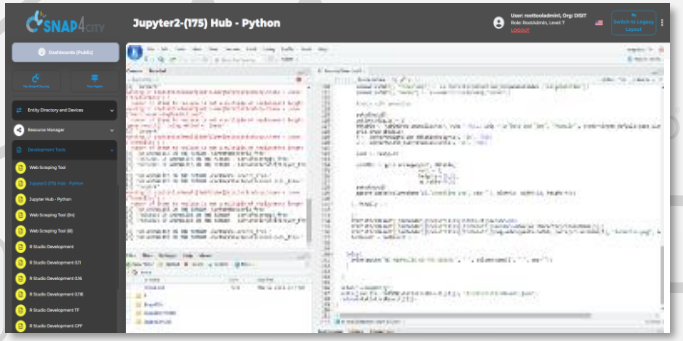












Third parties solutions

A&A, SSO, Blockchain, Resource Managers and Sharing: IoT App, Data Analytics, …

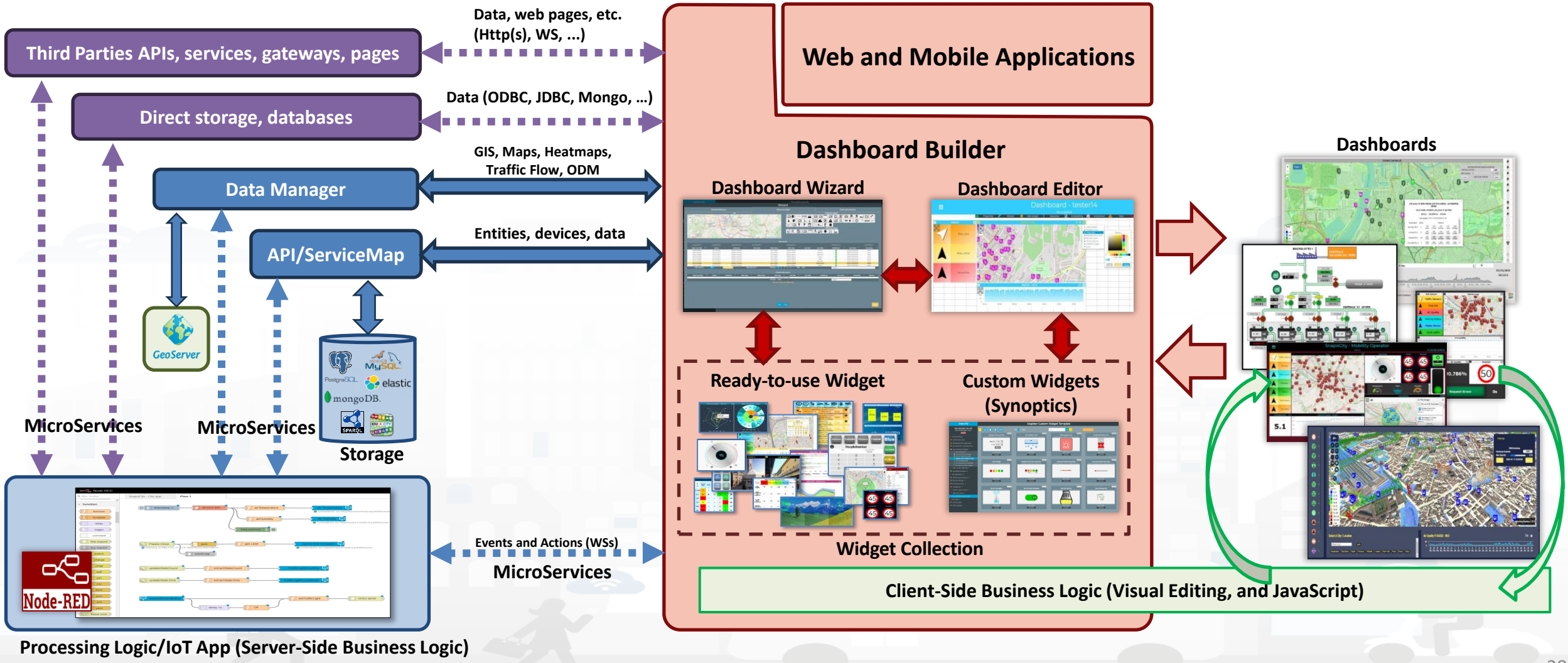
TOP

BI-CSBL

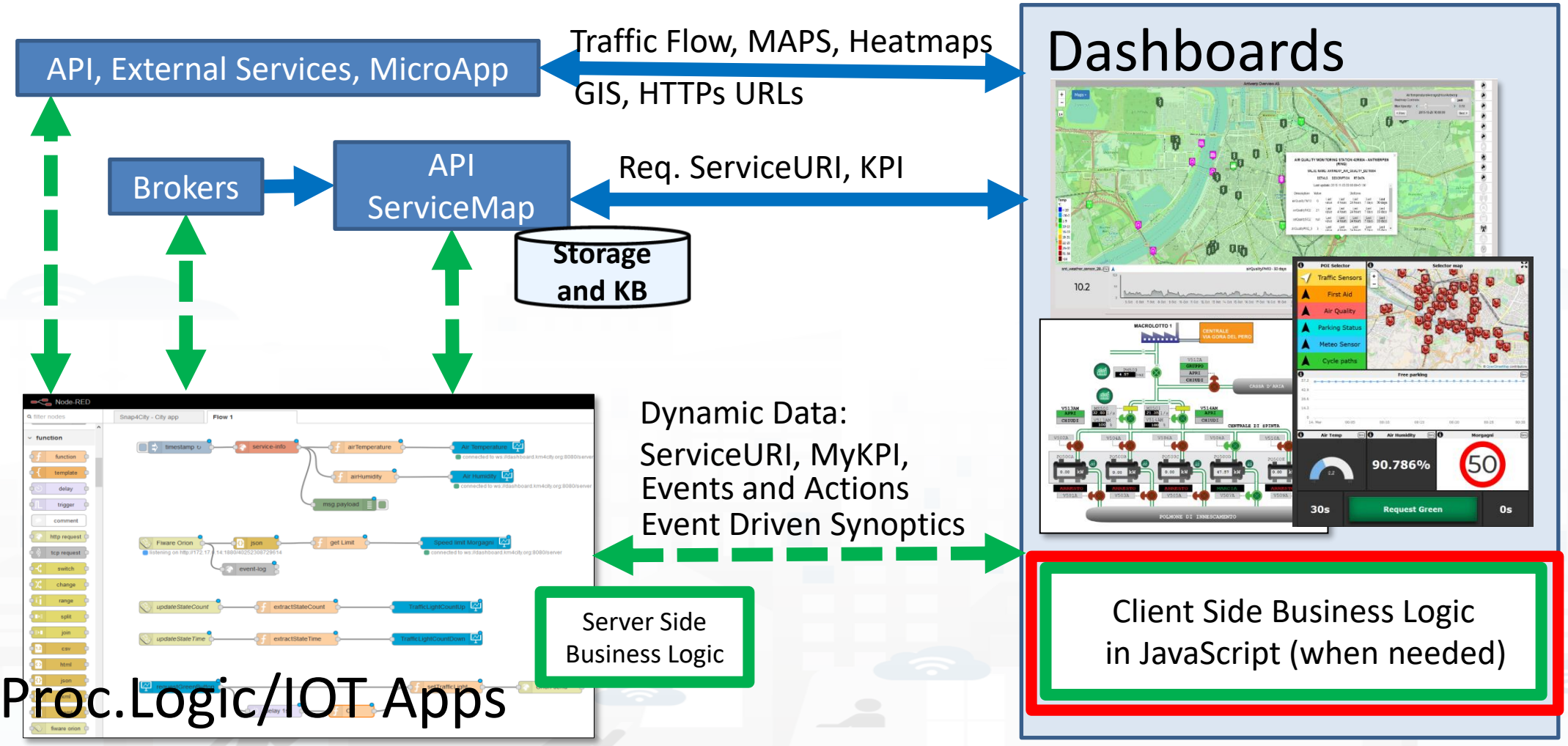
Smart Application Business Intelligence

	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								

How the Dashboards / Apps exchange data



How the Dashboards exchange data

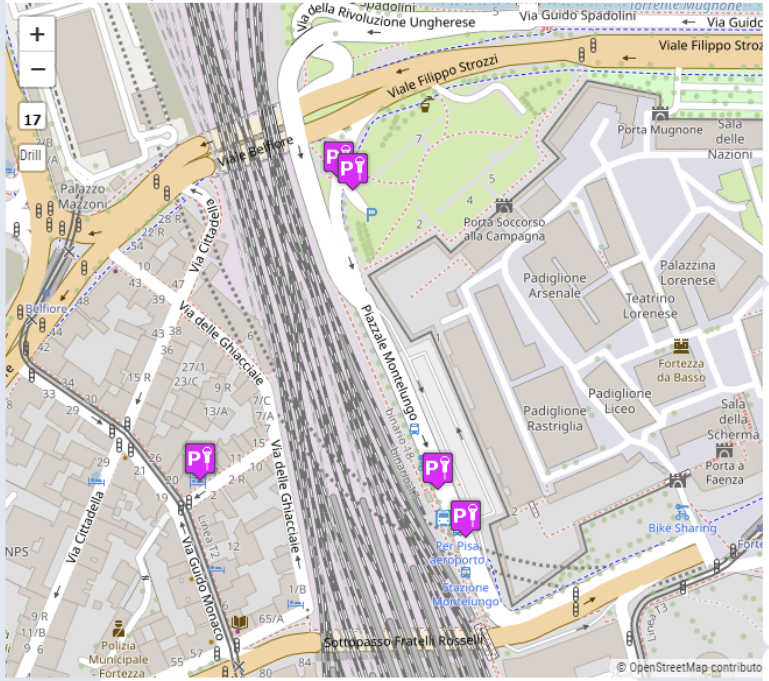


example

First BI Example

Mon 10 Apr 12:00:40

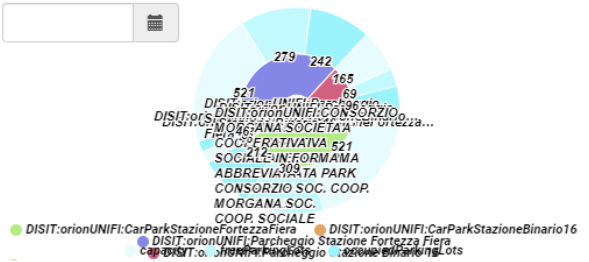
Selector - Map



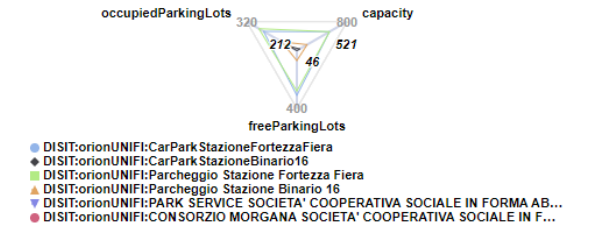
Selector

- Car_park
- metrotrafficsensor
- Air_quality_monitoring_station
- Weather_sensor

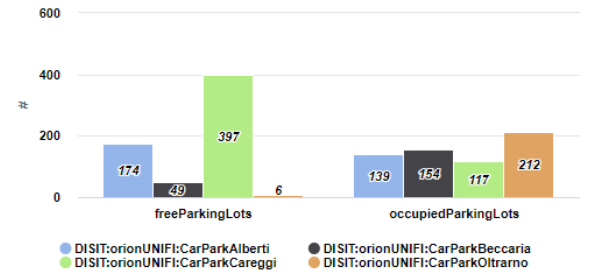
Pie Chart 9m



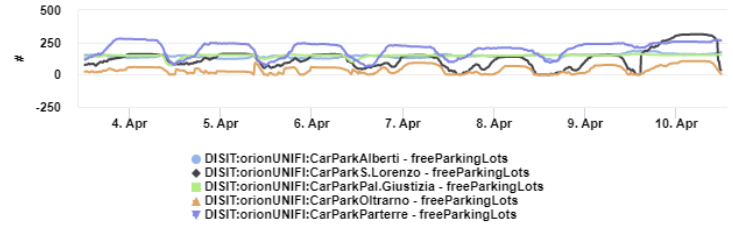
Radar Series 4m



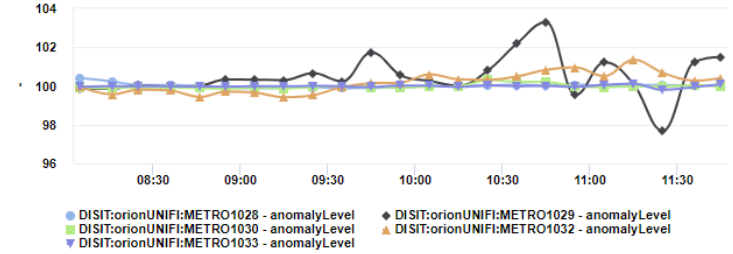
Bar Series 4m



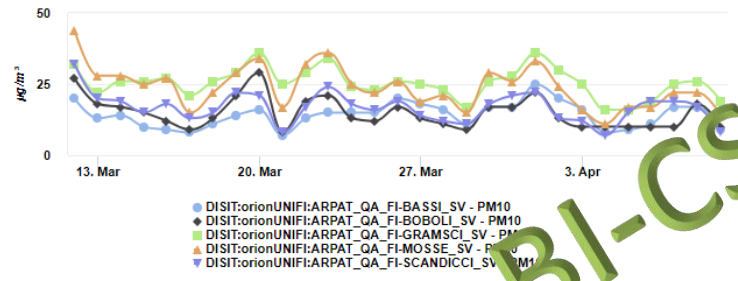
Time Trend Comparison 4m



Time Trend Comparison 4m



Time Trend Comparison 4m



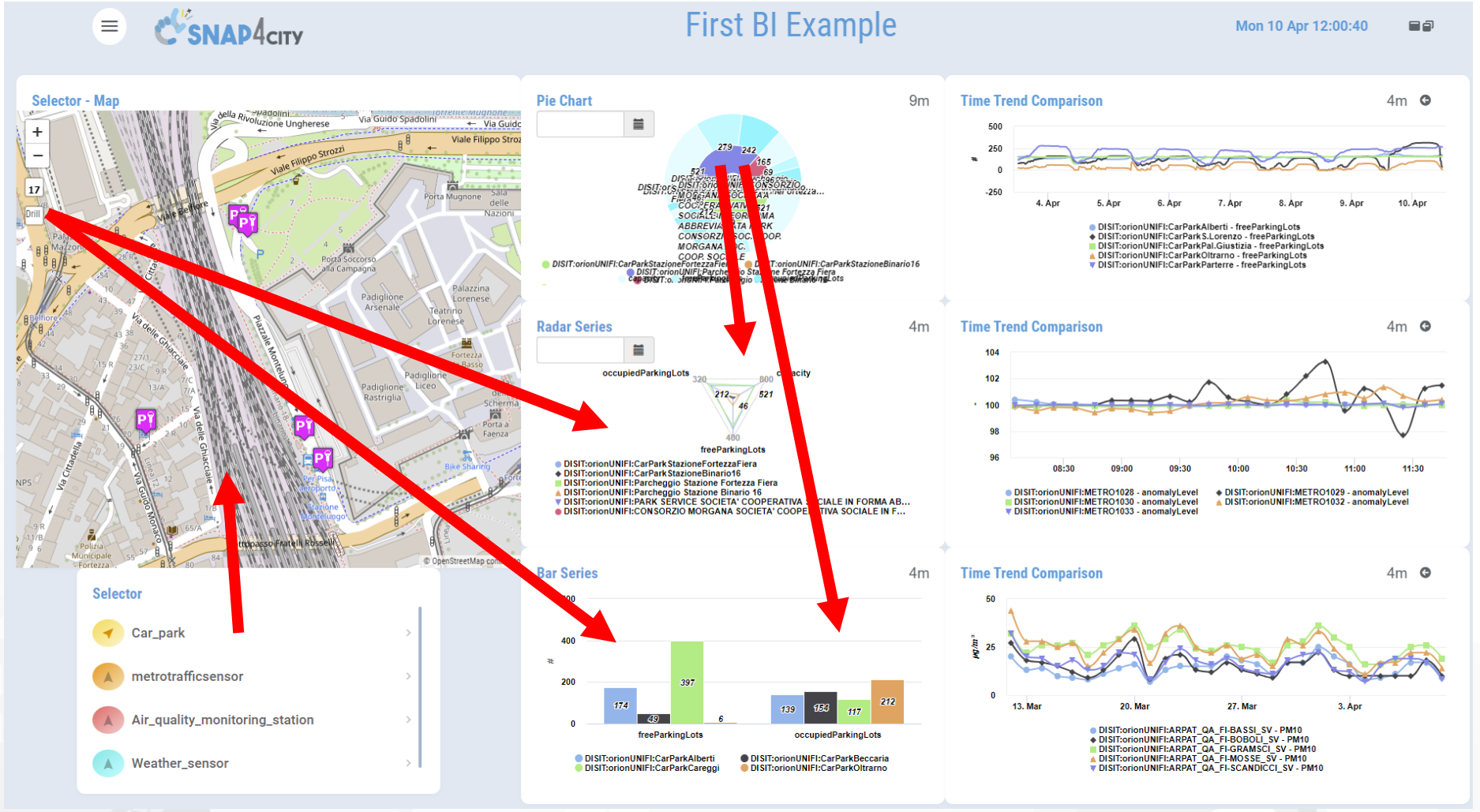
BI-CSBL

https://www.snap4city.org/dashboardSmartCity/view/Gea.php?iddasboard=MzcyNA==

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

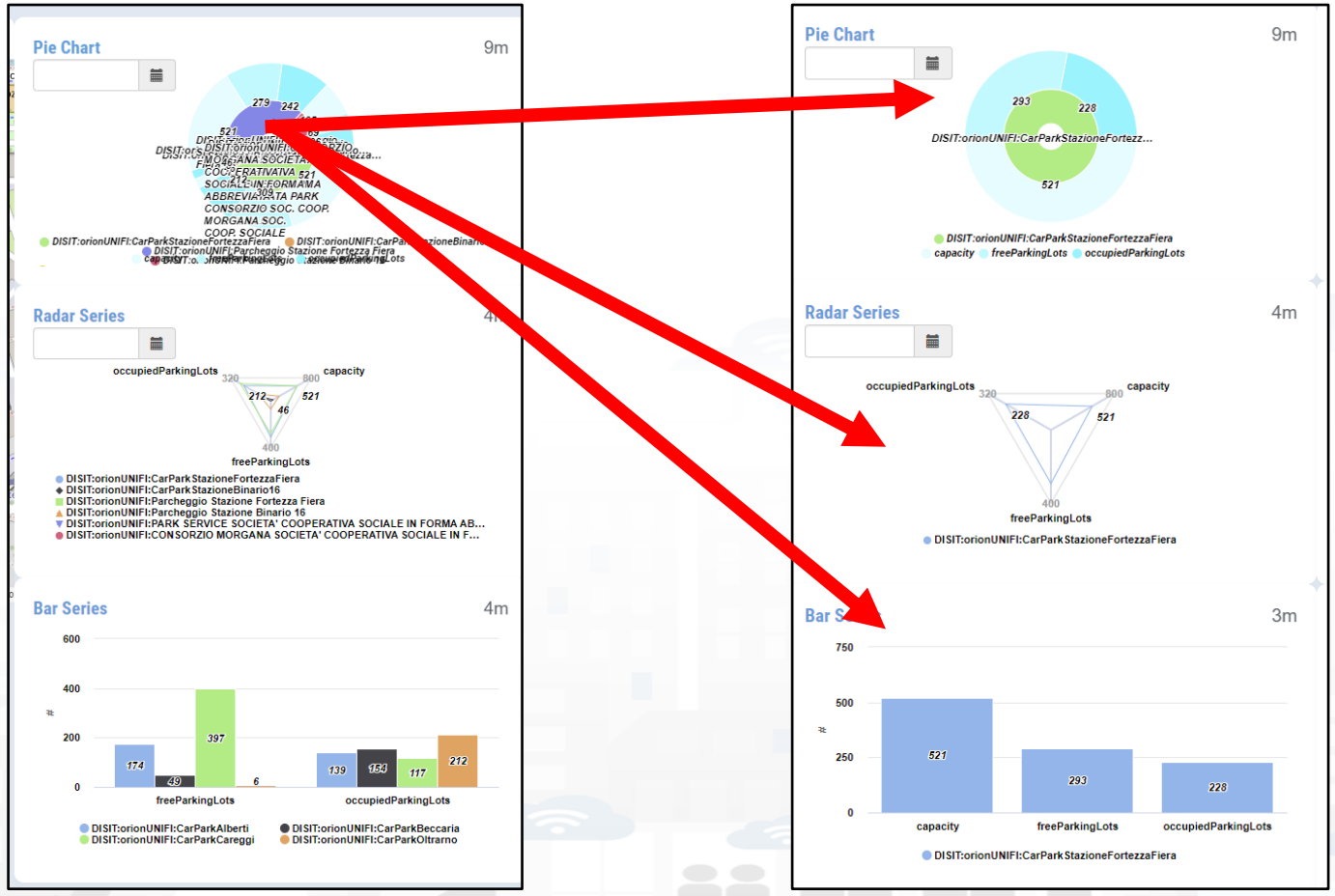
4) The JavaScript CSBL on Map will send data to the programmed Widgets. In this case, arrowed in RED



Example: From Data Graphs to Graphs (drill down)

1) Click on the Donut element

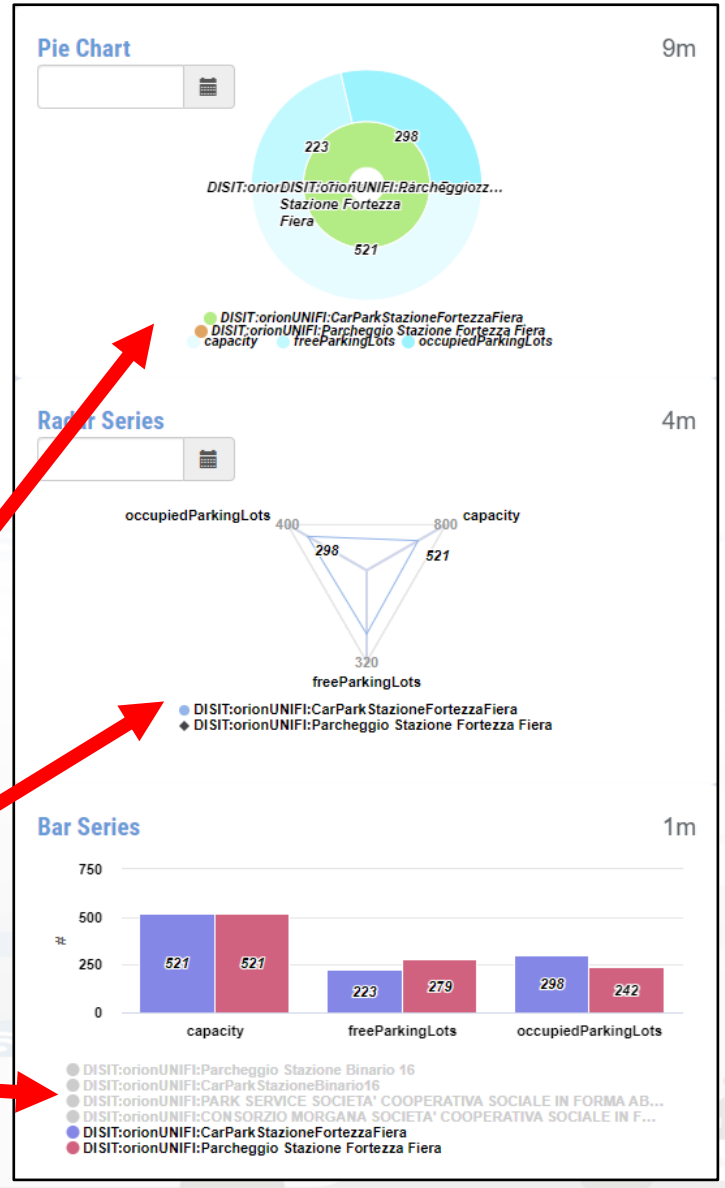
2) The JavaScript CSBL on the Donut Widget will send commands to the programmed Widgets to focus on selection, as highlighted by the red arrows



BI-CSBL

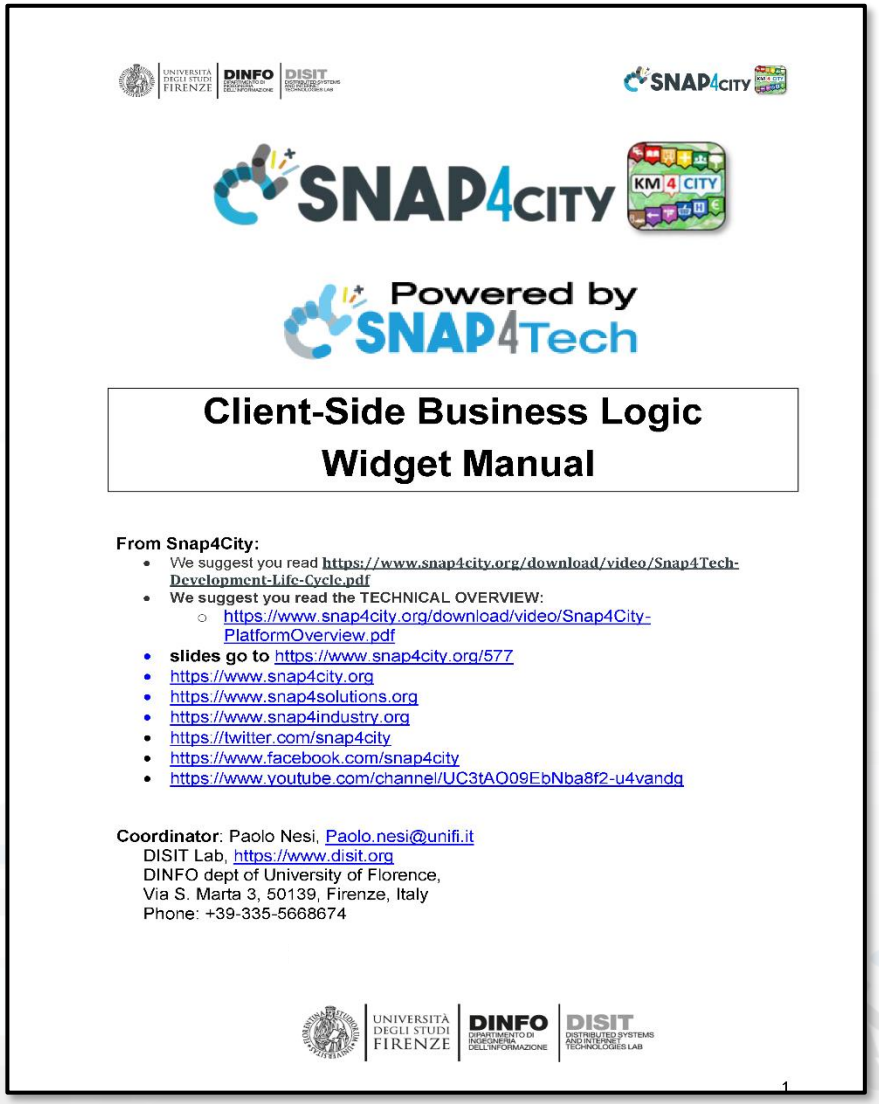
1) Click on the Legenda of Bar Series

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



CSBL

Client Side Business Logic



Powered by SNAP4Tech

Client-Side Business Logic
Widget Manual

From Snap4City:

- We suggest you read https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf
- We suggest you read the TECHNICAL OVERVIEW:
  - https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf
- **slides go to** https://www.snap4city.org/577
- https://www.snap4city.org
- https://www.snap4solutions.org
- https://www.snap4industry.org
- https://twitter.com/snap4city
- https://www.facebook.com/snap4city
- https://www.youtube.com/channel/UC3tAQ09EbNba8f2-u4vandg

Coordinator: Paolo Nesi, 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

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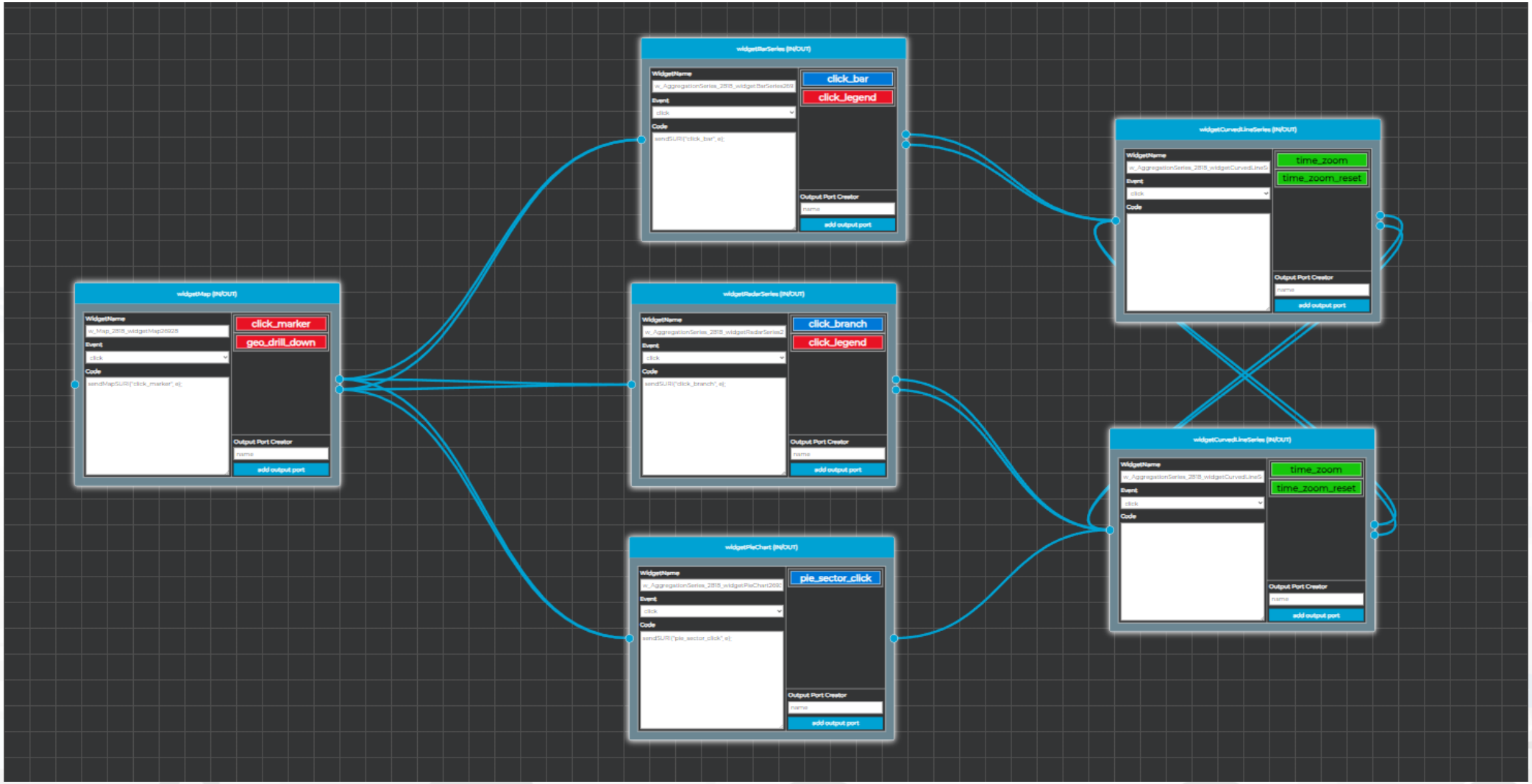
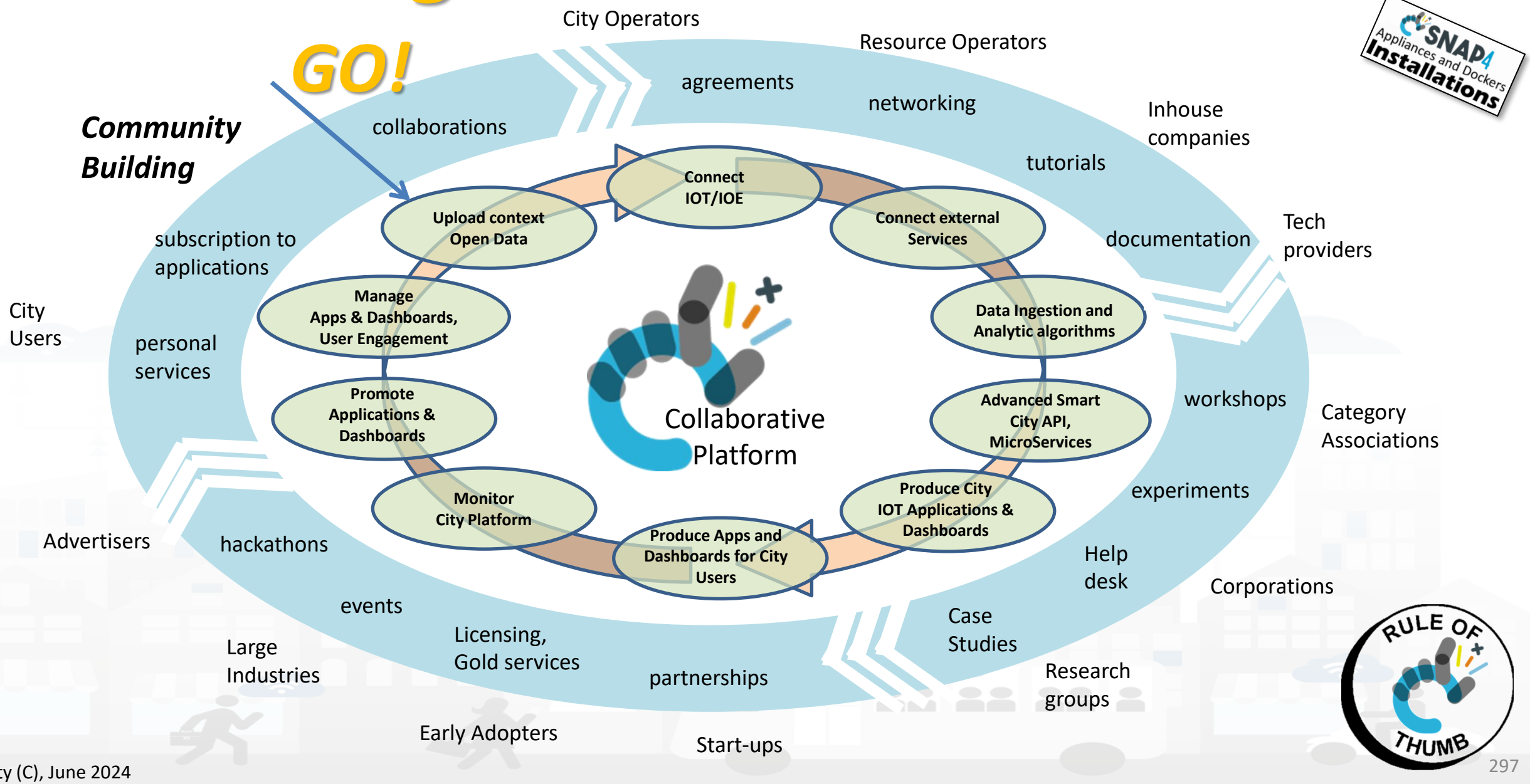
https://www.snap4city.org/download/video/ClientSideBusinessLogic-WidgetManual.pdf

Visual programming for CSBL, accessible in beta



Context and Life Cycle and Living Lab support

Accelerating GO!



Phases' Coverage

Data Identification → Data Gathering → Data Aggreg. Process. → Data Storage, semantic → Data search Retrieval → Data Analysis → Data Visualization → Visual Analytics

what	Identification	Gathering	Complex data types	Aggregation	Storage (semantic)	Efficient Retrieval	Semantic Modeling, query	Data Analytics (micro, marco)	Scenarios context	Artificial Intelligence	Data rendering	Real Time Dashboard	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

SNAP4 Appliances and Dockers Installations

Installing Snap4City

Installations

docker

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

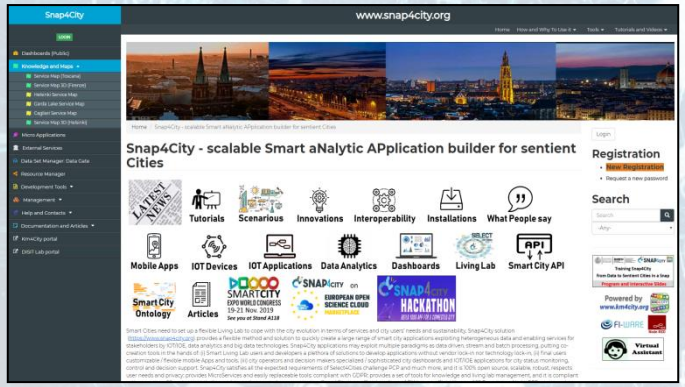
https://www.snap4city.org/738 for container

To get an updated version read it!

How to adopt Snap4City

SNAP4CITY

Https://www.snap4city.org



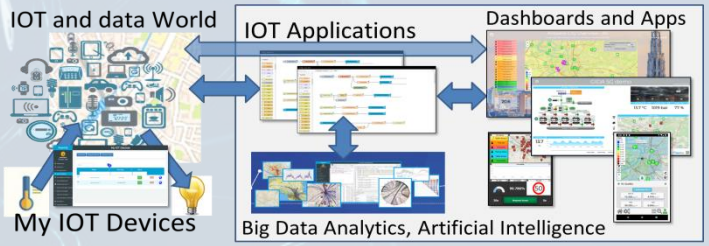
Smart City as a Service

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

SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

Download and deploy

On your premise



Powered by SNAP4Tech

Installation on your premise

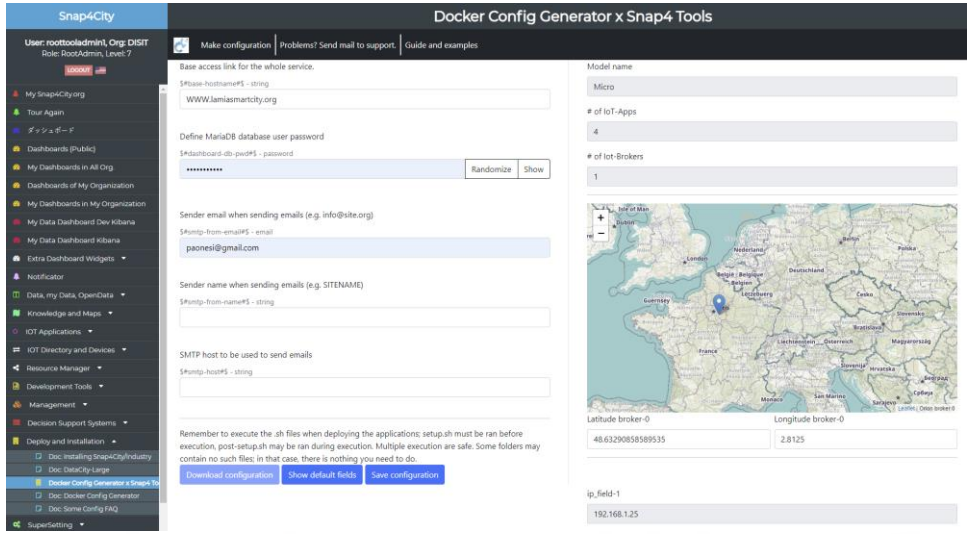
- **Virtual Machines or Dockers**
- Different configurations
  - From small to scalable
  - Exploiting your legacy tools
  - Interoperable with any tool
- No vendor lock-in, No tech lock-in

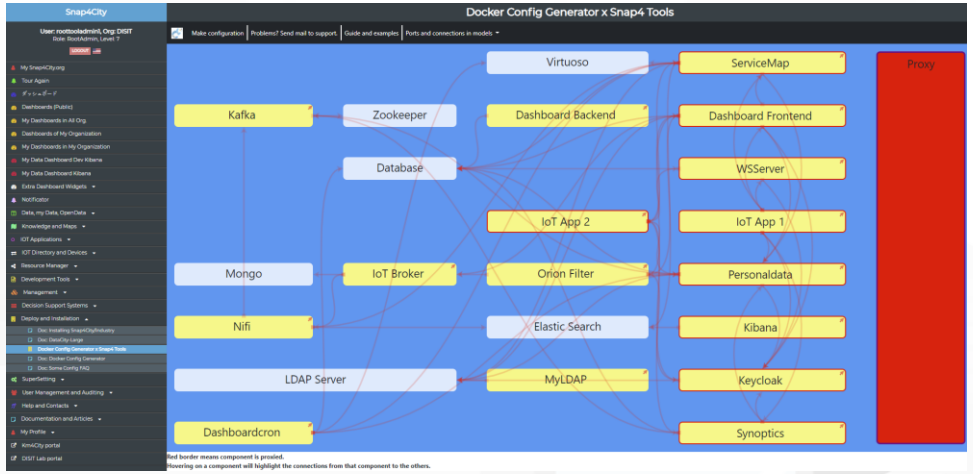
Mixed solutions! For example:

- 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

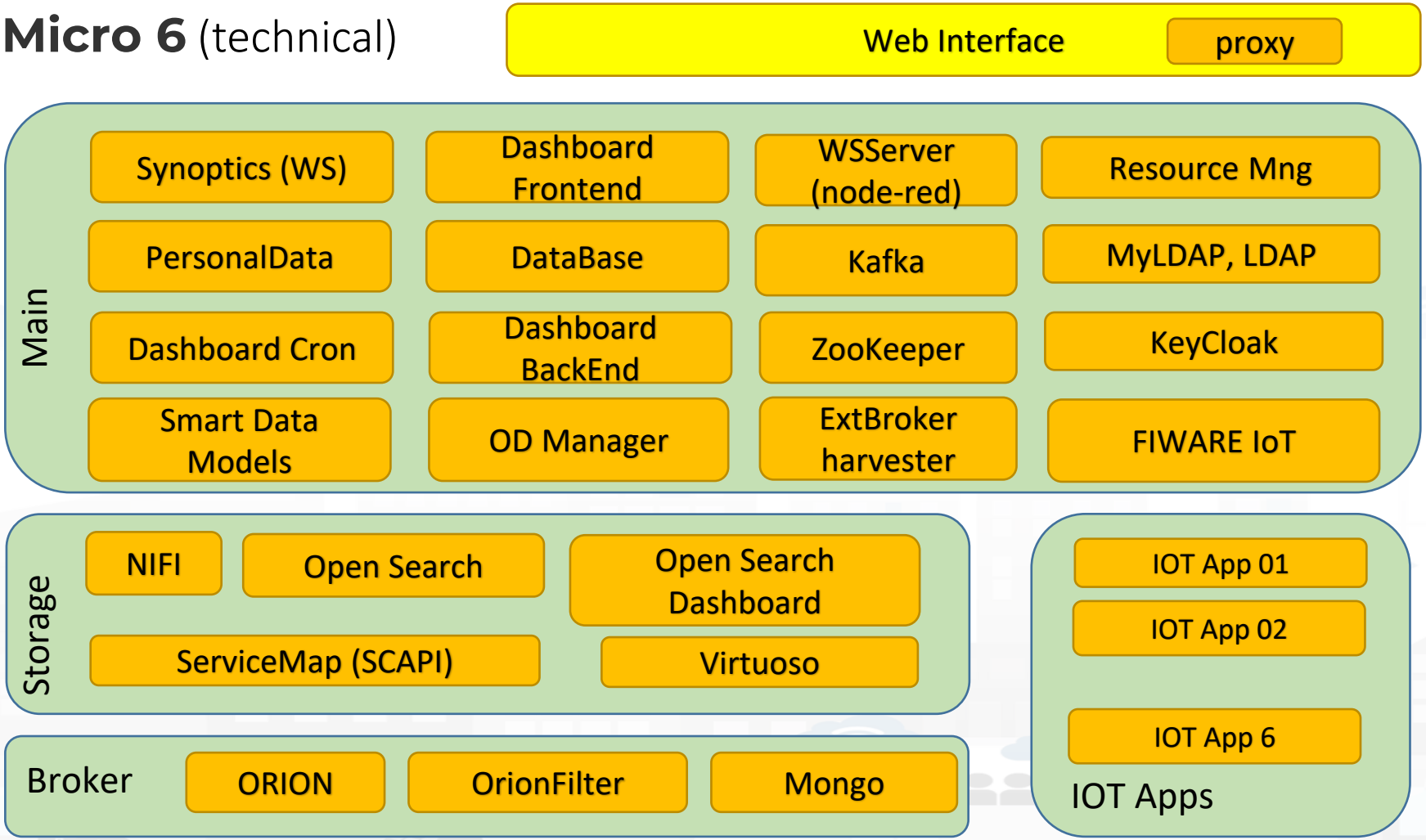




https://www.snap4city.org/docker-generator/selecting_model

Micro 6 model

Micro 6 (technical)



1Hour installation and ready to use

Support

- **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**

UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB | SNAP4CITY

legenda

SNAP4CITY | KM 4 CITY

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

Dashboard Builder | Dashboard Mng | Synoptics | 3D Digital Twin | Dashboard Wizard | Data Inspector | Scenario Editor | CSBL

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

Super | ASCAPI | kafka | WebSocket

Operation:

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

R Studio | python | docker | .....

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

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

Internal Interoperability: API, MicroServices

Snap4City Node-red Libraries | ASCAPI | WebSocket | FIWARE

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

Service Map | LOGraph | SuperServiceMap | DevDash | OpenSearch | nifi | virtuoso

NGSI V1, V2, LD FIWARE

Linked Data triples

Data Collection: data mining, harvesting, integration, transformation, data models, …

Directory | Blockchain | Harvester | Data Manager | Brokers | FIWARE | Node-RED

Any protocol and format

Any protocol and format

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

Node-RED

Any protocol and format

Any protocol and format

GIS | BIM | OSM | Gateways | External Services | Web Scraping | Social Media

External Third Party Services

Device Layer

Node-RED

Proc.Logic / IoT Applications Data Flow Logic

Platform Management: docker | SNAP4CITY

Authentication and Authorization: KEYCLOAK | OpenLDAP | SNAP4CITY

GDPR compliant

Partecipatori and Living Lab Supports

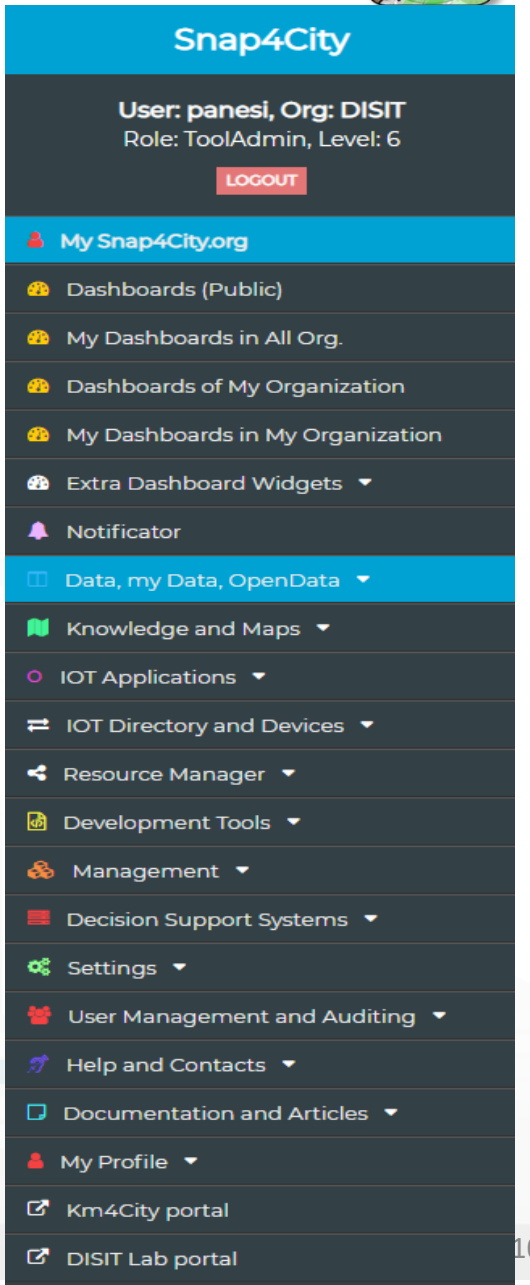
TOP

Platform Administration

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

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**



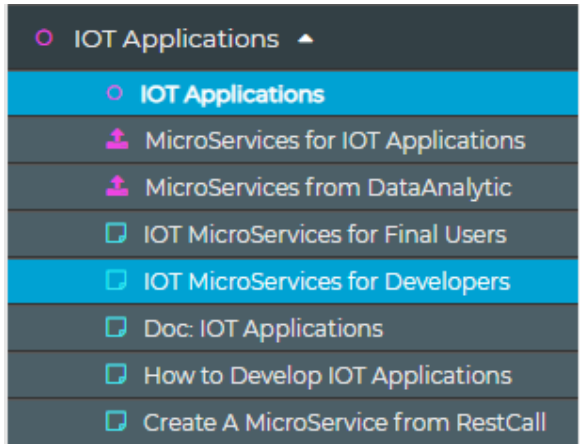
UNIVERSITÀ DEGLI STUDI FIRENZE

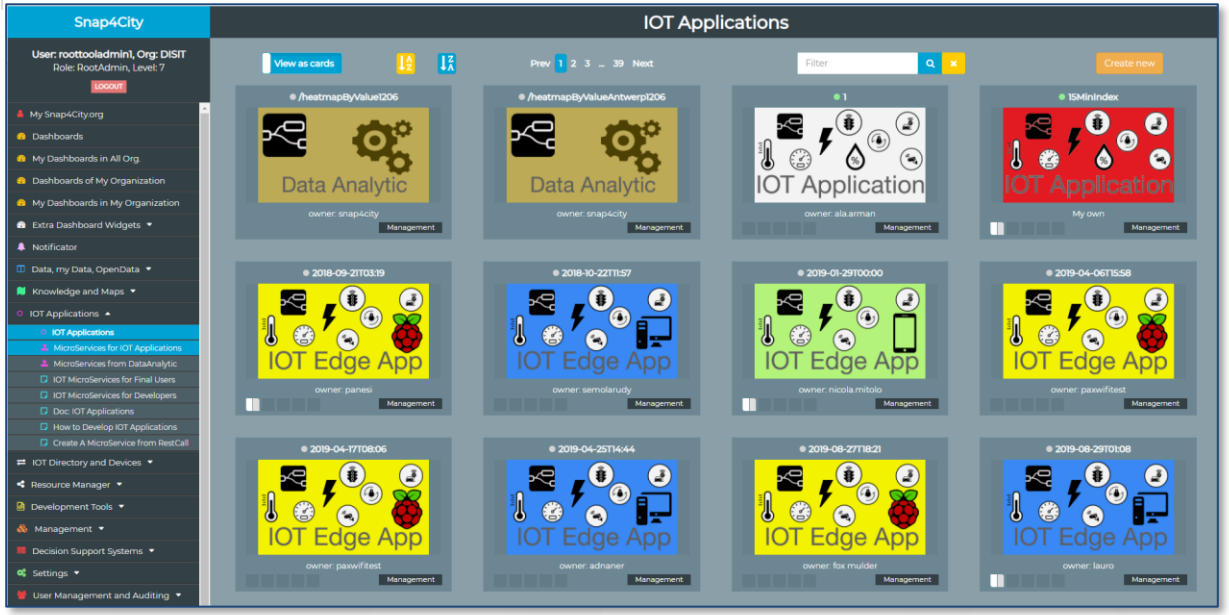
DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

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

IOT App

SNAP4CITY KM4CITY

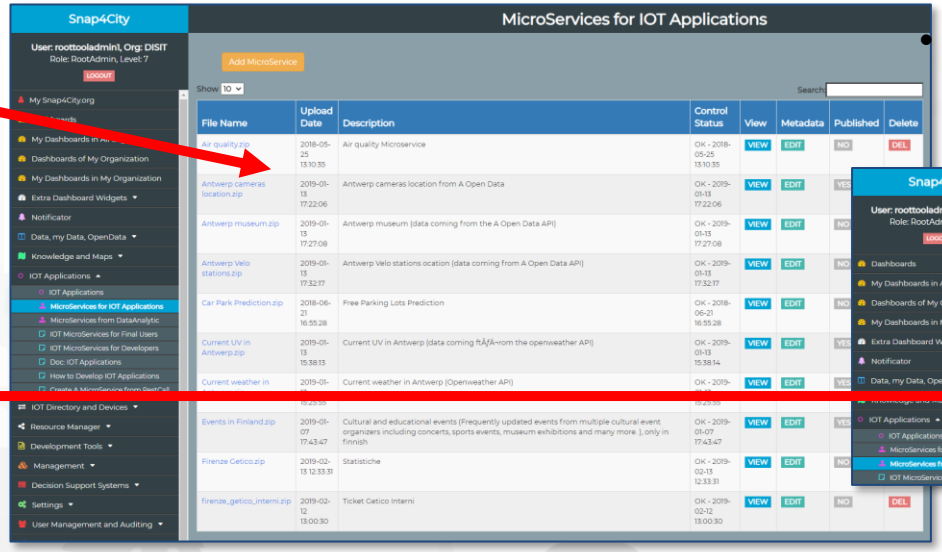


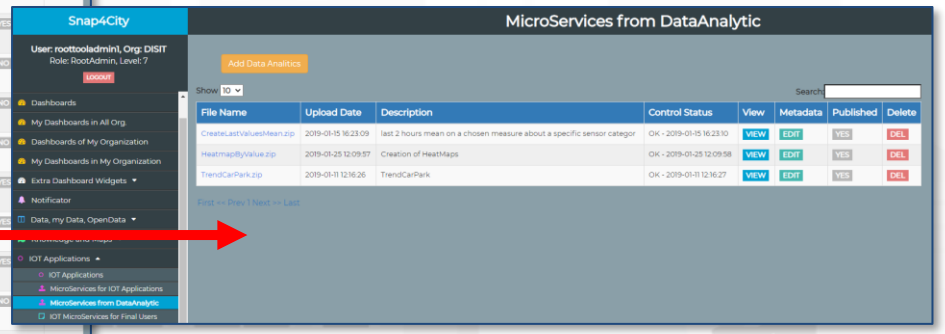


- **IOT Applications**: a view to manage Containers / IOT Edge Apps: IOT Apps, Data Analytics (R and Python), WebScraping, IOT edge, etc.

Managing also

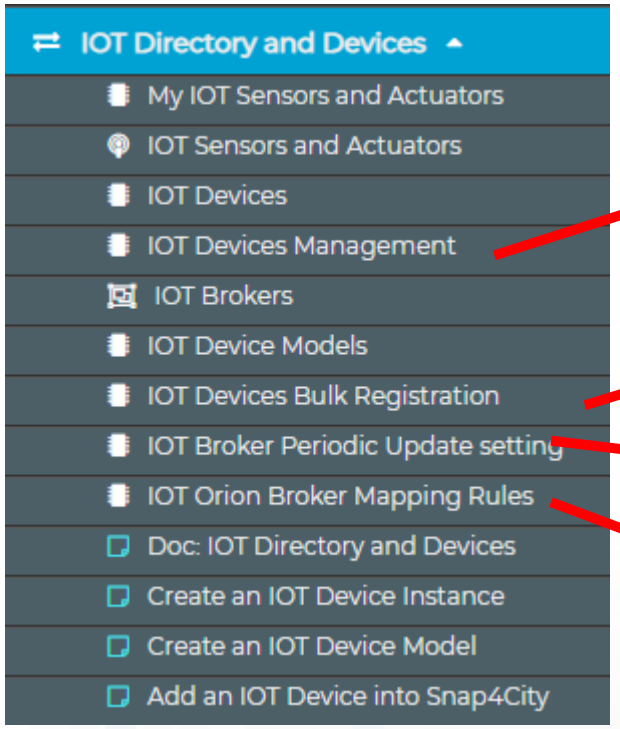
- **MicroServices for IOT App exploiting REST Call**
- **MicroServices from DataAnalytics**

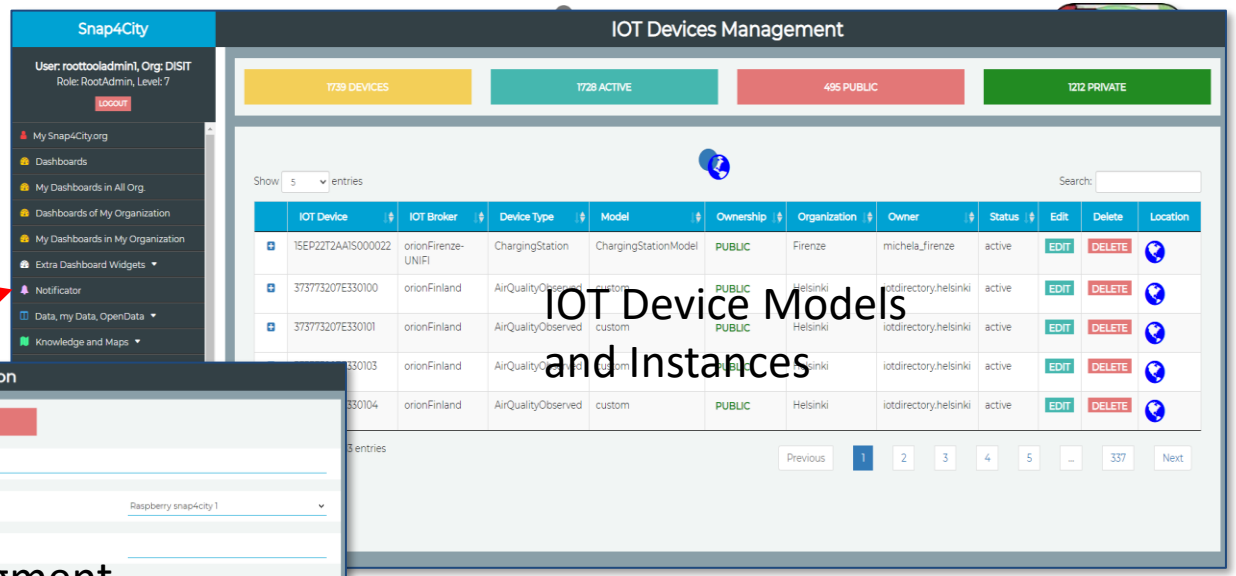




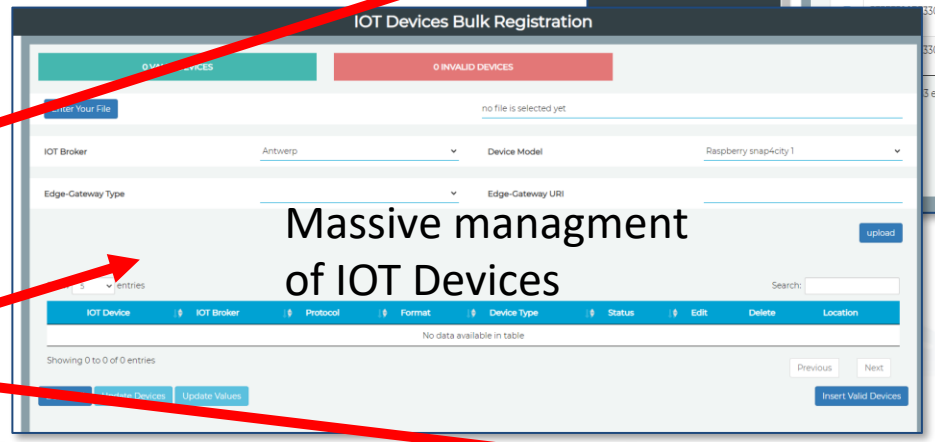
For non admin tools see Training parts 3 and 5: https://www.snap4city.org/577

IOT Directory and Devices

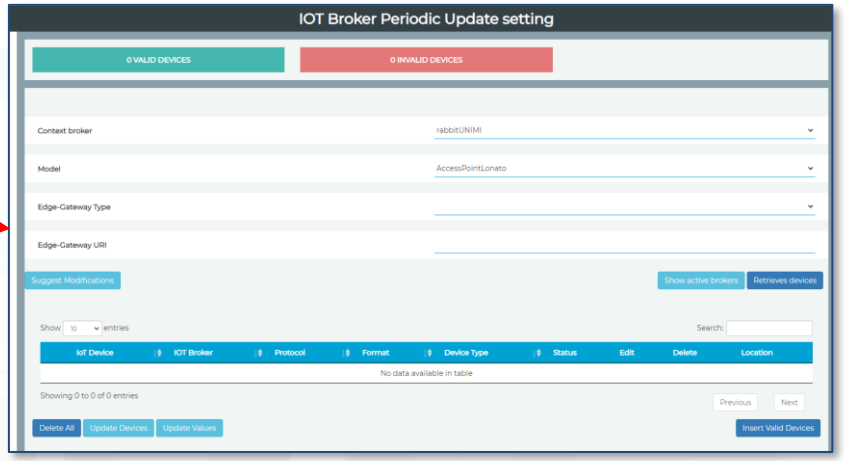


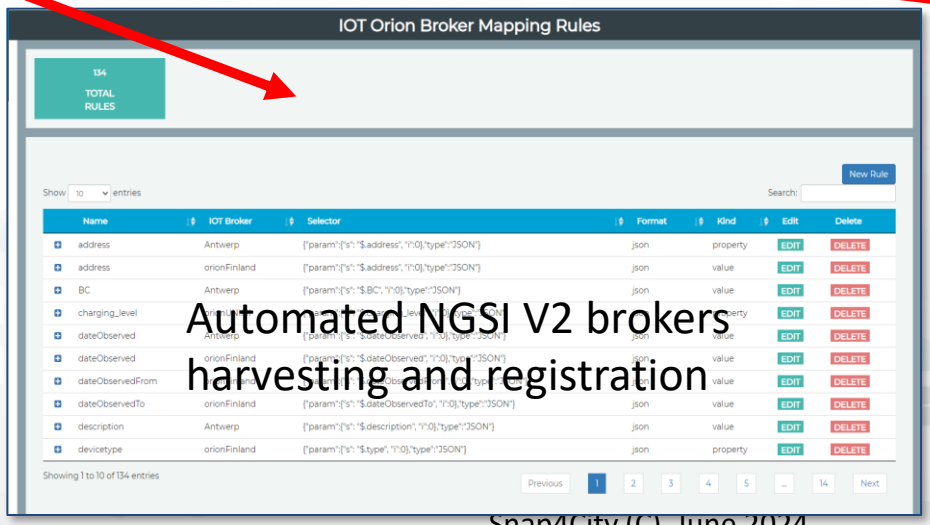


IOT Device Models and Instances



Massive managment of IOT Devices



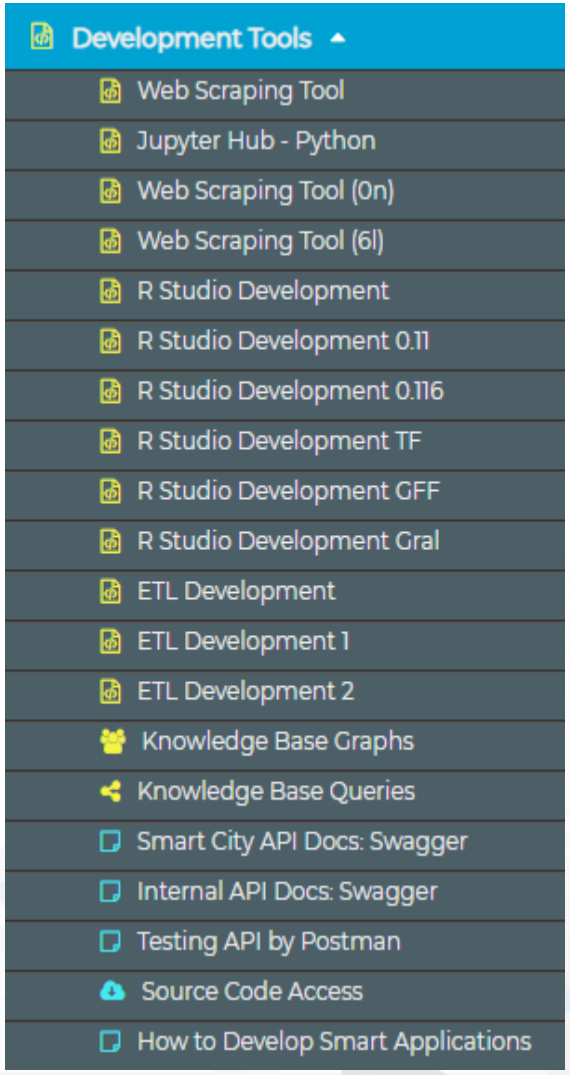


Automated NGSI V2 brokers harvesting and registration

IOT Directory manages multiple internal and external IoT Context Brokers

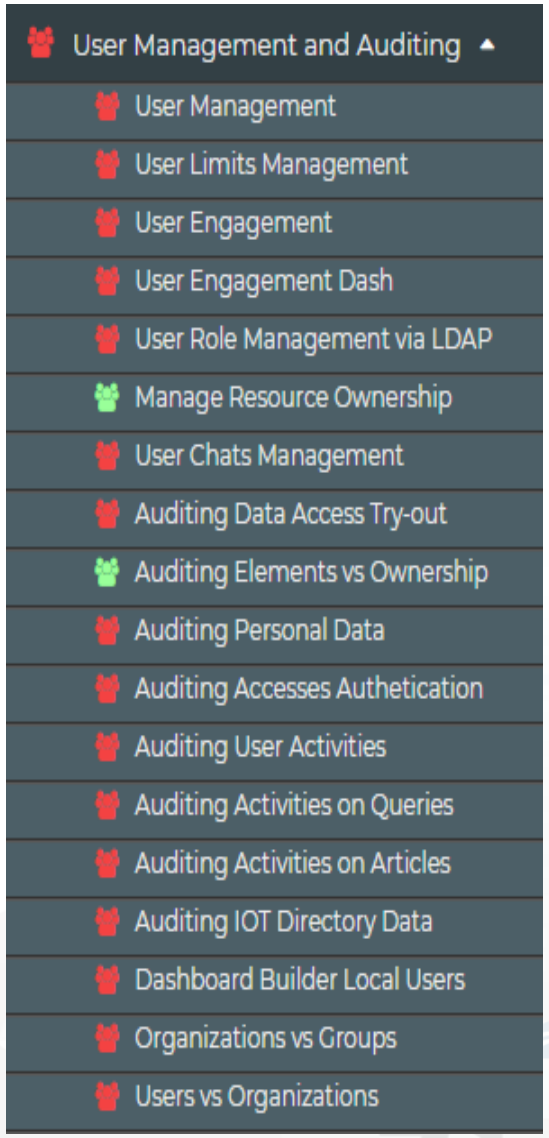
- For non admin tools see Training parts 3 and 5: https://www.snap4city.org/577

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)

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

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT

SNAP4INDUSTRY

KM4CITY

FROM CITY DASHBOARD TO APPLICATIONS

DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

IOT/IOE DEVICES AND NETWORKS

IOT APPLICATIONS VS IOT EDGE DEVICES

IOT APPLICATIONS, THE LOGIC AND

ADVANCED SMART CITY API, MICROSERVICES, SNAP4CITY API

SNAP4CITY FOR BEGINNERS

DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT-IF AND SIMULATION

SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS AND STAKEHOLDERS

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

SNAP4CITY AND KM4CITY PROJECTS

SNAP4CITY THE VIEW OF THE

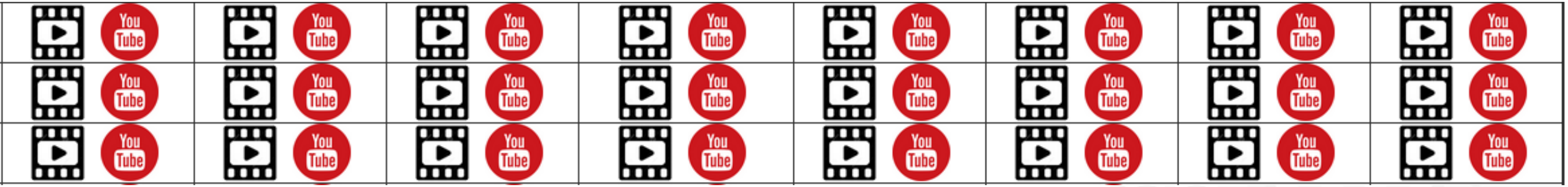
Training

	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

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** !

- 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

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

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FIWARE Node-RED

Sii-Mobility

Organization Groups

DISIT
- Developer
- Operativo

Updates on Tools

Training Course Snap4City - 2023 Edition new
drupaladmin

Snap4City Newsletter of April 2023 new
roottooladmin1

Dashboards (Public)

My Snap4City.org | Tour Again

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

Snap4City: Smart aNalytic APp builder for sentient Cities and IOT

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Tutorials


Scenarious


Organizations


Innovations


Interoperability


Installations


What People say


Mobile Apps

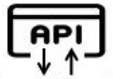

IOT Devices


IOT Applications


Data Analytics


Dashboards

Living Lab



Smart City API

Ontology


Work with Us


Articles

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/DRL_SNAP4SOLU.pdf

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Username: paolo.disit

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Updates on

2023 booklets

- Smart City

https://www.snap4city.org/download/video/DPL_SNAP4CITY.pdf

- Industry

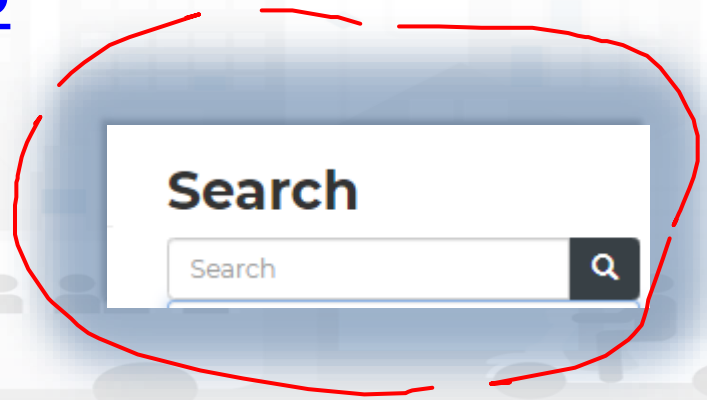
https://www.snap4city.org/download/video/DPL_SNAP4INDUSTRY.pdf

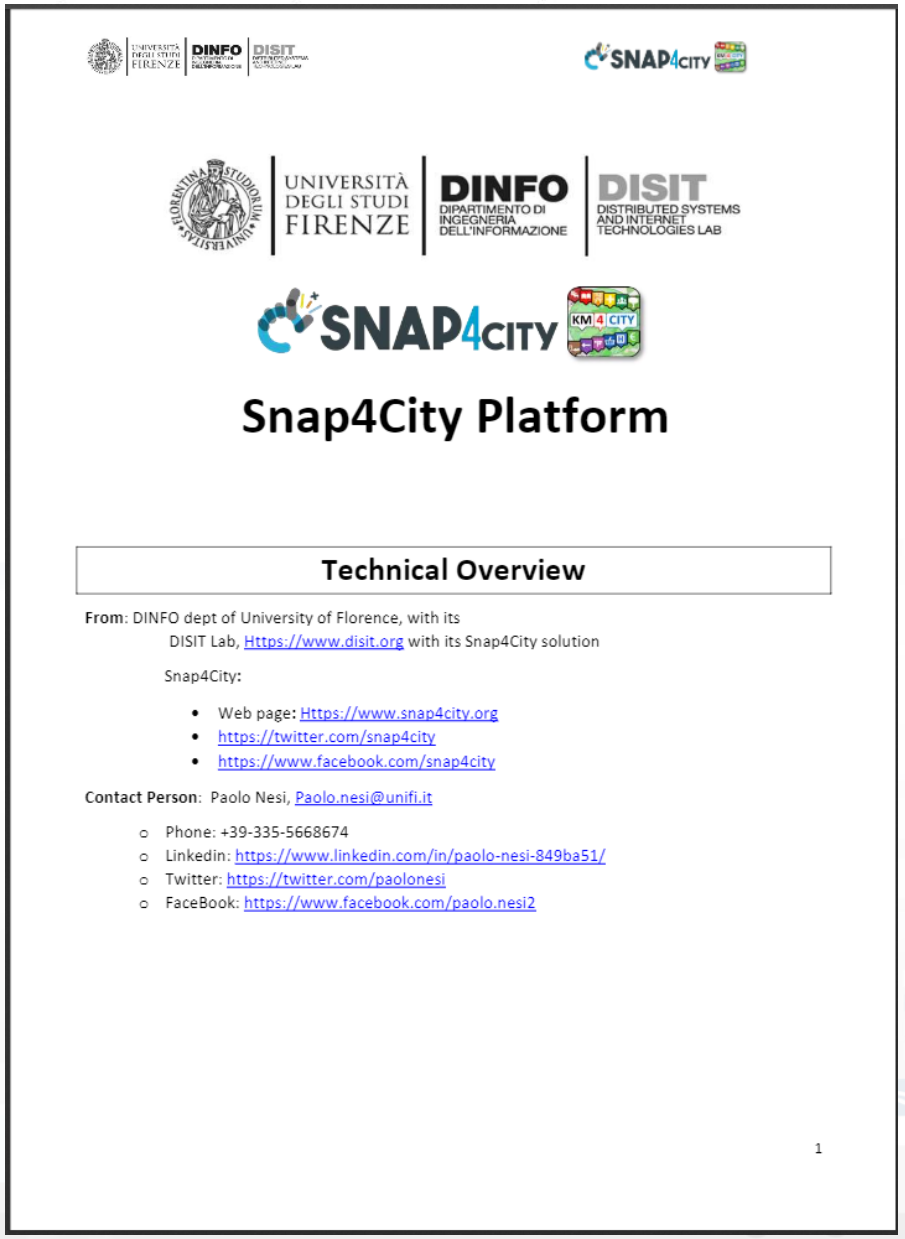
- Artificial Intelligence

https://www.snap4city.org/download/video/DPL_SNAP4SOLU.pdf

The Platform

- **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***





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SNAP4CITY KM4CITY

Snap4City Platform

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

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

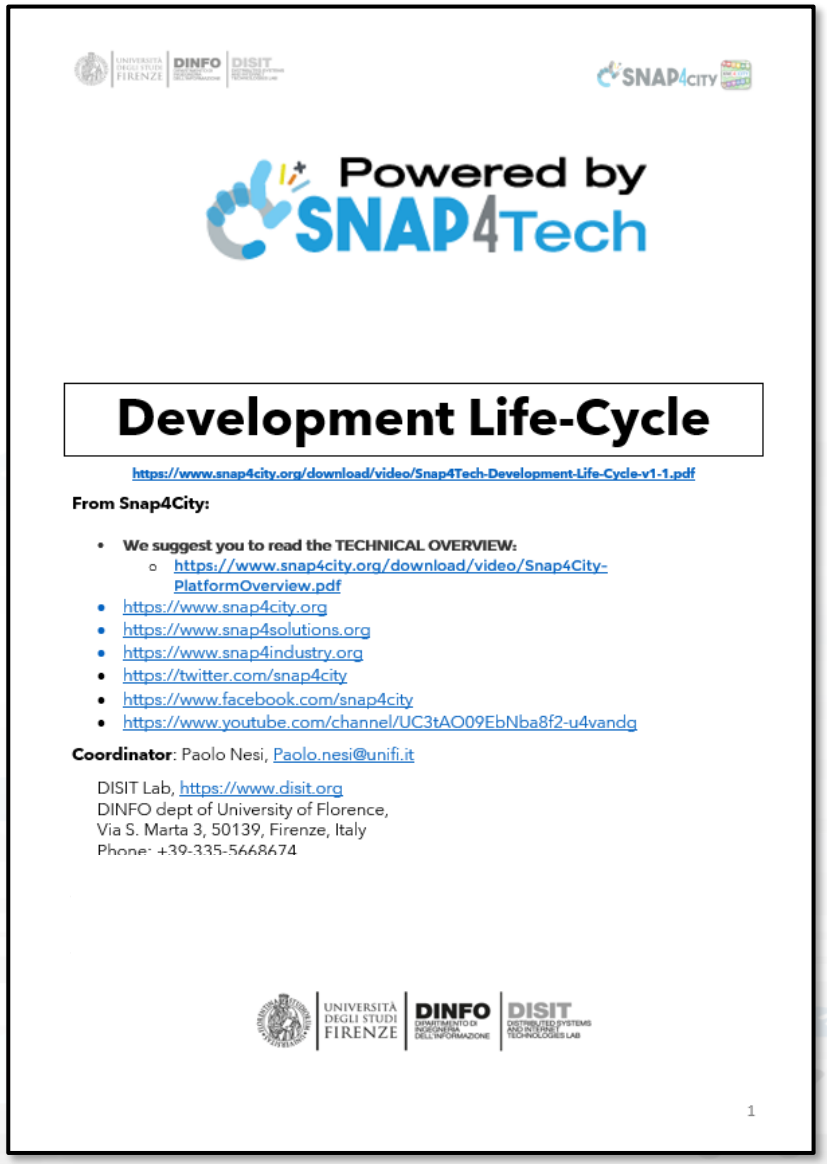
1

Tech Overview

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

Development

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



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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

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

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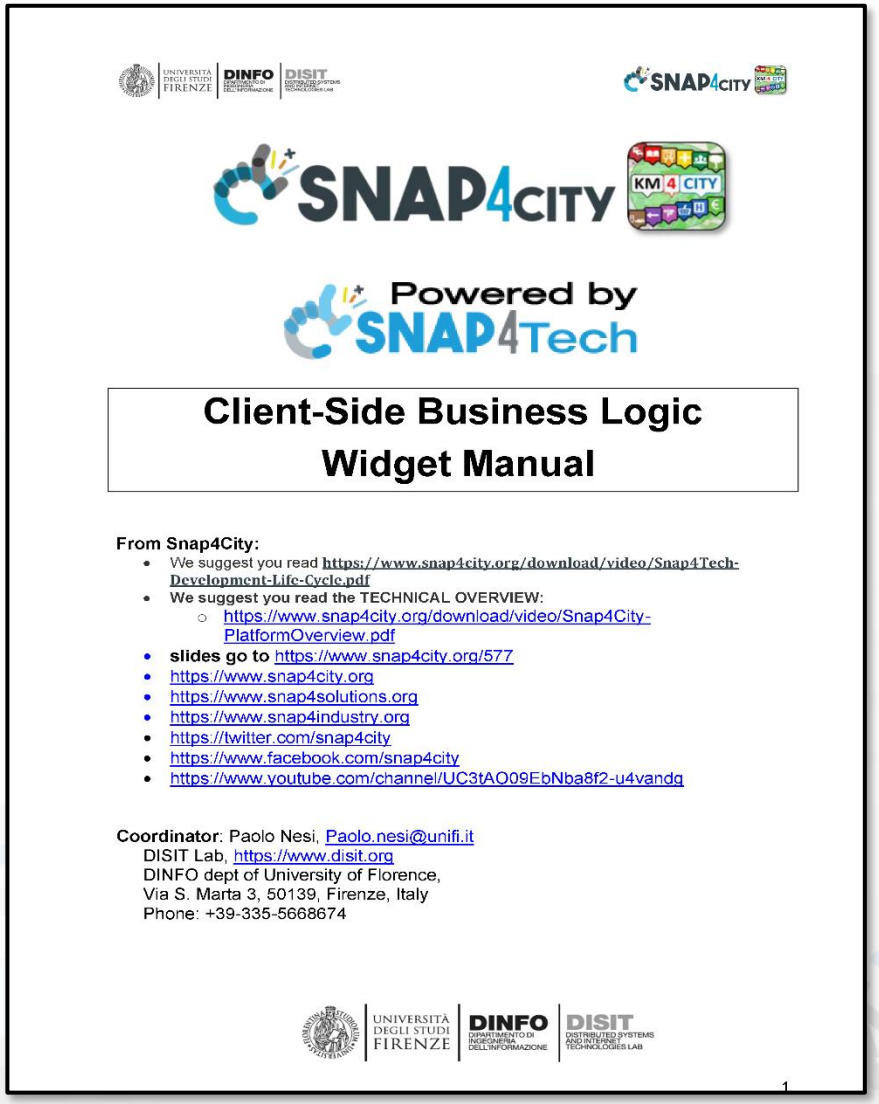
1

Client Side Business Logic



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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:
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- **slides go to** https://www.snap4city.org/577
- https://www.snap4city.org
- https://www.snap4solutions.org
- https://www.snap4industry.org
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- https://www.facebook.com/snap4city
- https://www.youtube.com/channel/UC3tAQ09EbNba8f2-u4vandg

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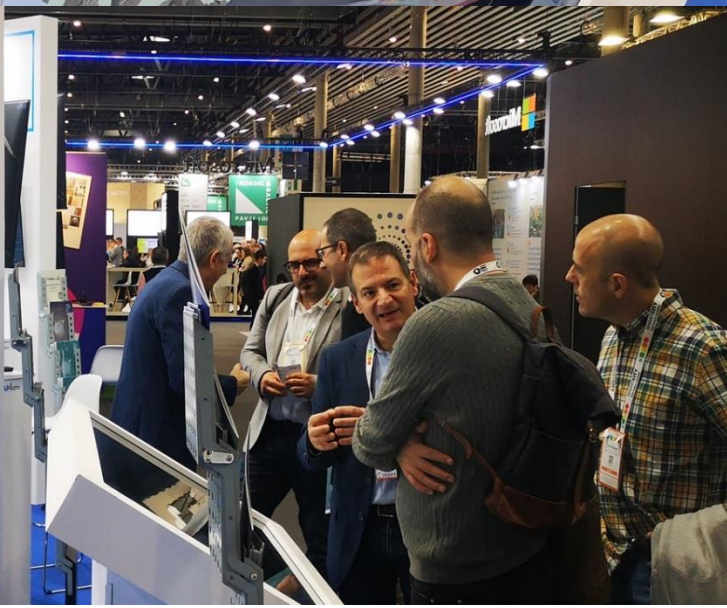
https://www.snap4city.org/download/video/ClientSideBusinessLogic-Widget.pdf

Overview

- 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



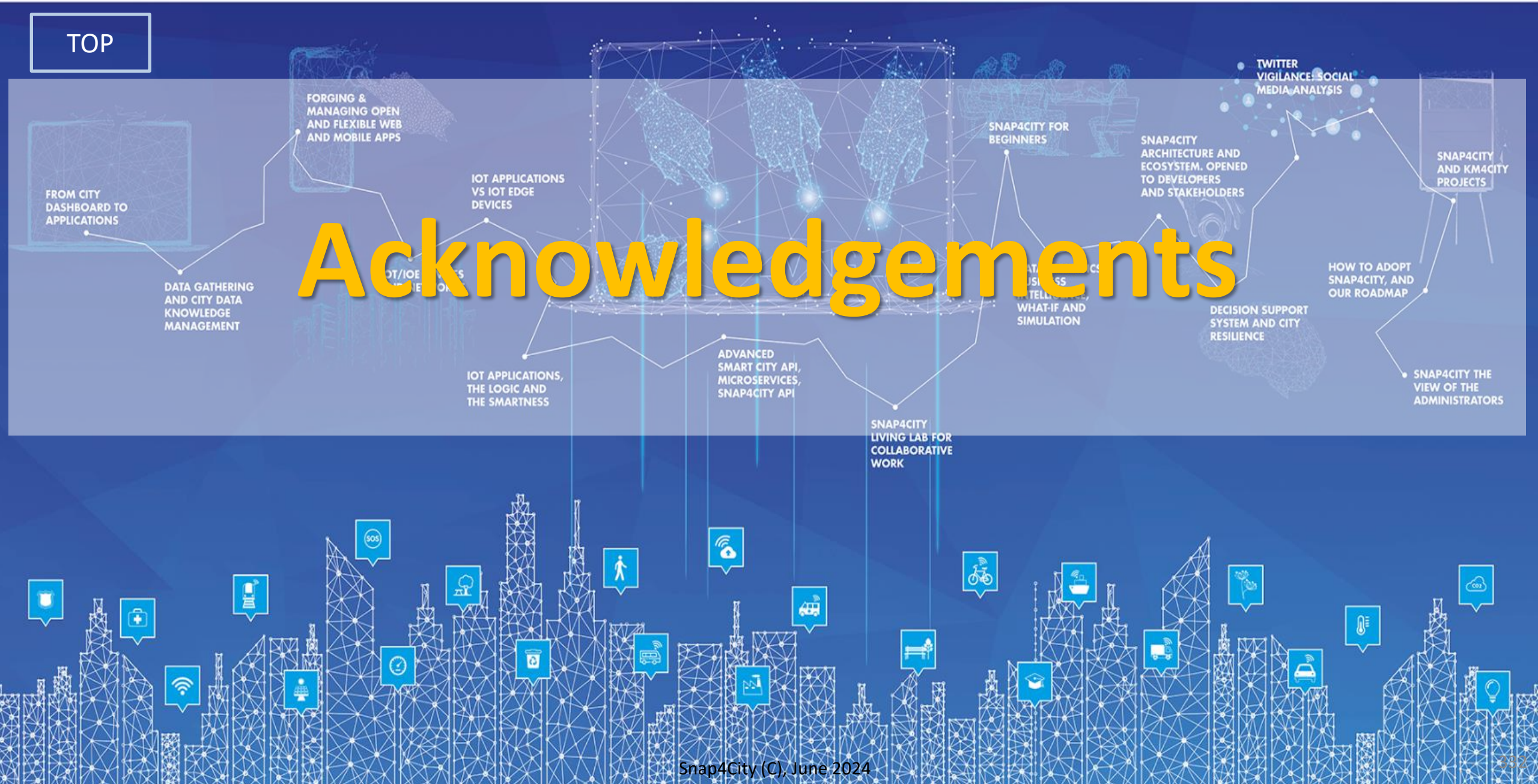
SMARTCITY

EXPO WORLD CONGRESS

7 - 9 NOVEMBER 2023

PAVILLON 1 - STAND D 100

TOP



Acknowledgements

DISIT lab roadmap vs model and tools' usage

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
Km4City 1.5

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

ckan, resolute, H2020 (2015-18)

2016
(2016-21) H2020 REPLICATE

Km4City 1.6.4

- Smart Energy
- Sustainable Mobility
- Control Room
- Dashboard

Km4City 1.6.2

Sii-Mobility (2016-21) MIUR

SII-MOBILITY SCN

- Infomobility
- Mobile App
- Routing
- Multimodality

FIWARE

Km4City 1.5

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

2017
Sii-Mobility

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

E0l5 digital ecosystem (Powered by EXPO MILANO 2015)

(2016-19) MIUR GHOST SIR

- Sardinia Region Smart City Strategies and plan

GREEN IMPACT C.A.P.A.C.I.T.Y.

GREEN IMPACT
POR FESR 2014-2020

- Industry 4.0
- Critical Plant
- Monitoring

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

life weee (2017-20)

- Smart Waste

2018
MOSAiC Mobility 4.0 for SmArt (i) City (2018-20)

- Mobility Demand / Offer Analytics and Strategy

5G (2018-21)

- 5G tech
- Energy
- Industry 4.0
- Synoptics

Sii-Mobility

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

IOT/IOE

Km4City 1.6.6

Node-RED

SNAP4CITY SELECT for Cities H2020 (2017-19)

SIRIUS

TRAFAIR CEF (2018-21)

- Traffic and Mobility Impact on Pollution
- NOX predictions

2019
EUROPEAN OPEN SCIENCE CLOUD

LAID Smart Bed

- Smart Health

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

- Industry 4.0

bee smart city

- Smart Lonato

Reverberi Enetec Gruppo MPES

Winner of Select4Cities PCP

SNAP4CITY roadmap

Km4City 1.6.7

2020

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

- Smart Mobility
- PISA, PUMS
- Living lab

2021

Smart Ambulance (2021-22)

Enterprise (2021-22) Industry 4.0

Sii-Mobility

enel x Contract

JRC EUROPEAN COMMISSION Contract

PC4City (2020-21) Monitoring Terrain

Winner of Open Data Challenge of enel x

CAPELON

- Smart Light
- Sweden

2022

Almafluida Industry 4.0 (2021-22)

AMPERE (2021-22) Industry 4.0

SYN-RG-AI SmartCity

GRUPPO PRETTO Industry 4.0

uni.systems SmartCity, 2021-23

AXIS COMMUNICATIONS AXIS collab SmartCity

ASYMMETRICA URBAN TECHNOLOGY Asymmetrica Smart City, 2022-23

2023

JRC EUROPEAN COMMISSION Contract, 2022-23

ART-ER ATTRATTIVITÀ RICERCA TERRITORIO Contract, 2022-23

Filippi 2022-2023

enel x Contract, 15min

IMPETUS Security and Risk

Smartea

ITALFERR GRUPPO FERROVIE DELLO STATO ITALIANE Italferr, Smart City

2024

JRC EUROPEAN COMMISSION Contract, 2024-25

MOST CENTRO NAZIONALE PER LA MOBILITÀ SOSTENIBILE CN MOST, 2022-26

Italiadomani

EI THE, 2022-26

Italiadomani

G. Agile, 2021-23

TUSCANY X.0 EDIH 2023-26

Finanziato dall'Unione europea NextGenerationEU

Merano, smart light

OceanRace, Genova, AWS

Cuneo, smart city

TOURISMO

ELLIE IA 2024-2027

SASUAM

MOST

Italiadomani

CAI4DSA

FAIR Future Artificial Intelligence Research

Italiadomani

Rhodes, smart city

eShare UNIFI TUSS

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SNAP4 Appliances and Dockers **Installations**

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www.snap4city.org

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Università degli Studi di Firenze - School of Engineering

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