



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

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



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB

**Overview**  
**Short November 2025**  
**ANCI General Assembly 2025**



Ministero  
dell'Università  
e della Ricerca



Italiadomani  
PIANO NAZIONALE DI RIPRESA E RESILIENZA



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

*AI Digital Twin Platform  
to set-up Sustainable  
Decision Support Systems  
& Business Intelligence*

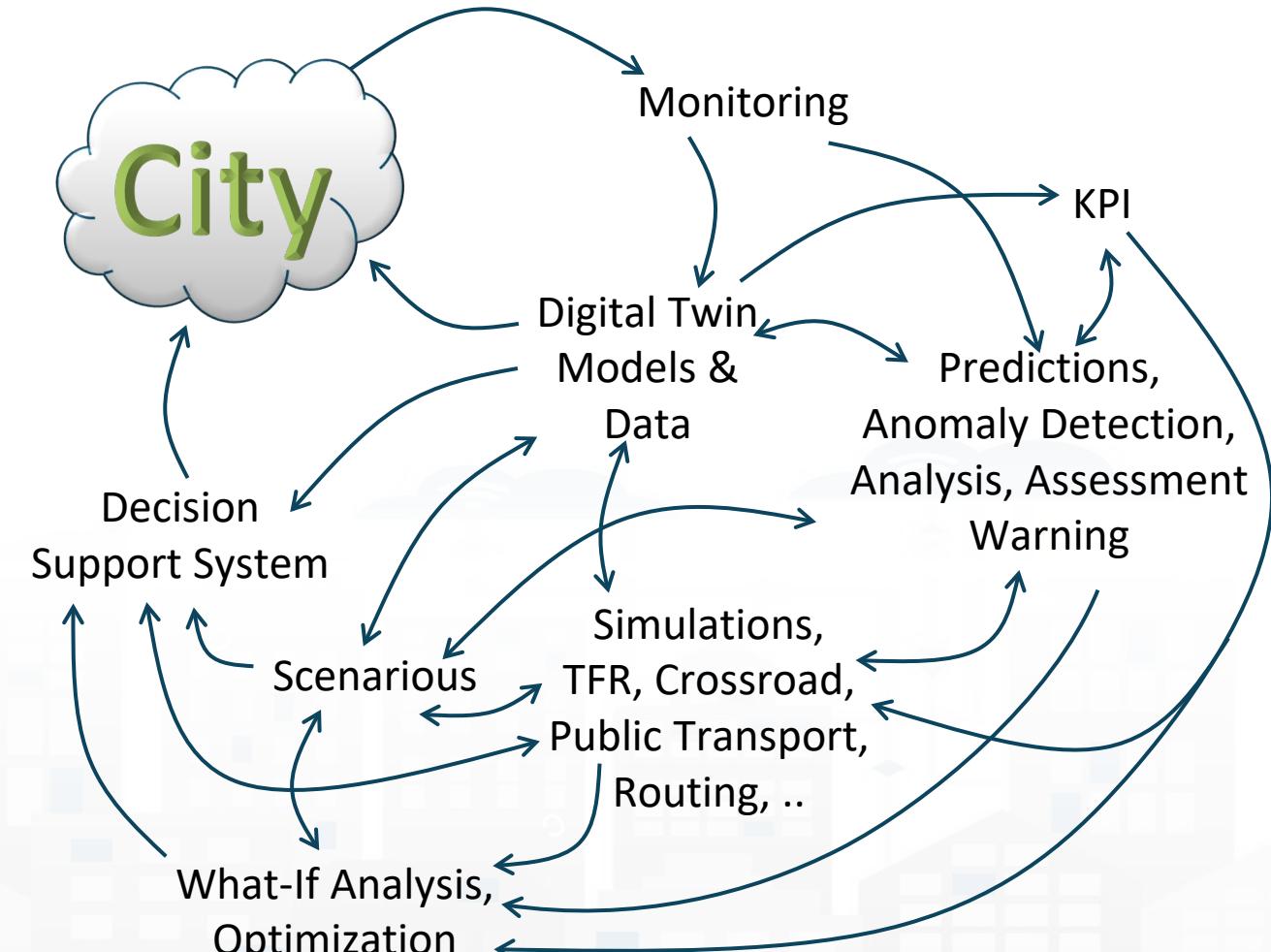
#snap4city  
#km4city  
#disitlab  
@snap4city



# Main tasks



- **Controlling Status:** management, and operational
  - Monitoring via KPI
  - Predictions vs KPI
  - Anomaly detection
  - Neuro-Symbolic analysis
  - Risk assessment
  - Early warning on critical conditions
  - Fast What-if analysis
- **Making plan:** tactic and strategic, medium and long range, micro/macro
  - Simulation & optimization
  - Generative AI Prescriptions, scenarios
  - Resilience to Unexpected unknowns
  - What-if analysis wrt scenarios
  - Collaboration with stakeholders





City

Monitoring

Digital Twin  
Models &

KPI

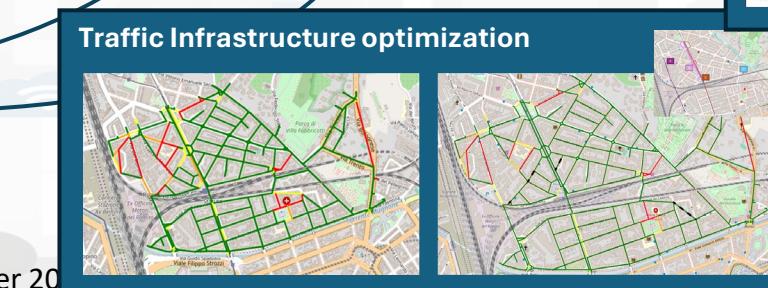
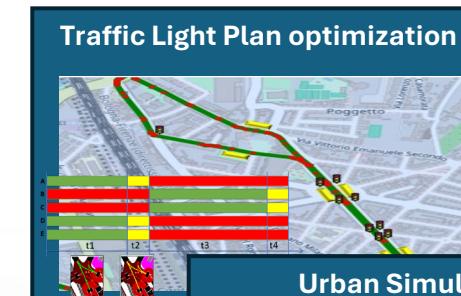
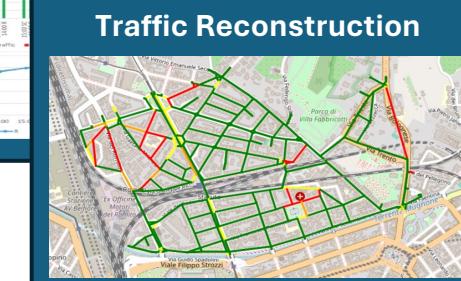
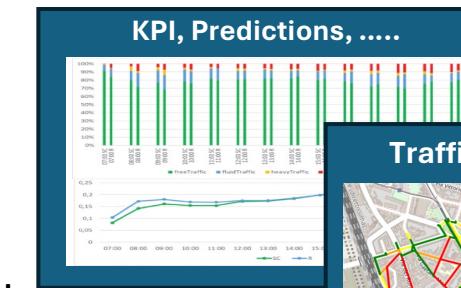
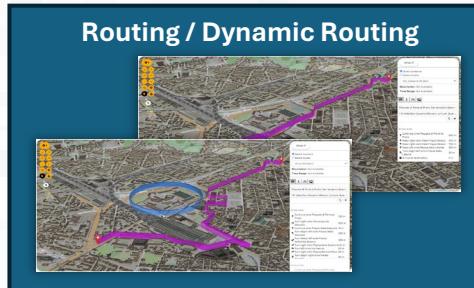
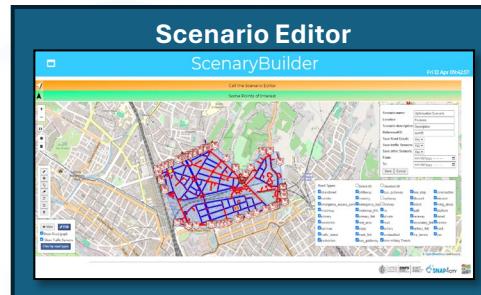
Predictions,  
Anomaly Detection,  
Analysis, Assessment  
Warning

Decision  
Support System

Data

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

What-If Analysis,  
Optimization





Powered by

FREE  
TRIAL

PEN Test  
Passed

EU GDPR  
COMPLIANT

Appliances and Dockers  
Installations

Node-RED

Foundation

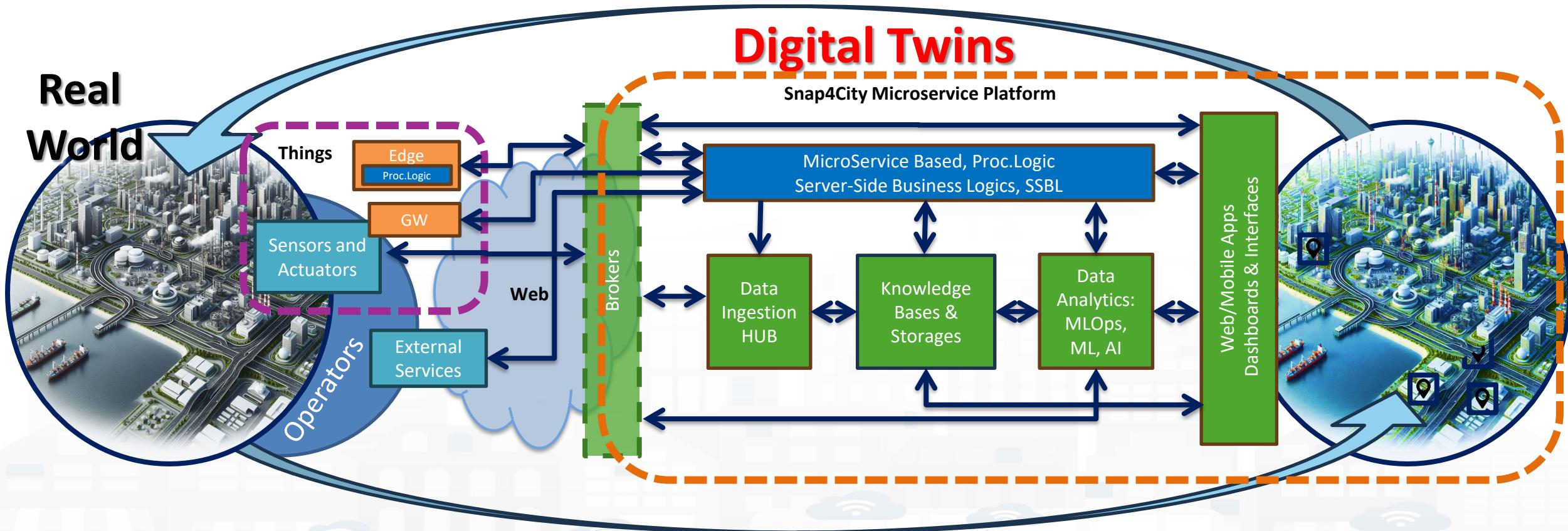
E015  
digital ecosystem

NVIDIA

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

<b>HORIZONTAL AI PLATFORM</b> 	<b>MOBILITY AND TRANSPORT</b> 	<b>SMART ENERGY AND SMART BUILDING</b> 	<b>ENVIRONMENT AND WASTE MANAGEMENT</b> 	<b>CITY USER'S SERVICES AND TOURISM MANAGEMENT</b> 	<b>SNAPADVISOR</b> 
<b>BUSINESS INTELLIGENCE - SIMULATIONS - VISUAL ANALYTICS - SYNOPTICS - GRAPHICAL WIDGETS - ANALYTICS</b>					
<b>DASHBOARDS, WIDGETS TEMPLATES</b> 	<b>PREDICTION - ANOMALY DETECTION - CLUSTERING - ROUTING - SENTIMENT NLP - TRAFFIC FLOW - PEOPLE FLOWS - SDG 15 MIN CITY INDEX - KPI - HEATMAPS - ORIGIN DESTINATION - MAPS - VECTOR FIELD - ETC...</b>				<b>API - MICROSERVICES - GIS - BPM VIDEO - REPORTS - MAPS - 3D ...</b> 
<b>EXPERT SYSTEM, KNOWLEDGE BASE SEMANTIC REASONING SMART DATA MODEL IOT DEVICE MODELS, DATA SPACES</b> 	<b>BIG DATA ANALYTICS, ARTIFICIAL INTELLIGENCE EXPLAINABLE AI, MACHINE LEARNING, GENERATIVE AI OPERATIVE RESEARCH, STATISTICS</b> 				<b>VISUAL PROGRAMMING, ADAPTERS DATA FLOWS, WORKFLOWS PARALLEL DISTRIBUTED PROCESSING DATA DRIVEN</b> 
<b>FULL INTEROPERABILITY, ANY: DATA, BROKERS, NETWORKS AND VERTICALS</b>					
<b>NATIVE AND EXTERNAL APPLICATIONS</b> <ul style="list-style-type: none"> <li>Smart Parking</li> <li>Smart Light</li> <li>Smart Waste</li> <li>Smart Energy</li> <li>Smart Building</li> <li>Smart Tourism</li> <li>...</li> </ul>					

# Digital Twin Development Platform



# High Level Types

© Snap4City, October 2025, DISIT lab



- 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, ..
- Vector fields + heatmaps, ..
- 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, ..
- scenarios, ....
- etc.

# Expert System semantic queries



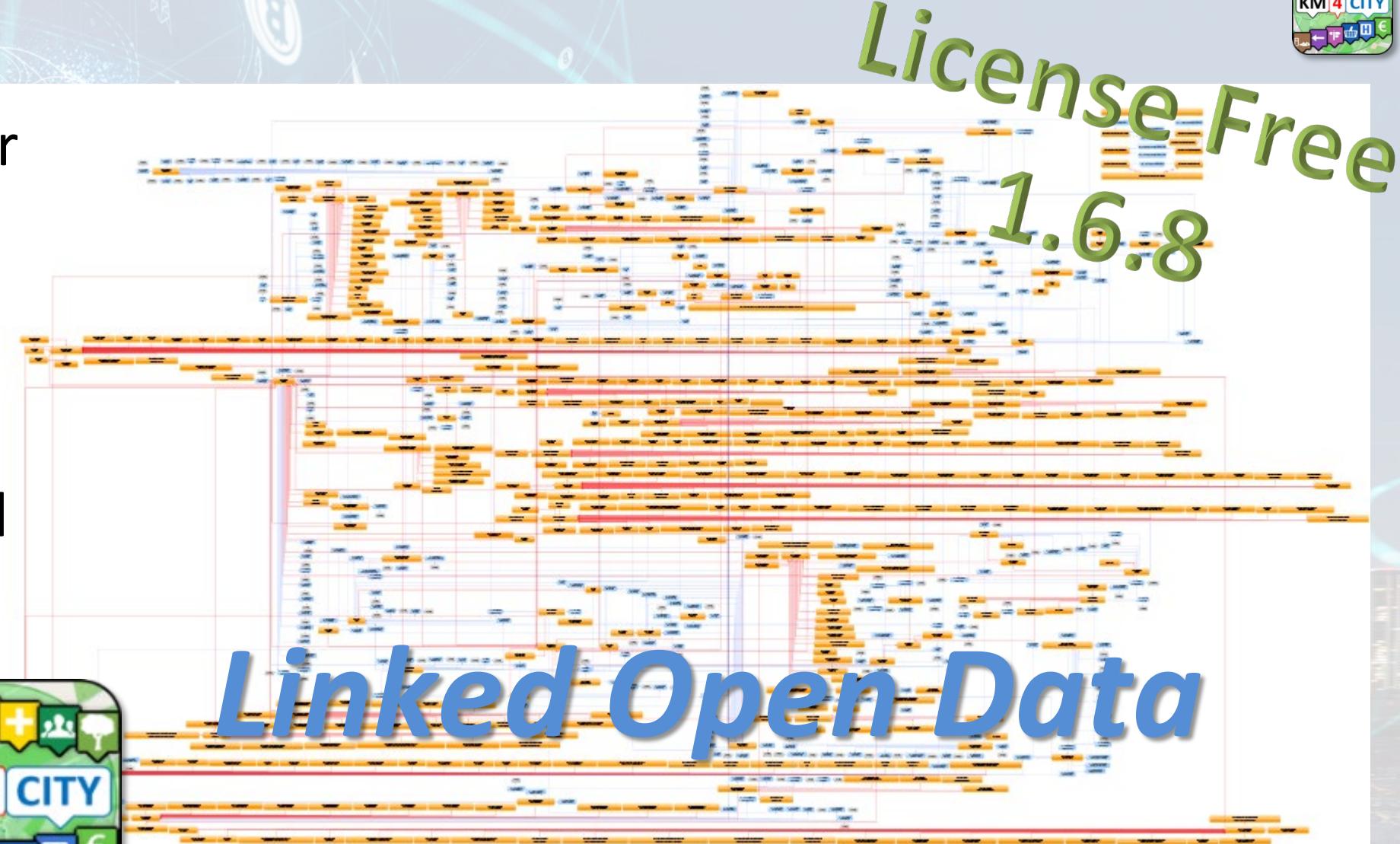
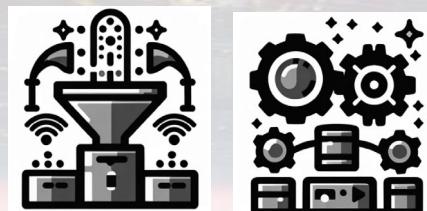
UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB



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



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

# Standards and Interoperability



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

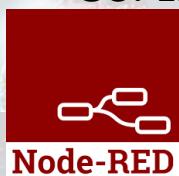
**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB



## 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, SNMP, TCP, UDP, SOAP, WSDL, FTP, FTPS, WebSocket, WebSocket Secure, GML, WFS, WMS, WCS, RTSP, ONVIF, AXIS TVCam, CISCO Meraki, OSM, Copernicus, The Weather Channel, Open Weather, OLAP, VMS Milestone, TIM, HERE, OGC, ....
- **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, aggreg. → exploitation



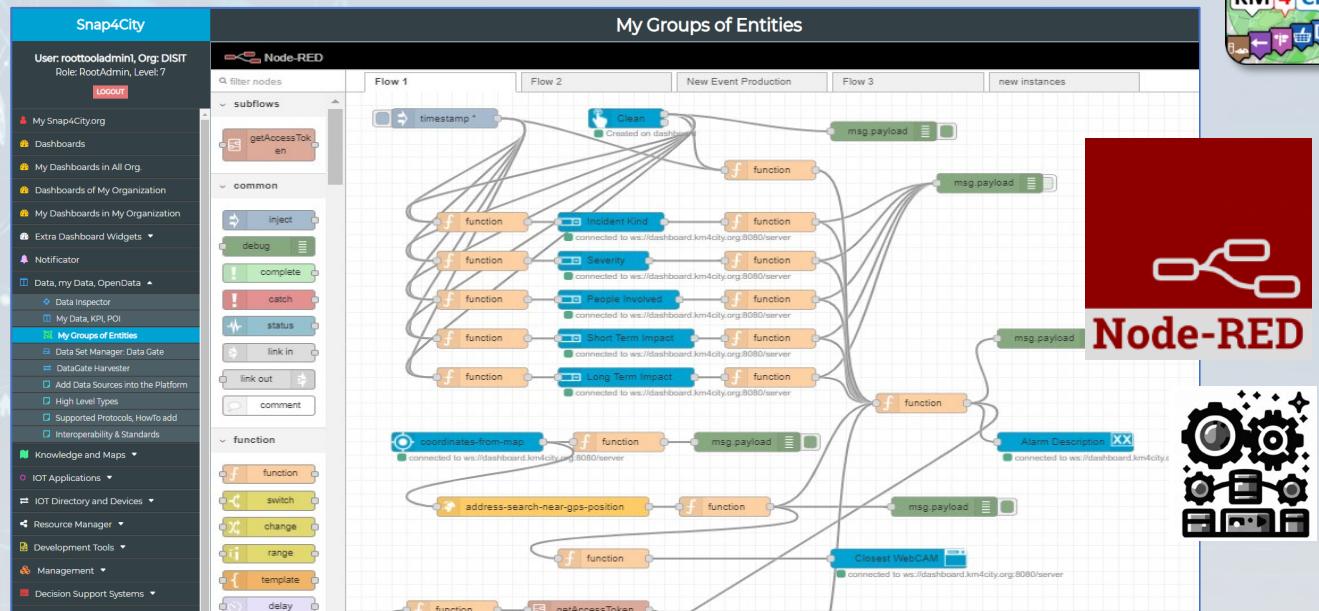
UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB

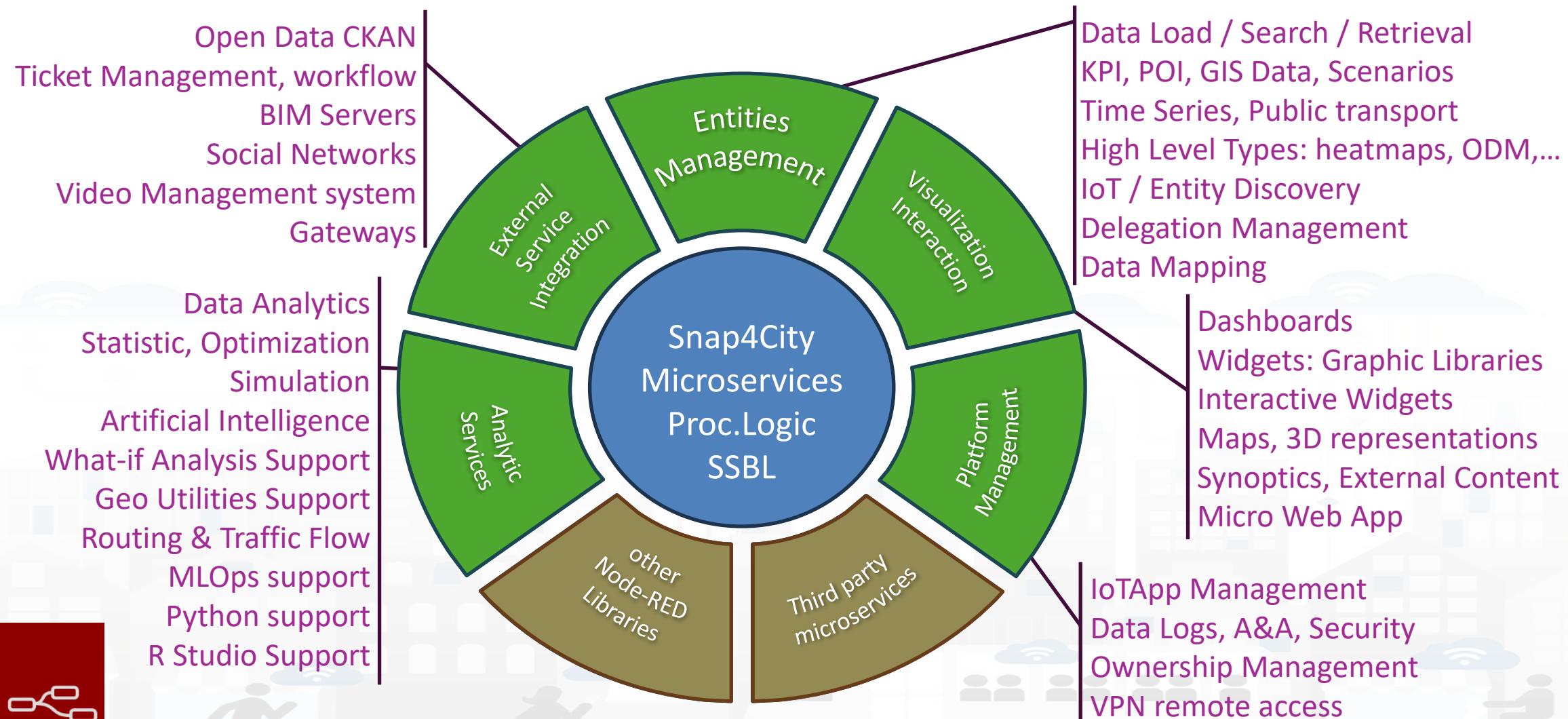


- IoT App Visual Programming, no coding
  - Data transformation
  - Integration, Interoperab.
  - Scripting Data Analytics
  - Data ingestion
  - Business logic Server Side
- Edge and Cloud
- **MicroServices** data event driven develop via visual language Node-RED



> 60.000 downloads (up to 2024)

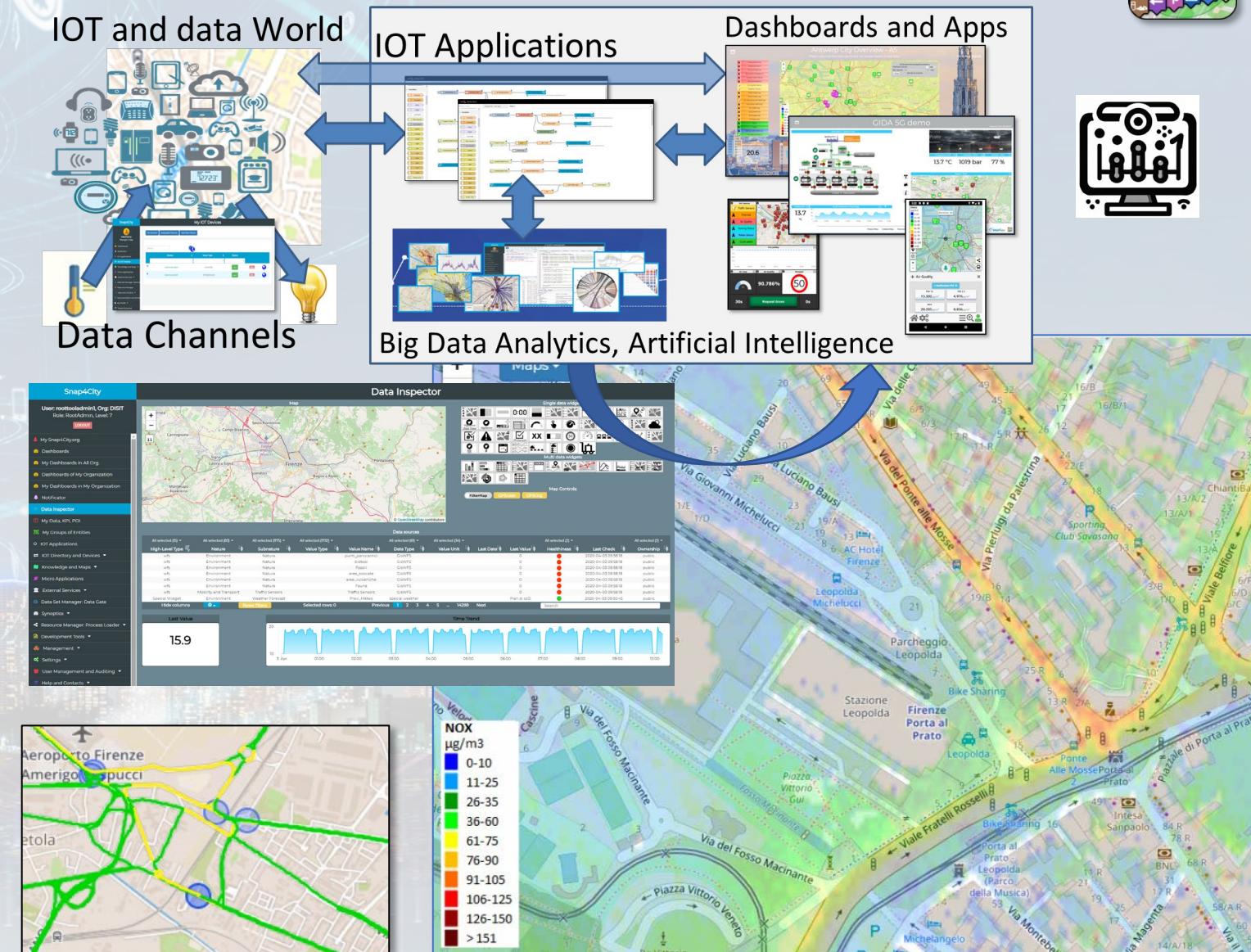
## Areas

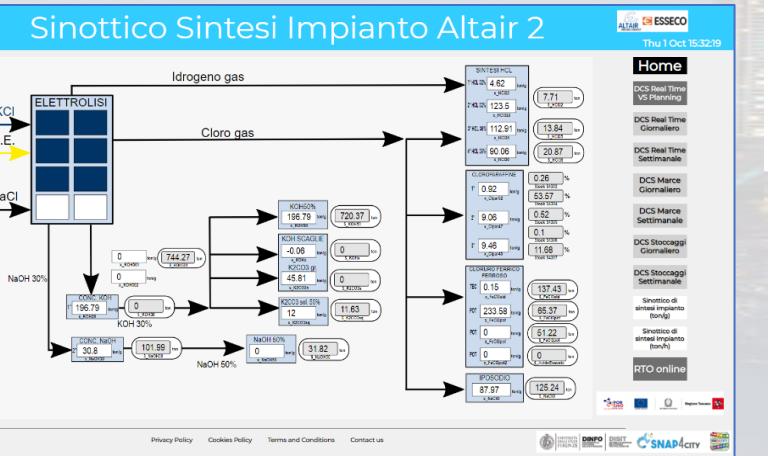
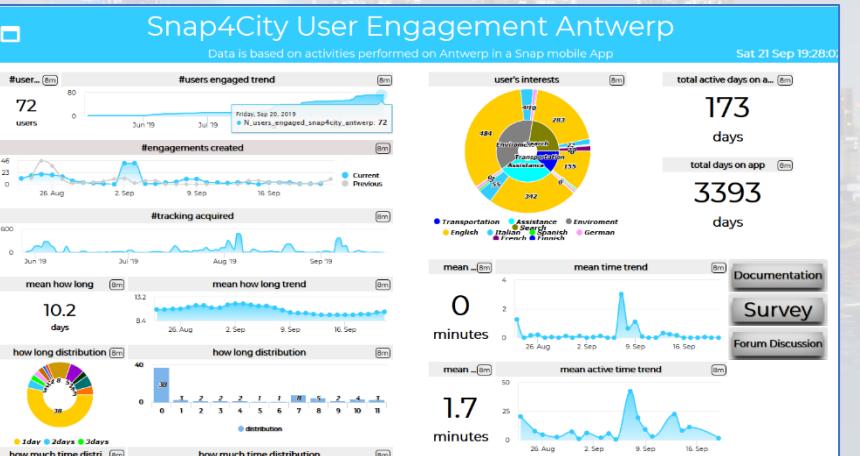
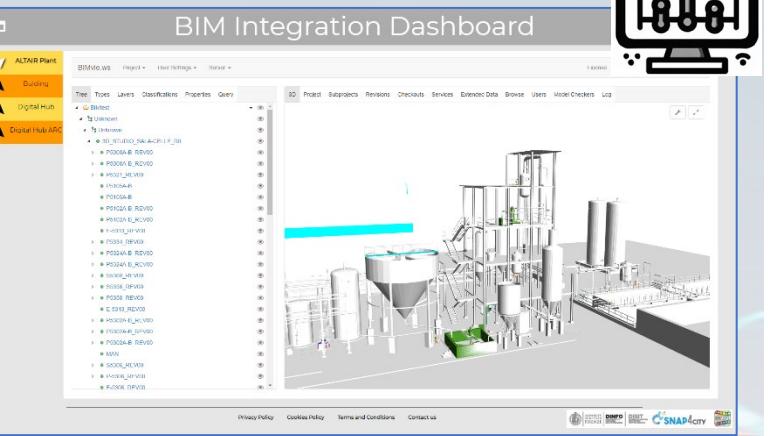
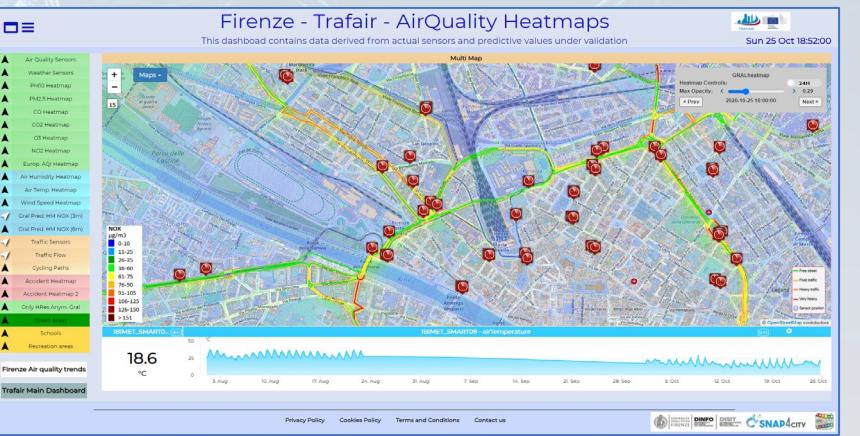
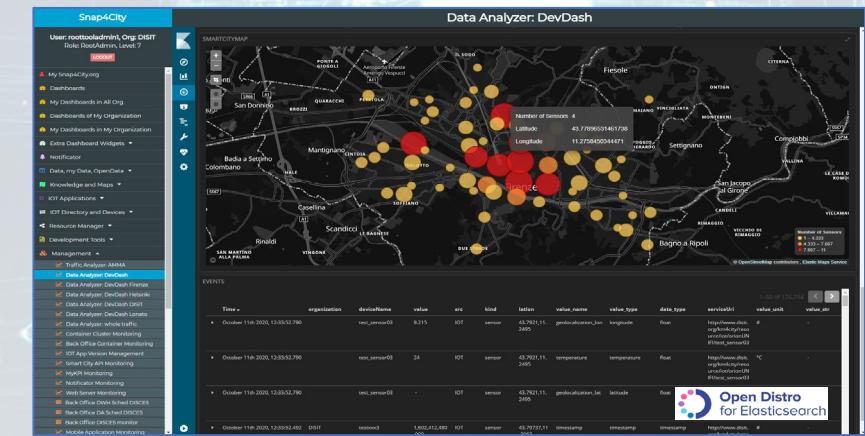
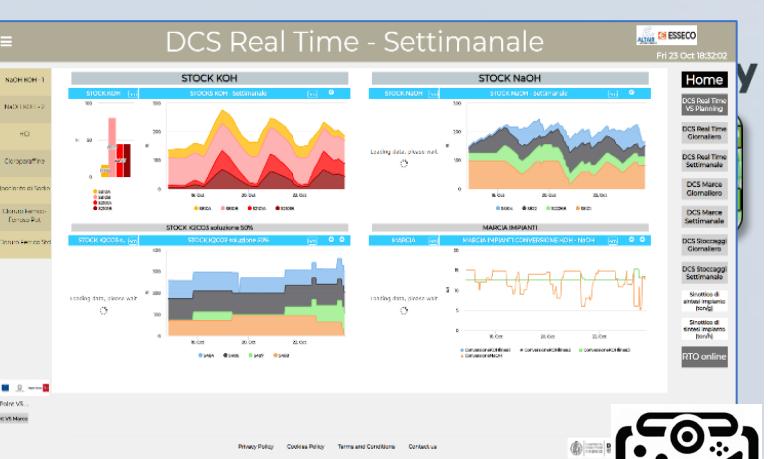
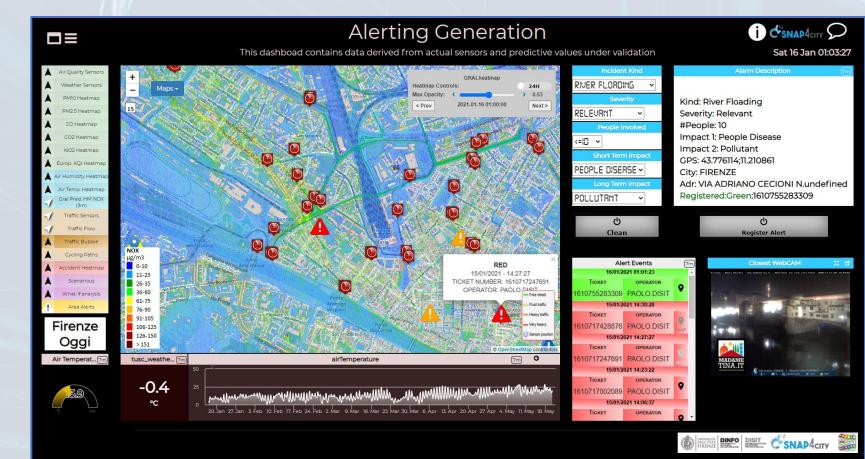


# Solutions: reliable, secure and fast to realize

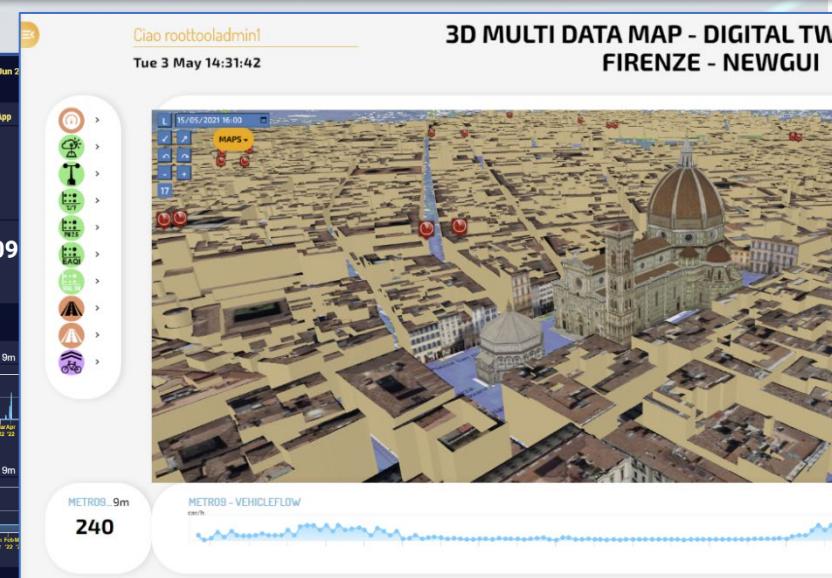
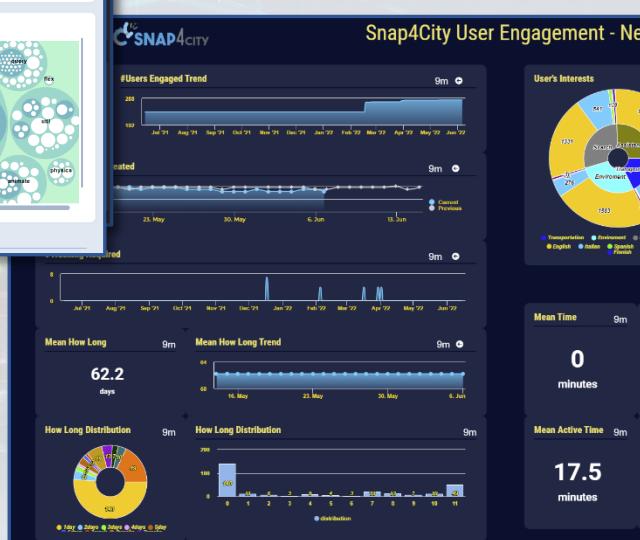
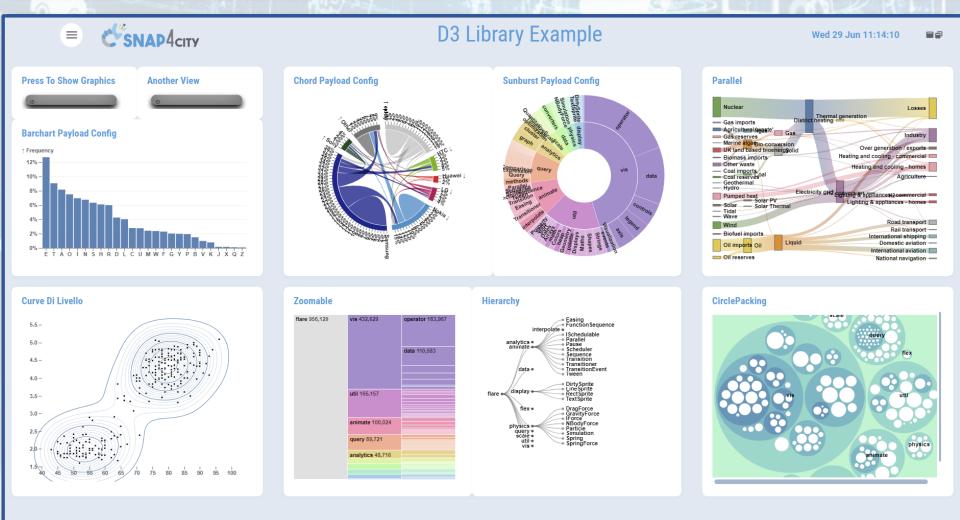
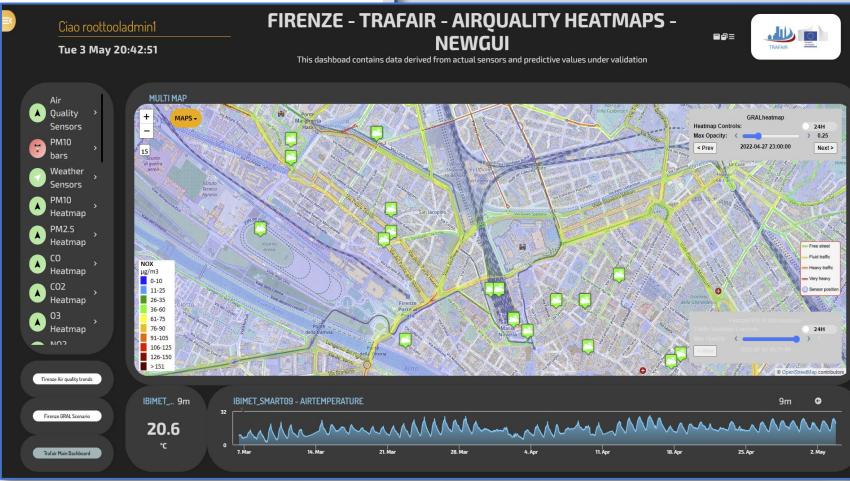
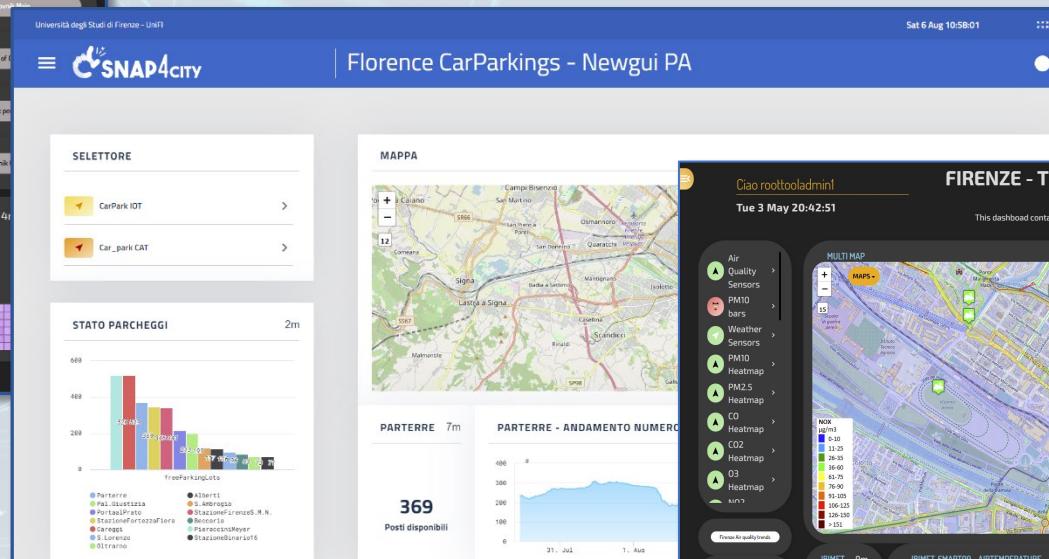
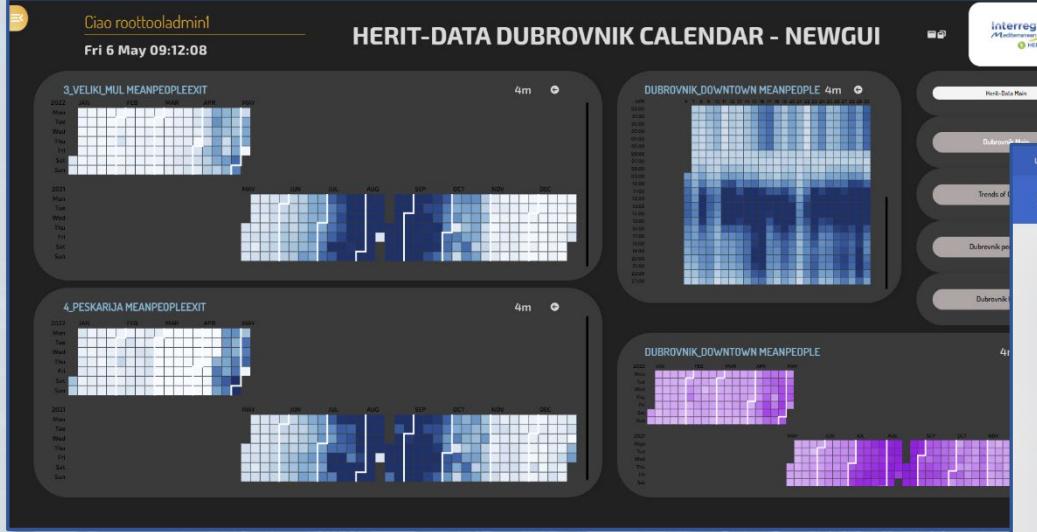


- Via Snap4City tools
  - Dashboard Wizard
  - Dashboard Builder
  - Data/Visual Analytic
- Smart Solutions results to be
  - Real time data drive
  - Secure end-to-end
  - GDPR compliant
  - Reliable, interoperable
  - Auditable, marketable





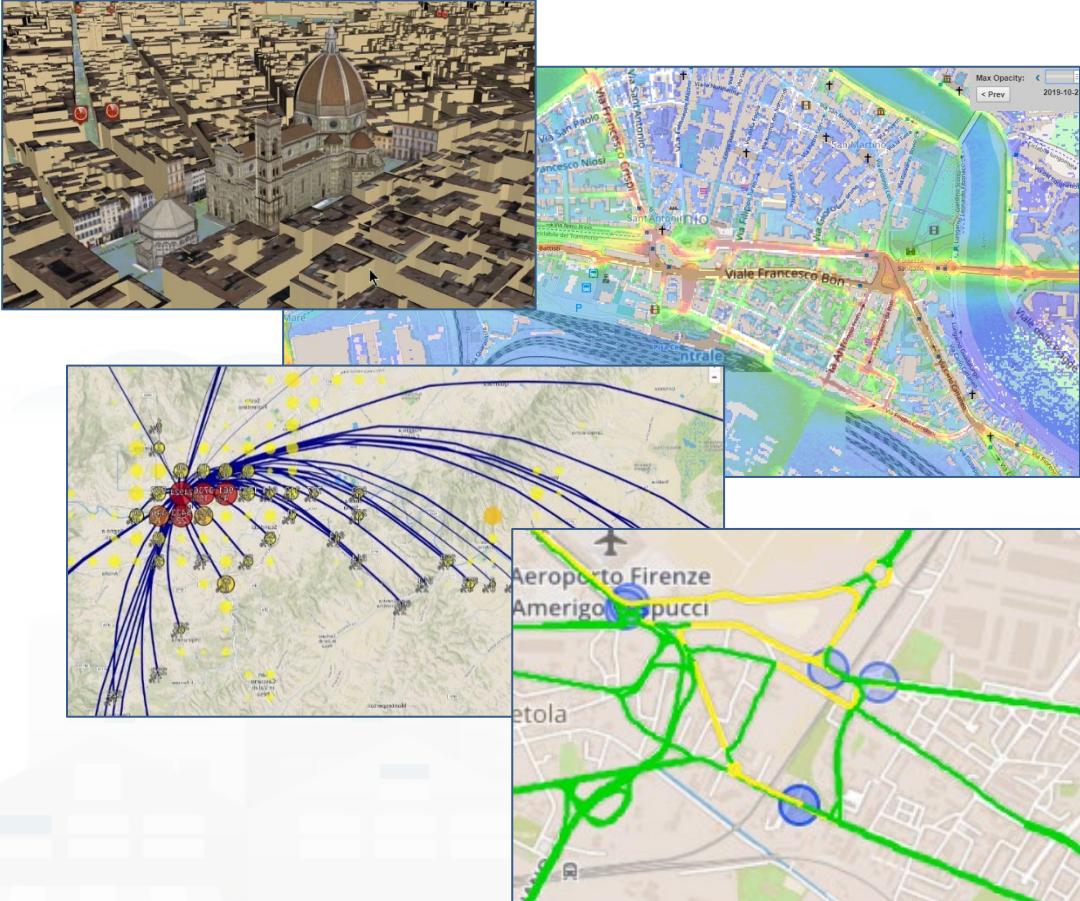
# Different Themes



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

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

# 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 / optimization
- Collaborative and shared representation
- Sustainable, shared, open source 100%



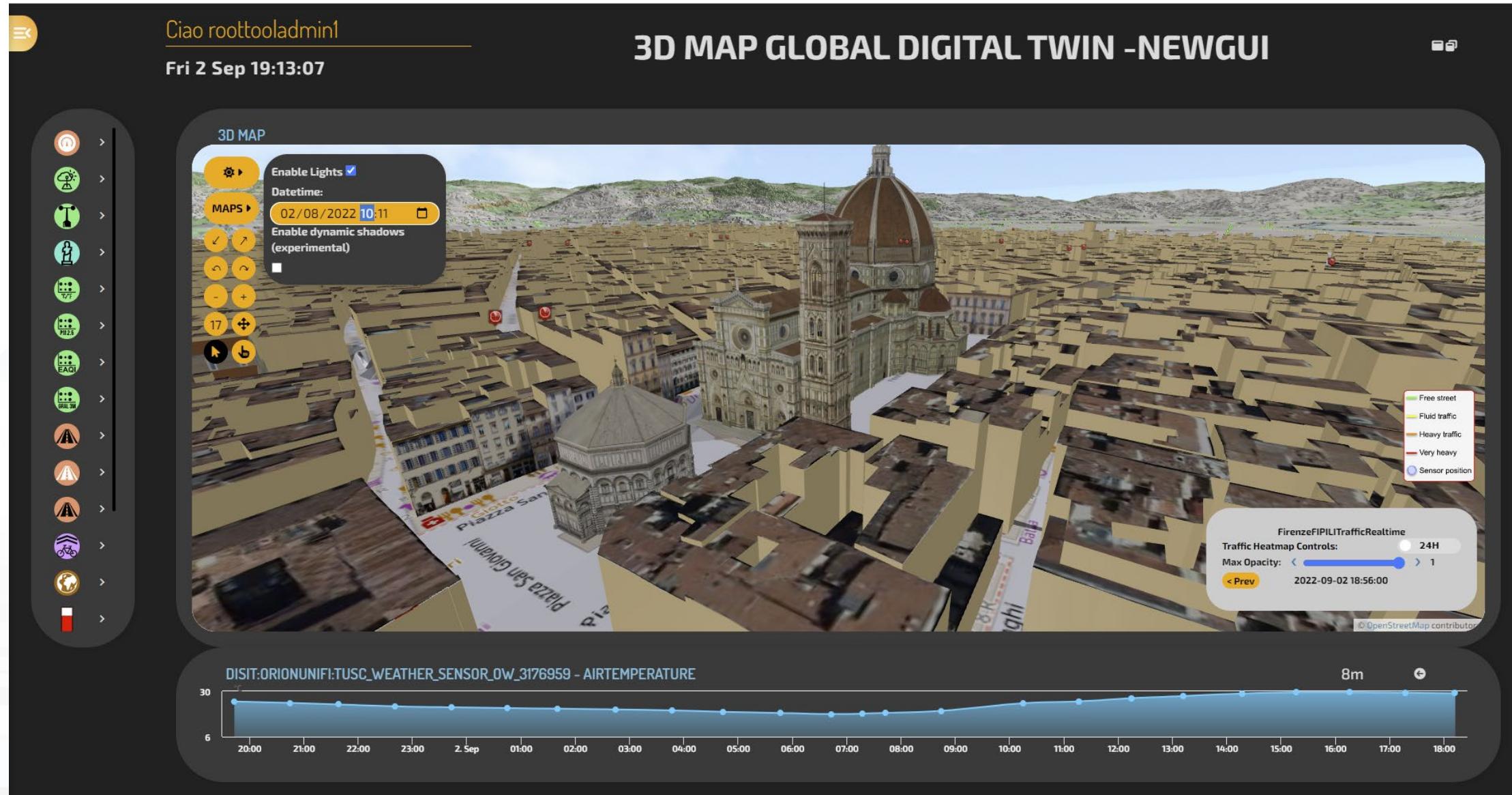
## Complex and heterogeneous information, interoperability

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

Ciao roottooladmin1

Fri 2 Sep 19:13:07

## 3D MAP GLOBAL DIGITAL TWIN -NEWGUI



**3D MAP**

- Enable Lights
- Datetime: 02/08/2022 10:11
- Enable dynamic shadows (experimental)

MAPS

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

FirenzeFiPILITrafficRealtime

Traffic Heatmap Controls: 24H

Max Opacity: 1

2022-09-02 18:56:00

Piazza San Giovanni

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

8m

30

6

20:00 21:00 22:00 23:00 2. Sep 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00

Ciao

Fri 13 Oct 18:29:18

## FLORENCE SCDT

**SELECT...**

## DOUBLE MAP



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

# Predictions and Heatmaps in Real Time

**Computing Predictions And Heatmaps** Sun 13 Oct 17:22:50

☰

**Selector - Map**

MAPS 

16 

Vehicle Flow

- Free
- Fluid
- Heavy
- Very heavy

Show Road graph  Show Traffic Sensors  Filter by road types

paolo6\_vehicleFlow

Heatmap Controls: 24H  0.35

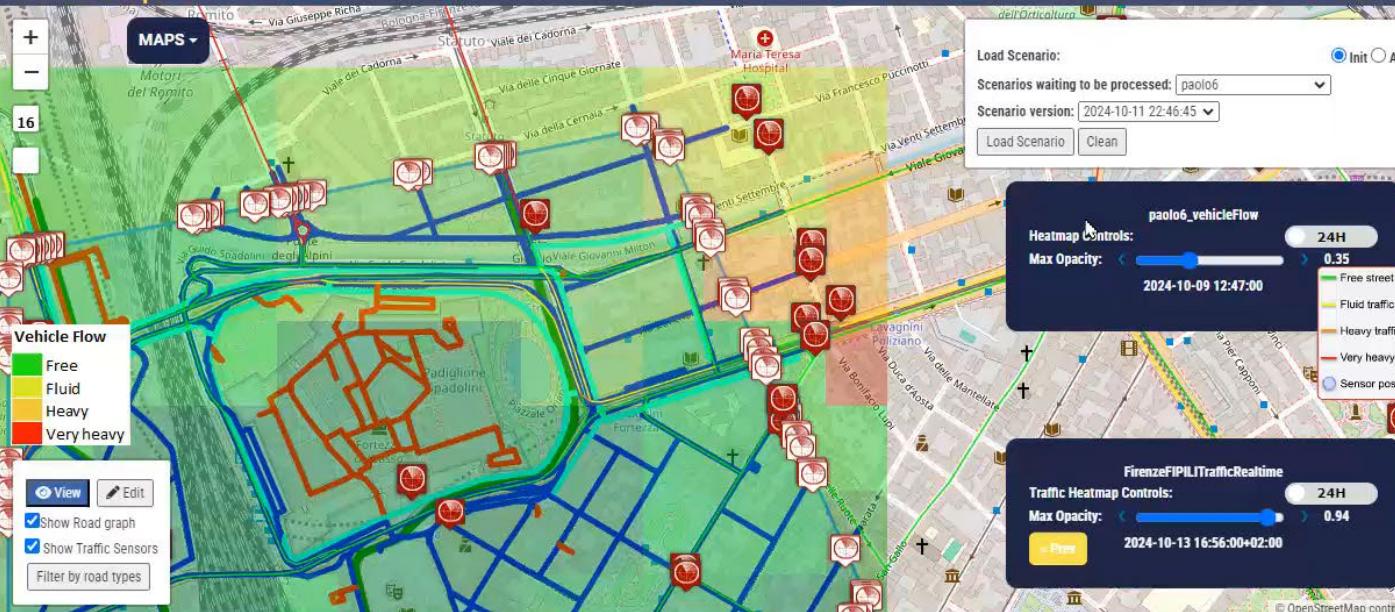
2024-10-09 12:47:00

FirenzeFIPIITrafficRealtime

Traffic Heatmap Controls: 24H  0.94

2024-10-13 16:56:00+02:00





Compute Predictions Compute Heatmaps Show Heatmaps

Data Update

Select a Scenario

Scenario Version

Select a color map

Clustered:  Yes  No

File:  Yes  No

Model: IDW

From Date gg/mm/aaaa

To Date gg/mm/aaaa

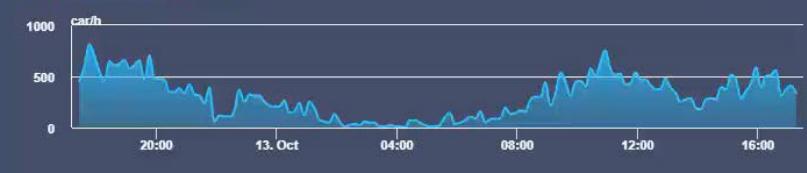


CongestionLevel - 4 Hours

6m 

1000 car/h

0



20:00 13. Oct 04:00 08:00 12:00 16:00

Selected Trend And Predictions

11m 

800

0



20:00 13. Oct 04:00 08:00 12:00 16:00 20:00

METRO1128 - vehicleFlow METRO1128 - Predicted - vehicleFlow

# Available AI Solutions on Snap4City

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

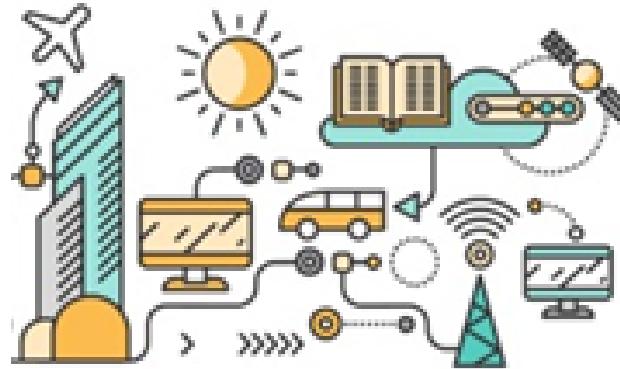
More than 80 Available Solutions & 300 AI applic.

- 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/course/p4/>



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

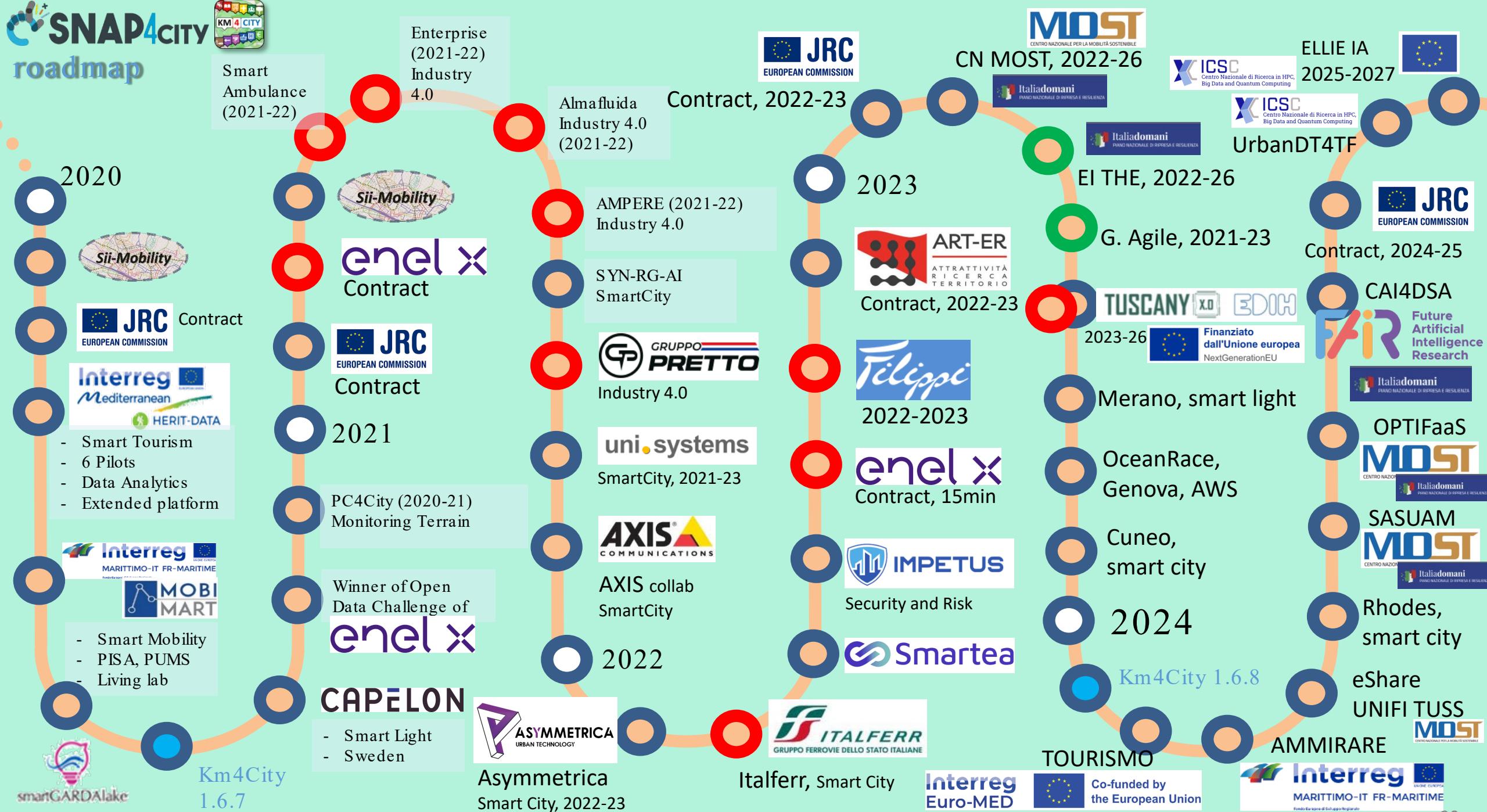


# Scenarious

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

# Scenarios





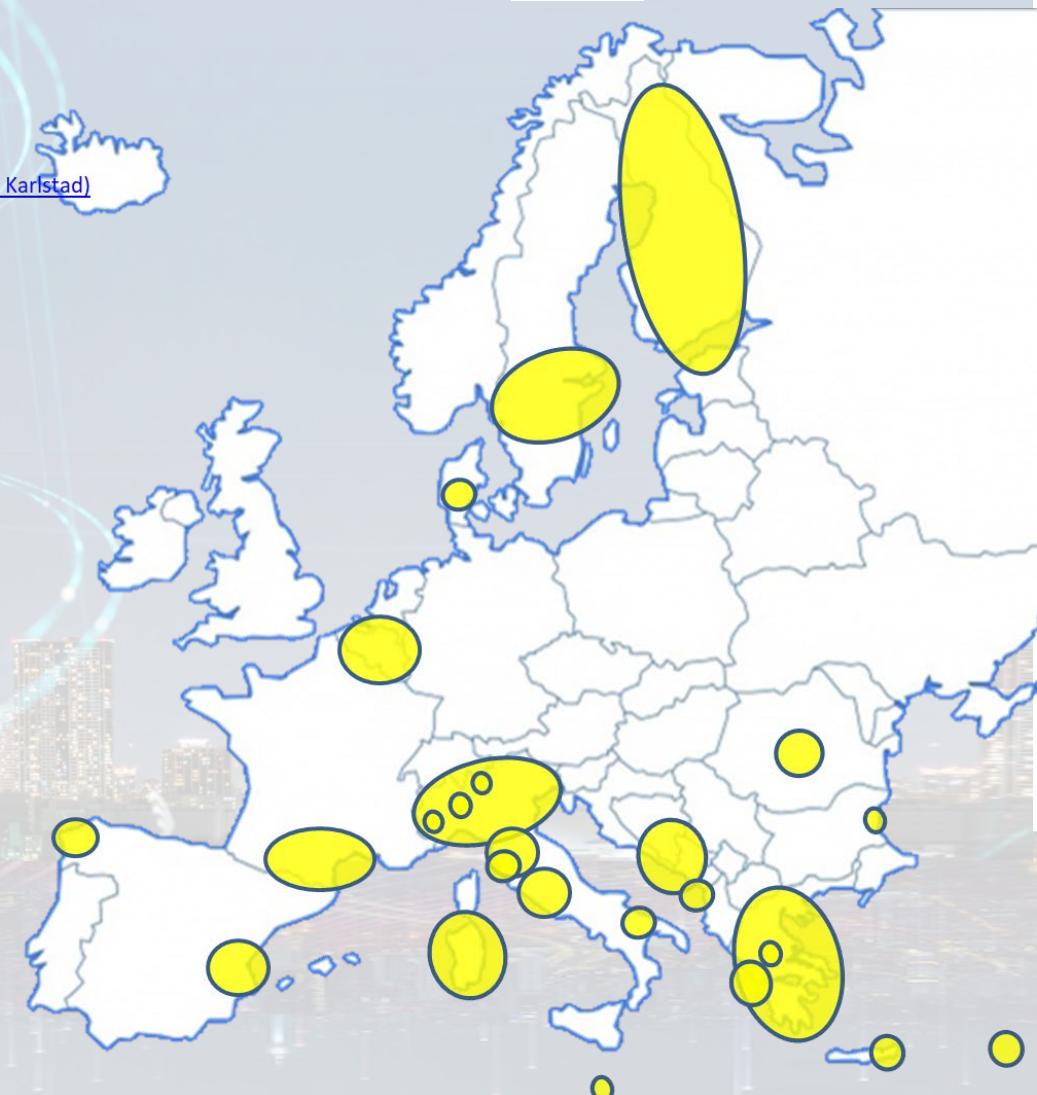
- **UrbanDT4TF**, CN HPC: Digital Twin mobility, <https://www.snap4city.org/drupal/node/1057>
- **DI-DTPlatform**, CN HPC: Digital Twin, mobility, environment, <https://www.snap4city.org/drupal/node/1097>
- **Sasuam**, CN MOST, PNRR: AI, mobility, <https://www.snap4city.org/drupal/node/999>
- **OPTIFaaS**, CN MOST, PNRR: AI, mobility, DSS, <https://www.snap4city.org/drupal/node/1008>
- **LeverageOPTIFaaS**, CN MOST: PNRR, mobility, <https://www.snap4city.org/drupal/node/1064>
- **TOURISMO**, Interreg, EC: Tourism, NLP, DSS, <https://www.snap4city.org/drupal/node/1001>
- **ELLIE**, Horizon Europe, EC: AI, VR, <https://www.snap4city.org/drupal/node/1056>
- **CN MOST**, PNRR: sustainable mobility, platform, <https://www.snap4city.org/drupal/node/1050>
- **ISPRA JRC contract**, EC: DSS, SOC, control room, energy, <https://www.snap4city.org/drupal/node/970>
- **AMMIRARE**, Interreg, EC: AI, environment, Big Data, <https://www.snap4city.org/drupal/node/1002>
- **CAI4DSA**, FAIR PE1, PNRR: AI, Neuro-Symbolic, PINN, NG-DSS, <https://www.snap4city.org/drupal/node/1016>
- **SADI-MIAC**, RT, partner: AI, Tourism, Retail, Computer Vision, <https://www.snap4city.org/drupal/node/1055>
- **SMART3R**, PRIN UNICagliari: mobility, DSS, <https://www.snap4city.org/drupal/node/1087>
- **Tuscany X.0, EDIH**, TestBeforeInvest, Training on AI, Big Data, Security, HPC: <https://www.tuscanyx.eu/>
- **Reg4IA**, AI for regional public administration, A project of presidency of national council
- **SmartCyprus**, a project of Cyprus Ministry of Digital Innovation and Policy
- **The IE**, PNRR: AI, NLP, LLM, Legal Aspects
- **BullIVIT**, RT, conv: AI, NLP, LLM on commercial phases
- **Energia**, RT, conv: AI, PINN, DSS, on manufacturing
- **RFI contract**: mobility, AI, DSS
- **Salerno Port**: AI for container ID recognition and tracking
- **Talent Hub**, ECRF, conv: NLP, match demand vs offer
- + currently: Merano, Salerno, Cuneo, Rhodes, Reverberi, Florence, IDTS, ALTAIR, etc.



- 11 running installations in Europe
  - Snap4city.org, Greece, Merano, Cuneo, ...
  - Toscana, Pisa, Sweden, ISPRA, Snap4.eu,
  - Altair, Italmatic, M4F, Romania, ....
- 20 projects, 12 pilots on 10 Countries
  - >40 cities/area
- **Widest MULTI-tenant deploy has**
  - 26 Organizations / tenant
  - > 8850 users on
  - > 1800 Dashboards
  - > 17 mobile Apps
  - **> 2.2 Million of structured data per day**
  - > 580 IoT Applications/node-RED
  - > 850 web pages with training
  - > 85 videos, training videos

#### Main Organizations/areas

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



# booklets

- Smart City



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

- Industry



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

- Artificial Intelligence



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

# Control Planning

# Goals

## Control

**Management and Operational**  
(monitoring, KPI, anomaly detection, early warning)

## Planning

**Tactic and strategic, medium and long range, micro/macro**  
(simulations and predictions, what-if analysis)





Powered by  
**FIWARE**

**FREE  
TRIAL**

**PEN Test  
Passed**

**EU GDPR  
COMPLIANT**

**Appliances and Dockers  
Installations**

**EUROPEAN OPEN  
SCIENCE CLOUD**

**Node-RED**

**JS Foundation**

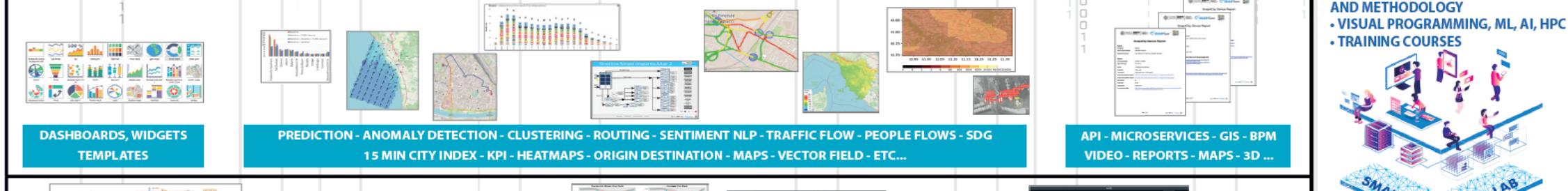
**E015**  
digital ecosystem

**NVIDIA**

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



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

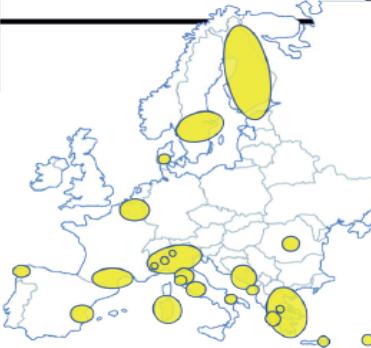


**FULL INTEROPERABILITY, ANY: DATA, BROKERS, NETWORKS AND VERTICALS**



**NATIVE AND EXTERNAL  
APPLICATIONS**

- Smart Parking
- Smart Light
- Smart Waste
- Smart Energy
- Smart Building
- Smart Tourism
- ...



# Control Horizontal Platform

- **Goals:**

- Increasing quality of Life, quality of services,
- Decongestion, Decarbonization, Sustainability
- increase efficiency and production optimization
- Improve accessibility to services: citizens, Tourists, commuters, etc.
- Improve security/Safety of city users, risk reduction
- Costs reduction of services, energy consumption reduction
- Reduction of emissions and EC taxations

- **Horizontal homogeneous platform Uniform Technology for**

- **Any Vertical operation/plan:** mobility, energy, environment, security, tourism, infrastructure and assets control, buildings, etc.
- **AI Solutions: early warning, predictions, simulation, what-if, optimisation, MLOps;**
  - AI: Deep Learning, ML, BERT, LLM/RAG, XAI (Shap/Lime), etc.
  - Simulations: SUMO, DORAM, Routing, TFR, Flooding, people flow, etc.
- **Development Environment for any vertical, Digital Twin:** City Global and Local, IoT, VR, Visual Programming, business intelligence, CSBL, SSBL, etc.
- **Interoperability:** any format, any protocol, any video management system, any sensor, any device, etc.

- **KPI:** multidomain KPI, general management, early warning, early detection of critical conditions, 15 Min City Index, SDG, SUMI/SUMP

- **Mobile App:** modular applications, operators' modules, multiple cities, etc.

- **Participatory:** problem reporting, ticketing, etc.

- **Integration of any kind**



# Key Performance Indicators, KPI



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

- United Nations Sustainable Development Goals, SDGs (for which cities can do more to achieve some of the 17 SDGs, <https://sdgs.un.org/goals>);

- 15 minutes cities (where primary services must be accessible within 15 minutes on foot);

- objectives of the European Commission in terms of pollutant emissions for: NO<sub>2</sub>, PM10, PM2.5 ([https://environment.ec.europa.eu/topics/air\\_en](https://environment.ec.europa.eu/topics/air_en));

- SUMI: mobility and transport vs env

• <https://www.snap4city.org/951>

- SUMP/PUMS: mobility and transport vs env.

- ISO indicators: city smartness, digitization, tech level.

- Low Level/Real Time: global traffic, quality of service, betweenness, centrality, queue, time to travel, etc.

Global  
&  
Local  
  
Periodic  
&  
Realtime

**1** NO POVERTY

**2** ZERO HUNGER

**3** GOOD HEALTH AND WELL-BEING

**4** QUALITY EDUCATION

**7** AFFORDABLE AND CLEAN ENERGY


- Optimization of car sharing/pooling
- Monitoring and Prediction of energy consumption
- Stimulating: Bike sharing, e-bikes, car charge, etc.
- Sizing energy plants, Community of energy

**11** SUSTAINABLE CITIES AND COMMUNITIES


- Reduction of emissions, reduction of congestions
- Smart City infrastructure: monitoring and resilience, long terms predictions, optim. operation and plan
- Effective and Low cost smart solutions
- What-if analysis, Simulations, optimization
- Origin Destination matrices computation

**13** CLIMATE ACTION

**15** LIFE ON LAND


- Reduction of emissions, reduction of congestions
- Monitoring and Predicting: NO<sub>2</sub>, NO<sub>X</sub>, CO<sub>2</sub>, Traffic flow, pollutant, landslide, waste, etc.
- Traffic flow reconstruction, optimisation
- Demand vs Offer of Mobility analysis

## • **15 Minute City Index:**

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

**9** INDUSTRY, INNOVATION AND INFRASTRUCTURE


- Predictive maintenance
- Decisions Support Systems
- Process optimization, control
- Industry 4.0 integrated solutions
- AI assistant for commercial activities

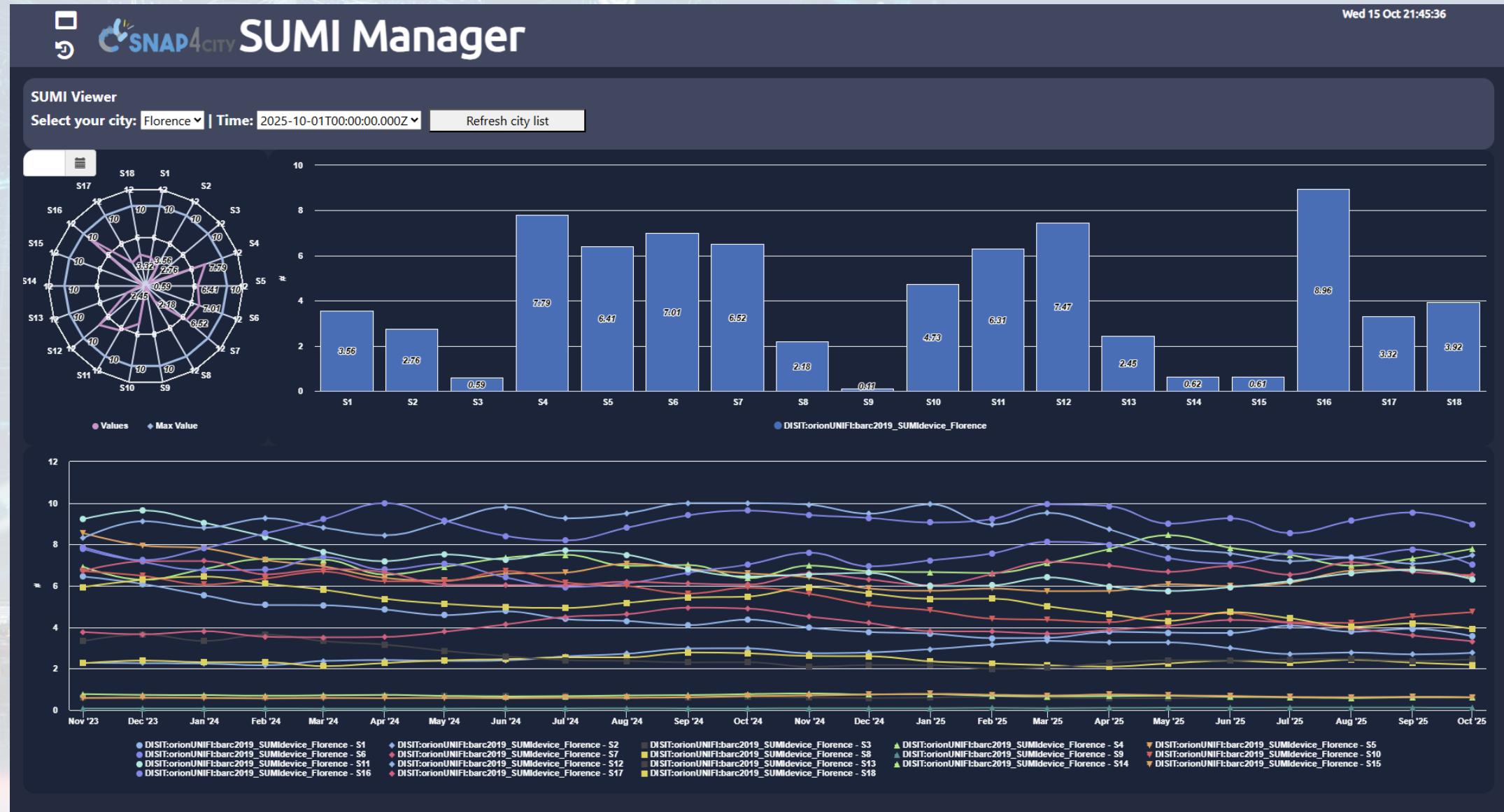
**12** RESPONSIBLE CONSUMPTION AND PRODUCTION


- Optimization of Waste Collection
- business intelligence tools for decision makers
- Reduction production costs
- Monitoring resource consumption
- Advisor for documentation, generative AI

**16** PEACE, JUSTICE AND STRONG INSTITUTIONS


- Shortening justice time
- Prediction of mediation proneness
- Assisting institution is taking legal decisions
- Anonymization and indexing legal docs.
- Ethical Explainable Artificial Intelligence
- Advisor for legal documentation, generative AI

# SUMI: Sustainable Urban Mobility Indicators





# Control Room



# Smart City Control Room

## Florence Metropolitan City



reference



### • Multiple Domain Data

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

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

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

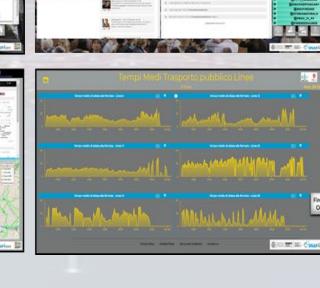
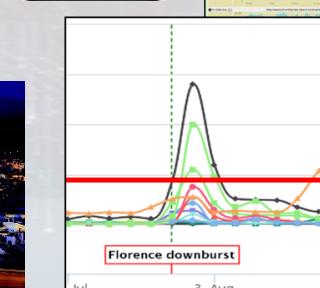
### • Historical and Real Time data

- Billions of Data

### • Services Exploited on:

- Multiple Levels, Mobile Apps, API

### • Since 2017



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

# Cuneo Assets' Monitoring, Safety



SNAP4

## Monitoraggio Generale

Thu 4 Jan 18:13:19

Map showing various monitoring points across Cuneo, including cameras, traffic gates, and switches. A callout for 'SWITCH015' shows its details.

**SWITCH015**  
VALUE NAME: 1721615250

Details: [DETAILS](#) [DESCRIPTION](#) [RT DATA](#)

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

**Legenda**

Valore	Significato	Simbolo
0	Buono stato	●
1	Non raggiungibile	○
2	Raggiungibile, dati non disponibili	■
3	Identificata anomalia	●

**GENERAL STATUS**

Valore	Significato	Simbolo
0	Buono stato	●
1	Non raggiungibile	○
2	Raggiungibile, dati non disponibili	■
3	Identificata anomalia	●

**TempValue... 9m**

**TempValue1 - 7 Days**

49

My Profile

Privacy Policy Cookies Policy Terms and Conditions

- TV Cams: color, Thermal
- Traffic Gates
- Switches
- UPS

## Monitoraggio Dettagliato

Thu 4 Jan 18:05:15

**Tabella Device**

Cerca per Indirizzo, ID o device...

Camera UPS Switch

Indirizzo

IP

Azioni

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

**Tabella Dettaglio**

**TC010185**

dateObserved	04/01/2024, 14:34
generalStatus	●
tempStatus1	1

**TEMP STATUS**

Valore	Significato
1	Buono stato
2	Lettura dato fallita

**Legenda**

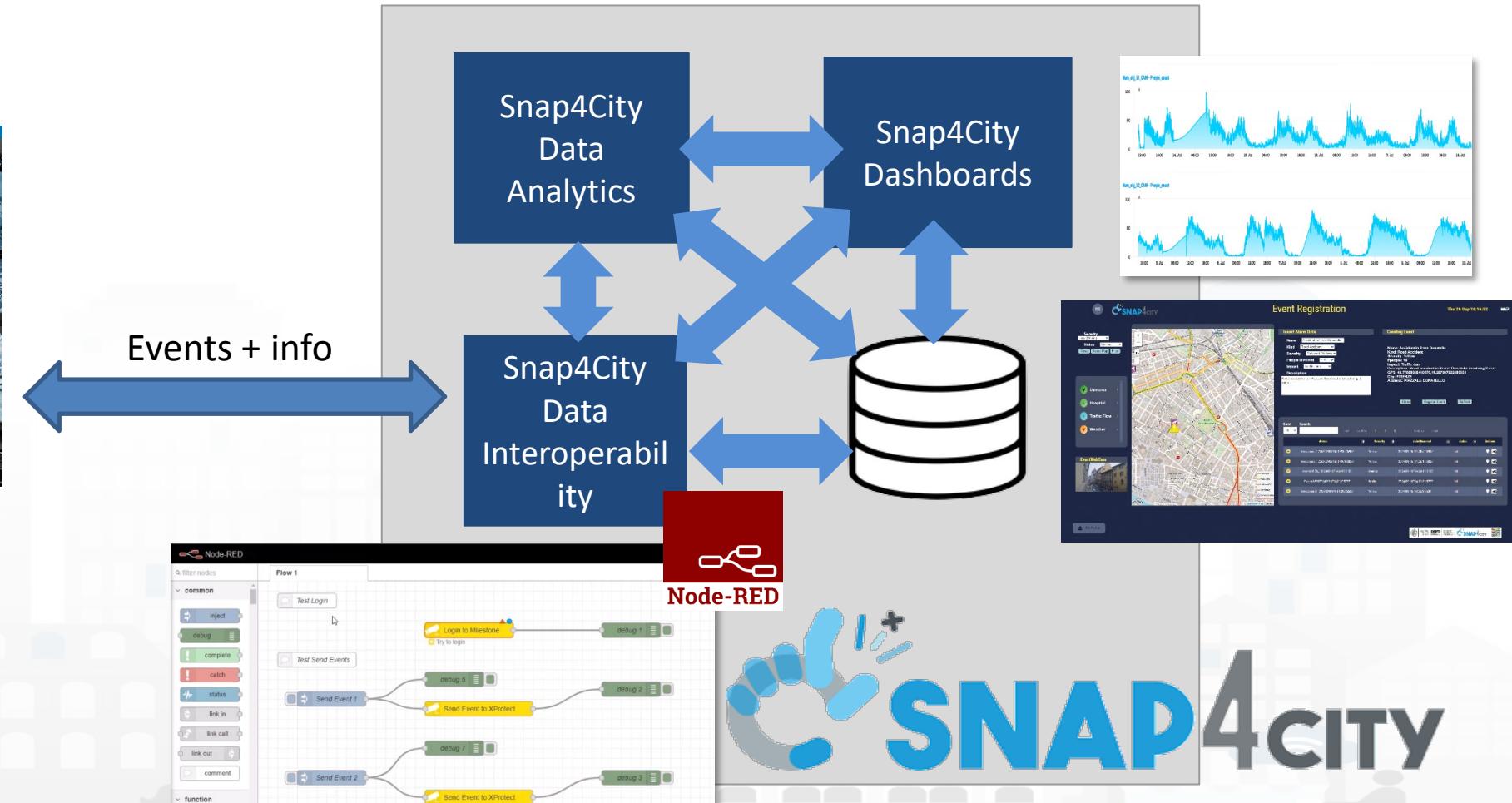
Valore	Significato	Simbolo
115	Buono stato	●
13	Non raggiungibile	○
22	Dati non disponibili	■
4	Identificata anomalia	●

My Profile

Privacy Policy Cookies Policy Terms and Conditions

DISIT | DINFO | DISIT

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





# Video Event Management

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

# Event Registration

Tue 31 Oct 23:14:19

Severity   14

Status

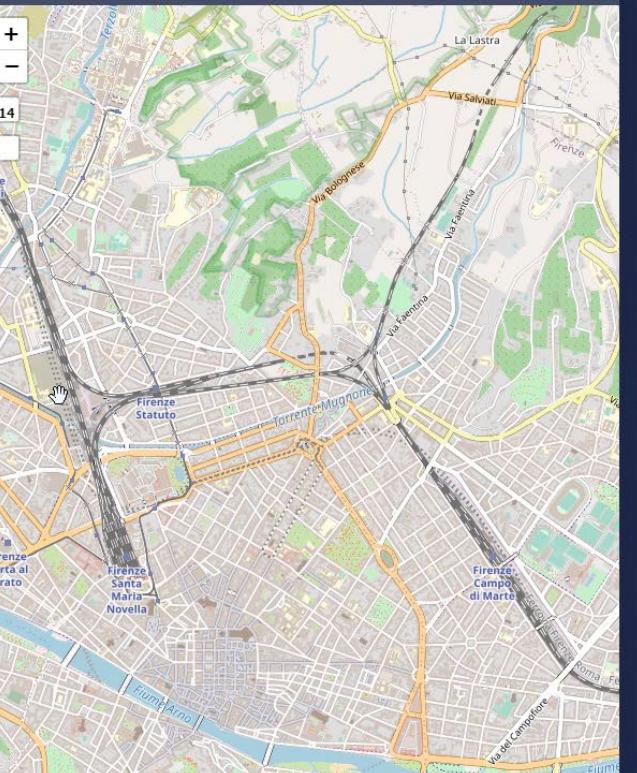
Cameras >

Hospital >

Traffic Flow >

Weather >

EventWebCam



Insert Alarm Data

Name  Kind

Severity  People Involved  Impact

Description

Creating Event

Clear Register Event Refresh

Show Search: 5 First << Prev 1 2 3 ... Next >> Last

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

# Mobility and Transport

# Goals



Decongestion



Safety



Accessibility



Cost Reduction



Decarbonization

# Mobility & Transport

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



# Smart Energy and Smart Building

# Goals

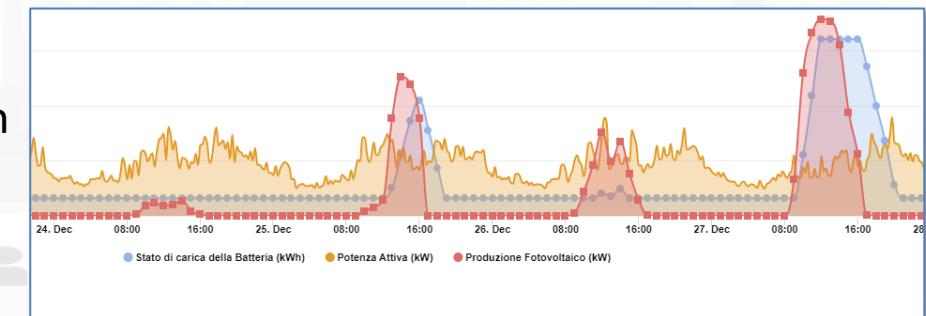
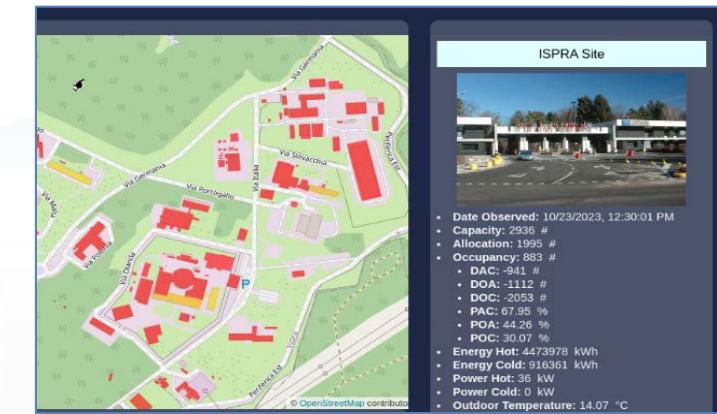


Cost Reduction

- Energy consumption reduction,
- increment of efficiency,
- Areas and building sustainability
- Improve accessibility to services,
- security and safety

# City Energy and Buildings

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



# Environment and Waste Management

# Goals

*Control of emissions*

*Reduction of emissions*

*Early warning*

*Meet the EC targets*

*Reduction of EC taxation*

# Environment and Waste

- Goals:**

- Reduction of emissions and EC taxations
- Cost reduction for waste collection,
- reduction of waste collection impact on mobility

- AIR quality (Indexes) monitoring and warning**

- Environment Management & producing predictions/prescriptions:**

- Monitoring, long and short-term predictions, warning for:
  - GHG, emissions, pollutants, aerosol, chemical plants analysis
  - Traffic Flow impact emissions, predictions
  - Sea conditions, UV conditions, etc.

- Land slide prediction warning**

- Coastal erosion monitoring and analysis**

- Smart Waste Management and Optimisation:**

- costs reduction, optimal routing production, pay as you throw,
- avoiding out of bins, predictions of waste production on bins, alarms

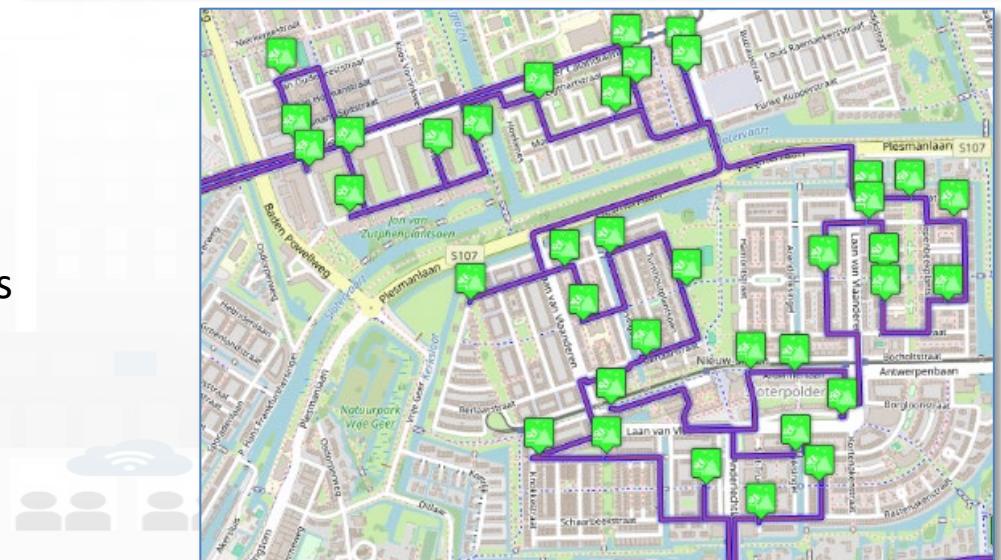
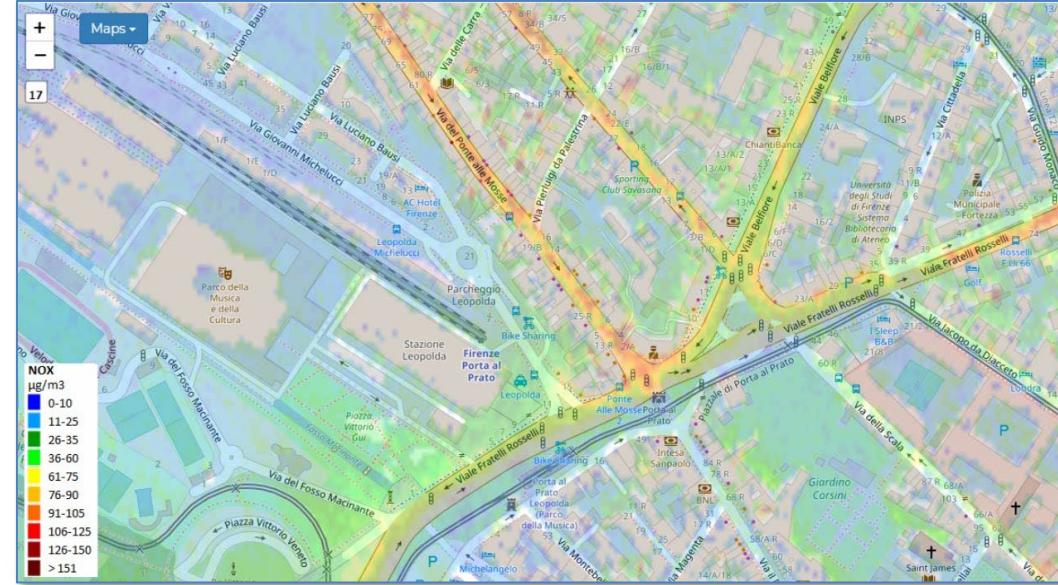
- KPI:** SDG, 15MinCityIndex, QOS, costs, Km, collecting time, EC KPI, emissions

- Mobile App:** final users services/informing and operators

- Info Waste for operators, participation, optimal routing, RAEE Collection, ..

- Participatory:** problem reporting, ticketing, etc.

- Integration of any kind:** env/weather, mobility, ticketing, presences, POI, ..



# City Users' Services and Tourism Management

# Goals

- Improve Quality of Life and quality of services,
- Over tourism mitigation, sustainability
- Costs reduction of services
- Improve accessibility to services: citizens, Tourists, commuters, etc.
- Improve Security/Safety of city users

# City User Behaviour/services, Tourism and Safety

- **Goals:**

- Improve Quality of Life and quality of services,
- Over tourism mitigation, sustainability
- Costs reduction of services
- Improve accessibility to services: citizens, Tourists, commuters, etc.
- Improve Security/Safety of city users

- **People Flow Analysis / Management:** in/out-door, retail, attractions

- Counting, tracking, Flows, ODM, sentiment, recency/frequency, etc.,
- multiple sources: thermal & TV cameras, radar sensors, PAX sniffers, mobile data, ...
- Data and/or **OD matrices** from: Wi-Fi, traffic data, mobile phone data
- **Suggestions:** info Tourism, digital signages, engagement, .., via email, mobile apps, etc.



- **Tourists Flows & Retail Management:** predictions of presences, services' reputations, suggestions on second offers, over-tourism, notifications, early warning,

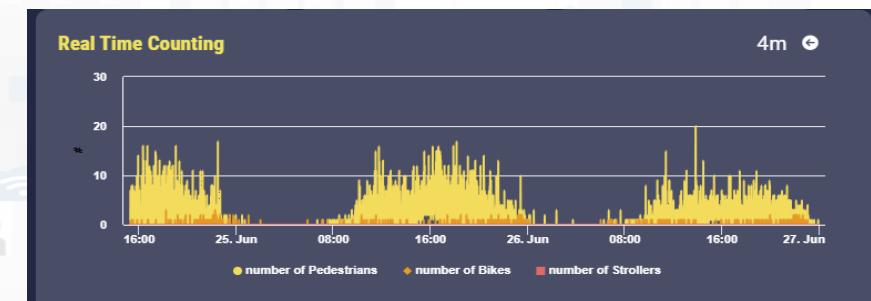
- **KPI:** 15 MinCityIndex, energy vs people, over-tourism, accepted suggestions, precision

- **Mobile App:** final users services/informing and operators

- Info Tourism, people flows, info mobility, sharing, ...
- Participation, engagement, ..

- **Participatory:** problem reporting, ticketing, etc.

- **Integration of any kind:** env/weather, mobility, ticketing, presences, POI, ..



*Assistants on taking decision  
and for development/training*

**Goals**

*Details*



Powered by  
**FIWARE**

**FREE  
TRIAL**

**PEN Test  
Passed**

**EU GDPR  
COMPLIANT**

**Appliances and Dockers  
Installations**

**EUROPEAN OPEN  
SCIENCE CLOUD**

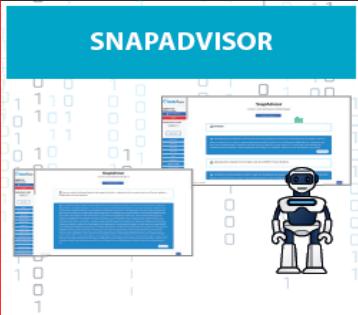
**Node-RED**

**JS Foundation**

**E015  
digital ecosystem**

**NVIDIA**

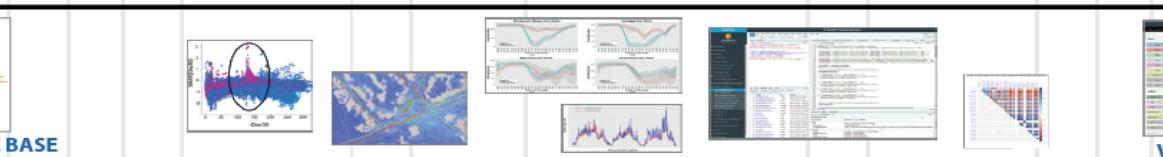
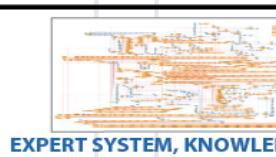
**OPERATION AND PLAN - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - OPTIMIZATION - APPLICATIONS**



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



- DEVELOPMENT ENVIRONMENT AND METHODOLOGY
- VISUAL PROGRAMMING, ML, AI, HPC
- TRAINING COURSES



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

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

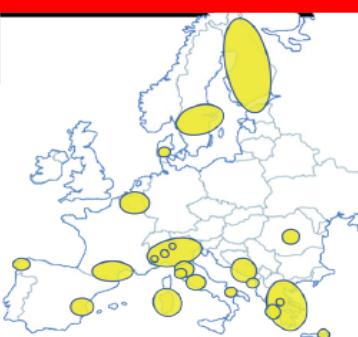
**VISUAL PROGRAMMING, ADAPTERS  
DATA FLOWS, WORKFLOWS  
PARALLEL DISTRIBUTED PROCESSING  
DATA DRIVEN**

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



**NATIVE AND EXTERNAL  
APPLICATIONS**

- Smart Parking
- Smart Light
- Smart Waste
- Smart Energy
- Smart Building
- Smart Tourism
- ...





Logged in as:  
edoardo\_tester

Your Profile

Logout

SnapAssistant model:

Llama3.3 ▾

New Chat

EdoChat1

EdoChat2

EdoChat3

EdoChat4

prova

chatNuova

chatTest1LLAMA

chatTest2LLAMA

testGianniLLAMA

testTastoInvioPreChanges

ChatTestPostPSWINVIO

https://www.snap4city.org/1116

## SnapAdvisor

Current chat: debug0

Visualize references



Come creo una dashboard?

💡 Per creare una dashboard, puoi utilizzare la piattaforma Snap4City. La dashboard si compone di un insieme di widget grafici che possono essere impostati separatamente assegnando una serie di parametri, come origine dati, dimensioni, colori, forma, font, allarmi, relazioni con altri, ecc. (SOURCE: Snap4 City per la creazione di Smart City Control Room, SCCR). Inoltre, la piattaforma offre la possibilità di creare vere e proprie applicazioni interattive, multipagina/multidashboard, e non semplici storie monopagina da scrollare. Puoi anche condividere la dashboard con altri utenti anche fuori dalla Smart City Control Room tramite canali autenticati e protetti in HTTPS, in accordo al GDPR (SOURCE: Snap4 City per la creazione di Smart City Control Room, SCCR). Per vedere alcuni esempi di dashboard, puoi visitare il sito [https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MjU0Mg==](https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MjU0Mg==) (SOURCE: Snap4 City 1st Overview v4 8 annot). Tuttavia, non ho trovato informazioni dettagliate sulla procedura di creazione di una dashboard. Se hai bisogno di ulteriore assistenza, ti consiglio di contattare direttamente il team di supporto di Snap4City. Non so dirti altro in merito.

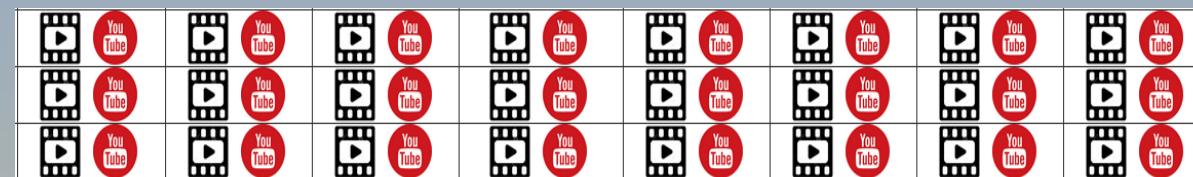
Write a message...



Personal  
Advisor LLM

# Developing on Snap4City

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



# Visual Development Tools



**My IOT Sensors and Actuators**

Add My New Device

Entity/Device Management

DEVICES ACTIVE: 3032 ACTIVE, 9999 PUBLIC, 7000 PRIVATE

Entities/Devices Management

Device identifier: KIT Sensor, Device Type: PRIVATE, Owner: Antwerp, Organization: Unbeknownst, Owner: Antwerp, Status: ACTIVE, Last: 2023-09-18 10:00:00, Location: Antwerp, Belgium

**Service Map (Toscana)**

Entity/Device Management

Data Inspector

My Data Dashboard Dev Kibana

My Data Dashboard Dev Kibana

POINT RESULTS

29,146,065

**Jupyter2-(175) Hub - Python**

Resource Manager

Development Tools

Custom Widgets / Synopses

Custom Widgets / Synopses

**Proc.Logic / IoT App**

15MININDEX

Node-RED

Node-RED

**My Dashboards in My Organization**

3D MAP GLOBAL DIGITAL TWIN - NEWGUI

Maintenance

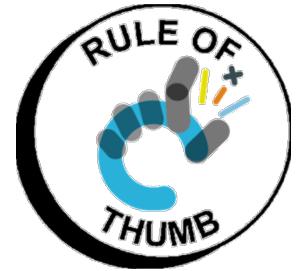
Client-Side Business Logic - Test

Service Map

FIRENZE - TRAFAI - AIRQUALITY HEATMAPS - NEWGUI

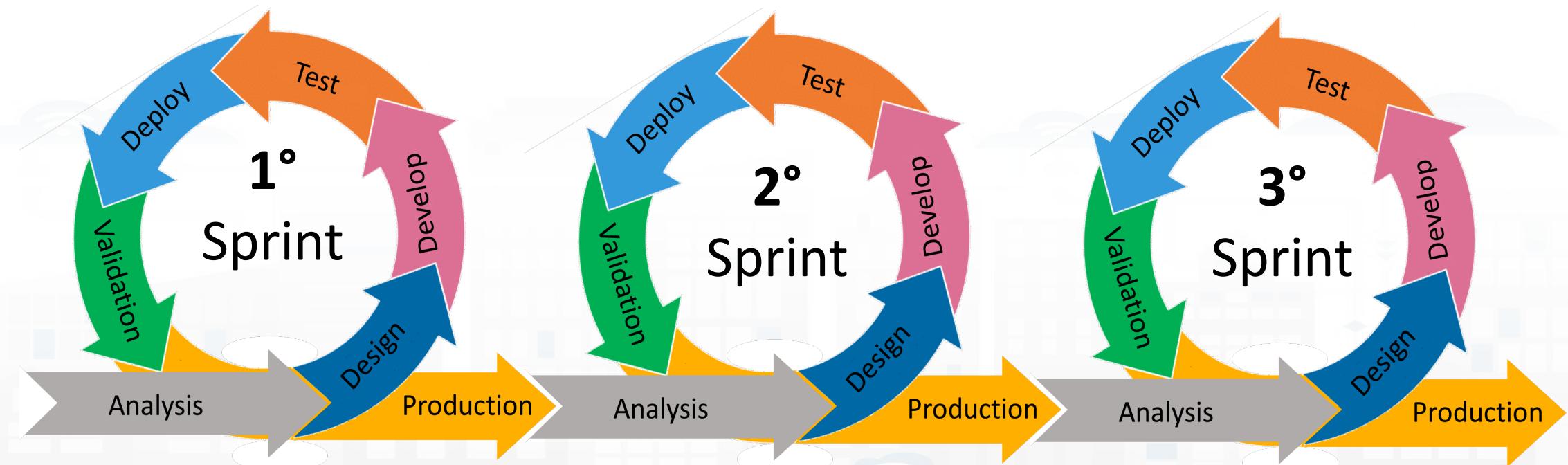
Data Analytics



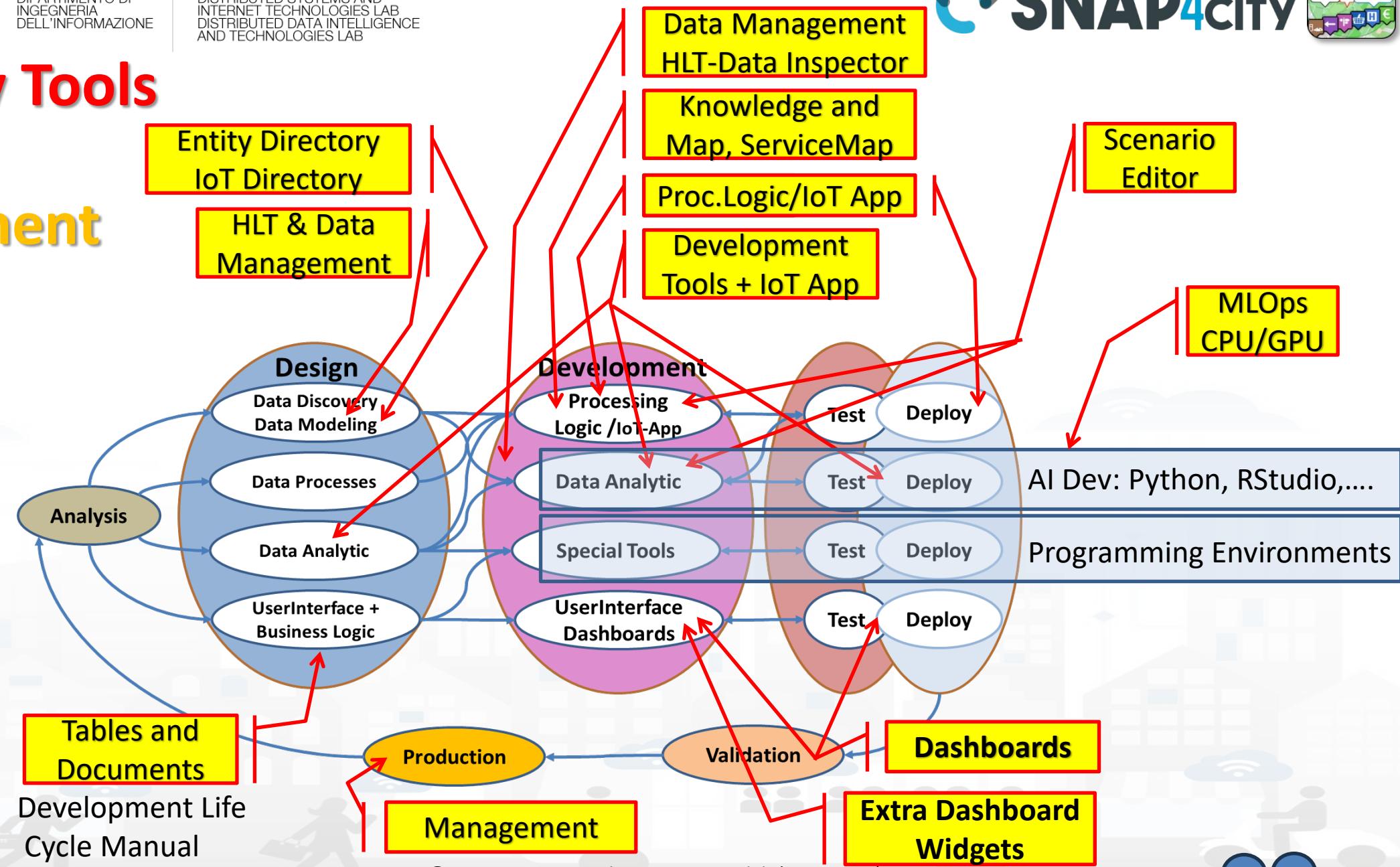


# Agile Development Life Cycle by sprint

## Smart Solutions



# Snap4City Tools vs Development Life Cycle

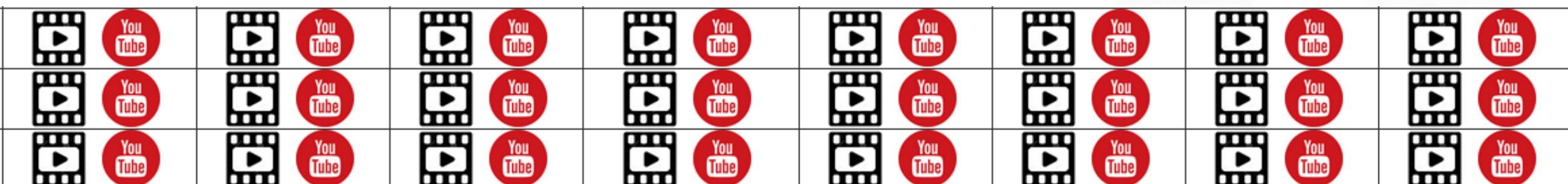


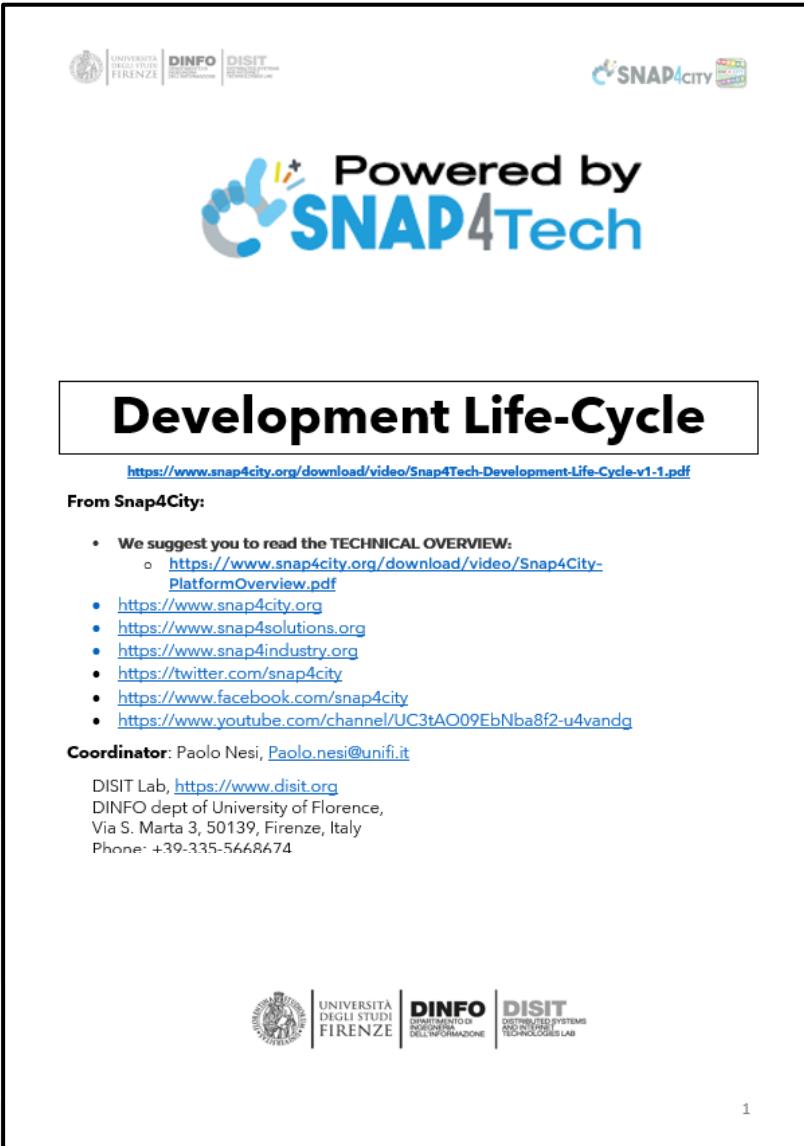
<https://www.snap4city.org/944>

*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
							
							





**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](mailto:Paolo.nesi@unifi.it)

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

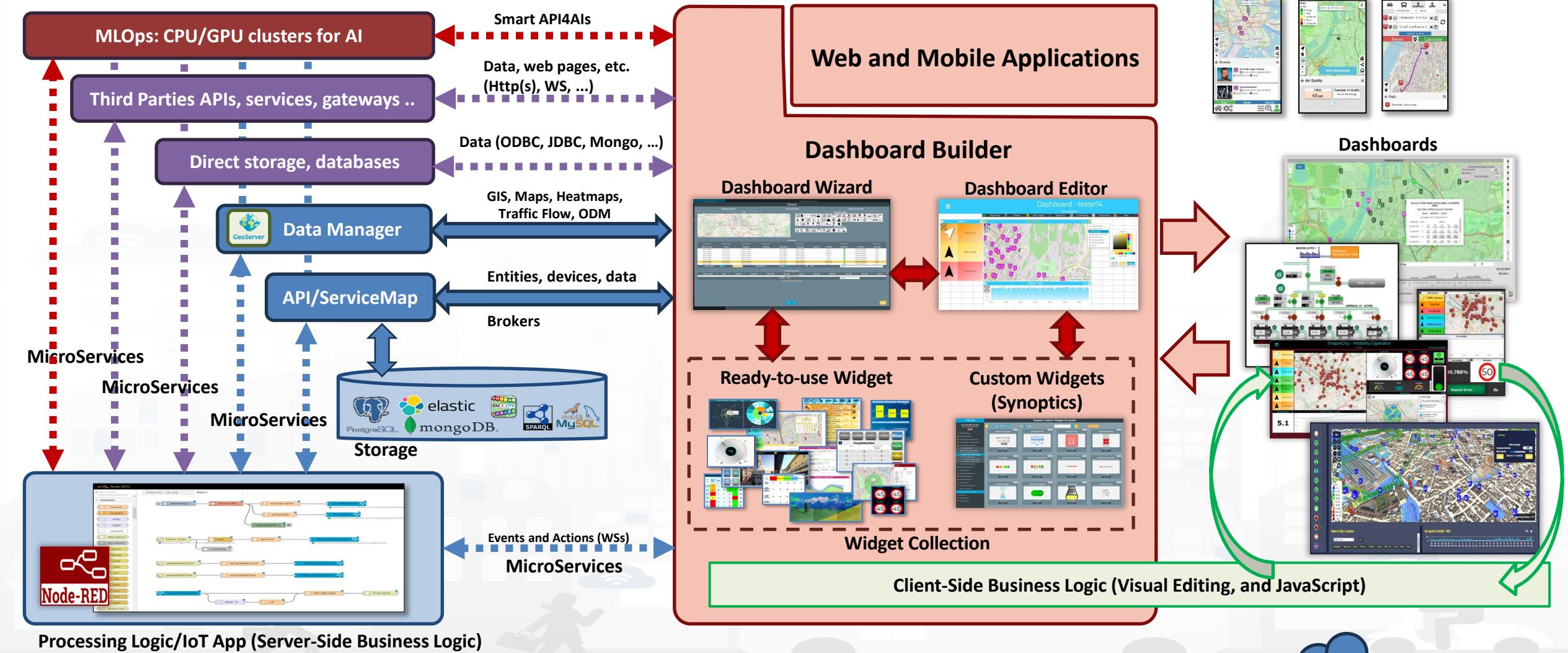
1

# Development

[https://www.snap4city.org/d  
ownload/video/Snap4 Tech-  
Development-Life-Cycle.pdf](https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf)



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



# Internal and External Smart City API

The image shows two side-by-side screenshots of the Smart City API Docs: Swagger interface.

**Left Screenshot (External API Docs: Swagger):**

- Header:** Smart City API Docs: Swagger
- Toolbar:** swagger, Select a spec (Advanced Smart City API), Logout
- Section:** Advanced Smart City API (version 0.0.0, OAS3)
- Sub-sections:**
  - Services:** GET / Service discovery and information
  - Events:** GET /events/ Event search
  - Locations:** GET /location/ Address and geometry search by GPS
  - Public Transport:**
    - GET /tp1/agencies/ Agency list
    - GET /tp1/bus-lines/ (Bus) Lines list
    - GET /tp1/bus-routes/ (Bus) Routes list
- Bottom:** SMART CITY API WEB DOCUMENTATION, Servers: https://servicemap.disit.org/WebAppGrafo/api/v1

**Right Screenshot (Internal API Docs: Swagger):**

- Header:** Internal API Docs: Swagger
- Toolbar:** Select a spec (IoT device registration API), Logout
- Section:** IoT device registration API
- Sub-sections:**
  - IoT device registration API
  - Notificator API
  - DISCES scheduler API
  - Resource Manager API
  - Sensors API
  - Event Logger API
  - Ownership API
  - Data Manager API
  - Device, Broker and Value Mgmt API
  - Smart4City Application API
  - Engager API
  - Wallet API
  - User Profiler API
  - My KPI API
  - Smart4City vs Openmant API
  - Device Groups API
  - Sci-Hub Processing API

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

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



*Be smart in a SNAP!*



**SMARTCITY**  
EXPO WORLD CONGRESS

## CONTACT

DISIT Lab, DINFO: Department of Information Engineering  
Università degli Studi di Firenze - School of Engineering

Via S. Marta, 3 - 50139 Firenze, ITALY  
[https://www.disit.org](http://www.disit.org)

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

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

Email: [snap4city@disit.org](mailto:snap4city@disit.org)

Office: +39-055-2758-515 / 517  
Cell: +39-335-566-86-74  
Fax.: +39-055-2758570



UNIVERSITÀ  
DEGLI STUDI  
FIRENZE

**DINFO**  
DIPARTIMENTO DI  
INGEGNERIA  
DELL'INFORMAZIONE

**DISIT**  
DISTRIBUTED SYSTEMS  
AND INTERNET  
TECHNOLOGIES LAB