Snap4Industry

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

info@disit.org
https://www.Snap4city.org,
https://www.Snap4Industry.org

Powered by SNAP4Tech

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

SNAP4INDUSTRY KM4CITY

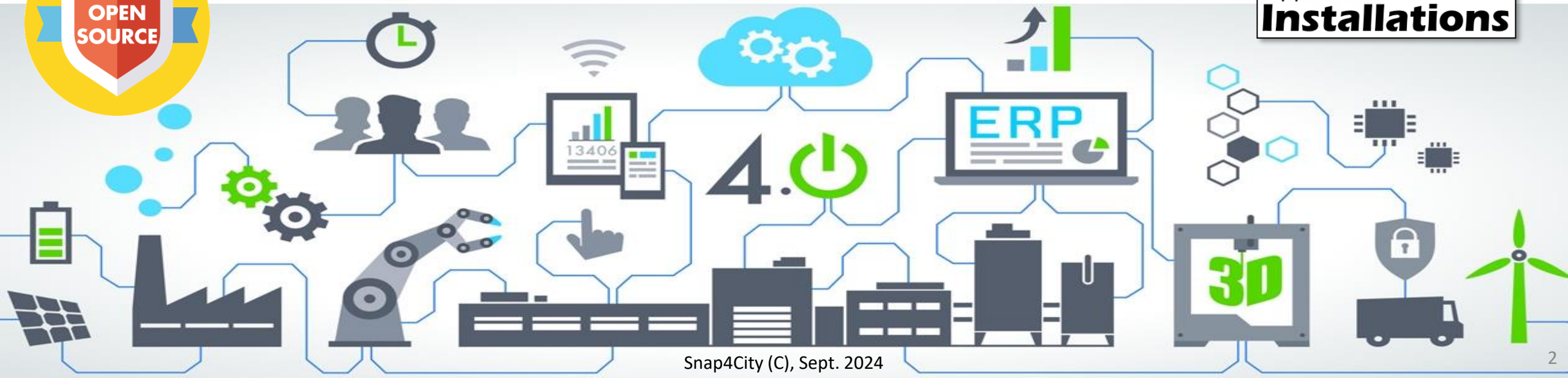
SNAP4INDUSTRY

https://www.snap4industry.org

Powered by SNAP4Tech

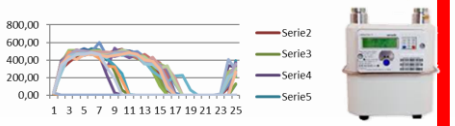
100% OPEN SOURCE

SNAP4 Appliances and Dockers **Installations**



https://www.snap4city.org/369

External Services



Fleet management

IoT Devices/Edge

IoT Broker

Internet

SECURE

Admin

DCS

IoT Broker

PLC

IoT Devices/Edge

Industry Plant1.....

SCADA

IoT Broker

PLC/ RTU

IoT Devices/Edge

Industry Plant2.....

IOT Applications

Dashboards and Apps

Big Data Analytics, Artificial Intelligence

Control and Supervision on Multiple Supply Chains

Industry 4.0 as a Service

What we do

- **Data modelling and management**
  - Data discovery and data surrogates/replacements
  - Big data management and provider
  - GIS data management
  - satellite Copernicus data processing for smart city and industry
  - IoT interoperability, edge, fog and cloud
  - Data interoperability, data aggregation and semantic processing
- **AI, Data Analytic, Visual Analytic**
  - AI for: **predictions**, **anomaly detection**, **clustering**, suggestions, simulation, fluid dynamics, classification, recognition, ..
  - **XAI, Explained AI, Trustworthy AI**
  - cognitive reasoning: ontology development, semantic computing
  - modelling and computing KPI
  - What-if analysis by mixing simulation, AI, statistics, semantics
  - Optimisation, simulation
- **Different contexts:**
  - industry, smart city, human behaviour, mobility, environment, terrain sliding
  - E.g. predictions pollutants/aerosol, CO2, NO2, GHG; traffic, parking, etc.

to cope with

- any data, format
- any channel, protocol
- any AI/ML
- any place
- online development
- multi-tenant
- Secure, PENTest
- GDPR, privacy
- → ***low costs***
- → ***easy to evolve***

Smart Solutions and Decision Support Systems

100% OPEN SOURCE

Powered by FIWARE

FREE TRIAL

PEN Test Passed

EU GDPR COMPLIANT

SNAP4 Appliances and Dockers Installations

EUROPEAN OPEN SCIENCE CLOUD

Node-RED

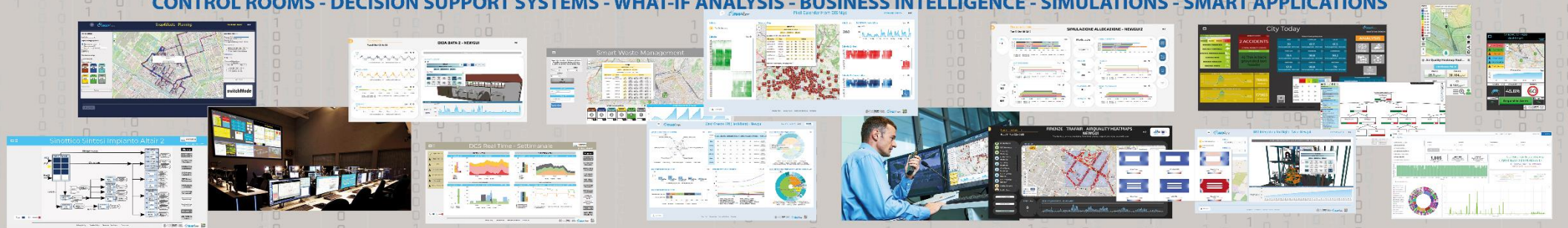
JS Foundation

E015 digital ecosystem

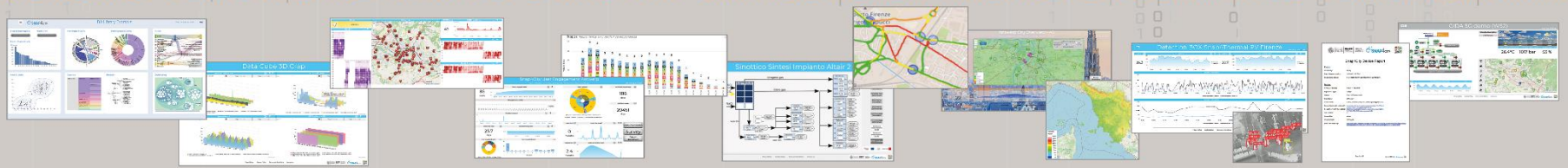
NVIDIA

UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO | DISIT | SNAP4INDUSTRY | KM4CITY

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



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

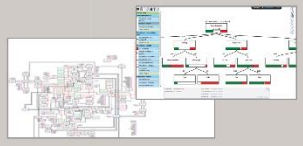


DASHBOARDS, WIDGETS
TEMPLATES

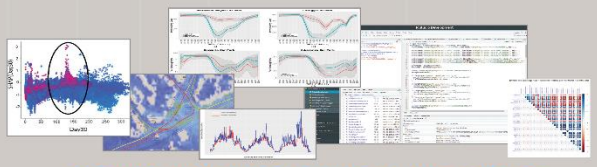
PREDICTION - ANOMALY DETECTION - CLUSTERING - ROUTING - SENTIMENT NLP - TRAFFIC FLOW
PEOPLE FLOWS - SDG - 15 MIN CITY INDEX - KPI - HEATMAPS - ORIGIN DESTINATION - ETC...

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

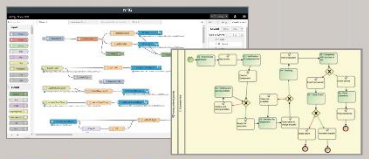
ANY: DATA, BROKER, NETWORK AND VERTICAL



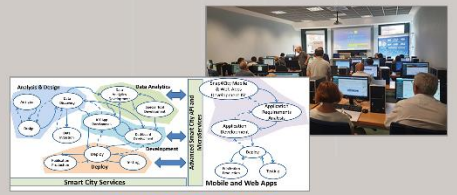
EXPERT SYSTEM, KNOWLEDGE BASE
SEMANTIC REASONING
SMART DATA MODEL
IOT DEVICE MODELS, STORAGE



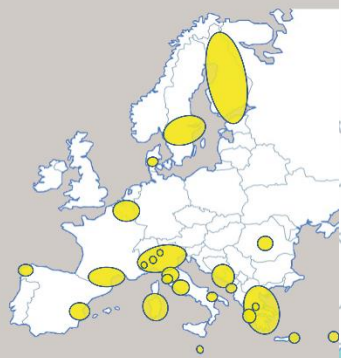
BIG DATA ANALYTICS, ARTIFICIAL INTELLIGENCE
EXPLAINABLE AI, MACHINE LEARNING
OPERATIVE RESEARCH, STATISTICS



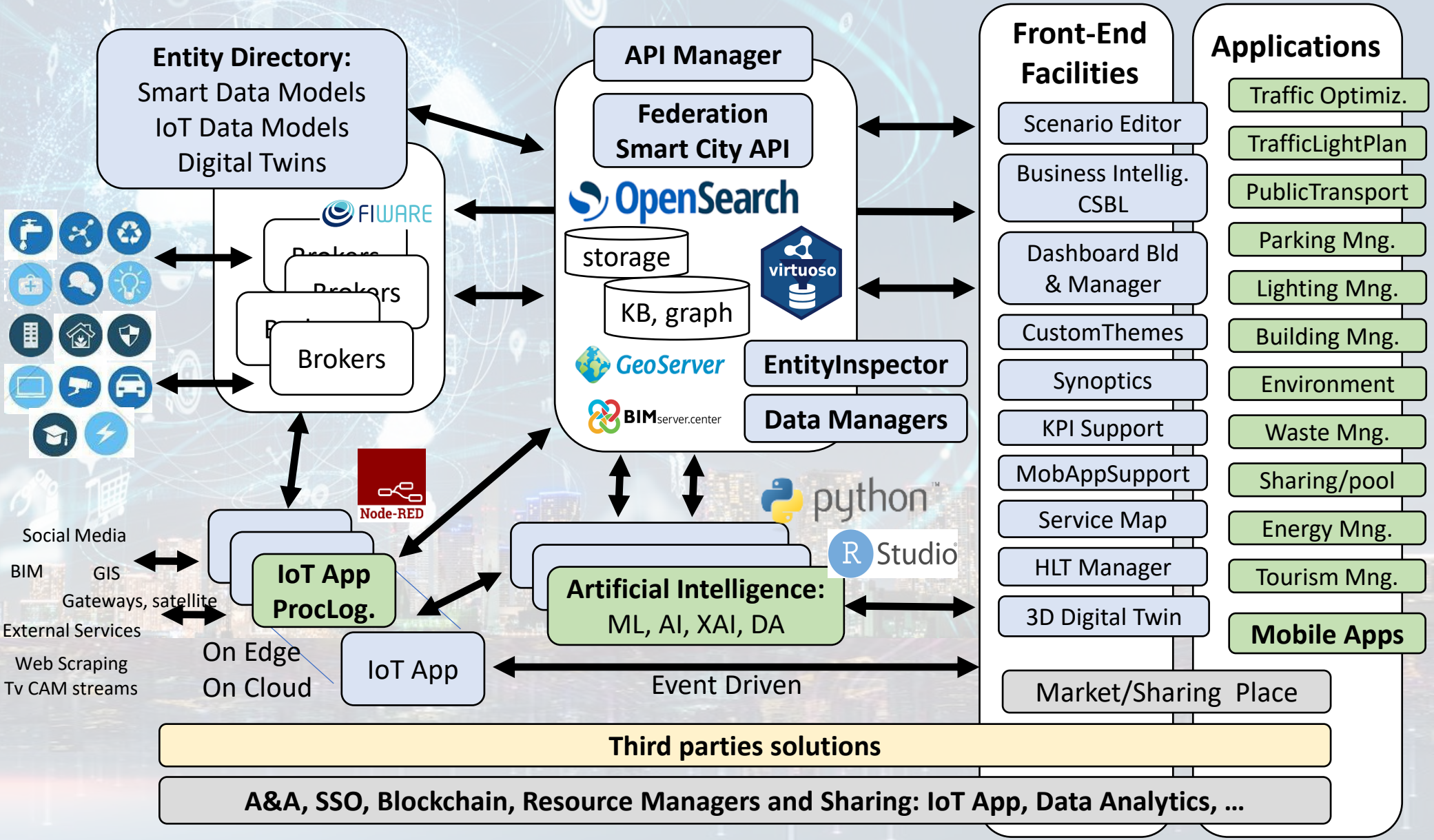
VISUAL PROGRAMMING, ADAPTERS
DATA FLOWS, WORKFLOWS
PARALLEL DISTRIBUTED PROCESSING
DATA DRIVEN



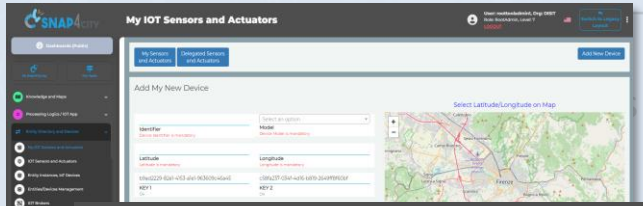
METHODOLOGIES
LIVING LABS
COURSES AND COMMUNITY
DEVELOPMENT TOOLS

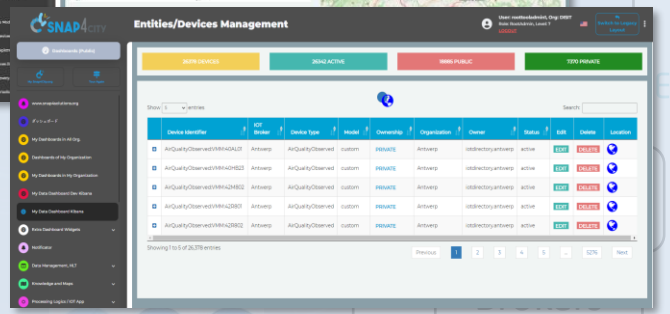


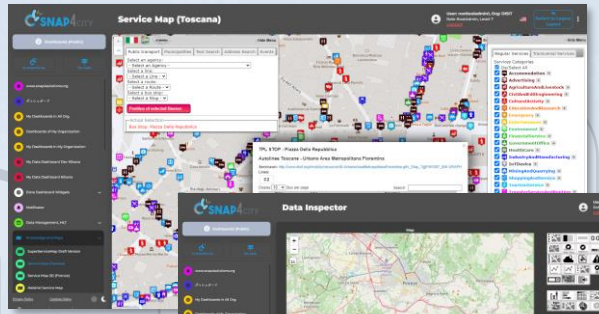
Technical Architecture

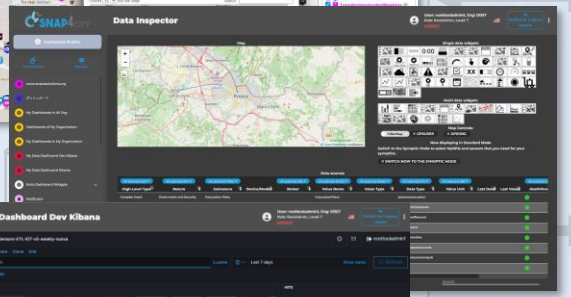


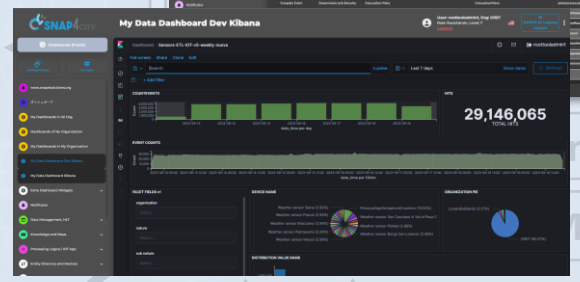
Visual Development Tools

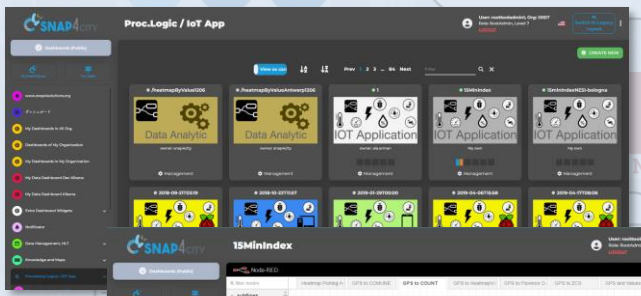


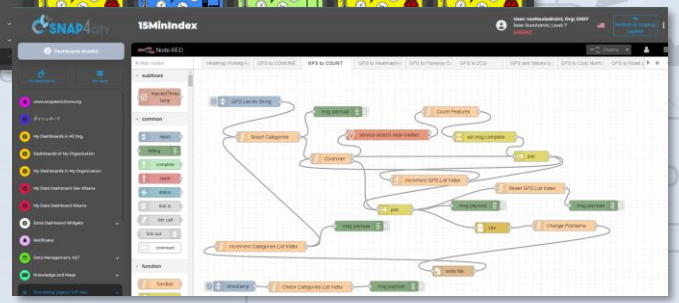


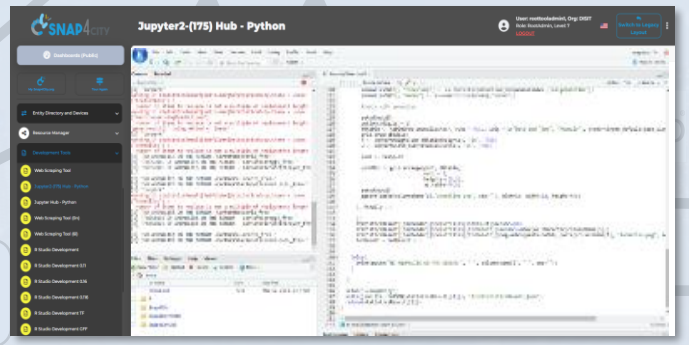


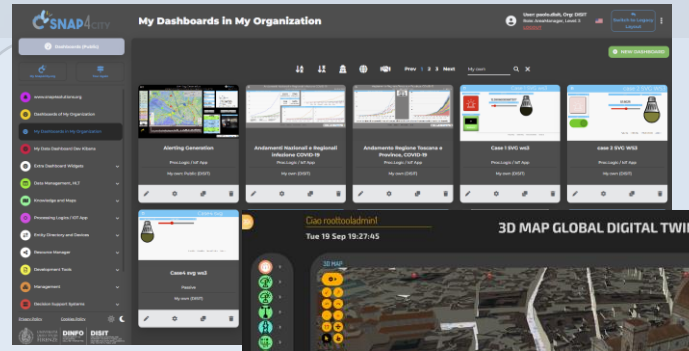


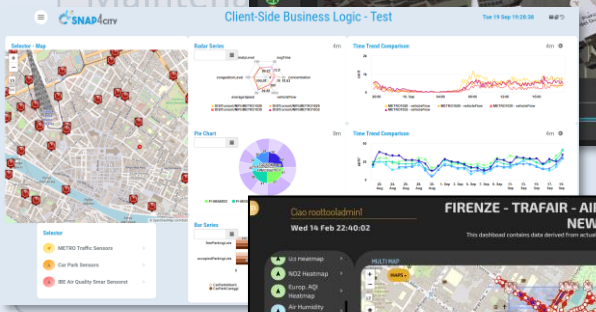


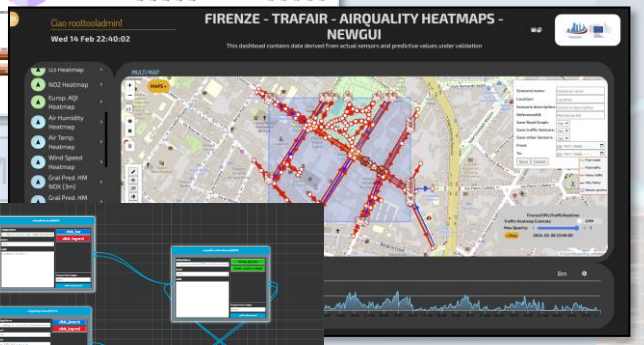


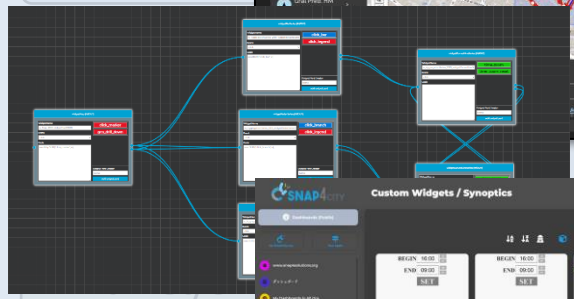












Maintena

nspector

Managers

Service M

Node-RED

Third parties solutions

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

Big Data Analytics + Artificial Intelligence

- **Decision support**
  - **Early warning, City Indexes, etc.**
  - **What-IF analysis** (simulation + AI + data)
- **Predictions**
  - **Short and Long terms predictive models on:**
    - traffic, parking, people flow, maintenance, land sliding, NO2
  - **3D Flow prediction:** Pollutant (NOX, NO2, …)
- **Suggestions and recommendations**
- **Modeling, simulation, routing**
  - **Traffic Flow reconstruction**
  - **Constrained Routing**

AI & XAI:

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

Representations, animated

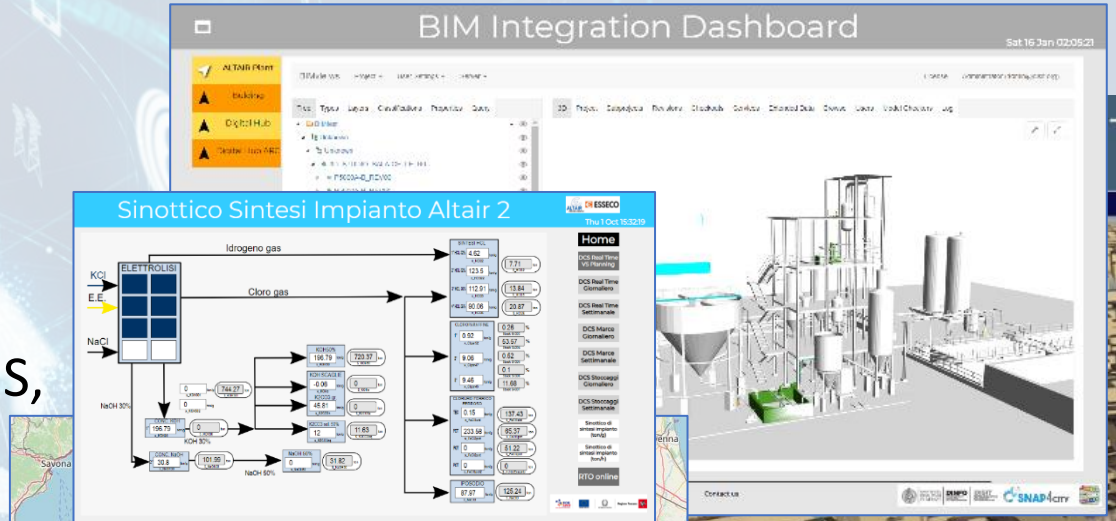
- Heatmaps, Traffic, Flows, ..
- Trajectories, OD matrices,
- 3D Rendering
- Typical Time Trends, etc.

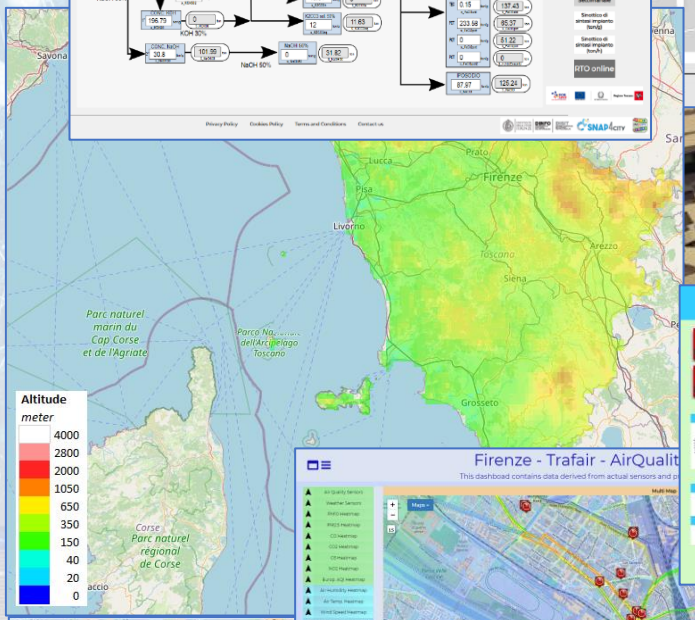
https://www.snap4city.org/download/video/course/da/

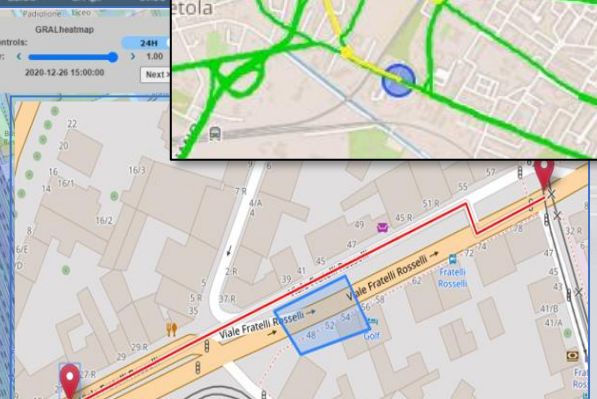
High Level Types

Snap4City (C), Sept. 2024

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







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

E015 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 (POR CreO, Regione Toscana)

(2018-20)

- Mobility Demand / Offer Analytics and Strategy

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)

2019
5G (2018-21)

- 5G tech
- Energy
- Industry 4.0
- Synoptics

TRAFAIR CEF (2018-21)

- Traffic and Mobility Impact on Pollution
- NOX predictions

EUROPEAN OPEN SCIENCE CLOUD

SIRIUS

LAID Smart Bed (POR CreO, Regione Toscana)

- Smart Health

GREEN FIELD PEAS Soda4.0 Optimization and Automated Decision System 4.0 (POR CreO, Regione Toscana)

- Industry 4.0

bee smart city

- Smart Lonato

Reverberi Enetec Gruppo MPES

SNAP4CITY KM4CITY

SODA

Winner of Select4Cities PCP

SNAP4CITY roadmap

2020

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

- Smart Mobility
- PISA, PUMS
- Living lab

Km4City 1.6.7

2021

Smart Ambulance (2021-22)

Enterprise (2021-22) Industry 4.0

Sii-Mobility

Contract

Contract

PC4City (2020-21) Monitoring Terrain

Winner of Open Data Challenge of

- Smart Light
- Sweden

2022

Almafluida Industry 4.0 (2021-22)

AMPERE (2021-22) Industry 4.0

SYN-RG-AI SmartCity

Industry 4.0

SmartCity, 2021-23

AXIS collab SmartCity

Asymmetrica Smart City, 2022-23

Contract, 2022-23

2023

Contract, 2022-23

2022-2023

Contract, 15min

Security and Risk

Italferr, Smart City

CN MOST, 2022-26

EI THE, 2022-26

G. Agile, 2021-23

2023-26

Merano, smart light

OceanRace, Genova, AWS

Cuneo, smart city

2024

TOURISMO

ELLIE IA 2025-2027

Contract, 2024-25

CAI4DSA

OPTIFaaS

SASUAM

Rhodes, smart city

eShare UNIFI TUSS

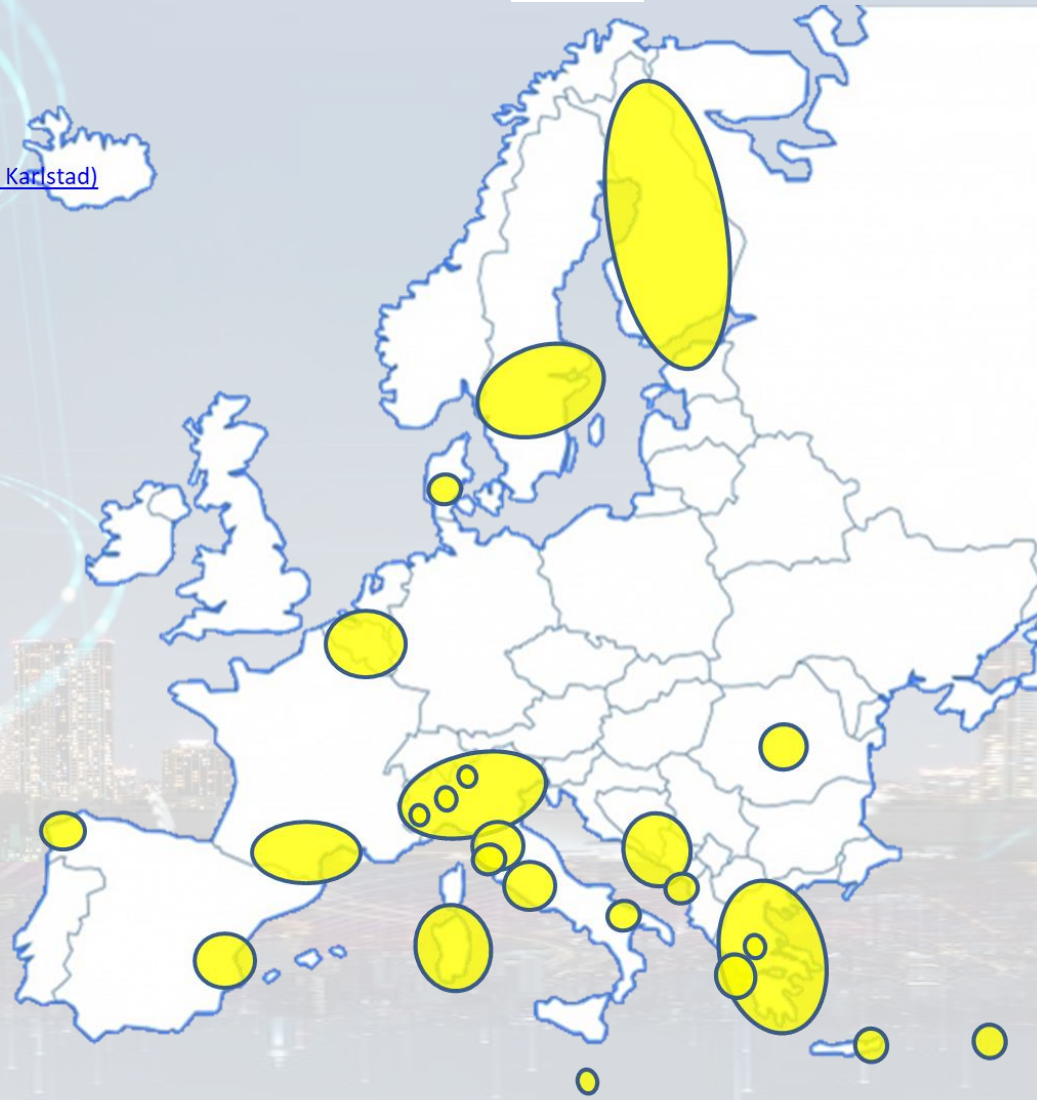
AMMIRARE

https://www.Snap4City.org

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

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)
- Venezia area (I)
- WestGreece area (Gr)

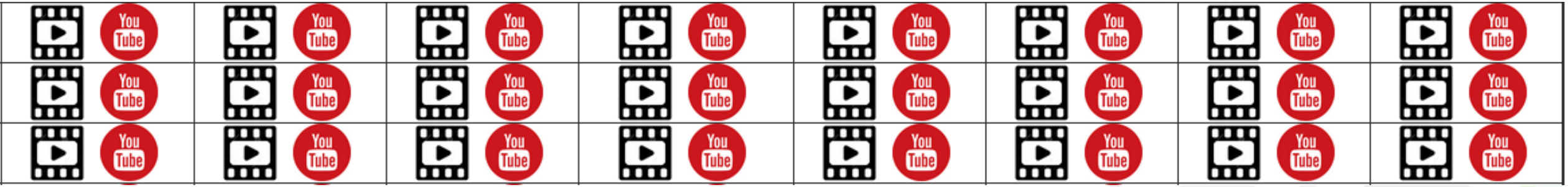


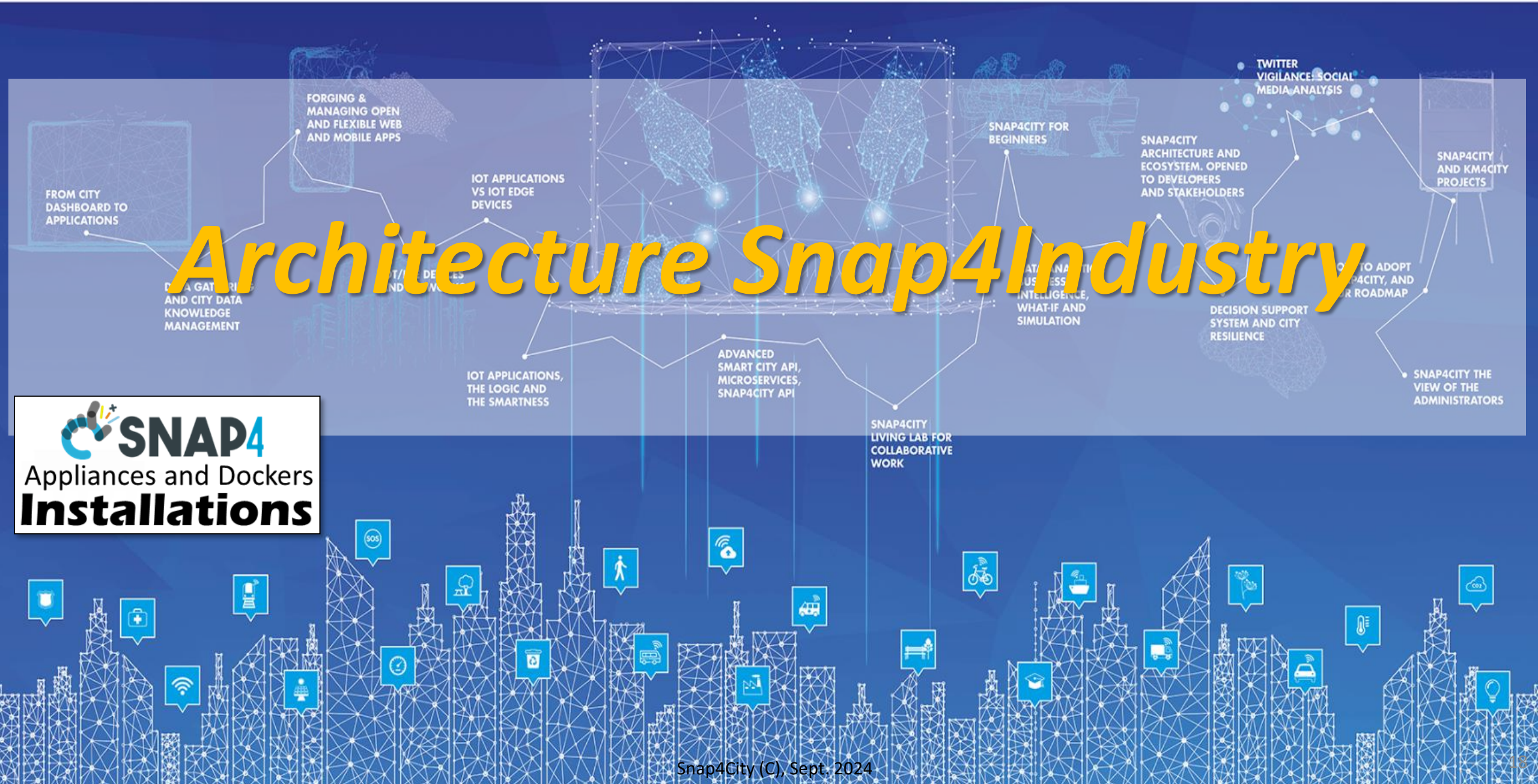
- **+ Israel, Colombia, Brasile, Australia, India, China, etc.**

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





Architecture Snap4Industry

SNAP4
Appliances and Dockers
Installations

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.

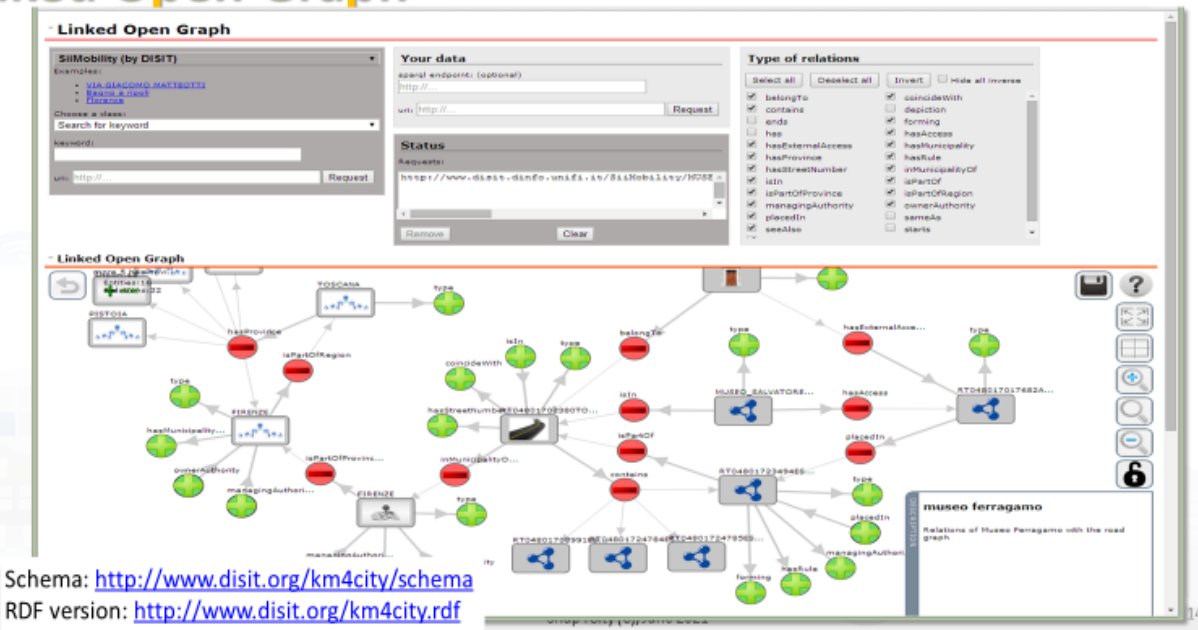
https://www.snap4city.org/65

Knowledge Engineering

Linked Open Data

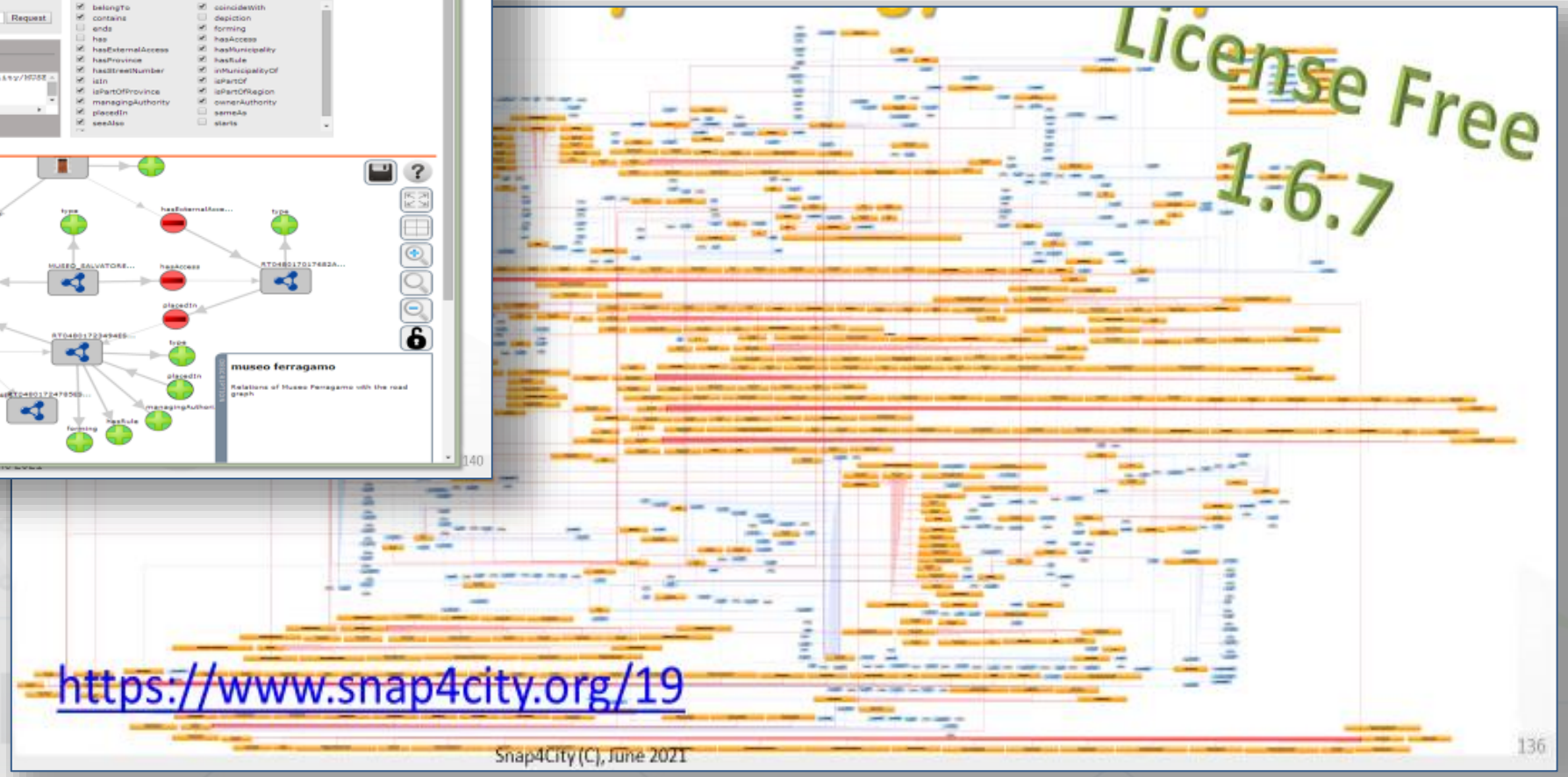
Linked Open Graph

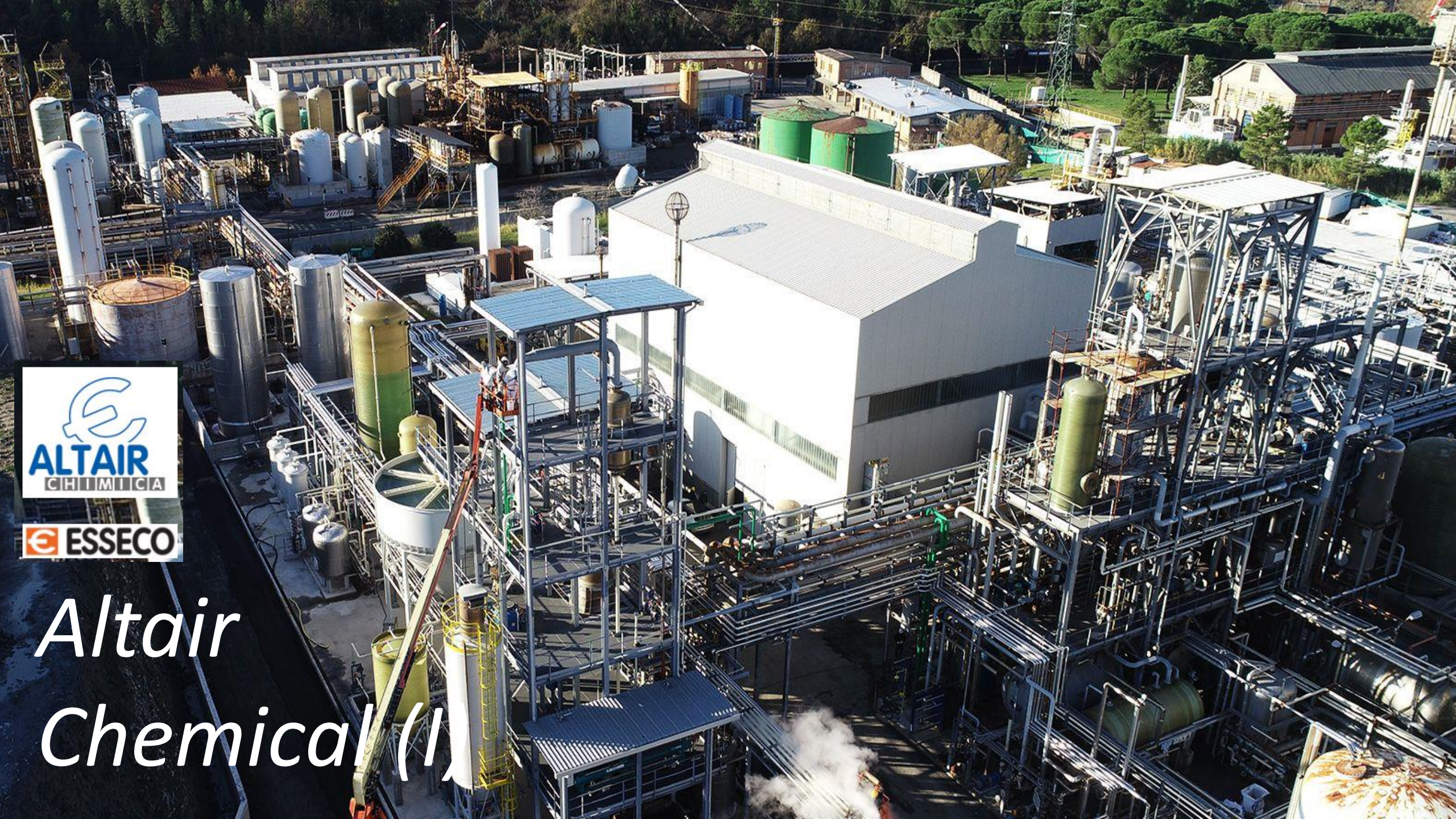
LOG: https://log.disit.org



Schema: http://www.disit.org/km4city/schema

RDF version: http://www.disit.org/km4city.rdf



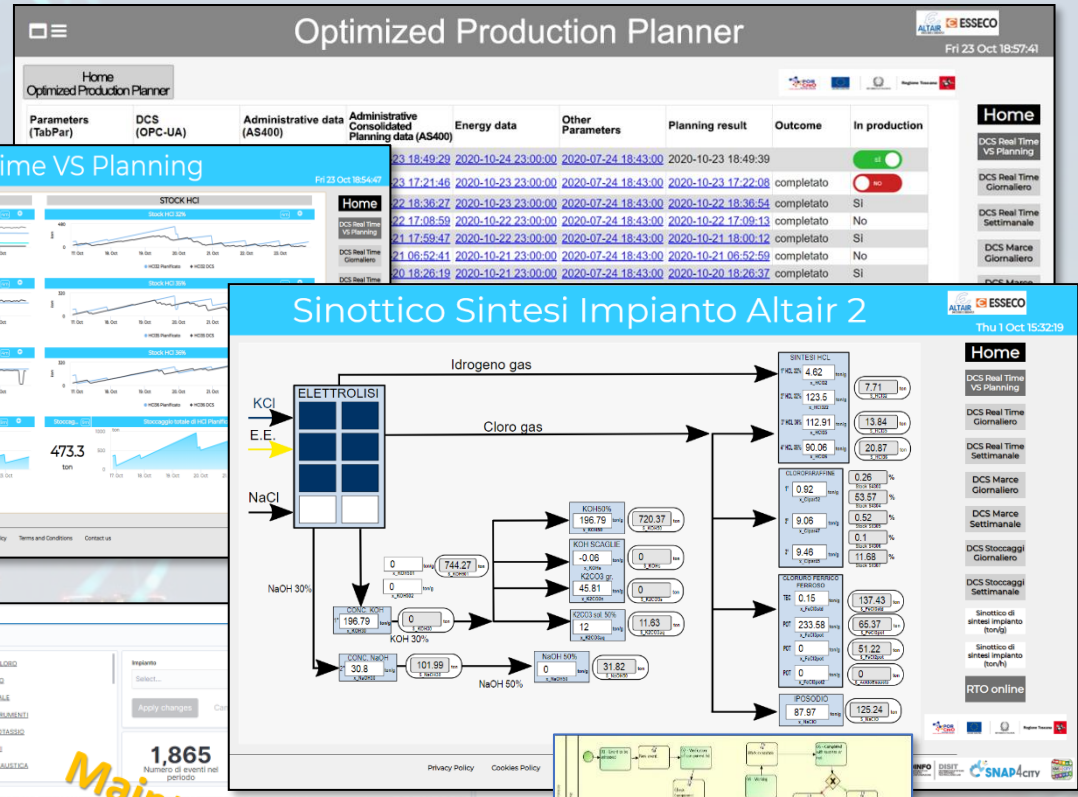


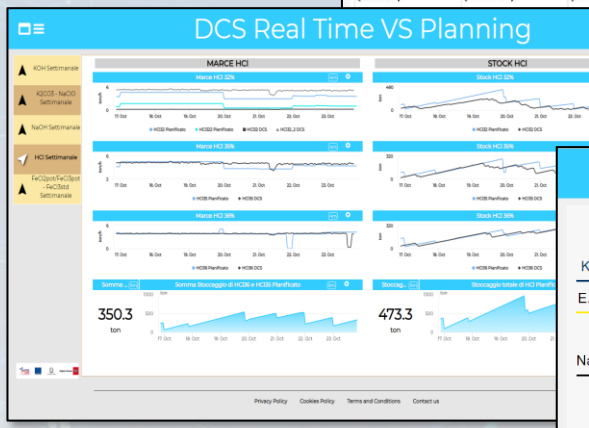
Altair Chemical (I)

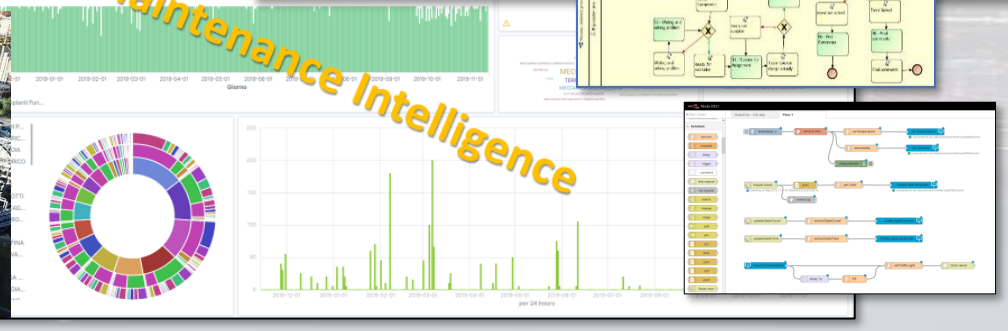
Snap4Altair Decision Support supervision and control, Industry 4.0

SNAP4INDUSTRY 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**







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)

MicroService Architecture

Energy Service

Data Connections and Transformation

IoT App/DA: Real Time & Stream Processing

Predictive Maintenance

Prod. Plan Optimization

API/MicroServices

Maintenance Intelligence

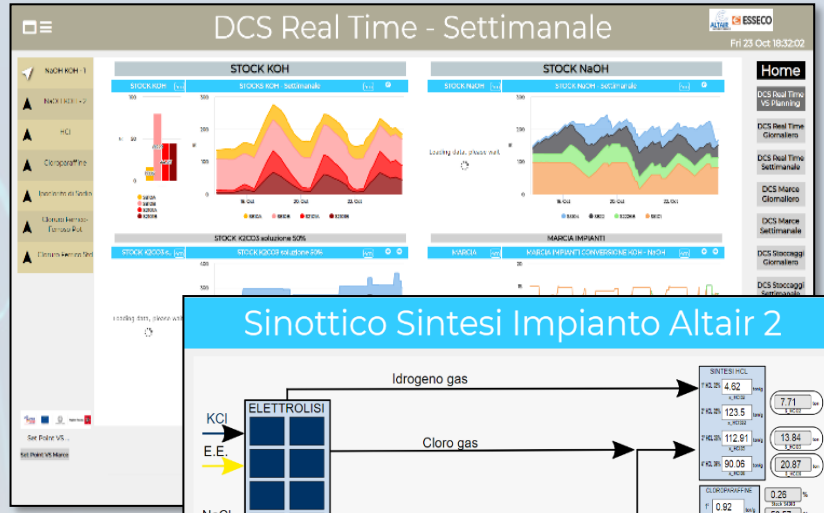
Digital Twin Local / BIM

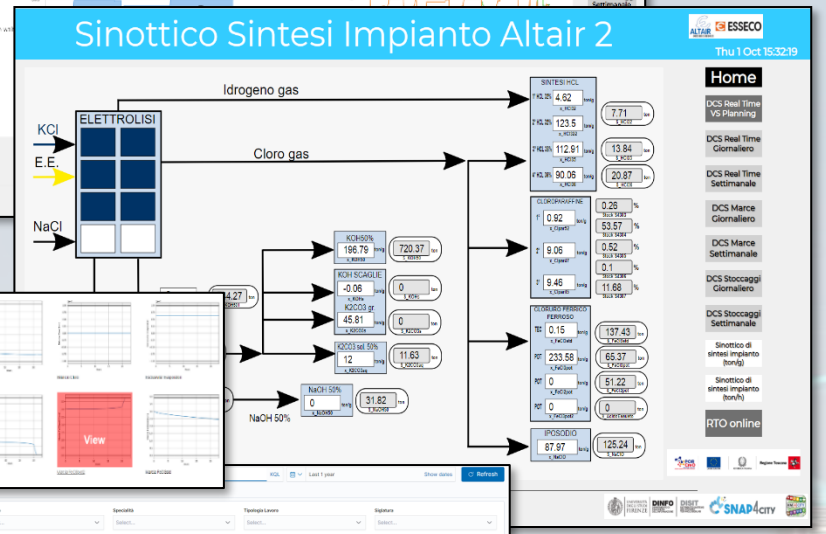
.....

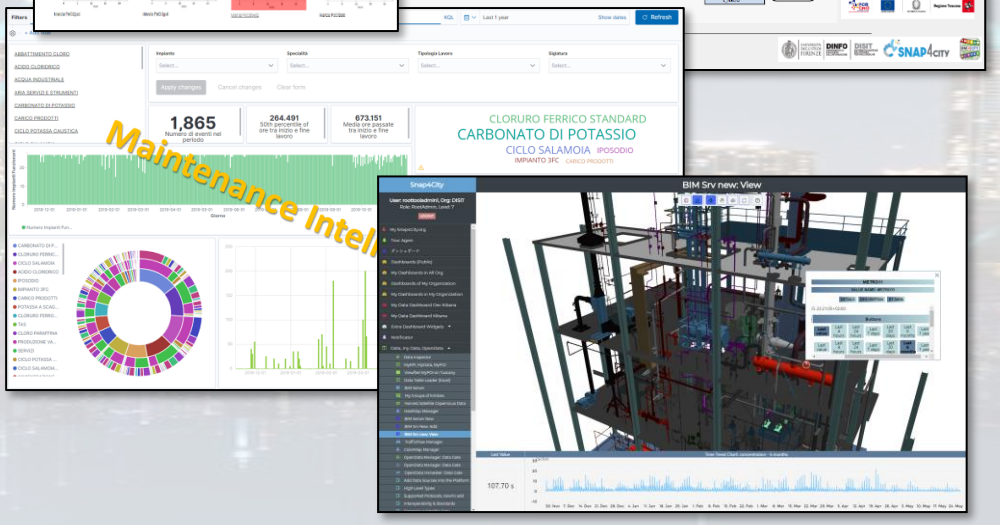
Data Storage

Management, Auth./Autoriz.

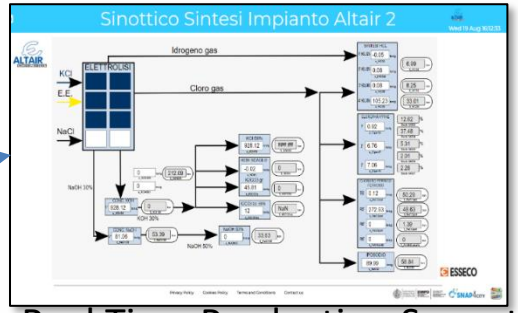
Snap4City Dashboard Builder







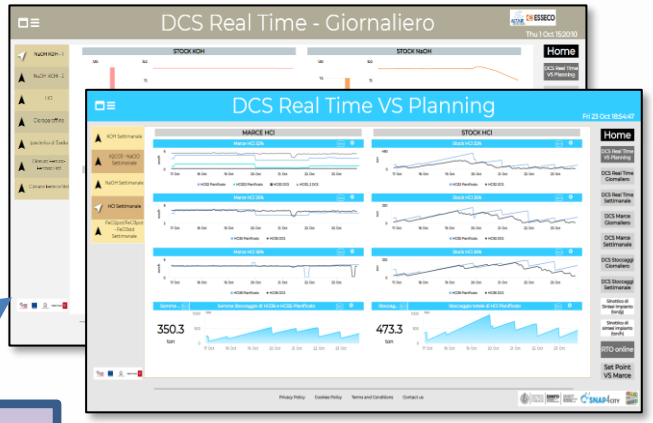
Plant Status



Real Time Production Synoptic

Production Plan

Production vs Planning



Data Storage

Decision Support

Data Ingestion

AS400

Orders

Energy Service

Transportation

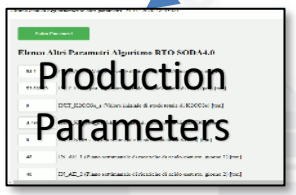
Other Costs

Production Plant Management

Optimized Production Planner

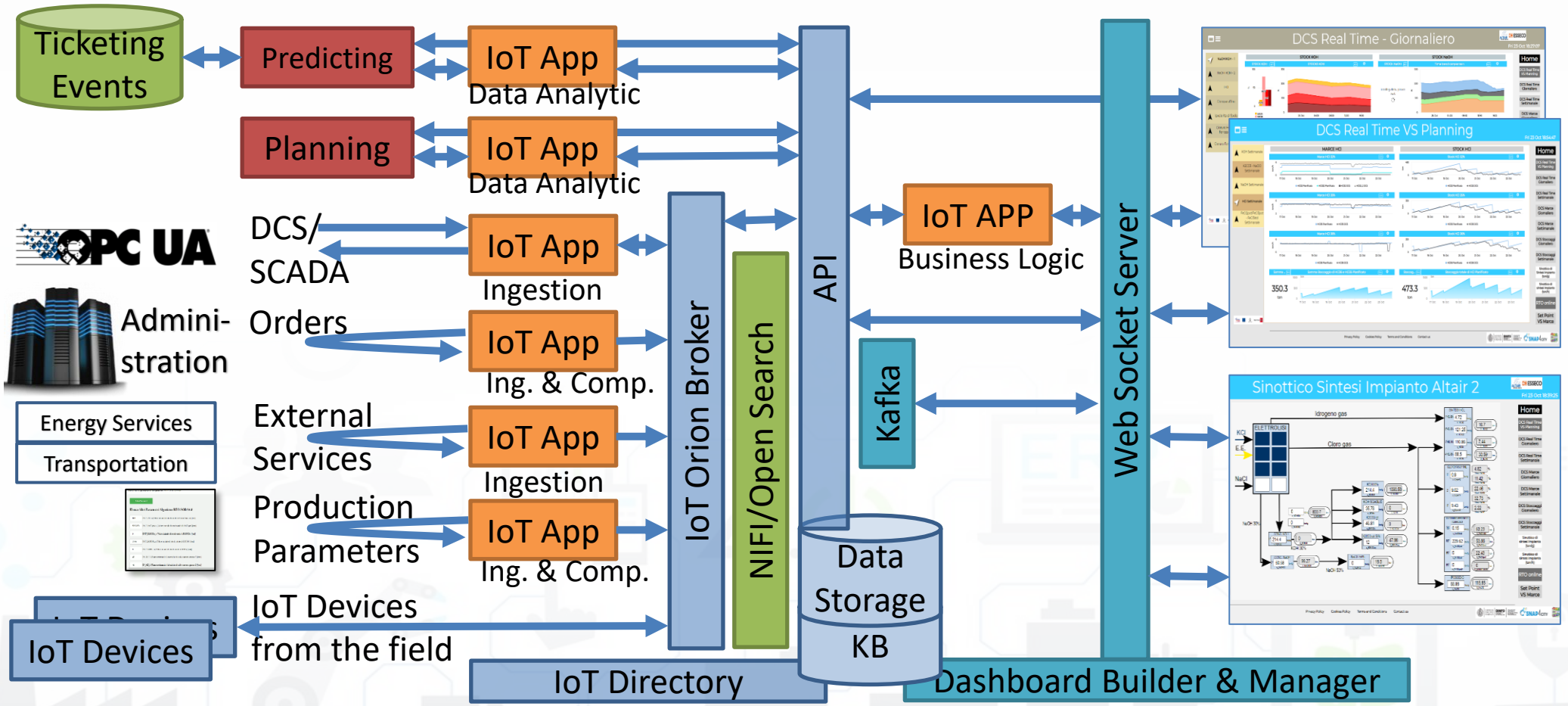
Possible Plan

Possible Plans

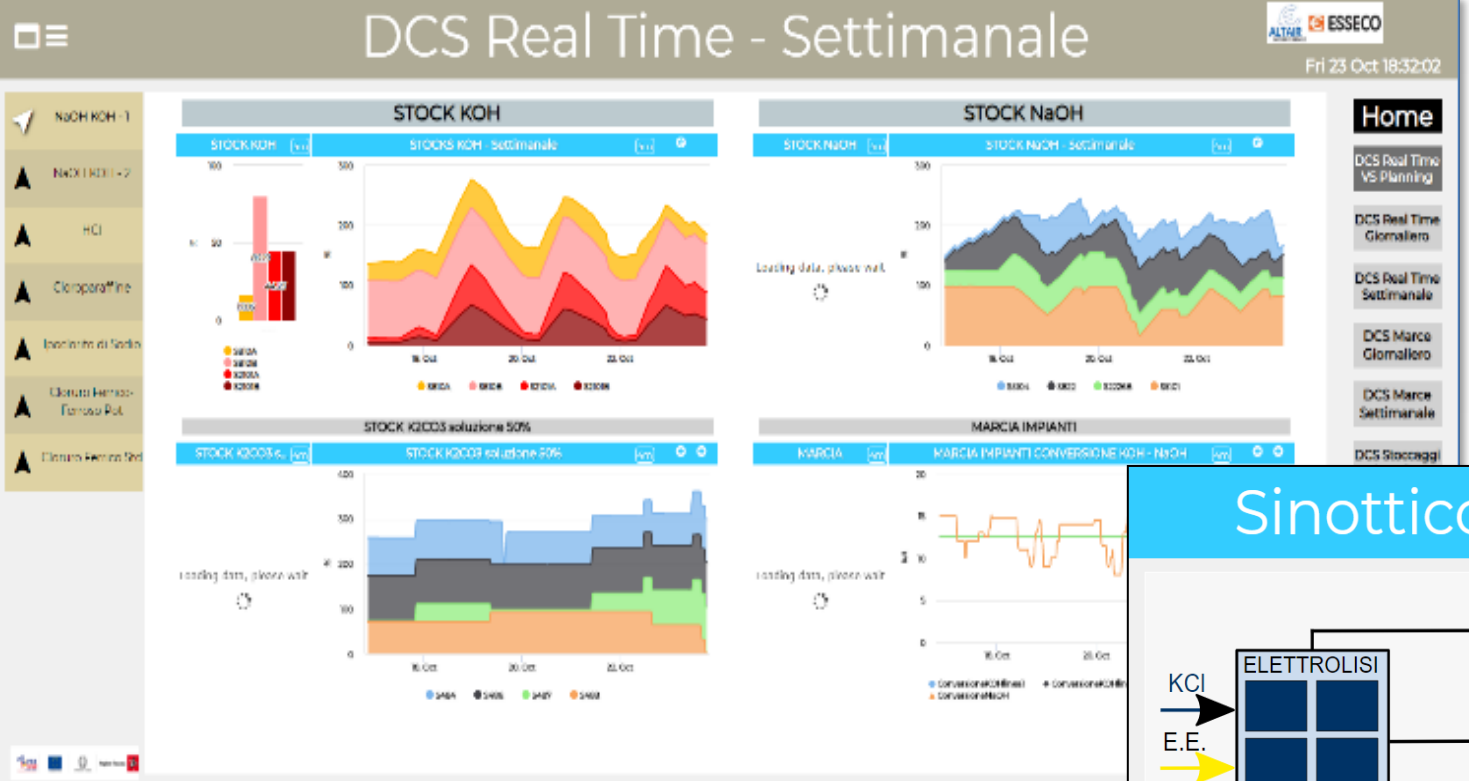


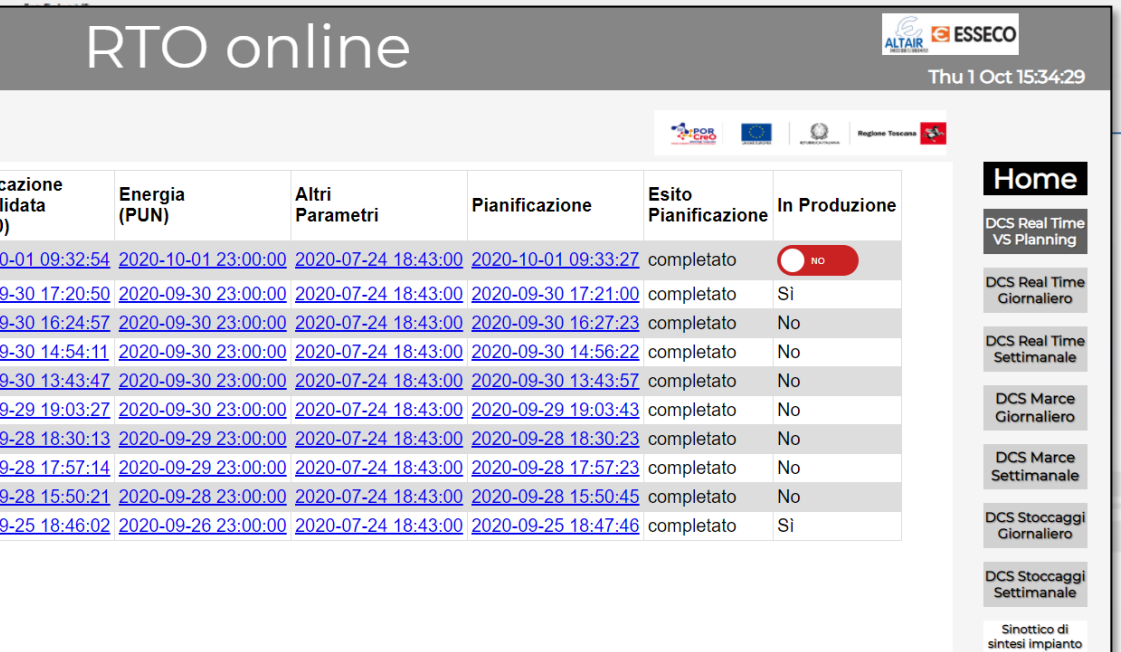
Plant Management

Snap4Industry IOT Architecture

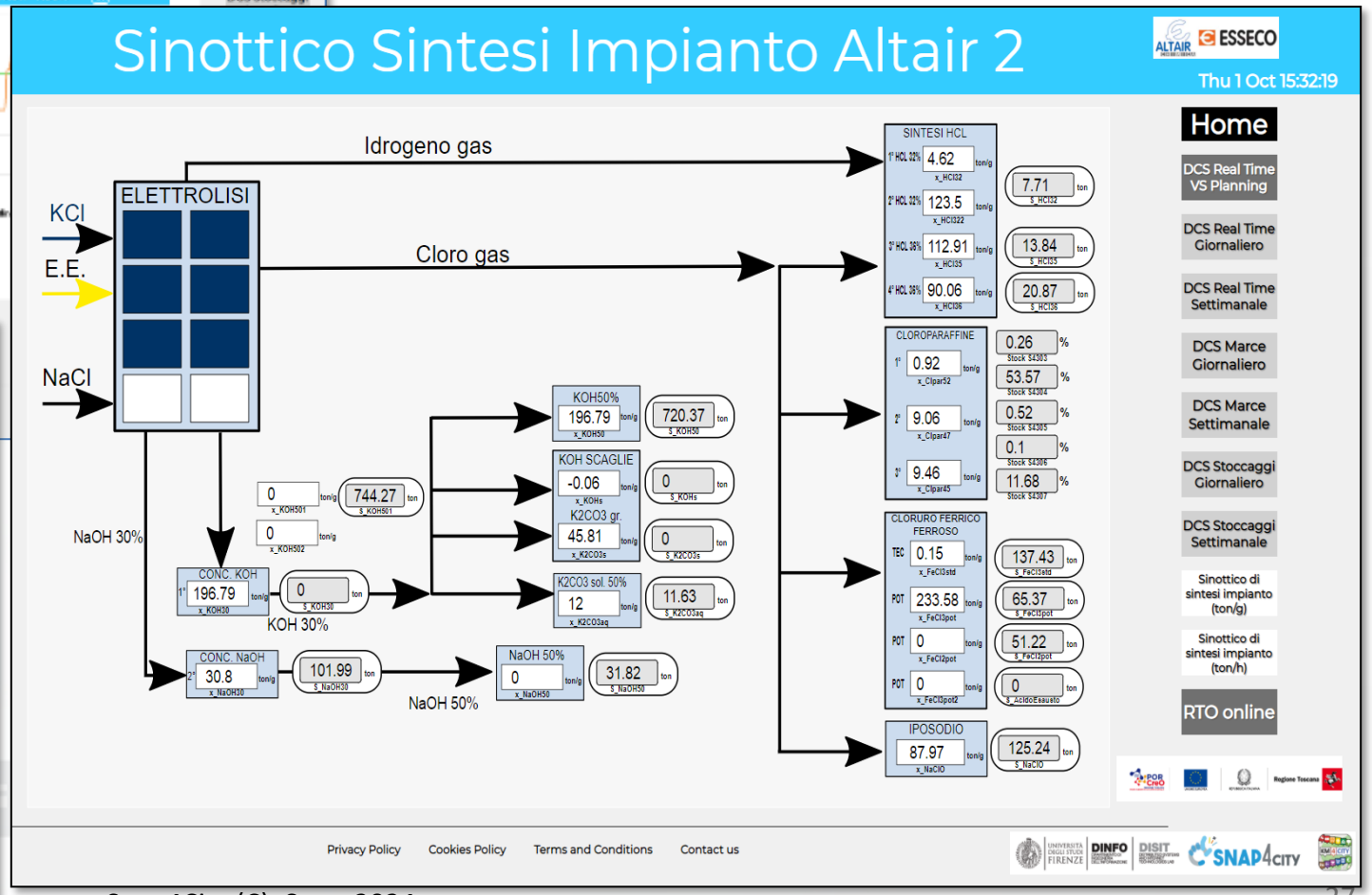


FIWARE

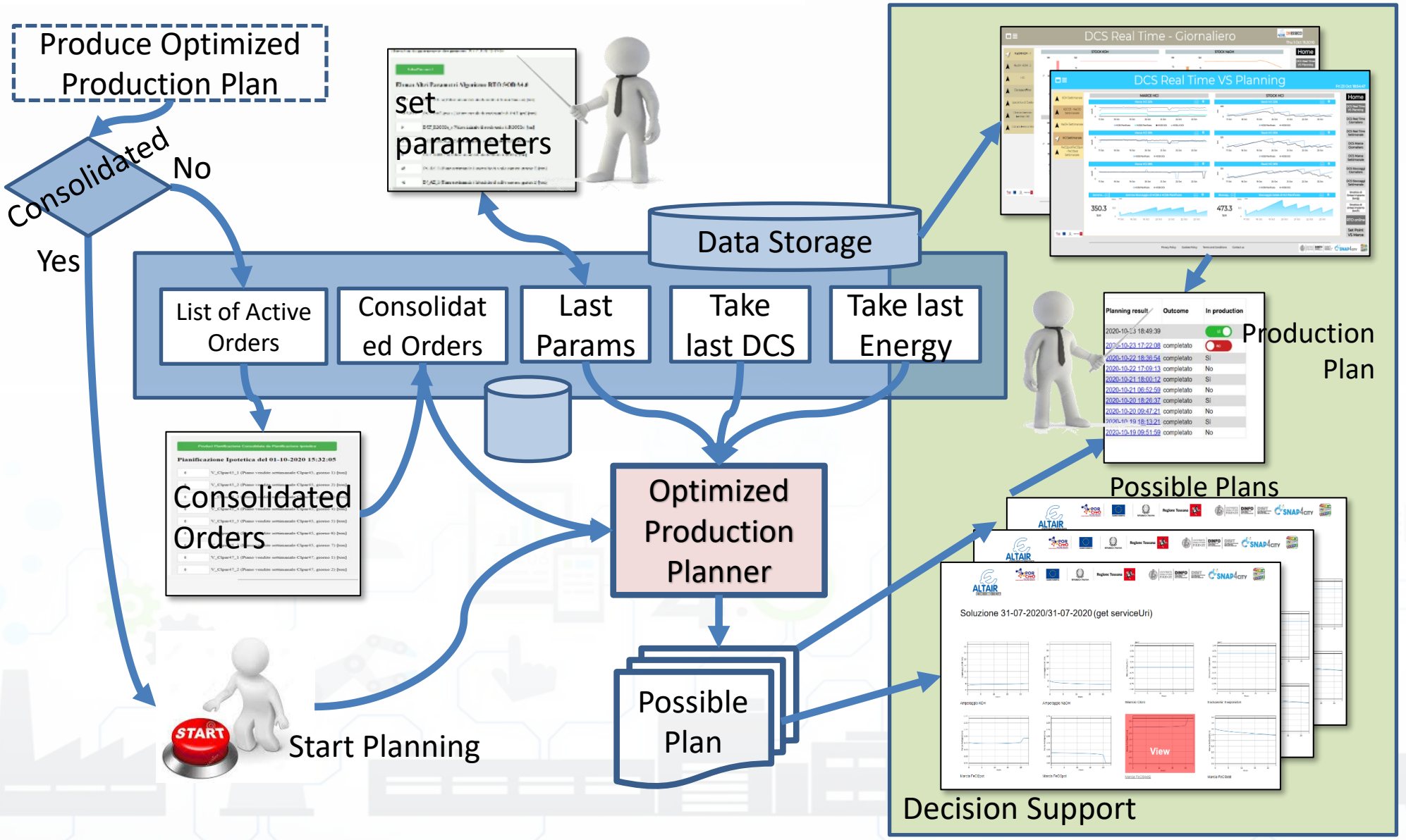




cazione lidata)	Energia (PUN)	Altri Parametri	Pianificazione	Esito Pianificazione	In Produzione
0-01 09:32:54	2020-10-01 23:00:00	2020-07-24 18:43:00	2020-10-01 09:33:27	completato	NO
9-30 17:20:50	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 17:21:00	completato	Sì
9-30 16:24:57	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 16:27:23	completato	No
9-30 14:54:11	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 14:56:22	completato	No
9-30 13:43:47	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-30 13:43:57	completato	No
9-29 19:03:27	2020-09-30 23:00:00	2020-07-24 18:43:00	2020-09-29 19:03:43	completato	No
9-28 18:30:13	2020-09-29 23:00:00	2020-07-24 18:43:00	2020-09-28 18:30:23	completato	No
9-28 17:57:14	2020-09-29 23:00:00	2020-07-24 18:43:00	2020-09-28 17:57:23	completato	No
9-28 15:50:21	2020-09-28 23:00:00	2020-07-24 18:43:00	2020-09-28 15:50:45	completato	No
9-25 18:46:02	2020-09-26 23:00:00	2020-07-24 18:43:00	2020-09-25 18:47:46	completato	Sì

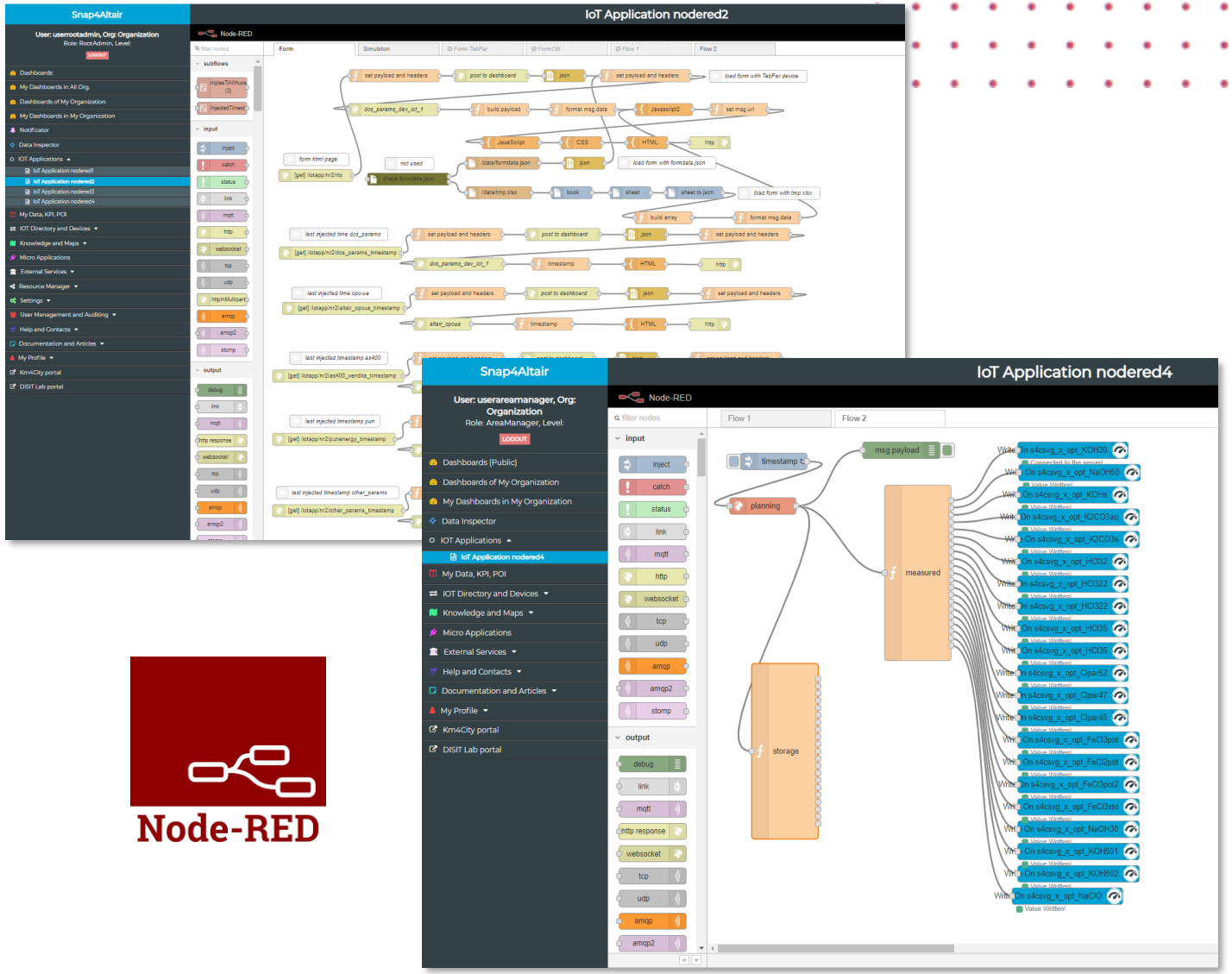


Business Logic

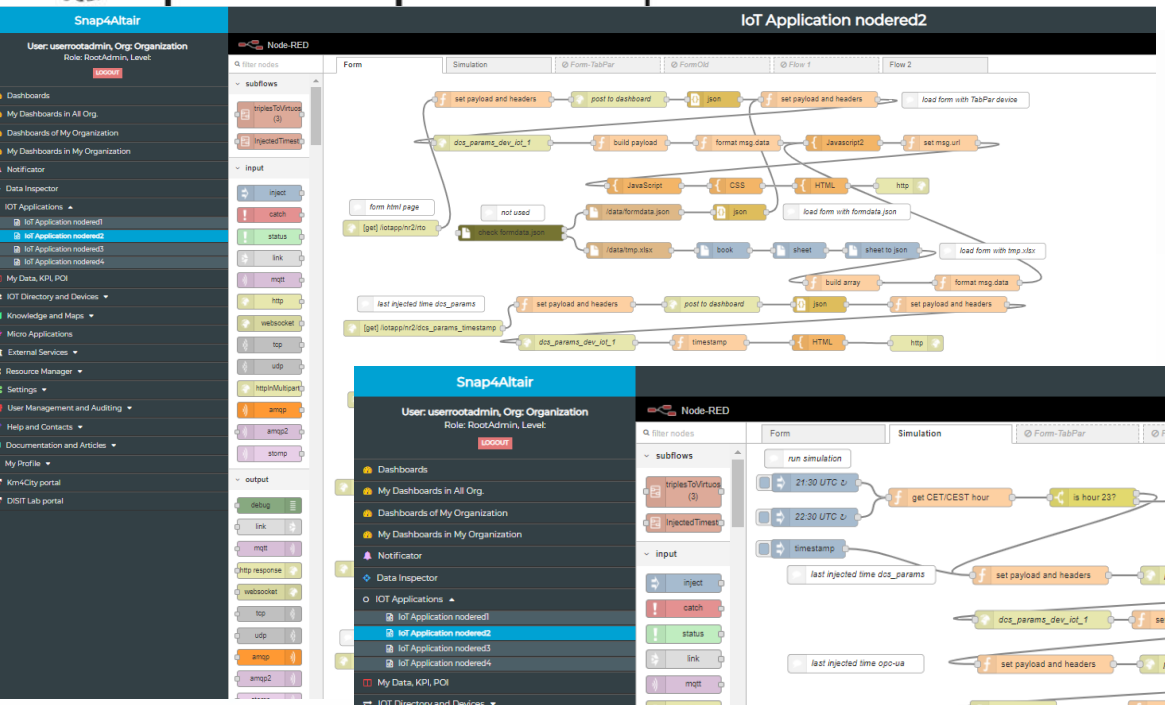


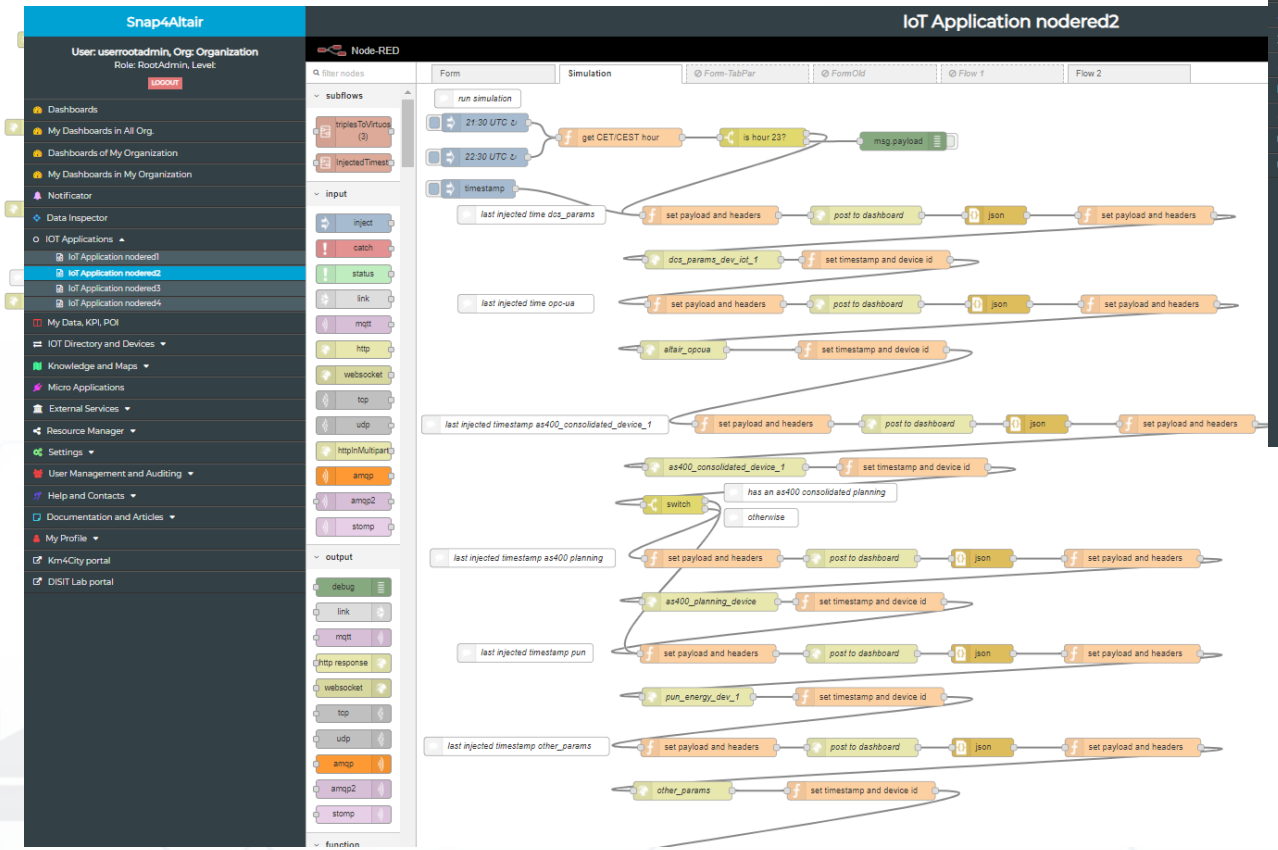
Snap4City/Industry IoT Apps

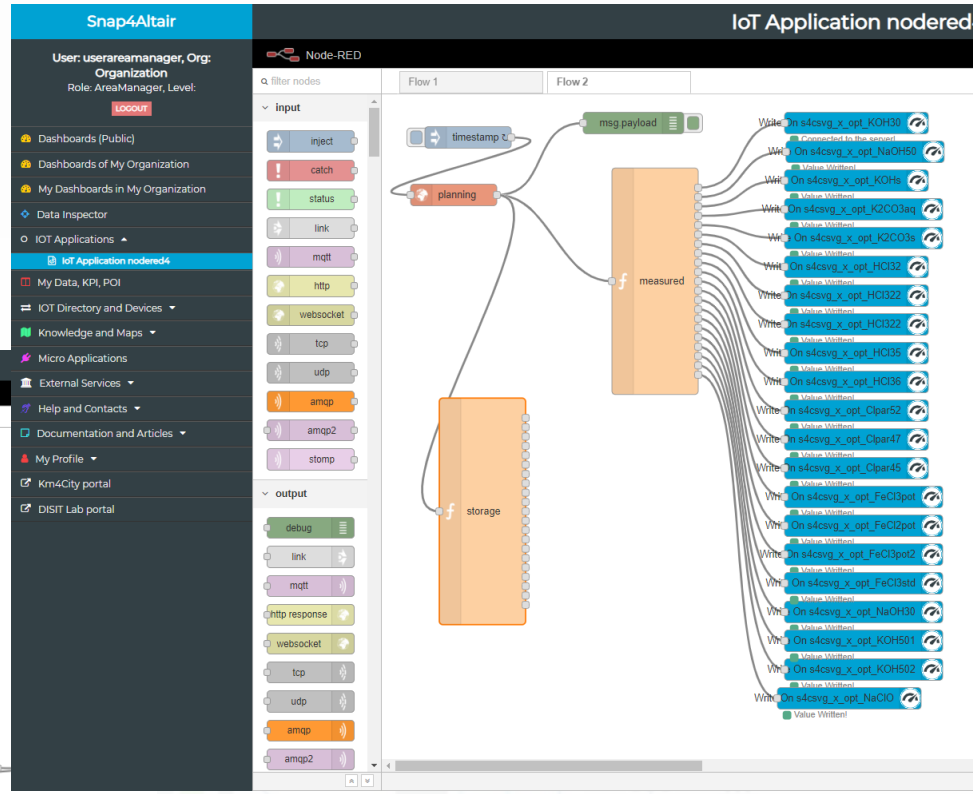
- Integration
  - Connection with Brokers, GWs, External services
- Data Driven Processing
- Data Analytics Manag.
- Smart City API
  - Search, discovering
  - Routing, Picking
- Dashboard Business logic
- Workflow, Digital Twin
- Management
- Scheduling
- ...etc...

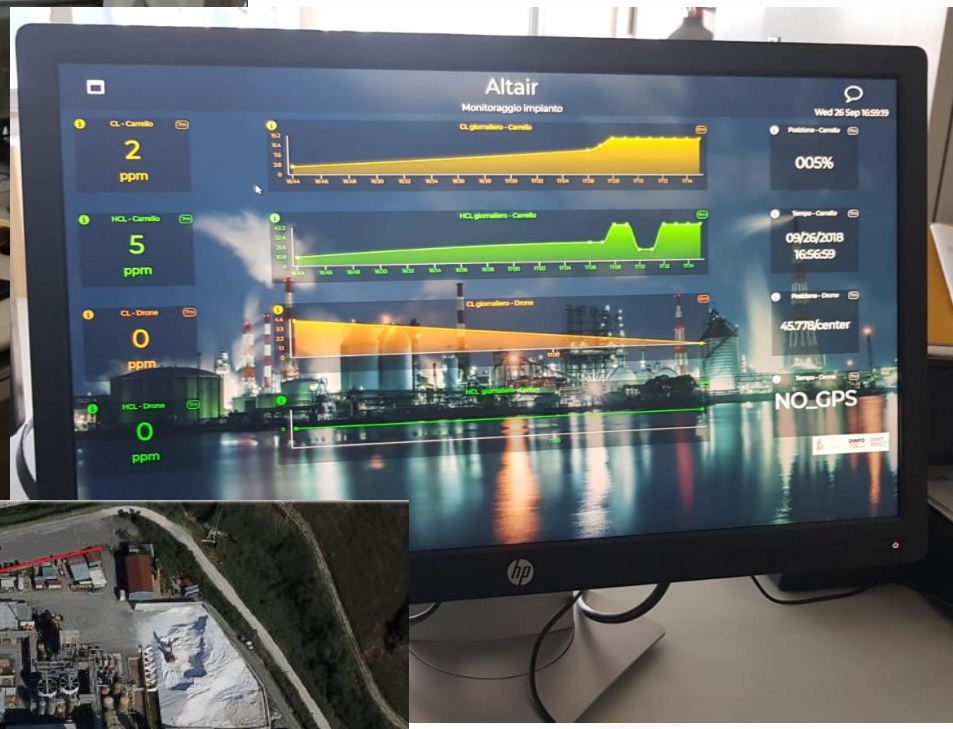


Some Flows


Snap4Altair
IoT Application nodered2
Node-RED


Snap4Altair
IoT Application nodered2
Node-RED


Snap4Altair
IoT Application nodered
Node-RED

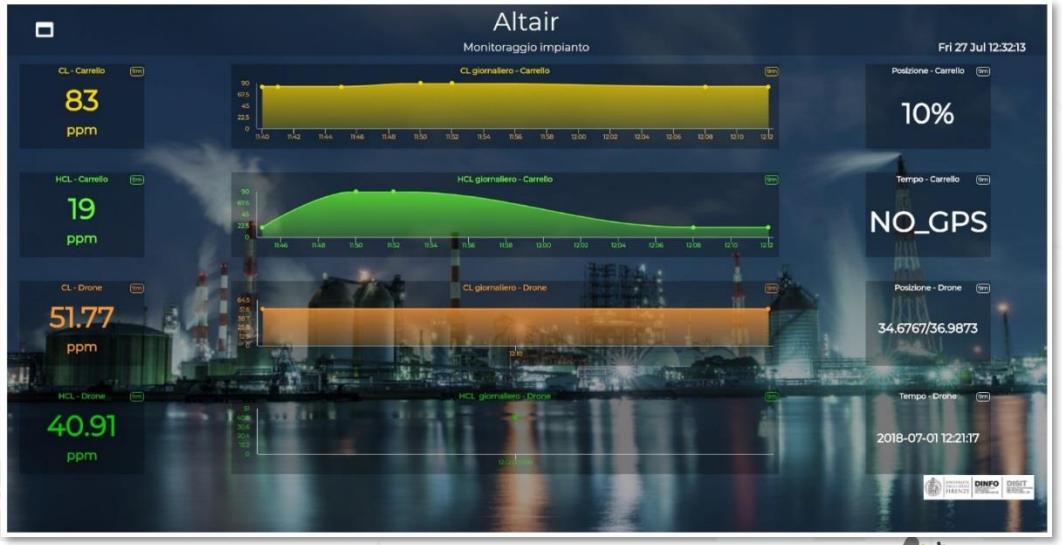


Green Impact Capacity (GIC)

Altair Control room

Green Impact Capacity (GIC)

- Improve productivity of chemical plant
- Keep GREEN the environmental impact
- Exploiting innovative technologies
- Diversify the production
- Monitoring environmental conditions

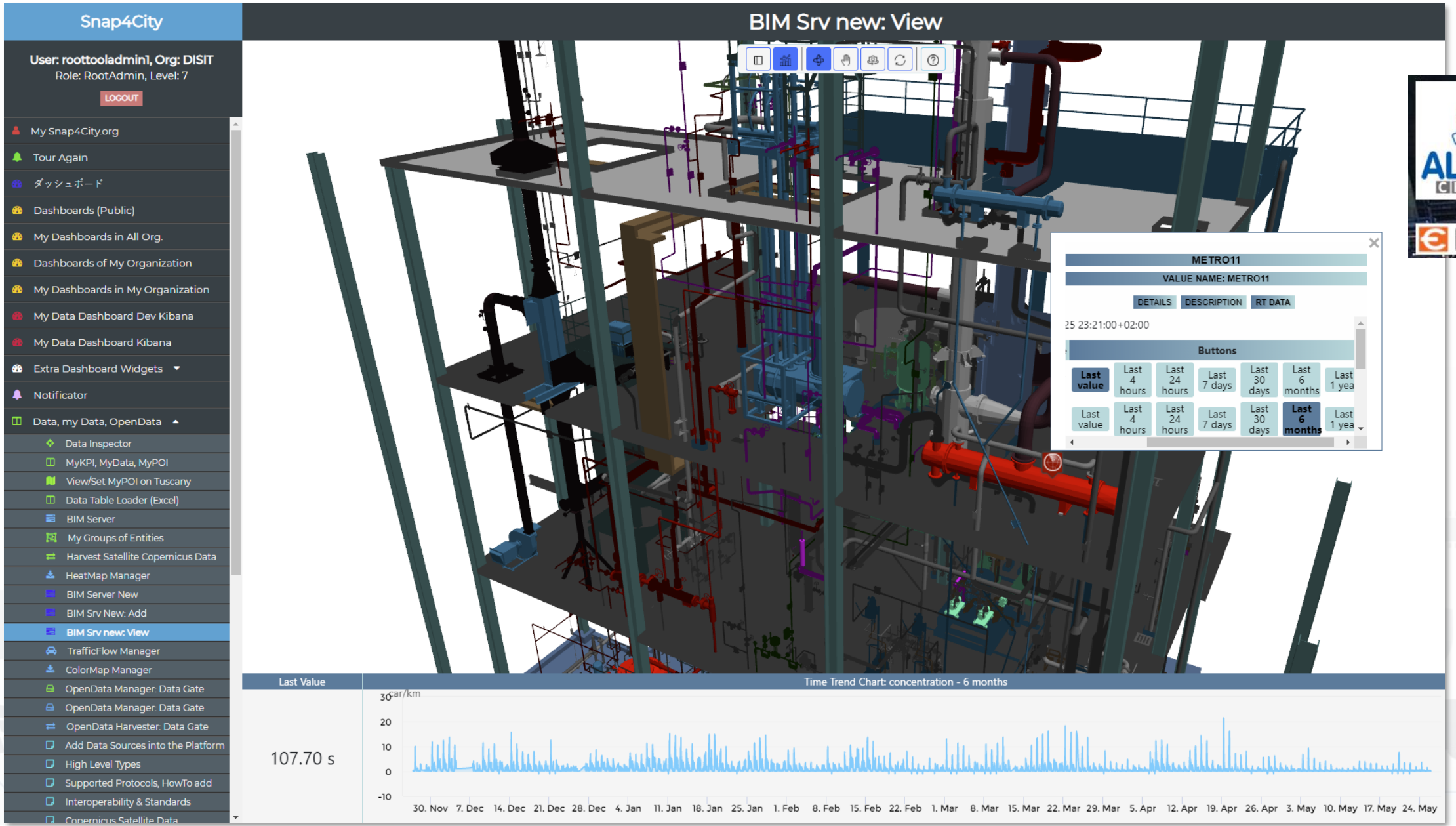


Digital Twin vs BIM

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

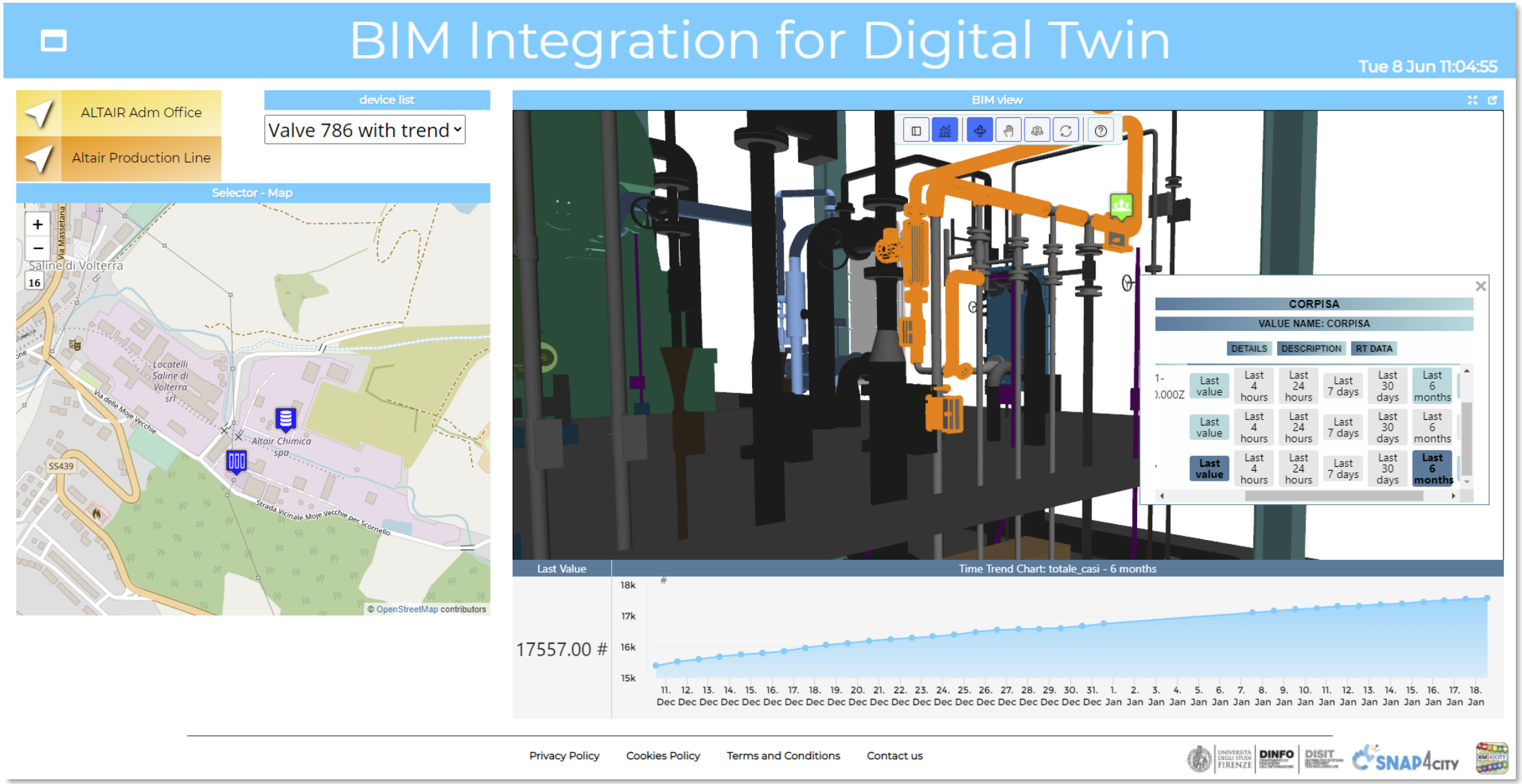
Digital Twin Local

SNAP4INDUSTRY | KM4CITY

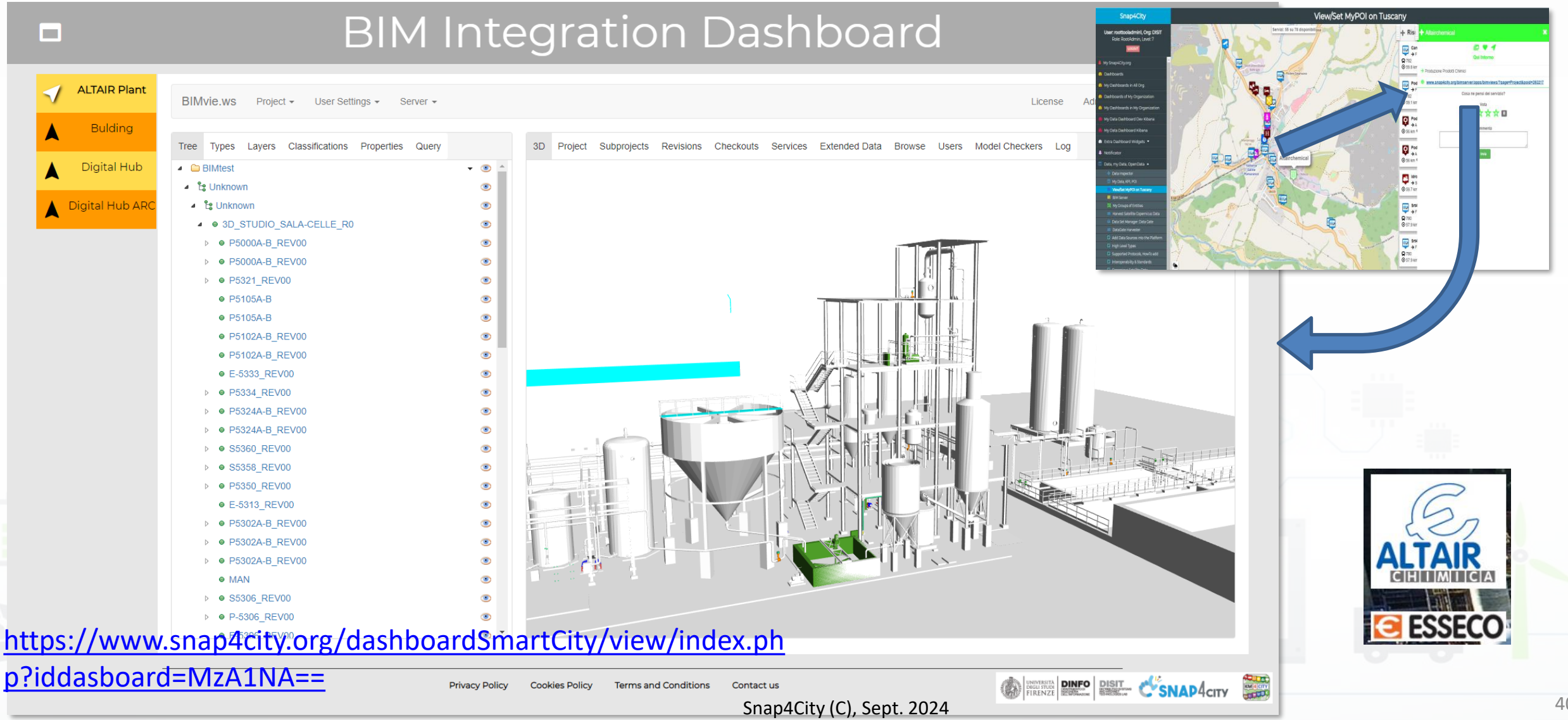


ALTAIR CHIMICA | ESSECO

Digital Twin Local, 3D vs Real Time Data



BIM view of the Altair Chemical Plant

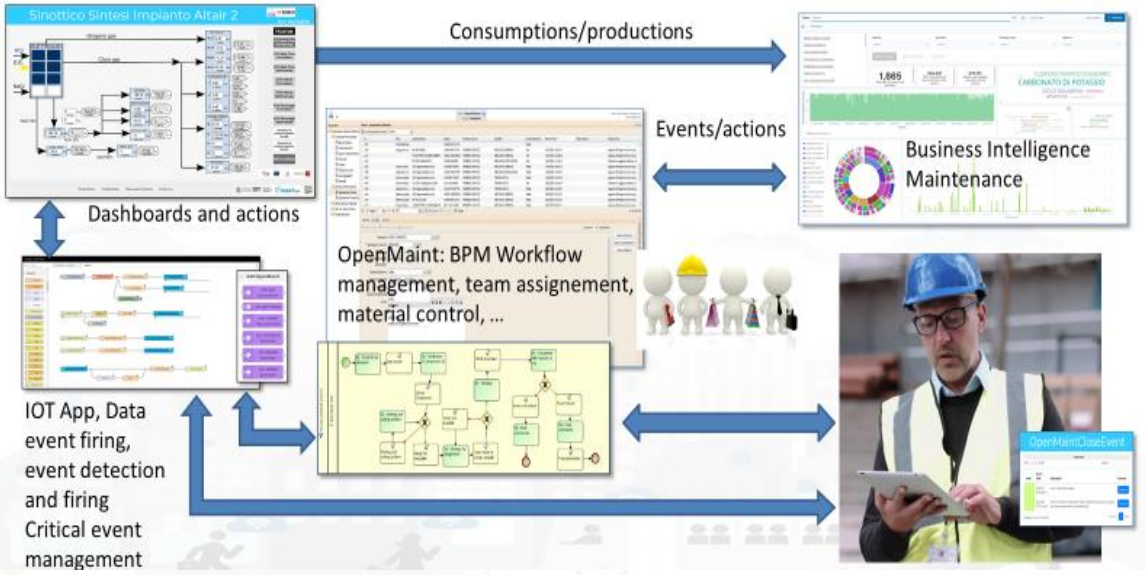


https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA1NA==

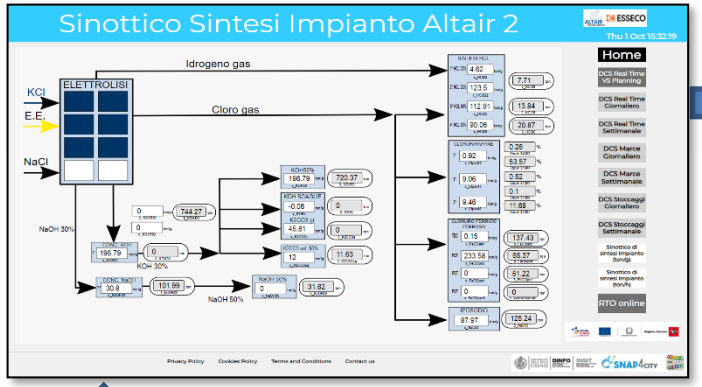
Integration with Ticketing Systems Workflows

Snap4City Maintenance Solution

- **OpenMaint** open source solution for property & facility management which is a BPM;
  - Inventory of industry assets (movable, logistics, equipment, etc.)
  - Tickets management for corrective maintenance
  - User management with different levels of access
  - BIM Server integrated with OpenMaint
- **Snap4City OpenMaint Extension**
  - **Extended API** developed by Snap4City
    - Create new tickets
    - Manage steps, workflow
    - Collecting feedbacks and results from teams
    - Manage all phases of the workflow on the fields via IOT Apps and logics
    - The integration if via API and MicroServices into IOT App.
  - **MicroServices** integrated with Snap4City via IOT Applications
- **Business Intelligence** which is the **Snap4City tool based on** Elastic Search: which work on top of the database of tickets collected on OpenMaint
- **BIMServer** integration with Snap4City Dashboards;

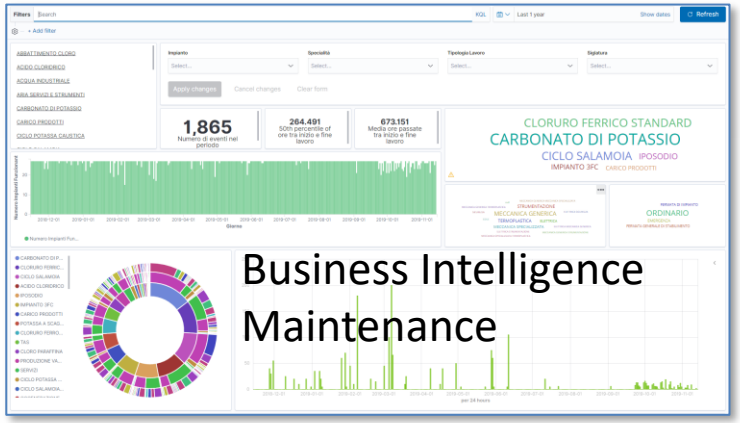


Example of Integrated workflow



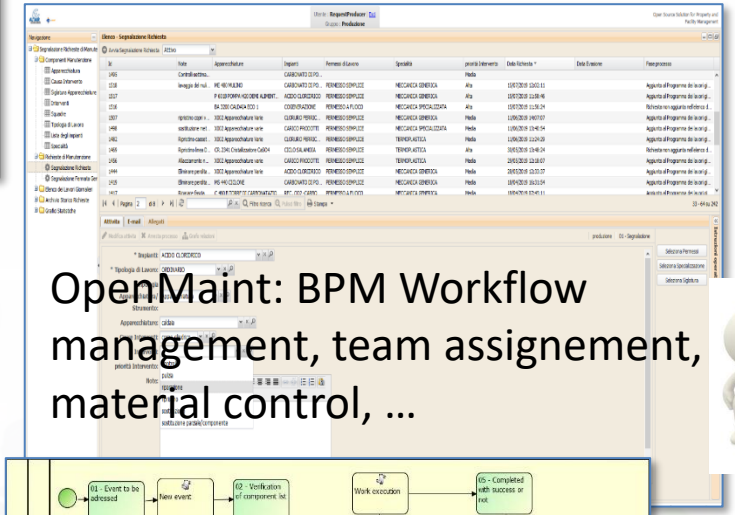
Dashboards and actions

Consumptions/productions

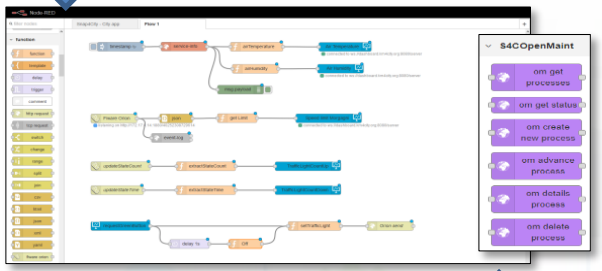


Business Intelligence
Maintenance

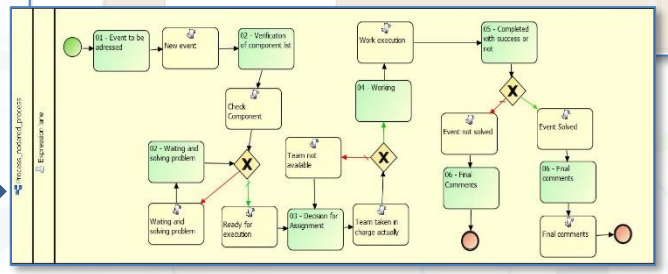
Events/actions

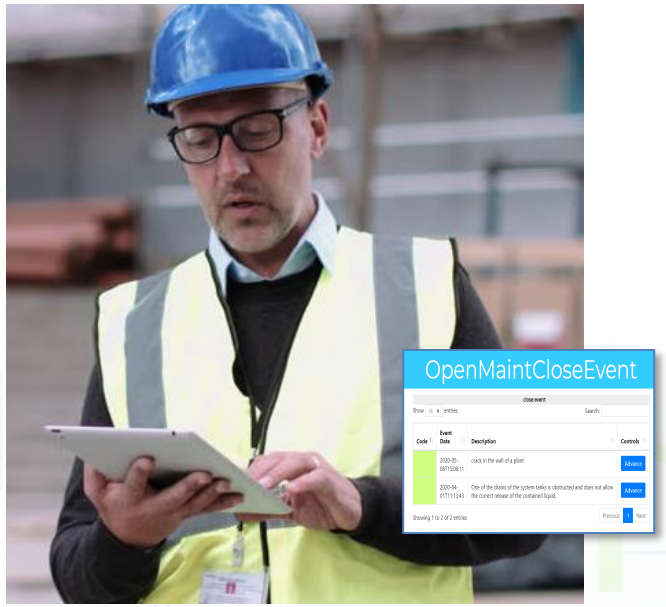


OpenMaint: BPM Workflow management, team assignement, material control, …



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

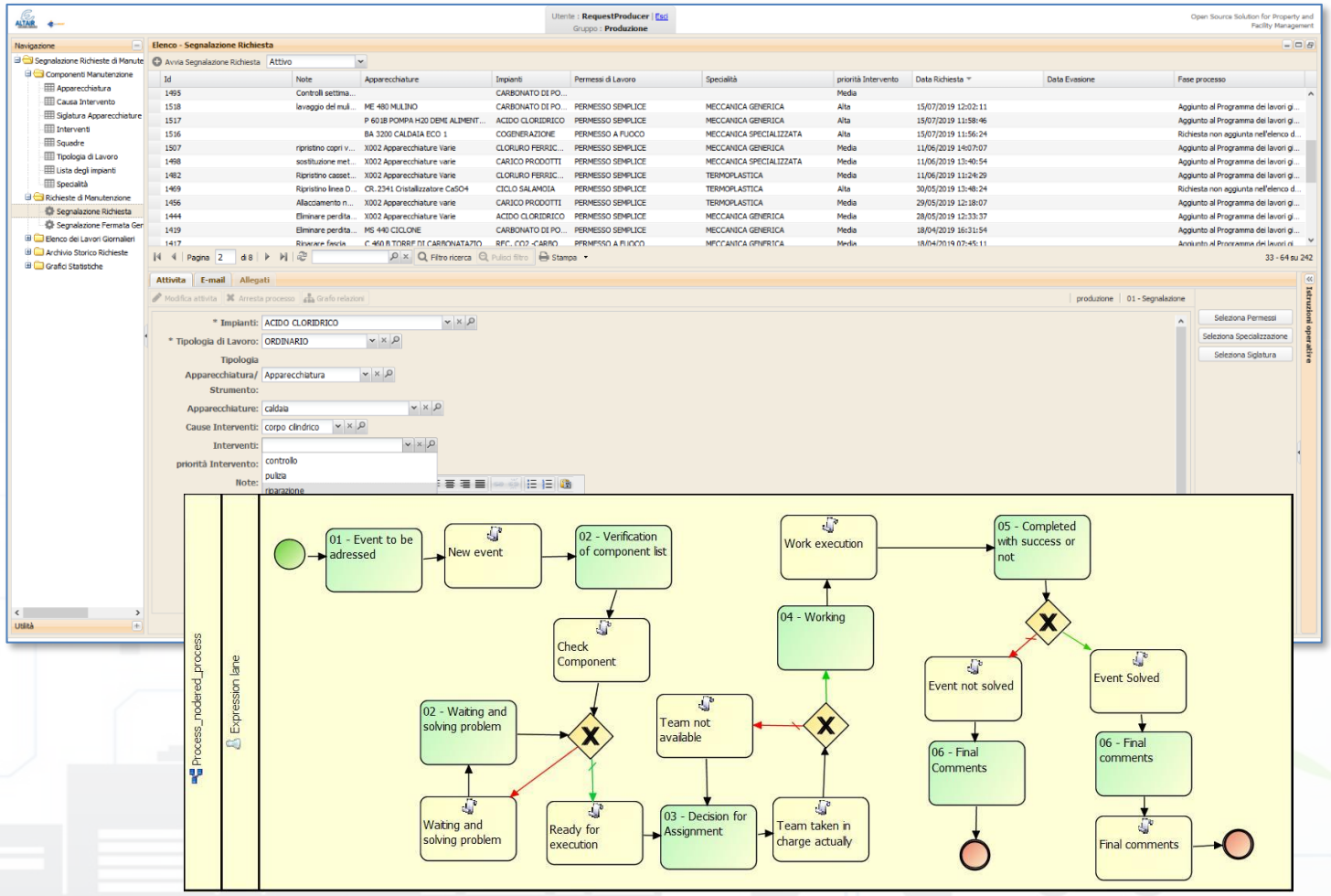




Integration with Ticketing Systems Workflow

- **Snap4City is integrated with OpenMaint Ticketing system. An Open Source solution for ticketing and workflow management, incident management.**

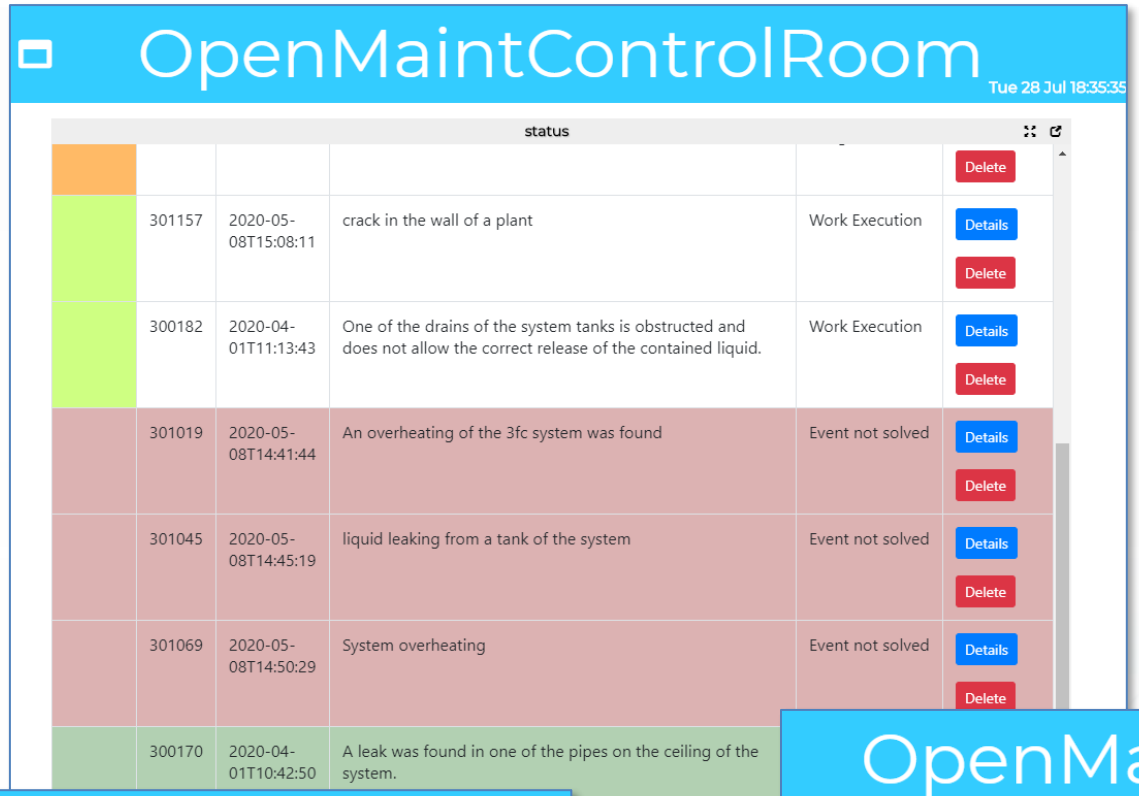
- Any ticketing systems can be integrated with Snap4City, by means of IOT Applications and Dashboards
- https://www.snap4city.org/597

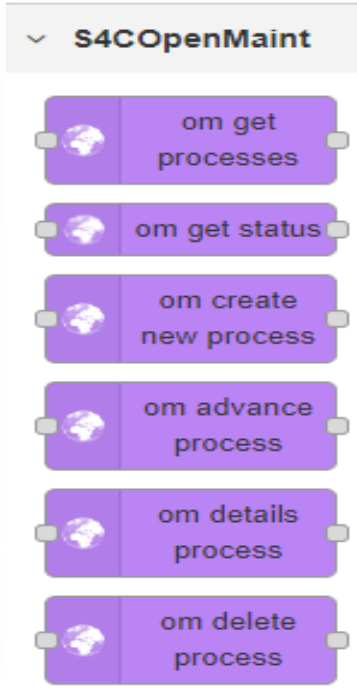


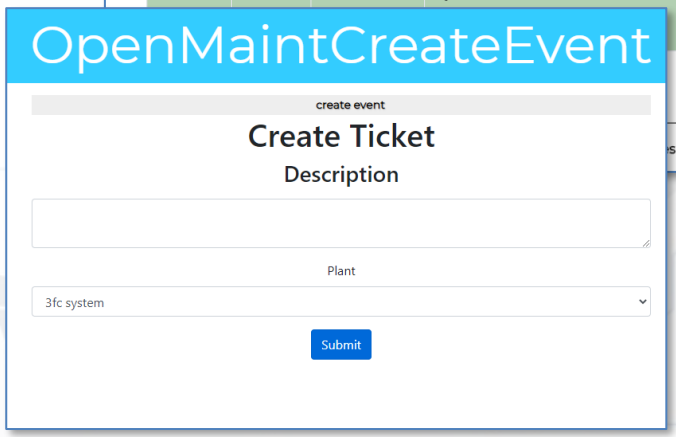
Solution for Asset Management and Maintenance

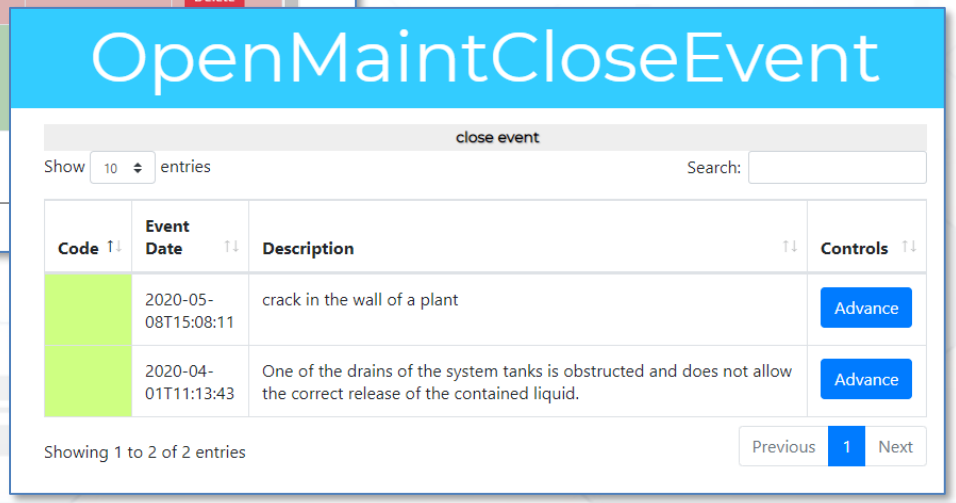
- Inventory of industry assets (movable, logistics, equipments, etc.)
- Tickets management for corrective maintenance
- Reports and Dashboards
- Predictive maintenance and Early Warning support via analytics
- Business Intelligence support
- User management with different levels of access

Dashboards









- **Snap4City can**
  - Create new tickets
  - Manage steps, workflow
  - Collecting feedbacks and results from teams
  - Manage all phases of the workflow on the fields via IOT Apps and logics
  - The integration if via API and MicroServices into IOT App.

Filters | Search | KQL | Last 1 year | Show dates | Refresh

+ Add filter

ABBATTIMENTO CLORO
ACIDO CLORIDRICO
ACQUA INDUSTRIALE
ARIA SERVIZI E STRUMENTI
CARBONATO DI POTASSIO
CARICO PRODOTTI
CICLO POTASSA CAUSTICA

Impianto: Select...
Specialità: Select...
Tipologia Lavoro: Select...
Siglatura: Select...

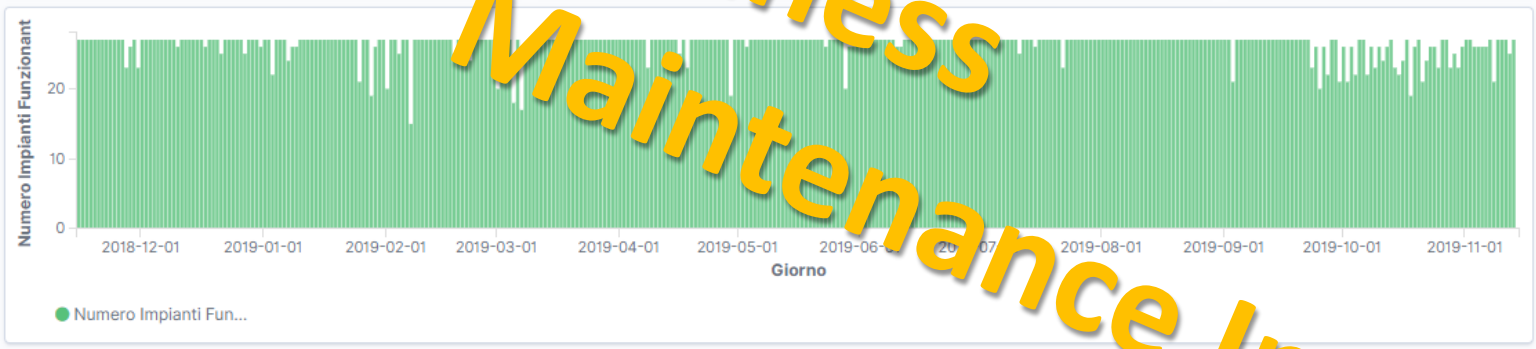
Apply changes | Cancel changes | Clear form

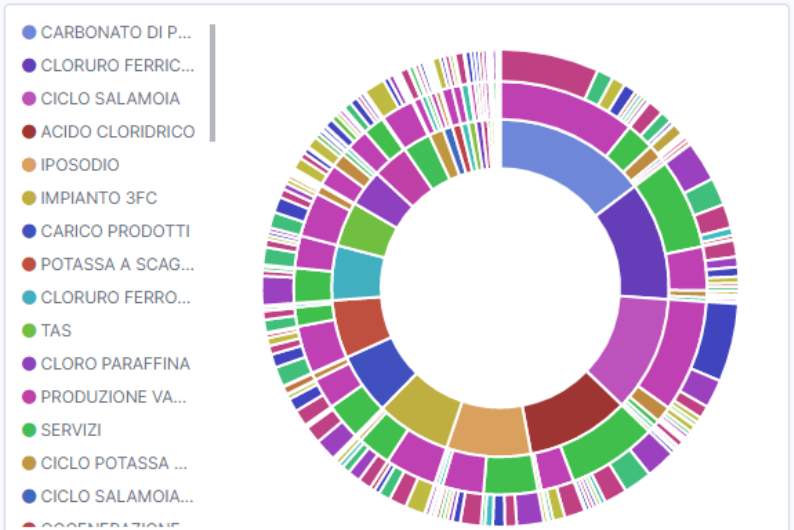
4.865
Numero eventi nel periodo

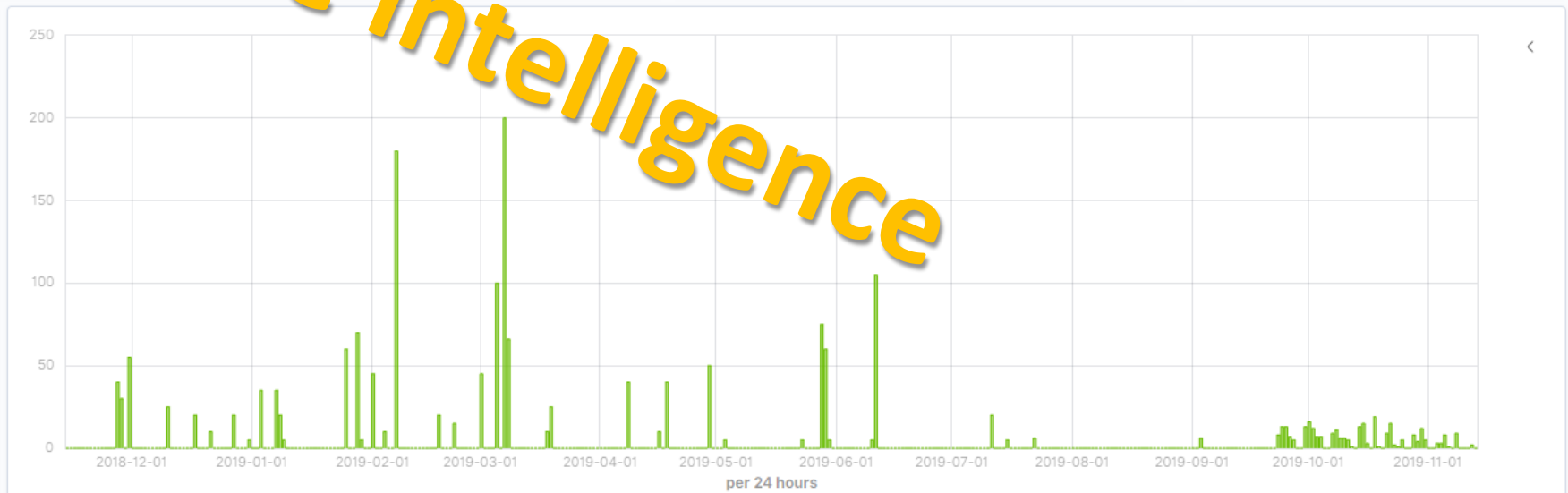
264.491
50th percentile of ore tra inizio e fine lavoro

673.151
Media ore passate tra inizio e fine lavoro

CLORURO FERRICO STANDARD
CARBONATO DI POTASSIO
CICLO SALAMOIA IPOSODIO
IMPIANTO 3FC CARICO PRODOTTI





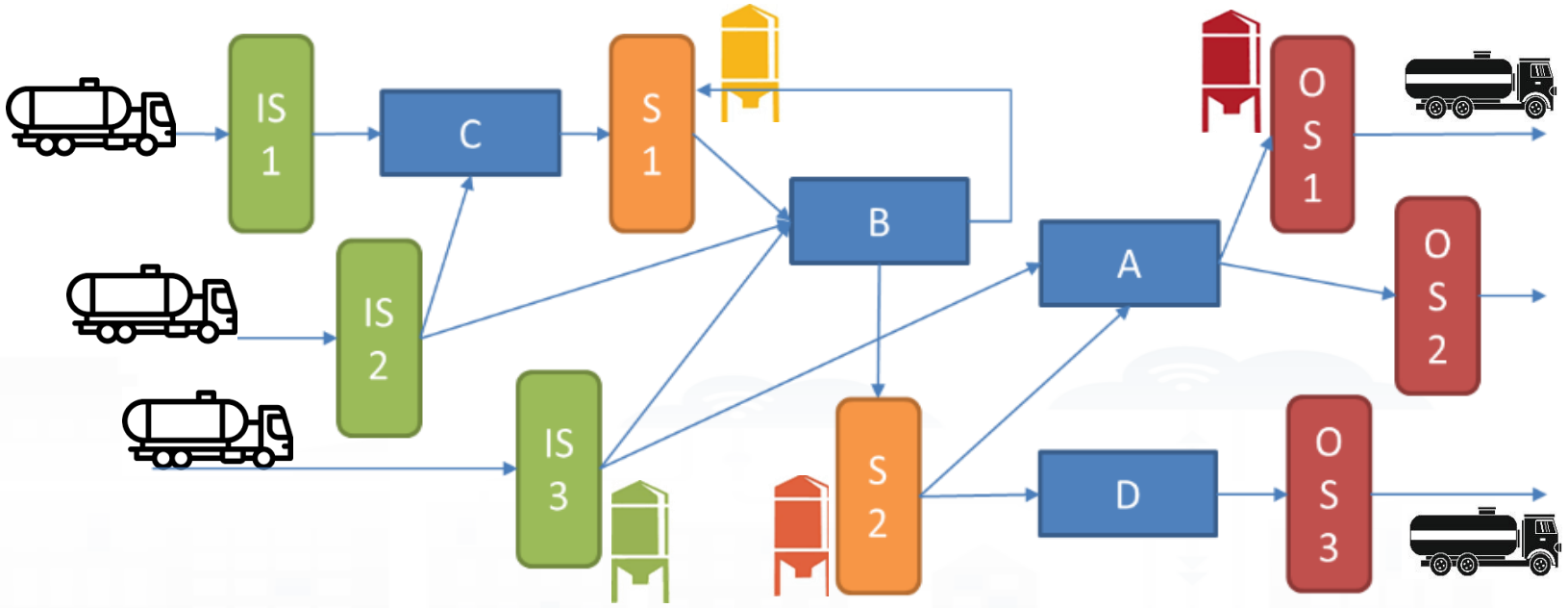


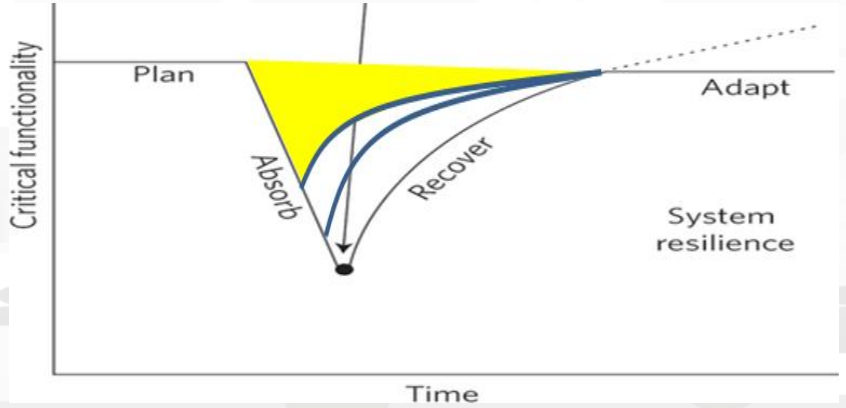
Business Maintenance Intelligence

Predictive Maintenance

Complex cause-effect relationships

- **Elements:**
  - Machines: A…C
  - Storage: silos…
  - Flows:…
- **Dependencies**
  - Cascade effects
- **Early warning**
  - Reduction of costs
  - Recovering from failure is more expensive than correcting in advance
  - Possible advanced replan and reschedule: secondary solutions





Workflow

Data acquisition
Production - Maintenance

Feature selection,
Feature engineering

CNN-LSTM Training

Validation AI
Model

Classification
Model

CNN-LSTM
Engine

F/NF

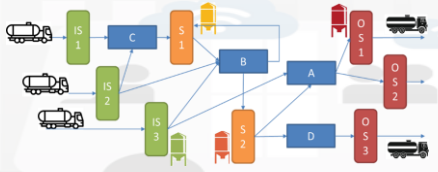
Explainable/XAI
(Shap)

{features (t)}

Business Intelligence for
Maintenance

integration of workflow management system for maintenance with general control systems and data flow

Structure of the plant



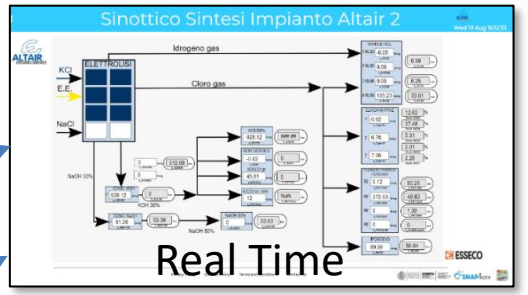
Decision making
on more cases

KPI

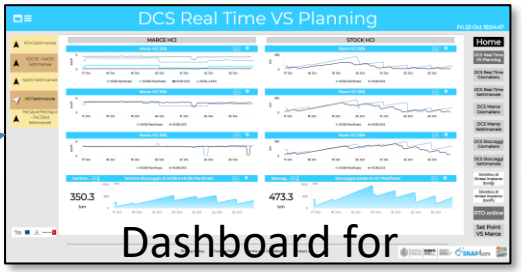
CNN: Convolutionary NN
LSTM: Long Short-Term Memory
(deep learning model)

Solution

Plant Status

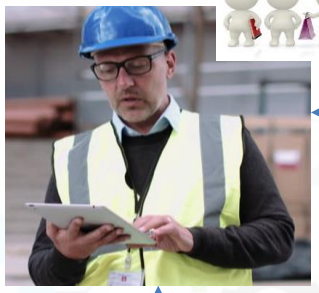


Real Time Production Synoptic



Dashboard for Production Control

Control Supervisor



Business Logic

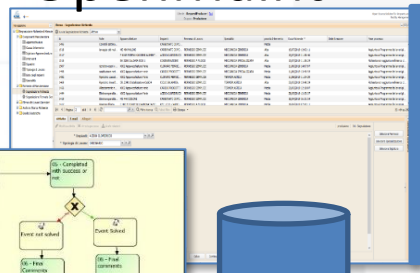
IoT App

Data Storage

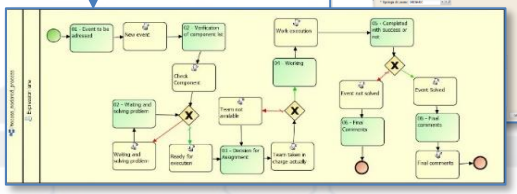
Elastic Search

Business Intelligence Maintenance

OpenMaint



API



IoT App

IoT App

Business Logic 2

Predictive Maintenance

Predictive Training

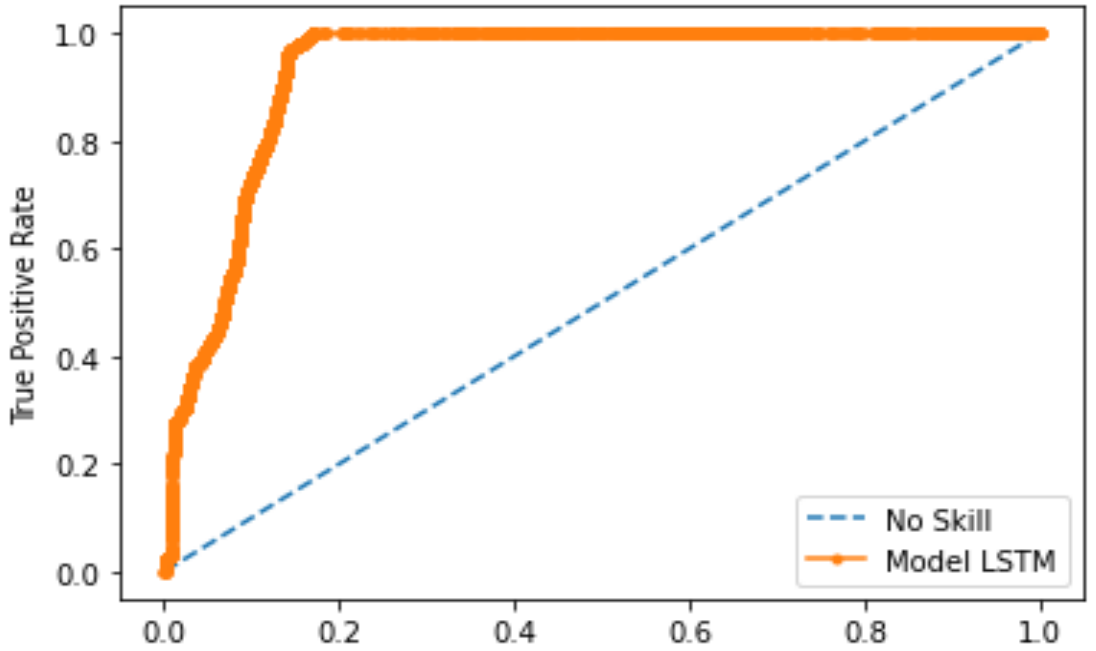
Overview Features

Feature	Plant	Description	Unit of measure
TempreactoreR4001 - TempreactoreR4002 - TempreactorR4003	chlorine paraffins (CPS)	reactor temperature indication	°C
S904A - S904B - S904C	Potable Ferric std	Storage level indication	%
S4304	chlorine paraffins (CPS)	Storage level indication	%
standardFerric Chloride	Potable Ferric std	flow rate measurement and totalization	m3
potFerricChloride	Potable Ferric Chloride	flow rate measurement and totalization	m3
S904E - S904D	Potable Ferric Chloride	Storage level indication	%
QuantNaOHperBatchNaClO - QuantNaOHBatchNaClO_2	NaOH KOH	flow rate measure and totalization	lt – m3
ConversionNaOH - ConversionKOHlinea1	NaOH KOH	electrolysis load adjustment (production)	kA
KOH_1_charge - KOH_2_charge	NaOH KOH	flow rate measure and totalization	m3
S487 - S484 - S5104	NaOH KOH	Storage level indication	%
hypo sodium	sodium hypochlorite	quantity of material produced	m3
S851 - S852 - S854 - S856 - S857	sodium hypochlorite	Storage level indication	%
S871	HCl	Storage level indication	%
RedoxFeCl3Pot	Ferric Chloride std	potential measure redox Ferric Chloride	mV

Preditive capabilities

- Deep Learning: LSTM, CNN-LSTM approached
- Explainable AI: Identification of possible causes of fault

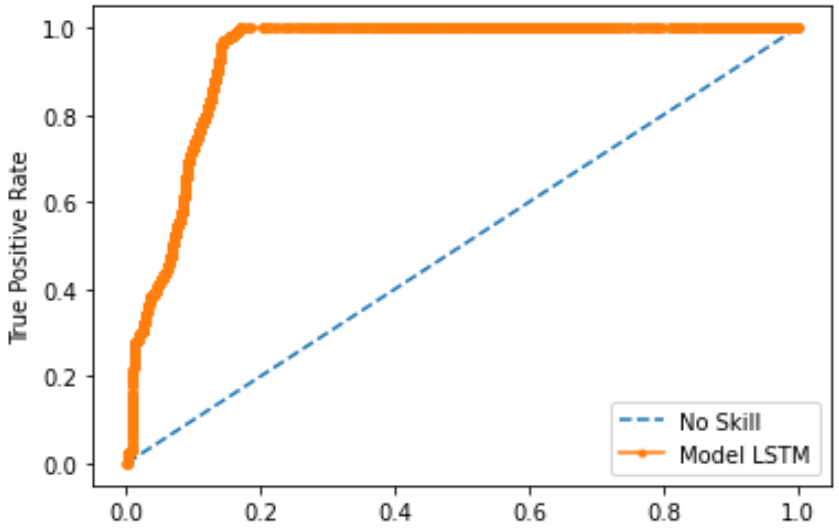
	Precision %	Recall %	F_1 score %
weighted avg	0.90	0.92	0.90



Classification model CNN-LSTM

Layer (type)	Output Shape	Param #
conv1d (Conv1D)	(None, 20, 64)	8320
average_pooling1d (AveragePo	(None, 10, 64)	0
lstm (LSTM)	(None, 10, 200)	212000
lstm_1 (LSTM)	(None, 10, 200)	320800
lstm_2 (LSTM)	(None, 10, 200)	320800
lstm_3 (LSTM)	(None, 10, 200)	320800
lstm_4 (LSTM)	(None, 100)	120400
dropout (Dropout)	(None, 100)	0
dense (Dense)	(None, 1)	101

Total params: 1,303,221
Trainable params: 1,303,221
Non-trainable params: 0



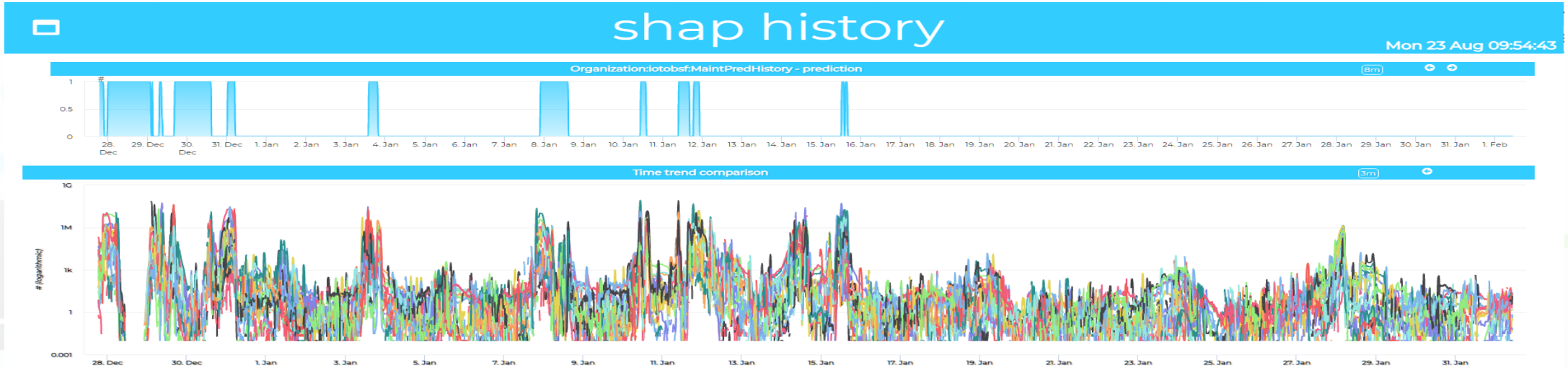
Actual Class \ Predicted Class	Normality	Fault
Normality	45811	903
Fault	3306	1376

	Precision %	Recall %	F_1 score %
weighted avg	0.90	0.92	0.90

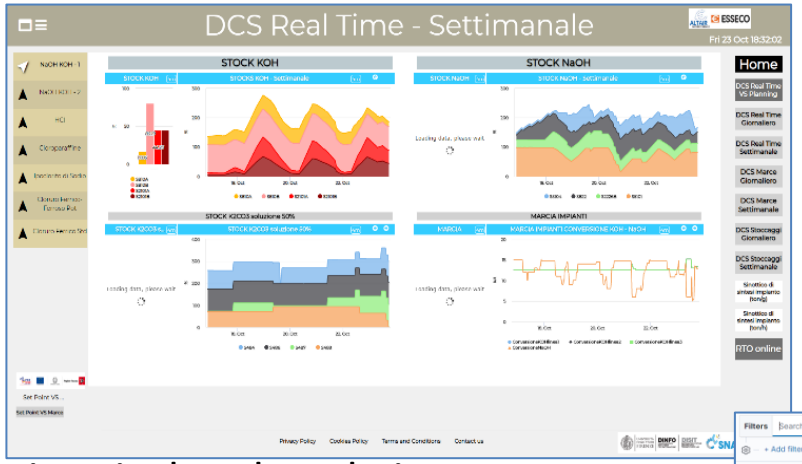
Explainable/XAI - CNN-LSTM (SHAP)

Explanation of prediction generated by model for fault

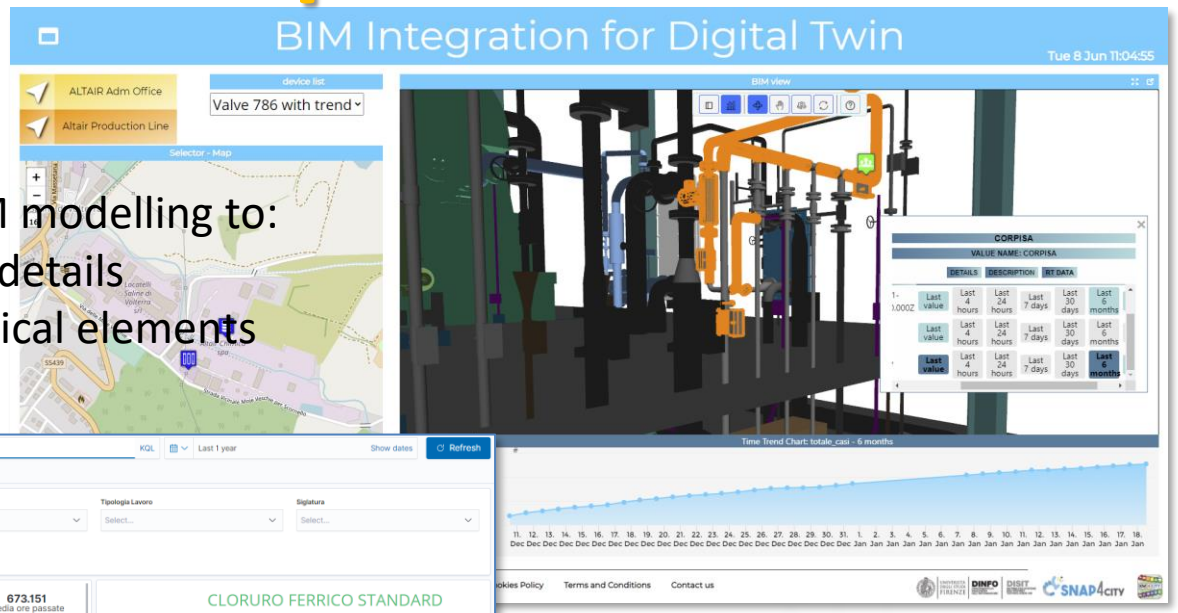
Explanation of prediction generated by model for normality



Closing the loop

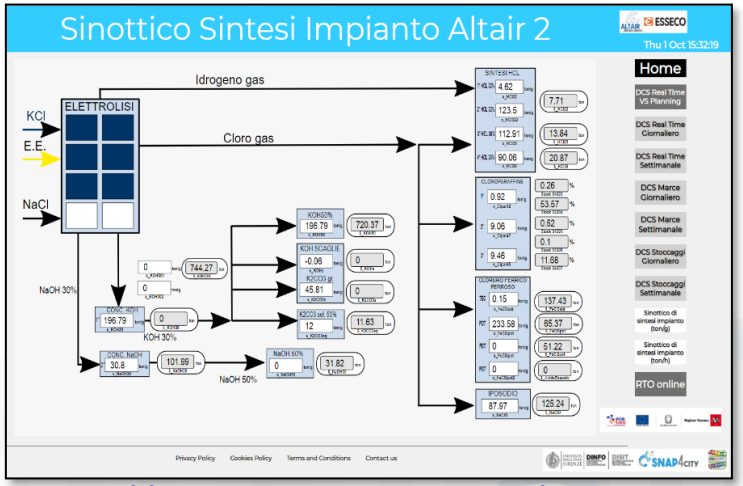


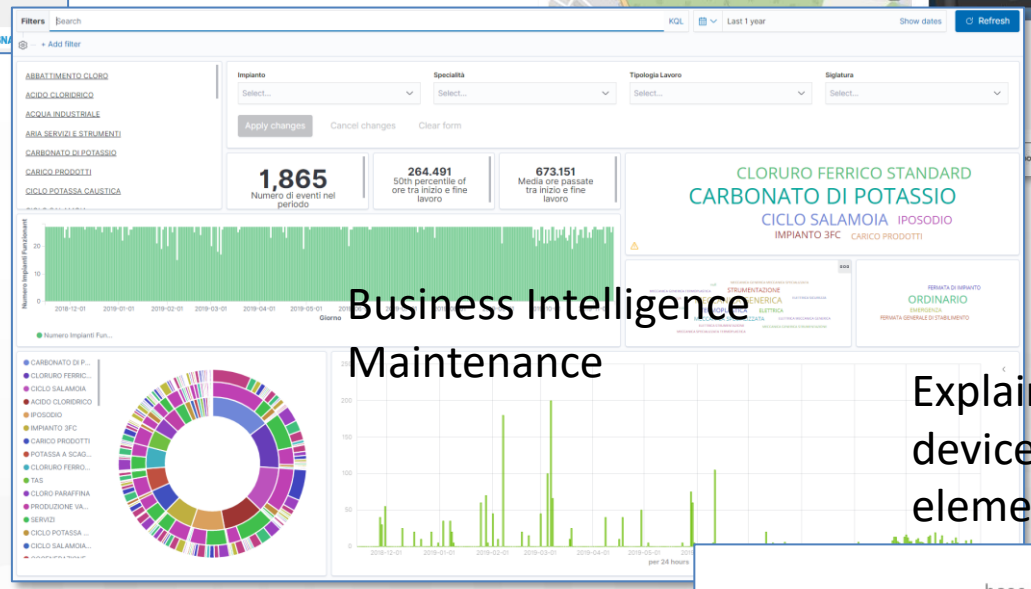
Historical and Real Time Data



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

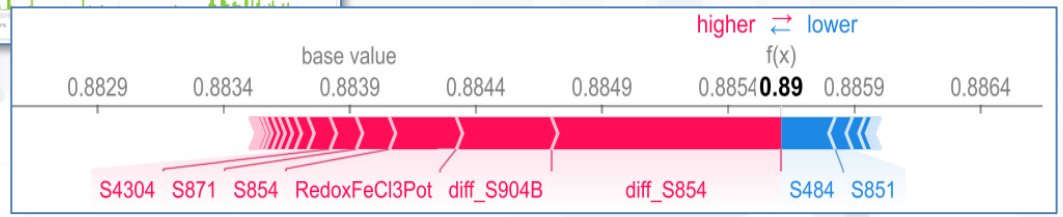
Synoptics for real time monitoring





Business Intelligence Maintenance

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



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

WHAT-IF Analysis

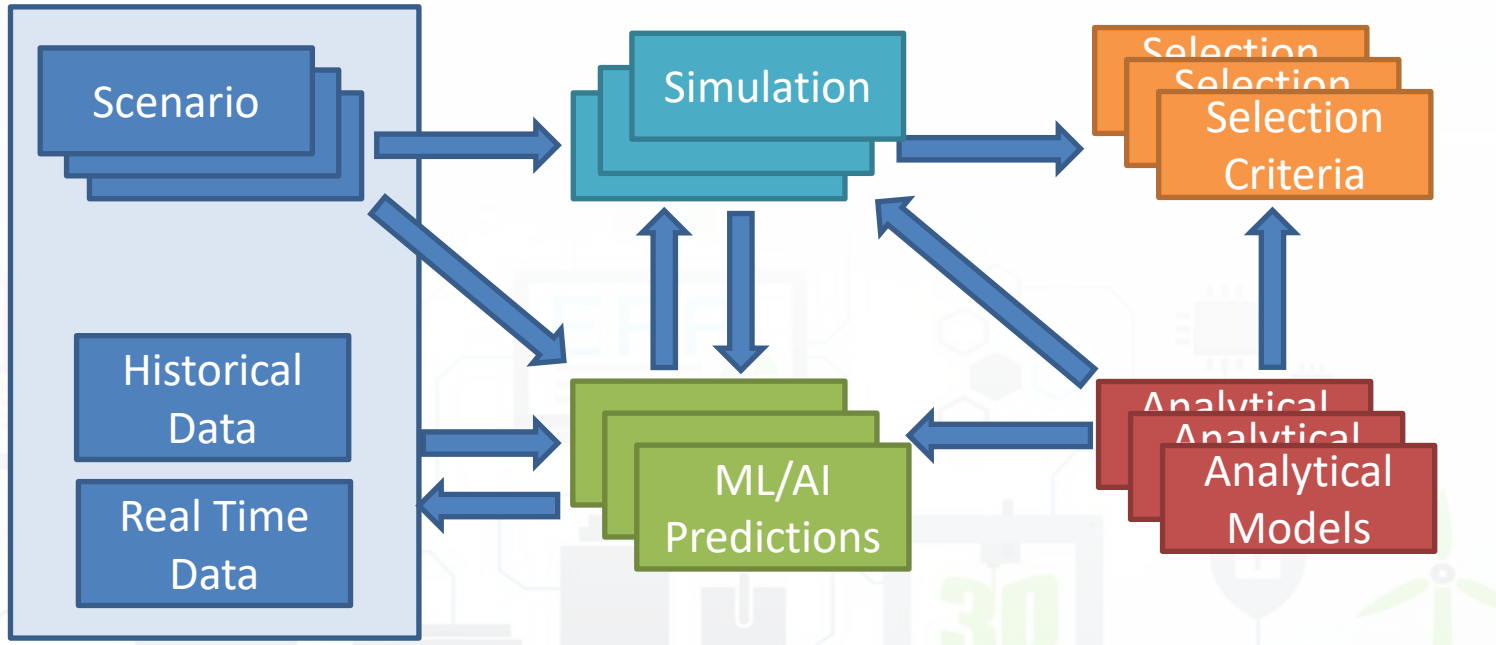
What-If Analysis

Available data and techniques	What happened	What is going on now	What is going to happen	What-If: what is going to happen if a scenario occurs in the future	Which is the best solution
Historical Data, HD	Yes	No	No	No	No
Real Time Data, RTD	No	Yes	No	No	No
HD + RTD + Short term Predictions, STP(.)	Yes	Yes	Yes	No	No
HD + RTD + Analytical Model, AM(.) + Scenario Model, SM(.)	Yes	Yes	Yes	(Yes)	No
HD + RTD + Short and Very Long Term Predictions, SVLTP(.) + AM(.) + SM(.) + Simulation, S(.)	Yes	Yes	Yes	Yes	No
HD + RTD + SVLTP(.) + AM(.) + SM(.) + S(.) + KPI(.) based Decision	Yes	Yes	Yes	Yes	Yes

What-if: what is going to happen if …. this and that

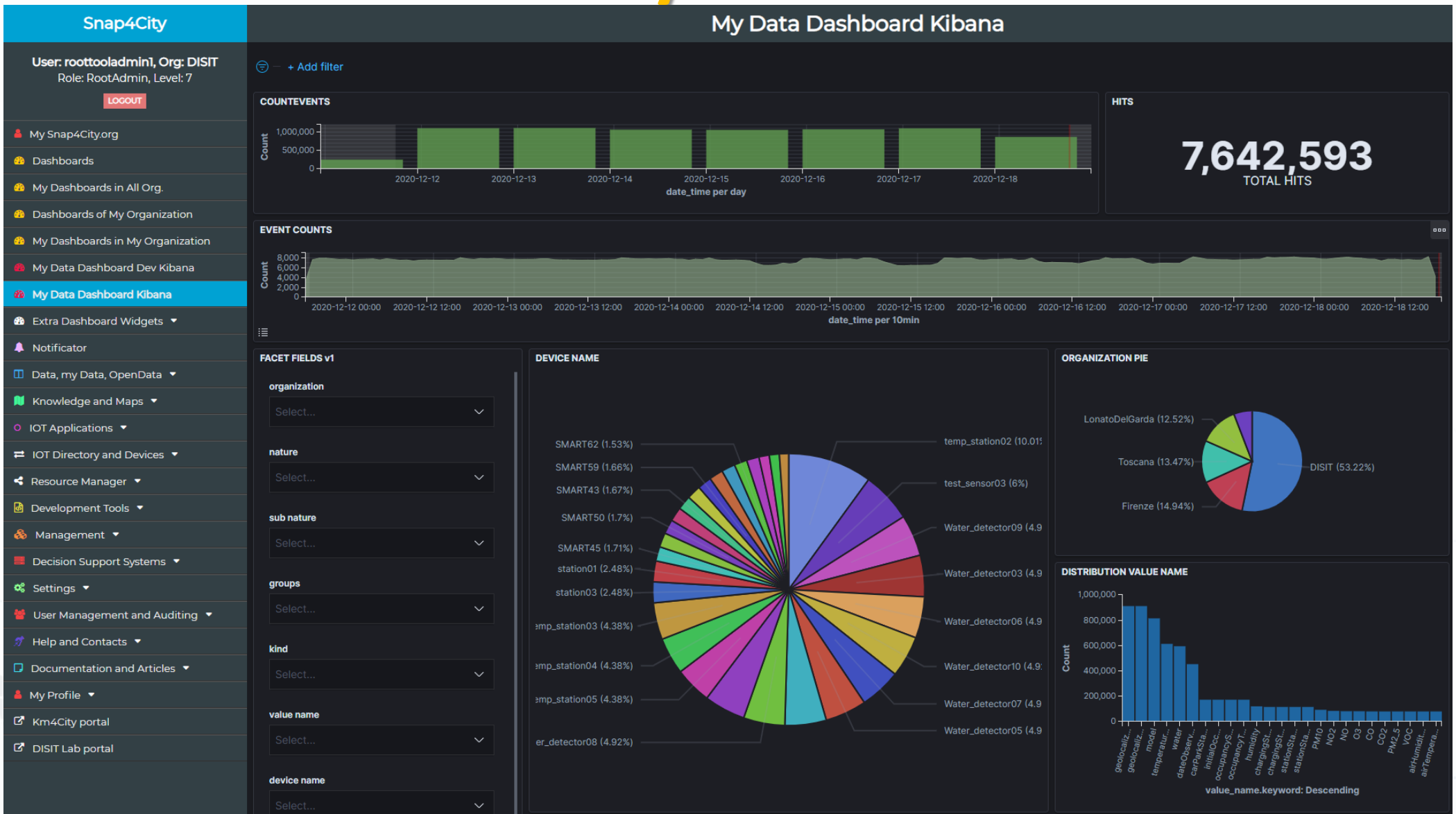
- **What is going to happen at:**
  - People, Economy, Society, ..
  - Traffic, Pollutant, Parking, structures
  - Equipment, .. …
- **if certain unexpected events would occur**
  - Scenario definition
  - Guessing future data…
- **Taking into account**
  - Historical Data
  - Real Time Data
  - Contextual data

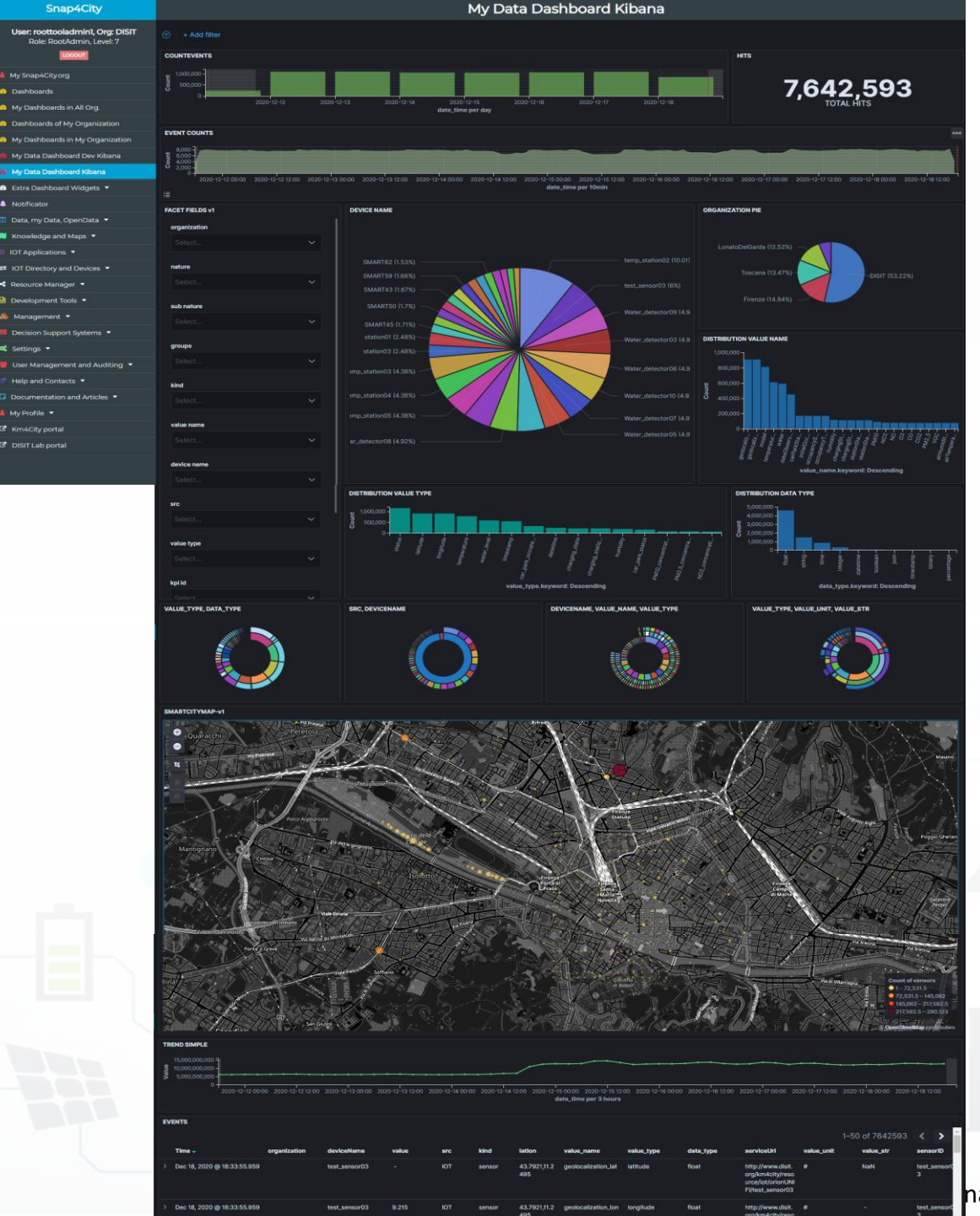
Decision Support System
KPI, Optimization
Visual Analytic: animations



Business Intelligence

DevDash: My Data Dashboard Kibana





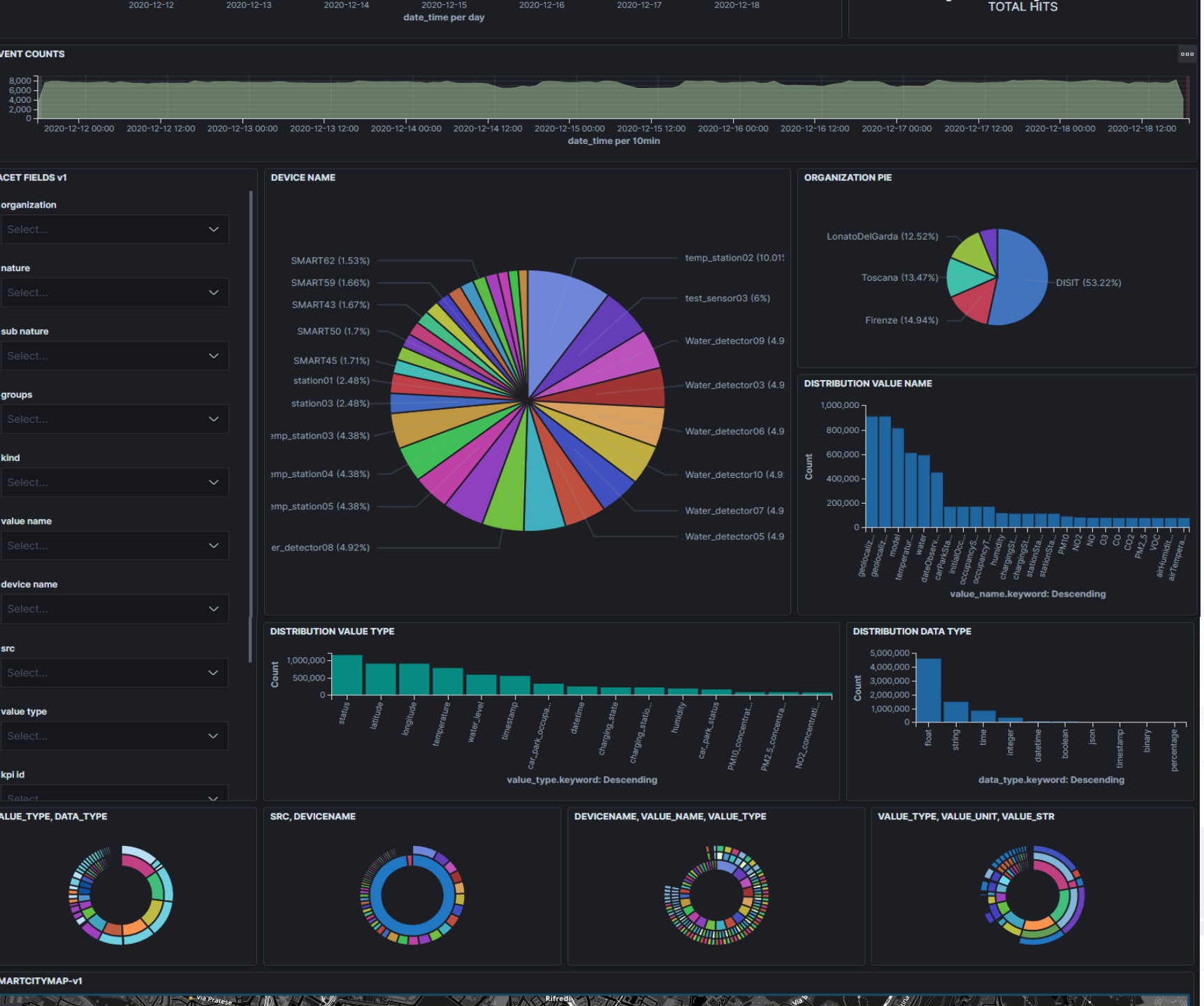
kibana

SNAP4INDUSTRY

KM4CITY

Business Analysis Dashboards For all kind of users: DevDash

- Dynamic Filtering, Adaptable, …
- Full data details, drill down,…
- Synergic with **Data Inspector** which addresses data relationships, processing and information
- **Only Your Data for**
  - Manager and Area Managers
- **All Accessible Data for**
  - ToolAdmin and RootAdmin



SNAP4INDUSTRY

KM4CITY

- Multi faceted Search by
  - Devices
  - Organization
  - Drill on Time
  - Drill on Map
  - Value Types
  - Data Type
  - Value name
  - Data table
  - Etc.

kibana

- Respect Privacy and GDPR

IoT Edge: IOT App
Smart Industry 4.0

Measuring any kind of sensors values

Controlling Energy Power

Measuring
Energy Consumption

Any kind of notification channel

IOT Edge:
Node-RED
+
Snap4City

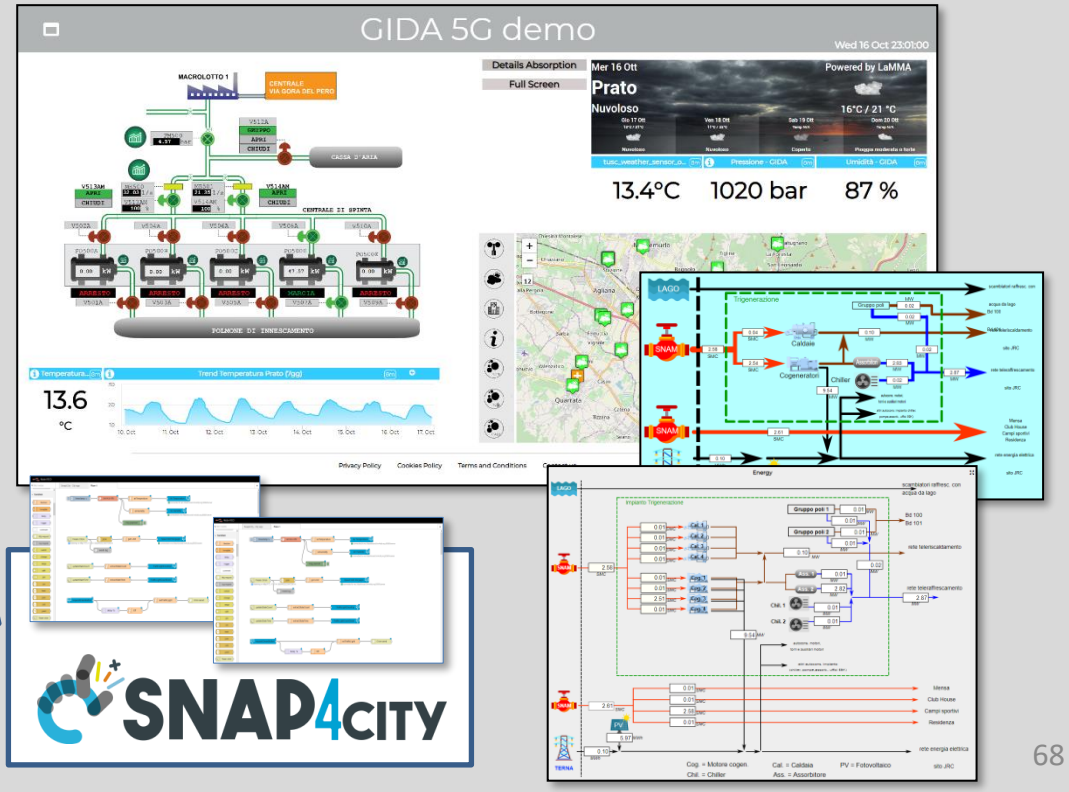
Local Control

DCS

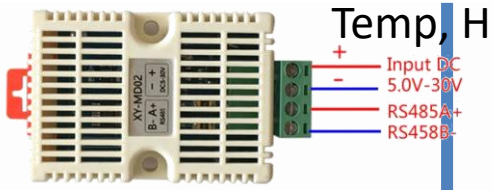
Administrative Servers

Alexa: Voice Commands

Contextual (smart city/home) data, Data Analytics
Historical Data, Remote Control, Mobile App



Devices

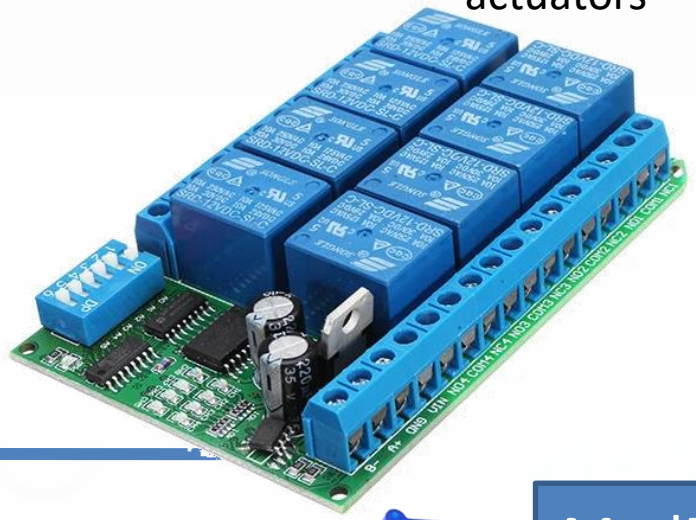


Temp, Humidity

Energy Metering

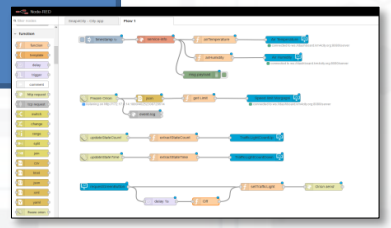
Modbus

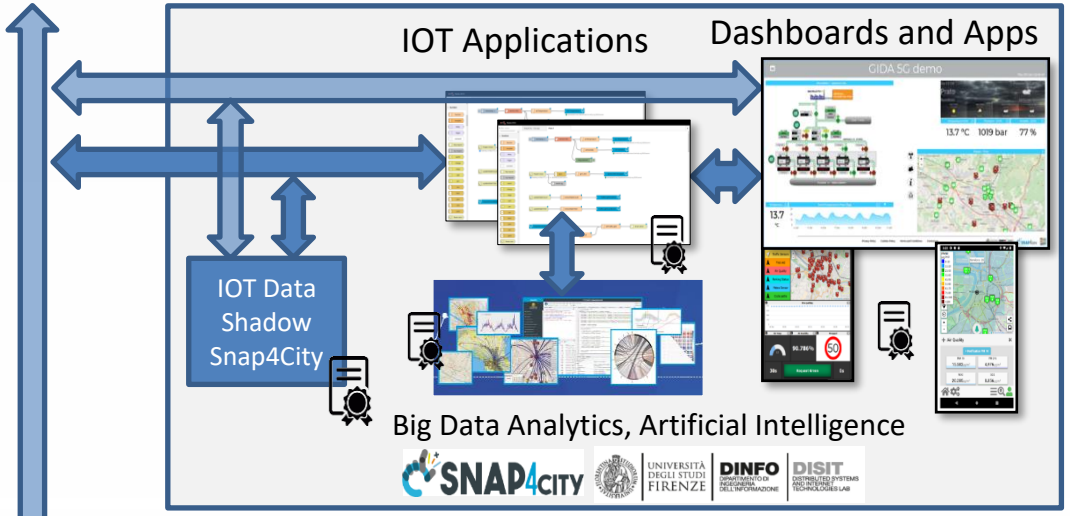
8 Relais, actuators



USB -- ModBus

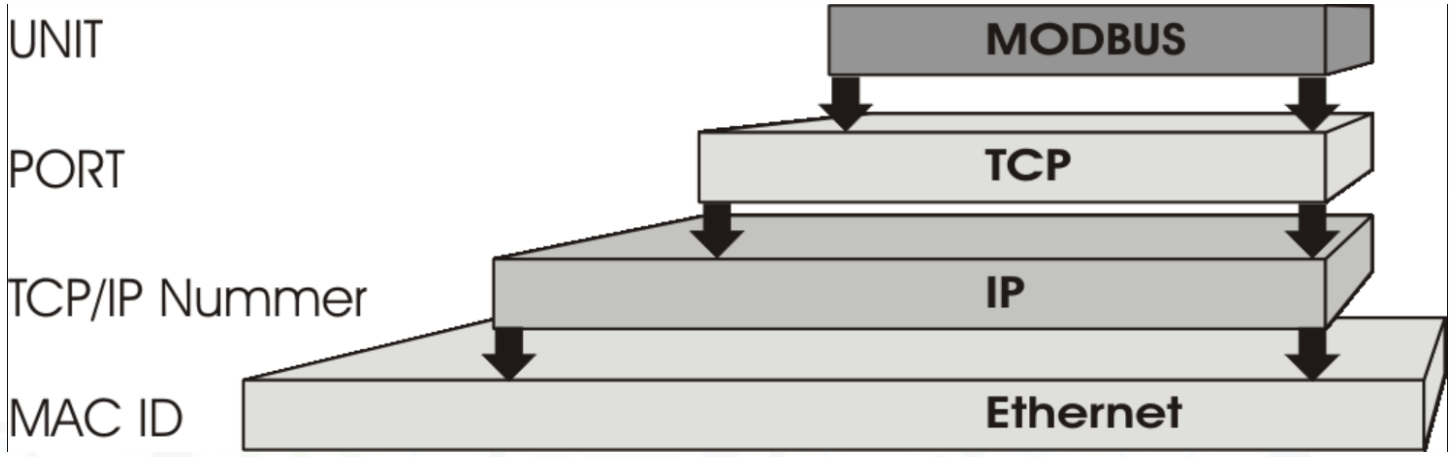
ModBus to Snap4City Gateway Edge





- A large range of devices: sensors and actuators
- Over serial as RS485 and/or IP

- modbus-response
- modbus-read
- modbus-getter
- modbus-flex-getter
- modbus-write
- modbus-flex-write
- modbus-server
- modbus-flex-server
- modbus-queue-info
- modbus-flex-connector
- modbus-io-config
- modbus-response-filter



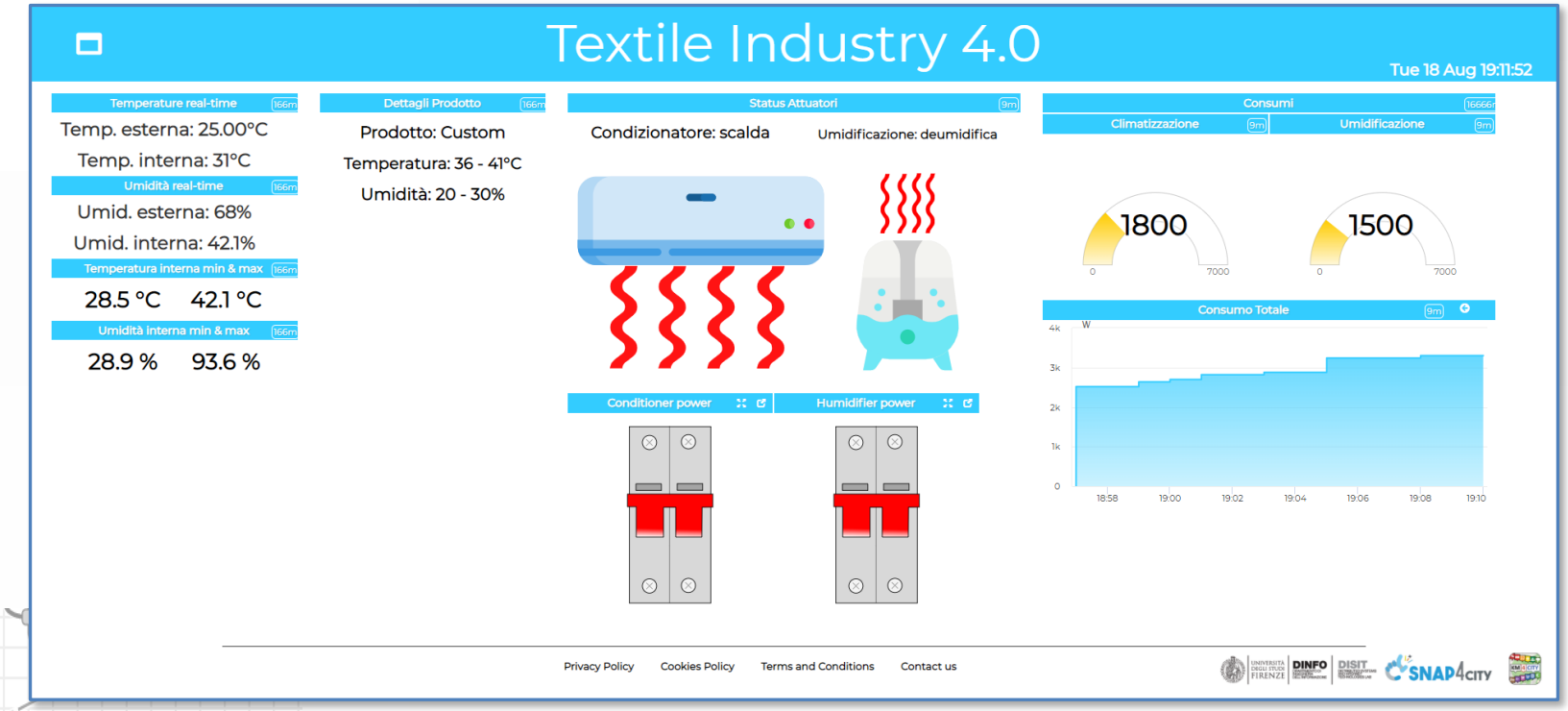
- ..

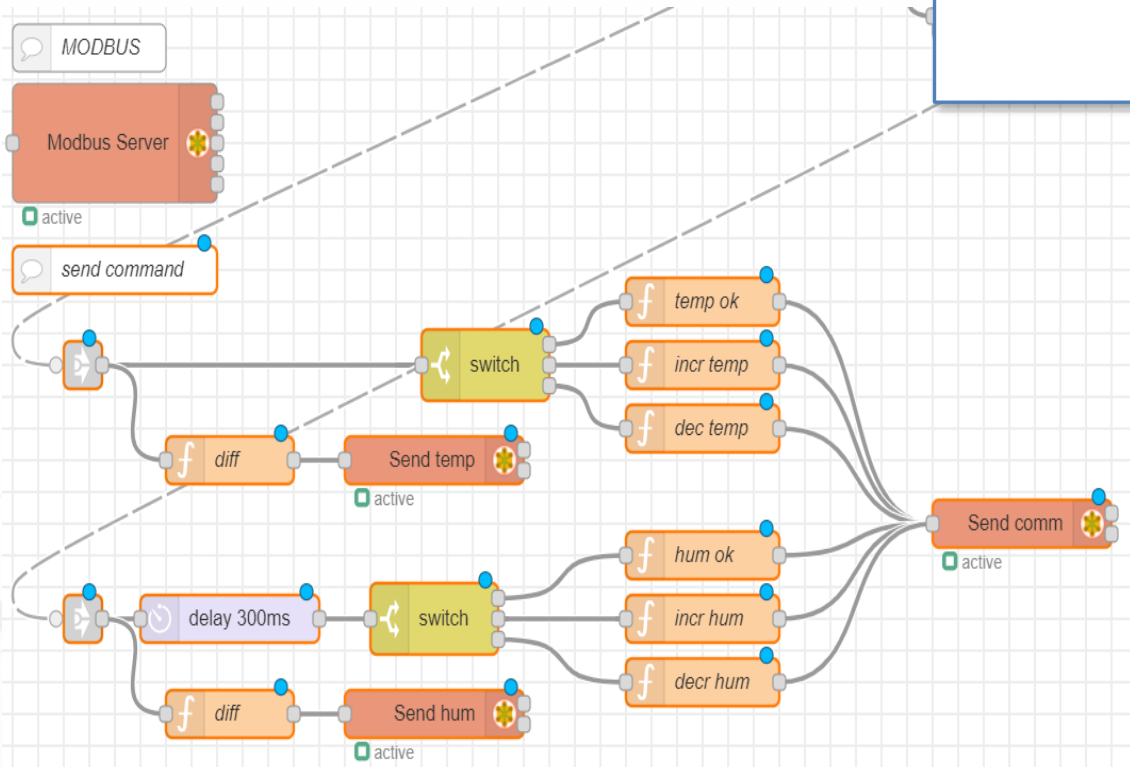
UNIVERSITÀ DEGLI STUDI FIRENZE

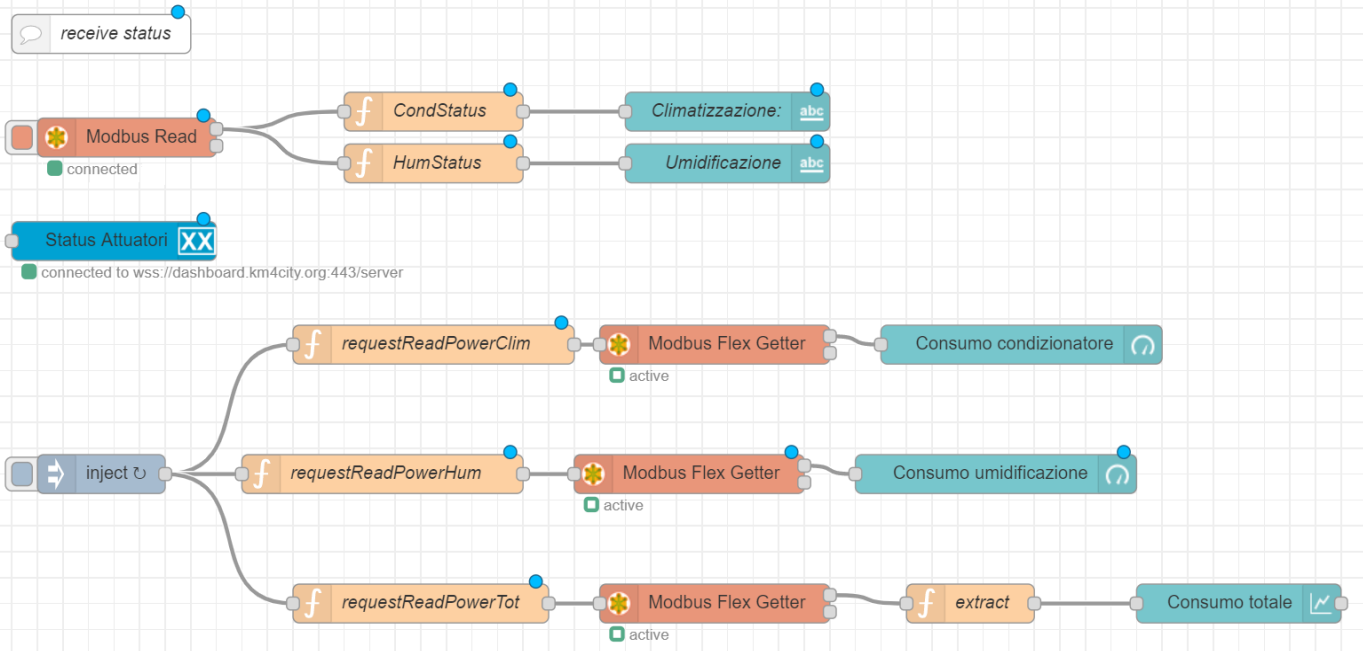
DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

Modbus







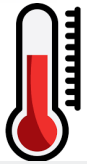
IoT edge

Hue Hub

Motion Control / Alarm

TP Link plugs: meter

Alexa: Voice Control



IOT Edge:

Raspberry pi: Node-RED + Snap4City MicroService Library

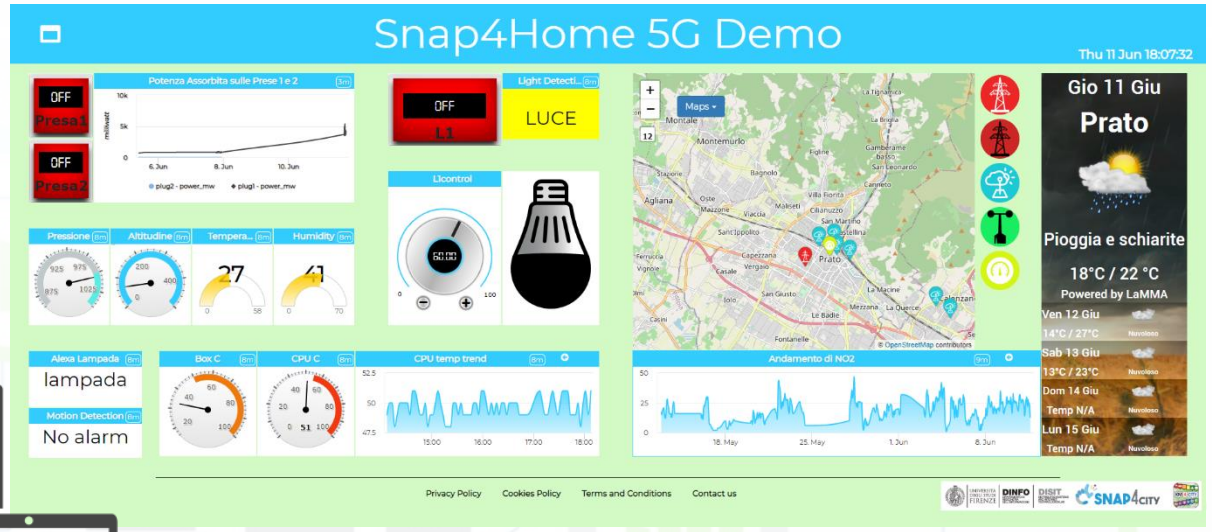
5G gateway

FIWARE Orion Broker

Dashboards

Advanced Smart City API

Environmental Contextual data from the city. Historical Data, Remote Control, Mobile App



IoT Edge

Sonoff: Controlling Energy Power

Philips Hue: Controlling Lights

Hue: Motion Control / Alarm

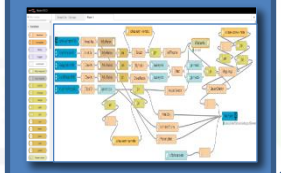
Measuring
Energy Consumption

TP Link: Controlling / Measuring Energy Plugs

Alexa: Voice Control

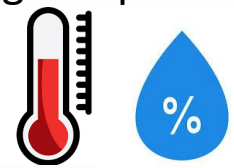
IOT Edge:

Raspberry pi: Node-RED + Snap4City



Local Control

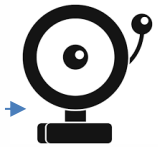
Measuring Temperature and Humidity



Garage Door

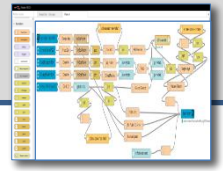
Window
Roller Shutters

Controlling Motors

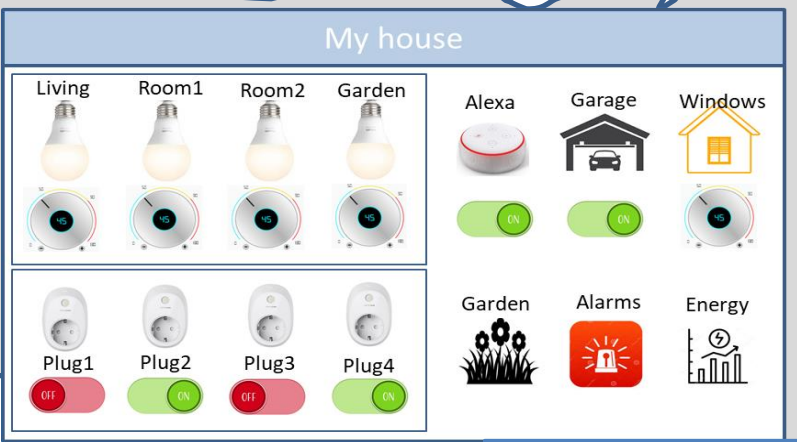


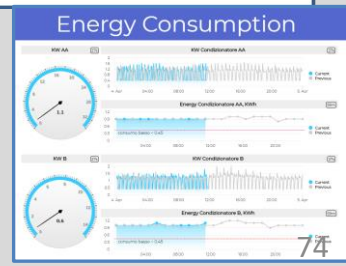
Alarm sound
and light

Controlling
Irrigators



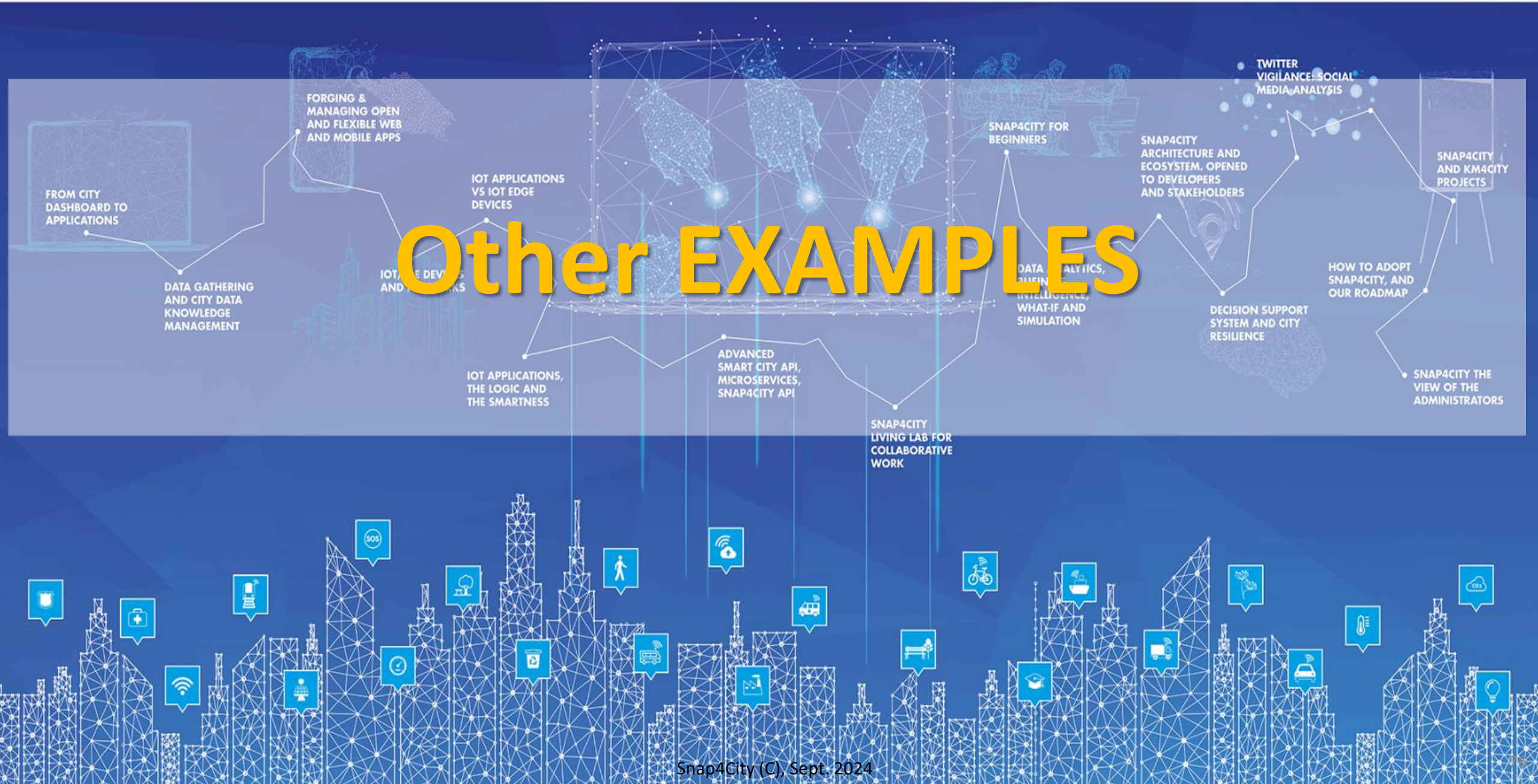
SNAP4CITY





Environmental Contextual data from the city
Historical Data, Remote Control, Mobile App

https://www.snap4city.org/620



Other EXAMPLES

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

PaD

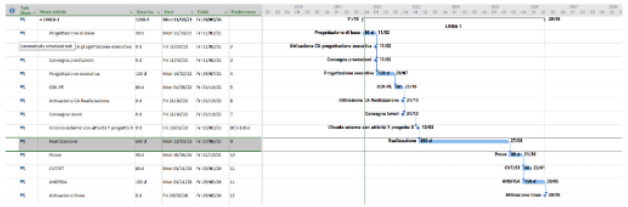
Predictive Analytics Dashboard

ITALFERR
Mon 17 Jan 17:31:13

Piano Linea 2

Dettaglio Linea 2 | Vista Complessiva

Sintesi Linea 2
Allocazione Squadre Linea 2
Simulazione Allocazione Linea 2



	Data partenza in stima	Data fine in stima	Durata stimata	Data effettiva partenza	Data effettiva fine	Durata
Progetto di base	02/06/2022	31/08/2022	90	02/06/2022	31/08/2022	
Progetto esecutivo	31/08/2022	29/11/2022	90	31/08/2022	29/11/2022	
Vr_ODI PE	29/11/2022	28/01/2023	60	29/11/2022	28/01/2023	
Realizzazione	28/01/2023	20/09/2025	966	28/01/2023	20/09/2025	
Prove	20/09/2025	19/12/2025	90	20/09/2025	19/12/2025	
CVT e ANSFISA	19/12/2025	18/05/2026	150	19/12/2025	18/05/2026	
Totale	**02/06/2022**	**18/05/2026**	**1446**	**02/06/2022**	**18/05/2026**	

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PAD
Predictive Analytics Dashboard
Powered by
ITALFERR
GRUPPO FERROVIE DELLO STATO ITALIANE
SNAP4

Simulazione Allocazione

Sat 22 Jan 09:22:18

squadre: 5

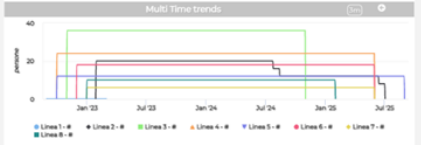
Pianificazione Stimata

MaxSquadre: MaxSquadre
MaxGiorni: GG 520
Submit
msg: Infattibile

Schedula effettiva

Predictive Analytics Dashboard
Sintesi Linea 2
Allocazione Squadre Linea 2

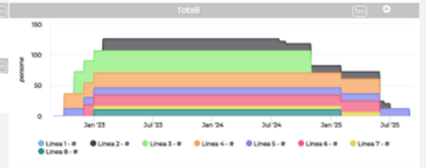
Multi Time trends



Totali Eff

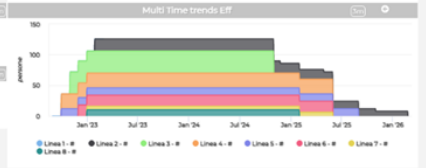
Max Pers...: 126
Durata: 886

Totali



Max Persone ...: 126
Durata Eff: 1123

Multi Time trends Eff



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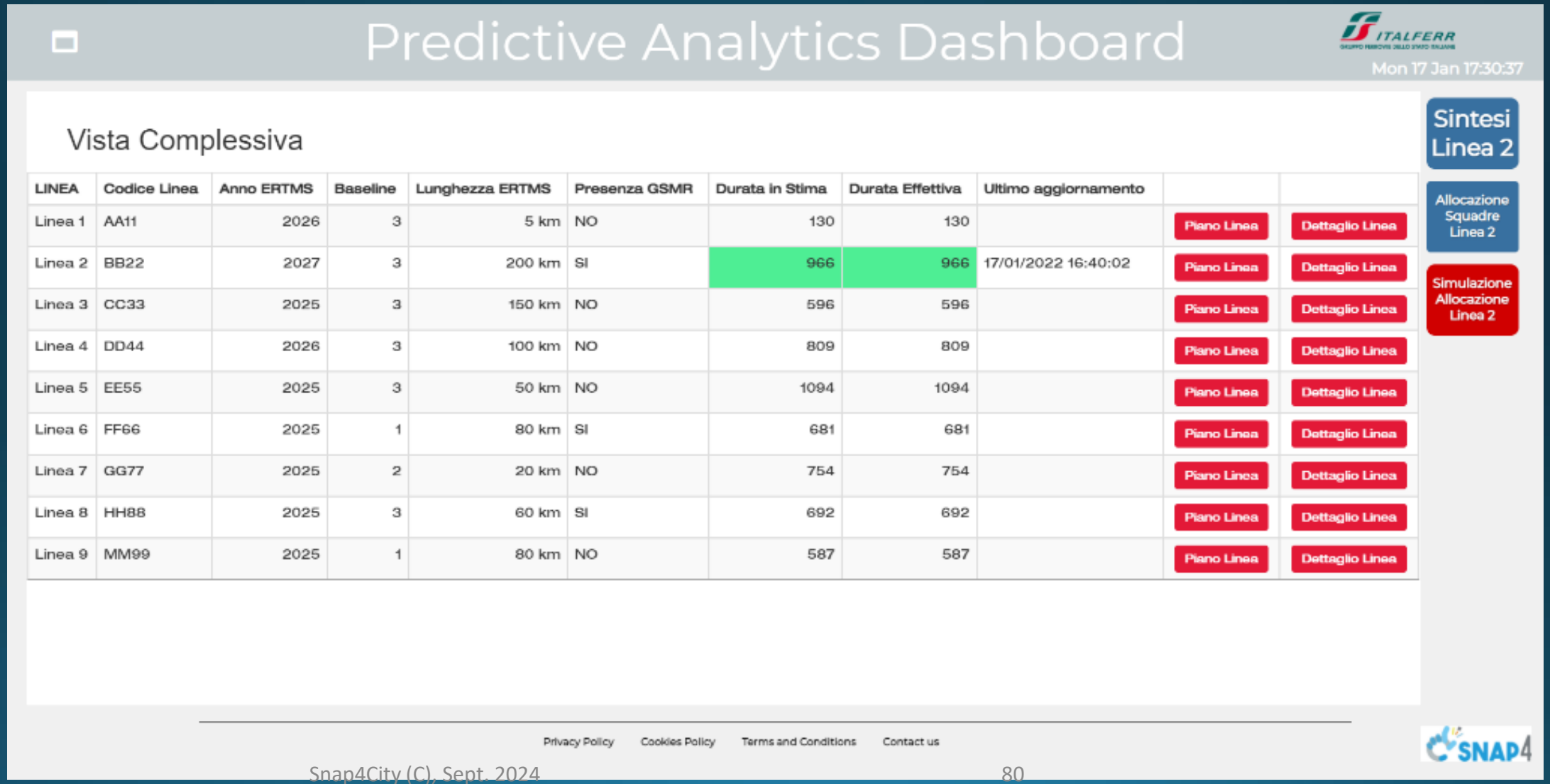
SNAP4

PaD

Open Italy 2021



LINEA	Codice Linea	Anno ERTMS	Baseline	Lunghezza ERTMS	Presenza GSMR	Durata in Stima	Durata Effettiva	Ultimo aggiornamento		
Linea 1	AA11	2026	3	5 km	NO	130	130		Piano Linea	Dettaglio Linea
Linea 2	BB22	2027	3	200 km	SI	966	966	17/01/2022 16:40:02	Piano Linea	Dettaglio Linea
Linea 3	CC33	2025	3	150 km	NO	596	596		Piano Linea	Dettaglio Linea
Linea 4	DD44	2026	3	100 km	NO	809	809		Piano Linea	Dettaglio Linea
Linea 5	EE55	2025	3	50 km	NO	1094	1094		Piano Linea	Dettaglio Linea
Linea 6	FF66	2025	1	80 km	SI	681	681		Piano Linea	Dettaglio Linea
Linea 7	GG77	2025	2	20 km	NO	754	754		Piano Linea	Dettaglio Linea
Linea 8	HH88	2025	3	60 km	SI	692	692		Piano Linea	Dettaglio Linea
Linea 9	MM99	2025	1	80 km	NO	587	587		Piano Linea	Dettaglio Linea

PaD

Open Italy 2021

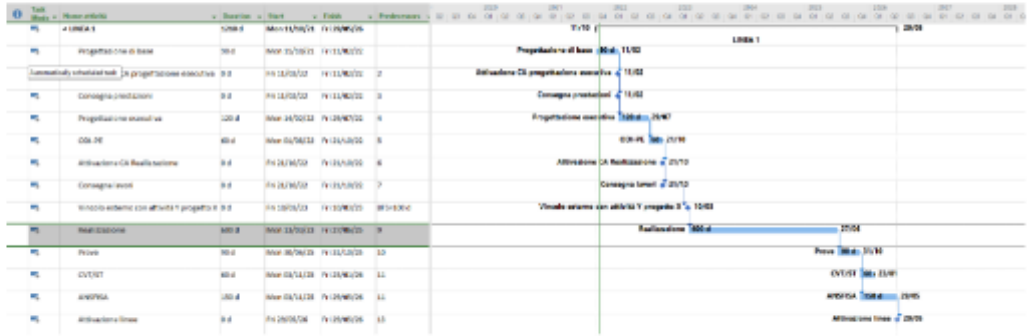
Predictive Analytics Dashboard

ITALFERR

Mon 17 Jan 17:31:13

Piano Linea 2

Dettaglio Linea 2 | Vista Complessiva



Sintesi Linea 2

Allocazione Squadre Linea 2

Simulazione Allocazione Linea 2

	Data partenza in stima	Data fine in stima	Durata stimata	Data effettiva partenza	Data effettiva fine	Durata effettiva
Progetto di base	02/06/2022	31/08/2022	90	02/06/2022	31/08/2022	90
Progetto esecutivo	31/08/2022	29/11/2022	90	31/08/2022	29/11/2022	90
Vr_ODI PE	29/11/2022	28/01/2023	60	29/11/2022	28/01/2023	60
Realizzazione	28/01/2023	20/09/2025	966	28/01/2023	20/09/2025	966
Prove	20/09/2025	19/12/2025	90	20/09/2025	19/12/2025	90
CVT e ANSFISA	19/12/2025	18/05/2026	150	19/12/2025	18/05/2026	150
Totale	**02/06/2022**	**18/05/2026**	**1446**	**02/06/2022**	**18/05/2026**	**1446**

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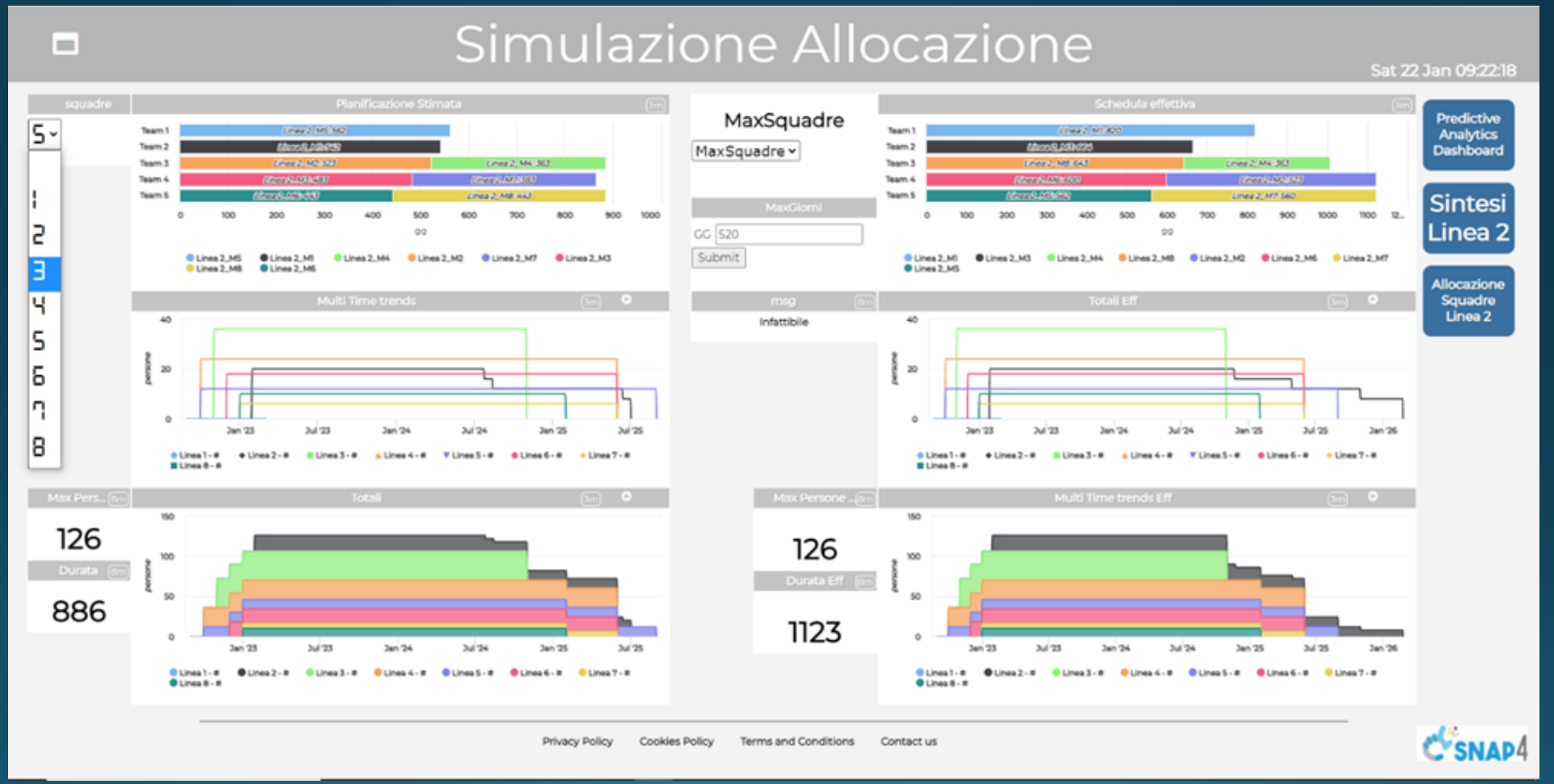
PaD

Open Italy 2021



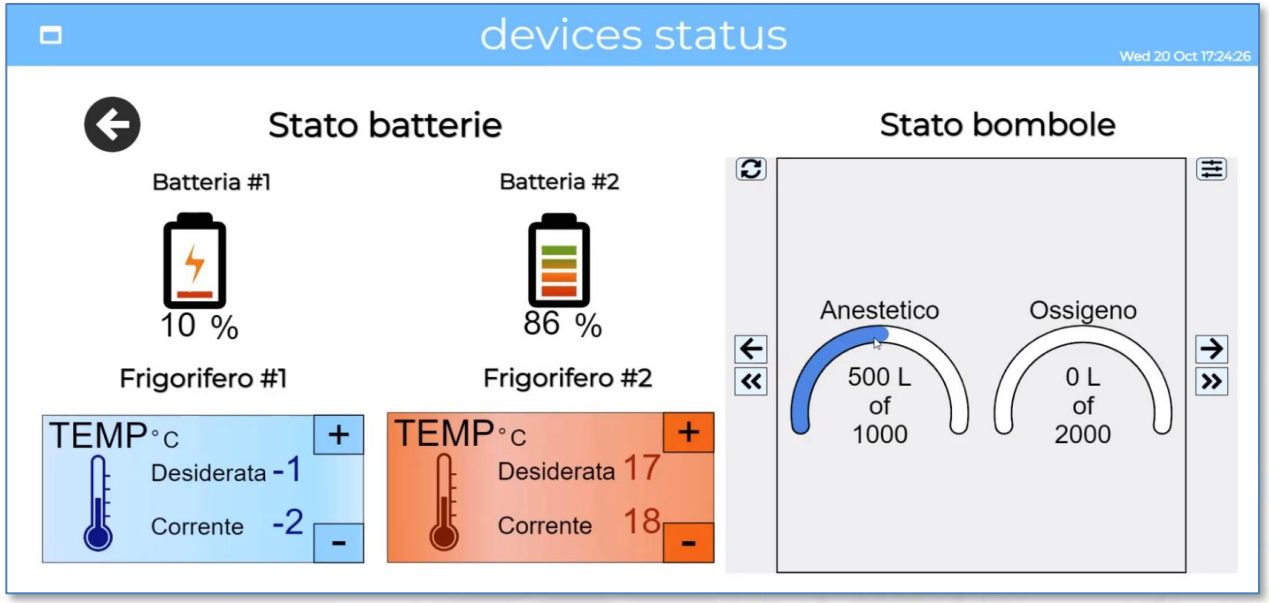
IoT Health Scenarios

1) Smart Ambulance:
Collecting and managing local data from tools and sensors inside the ambulance, IoT Devices, Tablets, Drones etc.

2) Personal Health devices:
e.g.: glucometers, etc.

3) Smart Bed:
Collecting and managing data from smart bed sensors, monitoring parameters in real-time

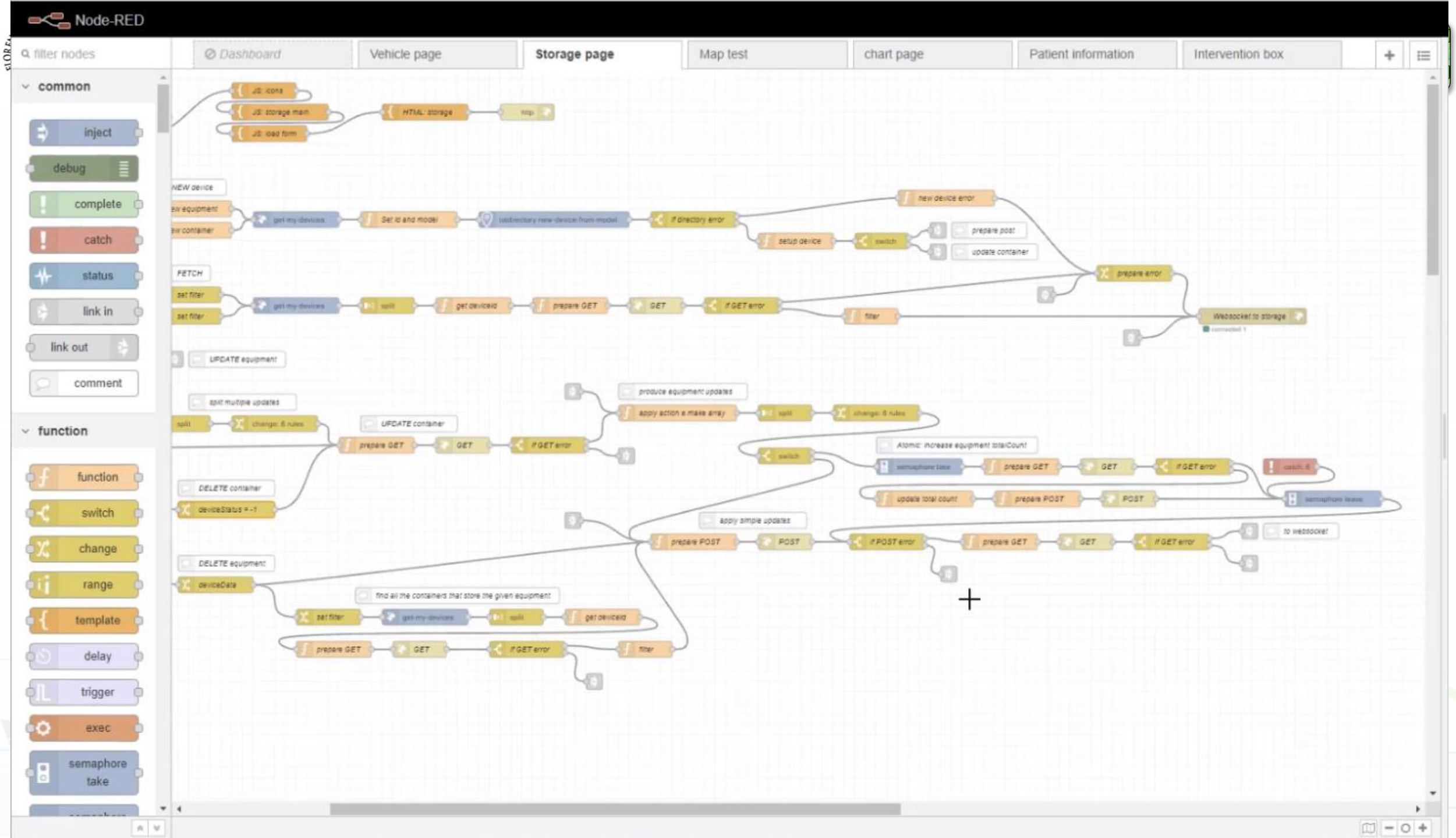
Smart Ambulance



Smart Ambulance

- **HUD control**
- Monitoring Patient
- Intervention data

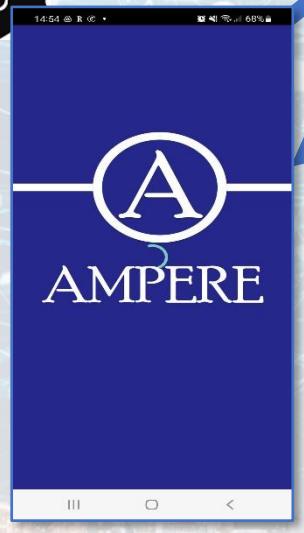
- Device/equipment Status:
  - Fridge, tanks (anestetic, oxigen, etc.)
- Stock
  - Load/get any drug/item per box/container
- Car Maintenance
  - Programmed, and accidents


Node-RED
filter nodes
Dashboard
Vehicle page
Storage page
Map test
chart page
Patient information
Intervention box
common
inject
debug
complete
catch
status
link in
link out
comment
function
function
switch
change
range
template
delay
trigger
exec
semaphore take
JS: icons
JS: storage main
JS: load form
HTML: storage
http
NEW device
get my devices
Set id and model
add/directory new-device-from-model
if directory error
new device error
setup device
switch
prepare post
update container
FETCH
set filter
set filter
get my devices
split
get deviceId
prepare GET
GET
if GET error
filter
prepare error
Websocket to storage
UPDATE equipment
split multiple updates
split
change: 6 rules
UPDATE container
prepare GET
GET
if GET error
produce equipment updates
apply action e make array
split
change: 6 rules
switch
Atomic: increase equipment totalCount
semaphore take
prepare GET
GET
if GET error
catch: 6
update total count
prepare POST
POST
semaphore leave
DELETE container
deviceStatus = -1
apply simple updates
prepare POST
POST
if POST error
prepare GET
GET
if GET error
to websocket
DELETE equipment
deviceData
find all the containers that store the given equipment
set filter
get my devices
split
get deviceId
prepare GET
GET
if GET error
filter

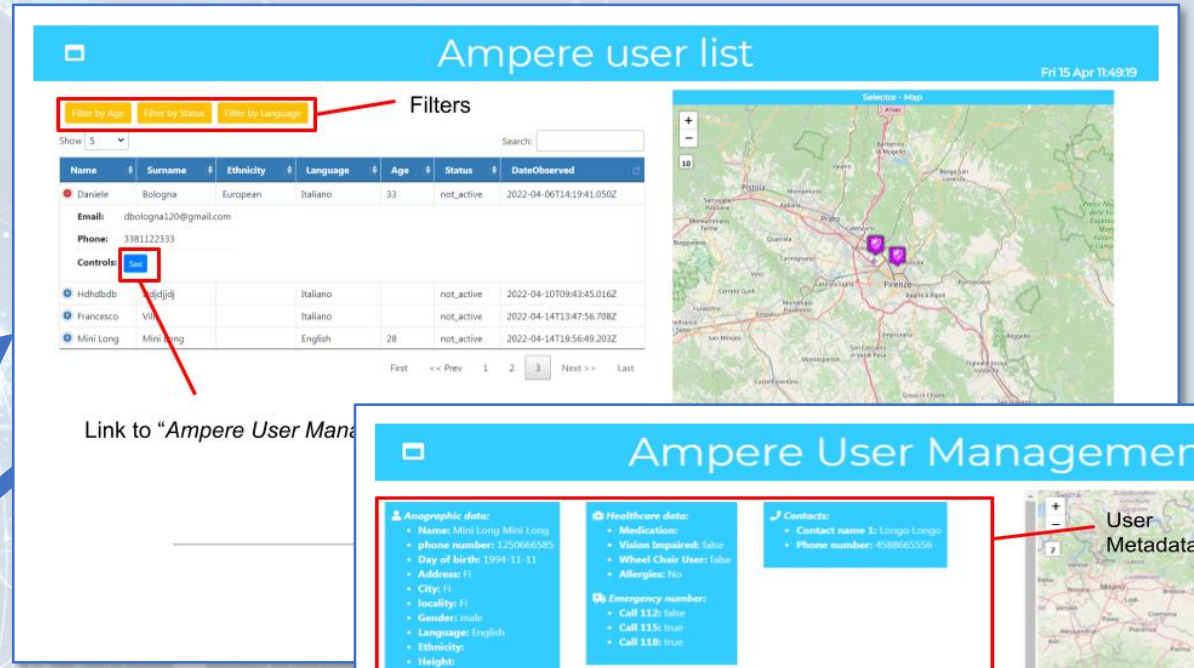
Jewel Alarms AMPERE

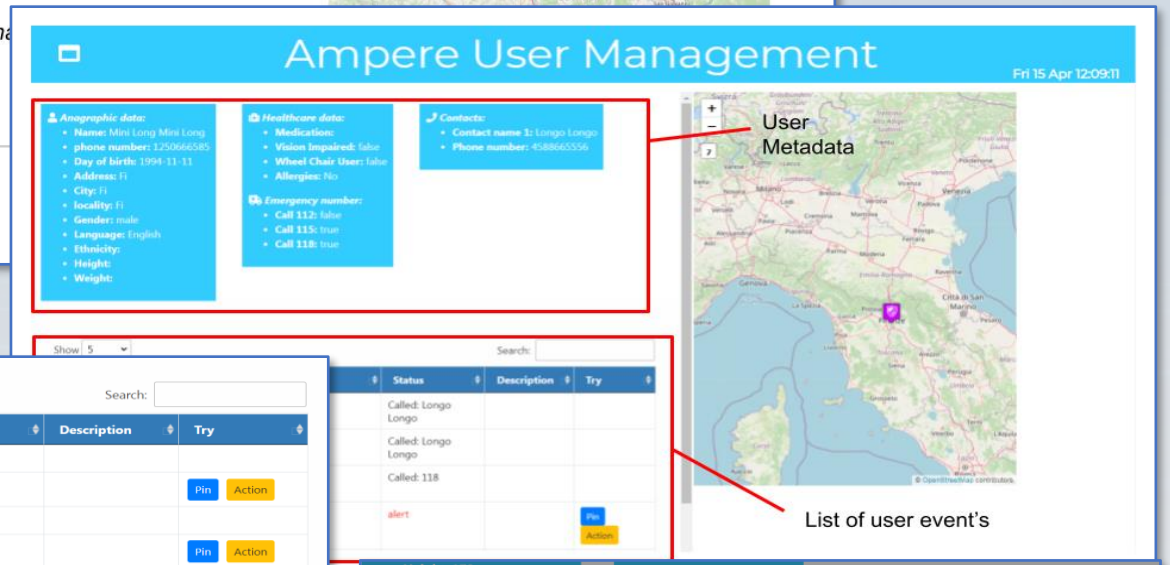
NFC

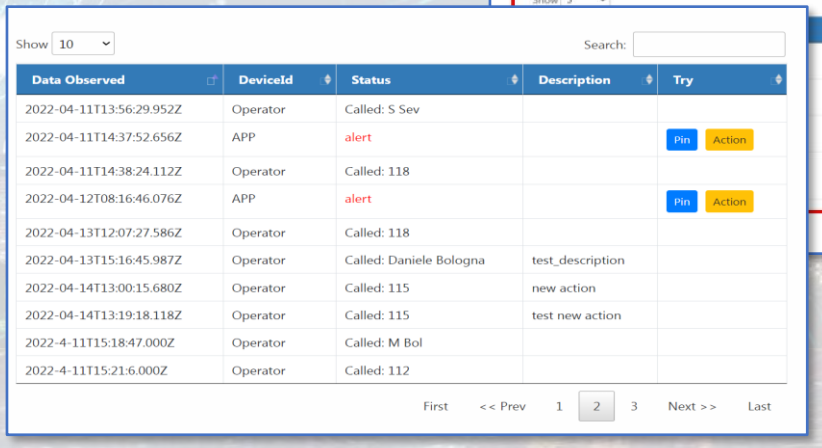
BLE

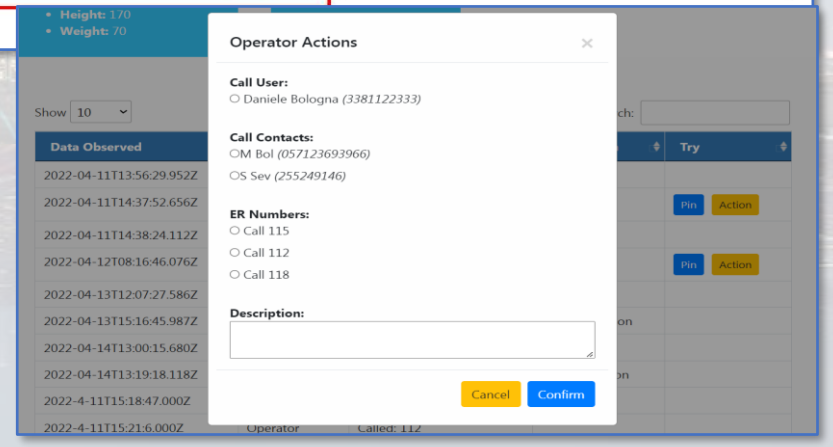


Click on Jewel









Energy monitoring and business intelligence

Green and Data Driven District @ MIND

Aggregated KPI | JuicePark | SmartPole | CityAnalytics

enel x

Energy produced to date		CityAnalytics insight		Videoanalysis – KPI to date	
JuicePark	0 kWh	Average daily people	9845.3	People counted	0
SmartPole	27.341 kWh	Average Milan resident over tourist ratio	1.57	Vehicle counted	520
				People aggregation	0
WiFi sessions daily peak		**SOS events to date**		**Vehicle charging sessions to date**	
Max connected devices	0	SmartPole requests	0	EV car	0
		JuicePark requests	0		
		AED requests	0		

Juice Park Detailed KPIs

Smart Pole Detailed KPIs

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enel-x juice park

enel x Thu 21 Apr 10:48:31

main

smart pole

Charging Station

Number of Daily Ses...	Daily Energy Consumpti...
0 #	0 kWh
Number of Total Ses...	Total Energy Consumed
10 #	15 kWh

SOS - Number of Pushes: 7 #

SOS - Last button us...: 29/03/2022 11:48

SOS - Daily Number of Button Pus...: 0 #

Power Meter - Energy Consumed

Power Meter - Energy Produced

Video Analysis

People Counts (hourly)

People in Forbidden Area

People Aggregation

WiFi - Connections per Day

Last Event: 21/04/2022 10:48

Last Event: 21/04/2022 10:47

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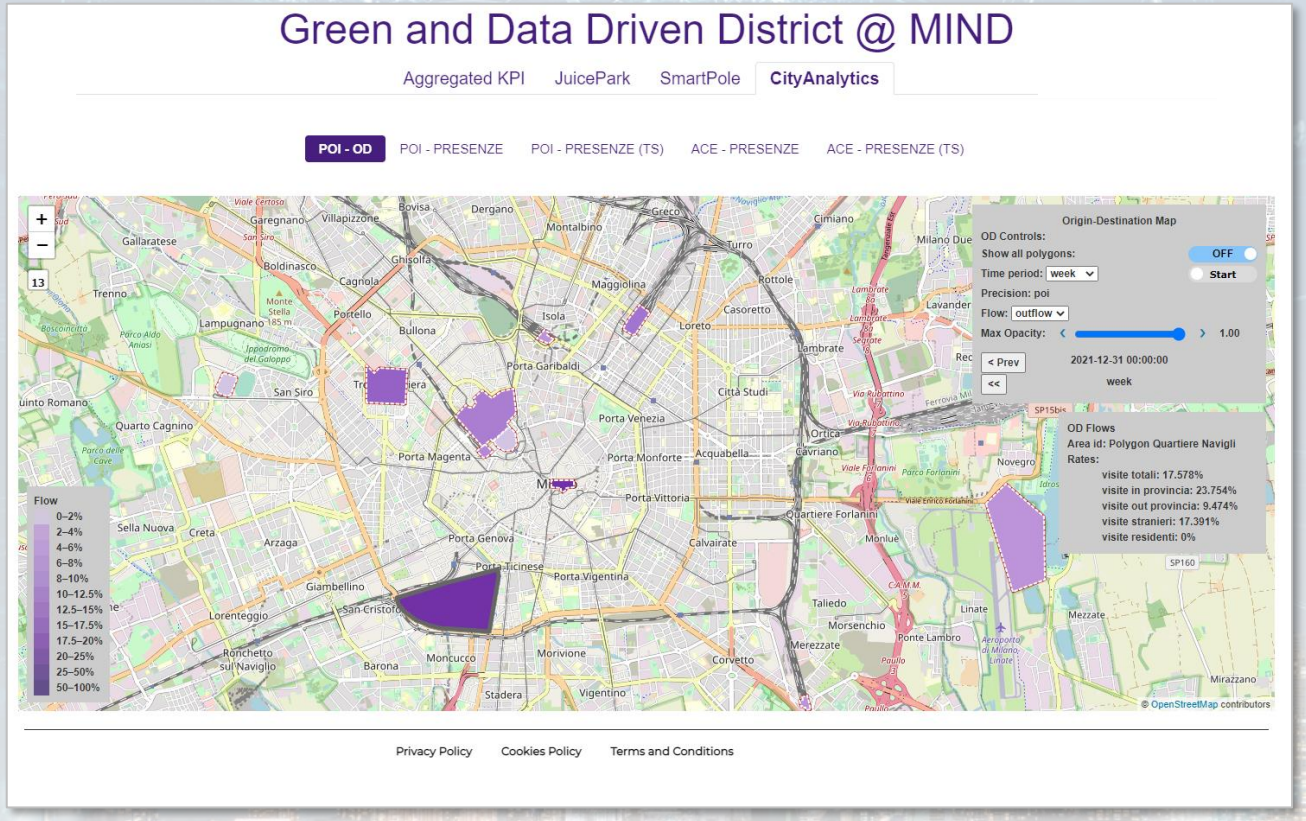
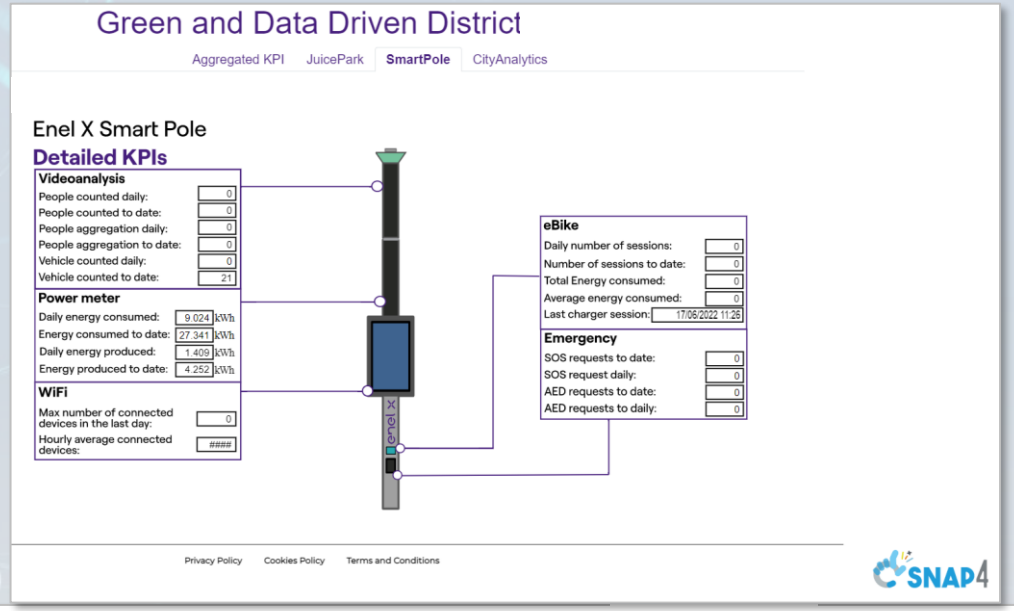
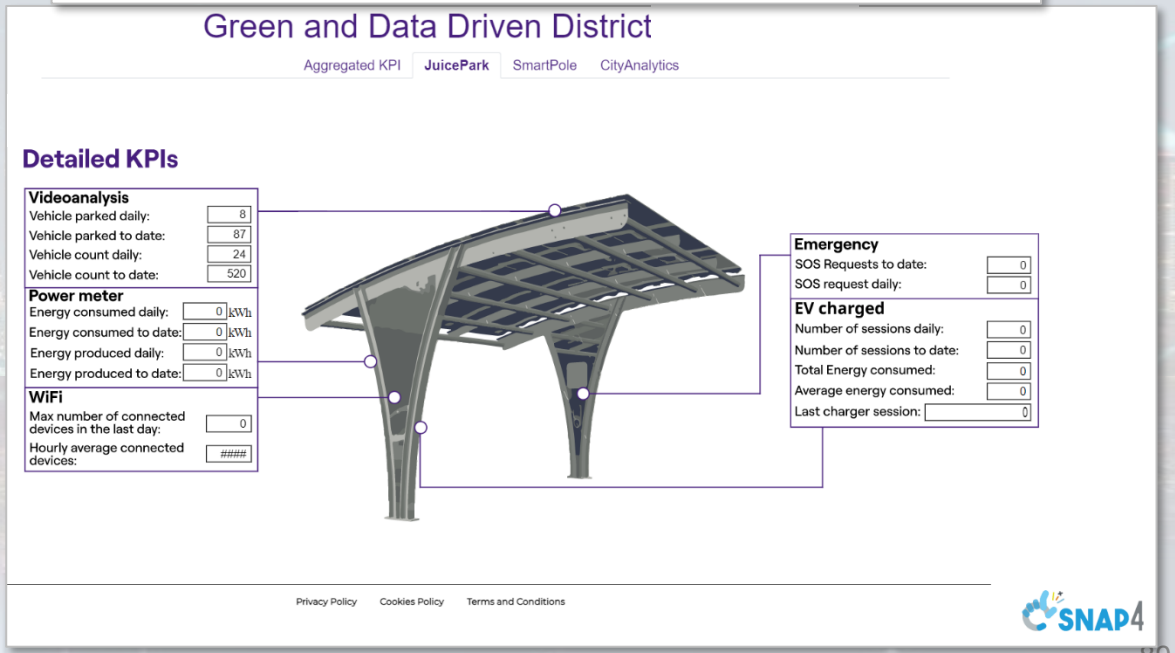
SNAP4

enel x

Energy monitoring and business intelligence







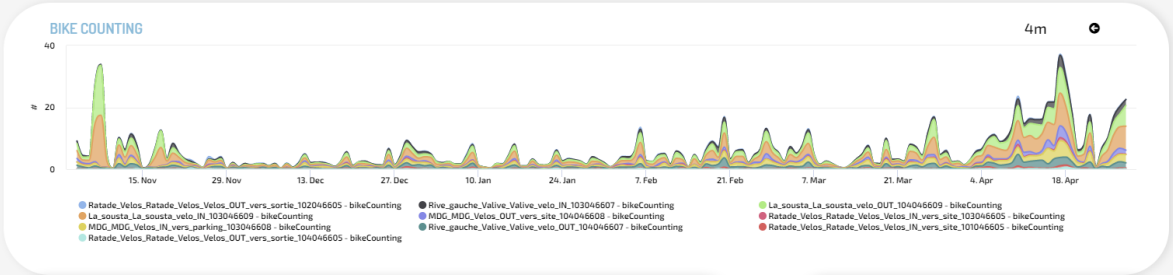
7 AFFORDABLE AND CLEAN ENERGY

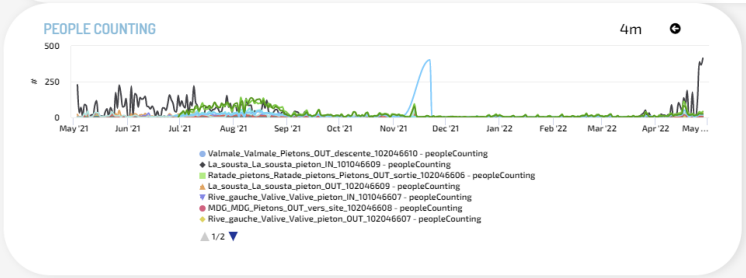
11 SUSTAINABLE CITIES AND COMMUNITIES

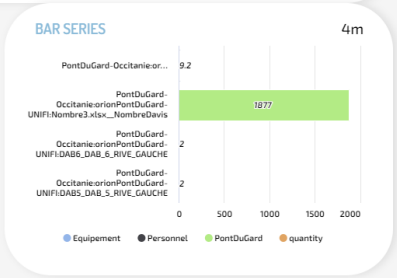
Ciao roottooladmin1

Tue 3 May 14:13:30

PONT DU GARD: PEOPLE AND BIKES COUNTING HERIT-DATA - CLONED NEWGUI







Pont du Gard Main

Pont du Gard Dashboard

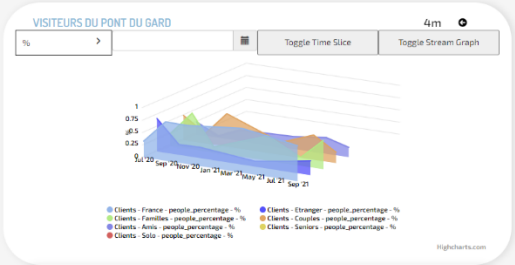
Pont du Gard Consumer Satisfaction

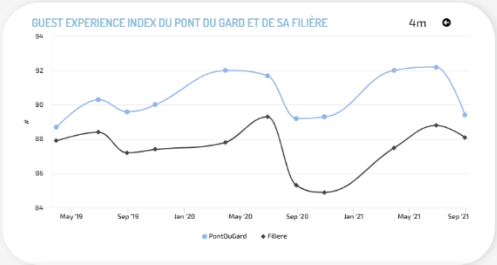
Pont du Gard Ticketing

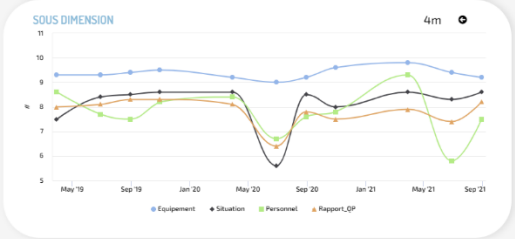
Ciao roottooladmin1

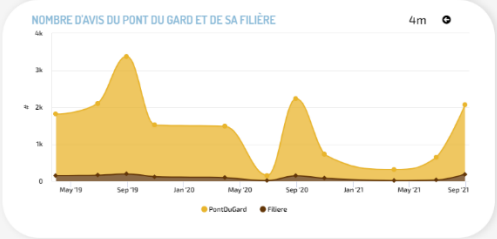
Tue 3 May 14:34:55

HERIT-DATA - PONT DU GARD CONSUMER SATISFACTION - CLONED-NEWGUI









Pont du Ga Main

Pont du Ga Dashboard

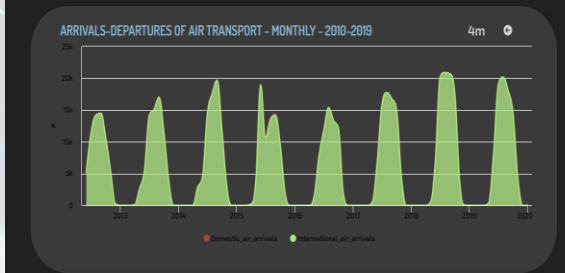
Pont du Ga Ticketing

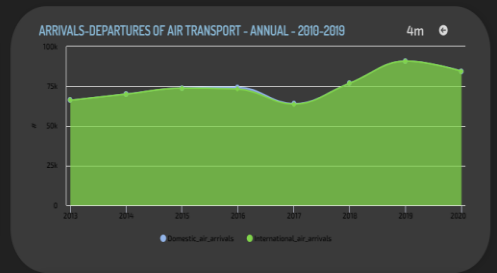
Pont du Gard Pa and Bikes Coun

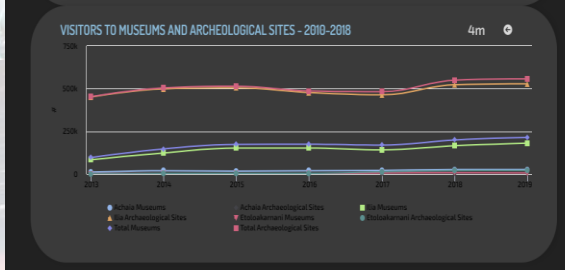
Ciao roottooladmin1

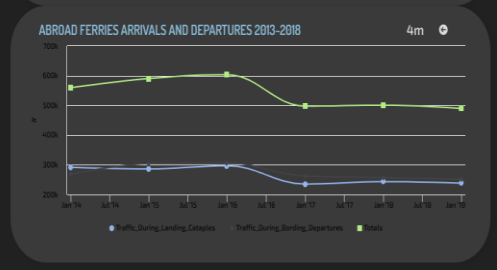
Tue 3 May 14:03:11

HERIT-DATA - WEST GREECE VARIOUS DATA - NEWGUI





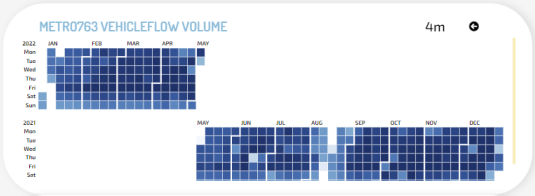


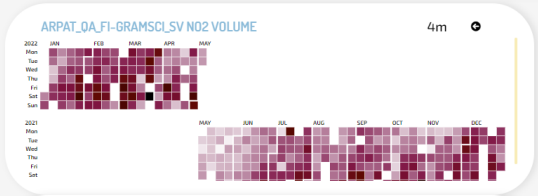


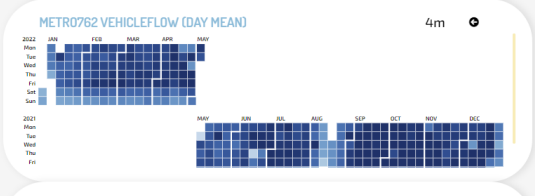
Ciao roottooladmin1

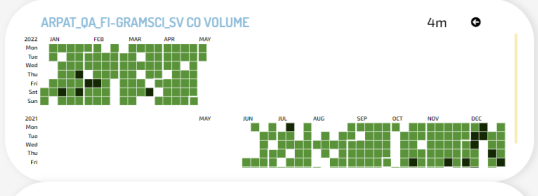
Tue 3 May 13:59:05

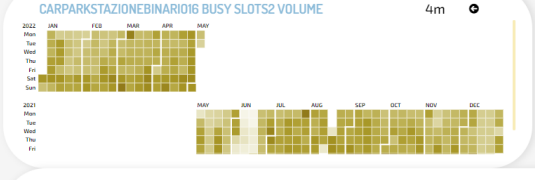
HERIT-DATA - ACTIVITIES CALENDAR - NEWGUI

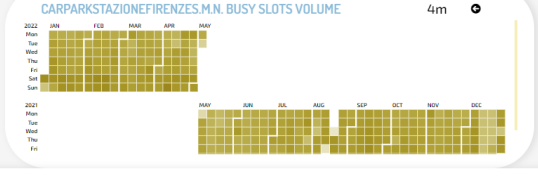




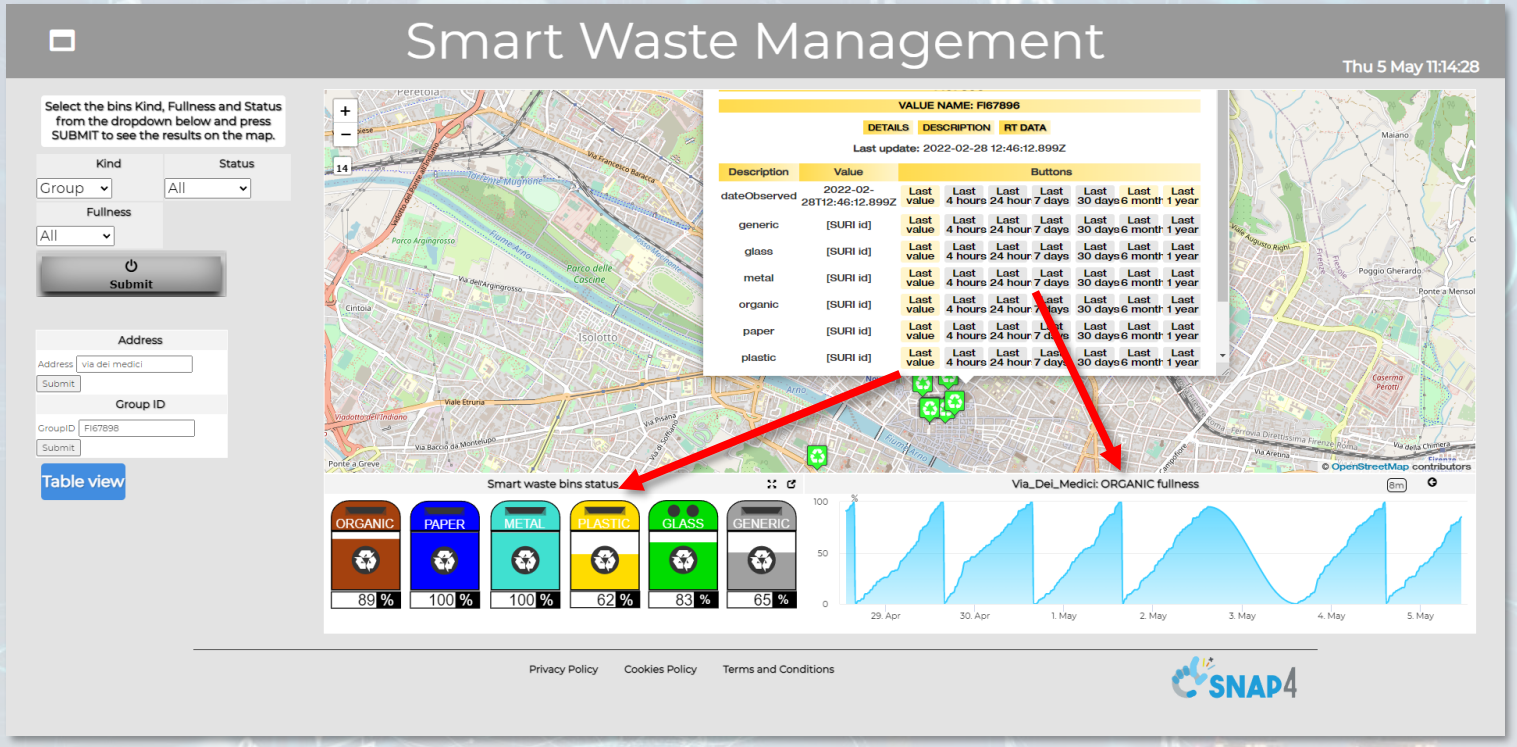








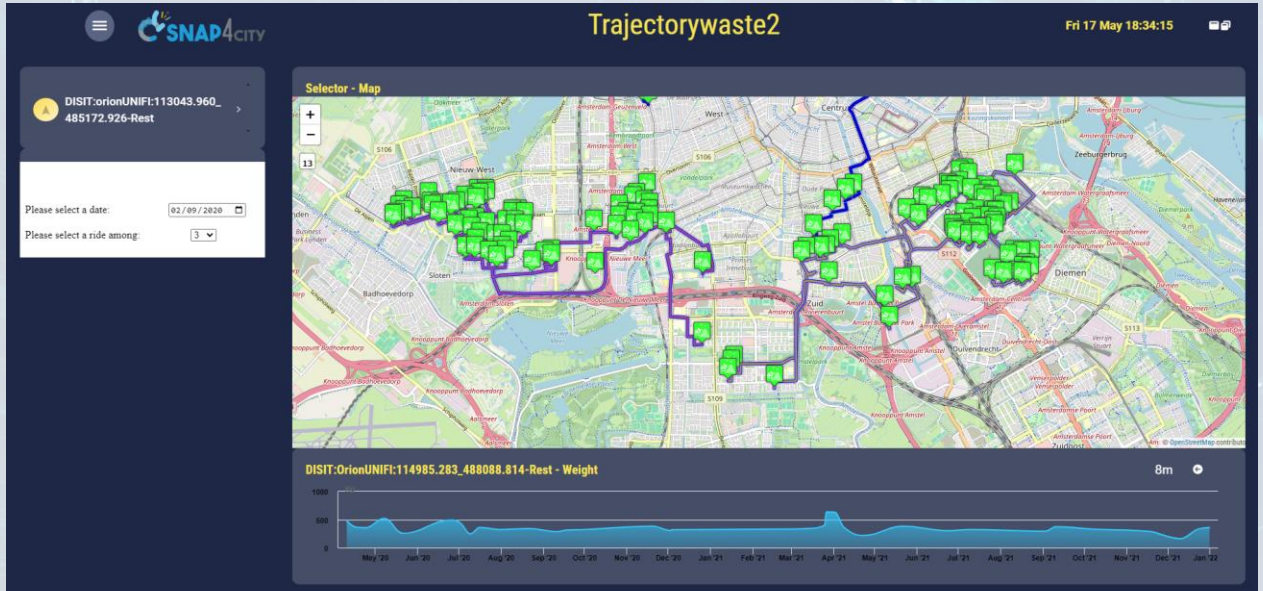
Smart Waste – Map view

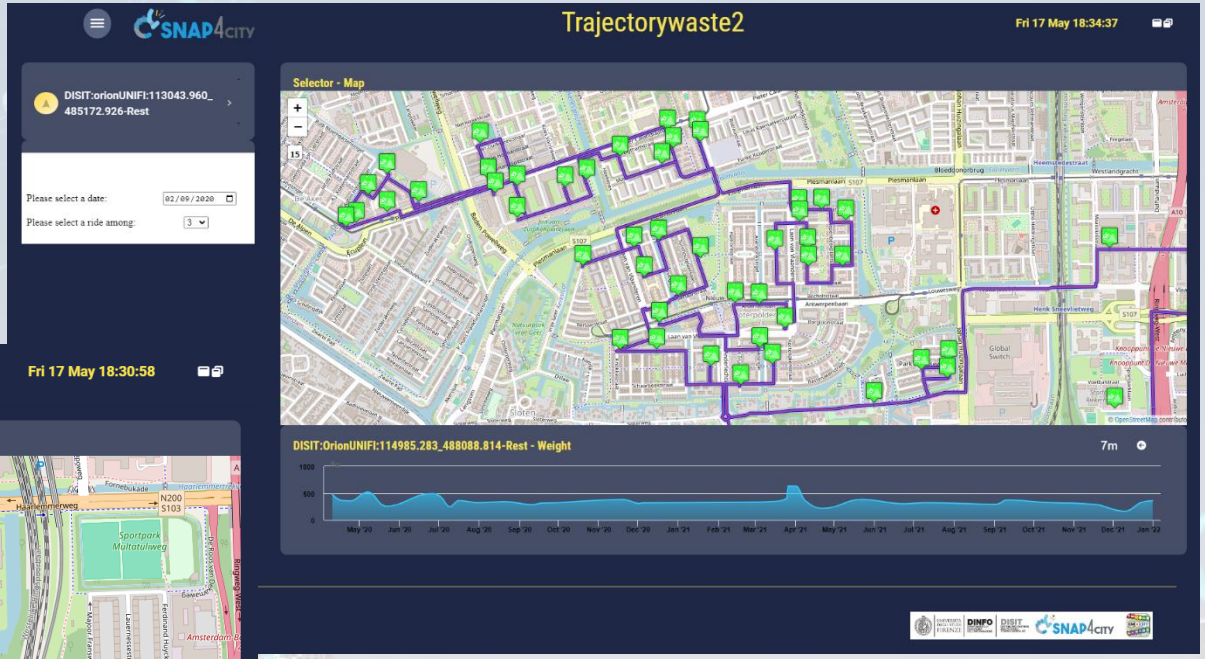


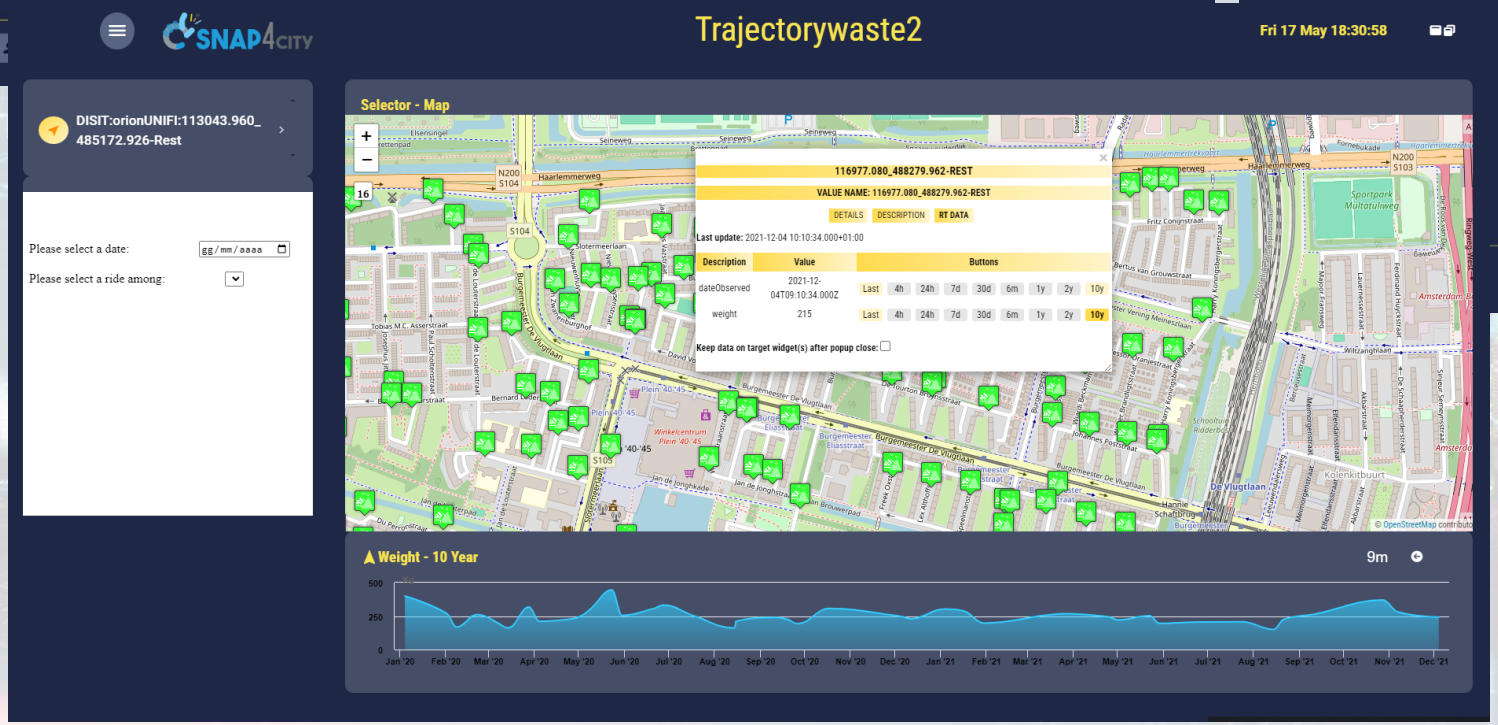
Search bins on map by filtering per:

- **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

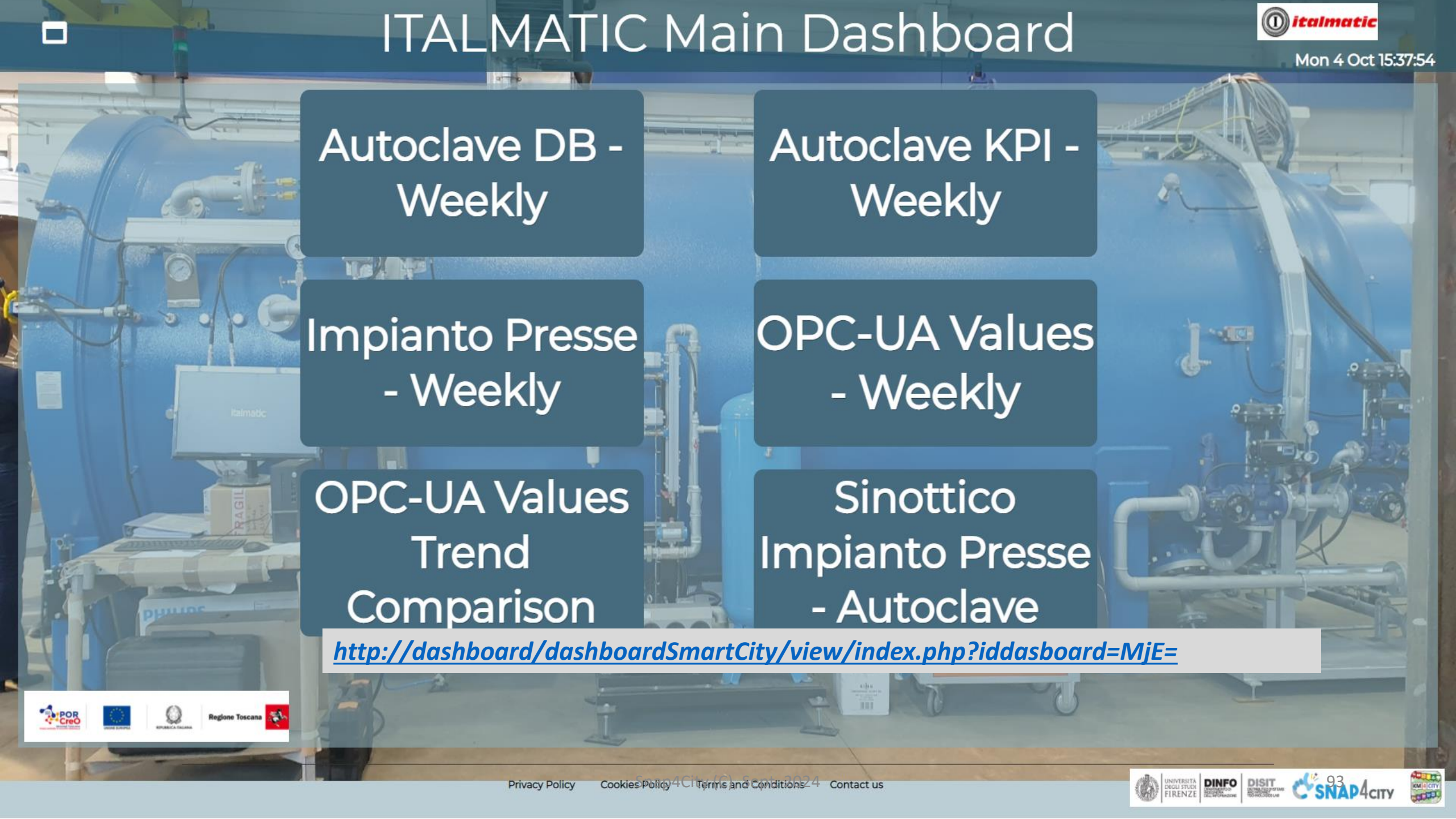

Trajectorywaste2
Fri 17 May 18:34:15
DISIT:orionUNIFI:113043.960_485172.926-Rest
Please select a date:
02/09/2020
Please select a ride among:
3
Selector - Map
DISIT:OrionUNIFI:114985.283_488088.814-Rest - Weight
8m


Trajectorywaste2
Fri 17 May 18:34:37
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
7m


Trajectorywaste2
Fri 17 May 18:30:58
DISIT:orionUNIFI:113043.960_485172.926-Rest
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


ITALMATIC Main Dashboard
italmatic
Mon 4 Oct 15:37:54
Autoclave DB - Weekly
Autoclave KPI - Weekly
Impianto Presse - Weekly
OPC-UA Values - Weekly
OPC-UA Values Trend Comparison
Sinottico Impianto Presse - Autoclave
http://dashboard/dashboardSmartCity/view/index.php?iddasboard=MjE=
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DINFO
DISIT
SNAP4CITY

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

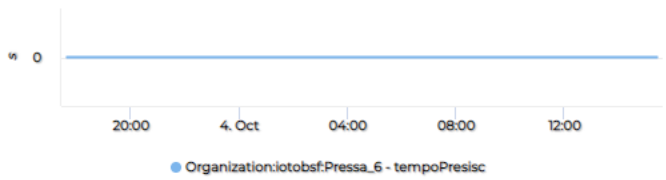
Press to update the list

Status

NO STATUS

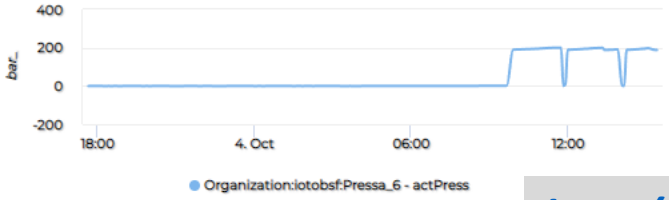
Tempo Vulcanizzione Pressa 4m

Tempo Preriscaldo Pressa 4m



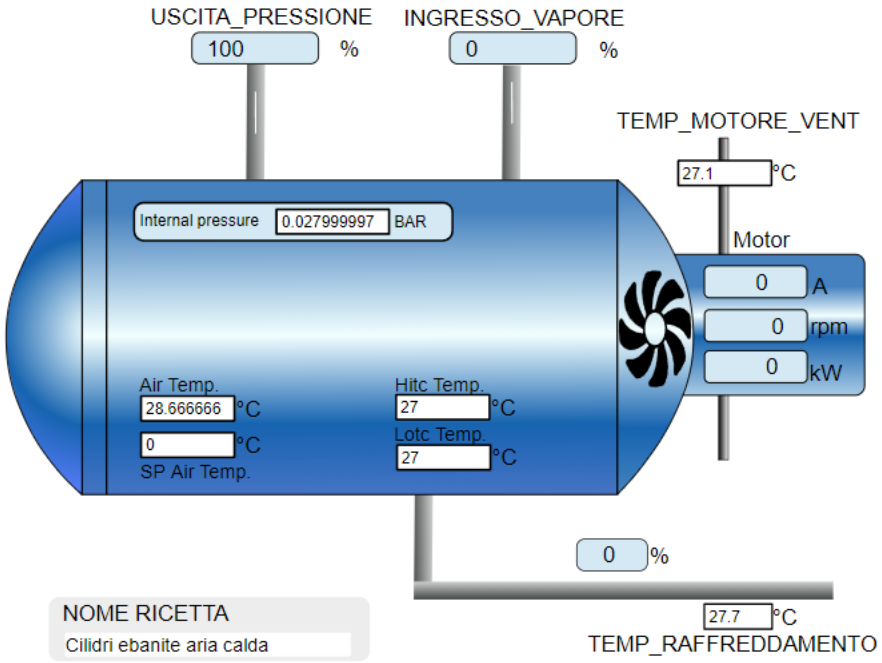
Temperatura Settore Pressa 4m

Pressione Pressa 4m



Temperatura Piani Pressa 4m

Stato autoclave



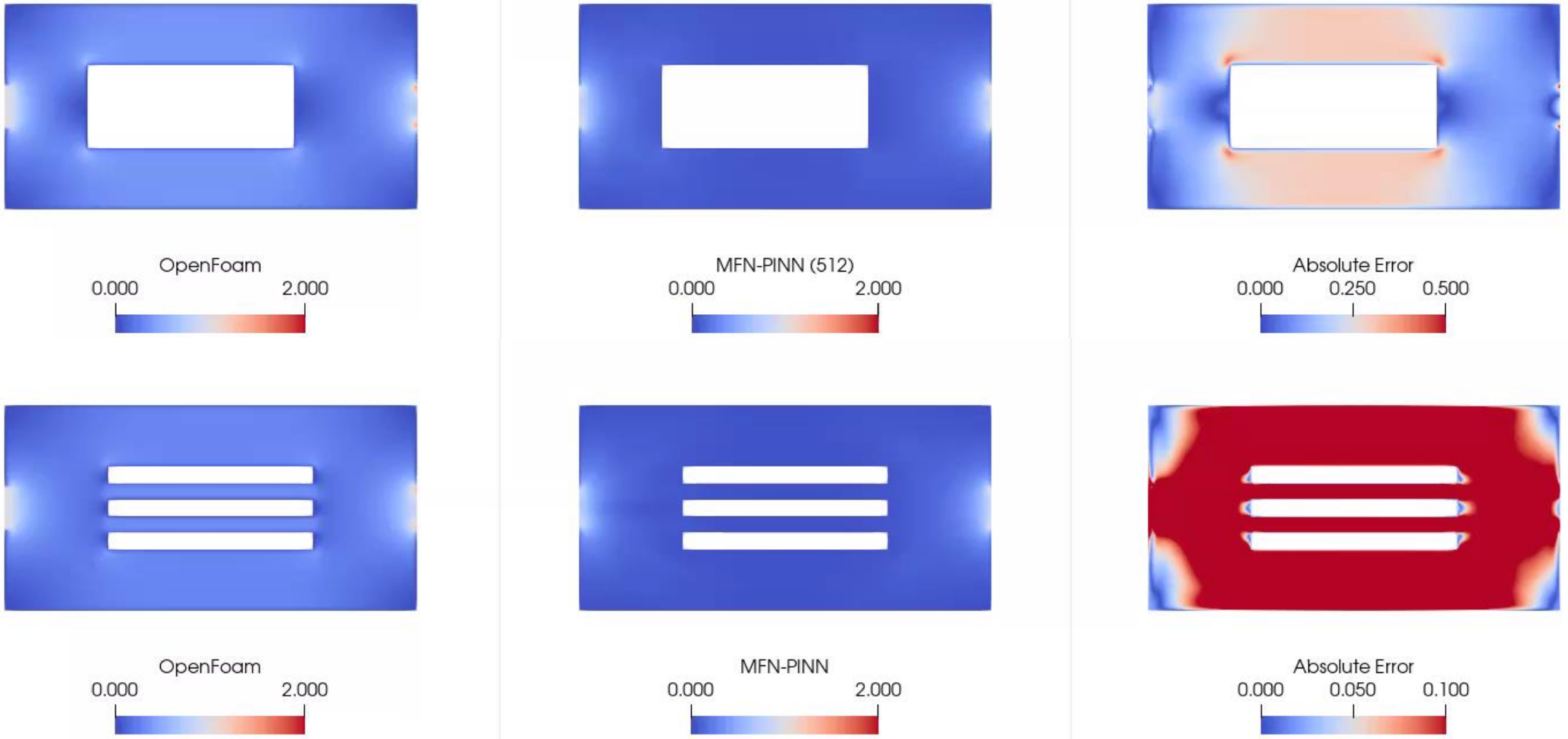
- Main Dashbaord
- Autoclave db - Weekly
- Autoclave KPI - Weekly
- Impianto Presse - Weekly
- OpcUaValues - Weekly
- OpcUaValues Trend Comparison

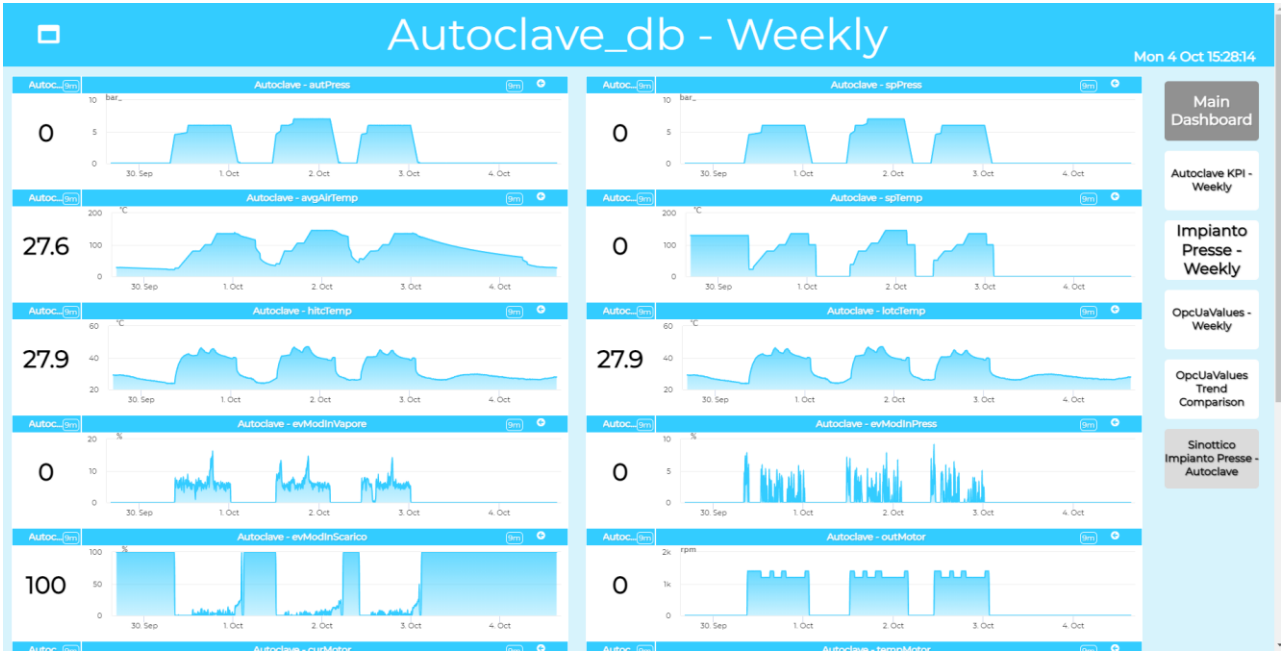
http://dashboard/dashboardSmartCity/view/index.php?iddasboard=MTk=

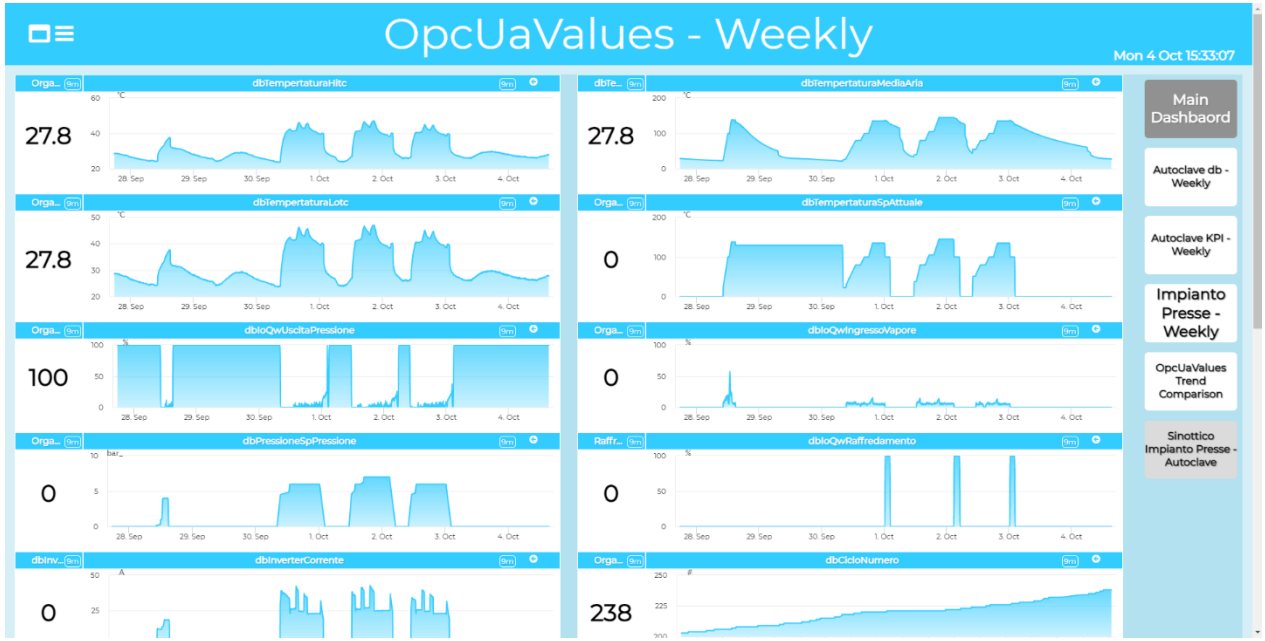
PINN: Physically Informed Neural Neworks Models

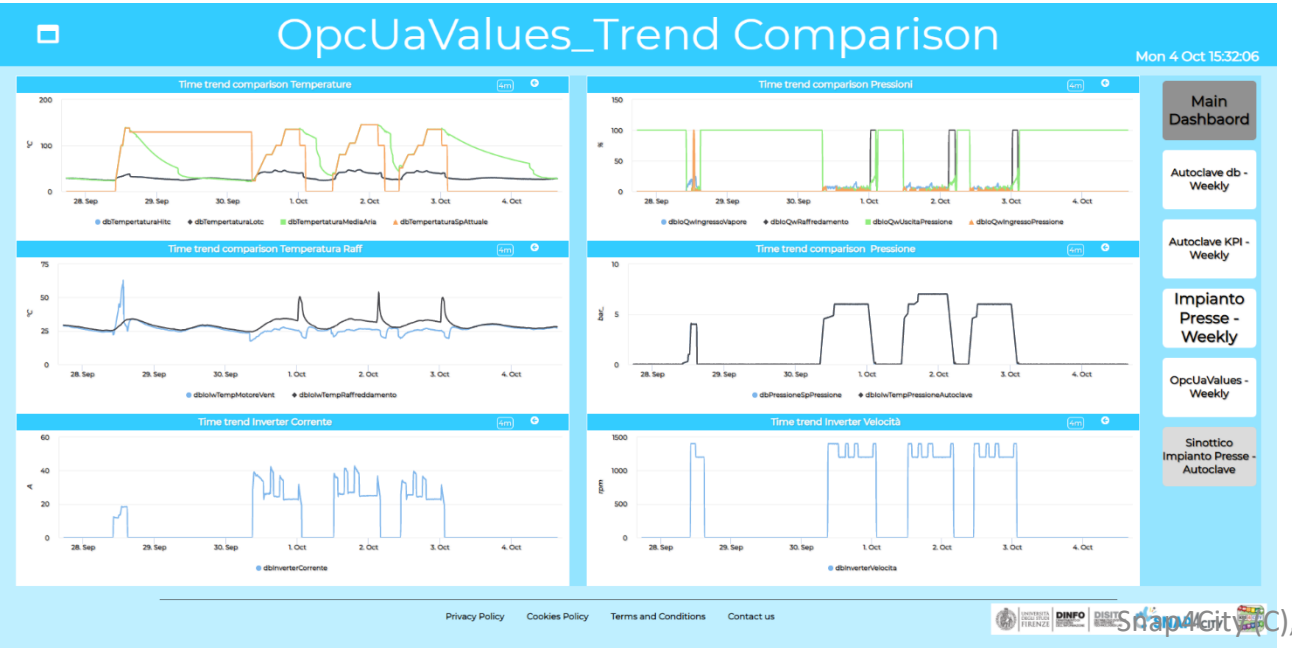
- **Solving Navier-Stokes PDE** (partial differential equations) equation, **via PINN** approach
  - Reduction of computing costs for simulating load effect into the autoclaves curing process
  - Validation wrt Open Foam
  - Precision on steady and transitory cases
  - Definition of Transfer Learning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

Comparison of PINN vs OpenFoam and error




Autoclave_db - Weekly
Mon 4 Oct 15:28:14
Autoclave - autPress
Autoclave - spPress
Autoclave - avgAirTemp
Autoclave - spTemp
Autoclave - hitcTemp
Autoclave - lotcTemp
Autoclave - evModInVapore
Autoclave - evModInPress
Autoclave - evModInScarico
Autoclave - outMotor
Main Dashboard
Autoclave KPI - Weekly
Impianto Presse - Weekly
OpcUaValues - Weekly
OpcUaValues Trend Comparison
Sinottico Impianto Presse - Autoclave


OpcUaValues - Weekly
Mon 4 Oct 15:33:07
dbTempertaturaHitc
dbTempertaturaMediaAria
dbTempertaturaLotc
dbTempertaturaSpAttuale
dbloQwUscitaPressione
dbloQwIngressoVapore
dbPressioneSpPressione
dbloQwRaffredamento
dbInverterCorrente
dbCicloNumero
Main Dashboard
Autoclave db - Weekly
Autoclave KPI - Weekly
Impianto Presse - Weekly
OpcUaValues Trend Comparison
Sinottico Impianto Presse - Autoclave


OpcUaValues_Trend Comparison
Mon 4 Oct 15:32:06
Time trend comparison Temperature
Time trend comparison Pressioni
Time trend comparison Temperatura Raff
Time trend comparison Pressione
Time trend Inverter Corrente
Time trend Inverter Velocità
Main Dashboard
Autoclave db - Weekly
Autoclave KPI - Weekly
Impianto Presse - Weekly
OpcUaValues - Weekly
Sinottico Impianto Presse - Autoclave
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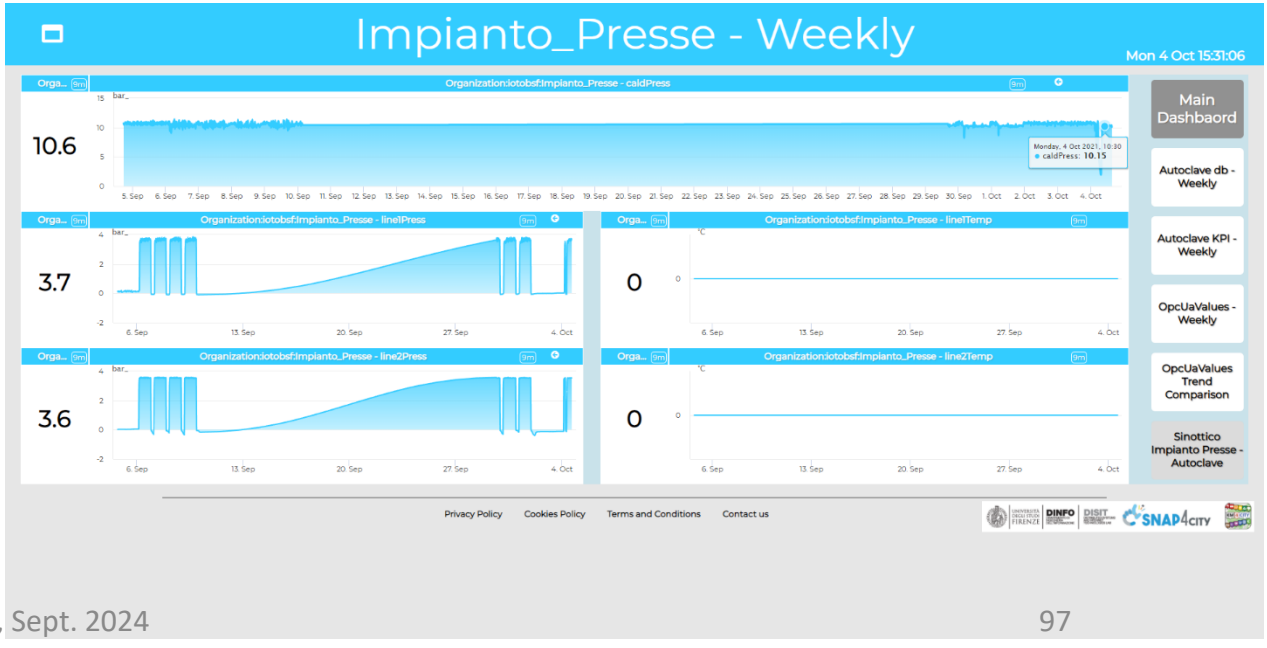
Impianto_Presse - Weekly
Mon 4 Oct 15:31:06
Organization:iotobsf:Impianto_Presse - caldPress
Organization:iotobsf:Impianto_Presse - line1Press
Organization:iotobsf:Impianto_Presse - line1Temp
Organization:iotobsf:Impianto_Presse - line2Press
Organization:iotobsf:Impianto_Presse - line2Temp
Main Dashboard
Autoclave db - Weekly
Autoclave KPI - Weekly
OpcUaValues - Weekly
OpcUaValues Trend Comparison
Sinottico Impianto Presse - Autoclave
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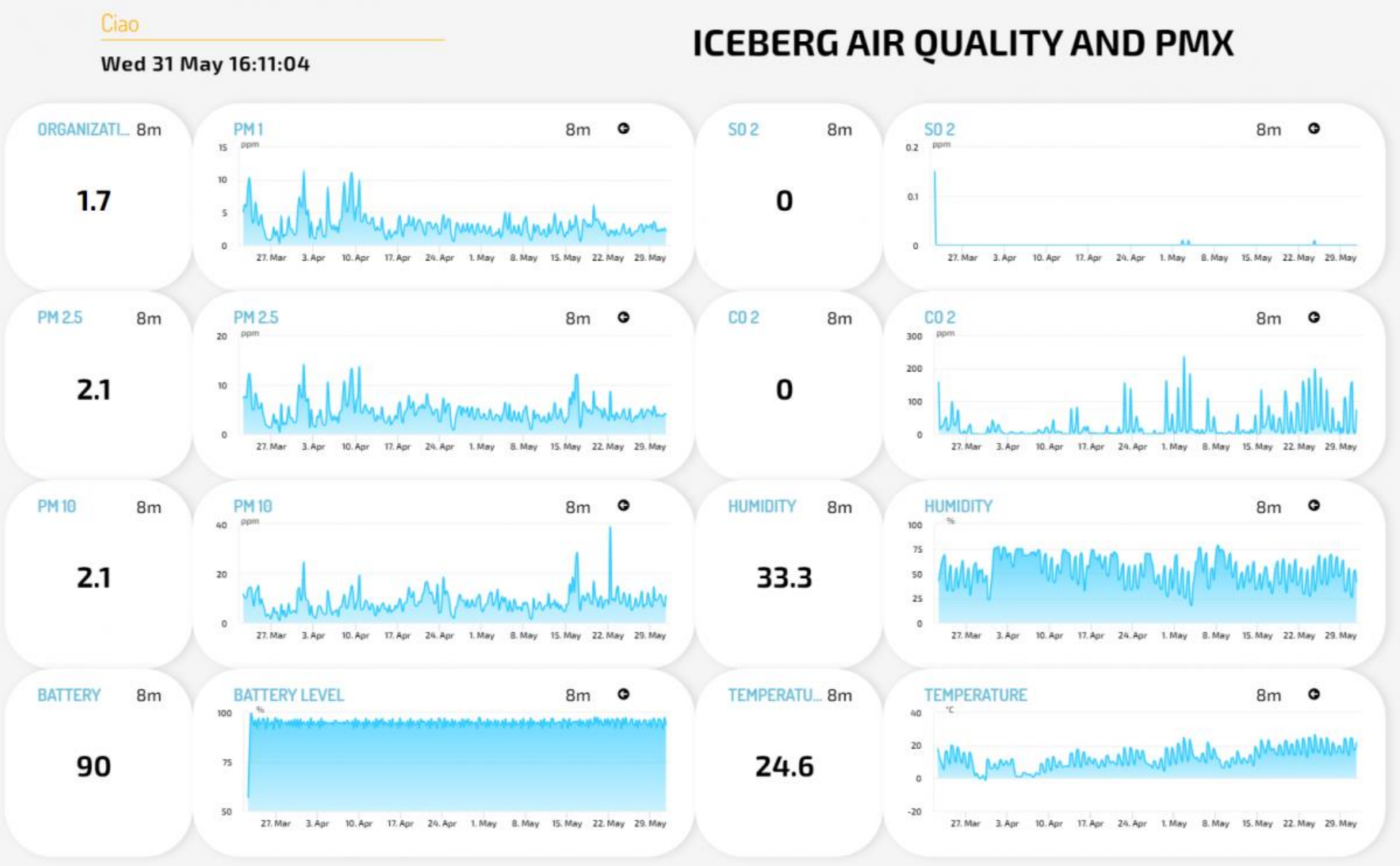
TheLab.City LivingLab by ICEBERG, Romania

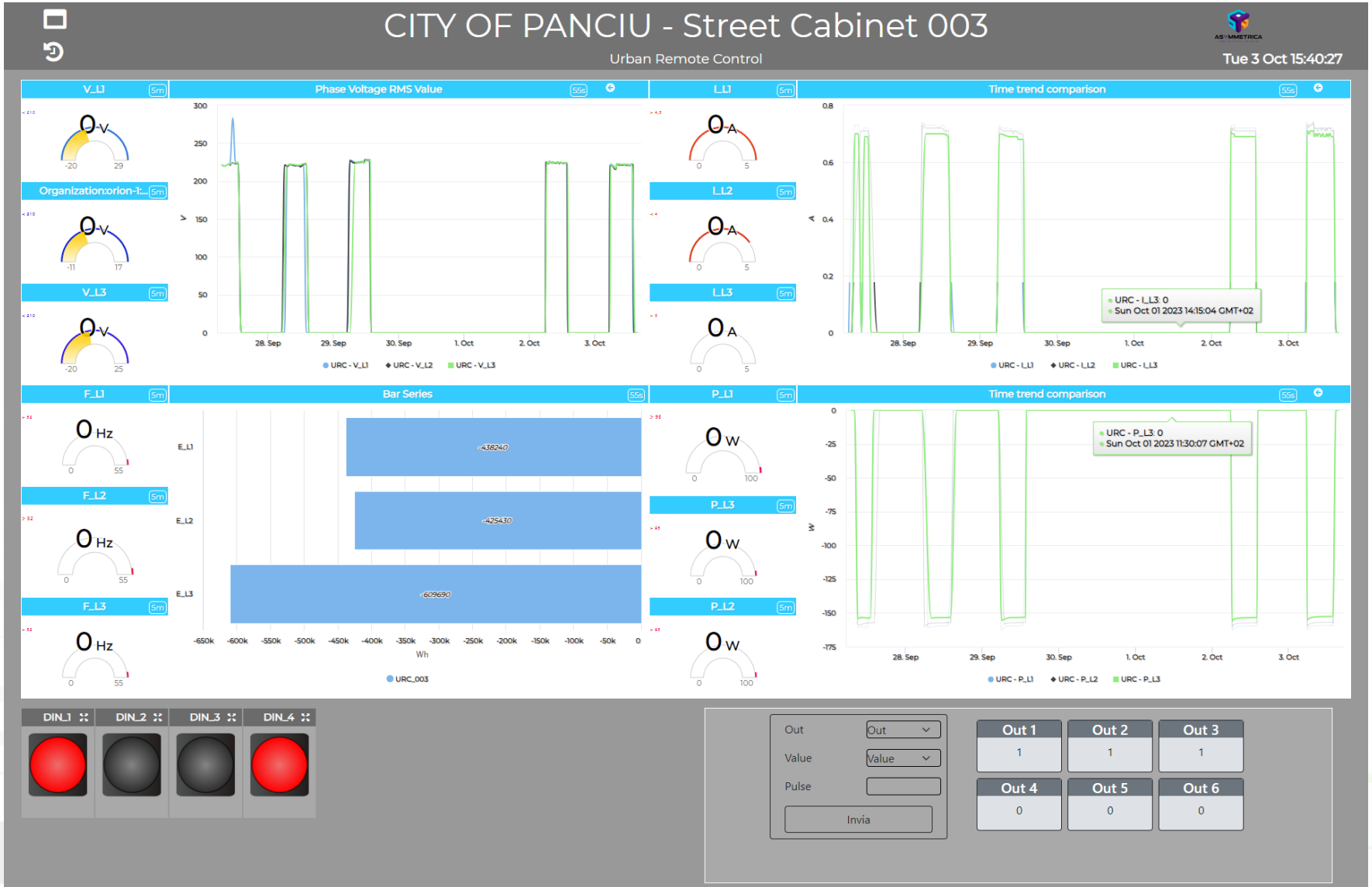


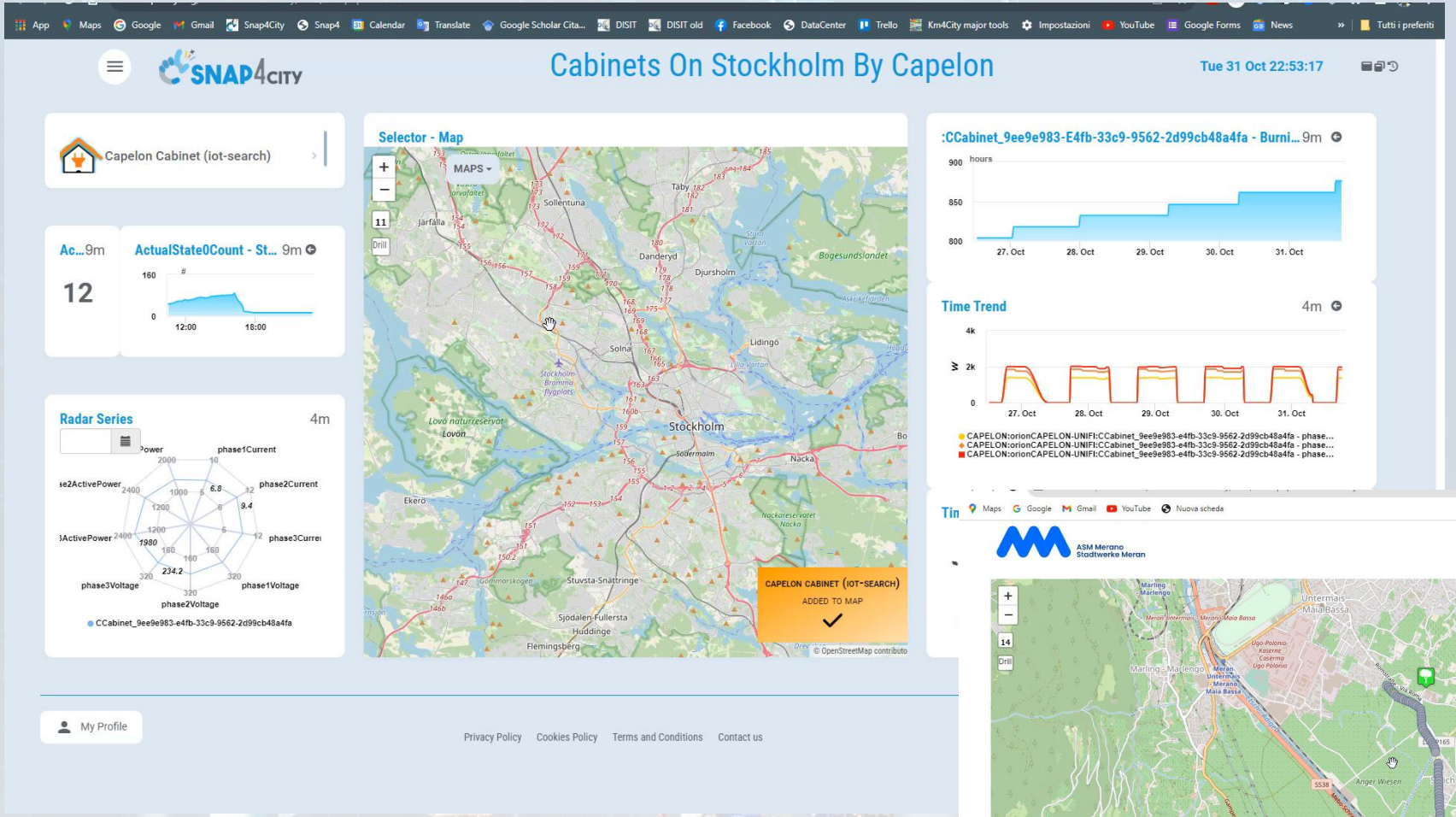
- Airquality
- Urban planning
- Parking
- Waste
- Etc.

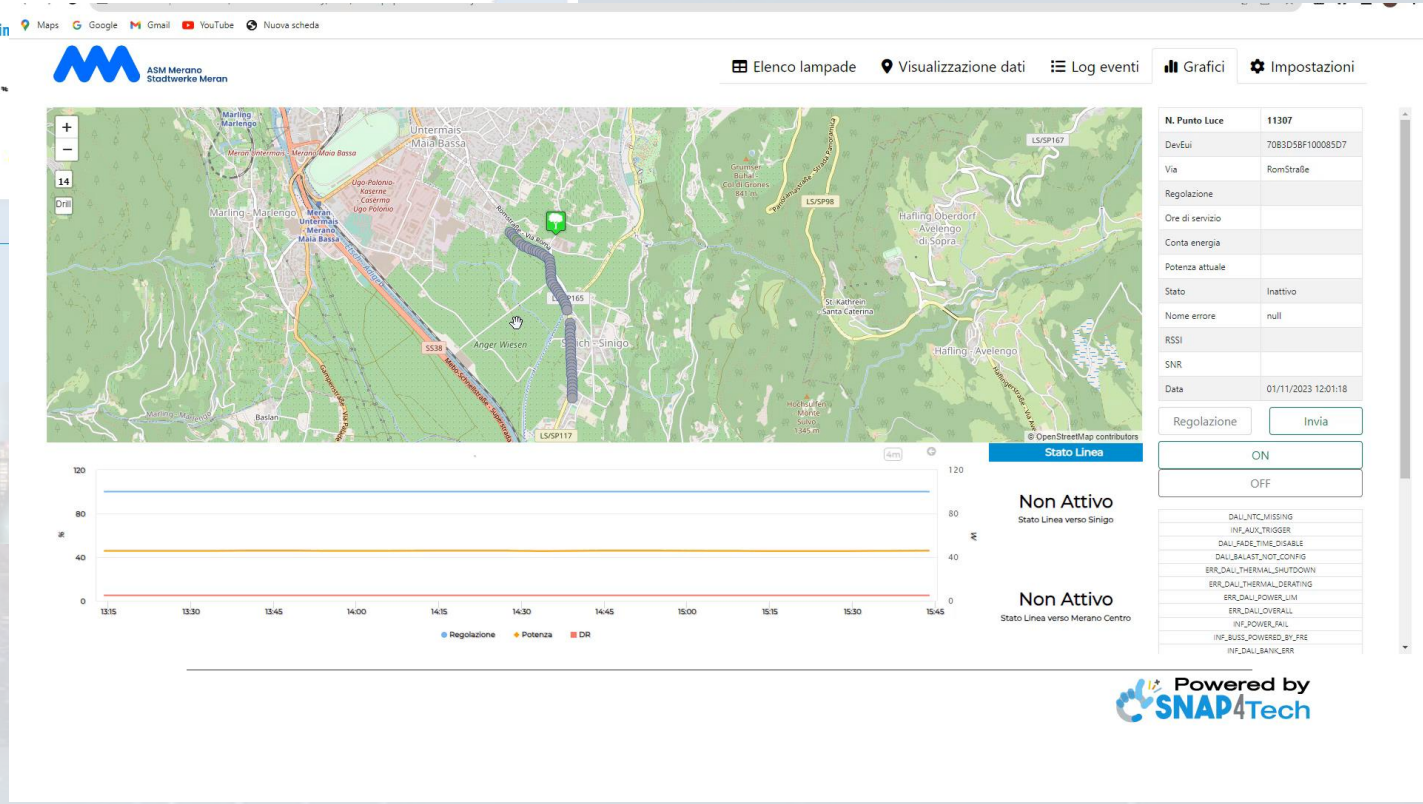
https://thelab.city/

City of Panciu in Romania

By Asymmetrica and Snap4







Smart Light Management

ASM Merano Stadtwerke Meran

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

SNAP4CITY

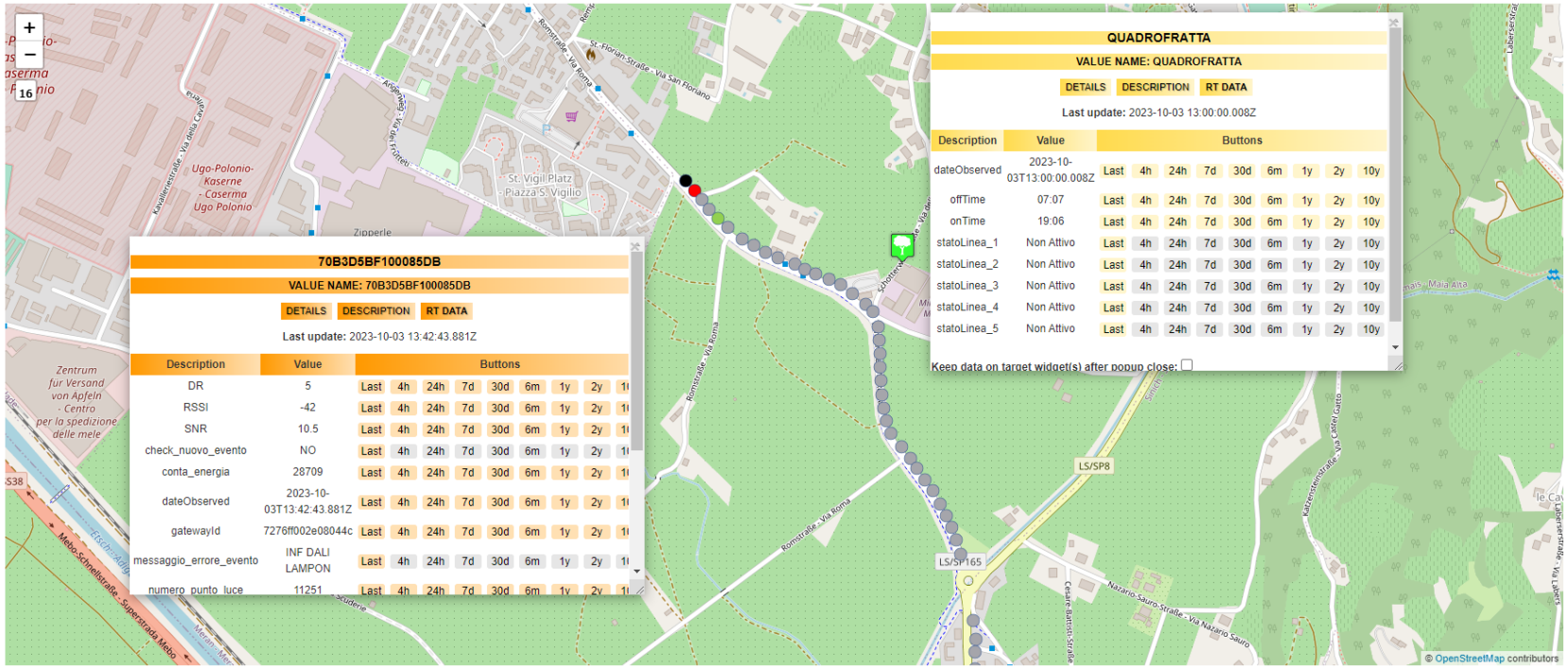
KM 4 CITY

Show 500 entries

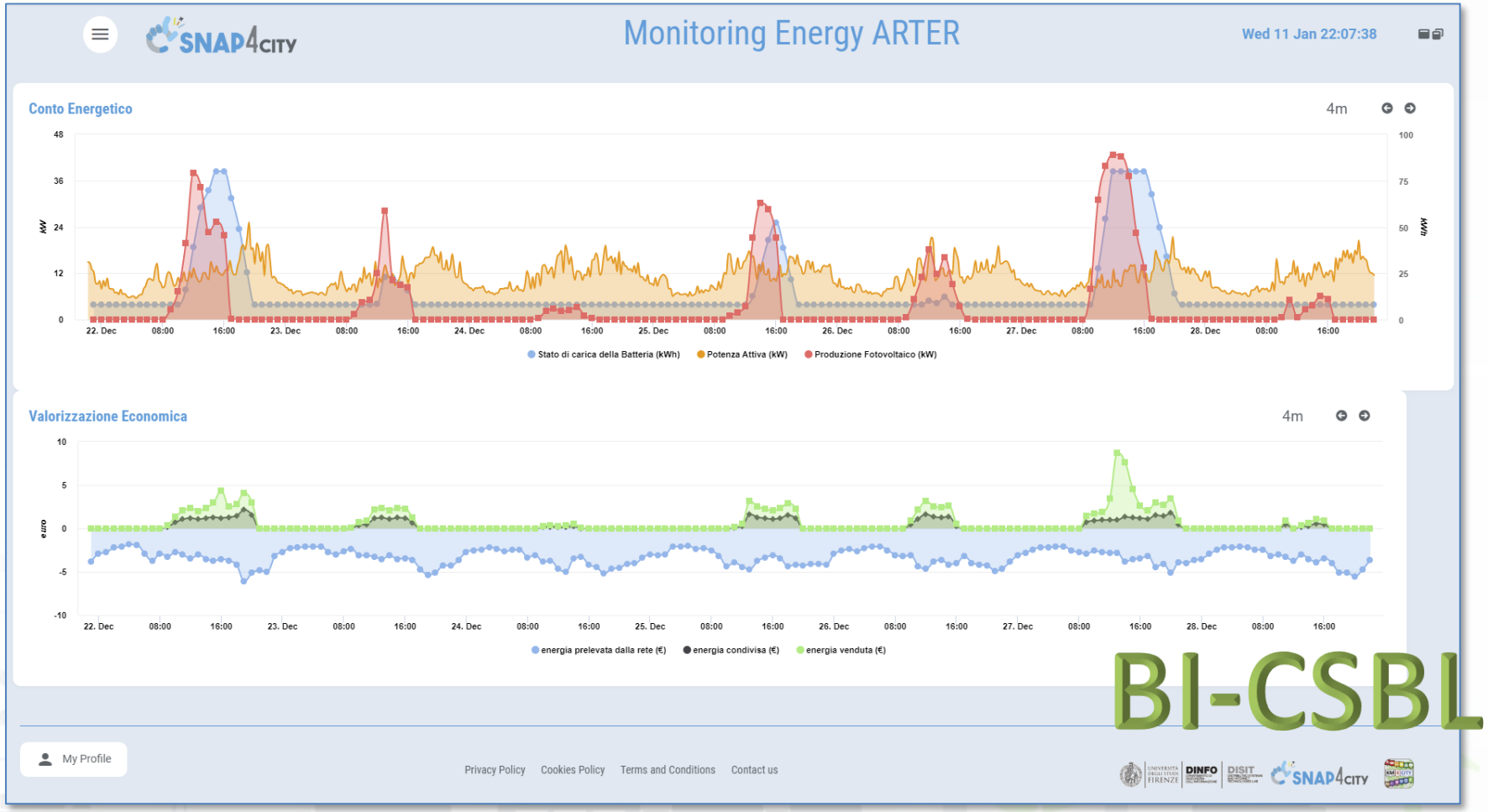
Data	Numero punto luce (Punto Luce)	DevEui Lorawan	Via	Eventi e messaggi d'errore (Search..)
30/09/2023 23:51:59	11710	70B3D5BF100085E8	RomStraße	INF LL CHANGED, INF DALI LAMPON
30/09/2023 23:42:28	9	70B3D5BF100085F9	RomStraße	INF LL CHANGED, INF DALI LAMPON
30/09/2023 23:42:23	22	70B3D5BF100085ED	RomStraße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

ASM Merano Stadtwerke Meran

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



- **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



https://www.selfuser.it

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

SNAP4INDUSTRY | KM4CITY

https://www.snap4city.org/dashboardSmartCity/view/Gea.php?iddasboard=MzY3Ng==

SNAP4CITY

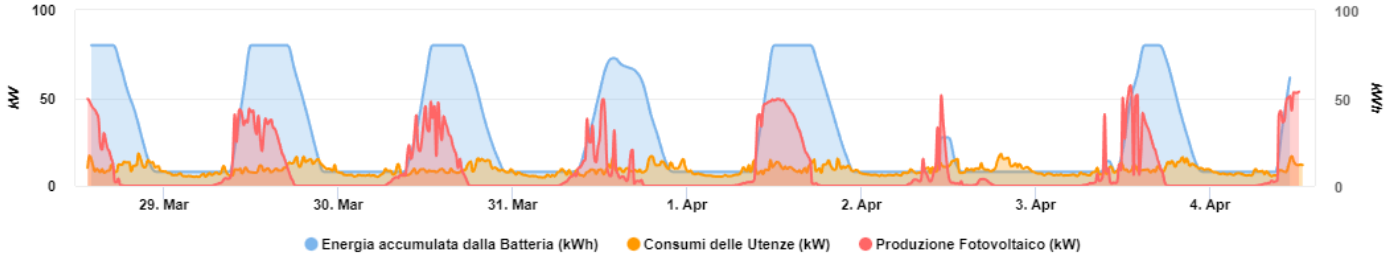
SELF USER

Monitoraggio in tempo reale della comunità energetica condominiale

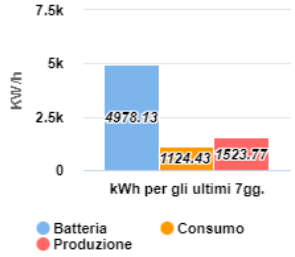
Tue 4 Apr 13:20:04

SELF USER

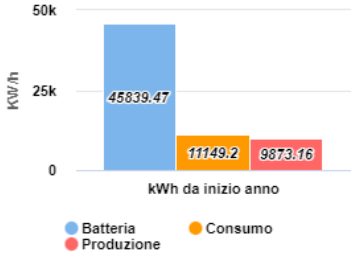
Conto Energetico



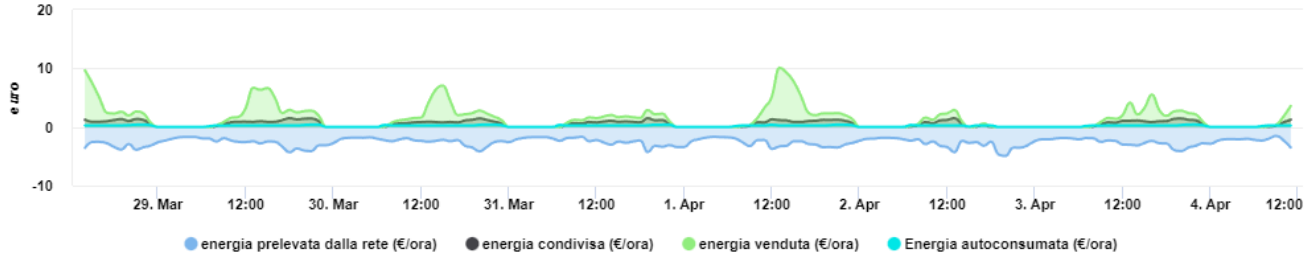
KWh Ultimi 7 Gg.



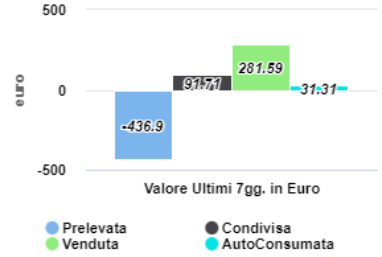
KWh Da Inizio Anno



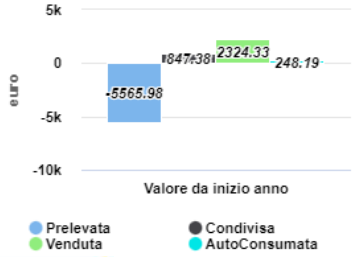
Valorizzazione Economica



Valore Ultimi 7gg.



Valore Da Inizio Anno



Regione Emilia-Romagna | ART-ER | ACER | ENEA | enel x

7 AFFORDABLE AND CLEAN ENERGY

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

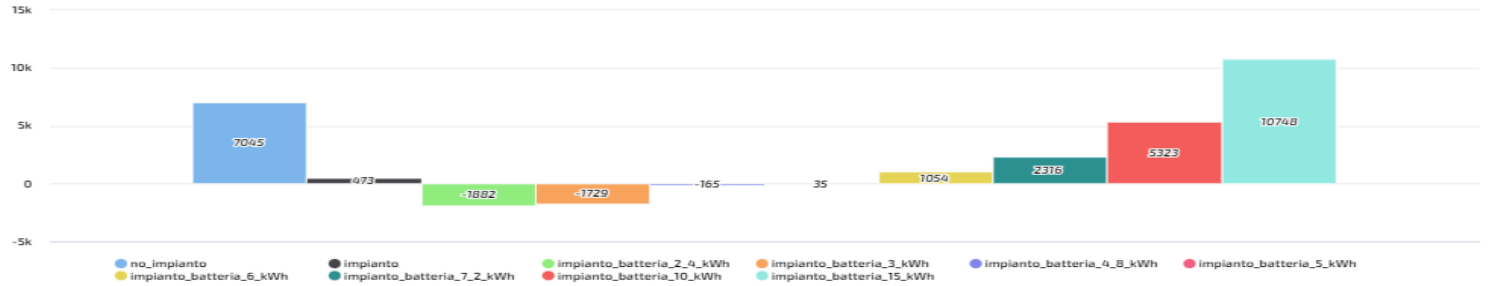
Ciao roottooladmin1

Tue 4 Apr 13:15:34

SIMULATORE IMPIANTO FOTOVOLTAICO

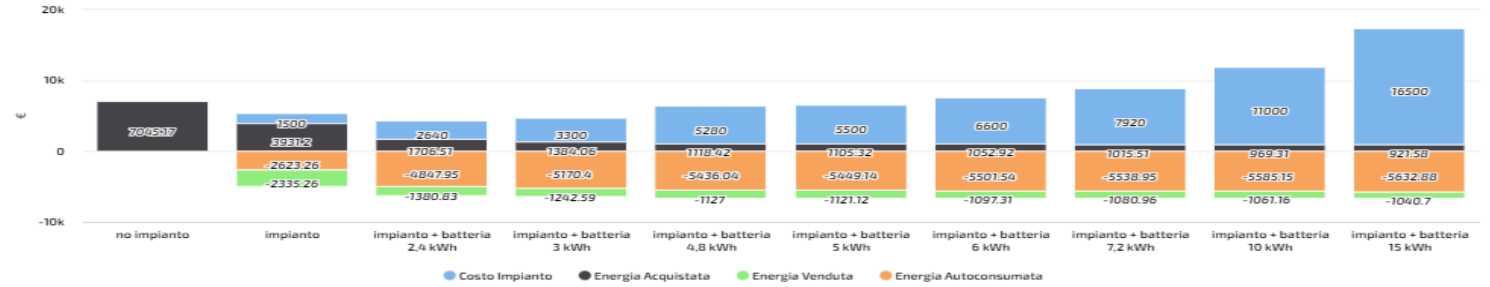
COSTO COMPLESSIVO NEGLI ANNI DI INVESTIMENTO

599m



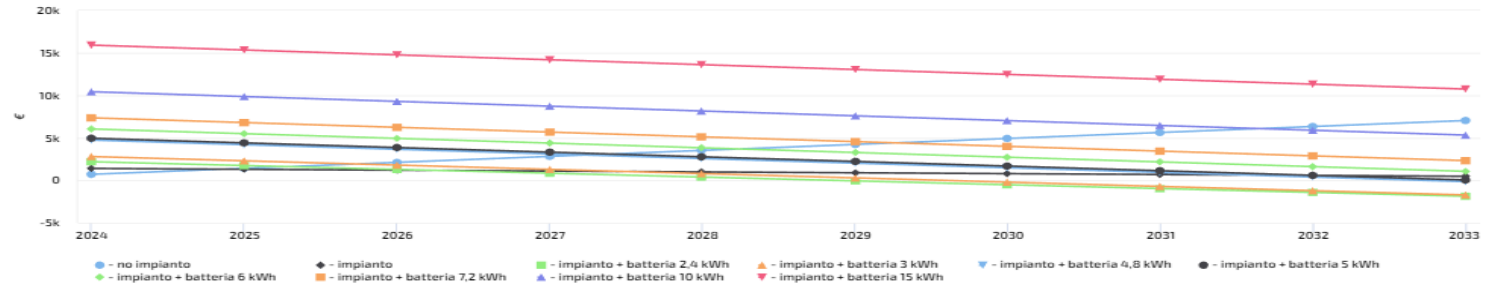
COSTO COMPLESSIVO NEGLI ANNI DI INVESTIMENTO PARTIZIONATO

599m



ANDAMENTO PREZZO CUMULATIVO ANNUO

599m



Manuale Utente

English Version

PARAMETRI DELL'IMPIANTO

Ti consigliamo un impianto con batteria da 2,4 kWh

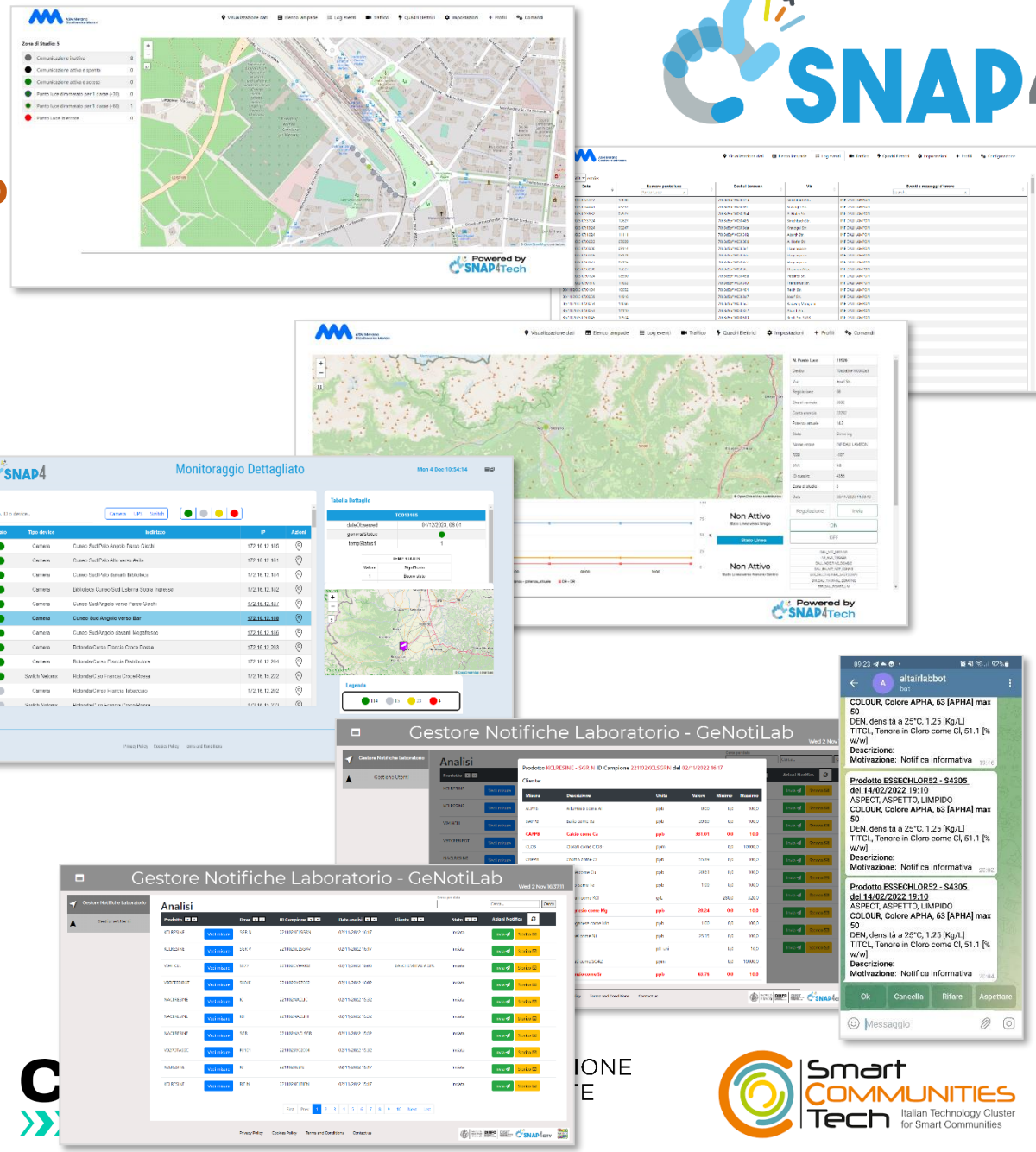
Gruppo di Consumo Annuale	2000 kWh
Prezzo Energia Vendita (€/kWh)	0,15
Prezzo Energia Acquisto (€/kWh)	0,35
Anni di Investimento	10
Mese da simulare	Gennaio

Invia

7 AFFORDABLE AND CLEAN ENERGY

RECENT TRACK RECORD

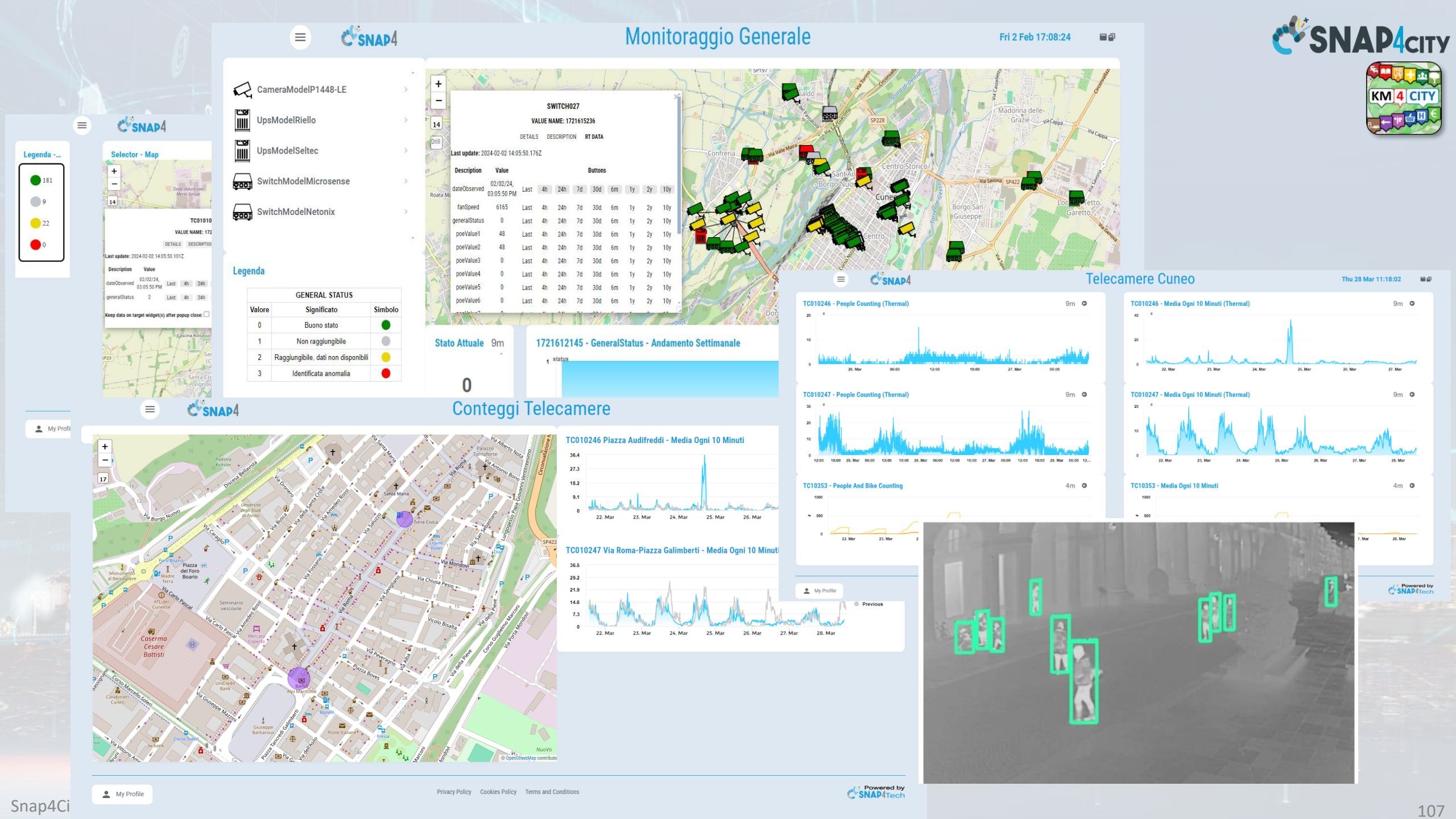
- **Snap4Meran:**
  - Gestione Smart di 1009 punti luce in Merano
  - 70 Quadri illuminazione e consumi
  - 50 Misuratori traffico
  - Gestione TAI (Traffic Adaptive Installation)
- **Snap4Cuneo**
  - Monitoraggio e controllo dei servizi
    - Videosorveglianza
    - Varchi traffico
    - Infrastruttura ICT
- **Snap4Altair Chimica**
  - Notificatore Smart per il monitoraggio della qualità della produzione
- **…**



Innovation meeting | 4 dicembre 2023

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



Monitoraggio Generale
Fri 2 Feb 17:08:24
CameraModelP1448-LE
UpsModelRiello
UpsModelSeltec
SwitchModelMicrosense
SwitchModelNetonix
Legenda
GENERAL STATUS
Valore | Significato | Simbolo
0 | Buono stato
1 | Non raggiungibile
2 | Raggiungibile, dati non disponibili
3 | Identificata anomalia
SWITCH027
VALUE NAME: 1721615236
DETAILS DESCRIPTION RT DATA
Last update: 2024-02-02 14:05:50.176Z
Description Value Buttons
dateObserved 02/02/24, 03:05:50 PM Last 4h 24h 7d 30d 6m 1y 2y 10y
fanSpeed 6165 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
poeValue2 48 Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue3 0 Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue4 0 Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue5 0 Last 4h 24h 7d 30d 6m 1y 2y 10y
poeValue6 0 Last 4h 24h 7d 30d 6m 1y 2y 10y
Stato Attuale 9m
0
1721612145 - GeneralStatus - Andamento Settimanale
Legenda -...
181
9
22
0
Selector - Map
Telecamere Cuneo
Thu 28 Mar 11:18:02
TC010246 - People Counting (Thermal) 9m
TC010246 - Media Ogni 10 Minuti (Thermal) 9m
TC010247 - People Counting (Thermal) 9m
TC010247 - Media Ogni 10 Minuti (Thermal) 9m
TC10353 - People And Bike Counting 4m
TC10353 - Media Ogni 10 Minuti 4m
Conteggi Telecamere
TC010246 Piazza Audifreddi - Media Ogni 10 Minuti
TC010247 Via Roma-Piazza Galimberti - Media Ogni 10 Minuti
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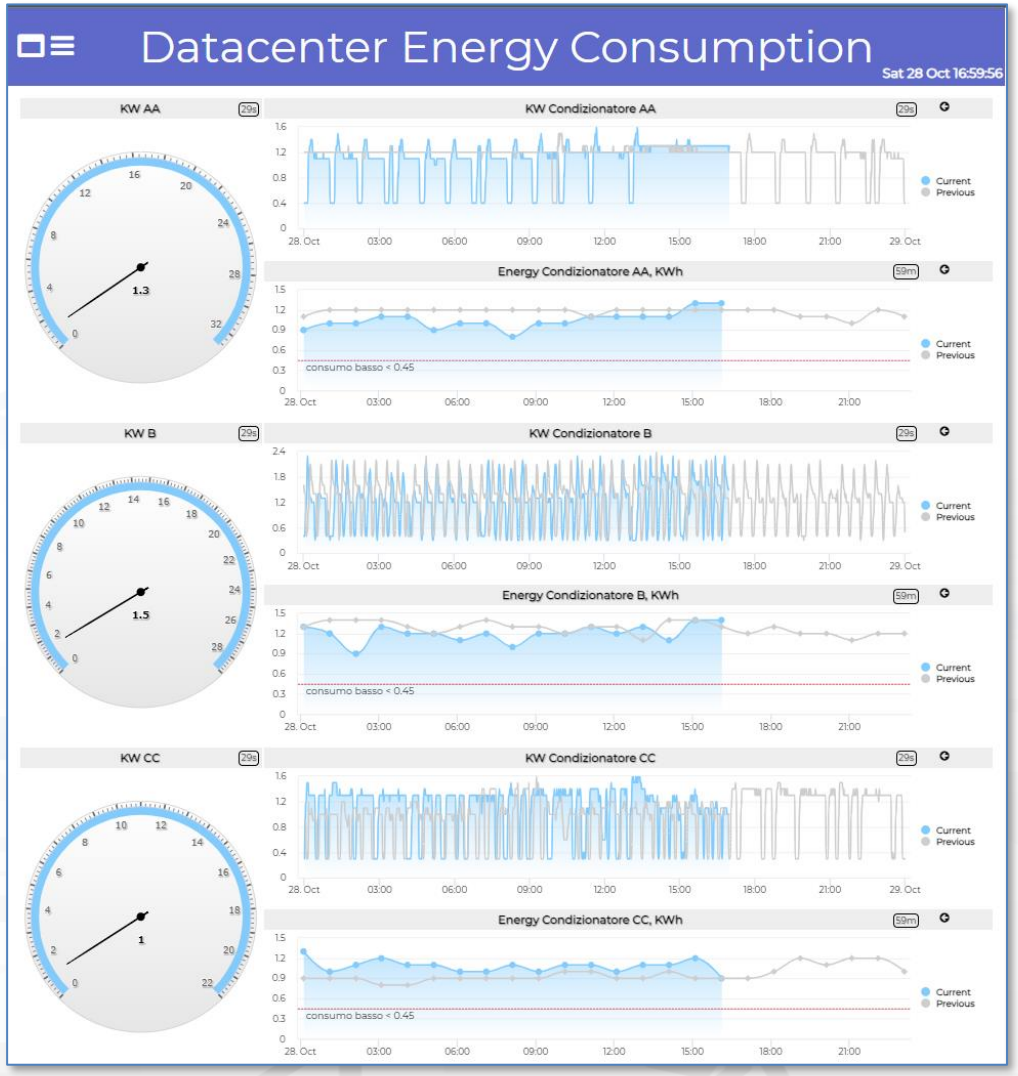
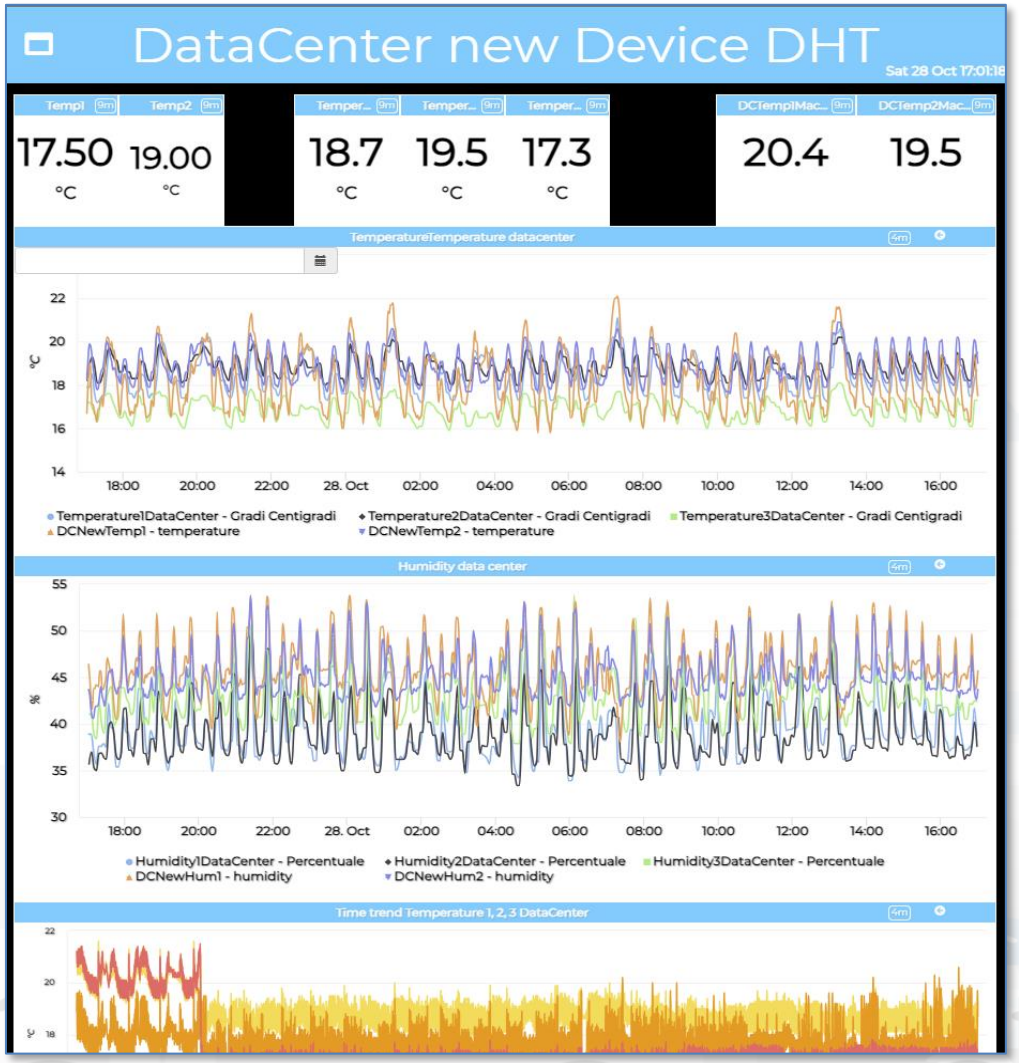
My Profile
Privacy Policy
Cookies Policy
Terms and Conditions
Powered by SNAP4Tech

Data Center monitoring





EN.TE.R.PR.I.S.E.

(**EN**hanced **TE**chnological **R**&D of new **PR**oducts and Processes for **I**nnovation, **S**mart factory and green **E**conomy)

ALTAIR CHIMICA

Administrative Data from AS400

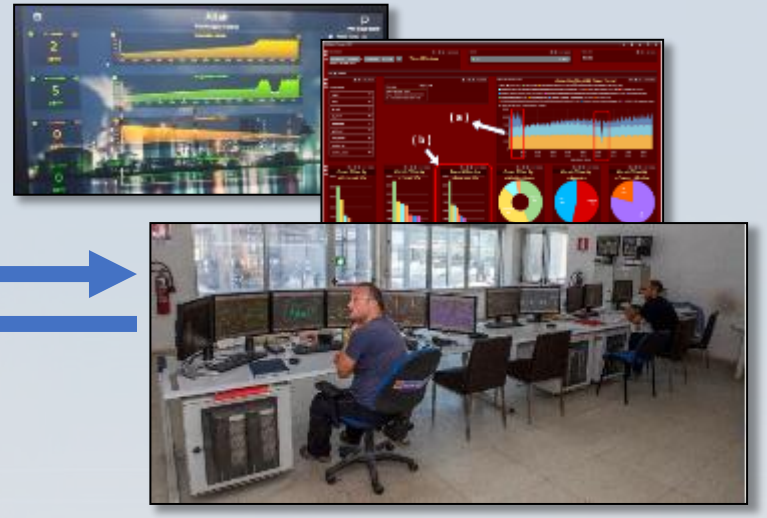
Real Time Data, Historical, Events from DCS

OPC UA

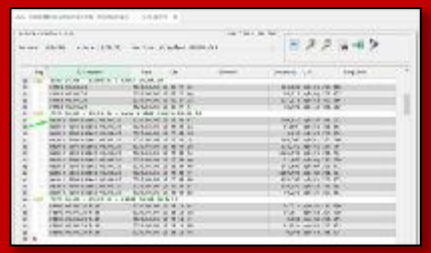
Unique National Energy Costs (PUN)

Big Data Analytics Artificial Intelligence Engine

SNAP4INDUSTRY

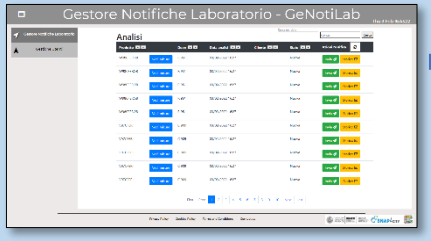


Analytical Data from the product quality Lab (LIMS/SAM)



SNAP4

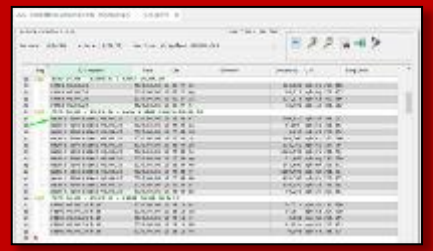
GeNotiLab



POR CreO REGIONE TOSCANA FONDO EUROPEO DI SVILUPPO REGIONALE 2014 2020 | UNIONE EUROPEA | REPUBBLICA ITALIANA | Regione Toscana

GeNotiLab Architecture for ALTAIR

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



AS400

IOT App

Users

Analysis

Notifications

IOT App Analytics

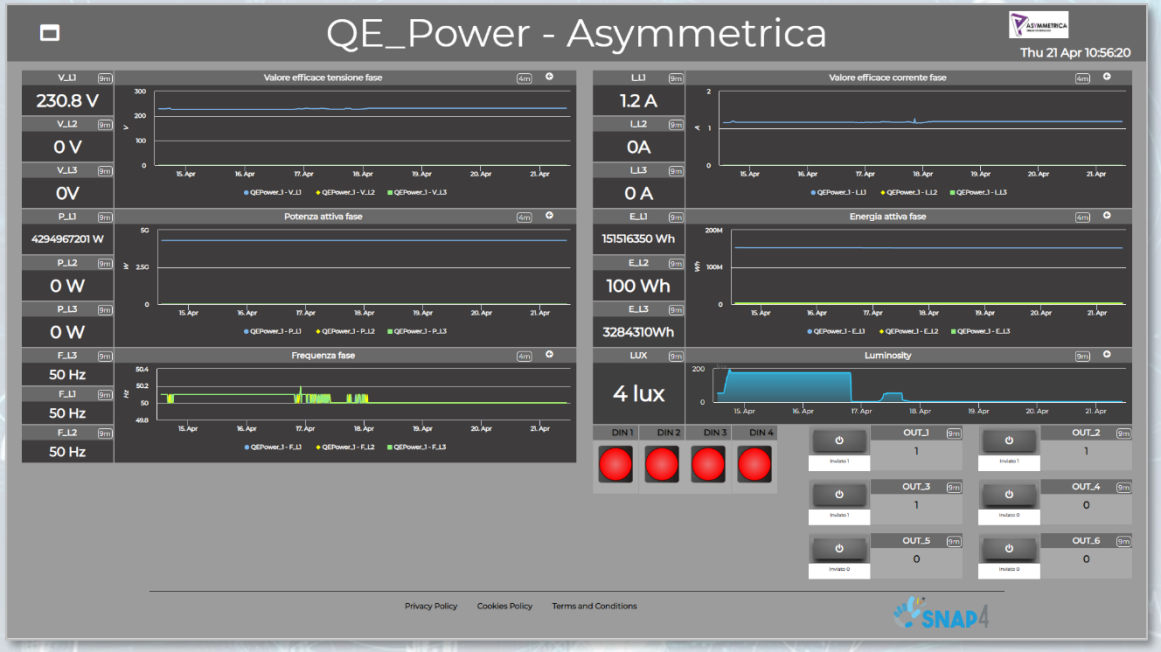
Dashboards

IOT App Management

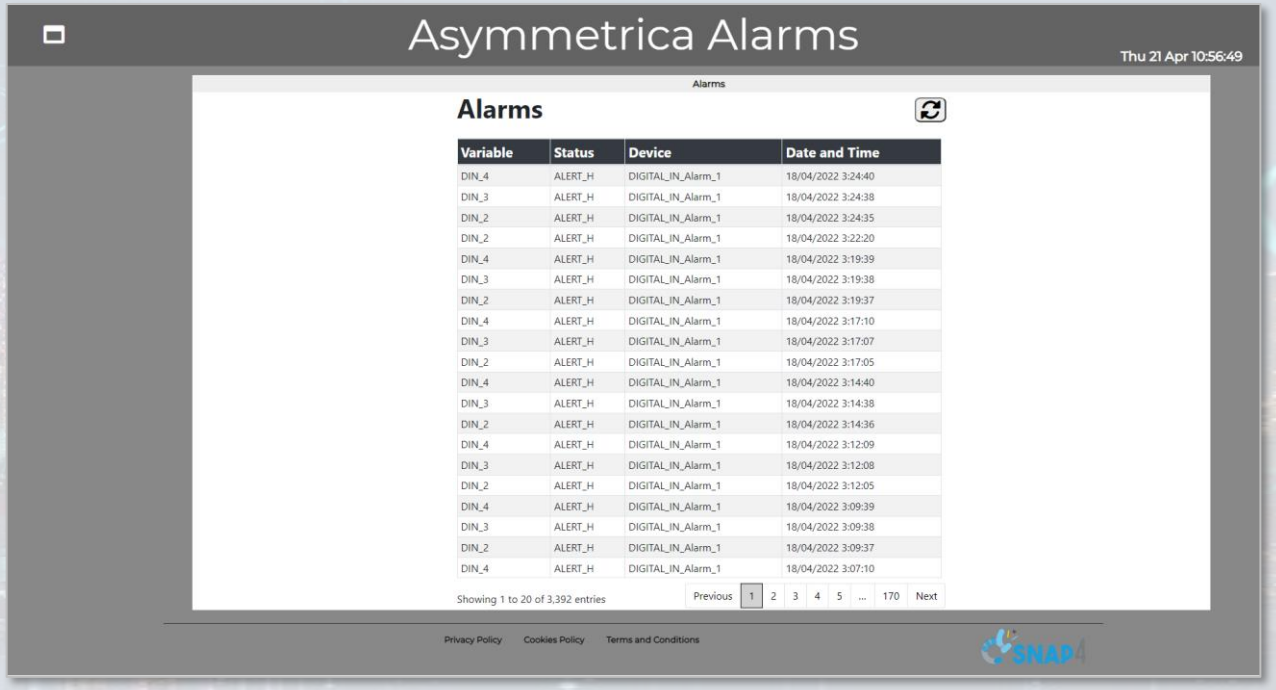
Tools:
-- List of Chemical Analyses
-- List of Notifications
-- Define notifications
-- Program, send notifications
-- see notification status

IOT App Vs Telegram

Telegram Bot



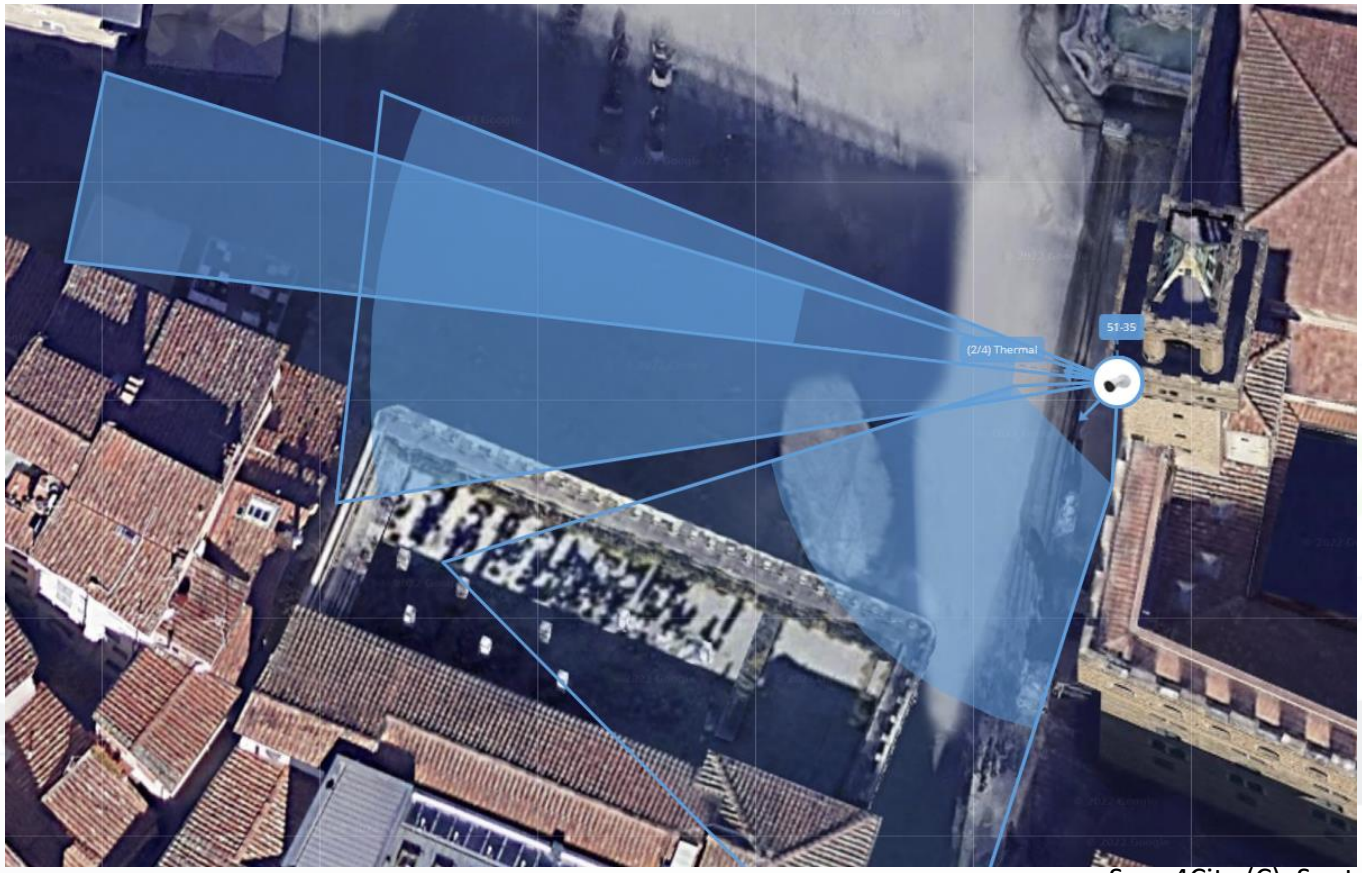
- Environmental data
- Power meter Data
- Smart Light data are coming (in collaboration with a multinational company)



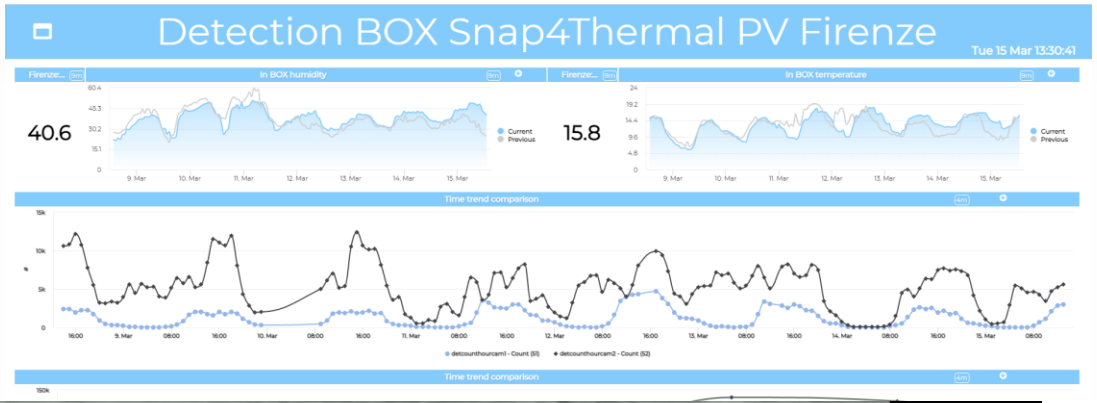
Monitoring and Tracking via Thermal Cameras

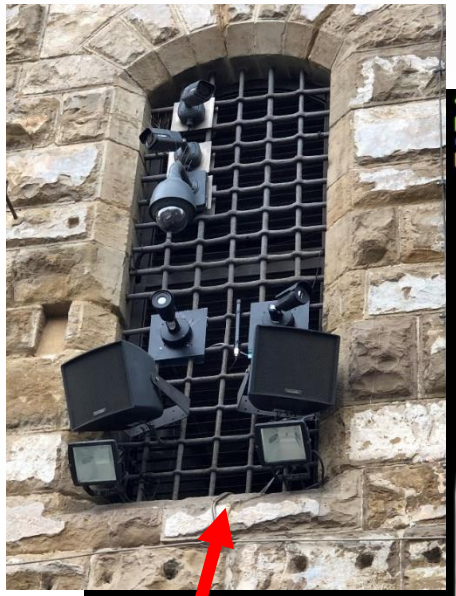
AXIS COMMUNICATIONS

Tracking People
AXIS Camera with Snap4City

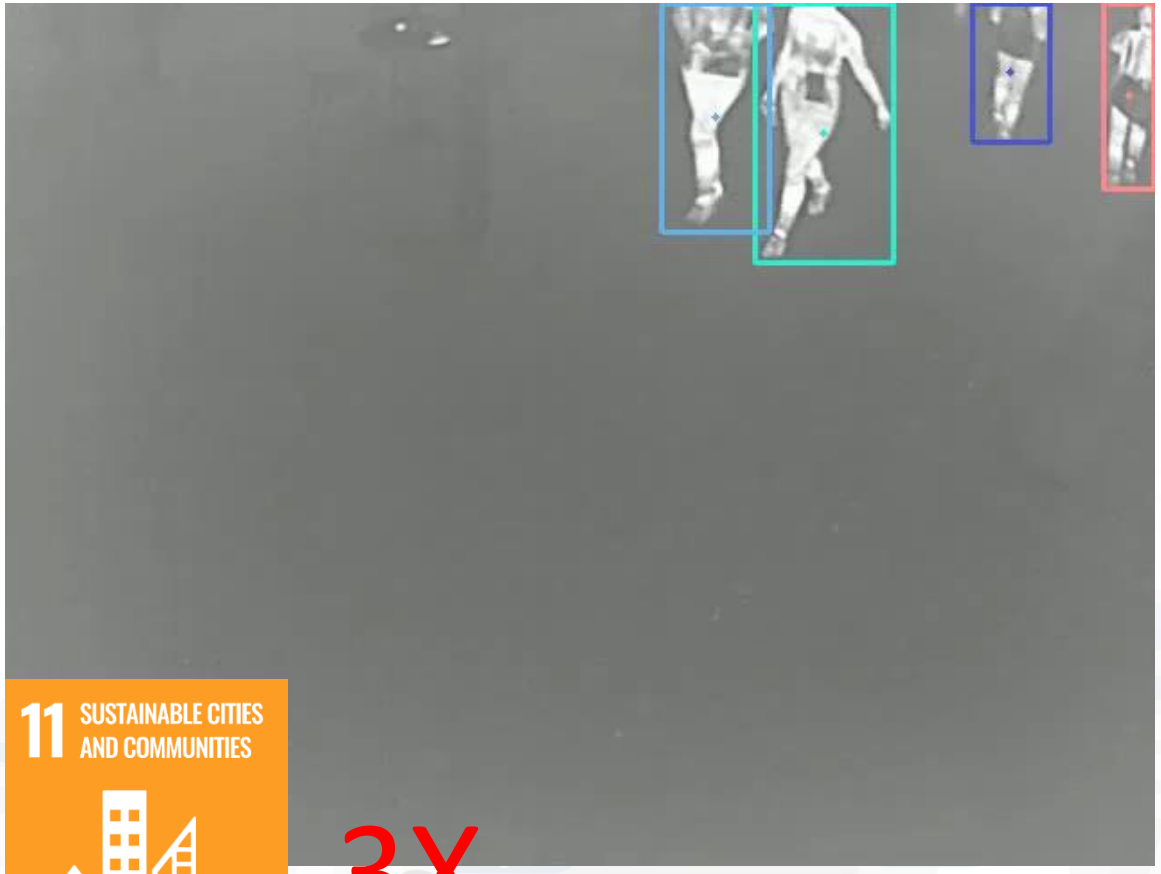


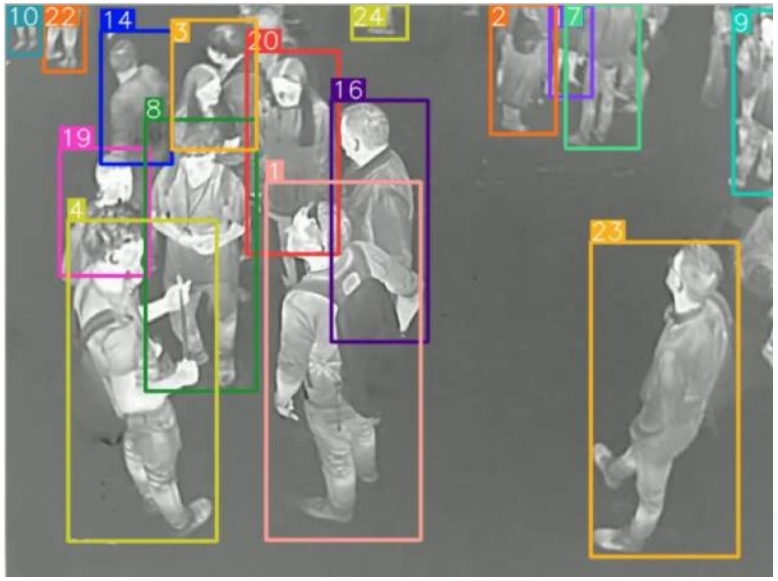
A view and data from the Thermal Camera

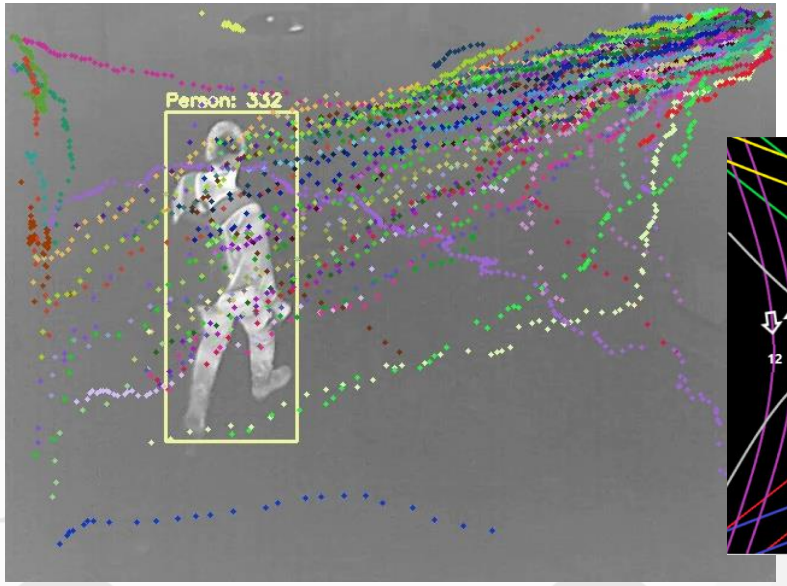


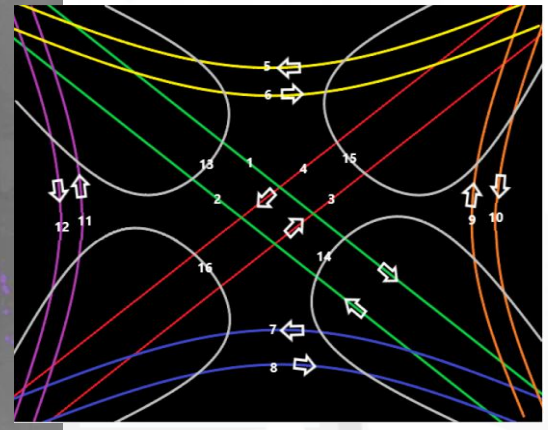


People Counting and Tracking









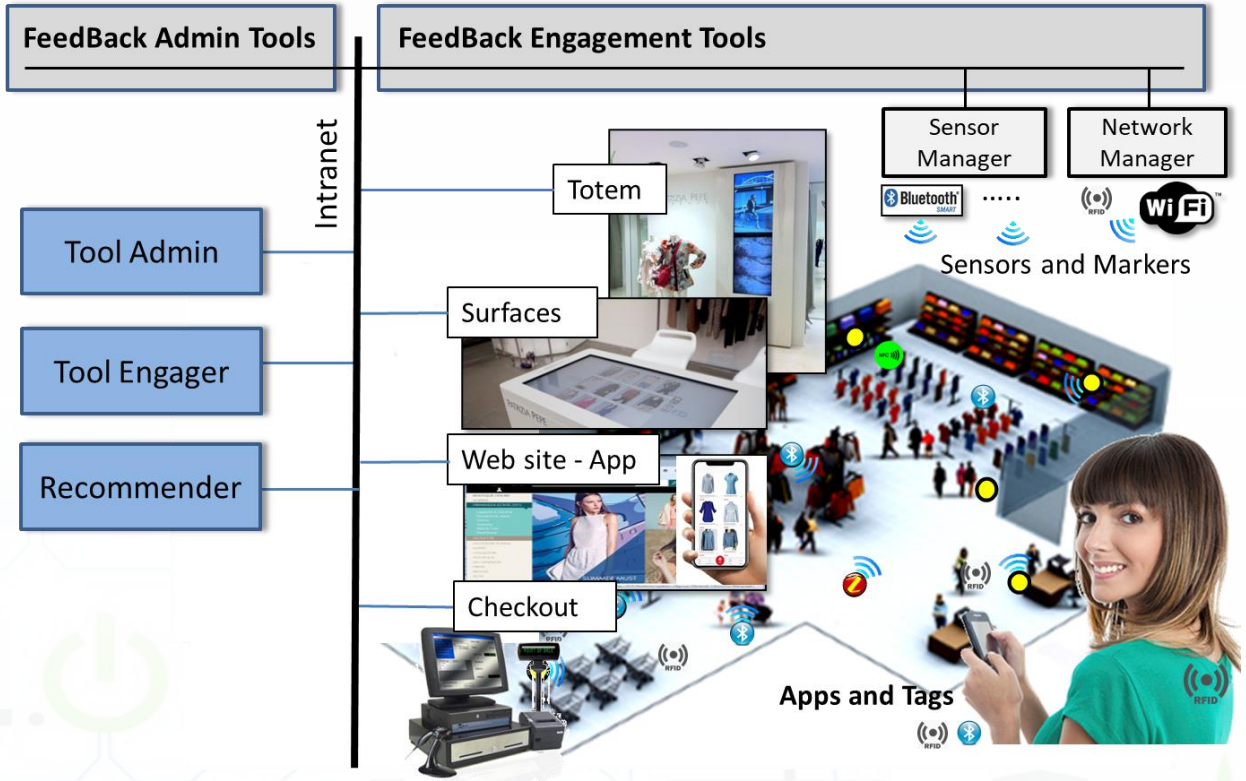
11 SUSTAINABLE CITIES AND COMMUNITIES

3X

Retail Recommendations Feedback Pilot

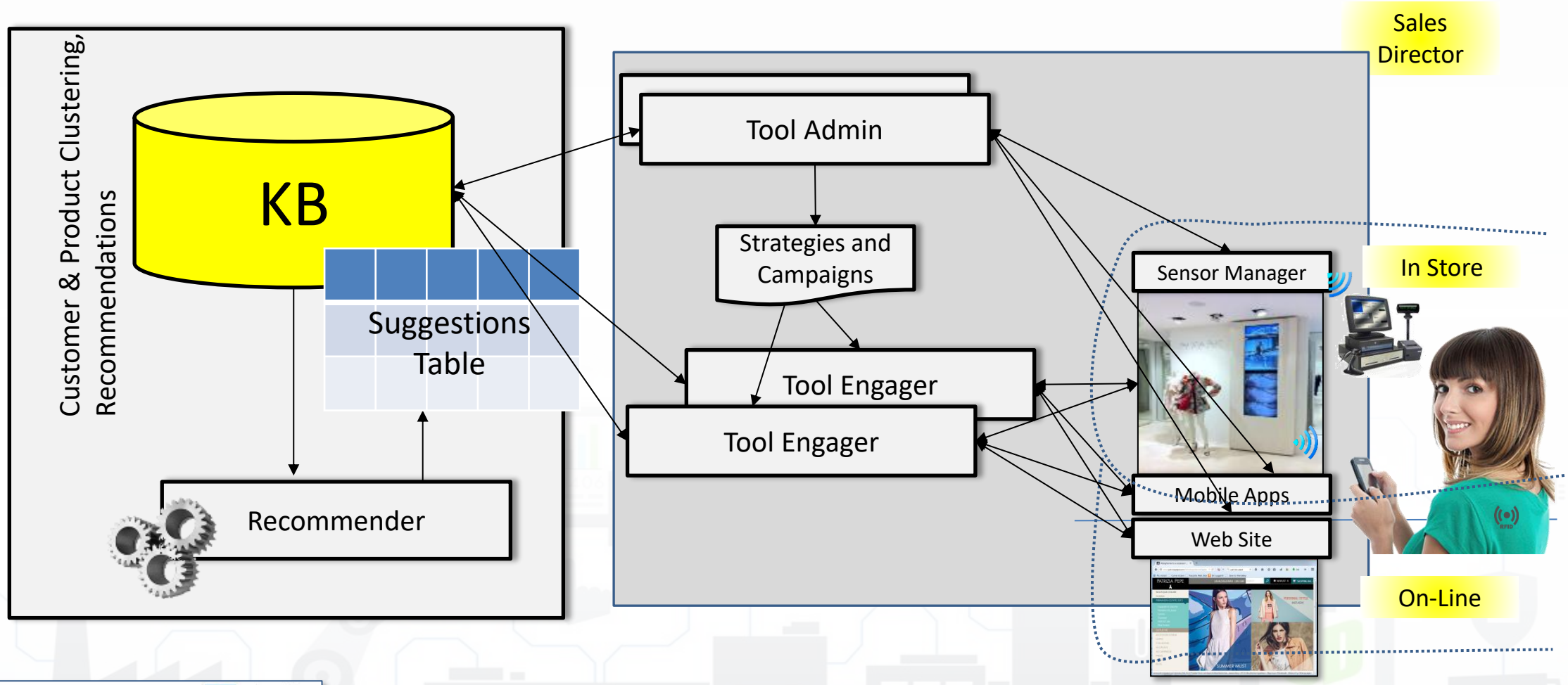
Smart Retail

- **Feedback,** Flexible Advanced Engagement Exploiting User Profiles and Product/Production Knowledge
  - VAR, PatriziaPepe (Tessilform), DISIT, Effective Knowledge, SICE
  - Keywords: retail, GDO, …
- **Goals and drivers:**
  - adaptive user engagement, customer experience
  - Advanced user profiling, user behavior analysis
  - Predictive models for engagement
  - IOT and instrumentation
  - Integrated in city customer

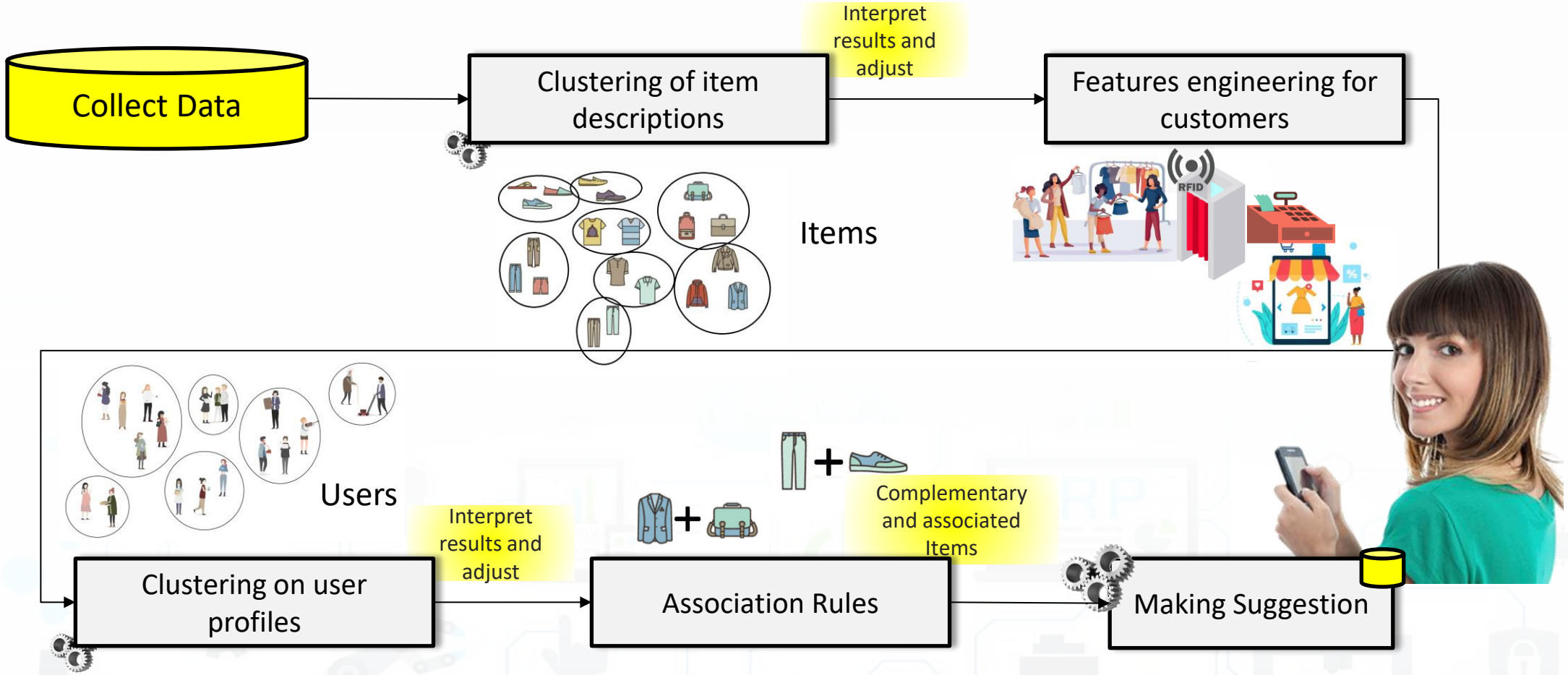


feedback

Reference Architecture



Workflow


Collect Data
Clustering of item descriptions
Interpret results and adjust
Features engineering for customers
Items
RFID
Users
Clustering on user profiles
Interpret results and adjust
Association Rules
Complementary and associated Items
Making Suggestion

feedback

- Using the stimulus of the recommendation system, we have increased the customers' attention of the 3.48%
- The solution is also functional in presence of a low number of customers and items
- The solution solved the cold start problems
- GDPR compliant

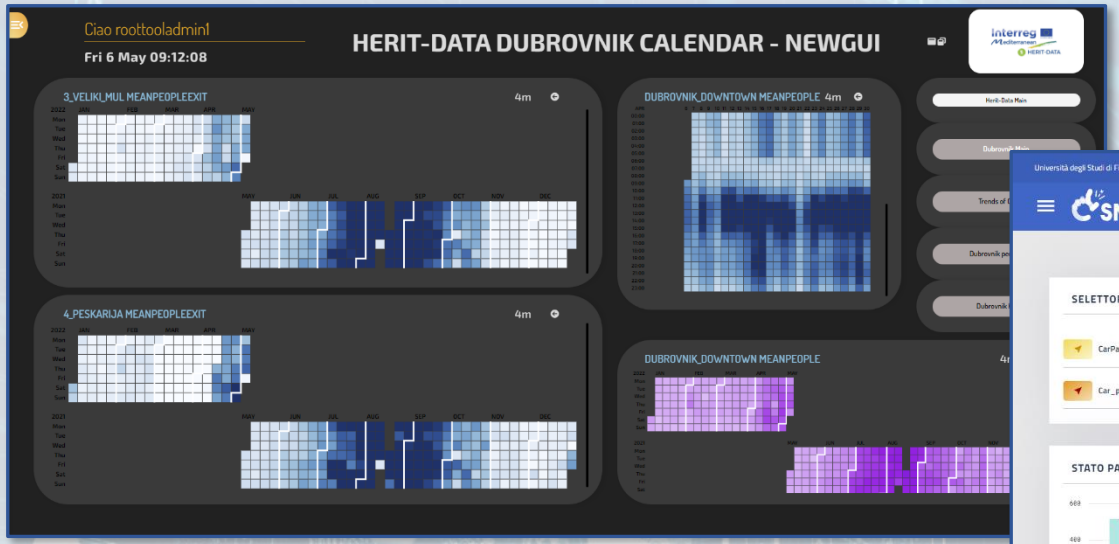
How to Develop

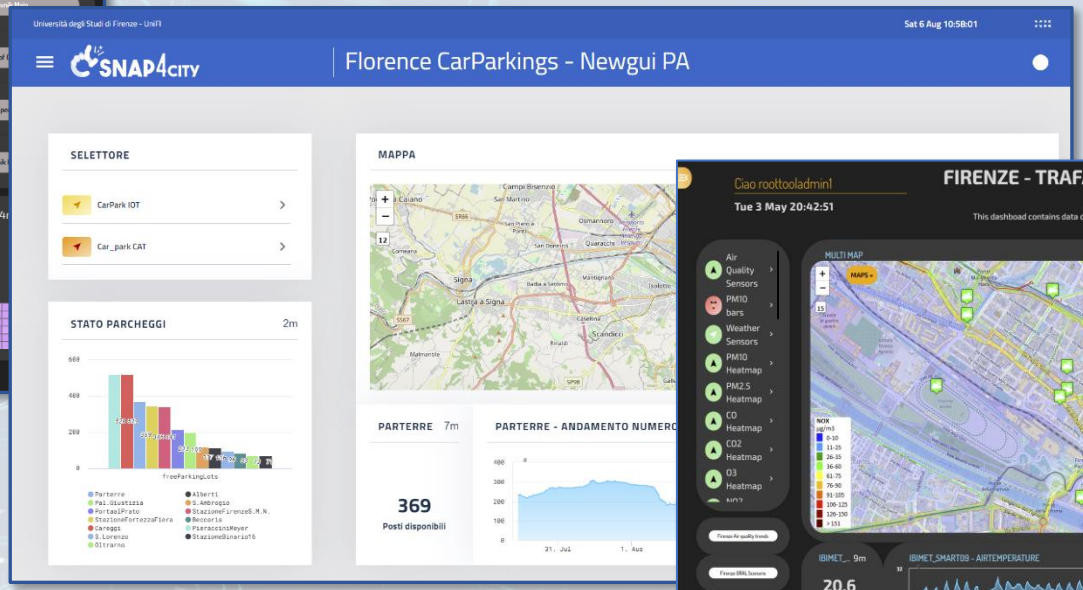
https://www.snap4city.org/download/video/course/dev/

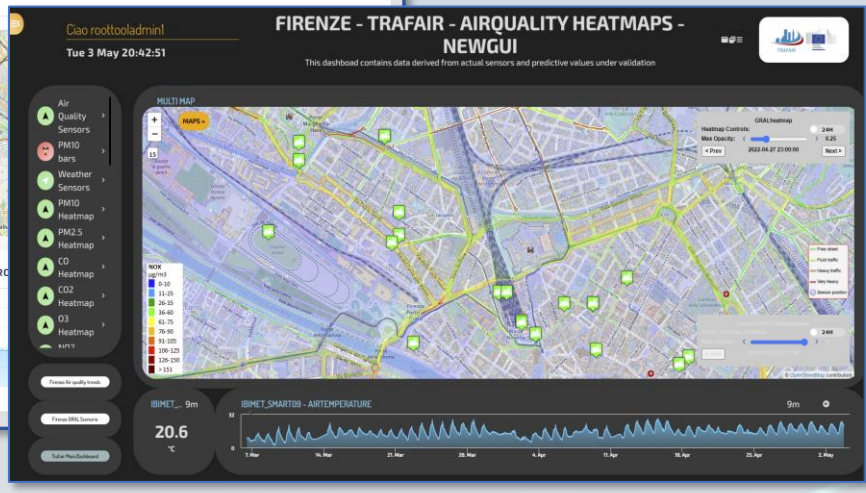
https://www.snap4city.org/download/video/Snap4Tech-Development-Life-Cycle.pdf

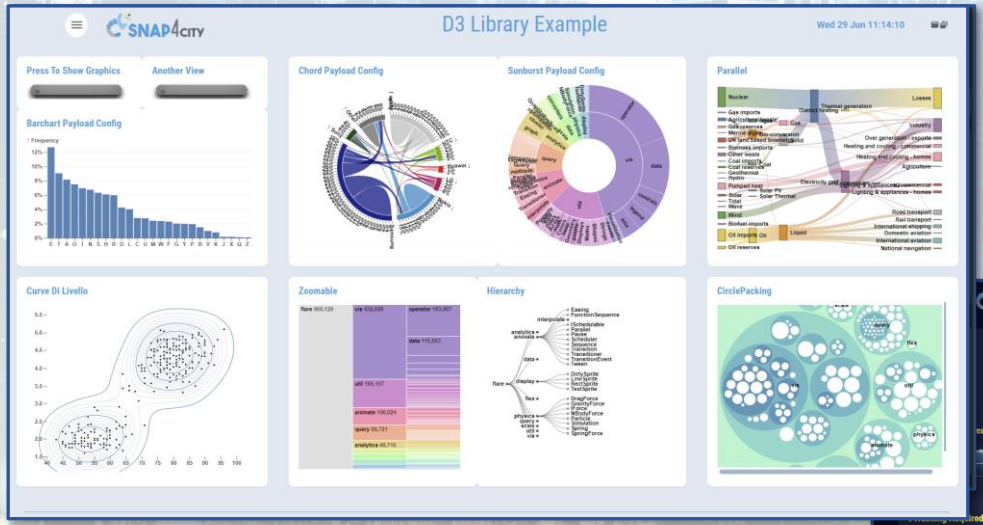
Creation of Dashboards and Applications

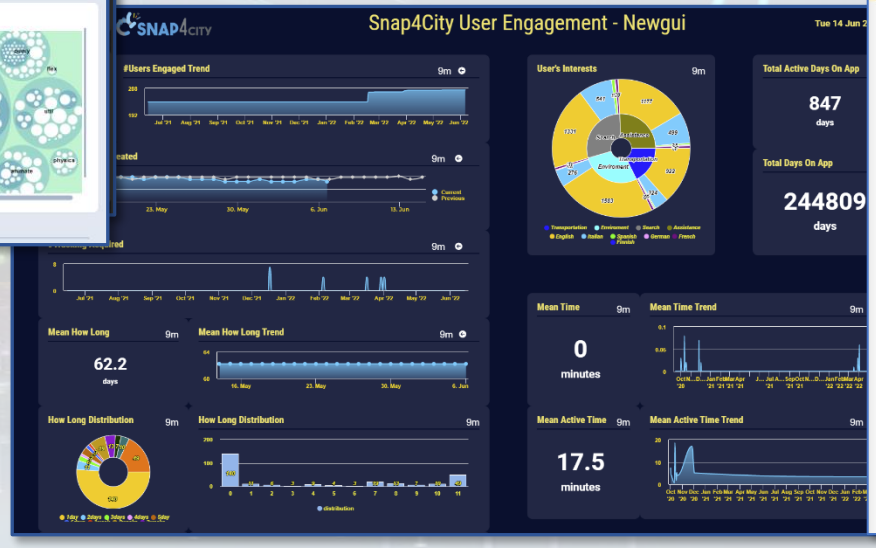
Different Themes

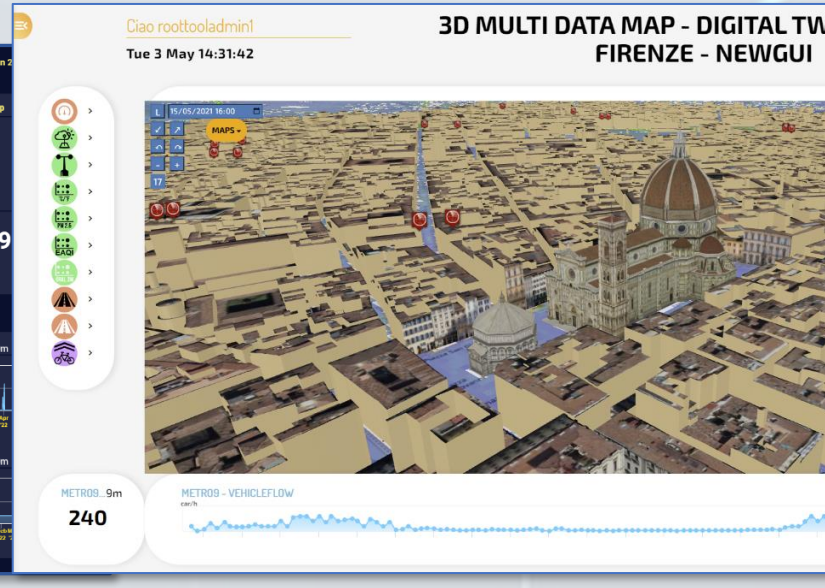








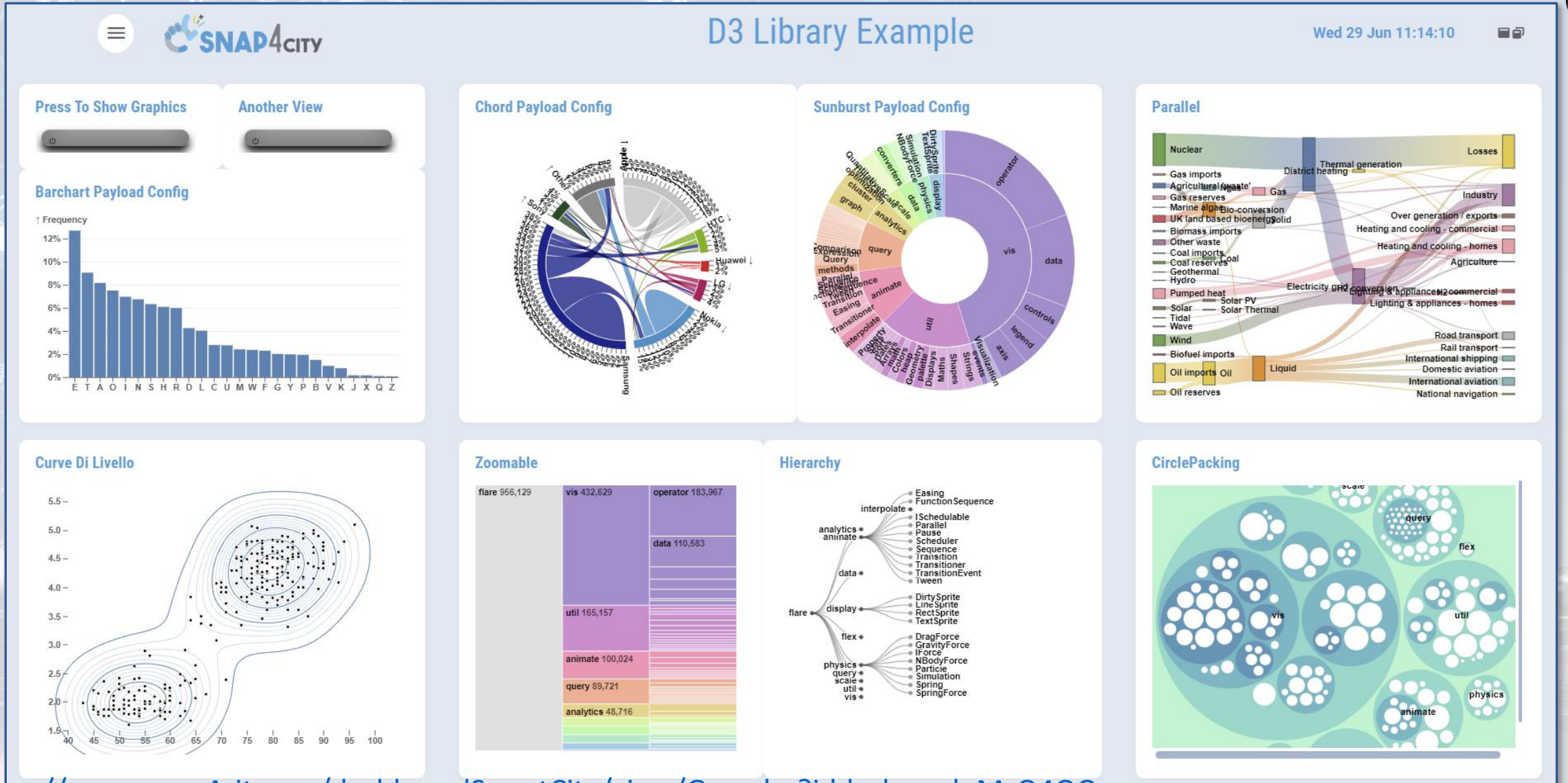




New styles/themes can be developed by specializing a few files from open source

https://www.snap4city.org/793

D3 Graph library capability



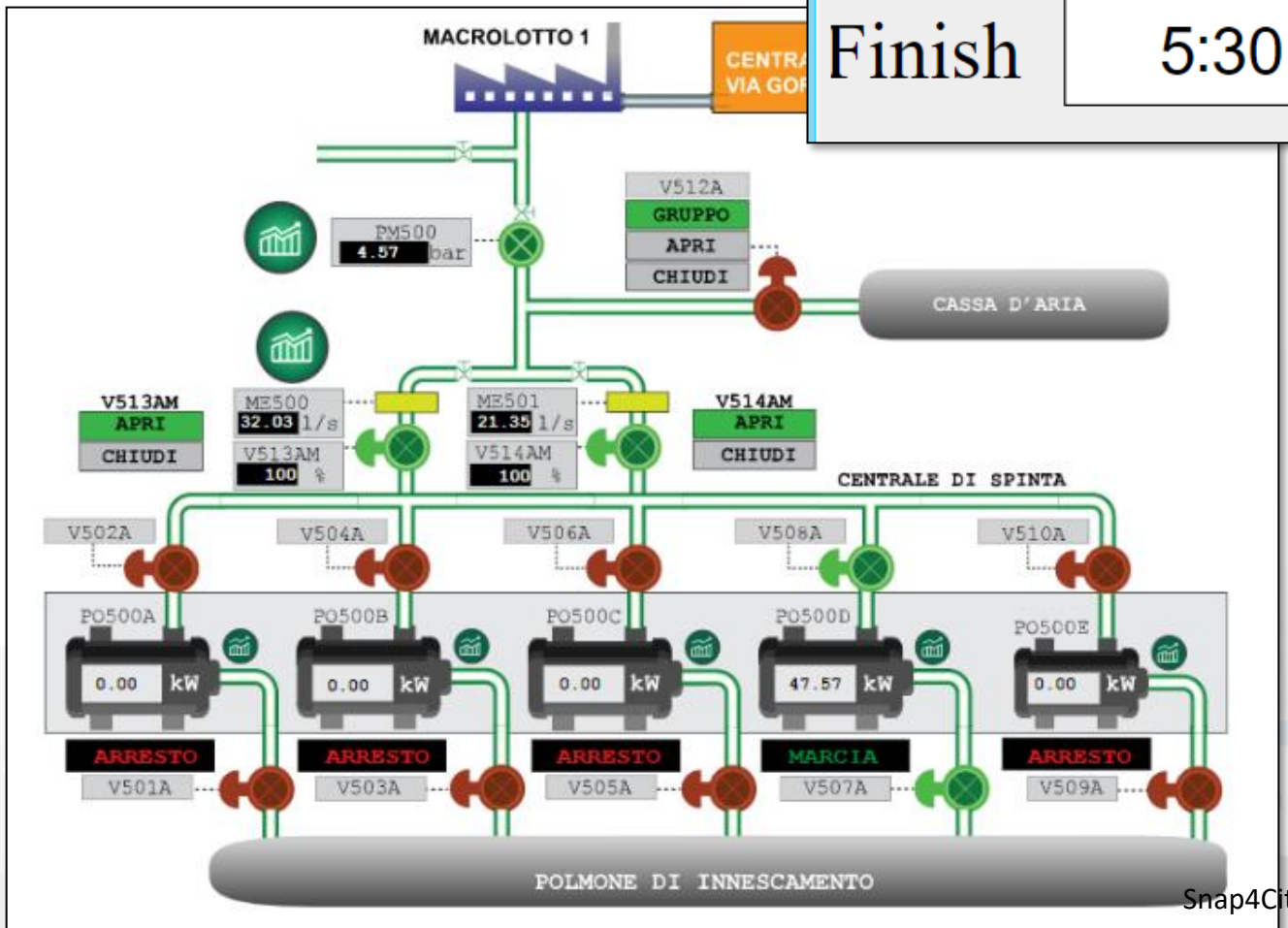
https://www.snap4city.org/dashboardSmartCity/view/Gea.php?iddasboard=MzQ4OQ==

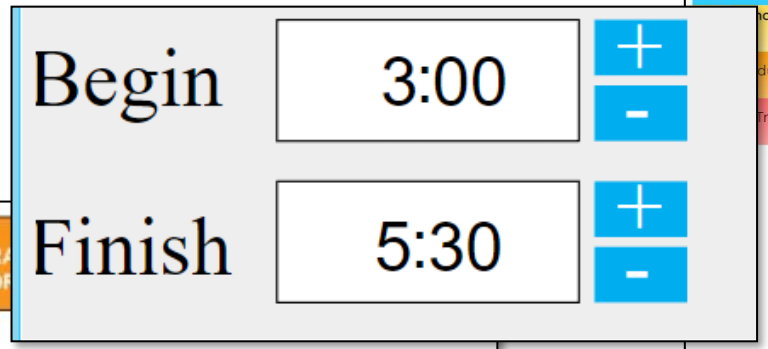
Custom Widgets

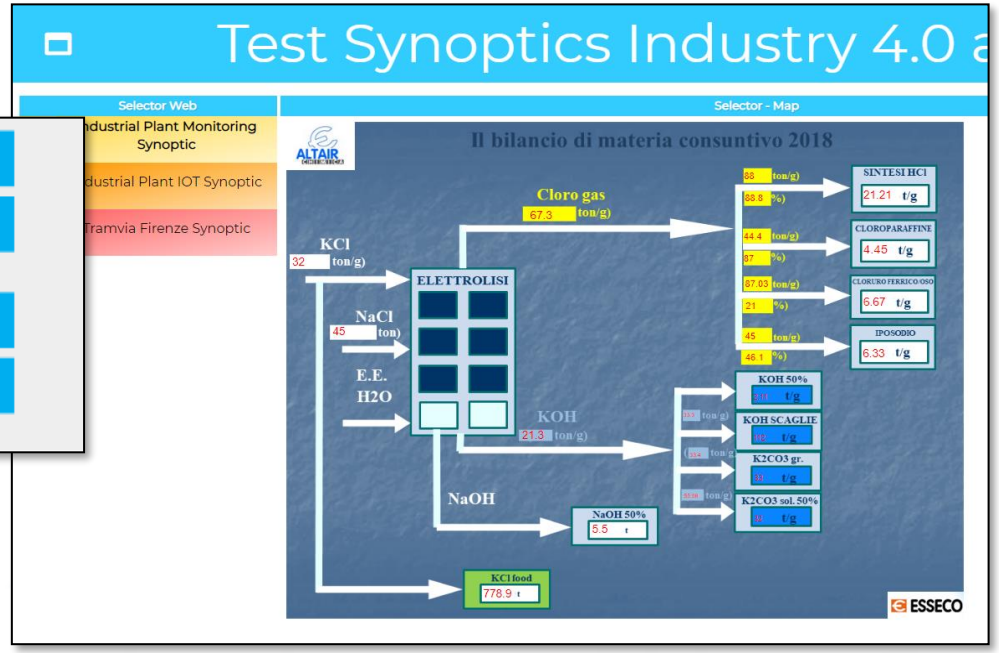
Custom Dashboards and Widgets (interactive, Animations, etc.)

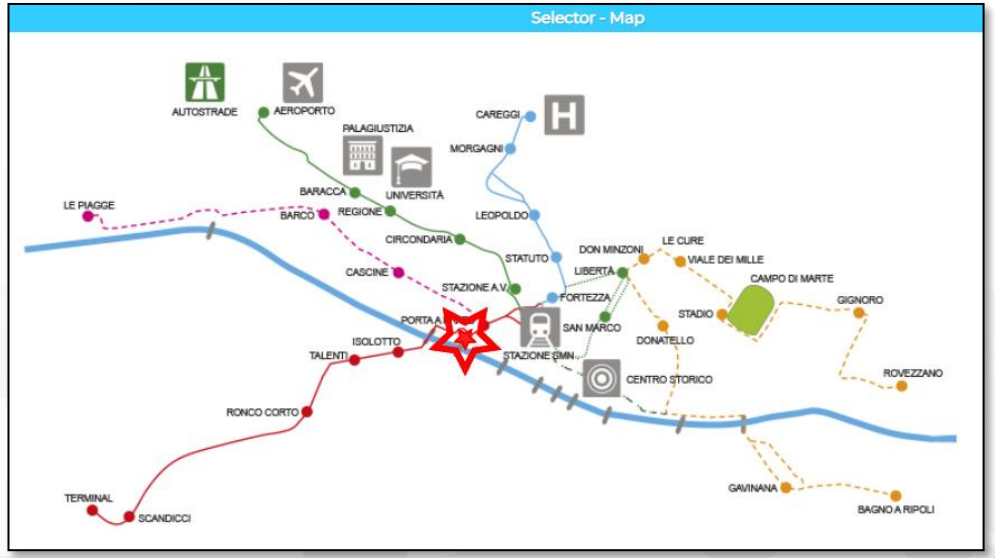
-- SVG for graphic design

-- MyKPI for collecting data









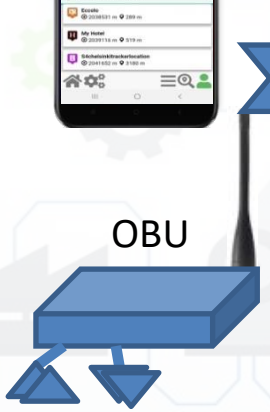
MyKPI: Tracking of Devices and Mobiles

- Real Time Trajectories for
  - Mobile Phone
  - Moving IOT Devices
  - OBU, Vehicular Kits
  - Multiple tracks
  - Day by day
- Micro Application

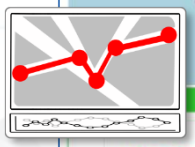
Mobile
PAX Counter

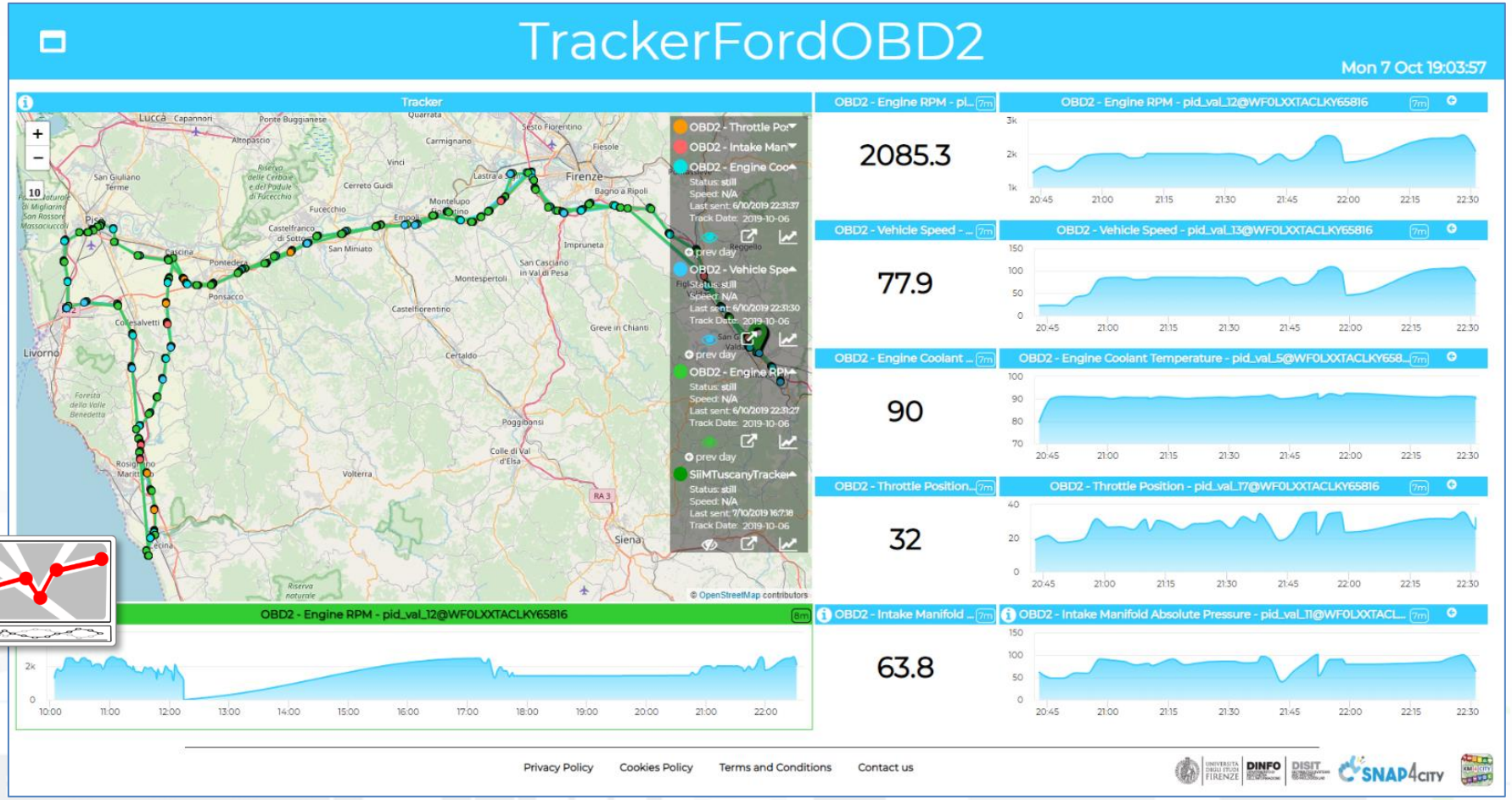
Apps

OBD2



OBU

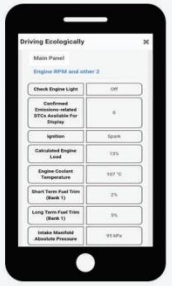


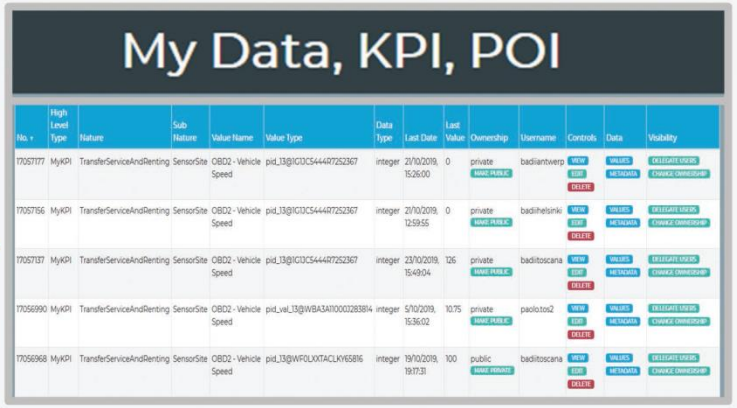


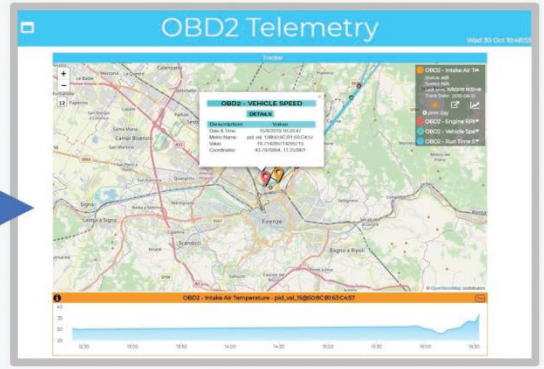
IOE – Vehicle Monitoring

CANBUS sniffer

Bluetooth



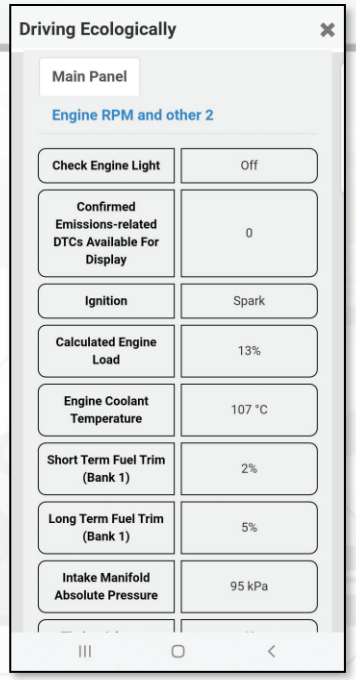


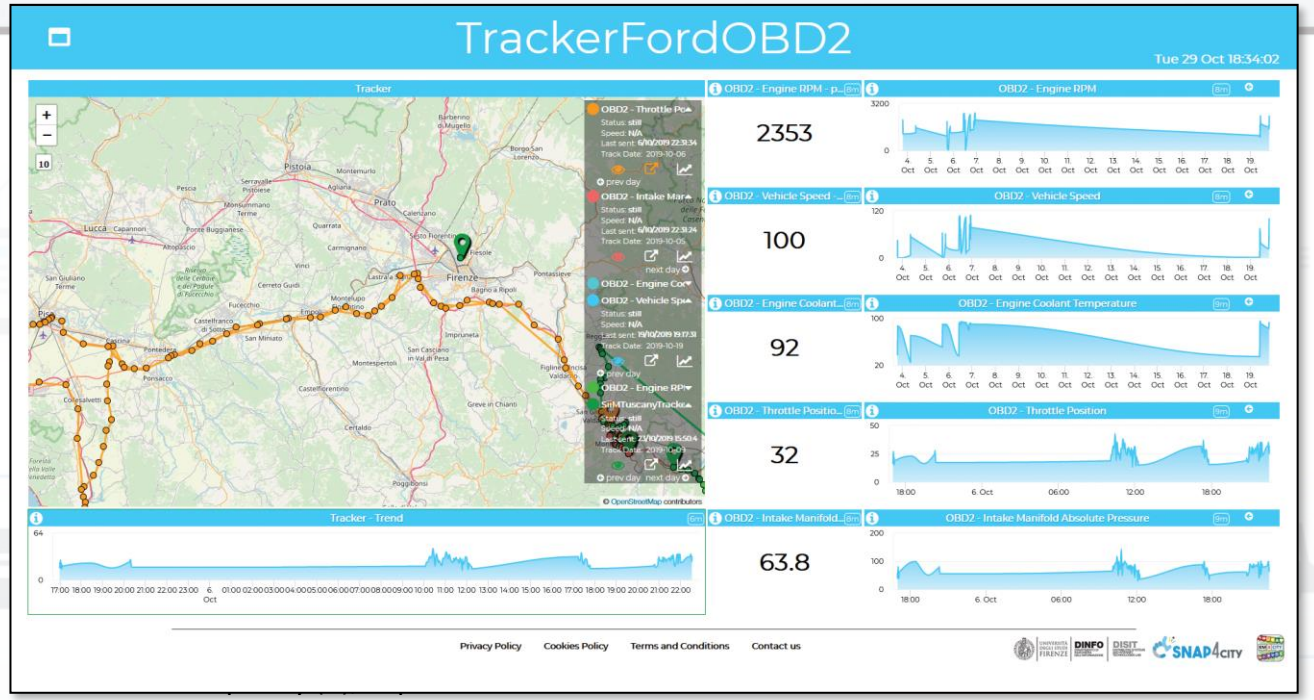


Tuscany in a Snap Mobile App on Android

TOSCANA

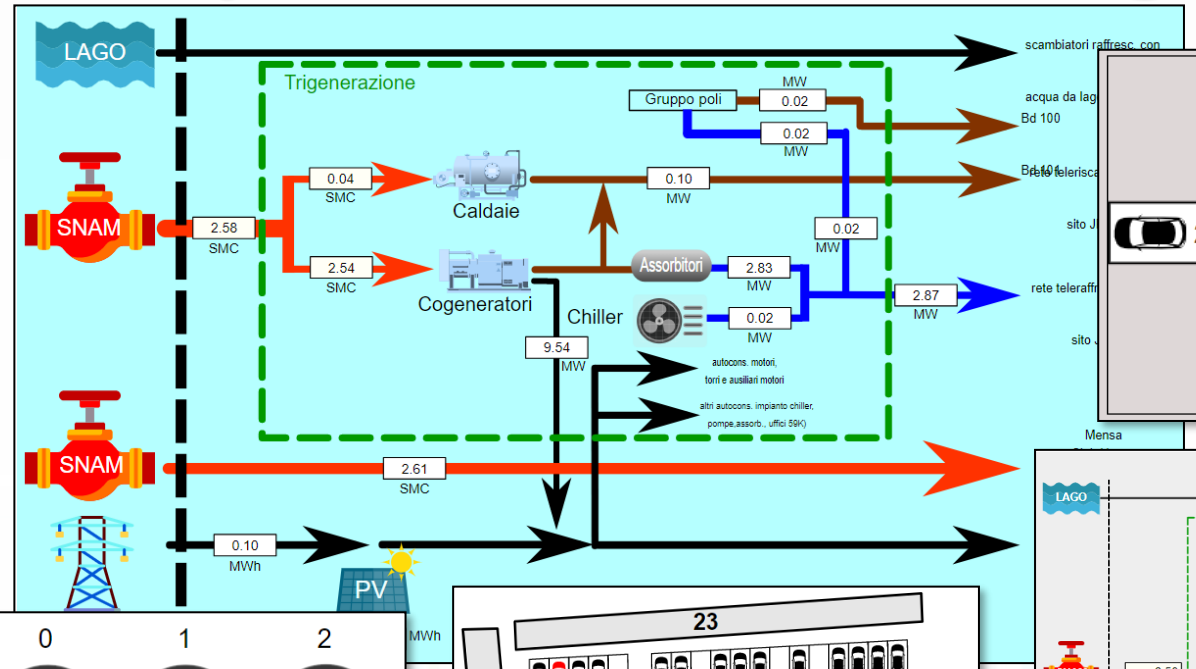
GET IT ON Google play

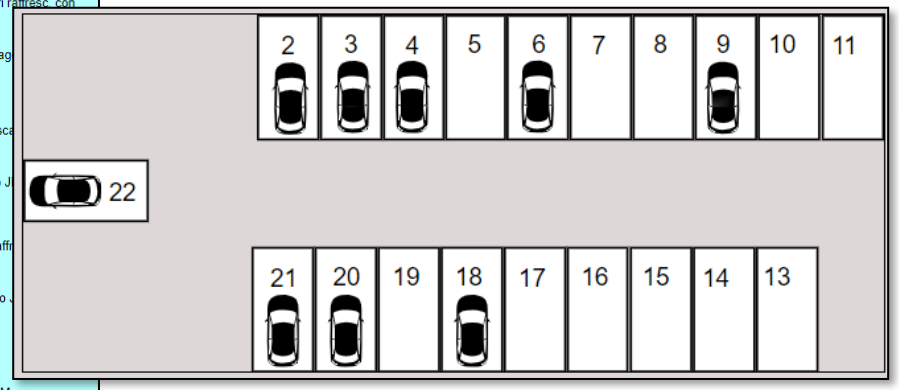


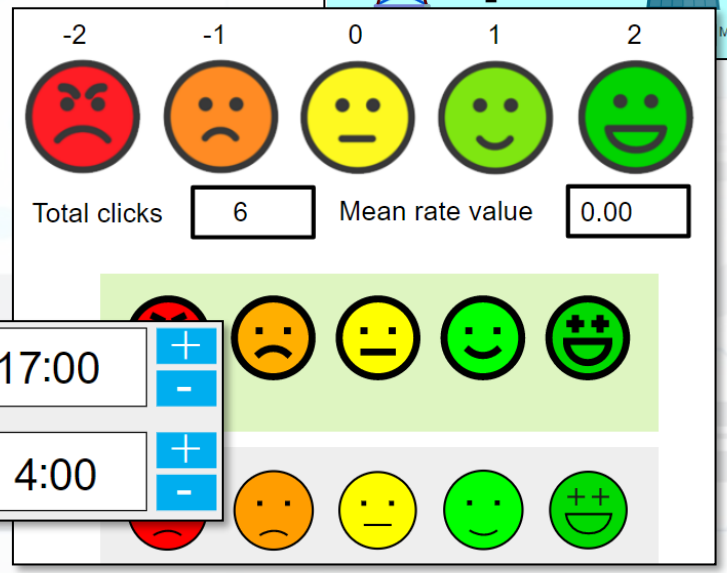


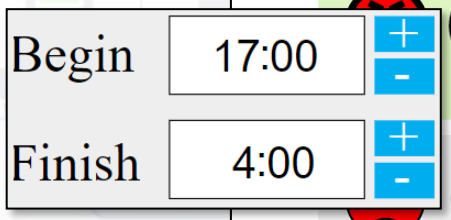
Special Custom Widgets

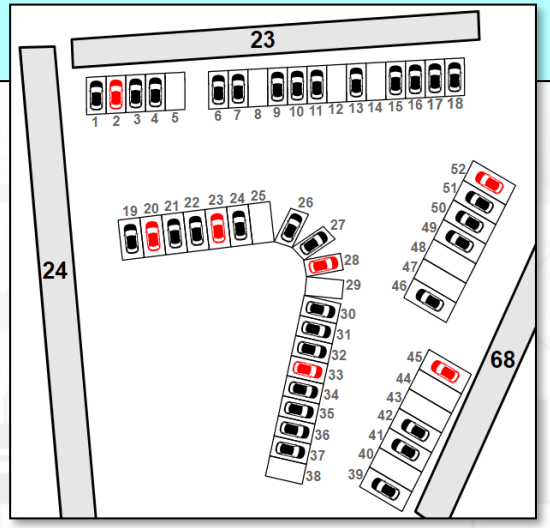
- Smart parking
- Smart Energy
- Smart Light
- Smart ….
- Energy View
- Custom Controls

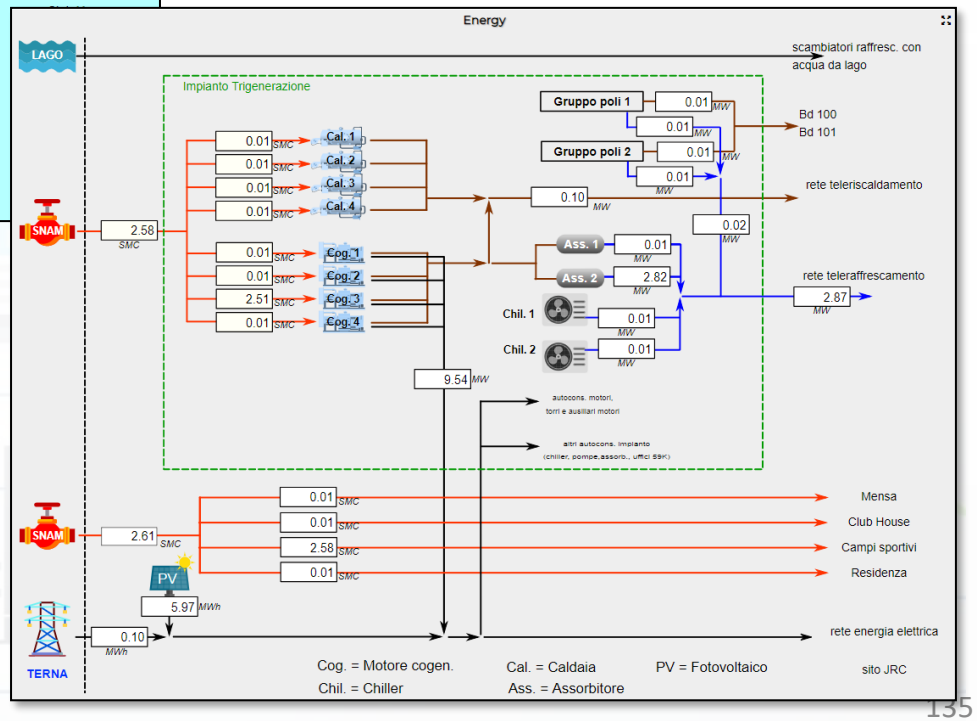




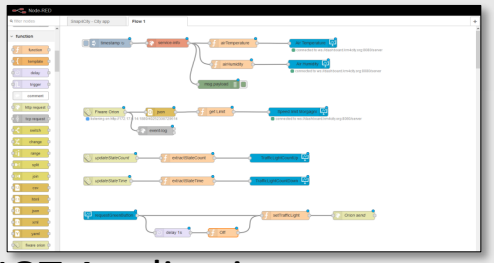








Dashboard Development



IOT Applications

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

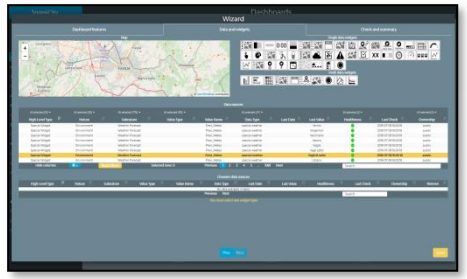
Widget Collection

Micro
Applicat
ions

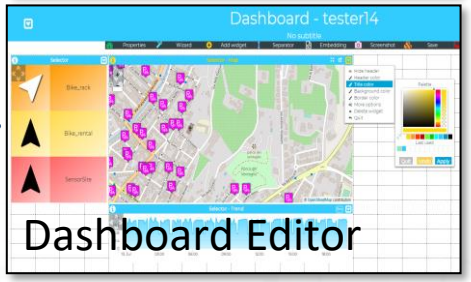
External
Services

Custom
Widgets/
Synoptics

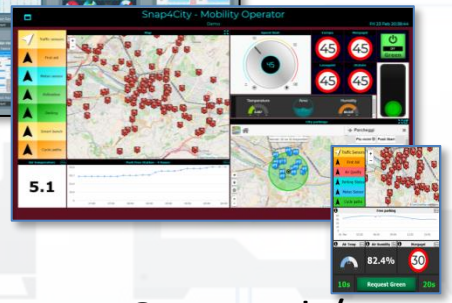
Dashboard Wizard



Create, save, load,
delegate, grant access



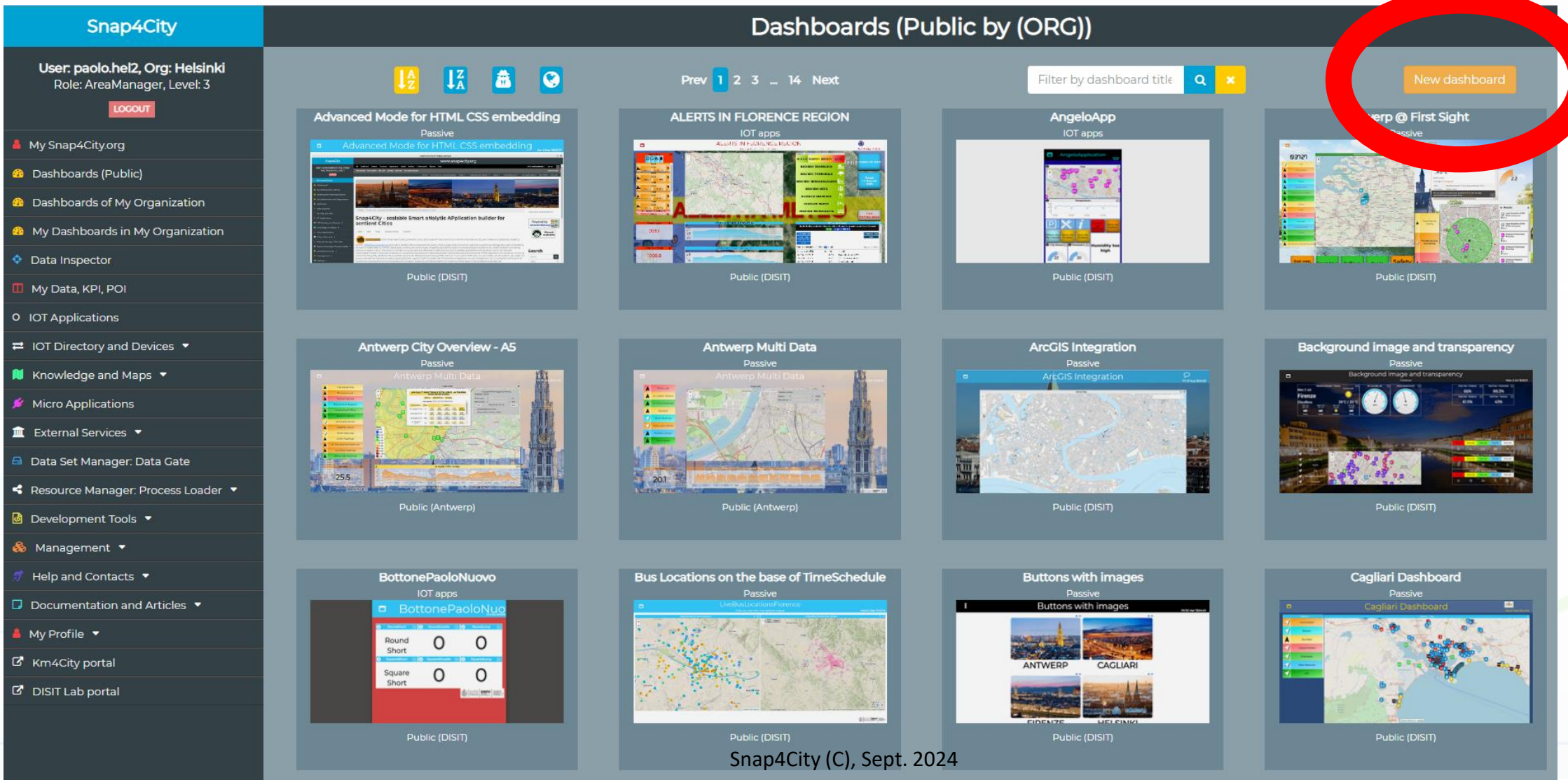
Dashboard Editor



Public
Dashboard
Collection

My Own Dash/App

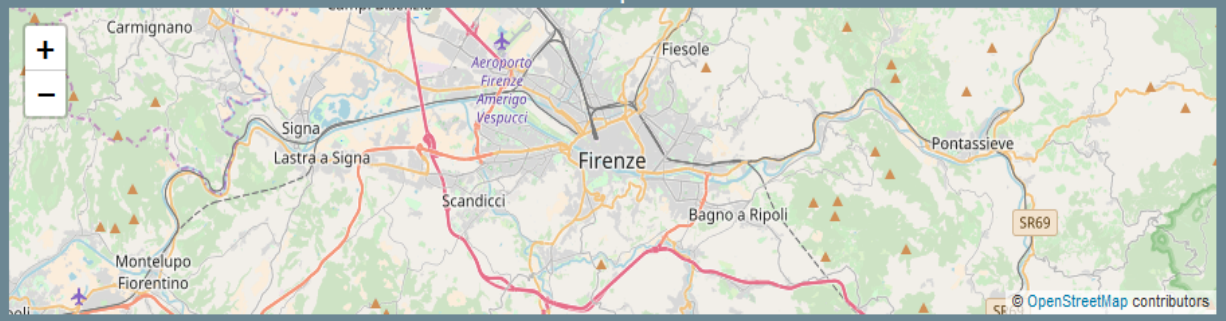
Dashboard List and Editor



Wizard

Dashboard features | Data and widgets | Check and summary

Map



Single data widgets

Multi data widgets

Data sources

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

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

Choosen data sources

High-Level Type	Nature	Subnature	Value Type	Value Name	Data Type	Last Date	Last Value	Healthiness	Last Check	Ownership	Remove

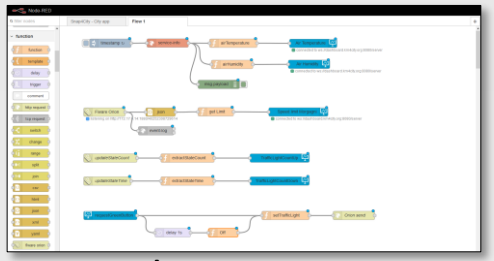
Previous Next | Search

Close

Wizard

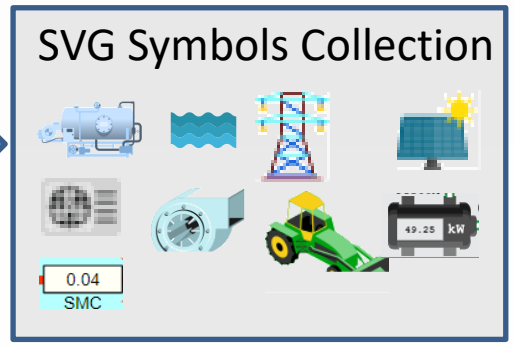
- Select the area of your interest: panning and zooming
- Select the
  - graphic aspect of your interest, or
  - High Level Type of your interest, or
  - Make a search if you a have a precise idea or
  - Act on filters: nature, subnature, type, name, value, date, health, owner, …
  - Combine them as you like
- Select the lines of your interest
- Then click on Next and get the Dashboard by wizard

Custom Widget / Synoptic Development

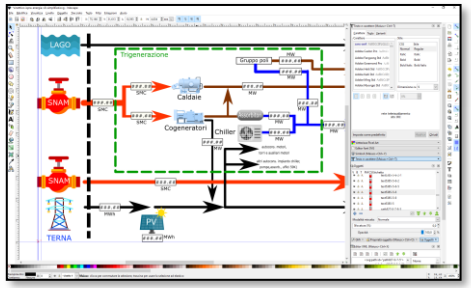


IOT Applications

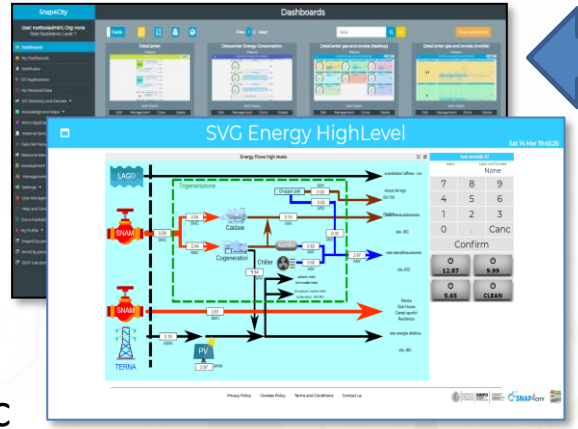
Knowledge and Storage Data from the Field and City



Inkscape editor on your computer

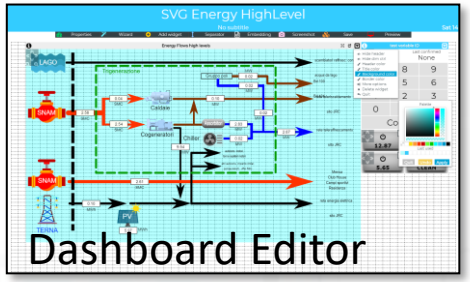


Create, save a Custom Widget in SVG



Public Dashboard Collection

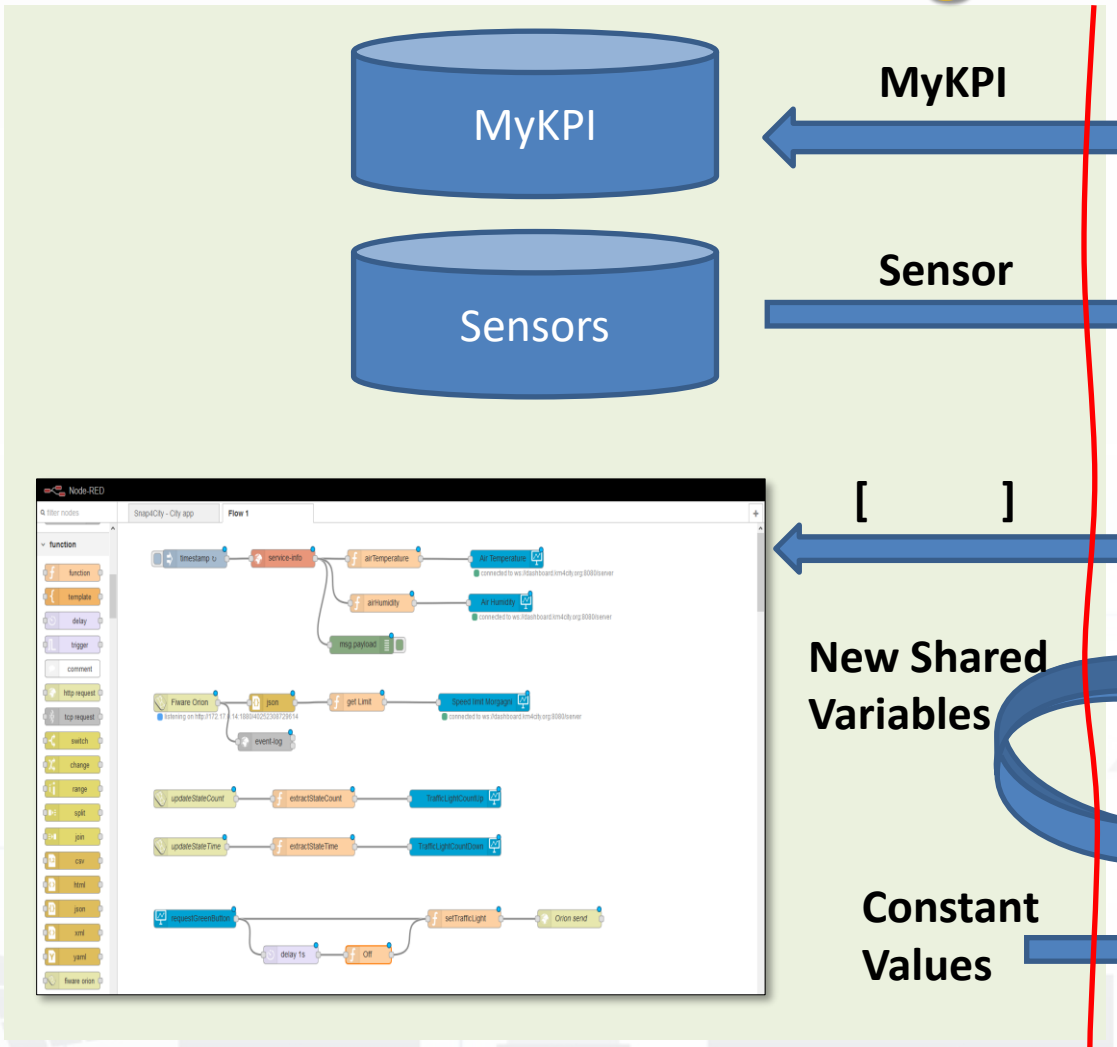
My Own Dash/App

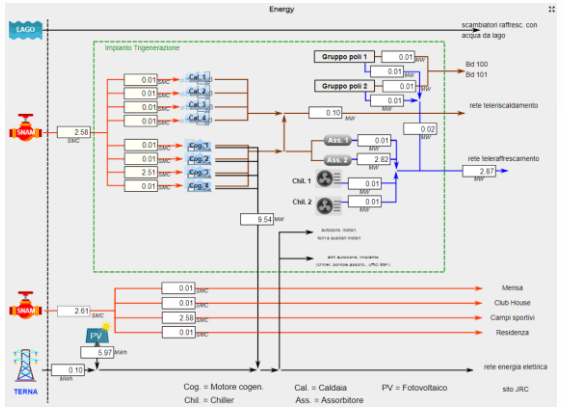


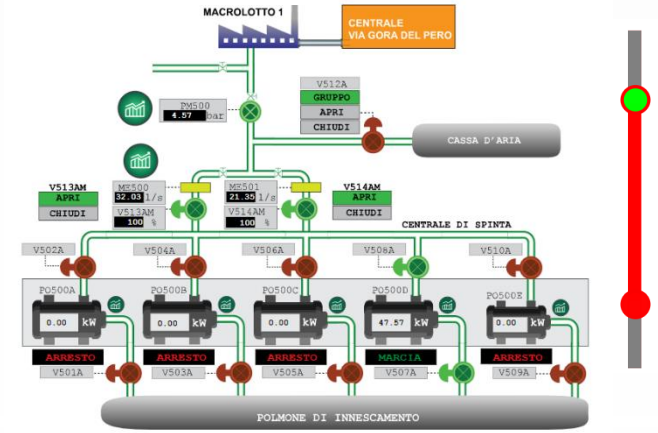
Create, save, load, delegate, grant access

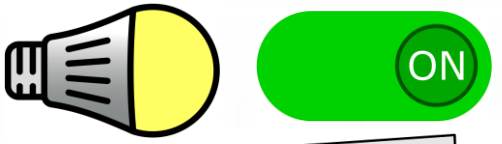
1. Create and Load a Custom SVG
2. Select/Reuse an SVG
3. Make and Instance of Synoptic by Associate Variables with MyKPI
4. Create on Dashboard a Widget based on Synoptic HLT such as Ext. Srv.:
   - https://www.snap4city.org/synoptic/v2/synoptic.html?id=xxxx

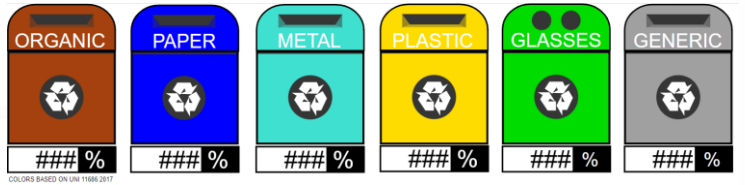
From-To Custom Widgets / Synoptics to Storage in WS

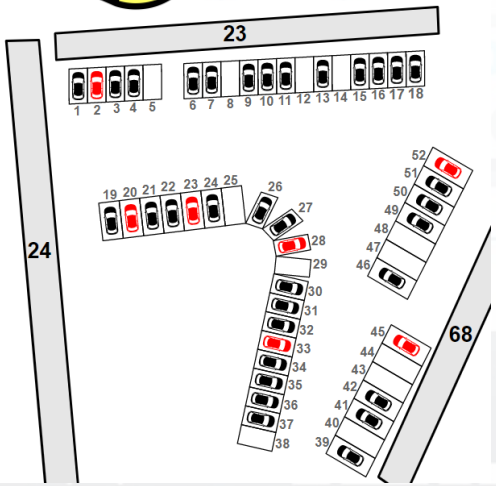


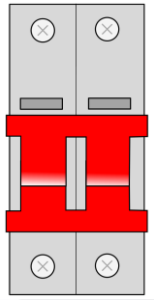


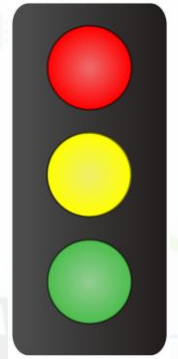












Dashboards' Intelligence on Web and Mobile Devices

IOT Applications

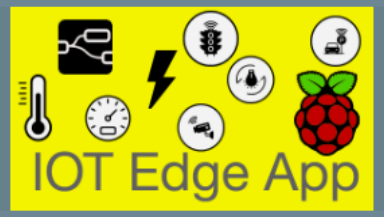
User: roottooladmin1, Org: DISIT
Role: RootAdmin, Level: 7

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

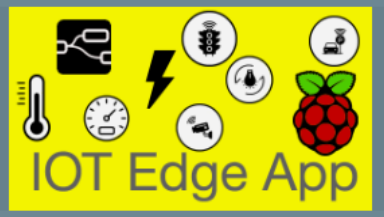
Prev 1 2 3 ... 9 Next

Filter

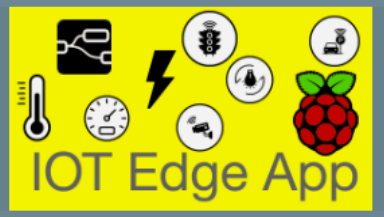
Create new

2018-09-14T04:44


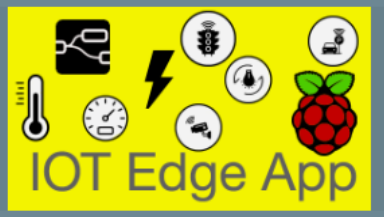
owner: badii
Management

2018-09-21T03:19


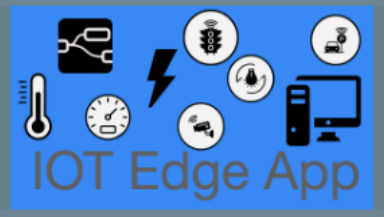
owner: panesi
Management

2018-10-19T16:07


owner: pb3
Management

2018-10-19T17:17


owner: pb3
Management

2018-10-22T11:57


owner: semolarudy
Management

application

owner: tester5
Management

Bib APP

owner: semolarudy
Management

ChargingStations

owner: comunedashres
Management

Deprecated - SiiMobilityControlRoom

owner: badii
Management

SamsungGalaxyS4BarCode

owner: badii
Management

esercitazione

owner: tester2
Management

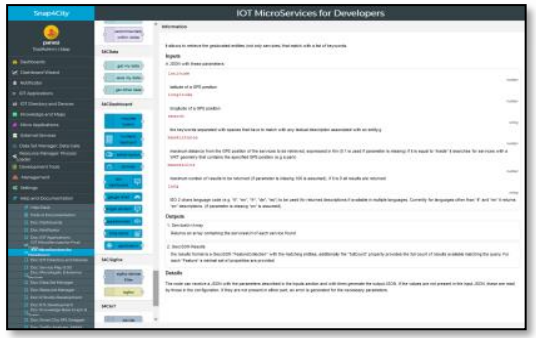
Iot-App

owner: tester14
Management

IOT Applications Development

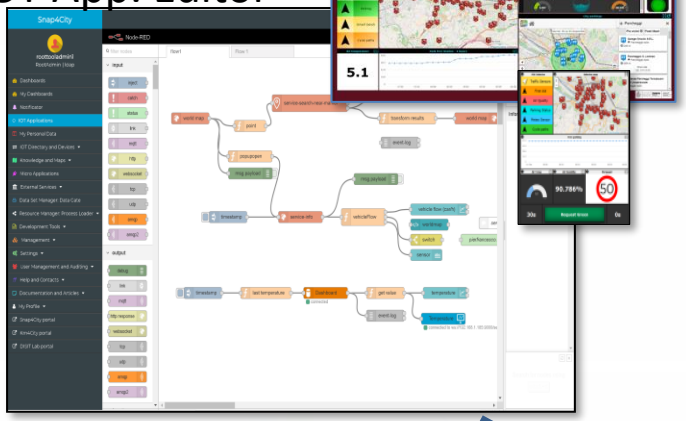
IOT Discovering

MicroServices collections

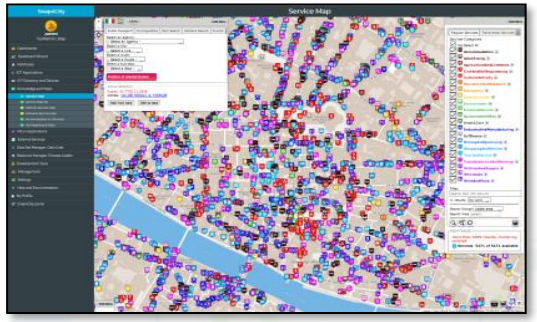


My IOT Applications

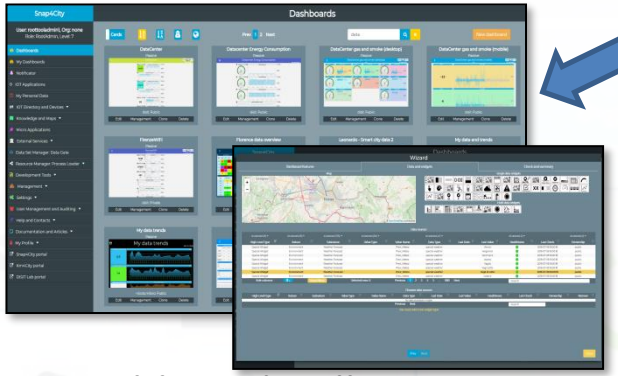
IOT App. Editor



Generating IOT App
With Dashboard



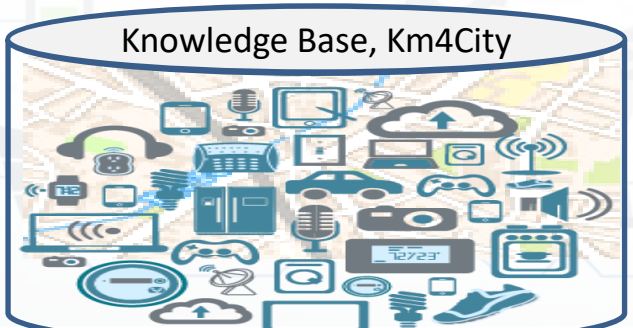
ServiceMap Discovery

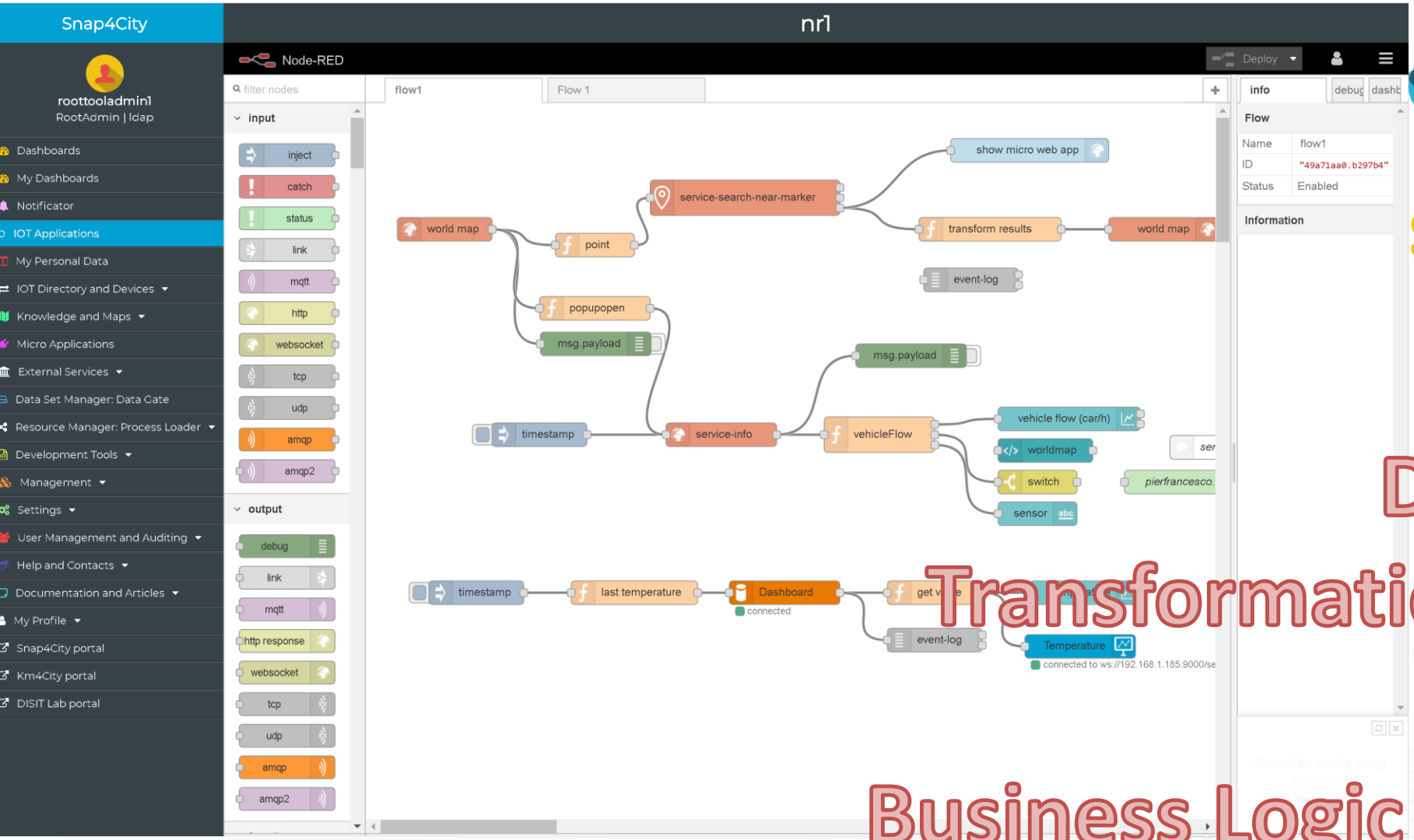


Dashboard Collection,
Editor and Wizard

Sharing/saving
reusing IOT App

Resource Manager





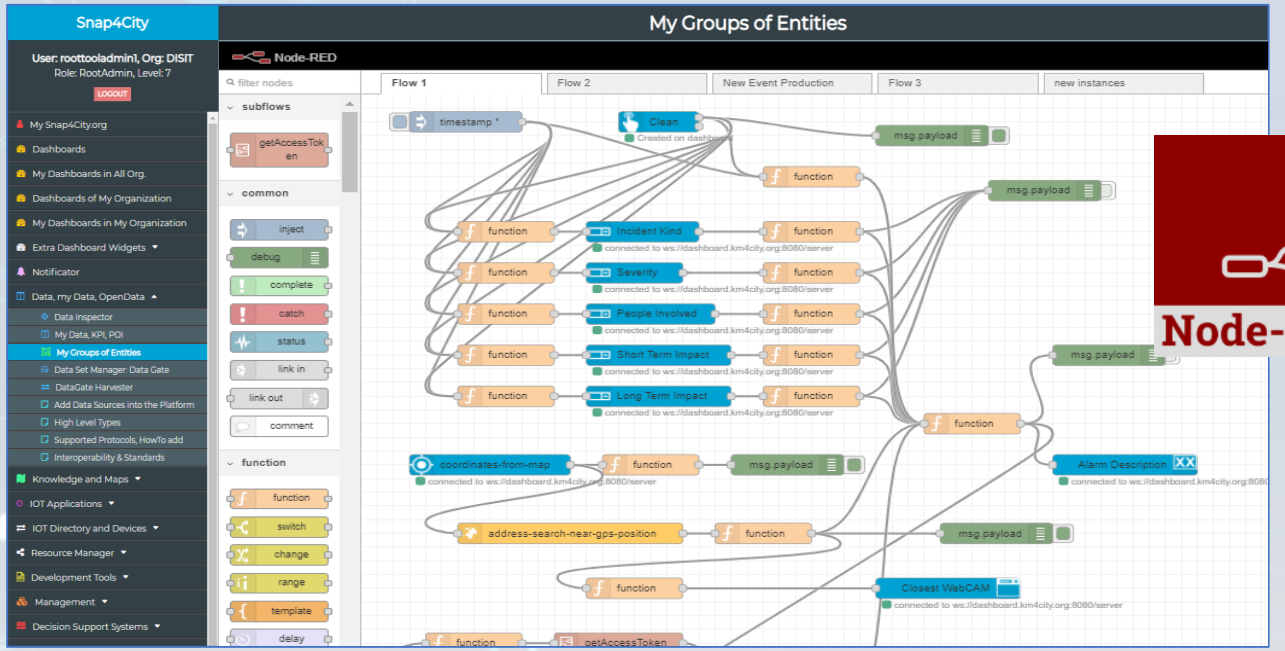
Data Adapation
Transformation, Conversion
Integration
Business Logic vs Dashboards
Data Analytics control
Everywhere: Cloud, on IoT Edge Devices

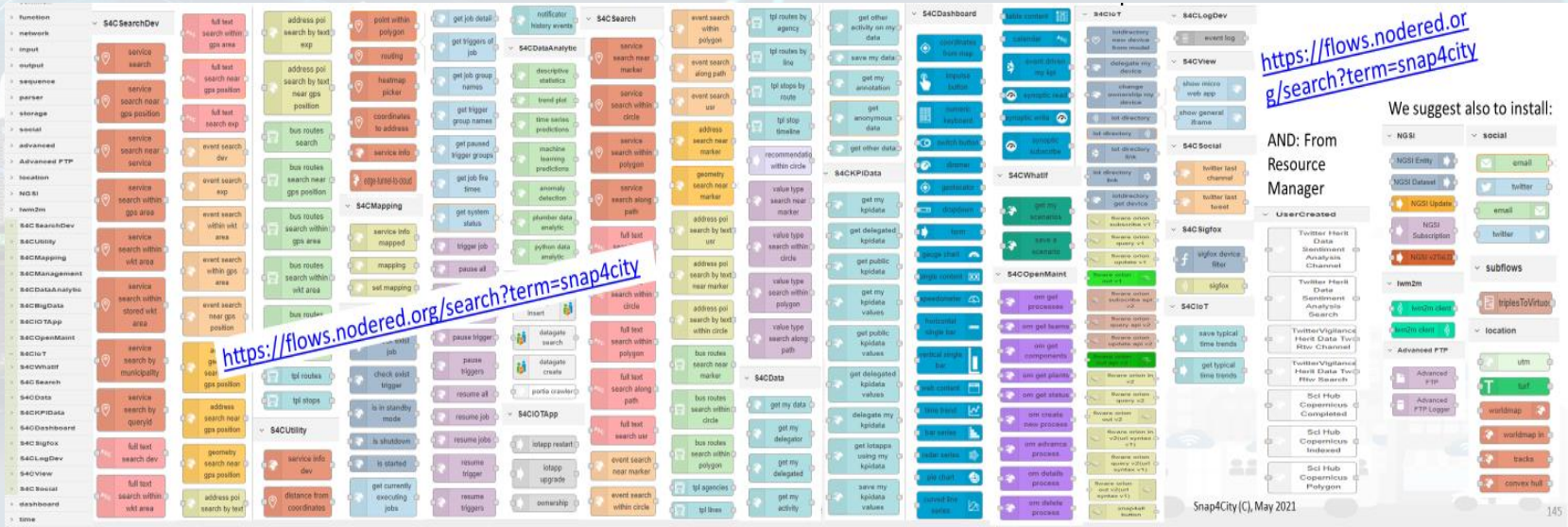
IoT Applications

- **Data ingestion**: more than 70 protocols IOT and Industry 4.0, web Scraping, external services, any protocol database, etc.
- **Data access**: save/retrieve data, query search on expert system, georeverse solution, search on expert system Km4City ontology, etc.
- **Data Transformation/transcoding:** binary, hexadecimal, XML, JSON, String, any format
- **Integration**: CKAN, Web Scraping, FTP, Copernicus satellite, Twitter Vigilance, Workflow OpenMaint, Digital Twin BIMServer, any external service REST Call, etc.
- **Manipulation of complex data**: heatmaps, scenarios, typical time trend, multi series, calendar, maps, etc.
- **Access to Smart City Entities and exploitation of Smart City Services**: transport, parking, POI, KPI, personal data, scenarios, etc.
- **Data Analytic**: managing Python native, calling and scheduling Python/Rstudio containers as snap4city microservices (predictions, anomaly detection, statistics, etc.)
- **User interaction on Dashboard**: get data and message from the user interface, providing messages to the user (form, buttons, switches, animations, selector, maps, etc.)
- **Custom Widgets**: SVG, synoptics, animations, dynamic pins on maps, etc
- **Event management**: Telegram, Twitter, Facebook, SMS, WhatsApp, CAP, etc.
- **Hardware Specific Devices**: Raspberry Pi, Android, Philips, video wall management, etc.

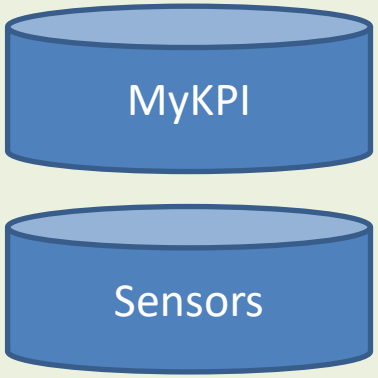
Ingestion, aggreg. → exploitation

- **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





From-To Custom Widgets / Synoptics to Storage in WS



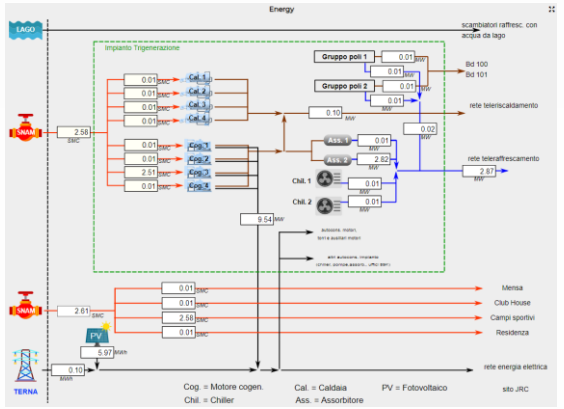
MyKPI

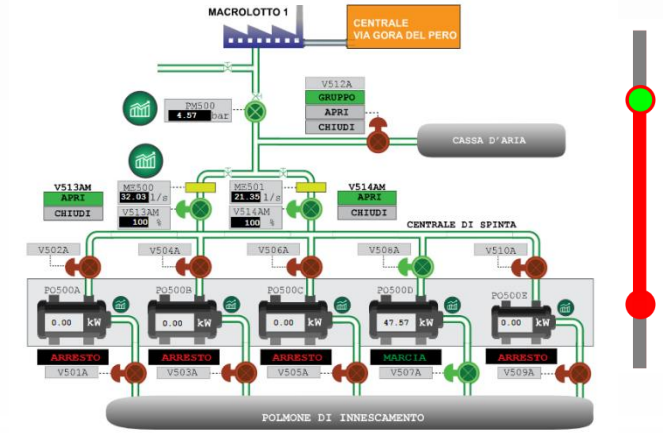
Sensor

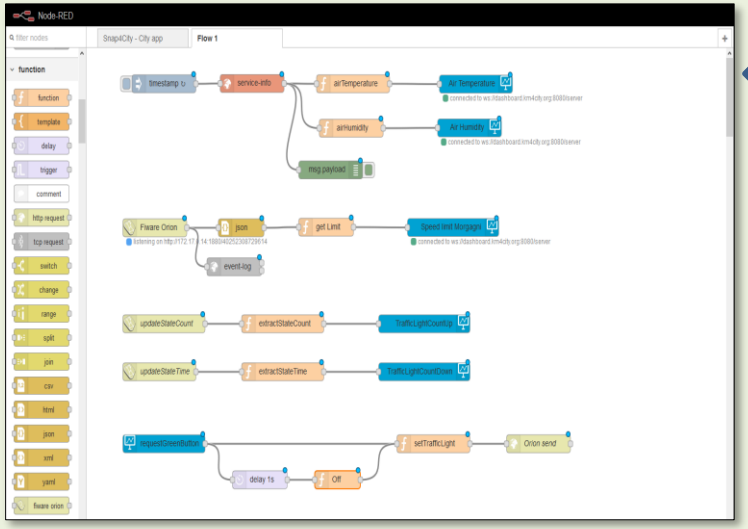
[ ]

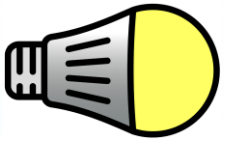
New Shared Variables

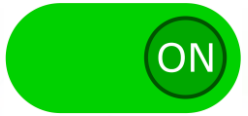
Constant Values

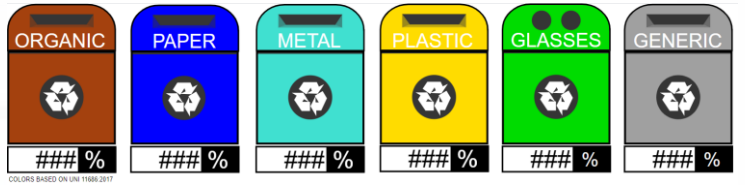


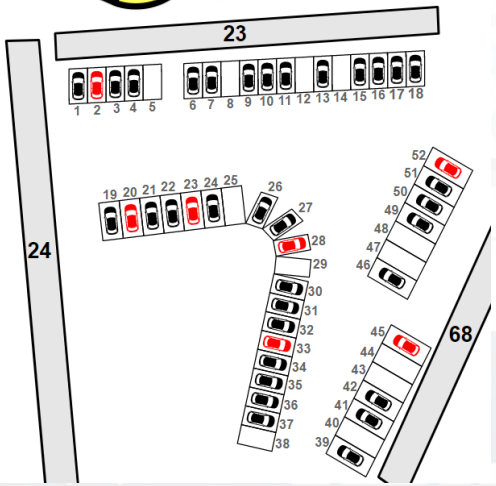


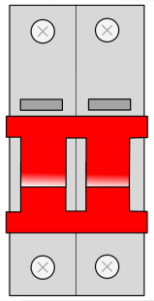


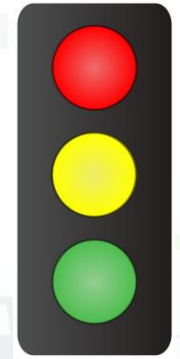












Web Socket Secure

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

Snap4Industry vs Formats

- Snap4City is capable to ingest and work with any format:
  - Data **exchange**: JSON, GeoJSON, XML, HTML, HTML5, DATEX, GTFS, binary, etc.
  - **Table**: CSV, XLSX, XLS, database, …
  - Any **archive** file format: zip, rar, 7z, tgz, …
  - Any **image** format: png, gif, tiff, ico, jpg, …
  - Any **video** format: mp4, avi, mov, …
- Search the format you need to cope on the search box of Snap4City portal!

HLT: Unified Classification for Data and Services

IoT Device Variable, Sensor Device	All selected (15)	All selected (48)	All selected (27)		All selected (1499)	All selected (159)	All selected (15)	All selected (63)		All selected (2)		All selected (2)
High-Level Type	Nature	Subnature	Device/Model	Broker	Value Name	Value Type	Data Type	Value Unit	Last Date Last Value	Healthiness	Last Check	Ownership
IoT Device Variable	IoTDevice	IoTSensor	devicetest1	orionUNIFI	temperature	temperature	float	°C			2021-10-15 10:01:02	private (My Own)
IoT Device Variable	IoTDevice	IoTSensor	devicetest1	orionUNIFI	humidity	humidity	float	#			2021-10-15 10:01:02	private (My Own)
IoT Device Variable	IoTDevice	IoTSensor	MyThermometer_001	orionUNIFI	temperature	temperature	float	°C			2021-10-15 10:01:01	private
IoT Device Variable	IoTDevice	IoTSensor	MyThermometer_001	orionUNIFI	humidity	humidity	float	#			2021-10-15 10:01:01	private
IoT Device Variable	IoTDevice	IoTSensor	adminTest1	orionUNIFI	temperature	temperature	string	°C	2018-05-31 19:16:05		2021-10-15 10:01:00	private (My Own)
IoT Device Variable	IoTDevice	IoTSensor	adminTest1	orionUNIFI	humidity	humidity	string	%	2018-05-31 19:16:05		2021-10-15 10:01:00	private (My Own)
IoT Device Variable	IoTDevice	IoTSensor	newmarcodev1	orionUNIFI	temperature	temperature	float	°C			2021-10-15 10:00:59	private
IoT Device Variable	IoTDevice	IoTSensor	newmarcodev1	orionUNIFI	humidity	humidity	float	%			2021-10-15 10:00:59	private

Hide columns | Reset filters | Selected rows: 1 | Previous 1 2 3 4 5 ... 2466 Next | Search

High Level Types

Nature

SubNature

Semantic Classific.

Dev/Model name

Broker name

Technical Source

Value Name

Value Type

Data Type

Value Unit

Variables, names

Last Date/Time

Last Value

Real Time

Healthiness

Last Check

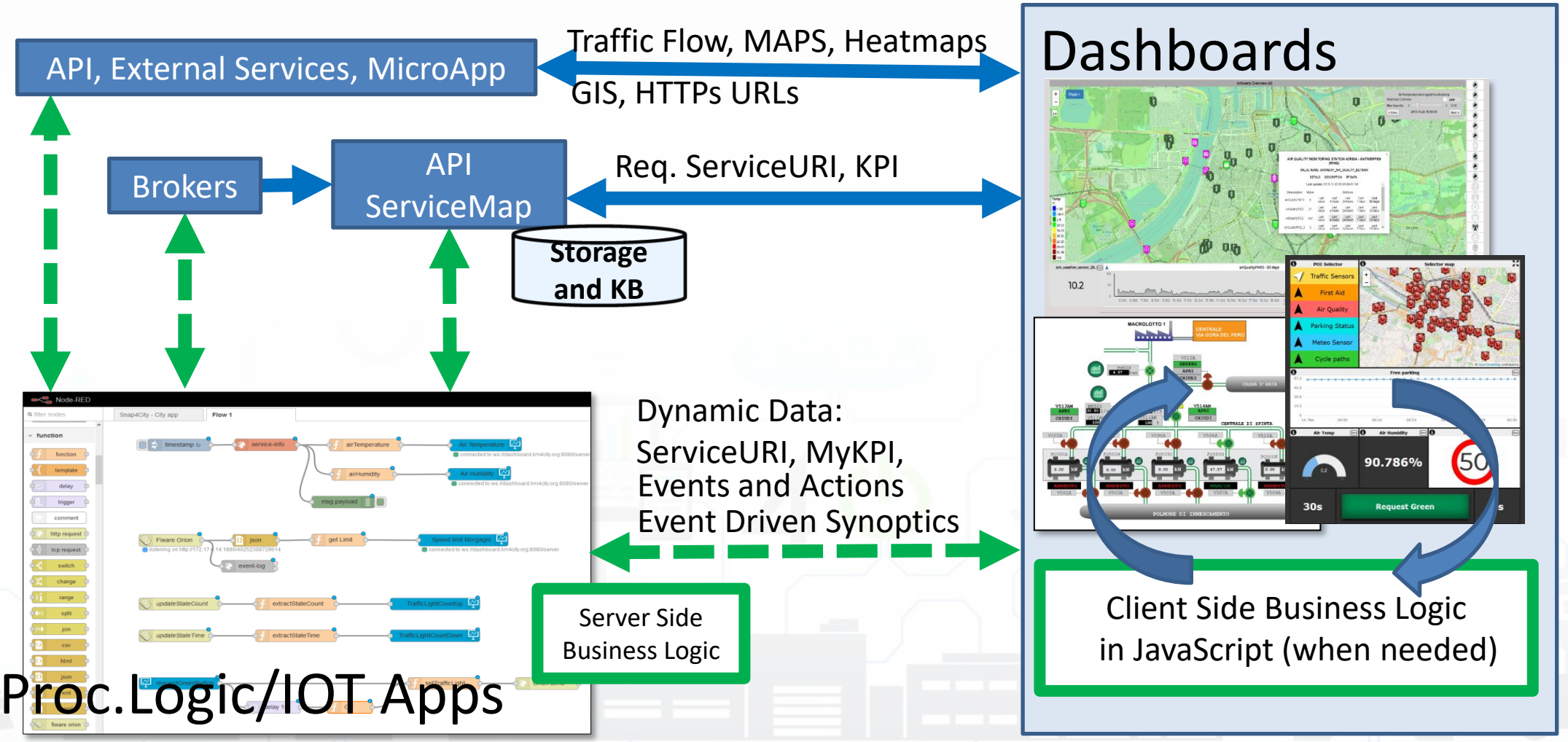
Status

Ownership

Organization

For Admin

How the Dashboards exchange data



How the Dashboards exchange data (2022)

Snap4City BigData Storage and KB

IOT Broker Orion Quantum Leap

ServiceMap Super ServiceMap

- Req. ServiceURI

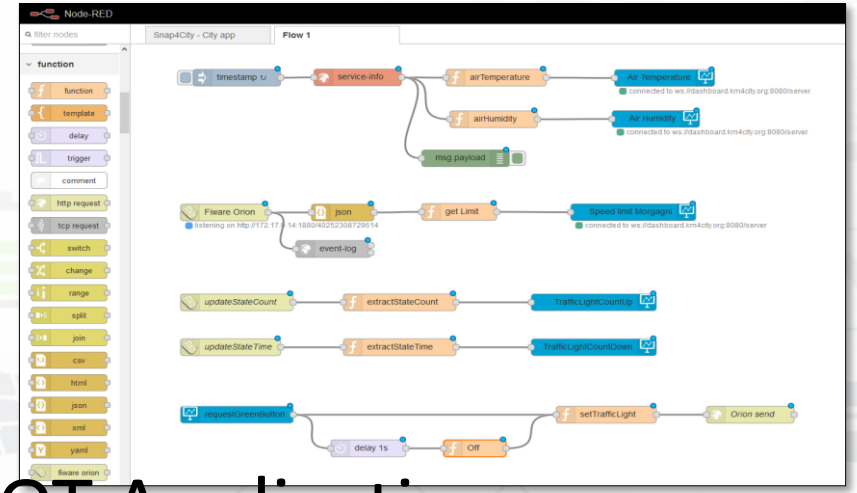
Metric, KPI

MyKPI, MyPOI, …

- Req. KPI, Metric ID
- Req. MyKPI ID

API, External Services, MicroApp

- Traffic Flow, MAPS, Heatmaps
- GIS, HTTPs URLs



IOT Application

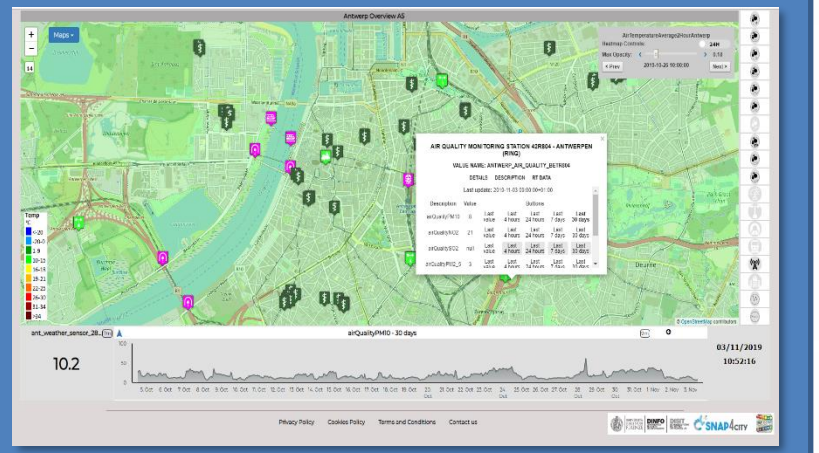
- ServiceURI (ID)
- MyKPI, Metric (ID)
- Dynamic Data, computed into IOT Application

- Rx. Dynamic Data

- Event Driven Synoptics

- Actions, Show

Dashboards



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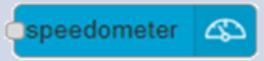
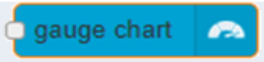
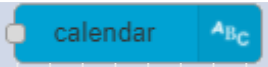
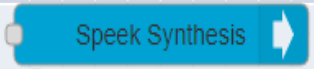
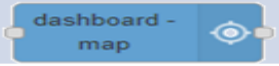
Dynamic (4/22)

SNAP4CITY | Node-RED

Widgets ICONS	Widget Name, Description	IOT App	Dashboard-IOT App	KPI (metric)	MyPersonalData	MyData	My KPI	Sensor
XX	Single Content	X (cs)	X (DD)	X	X	X	X	X
50	Speed Limit (see custom widget for more)			X				X
	Speedometer 	X (cs)	X (DD)	X	X	X	X	X
	Gauge 	X (cs)	X (DD)	X	X	X	X	X
	Single Bar, V/H	X	X (DD)	X				
	Single and Multiple Bars, stacked or not, ordered	X (cs)	X (DD)	X	X	X	X	X
	MultiSeries, shaded, staked and non staked, TTT	X (cs)	X (DD)	X	X	X	X	X
	Time Trend (single)	X	X (DD)	X	X	X	X	X
XX YY ZZ	Time Trend Compare			X			X	X
	SpiderNet, radar, Kiviat	X (cs)	X (DD)	X	X	X	X	X
	Pie, Donut, 2 layers Donut	X (cs)	X (DD)	X	X	X	X	X
	Table	X (cs)	X (DD)	X	X	X	X	X
	Calendar 	X (cs)	X (DD)				X	X
	Speak Synthesis 	X (cs)	X (DD)				string	string
	Maps 	X (cs)	X (DD)	Many High Level Types			X	X

DD: Data Driven

Legenda

- **IOT APP column in previous table:**
  - **X**: means that from the IOT App you can send a new value or array to the widget directly, without the need to have is stored into Sensor or MYKPI variable, etc.
  - **CS, widget supports Change Source**, in the sense that: from the IOT App is possible to send a command to the Widget to change the data source. E.g., selecting sources among: Sensors (service URI), MyKPI (ID), any value produced on the IOT App directly. (cs) recent additions
- **Dashboard IOT App column in previous table**:
  - **X:** there is a MicroService / node on IOT App to act on those widgets on dashboard. The data are visualized.
  - **DD, widget is Data Driven**, in the sense that new data in push can be sent and the widget is updated in real time on web page without web page realoading

TC4.9: New Support Widgets for Bars, Barseries, Trend, and Series, on Dashboards and IOT Applications (partially obsolete)

Dynamic Widget data

ServiceURI (ID)

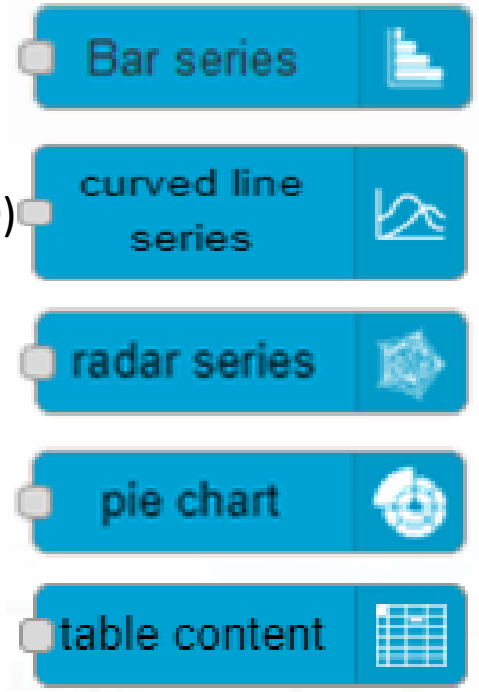
ServiceURI (ID)

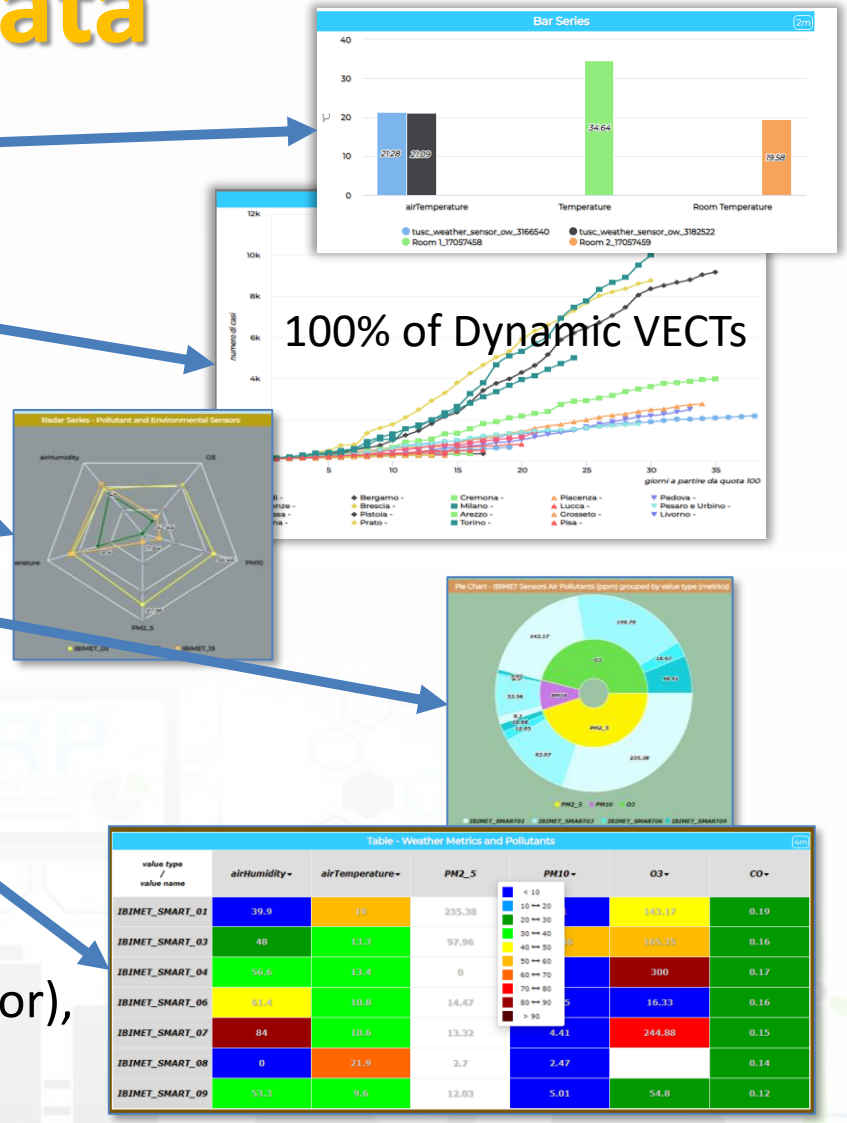
MyKPI (ID)

Dynamic

Dynamic


```
▾0: object
    metricId: "http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3166540"
    metricHighLevelType: "Sensor"
    metricName: "tusc_weather_sensor_ow_3166540"
    metricType: "airTemperature"
▾1: object
    metricId: "https://servicemap.disit.org/WebAppGrafo/api/v1/?
    serviceUri=http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3182522&format=json"
    metricHighLevelType: "Sensor"
    metricName: "tusc_weather_sensor_ow_3182522"
    metricType: "airTemperature"
▾2: object
    metricId: "17056320"
    metricHighLevelType: "MyKPI"
    metricName: "SiiMTuscanyTrackerLocation"
    metricType: "Velocity"
▾3: object
    metricId: ""
    metricHighLevelType: "Dynamic"
    metricName: "BatteryTemperatureGalaxyNote"
    metricType: "Gradi Centigradi"
    metricValueUnit: "°C"
    measuredTime: "2019-11-21T14:51:00Z"
    value: 6.688898111364505
▾4: object
    metricId: ""
    metricHighLevelType: "Dynamic"
    metricName: "BatteryTemperaturemia"
    metricType: "Gradi Centigradi"
    metricValueUnit: "°C"
    measuredTime: "2019-11-21T14:51:00Z"
    value: 62.8502788741156
```

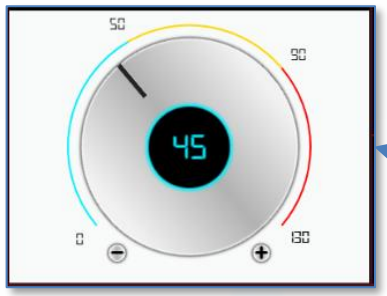





- **ServiceURI** (ID)
- **MyKPI (ID)**, Metric (ID)
- **Dynamic** Data in JSON (single or Vector), computed into IOT Application

[TC4.9: New Support Widgets for Bars, Barseries, Trend, and Series, on Dashboards and IOT Applications]

IOT Data Driven



Actuator

Sensor Actuator

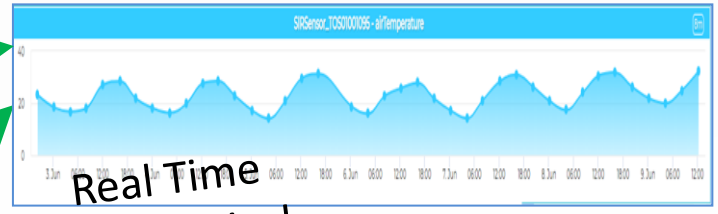
From Dashboard to IOT Device

From IOT Device to KB

Sensors

IOT Applications

Real Time



Real Time + Historical

Snap4city Platform storage for «Data Shadow» and much more

Sensors

Snap4City IOT Brokers

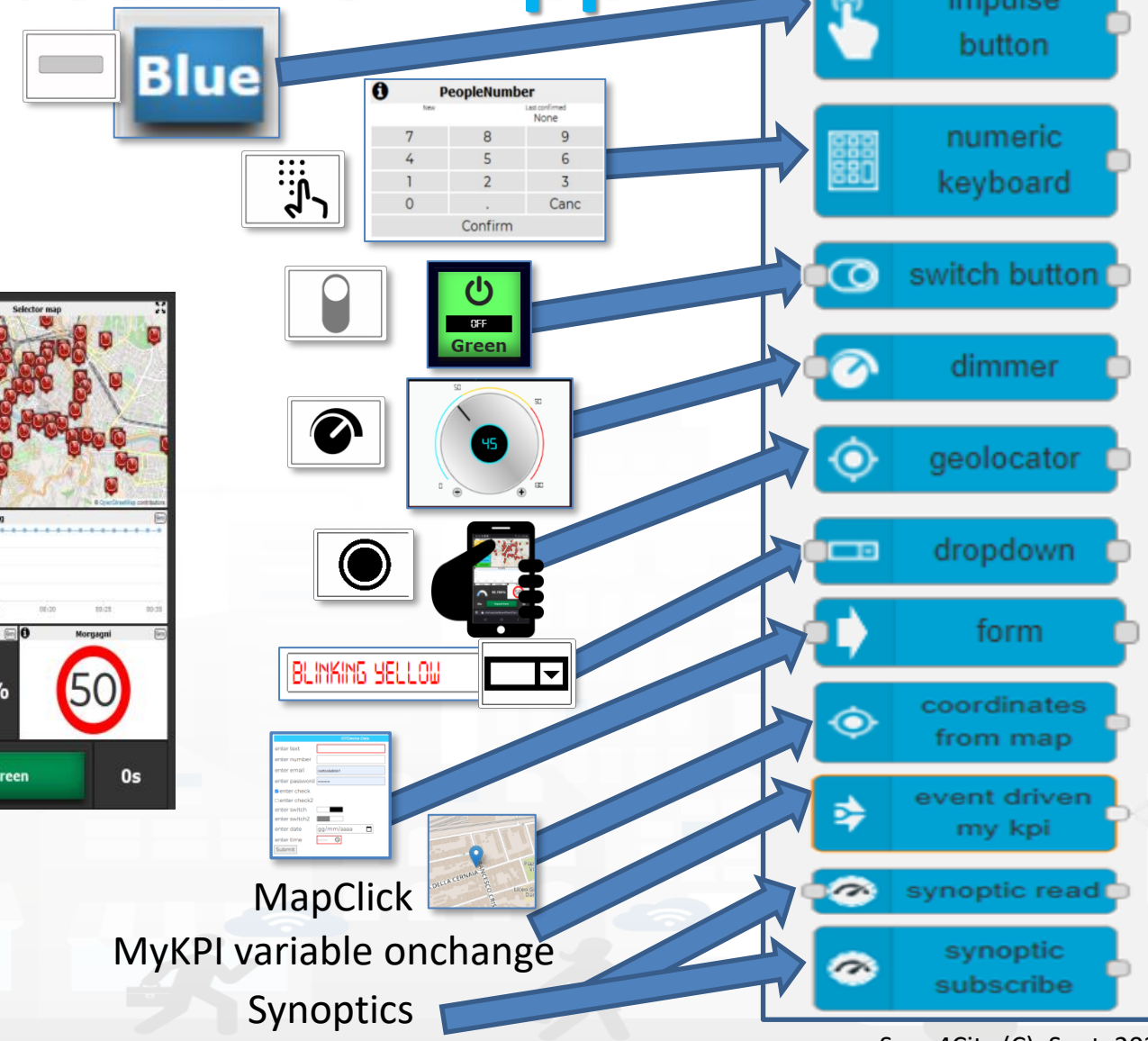
Managing Public and Private IOT/IOE Devices

Sensors

Dashboards also provide rendering for sensor values

Towards any IOT Device and/or Dashboard

Dashboard-IOT App

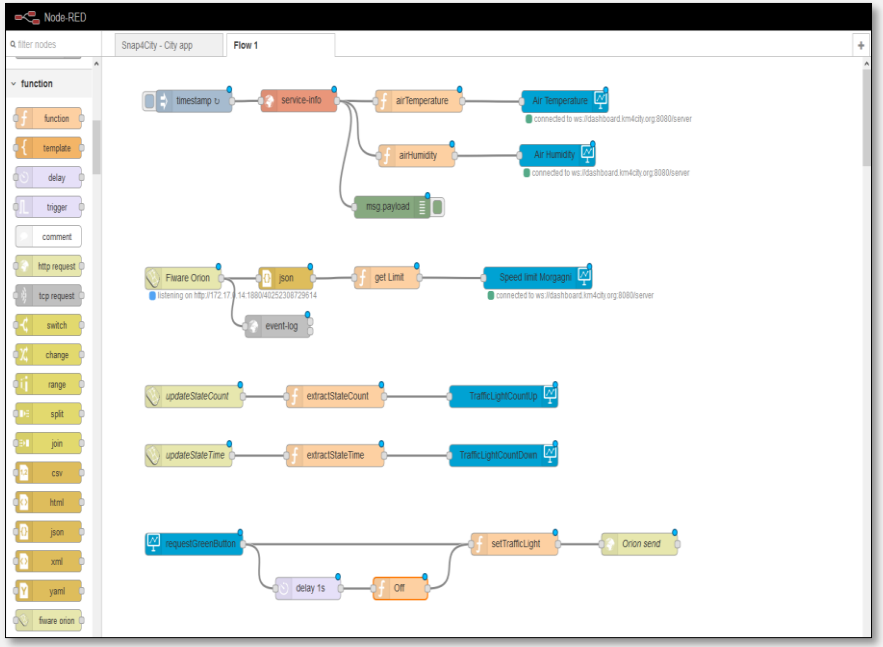


MapClick

MyKPI variable onchange

Synoptics

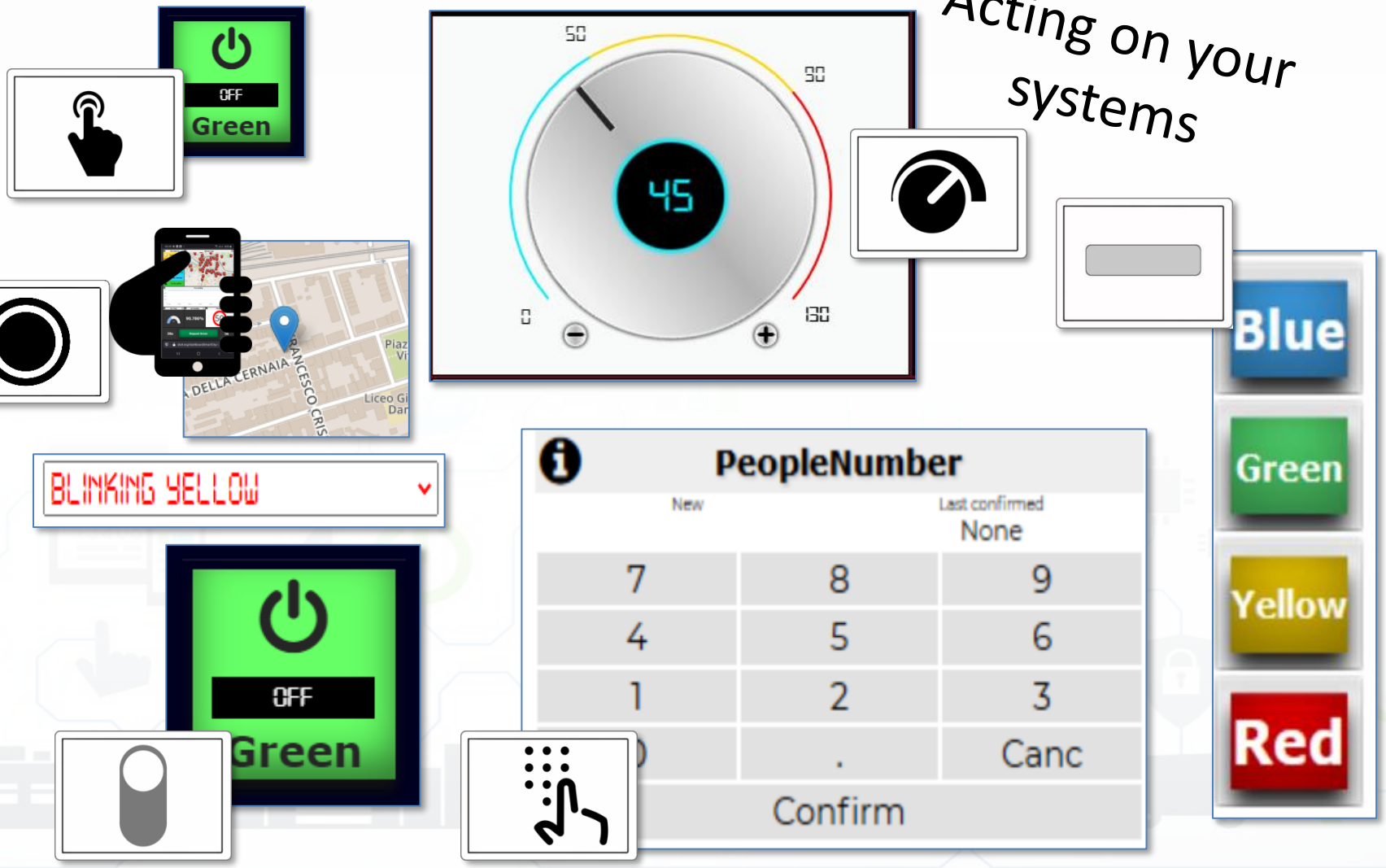
From Dashboard to IOT App



IOT Application

From Dashboard to IOT Devices/App

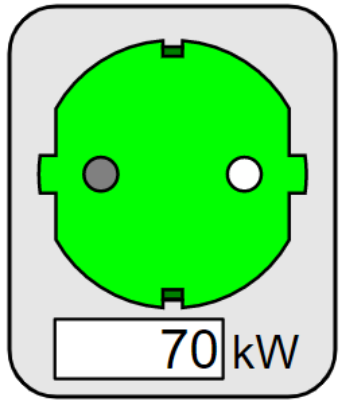
- **Widgets:**
  - Impulse Button
  - Button
  - Switch
  - Dimer/Knowb
  - KeyPad
  - Geolocator
  - Selection
  - Map Picking
- **Registered** on some IOT brokers with NGSI mutual authentication



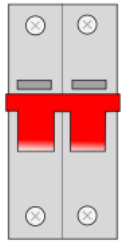
SVG Custom Widgets Examples 2

Tue 17 Nov 18:46:47

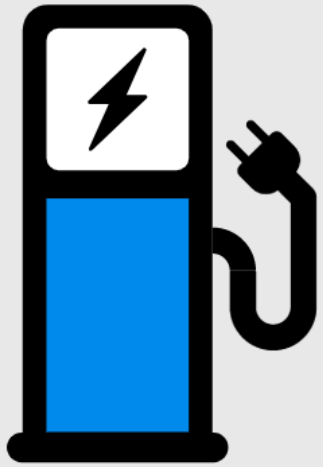
SVG shucko plug



Schuko switch



Charging Station Status



Legenda

Charging Station Status

Set on the keypad one of the following values

0 = ERROR (RED)

1 = AVAIBLE (GREEN)

2 = BOOKED (YELLOW)

3 = CHARGING

9999 = white icon

Charging Station status

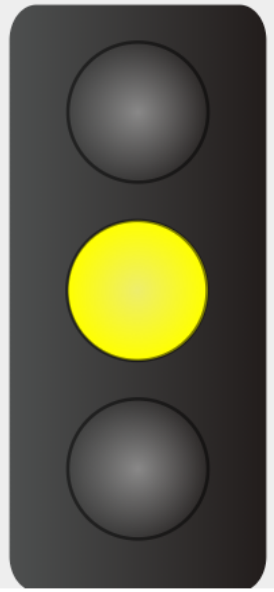
New | Last confirmed: None

7	8	9
4	5	6
1	2	3
0	.	Canc
Confirm		

Underpass

Set tunnel st...

Traffic Light



Traffic Light status set

YELLOW LIGHT

Speed Limit Set

New | Last confirmed: None

7	8	9
4	5	6
1	2	3
0	.	Canc
Confirm		

Dynamic Speed Limit Sign

Speed Limit Explaination

Speed Limit Custom Widget example

Write the speed limit by using the keypad and click CONFIRM.

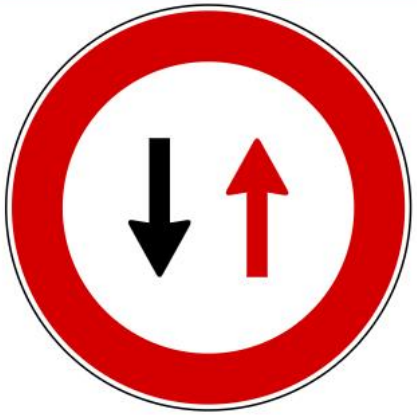
9999 = white sign.

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjk4Ng==

SVG Custom Widgets Examples

Sat 19 Dec 00:10:12

Precedence Italians Road signals

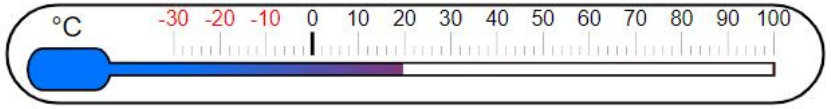


Select a code from 0 to 11 to change the road sign

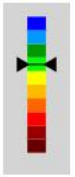
New		Last confirmed: None
7	8	9
4	5	6
1	2	3
0	.	Canc
Confirm		

s... | **Smart Light Luminosity**

Air Temperature in Florence



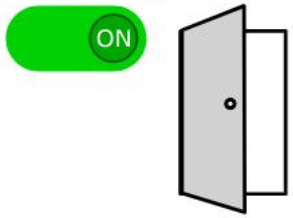
PM10 level - Bologna



fan | **Fan velocity**

Symbols Legenda

open/... | **M...**



Dynamic Prohibition...

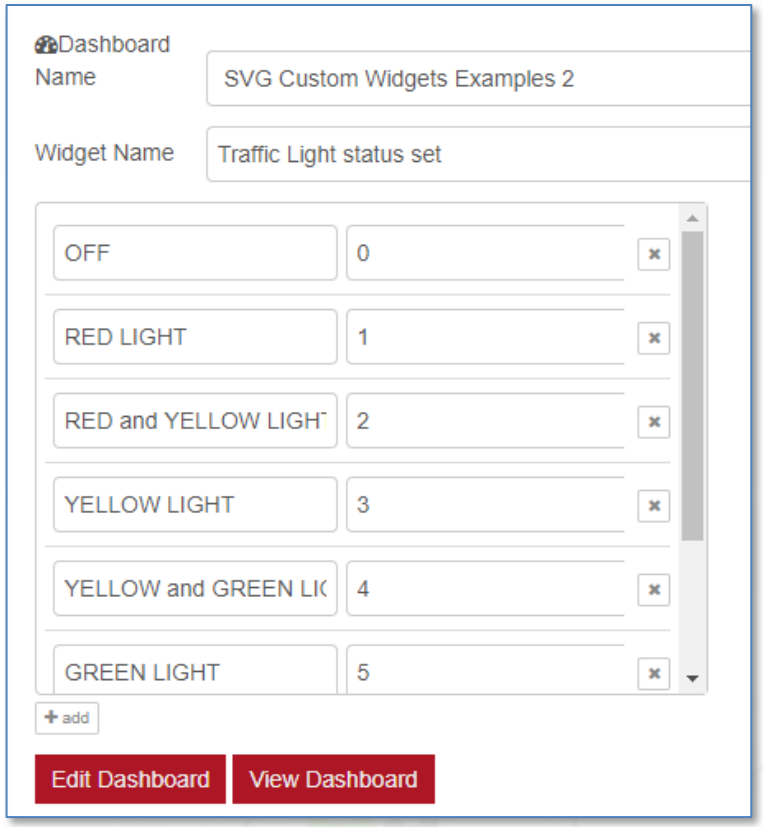
Prohibition Traffic Signs Co...

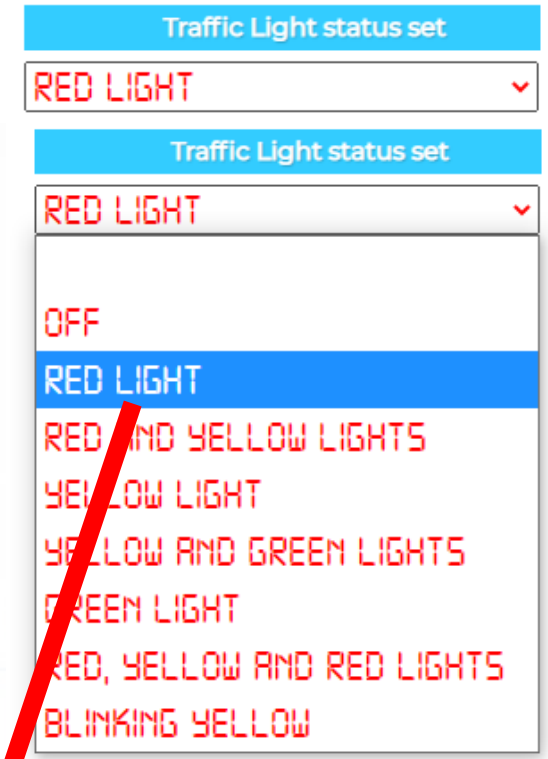
New		Last confirmed: None
7	8	9
4	5	6
1	2	3
0	.	Canc
Confirm		

Prohibition Traffic Signs Legenda

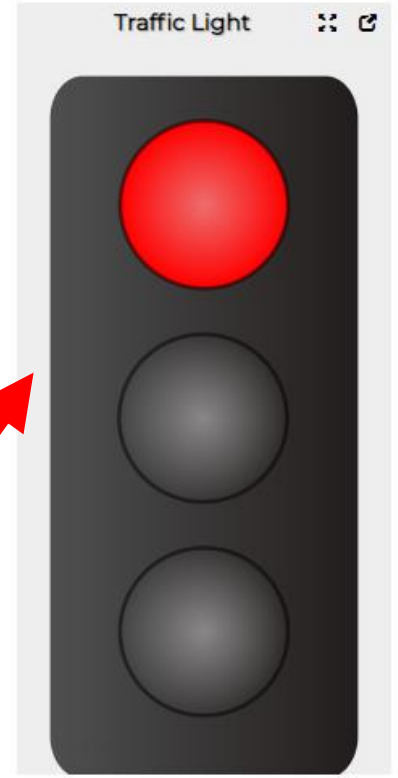
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjk0NQ==

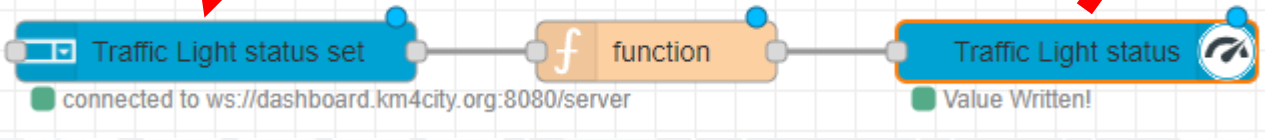
Selector





- Selecting MSG to be sent on the Business Logic IOT Application





```
msg.payload = {value:JSON.parse(msg.payload).selected};
return msg;
```

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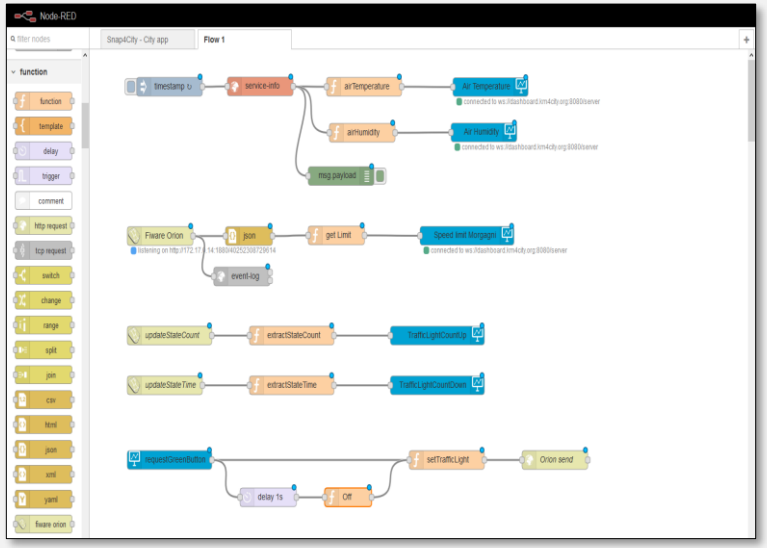
Nature Dashboard-IOT App

SNAP4CITY Node-RED

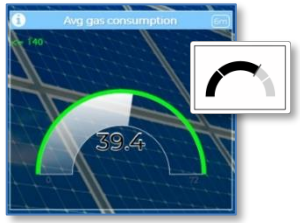
From IOT App to Dashboard

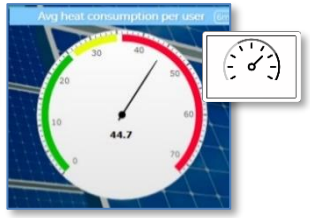


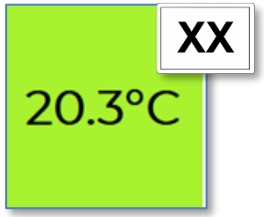
IOT Application

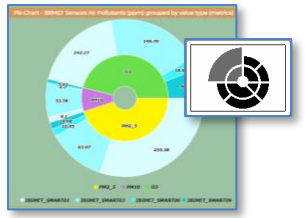
- gauge chart
- single content
- speedometer
- horizontal single bar
- vertical single bar
- web content
- time trend
- bar series
- radar series
- pie chart
- curved line series
- table content
- calendar
- speak synthesis
- synoptic write
- Selector - Map

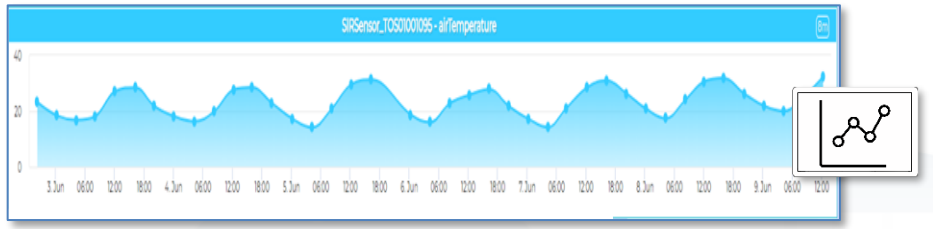
- Snap4D3
- dashboard - map
- event table
- device table

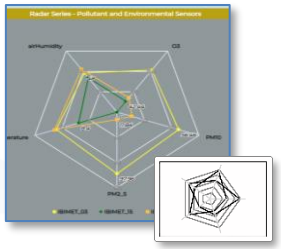


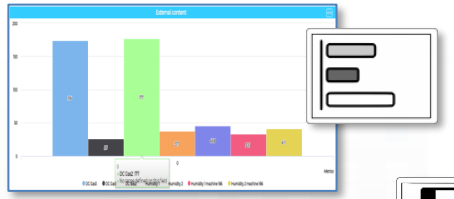


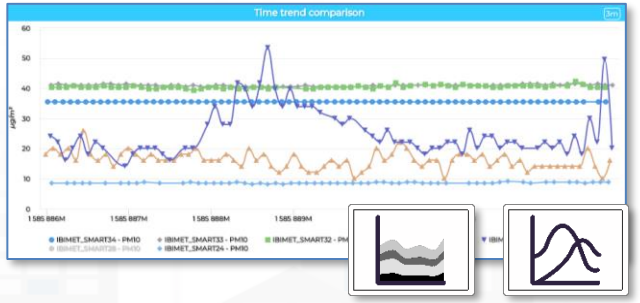


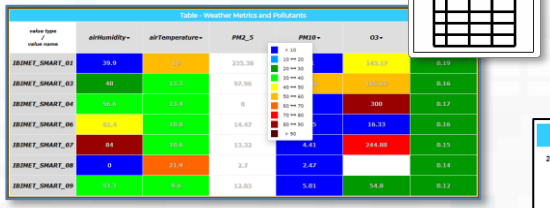


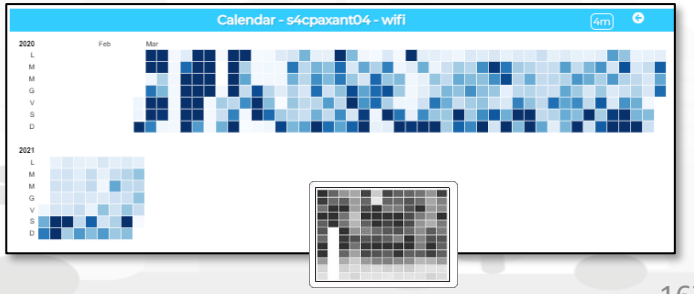








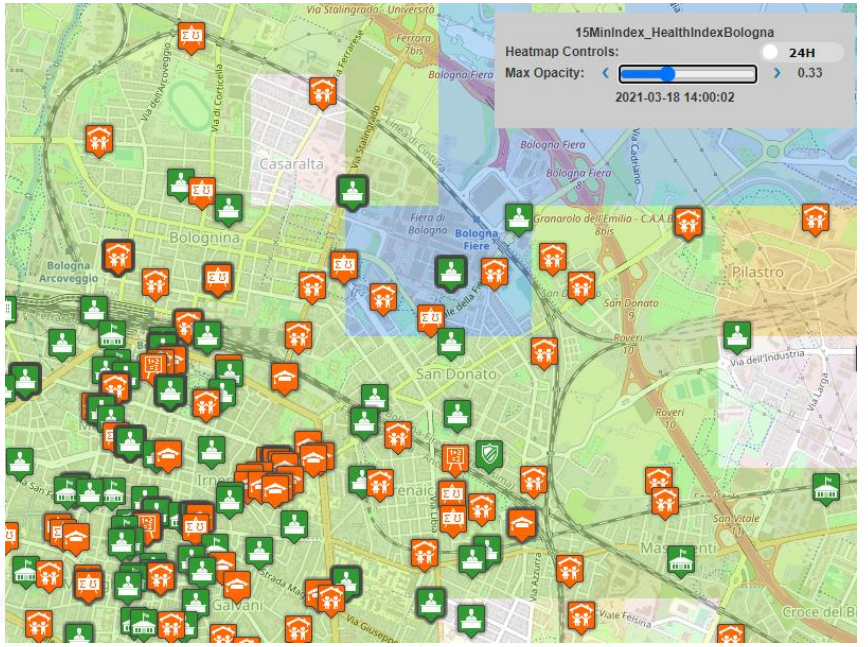




Selector Map

Controlling Maps from IOT Apps

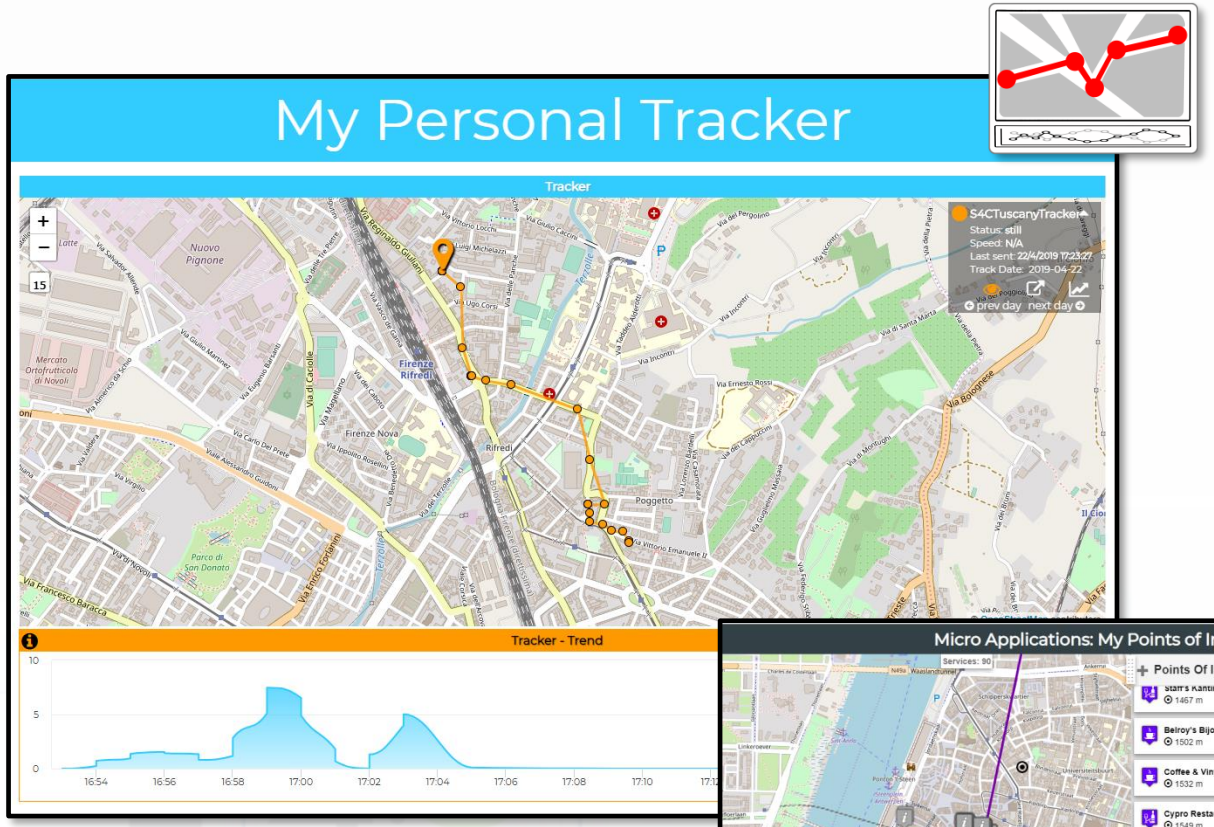
- User manual: https://www.snap4city.org/774
- To control Multi Data Map from IOT App
  - Add/remove a Category/SubCategory of Entities, via ***more option query***
  - Add/remove a single Device/PIN, MyPOI, MyKPI, Dynamic Pins, moving devices, etc.....
  - Add/remove cycling paths
  - Add/remove OD Matrix
  - Add/remove an Heatmap, a Traffic Flows, …
  - Add/remove multiple entities with multiple More Option Queries
  - Add/remove Special Tools: scenarios, whatif, etc.
  - Add/remove a set/single temporary GeoInfoPin

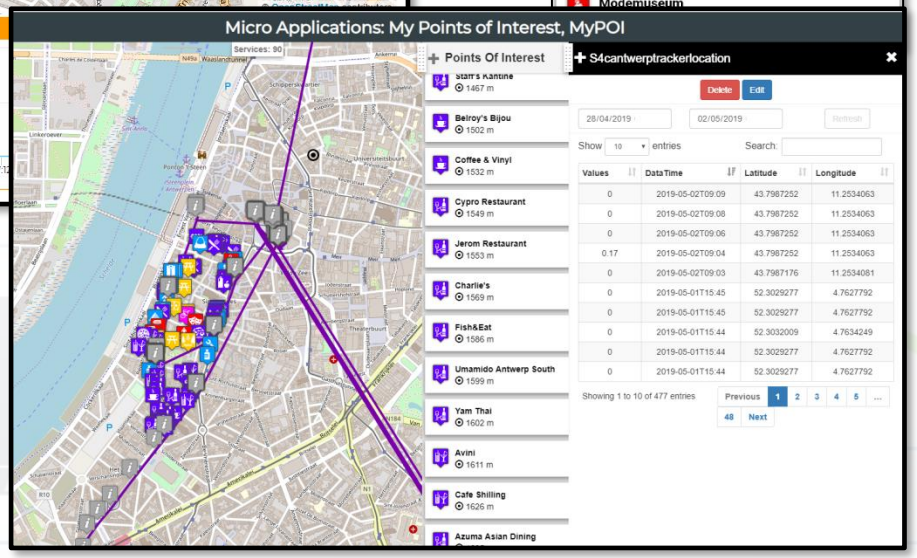


• Trajectories

High Level Types

- **Variables**, Sensor/sensor-actuator, :
  - **Mobile Device Variable, Data Table Variable, Dashboard-IOT App**: messages from GUI to Business Logic on IoT App
- **MyKPI**: dynamic GPS, info, single variable, Time Series, (Classification)



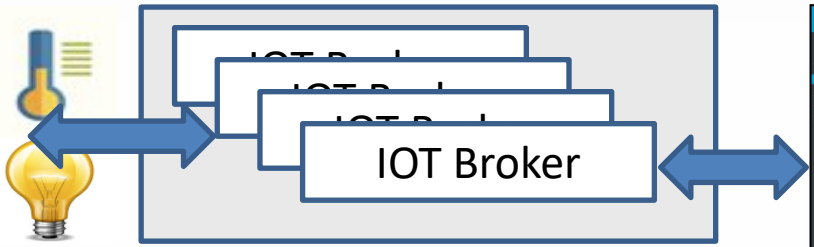


- **Real Time Tracking**
- **Hystorical Tracks**
- **MicroApplications**

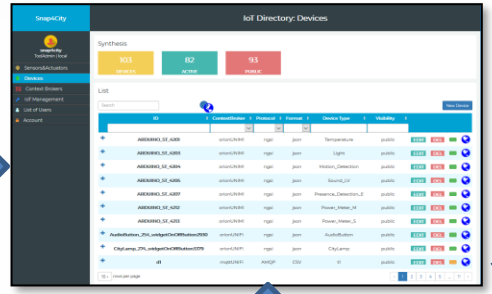
IoT Devices and IoT Apps

IOT Network Manager vs Final User

Network of IOT Brokers



IOT Directory

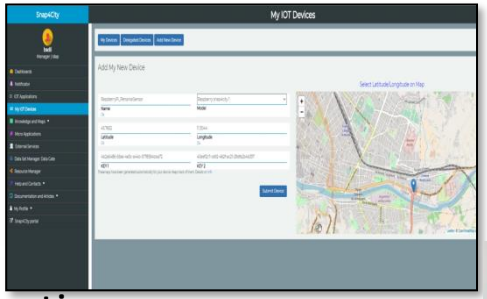


Registering

Discovering

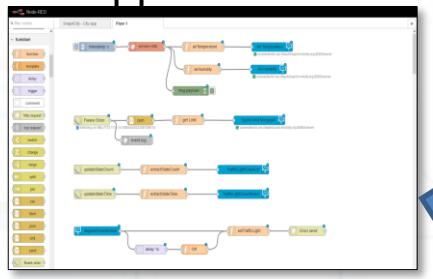
IOT Network Manager

My IOT Device



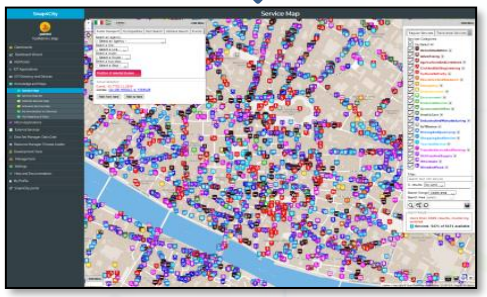
Register

IOT Application



Final user Manager

Browsing



ServiceMap Knowledge Base

Discovering

Dashboard Wizard

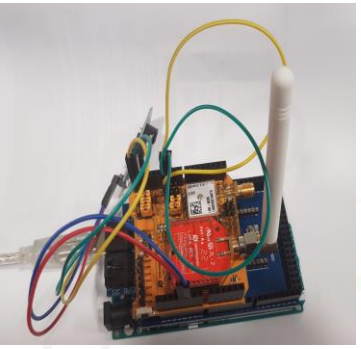
Knowledge and Storage Data from the Field and From the City if needed

IOT Devices

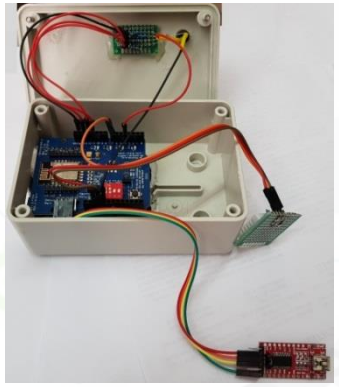
Sensors/
Actuators

IOT Edge Devices

LoraWAN +
Arduino +
I2C, NGSI



Arduino,
Wi-Fi, NGSI

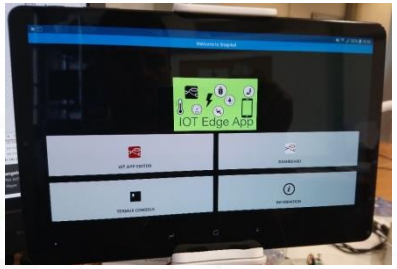


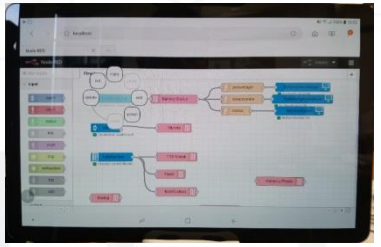
Snap4All
IOT Button
ESP, NGSI,
Wi-FI, BT

Snap4All PAX
Counter
LoraWAN
WIFI, NGSI,
GPS

IOT Edge
NodeRED:
Raspberry Pi,
NGSI, WiFi,
RJ45,..

IOT Edge
NodeRED:
Android, LINUX,
Windows, …



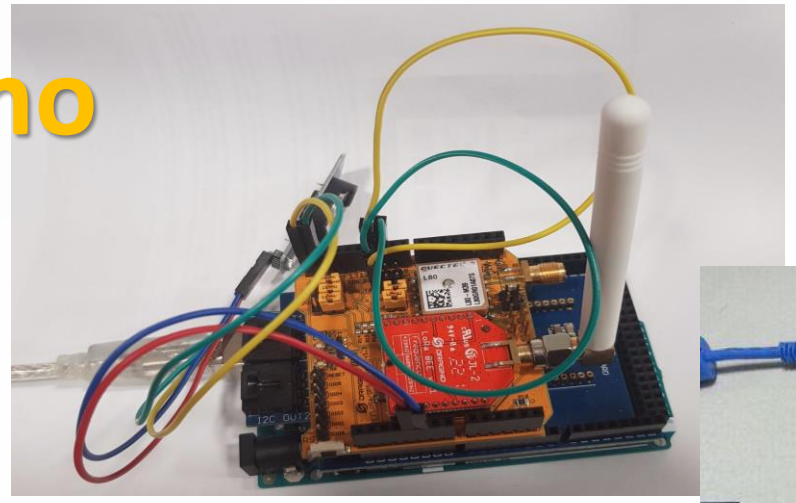


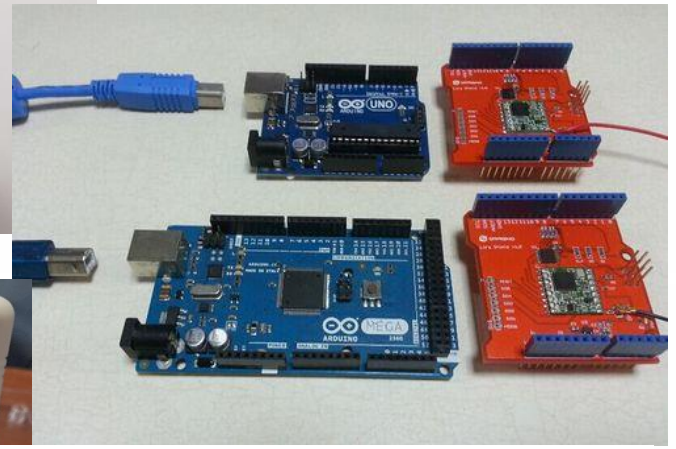
LoraWan
Gateway:
IOT Edge, NGSI,
WIFI, RJ45, GPS

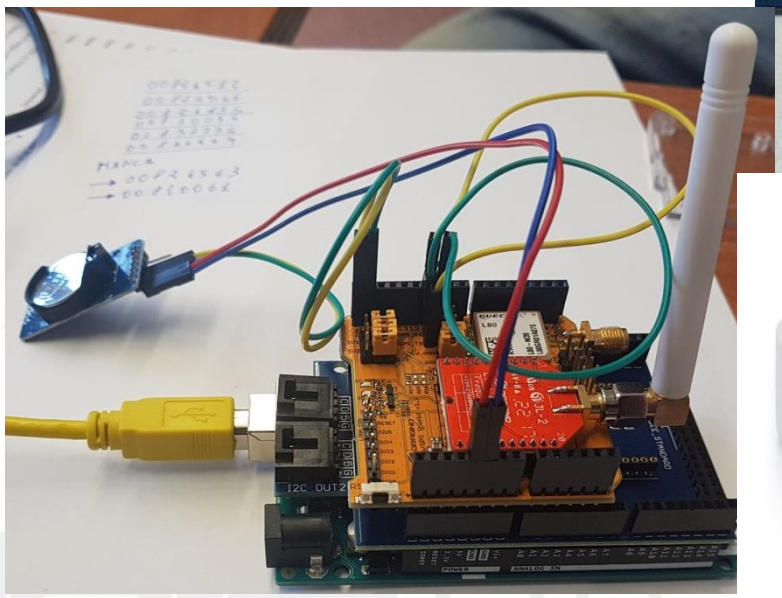
Any Sensor / Actuator
Open to other protocols

Lora IOT Device, Arduino

- Arduino Uno, Mega
- LoraWan Connection
- Any sensor, + I2C
- Fully Customizable
- Open Source
- NGSI or any other protocols
- Gateway: Dragino



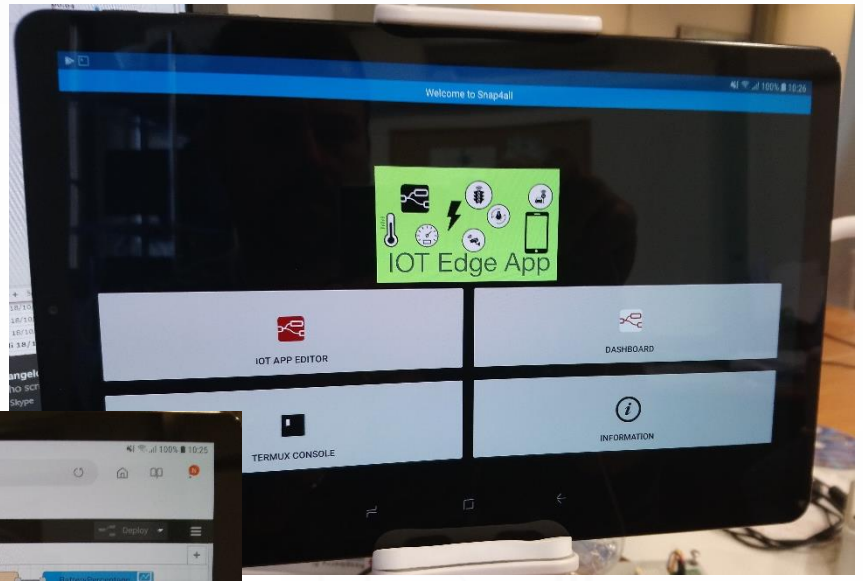


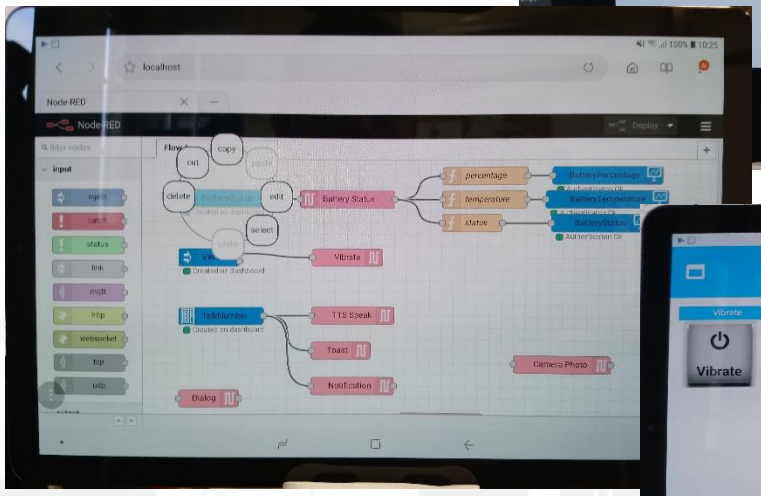


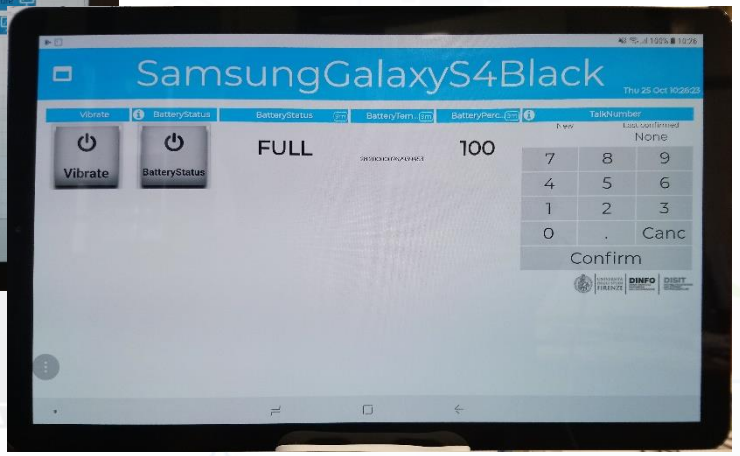
https://www.snap4city.org/drupal/node/216

IOT Edge Snap4All App for Android

- **Android**, any version, App from: https://www.snap4city.org/download/video/Snap4All.apk
- **Mutual Authentication** with certificates
- *Secure encrypted connection*, NGSI
- **IOT Application inside**
- **Any sensor** + Local device sensors
- **Any protocol** from IOT devices
- **NGSI** or any other protocol
- **Fully Customizable**
- Local and Cloud Dashboard
- **Special MicroServices**



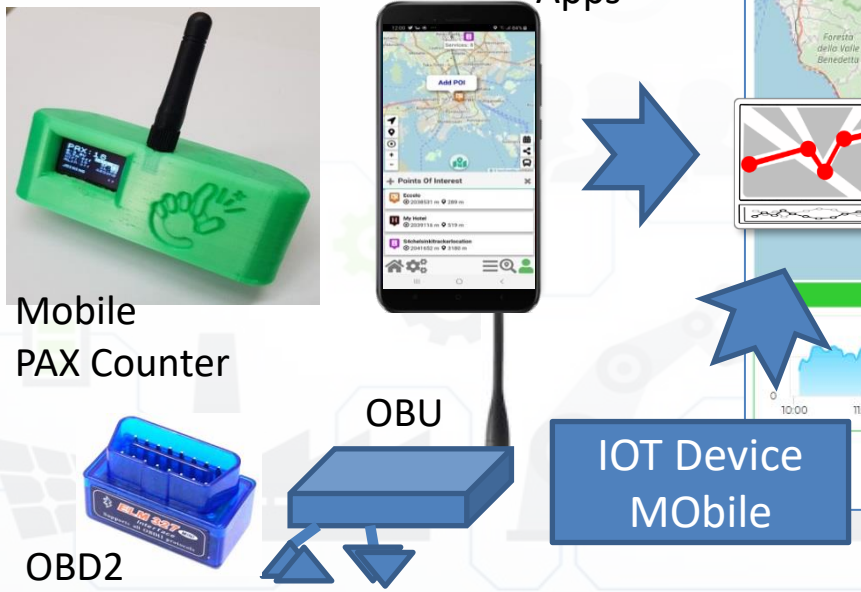


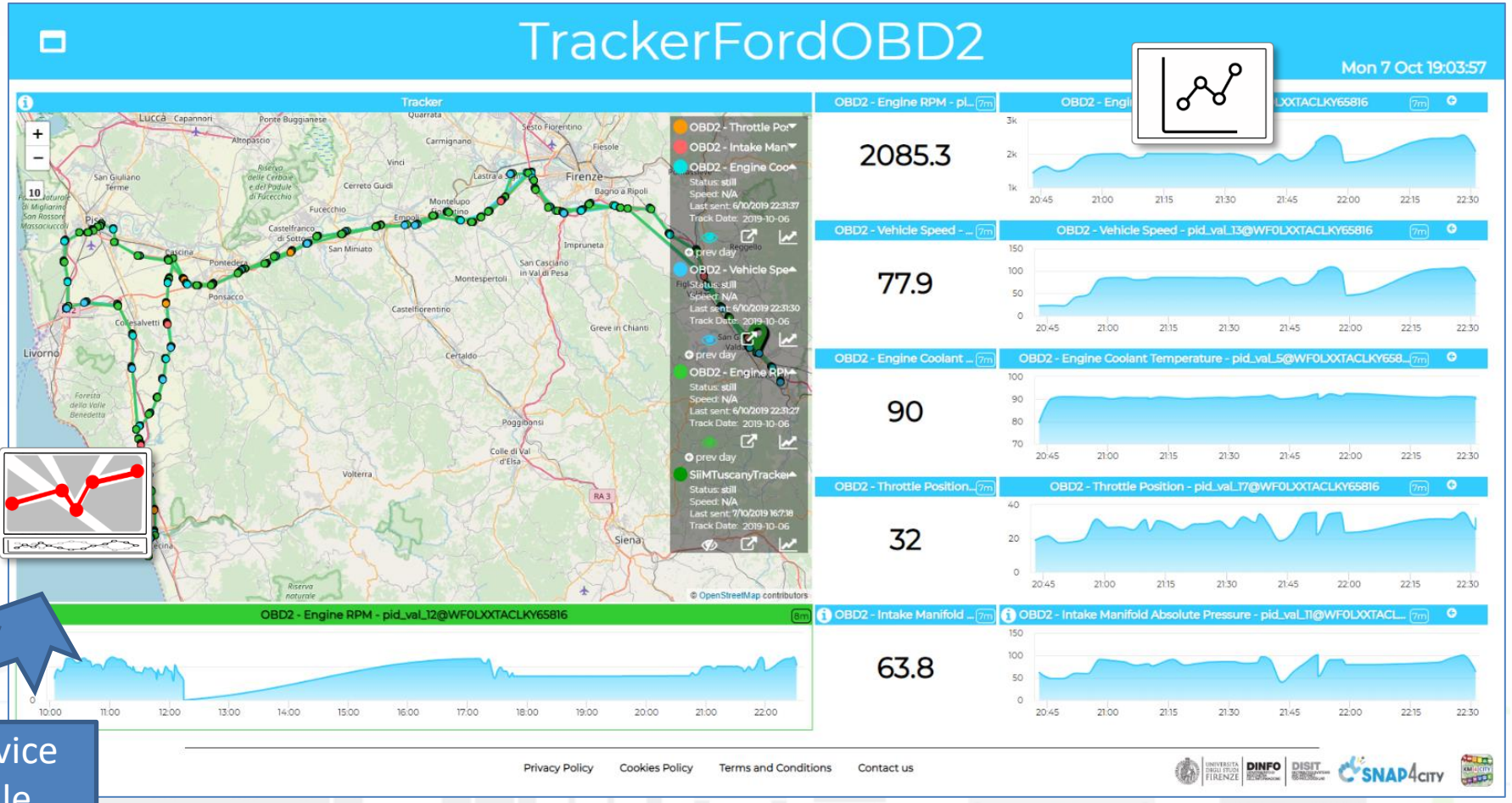


Moving IOT Devices / Sensors, Tracking Devices

MyKPI: Tracking of Devices and Mobiles

- Real Time Trajectories for
  - Mobile Phone
  - Moving IOT Devices
  - OBU, Vehicular Kits
  - Multiple tracks
  - Day by day
- Micro Application

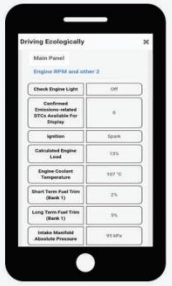


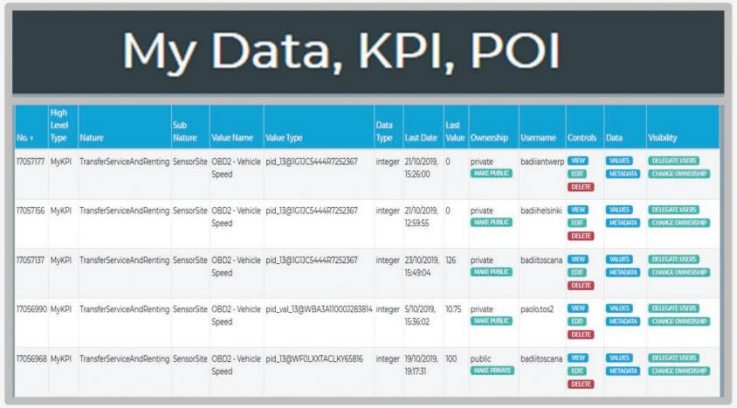


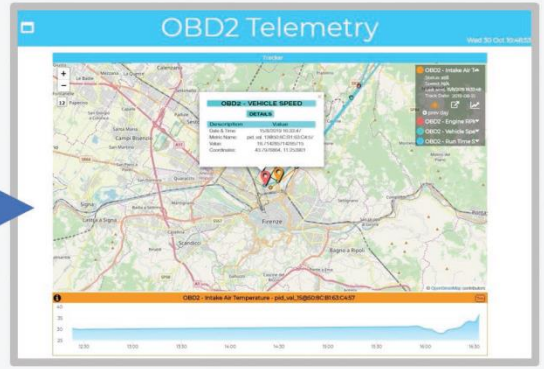
IOE – Vehicle Monitoring

CANBUS sniffer

Bluetooth



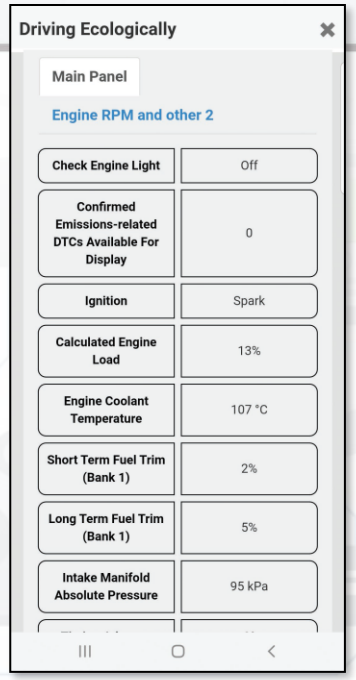


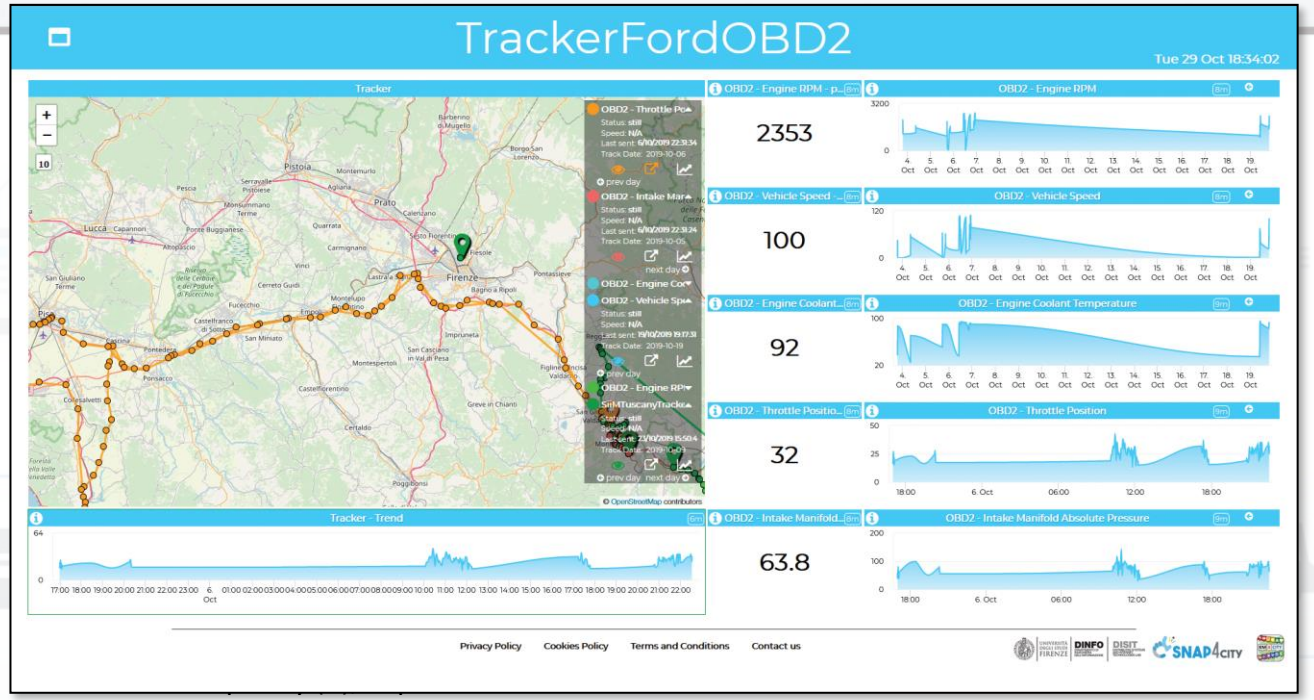


Tuscany in a Snap Mobile App on Android

TOSCANA

GET IT ON Google play





Real time device tracking

Start

moving device

Selector

start

DISIT:orionUNIFI:MyMobileDeviceTest

movit it

movit it

Selector - Map

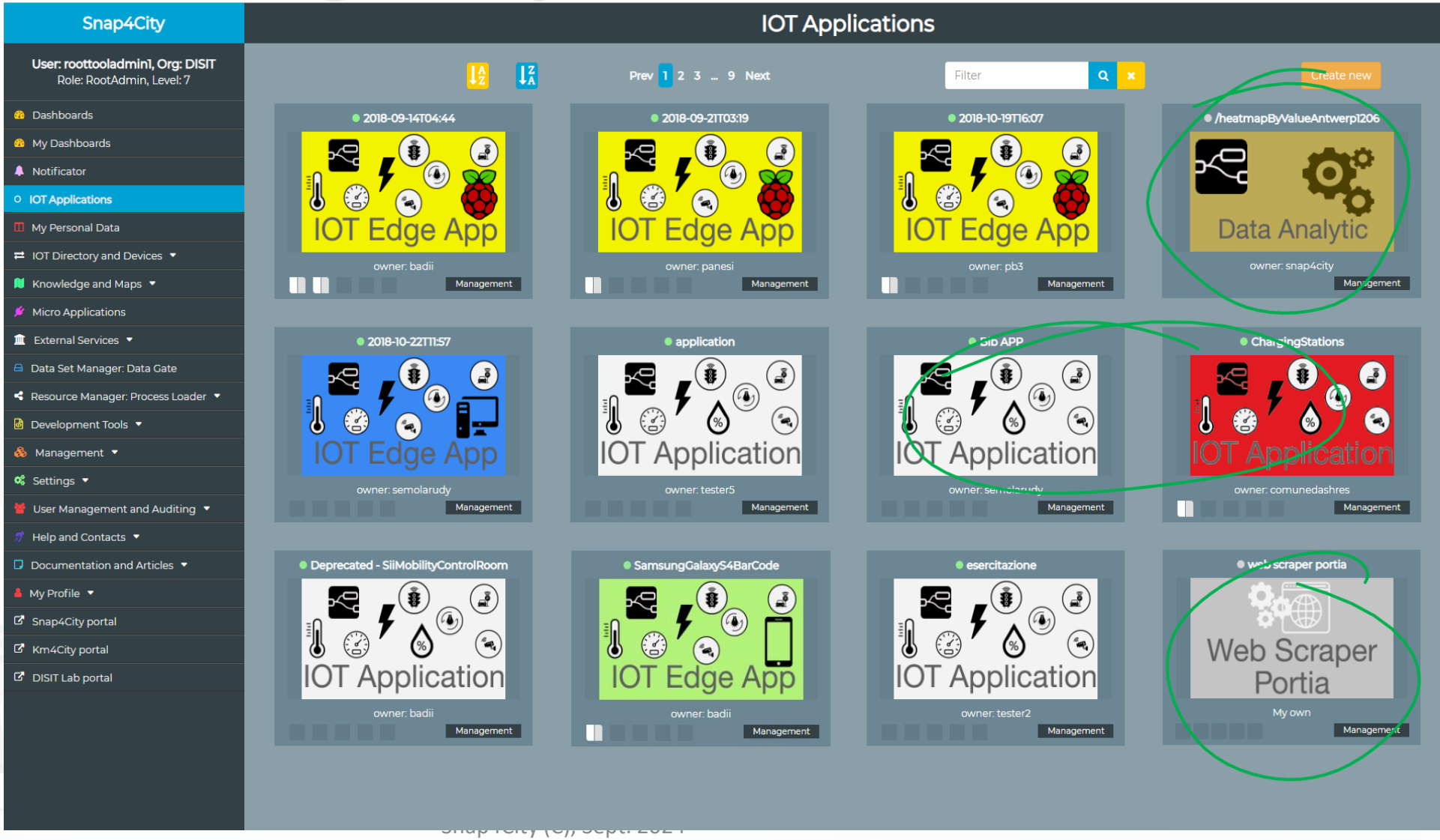
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA1Ng==

Moving and changing Dynamic PIN

Managing IOT Applications

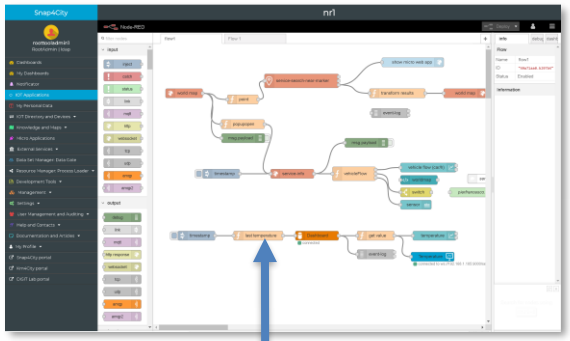
IOT Application Listing, they can be

- Basic (white)
- Advanced (red)
- IOT Edge
  - Raspberry Pi
  - Android
  - Win/Linux
- Data Analytic (Plumber)
- Web Scraper (Portia)

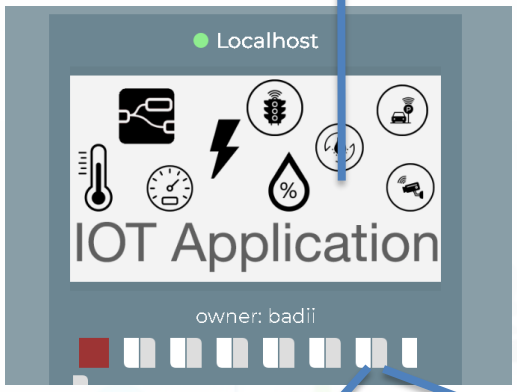


IOT Applications Listing

- Basic / Advanced
- On IOT Edge Raspberry Pi
- On IOT Edge Android
- On IOT Edge Win/Linux

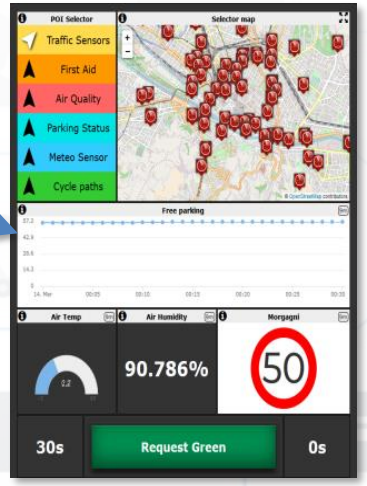


EDIT IOT APP



VIEW

EDIT



IOT App title

Ownership of the IOT App

Click the icon to edit the IOT App

Click to open the Node-RED IOT App dashboard

Click to edit IOT App properties

Click to view the Snap4City Dashboard

Click to edit the Snap4City Dashboard

IOT Edge Device

Other Local Connections

IOT Brokers

IOT Brokers

HTTPS

HTTPS

WiFi

Modbus

OPC UA

IOT Edge:
Node-RED + Snap4City

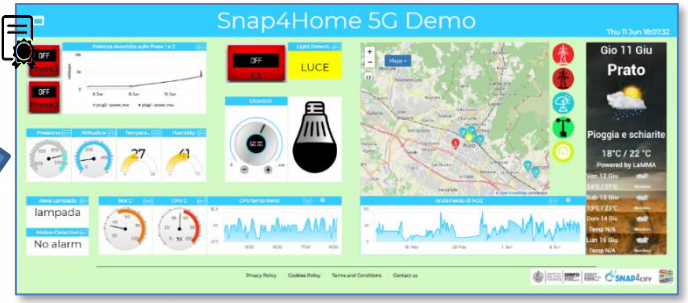
edge-tunnel-to-cloud

Search and Query, Smart City API
Facet, semantic search

Knowledge base
Semantic reasoners

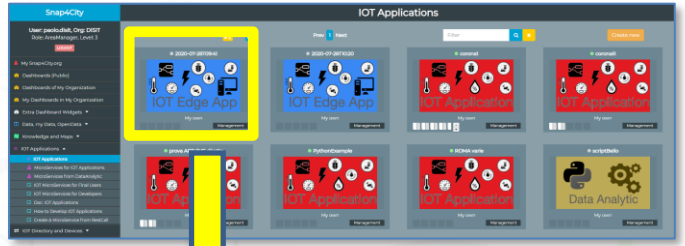
Indexing and aggregating
Elastic search

SNAP4CITY

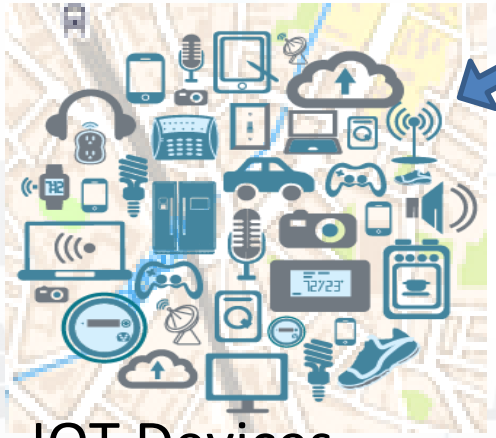


WSs

Firewall
Gateway
Towards internet

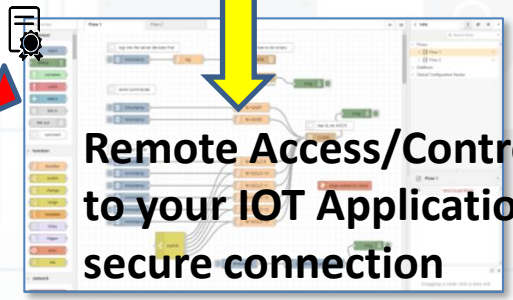


HTTPS



IOT Devices

Access to IoT Edge Maintenance



Remote Access/Control/program to your IOT Applications via secure connection

HOW To install IOT Edge Remote Control feature

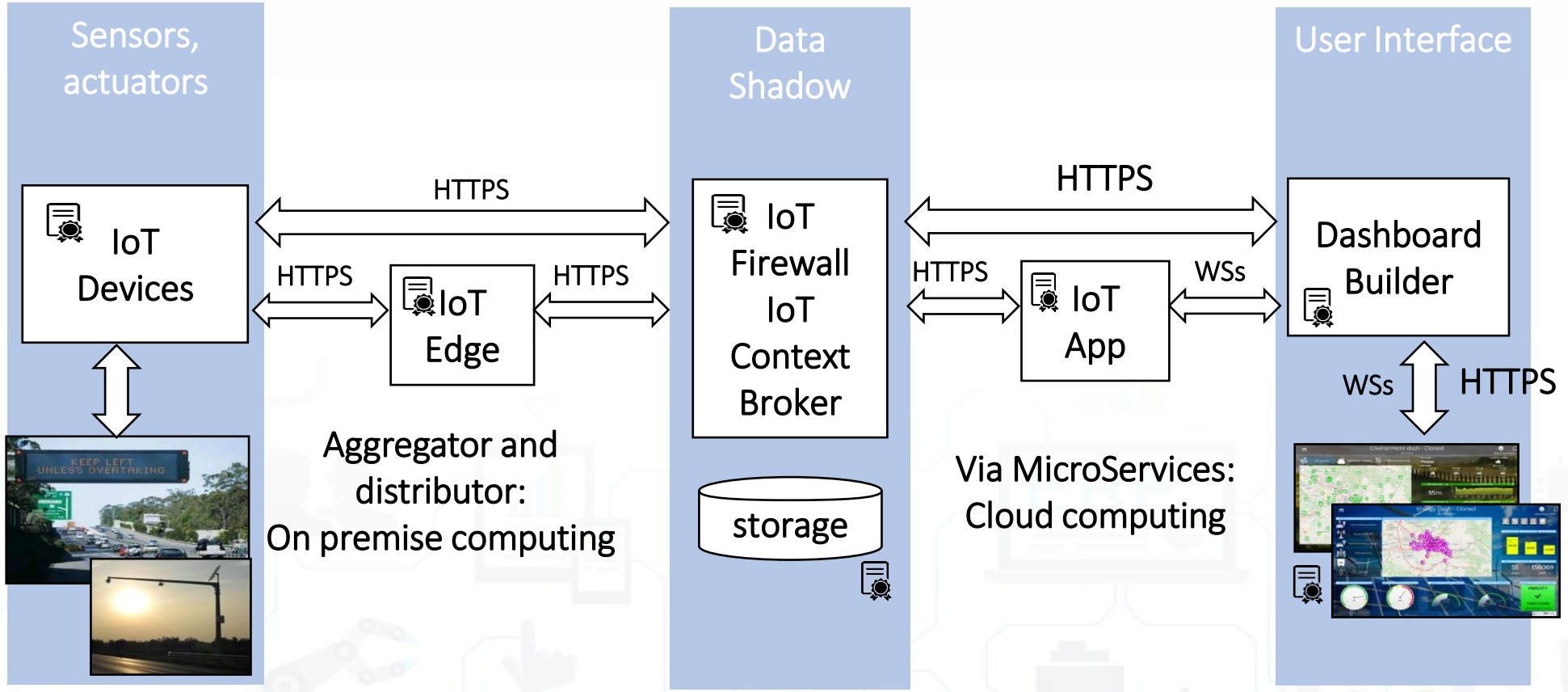
- **The installation is very simple**

1. install Snap4City basic library
2. Drag and drop block from S4CUtility

3. Configure the block with your credentials
4. Deploy of the IOT App
5. Go in the list of Your IOT Applications on Snap4City.org or other cloud or on premise installations
6. Identify the IOT Edge IOT App and click on it to open the view on the IOT Applications flows

Secure IOT Devices, IOT Edge Sensor and Dev Networking

The secure stack



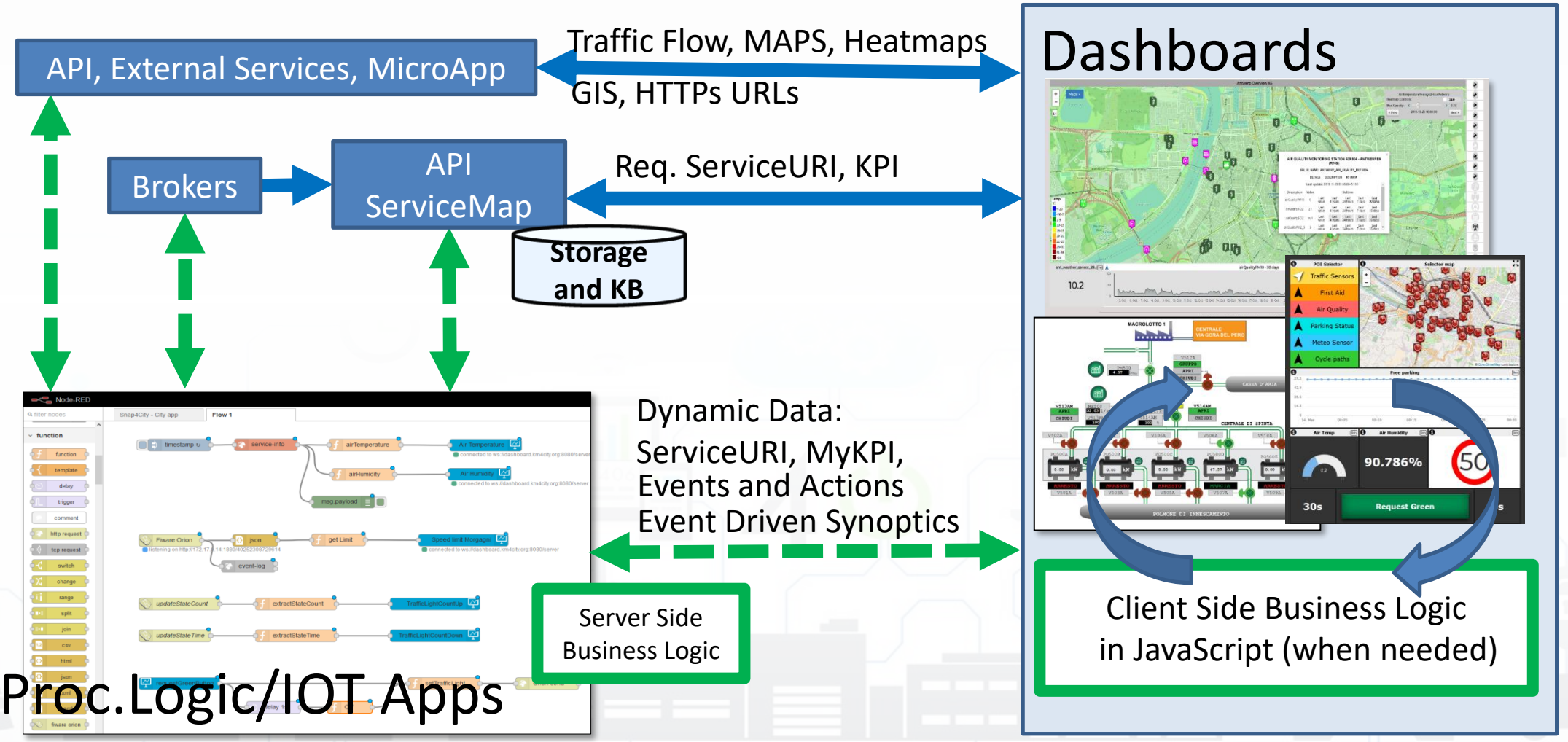
TOP

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								

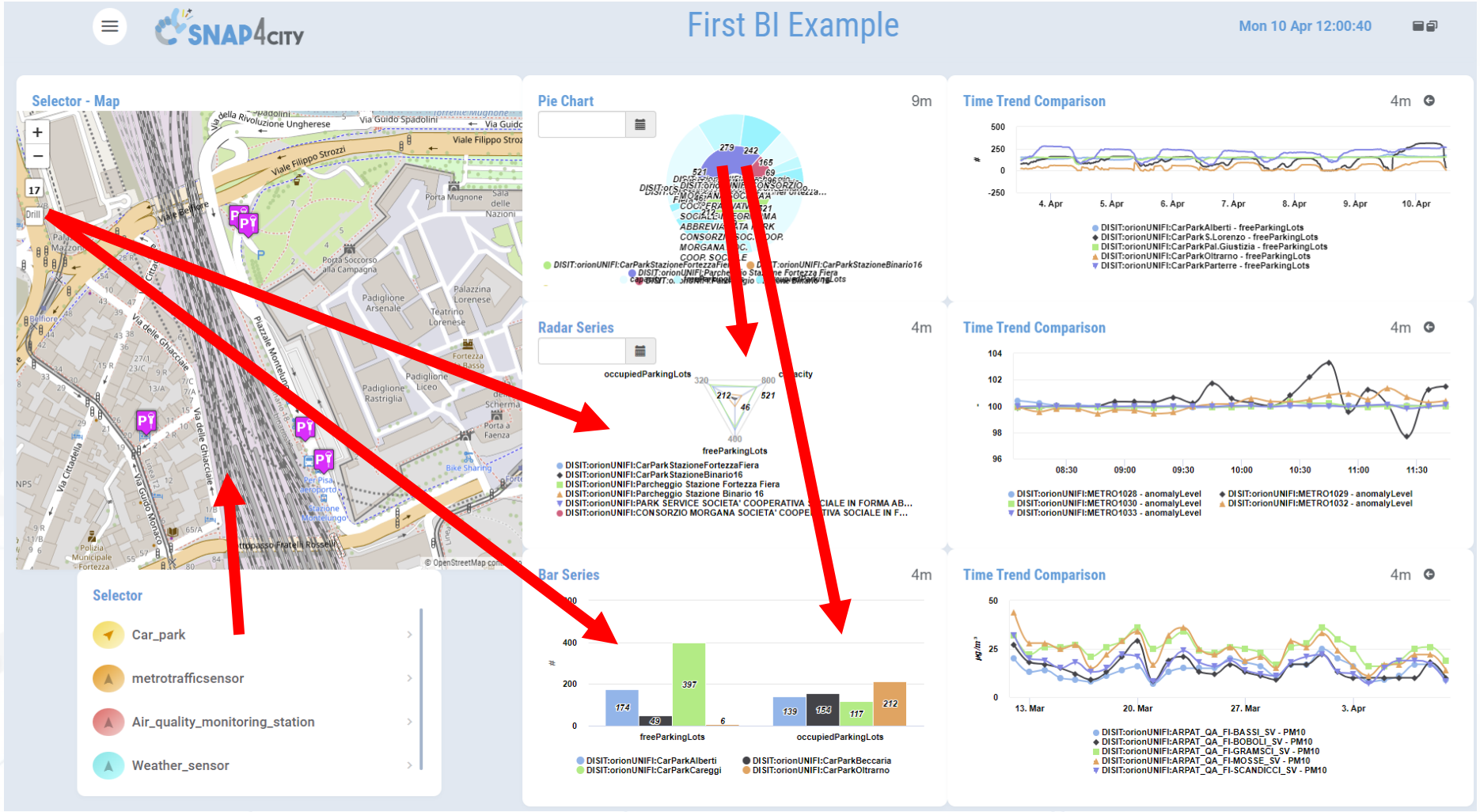
How the Dashboards exchange data



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

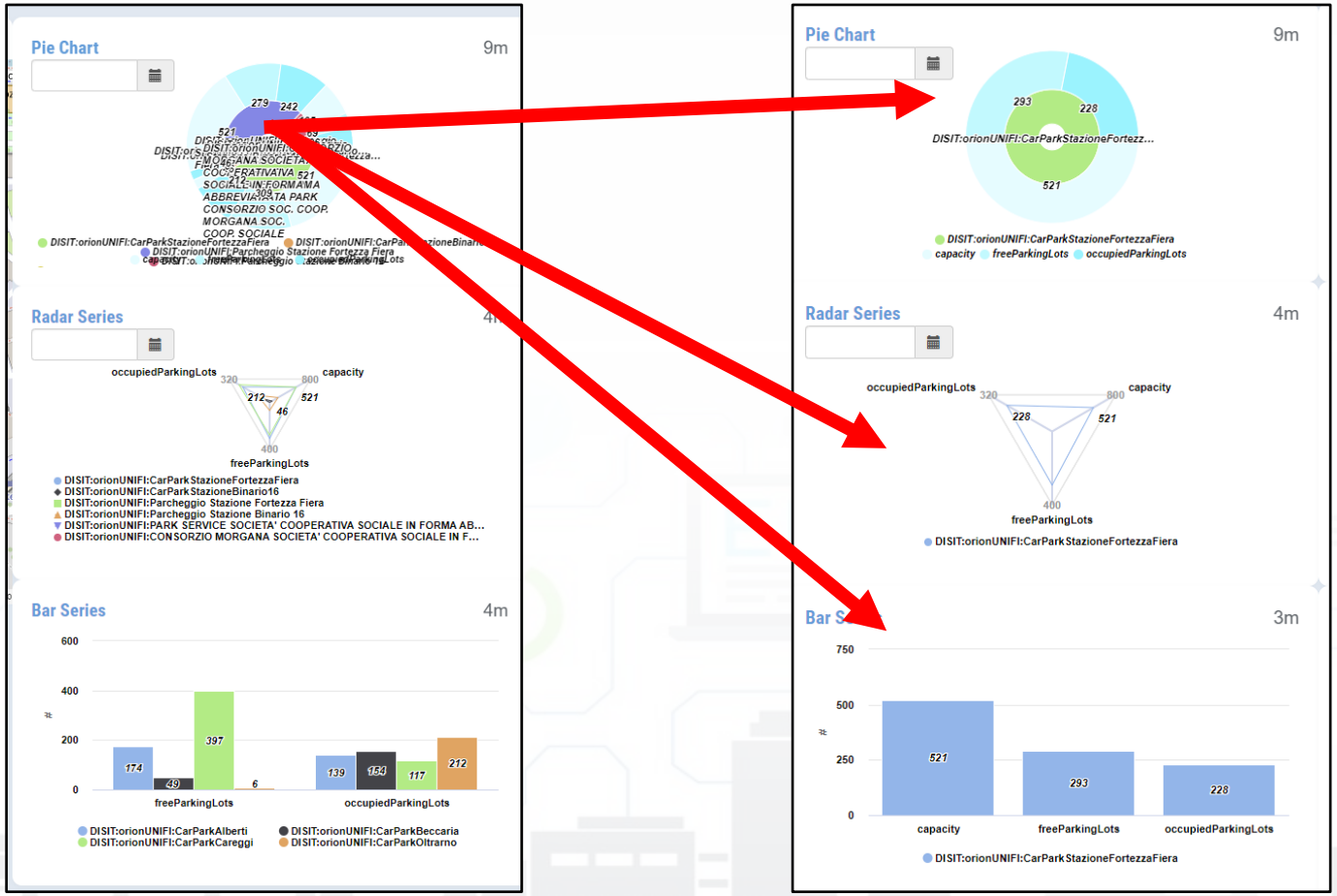
4) The JavaScript CSBL on Map will send data to the programmed Widgets. In this case, arrowed in RED



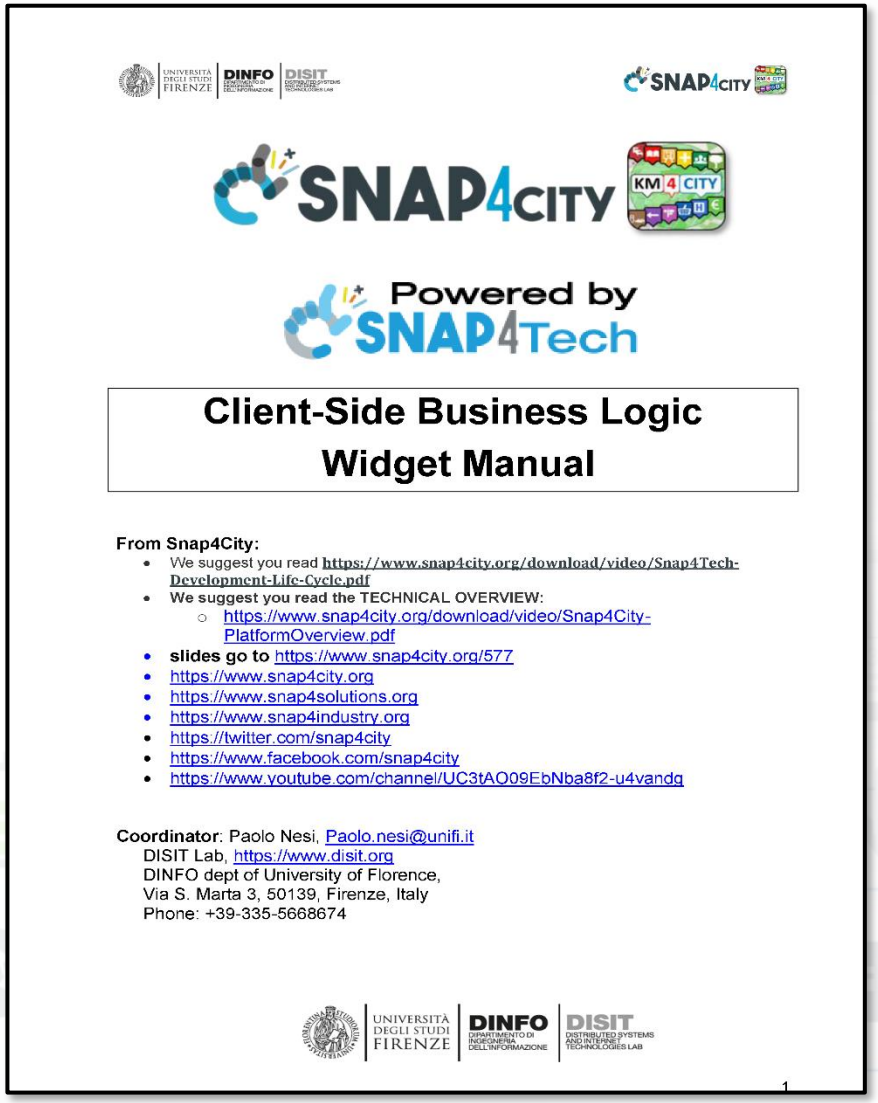
Example: From Data Graphs to Graphs (drill down)

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



Client Side Business Logic



SNAP4CITY | KM 4 CITY

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

UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO | DISIT

1

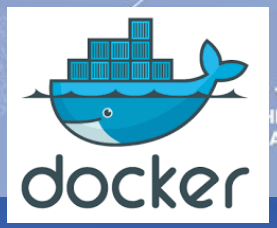
https://www.snap4city.org/download/video/ClientSideBusinessLogic-Widget.pdf

TOP

Installing Snap4City

SNAP4
Appliances and Dockers
Installations

Installations

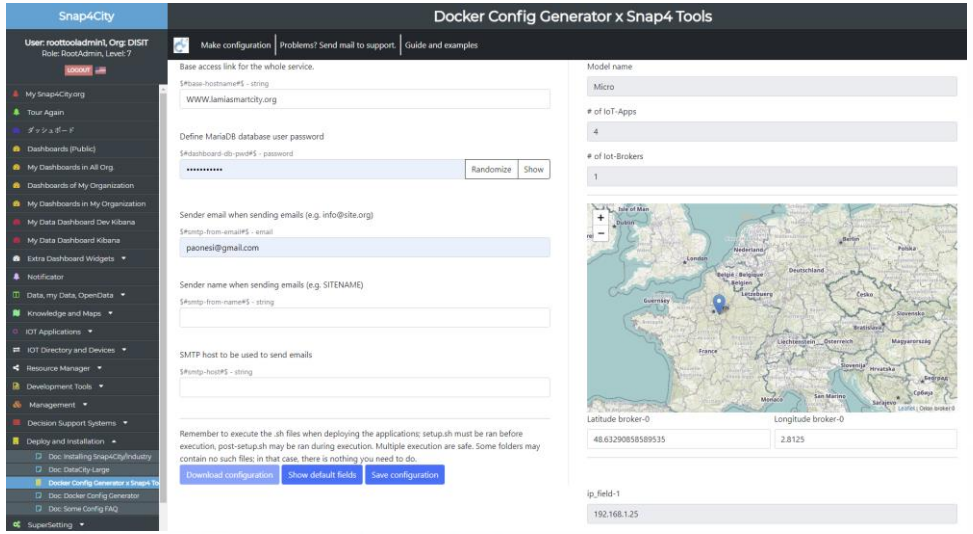


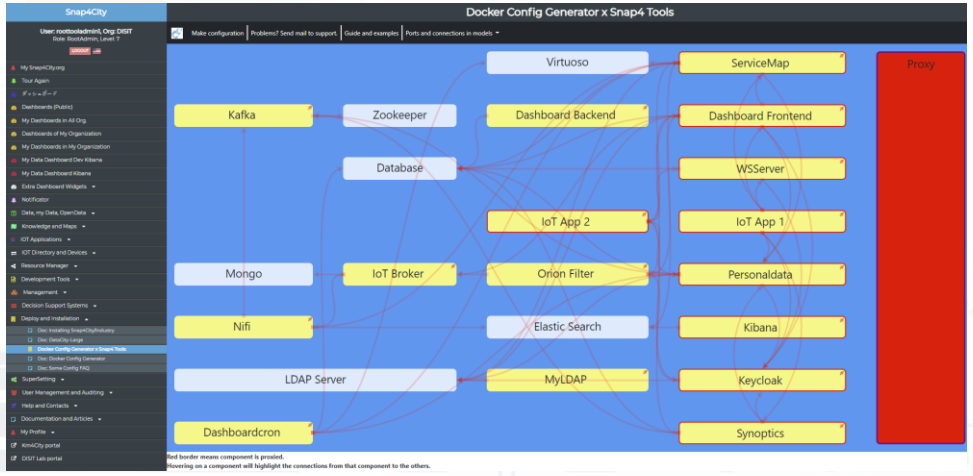
https://www.snap4city.org/471

To get an updated version read it!

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

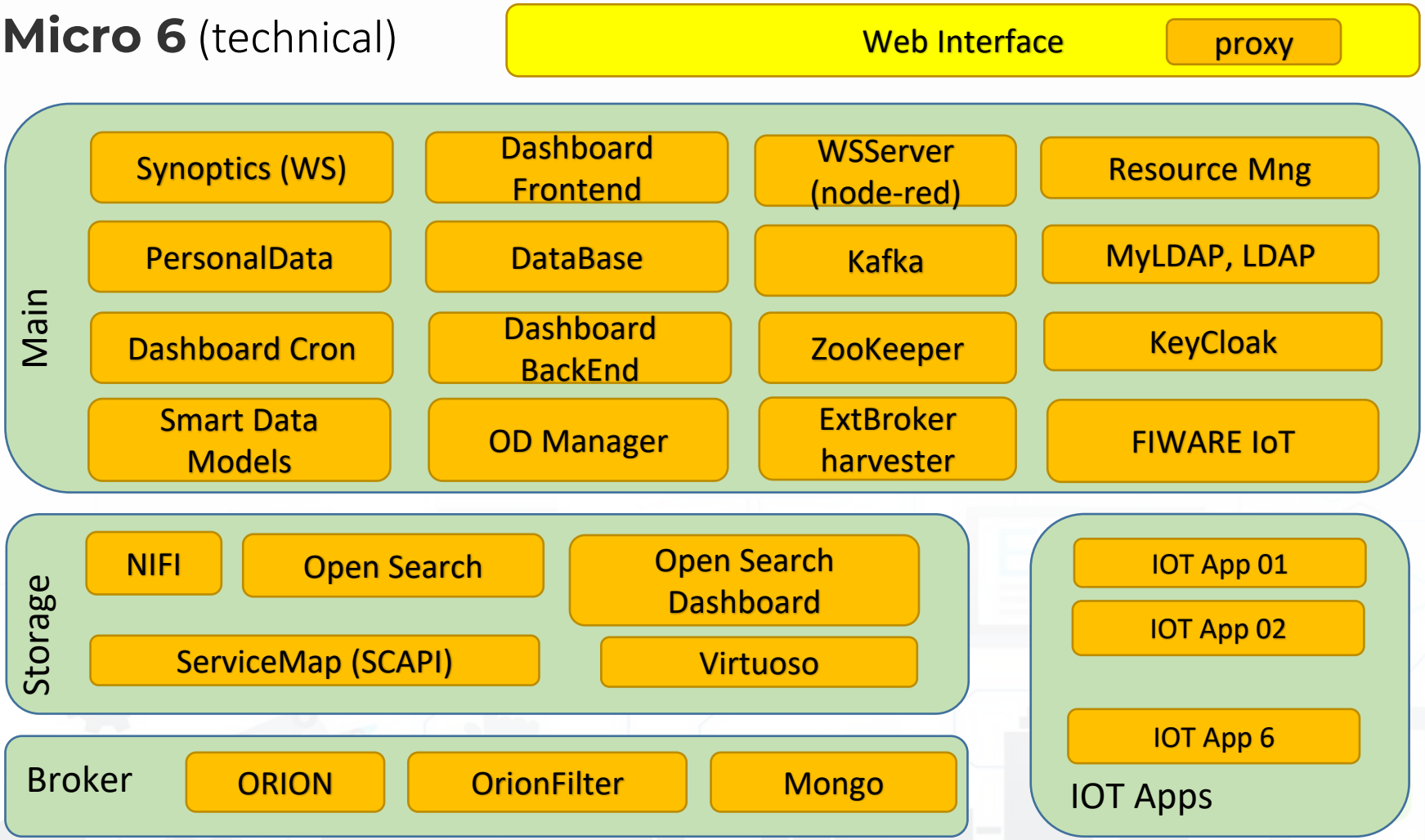




https://www.snap4city.org/docker-generator/selecting_model

Micro 6 model

Micro 6 (technical)



1Hour installation and ready to use

DATA ANALYTICS, Big Data Science

Big Data Analytics + Artificial Intelligence

- **Decision support**
  - **Early warning, City Indexes, etc.**
  - **What-IF analysis** (simulation + AI + data)
- **Predictions**
  - **Short and Long terms predictive models on:**
    - traffic, parking, people flow, maintenance, land sliding, NO2
  - **3D Flow prediction:** Pollutant (NOX, NO2, …)
- **Suggestions and recommendations**
- **Modeling, simulation, routing**
  - **Traffic Flow reconstruction**
  - **Constrained Routing**

AI & XAI:

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

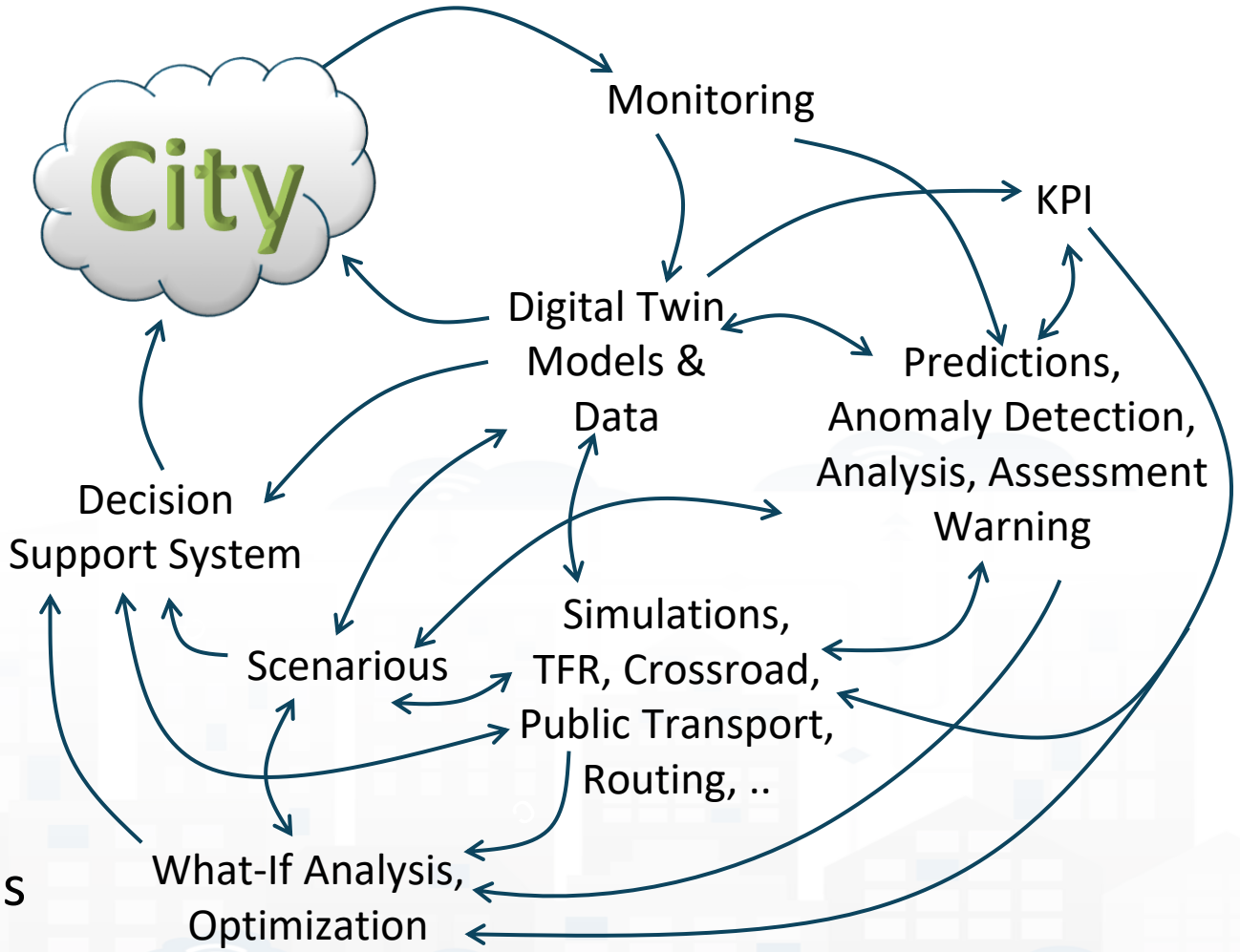
Representations, animated

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

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

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

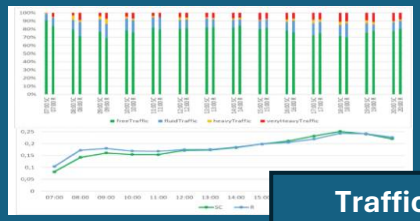
Decision
Support System

Scenarious

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

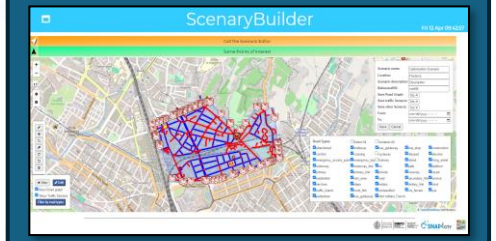
What-If Analysis,
Optimization

KPI, Predictions, ...



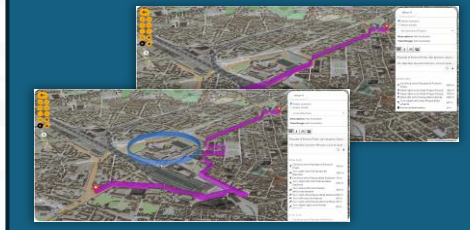
Traffic Reconstruction

Scenario Editor

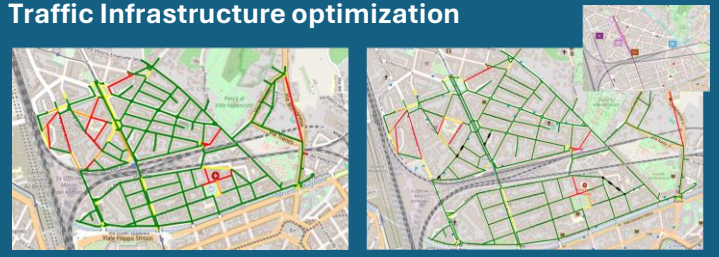


Traffic Light Plan optimization

Routing / Dynamic Routing

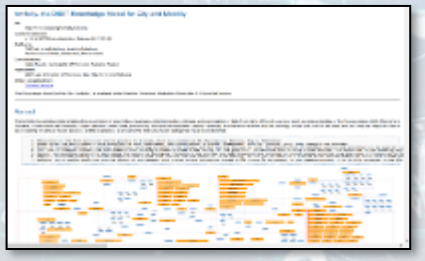


Traffic Infrastructure optimization



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

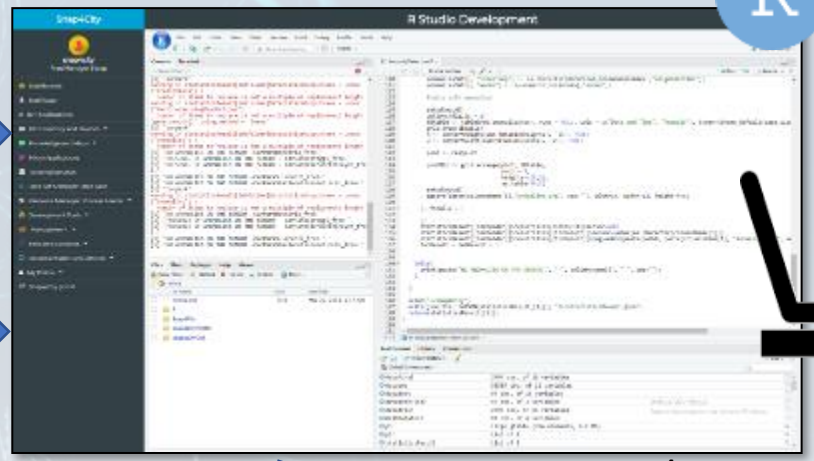
TensorFlow

NVIDIA CUDA

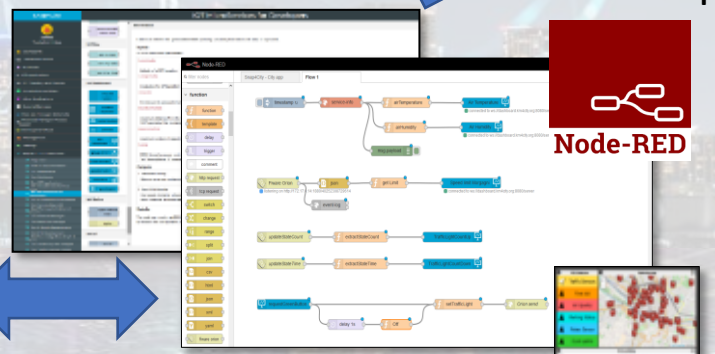
python

jupyter

R Studio

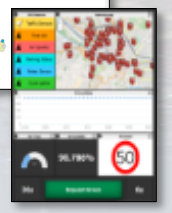


Creating MicroServices



Node-RED

Using them into IOT Applications



Saving / Sharing reusing

Resource Manager

- ***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

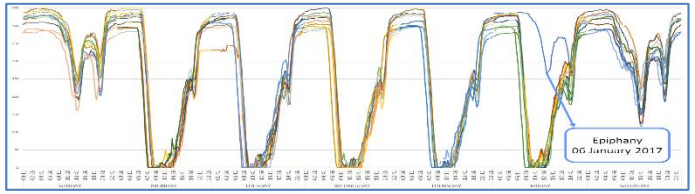
- business intelligence tools for decision makers
- Reduction production costs
- Monitoring resource consumption
- Optimization of Waste Collection

- 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

Parking predictions

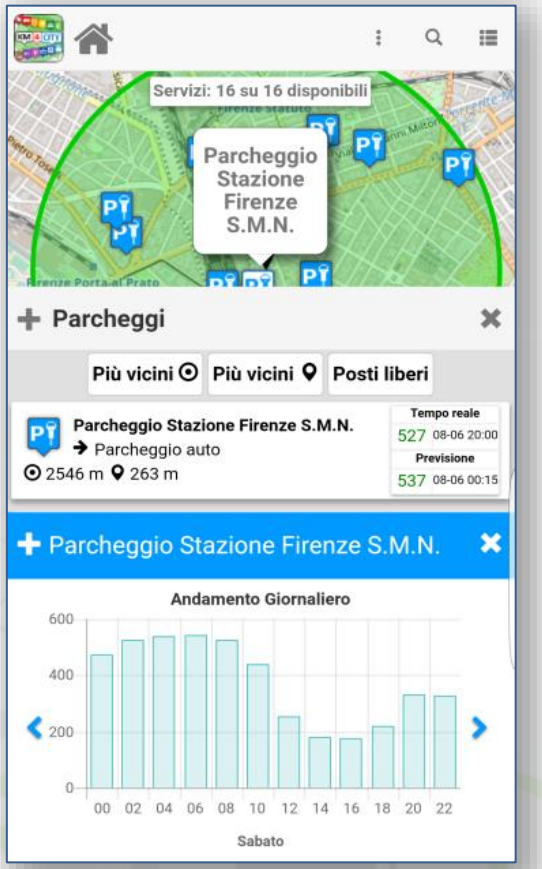
I would arrive to surely Park in 45 Minutes??



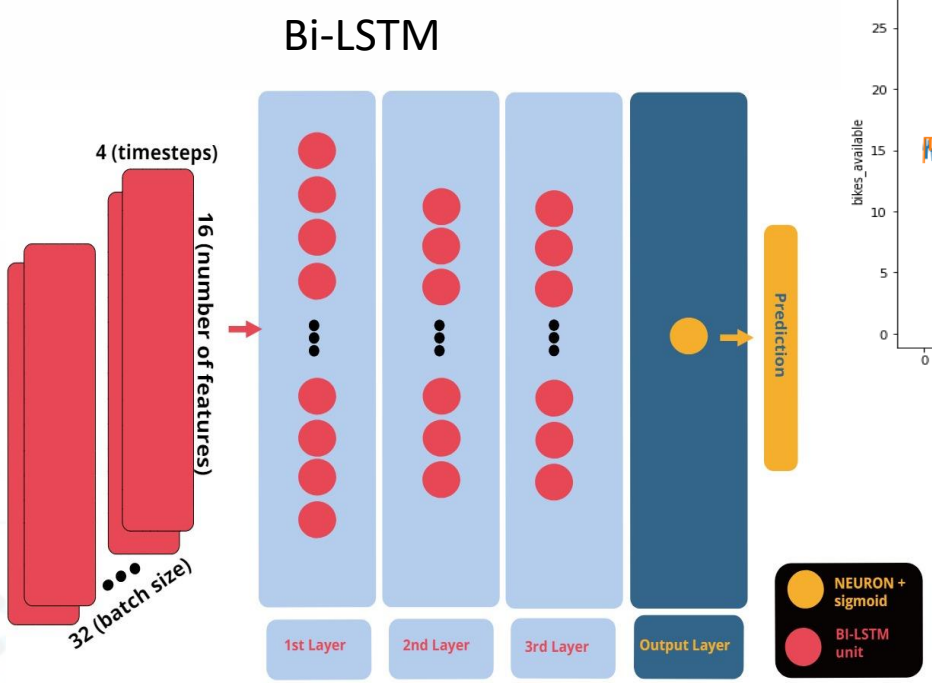
Category	Features	Description of features variable
Baseline features of free slot data	Free parking slots	Real number of available slots recorded every 15 minutes
	Time	Hours and minutes
	Month	Month of the year (1-12)
	Day	Day of the month (1-31)
	Day week	Day of the week (0-6)
	Weekend	0 for working days, 1 else
	Previous observation's difference (POD)	Difference between the number of free spaces at time i and number of free spaces at time (i − 15 minutes) recorded in the previous week
	Subsequent observation's difference (SOD)	Difference between the number of free spaces at time i, and the number of free spaces at time (i + 15 minutes) recorded in the previous week
Weather features	Temperature	City temperature measured one hour earlier than Time (°C)
	Humidity	City humidity measured one hour earlier than Time (%)
	Rainfall	City rainfall measured one hour earlier than Time (mm)
Traffic Sensors features	Average Vehicle Speed	Average speed of vehicles on the road being closest to the parking, over one-hour period (km/h)
	Vehicle Flow	Number of vehicles passing by closest to the parking, over one-hour period
	Average Vehicle Time	Average of distance between vehicles, over one-hour period
	Vehicle Concentration	Number of vehicles per kilometer, over one-hour period

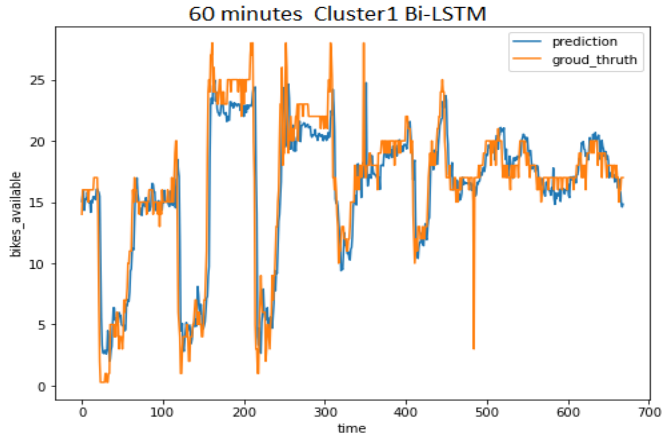
Artificial Intelligence Predictions

97% of precision



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

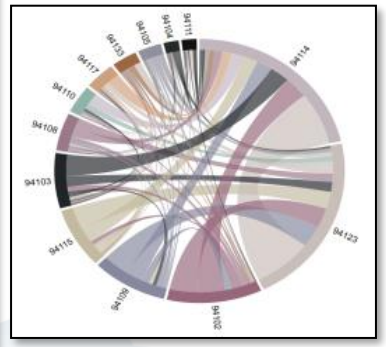




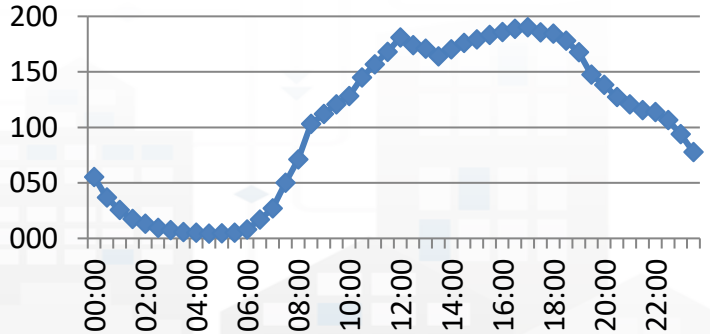
E. Collini, P. Nesi and G. Pantaleo, "Deep Learning for Short-Term Prediction of Available Bikes on Bike-Sharing Stations," in *IEEE Access*, vol. 9, pp. 124337-124347, 2021, doi: 10.1109/ACCESS.2021.3110794.
https://ieeexplore.ieee.org/abstract/document/9530580

Predicting users movements

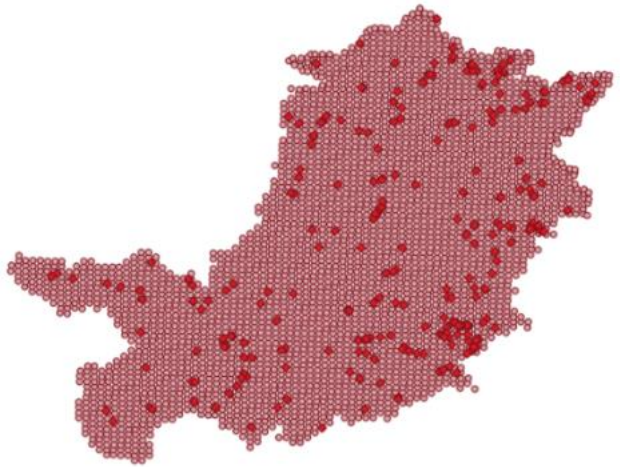
- **Issue:**
  - **How they move: vehicles, pedestrian, bike, ferry, metro,**
  - **Where they go….**
- **Impact:**
  - **Tuning the services: cleaning, police, control, security**
- **Several metrics related to**
  - **Knowledge of the Context**
  - **Monitoring traffic and people flow**
  - **…….**

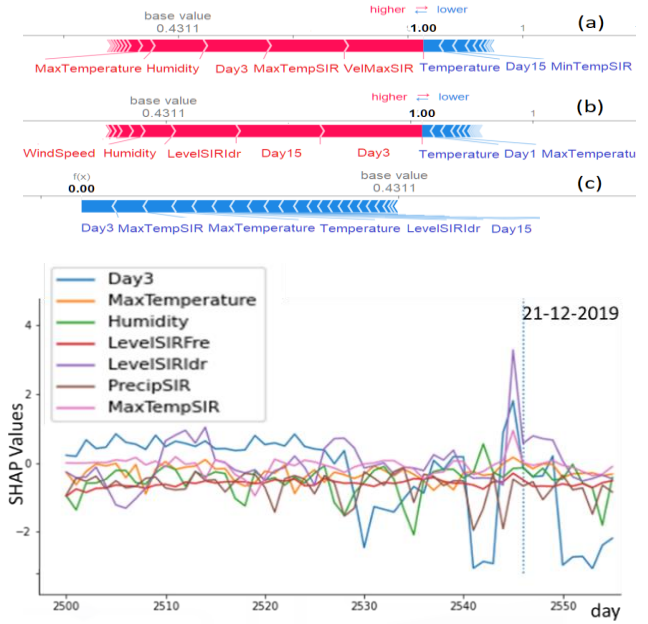


- Daily trends
- OD matrices
- Trajectories
- Prediction models



Predicting Land slides





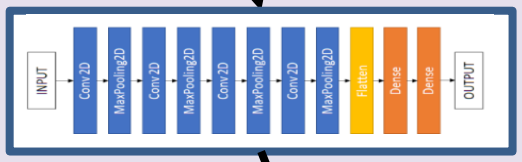
Dataset Construction

Previsional Model

Dataset Construction

Model training And validation

Model



Data

SNAP4City Advanced APIs

landslide DB

Real Time data from Field: rain, weather, etc.

Processes

Ingestion

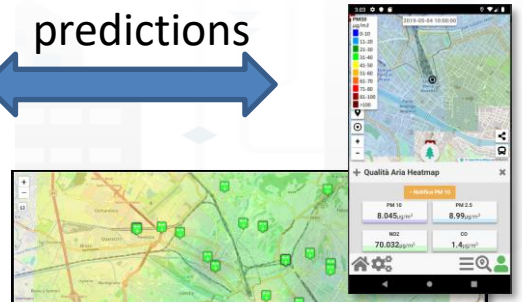
Big Data Storage and KB

Predictions

Model execution Shap Assessment

Data Analytics IOT App Management

predictions

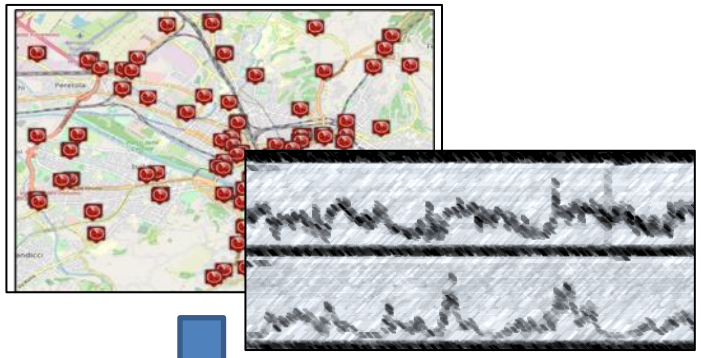


Dashboards and Mobile Apps

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
- **Dense estimation of CO2 into the city** is very useful to know to target EC's KPIs

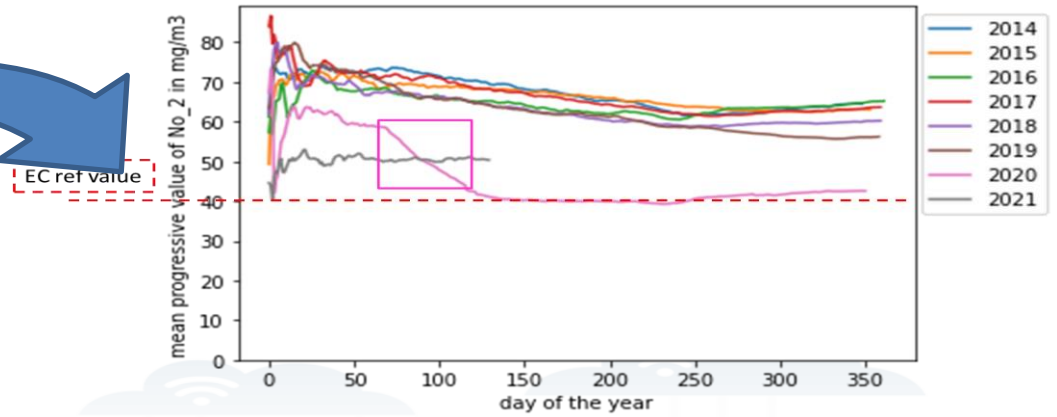
Computing CO2 on the basis of traffic flow data

CO2 estimation

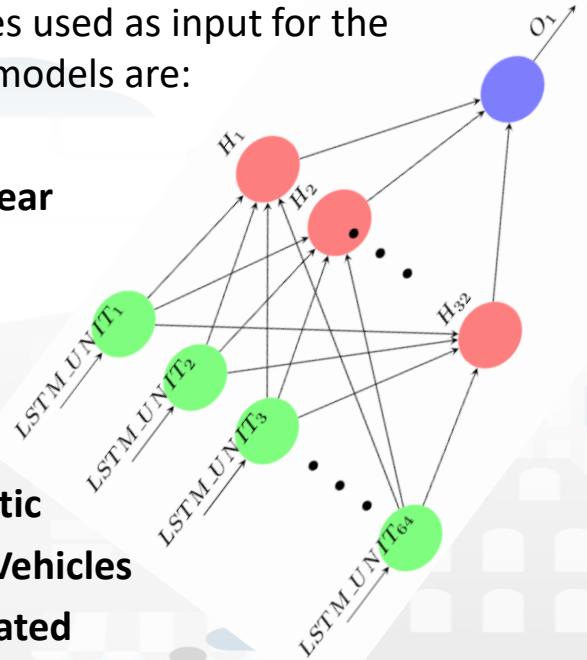
S. Bilotta, P. Nesi, "Estimating CO2 Emissions from IoT Traffic Flow Sensors and Reconstruction", Sensors, MDPI, 2022. https://www.mdpi.com/1424-8220/22/9/3382/

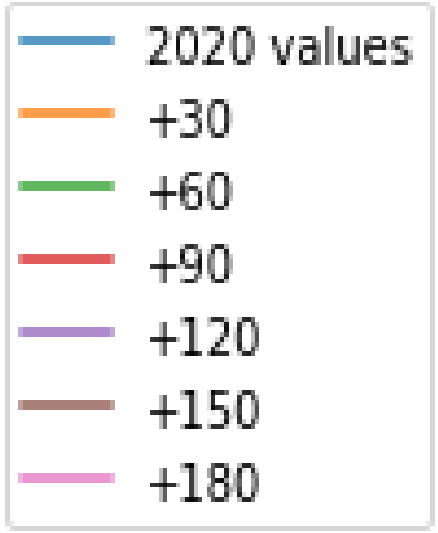
Predicting EC's KPI on NO2 months in advance

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**



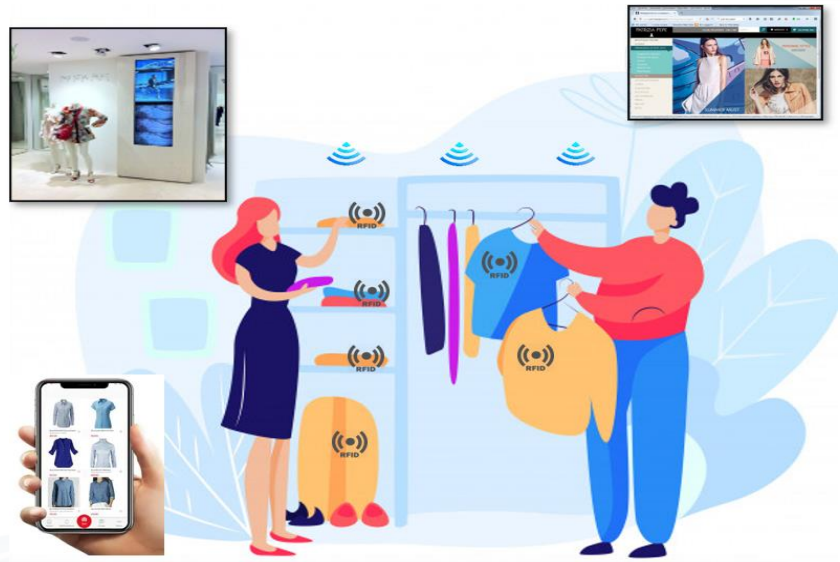


	Air Quality Directive			WHO guidelines	
Pollutant	**Averaging period**	**Objective and legal nature and concentration**	**Comments**	**Concentration**	**Comments**
$PM_{2.5}$	One day			25 µg/m³ (*)	99th percentile (3 days/year)
$PM_{2.5}$	Calendar year	Target value, 25 µg/m³	The target value has become 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	

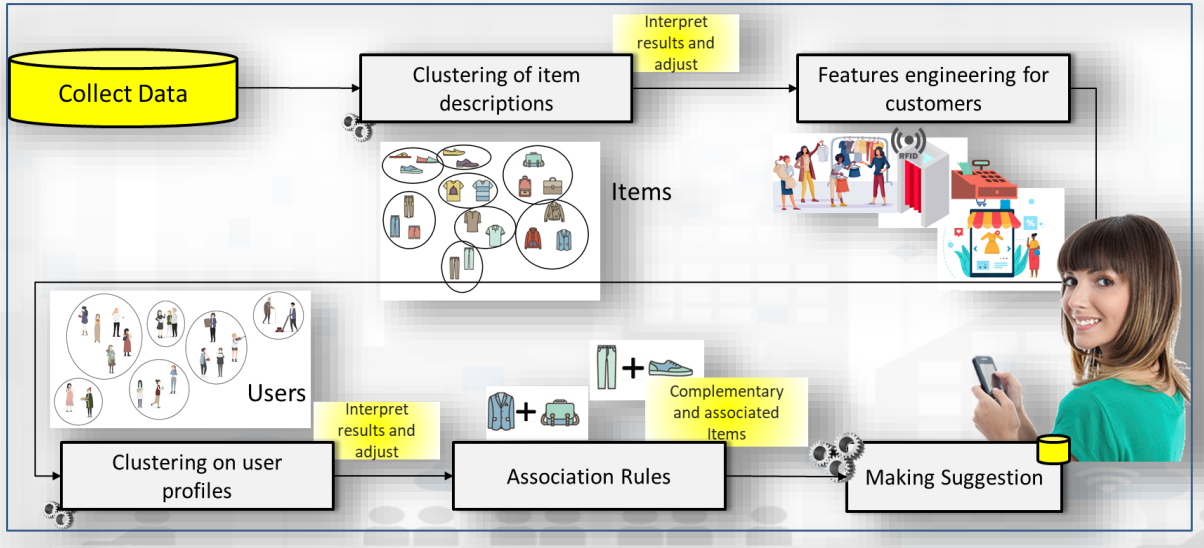
Smart Retail

- **Recommendations**
  - adaptive user engagement, customer experience
  - Advanced user profiling, user behaviour analysis
  - IOT and instrumentation
  - Predictive models for engagement
  - Integrated in city customer experience

Techniques
- Multiple clustering
- Prediction models

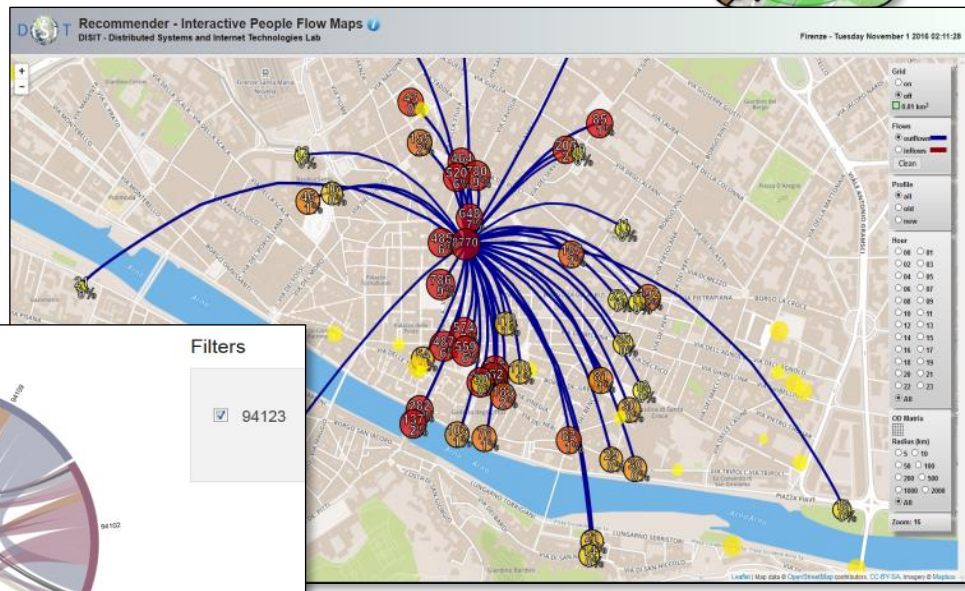


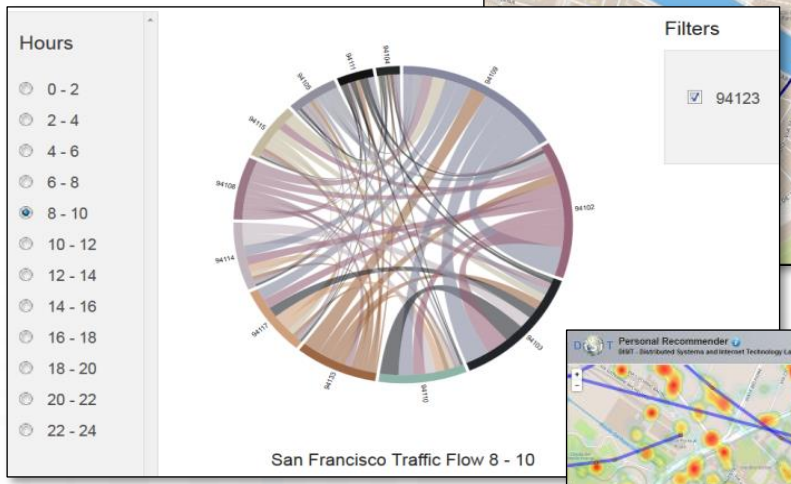
- **Feedback:**
  - Flexible Advanced Engagement Exploiting User Profiles and Product/Production Knowledge
  - Keywords: retail, GDO, …

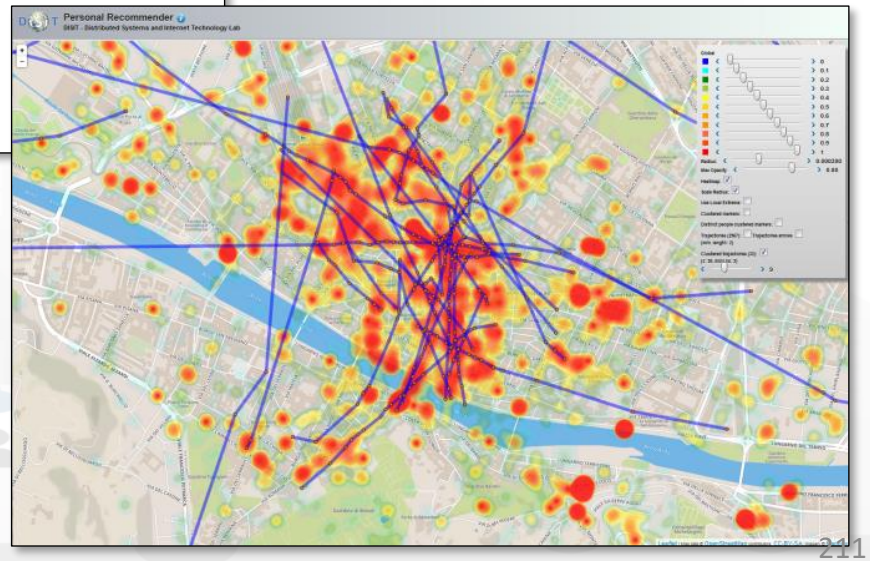


User Behaviour Analysis

- **Monitoring movements by traffic flow sensors**
  - Spires and virtual spires
- **Monitoring movements from Mobile Cells**
  - Unsuitable for precise tracking and OD production
- **Monitoring movements from Wi-Fi**
- **Monitoring movements** and much more from mobile Apps

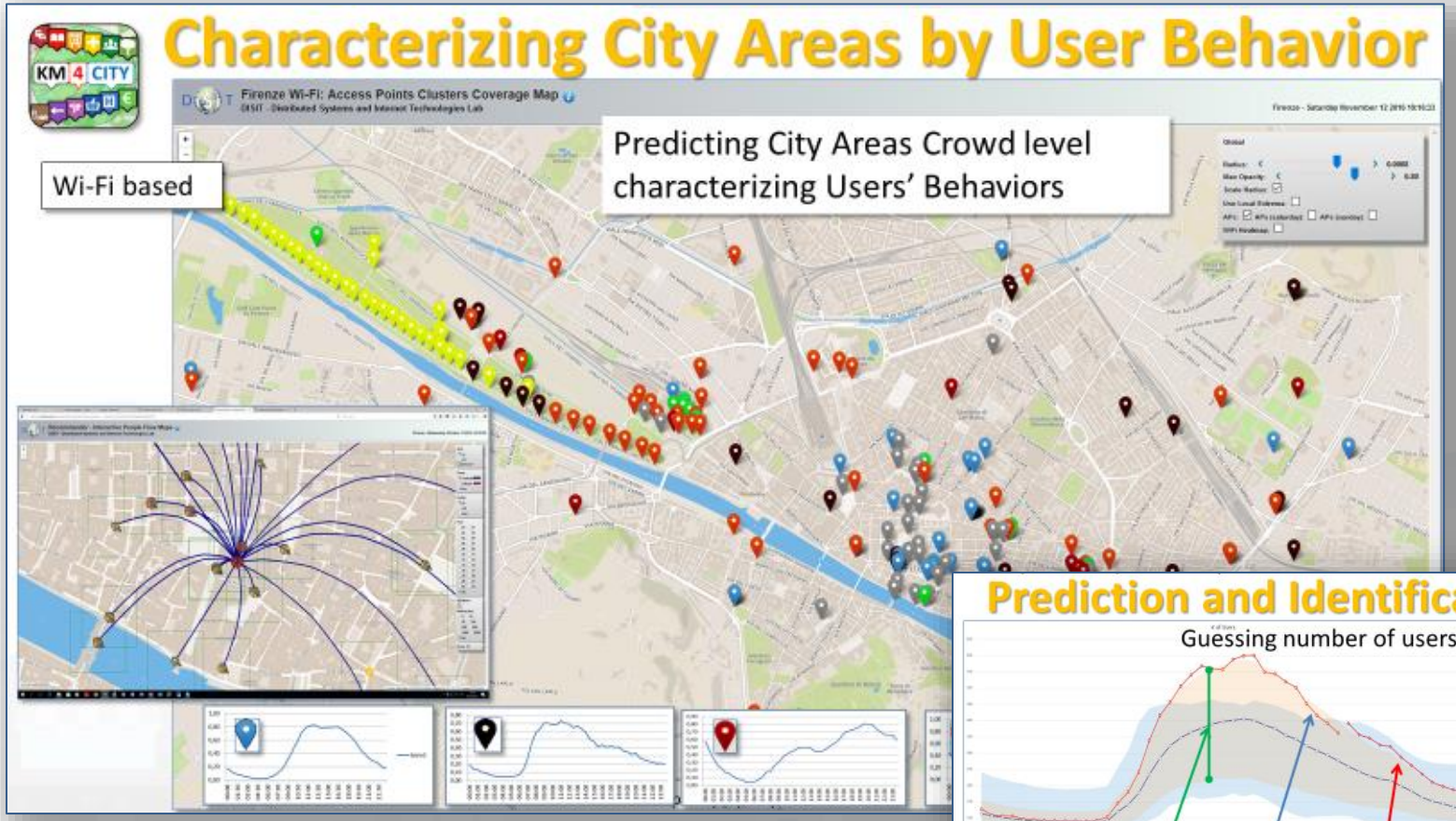


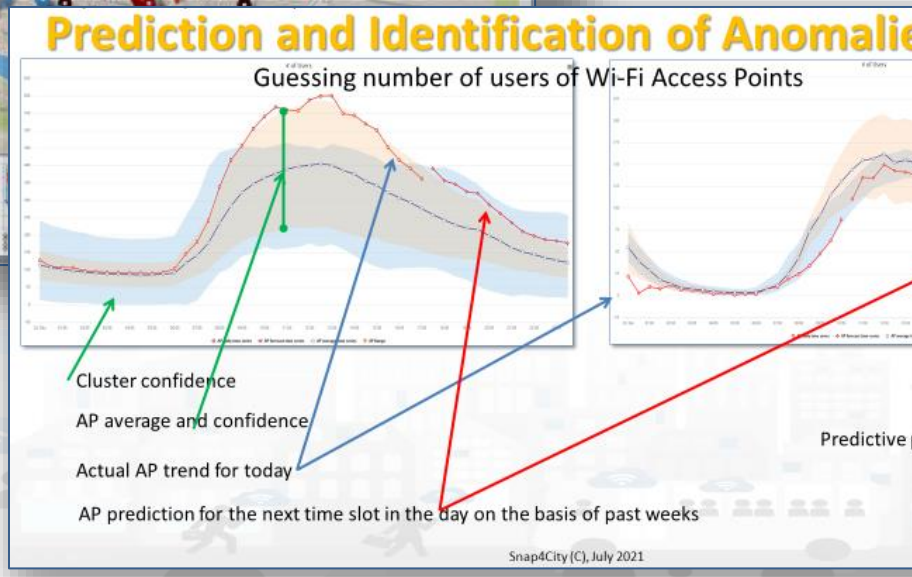




People Flows

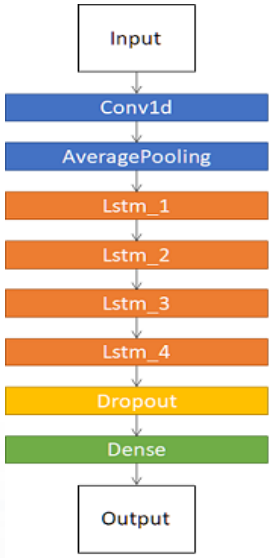
- **Prediction of people flows** on the basis of Wi-Fi data
- **Anomaly** detection
- **Resolute** H2020
- Classification of city areas





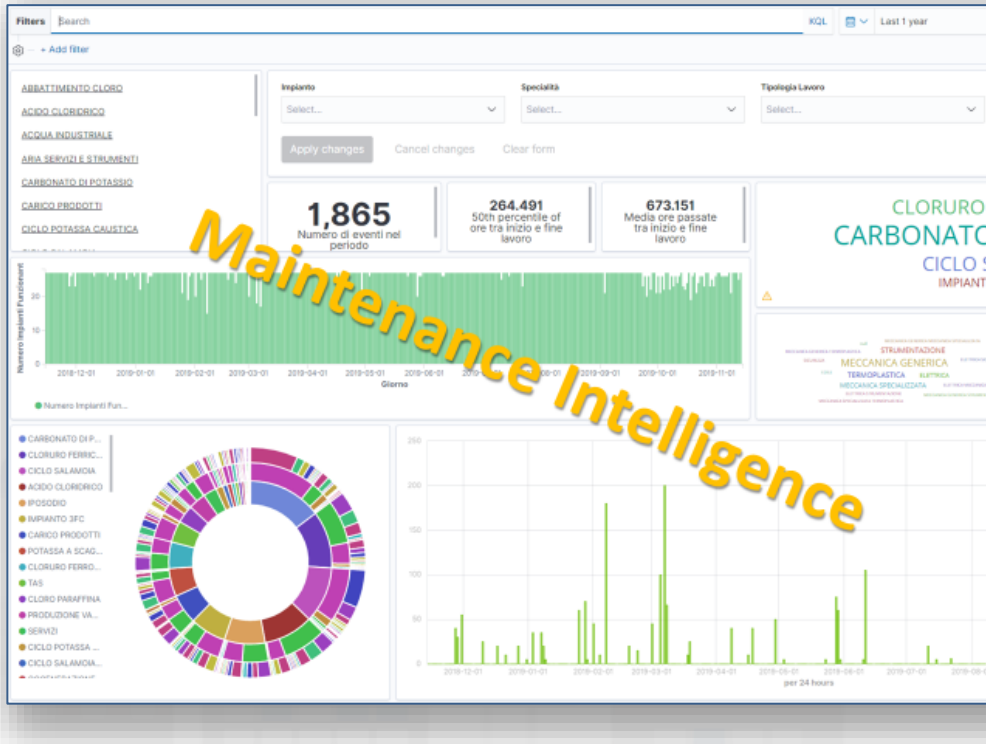
Predictive Maintenance

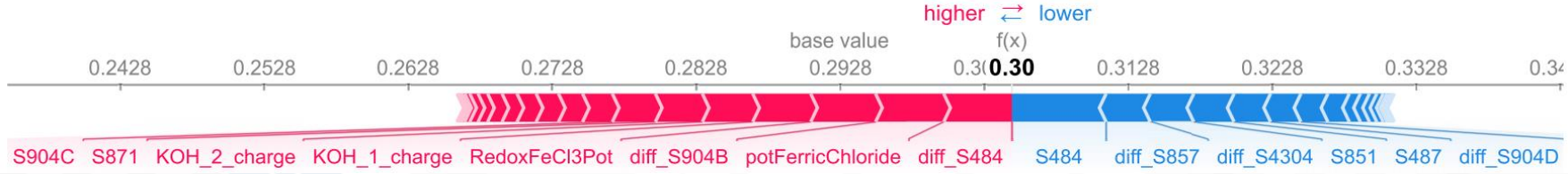
- **Predictive** Maintenance
  - LSTM
  - CNN-LSTM
- **Maintenance** Intelligence
- Explainable AI: SHAP, …



Layer (type)	Output Shape	Param #
conv1d (Conv1D)	(None, 20, 64)	8320
average_pooling1d (AveragePo	(None, 10, 64)	0
lstm (LSTM)	(None, 10, 200)	212000
lstm_1 (LSTM)	(None, 10, 200)	320800
lstm_2 (LSTM)	(None, 10, 200)	320800
lstm_3 (LSTM)	(None, 10, 200)	320800
lstm_4 (LSTM)	(None, 100)	120400
dropout (Dropout)	(None, 100)	0
dense (Dense)	(None, 1)	101

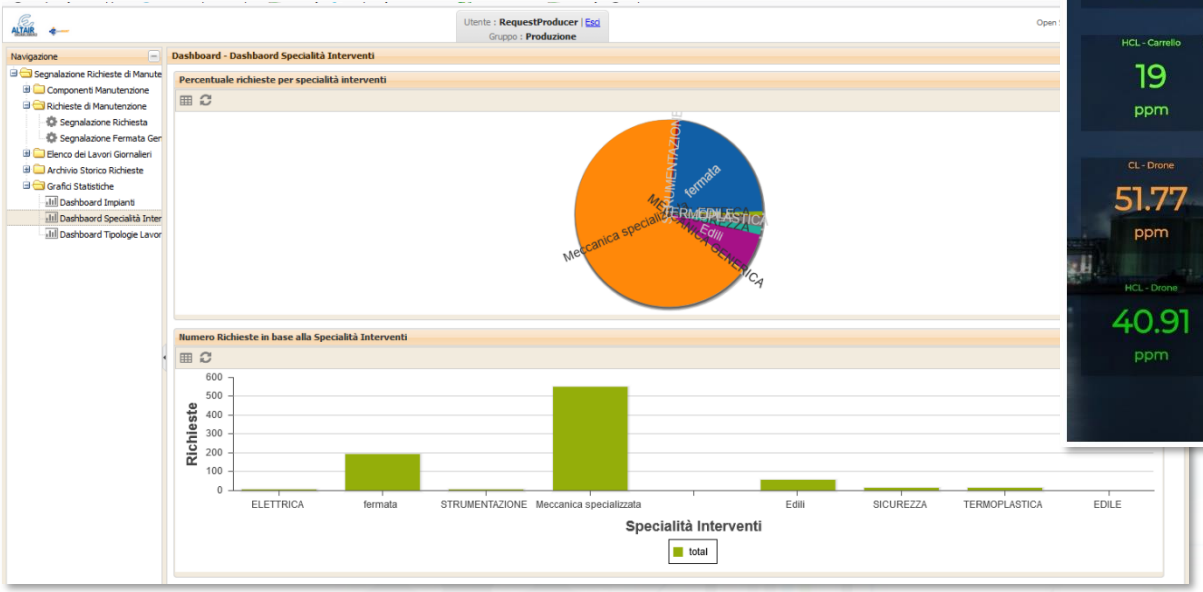
Total params: 1,303,221
Trainable params: 1,303,221
Non-trainable params: 0

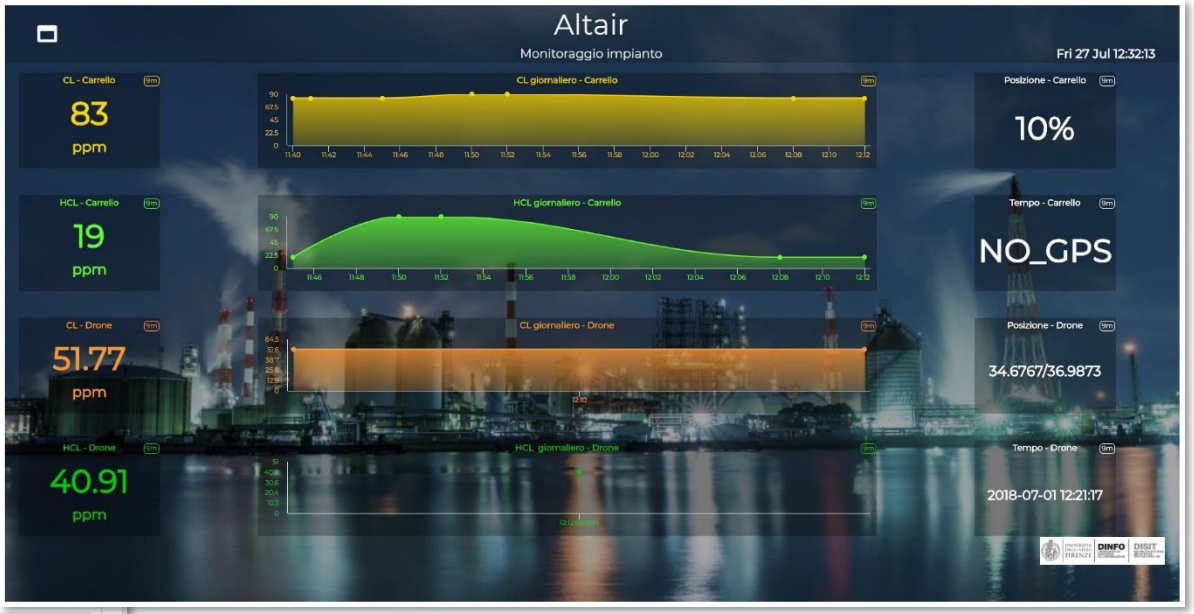




9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

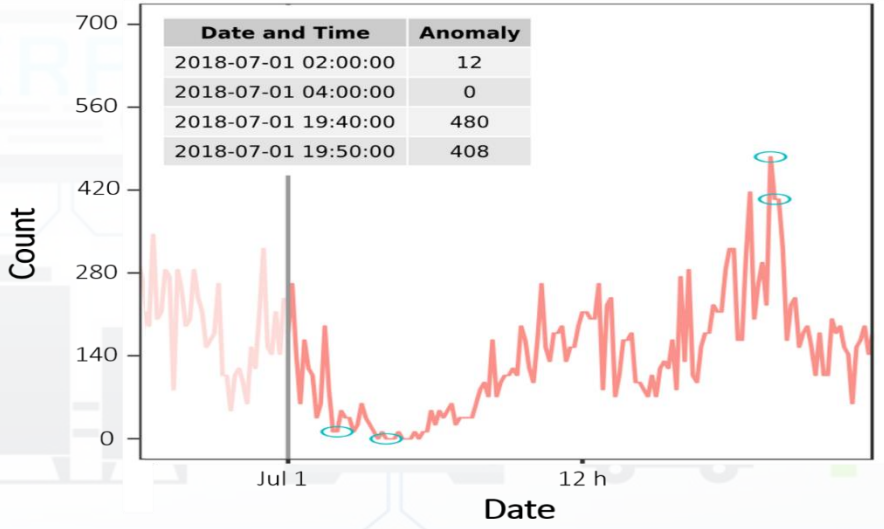
Reports and Dashboards





Anomaly detection Early Warning

Date and Time	Anomaly
2018-07-01 02:00:00	12
2018-07-01 04:00:00	0
2018-07-01 19:40:00	480
2018-07-01 19:50:00	408



TOP

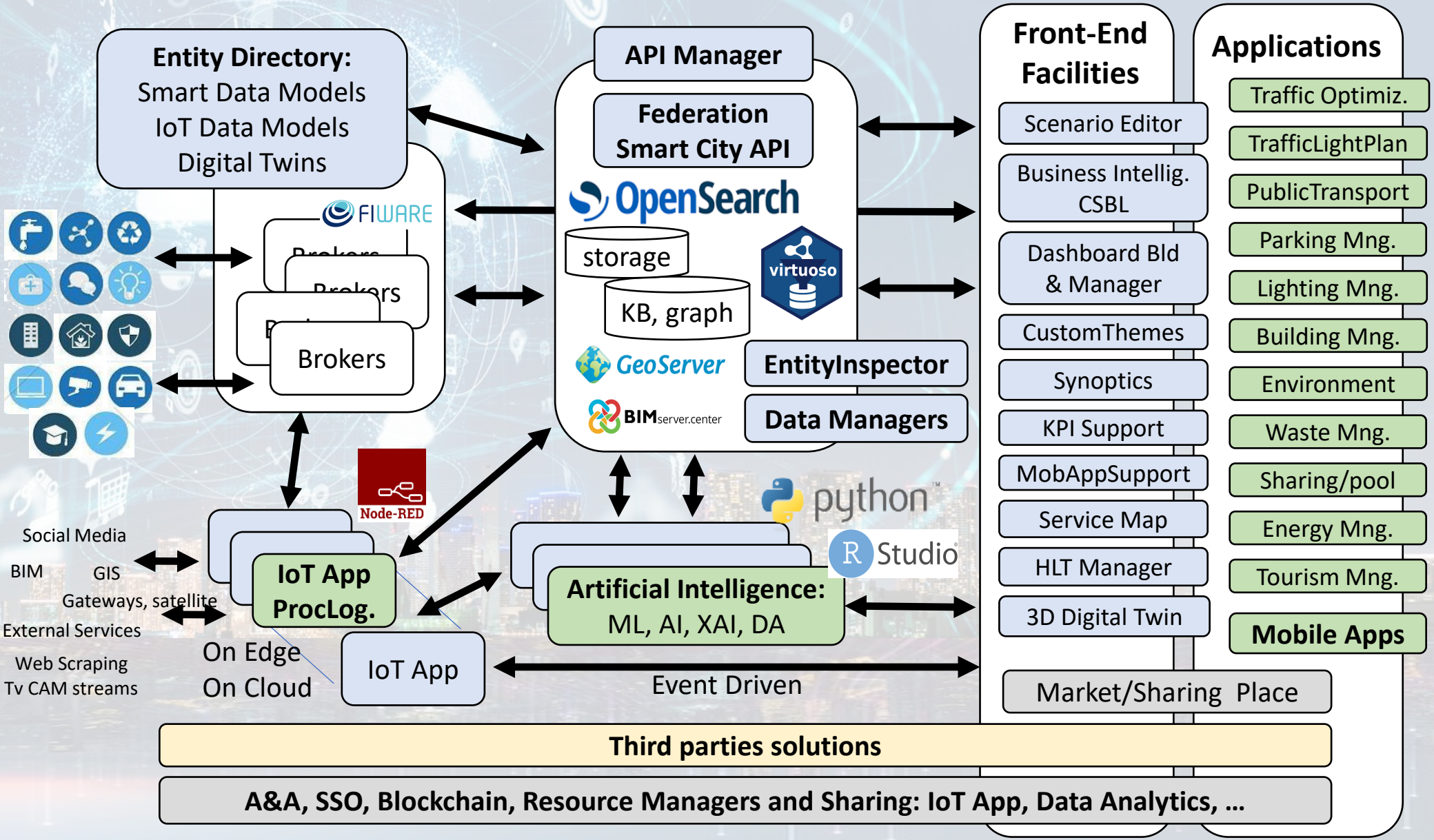
FIWARE & Snap4City

Powered by FIWARE

- Snap4City - Powered by FIWARE Solution & Platform:
  - https://marketplace.fiware.org/pages/solutions/b8905e91973b420189cce972
  - https://marketplace.fiware.org/pages/solutions/d68534ec827500f1bde8720f
  - NGSI V1, V2 The IOT Orion Broker
  - IOT Orion Broker can connect JSON, MQTT, Lightweight M2M, LoraWAN, OPC, SigFOX, etc. see FiWare Https://www.fiware.org
- Snap4City - FIWARE Training Services:
  - https://marketplace.fiware.org/pages/solutions/03bccd83a0e1b0398ba7a0bf
- Snap4City - FIWARE Consultancy Services:
  - https://marketplace.fiware.org/pages/solutions/907f5ecc63927f643dd8421b
- **Snap4City is compatible** with all the above protocols
  - via IOT Orion Broker,
  - via IOT Applications.
  - via direct connection on ETL processes on their corresponding IOT brokers, and/or
- **Snap4City is also compatible** with many other protocols, see the table reported in page: https://www.snap4city.org/65

Powered by FIWARE

Technical Architecture



Functional: FIWARE ref arc wrt Snap4City solutions

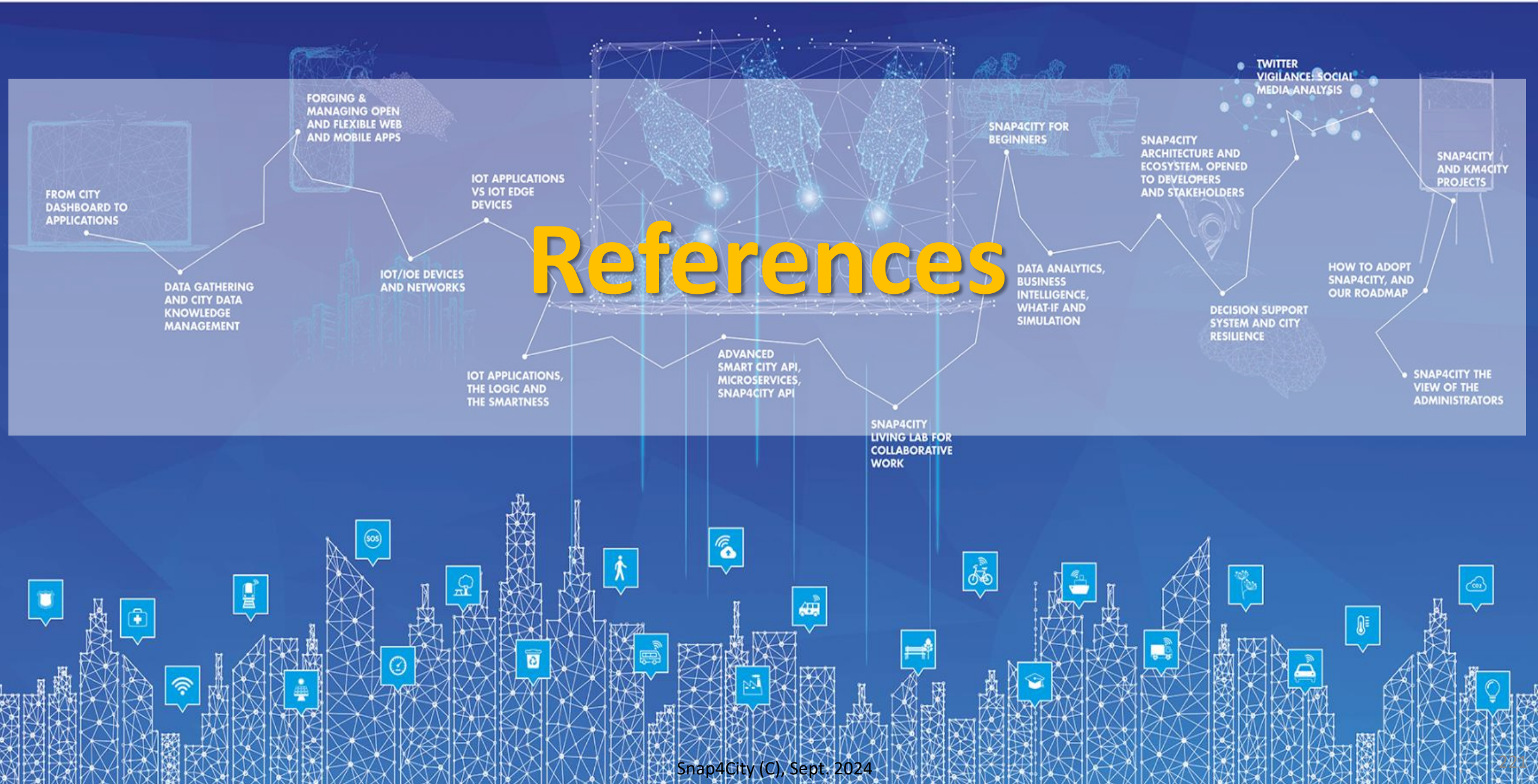
	FIWARE ref arc smart city	Snap4City
Multiple Protocols: IoT, Databases, etc..	10 on IOT, Limited on databases, etc.	More than 200, very very wide
Large set of high level types: maps, trends, heatmaps, traffic, trajectories, scenarios,…	No	Yes:
Integration with workflows, BPM	Not Supported	Yes: bidirectional
Integration and Modeling Digital Twin BIM	Not Supported	Yes: bidirectional
Integration with GIS: WFS, WMS	Not fully supported	Yes: bidirectional
Integration with Heatmaps and Satellite	Partially, not caòibrated	Yes: fully; calibarate and multiple versions, animations
Integration with Satellite	not supported	Yes: fully
Smart City API	no	Yes
Open Data Management	Partial with CKAN	Yes, Fully automated with CKAN
Federation of platforms	Partial on brokers	Full on Brokers and Knowledge base and API
Semantic model and queries	No, probably with NGSI-LD in the future	Yes since 2013
Multiple kinds of IoT Brokers	No, only agents	Yes: NGSI, COAP, AMQP, MQTT, SigFOX, etc.

Interoperability
Openess

Functional: FIWARE ref.arc. wrt Snap4City solutions

	FIWARE ref arc smart city	Snap4City
Data Transformation	Coding	Yes: IOT App, Node.JS, Visual Programming, scalable
Data Analytics	No	Yes
on line development	No, limited	Yes: Rstudio, Python, Tensor Flow, MapReduce, etc.
Dashboard on data	Grafana no LDAP	Yes: Dashboard Builder, OpenSeachDash with GDPR, LDAP (Open Search)
Dashboard Widgets	Limited, no custom, coding needed	Yes: A wide range including custom widgets, secure compliant, animations, configuration, also open to new development
Real Time end-to-end from Dashboards to any other channel, event driven	No, very limited	Yes, fully supported
Multi Data Map	Limited with non OS	Very extensive, with multiple widgets and sync
MicroApplications	No	Yes
Auditing, Assessment, accounting	No, no, no	Yes, Yes, Yes
Multitenacy on data management	No only on broker	Yes: on Broker, on data management, on dashboards, etc..
Living Lab for creating/managing communities/groups	Not supported	Yes: provided in the open source
Report generation/management	No	Yes

Process Graphics Manag.


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 THE SMARTNESS
ADVANCED SMART CITY API, MICROSERVICES, SNAP4CITY API
SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK
SNAP4CITY FOR BEGINNERS
DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT-IF AND SIMULATION
SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS AND STAKEHOLDERS
DECISION SUPPORT SYSTEM AND CITY RESILIENCE
TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS
HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP
SNAP4CITY AND KM4CITY PROJECTS
SNAP4CITY THE VIEW OF THE ADMINISTRATORS

References

booklets

- Smart City

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

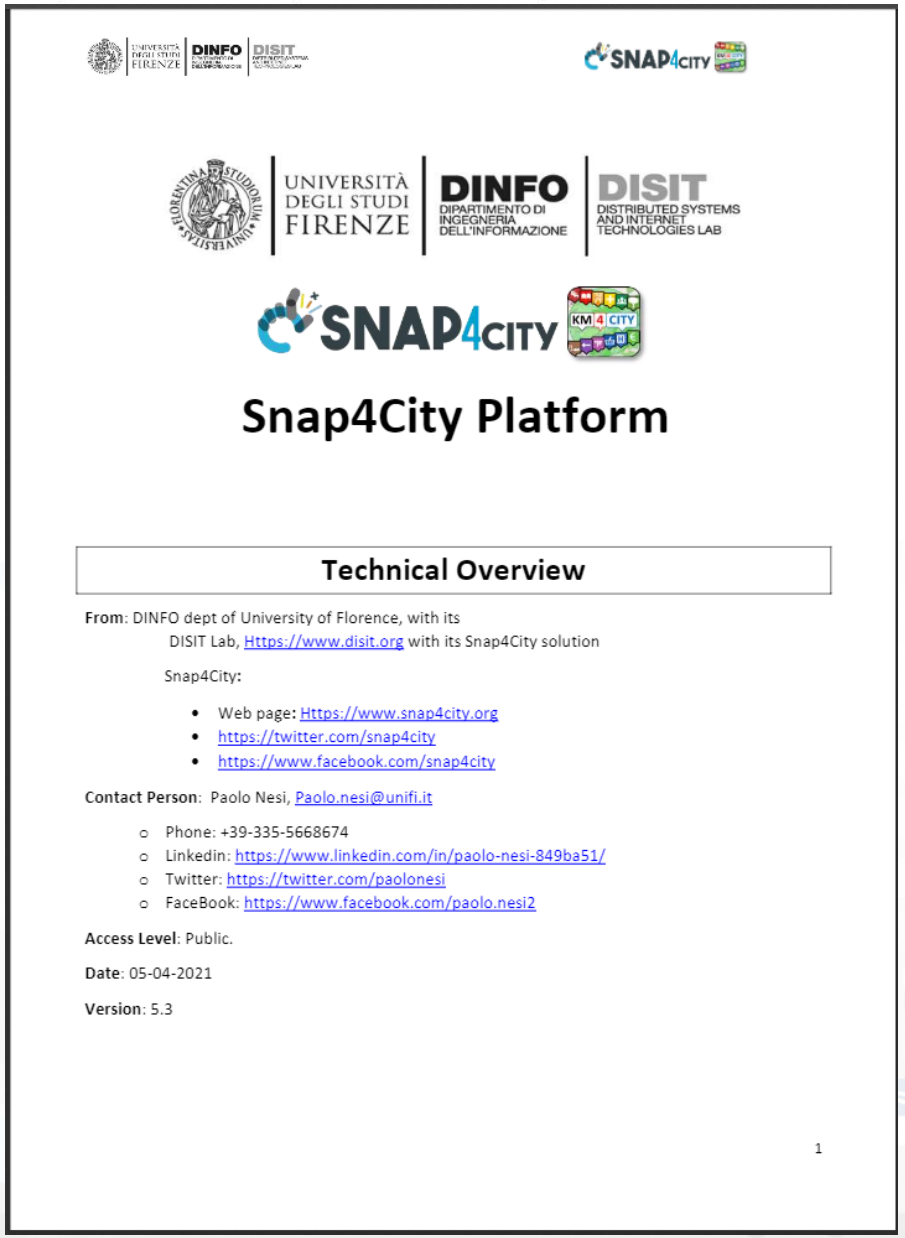
- Industry

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

- Artificial Intelligence

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

Overview



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

Access Level: Public.

Date: 05-04-2021

Version: 5.3

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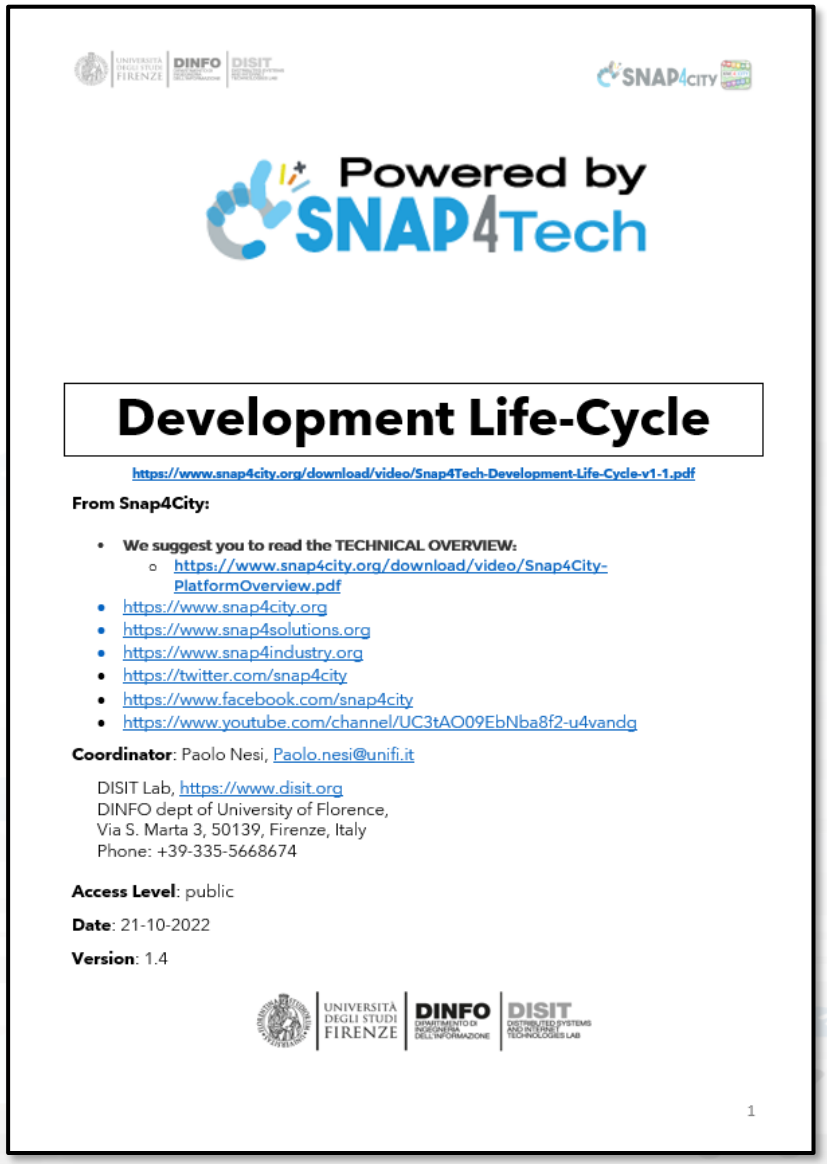
- https://www.snap4city.org/drupal/sites/default/files/files/Snap4City-PlatformOverview.pdf

Development



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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

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Phone: +39-335-5668674

Access Level: public

Date: 21-10-2022

Version: 1.4

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

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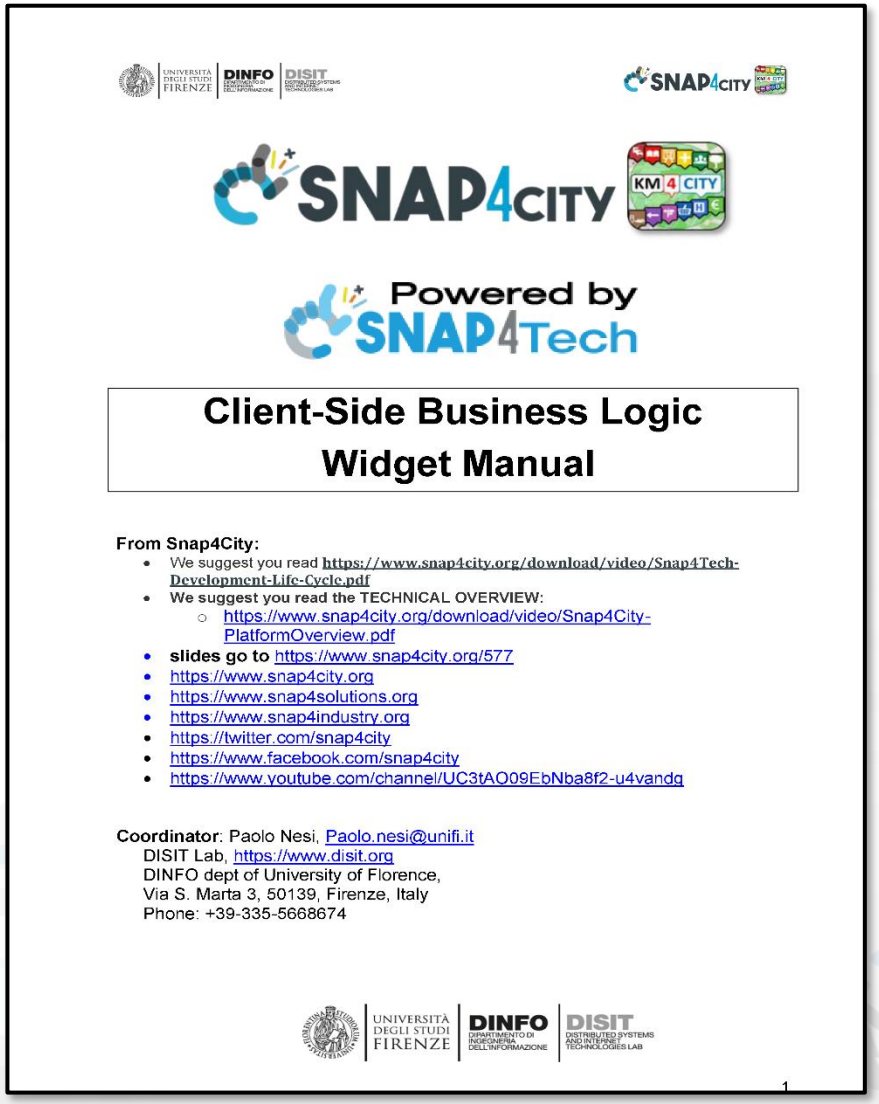
CSBL

SNAP4CITY KM4CITY

Client Side Business Logic



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SNAP4CITY KM4CITY

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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:**
  - https://www.snap4city.org/download/video/Snap4City-PlatformOverview.pdf
- **slides go to** https://www.snap4city.org/577
- https://www.snap4city.org
- https://www.snap4solutions.org
- https://www.snap4industry.org
- https://twitter.com/snap4city
- https://www.facebook.com/snap4city
- https://www.youtube.com/channel/UC3tAO09EbNba8f2-u4vandg

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

SNAP4INDUSTRY

KM 4 CITY

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SNAP4
Appliances and Dockers
Installations

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Università degli Studi di Firenze - School of Engineering

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