



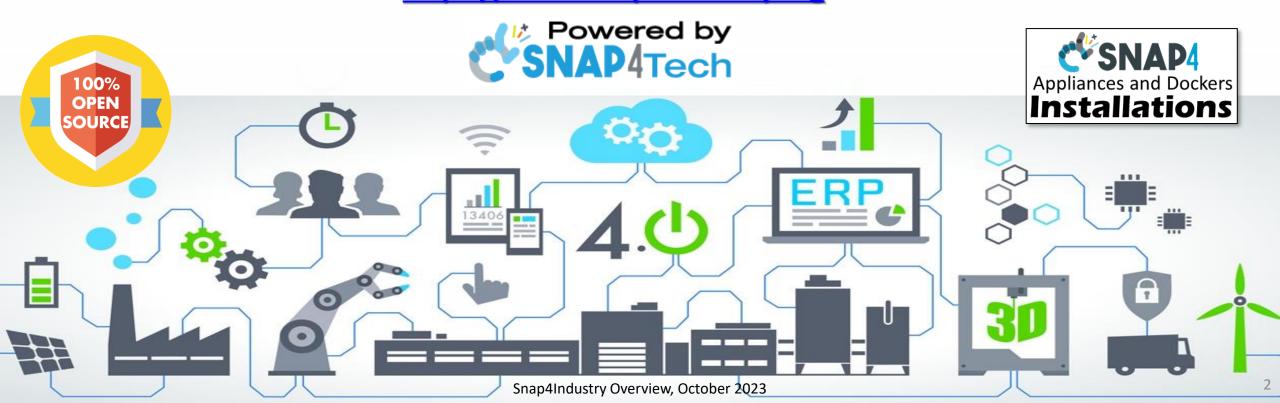








https://www.snap4industry.org







https://www.snap4city.org/369







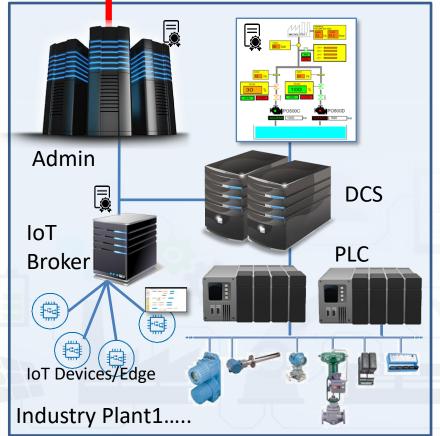
Fleet management

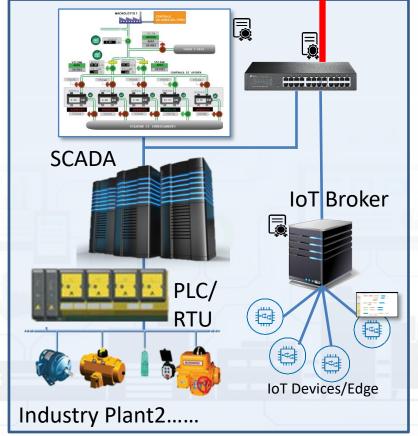


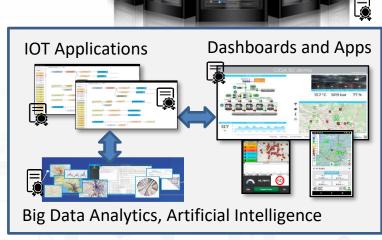
IoT Broker

SECURE

Internet







Control and Supervision on Multiple Supply Chains **Industry 4.0 as a Service**





Aims

- Increase:
 - control, telecontrol and hyper-automation
 - Product Quality, Control, process understanding
- Reduce:
 - Downtime, Costs (reducing waste), and Reaction Time to unpredicted events
- By Means
 - Data aggregation, modelling, integrating and exploiting data of
 - Digital Twin, IoT Brokers/Edge, SCADA, MES, ERP, DCS, Admin Data, BIM, Ticketing, etc.
 - Ontology and semantic reasoner for the industry plant
 - Data Analytics:
 - descriptive, predictive and prescriptive
 - Beyond: Decision Support Systems, DSS
 - Simulation, Visual Analytics, Data Analytics, Synoptics
 - XAI on predictions, anomaly detection (early warning), classifications
 - Large Scale Integration
 - Security, privacy, ethics, GDPR, etc.





FREE TRIAL















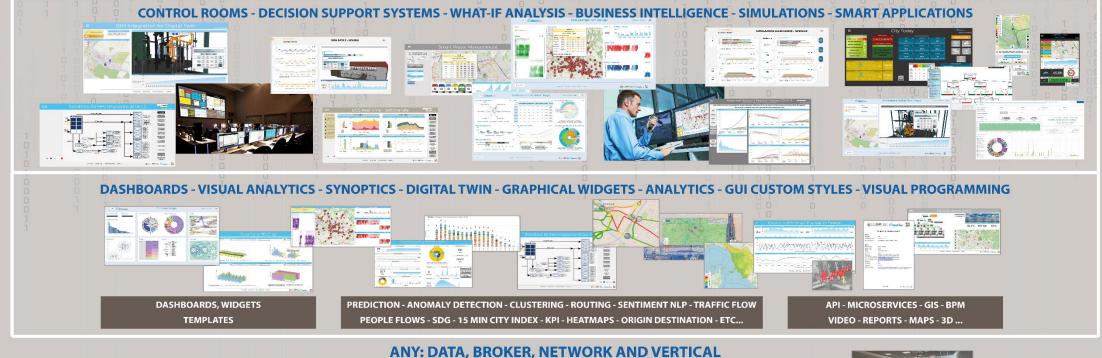


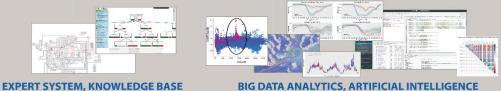


SEMANTIC REASONING

SMART DATA MODEL

SNAP4INDUSTRY SMART Solutions and Decision Support Systems



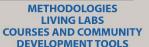






VISUAL PROGRAMMING, ADAPTERS DATA FLOWS, WORKFLOWS PARALLEL DISTRIBUTED PROCESSING







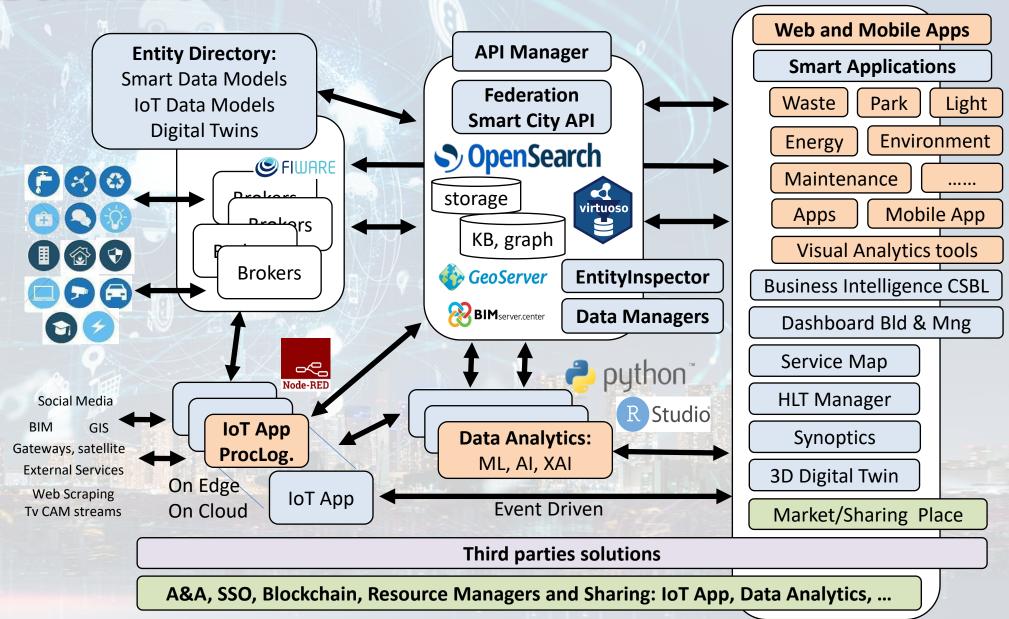




Tech Arch



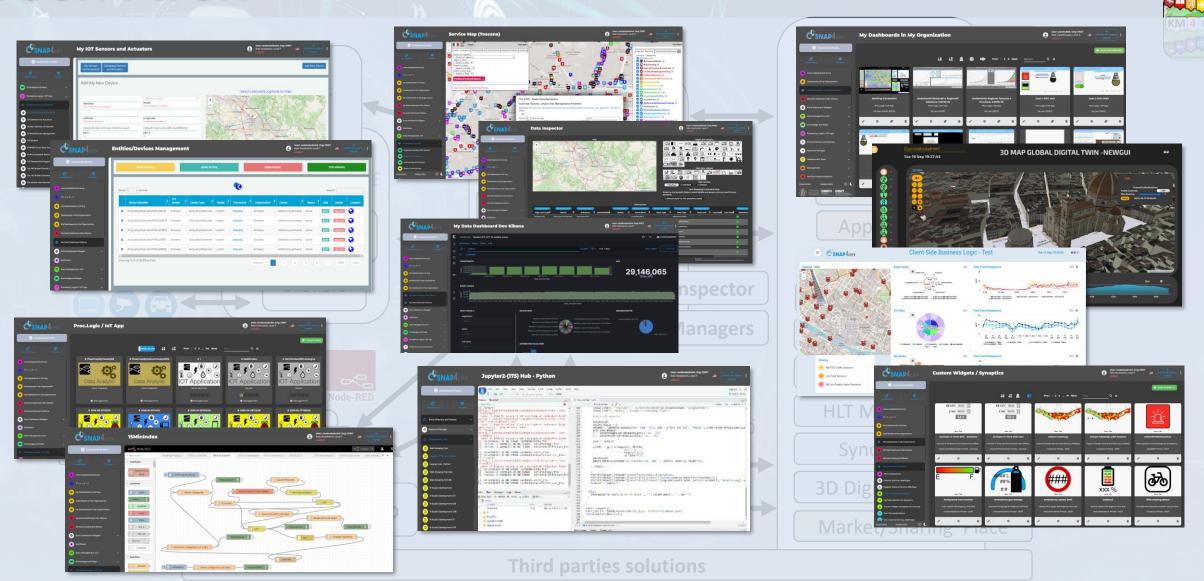




11/23

Tech Arch





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

09/23

Big Data Analytics + Artificial Intelligence

SNAP4city

KM 4 City

- Decision support
 - Early warning, City Indexes, etc.
 - What-IF analysis (simulation + Al + 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/

Snap4Industry Overview, October 2023

What we do

SNAP4city KM 4 city

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

- Al 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

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

High Level Types

Snap4Industry Overview, October 2023

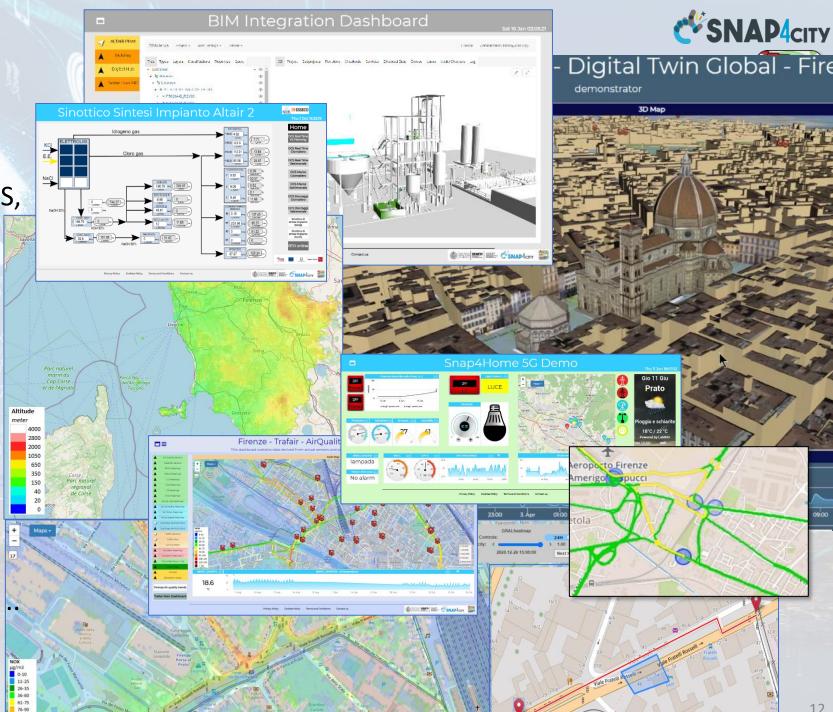
- POI, IOT Devices, shapes,...
 - FIWARE Smart Data Models,
 - IoT Device Models
- GIS, maps, orthomaps, WFS/WMS, GeoTiff, calibrated heatmaps, ...
- Satellite data, ..
- traffic flow, typical trends, ..
- trajectories, events, Workflow, ...
- 3D Models, BIM, Digital Twins, ...
- OD Matrices of several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

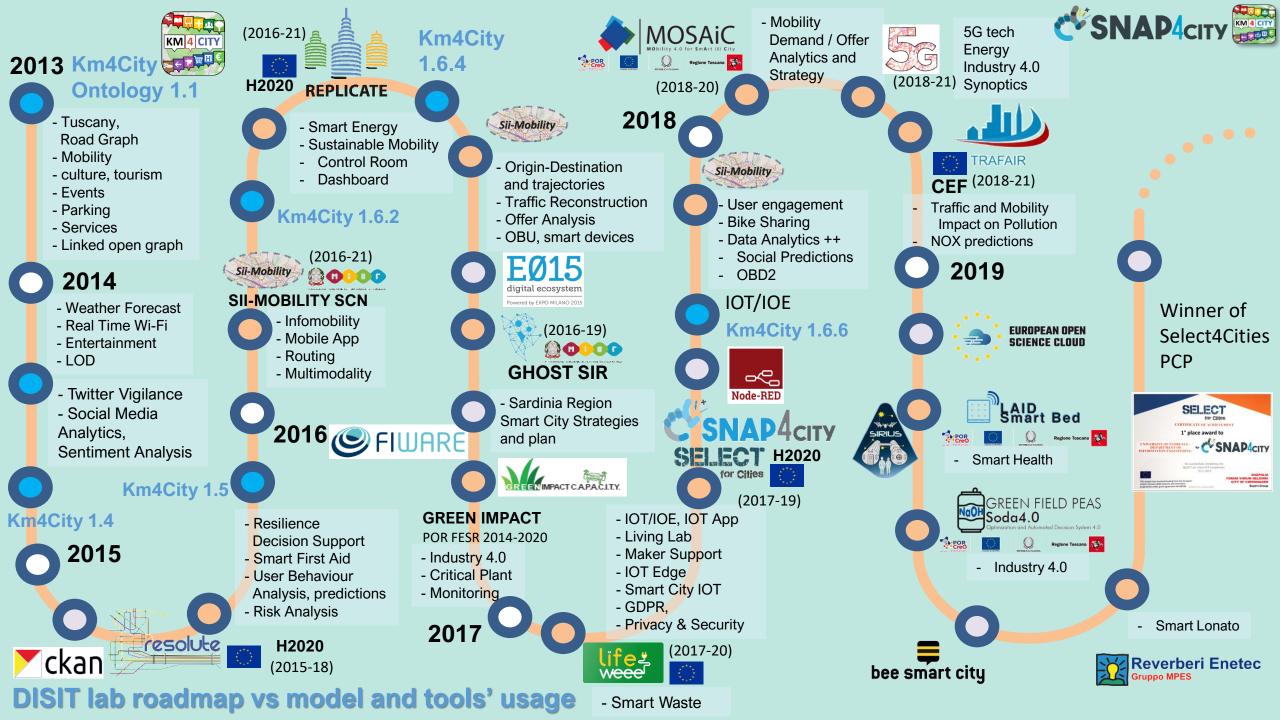














PISA, PUMS Living lab

smartGARDAlake





Sii-Mobility

Contract

2021

I JRC

PC4City (2020-21)

Monitoring Terrain

Winner of Open

Data Challenge of

enel X

enel X

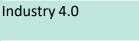














SmartCity, 2021-23



AXIS collab SmartCity





ART-ER

Contract, 2022-23

2023





Security and Risk





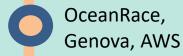
Merano, smart light

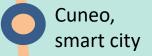
CN MOST, 2022-26

EI THE, 2022-26

G. Agile, 2021-23

2024











I JRC

Contract, 2022-23









- Smart Light
- Sweden

Km4City

1.6.7



Asymmetrica Smart City, 2022-23



Italferr, Smart City



https://www.Snap4City.org













11 running installations in Europe

- Snap4.city.org, Greece, Merano, ...
- Toscana, Pisa, Sweden, ISPRA, Snap4.eu,
- Altair, Italmatic, Sweden, Romania,
- 16 projects, 12 pilots on 10 Countries
 - >40 cities/area

Widest MULTI-tenant deploy has

- 19 Organizations / tenant
- > 8000 users on
- > 1600 Dashboards
- > 16 mobile Apps
- > 2.2 Million of structured data per day
- > 520 IoT Applications/node-RED
- > 700 web pages with training
- > 70 videos, training videos



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





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

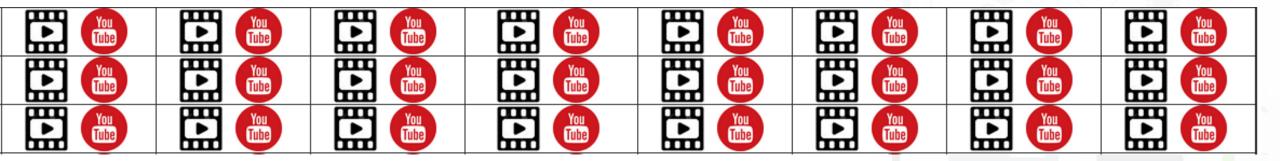
https://www.snap4city.org/944

On Line Training Material (free of charge)





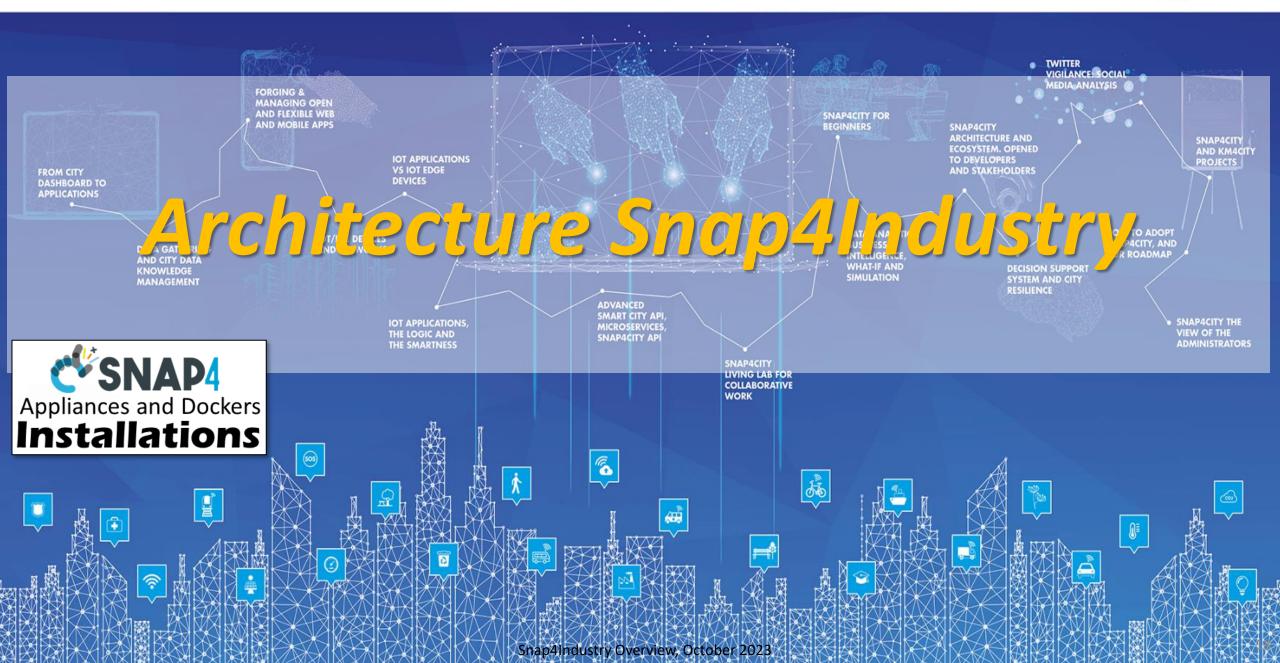
Overview Dasnboards IOT App, IOT Network Data Analytics processes Install Web & Mob. App Smart Solutions								
Overview Dashdorrds Install Web & Mob. App Smart Solutions	1st part	2nd part	3rd part	4th part	5th part	6th part	7th part	8th
STANDARD STA	Overview	Dashboards	IOT App, IOT Network	Data Analytics				Design and Develor Smart Solutions
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SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT SNAP4INDUSTRY







Standards and Interoperability (6/2023)

SNAP4CITY

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









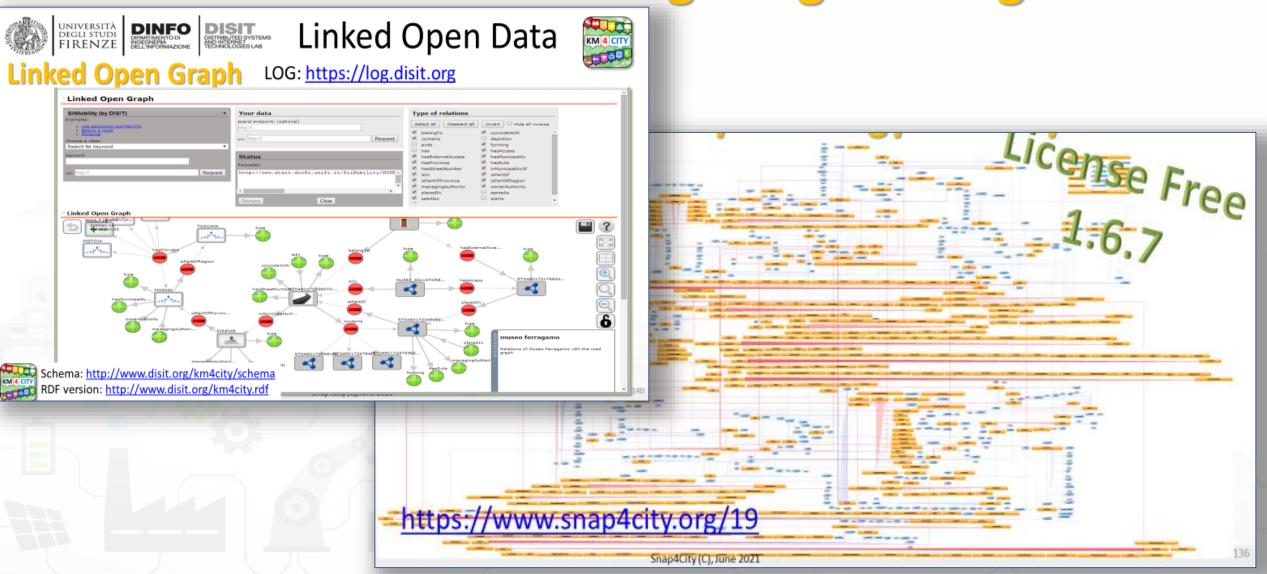








Knowledge Engineering





Snap4Altair Decision Support supervision and control, Industry 4.0







• 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





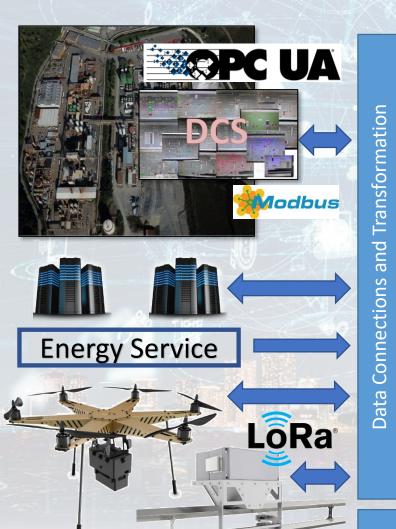
Aims

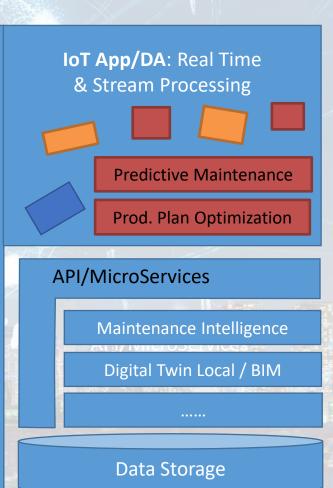
- **Control Room**: Higher level supervision and monitoring (since 2020)
 - Management of Production Plan Optimization
 - Control of Perimeter with drone and sensors

Maintenance ticketing (since 2017)

- predictive (in development)
- 3D Digital Twin (in development)

MicroService Architecture

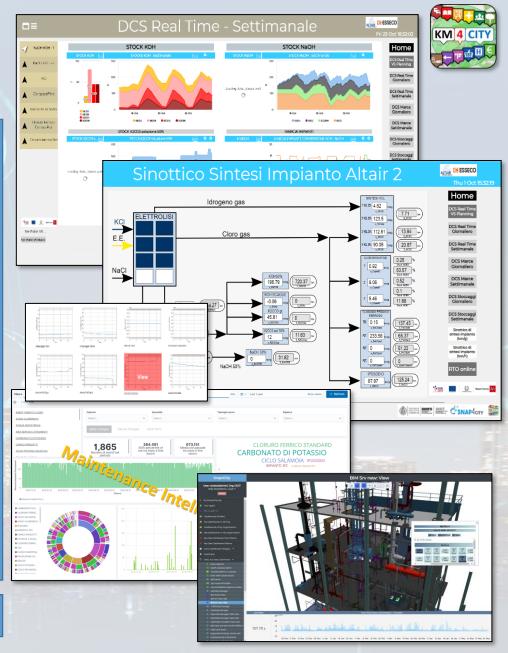




Management, Auth./Autoriz.

Snap4City Dashboard Builder



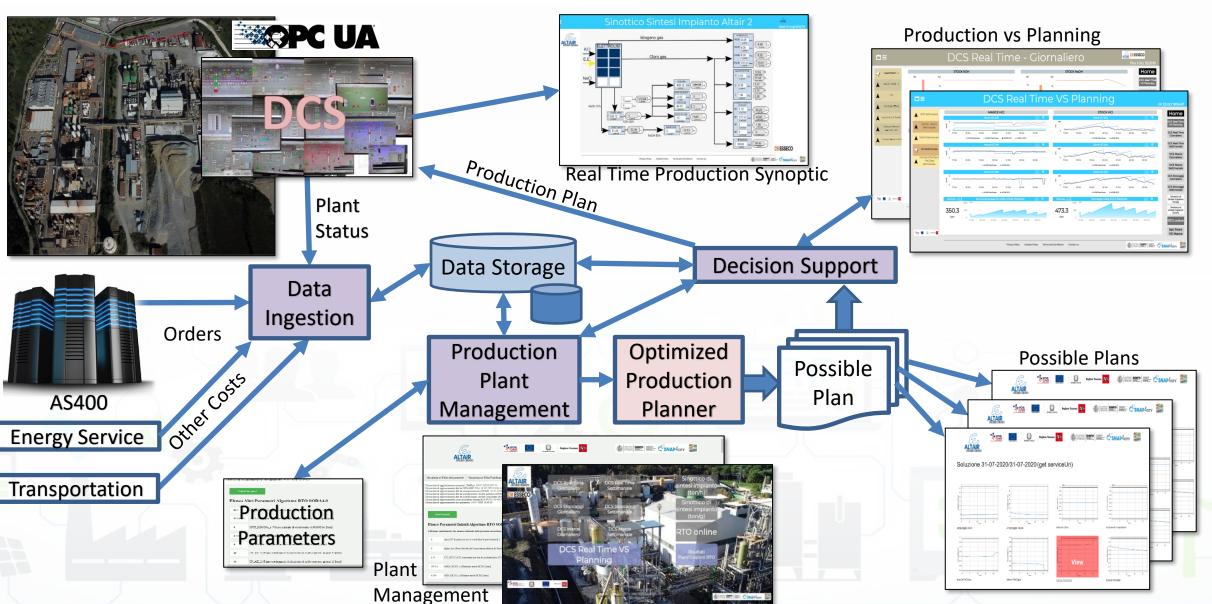










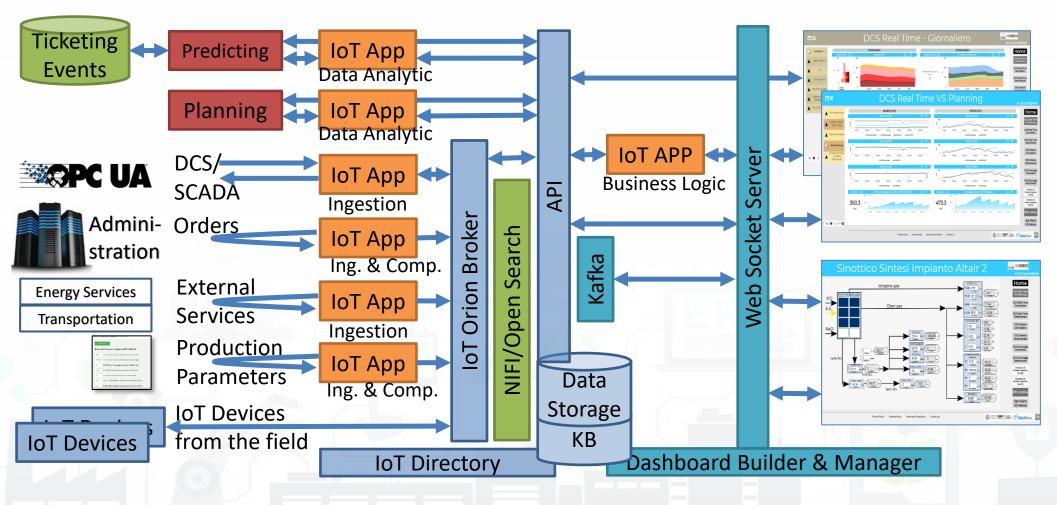




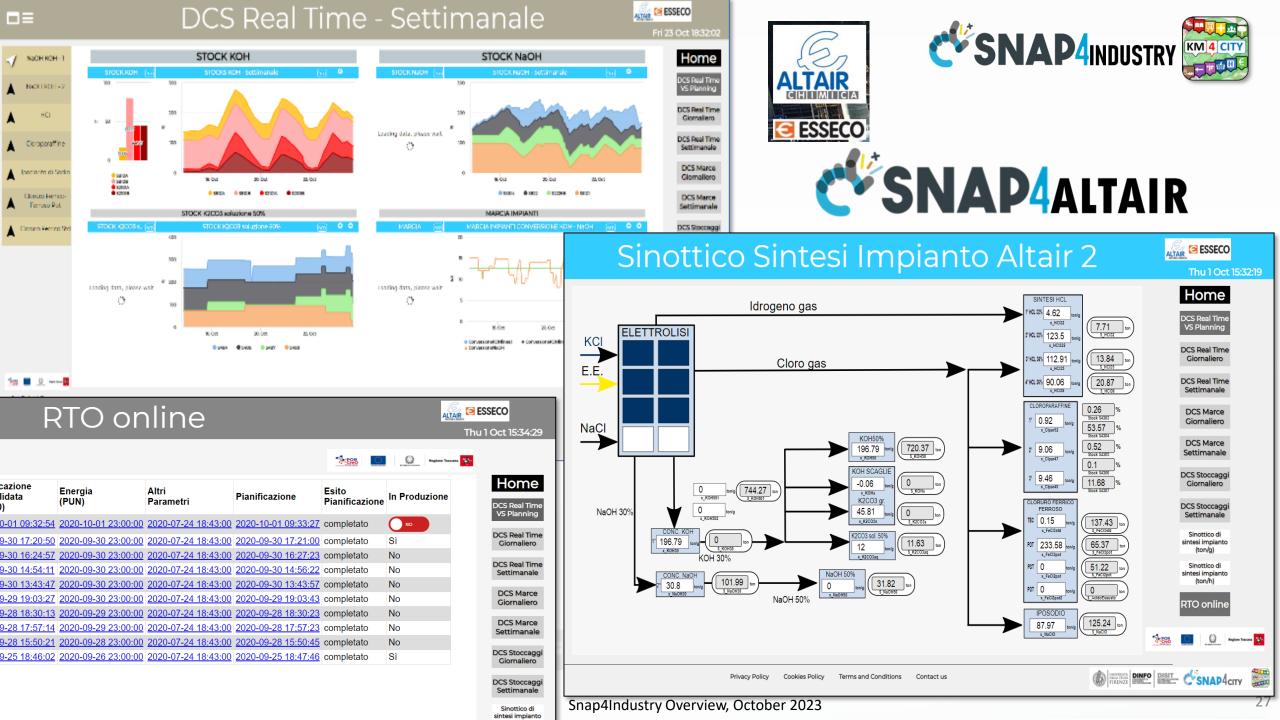




Snap4Industry IOT Architecture





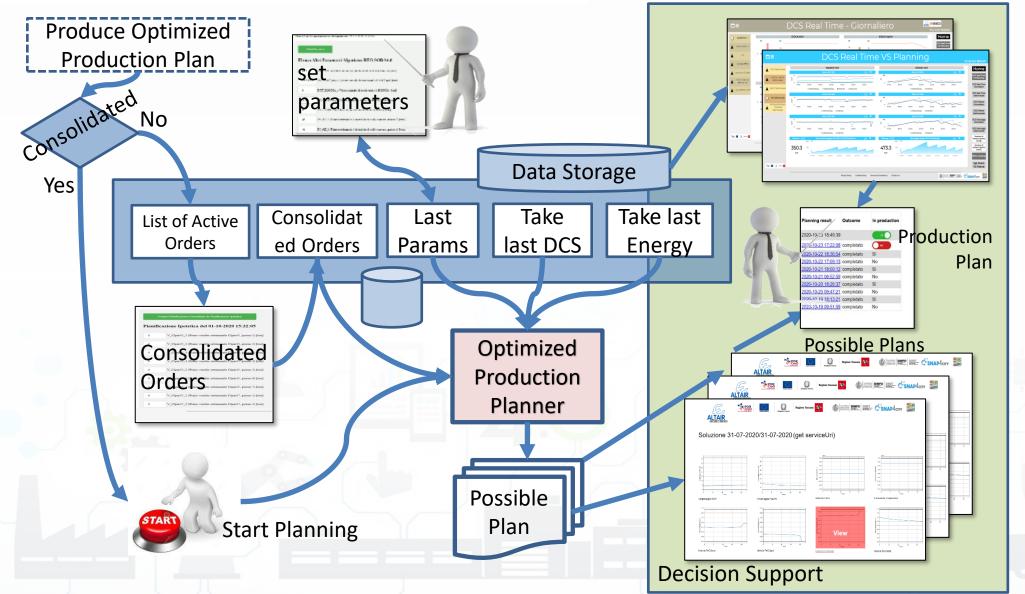






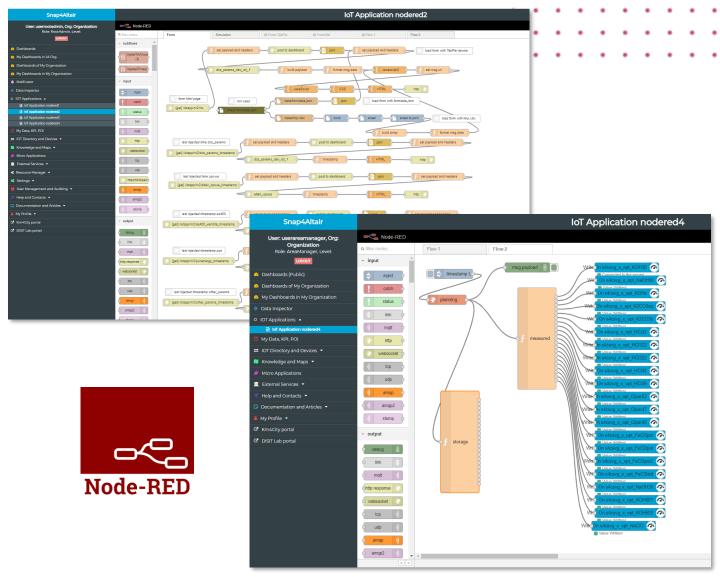
Business Logic





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...







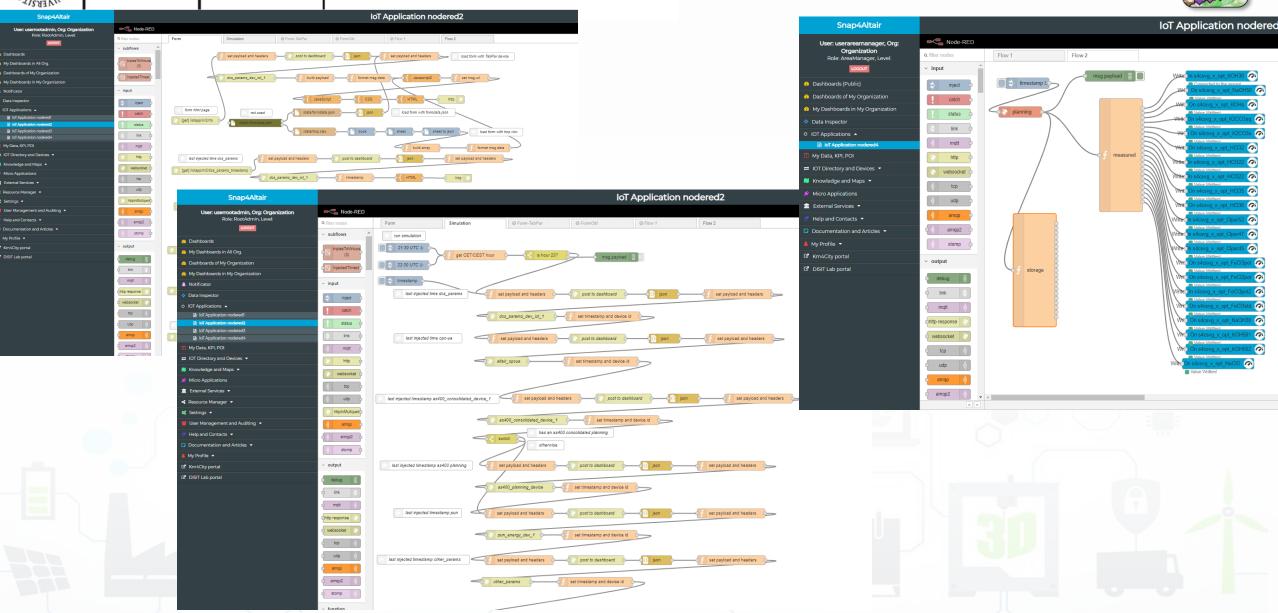






Some Flows







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





















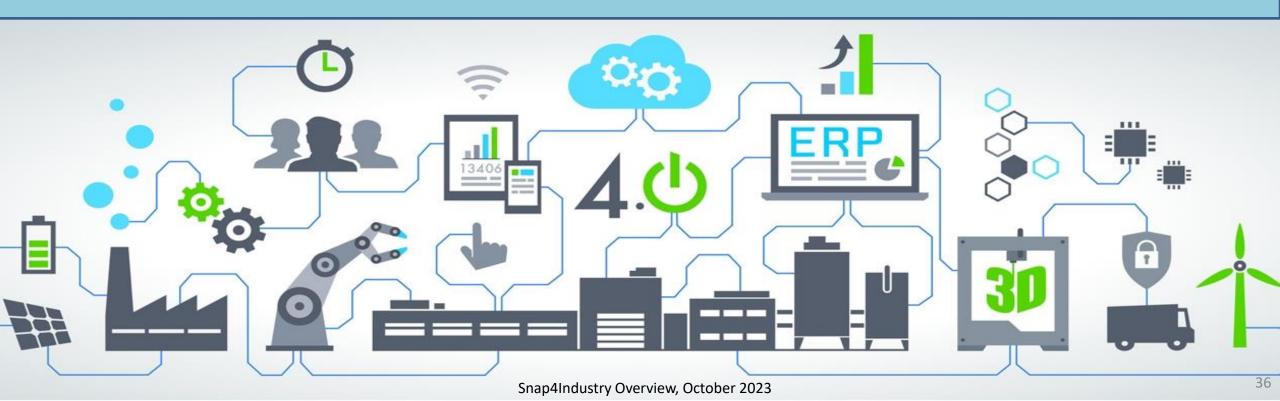








Digital Twin vs BIM





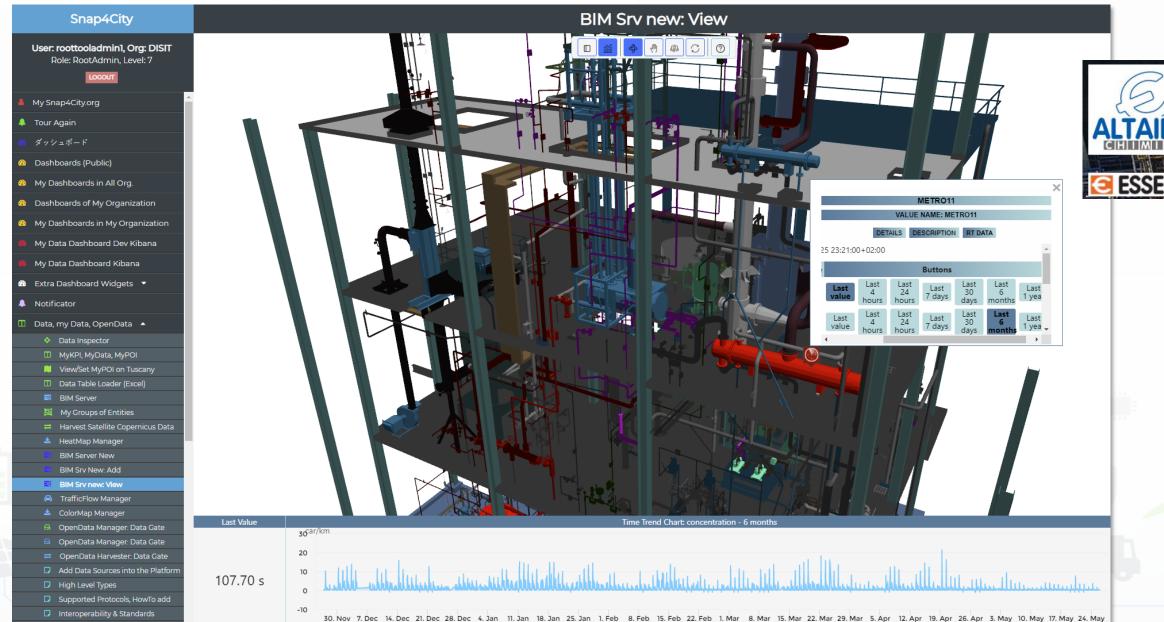




Digital Twin Local SNAP4INDUSTRY





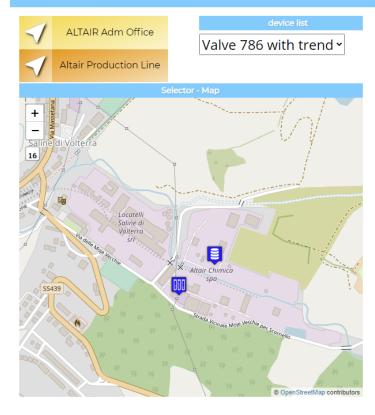


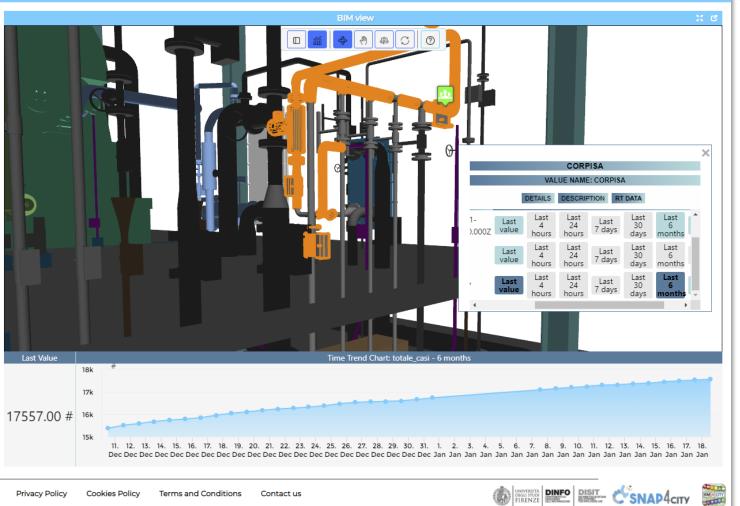
Digital Twin Local, 3D vs Real Time Data



BIM Integration for Digital Twin

Tue 8 Jun 11:04:55











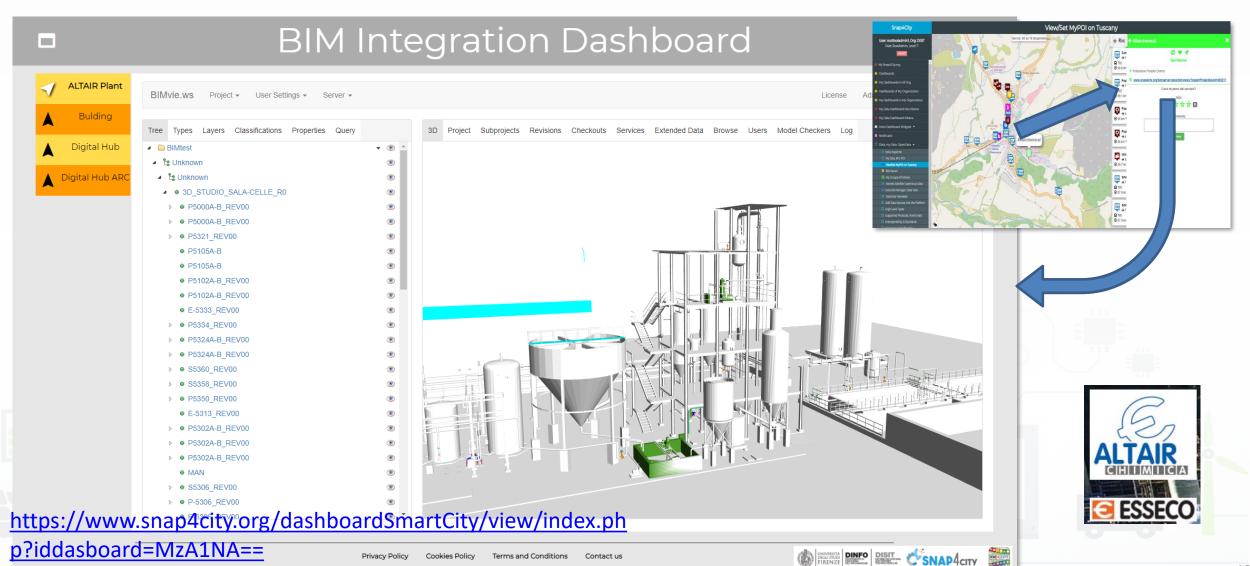








BIM view of the Altair Chemical Plant

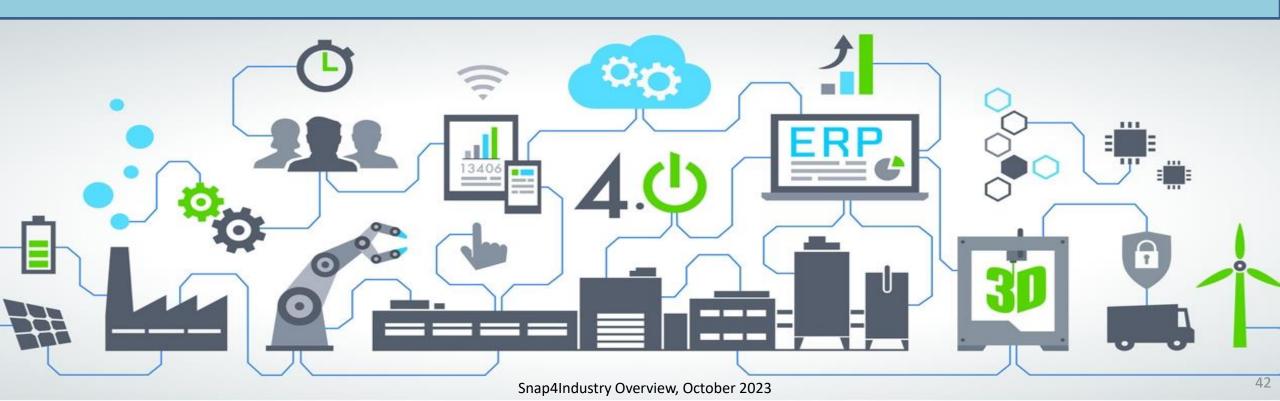


Snap4Industry Overview, October 2023





Integration with Ticketing Systems Workflows





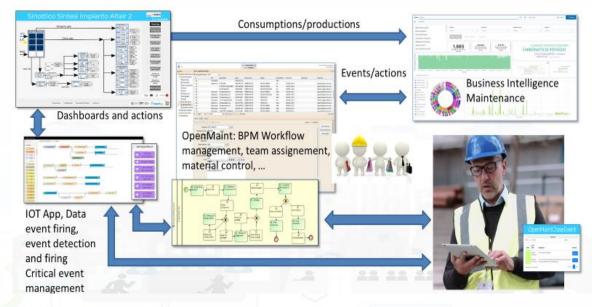






Snap4City Maintenance Solution

- **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;



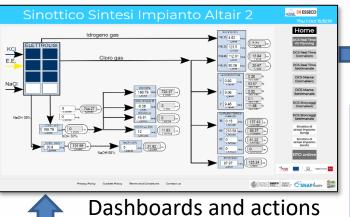




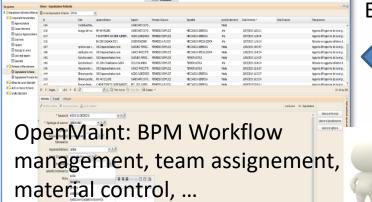




DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LA EXAMPLE TECHNOLOGIES



Consumptions/productions

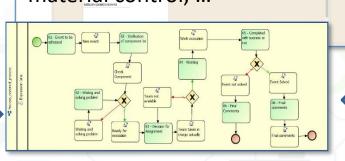


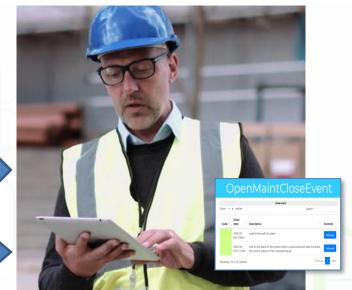
Events/actions



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

management







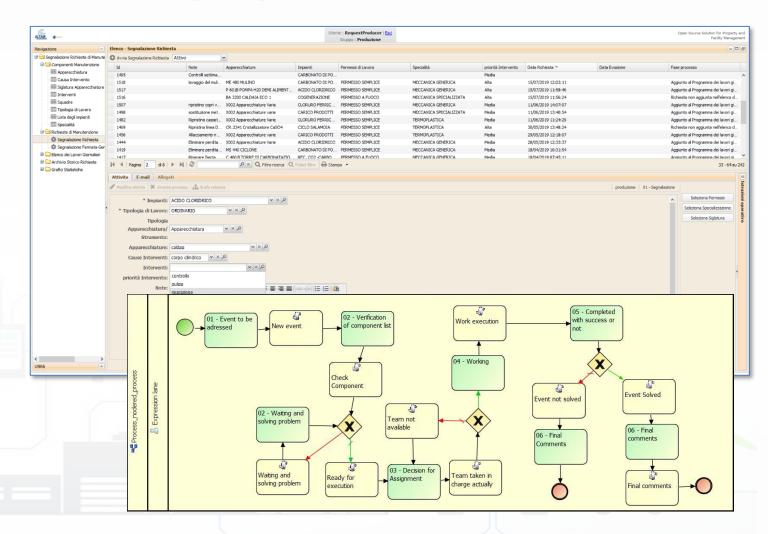






Integration with Ticketing Systems Workflow

- **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/59







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



Plant

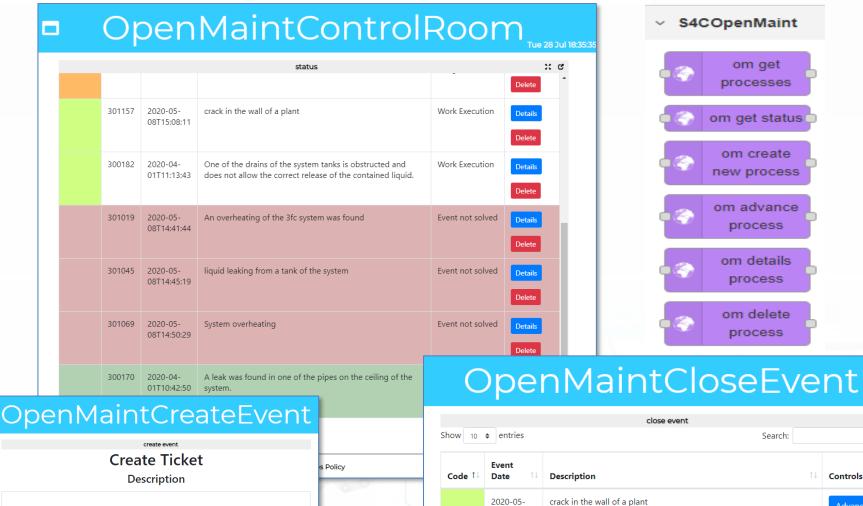
3fc system





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.

the correct release of the contained liquid

One of the drains of the system tanks is obstructed and does not allow

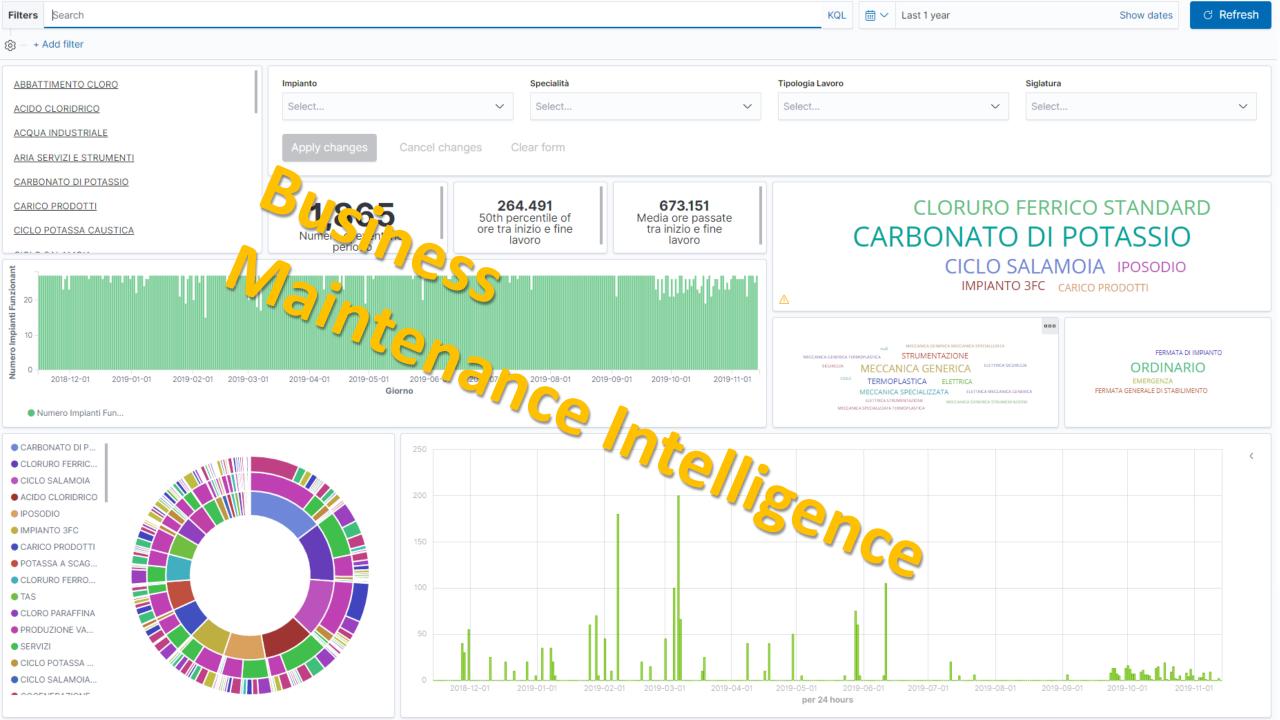
08T15:08:11

2020-04-

Showing 1 to 2 of 2 entries

01T11:13:43

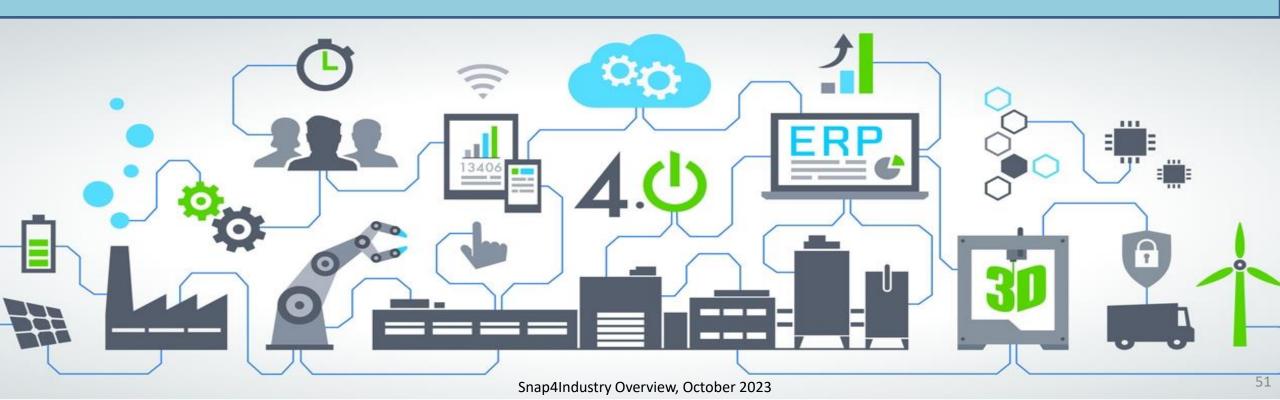
Controls







Predictive Maintenance







Complex cause-effect relationships

Elements:

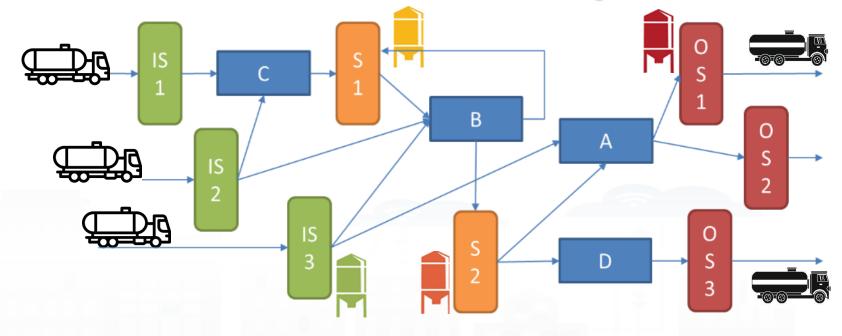
- Machines: A...C
- Storage: silos...
- Flows:...

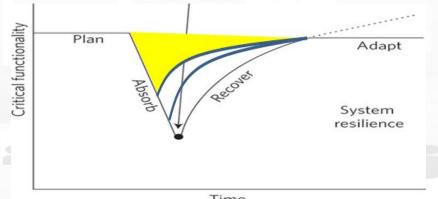
Dependencies

Cascade effects

Early warning

- Reduction of costs
- Recovering from failure is more expensive than correcting in advance
- Possible advanced replan and reschedule: secondary solutions



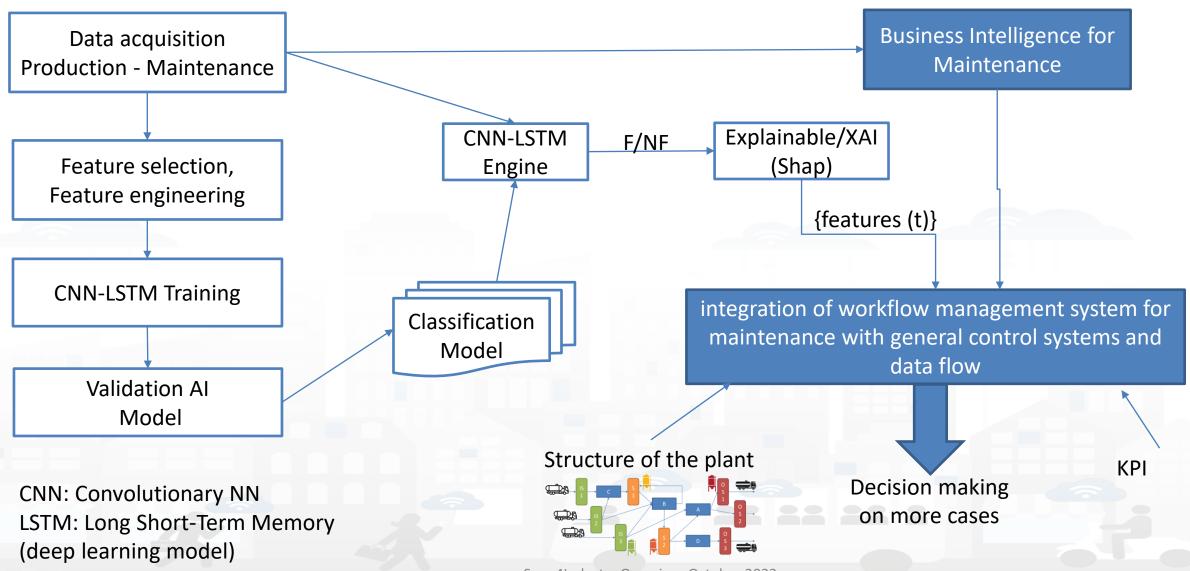






Workflow





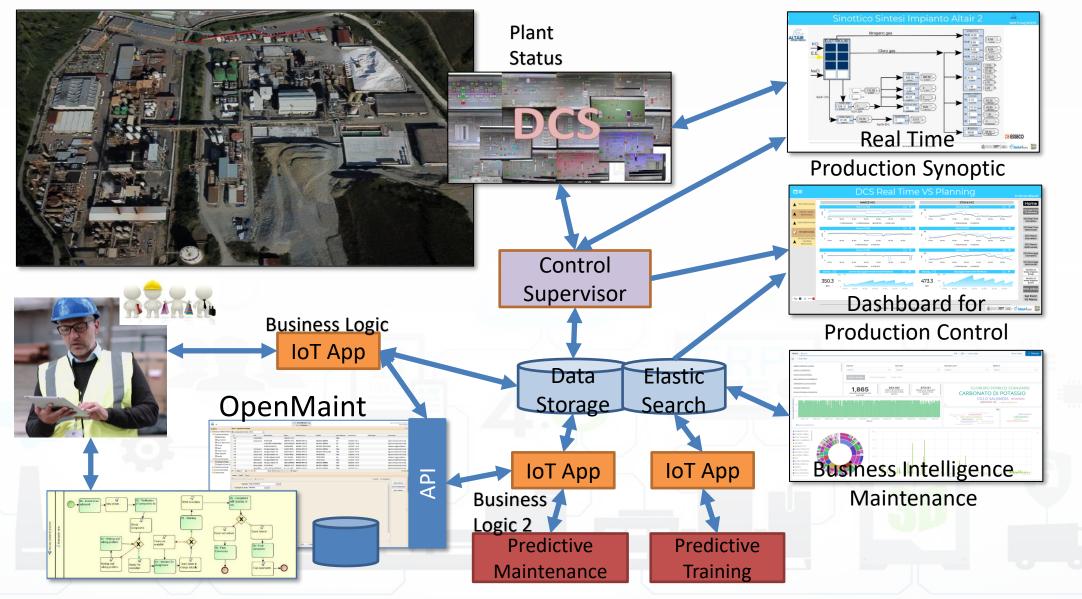






Solution













Overview Features

Feature	Plant	Description	Unit of measure
TempreactoreR4001 -	chlorine paraffins (CPS)	reactor temperature indication	°C
TempreactoreR4002 -			
TempreactorR4003			
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 -	NaOH KOH	flow rate measure and totalization	lt – m3
QuantNaOHBatchNaClO_2		now rate measure and totalization	$\Pi - \Pi \Omega$
ConversionNaOH -	NaOH KOH	electrolysis load adjustment (production)	kA
ConversionKOHlinea1		electrorysis load adjustment (production)	NΛ
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	HC1	Storage level indication	%
RedoxFeCl3Pot	Ferric Chloride std	potential measure redox Ferric Chloride	mV





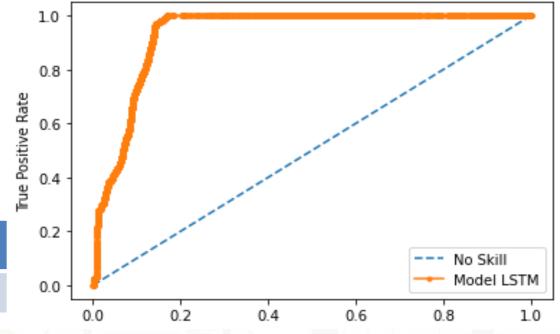




Preditive capabilities

- 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



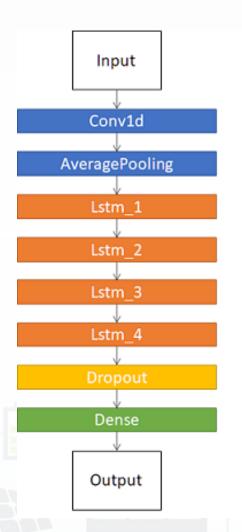






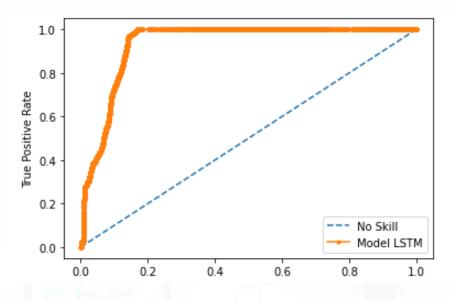


Classification model CNN-LSTM



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



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

	Precision %	Recall %	F ₁ score %
weighted avg	0.90	0.92	0.90



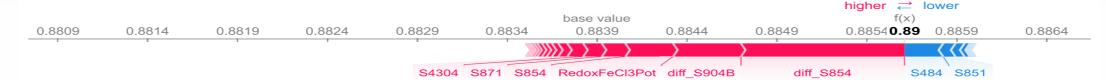




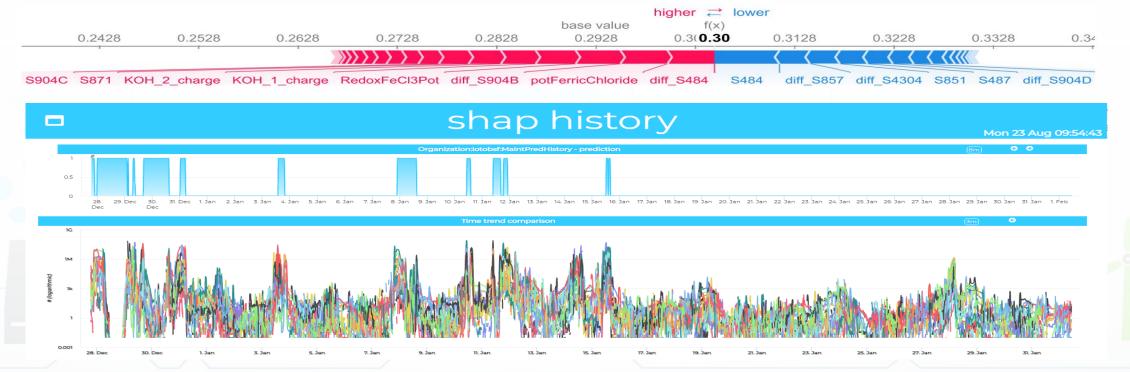


Explainable/XAI - CNN-LSTM (SHAP)

Explanation of prediction generated by model for fault



Explanation of prediction generated by model for normality

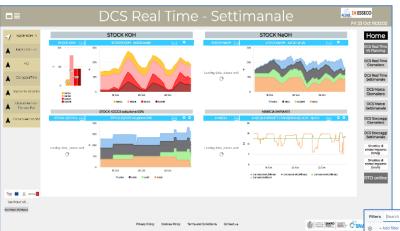






Closing the loop



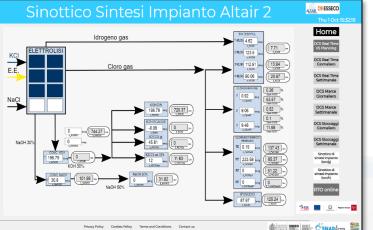


Map and 3D BIM modelling to:

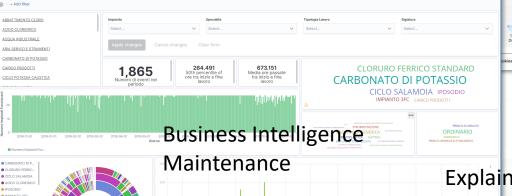
- -- represent the details
- -- associate physical elements with data

Historical and Real Time Data

Synoptics for real time monitoring



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



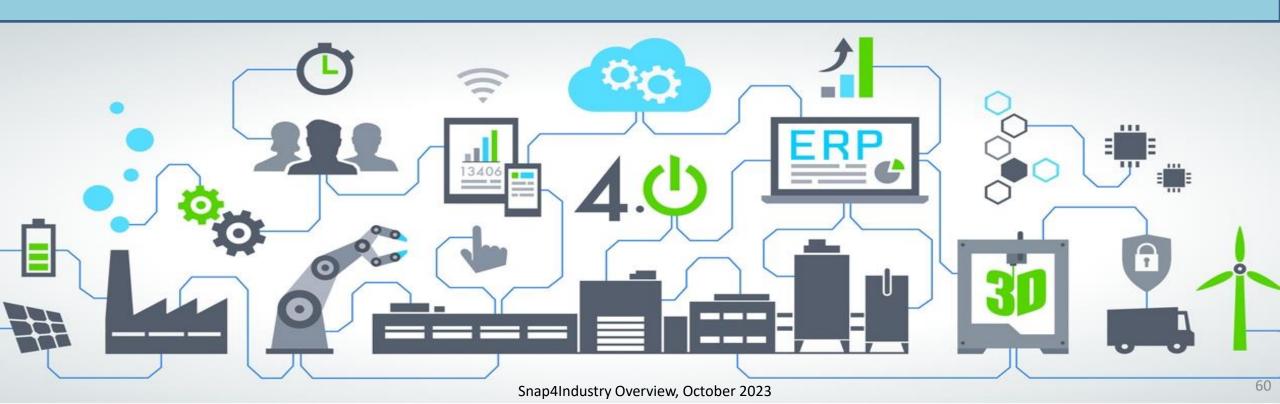
Explainable AI to map critical values of devices and detection to physical elements in the plant







WHAT-IF Analysis



What-If Analysis



Available data and techniques	What happe ned	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

Snap4Industry Overview, October 2023







HOW TO RESPOND/REACT



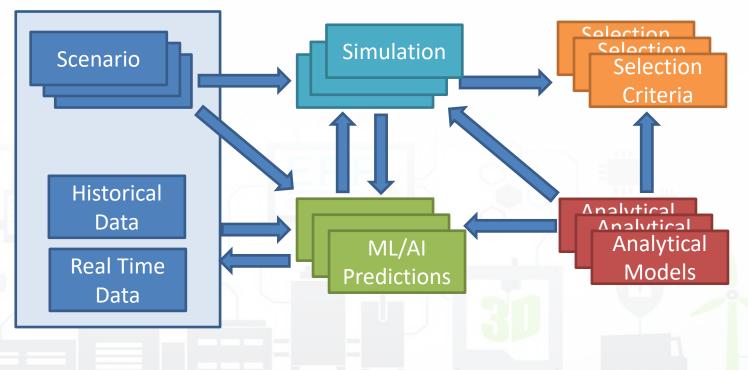


What-if: what is going to happen if this and that

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

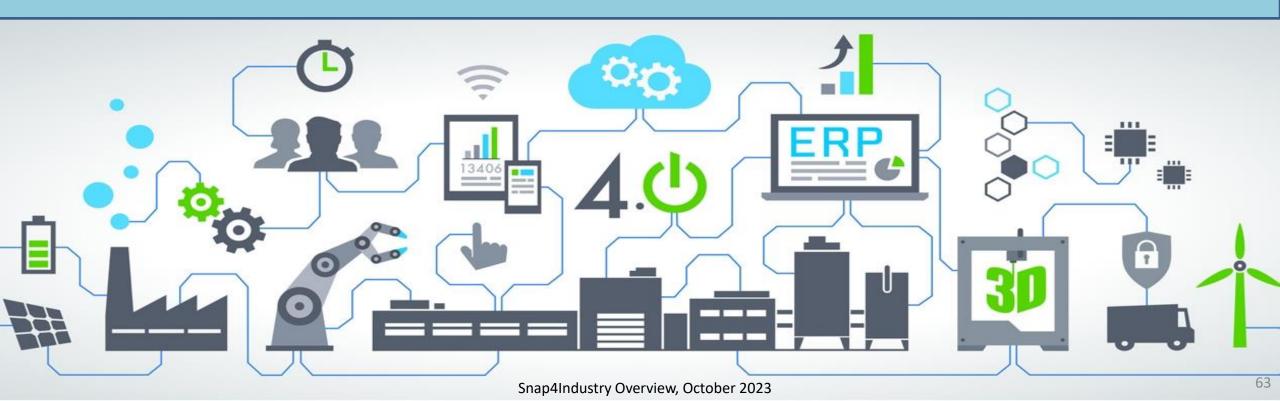
Decision Support System KPI, Optimization Visual Analytic: animations







Business Intelligence



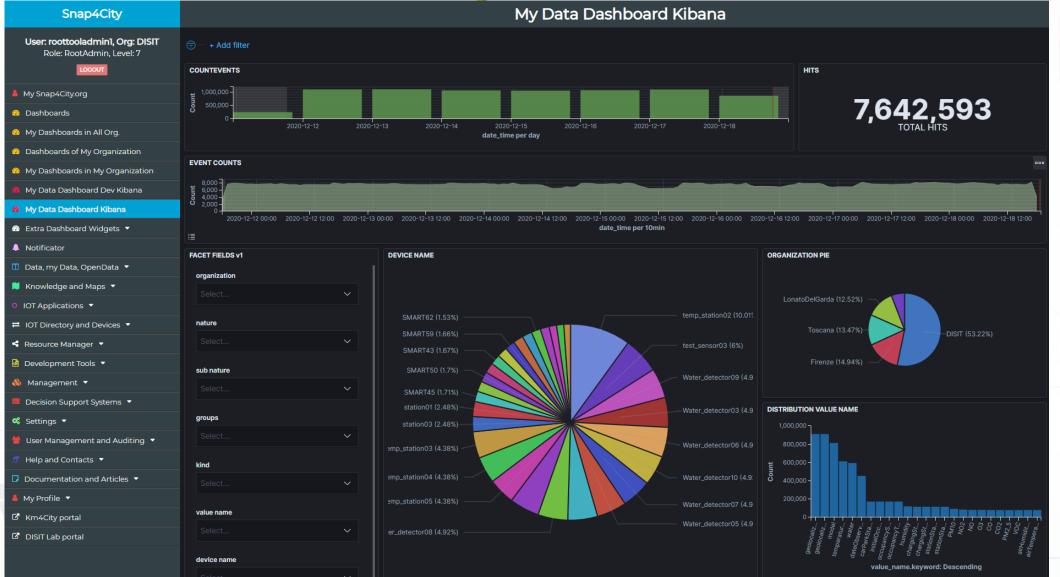








DevDash: My Data Dashboard Kibana













- 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





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



Respect Privacy and GDPR





IoT Edge: IOT App Smart Industry 4.0

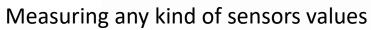
























Any kind of notification channel





Controlling Energy Power











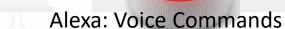
Local Control



Administrative Servers



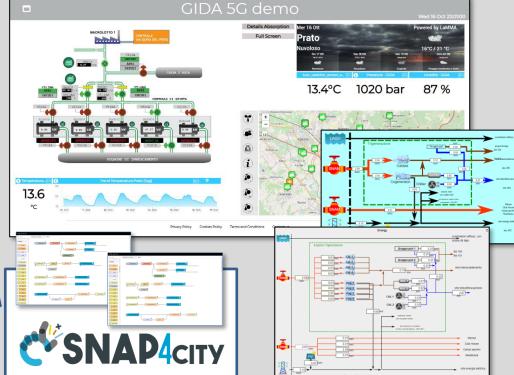
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WiFi

Snap4Industry Overview, October 2023

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

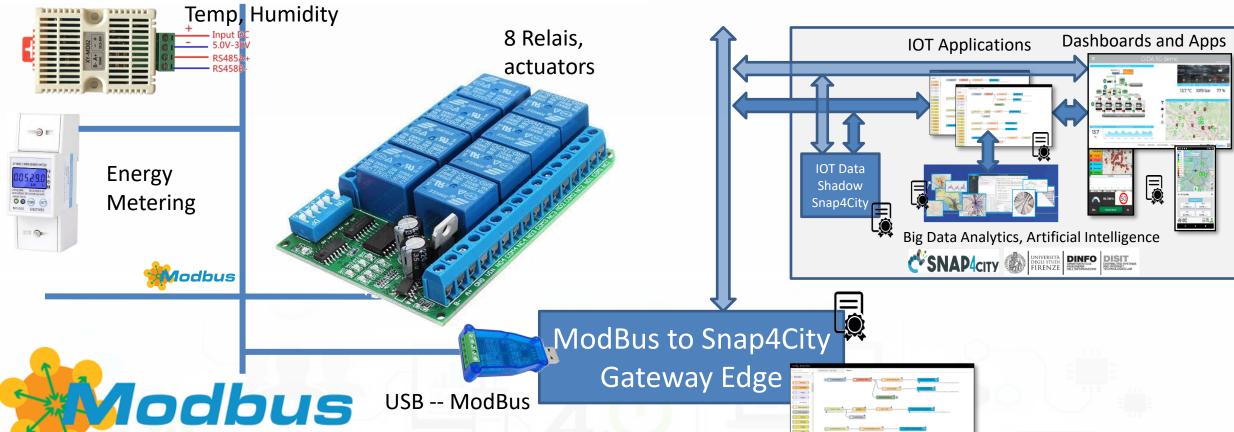






Devices





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



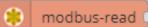


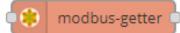


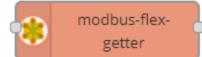








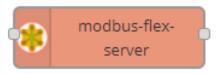


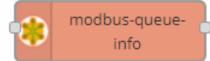


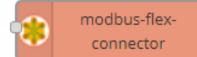
* modbus-write



modbus-server (

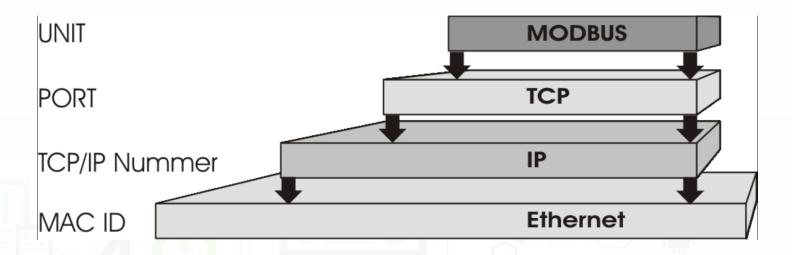






modbus-io-config



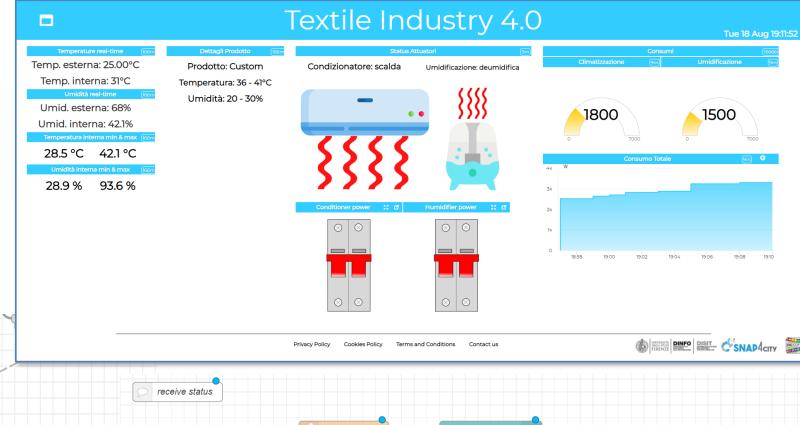


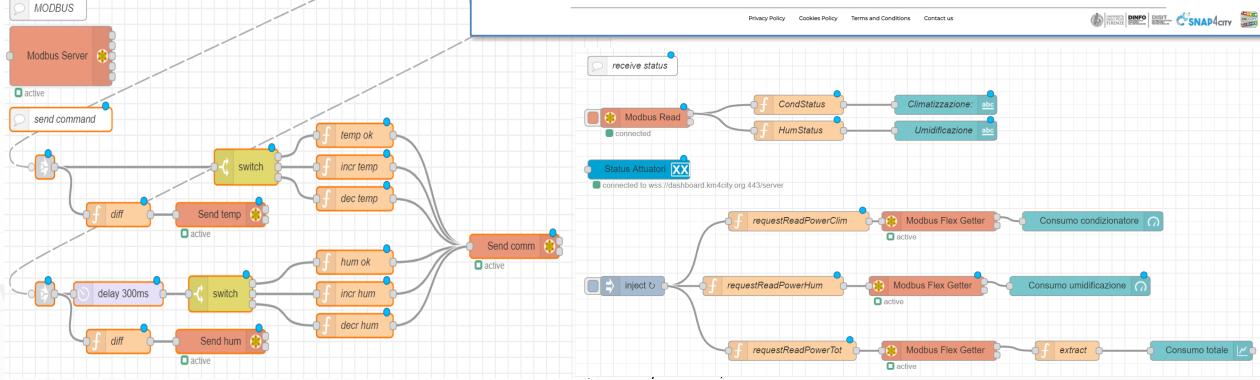




DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB













IoT edge







Motion Control / Alarm



TP Link plugs: meter



Alexa: Voice Control

Micro











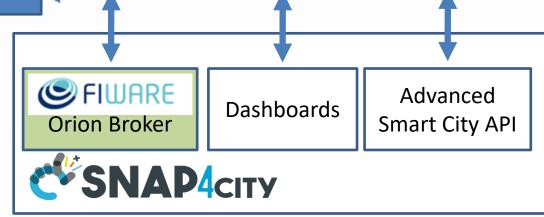
5G gateway

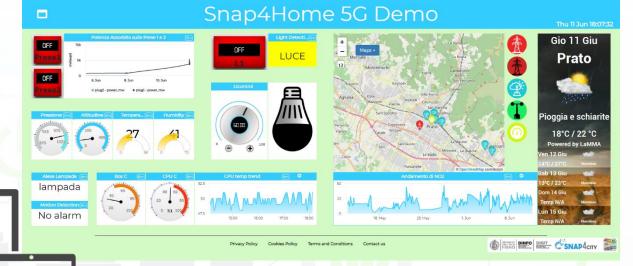
SNAP4 IOT Edge:

ioi Luge

Raspberry
pi:
Node-RED
+
Snap4City
MicroServ
ice
Library

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





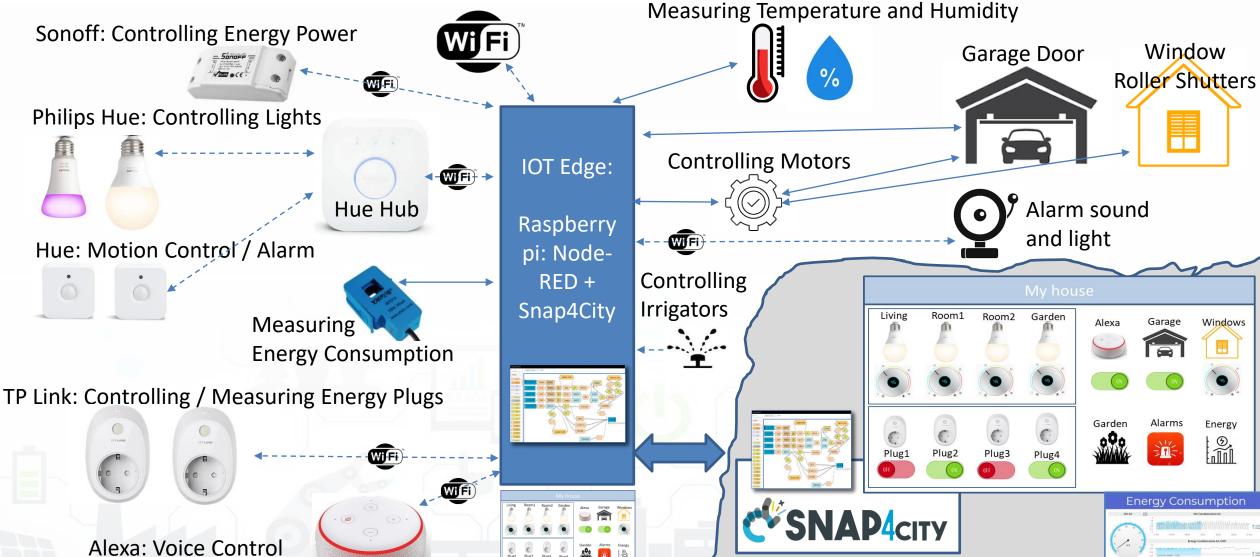




IoT Edge







https://www.snap4city.org/620

Snap4Industry Overview, October 2023

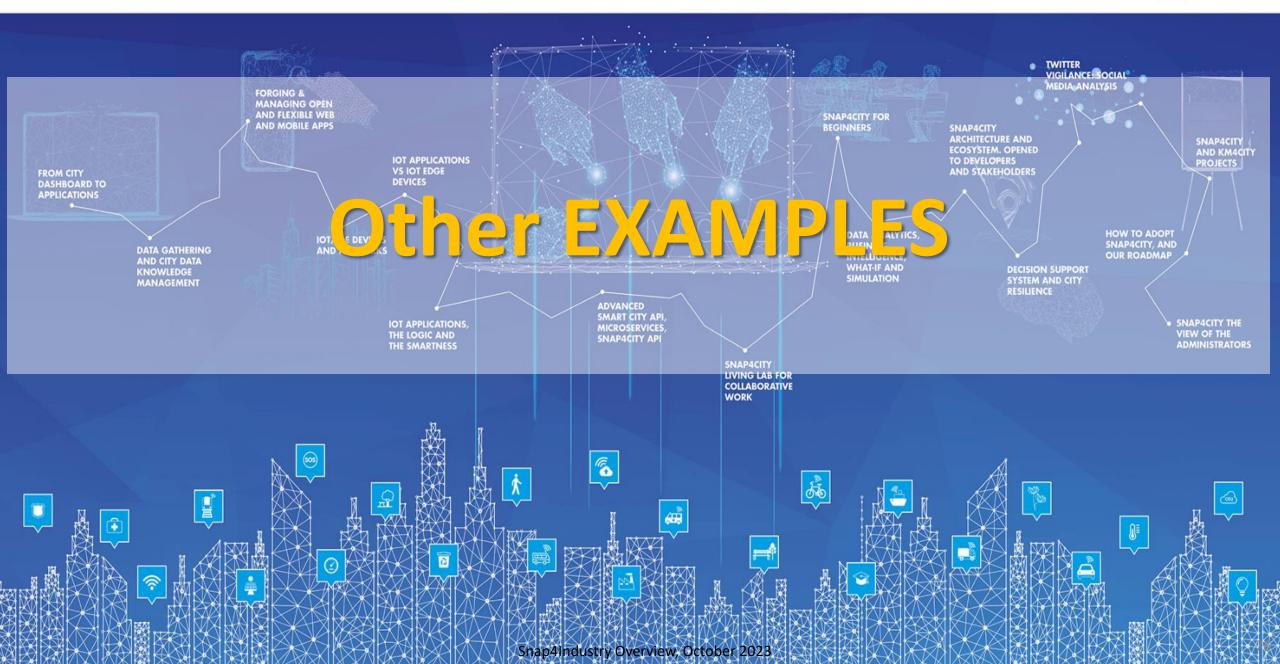
Local Control

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

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT SNAP4INDUSTRY







Predictive Analytics Dashboarc

Piano Linea 2

| Description | Section |







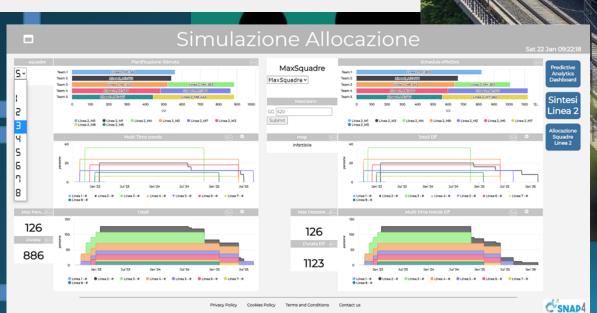
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	Data partenza in stima	Data fine in stima	Durata stimata	Data effettiva partenza	Data effettiva fine	Durat
Progetto di base	02/06/2022	31/08/2022	90	02/06/2022	31/08/2022	
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Vr_ODI PE	29/11/2022	28/01/2023	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	18/05/2028	1446	02/06/2022	18/05/2026	

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Predictive Analytics Dashboard





C SNAP4

Mon 17 Jan 17:29:30

Open Italy 2021

Predictive Analytics Dashboard



Vista Complessiva

Codice Linea Anno ERTMS Baseline Lunghezza ERTMS



Linea 1	AA11	2026	3	5 km	NO	130	130	Piano Linea	Dettaglio Linea
			_						

Presenza GSMR

Allocazione Squadre Linea 2

Linea 2

Linea	AAII	2026	3	5 KIII	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	1 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	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	3 HH88	2025	3	60 km	SI	692	692		Piano Linea	Dettaglio Linea
Linea	MM99	2025	1	80 km	NO	587	587		Piano Linea	Dettaglio Linea



Open Italy 2021

Predictive Analytics Dashboard



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

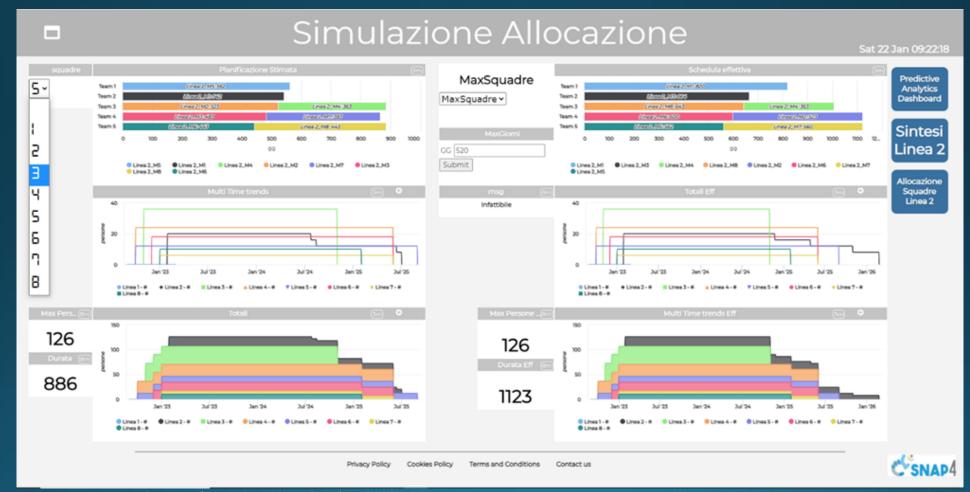
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	Data partenza in stima	Data fine in stima	Durata stimata	Data effettiva partenza	Data effettiva fine	Durata effettiva
Progetto di base	02/06/2022	31/08/2022	90	02/06/2022	31/08/2022	90
Progetto esecutivo	31/08/2022	29/11/2022	90	31/08/2022	29/11/2022	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	02/08/2022	18/05/2026	1446

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Open Italy 2021



IoT Health Scenarios





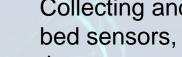
1) Smart Ambulance: Collecting and managing local data from tools and sensors inside the ambulance, IoT Devices,

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 realtime











Smart Ambulance





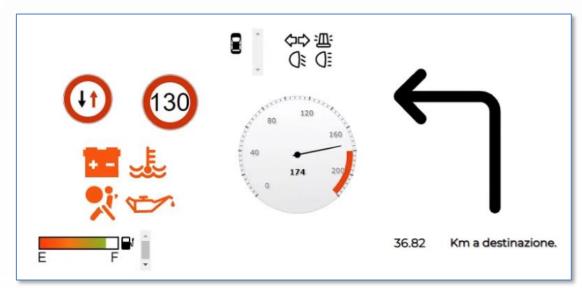


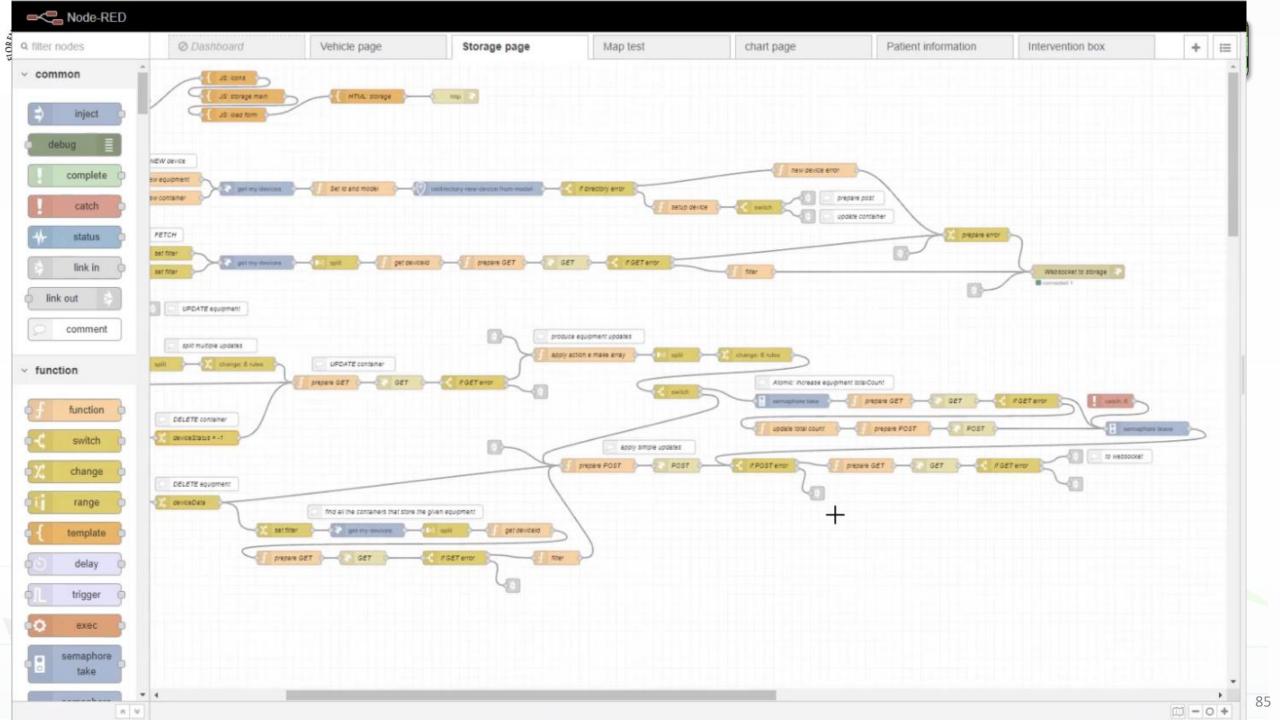
Smart Ambulance



- 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





Jewel Alarms AMPERE





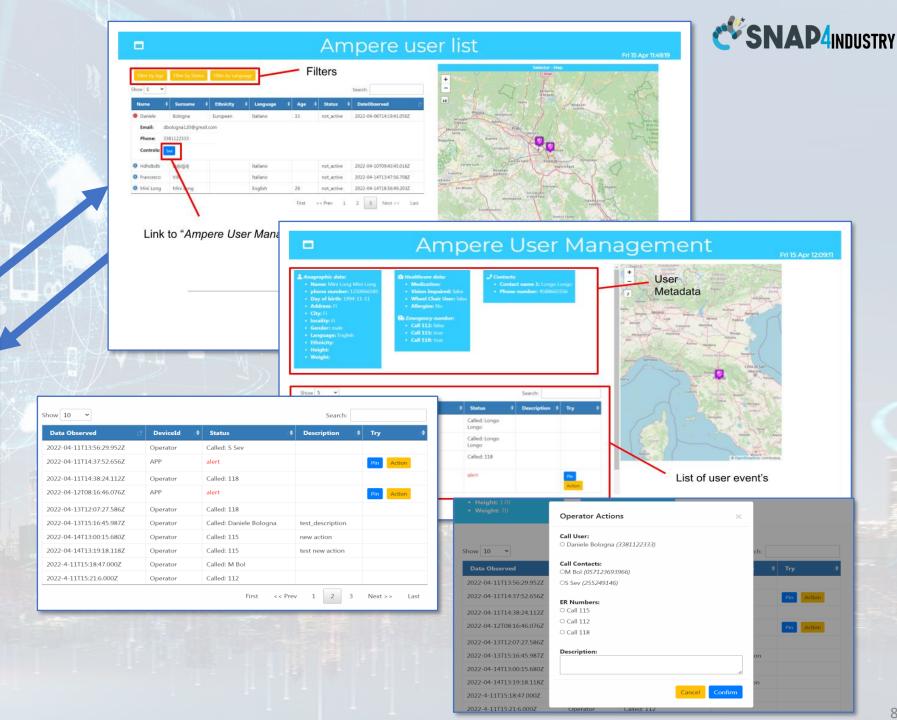






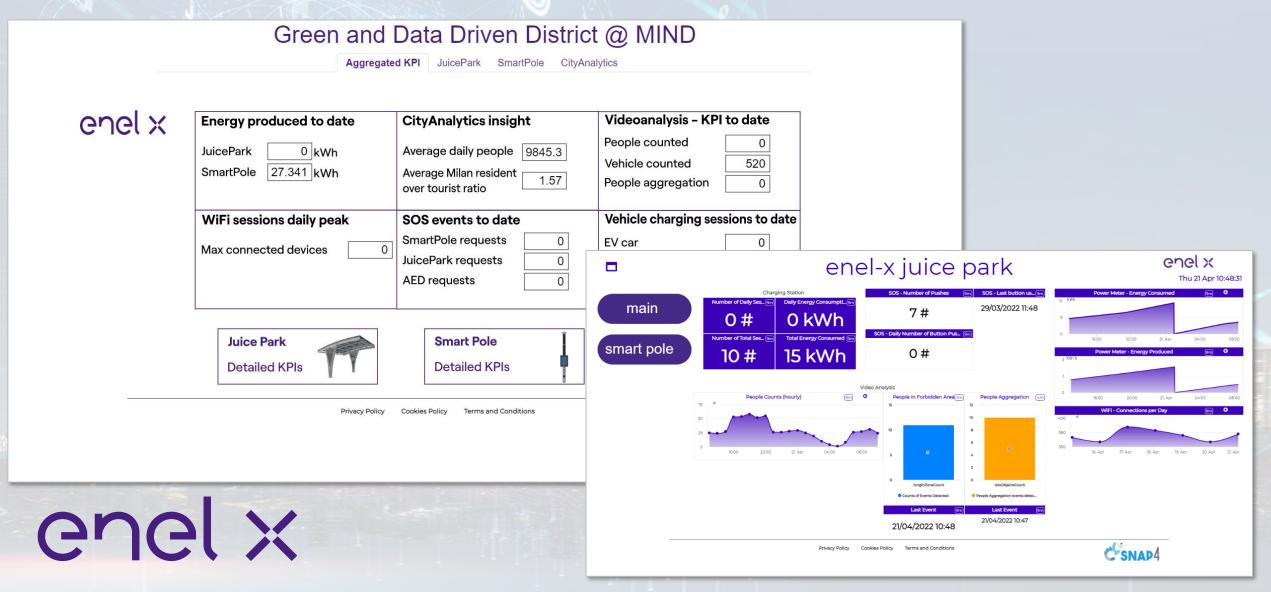


Click on Jewel



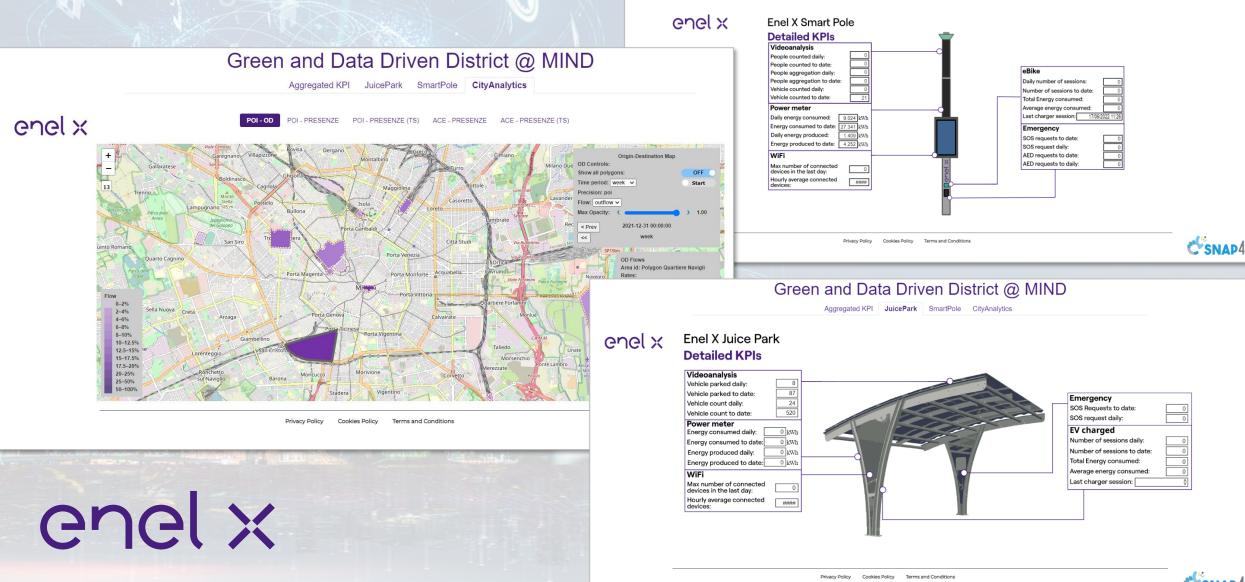


Energy monitoring and business intelligence





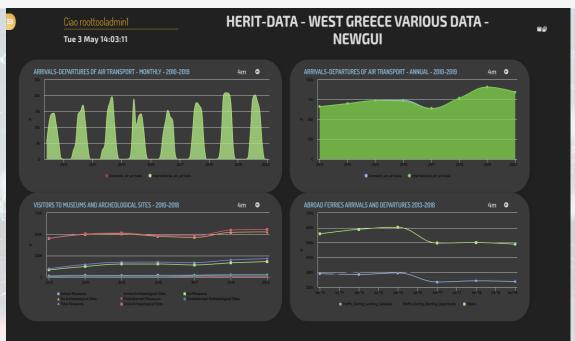
Energy monitoring and business intelligence and Data Driven District @ MIND

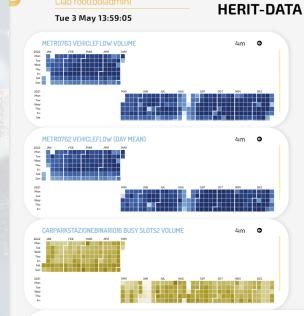


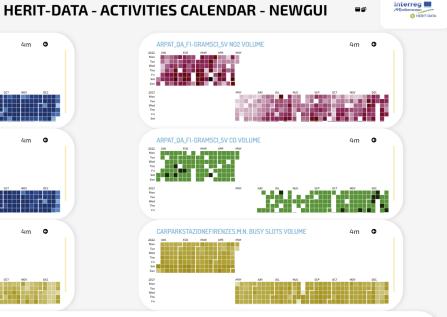
PONT DU GARD: PEOPLE AND BIKES COUNTING **HERIT-DATA - CLONED NEWGUI** Tue 3 May 14:13:30 BIKE COUNTING Pont du Gard Main Tue 3 May 14:34:55 La sousta La sousta velo IN 103046609 - bikeCounting MDG MDG Velos OUT vers site 104046608 - bikeCounting Ratade Velos Ratade Velos Velos IN vers site 103046605 - bikeCounting MDG_MDG_Velos_IN_vers_parking_103046608 - bikeCounting Ratade_Velos_Ratade_Velos_OUT_vers_sortie_104046605 - bikeCounting Rive_gauche_Valive_Valive_velo_OUT_104046607 - bikeCounting Ratade_Velos_Ratade_Velos_Velos_IN_vers_site_101046605 - bikeCounting **BAR SERIES** PEOPLE COUNTING 0 PontDuGard-Occitanie-or 9.2 Sep '21 Oct '21 Nov '21 Dec '21 Jan '22 Feb '22 Mar '22 Apr '22 May SOUS DIMENSION 4m **G** ■ Valmale, Valmale, Pietons, OUT, descente_102046610 - peopleCounting ♣ La_sousts_La_sousts_pieton IN_10106609 - peopleCounting ♣ Lade_pietons_Pastade_pietons_Pieton_OUT_sorter_102046660 - peopleCounting ♣ La_sousts_La_sousts_pieton_OUT_102046609 - peopleCounting ♣ La_sousts_La_sousts_pieton_OUT_102046609 - peopleCounting ₱ Wine_pauch_Vallow_pieton_IN_101046607 - peopleCounting ₱ MIDG_MOD_Pietons_OUT_vers_sine_102046609 - peopleCounting ₱ Wine_pauch_Vallow_pieton_OUT_102046607 - peopleCounting ₱ Wine_pauch_Vallow_pieton_OUT_10204607 - peopleCounting ₱ Wine_pauch_Vallow_pieton_Pieton_Vallow_pieton_Piet Occitanie:orionPontDuGard-UNIFI:DABS_DAB_S_RIVE_GAUCHE **HERIT-DATA - WEST GREECE VARIOUS DATA -**NEWGUI Tue 3 May 14:03:11









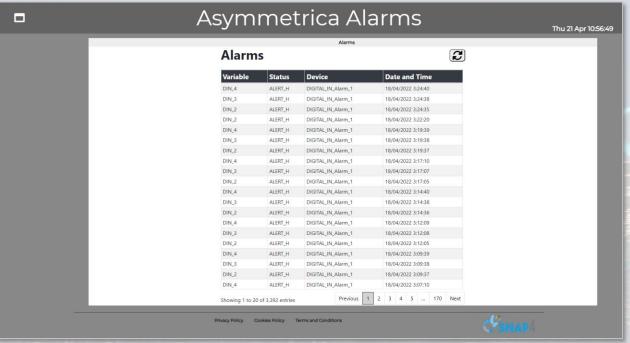






- Environmental data
- Power meter Data
- Smart Light data are coming (in collaboration with a multinational company)





Snap4Industry Overview, October 2023

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)

- 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 Snap4Industry Overview, October 2023





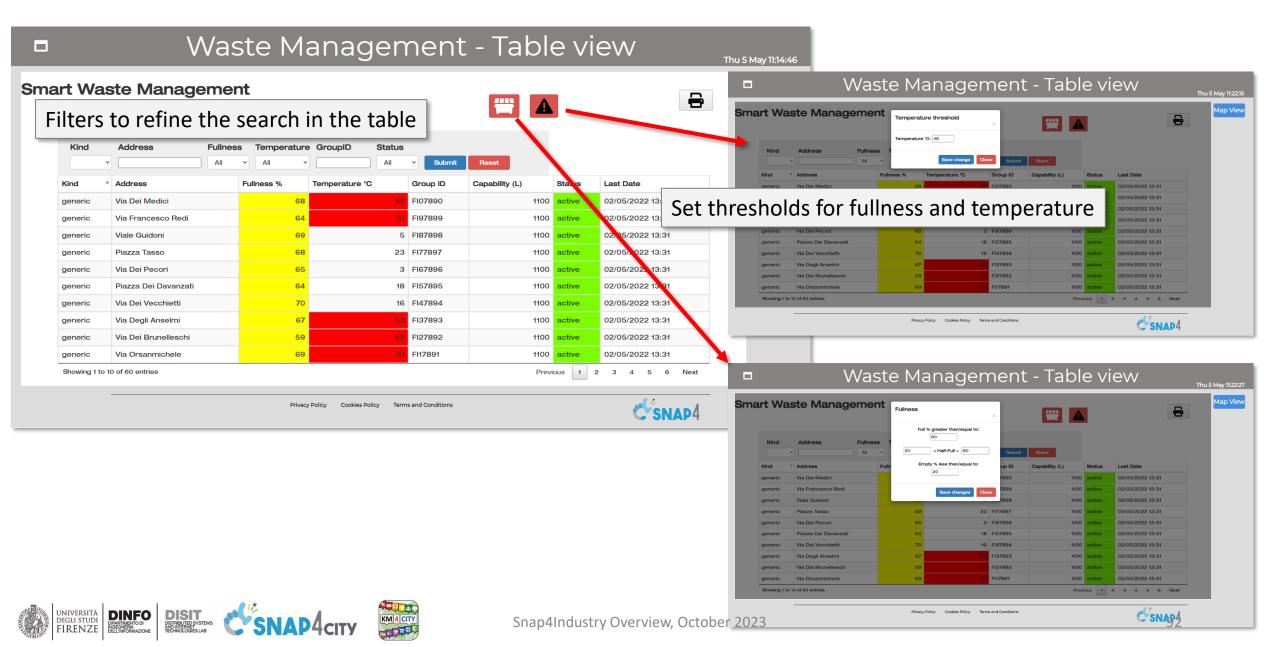






Smart Waste – Table view





ITALMATIC Main Dashboard



Mon 4 Oct 15:37:54

Autoclave DB - Weekly

Impianto Presse - Weekly

OPC-UA Values
Trend
Comparison

Autoclave KPI - Weekly

OPC-UA Values - Weekly

Sinottico Impianto Presse - Autoclave

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

















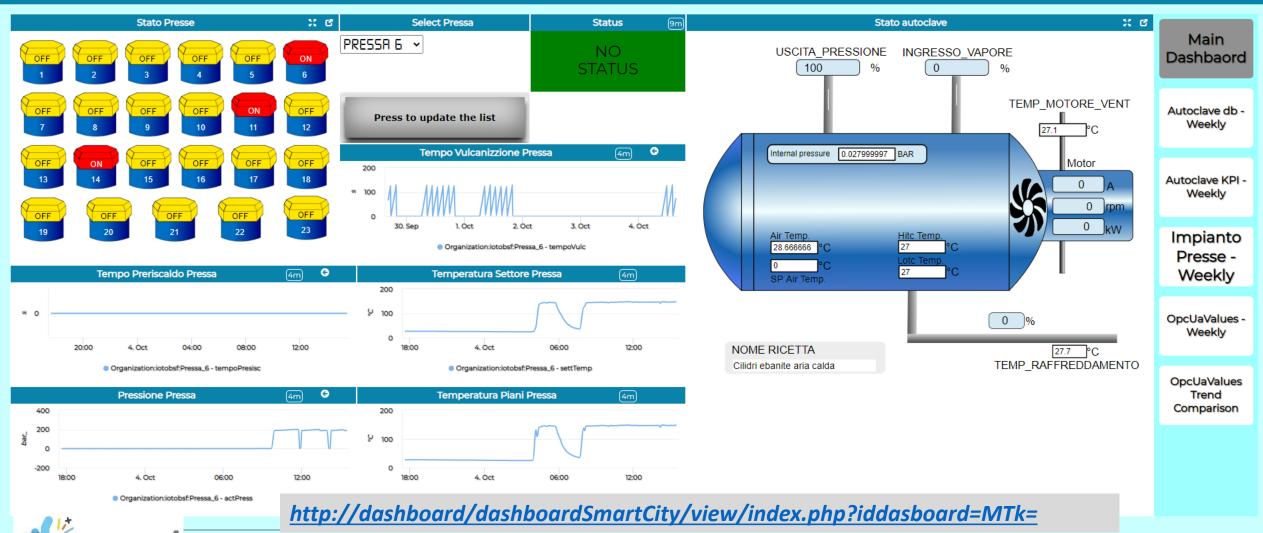


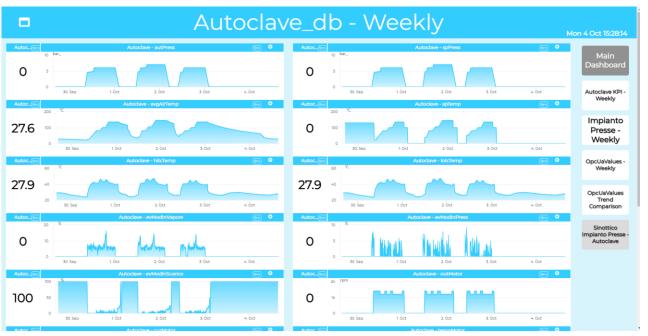
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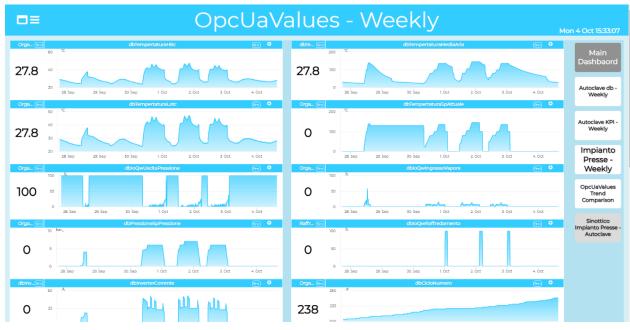
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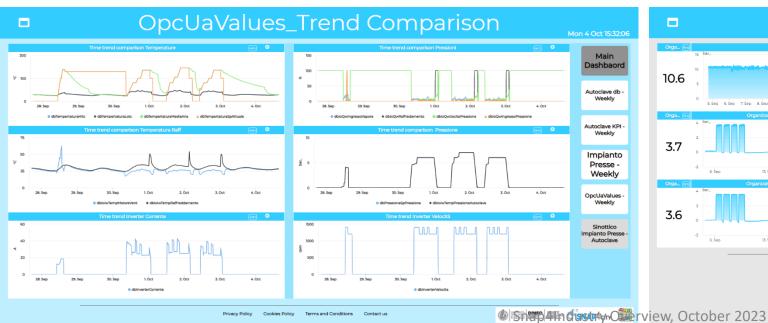


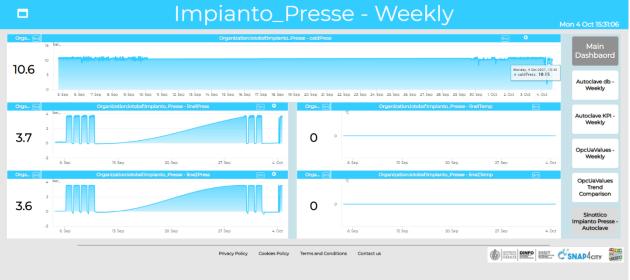
Mon 4 Oct 15:34:59











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

(**EN**hanced **TE**chnological **R**&D of new **PR**oducts and Processes for Innovation, Smart factory and green **E**conomy)

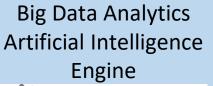




Administrative Data from AS400

Real Time Data, Historical, Events from DCS PC UA

Unique National Energy Costs (PUN)











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



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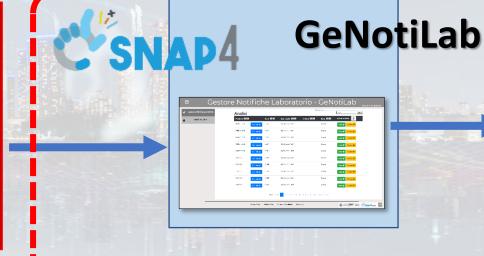






Regione Toscana







GeNotiLab Architecture for ALTAIR





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

AS400

IOT App



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100					

Users

Analysis

Notifications



IOT App Analytics





IOT App Management



Tools:

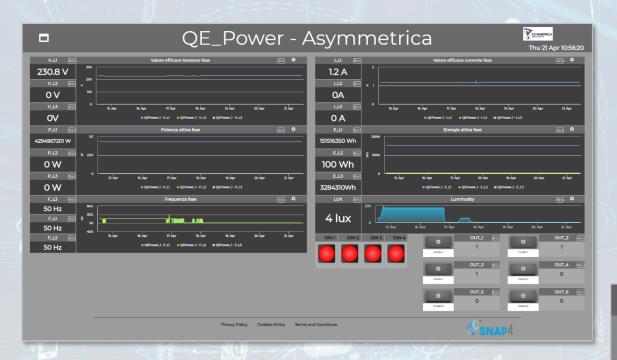
- -- List of Chemical Analyses
- -- List of Notifications
- -- Define notifications
- -- Program, send notifications
- -- see notification status





Telegram Bot





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

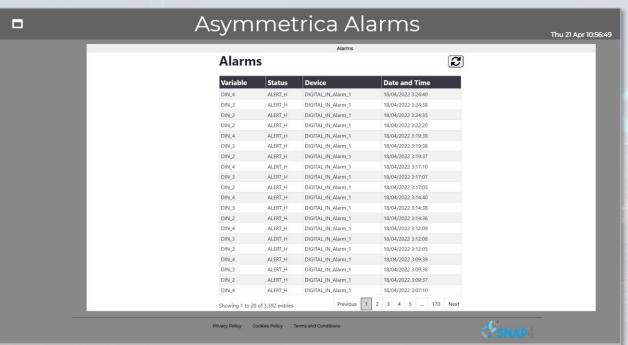








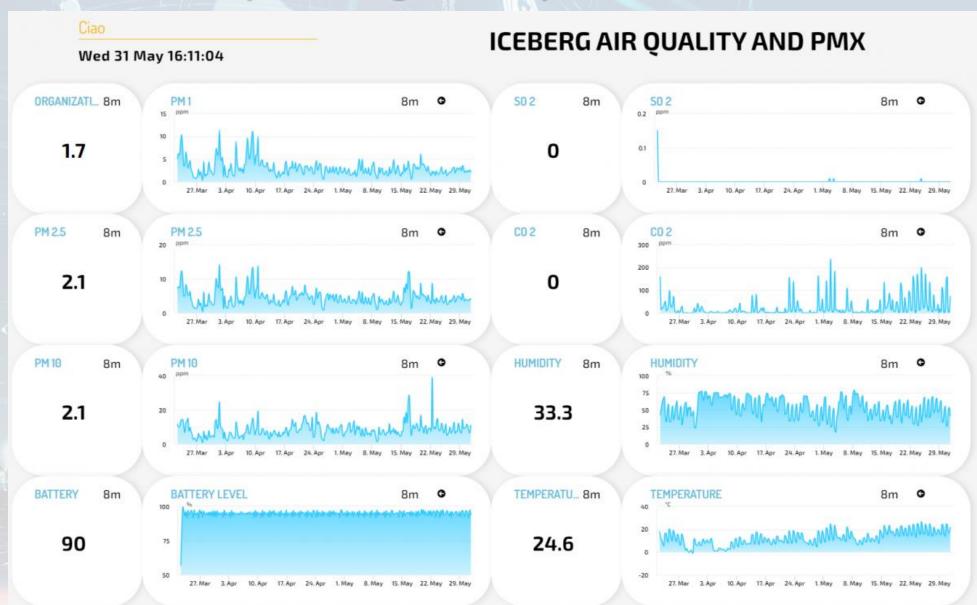




Snap4Industry Overview, October 2023

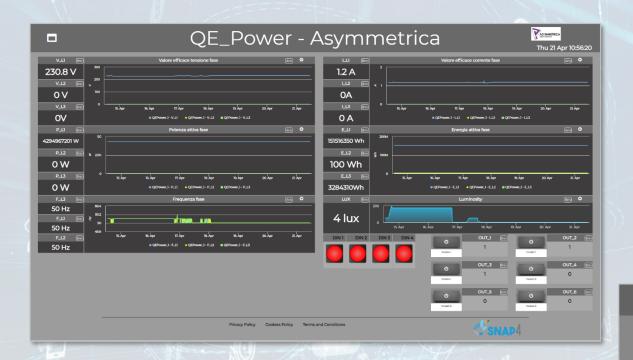
TheLab.City LivingLab by ICEBERG, Romania





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

https://thelab.city/



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













Snap4Industry Overview, October 2023



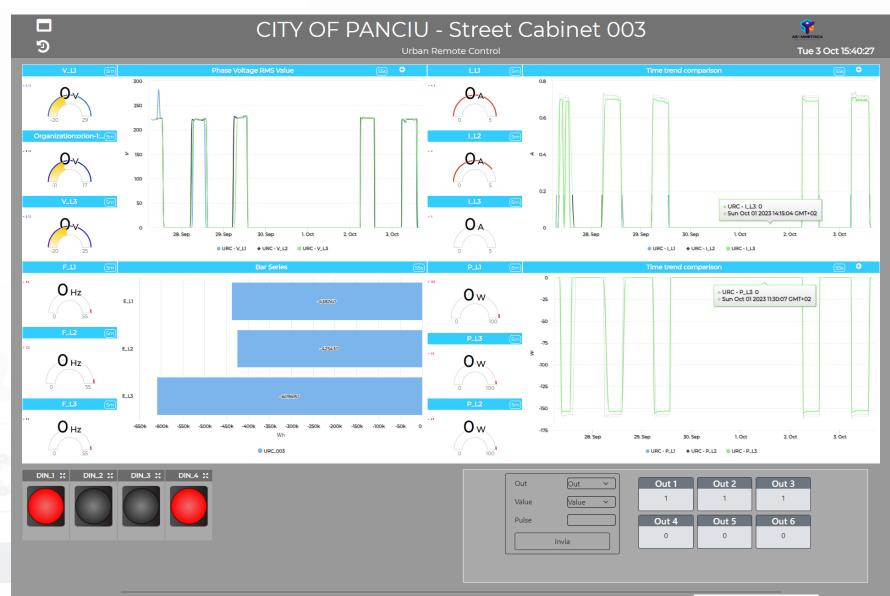


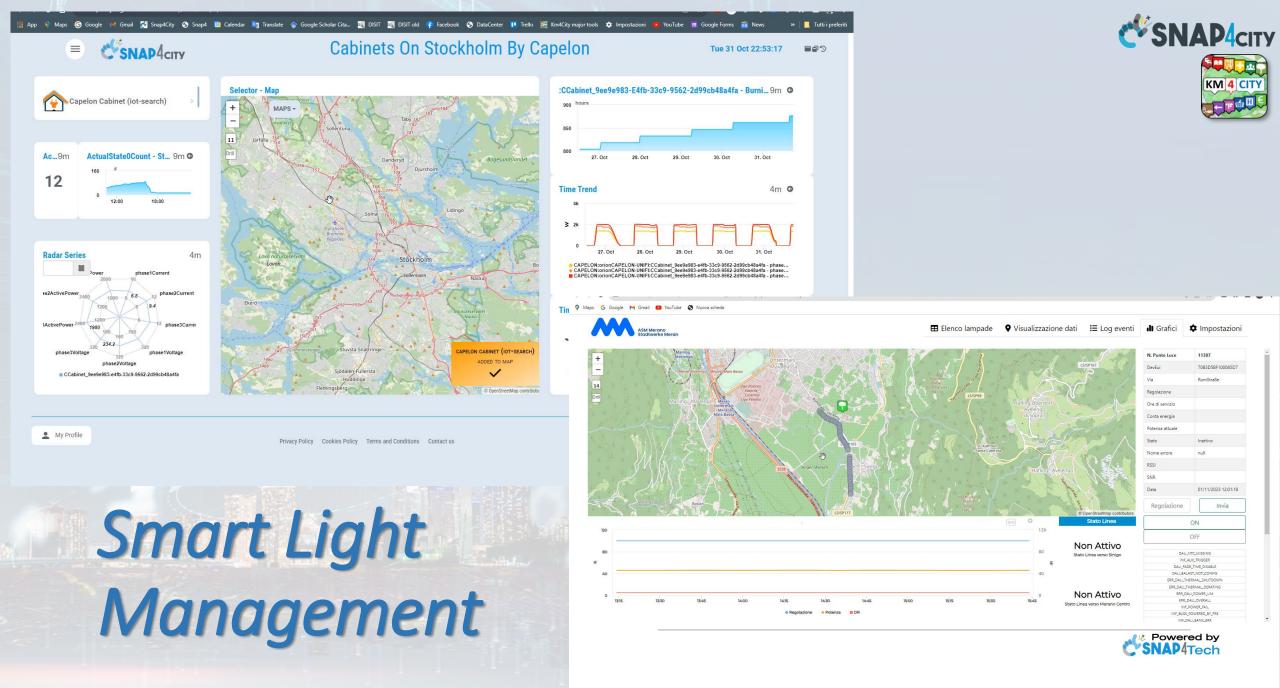




City of Panciu in Romania

By
Asymmetrica
and Snap4





Snap4City (C), November 2023



Search..

Eventi e messaggi d'errore

Х





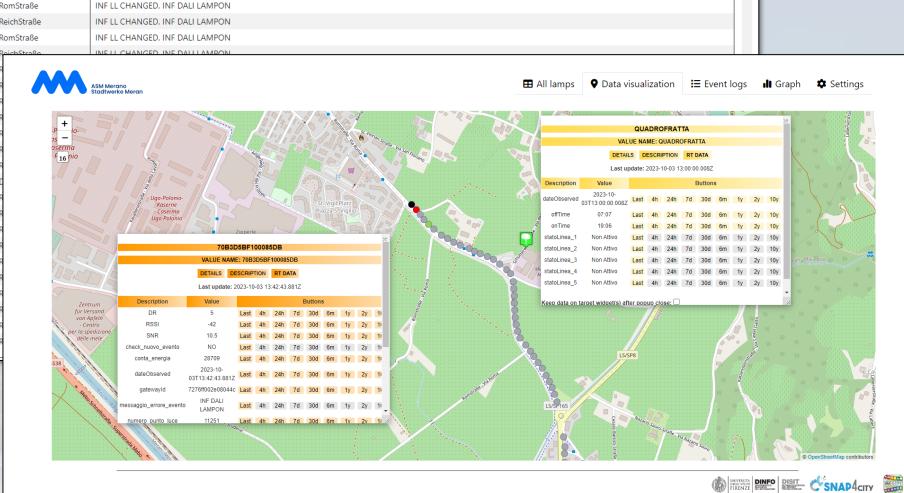
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	30/09/2023 23:42:23	22	70B3D5BF100085ED	RomStraße					
	30/09/2023 23:42:22	11261	70B3D5BF100085E2	RomStraße					
	30/09/2023 23:22:38	10974	70B3D5BF10008610	ReichStraße					
	30/09/2023 23:22:35	28	70B3D5BF100085F7	RomStraße					
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	30/09/2023 22:42:27	16416	70B3D5BF100085FC	R					
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Via

INF LL CHANGED, INF DALI LAMPON INF LL CHANGED, INF DALI LAMPON

INF LL CHANGED, INF DALI LAMPON







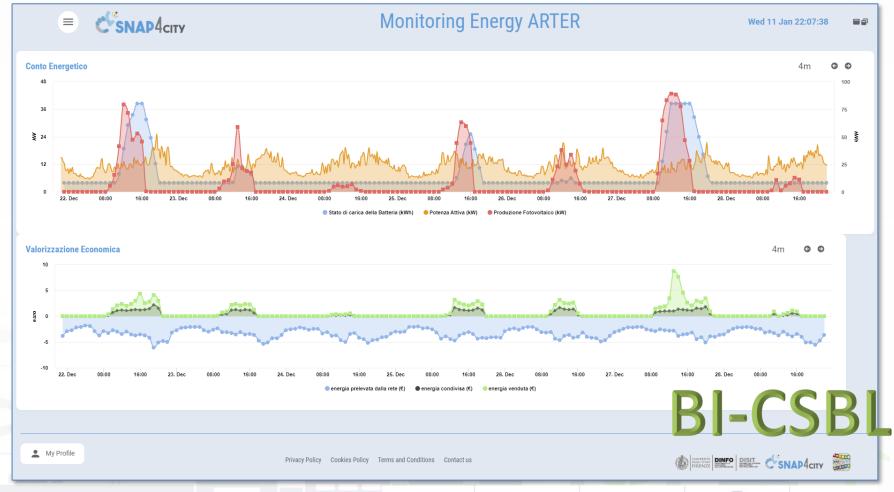








- Field-tested energy community: the selfconsumer condominium
- The Self User project creates in the pilot condominium, through the collection and analysis of data, a model for calculating and enhancing the impact of an energy community on a community of people, with a view to actions to combat energy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























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

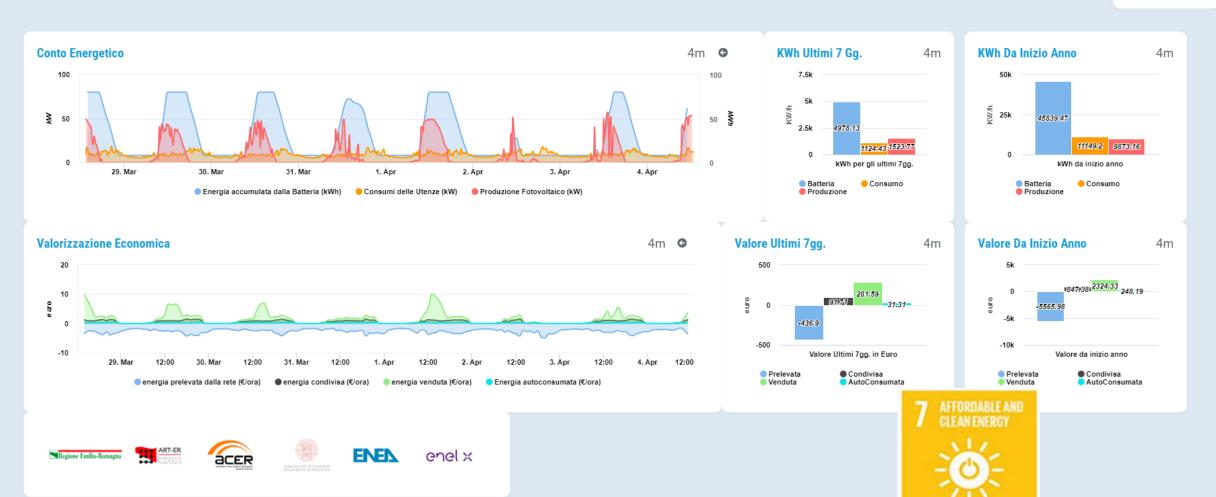


SELF USER

Monitoraggio in tempo reale della comunità energetica condominiale

Tue 4 Apr 13:20:04







- no impianto

- impianto + batteria 6 kWh





- impianto + hatteria 2 4 kWh

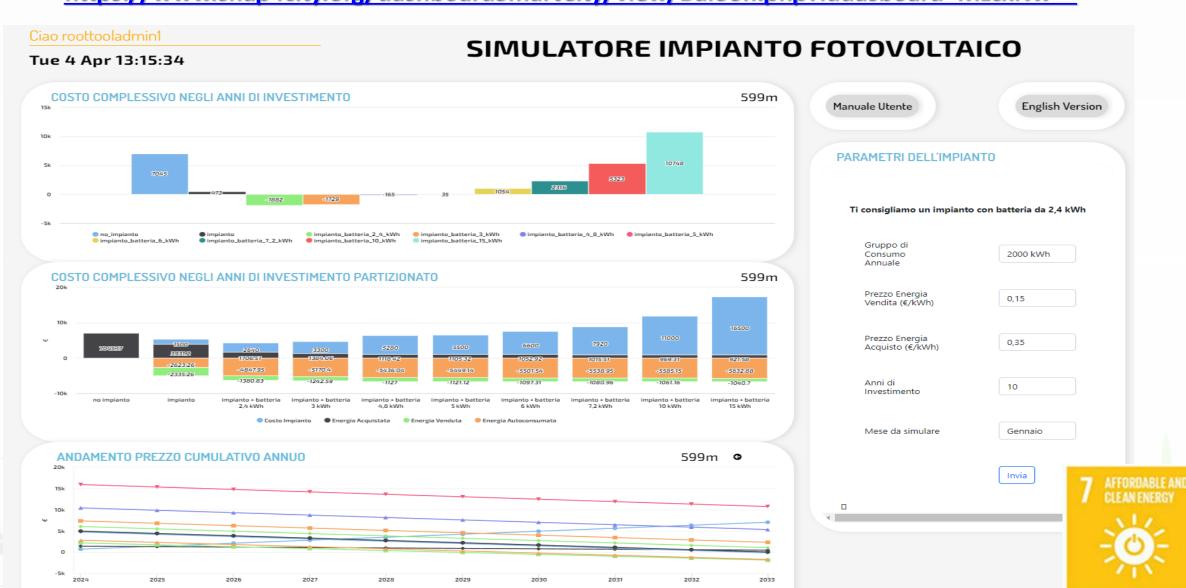
🛕 - impianto + batteria 10 kWh

A - impianto + hatteria 3 kWh

- impianto + batteria 15 kWh



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



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)

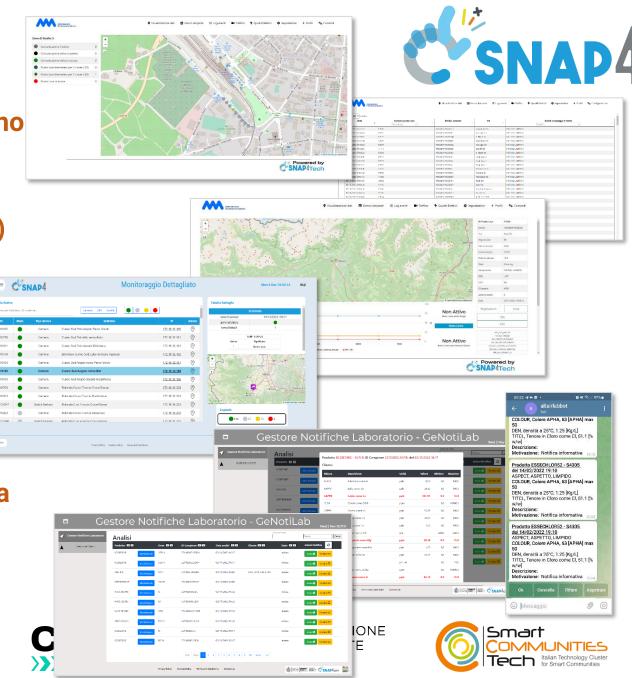
Snap4Cuneo

- Monitoraggio e controllo dei servizi
 - Videosorveglianza
 - Varchi traffico
 - Infrastruttura ICT

Snap4Altair Chimica

 Notificatore Smart per il monitoraggio della qualità della produzione













Monitoring and Tracking via Thermal Cameras AXISA





DINFO
IPARTIMENTO DI
IGEGNERIA
ELL'INFORMAZIONE

DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB





Tracking People AXIS Camera with Snap4City











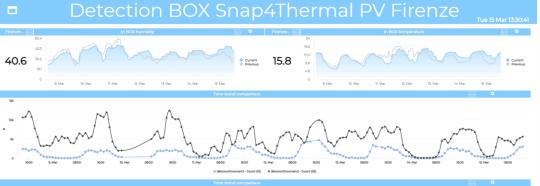








A view and data from the Thermal Camera















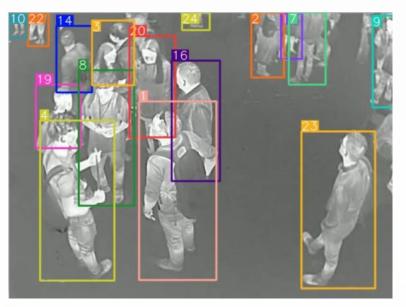


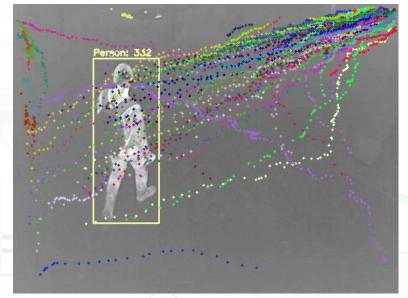


People Counting and Tracking







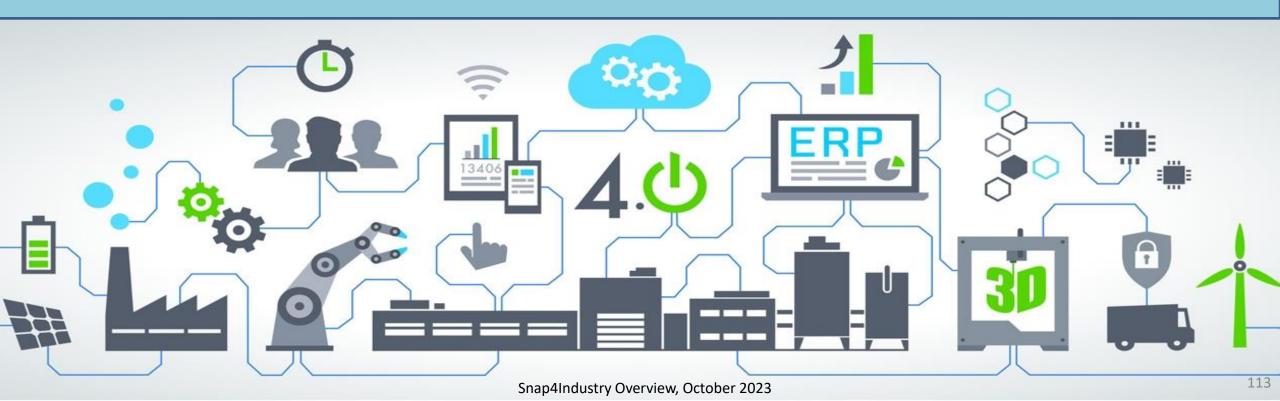








Retail Recommendations Feedback Pilot









Smart Retail

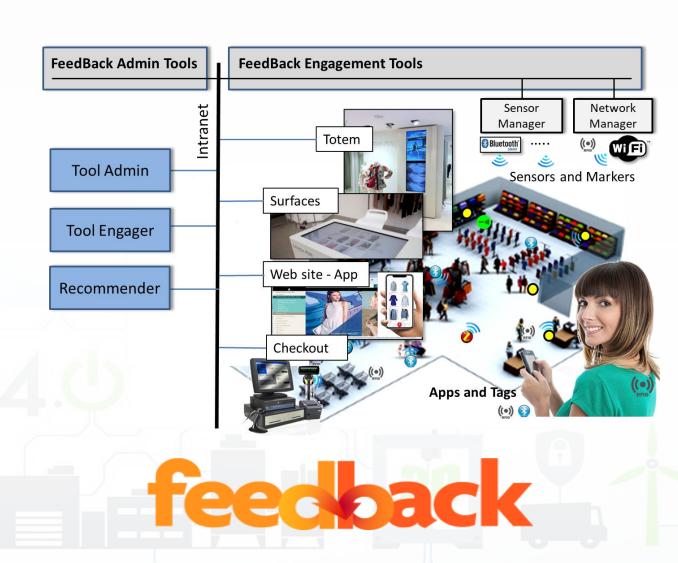


- Feedback, Flexible Advanced Engagement Exploiting User Profiles and Product/Production Knowledge
 - VAR, PatriziaPepe (Tessilform), DISIT, Effective Knowledge, SICE
 - Keywords: retail, GDO, ...

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





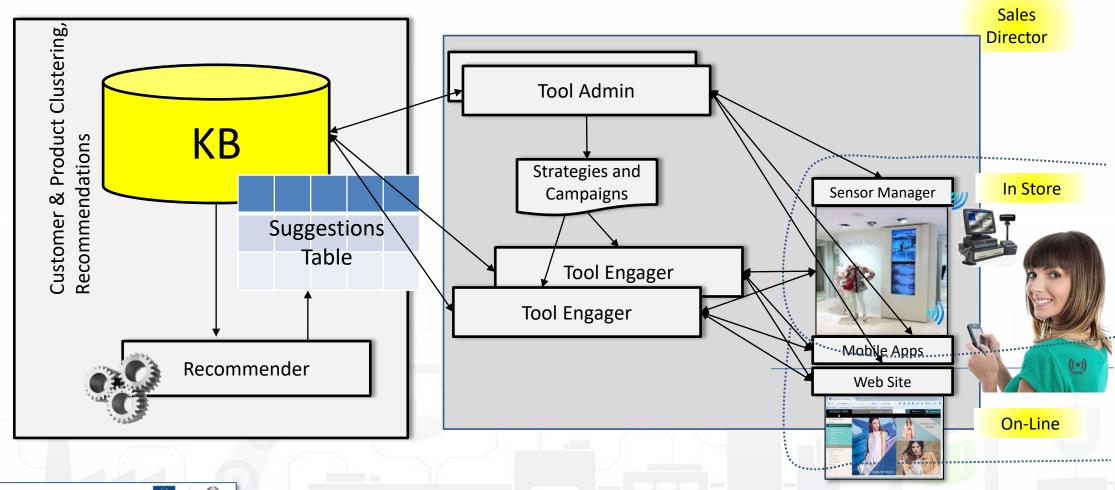








Reference Architecture







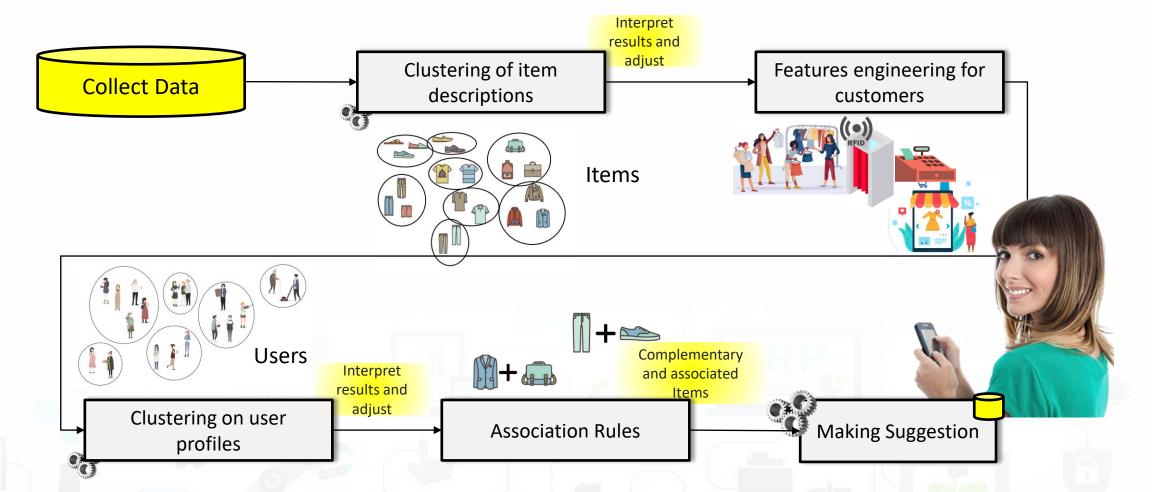








Workflow

















- 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

















SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT SNAP4INDUSTRY



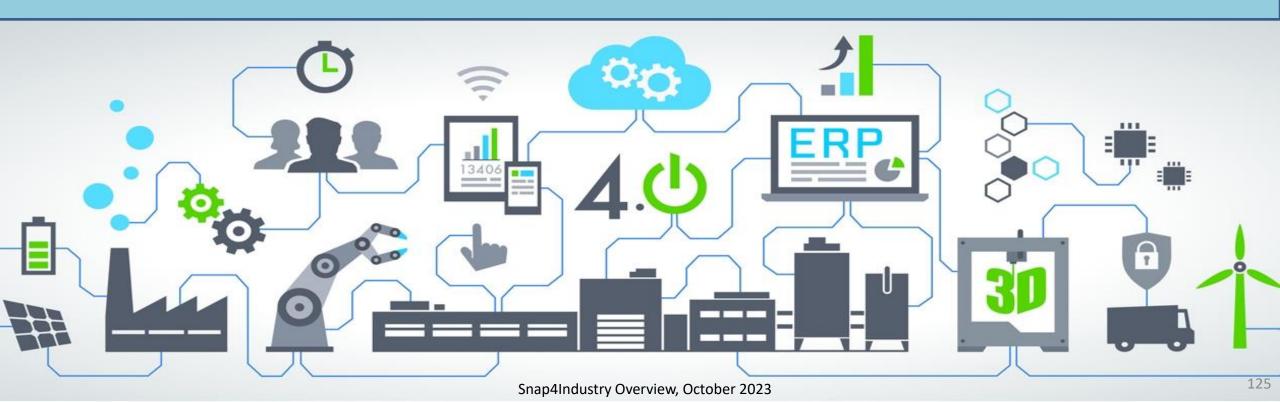


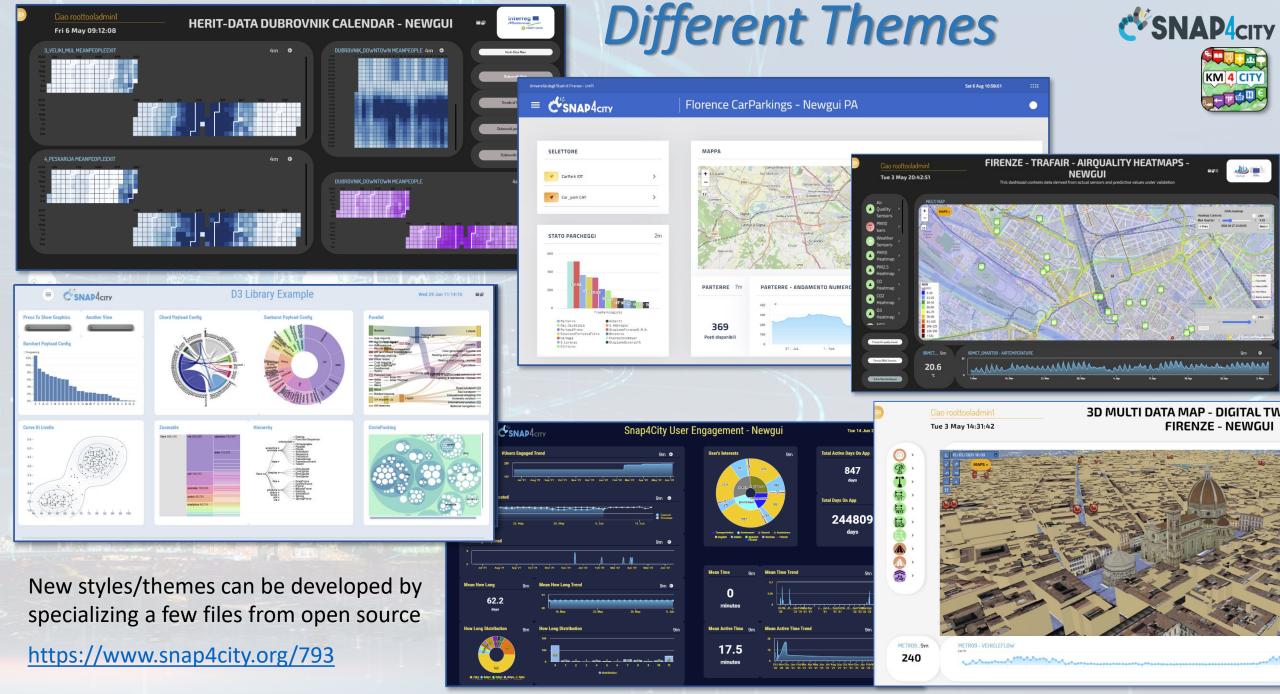






Creation of Dashboards and Applications





Snap4Industry Overview, October 2023



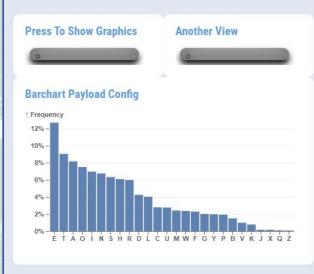
D3 Graph library capability

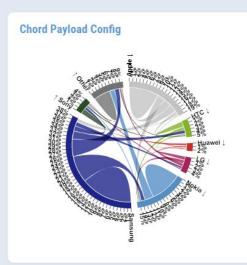


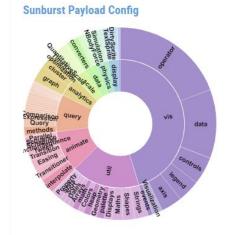


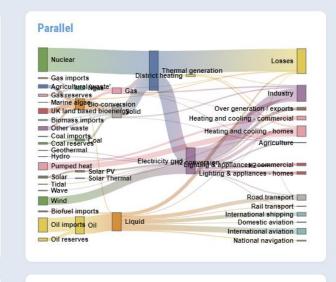
D3 Library Example

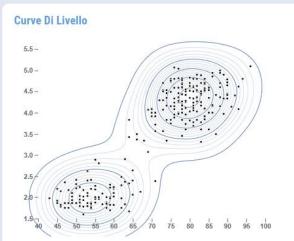


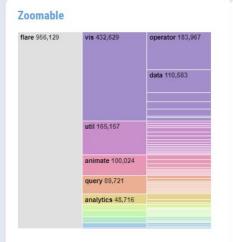


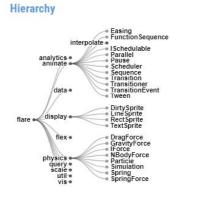


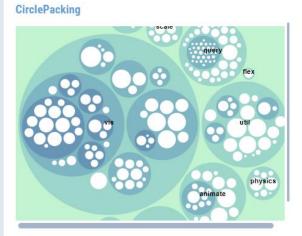












https://www.snap4city.org/dashboardSmartCity/view/Gea.php?iddasboard=MzQ4OQ==

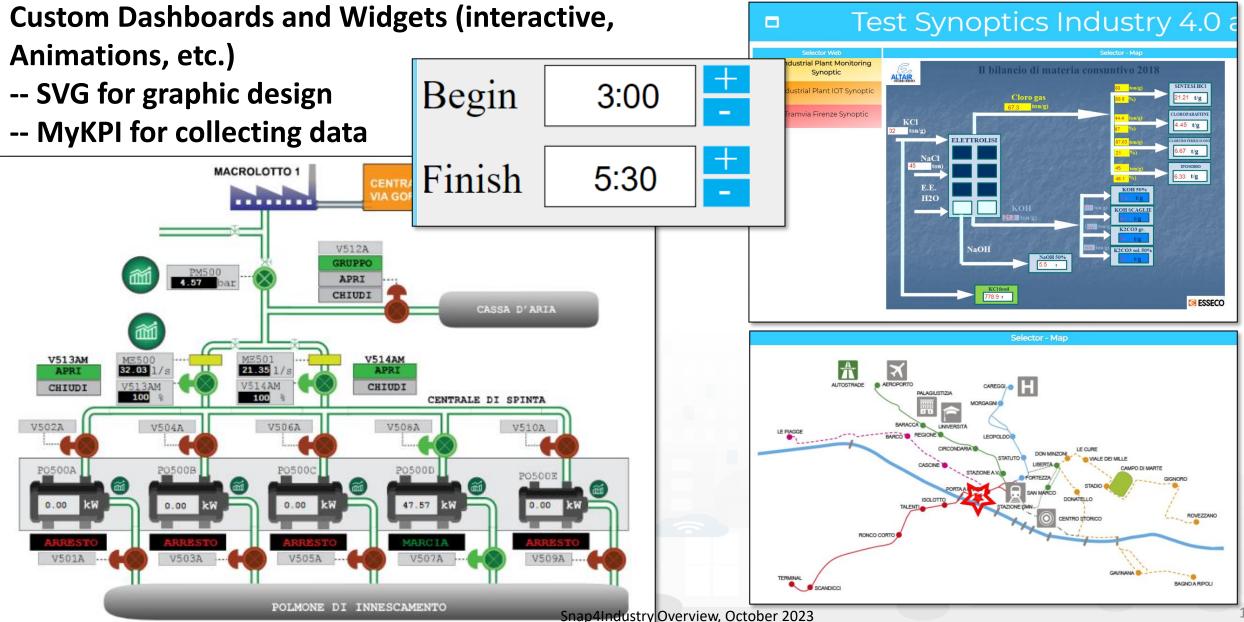




DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB CUSTOM Widgets







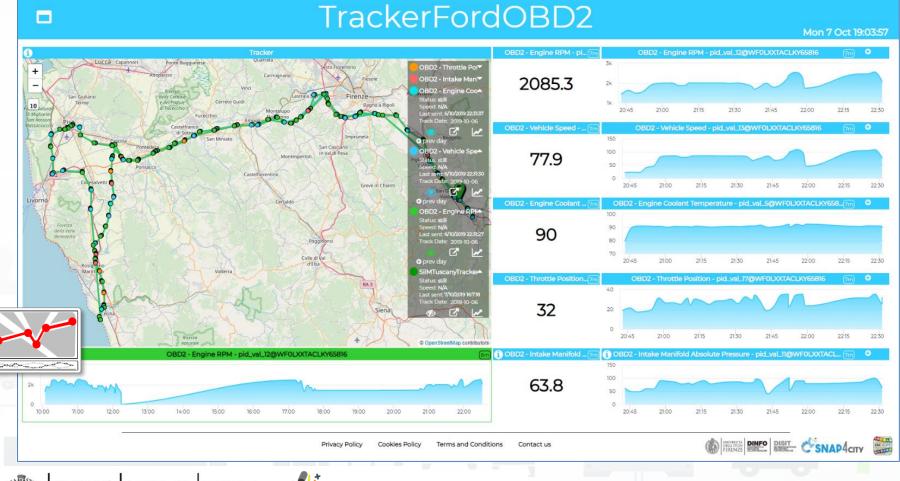




MyKPI: Tracking of Devices and Mobiles • Real Time Trajectories for

- - Mobile Phone
 - **Moving IOT Devices**
 - **OBU**, Vehicular Kits
 - Multiple tracks
 - Day by day
- Micro Application













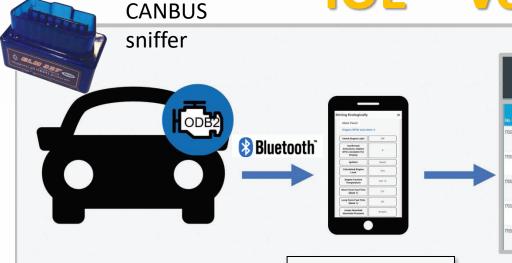








IOE – Vehicle Monitoring

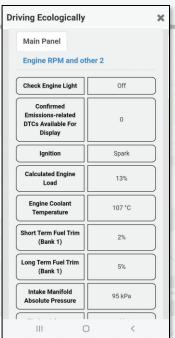


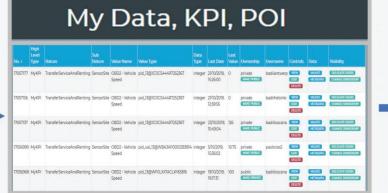
Tuscany in a **Snap Mobile**

App on **Android**

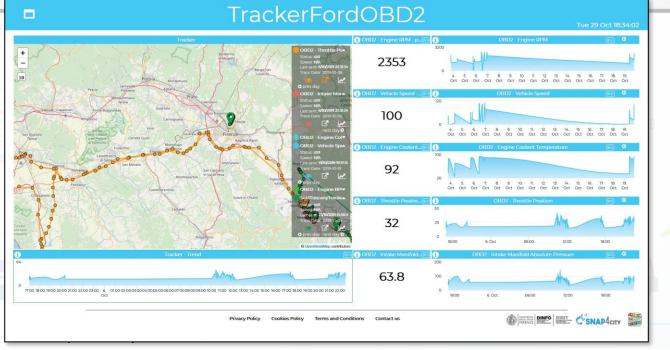




















Special Custom Widgets



- Smart Energy
- Smart Light
- Smart

Begin

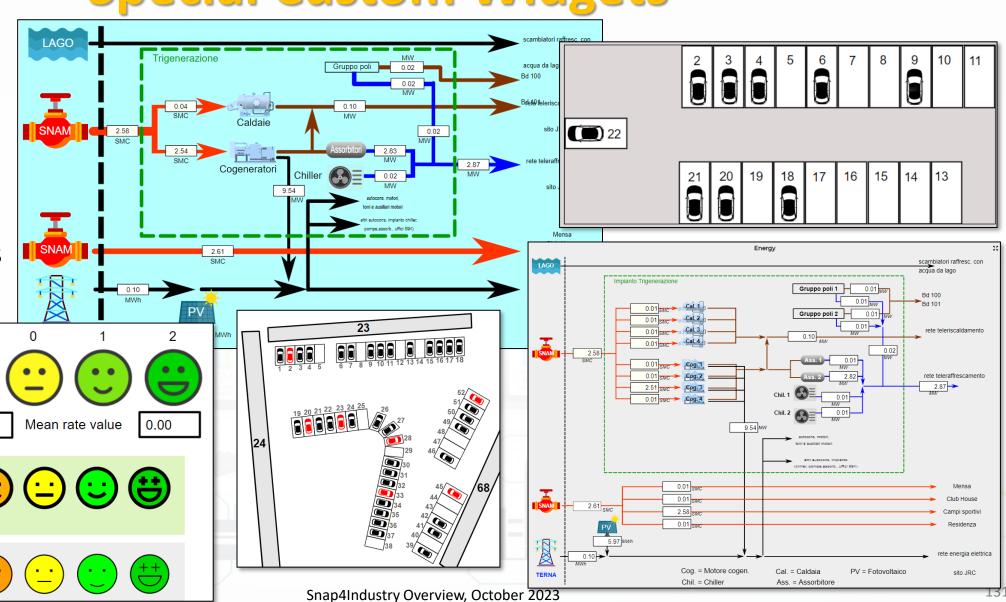
Finish

- Energy View
- Custom Controls

Total clicks

17:00

4:00





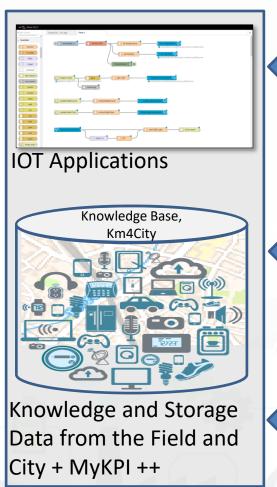




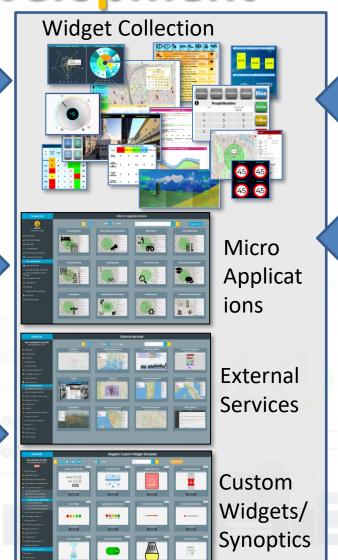




Dashboard Development









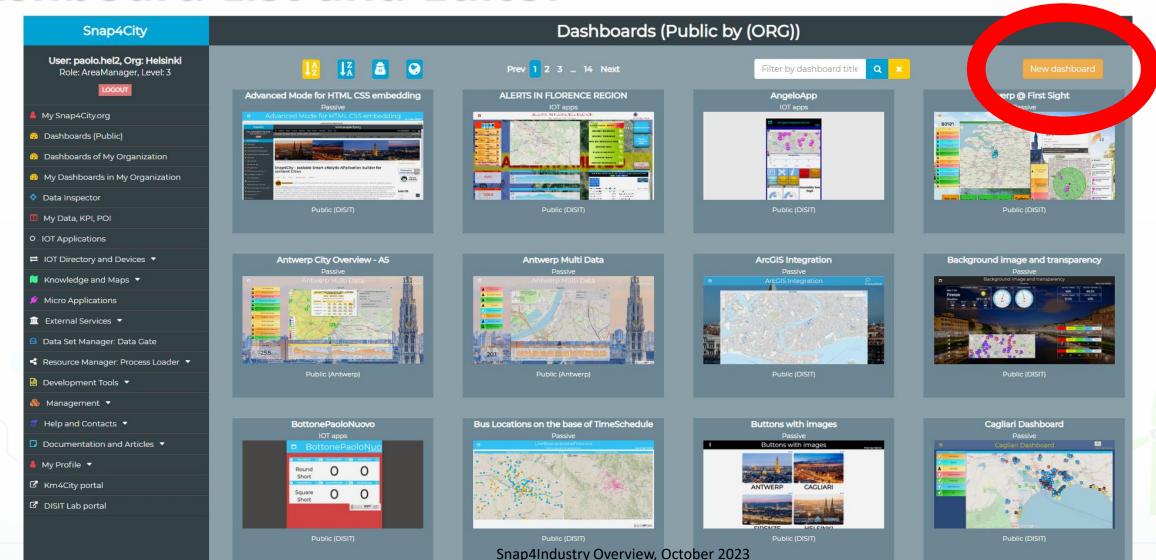








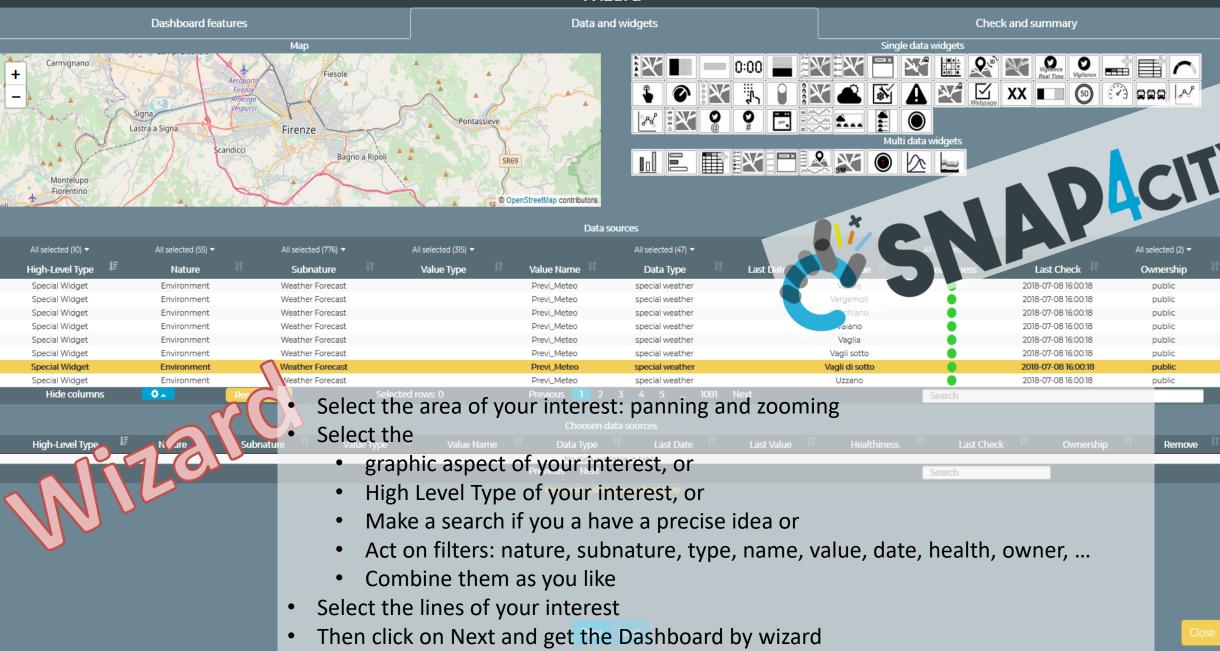
Dashboard List and Editor



Snan4City

Dashboards

Wizard





IOT Applications

Knowledge Base, Km4City

Knowledge and Storage

Data from the Field and

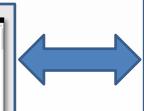
City







stom Widget / Synoptic Development
Inkscape editor on your computer



SVG Symbols Collection





Create, save a Custom Widget in SVG



Create, save, load, delegate, grant access





Public

Dashboard Collection

My Own Dash/App







- Create and Load a Custom SVG
- Select/Reuse an SVG

Dashboard Editor

- 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/v 2/synoptic.html?id=xxxx









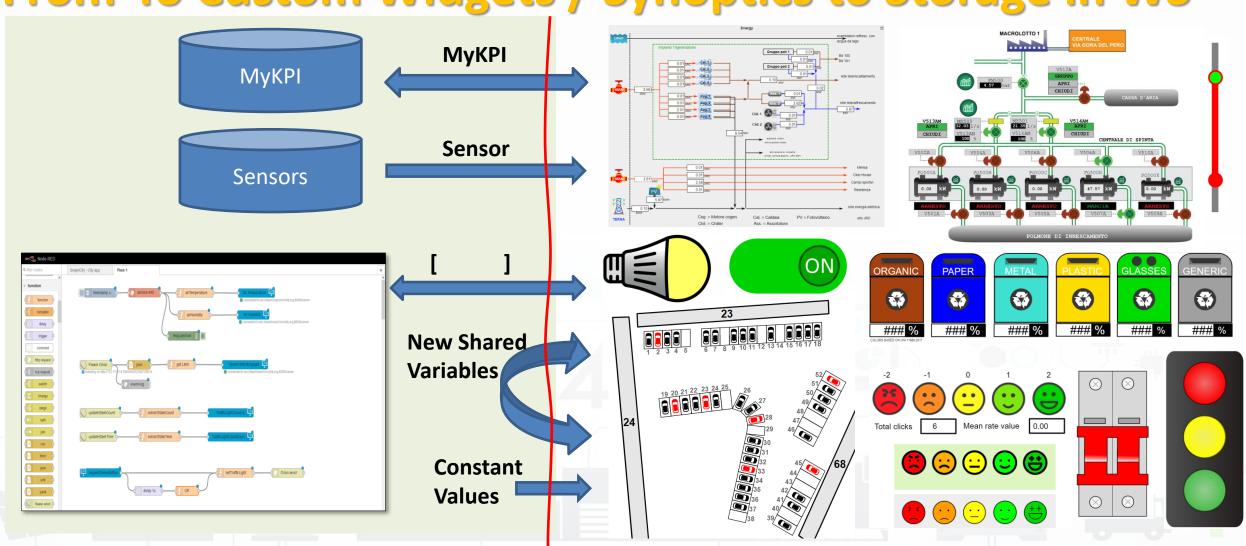








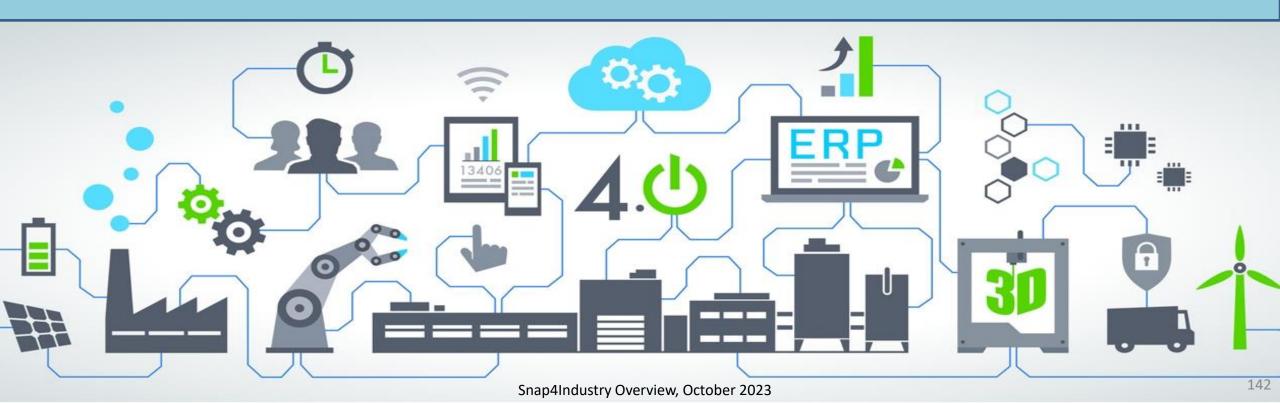
From-To Custom Widgets / Synoptics to Storage in WS







Dashboards' Intelligence on Web and Mobile Devices



Snap4City

IOT Applications

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

- Oashboards
- 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 🔻
- Management ▼
- User Management and Auditing
- □ Documentation and Articles ▼
- My Profile ▼
- ☑ Snap4City portal
- ☑ Km4City portal
- ☑ DISIT Lab portal



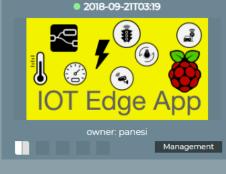
2018-10-22T11:57

Deprecated - SiiMobilityControlRoom

owner: badii

Management

Management



Prev 1 2 3 ... 9 Next







Filter

Q











IOT Discovering

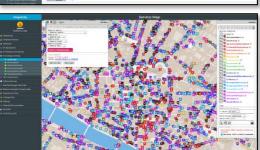




IOT Applications Development

MicroServices collections





ServiceMap Discovery



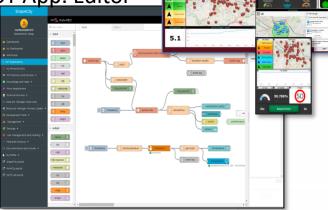






Dashboard Collection, Editor and Wizard

IOT App. Editor Generating IOT App
With Dashboard

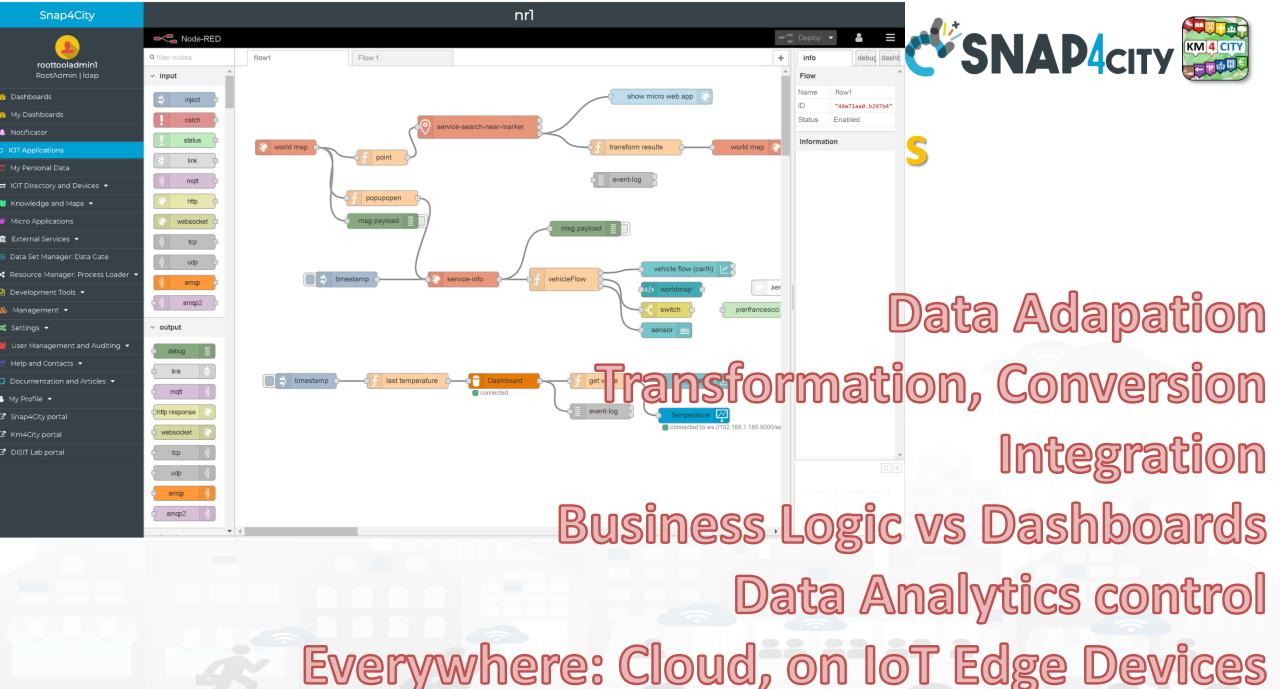


Sharing/saving reusing IOT App.



Resource Manager











- **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

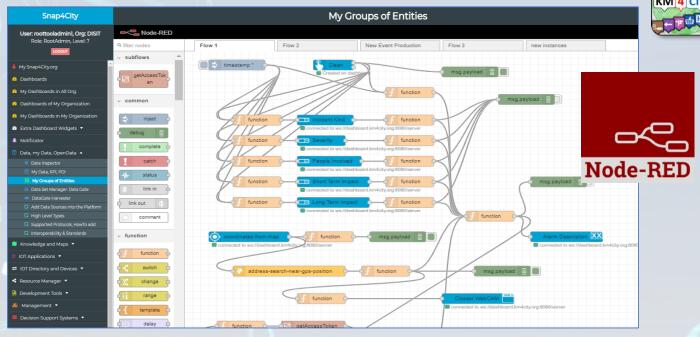


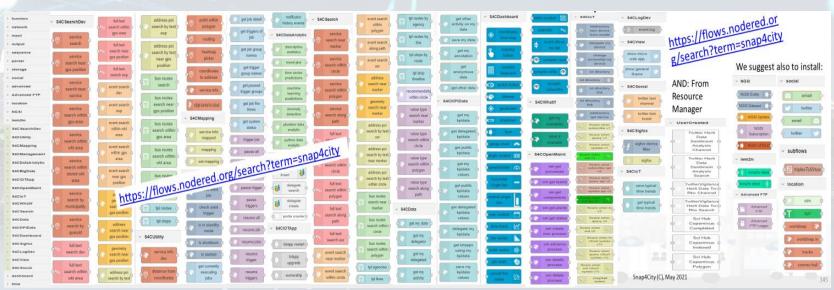






- IoT App Visual Programming, no coding
 - Data transformation
 - Integration, Interoperab.
 - Scripting Data Analytics
 - Data ingestion
 - Business logic
- Edge and Cloud
- MicroServices data driven develop via visual language Node-RED





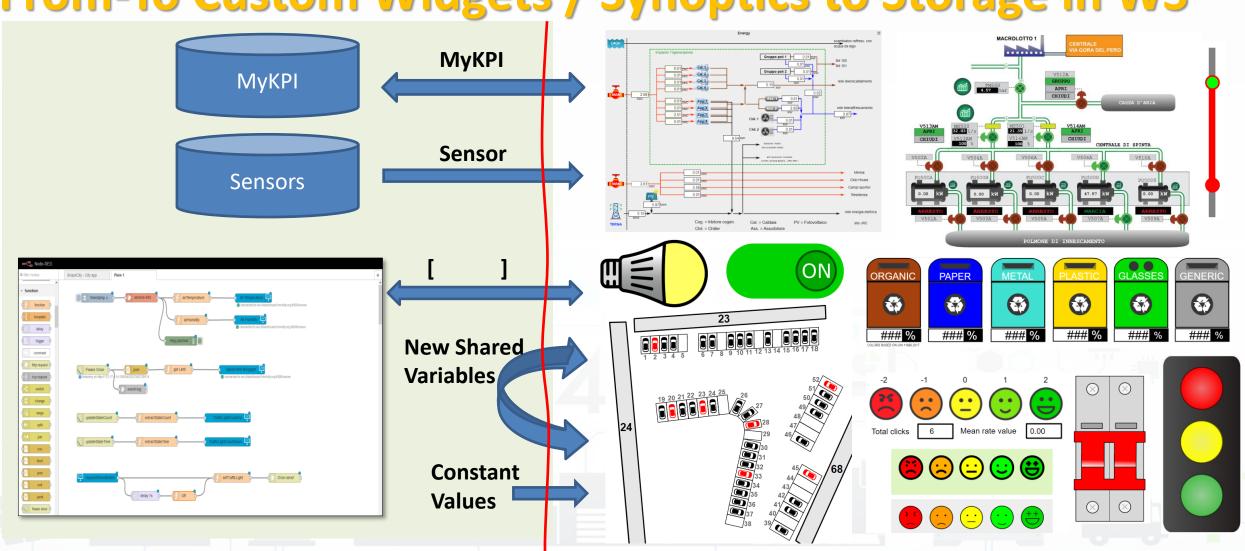








From-To Custom Widgets / Synoptics to Storage in WS



Standards and Interoperability (6/2023)

SNAP4city

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!

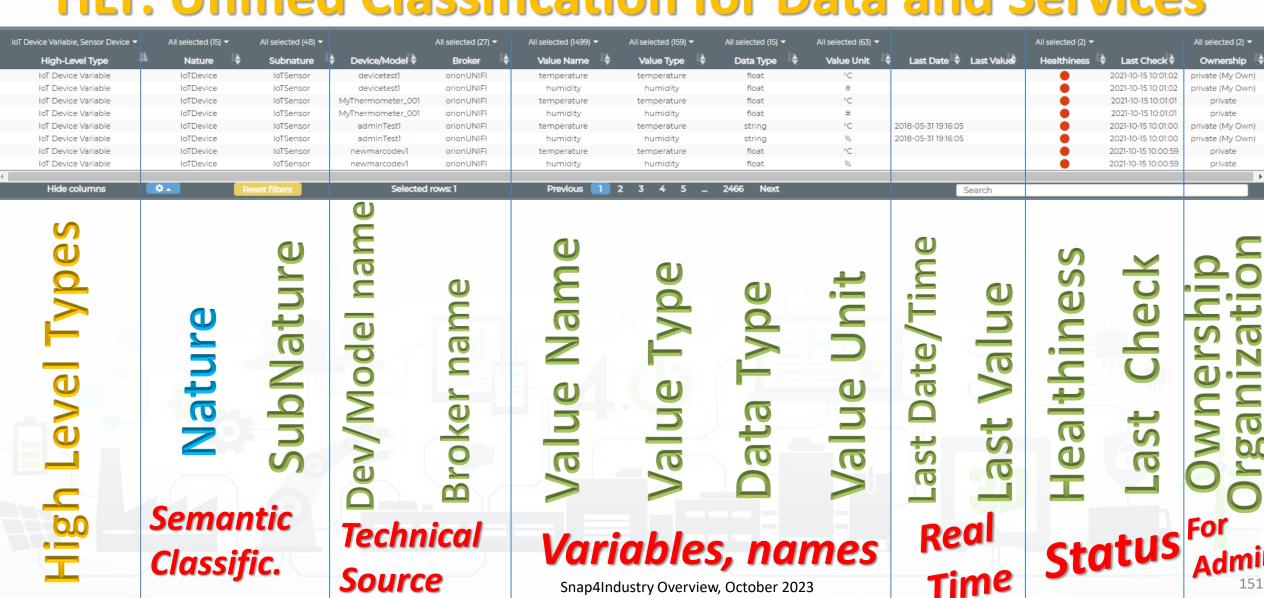








HLT: Unified Classification for Data and Services

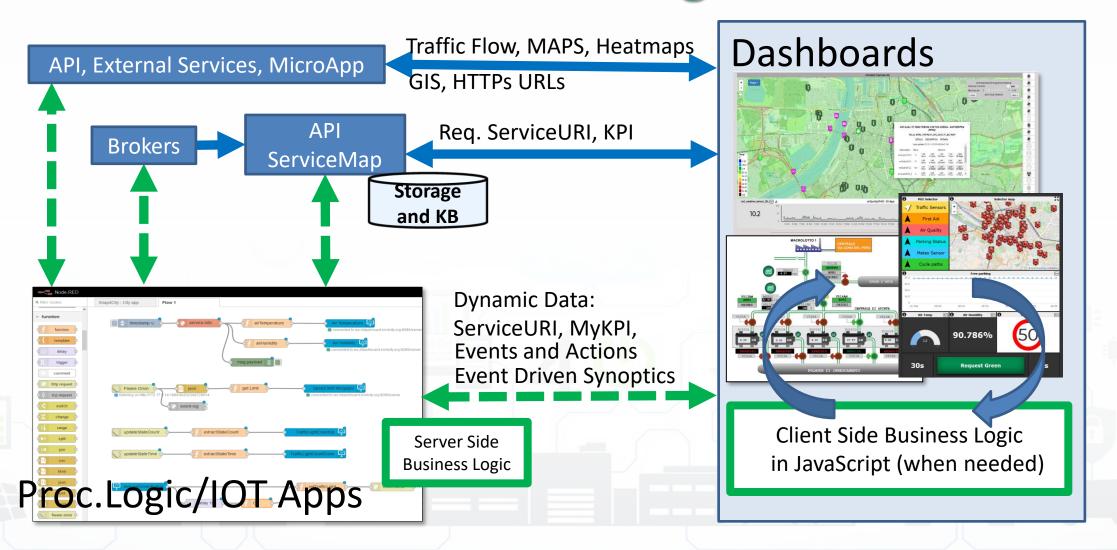








How the Dashboards exchange data













How the Dashboards exchange data (2022)

Snap4City BigData Storage and KB

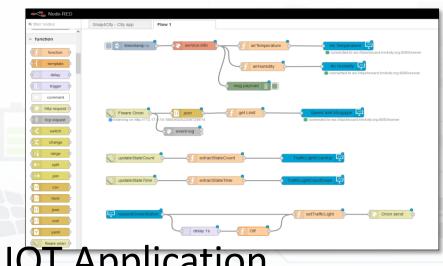
IOT Broker Orion Quantum Leap

ServiceMap Super ServiceMap

Metric, KPI

MyKPI, MyPOI, ...

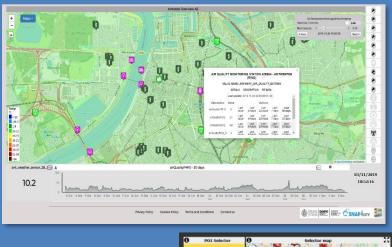
API, External Services, MicroApp



Req. ServiceURI

- Req. KPI, Metric ID
- Req. MyKPI ID
- Traffic Flow, MAPS, Heatmaps
 - GIS, HTTPs URLs
 - ServiceURI (ID)
 - MyKPI, Metric (ID)
 - Dynamic Data, computed into IOT Application
 - Rx. Dynamic Data
 - **Event Driven Synoptics**
 - Actions, Show

Dashboards











UNIVERSITÀ DEGLI STUDI FIRENZE DIPARTIMENTO DI DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB DYNAMIC (4/22) CSNAP4CITY Node PED



MINE								Node-RE
/idgets ICONS	Widget Name, Description	IOT App	Dashboard-IOT App	KPI (metric)	MyPersonalD ata	MyDa ta	My KPI	Sensor
XX	Single Content Single content	X (cs)	X (DD)	X	X	X	Χ	Χ
50	Speed Limit (see custom widget for more)			Χ				Χ
(3)	Speedometer speedometer 4	X (cs)	X (DD)	X	X	Χ	Χ	Χ
	Gauge chart 🔼	X (cs)	X (DD)	Χ	X	Χ	Χ	Χ
	Single Bar, V/H	X	X (DD)	Χ				
	Single and Multiple Bars, stacked or not, ordered Bar series Bar series	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) time trend	X	X (DD)	Χ	Χ	Χ	Χ	Χ
XX XX XX XX XX XX XX X	Time Trend Compare			X			Χ	Χ
	SpiderNet, radar, Kiviat radar series	X (cs)	X (DD)	Χ	Χ	Χ	Χ	X
	Pie, Donut, 2 layers Donut	X (cs)	X (DD)	Χ	X	Х	Χ	X
	Table table content	X (cs)	X (DD)	X	X	Х	Χ	X
Thin:	Calendar Cal	X (cs)	X (DD)				Χ	X
	Speak Synthesis Speek Synthesis	X (cs)	X (DD)				string	strin
	Maps Gashboard - Selector - Map Selector - Map	X (cs)	X (DD)	Many Hig	h Level Types		X	Χ









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)



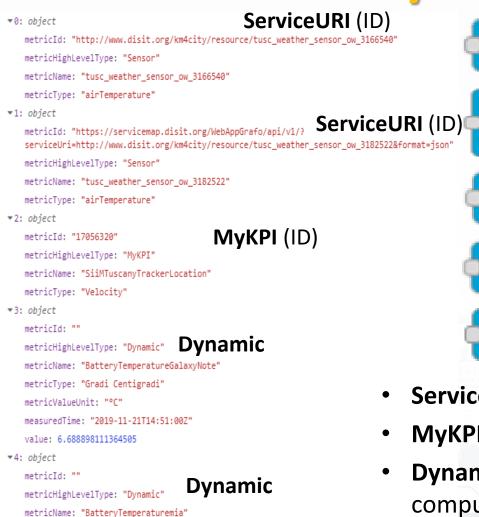






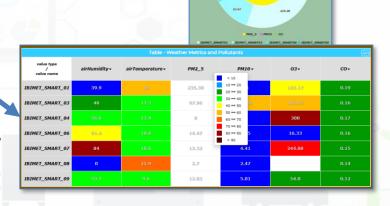
100% of Dynamic VECTs

ynamic Widget data



Bar series curved line series radar series pie chart table content

- 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

metricType: "Gradi Centigradi" metricValueUnit: "°C"

measuredTime: "2019-11-21T14:51:00Z"



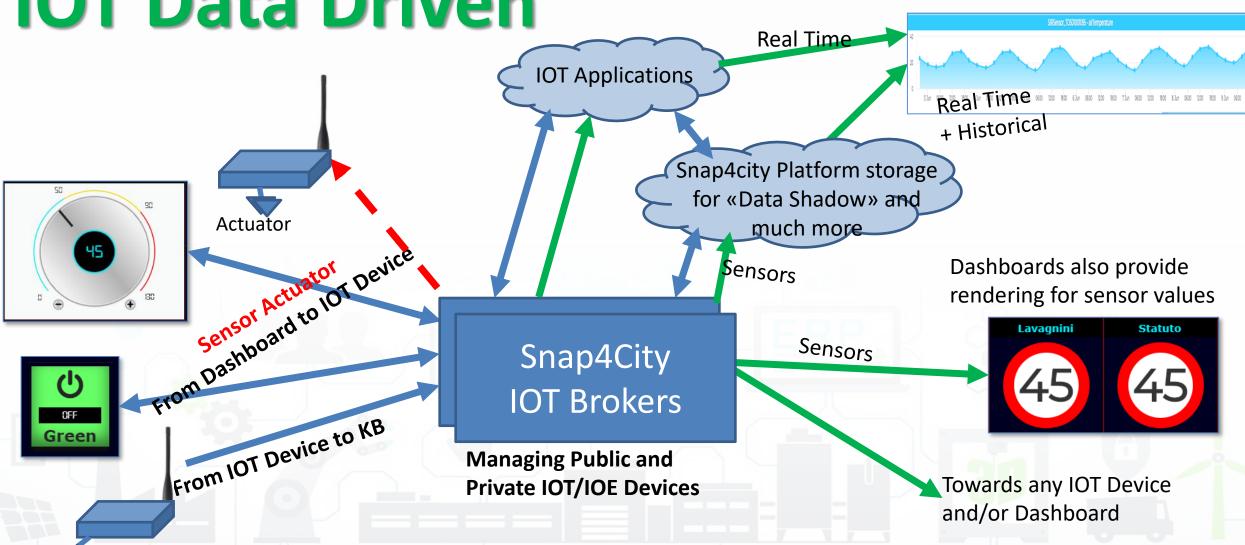
Sensors







IOT Data Driven









Nature



Dashboard-IOT App













BLINKING YELLOW	▼

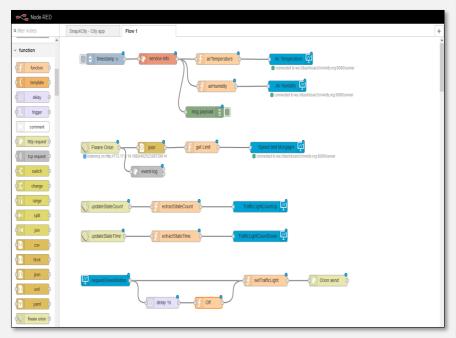


MapClick

MyKPI variable onchange

Synoptics

From Dashboard to IOT App



IOT Application

switch button

dimmer

geolocator

dropdown

form

coordinates

from map

event driven my kpi

synoptic read

synoptic subscribe

100



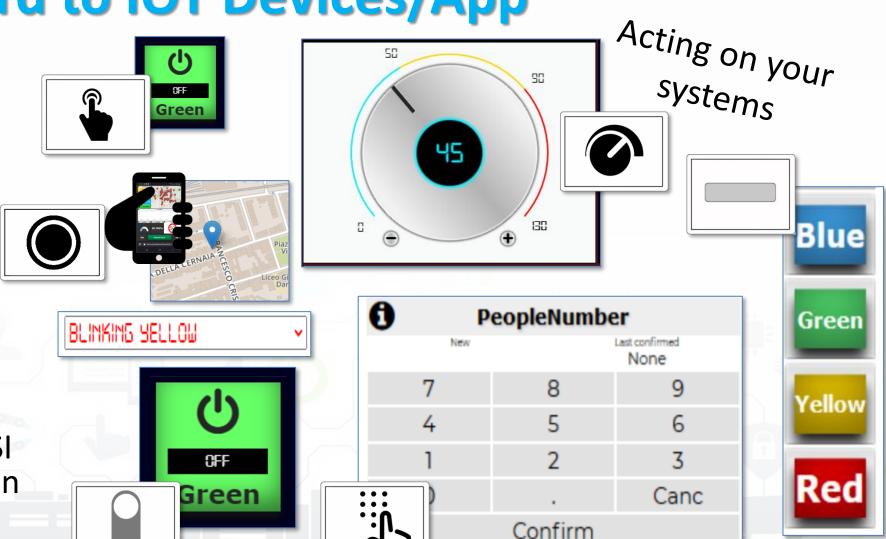






From Dashboard to IOT Devices/App

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











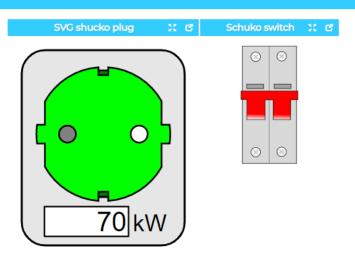


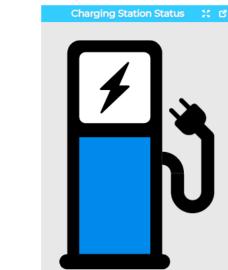
SVG Custom Widgets Examples 2

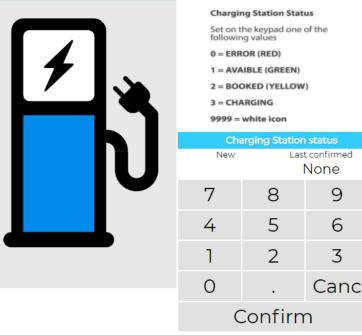
Legenda

Tue 17 Nov 18:46:47

Traffic Light

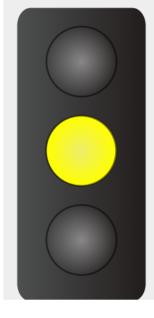












	Speed Limit Set					
New	Last confirmed None					
7	8	9				
4	5	6				
1	2	3				
0		Canc				
Confirm						



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/i ndex.php?iddasboard=Mjk4Ng==















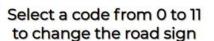




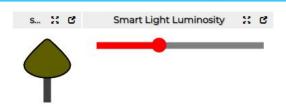
SVG Custom Widgets Examples

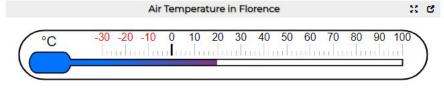
Sat 19 Dec 00:10:12



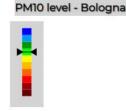


New	Last confirmed None			
7	8	9		
4	5	6		
1	2	3		
0		Canc		
Confirm				





Fan velocity

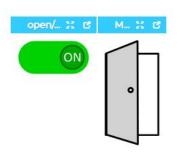








Symbols Legenda







Terms and Conditions









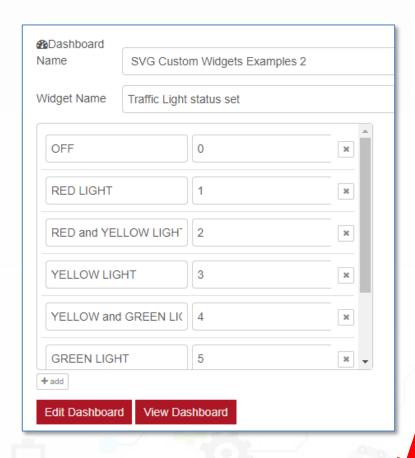






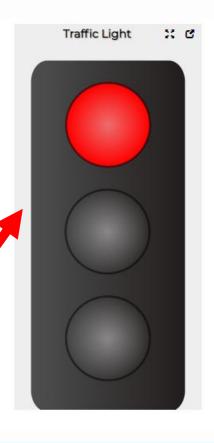
Selector







Selecting
 MSG to be
 sent on the
 Business
 Logic IOT
 Application



Traffic Light status set

RED LIGHT

Traffic Light status set

function

Traffic Light status

Connected to ws://dashboard.km4city.org:8080/server

Value Written!

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







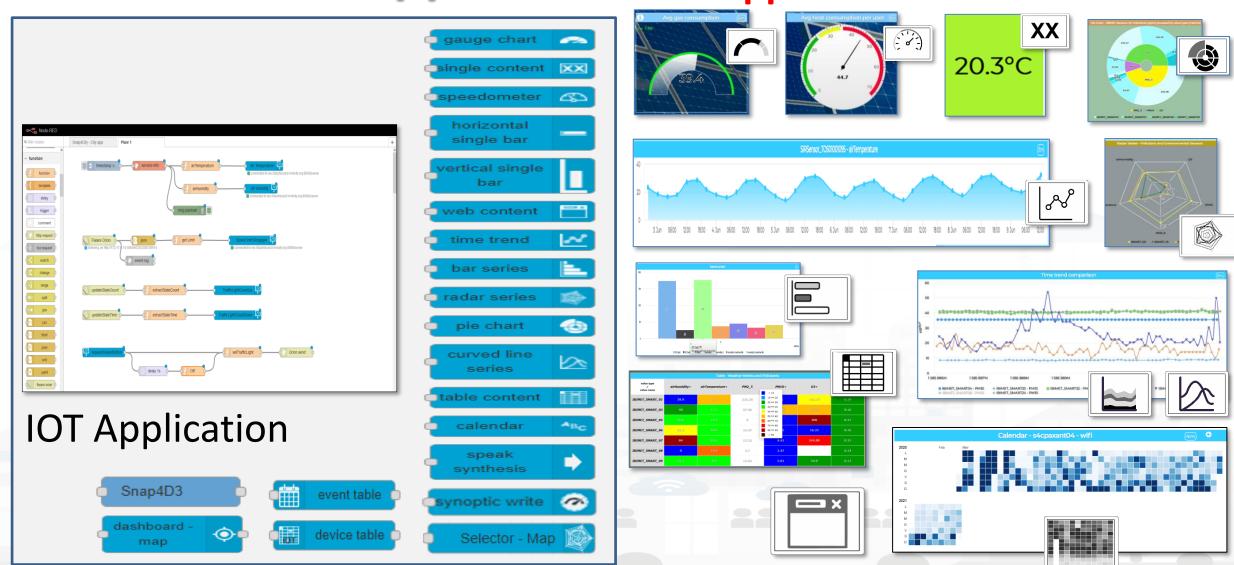
Nature





Dashboard-IOT App

From IOT App to Dashboard









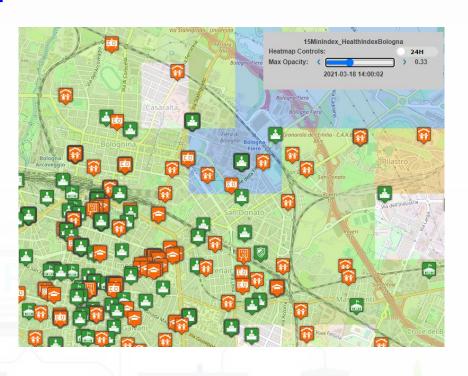
Selector Map





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

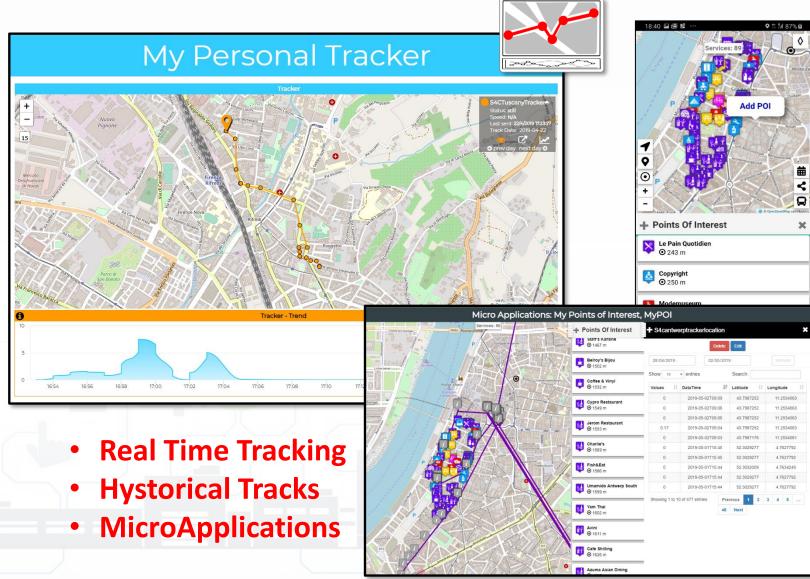






Trajectories

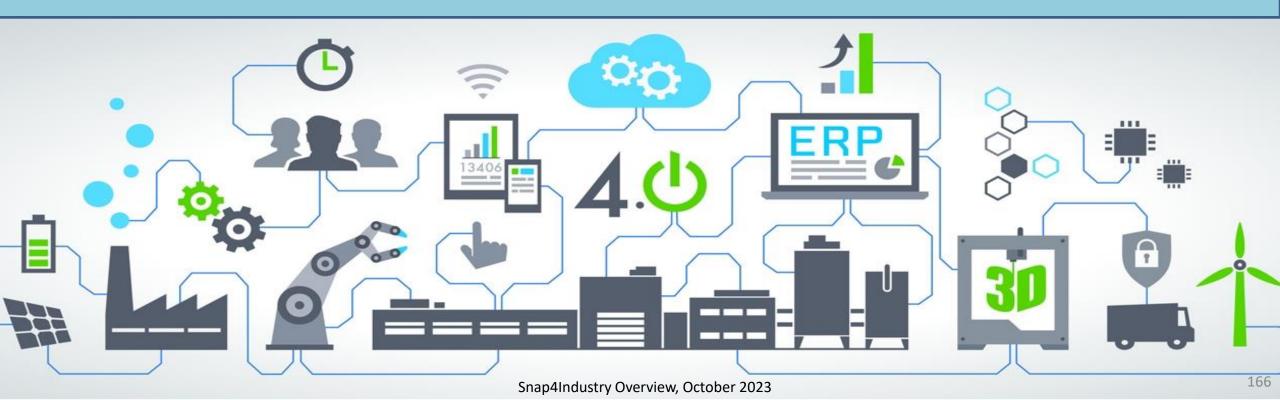
- Variables,
 Sensor/sensoractuator, :
 - Mobile Device
 Variable, Data Table
 Variable,
 Dashboard-IOT App:
 messages from GUI
 to Business Logic on
 IoT App
- MyKPI: dynamic GPS, info, single variable, Time Series, (Classification)







IoT Devices and IoT Apps







IOT Network Manager vs Final User Network of IOT Brokers IOT Directory



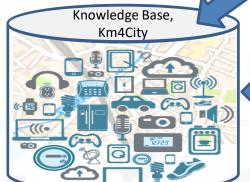
Discovering







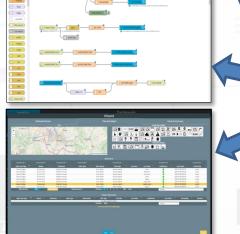
Registering



Browsing

ServiceMap **Knowledge Base**

Discovering



Dashboard Wizard

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

Final user

Manager









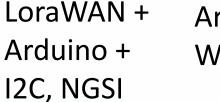


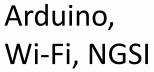






IOT Devices





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



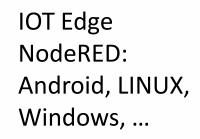
Snap4All PAX Counter LoraWAN WIFI, NGSI, GPS

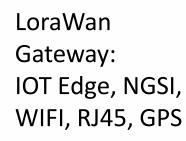
Sensors/ **Actuators**

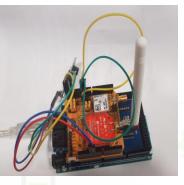


IOT Edge Devices

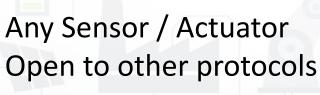
IOT Edge NodeRED: Raspberry Pi, NGSI, WiFi, RJ45,..





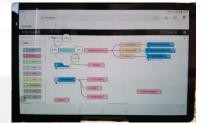
















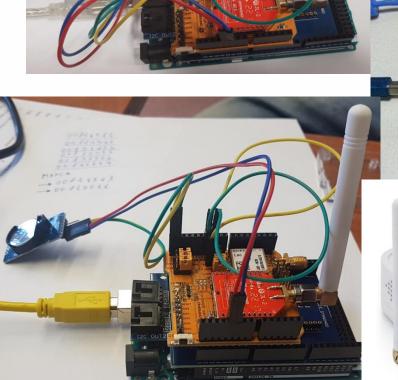


Lora IOT Device, Arduino

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

















IOT Edge Snap4All App for Android

- Android, any version, App from: https://www.snap4city.org/download/vi deo/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**











TOP

Moving IOT Devices / Sensors, Tracking Devices

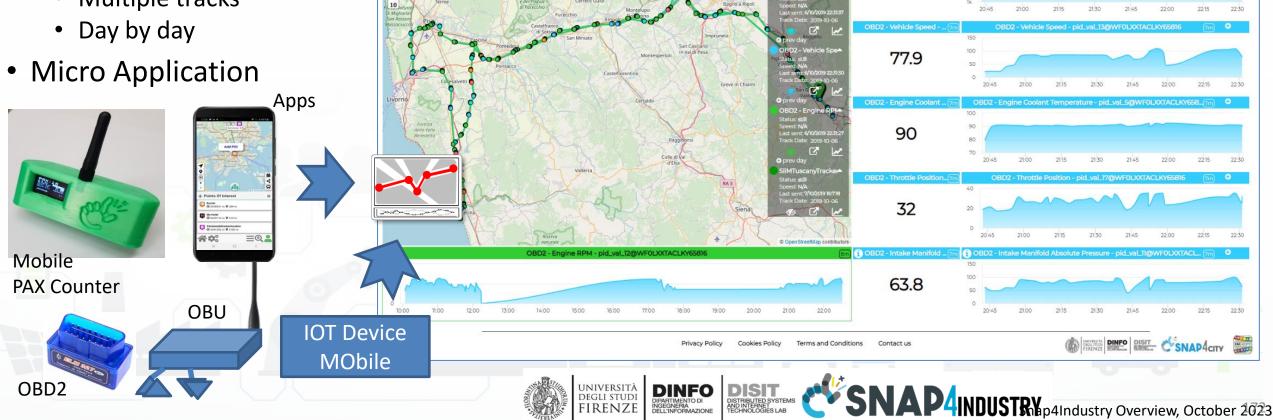






MyKPI: Tracking of Devices and Mobiles • Real Time Trajectories for

- - Mobile Phone
 - **Moving IOT Devices**
 - **OBU**, Vehicular Kits
 - Multiple tracks



TrackerFordOBD2

2085.3

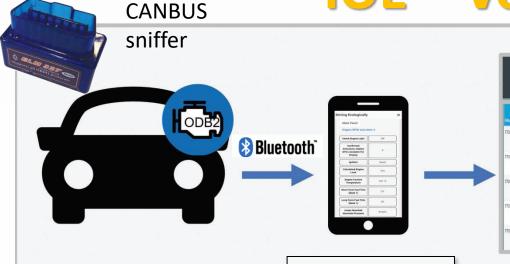








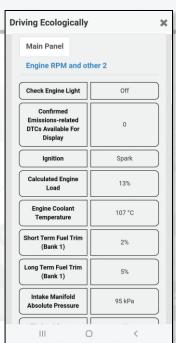
IOE – Vehicle Monitoring

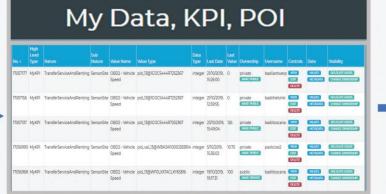


Tuscany in a **Snap Mobile** App on **Android**

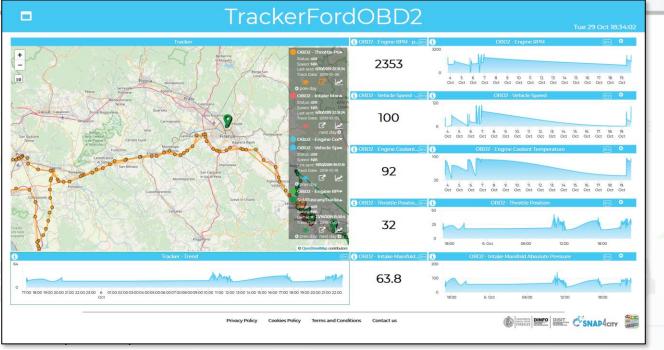










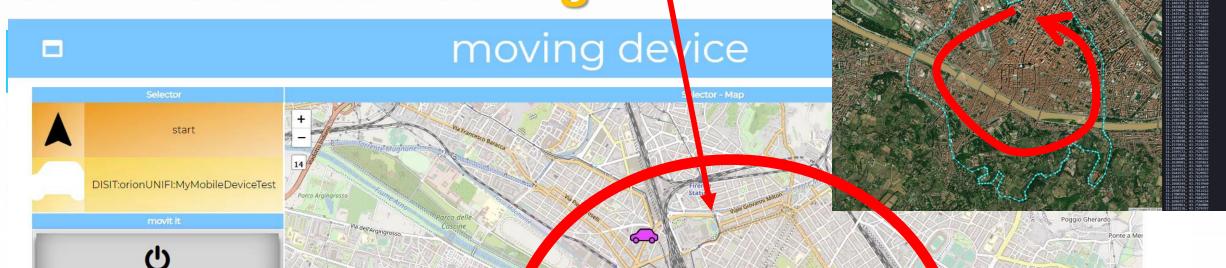




movit it







Start

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

Moving and changing Dynamic Pslandustry Overview, October-2023







TOP

Managing IOT Applications





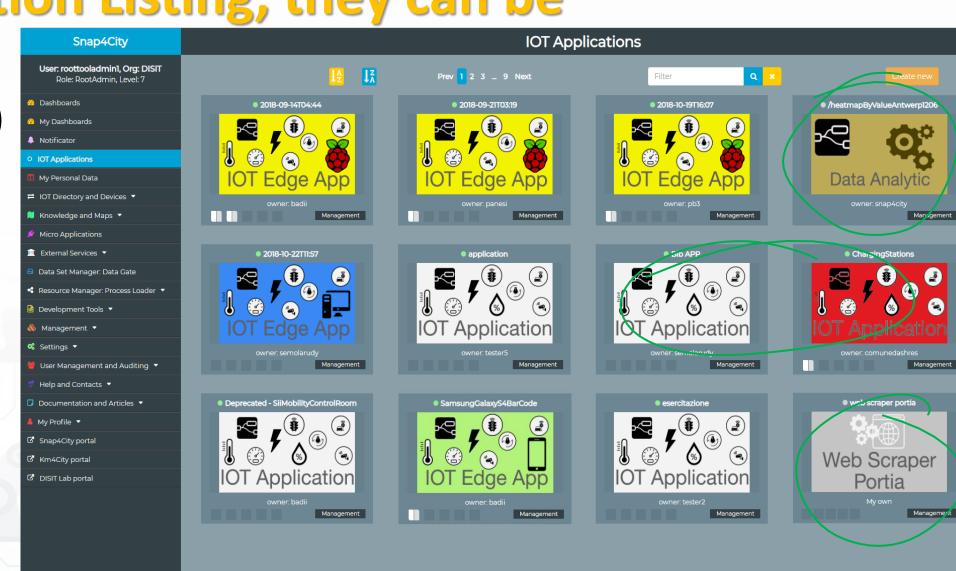






IOT Application Listing, they can be

- 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

Localhost

Localhost

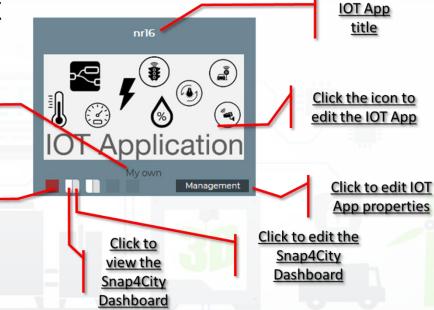
Localhost

Owner: badii

On IOT Edge Win/Linux



VIEW



Ownership of

the IOT App

Click to open

the Node-RED

IOT App

dashboard

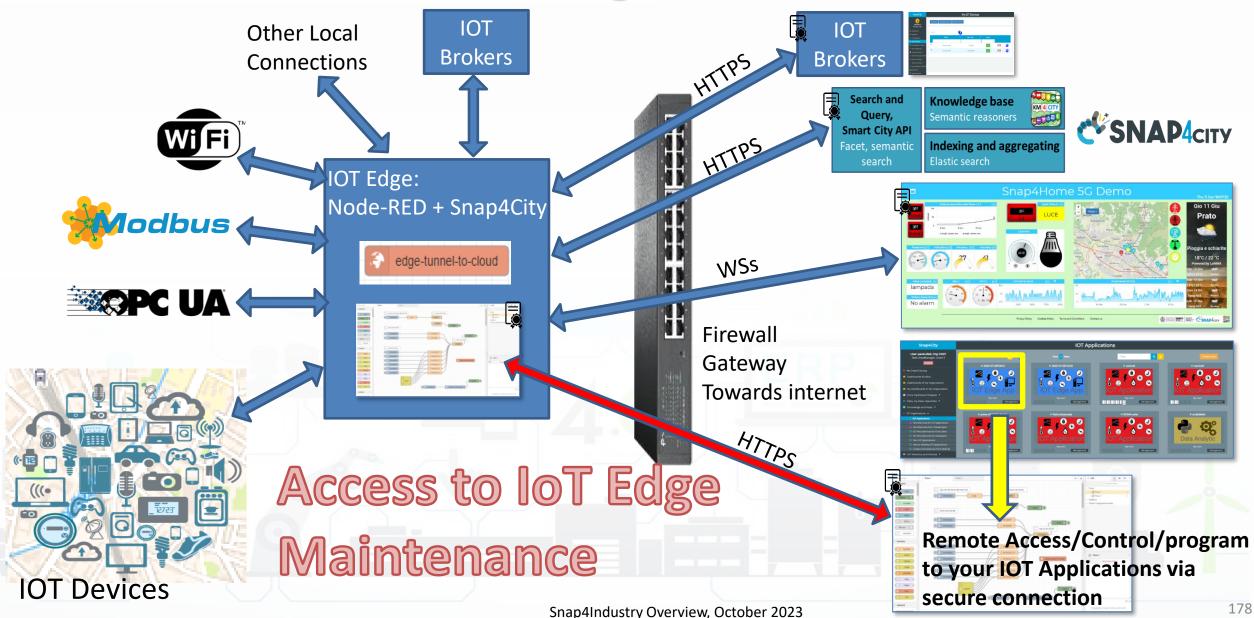






IOT Edge Device









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



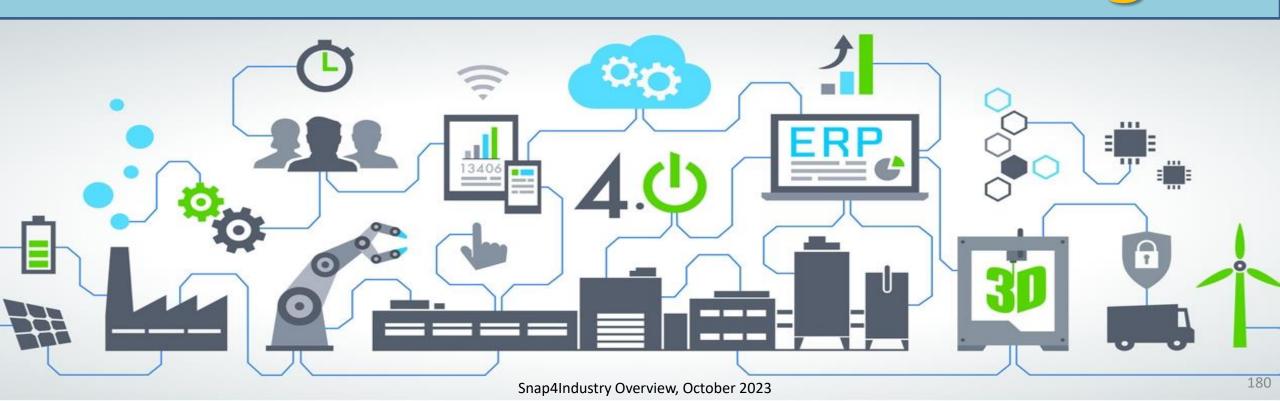
- 3. Configure the block with your credentials
- 4. Deploy of the IOT App
- 5. Go in the list of Your IOT Applications on Snap4City.org or other cloud or on premise installations
- 6. Identify the IOT Edge IOT App and click on it to open the view on the IOT Applications flows







Secure IOT Devices, IOT Edge Sensor and Dev Networking



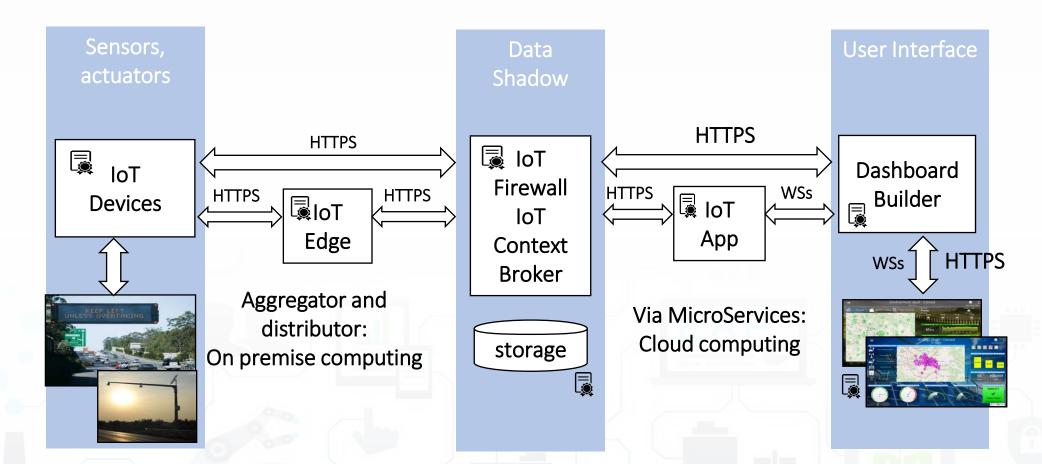






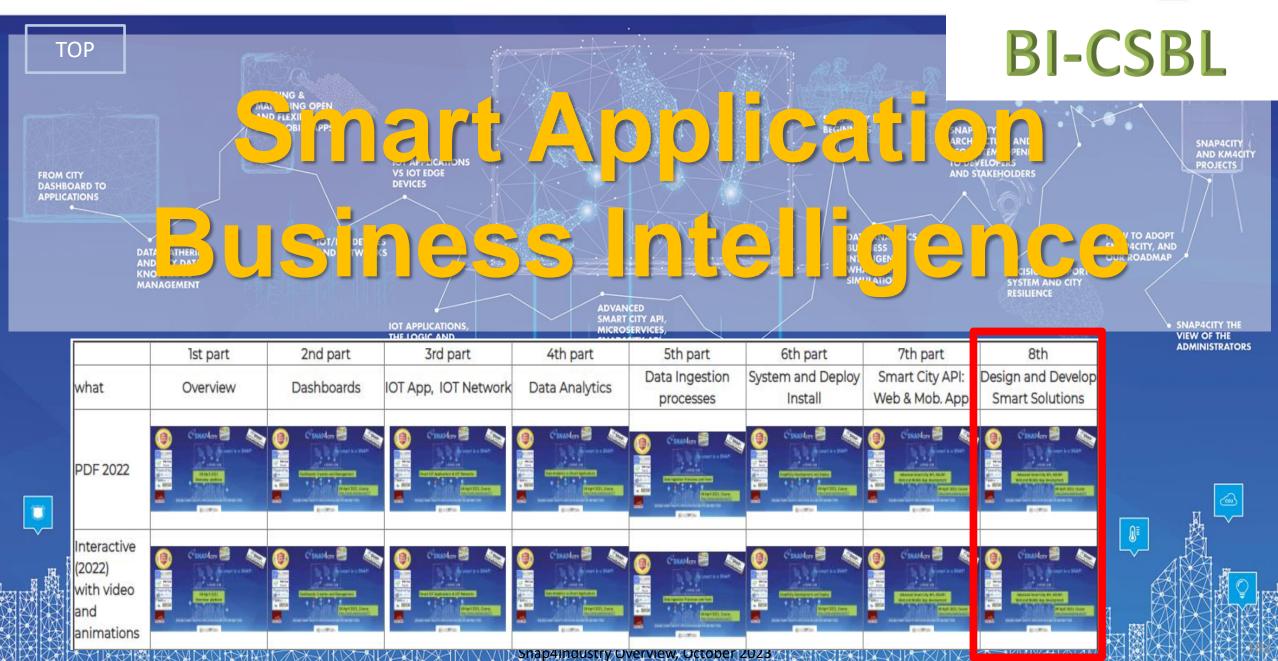


The secure stack



SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES



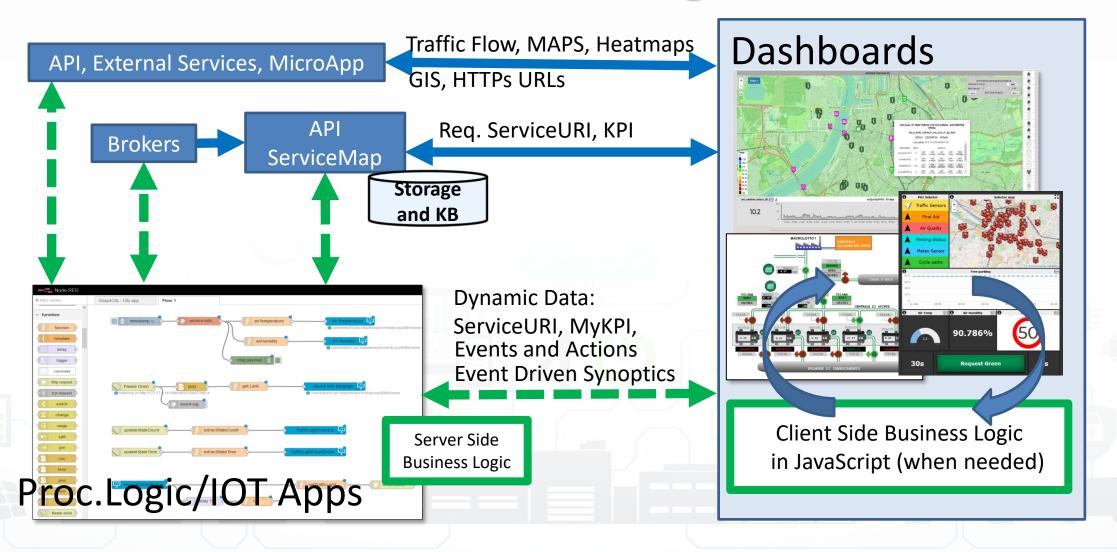








How the Dashboards exchange data





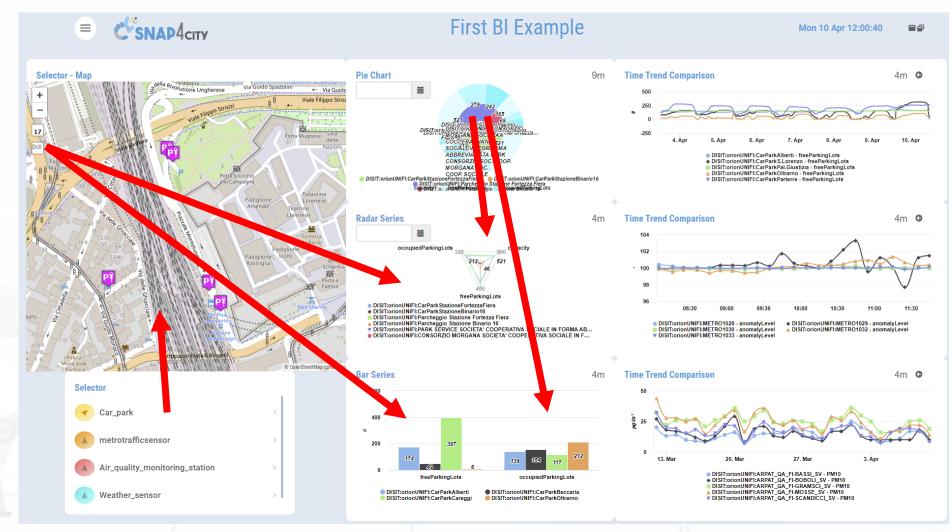






Example: From Map to Graphs (spatial drill down)

- 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





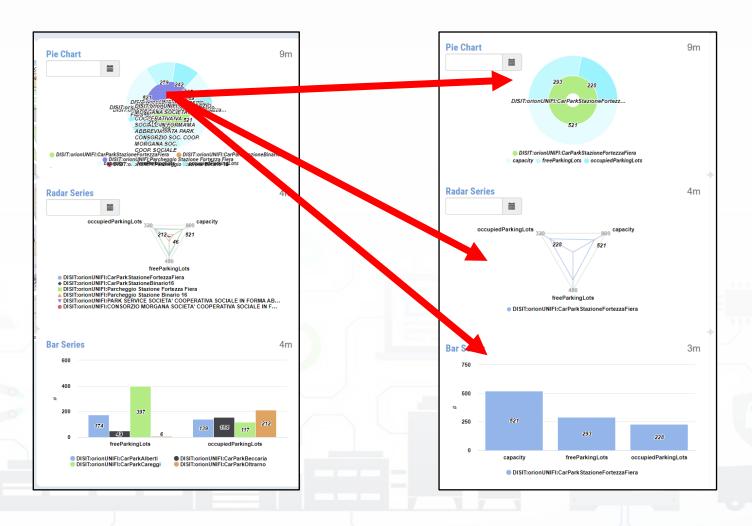






Example: From Data Graphs to Graphs (drill down)

- 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









BI-CSBL



Client Side Business Logic











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-
- https://www.snap4city.org

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





https://www.snap4city.org/d ownload/video/ClientSideBus inessLogic-



SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES





Snap4Industry Overview, October 2023





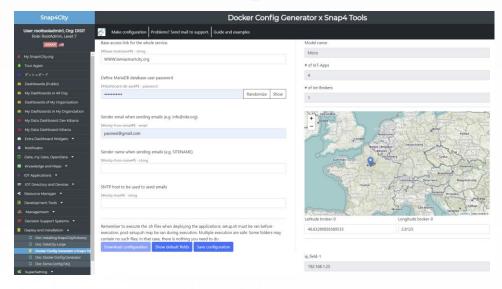


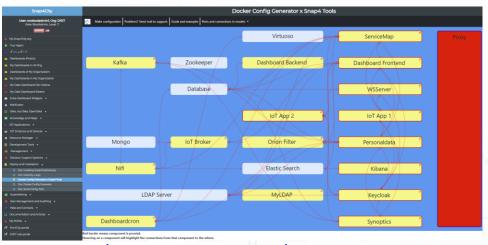


Installations, different models a TOOL to get them

- 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





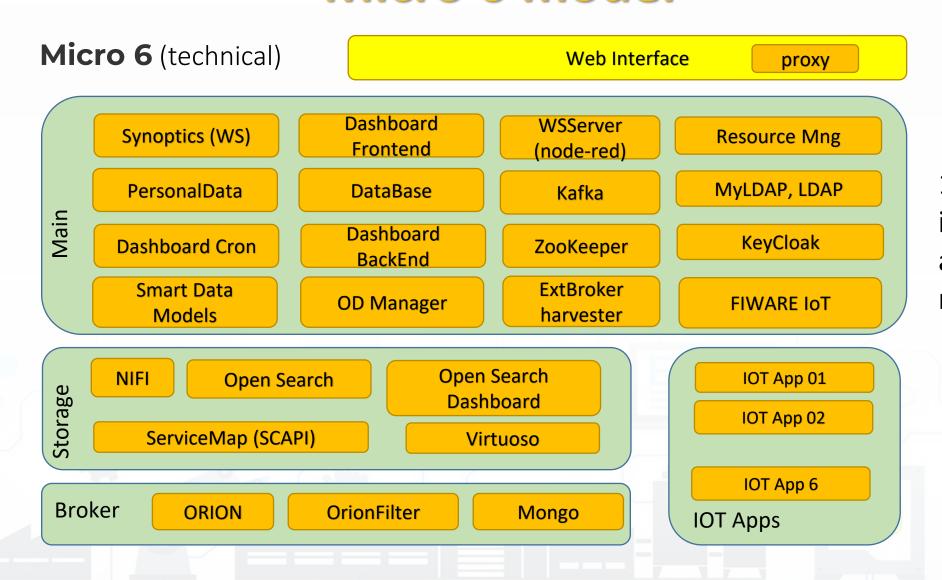












1Hour installation and ready to use

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT SNAP4INDUSTRY







Big Data Analytics + Artificial Intelligence

SNAP4city

KM4 city

- Decision support
 - Early warning, City Indexes, etc.
 - What-IF analysis (simulation + Al + 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

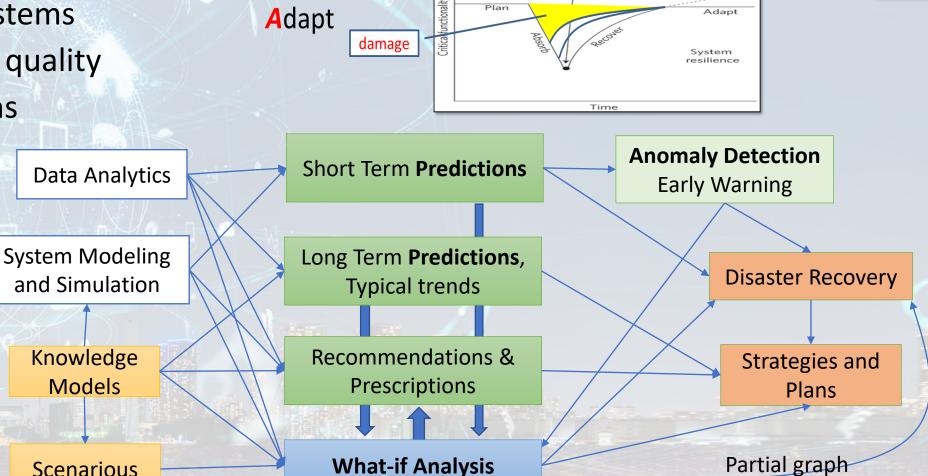
- Heatmaps, Traffic, Flows, ...
- Trajectories, OD matrices,
- 3D Rendering
- Typical Time Trends, etc.

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

Snap4Industry Overview, October 2023

Snap4City What-If

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



Consequence

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

What-if Analysis

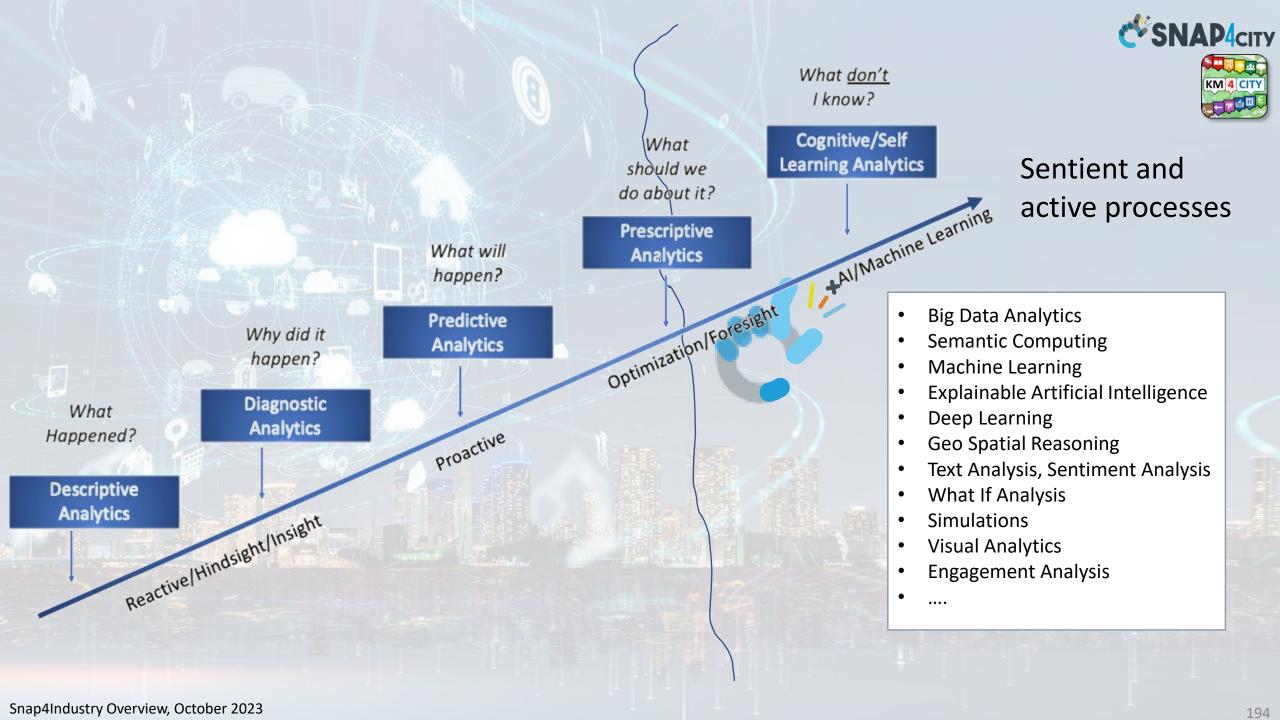
Snap4City (C), November 2023 193

Scenarious

Prepare

Absorb

Recover



Data Analytics on Snap4City platform

tools

other

and

API

City

Smart



Resource Manager







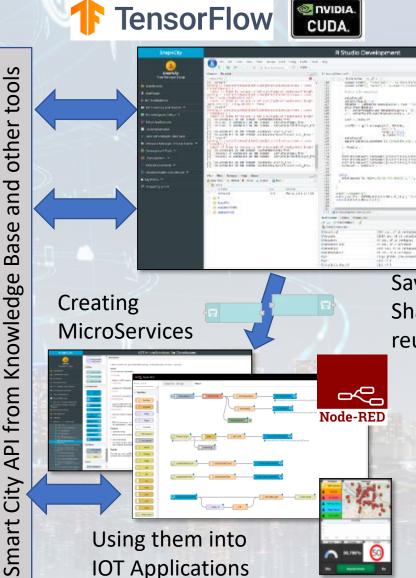


Ontology Schema



from Knowledge LOG.disit.org **Big Data Store**

Facility

















10/22









15 Minute City Index:

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



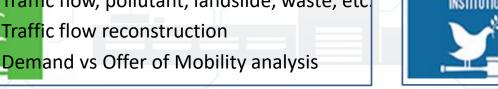
- Monitoring and Prediction of energy consumption
- Stimulating: Bike sharing, e-bikes, car charge, etc.
- Community of Energy, planning energy plant



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



Monitoring and Predicting: NO2, NOX, CO2, Traffic flow, pollutant, landslide, waste, etc. Traffic flow reconstruction





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



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



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







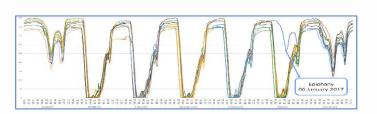
Parking predictions CSNAP4INDUSTRY





I would arrive to surely Park in 45 Minutes??

Description of features variable



ory				
	Free parking	Real number of available slots recorded		
Baseline features of free slot data	slots	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		
es	Previous	Difference between the number of free		
喜	observation's	spaces at time i and number of free		
Ę	difference	spaces at time $(i - 15 \text{ minutes})$ recorded		
Baseline	(POD)	in the previous week		
	Subsequent	Difference between the number of free		
	observation's	spaces at time i , and the number of free		
	difference	spaces at time $(i + 15 \text{ minutes})$ recorded		
	(SOD)	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 (%)		
		City rainfall measured one hour earlier		
	Rainfall	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	Average of distance between vehicles,		
	Vehicle Time	over one-hour period		
	Vehicle Concentration	Number of vehicles per kilometer, over		
		one-hour period		

Features

Artificial Intelligence **Predictions**

97% of precision





STREET, STREET,



13 CLIMATE ACTION



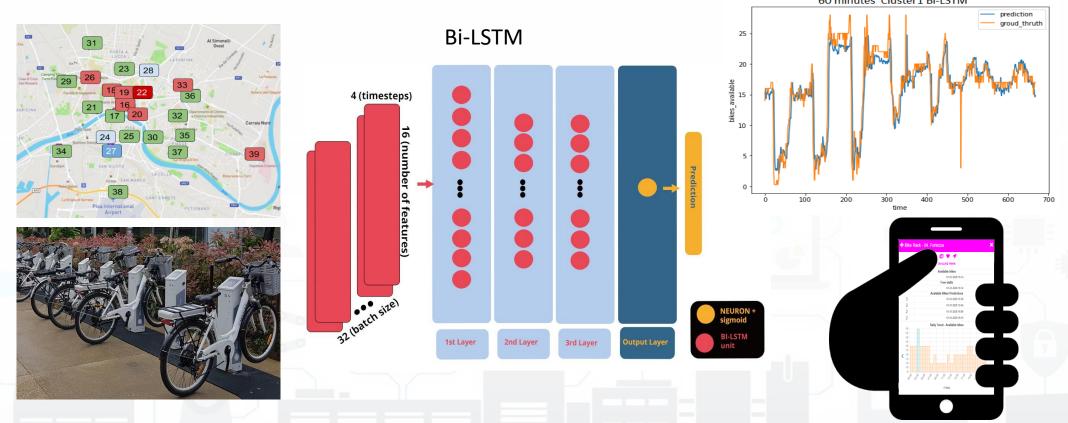








Deep Learning for Short-Term Prediction of Available Bikes on Bike-Sharing Stations



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



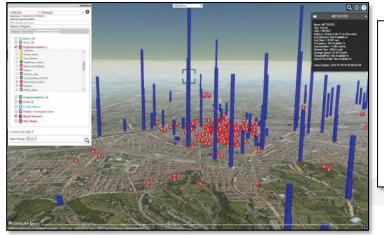
Predicting users movements

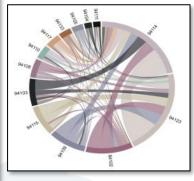
Issue:

- How they move: vehicles, pedestrian, bike, ferry, metro,
- Where they go....

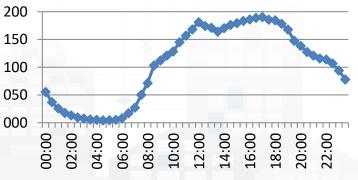
Impact:

- 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







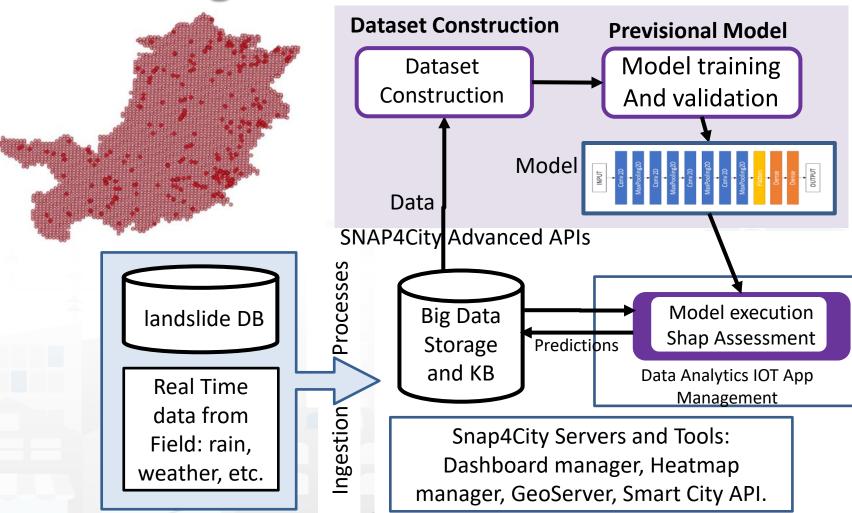








Predicting Land slides





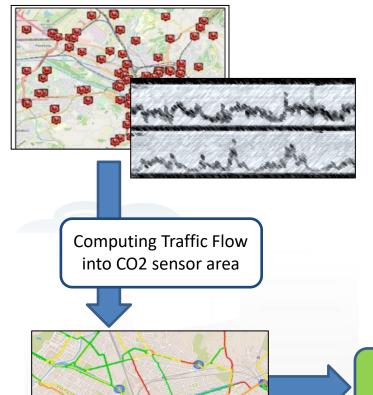
E. Collini, L. A. I. Palesi, P. Nesi, G. Pantaleo, N. Nocentini and A. Rosi, "Predicting and Understanding Landslide Events with Explainable AI," in *IEEE Access*, doi: 10.1109/ACCESS.2022.3158328.



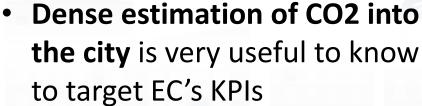
Stranger of the property Local CO2 from Traffic Flores



Data



 Traffic Flow is one the main source of CO2



Computing CO2 on the basis of traffic flow data





400-410 410-420 >420

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/





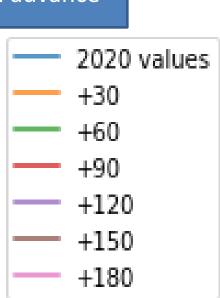


Predicting EC's KPI on NO2 months in

<u>advance</u>

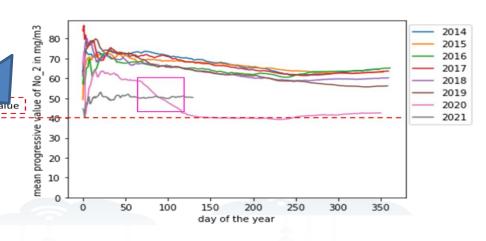
Deep Learning Long Terms Predictions of NO2 mean values, From 30 to 180 days in advance

- The features used as input for the predictive models are:
- Month
- dayOfTheYear
- NO2
- Tmean
- Humidity
- windMean ^{ເອົ້າ}
- NoxDomestic
- numberOfVehicles
- NO2cumulated
- NO2progresseveMean
- numberOfVehiclesCumulated









Air Quality Directive					WHOguidelines	
Pollutant	Averaging period	Objective and legal nature concentration	and Comments	Concentration	Comments	
PM _{2.5}	One day			25 μg/m³ (*)	99 th percentile (3 days/year)	
PM _{2.5}	Calendar year	Target value 75 ug/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 (*)	99 th 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 t	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

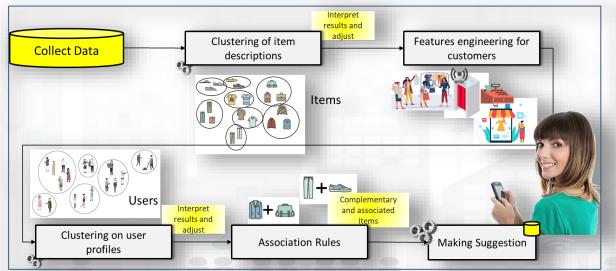
Feedback:

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

Techniques

- Multiple clustering
- Prediction models











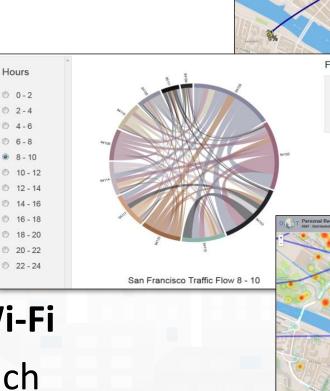
Sii-Mobility

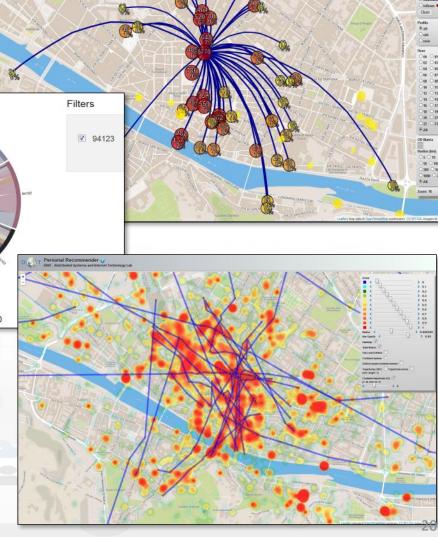
Recommender - Interactive People Flow Maps



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





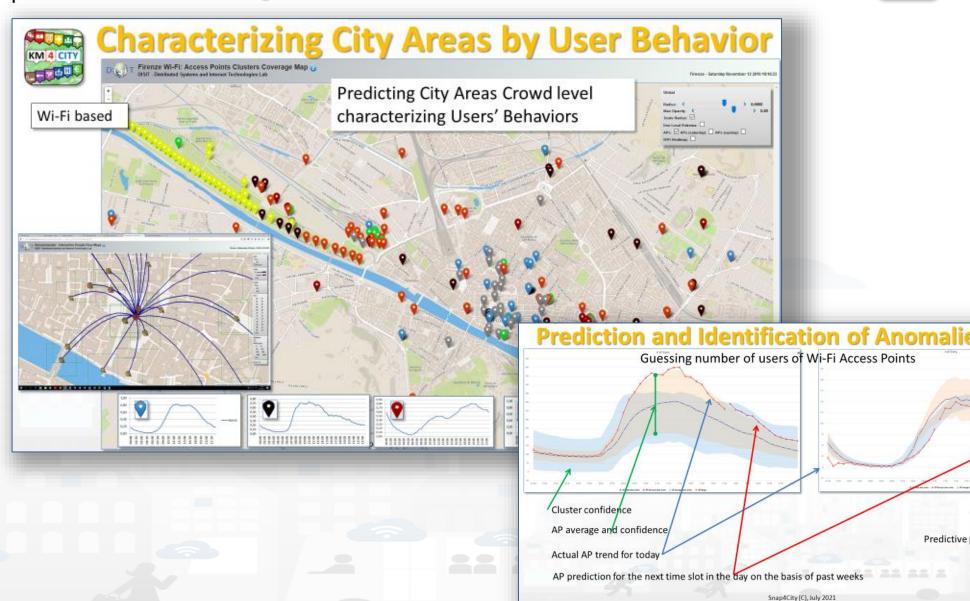




People Flows



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









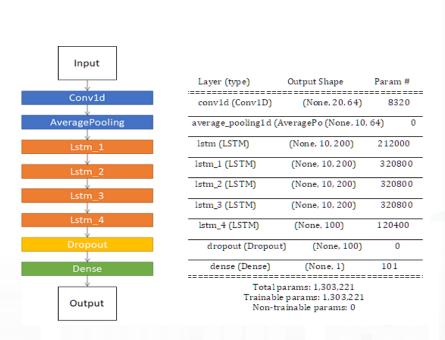


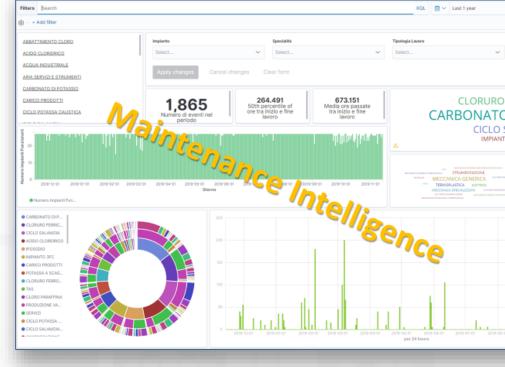


Predictive Maintenance

- Predictive Maintenance
 - LSTM
 - CNN-LSTM
- Maintenance Intelligence
- Explainable AI: SHAP, ...









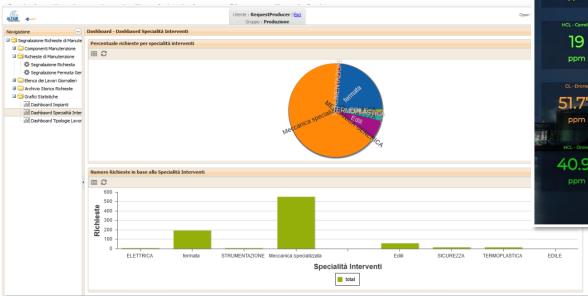






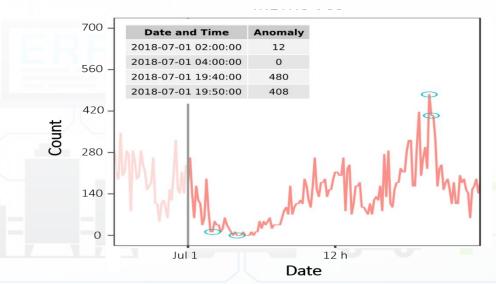


Reports and Dashboards



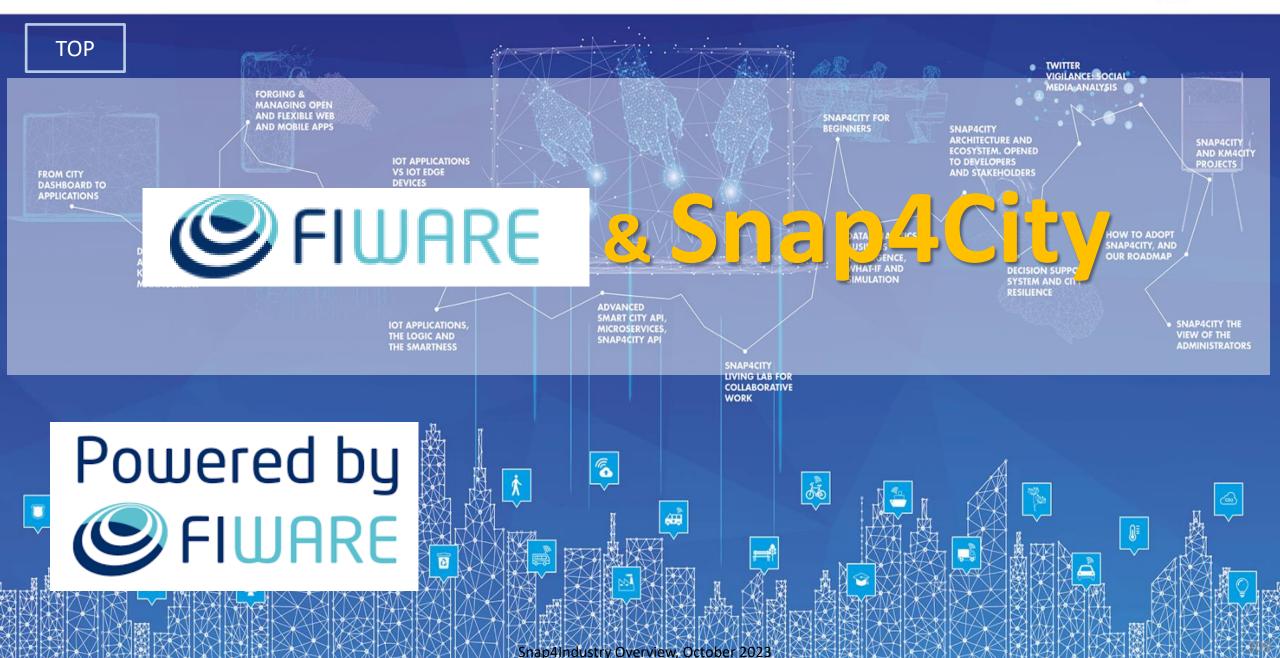






SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES

















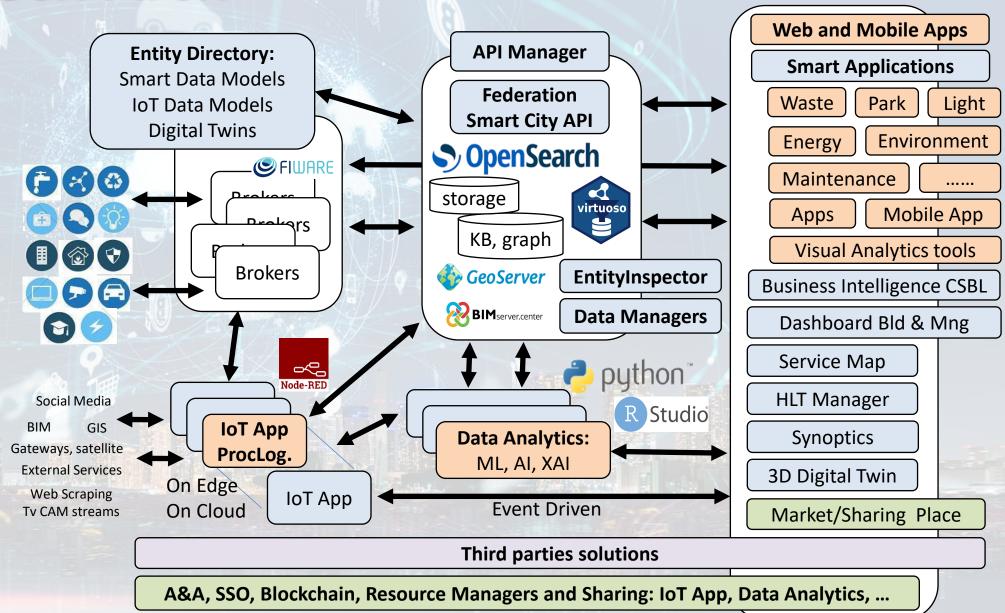
- Snap4City Powered by <u>FIWARE</u> Solution & Platform:
 - https://marketplace.fiware.org/pages/solutions/b8905e91973b420189cce972
 - https://marketplace.fiware.org/pages/solutions/d68534ec827500f1bde8720f
 - NGSI V1, V2 The IOT Orion Broker
 - IOT Orion Broker can connect JSON, MQTT, Lightweight M2M, 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



Tech Arch







11/23









Functional: FIWARE ref arc wrt Snap4City solutions

	FIWARE ref arc smart city	Snap/City
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.







DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB FIVARE 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: on Broker, on data management, on dashboards, etc Yes: provided in the open source	
Report generation/management	No	Yes	









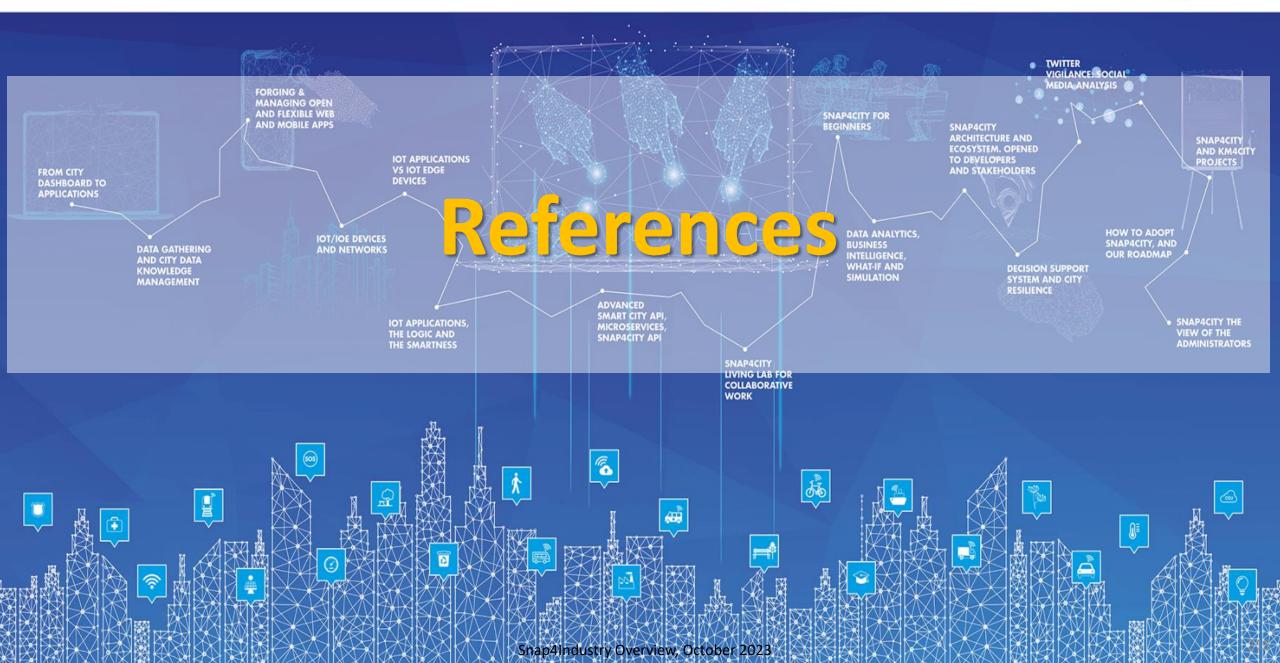
Exploiting FIWARE Smart Data Models

- Smart Data Models can be used into Snap4City:
 - as initial IoT Data Model without precise Variable Definitions
 - Attach automated rules to each specific Smart Data Model of a Broker for directly registration and management of IoT Device Messages
- Exploitation to simplify IoT Device Registration from Orion Brokers, for
 - External Brokers: automating Device Registration while Device Discovery
 - Internal Brokers: exploiting the Smart Data Model as a Template for Device Registration

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT SNAP4INDUSTRY







2023 booklets

Smart City





https://www.snap4city.org /download/video/DPL_SN AP4CITY.pdf Industry





https://www.snap4city.org/download/video/DPL SNAP4INDUSTRY.pdf

Artificial Intelligence





https://www.snap4city.o rg/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: <u>Https://www.snap4city.org</u>
- https://twitter.com/snap4city
- https://www.facebook.com/snap4city

Contact Person: Paolo Nesi, Paolo.nesi@unifi.it

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

Access Level: Public

Date: 05-04-2021

Version: 5.3

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



















Development Life-Cycle

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

From Snap4City:

- We suggest you to read the TECHNICAL OVERVIEW:
 - https://www.snap4citv.org/download/video/Snap4Citv-
- https://www.snap4city.org
- https://www.snap4industrv.org
- https://twitter.com/snap4city
- https://www.facebook.com/snap4city
- https://www.youtube.com/channel/UC3tAO09EbNba8f2-u4vandg

Coordinator: Paolo Nesi, Paolo.nesi@unifi.it

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

Access Level: public

Date: 21-10-2022

Version: 1.4







https://www.snap4city.org/d ownload/video/Snap4Tech-**Development-Life-Cycle.pdf**













Client Side Business Logic











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-

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







https://www.snap4city.org/d ownload/video/ClientSideBus









Overview





SMART CITIES AND SMART INDUSTRY

Snap4City: FIWARE powered smart app builder for sentient cities

Vith the contribution of







- https://fiwarefoundation.medium.com/sna p4city-fiware-poweredsmart-app-builder-forsentient-cities-acfe24df49d5
- https://www.snap4city.org/d rupal/sites/default/files/files/FF ImpactStories Snap4Cit y.pdf







Be smart in a SNAP!



CONTACT

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

Via S. Marta, 3 - 50139 Firenze, ITALY https://www.disit.org

www.snap4city.org



Email: snap4city@disit.org

Office: +39-055-2758-515 / 517

Cell: +39-335-566-86-74 Fax.: +39-055-2758570