









SNAP4INDUSTRY by Snap4 Technology

https://www.snap4industry.org **CSNAP4** Appliances and Dockers
Installations 100% Snap4Industry Overview, August 2021





https://www.snap4city.org/369







Fleet management

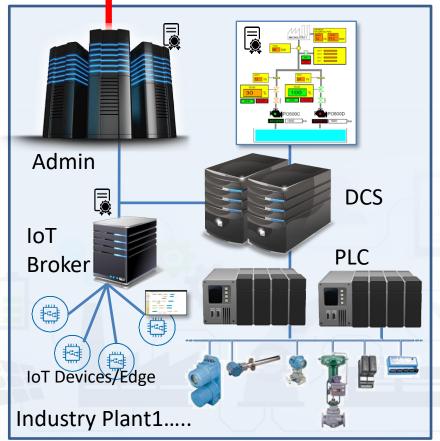


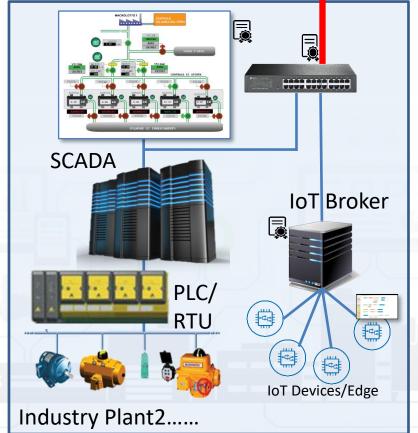
IoT Broker

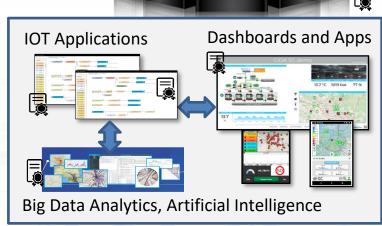


SECURE

Internet







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





Aims

- Increasing control, telecontrol and hyper-automation
- Reduction of: Downtime, Costs (reducing waste), and Reaction Time to unpredicted events
- Increment of Product Quality, Control, process understanding

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: from descriptive to prescriptive
- Decision Support Systems, DSS
 - Simulation, Visual Analytics, Data Analytics, Synoptics
 - XAI on predictions, anomaly detection (early warning), classifications
- Large Scale Integration
- Security, GDPR, etc.







Tools for rapid implementation of sustainable **Smart Solutions and Decision Support Systems**





FREE TRIAL



















DASHBOARDS AND APPS - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - VISUAL ANALYTICS

PREDICTION - ANOMALY DETECTION - ENVIRONMENTAL MODEL - 3D MODEL KPI - SIMULATION - EARLY WARNING - SYNOPTIC - DIGITAL TWIN - VIRTUAL REALITY



BIG DATA ANALYTICS EXPERT SYSTEM EXPLAINABLE ARTIFICIAL INTELLIGENCE KNOWLEDGE BASE BUSINESS INTELLIGENCE STORAGE MACHINE LEARNING



DATA FLOWS, DATA DRIVEN WORKFLOWS, MICROSERVICES PARALLEL DISTRIBUTED PROCESSING



METHODOLOGIES COURSES AND COMMUNITY LIVING LABS **DEVELOPMENT TOOLS**



Big Data Analytics + Artificial Intelligence

SNAP4city

- Short and Long terms predictive models on:
 - traffic, parking, people flow, maintenance, land sliding, NO2
- 3D Flow prediction: Pollutant (NOX, NO2, ...)
- Early warning, City Indexes, etc.
- AI & XAI:

Snap4 Overview, 2021

- RF, XGBoost, BRNN, RNN, SVR, DNN, LSTM, CNN-LSTM, Autoencoders, ...
- Clustering: K-means, K-Medoid, ...
- XAI: Shap, variations, ..
- Modeling, simulation, routing
 - Traffic Flow reconstruction
 - Constrained Routing
- What-IF analysis (simulation + AI + data)
- Based on several computational models:
 - trajectories, OD matrices, Typical Time Trends, etc.

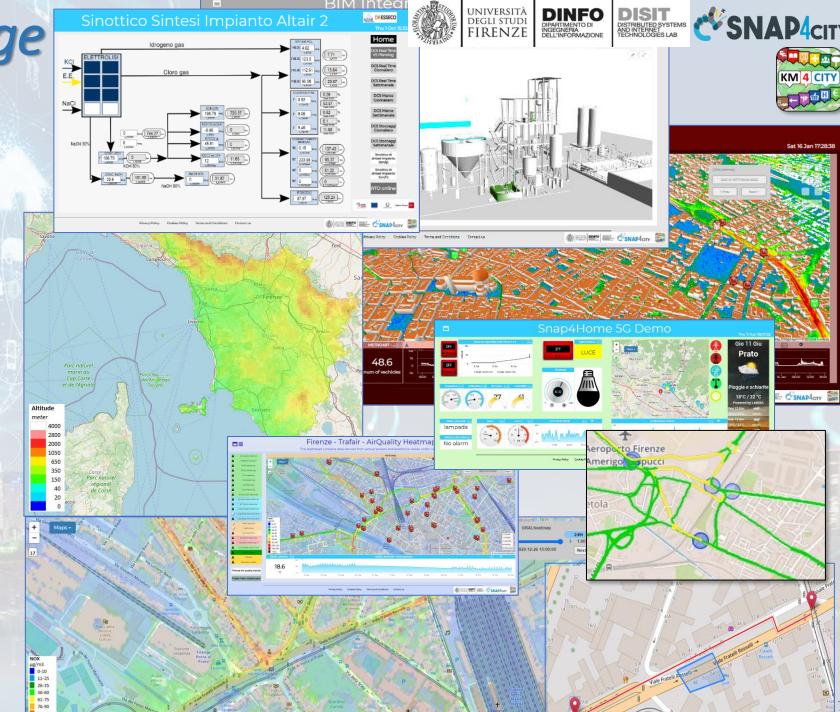
to cope with

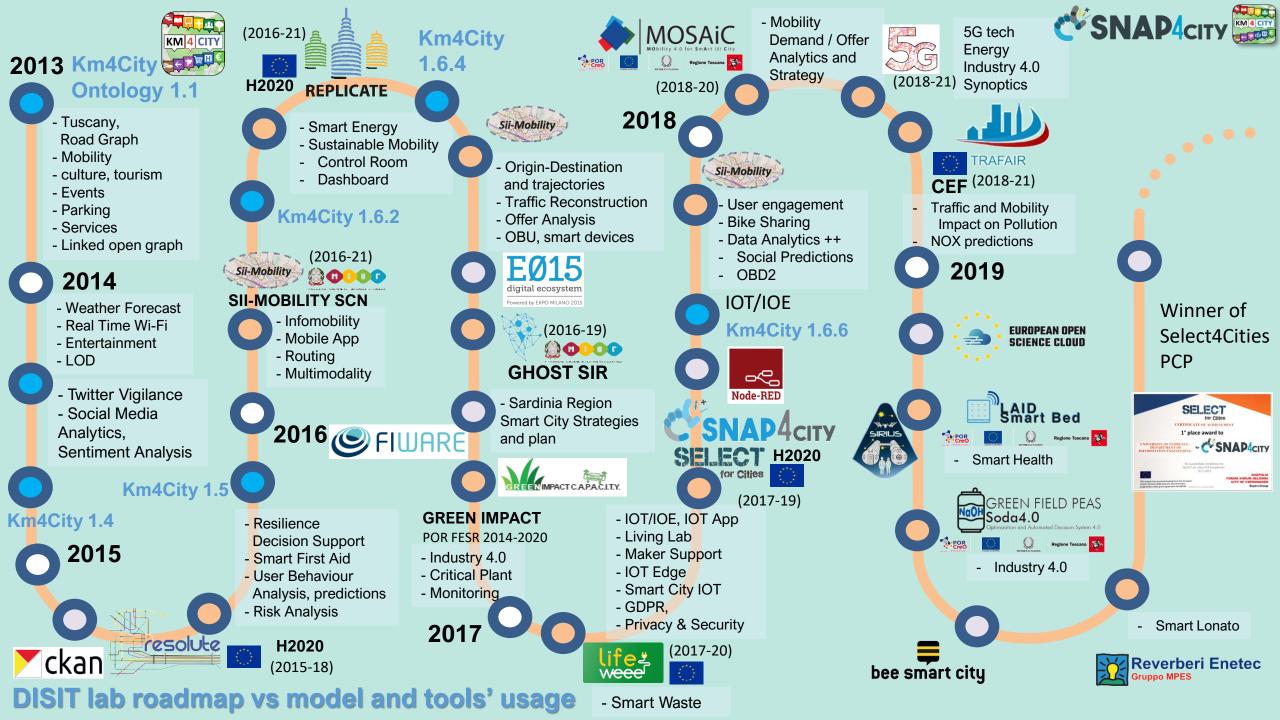
- any data, format
- any channel, protocol
- any AI/ML
- any place
- online development
- multi-tenant
- Secure, PENTest
- GDPR, privacy
- > low costs
- → easy to evolve

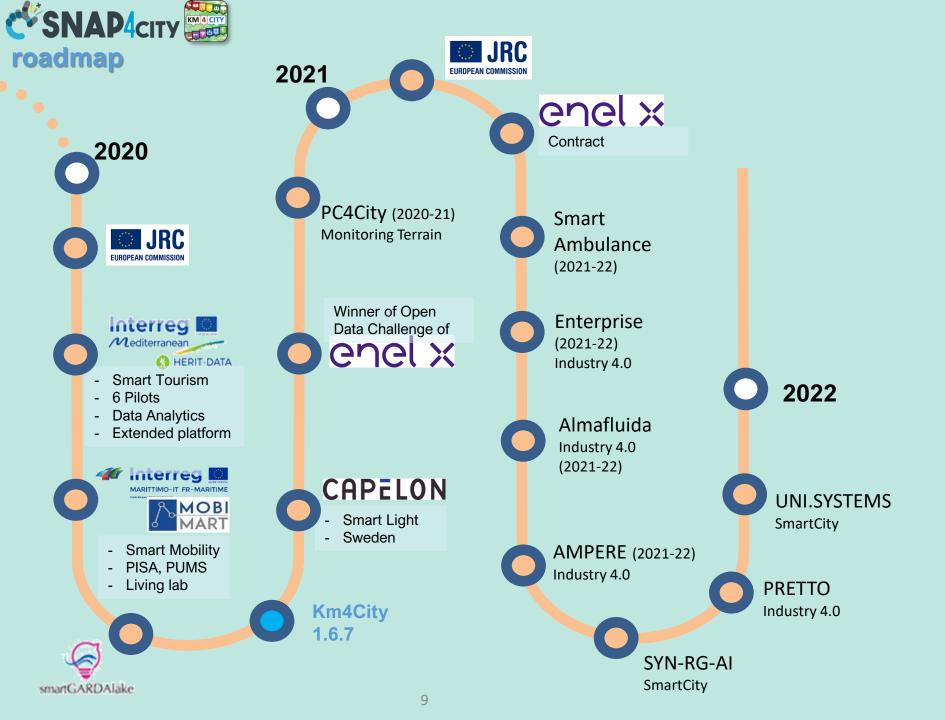
https://www.snap4city.org/download/video/course2020/da/S

Data Type Coverage

- POI, IOT, shapes,...
- maps, orthomaps, GTFS, GIS WFS/WMS, GeoTiff, ..
- calibrated heatmaps, ...
- traffic flow, typical trends, ..
- trajectories, events, ...
- 3D, BIM, Workflow, ...
- Dynamic icons/pins, ...
- OD Matrices, scenarios, ...
- prediction models,
- decision support,
- Synoptics, animations, ...
- social media, Routing, ...
- Satellite data, ...
- KPI, personal KPI,...
- · etc.













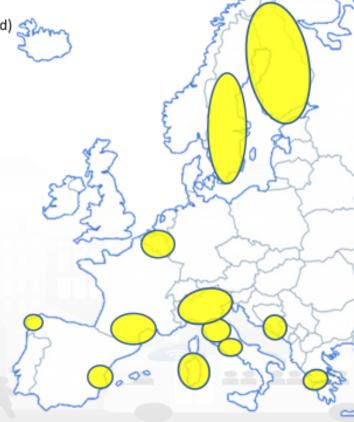
Snap4City/Industry Community

- Most of Organizations on Snap4City.org also correspond to companies or institutions that have an installation of Snap4City tools on their Premise,
 - such as: Pisa, SmartGarda Lake, Snap4, ALTAIR, etc.
- This double way allows them to:
 - test the news,
 - share experiences with other groups,
 - get visibility,
 - work in the collaborative environment, and
 - be better supported by Snap4City.org and DISIT Lab personnel.
- Each instance of Snap4xxxx solution *can decide to join the federation* of SmartCity API to exploit shared data.
 - This allows to exploit regional data for city installations applications (web, mobile, dashboards, etc.) without reloading them for example.

Main Organizations/areas

- Antwerp area (Be)
- Capelon (Sweden: Västerås, Eskilstuna, Karlstad)
- DISIT demo (multiple)
- Dubrovnik, Croatia
- Firenze area (I)
- Garda Lake area (I)
- · Helsinki area (Fin)
- · Livorno area (I)
- Lonato del Garda (I)
- Modena (I)
- Mostar, Bosnia-Herzegovina
- Pisa area (I)
- Pont du Gard, Occitanie (Fr)
- Roma (I)
- Santiago de Compostela (S)
- Sardegna Region (I)
- SmartBed (multiple)
- Toscana Region (I), SM
- Valencia (S)
- Venezia area (I)
- WestGreece area (Gr)

Snap4City (C), October 2020



https://www.snap4city.org/577



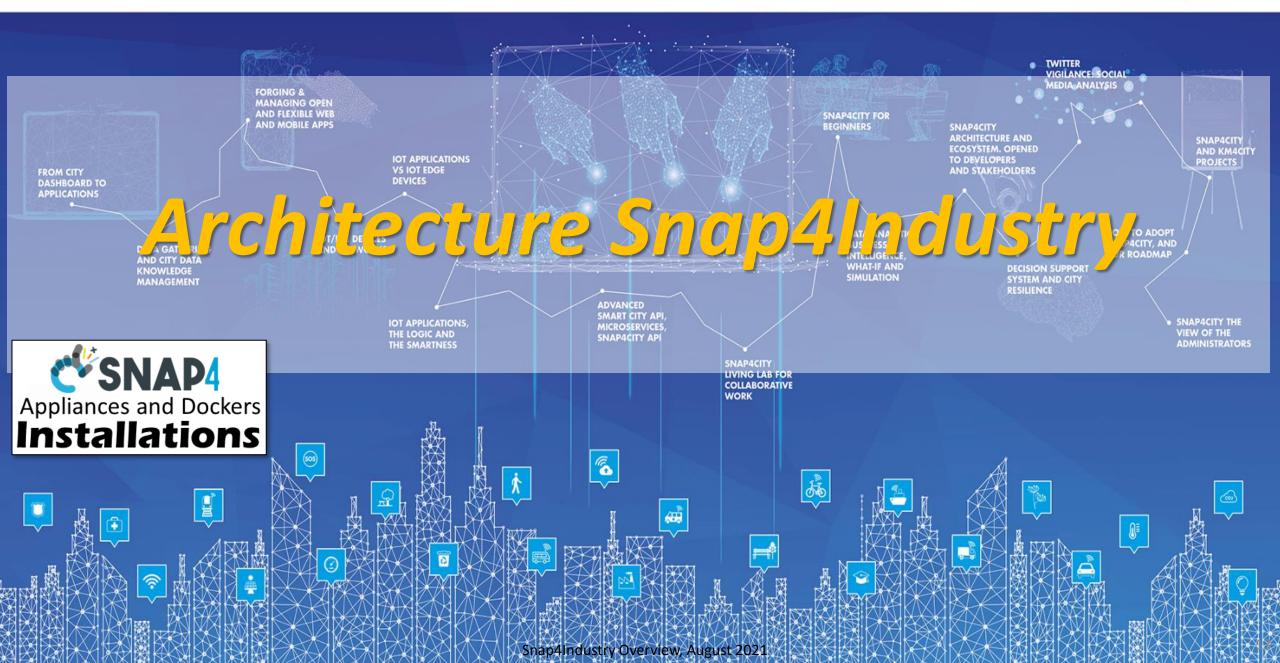
On Line Training Material (free of charge)

	1st part (*)	2nd part (*)	3rd part (*)	4th part (*)	5th part (*)	6th part (*)	7th part (*)	
what	General	Dashboards	IOT App, IOT Network	Data Analytics	Data Ingestion processes	System and Deploy Install	Smart City API: Web & Mob. App	
PDF	CANALISTON DE LOS DELOS DE LOS DELOS DE LOS DELOS DE LOS DELOS	COMMITTED COMMIT	CENANGE OF SOME STATE OF SOME SOME SOME SOME SOME SOME SOME SOME	C'SNAN-CON CONTROL DE DESAT	CENARATOR DE CONTROL DE LIMITA DE LI	CEMASACIO	CEMAN For Comment to a SHAP of the and the Annual Comment to a SHAP of the and the Annual Comment to a SHAP of the and the Annual Comment to a SHAP of the and the Annual Comment to a SHAP of the and the Annual Comment to a SHAP of the Annual Comment to a	
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Video2	You	You	You	You	You	You	You	
Video3	You Tube	You	You	You	You	You	You Tube	
Video4	You	You	You	none	You	none	none	
duration	2:55	3:16	3:41	2:00	2:48	2:35	1:47	

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT SNAP4INDUSTRY





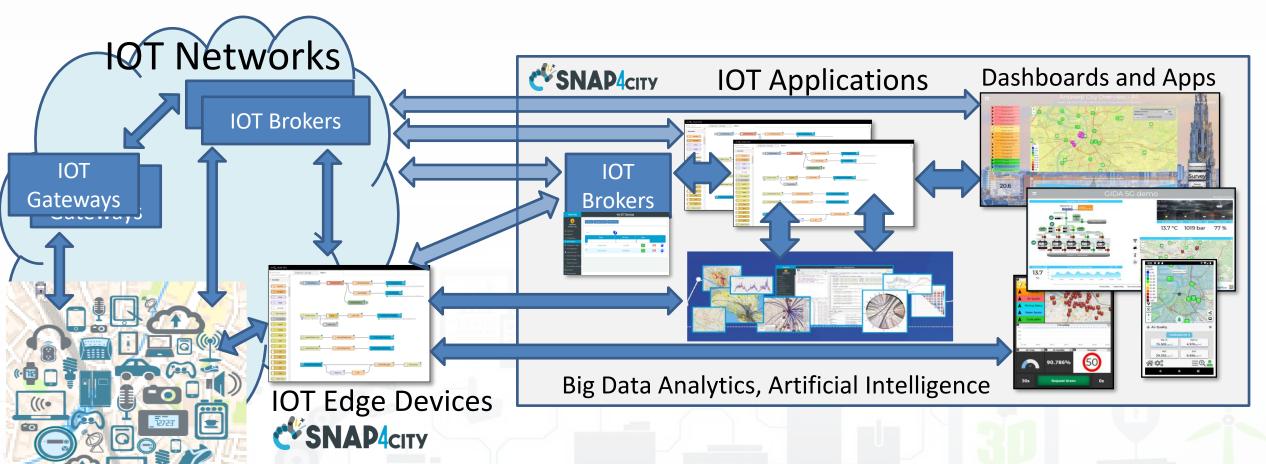




IOT Devices



Services on Cloud and on IOT Edge!!!



Mainly fog computing and NGSI V1, V2 with security





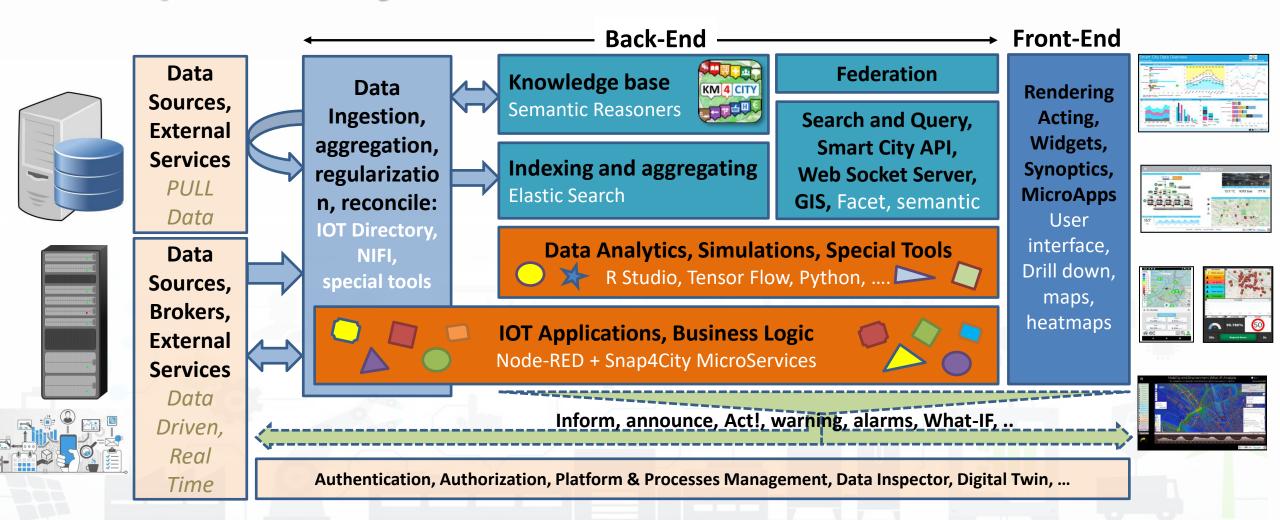








Snap4Industry Architecture, V2



Standards and Interoperability (2021)

Compliant with: AMQP, COAP, MQTT, OneM2M, HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, NGSI, LoRa, LoRaWan, TheThingsNetwork, SigFOX, DATEX II, SOAP, WSDL, Twitter, FaceBook, Telegram, SMS, OLAP, MySQL, Mongo, HBASE, SOLR, SPARQL, EMAIL, FTP, FTPS, WebSocket, WebSocket Secure, ModBUS, OPC/OPC-UA, GML, RS485, RS232, WFS, WMS, ODBC, JDBC, Elastic Search, Phoenix, XML, JSON, CSV, GeoTIFF, OWL, WKT, KML, SHP, db, GeoJSON, Enfuser FMI, Android, Raspberry Pi, Local File System, ESP32, Libelium, IBIMET/IBE, OBD2, SVG, XLS, XLSX, TXT, HTML, CSS, KNX, Enocean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Copernicus, Protocol Buffer, IFC, XPDL,







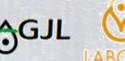
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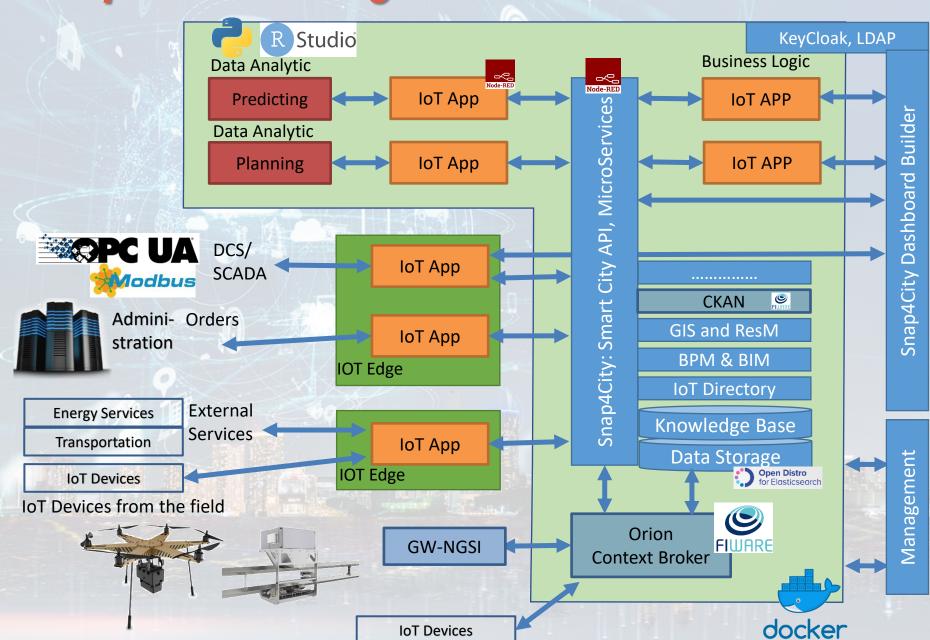


etc.



Snap4Industry Detailed Architecture



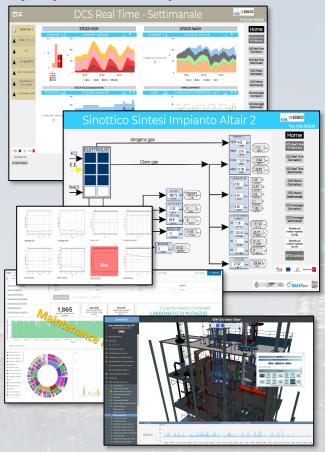




Production Parameters



Dashboards, Visual Analytics, Synoptics, 3D, Maps





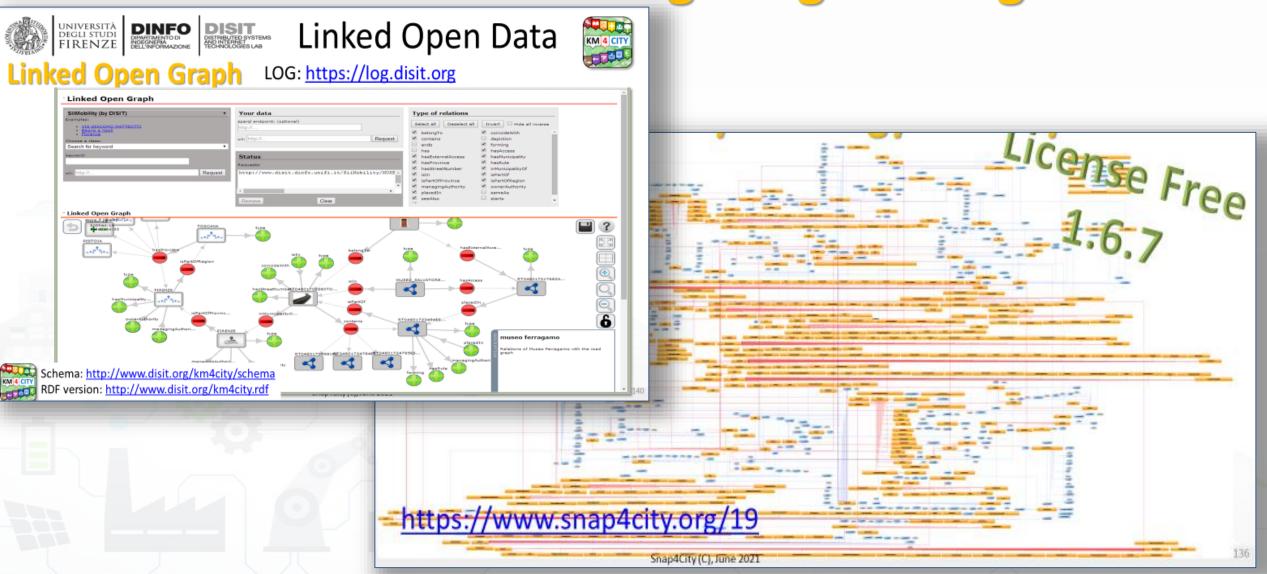








Knowledge Engineering





Snap4Altair Decision Support supervision and control, Industry 4.0







Multiple Domain Data

• Distributed Control System: energy, flows, storage,

chemical data, settings, ...

- Cost of energy, Orders,
- Production Parameters
- Maintenance data

Multiple Levels & Decision Makers

- Optimized planning on chemical model
- Business Intelligence on Maintenance data
- Historical and Real Time data
 - Billions of Data
- Services Exploited on:
 - Multiple Levels, Mobile Apps, API
- Since 2020



Industry Plant Supervision and Maintenance

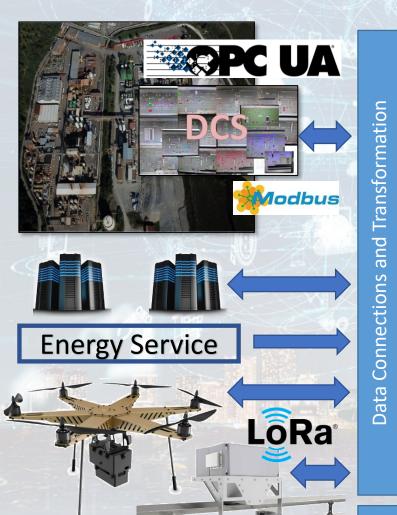


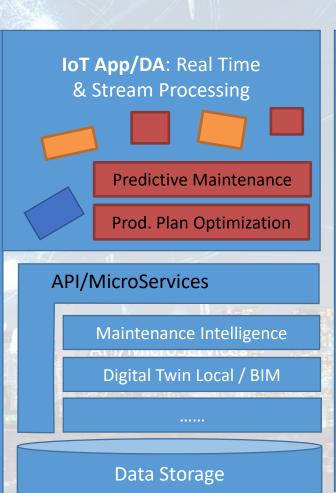


Aims

- Control Room: Higher level supervision and monitoring (since 2020)
 - Management of Production Plan Optimization
 - Control of Perimeter with drone and sensors
- Maintenance ticketing (since 2017)
 - predictive (in development)
 - 3D Digital Twin (in development)

MicroService Architecture

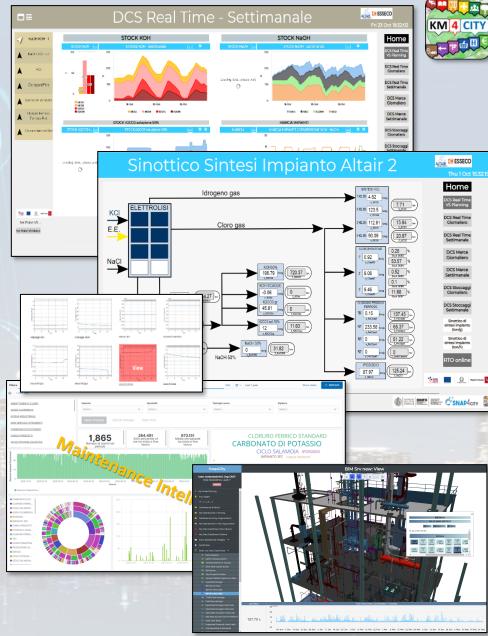




Management, Auth./Autoriz.

Snap4City Dashboard Builder

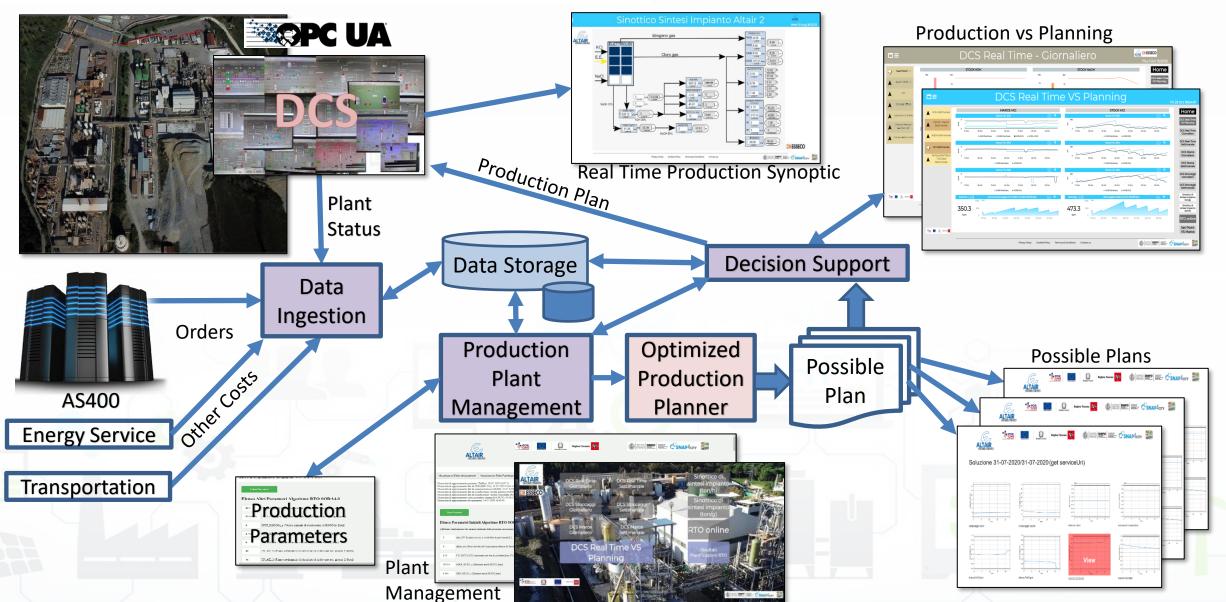


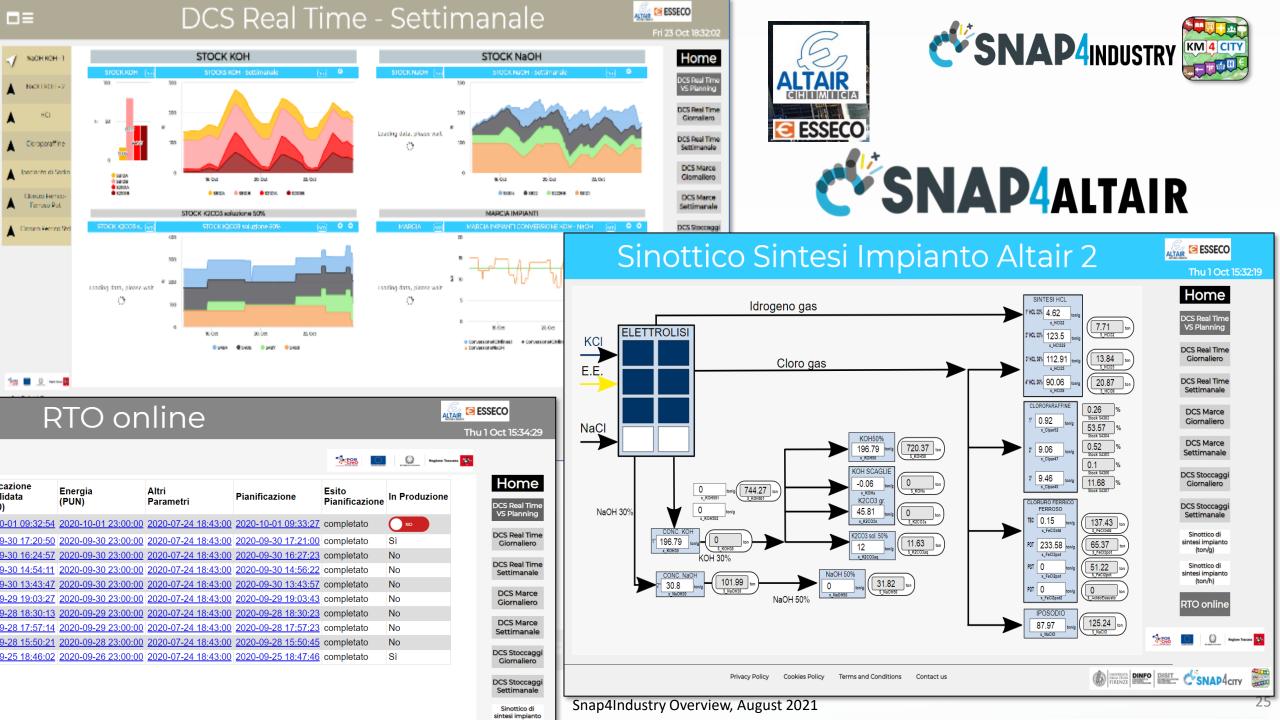


















Optimized Production Planner



Fri 23 Oct 18:57:41

Home Optimized Production Planner

Parameters (TabPar)	DCS (OPC-UA)	Administrative data (AS400)	Administrative Consolidated Planning data (AS400)	Energy data	Other Parameters	Planning result	Outcome	In production
2020-09-25 18:47:36	2020-10-23 18:49:02	2020-10-23 18:49:29	2020-10-23 18:49:29	2020-10-24 23:00:00	2020-07-24 18:43:00	2020-10-23 18:49:39		si
2020-09-25 18:47:36	2020-10-23 17:22:03	2020-10-23 17:21:46	2020-10-23 17:21:46	2020-10-23 23:00:00	2020-07-24 18:43:00	2020-10-23 17:22:08	completato	NO
2020-09-25 18:47:36	2020-10-22 18:36:02	2020-10-22 18:36:27	2020-10-22 18:36:27	2020-10-23 23:00:00	2020-07-24 18:43:00	2020-10-22 18:36:54	completato	Sì
2020-09-25 18:47:36	2020-10-22 17:09:02	2020-10-22 17:08:59	2020-10-22 17:08:59	2020-10-22 23:00:00	2020-07-24 18:43:00	2020-10-22 17:09:13	completato	No
2020-09-25 18:47:36	2020-10-21 18:00:02	2020-10-21 17:59:47	2020-10-21 17:59:47	2020-10-22 23:00:00	2020-07-24 18:43:00	2020-10-21 18:00:12	completato	Sì
2020-09-25 18:47:36	2020-10-21 06:52:02	2020-10-21 06:52:41	2020-10-21 06:52:41	2020-10-21 23:00:00	2020-07-24 18:43:00	2020-10-21 06:52:59	completato	No
2020-09-25 18:47:36	2020-10-20 18:26:02	2020-10-20 18:26:19	2020-10-20 18:26:19	2020-10-21 23:00:00	2020-07-24 18:43:00	2020-10-20 18:26:37	completato	Sì
2020-09-25 18:47:36	2020-10-20 09:47:03	2020-10-20 09:47:05	2020-10-20 09:47:05	2020-10-20 23:00:00	2020-07-24 18:43:00	2020-10-20 09:47:21	completato	No
2020-09-25 18:47:36	2020-10-19 18:13:02	2020-10-19 18:13:09	2020-10-19 18:13:09	2020-10-20 23:00:00	2020-07-24 18:43:00	2020-10-19 18:13:21	completato	Sì
2020-09-25 18:47:36	2020-10-19 09:51:02	2020-10-19 09:51:08	2020-10-19 09:51:08	2020-10-19 23:00:00	2020-07-24 18:43:00	2020-10-19 09:51:59	completato	No

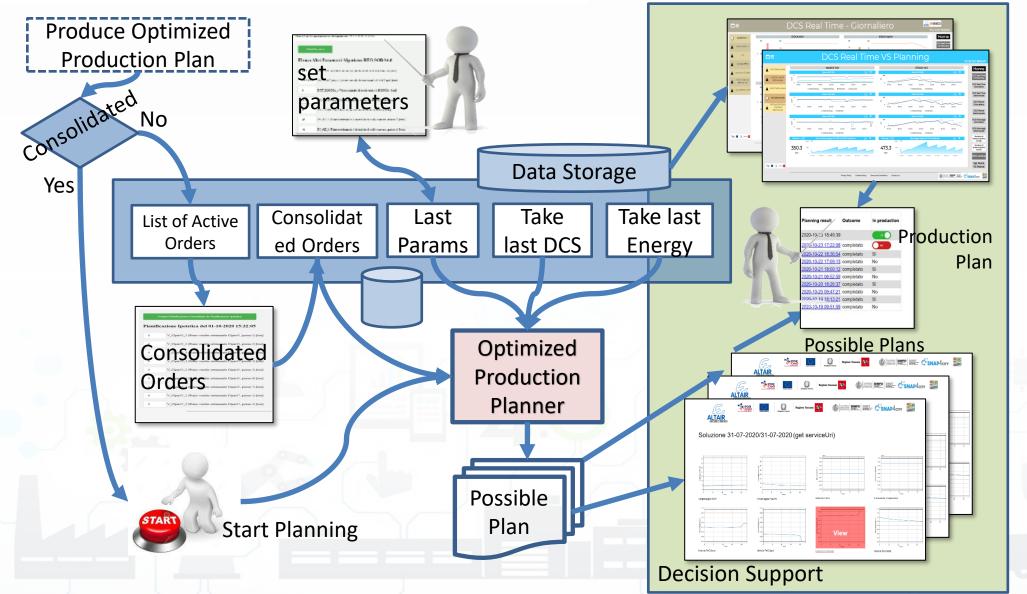
Home
DCS Real Time VS Planning
DCS Real Time Giornaliero
DCS Real Time Settimanale
DCS Marce Giornaliero
DCS Marce Settimanale
DCS Stoccaggi Giornaliero
DCS Stoccaggi





Business Logic

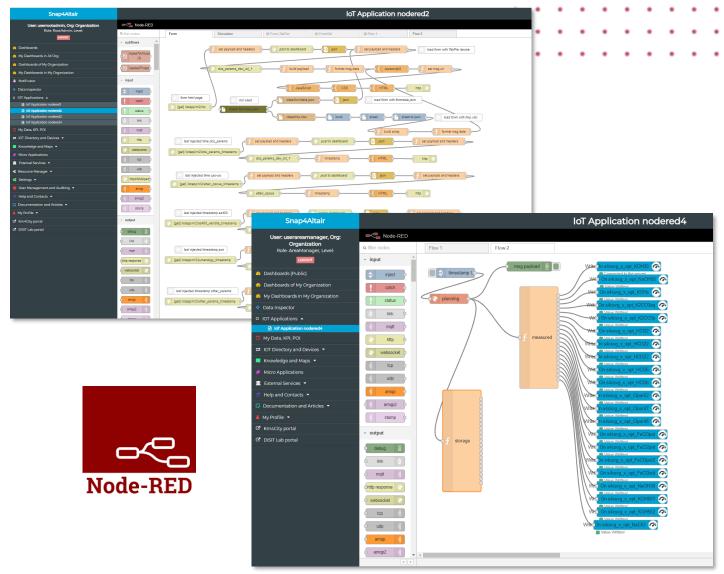




Snap4Industry Overview, August 2021

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...







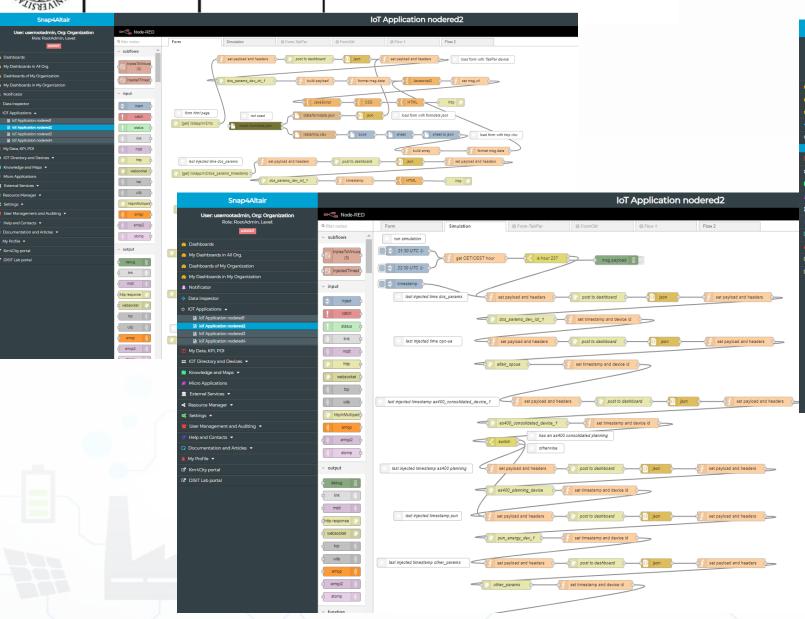


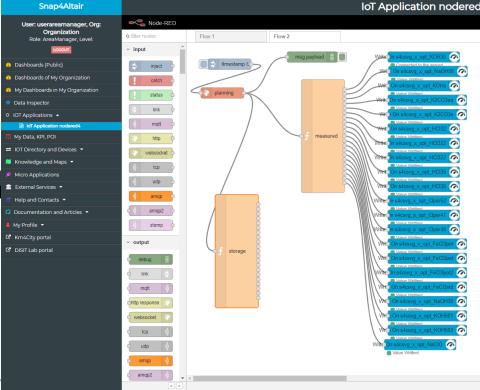




Some Flows















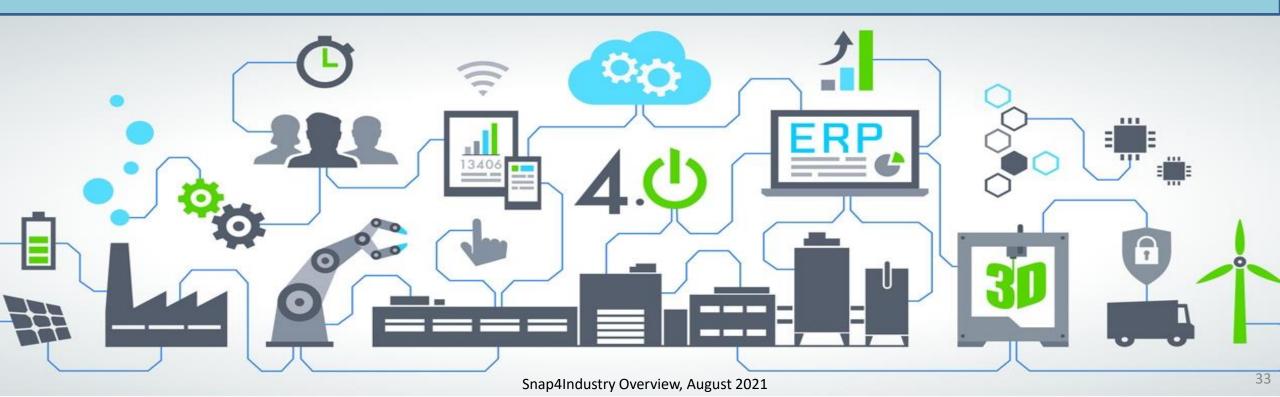








Digital Twin vs BIM





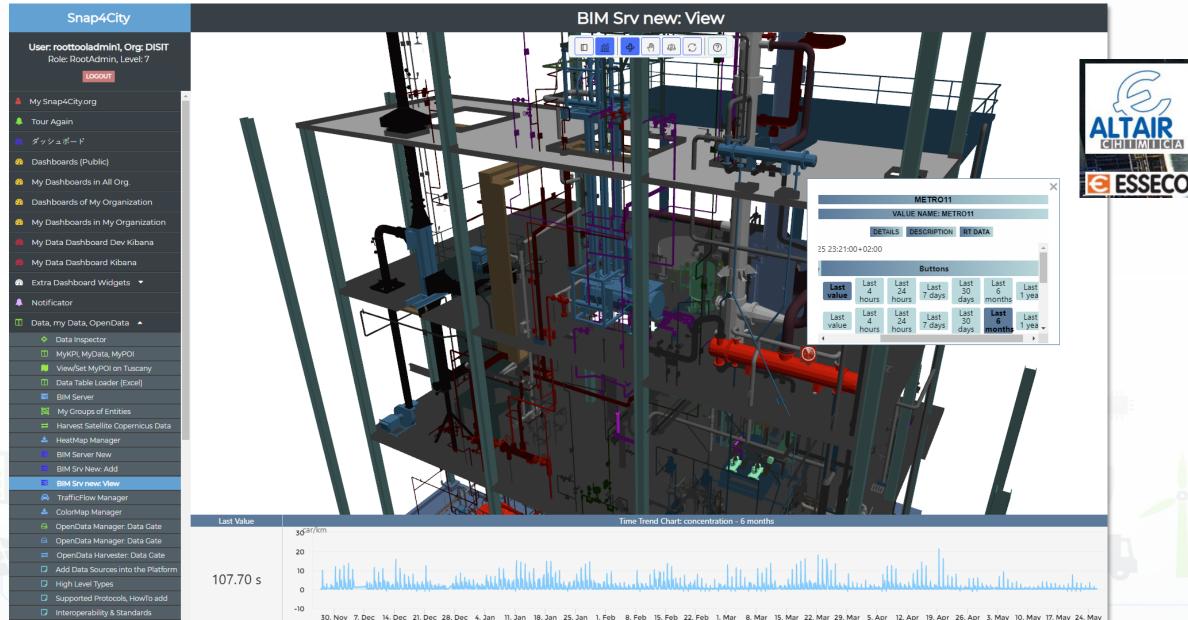




Digital Twin Local SNAP4INDUSTRY





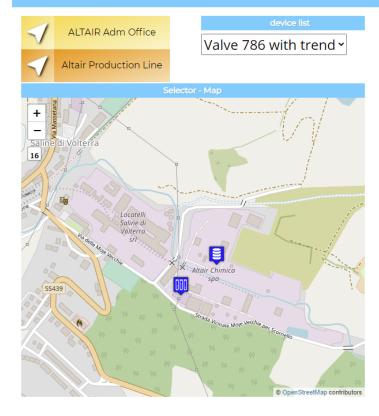


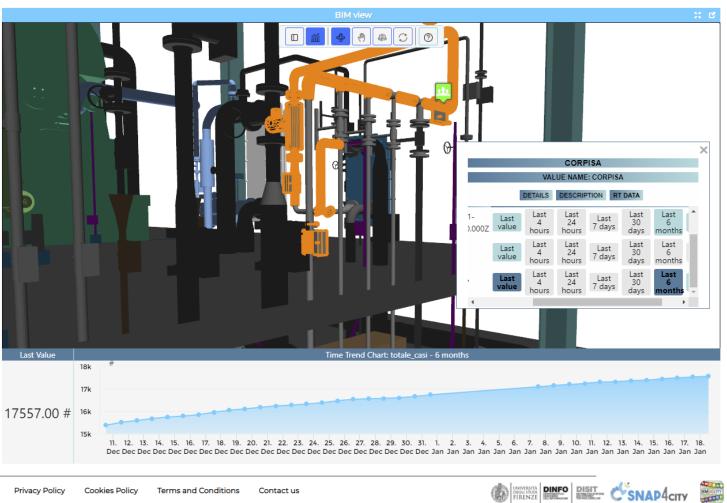
Digital Twin Local, 3D vs Real Time Data



BIM Integration for Digital Twin

Tue 8 Jun 11:04:55













Terms and Conditions

Contact us

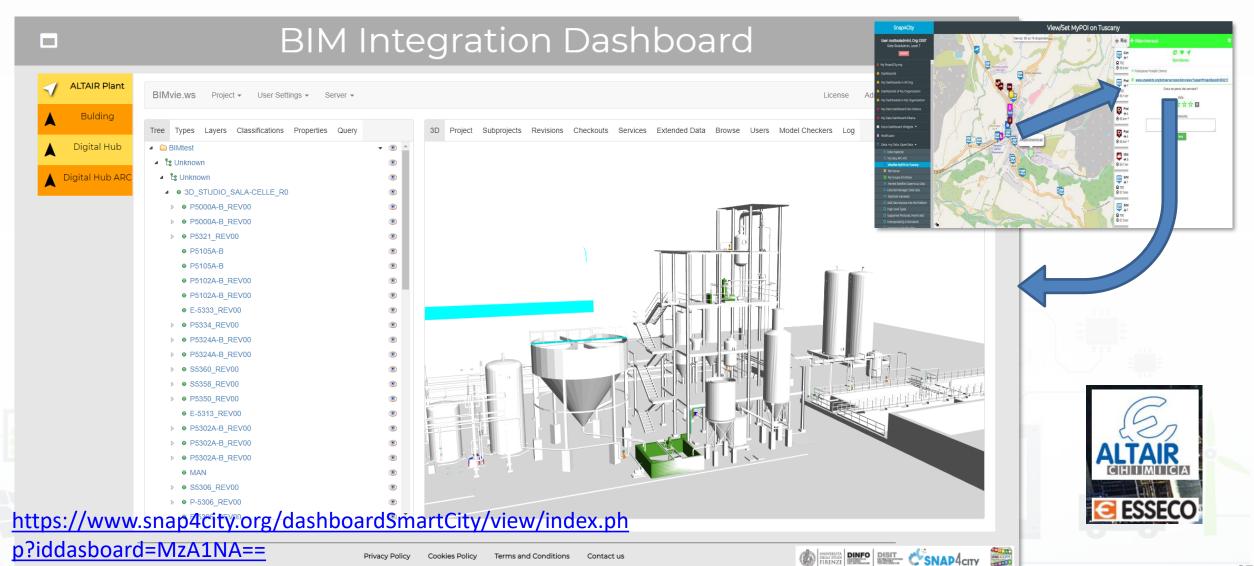








BIM view of the Altair Chemical Plant



Snap4Industry Overview, August 2021





Integration with Ticketing Systems Workflows







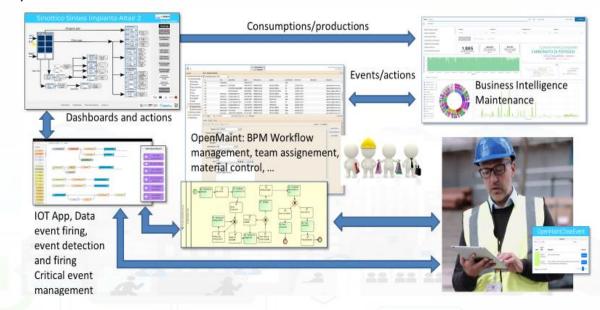






Snap4City Maintenance Solution

- **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;

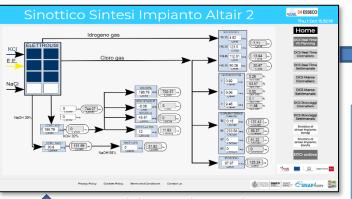




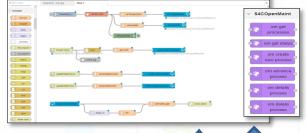




DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LA EXAMPLE TECHNOLOGIES

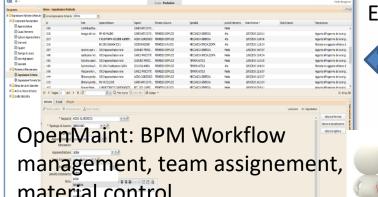


Dashboards and actions

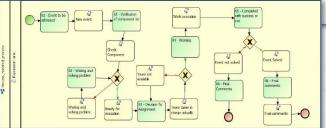


IOT App, Data event firing, event detection and firing Critical event management

Consumptions/productions

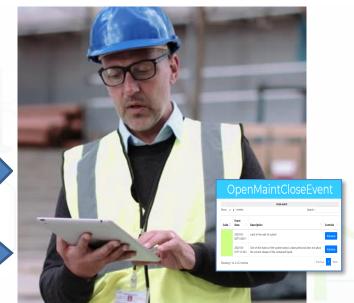


material control, ...



Events/actions





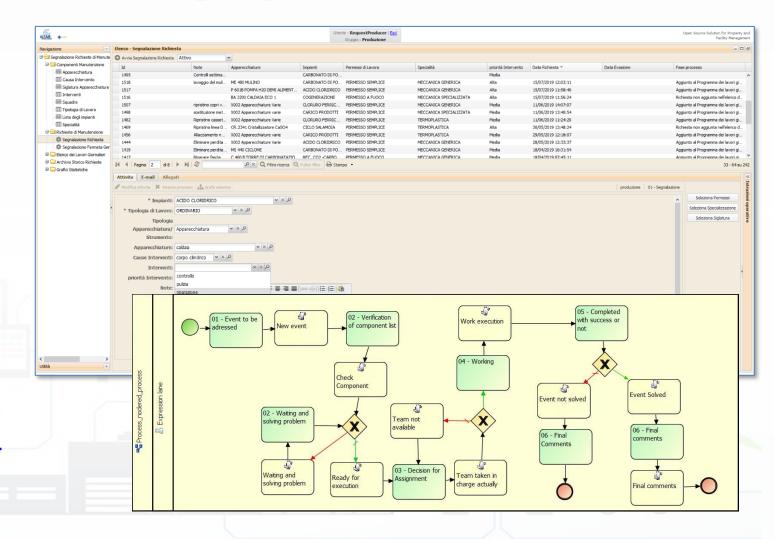






Integration with Ticketing Systems Workflow

- Snap4City is integrated with OpenMaint Ticketing system. An Open Source solution for ticketing and workflow management, incident management.
- Any ticketing systems can be integrated with Snap4City, by means of IOT Applications and Dashboards
- https://www.snap4city.org/597



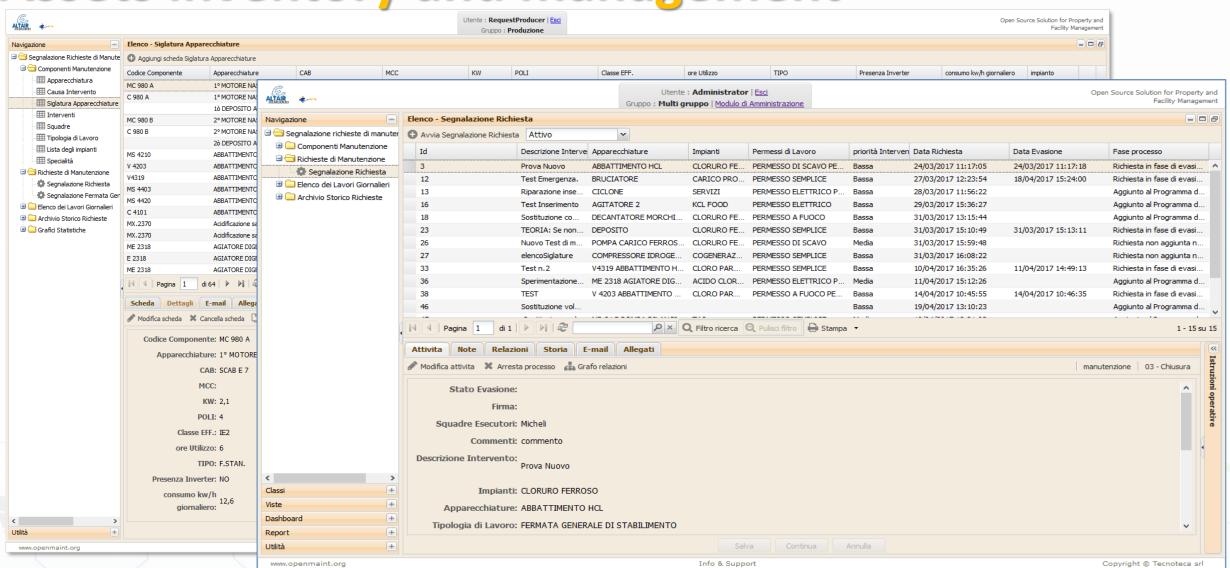




DELL'INFORMAZIONE



Assets inventory and management







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

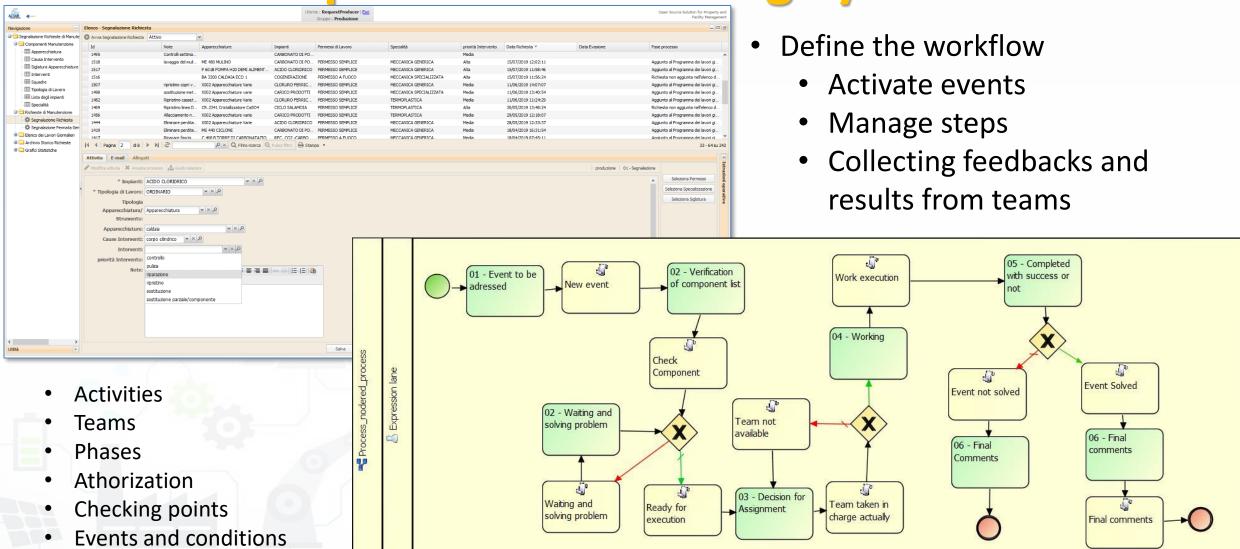








OpenMaint Ticketing System



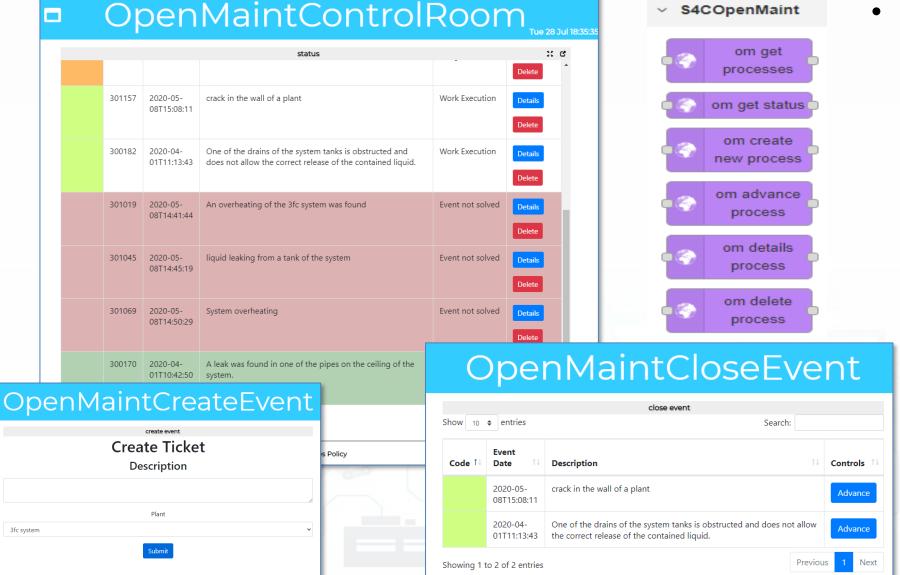




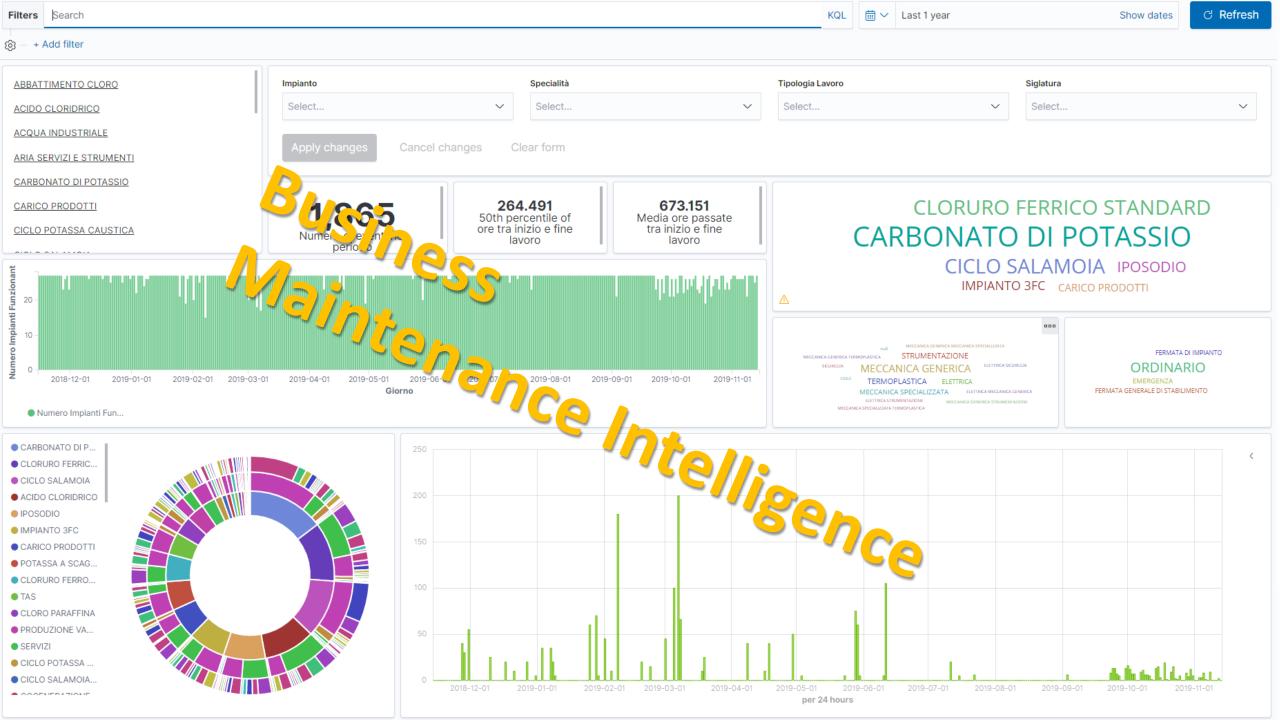


Dashboards





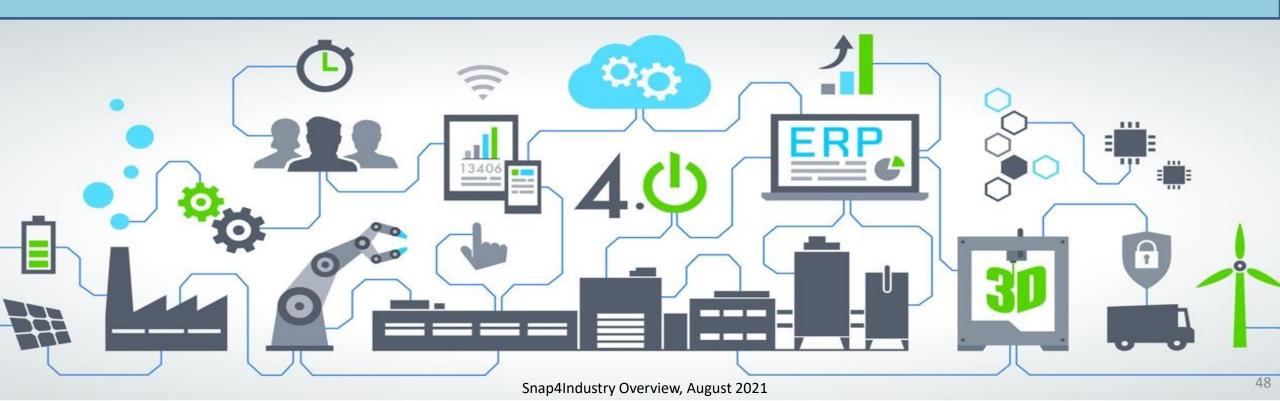
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Predictive Maintenance

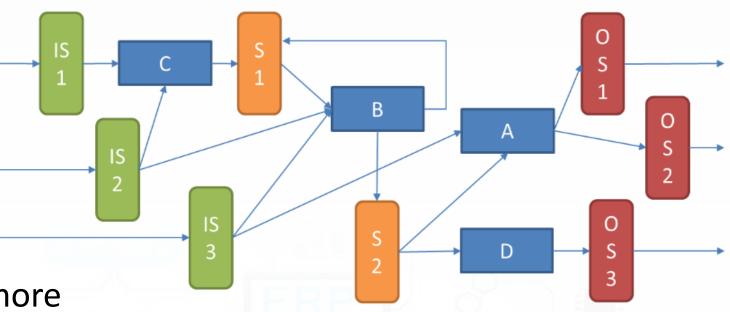






Complex cause-effect realtionships

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



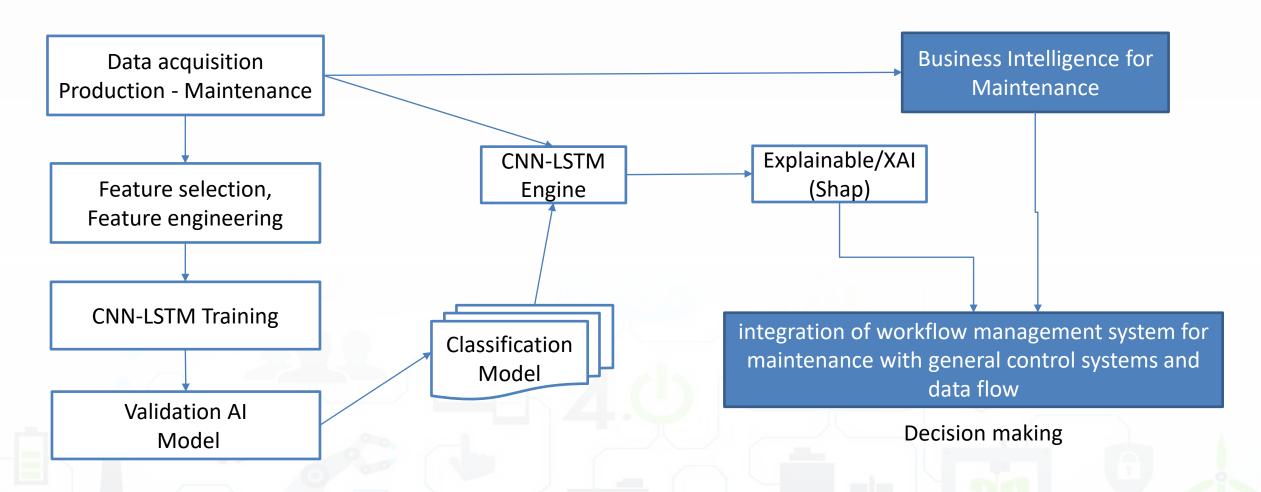








Workflow



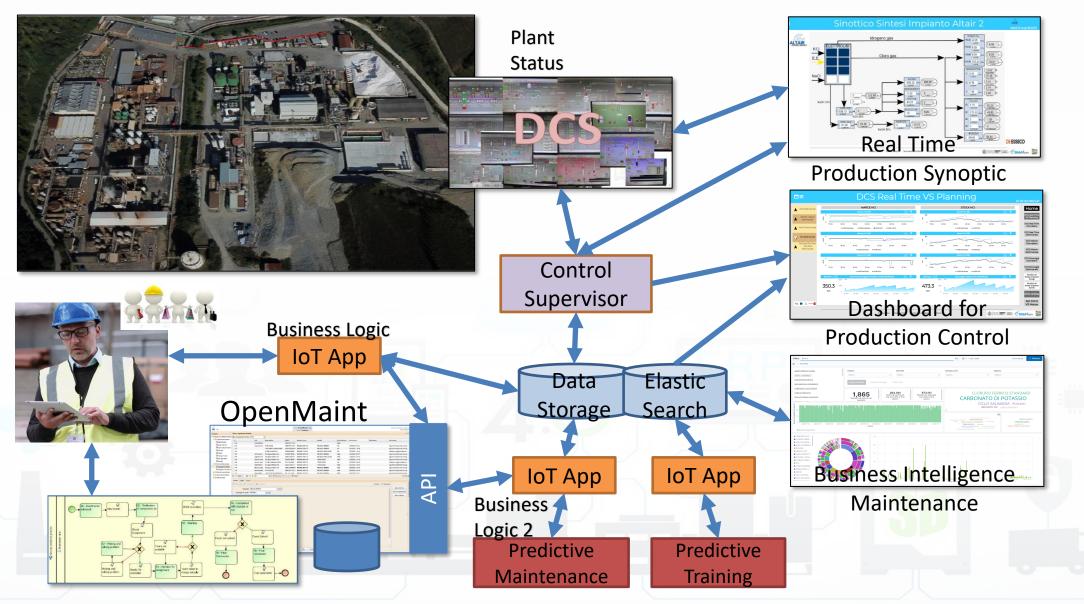






Solution













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	II – IIIJ
ConversionNaOH -	NaOH KOH	electrolysis load adjustment (production)	kA
ConversionKOHlinea1		electrorysis load adjustment (production)	KA
KOH_1_charge - KOH_2_charge	NaOH KOH	flow rate measure and totalization	m3
S487 - S484 - S5104	NaOH KOH	Storage level indication	%
hypo sodium	sodium hypochlorite	dium hypochlorite quantity of material produced	
S851 - S852 - S854 - S856 - S857	sodium hypochlorite	Storage level indication	%
S871	HCl	Storage level indication	%
RedoxFeCl3Pot	Ferric Chloride std	potential measure redox Ferric Chloride	mV





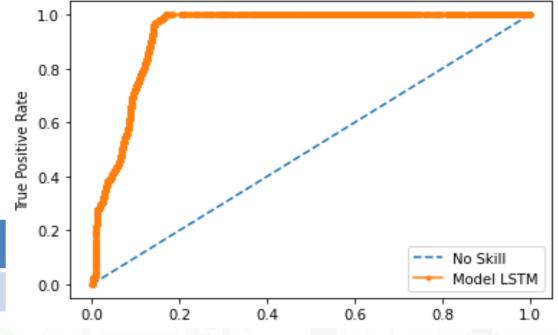




Preditive capabilities

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

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



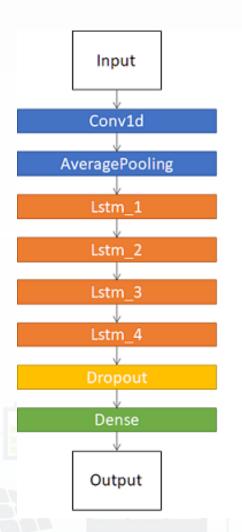






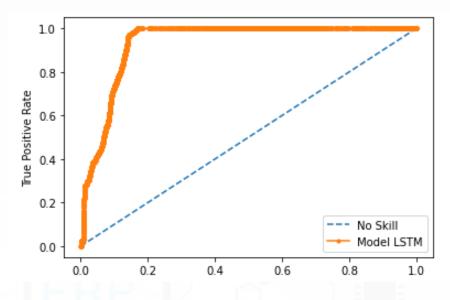


Classification model CNN-LSTM



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

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



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







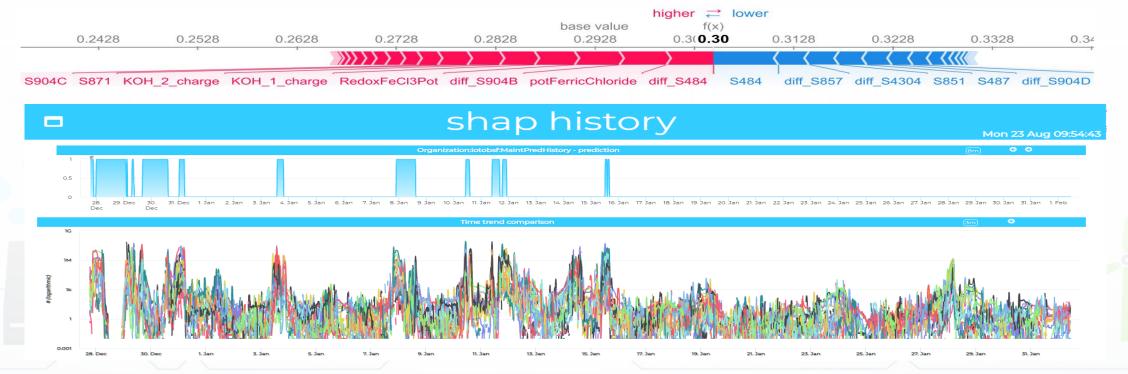


Explainable/XAI - CNN-LSTM (SHAP)

Explanation of prediction generated by model for fault



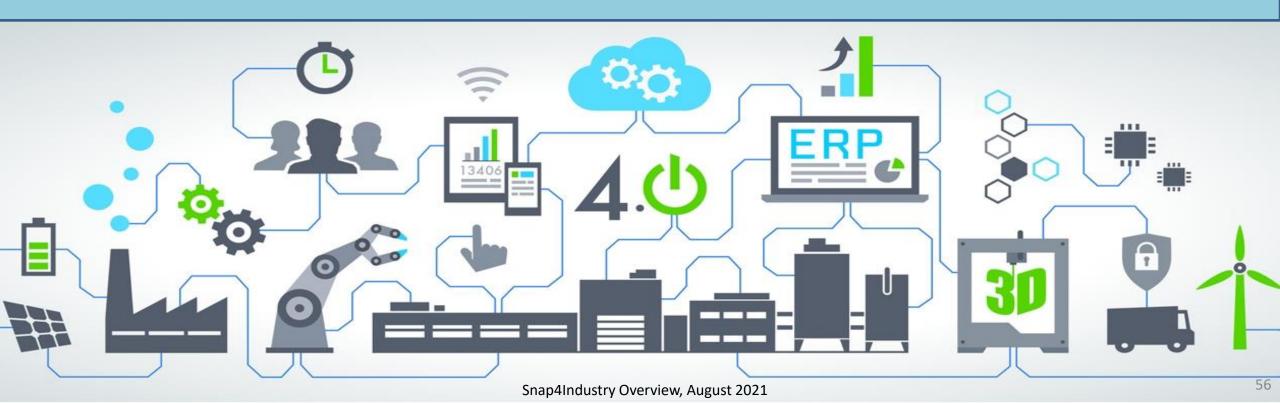
Explanation of prediction generated by model for normality







WHAT-IF Analysis











What-IF analysis

	What happened	What is going on now	What is going to happen	What-if: what is going to happen if this and that
Historical Data, HD	✓		×	
Real Time, RT, Observed Data + HD			×	
Analytical Models, AM + RT + HD	✓		*	*
AM + Simulations + RT + HD	✓			
AM + Predictions (AI, Machine Learning) + Simulations + RT + HD				

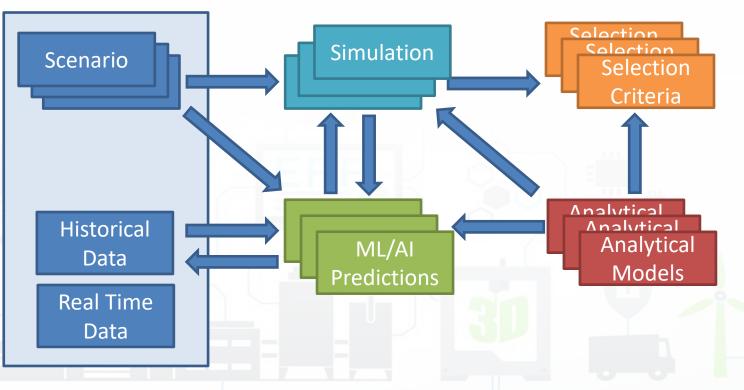




What-if: what is going to happen if this and that

- what is going to happen at:
 - Production, selling, …
 - People, Economy, social, ...
 - **—** ...
- This and that context:
 - Scenarios
 - Historical Data
 - Real Time Data

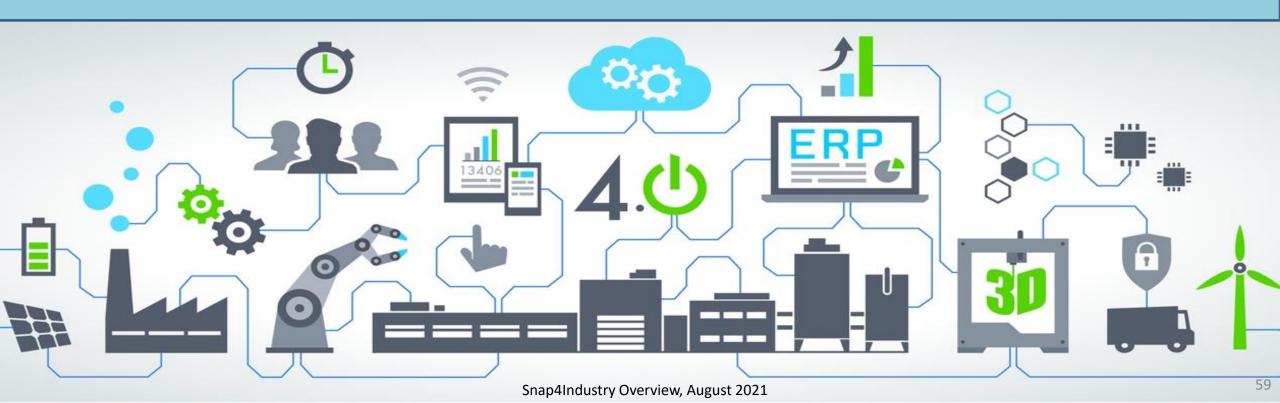
Decision Support System KPI, Optimization Visual Analytic: animations







Business Intelligence



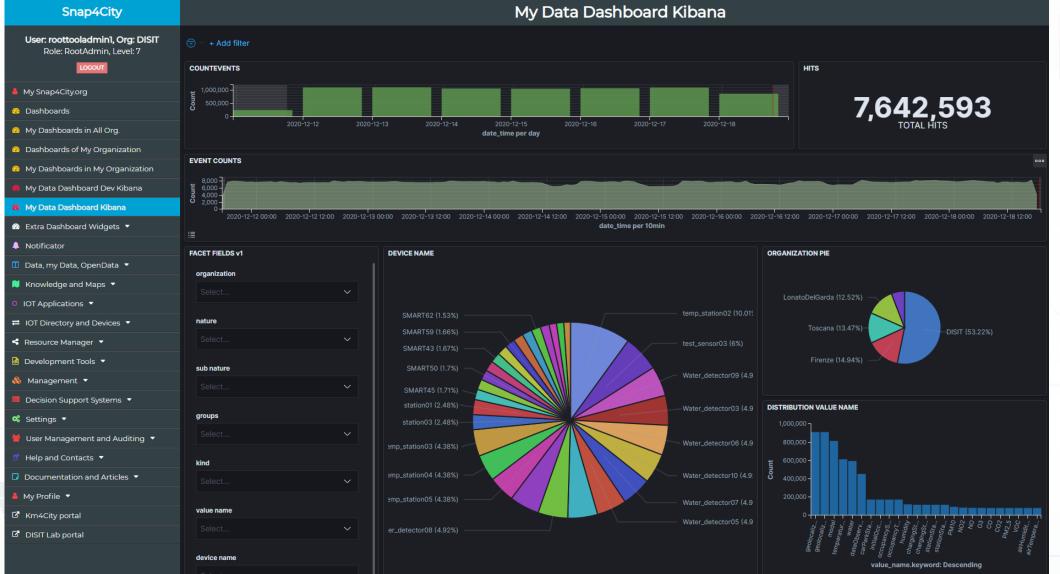








DevDash: My Data Dashboard Kibana













Business Analysis Dashboards For all kind of users: DevDash

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





- 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





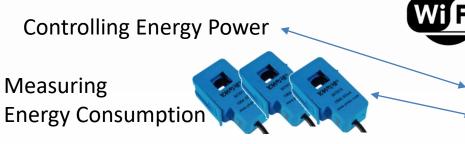




















Any kind of notification channel



IOT Edge: Node-RED

Snap4City



Local Control





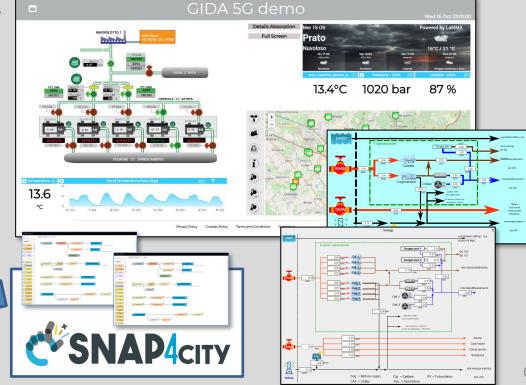
ODBC

Alexa: Voice Commands

WiFi

Snap4Industry Overview, August 2021

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



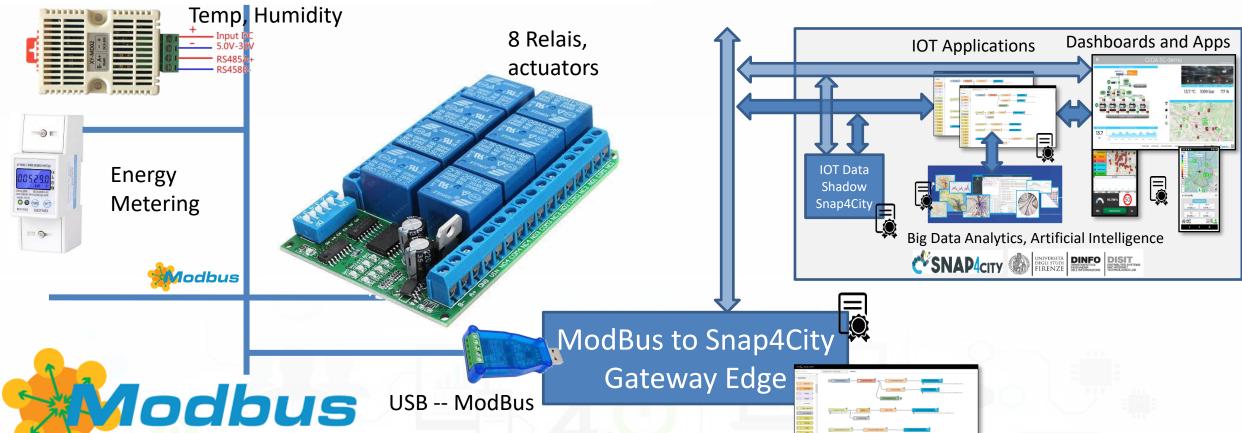






Devices





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



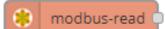


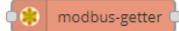


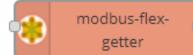


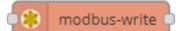






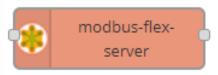


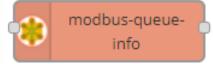






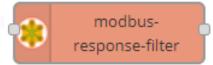
modbus-server

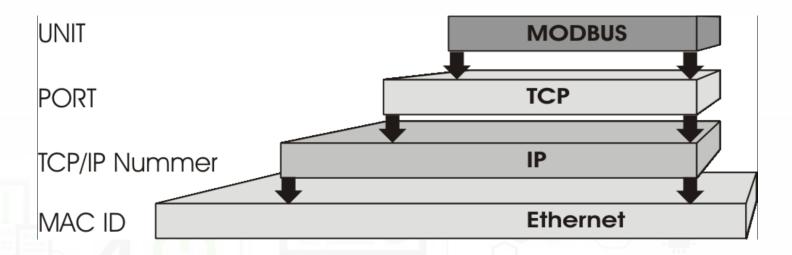






modbus-io-config



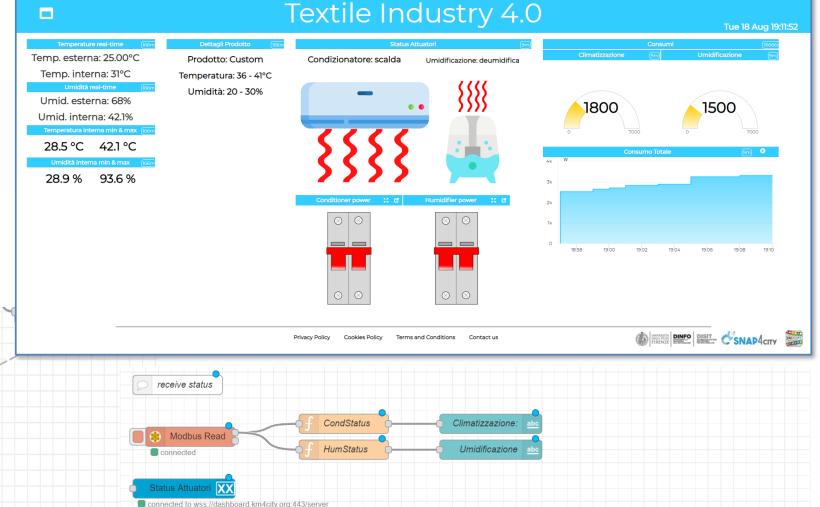


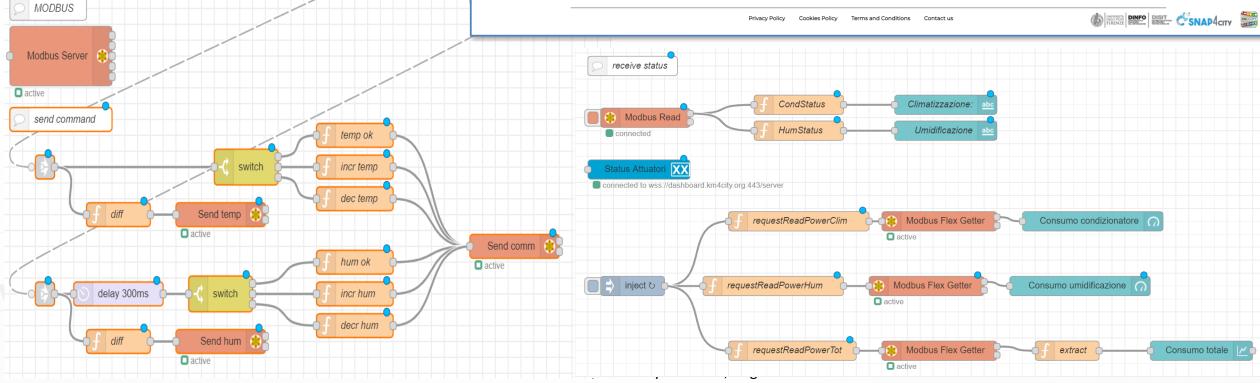




DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB













loT edge







Motion Control / Alarm



TP Link plugs: meter















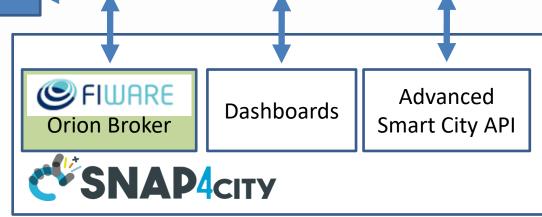


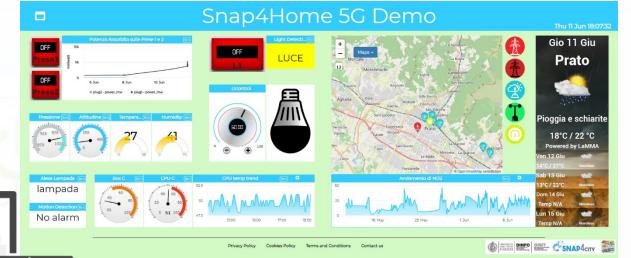
SNAP4city **IOT Edge:**

Raspberry pi: **Node-RED Snap4City** MicroServ ice

Library

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





69

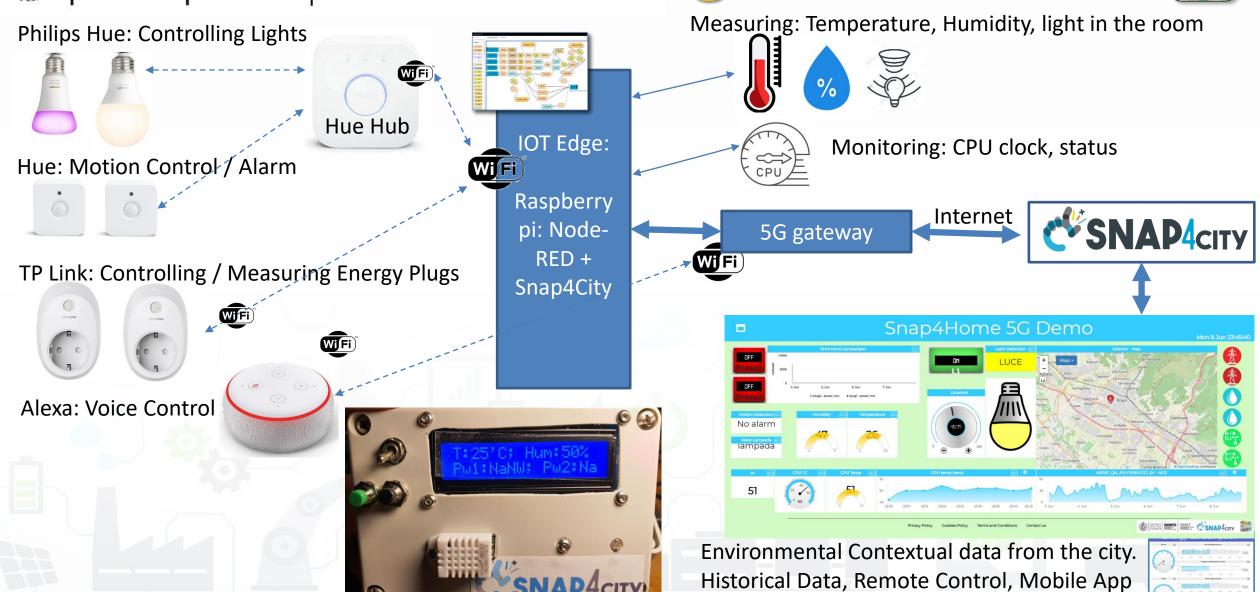






IoT edge







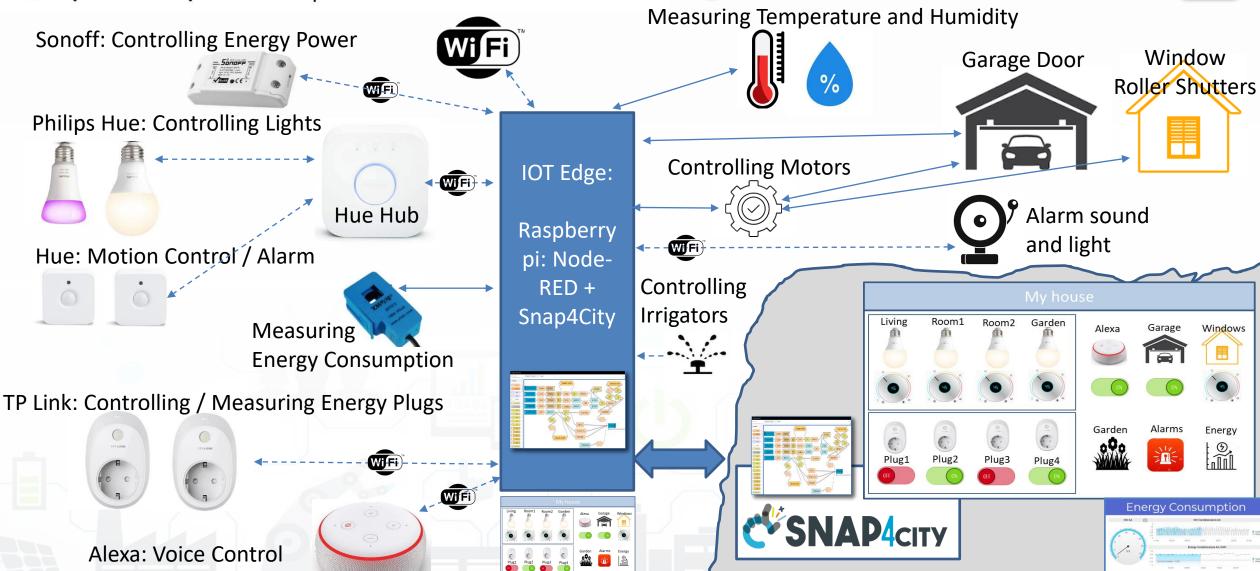


IoT Edge



Environmental Contextual data from the city

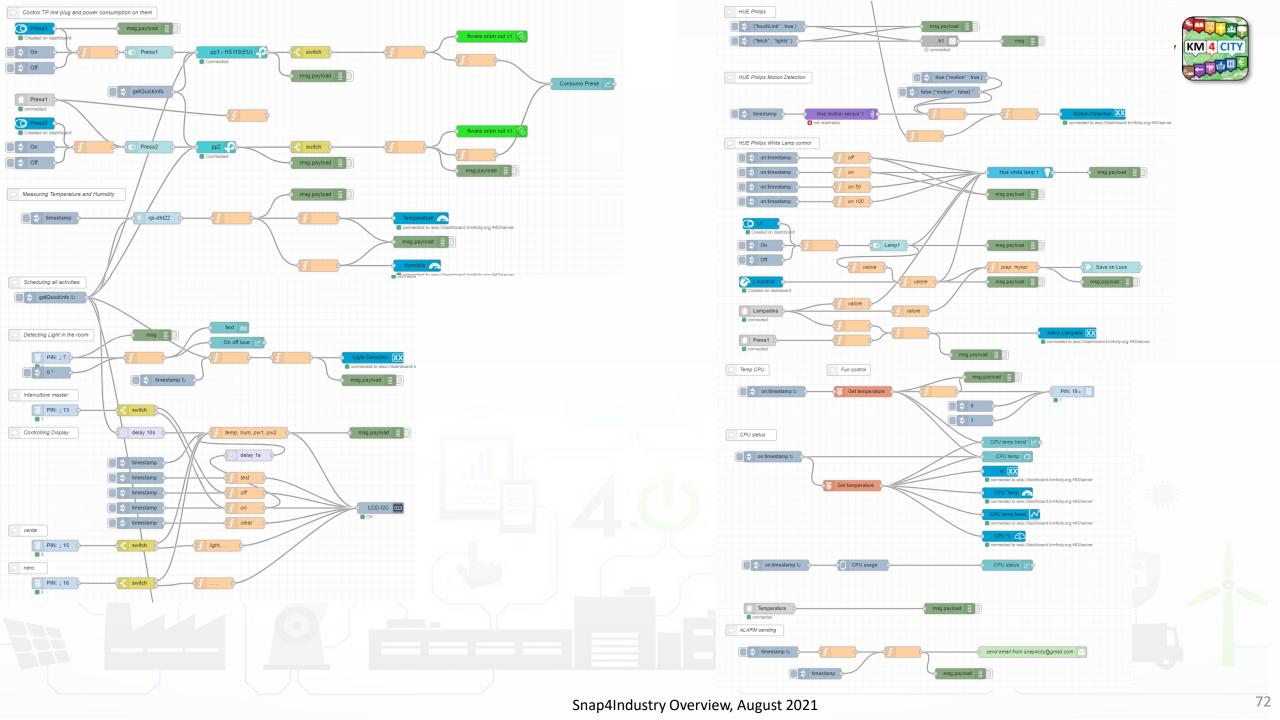
Historical Data, Remote Control, Mobile App



https://www.snap4city.org/620

Snap4Industry Overview, August 2021

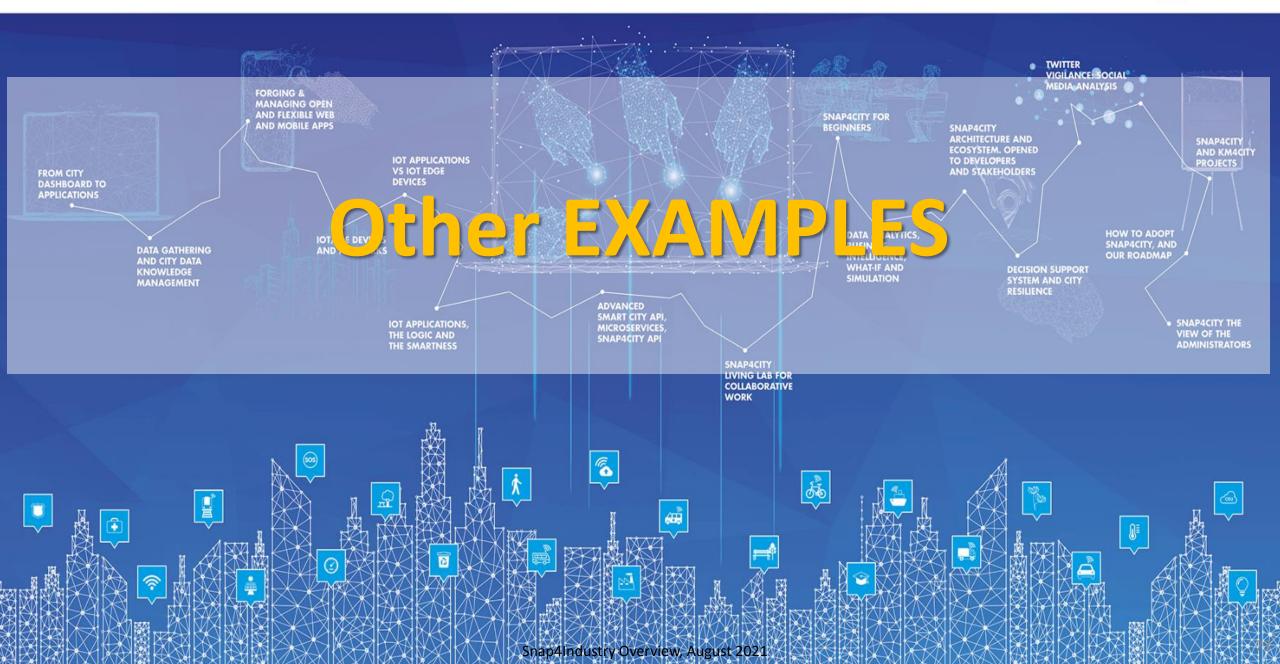
Local Control



SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT SNAP4INDUSTRY



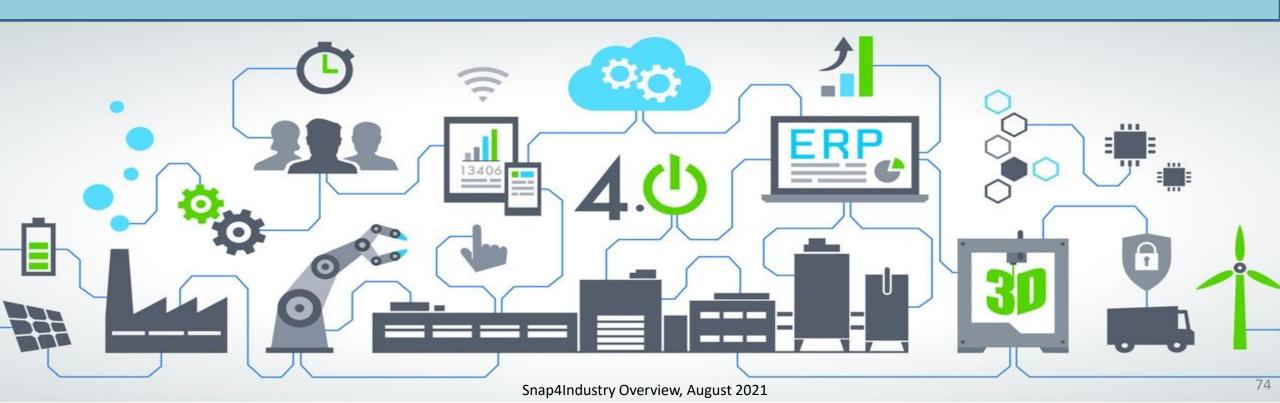








IoT Health Scenarios



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:

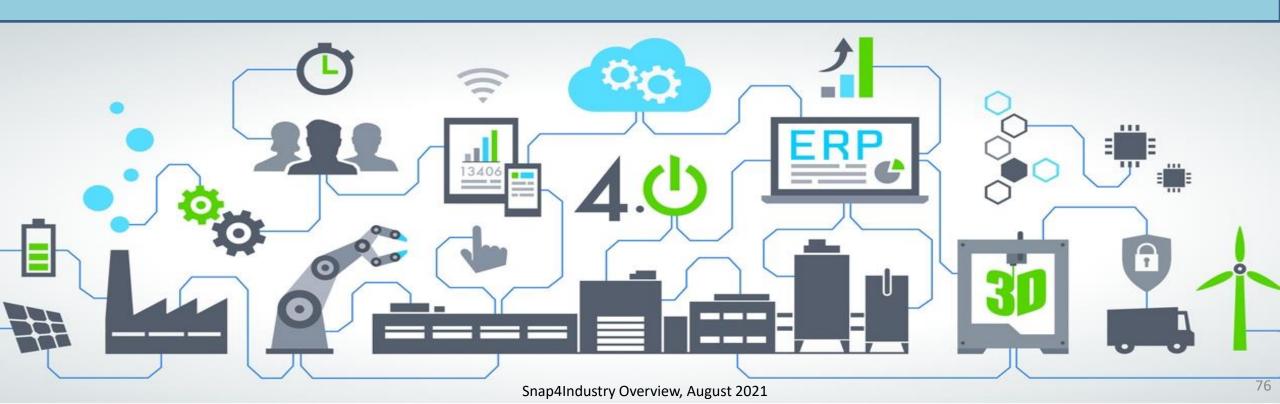
Collecting and managing data from smart bed sensors, monitoring parameters in realtime







Water Depuration Plant







GIDA set up

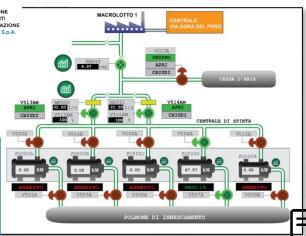




Smart City data from many sources

Modbus

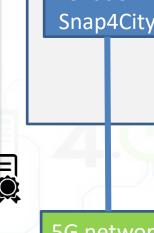


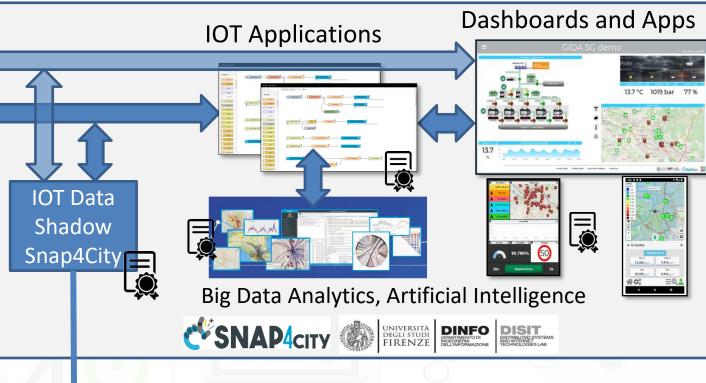


ModBus to

Snap4City

Gateway Edge





5G network devices Telemonitoring Telecontrol

ZTE



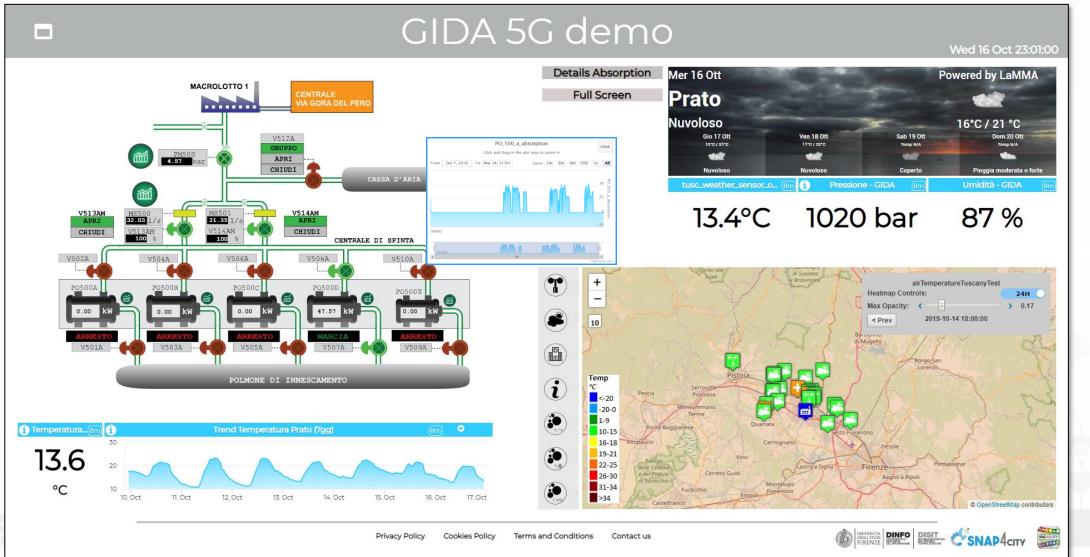
Demo UC5 GIDA







SNAP4city





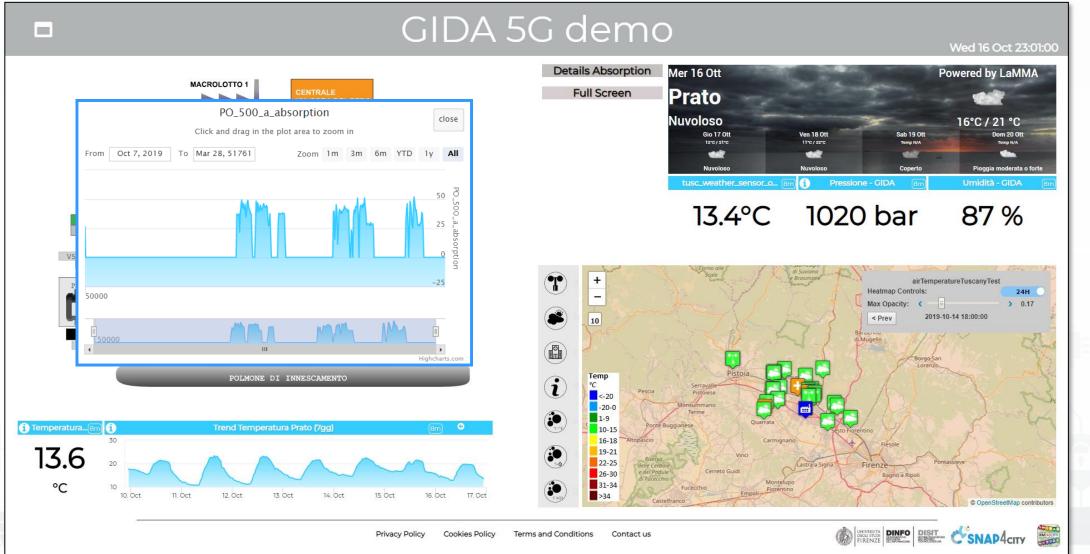
Demo UC5 GIDA







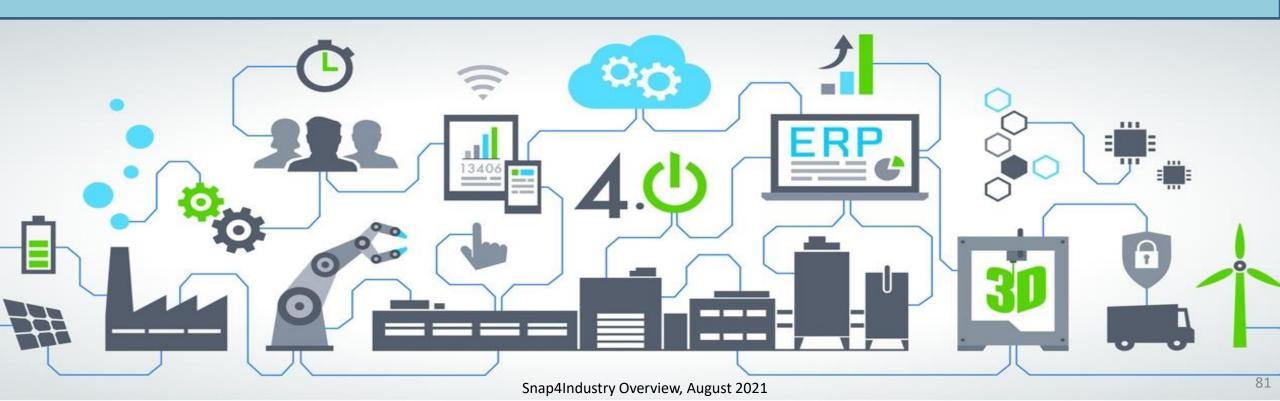








Retail Recommendations Feedback Pilot









Smart Retail

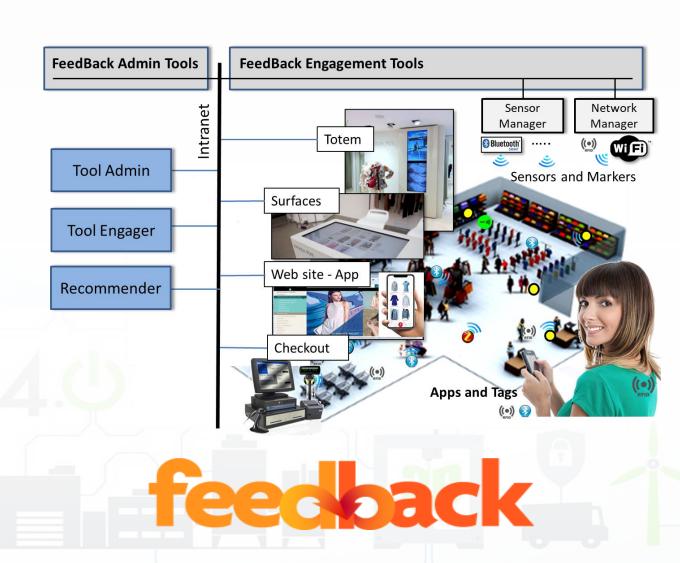


- Feedback, Flexible Advanced Engagement Exploiting User Profiles and Product/Production Knowledge
 - VAR, PatriziaPepe (Tessilform), DISIT, Effective Knowledge, SICE
 - Keywords: retail, GDO, ...

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





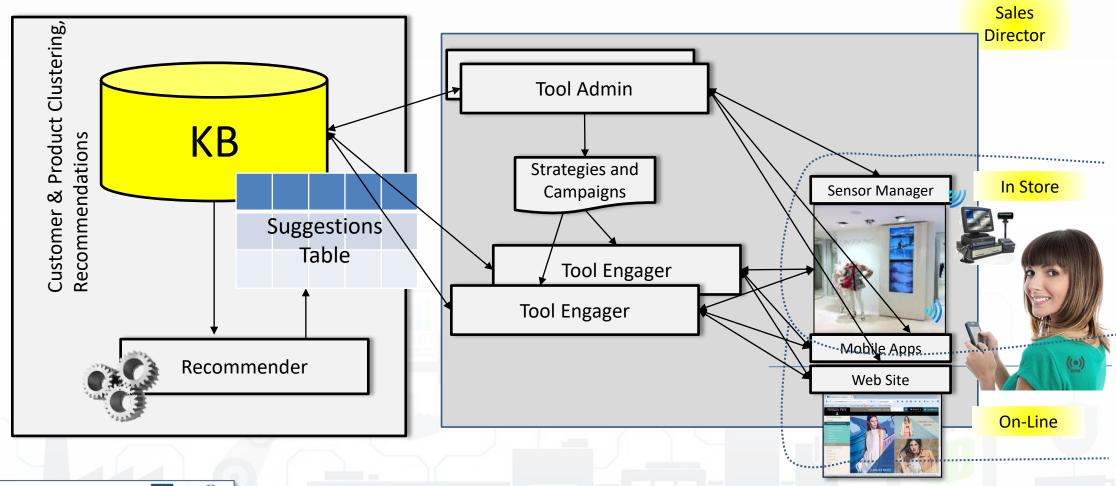








Reference Architecture







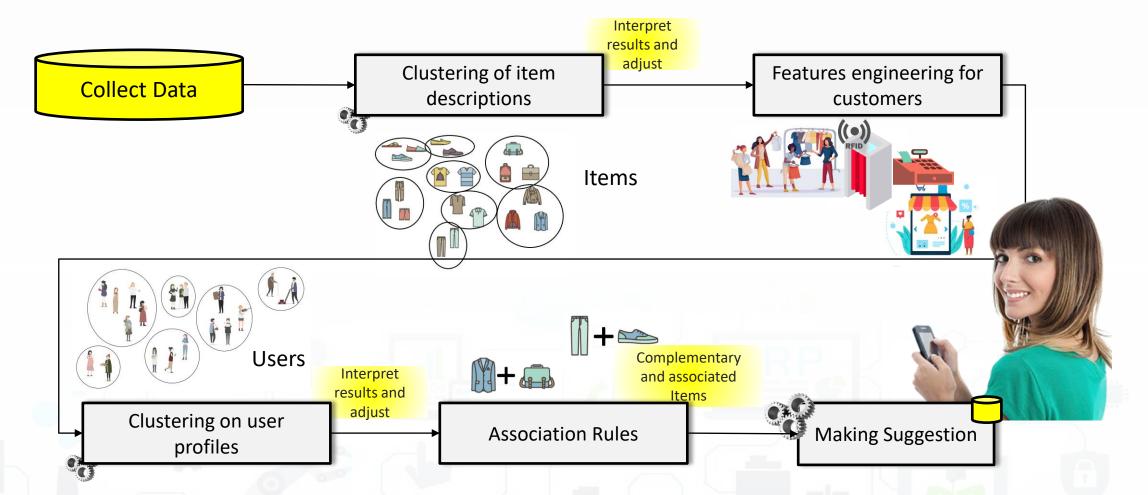








Workflow

















- 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







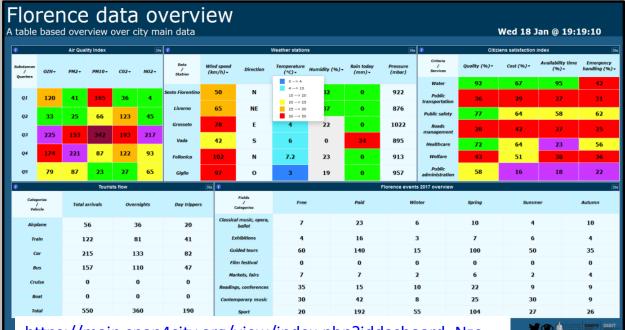




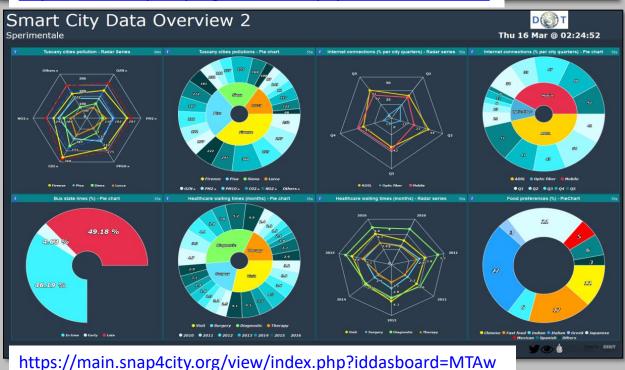
Creation of Dashboards and Applications

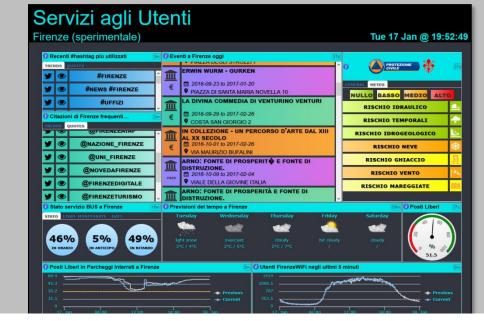




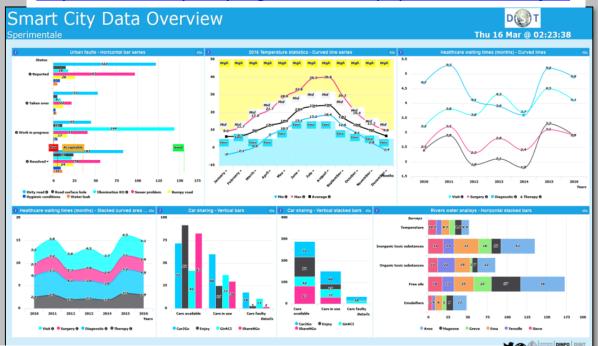


https://main.snap4city.org/view/index.php?iddasboard=Nzc=





https://main.snap4city.org/view/index.php?iddasboard=NjQ=



https://main.snap4city.org/view/index.php?iddasboard=ODM=

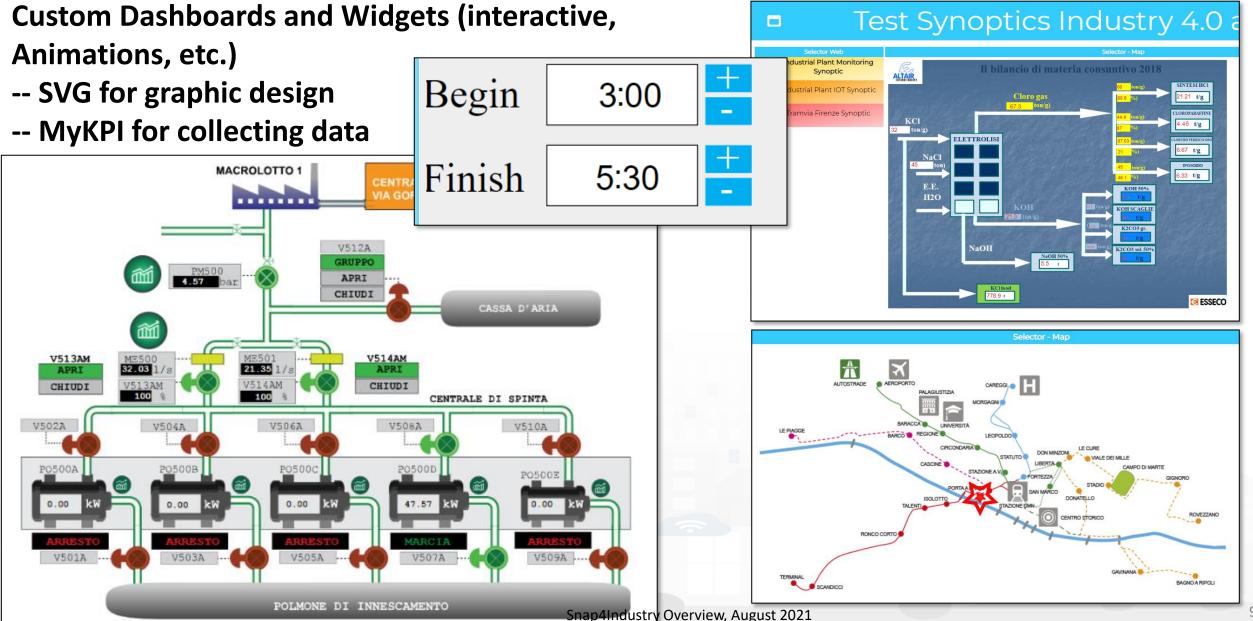




DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB CUSTOM Widgets







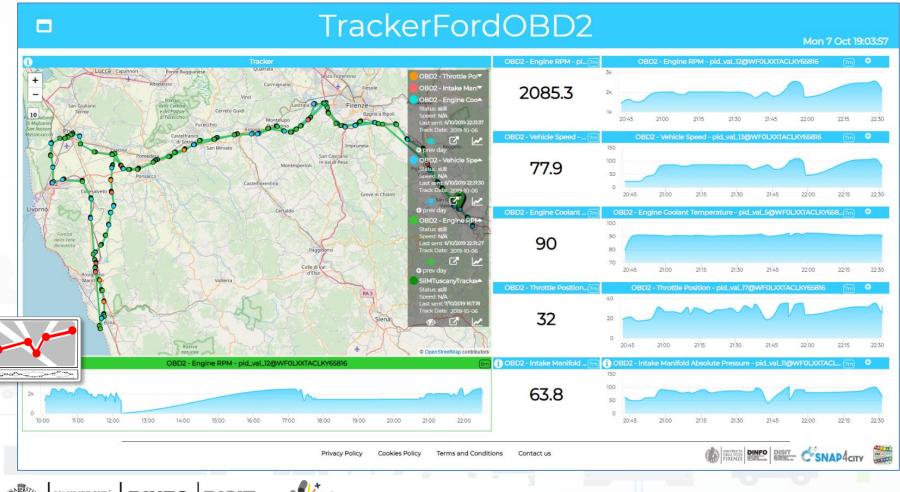




MyKPI: Tracking of Devices and Mobiles • Real Time Trajectories for

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















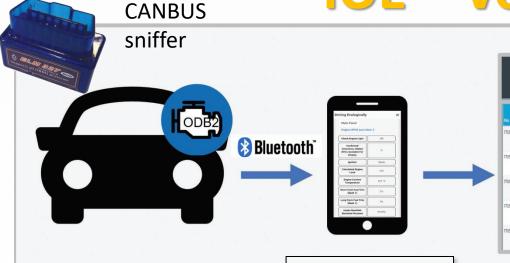








IOE – Vehicle Monitoring

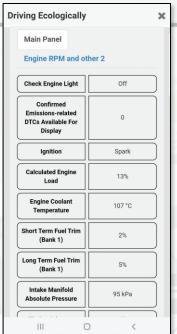


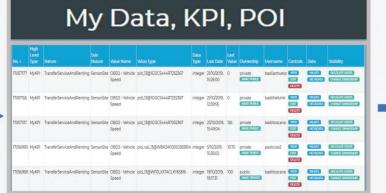
Tuscany in a **Snap Mobile**

App on **Android**

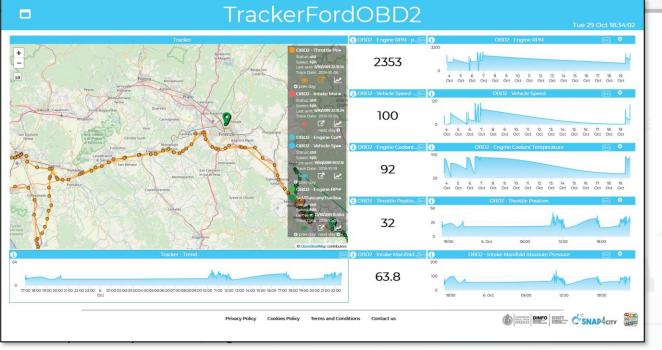




















Special Custom Widgets

Smart parking

Smart Energy

Smart Light

Smart

Begin

Finish

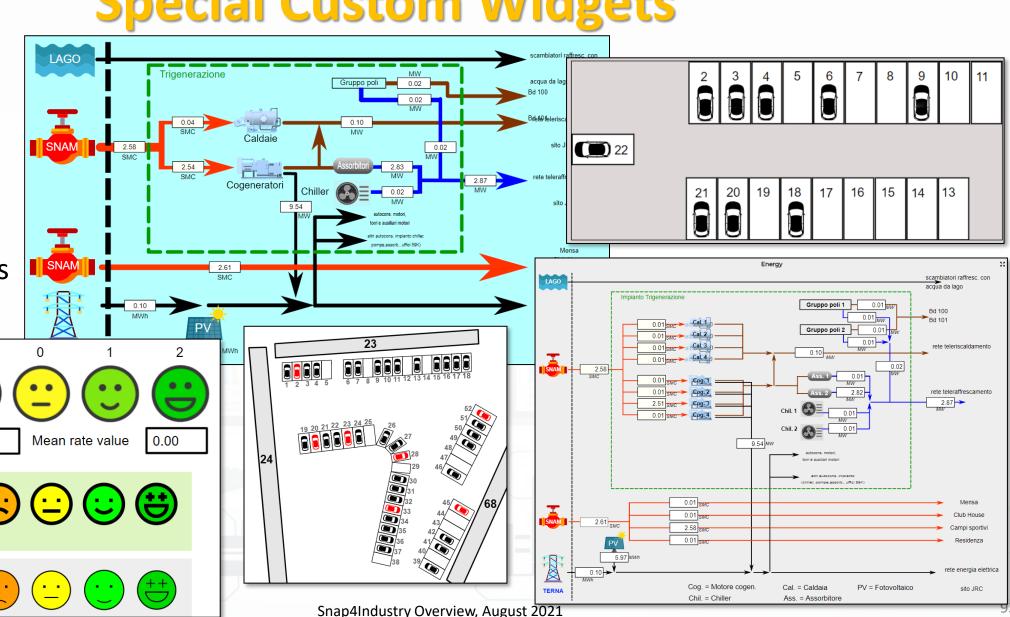
Energy View

Custom Controls

Total clicks

17:00

4:00





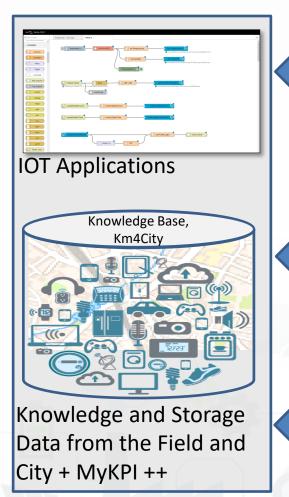




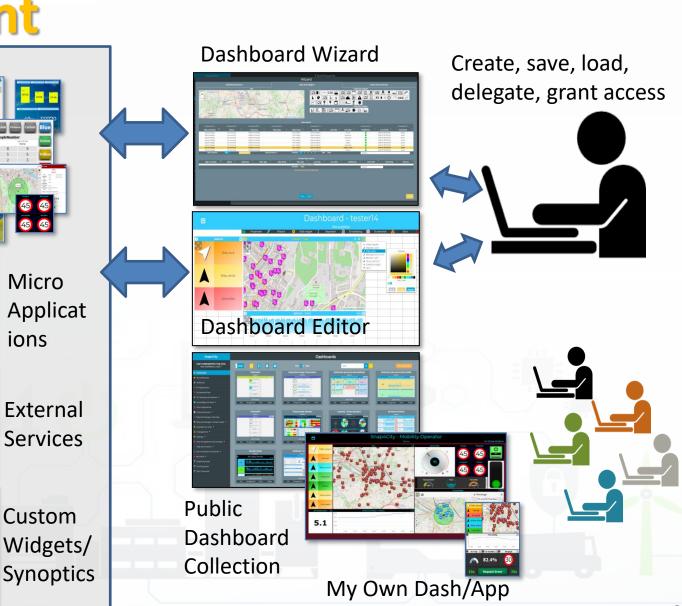




Dashboard Development







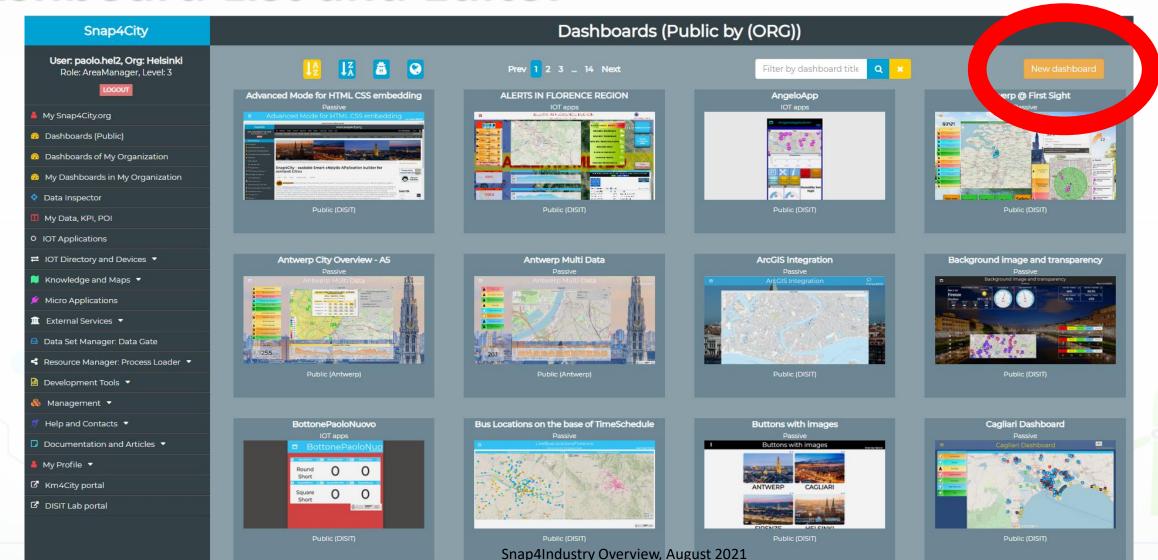








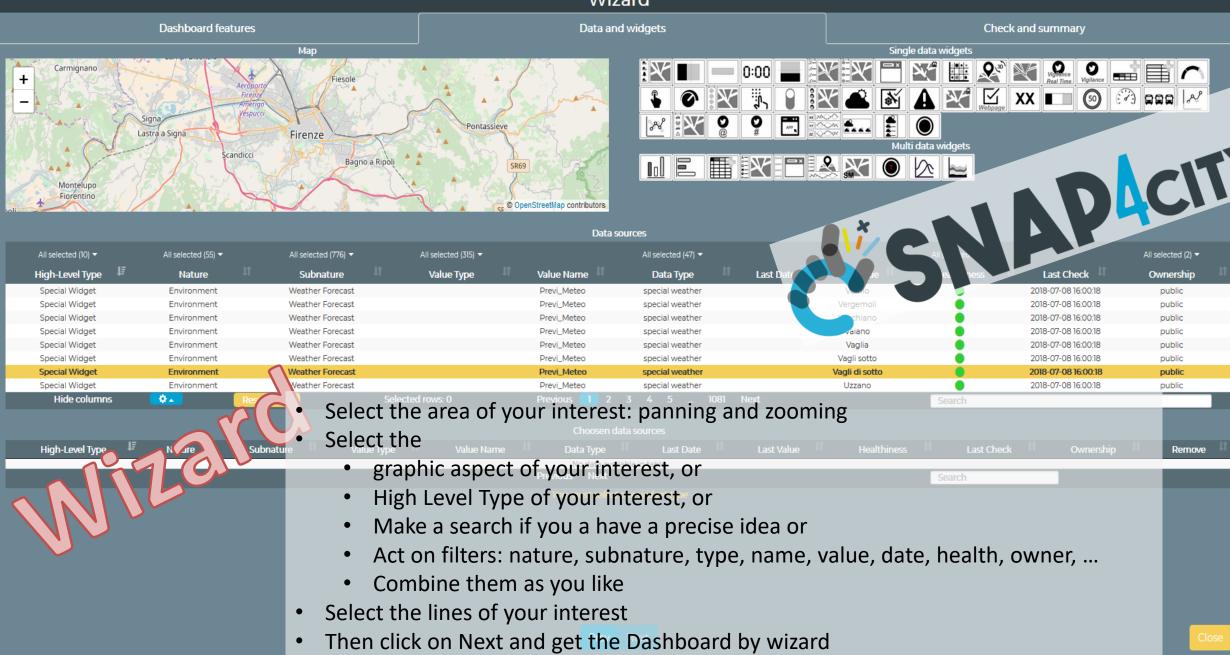
Dashboard List and Editor



Snap4City

Wizard

Dashboards





IOT Applications

Knowledge Base, Km4City

Knowledge and Storage

Data from the Field and

City





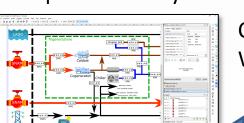


stom Widget / Synoptic Development
Inkscape editor on your computer



SVG Symbols Collection

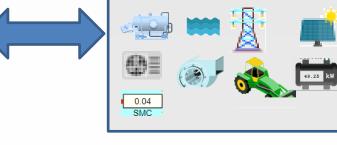




Create, save a Custom Widget in SVG



Create, save, load, delegate, grant access





Public

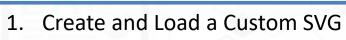
Dashboard Collection

My Own Dash/App









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



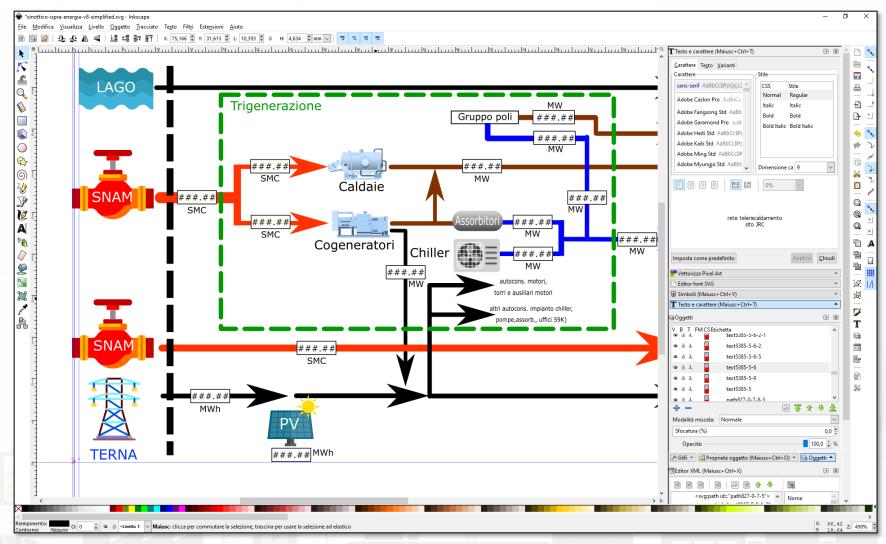












How to create a custom Widget



User manual on: https://www.snap4city.org/595

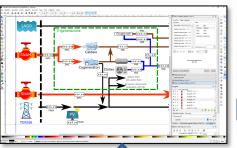








Create, save a Custom Widget in SVG



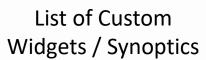
SVG Symbols Collection

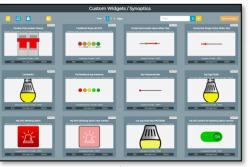
From any open library



Upload as Custom Widget Template





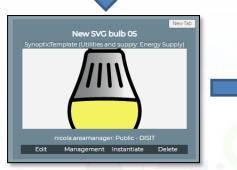








select







Final Dashboard

Select MyKPI and Sensor Data for Synoptics cases



Instantiate as
Custom Widgets /
Synoptics
Connect with
WebSockets





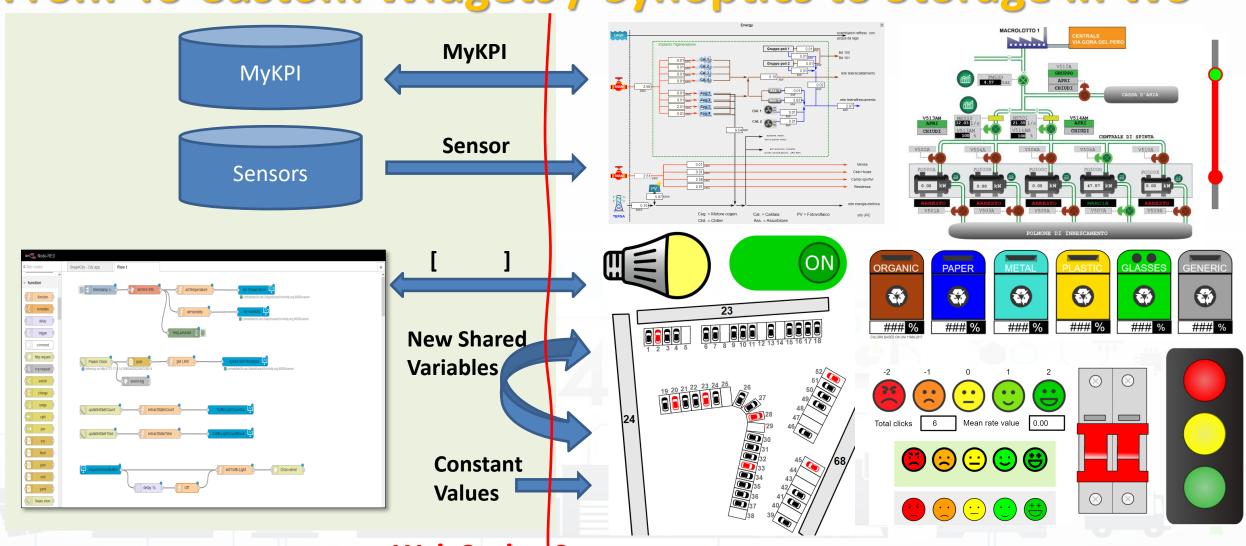








From-To Custom Widgets / Synoptics to Storage in WS



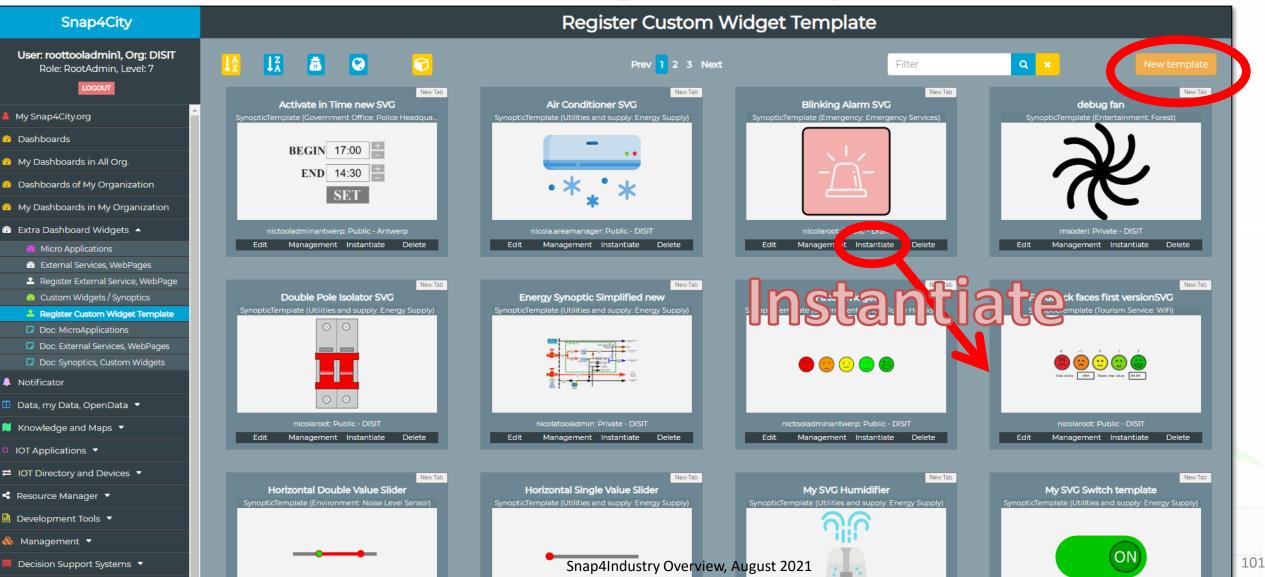








Custom Widgets Templates







Dashboards summary and further readings

- Suitable as: City Dashboard, App interface, and Control Room Dashboards, Situation Room Dashboard, Operator Dashboard
- Created visually compounding graphic Widgets
 - Each widget can be set to have an autonomous update
 - Each metric/data-source may have associated with an alarm: blinking and sending events to people and machines in different manners
- Can be: public or private, private dash can be delegated or passed in ownership
- See https://main.snap4city.org/management/dashboards.php?linkId=dashboardsLink&fromSubmenu=false&sorts[title_header]=1
- See the following tutorials
 - HOW TO: create a Dashboard in Snap4City
 - HOW TO: add data sources to the Snap4City Platform
 - US1. Using City Dashboards
 - US2. Using and Creating Snap4City Applications with Dashboards
 - US4. Creating City Dashboards and related Event Monitoring and Actions









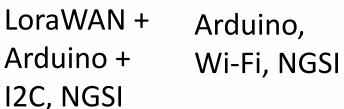


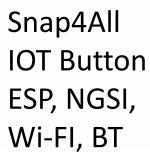






IOT Devices







Snap4All PAX Counter LoraWAN WIFI, NGSI, GPS

Sensors/ **Actuators**

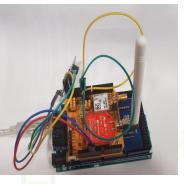


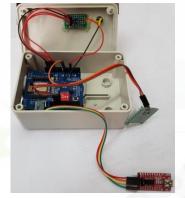
IOT Edge Devices

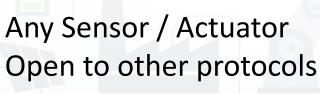
IOT Edge NodeRED: Raspberry Pi, NGSI, WiFi, RJ45,...



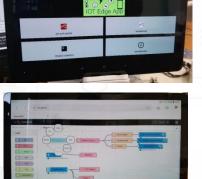
LoraWan Gateway: IOT Edge, NGSI, WIFI, RJ45, GPS









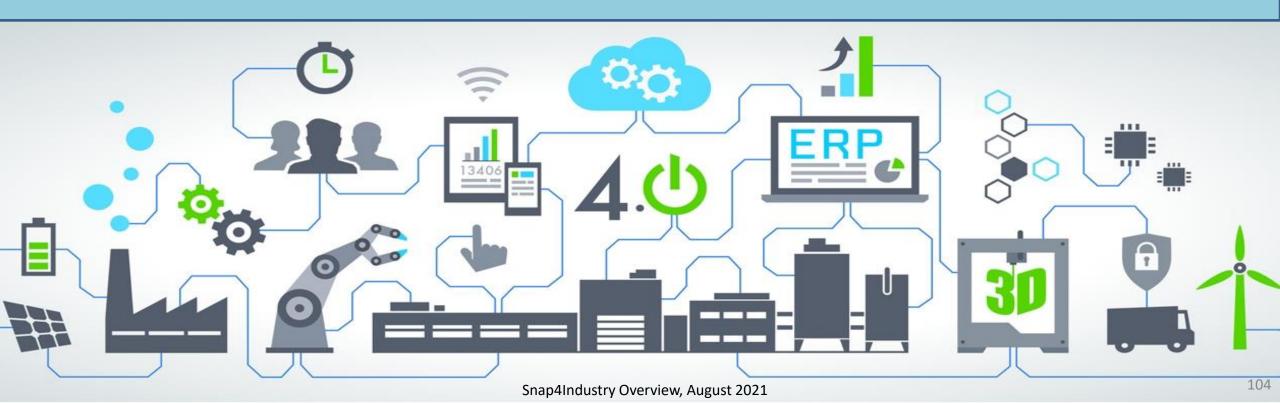








Dashboards' Intelligence on Web and Mobile Devices



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











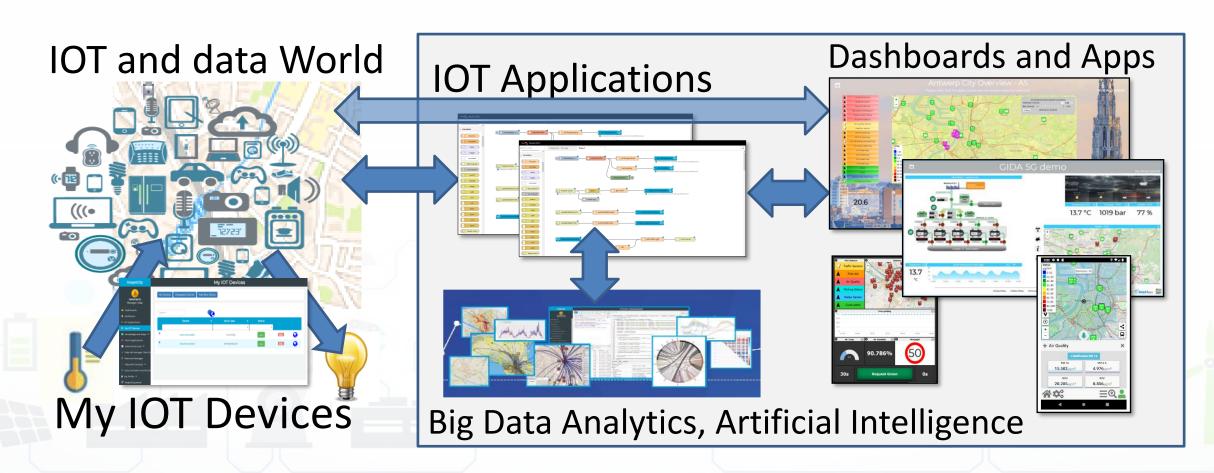






Sentient Solutions

Dashboards with data driven IOT Applications enforcing intelligence



IOT Discovering

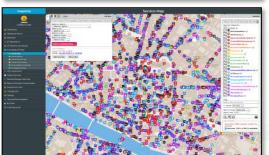




IOT Applications Development

MicroServices collections

| Comment of the comm



ServiceMap Discovery



My IOT Applications

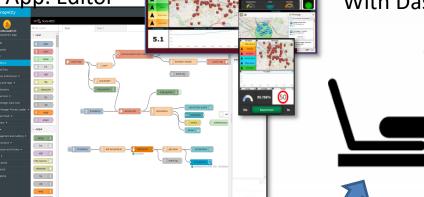




Dashboard Collection, Editor and Wizard

IOT App. Editor

Generating IOT App
With Dashboard

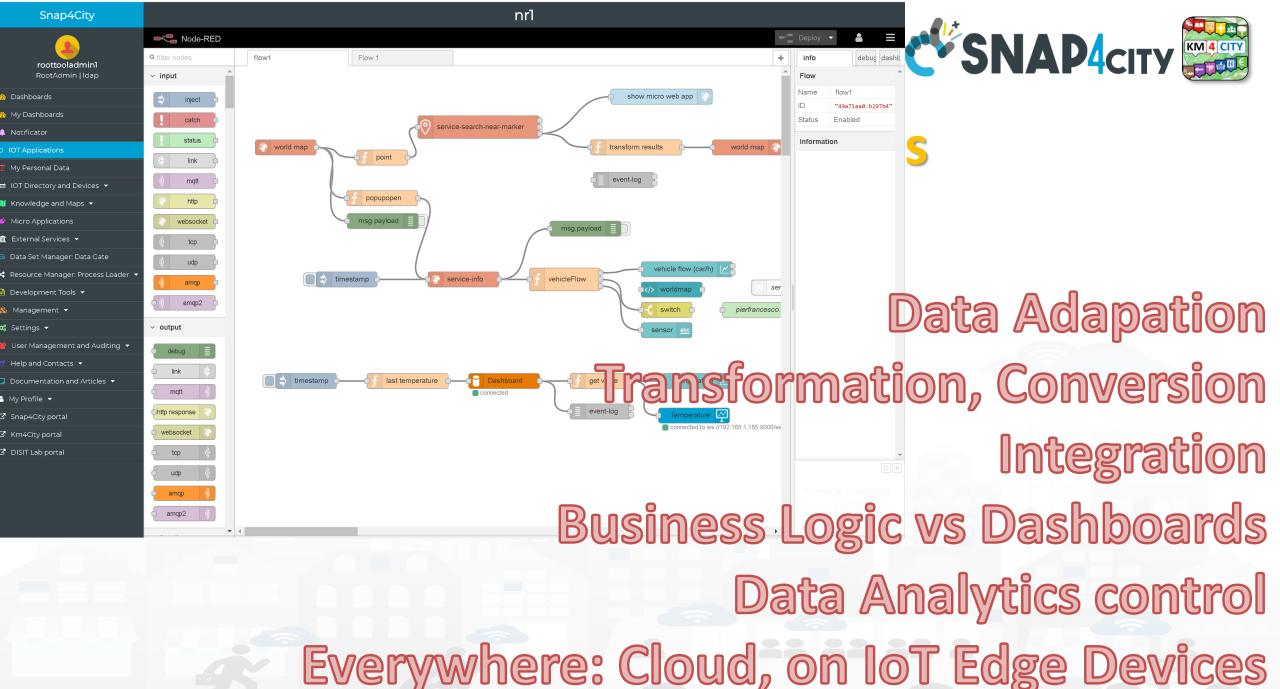


Sharing/saving reusing IOT App



Resource Manager







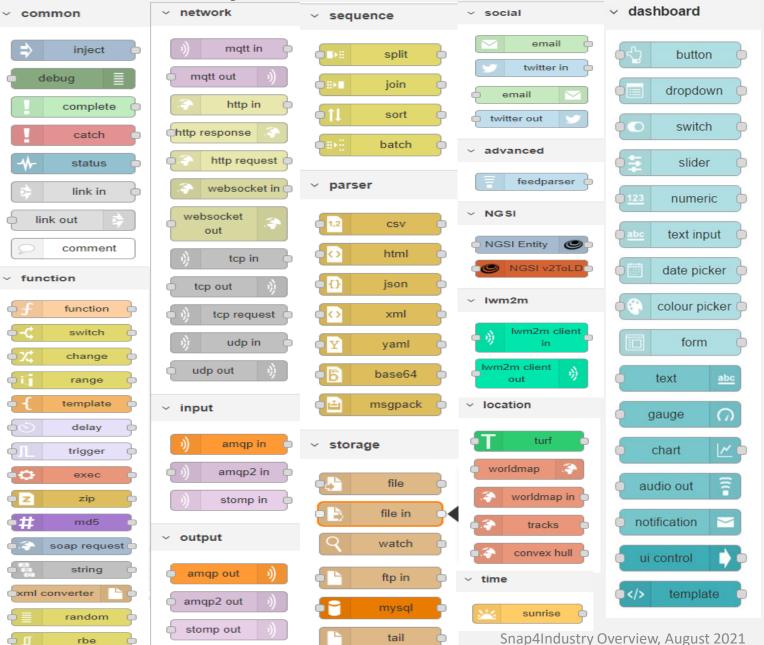




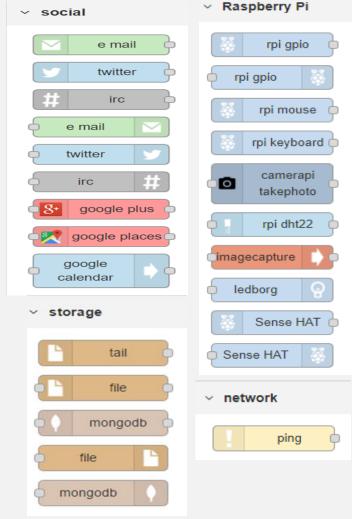
- **Data ingestion**: more than 70 protocols IOT and Industry 4.0, web Scraping, external services, any protocol database, etc.
- **Data access**: save/retrieve data, query search on expert system, georeverse solution, search on expert system Km4City ontology, etc.
- **Data Transformation/transcoding:** 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.

Basic Node.js Blocks on NodeRed on our Advanced IOT Apps





+ on IOT Edge Raspberry





> time

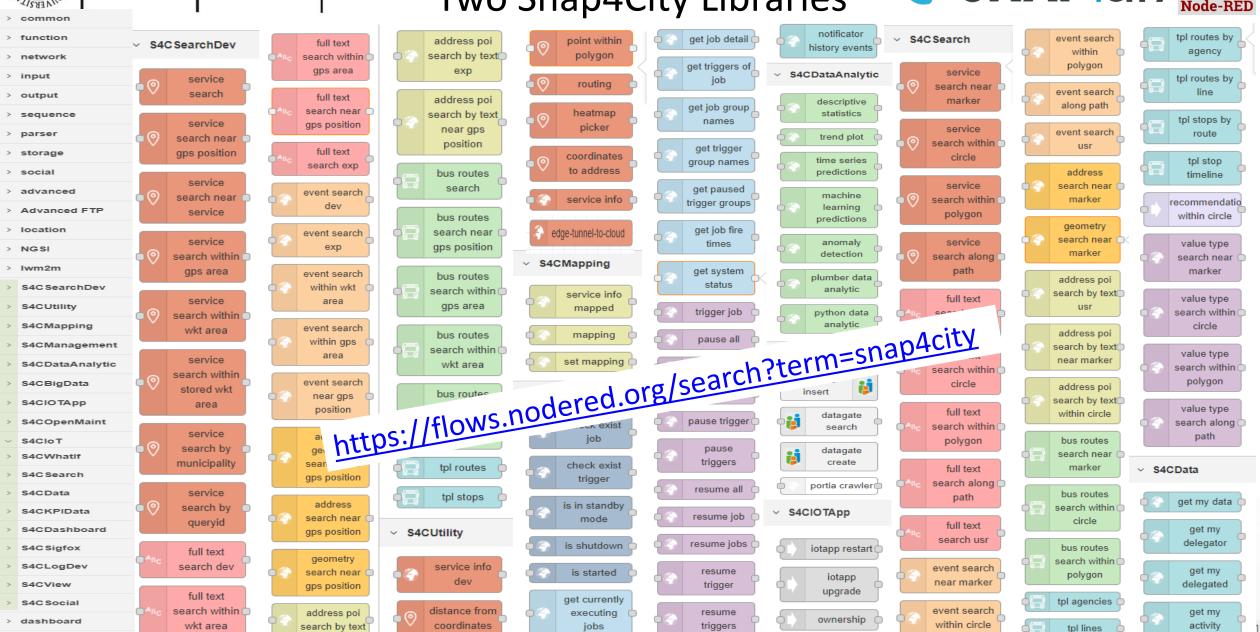
DELL'INFORMAZIONE

DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

April 2021 collection
Two Snap4City Libraries









DELL'INFORMAZIONE

DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

April 2021 collection SNAP4city Node-RED Two Snap4City Libraries







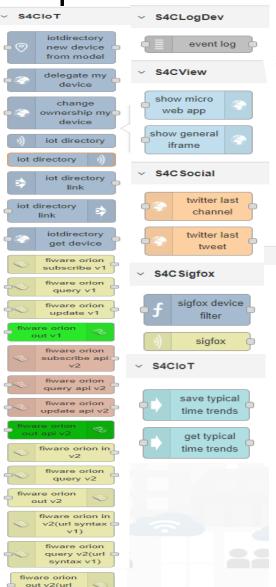
dashboard

> time

kpidata

values

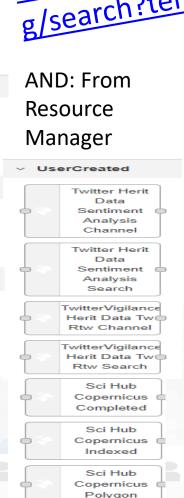




syntax v1)

process

snap4all



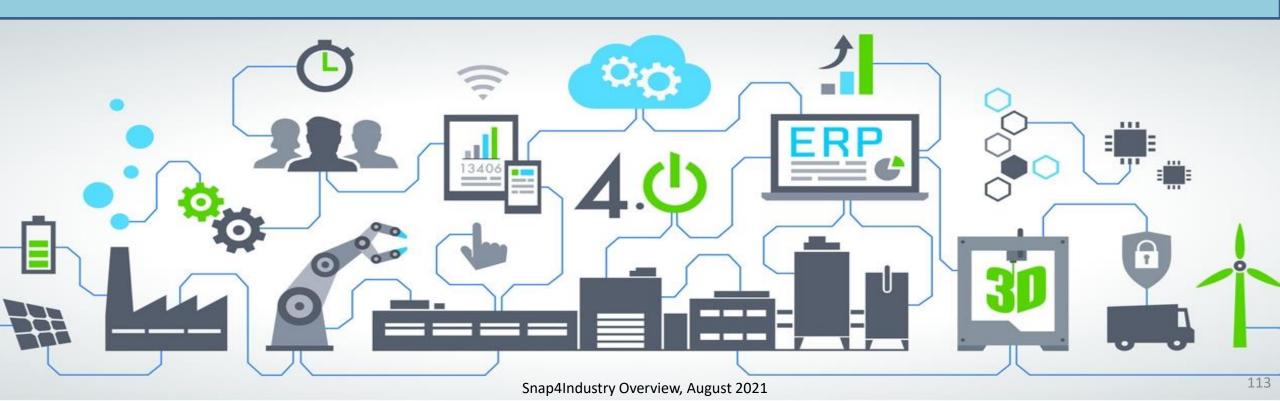
https://flows.nodered.or g/search?term=snap4city We suggest also to install:







IoT App: Virtual Sensors Actuators concepts













ingle content 💢

single bar

bar

time trend

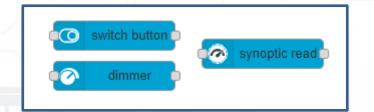
pie chart

curved line

ynoptic write 🧀

Advanced Feature of Snap4City Dash Widgets

- Dashboard widgets can be classified in:
 - Virtual Sensors
 - Those that produce the data From IOT App on Dashboard
 - Virtual Actuators
 - Those that produce the data From Dashboard to IOT App
- impulse
- Virtual Sensors Actuators
 - Those that produce/receive the data From/to Dashboard to/from IOT App



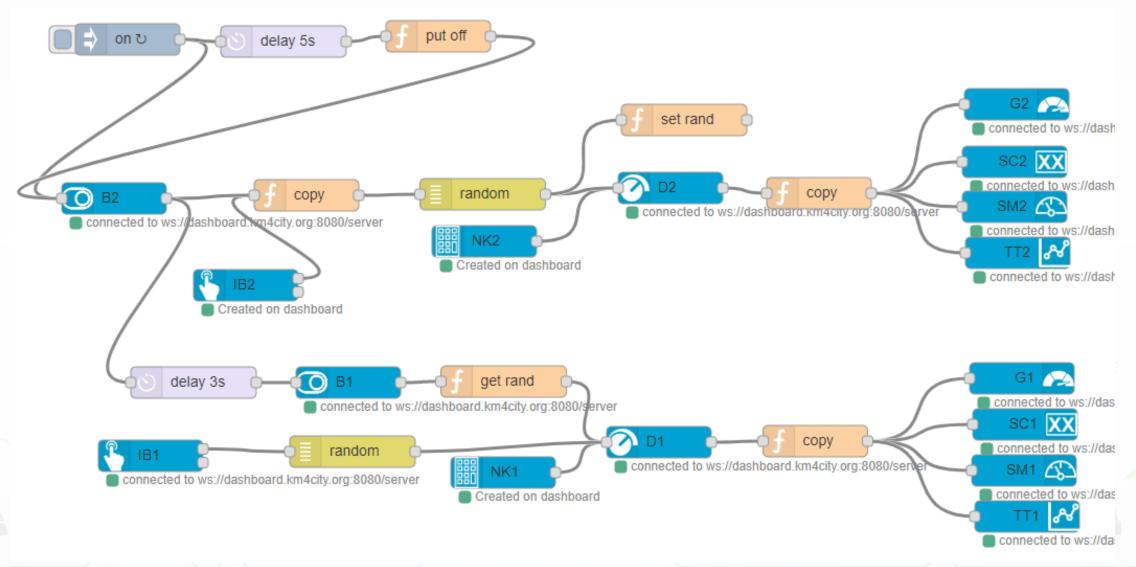
TC9.18: Advanced Features of Sensors Actuators of Dashboards vs IOT App







DINFO DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB Sensors Actuators Allow to change the set up





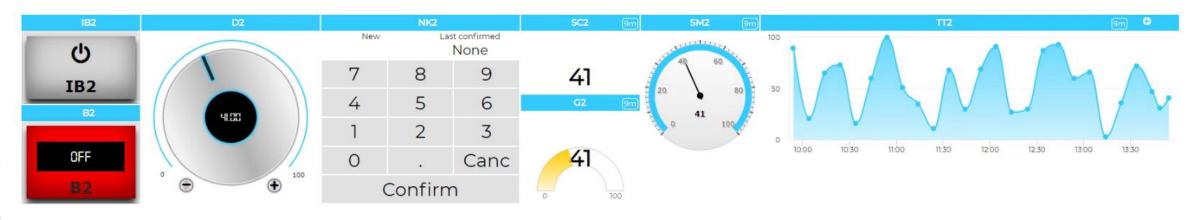
The SATEST Dash



Test SA and WS

Mon 27 Jul 13:54:33





Cookies Policy

Terms and Conditions

Contact us





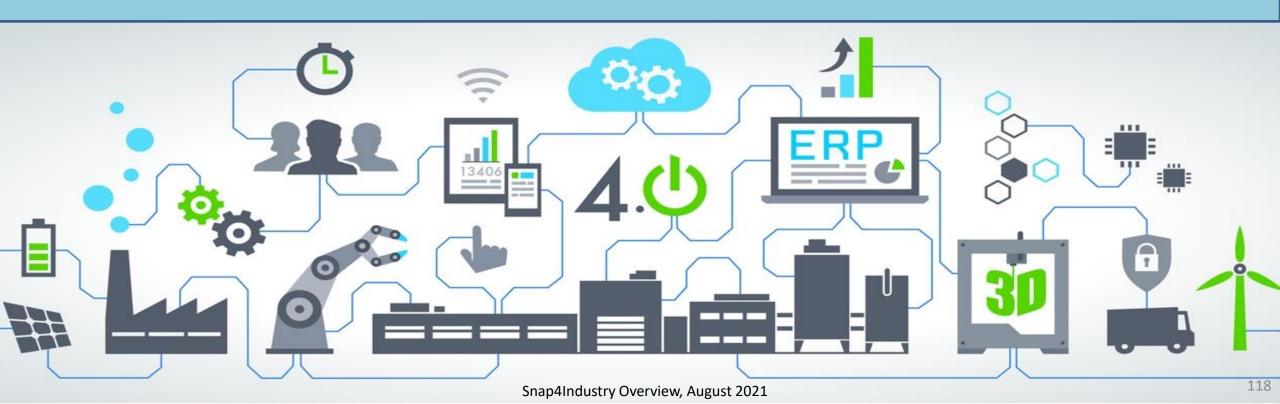








IoT App: with Synoptics



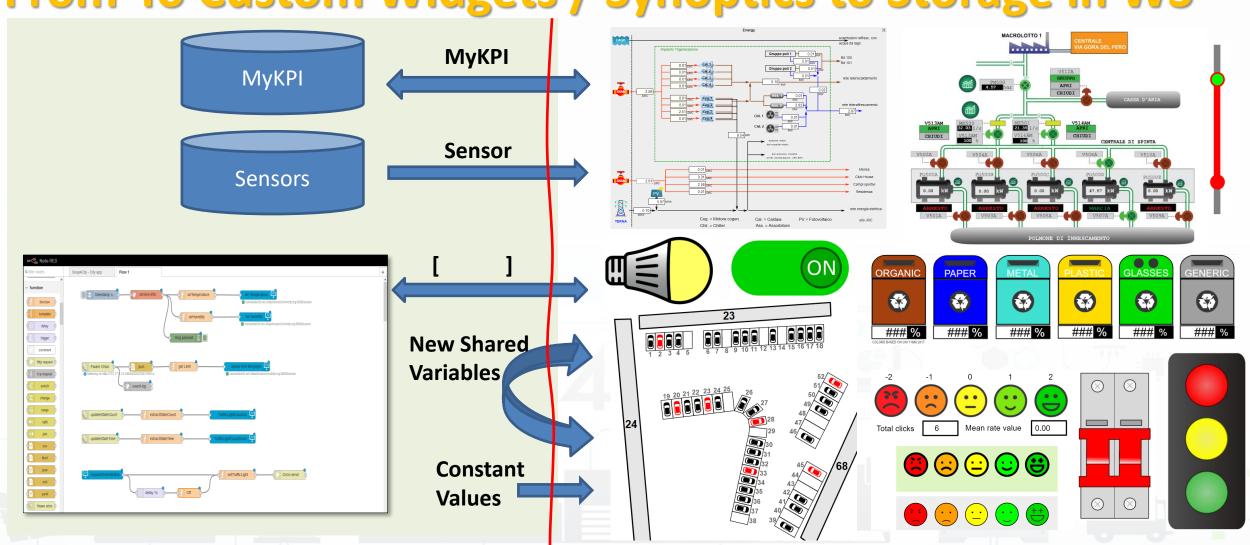








From-To Custom Widgets / Synoptics to Storage in WS

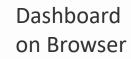






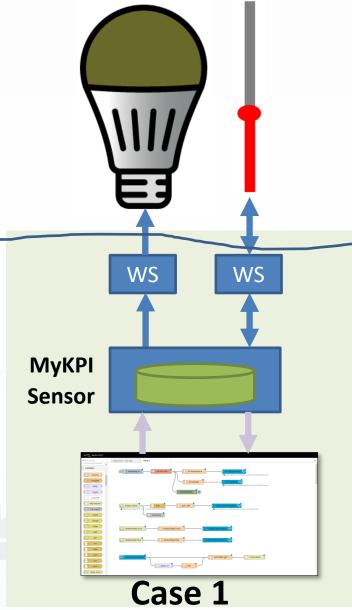


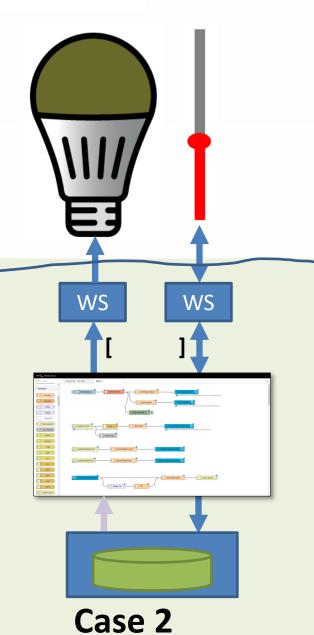


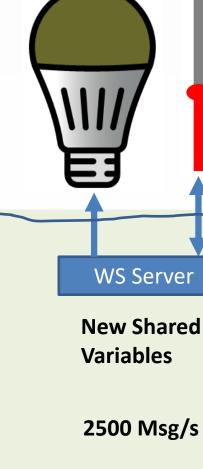


Internet

Storage and IOT App on cloud or on **Premise**







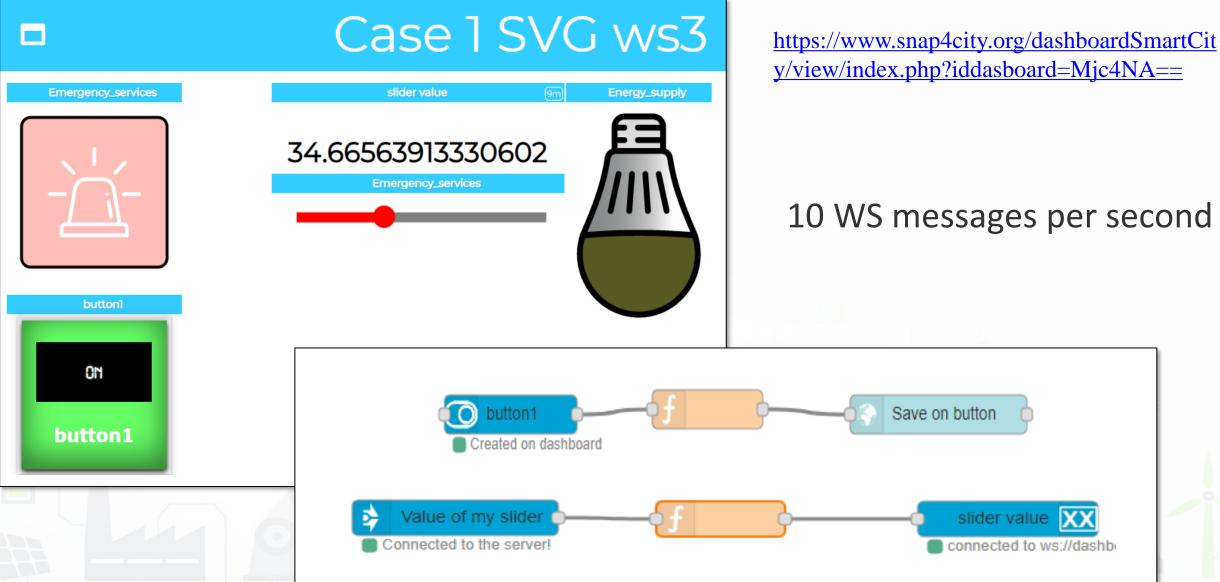












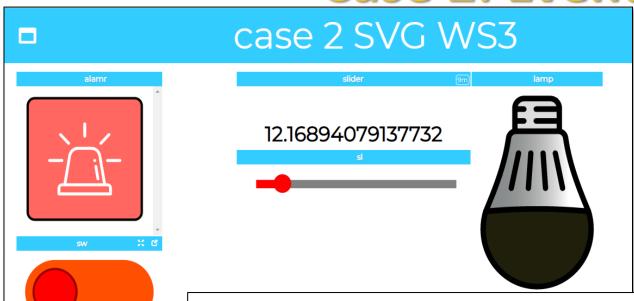






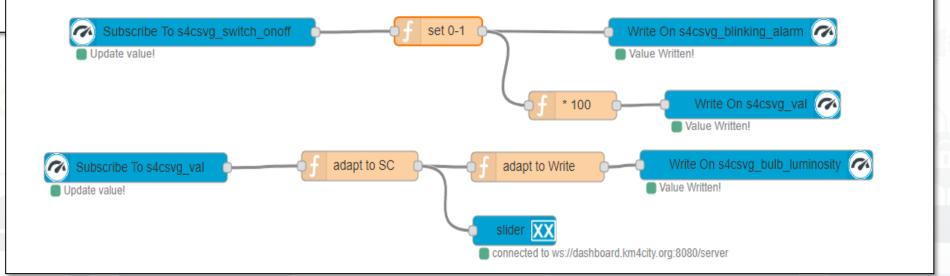


Case 2: Event Driven 100%



https://www.snap4city.org/dashboardSmartCity/vie
w/index.php?iddasboard=Mjc4NQ==

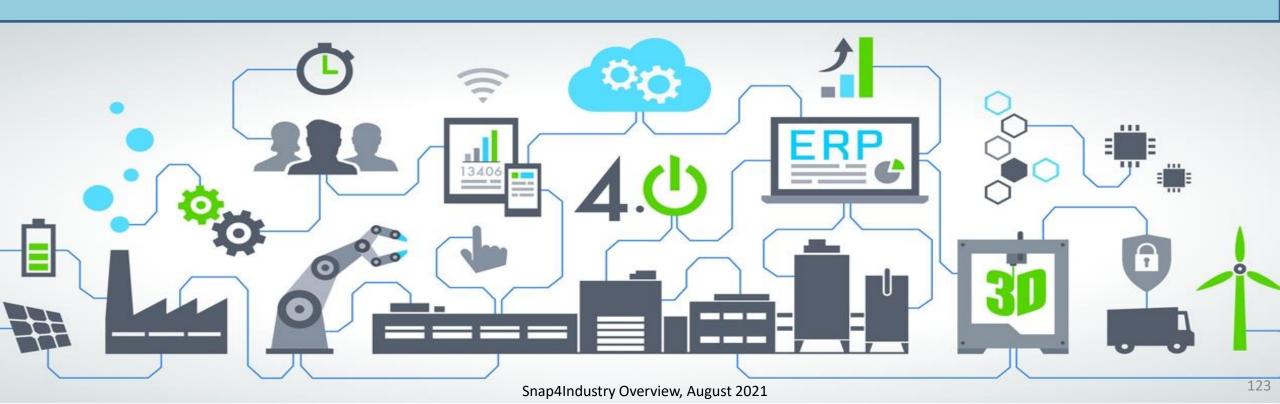
40 messages per second







Data Gathering and Integration





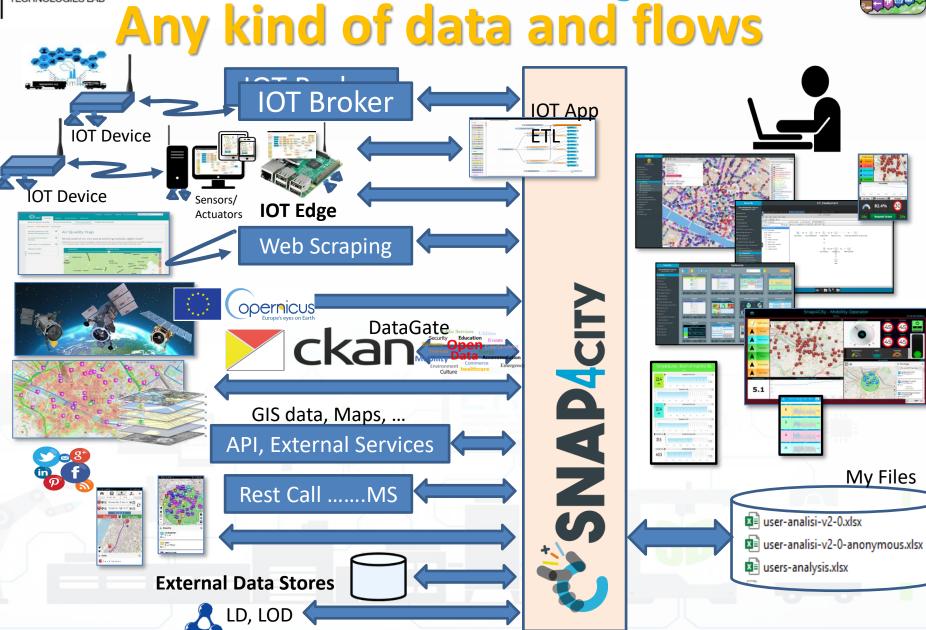




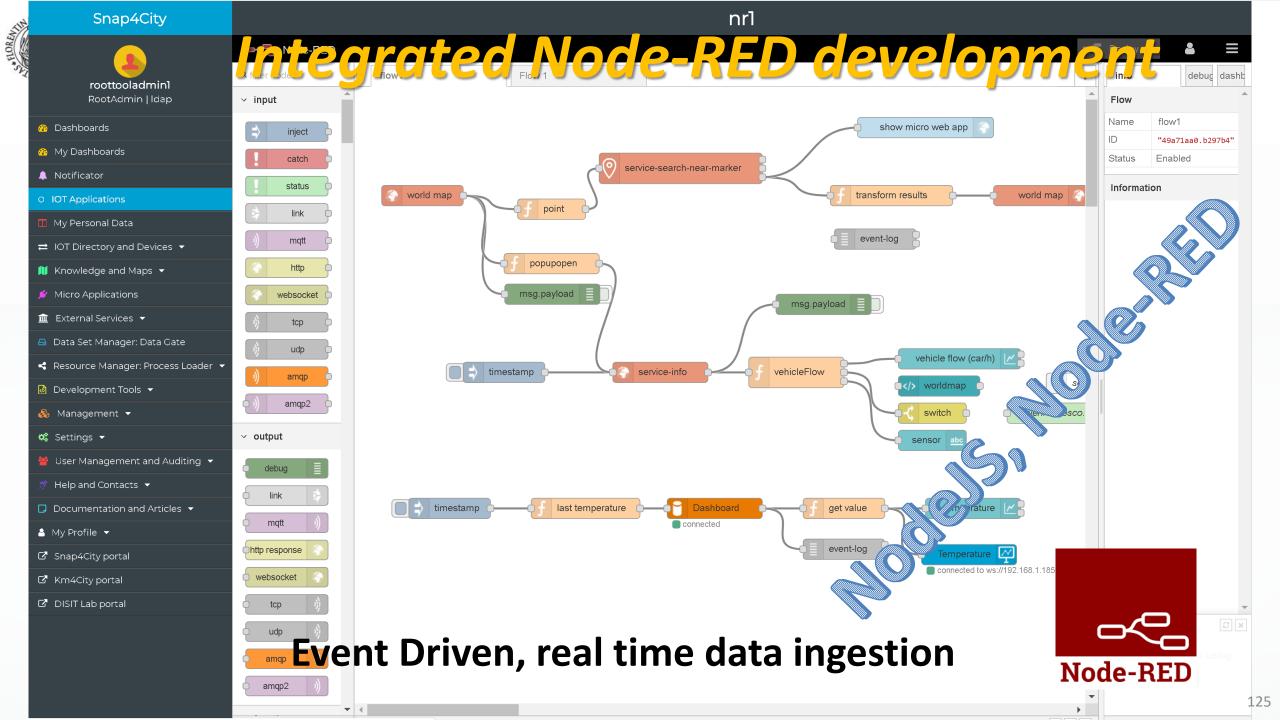
SNAP4INDUSTRY KM4 CITY

Open Data:

- Data gate, federation of Open **Data Portals**
- IOT App, ETL proc(PULL)
- **IOT Networks:**
 - IOT Application processes, data driven or PULL
 - IOT Brokers (Push) → IOT Shadow
- Web Pages:
 - Web scraping, crawling processes
- Satellite data
- Social media: Twitter, Facebook,...
 - Twitter Vigilance, IOT App
- **Mobile Apps**
 - Smart City API
- Files upload: CSV, Excel, etc.
 - IOT Applications, ETL
- REST API, WS, FTP, LD, LOD, etc.
 - IOT Applications, ETL
- Data base accesses
 - GIS: WFS, WMS
 - ETL, IOT Application



My Files







DISIT DISTRIBUTED SYSTEMS OT/IOE Protocols SNAP4INDUSTRY



Communication Patterns





Broker Gateway

Discovery

Discover register and "thrust" new devices on the network

Registration





Broker Gateway

Telemetry

Information Flows From device to another system for conveying status changes in the device

Push





Brokers Gateways

Inquiries
Requests from devices looking to gather required information or asking to initiate activities







Broker Gateway

Commands

Commands from other systems to a device or a group of devices to perform specific activities

Bulk action



Broker

Gateway

from other

systems to a

for conveying

the world

Notifications

Information flows

device or a group

status changes in

- **MQTT**
- HTTP(s)
- **AMQP**
- COAP
- NGSI
- OneM2M
- WebSockets

.

Etc.











https://www.snap4city.org/65





Standards and Interoperability

Compliant with: AMQP, COAP, MQTT, OneM2M, HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, NGSI, LoRa, LoRaWan, TheThingsNetwork, SigFOX, DATEX II, SOAP, WSDL, Twitter, FaceBook, Telegram, SMS, OLAP, MySQL, Mongo, HBASE, SOLR, SPARQL, EMAIL, FTP, FTPS, WebSocket, WebSocket Secure, ModBUS, OPC, GML, RS485, RS232, WFS, WMS, ODBC, JDBC, Elastic Search, Phoenix, XML, JSON, CSV, db, GeoJSON, Enfuser FMI, Android, Raspberry Pi, Local File System, ESP32, Libelium, IBIMET/IBE, OBD2, SVG, XLS, XLSX, TXT, HTML, CSS, KNX, Enocean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Copernicus, Protocol Buffer, IFC, XPDL, etc.



























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!



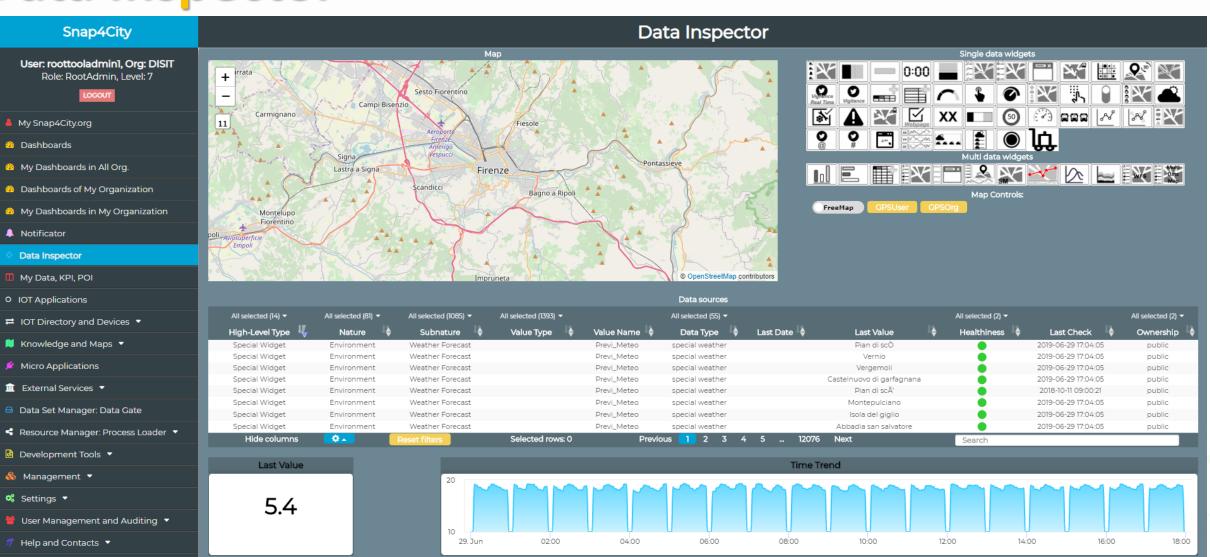
Documentation and Articles







Data Inspector











Unified Data and Services Model/Classification











How the Dashboards exchange data

Snap4City BigData
Storage and KB

IOT Broker Orion Quantum Leap ServiceMap Super ServiceMap

Metric, KPI

MyKPI, MyPOI, ...

API, External Services, MicroApp

Snap4City - City app

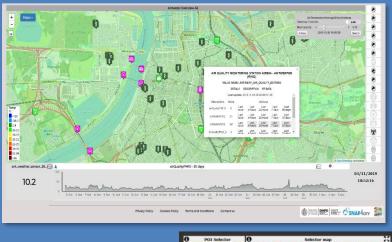
Flow 1

Innestant to transport to t

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











DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB DYNAMIC (7/21) CSNAP4CITY CONTROLOGIES LAB DYNAMIC (7/21) CSNAP4CITY





Widgets ICONS	Widget Name, Description	IOT App	Dashboard-IOT App	KPI (metric)	MyPersonalDa ta	MyDat a	My KPI	Sensor
XX	Single Content single content	X (cs)	X (DD)	X	X	X	X	X
50	Speed Limit (see custom for more)			Χ				X
(3)	Speedometer speedometer 42	X (cs)	X (DD)	X	X	Χ	X	X
	Gauge chart	X (cs)	X (DD)	Χ	Χ	Χ	Χ	Χ
	Single Bar, V/H	Х	X (DD)	X				
	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	Х	X	X
8	Time Trend (single)	X	X (DD)	X	X	Χ	Χ	Χ
	Time Trend Compare			X			X	X
	SpiderNet, radar, Kiviat	X (cs)	X (DD)	Χ	Χ	Χ	Χ	X
	Pie, Donut, 2 layers Donut	X (cs)	X (DD)	X	X	X	X	X
	Table table content	X (cs)	X (DD)	X	X	X	Χ	Χ
	Calendar Calendar Calendar	X (cs)	X (DD)				Χ	X





Legenda



IOT APP column in previous table:

- X: means that from the IOT App you can send a new value or array to the widget directly, without the need to have is stored into Sensor or MYKPI variable, etc.
- CS, widget supports Change Source, in the sense that: from the IOT App is possible to send a command to the Widget to change the data source. E.g., selecting sources among: Sensors (service URI), MyKPI (ID), any value produced on the IOT App directly. (cs) recent additions

Dashboard IOT App column in previous table:

- X: there is a MicroService / node on IOT App to act on those widgets on dashboard. The data are visualized.
- DD, widget is Data Driven, in the sense that new data in push can be sent and the widget is updated in real time on web page without web page realoading

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



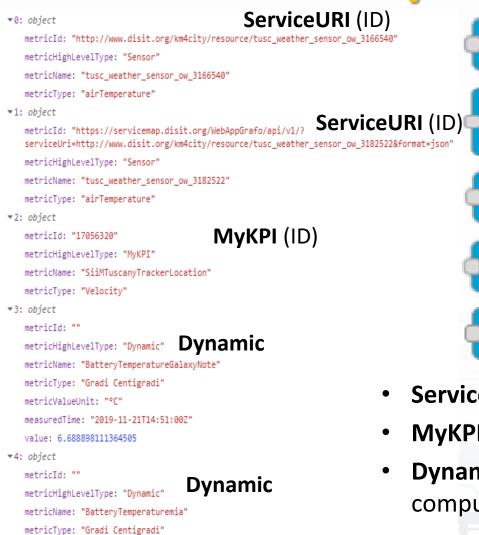






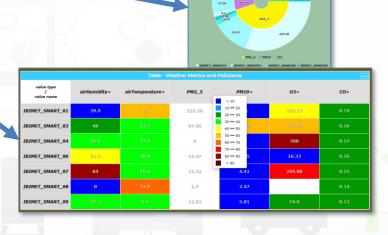
100% of Dynamic VECTs

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

value: 62.8502788741156

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

metricValueUnit: "°C"

HLT: Sensors

- **Complex Event**
- Dashboard-IOT App
- **External Service**
- Heatmap
- **KPI** (Key Performance Indicator)
- **MicroApplication**
- My Personal Data
- MyKPI
- MyPOI
- POI (Point of Interest)
- Sensor
- (Sensor Actuator)
- **Special Widget**
- Wfs (GIS)







Nature

HLT: Sensors

- Sensors can arrive in platform as follows (see Nature)
 - ETL processes in PULL
 - As Periodic processes
 - From IOT Devices to KB (knowledge base). Registered via IOT Directory, arriving via IOT Broker and saved into the Data Shadow,
 - IOT data driven process in PUSH
 - From Dashboard to IOT Devices (echo) is a virtual sensor Sensor Actuators (HLT),
 - IOT data driven process in PUSH

Accommodation + Advertising + AgricultureAndLivestock + CivilAndEdilEngineering + CulturalActivity + EducationAndResearch + + Emergency + Lntertainment + Environment + 6 FinancialService + GovernmentOffice + IndustryAndManufacturing + ☑ IoTDevice + MiningAndQuarrying + ShoppingAndService + TourismService + TransferServiceAndRenting + UtilitiesAndSupply + Wholesale +

WineAndFood +

SubNature

EducationAndResearch

Educational_support_activities

Higher_education

Language_courses

Performing_arts_schools

Post_secondary_education

Pre_primary_education

Primary_education

Private_high_school

Private_junior_high_school



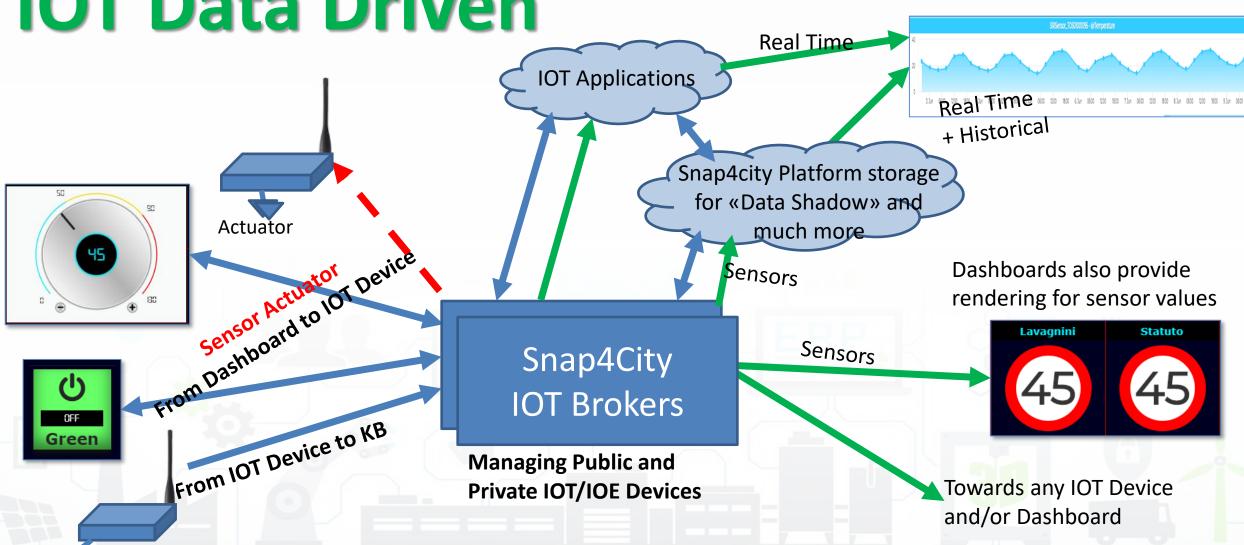
Sensors







IOT Data Driven











Canc

Confirm

From Dashboard to IOT Devices/App

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



Green

Yellow

Red

CFF

Green



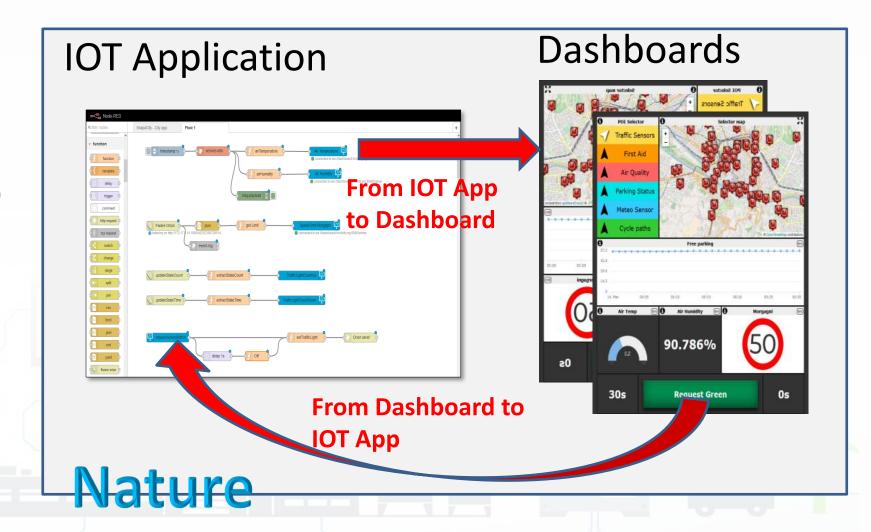






HLT: Sensors-Actuators

- Complex Event
- Dashboard-IOT App
- External Service
- Heatmap
- **KPI** (Key Performance Indicator)
- MicroApplication
- My Personal Data
- MyKPI
- MyPOI
- POI (Point of Interest)
- Sensor
- Sensor Actuator
- Special Widget
- Wfs (GIS)









Nature

numeric keyboard

switch button

dimmer

geolocator

dropdown

form

coordinates

from map

event driven my kpi

synoptic read

synoptic subscribe

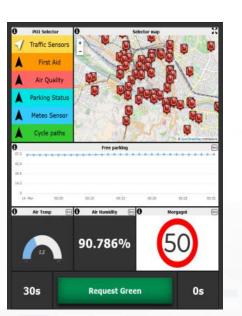
100



Dashboard-IOT App



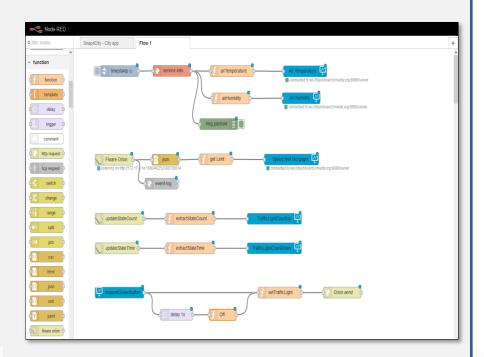
U	P	еоріемить	ar.
	New		None None
7	7	8	9
4	4	5	6
1	1	2	3
()		Cano
		Confirm	





MapClick
MyKPI variable onchange
Synoptics

From Dashboard to IOT App



IOT Application



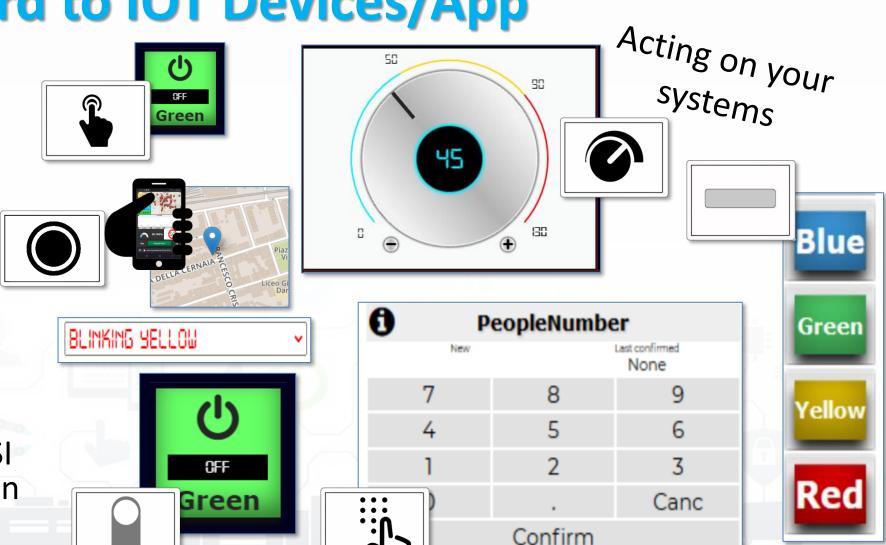






From Dashboard to IOT Devices/App

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









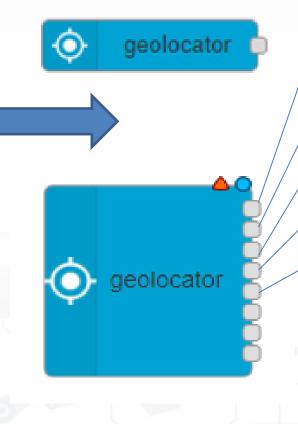




Geolocation of Mobile Device



Web Browser GPS data rendering the Snap4City Dashboard can be passed to IOT Applications and saved ©



- Complete message
 - Returns a JSON containing all information about geolocation
- Latitude
 - Returns the latitude
- Longitude
 - Returns the longitude
- Accuracy
 - Returns the accuracy of latitude and longitude
- Altitude
 - Returns the altitude
- Altitude Accuracy
 - Returns the altitude accuracy
- Heading
 - Returns the heading
- Speed
 - Returns the speed









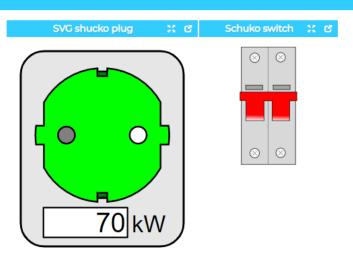


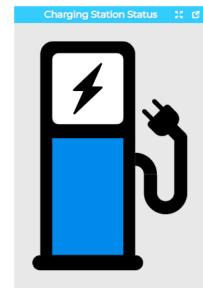
SVG Custom Widgets Examples 2

Legenda

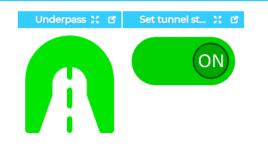
Tue 17 Nov 18:46:47

Traffic Light

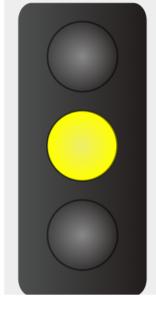




Charging Station Status 2. U		Legenda	
	Chargir	ng Station Stat	us
	Set on t followin	he keypad one ig values	of the
	0 = ERR	OR (RED)	
17 1.	1 = AVA	IBLE (GREEN)	
		OKED (YELLOW)
		ARGING	
	9999 =	white icon	
	Charging Station status		
	New		t confirmed None
	_		_
	7	8	9
	4	5	6
	1	2	3
	0		Canc
		Confirn	า







	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==

















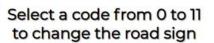




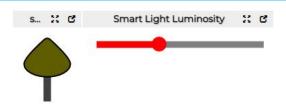
SVG Custom Widgets Examples

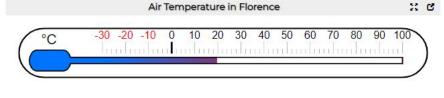
Sat 19 Dec 00:10:12

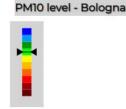




New	Last confirmed None		
7	8	9	
4	5	6	
1	2	3	
0		Canc	
Confirm			



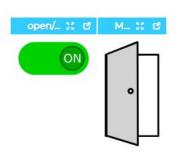
















Terms and Conditions













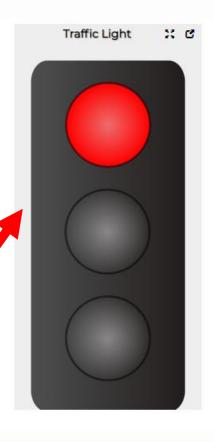
Selector







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/sel	rver	Value Written!

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









```
msg.payload ={ "form": { "options": [
{ "label": "enter text", "value": "", "type": "text", "required": true },
{ "label": "enter number", "value": "", "type": "number", "required": false },
{ "label": "enter email", "value": "", "type": "email", "required": false },
{ "label": "enter password", "value": "", "type": "password", "required": false },
{ "label": "enter check", "value": "checked", "type": "checkbox", "required": false },
{ "label": "enter check2", "value": "", "type": "checkbox", "required": false },
{ "label": "enter switch", "value": "on", "type": "switch", "required": false },
{ "label": "enter switch2", "value": "", "type": "switch", "required": false },
{ "label": "enter date", "value": "", "type": "date", "required": false },
{ "label": "enter time", "value": "", "type": "time", "required": true }
], "selected": [] } }
return msg;
                                                                form
```

	IOTDevice Data
enter text	
enter number	
enter email	
enter password	•••••
✓ enter check	
□enter check2	
enter switch	
enter switch2	
enter date	gg/mm/aaaa 📋
enter time	: O
Submit	











```
msg.payload ={ "form": { "options": [
{ "label": "enter text", "value": "", "type": "text", "required": true },
{ "label": "enter number", "value": "", "type": "number", "required": false },
{ "label": "enter email", "value": "", "type": "email", "required": false },
{ "label": "enter password", "value": "", "type": "password", "required": false },
{ "label": "enter check", "value": "checked", "type": "checkbox", "required": false },
{ "label": "enter check2", "value": "", "type": "checkbox", "required": false },
{ "label": "enter switch", "value": "on", "type": "switch", "required": false },
{ "label": "enter switch2", "value": "", "type": "switch", "required": false },
{ "label": "enter date", "value": "", "type": "date", "required": false },
{ "label": "enter time", "value": "", "type": "time", "required": true }
], "selected": [] } }
return msg;
                                                                form
```

	IOTDevice Data
enter text	a text
enter number	123
enter email	paolo.nesi@unifi.it
enter password	•••••
✓ enter check	
□enter check2	
enter switch	
enter switch2	
enter date	19/03/2021
enter time	09:38 ©
Submit	

<mark>"selected":["</mark>a text","123", "paolo.nesi@unifi.it","aaaaaa", " "checked","","on","","2021-03-19","09:38"]



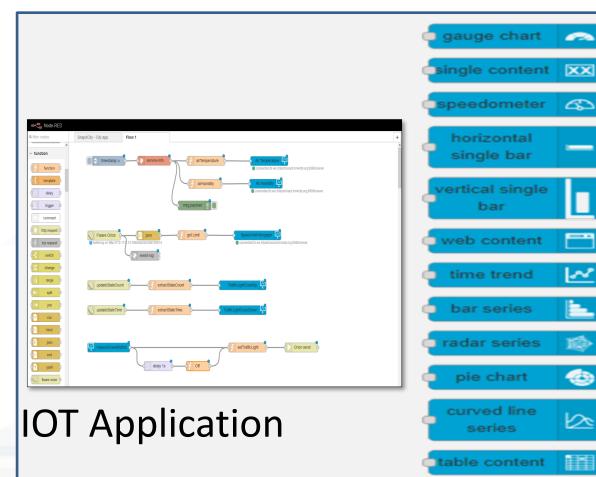


Nature



Dashboard-IOT App

From IOT App to Dashboard





ynoptic write

calendar





246 TOT. EVENTI SULLA RETE

COLONNINE RICARICA

176 INSTALLATE

Single Content Widget (flexibility)

From Dashboard
Editor and IOT
Applications, accepts
in input:

- Numbers
- String
- HTML code



Helsinki:orio... 9m

7.4

µg/m3

20.3°C

11440 Utenti WiFi

Position Updated, press Show My Position





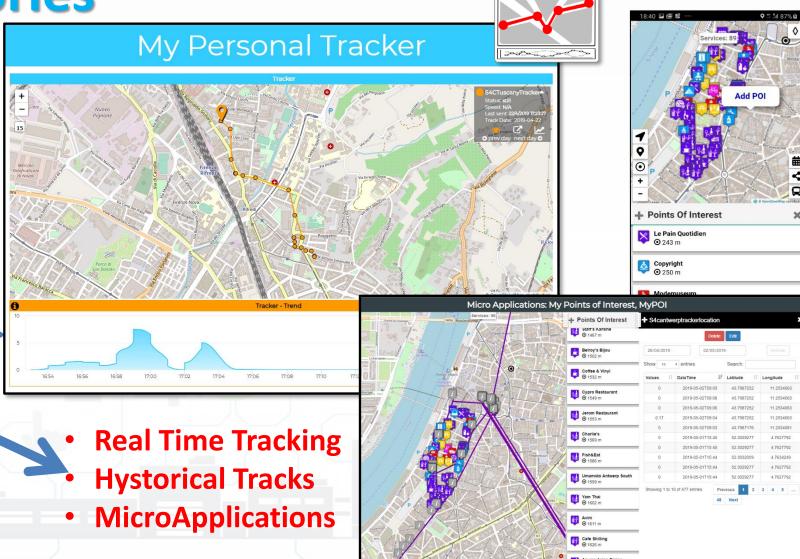


https://www.snap4city.org/578



MyKPI as Trajectories

- Complex Event
- Dashboard-IOT App
- External Service
- Heatmap
- **KPI** (Key Performance Indicator)
- MicroApplication
- My Personal Data
- MyKPI
- MyPOI
- POI (Point of Interest)
- Sensor
- Sensor Actuator
- Special Widget
- Wfs (GIS)



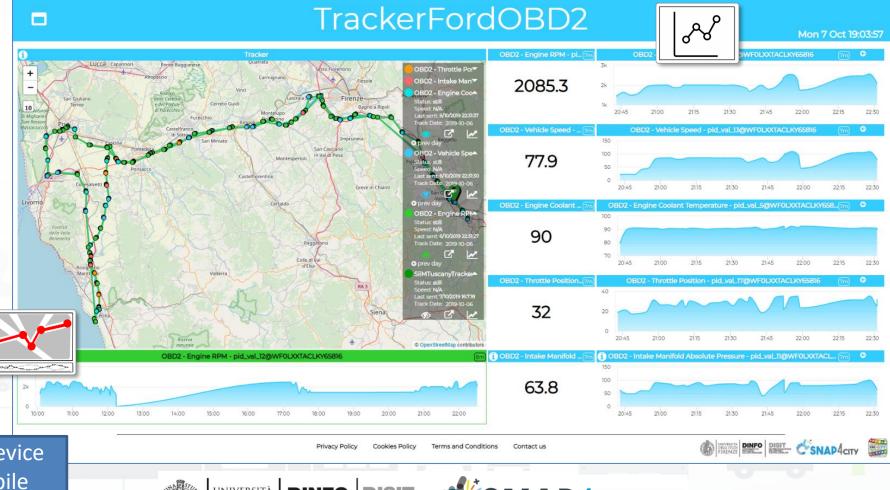




MyKPI: Tracking of Devices and Mobiles • Real Time Trajectories for

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

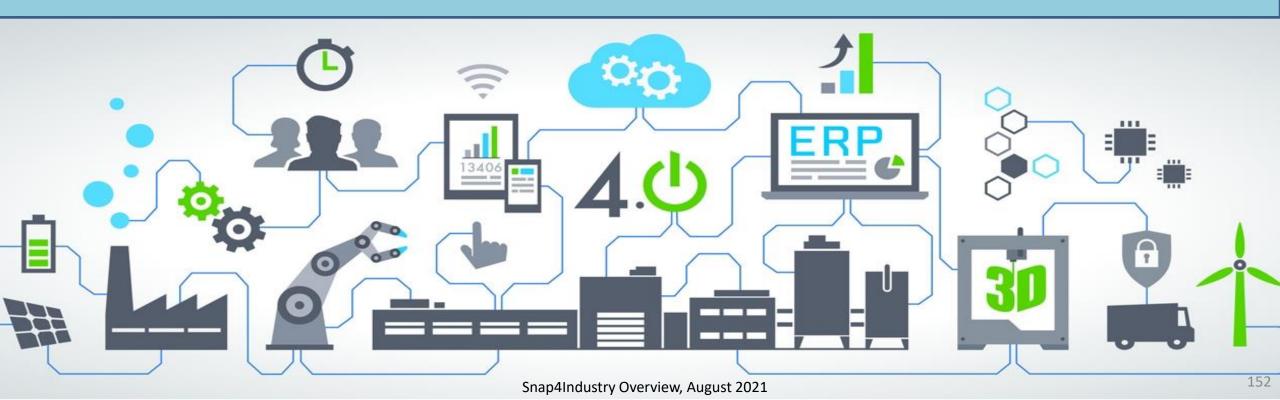








IoT Devices and IoT Apps







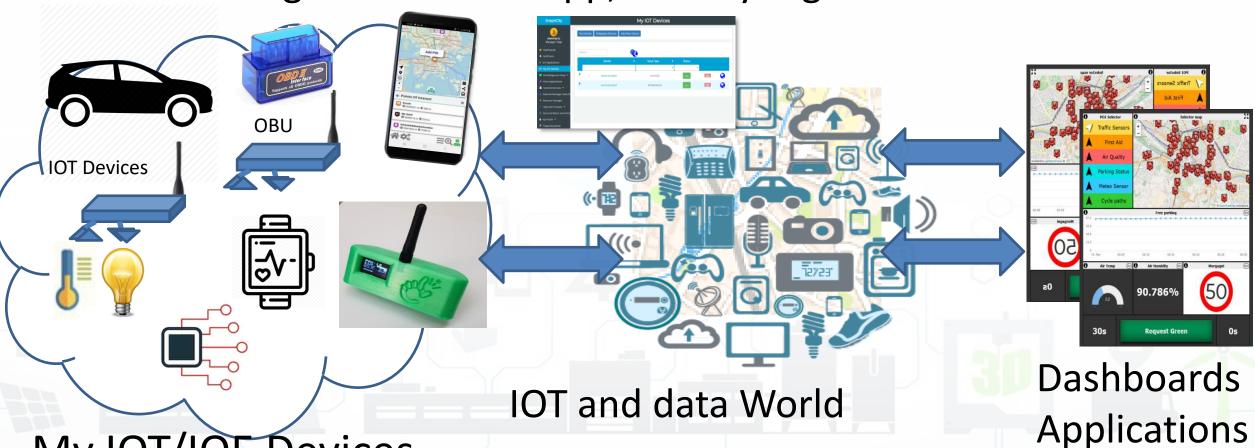
My IOT/IOE Devices





To Start we are going to use Direct Dashboards

Dashboards accessing data available on Platform, including your own data coming from Mobile App, already registered!!!







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







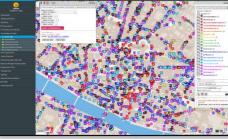


Registering



Browsing

Discovering



Discovering

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

ServiceMap **Knowledge Base**

Final user

Manager











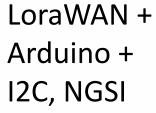




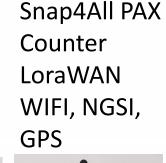




IOT Devices



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

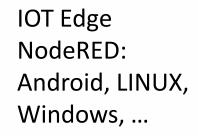


Sensors/ **Actuators**

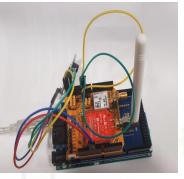


IOT Edge Devices

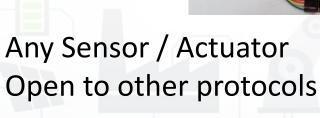
IOT Edge NodeRED: Raspberry Pi, NGSI, WiFi, RJ45,..



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













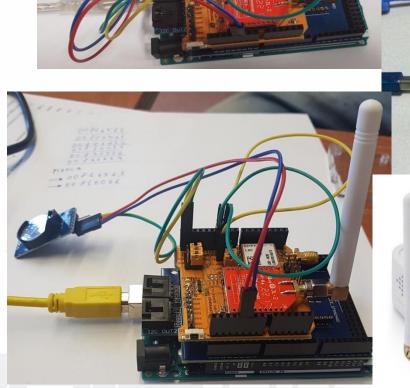




Lora IOT Device, Arduino

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











LoraWan Gateway out of the Box

- Raspberry Pi Based LoraWan Gateway
- Physical UpLink as: Wi-Fi, RJ45
- Logical UpLink: LoraWAN TheThingsNetwork, NGSI V2 (mutual authenticated Snap4City)
- Powered 5V
- GeoLocated GPS Antenna
- IOT Edge Snap4City Included if needed







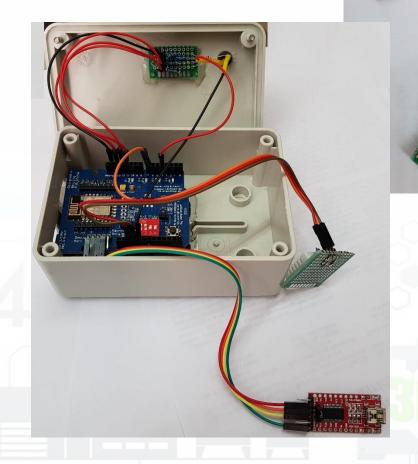






IOT Device with Arduino

- Arduino Uno
- Wi-Fi shield, standard
- Mutual Authentication with certificates, or K1,K2,sha
- Secure encrypted connection, NGSI
- Open Source
- Fully Customizable
 - Any sensor
 - NGSI or any other protocol



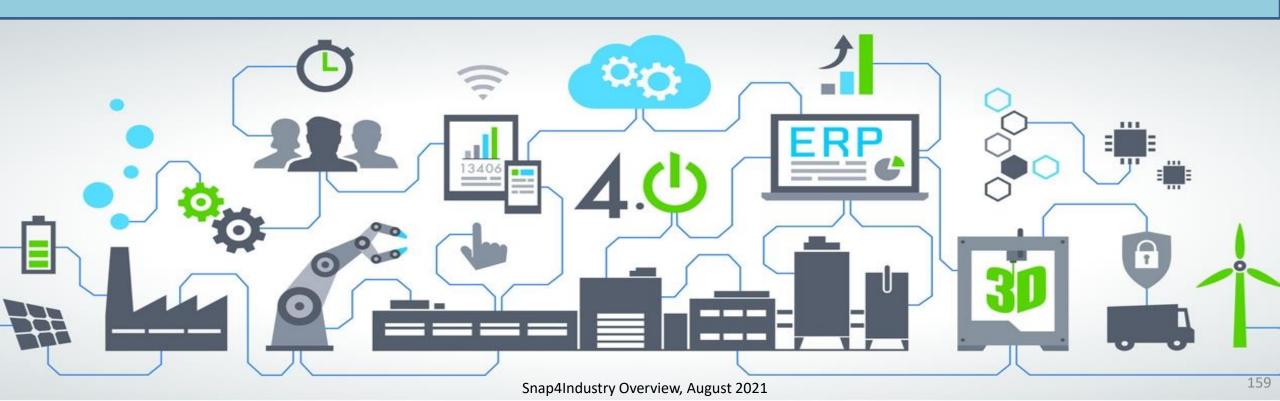








IOT Applications and IOT Edge Devices





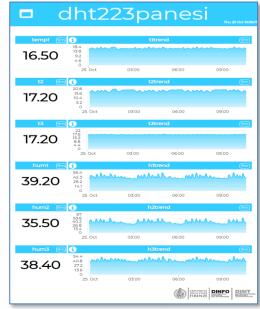
SNAP4INDUSTRY

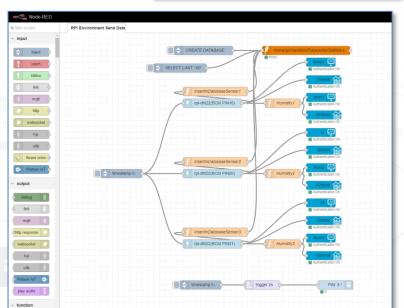
IOT Edge on Raspberry Pi

- Raspberry Pi
- Mutual Authentication with certificates
- Secure encrypted connection
- IOT Application inside
- Any sensor
- Any protocol from IOT devices
- NGSI or any other protocol
- Fully Customizable
- Local and Cloud Dashboard
- Special MicroServices













MicroServices:

- DHT
- ModBus
- any shield
- etc....

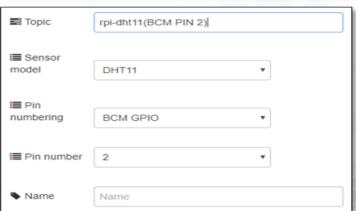


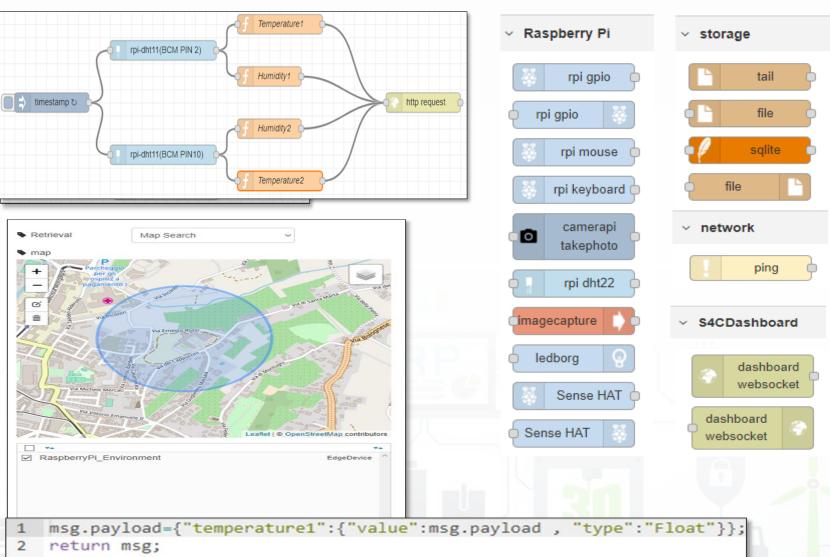


DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB













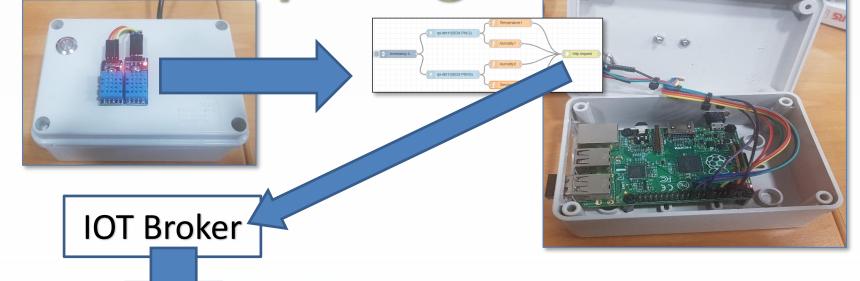




City user

Would like to:

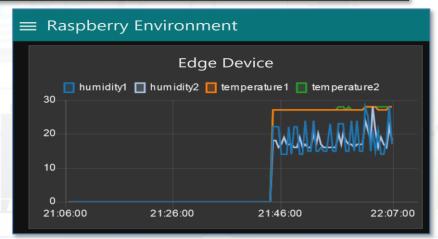
- **Monitor and exploit** temperature and humidity
- Manage sensors
- Perform edge computing
- Using these data for multiple applications



Click here

Steps:

- Registering the device and sensors
- Create flow on edge device using NodeRed with Snap4City, sending data to Broker
- **Use data from Broker on Snap4City IOT App**











- Android, any version, App from: <u>https://www.snap4city.org/download/video/Snap4All.apk</u>
- 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











IOT Edge Snap4All App for Android



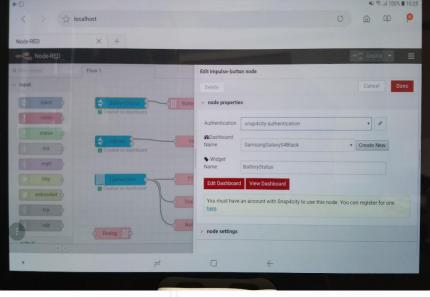
termux-dialog



Node-RED At Social Loss Node-RED Atternodes Flow 1 Injust Created on deshboard Toast II Notification III Notification II Notification III Notification II Notification III Notification II Notificat

MicroServices:

- Snap4City
- Termux Snap4City specific
- etc.



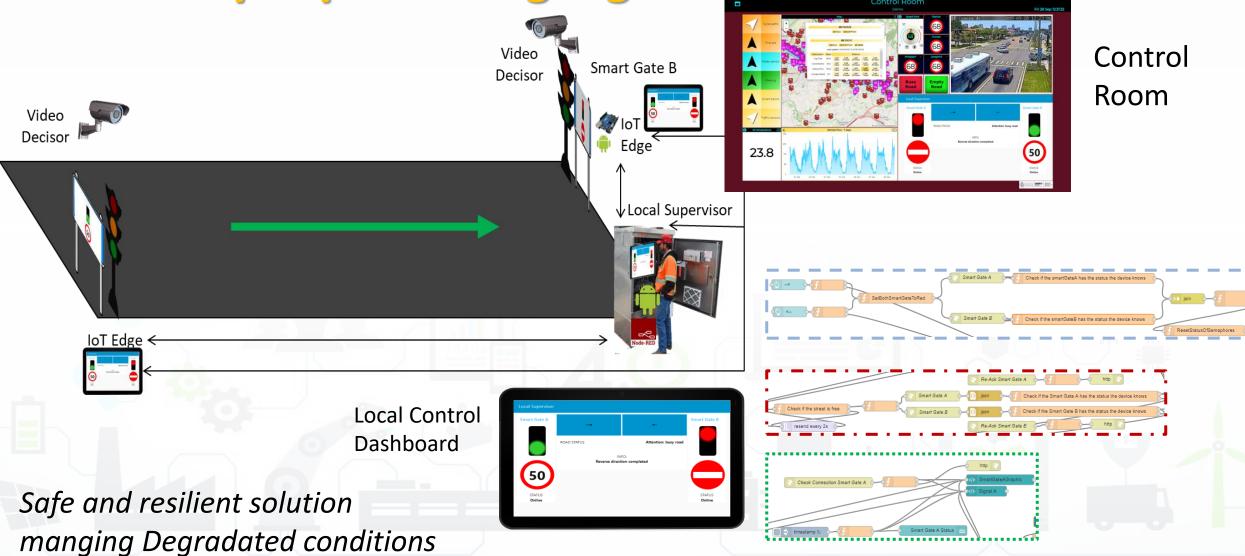








Sii-Mobility: Dynamic Signage and Street Mng











TOP

Moving IOT Devices / Sensors, Tracking Devices

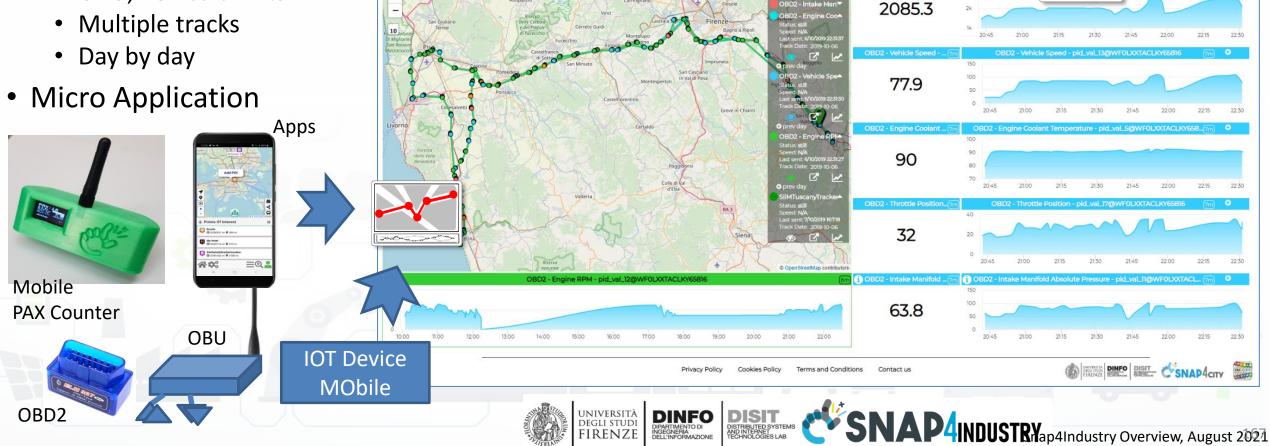






MyKPI: Tracking of Devices and Mobiles • Real Time Trajectories for

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



TrackerFordOBD2



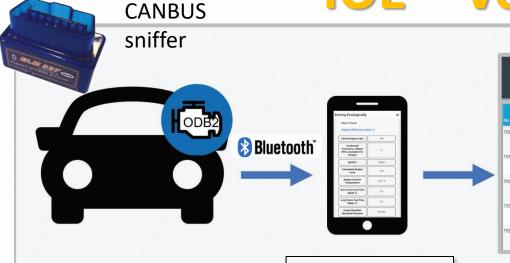








IOE – Vehicle Monitoring

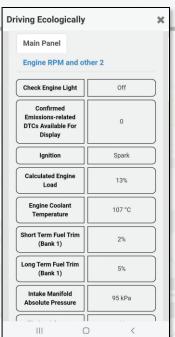


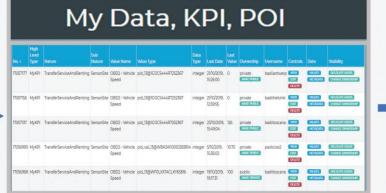
Tuscany in a **Snap Mobile** App on

Android

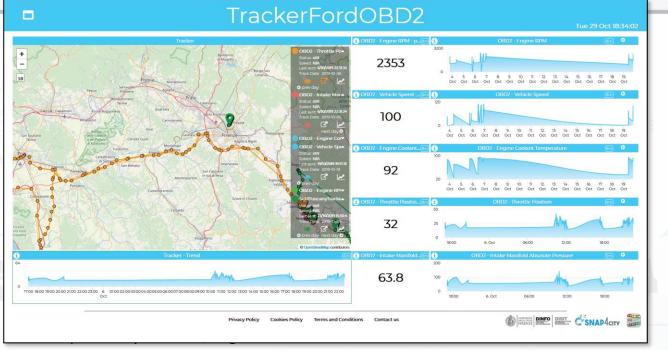






















PaxCounter devices



- Fixed PaxCounter LoraWan
 - Based on Wi-Fi- Bluetooth
- Mobile PaxCounter LoraWan
 - Based on Wi-Fi- Bluetooth
- Fixed PaxCounter(LoraWan+Wifi out)
 - Based on Wi-Fi- Bluetooth







https://www.snap4city.org/drupal/node/456

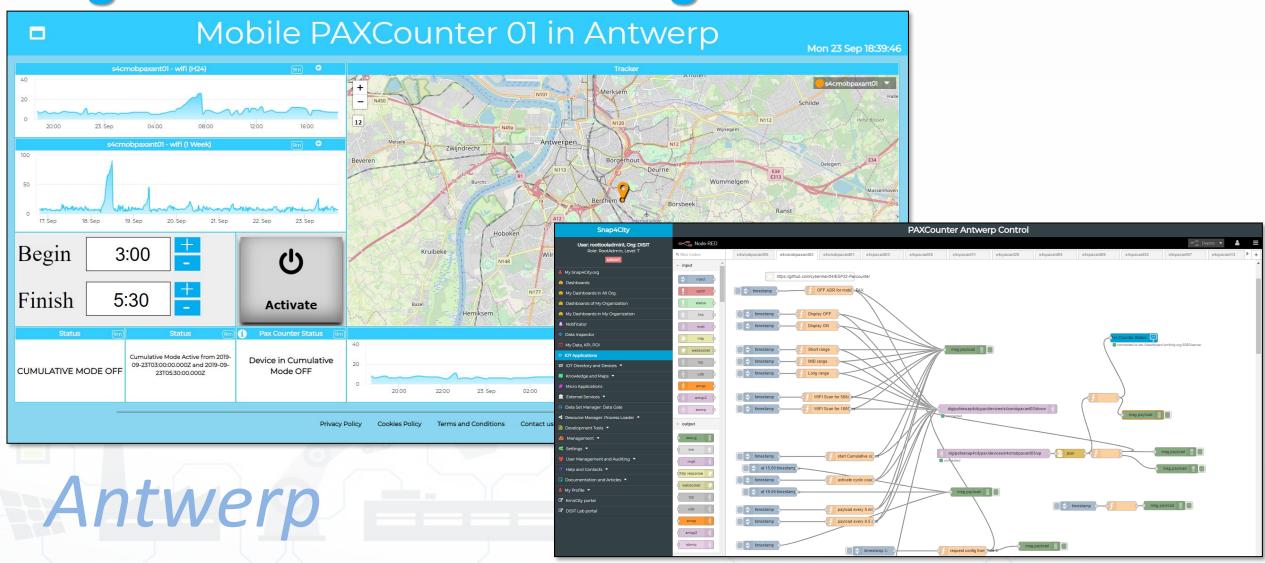








Programmable PAX counting







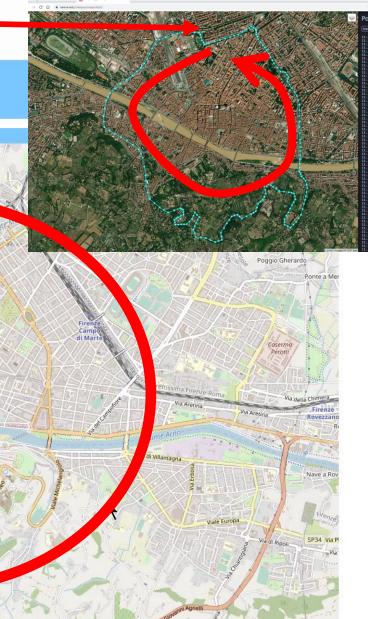


moving device



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

Moving and changing Dynamic Plant Industry Overview, August 2021









TOP

Managing IOT Applications





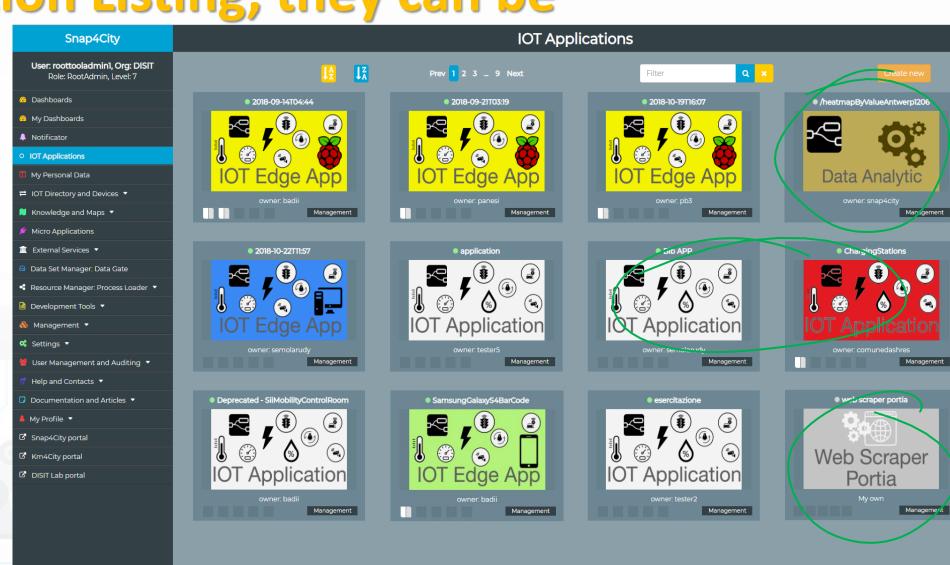






IOT Application Listing, they can be

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



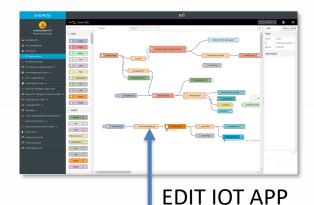
Thap Illianstry overview, magast 202











- **IOT Applications Listing**
 - Basic / Advanced
 - On IOT Edge Raspberry Pi
 - On IOT Edge Android

Localhost

Localhost

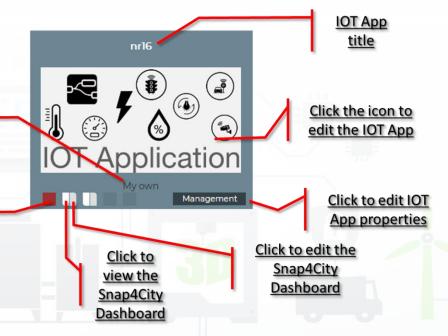
Over: badii

On IOT Edge Win/Linux



VIEW



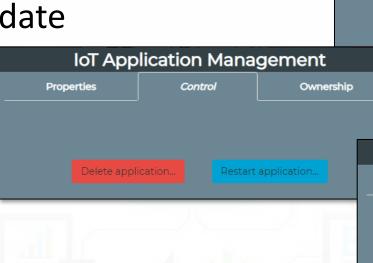






IOT Application Management

- Properties
 - Name, Type, Creation date
- Control
 - Restart
 - Delete
- Change of ownership
 - Toward another Snap4City User
- From inside the flow
 - Restart
 - Update



S4CIOTApp



iotapp restart (

iotapp upgrade

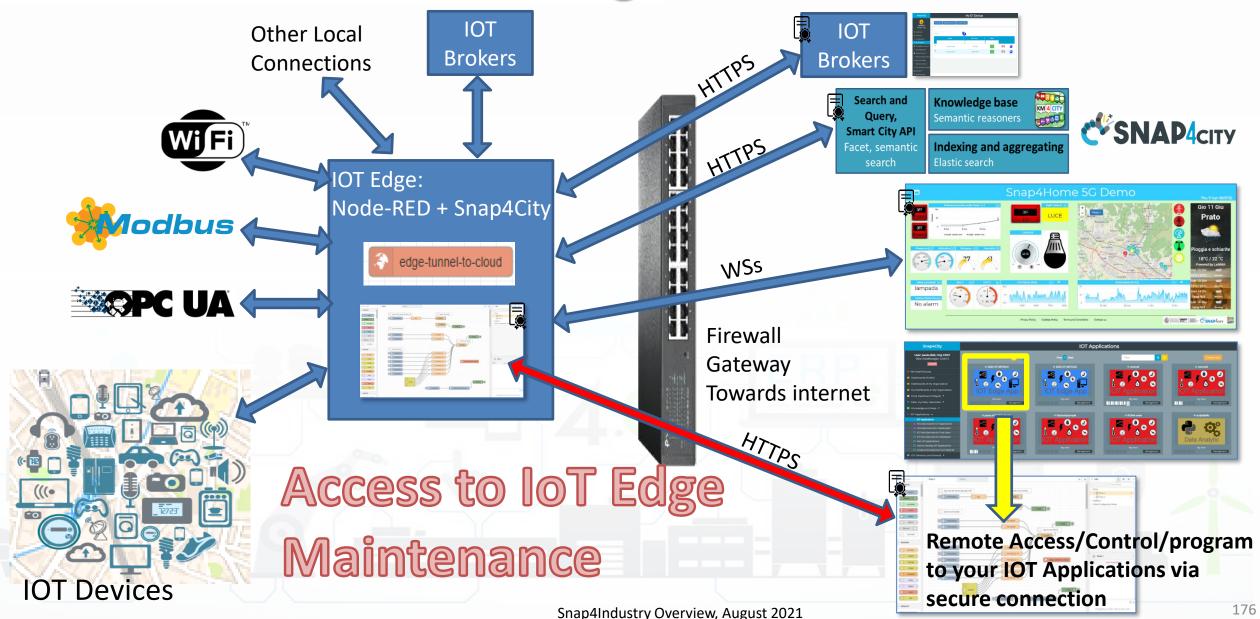






IOT Edge Device



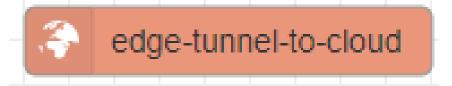






HOW To install IOT Edge Remote Control feature

- The installation is very simple
- 1. install Snap4City basic library
- 2. Drag and drop block from S4CUtility



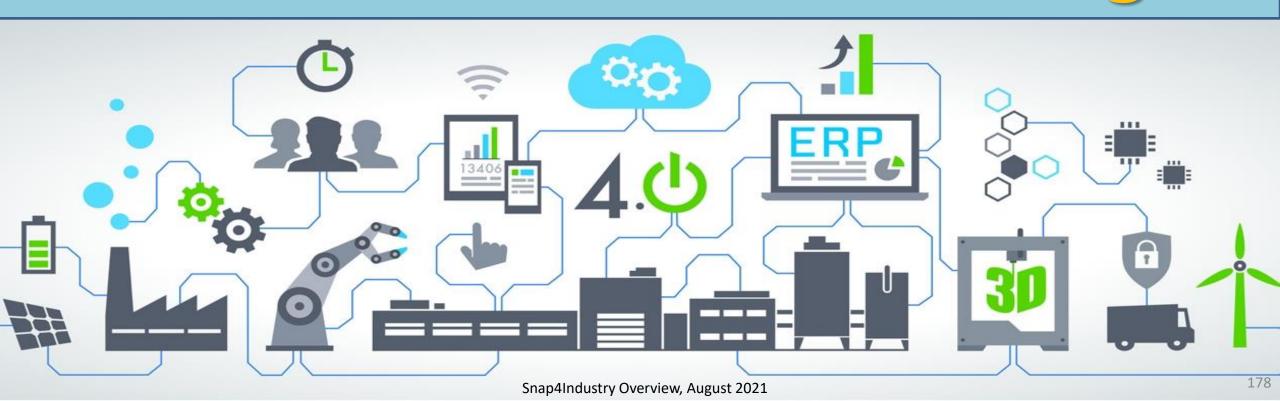
- 3. Configure the block with your credentials
- 4. Deploy of the IOT App
- 5. Go in the list of Your IOT Applications on Snap4City.org or other cloud or on premise installations
- 6. Identify the IOT Edge IOT App and click on it to open the view on the IOT Applications flows







Secure IOT Devices, IOT Edge Sensor and Dev Networking

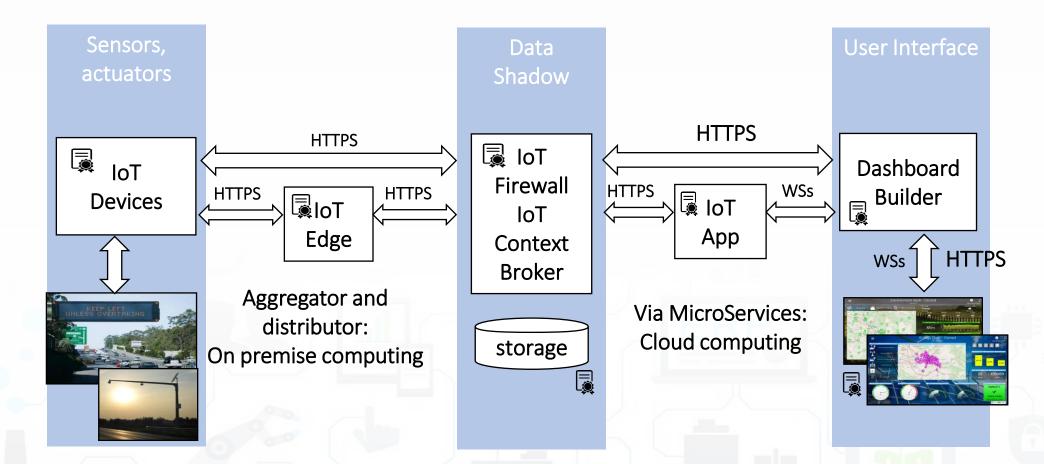








The secure stack

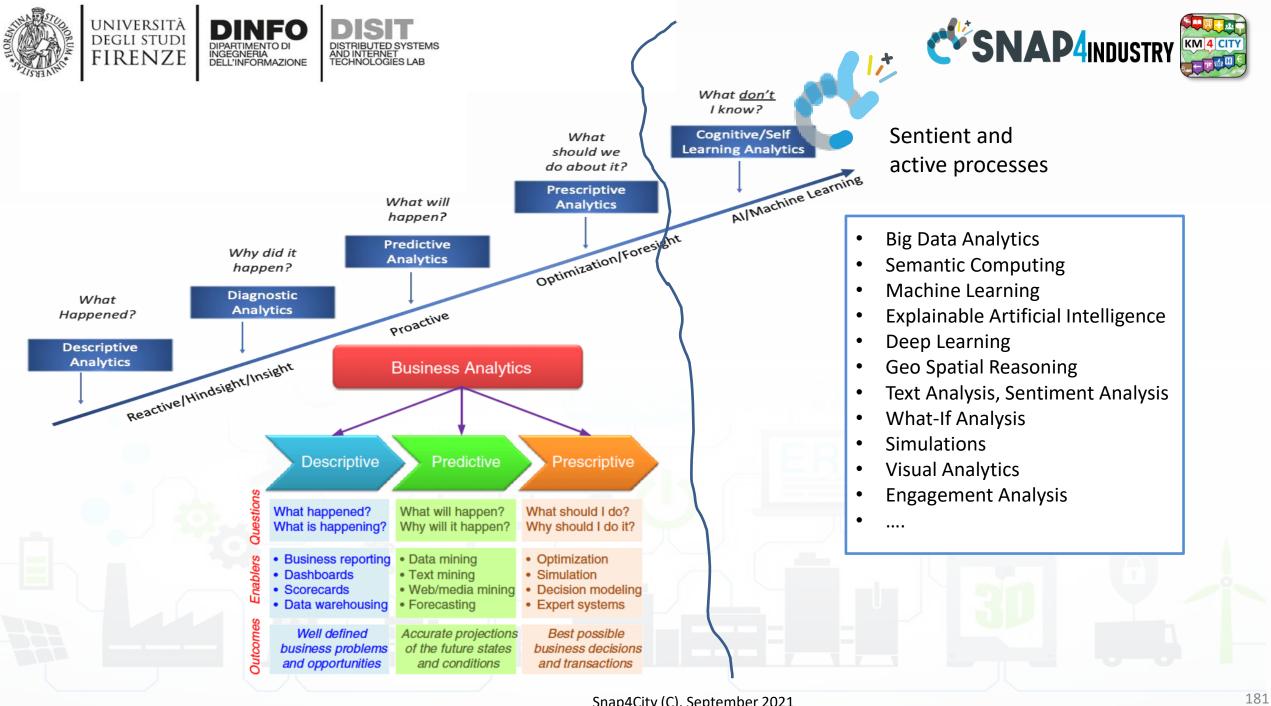


SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT SNAP4INDUSTRY

















Studio

Data Analytics Dev. in R Studio and/or Tensor Flow

tools

other

and

ase $\tilde{\Omega}$



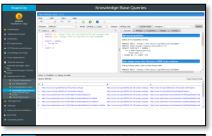




Ontology Schema

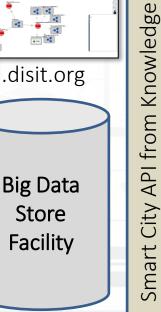


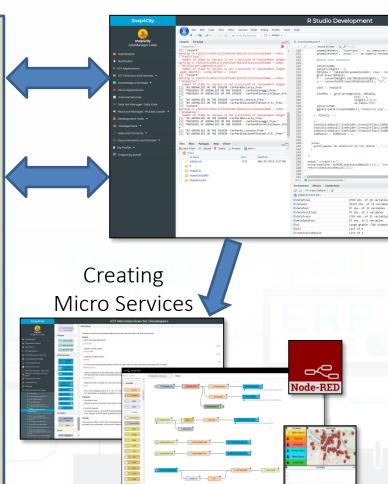
SPARQL, FLINT





LOG.disit.org





Saving Sharing Reusing



Resource Manager





Using them into

IOT Applications









Coding

Testing

Data Analytics Development in Python, 🔑 python







Ontology Schema



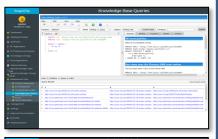
SPARQL, FLINT

tools

other

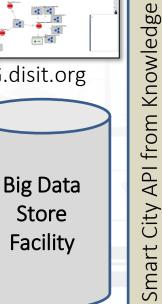
and

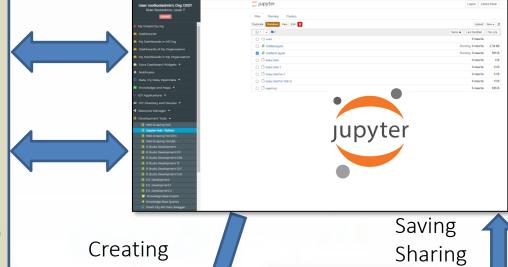
ase $\tilde{\Omega}$





LOG.disit.org









Reusing



Resource Manager



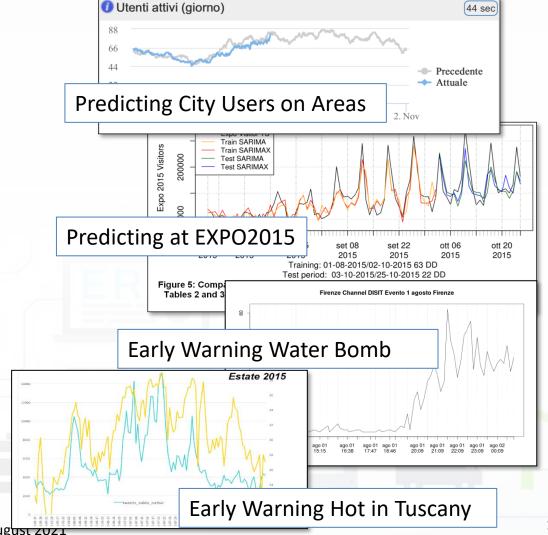






Predicting Models

- Aiming at improving
 - quality of service, distributing workload
 - early warning
- Predictions: Short (15 min, 30 Min) and mid Term (1 week)
- Data Analytics: ML, NLP/SA, Clust., ...
 - Traffic Flows → multi-flow reconstruction
 - Parking Status → free slots
 - Environmental Alarms
 - Air Quality parameters and indexes
 - People Flows (Wi-Fi, Twitter)
 → crowd , #number of people



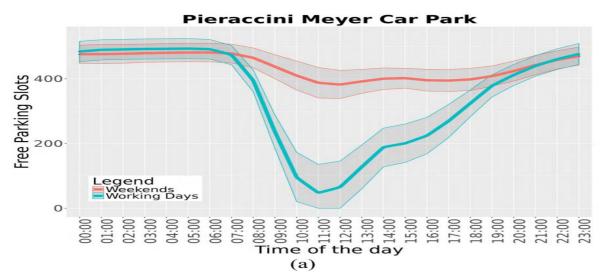


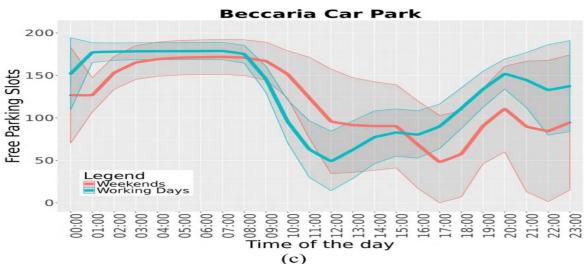


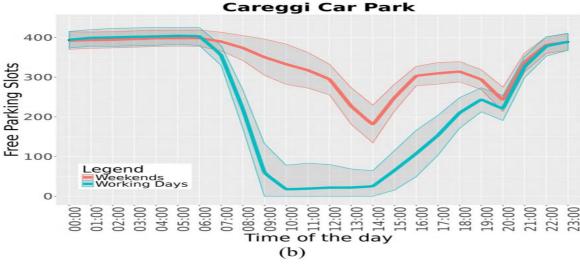


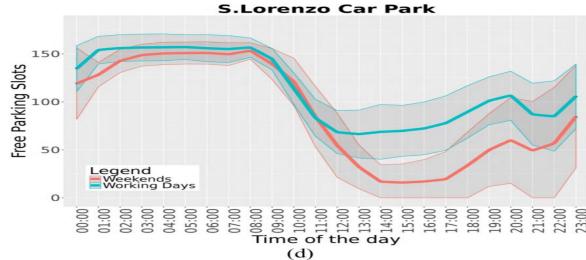
Free Parking space trends KM4 CITY















12 parking areas in Florence



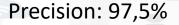
Free Parking Predictions



Careggi car park			
Model	BRNN model results		
features	R-squared	RMSE	MASE
Baseline	0.974	24	1.87
Baseline + Weather	0.975	24	1.75
Baseline + Traffic sensors	0.975	24	2.04
Baseline + Weather + Traffic sensors	0.975	24	1.87

Active on Mobile Apps as:

- «Firenze dove cosa»
- «Toscana dove cosa»









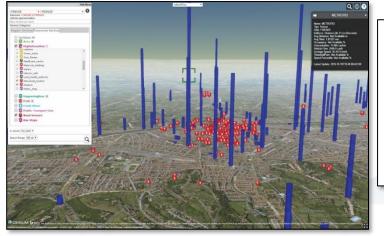
Predicting users movements

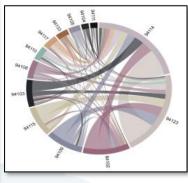
Issue:

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

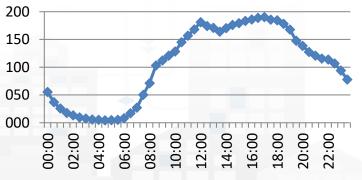
Impact:

- 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





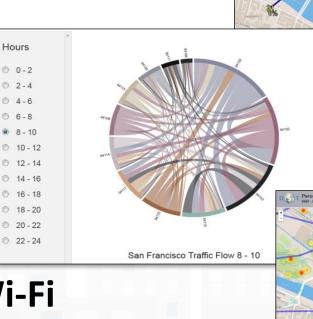
Sii-Mobility

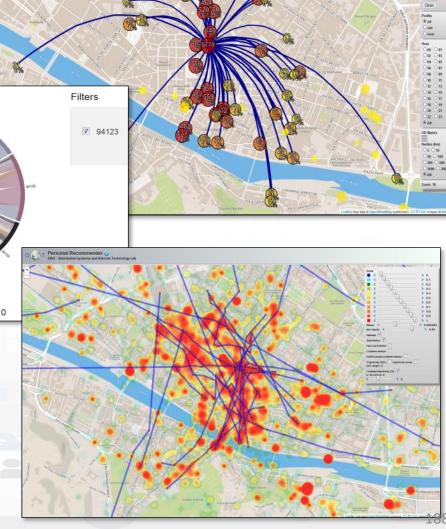
Recommender - Interactive People Flow Maps



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





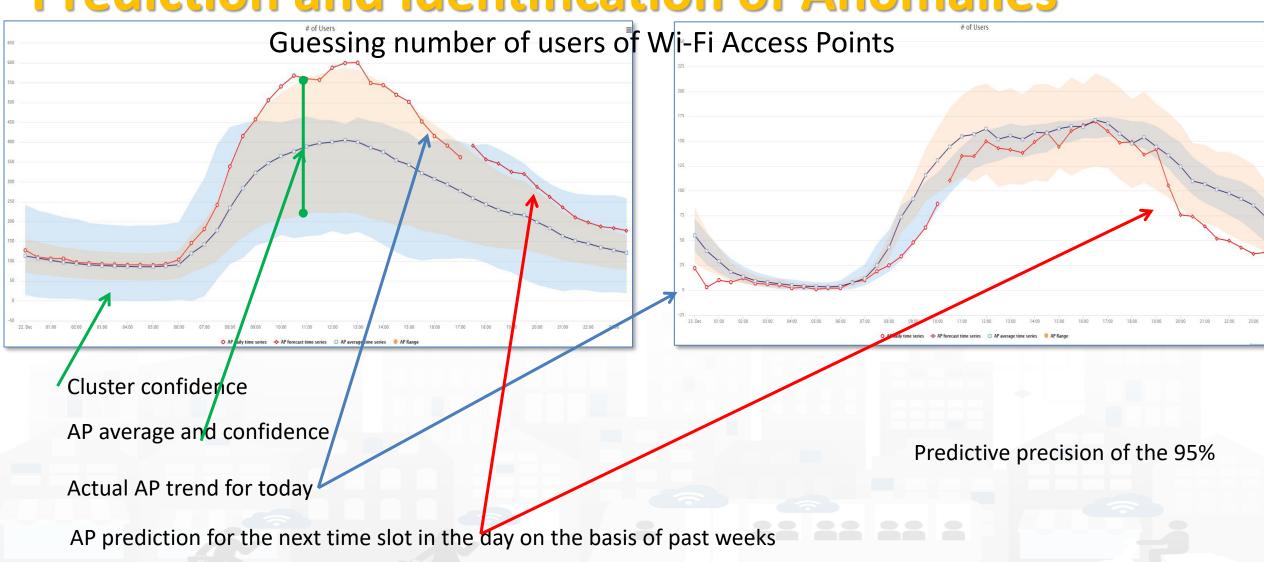








Prediction and Identification of Anomalies







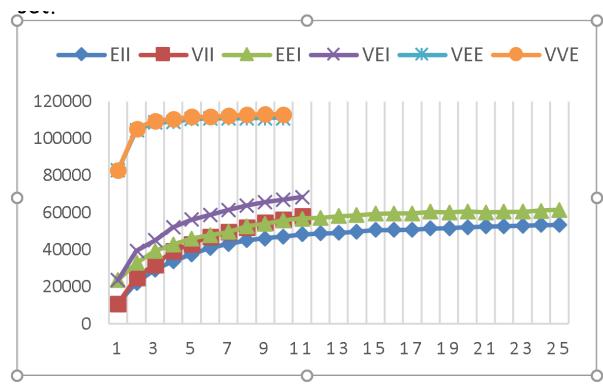
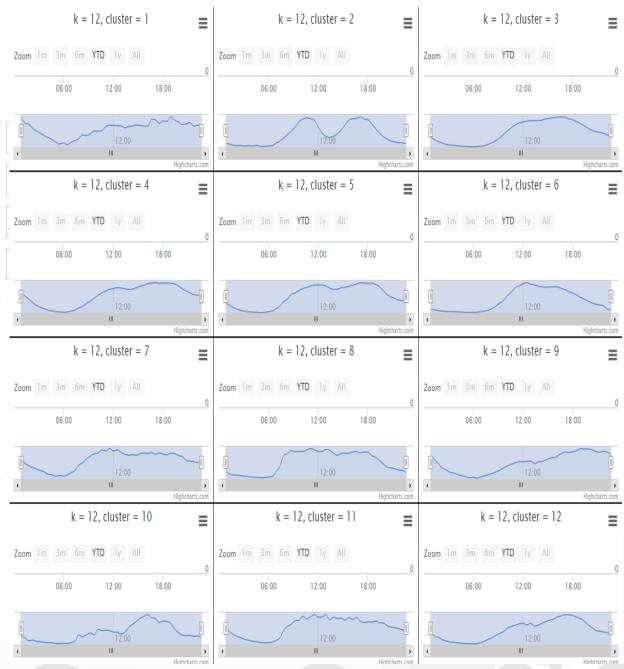


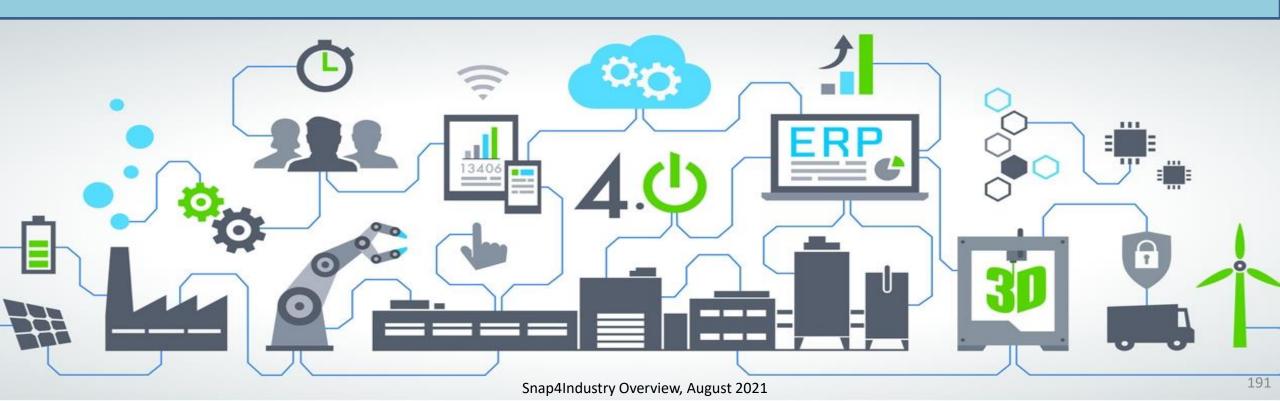
Figure 14 – Average BIC for mixture models vs K number of cluster, higher values are better, the curves are truncated at the best value for K they found.







Anomaly Detection



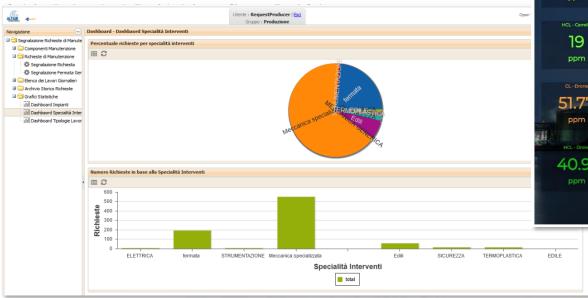








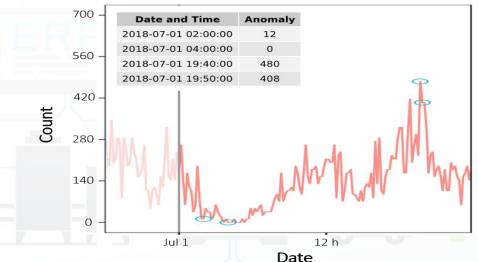
Reports and Dashboards



Anomaly detection Early Warning

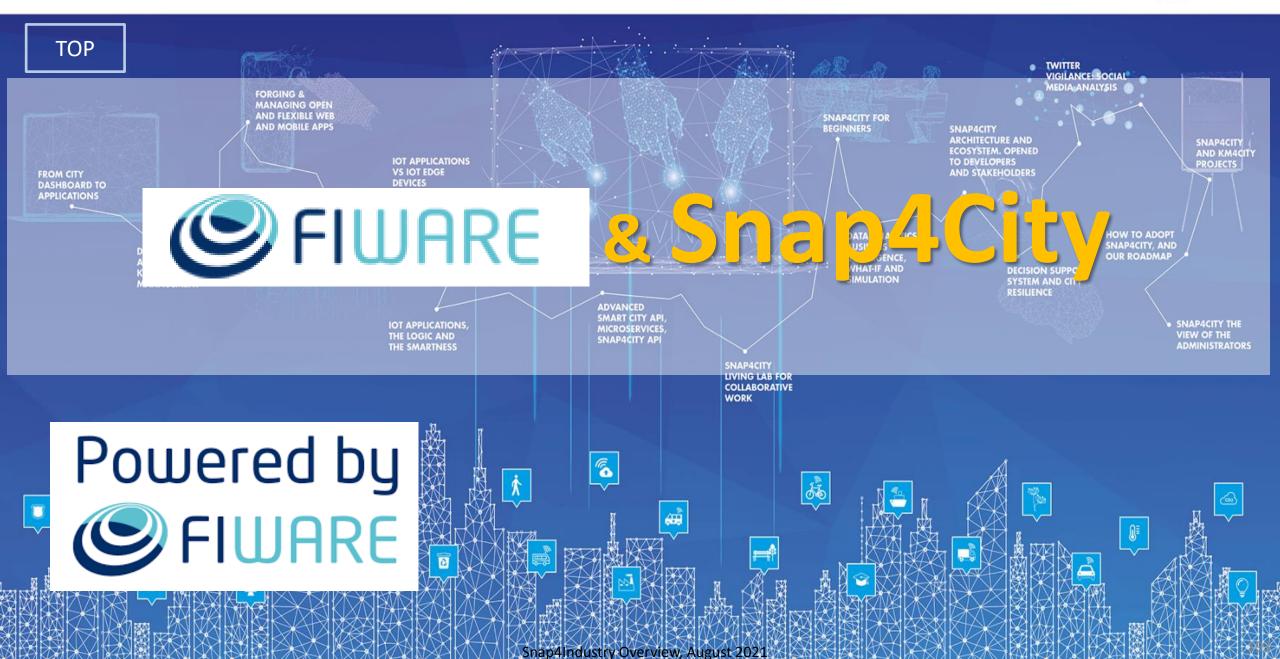


Altair



SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES

















- Snap4City Powered by FIWARE Solution:
 - https://marketplace.fiware.org/pages/solutions/b8905e91973b4201 89cce972
 - 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 <u>FIWARE</u> Training Services:
 - https://marketplace.fiware.org/pages/solutions/03bccd83a0e1b039 8ba7a0bf
- Snap4City <u>FIWARE</u> Consultancy Services:
 - https://marketplace.fiware.org/pages/solutions/907f5ecc63927f643 dd8421b
- 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, August 2021









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

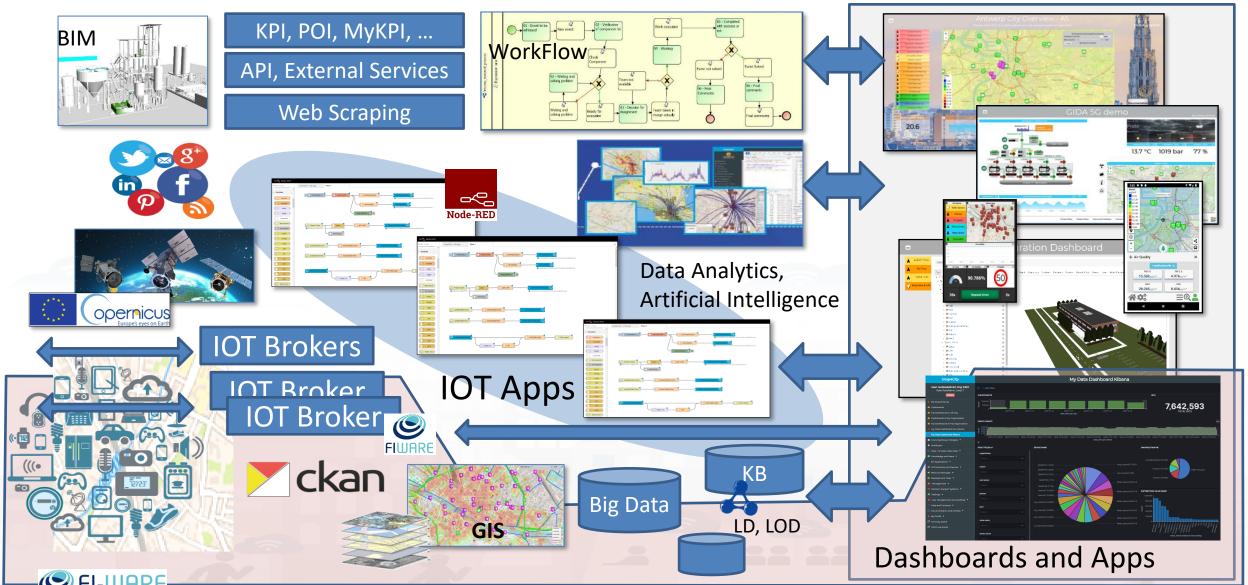






Concept













Functional: FIWARE ref arc wrt Snap4City solutions

	FIWARE ref arc smart city	Snap City Snap
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.







DINFO DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB CTIONAL: FIWARE refarc wrt Snap4City solutions

	111111111111111111111111111111111111111		
	FIWARE ref arc smart city	Snap4City 🔬	
Data Transformation	Coding	Yes: IOT App, Node.JS, Visual Programming, scalable	
Data Analytics	No	Yes	C
on line development	No, limited	Yes: Rstudio, Python, Tensor Flow, MapReduce, etc.	
Dashboard on data	Grafana no LDAP	Yes: Dashboard Builder, Kibana with GDPR, LDA (Open Distro)	
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	6
Auditing, Assessment, accounting	No, no, no	Yes, Yes, Yes	A)
Multitenacy on data management	No only on broker	Yes: on Broker, on data management, on dashboards, etc	
Living Lab for creating/managing communities/groups	Not supported	Yes: provided in the open source	
Report generation/management	No	Yes	

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CSNAP4INDUSTRY













Main running instances



































- Sii-Mobility

 mobility and transport, sustainability
- REPLICATE → ICT, smart City Control room, Energy, IOT
- RESOLUTE → Resilience, ICT, Big Data
- GHOST → Strategies, smart city
- TRAFAIR → Environment & transport
- MOSAIC → mobility and transport
- WEEE Life → Smart waste, environment
- Smart Garda Lake

 Castelnuovo del Garda
- 5G → Industry 4.0 vs SmartCity
- Green Impact → Industry 4.0, Chemical Plant
- SmartBed (laid → smart health
- Green Field Peas (soda) → Industry 4.0, Chemical plant
- MobiMart and PISA Agreement → data aggregation, Living Lab
- Lonato del Garda → smart parking, environment
- Herit Data → tourism, culture and management
- ISPRA JRC → site management and services
- Capelon (Sweden) → smart light solutions

Acknowledgements

- Thanks to the European Commission for founding. All slides reporting logo of Snap4City https://www.snap4city.org of Select4Cities H2020 are representing tools and research founded by European Commission for the Select4Cities project. Select4Cities has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation Programme (grant agreement n° 688196)
- TRAFAIR is a CEF project. All slides reporting logo of TRAFAIR project are representing tools and research founded by the EC on CEF programme http://trafair.eu/
- Thanks to the European Commission for founding. All slides reporting logo of REPLICATE H2020 are representing tools and research founded by European Commission for the REPLICATE project. **REPLICATE** has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation Programme (grant agreement n° 691735).
- Thanks to the European Commission for founding. All slides reporting logo of **RESOLUTE H2020** are representing tools and research founded by European Commission for the RESOLUTE project. **RESOLUTE** has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation Programme (grant agreement n° 653460).
- Thanks to the MIUR for co-founding and to the University of Florence and companies involved. All slides reporting logo of Sii-**Mobility** are representing tools and research founded by MIUR for the Sii-Mobility SCN MIUR project.
- **Km4City** is an open technology and research line of DISIT Lab exploited by a number of projects. Some of the innovative solutions and research issues developed into projects are also compliant and contributing to the Km4City approach and thus are released as open sources and are interoperable, scalable, modular, standard compliant, etc.











INEA CEF-TELECOM Project funded by European Union





European Union Funding for Research & Innovation























GREEN FIELD PEAS





















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