SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT

SNAP4INDUSTRY

SNAP4 Appliances and Dockers Installations

by Snap4 Technology

https://www.snap4city.org

100% OPEN SOURCE

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

EXPERT SYSTEM
KNOWLEDGE BASE
STORAGE

BIG DATA ANALYTICS
ARTIFICIAL INTELLIGENCE
BUSINESS INTELLIGENCE
MACHINE LEARNING

DATA FLOWS, WORKFLOWS
MICROSERVICES
MANAGEMENT

METHODOLOGIES
COURSES AND COMMUNITY
LIVING LABS
DEVELOPMENT TOOLS

Snap4Industry by Snap4City (C), May 2021

Snap4City/Industry structure

- The **Snap4xxxx** solution is released in Open Source, VM and Docker with fully support of MultiTenacy/multiple-Organizations
  - Each Organization may be configured for a separate environment with a set of Maps, Menus, Users, Data, Dashboards, IOT Applications, MicroApplications, Custom Widgets, etc.

- Https://www.Snap4City.ORG is the main instance of Snap4xxxx solution managed by DISIT Lab. The main documentation is located and updated on Snap4City.org and GitHUB and dockerHub and Node-Red Library. Snap4City.org is where the last tools are tested and news published.
  - Organizations on Snap4City.org have been created with contracts as for *Platform as a Service*, for testing and for providing *SmartCity as a Service* or *Industry 4.0 as a Service*
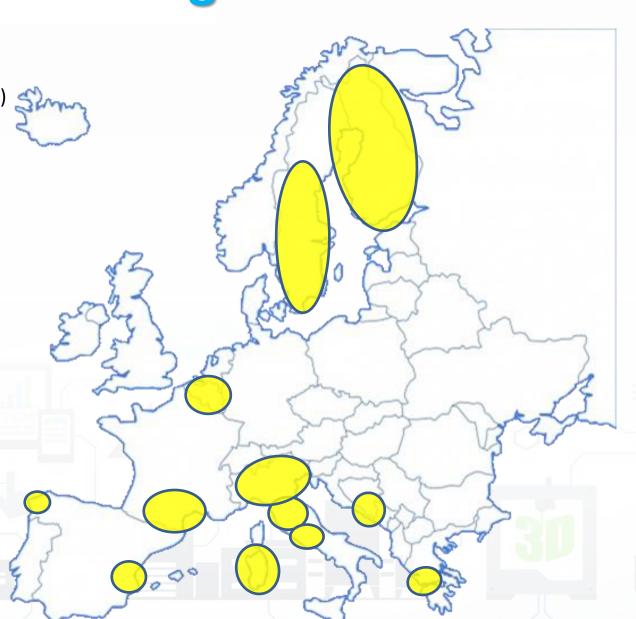
Coverage 2020

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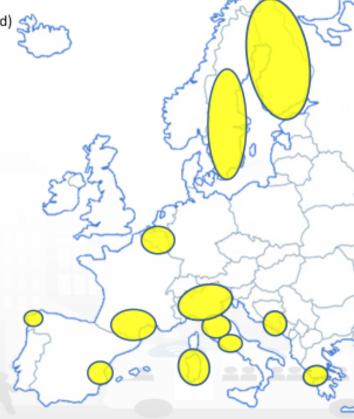- Valencia (S)
- Venezia area (I)
- WestGreece area (Gr)

Snap4City/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)
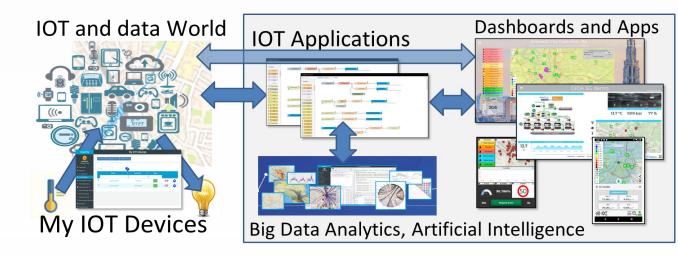
Snap4City (C), October 2020

Free Trial

- Register on WWW.snap4city.org
  - Subscribe on **DISIT Organization**

- **You can:**
  - Access on basic Tools
  - Access to a large volume of Data
  - Create Dashboards
  - Create IOT Applications
  - Connect your IOT Devices
  - Exploit Tutorials and Demonstrations

IF you need to go more in deep you can ask us to pass at the next Role becoming full AreaManager with full rights of development, also for Data Analytics, machine learning, etc.

https://www.snap4city.org/577

On Line Training Material (free of charge)

| what	1st part (*) General	2nd part (*) Dashboards	3rd part (*) IOT App, IOT Network	4th part (*) Data Analytics	5th part (*) Data Ingestion processes	6th part (*) System and Deploy Install	7th part (*) Smart City API: Web & Mob. App
PDF							
Inter active							
Video1	▶ YouTube	▶ YouTube	▶ YouTube	▶ YouTube	▶ YouTube	▶ YouTube	▶ YouTube
Video2	▶ YouTube	▶ YouTube	▶ YouTube	▶ YouTube	▶ YouTube	▶ YouTube	▶ YouTube
Video3	▶ YouTube	▶ YouTube	▶ YouTube	▶ YouTube	▶ YouTube	▶ YouTube	▶ YouTube
Video4	▶ YouTube	▶ YouTube	▶ YouTube	none	▶ YouTube	none	none
duration	2:55	3:16	3:41	2:00	2:48	2:35	1:47

Overview
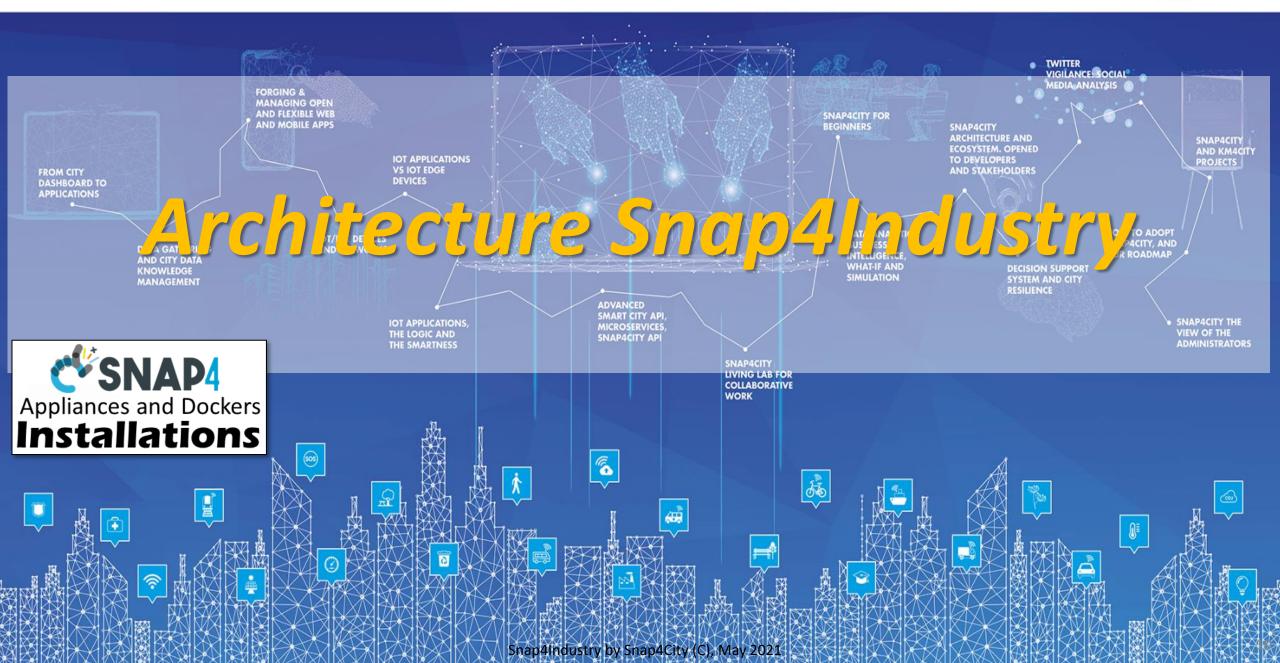
- Architecture of Snap4Industry
  - Creation of Dashboards and Applications
  - Dashboards' Intelligence on Web and Mobile Devices
  - IOT Applications: virtual sensors and actuators
  - IOT Applications integration with Synoptics
- Data Gathering and Knowledge Management 4.0
- IOT Devices and IOT Applications
  - IOT Application vs IOT Edge Devices
  - Managing IOT Applications
  - Remote Control of IOT Applications on IOT Edge Devices
  - Secure IOT Devices, IOT Edge Sensor and Dev Networking
- Integration with Ticketing System Workflows
  - Managing Maintenance, predictive maintenance, anomaly detection
- Data Analytics, Big Data Science
  - Anomaly detection
- Living Lab for Collaborative Work
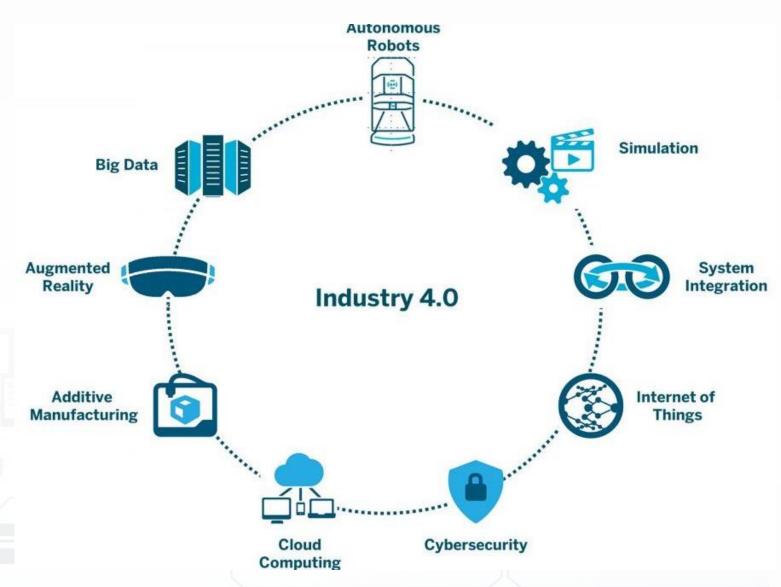- Roadmap and Projects
- Acknowledgements

Industry 4.0

- Big Data
- Cloud Computing
- Cybersecurity
- IOT/IOE
- System Integration
- Simulation
- Data Analytics

Objective

- Industry
  - Integration of SCADA (Supervisory control and data acquisition), DCS (Distributed Control Systems), RTU (remote terminal units) concepts
  - Industry 4.0 protocols
- IOT:
  - **Abstraction of IOT Devices** (Edge) on IOT Directory and IOT App
  - High integration with IOT Networks and IOT Directory for IOT net abstraction
  - Usage of Node-RED as IOT Edge, **controllable/editable from remote**
- Scalability
  - Big Data: MicroServices for data access and retrieval, discovery
  - Cloud Management on dockers and scalability
- **Secure connection** for Data and Dashboards: SSO, TLS
  - Privacy with GDPR compliance
- **Exploitation of Data Analytic** on Edge and Cloud, from Edge and Cloud
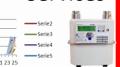- **Synoptics via Secure WebSockets, custom widgets**
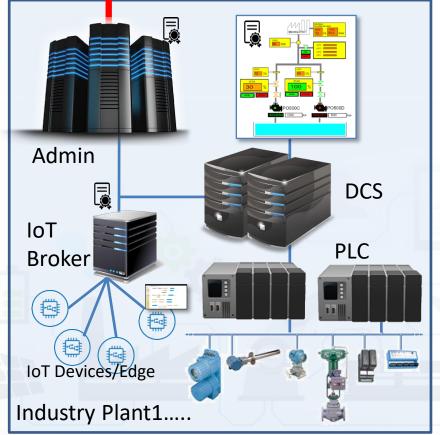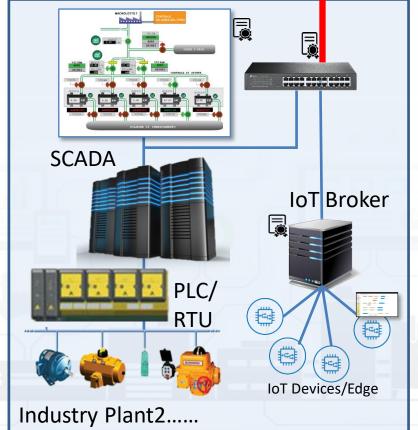
https://www.snap4city.org/369

External Services

Fleet management

IoT Devices/Edge

IoT Broker

Internet

SECURE

Admin

DCS

SCADA

PLC

IoT Broker

PLC/RTU

IoT Broker

IoT Devices/Edge

IoT Devices/Edge

IoT Devices/Edge

Industry Plant1…..

Industry Plant2……
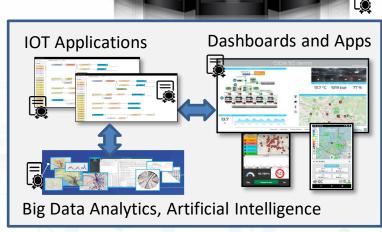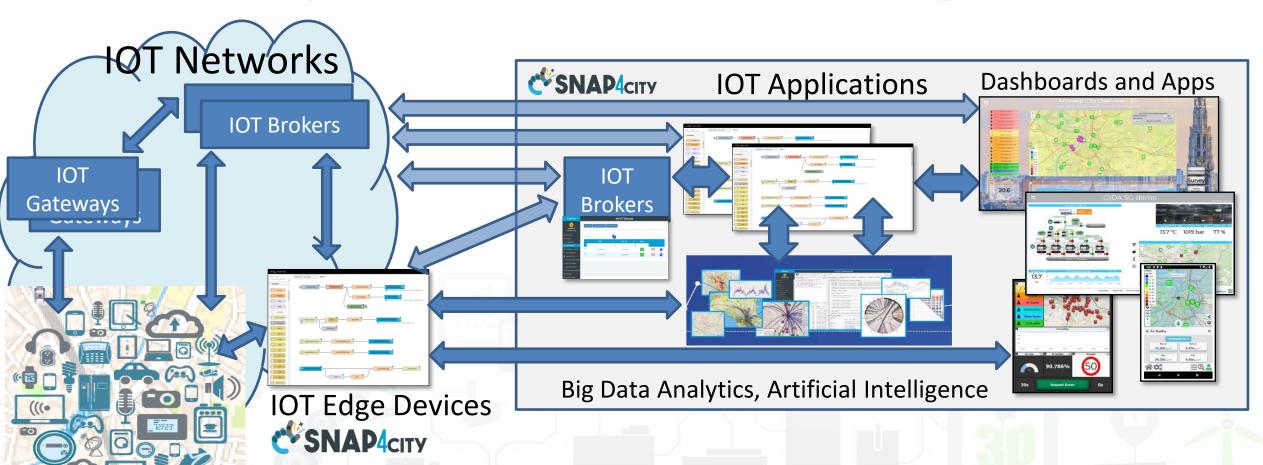
IOT Applications

Dashboards and Apps

Big Data Analytics, Artificial Intelligence

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

13

Snap4 Services also on IOT Edge!!!

IOT Networks

IOT Brokers

IOT Gateways

Gateways

IOT Applications

Dashboards and Apps

IOT Brokers

IOT Edge Devices

IOT Devices

Big Data Analytics, Artificial Intelligence

Mainly fog computing and NGSI V1, V2 with security
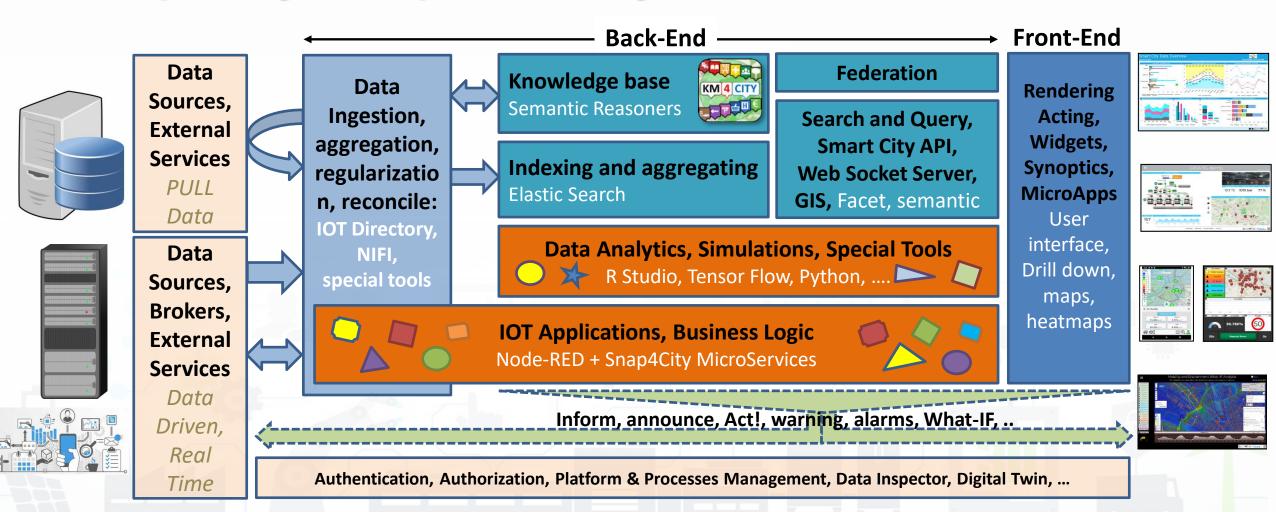
Snap4City, Snap4Industry Architecture, V2

Back-End ← → **Front-End**

Data Sources, External Services *PULL Data*

Data Sources, Brokers, External Services *Data Driven, Real Time*

Data Ingestion, aggregation, regularization, reconcile: IOT Directory, NIFI, special tools

Knowledge base Semantic Reasoners

Indexing and aggregating Elastic Search

Data Analytics, Simulations, Special Tools R Studio, Tensor Flow, Python, ...

IOT Applications, Business Logic Node-RED + Snap4City MicroServices

Federation

Search and Query, Smart City API, Web Socket Server, GIS, Facet, semantic

Rendering Acting, Widgets, Synoptics, MicroApps User interface, Drill down, maps, heatmaps

Inform, announce, Act!, warning, alarms, What-IF, ..

Authentication, Authorization, Platform & Processes Management, Data Inspector, Digital Twin, ...

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.

ALTAIR CHIMICA

ESSECO

Altair Chemical (I)

Snap4Altair *Decision Support supervision and control, Industry 4.0*

reference
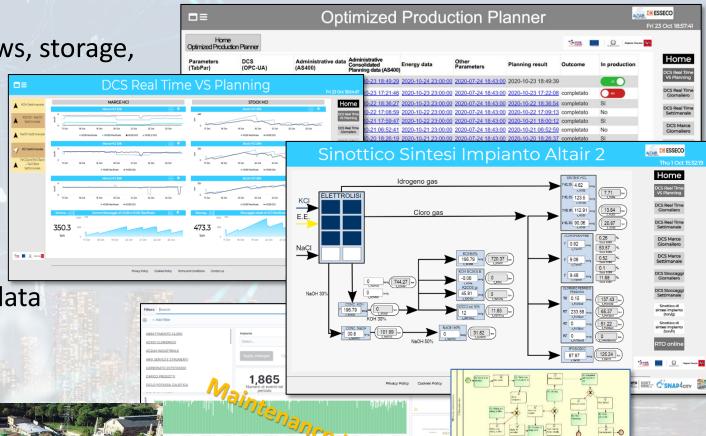
- **Multiple Domain Data**
  - Distributed Control System: energy, flows, storage, chemical data, settings, ..
  - Cost of energy, Orders,
  - Production Parameters
  - Maintenance data

- **Multiple Levels & Decision Makers**
  - Optimized planning on chemical model
  - Business Intelligence on Maintenance data

- **Historical and Real Time data**
  - Billions of Data

- **Services Exploited on:**
  - Multiple Levels, Mobile Apps, API

- **Since 2020**

Maintenance Intelligence

Production vs Planning

Real Time Production Synoptic

Possible Plans

Plant Management
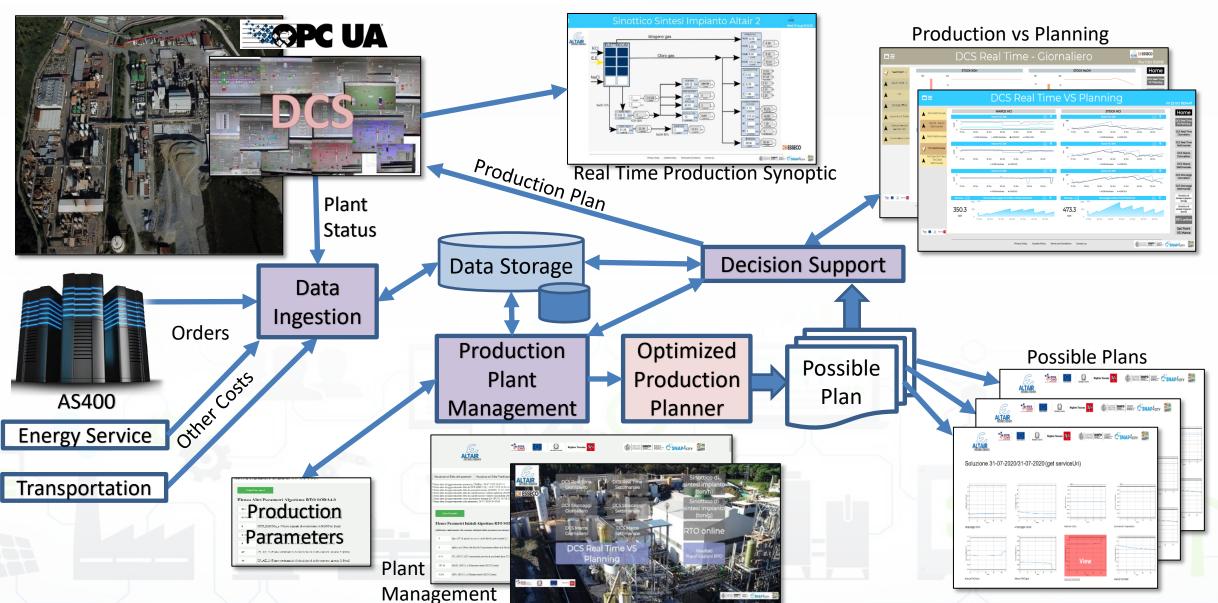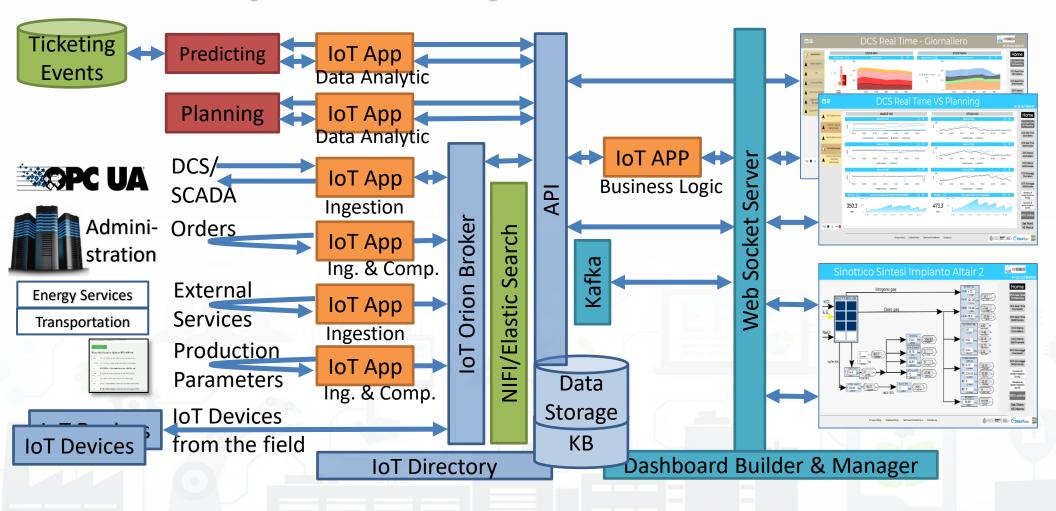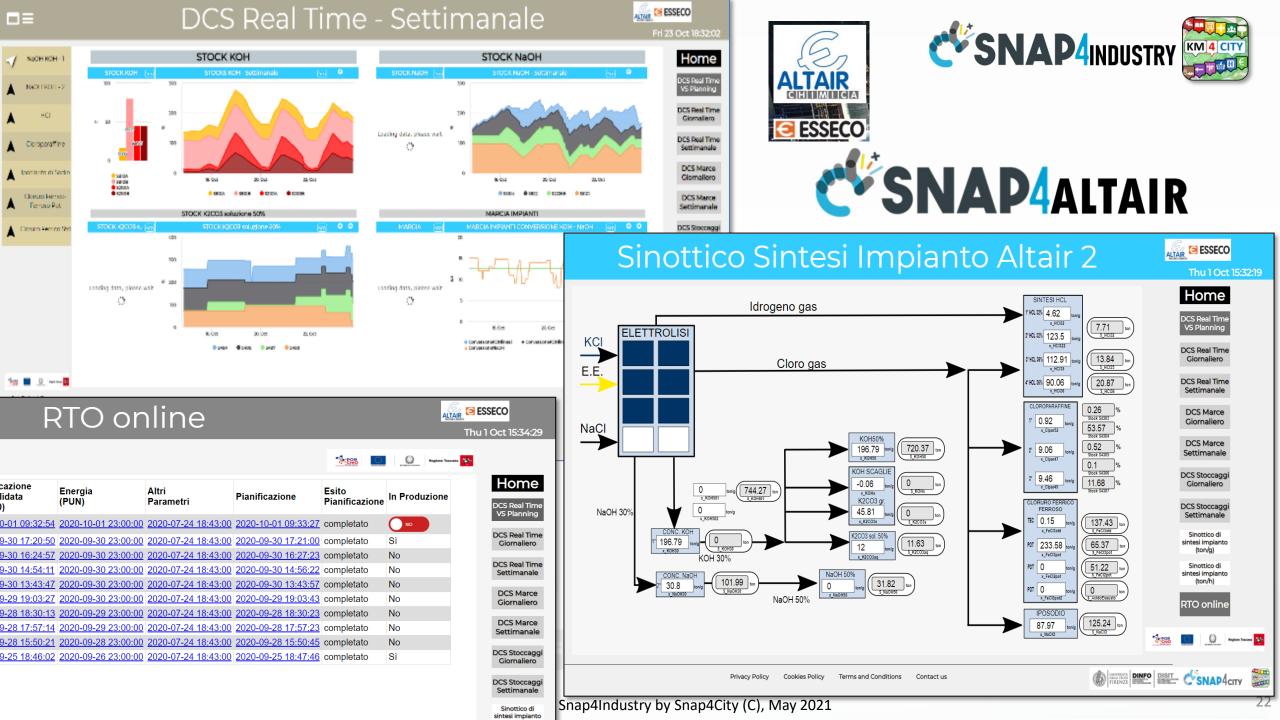
Snap4Industry IOT Architecture

Snap4Industry by Snap4City (C), May 2021

Business Logic

Produce Optimized Production Plan

Consolidated — No / Yes

set parameters

Data Storage

List of Active Orders

Consolidated Orders

Last Params

Take last DCS

Take last Energy

Consolidated Orders
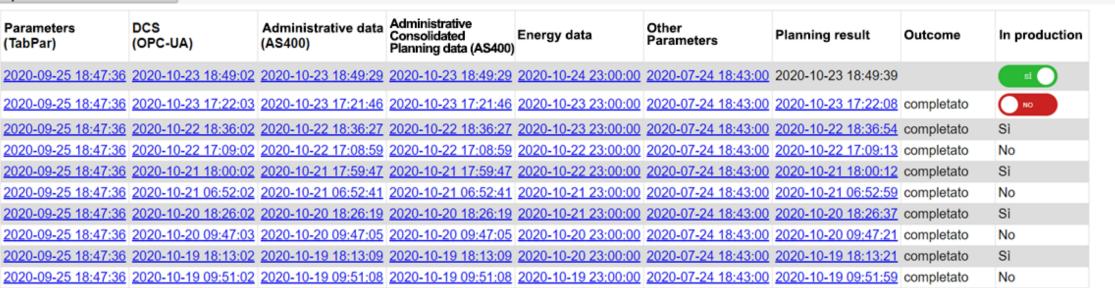
Optimized Production Planner

Possible Plan

Start Planning

DCS Real Time - Giornaliero

DCS Real Time VS Planning

Production Plan

Possible Plans

Decision Support

Snap4Industry by Snap4City (C), May 2021

24

Some Flows

Chemical Plant Dashboard

Green Impact Capacity (GIC)
Altair Control room

Snap4Industry by Snap4City (C), May 2021
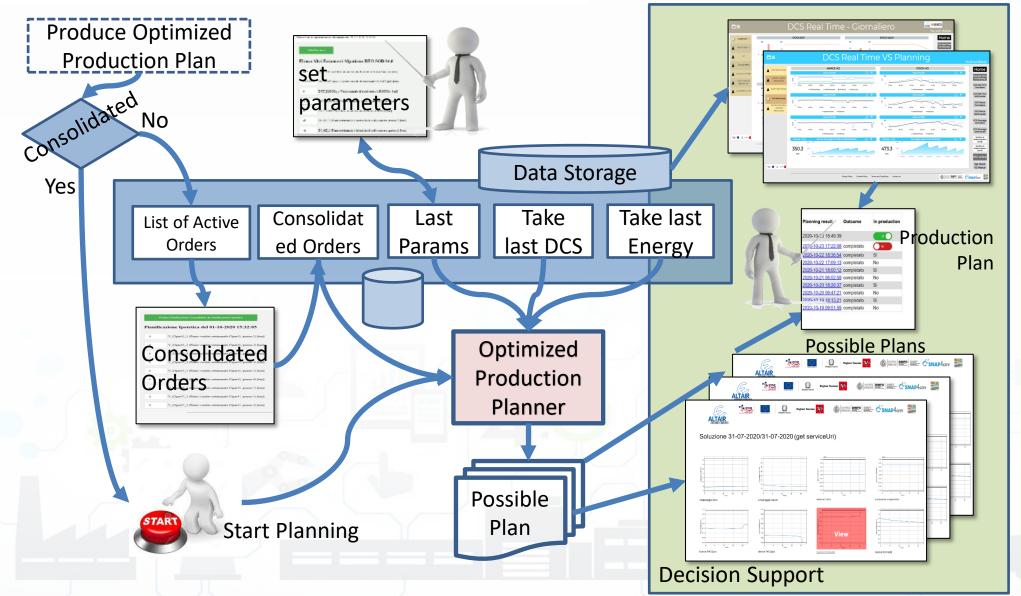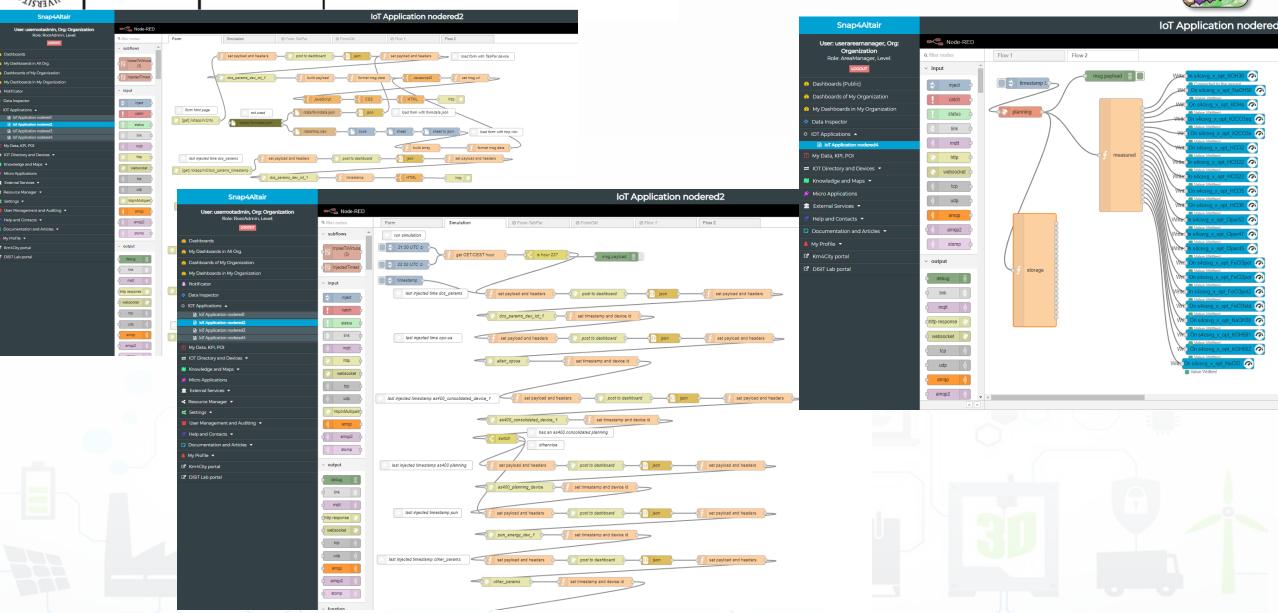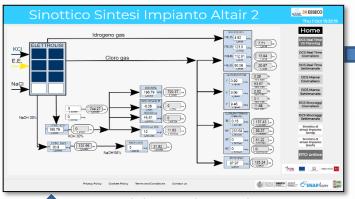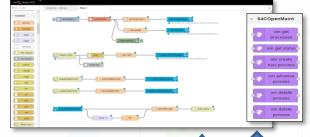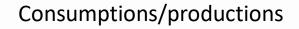
Workflow for Ticket management

Consumptions/productions

Events/actions

Business Intelligence
Maintenance

Dashboards and actions
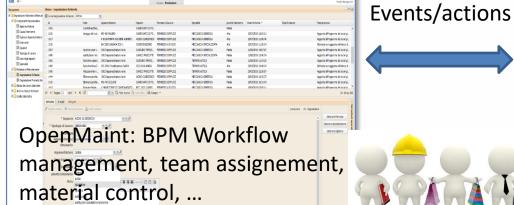
OpenMaint: BPM Workflow
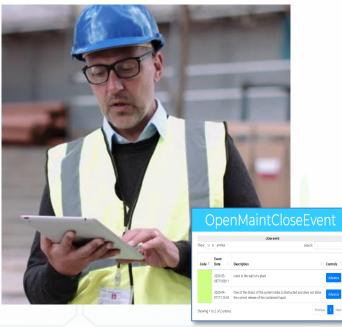management, team assignement,
material control, …

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

OpenMaintCloseEvent

OpenMaint Workflow Ticketing System

- Define the workflow
  - Activate events
  - Manage steps
  - Collecting feedbacks and results from teams

- Activities
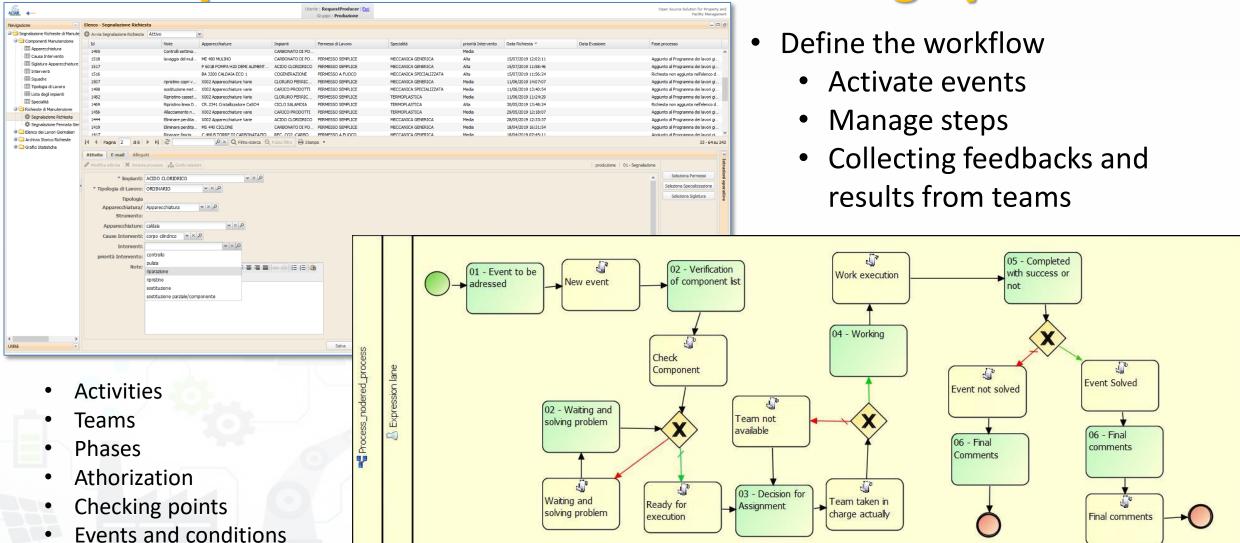- Teams
- Phases
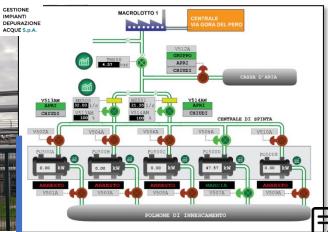- Athorization
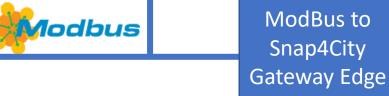- Checking points
- Events and conditions
- …
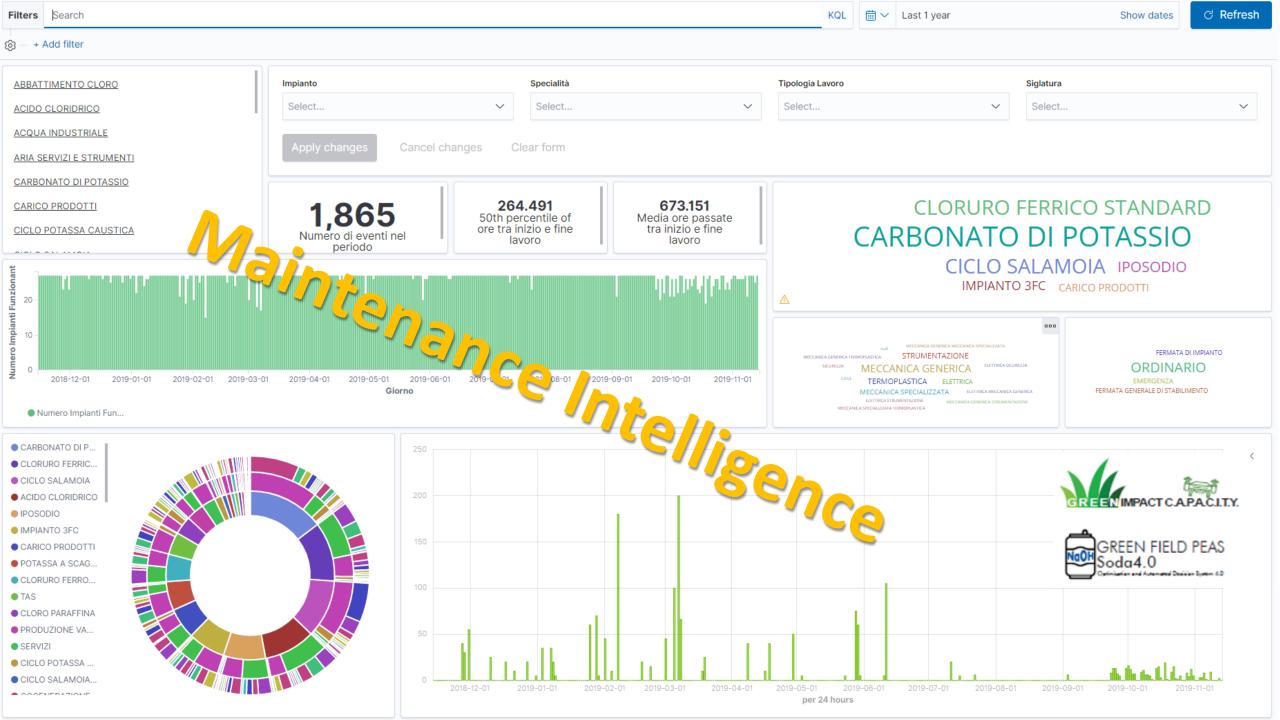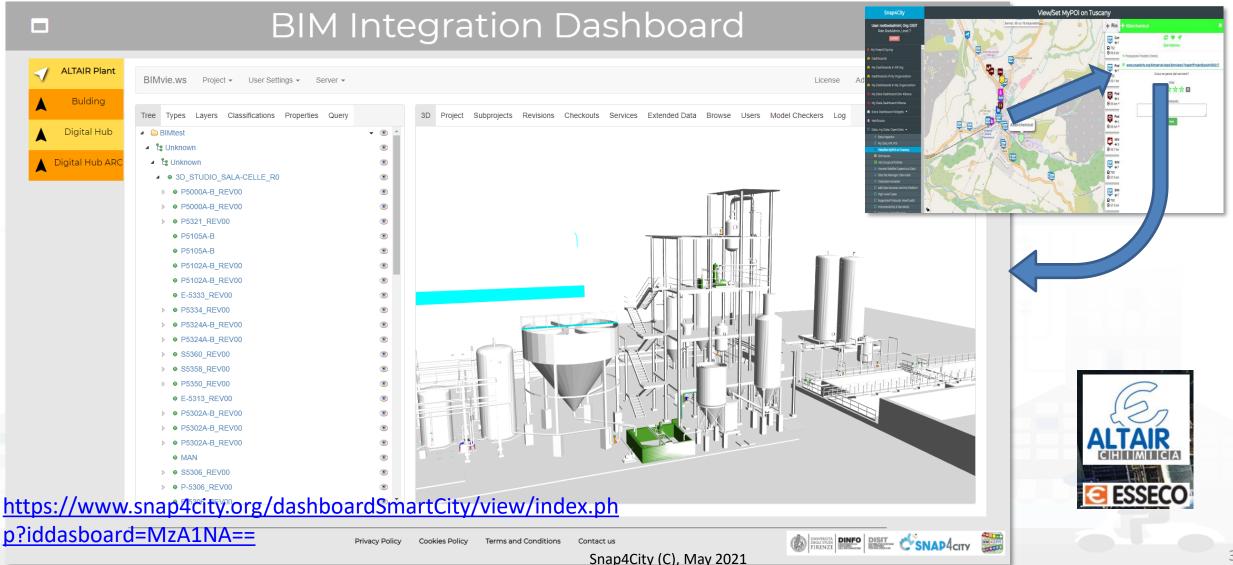
BIM view of the Altair Chemical Plant
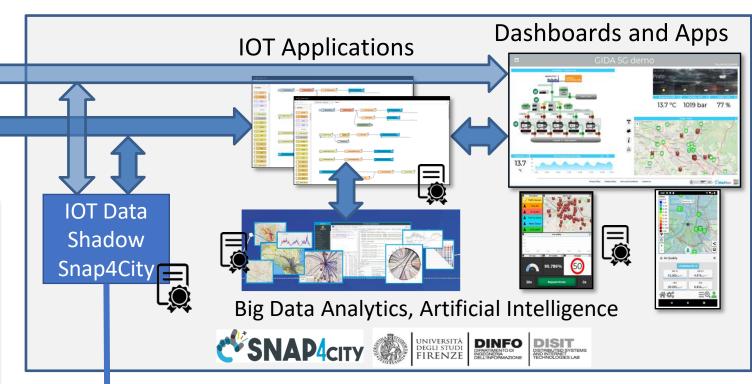
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA1NA==

Prato
Smart City vs Industry 4.0

GIDA set up
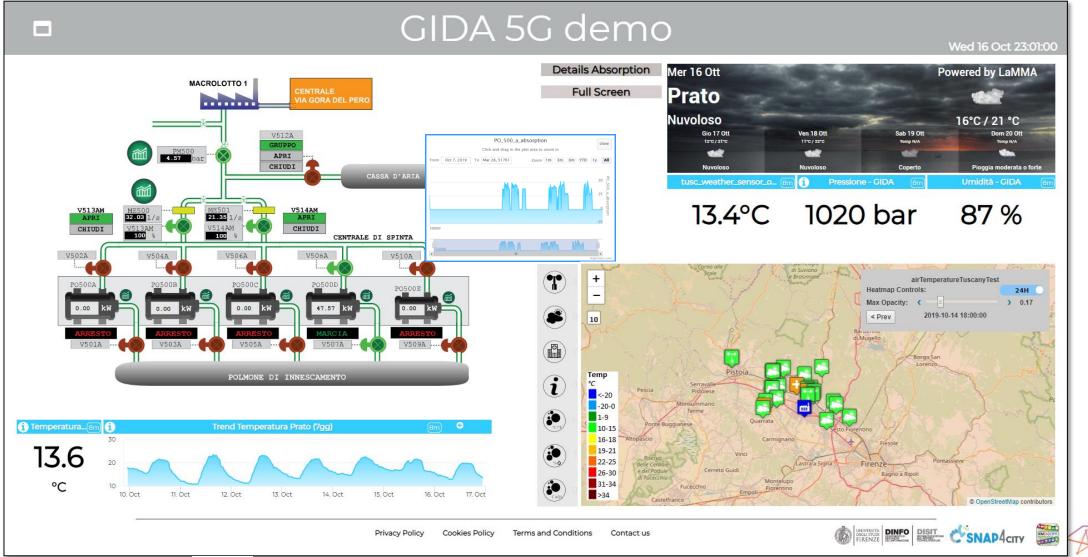
Demo UC5 GIDA

Demo UC5 GIDA

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjIyNg==
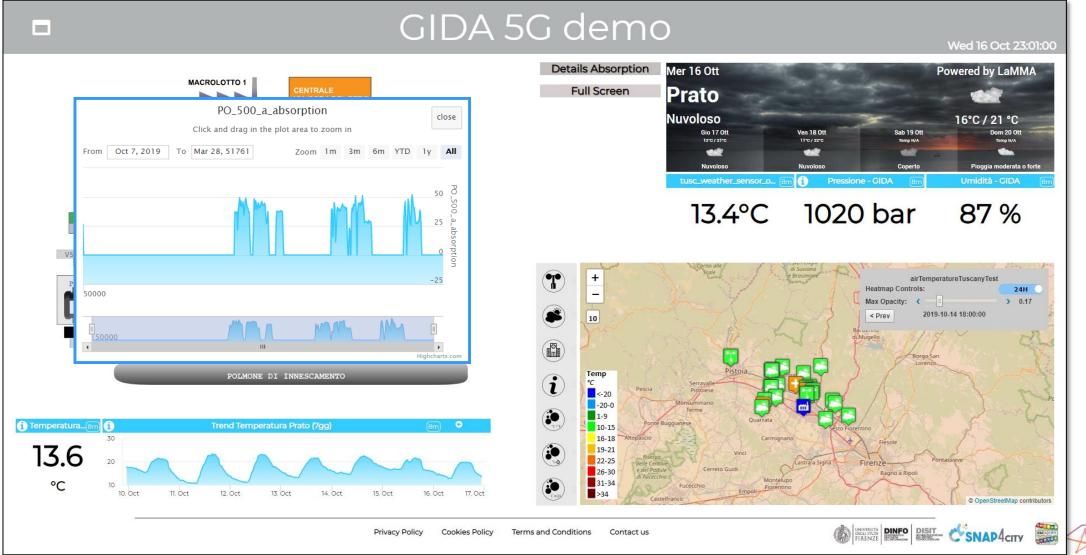
IOT App Smart Industry 4.0 ModBus Integration

Devices

Temp, Humidity

+ Input DC
- 5.0V-30V
RS485A+
RS458B-

8 Relais, actuators

Energy Metering

Modbus

IOT Applications

Dashboards and Apps

IOT Data Shadow Snap4City

Big Data Analytics, Artificial Intelligence

SNAP4CITY

UNIVERSITÀ DEGLI STUDI FIRENZE

DINFO
DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB
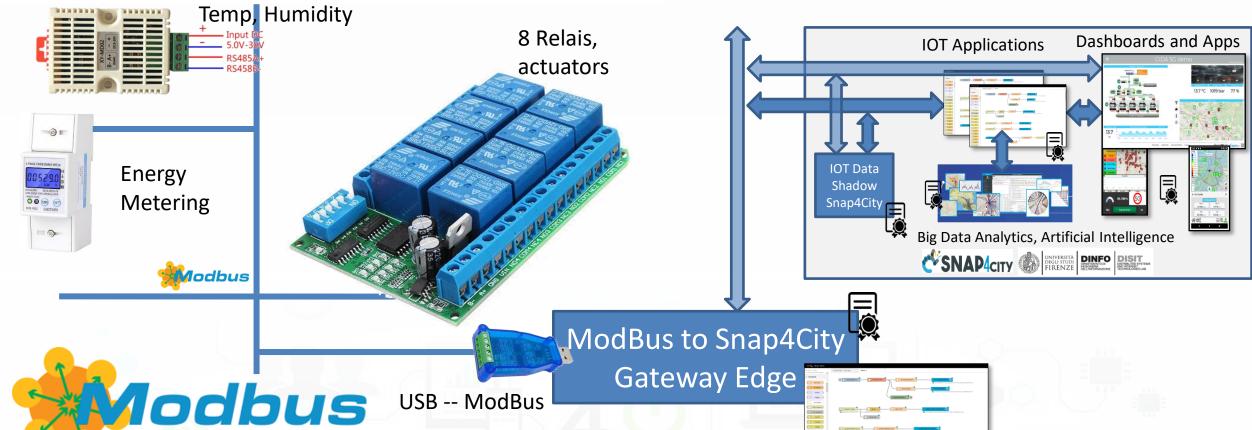
ModBus to Snap4City Gateway Edge

USB -- ModBus

Modbus

- A large range of devices: sensors and actuators

- Over serial as RS485 and/or IP

UNIVERSITÀ DEGLI STUDI FIRENZE

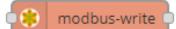DINFO
DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

DISIT
DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

Modbus

Textile Industry 4.0

Tue 18 Aug 19:11:52

Temperature real-time
Temp. esterna: 25.00°C
Temp. interna: 31°C

Umidità real-time
Umid. esterna: 68%
Umid. interna: 42.1%

Temperatura interna min & max
28.5 °C   42.1 °C

Umidità interna min & max
28.9 %   93.6 %

Dettagli Prodotto
Prodotto: Custom
Temperatura: 36 - 41°C
Umidità: 20 - 30%

Status Attuatori
Condizionatore: scalda   Umidificazione: deumidifica

Conditioner power   Humidifier power

Consumi
Climatizzazione   Umidificazione

1800   1500
0   7000   0   7000

Consumo Totale
4k
W
3k
2k
1k
0
18:58 19:00 19:02 19:04 19:06 19:08 19:10

Privacy Policy   Cookies Policy   Terms and Conditions   Contact us

SNAP4CITY

MODBUS

Modbus Server
active

send command

switch
temp ok
incr temp
dec temp

diff
Send temp
active

delay 300ms
switch
hum ok
incr hum
decr hum

diff
Send hum
active

Send comm
active

receive status

Modbus Read
connected
CondStatus → Climatizzazione:
HumStatus → Umidificazione

Status Attuatori XX
connected to wss://dashboard.km4city.org:443/server

requestReadPowerClim → Modbus Flex Getter
active → Consumo condizionatore

inject
requestReadPowerHum → Modbus Flex Getter
active → Consumo umidificazione

requestReadPowerTot → Modbus Flex Getter
active → extract → Consumo totale

IOT App vs Smart Home Snap4Home
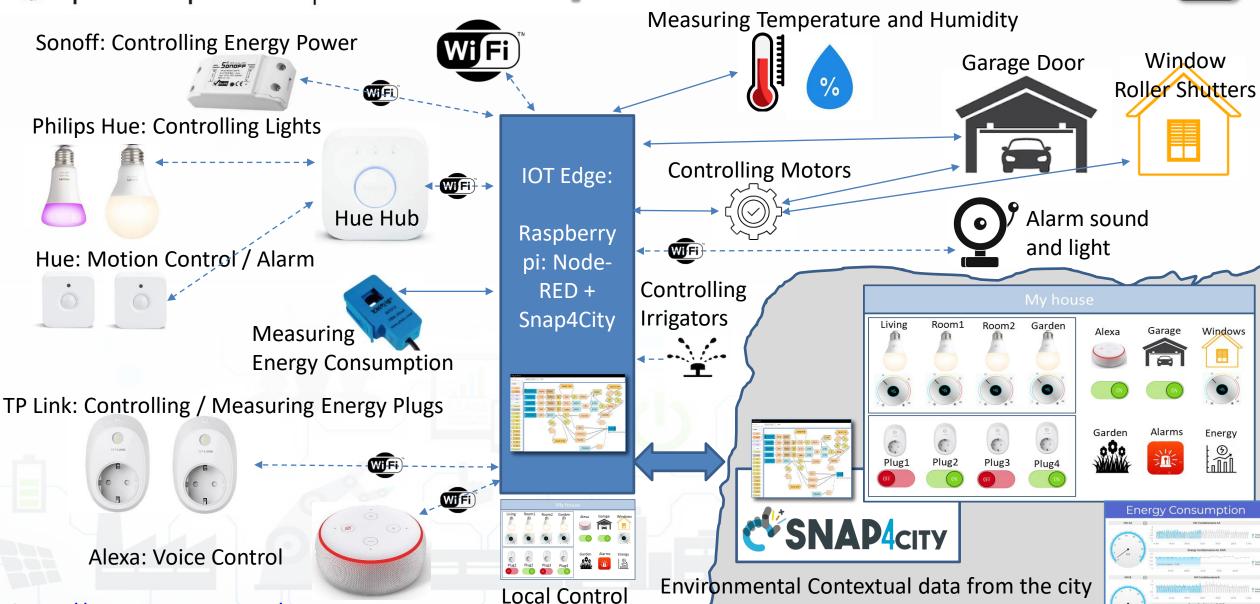
Snap4Home

Sonoff: Controlling Energy Power

Philips Hue: Controlling Lights

Hue Hub

Hue: Motion Control / Alarm

Measuring Energy Consumption

TP Link: Controlling / Measuring Energy Plugs

Alexa: Voice Control

Measuring Temperature and Humidity

Garage Door

Window Roller Shutters

IOT Edge:

Raspberry pi: Node-RED + Snap4City

Controlling Motors

Alarm sound and light

Controlling Irrigators

My house

Local Control

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

Energy Consumption

https://www.snap4city.org/620

Snap4Industry by Snap4City (C), May 2021

49

Example: IOT App on Snap4Home

Snap4Home

Philips Hue: Controlling Lights

Hue Hub
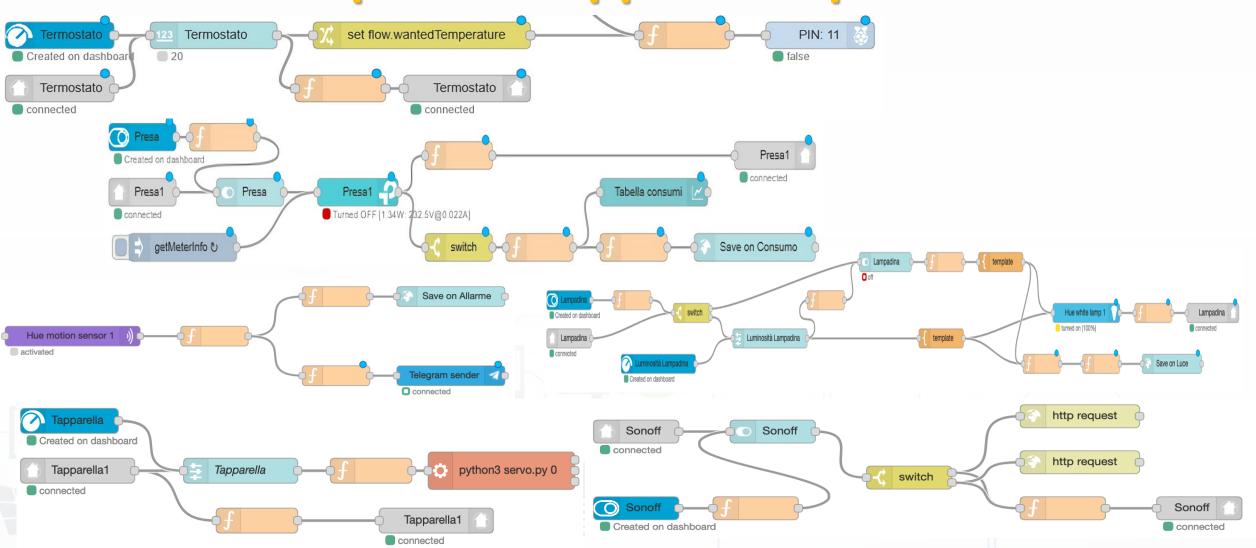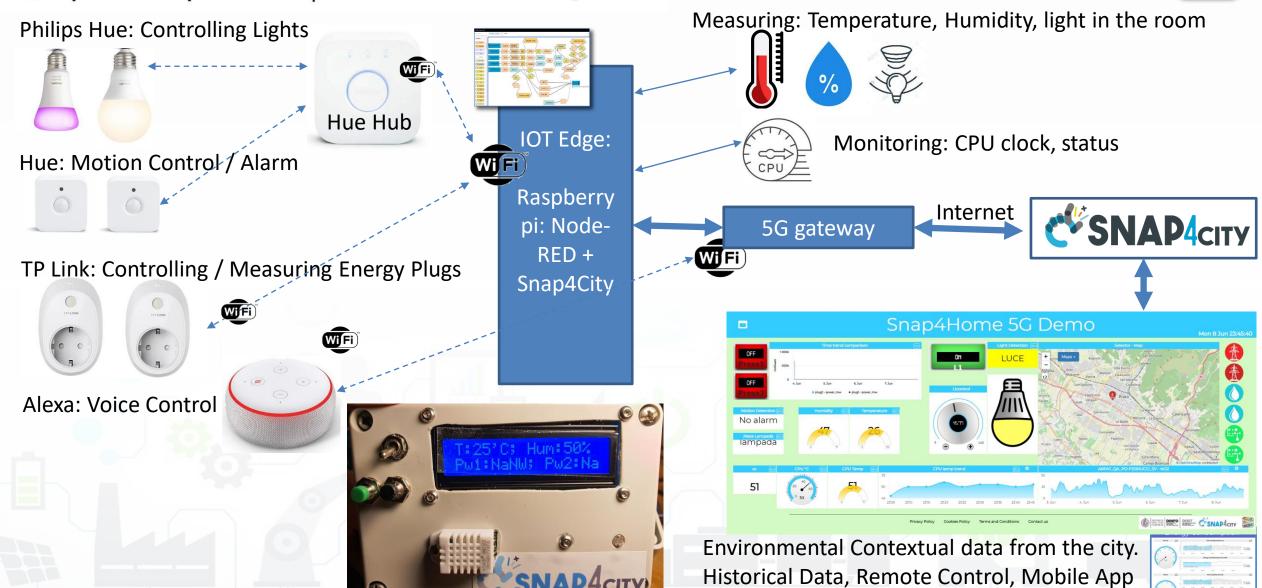
Hue: Motion Control / Alarm

TP Link: Controlling / Measuring Energy Plugs

Alexa: Voice Control

IOT Edge:

Raspberry pi: Node-RED + Snap4City

Measuring: Temperature, Humidity, light in the room

Monitoring: CPU clock, status

5G gateway

Internet

SNAP4CITY

Snap4Home 5G Demo

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

T:25'C; Hum:50%
Pw1:NaNW; Pw2:Na

Snap4Industry by Snap4City (C), May 2021

54

Business Intelligence Via My Data Dash Elastic Search + Kibana
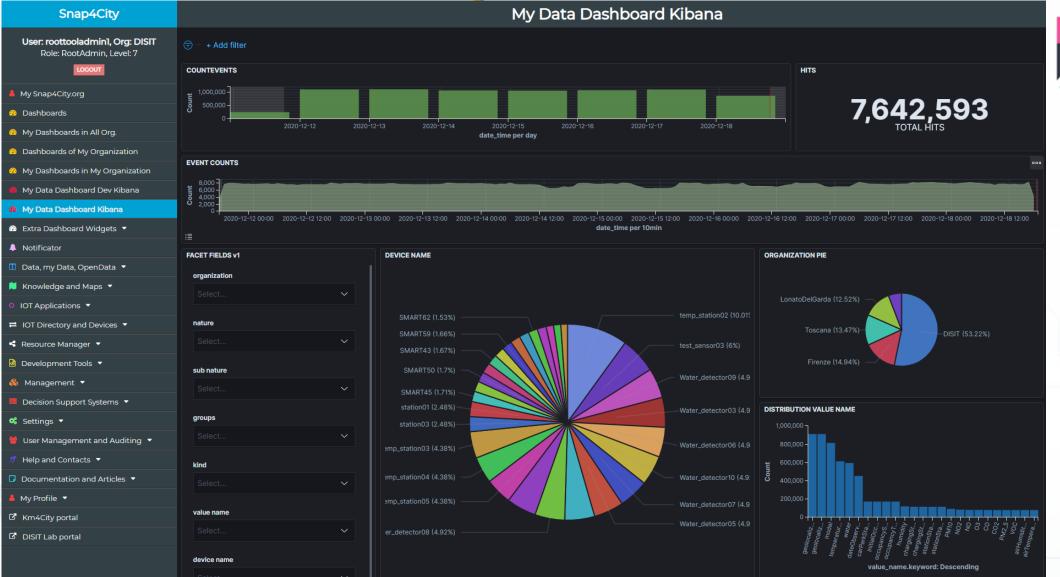
DevDash: My Data Dashboard Kibana

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
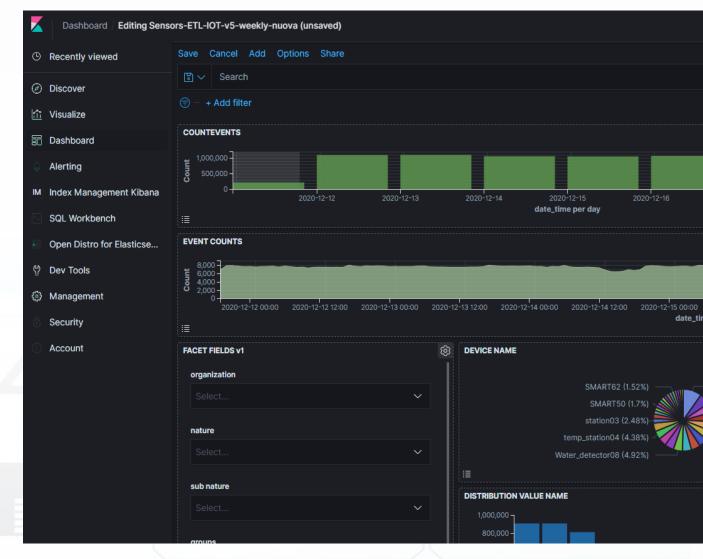
My Data Dashboard Customization
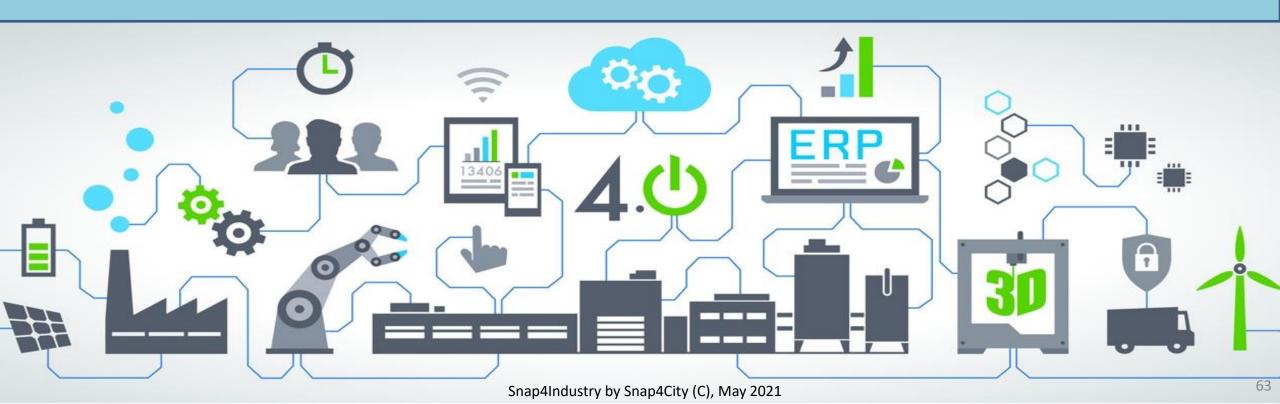
- My Data Dashboards (for Developers and for Managers) can be customized by RootAdmin.
  - Authority for Customizzation can be also extended to other role on Premise solutions
- Customizations is based on Full editing Capabilities of Kibana Elastic Search 7, and with multiple indexes of Snap4City
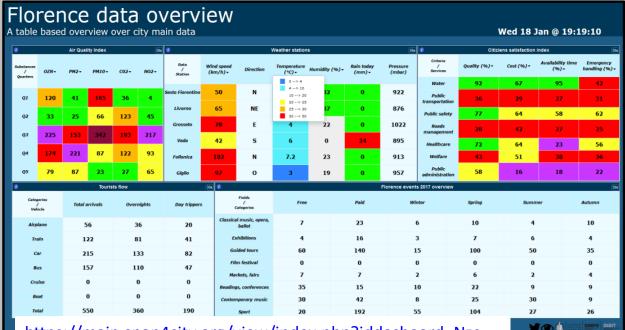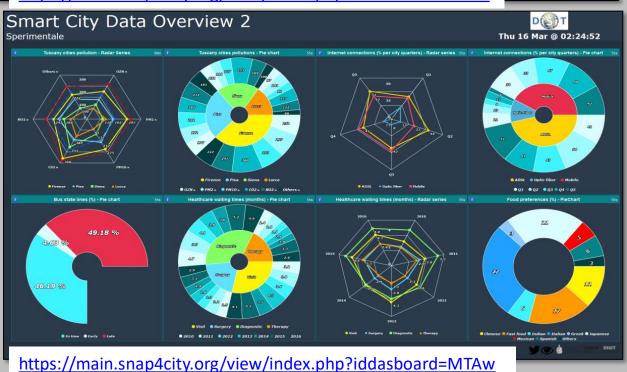
Creation of Dashboards and Applications
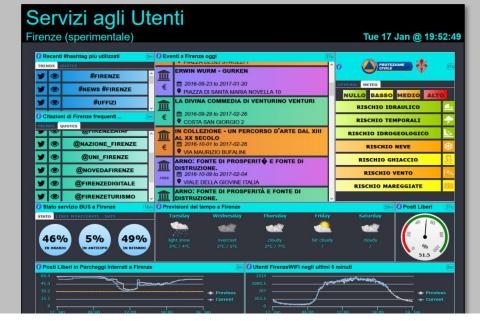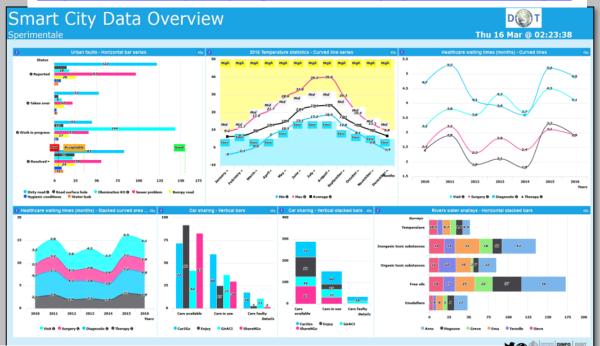
https://main.snap4city.org/view/index.php?iddasboard=Nzc=

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

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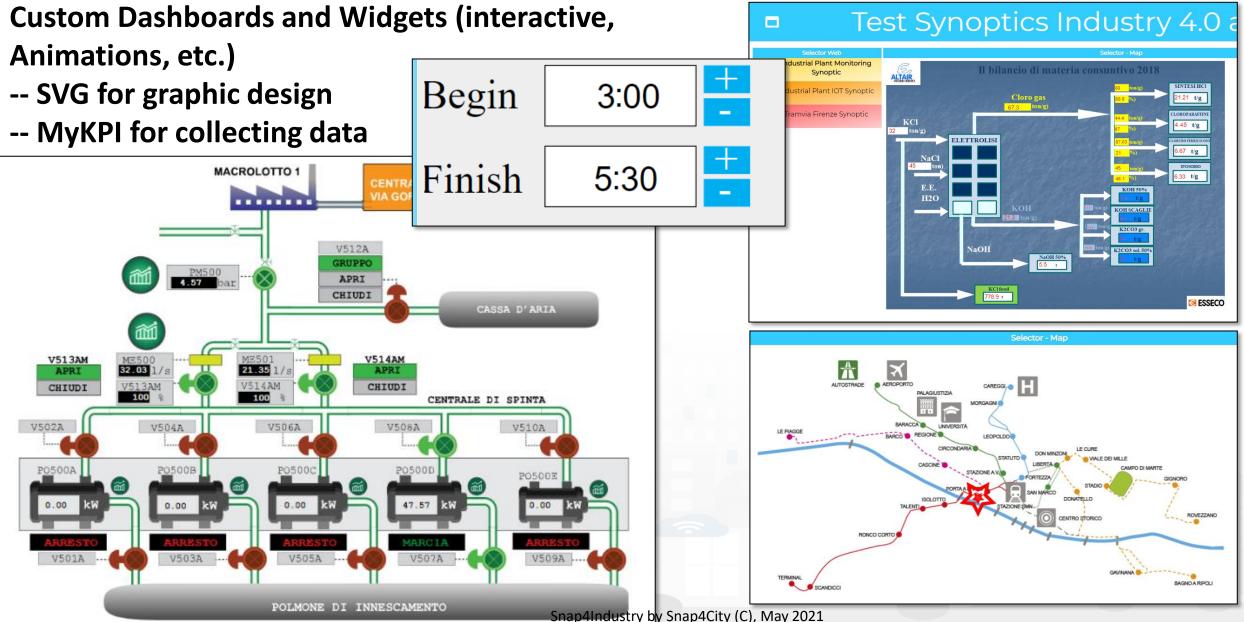
https://main.snap4city.org/view/index.php?iddasboard=ODM=

Custom Widgets

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

-- SVG for graphic design

-- MyKPI for collecting data

MyKPI: Tracking of Devices and Mobiles

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

- Micro Application

Mobile
PAX Counter

Apps

OBU

OBD2

IOE – Vehicle Monitoring

CANBUS sniffer
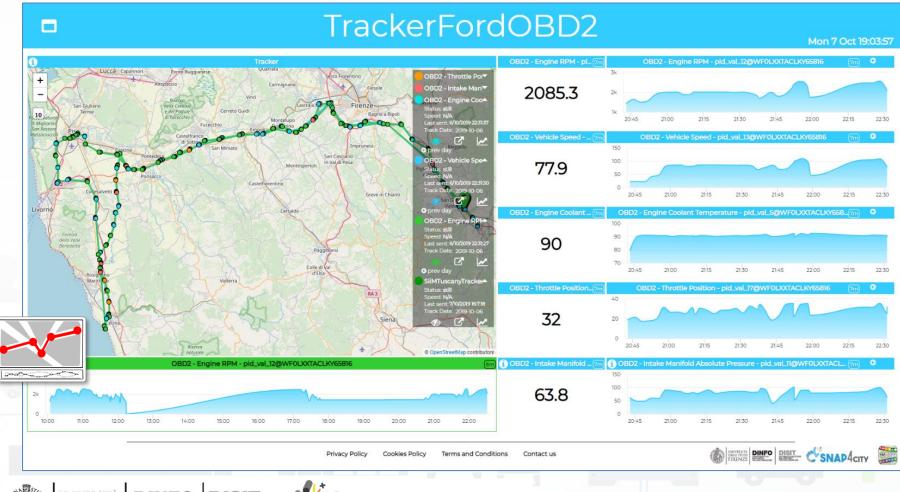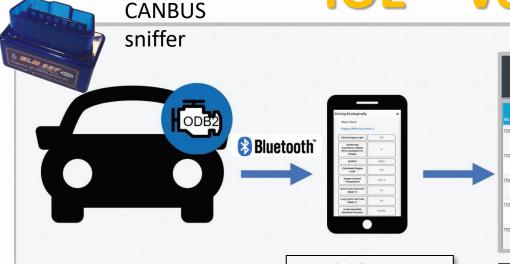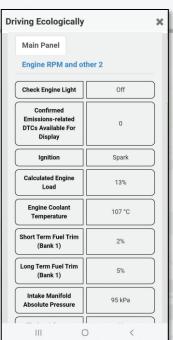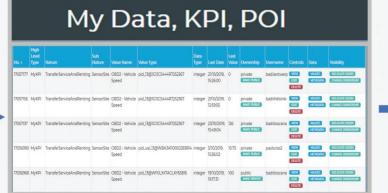
Tuscany in a Snap Mobile App on Android
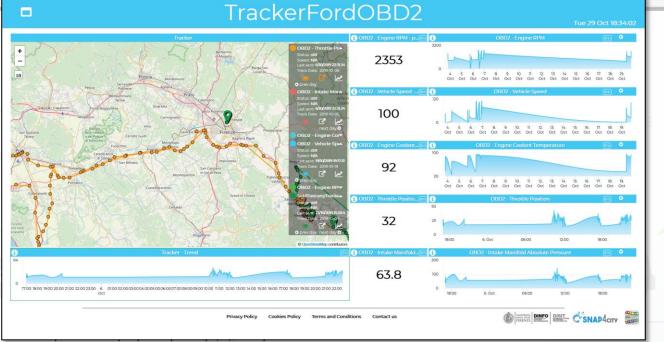
Special Custom Widgets

- Smart parking
- Smart Energy
- Smart Light
- Smart ....
- Energy View
- Custom Controls
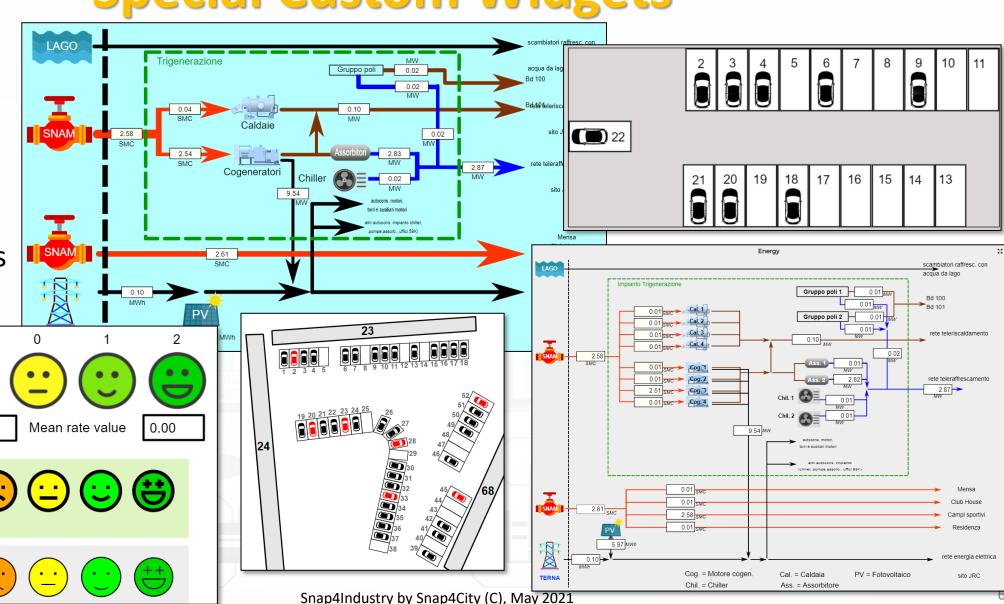
Dashboard Development

Widget Collection

Dashboard Wizard

Create, save, load, delegate, grant access

IOT Applications

Knowledge Base, Km4City

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

Micro Applications

External Services

Custom Widgets/ Synoptics

Dashboard Editor

Public Dashboard Collection

My Own Dash/App
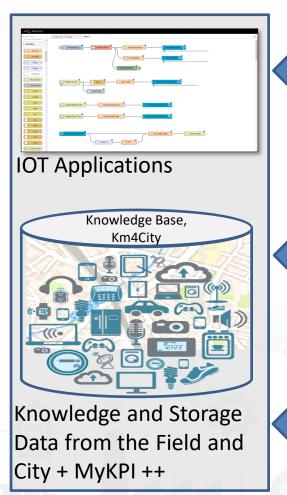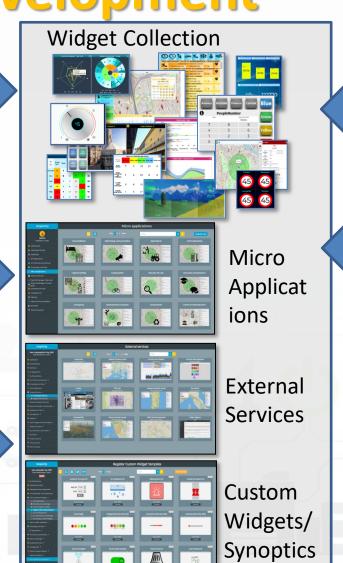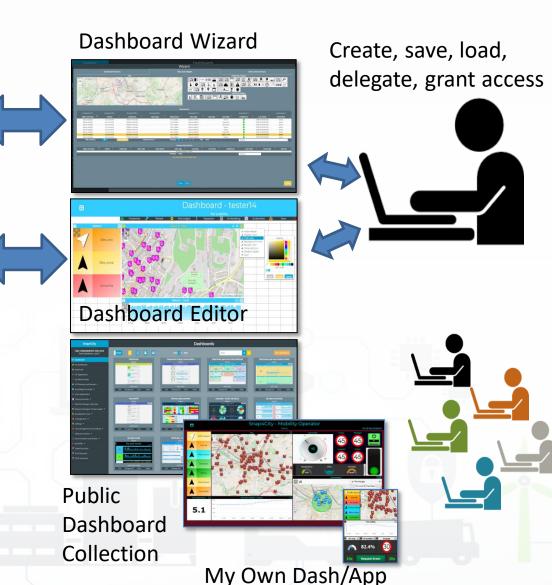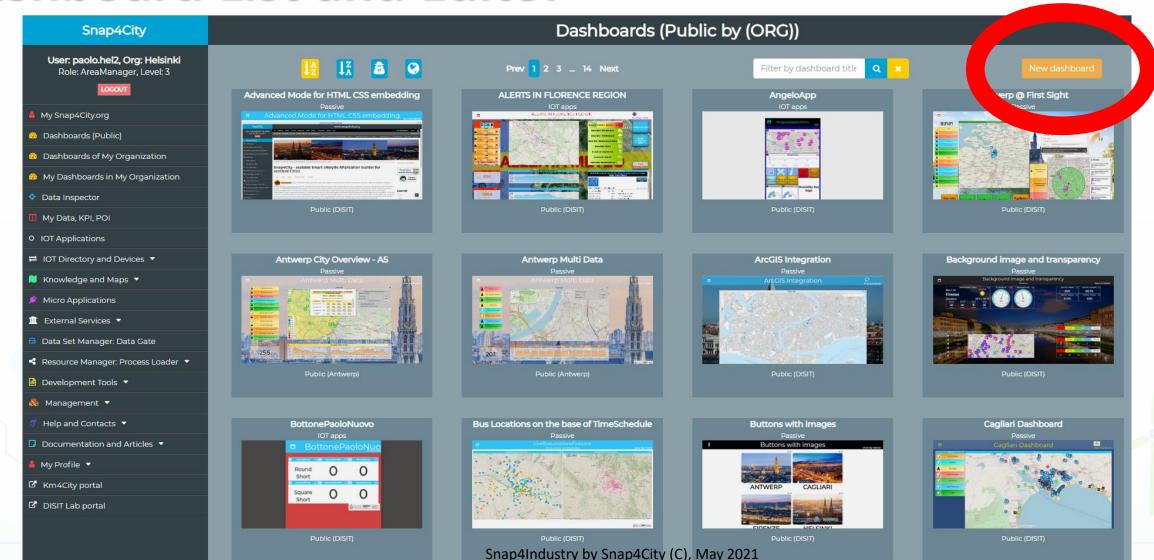
Dashboard List and Editor

Snap4Industry by Snap4City (C), May 2021

From Templates to Wizard and Dashboards
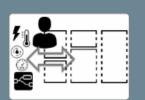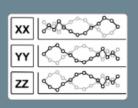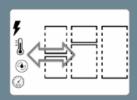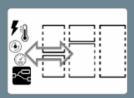
- to create a new Dashboard

- to add widgets and/or groups of them on any Dashboard

Wizard

Dashboard features	Data and widgets	Check and summary

Map

Single data widgets

Multi data widgets

Data sources

High-Level Type	Nature	Subnature	Value Type	Value Name	Data Type	Last Date			Last Check	Ownership
All selected (10) ▼	All selected (55) ▼	All selected (776) ▼	All selected (315) ▼		All selected (47) ▼					All selected (2) ▼
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather				2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather			Vergemoli	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather			chiano	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather			aiano	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather			Vaglia	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather			Vagli sotto	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather			Vagli di sotto	2018-07-08 16:00:18	public
Special Widget	Environment	Weather Forecast		Previ_Meteo	special weather			Uzzano	2018-07-08 16:00:18	public

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

Choosen data sources

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

Previous Next   Search

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

Close

74

Custom Widget / Synoptic Development

SVG Symbols Collection

Inkscape editor on your computer

Create, save a Custom Widget in SVG

IOT Applications

Knowledge Base, Km4City

Knowledge and Storage Data from the Field and City

Public Dashboard Collection

My Own Dash/App

SVG Energy HighLevel

Dashboard Editor

Create, save, load, delegate, grant access

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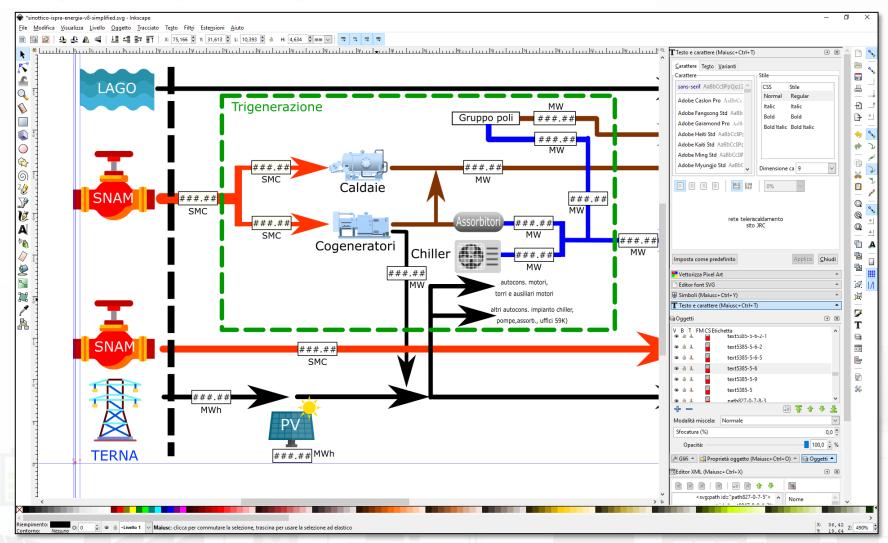
How to create a custom Widget

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

Create, save a Custom Widget in SVG

Upload as Custom Widget Template
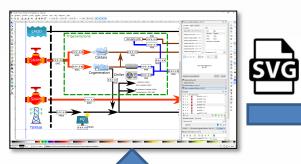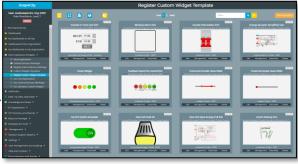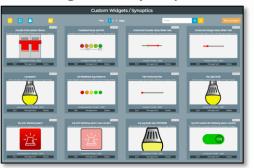
List of Custom Widgets / Synoptics

Dashboard Editing

SVG Symbols Collection

From any open library

select

New SVG bulb 05

Instantiate as Custom Widgets / Synoptics Connect with WebSockets
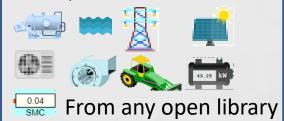
Final Dashboard

Select MyKPI and Sensor Data for Synoptics cases

From-To Custom Widgets / Synoptics to Storage in WS

Web Socket Secure
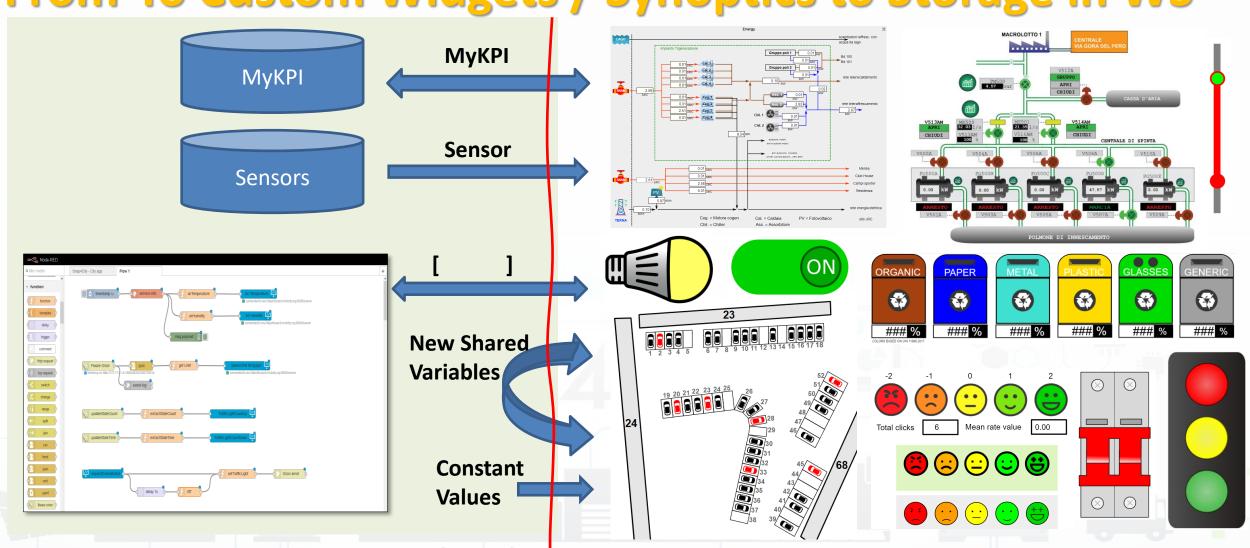
Custom Widgets Templates

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**
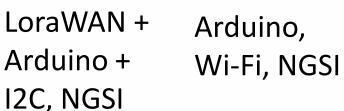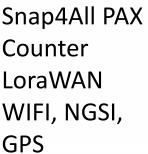
IOT Devices

Sensors/ Actuators
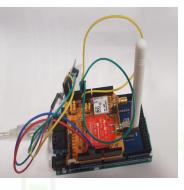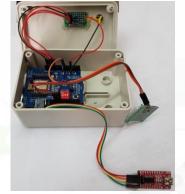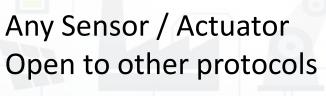
IOT Edge Devices

LoraWAN + Arduino + I2C, NGSI

Arduino, Wi-Fi, NGSI

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

Snap4All PAX Counter LoraWAN WIFI, NGSI, GPS

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

IOT Edge NodeRED: Android, LINUX, Windows, …

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

Any Sensor / Actuator Open to other protocols
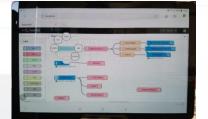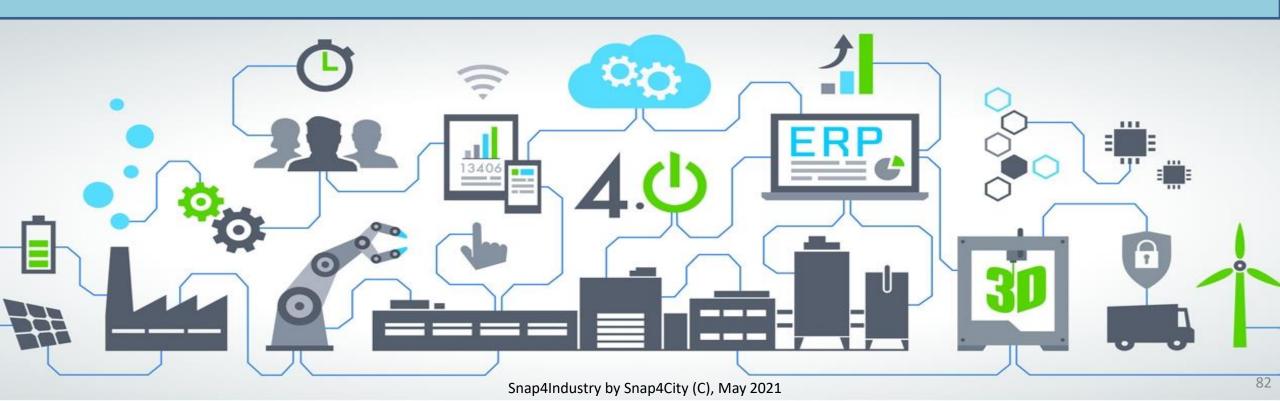
Dashboards' Intelligence on Web and Mobile Devices
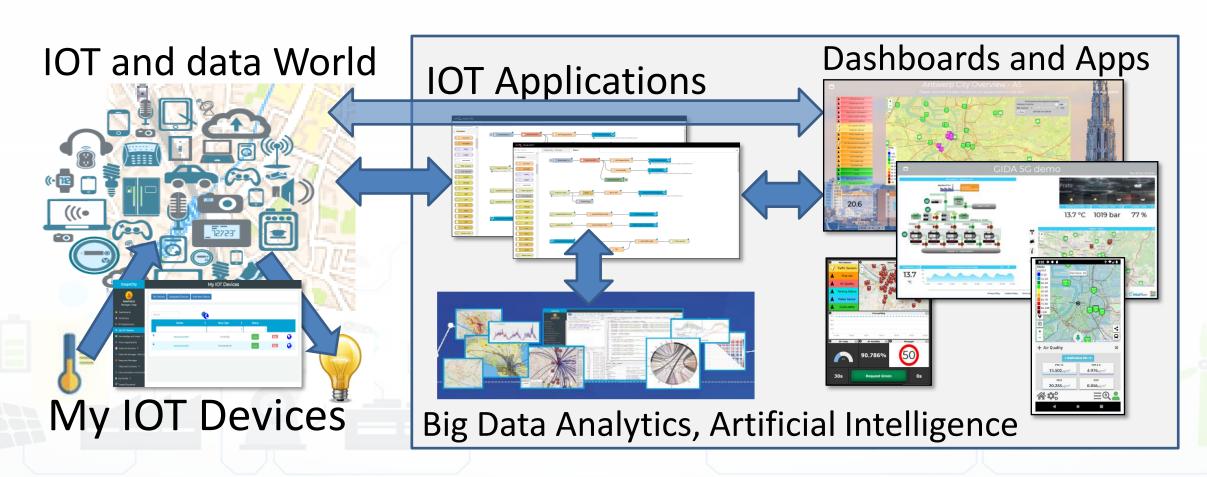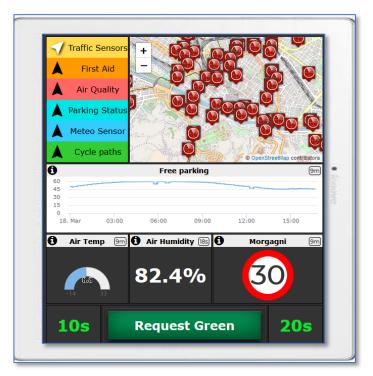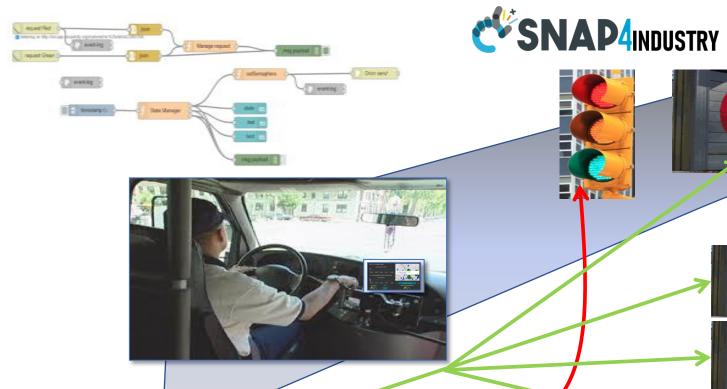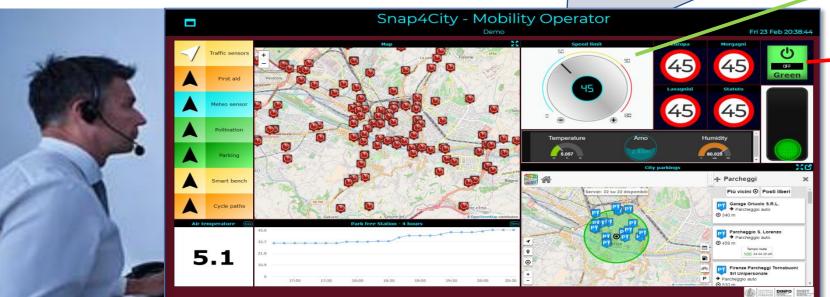
Sentient Solutions

Dashboards with data driven IOT Applications enforcing intelligence

IOT and data World

IOT Applications

Dashboards and Apps

My IOT Devices

Big Data Analytics, Artificial Intelligence

IOT Applications Development

MicroServices collections

My IOT Applications

IOT App. Editor

Generating IOT App With Dashboard

IOT Discovering

ServiceMap Discovery

Knowledge Base, Km4City

Dashboard Collection, Editor and Wizard

Sharing/saving reusing IOT App

Resource Manager

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

IoT Applications

- **Data ingestion**: more than 70 protocols IOT and Industry 4.0, web Scraping, external services, any protocol database, etc.

- **Data access**: save/retrieve data, query search on expert system, georeverse solution, search on expert system Km4City ontology, etc.

- **Data Transformation/transcoding:** binary, hexadecimal, XML, JSON, String, any format

- **Integration**: CKAN, Web Scraping, FTP, Copernicus satellite, Twitter Vigilance, Workflow OpenMaint, Digital Twin BIMServer, any external service REST Call, etc.

- **Manipulation of complex data**: heatmaps, scenarios, typical time trend, multi series, calendar, maps, etc.

- **Access to Smart City Entities and exploitation of Smart City Services**: transport, parking, POI, KPI, personal data, scenarios, etc.

- **Data Analytic**: managing Python native, calling and scheduling Python/Rstudio containers as snap4city microservices (predictions, anomaly detection, statistics, etc.)

- **User interaction on Dashboard**: get data and message from the user interface, providing messages to the user (form, buttons, switches, animations, selector, maps, etc.)

- **Custom Widgets**: SVG, synoptics, animations, dynamic pins on maps, etc

- **Event management**: Telegram, Twitter, Facebook, SMS, WhatsApp, CAP, etc.

- **Hardware Specific Devices**: Raspberry Pi, Android, Philips, video wall management, etc.

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

+ on IOT Edge Raspberry
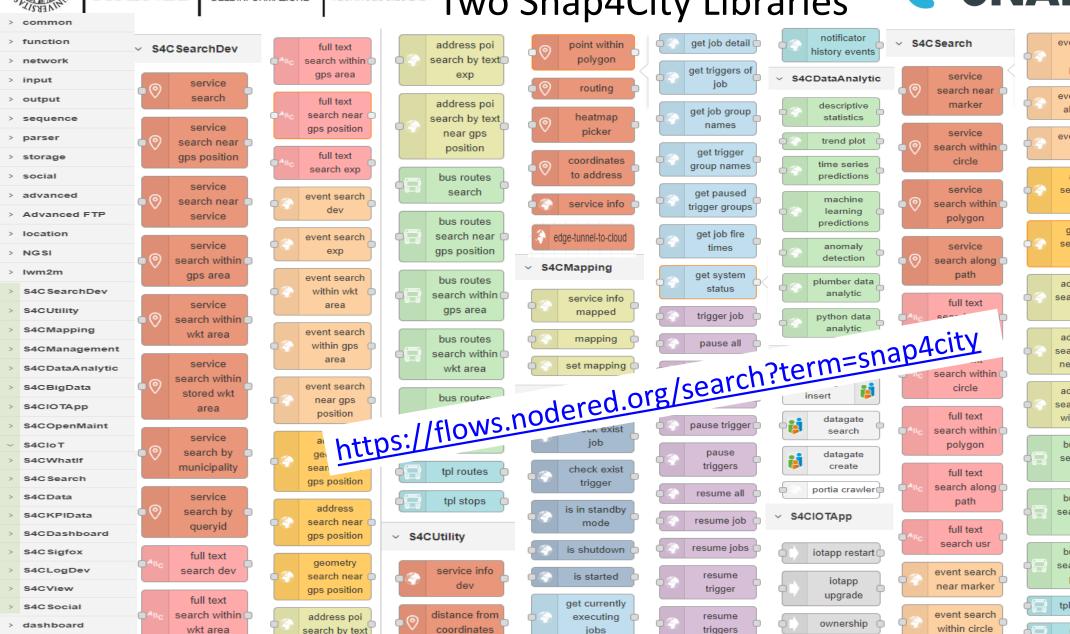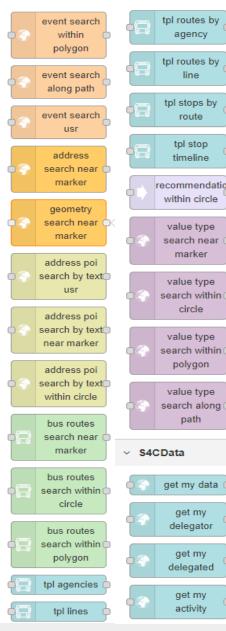
April 2021 collection
Two Snap4City Libraries

https://flows.nodered.org/search?term=snap4city

April 2021 collection
Two Snap4City Libraries
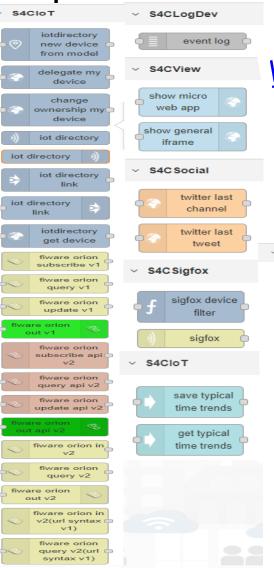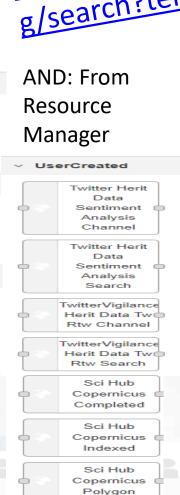
https://flows.nodered.org/search?term=snap4city

We suggest also to install:

AND: From Resource Manager

IOT Applications vs Dashboards

- **IOT Applications**, realized by using Node-RED and integrated with Snap4City Nodes/MicroServices block, can be behind dashboards to get data from them with Virtual Sensors and Actuators.
  - Dashboards may be connected to multiple IOT Applications and IOT devices
  - IOT Applications may be connected with multiple Dashboards and IOT devices
- **A network of Dashboards, IOT Apps and IOT Devices** and data is easily realized exchanging data via secure connections.
- **Training Cases**:
  - [US2.   Using and Creating Snap4City Applications with Dashboards](#)
  - [US9.   Creating Snap4City IOT Applications, different formats, protocols, brokers, communications](#)

IOT Application stressing Virtual Sensors Actuators concepts
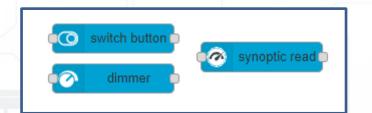
Advanced Feature of Snap4City Dash Widgets

- 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
  - **Virtual Sensors Actuators**
    - Those that produce/receive the data
      From/to Dashboard to/from IOT App
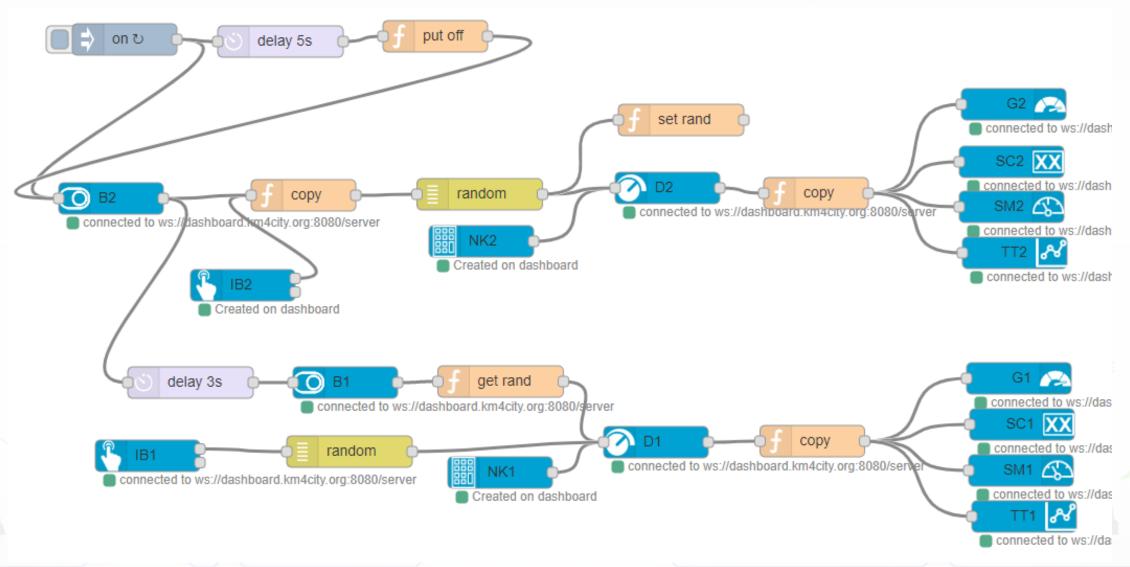
TC9.18: Advanced Features of Sensors Actuators of Dashboards vs IOT App

Sensors Actuators Allow to change the set up

The SATEST Dash

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjc2NA==
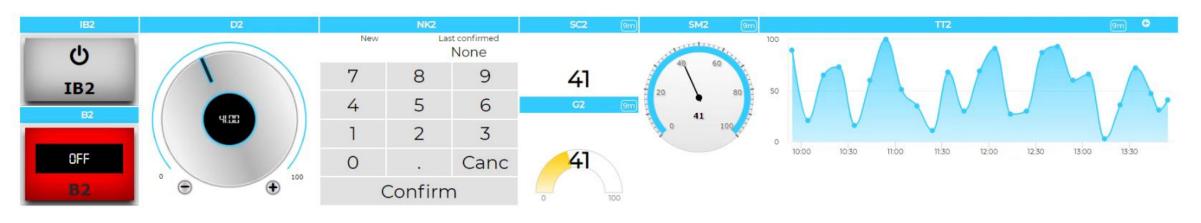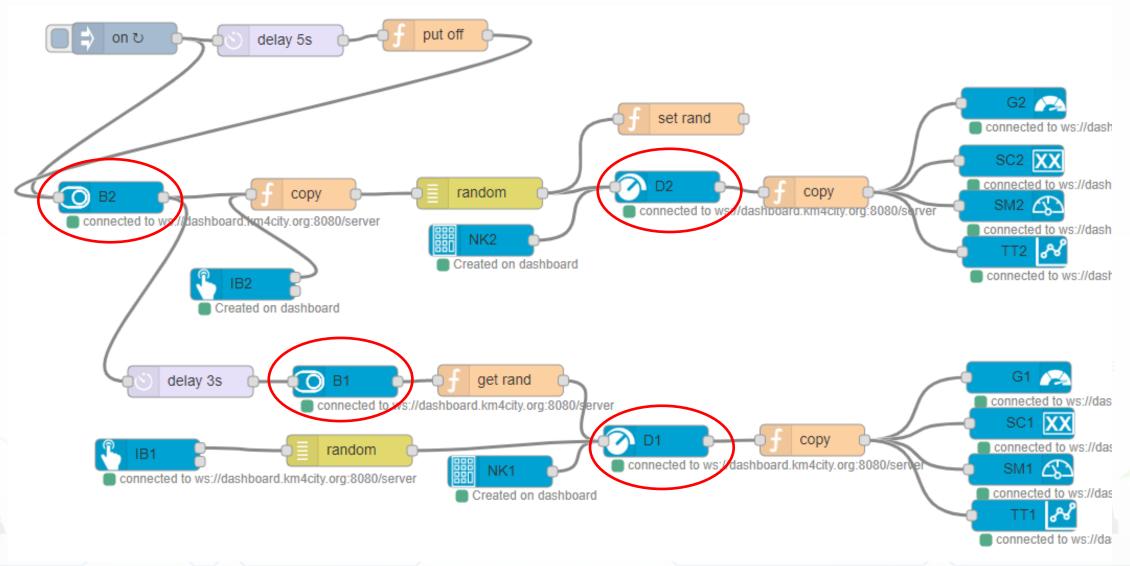
Sensors Actuators Allow to change the set up

IOT Application Integration with Synoptics

From-To Custom Widgets / Synoptics to Storage in WS

Web Socket Secure

Dashboard on Browser
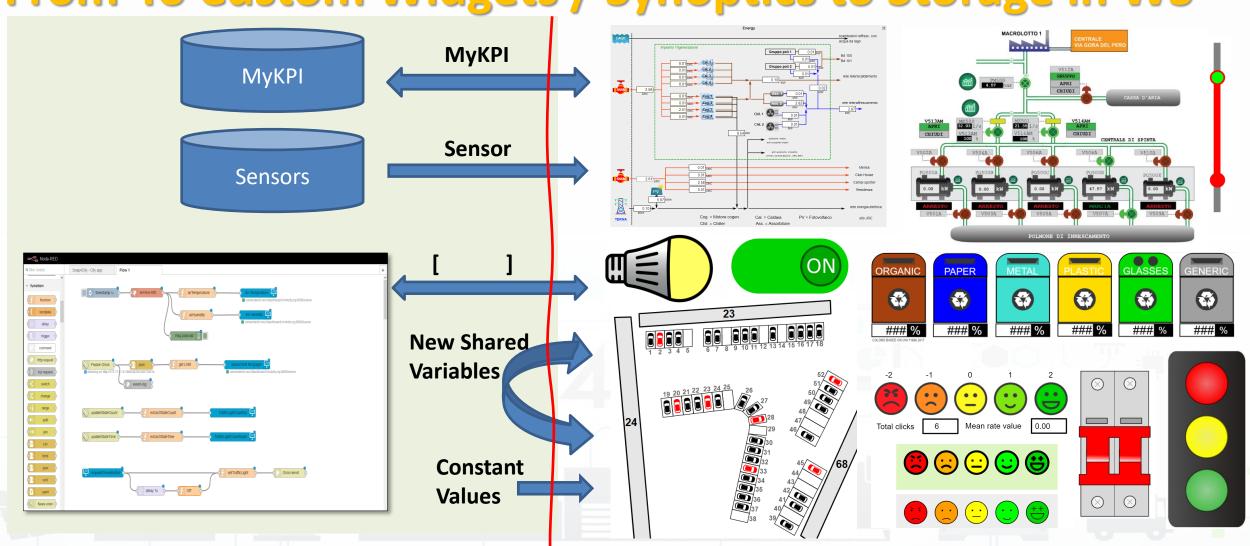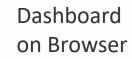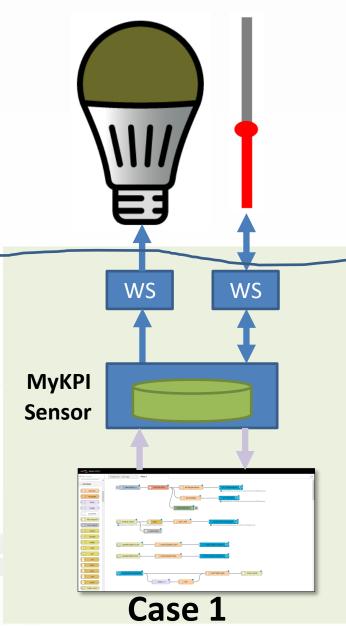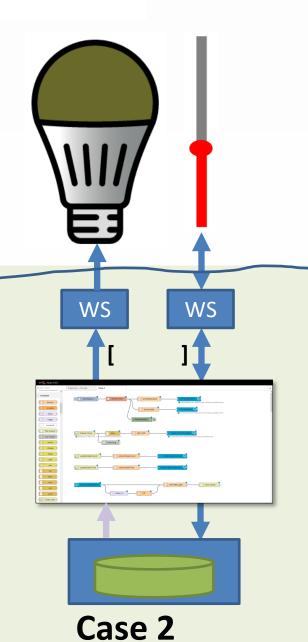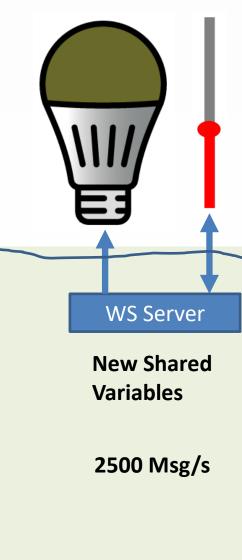
Internet

Storage and IOT App on cloud or on Premise

WS

WS

WS

WS

WS Server

MyKPI Sensor

[

]

New Shared Variables

2500 Msg/s

Case 1

Case 2

Case 3/4
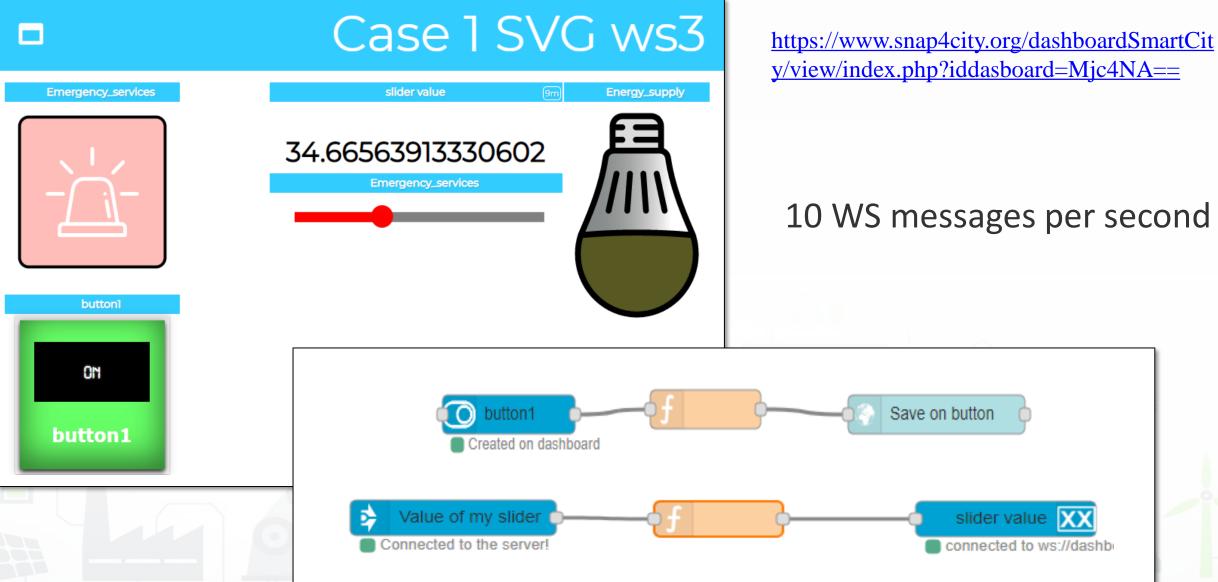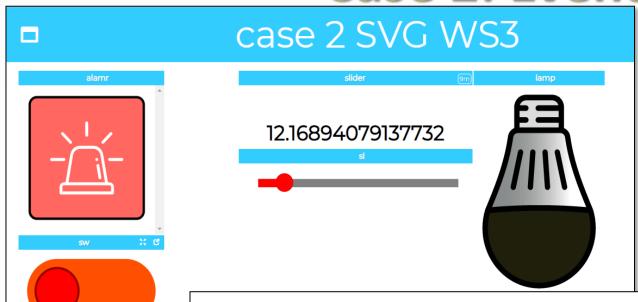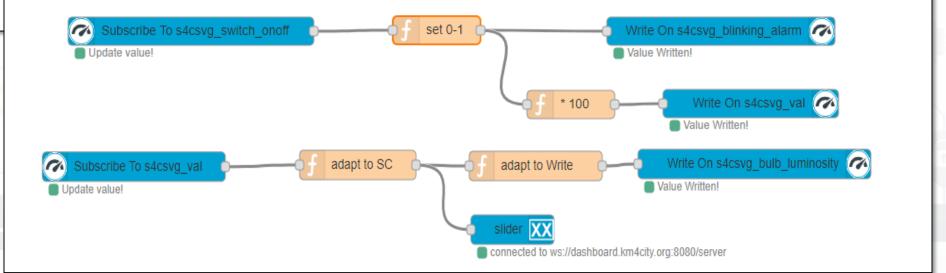
Case 2: Event Driven 100%

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

40 messages per second
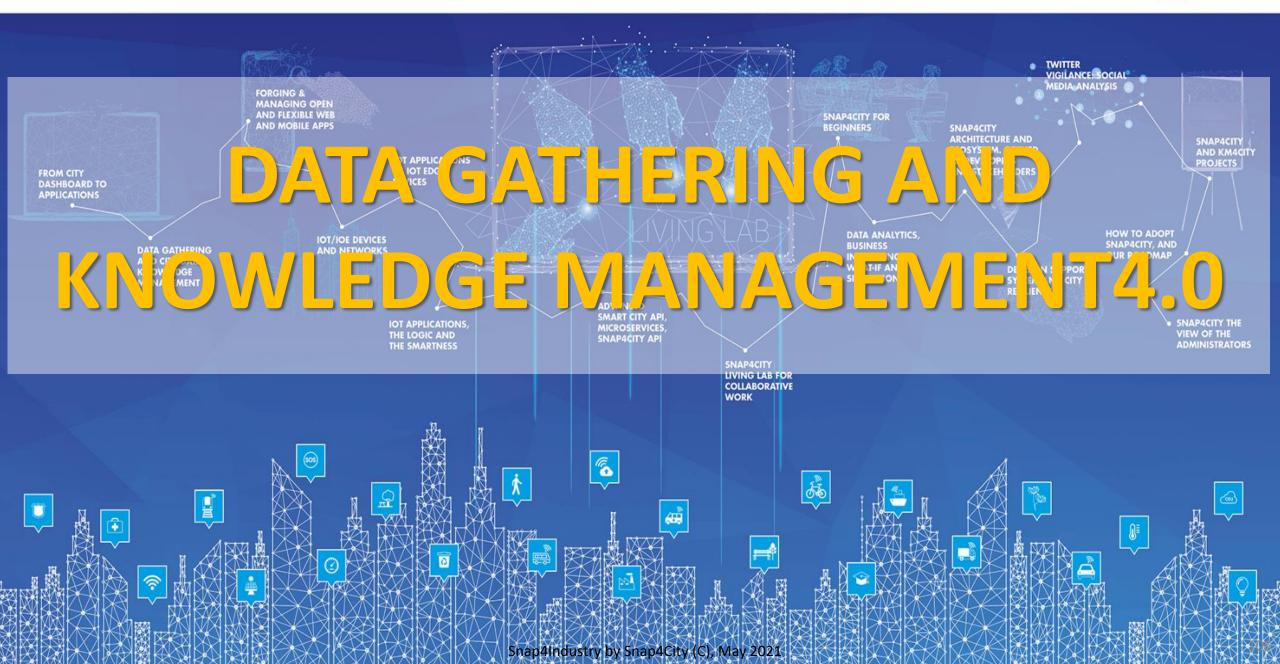
Read more on

- [TC9.19: Custom Widgets / Synoptics controlled by IOT Applications](#)

- [Custom Synoptics and Widgets for Dashboards](#)

- [Scenario: 5G Enabled Water Cleaning Control](#)

- [Snap4Industry: Snap4City for Industry 4.0](#)

- [TC1.22: Create and configure a Snap4City SVG Custom Widget for real-time interaction](#)

DATA GATHERING AND KNOWLEDGE MANAGEMENT4.0

Any kind of data and flows

Integrated Node-RED development

Event Driven, real time data ingestion

IOT/IOE Protocols

Communication Patterns

Discovery
Discover, register and "thrust" new devices on the network

Registration

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

Push

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

1:N

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

Bulk action

Notifications
Information flows from other systems to a device or a group for conveying status changes in the world

Broker Gateway

- MQTT
- HTTP(s)
- AMQP
- COAP
- NGSI
- OneM2M
- WebSockets
- ....
- Etc.

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!

In which case case you are?

https://www.snap4city.org/drupal/node/474

Case B2

IOT Device → IOT Broker   SNAP4CITY

Case B1

IOT Device → IOT Broker → SNAP4CITY

i) Registered IOT Broker on Snap4City

Case A1.2

IOT Device → IOT Broker   SNAP4CITY

a) Registered IOT Device on Broker

Case A2

IOT Device → IOT Broker → SNAP4CITY

a) Registered IOT Device on Broker

i) Registered IOT Broker on Snap
ii) Registered IOT Device on Snap

Protocols/formats

- Snap4City supports a large range of protocols for communicating with servers, services, IOT devices, legacy systems, GIS, etc., and format

- See also

  - **Supported Protocols**

  - **High Levels IOT Protocols**

  - **TC9.2 - Managing heterogeneous File Ingestion, protocols, formats via IOT applications, and open standards**

  - **US9. Creating Snap4City IOT Applications, different formats, protocols, brokers, communications**

  - **TC2.14 - IOT Applications using multiple protocols, and formats for files Creating IOT Applications coping with heterogeneous data**
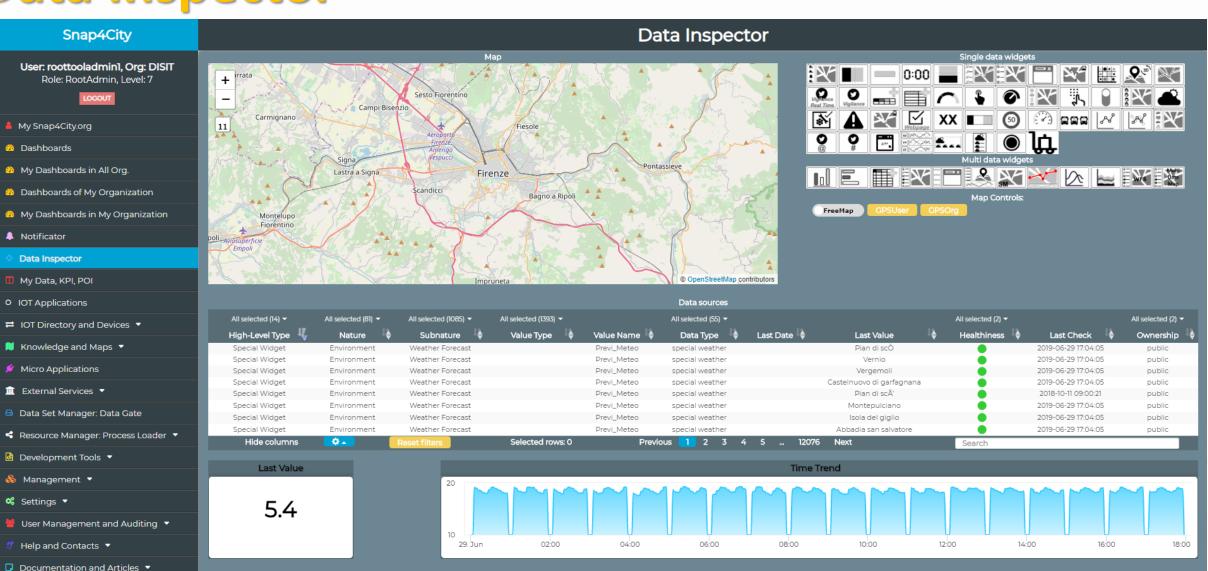
Data Inspector
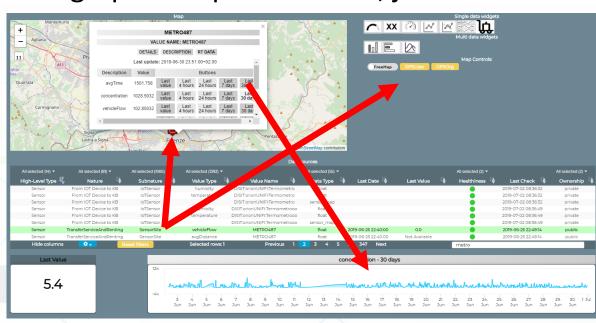
Data Inspector (open on your left side menu)

- **Cross Filtering on the basis of**:
  - MAP: pan and zoom → lock , center on GPS coordinates of the user
  - Data Source Classification:
    - faceted filtering
    - full text search
  - Click on data source to see it on map, and see the graphics representation, just to learn how widgeting it.

- **Selecting a Data Source on Map**: on its Pin you can see:
  - Real time data
  - Time trend: 4 hours, 12 hours, 1 day, 1 week, 30 days.
  - Full status and description (only for Administrators)

Unified Data and Services Model/Classification

High-Level Type	Nature	Subnature	Value Type	Value Name	Data Type	Value Unit	Last Date	Last Value	Healthiness	Last Check	Ownership	Organizations
MyKPI	Environment	Weather_sensor	Gradi Centigradi	BatteryTemperatureGalaxyTabS4	float-mykpi	°C	2019-11-21 15:51:25	28	🟢	2020-04-03 10:23:02	private	Firenze,dc=ldap,dc=disit,dc=org,
MyKPI	Environment	Weather_sensor	Gradi Centigradi	BatteryTemperatureS6Edge	float-mykpi	°C	2020-01-23 12:37:34	25.299999237060547	🟢	2020-04-03 10:23:02	private	DISIT
MyKPI	Environment	Weather_sensor	Gradi Centigradi	BatteryTemperatureSamsungS9	float-mykpi	°C	2019-04-23 05:54:21	24.399999618530273	🟢	2020-04-03 10:23:02	private	Firenze,dc=ldap,dc=disit,dc=org,
MyKPI	Environment	Smart_waste_container	Level_percentage	Bin_001	percentage-mykpi	%	1970-01-01 01:00:00		🟢	2020-04-03 10:23:02	private	DISIT,dc=ldap,dc=disit,dc=org,
MyKPI	Environment	People_counter	Battery Percentage	borrowed_tbeam_pax_green BATTERY	percentage-mykpi	%	2019-03-13 20:24:52	4.202	🟢	2020-04-03 10:23:02	private	Firenze,dc=ldap,dc=disit,dc=org,
MyKPI	Environment	People_counter	Battery percentage	borrowed_ttgov21new_pax_black BATTERY	percentage-mykpi	%	2019-05-06 10:03:55	4.132	🟢	2020-04-03 10:23:02	private	Firenze,dc=ldap,dc=disit,dc=org,
MyKPI	Environment	People_counter	Battery Percentage	borrowed_ttgov21new_pax_green BATTERY	percentage-mykpi	%	2019-11-19 08:56:56	4.072	🟢	2020-04-03 10:23:02	private	Firenze,dc=ldap,dc=disit,dc=org,
MyKPI	HealthCare	Health_district	tassodicrescita	corkpimemilia	float-mykpi	%	1970-01-01 01:00:00		🟢	2020-03-24 13:13:24	private	DISIT

Hide columns   Reset filters   Selected rows: 0   Previous 1 2 **3** 4 5 ... 35 Next   Search

High Level Types — Nature — SubNature — Value Type — Value Name — Data Type — Value Unit — Last Date/Time — Last Value — Healthiness — Last Check — Ownership — Organization

Semantic   *Technical*   *RealTime* *Status*   *For Admin*

For examples

- HLT: MyKPI
- Nature: Industry and manufacturing
- Subnature: Chemical
- Value Type: Density percentage
- Value name: CloroParaffine
- Data Type: float mykpi
- Value Unit: %
- Last Date: 2019-02-25
- Last Value: 87.0
- Healthiness: 🟢
- Last Check: 2020-04-03 10:28:12
- Ownership: private
- Organization: Firenze

- HLT: Sensor
- Nature: From IOT Device to KB
- Subnature: IOT Sensor
- Value Type: Battery Level
- Value name: Irrigator fioriera Gag
- Data Type: float
- Value Unit: V
- Last Date: 2020-04-01 12:59:00
- Last Value: 5.18
- Healthiness: 🟢
- Last Check: 2020-04-03 03:28:12
- Ownership: public
- Organization: Firenze

How to Ingest

All of them can be shown on Dashboards, what about manipulate them!!!!

HLT, High Level Types++	GPS	Static	Dynamic	MacroCat	Single	Time Series	Trajectory	HTTP	How to ingest/change/manage
Complex Event (msg)	Yes	Yes	Yes	Yes	Yes	Yes			Dashboard, ETL, Special, IOT App
API (Ext. Srv., any prot.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	ETL, Special, IOT App
External Service (web pag)		Yes	--					Yes	ETL, Special, IOT App, Web Scraper
KPI (metrics) data		Yes	Yes		Yes	Yes			Dashboard, IOT App, API, Metrics SQL calls
MicroApplication (webapp)		Yes	--					Yes	Dashboard, IOT App, API, FTP
Dashboard-IOT App (msg)		Yes	Yes		Yes	Yes			Dashboard, IOT App, API
My Personal Data		Yes	Yes		Yes	Yes			Dashboard, IOT App, UserInterf, API
MyKPI data	Yes	Yes	Yes		Yes	Yes	Yes		Dashboard, IOT App, UserInterf, API
MyPOI data	Yes	Yes		Yes	Yes				Dashboard, IOT App, UserInterf, API
Heatmap matrix	Yes	Yes	Yes		Yes	Yes			IOT App, MicroService, UserInterf, API
Sensor data	Yes	Yes	Yes	Yes	Yes	Yes			IOT Directory, IOT App, UserInterf, API
Sensor Actuator data	Yes	Yes	Yes	Yes	Yes	Yes			Dashboard, IOT App, UserInterf, API
POI (Point of Interest)	Yes	Yes		Yes	Yes				DataGate, ETL, IOT App, API
Special Widget (complex)		Yes	Yes		Yes	Yes		Yes	ETL, special, IOT App, API
Synoptics MyKPI (groups)		Yes	(Yes)		(Yes)	(Yes)		Yes	Special, API
Special Tools (functional)	(Yes)		(Yes)		(Yes)		(Yes)	Yes	As MyPersonalData
WFS/WMS (GIS data)	Yes	[yes]	[yes]					Yes	GIS tools, or GeoServer, IOT App

19

Legenda: How to ingest/change/manage

- **Dashboard**: by creating a Dashboard Widget that can act/change the values with actuators (2nd Day Slides)
- **API**: you can use the Smart City API to change / provide the values (see 3rd Day Slides)
- **IOT App**: by developing an IOT Application on Node-RED exploiting Snap4City MicroServices (4th Day Slide, and in part in these slides)

- **DataGate**: you can use the DataGate tool to ingest the data, and publish them
- **ETL**: by developing an ETL process, and put it in execution via DISCES
- **IOT Directory**: you can use the IOT Directory tool to change the parameters, and set up the ingestion process, via IOT Brokers, IOT Devices, IOT Edge.
- **Special**: by using a special tool for developing a process, or for creating SVG Synoptics
- **UserInterf**: there is a number of Tools with Graphic User Interface that you can use to change the values, see in the menu on the left.
- **Web Scraper**: by creating a Web Scraping process and exploiting the results into an IOT Application

- **As MyPersonalData**: they are substantialy MyPersonalData
- **From third party tools**: they can be manipulated by using third party tools

How the Dashboards exchange data

- 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
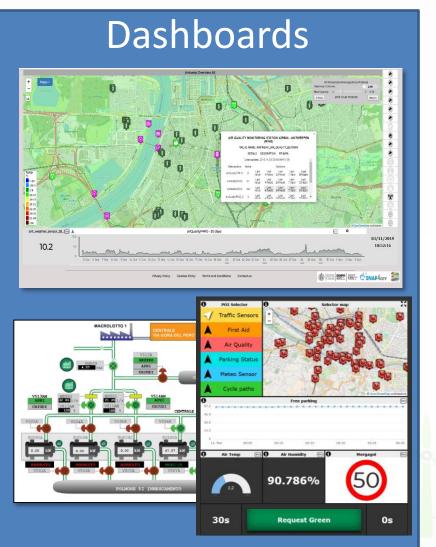
Snap4City BigData Storage and KB

IOT Broker Orion Quantum Leap

ServiceMap Super ServiceMap

Metric, KPI

MyKPI, MyPOI, …

API, External Services, MicroApp

Dashboards

IOT Application

Widgets ICONS		Widget Name, Description		IOT App	Dashboard-IOT App	KPI (metric)	MyPersonalData	MyData	My KPI	Sensor
XX		Single Content	single content XX	X (cs)	X (DD)	X	X	X	X	X
	50	Speed Limit				X				X
⌚		Speedometer	speedometer	X (cs)	X (DD)	X	X	X	X	X
◗		Gauge	gauge chart	X (cs)	X (DD)	X	X	X	X	X
▮▯	▬	Single Bar, V/H	horizontal single bar / vertical single bar	X	X (DD)	X				
▤	▥	Single and Multiple Bars, stacked or not	Bar series	X (cs)	X (DD)	X	X	X	X	X
⟋	⟋	MultiSeries, shaded, staked and non staked, TTT	curved line series	X (cs)	X (DD)	X	X	X	X	X
⟋		Time Trend (single)	time trend	X	X (DD)	X	X	X	X	X
⟋	⟋	Time trend Compare				X			X	X
◈		SpiderNet, radar, Kiviat	radar series	X (cs)	X (DD)	X	X	X	X	X
◕		Pie, Donut, 2 layers Donut	pie chart	X (cs)	X (DD)	X	X	X	X	X
▦		Table	table content	X (cs)	X (DD)	X	X	X	X	X
▦		Calendar	calendar	X	X (DD)				X	X

DD: Data Driven

- **IOT APP column in previous table:**

  - **X**: means that from the IOT App you can send a new value or array to the widget directly, without the need to have is stored into Sensor or MYKPI variable, etc.

  - **CS, widget supports Change Source**, in the sense that: from the IOT App is possible to send a command to the Widget to change the data source. E.g., selecting sources among: Sensors (service URI), MyKPI (ID), any value produced on the IOT App directly. (cs) recent additions

- **Dashboard IOT App column in previous table**:

  - **X:** there is a MicroService / node on IOT App to act on those widgets on dashboard. The data are visualized.

  - **DD, widget is Data Driven**, in the sense that new data in push can be sent and the widget is updated in real time on web page without web page realoading

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

Dynamic Widget data

ServiceURI (ID)

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

ServiceURI (ID)

MyKPI (ID)

Dynamic

Dynamic

100% of Dynamic VECTs

- **ServiceURI** (ID)
- **MyKPI (ID)**, Metric (ID)
- **Dynamic** Data in JSON (single or Vector), computed into IOT Application
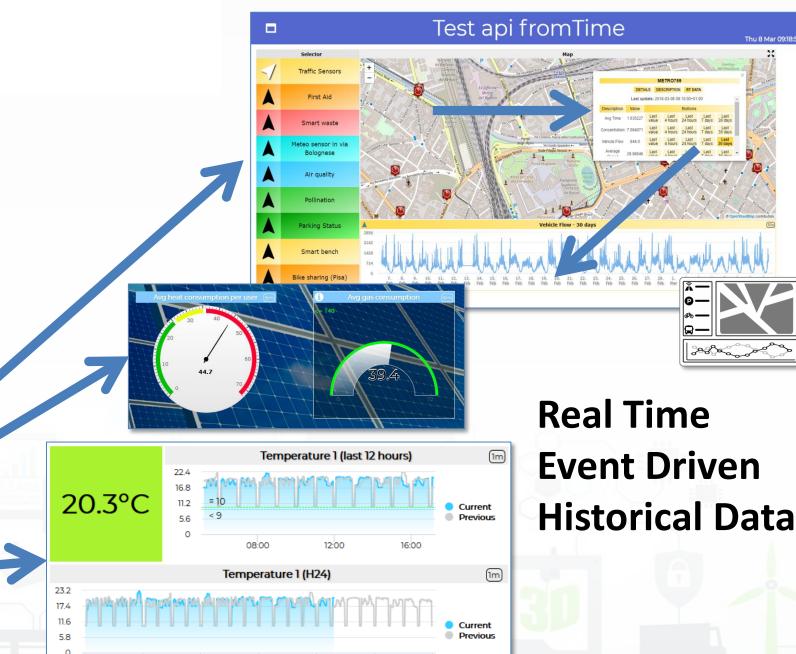
TC4.9: New Support Widgets for Bars, Barseries, Trend, and Series, on Dashboards and IOT Applications

HLT: Sensors

High Level Types

- **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)

Real Time

Event Driven

Historical Data

HLT: Sensors

IOT Data Driven

- 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

Nature

- Accommodation +
- Advertising +
- AgricultureAndLivestock +
- CivilAndEdilEngineering +
- CulturalActivity +
- EducationAndResearch +
- Emergency +
- Entertainment +
- Environment +
- FinancialService +
- GovernmentOffice +
- HealthCare +
- 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_infant_school
  - Private_junior_high_school

IOT Data Driven

Real Time

IOT Applications

Real Time
+ Historical

Snap4city Platform storage
for «Data Shadow» and
much more

Sensors

Actuator

Sensor Actuator
From Dashboard to IOT Device

Snap4City
IOT Brokers

**Managing Public and
Private IOT/IOE Devices**

Dashboards also provide
rendering for sensor values

Lavagnini   Statuto

45   45

From IOT Device to KB

Green
OFF

Sensors

Sensors

Towards any IOT Device
and/or Dashboard
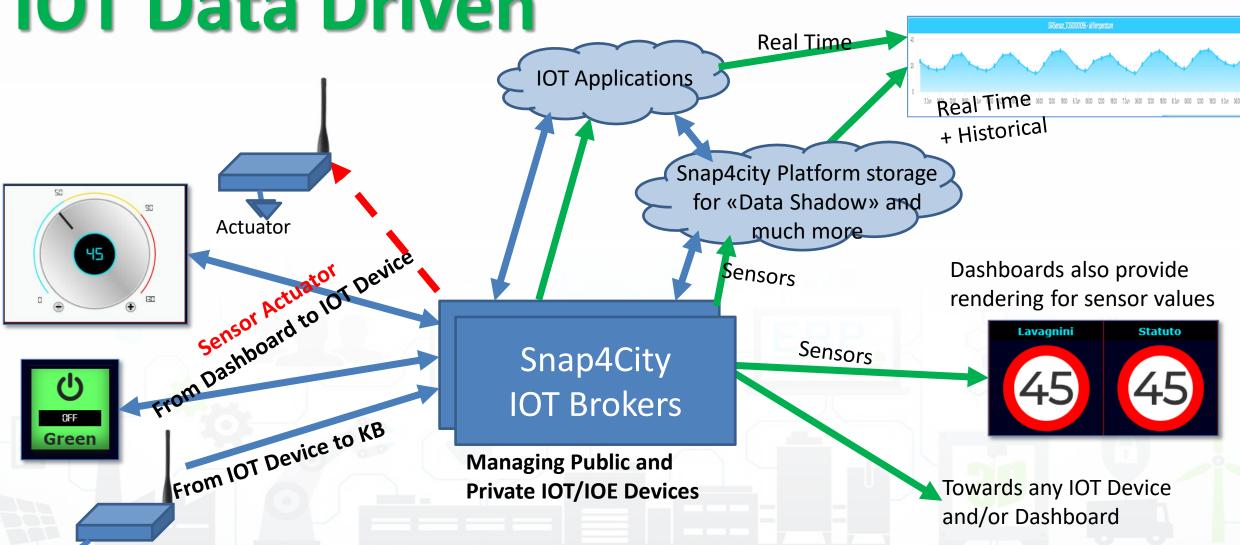
From Dashboard to IOT Devices/App

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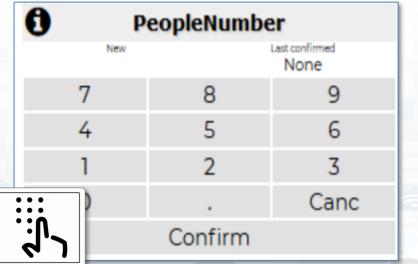
Acting on your systems

HLT: Sensors-Actuators

High Level Types

- **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)

IOT Application

Dashboards

From IOT App to Dashboard

From Dashboard to IOT App
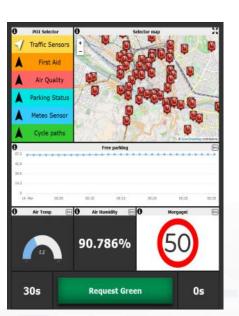
Nature

Dashboard-IOT App

Nature

From Dashboard to IOT App

- impulse button
- numeric keyboard
- switch button
- dimmer
- geolocator
- dropdown
- form
- coordinates from map
- event driven my kpi
- synoptic read
- synoptic subscribe
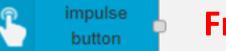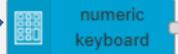
MapClick

MyKPI variable onchange

Synoptics
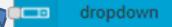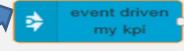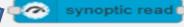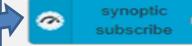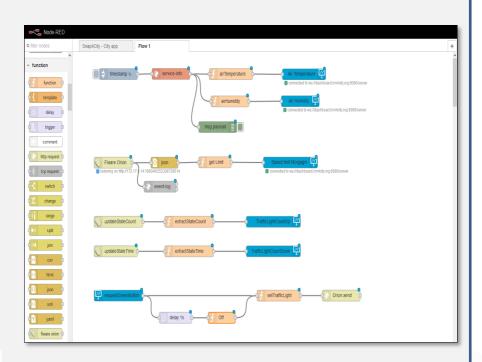
IOT Application

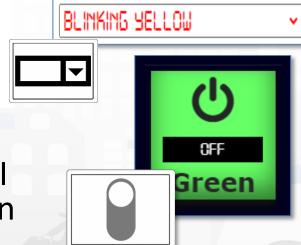# From Dashboard to IOT Devices/App

Acting on your systems

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

BLINKING YELLOW

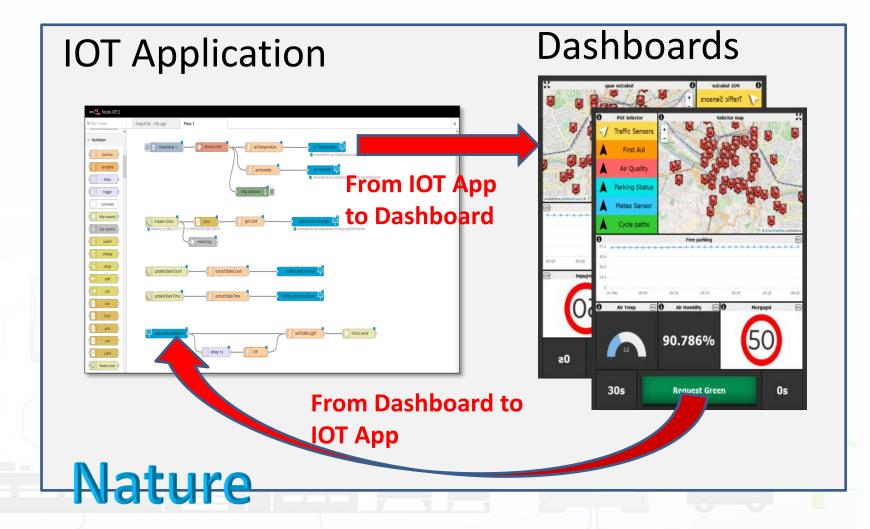**PeopleNumber**

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

Blue
Green
Yellow
Red
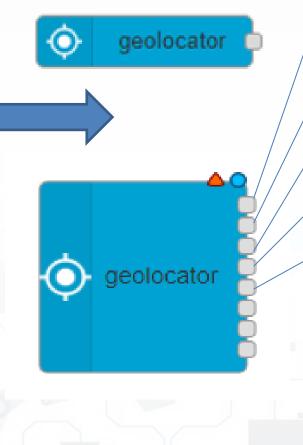
Geolocation of Mobile Device

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

SVG shucko plug

70 kW

Schuko switch

Charging Station Status

Legenda

Charging Station Status

Set on the keypad one of the following values

0 = ERROR (RED)

1 = AVAIBLE (GREEN)

2 = BOOKED (YELLOW)

3 = CHARGING

9999 = white icon

Charging Station status

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

Underpass   **Set tunnel st...**

ON

Traffic Light status set

YELLOW LIGHT

Traffic Light
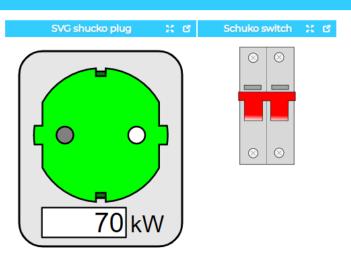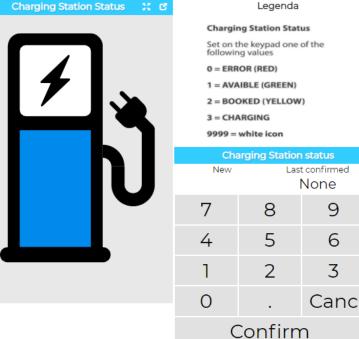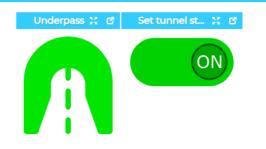
Speed Limit Set

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

Dynamic Speed Limit Sign

24

Speed Limit Explaination

Speed Limit Custom Widget example

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

9999 = white sign.

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjk4Ng==
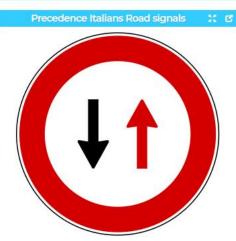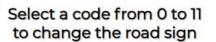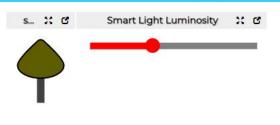
SVG Custom Widgets Examples
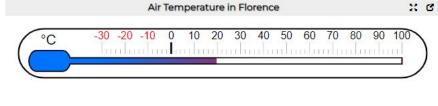
Selector
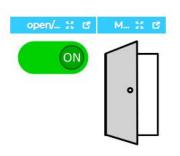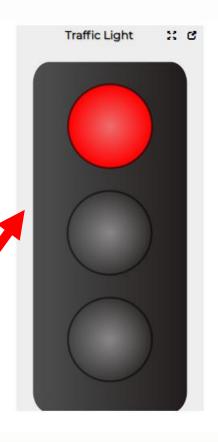
- Selecting MSG to be sent on the Business Logic IOT Application

Dashboard Name: SVG Custom Widgets Examples 2

Widget Name: Traffic Light status set

OFF	0	✕
RED LIGHT	1	✕
RED and YELLOW LIGHT	2	✕
YELLOW LIGHT	3	✕
YELLOW and GREEN LIG	4	✕
GREEN LIGHT	5	✕

+ add

Edit Dashboard   **View Dashboard**

Traffic Light status set

RED LIGHT

Traffic Light status set

RED LIGHT

OFF
RED LIGHT
RED AND YELLOW LIGHTS
YELLOW LIGHT
YELLOW AND GREEN LIGHTS
GREEN LIGHT
RED, YELLOW AND RED LIGHTS
BLINKING YELLOW

Traffic Light

Traffic Light status set — connected to ws://dashboard.km4city.org:8080/server

function

Traffic Light status — Value Written!

Traffic Light status set

RED LIGHT

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

Form

```
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

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;

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

form

"selected":["a text","123", "paolo.nesi@unifi.it","aaaaaa", "checked","","on","","2021-03-19","09:38"]
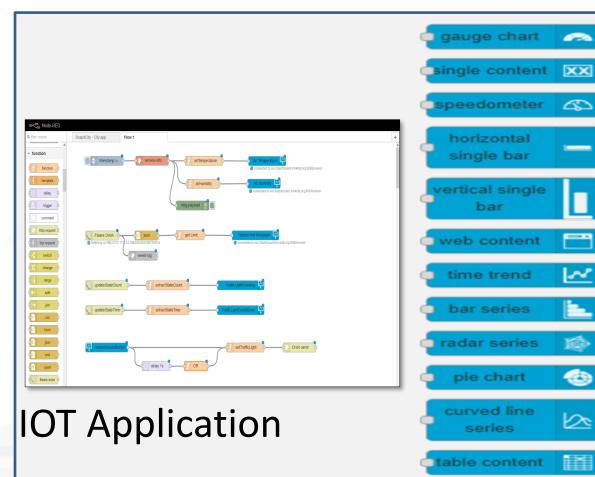
Dashboard-IOT App

Nature

From IOT App to Dashboard

IOT Application

gauge chart

single content

speedometer

horizontal single bar

vertical single bar

web content

time trend

bar series

radar series

pie chart

curved line series

table content

synoptic write

calendar

Single Content Widget (flexibility)

From Dashboard Editor and IOT Applications, accepts in input:

- Numbers
- String
- HTML code

https://www.snap4city.org/578

Helsinki:orio... *9m*

7.4
µg/m3

20.3°C

246 TOT. EVENTI SULLA RETE

COLONNINE RICARICA· *8m*
176 INSTALLATE

11440 Utenti WiFi
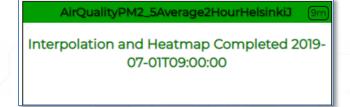
Messages *9m*
Position Updated, press Show My Position

AirQualityPM2_5Average2HourHelsinkiJ *9m*
Interpolation and Heatmap Completed 2019-07-01T09:00:00

XX

single content XX

SO2Average24HourFlorence *8m*
No Availabe Data for airQualitySO2 : All ServiceUris are empty 2019-06-26T07:00:00

SMN *8m*	BINARIO16 *8m*
39.5	73.9
% occupati su 901 posti	% occupati su 165 posti
LEOPOLDA *8m*	CALZA *8m*
27.7	44.6
% occupati su 300 posti	% occupati su 218

MyKPI as Trajectories

High Level Types

- **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)

My Personal Tracker

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

MyKPI: Tracking of Devices and Mobiles

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

- Micro Application

Mobile
PAX Counter

Apps

OBU

OBD2

IOT Device MObile
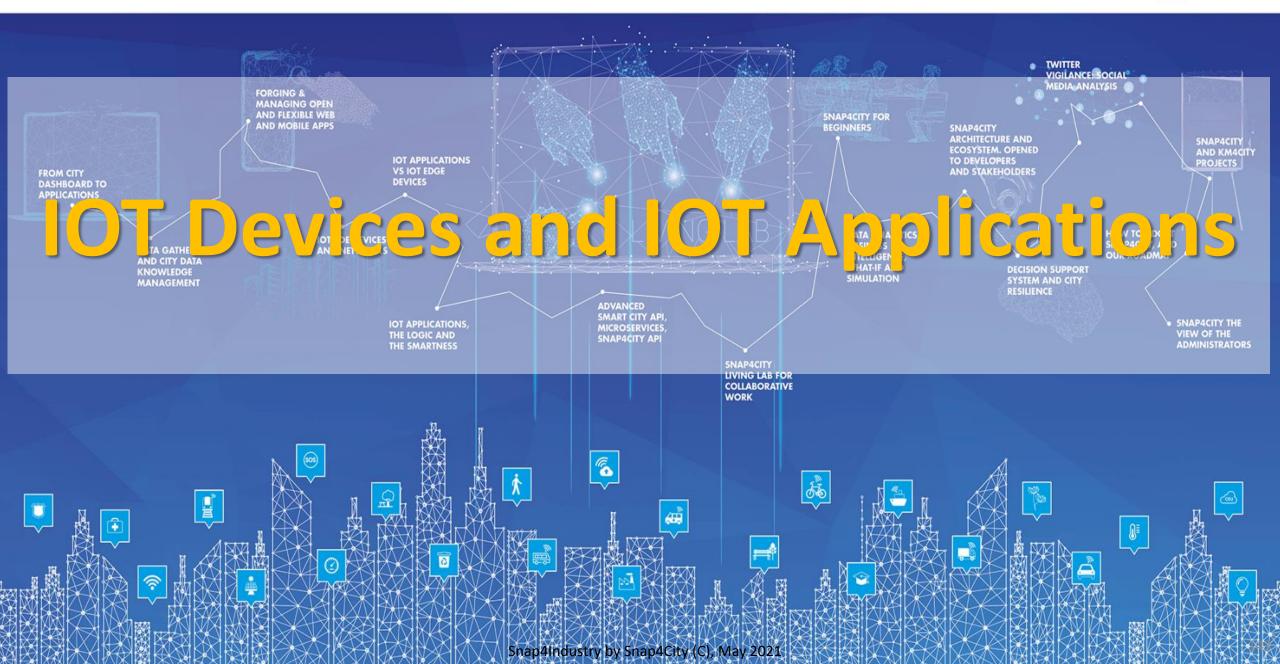
Data Gathering and Knowledge Management

- Data ingestion can be performed by using multiple tools:
  - ETL processes, IOT Applications, Data Gate, WebScraping. We suggest:
    - ETL for static / periodic data in PULL
    - IOT App for real time data and flow, from IOT Brokers/Devices
    - DataGate for Static Data, upload them as files, or collected from other CKAN
    - WebScraper for scraping data from Web Pages, when authorized!
- See how to test cases:
  - **HOW TO: add data sources to the Platform**
  - **HOW TO: define privacy rules for personal data, produced by the end-users own device**
  - **US6.   Developing and using processes for data transformation**
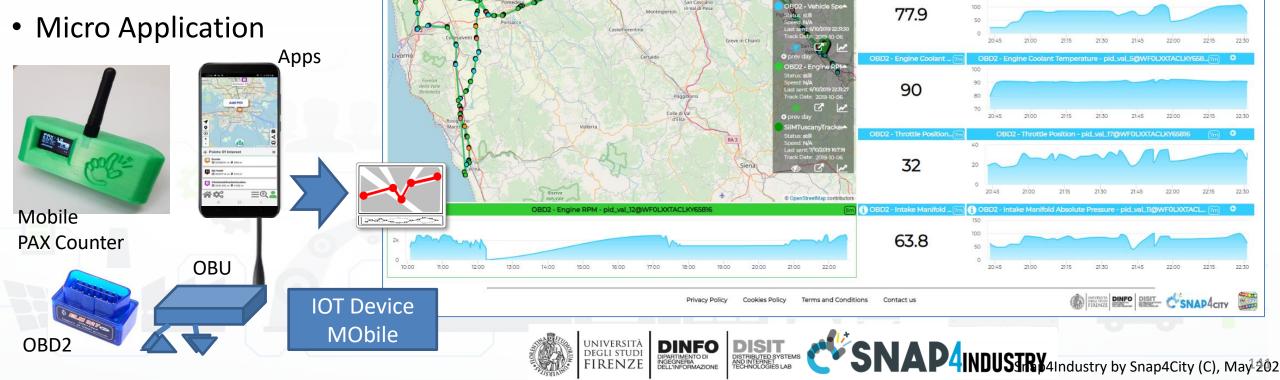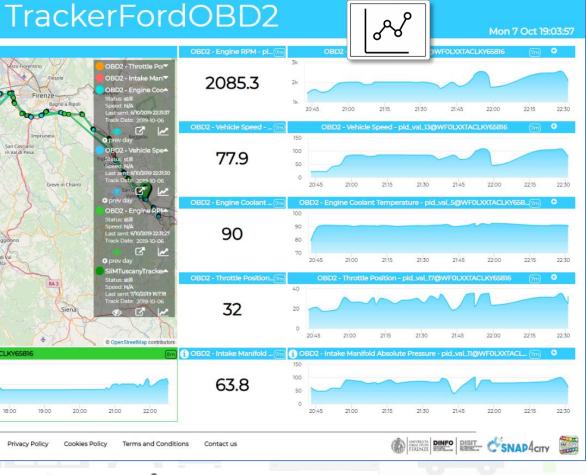 - **TC6.1 - Managing DataSets via DataGate: ingest, search, download, upload, annotate, share**
  - **TC6.3 - Creating ETL processes for automated data ingestion and data transformation**
  - **TC6.5 - Managing Heterogeneous File Ingestion via ETL processes**
  - **TC6.9 - ETL processes for multiprotocol and format data ingestion, see on GITHUB for library**
  - **TC9.2 - Managing heterogeneous File Ingestion, protocols, formats via IOT applications, and open standards**

IOT Devices and IOT Applications
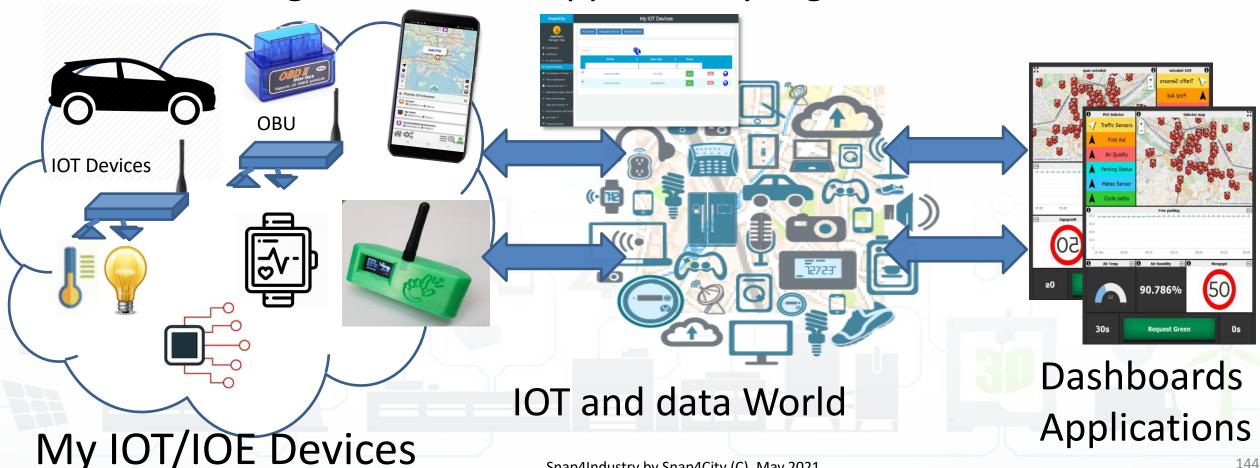
To Start we are going to use Direct Dashboards
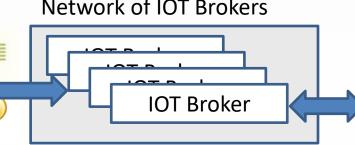
Dashboards accessing data available on Platform, including your own data coming from Mobile App, already registered!!!

IOT Devices

OBU

My IOT/IOE Devices

IOT and data World

Dashboards Applications

IOT Network Manager vs Final User

Network of IOT Brokers

IOT Directory

IOT Network Manager

My IOT Device

Register

Registering

Discovering

Knowledge Base, Km4City

ServiceMap Knowledge Base
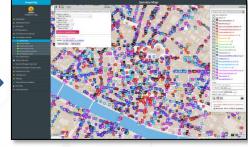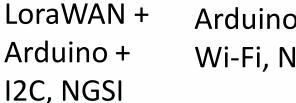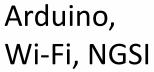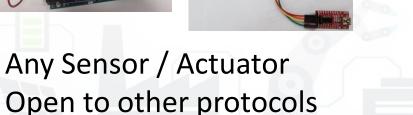
Browsing

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

Discovering

IOT Application

Final user Manager

Dashboard Wizard

IOT Devices

Sensors/ Actuators

IOT Edge Devices

LoraWAN +
Arduino +
I2C, NGSI

Arduino,
Wi-Fi, NGSI

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

Snap4All PAX
Counter
LoraWAN
WIFI, NGSI,
GPS

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

IOT Edge
NodeRED:
Android, LINUX,
Windows, …

LoraWan
Gateway:
IOT Edge, NGSI,
WIFI, RJ45, GPS
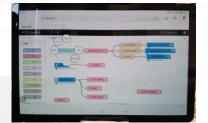
Any Sensor / Actuator
Open to other protocols

IOT Dev Management: activities

- **IOT Devices can be open or proprietary**
- **IOT Devices**: a large range of protocols, formats and kind
  - IOT Devices (single or in bulk) are **registered** on IOT Directory and thus according to Knowledge base are registered to be used in IOT Applications, Dashboards, etc. with Shadow values, etc.
  - IOT Models are saved on IOT Directory for shortening the registration process
  - IOT Device healthiness is monitored automatically
- **IOT Devices can be public or private**
  - **Full support of Proprietary protocols and devices**
  - **Providing Open Hardware and Open Software** IOT Devices/IOT Edge: NGSI fully secure
- **IOT Edge** are devices with some computing capability, realized by using: Raspberry, Android, Linux, Windows, etc.
  - **Release as**: OS images on SD, APK for Android, Virtual Machine, Docker Container, etc.
- IOT Devices are connected via **Secure Encrypted Mutual Authenticated** channel of communication
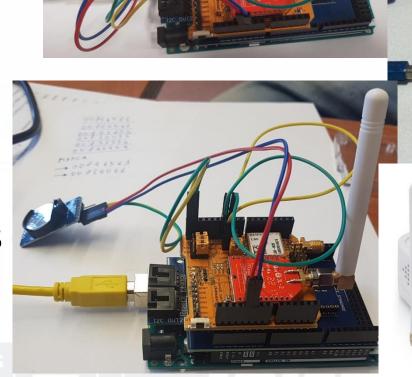
Lora IOT Device, Arduino

- 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
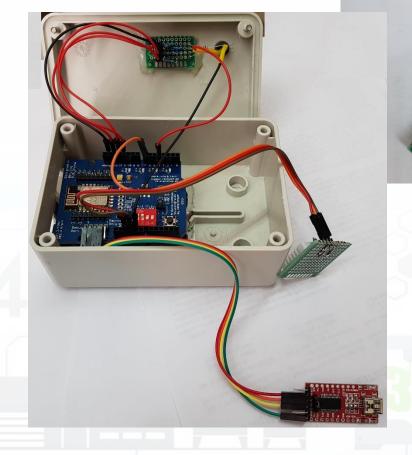
IOT Device with Arduino

- 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

Snap4All IOT Button

version: 3
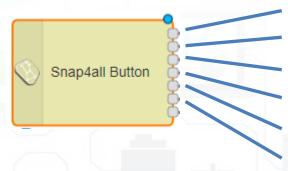
- Multi Wi-Fi

- Ready to use BLE

- ESP based, cheap & easy
  - low/no energy consumption/ standby

- Mutual Authentication with certificates, or K1,K2,sha

- secure encrypted connection, NGSI

- Open Source, Fully Customizable

- HW extensible to sensors
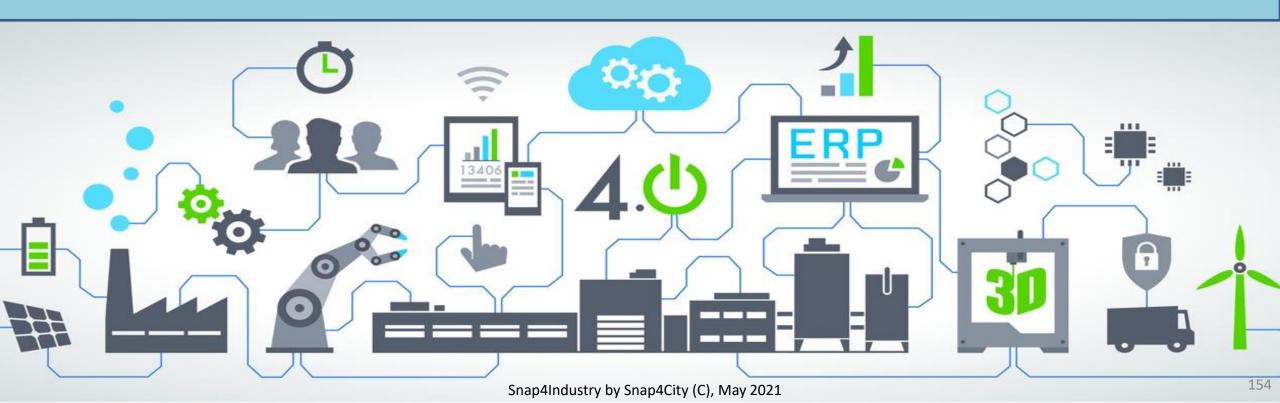
Squared Short
Squared Double
Squared Long
Round Short
Round Double
Round Long

Snap4all Button

https://www.snap4city.org/drupal/node/276
https://www.snap4city.org/drupal/node/297 help config

IOT Applications and IOT Edge Devices
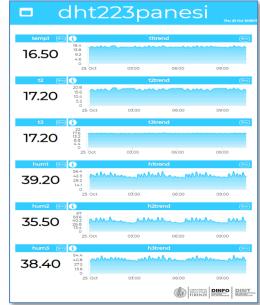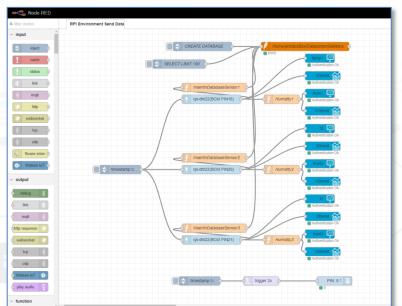
IOT Edge on Raspberry Pi

- 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....

Snap4 on Raspberry Pi, IOT edge

IOT Edge Computing
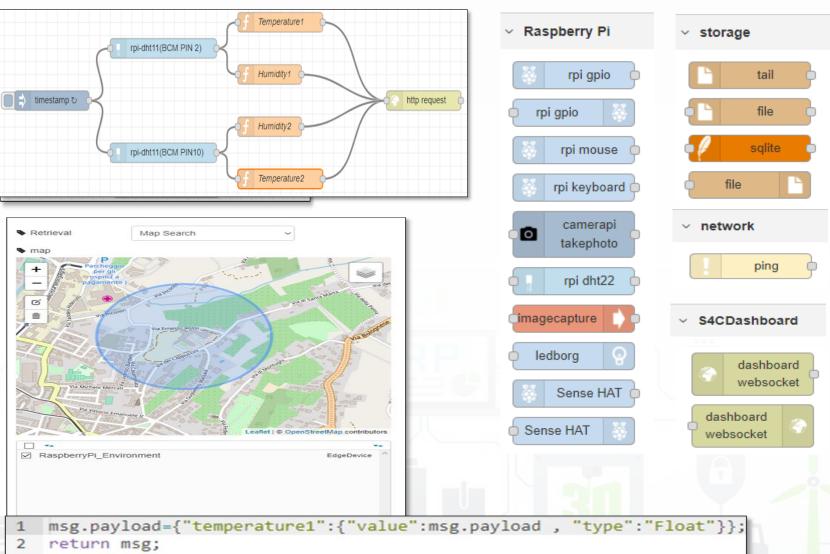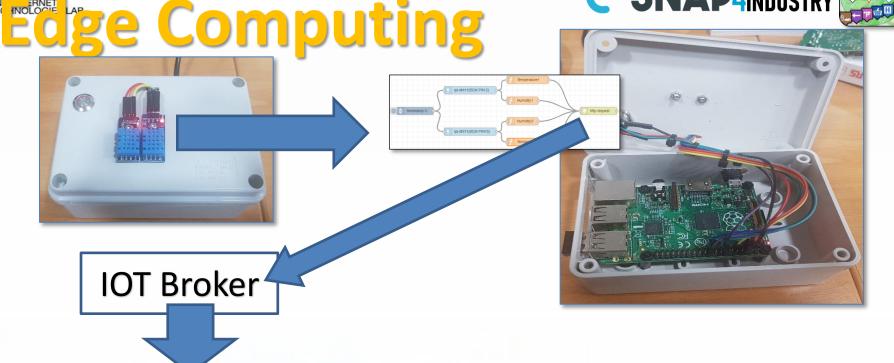
City user

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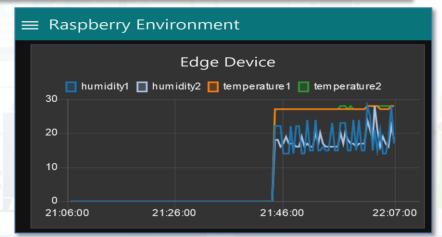
- **Monitor and exploit temperature and humidity**
- **Manage sensors**
- **Perform edge computing**
- **Using these data for multiple applications**

IOT Broker

Click here

RaspberryPi_Environment

Steps:

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

IOT Edge Snap4All App for Android

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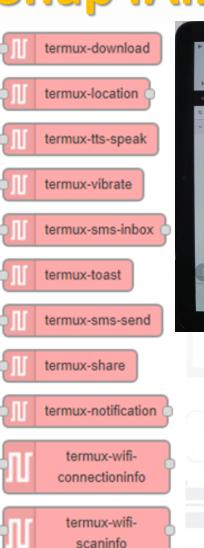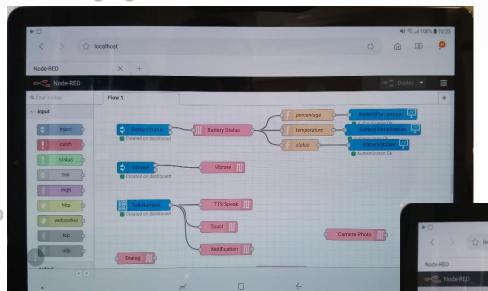
IOT Edge Snap4All App for Android

termux-battery-status

termux-camera-info

termux-clipboard-get

termux-contact-list

termux-telephony-cellinfo

termux-telephony-deviceinfo

termux-tts-engines

termux-camera-photo

termux-clipboard-set

termux-dialog

termux-download

termux-location

termux-tts-speak

termux-vibrate

termux-sms-inbox

termux-toast

termux-sms-send

termux-share

termux-notification

termux-wifi-connectioninfo

termux-wifi-scaninfo

MicroServices:
- Snap4City
- Termux Snap4City specific
- etc.
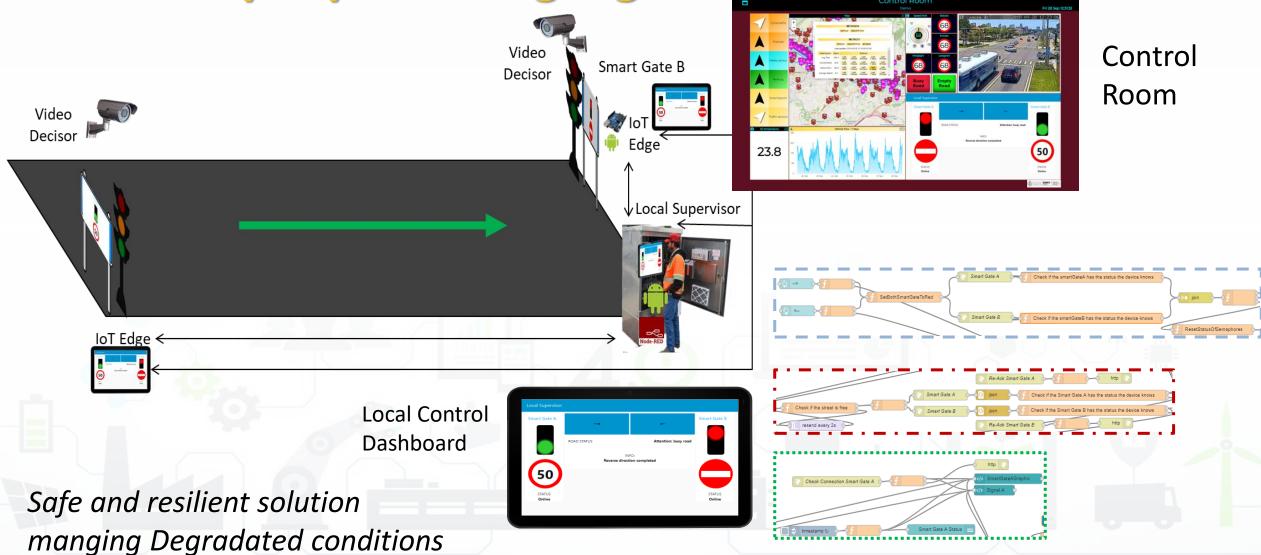
Sii-Mobility: Dynamic Signage and Street Mng

Control Room

Video Decisor

Video Decisor

Smart Gate B

IoT Edge

Local Supervisor

IoT Edge

Local Control Dashboard

Safe and resilient solution manging Degradated conditions

IOT Devices and IOT Edge

- **A large range of Devices** can be used on Snap4City:
  - Proprietary or Open HW/SW.
  - Devices of/for makers on which we provide Open source code
- **Documentation and instructions:**
  - [**TC9.4 - IOT application exploiting Edge computing with Raspberry**](#)
  - [**TC9.7 - Connection from LoraWan Dragino/arduino to Orion broker**](#)
  - [**Snap4City: Arduino & ESP8266 IOT Device NGSI**](#)
  - [**Snap4City IOT Devices Registration**](#)
  - [**Snap4All IOT Button: based on ESP32, NGSI compliant secure connection**](#)
  - [**IDE Setup for Snap4All IOT Button, and source code**](#)
  - [**Registering IOT Edge: example of Raspberry Pi, total security**](#)
  - [**Creating: IOT Device, Raspberry Pi based, totally compliant with Snap4City**](#)

Moving IOT Devices / Sensors, Tracking Devices
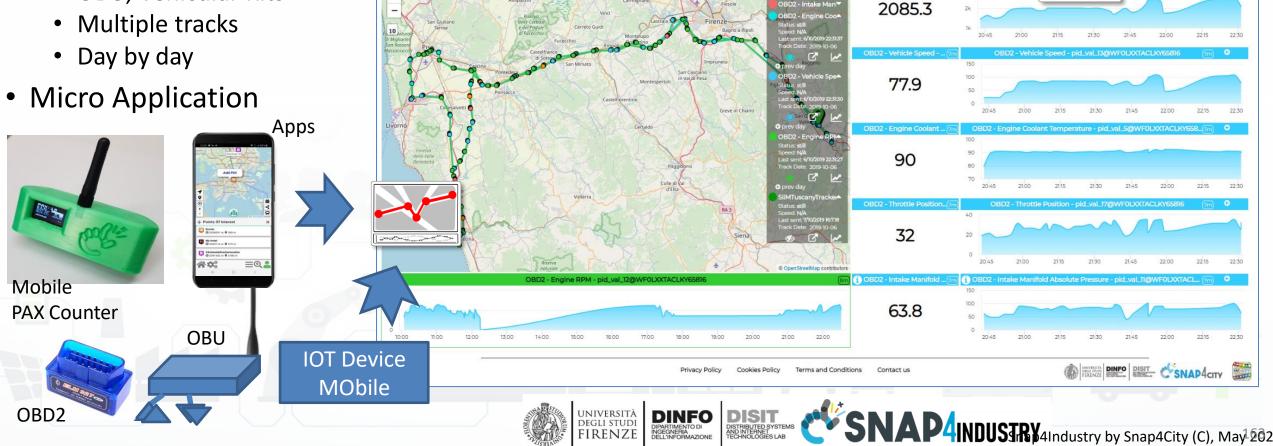
MyKPI: Tracking of Devices and Mobiles

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

- Micro Application

Mobile
PAX Counter

Apps

OBU

OBD2

IOT Device
MObile

IOE – Vehicle Monitoring

CANBUS sniffer
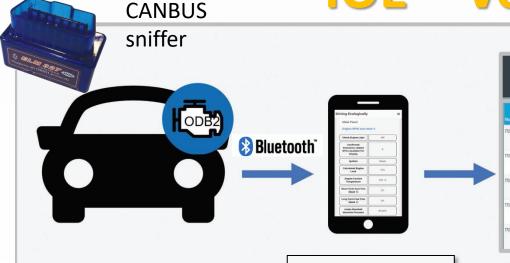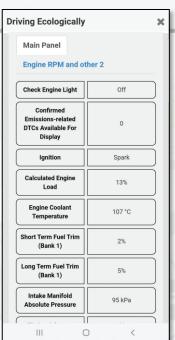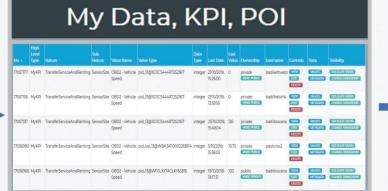
Tuscany in a Snap Mobile App on Android
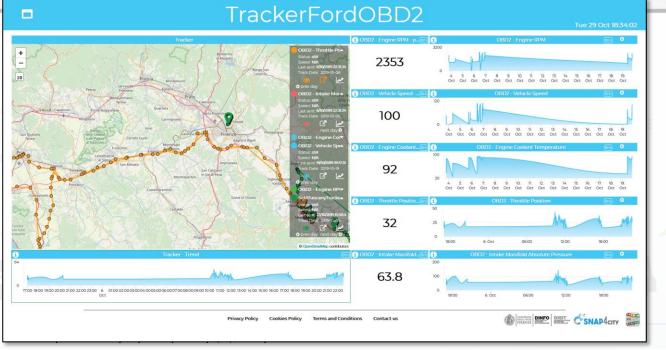
PaxCounter devices

- 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
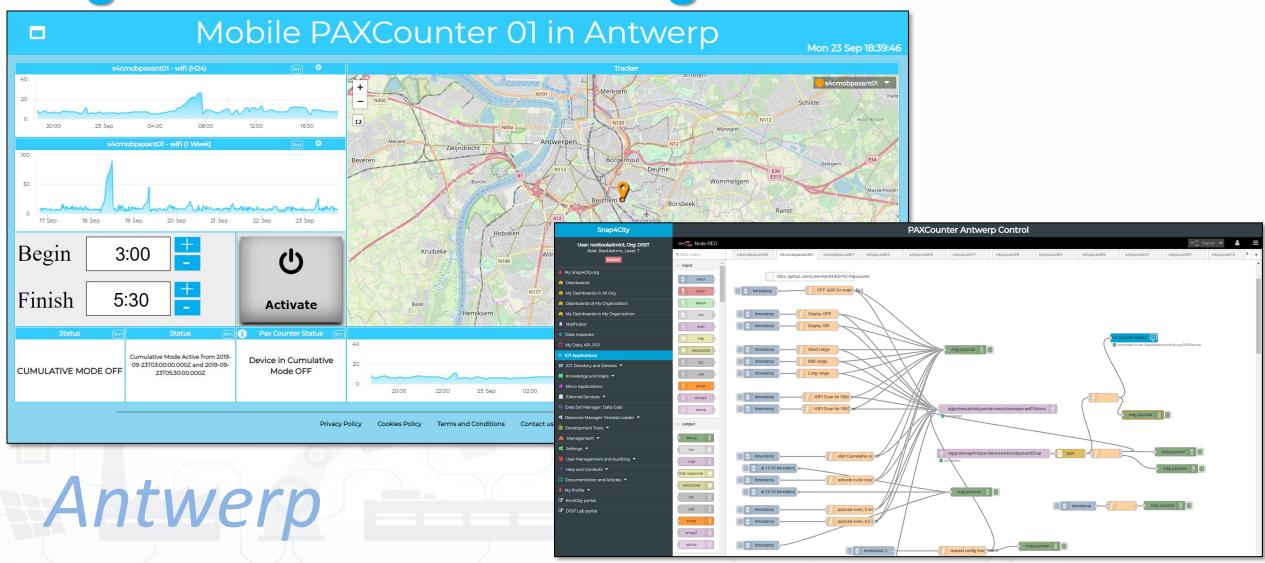
Programmable PAX counting
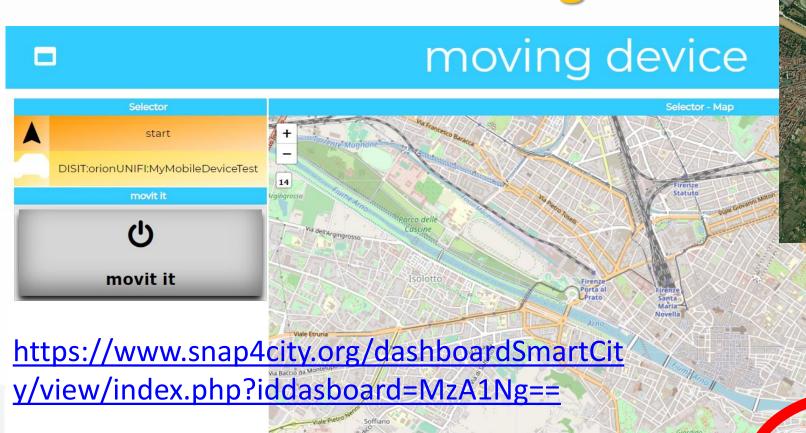
Real time device traking

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

Moving and changing Dynamic PIN at the same time

Managing IOT Applications
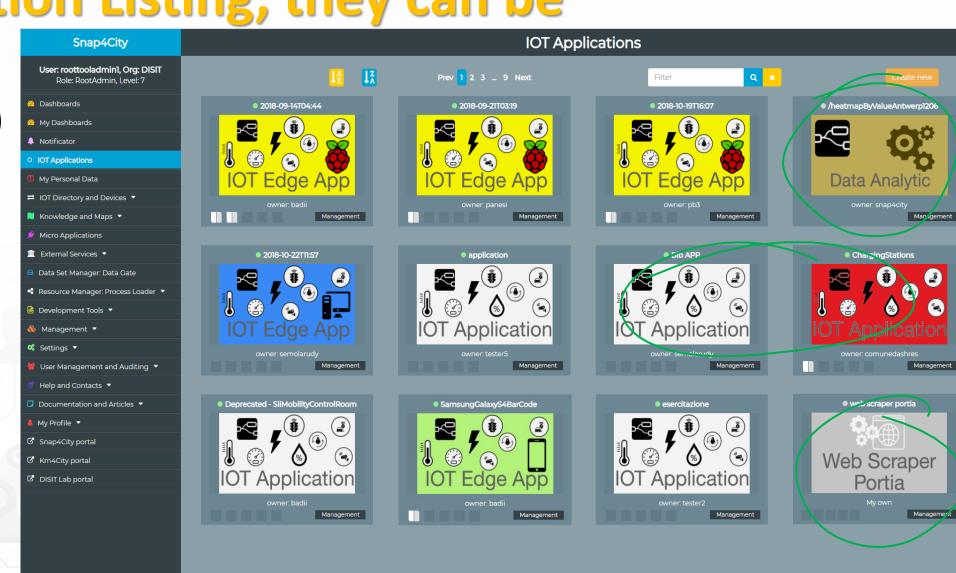
IOT Application Listing, they can be

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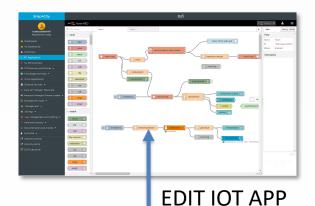
IOT Applications Listing

– Basic / Advanced

– On IOT Edge Raspberry Pi

– On IOT Edge Android

– On IOT Edge Win/Linux

EDIT IOT APP

VIEW

EDIT

IOT App title

Click the icon to edit the IOT App

Ownership of the IOT App

Click to open the Node-RED IOT App dashboard

Click to view the Snap4City Dashboard

Click to edit IOT App properties
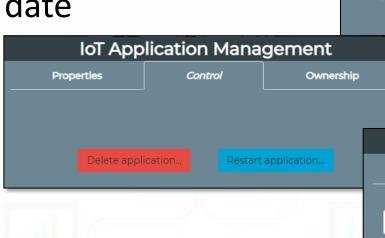
Click to edit the Snap4City Dashboard

IOT Application Management

- **Properties**
  - Name, Type, Creation date

- **Control**
  - Restart
  - Delete

- **Change of ownership**
  - Toward another Snap4City User

- **From inside the flow**
  - Restart
  - Update
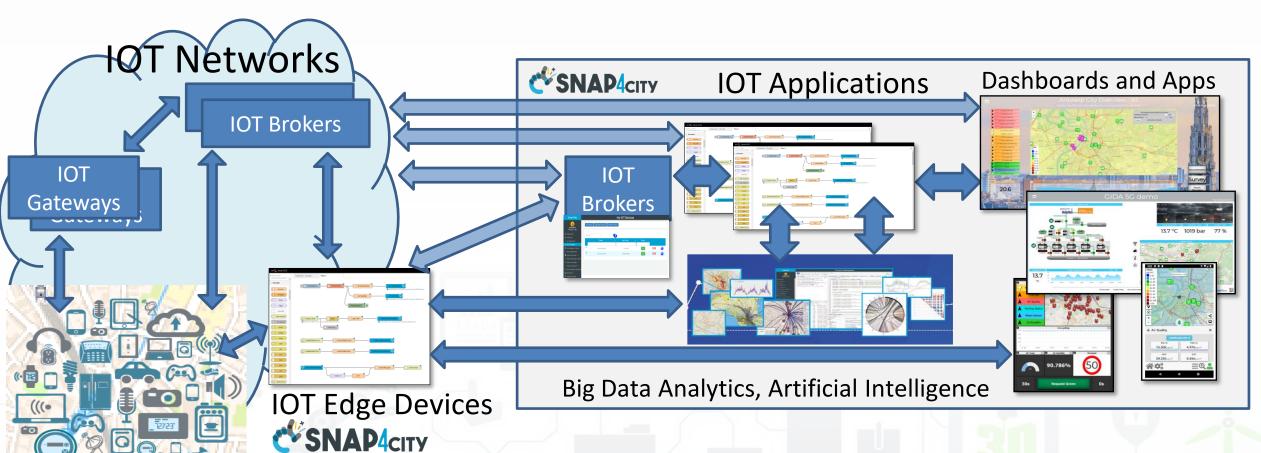
Remote Control of IOT Applications on IOT Edge Devices

Snap4City Services also on IOT Edge!!!

IOT Networks

IOT Brokers

IOT Gateways

IOT Applications

Dashboards and Apps

IOT Brokers

IOT Edge Devices

Big Data Analytics, Artificial Intelligence

IOT Devices

Why it is useful

- **Need to transform** data from your local devices to Snap4City devices or data storage or dashboards,

- **Need to play the role of multiprotocol HUB** as in:
  - **Snap4Home**: Scenario: Snap4Home, how to exploit Snap4City solution on home automation
  - **Snap4Industry**:
    - **Scenario: High Level Control of Industrial Plant**
    - **Snap4Industry: Snap4City for Industry 4.0**
    - **Scenario: 5G Enabled Water Cleaning Control**

IOT Edge Device for Snap4City

- **Computer based solutions with** *Node-RED + Snap4City Library*

- **Node-red supports:**
  - Raspberry pi, Linux based, Windows based, android with Termux, and also on a several servers. https://nodered.org/docs/getting-started/

- **Snap4City Library:**
  - From Node-RED: "manage palette" in the main menu'.
  - From Node-RED library: https://flows.nodered.org/search?term=snap4city

- *You can add any kind of protocol and interface to IOT Edge Device*

IOT Edge Device

Other Local Connections

IOT Brokers

WiFi™

Modbus

OPC UA

IOT Edge:
Node-RED + Snap4City

edge-tunnel-to-cloud

IOT Devices

HTTPS

IOT Brokers

HTTPS

Search and Query, Smart City API
Facet, semantic search

Knowledge base
Semantic reasoners

Indexing and aggregating
Elastic search

SNAP4CITY

Snap4Home 5G Demo

WSs

Firewall Gateway Towards internet

HTTPS

IOT Applications

Access to IoT Edge Maintenance

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

Advantages of IOT Edge remote control/program

- You do not need to be/move in the local network to access at Your IOT Edge Devices for programming or maintenance, SINCE With Snap4City:
  - *You can update the logic flow of your IOT Edge Devices from remote,*
  - *You can perform remote maintenance of your IOT Edge Devices and programms without moving from your office*

AND

- You can access to the IOT edge from remote by using a secure connection
- You can activate the remote control feature singularly for each IOT Edge Device
- You do not need to reconfigure your Firewall or Gateway in most of the cases

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

edge-tunnel-to-cloud
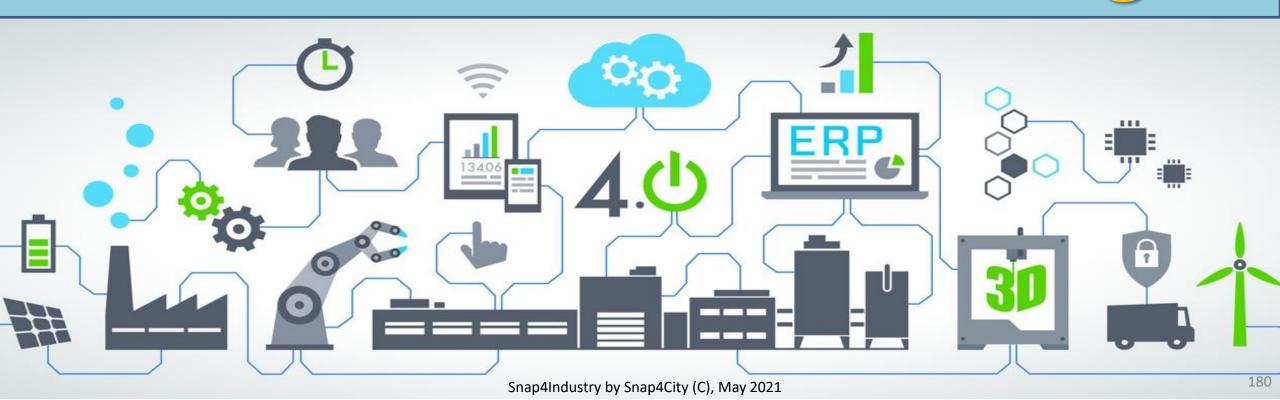
3. Configure the block with your credentials

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

Snap4Industry by Snap4City (C), May 2021

181
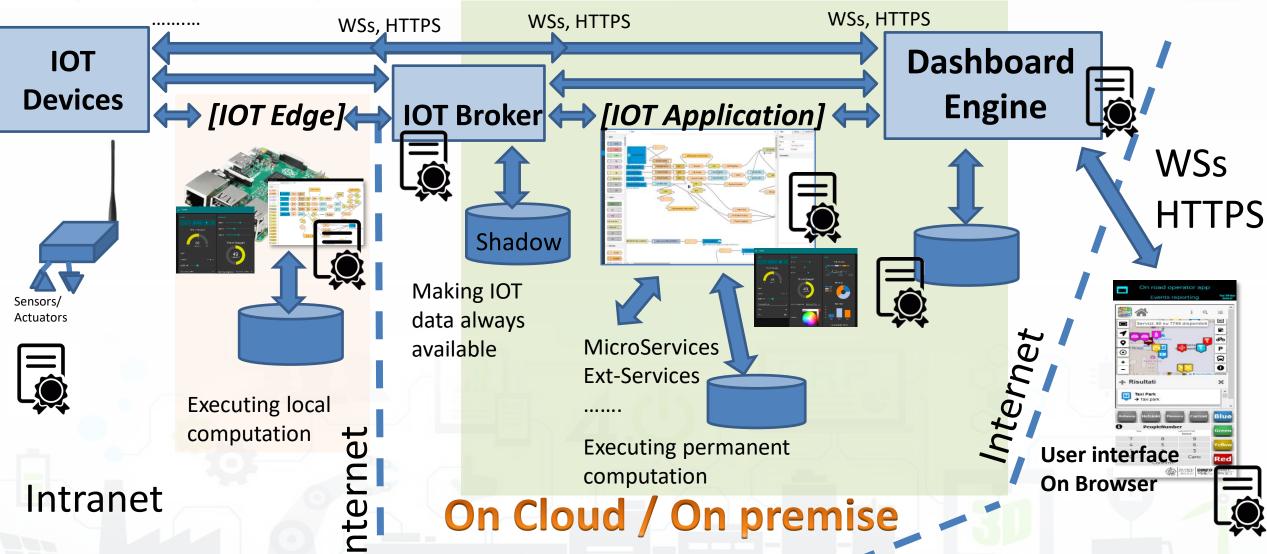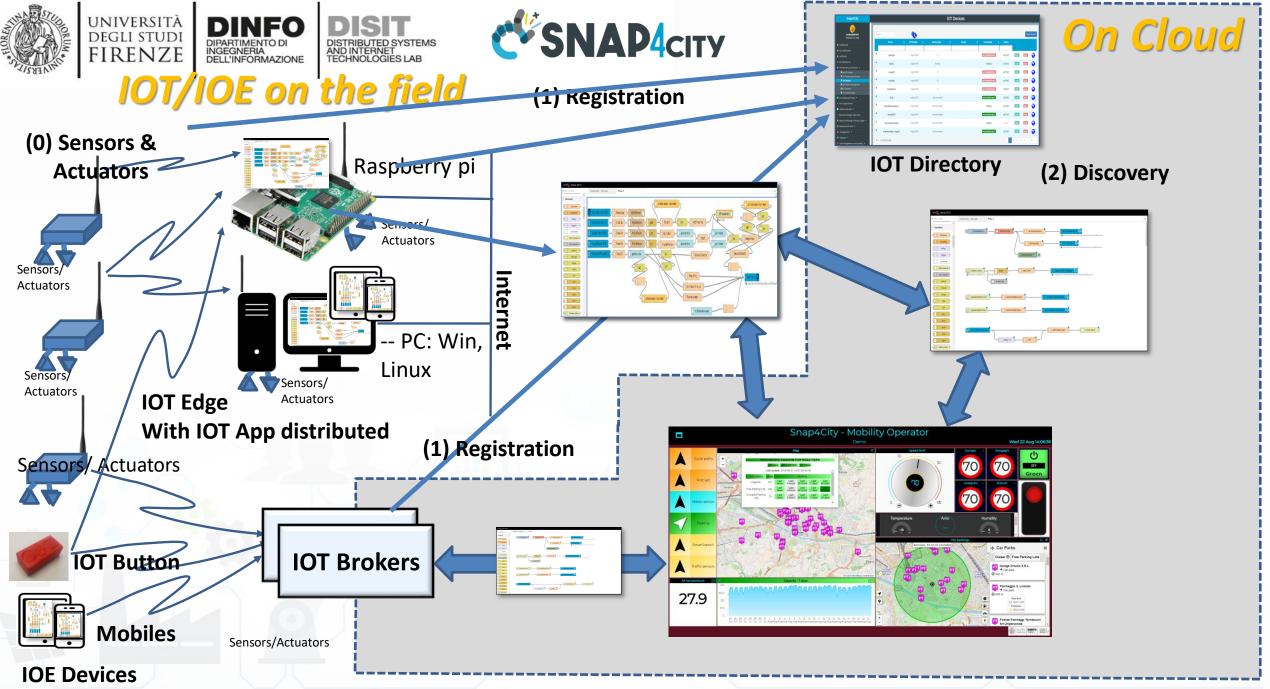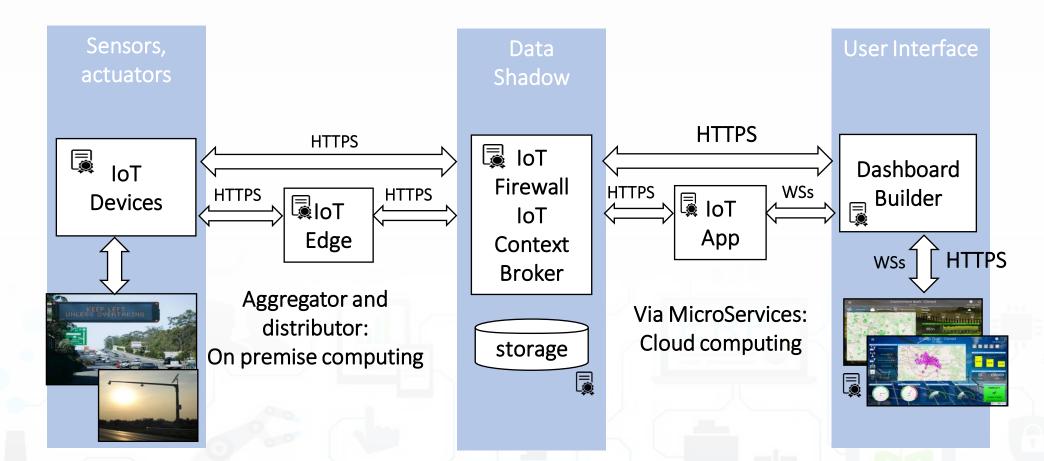
The secure stack
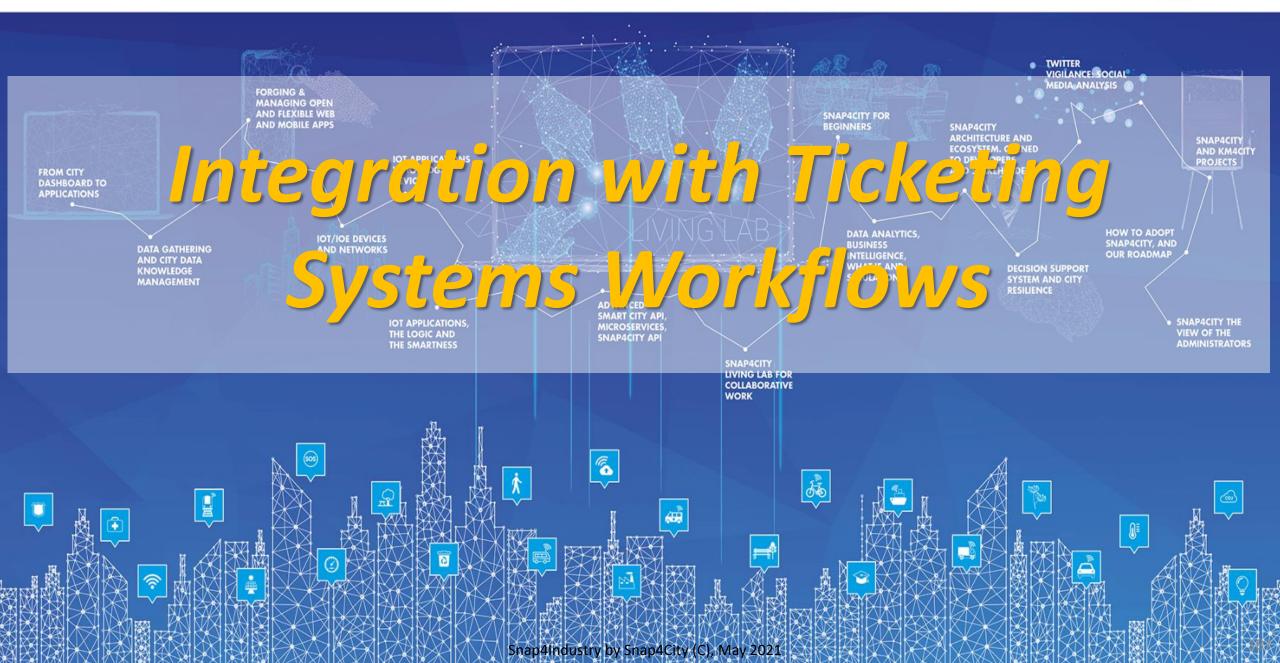
Capabilities

- **Creating IOT Applications for:**
  - **Controlling industrial/local processes** locally and globally
  - **Exploiting IOT Edge for local IOT Applications**
    - Local smartness, limited computational capabilities, limited dashboarding
    - Resilience wrt lack of power and connectivity: autonomous
  - **Sending data on Cloud** via secure connection and for:
    - business intelligence, data analytics, machine learning
    - Global scale and local scale analytics
    - Dashboarding at global scale
    - remote control and actions on industrial processes
    - Logging of the activities

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, equipments, etc.)
  - Tickets management for corrective maintenance
  - User management with different levels of access
  - BIM Server integrated with OpenMaint
- **Snap4City OpenMaint Extension**
  - **Extended API** developed by Snap4City
    - Create new tickets
    - Manage steps, workflow
    - Collecting feedbacks and results from teams
    - Manage all phases of the workflow on the fields via IOT Apps and logics
    - The integration if via API and MicroServices into IOT App.
  - **MicroServices** integrated with Snap4City via IOT Applications
- **Business Intelligence** which is the **Snap4City tool based on** Elastic Search: which work on top of the database of tickets collected on OpenMaint
- **BIMServer** integration with Snap4City Dashboards;
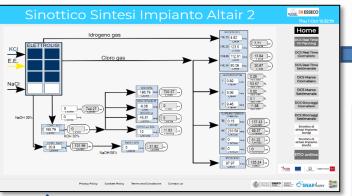
Example of Integrated workflow

Consumptions/productions

Events/actions

Business Intelligence
Maintenance

Dashboards and actions

OpenMaint: BPM Workflow
management, team assignement,
material control, …
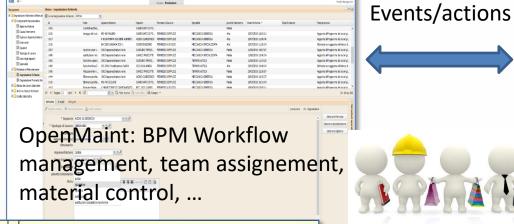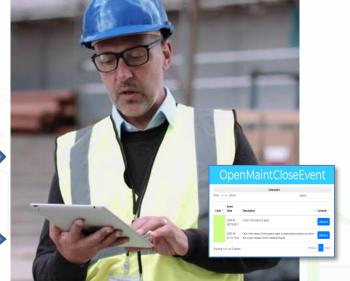
IOT App, Data
event firing,
event detection
and firing
Critical event
management
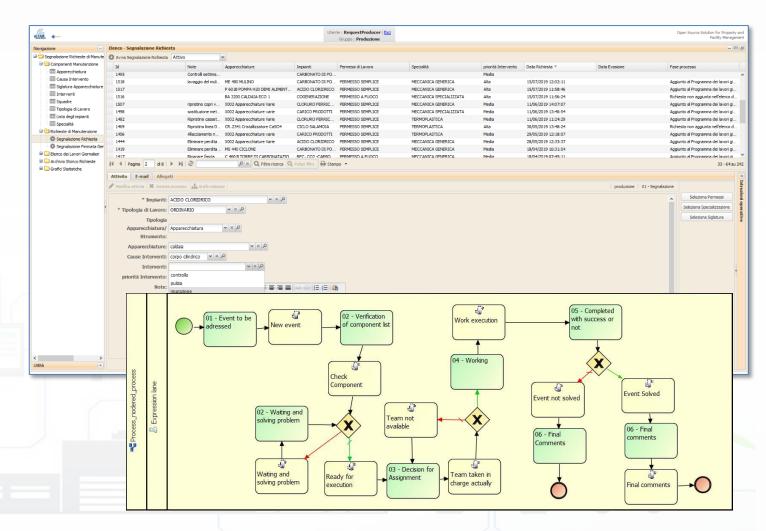
Integration with Ticketing Systems Workflow

- **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
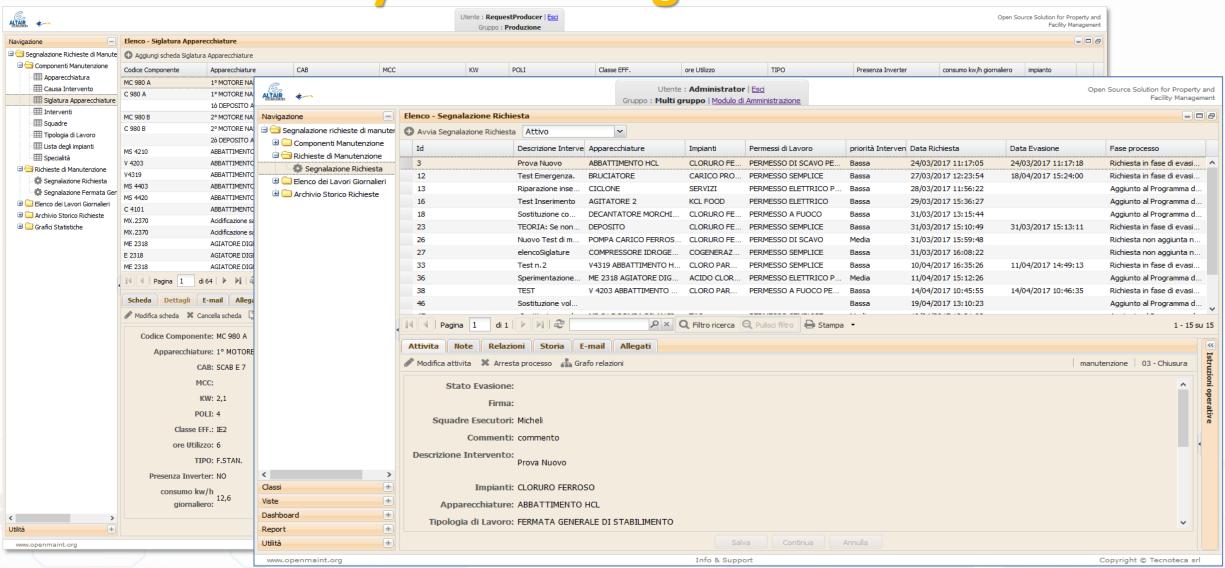
Assets inventory and management

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

- Define the workflow
  - Activate events
  - Manage steps
  - Collecting feedbacks and results from teams

- Activities
- Teams
- Phases
- Athorization
- Checking points
- Events and conditions
- ...
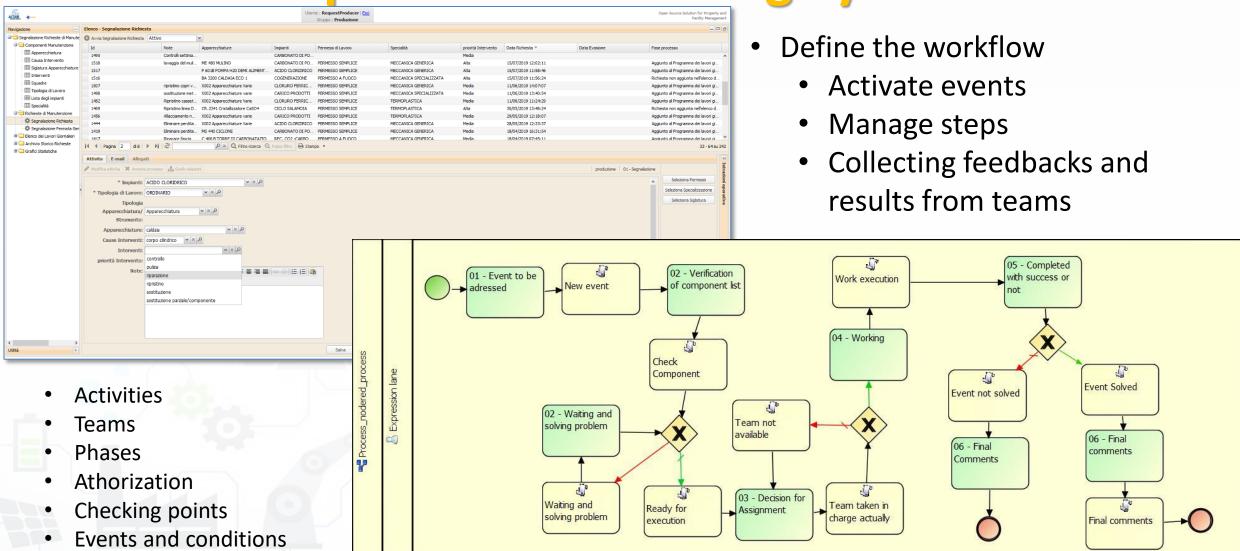
Dashboards
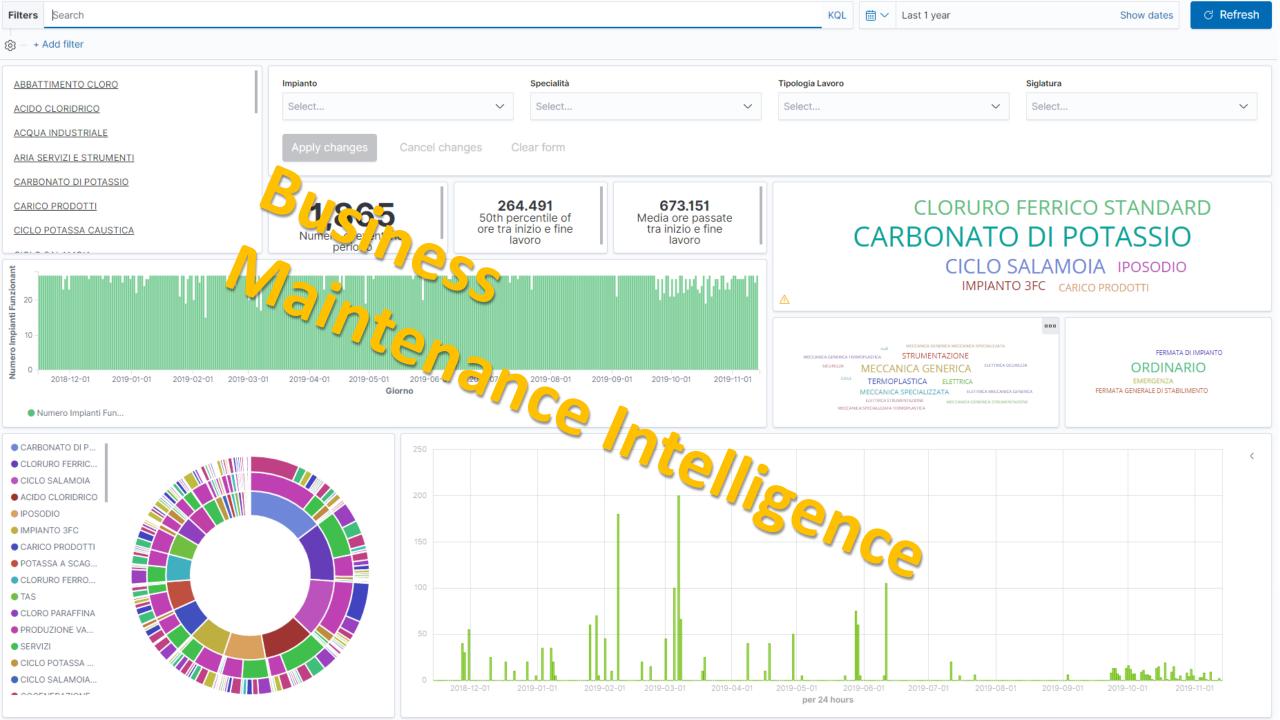
Snap4City can
- Create new tickets
- Manage steps, workflow
- Collecting feedbacks and results from teams
- Manage all phases of the workflow on the fields via IOT Apps and logics
- The integration if via API and MicroServices into IOT App.

+ Add filter

Impianto
Select...

Specialità
Select...

Tipologia Lavoro
Select...

Siglatura
Select...

Apply changes   Cancel changes   Clear form

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

1.865 Numero... periodo

264.491 50th percentile of ore tra inizio e fine lavoro

673.151 Media ore passate tra inizio e fine lavoro

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

MECCANICA GENERICA MECCANICA SPECIALIZZATA
MECCANICA GENERICA TERMOPLASTICA
STRUMENTAZIONE
SICUREZZA   ELETTRICA SICUREZZA
MECCANICA GENERICA
EDILE   TERMOPLASTICA   ELETTRICA
MECCANICA SPECIALIZZATA   ELETTRICA MECCANICA GENERICA
ELETTRICA STRUMENTAZIONE   MECCANICA GENERICA STRUMENTAZIONE
MECCANICA SPECIALIZZATA TERMOPLASTICA
null

FERMATA DI IMPIANTO
ORDINARIO
EMERGENZA
FERMATA GENERALE DI STABILIMENTO

Numero Impianti Funzionanti — Giorno

● Numero Impianti Fun...

● CARBONATO DI P...
● CLORURO FERRIC...
● CICLO SALAMOIA
● ACIDO CLORIDRICO
● IPOSODIO
● IMPIANTO 3FC
● CARICO PRODOTTI
● POTASSA A SCAG...
● CLORURO FERRO...
● TAS
● CLORO PARAFFINA
● PRODUZIONE VA...
● SERVIZI
● CICLO POTASSA ...
● CICLO SALAMOIA...

per 24 hours

OpenMaint BPM, BIM
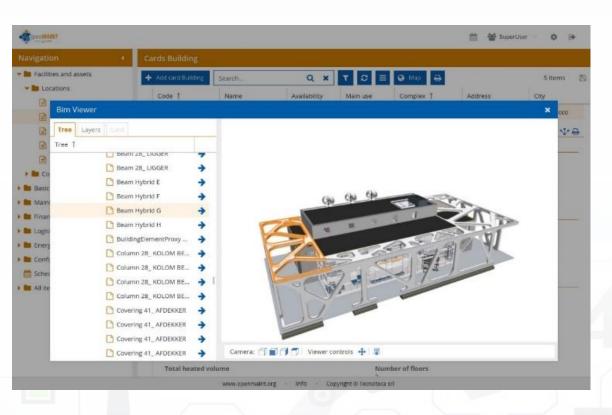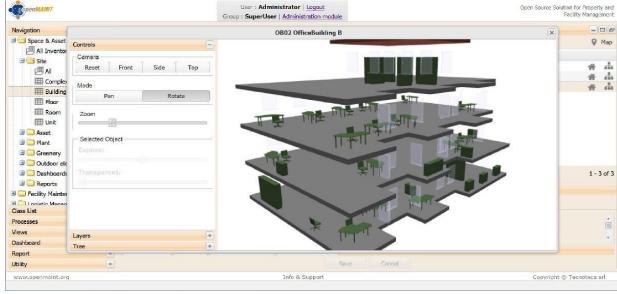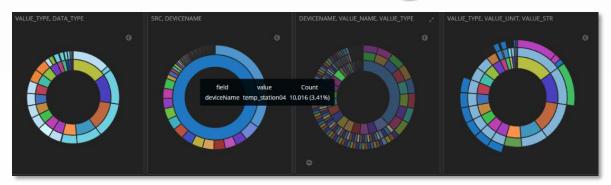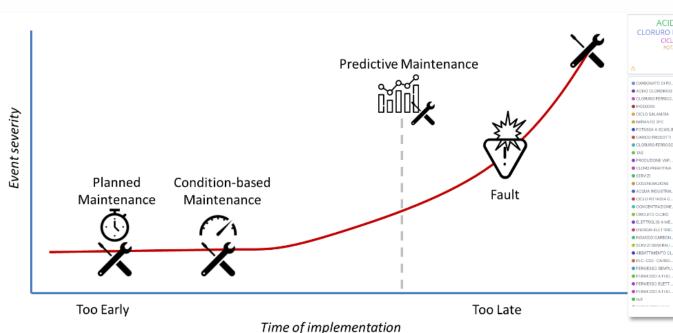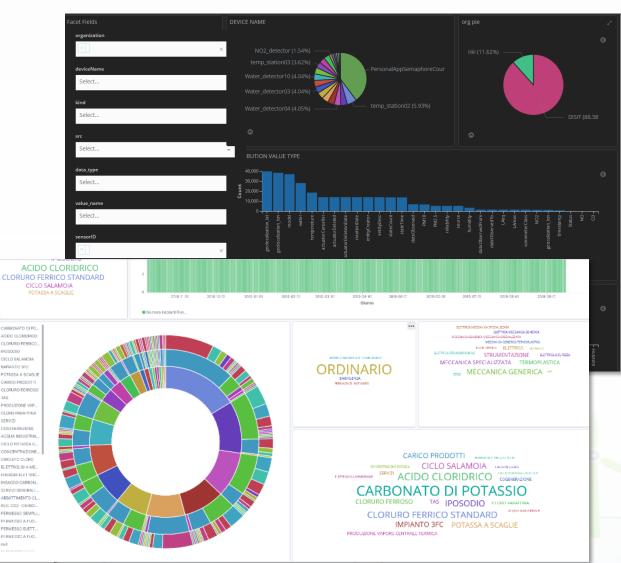
Business Intelligence and Predictive Maintenance

DATA ANALYTICS,
Big Data Science

WHAT IS DATA SCIENCE

Sentient and active processes

- Big Data
- Semantic Computing
- Machine Learning
- Geo Spatial Reasoning
- Sentiment Analysis
- What If Analysis
- Text Analysis
- Simulations
- Visual Analytics
- MicroServices
- Scalability
- Engagement Analysis
- ....

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

Swagger

SPARQL, FLINT

Ontology Schema

LOG.disit.org

Knowledge Base, Km4City

Big Data Store Facility

Smart City API from Knowledge Base and other tools

R Studio

Creating Micro Services

Saving Sharing Reusing

Using them into IOT Applications

Node-RED

Resource Manager

Snap4Industry by Snap4City (C), May 2021

Data Analytics Development in Python, ...

Swagger

SPARQL, FLINT

Coding Testing

Ontology Schema

LOG.disit.org

Smart City API from Knowledge Base and other tools

Knowledge Base, Km4City

Big Data Store Facility

Creating Micro Services

Saving Sharing Reusing

Using them into IOT Applications

Resource Manager

Snap4Industry by Snap4City (C), May 2021

201

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

Predicting City Users on Areas

Predicting at EXPO2015

Early Warning Water Bomb
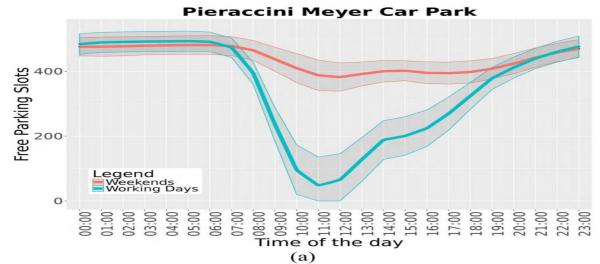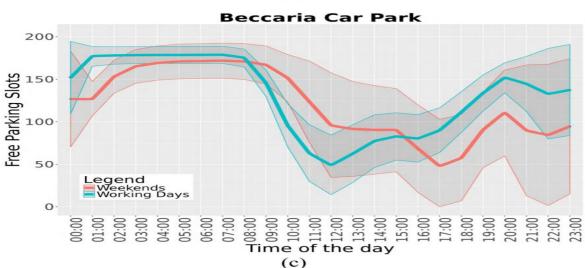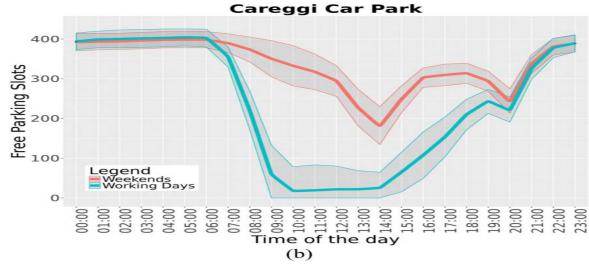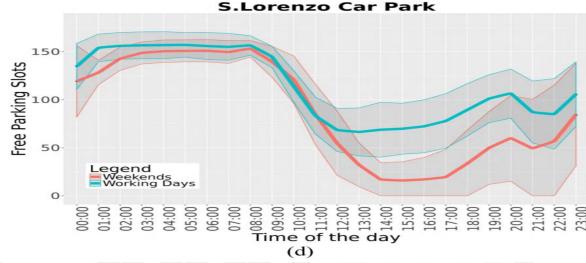
Early Warning Hot in Tuscany

12 parking areas in Florence

Free Parking Predictions

Careggi car park			
Model features	**BRNN model results**		
	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»

Precision: 97,5%
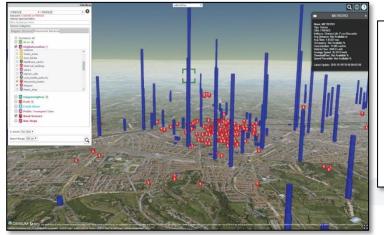
Predicting users movements
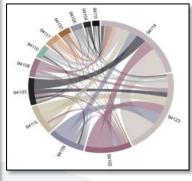
- **Issue:**
  - **How they move: vehicles, pedestrian, bike, ferry, metro,**
  - **Where they go….**
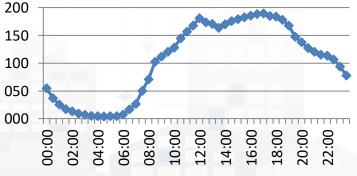
- **Impact:**
  - **Tuning the services: cleaning, police, control, security**

- **Several metrics related to**
  - **Knowledge of the Context**
  - **Monitoring traffic and people flow**
  - **…….**

- Daily trends
- OD matrices
- Trajectories
- Prediction models
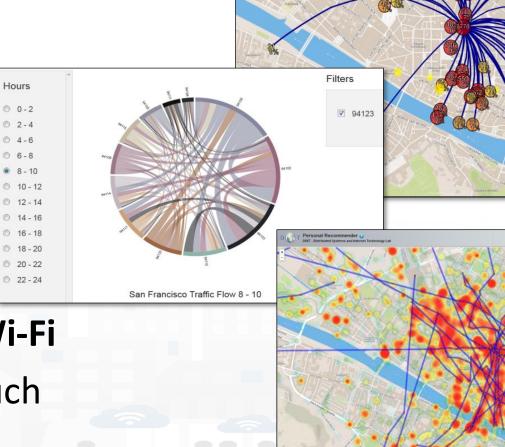
User Behaviour Analysis

- **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
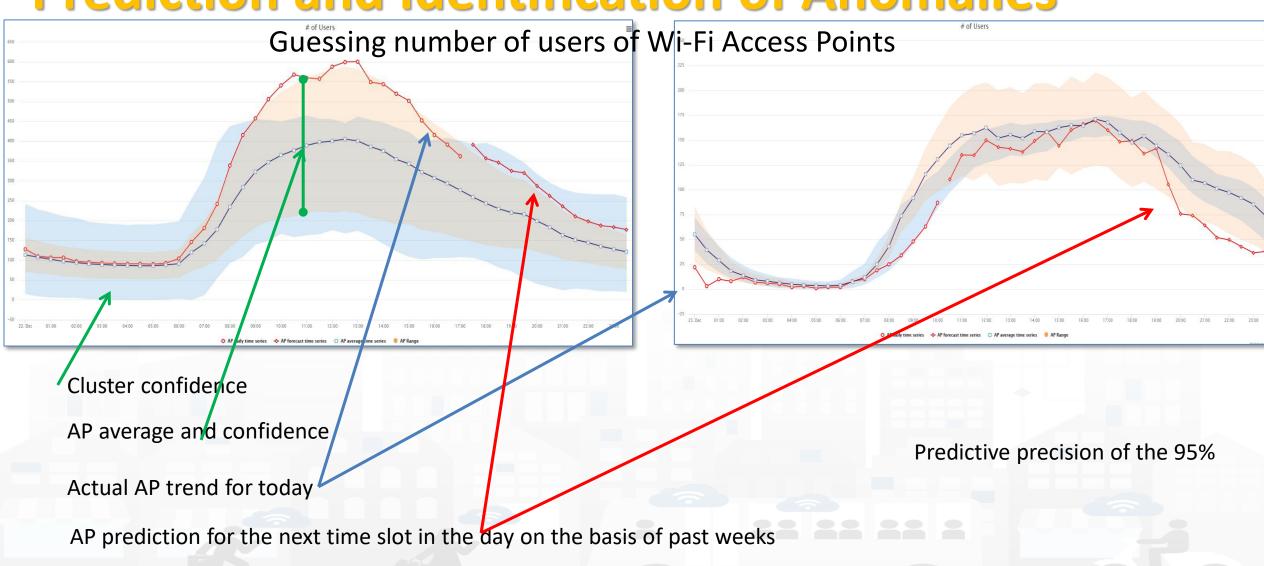
Prediction and Identification of Anomalies

Guessing number of users of Wi-Fi Access Points

Cluster confidence

AP average and confidence

Actual AP trend for today

AP prediction for the next time slot in the day on the basis of past weeks

Predictive precision of the 95%
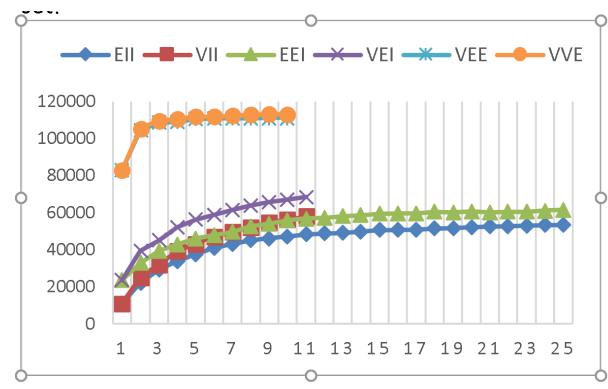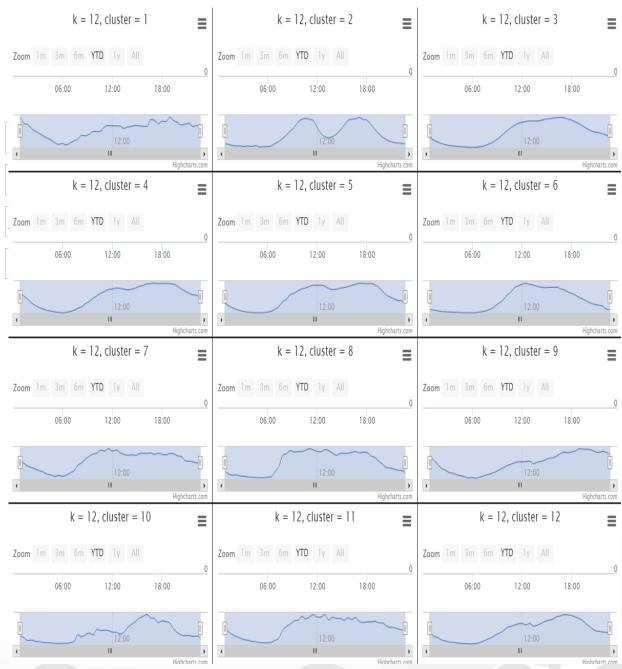
Figure 14 – Average BIC for mixture models vs K number of cluster, higher values are better, the curves are truncated at the best value for K they found.
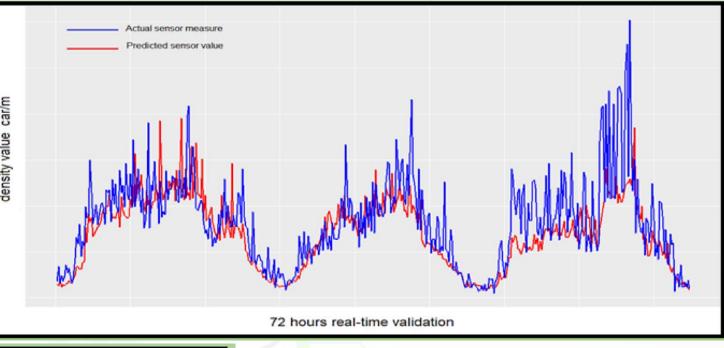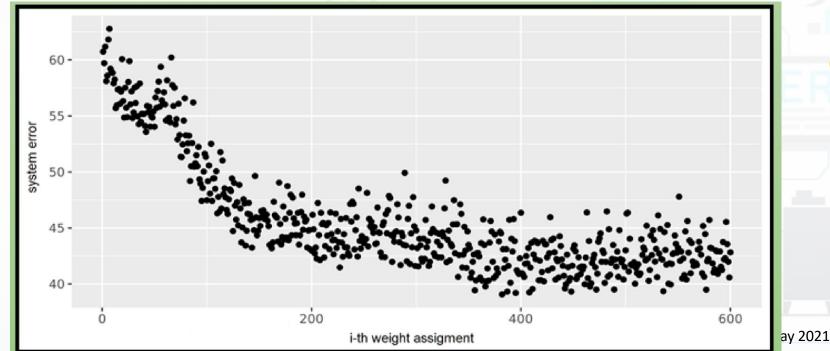
Convergence of learning phase

Traffic Flow reconstruction, real time

Qualità Trasporto Pubblico - Cloned

Firenze - 6 linee

Sat 22 Jun 07:45:48

Anomaly Detection
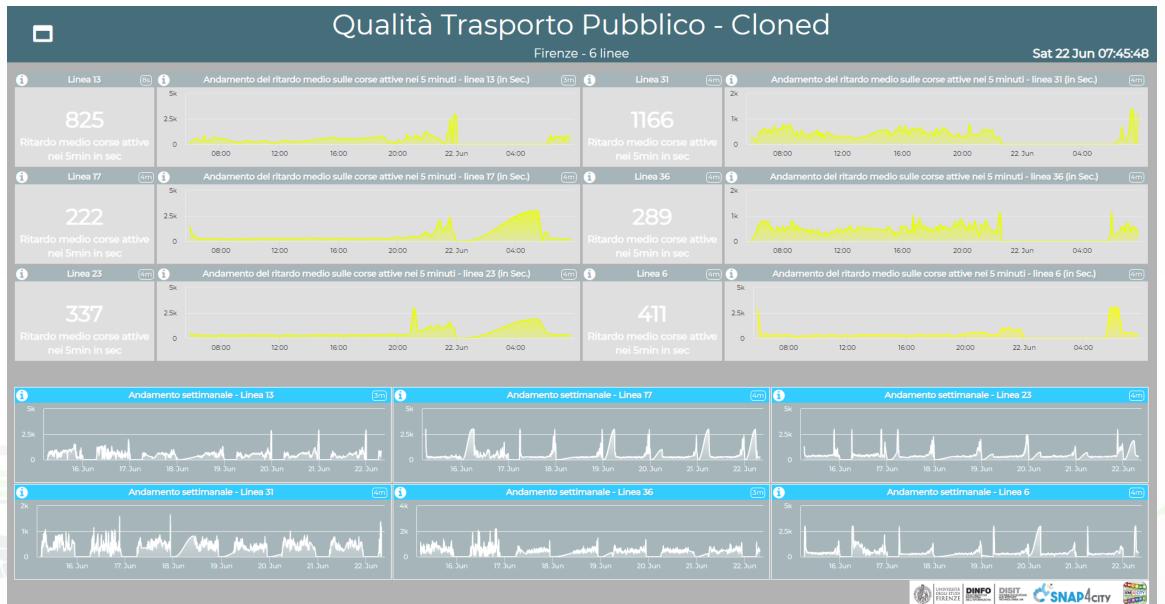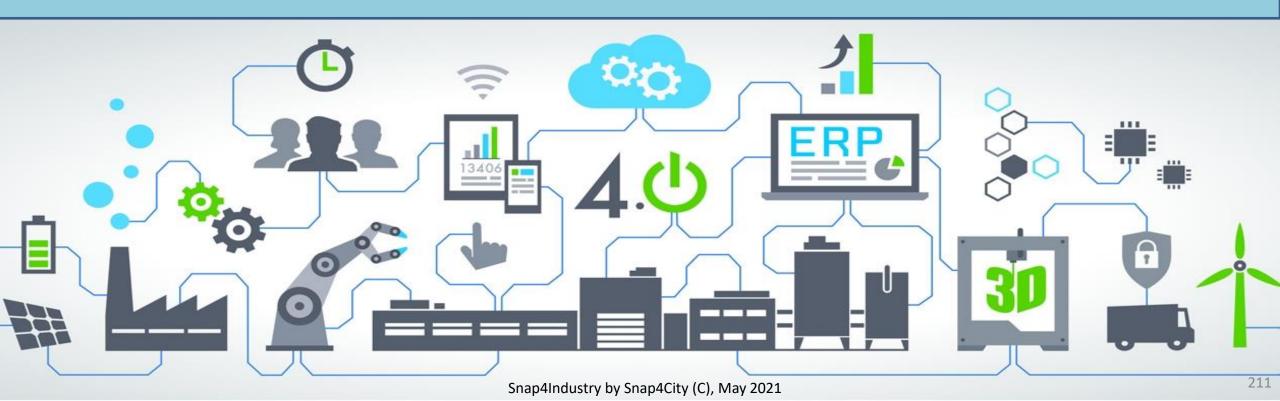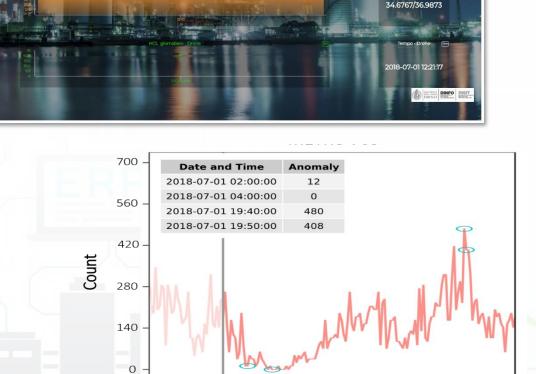
Reports and Dashboards

Anomaly detection
Early Warning

DevDash: My Data Dashboard Kibana

TOP

& Snap4City

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

IOT APPLICATIONS VS IOT EDGE DEVICES

FROM CITY DASHBOARD TO APPLICATIONS

SNAP4CITY FOR BEGINNERS

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS AND STAKEHOLDERS

SNAP4CITY AND KM4CITY PROJECTS

HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP

DATA ANALYTICS BUSINESS INTELLIGENCE, WHAT-IF AND SIMULATION

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

IOT APPLICATIONS, THE LOGIC AND THE SMARTNESS

ADVANCED SMART CITY API, MICROSERVICES, SNAP4CITY API

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK

SNAP4CITY THE VIEW OF THE ADMINISTRATORS

Powered by FIWARE

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

Powered by FIWARE

Overview

SMART CITIES AND SMART INDUSTRY

**Snap4City:
FIWARE powered smart app
builder for sentient cities**

With the contribution of

- https://fiware-foundation.medium.com/snap4city-fiware-powered-smart-app-builder-for-sentient-cities-acfe24df49d5

- https://www.snap4city.org/drupal/sites/default/files/files/FF_ImpactStories_Snap4City.pdf
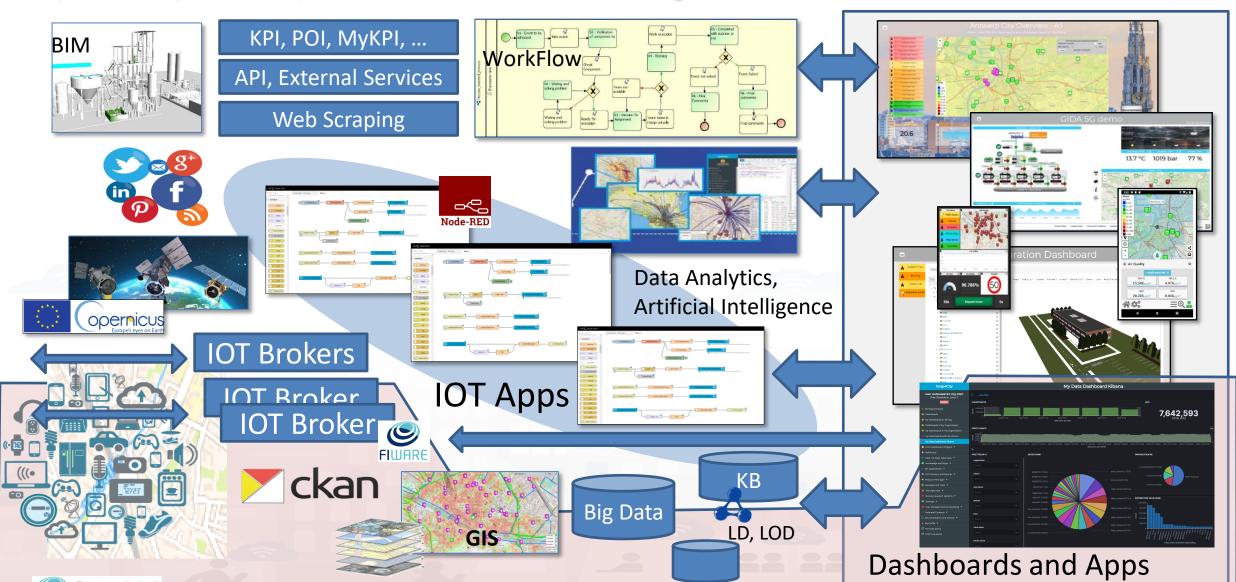
Concept

BIM

KPI, POI, MyKPI, …

API, External Services

Web Scraping

WorkFlow

Node-RED

Data Analytics,
Artificial Intelligence

IOT Brokers

IOT Broker

IOT Broker

IOT Apps

FIWARE

ckan

GIS

Big Data

KB

LD, LOD

Dashboards and Apps

FI-WARE

SNAP4CITY   KM4CITY

Functional: FIWARE refarc wrt Snap4City solutions

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

Interoperability Openess

Functional: FIWARE refarc wrt Snap4City solutions

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

Process

Graphics

Manag.

Snap4City

Home   Partners and Interoperability   Tools ▾   Tutorials and Videos ▾   Blog ▾   Contributions ▾

Your Level

User: adifino, Org: DISIT
Role: Manager, Level: 4

- Dashboards (Public)
- Dashboards of My Organization
- My Dashboards in My Organization
- IOT Applications
- My IOT Devices
- Knowledge and Maps ▾
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager
- Help and Contacts ▾
- Documentation and Articles ▾
- My Profile ▾
- Snap4City portal
- Km4City portal
- DISIT Lab portal

All Tools

Home / Tutorials and Videos / Welcome: how to start using Snap4City for beginners

Username: adifino

Welcome: how to start using Snap4City for beginners

Powered by
www.km4city.org
KM4CITY

Personalized Suggestions

Full Search

Snap4City developers suggest you reading:

You have already created a **Dashboard**. Now, you may decide to make it public (visible and accessible) to all on WEB, or to provide access in view to other specific users that you know by nickname. In addition, you can pass the Ownership of a **Dashboard** to some other user of the system, and you can clone the **Dashboard** as well. So that you can create **Dashboard** for other users as well. We suggest to test these functionalities since you can:

- access to Data Set **Manager** to upload/download, share data sets as files in CSV: https://datagate.snap4city.org/ssologin_handler
- upload data for the **knowledge base** and **dashboards** via Data Set **Manager**,
- access and share of resources as: **dashboards**, **IOT Applications**, blocks, etc.; https://processloader.snap4city.org/processloader/ssoLogin.php?redirect=page.php%3FshowFrame=false
- access to help and contacts, FAQ, documentation and articles
- manage personal data: profile, IOT Sensors, **Annotations**, Personal Data, Dashboards..; https://www.snap4city.org/drupal/myprofiledata
- Auditing Access to My Data according to **GDPR**.

Search

Search [ ]

Organization Groups

DISIT

- Operativo

Your Org

See this Tutorial on development of the above possibilities:

Exercises

TC1.10.   Dashboard delegation to access, and passage of ownership, and/or cloning

SLIDES

If you are not registred please apply for a **free registration from https://www.snap4city.org** and then pass to ACCESS AT THE TOOLS and full Snap4City environment

Snap4City puts in the hands of City Users a flexible environment to quickly create a large range of smart city applications/views exploiting heterogeneous data and services of stakeholders by IOT/IOE and big data technologies. For Snap4City, City Users can be citizens, students, operators, researchers, decision makers, developers, etc. see Users' Roles on Snap4City.

- **Manager**: is a **final user**, has the capability of: accessing and creating Dashboards with a large set of data (high level types as: POI, sensors, KPI, micro applications, external services, etc.), attaching alerts and notifications; registering IOT Devices; creating IOT Applications exploiting MicroServices; loading and sharing data sets; managing personal data and annotations; full access to documentation, help desk, FAQ, coworking; managing personal profile and data according to GDPR; **NOTE:** accessible features are mainly visual and simple to understand and to use, and provide a limited number of parameters on each dialog and for each action. Default values of created elements can be changed editing elements.
- **AreaManager**: is a **Developer/researcher, students, city operator**, with additional capabilities with respect to the Manager to: register IOT Brokers; creating advanced IOT applications; create massive data transformation processes; create data analytics in multiple languages, testing and load them, create microservices; adding external services; sharing results, loading shapes; analyzing performance of the back office; **NOTE:** technical views and details are fully accessible

Recent comments

- 1 month 6 days ago

Recent content

Last Art.

Ti Suggeriamo come realizzare la tua prima Dashboard (Step 1) new roottooladmin1

News

Flyer

Download Flyer

NEWS

VIDEOS

Suggested Activities to be performed to Learn HOW to use Snap4City:

This page would guide you along few steps to show how the solution allows you to incrementally pass from Level 0 to 5, from a Manager to an Area Manager:

- Level 0 user: access at data/services views of the city by using public Dashboards; (Public User) (overview on dashboards)
- Level 1 user: create personal/professional views/dashboards on data; (Manager)

Snap4 Industry by Snap4City [C]   May 2021

Benvenuto al nostro Sindaco ed al suo Team new roottooladmin1

We sugges to Antwerp Developers: How to manage my Dashboards

221

Living Lab Flexibility

Snap4City Satisfies all Requirements of ENOLL Select4Cities and EIP-SCC

- **Multiple modalities to perform the same activities**
- **Tuned for Beginners and Skilled people**
- **Visual interface and programming tools**
- **Resources and artefacts sharing for learn acceleration and co-working**
- **Open Living and co-working Portal**: https://www.Snap4City.org

Living Lab training
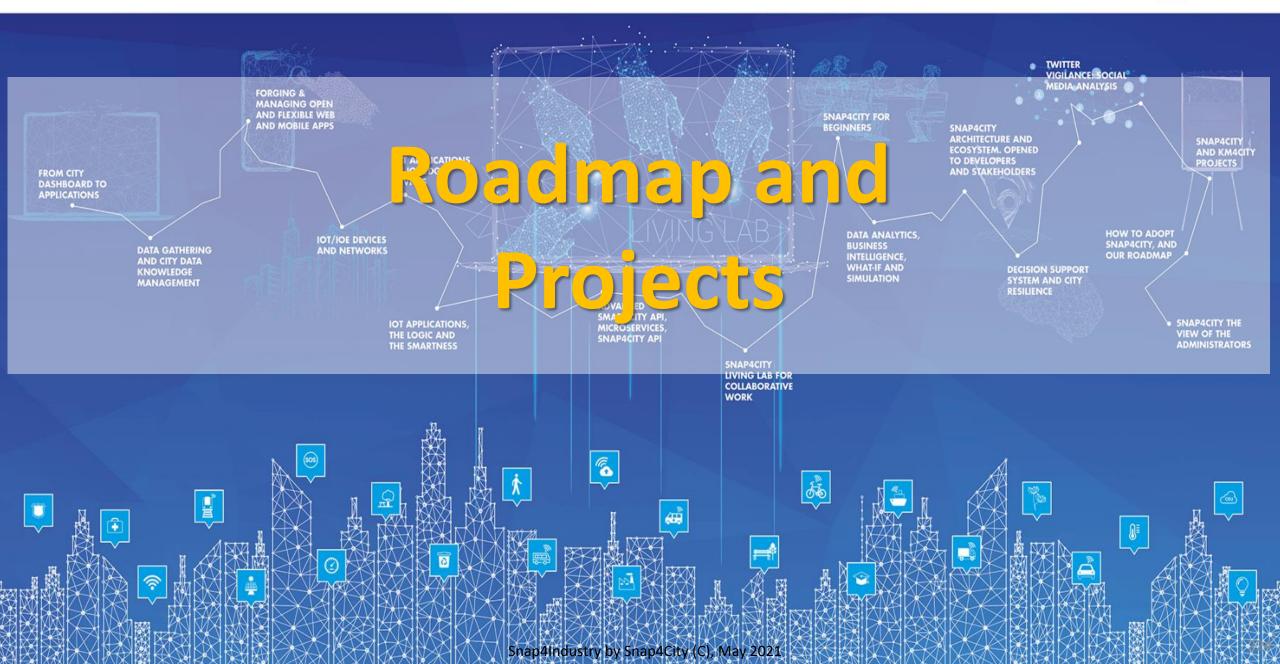
- **Snap4City Living Lab Life Cycle**

- **TC8.6 - Snap4City Living Lab Life Cycle**

- **US8. Using the Living Lab Support tools**

- **Snap4City platform: from cloud to data analytic as a Living Lab for Student and Researchers**

- **Contributing as city stakeholder: company, citizen/developer, researcher, etc., to the Living Lab**

- **TC8.1 - Snap4City Portal as a support for Living Labs, collaborative and co-work, Snap4City Portal as a single point to information Access and Discussion**

Satisfy all Requirements of ENOLL

European Network of Living Labs

Roadmap and Projects

DISIT lab roadmap vs model and tools' usage

2013 Km4City Ontology 1.1
- Tuscany, Road Graph
- Mobility
- culture, tourism
- Events
- Parking
- Services
- Linked open graph

2014
- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- LOD
- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

Km4City 1.5

Km4City 1.4

2015
- Resilience Decision Support
- Smart First Aid
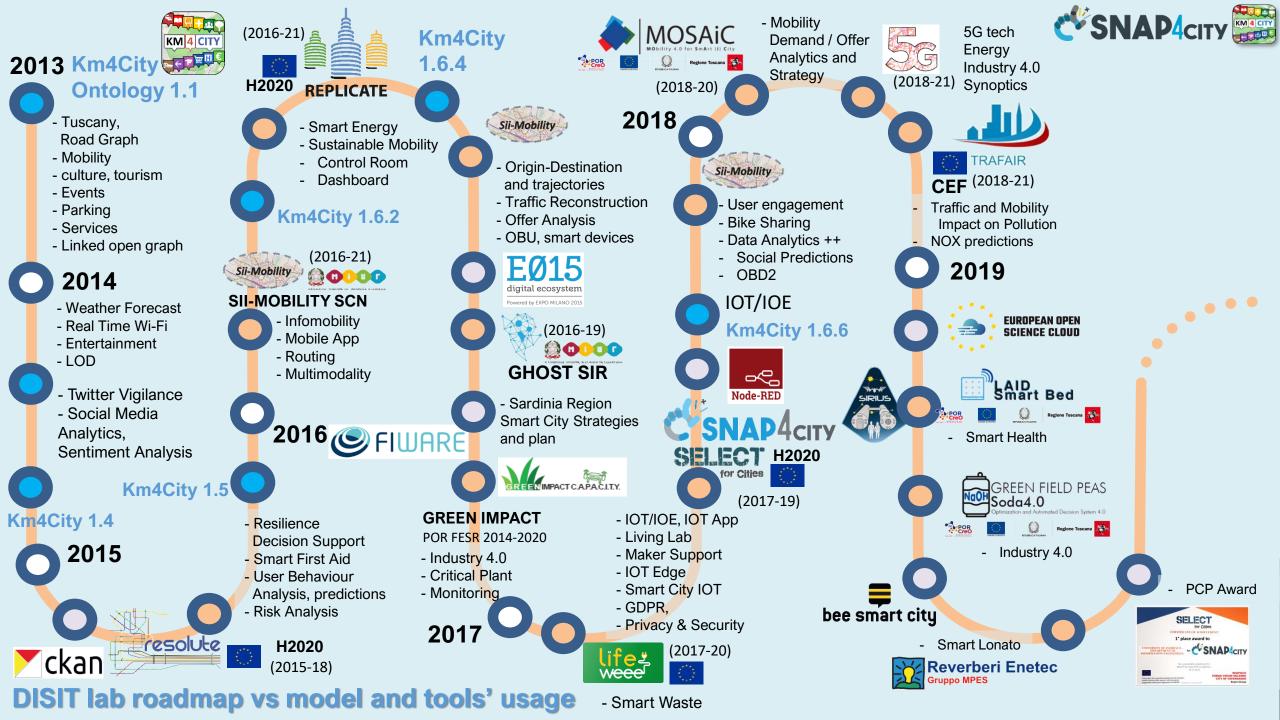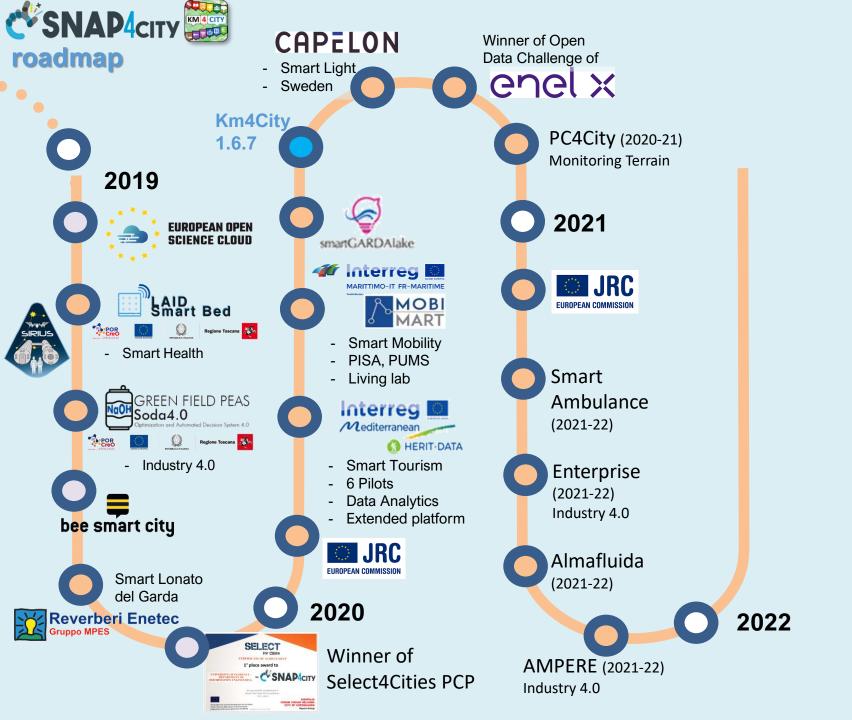- User Behaviour Analysis, predictions
- Risk Analysis

H2020 (2015-18)

ckan
resolute

(2016-21)
H2020 REPLICATE
- Smart Energy
- Sustainable Mobility
- Control Room
- Dashboard

Km4City 1.6.2

(2016-21)
Sii-Mobility MIUR
SII-MOBILITY SCN
- Infomobility
- Mobile App
- Routing
- Multimodality

2016 FIWARE

Km4City 1.6.4
Sii-Mobility
- Origin-Destination and trajectories
- Traffic Reconstruction
- Offer Analysis
- OBU, smart devices

E015 digital ecosystem
Powered by EXPO MILANO 2015

(2016-19) MIUR
GHOST SIR
- Sardinia Region Smart City Strategies and plan

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

GREEN IMPACT
POR FESR 2014-2020
- Industry 4.0
- Critical Plant
- Monitoring

2017

life weee **(2017-20)**
- Smart Waste

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

MOSAiC MObility 4.0 for SmArt (i) City
POR CreO UNIONE EUROPEA REPUBBLICA ITALIANA Regione Toscana
(2018-20)

2018

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

IOT/IOE
Km4City 1.6.6
Node-RED

SNAP4CITY
SELECT for Cities **H2020**
(2017-19)

- Mobility Demand / Offer Analytics and Strategy

5G **(2018-21)**
5G tech Energy Industry 4.0 Synoptics

TRAFAIR CEF (2018-21)
- Traffic and Mobility Impact on Pollution
- NOX predictions

2019

EUROPEAN OPEN SCIENCE CLOUD

LAID Smart Bed
POR CreO UNIONE EUROPEA REPUBBLICA ITALIANA Regione Toscana
- Smart Health

GREEN FIELD PEAS Soda4.0
Optimization and Automated Decision System 4.0
POR CreO UNIONE EUROPEA REPUBBLICA ITALIANA Regione Toscana
- Industry 4.0

SIRIUS

bee smart city
- Smart Lonato
Reverberi Enetec Gruppo MPES

SELECT for Cities
CERTIFICATE OF ACHIEVEMENT
1° place award to SNAP4CITY
- PCP Award

SNAP4CITY KM4CITY

SNAP4CITY roadmap

CAPELON
- Smart Light
- Sweden

Winner of Open Data Challenge of
enel X

Km4City 1.6.7

2019

EUROPEAN OPEN SCIENCE CLOUD

SIRIUS

LAID Smart Bed
POR CreO | UNIONE EUROPEA | REPUBLICA ITALIANA | Regione Toscana
- Smart Health

GREEN FIELD PEAS
Soda4.0
Optimization and Automated Decision System 4.0
POR CreO | UNIONE EUROPEA | REPUBLICA ITALIANA | Regione Toscana
- Industry 4.0

bee smart city

Smart Lonato del Garda

Reverberi Enetec
Gruppo MPES

SELECT for Cities
CERTIFICATE OF ACHIEVEMENT
1° place award to
SNAP4CITY

2020

Winner of Select4Cities PCP

smartGARDAlake

Interreg MARITTIMO-IT FR-MARITIME
MOBI MART
- Smart Mobility
- PISA, PUMS
- Living lab

Interreg Mediterranean
HERIT·DATA
- Smart Tourism
- 6 Pilots
- Data Analytics
- Extended platform

JRC EUROPEAN COMMISSION

PC4City (2020-21)
Monitoring Terrain

2021

JRC EUROPEAN COMMISSION

Smart Ambulance (2021-22)

Enterprise (2021-22)
Industry 4.0

Almafluida (2021-22)

AMPERE (2021-22)
Industry 4.0

2022

Dashboards & Services:

Acknowledgements

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

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