100% OPEN SOURCE

EU GDPR COMPLIANT

PEN Test Passed

Powered by FIWARE

SNAP4CITY on EUROPEAN OPEN SCIENCE CLOUD MARKETPLACE

Node-RED

# SNAP4CITY

KM4CITY

SNAP4 Appliances and Dockers Installations



## Be smart in a SNAP!

LIVING LAB

## Dashboards Creation and Management



July 2022, Course
https://www.snap4city.org/577

SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES

UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DEPARTMENT OF INFORMATION ENGINEERING | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

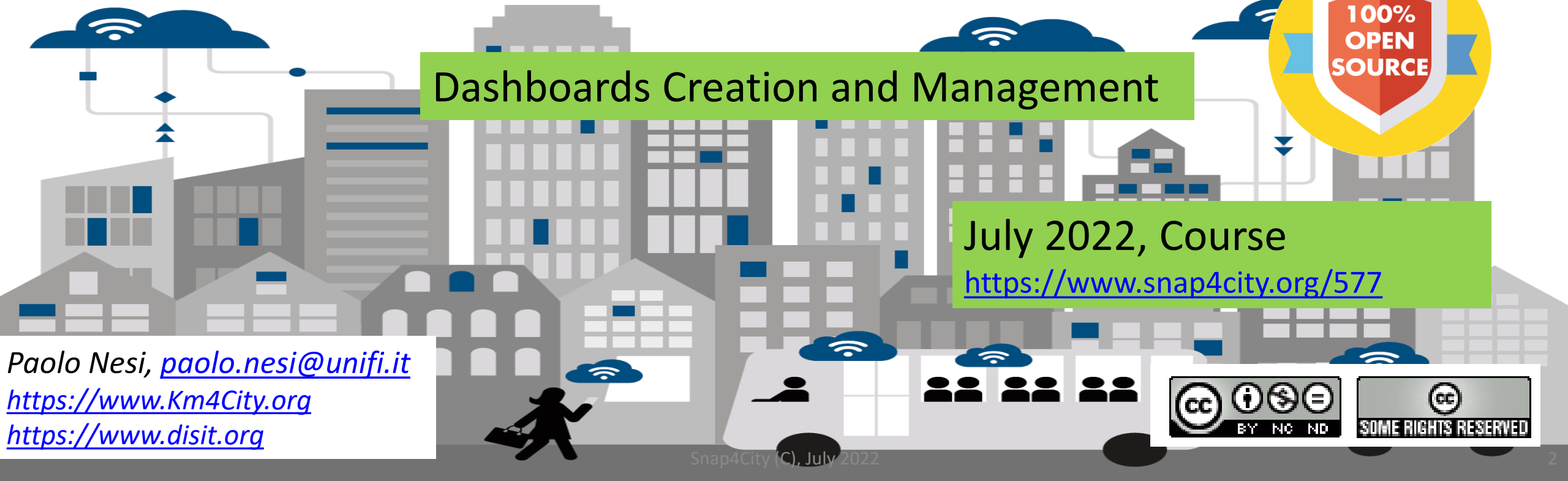
UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

SNAP4CITY

Powered by KM4CITY

# scalable Smart aNalytic APplication builder for sentient Cities: for Living Lab and co-working with Stakeholders

## https://www.Snap4City.org



Dashboards Creation and Management

100% OPEN SOURCE

July 2022, Course
https://www.snap4city.org/577

*Paolo Nesi, paolo.nesi@unifi.it*
https://www.Km4City.org
https://www.disit.org

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

www.snap4city.org

100% OPEN SOURCE

Powered by FIWARE

FREE TRIAL

PEN Test Passed

EU GDPR COMPLIANT

SNAP4 Appliances and Dockers Installations

EUROPEAN OPEN SCIENCE CLOUD

Node-RED

JS Foundation

E015 digital ecosystem

NVIDIA

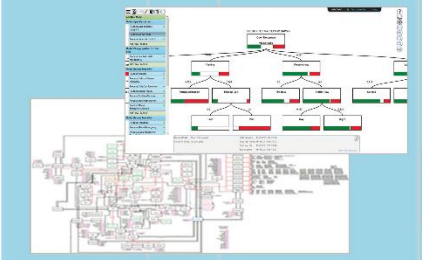




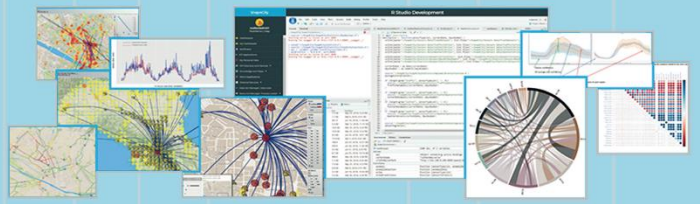


DASHBOARDS AND APPS - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - VISUAL ANALYTICS

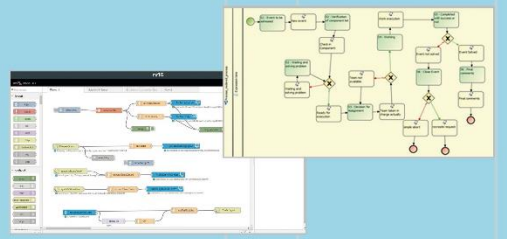
PREDICTION - ANOMALY DETECTION - ENVIRONMENTAL MODEL - 3D MODEL
KPI - SIMULATION - EARLY WARNING - SYNOPTIC - DIGITAL TWIN - VIRTUAL REALITY



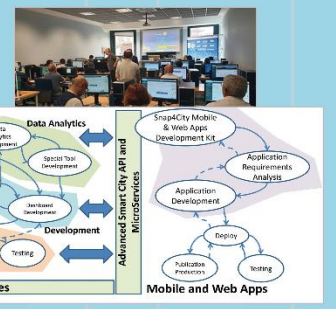
EXPERT SYSTEM
KNOWLEDGE BASE
STORAGE



BIG DATA ANALYTICS
EXPLAINABLE ARTIFICIAL INTELLIGENCE
BUSINESS INTELLIGENCE
MACHINE LEARNING



DATA FLOWS, DATA DRIVEN
WORKFLOWS, MICROSERVICES
PARALLEL DISTRIBUTED PROCESSING




METHODOLOGIES
LIVING LABS
COURSES AND COMMUNITY
DEVELOPMENT TOOLS



# Snap4City/Industry structure

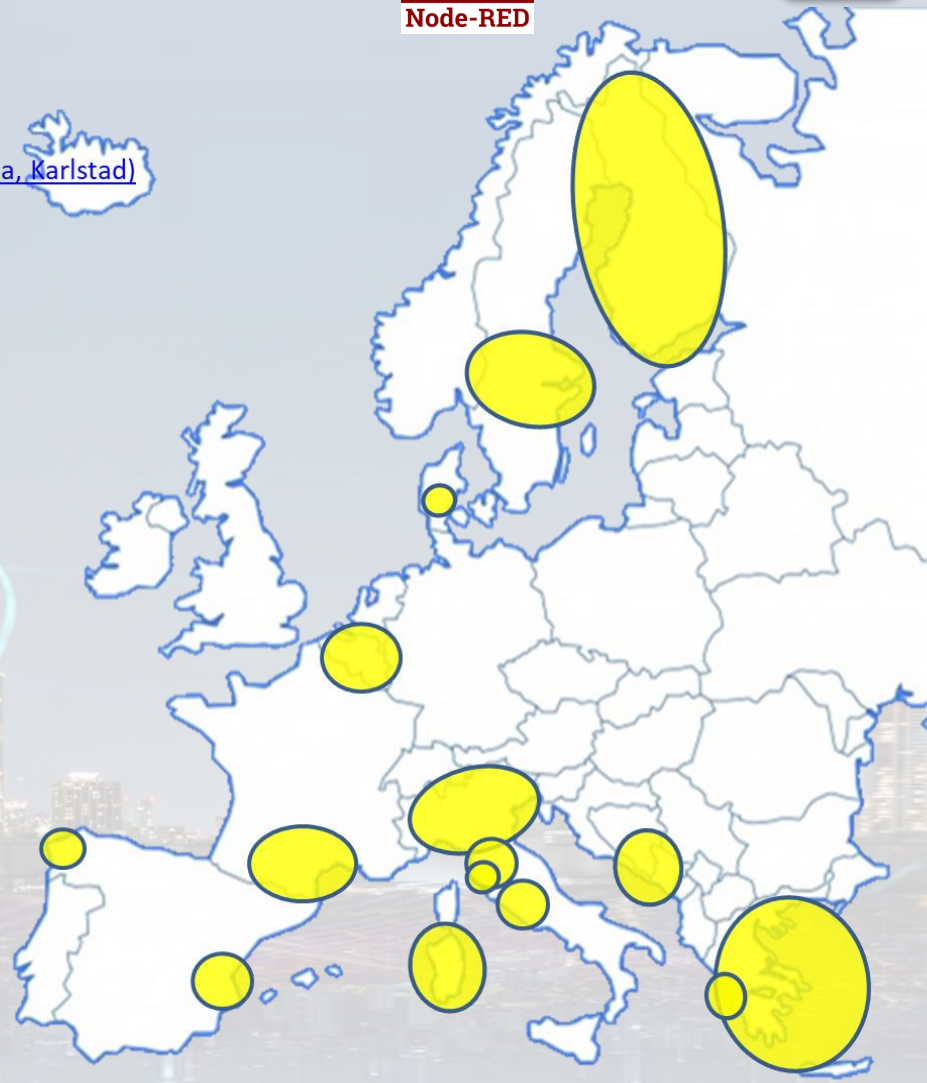
- The **Snap4xxxx** solution is released in Open Source, VM and Docker with fully support of MultiTenant/multiple-Organizations
  - Each Organization may be configured for a separate environment with a set of Maps, Menus, Users, Data, Dashboards, IOT Apps, MicroApplications, Custom Widgets, Models, resources, open data, 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, GitHUB, 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* as well as *Industry 4.0 as a Service*

# https://www.Snap4City.org

- > 7 running installations
  - Toscana, Pisa, Sweden, ISPRA, Snap4.eu,
  - Altair, Italmatic, ….
- 13 projects, 12 pilots on 10 Countries
  - >40 cities/area
- **Wide MULTItenant deploy, e.g.,**
  - 18 Organizations / tenant
  - > 7400 users on
  - > 1400 Dashboards
  - > 16 mobile Apps
  - **> 2 Million of structured data per day**
  - > 520 IoT Applications/node-RED
  - > 700 web pages with training
  - > 60 videos, training videos

**Main Organizations/areas**

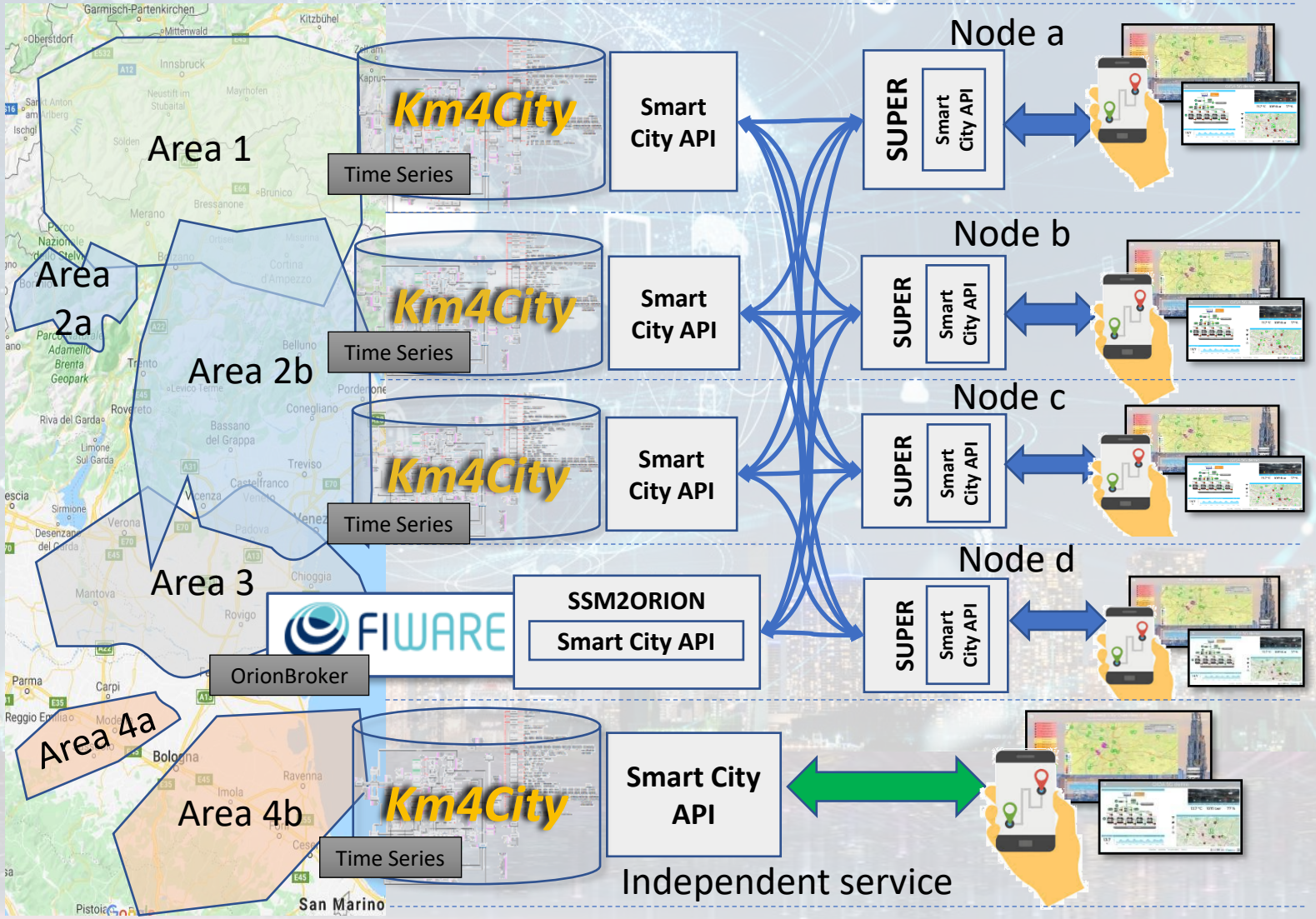
- Antwerp area (Be)
- Bologna (I)
- Capelon (Sweden: Västerås, Eskilstuna, Karlstad)
- DISIT demo (multiple)
- Dubrovnik, Croatia
- Firenze area (I)
- Garda Lake area (I)
- Greece (Gr)
- Helsinki area (Fin)
- Livorno area (I)
- Lonato del Garda (I)
- Modena (I)
- Mostar, Bosnia-Herzegovina
- Oslo & Padova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



- **Trials in Israel, Brasile, Australia, India, etc……**

# Federation of Smart City Services

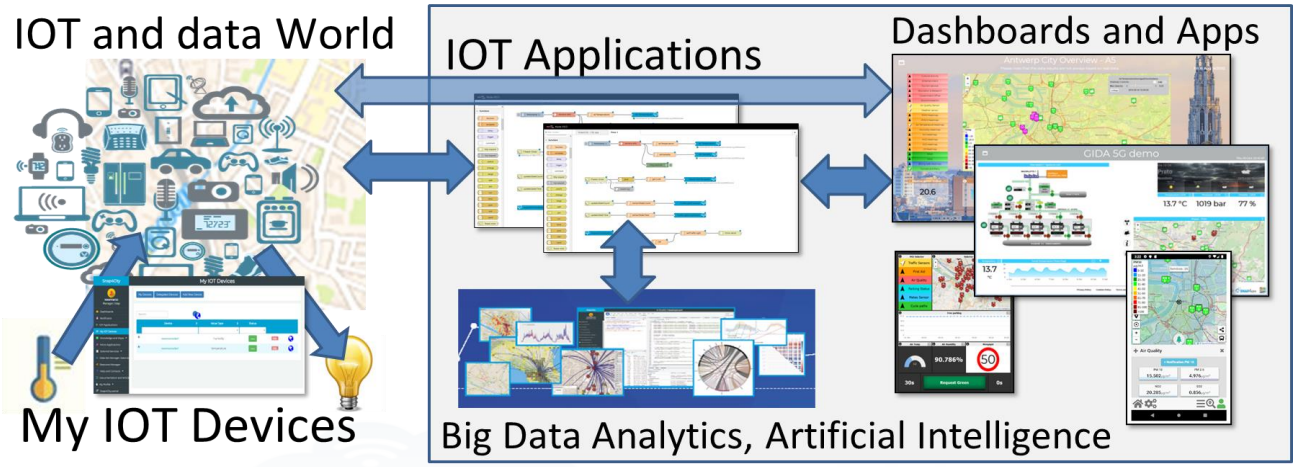
**Knowledge Base**
Semantic Reasoners




- Km4City **Semantic Reasoner**
- **ServiceMap** interoperability
- **Seamless for multiple Mobile Apps**
- **Smart City API**
- **Super**:
  - distributed access and sharing services
  - Each city control its own data
  - Final user can pass from one city / area to another in seamless manner: without changing the mobile Apps

# Free Trial

- Register on [WWW.snap4city.org](http://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)

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

# General Overview of the full Course 2021

- ***1st part:*** *General Overview*
- ***2nd part:*** *Dashboards Creation and Management*
- ***3rd part:*** *IOT Applications development, IOT Devices, IOT Networks*
- ***4th part:*** *Data Analytics, in R Studio, in Python, how to Exploit and Manage Data Analytics in IOT Applications*
- ***5th part:*** *Data Ingestion, Data Warehouse, Data Gate, IOT Device Data ingestion, IOT App for Data Ingestion, Interoperability, etc.*
- ***6th part:*** *Snap4City Development, Extension, Administration, and Installation*
- ***7th part****: Smart city API (internal and external) Web and Mobile App development tool kit*

*A number of the training sections include exercitations*

*Updated versions on: https://www.snap4city.org/577*

See also courses in ITALIANO: https://www.snap4city.org/485

# 2nd part Agenda

GO
- **Recall on Snap4City Architecture**
  - Dashboard builder vs Kibana/Grafana

GO
- **Dashboard Usage and Authoring**
  - Dashboard usage vs Widgets, Multi Data Map Widget, Data Kinds vs Graphic Widgets,
  - Special Widgets vs Special Data, Dashboard Menus of Organizations

GO
- **External Services (integration of) your of third party web pages**
  - external service widget and family, Custom Widgets are seen as External Services, Event Driven Custom Widgets, dynamic widgets

GO
- **GIS Data Import, Export and Exploitation**

GO
- **Unified Data Model (for All) and Data Inspection (for Admin)**
  - Data Inspector vs Data Processes Details (for Admin), Digital Twin

GO
- **Dashboard Creation by Wizard & Exercitation**
  - Dashboard Creation, Exercitation, Mechanisms of Selector for the Multi Data Map widget

GO
- **Dashboard Business Logic Via IOT Applications USAGE AND AUTHORING**
  - IOT App Business Intelligence for Dashboards, Web and Mobile Apps
  - Widgets Interacting with IOT Apps virtual Sensors and Actuators
  - Dynamic Widgets data on Dashboard from IOT Applications
  - Synoptics and Custom Widgets Creation

GO
- **Flexible What-If Capabilities as Decision Support System**

GO
- **Dashboard Event Management**
  - Private Dashboard ChatRoom, Notifications from Dashboard and from any Data Condition

GO
- **Dashboard other Features**
  - Dashboard Embedding into third party Web Sites/pages, controlling header and footer, etc.

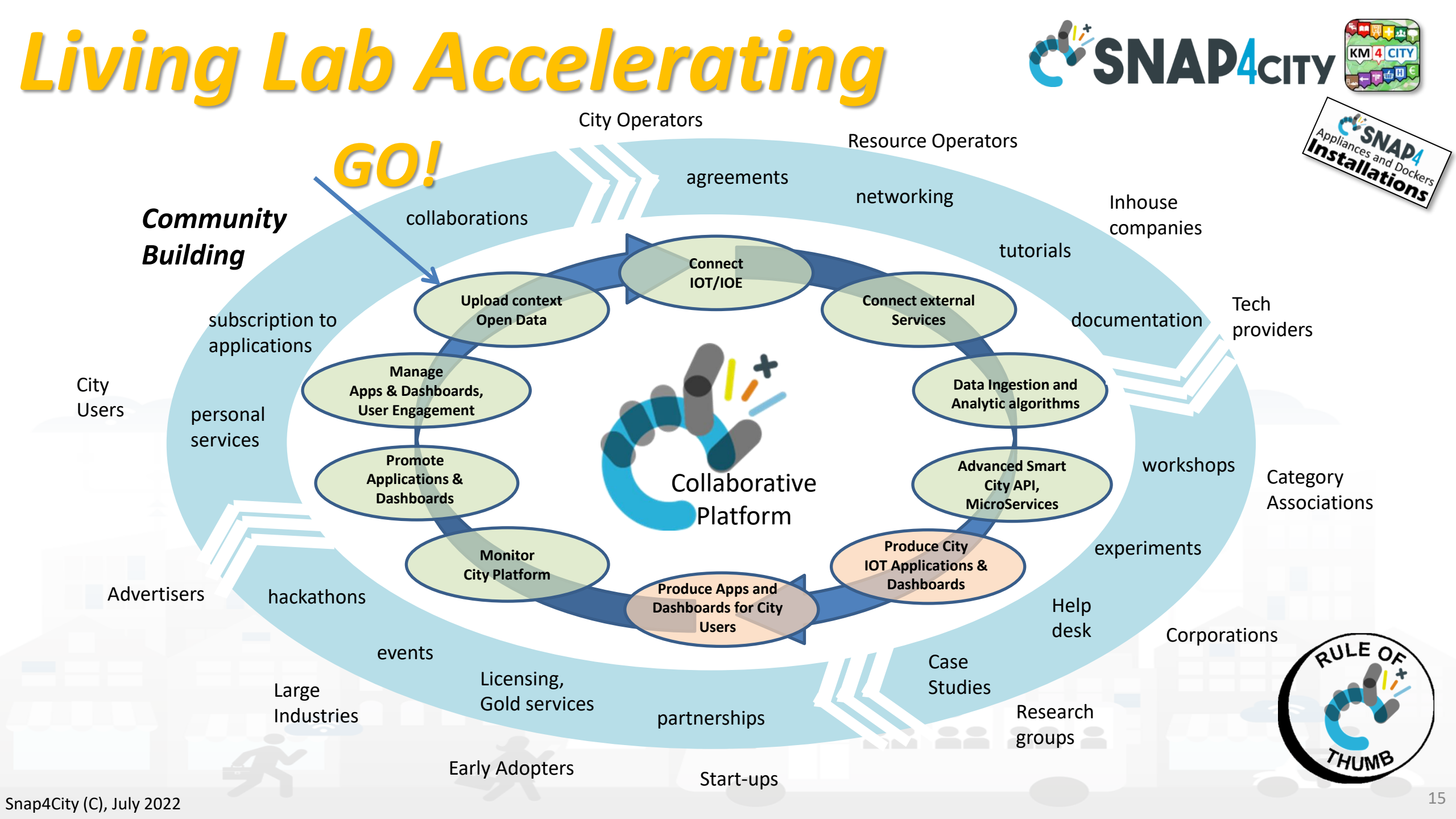
GO
- **Dashboards Listing, Managing, Sharing, Delegation**
  - Dashboard Listing, Managing, Sharing, Delegation

GO
- **Data Type Management GDPR Compliant**
  - Dashboards GDPR Management, Personal Data Management GDPR Compliant: POI, Data, KPI

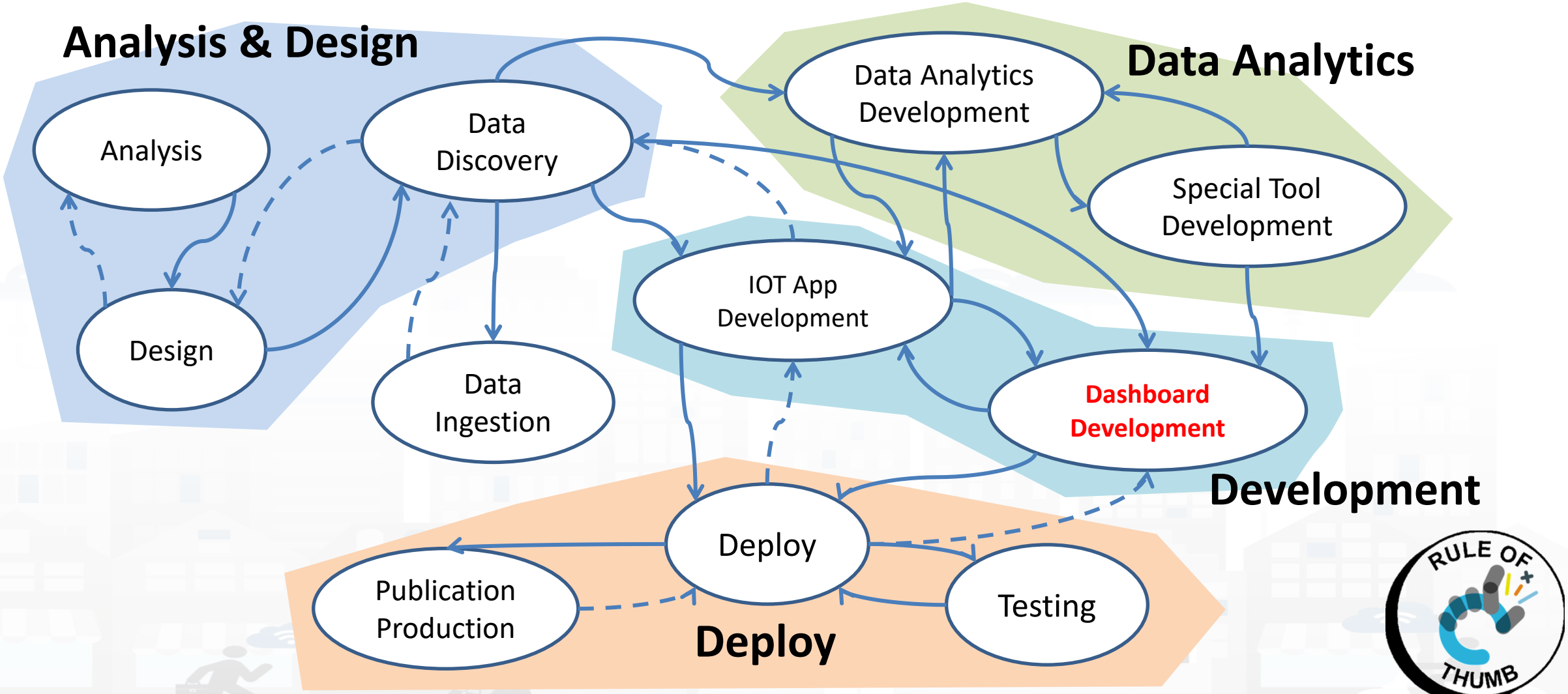
GO
- **DevDash: My Data Dashboard based on Kibana**

GO
- **Acknowledgments**

# Living Lab Accelerating



# Development Life Cycle Smart City Services



TOP

# Recall on Snap4City Architecture



# URBAN PLATFORM: SMART CITY IOT AS A SERVICE AND ON PREMISE

100% OPEN SOURCE

**APPLIANCES CONTAINERS**




- LOCAL GOVERN
- STAKEHOLDERS
- CITY USERS
- IN-HOUSE
- ENERGY OPERATORS
- MOBILITY OPERATORS
- COMMERCIAL OPERATORS
- SECURITY OPERATORS
- INDUSTRIES
- RESEARCHERS
- START-UPS
- ASSOCIATIONS

- GDPR
- SECURITY
- PRIVACY
- ASSESSMENT
- AUDITING
- PENTESTED

- OPEN IOT DEVICES
- IOT EDGE
- IOT GATEWAY
- PAX COUNTERS
- IOT BUTTONS

- TEST CASES, SCENARIOUS, VIDEOS, HACKATHONS
- OPEN SOURCES, COMMUNITY OF CITIES
- TRAINING TUTORIALS, COMMUNITY MANAGEMENT

## IOT APPLICATIONS - INSTANT APPS



DATA DRIVEN APPLICATIONS • REAL TIME PROCESSING • BATCH PROCESSING • ANY PROTOCOL & FORMAT

## DASHBOARDS & APPLICATIONS



CONTROL ROOM • SITUATION ROOM • OPERATOR DASHBORDS • BUSINESS INTELLIGENCE • WHAT-IF ANALYSIS • DECISION SUPPORT • SIMULATIONS • RISK ANALYSIS • RESILIENCE ANALYSIS

## MOBILE & WEB APPLICATIONS



DEVELOPMENT KIT • SUGGESTIONS • MOBILE APPS • MONITORING PANELS • PLATFORM UTILITIES • READY TO USE SMART APPLICATIONS

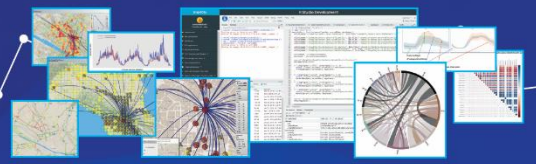
## MICROSERVICES & ADVANCED SMART CITY API

## LIVING LAB - DEV TOOLS - COWORKING

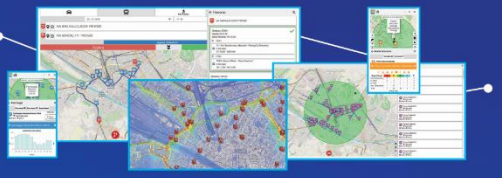


IOT DIRECTORY • SERVICE MAP • RESOURCE MANAGER • DATA GATE • R STUDIO • ETL

## BIG DATA - DATA ANALYTICS



## DATA ANALYTICS TOOLS - MICRO-APPLICATIONS



PREDICTIONS • ANOMALY DETECTION • WHAT-IF ANALYSIS • TRAFFIC FLOW RECONSTRUCTION • ORIGIN-DESTINATION MATRICES • SOCIAL MEDIA ANALYSIS • OFFER VS DEMAND ANALYSIS • ENVIRONMENTAL DATA ANALYSIS AND PREDICTIONS • REAL TIME HEATMAPS • ROUTING • ALERTING • EARLY WARNING • PERSONAL AND VIRTUAL ASSISSTANTS • SMART SOLUTIONS • SMART SHARING • PARTECIPATORY

## KM4CITY DATA AGGREGAT KNOWLEDGE BASE - EXPERT SYSTEM OF THE CITY – BIG DATA STORE

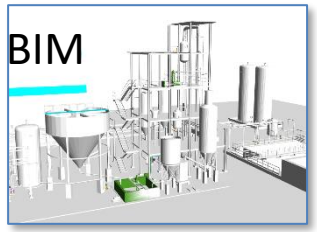
## IOT MNG - DATA MNG - DATA INSPECTOR – PROCESS MNG – USER ENGAGEMENT – GDPR MNG ...

| GIS | CITY UTILITIES | OPEN DATA | LEGACY & EXTERNAL SERVICES | PERSONAL DATA | IOT / IOE | BROKERS | KPI | INDUSTRY 4.0 | SOCIAL MEDIA |
|---|---|---|---|---|---|---|---|---|---|



# Concept

BIM

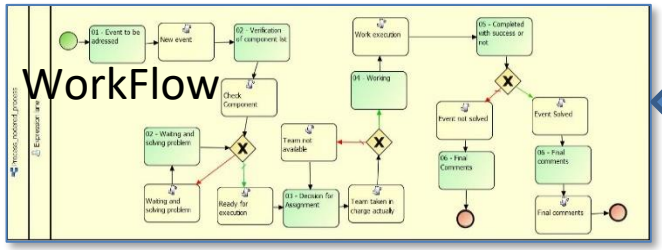


KPI, POI, MyKPI, …

API, External Services

Web Scraping

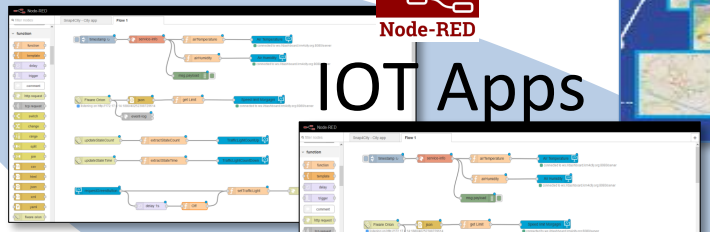
WorkFlow

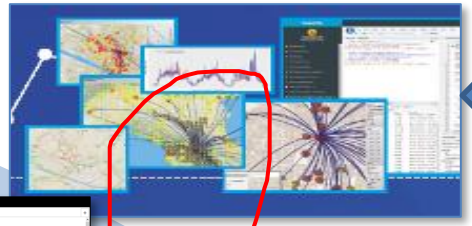




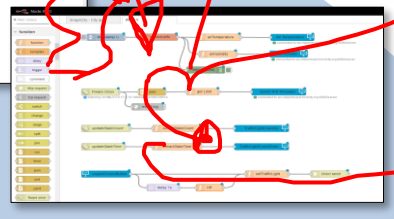
Node-RED

IOT Apps





Data Analytics,
Artificial Intelligence





IOT Brokers

IOT Broker

IOT Broker



FIWARE



GIS

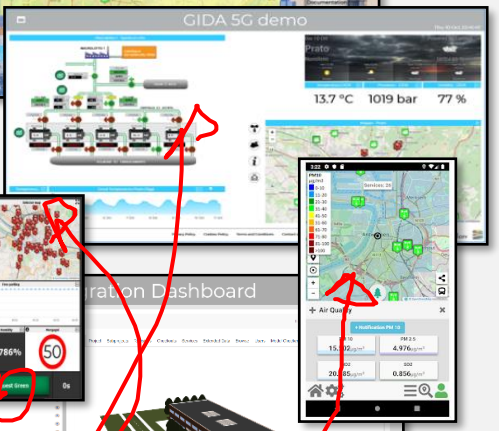
Big Data

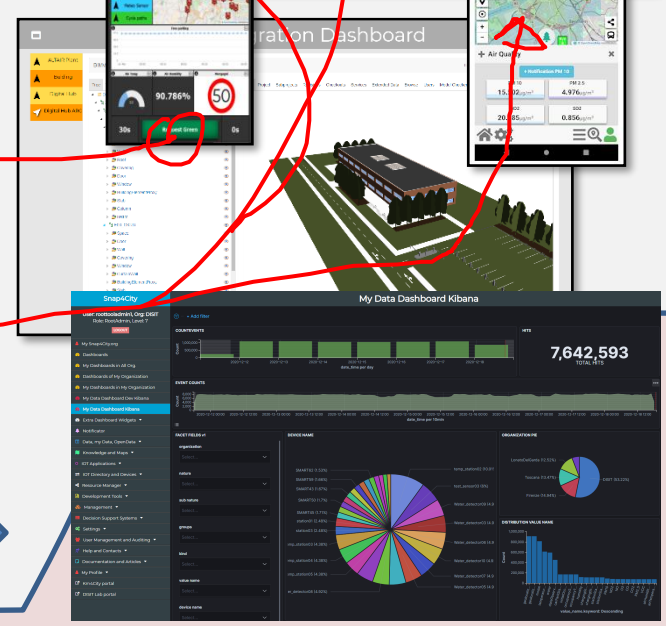
KB

LD, LOD

ckan







Dashboards and Apps

FI-WARE

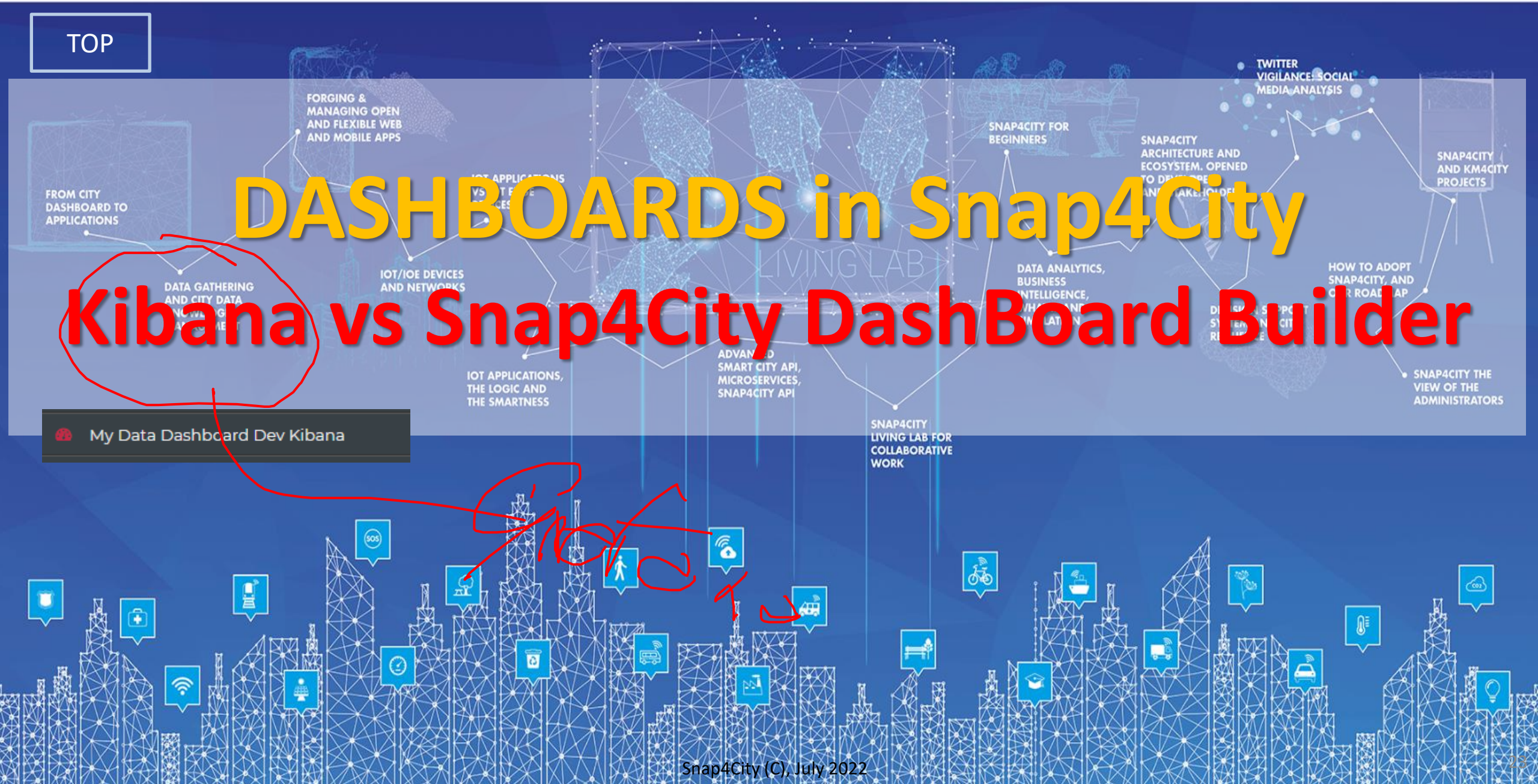
# The usage of IOT Applications

- IOT Applications = Node-RED + Snap4City Libraries
- Used for:
  - **Data Ingestion, Transformation, Extract, Load, and Adaptation** (format and protocol), See Part 5 of the Course
  - **IOT Edge Devices logic**, for implementing logic on IOT Edge, including **IOT Device control** (see on Part 3 of the course)
  - **Business Logic** control of Dashboards, via Web Sockets secure
    - see Part 2 of the Course (this part)
  - **Control and schedule of Data Analytic**, and Machine Learning (see part 4 of the Course)
  - **Firing and condition identification and alerting**.

TOP

# DASHBOARDS in Snap4City

# Kibana vs Snap4City DashBoard Builder



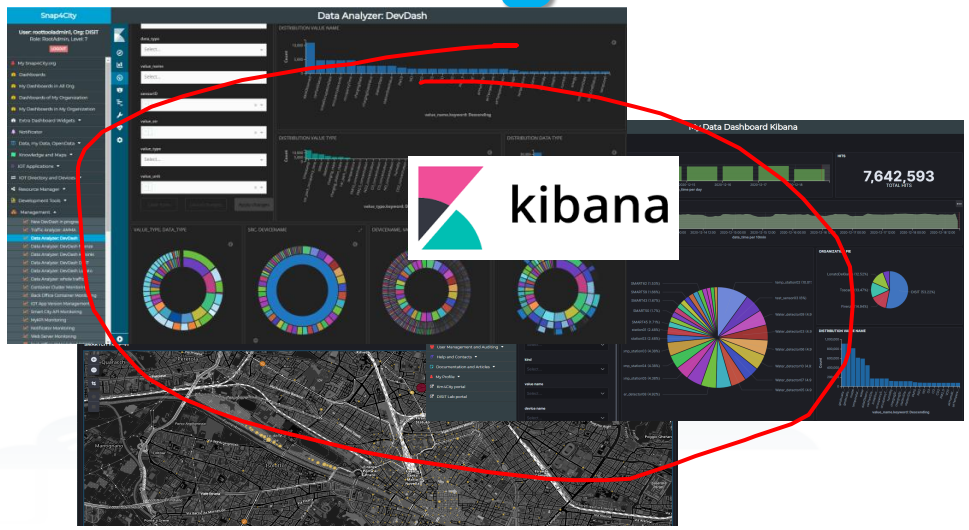
# Two Main Lines for Dashboarding

- **Kibana (DevDash, My Dashboard (Dev) Kibana )**

Ready to use

You can customize

Limited details




- **Dashboard Builder of Snap4City**

You need to create / customize

Full Control

Professional details



# My Dashboard (Dev) Kibana

- also called DevDash, AMMA, also accessible as Grafana
- For accessing and browsing data on OpenDistro (Elastic Search) storage and other sources supported
- **No Support for real time event driven** widgets/panels, actuators and synoptics, no sophisticated maps, etc.
- **Not suitable for control room**, decision makers, etc.
- **Not integrated with IoT App**, Custom widgets, animation, external services.
- **Oriented to developers**, complex production of custom views, etc.
- **Partial support of GDPR** and deep control of access.

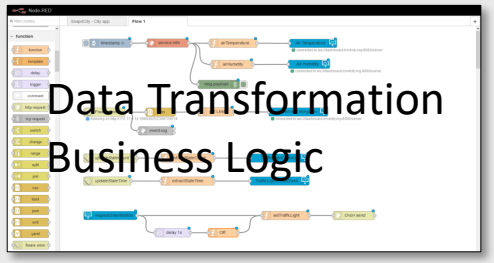


# Dashboard Builder of Snap4City

- For accessing and browsing data on: OpenDistro (ElasticSearch), Mongo, MySQL, Smart City API, Super and thus from federated Smart City API, etc.
- **Supports sensors/actuators**: data driven data, maps in extended manner, data driven widgets, large collection of widgets, direct IoT Connections, custom widgets, animated PIN on maps, a large set of panel/widgets, etc.
- **Very simple to be used for control room**, decision makers, situation rooms, operators, etc.
- **Very well integrated with IoT App**, Custom widgets, animation, external services.
- **Very simple to be customized** for non programmers since all the tools are visual.
- **Support for GDPR** and deep control of access.
- Can integrate Kibana/Grafana Views into a Widget



# Dashboard Builder: Development



Data Transformation
Business Logic

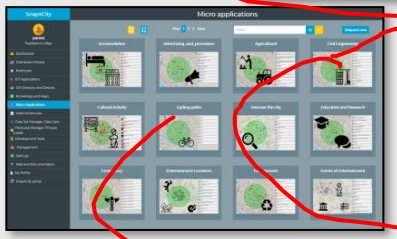
IOT Applications



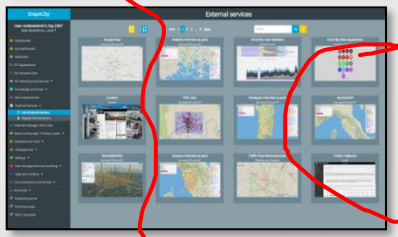

Knowledge and Storage
Data from the Field and
City + MyKPI ++

Widget Collection

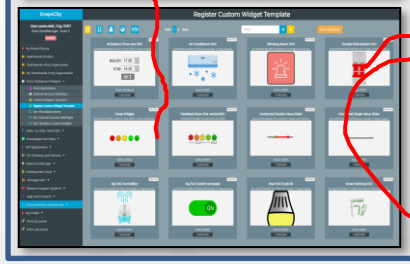




Micro
Applicat
ions

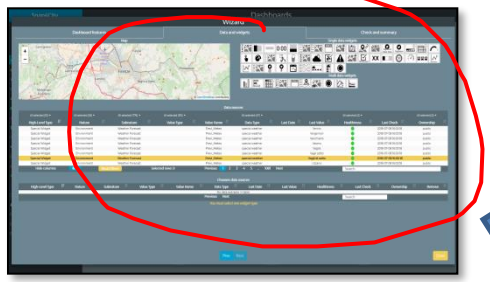


External
Services



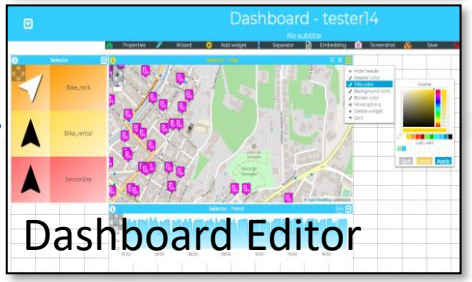
Custom
Widgets/
Synoptics

Dashboard Wizard



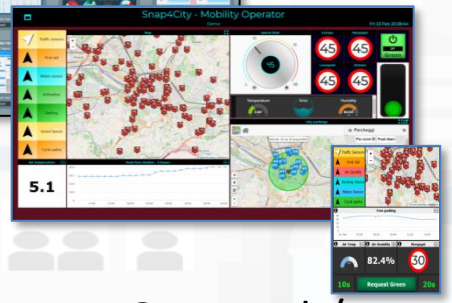
Create, save, load,
delegate, grant access,
change ownership






Dashboard Editor






Public
Dashboard
Collection

My Own Dash/App

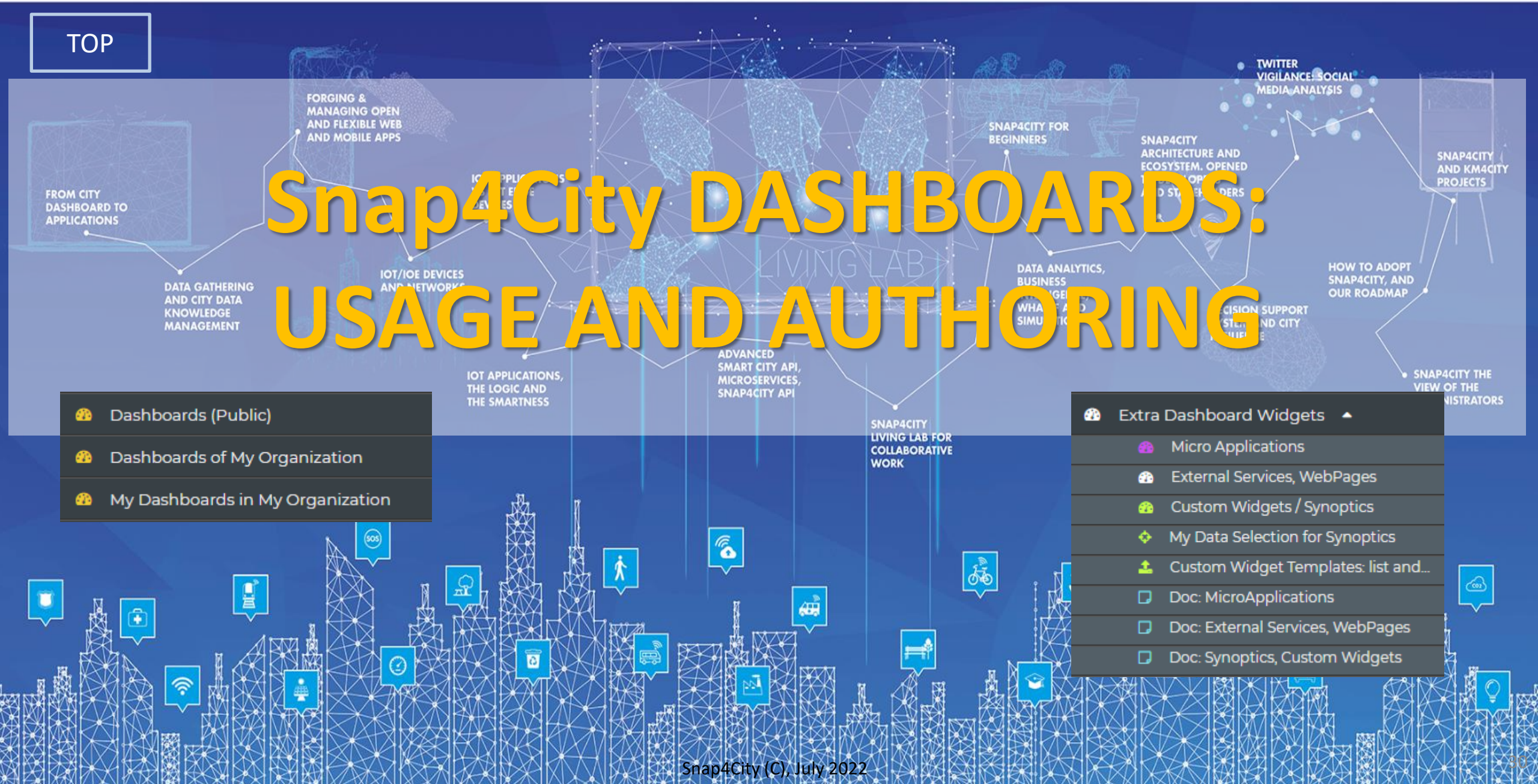


# Snap4City Dashboard Builder vs Kibana

| Features | Snap4City Dashboard Builder | Kibana, Grafana |
|---|---|---|
| Large Collection of Widgets | YES | Nothing |
| Custom Widgets SVG of any kind, full defined process for customization | YES | Nothing |
| Real time event driven widgets and data | YES | Nothing |
| Business Logic for data transformation with visual programming: Node-RED | YES: visual/coding | coding |
| Maps with custom PIN, bubbles, animated and moving, etc. | YES | Nothing |
| Maps with paths, shapes, traffic flow, scenarios, routing, heatmaps, what-if, … | YES | Nothing |
| Maps with Orthomaps from WFS, WMS, GIS connection, etc. | YES | Nothing |
| TV camera integration and selection | YES | Nothing |
| Widgets for business logic integration on real time: buttons, selector, switch, etc. | YES | Nothing |
| Kiviat, Spider net, Calendar | YES | Nothing |
| Typical Time Trends: day hours, month week, month days, ….. | YES | Nothing |
| Time Trend Compare: day, eek, month, year | YES | Nothing |
| Selectors/Menus: text, icons, etc., also in connection with IOT APP, Node-RED | YES | Nothing |
| Full control of graphic layout, font, colours, refresh per widget, etc. | YES | Nothing |
| Iframe integration of third party widgets and web pages, nesting dashboards, embedding Kibana | YES | Nothing |
| Connection among multiple Dashboards and Widgets | YES | Nothing |
| Synchronization with Video Wall, and Operators Views | YES | Nothing |
| Multiseries, bar lines, charts, pie, donut, simple selectors, trends, etc., also from business logic | YES | Limited |
| Single content, string, html, any data, etc. | YES | Limited |
| Special widgets: Weather forecast, civil protection, road plates, Twitter, etc… | YES | Nothing |
| Digital Twin Local and Global | YES | Nothing |
| Faceted search | YES: selectors, forms, buttons | YES |

TOP

# Snap4City DASHBOARDS: USAGE AND AUTHORING



# Public Dashboards (see them on the Portal)

Snap4City

LOGIN

- Dashboards (Public)
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager
- Development Tools
- Management
- Help and Contacts
- Documentation and Articles
- Km4City portal
- DISIT Lab portal

## Dashboards (Public by (ORG))

Prev 1 ... 12 13 14 15 16 ... 20 Next

Filter by dashboard title

**ServiceMap for data comparison**
Passive


Public (DISIT)

**Servizi agli utenti**
Passive


Public (DISIT)

**Smart City Control Room Console**
Passive


Public (DISIT)

**Smart City Control Room Console - new**
Passive

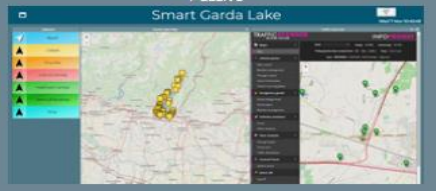

Public (DISIT)

**Smart City Data Overview**
Passive


Public (DISIT)

**Smart City Data Overview 2**
Passive


Public (DISIT)

**Smart Garda Lake**
Passive


Public (DISIT)

**SmartCity processes**
Passive

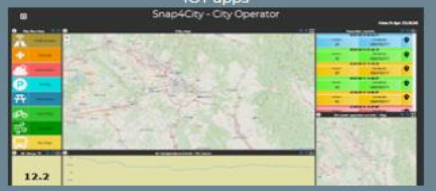

Public (DISIT)

**Snap4City - App dashboard**
IOT apps

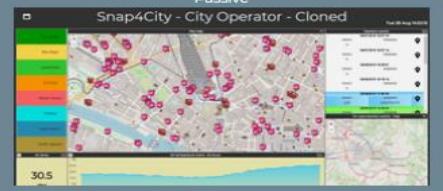

Public (DISIT)

**Snap4City - Buttons with images**
Passive


Public (DISIT)

**Snap4City - City Operator**
IOT apps


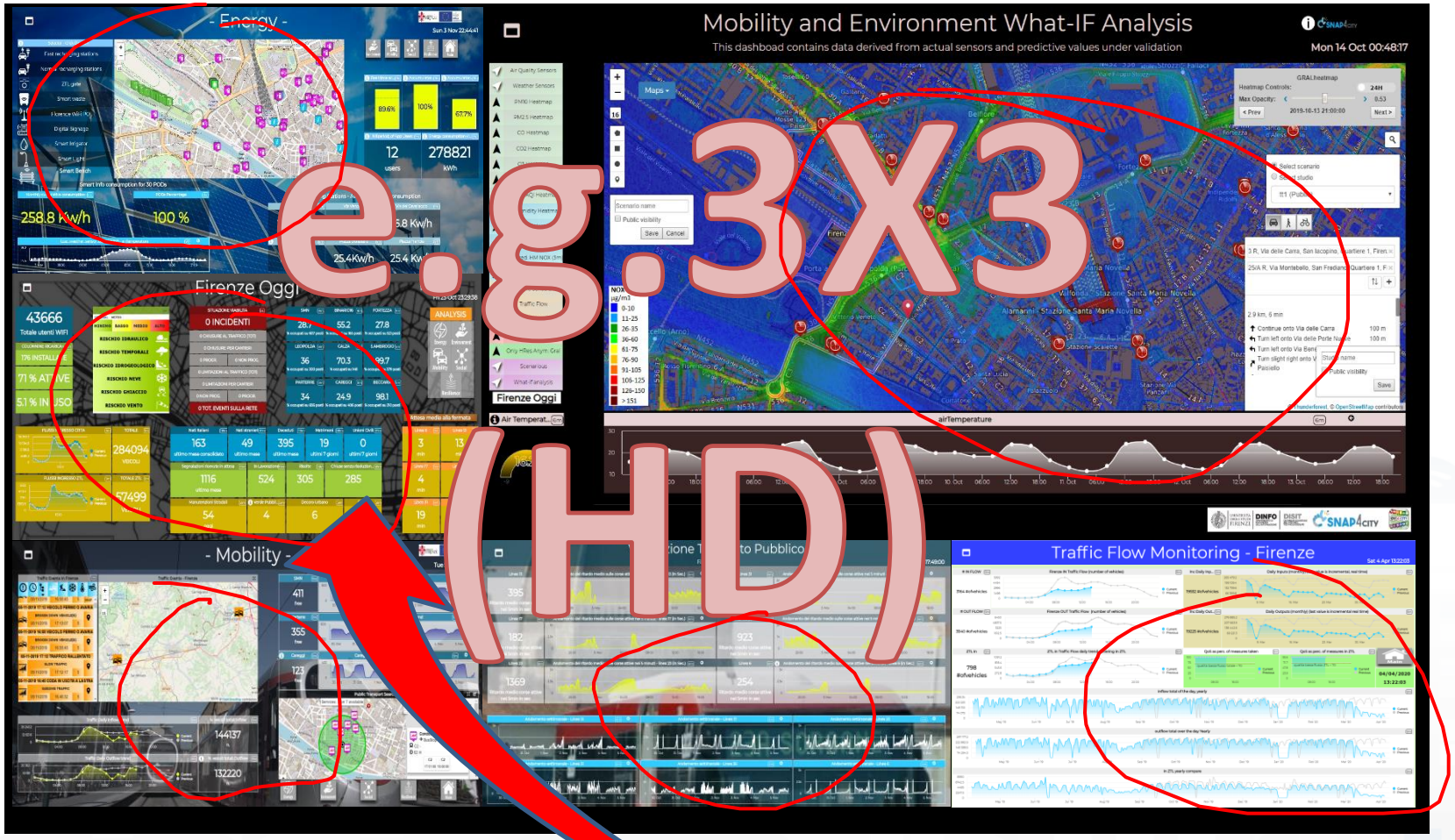
Public (DISIT)

**Snap4City - City Operator - Cloned**
Passive


Public (DISIT)

# DEMO Section

# Video Wall









From Consolle Operator to the Video Wall

# Control Room







https://www.snap4city.org/621



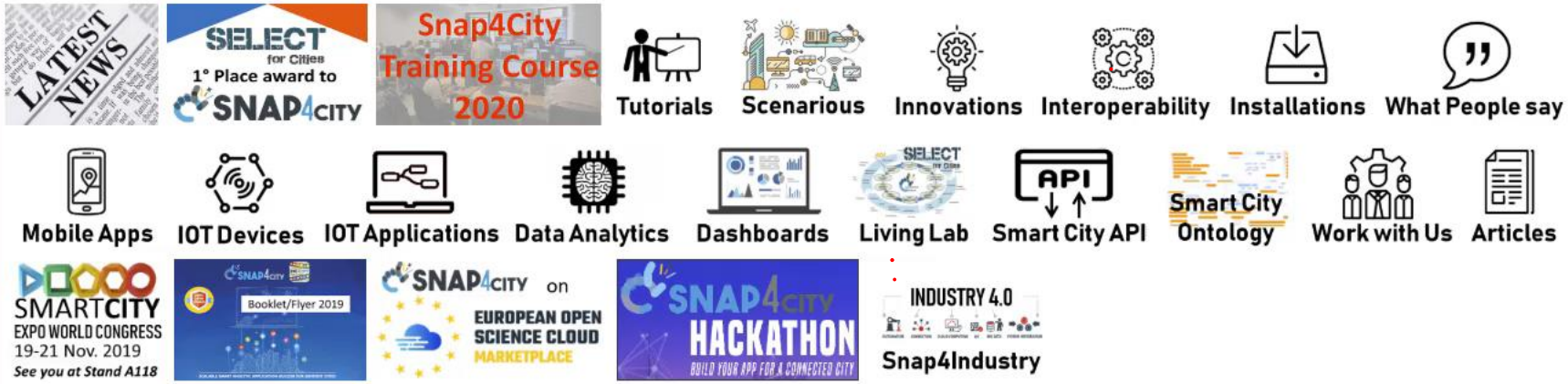

https://www.snap4city.org/511


MAPPA FIRENZE
Fri 19 Oct 17:24:39
Colonnine Ricarica
Colonnine ricarica Fast
Pannelli a Messaggio Variabile
Parcheggi
Piste Ciclabili
Sensori del Traffico
Stazioni ambientali
Stazioni meteo
Traffico Real Time
Varchi ZTL
Wi-Fi
Eventi Traffico a Firenze
Concentration - 7 days
Main





# Snap4City - scalable Smart aNalytic APplication builder for sentient Cities




Smart Cities need to set up a flexible Living Lab to cope with the city evolution in terms of services and city users' needs and sustainability. Snap4City solution (https://www.snap4city.org) provides a flexible method and solution to quickly create a large range of smart city applications exploiting heterogeneous data and enabling services for stakeholders by IOT/IOE, data analytics and big data technologies. Snap4City applications may exploit multiple paradigms as data driven, stream and batch processing, putting co-creation tools in the hands of: (i) Smart Living Lab users and developers a plethora of solutions to develop applications without vendor lock-in nor technology lock-in, (ii) final users customizable / flexible mobile Apps and tools, (iii) city operators and decision makers specialized / sophisticated city dashboards and IOT/IOE applications for city status monitoring, control and decision support. Snap4City satisfies all the expected requirements of Select4Cities challenge PCP and much more, and it is 100% open source, scalable, robust, respects user needs and privacy; provides MicroServices and easily replaceable tools; compliant with GDPR; provides a set of tools for knowledge and living lab management, and it is compliant with more than 60 protocols including end-to-end encrypted communication. Snap4City is an official platform of FiWare, an official library of JS Foundation Node-RED, registered on E015, present on EOSC marketplace, and BeeSmartCity MarketPlace, etc. Snap4City obtained the 1st place award by Select4Cities partners and PCP (Antwerp, Copenhagen and Helsinki).

# Data vs Visual Representation, Visual Analytics



# Snap4City: Builder of Sentient Cities Solutions

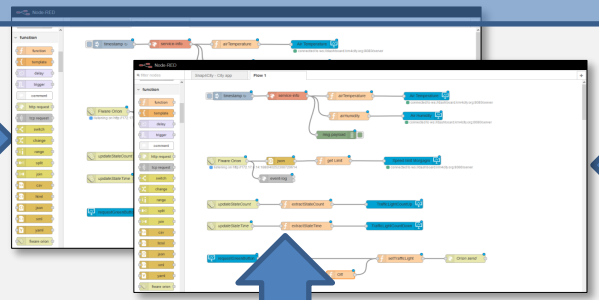
Dashboards with data driven IOT Applications enforcing intelligence

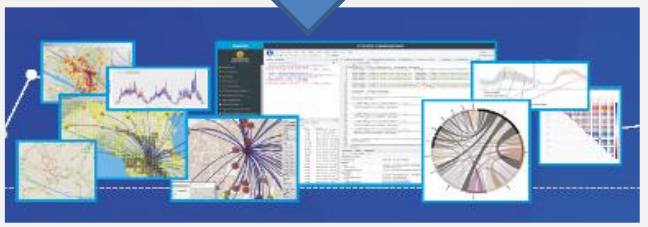
IOT and data World



Data Channels

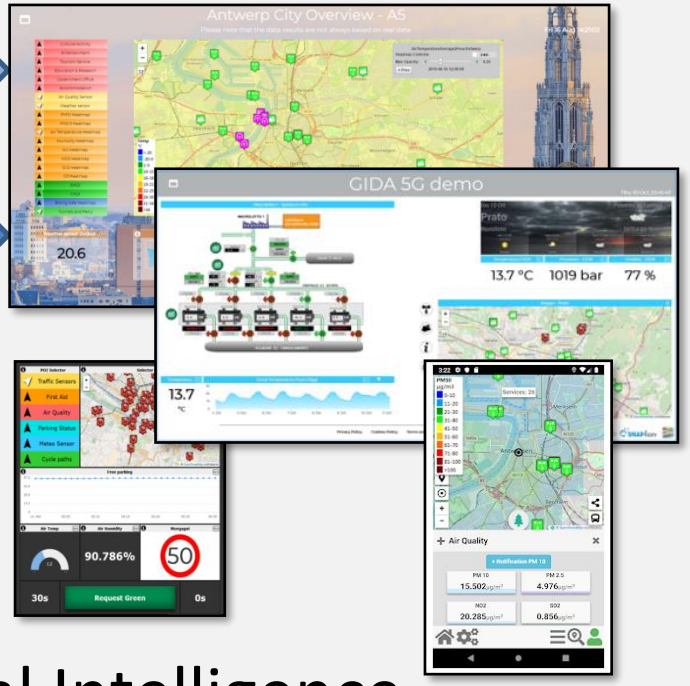
IOT Applications





Big Data Analytics, Artificial Intelligence

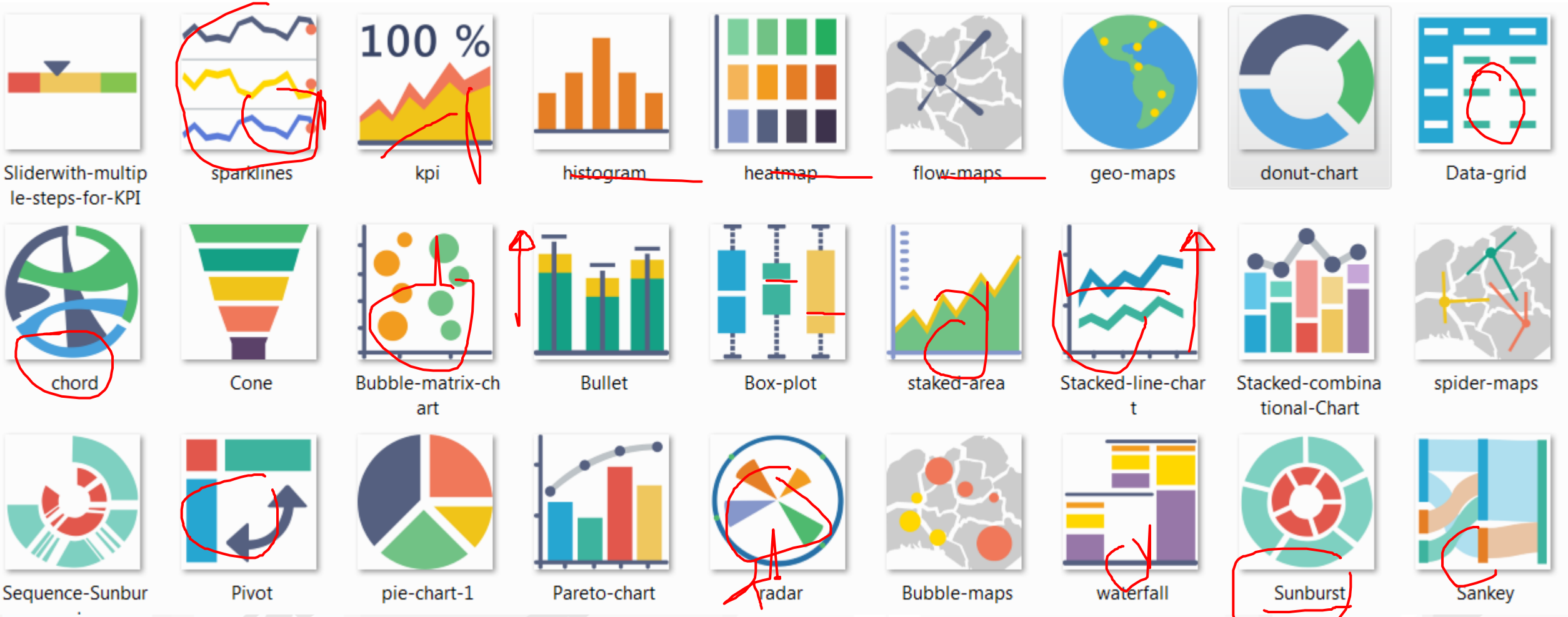
Dashboards and Apps

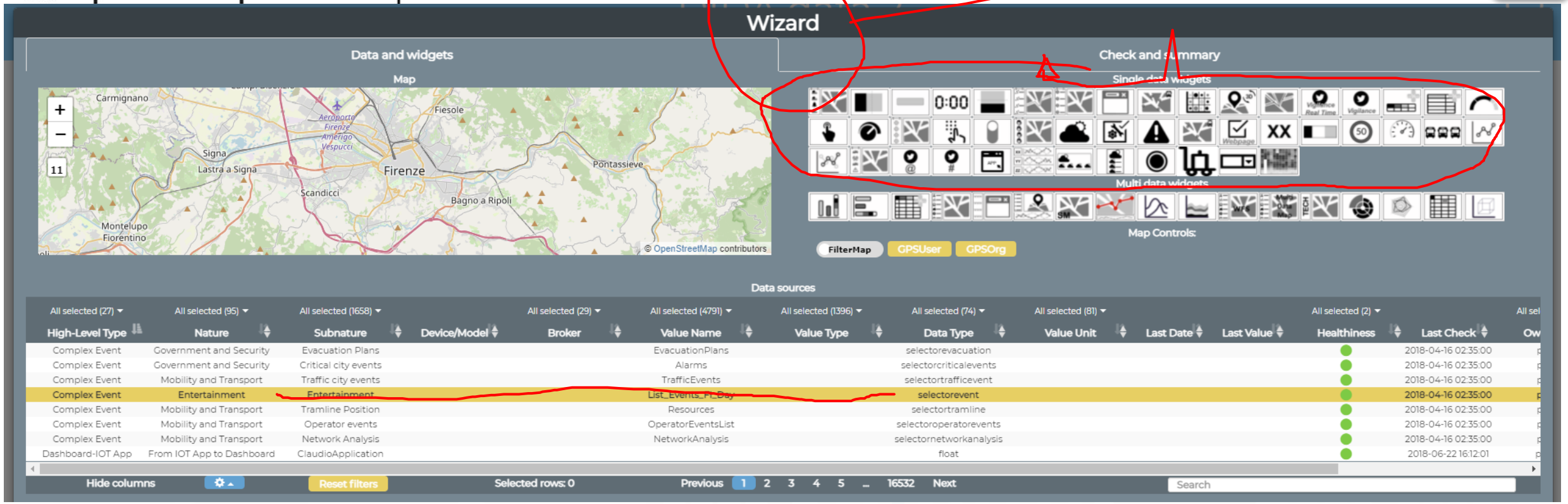


# From Data to Visualization



# Visual Representations






- Visual Representation should provide hints hiding complexity
- **Data vs Representation**
  - Not all data can be represented by all Visual Representation
    - **→ From Data to possible representation and viceversa**

# Visual analytics

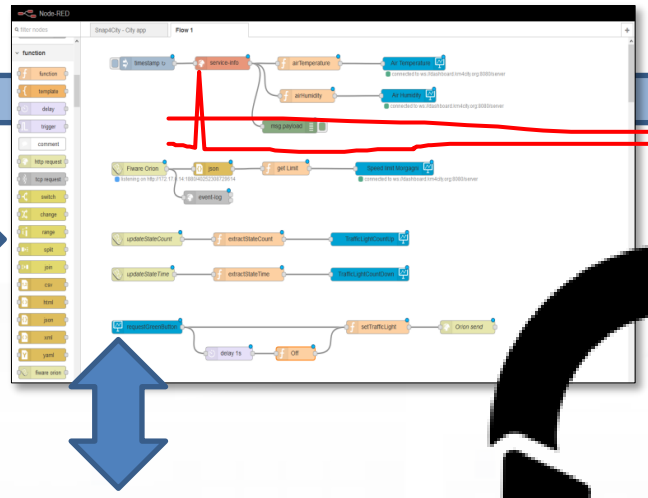
1. increasing cognitive resources, using a visual resource to ***expand human working memory***,
2. reducing search, r**epresenting a large amount of data in a small space**,
3. enhancing the recognition of patterns, **organize in space and time by relationships**,
4. make **easy perceptual inference of relationships** that are otherwise more difficult to induce,
5. perceptual **monitoring large number of potential events**, and
6. Way to **real time manipulation to explore data space in time and relationships.**

# Visual Analytics

Business Logic to change data, and user interface

Dashboards and Apps





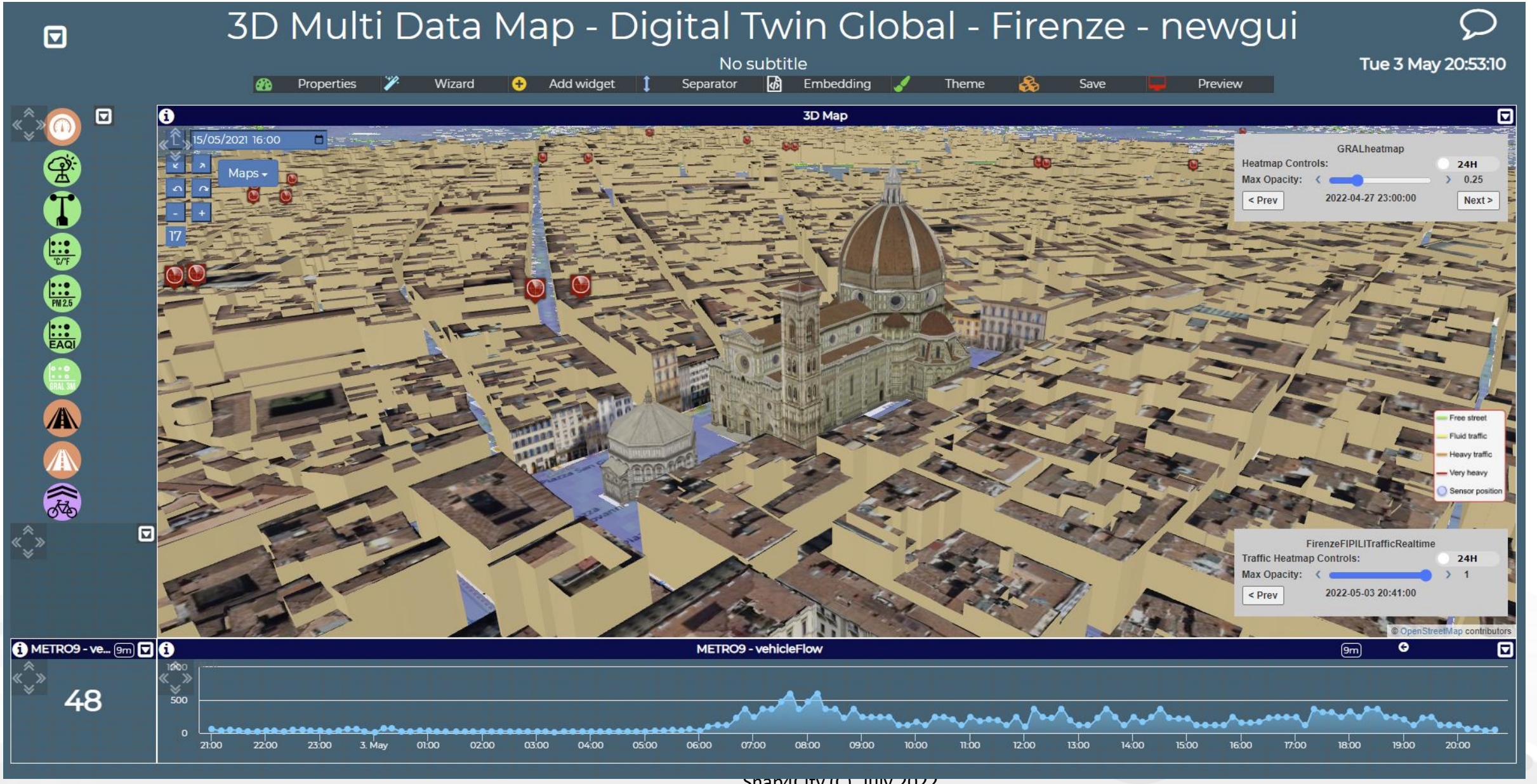



Data and relationships



Big Data Analytics, Artificial Intelligence

# Editing


3D Multi Data Map - Digital Twin Global - Firenze - newgui
No subtitle
Tue 3 May 20:53:10
Properties
Wizard
Add widget
Separator
Embedding
Theme
Save
Preview
3D Map
15/05/2021 16:00
Maps
17
GRALheatmap
Heatmap Controls:
24H
Max Opacity:
0.25
< Prev
2022-04-27 23:00:00
Next >
Free street
Fluid traffic
Heavy traffic
Very heavy
Sensor position
FirenzeFIPILITrafficRealtime
Traffic Heatmap Controls:
24H
Max Opacity:
1
< Prev
2022-05-03 20:41:00
© OpenStreetMap contributors
METRO9 - ve...
9m
48
METRO9 - vehicleFlow
9m
1000
500
0
21:00
22:00
23:00
3. May
01:00
02:00
03:00
04:00
05:00
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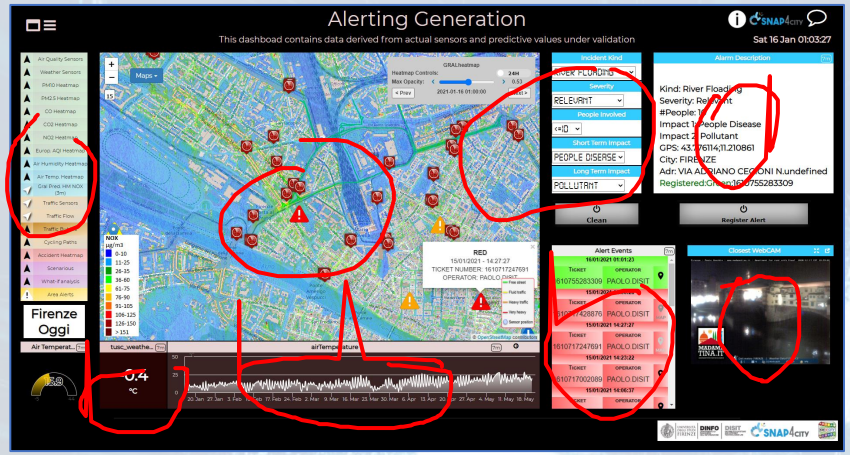
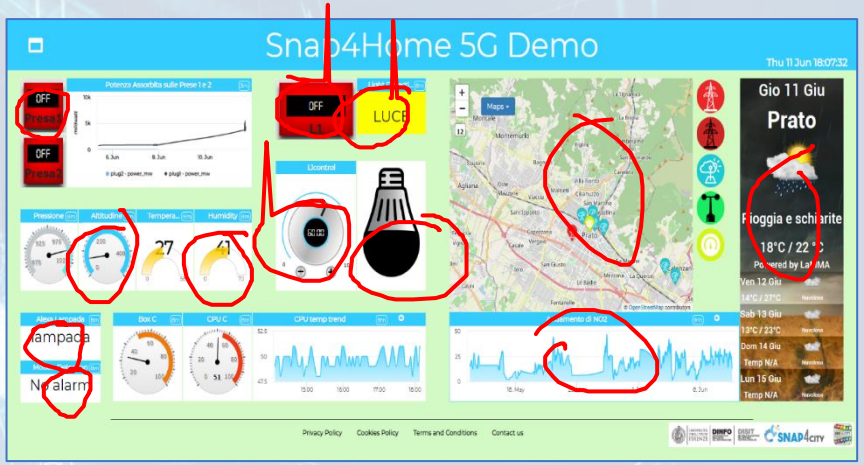
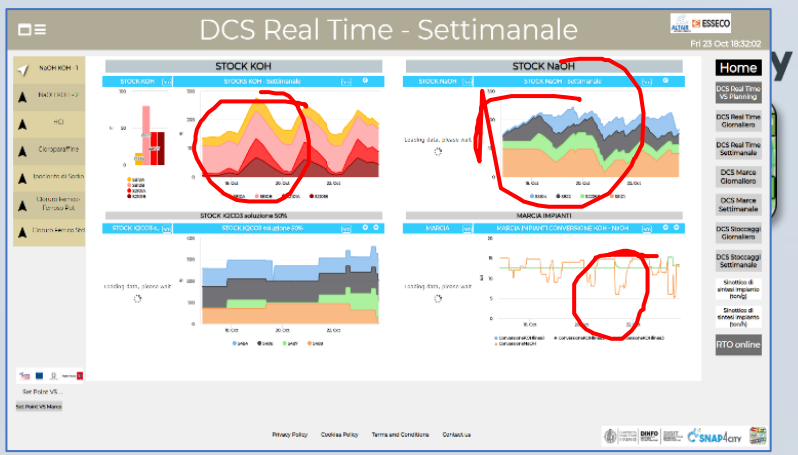
18:00
19:00
20:00

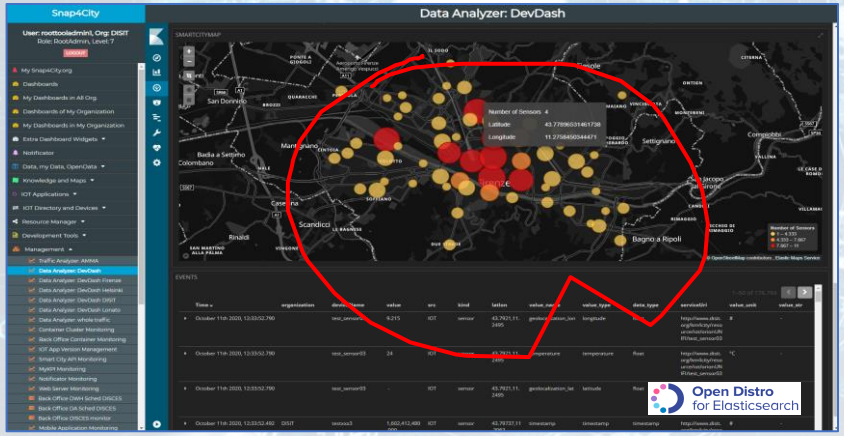
# Dashboard Themes: Changing Style

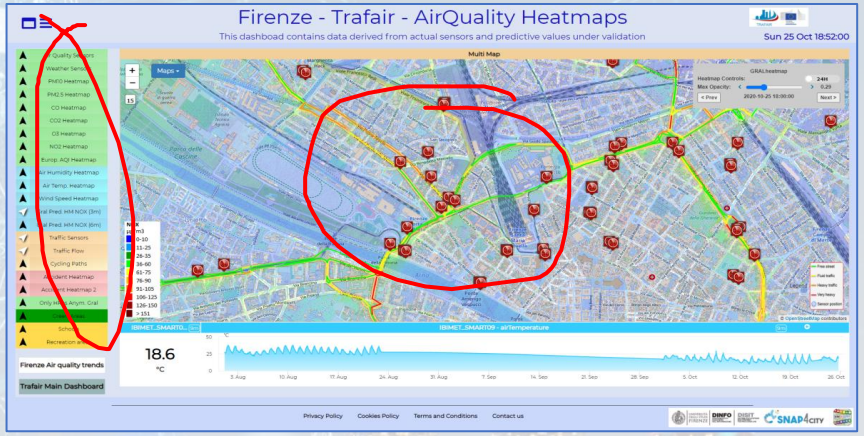


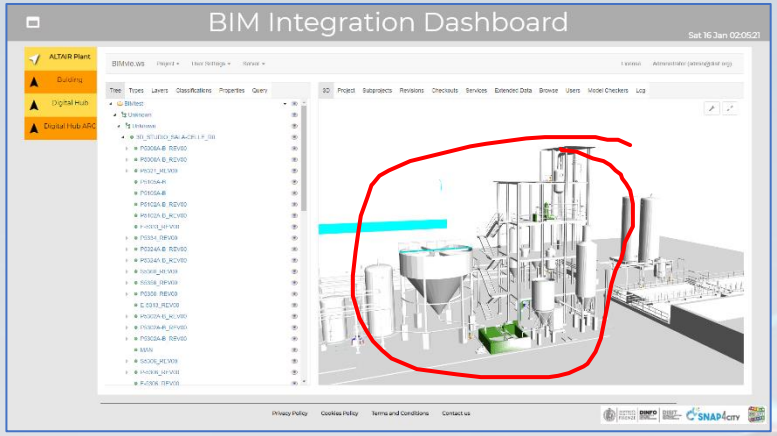

Alerting Generation
This dashboad contains data derived from actual sensors and predictive values under validation
Sat 16 Jan 01:03:27
Firenze Oggi

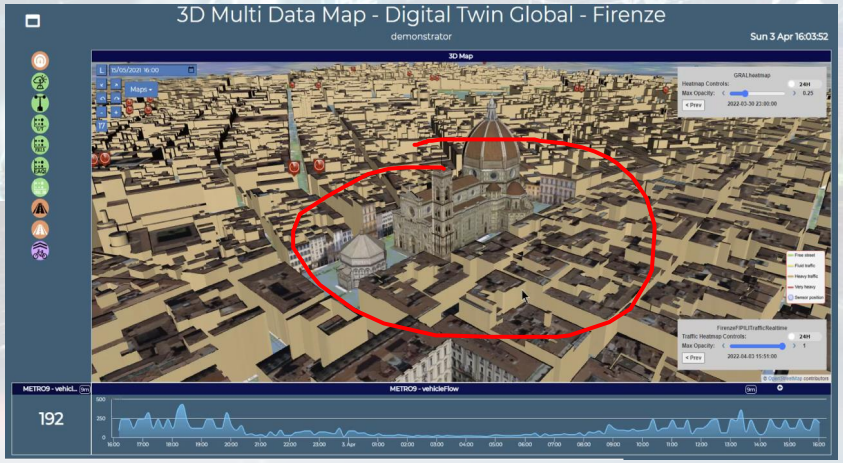

Snap4Home 5G Demo
Thu 11 Jun 18:07:32
Gio 11 Giu
Prato
Pioggia e schiarite
18°C / 22°C
Lampada
No alarm

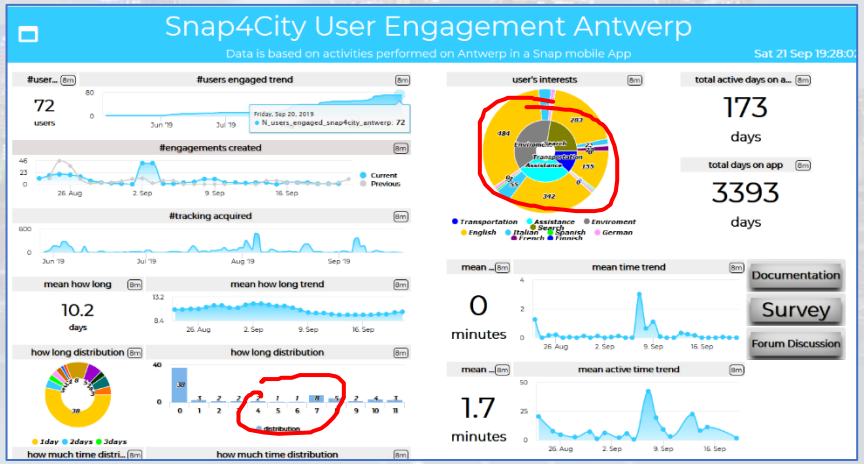

DCS Real Time - Settimanale
Fri 23 Oct 18:32:02
STOCK KOH
STOCK NaOH
Home

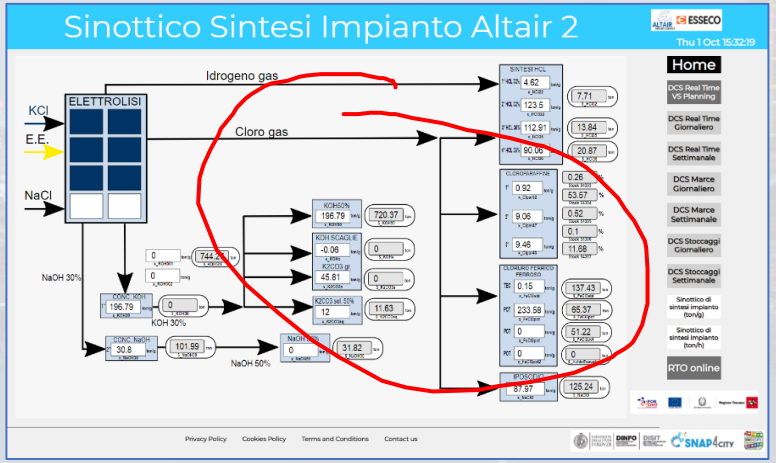

Data Analyzer: DevDash
Open Distro for Elasticsearch


Firenze - Trafair - AirQuality Heatmaps
This dashboad contains data derived from actual sensors and predictive values under validation
Sun 25 Oct 18:52:00
18.6

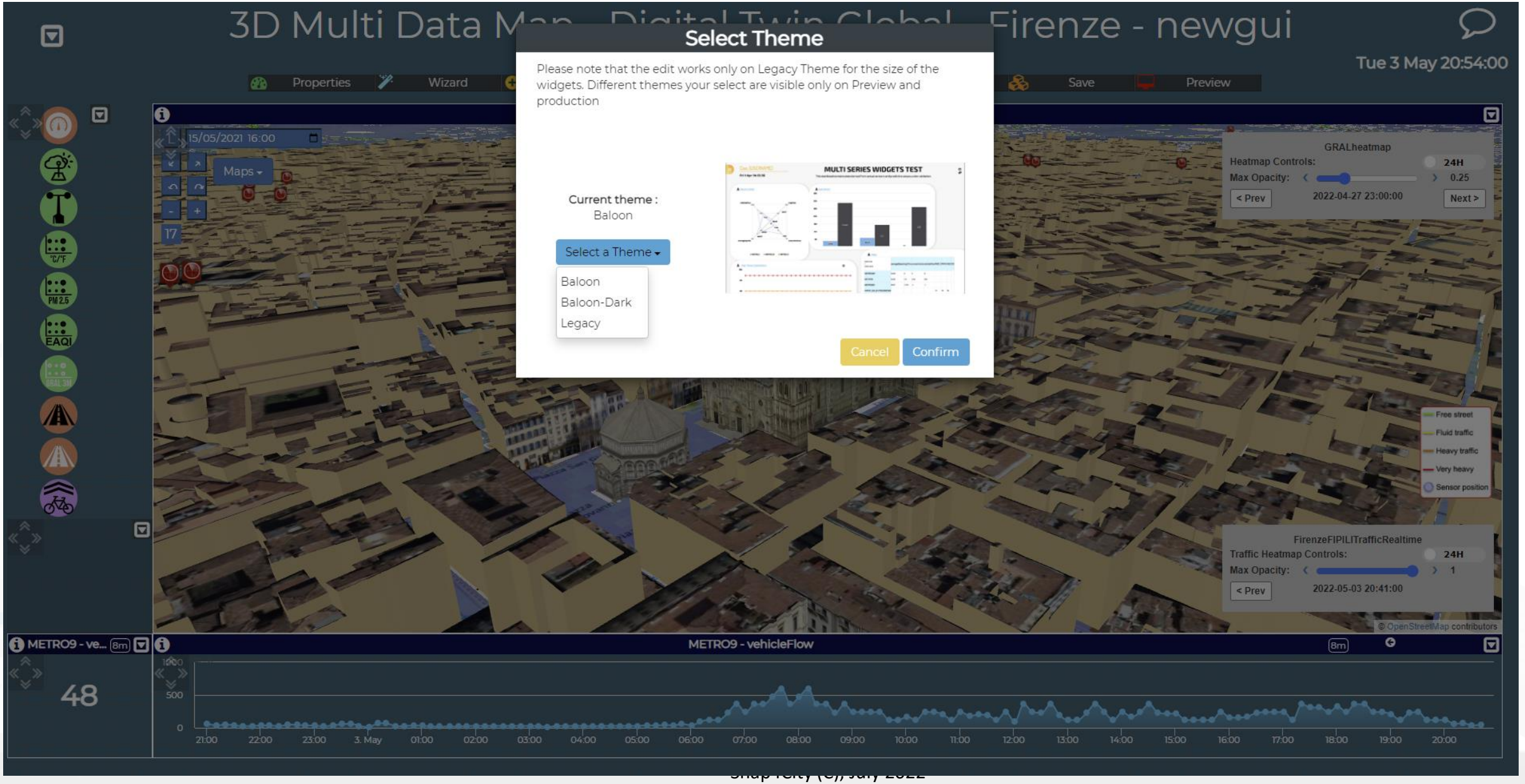

BIM Integration Dashboard
Sat 16 Jan 02:05:21


3D Multi Data Map - Digital Twin Global - Firenze
demonstrator
Sun 3 Apr 16:03:52
192


Snap4City User Engagement Antwerp
Data is based on activities performed on Antwerp in a Snap mobile App
Sat 21 Sep 19:28:0
72
users
173
days
3393
days
0
minutes
1.7
minutes
Documentation
Survey
Forum Discussion

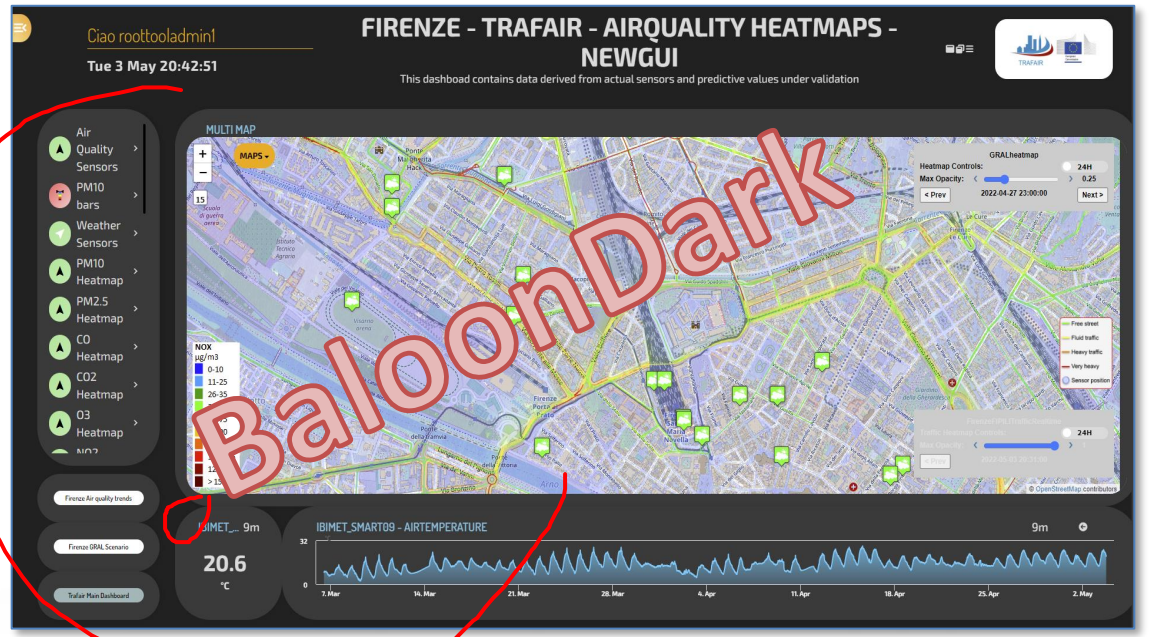

Sinottico Sintesi Impianto Altair 2
Thu 1 Oct 15:32:19
Home
Idrogeno gas
Cloro gas
ELETTROLISI
KCl
E.E.
NaCl
NaOH 30%
KOH 30%
NaOH 50%

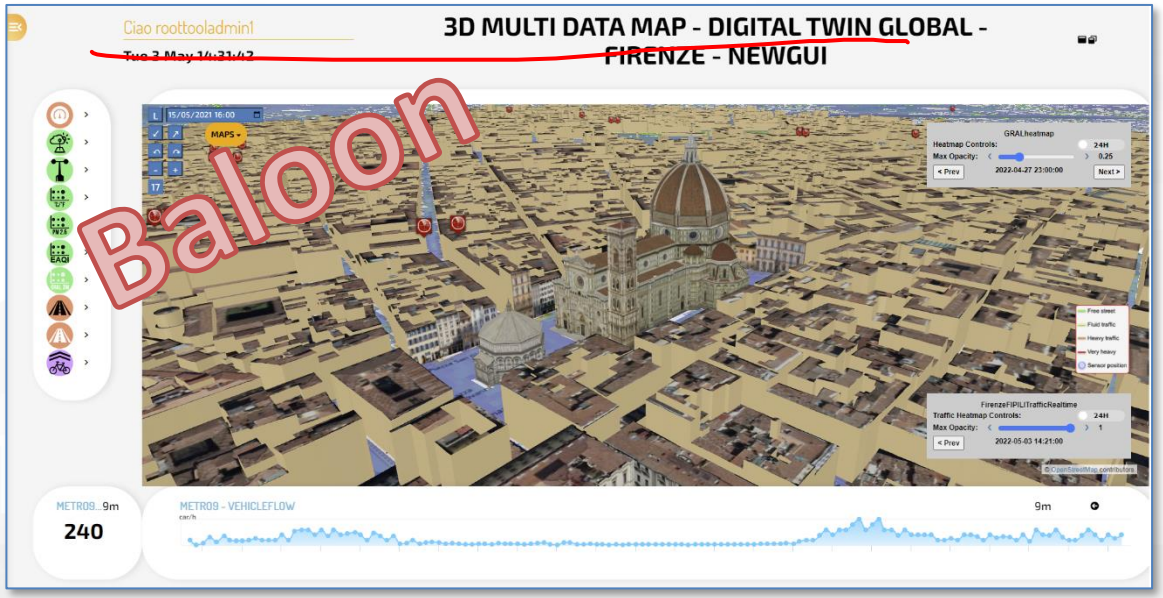
# Changing Theme

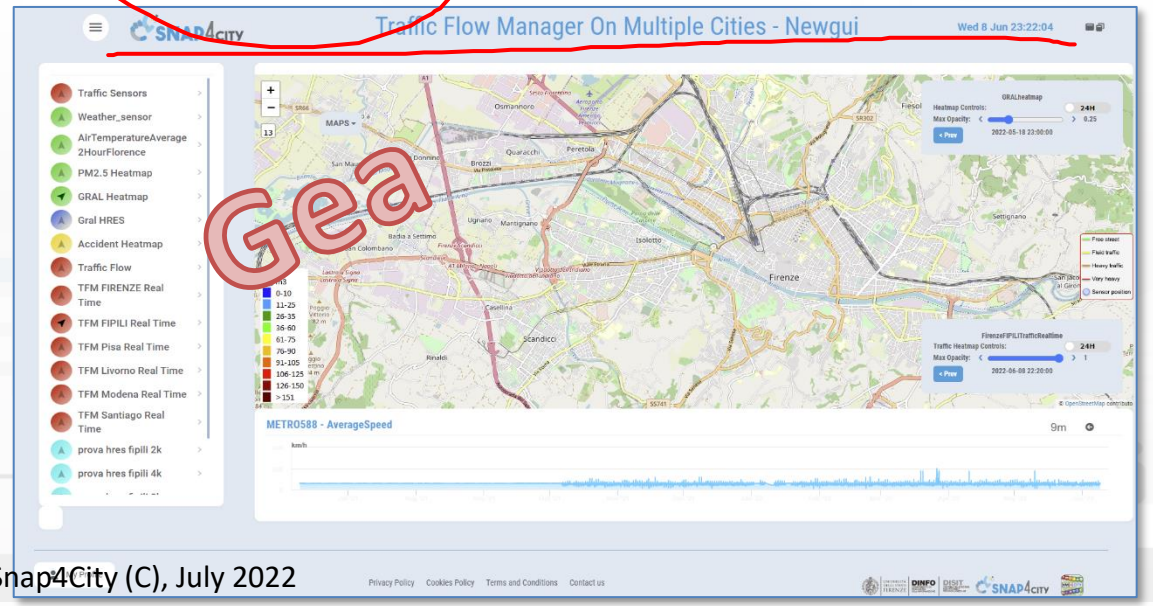


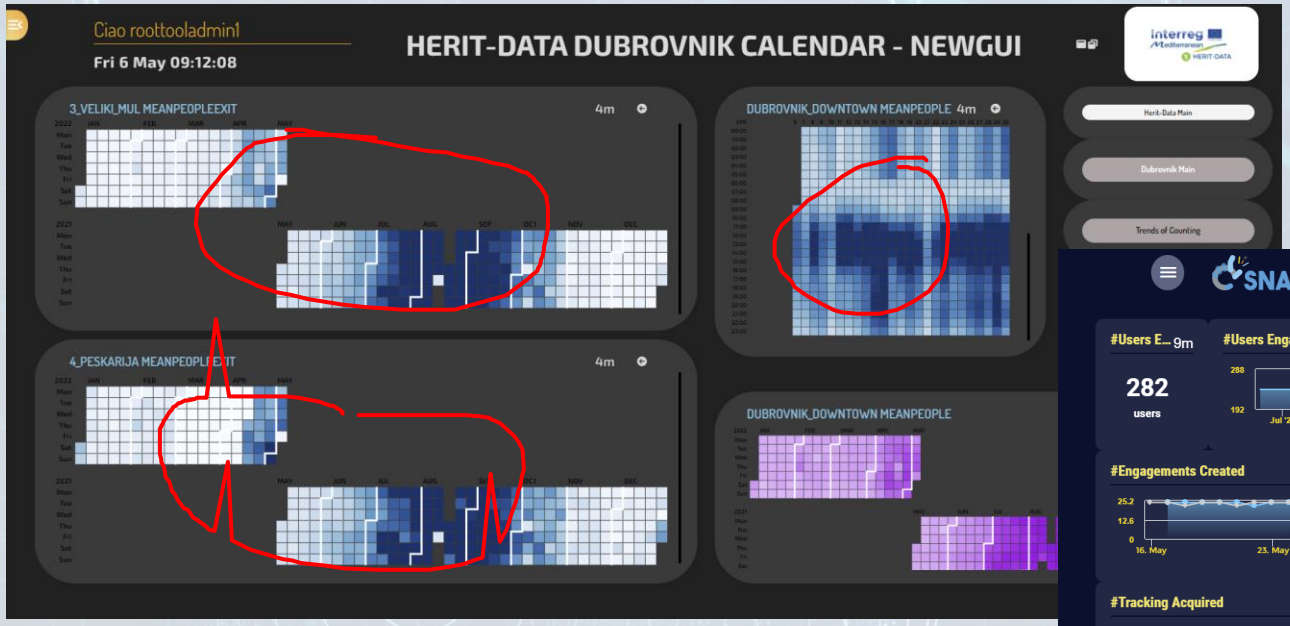
# Different Themes

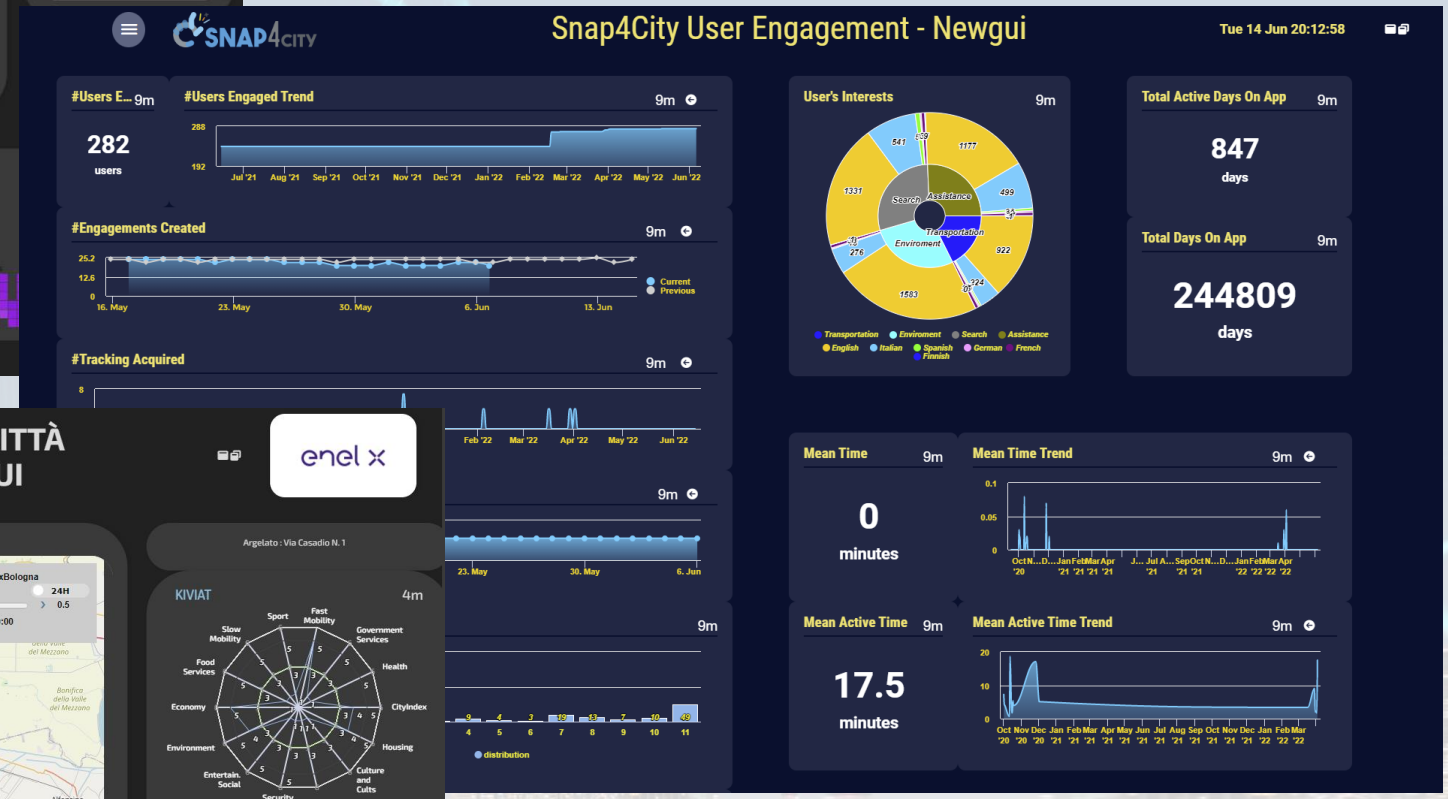


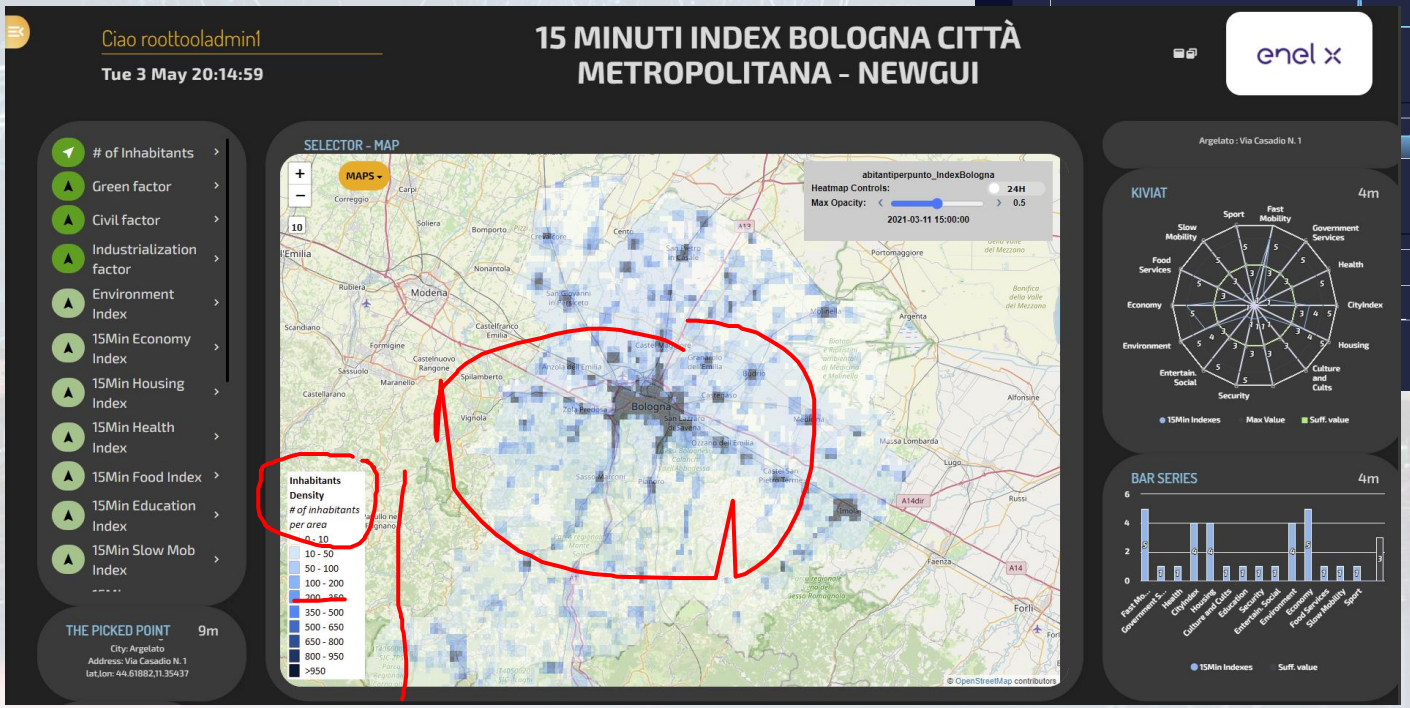



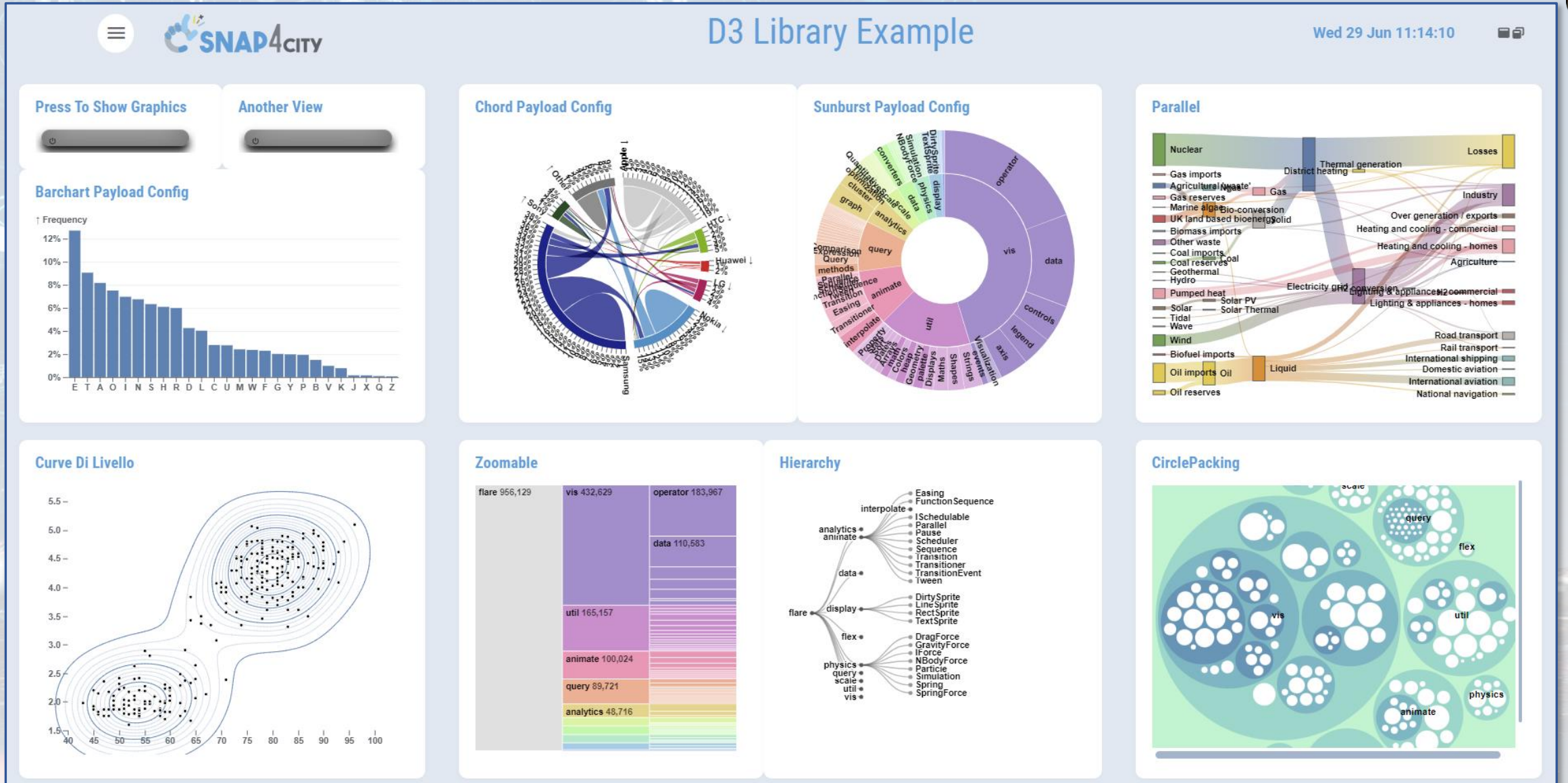




Ciao roottooladmin1
Fri 6 May 09:12:08
HERIT-DATA DUBROVNIK CALENDAR - NEWGUI
3_VELIKI_MUL MEANPEOPLEEXIT 4m
DUBROVNIK_DOWNTOWN MEANPEOPLE 4m
4_PESKARIJA MEANPEOPLE EXIT 4m
DUBROVNIK_DOWNTOWN MEANPEOPLE


Snap4City User Engagement - Newgui
Tue 14 Jun 20:12:58
#Users E... 9m
282
users
#Users Engaged Trend 9m
#Engagements Created 9m
#Tracking Acquired 9m
User's Interests 9m
Total Active Days On App 9m
847
days
Total Days On App 9m
244809
days
Mean Time 9m
0
minutes
Mean Time Trend 9m
Mean Active Time 9m
17.5
minutes
Mean Active Time Trend 9m


Ciao roottooladmin1
Tue 3 May 20:14:59
15 MINUTI INDEX BOLOGNA CITTÀ METROPOLITANA - NEWGUI
# of Inhabitants
Green factor
Civil factor
Industrialization factor
Environment Index
15Min Economy Index
15Min Housing Index
15Min Health Index
15Min Food Index
15Min Education Index
15Min Slow Mob Index
THE PICKED POINT 9m
City: Argelato
Address: Via Casadio N. 1
lat,lon: 44.61882,11.35437
SELECTOR - MAP
Inhabitants Density
# of inhabitants per area
KIVIAT 4m
BAR SERIES 4m

# D3 Graph library capability



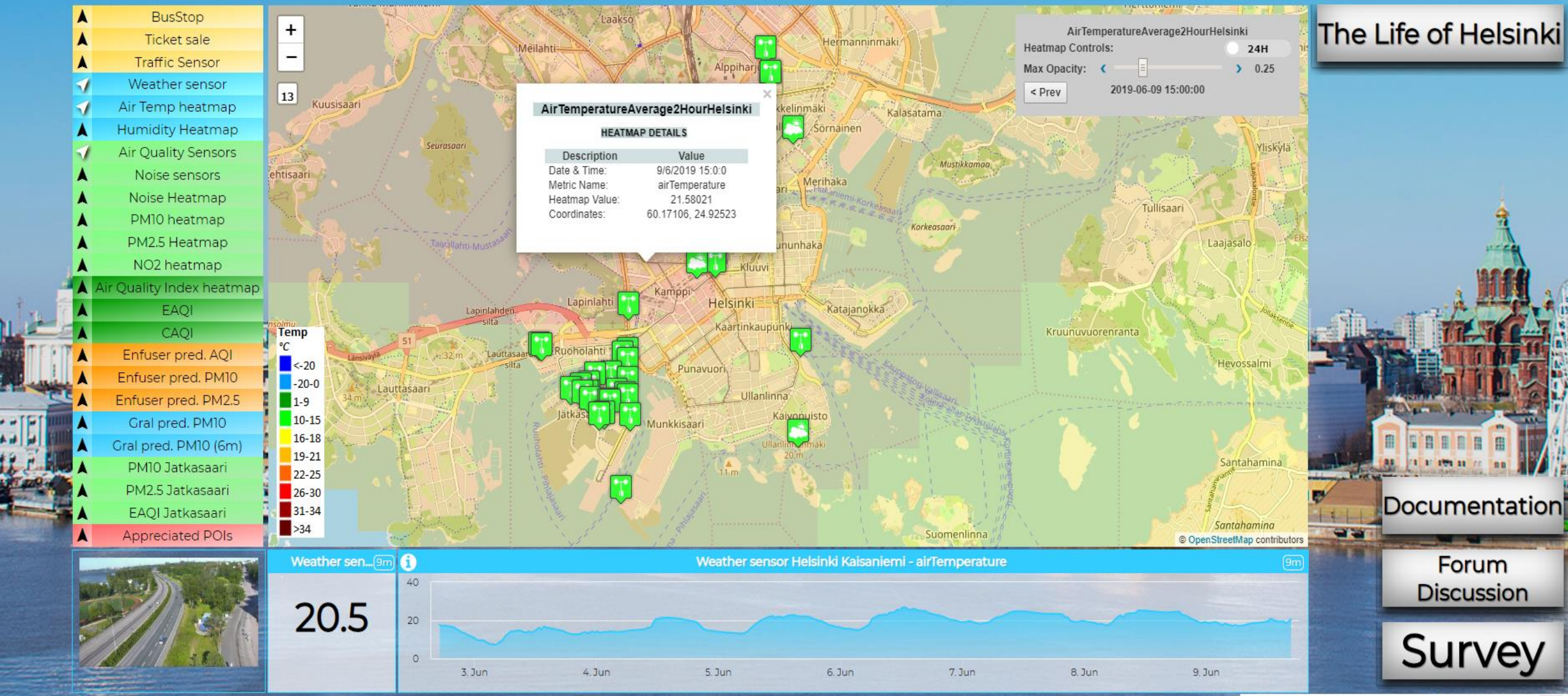
# Dashboards Usage vs Widgets



# Helsinki City Overview (H5a)

Please note that the data results are not always based on real data.

Sun 9 Jun 17:07:25




The Life of Helsinki

Documentation

Forum Discussion

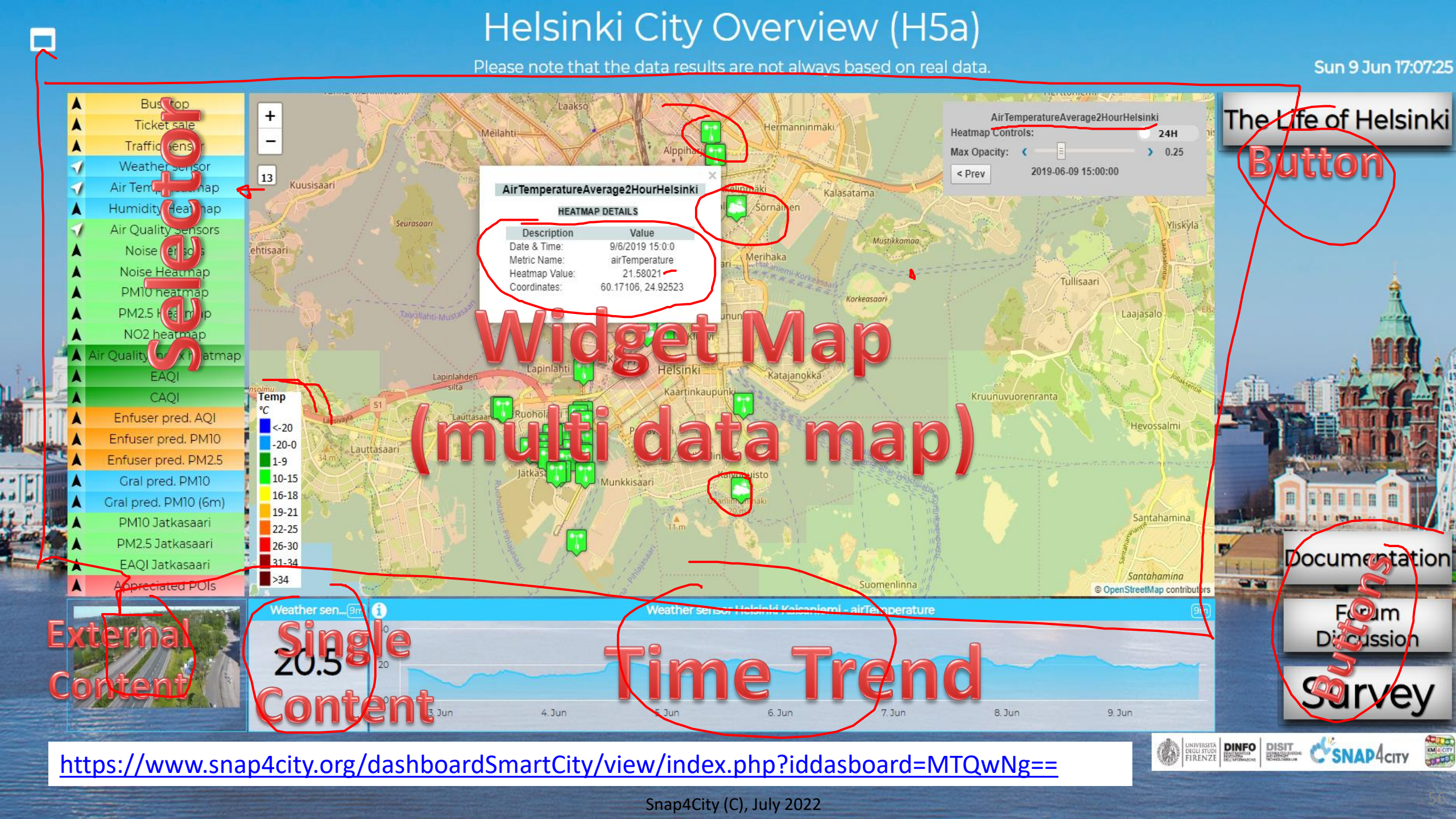
Survey

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

# Helsinki City Overview (H5a)

Please note that the data results are not always based on real data.

Sun 9 Jun 17:07:25




Selection

Widget Map (multi data map)

Button

External Content

Single Content

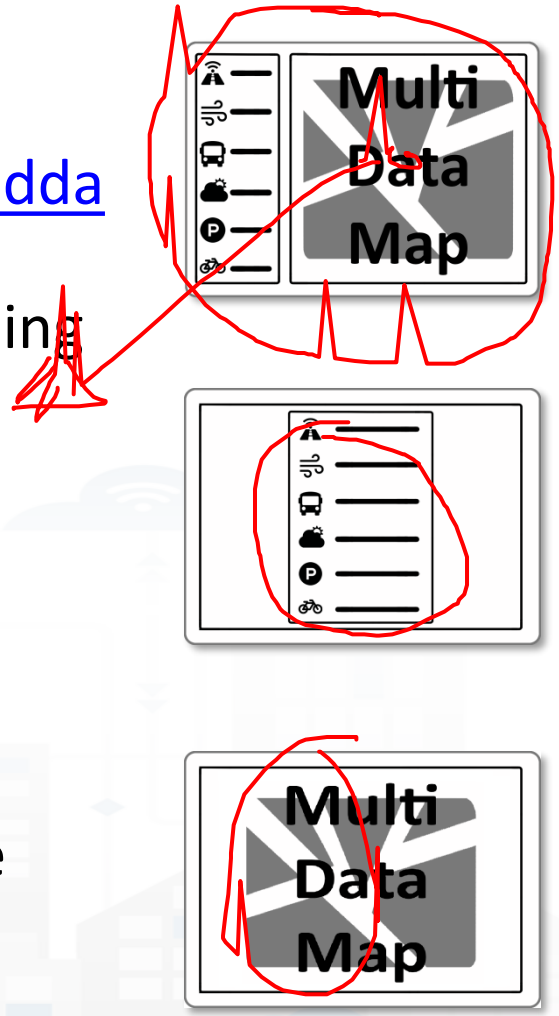
Time Trend

Buttons

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

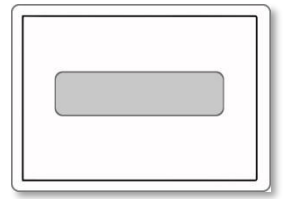
# Dashboard Usage & Recipe

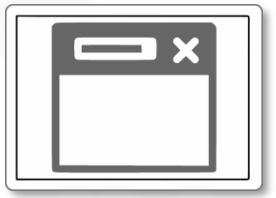
- https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNg==
- **Selector Widget**: (of different kinds) present “Information”, according to the HighLevelType (**HLT**), as overlapped layers on Target
  - **Additive**: PIN (POI, sensors, etc.), Cycling Paths, shapes, ...
  - **Mutual Exclusive by group**:
    - Heatmaps,
    - traffic,
    - Scenarios + what-if,
    - etc.
- **MultiDataMap Widget (Target**: (may be of different kind), this one may manage
  - Multiple representations on the same map
  - Each representation may provide specific interaction modalities and controls

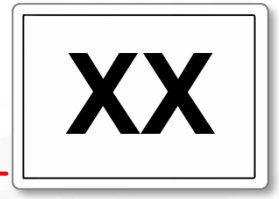


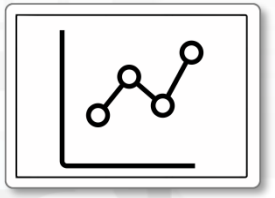
# Other Widgets in the dashboard

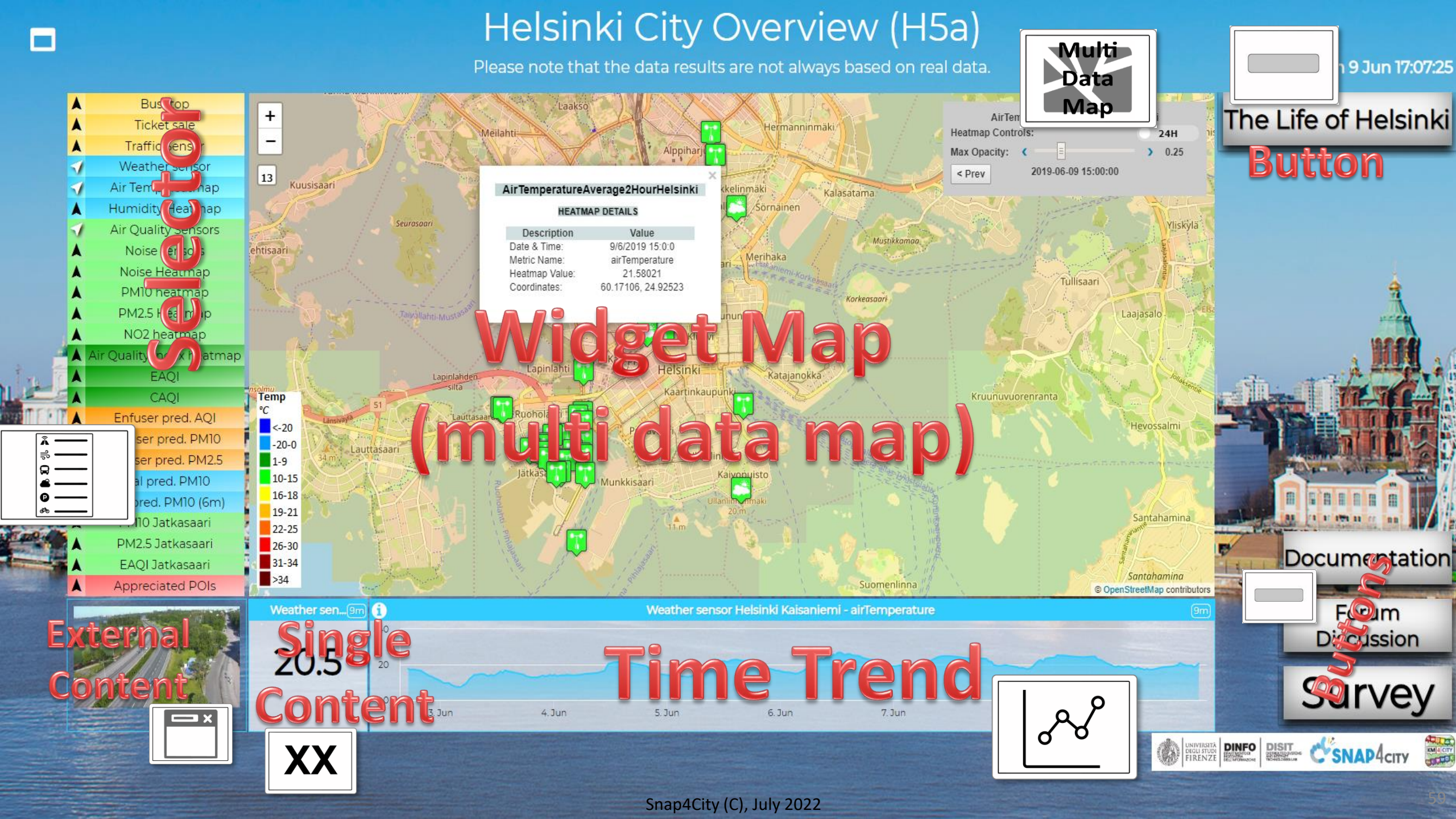
- **Button Widget** may be of different kind and may
  - Open external web pages, services, forum, surveys, etc.
  - Send messages on the field (IOT), etc.
- **External Content**:
  - Web pages (HTML + CSS + etc..), Video Streams
  - Many many other tools see next exercise
- **Single Content**
  - Single value: numeric, string, HTML, etc.
- **Time Trend**
  - Time Series: numeric values over time



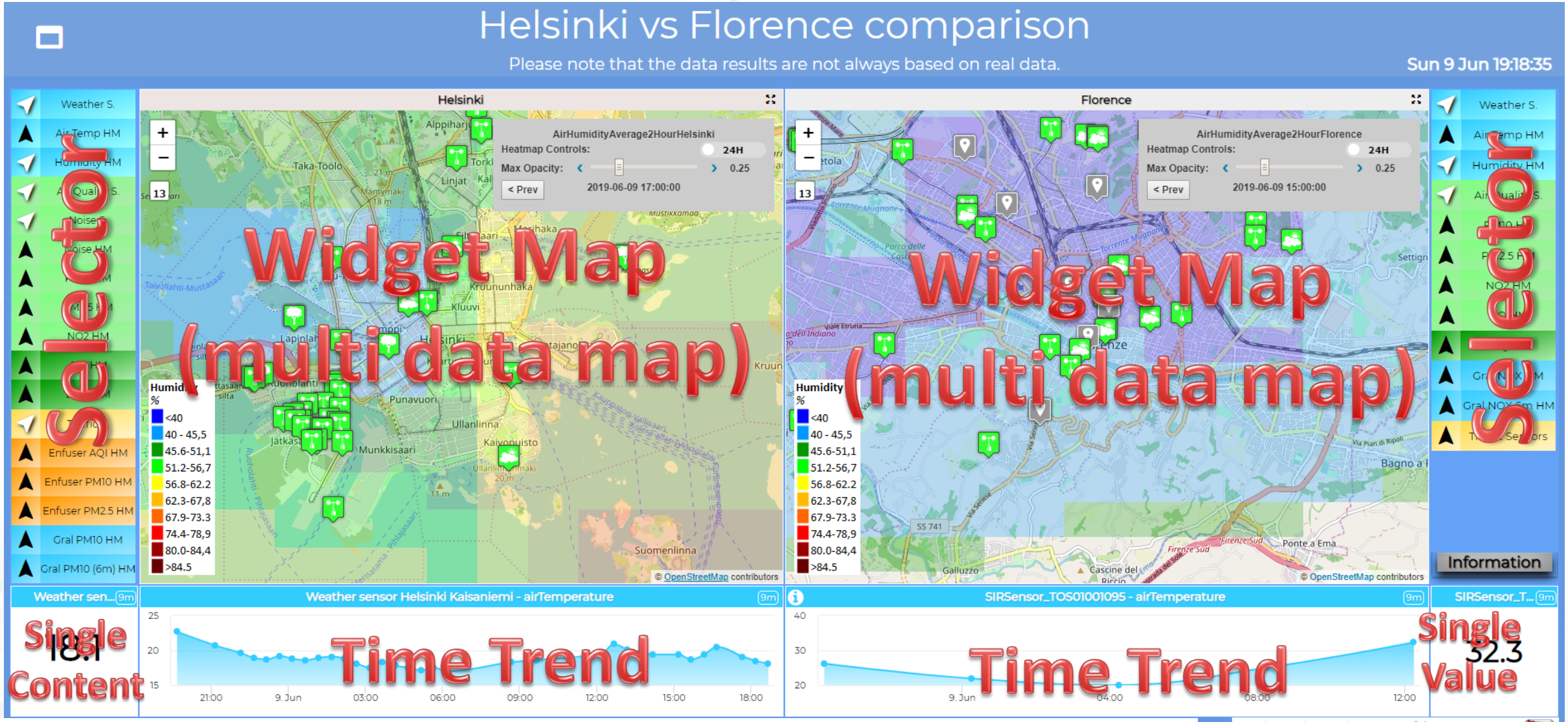





Helsinki City Overview (H5a)
Please note that the data results are not always based on real data.
Multi Data Map
The Life of Helsinki Button
Bus stop
Ticket sale
Traffic sensor
Weather sensor
Air Temp heatmap
Humidity heatmap
Air Quality Sensors
Noise sensors
Noise Heatmap
PM10 heatmap
PM2.5 heatmap
NO2 heatmap
Air Quality Index heatmap
EAQI
CAQI
Enfuser pred. AQI
Enfuser pred. PM10
Enfuser pred. PM2.5
Enfuser pred. PM10
Enfuser pred. PM10 (6m)
PM10 Jatkasaari
PM2.5 Jatkasaari
EAQI Jatkasaari
Appreciated POIs
Select
AirTemperatureAverage2HourHelsinki
HEATMAP DETAILS
Description Value
Date & Time: 9/6/2019 15:0:0
Metric Name: airTemperature
Heatmap Value: 21.58021
Coordinates: 60.17106, 24.92523
Heatmap Controls:
24H
Max Opacity:
0.25
< Prev
2019-06-09 15:00:00
Temp °C
<-20
-20-0
1-9
10-15
16-18
19-21
22-25
26-30
31-34
>34
Widget Map
(multi data map)
© OpenStreetMap contributors
Documentation
Forum Discussion
Survey
Buttons
External Content
Single Content
Weather sen...
20.5
Weather sensor Helsinki Kaisaniemi - airTemperature
Time Trend
3. Jun
4. Jun
5. Jun
6. Jun
7. Jun
XX
SNAP4CITY

# Helsinki vs Florence comparison

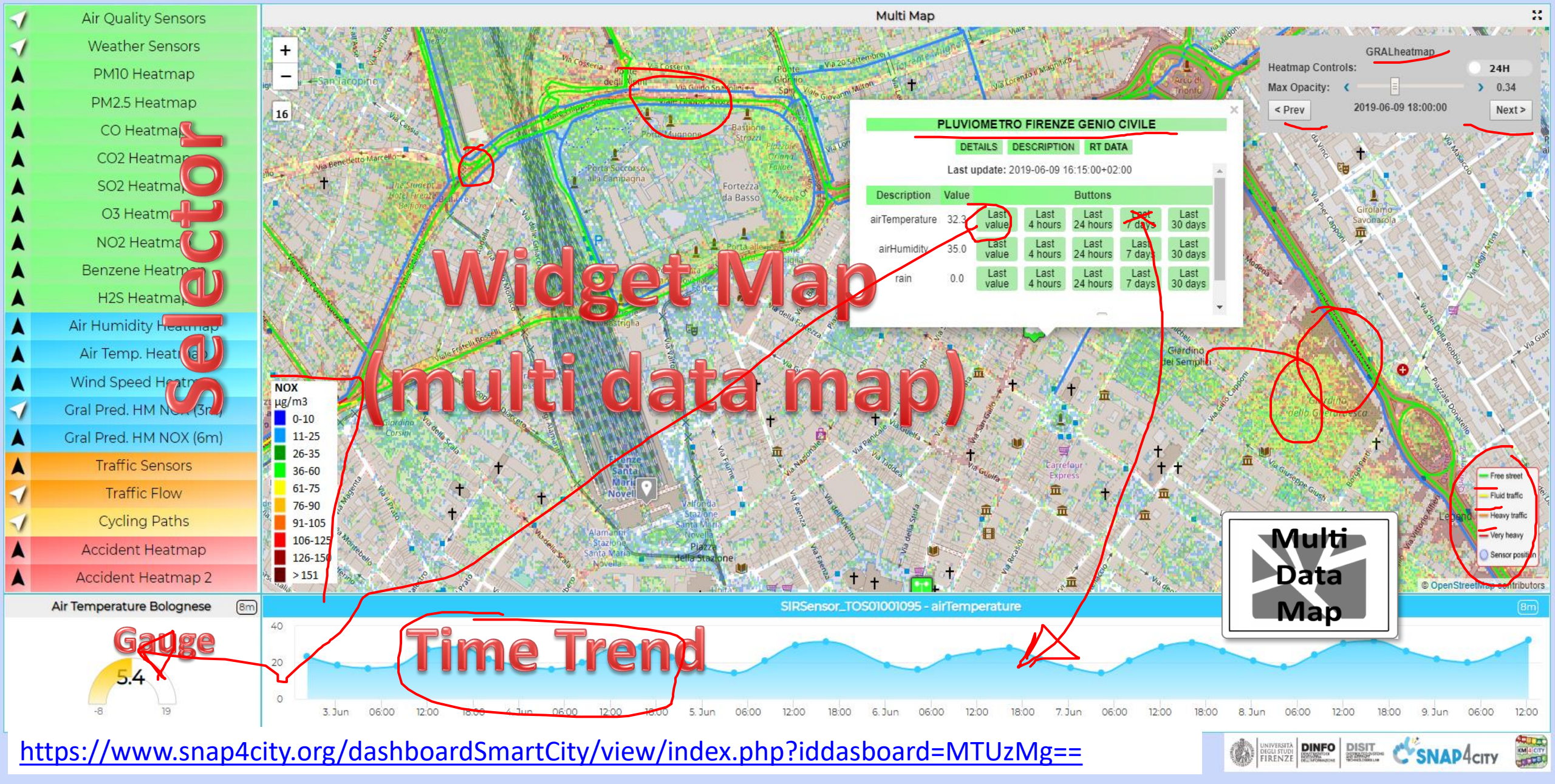



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc0MQ==

# Firenze - Trafair - AirQuality Heatmaps

This dashboad contains data derived from actual sensors and predictive values under validation

Sun 9 Jun 18:53:01



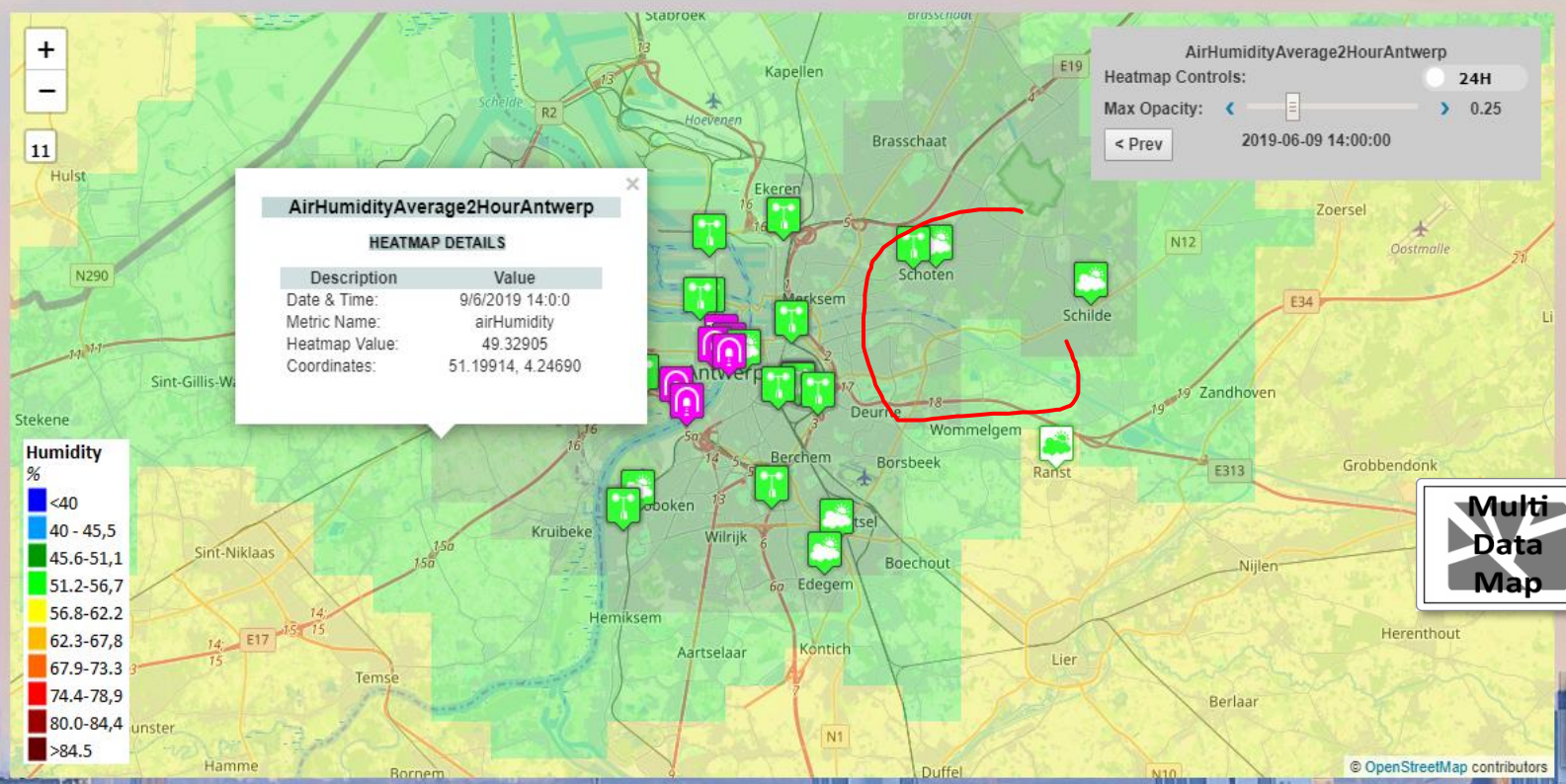

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTUzMg==

# Antwerp City Overview - A5

Please note that the data results are not always based on real data.

Sun 9 Jun 17:09:04

- Cultural Activity
- Entertainment
- Tourism Service
- Education & Research
- Government Office
- Accommodation
- Air Quality Sensor
- Weather sensor
- PM10 Heatmap
- PM2.5 Heatmap
- Air Temperature Heatmap
- Humidity Heatmap
- NO Heatmap
- NO2 Heatmap
- SO2 Heatmap
- O3 Heatmap
- EAQI
- CAQI
- Biking Safe Heatmap
- Tunnels and Ferry




Multi Data Map

Documentation

Survey

Forum Discussion

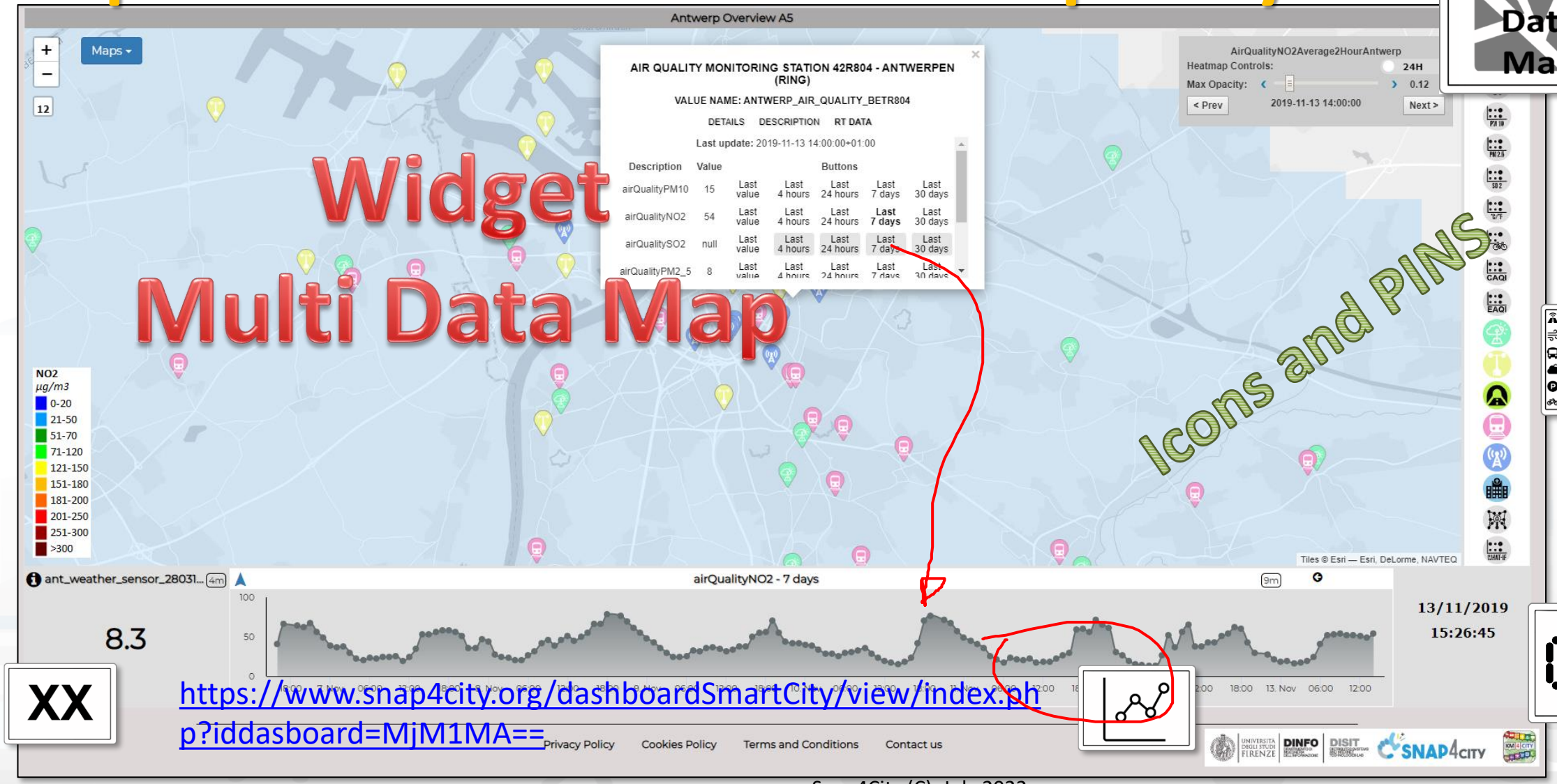






https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNw==

# Unique Dashboard builder Multiple Styles




Widget Multi Data Map

Icons and PINS

Multi Data Map

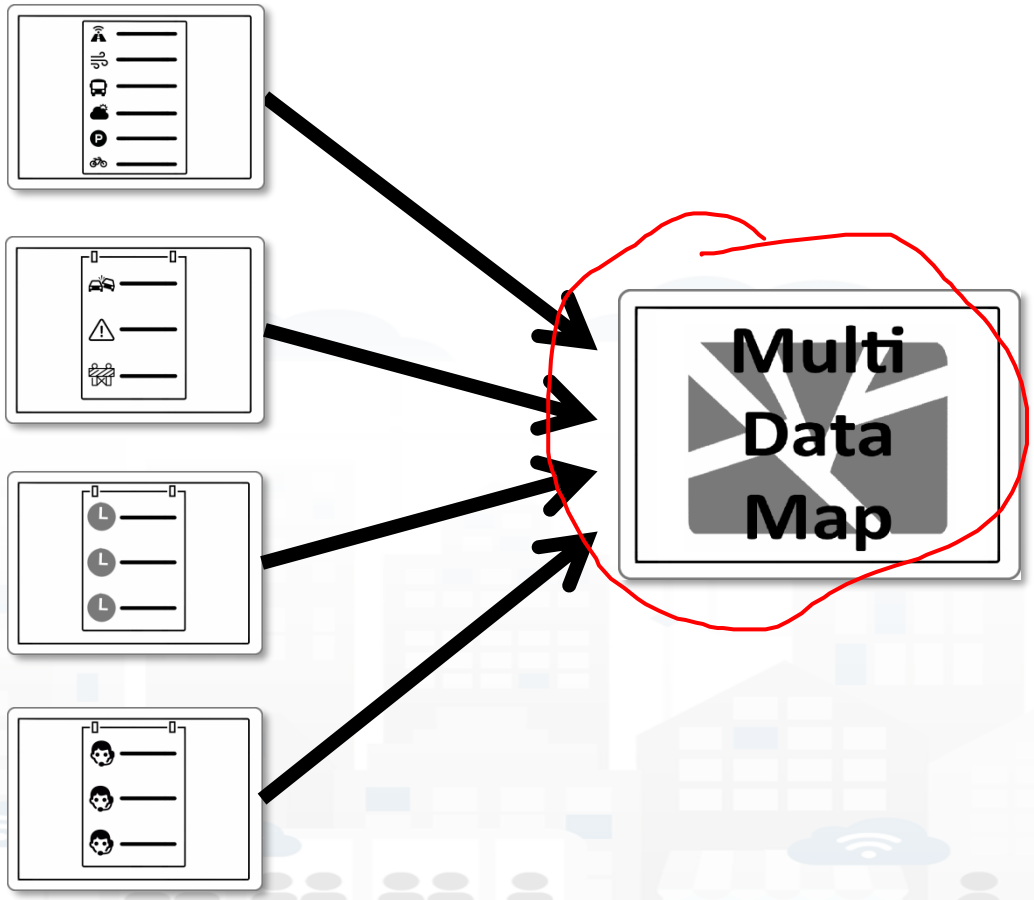
Multi Data Map

XX

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjM1MA==

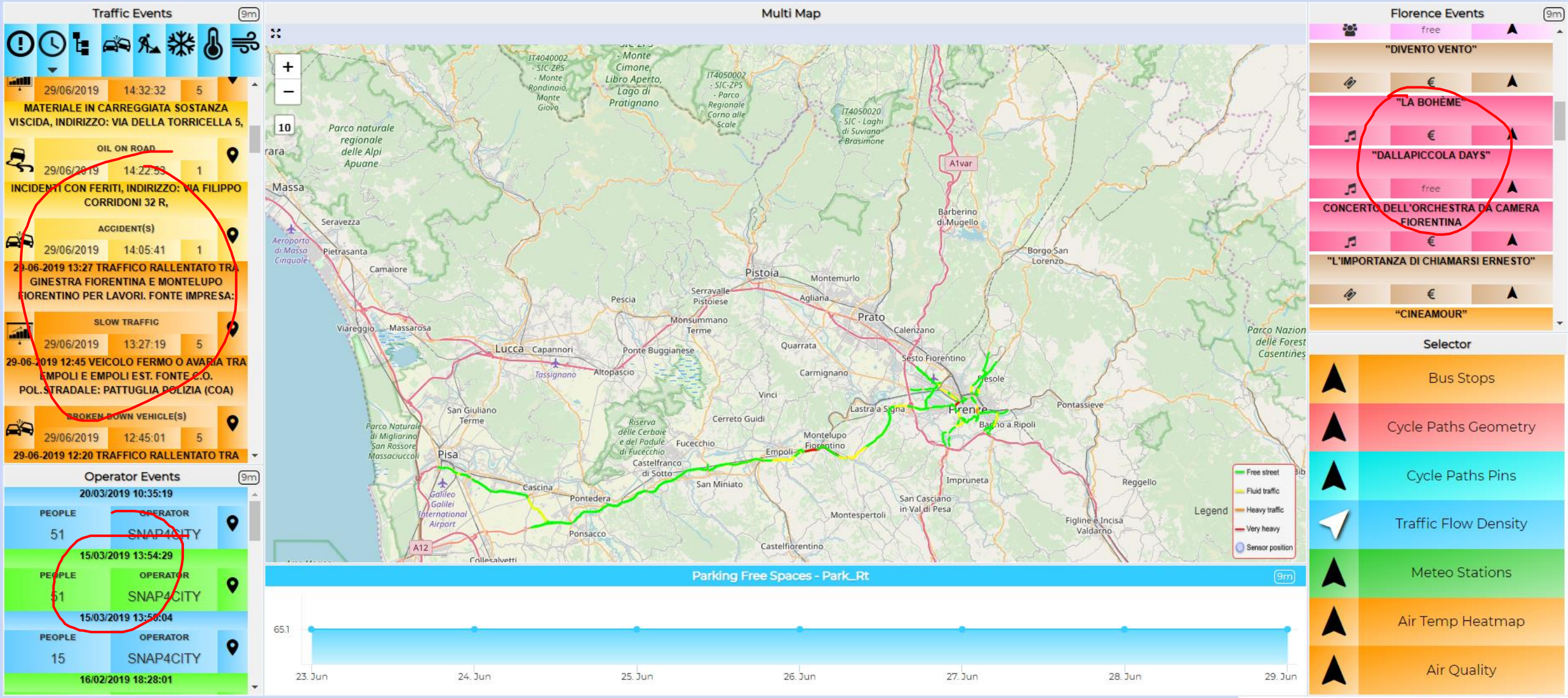
# Dashboard Usage and recipe: Event map target

- **Selector**
  - **POI, Heatmap, traffic, etc.**
- **Traffic Events:**
  - From gestore (manager)
- **Entertainment events:**
  - From several sources
- **Mobile Operator Events:**
  - From operators with Mobile Apps



# Multi-Widget Map - Demo

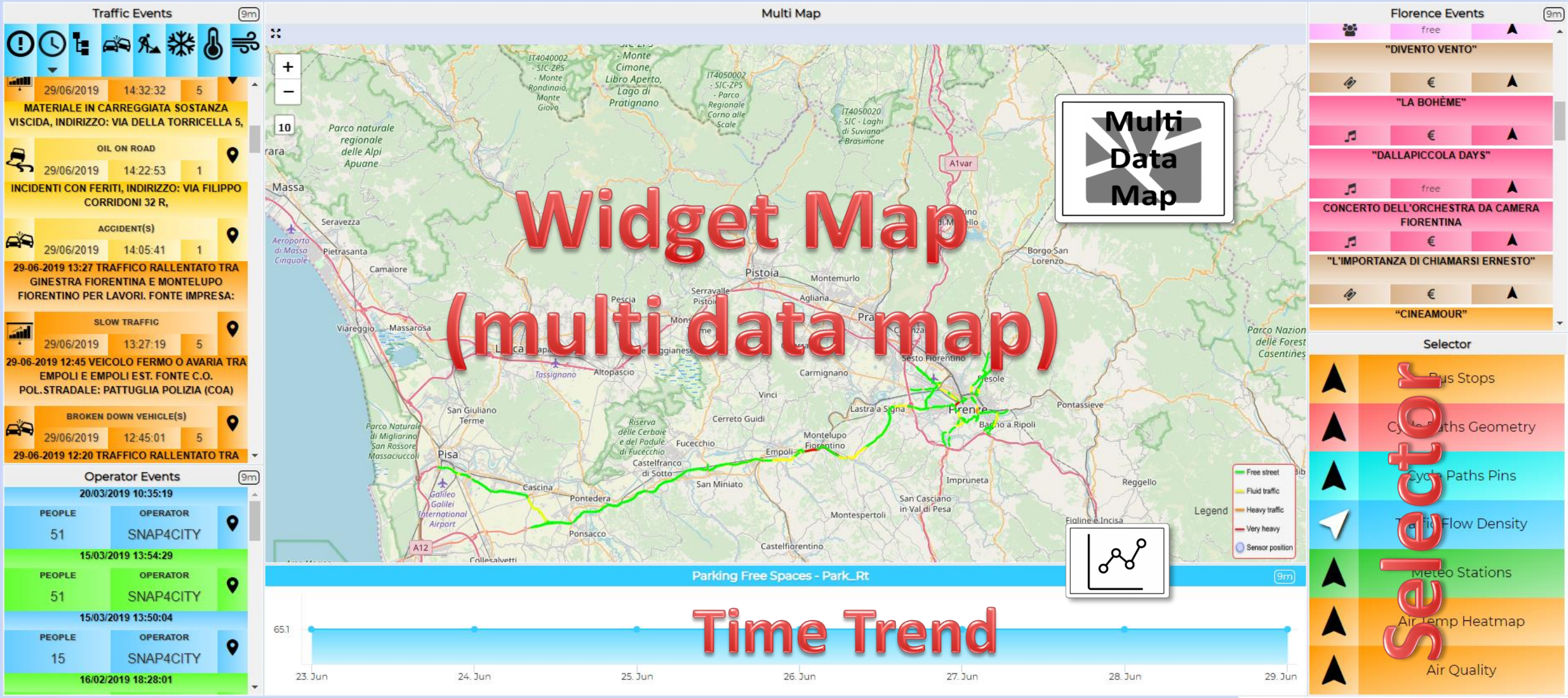
Sat 29 Jun 16:42:24




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTA2NA==

# Multi-Widget Map - Demo

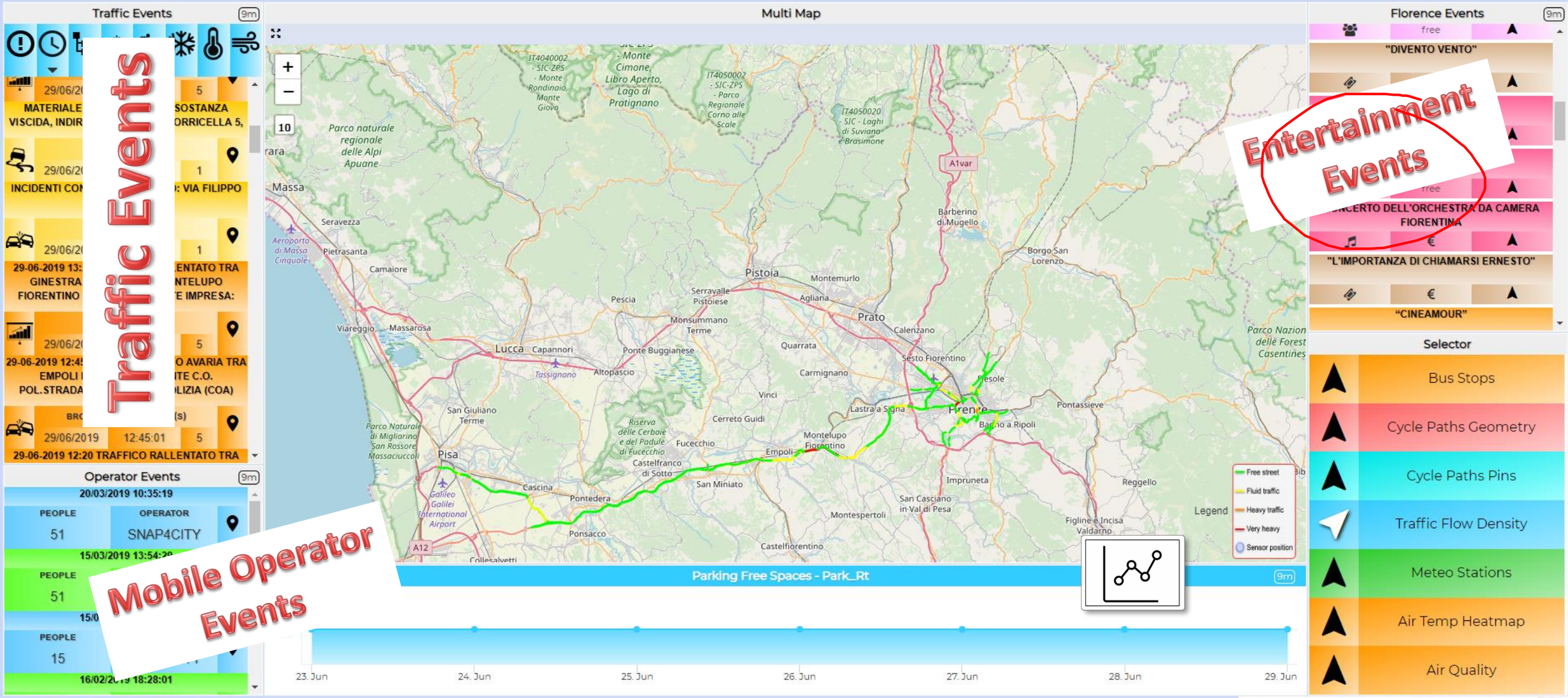
Sat 29 Jun 16:42:24




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTA2NA==

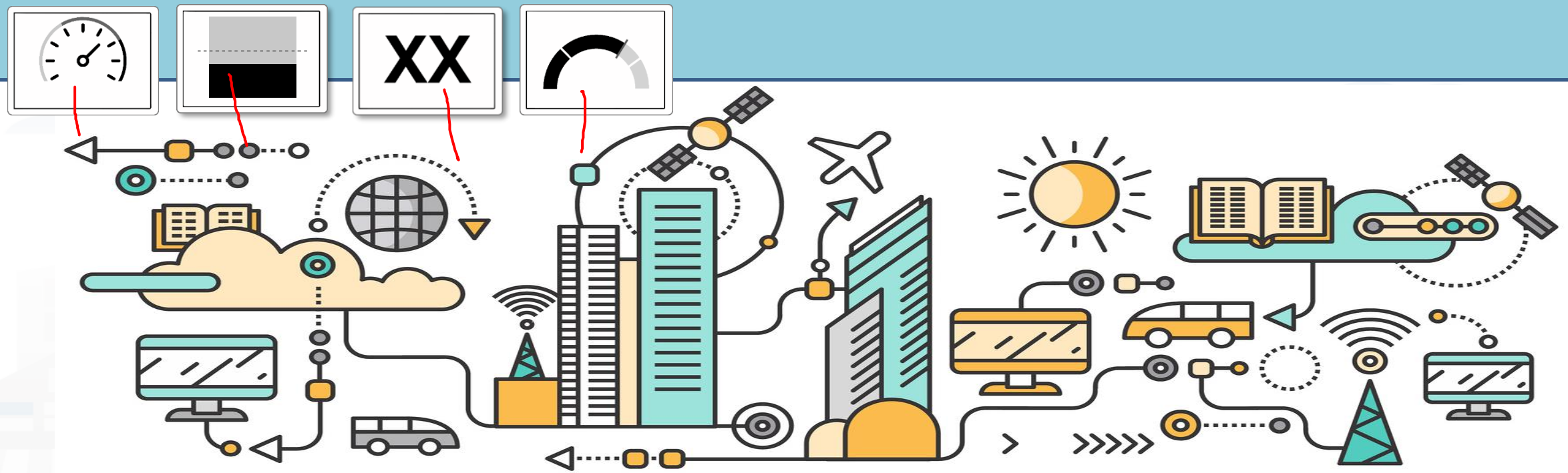
# Multi-Widget Map - Demo

Sat 29 Jun 16:42:24




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTA2NA==

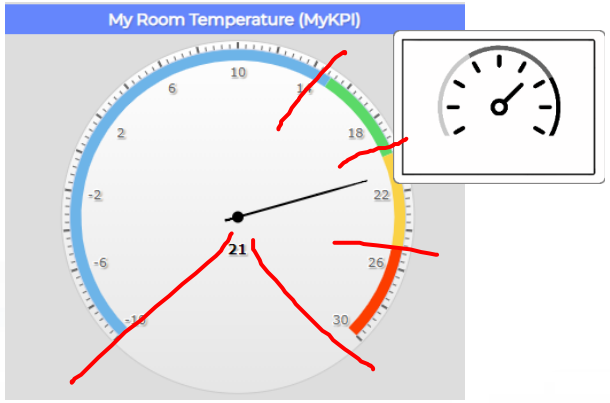
# Main Single Values Widgets

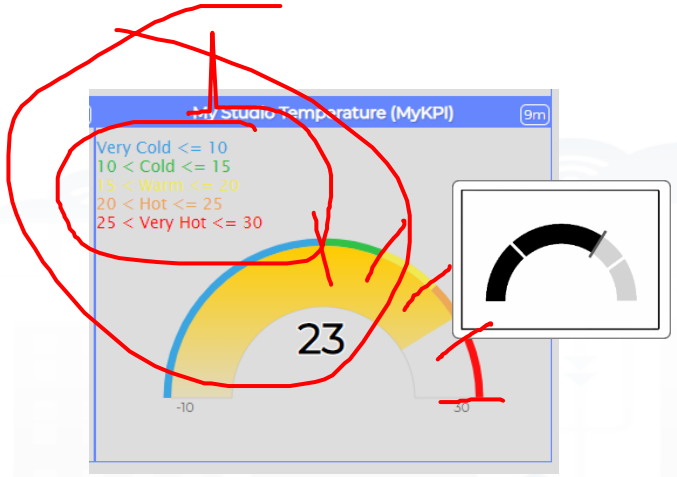


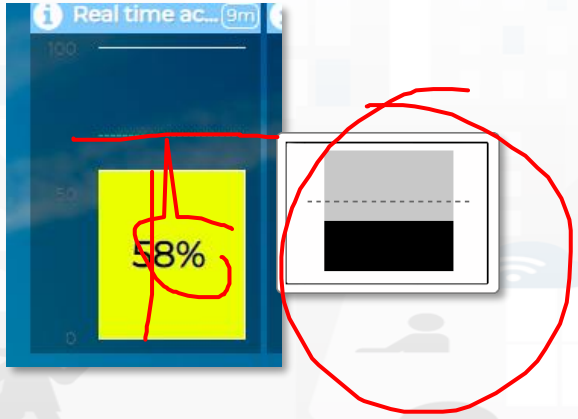
# Single values

- **Single Content**
- **Speedometer**
- **Gauge**
- **Single Bar**



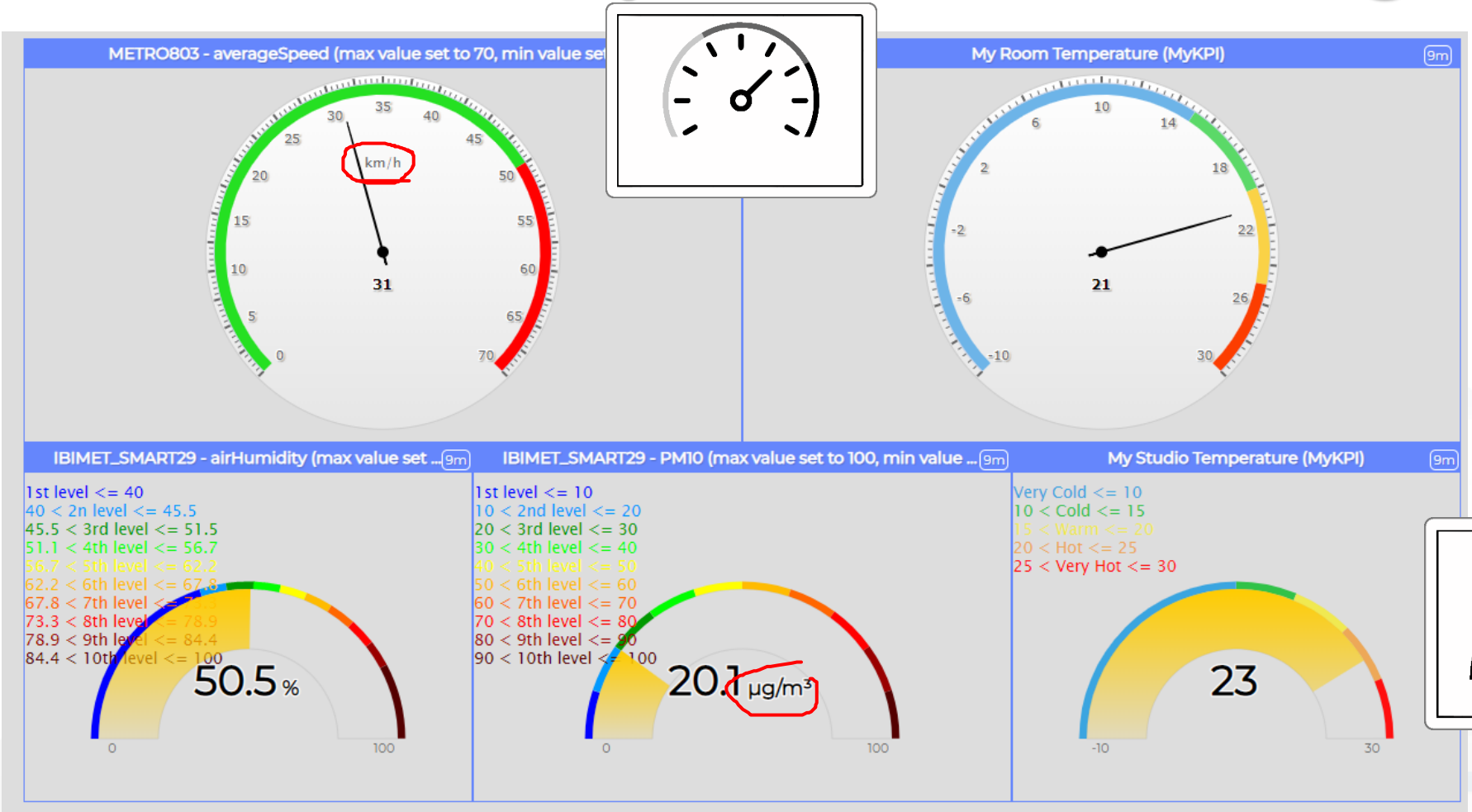




*Most of the multi xxxx widgets can show also single values*

# Speedometers- Gauges




- Coloured custom
- Unit of measure
- Bounds
- ….

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjU0MA==

# Time Series, Multi Series Widgets

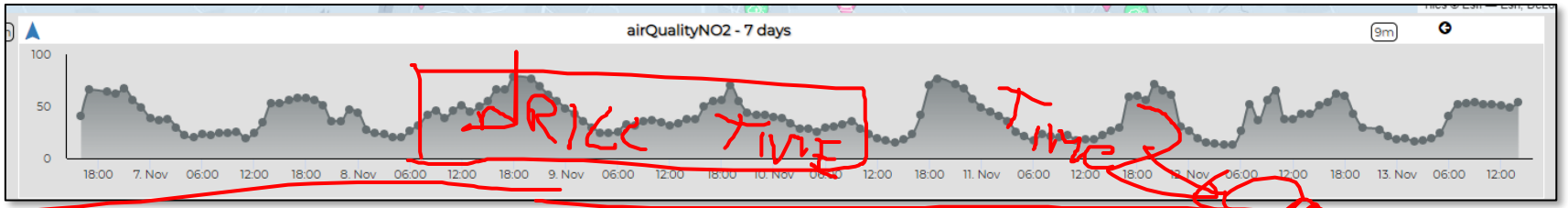




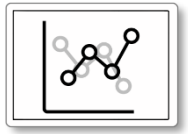
# Time Series

- **Time Trend**

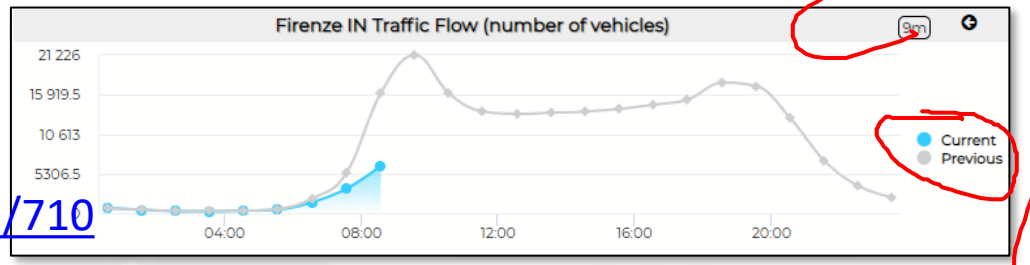





- **Time Trend Compare**
  - Comparing trends of the same time series

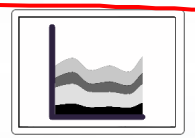


https://www.snap4city.org/710




- **Multi Series**
  - Showing multiple trends of multiple time series with same unit








- **Typical Time Trend**
  - Showing the typical trend of a time serie: multiple modalities

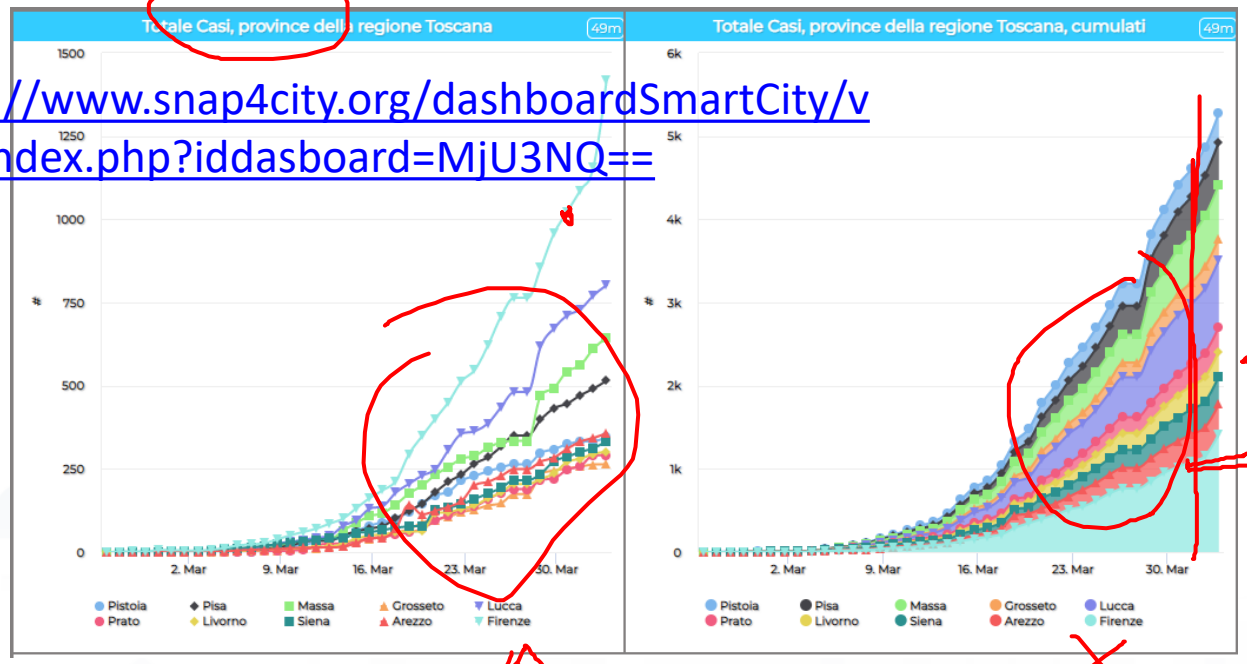





https://www.snap4city.org/705

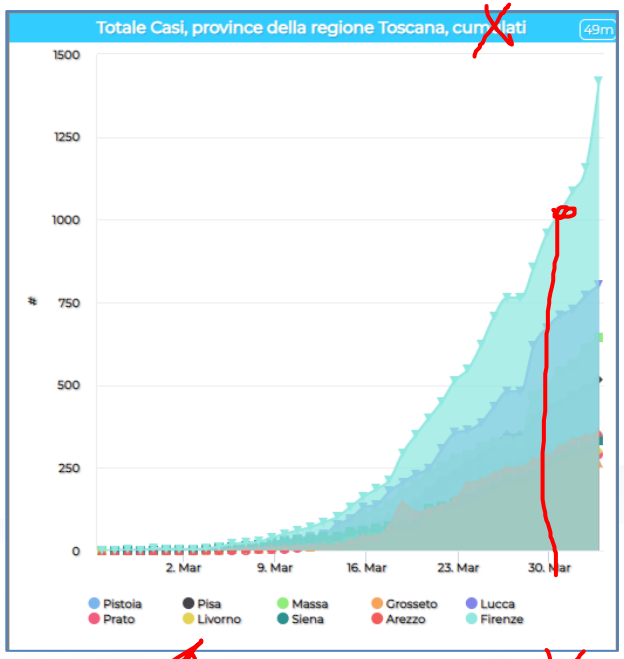
# MultiSeries

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjU3NQ==

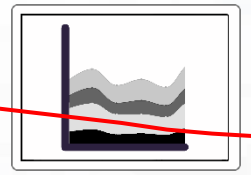


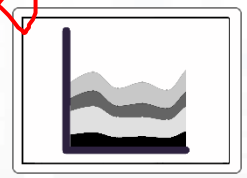








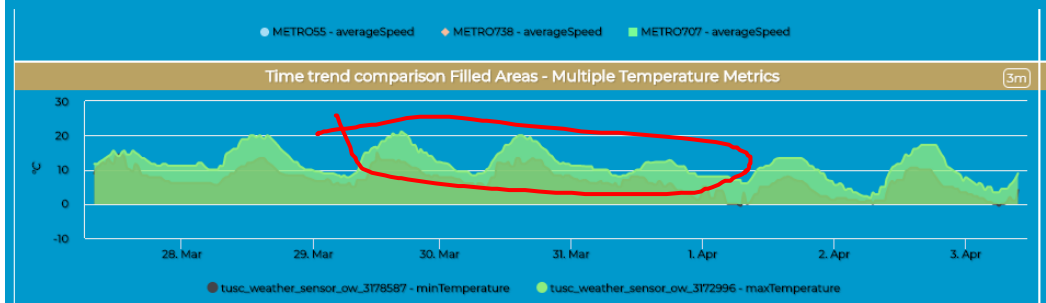


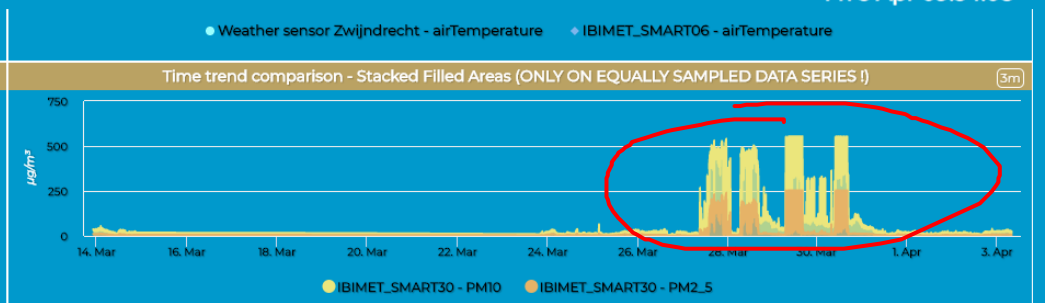
- **Staked, shaded or regular**,
- Grouped by Value_unit, **linear** or **Logarithmic**
- From historical data and/or **dynamic** data from IOT Applications

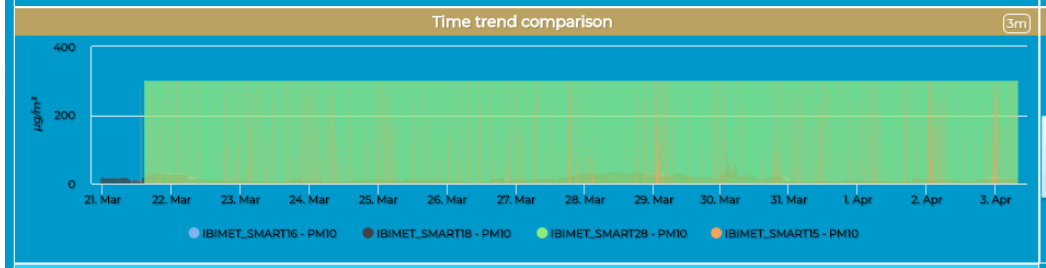
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjUzMg=

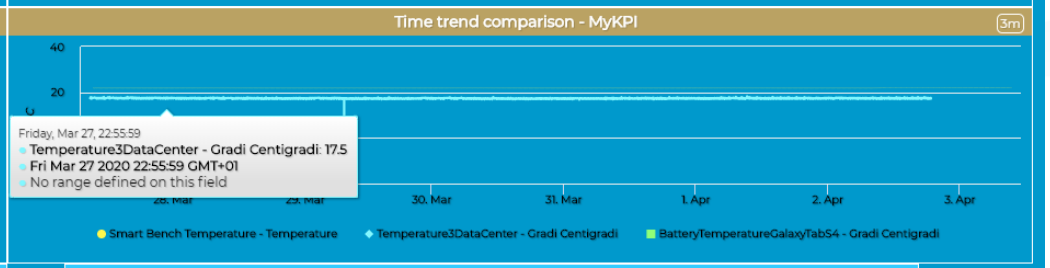
# Time Series Test - Cloned

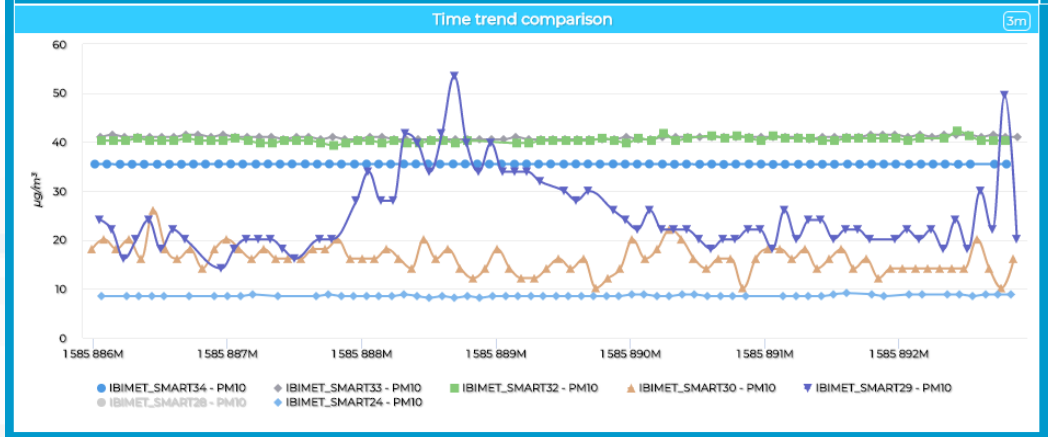
Fri 3 Apr 09:54:08

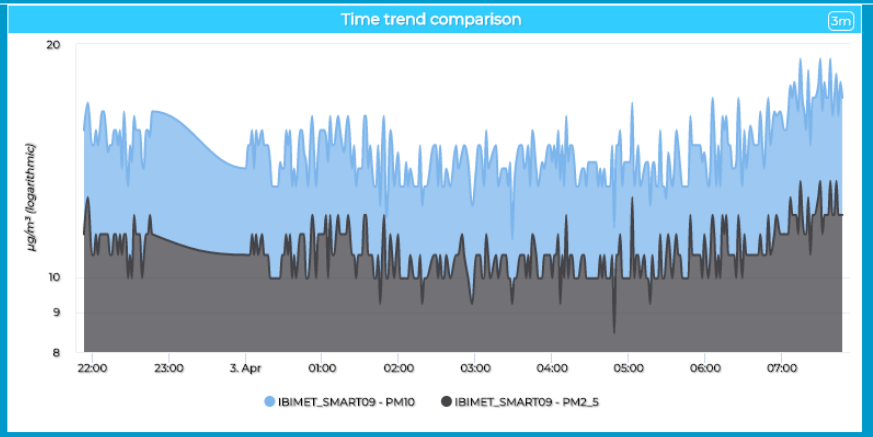
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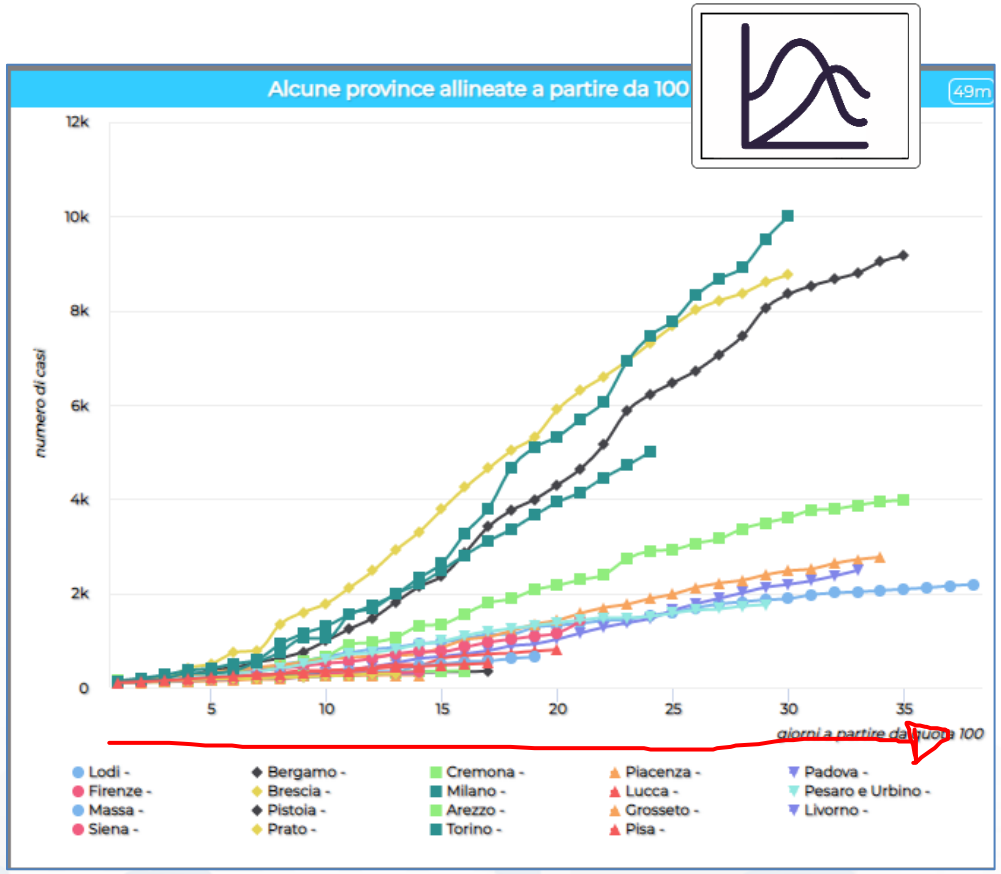
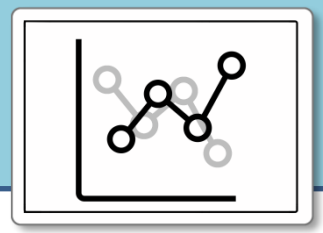
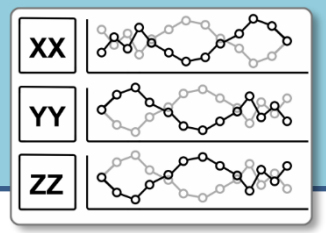
# Ordered Data Series

- A series or multiple series which are ordered by a number:
  - E.g., 1,2,3,4,5,……N
- For each number (position over X axis, a value on Y axis is provided)
- It is provided from the multiseries widget with setting parameters from MoreOptions
- Series can be also provided from IOT Apps



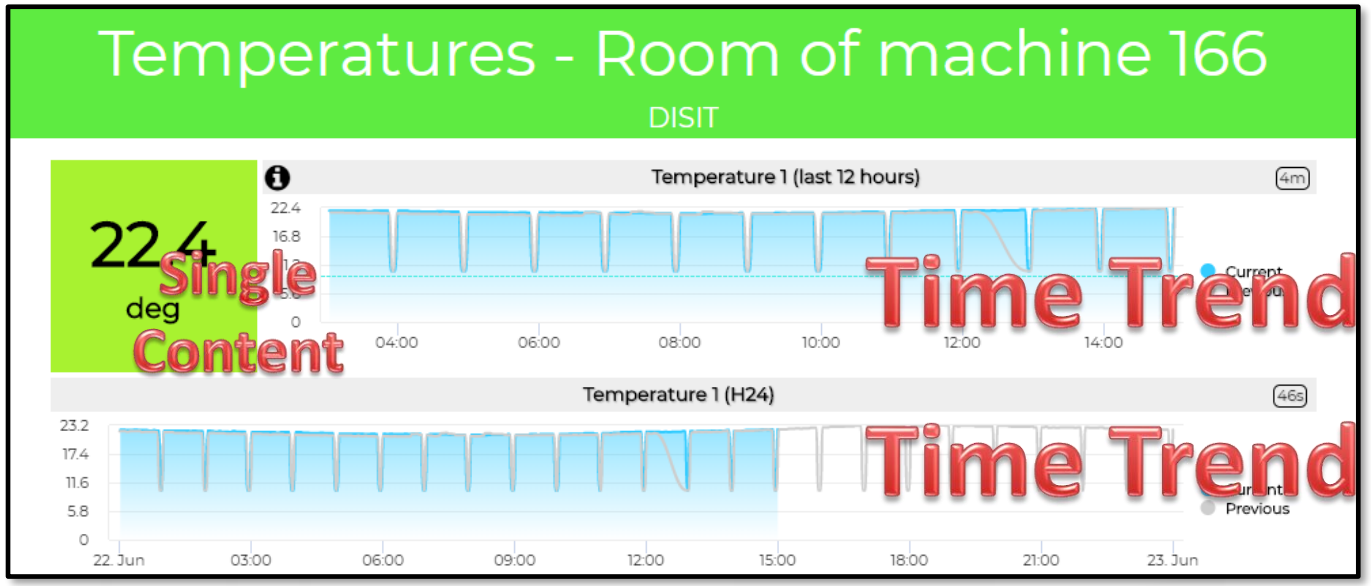
# Time Trend Compare Widgets for Time Series







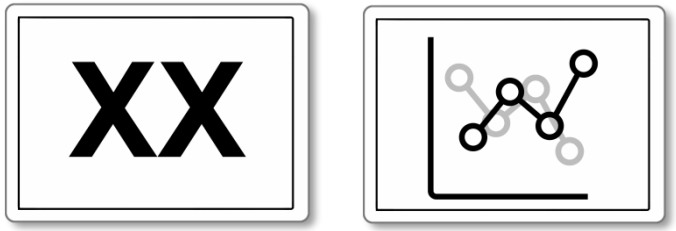

https://www.snap4city.org/710

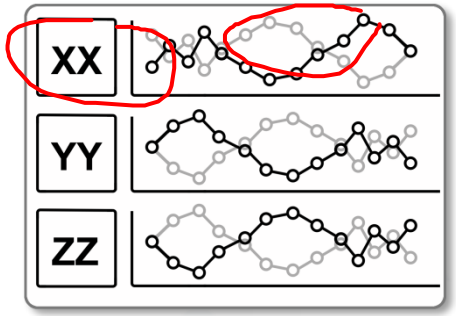


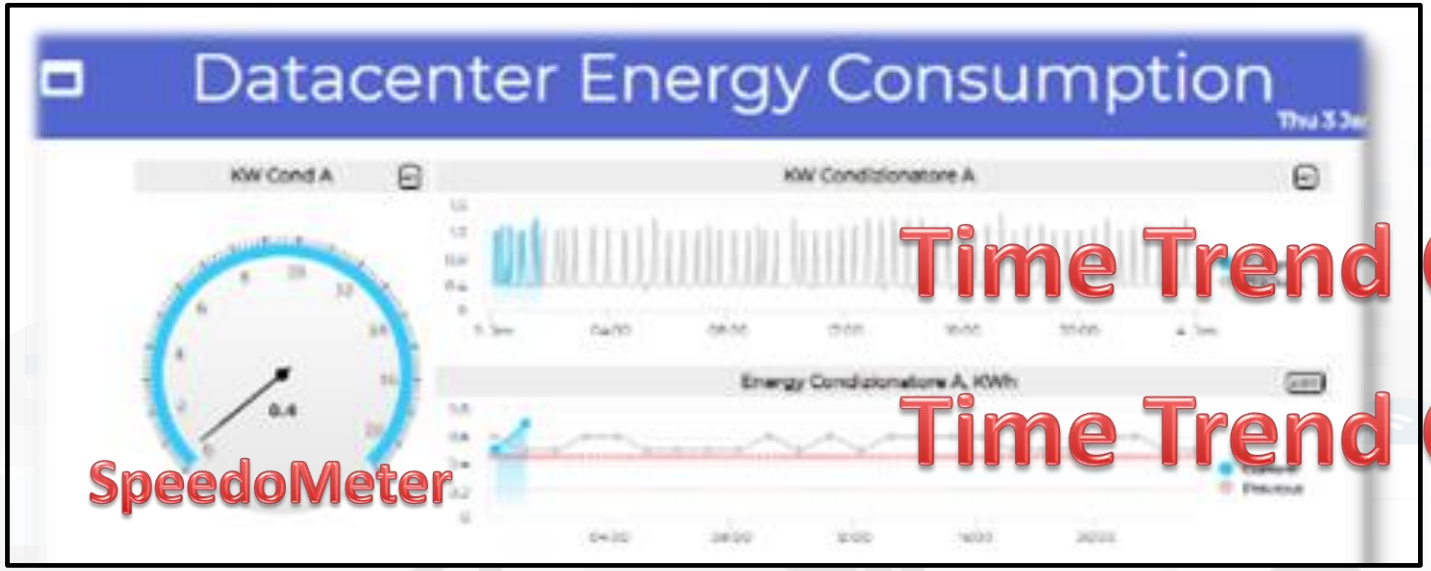

Single Content

Time Trend Compare

Time Trend Compare



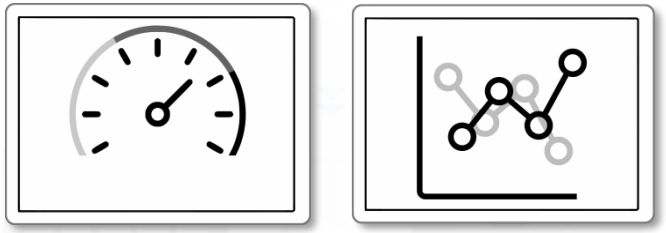




SpeedoMeter

Time Trend Compare

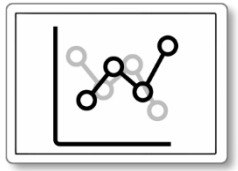
Time Trend Compare



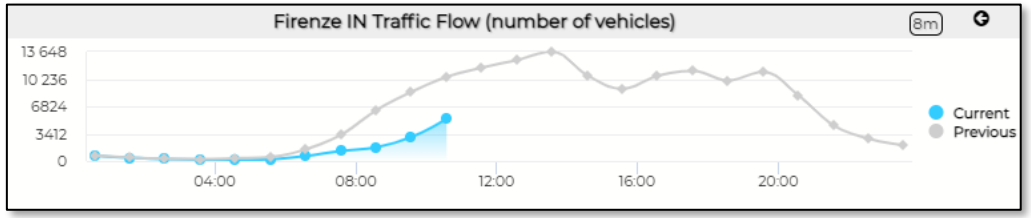
They manage
HLT: Sensor

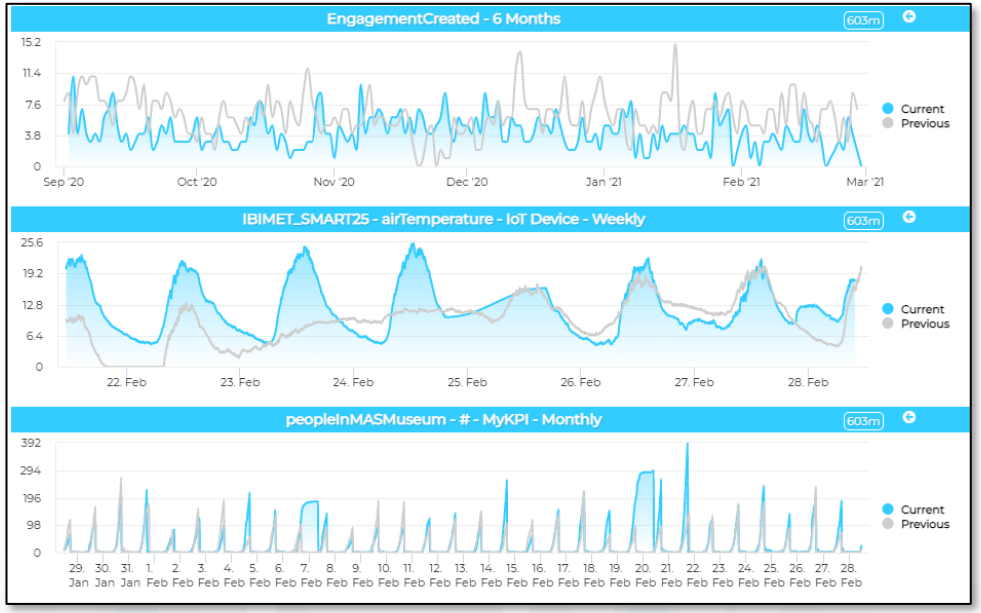
# Time Trend Compare

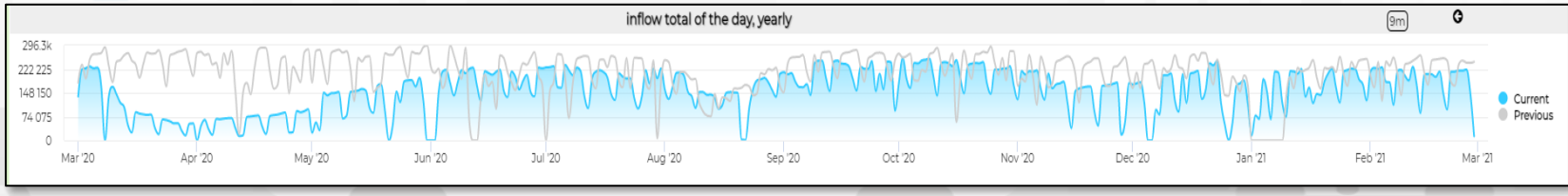
## A tool for visual Analytics, Comparing



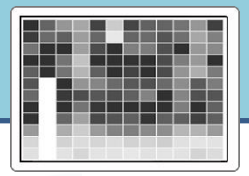
- **4 hours** wrt those before, or same hours of previous day
- **12 hours** wrt those before, or same hours of previous day
- **Day** wrt day before, or same day of previous week or month
- **Week** wrt to previous week, or
  - week starting on Monday
- **Month** wrt to previous month, or
  - previous month starting 1st day, or
  - same month of the previous year
- **6 Months** wrt to previous 6 months, or
  - Aligned day 1 or same 6 months previous year day 1 or
  - 6 months previous year day 1 aligned 1st or 2nd semester
- **Year** wrt to previous year, or
  - previous year starting 1st day, or
  - previous year starting same month



# Calendar Widgets for Time Series



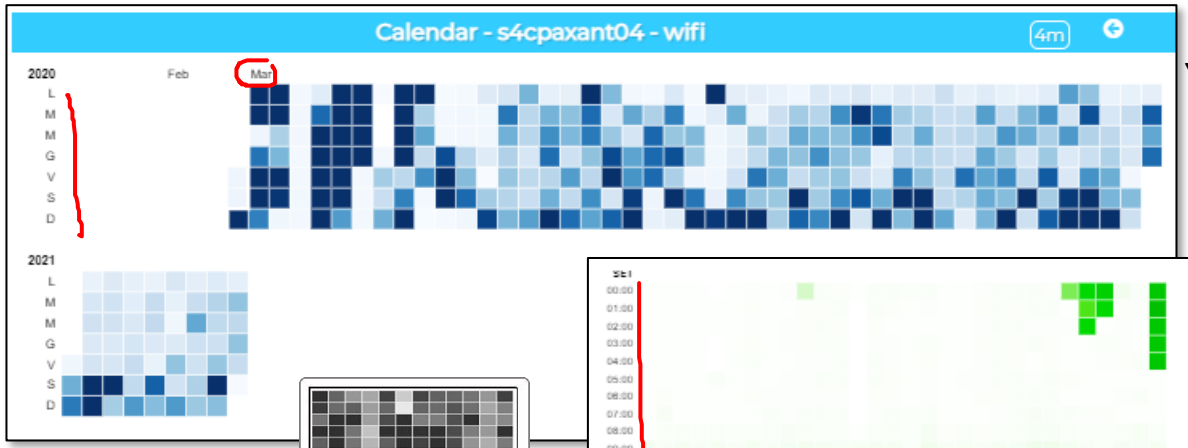


# Calendar

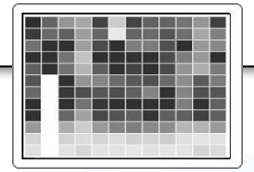
https://www.snap4city.org/706

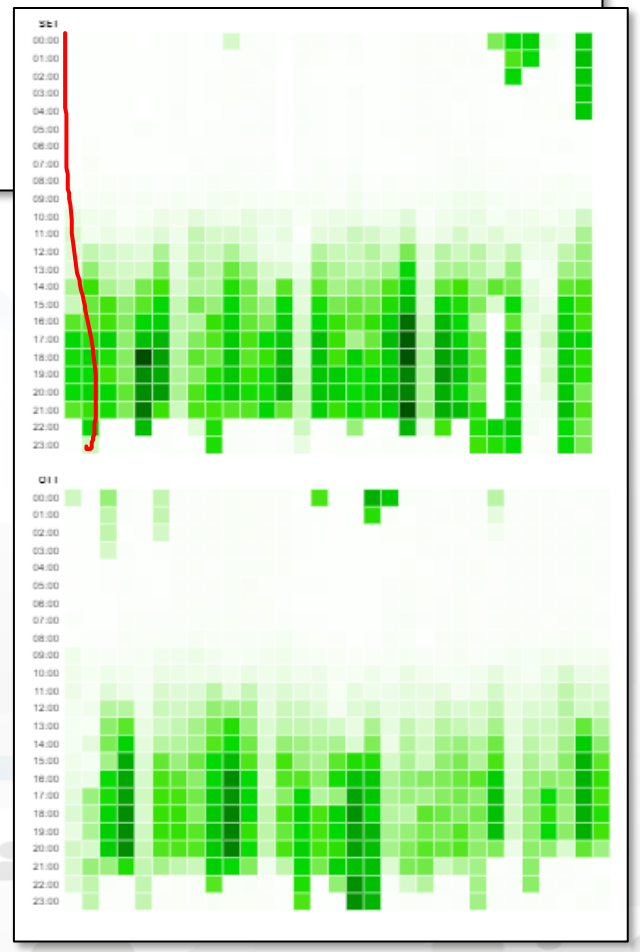
Showing: **Sum, Average or Median** value of a variable as a colored calendar:

- **Year**
  - 1 Year, 12 months, by weeks, per days
  - Time Range: 1D, 7D, 1M, 6M, 1Y
- **Month**
  - 30 days, 24 hours
  - Time Range: 1D, 7D, 1M, 6M, 1Y
- **You can scroll in history**
- **They manage HLT: Sensor, MyKPI and work receiving Dynamic data from IOT App**




Year, 1Y

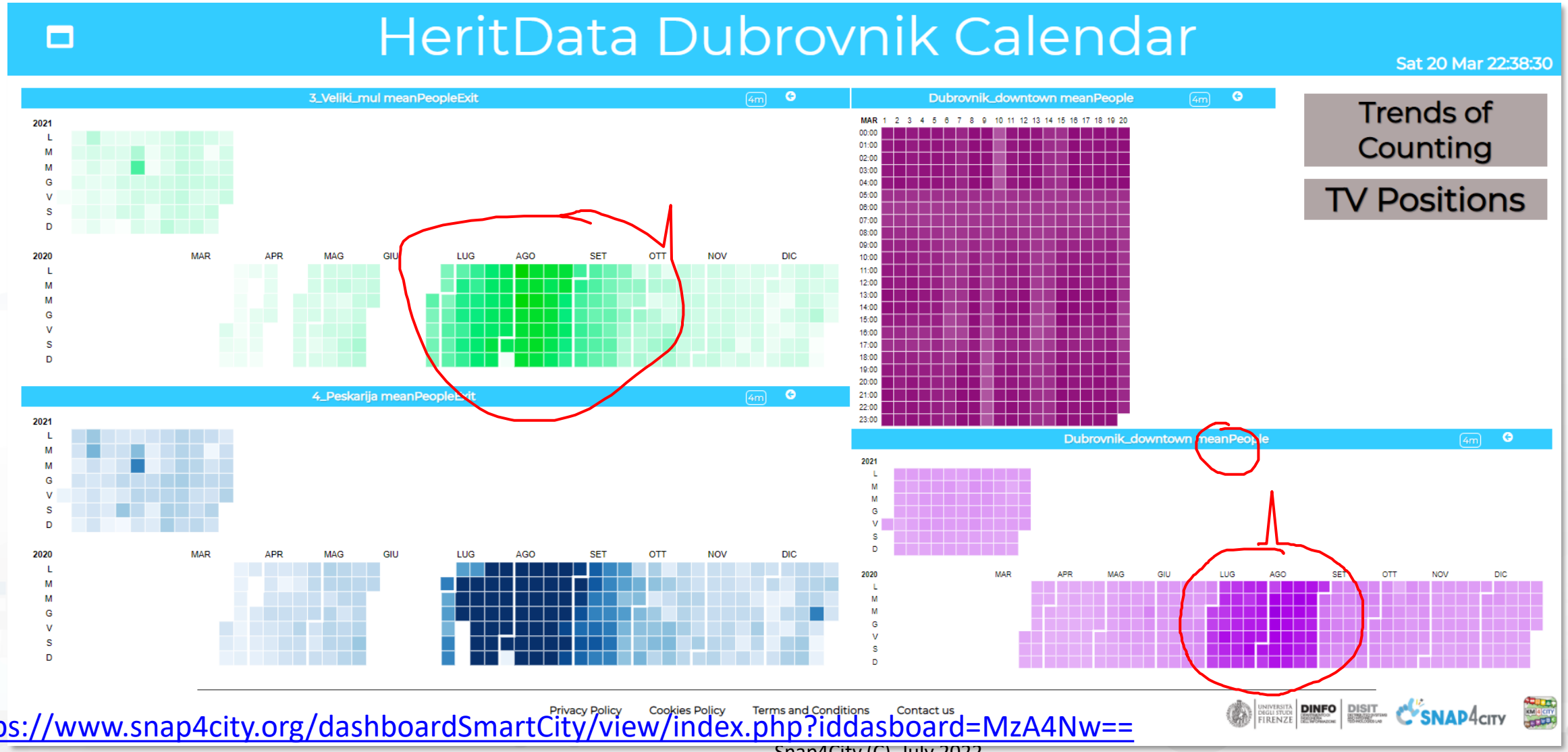




Month, 6M

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA4MA==

# Dubrovnik Calendar: Tvcamera people counting



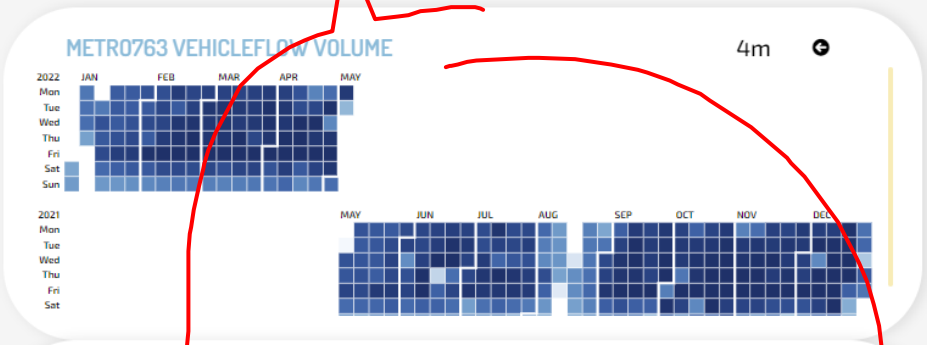

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA4Nw==

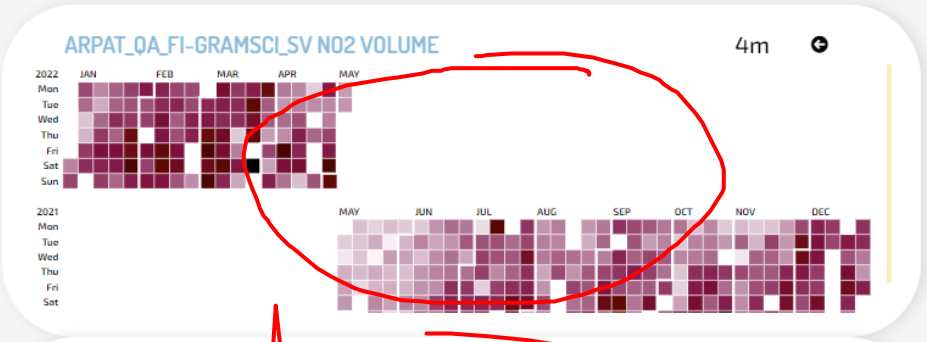
Ciao roottooladmin1

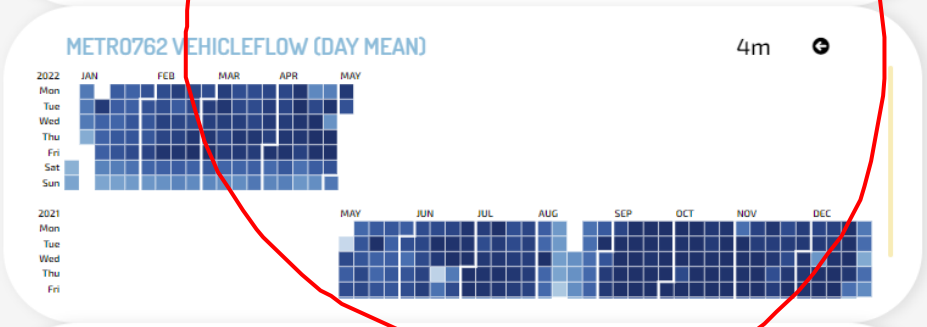
Tue 3 May 13:59:05

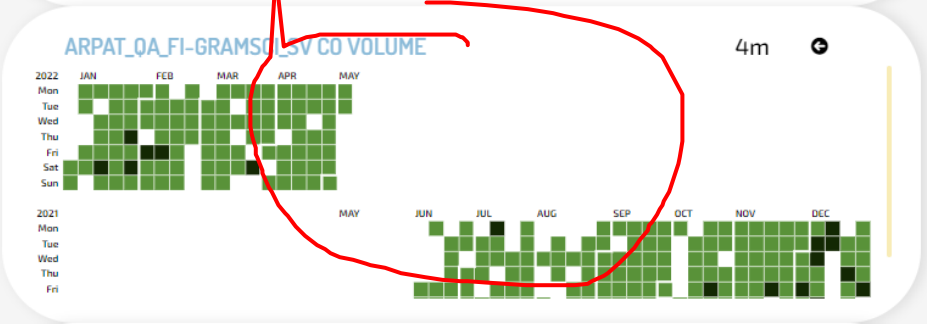
# HERIT-DATA - ACTIVITIES CALENDAR - NEWGUI

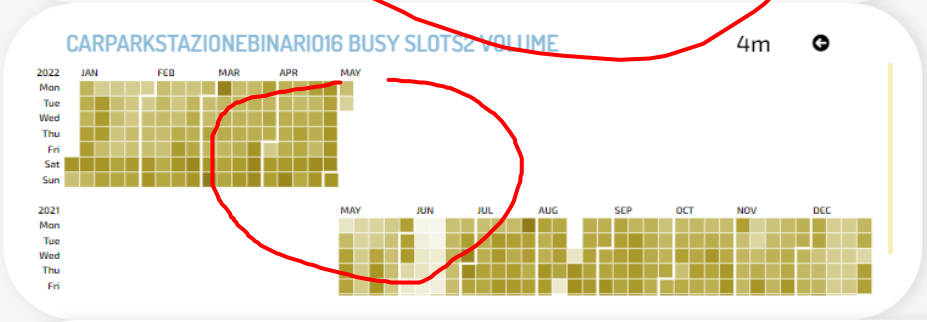
Interreg Mediterranean HERIT-DATA

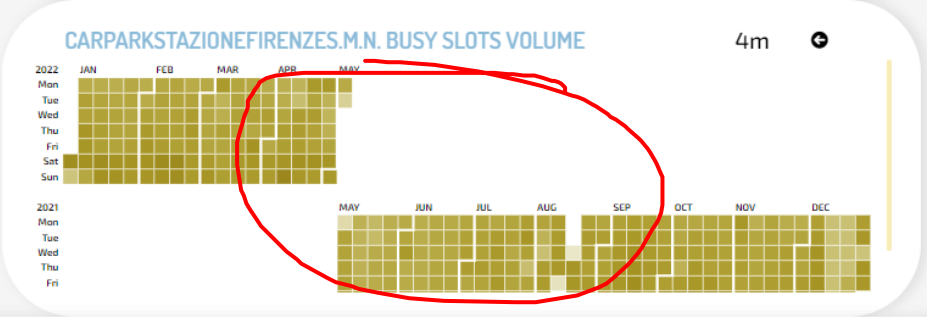


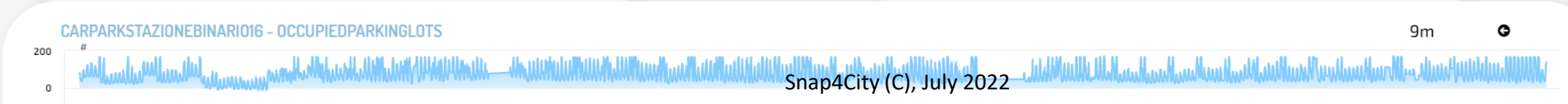



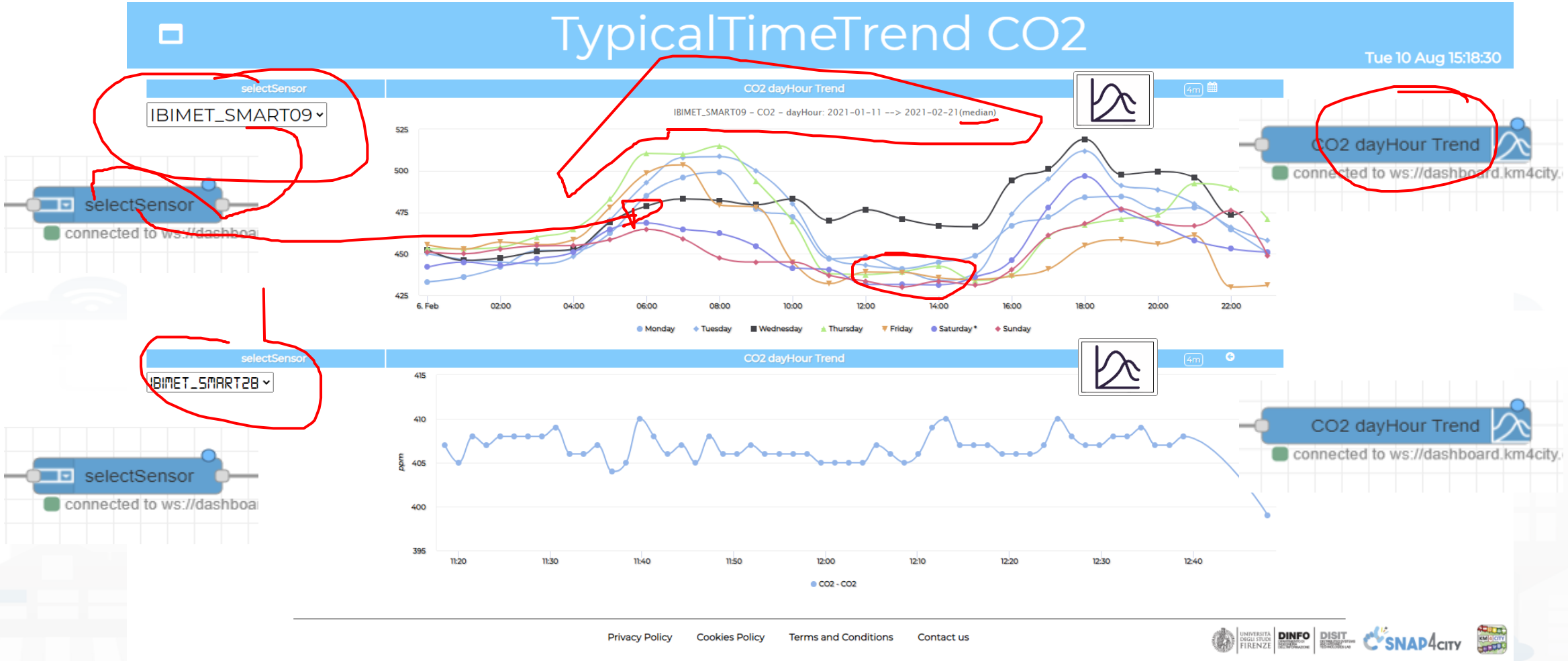



# Typical Time Trend, Visual Analytic on Time Series

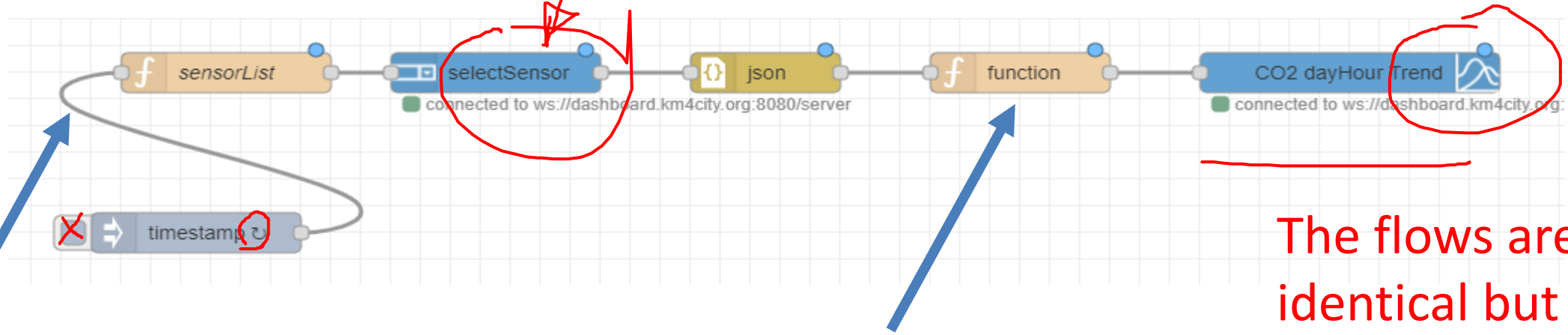


https://www.snap4city.org/705




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

# IoT App




```
msg.payload = { "options":   [
{ "label": "IBIMET_SMART09",
"value": "IBIMET_SMART09"},
{ "label": "IBIMET_SMART27",
"value": "IBIMET_SMART27"},
{ "label": "IBIMET_SMART28",
"value": "IBIMET_SMART28"},
{ "label": "IBIMET_SMART29",
"value": "IBIMET_SMART29"}
],   "selected":
"IBIMET_SMART09"  }return
msg;
```

```
msg.payload =
[ {
 "metricHighLevelType": "Sensor",
"metricName": "CO2",
"smField": "CO2",
"serviceUri": "http://www.disit.org/km4city/resource/"+msg.payload.selected      }
]
return msg;
```

The flows are identical but the different visualization is set via MoreOptions

# Typical Time Trend, & dynamic time series

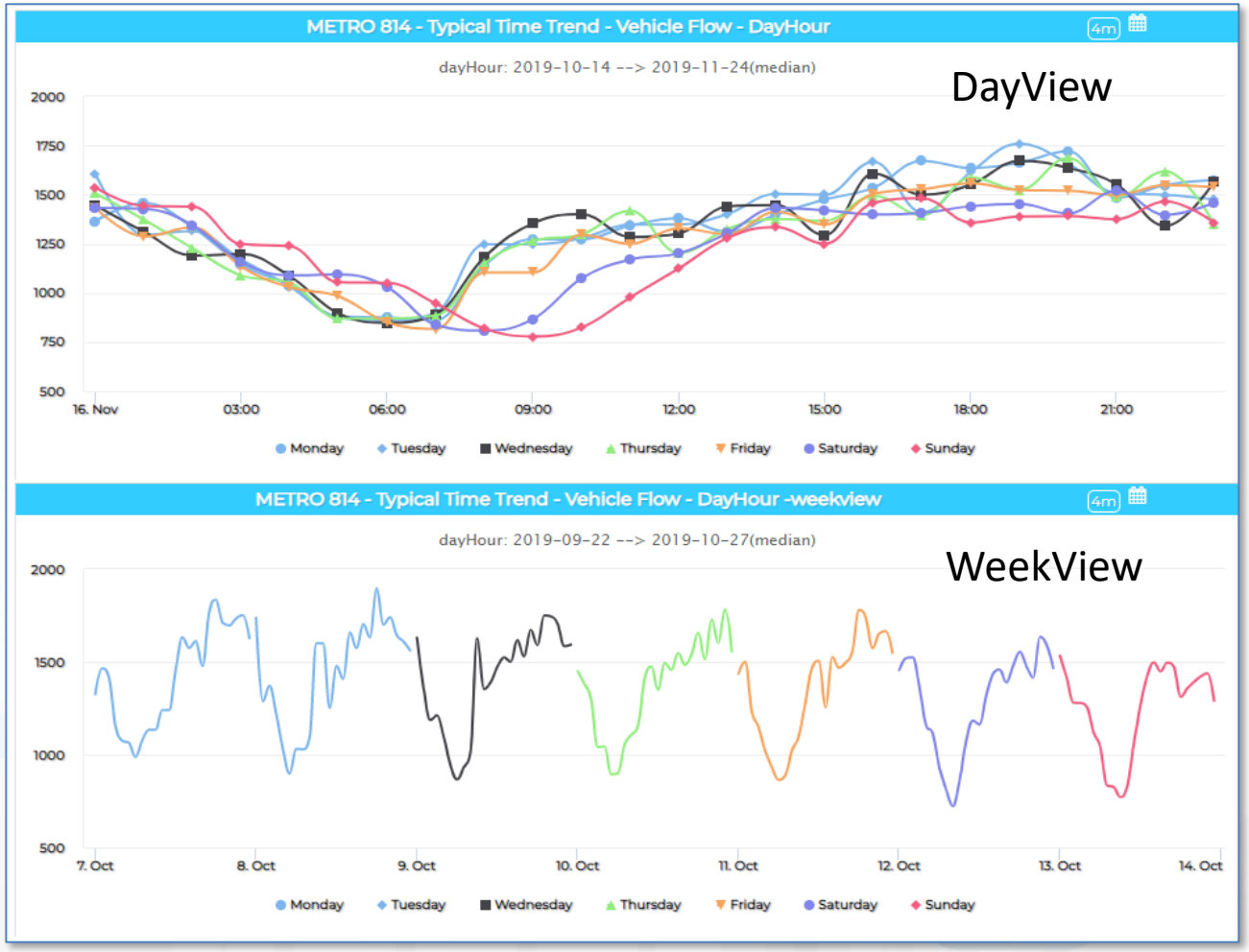


https://www.snap4city.org/705

# Typical Time Trend

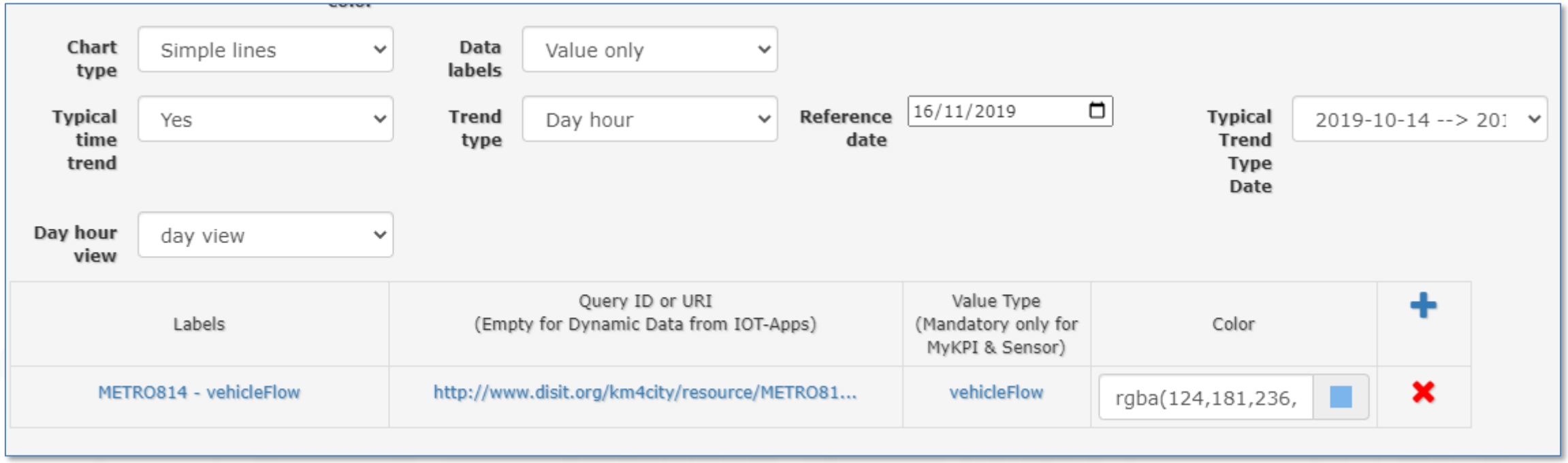


- They:
  - **need to be computed in advance** on the basis of a Time Serie variable, and a reference period of computation.
  - **represent typical trends of: min, max, average, median**
  - You can change the data on view
- **Formats**:
  - **DayHour**: 7 time trends, one for each day of the week, each hour, 24 values.
    - As DayView or WeekView, start monday
  - **MonthDay**: a value per day, 30 values of the month.
  - **MonthWeek**: a value per day aligned to week days: 28 values, 4 weeks.
    - 1st Monday of the month
    - 3rd Friday, etc.




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA4NA==

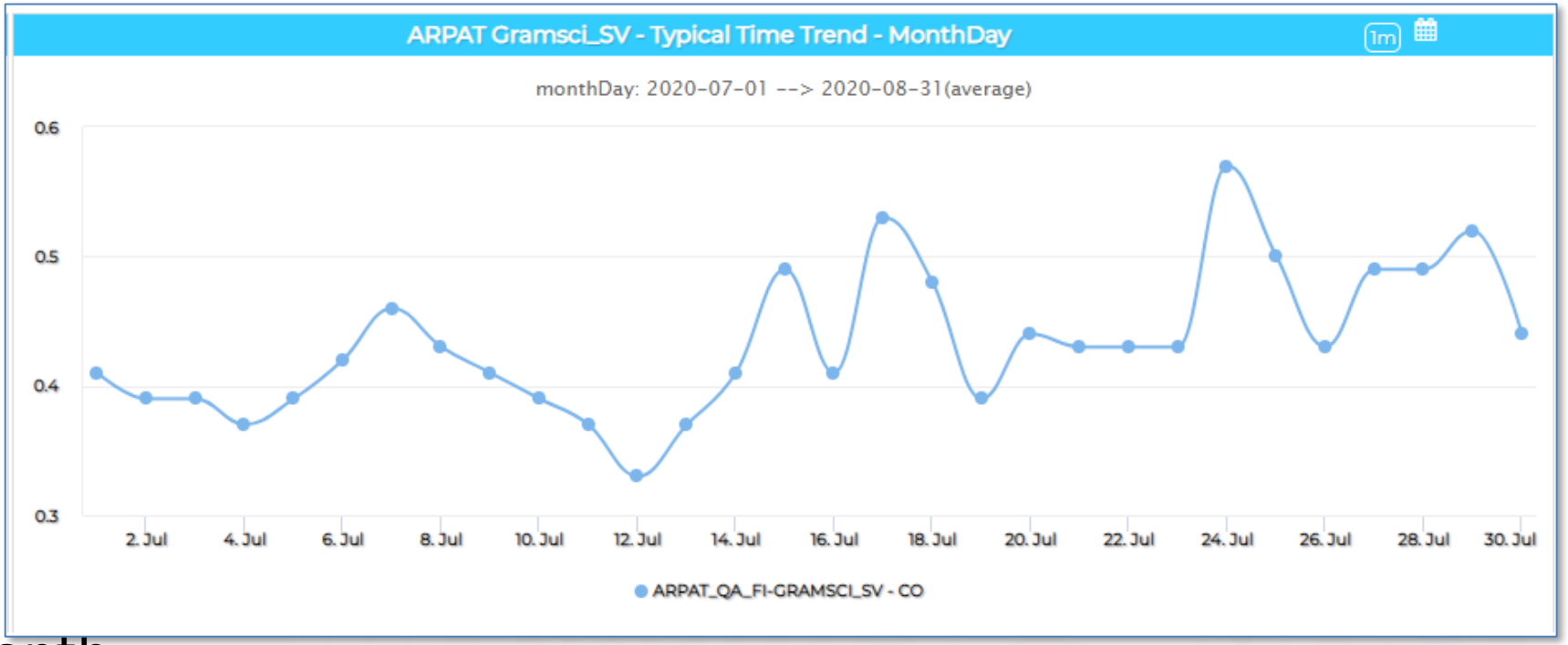
# TTT More Options




- DayHour as DayView
- Any TTT which can include the data 16/11/2019
- Each TTT is computed on the basis of  a Time range: from-to including that date

# TTT: Month Day

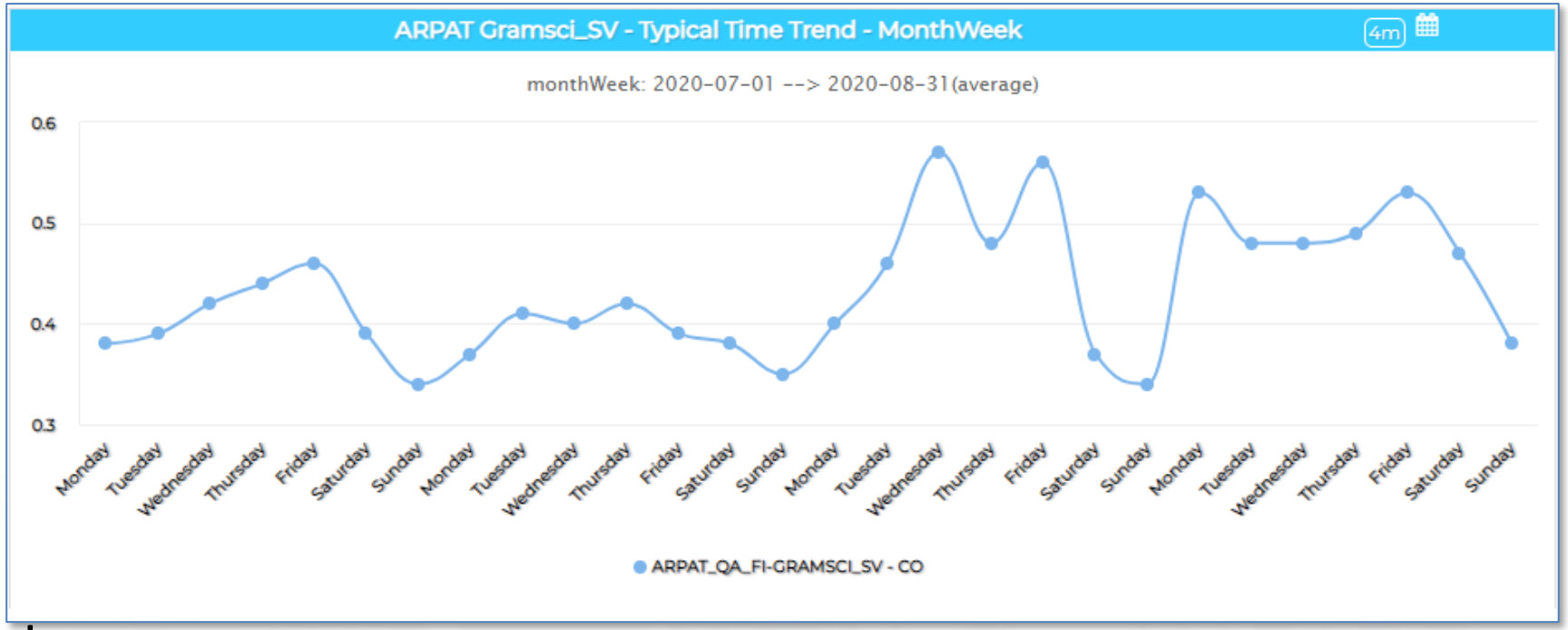





- **MonthDay**:
  - a value per day,
  - 30 values of the month.
  - Aligned from the first day of the month
  - computed on the basis of  a Time range: from-to including that date
    - e.g.: 2 months
    - As min, max, average, median
    - You can change the data on view

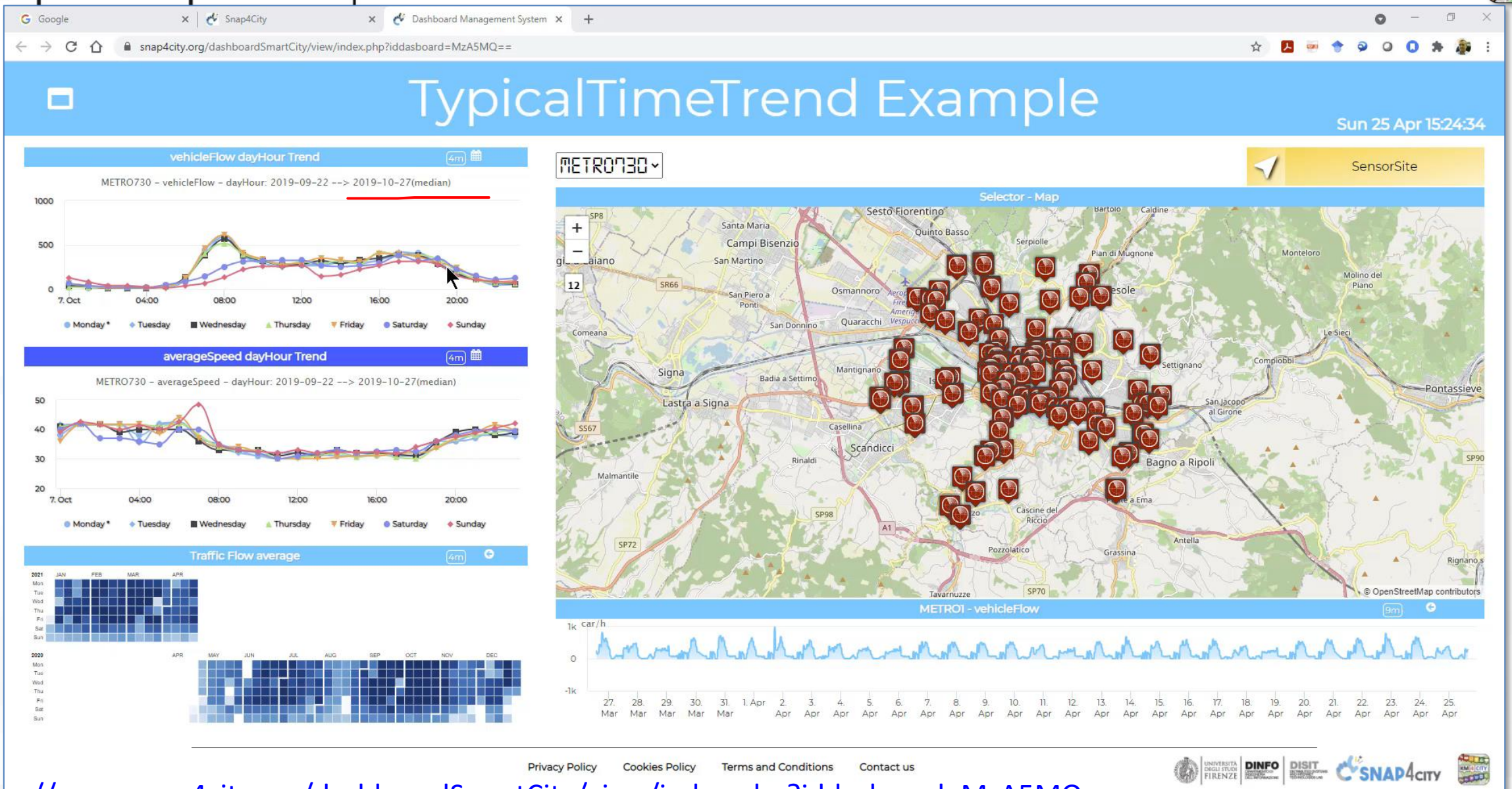
# TTT: Month Week






- **MonthWeek**:
  - a value per day,
  - 30 values of the month.
  - Aligned from the first Monday of the first week of the month
  - computed on the basis of  a Time range: from-to including that date
    - e.g.: 2 months
    - As min, max, average, median
    - You can change the data on view

# Typical Time Trends

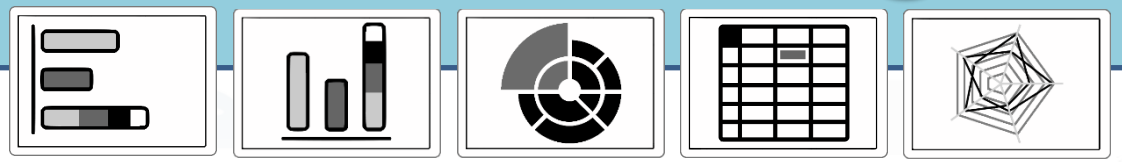


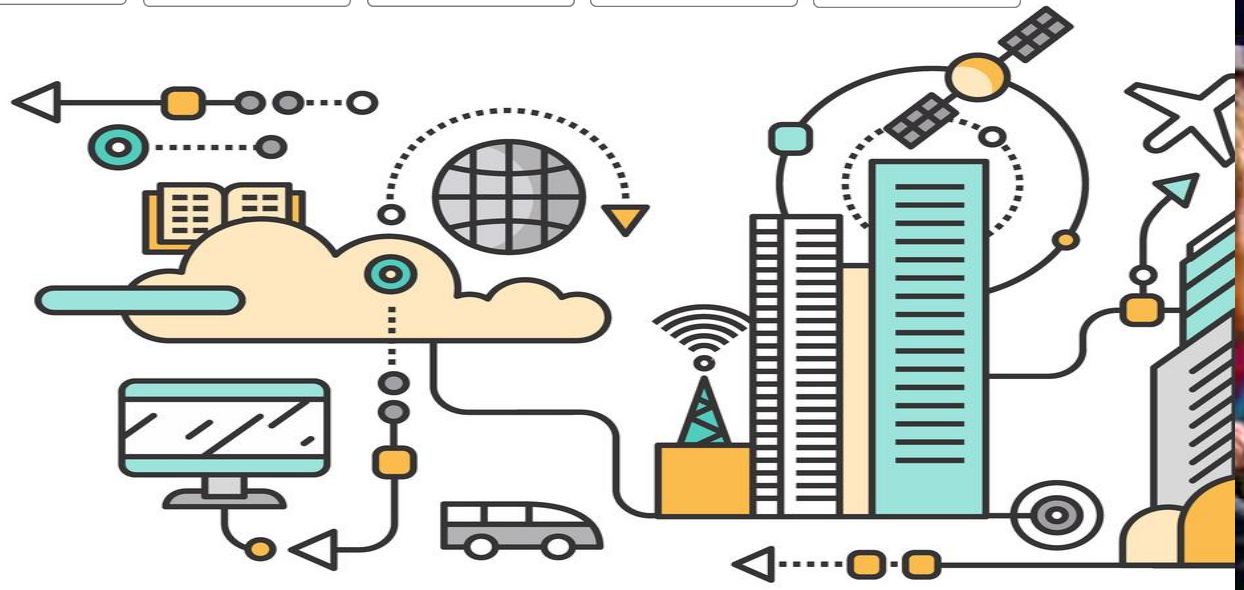

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA5MQ==

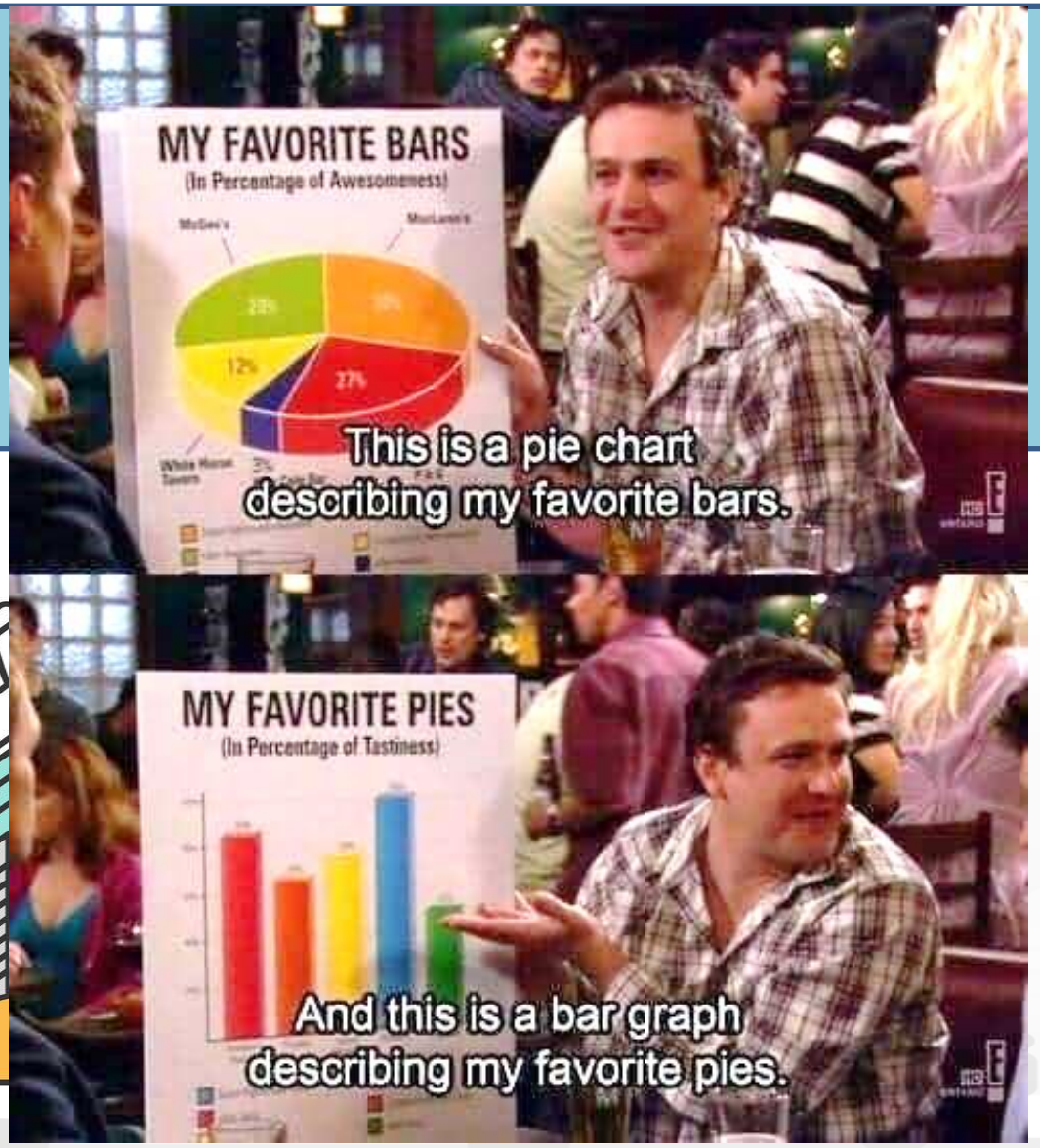
# Typical Time Trend

- **They can be generated from IOT App**
  - 1) exploit MultiSeries block on Node-RED
  - 2) send sensors ServiceURI, or MyKPI ID or dynamic vector
  - 3) go on dashboard and set the parameters on More Option as described above.
- **They can be used as low costs predictions:** produced with a part of the temporal window in the future. For example,
  - 2 weeks in advance
  - Exploiting the 4 weeks in pasts

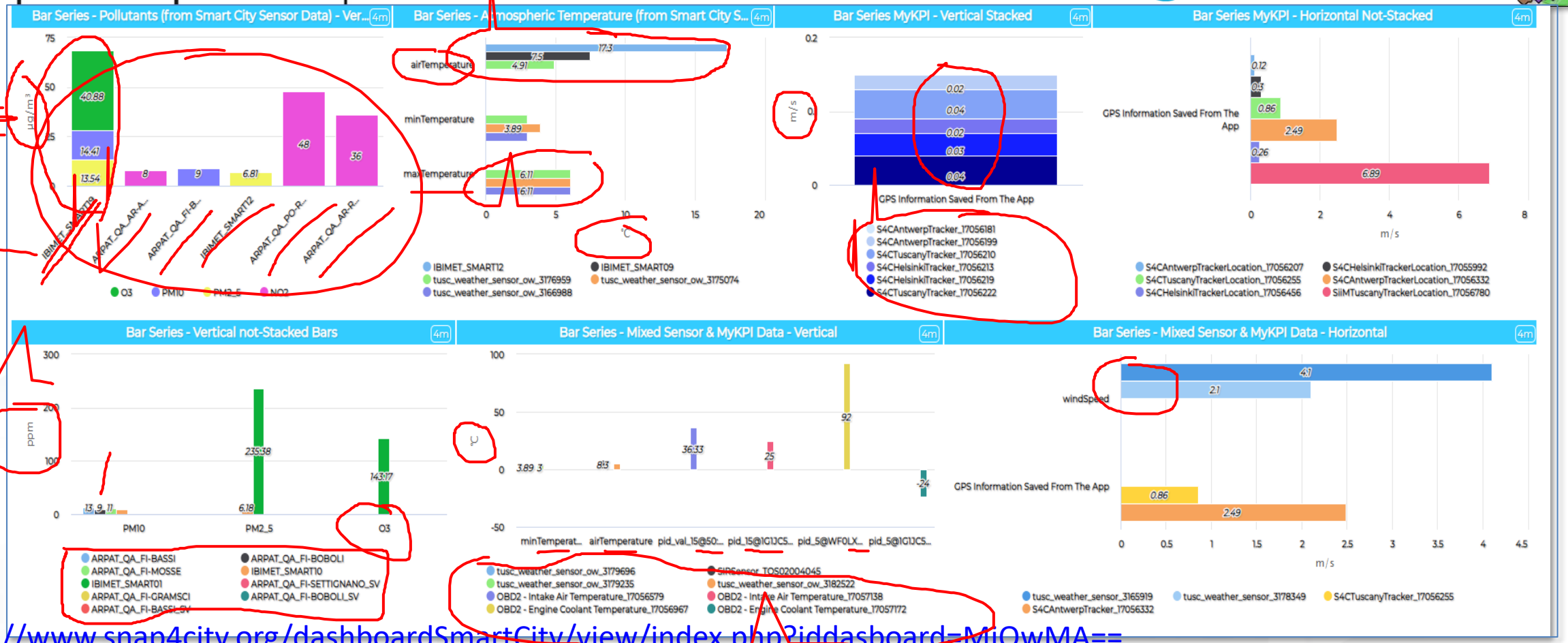
# Bars, Pies, Donut, Tables Widgets





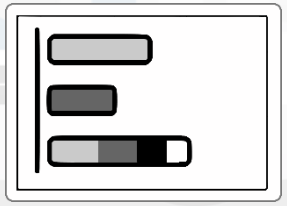


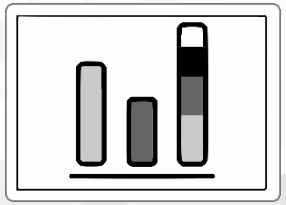
# Barseries



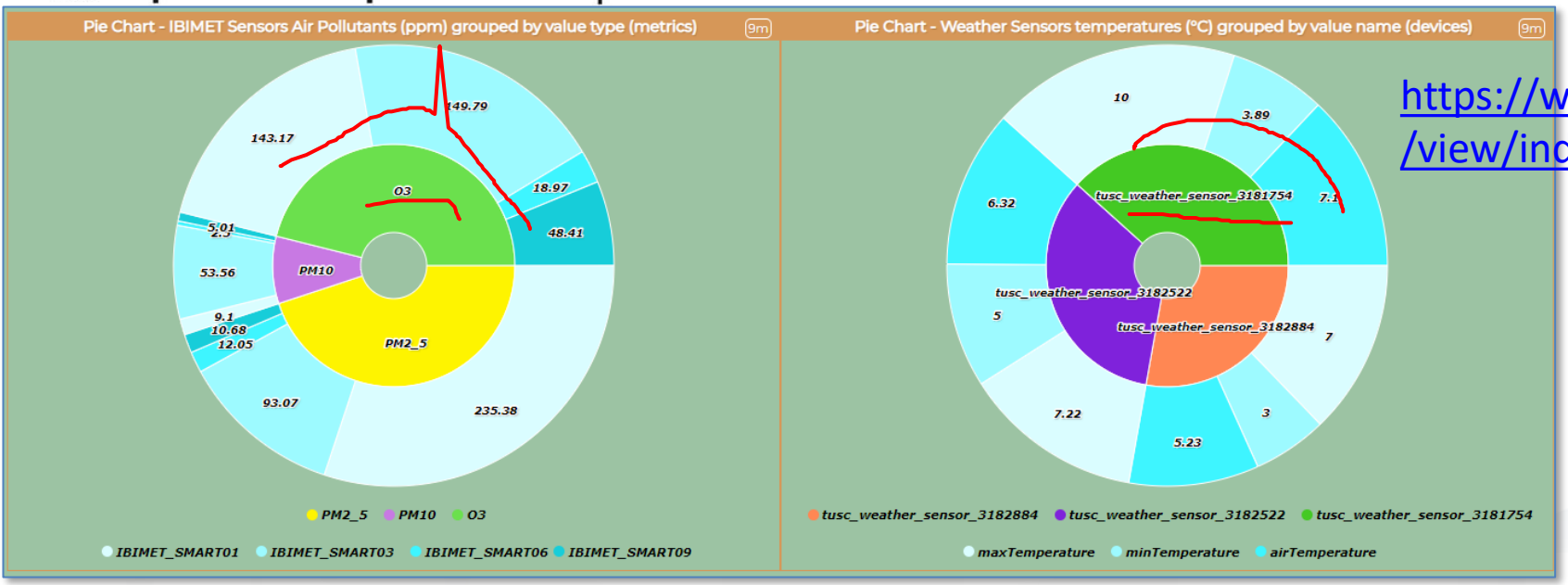

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjQwMA==

- **Staked and grouped** by Value_Name / Value_Type
- **Oriented**: Vertical and Orizontal
- **ordered** by value: crescent, descendent
- From historical data and/or dynamic data from IOT Applications





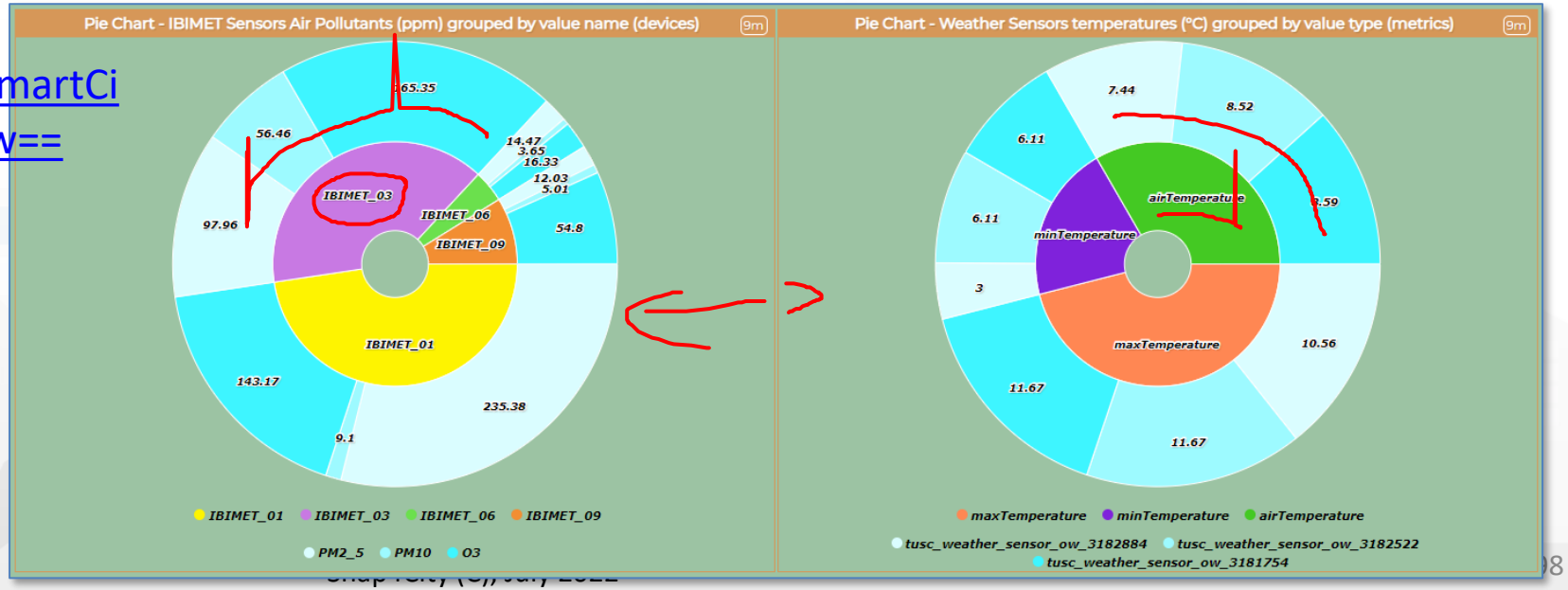
# Pie & Donut




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

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

- Single level Pie and two levels as Donut
- Grouped ValueType, ValueUnit



# Tables

Table - Weather Metrics and Pollutants

| value type / value name | airHumidity | airTemperature | PM2_5 | PM10 | O3 | CO |
|---|---|---|---|---|---|---|
| IBIMET_SMART_01 | 39.9 | 19 | 235.38 | | 143.17 | 0.19 |
| IBIMET_SMART_03 | 48 | 13.3 | 97.96 | | 165.35 | 0.16 |
| IBIMET_SMART_04 | 56.6 | 13.4 | 0 | | 300 | 0.17 |
| IBIMET_SMART_06 | 61.4 | 10.8 | 14.47 | | 16.33 | 0.16 |
| IBIMET_SMART_07 | 84 | 10.6 | 13.32 | 4.41 | 244.88 | 0.15 |
| IBIMET_SMART_08 | 0 | 21.9 | 2.7 | 2.47 | | 0.14 |
| IBIMET_SMART_09 | 53.3 | 9.6 | 12.03 | 5.01 | 54.8 | 0.12 |

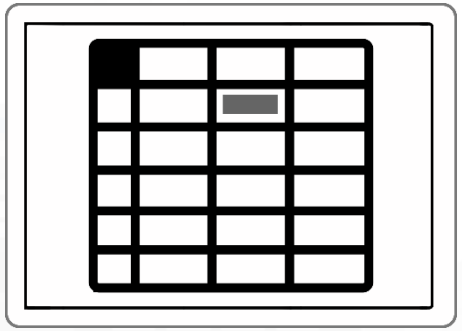
< 10
10 ⟷ 20
20 ⟷ 30
30 ⟷ 40
40 ⟷ 50
50 ⟷ 60
60 ⟷ 70
70 ⟷ 80
80 ⟷ 90
> 90

Table

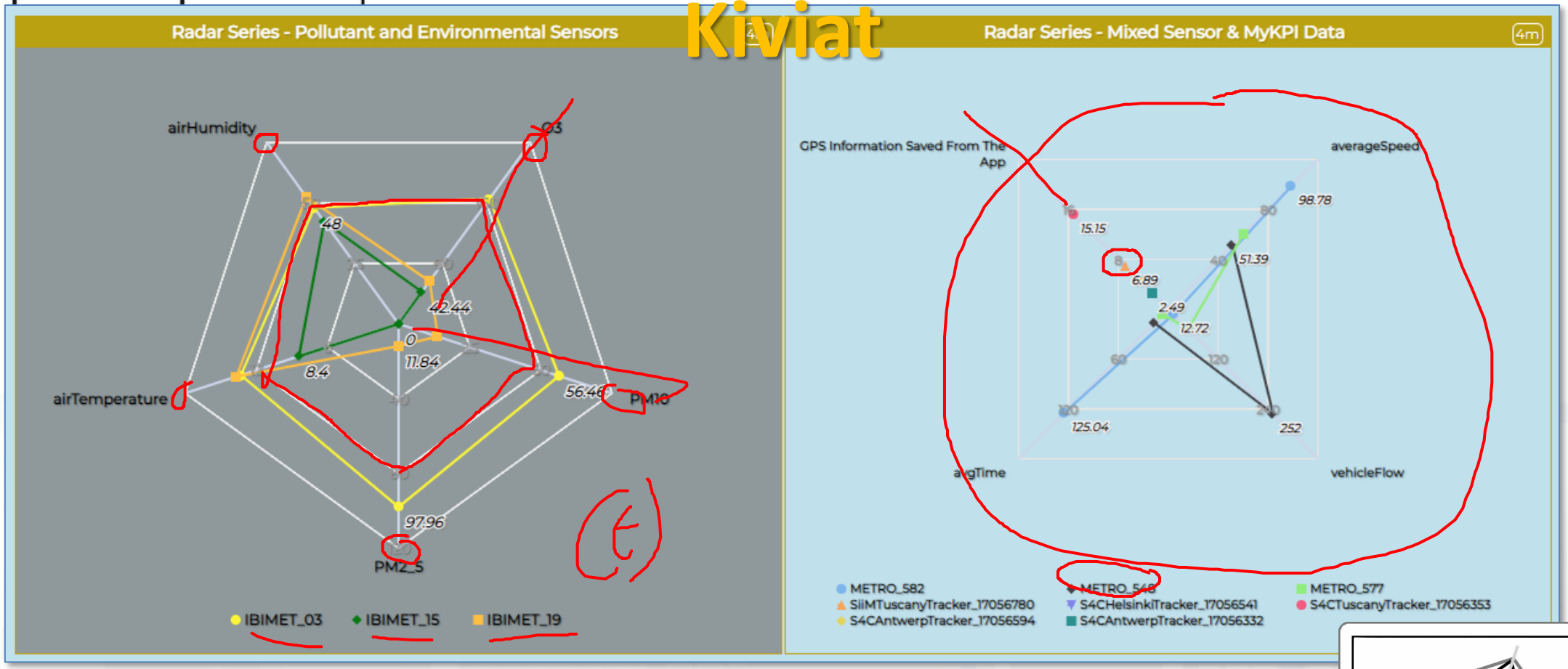
| value type / value name | chargingState | stationState |
|---|---|---|
| eCharging_15EP22T2AA1S000001 | AVAILABLE | ACTIVE |
| eCharging_15EP22T2AA1S000002 | FAULT | MAINTENANCE |
| eCharging_15EP22T2AA1S000003 | AVAILABLE | ACTIVE |
| eCharging_15EP22T2AA1S000004 | AVAILABLE | ACTIVE |
| eCharging_15EP22T2AA1S000006 | FAULT | MAINTENANCE |
| eCharging_15EP22T2AA1S000007 | AVAILABLE | ACTIVE |
| eCharging_15EP22T2AA1S000008 | AVAILABLE | ACTIVE |
| eCharging_15EP22T2AA1S000009 | AVAILABLE | ACTIVE |

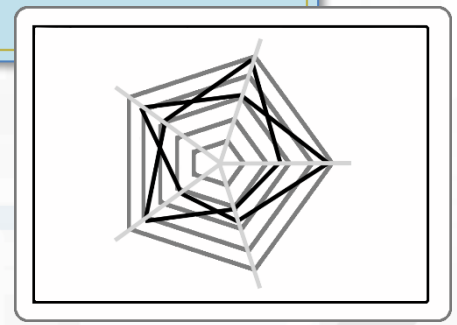
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjUzMw==

- Neutral or Colormapped, the same of heatmaps
- Number/text



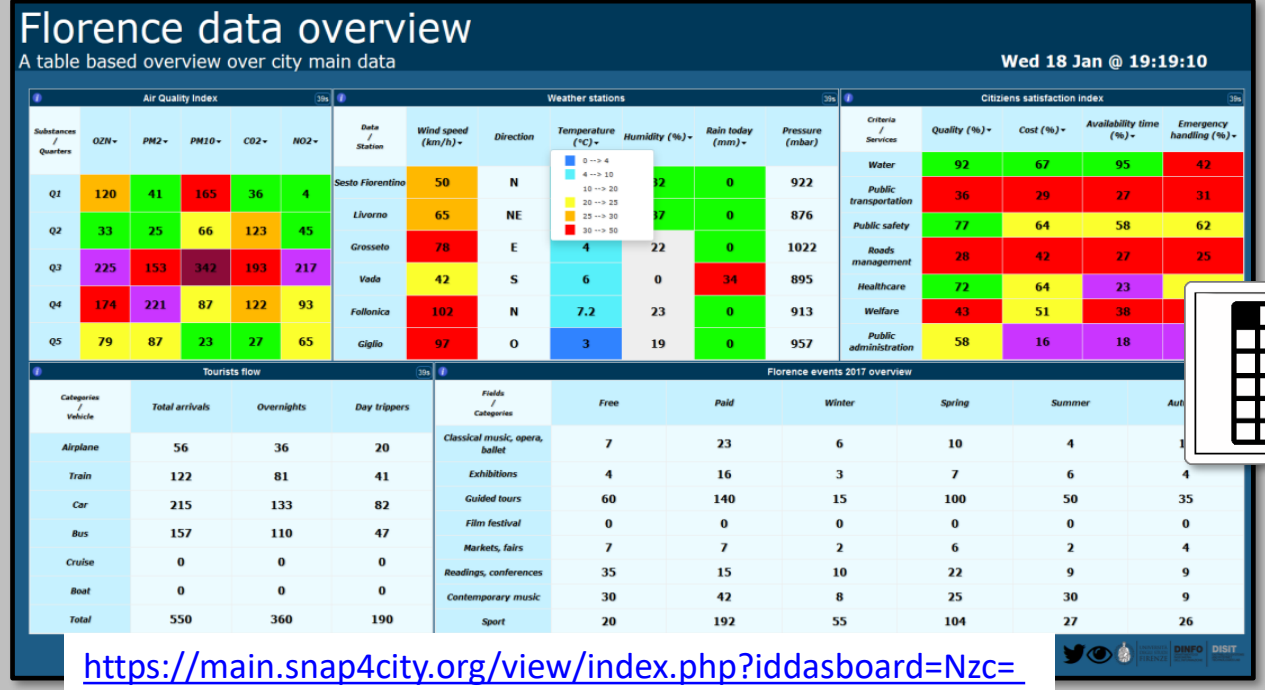
# Radar, SpiderNet Kiviat



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

- Normalized, multiple value units
- Hystorical, KPI and Dynamic from IOT App

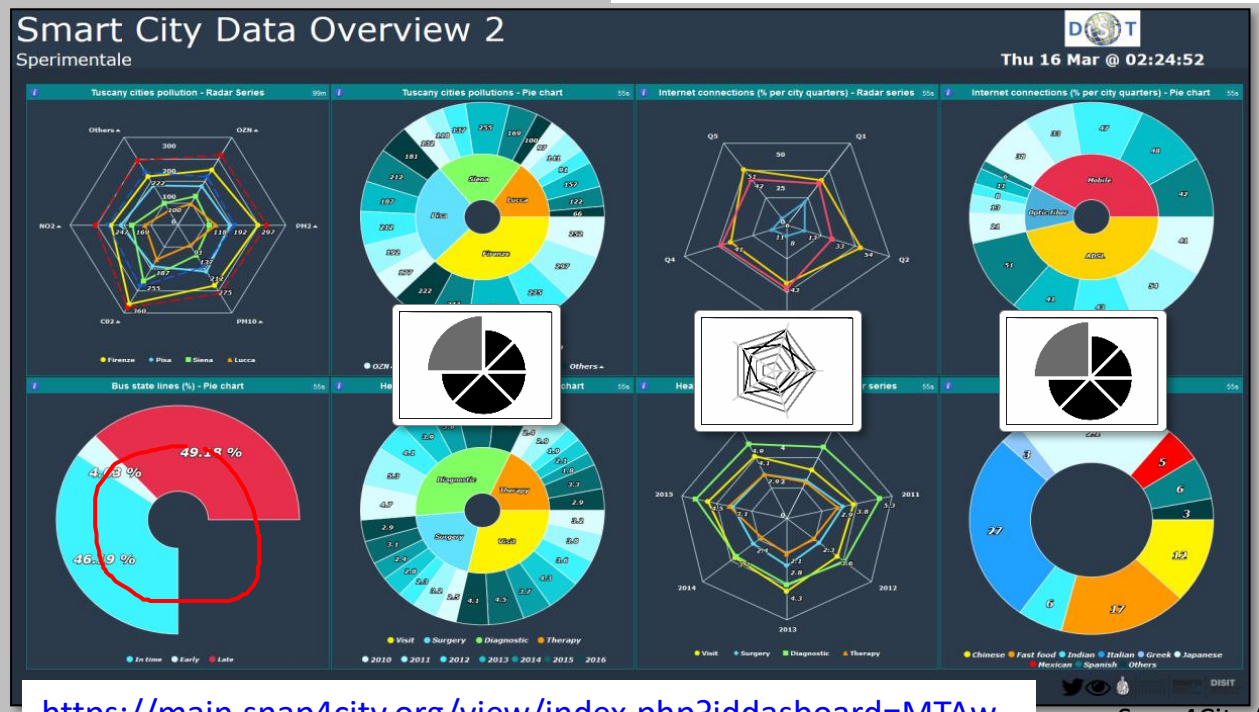



Table

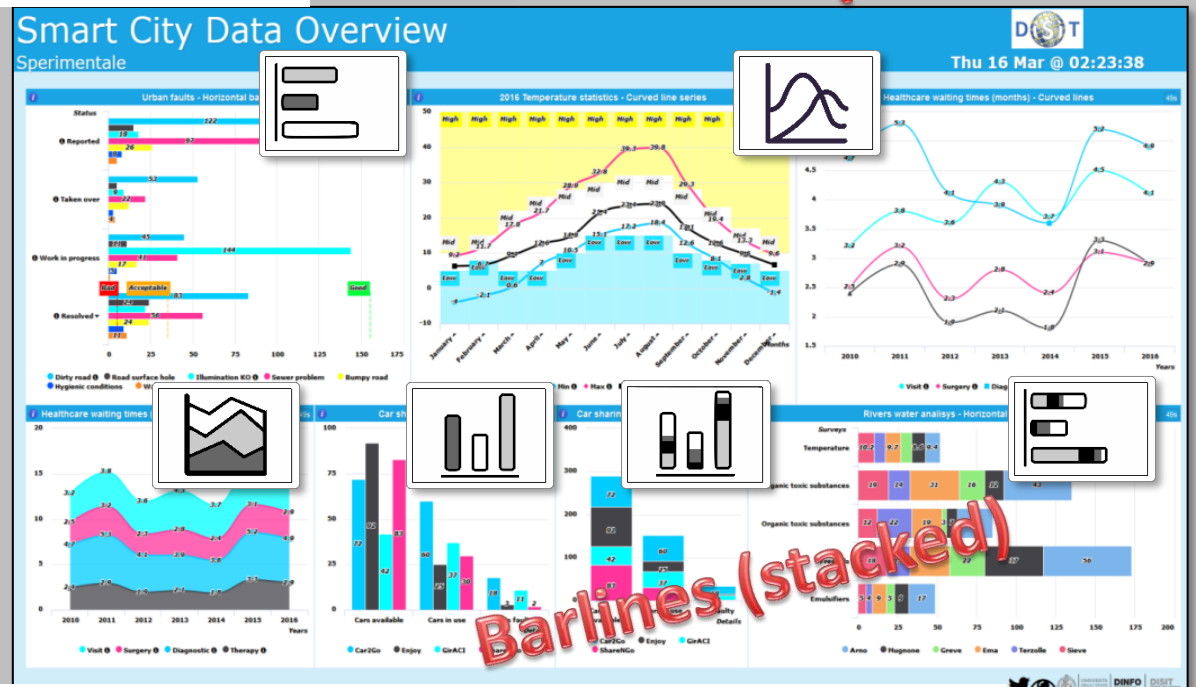
Kiviat and Pies

Curved Lines (stacked)

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



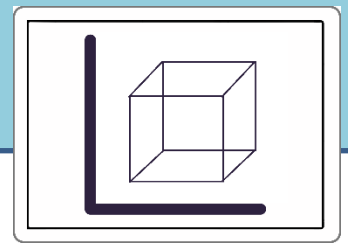

https://main.snap4city.org/view/index.php?iddasboard=MTAw




Barlines (stacked)

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

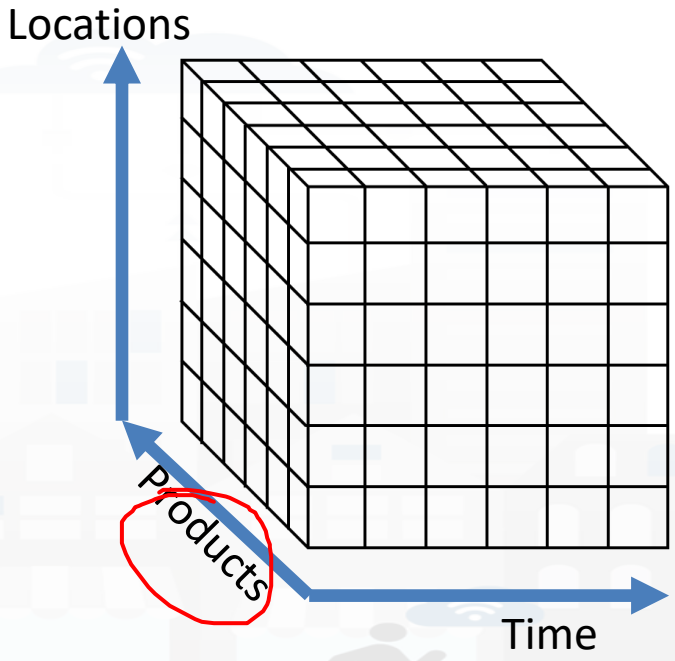
# OLAP Data Cubes Widgets

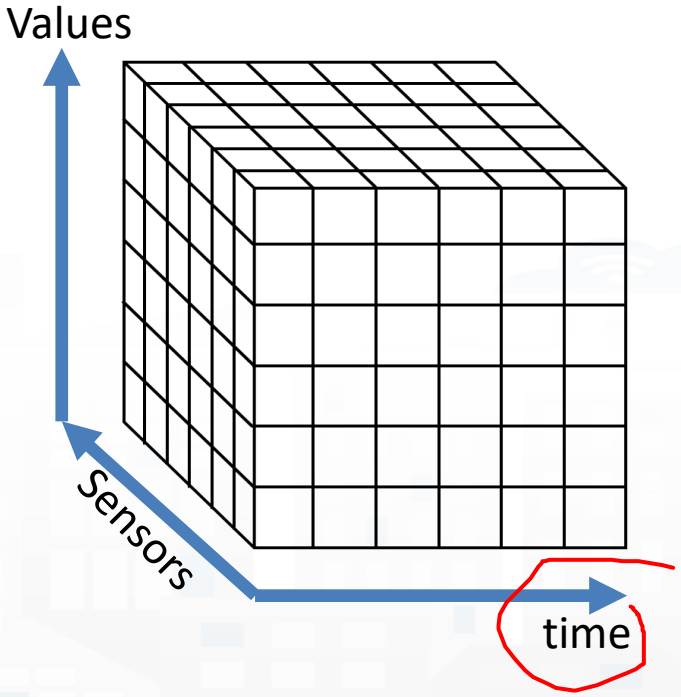


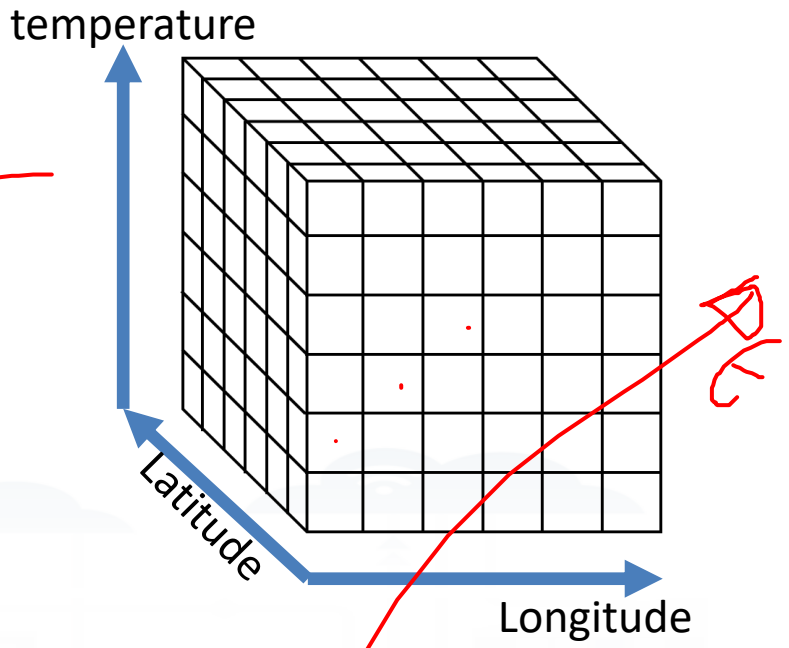


# The Data Cube

- Many different data Cube can be defined

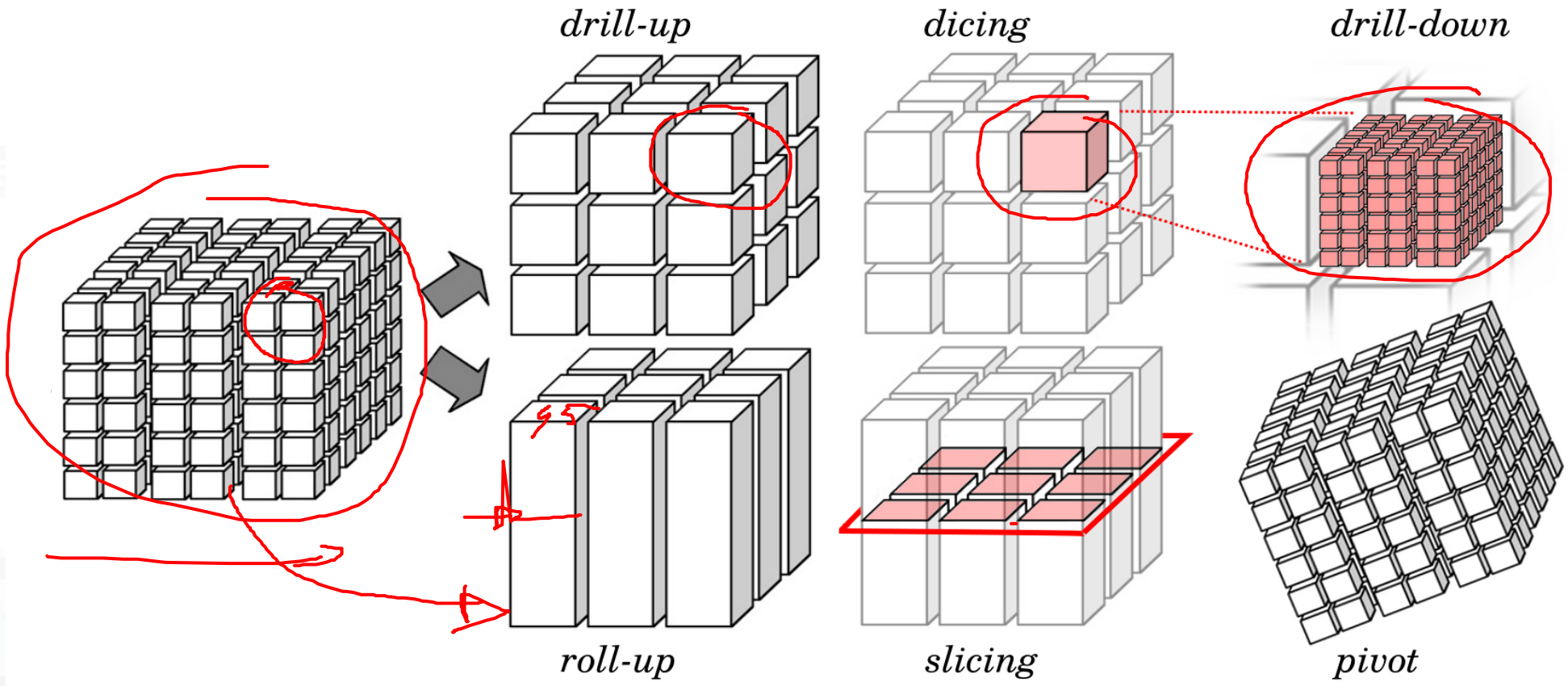


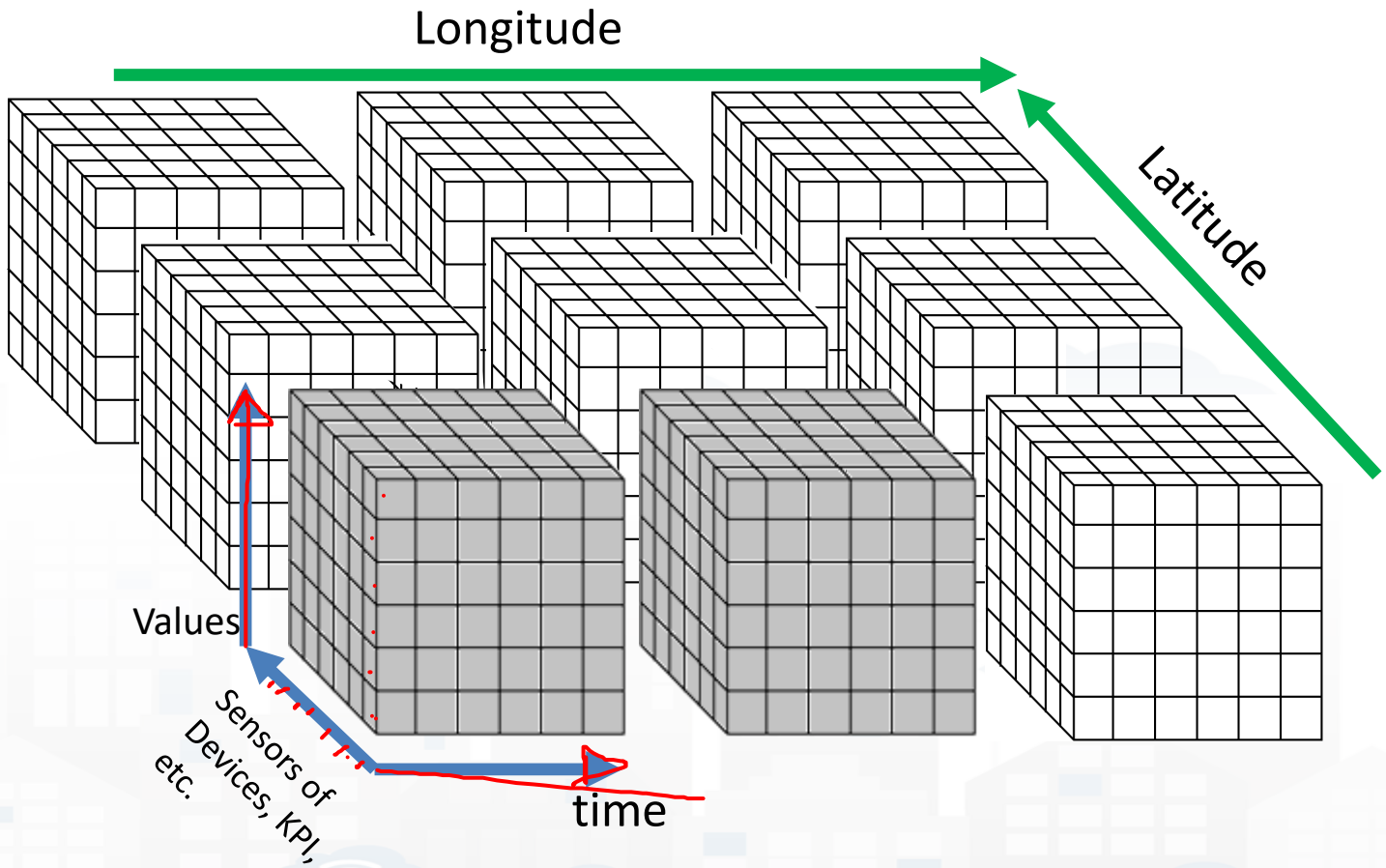
# The data cubes

- Using Dashboard Wizard with Widgets all the different transformations may be possible with different representations.
- The IoT App allows to make them Dynamic

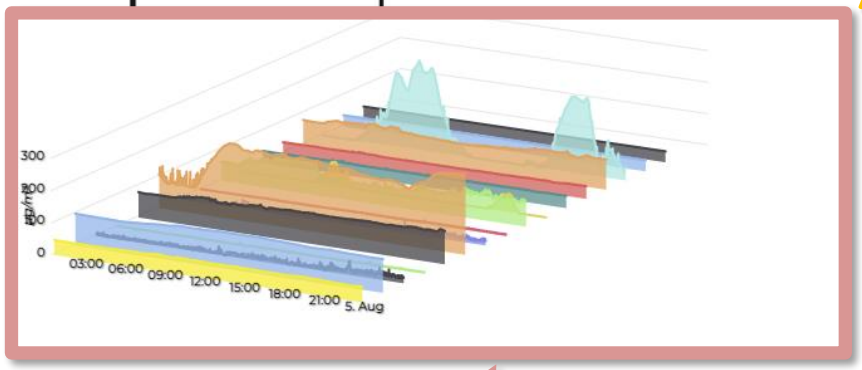


# Hypercube

- IoT Devices may have multiple  Sensors
  - KPI and Sensors may have different ValueUnits (%, Kg, Km, um/m3, ppm, Kw, etc.)
- They are distributed in the maps
  - Multi Data Maps Widget can show multiple values and layers



# Hypercube





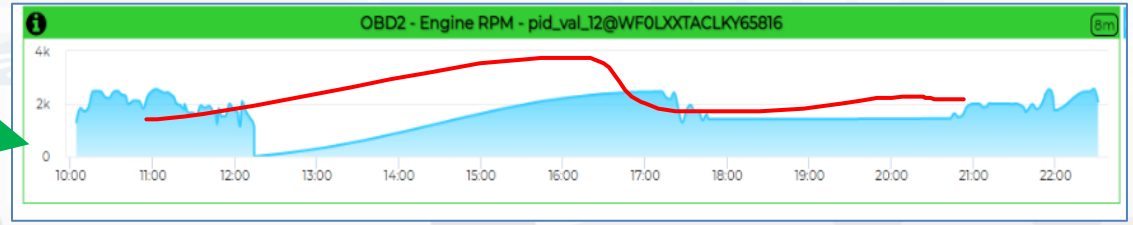

Longitude

Latitude

Values

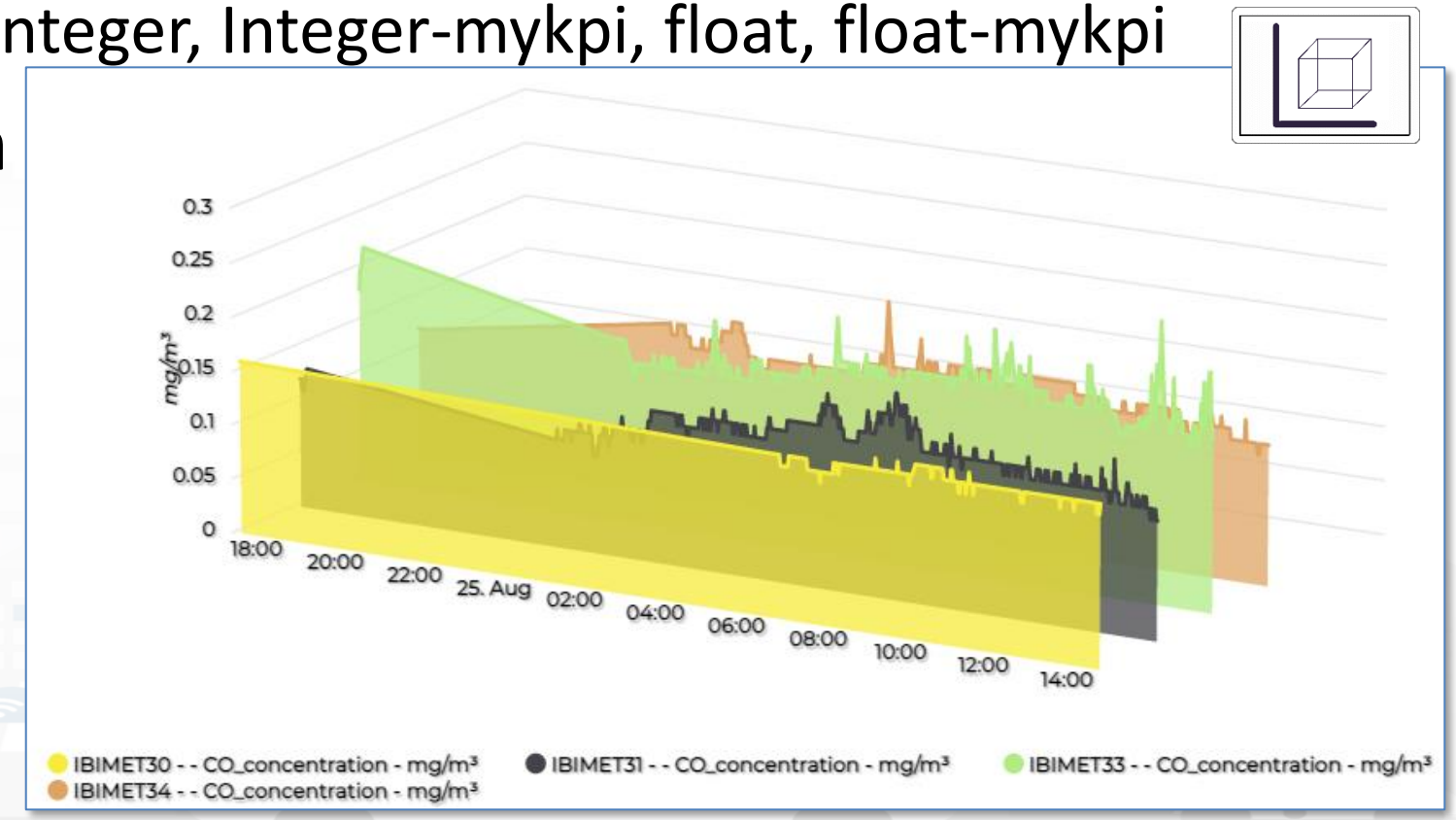
Sensors of Devices, KPI, etc.

time



# OLAP widget vs Dashboard Wizard

- You can select a mix of:
  - HLT: MyKPI & Sensors (device, sensor_map) & Sensor (ValueName)
  - DataType: Sensor_map, integer, Integer-mykpi, float, float-mykpi
- The cube is created with all data
- The cube is visualized as a 3D multiseries (time) with the first DataType

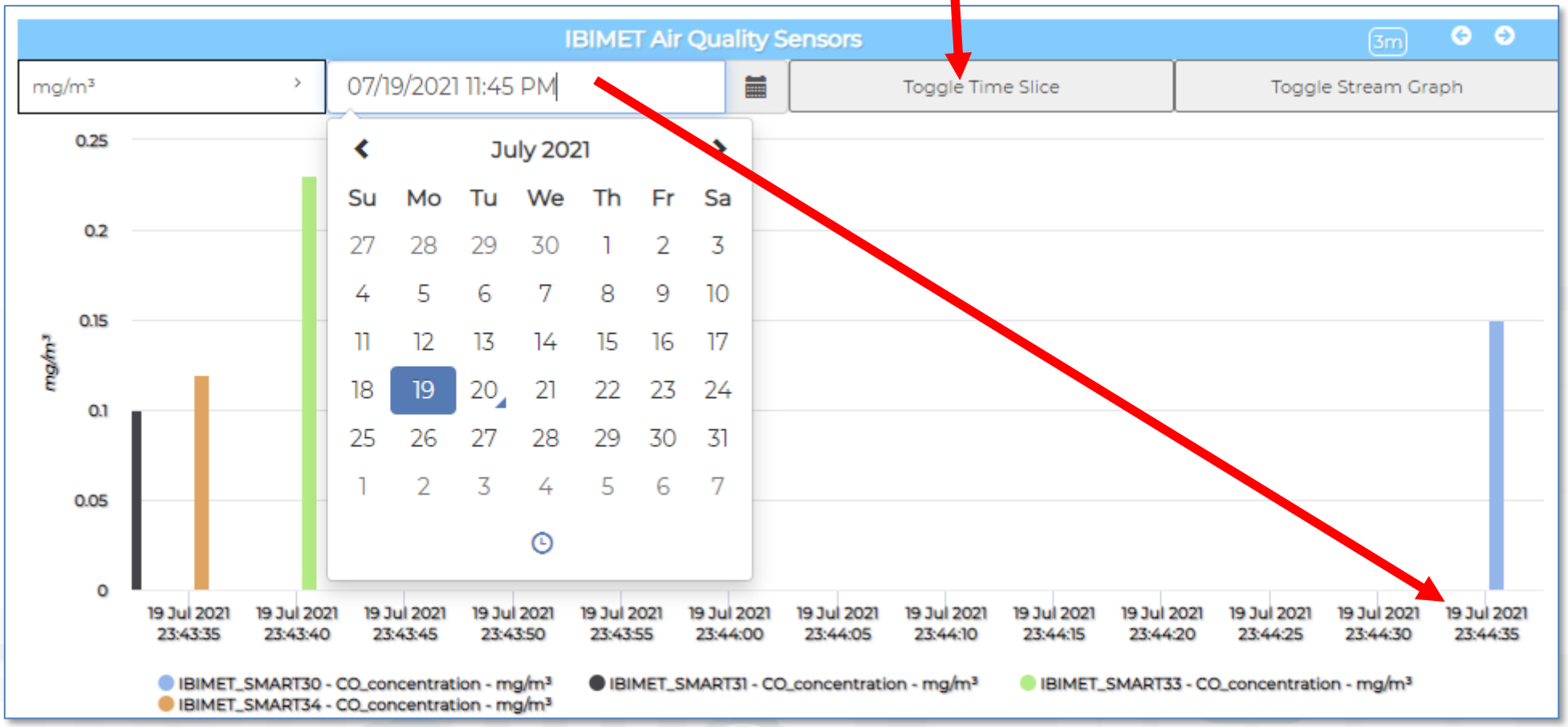


# OLAP widget vs Dashboard Wizard

- The cube is visualized as a 3D multiseries (time) with the first DataType
  - Different DataType can be selected for slicing over TYPE
  - Different Date and Time can be selected for temporal slicing

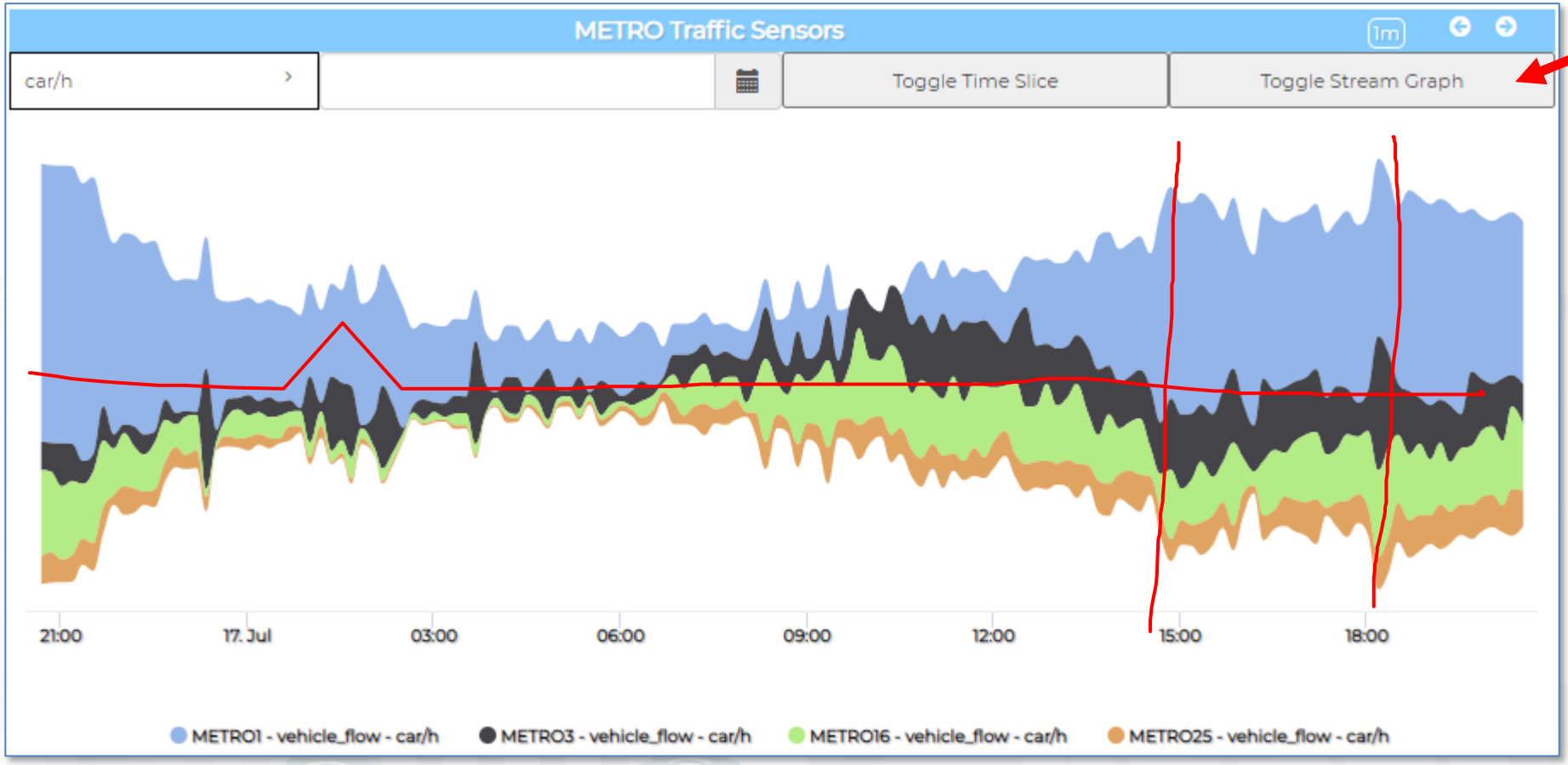


# Slicing on Time



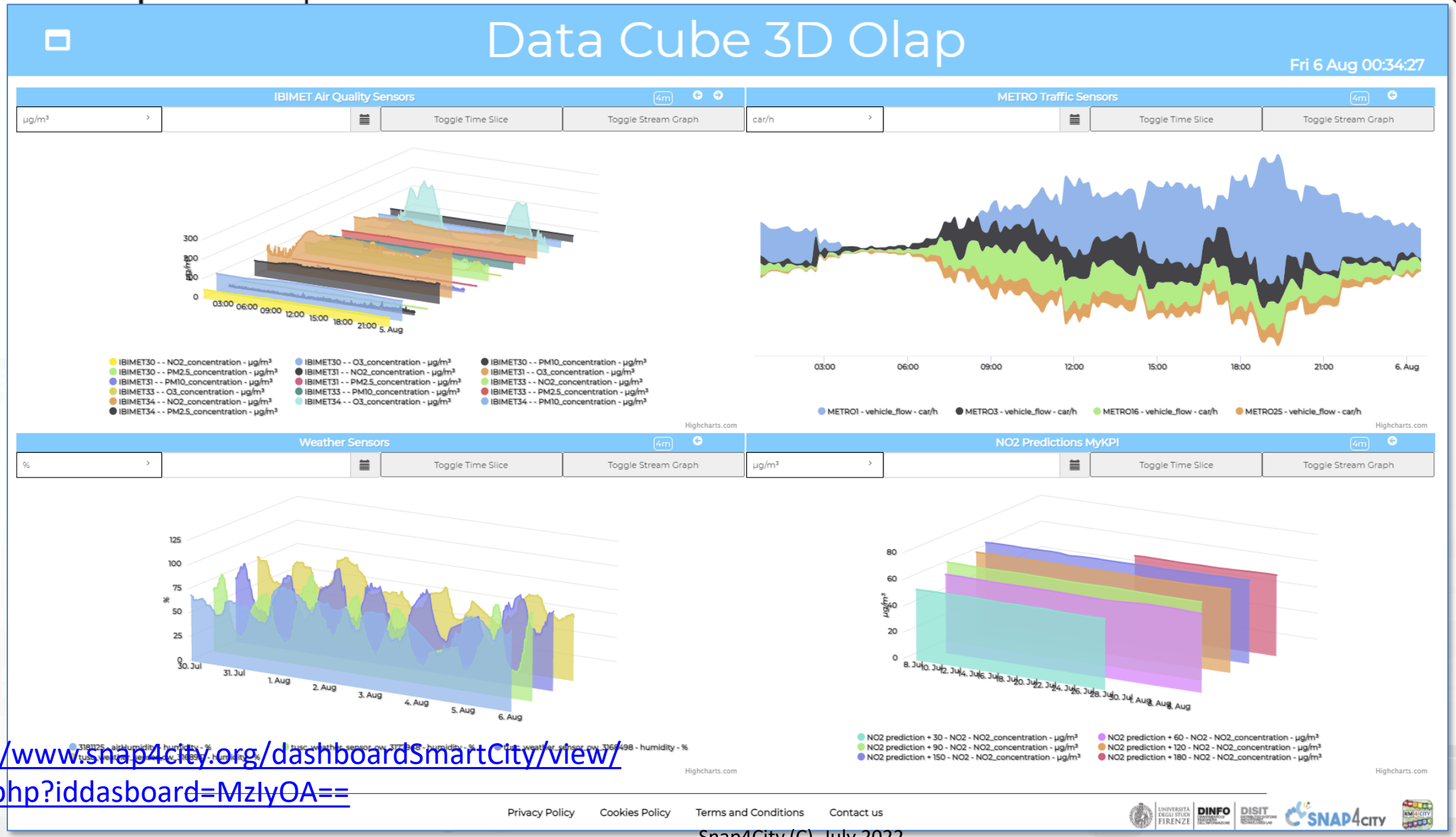

- **Drill down on time**
- **Drill up on time** is performed on More Option on Editing only

# View from top: Stream Graph




Please note that if the data are sporadic in the time the streams are visualized as bars

# Data Cube 3D Olap




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

# Combining Widgets:
# Nesting & Linking Dashboards



# Mixt per Roma

MENU

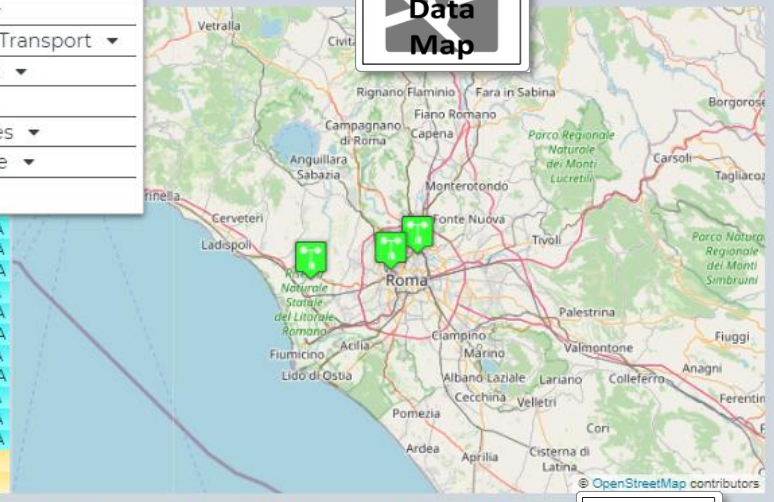
## Roma Demo3 (Qualità dell'Aria)

Thu 23 Jul 13:35:09

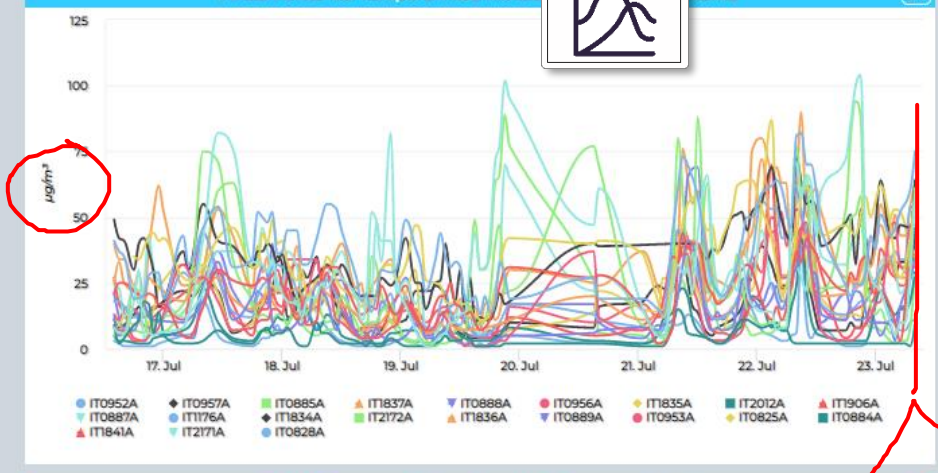
- Mobility and Transport
- Environment
- Social
- Some Services
- Infrastructure
- Quit

Multi Data Map

IT1836A
IT0957A
IT0828A
IT2171A
IT0952A
IT0885A
IT1837A
IT0888A
IT1176A
IT1835A
IT1834A
O3
NO2



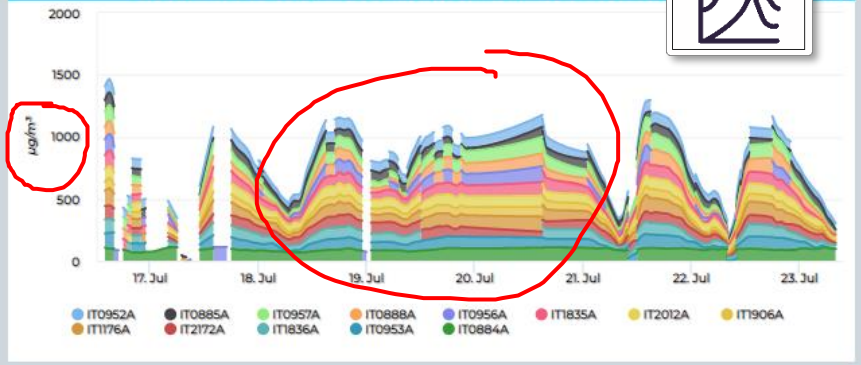

Andamento nel Tempo di NO2 rilevato [illegible] Roma



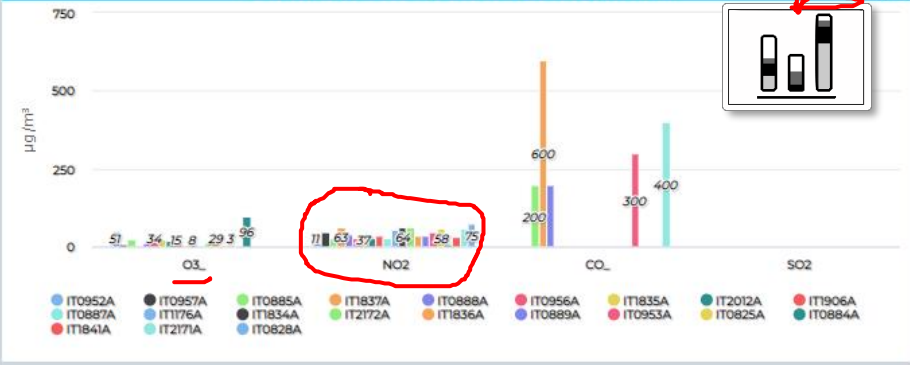

Valori Inquinanti in tempo reale, mappe

| value type / value name | O3_ | NO2 | CO_ | SO2 |
|---|---|---|---|---|
| IT0952A | 51 | 11 | | |
| IT0957A | 7 | 46 | | |
| IT0885A | 25 | 29 | 200 | |
| IT1837A | | 63 | 600 | |
| IT0888A | 11 | 37 | 200 | |
| IT0956A | 34 | 29 | | |
| IT1835A | 24 | 37 | | |
| IT2012A | 20 | 29 | | |
| IT1906A | 15 | 34 | | |
| IT0887A | | 28 | | |
| IT1176A | 8 | 54 | | |
| IT1834A | | 64 | | |
| IT2172A | 15 | 61 | | |
| IT1836A | 29 | 35 | | |
| IT0953A | 3 | 47 | 350 | 1.3 |
| IT0889A | | 34 | | |
| IT0825A | | 58 | | |
| IT0884A | 96 | 9 | | |
| IT1841A | | 31 | | |
| IT2171A | | 57 | 400 | |
| IT0828A | | 75 | | |

Andamento nel Tempo di O3 rilevato nelle stazioni in Roma (st[illegible]




Dati in Tempo reale inquinanti in Roma e provincia

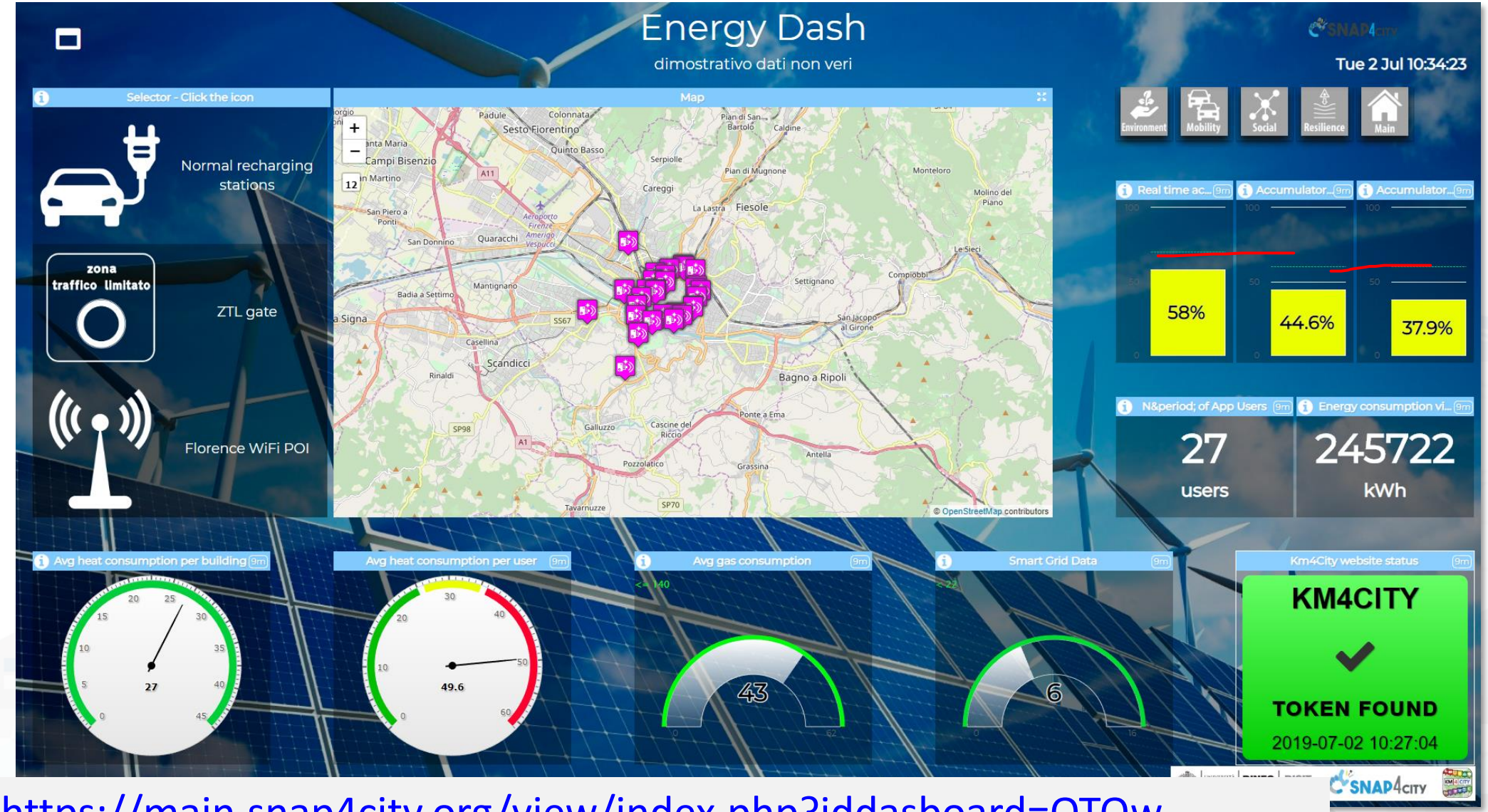


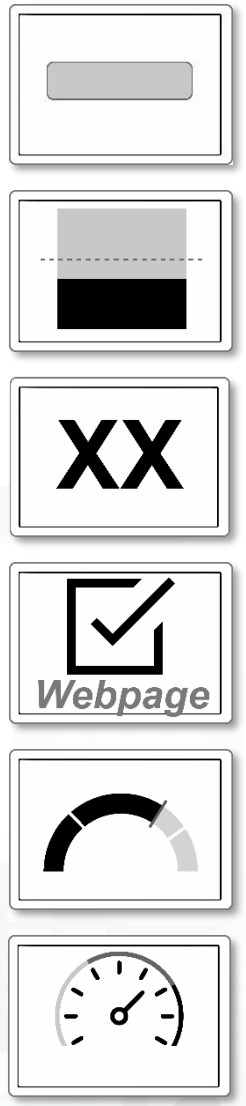

Home Trasporti

Privacy Policy Cookies Policy Terms and Conditions Contact us

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

# Match Widget vs Icon



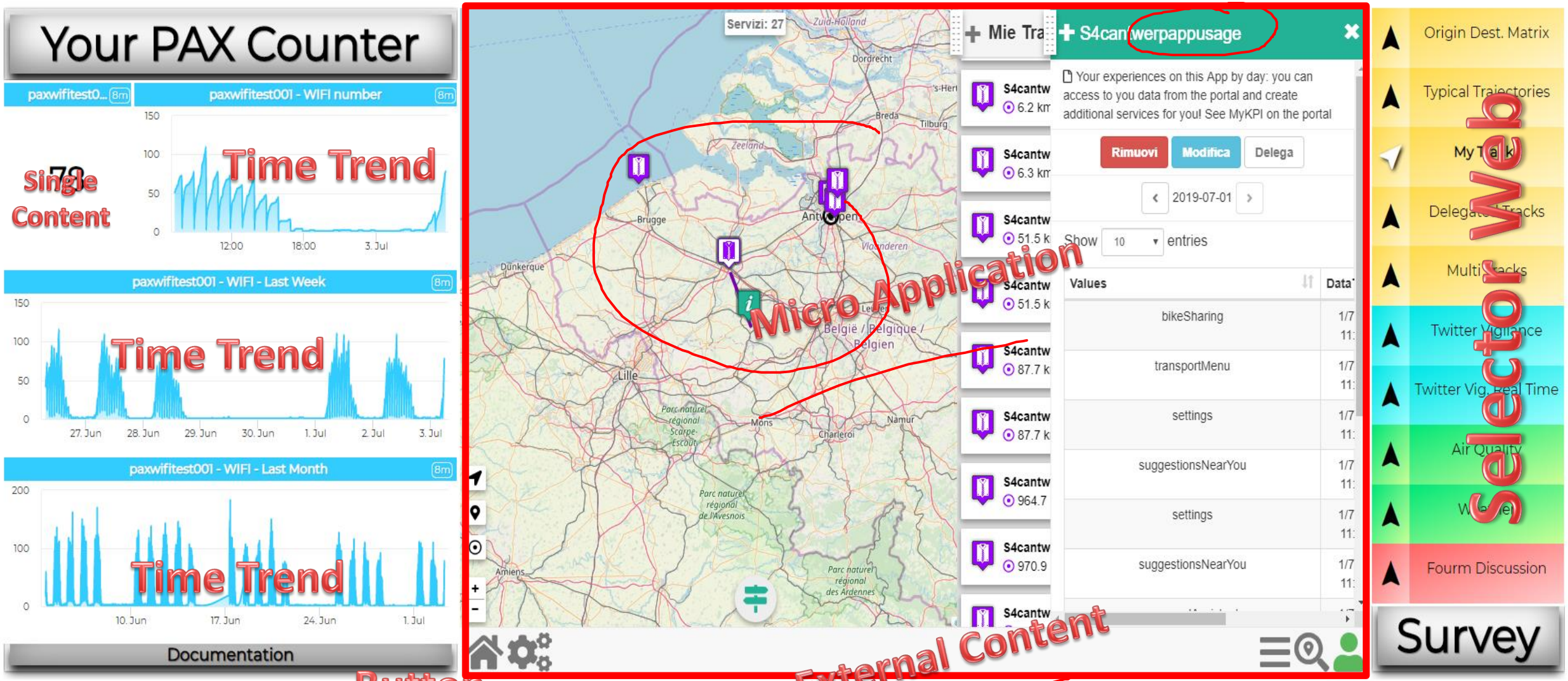




https://main.snap4city.org/view/index.php?iddasboard=OTQw

# Monitoring My PAXCounter and Tracks (example)

Please note that the data results are not always based on real data.

Wed 3 Jul 09:18:07

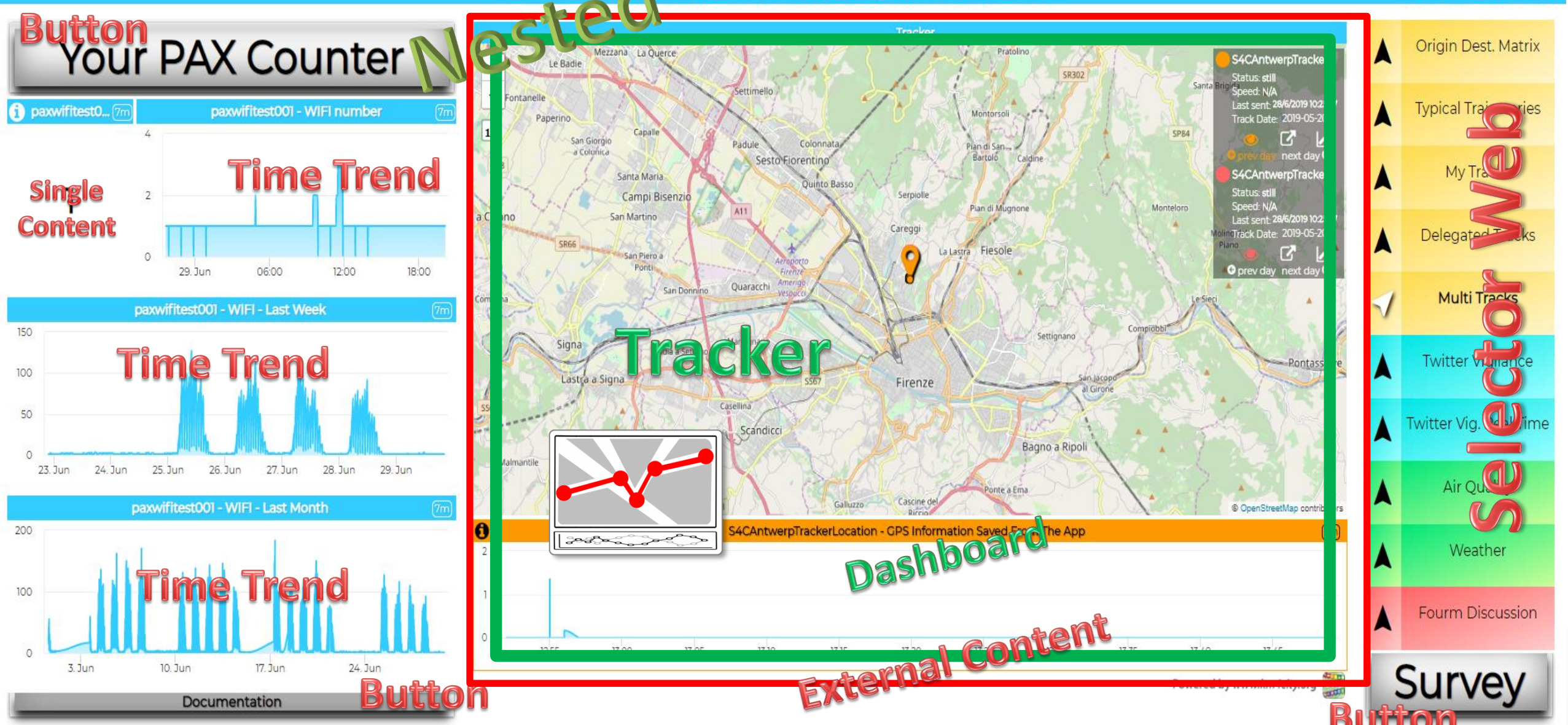



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc0NQ==

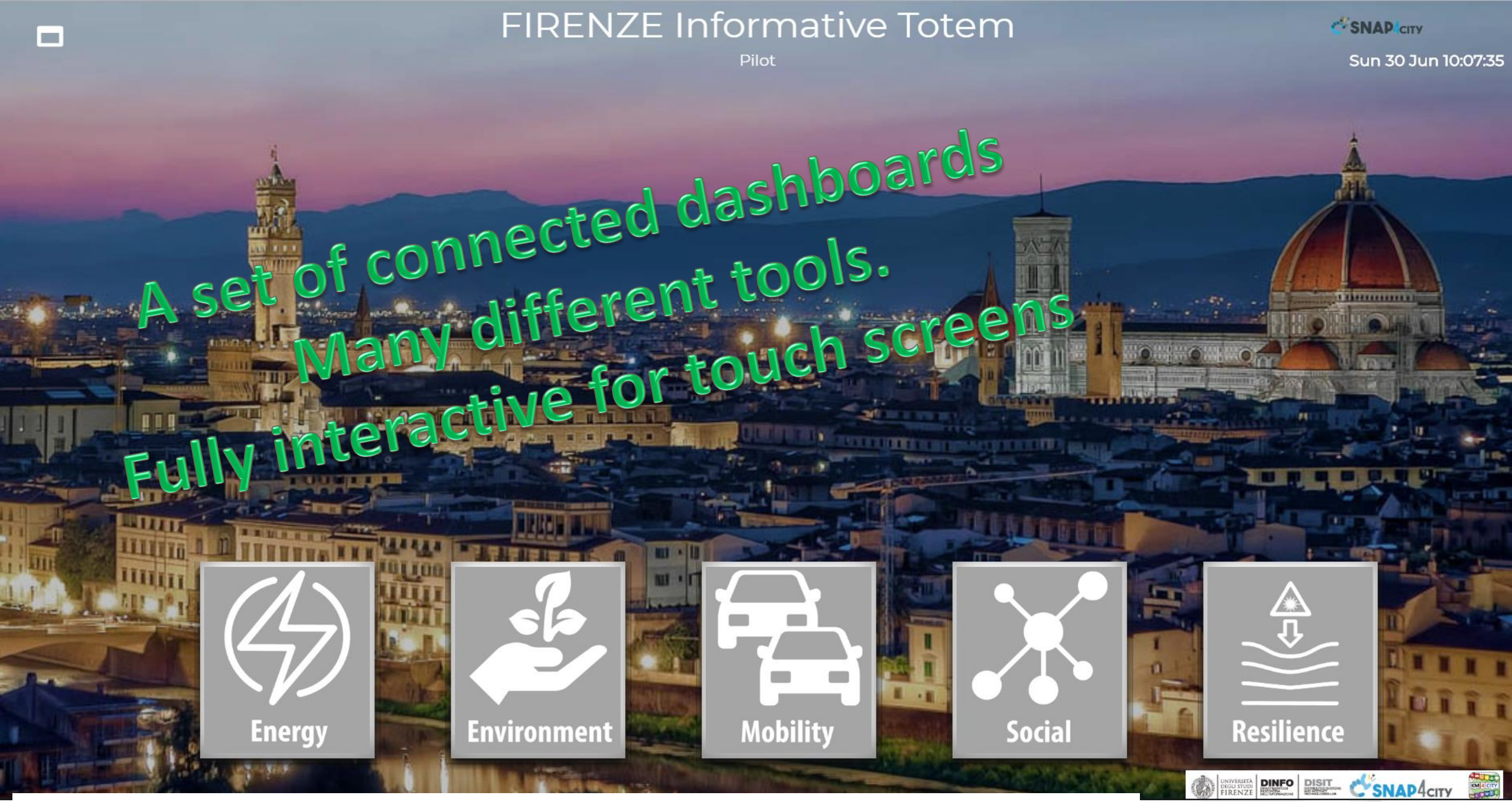
# Monitoring My PAXCounter and Tracks (example)

Please note that the data results are not always based on real data.

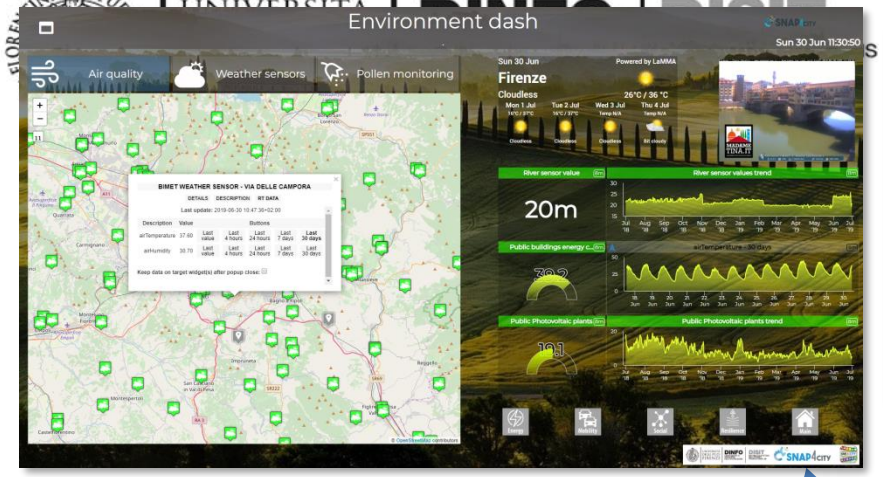
Sat 29 Jun 23:42:05

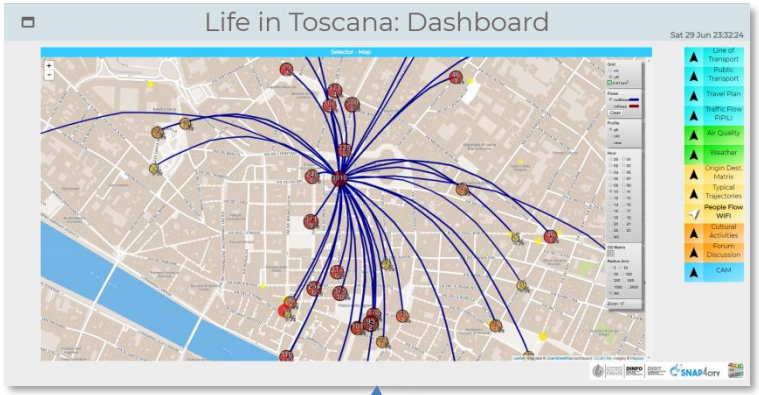



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc0NQ==

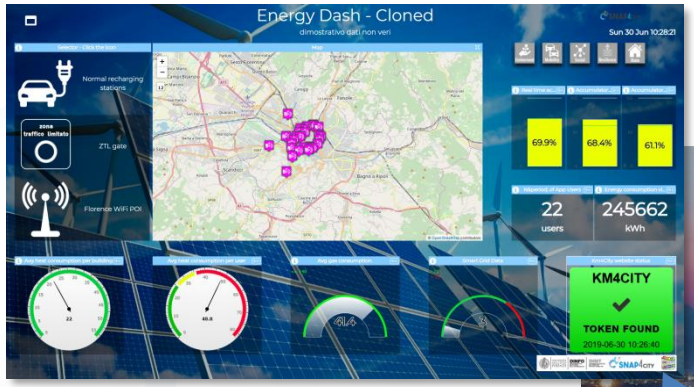



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=OTM5

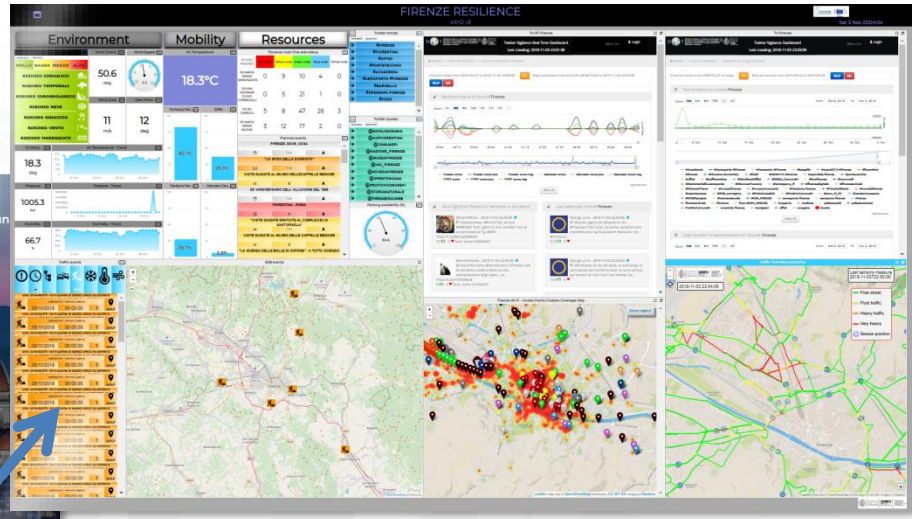

Environment dash
Air quality
Weather sensors
Pollen monitoring
Firenze
20m


Life in Toscana: Dashboard


Citizens Engagement


Energy Dash - Cloned
KM4CITY
TOKEN FOUND


FIRENZE Informative Totem
Pilot
Energy
Environment
Mobility
Social
Resilience


FIRENZE RESILIENCE
Environment
Mobility
Resources

# FIRENZE

Tue 16 Oct 16:18:39

INDICI DI CRITICITA' DELLA QUALITA' DELL'ARIA (ICQA) 2 — inviata comunicazione alla cittadinanza

OZONO 200 µ/m³ — superata la soglia di informazione

39492 Utenti WiFi

STATI DI ALLERTA 9m

GENERAL METEO

MINIMO BASSO MEDIO ALTO

RISCHIO IDRAULICO

RISCHIO TEMPORALI

RISCHIO IDROGEOLOGICO

RISCHIO NEVE

RISCHIO GHIACCIO

Mar 16 Ott
Firenze
Nuvoloso
19°C / 24 °C
Powered by LaMMA

| | | |
|---|---|---|
| Mer 17 Ott | 16°C / 24°C | Nuvoloso |
| Gio 18 Ott | 15°C / 26°C | Nuvoloso |
| Ven 19 Ott | Temp N/A | Sereno |
| Sab 20 Ott | Temp N/A | Sereno |

TPL

| N | 14 | 57 | 21 |
|---|---|---|---|
| Attesa | 3' | 8' | 5' |
| Ritardo | 2' | 0' | 2' |

COLONNINE RICARICA 9m

180 INSTALLATE

81.1 % ATTIVE

8.9 % IN USO

REPLICATE — DISIT

FLORENCE DASHBOARD

This dashboard is the main entry point to access dashbaords realised in the REPLICATE H2020 EC project.

REPLICATE has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 691735.

FLUSSI INGRESSO CITTA 9m

25 355.2
19 016.4
12 677.6
6338.8
0
08:00
Current
Previous

TOTALE 9m

141608

VEICOLI

FLUSSI INGRESSO ZTL 9m

7337.2
5502.9
3668.6
1834.3
0
08:00
16:00
Current
Previous

TOTALE ZTL 9m

41146

VEICOLI

SITUAZIONE VIABILITA 54s

4 INCIDENTI

0 CHIUSURE AL TRAFFICO (TOT)

0 CHIUSURE PER CANTIERI

0 PROGR. | 0 NON PROG.

0 LIMITAZIONI AL TRAFFICO (TOT)

0 LIMITAZIONI PER CANTIERI

0 NON PROG. | 0 PROGR.

4 TOT. EVENTI SULLA RETE

| SMN 9m | BINARIO16 9m | FORTEZZA 9m |
|---|---|---|
| 63.4 % occupati su 901 posti | 83 % occupati su 165 posti | 17.9 % occupati su 521 posti |
| **LEOPOLDA 9m** | **CALZA 9m** | **S.AMBROGIO 9m** |
| 36.3 % occupati su 300 posti | 69.3 % occupati su 218 | 67 % occupati su 379 posti |
| **PARTERRE 9m** | **CAREGGI 9m** | **BECCARIA 9m** |
| 64.9 % occupati su 106 posti | 90.4 % occupati su 406 posti | 78.6 % occupati su 210 posti |

STATO TRIAGE CAREGGI 9m

| Red code | Yellow code | Green code | Blue code | White code |
|---|---|---|---|---|
| 3 | 12 | 83 | 37 | 9 |

MAPPA

Energy — Environment — Mobility — Social — Resilience

| PM10 | Riciclo rifiuto | Rifiuto per abitante | PIL residenti | Tasso di disoccupazione | Piste Ciclabili |
|---|---|---|---|---|---|
| 26 superamenti/anno | 56% | 0,629 t/pers/anno | 23.606 euro/pers | 6,8% | 19.7% km ciclabili/km totali |

Most of the widgets are connected to an URL to jump to other views/dashboards


FIRENZE
Tue 16 Oct 16:18:39
Single Content
Single Content
Single Content
Single Content
Single Content
Civil Protection
SOC
GENERAL
METEO
MINIMO
ALTO
RISCHIO IDRAULICO
RISCHIO TEMPORALI
RISCHIO IDROGEOLOGICO
RISCHIO NEVE
Meteo
Mar 16 Ott
Firenze
Nuvoloso
19°C / 24 °C
Mer 17 Ott
16°C / 24°C
Nuvoloso
Gio 18 Ott
15°C / 26°C
Nuvoloso
Ven 19 Ott
Temp N/A
Sereno
Sab 20 Ott
Temp N/A
Sereno
External Content
TPL
N
14
57
21
COLONNINE RICARICA
INSTALLATE
81.1 %
8.9 % IN USO
3 Single Content
External Content
FLORENCE DASHBOARD
REPLICATE H2020 EC project.
REPLICATE has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 691735.
FLUSSI INGRESSO CITTA
TOTALE
Time Trend Compare
Single Content
FLUSSI INGRESSO ZTL
TOTALE ZTL
Time Trend Compare
Single Content
SITUAZIONE VIABILITA
4 INCIDENTI
0 CHIUSURE AL TRAFFICO (TOT)
0 PROGR.
0 NON PROG.
0 PROGR.
4 TOT. EVENTI SULLA RETE
10 Single Content
SMN
63.4
BINARIO16
83
FORTEZZA
17.9
LEOPOLDA
36.3
69.3
67
PARTERRE
64.9
78.6
9 Single Content
STATO TRIAGE CAREGGI
Red code
Yellow code
Green code
Blue code
White code
3
9
First AID
MAPPA
Energy
Social
Resilience
6 Buttons
26
superamenti/anno
56%
Rifiuto per abitante
0,629
t/pers/anno
PIL residenti
23.606
euro/pers
Tasso di disoccupazione
6,8%
Piste Ciclabili
19.7%
km ciclabili/km totali
6 Buttons
Most of the widgets are connected to an URL to jump to other views/dashboards

# Mobility and Environment What-IF Analysis

This dashboad contains data derived from actual sensors and predictive values under validation

Mon 14 Oct 00:48:17



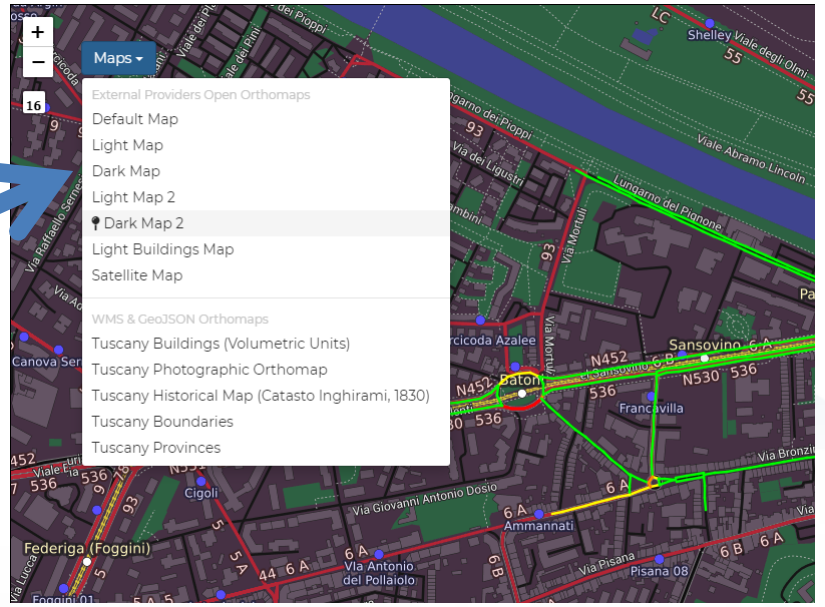

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

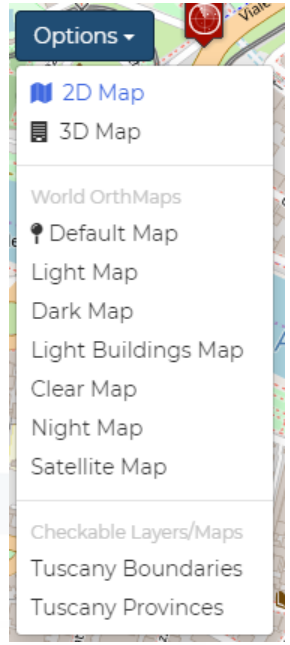
# Multi Data Maps Widget



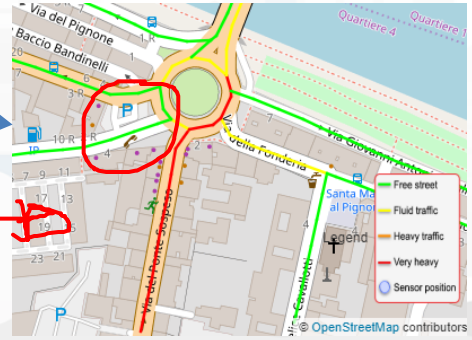
# Multi Data Map Widget

- The most powerful Data Map rendering tool, it supports:
  - **KB Sensor data**: POI, sensors, actuators, etc. (see in the following), moving devices
  - **WFS data** (see in the following)
  - **WMS background maps**
    - Ask to a **RootAdmin** for activating this feature on your MultiDataMap widgets once created the dashboard
    - Maps can come from GIS servers, and WMS
  - **WMS Heatmaps GeoTiFF**
  - **WMS Traffic Flow GeoTIFF**
  - **GTFS data from Public Transport**
  - **Special tools**
    - Scenario (see in the following)
    - What-IF (see in the following)

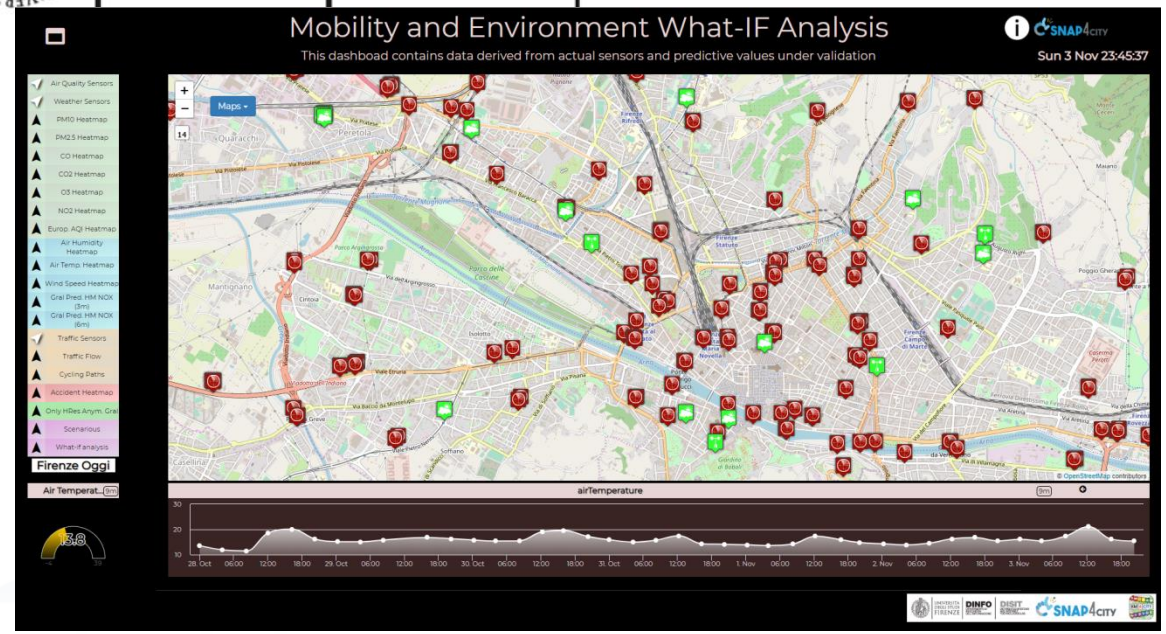


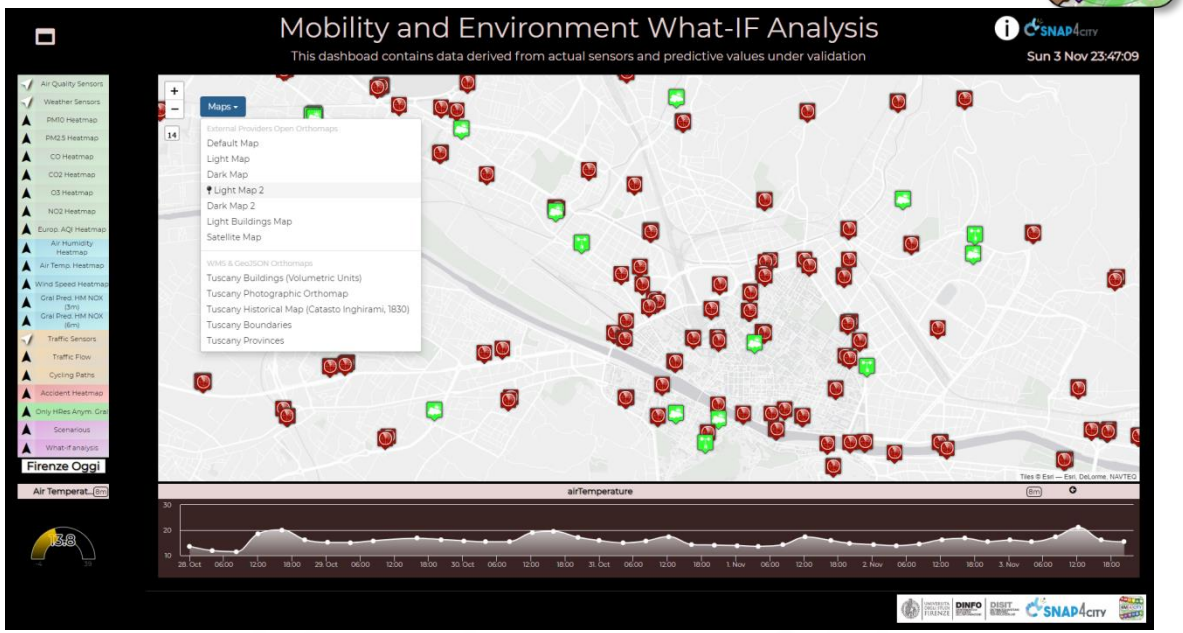




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==#

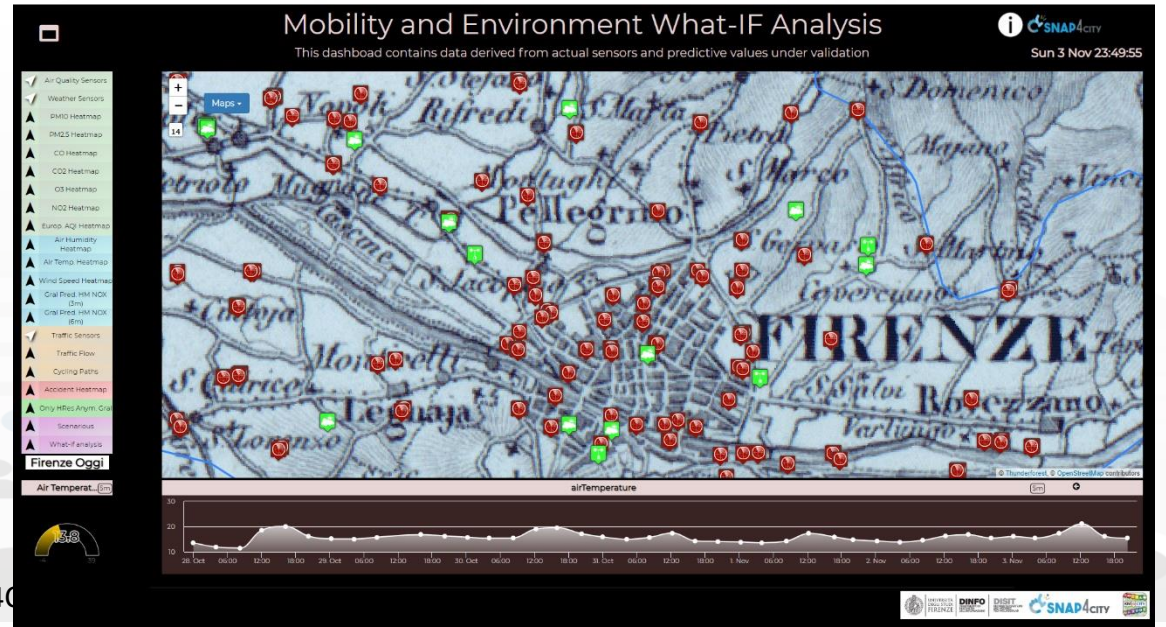


# Orthomaps


Mobility and Environment What-IF Analysis
This dashboad contains data derived from actual sensors and predictive values under validation
Sun 3 Nov 23:45:37
Maps
airTemperature


Mobility and Environment What-IF Analysis
This dashboad contains data derived from actual sensors and predictive values under validation
Sun 3 Nov 23:47:09
Maps
Default Map
Light Map
Dark Map
Light Map 2
Dark Map 2
Light Buildings Map
Satellite Map
Tuscany Buildings (Volumetric Units)
Tuscany Photographic Orthomap
Tuscany Historical Map (Catasto Inghirami, 1830)
Tuscany Boundaries
Tuscany Provinces
airTemperature


Mobility and Environment What-IF Analysis
This dashboad contains data derived from actual sensors and predictive values under validation
Sun 3 Nov 23:48:22
Maps
Default Map
Light Map
Dark Map
Light Map 2
Dark Map 2
Light Buildings Map
Satellite Map
Tuscany Buildings (Volumetric Units)
Tuscany Photographic Orthomap
Tuscany Historical Map (Catasto Inghirami, 1830)
Tuscany Boundaries
Tuscany Provinces
airTemperature

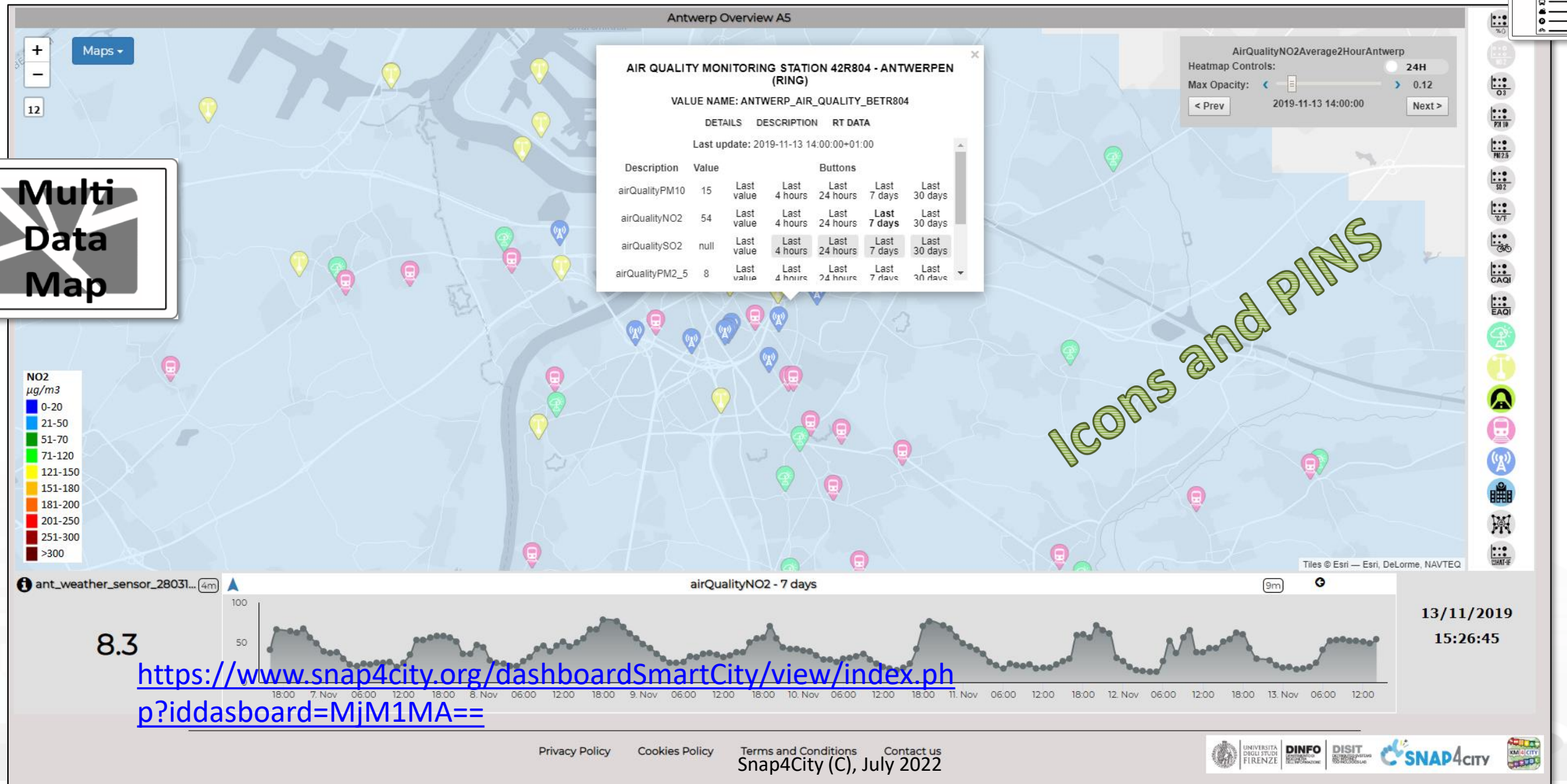

Mobility and Environment What-IF Analysis
This dashboad contains data derived from actual sensors and predictive values under validation
Sun 3 Nov 23:49:55
Maps
FIRENZE
airTemperature

# Orthomaps as graphic layers

- **Orthomaps can be**:
  - Directly exploited from public service via WMS protocol, from some GIS services as GeoServer
  - Loaded into the Snap4City GeoServer
  - Layered if they can be overlapped each other, such as map with gov border above.
- The Dashboard owner can
  - Select the Orthomaps to be used shown as default in the dashboard
- Each organization has its own set of Orthomaps

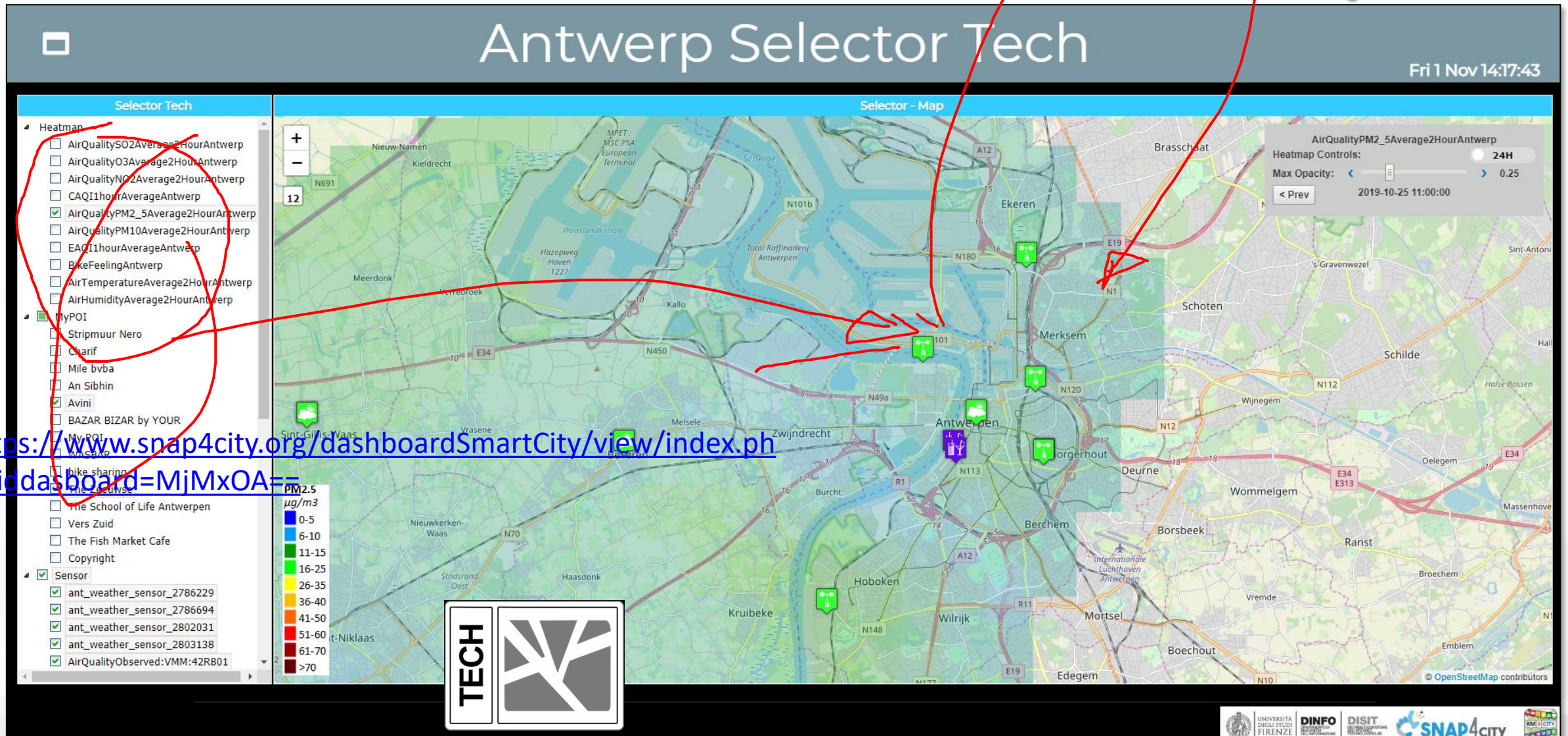
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

# Menu Icon and PINs as Icons



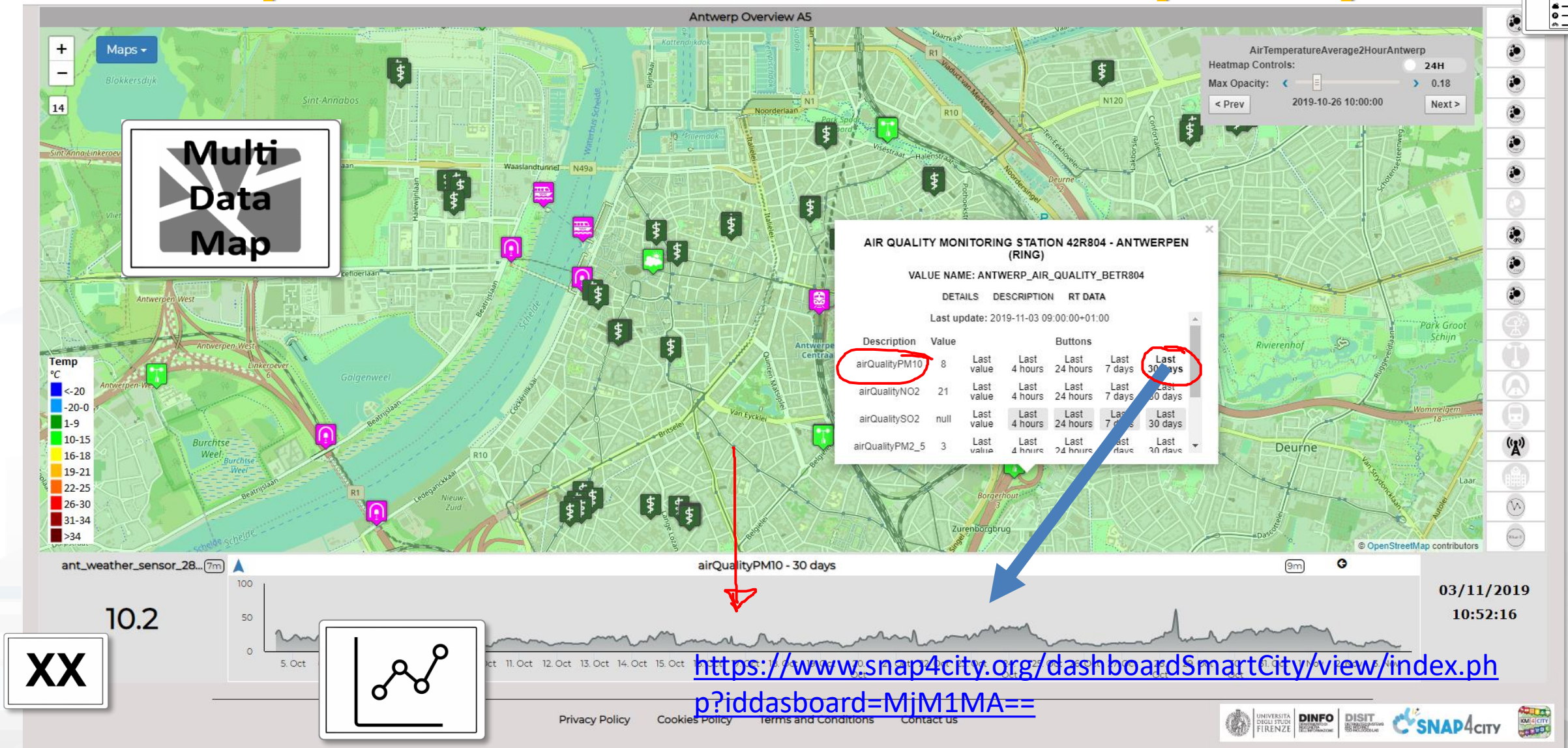

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjM1MA==

# Technical Selector: TECH MultiDataMap




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MjMxOA==

# Unique Dashboard builder Multiple Styles




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjM1MA==

# 3D views




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

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

SNAP4CITY KM4CITY

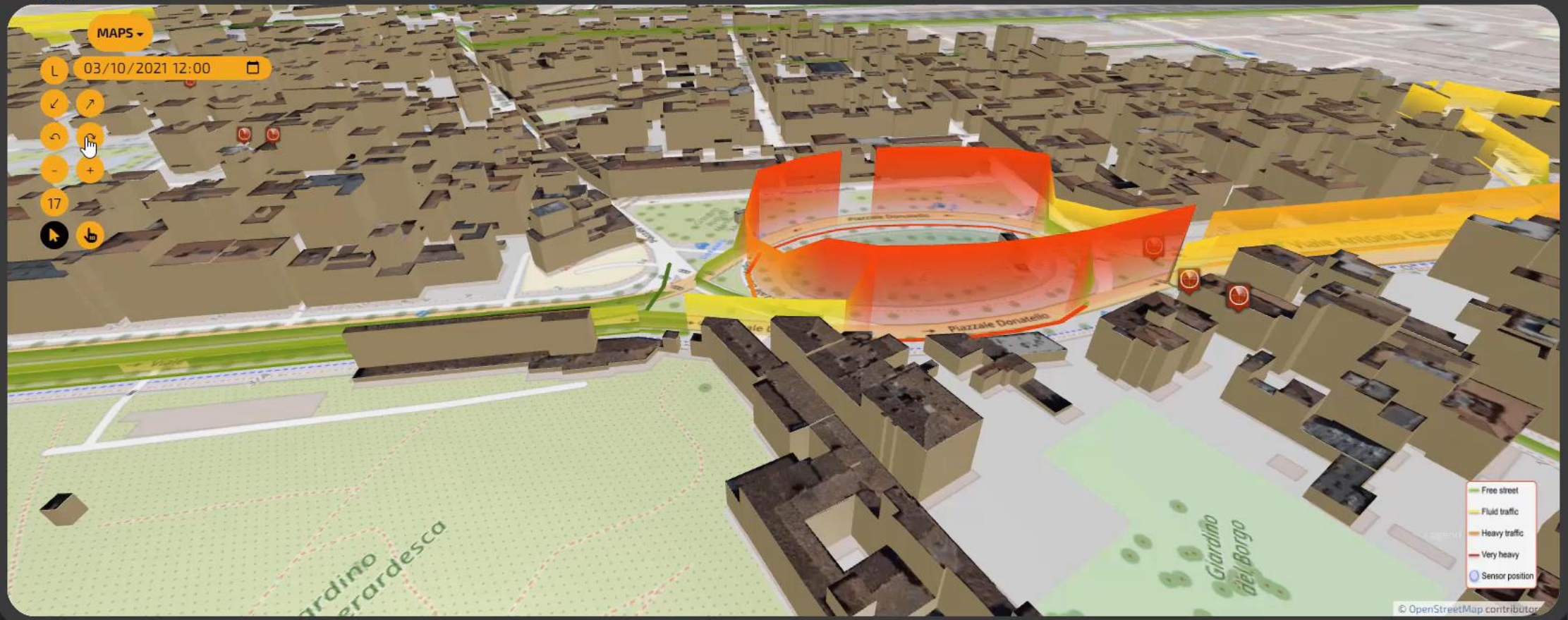
Ciao roottooladmin1

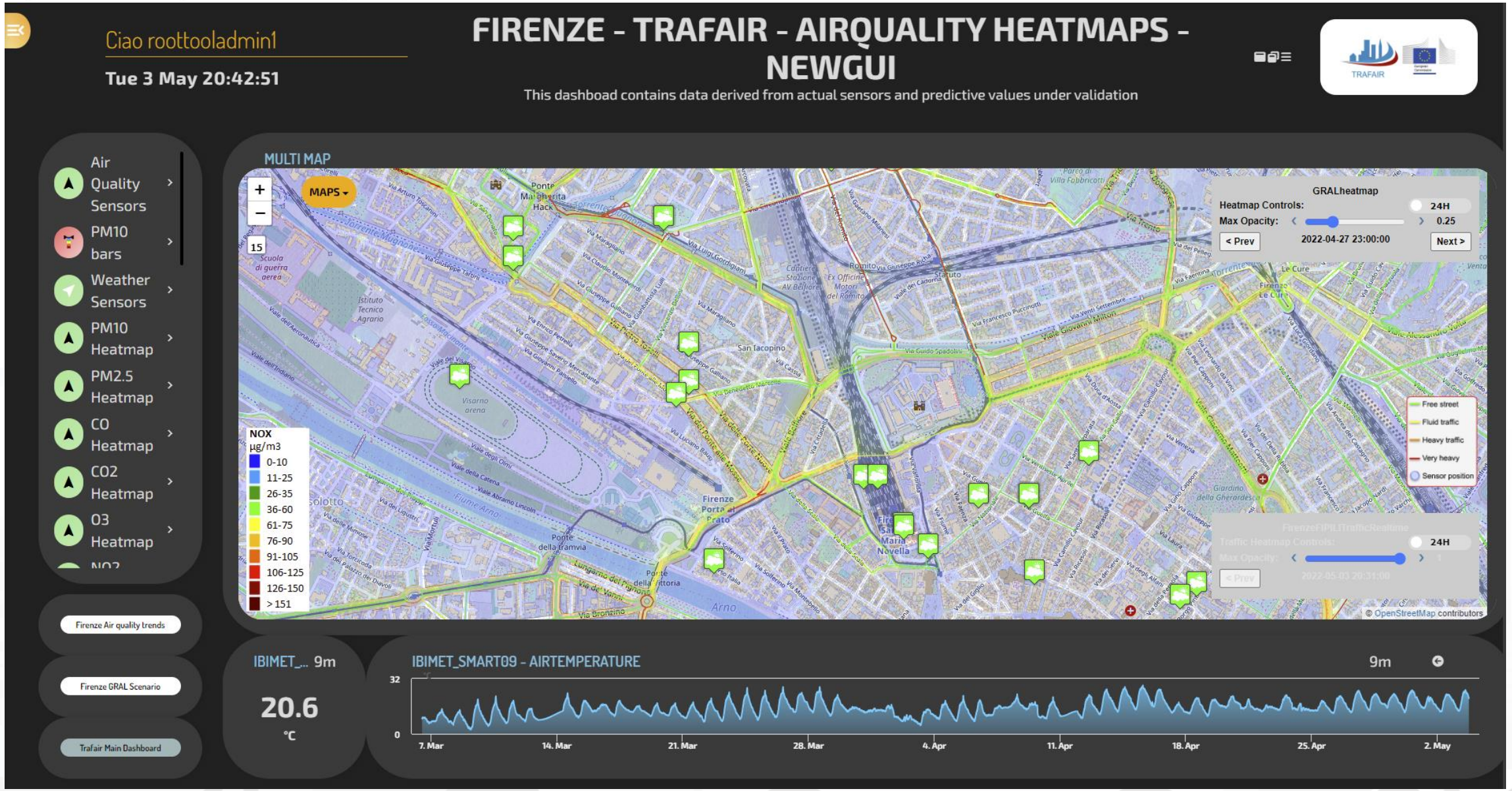
Thu 16 Jun 15:15:03

# 3D MAP DECK TEST-NEWGUI

demonstrator

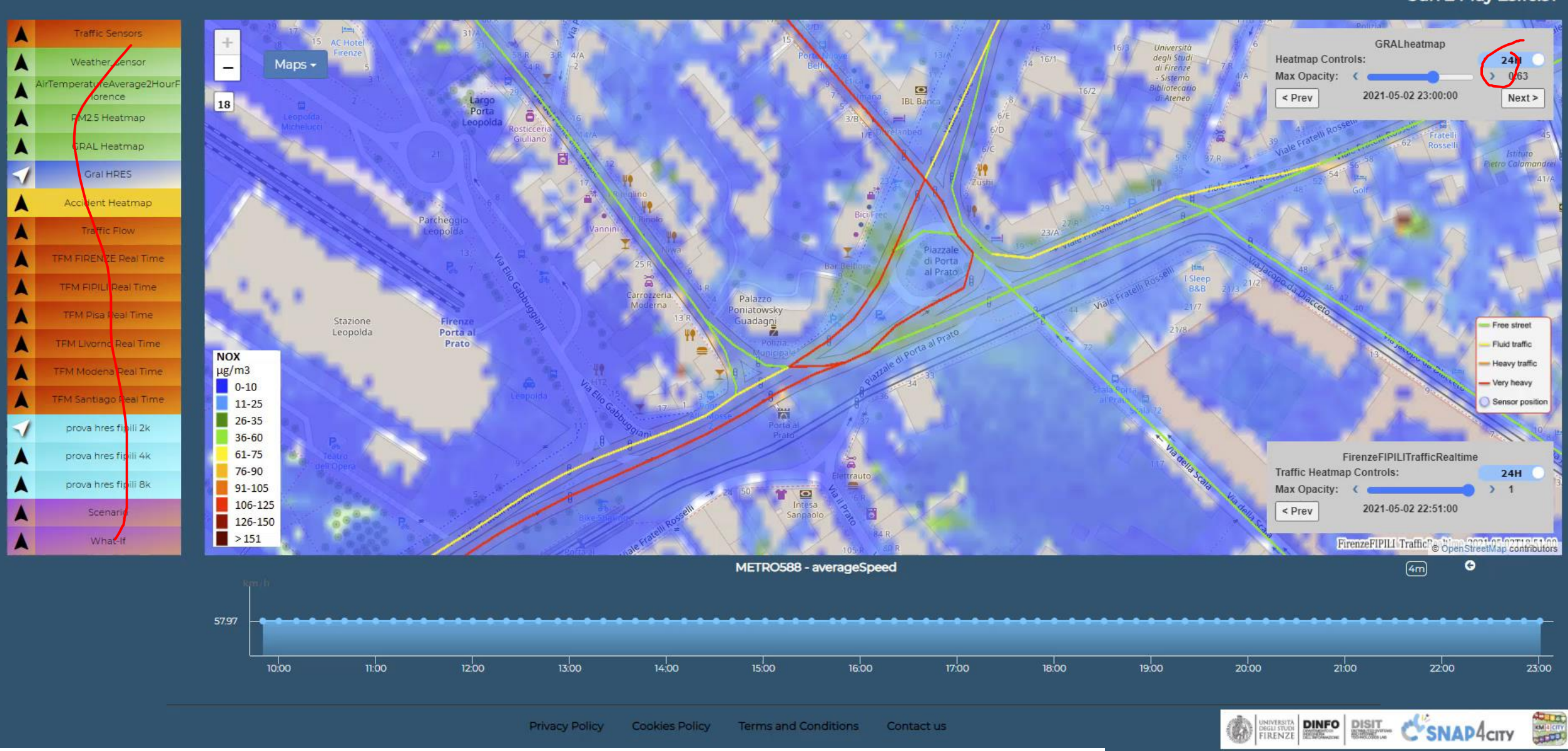
3D MAP





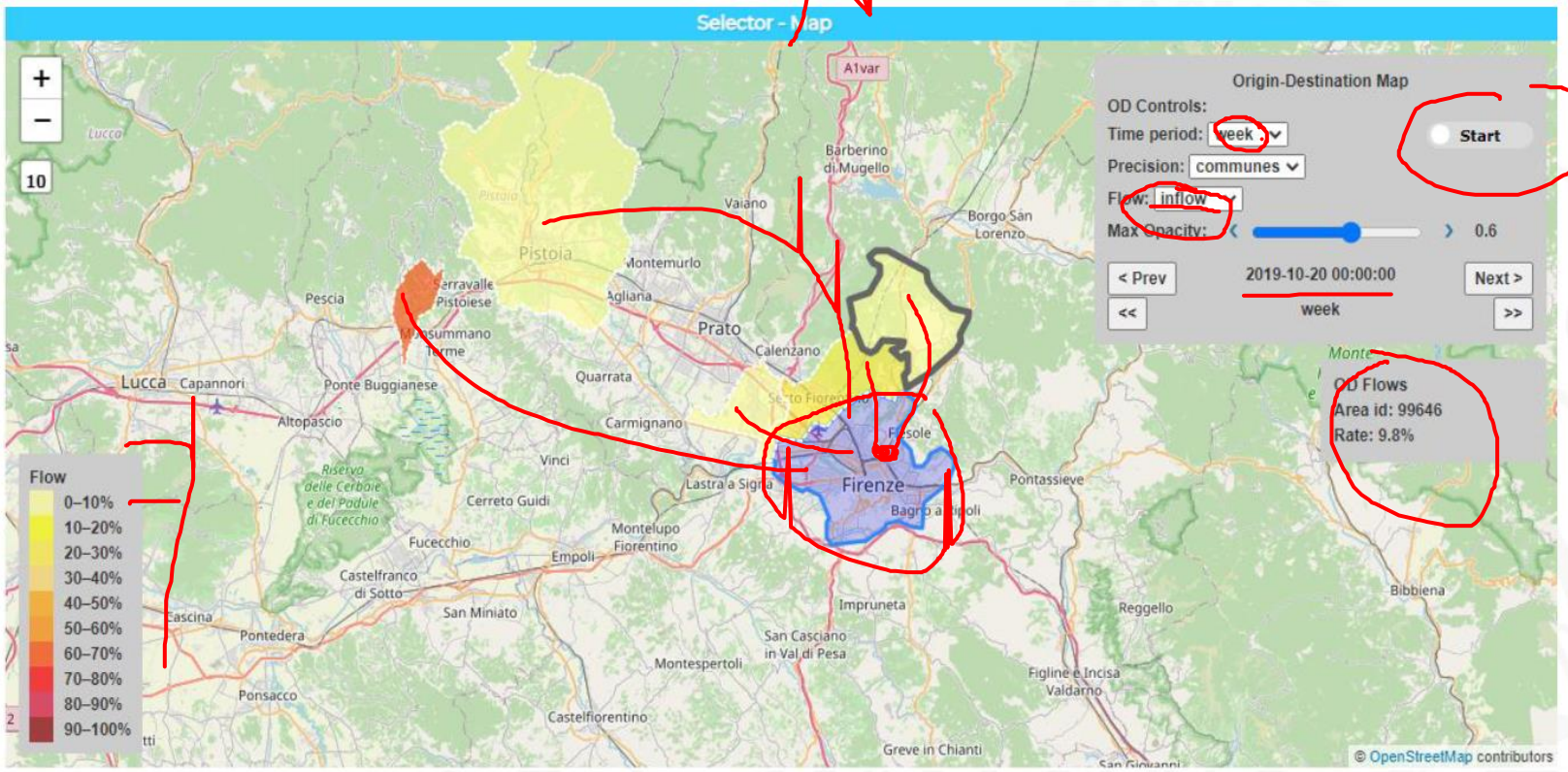

https://www.snap4city.org/dashboardSmartCity/view/Baloon-Dark.php?iddasboard=MzQyMw==

# Traffic Flow Manager on multiple cities



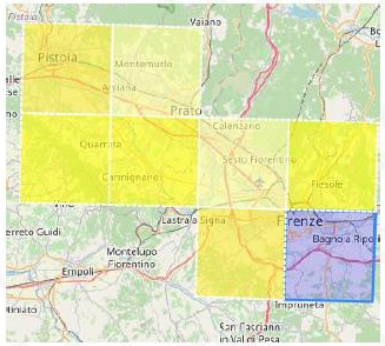

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzEyNg==

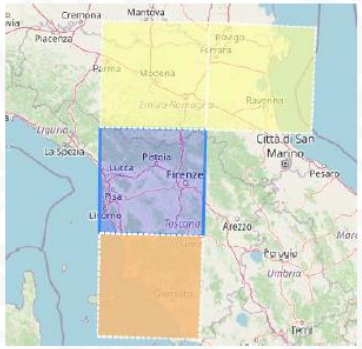
# Different Origin Destination Matrices




- Get specific value
- Time window
- Opacity
- Animation
- Inflow/outflow
- Sequence of OD matrices: next/prev



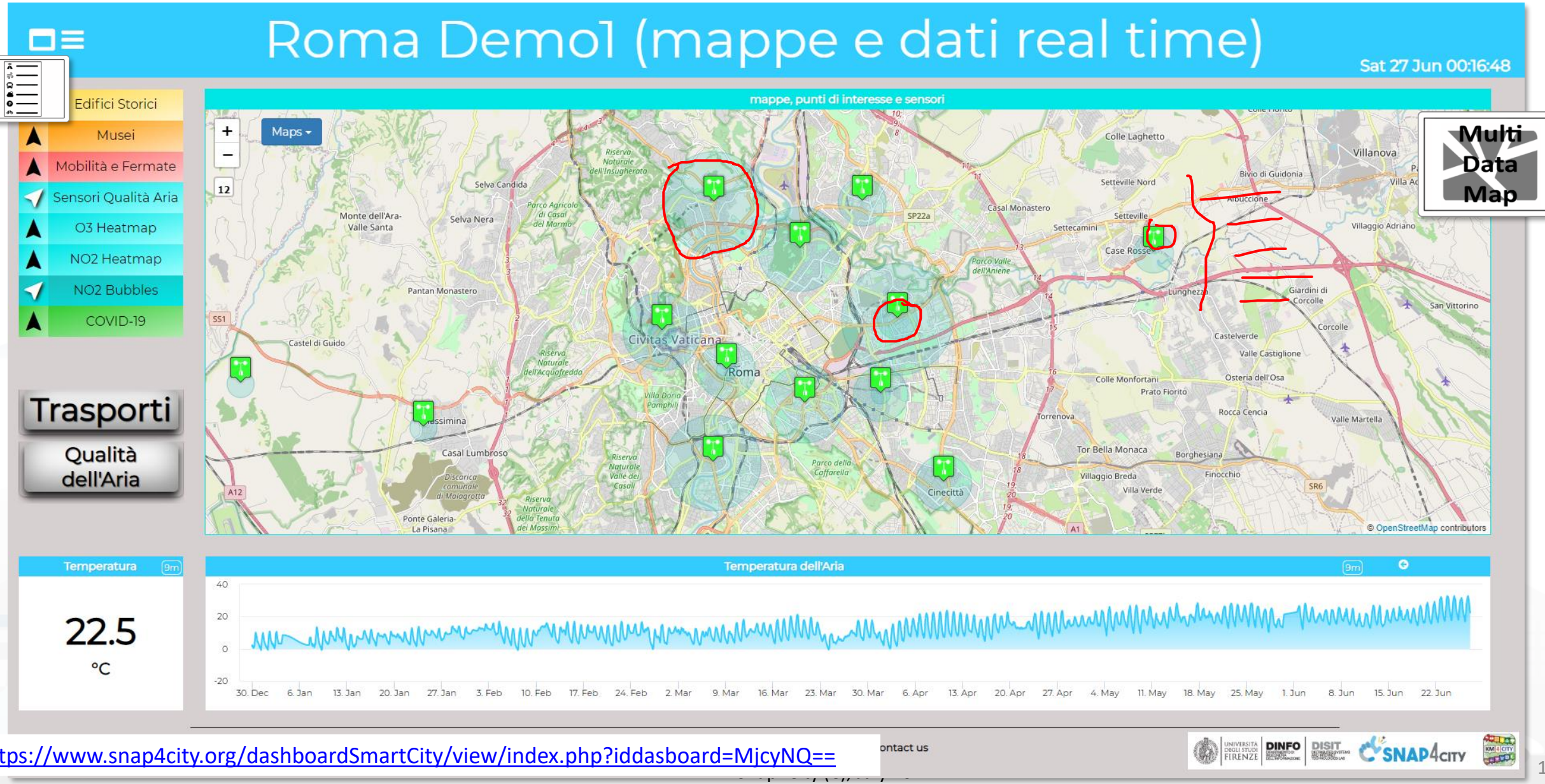




## Geo shapes as:

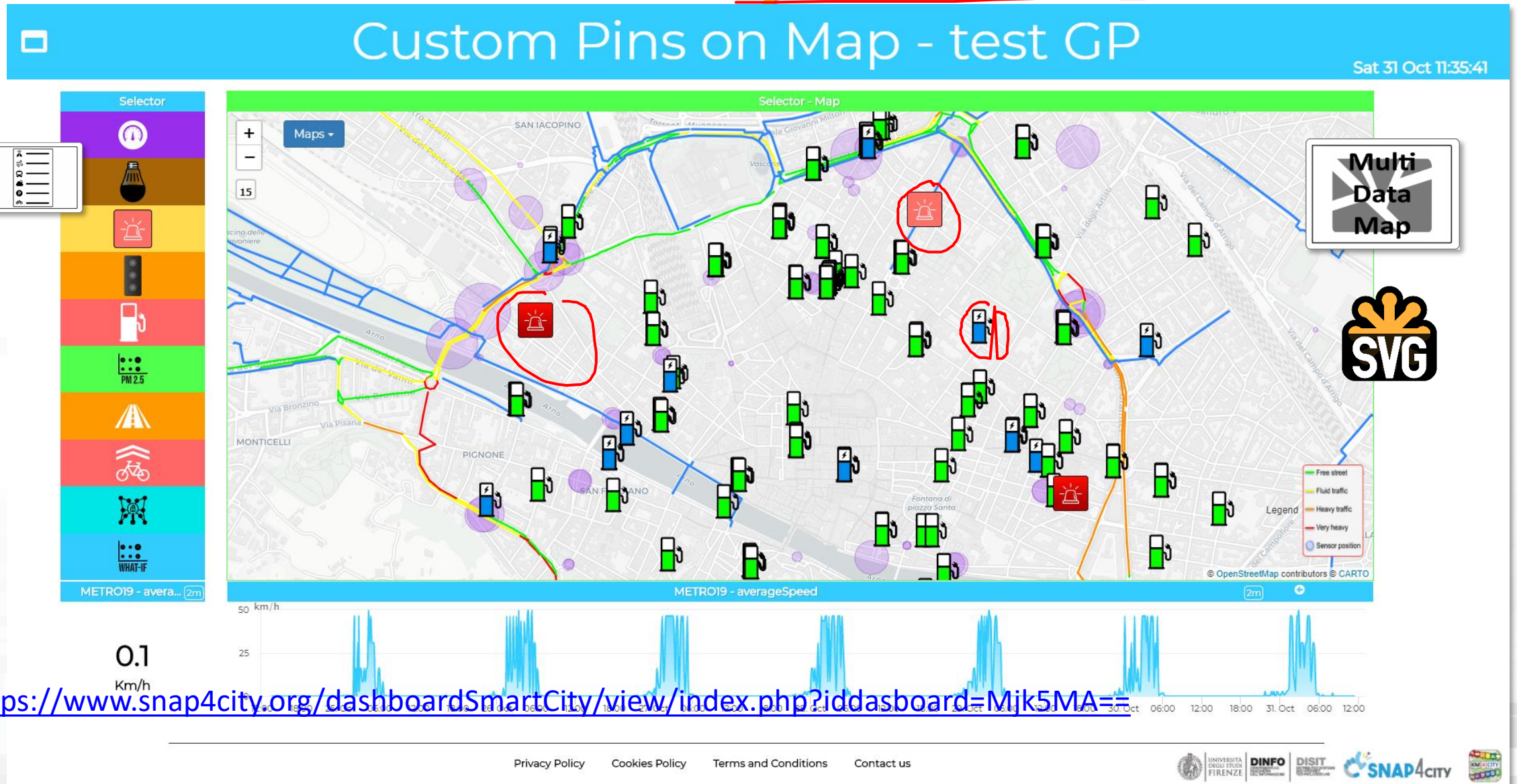
- **Shapes**: city, region, territories, etc.
- **MGRS**: 1Km, 10Km, 100Km

# Weighted Bubbles




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

# Custom Dynamic Pins




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjk5MA==

# Multi Data Map: many kinds of data

- **Orthomaps**: plain maps and overlapped layers
- A range of **Pins Kinds** for marking Services, IOT Devices, etc.
- **Services**:
  - POI, MyPOI, IOT Devices, Sensors, Actuators, IOT Device Moving, etc.
  - Cycling paths
  - Areas shapes: gardens, etc…
  - GIS data
- **Heatmaps**: different types
- **Traffic Flows:** different kinds
- **Special data:**
  - **What-If** analysis: routing, public routing, traffic flow
  - **Routing: private, public, pedestrian, public means**
  - **Scenarios** definition
- **3D** buildings
- ….

# Pins on Multi Data Maps (1)

Normal Over



- **Classic**: (default)
  - Text menu or Icon Menu
    - Custom color of the Menu only
  - Fixed on the basis of Nature and Subnature

Normal Over Icon Menu



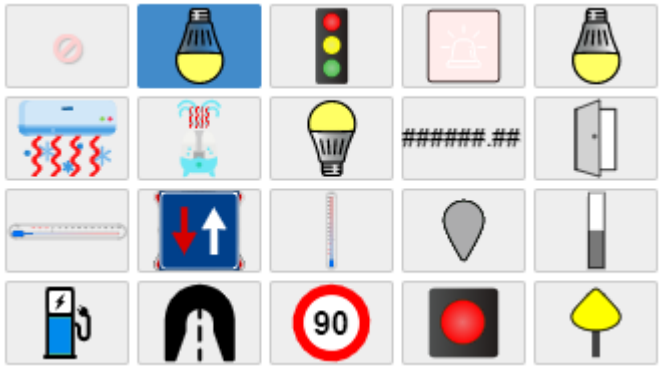
- **Icon**: (accessible as **Icon Mode** of selector)
  - Also usable with **Text Mode** of the menu
  - Selectable from a large set
  - Coherent with Icon on Menu
  - Custom Color

# Pins on Multi Data Maps (2)



Bubble Pins

- **Bubble**:
  - Text Menu or Icon Menu
  - Custom Color
  - Size depending on ServiceURI Attribute, IOT Device ValueName
- **Custom**: (accessible from Alternate View Mode)
  - Can be created by AreaManagers as **Custom Widgets** https://www.snap4city.org/663
  - Selectable from a set
  - Coherent with Menu, also usable with text menu
  - Variable/Dynamic colors/animations associated with ServiceURI Attribute, IOT Dev ValueName



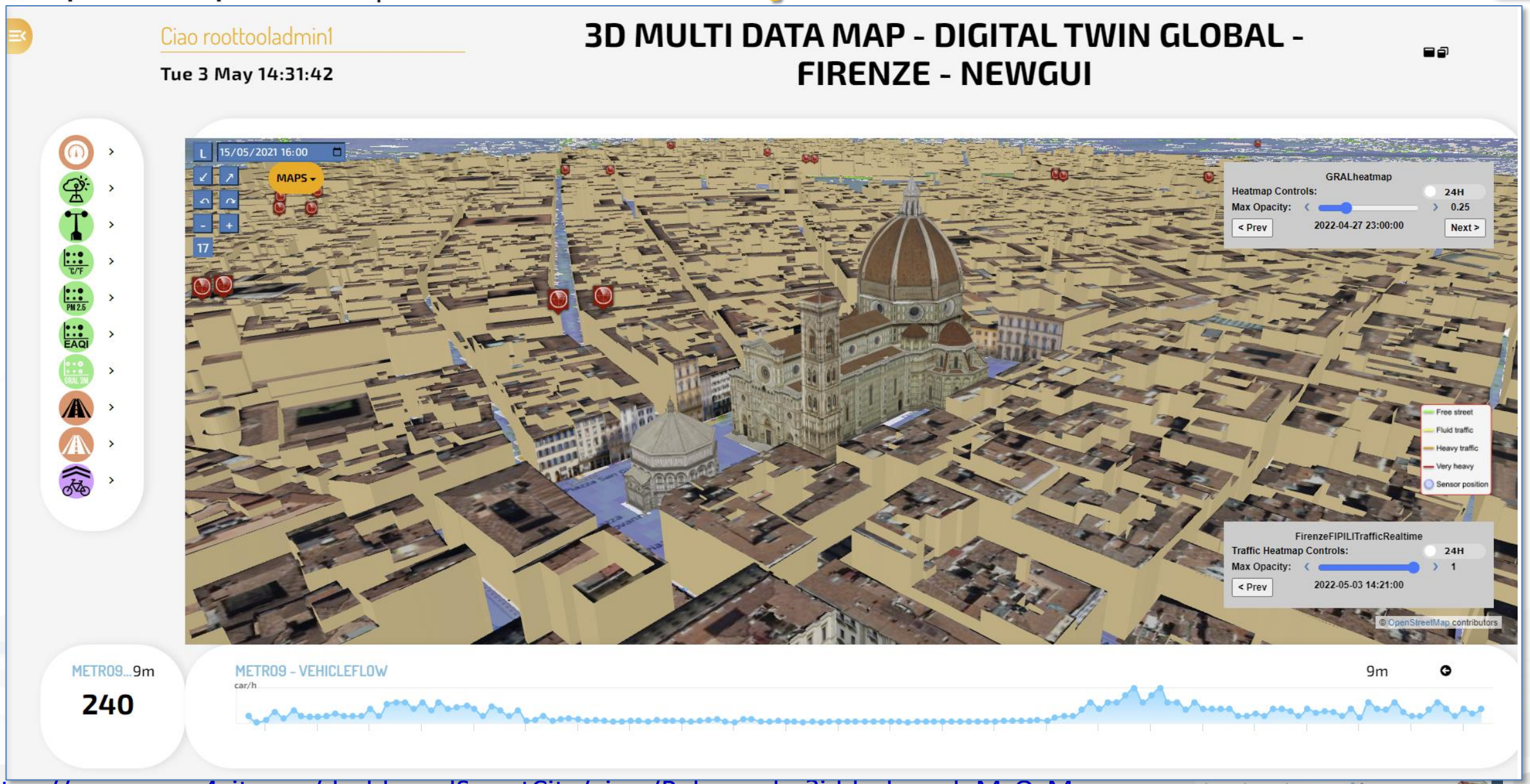

Pins and Menu icons

# 3D - Multi Data Maps Widget

# Global Digital Twin



# 3D City Views




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


Ciao roottooladmin1
Thu 16 Jun 15:13:42
3D MAP DECK TEST-NEWGUI
demonstrator
3D MAP
MAPS
03/10/2021 12:00
16
Free street
Fluid traffic
Heavy traffic
Very heavy
Sensor position
FirenzeFIPILITrafficRealtime
Traffic Heatmap Controls:
24H
Max Opacity:
1
< Prev
2022-06-16 15:01:00
© OpenStreetMap contributors

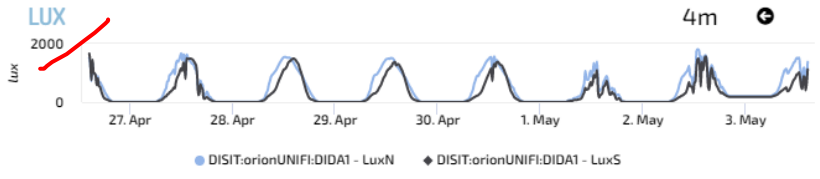
# Smart Building

Ciao roottooladmin1

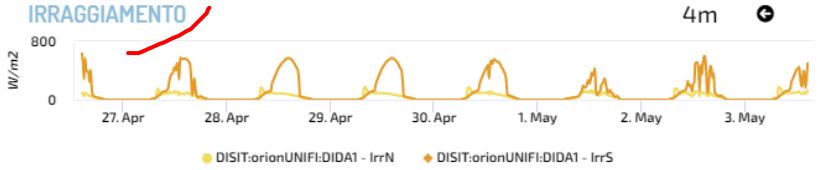
Tue 3 May 14:37:14

## DIDA DATA 2 - NEWGUI

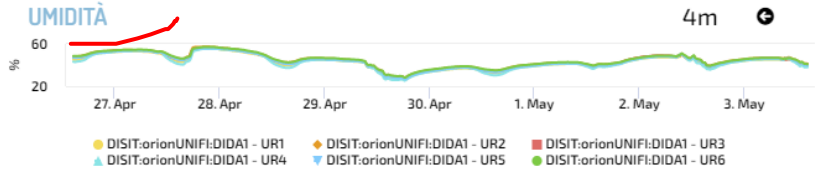
LUX 4m



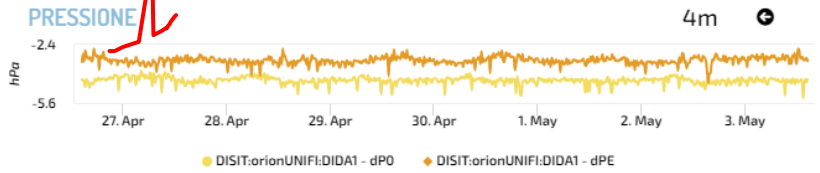

IRRAGGIAMENTO 4m




UMIDITÀ 4m

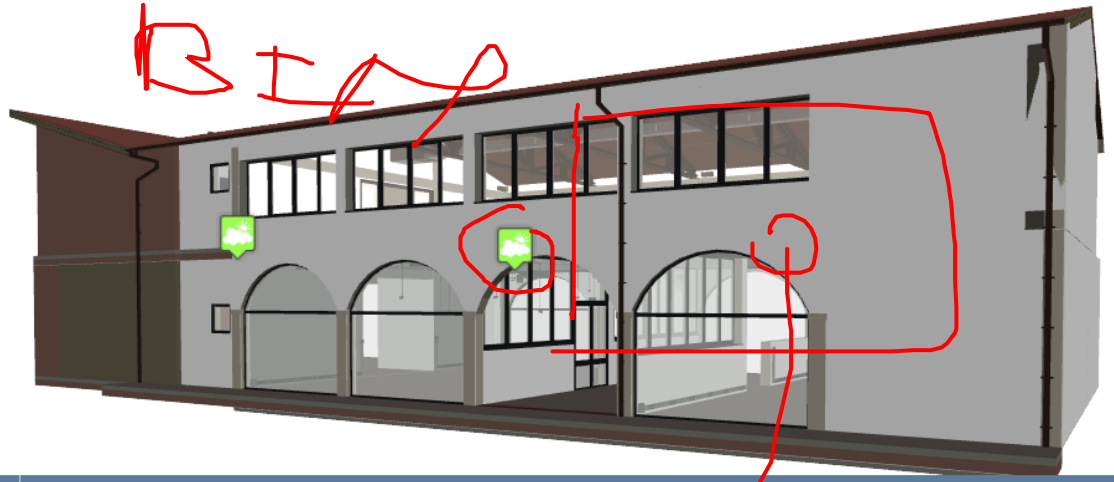



PRESSIONE 4m




to see BIM log as user: info@disit.org, passwd: guest

BIM SANTA VERDIANA



Last Value

No data

Time Trend Chart: Glob - Day




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzI4OA==

# Global City Digital Twin

- **Real Time Rendering Maps with 3D City Digital Twin**
  - Full control:
    - pan, zoom, tilt, rotation, etc.,
    - simulation of light conditions: over the daylight and night
    - Plus Full control with right button and wheel of the mouse
  - Full control of pre-setting for direct show specific condition when loading
  - Section modality to pick the single Building or part of it, and to start a navigation towards other views, via relationships managed by an IoT App of reference
- **3D City Construction is an comprehensive and scalable process**

# 3D City Construction

Multiple images from several points of views



Raw Facades pictures

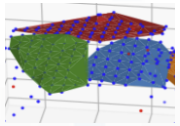


GIS orthomap



GIS Building plant shapes and positions

Building heights (at the eaves)



Lidar Data



Sky Pattern



Terrain (DTM)

Heatmaps, Traffic flow, Pins, IOT, POI, RT data, .....

3D design of High Value Buildings, HVB

Facades patterns extraction

Roof patterns extraction

Create 3D building with flat roofs (by extrusion)

Create 3D buildings with 3D roofs' shapes

Integrated view of HVB + building with roofs and facades

Generate 3D city representation

3D City Digital Twin on Dash

HVB model with patterns

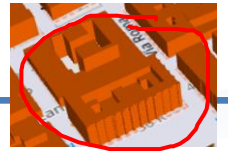


Facades' patterns



Roof patterns







Create 3D building with photorealistic texture

3D buildings with roof and facade patterns

Extruded building with picking functionality

Orientation, Position, Light, zoom, view point, etc.

# Interacting with 3D City Digital Twin

- You can see in the 3D model
  - Terrain model defining the level of  the terrain and of the building
  - Generic Buildings, high value buildings, HVB (e.g., Dome, Palazzo Vecchio, etc.), facades, roofs, etc.
  - Sky pattern: sun, cloudy, etc.
  - Orthomaps below the buildings, by selection
  - Heatmaps, over orthomaps, and below buildings:
    - temperature, traffic, pollutant
  - Cycling paths and other shapes, polylines
  - Traffic Flows: as crests shaping the traffic flow density in high and color according to color map
  - POI, Sensors: PopUps to see real time data
  - Pillars reporting in 3D  the values of specific sensors: temperature, traffic flow, people counting, pollutant, etc.

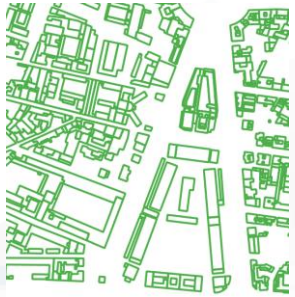
# 3D Map Texturing



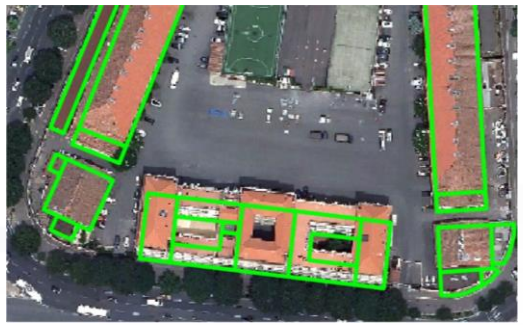
HVB inclusion

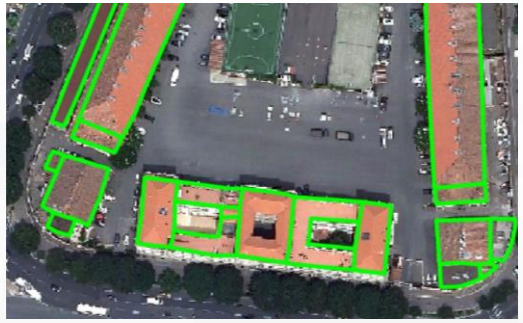


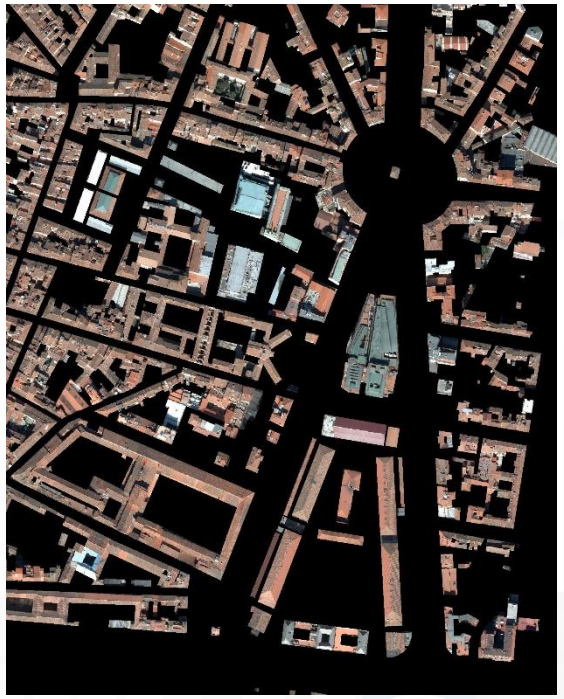
Orthomaps

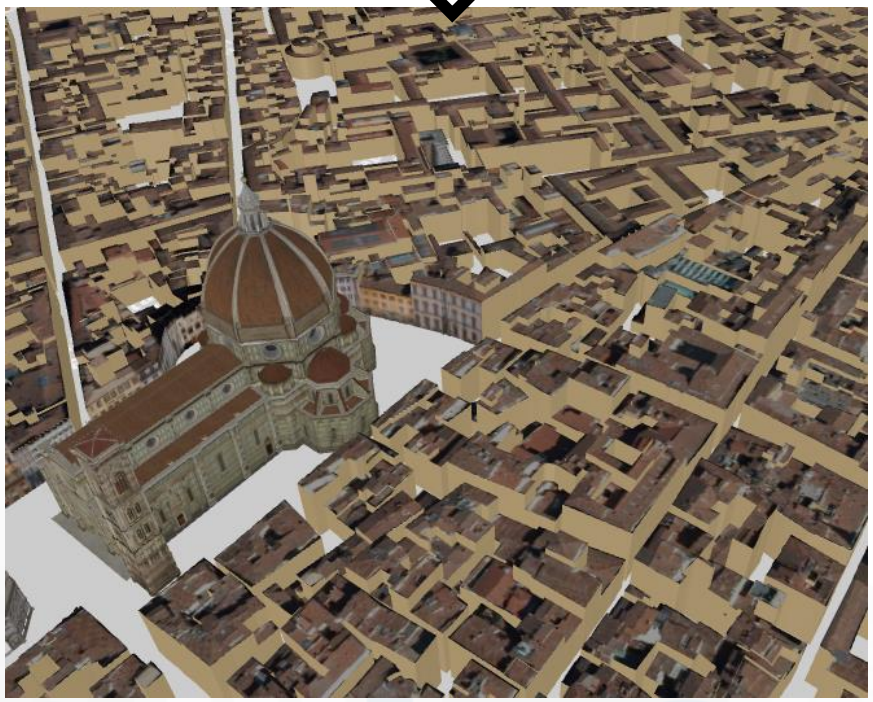


Building shapes









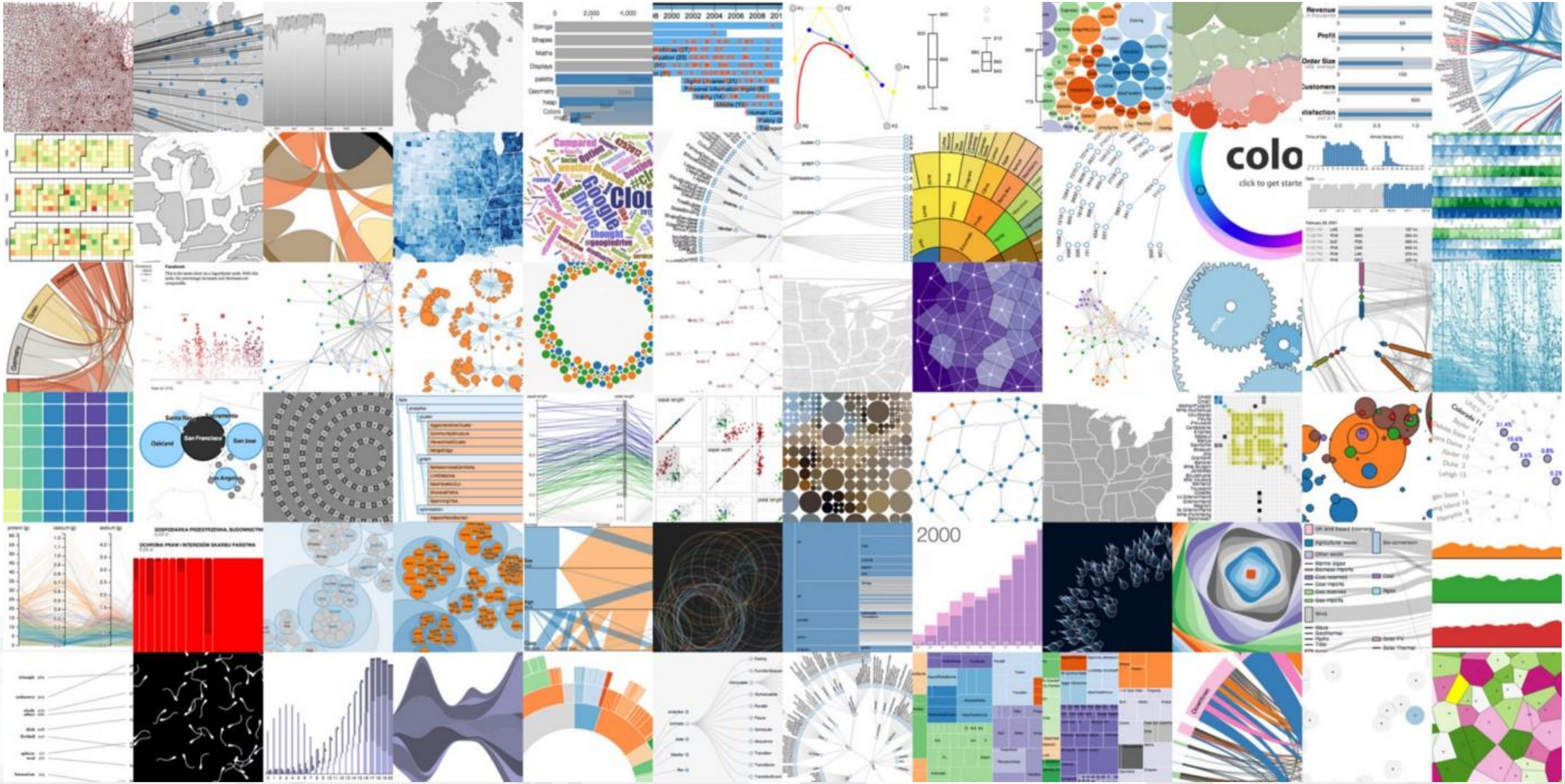
**Input** → **Deep network alignment** → **Rooftop texture extraction and warping** → **Final textured 3D map**

# D3.js Graphic Widgets
# Advanced Interactive Graphs



# D3.js graphs

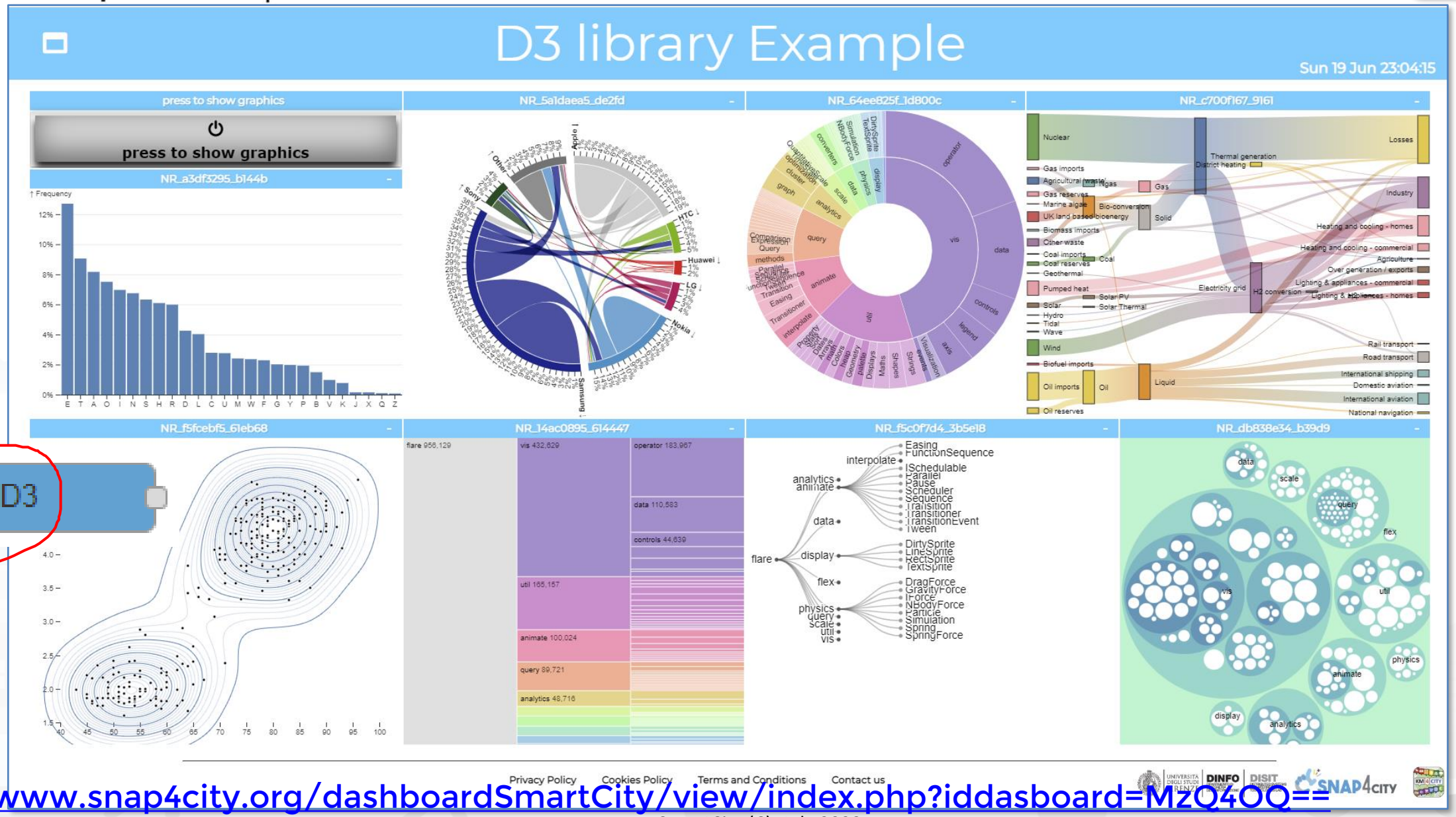




# D3.js graphs on Snap4City

- D3.js Graphs: https://d3js.org/
- Any D3.js graph can be shown on Snap4City Dashboards
- The generation of the graph is performed on Node-RED IoT App of Snap4City using library:
  - https://flows.nodered.org/node/node-red-contrib-snap4city-d3-dashboard-widgets
- On Snap4City IOT App the graph is generated by:
  - JSON Data which can be automaticaly produced by Snap4City processes
  - Functions to define the interaction with the graph
- See: HOW TO: Exploit the D3.js graphic library in Snap4City Dashboards

# D3.JS Widgets




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

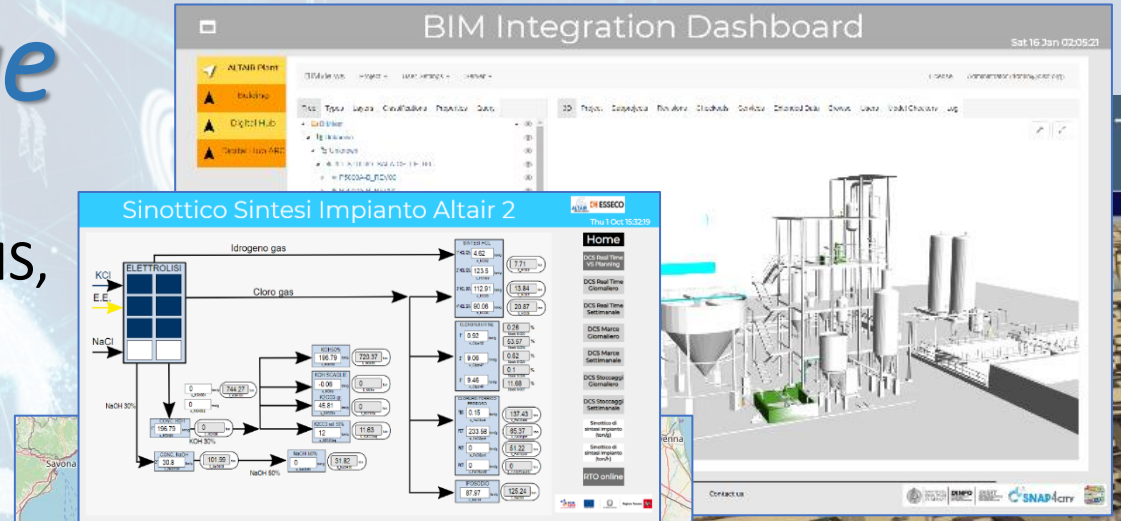
# Data Kinds vs Graphic Widgets

# HLT, High Level Types



# Data Type Coverage

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

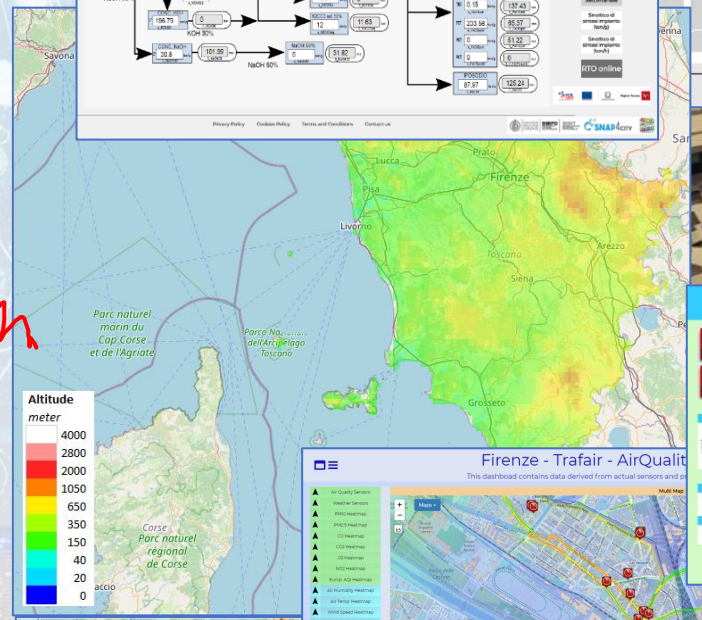












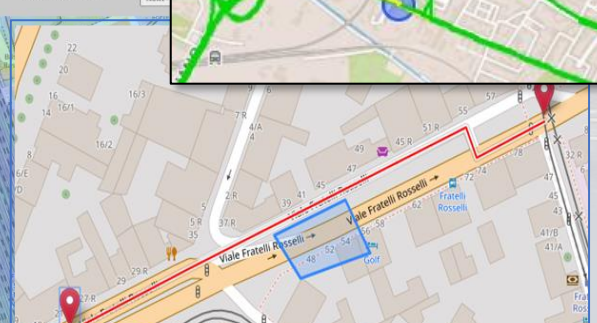






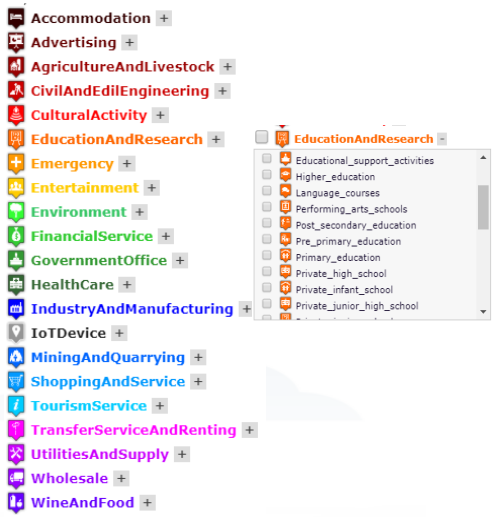






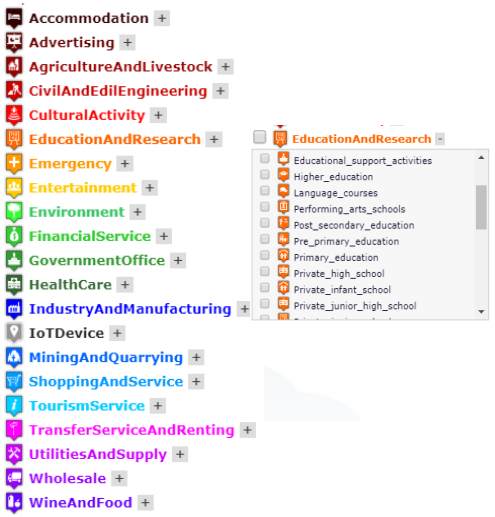
# HLT: Unified Classification for Data and Services

- **Data Models**: all devices sprunt from that model
  - IoT Device Model, Mobile Device Model, Data Table Model
- **Devices**: are instances of some model or sprunt from processes
  - IoT Device, Mobile Device, Data Table Device, Sensor Device
- **Variables**, Sensor/sensor-actuator, :
  - IoT Device Variable, Mobile Device Variable, Data Table Variable, Sensor, Sensor-Actuator
  - **Dashboard-IOT App:** messages from GUI to Business Logic on IoT App
- **MyKPI**: dynamic GPS, info, single variable, Time Series, (Classification)
  - **KPI:** former KPI model
  - **MyPersonaData/MyData**: safes in which specific personal data are saved.
- **POI**: static GPS, info about a location, (Classification),
  - **MyPOI**: personal POI that can be leveraged to standard POI by administrator
- **Heatmaps**: matrices on some area, Time Series, (Classification)
- **Traffic Flow**: road segments with flow  density, Time Series, (Classification)
- **OD Matrices**: origin destination matrices, Time Series, (Classification)
- **Complex events:** emergency, alarm, entertainment, CAP, … special widgets

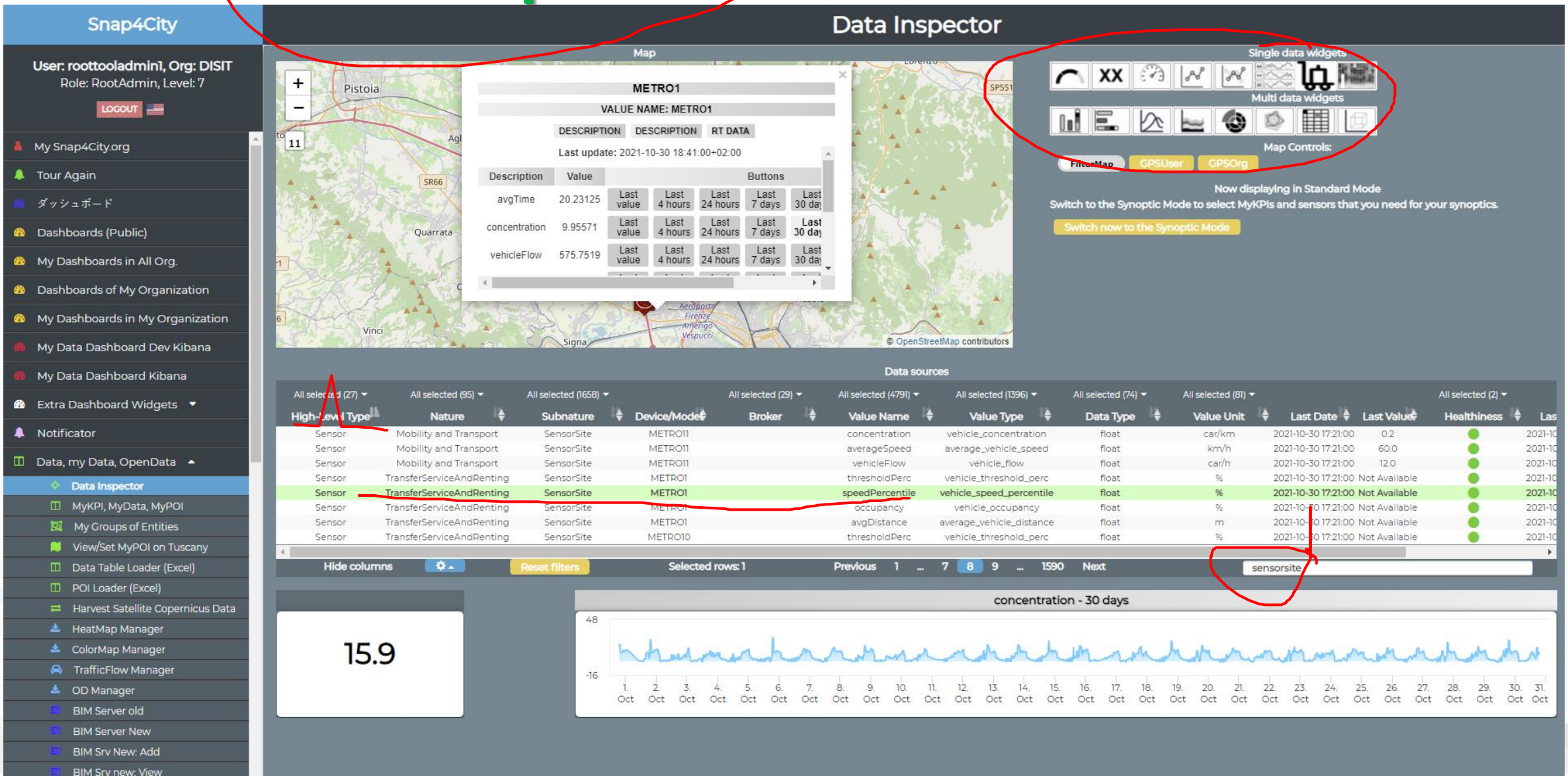


# HLT: Unified Classification for Data and Services

- **External Service**: third party visualization tools, iFRAMED…
  - Also TV CAMs are rendered here, and substantially all the other Services
- **Synoptics**: graphic representations with animation connected to variables and/or MyKPI and/or IoTApp, etc.
- **BIM representations**: Digital Twin Local, …
- **Micro Applications**: Snap4City, Km4City micro applications, iFRAMED
- **Special Widget**: a set of special visualization tool with their dedicated data type
- **WFS**: a specific tool for WFS GIS rendering, please note almost the same kind of data type can be visualized as Data above described



# Data Inspector: HLT classification



# HLT: Unified Classification for Data and Services

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

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

High Level Types

Nature

SubNature

**Semantic Classific.**

Dev/Model name

Broker name

**Technical Source**

Value Name

Value Type

Data Type

Value Unit

**Variables, names**

Last Date/Time

Last Value

**Real Time**

Healthiness

Last Check

**Status**

Ownership

Organization

**For Admin**

# How the Dashboards exchange data (2022)

Snap4City BigData Storage and KB

IOT Broker Orion Quantum Leap

ServiceMap Super ServiceMap

- Req. ServiceURI

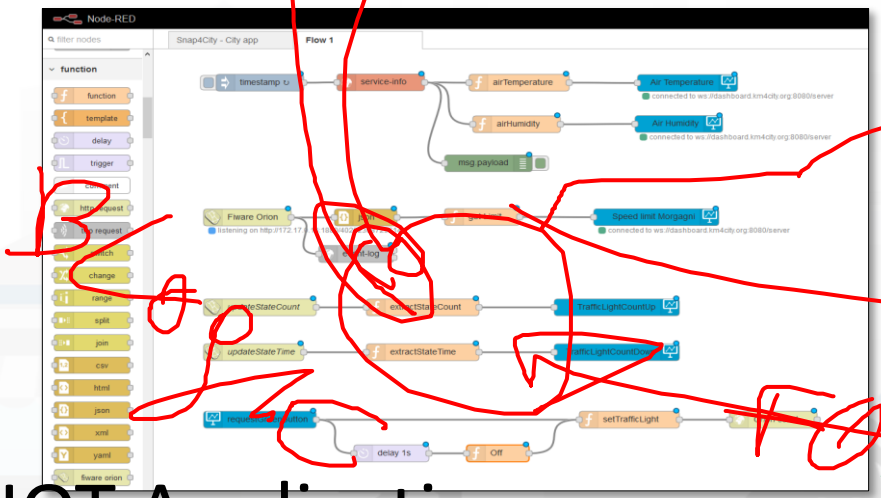
Metric, KPI

MyKPI, MyPOI, …

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

API, External Services, MicroApp

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




IOT Application

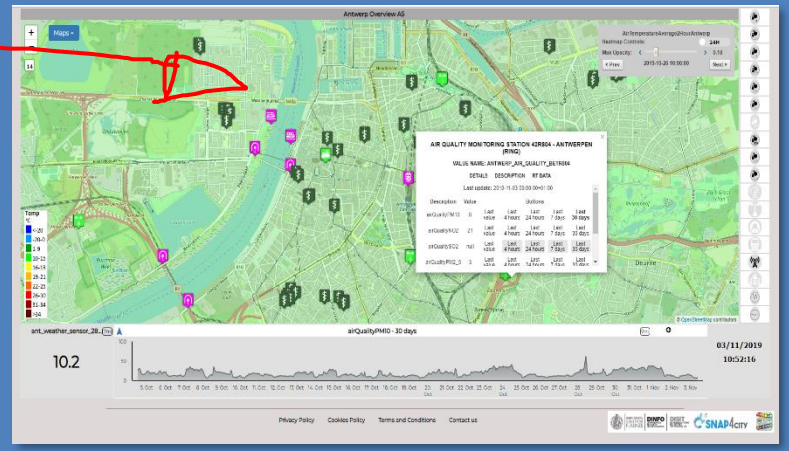
- ServiceURI (ID)
- MyKPI, Metric (ID)
- Dynamic Data, computed into IOT Application

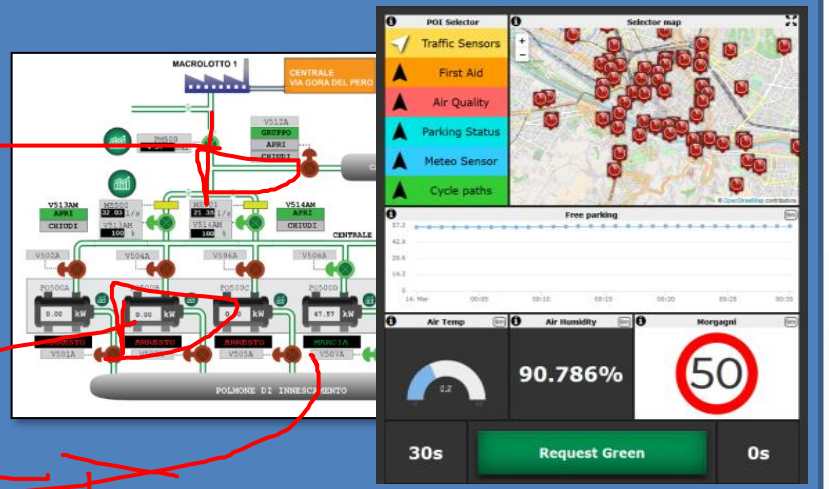
- Rx. Dynamic Data

- Event Driven Synoptics

- Actions, Show

## Dashboards



# What the Dashboards can directly exploit (2022)

IOT Broker

IOT Device

IOT Edge

Sensors/ Actuators

GIS data, Maps, ...

Snap4City BigData Storage and KB

External Data Stores

LD, LOD

API, External Services

DataGate

Web Scraping

IOT Application

Dashboards

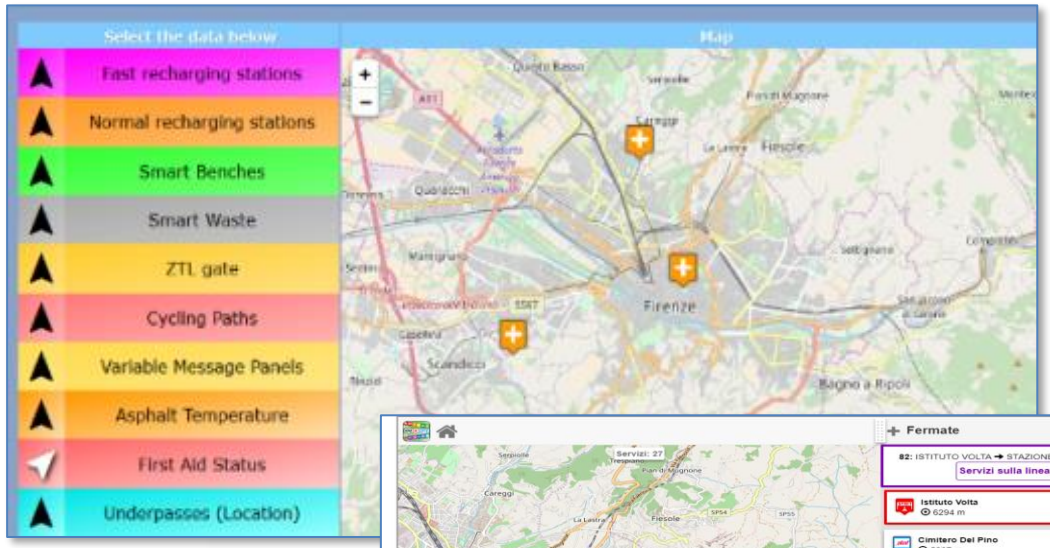
From IOT App to Dashboard

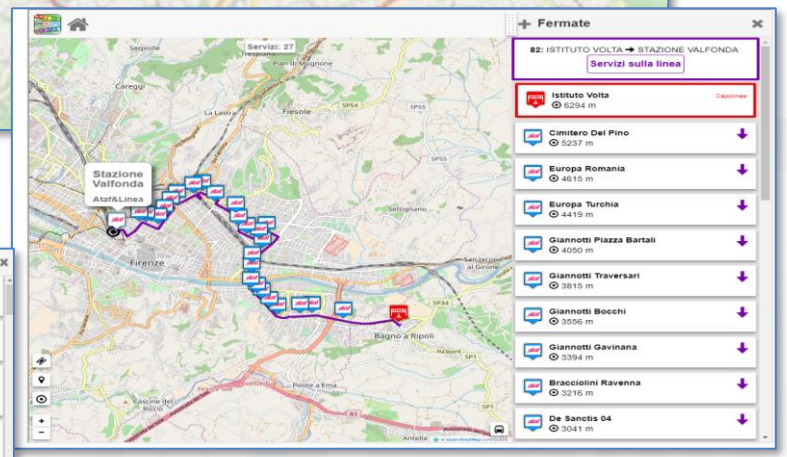
From Dashboard to IOT App

Big Data Analytics, Artificial Intelligence Access to all data

# HLT:POI

High Level Types




Single POI




Categories

- Accommodation
- Advertising
- AgricultureAndLivestock
- CivilAndEdilEngineering
- CulturalActivity
- EducationAndResearch
- Emergency
- Entertainment
- Environment
- FinancialService
- GovernmentOffice
- HealthCare
- IndustryAndManufacturing
- IoTDevice
- MiningAndQuarrying
- ShoppingAndService
- TourismService
- TransferServiceAndRenting
- UtilitiesAndSupply
- Wholesale
- WineAndFood

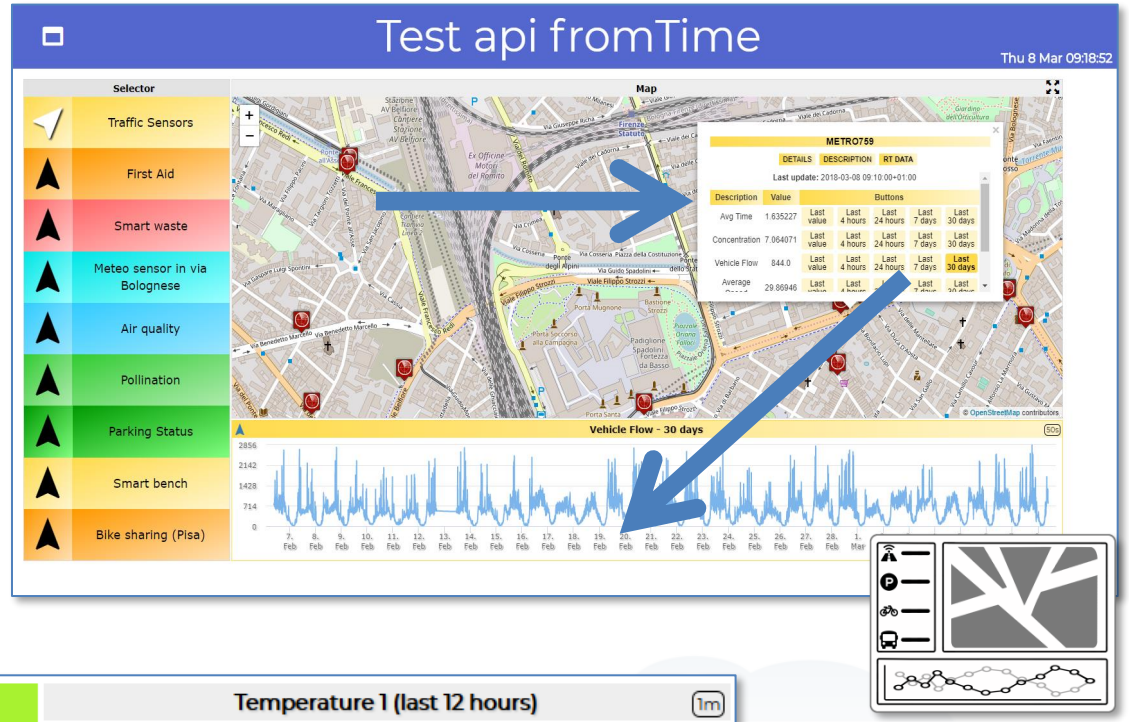
EducationAndResearch
- Educational_support_activities
- Higher_education
- Language_courses
- Performing_arts_schools
- Post_secondary_education
- Pre_primary_education
- Primary_education
- Private_high_school
- Private_infant_school
- Private_junior_high_school

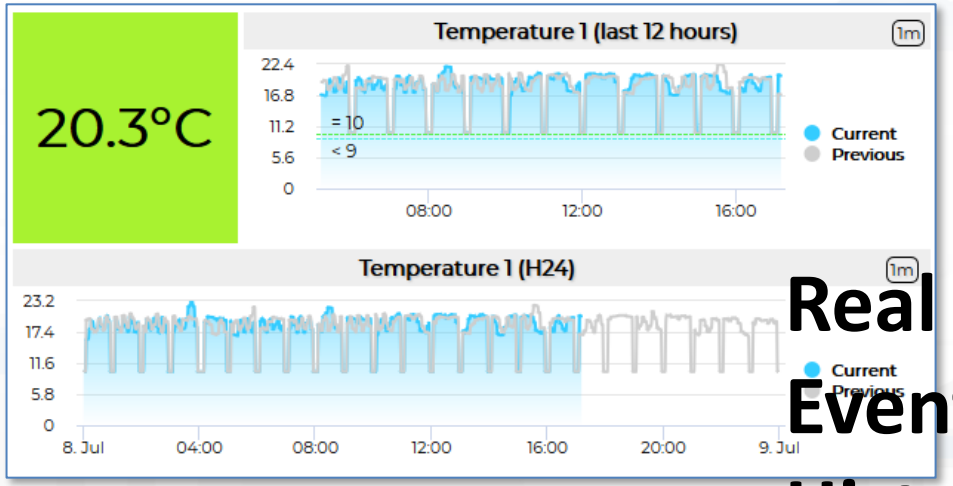
**POI**: static GPS, info about a location, (Classification),
**MyPOI**: personal POI that can be leveraged to standard POI by administrator

# HLT: data

High Level Types

- **Data Models**: all devices sprunt from that model
  - IoT Device Model, Mobile Device Model, Data Table Model
- **Devices**: are instances of some model or sprunt from processes
  - IoT Device, Mobile Device, Data Table Device, Sensor Device
- **Variables**, Sensor/sensor-actuator, :
  - IoT Device Variable, Mobile Device Variable, Data Table Variable, Sensor, Sensor-Actuator
  - **Dashboard-IOT App:** messages from GUI to Business Logic on IoT App
- **MyKPI**: dynamic GPS, info, single variable, Time Series, (Classification)
  - **KPI:** former KPI model
  - **MyPersonaData/MyData**: safes in which specific personal data are saved.

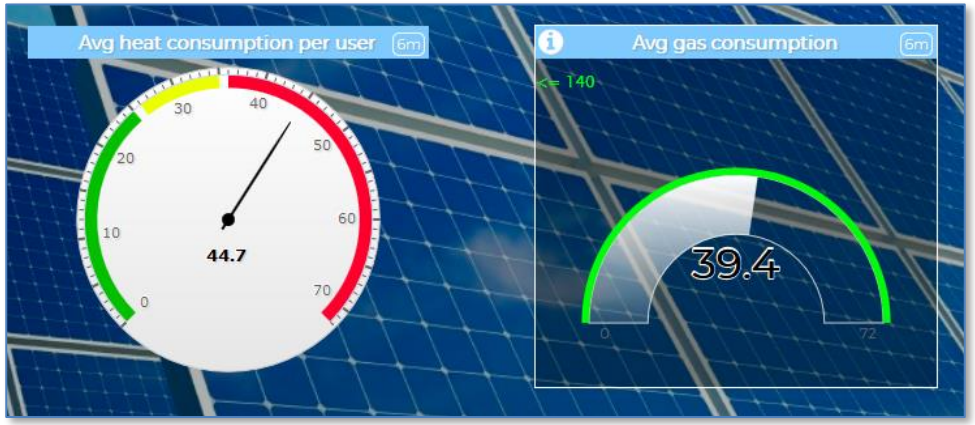


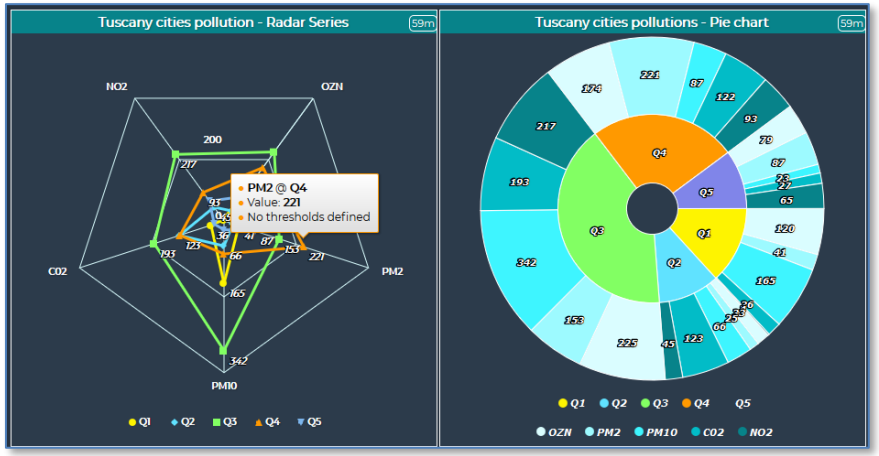



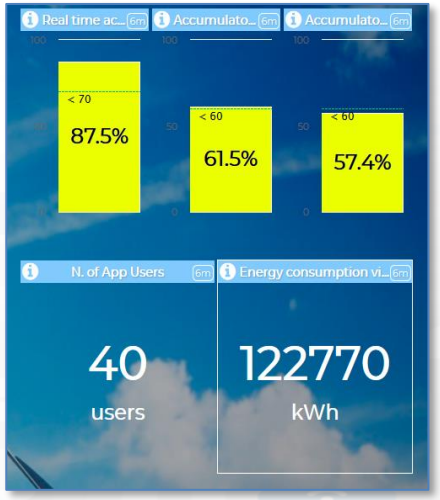

**Real Time**
**Event Driven**
**Historical Data**

# HLT: data

High Level Types

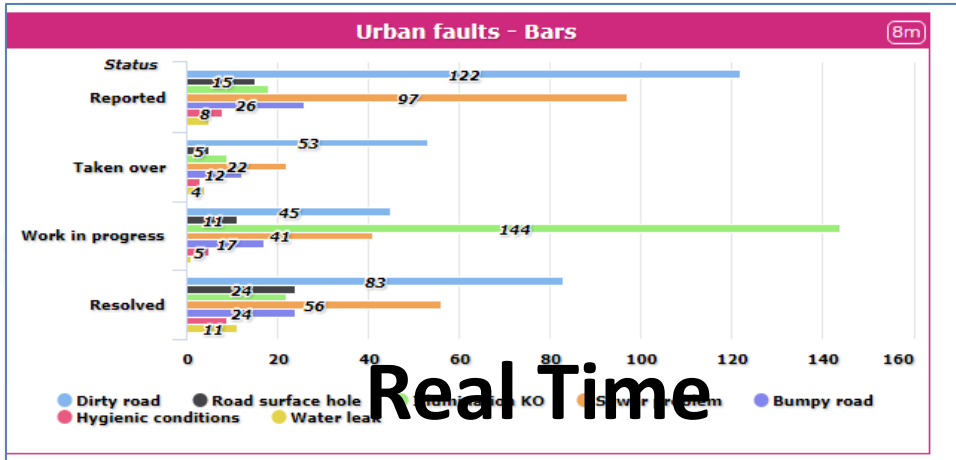


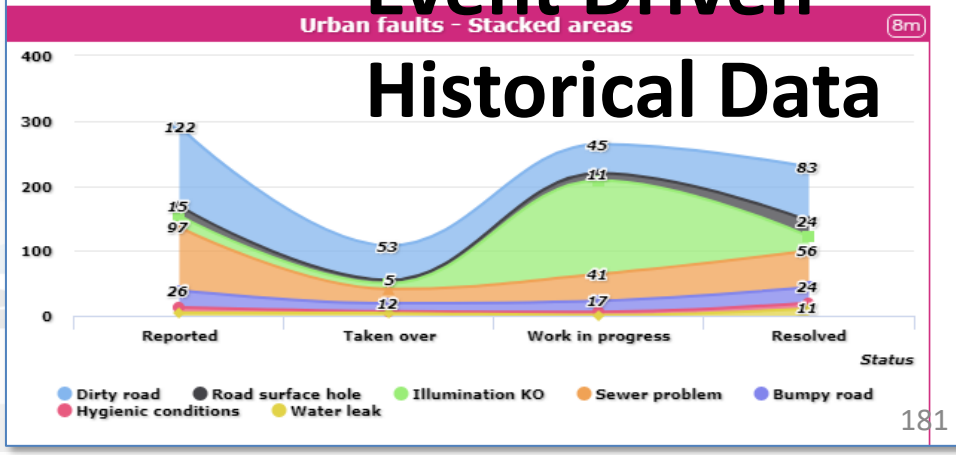

Weather stations

| Data / Station | Wind speed (km/h) | Direction | Temperature (°C) | Humidity (%) | Rain today (mm) | Pressure (mbar) |
|---|---|---|---|---|---|---|
| Sesto Fiorentino | 50 | N | 7 | 32 | 0 | 922 |
| Livorno | 65 | NE | 5.5 | 37 | 0 | 876 |
| Grosseto | 78 | E | 4 | 22 | 0 | 1022 |
| Vada | 42 | S | 6 | 0 | 34 | 895 |
| Follonica | 102 | N | 7.2 | 23 | 0 | 913 |
| Giglio | 97 | O | 3 | 19 | 0 | 957 |




Real Time

Event Driven

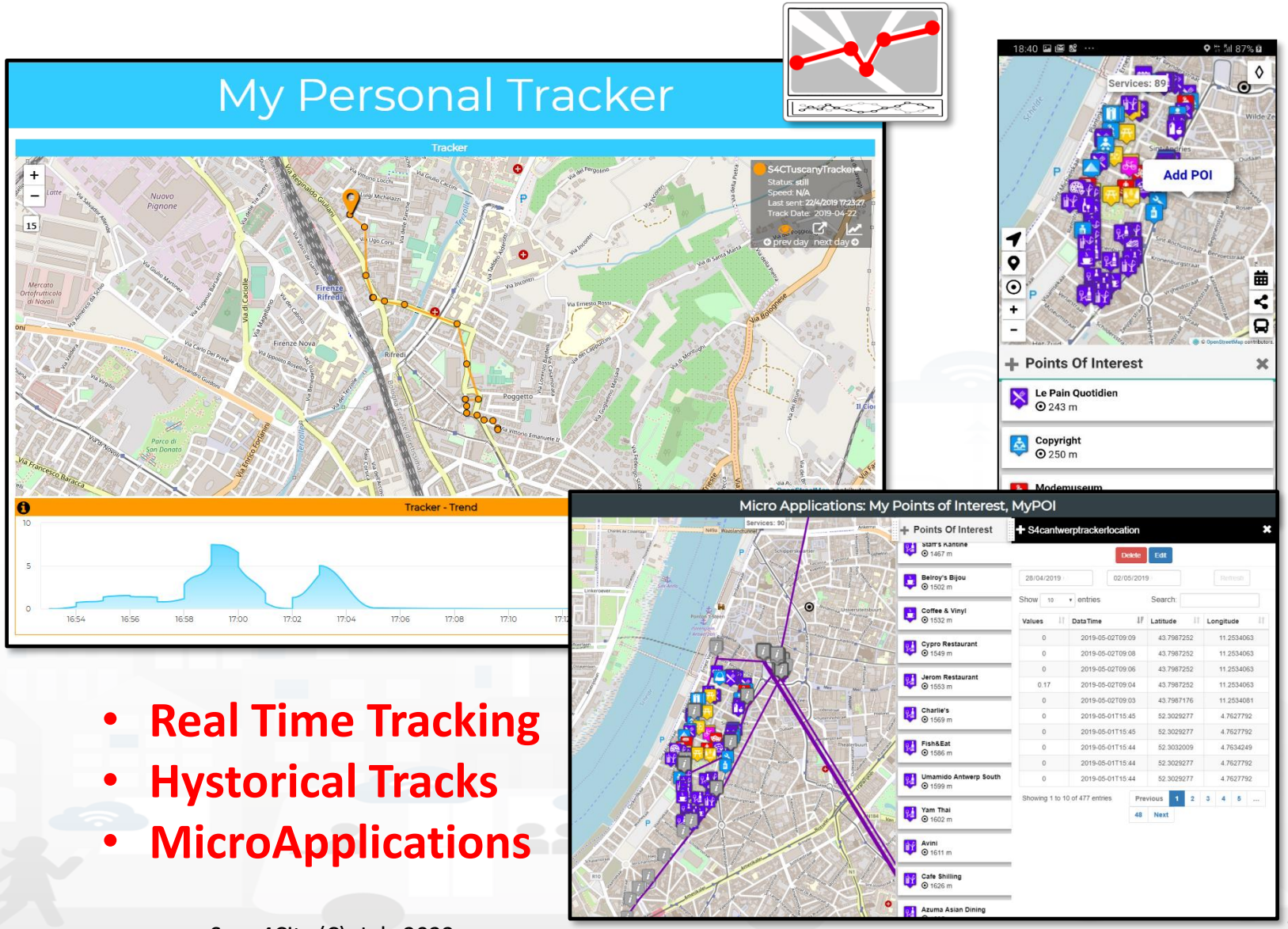



Historical Data

# • Trajectories

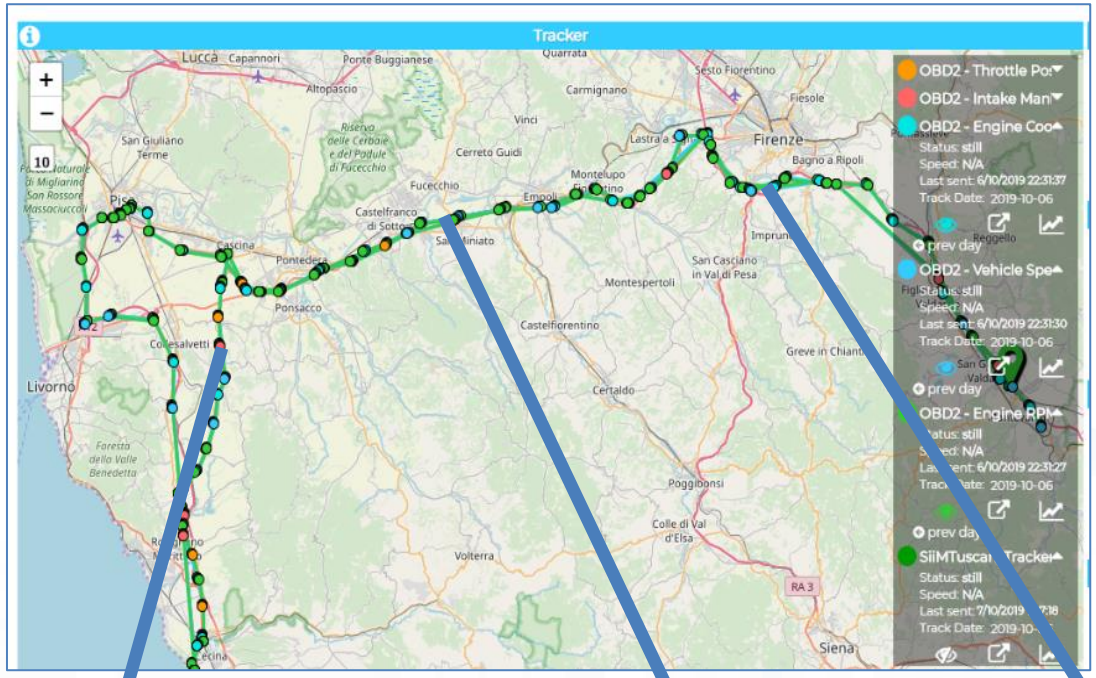
High Level Types

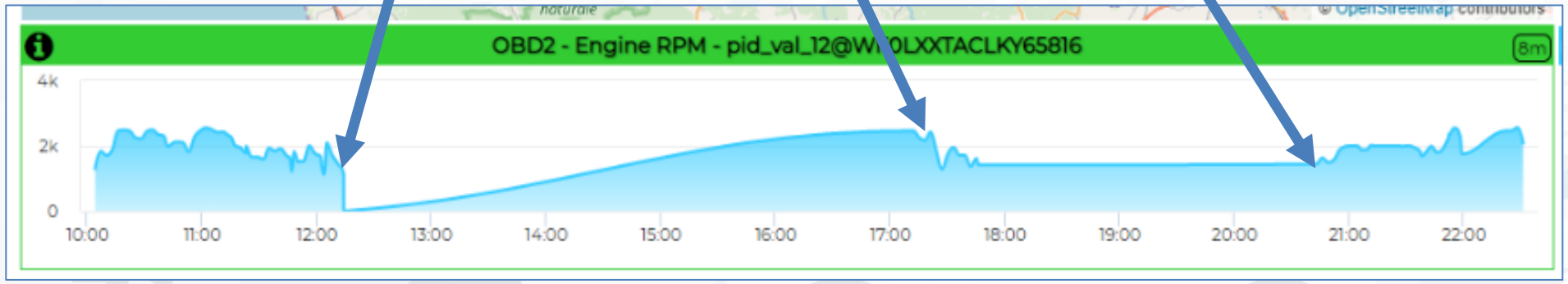
- **Variables**, Sensor/sensor-actuator, :
  - **Mobile Device Variable, Data Table Variable, Dashboard-IOT App**: messages from GUI to Business Logic on IoT App
- **MyKPI**: dynamic GPS, info, single variable, Time Series, (Classification)




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

# MyKPI: Time Series over GSP locations




Moving Sensors
Moving devices
Tracking

# MyKPI: Tracking of Devices and Mobiles

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



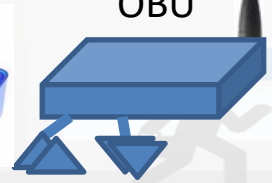
Mobile
PAX Counter



Apps

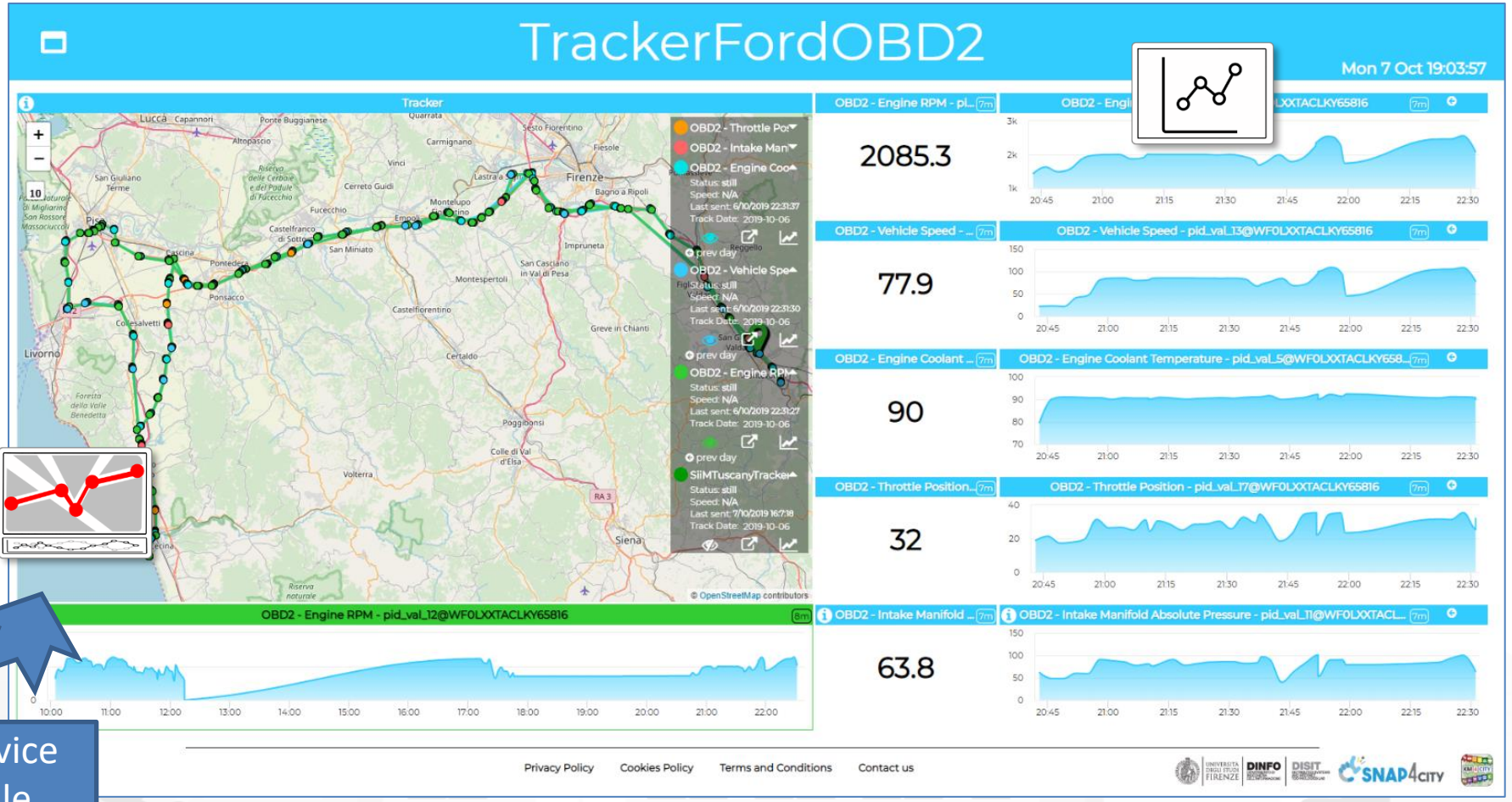


OBD2

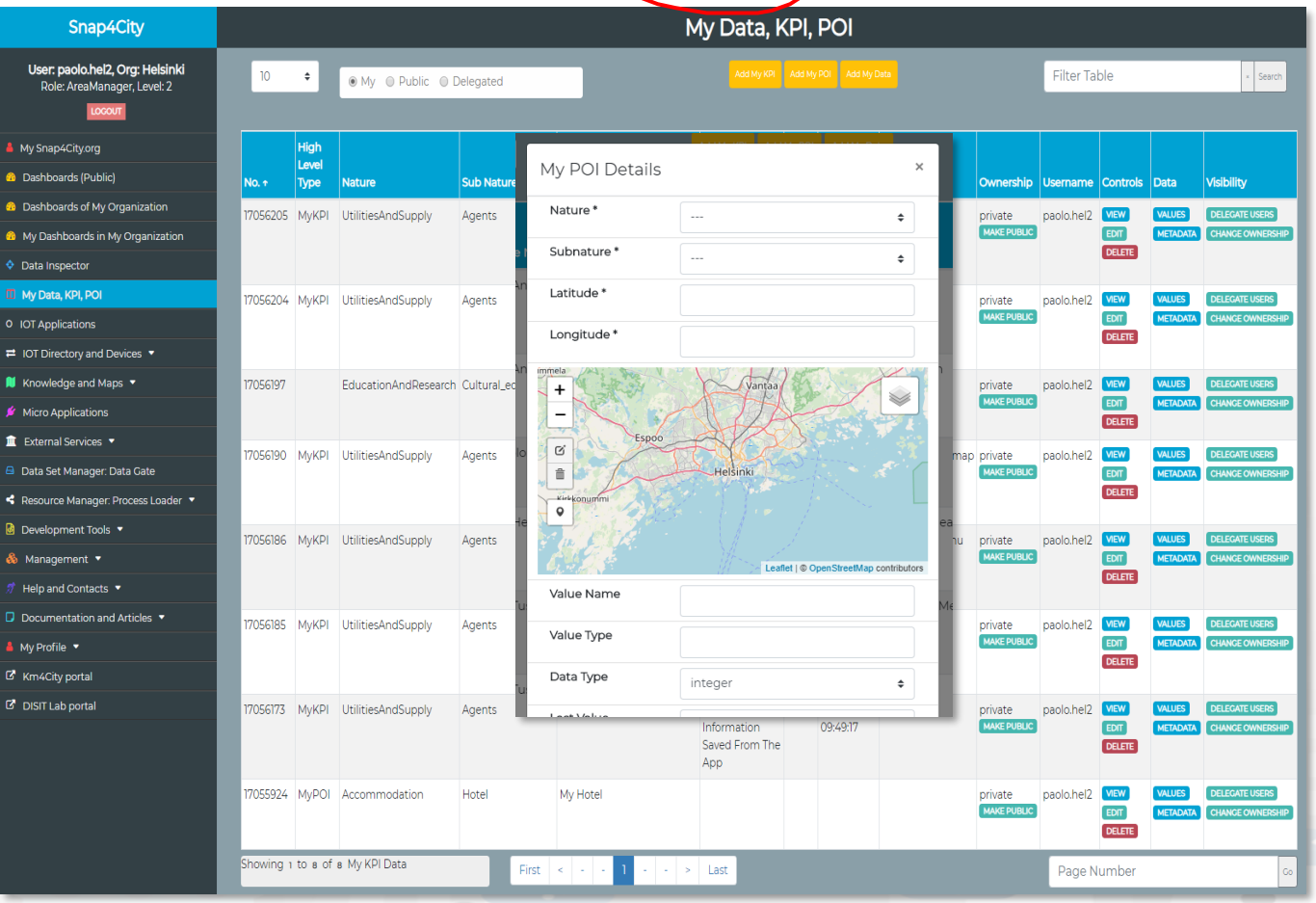


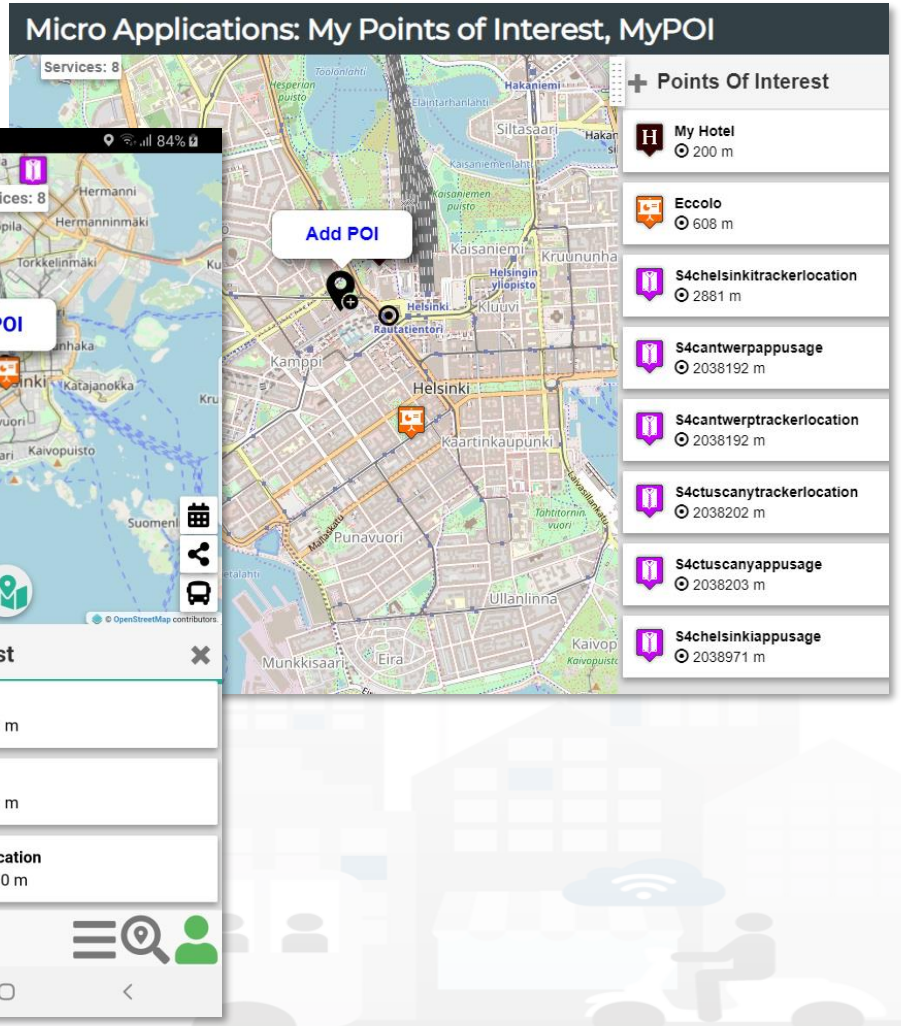
OBU

IOT Device
MObile



# MyKPI, MyPOI: Management as GDPR



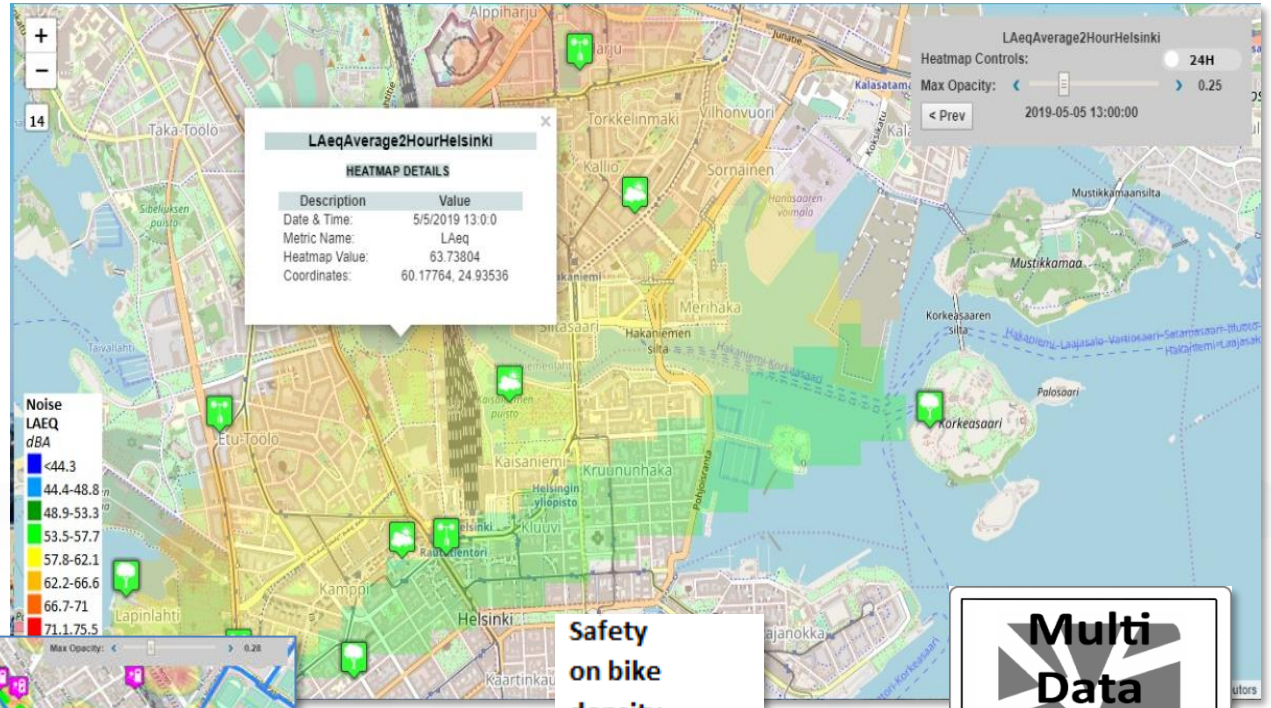
# HLT: Heatmaps

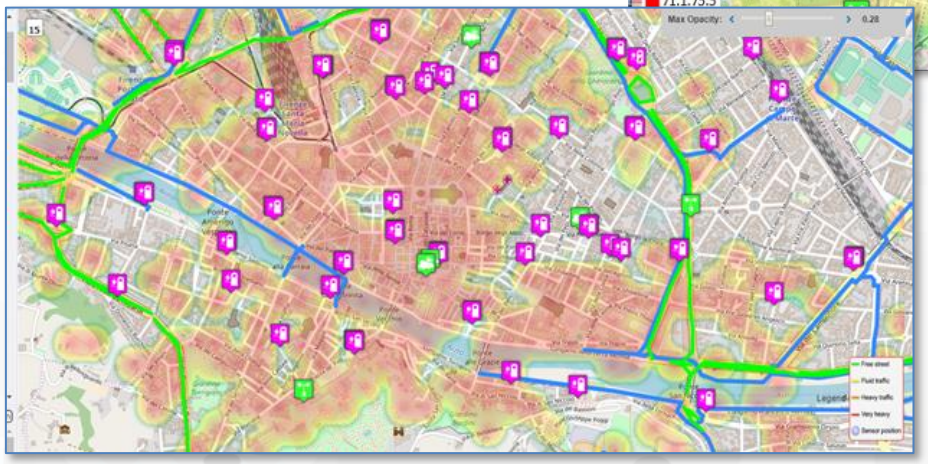
High Level Types

ColorMaps For Calibrated

**EAQI**
*Index*
1. Good
2. Fair
3. Moderate
4. Poor
5. Very poor

Type: calibrated



**Safety on bike density**
Very bad
Bad
Not so good
Neutral
Good
Very good
Excellent

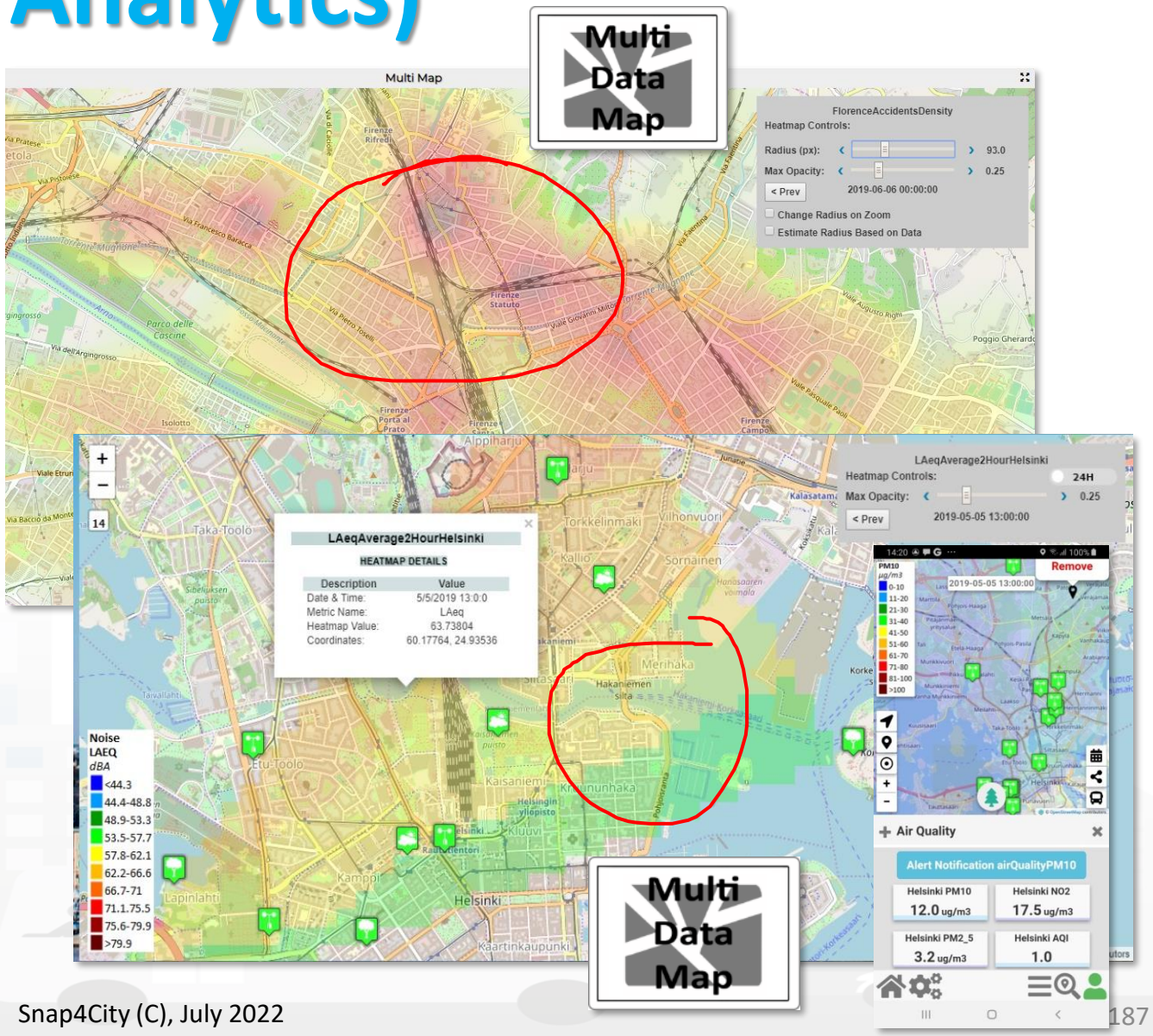
Multi Data Map

**Noise LAEQ** *dBA*
<44.3
44.4-48.8
48.9-53.3
53.5-57.7
57.8-62.1
62.2-66.6
66.7-71
71.1.75.5
75.6-79.9
>79.9

Type: Gaussian

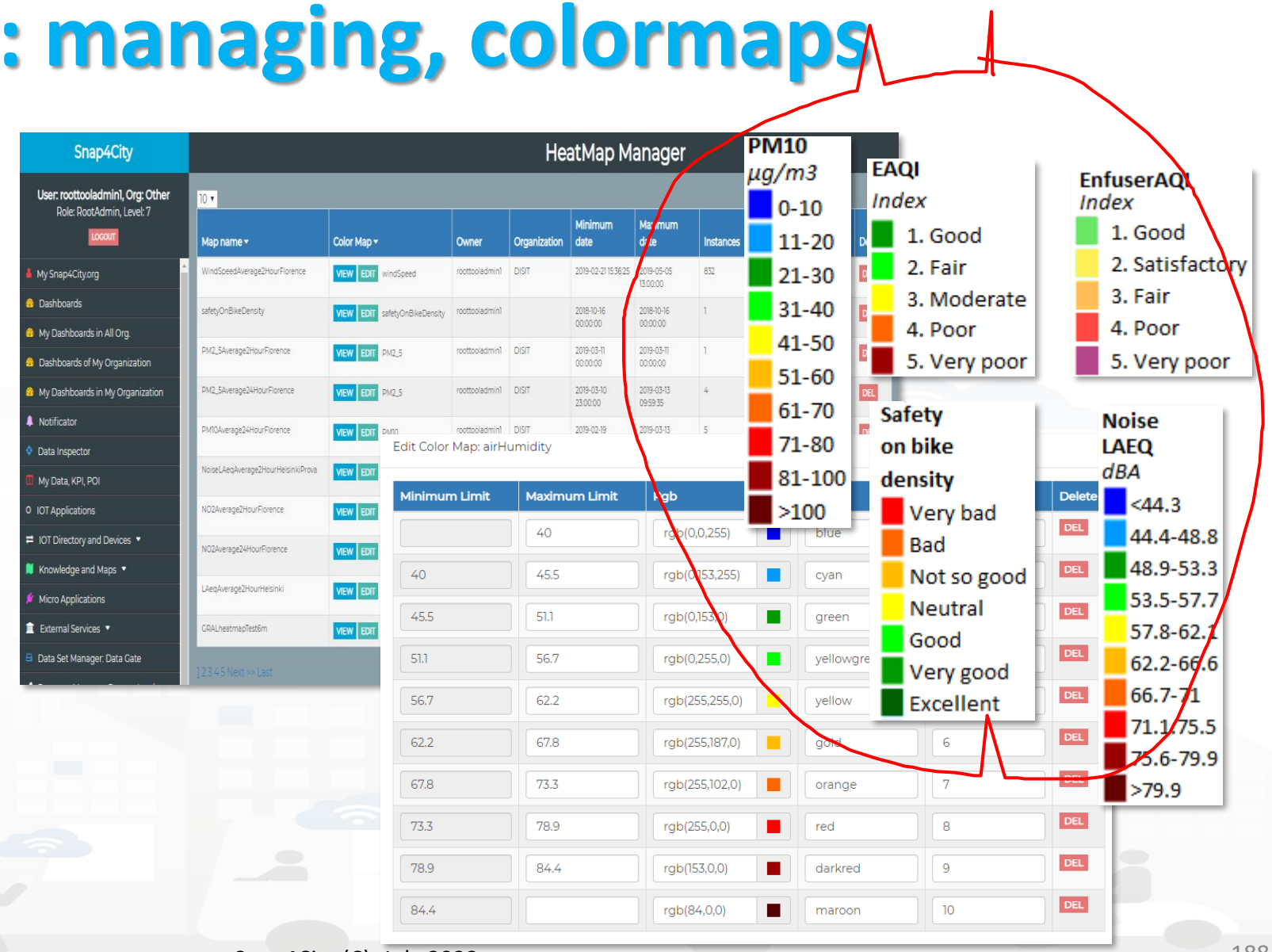
# Heatmaps (flexible Data Analytics)

- **Main:**
  - **Heatmaps are Time series**
- **A) Gaussian Heatmaps**
- **B) Calibrated heatmaps**
  - From KmxKm to 4x4 mt
  - PM10, PM2.5, SO2, NO2, Noise, NO, O3, Enfuser, **GRAL**,…. Copernicus
  - Any programmed ColorMap
  - Animations
  - Piking values in any place, values on their position.
  - On Web and Mobile App



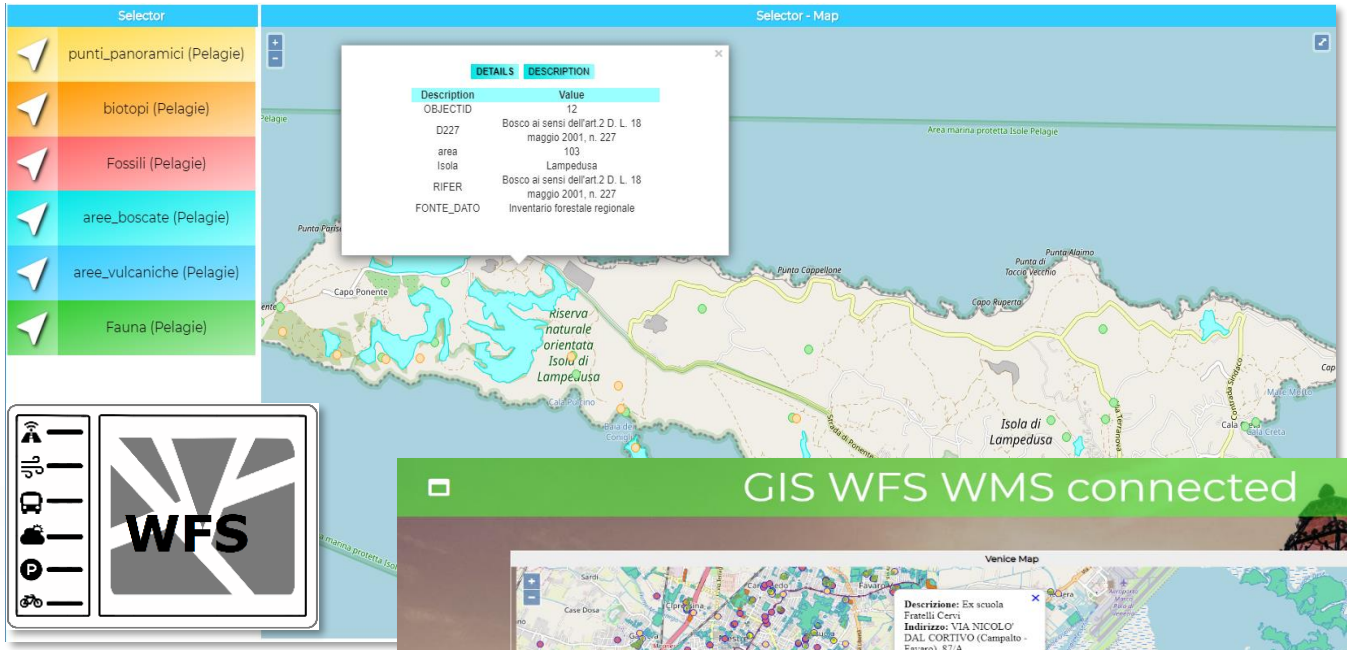
# HeatMap Manager: managing, colormaps

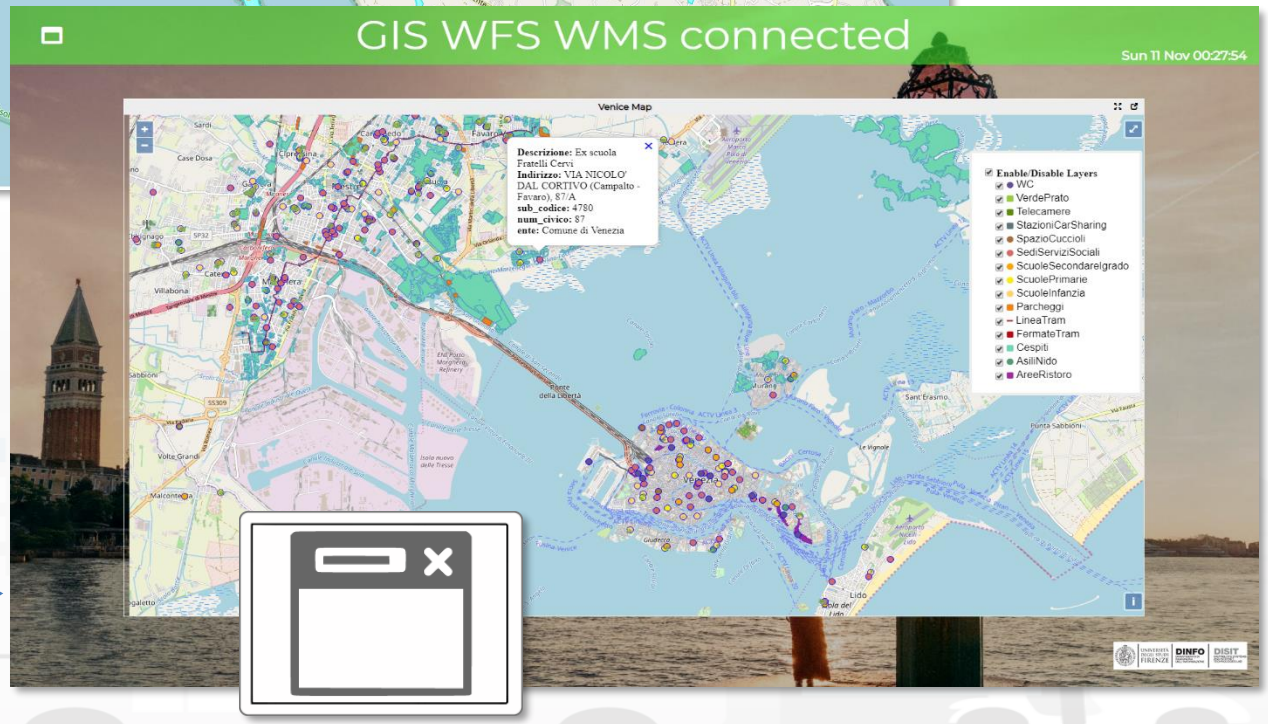
- Historical data, time series
- Huge amount of data and points per heatmap
- Data coming from: sensors, IOT App, Copernicus Satellite, …
- Multiple formats
- High speed computing
- WMS (GIS) compliant
- Animations
- Color maps: from few (5) to dense color scale (1000)
- Picking any place
- Smart City API to get them
- MicroServices for IOT Applications



# HLT: WFS (GIS)

High Level Types



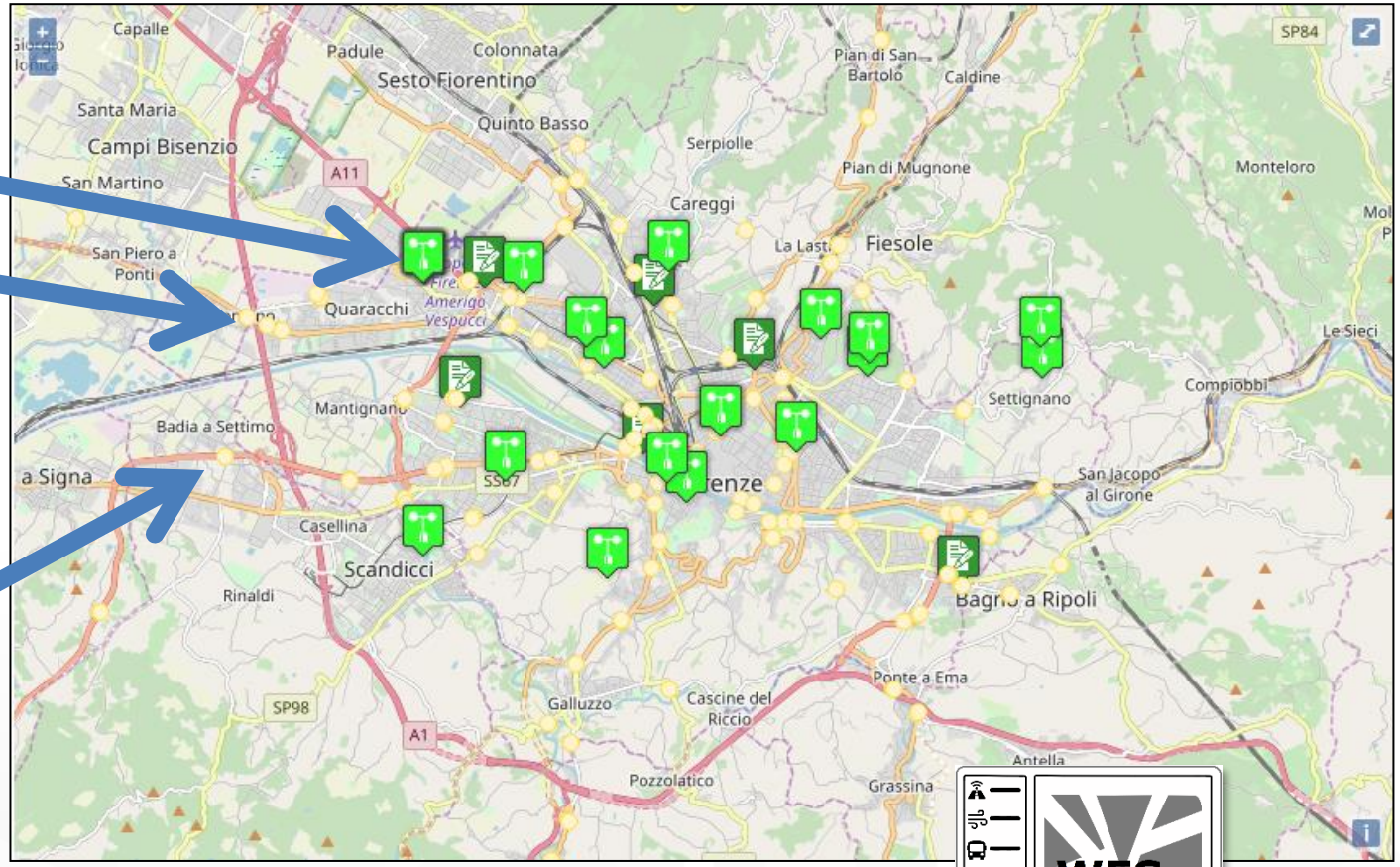

-Points
-Shapes, paths
-Heatmaps
-.....

Snap4City WFS WMS Tools

# HLT: WFS (GIS)

High Level Types

- **POI (Point of Interest)**
- **Wfs (GIS)**




GIS WFS Servers

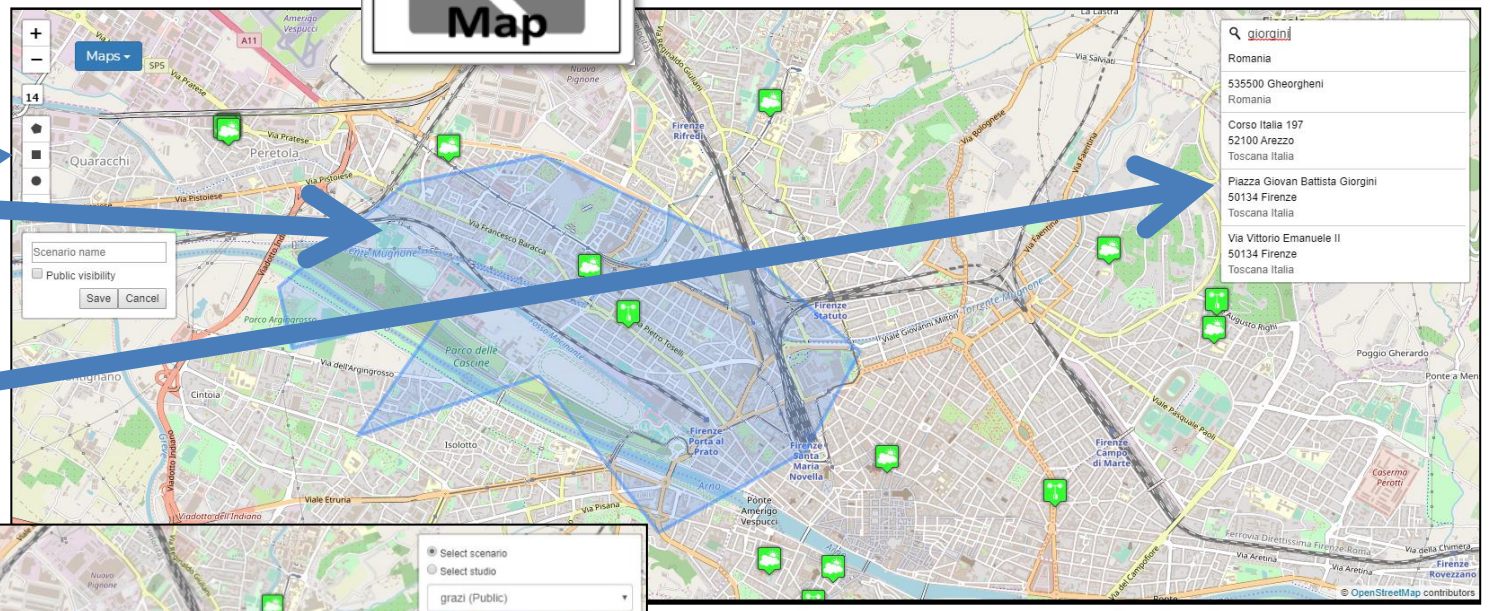
Multi Data Map

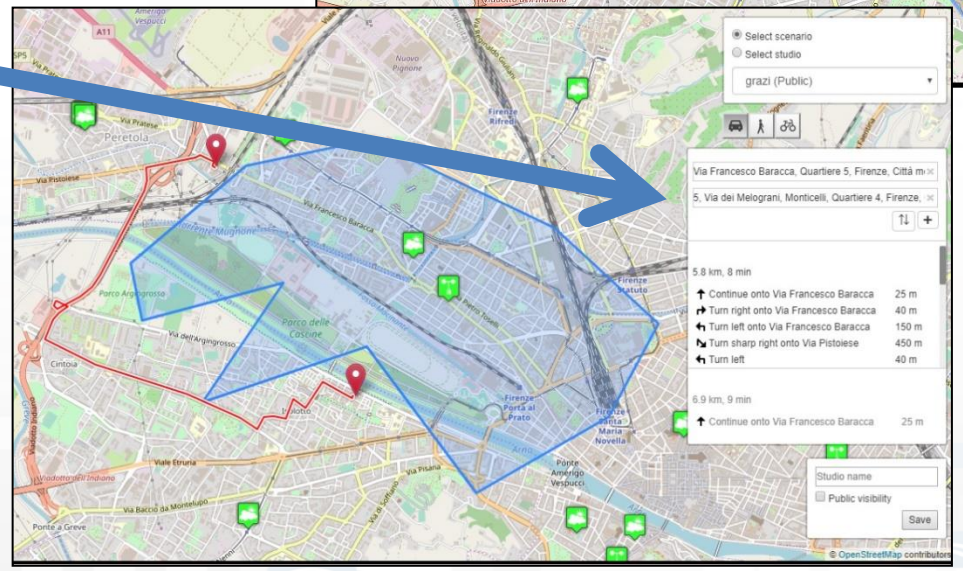
SNAP4CITY KM4CITY

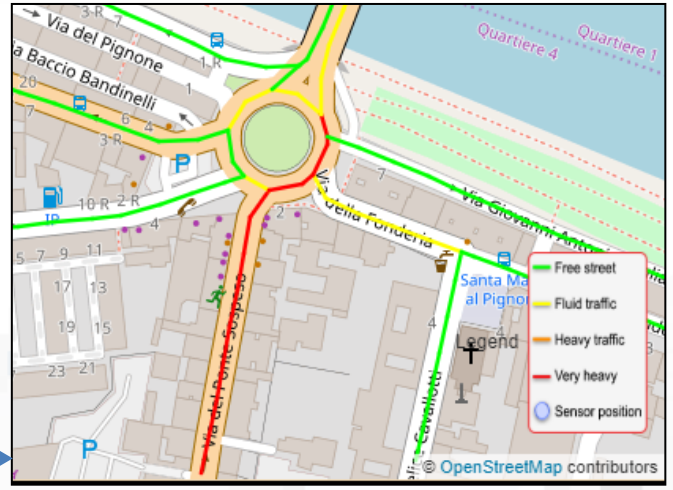
# HLT: Special Tools

High Level Types

- **Scenarious**
  - Full text search of roads and geolocations.
  - Multiple areas, days
  - Global map of OSM
- **What-IF**
  - Conditional routing
  - Dynamic routing
  - Multiple paths
- **Traffic Flows**




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

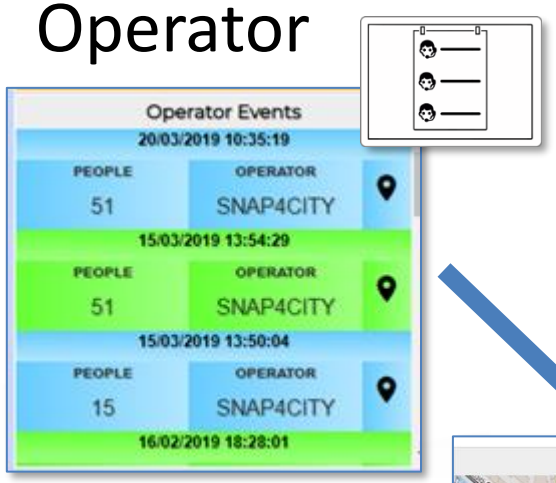
# Special Widgets vs Special Data



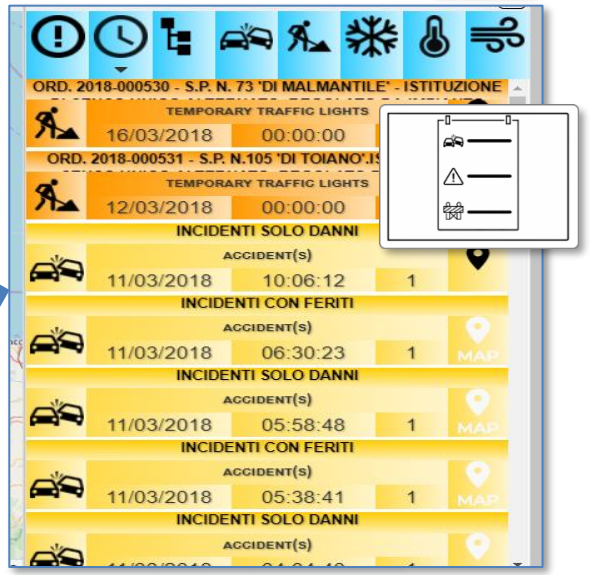
# HLT: Complex events

High Level Types

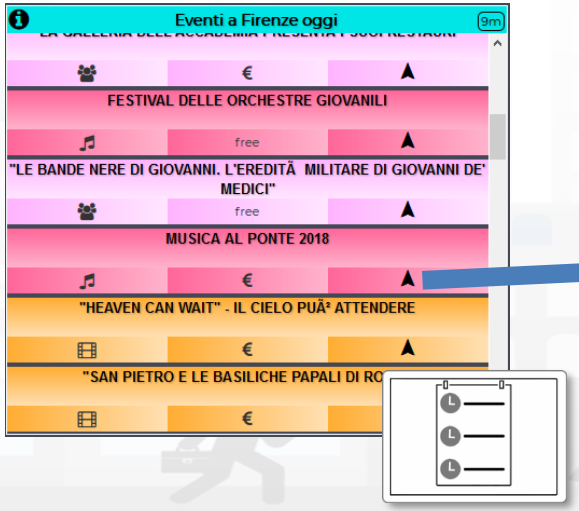
Operator

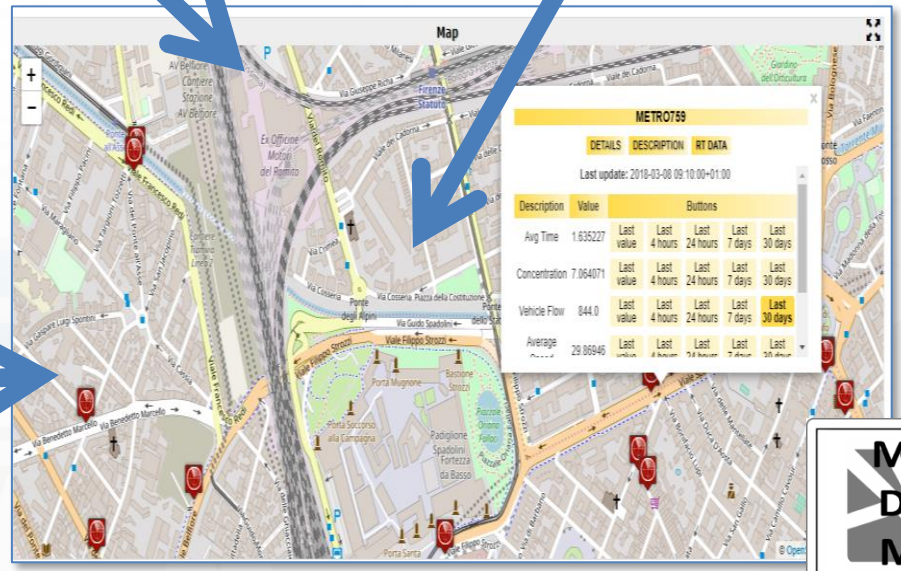



Traffic Events




Entertainment Events




Multi Data Map

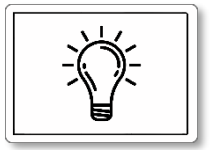
# HLT: Special Widgets

High Level Types

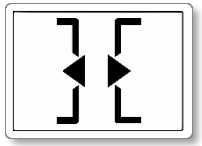


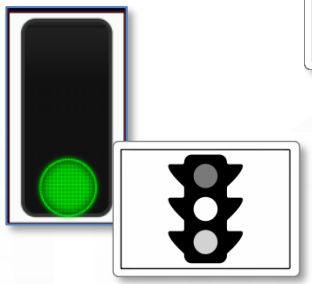








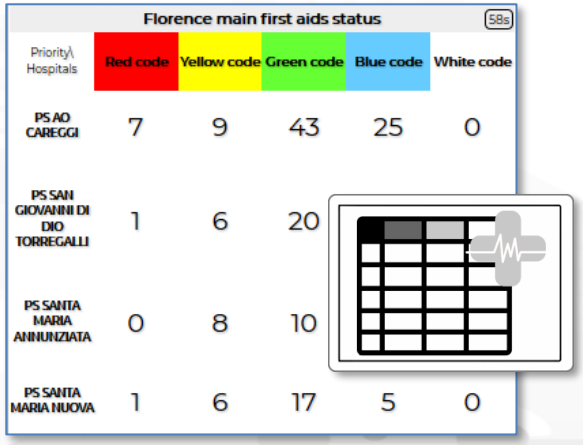


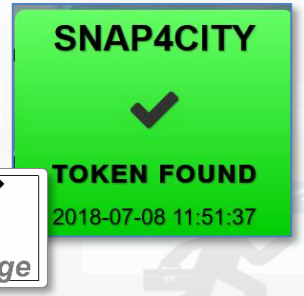








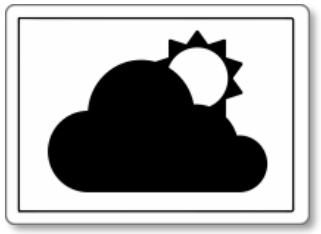

















**Firenze** Powered by LaMMA
Nuvoloso
8°C / 15 °C

**Lunedì 2 Marzo**
Pioggia debole
8°C / 13°C

**Martedì 3 Marzo**
Pioggia debole
10°C / 15°C

**Mercoledì 4 Marzo**
Pioggia e schiarite
Temp N/A

**Giovedì 5 Marzo**
Poco nuvoloso
Temp N/A

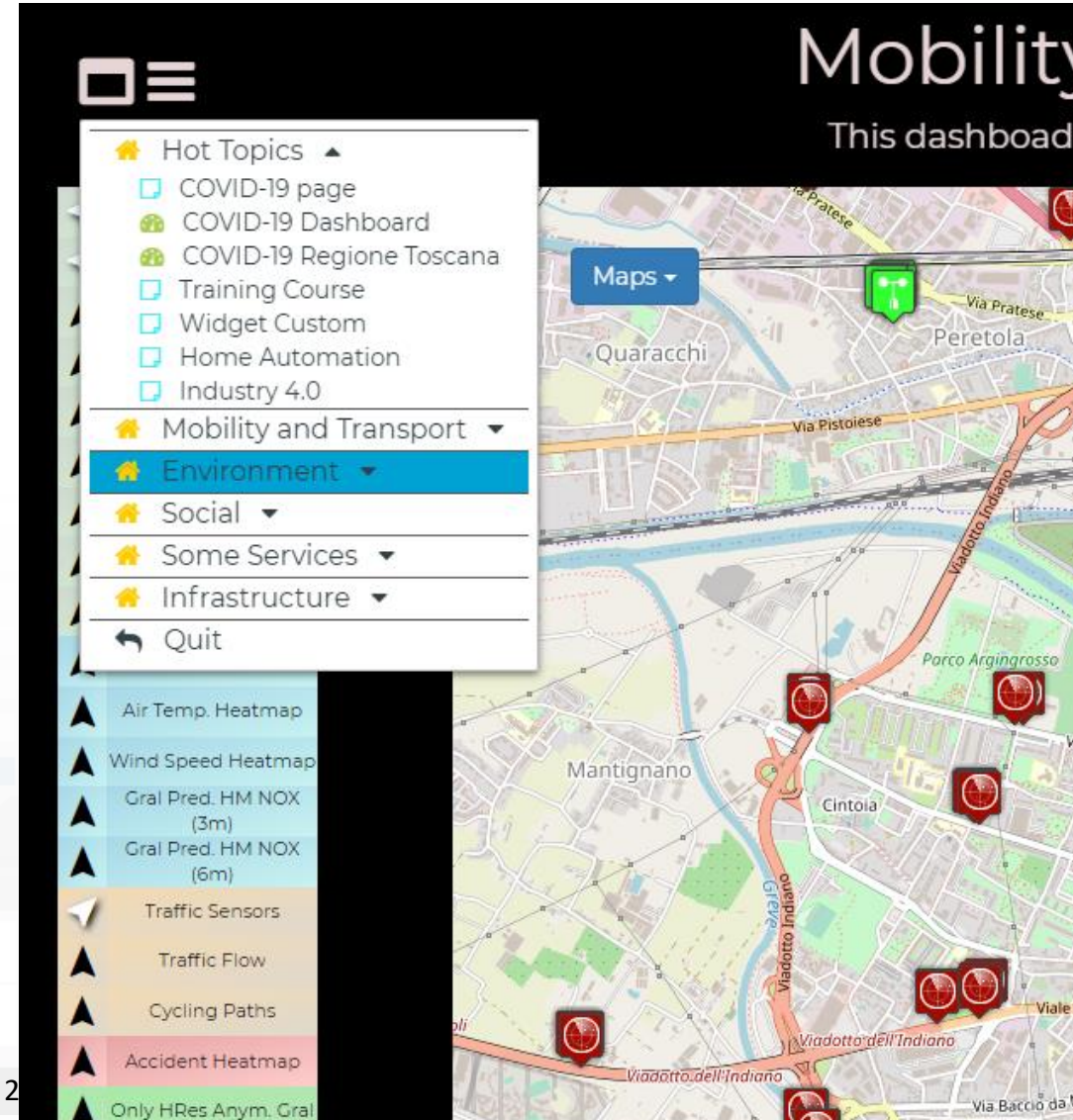


# The Organization and its Dashboard menu



# Dashboard Menu a Short Cut for other…..

- **Each Organization** on Snap4City may define its own Menu on Dashboards
  - The Menu can be activated or not in each single Dashboard of the ORG
- **Definition includes a** list of Items and Subitems, each of which with
  - colors & icons
  - Links to web pages/dashboards to be activated and modality
  - User Roles at which it has to be proposed
  - Etc.




**TC 1.23 – Dashboard Menu management per Organization**

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

# Mixt per Roma

MENU

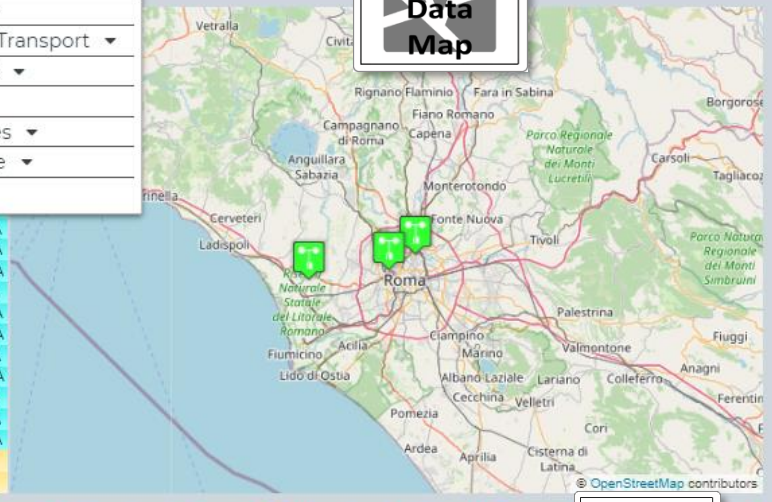
## Roma Demo3 (Qualità dell'Aria)

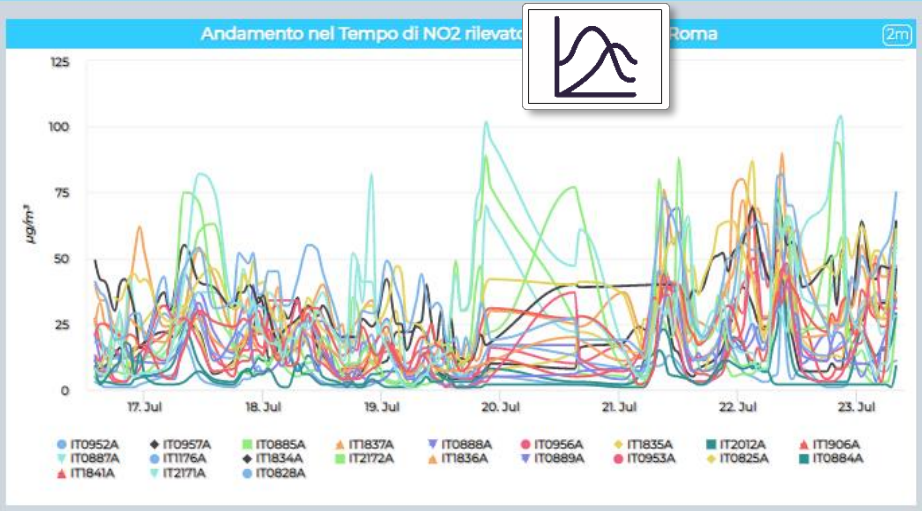
Thu 23 Jul 13:35:09

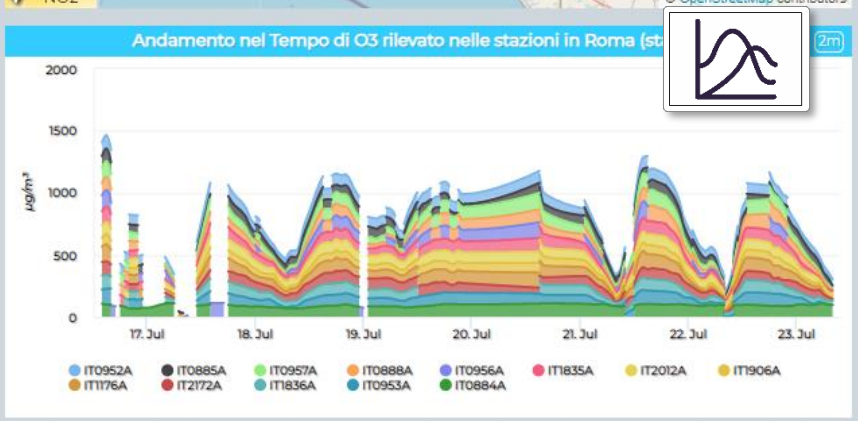
- Mobility and Transport
- Environment
- Social
- Some Services
- Infrastructure
- Quit

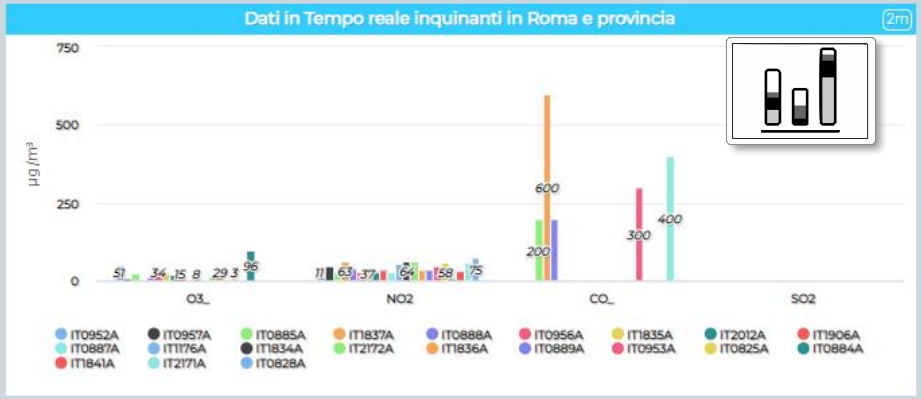
Multi Data Map

IT1836A
IT0957A
IT0828A
IT2171A
IT0952A
IT0885A
IT1837A
IT0888A
IT1176A
IT1835A
IT1834A
O3
NO2




Valori Inquinanti in tempo reale, mappe 2m

| value type / value name | O3_ | NO2 | CO_ | SO2 |
|---|---|---|---|---|
| IT0952A | 51 | 11 | | |
| IT0957A | 7 | 46 | | |
| IT0885A | 25 | 29 | 200 | |
| IT1837A | | 63 | 600 | |
| IT0888A | 11 | 37 | 200 | |
| IT0956A | 34 | 29 | | |
| IT1835A | 24 | 37 | | |
| IT2012A | 20 | 29 | | |
| IT1906A | 15 | 34 | | |
| IT0887A | | 28 | | |
| IT1176A | 8 | 54 | | |
| IT1834A | | 64 | | |
| IT2172A | 15 | 61 | | |
| IT1836A | 29 | 35 | | |
| IT0953A | 3 | 47 | 300 | 1.3 |
| IT0889A | | 34 | | |
| IT0825A | | 58 | | |
| IT0884A | 96 | 9 | | |
| IT1841A | | 31 | | |
| IT2171A | | 57 | 400 | |
| IT0828A | | 75 | | |

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

# Video Streams from TV Cameras

## Settings for RootAdmin Only



# TV Cameras

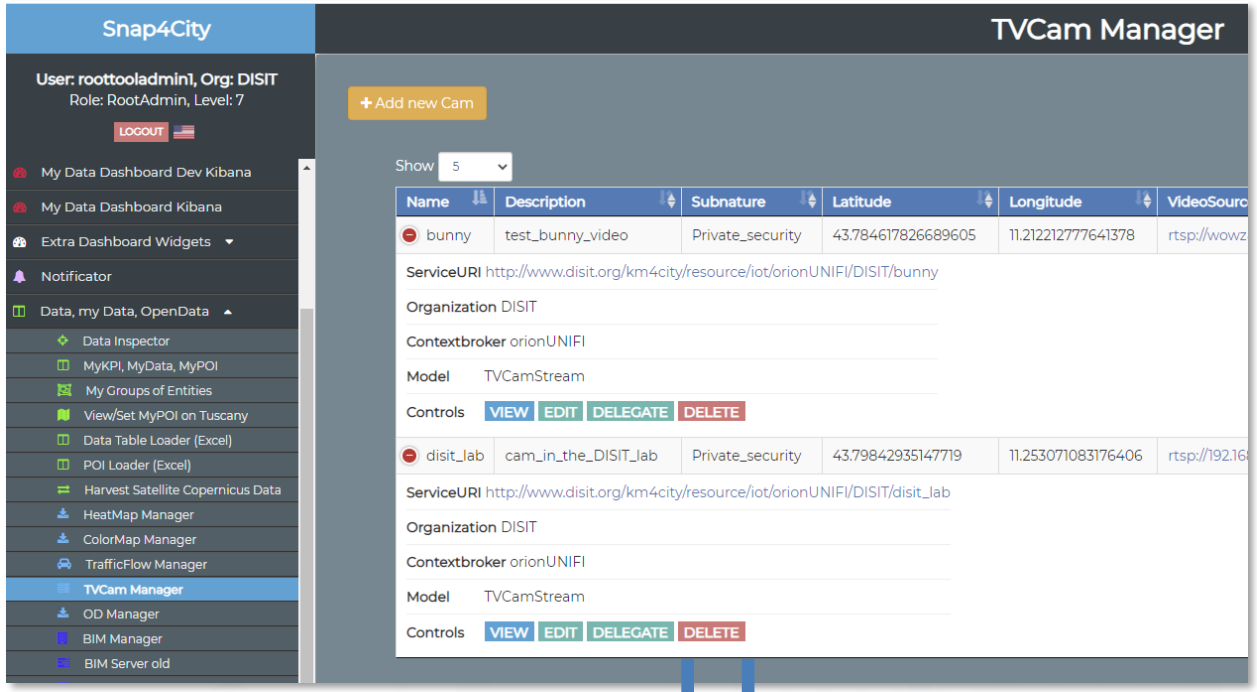
- **Two main modalities**
  - **Image frames**, periodically updated
    - Format: JPG
    - Protocols: http/https  (with and without autentication)
    - Via **IPCAM Service**
  - **Video Stream**
    - Formats: MP4, H264,
    - Protocol: RTSP, ONVIF (with and without autentication)
    - Via **TVCam Manager**
      - ***based on Kurento, TURN, WebRTC***

# IPCAM Service

- Examples:
  - https://main.snap4city.org/cam/ipCam.php?IP=www.meteofirenzehoteldavid.com/webcam/pontevecchio.jpg
  - https://main.snap4city.org/cam/ipCam.php?IP=www.meteofirenzehoteldavid.com/webcam/Firenze-HotelDavid.jpg
  - https://main.snap4city.org/cam/ipCam.php?IP=192.168.0.240/tmpfs/auto.jpg
  - https://main.snap4city.org/cam/ipCam.php?IP=www.cagliarimeteo.it/images/webcam/1/Cam1.jpg
  - …
  - To access with credentials you need to add setting on an IP Cam Table on Dashboard Builder!
  - Use https://main.snap4city.org/cam/ipCams.php?IP= for IP CAM with HTTPS connections



# TVCam Manager

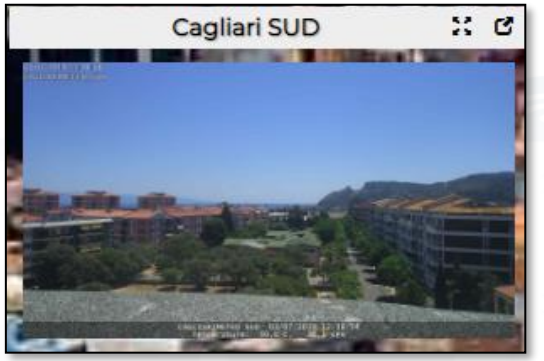





RTSP
ONVIF

**TVCam Streaming Servers**

WebRTC






# Video Device Model: TVCamStream

| Variable | | example |
|---|---|---|
| dateObserved | Timestamp | |
| name | ID camera | bunny |
| description | Text | test_bunny_video |
| videoSource | Call | rtsp://wowzaec2demo.streamlock.net/vod/mp4:BigBuckBunny_115k.mp4 |
| …. custom | | It is possible to create other models extending this kind of model |

**In addition you have:**

- Model: TVCamStream
  - ContextBroker: selected in the model
- ServiceURI (automatically assigned)
- Nature and Subnature: ……..
- GPS Lat, Long: you can decide at the instance

**Optional:**

- Username: ……..
- Password: ……..

# SCALABLE SMART ANALYTIC APPLICATION BUILDER FOR SENTIENT CITIES

TOP

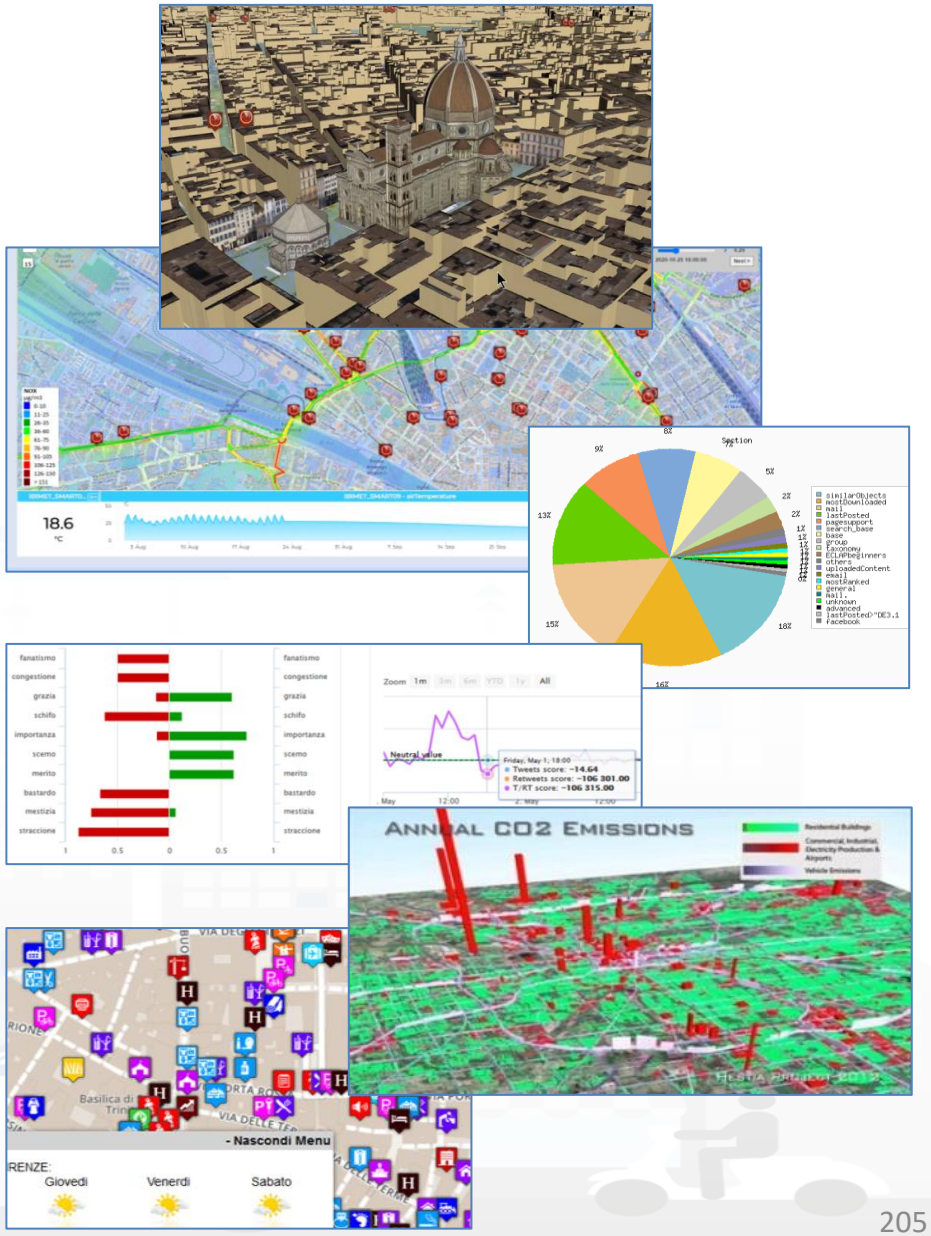



# Digital Twin Global and Local

- Data, my Data, OpenData
  - Data Inspector
  - MyKPI, MyData, MyPOI
  - My Groups of Entities
  - View/Set MyPOI on Tuscany
  - Data Table Loader (Excel)
  - POI Loader (Excel)
  - Harvest Satellite Copernicus Dat...
  - BIM Server old
  - BIM Server New
  - BIM Srv New: Add
  - BIM Srv new: View
  - OpenData Manager: Data Gate
  - OpenData Manager: Data Gate
  - Doc: Data Table Loader
  - Add Data Sources into the Platfo...

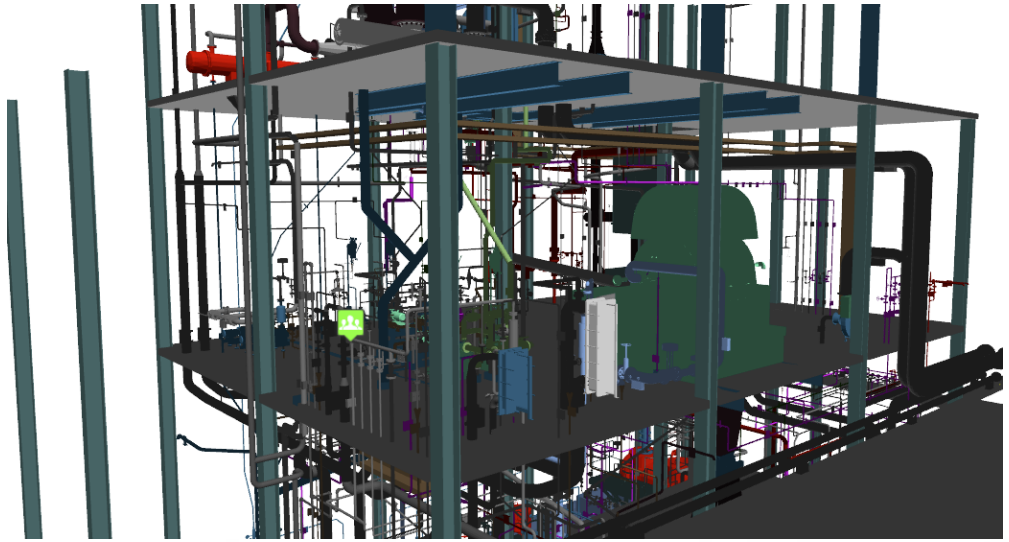
# Digital Twin

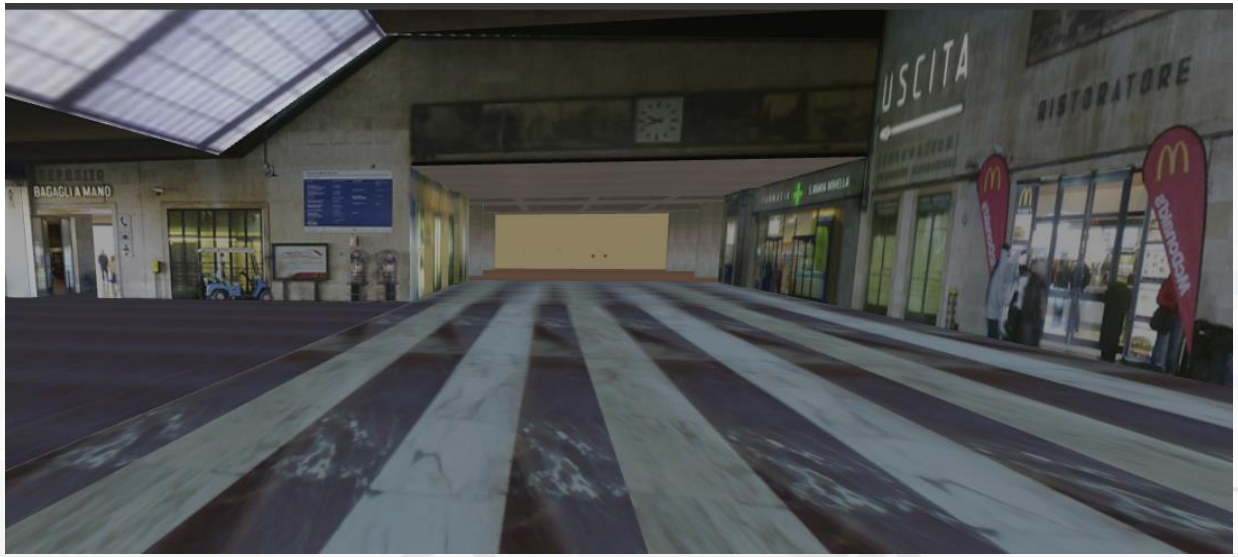
- **Digital Twin**
  - **Connected** with real physical systems
  - **Modelling aspects**: structural, visual, informative, real time data sensors (context), POI, functional, resource managements, etc.
  - **Integration of** AI/XAI techniques with simulations and modelling
- **Easier to understand the context, review from multiple points of view**
- **Useful to perform**
  - Discussion with city users
  - Support decision makers
  - By Case Experiments for analysing
    - New solutions, impact of disaster (natural and provoked)
    - Reduction of costs in the analysis, in reduction of mistakes

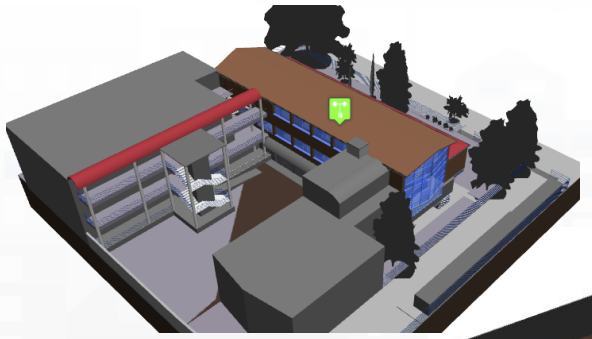


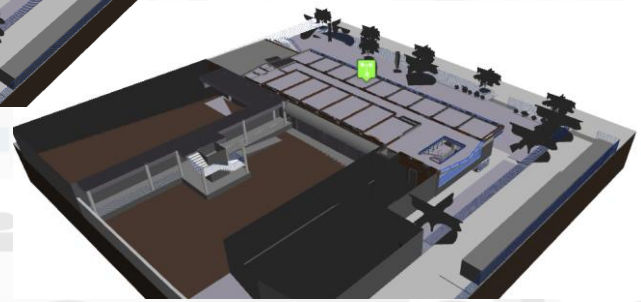
# Digital Twin
# Global vs Local







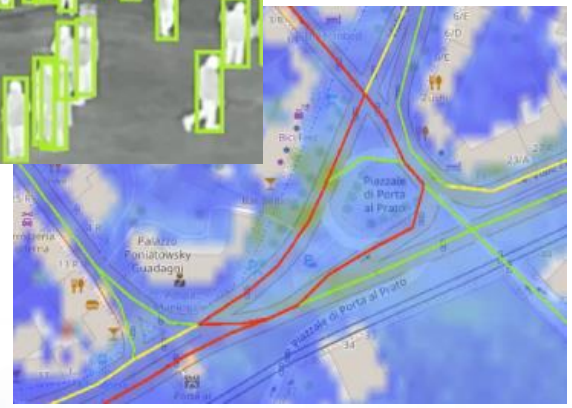



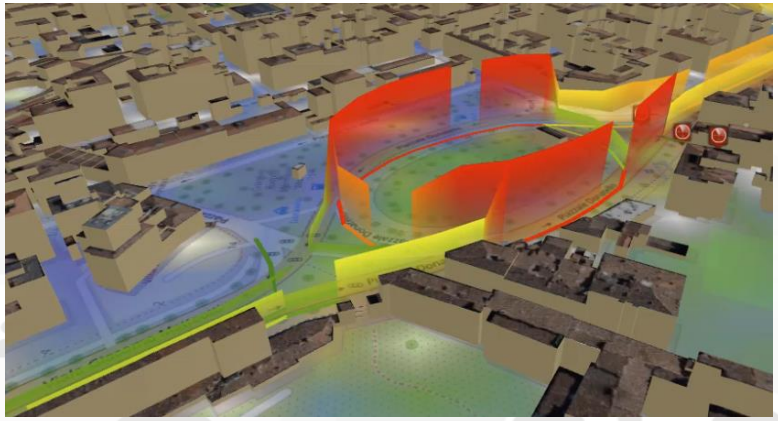


# Awareness to manage and improve ….

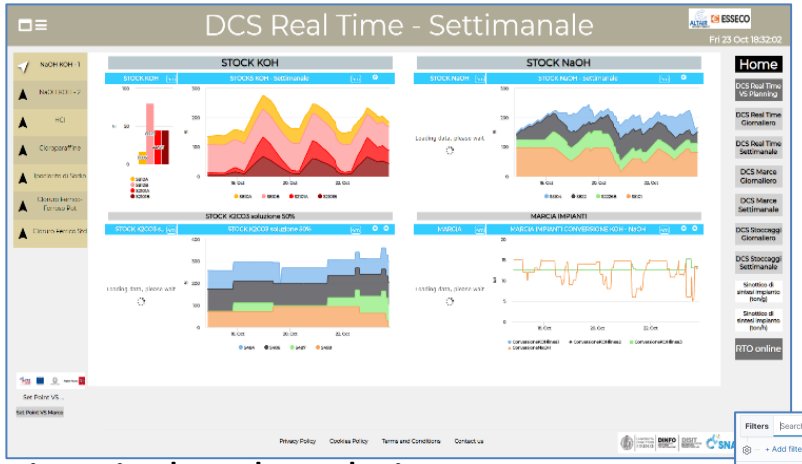
- **Infrastructures** of the cultural cities:
  - **Security and Safety**: roads, buildings, squares
  - **Mobility and Transport**: traffic flow, parking, etc.
  - **Environment**: microclimate, predictions, assessment for acting
- **Services / events**: assessment and plan:
  - **Most of the cities provide diffuse cultural heritage as a wall**
    - Security, clean, public transport, environment, delivery, etc.
  - **Global and Local**: events vs actions
  - **Local Structures**: museums, events, shopping, attractions, ..
- **People and Transport Means (city users: citizens, tourists, etc.) :**
  - **Understand:**
    - flows, density, behaviour, classifications of user/means
    - reputation, appreciation Trip Advisor, Twitter, etc.
  - **Suggest, Recommend, Engage, Guide..**
    - Context based



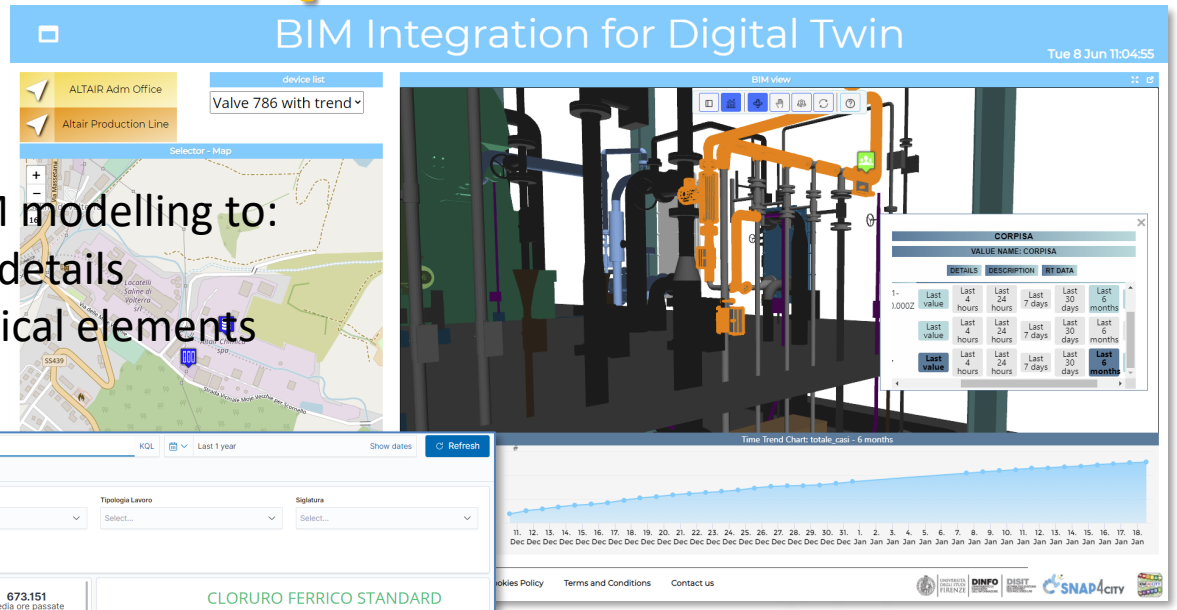




# Closing the loop

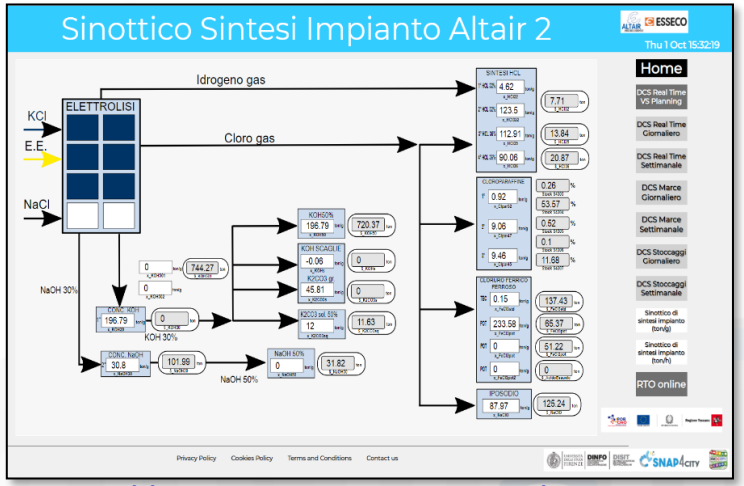


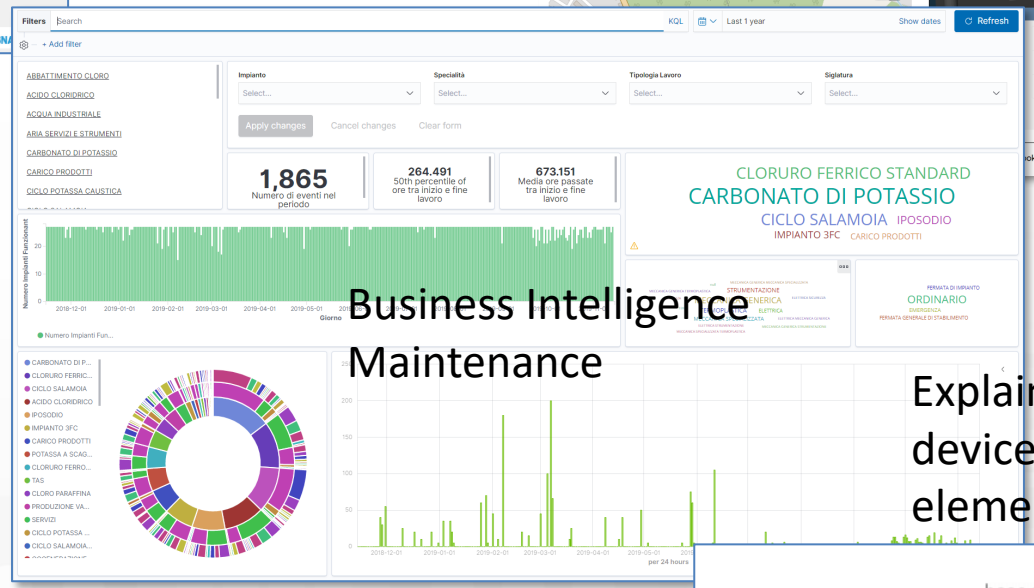

Historical and Real Time Data




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

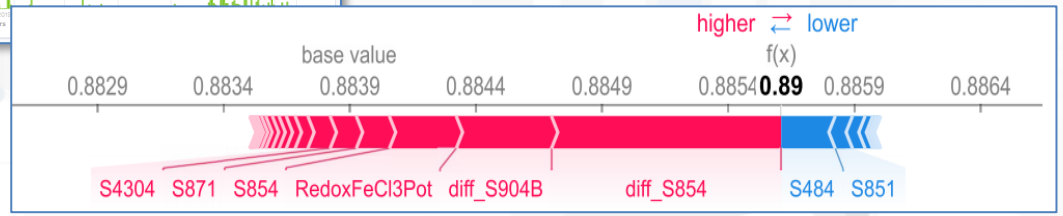
Synoptics for real time monitoring




Business Intelligence Maintenance

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

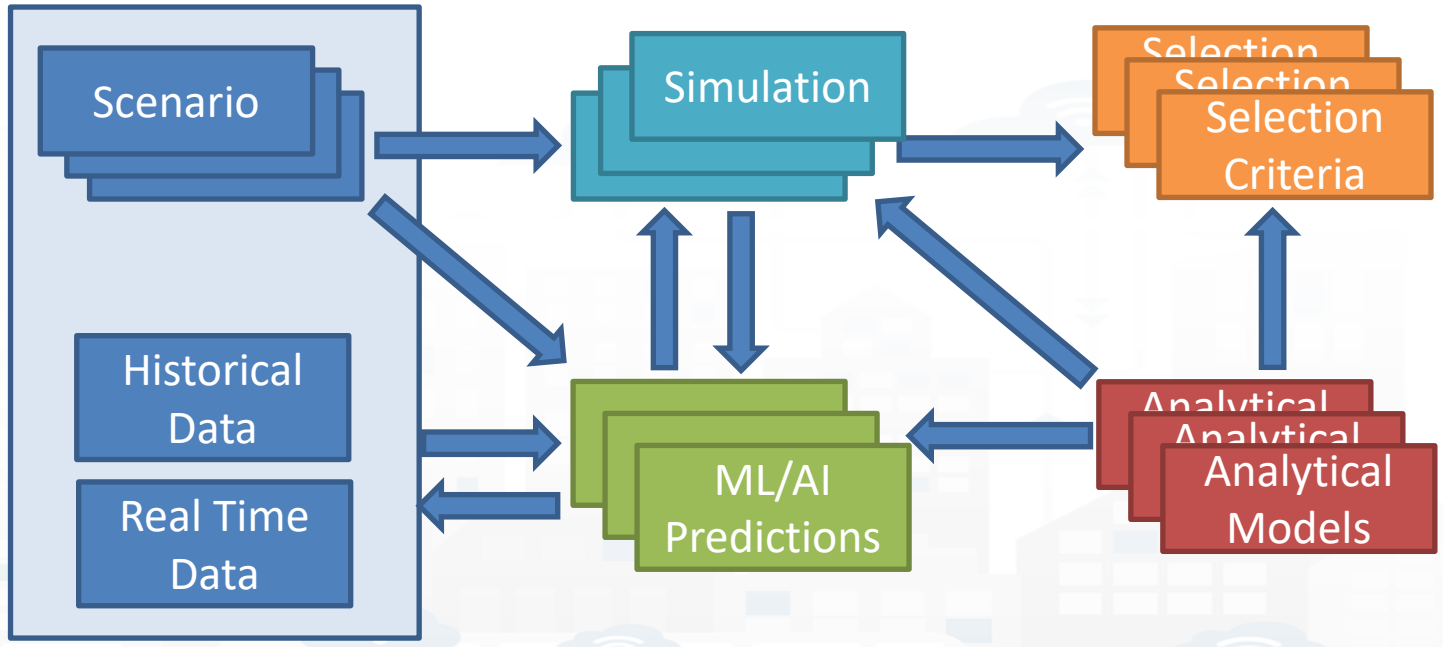



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA1NA==

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

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

Decision Support System
KPI, Optimization
Visual Analytic: animations



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SNAP4CITY KM4CITY

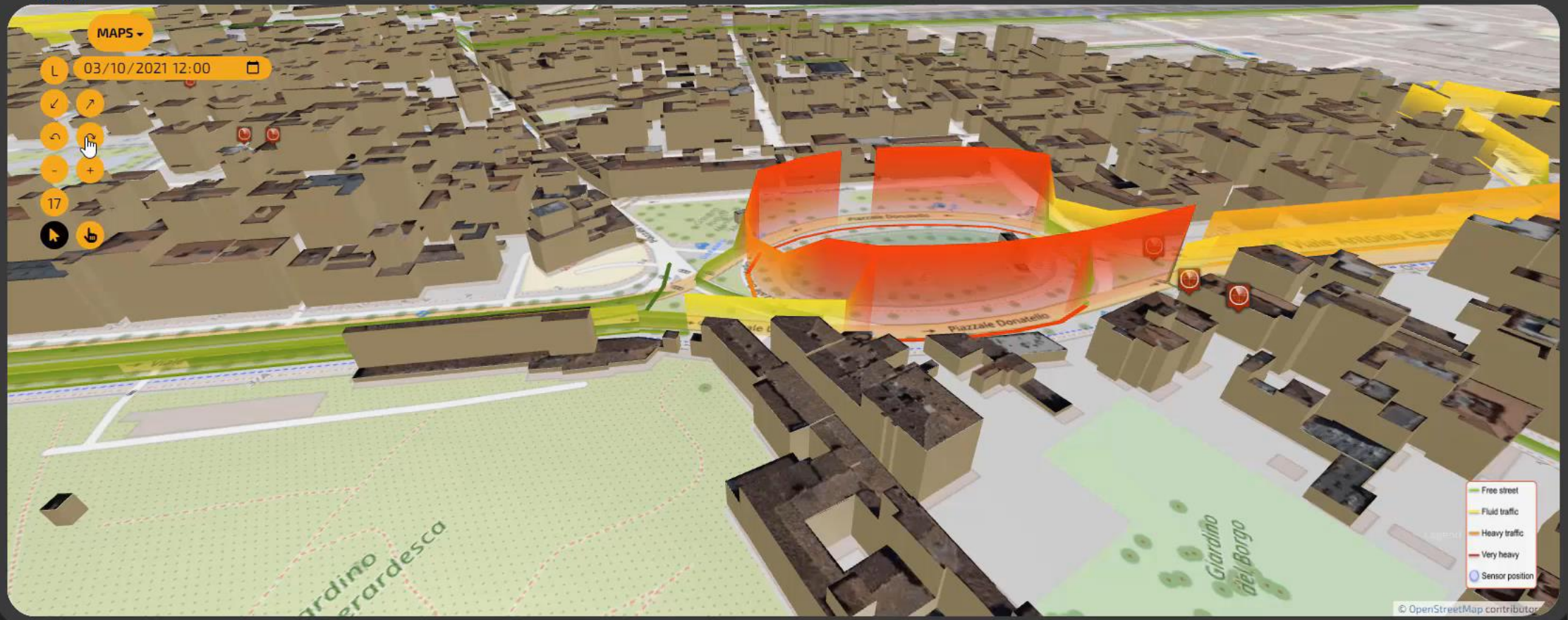
Ciao roottooladmin1

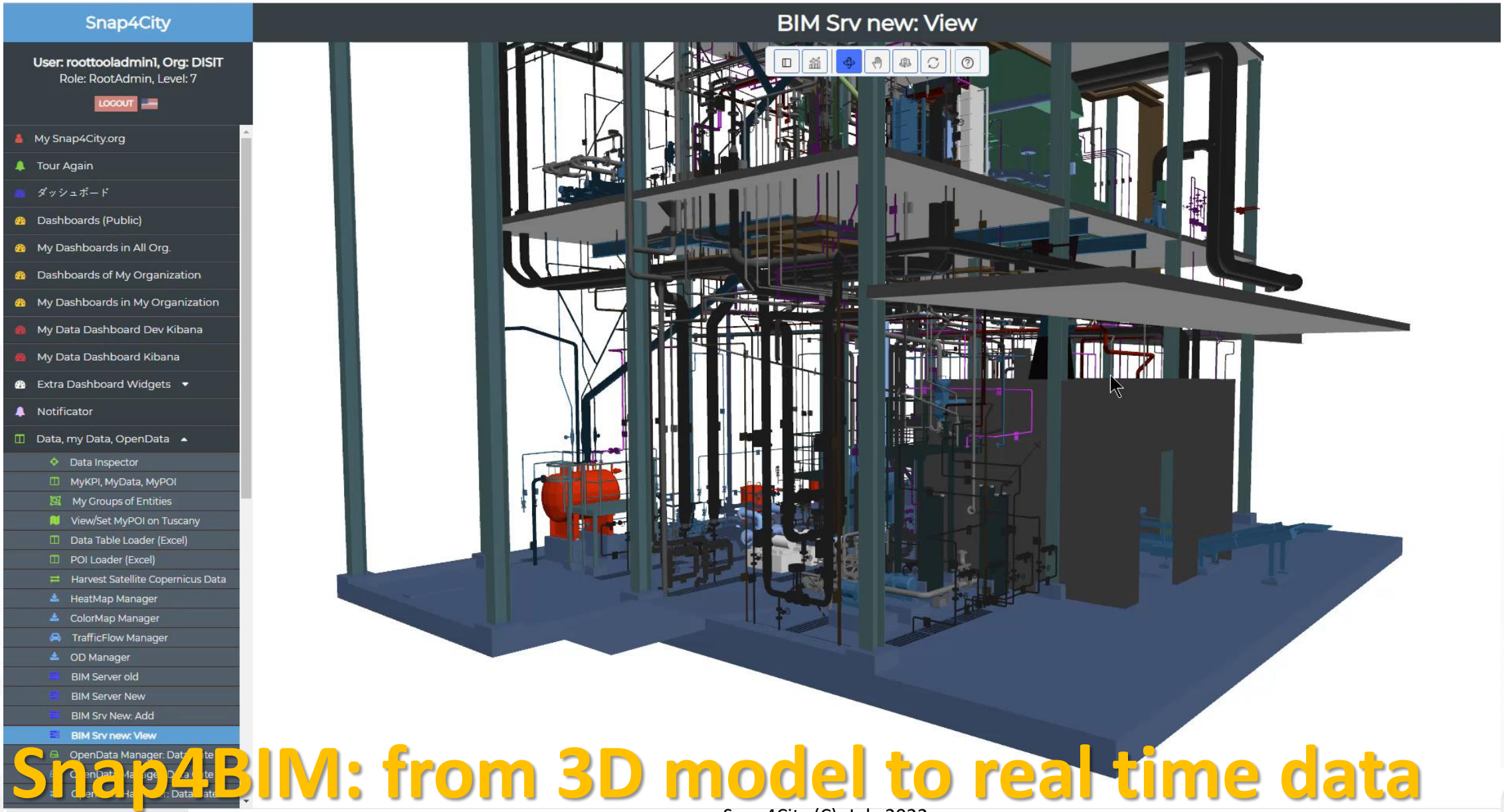
Thu 16 Jun 15:15:03

# 3D MAP DECK TEST-NEWGUI

demonstrator

3D MAP



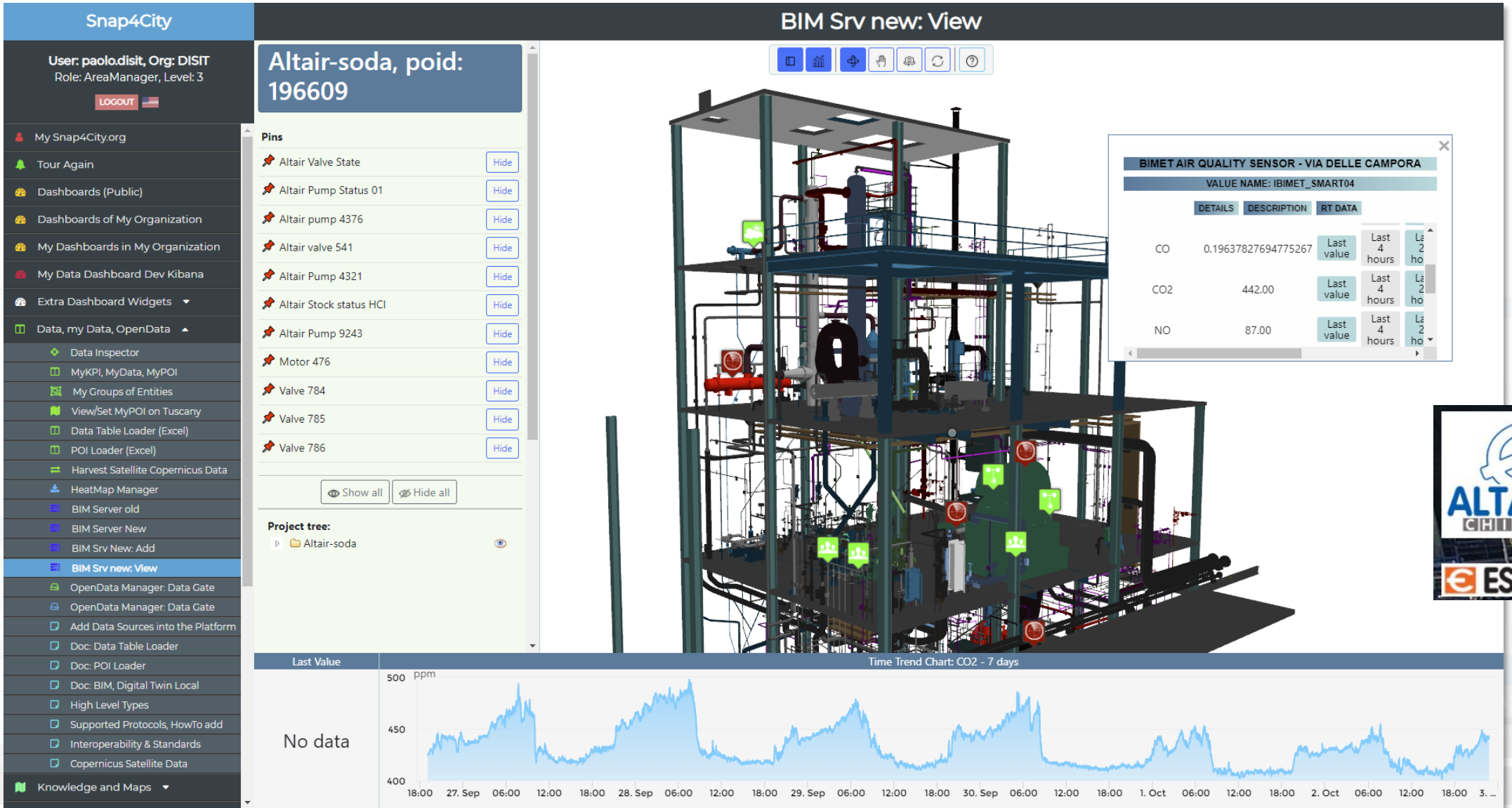



# Snap4BIM: from 3D model to real time data

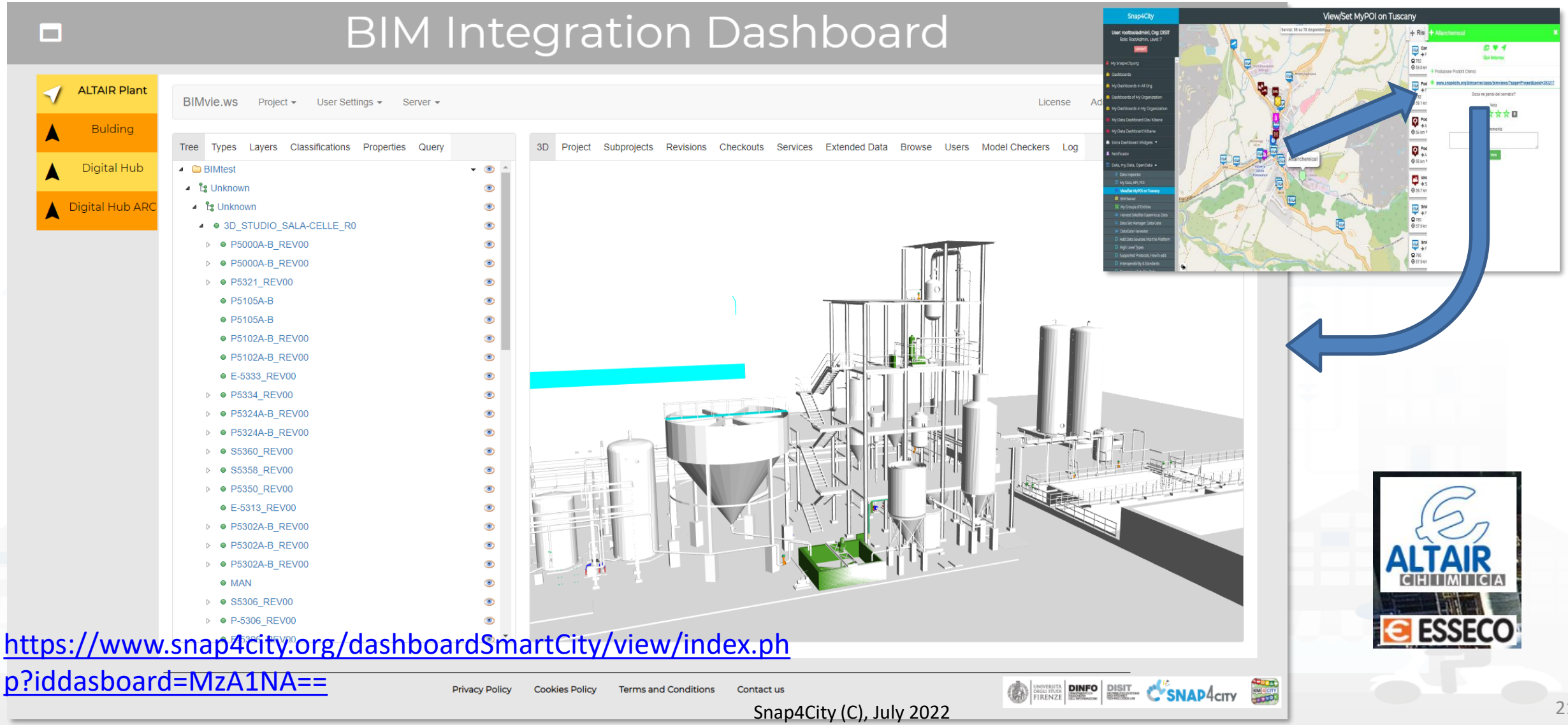
# BIM as Digital Twin in Snap4City

- You can create 3D BIM representation by using standard tools mainly for IFC format but also in other different formats as AutoDesk.
  - They can be loaded into a BIM Servers
- **Snap4BIM is an application for**
  - Connecting BIM models with ServiceURI data into Snap4City, Snap4Industry, so that they can be: IoT Devices, POI, etc.
    - Observing PIN from any view
    - Positioning PIN in any place of the 3D space
  - Accessing to any element of the 3D model and to any position with the 3D interactive viewer.
  - Controlling the user interface interaction.
  - Showing the data, and  selecting the 3D elements
- **Snap4City/Industry** can pass from any PIN on map to BIM / Digital Twin Local and related data in click

# Snap4BIM: from 3D model to real time data

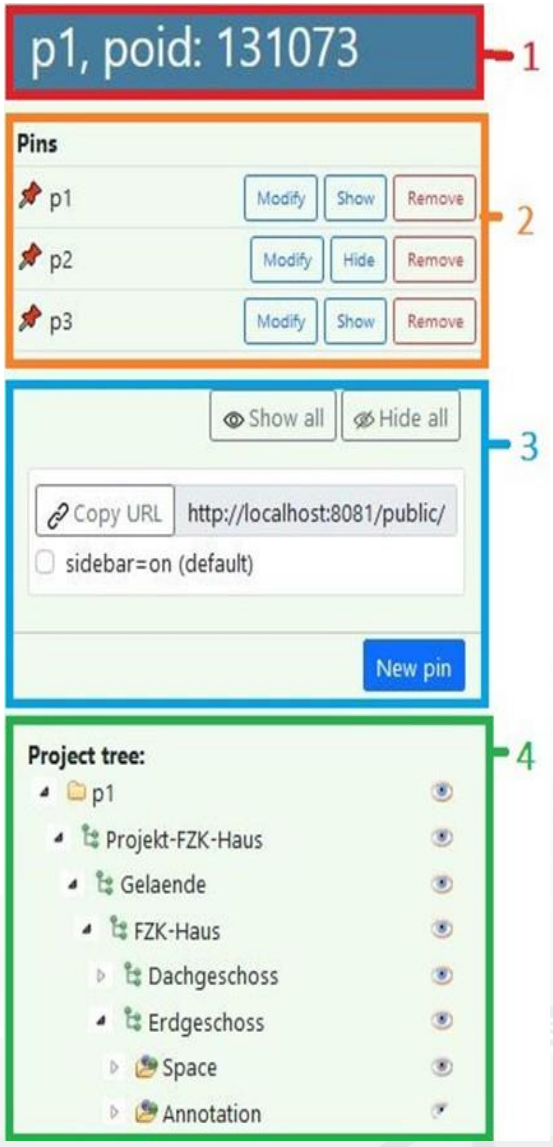


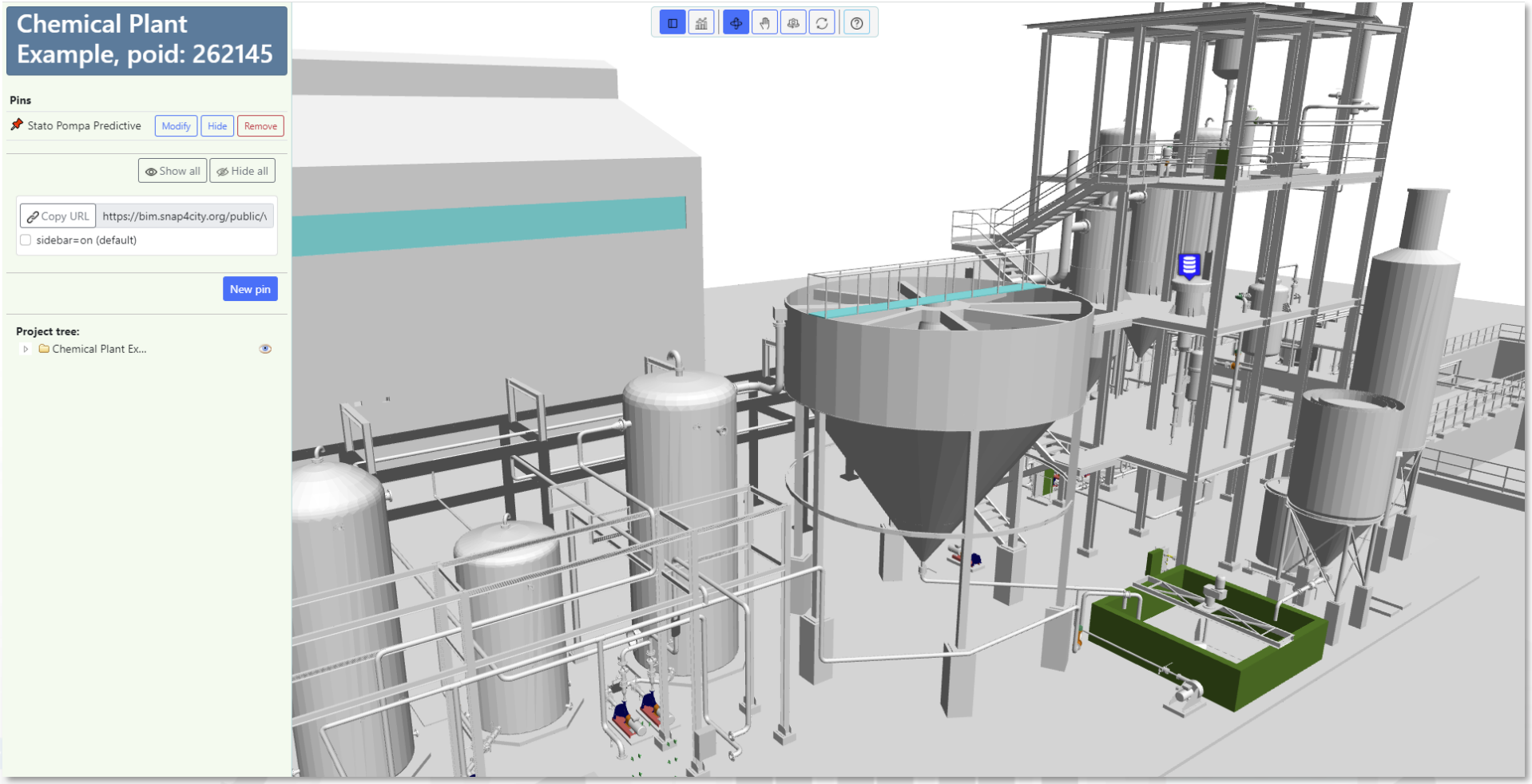
# BIM view of the Altair Chemical Plant




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

# Snap4BIM interctive editor



# Digital Twin Local, 3D vs Real

## BIM Integration for Digital Twin

Tue 8 Jun 11:04:55

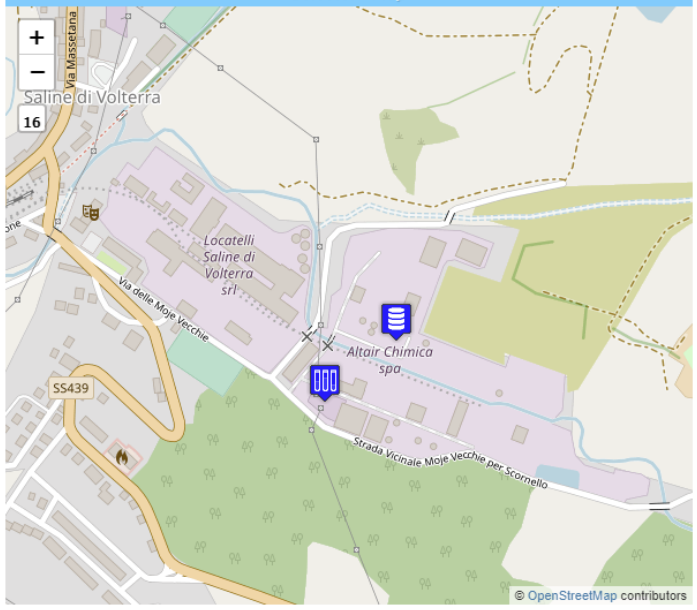
ALTAIR Adm Office

Altair Production Line

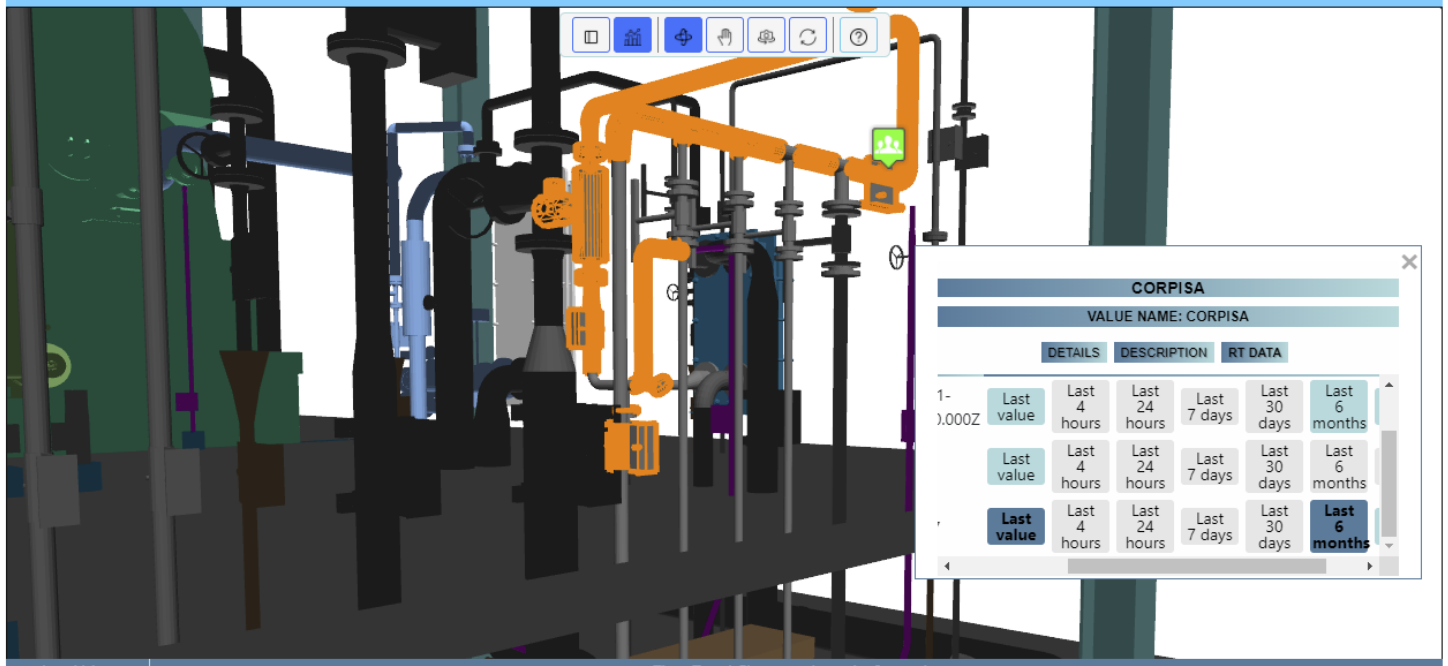
device list

Valve 786 with trend

Selector - Map



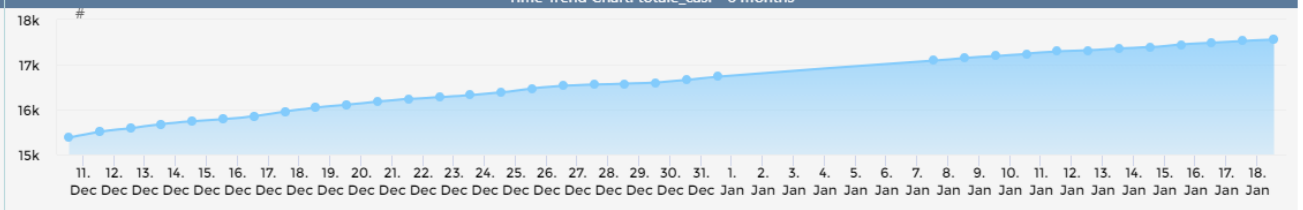

BIM view




Last Value

17557.00 #

Time Trend Chart: totale_casi - 6 months

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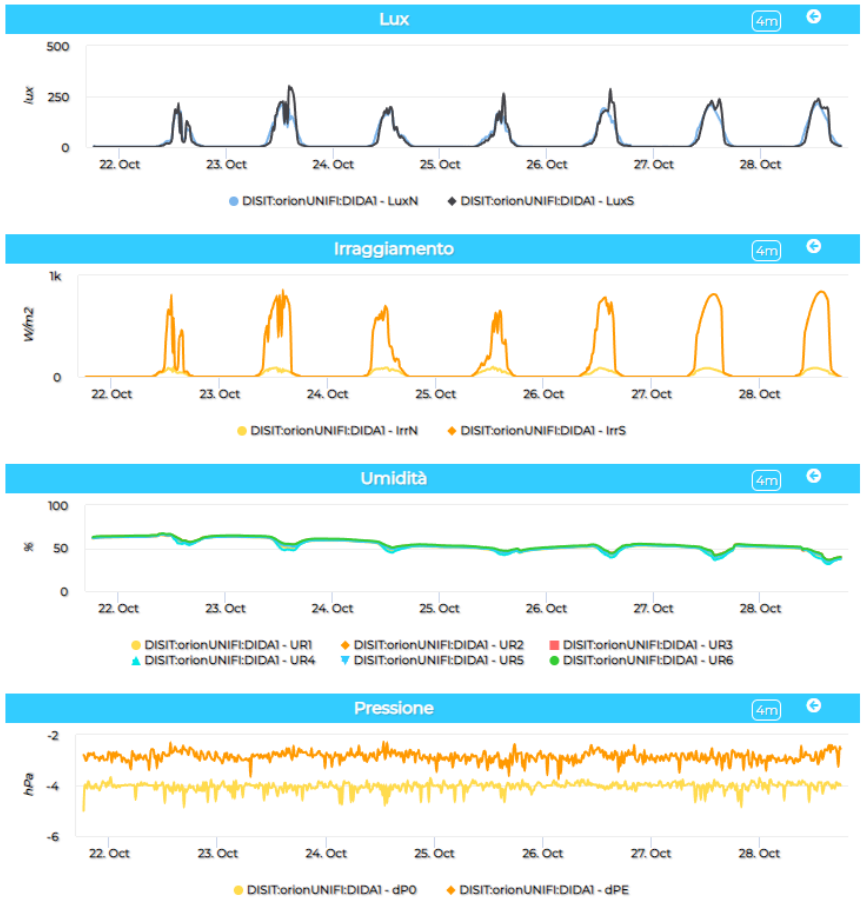
# Smart Building

## DIDA data 2

Thu 28 Oct 18:17:39







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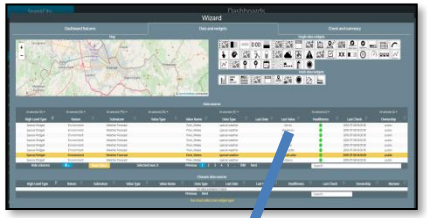
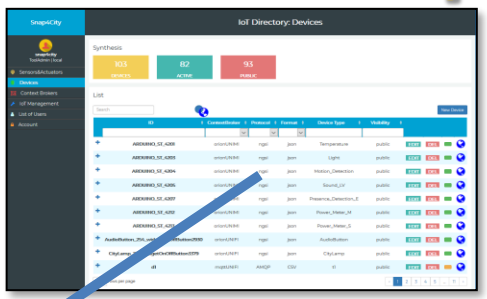
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzI4OA==

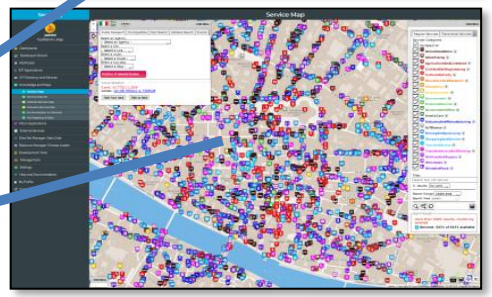
# Snap4BIM: how it works

IOT Directory



Wizard
Data Inspector



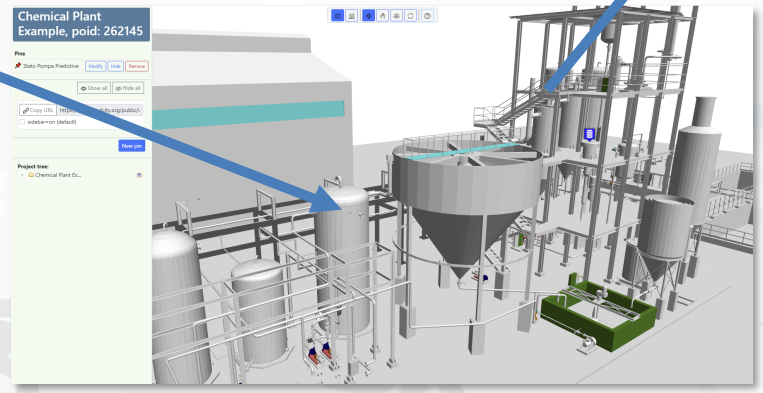


ServiceMap Discovery

Get ServiceURI



Attach the
SURI at the
BIM details or
Coordinates

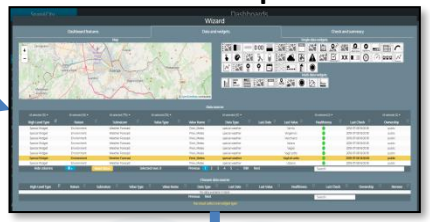



Define view
details

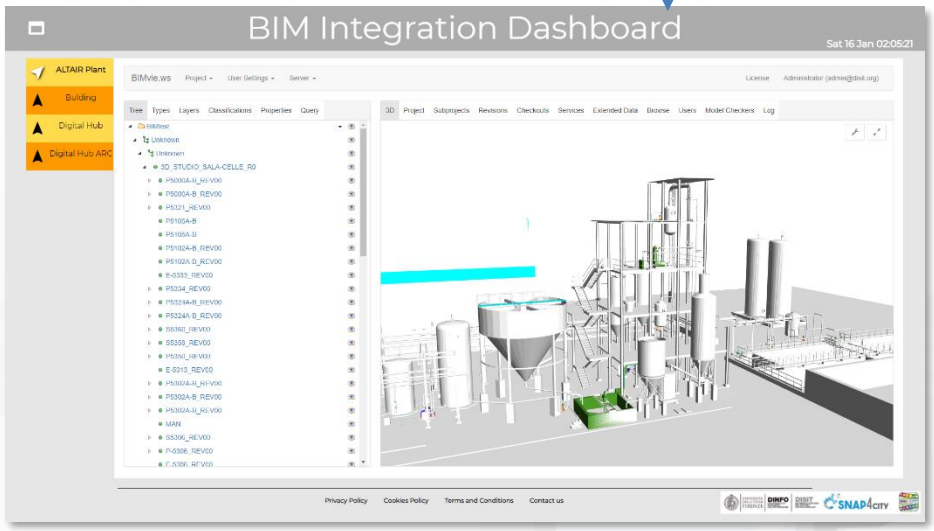



Snap4BIM manager

Wizard
Data Inspector



Making Dashboard



# information

- HOW To: Manage BMP and BIM: main features of openMAINT, BMP, BIM
- BIM integration in Snap4City: Digital Twin Local
- Digital Twin (local and global): Snap4City view
- DOC: Global Digital Twin for Florence by Snap4City, 3D city view

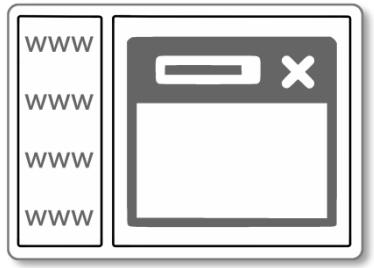
TOP

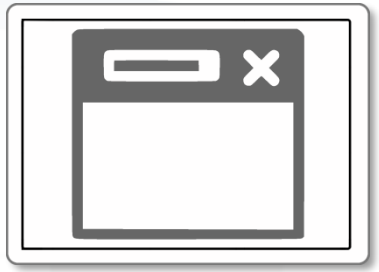
# External Services (integration of) your of third party web pages

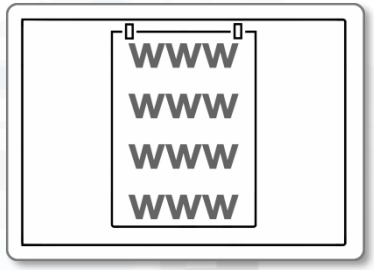


# Dashboard Usage and Recipes

- https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc3NA==
- **External Content Widget (optional zoom feature):**
  - **External Services**: Web Pages, web sites, web tools (registered or not)
    - **Tools**: Twitter Vigilance, Origin Destination Matrices, WiFi Tool, …
    - **GIS & MAPs**: ServiceMap, ArcGIS, ServiceMap3D, GoogleMap, etc. etc.
    - **TV CAM** Proxy adapted, VideoCam Streams, …
  - **MicroApplications**
    - More than 300 micro applications based on Snap4City and Km4City Tech.
  - **Synoptics and Custom widgets**
  - **Snap4City pages**: Form discussion, help desk, user manual, …
  - **Snap4City Dashboards** for nested views, MultiDashboards views
    - Ultra HD screens, UHD or even wider….
- **Selector WEB**
  - Anything that can be shown on External Content WG, one or more





# External Services (registered)

Snap4City

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

- My Snap4City.org
- Dashboards
- My Dashboards in All Org.
- Dashboards of My Organization
- My Dashboards in My Organization
- Notificator
- Data Inspector
- My Data, KPI, POI
- IOT Applications
- IOT Directory and Devices
- Knowledge and Maps
- Micro Applications
- External Services
- Data Set Manager: Data Gate
- Resource Manager: Process Loader
- Development Tools
- Management
- Settings
- User Management and Auditing
- Help and Contacts
- Documentation and Articles
- My Profile

## List of External Services

Prev 1 2 3 4 5 ... 13 Next

Filter

New Tab
**Firenze: Recency and Frequency from WiFi...**
Government and Security

New Tab
**Firenze: Tracking rescue teams**
Government and Security

New Tab
**Firenze: Trajectories from Mobile App**
Government and Security

New Tab
**Flanders Environment Agency**
Environment

New Tab
**Garda Lake Overview (a part)**
Services POI and IOT

New Tab
**GDS test**
Environment

New Tab
**Google Map**
Services POI and IOT

New Tab
**Helsinki Map GIS, Kartta**
GovernmentOffice

New Tab
**Helsinki Overview (a part)**
Services POI and IOT

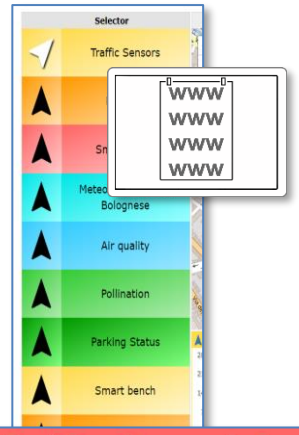
New Tab
**Indice della Qualita dell'aria in Italia, by UNI...**
Environment

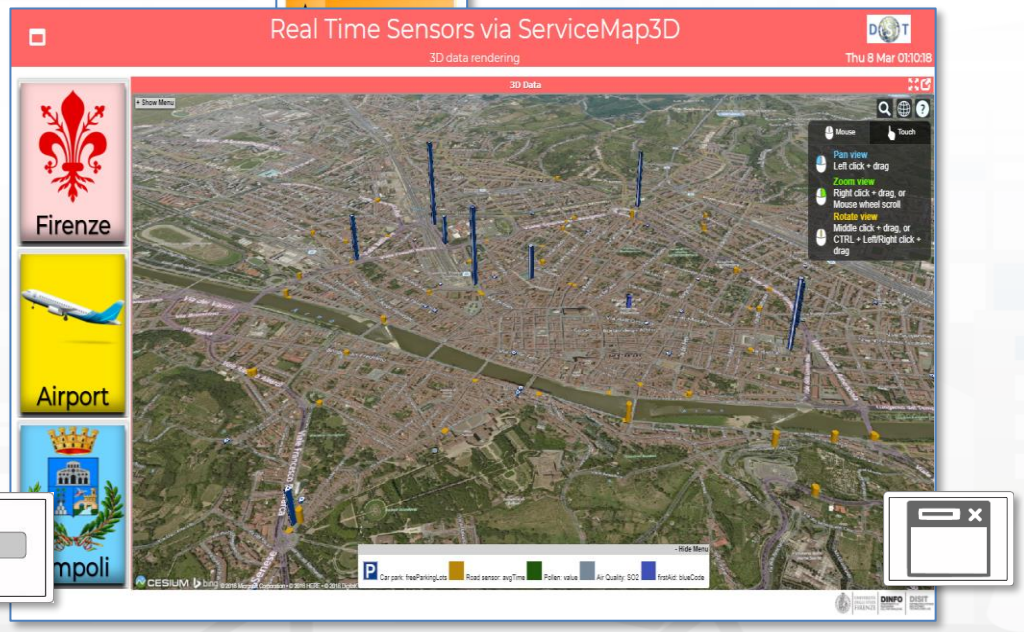
New Tab
**Interactive Maps Amsterdam**
GovernmentOffice

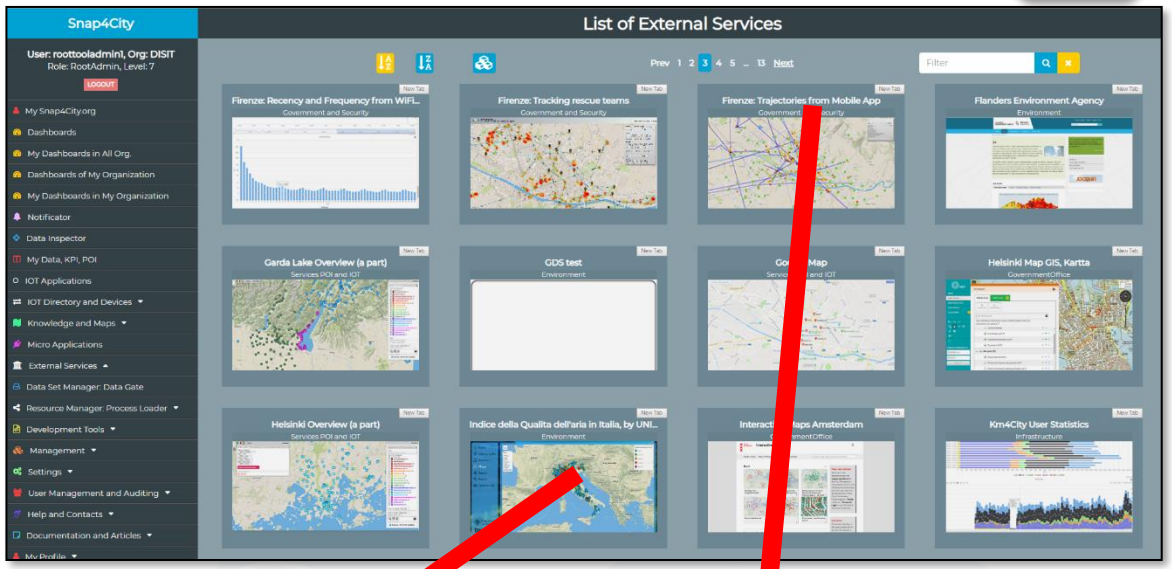
New Tab
**Km4City User Statistics**
Infrastructure

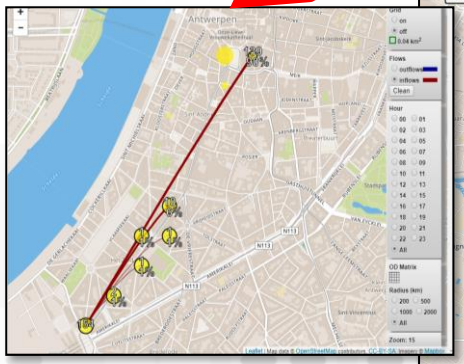
# HLT: External Services

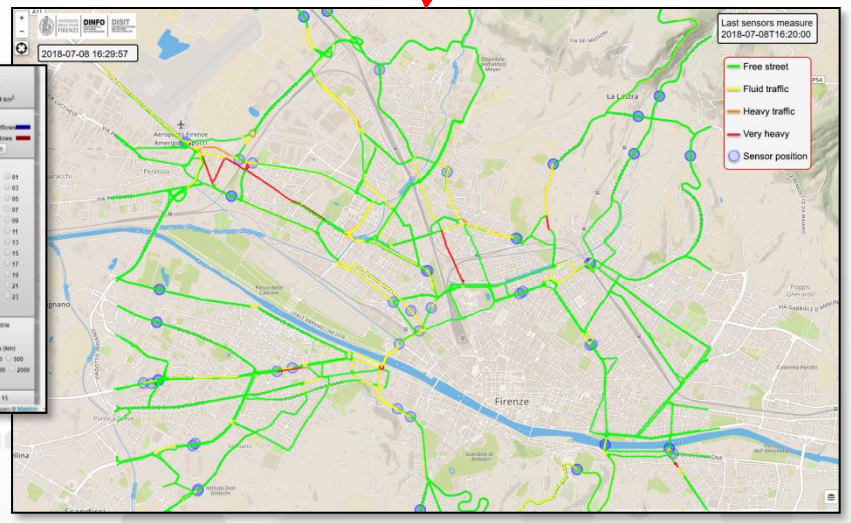
High Level Types



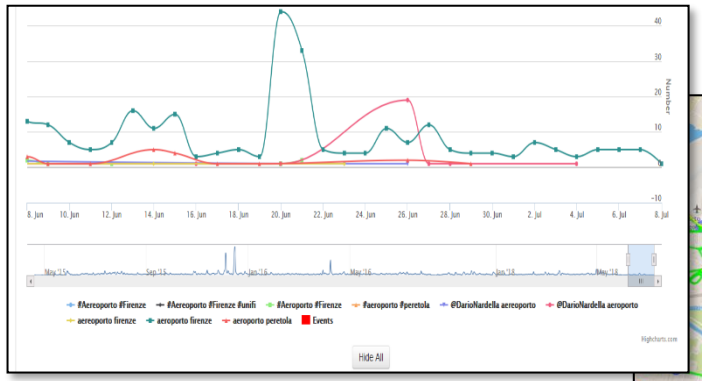



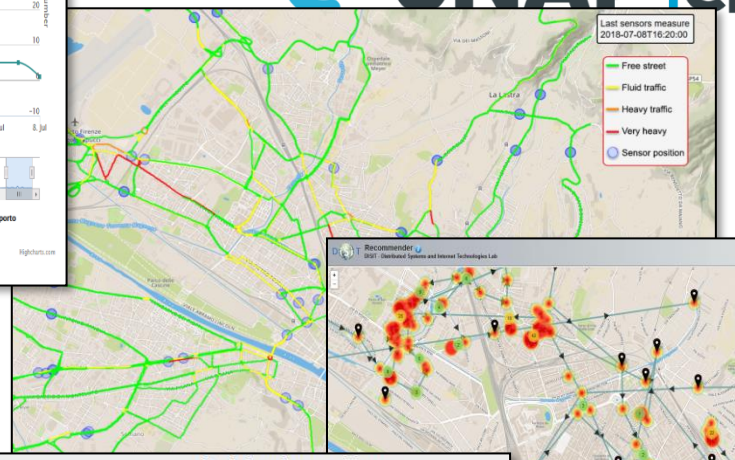


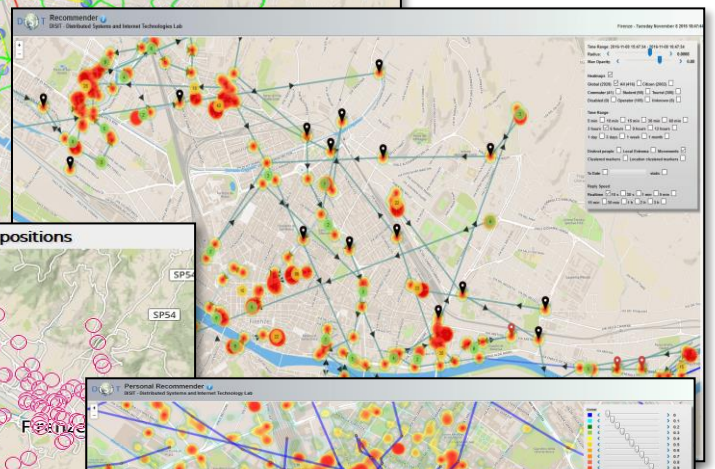
# External Services

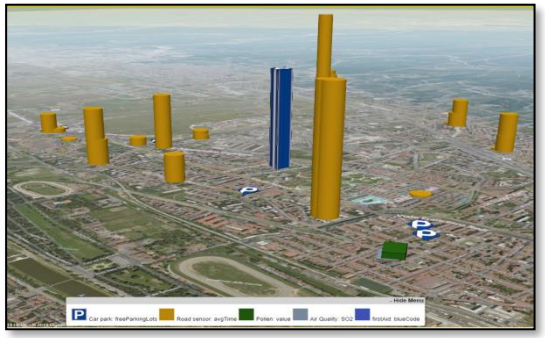
Nature

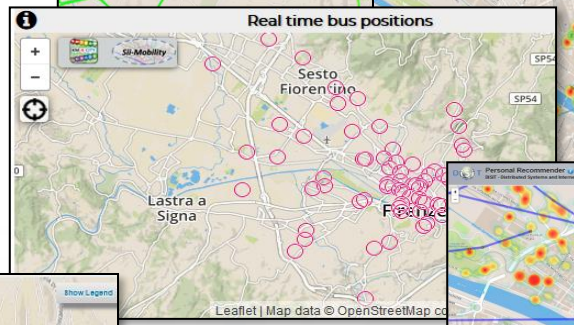
- **Twitter Vigilance:**
  - Daily and real time
  - Volume and sentiment analysis
- Services on Maps, GIS, ArcGIS
- Real time sensors on 3D
- Web HTML5 Applications
- Origin Destination Matrix
- Real Time fleets
- Routing, Multimodal tools
- **IPCAM** connector
- **Synoptics**
- **Third party tools!**
- **…..**
- **Other tools also internal**
  - Traffic Flow Reconstruction
  - User behaviour monitoring
  - Tracking tools
  - Heatmaps tools
  - Trajectories tools

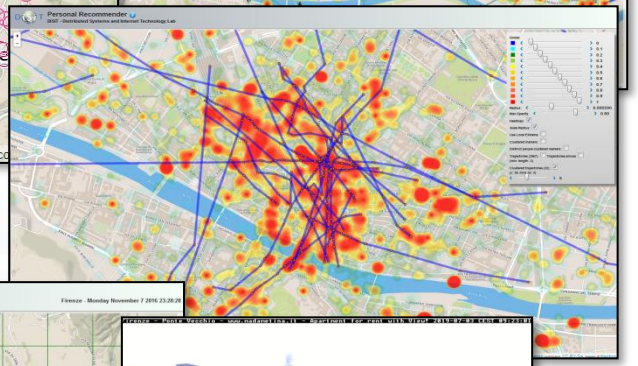


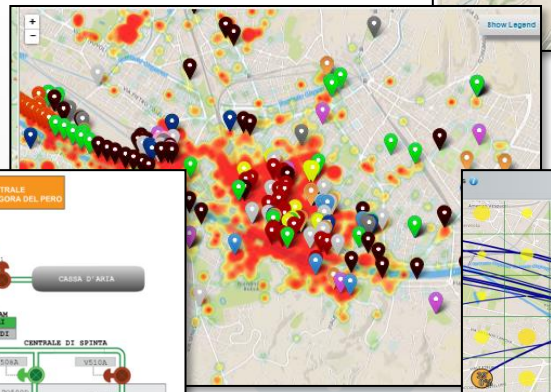



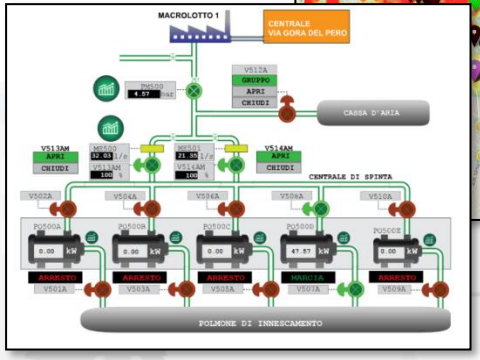



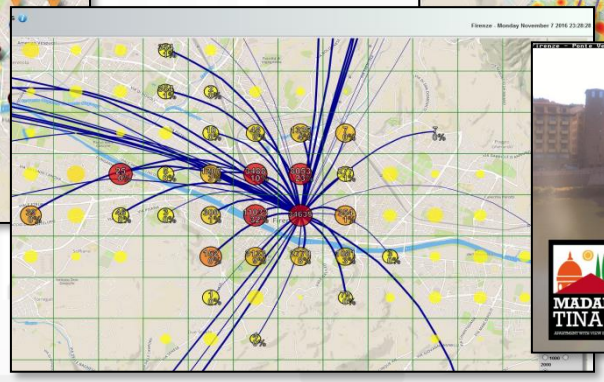






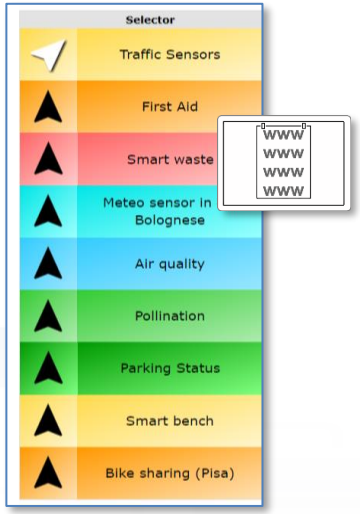


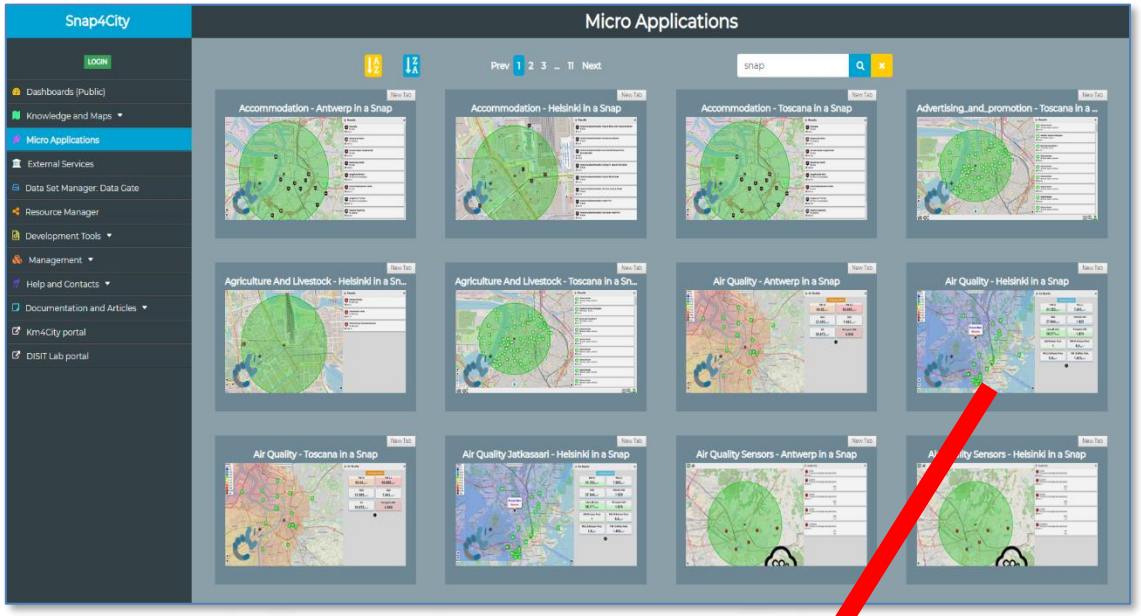



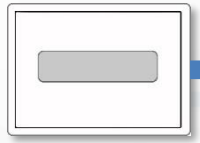


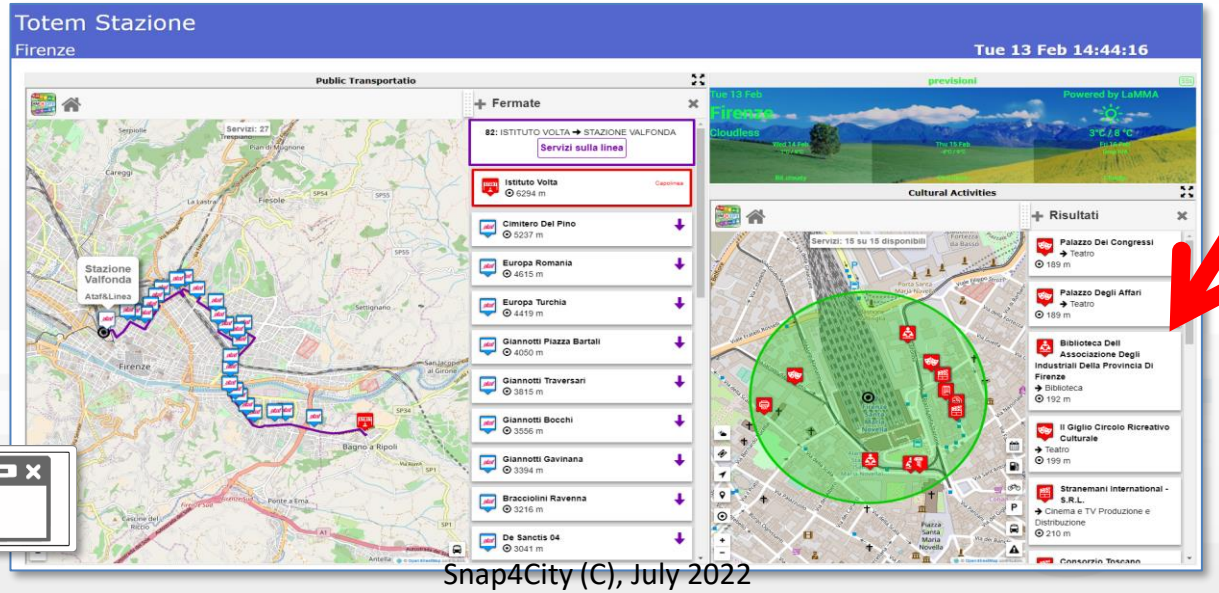
# HLT: MicroApplications

High Level Types



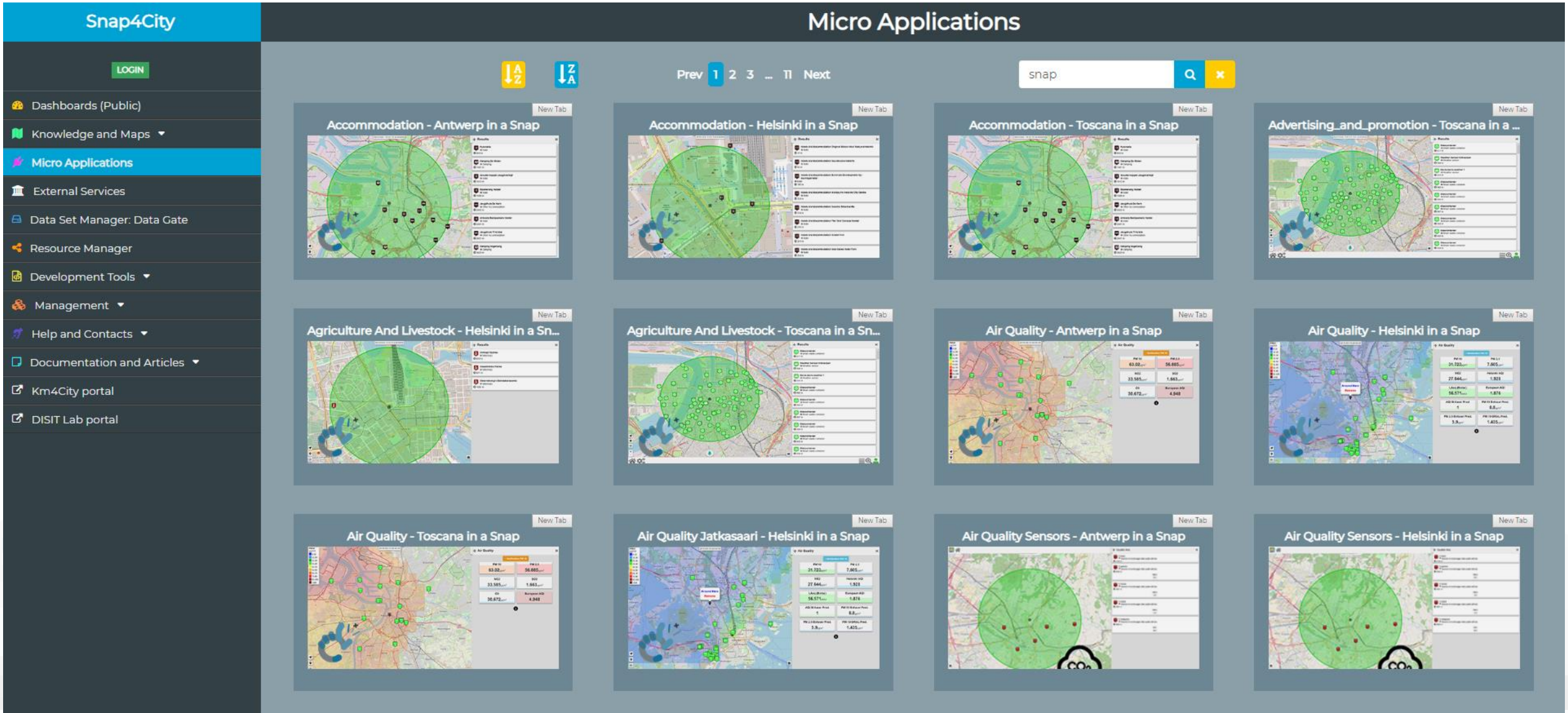





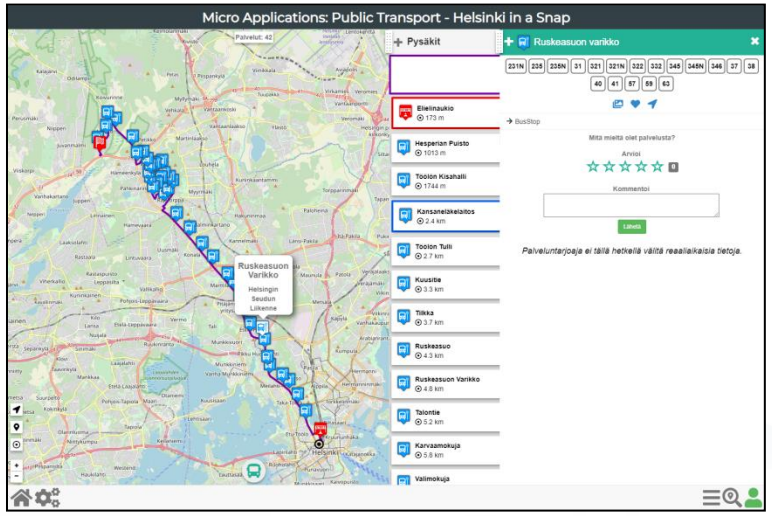


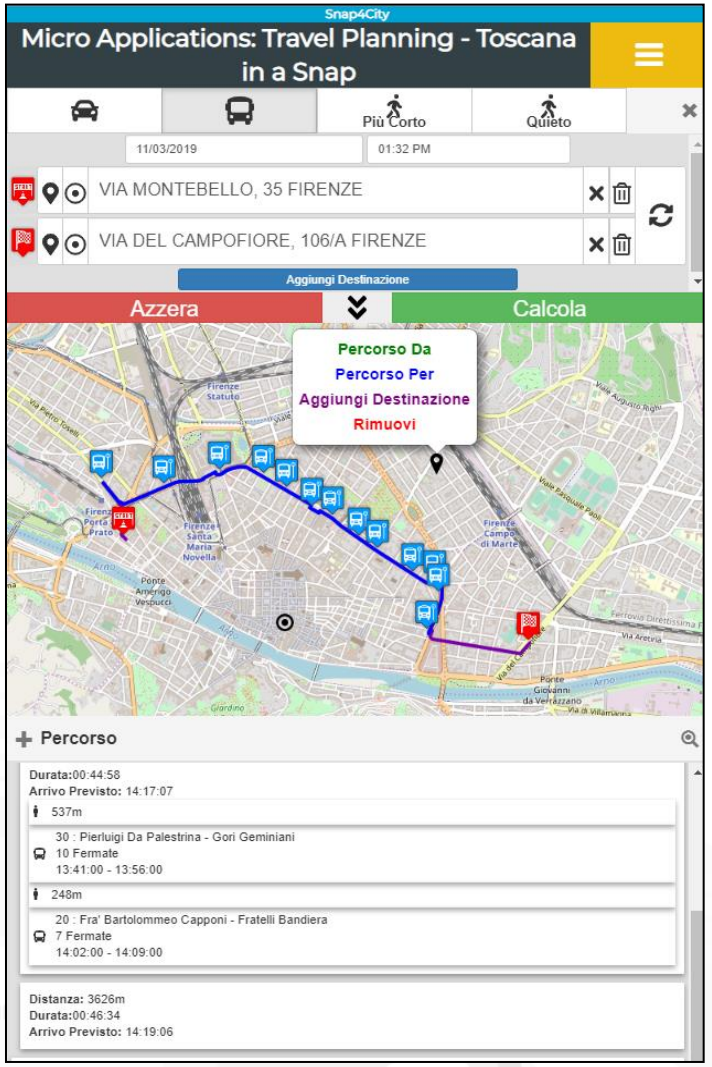

# MicroApplications

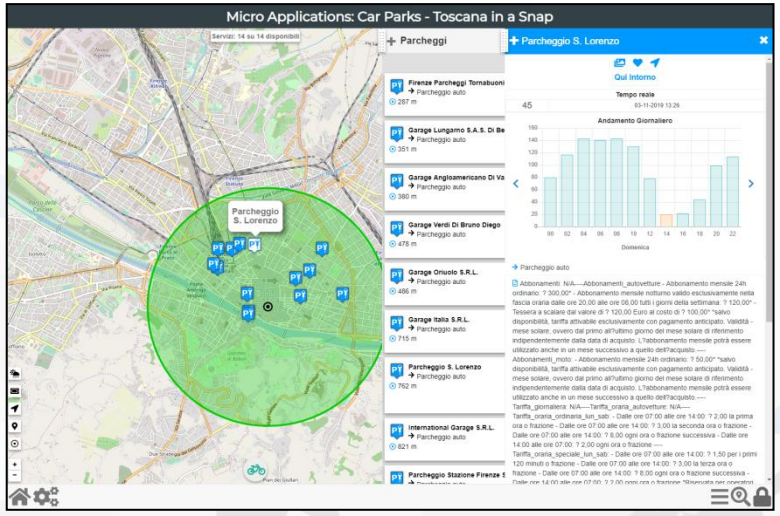


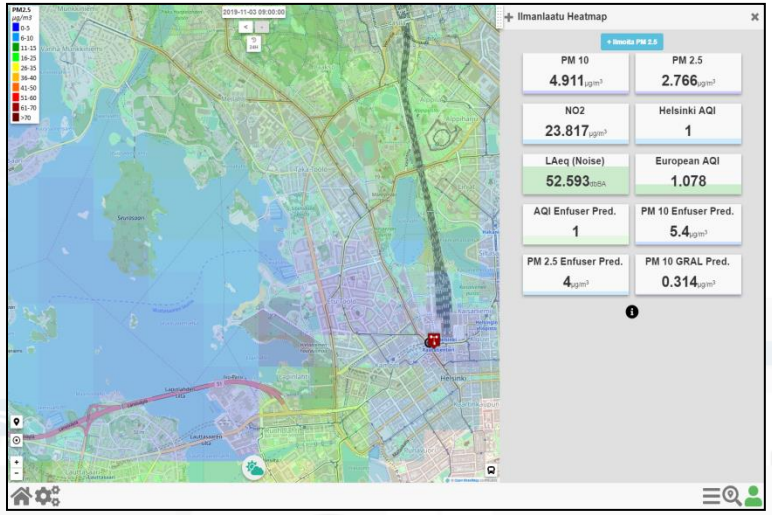
# MIcroApplications for Dashboards



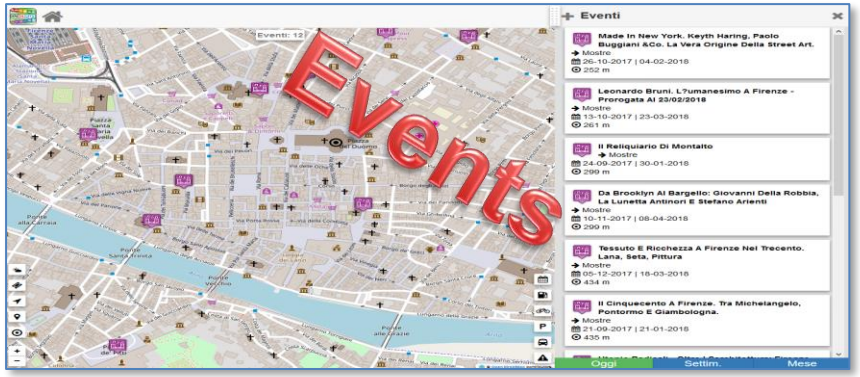



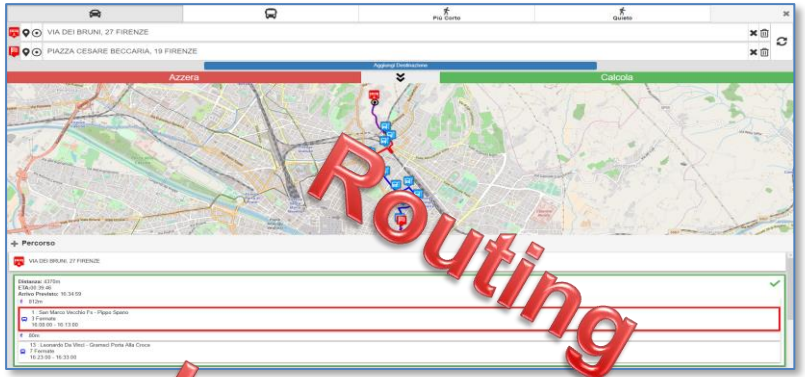



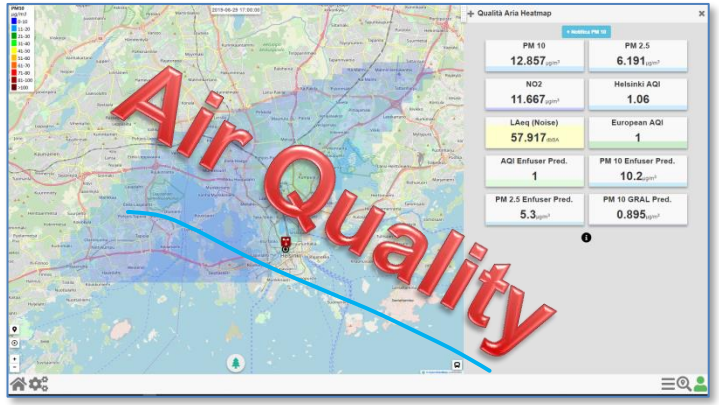



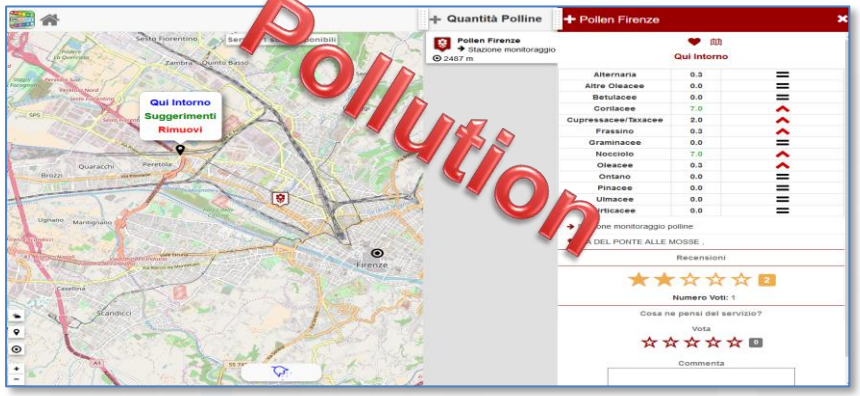



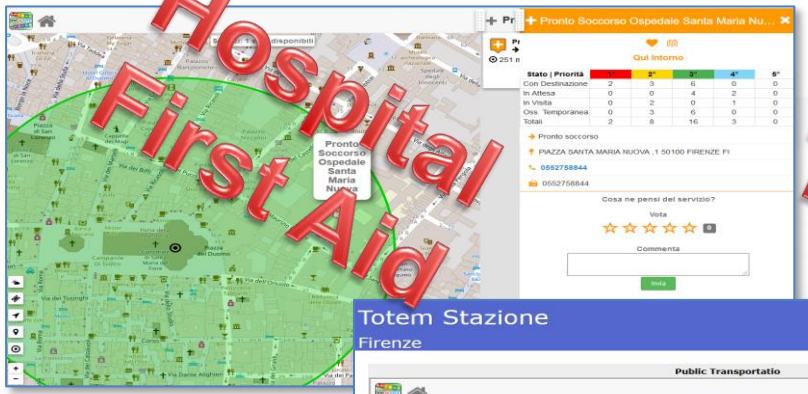
# HTML5 MicroApplications

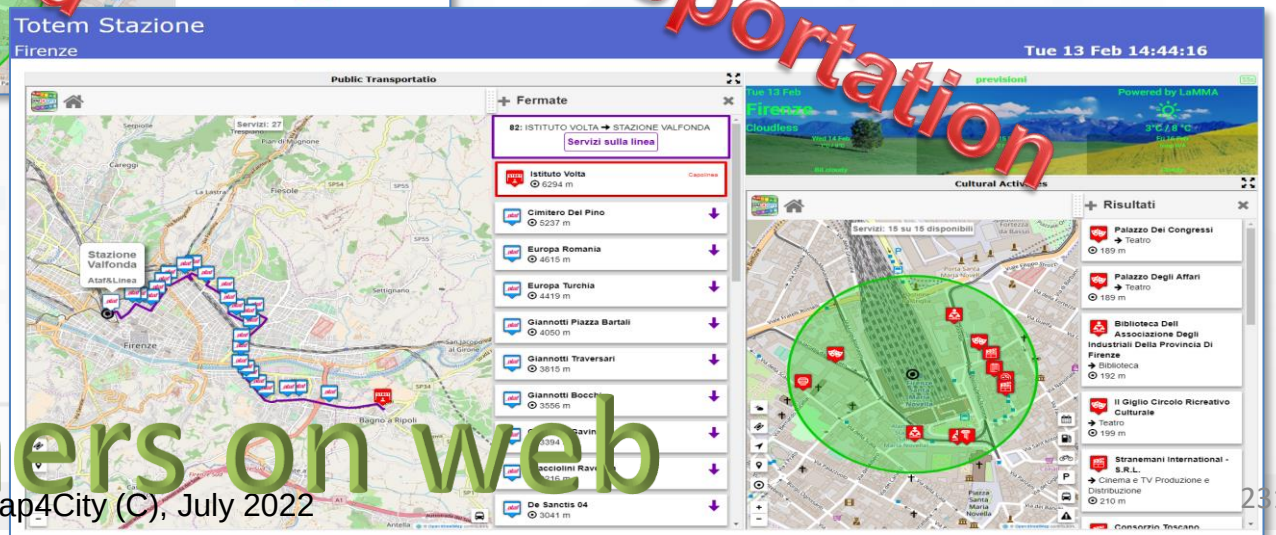


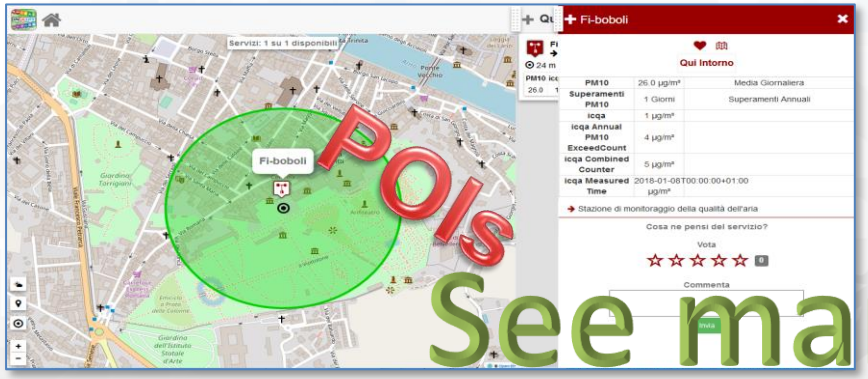



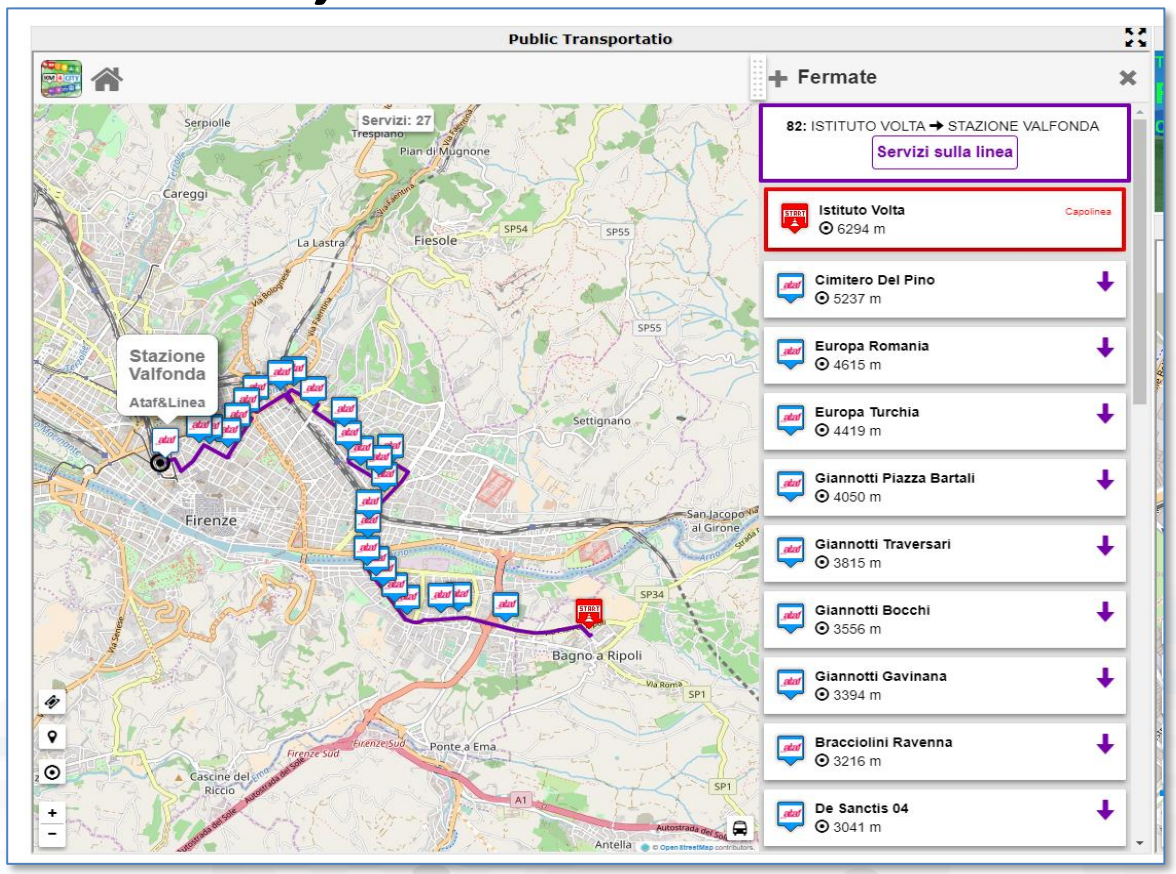



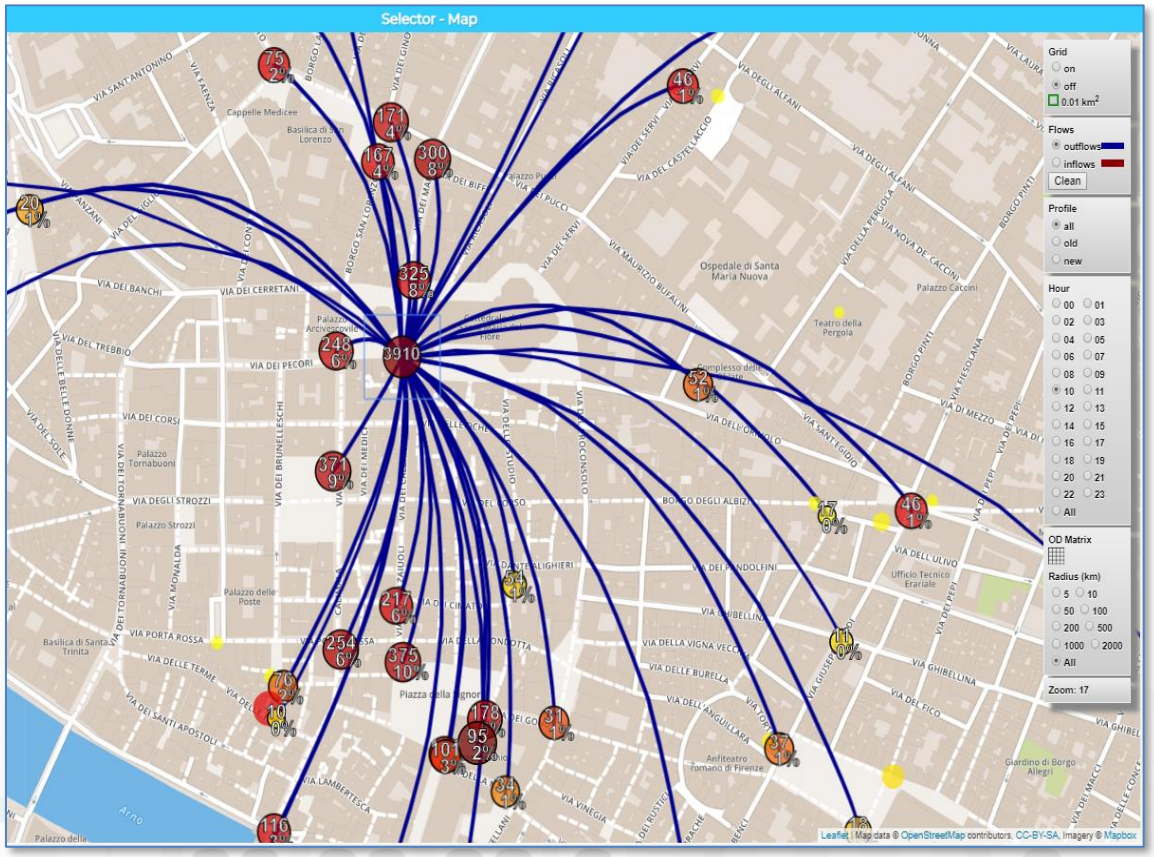

See many others on web

# Special data are managed with Special Tools

- GTFS, also on MDM




- Origin Destination Matrices




# HLT: MicroApplications, ExternalServices

# External Services

- Are **Web Pages** *by you or by Third Parties*. They can be embedded into an **External Content Widget** only if they:
  - are HTTPS page for the limitation of the browser,
  - do not present limitations to be “iframed” imposed by third party, that is always possible to be imposed by the page owner.



- You can **exploit/integrate External Services** by:
  - put them into an External Content Widget
  - Call them from a Widget Button to be open into another Tab of the browser or into an External Content Widget.
  - Call them from a Selector Web Widget, if you have multiple of them with a menu you can make a selection among several of them to be open into an External Content Widget
  - Call of them from the Dashboard Menu, to be open into the current or separate Tab of the Browser

# IPCAM Service

- Examples:
  - https://main.snap4city.org/cam/ipCam.php?IP=www.meteofirenzehoteldavid.com/webcam/pontevecchio.jpg
  - https://main.snap4city.org/cam/ipCam.php?IP=www.meteofirenzehoteldavid.com/webcam/Firenze-HotelDavid.jpg
  - https://main.snap4city.org/cam/ipCam.php?IP=192.168.0.240/tmpfs/auto.jpg
  - https://main.snap4city.org/cam/ipCam.php?IP=www.cagliarimeteo.it/images/webcam/1/Cam1.jpg
  - …
  - To access with credentials you need to add setting on an IP Cam Table on Dashboard Builder!
  - Use https://main.snap4city.org/cam/ipCams.php?IP= for IP CAM with HTTPS connections



# First aids overview - Tuscany

Service status of main first aid

Thu 25 Ma

**Careggi hospital (Florence) -**

| Priority\Status | Red code | Yellow code | Green code | | |
|---|---|---|---|---|---|
| Addressed | 1 | 4 | 3 | 0 | 0 |
| Waiting | 0 | 2 | 9 | 2 | 0 |
| In visit | 1 | 9 | | 3 | 0 |
| In observation | 4 | 19 | 2 | 0 | 0 |
| Totals | 6 | 34 | 32 | 5 | 0 |

First AID

**Santa Chiara hospital (Pisa) - D**

| Priority\Status | Red code | Yellow code | Green code | | |
|---|---|---|---|---|---|
| Waiting | 0 | 1 | 7 | 9 | 3 |
| In visit | | | | 1 | 6 |
| Totals | 0 | 8 | 8 | 10 | 9 |

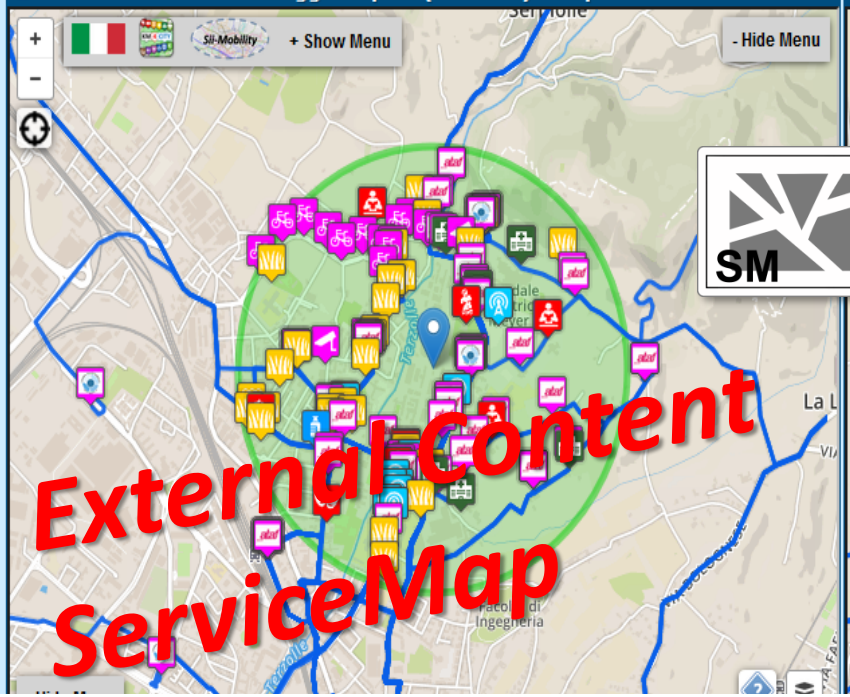
First AID

**Other hospitals - Sum**

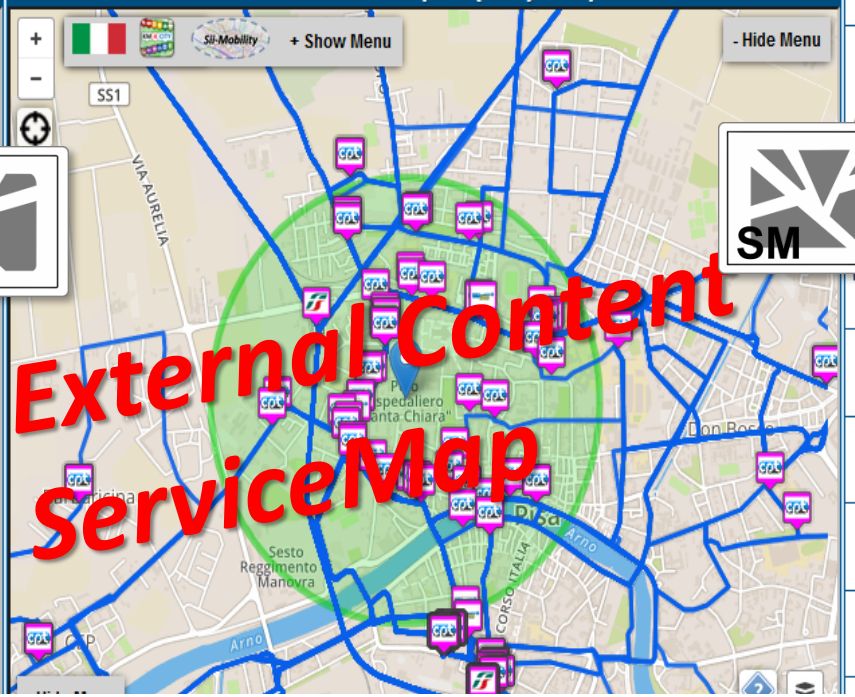
| Priority\Hospitals | Red code | Yellow code | Green c | | ode |
|---|---|---|---|---|---|
| PS SAN GIOVANNI DI DIO TORREGALLI | 1 | 16 | 20 | 1 | 0 |
| PS SANTA MARIA NUOVA | 1 | | 22 | 3 | 0 |
| PS AO CAREGGI | 6 | 34 | 32 | 5 | 0 |
| PS SANTA MARIA ANNUNZIATA | 1 | 8 | 11 | 1 | 0 |
| RGO ENZO | 0 | 3 | 3 | 4 | 0 |
| PS OSPEDALI RIUNITI | 3 | 8 | 18 | 1 | 1 |
| PS CASENTINO | No data available for this hospital | | | | |
| PS SANTA CROCE | No data available for this hospital | | | | |
| PI PO CORTONA | No data available for this hospital | | | | |
| PS CIVILE PIOMBINO | No data available for this hospital | | | | |
| | No data available for this hospital | | | | |

First AID Multi

**Careggi hospital (Florence) - Map**




**Santa Chiara hospital (Pisa) - Map**



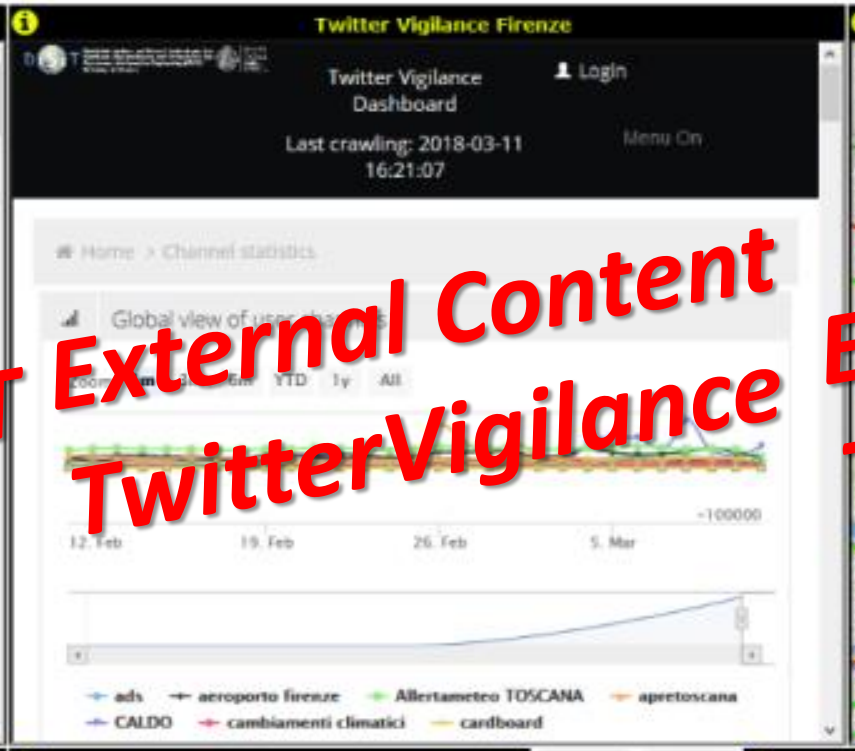

https://main.snap4city.org/view/index.php?iddasboard=MTIy

# Firenze Social and Social Media new

Demo cams

Sun 11 Mar 16:24:55





















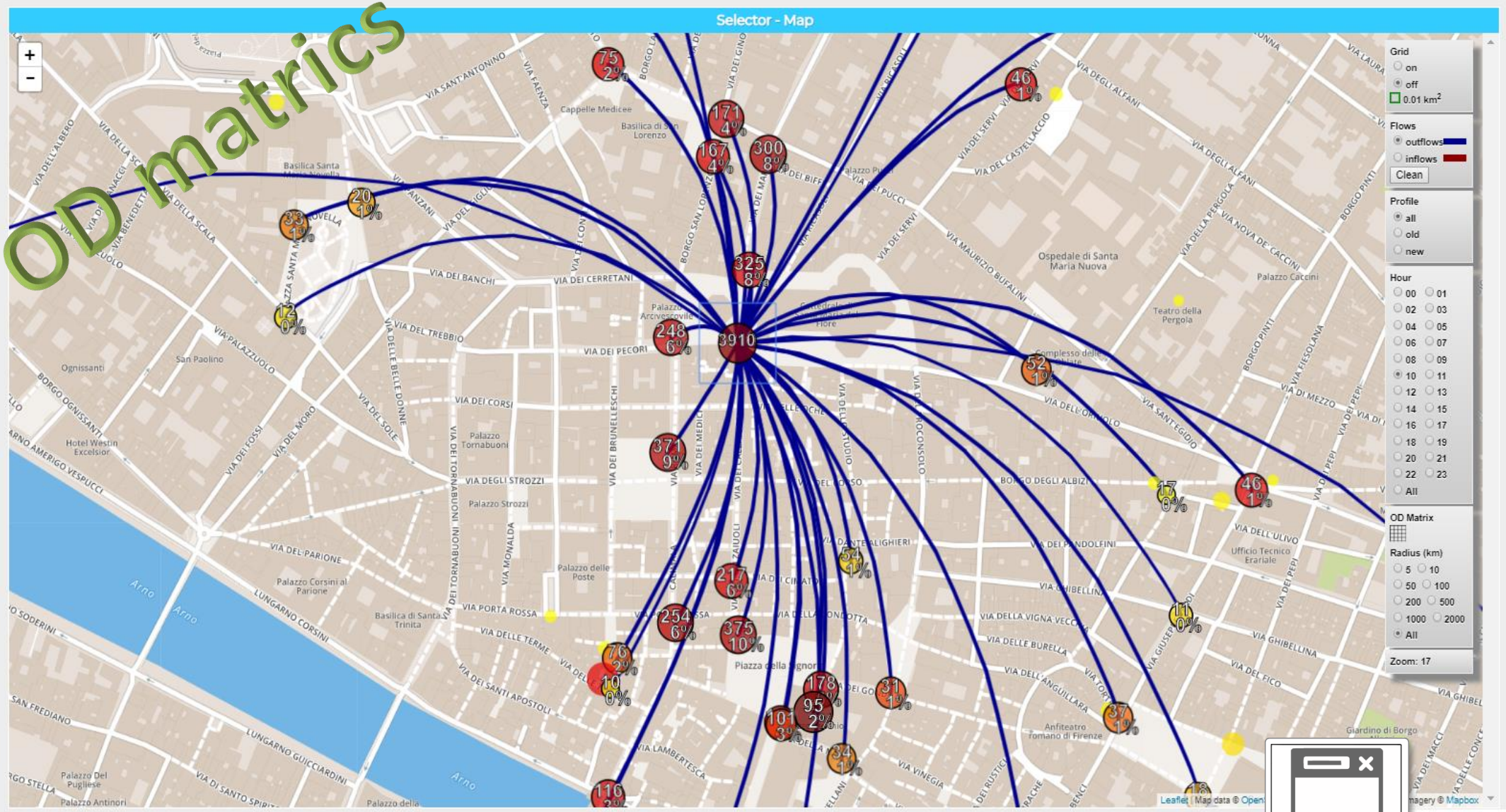




https://dashboard.km4city.org/view/index.php?iddasboard=MjY3

# Life in Toscana: Dashboard

Sat 29 Jun 23:32:24




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc3NA==

# Life in Toscana: Dashboard

Sat 29 Jun 23:32:24




Selector web

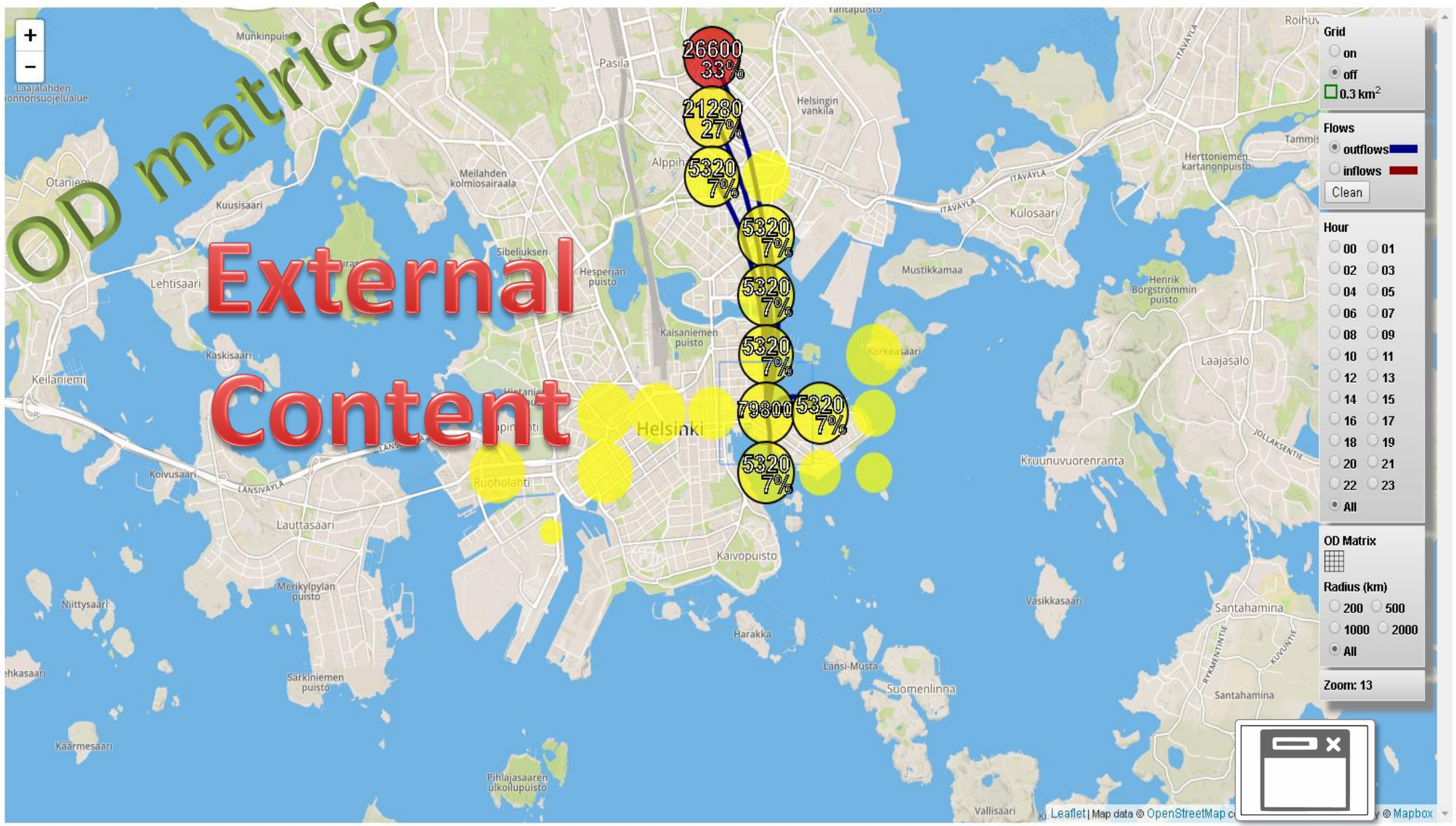
- Line of Transport
- Public Transport
- Travel Plan
- Traffic Flow FIPILI
- Air Quality
- Weather
- Origin Dest. Matrix
- Typical Trajectories
- People Flow WIFI
- Cultural Activities
- Forum Discussion

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc3NA==

# Helsinki White Dashboard

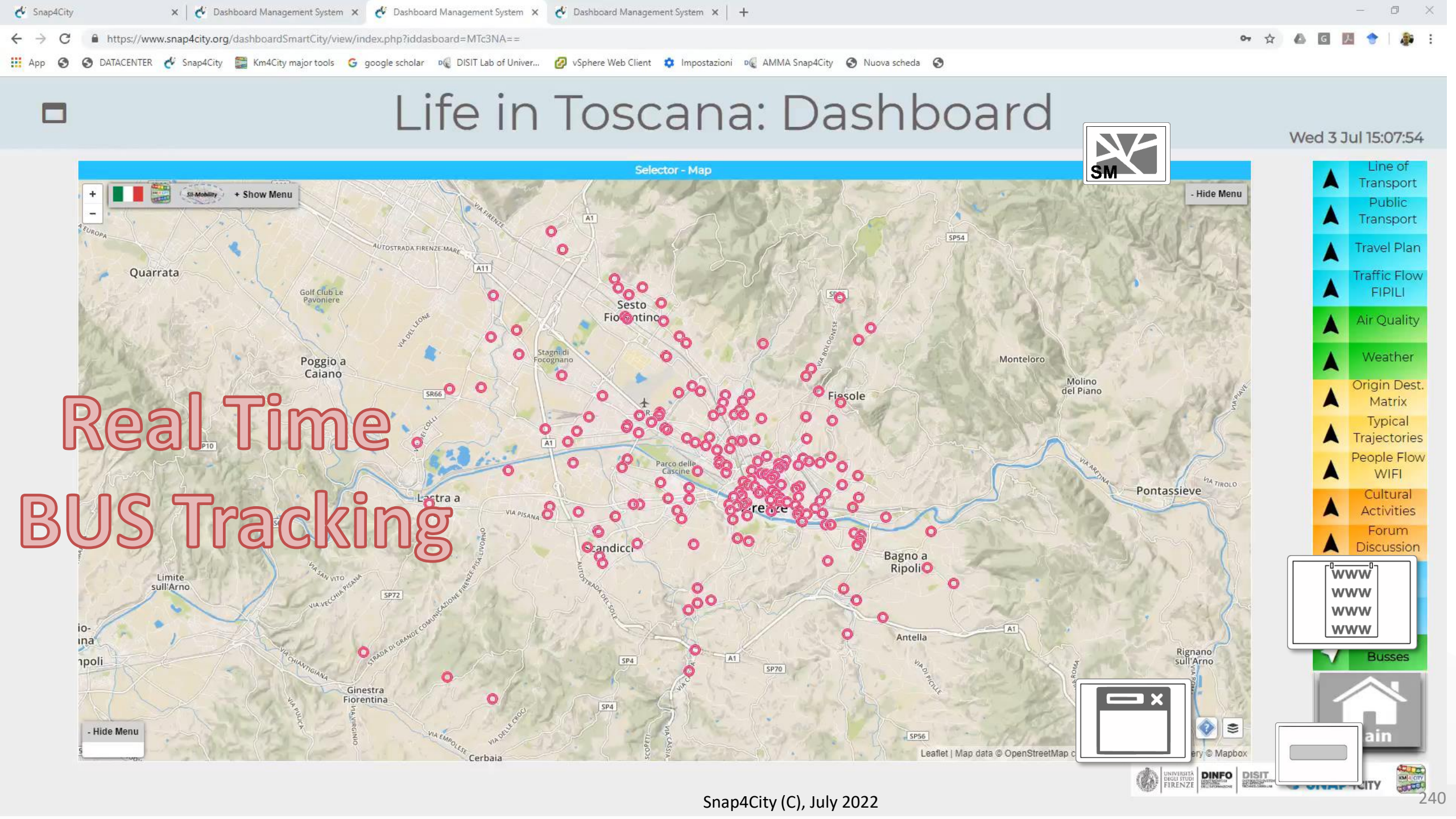
Please note that the data results are not always based on real data.

Thu 13 Jun 23:37:56

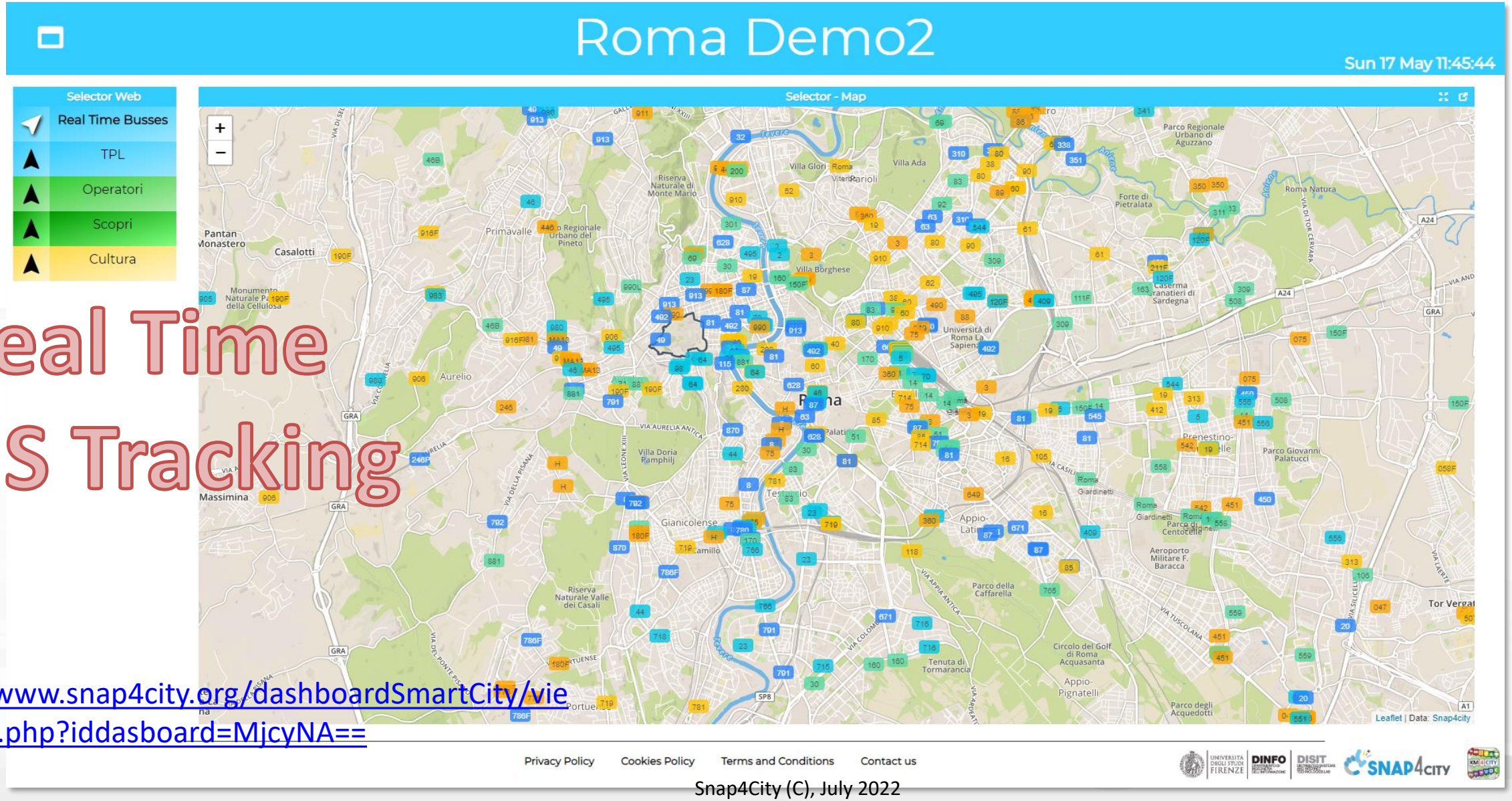



Selector web

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


Snap4City
Dashboard Management System
Dashboard Management System
Dashboard Management System
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc3NA==
App
DATACENTER
Snap4City
Km4City major tools
google scholar
DISIT Lab of Univer...
vSphere Web Client
Impostazioni
AMMA Snap4City
Nuova scheda
Life in Toscana: Dashboard
Wed 3 Jul 15:07:54
Selector - Map
+ Show Menu
- Hide Menu
Line of Transport
Public Transport
Travel Plan
Traffic Flow FIPILI
Air Quality
Weather
Origin Dest. Matrix
Typical Trajectories
People Flow WIFI
Cultural Activities
Forum Discussion
Busses
Real Time
BUS Tracking
Quarrata
Poggio a Caiano
Sesto Fiorentino
Fiesole
Monteloro
Molino del Piano
Pontassieve
Bagno a Ripoli
Antella
Rignano sull'Arno
Limite sull'Arno
Ginestra Fiorentina
Cerbaia
Leaflet | Map data © OpenStreetMap
Snap4City (C), July 2022

# Roma example




## Real Time BUS Tracking

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

https://main.snap4city.org/view/index.php?iddasboard=MTY2

# Real Time Sensors via ServiceMap3D

3D data rendering

Sat 1 Dec 16:57:33

Button

Firenze

Button

Airport

Button

Empol

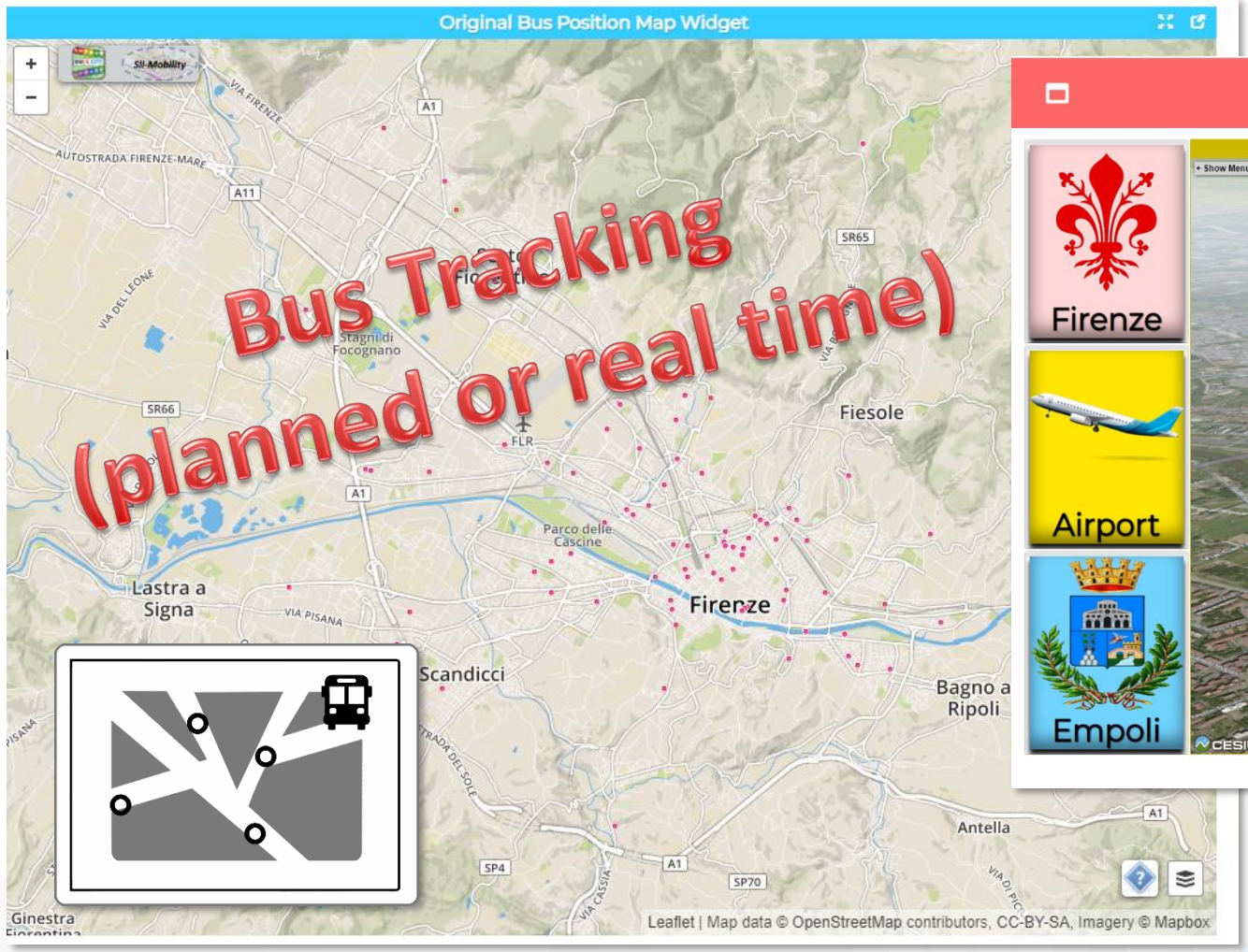
External Content

Airport

- Hide Menu

Car park: freeParkingLots | Road sensor: avgTime | Pollen: value | Air Quality: SO2 | firstAid: blueCode

CESIUM bing © 2018 Microsoft Corporation - © 2018 HERE - © 2018 Digital





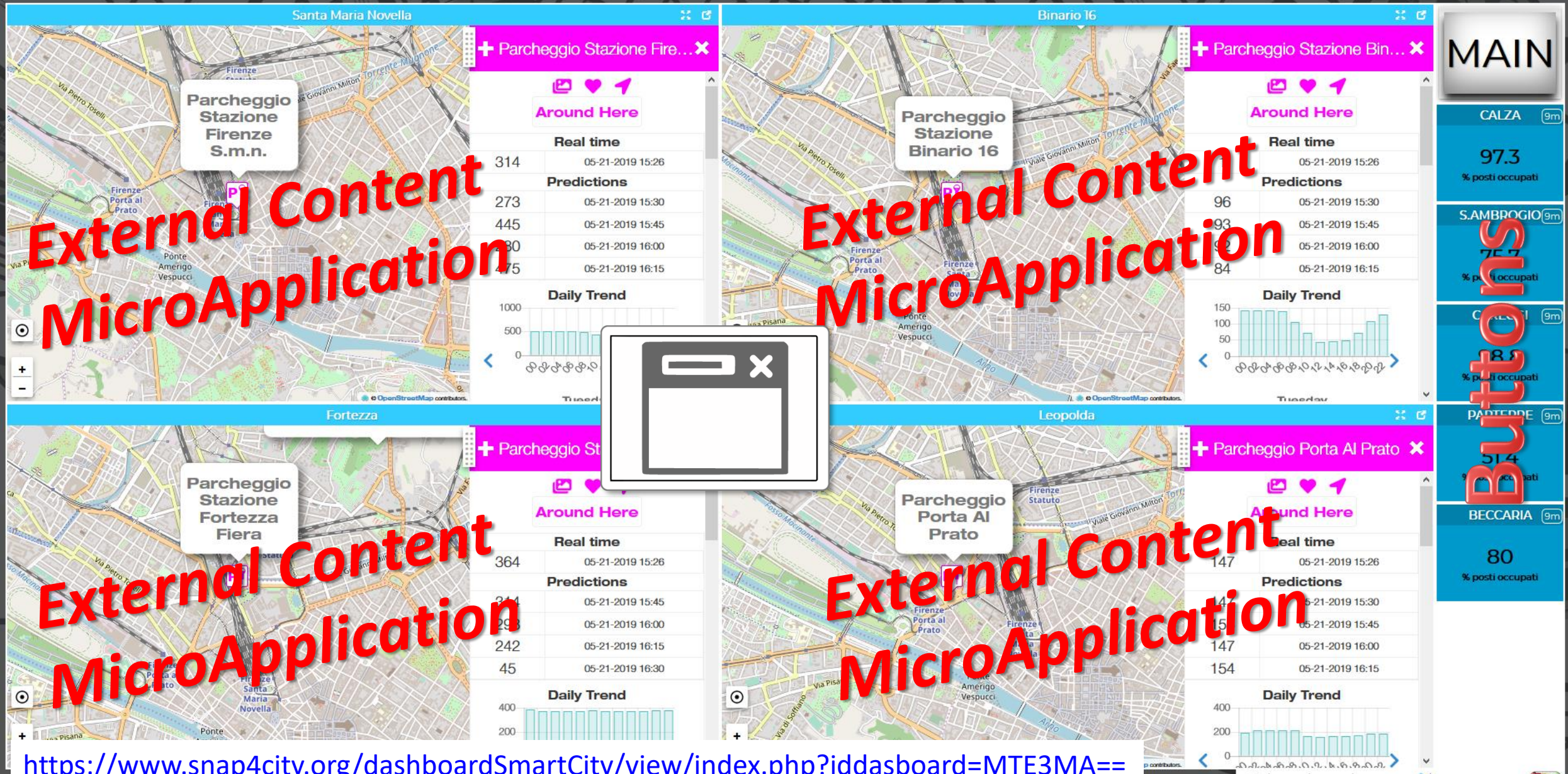


https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTUxMQ==

https://main.snap4city.org/view/index.php?iddasboard=MTY2

# Parking Monitoring Firenze

Tue 21 May 15:23:09

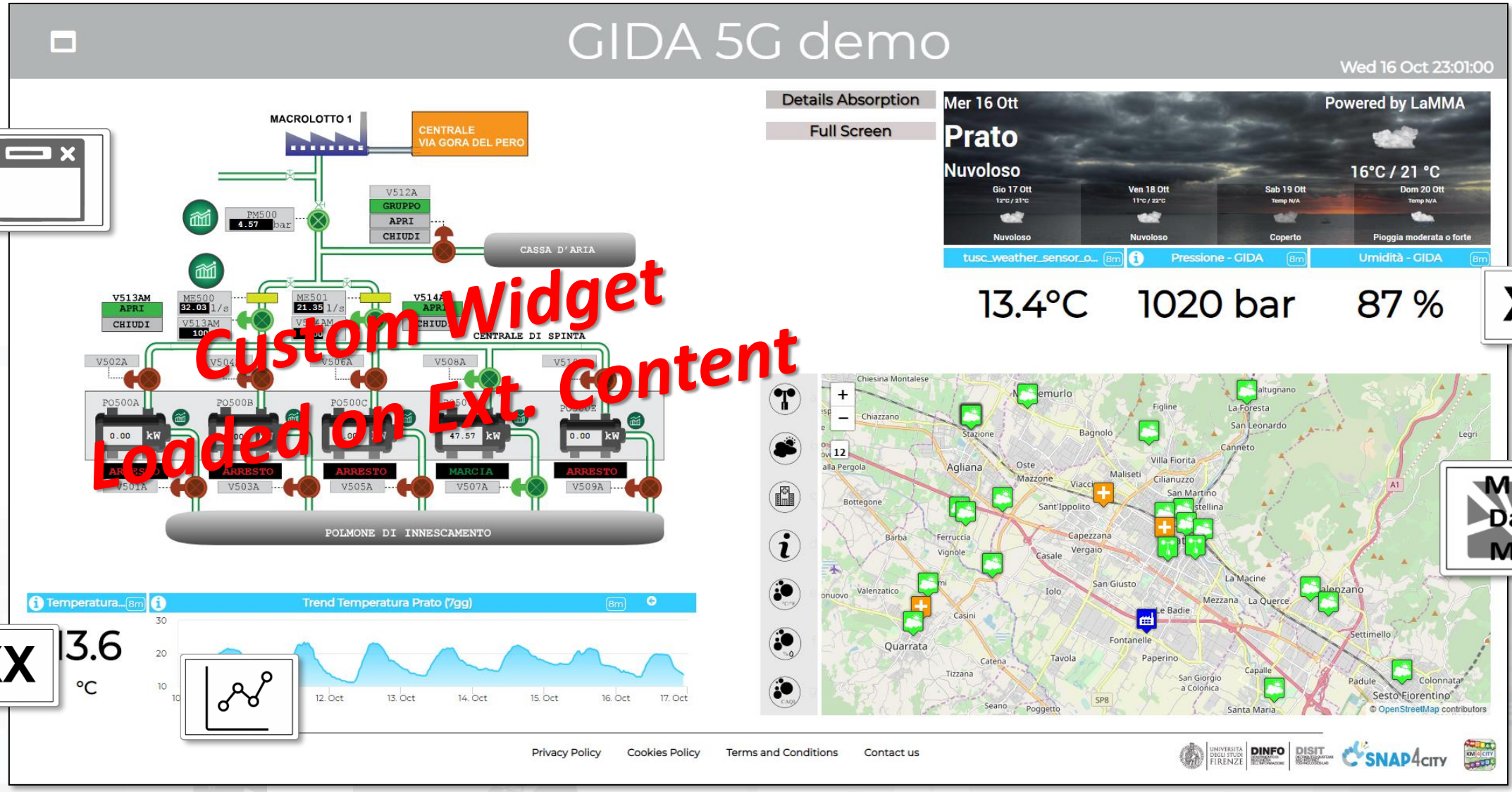



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTE3MA==

# Synoptics, Custom Widgets as External Services



# Demo UC5 GIDA



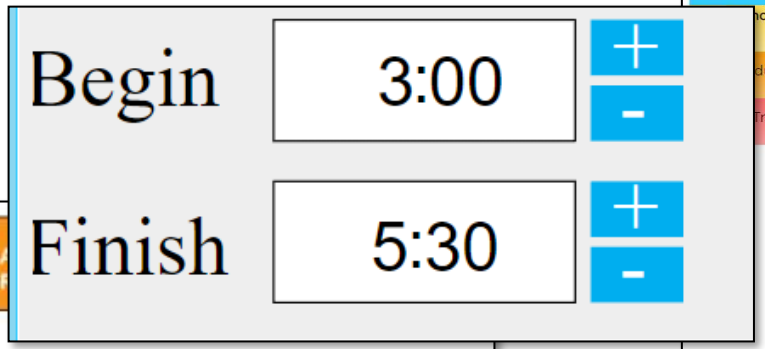

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjIyNg==

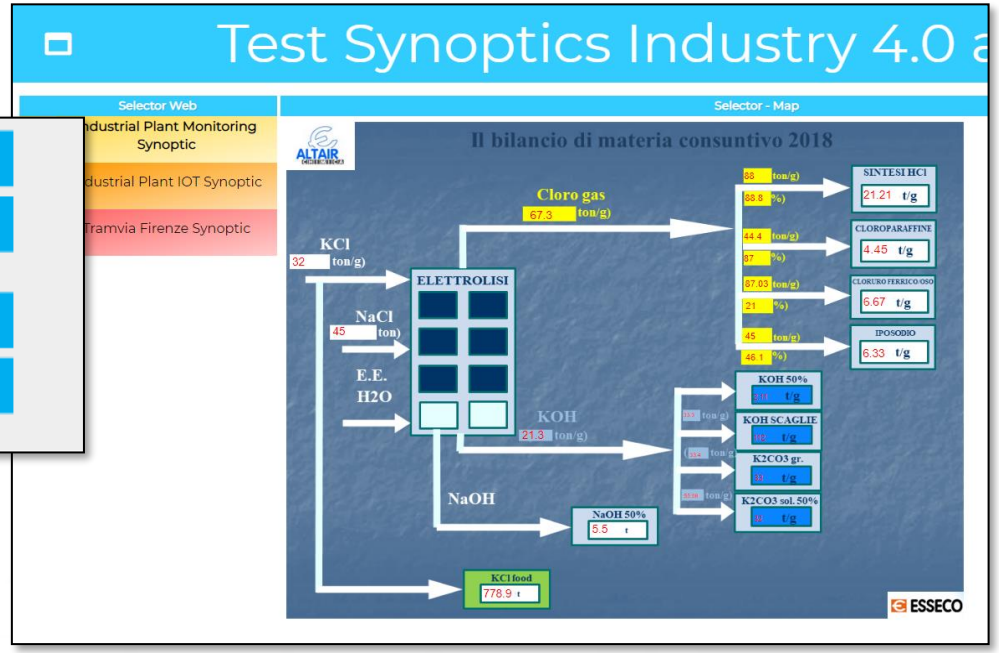
# Custom Widgets

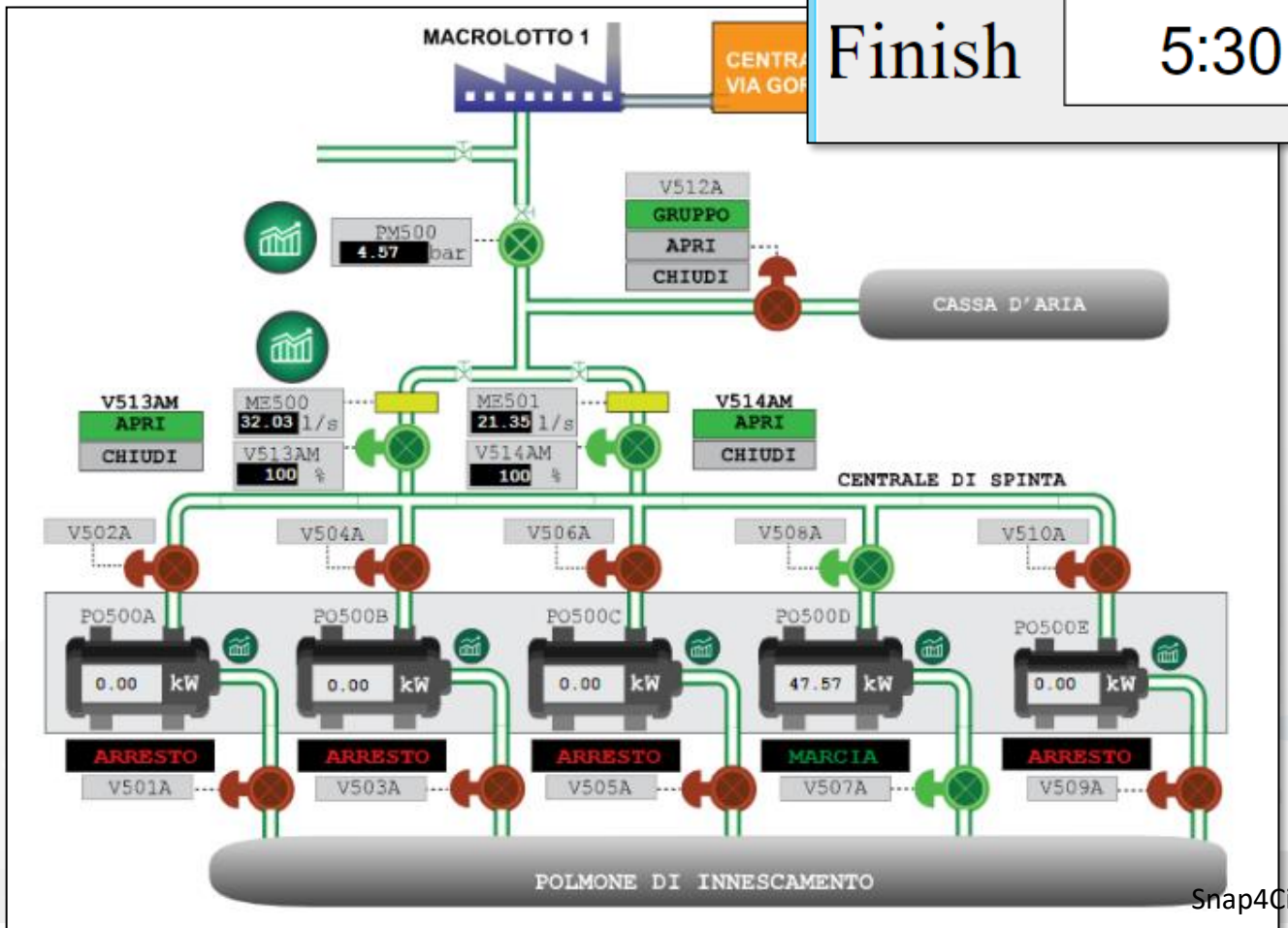
**Custom Dashboards and Widgets (interactive, Animations, etc.)**

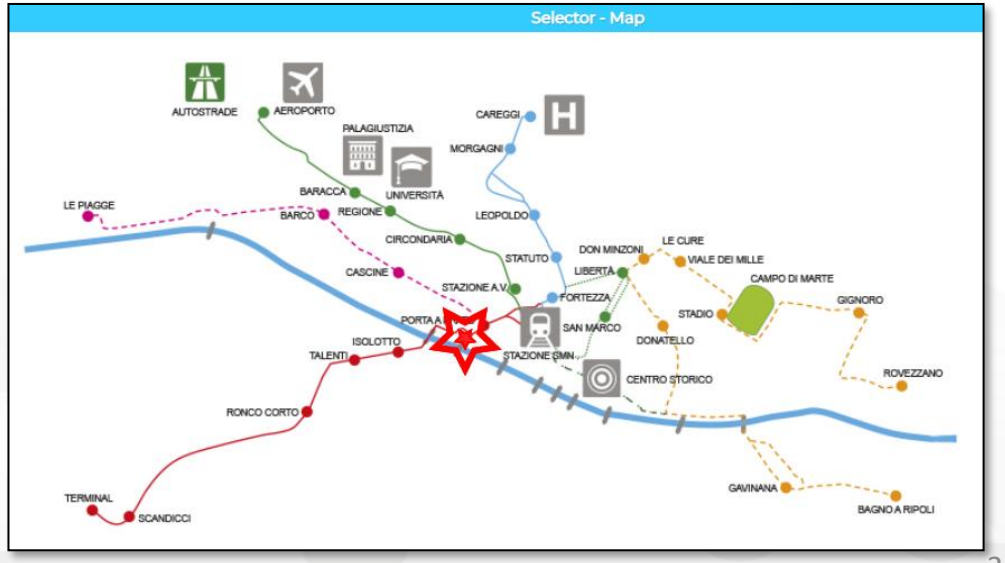
**-- SVG for graphic design**

**-- MyKPI for collecting data**



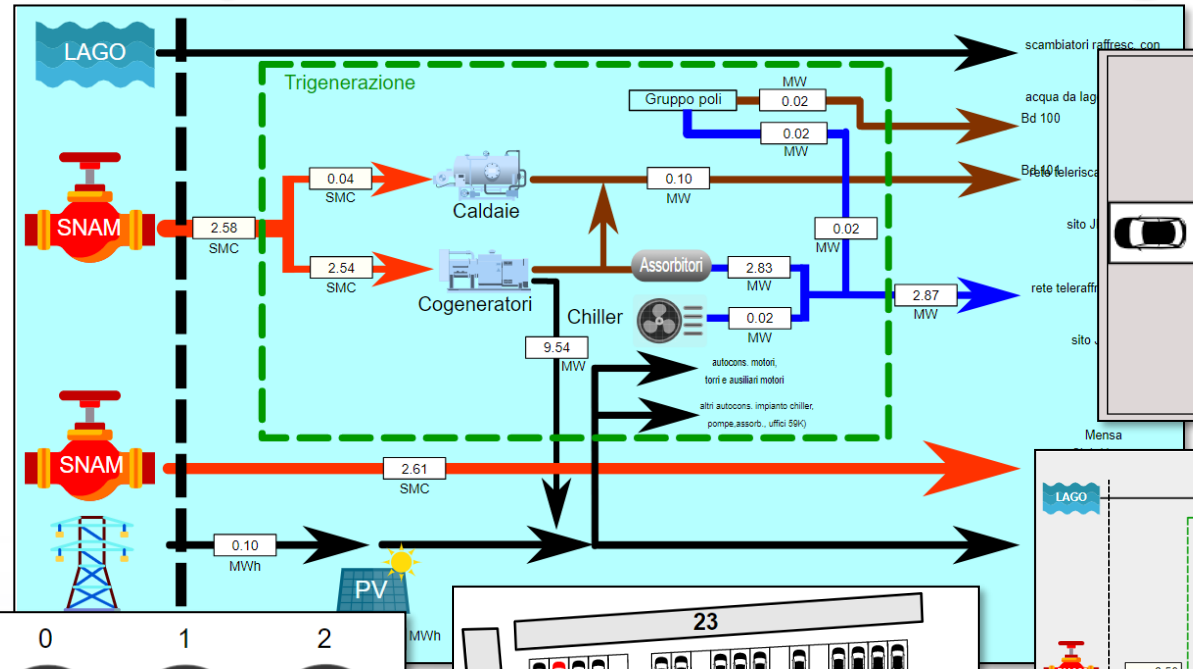



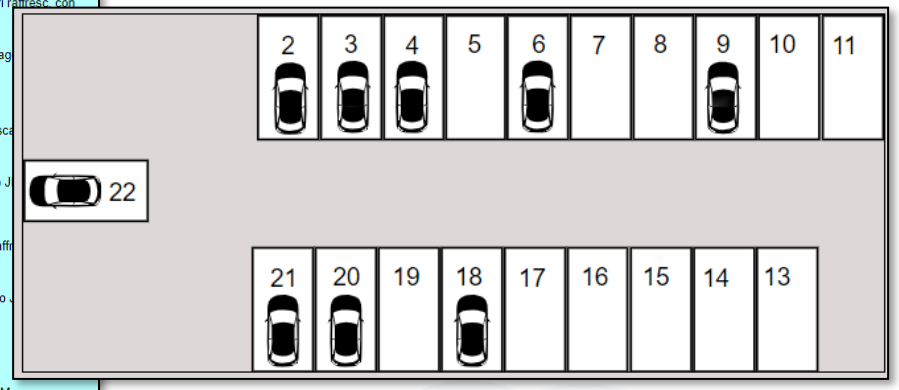



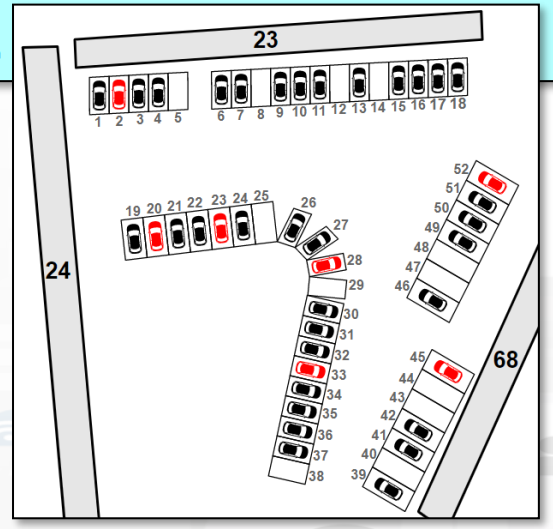



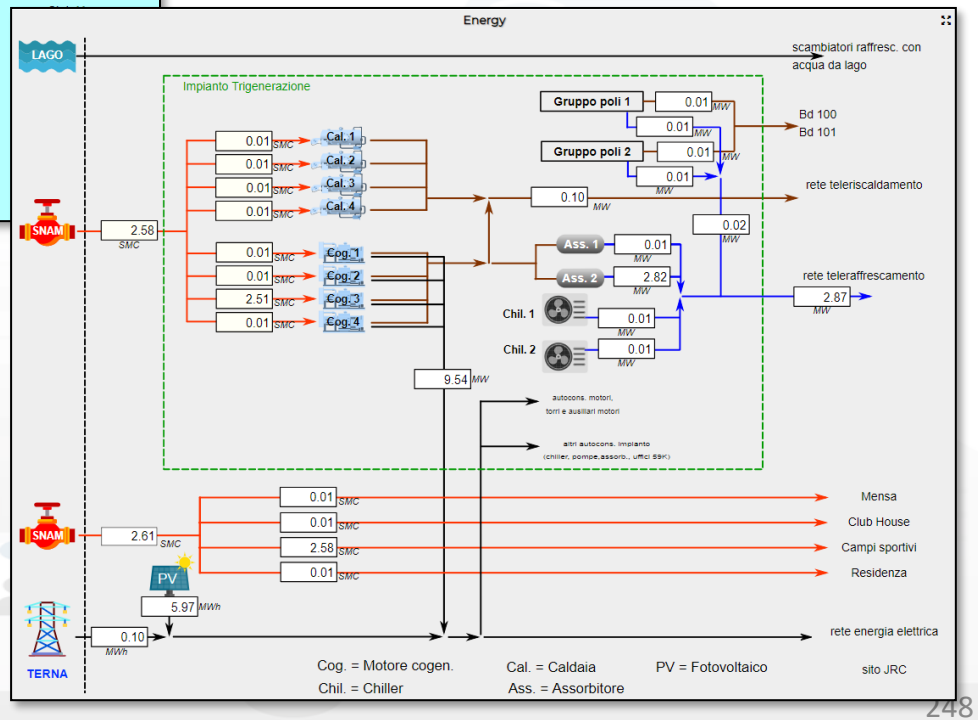
# Special Custom Widgets

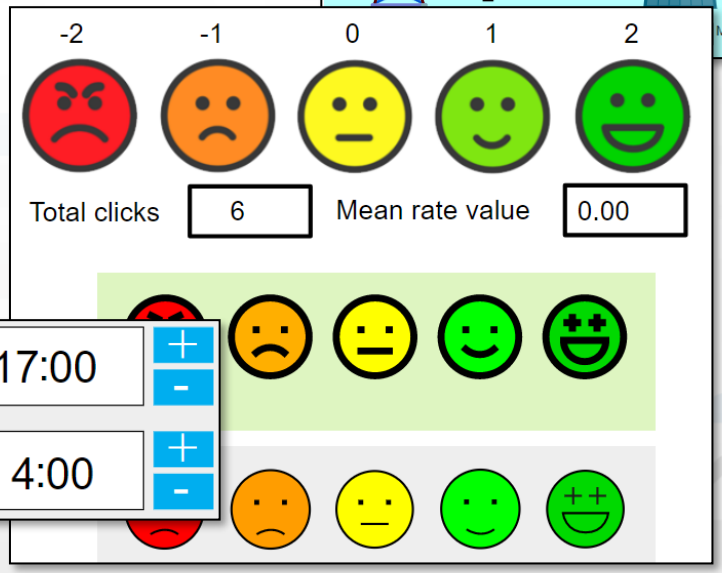
- Smart parking
- Smart Energy
- Smart Light
- Smart ….
- Energy View
- Custom Controls

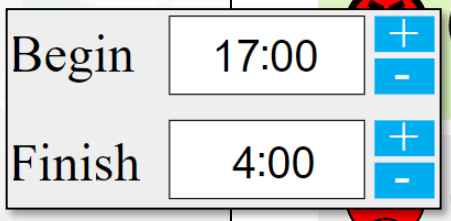


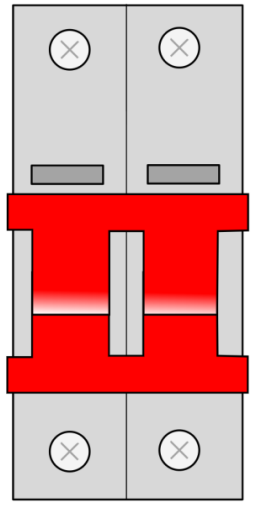



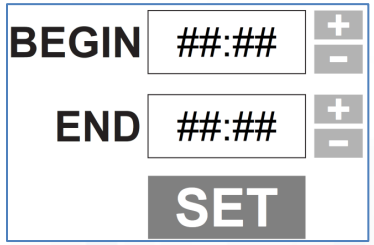



# Other examples



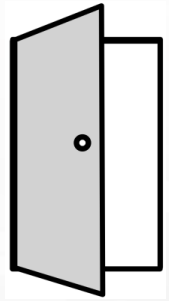
- **Virtual Actuators (sensor-actuator)**
  - From: Dashboard
  - To: IOT App, MyKPI, other Synoptics













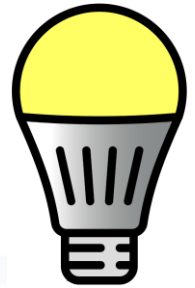




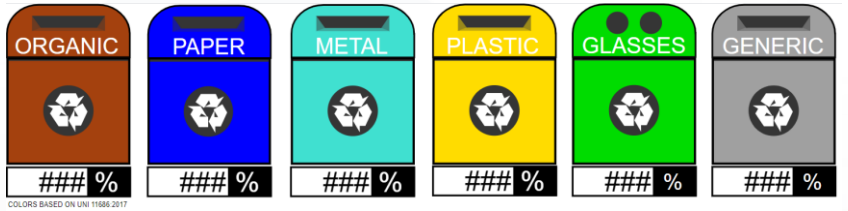
- **Virtual Sensors**
  - From: MyKPI, Sensors, IOT App, other Synoptics
  - To: Dashboards

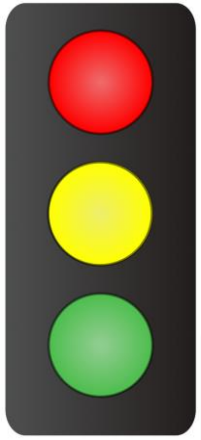


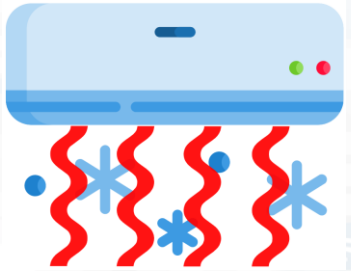


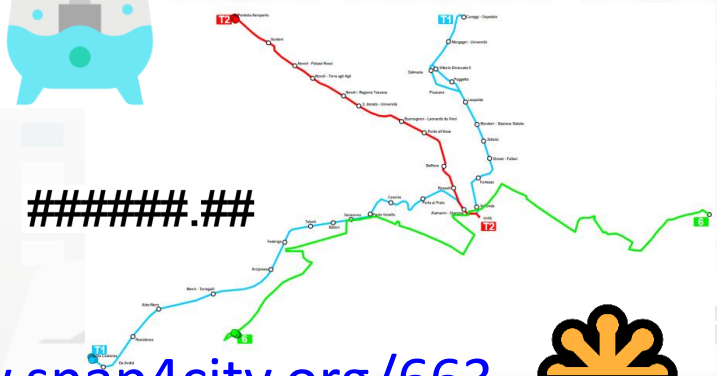











https://www.snap4city.org/663

# Snap4Home 5G Demo

Thu 11 Jun 18:07:32

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open fiber WIND ZTE estra

# Smart Lonato del Garda

Sat 9 Nov 17:20:59

Slot 1
Slot 2
Slot 3
Slot 4
Slot 5
Slot 6
Slot 7
Slot 8
Slot 16
Slot 17
Slot 18
Slot 19
Slot 20
Slot 21
Slot 22
Environment
other

Selector - Map

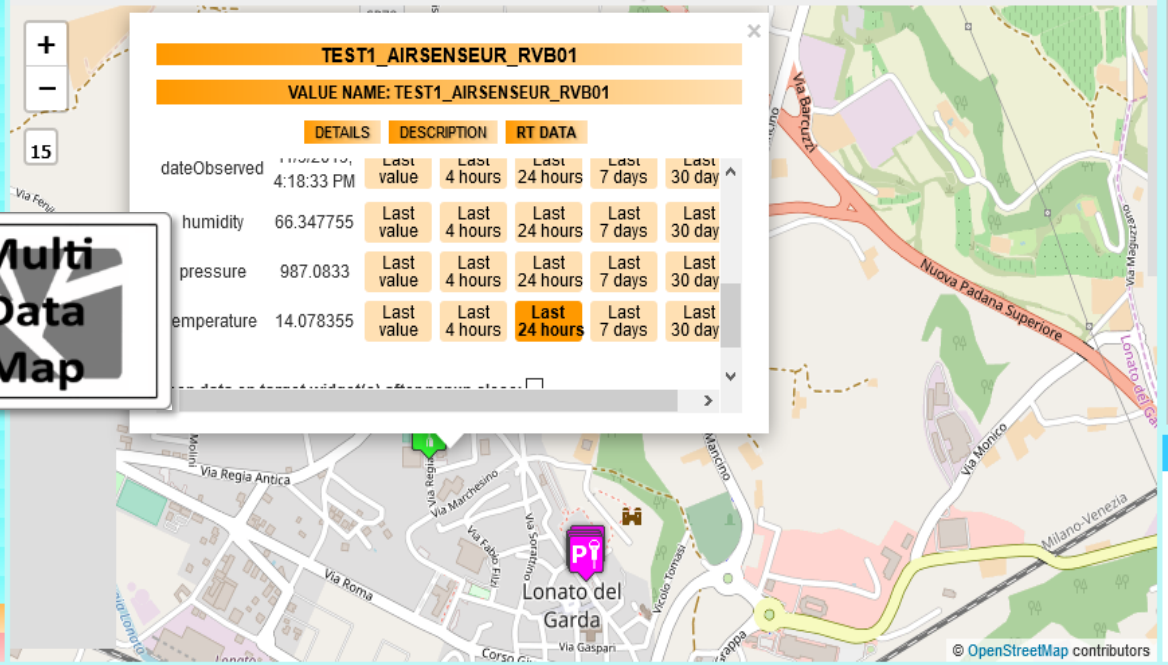
Multi Data Map

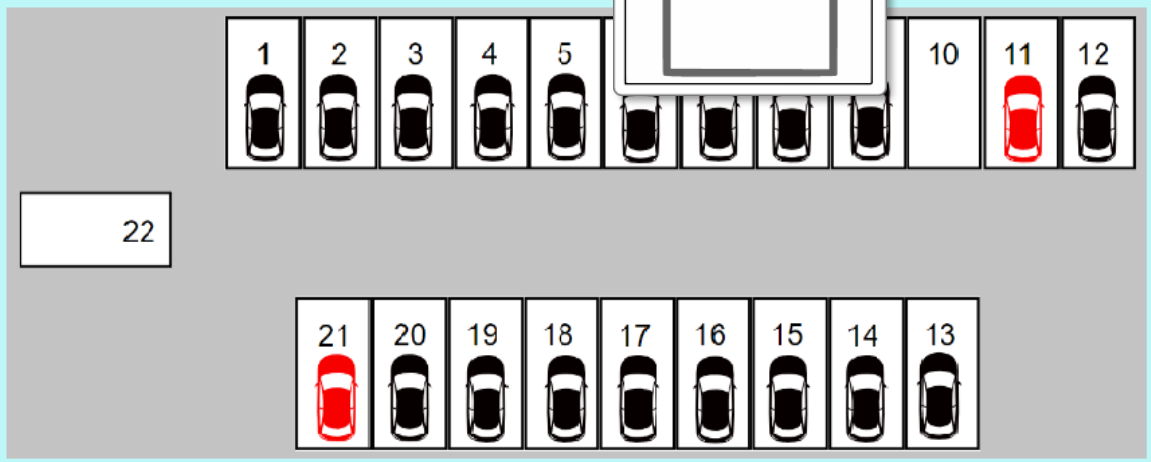
TEST1_AIRSENSEUR_RVB01

VALUE NAME: TEST1_AIRSENSEUR_RVB01

DETAILS | DESCRIPTION | RT DATA

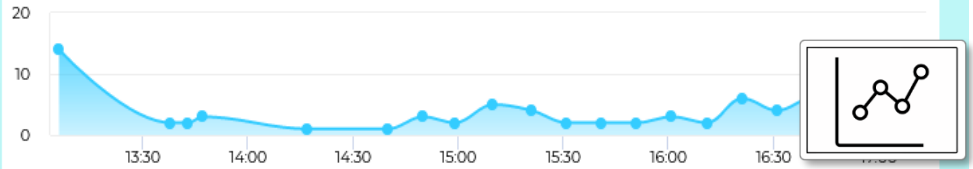
| | | | | | | |
|---|---|---|---|---|---|---|
| dateObserved | 4:18:33 PM | Last value | Last 4 hours | Last 24 hours | Last 7 days | Last 30 day |
| humidity | 66.347755 | Last value | Last 4 hours | Last 24 hours | Last 7 days | Last 30 day |
| pressure | 987.0833 | Last value | Last 4 hours | Last 24 hours | Last 7 days | Last 30 day |
| temperature | 14.078355 | Last value | Last 4 hours | Last 24 hours | Last 7 days | Last 30 day |



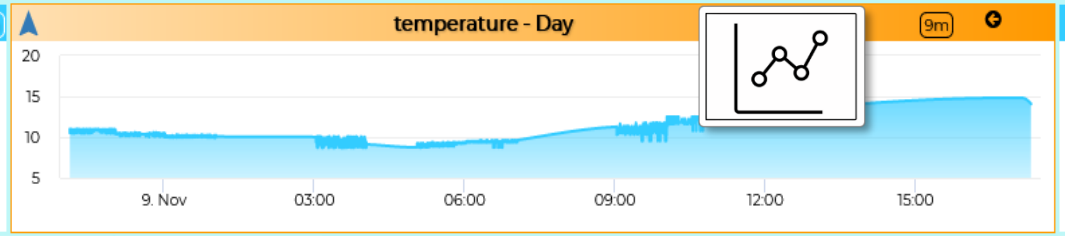

NumFreeSlo... 9m
XX

NumFreeSlots - Slots 9m

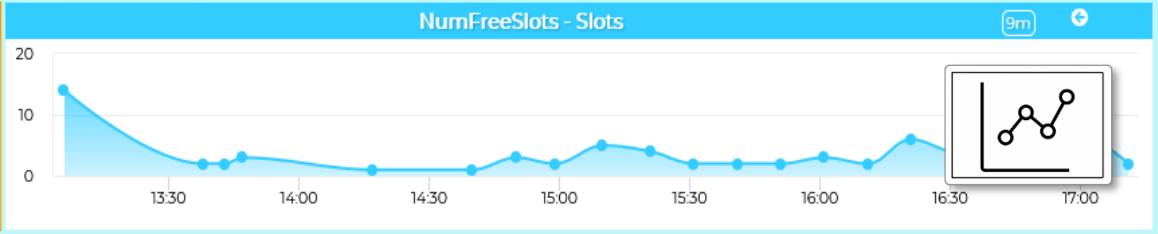



SmartParkingLonato_1 ... 9m
XX
0
status

temperature - Day 9m




NumFreeSlots - Slots 9m



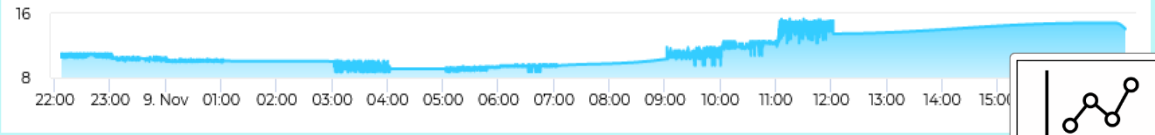

| pressure 9m | humidity % 9m | temperature 9m |
|---|---|---|
| 987.1 | 66.3 | 14.1 |
| mm | % | |

XX XX

| Slot ID 9m | Max Present Duration 9m |
|---|---|
| 14 | 19 ore e 11 minuti |
| slot ID | |

XX

TEST1_AirSensEUR_RVB01 - temperature 9m

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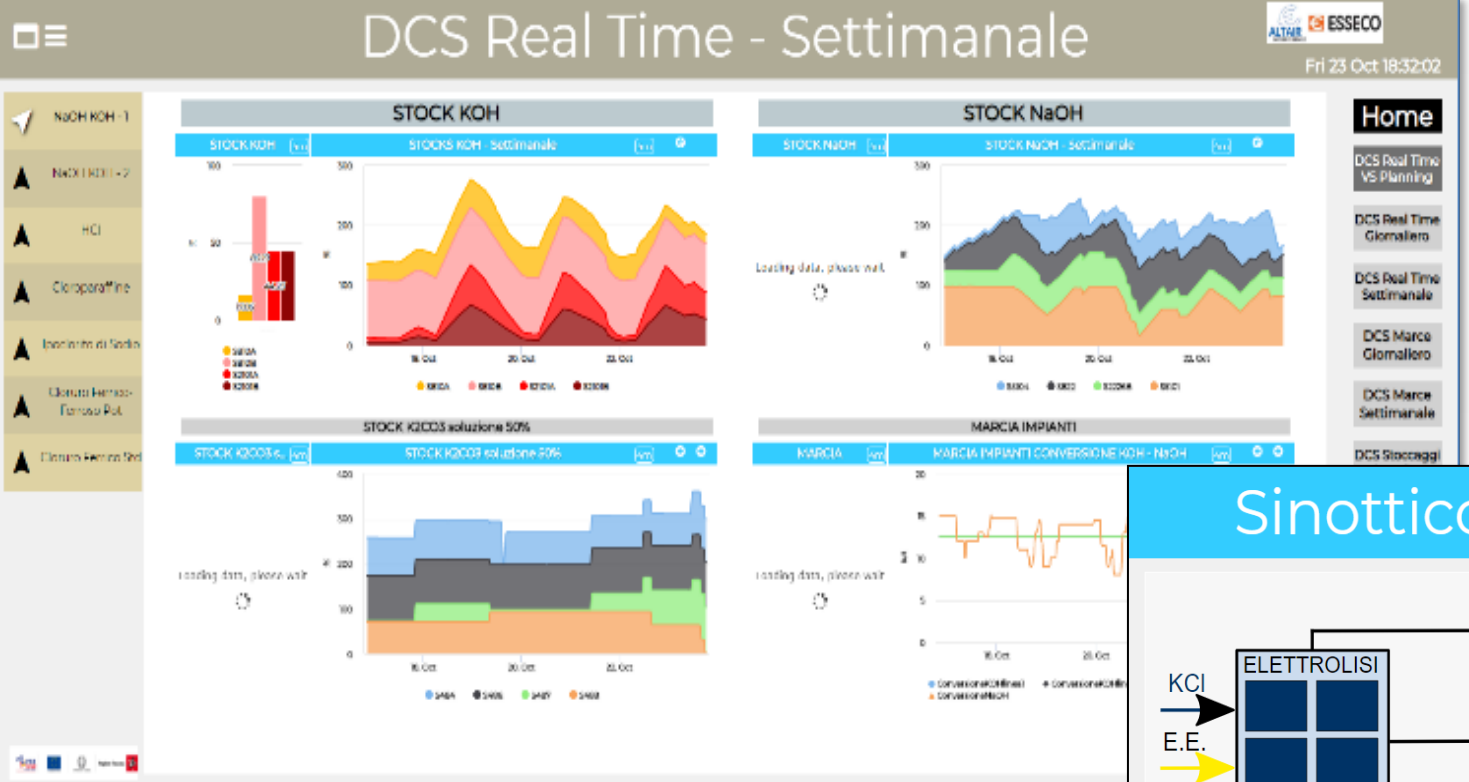
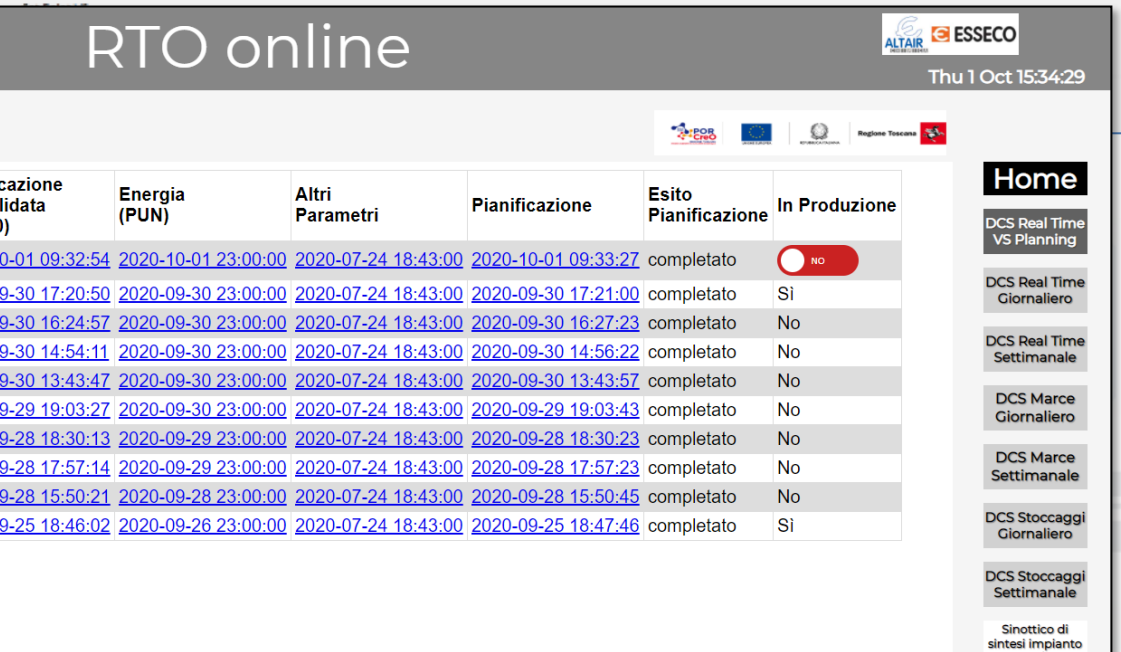
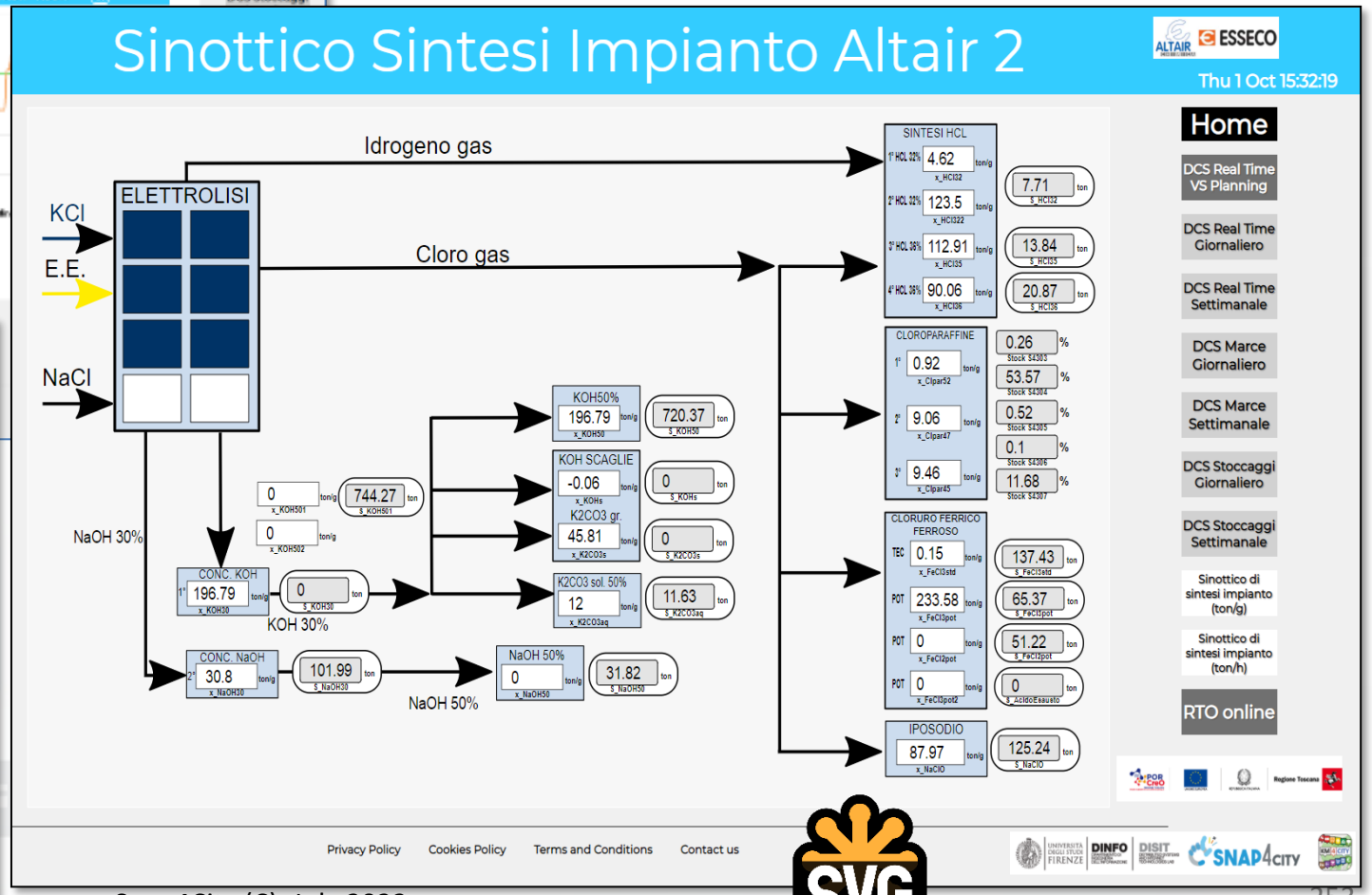



| cazione lidata) | Energia (PUN) | Altri Parametri | Pianificazione | Esito Pianificazione | In Produzione |
|---|---|---|---|---|---|
| 0-01 09:32:54 | 2020-10-01 23:00:00 | 2020-07-24 18:43:00 | 2020-10-01 09:33:27 | completato | NO |
| 9-30 17:20:50 | 2020-09-30 23:00:00 | 2020-07-24 18:43:00 | 2020-09-30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

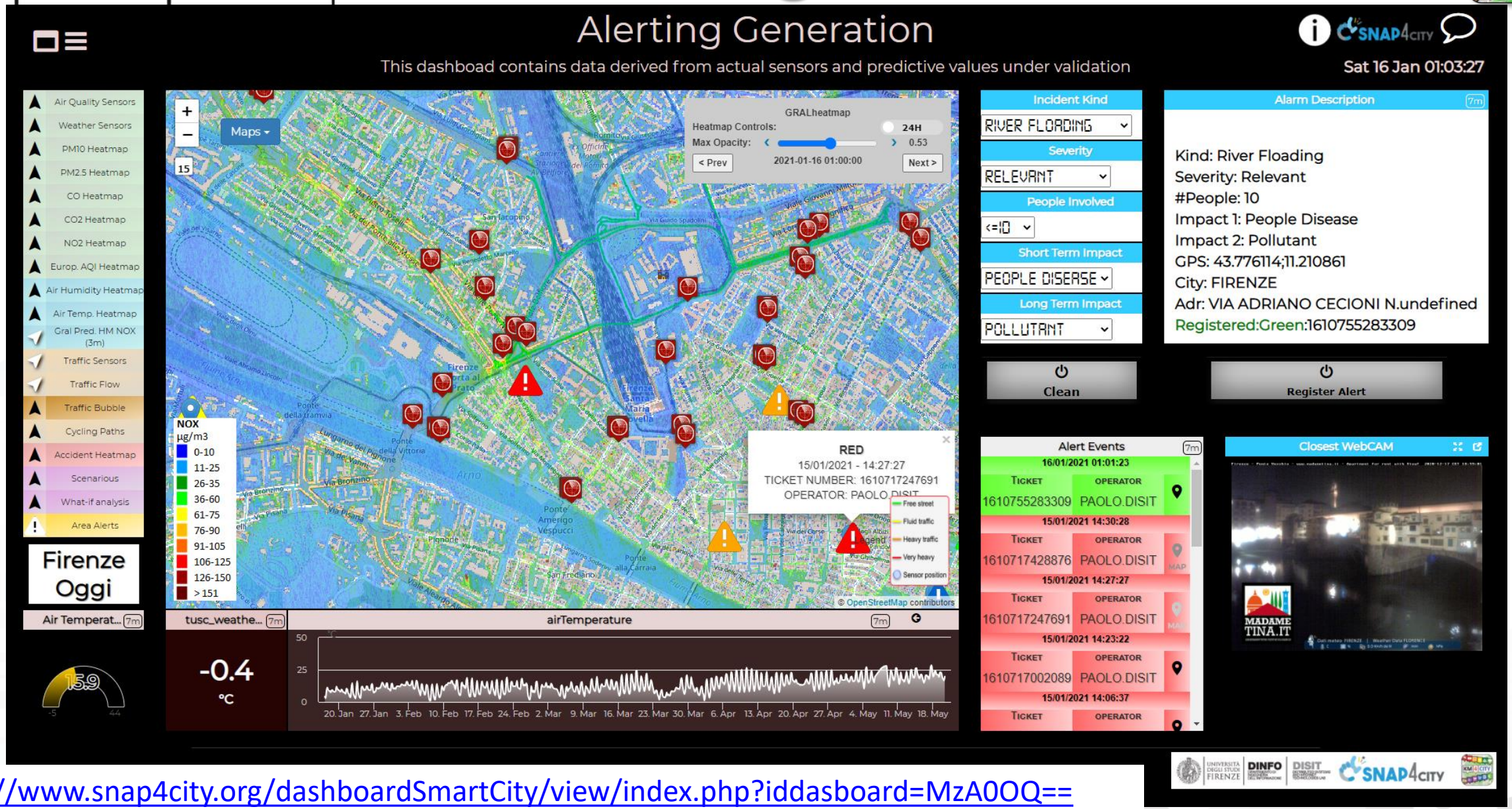


# Event Driven Custom Widgets

https://www.snap4city.org/663 for the manual

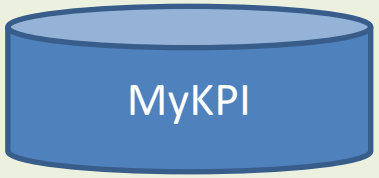


# Alert Registration

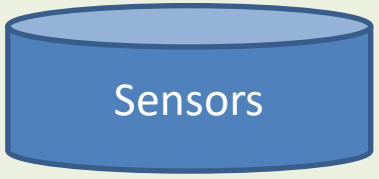



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA0OQ==

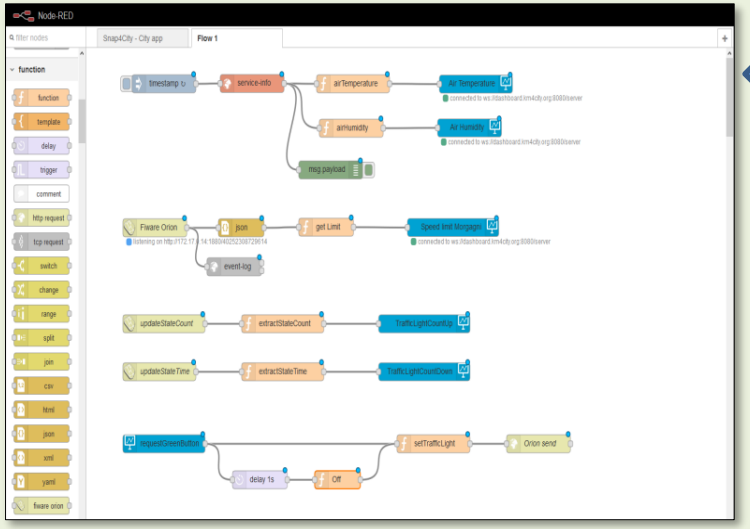
# From-To Custom Widgets / Synoptics to Storage in WS




MyKPI



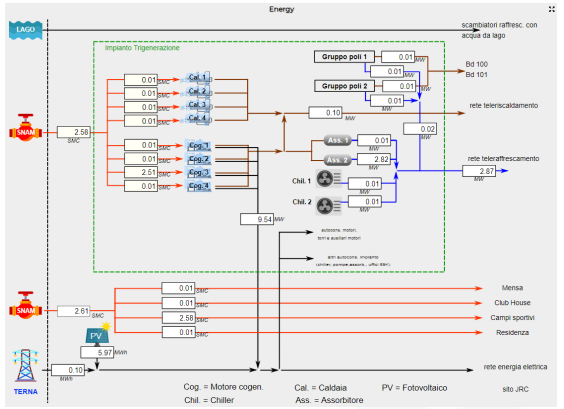

Sensor

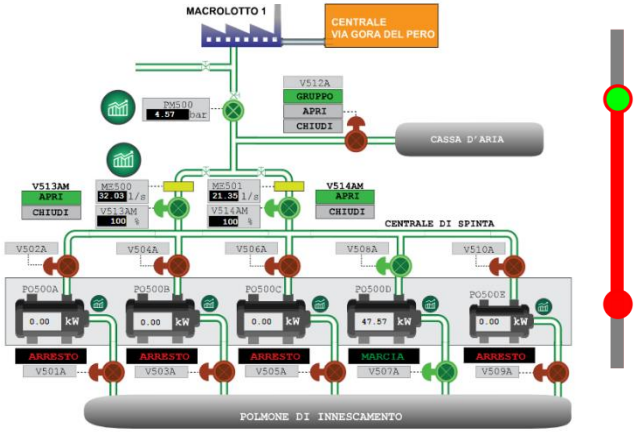


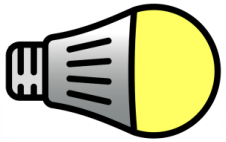
[ ]

New Shared Variables

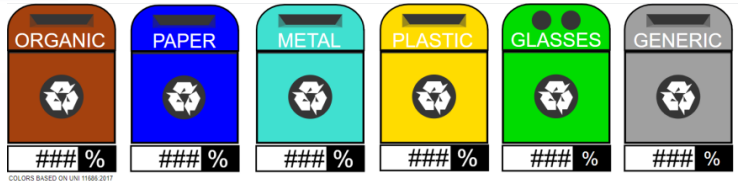
Constant Values

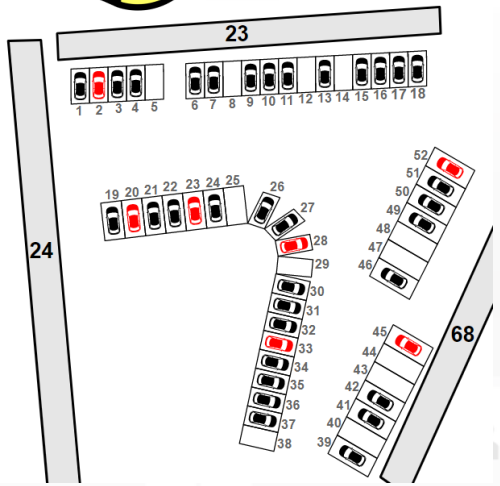


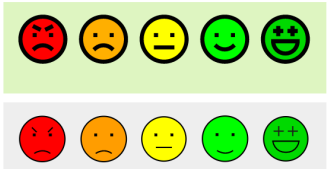


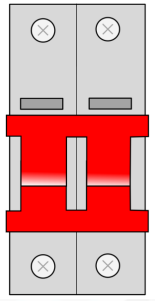



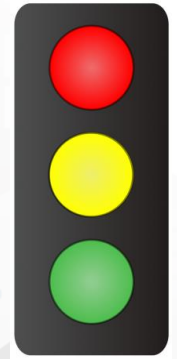









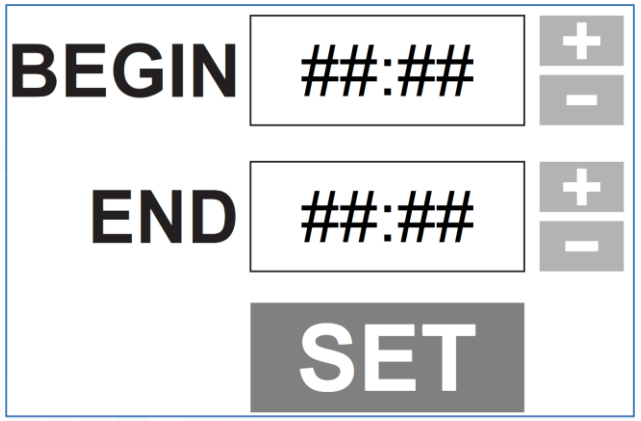


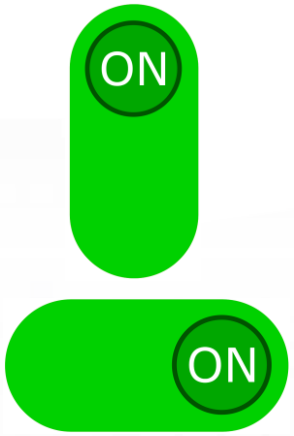


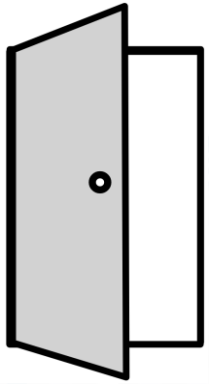
**Web Socket Secure**

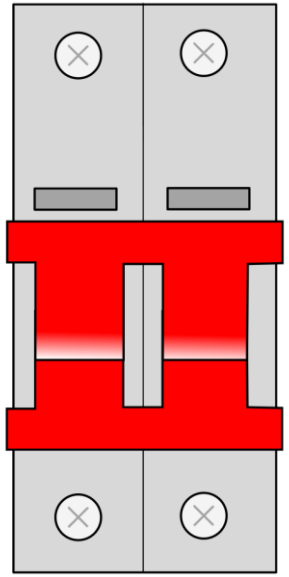
# Other examples

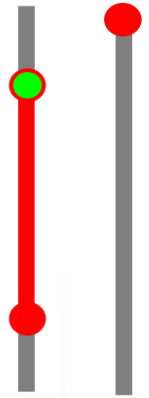
- **Virtual Actuators (sensor-actuator), Read and Write Variable**
  - From: Dashboard; To: IOT App, MyKPI, other Synoptics
  - And from IOT App to Dashboard





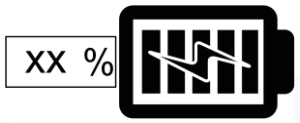


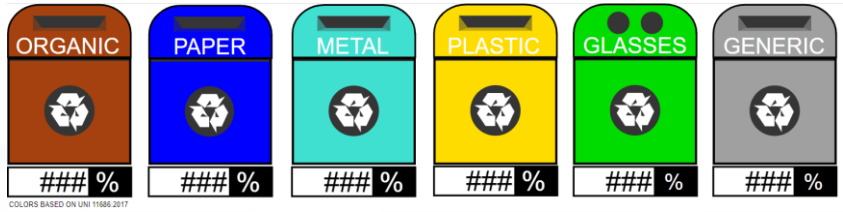


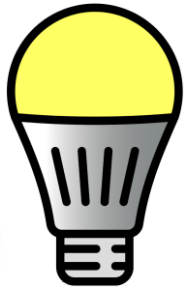


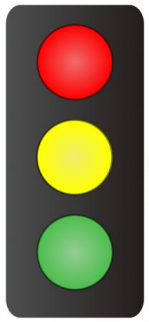
# Other examples

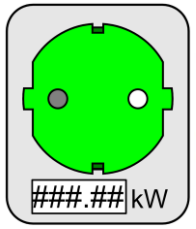
- **Virtual Sensors (only Read Variable)**
  - From: MyKPI, Sensors, IOT App, constants, other Synoptics
  - To: Dashboards



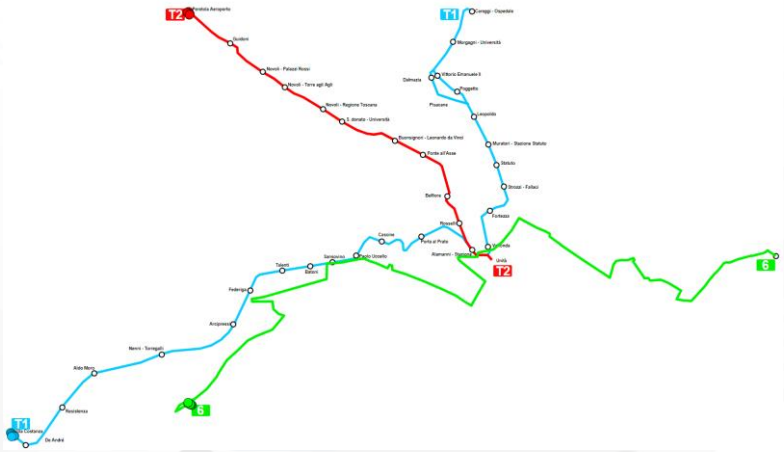


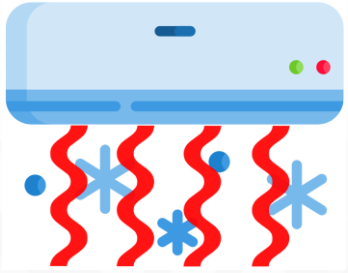




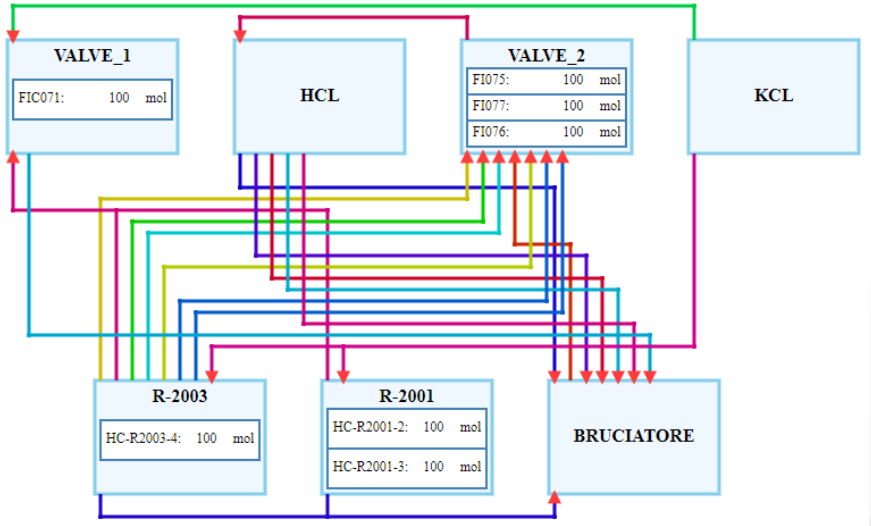












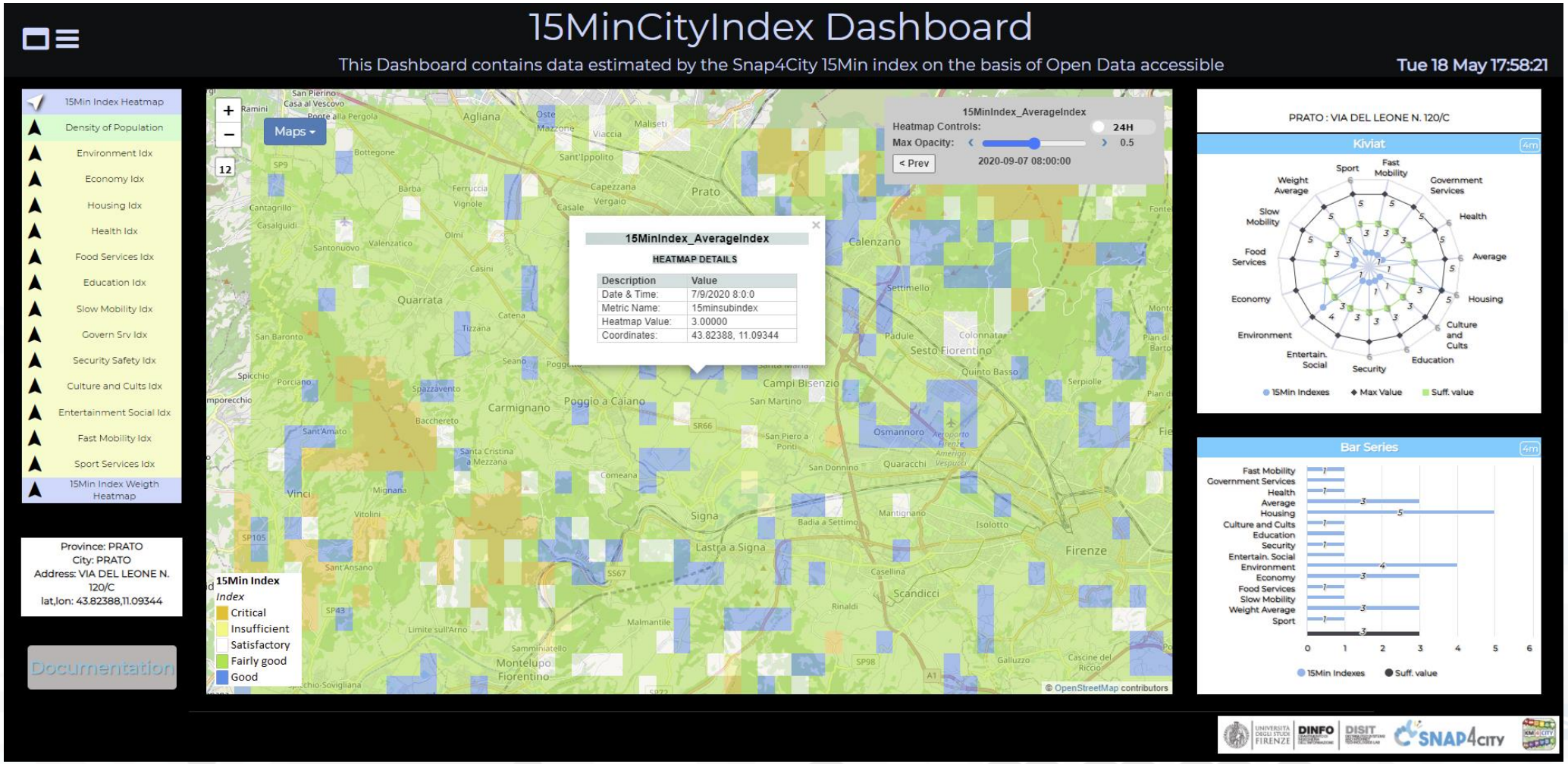






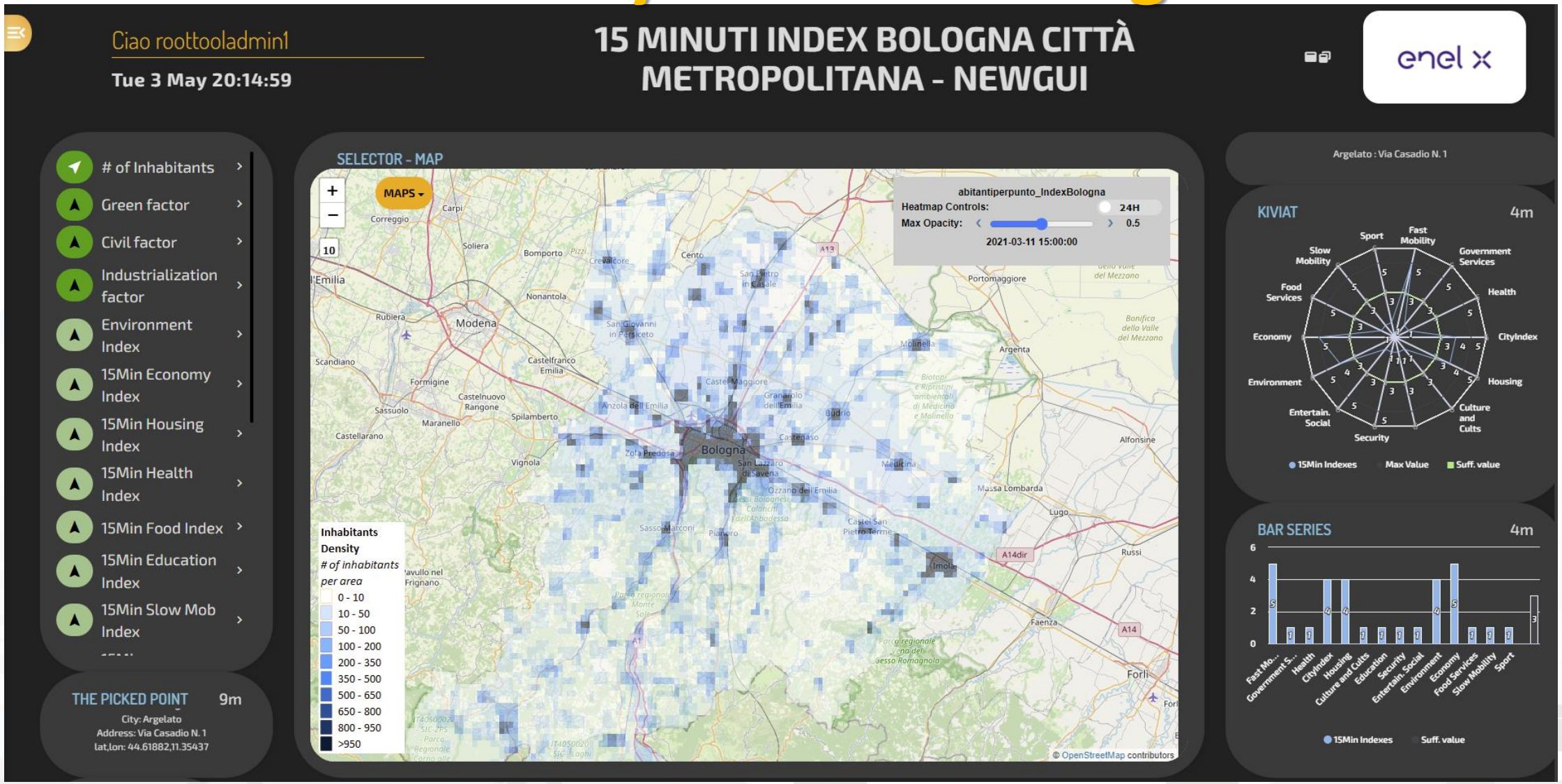



# 15MinCityIndex Firenze

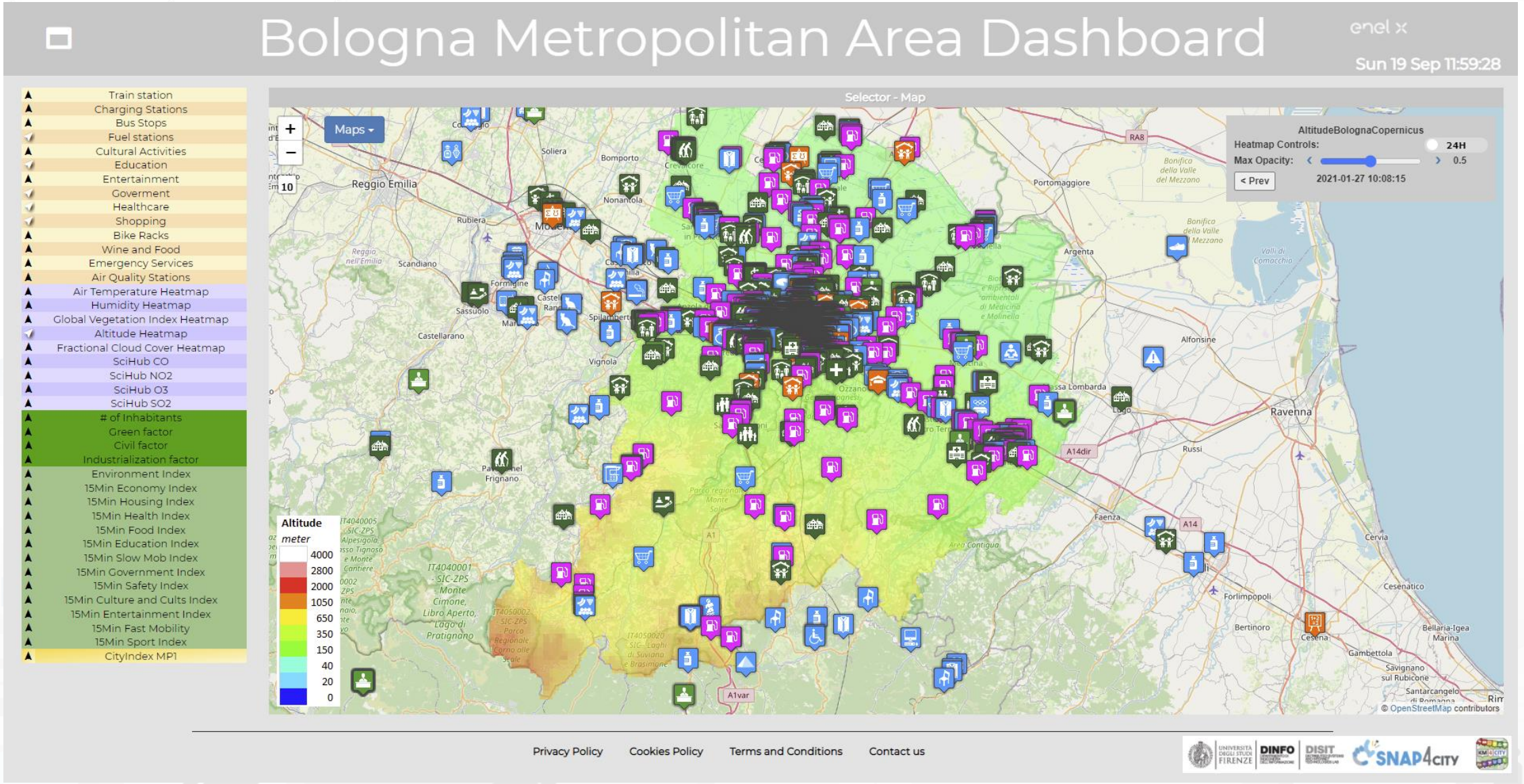



- https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjkzOA==

# 15MinCityIndex on Bologna



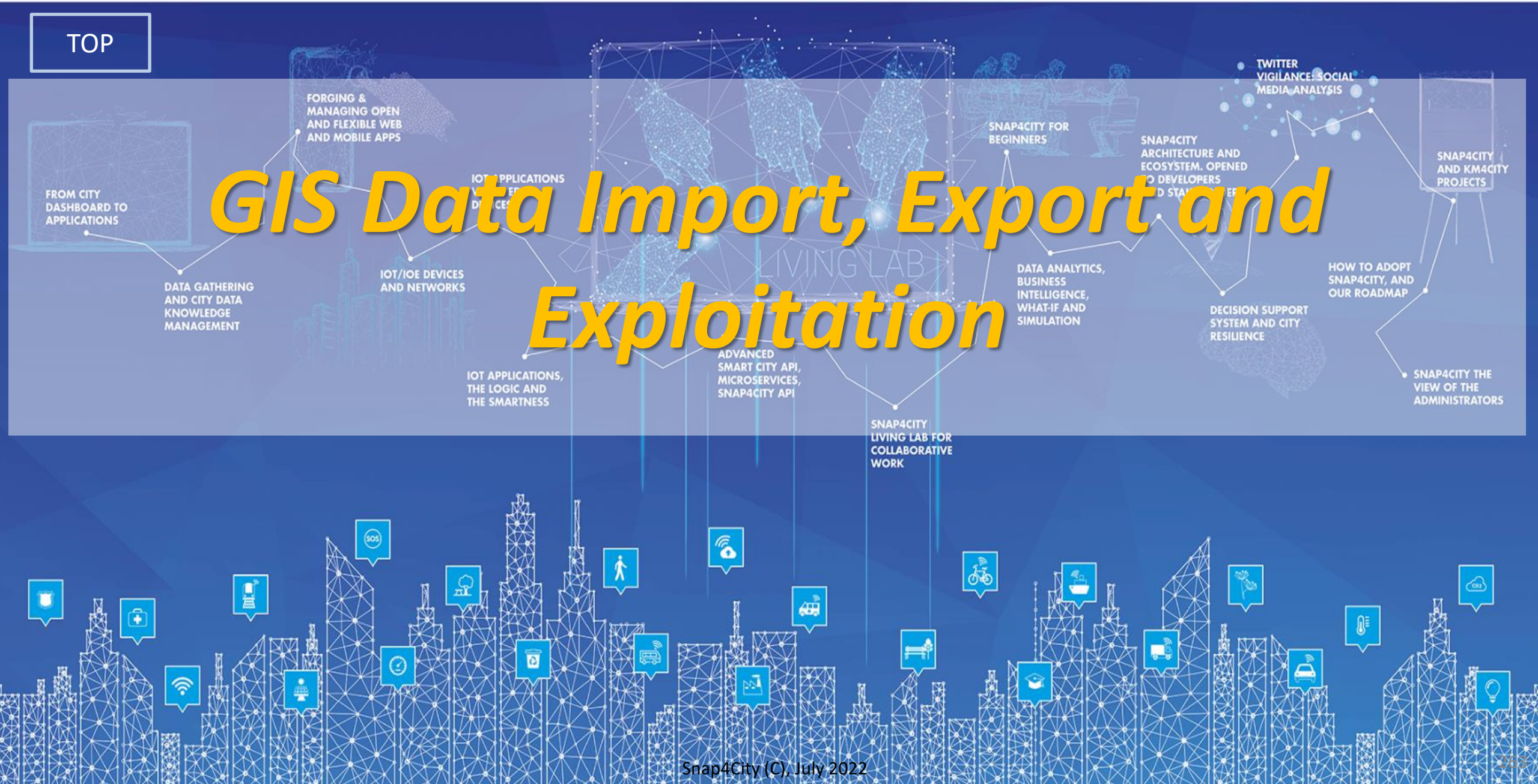

https://www.snap4city.org/dashboardSmartCity/view/Baloon-Dark.php?iddasboard=MzQxMg==




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA1OA==

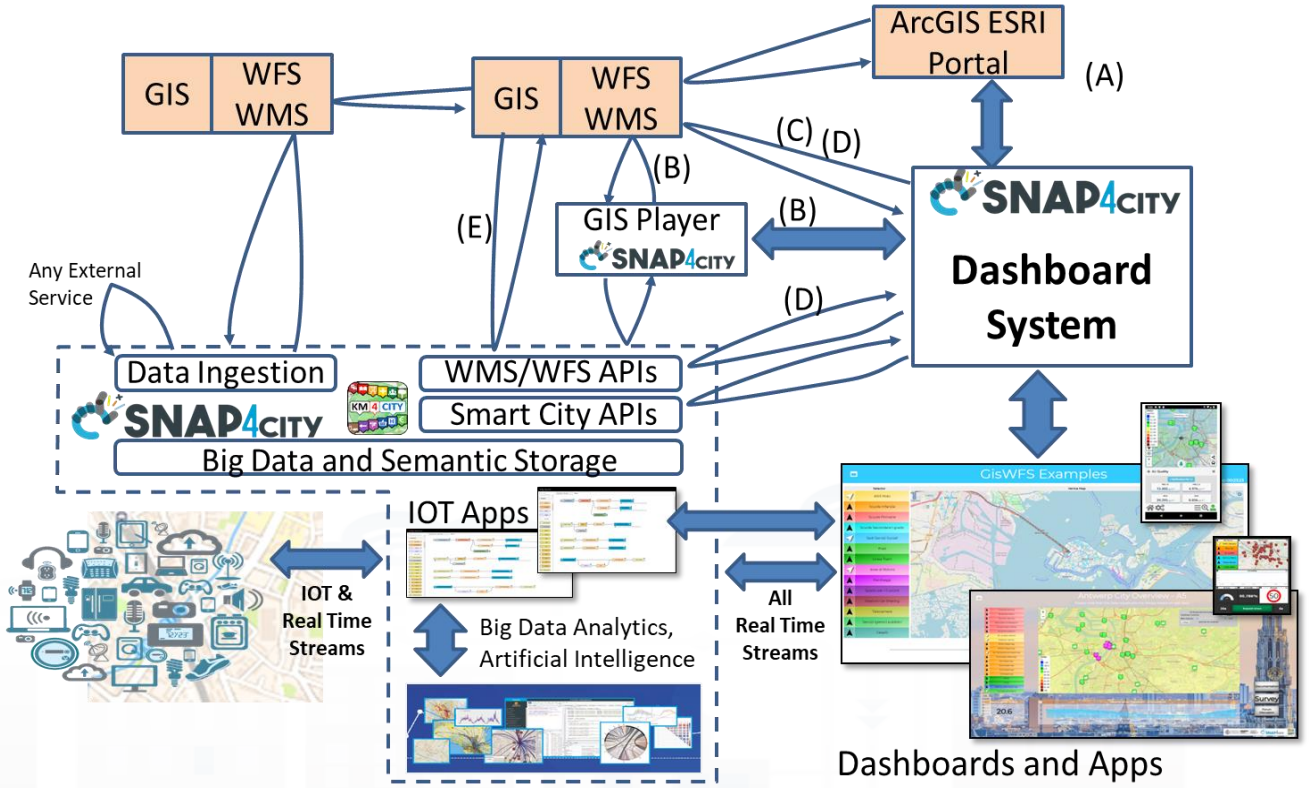
TOP

# GIS Data Import, Export and Exploitation



# Interoperability ESRI

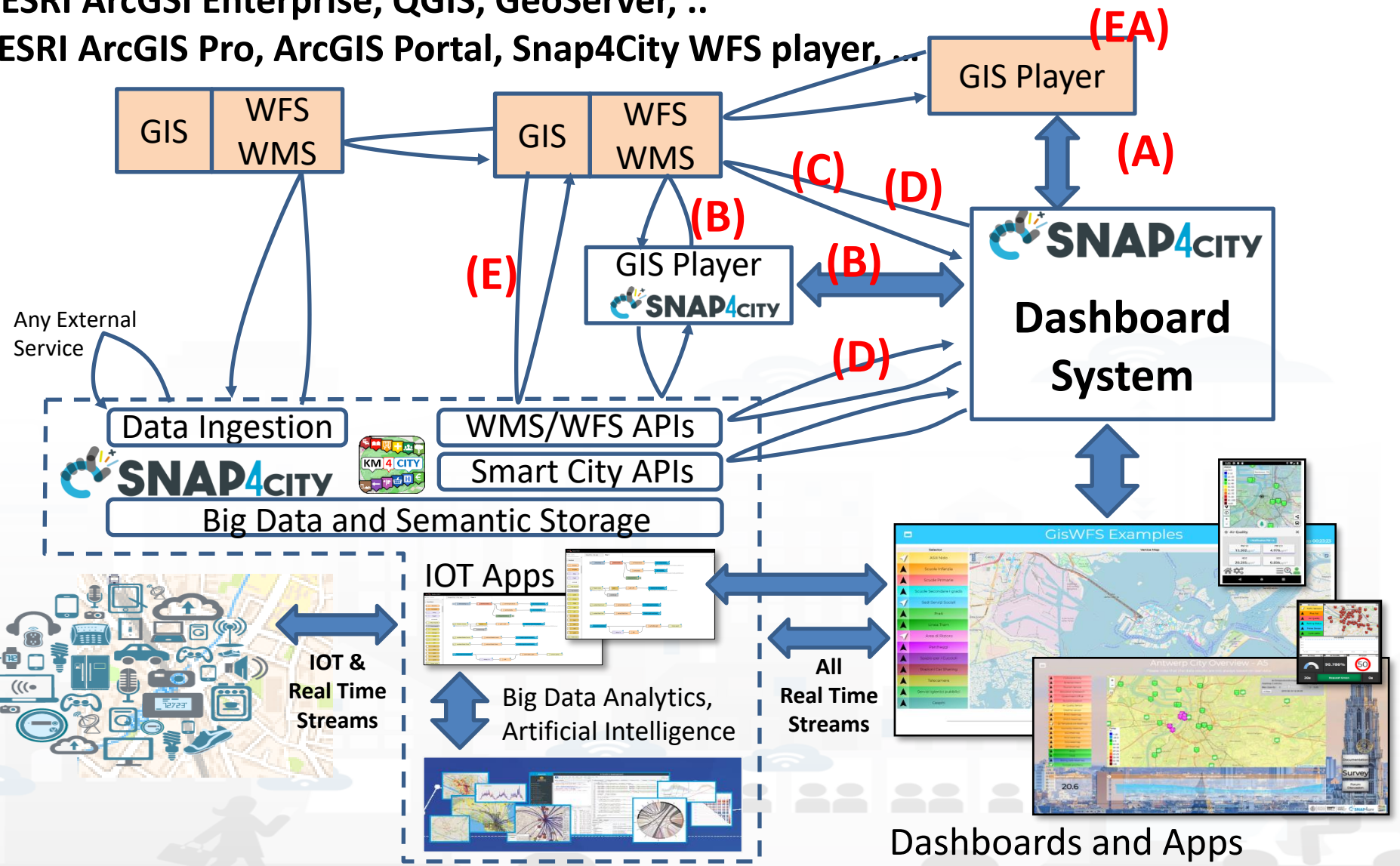
- **Snap4City is interoperable with**
  - ESRI ArcGIS Enterprise, Portal, Pro/MAP, ...
  - other GIS tools supporting WFS, WMS, GeoJSON, GML
- **Snap4City is interoperable since:**
  - **Provides** info/data in WFS, WMS
  - **Exploits** data/info from WFS, WMS
  - **Import** data/info from WFS/WMS




- The Snap4City platform can be installed on premise using **Snap4City Appliance** https://www.snap4city.org/471
  - **StartSNAP4CITYVM** includes the Dashboard Builder that is capable to work with WFS WMS protocols for the integration with GIS platforms as ESRI ArcGIS, QGIS, directly or using **Snap4City GIS player**.
  - **KBSSMVM** includes the Smart City API and WFS API which can be used to data harvest from any GIS servers and GIS desktop tool

# Case ESRI ArcGIS

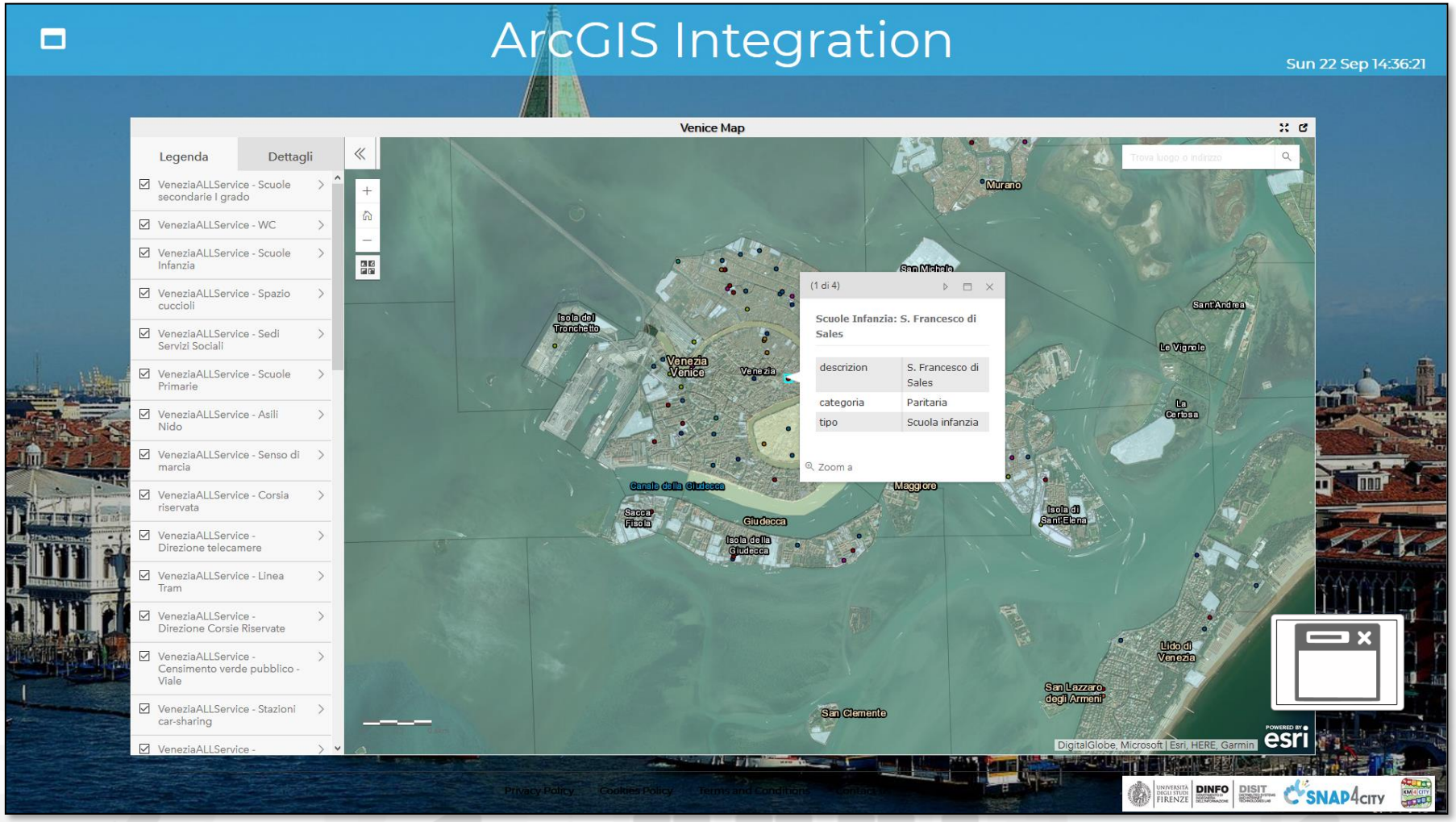
**GIS Server can be: ESRI ArcGSI Enterprise, QGIS, GeoServer, ..**
**GIS Player can be: ESRI ArcGIS Pro, ArcGIS Portal, Snap4City WFS player, ...**




- **GIS:**
  - Geographic Information System
- **WMS:**
  - Web Map Service
- **WFS:**
  - Web Feature Services

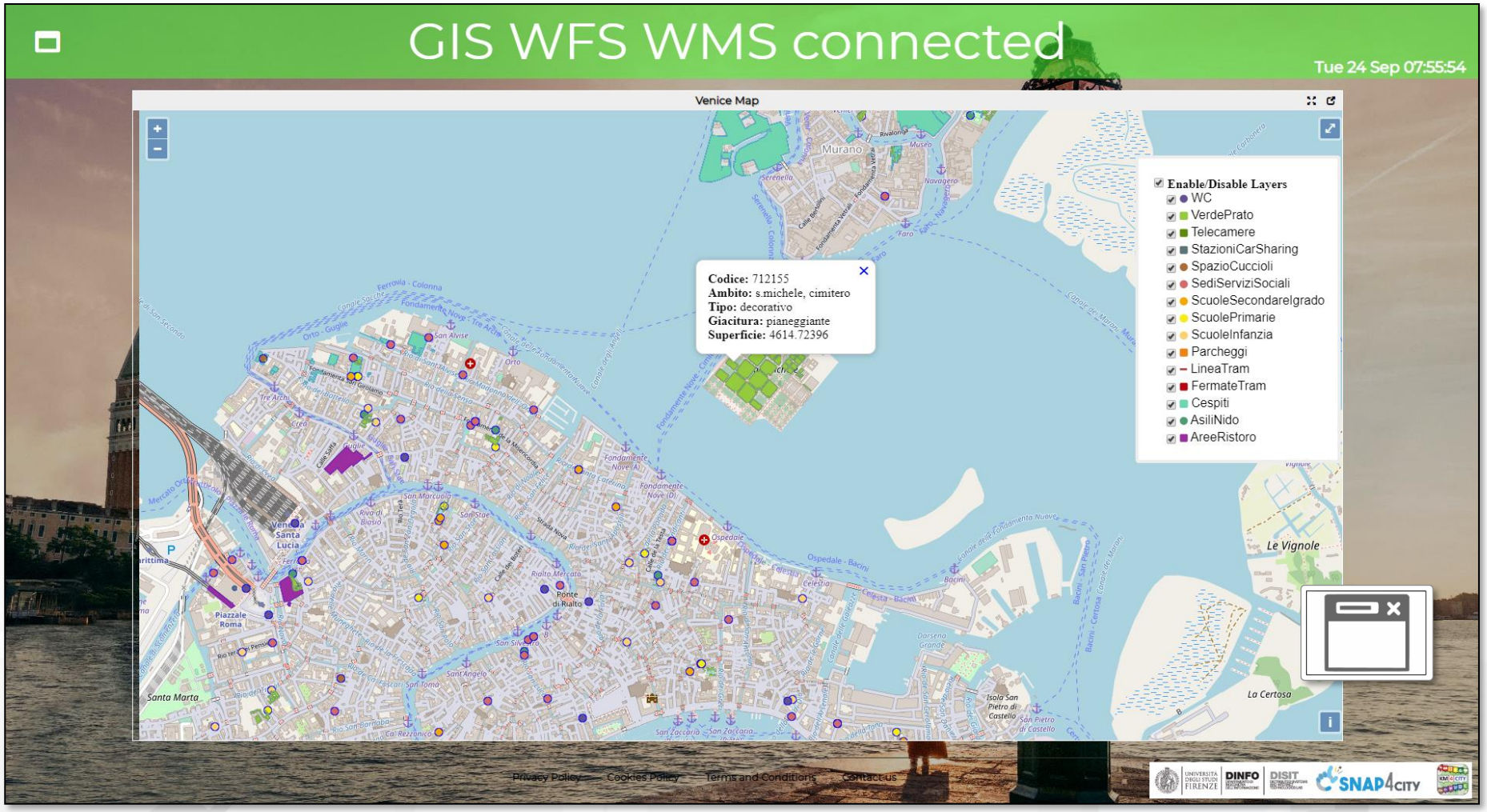
# (A) ArcGIS ESRI as External Service

- DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed
- ArcGIS Portal accesses to ArcGIS Enterprise server
  - https://arcgis.km4city.org/arcgisportal/apps/Embed/index.html?webmap=5774fa9d0f7f4a2fb2d7cd52dffcd8c9&extent=12.3144,45.4276,12.3461,45.4419&home=true&zoom=true&previewImage=false&scale=true&search=true&searchextent=true&details=true&legendlayers=true&active_panel=details&basemap_gallery=true&disable_scroll=true&theme=light
- Snap4City Dashboard uses as External Service: ArcGIS ESRI Portal
- https://main.snap4city.org/view/index.php?iddasboard=OTkw



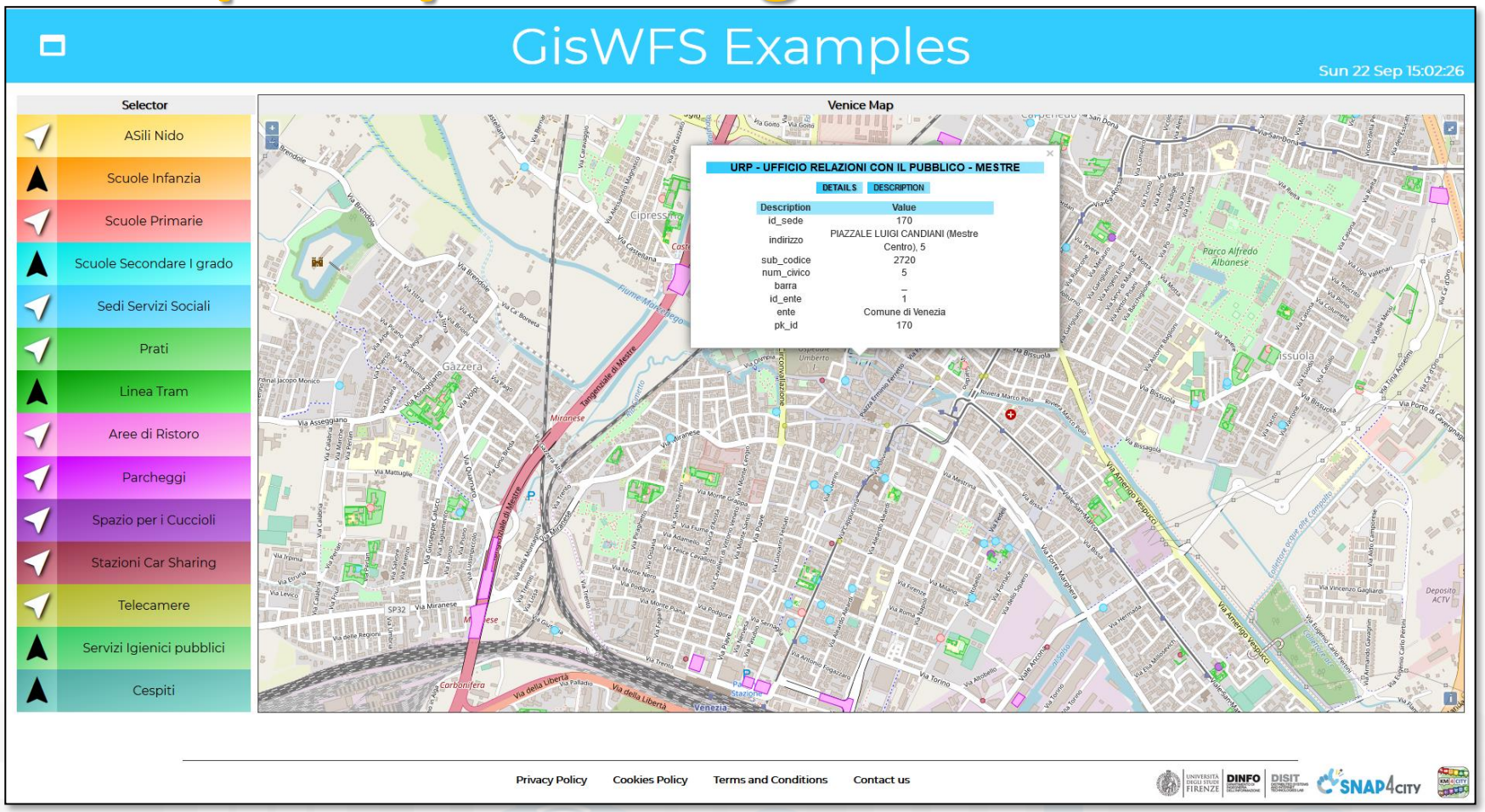
# (B) GIS data on Dashboard via Snap4City GIS Player

- DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed
- Snap4City has its WFS Player https://main.snap4city.org/widgets/venezia/index.php
- Snap4City Dashboard uses as External Service: Snap4City GIS viewer via WFS/WMS: https://main.snap4city.org/view/index.php?iddasboard=MTIxNg==



# (C) Dash with Snap4City GIS widget and Selector

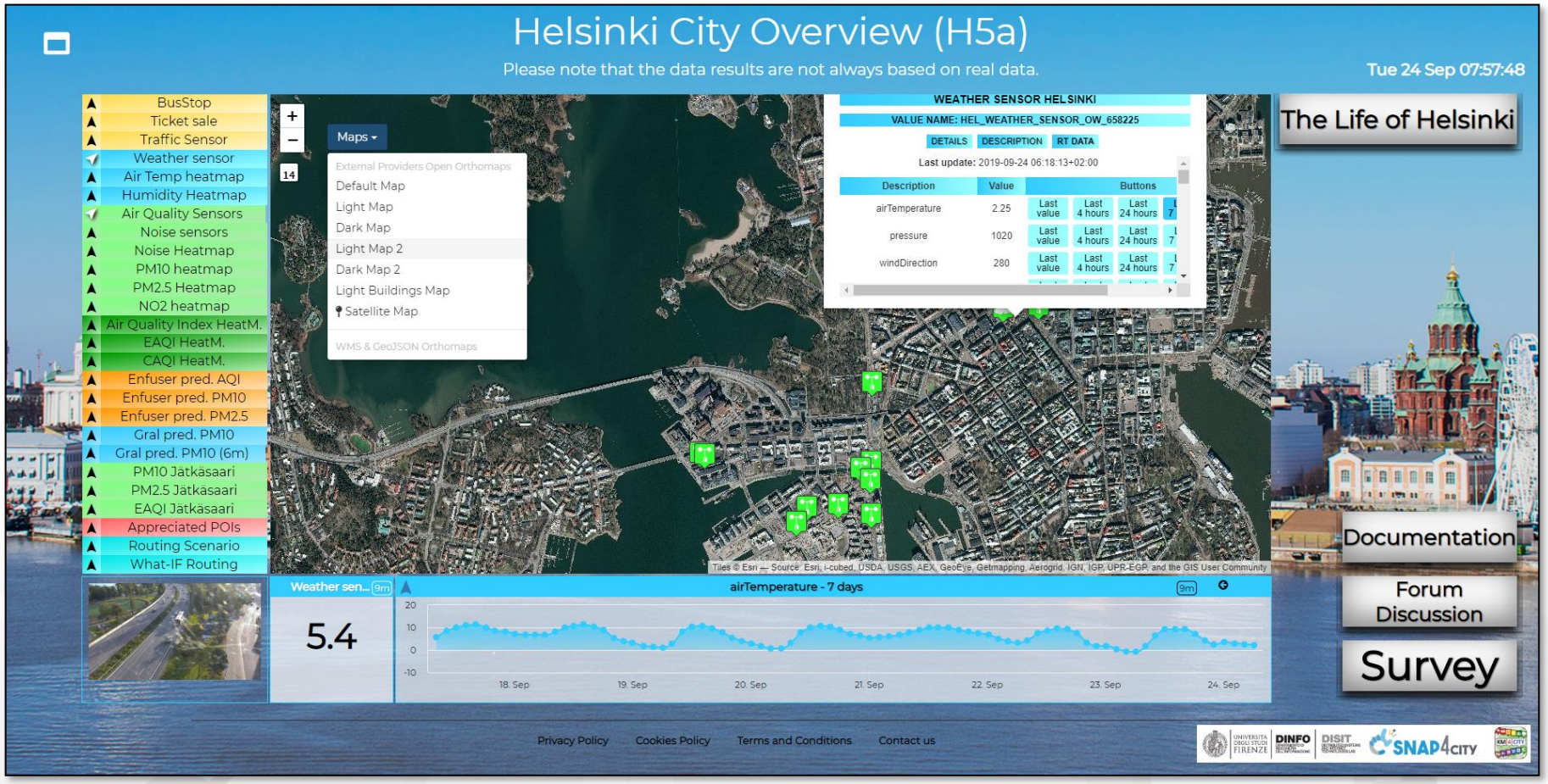
- DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed
- Snap4City has its WFS / WMS widget / Player
- Snap4City Dashboard shows WFS/WMS data via Special GIS Widget Map:
  - https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwMw==
- Snap4City can use **Selector** to select WFS / WMS sources to be shown from ESRI ArcGIS (as well as from any other WFS service) on Widget map




The Snap4City Widget Map allows to **mixt WFS GIS sources with Smart City API**
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTM5NA==

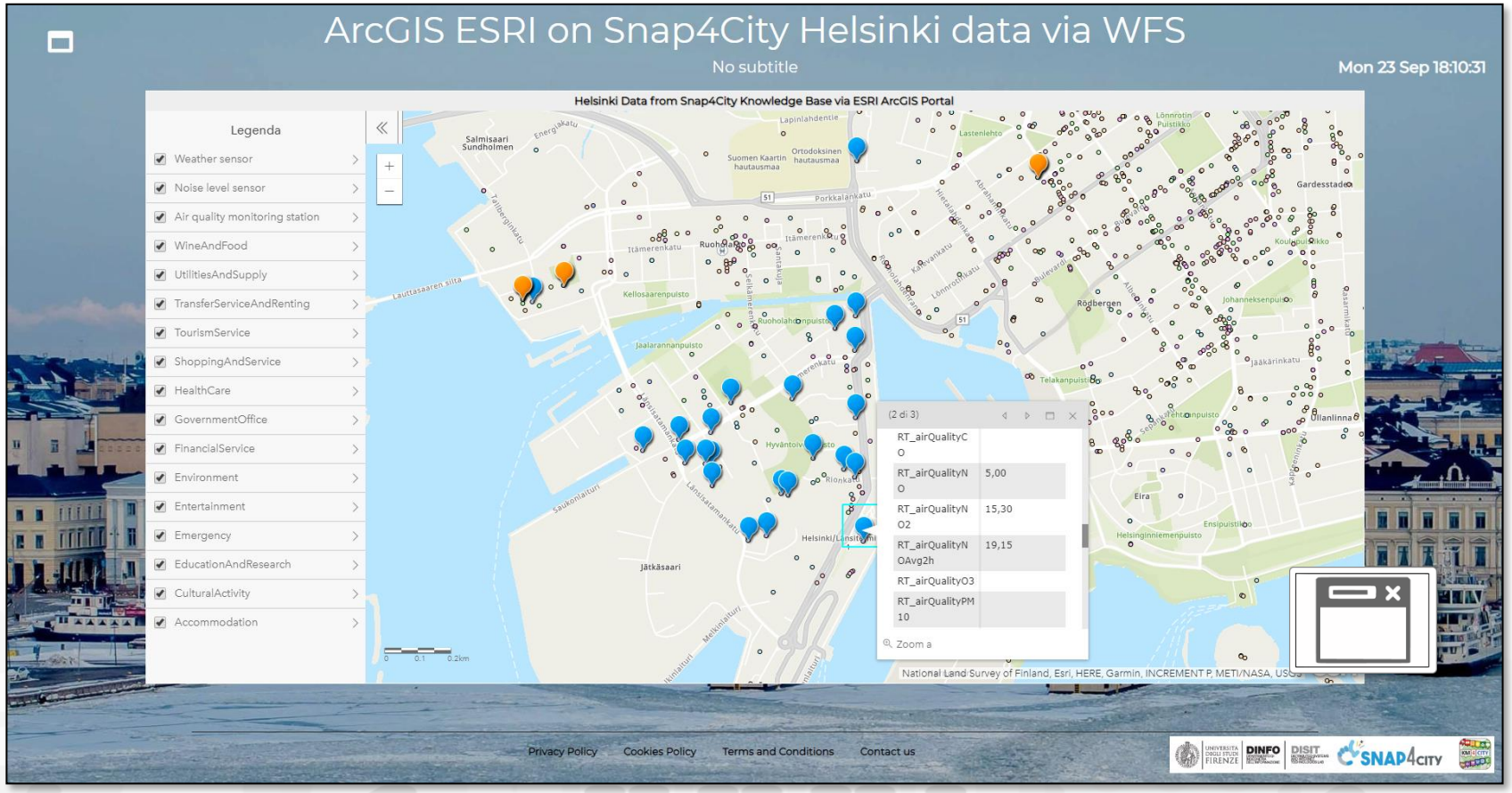
# (D) Dashboard with Orthomaps and shapes layers based on WMS, GeoJSON

- DISIT Lab has ESRI ArcGIS Enterprise 10.6 installed, and GeoServer
- Snap4City main MultidataMap Widget can load WMS background images and shapes, the Orthomaps
- Also Heatmaps calibrated are provided from GeoServer using WMS protocol
- Maps in this case are directly **taken from ESRI Server, free of charge**
- [https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNg==#](https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNg==#)



# (E) Snap4City via WFS on top of Smart City API provide data to ESRI ArcGIS Enterprise or ArcGIS Pro, and thus the data become accessible on ArcGIS ESRI Portal

- Snap4City provides a WFS service on top of SmartCity API. Thus providing data to any GIS/WFS client, including ESRI ArcGIS Enterprise, ArcGIS Pro, QGIS, etc.
- In the example, our ingested Helsinki Data have been harvested from ESRI ArcGIS via WFS.
- Once ingested on ESRI ArcGIS can be visualized, by using ArcGIS Portal
  - https://arcgis.km4city.org/arcgisportal/apps/Embed/index.html?webmap=fbcec7055a3446e29fc1e9c55cb53d79&extent=24.8335,60.1465,25.013,60.1965&zoom=true&previewImage=false&scale=true&legendlayers=true&disable_scroll=false&theme=light
- Snap4City Dashboard can show ESRI ArcGIS Portal **(A)** as External Services in a dashboard.
  - https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjIwNg==



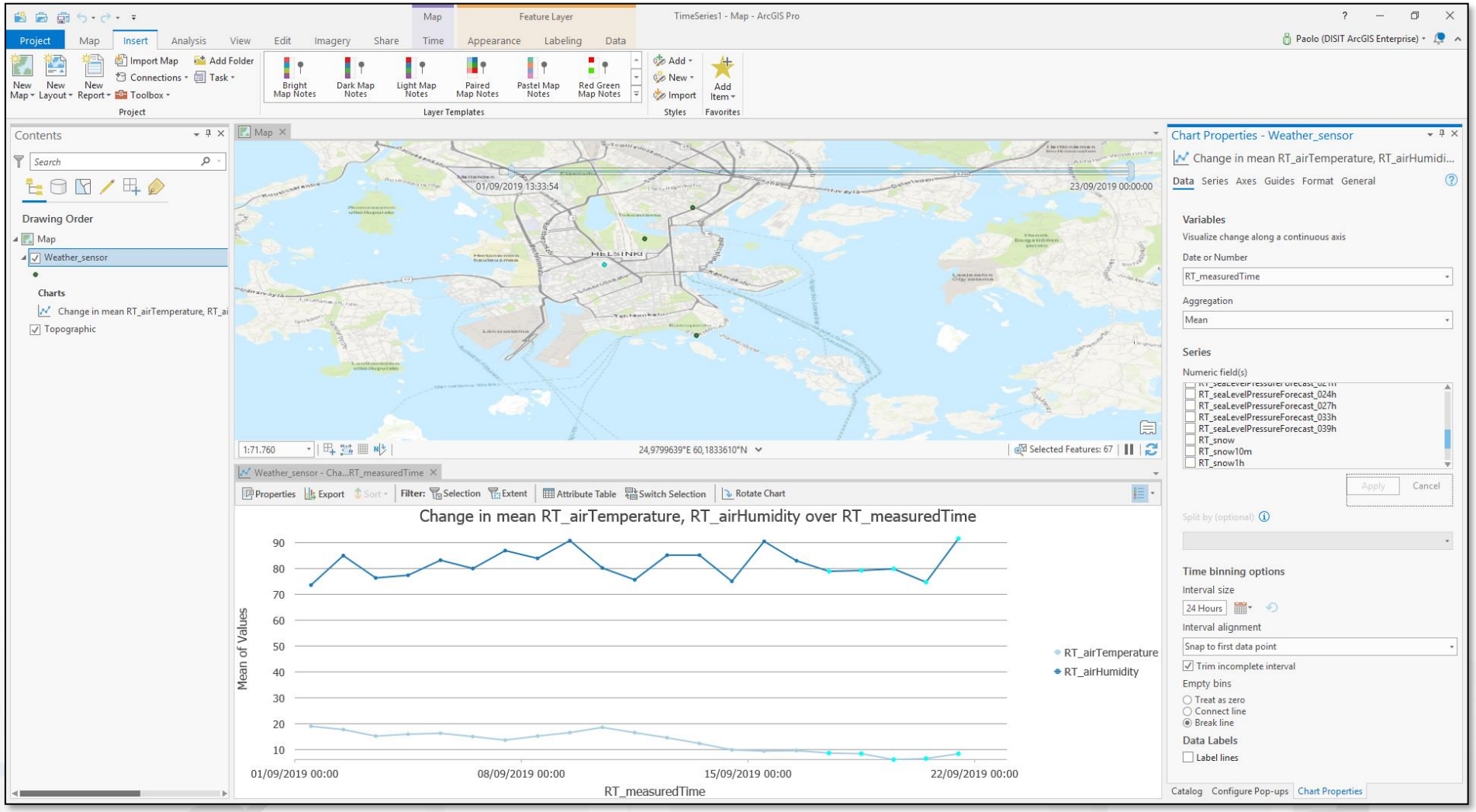
# (EA) ArcGIS ESRI Pro as GIS / WFS play

To test you need to have installed ArcGIS pro on your pc and connect with Snap4City WFS/WMF server or with ArcGIS server which has done the same connection with our server WFS/WMS

On PC:

(i) Get data via WFS connected to ESRI ArcGIS Enterprise or other sources

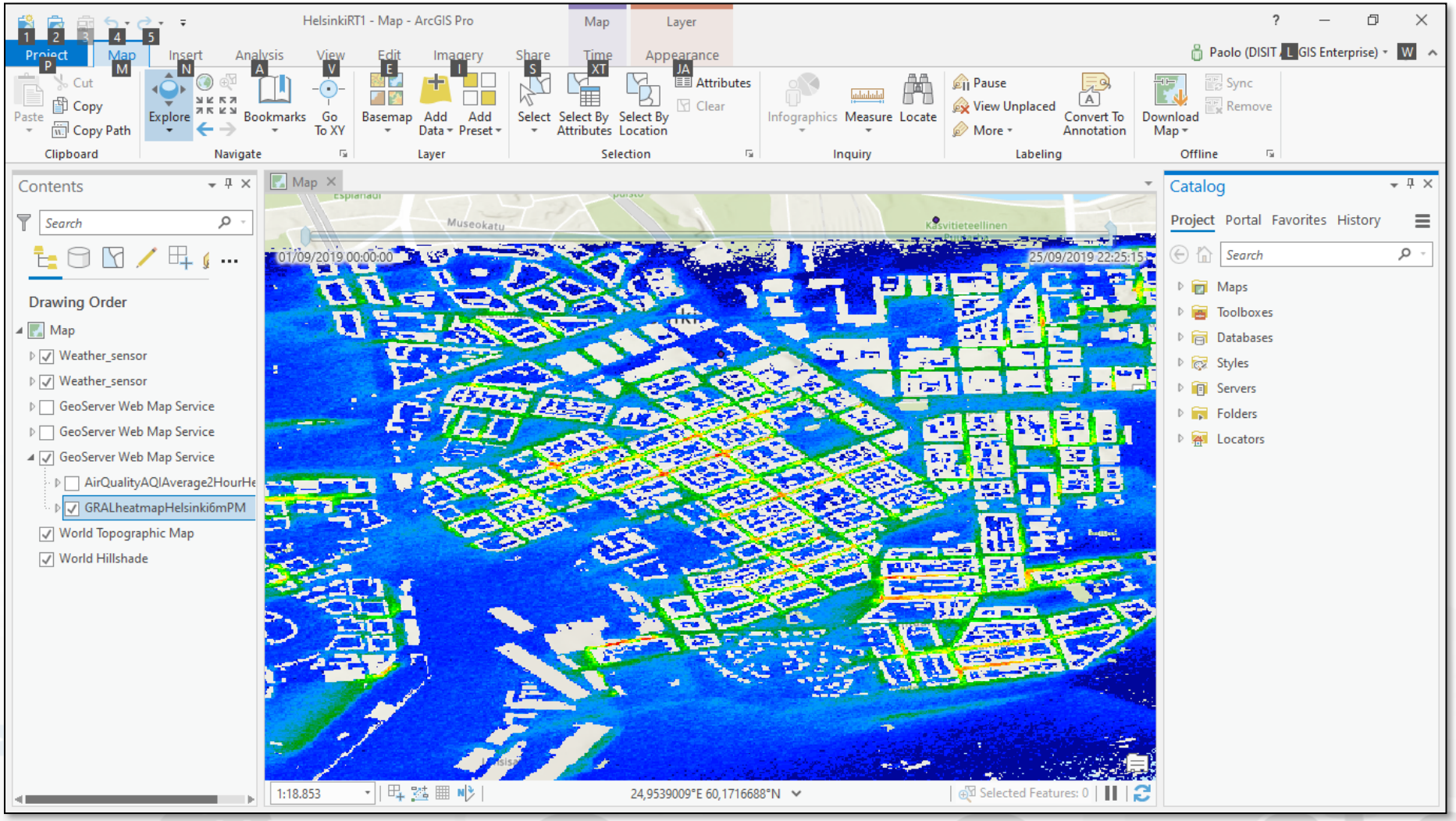
(ii) Download data via WFS … from…



# (EA) ArcGIS ESRI Pro as GIS / WMS play

To test it you need to have installed ArcGIS pro on your pc and connect with our WFS/WMF server or with ArcGIS server which has done the same connection with our server WFS/WMS

Heatmap taken from Snap4City GeoServer via WMS protocol



# ESRI ArcGIS has an IOT solution based on ESRI GeoEvent, for real time data

- **You need to have**
  - **ArcGIS Enterprise + GeoEvent Server + SpatioTemporal Big Data Store**
- **Limitations on the number of protocols addressed**
- **Snap4City solution solves the limitations** by ingesting data from a plethora of protocols and sources and
  - (a) posting the IOT data into their **Spatio-Temporal Big Data Store**
  - (b) collecting data from several protocols and posting them into **ESRI GeoEvent in MQTT**,
  - (c) making them available via WFS protocol.

# Snap4City vs GIS, WFS/WMS

- GIS data:
  - Ingested via WFS/WMS protocols, and then managed as the other data. Data ingestion from GIS server can be performed via ETL processes, or directly from Dashboards
  - Shown on Dashboards via third party GIS tools as External Services
  - Shown on Dashboards using Special GIS Widget Map which directly access to GIS data via WFS/WMS
  - Heatmaps and Maps are distributed via a GeoServer
- Snap4City can interact with ArcGIS Real Time Events via MQTT protocol as well

# Maps, etc.

MultiDataMap: Heatmaps and special tools (as cycling paths, traffic flow, what if scenario, routing), MyData, MyKPI (not RT), MyPOI, POI, Sensors (include selector new, or tech (with some limitations)

- they may also include maps, orthomaps, and 3D (in beta), please ask to Snap4City Staff to activate those features in your widget/dashboard

WFS: WFS, POI (manually added) (include selector)

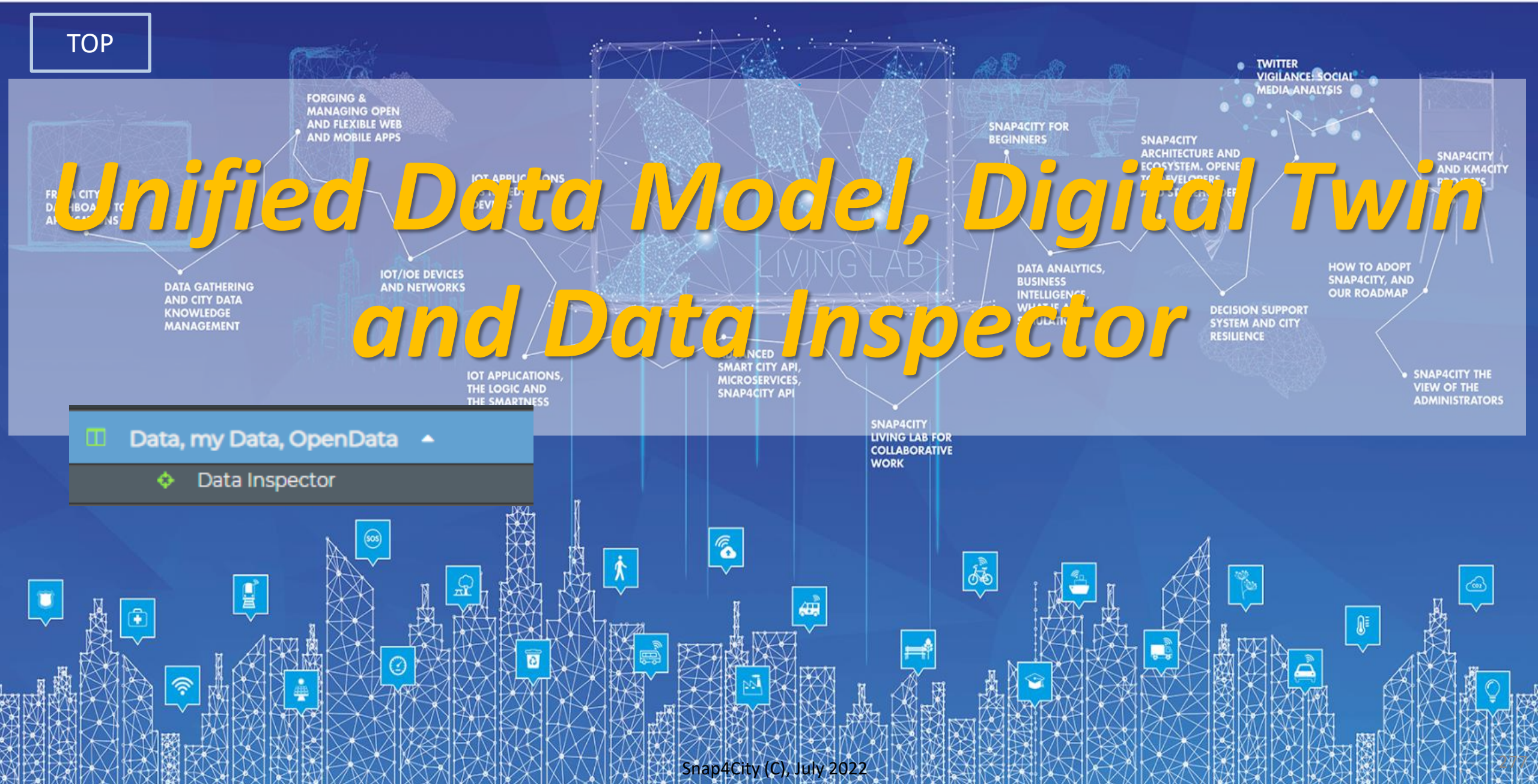
ServiceMap: POI, with integrated menu (usable with selector web)

Web page https://www.snap4city.org/408 web content

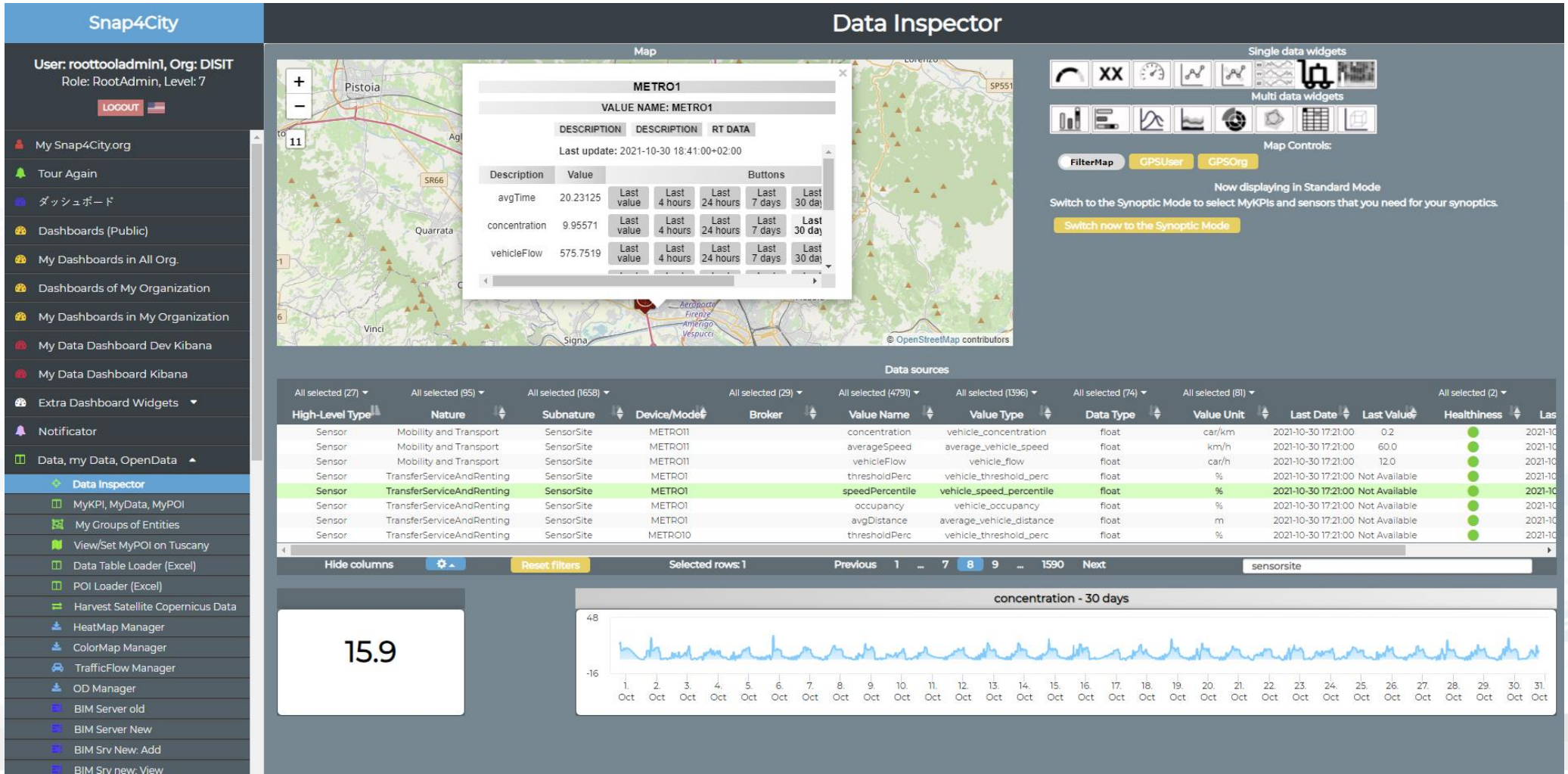
- IOT App: means that the widget data can be created and manipulated dynamically from the IOT App
- All the X represent feature available from Wizard production of Dashboard
- (*) means that the production is still manual and not via wizard
- (X) in progress
- "sensors" are data ingested via IOT Brokers, or ETL that in any case are indexed into the KB, may be on HBASE or on OpenDistro (Elastic Search)
- "MyKPI" are data ingested via Mobile Apps, IOT Apps, manually, etc.; They may be on MySQL, and recently are coming to OpenDistro (Elastic Search)
- "MyPersonalData" are ingested via IOT Apps, or manually; They may be on MySQL only
- "KPI, Metrics" are ingested via SQL, NoSQL queries (ODBC, JDBC, Mongo, SPARQL, etc.) from Database sources and are on MySQL
- etc.

TOP

# Unified Data Model, Digital Twin and Data Inspector

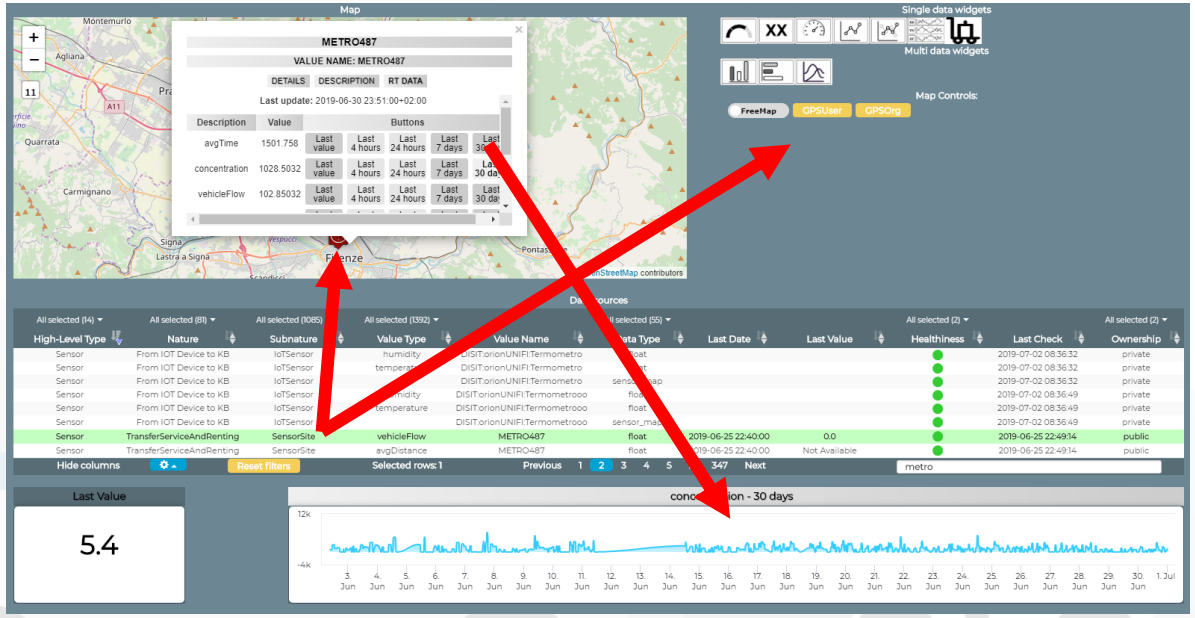


# Data Inspector: all you need to know about data, data sources and ingestion processes



# 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)



# HLT: Unified Classification for Data and Services

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

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

High Level Types

Nature

SubNature

Semantic Classific.

Dev/Model name

Broker name

Technical Source

Value Name

Value Type

Data Type

Value Unit

Variables, names

Last Date/Time

Last Value

Real Time

Healthiness

Last Check

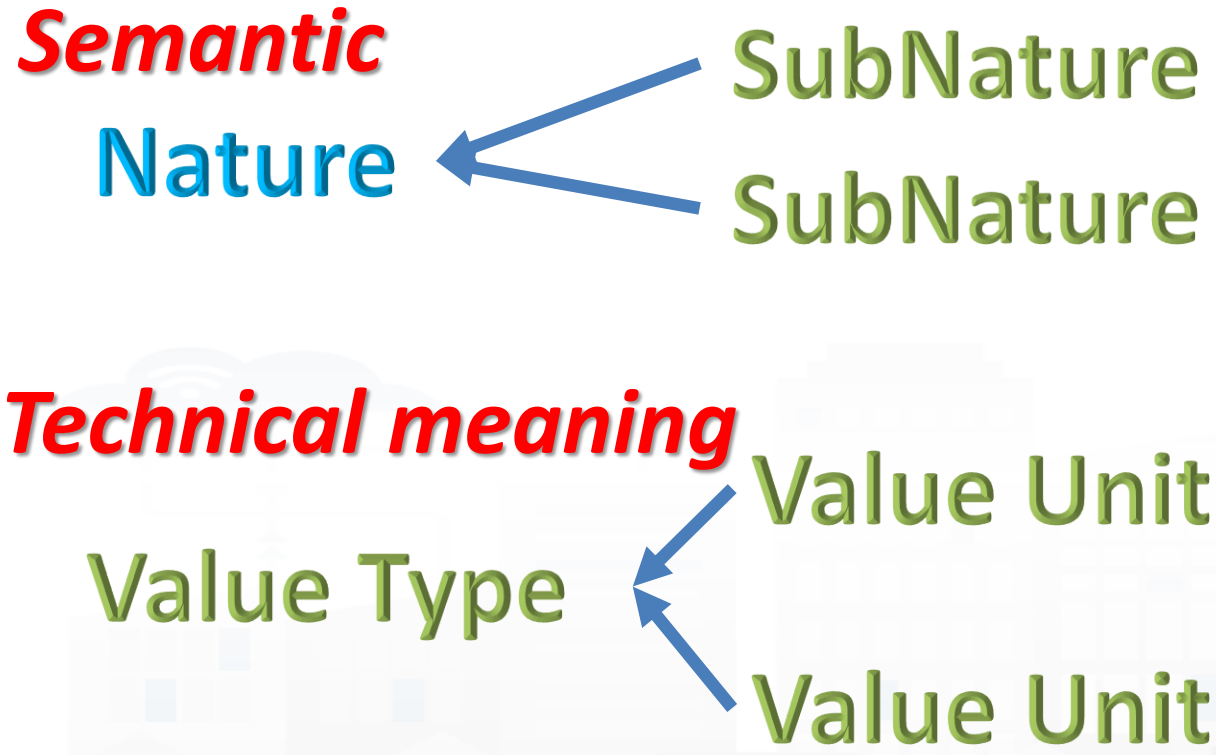
Status

Ownership

Organization

For Admin

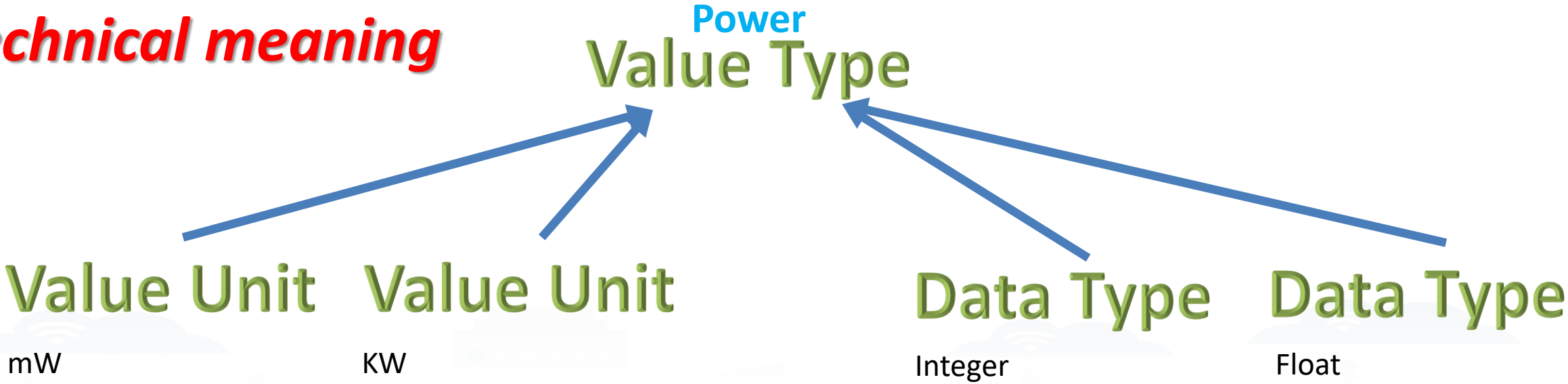
# Unified Data and Services Model/Classification



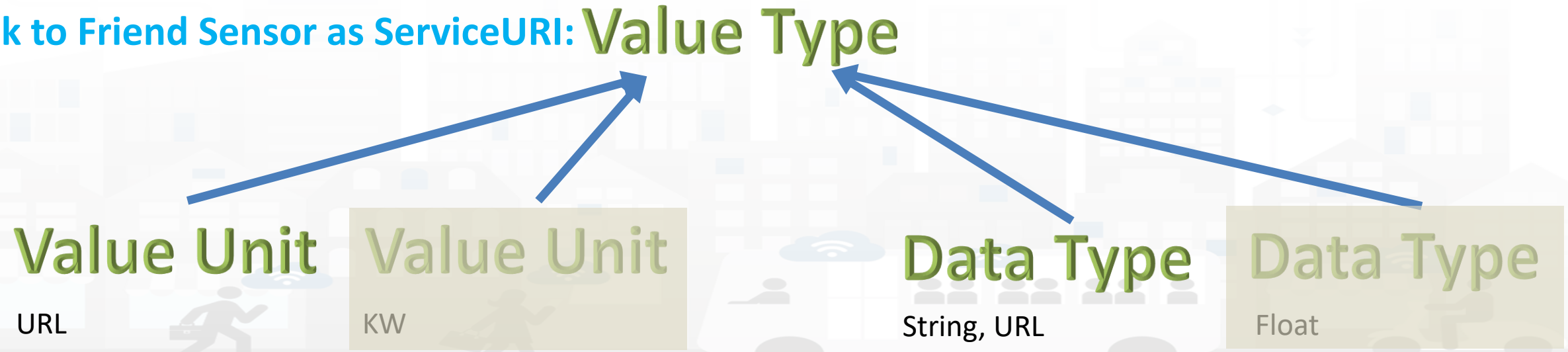

- Exists a Dictionary for the 4 categories
- They are related each other and not all values are possible
- Right setting lead to right rendering on graphs and automated combinations and processing
- The Disctionary is used by many tools

# For example

***Technical meaning***




**Link to Friend Sensor as ServiceURI:**



# Main HLT diff.

- HLT: MyKPI
- **Nature**: Industry and manufacturing
- **Subnature**: Chemical
- **Value Name**: CloroParaffine
- **Value Type: Density percentage**
- **Value Unit: %**
- **Data Type**: float mykpi
- **Last Date**: 2019-02-25 *«DateTime»*
- **Last Value**: 87.0
- **Healthiness**:
- **Last Check**: 2020-04-03 10:28:12
- **Ownership**: private for xyz…
- **Organization**: Firenze

***Single Variable for MyKPI***

- HLT: IoT Device, Sensor Device, Data Tab Devic
- **Nature**: Industry and manufacturing
- **Subnature**: Chemical
- **Value Name**: Irrigator fioriera Gag
- **Value Type: Battery Level**
- **Value Unit: V**
- **Data Type**: float
- **Last Date**: 2020-04-01 12:59:00 *«dateObserved»*
- **Last Value**: 5.18
- **Healthiness**:
- **Last Check**: 2020-04-03 03:28:12
- **Ownership**: public/private
- **Organization**: Firenze

This Section is repeated for each variable

***an IoT Device may have multiple Sensors/variables***

# 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 |
|---|---|---|---|---|---|---|---|---|---|
| IoT Device Model | -- | | | Yes | | Yes | | | Broker, IOT App, Data Table, API, UserInterf, |
| Mobile Device Model | -- | | | Yes | | Yes | Yes | | Broker, IOT App, Data Table, API, UserInterf, |
| Data Table Model | -- | | | Yes | | Yes | Yes | | Data Table, then as IoT Device |
| **IoT Device** | Yes | Yes | Yes | Yes | Yes | Yes | | | Broker, IOT App, Data Table, API, UserInterf, |
| IoT Device Variable | | | | | | | | | Into the corresponding device |
| **Mobile Device** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | Broker, IOT App, Data Table, API, UserInterf, |
| Mobile Device variable | | | | | | | | | Into the corresponding device |
| **Data Table Device** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | Data Table, then as IoT Device |
| Data Table device Variable | | | | | | | | | Into the corresponding device |
| **Sensor Device** | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | Dashboard, IOT App, UserInterf, API, … |
| Sensor / Sens. Actuator | | | | | | | | | Into the corresponding device |
| **MyKPI** | Yes | Yes | Yes | | Yes | Yes | Yes | | Dashboard, IOT App, UserInterf, API, … |
| KPI (metrics) data | | Yes | Yes | | Yes | Yes | | | Dashboard, IOT App, API, Metrics SQL calls |
| My Personal Data | | Yes | Yes | | Yes | Yes | | | Dashboard, IOT App, UserInterf, API, … |
| **POI (Point of Interest)** | Yes | Yes | | Yes | Yes | | | | DataGate, ETL, IOT App, API, … |
| MyPOI data | Yes | Yes | | Yes | Yes | | | | Dashboard, IOT App, UserInterf, API, … |
| **Dashboard-IOT App (msg)** | | Yes | Yes | | Yes | Yes | | | Dashboard, IOT App, API, … |
| Complex Event (msg) | Yes | Yes | Yes | Yes | Yes | Yes | | | Dashboard, ETL, Special, IOT App, … |

# How to cope

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 |
|---|---|---|---|---|---|---|---|---|---|
| Heatmap matrix | Yes | Yes | Yes | | Yes | Yes | | | IOT App, MicroService, UserInterf, API, … |
| Traffic Flow | Yes | Yes | Yes | | Yes | Yes | | | IOT App, MicroService, UserInterf, API, … |
| OD Matrix | Yes | Yes | Yes | | Yes | Yes | | | IOT App, MicroService, UserInterf, API, … |
| | | | | | | | | | |
| External Service (web pag) | | Yes | -- | | | | | Yes | ETL, Special, IOT App, Web Scraper, … |
| Synoptics (groups) | | Yes | (Yes) | | (Yes) | (Yes) | | Yes | Special, API, … |
| BIM View | | Yes | Yes | | (Yes) | (Yes) | | Yes | Special, API, … |
| BIM Device | | Yes | Yes | | Yes | Yes | | Yes | Special, API, … |
| MicroApplication (webapp) | | Yes | -- | | | | | Yes | Dashboard, IOT App, API, FTP, … |
| Special Widget (complex) | | Yes | Yes | | Yes | Yes | | Yes | ETL, special, IOT App, API, … |
| WFS/WMS (GIS data) | Yes | [yes] | [yes] | Yes | Yes | | | Yes | GIS tools, or GeoServer, IOT App, … |
| | | | | | | | | | |
| Tools (functional) | (Yes) | | (Yes) | | (Yes) | | (Yes) | MDM | Scenario, What-If, etc. |
| | | | | | | | | | |

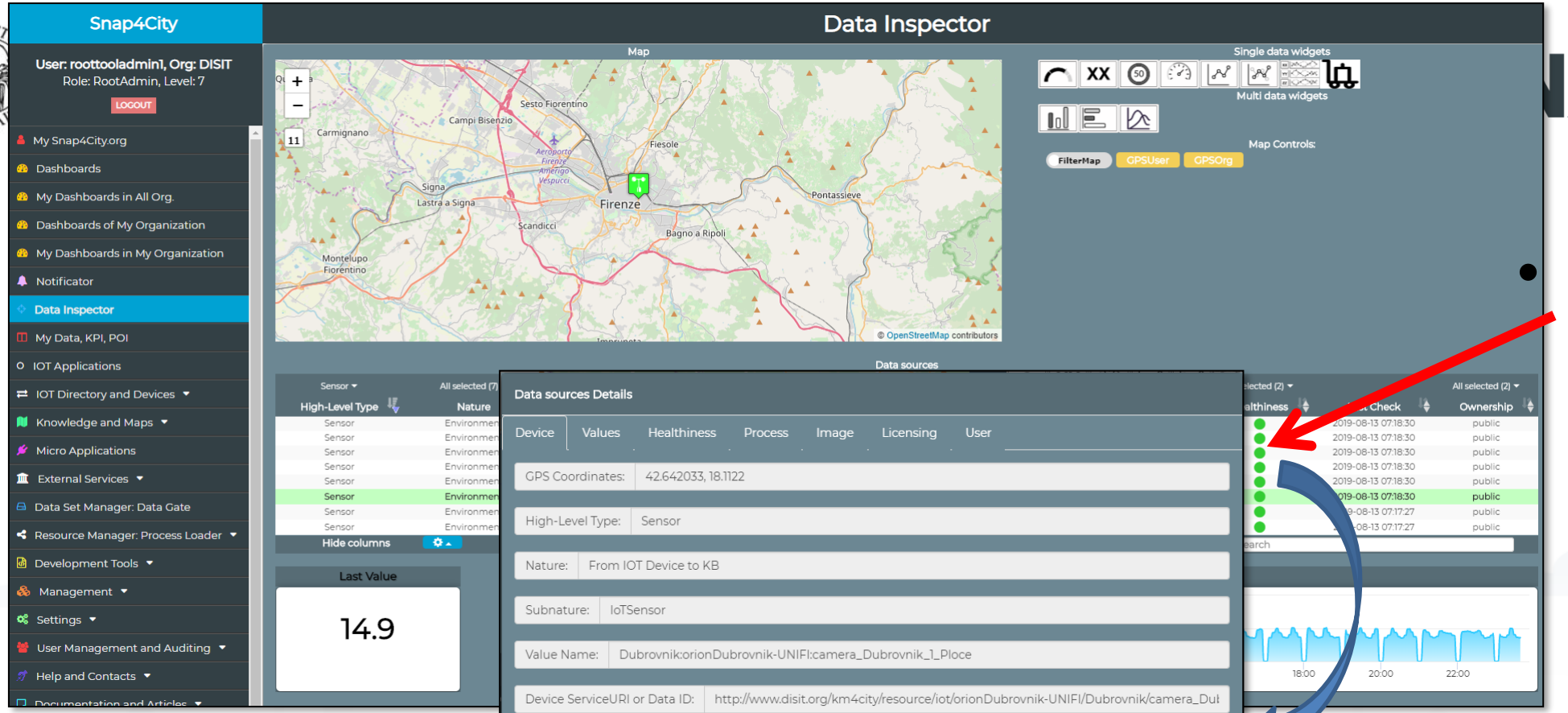
# Data Inspector vs Data Processes Details

## (some features are only accessible to *Admin roles)



# Advanced Features of the Data Inspector

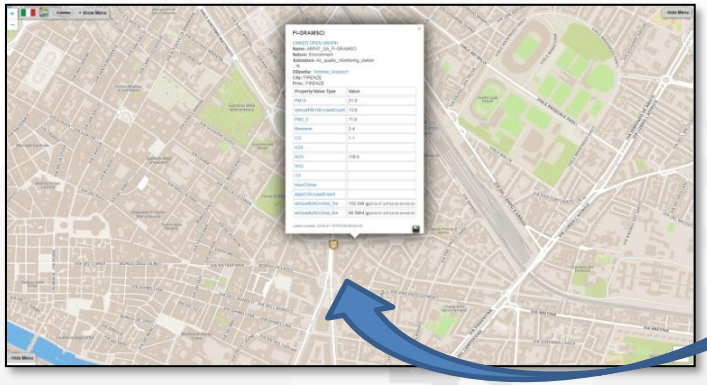
- Some features accessible only for the Owner and *Admin, such as:
  - Specific information on the basis of the High Level Type
  - Values connected to the data (structure of the single data)
  - Details regarding the ingestion process
  - Eventual image representing the City Entity, for example the sensor
  - Ownership (licensing) details regarding the data owner
- So that you can access on all of them in the Snap4City version if you install on premise.
- A part of these features can be activated for the Organization Managers, namely: «ToolAdmin» roles.

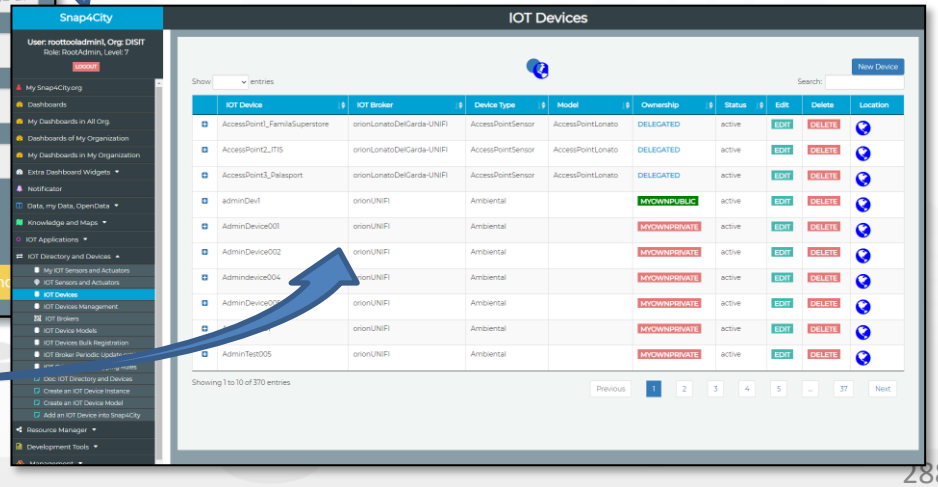



- Click with the mouse on it

**HLT: Sensor**

Knowledge Base view





# HLT: Sensor

- Specific values of selected
- Information of the values of the other sensors on the same device
- View Trends, marking problems, healthiness by point according to a Fuzzy model
- Marking problems for future machine learning processes (separate tool)

Data sources Details

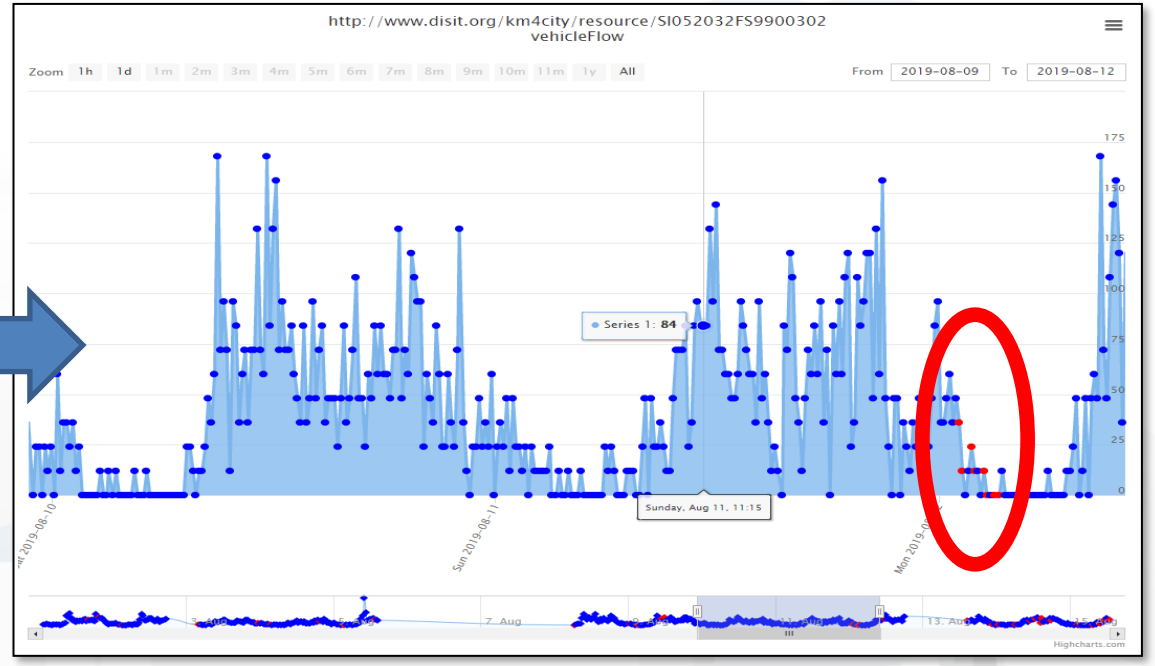
Device | Values | Healthiness | Process | Image | Licensing | User

Last Date: 2020-07-21 19:00:00

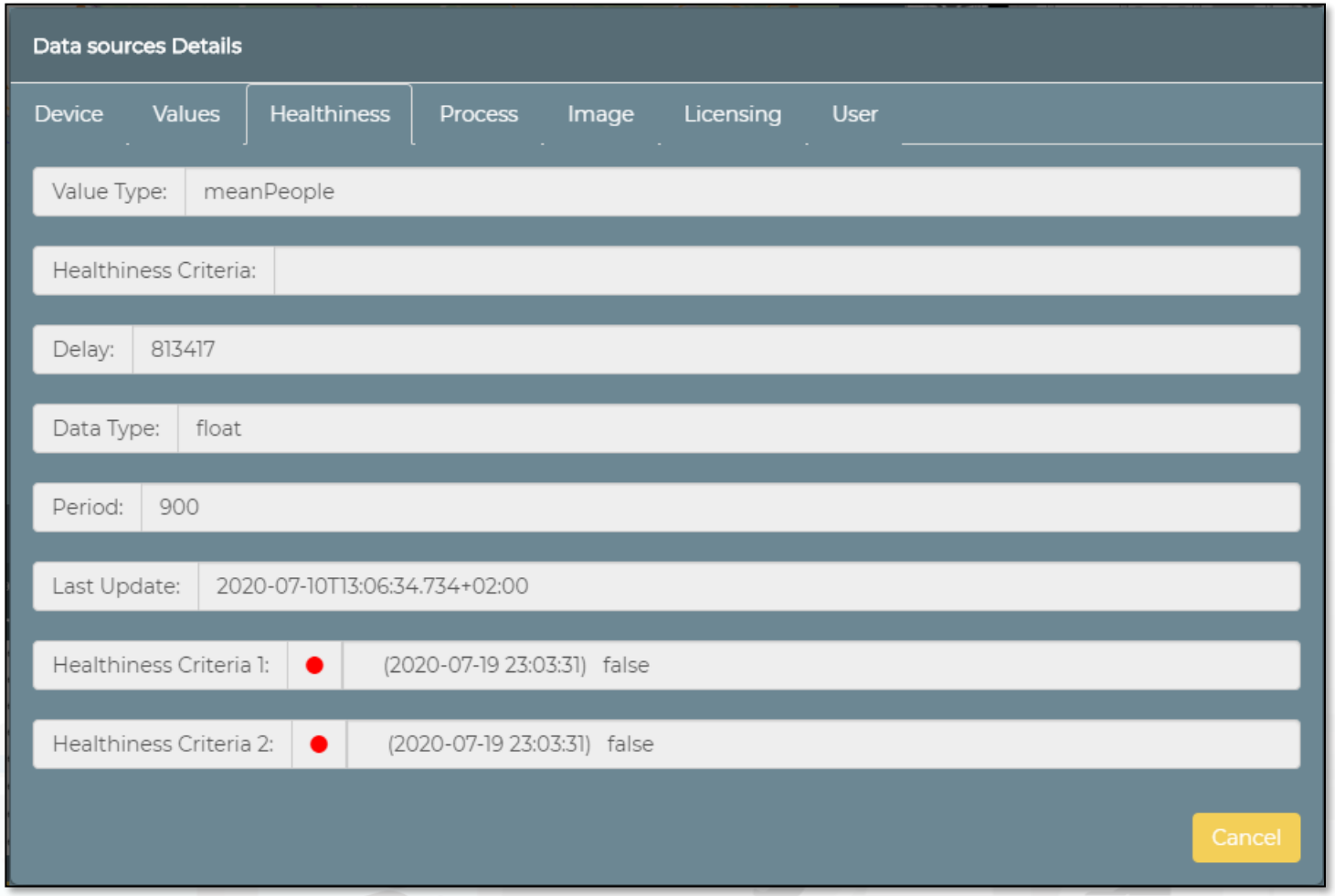
Last Value:

| Value Type | Healthy | Delay (s) | Reason | Healthiness Criteria | Refresh Rate (s) | Data type | Unit | Value | Time Trend |
|---|---|---|---|---|---|---|---|---|---|
| dateObserved | ● | 61890 | undefined | undefined | 300 | time | timestamp | 2020-07-21T17:00:00.000Z | VIEW |
| deceduti | ● | 61890 | undefined | undefined | 300 | integer | # | 16797 | VIEW |
| dimessi_guariti | ● | 61890 | undefined | undefined | 300 | integer | # | 71775 | VIEW |
| isolamento_domiciliare | ● | 61890 | undefined | undefined | 300 | integer | # | 6838 | VIEW |
| nuovi_attualmente_positivi | ● | 61890 | undefined | undefined | 300 | integer | # | -131 | VIEW |
| ricoverati_con_sintomi | ● | 61890 | undefined | undefined | 300 | integer | # | 151 | VIEW |
| stato | ● | 61890 | undefined | undefined | 300 | string | # | ITA | VIEW |
| tamponi | ● | 61890 | undefined | undefined | 300 | integer | # | 1212468 | VIEW |
| terapia_intensiva | ● | 61890 | undefined | undefined | 300 | integer | # | 21 | VIEW |
| totale_attualmente_positivi | ● | 61890 | undefined | undefined | 300 | integer | # | 7010 | VIEW |
| totale_casi | ● | 61890 | undefined | undefined | 300 | integer | # | 95582 | VIEW |
| totale_ospedalizzati | ● | 61890 | undefined | undefined | 300 | integer | # | 172 | VIEW |
| codice_regione | ● | 61890 | missing value | undefined | 300 | integer | status | | VIEW |
| denominazione_regione | ● | 61890 | missing value | undefined | 300 | string | status | | VIEW |

Cancel



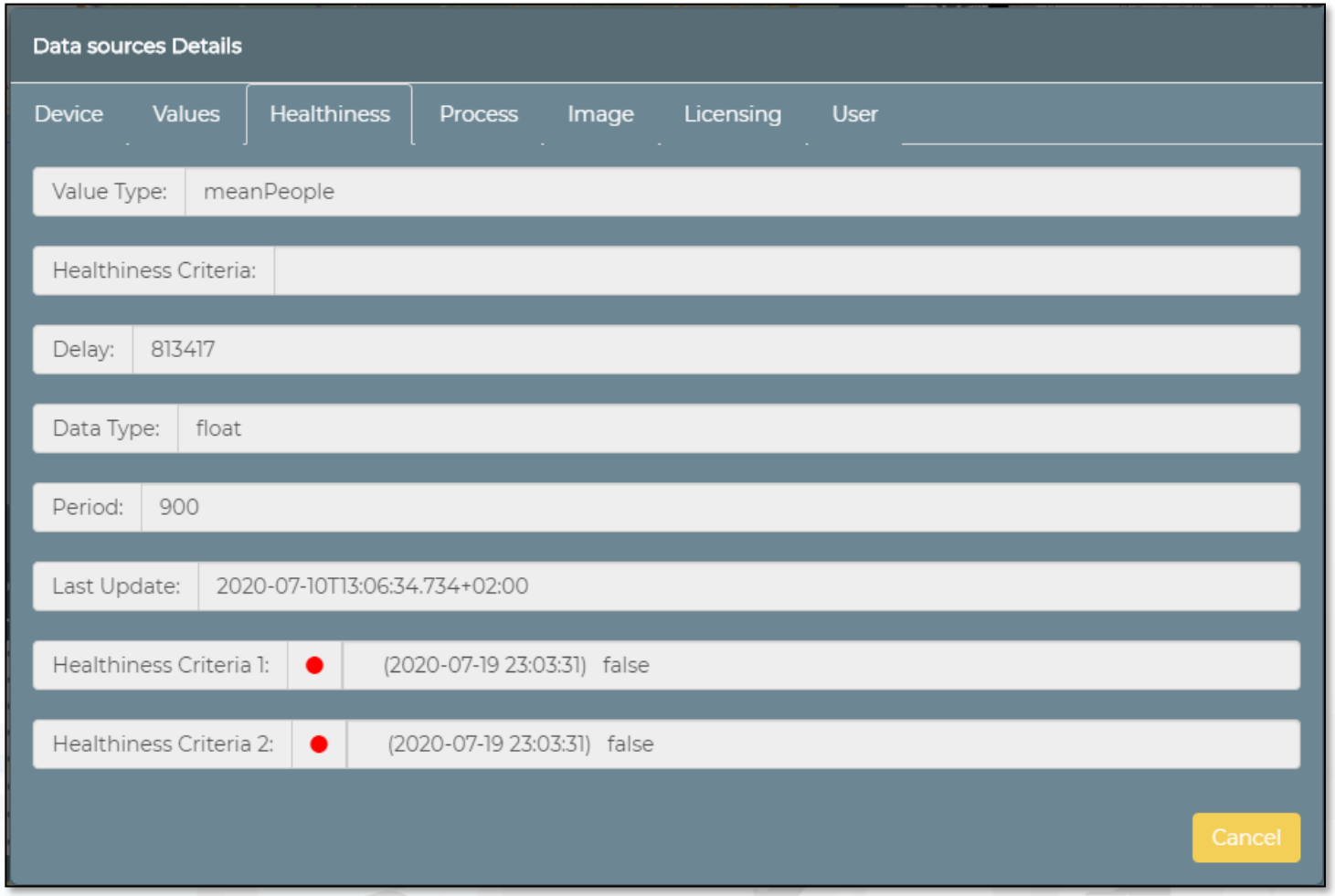
# HLT: Sensor Healthiness




- Two different criteria
  - **H1**: at least an event i nthe last 24 hours
  - **H2**: machine learning for most of Sensors devices

*Some functionalities are limited to certain roles*

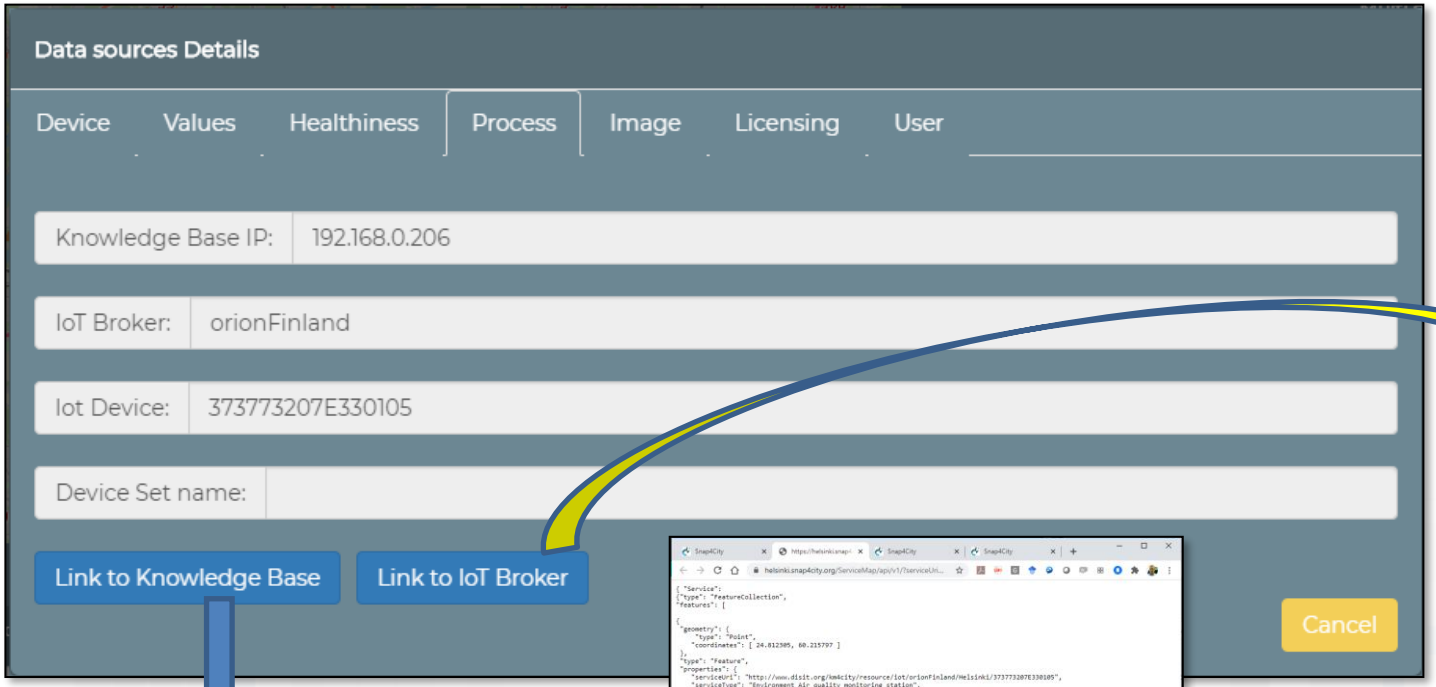
# HLT: Sensor Healthiness

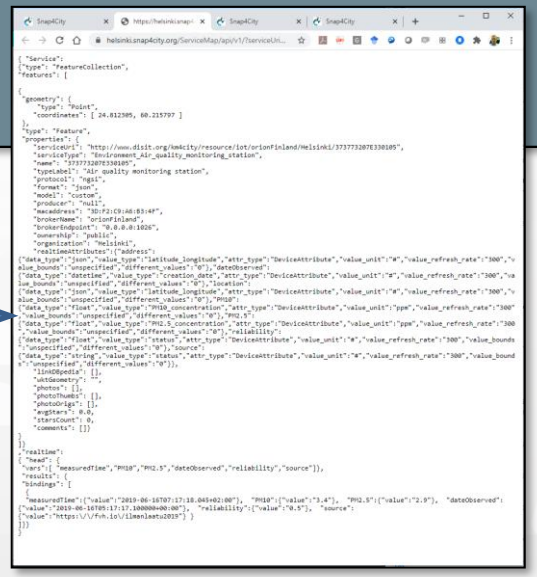


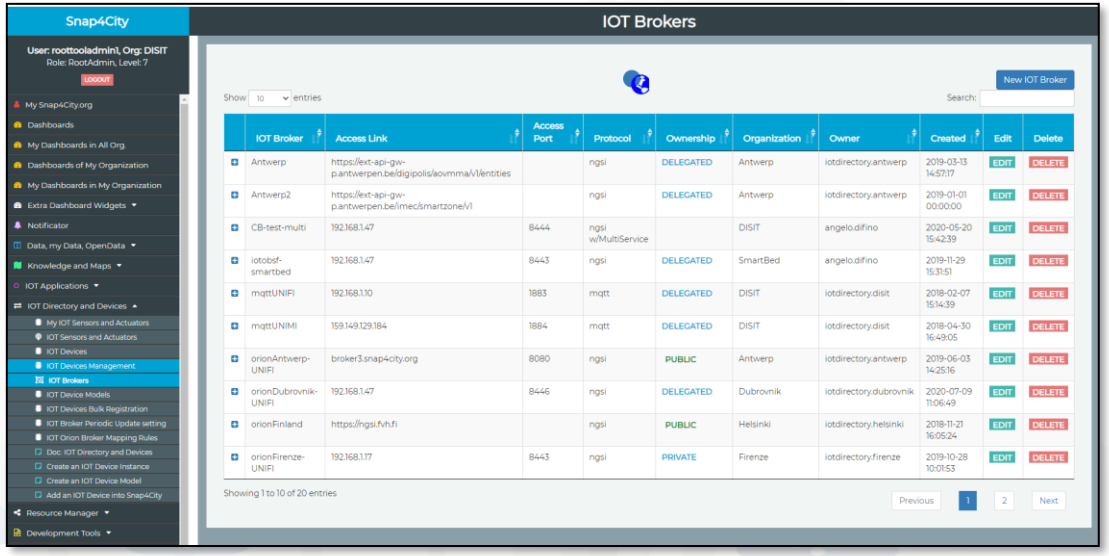

- Two different criteria
  - **H1**: at least an event i nthe last 24 hours
  - **H2**: machine learning for most of Sensors devices

*Some functionalities are limited to certain roles*

# Details regarding the IOT Ingestion process



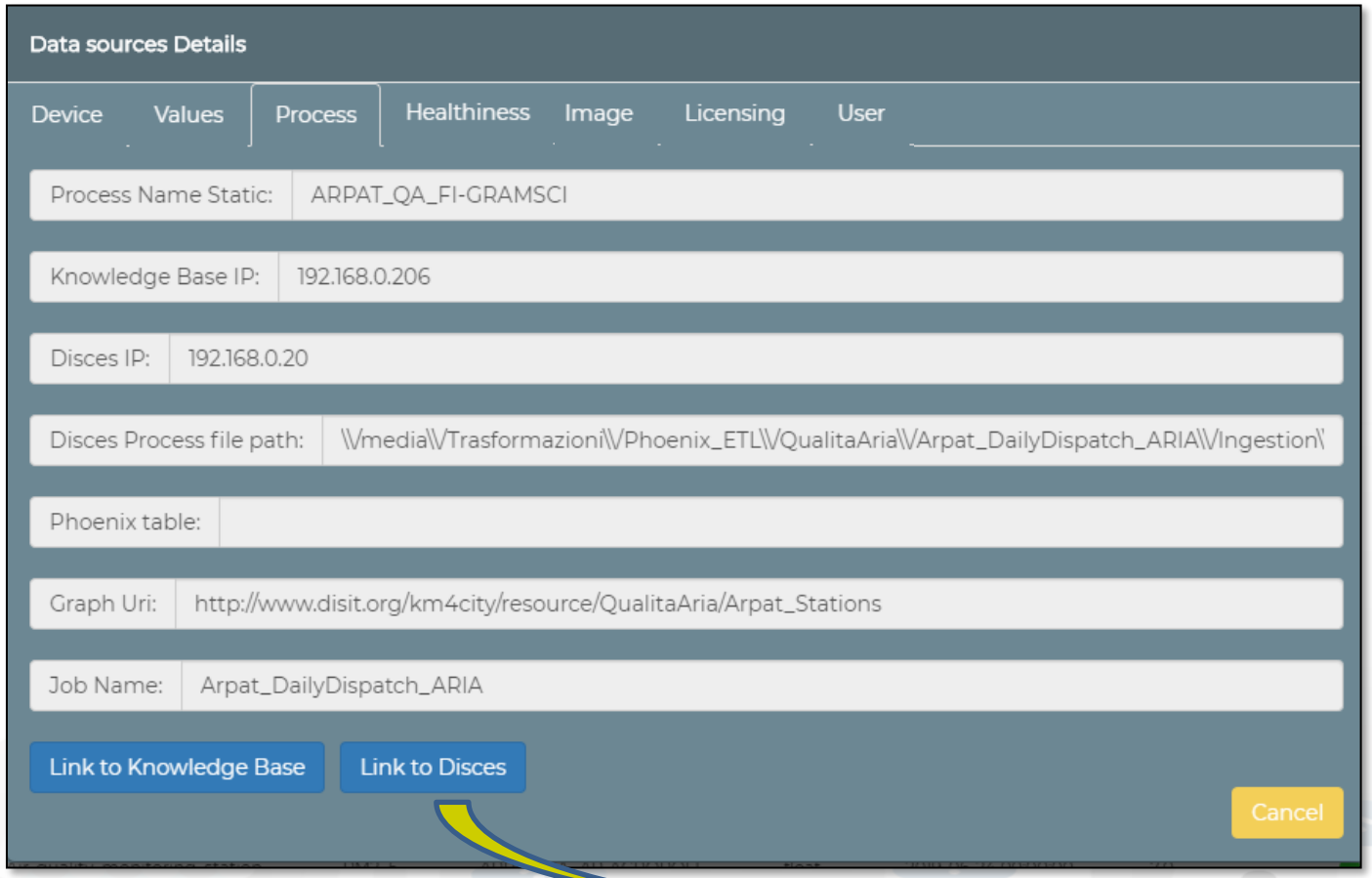



- For IOT Device data
- IOT Broker details

*Some functionalities are limited to certain roles*

# HLT: Sensor

# Details regarding the Ingestion process




- For ETL processes
- Scheduling details and status

DISCES Process Scheduler view

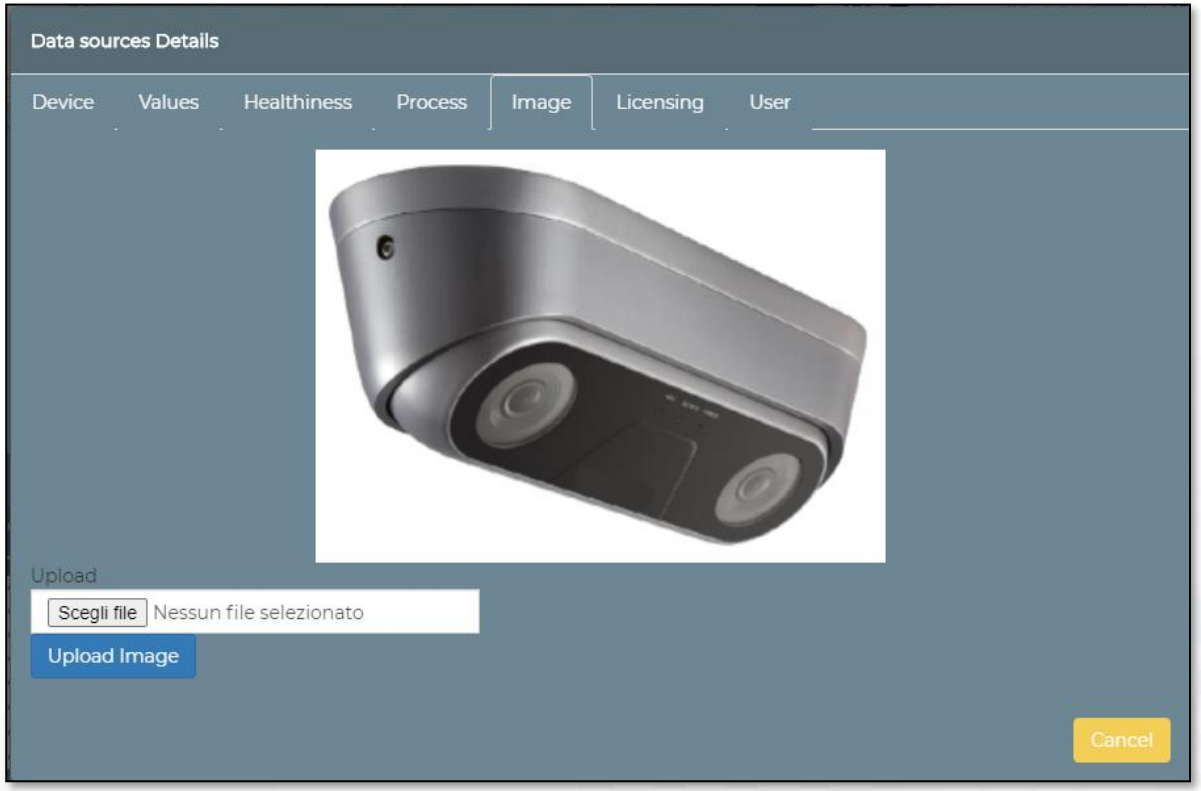


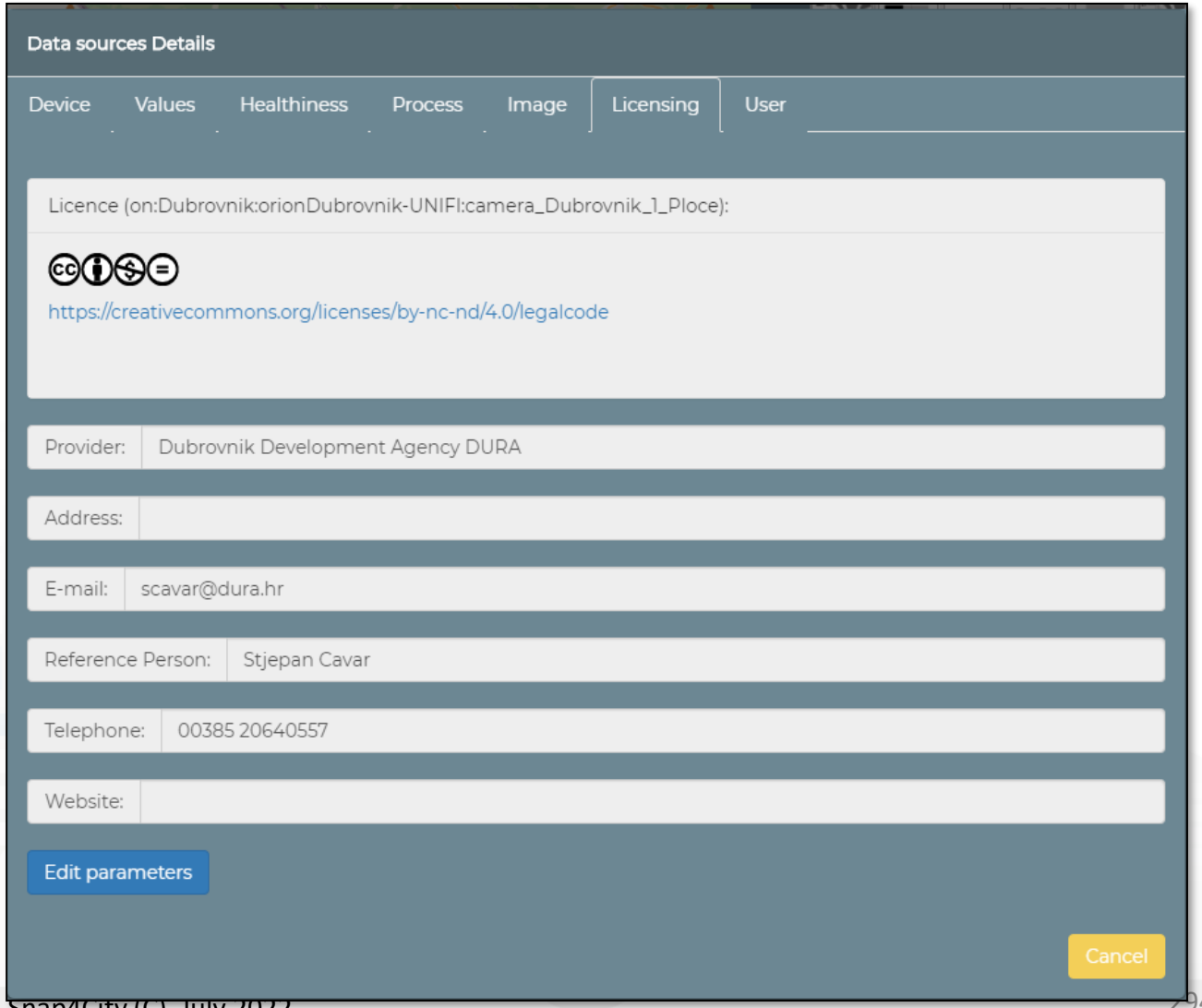

*Some functionalities are limited to certain roles*

# HLT: Sensor



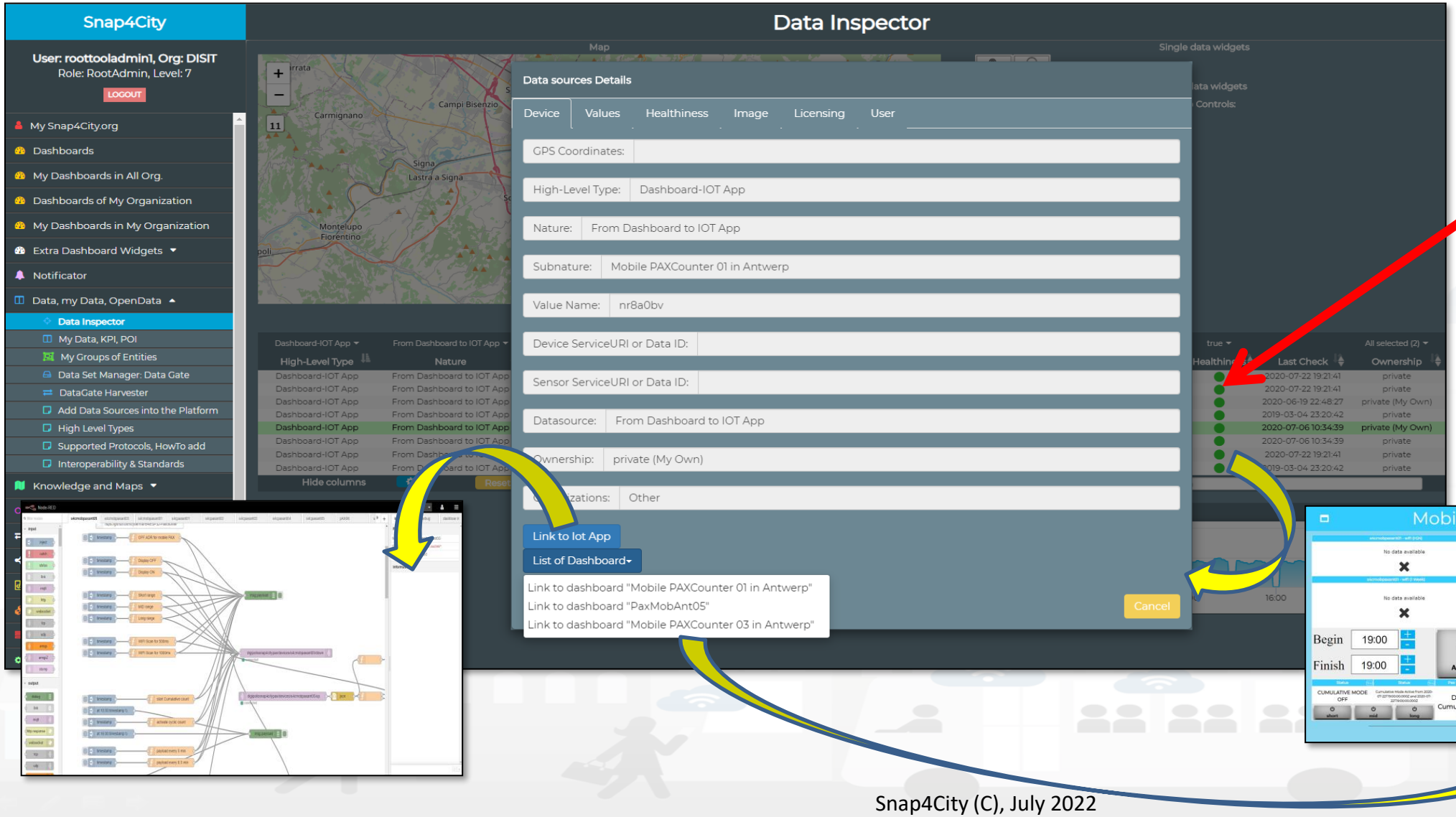
# Image of the Devices and Licensing



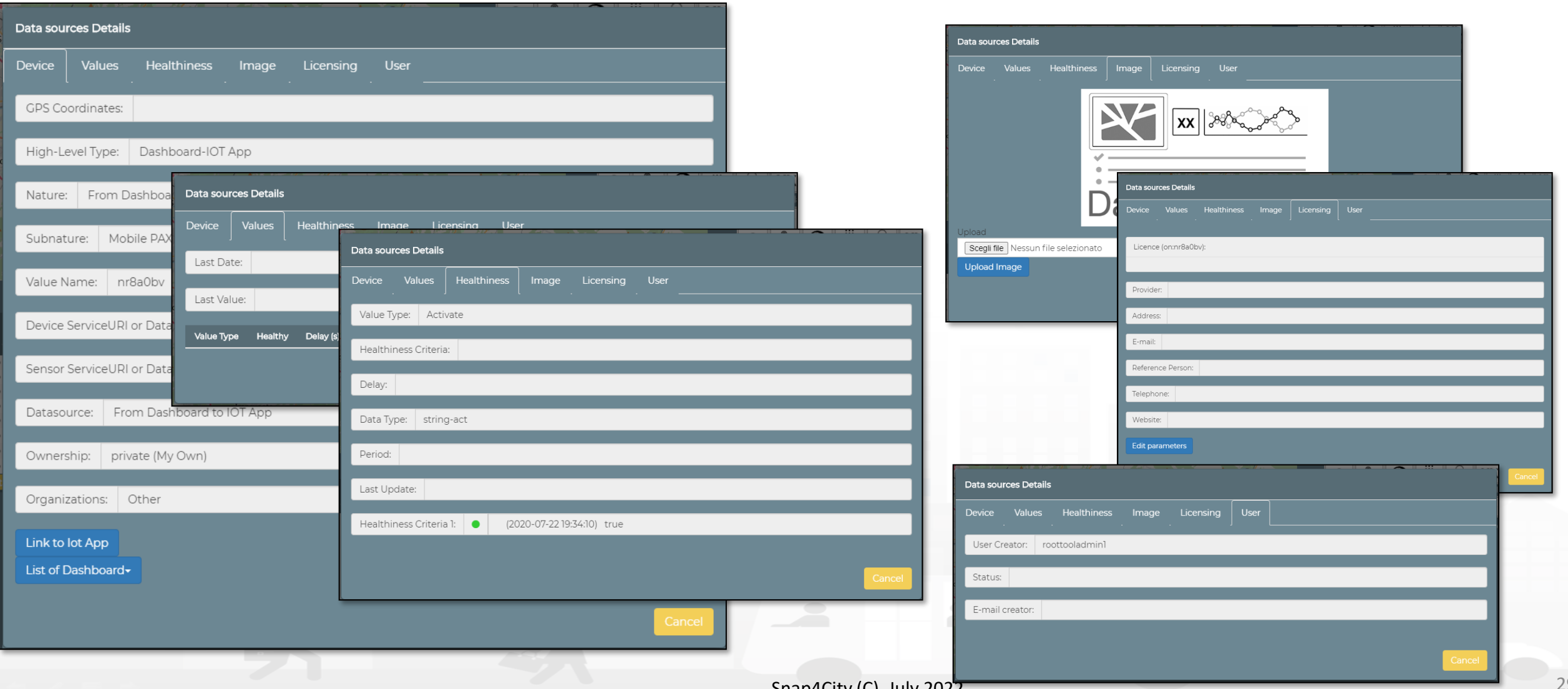

*Some functionalities are limited to certain roles*

# HLT: From Dashboard to IOT APP

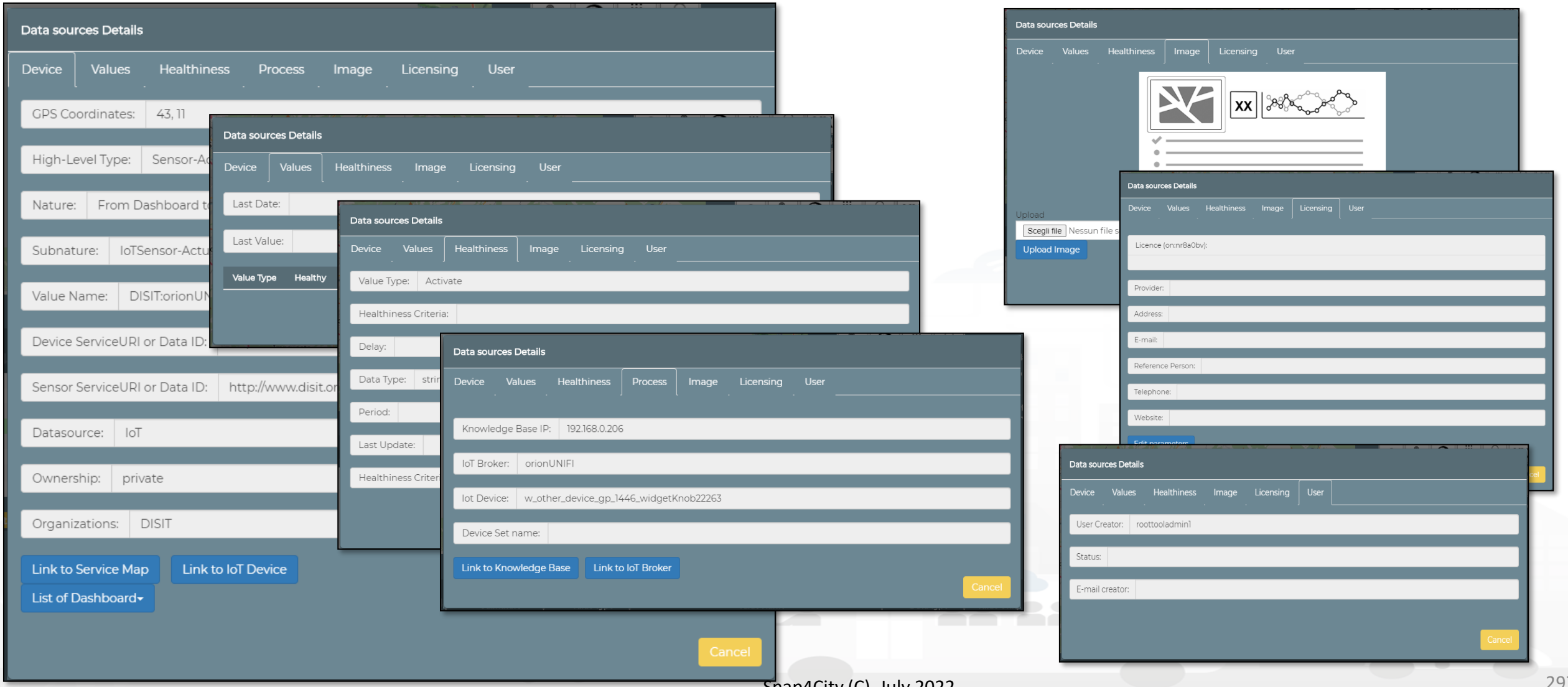



- Click with the mouse on it

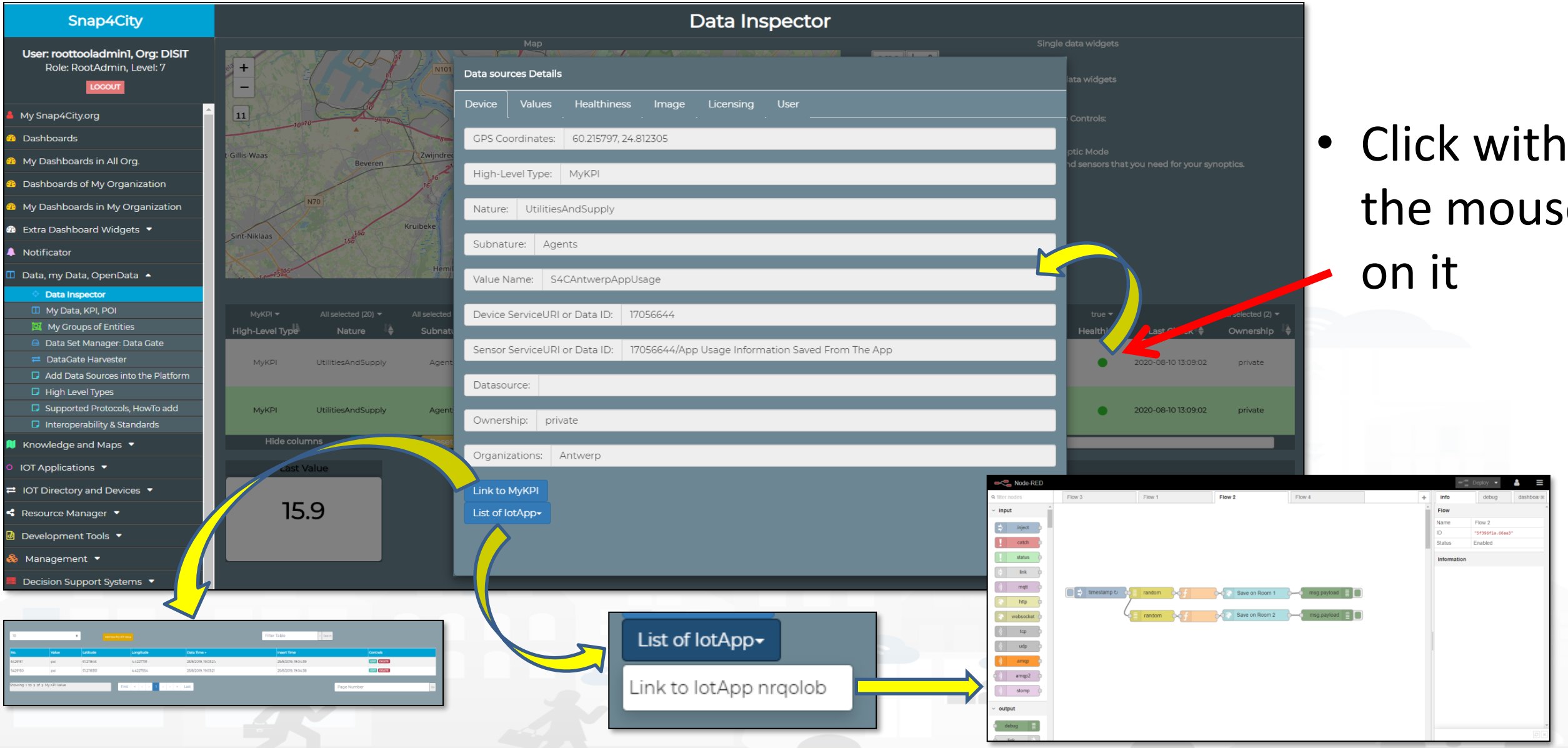
# HLT: Dashboard-IOT App (From Dashboard to IOT APP)



# HLT: Sensor-Actuator (From Dashboard to IOT Device)



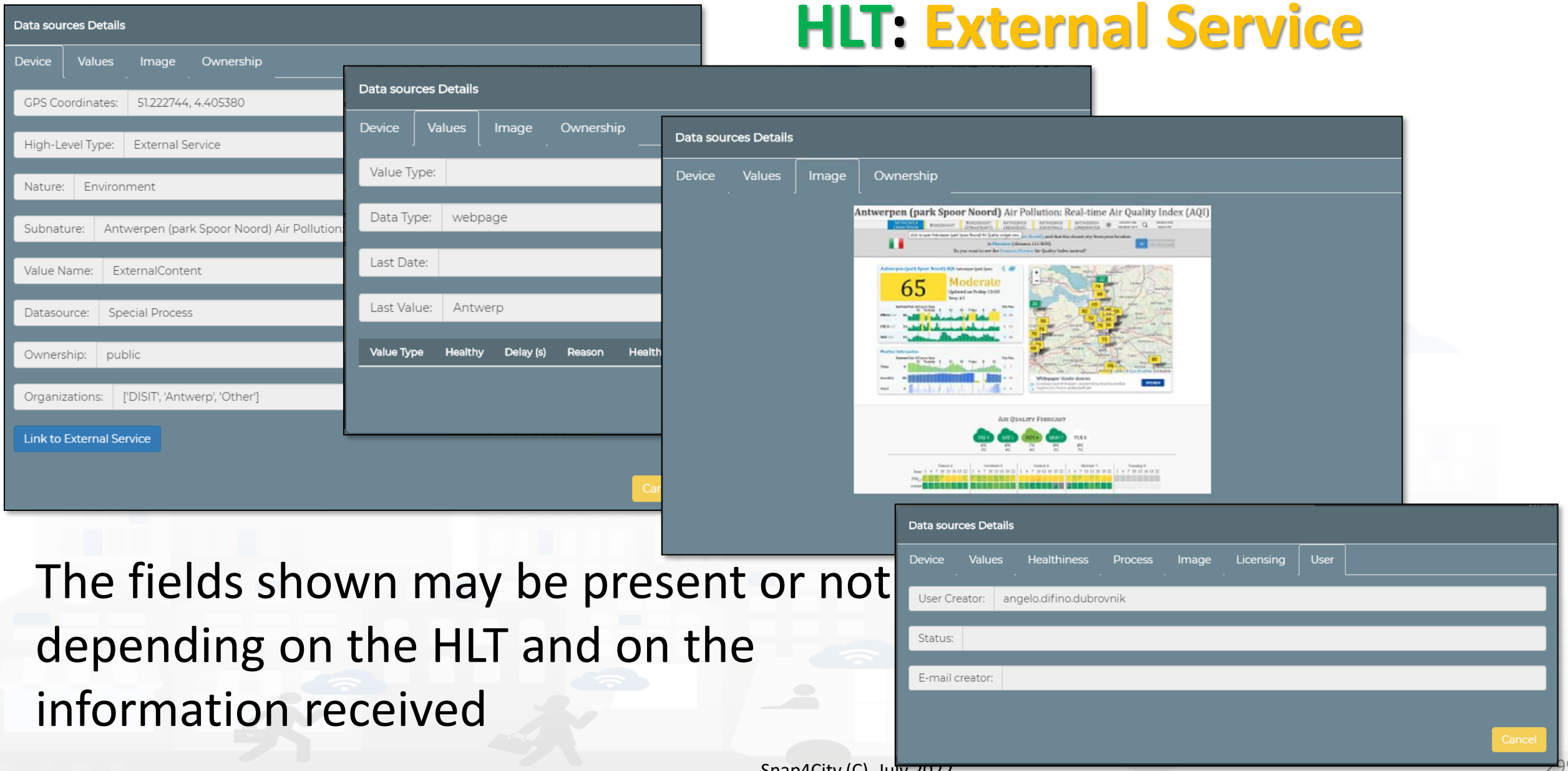
# HLT: MyKPI




- Click with the mouse on it

*Some functionalities are limited to certain roles*

# HLT: External Service



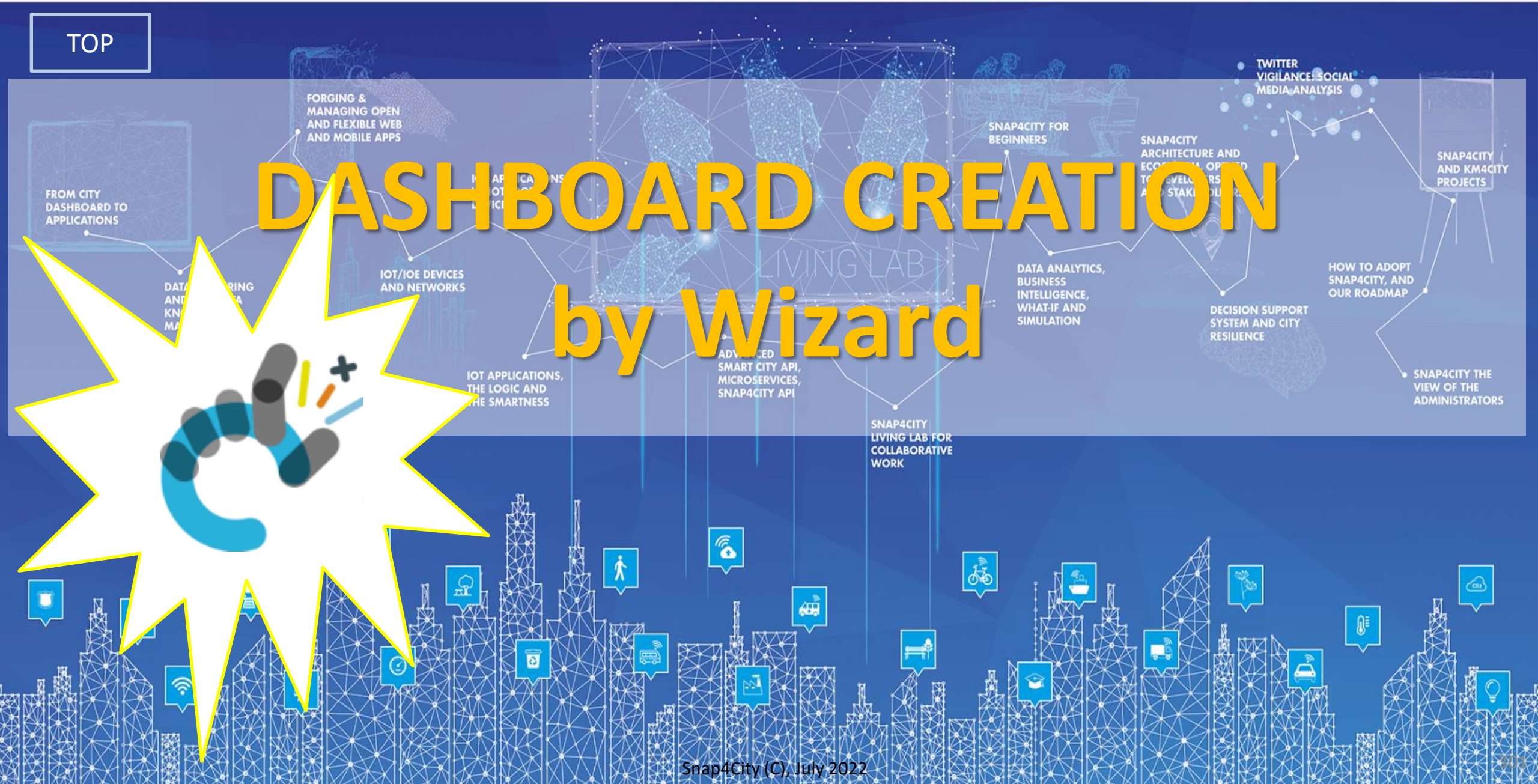

The fields shown may be present or not depending on the HLT and on the information received

# Data Inspector recent and future features

- Specific views for the  HLT
- Details on Healthiness
- More details on the Ingestion Process
- Capabilities of setting and changing the Healthiness criteria
- For data related to IOT App vs Dashboard, how the link to them
- A view about the data relationships, precisely to show the data used in dashboard, and used in IOT App, etc.
- For Sensors: a link to DevDash to see the time trend and relationships with other sensors and devices on the same Organization (for all in the case of RootAdmin)
- A reverse link from the SmartAppGraph to the Data Inspector data of various kind

TOP

# DASHBOARD CREATION by Wizard



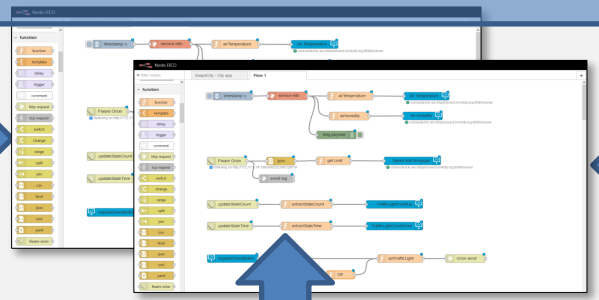
# Snap4City: Builder of Sentient Cities Solutions

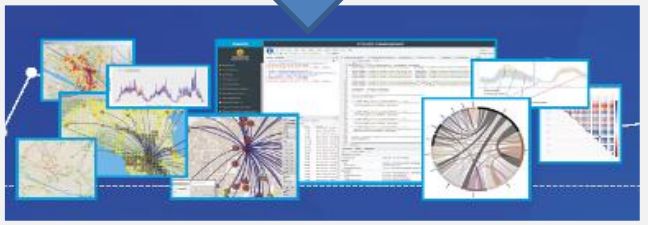
Dashboards with data driven IOT Applications enforcing intelligence

IOT and data World



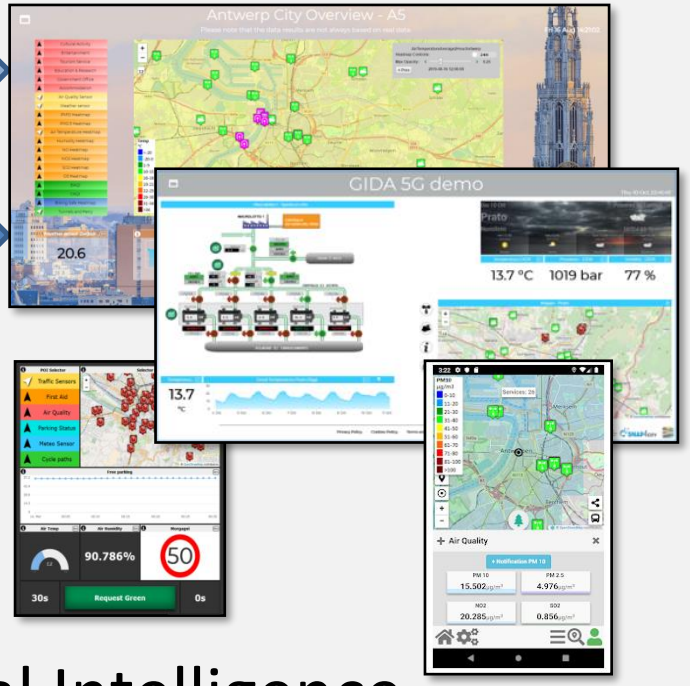

IOT Applications



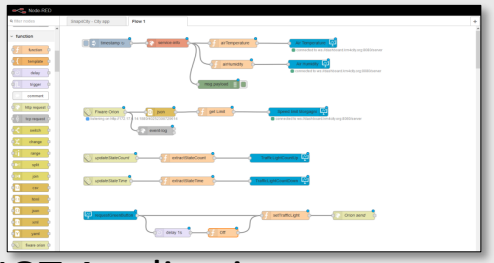


Big Data Analytics, Artificial Intelligence

Dashboards and Apps



# Dashboard Development



IOT Applications

Knowledge Base, Km4City



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

Widget Collection





Micro Applications

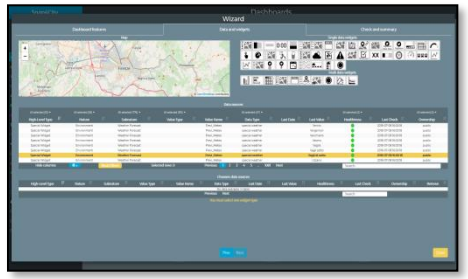


External Services



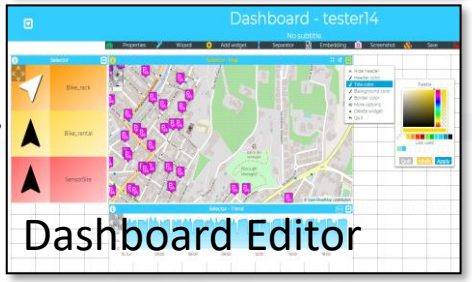
Custom Widgets/ Synoptics

Dashboard Wizard

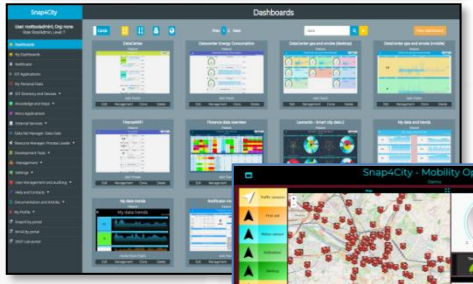


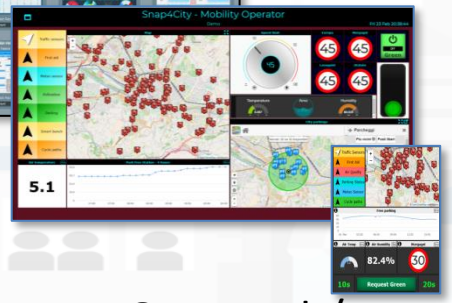
Create, save, load, delegate, grant access






Dashboard Editor






Public Dashboard Collection

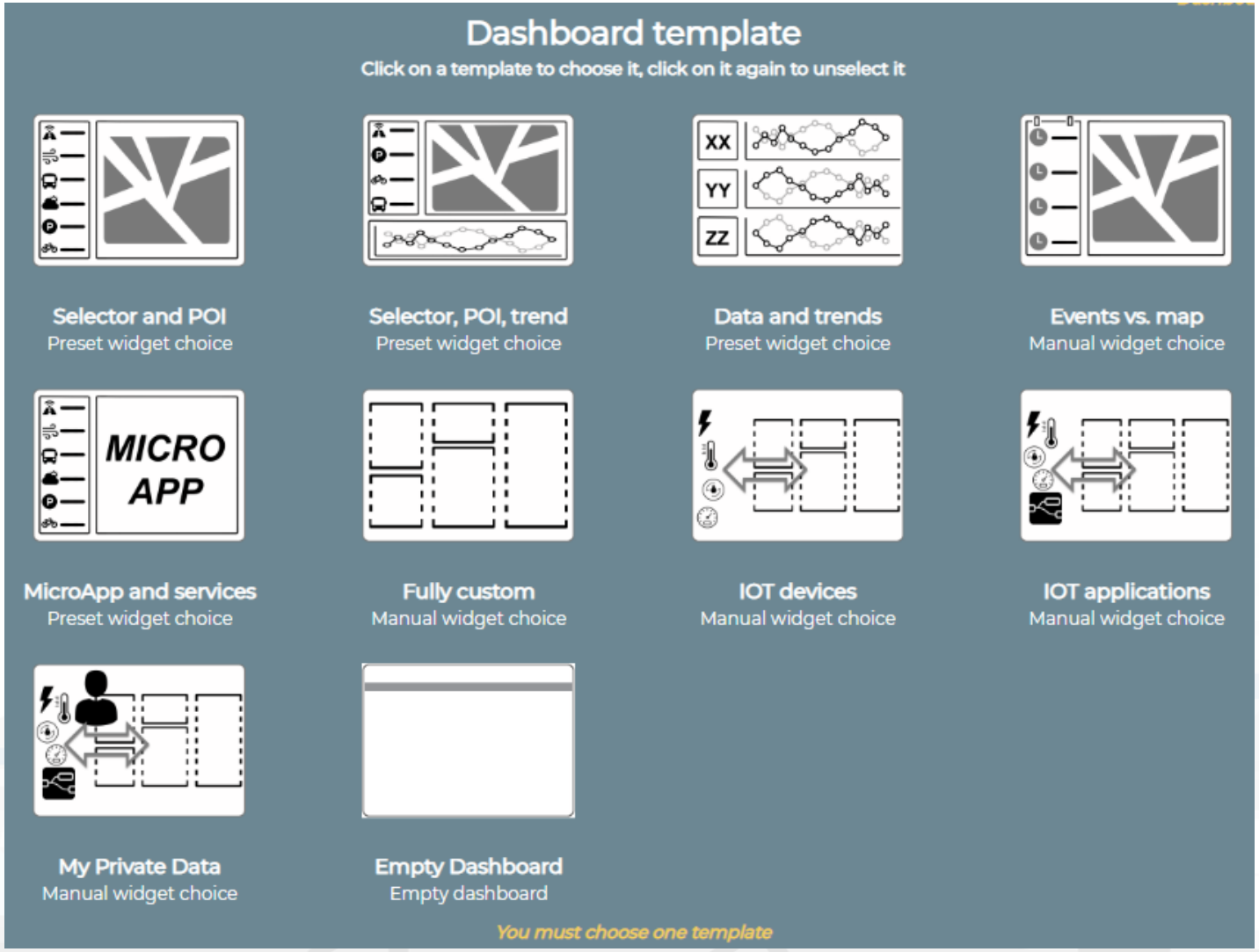
My Own Dash/App



# Dashboard List and Editor



# From Templates to Wizard and Dashboards

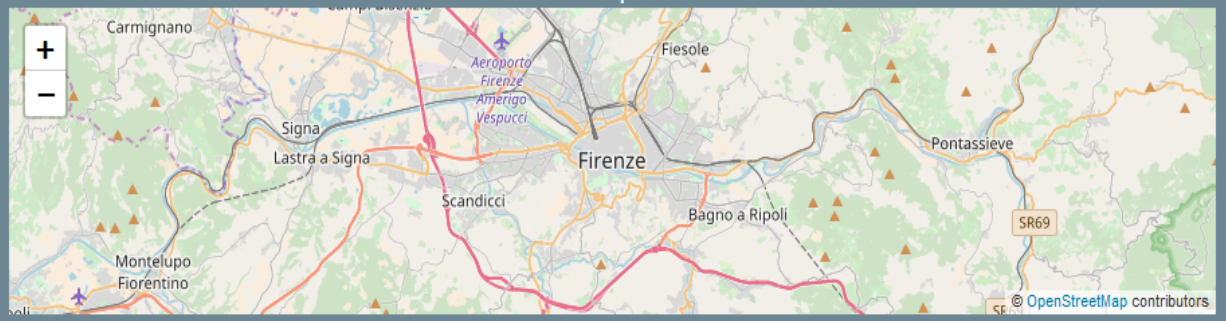



- to create a new Dashboard
- to add widgets and/or groups of them on any Dashboard

# Wizard

Dashboard features | Data and widgets | [illegible]

Map




Single data widgets



Multi data widgets



Data sources

| All selected (10) | All selected (55) | All selected (776) | All selected (315) | | All selected (47) | | | | All selected (2) |
|---|---|---|---|---|---|---|---|---|---|
| High-Level Type | Nature | Subnature | Value Type | Value Name | Data Type | Last Dat | | Last Check | Ownership |
| Special Widget | Environment | Weather Forecast | | Previ_Meteo | special weather | | | 2018-07-08 16:00:18 | public |
| Special Widget | Environment | Weather Forecast | | Previ_Meteo | special weather | | Vergemoli | 2018-07-08 16:00:18 | public |
| Special Widget | Environment | Weather Forecast | | Previ_Meteo | special weather | | 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

Wizard

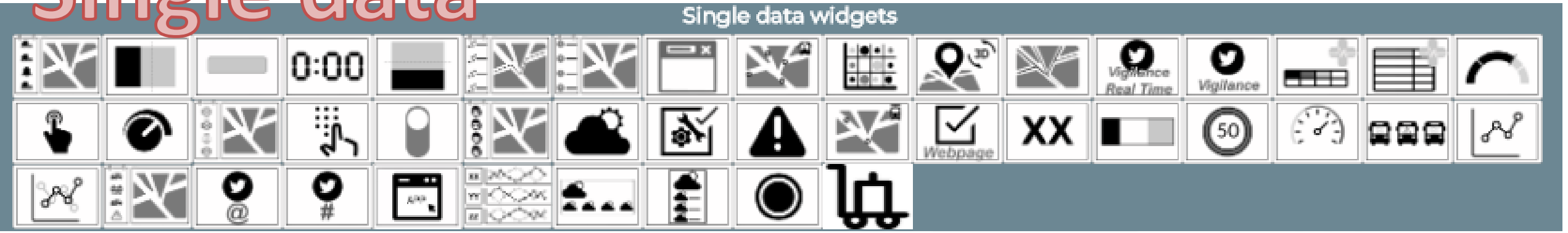
- Select the area of your interest: panning and zooming
- Select the
  - graphic aspect of your interest, or
  - High Level Type of your interest, or
  - Make a search if you a have a precise idea or
  - Act on filters: nature, subnature, type, name, value, date, health, owner, …
  - Combine them as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

RULE OF THUMB

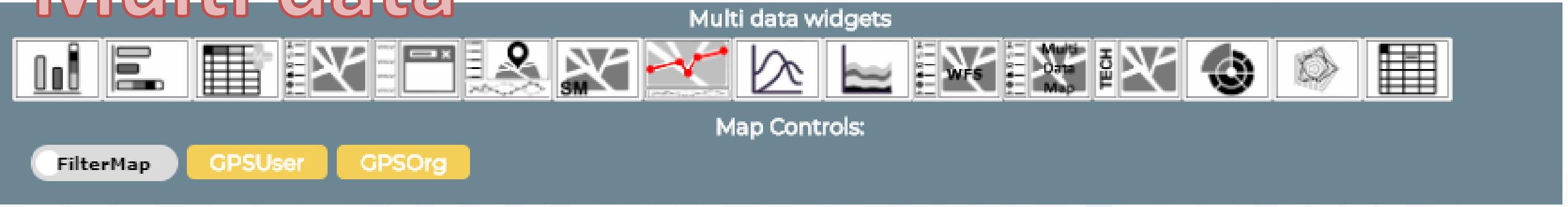
Close

# ICONS of Widgets

## Single data

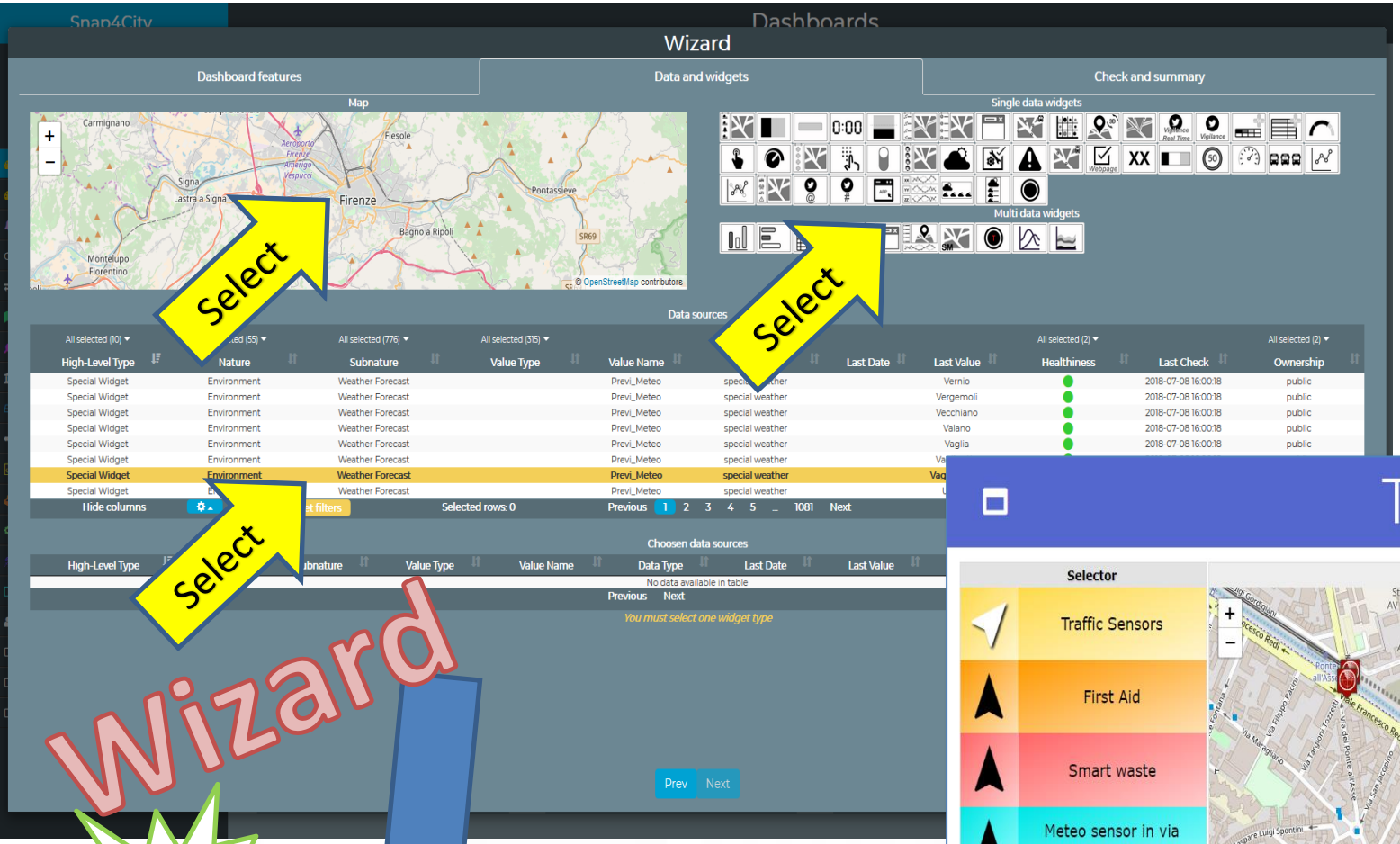


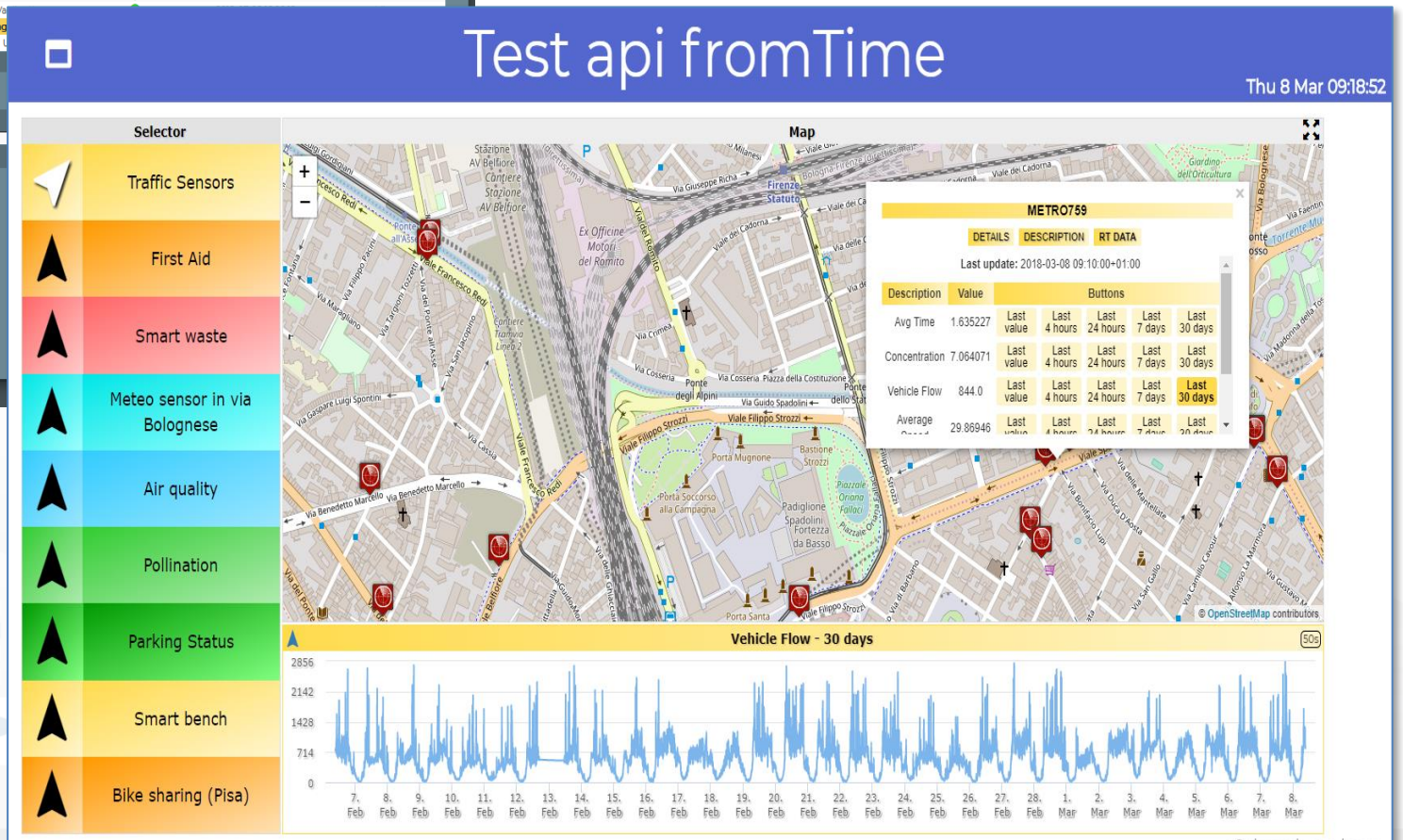

## Multi data




## Map Controls

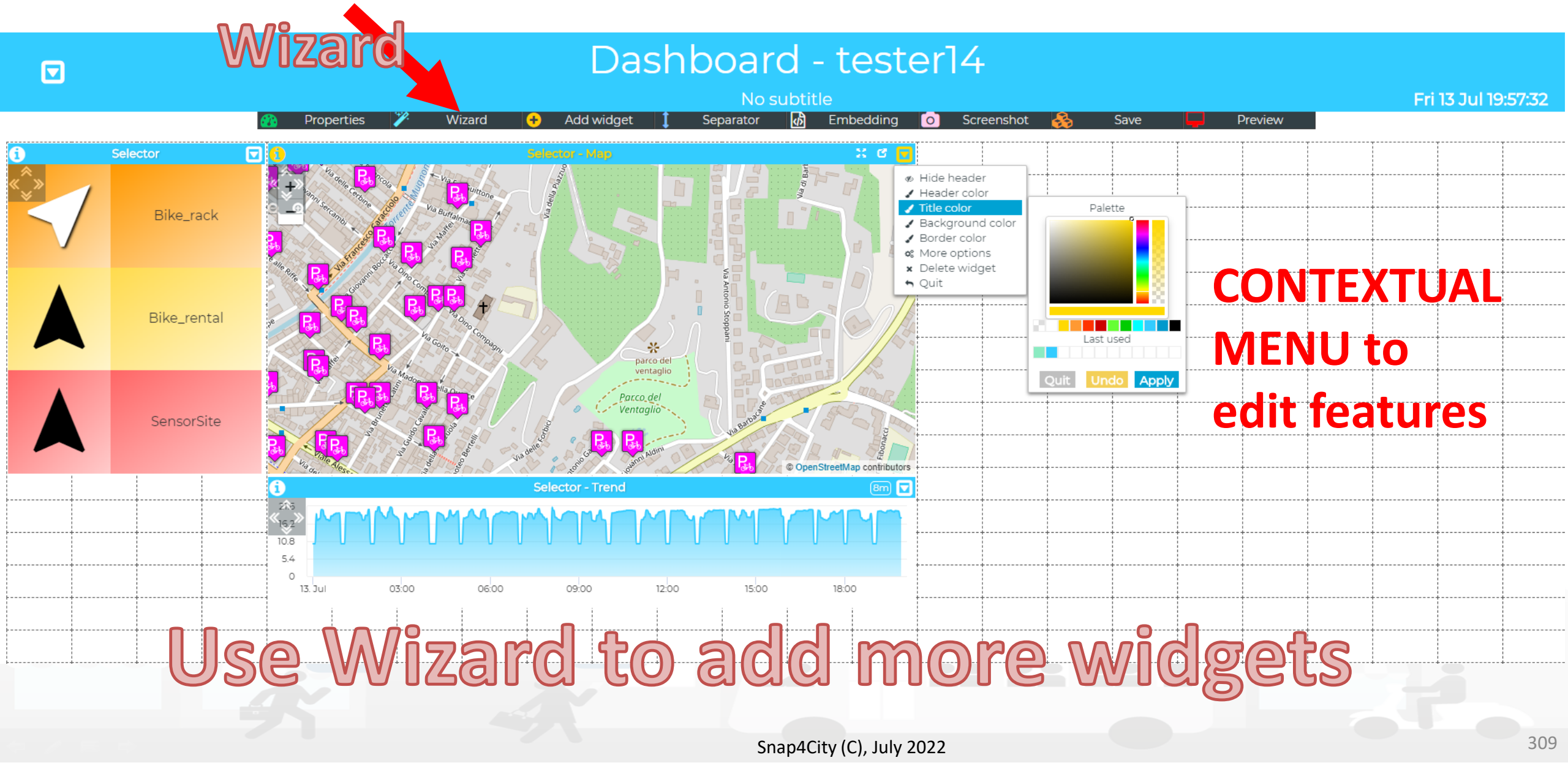
# Dashboard Wizard




The Wizard helps you in selecting only possible combinations of data and graphic representations

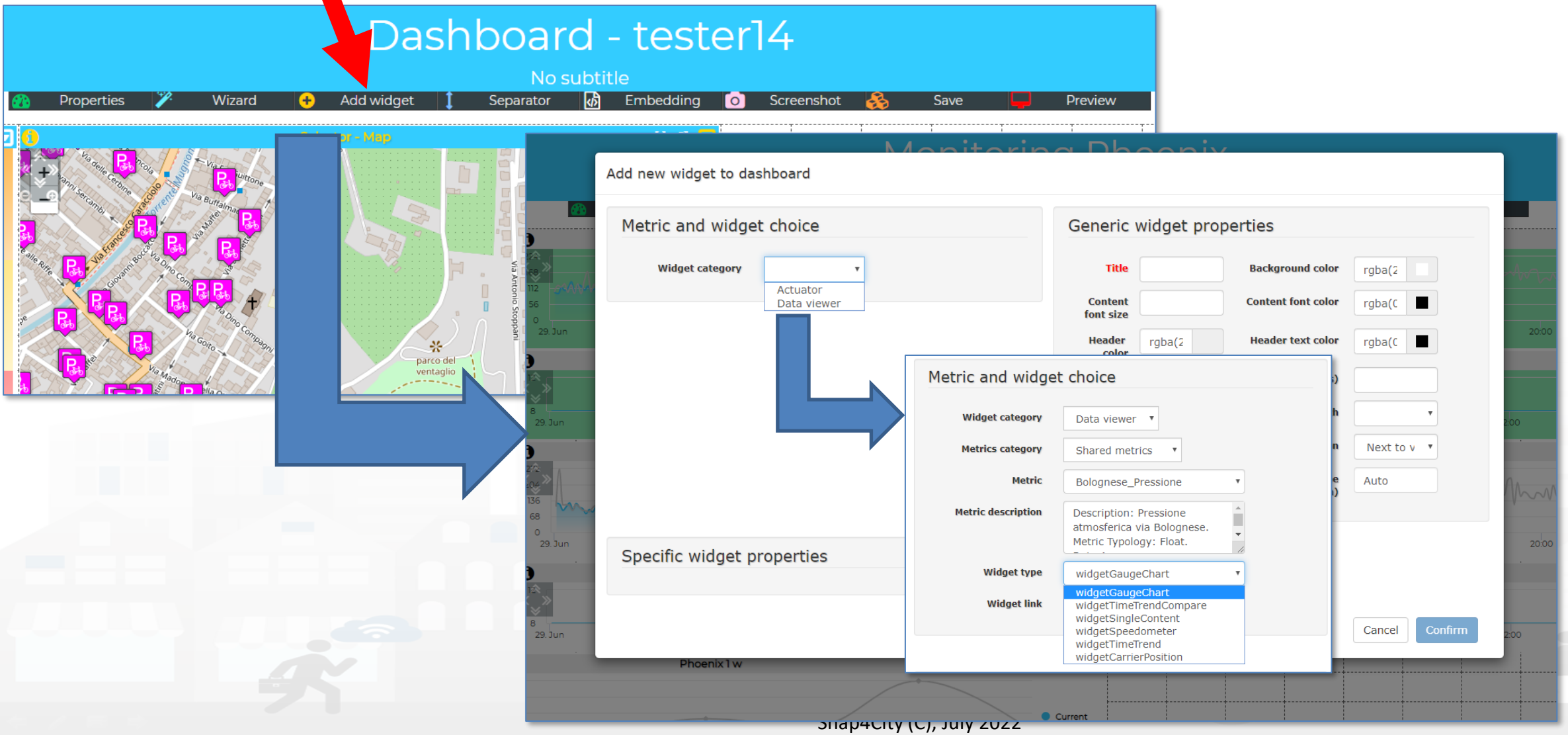
# Wizard




**CONTEXTUAL MENU to edit features**

# Use Wizard to add more widgets

# Manual Addition of Widgets



# Dashboards summary and further exercises

- **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**

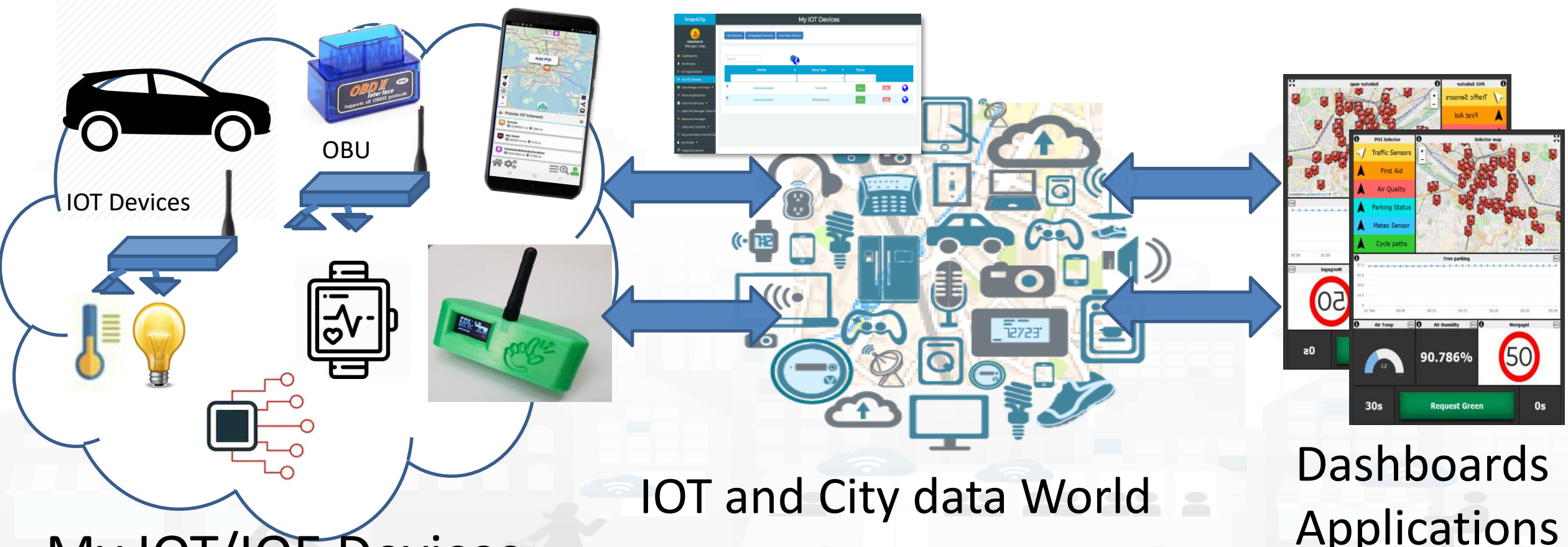
# Dashboards Creation Exercitation



# DEMO Section

# 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!!!

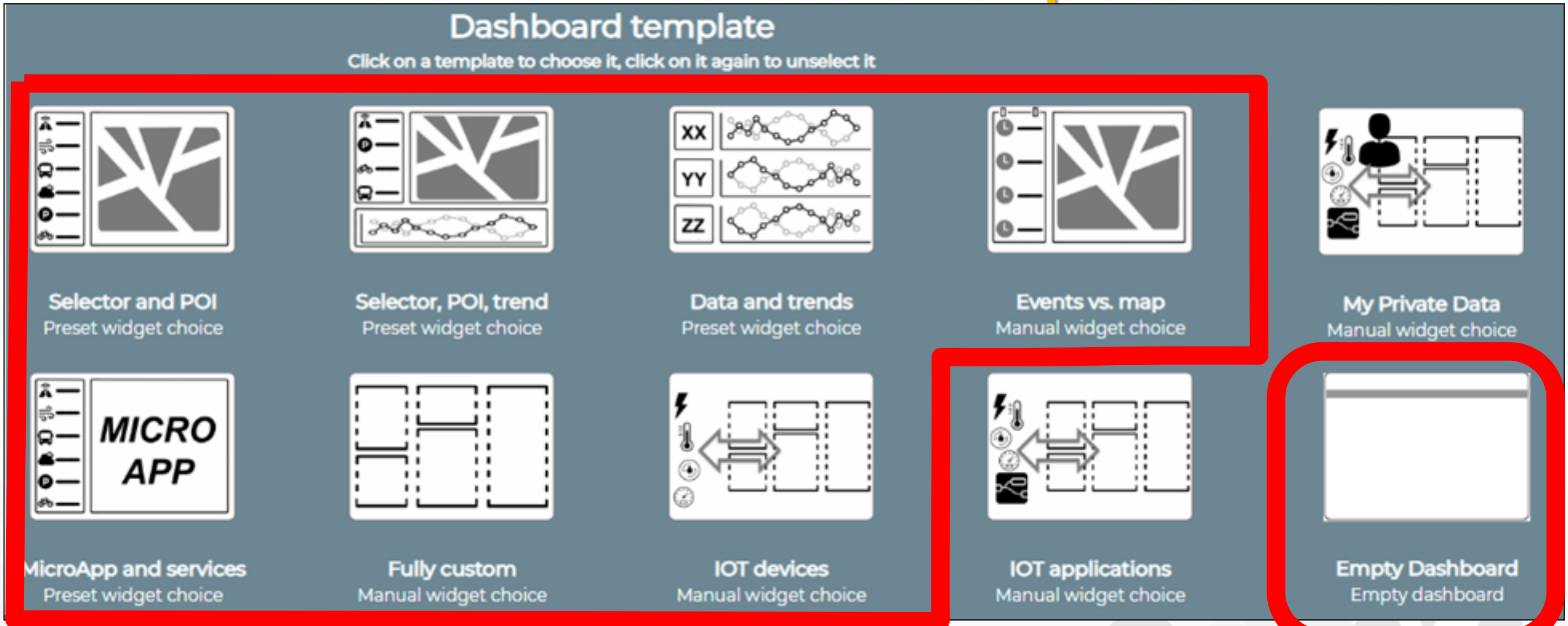



My IOT/IOE Devices

IOT and City data World

Dashboards Applications

# In this exercitation we are going to use the main Dashboard Templates



# Exercitation on dashboard building

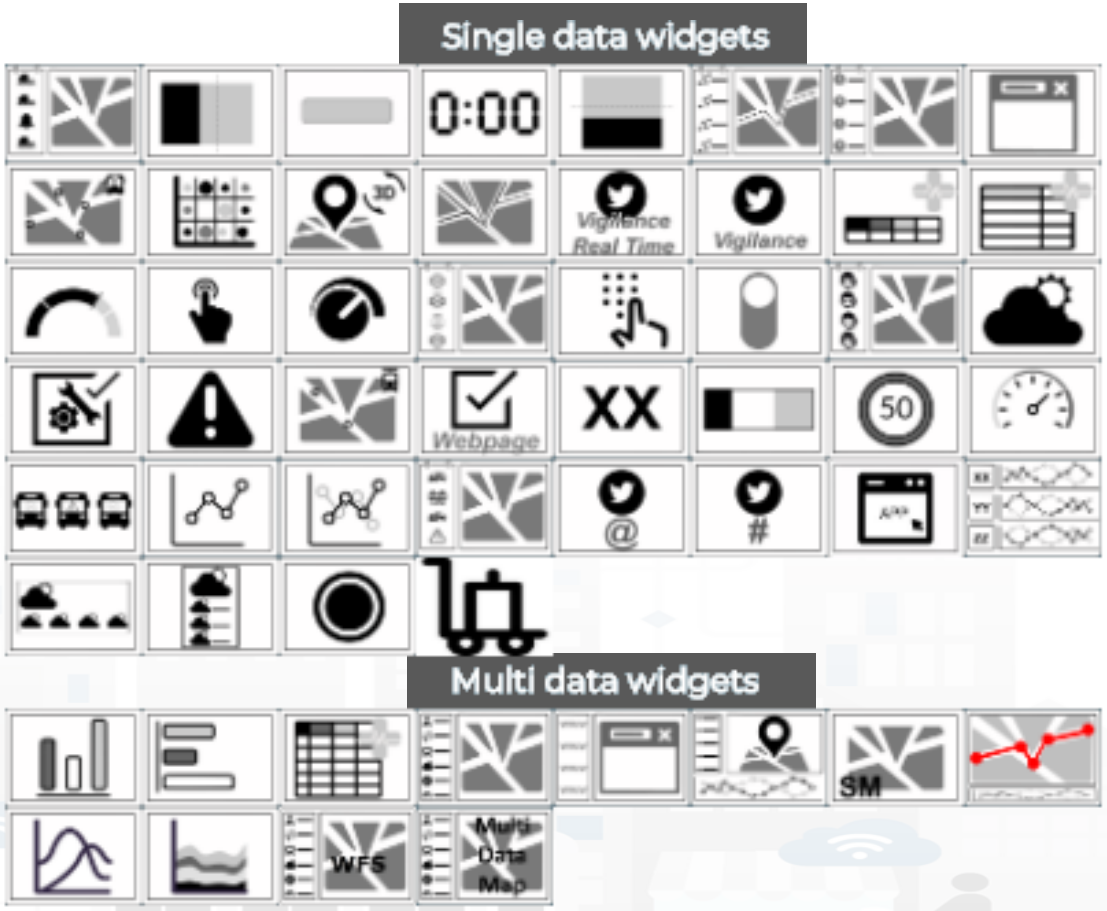
1. Create a Dashboard for the visualization of sensors values: actual and their trend
2. Create a Dashboard for the visualization of geolocated services (POI, Sensors, heatmap, etc.) and their selection on Map, with eventual target to see the time trend
3. Create a Dashboard for the visualization of MyKPI regarding my trajectories and eventually those of other users.

Nikname:.....



# 1) Create a Dashboard for the visualization of sensors values: actual and their trend

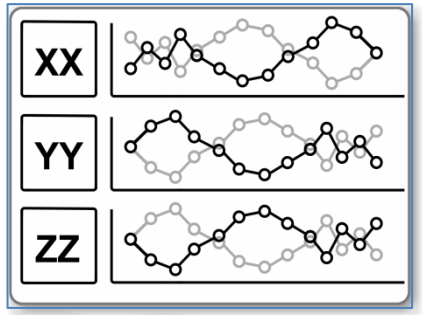
- The sensors to be selected should
  - Be located downtown in Florence around a POINT of YOUR interest: home, work, study, etc.
  - Report data regarding: environment, traffic, parking, pollution, etc.
- **We suggest to:**
  - Understand how to work with data by using the Data Inspector
  - Create a new Dashboard by Wizard
  - Customize look and fill of the Dashboard and widgets
- Time: 20 minutes

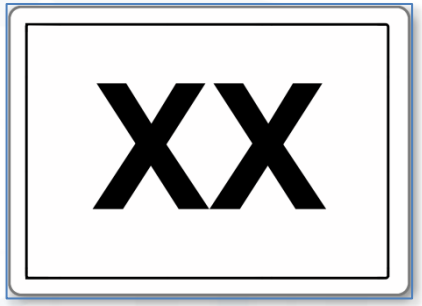


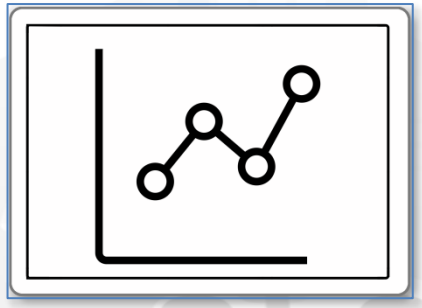

Identify your Widgets

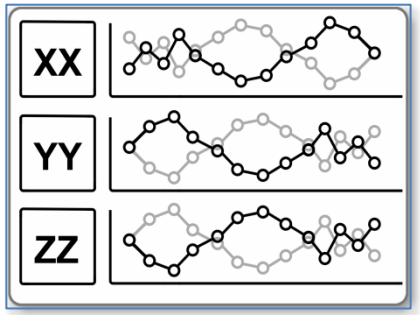
# 1) Create a Dashboard for the visualization of sensors values: actual and their trend

- The sensors to be selected should
  - Be located downtown in Florence around a POINT of YOUR interest: home, work, study, etc.
  - Report data regarding: environment, traffic, parking, pollution, etc.
- **We suggest to:**
  - Understand how to work with data by using the Data Inspector
  - Create a new Dashboard by Wizard
  - Customize look and fill of the Dashboard and widgets
- Time: 10-20 minutes



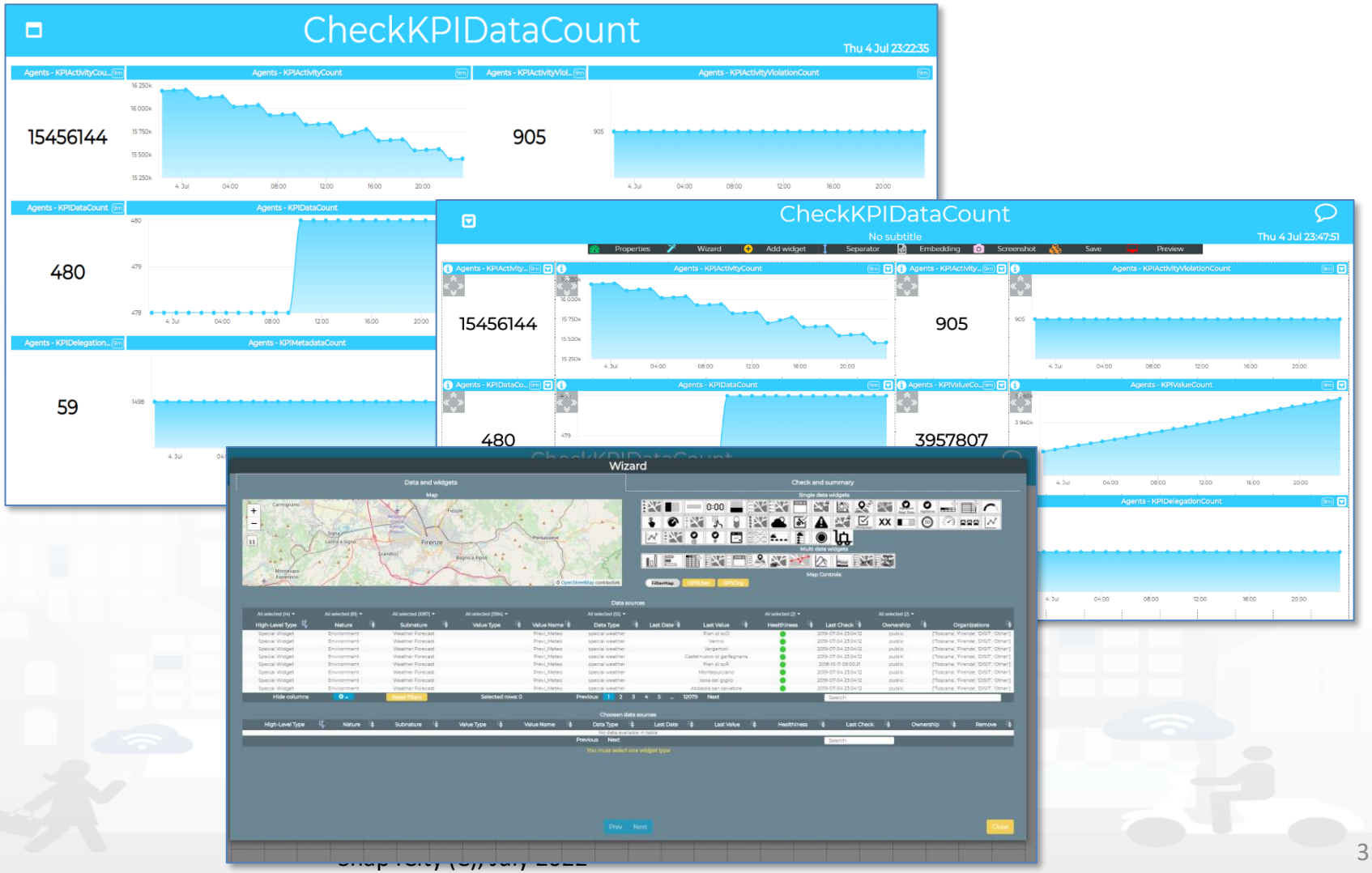






# Result could be similar to

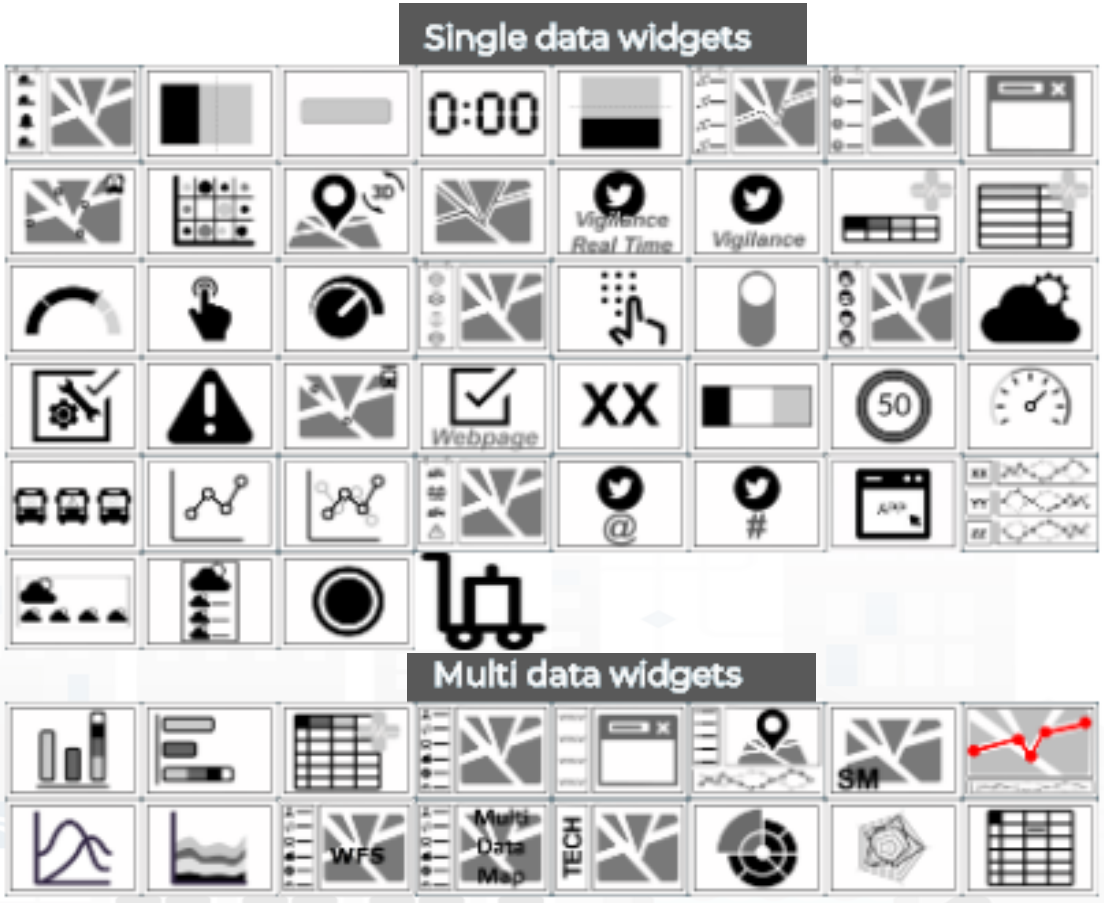
- You can add more Widgets by:
  - Wizard
  - Editor manually



Nikname:.....

# 2) Create a Dashboard for the visualization of geolocated services (POI, Sensors, heatmap, etc.) and their selection on Map, with eventual target to see the time trend

- **The HLT to be selected** should
  - Be located downtown in Florence
  - Could be of different kind **of** nature. At least 5 of them
  - Data regarding: environment, traffic, parking, pollution, etc.
- **We suggest to:**
  - Start creating the New Dashboard by Wizard
  - Customize look and fill of the Dashboard and widgets
- Time: 10-20 minutes
- There are different modalities to get similar results




Identify your Widgets

# 2) Create a Dashboard for the visualization of geolocated services (POI, Sensors, heatmap, etc.) and their selection on Map, with eventual target to see the time trend

- The HLT to be selected should
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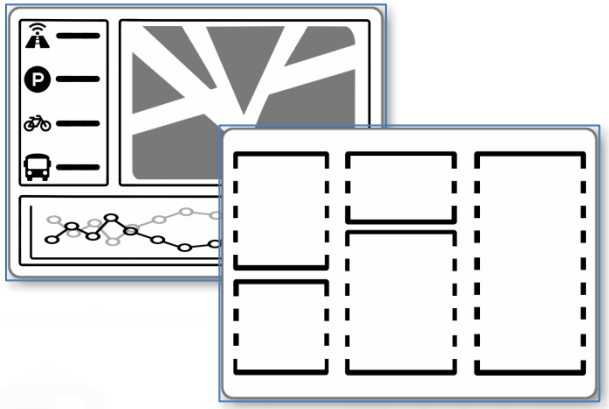
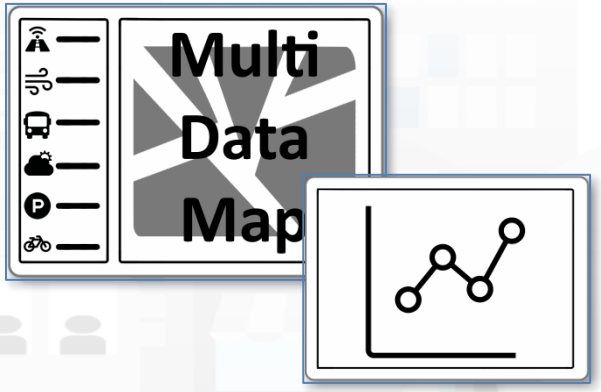
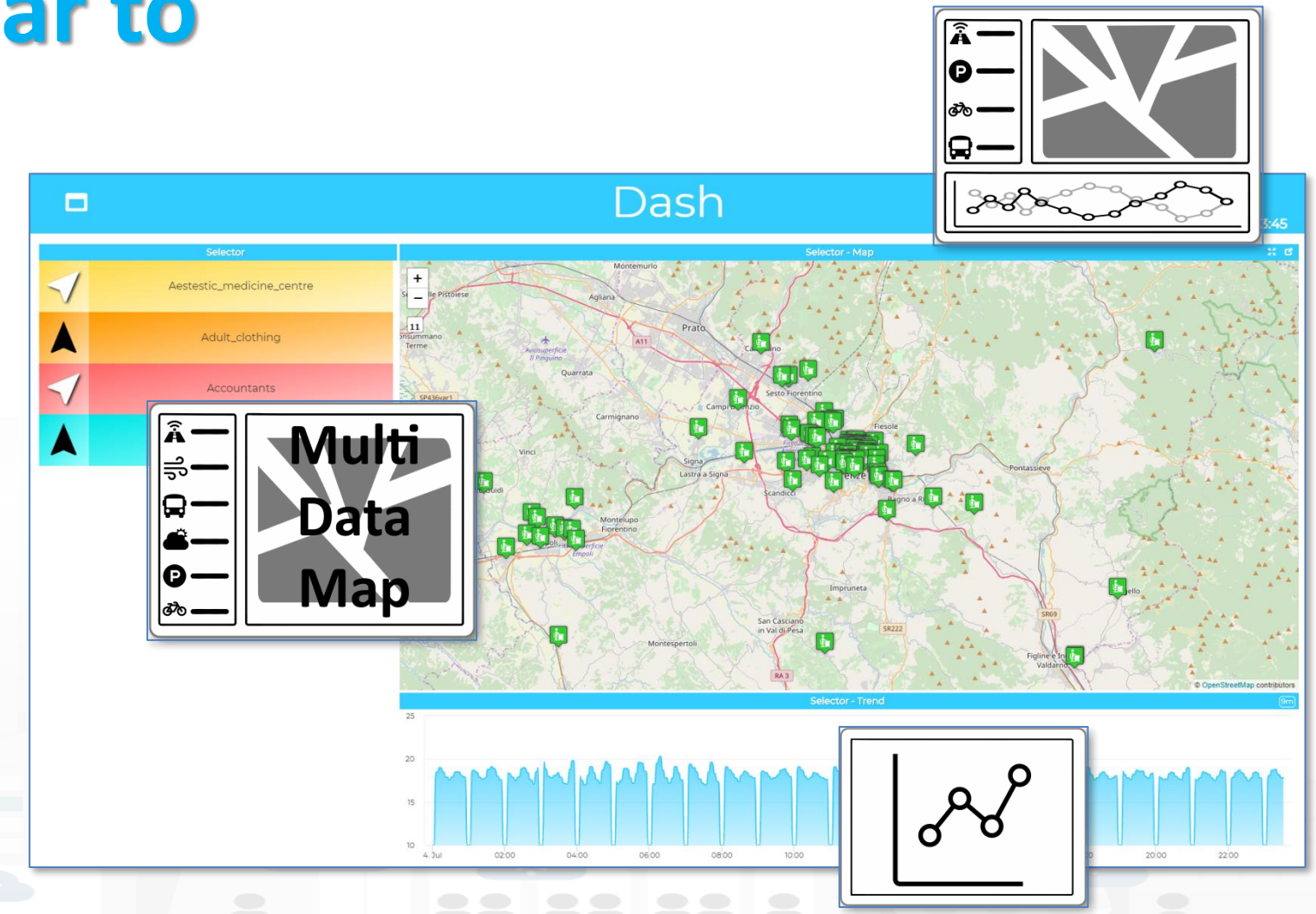




# Result could be similar to

- Not all combinations provide the same effective result
- You can
  - customize the resulting dash
  - add other widgets by wizard
  - see how a Selector is built
  - …..



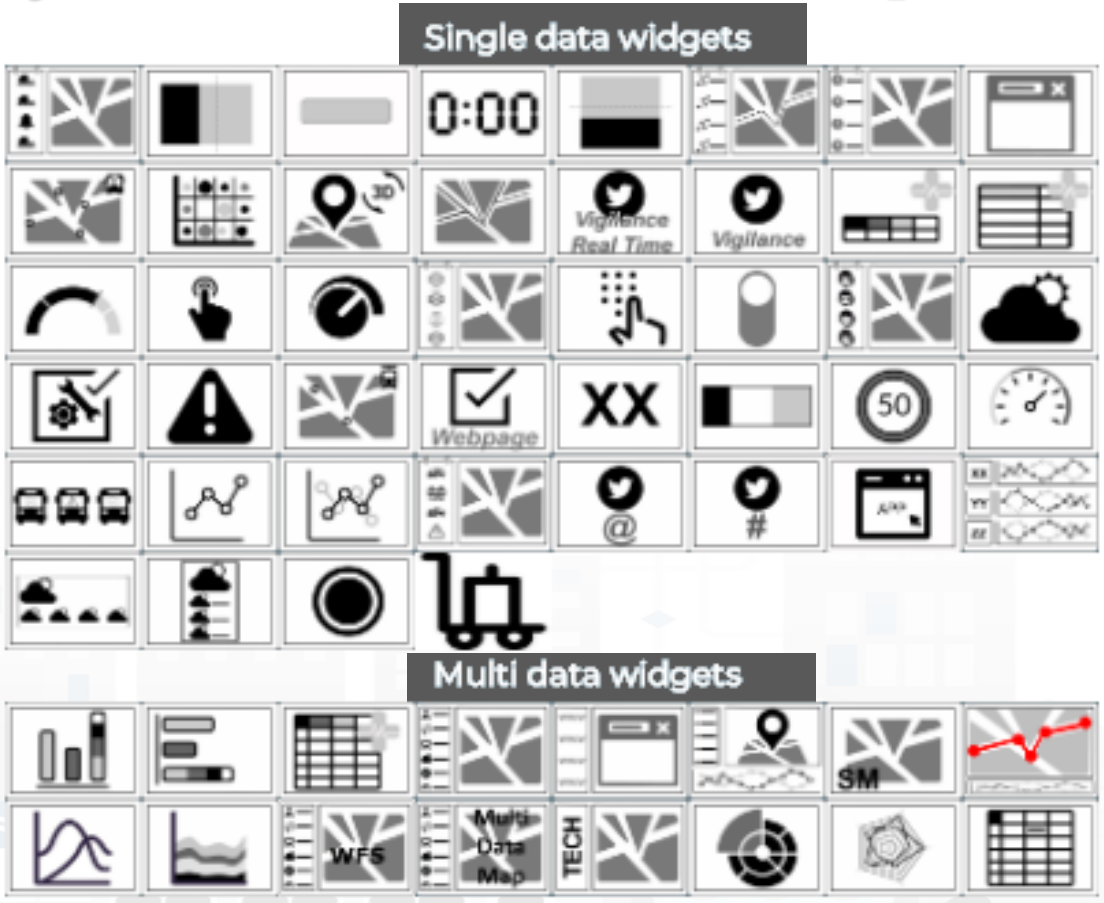

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjYxMg==

Nikname:.....



# 3) Create a Dashboard for the visualization of MyKPI regarding my trajectories and [eventually those of other users]

- **We suggest to:**
  - Open Dashboard Wizard
  - Search for your trajectory on mobile looking for MyKPI
  - Create a Dashboard exploiting the Widget Tracker
  - Customize look and fill of the Dashboard and widgets, change color of the header, etc.
- Time: 10-15 minutes




Identify your Widgets

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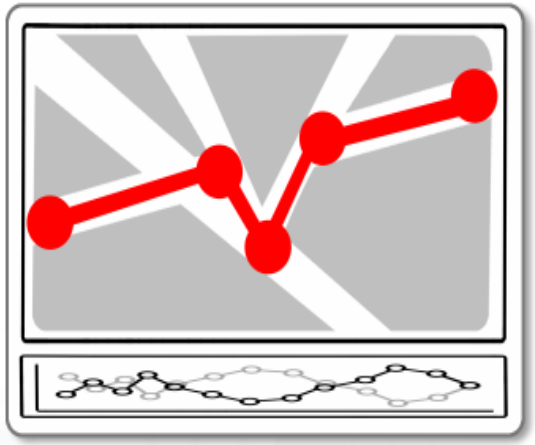
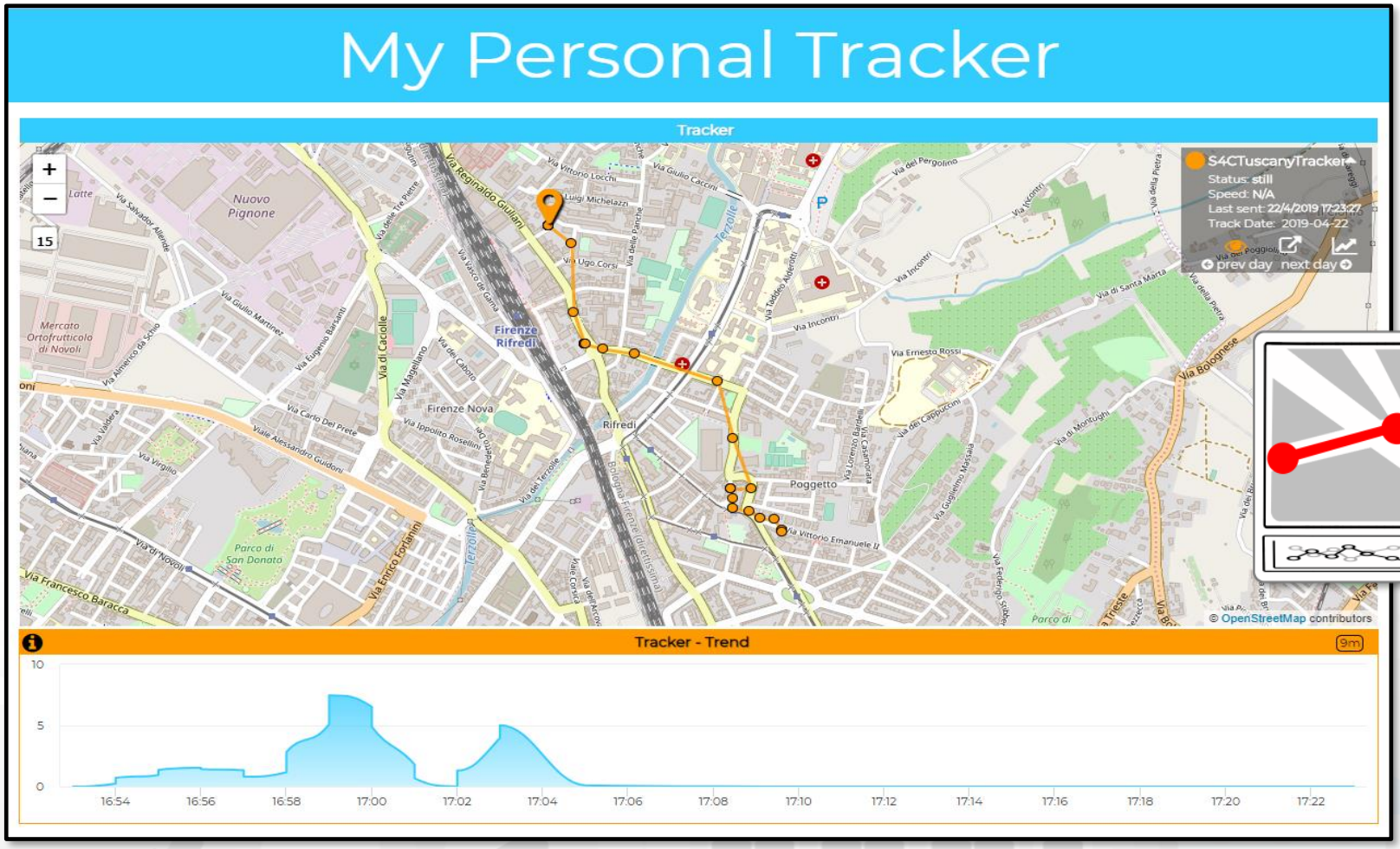


# Result could be similar to



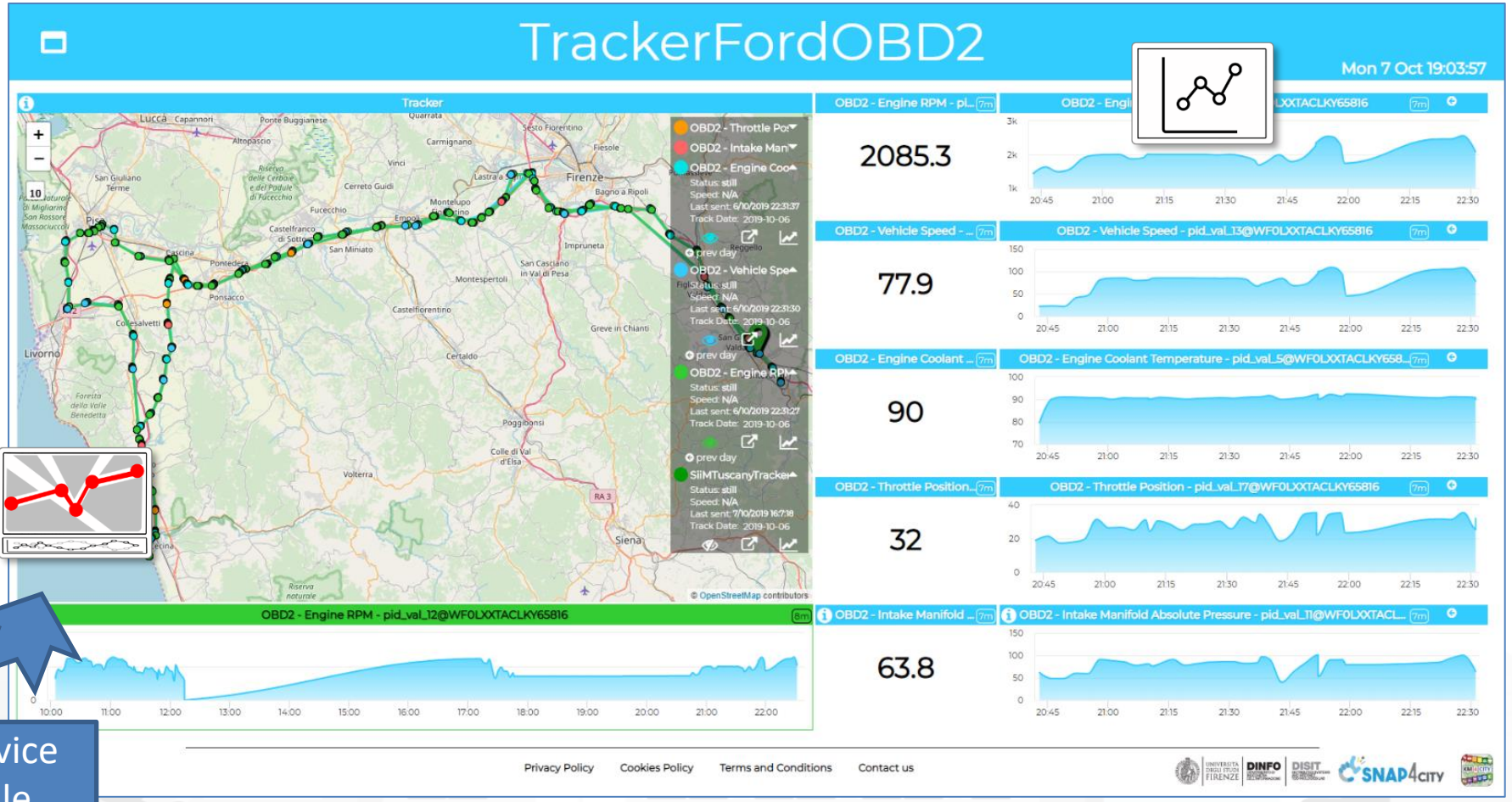




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjYxNA==

# MyKPI: Tracking of Devices and Mobiles

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



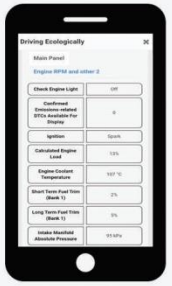
# IOE – Vehicle Monitoring

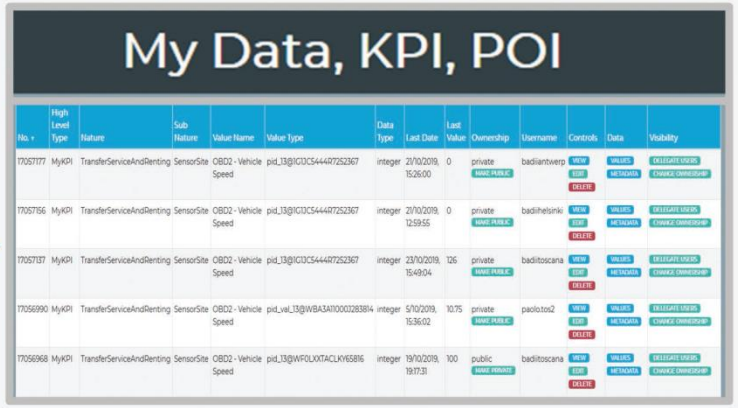


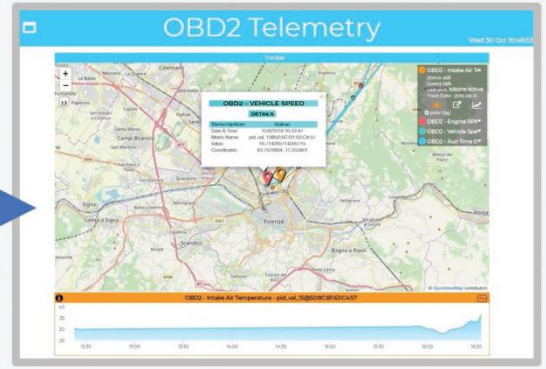
CANBUS sniffer



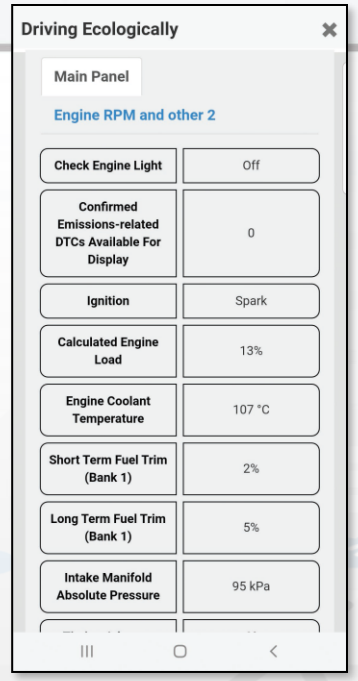

Bluetooth

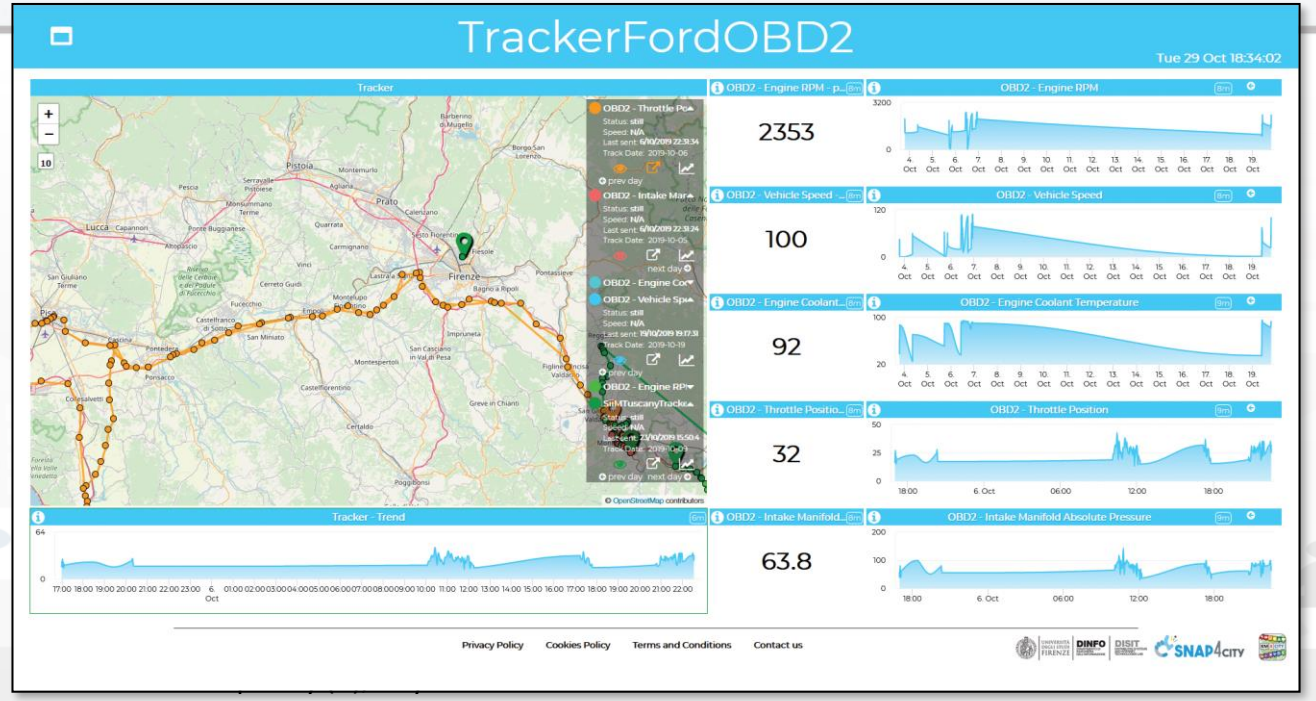





Tuscany in a Snap Mobile App on Android



# Real time device tracking

Start




moving device

Multi Data Map

Selector

start

DISIT:orionUNIFI:MyMobileDeviceTest

movit it

movit it

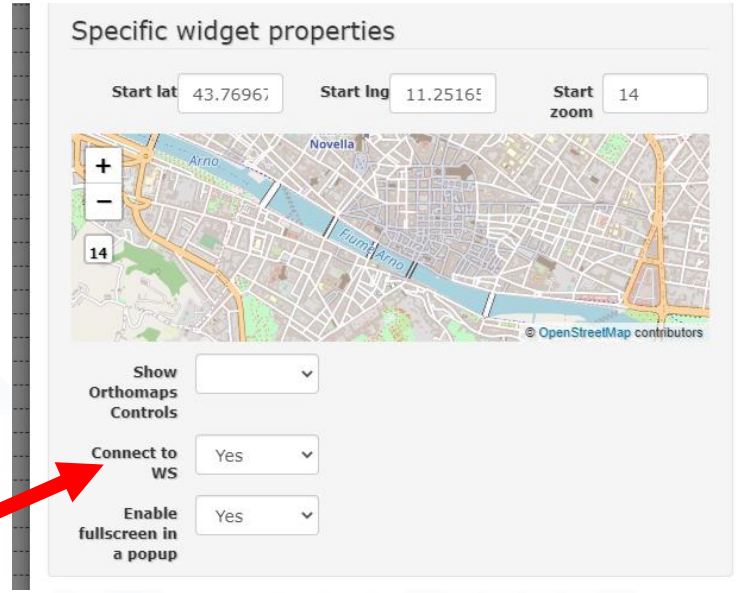
Selector - Map

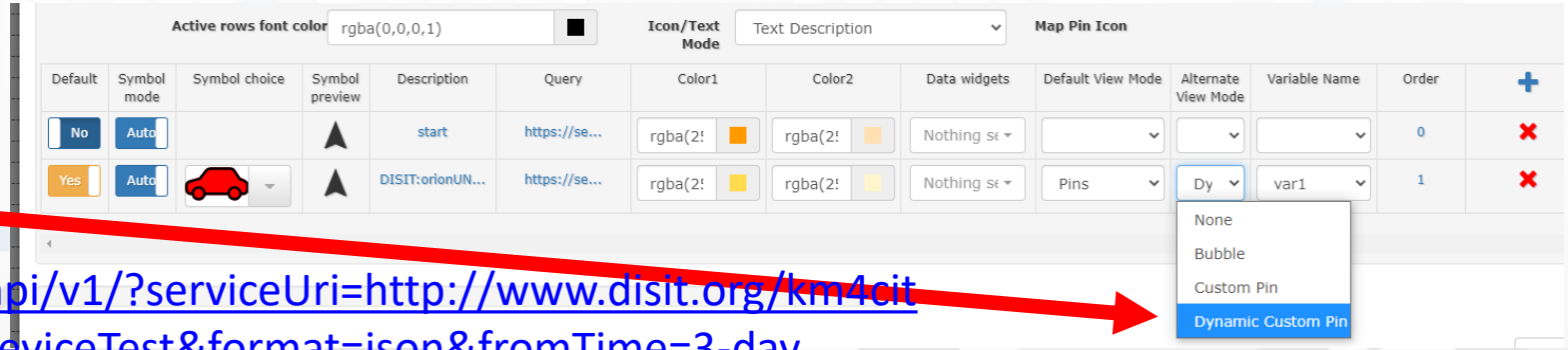
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA1Ng==

Moving and changing Dynamic PIN

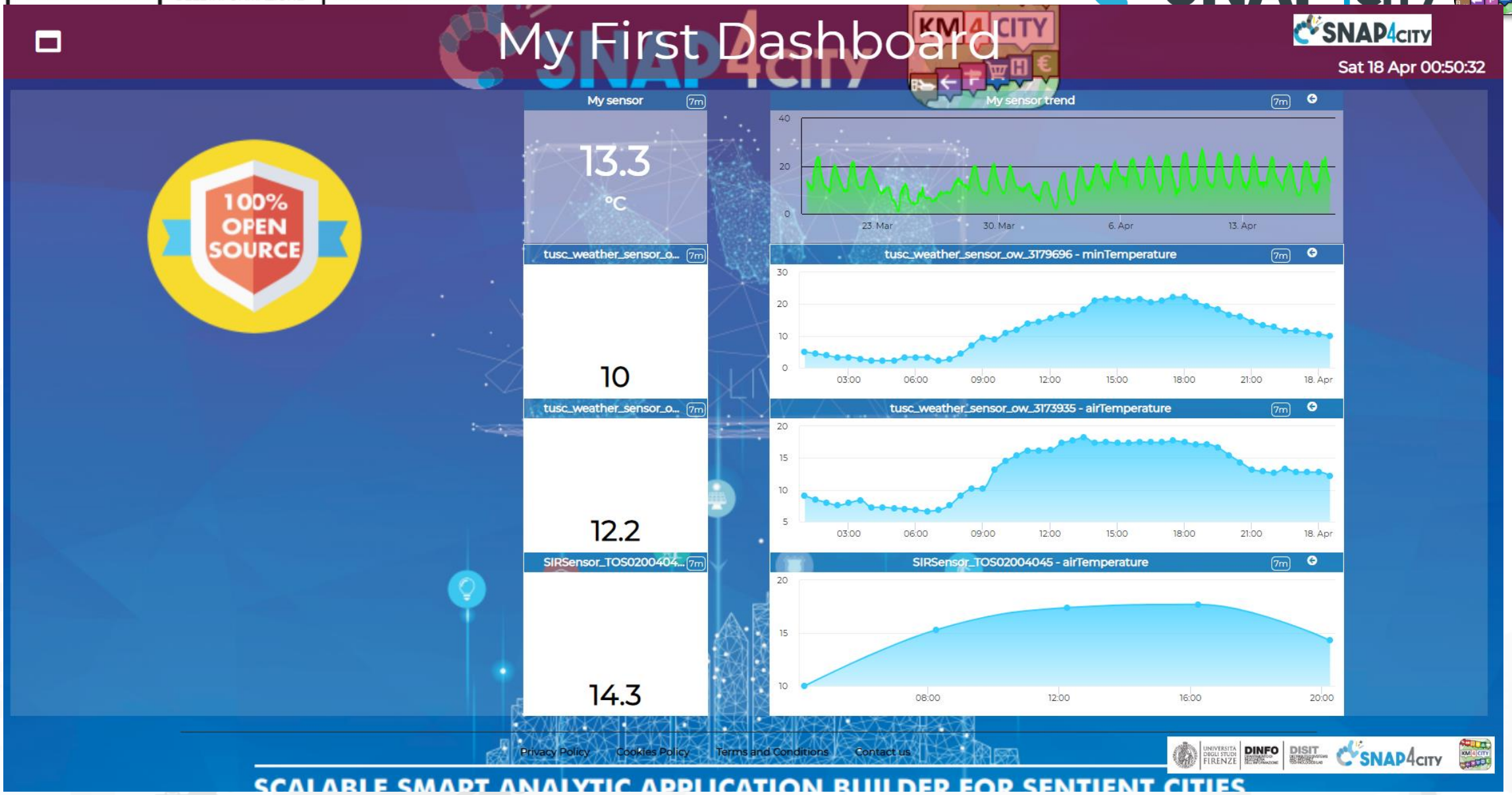
# How to create moving devices with dynamic pin

1. IOT Device Mobile is needed
2. Updates on Latitude and Longitutude have to arrive into the platform
3. Dashboard
   - MultiDataMap has to activate the Connection to WS service on MoreOptions
   - Selector on the specific PIN has to be set as




https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUri=http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/MyMobileDeviceTest&format=json&fromTime=3-day




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

# my example of dashboard

Sat 18 Apr 00:49:24

**Bar Series** (3m)

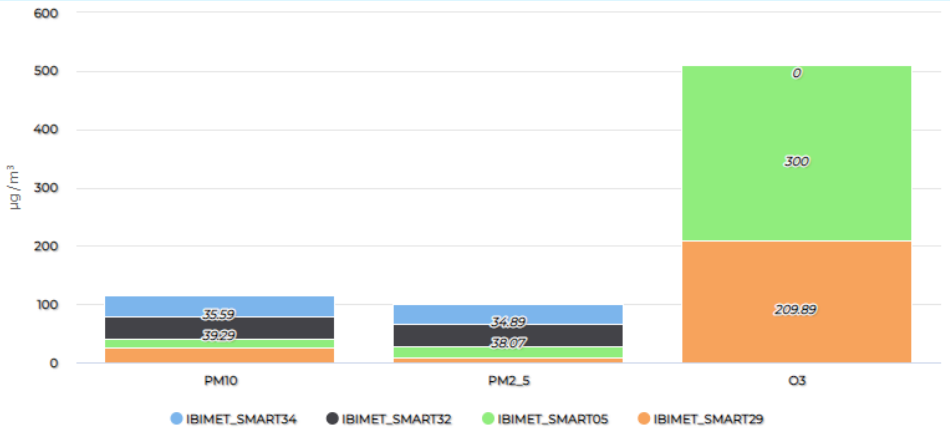
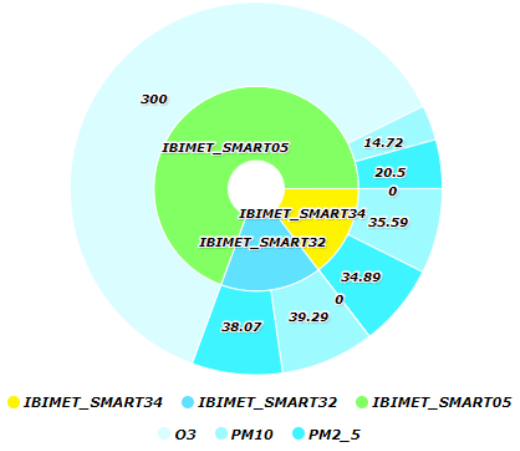


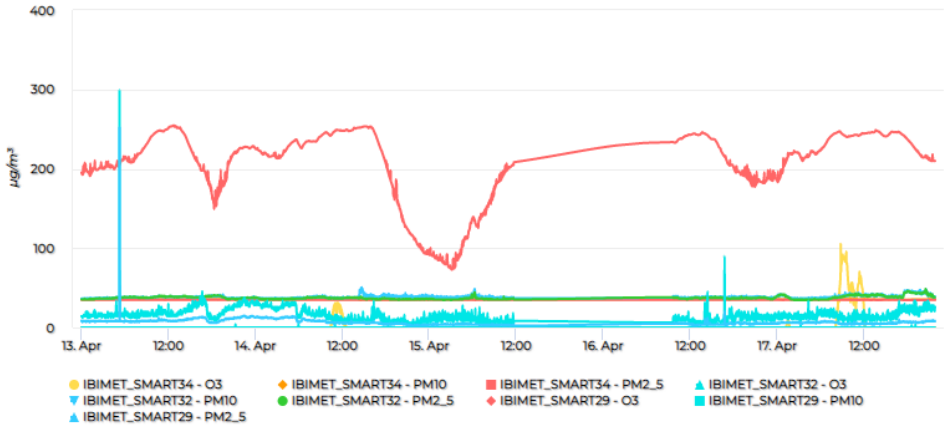

**Table** (3m)

| value type / value name | PM2_5 | PM10 | O3 | airHumidity | airTemperature |
|---|---|---|---|---|---|
| IBIMET_SMART19 | 17.85 | 20.63 | 107.51 | | |
| IBIMET_SMART12 | 6.81 | | 44.95 | 47.1 | 17.3 |
| IBIMET_SMART17 | | | 300 | 0 | 0 |
| IBIMET_SMART29 | | | | 90.1 | 14.6 |

**Pie Chart** (8m)




**Time trend comparison** (3m)




Privacy Policy Cookies Policy Terms and Conditions Contact us

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

# Mobility and Environment What-IF Analysis

This dashboad contains data derived from actual sensors and predictive values under validation

Mon 14 Oct 00:48:17

- Air Quality Sensors
- Weather Sensors
- PM10 Heatmap
- PM2.5 Heatmap
- CO Heatmap
- CO2 Heatmap
- O3 Heatmap
- NO2 Heatmap
- Europ. AQI Heatmap
- Air Humidity Heatmap
- Air Temp. Heatmap
- Wind Speed Heatmap
- Gral Pred. HM NOX (3m)
- Gral Pred. HM NOX (6m)
- Traffic Sensors
- Traffic Flow
- Cycling Paths
- Accident Heatmap
- Only HRes Anym. Gral
- Scenarious
- What-if analysis

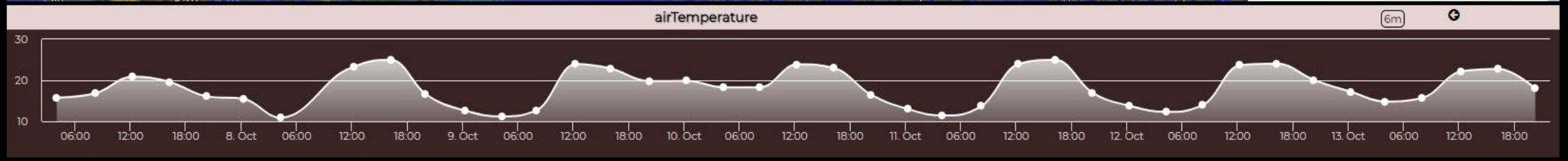
Firenze Oggi

Air Temperat... 6m










https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

# Mobility and Environment What-IF Analysis

This dashboad contains data derived from actual sensors and predictive values under validation

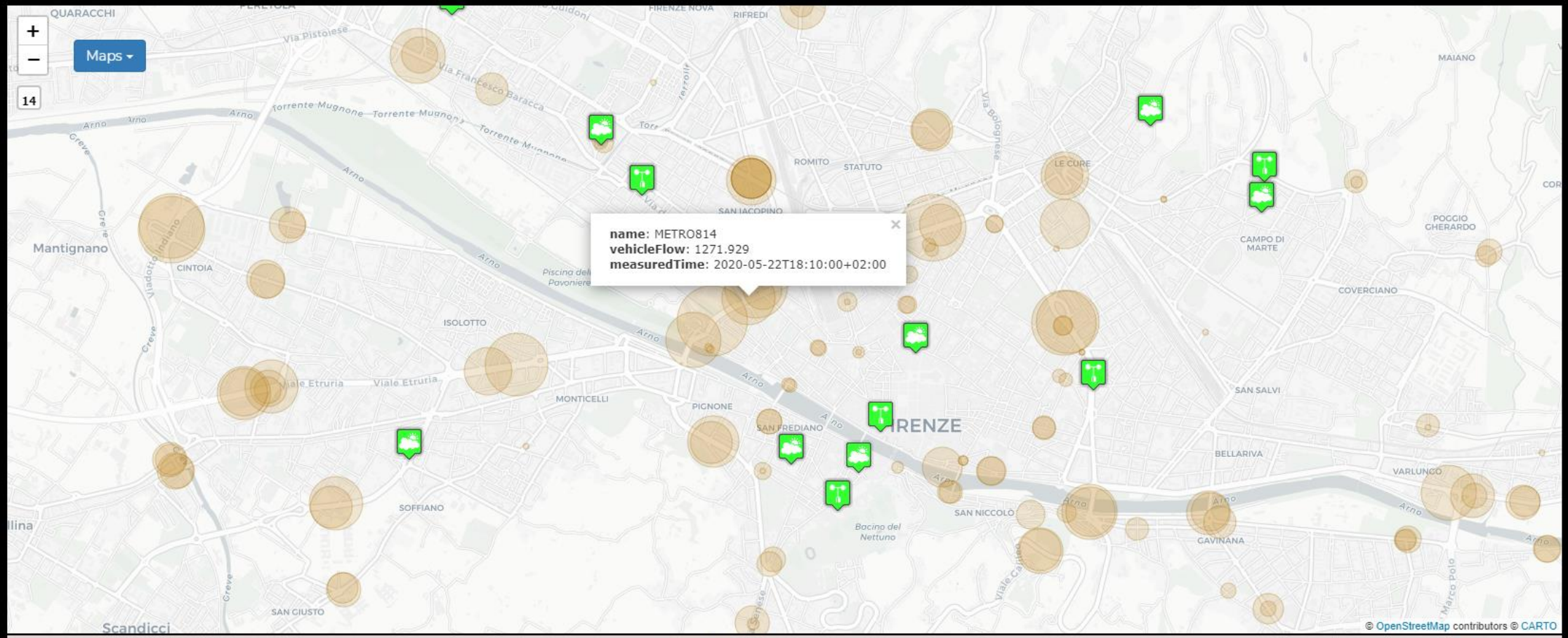
Fri 22 May 18:19:41

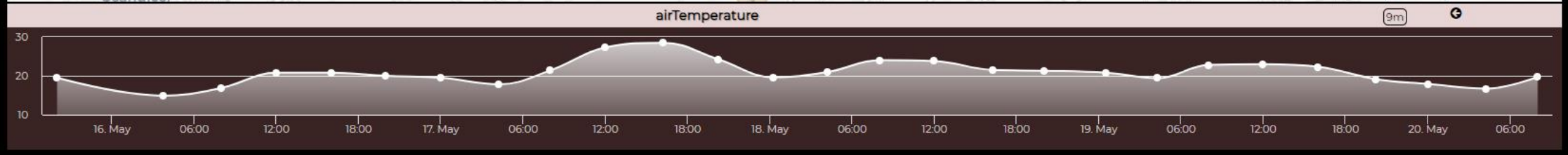
- Air Quality Sensors
- Weather Sensors
- PM10 Heatmap
- PM2.5 Heatmap
- CO Heatmap
- CO2 Heatmap
- O3 Heatmap
- NO2 Heatmap
- Europ. AQI Heatmap
- Air Humidity Heatmap
- Air Temp. Heatmap
- Wind Speed Heatmap
- Gral Pred. HM NOX (3m)
- Gral Pred. HM NOX (6m)
- Traffic Sensors
- Traffic Flow
- Traffic Bubble
- Cycling Paths
- Accident Heatmap
- Only HRes Anym. Gral
- Scenarious
- What-if analysis

Firenze Oggi

Air Temperat... 9m



# Dashboards

- **Suitable** as: City Dashboard, App interface, and Control Room Dashboards, Situation Room Dashboard, Operator Dashboard
- **Created** visually compounding graphic Widgets
  - Each widget has 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**
  - **US1. Using City Dashboards**
  - **US2. Using and Creating Snap4City Applications with Dashboards**
  - **US4. Creating City Dashboards and related Event Monitoring and Actions**

# Mechanisms of Selector for the Multi Data Map widget



# The Selector for Multi Data Maps









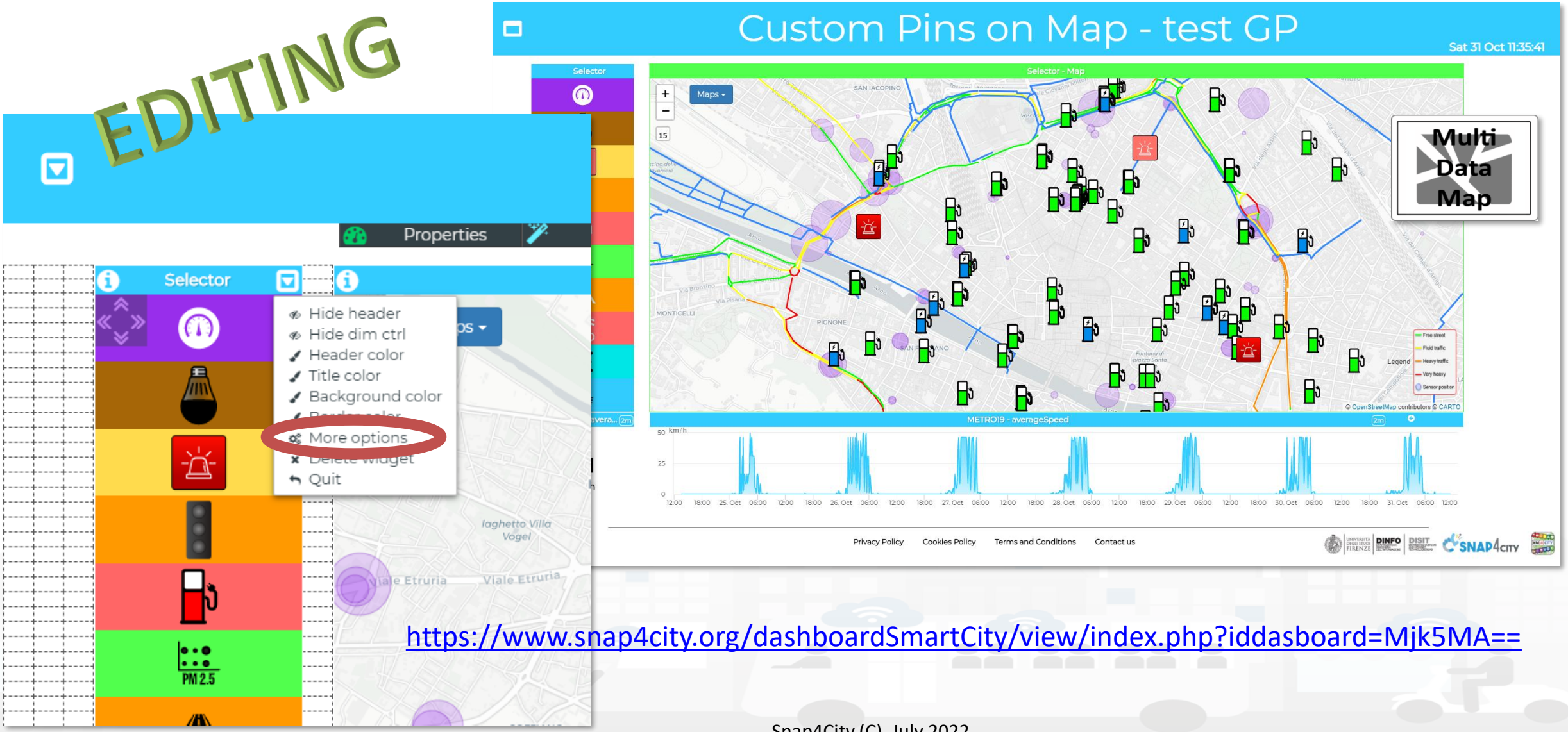




- **Different styles**
  - Icon and Text menu
  - Custom Menu Icon
  - Icon Menu buttons
  - Etc.
- **Features**
  - Removable header
  - Colours custom
  - Transparencies
  - Mixed modalities
- **Note:**
  - Manus can be realized also with a set of Buttons

*The Selector is the Map Controller*

# Custom Dynamic Pins




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjk5MA==

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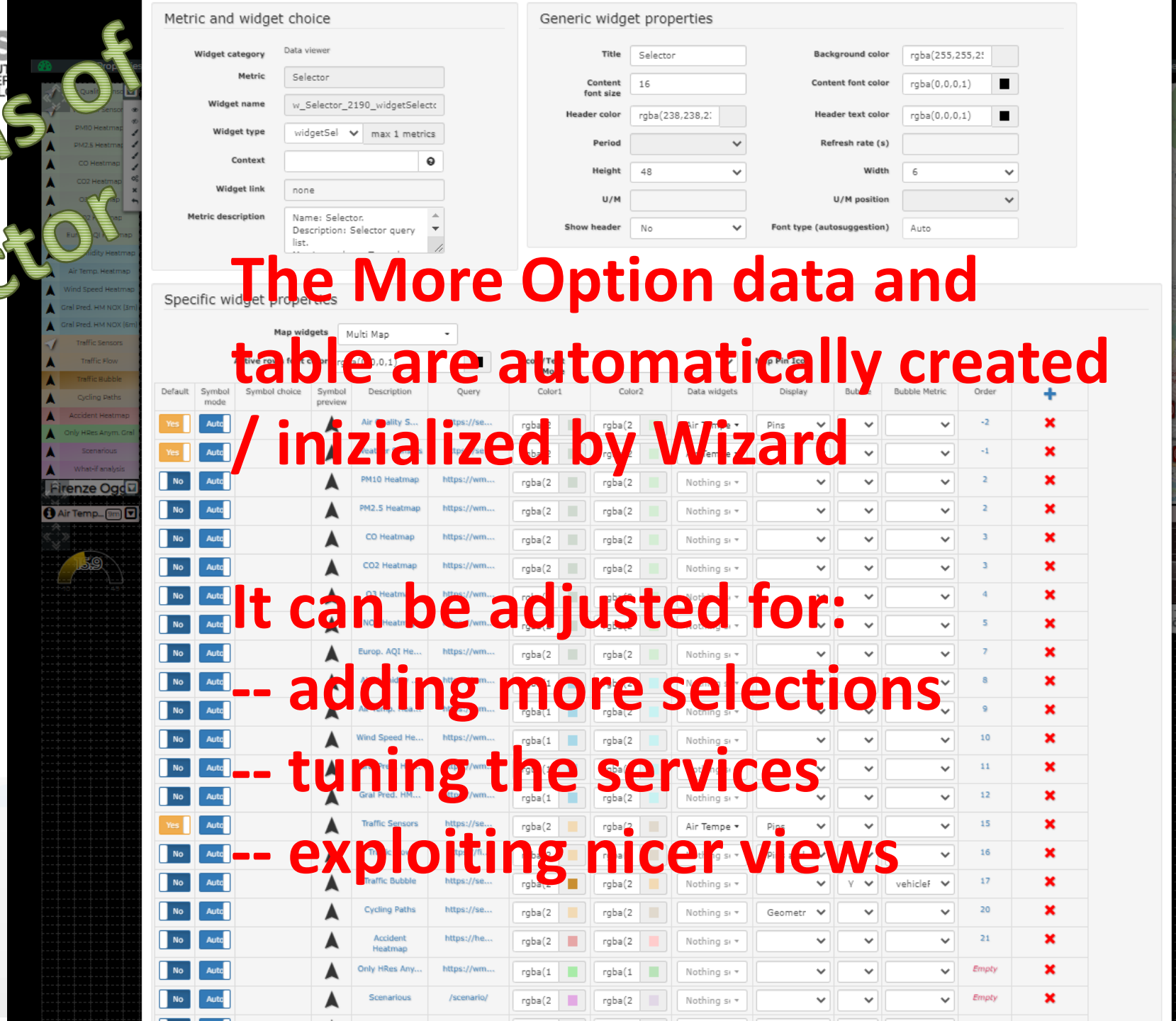
# More Options of the Selector

- Setting:
  - Heatmaps
  - Bubbles
  - Icons
  - Custom
  - Traffic flow
  - Cycling path
  - What-if
  - Etc. etc.




**The More Option data and table are automatically created / inizialized by Wizard**

**It can be adjusted for:**

**-- adding more selections**

**-- tuning the services**

**-- exploiting nicer views**

# MoreOptions (below part)

## Specific widget properties

**Map widgets** Selector Ma

**Active rows font color** rgba(0,0,0,1)

**Icon/Text Mode** Icon Only

**Map Pin Icon** Pin Icon

| Default | Symbol mode | Symbol choice | Symbol preview | Symbol color | Description | Query | Color1 | Color2 | Data widgets | Default View Mode | Map Icon color | Alternate View Mode | Variable Name | Order | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yes | Auto | | | | Traffic Bubbl... | https://se... | rgba(1! | rgba(1! | Nothing se | | | Bub | vehicleFl | 1 | ✖ |
| No | Auto | | | | Psvgb_X-val3 | https://se... | rgba(1( | rgba(1( | METRO19 | Pir | | Cus | val3 | 2 | ✖ |
| No | Auto | | | | Psvgb_X-val1 | https://se... | rgba(2! | rgba(2! | METRO19 | Pir | | Cus | val1 | 3 | ✖ |
| No | Auto | | | rgba(( | Psvgb_X-val4 | https://se... | rgba(2! | rgba(2! | METRO19 | Pir | | Cus | val4 | 4 | ✖ |
| No | Auto | | | rgba(! | recharging st... | https://se... | rgba(2! | rgba(2! | METRO19 | | Symbol ( | Cus | stationSt | 5 | ✖ |
| No | Auto | PM 2.5 | PM 2.5 | | PM2_5 Heatmap | https://wm... | rgba(8: | rgba(8: | Nothing se | | | | | Empty | ✖ |
| No | Auto | | | | Traffic Flow | https://fi... | rgba(2! | rgba(2! | Nothing se | | | | | Empty | ✖ |
| No | Auto | | | | Cycling Paths | https://se... | rgba(2! | rgba(2! | Nothing se | | | | | Empty | ✖ |
| No | Auto | | | | Scenario | /scenario/ | rgba(0, | rgba(1! | Nothing se | | | | | Empty | ✖ |
| No | Auto | WHAT-IF | WHAT-IF | | What-IF | /whatif/ | rgba(5: | rgba(1! | Nothing se | | | | | Empty | ✖ |

You may need to save and reopen the MoreOptions more than once to pass on different kinds of configurations

# The Selector is the Map Controller

MoreOptions

Specific widget properties

Selector - Map

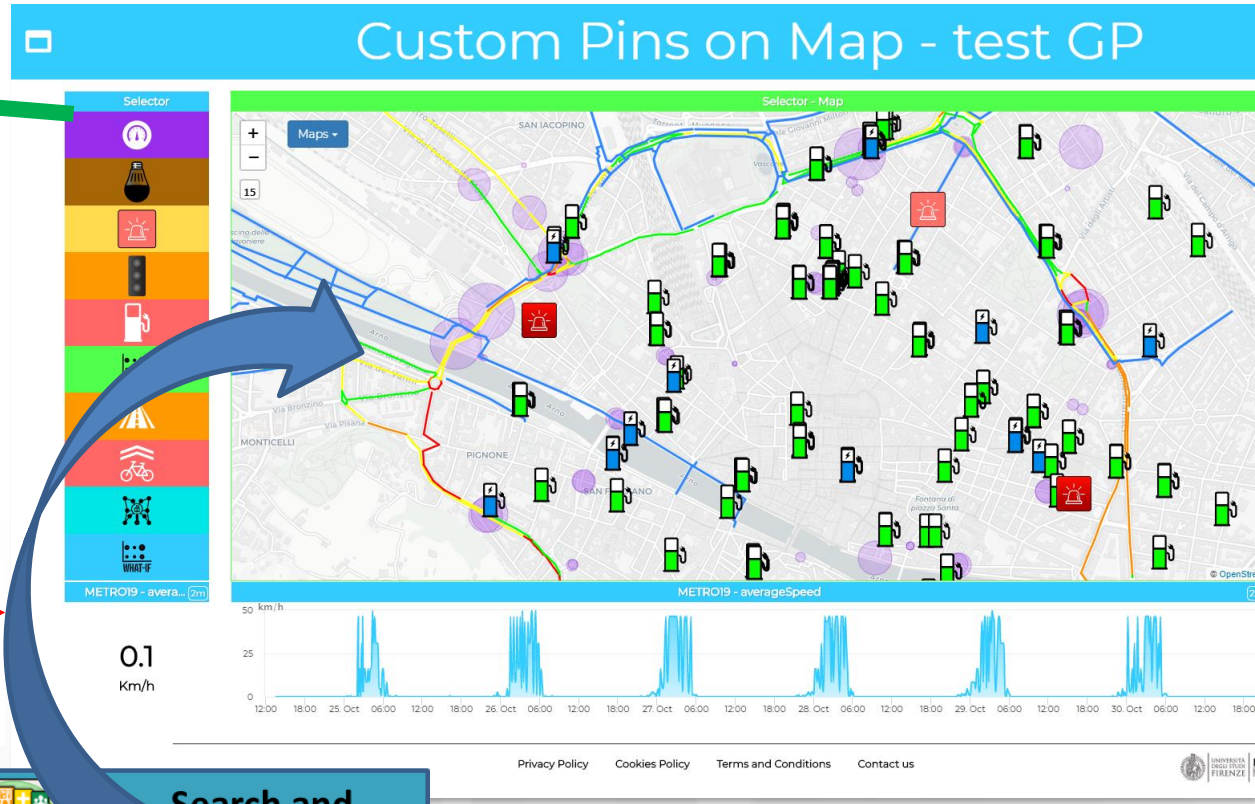
Active rows font color rgba(0,0,0,1)

Icon/Text Mode

| Default | Symbol mode | Symbol choice | Symbol preview | Symbol color | Description | Query |
|---|---|---|---|---|---|---|
| Yes | Auto | | | | Traffic Bubbl... | https://se... |
| No | Auto | | | | Psvgb_X-val3 | https://se... |
| No | Auto | | | | Psvgb_X-val1 | https://se... |
| No | Auto | | | rgba(( | Psvgb_X-val4 | https://se... |
| No | Auto | | | rgba(9 | recharging st... | https://se... |
| No | Auto | PM 2.5 | PM 2.5 | | PM2_5 Heatmap | https://wm... |
| No | Auto | | | | Traffic Flow | https://fi... |
| No | Auto | | | | Cycling Paths | https://se... |
| No | Auto | | | | Scenario | /scenario/ |
| No | Auto | WHAT-IF | WHAT-IF | | What-IF | /whatif/ |

More Options Edit

- Query ID
- REST CALL
- Command
- Heatmap




**Knowledge base**
Semantic reasoners

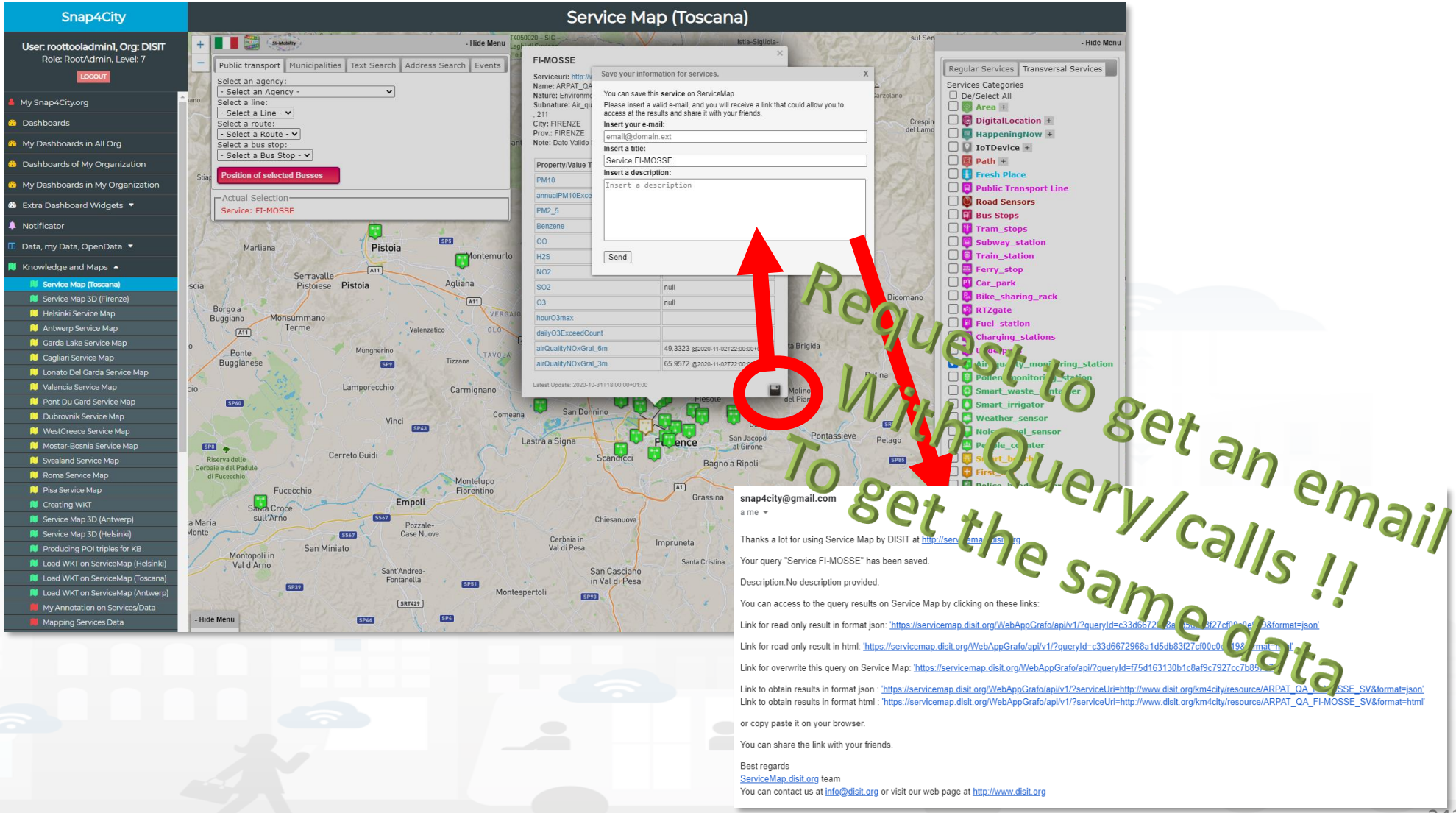
**Indexing and aggregating**
Elastic search

**Search and Query, Smart City API**
Facet, semantic search

- ***The Query is produced by Wizard but can be manually changed***

# How to Get the «Query» used in More Options (1)

- **Query ID**
  - **only Read and Read/Write of the query**
- **REST CALL of the Smart City APIs**
  - **JSON**
  - **HTML (do not use into MoreOptions)**



# The example of email from ServiceMap

**snap4city@gmail.com**

a me

Thanks a lot for using Service Map by DISIT at http://servicemap.disit.org

Your query "Service FI-MOSSE" has been saved.

Description:No description provided.

You can access to the query results on Service Map by clicking on these links:

Link for read only result in format json: 'https://servicemap.disit.org/WebAppGrafo/api/v1/?queryId=c33d6672968a1d5db83f27cf00c0e919&format=json'

Link for read only result in html: 'https://servicemap.disit.org/WebAppGrafo/api/v1/?queryId=c33d6672968a1d5db83f27cf00c0e919&format=html'

Link for overwrite this query on Service Map: 'https://servicemap.disit.org/WebAppGrafo/api/?queryId=f75d163130b1c8af9c7927cc7b857d70'

Link to obtain results in format json : 'https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUri=http://www.disit.org/km4city/resource/ARPAT_QA_FI-MOSSE_SV&format=json'
Link to obtain results in format html : 'https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUri=http://www.disit.org/km4city/resource/ARPAT_QA_FI-MOSSE_SV&format=html'

or copy paste it on your browser.

You can share the link with your friends.

Best regards
ServiceMap.disit.org team
You can contact us at info@disit.org or visit our web page at http://www.disit.org

# How to Get the «Query» used in More Options (2a)

- **REST CALL by category → JSON (Options in RED), they are REST ASCAPI calls**
  - **Requesting a category, so that to see all Services of the same category (subNature)**
    - http://svealand.snap4city.org/ServiceMap/api/v1/?selection=59.581458578537955;16.71183586120606;59.62875017053684;16.875171661376957&categories=Street_light&maxResults=100&format=json
      - Please note that in the MoreOption dashboard the GPS area is neglected
    - https://servicemap.disit.org/WebAppGrafo/api/v1/?selection=43.64471;11.005751;43.89471;11.505751&categories=Green_areas&maxResults=200&format=json
      - Please note that in the MoreOption dashboard the GPS area is neglected
    - Custom PINS note: "selection" coordinates are used for collecting attributes in custom PINS. Other options such as "maxDists" cannot be used in custom PIN. All parameters can be used in other cases.
    - Different KB links are identified by their ASCAPI links: svealand.snap4city.org, servicemap.disit.org, ….
  - **Requests to SuperServiceMap for the network of Federated KBs** by using /api/…….

    Without prefixed KB to obtain merged results from more KBs. For example as:
    - /api/v1/?categories=Air_quality_monitoring_station&format=json
    - Please note that the direct links to the superservicemap can be of the form:
      - https://www.disit.org/superservicemap/api/v1/? ……

# How to Get the «Query» used in More Options (2b)

- **REST CALL by ServiceURI → JSON (ServiceURI in RED), they are ASCAPI calls**
  - **Requesting single Service**
    - https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUri=http://www.disit.org/km4city/resource/ARPAT_QA_FI-BOBOLI&format=json
    - https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUri=http://www.disit.org/km4city/resource/ARPAT_QA_FI-MOSSE_SV&format=json
      - Different KBs links are identified by their ASCAPI links: svealand.snap4city.org, servicemap.disit.org,
  - **Requesting all IoT Devices that have been produced by the same Model**
    - **https://www.disit.org/superservicemap/api/v1?selection=59.36535064975547;13.457822799682619;59.39031474260852;13.566999435424806&model=SmartLightCapelon**&format=json
      - Please note that in this case the call is performed on the superservicemap, you can change to go directly on the right KB
      - You can specific both category and model to be more precise and focused.
    - **https://www.disit.org/superservicemap/api/v1/?selection=36.8092847020594;12.216796875000002;42.71473218539458;32.03613281250001&categories=Travel_information&format=json&fullCount=false&maxResults=500&model=DOMESTICMOVEMENTS2013-2018_1620304406**
      - In this case, we have a double filtering for model and for categories, plus other constraints
      - Please note that in the MoreOption dashboard the GPS area is neglected

# How to Get the «Query» used in More Options (2c)

- **Requesting view on map single device**
  - **Request to see the single device:**
    - https://svealand.snap4city.org/ServiceMap/api/v1/?serviceUri=http://www.disit.org/km4city/resource/iot/orionCAPELON-UNIFI/CAPELON/5C0272FFFE894AF7&format=json&fromTime=3-day
    - **With ServerURI:** http://www.disit.org/km4city/resource/iot/orionCAPELON-UNIFI/CAPELON/5C0272FFFE894AF7
    - **From KB:** https://svealand.snap4city.org

- **REST CALL into the query of the more options for GIS services**
  - **Requests from GIS servers** by using WFS API and services
    - https://os.cittametropolitana.fi.it/imobi-ds/trafficsensors/1758EB9B47A3904E05673BFEEE61AB1776C4C0050E7BD7FB195EA33CC56767BE/ows?service=WFS&version=1.1.0&request=GetFeature&typeName=TrafficSensors

# How to Get the «Query» used in More Options (3)

- **ServiceMap (specific KB) and Query service**
  - The Query performed is saved and can be recalled with a QueryID, valid for that specific KB, and not accessible via SuperServiceMap / Federated KB
  - The QueryID is communicated via email
  - Specific REST Call with HTML is also provided to change the Query in server associated with the QueryID received

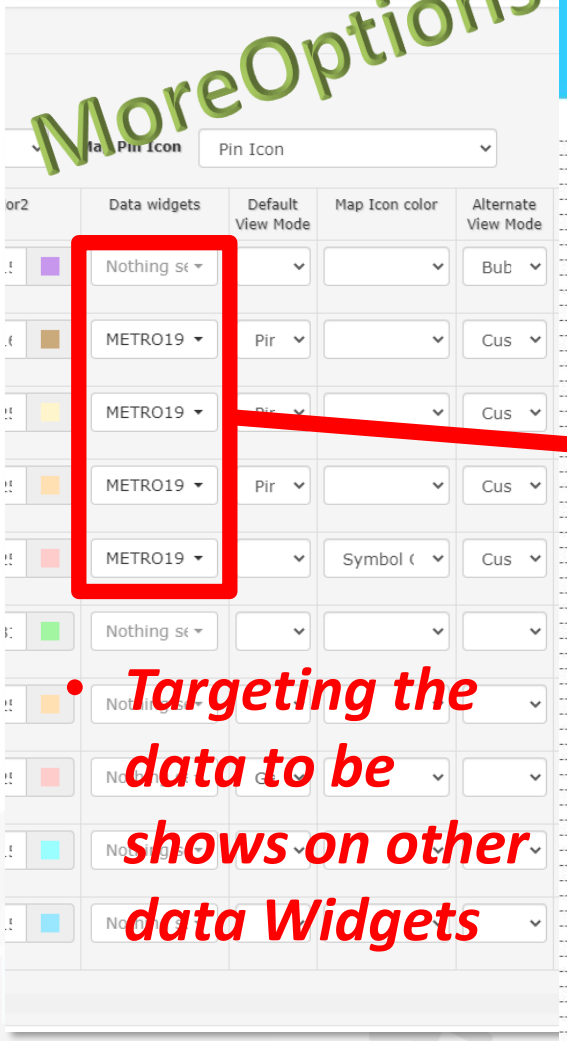
- **Query ID (only Read and Read/Write of the query)**
  - https://servicemap.disit.org/WebAppGrafo/api/v1/?queryId=1c8111893d40a2bb07a2078ffe299ced&format=json
  - Cannot be used for Custom PINs.
  - **Cannot be used to get data via ServiceMap since the Query ID is KB based**

# Special Commands in «Query» of More Options (4)

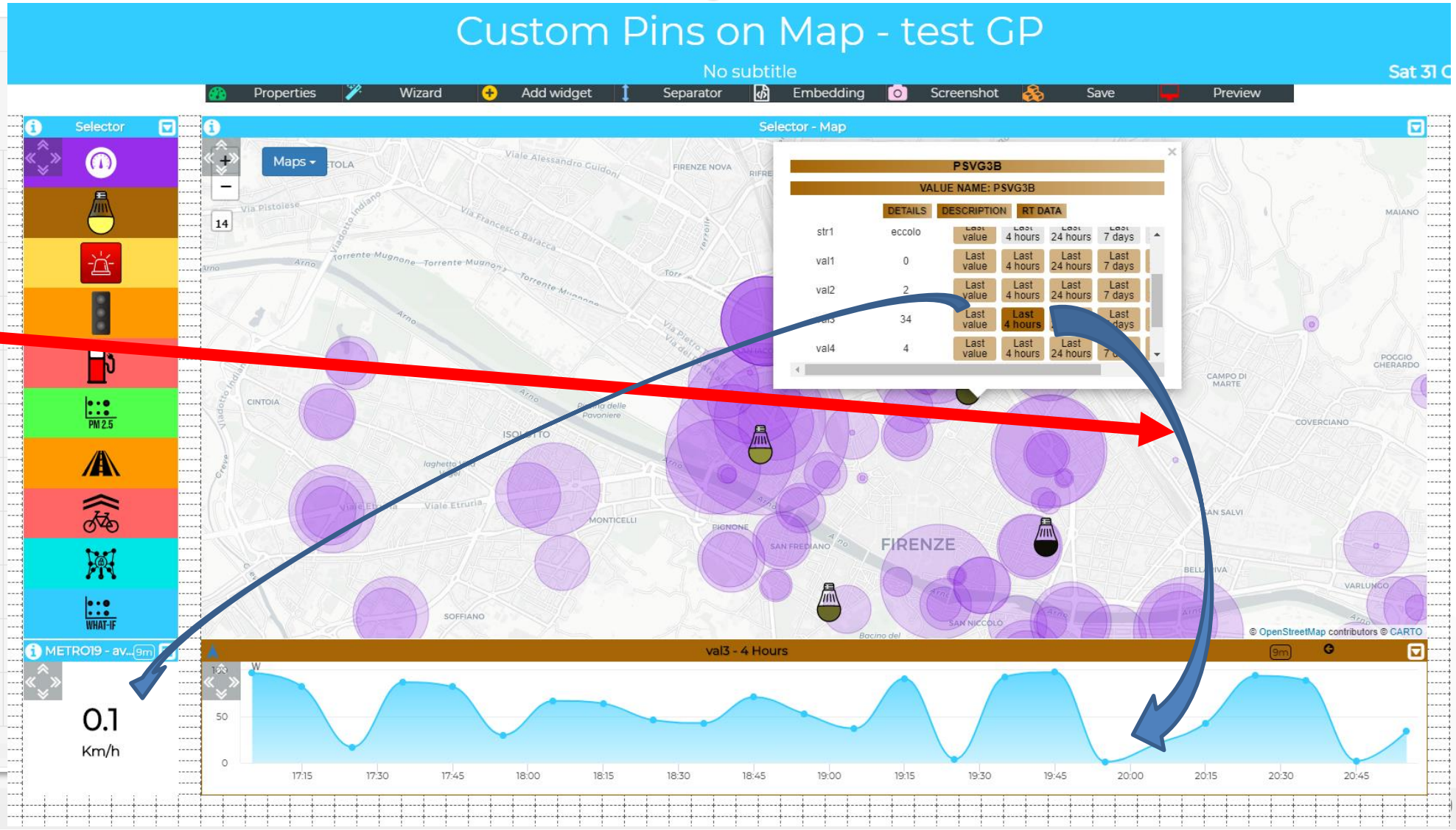
- **Commands for Special Tool**:
  - **Traffic Flow** tool: https://firenzetraffic.km4city.org/trafficRTDetails/roads/read.php
  - **Scenario** tool: /scenario/
  - **Whatif** tool: /whatif/
- **Heatmaps**, see Data Analytic part of the training for the several versions which can be used:
  - https://wmsserver.snap4city.org/geoserver/Snap4City/wms?service=WMS&layers=PM2_5Average24HourFlorence
  - https://wmsserver.snap4city.org/geoserver/Snap4City/wms?service=WMS&layers=denseNO2_Firenze_IDW
  - WMSServer that is a GeoServer may be different for different installations of Snap4City

# The Selector is the Map Controller

MoreOptions

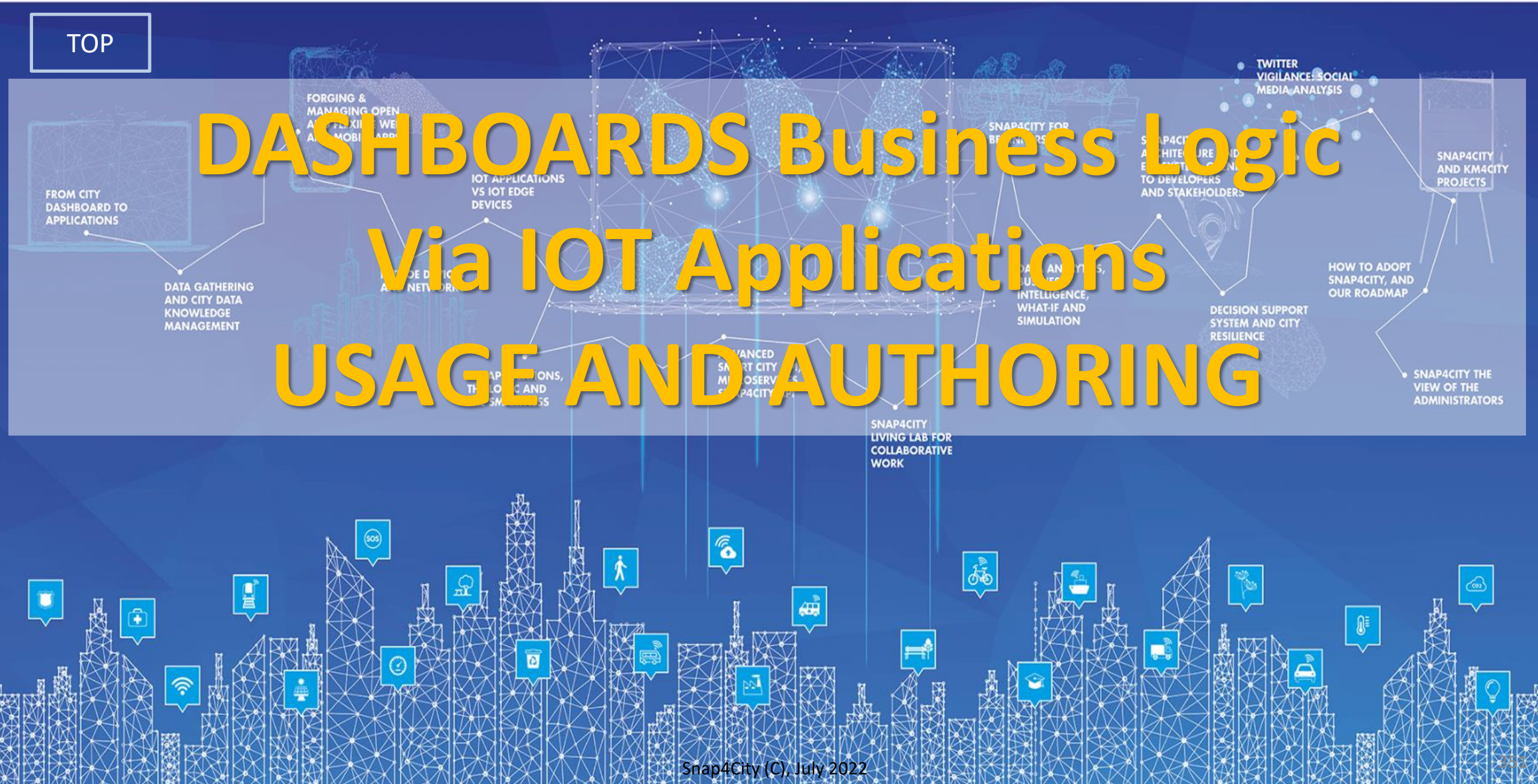



- *Targeting the data to be shows on other data Widgets*

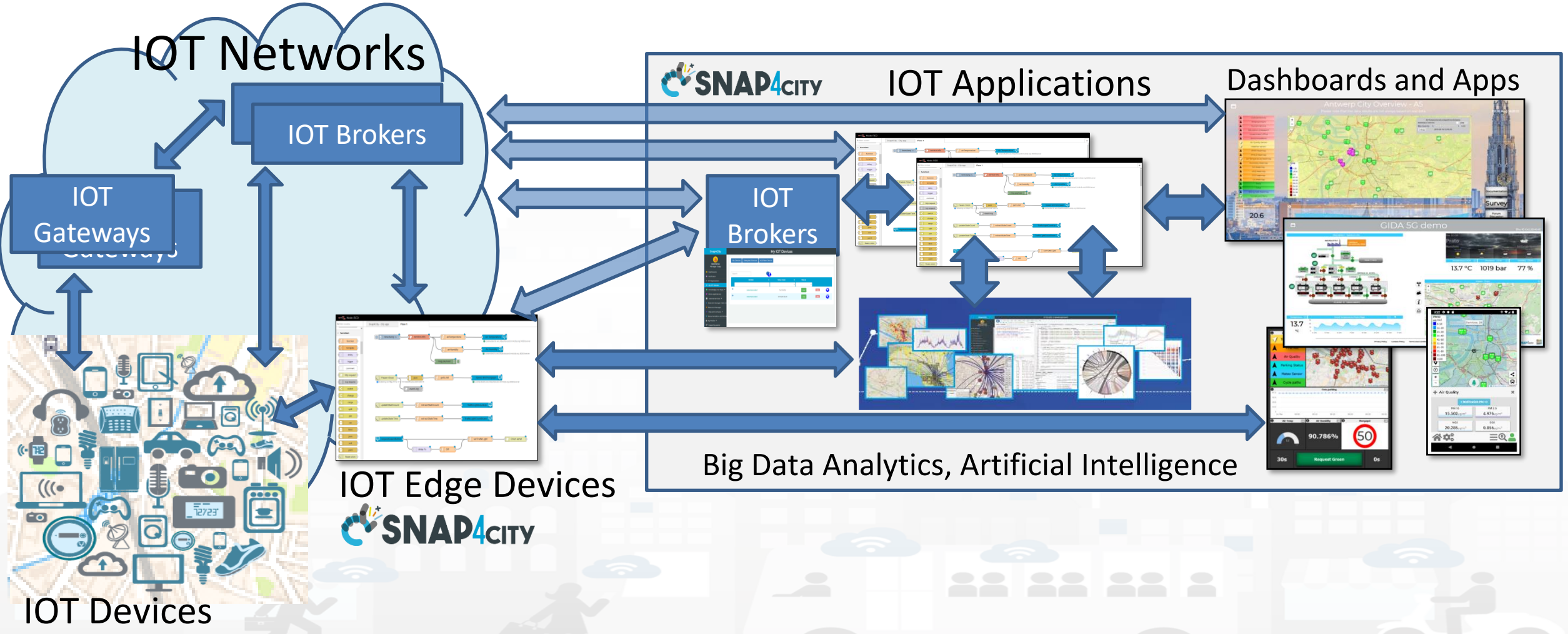


TOP

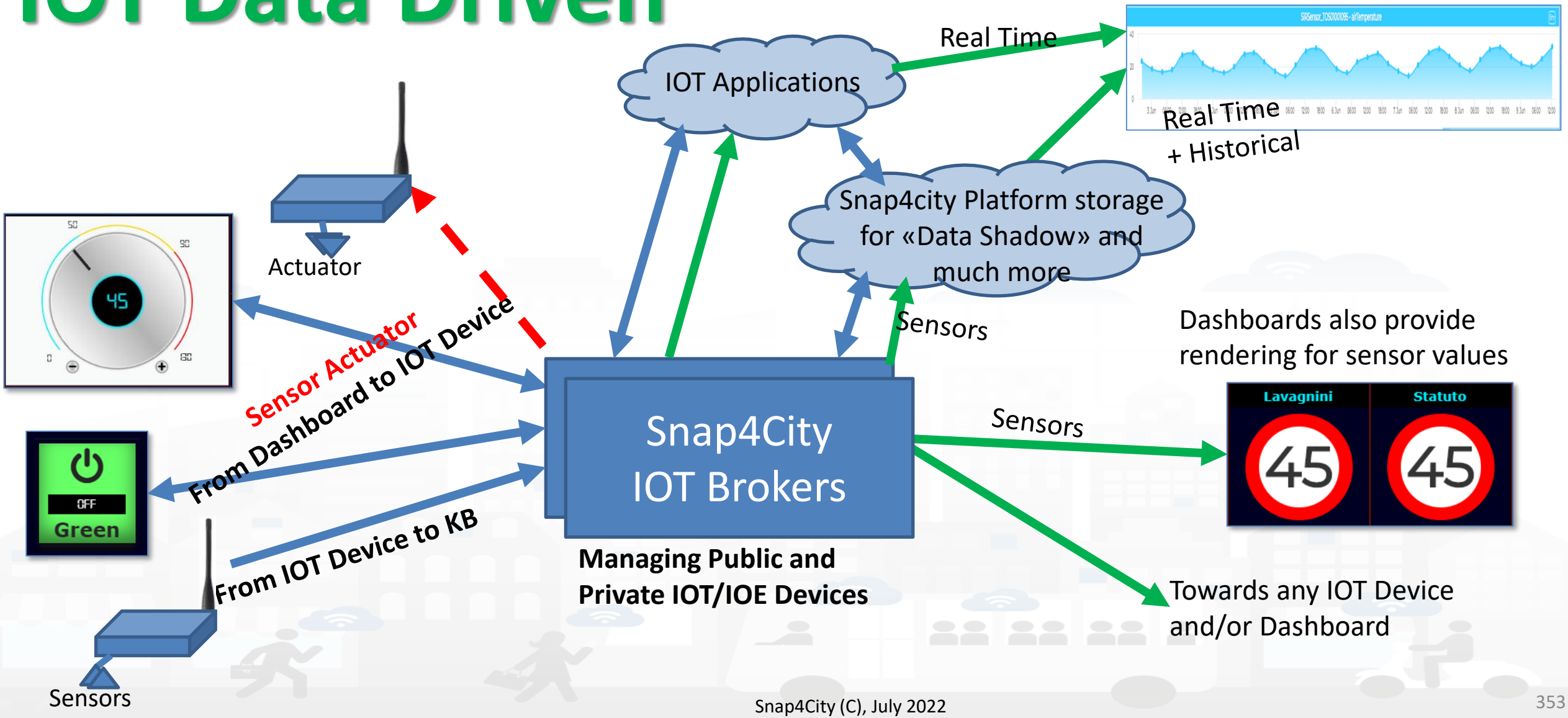
# DASHBOARDS Business Logic Via IOT Applications USAGE AND AUTHORING



# IOT App as Business Logic of Dashboards



# IOT Data Driven



# IOT App Business Intelligence for Dashboards, Web and Mobile Apps



# How the Dashboards exchange data

Snap4City BigData Storage and KB

IOT Broker Orion Quantum Leap

ServiceMap Super ServiceMap

- Req. ServiceURI

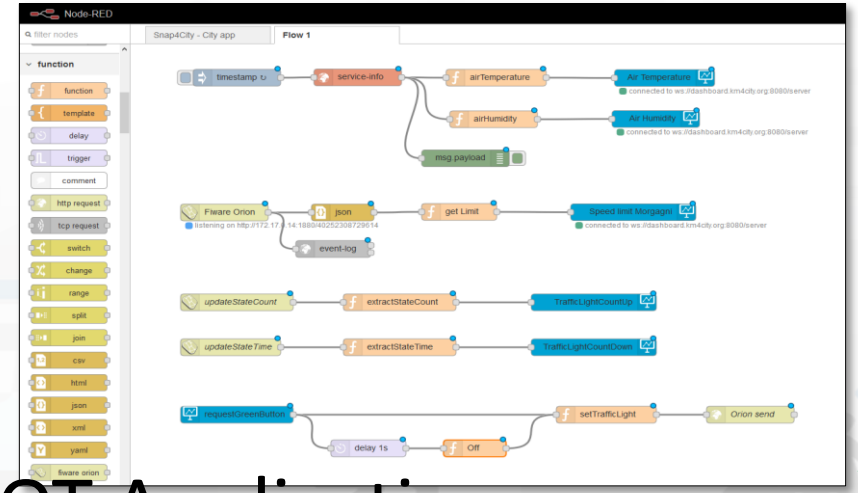
Metric, KPI

MyKPI, MyPOI, …

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

API, External Services, MicroApp

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

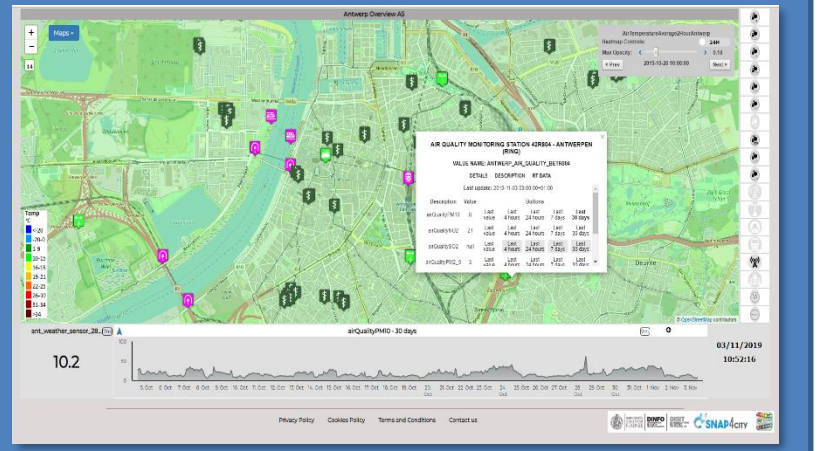


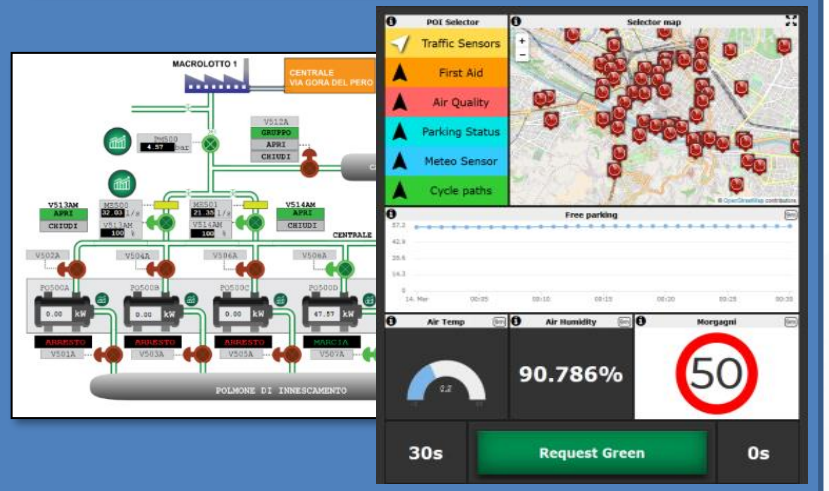

IOT Application

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

- Rx. Dynamic Data
- Event Driven Synoptics
- Actions, Show

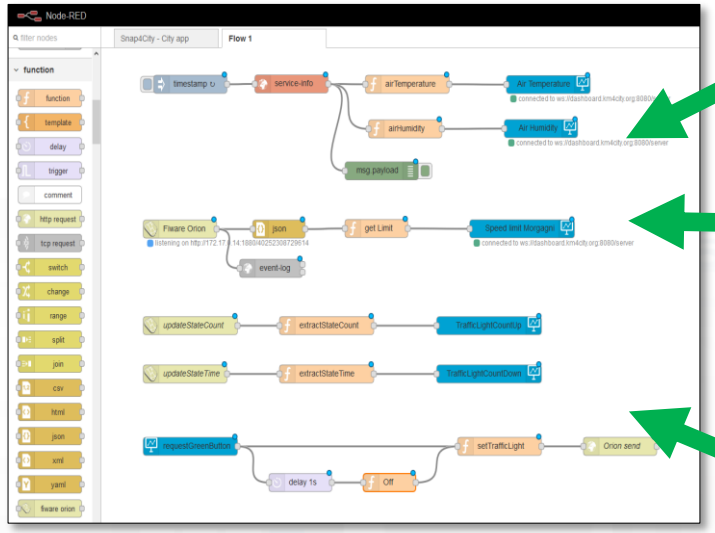
## Dashboards



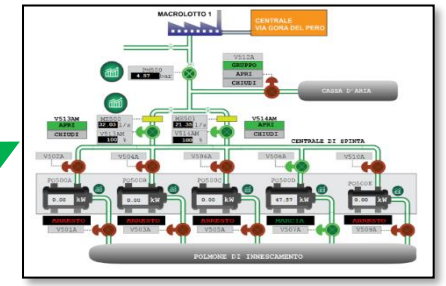


# Advanced IOT Applications

- **Synoptics can ……**
  - **do all ☺**
- **Widgets can**
  - send/receive dynamic data,
  - change data sources, etc.
  - Provide interactive maps
- **HTML pages** can
  - be dynamically generated
  - provide forms to produce data for IOT Applications
  - Collect files on web and system
  - produce files on web ad system
  - have CSS and AJAX control



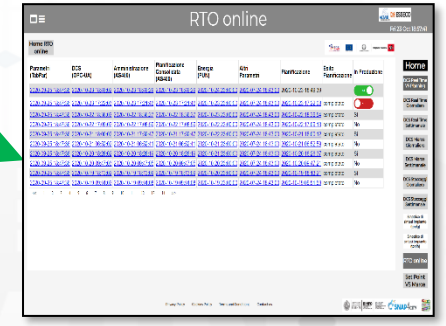

Synoptics
Custom
Widgets



Widgets
Maps
Buttons
Keypads
Controls
..



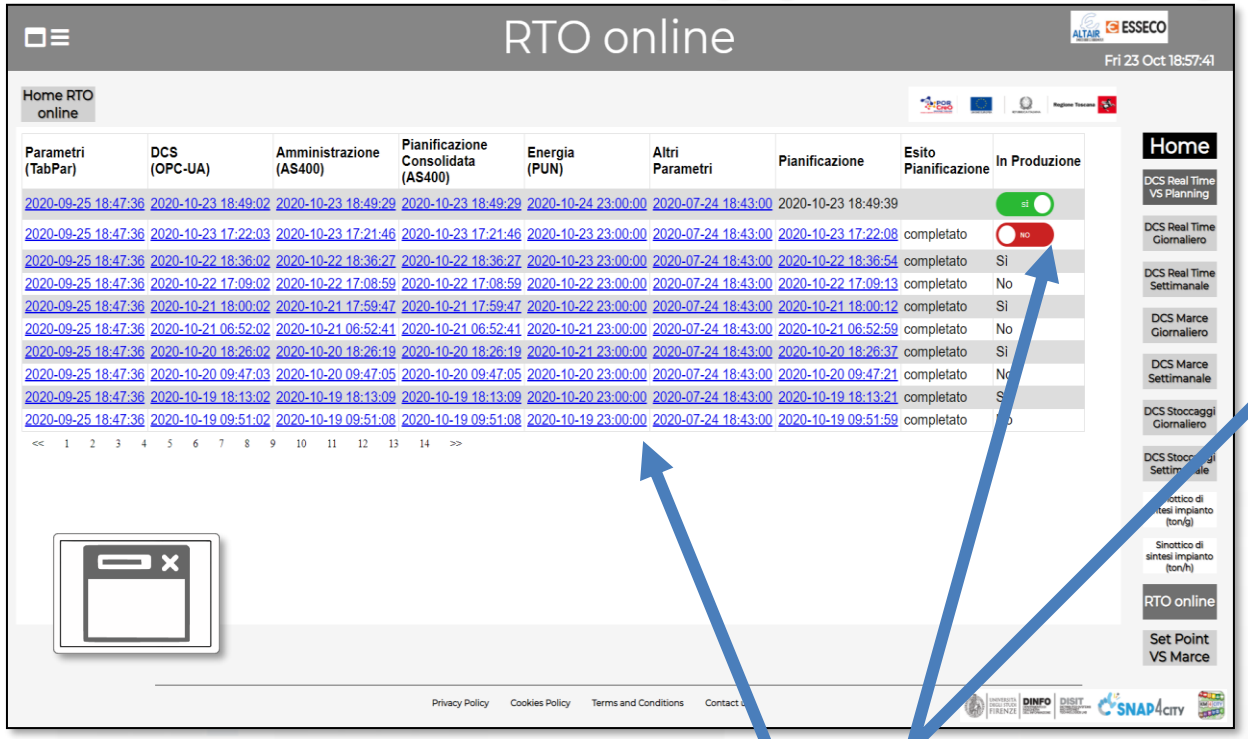

HTML pages
HTML Forms
Tables
..

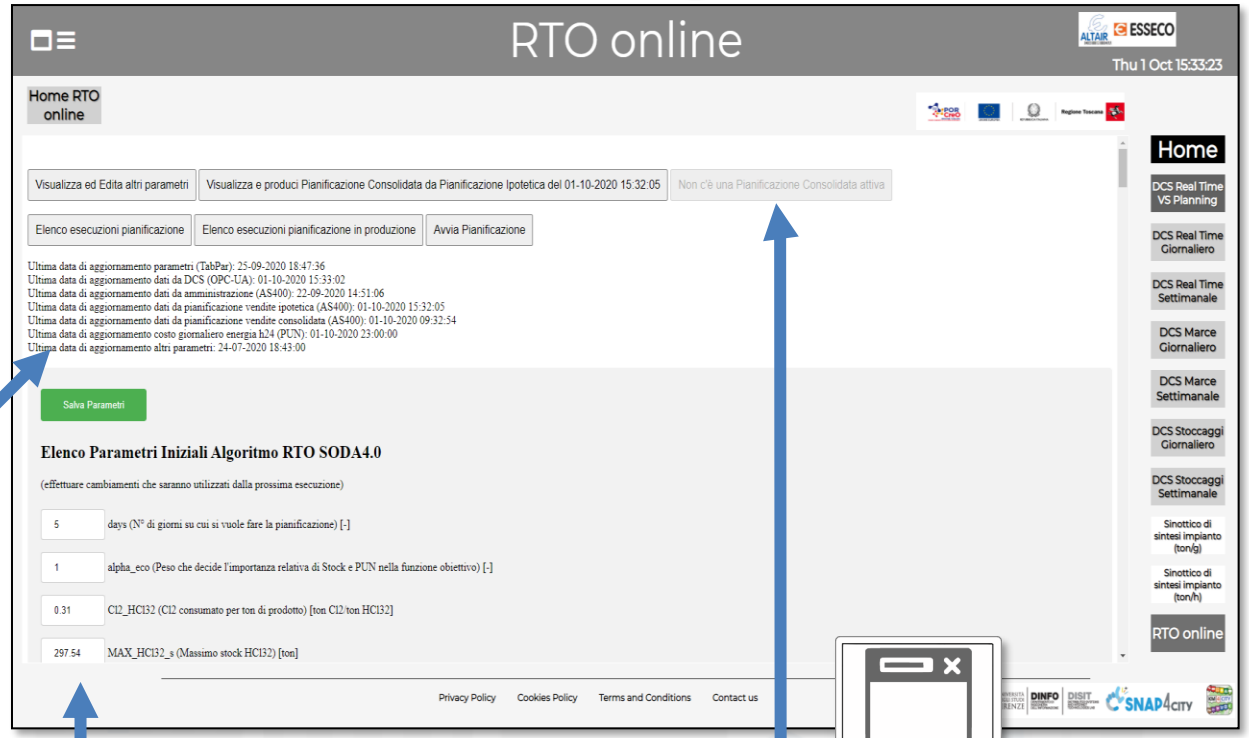



https://www.snap4city.org/394

https://www.snap4city.org/596

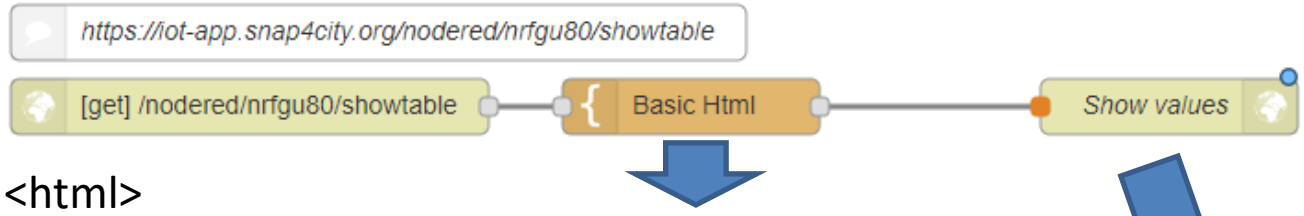
# IOT App with Dynamic Web Pages



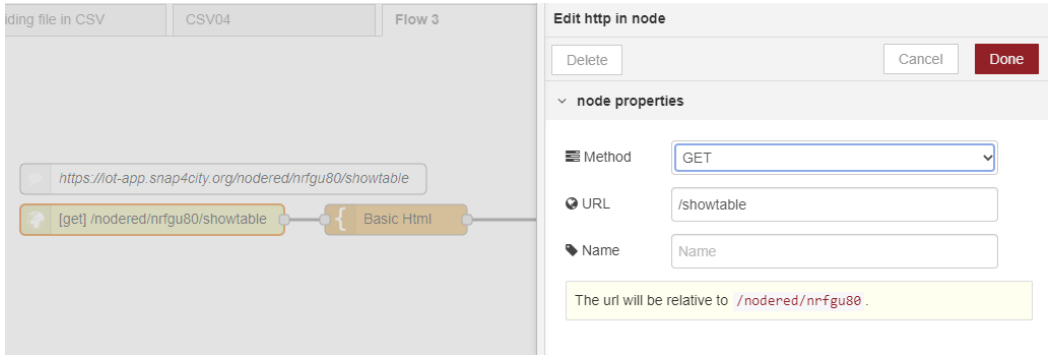




- **HTML pages** can
  - be dynamically generated from the IOT App
  - provide forms to produce data to the IOT App, also including interactive elements
  - collect file from users, and produce files to web and to the system
  - have CSS and AJAX controls

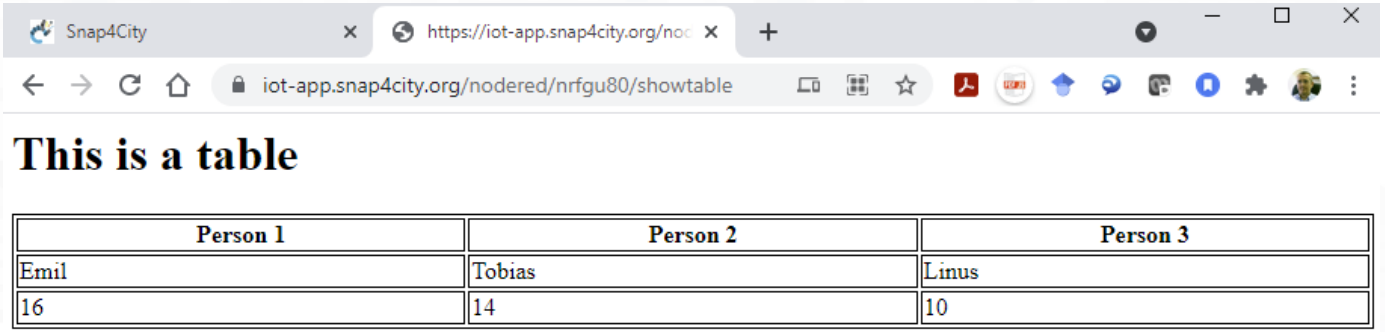
# From IoT App to HTML pages




```
<html>
<style>table, th, td {  border:1px solid black;}</style>
<head></head>
<body>
<h1>This is a table</h1><table style="width:100%">
      <tr>
        <th>Person 1</th>   <th>Person 2</th>   <th>Person 3</th>
      </tr>
      <tr>
        <td>Emil</td>   <td>Tobias</td>   <td>Linus</td>
      </tr>
      <tr>
        <td>16</td>   <td>14</td>   <td>10</td>
      </tr>
</table>
</body> </html>
```




Edit “HTTP IN NODE” as above, also to get the ID of your IoT APP.
The ID is used in the URL of the generated page



# HTML & Tables on Dashboards

- HTML page can expose forms to collect data for the IoT App.
- The table can be
  - constructed with the style you prefer according to HTML, CSS, etc.
  - dynamically generated on the basis of the values you collect/generate, receive, recover from storage in the flow
  - updated by send a message on the node
  - show on Dashboard by using the link (URL) into an External Content Widget
- In alternative there is to the Widget Table with less flexibility

# Snap4City: Builder of Sentient Cities Solutions

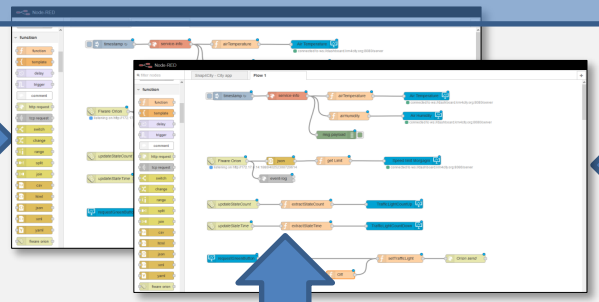
Dashboards with data driven IOT Applications enforcing intelligence

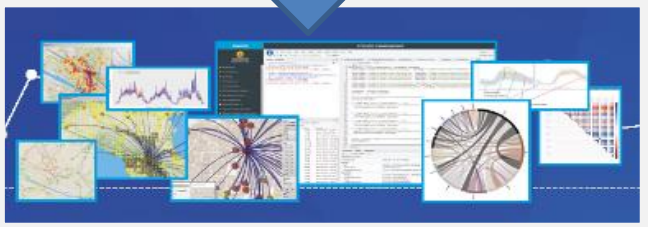
IOT and data World




Data Channels

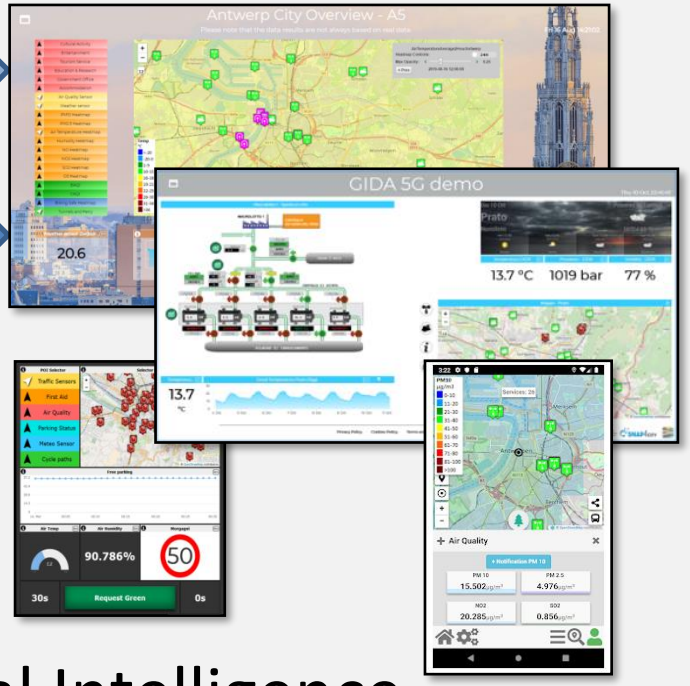
IOT Applications



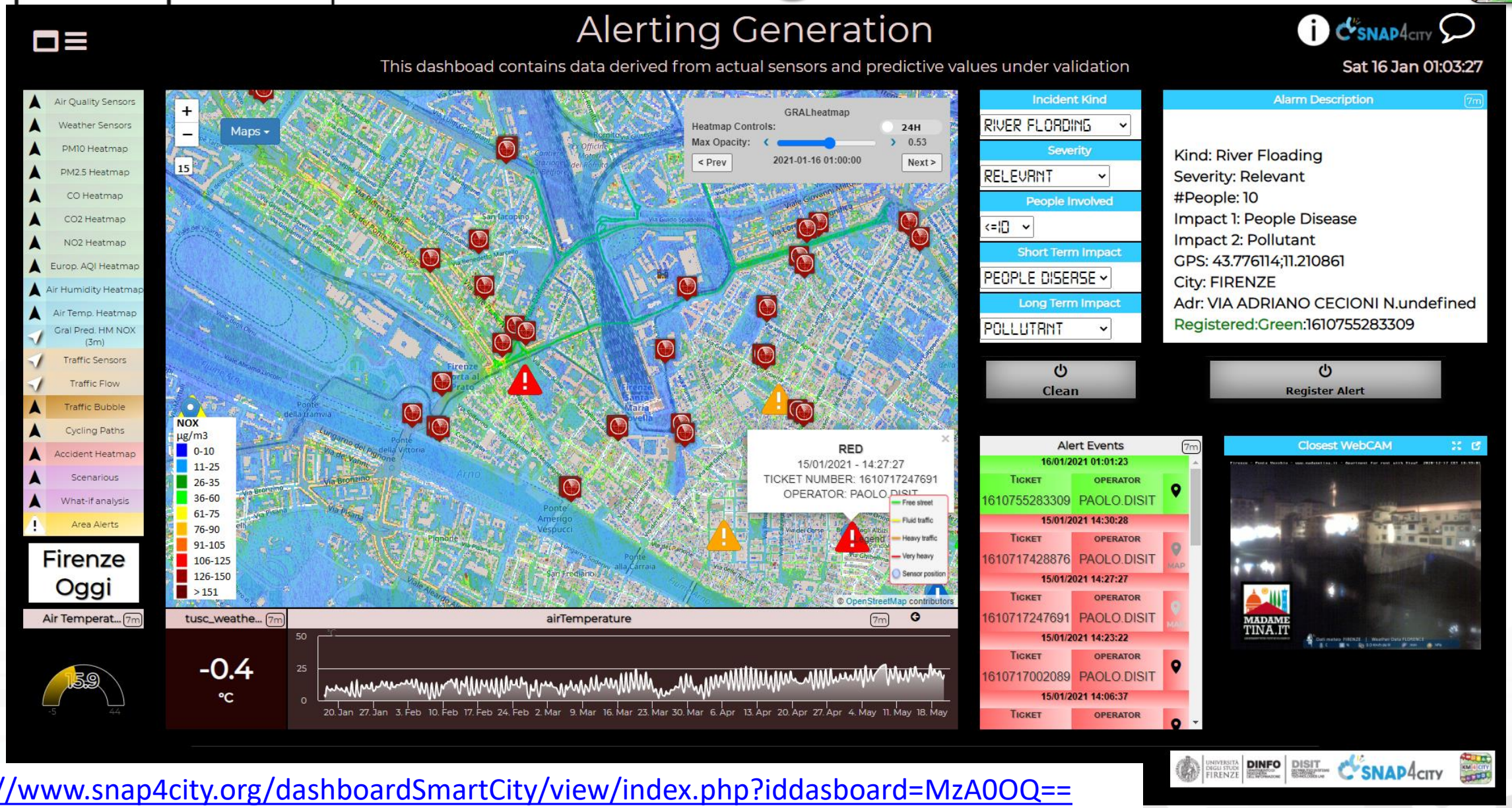


Big Data Analytics, Artificial Intelligence

Dashboards and Apps



# Alert Registration



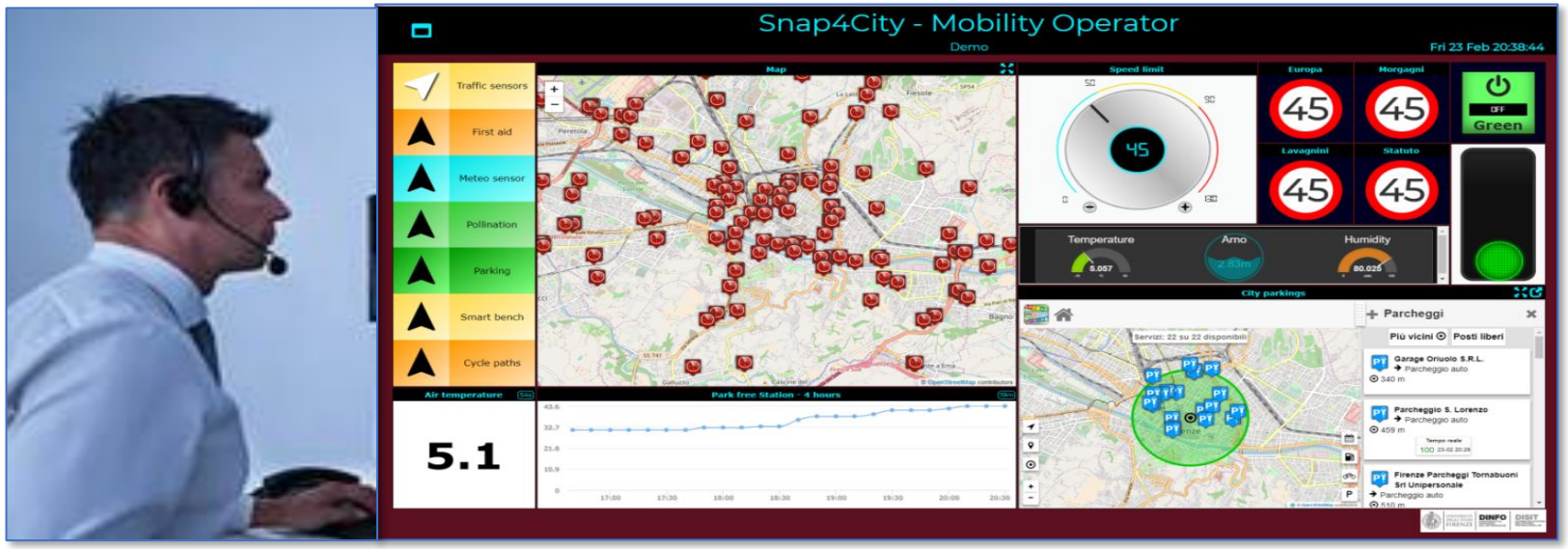

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA0OQ==

# City Dashboard + IOT App

## Control Room Operator

Would like to:

- **Monitor** traffic flow, Environment, Car parking, Cycling, First aid, temp., …
- **Act and monitor** Dynamic Plates
- **Act and monitor** red lights

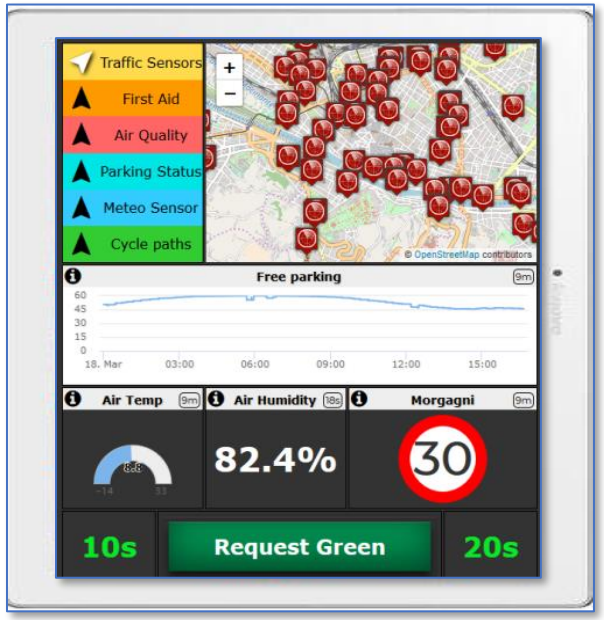



## Driver, Policeman

Would like to:

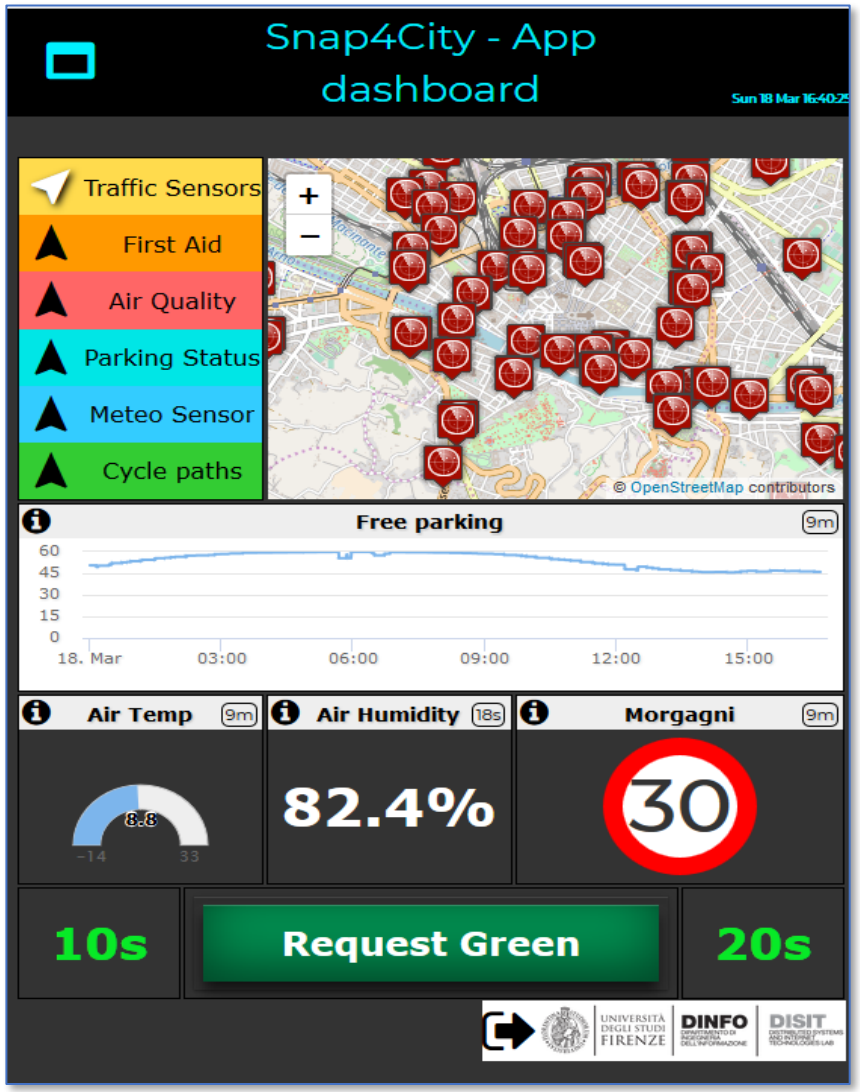
- **Monitor** traffic, Parking, env., speed limit, …
- **Act and monitor** red lights

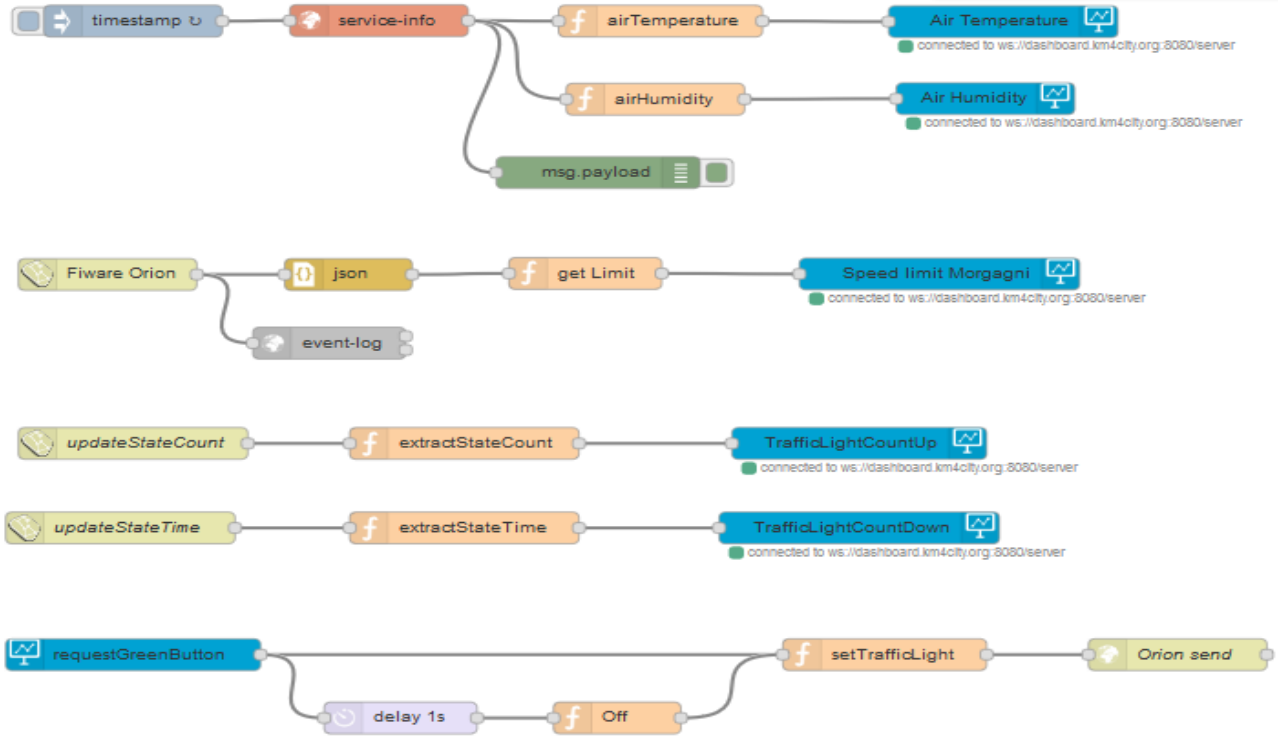




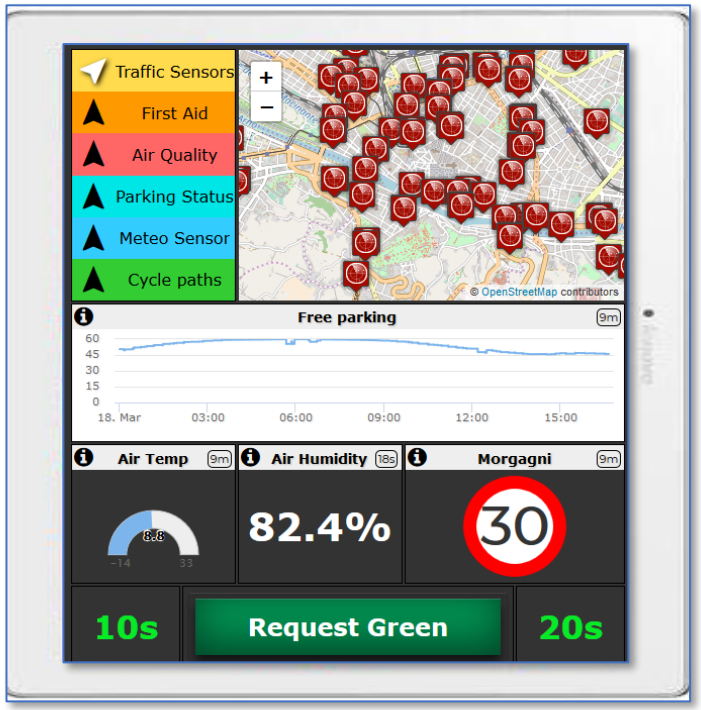
# IOT Application with City Dashboard Simple development






-Virtual Sensors and Virtual Actuators
-From Dashboard to IOT App and viceversa
-From Dashboard to IOT Brokers/Devices and viceversa


Traffic Sensors
First Aid
Air Quality
Parking Status
Meteo Sensor
Cycle paths
© OpenStreetMap contributors
Free parking
9m
60
45
30
15
0
18. Mar
03:00
06:00
09:00
12:00
15:00
Air Temp
9m
Air Humidity
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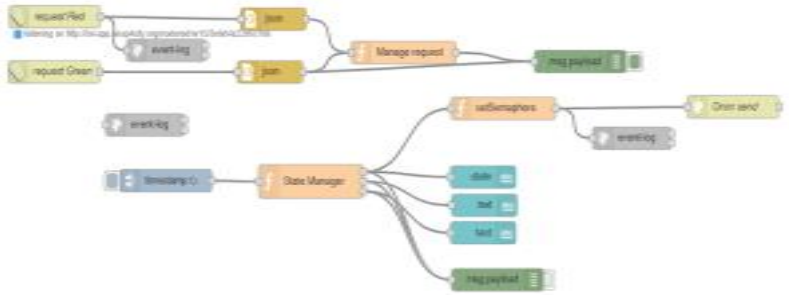
9m
82.4%
30
10s
Request Green
20s







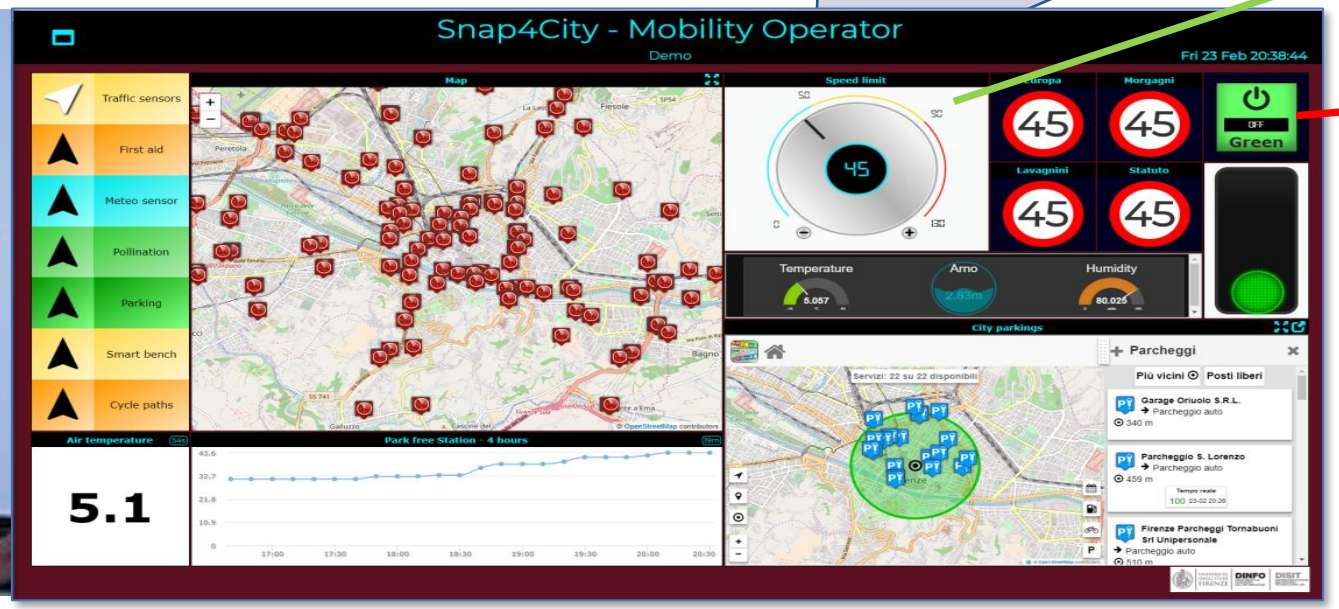


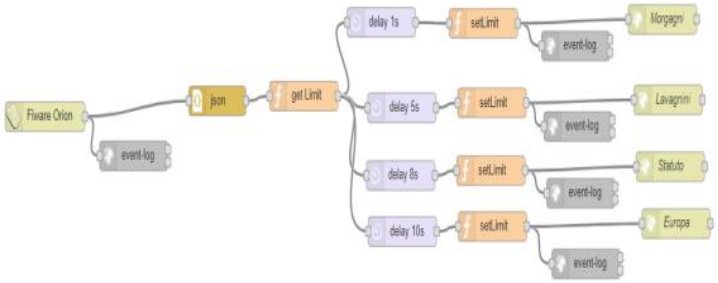









Snap4City - Mobility Operator
Demo
Fri 23 Feb 20:38:44
Traffic sensors
First aid
Meteo sensor
Pollination
Parking
Smart bench
Cycle paths
Map
Speed limit
Europa
Morgagni
Lavagnini
Statuto
45
OFF
Green
Temperature
Arno
Humidity
5.057
80.025
City parkings
Parcheggi
Più vicini
Posti liberi
Garage Oriuolo S.R.L.
Parcheggio S. Lorenzo
Firenze Parcheggi Tornabuoni Srl Unipersonale
Air temperature
Park free Station - 4 hours
5.1


Fiware Orion
event-log
json
get Limit
delay 1s
delay 5s
delay 8s
delay 10s
setLimit
event-log
Morgagni
Lavagnini
Statuto
Europa

# 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.

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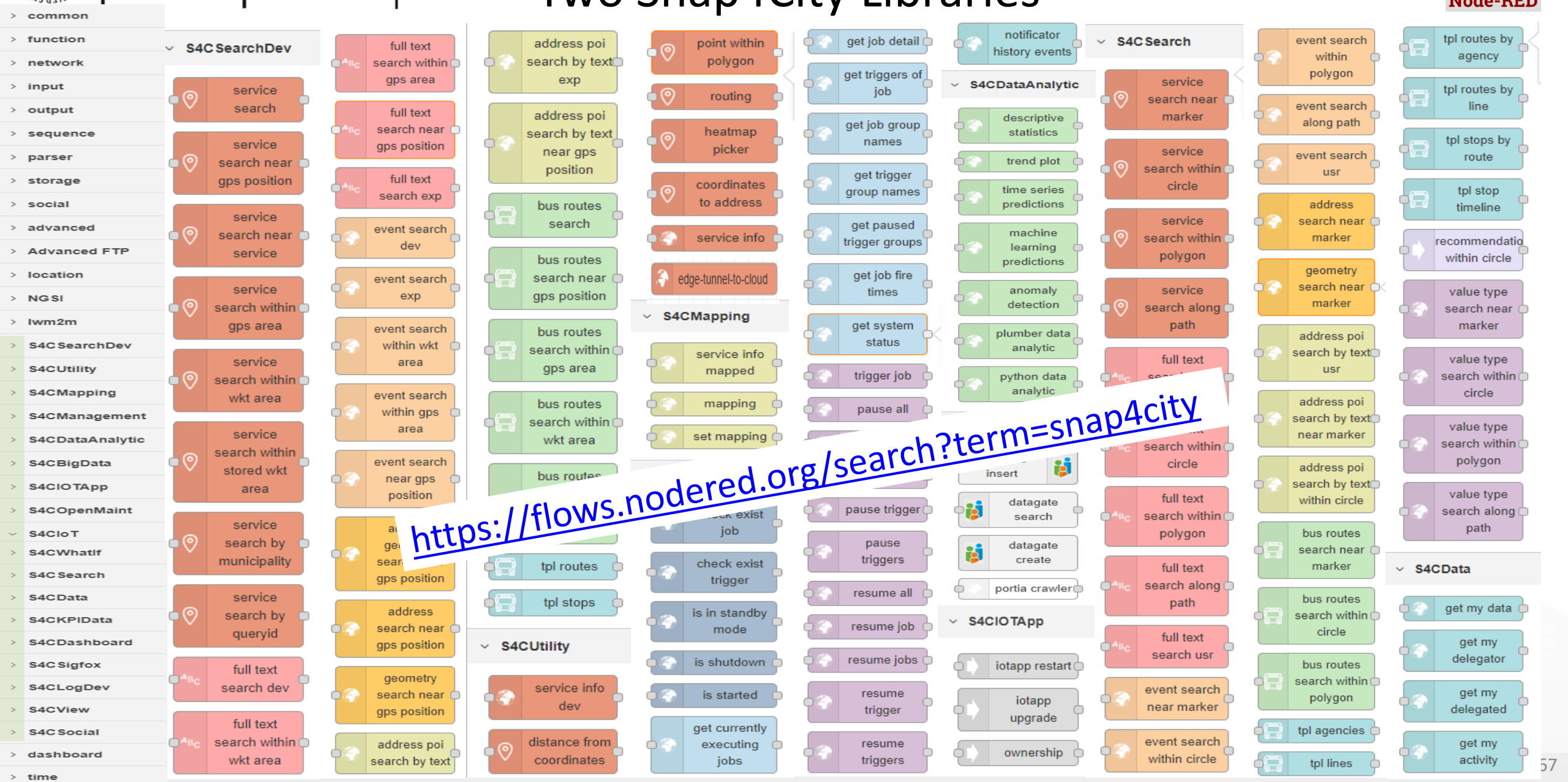
# June 2022 collection

## Two Snap4City Libraries

SNAP4CITY | Node-RED




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

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# June 2022 collection

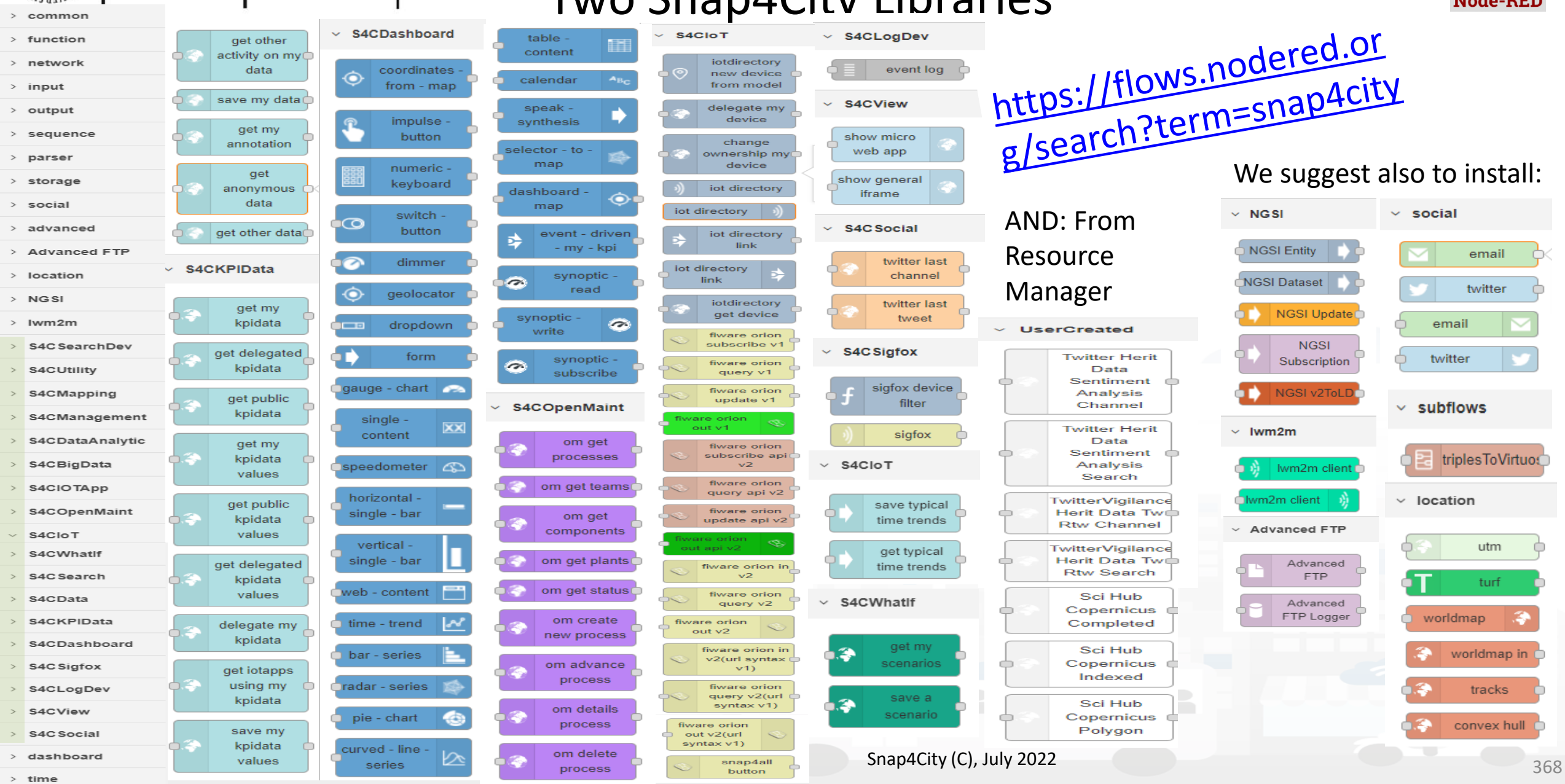
## Two Snap4Citv Libraries

SNAP4CITY | Node-RED

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 Snap4City 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**

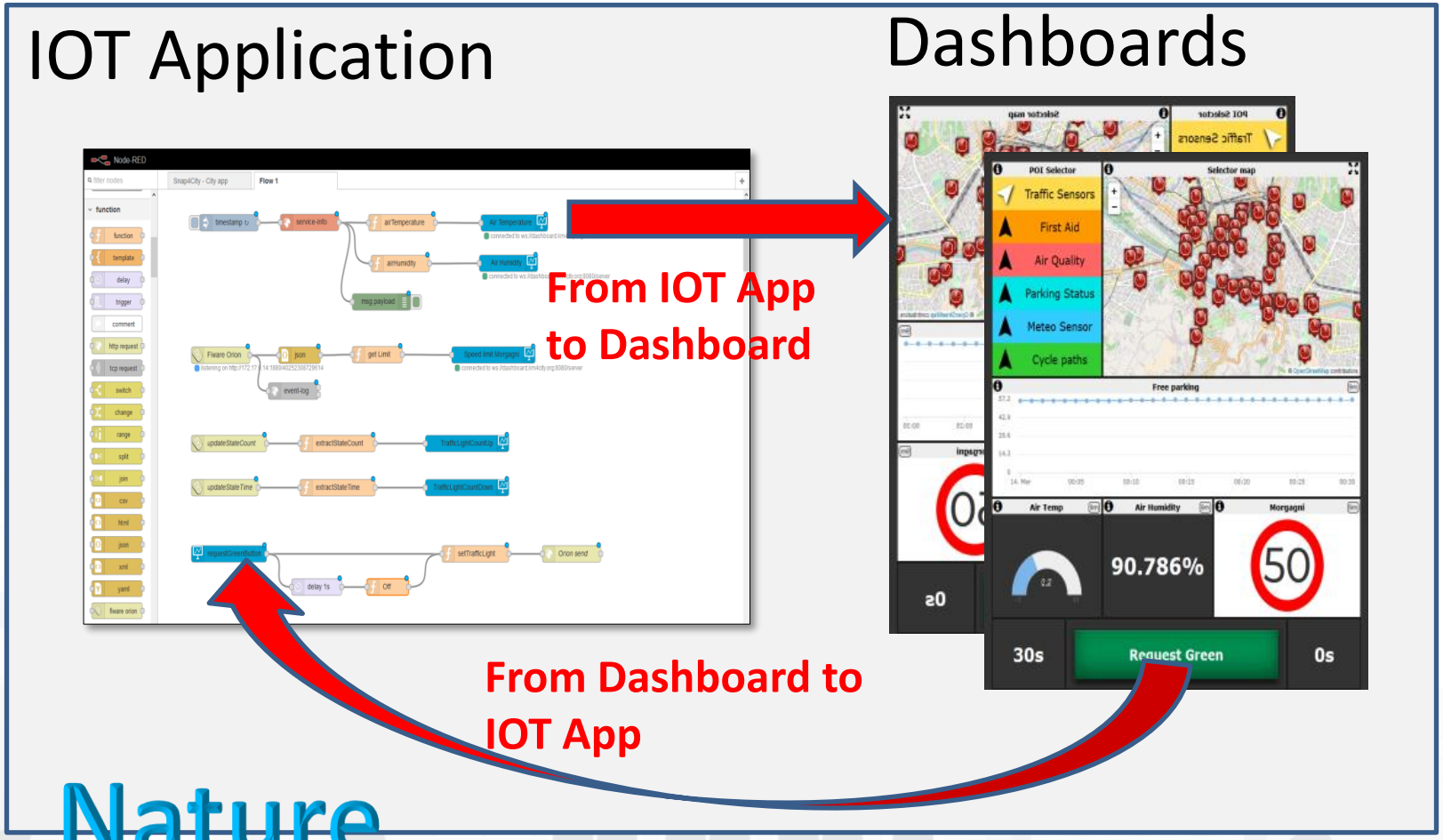
# Widgets Interacting with IOT Apps virtual Sensors and Actuators



# 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)

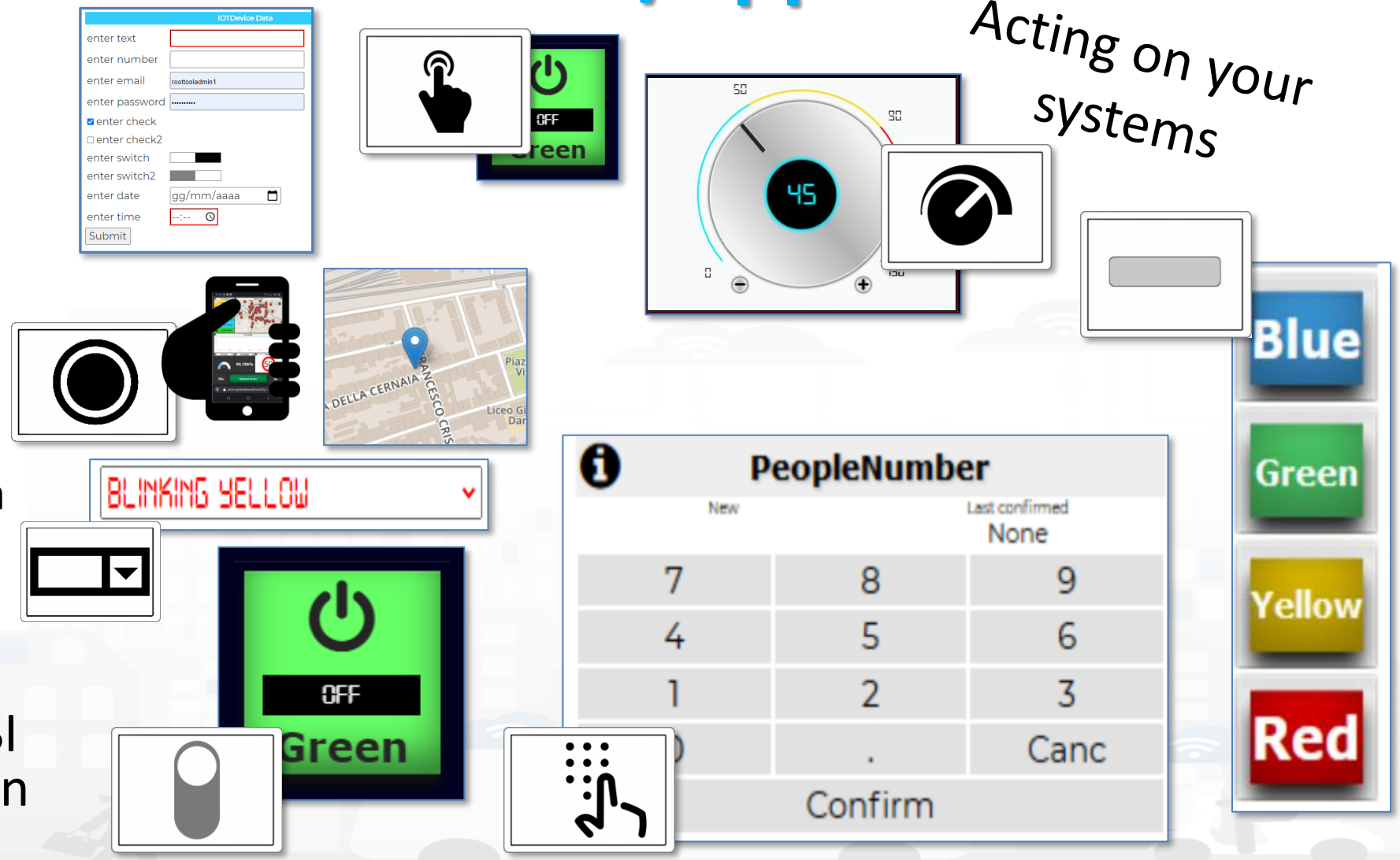


# Dashboard Widgets vs IOT Apps

- IOT App may create new Dashboards with new Widgets inside
- Some of the Dashboard Widgets interacting with IOT App can be ONLY created by starting from the IOT App
  - The creation is performed by putting the Node/Block in the IOT App and creating the widget in a Your Dashboard
- The removal of the Node/Block is removing the Widget as well. While the removal of the Widget in Dashboard is not removing the Node/Block into the IOT App
- The change of name of the Widget in Dashboard and/or in IOT App may create disconnections each other

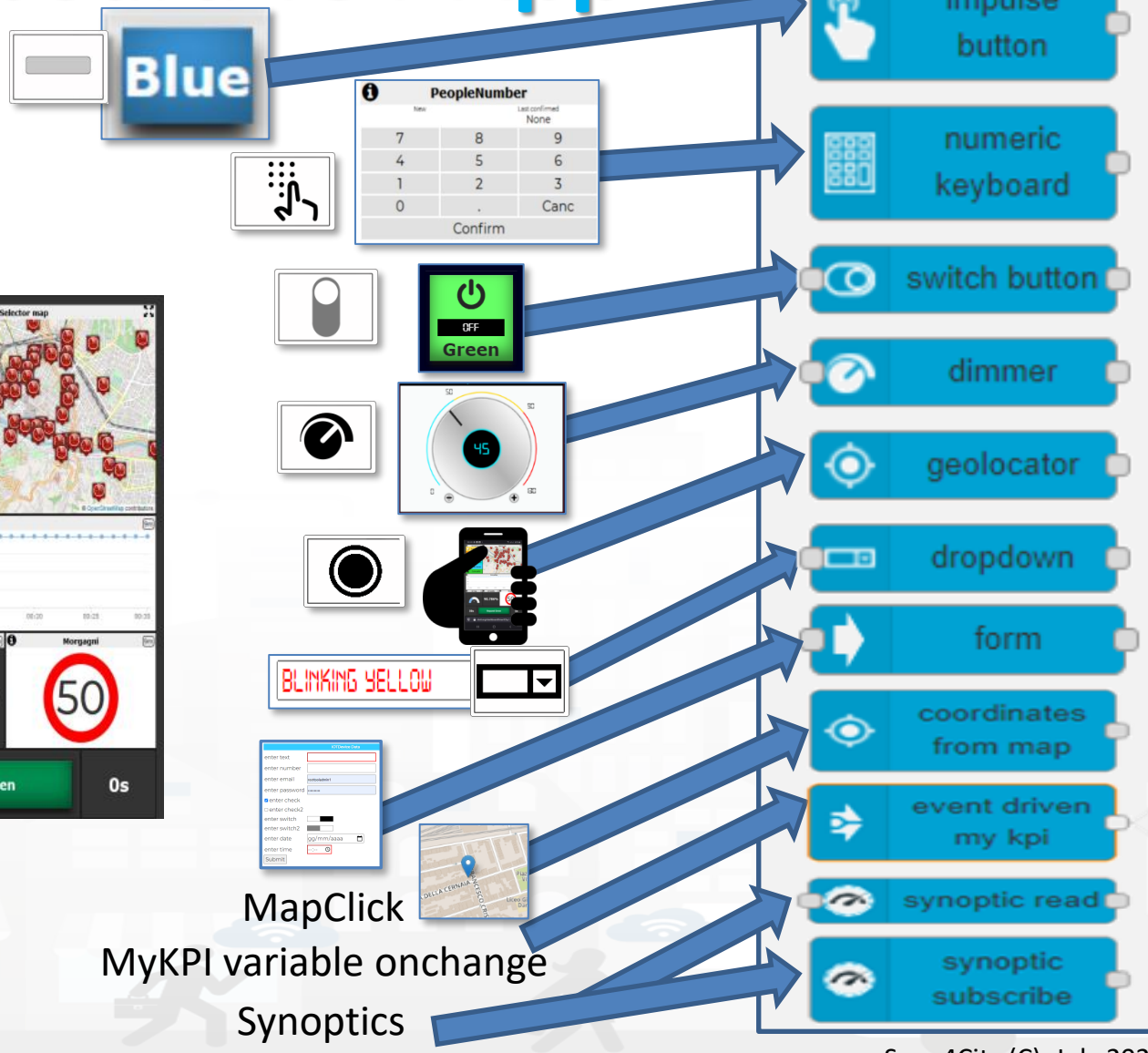
# From Dashboard to IOT Devices/App

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



# Dashboard-IOT App



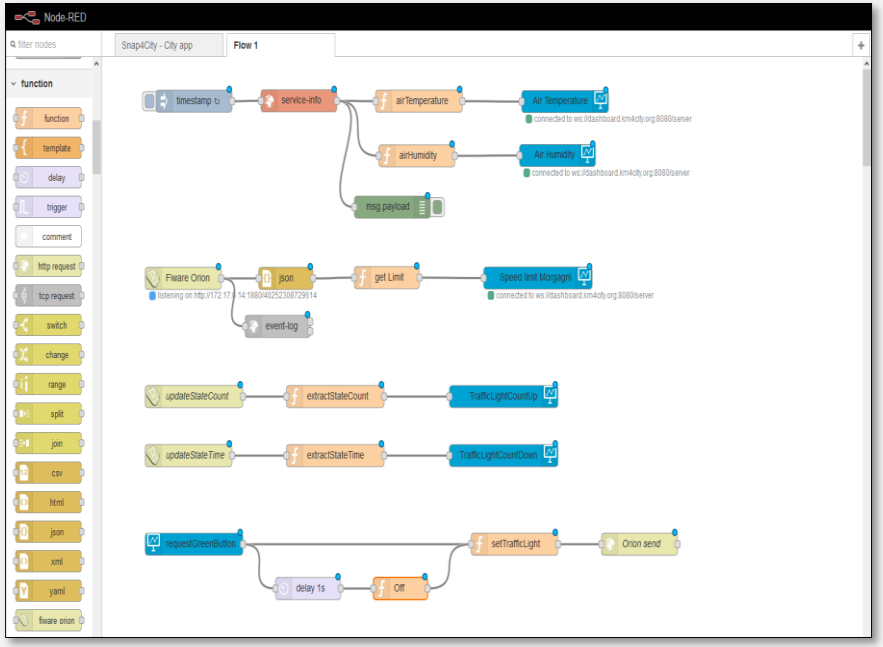




MapClick

MyKPI variable onchange

Synoptics

## From Dashboard to IOT App

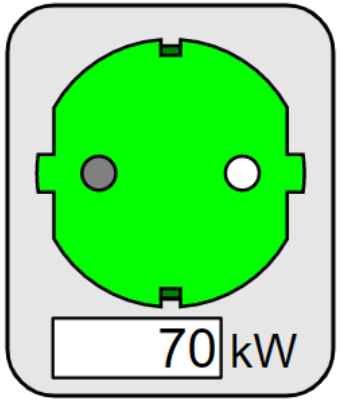



IOT Application

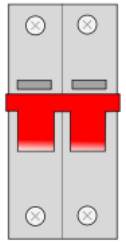
# SVG Custom Widgets Examples 2

Tue 17 Nov 18:46:47

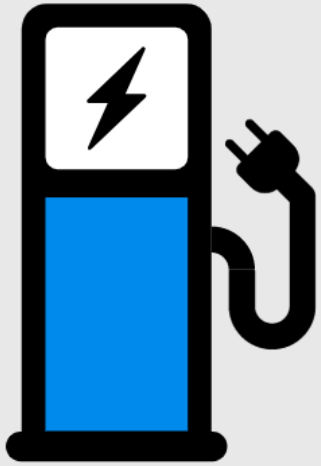
### SVG shucko plug




### Schuko switch



### Charging Station Status



Legenda

**Charging Station Status**

Set on the keypad one of the following values

**0 = ERROR (RED)**

**1 = AVAIBLE (GREEN)**

**2 = BOOKED (YELLOW)**

**3 = CHARGING**

**9999 = white icon**

### Charging Station status

New | Last confirmed: None

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

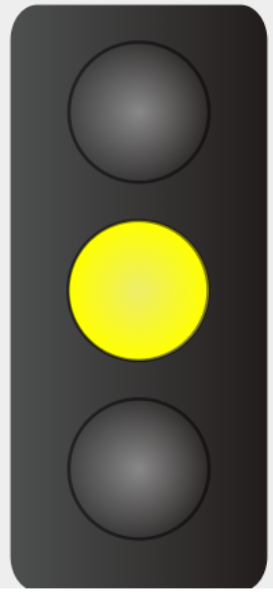
### Underpass



### Set tunnel st...




### Traffic Light



### Traffic Light status set

YELLOW LIGHT

### Speed Limit Set

New | Last confirmed: None

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

### Dynamic Speed Limit Sign




Speed Limit Explaination

**Speed Limit Custom Widget example**

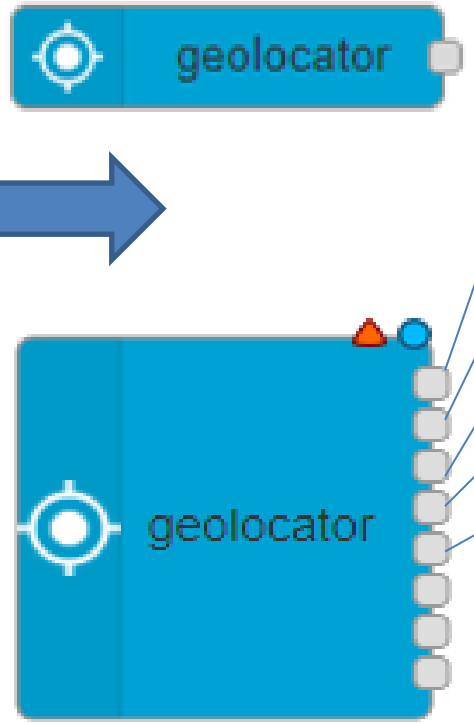
Write the speed limit by using the keypad and click CONFIRM.

9999 = white sign.

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

# Geolocation of Mobile Device




- 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

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

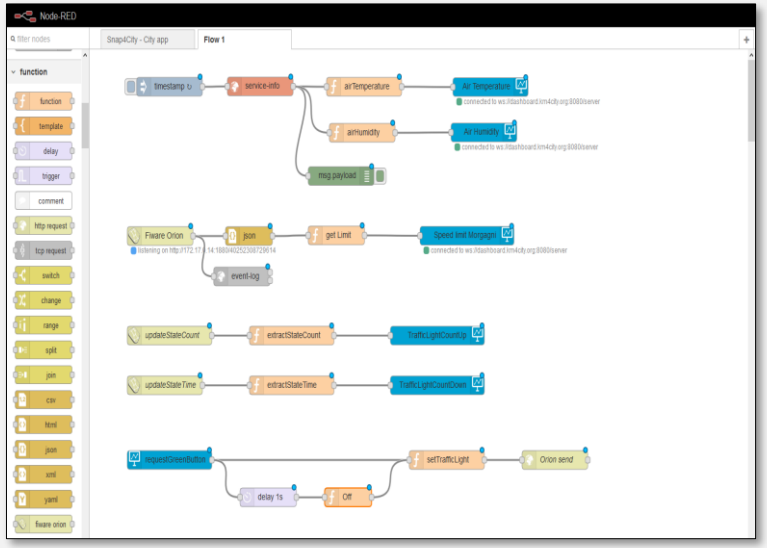
UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

# Nature

SNAP4CITY | Node-RED

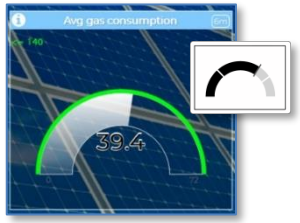
# Dashboard-IOT App

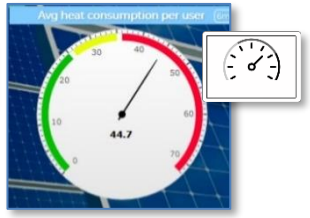
## From IOT App to Dashboard

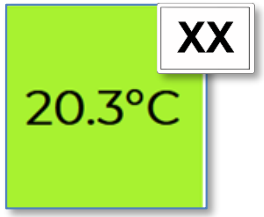


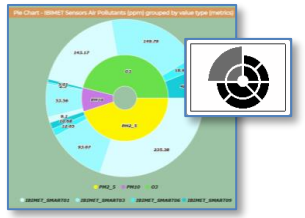

IOT Application

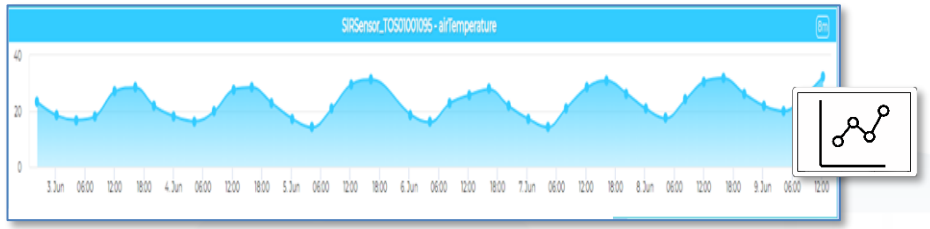
- gauge chart
- single content
- speedometer
- horizontal single bar
- vertical single bar
- web content
- time trend
- bar series
- radar series
- pie chart
- curved line series
- table content
- calendar
- speak synthesis
- synoptic write
- Selector - Map
- Event Table
- Snap4D3

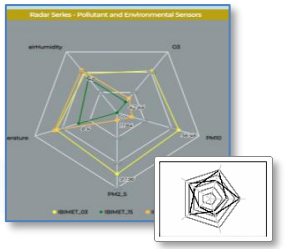


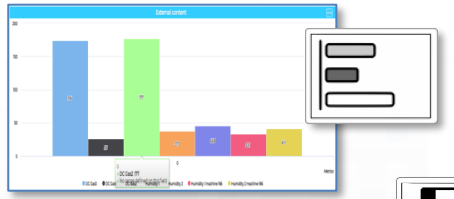



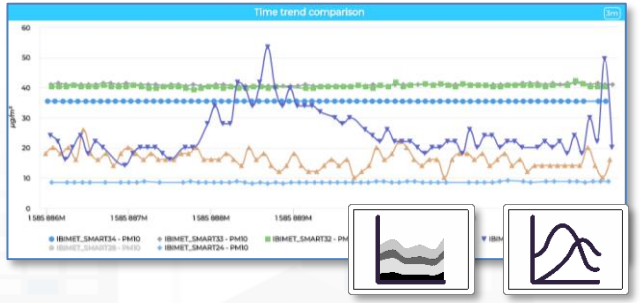



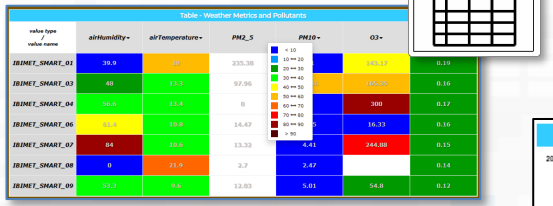



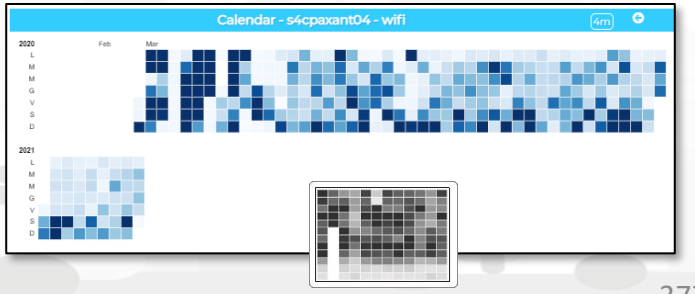


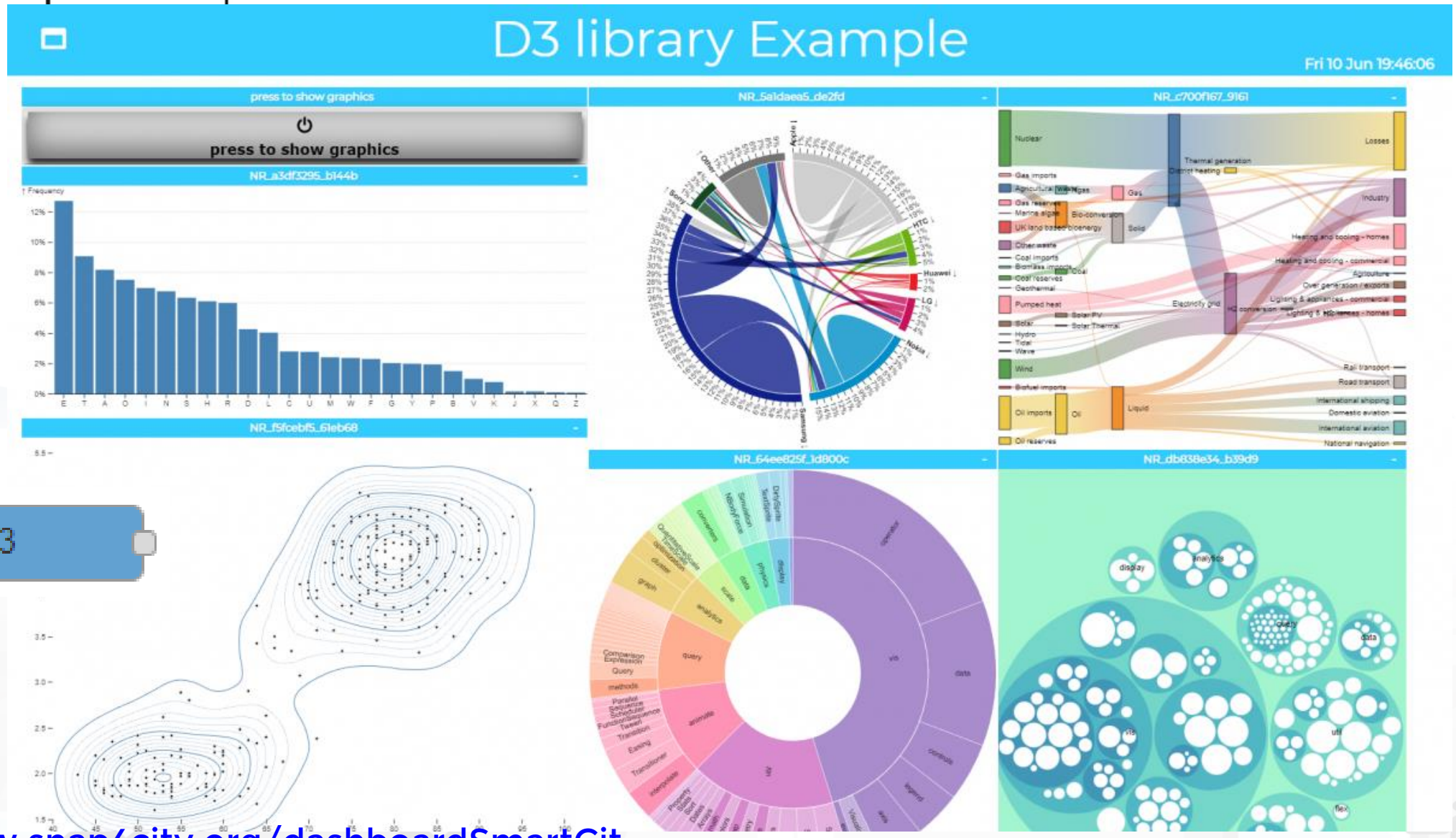




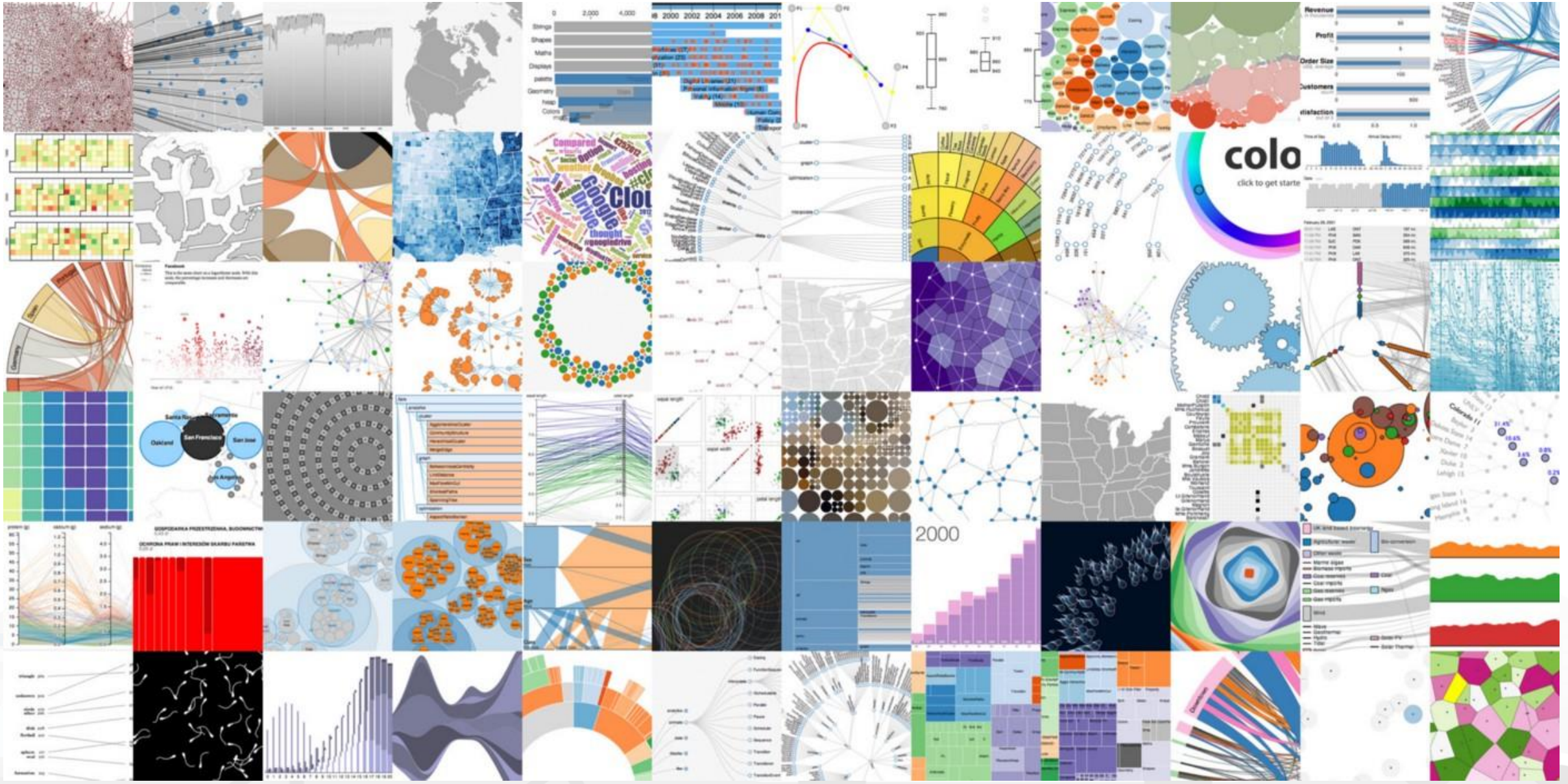
# + D3.JS Widgets




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

# D3.js graphs




Revenue
Profit
Order Size
Customers
colo
click to get starte
2000

# Single Content Widget (flexibility)

From Dashboard Editor and IOT Applications, accepts in input:

- Numbers
- String
- HTML code









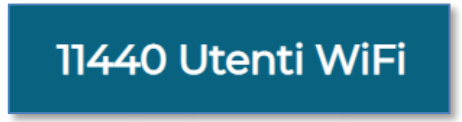

























https://www.snap4city.org/578




# Controlling Single Content from IOT App

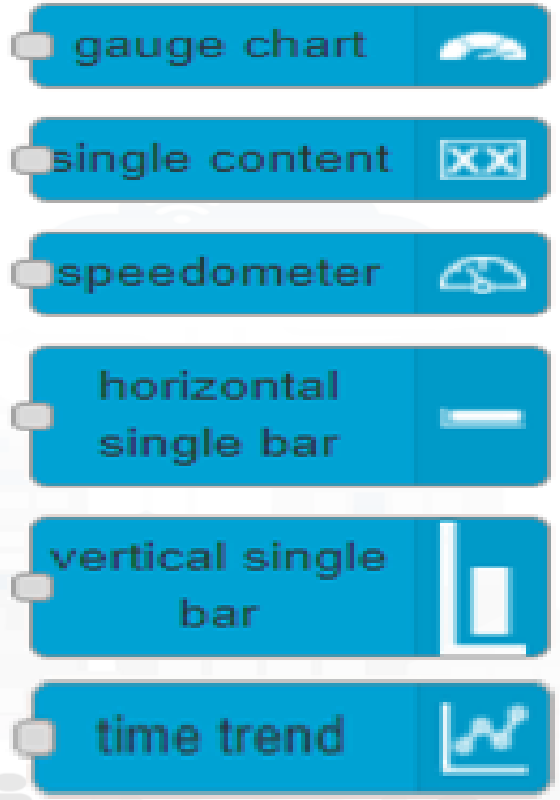
```
{
   "metricId": [The ID of a KPI], // or [Service Uri Of A Sensor]
   "metricHighLevelType": "MyKPI", // or "Sensor"
   "metricName": [The name of the MyKPI], // or [The name of the Sensor],
   "metricType": [The type of the measure saved in the KPI] // or [A measure recorded by the sensor]
}
```

***Two exmaples:***

```
{
   "metricId": "17056579",
   "metricHighLevelType": "MyKPI",
   "metricName": "OBD2 - Intake Air Temperature",
   "metricType": "Temperature"
}

{
   "metricId": "http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3166540",
   "metricHighLevelType": "Sensor",
   "metricName": "tusc_weather_sensor_ow_3166540",
   "metricType": "airTemperature"
}
```

Similarly



https://www.snap4city.org/575

# Controlling MultiSeries from IOT App

**Expected JSON in input**

```
[
  {
    "metricHighLevelType": "Sensor",
    "metricName": [The name of the Sensor],
    "smField": [A measure recorded by the sensor],
    "serviceUri": [Service Uri Of A Sensor]
  },
  {
    "metricHighLevelType": "MyKPI",
    "metricName": [The name of the MyKPI],
    "smField": [The type of the measure saved in the KPI],
    "serviceUri": [The ID of a KPI]
  },
  {
    "metricHighLevelType": "Dynamic",
    "metricName": [The name of the dynamic data],
    "smField": [The type of the dynamic data],
    "metricValueUnit": [The unit of the dynamic data],
    "value": [An array of array of timestamp and value]
  }
]
```



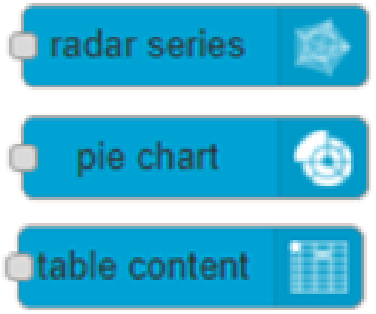
```
[
  {   "metricId": "http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3166540",
    "metricHighLevelType": "Sensor",      "metricName": "tusc_weather_sensor_ow_3166540",
    "metricType": "airTemperature"
  },
  {   "metricId": "http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3182522",
    "metricHighLevelType": "Sensor",      "metricName": "tusc_weather_sensor_ow_3182522",
    "metricType": "airTemperature"
  },
  {   "metricId": "17057447",
    "metricHighLevelType": "MyKPI",      "metricName": "OBD2 - Intake Air Temperature",
    "metricType": "Temperature"
  },
  {   "metricId": "17056579",
    "metricHighLevelType": "MyKPI",      "metricName": "OBD2 - Intake Air Temperature",
    "metricType": "Temperature"
  },
  {   "metricId": "",
    "metricHighLevelType": "Dynamic",      "metricName": "BatteryGalaxyNote",
    "metricType": "Temperature",      "metricValueUnit": "°C",
    "measuredTime": "2019-11-21T14:51:00Z",      "value": 42
  },
  {   "metricId": "",
    "metricHighLevelType": "Dynamic",      "metricName": "Storage",
    "metricType": "Space",      "metricValueUnit": "Gb",
    "measuredTime": "2019-11-21T14:51:00Z",      "value": 12
  }
]
```




https://www.snap4city.org/575

# Controlling BarSeries from IOT App

Similarly




**Expected JSON in input**

```
[
  {
    "metricId": [Service Uri Of A Sensor],
    "metricHighLevelType": "Sensor",
    "metricName": [The name of the Sensor],
    "metricType": [A measure recorded by the sensor]
  },
  {
    "metricId": [The ID of a KPI],
    "metricHighLevelType": "MyKPI",
    "metricName": [The name of the MyKPI],
    "metricType": [The type of the measure saved in the KPI]
  },
  {
    "metricId": "",
    "metricHighLevelType": "Dynamic",
    "metricName": [The name of the dynamic data],
    "metricType": [The type of the dynamic data],
    "metricValueUnit": [The unit of the dynamic data],
    "measuredTime": [The ISO time of the measure of dynamic data],
    "value": [A dynamic value]
  }
]
```




```
[
{"metricId":"17056320",
        "metricHighLevelType":"MyKPI",
        "metricName":"SiiMTuscanyTrackerLocation",
        "metricType":"Velocity"},
{"metricId":"http://www.disit.org/km4city/resource/tusc_weather_sensor_ow_3166540",
        "metricHighLevelType":"Sensor",
        "metricName":"tusc_weather_sensor_ow_3166540",
        "metricType":"airTemperature"},
{"metricId":"https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUri=http://www.d...",
        "metricHighLevelType":"Sensor",
        "metricName":"tusc_weather_sensor_ow_3182522",
        "metricType":"airTemperature"},
{"metricId":"",
        "metricHighLevelType":"Dynamic",    "metricName":"BatteryTemperatureGalaxyNote",
        "metricType":"Gradi Centigradi",    "metricValueUnit":"°C",
        "measuredTime":"2019-11-21T14:51:00Z",
        "value":55.395468539280635},
{"metricId":"",
        "metricHighLevelType":"Dynamic",    "metricName":"BatteryTemperaturemia",
        "metricType":"Gradi Centigradi",    "metricValueUnit":"°C",
        "measuredTime":"2019-11-21T14:51:00Z",
        "value":51.396725502373464},
{"metricId":"",
        "metricHighLevelType":"Dynamic",    "metricName":"BatteryTemperaturemia",
        "metricType":"airTemperature",      "metricValueUnit":"°C",
        "measuredTime":"2019-11-21T14:51:00Z",
        "value":29.150364690965127}
]
```

https://www.snap4city.org/706

# Controlling Calendar Historgram from IOT App

**Expected JSON in input**

```
[
  {     "metricId": [Service Uri Of A Sensor],
    "metricHighLevelType": "Sensor",
    "metricName": [The name of the Sensor],
    "smField": [A measure recorded by the sensor],
    "serviceUri": [Service Uri Of A Sensor]
  },
  {      "metricId": [The ID of a KPI],
    "metricHighLevelType": "MyKPI",
    "metricName": [The name of the MyKPI],
    "smField": [The type of the measure saved in the KPI],
    "serviceUri": [The ID of a KPI]
  },
  {     "metricId": "",
    "metricHighLevelType": "Dynamic",
    "metricName": [The name of the dynamic data],
    "smField": [The type of the dynamic data],
    "metricValueUnit": [The unit of the dynamic data],
    "value": [An array of array of timestamp and value]
  }
]
```


```
[
  {  "metricId": "serviceUri=http://www.disit.org/km4city/resource/IBIMET_SMART17",
     "metricHighLevelType": "Sensor",
     "metricName": "IBIMET_SMART12",          "smField": "PM10",
     "serviceUri": "http://www.disit.org/km4city/resource/IBIMET_SMART17"
              },
  { "metricId":
"https://servicemap.disit.org/WebAppGrafo/api/v1/?serviceUri=http://www.disit.org/km4city/
resource/IBIMET_SMART12&format=json",
     "metricHighLevelType": "Sensor",
     "metricName": "IBIMET_SMART12",          "smField": "PM10",
     "serviceUri": "http://www.disit.org/km4city/resource/IBIMET_SMART12"
              },
  {  "metricId": "17056191",          "metricHighLevelType": "MyKPI",
     "metricName": "S4CTuscanyTrackerLocation",
     "smField": "GPS Information Saved From The App",   "serviceUri": "17056191"
              },
  {  "metricId": "",                          "metricHighLevelType": "Dynamic",
     "metricName": "BatteryTemperatureGalaxyNote",
     "smField": "Gradi Centigradi",
     "metricValueUnit": "°C",
     "values": [
          [1580305500000, 19.5], [1580301900000, 20.0], [1580298300000, 20.5],
          [1580294700000, 18.5],  [1580291100000, 19],   [1580287500000, 18.5],
          [1580283900000, 21.5],  [1580280300000, 22.0],   [1580276700000, 19],
          [1580273100000, 17.5],   [1580269500000, 16.5],   [1580265900000, 17.0],
          [1580262300000, 18.5],  [1580258700000, 20.0],  [1580255100000, 19.5],
          [1580251500000, 21.5],    [1580247900000, 21]       ]
        }
]
```

# others



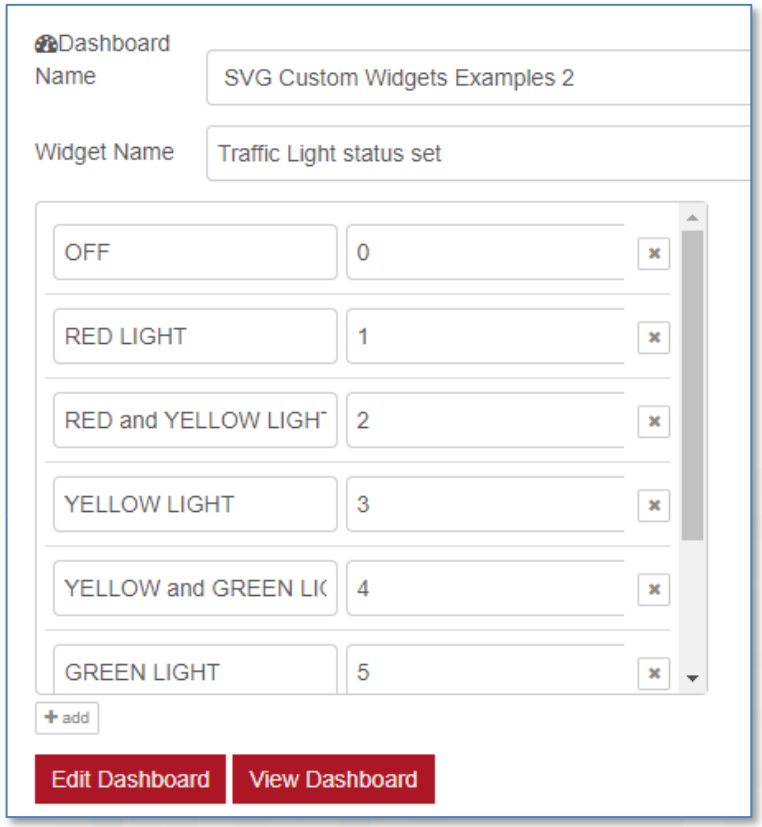



- an URL, a link to the web page to be loaded into an External Content Widget

# HTML forms vs IOT App data
# Getting data from Dashboards



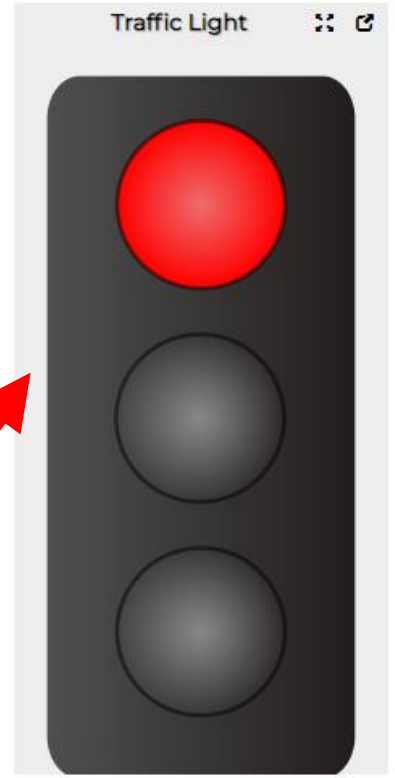
# DropDown Selector





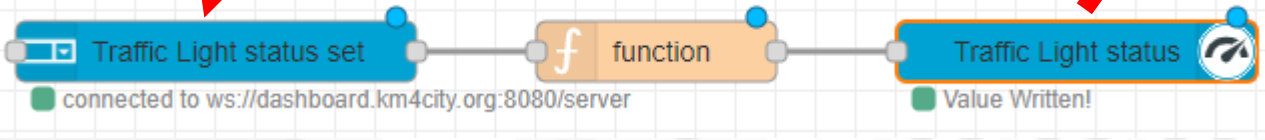


- Selecting MSG to be sent on the Business Logic IOT Application







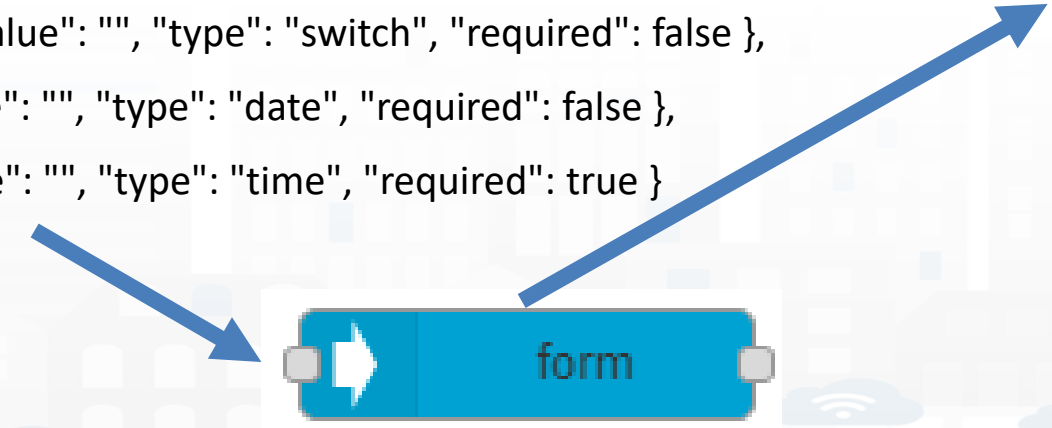


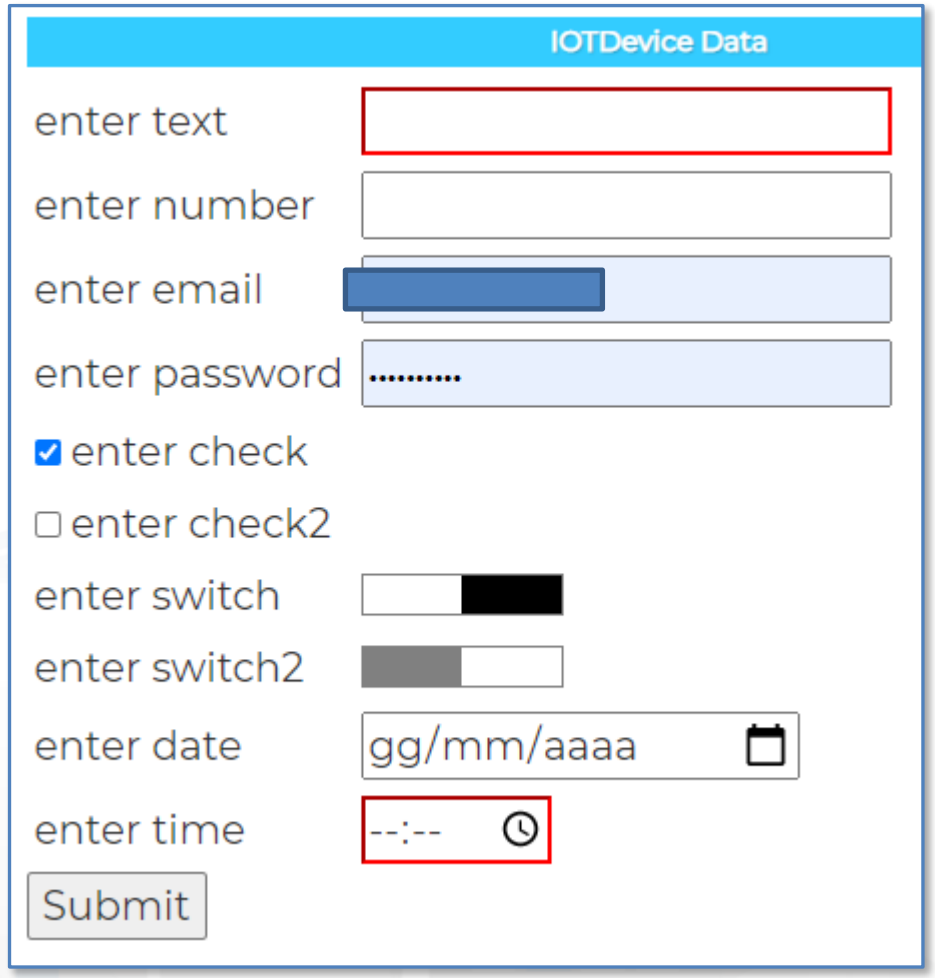

*HTML*

```
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;
```



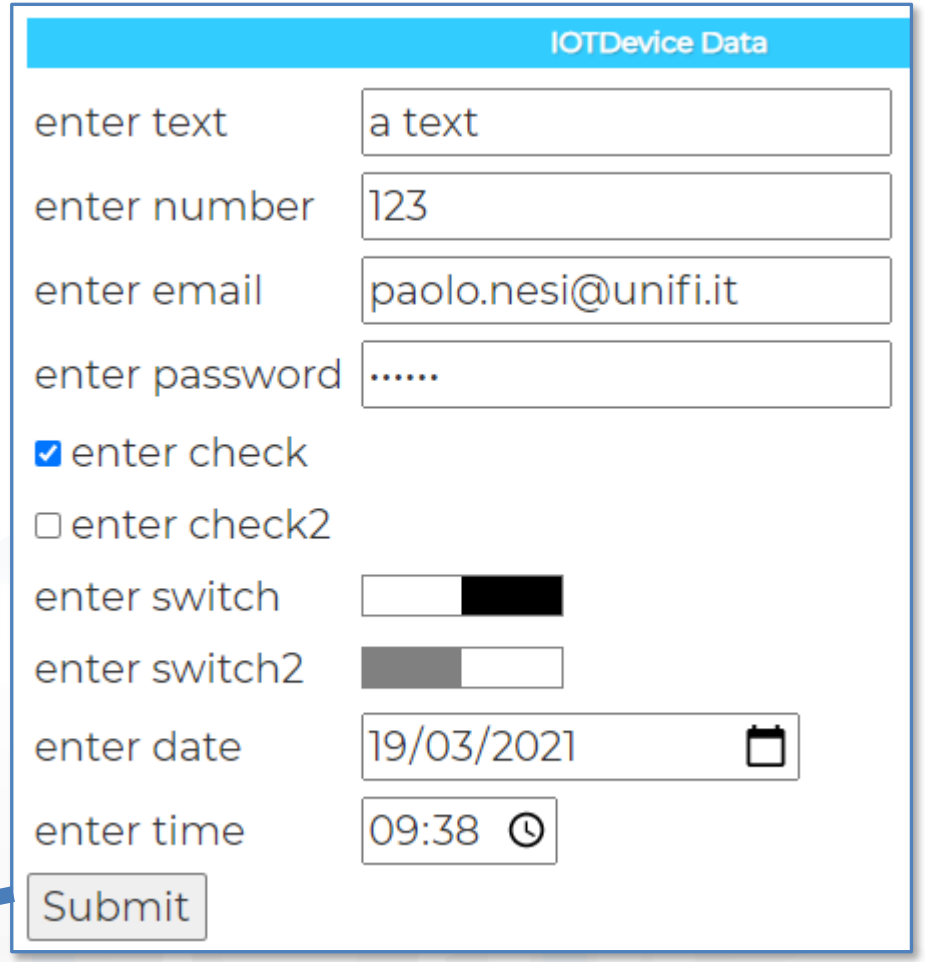




*HTML*

# 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;
```







*HTML*

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

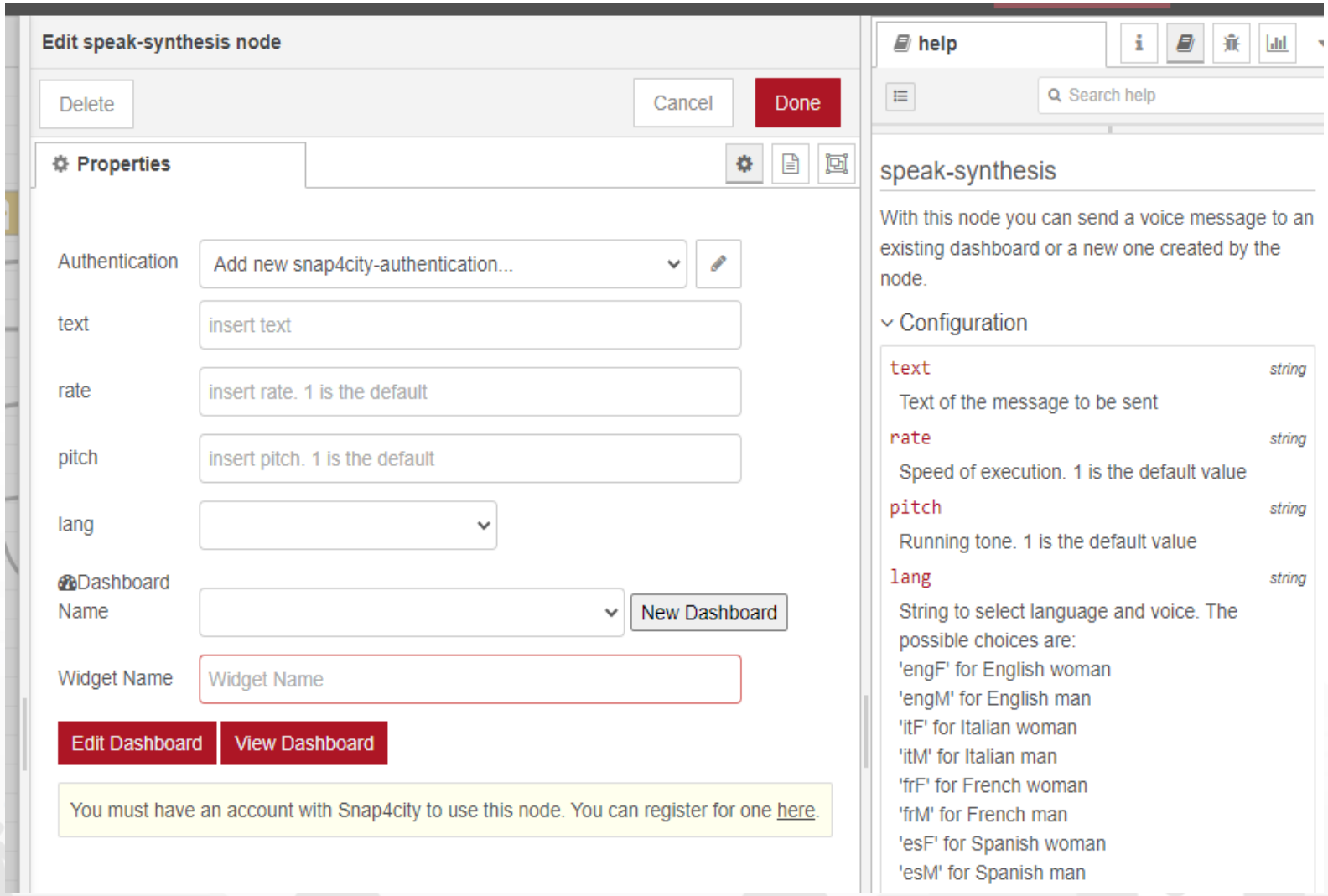
speak synthesis

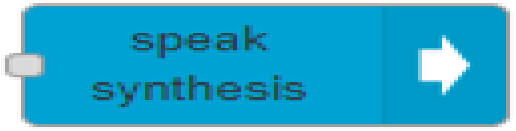
# Send Voice Messages on Dashboards

- **Connectable** on all «String» Variables
- **Controllable** from IoT Applications
- Play button on Dashboard




- **Configurable** as:
  - Voice Language and male, female, …
  - rate, pitch
  - ..



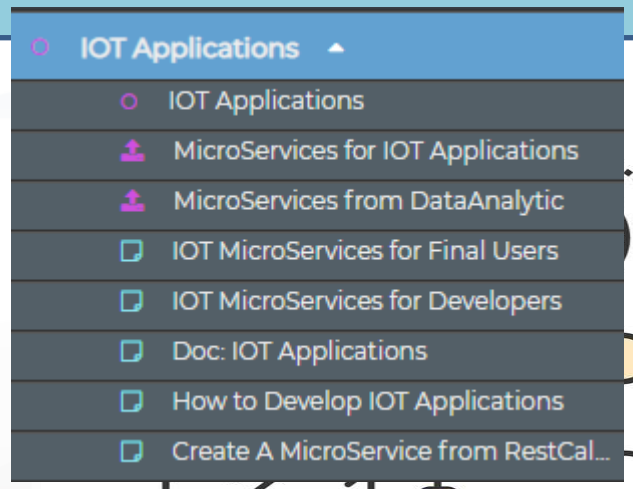



# Send Voice Messages on Dashboards

- Connectable on all «String» Variables
- Controllable from IoT Applications
- Simple Play button on Dashboard Widget
- Configured as:
  - Voice Language
  - Voice timbre: male, female, …
  - Voice Tone
  - Voice Volume
  - ..



# Event Tables vs IOT App data
# Getting data from Dashboards

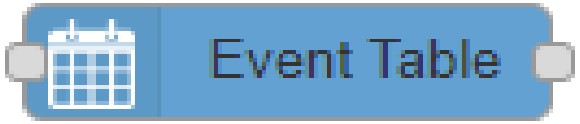


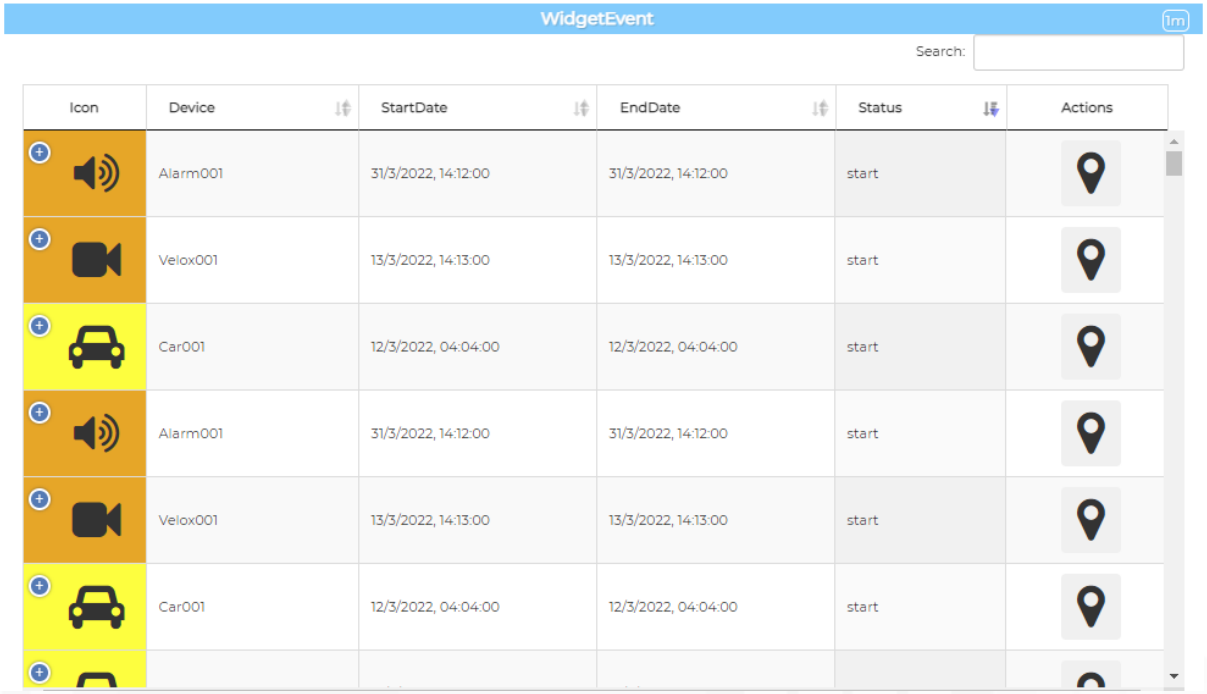



Node-RED

# Event Table

- A table for showing last messages of a set of SURI, IoT devices, mainly with a set of Variables
- The devices should have a number of minimal attributes as:
  - dateObserved
  - Icon to be visualized
  - Status
  - Expiration. Etc…..

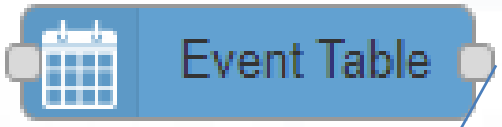


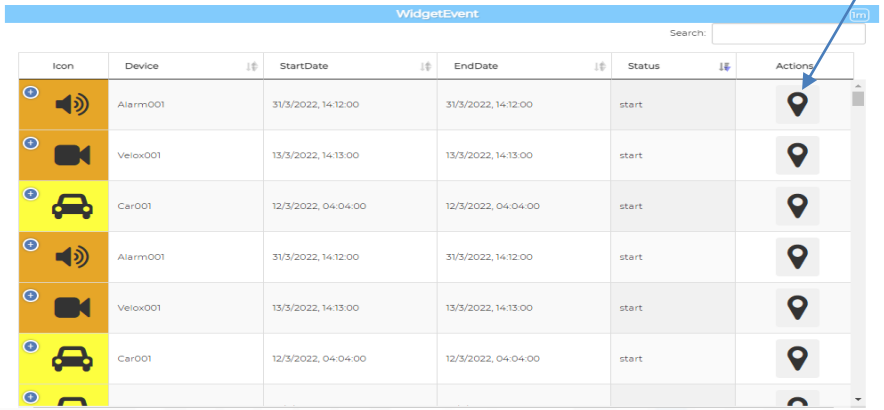



# Event Table

- The Node accepts in Input:
  - Ordering by a variable/attribute
  - List of SURI (one prefix and a number of Names)
  - List of Action as icons to be clicked
  - List of Columns to be shown on the table
- Output:
  - The Action clicked by the user with the  name of the SURI and ID

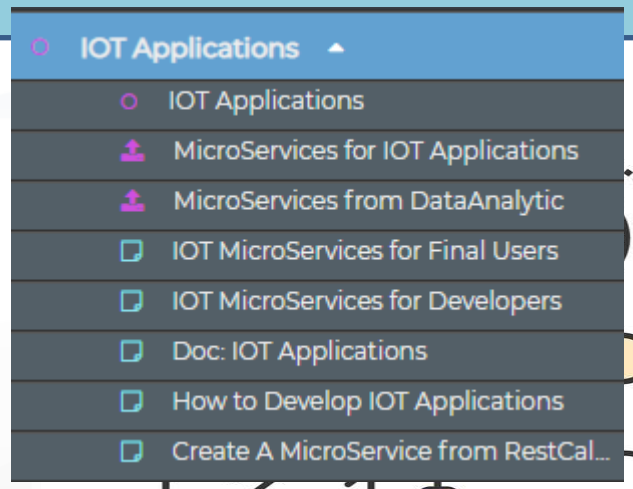
```
msg.payload = {
ordering: "status",
prefix: "http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/",
devices: ["Alarm001", "Car001", "Velox001",
"Earthquake001","Theater002", "Landslide001","Theater002",
"Landslide001"],
actions: ["pin", "Action1", "Action1", "https://www.aa.org/my.img", ],
columnsToShow:["device", "startDate", "endDate", "status"]
}
```




```
{"device":"Car001",
"prefix":"http://www.disit.org/km4city/resource/iot/orionUNIFI/DISIT/",
"ordering":"startDate",
"action":"Pin"
}
```

# Widgets MAP with business intelligence on IOT Apps





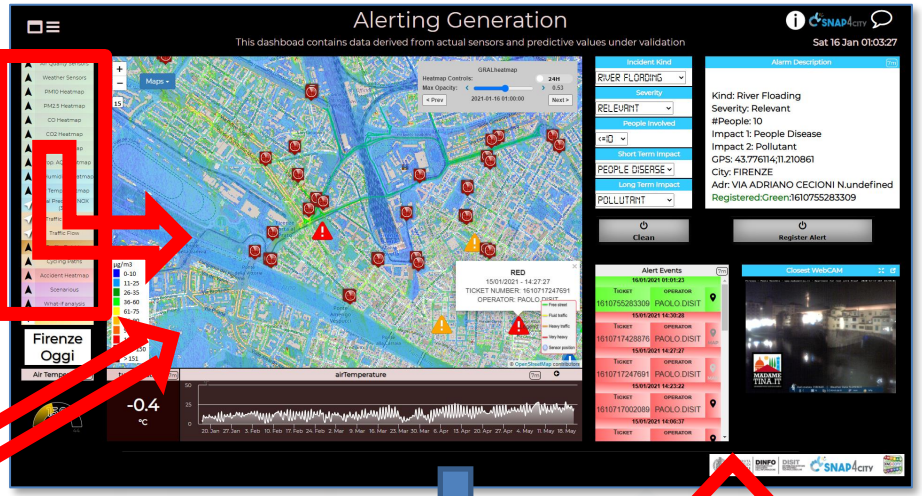

Node-RED

# Maps Business Logic vs IOT Apps

Any Snap4City data and sources: IoT Devices, Variables, Heatmaps, traffic, tools, KPI, etc.

data

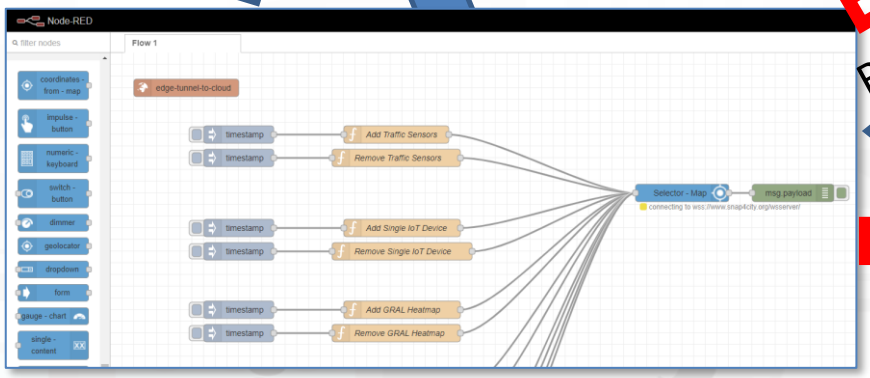
Selector




data

Data, changed data

References, commands, selections

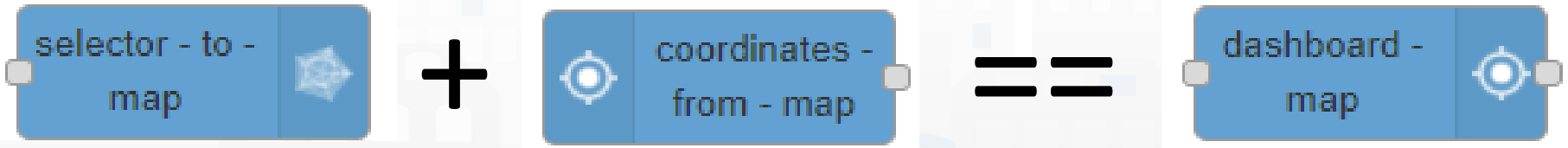



selections, positions, ServiceURI

# IoT App, Node-RED nodes: IoT App vs Dashbords

- **Coordinates From Map:**
  - Get GPS click from Map
  - Get Selected ServiceURI from Map
- **SelectorMap:**
  - Send commands, references, data to Maps

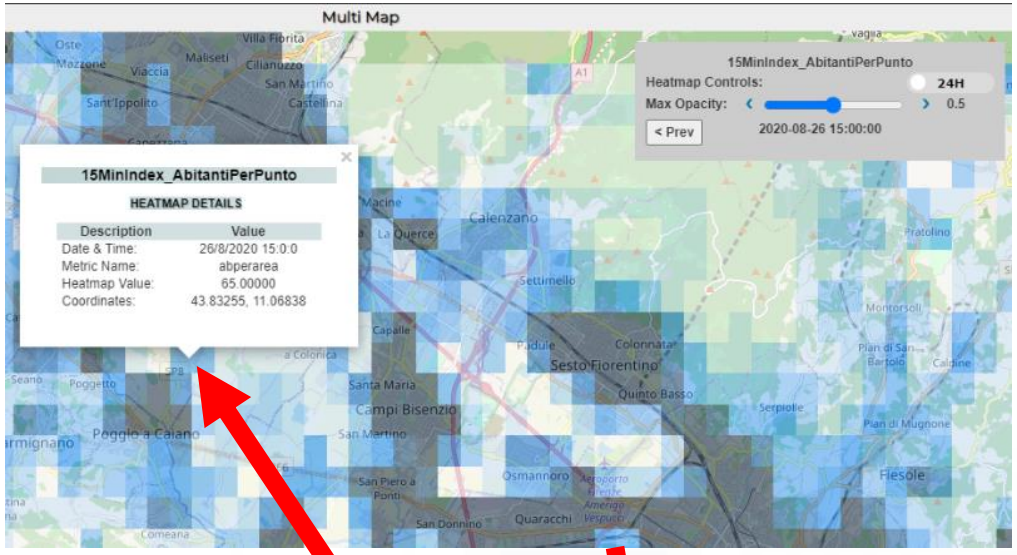
- **Dashboard Map provides:**
  - **All Features of**
    - **Coordinate From Map:**
    - **SelectorMap:**



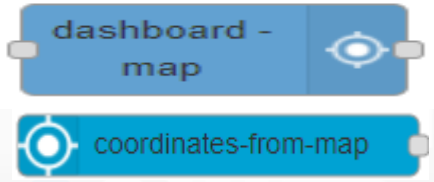

***SelectorMap* and *Coordinates From Map* will be Deprecated from Snap4City Library in late 2022**

***Dashboard Map is the only one supported since April 2022, Ver 0.9.17 of Snap4City user library on Node-RED***

# Multi Data Map GPS Location Picking vs IOT App



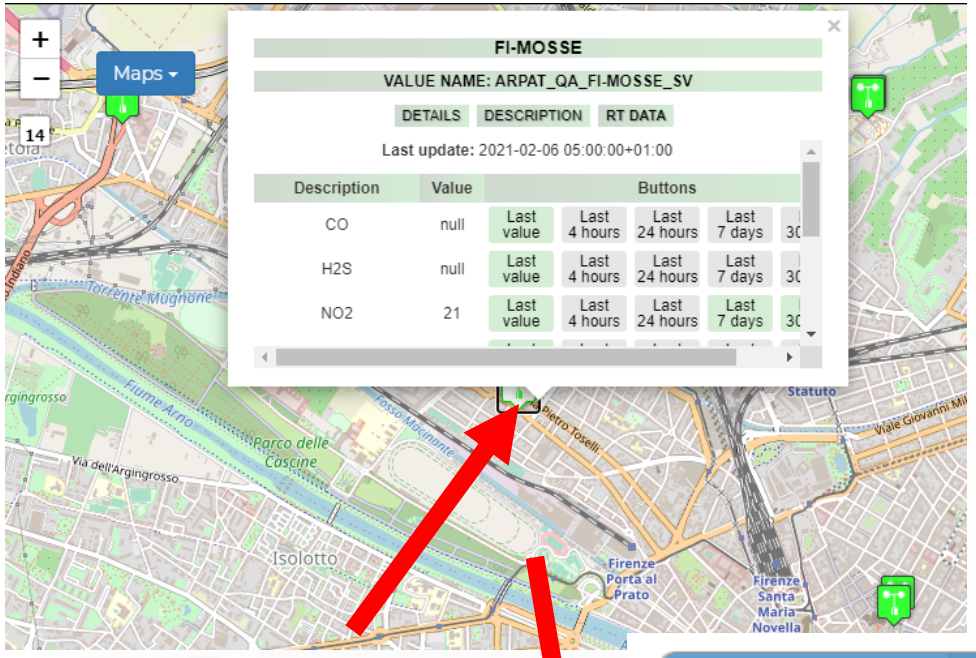

1) Click



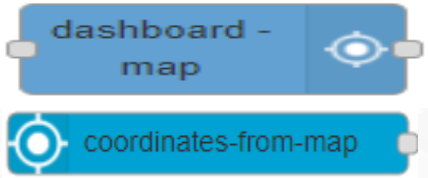

2) GET event with:
-- Lat,Long
-- ServiceURI

- 3) The click on the map passes GPS coordinates into IOT App. Thus you can use them to:
  - search for location
  - picking the value of one or more heatmaps
  - dynamically change data on widgets and dashboards
  - Etc.

# Multi Data Map ServiceURI selection vs IOT App




1) Click on PIN

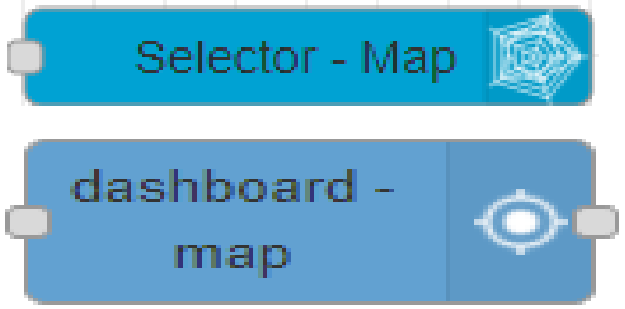



2) GET event with:
- Lat,Long
- **ServiceURI**

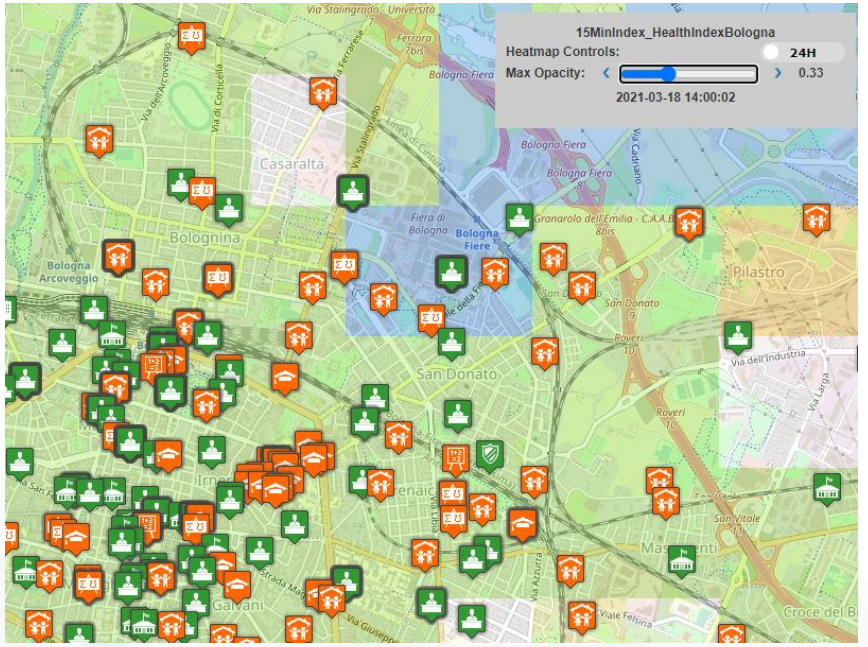
- 3) The click on the map passes GPS coordinates into IOT App and the ServiceURI. Thus you can use them to:
  - search for location
  - picking the value of one or more heatmaps
  - dynamically change data on widgets and dashboards
  - Get all the ServiceURI information and exploit them on Business Logic
  - Etc.

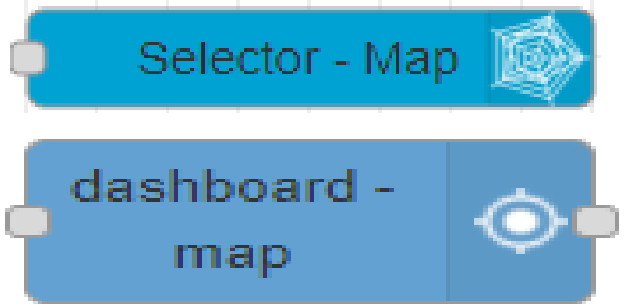
# Selector Map

# Controlling Maps from IOT Apps



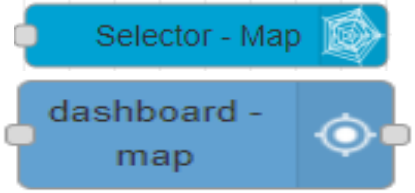

- User manual: https://www.snap4city.org/774
- To control Multi Data Map from IOT App
  - Add/remove a Category/SubCategory of Entities, via ***more option query***
  - Add/remove a single Device/PIN, MyPOI, MyKPI, Dynamic Pins, moving devices, etc.....
  - Add/remove cycling paths
  - Add/remove OD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






```
msg.payload = {
"type": "addSelectorPin",
"target": "w_Map_956_widgetMap32131",
"passedData": {
        "desc": "my studio temperature - GP -",
        "query": "datamanager/api/v1/poidata/17055853",
        "color1": "#ffdb4d",
        "color2": "#fff5cc",
        "display": "pins",
        "queryType": "MyPOI",
        "pinattr": "square",
        "pincolor": "#959595",
        "symbolcolor": "undefined",
        "iconTextMode": "text",
        "altViewMode": "None",
        "bubbleSelectedMetric": ""
        }
};
return msg;
```

# Add MyKPI
# Add MyPOI

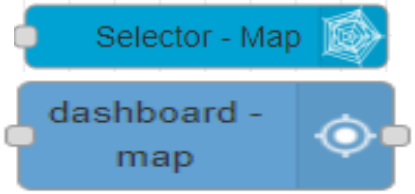



# Add Heatmap

```
msg.payload = {
"type": "addHeatmap",
"target": "w_Map_956_widgetMap32131",
"passedData":"https://wmsserver.snap4city.org/geoserver/Snap4City/wms?service=WMS&layers=FirenzeTrafficRealtime&trafficflowmanager=true",
"passedParams": {
    "desc": "Traffic Heatmap",
    "color1": "rgba(0,179,61,0)",
    "color2": "rgba(114,235,133,1)"
    }}
```

# Remove Heatmap

```
msg.payload = {
"type": "removeHeatmap",
"target": "w_Map_956_widgetMap32131«,
"isTrafficHeatmap": true
}
}
```






# Add OD Matrix

payload : {
"type": "addOD",
"target": "w_Map_956_widgetMap32131",
"passedData" : "https://odmm.snap4city.org/api/get?precision=communes&from_date=2017-10-19%2000:00:00&organization=Tuscany&inflow=True&longitude=11.257123947143556&latitude=43.771837562821375",
"passedParams": {
"desc": "OD Matrix Toscana",
"color1": "rgba(172,82,254,1)",
"color2": "rgba(172,82,254,0.46)",
}}

# Remove OD Matrix

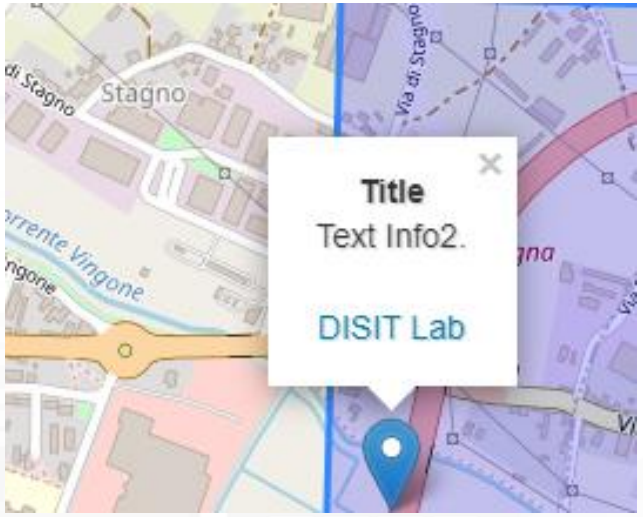
payload = {
"type": "removeOD",
"target": "w_Map_956_widgetMap32131",
}

# Add GeoInfoPin set of

```
payload : {
"type": "addGeoInfoPin",
"target": "w_Map_956_widgetMap32131",
"passedData": [{
      "id": "GeoInfoPin-01",
      "eventType": "GeoInfoPin",
      "textHtml": "<b>Title</b><br>Text Info2.<br><br><a href='http://www.disit.org/' target='_blank'>DISIT Lab</a>",
      "lat": " 43.76950",
      "lng": "11.125835"   }, … ]
}
```

# Remove GeoInfoPin set of

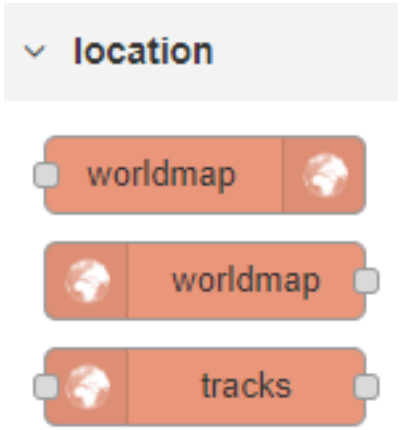
```
payload : {
"type": "removeGeoInfoPin",
"target": "w_Map_956_widgetMap32131",
"passedData": [{
      "id": "GeoInfoPin-01",
      "eventType": "GeoInfoPin",
      "lat": " 43.76950",
       "lng": "11.125835"
      }, ….]
}
```

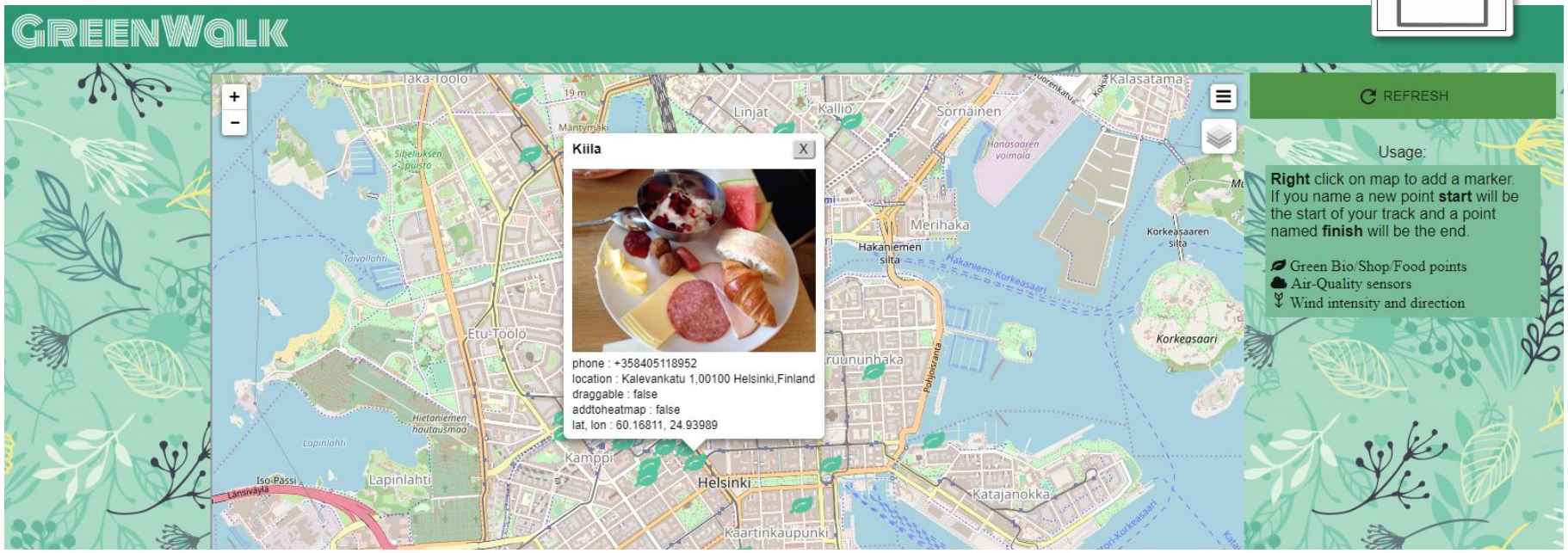


Deprecated for Snap4City IOT App since 2022, but usable



# Controlling Maps from IOT Apps



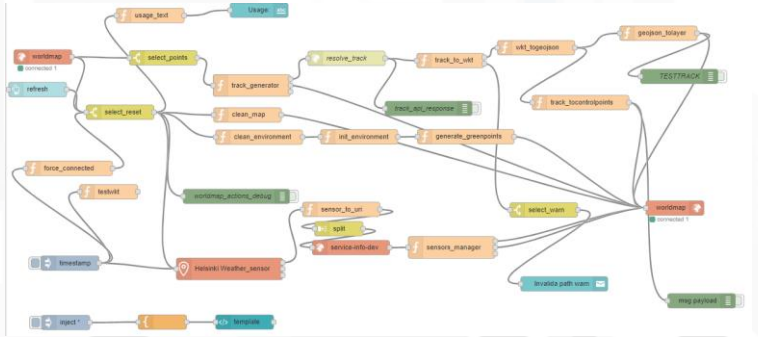




https://iot-app.snap4city.org/nodered/nrve0e3/ui/#!/0

- Show points on maps
- Get Points
- Tracks
- See examples on:

https://www.snap4city.org/409

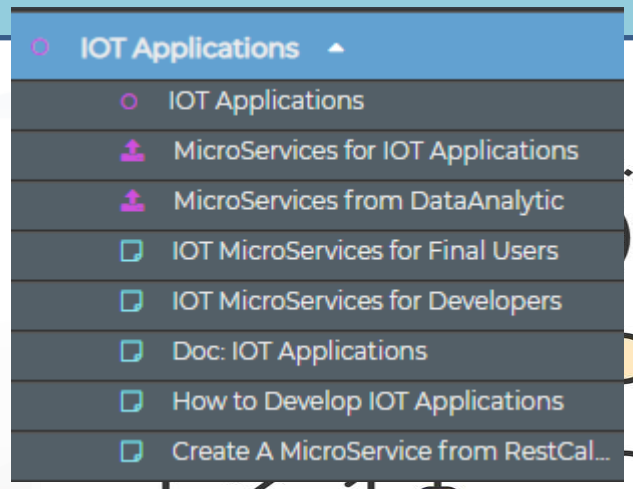
https://www.snap4city.org/417



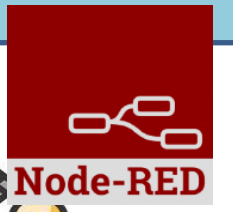
# Dashboards vs IOT Applications

- See a lot of more detailed examples into the Tutorial on IOT Applications
  - https://www.snap4city.org/577

# Dynamic Widgets data on Dashboard from IOT Applications





# How the Dashboards exchange data

Snap4City BigData Storage and KB

IOT Broker Orion Quantum Leap

ServiceMap Super ServiceMap

- Req. ServiceURI

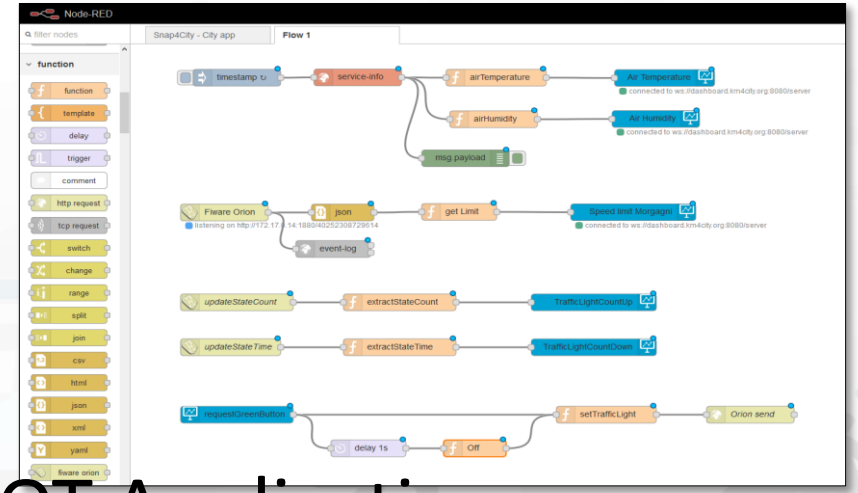
Metric, KPI

MyKPI, MyPOI, …

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

API, External Services, MicroApp

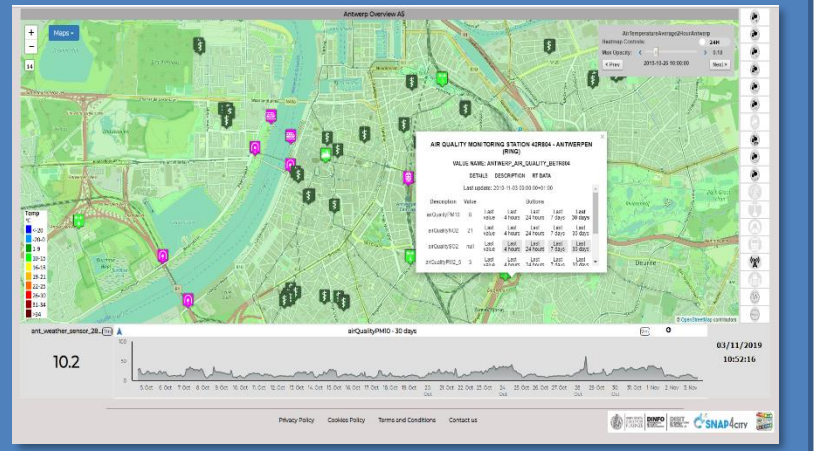
- Traffic Flow, MAPS, Heatmaps
- GIS, HTTPs URLs

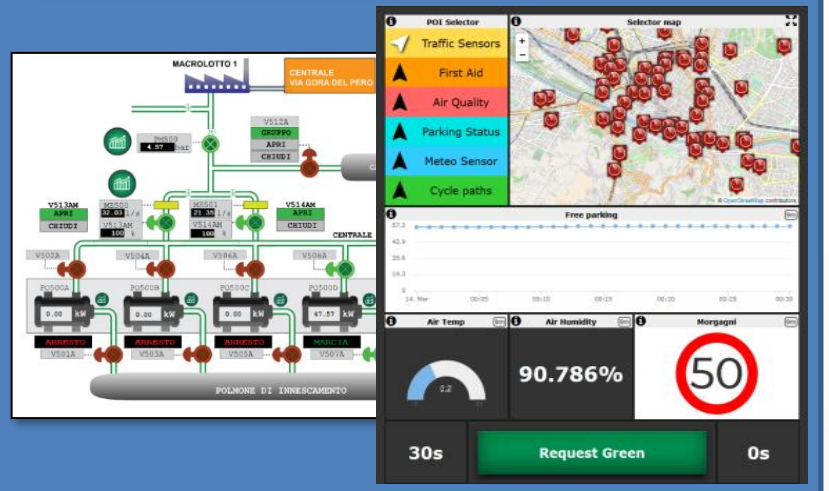



- ServiceURI (ID)
- MyKPI, Metric (ID)
- Dynamic Data, computed into IOT Application

- Rx. Dynamic Data
- Event Driven Synoptics
- Actions, Show

## Dashboards






IOT Application

# Dynamic Widget data


```
▾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
```

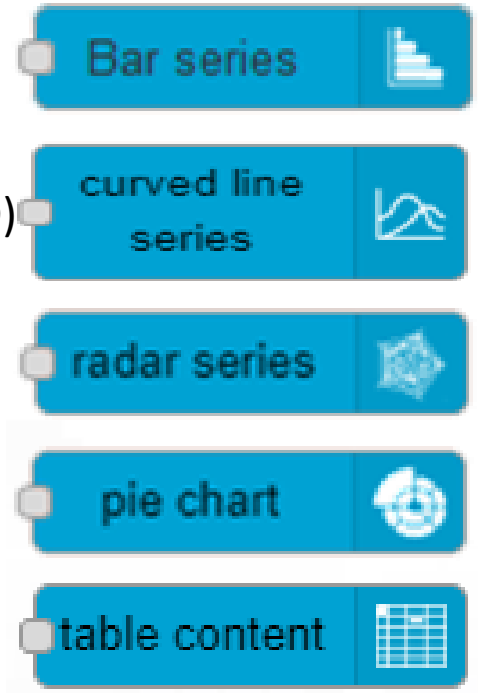

**ServiceURI** (ID)

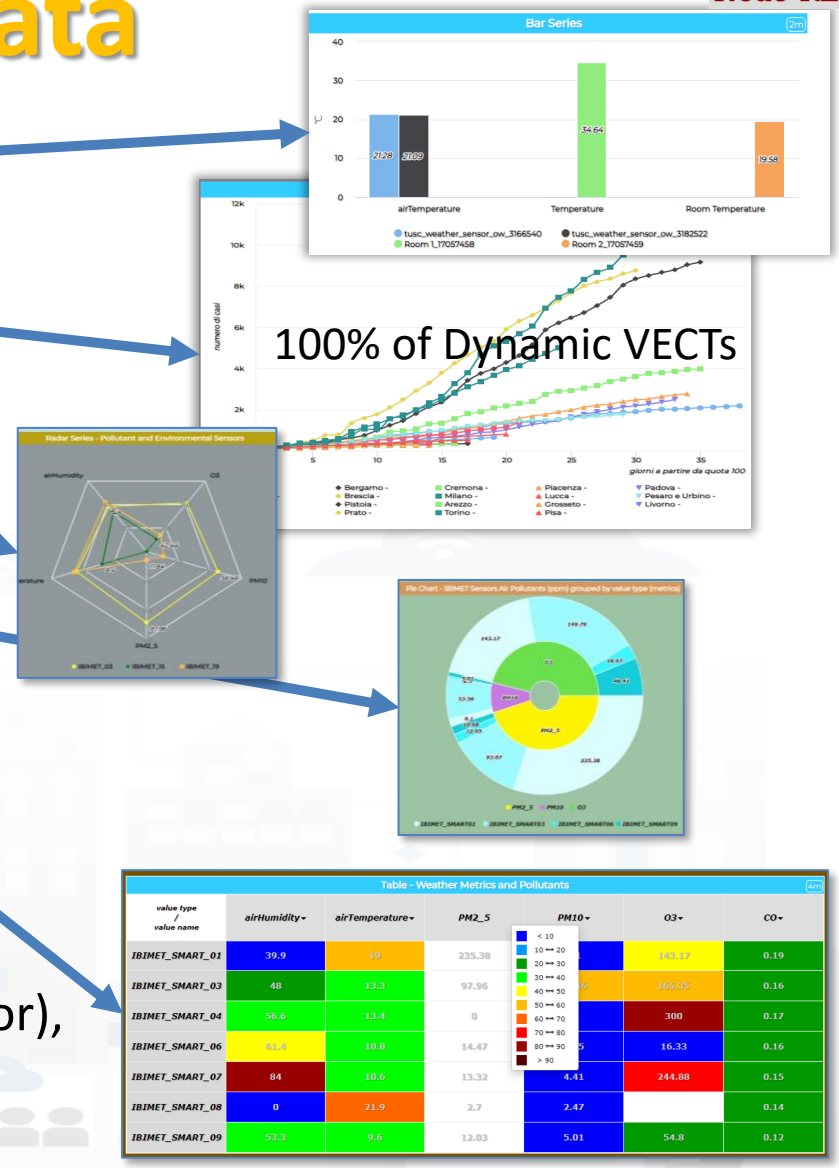
**ServiceURI** (ID)

**MyKPI** (ID)

**Dynamic**

**Dynamic**

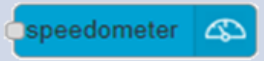
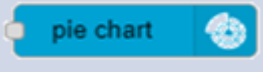
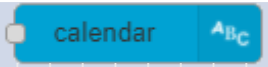
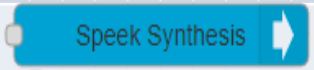



- **ServiceURI** (ID)
- **MyKPI (ID)**, Metric (ID)
- **Dynamic** Data in JSON (single or Vector), computed into IOT Application

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

# Dynamic (4/22)

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

DD: Data Driven

# Legenda

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

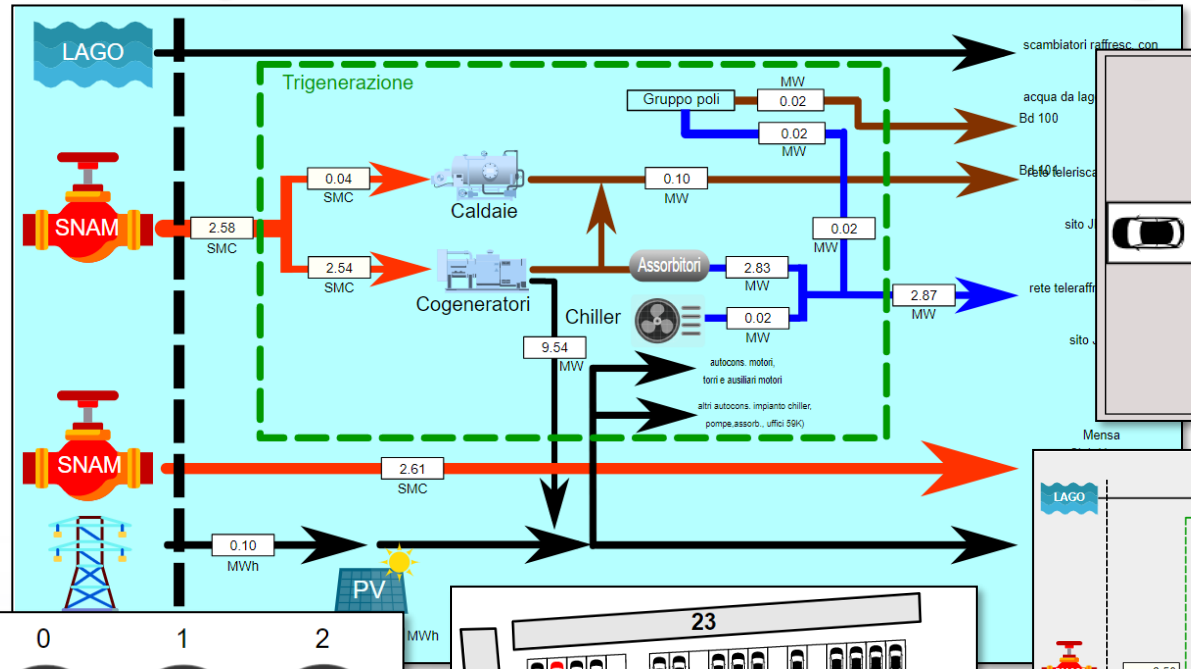
TC4.9: New Support Widgets for Bars, Barseries, Trend, and Series, on Dashboards and IOT Applications (partially obsolete)

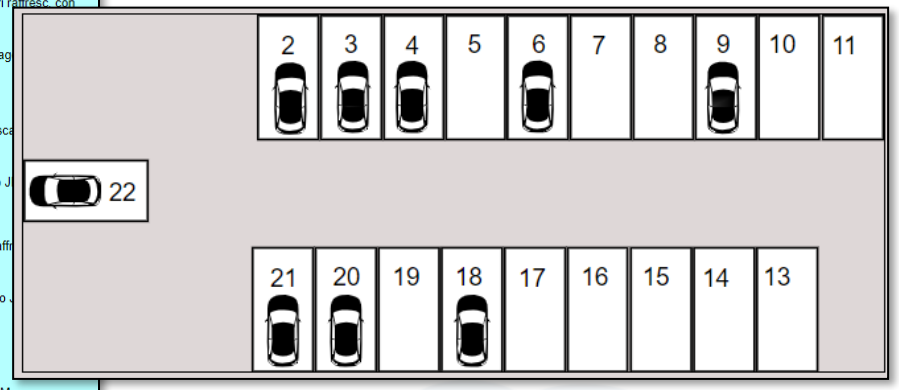
# Synoptic, Custom Widgets and PINS Creation

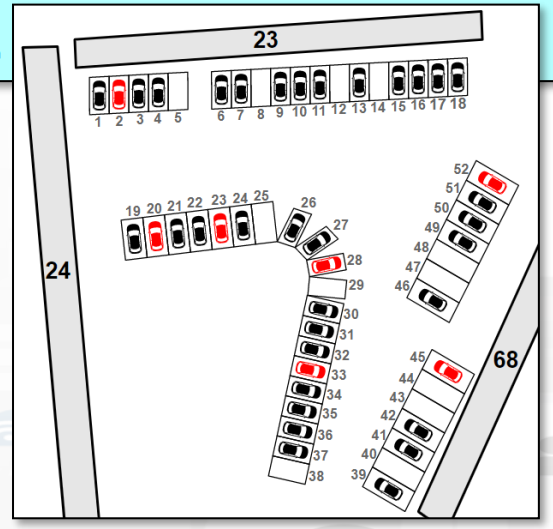


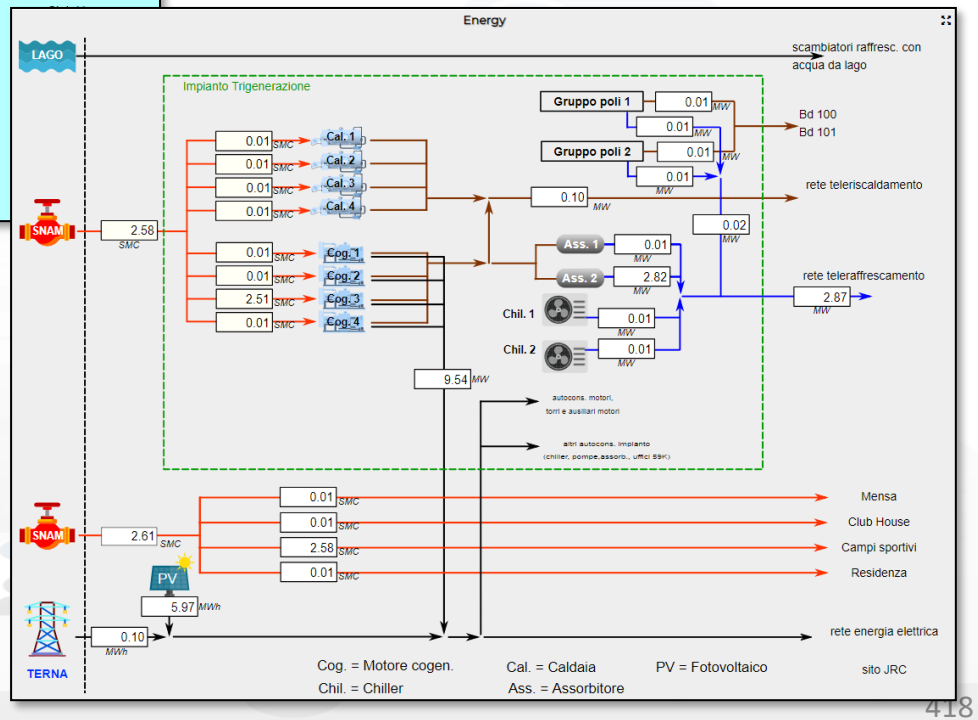
# Special Custom Widgets

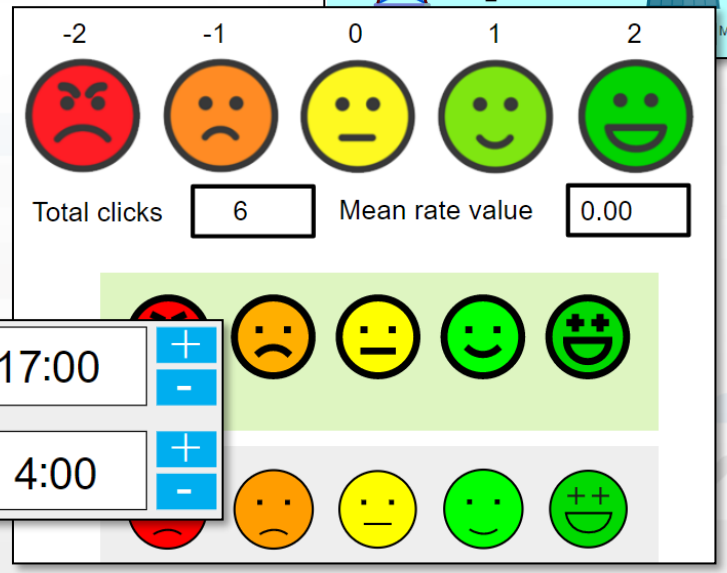
- Smart parking
- Smart Energy
- Smart Light
- Smart ….
- Energy View
- Custom Controls



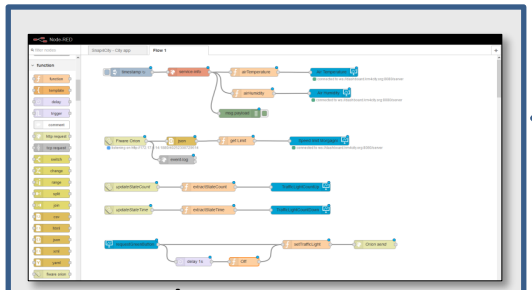



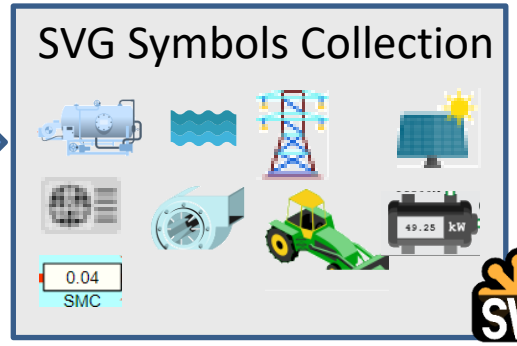



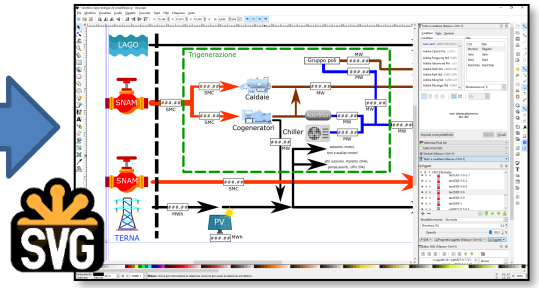
# Custom Widget / Synoptic / PIN Development



IOT Applications



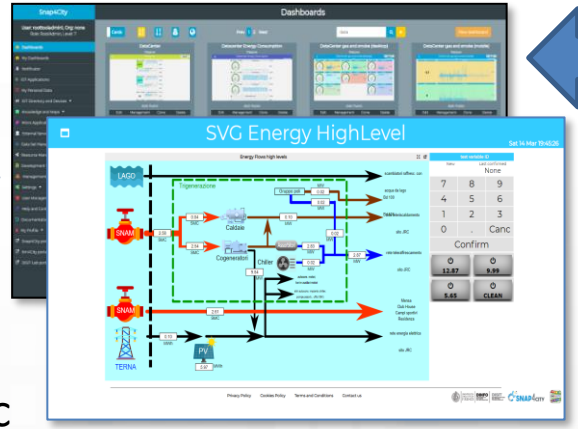

Inkscape editor on your computer




Create, save a Custom Widget in SVG

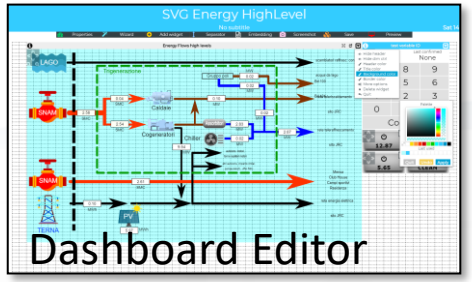



Knowledge and Storage Data from the Field and City




Public Dashboard Collection

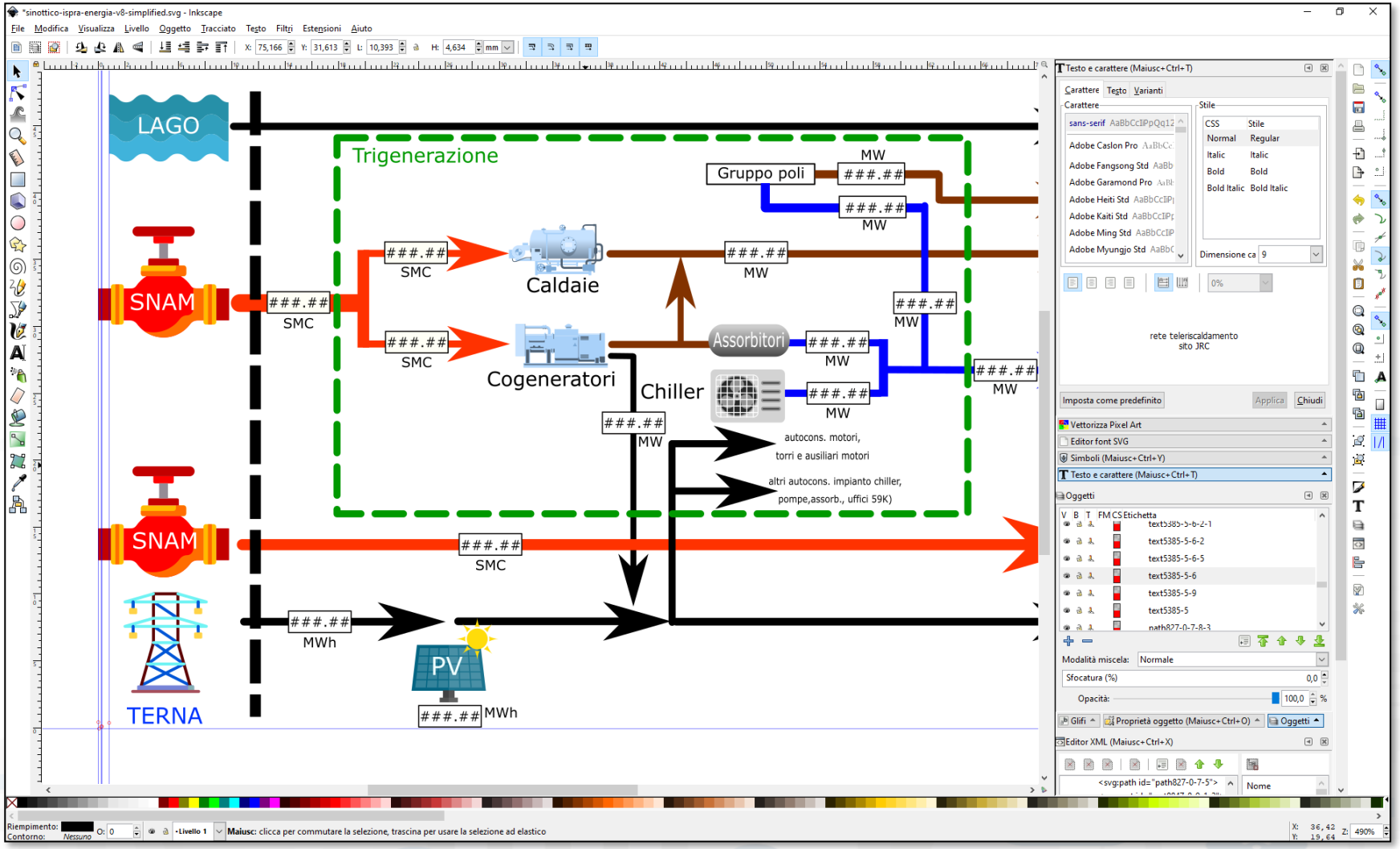
My Own Dash/App






Create, save, load, delegate, grant access

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

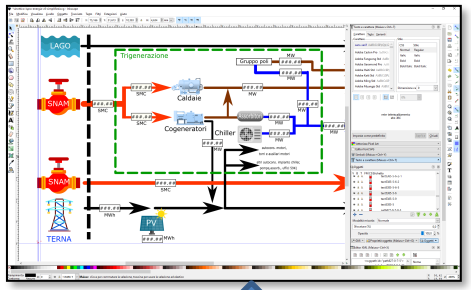



# How to create a custom Widget

- [User manual on: https://www.snap4city.org/595](https://www.snap4city.org/595)

**CW with a single READ Variable are automatically usable as PINS**

**Create**, save a Custom Widget in SVG

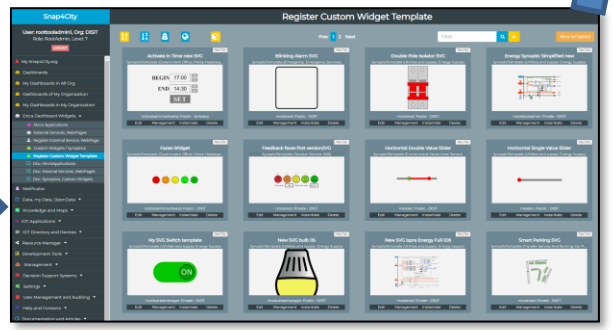


SVG Symbols Collection

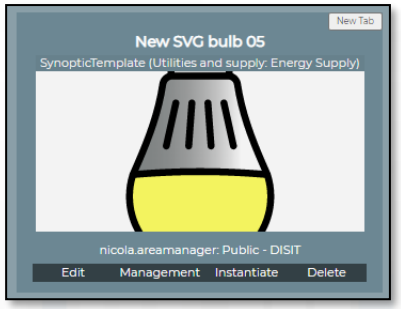


From any open library

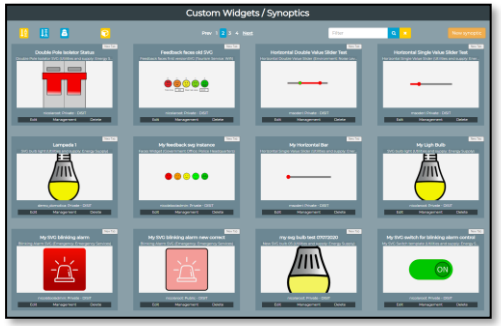
**Upload** as Custom Widget Template



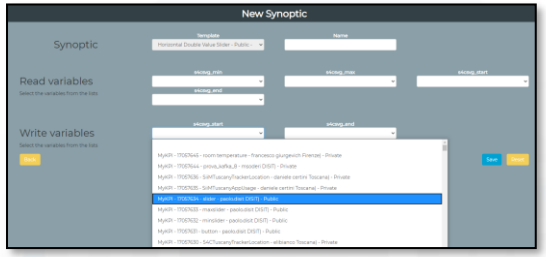

select



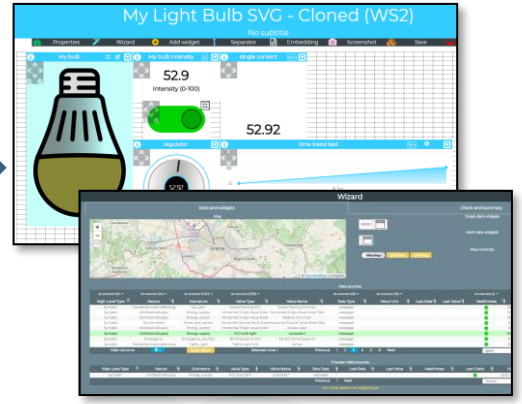

List of Custom Widgets / Synoptics

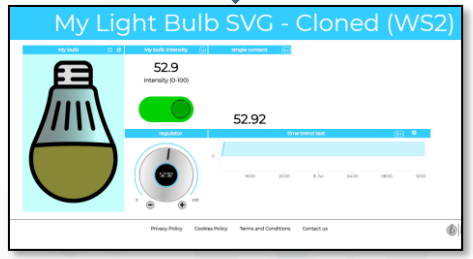



**Instantiate** as Custom Widgets / Synoptics Connect with WebSockets



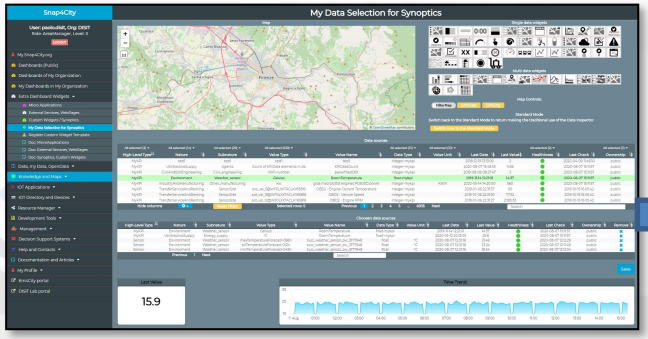

**Dashboard Editing/wizard**



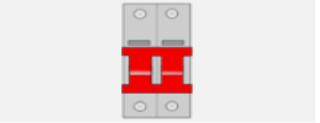




Final Dashboard

Select MyKPI and Sensor Data for Synoptics cases



# Help on Custom Widgets

| *Custom Widget name and image* | *Explanation* | *Variable(s)* | *Accepted values* |
|---|---|---|---|
| Activate in Time new SVG   | Set the begin and the end hours by using the small + and – buttons. Click SET to send the defined hours to the server. | s4csvg_begin (read and write variable)<br>Default value: ##:## | starting hour in the form HH:mm to be set by clicking the + and – button |
| | | s4csvg_finish (read and write variable)<br>Default value: ##:## | ending hour in the form HH:mm to be set by clicking the + and – button |
| Air Conditioner SVG  | Change the image according to the value received. | s4csvg_airconditioner_status (read variable)<br>Default value: undefined state, the SVG shows the overlapped cold and hot images. | 0 = OFF, 1 = cold, 2 = hot |
| Blinking Alarm SVG  | The image blink or stop to blink according to the value received.<br>Example: https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjc4NQ== | s4csvg_blinking_alarm (read variable)<br>Default value: 1, blinking | 0 = OFF (fixed image), 1 = blinking |
| Double Pole Isolator SVG  | By clicking the SVG, the status of the switch changes accordingly and the corresponding value is sent to the server.<br>Example: https://main.snap4city.org/view/index.php?iddasboard=Mjk4Ng== | s4csvg_isolator_onoff (read and write variable)<br>Default value: undefined state, the SVG shows the overlapped position up and position down images. | 0 = OFF (position down), 1 = ON (position up) |
| Faces Widget  | By clicking a coloured face the corresponding value is sent to the server.<br>Examples: https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjU0NA== | s4csvg_userFeedback: value sent to the server by clicking the corresponding face (write variable).<br>Default value: no value sent. The SVG shows the five | -2 = very bad, -1 = bad, 0 = so-and-so, 1 = quite-good, 2=good |

# From-To Custom Widgets / Synoptics to Storage in WS

MyKPI

Sensors

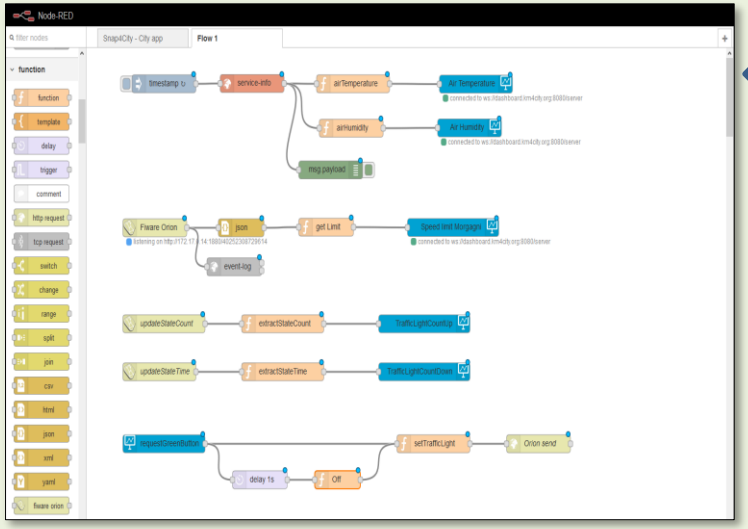
MyKPI

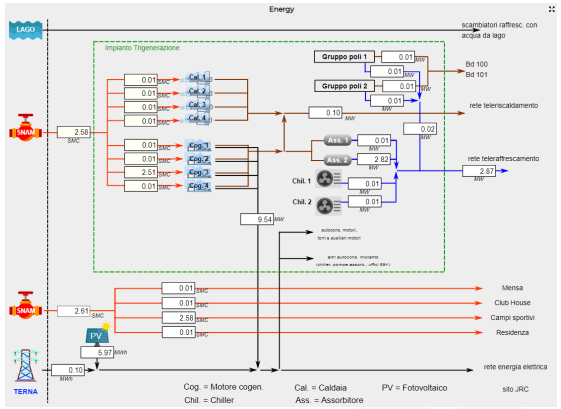
Sensor

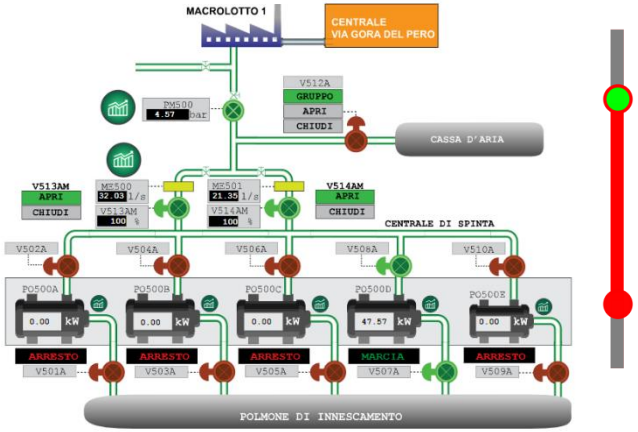
[ ]

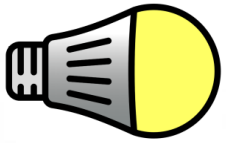
New Shared Variables

Constant Values

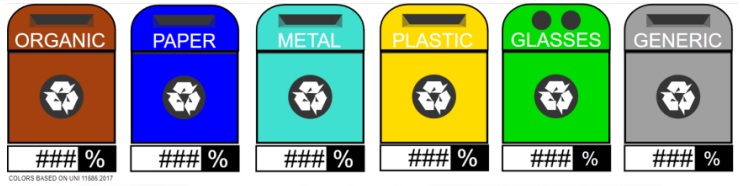


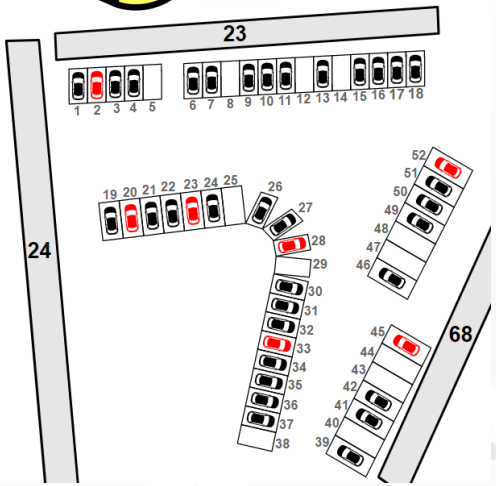



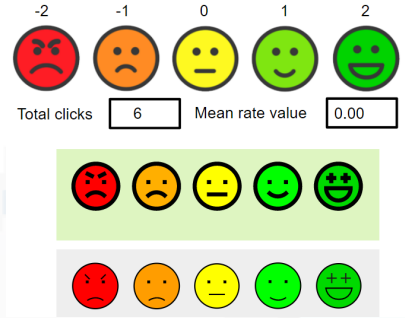



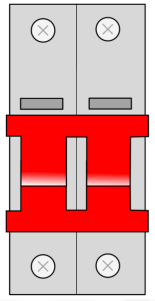



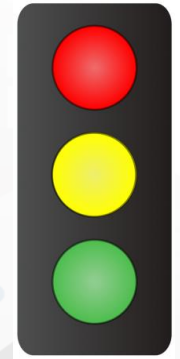


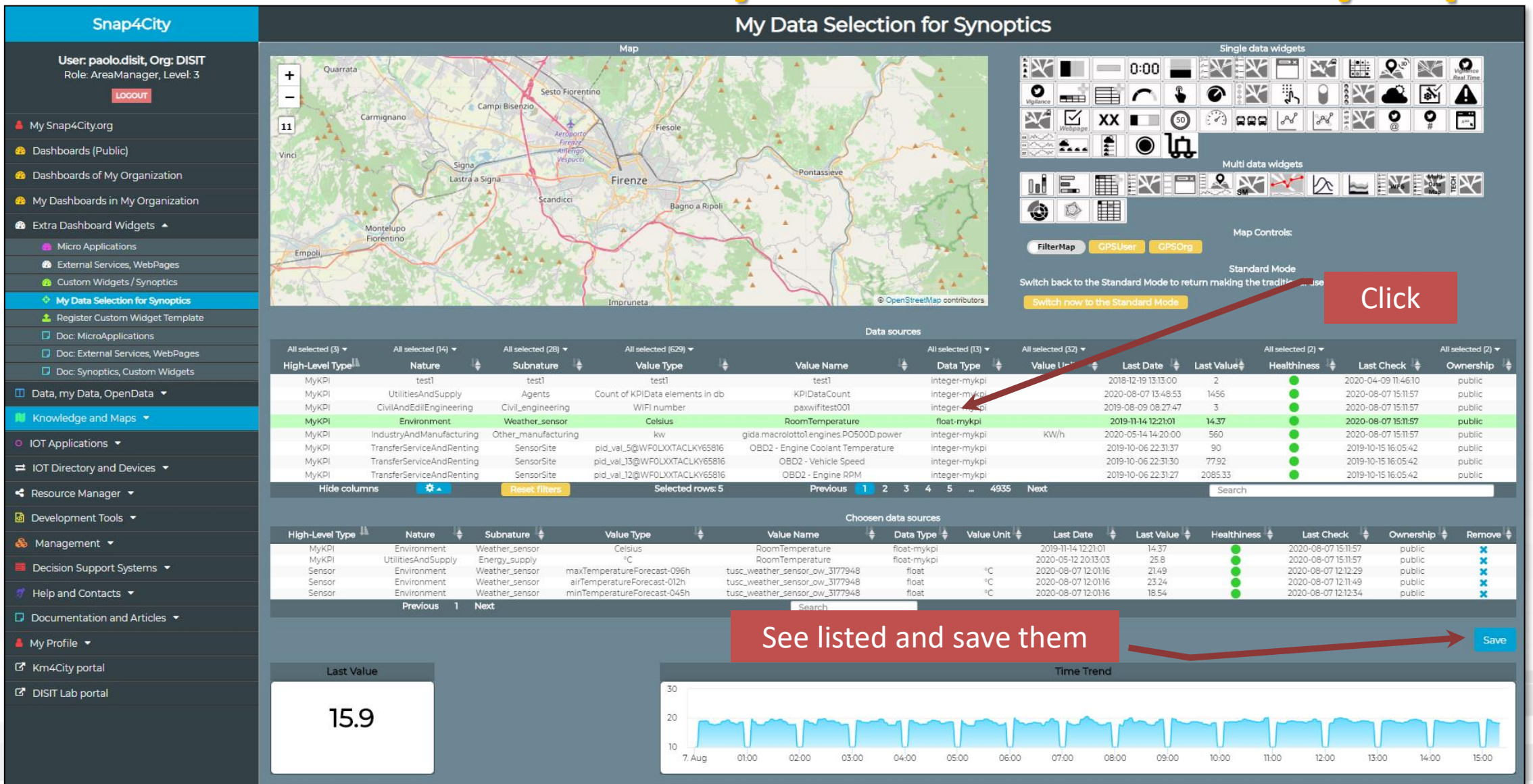





**Web Socket Secure**

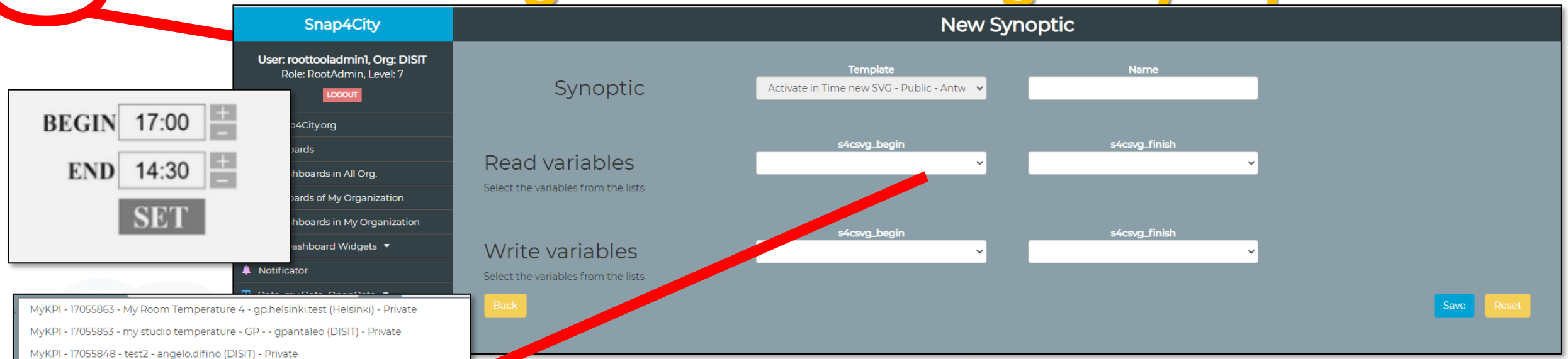
# Select the Sensors and MyKPI to be used on Synoptics



# Custom Widgets Templates

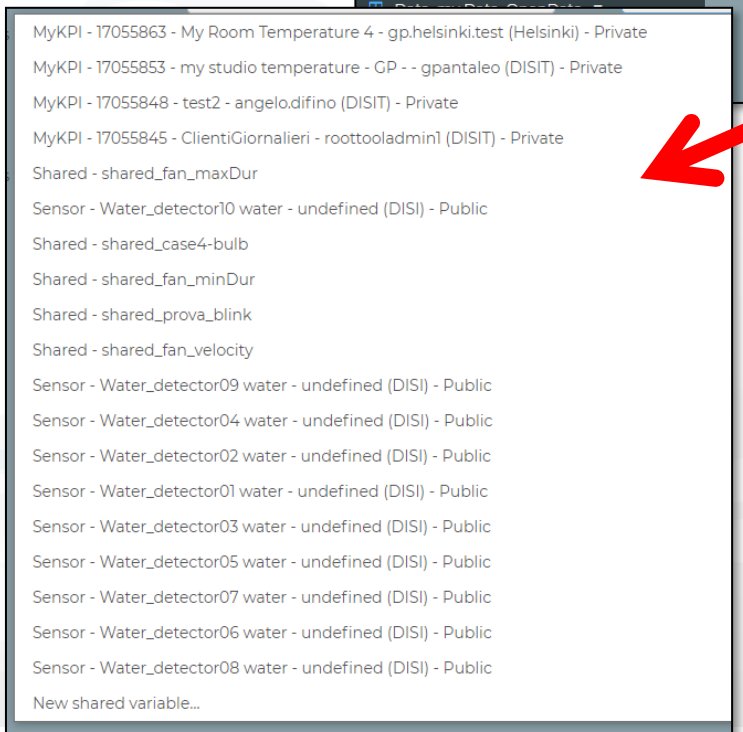


# Instantiating a Custom Widget Synoptic









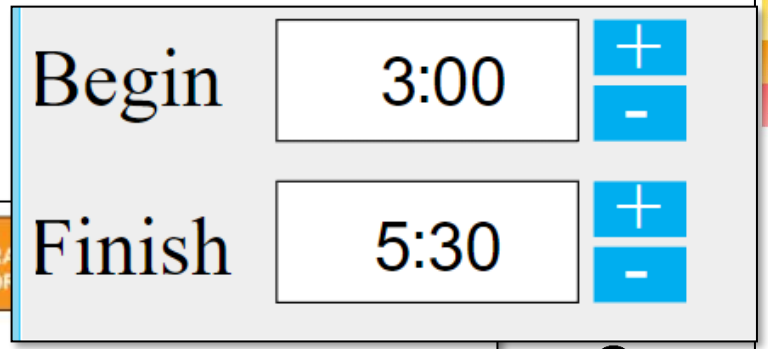

- **[ ]**
  - **leave it empty to connect later direcly from/to IOT APP**
- **MyKPI**
  - Read/write data, your KPI, and real time values
- **Sensors**
  - Your data collected as sensors only rendering data
- **New Shared Variables**
  - ….. Only for Case 3: Synoptic vs Synoptic Communications
  - No protection of data value

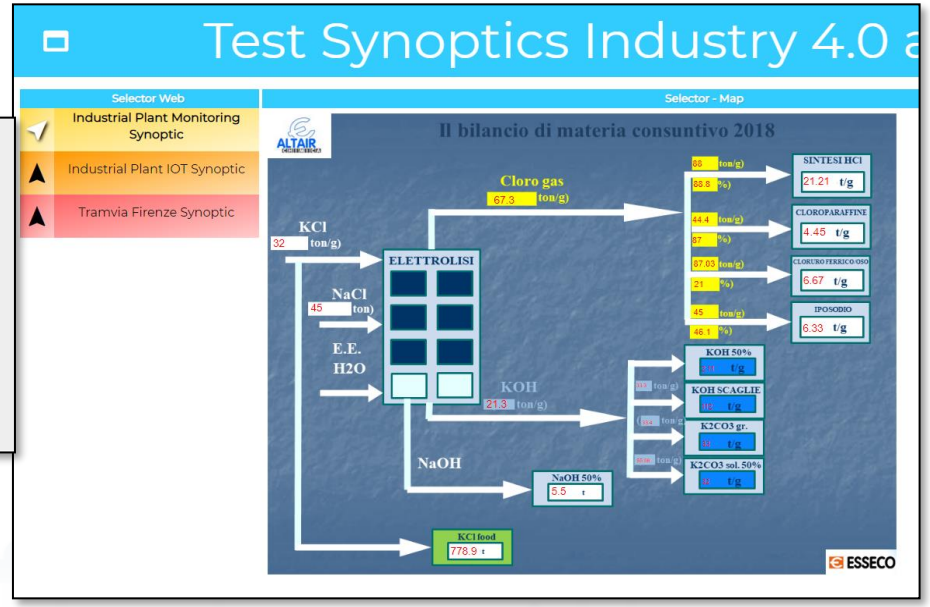
# Custom Widgets

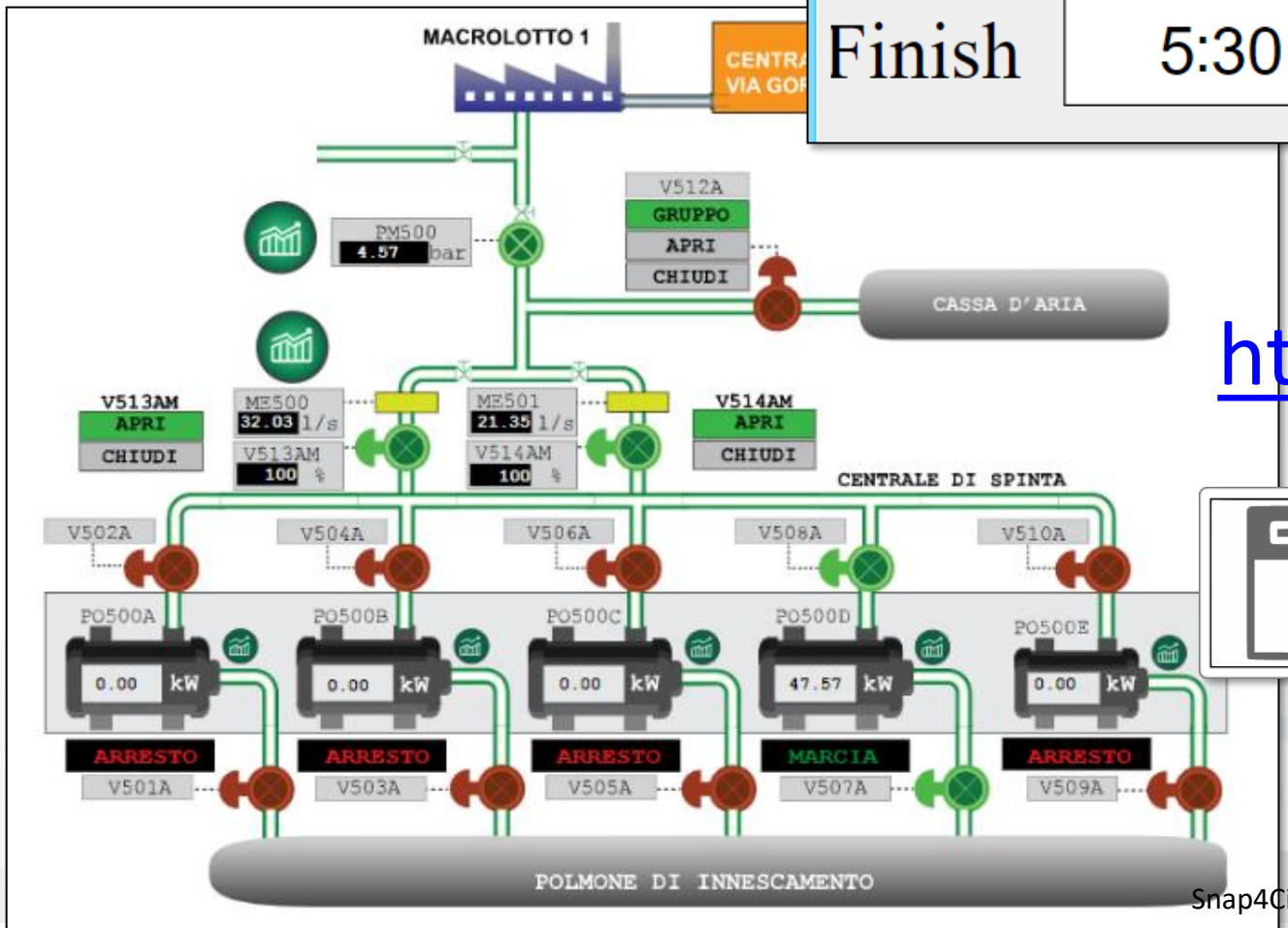
**Custom Dashboards and Widgets (interactive, Animations, etc.)**

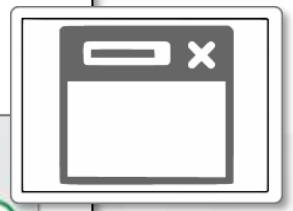
**-- SVG for graphic design**

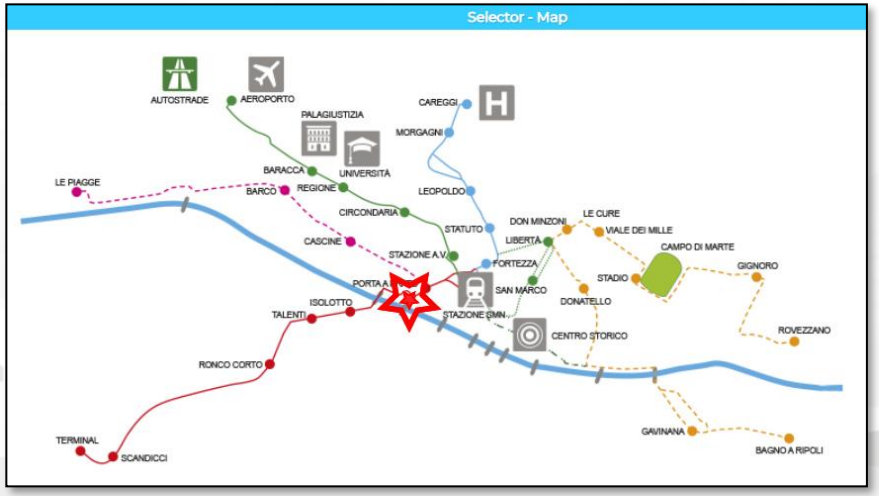
**-- MyKPI for collecting data**



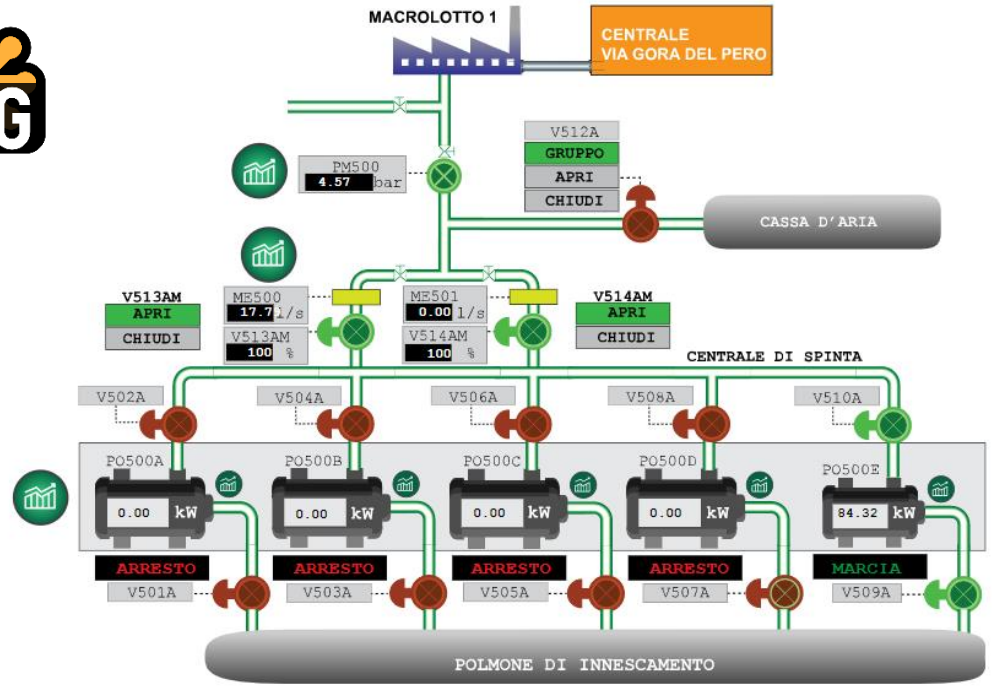



https://www.snap4city.org/504

# GIDA 5G demo

Sat 12 Oct 23:52:54

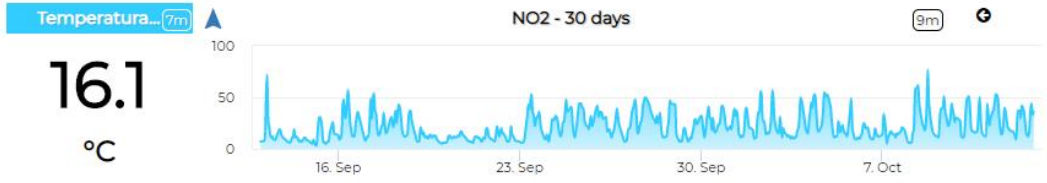
## Macrolotto 1 - Spinta in rete

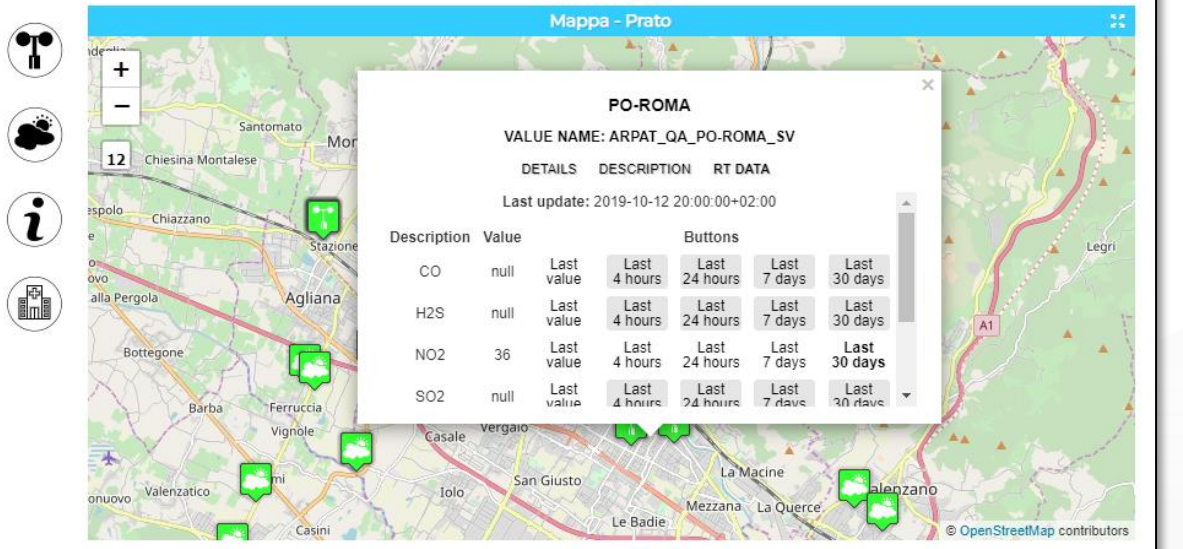






| Temperatura GIDA 7m | Pressione - GIDA 7m | Umidità - GIDA 7m |
|---|---|---|
| 16.1 °C | 1023 bar | 82 % |



# Smart Lonato del Garda

Sat 9 Nov 17:20:59

Slot 1
Slot 2
Slot 3
Slot 4
Slot 5
Slot 6
Slot 7
Slot 8
Slot 16
Slot 17
Slot 18
Slot 19
Slot 20
Slot 21
Slot 22
Environment
other

Selector - Map

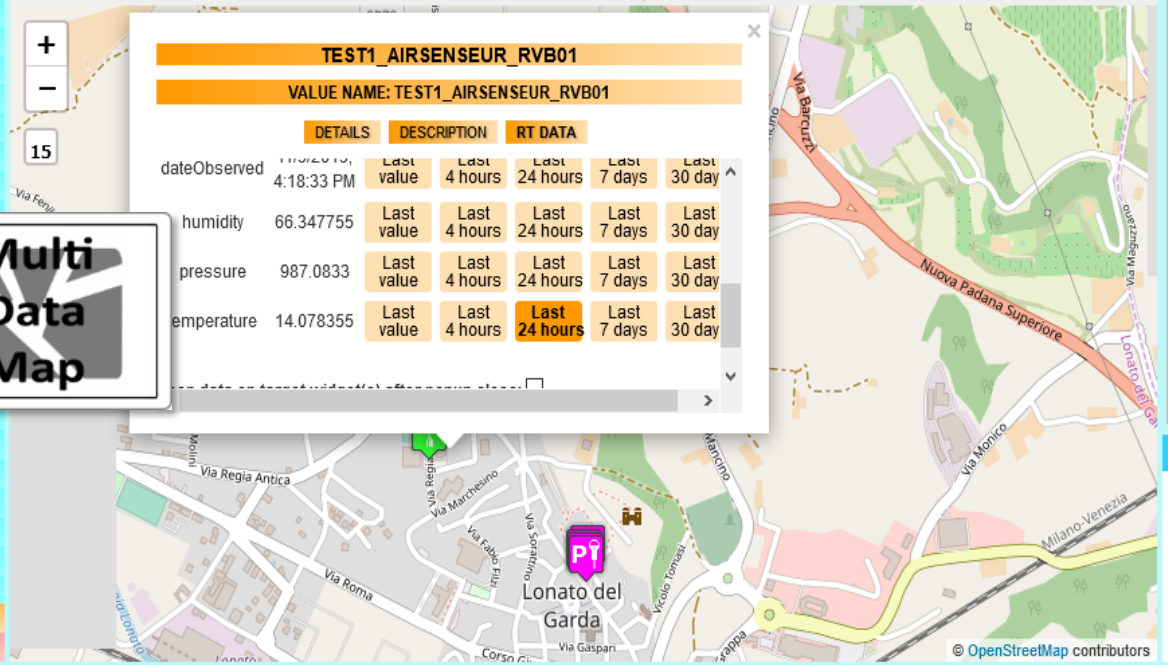
Multi Data Map

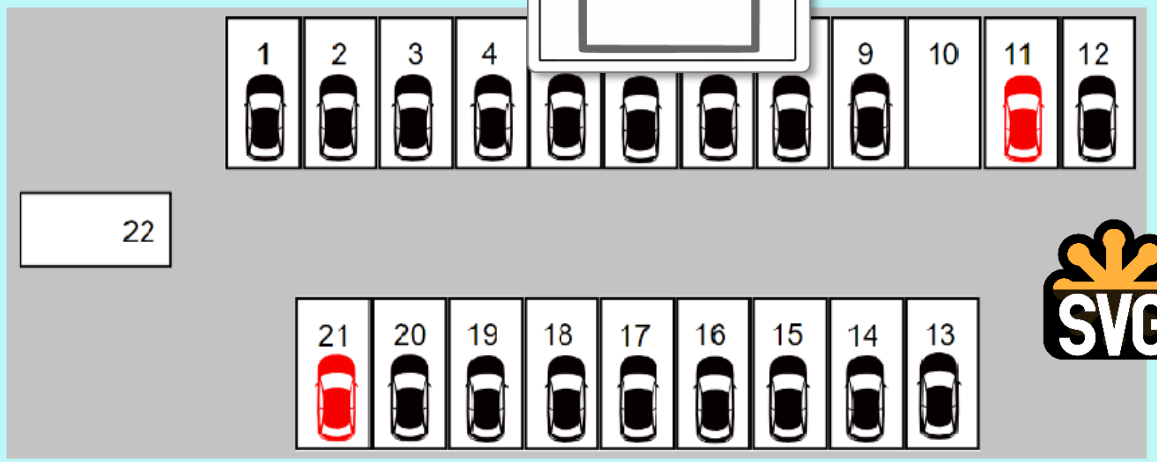
TEST1_AIRSENSEUR_RVB01

VALUE NAME: TEST1_AIRSENSEUR_RVB01

DETAILS | DESCRIPTION | RT DATA

| | | Last value | Last 4 hours | Last 24 hours | Last 7 days | Last 30 day |
|---|---|---|---|---|---|---|
| dateObserved | 4:18:33 PM | | | | | |
| humidity | 66.347755 | | | | | |
| pressure | 987.0833 | | | | | |
| temperature | 14.078355 | | | | | |

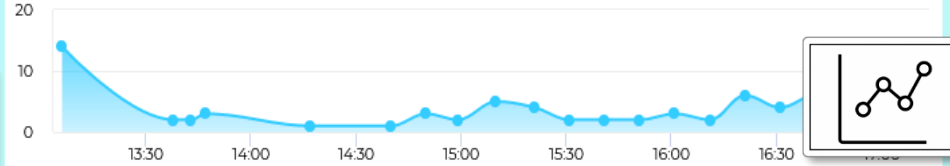



SVG

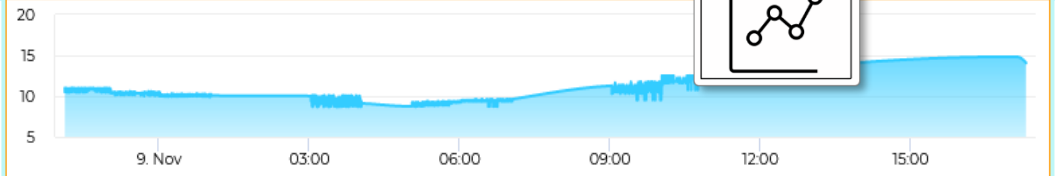
NumFreeSlo... 9m
XX

NumFreeSlots - Slots 9m

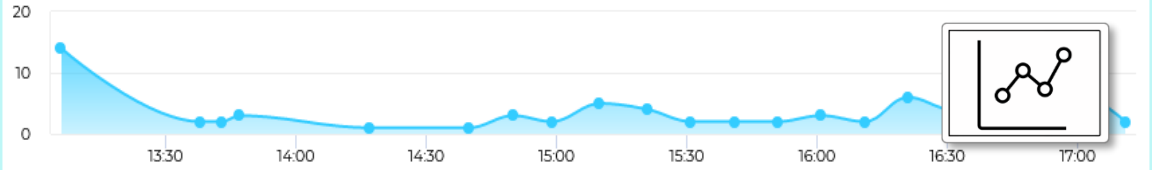



SmartParkingLonato_1 ... 9m
XX
0
status

temperature - Day 9m




NumFreeSlots - Slots 9m



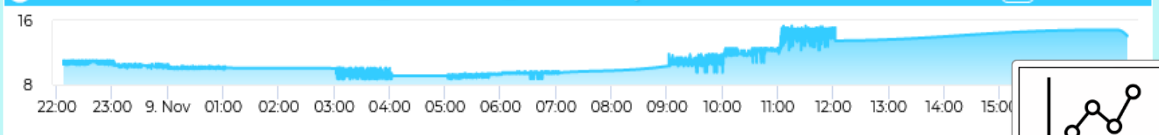

| pressure 9m | humidity % 9m | temperature 9m |
|---|---|---|
| 987.1 | 66.3 | 14.1 |
| mm | % | |

XX XX

| Slot ID 9m | Max Present Duration 9m |
|---|---|
| 14 | 19 ore e 11 minuti |
| slot ID | |

XX

TEST1_AirSensEUR_RVB01 - temperature 9m

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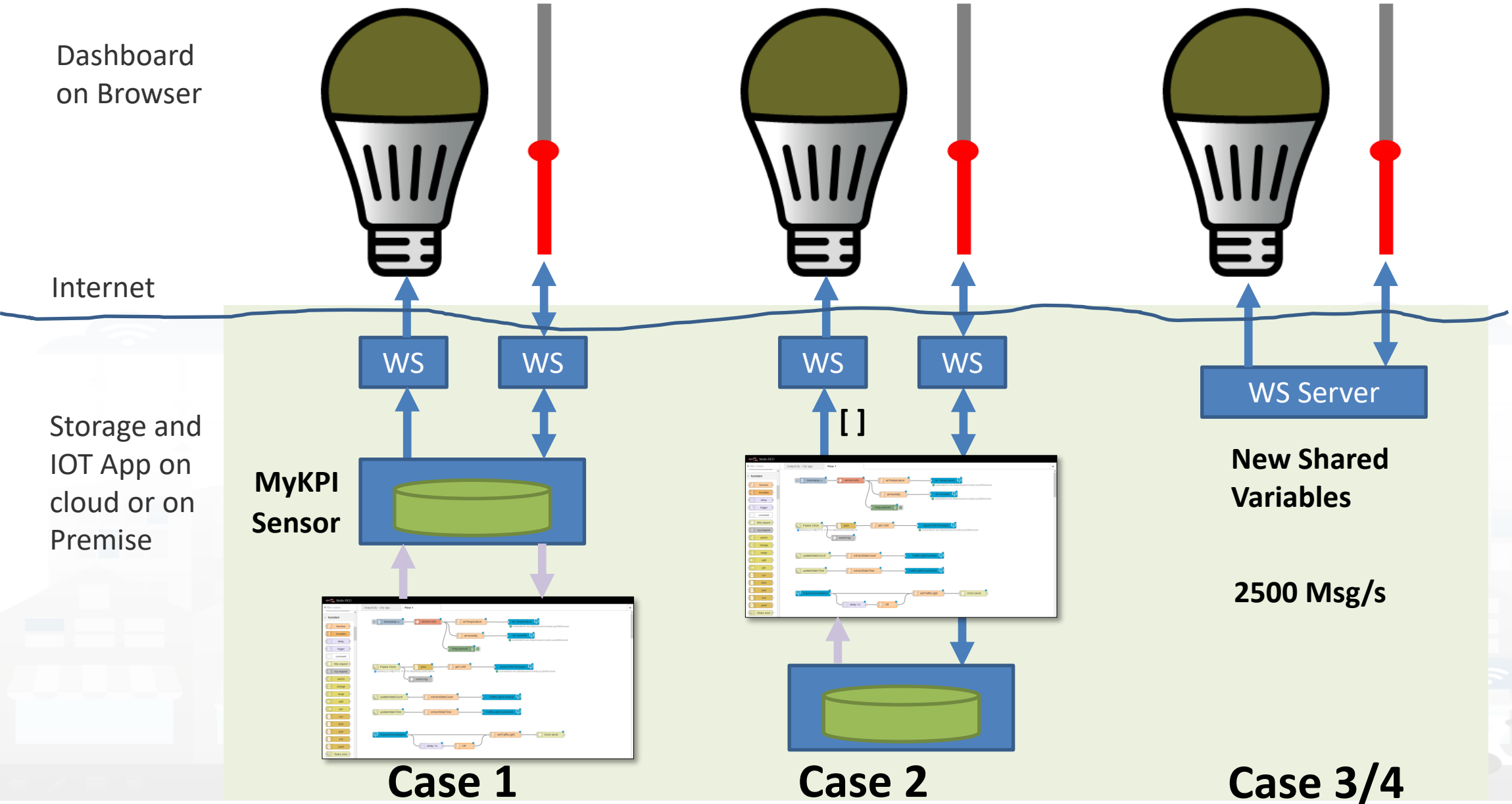
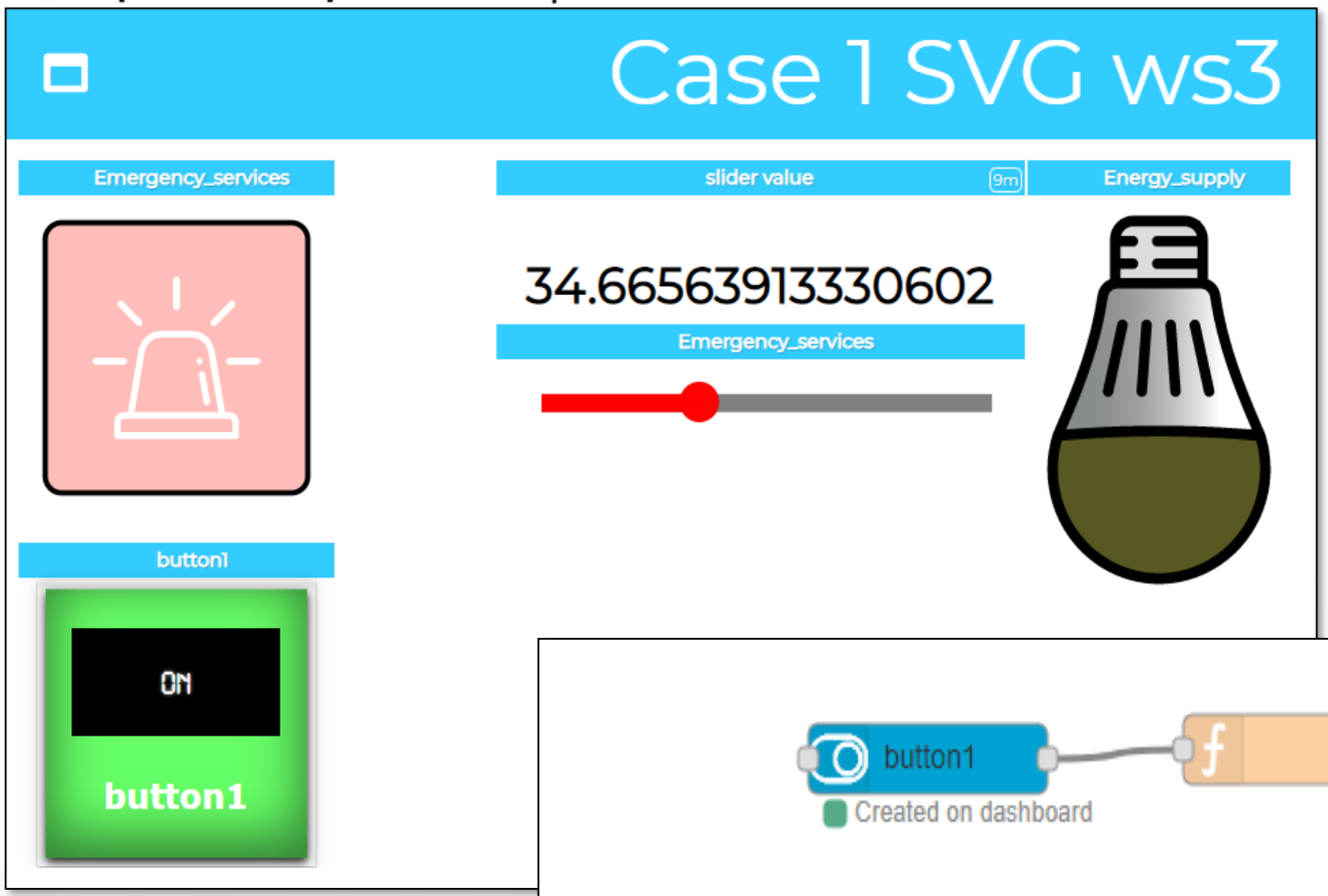
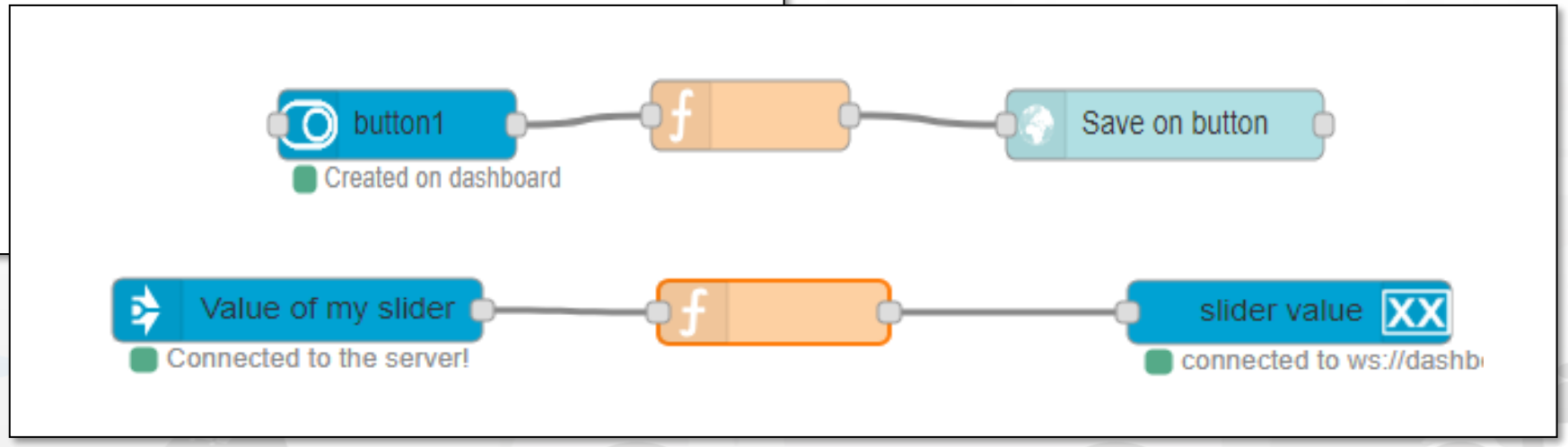

Dashboard on Browser
Internet
Storage and IOT App on cloud or on Premise
WS
WS
WS
WS
WS
WS Server
MyKPI Sensor
[ ]
New Shared Variables
2500 Msg/s
Case 1
Case 2
Case 3/4

# Case 1

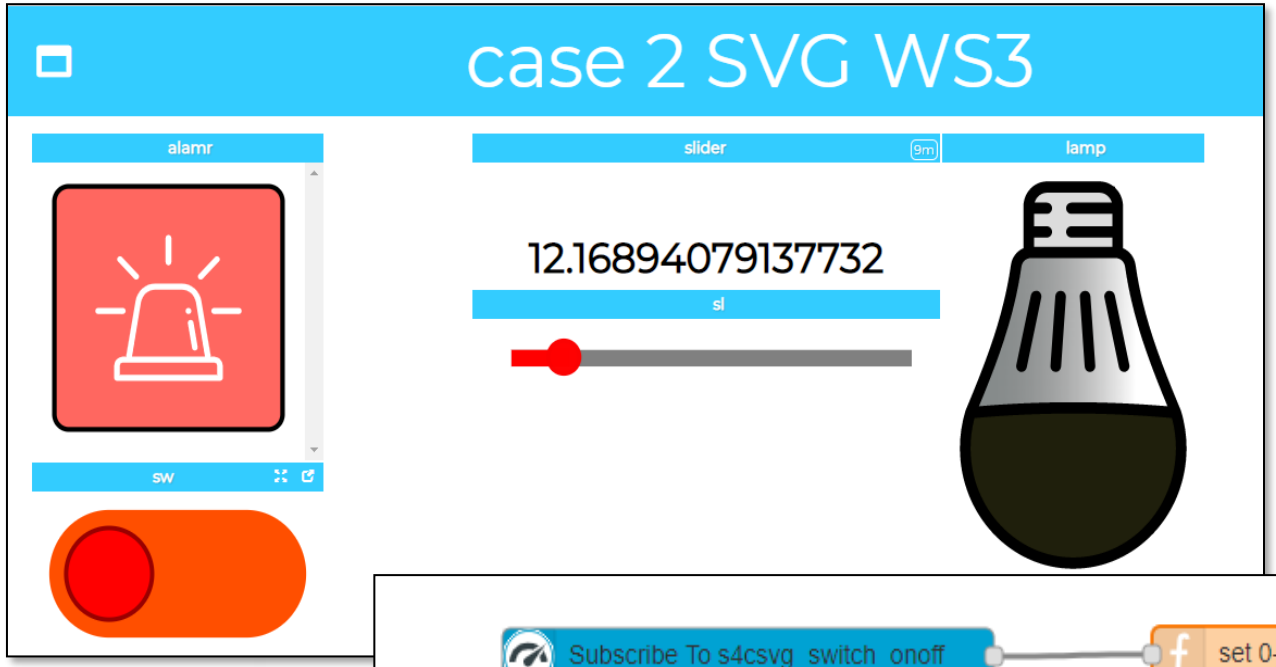



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjc4NA==

10 WS messages per second

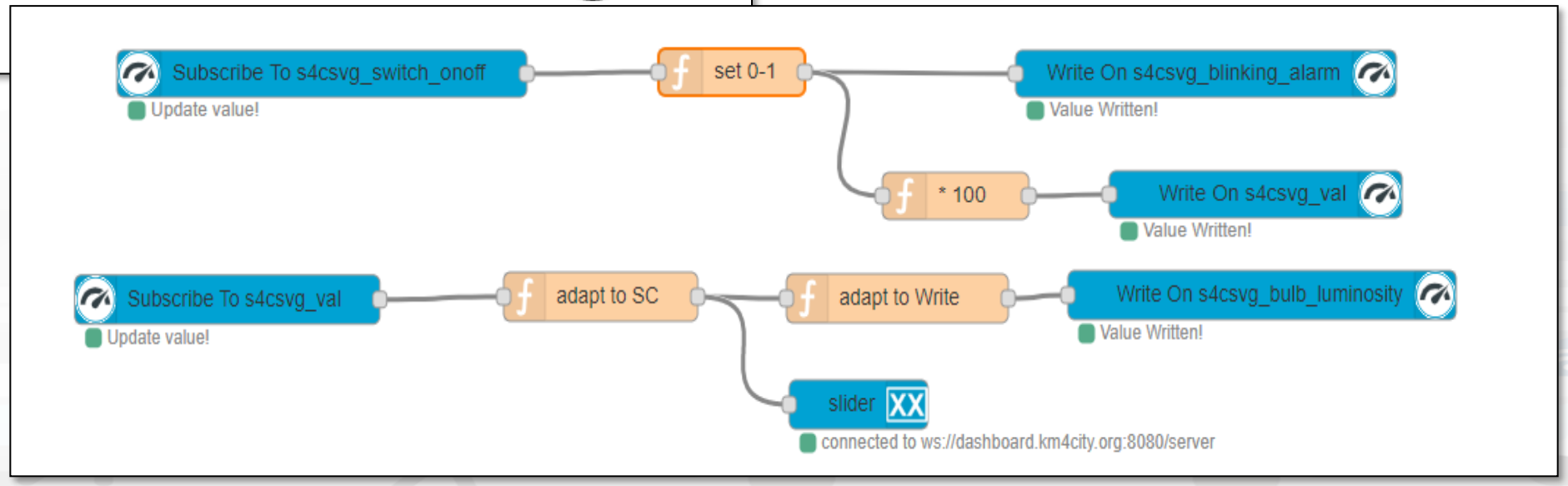


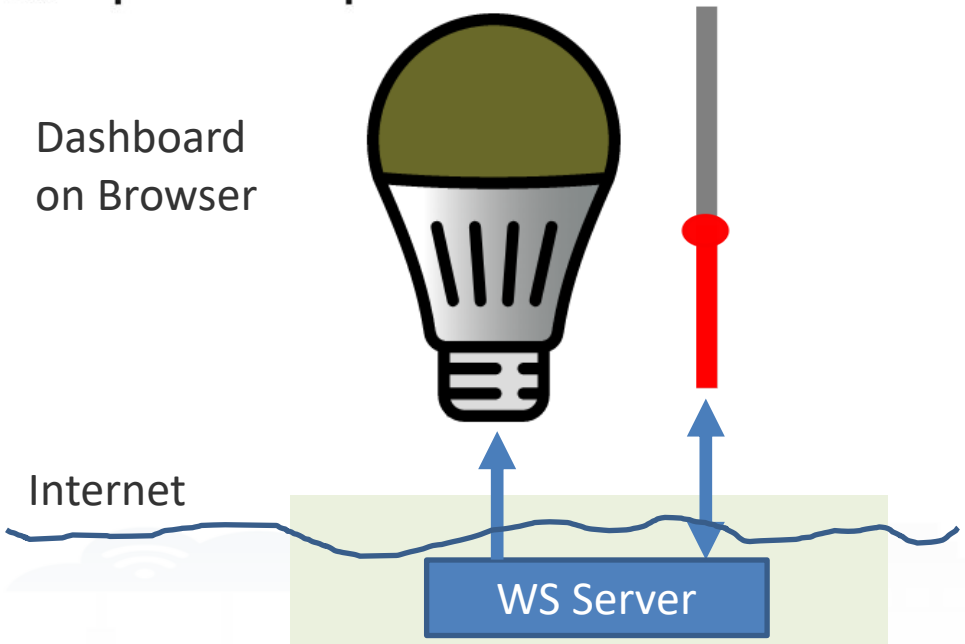
# Case 2: Event Driven 100%




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

40 messages per second

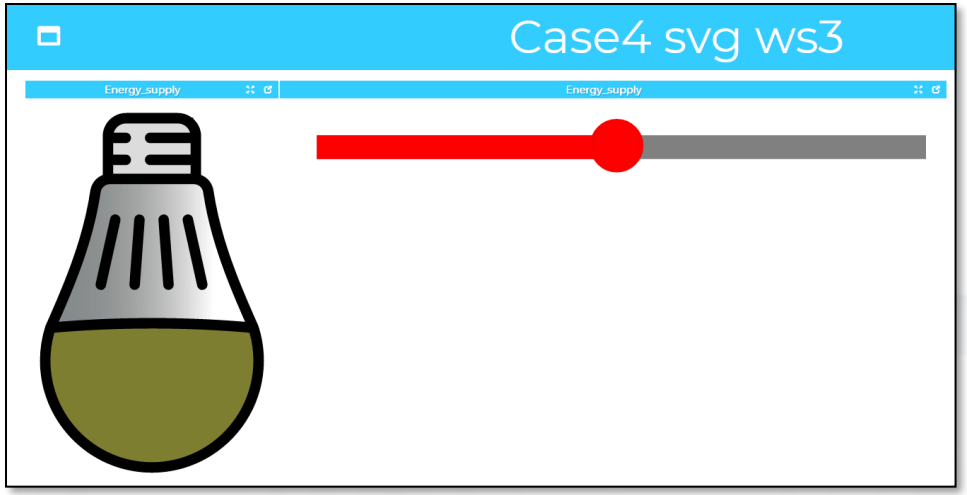





WS Server
on cloud or
on Premise

**New Shared Variables**

**2500 Msg/s**




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

# Case 3/4

# Snap4City

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

LOGOUT

My Snap4City.org
Dashboards
My Dashboards in All Org.
Dashboards of My Organization
My Dashboards in My Organization
Notificator
Data Inspector
My Data, KPI, POI
My Groups of Entities
IOT Applications
IOT Directory and Devices
Knowledge and Maps
Micro Applications
External Services
Data Set Manager: Data Gate
Synoptics
Resource Manager: Process Loader
Development Tools
Management
Settings
User Management and Auditing
Help and Contacts
Documentation and Articles

# Dashboards

Cards | Prev 1 2 3 ... 89 Next | Filter by dashboard title | New dashboard

**- Energy -**
Passive


comunedashres: Private - Firenze
Edit Management Clone Delete

**- Environment -**
Passive


comunedashres: Private - DISIT
Edit Management Clone Delete

**- Mobility -**
Passive


comunedashres: Private - Firenze
Edit Management Clone Delete

**- Smart Lonato del Garda -**
IOT apps


disit_lonatodelgarda: Private - LonatoDelGarda
Edit Management Clone Delete

**- Social -**
Passive


comunedashres: Private - Firenze
Edit Management Clone Delete

**0 - Dashboard new**
Passive
nicola.mitolo: Private - DISIT
Edit Management Clone Delete

**3D Map beta Testing**
Passive


gpantaleo1: Public - DISIT
Edit Management Clone Delete

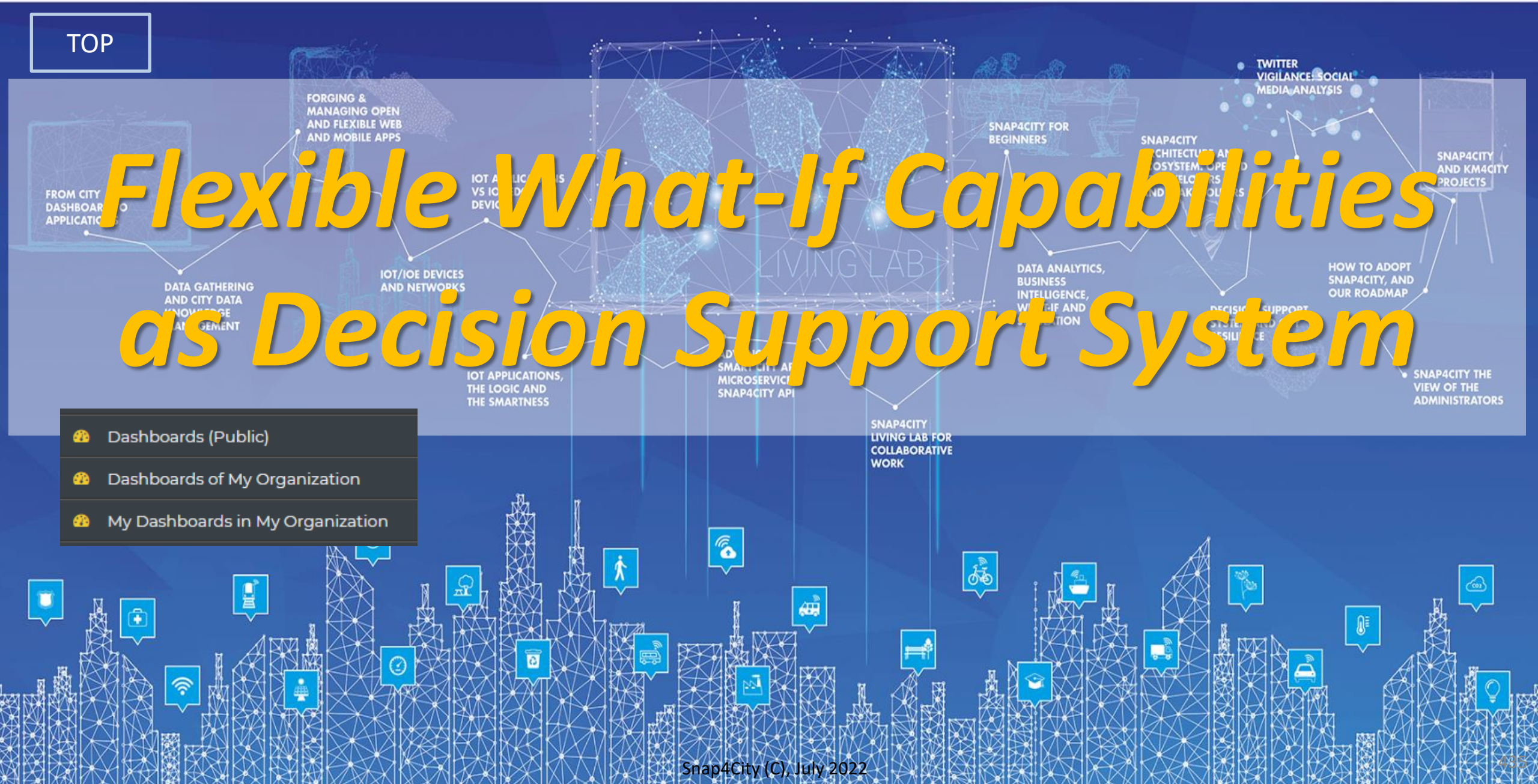
**3D Map beta Testing 2**
Passive
gpantaleo1: Private - DISIT
Edit Management Clone Delete

**3D Map test 2**
Passive
gpantaleo1: Private - DISIT
Edit Management Clone Delete

**a**
IOT apps
djqjq@163.com: Private - Antwerp
Edit Management Clone Delete

**AA-DASHBOARD-TEST-01**
Passive
andrea antonini: Private - DISIT
Edit Management Clone Delete

**AA-DASHBOARD-TEST-02**
Passive
andrea antonini: Private - DISIT
Edit Management Clone Delete




# Flexible What-If Capabilities as Decision Support System



# Mobility and Environment What-IF Analysis

This dashboad contains data derived from actual sensors and predictive values under validation

Mon 14 Oct 00:48:17

- Air Quality Sensors
- Weather Sensors
- PM10 Heatmap
- PM2.5 Heatmap
- CO Heatmap
- CO2 Heatmap
- O3 Heatmap
- NO2 Heatmap
- Europ. AQI Heatmap
- Air Humidity Heatmap
- Air Temp. Heatmap
- Wind Speed Heatmap
- Gral Pred. HM NOX (3m)
- Gral Pred. HM NOX (6m)
- Traffic Sensors
- Traffic Flow
- Cycling Paths
- Accident Heatmap
- Only HRes Anym. Gral
- Scenarious
- What-if analysis

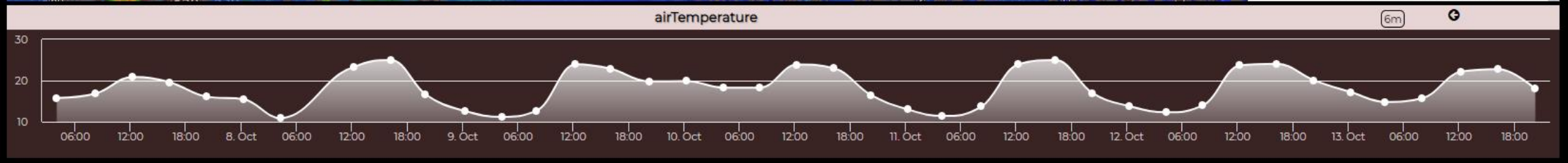
Firenze Oggi

Air Temperat... 6m





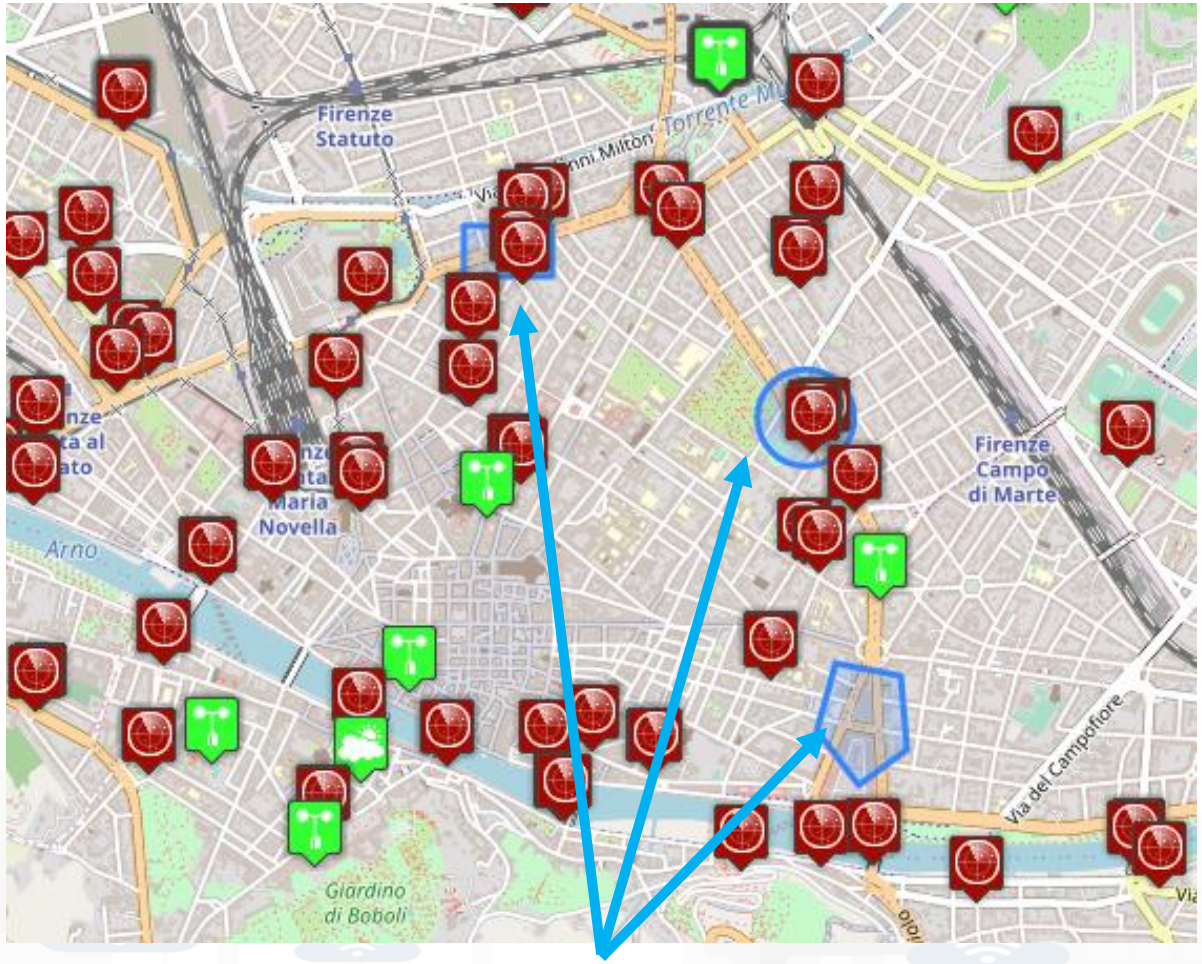





https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

# What-If Analysis Concepts

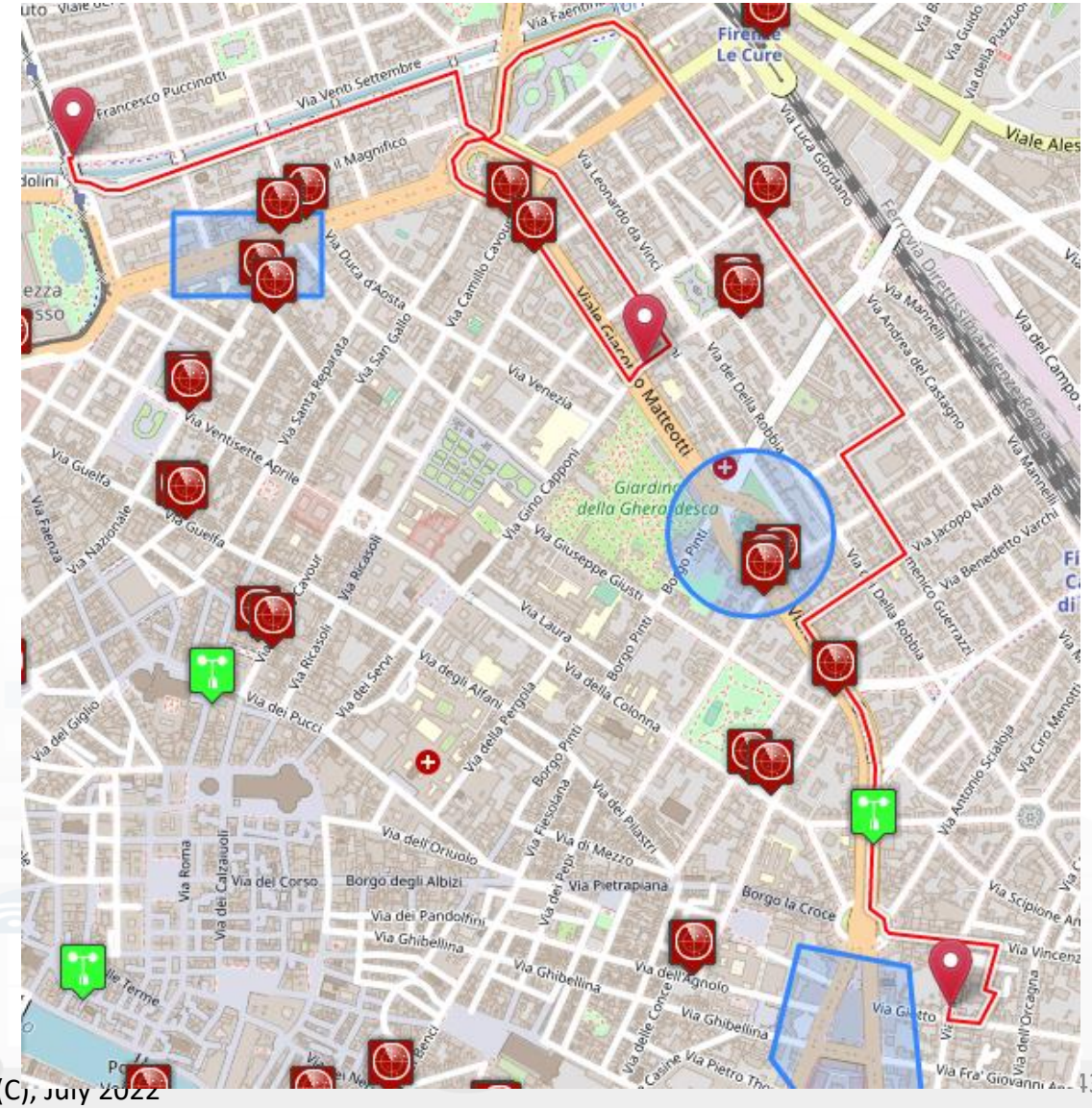
- What is going to happen at Services if certain conditions/ cases are going to occur
  - Formalize: Conditions/cases, Services
  - Scenarios of Cases+Services Vs Solutions are Studios
  - to define, save, load:
    - Scenarios and Studios
    - Save and compare several effects
    - Comparison on the basis of KPI



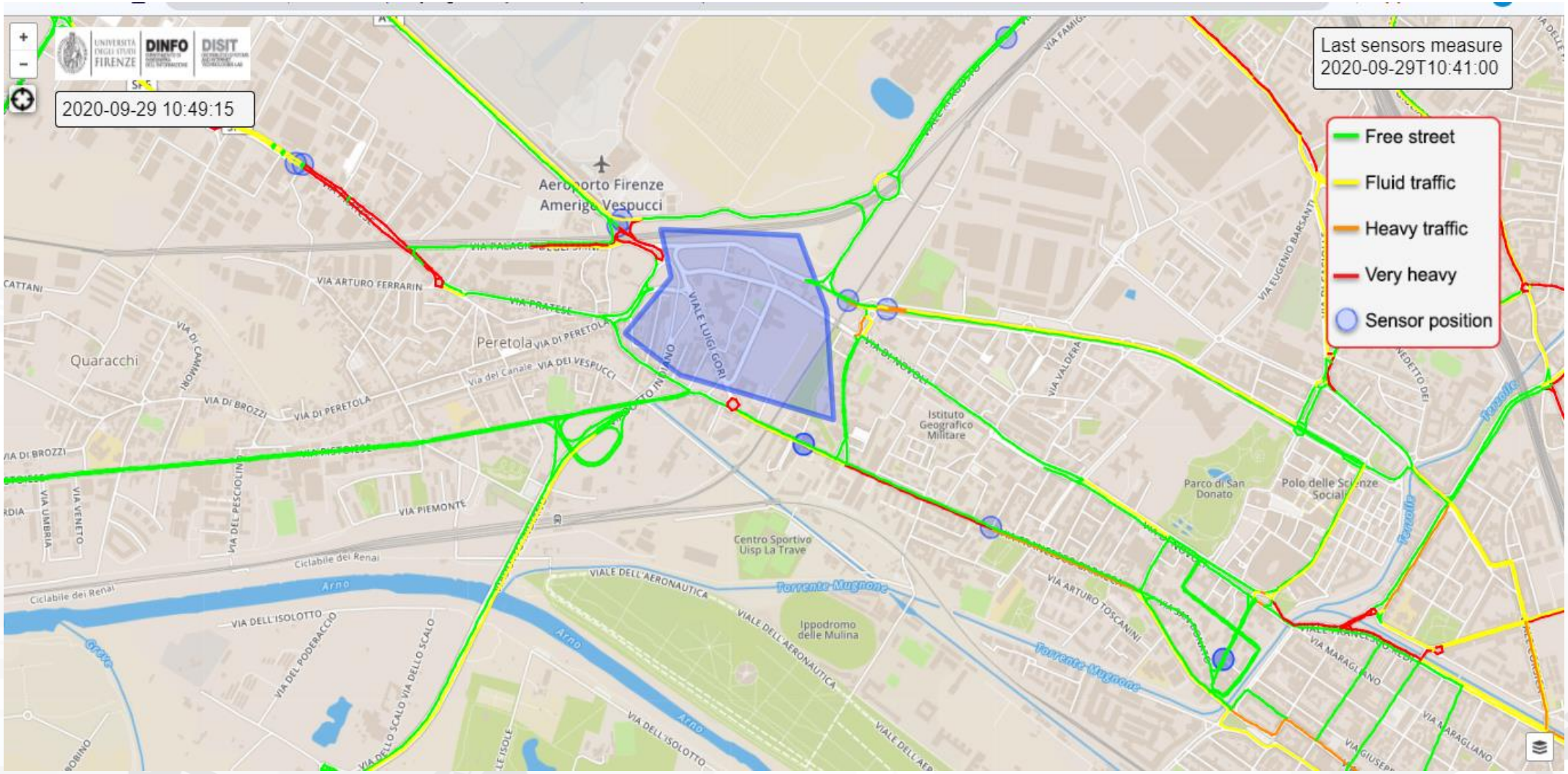

Scenario

# Impact on Routing

- Scenario with multiple shapes
- Conditional Routing
  - avoiding areas or
  - reducing traffic in those areas
  - Multiple stop points

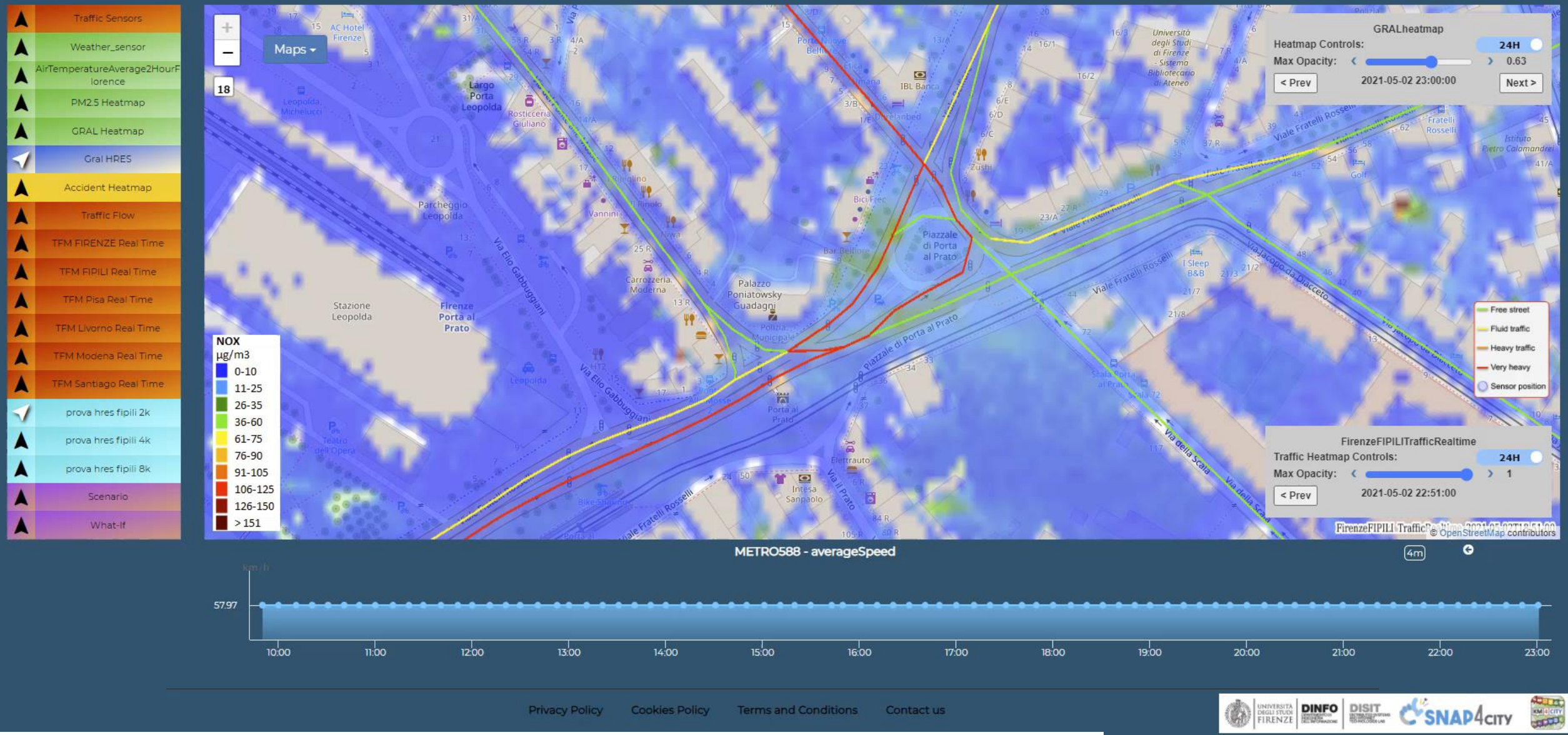


# Computation of Traffic Flow Evolution



# Traffic Flow Manager on multiple cities

Sun 2 May 23:16:31

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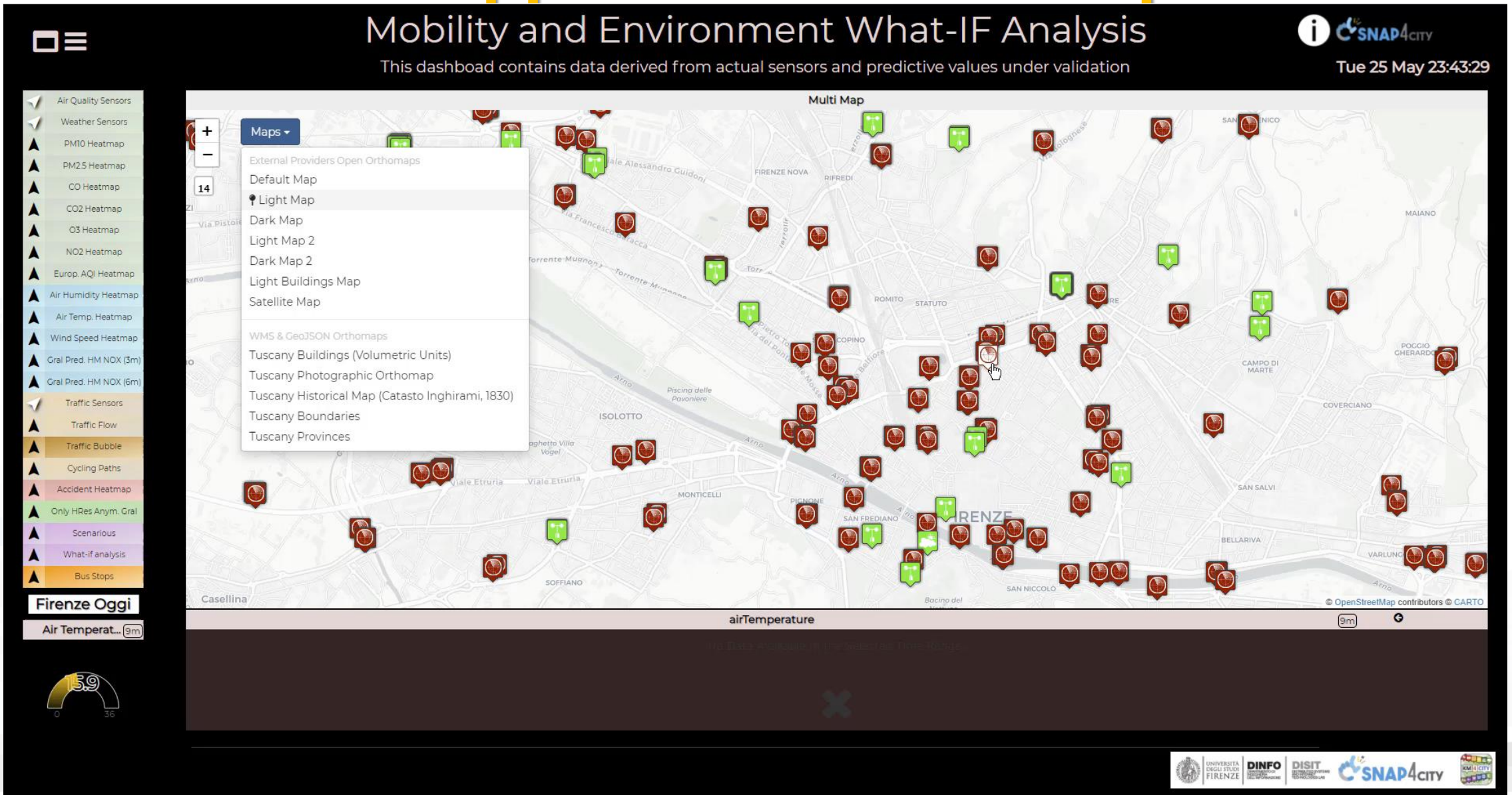
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzEyNg==

# What happen to Public Transport



# What-If Analysis

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

# Decision Support System and Resilience via FRAM

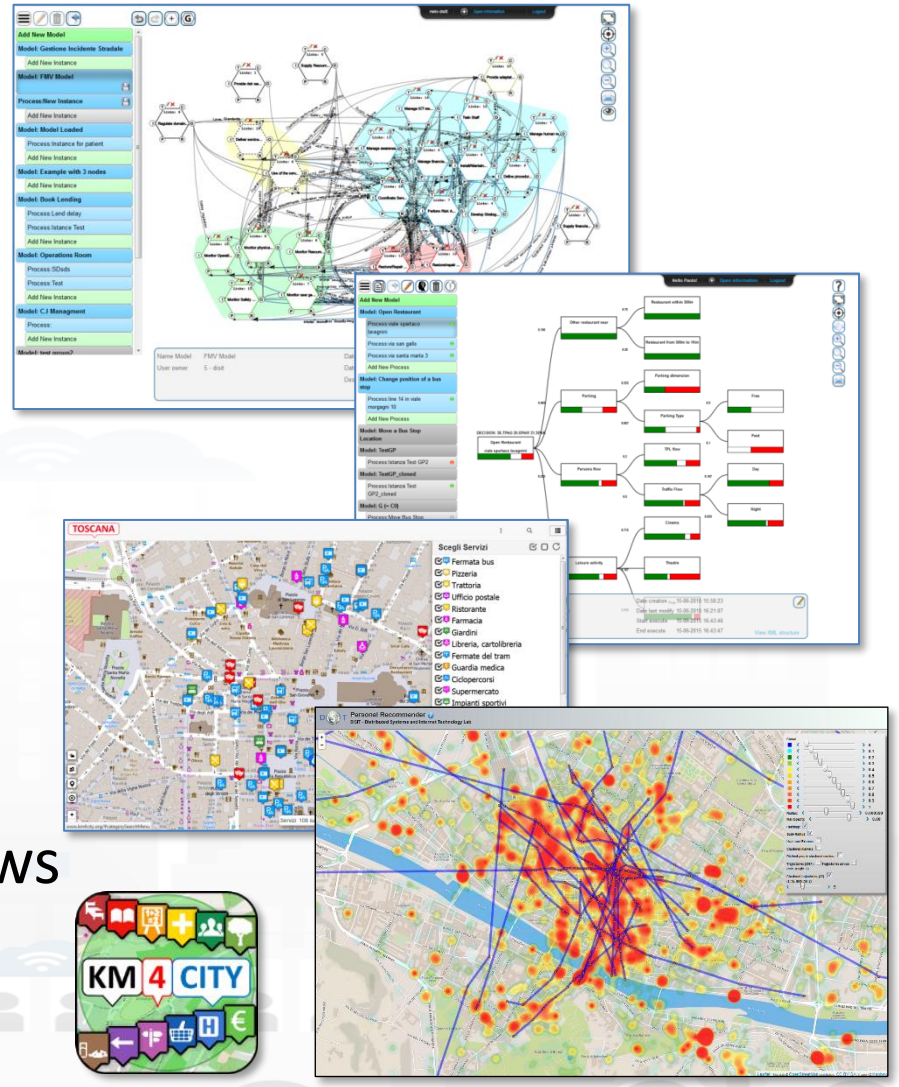
External Services, WebPages



- Decision Support Systems
  - Smart City Control Room
  - Workflow Management Ticketin...
  - Altair Maintenance
  - Altair Ticket Management
  - Altair Ticket Close Event
  - Workflow Management, Ticketin...
  - BIM Management and Dashboa...
  - DORAM Public Transport Analyz...
  - Doc: DORAM Pub Transp. Analyz...
  - Twitter Vigilance
  - Twitter Vigilance Real Time
  - Twitter Vigilance Antwerp
  - Twitter Vigilance Helsinki
  - Twitter Vigilance WestGreece
  - Twitter Vigilance Valencia
  - Twitter Vigilance Firenze HeritD...
  - Twitter Vigilance Pont Du Gard
  - Twitter Vigilance Dubrovnik
  - Twitter Vigilance Notes
  - What-If Analysis
  - Doc: What-If Analysis
  - Origing Destination Matrices
  - Traffic Flow Reconstruction
  - High Res. Pollutant Predictions
  - Resilience Decision Support Sys...
  - Smart Decision Support Sys
  - Doc: Smart & Resilience DSS

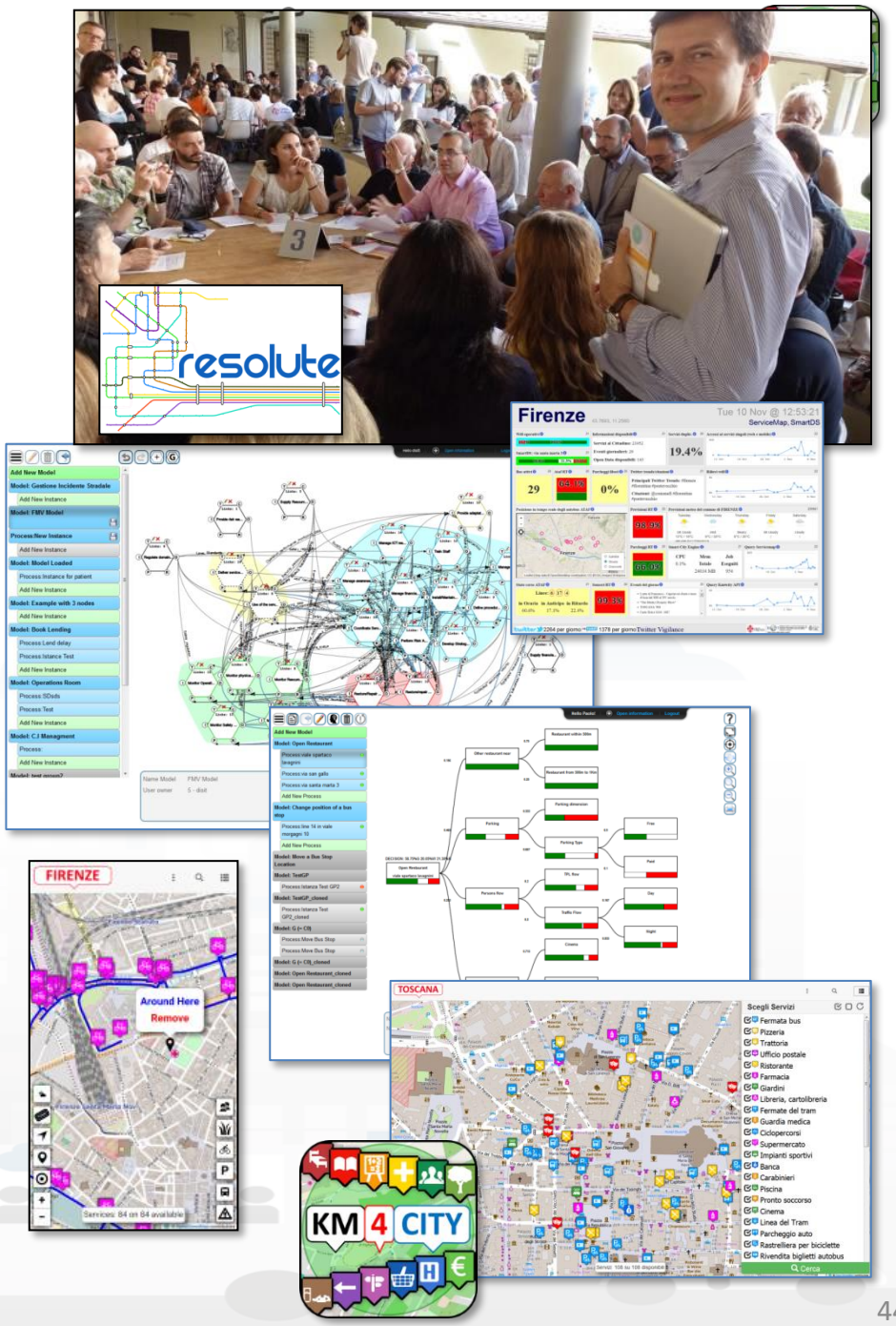
# Main Approach

- Three main layers
- Complex System modeling: function, processes, resources, time, events, etc.
  - Functional Resonance Analysis Method, FRAM
  - Resilience Analysis Grid, RAG
- Decision Support System, DSS
  - System Thinking, Goal Models
  - Risk analysis
  - UTS/ITS decision supports
- Data, big data access and exploitation
  - Data Analytics, Internet of Things, sensors, flows
  - People flow and behavior
  - Social Media



# Improve city resilience, reducing risks and decision support

- **assessing** city **resilience** level
- **improving** city **resilience**, providing objective hints
- **improving** city users **awareness** with personal city assistants and participatory tools



# RESOLUTE Dashboard 4XHD v5

Wed 21 Jun @ 12:49:14

## ESB

### Alarms

TEST - ALLUVIONE MUGNONE
MAJOR
07/08/2017 12:45:54

ALLUVIONE ARNO COVERCIANO
CRITICAL
15/08/2017 15:47:31

ALLUVIONE ARNO VIA PETRIOLO
MAJOR
07/08/2017 16:48:11

TEST - SCONTRI ALLO STADIO
CRITICAL
15/08/2017 09:50:04

### Traffic events

SEVERE ACCIDENT
SERIOUS ACCIDENT(S)
21/08/2017 11:24:01 5

ROAD WORKS
ROADWORKS
21/08/2017 11:24:10 6

ORD 2017-001302 - SP NÃ°17 Ã??ALTO VALDARNOÃ??IST...
RESTRICTIONS
13/08/2017 00:00:00 5

INTERVENTO URGENTE PUBLIACQUA
CLOSED AHEAD
20/08/2017 10:00:00 10

### Evacuation plans

PLAN N.1497263867
IN_PROGRESS
12/06/2017 - 11:37:47 PATHS: 3

PLAN N.2000000000
PROPOSED
16/08/2017 - 09:42:06 PATHS: 2

PLAN N.1497604404
PROPOSED
16/08/2017 - 11:06:47 PATHS: 1

### Tram position

TRAM/1
21/08/2017 11:32:27

TRAM/2
21/08/2017 11:32:31

### Network Analysis

FM0495
(NORMALIZED) NODE BETWEENNESS
1.0000

FM0496
(NORMALIZED) NODE BETWEENNESS
0.8091
ON MAP

FM0500
(NORMALIZED) NODE BETWEENNESS
0.7878

FM2276
(NORMALIZED) NODE BETWEENNESS
0.7856

FM0497
(NORMALIZED) NODE BETWEENNESS
0.7825

FM0701

## Environment

PROTEZIONE CIVILE

GENERAL | METEO

NULLO BASSO MEDIO ALTO

RISCHIO IDRAULICO
RISCHIO TEMPORALI
RISCHIO IDROGEOLOGICO
RISCHIO NEVE
RISCHIO GHIACCIO
RISCHIO VENTO
RISCHIO MAREGGIATE

Anemomet...
221

Ground Te...
22 C°

Temperatu...
24 C°

Umidity
20 %

Pluv. Flore...
24 mm

Pluviometer Florence City - last 24h

Hydromete...
20 m.s.z.l.

Hydrometer Arno Nave di Rosano - Last 24h

Hidromete...
24 m.s.z.l.

Hydrometer Arno Florence Uffizi - Last 24h

Hydromete...
24 m.s.z.l.

Hydrometer Mugnone Ponte alle Mosse - Last 24h

## Mobility

### Bus Lines Status

STATO | LINEE MONITORATE | DATE

ULTIMO AGGIORNAMENTO: 2016-08-04 23:59:03

Underpass Viale Mariti Aperto

Underpass Viale Talenti closed

Underpass Fortezza Aperto

Parterre Pa...
76.2%
23.8%

SMN
65.7%
34.3%

Fortezza Fi...
37.2%
62.8%

Mercato Ce...
65.4%
34.6%

## Resources

### Planned events

E 1966 - 2016 - LA BELLEZZA SALVATA - PROROGATA FINO AL 2
2016-12-01 to 2017-07-02
VIA CAMILLO CAVOUR 3

NE SPLORATI.LE BIBLIOTECHE DELL'UNIVERSITÀ DI FIRENZE IN
2017-02-15 to 2017-06-23
PIAZZA DI SAN LORENZO 9

BIBLIOTECHE DELL'UNIVERSITÀ DI FIRENZE IN MOSTRA - PROR
2017-02-15 to 2017-09-29
PIAZZA DI SAN LORENZO 9

Ambulance...
20 num.

Ambulance...
33

Voluntiers
33 num.

### Florence main first aids status

| Priority\ Hospitals | Red code | Yellow code | Green code | Blue code | White code |
|---|---|---|---|---|---|
| PS SANTA MARIA NUOVA | 1 | 7 | 14 | 1 | 0 |
| PS SAN GIOVANNI DI DIO TORREGALLI | 2 | 10 | 24 | 2 | 0 |
| PS AO CAREGGI | 10 | 27 | 31 | 10 | 2 |
| PS SANTA MARIA ANNUNZIATA | 2 | 9 | 22 | 4 | 0 |

TRENDS | QUOTES

#FIRENZE
#NEWS #FIRENZE
#FIRENZE #RIFIUTI
#UFFIZI
#PONTEVECCHIO
#BARGELLO
#AEROPORTO #FIRENZE
#DUOMO #FIRENZE
#VIAGGI #FIRENZE
#CRONACA #FIRENZE

@MUSEOFIRENZE
@COMUNEFI
@NAZIONE_FIRENZE
@PROTCIVCOMUNEFI
@UNI_FIRENZE
@HUBFIRENZE
@NOVEDAFIRENZE
@ILSITODIFIRENZE
@FIRENZETURISMO
@BIBLIO_COMUNEFI

Parking anailability (%)
28:2

## TV-RT Firenze

Twitter Vigilance Real Time Dashboard
Last crawling: 2017-06-21 12:44:30
Menu On | Login

Home > Channel statistics > Channel sentiment analysis

Channel active from 2016-06-27 to 2017-06-21 12:35:00
Data processed from 2016-06-28 08:10:00 to 2017-06-21 12:35:00
NLP SA

Sentiment trends in channel Firenze

Zoom 1H 3H 6H 12H 1D 1W 1M Y

Tweets score | Tweets score pos | Tweets score neg | Retweets score | Retweets score pos | Retweets score neg | T+RT score | T+RT score pos | T+RT score neg

Hide All

Most Significant Tweets for Sentiment

Last tweets per channel Firenze

@GiorgiaLodi - 2017-06-21 12:13:45
RT @emanuelegeri: Primo giorno d'#Estate: pubblicato aggiornamento luoghi freschi https://t.co/isKeZoeGhw su #opendatafirenze @comunefi

## TV Firenze

Twitter Vigilance Dashboard
Last crawling: 2017-06-21 12:44:49
Menu On | Login

Home > Channel statistics > Statistics on single Channel

Channel active from 2009-02-27 to today
Data processed from 2015-05-22 to 2017-02-24
NLP SA

Search related to channel Firenze

Zoom 1m 3m 6m YTD 1y All
From May 21, 2017 To Jun 21, 2017

#Aeroporto #Firenze | #Aeroporto #Firenze #unifi | #Aeroporto #Firenze
#americani #firenze | #bargello | #cronaca #firenze | #cultura #firenze
#duomo #firenze | #expo2015 #firenze | #Expo2015Firenze | #firenze
#firenze #abusivi | #firenze #allafacciadaidiviati | #firenze #bottiglia
#firenze #centrostorico | #firenze #docorourbano | #firenze #rifiuti
#firenze #souvenir | #firenze #turisti #coda | #firenze #turisti #folla
#firenze @UNESCO | #firenzecard | #Florence #smartcity | #LiberiamoFirenza
#lorociuffonna | #lungarnofirenza | #meteo #neve #Firenze | #news #Firenze
#notiziafirenza | #ODDIT15 #Firenza | #opendata firenze | #OpenDataDay #Firenze
#opendatafirenze | #pontevecchio | #previsionimeteo #Firenze

Hide All

Daily mumber of tweets/retweets for channel: Firenze

## ESB events

Show Menu | Hide Menu

Firenze

Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox

## Firenze Wi-Fi - Access Points Clusters Coverage Map

Firenze Wi-Fi: Access Points Clusters Coverage Map
DISIT - Distributed Systems and Internet Technologies Lab
Firenze - Wednesday June 21 2017 12:49:12

Show Legend

Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox

## Firenze Wi-Fi - APs Streaming Realtime

Firenze Wi-Fi: APs Streaming Realtime
DISIT - Distributed Systems and Internet Technologies Lab
Firenze - Wednesday June 21 2017 12:49:12

Show Legend

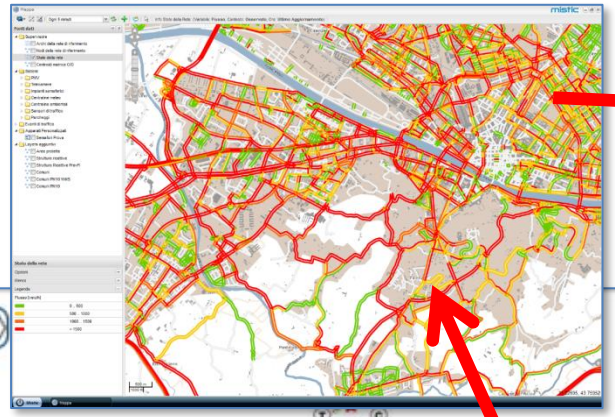
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox

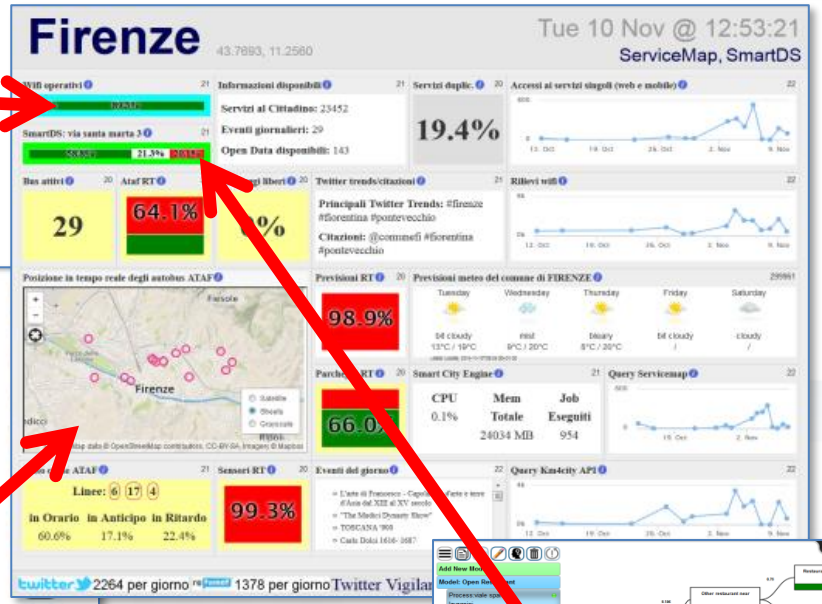
UNIVERSITÀ DEGLI STUDI FIRENZE | DINFO DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE | DISIT DISTRIBUTED SYSTEMS AND INTERNET TECHNOLOGIES LAB

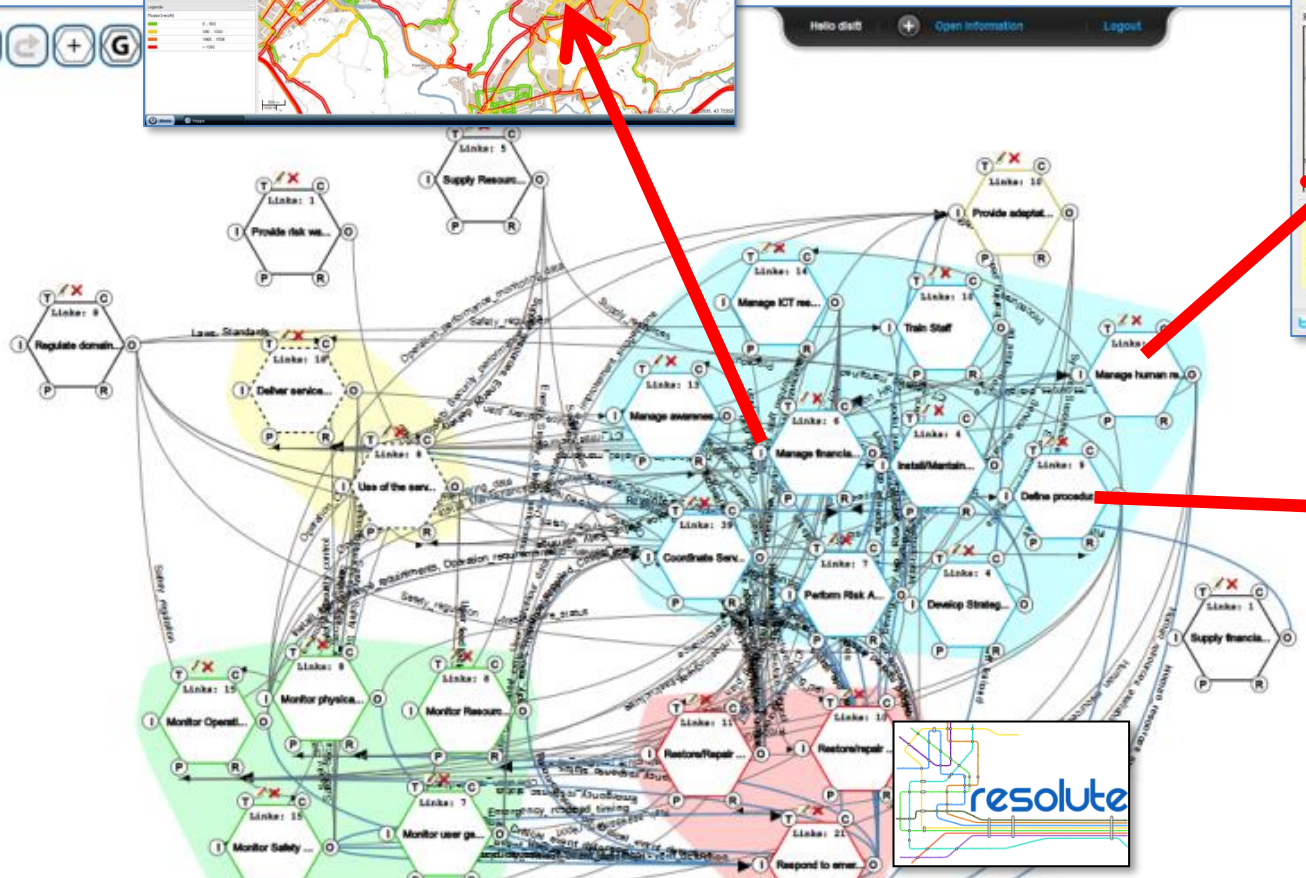
SN

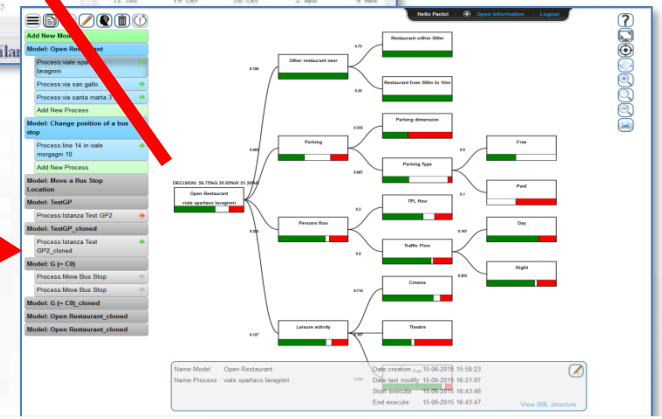
resolute

# Dashboarding City Resilience





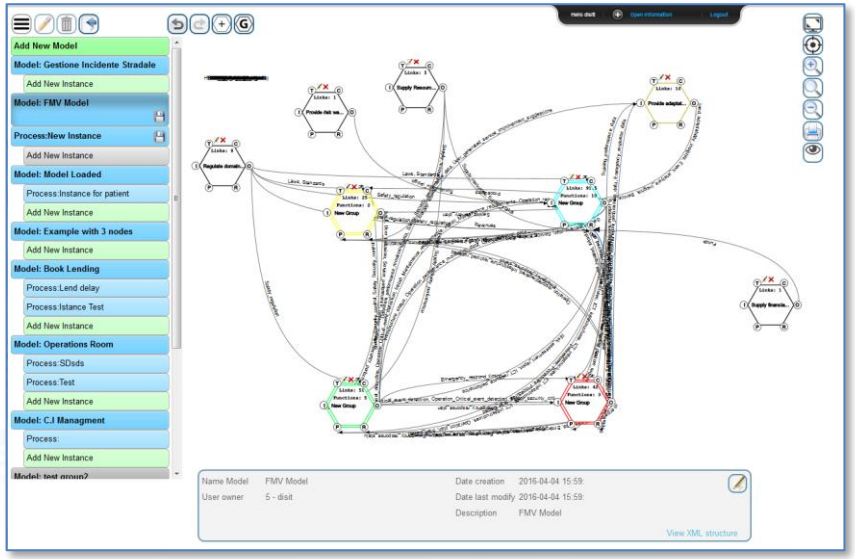



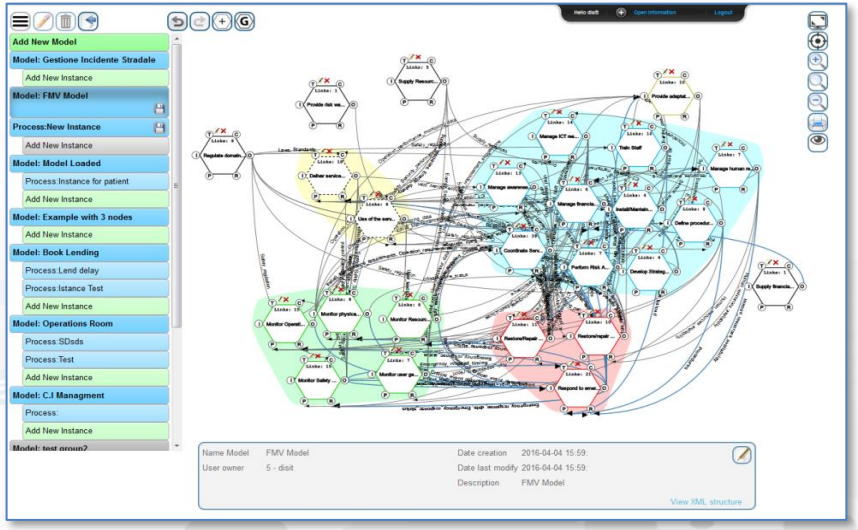


# ResilienceDS Tool

http://resilienceds.km4city.org

- **FRAM Model**
  - Macro FRAM processes
  - Metrics for Process complexity assessment
  - Operational Semantic for executing FRAM model
  - Connection with SmartDS
  - Connection with BigData open to multiple sources of data and workgroup results, Km4City
- **Collaborative work, web tool**
- **Open for all**
- **Validated on ERMG: European Guidelines**





# Functional Resonance Analysis Method




**Time:**
This is simultaneously a resource and a constraint

**Controls:**
That which supervises or adjust function performance

**Input:**
That which engages function operation and is used to produce the function output

**FRAM**
**Functional Resonance Analysis Method**

- Understand system interdependencies
- Monitor sources of variability
- Investigate system architecture and events

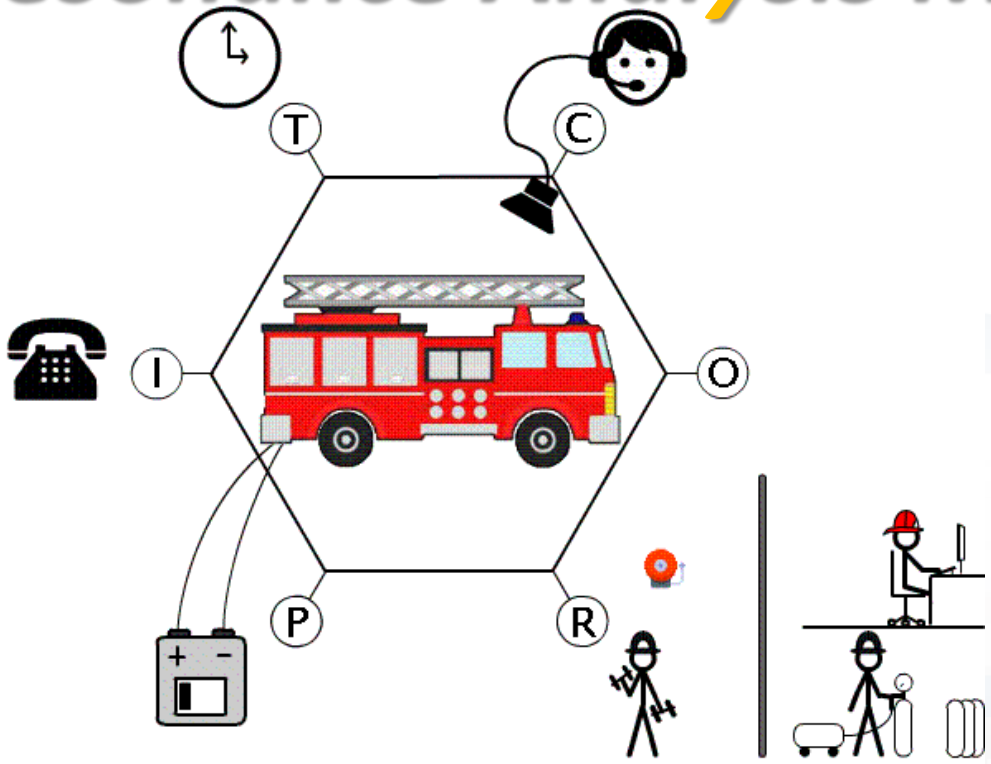
**Output:**
That which is produced by the function and becomes the input for other functions

**Preconditions:**
System conditions that must be met before function can be carried out

**Resources:**
That which is needed and/or consumed by the function to process the input

# Fram Model: *Functional Resonance Analysis Method*

- Success and failure are equivalent in the sense that they both emerge from performance variability.
- Variability, intended as a way for people to adjust tools and procedures to match operating conditions.
- Emergence of either success or failure is due to unexpected combination of variability from multiple functions.
- The unexpected “amplified” effects of interactions between different sources of variability are at the origin of the phenomenon described by functional resonance.



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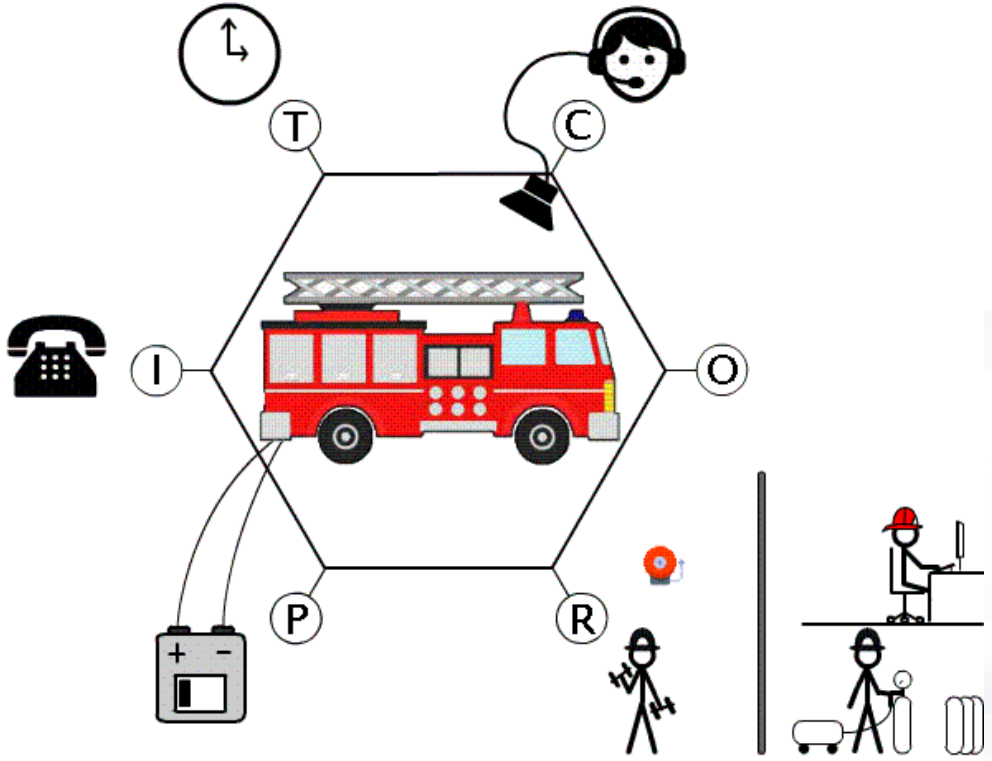
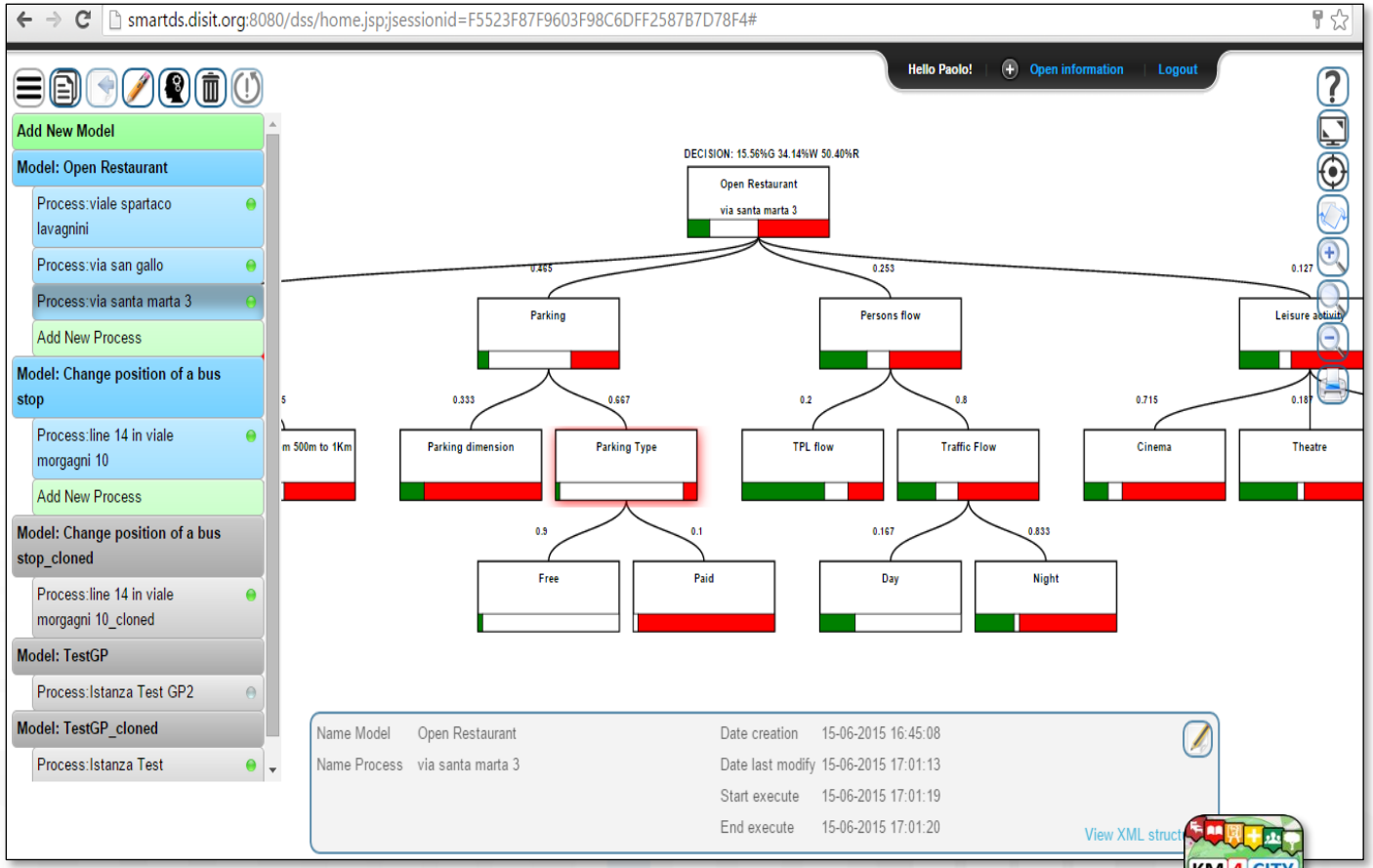


# Smart Decision Support , system thinking

- **Smart Decision Support System** based on System Thinking plus
- Actions to city reaction, resilience, smartness, …
- Enforcing Mathematical model for propagation of decision confidence..
- Collaborative work, …
- Processes connected to city data: DB, RDF Store, Twitter, etc.
- Production of alerts/alarms
- Data analytics process
- Twitter Processes
- reuse, copy past, …




http://smartds.km4city.org

TOP

# Dashboard Event Management

FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS

FROM CITY DASHBOARD TO APPLICATIONS

AND CITY DATA KNOWLEDGE MANAGEMENT

IOT APPLICATIONS VS IOT EDGE DEVICES

IOT APPLICATIONS, THE LOGIC AND THE SMARTNESS

ADVANCED SMART CITY API, MICROSERVICES, SNAP4CITY API

SNAP4CITY LIVING LAB FOR COLLABORATIVE WORK

SNAP4CITY FOR BEGINNERS

WHAT-IF AND SIMULATION

SNAP4CITY ARCHITECTURE AND ECOSYSTEM. OPENED TO DEVELOPERS AND STAKEHOLDERS

TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS

DECISION SUPPORT SYSTEM AND CITY RESILIENCE

SNAP4CITY AND KM4CITY PROJECTS

SNAP4CITY THE VIEW OF THE ADMINISTRATORS

- Dashboards (Public)
- Dashboards of My Organization
- My Dashboards in My Organization

# Alerting and events evidence on Dashboards

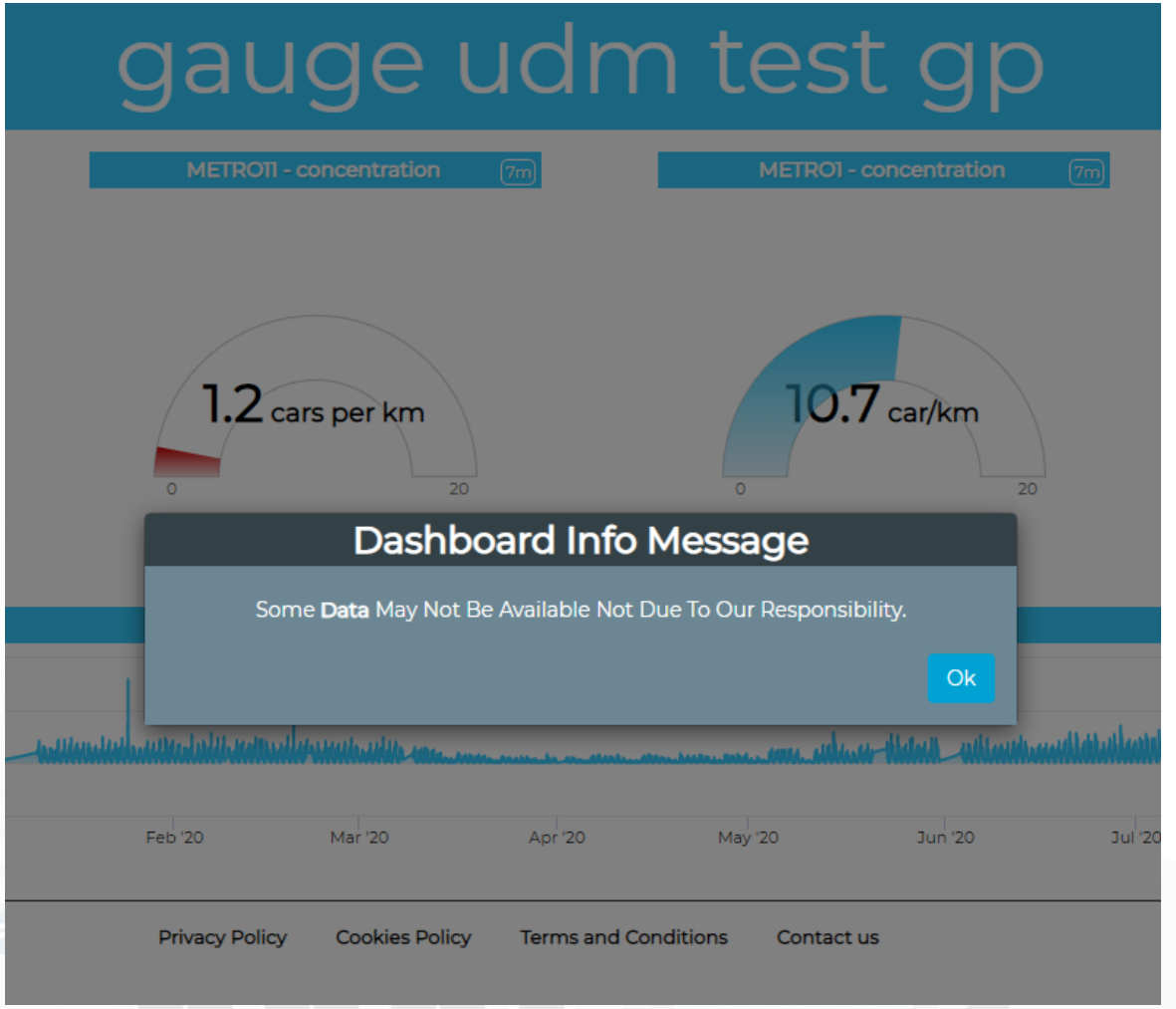
- Pop Up **Alarming** at the opening of the Dashboard, exploiting API and MicroService call when you need
- **Calling on the private Chat Room** of the dashboard.
- **Alerting via IOT Apps**, which may assess the firing conditions on the data and on the values/actions performed on Dashboards
  - Sending alerts via several channels
  - Blinking on Single Content Widgets, or on SVG Alarm of any shape
- Connection with **Ticketing System, Incident Management**
- Connection with **Notificator** (only for on premise)
  - Defining thresholds and blinking on Dashboard Widgets
- …etc..

# Dashboard Pop Up
# Alerting when needed



# Dashboard Info/alarm Message

- Each Dashboard may have a custom IOT APP to control the data and the general services via APIs.
- The IOT App logic can Turn on/off the **Info Message** and customize its HTML text dynamically on the basis of the problem detected.

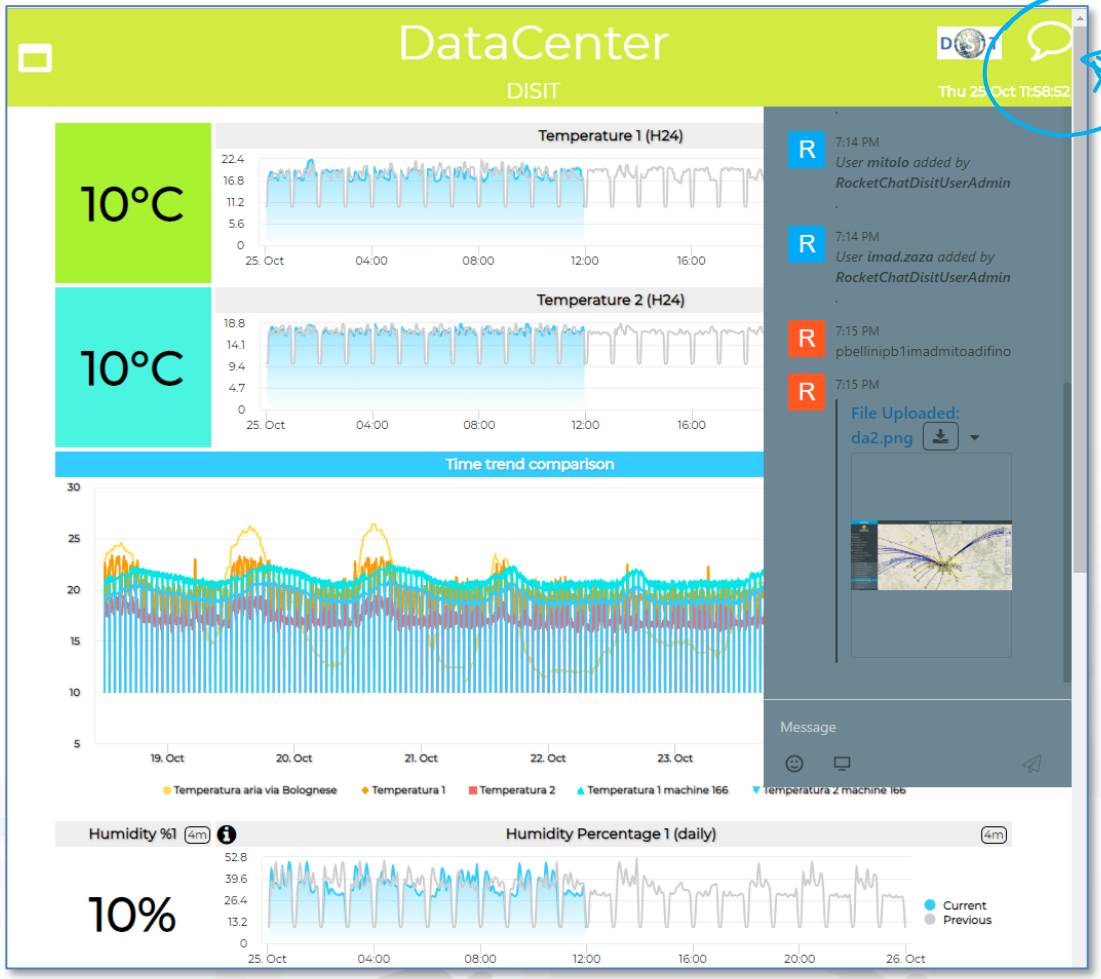



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjg5Nw==

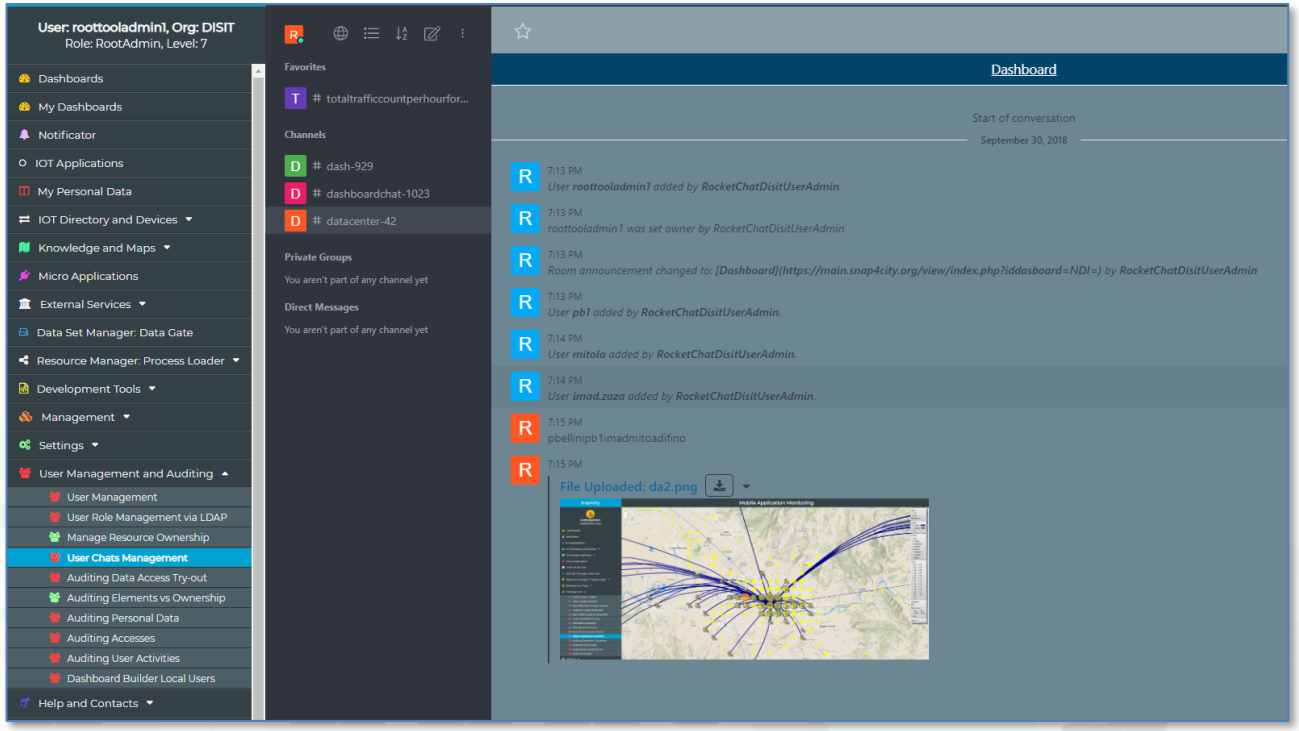
# Private Dashboard ChatRoom



# Private ChatRoom per Dashboard




Chat Management



# Chat Rooms

- **Activated** by the Dashboard creator which can invite a number of users of the platform to
  - Exchange Comments and Pictures
  - access on web and mobile
  - provoke notifications
- Accessible only under authentication
- The administrator can access to the log for review and log of the discussions.
- Chat Room capability is available as an additional appliance

# Dashboard Chat Rooms

- Each Dashboard may have only **one separate ChatRoom**
- The Dashboard Owner can
  - Activate the Chat Room on Dashboard header in Edit
  - Add users of the platform to the chat room
- The **Chat** Room
  - Allows to Exchange Comments and Pictures
  - Can be Accessed on web and mobile
  - May Provoke notifications on the header of the Dashboard
  - Is accessible only under authentication
- The Administrators can access to the Log for review of the discussions

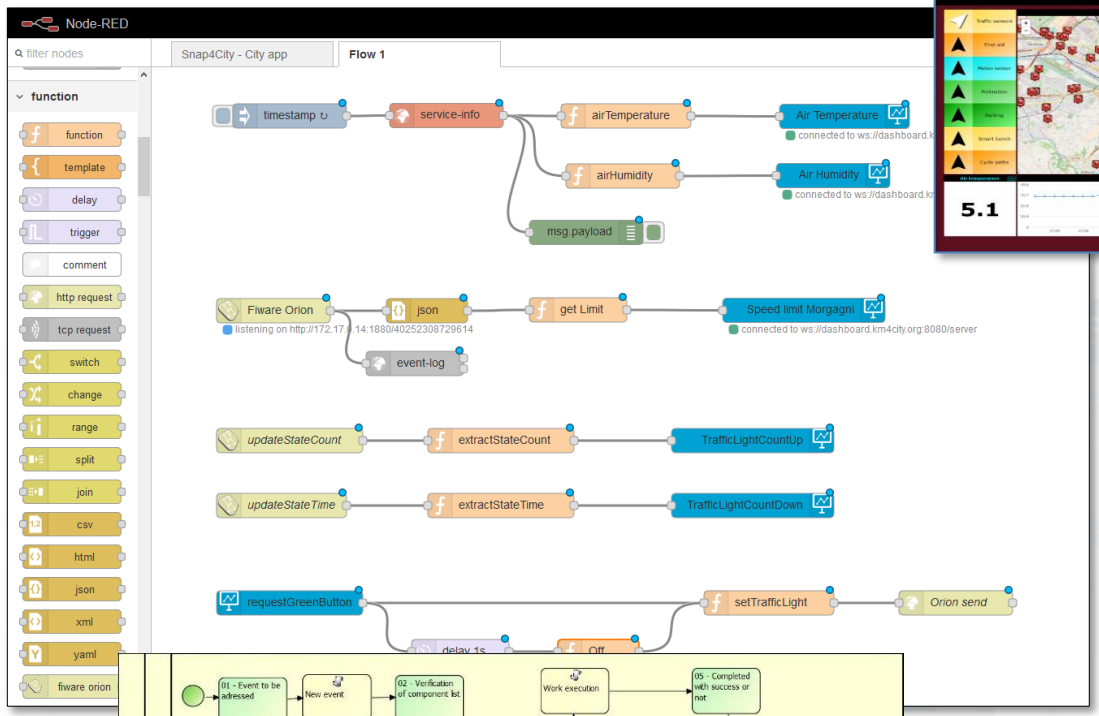
# Notifications from Dashboard and from any Data Condition

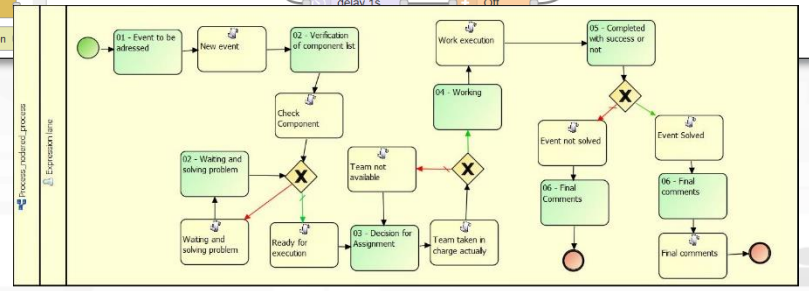


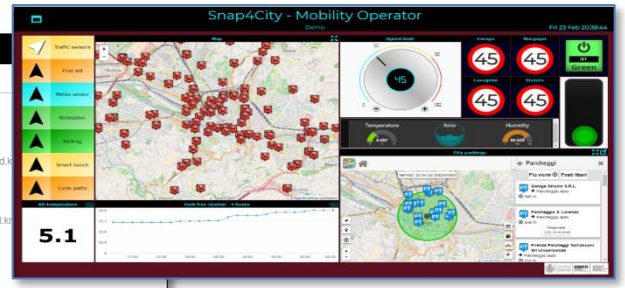
# Smart City Monitoring: notifications, alerting

**Notification with IOT App may**

- Fire on any kind of condition exploiting on IOT App logic
- produce messages/events on
  - **Facebook, Telegram,**
  - **SMS, MMS, IOT Devices, ..**
  - **email, LOGS, FTP, ..**
  - **dashboards**, mobiles, …
  - **Workflow/incident** management system for **ticketing**
  - **video wall** management,
  - etc. etc.







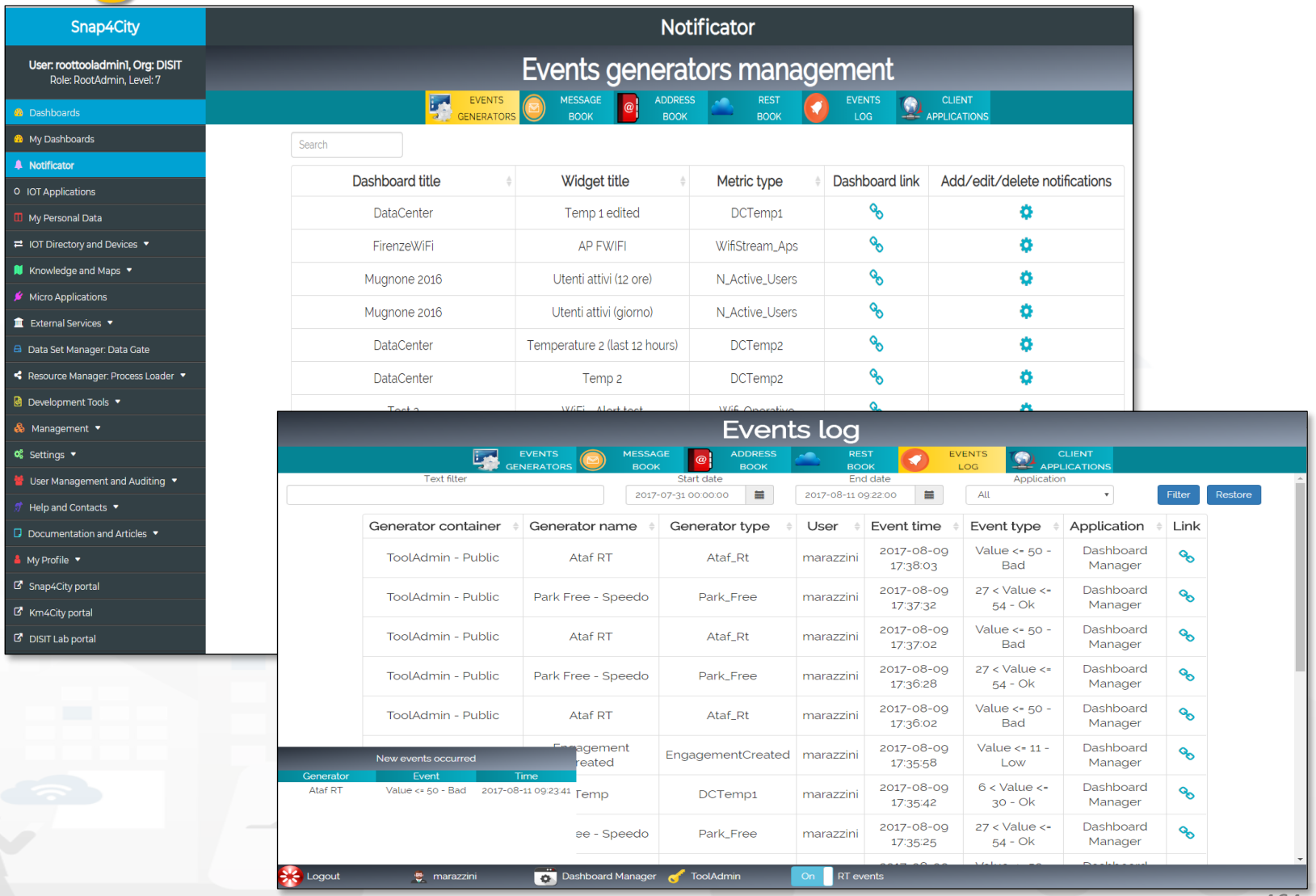




facebook

# Smart City Monitoring: Notificator

- **Each single metrics and Widget may activate a notification on Notificator**
- **Notificator** tool is attached to Dashboard Builder and it is available on Premise and for high roles
- **Blinking** on Dashboards



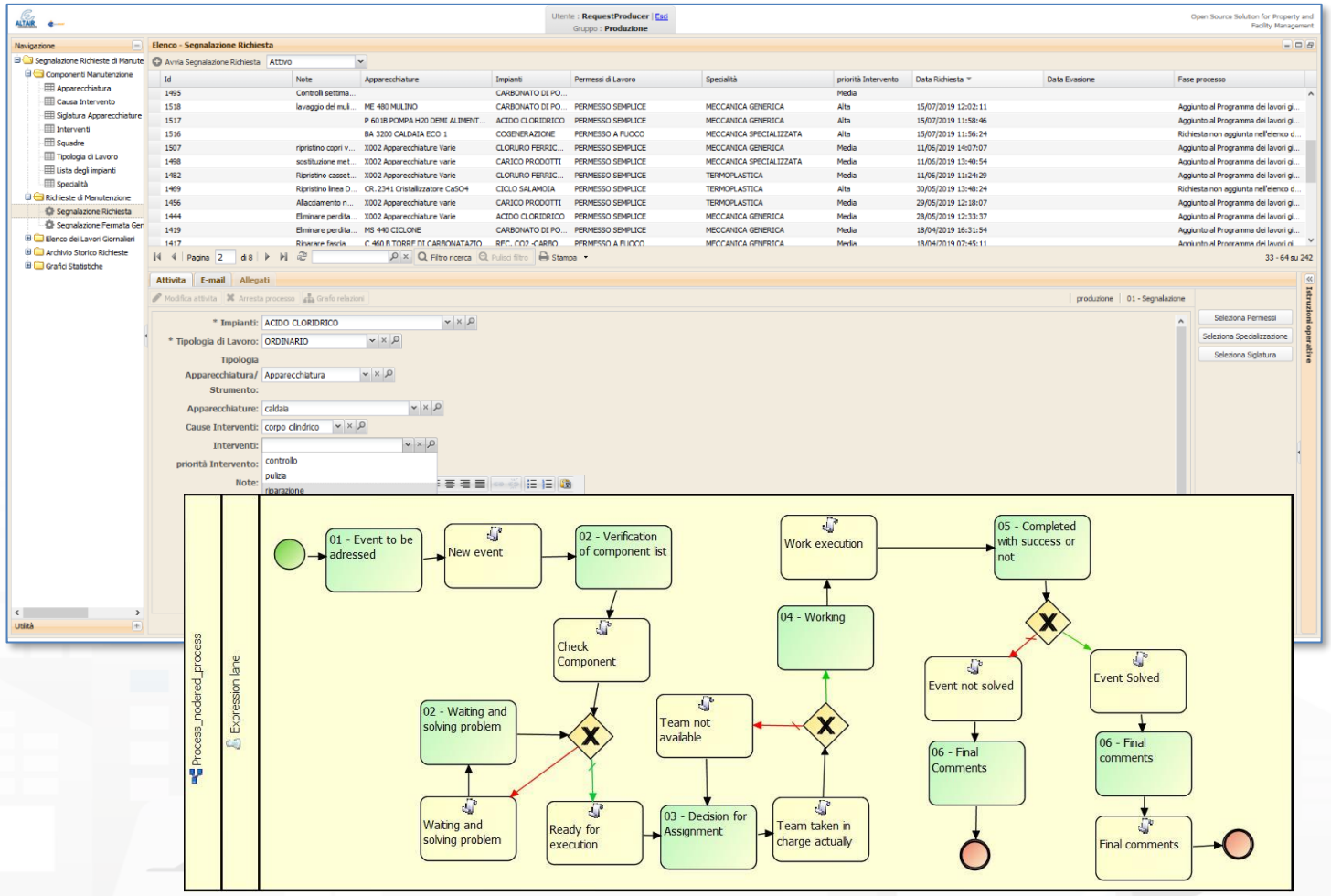
# Integration with Ticketing Systems Workflows, Incident Management



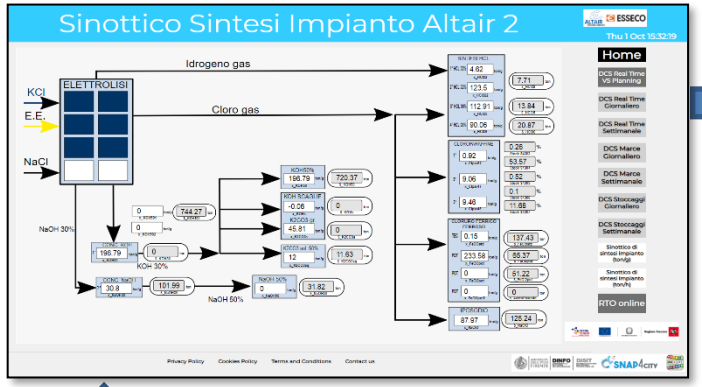
# Integration with Ticketing Systems Workflow

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

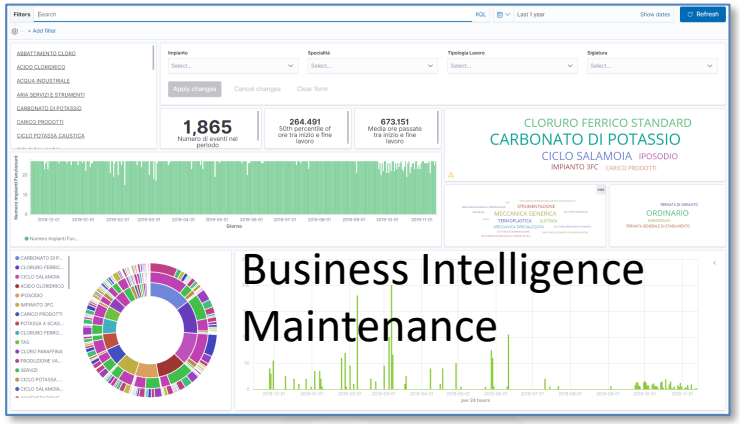
- Any ticketing systems can be integrated with Snap4City, by means of IOT Applications and Dashboards
- https://www.snap4city.org/597



# Example of Integrated workflow



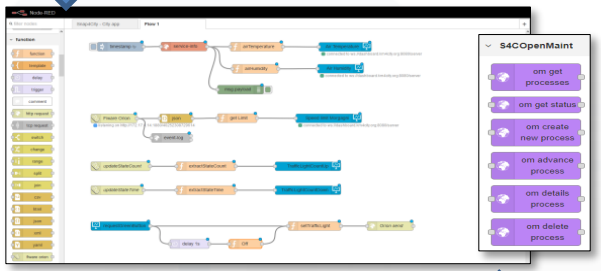

Consumptions/productions

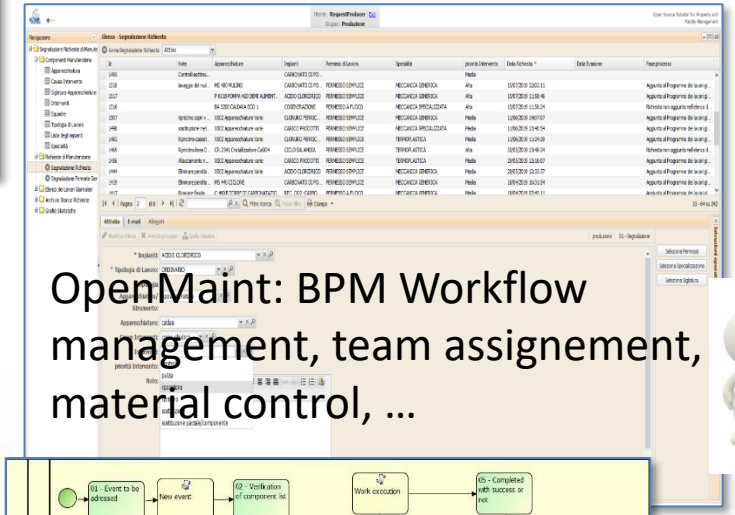



Events/actions

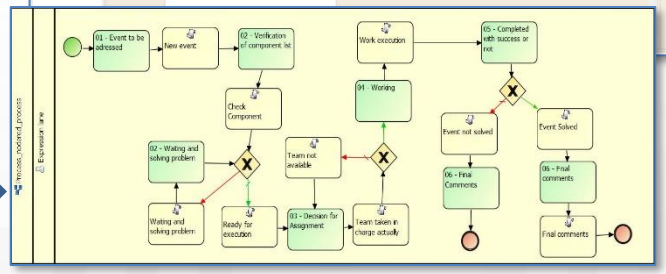
Business Intelligence
Maintenance

Dashboards and actions

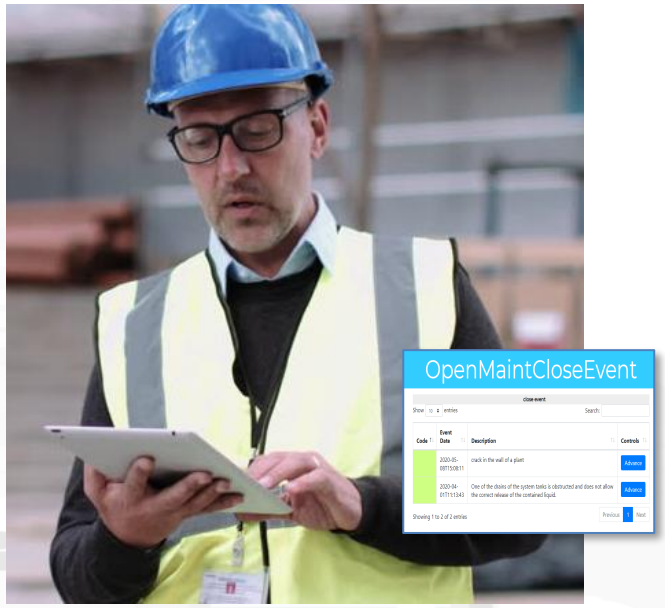


OpenMaint: BPM Workflow management, team assignement, material control, …

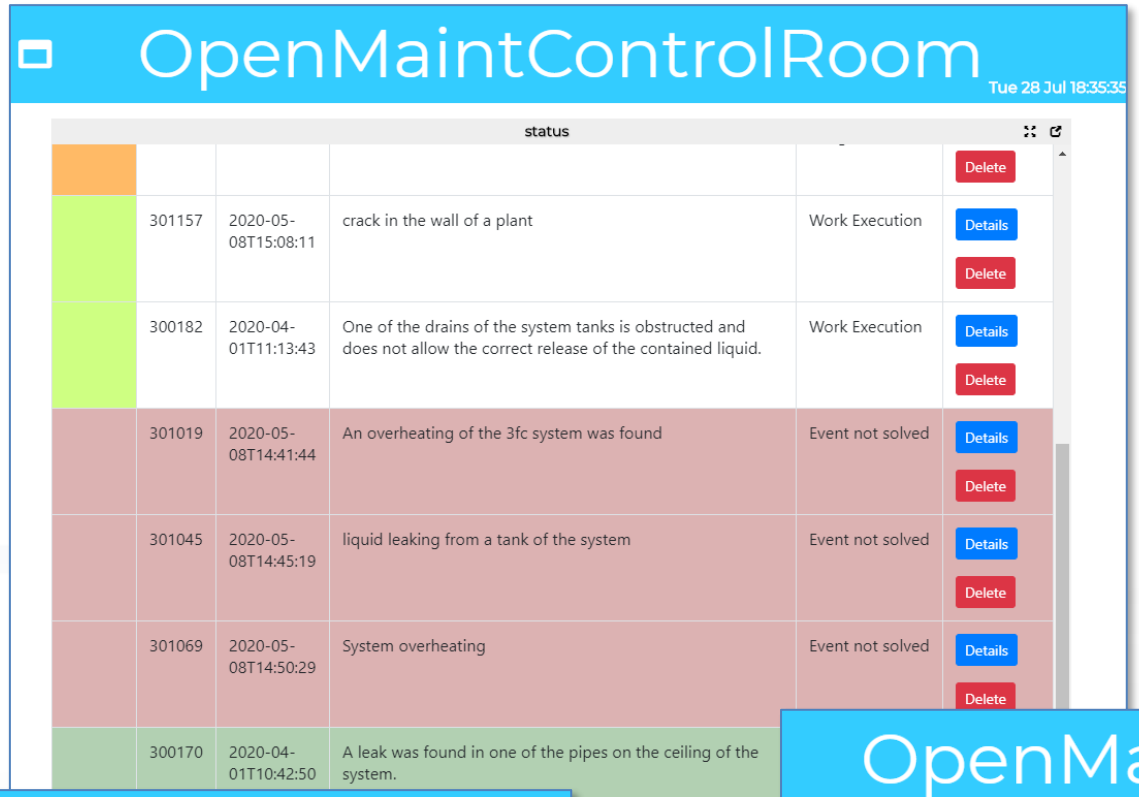


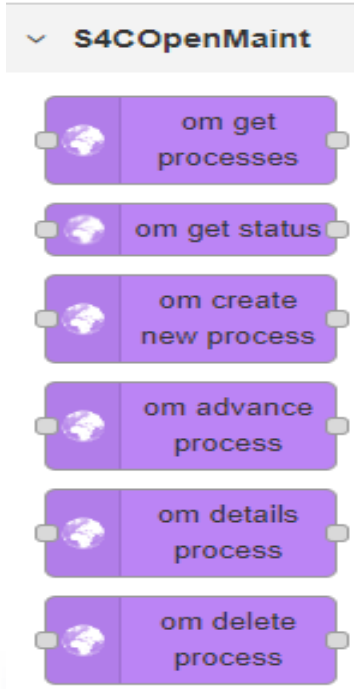


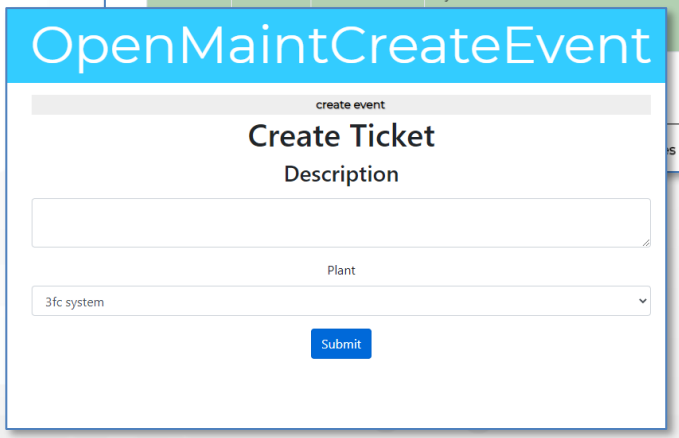



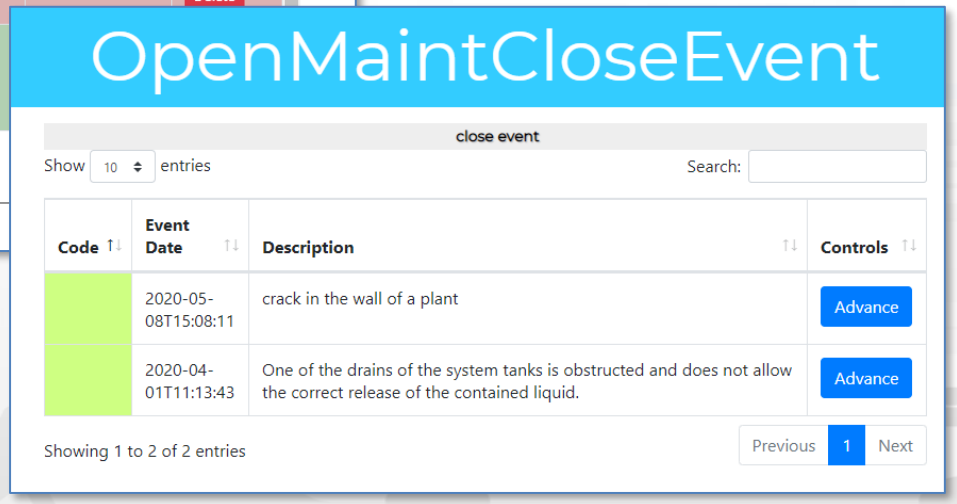

IOT App, Data event firing, event detection and firing Critical event management

# Dashboards




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

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

+ Add filter

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

Impianto: Select...

Specialità: Select...

Tipologia Lavoro: Select...

Siglatura: Select...

Apply changes | Cancel changes | Clear form

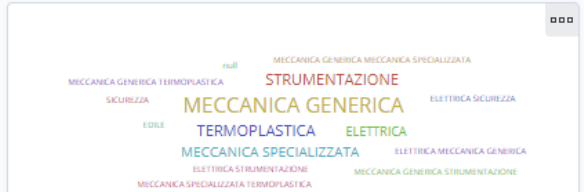
**1,865**
Numero di eventi nel periodo

**264.491**
50th percentile of ore tra inizio e fine lavoro

**673.151**
Media ore passate tra inizio e fine lavoro

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

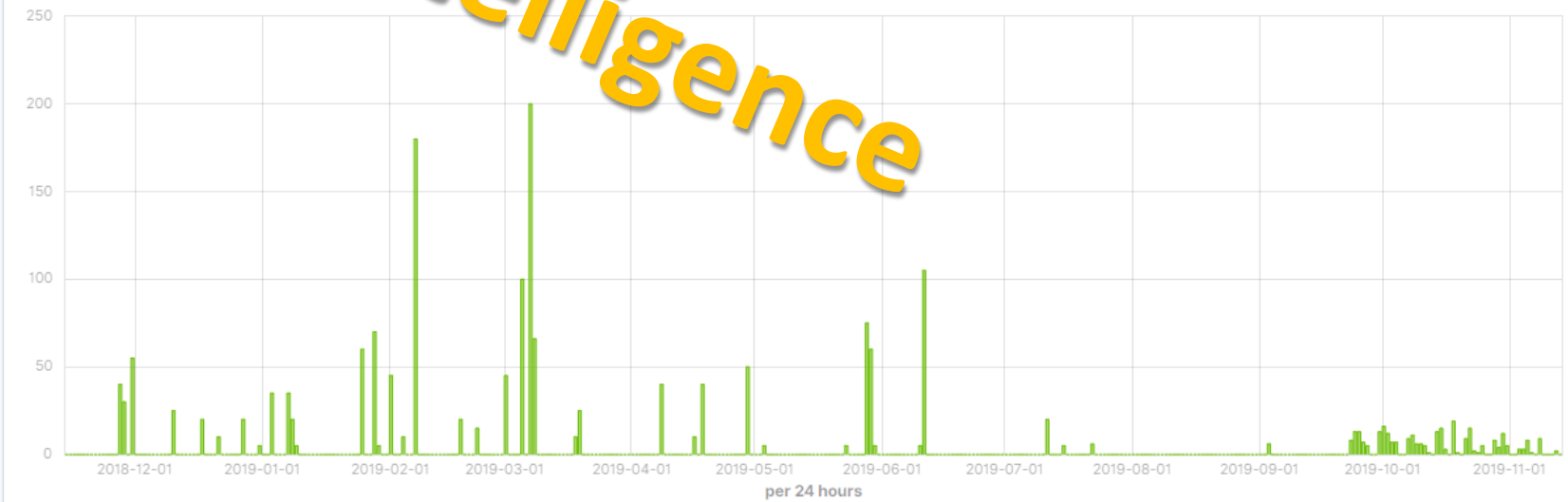



FERMATA DI IMPIANTO
ORDINARIO
EMERGENZA
FERMATA GENERALE DI STABILIMENTO

- 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...

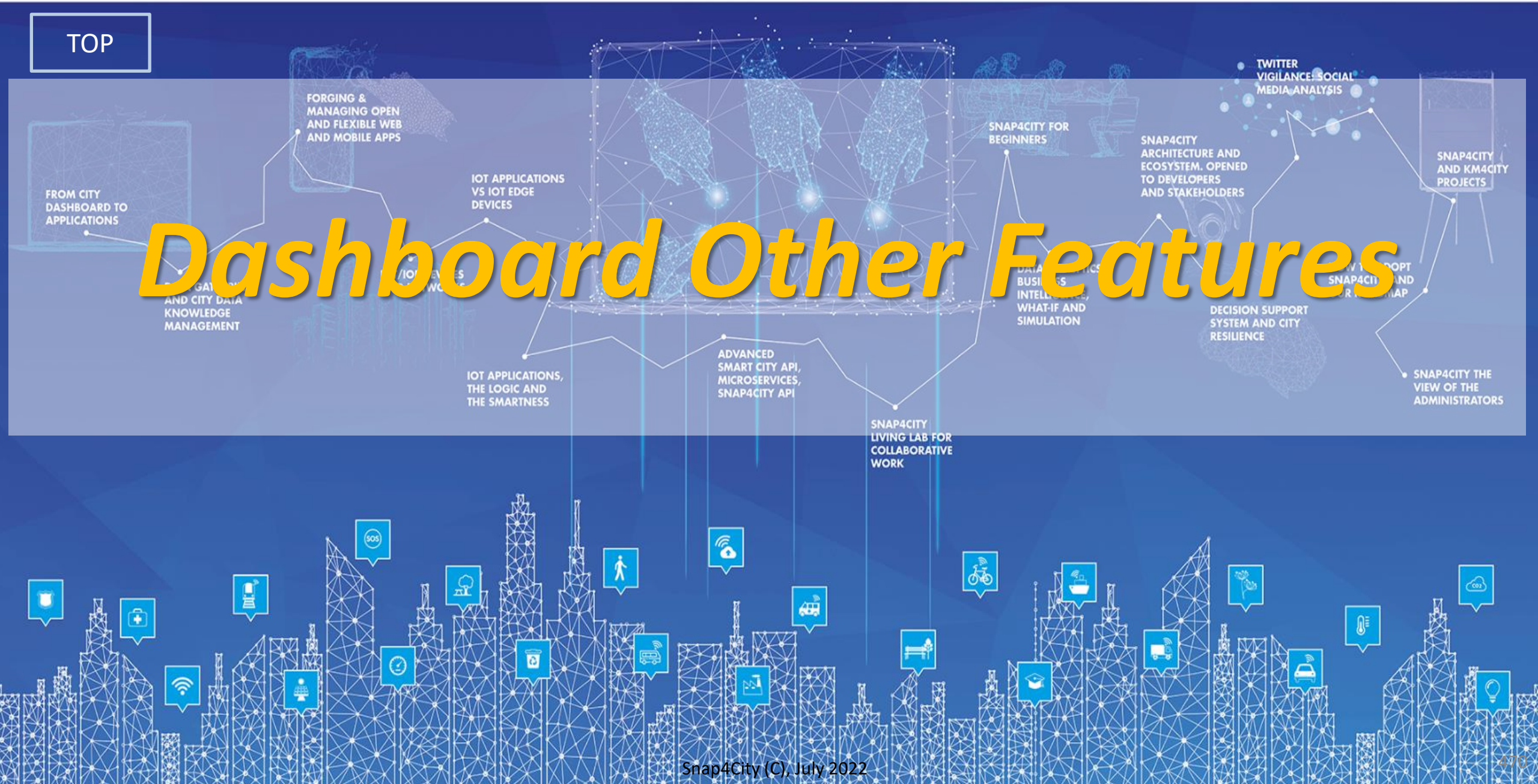





Maintenance Intelligence

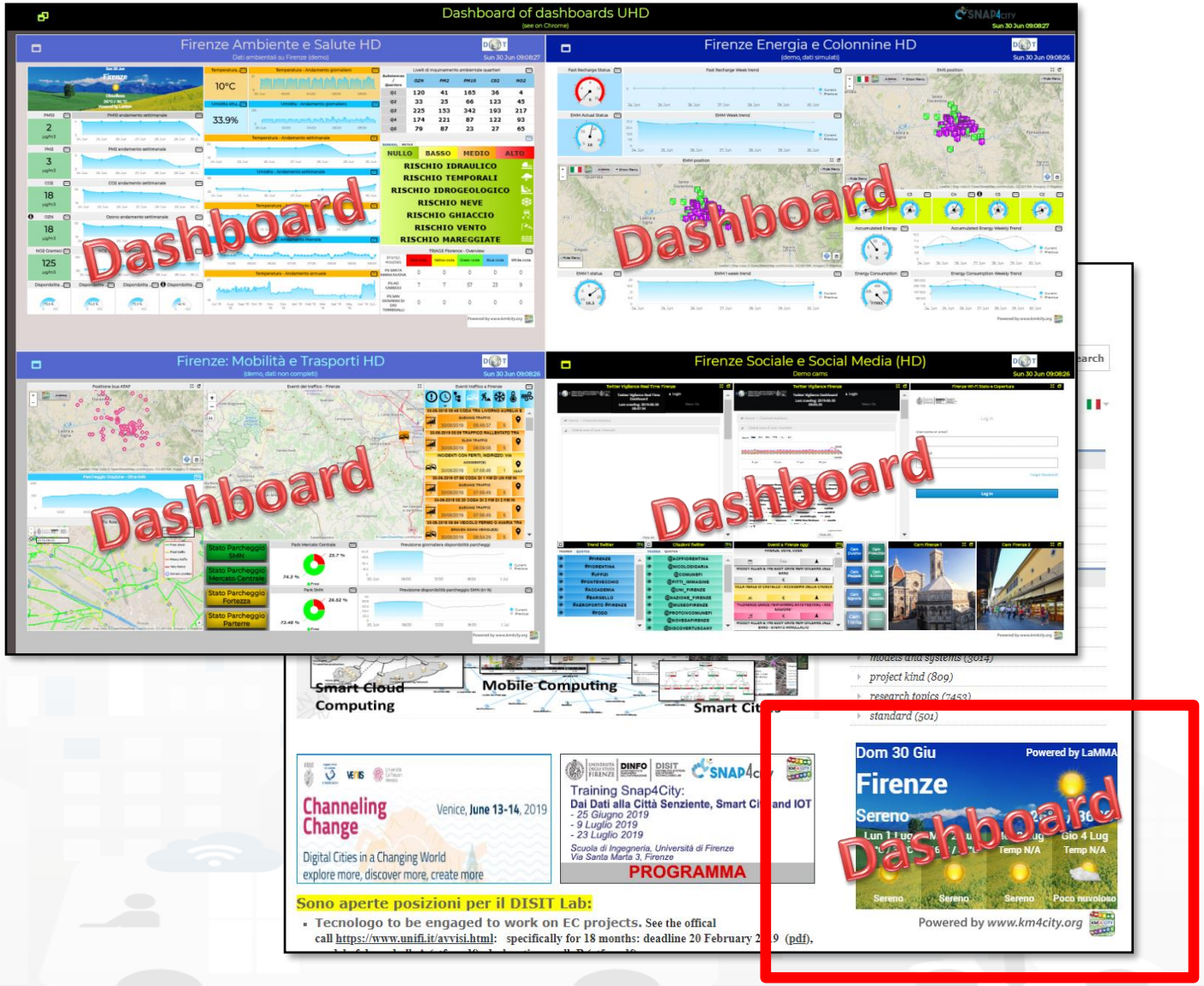
TOP

# Dashboard Other Features



# Additional Properties from Edit Dashboard

- **Embedding Dashboards into**
  - a Dashboard
  - third Party Web Page
- **Header** or not
- **Footer** or not
- **Responsive** or not
- **Size**: any
- **Background** Image: any
- Add / change Screenshot (**Thumbnails**)
- **Menu** on left upper corner or not



# Exmaple of Dashboard without header

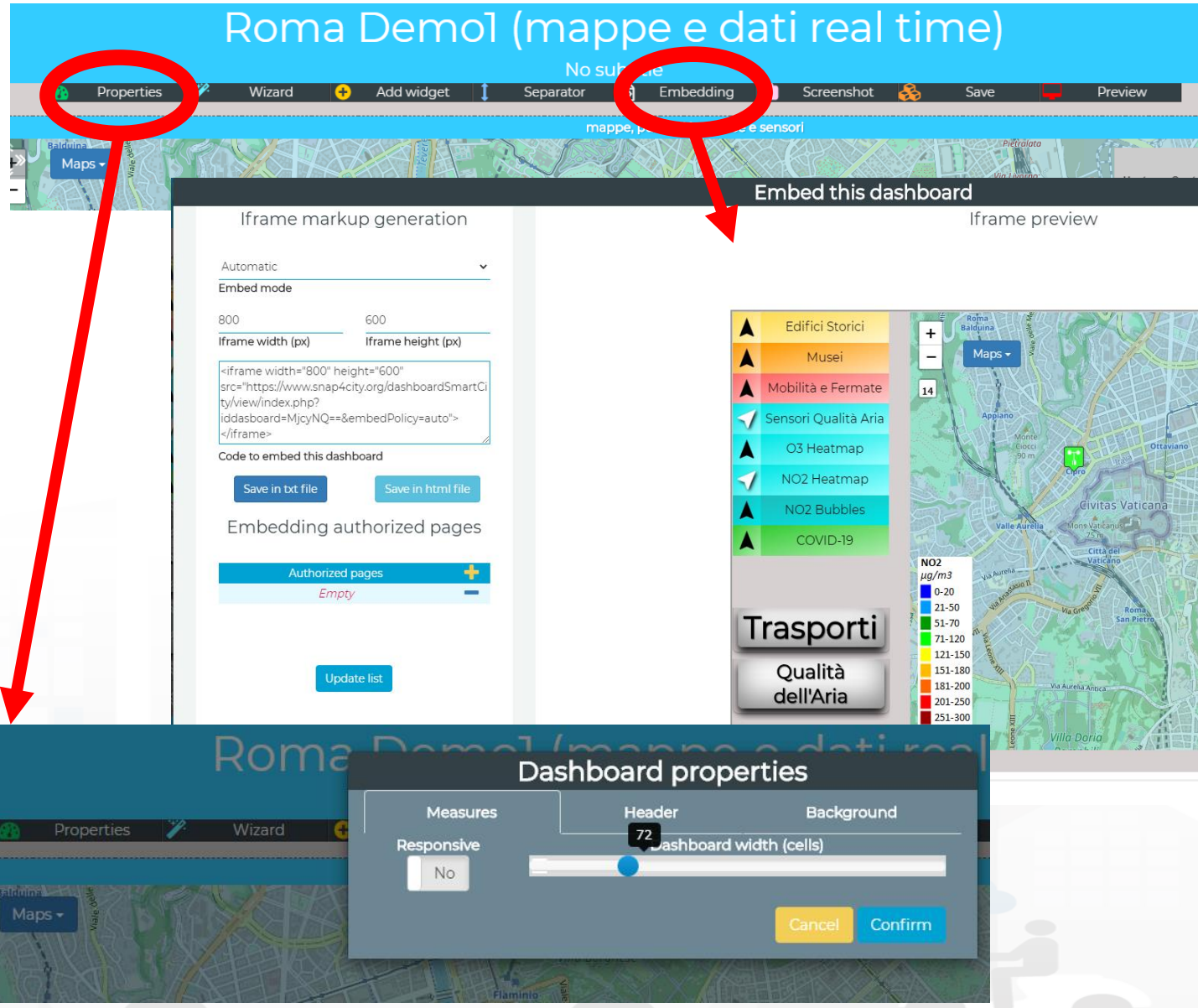
- To embed a dashboard without the header you can use the command
  - https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzMxNw==&embedPolicy=auto
  - embedPolicy can be: auto | manual
- Then:
  - header will be hiddend
  - footer will be reduced to the logo only, centered in the view

# Dashboard Embedding into third party Web Sites/pages



# Dashboard Embedding

- go in Dashboard Edit
  - Get code for embedding
  - Providing domain on which you embed
  - See Iframe preview
- **Dashboard properties**
  - we suggest set Responsive
  - deciding on header On Off
  - Adjust size of Iframe and dashboard for tuning

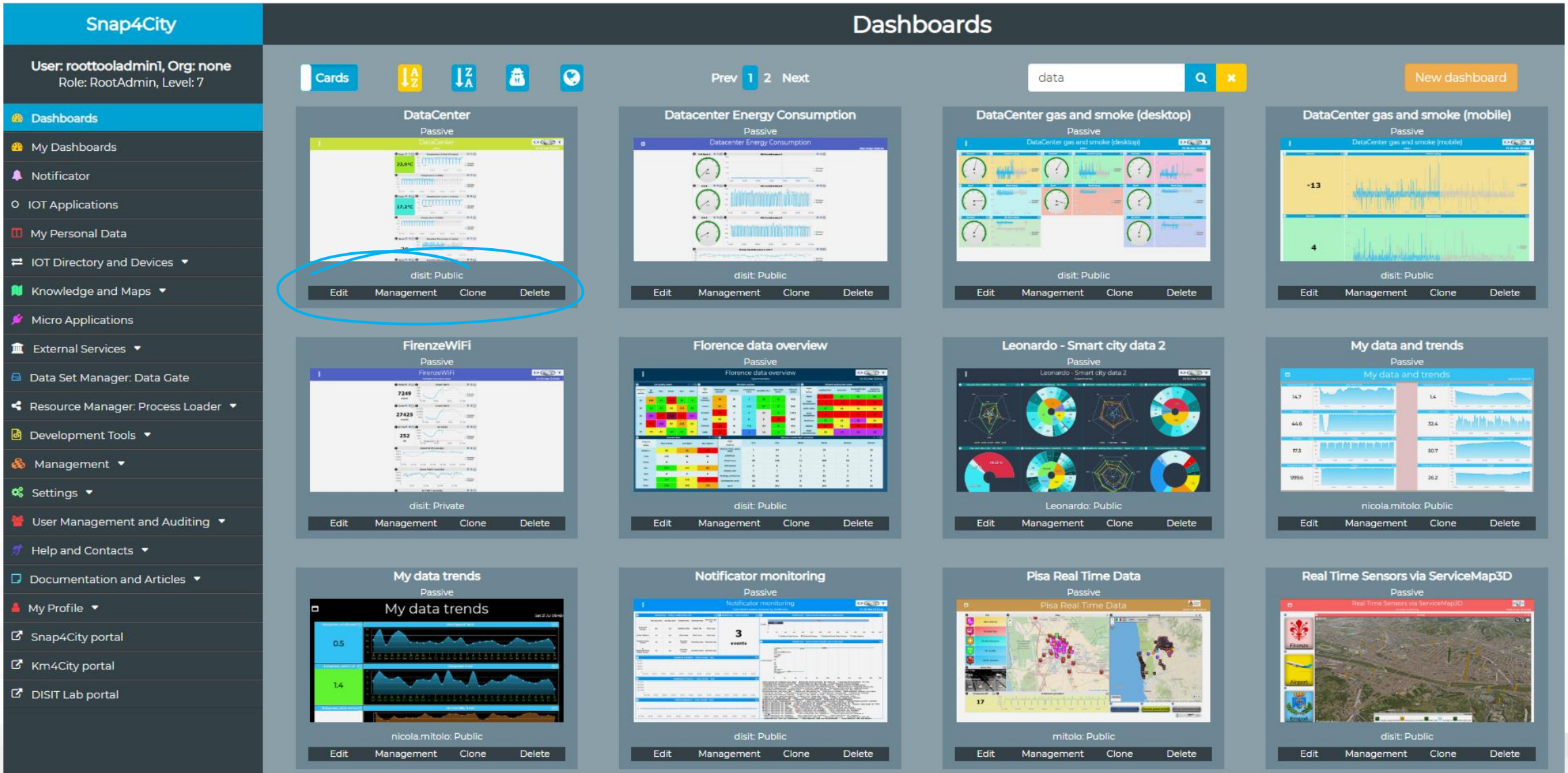


TOP

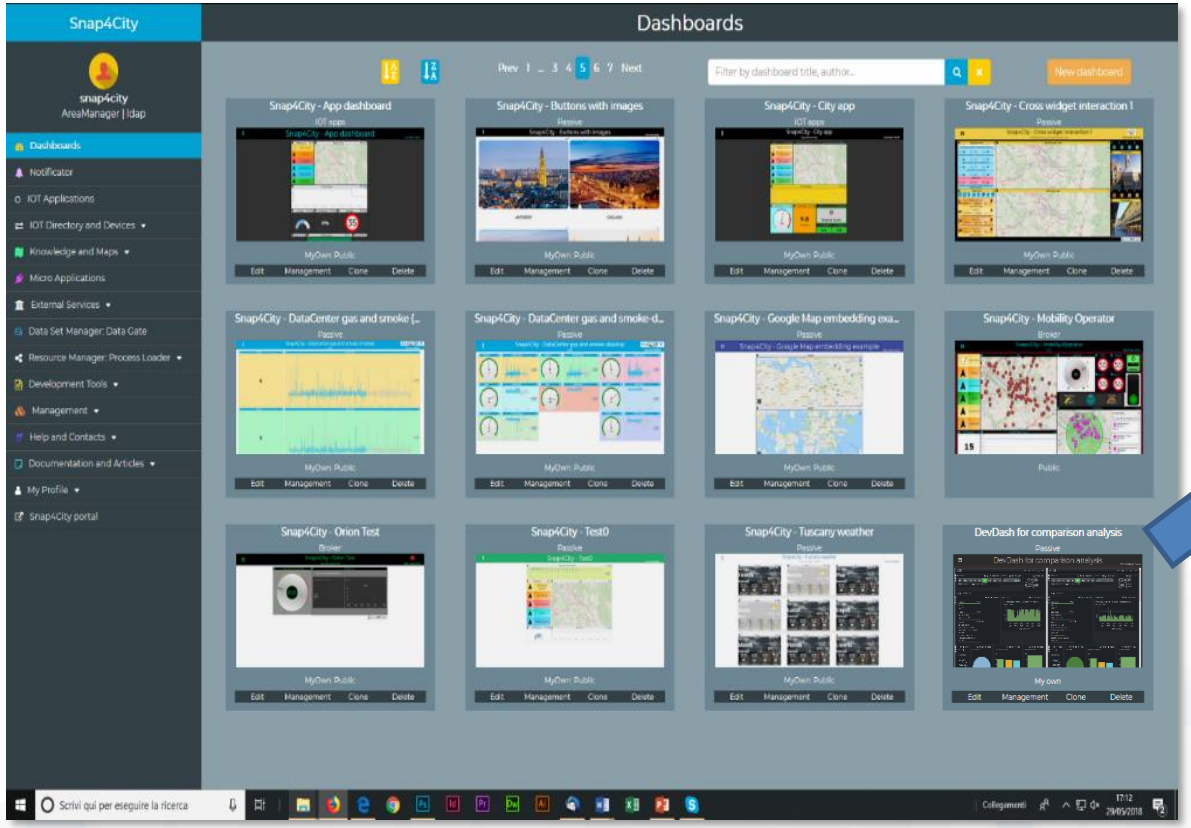
# Dashboards Listing, Managing, Sharing, Delegation

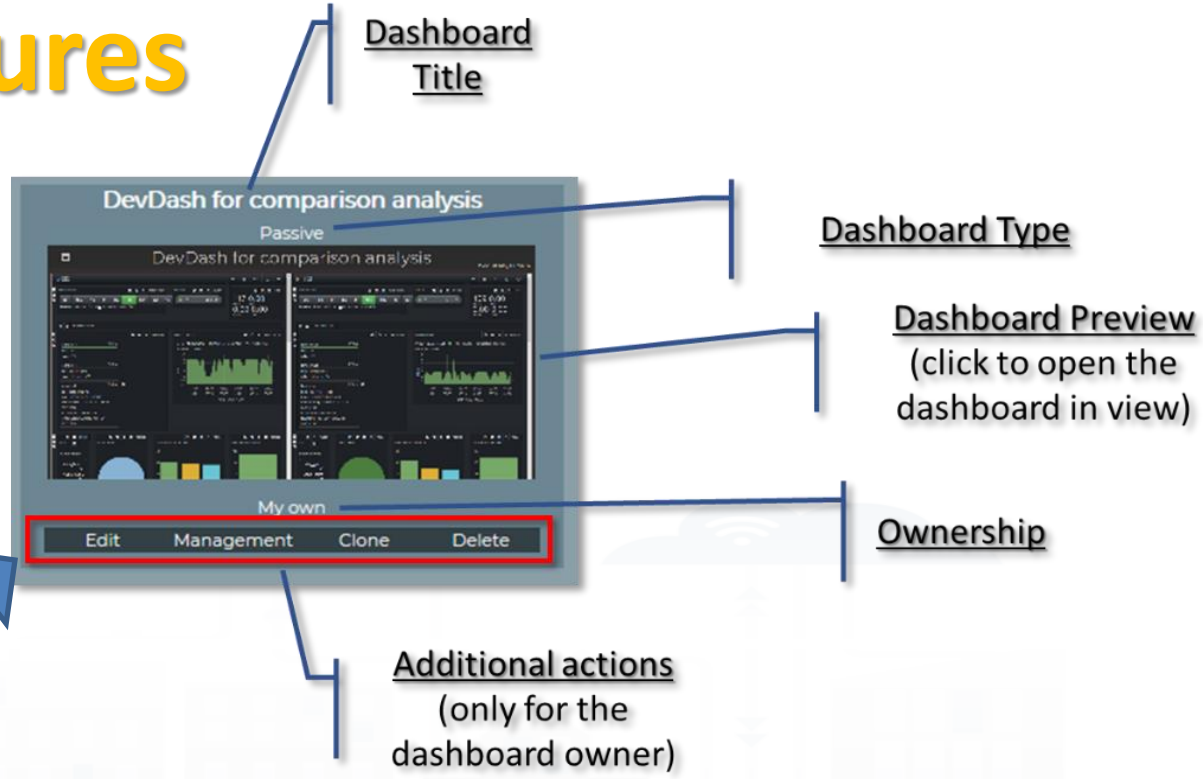


# Dashboard List and Editor



# Dashboard Listing and Features




- Edit (open Dashboard Builder)
- Management (see later)
- Clone (clone the Dashboard)
- Delete (delete the Dashboard)
- (add Thumbnail is inside Edit, as snapshot)

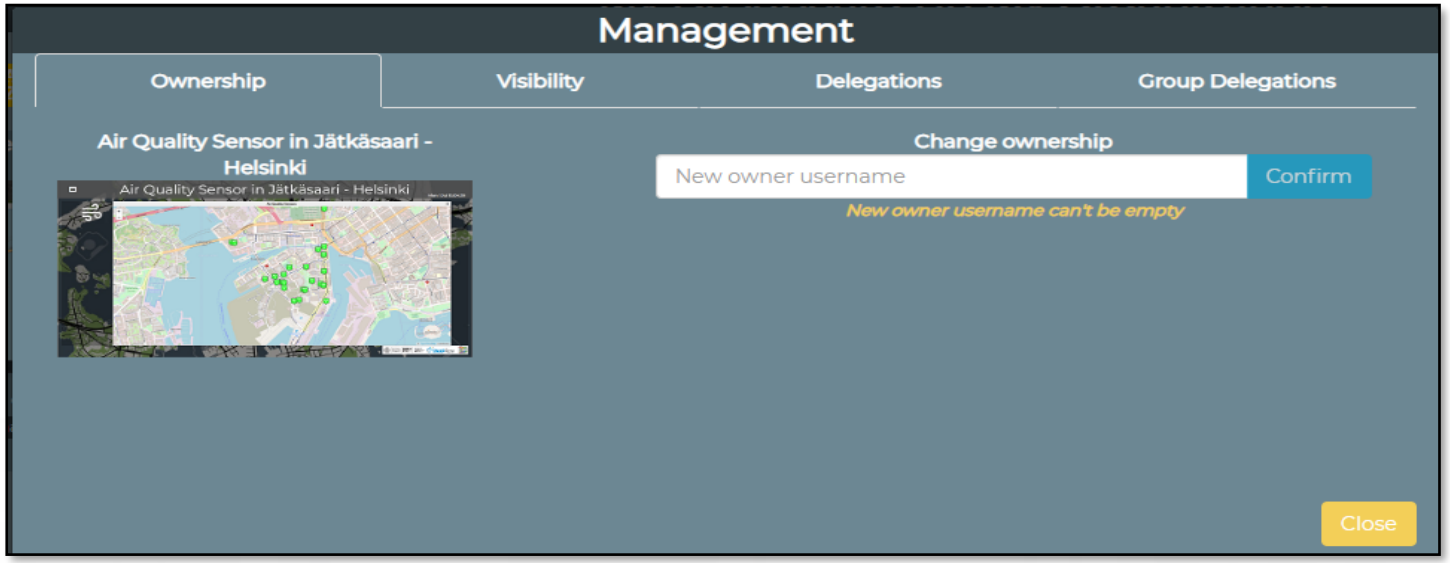
# Clone Dashboard




- Cloned: Same dash with title having «- Cloned» at the end
  - You can: Clone, change name, pass to your colleague, edit, etc.
- Be carefull that exploited resources are not cloned

# Dashboard Management

- Change Ownership
  - Towards any user
  - Knowing the nickname

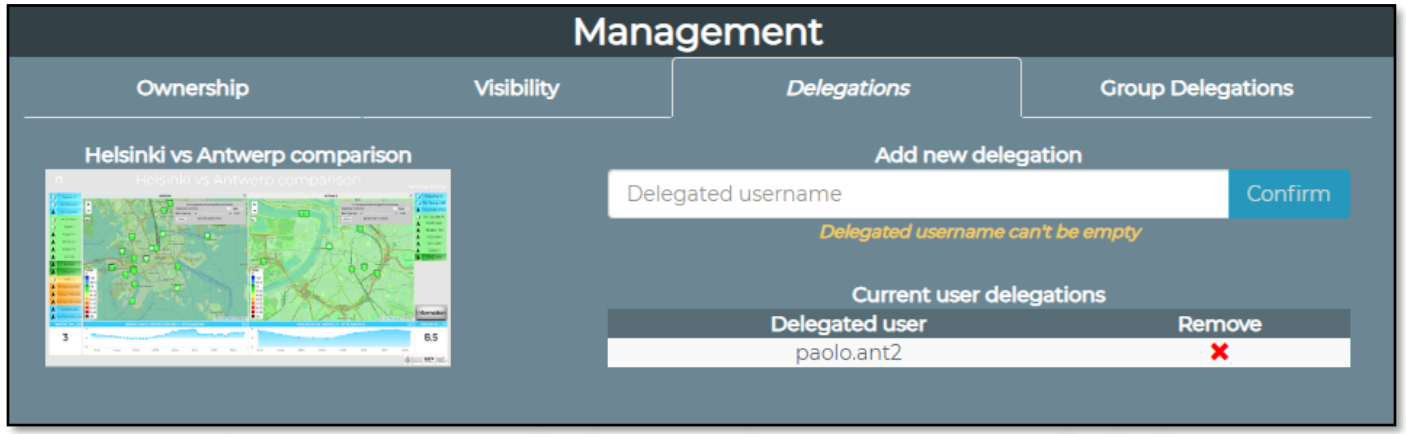



- Visibility
  - Public or Private
  - please note that data has to be published as well to make them accessible

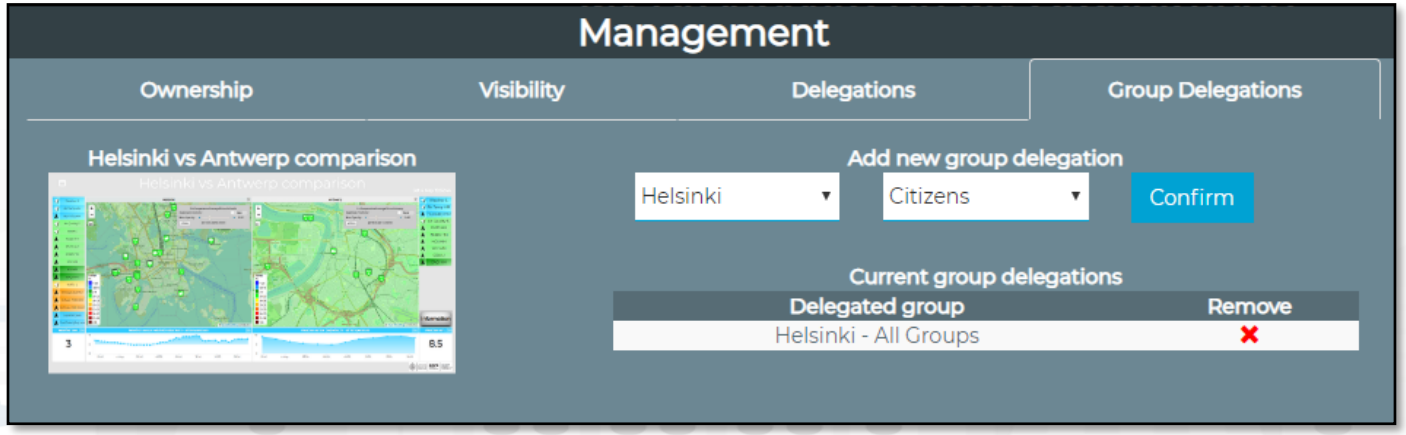


# Dashboard Management

- Delegation access to other users
  - See next example

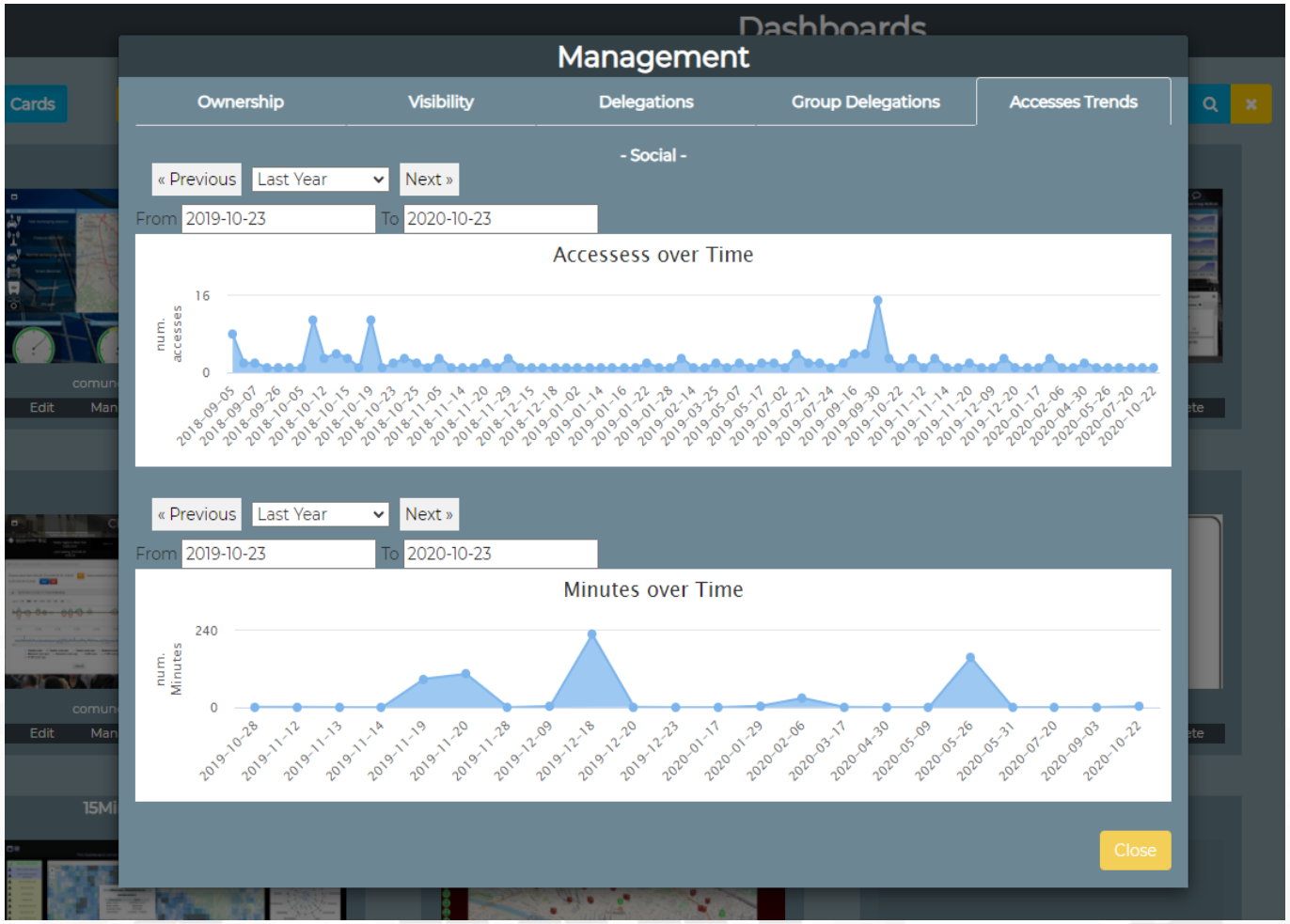



- Delegation Access to other Groups [Higher roles cross Organization]
  - See next example



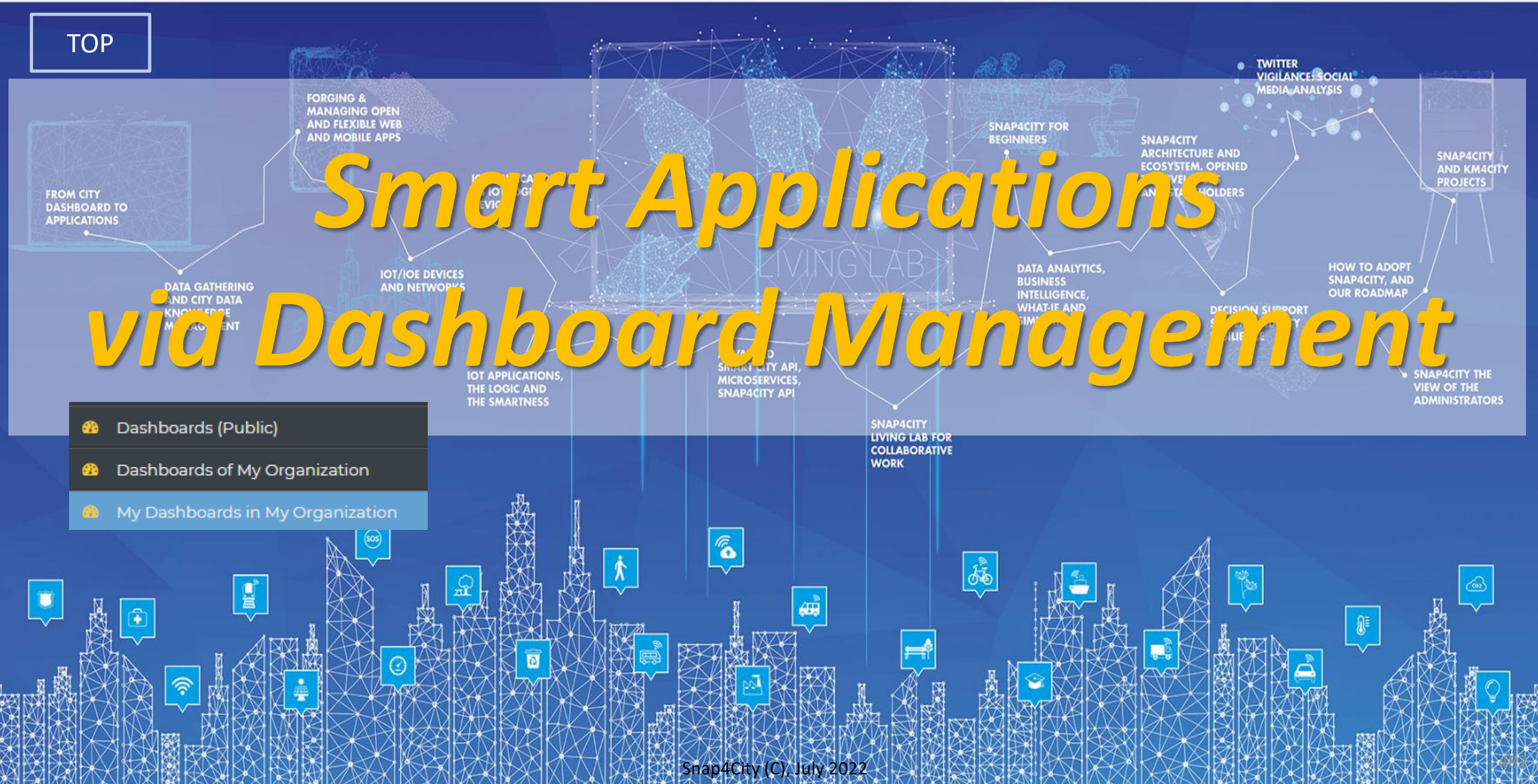
# Monitoring Dashboard Usage

- **Key Performance Indicators**
  - Number of Accesses
  - Minutes of exposition
- **Time Periods:**
  - Day by Day
  - Week by Week
  - Month by Month
  - 6 months by 6 months
  - Year by Year



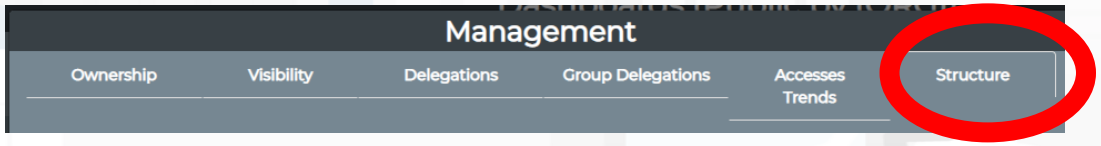
TOP

# Smart Applications via Dashboard Management

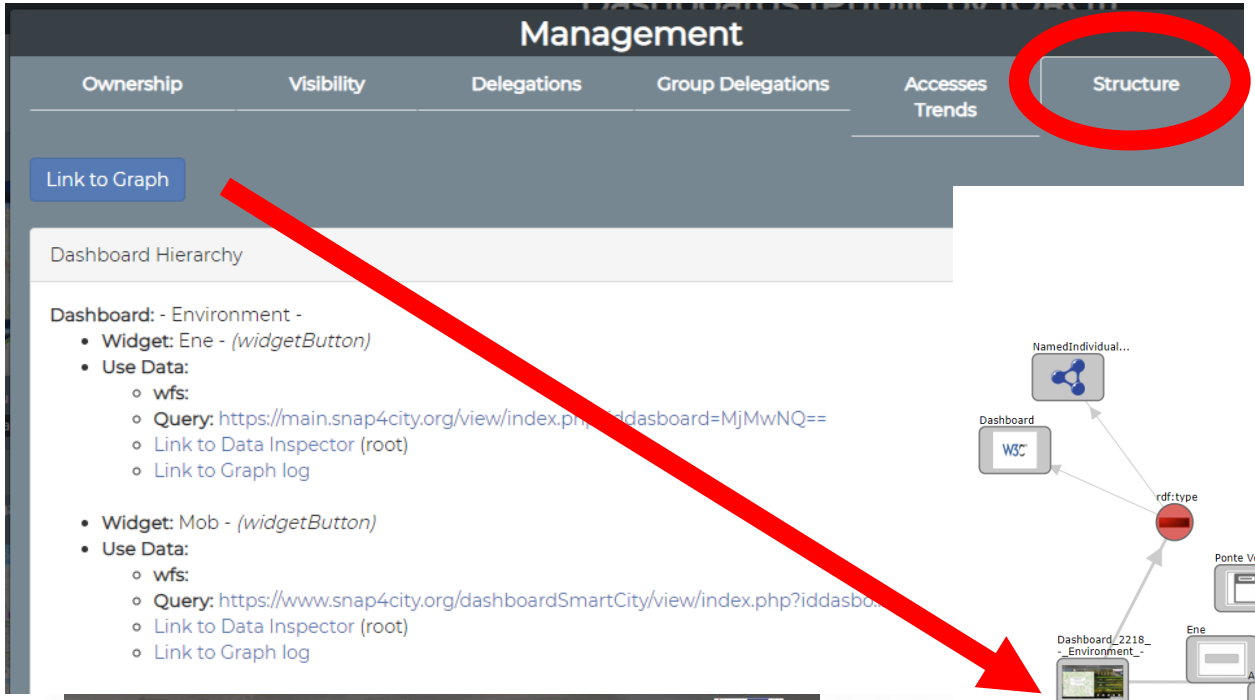


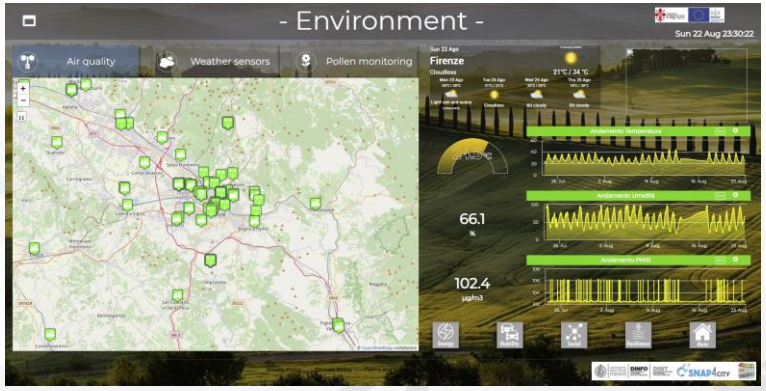
# Smart Application

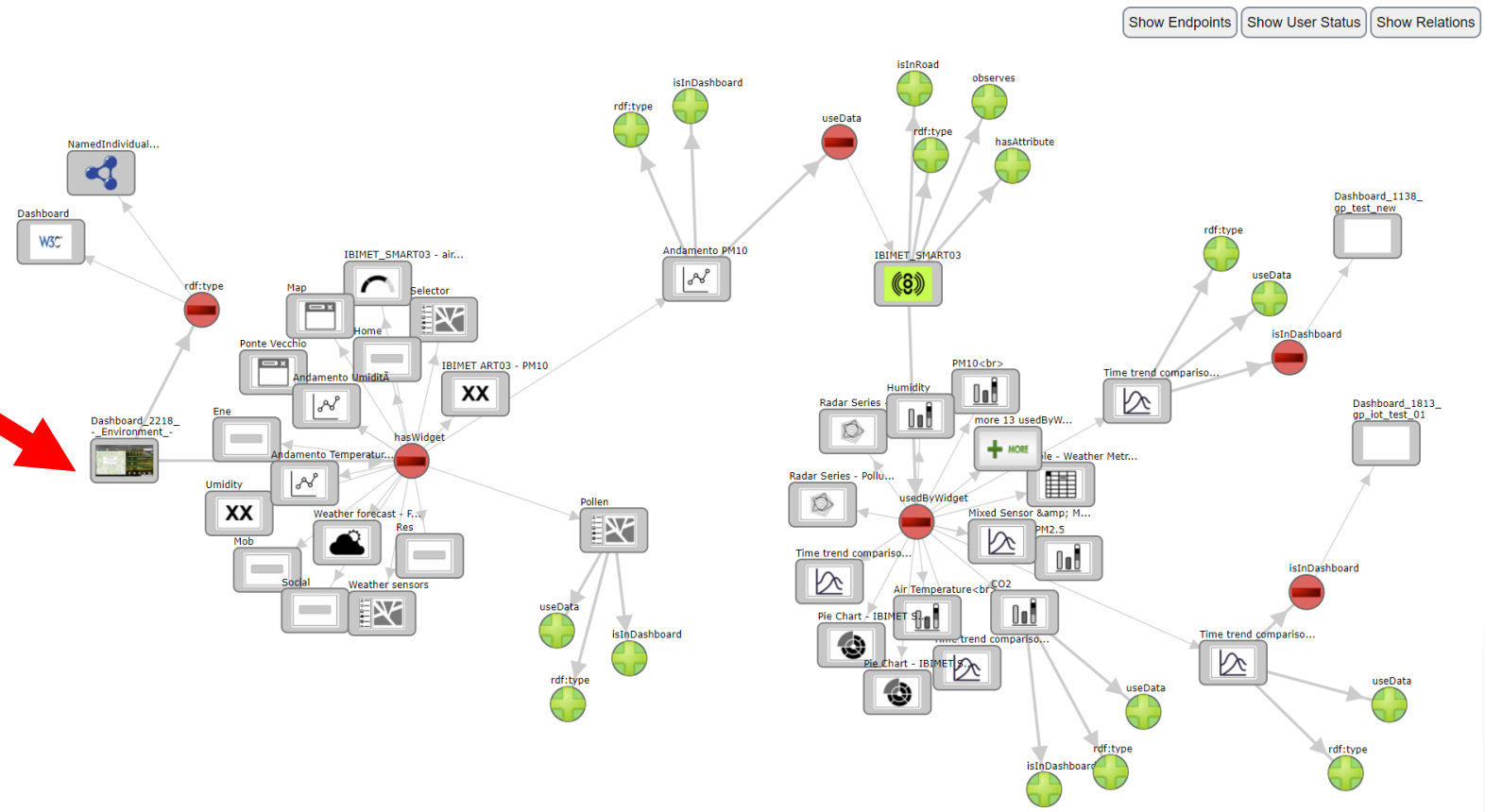
- **For each Dashboard** (Nane, ID, ORG, Users, etc.. )
  - W widgets
    - For each Widget
      - Name,
      - A data (1 …N)
  - I IoT Applications
    - ….
- **Thus:**
  - Different Dashboards may share the same data
  - Different Widgets in different Dashboards may share the same data…
  - Critical courses,….. More relevant data….
- **Access from Dashboard Management**



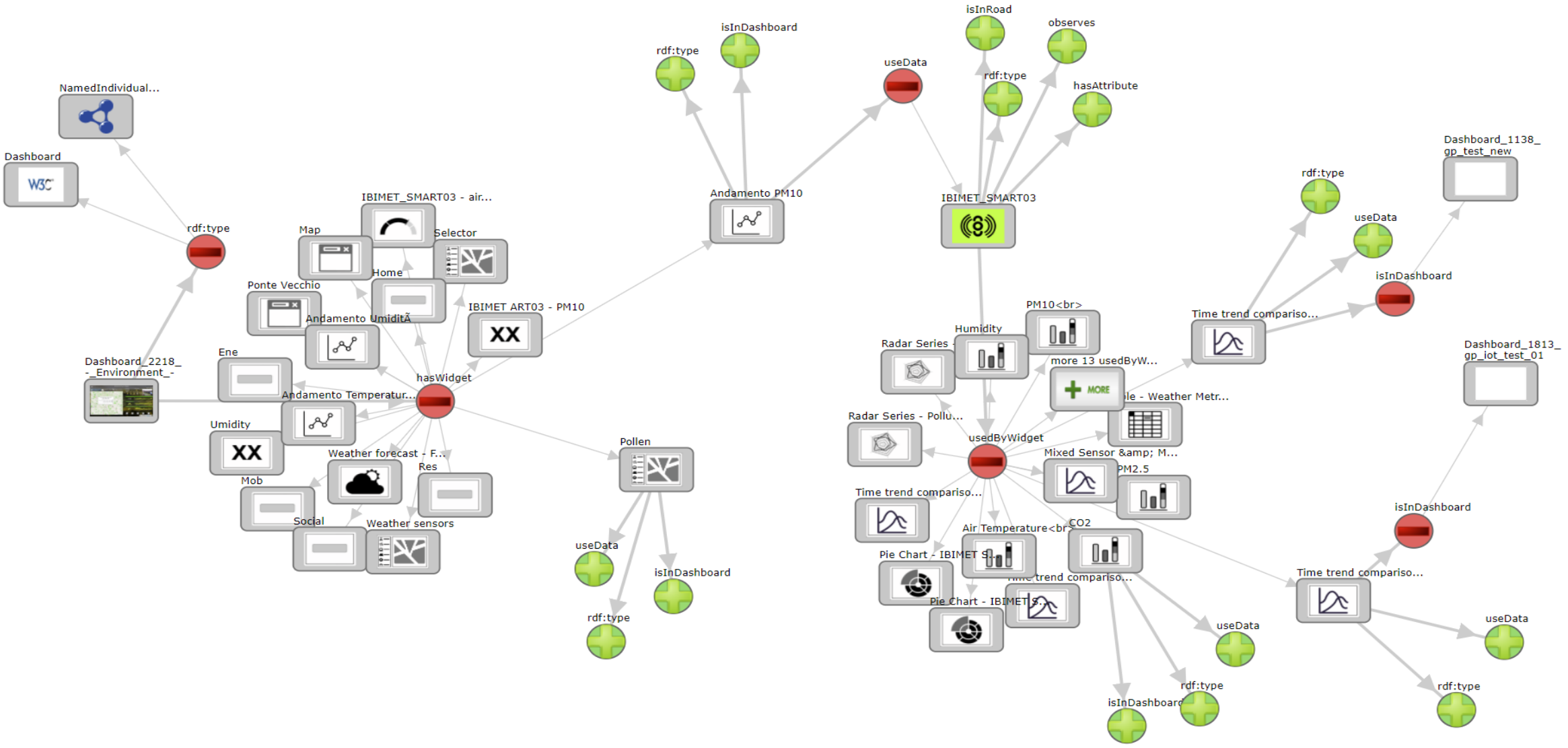
# Dashboard Management: Graph of Smart Application



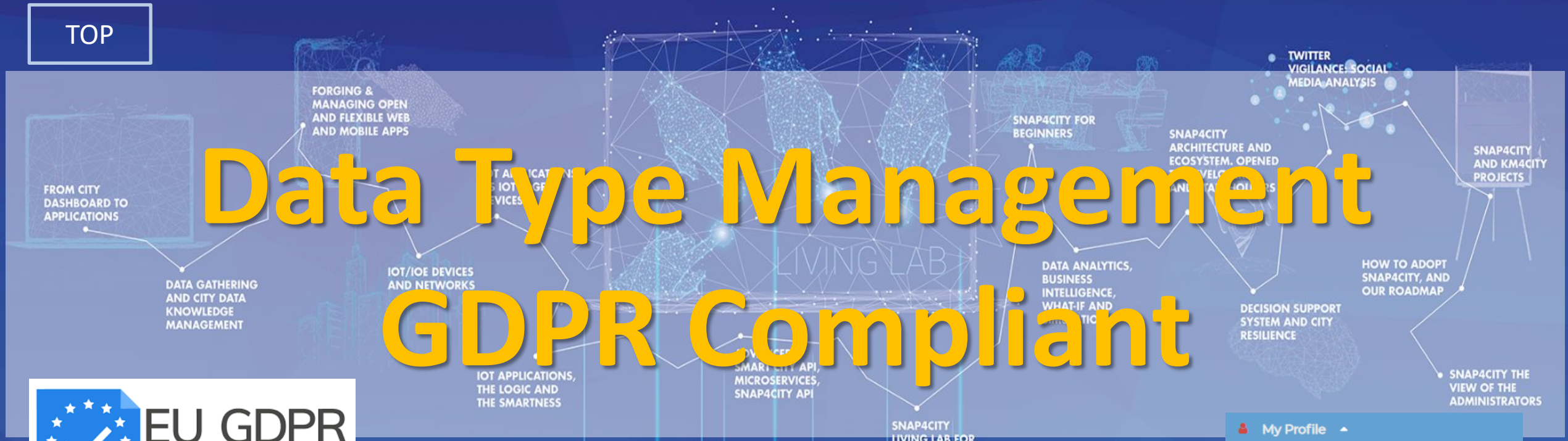



Show Endpoints | Show User Status | Show Relations

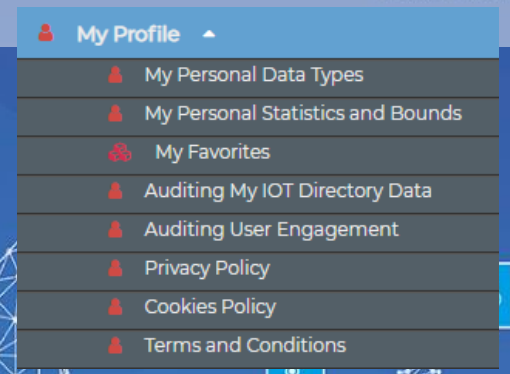


TOP

# Data Type Management GDPR Compliant




EU GDPR COMPLIANT



# GDPR: General Data Protection Regulation

**Users may** decide to:

- provide access to who, for do what, until when consented
- accept terms of use by **signed** consent **for** data management **service**

- Correctness
- Transparency
- Security
- Integrity
- Privacy
- Auditing
- …

**From each service, the user is** capable to:

- **See** what we collect in terms of Data Type: traces, logs, paths, profiles, accesses, IOT devices, sensors, maps, etc.
- **Download**, **delete**, **inspect** Data
- **Auditing** and **Revoke access** or **grant** access right to each **single Data**
- **Delete all Data in single shot** or singularly (**forget all about me**)

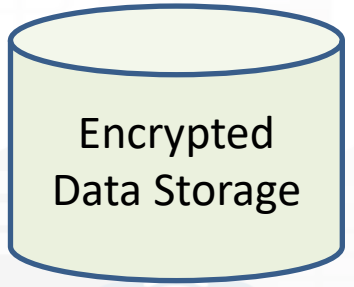
# GDPR: General Data Protection Regulation

If personal data are **published by the owner:**

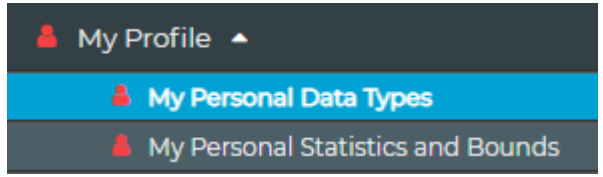
- the data are **released anonymously**,
  → also in this case they can be **revoked at any time**:

Snap4City is also compliant to GDPR **Technical Constraints** as it:

- **Performs Secure connections** in any private data exchange
- **Encrypts** data store for all private data
- **Decouples** data and personal IDs
- **Audits** private data usage



# GDPR Compliant




## My Personal Data Types

View | Edit | Track | Access control | Convert

This page allows you to access at your Data Types, which are your personal data that we c
most cases, a specific tool and view is provided to manage them.

- My profile data and Blogs
  - to manage your user profile data (name, email, ): view, edit, delete
- My Personal Statistics and Bounds: daily or Monthly
  - to access at your statistics about the data access and volume of resources use
    that may depend on the Organization at which one belong and on the role in
- My Personal Data, My KPI and My POI
  - to manage your personal MyKPI, MyPOI and trajectories, if any: view, edit, dele
- My Personal Engagement
  - to manage your personal engagements recevied on the Mobile Apps, auditing
- My IOT Devices
  - to manage your IOT Devices in which it is possible to: edit, delete, make public
- My IOT Applications
  - to manage your IOT Applications in which it is possible to: delete, restart, char
- My Dashboards
  - to manage your Dashboards in which it is possible to: edit, delete, change owr
- My IOT sensor data service URI (for programmers)
  - to manage the Delegations to access at the ServiceURI of the knowledge base
- My IOT sensor data service GraphID (for programmers)
  - to manage the Delegations to access at the a Graph (data set) of the knowled
- My personal data by IOT App (partially deprecated)
  - to manage your MyPersonal Data, if any: view, edit, delete, delegation in acces
- My Annotation data
  - to manage the Delegation to access at the Annotations: delegation in access,
- Auditing Access to My Data
  - to audit the accesses to MyData

Manage Profile and MyPersonalData

For each Data Type:

- Start as private → making them public (anonymous) and revoke
- The Owner is the only one that can: (1) modify values; (2) change the ownership
- Define/revoke Delegation to Access
- Delete/forget per Data Type and “me all”!
- Auditing

# GDPR vs Snap4City

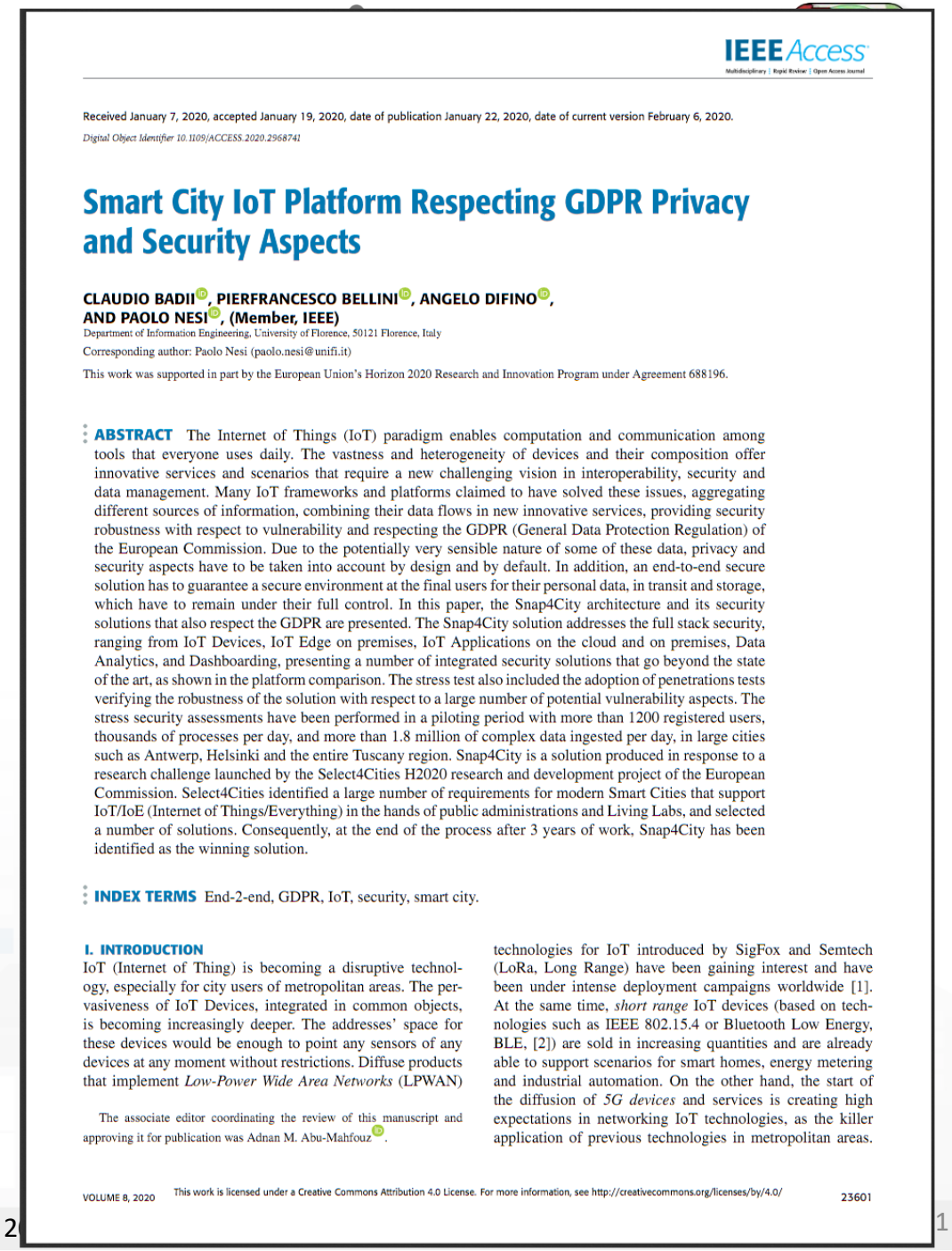
| GDPR Compliance Verification Features | Verif. | Reqs. |
|---|---|---|
| Signed consent | UI | R8 |
| User profile management and control | UI | R13 |
| Data Type private as default | UI | R8 |
| Rights to access per element | UI | R9 |
| Rights to transfer per element | UI | R10 |
| Rights to erase per element and total | UI | R13 |
| Rights to revoke/change per Data Type | UI | R10 |
| An interface for Right management for Data Type | UI | R9 |
| Clear Terms of Use and Privacy Policy | UI | -- |
| Auditing Tools for Data Type | UI | R14 |
| Publish as Anonymous | UI | R9 |
| Encrypt personal users' data | Code | R12 |
| Secure Authentication and Authorization | Code | R3 |
| Data protection by Design | Code | R17 |
| Secure connection | Code | R6 |
| Security Control, data breach control, anonymization, etc. | PEN Test | R15, R16, R18 |

Details on the paper cited in the following slide

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

IEEE Access

- C. Badii, P. Bellini, A. Difino, P. Nesi, "Smart City IoT Platform Respecting GDPR Privacy and Security Aspects", accepted for publication on IEEE Access, 2020. 10.1109/ACCESS.2020.2968741 https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8966344



IEEE Access

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# Smart City IoT Platform Respecting GDPR Privacy and Security Aspects

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**ABSTRACT** The Internet of Things (IoT) paradigm enables computation and communication among tools that everyone uses daily. The vastness and heterogeneity of devices and their composition offer innovative services and scenarios that require a new challenging vision in interoperability, security and data management. Many IoT frameworks and platforms claimed to have solved these issues, aggregating different sources of information, combining their data flows in new innovative services, providing security robustness with respect to vulnerability and respecting the GDPR (General Data Protection Regulation) of the European Commission. Due to the potentially very sensible nature of some of these data, privacy and security aspects have to be taken into account by design and by default. In addition, an end-to-end secure solution has to guarantee a secure environment at the final users for their personal data, in transit and storage, which have to remain under their full control. In this paper, the Snap4City architecture and its security solutions that also respect the GDPR are presented. The Snap4City solution addresses the full stack security, ranging from IoT Devices, IoT Edge on premises, IoT Applications on the cloud and on premises, Data Analytics, and Dashboarding, presenting a number of integrated security solutions that go beyond the state of the art, as shown in the platform comparison. The stress test also included the adoption of penetrations tests verifying the robustness of the solution with respect to a large number of potential vulnerability aspects. The stress security assessments have been performed in a piloting period with more than 1200 registered users, thousands of processes per day, and more than 1.8 million of complex data ingested per day, in large cities such as Antwerp, Helsinki and the entire Tuscany region. Snap4City is a solution produced in response to a research challenge launched by the Select4Cities H2020 research and development project of the European Commission. Select4Cities identified a large number of requirements for modern Smart Cities that support IoT/IoE (Internet of Things/Everything) in the hands of public administrations and Living Labs, and selected a number of solutions. Consequently, at the end of the process after 3 years of work, Snap4City has been identified as the winning solution.

**INDEX TERMS** End-2-end, GDPR, IoT, security, smart city.

## I. INTRODUCTION

IoT (Internet of Thing) is becoming a disruptive technology, especially for city users of metropolitan areas. The pervasiveness of IoT Devices, integrated in common objects, is becoming increasingly deeper. The addresses' space for these devices would be enough to point any sensors of any devices at any moment without restrictions. Diffuse products that implement *Low-Power Wide Area Networks* (LPWAN) technologies for IoT introduced by SigFox and Semtech (LoRa, Long Range) have been gaining interest and have been under intense deployment campaigns worldwide [1]. At the same time, *short range* IoT devices (based on technologies such as IEEE 802.15.4 or Bluetooth Low Energy, BLE, [2]) are sold in increasing quantities and are already able to support scenarios for smart homes, energy metering and industrial automation. On the other hand, the start of the diffusion of *5G devices* and services is creating high expectations in networking IoT technologies, as the killer application of previous technologies in metropolitan areas.

The associate editor coordinating the review of this manuscript and approving it for publication was Adnan M. Abu-Mahfouz.



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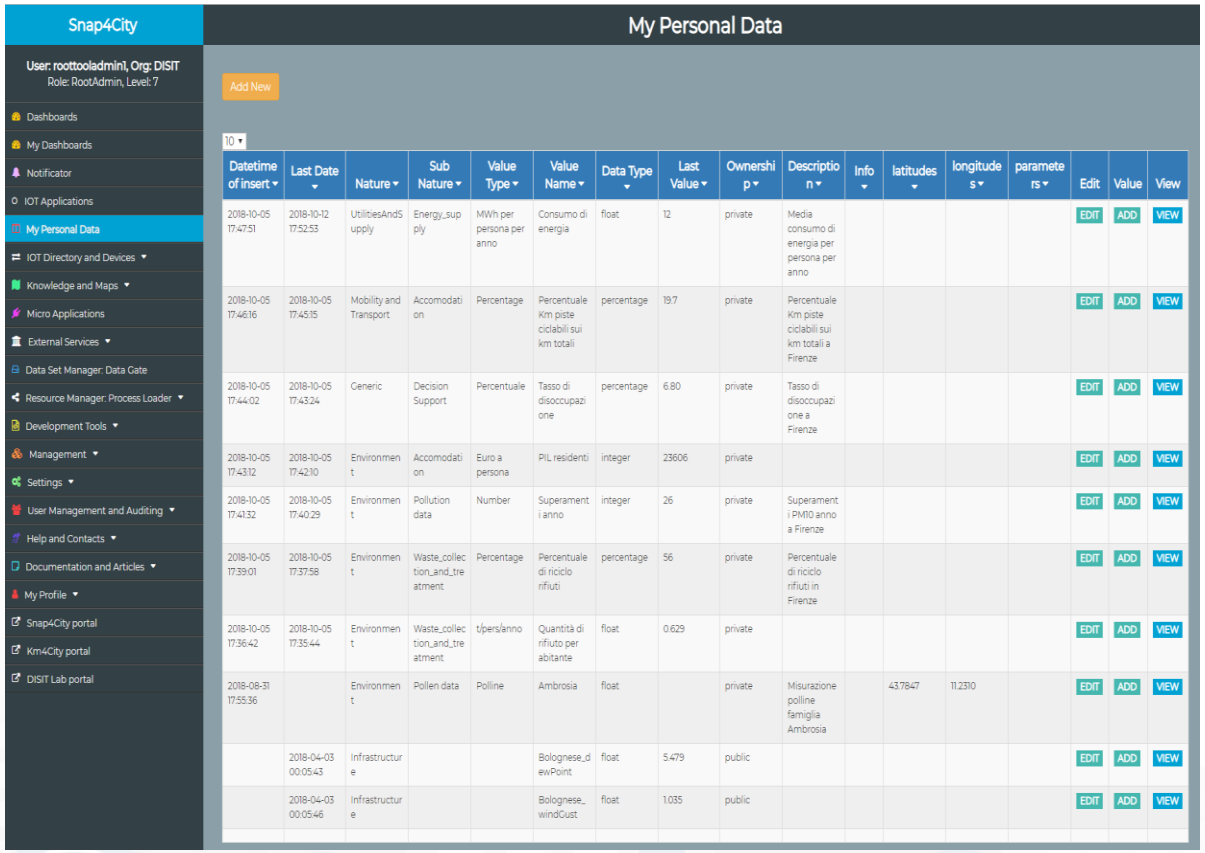
# Personal Data Management, GDPR compliant: POI, Data, KPI



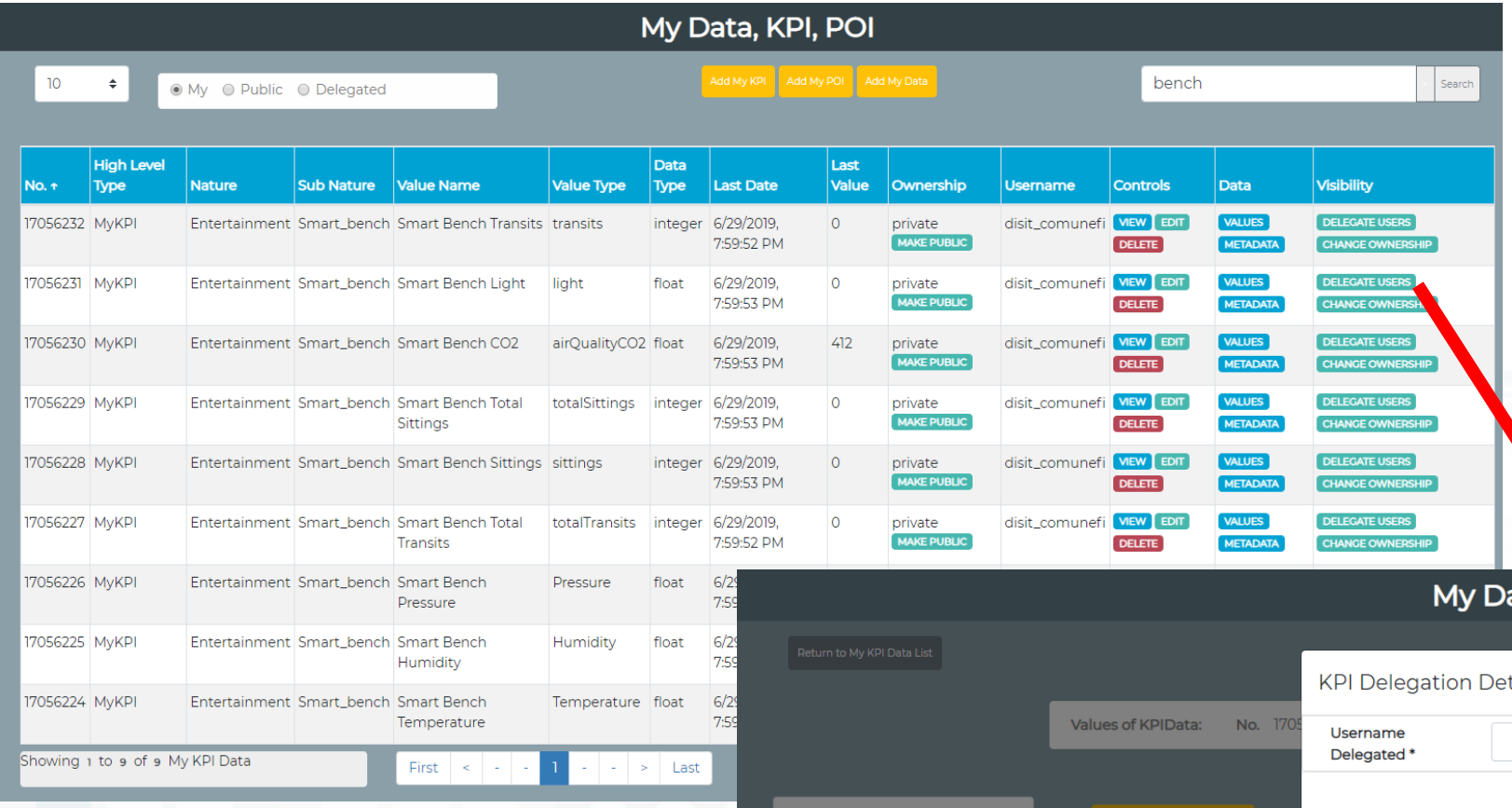
# Managing Personal: KPI, Data, POIs

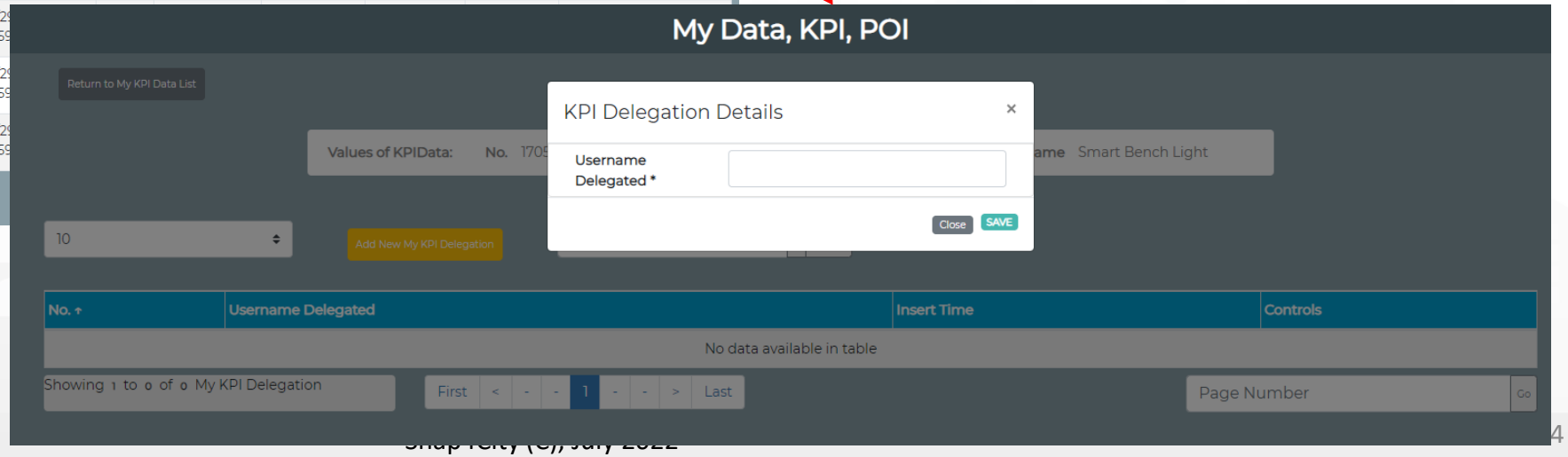
**Which can be**:

- **Acquired from any source:** SQL, SPARQL, API, etc., ODBC, JDBC, etc.
- **Computed** by means of IOT App, Data Analytics, ETL
- **Stored/retrieved** into personal safe or general storage
- **Edited** from tool, or from IOT App
- **Added** Manually or Automatically
- **Shown via Dashboard**

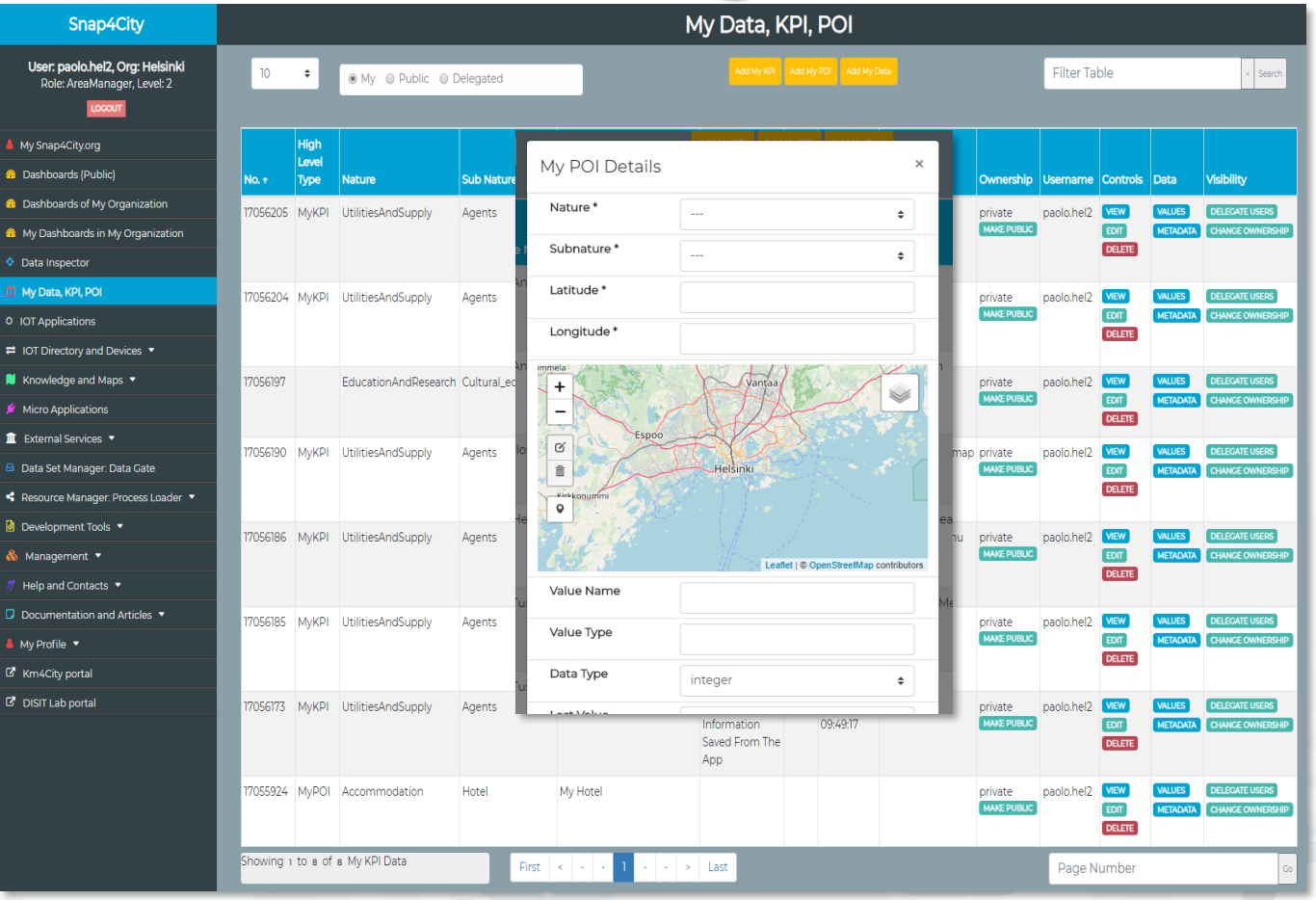


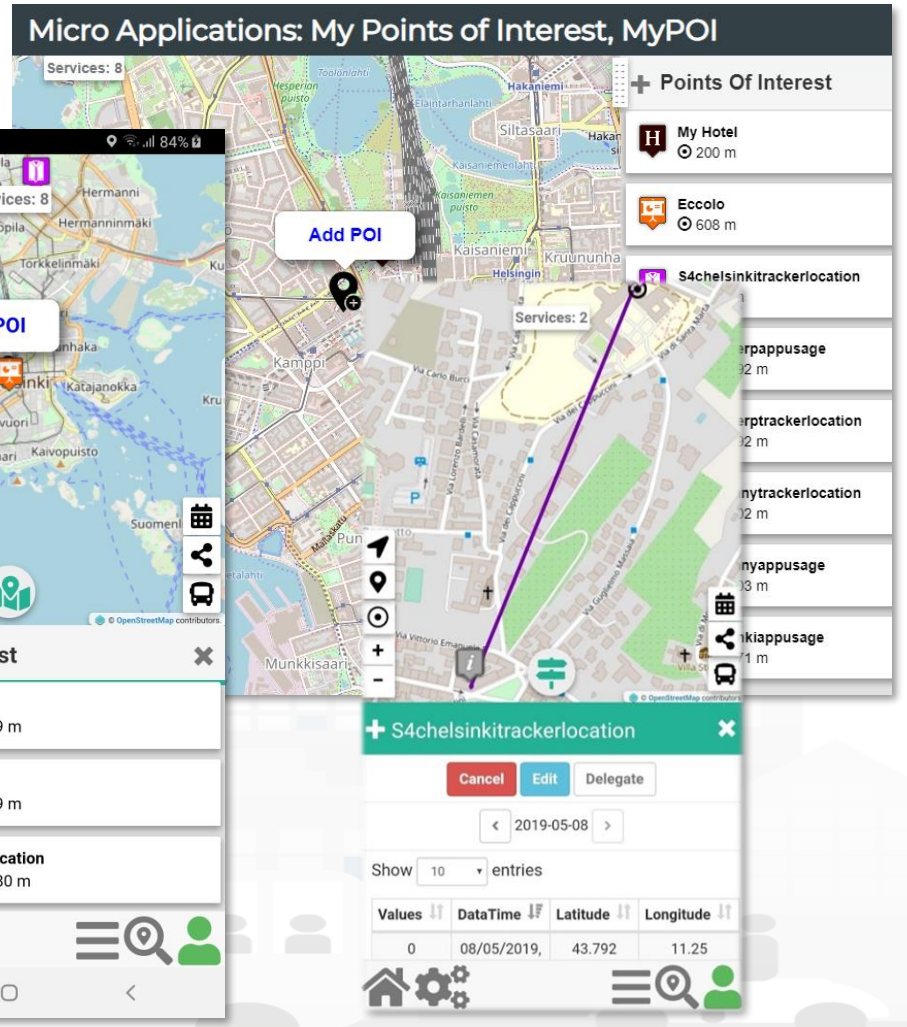
# Smart Bench Data Delegation



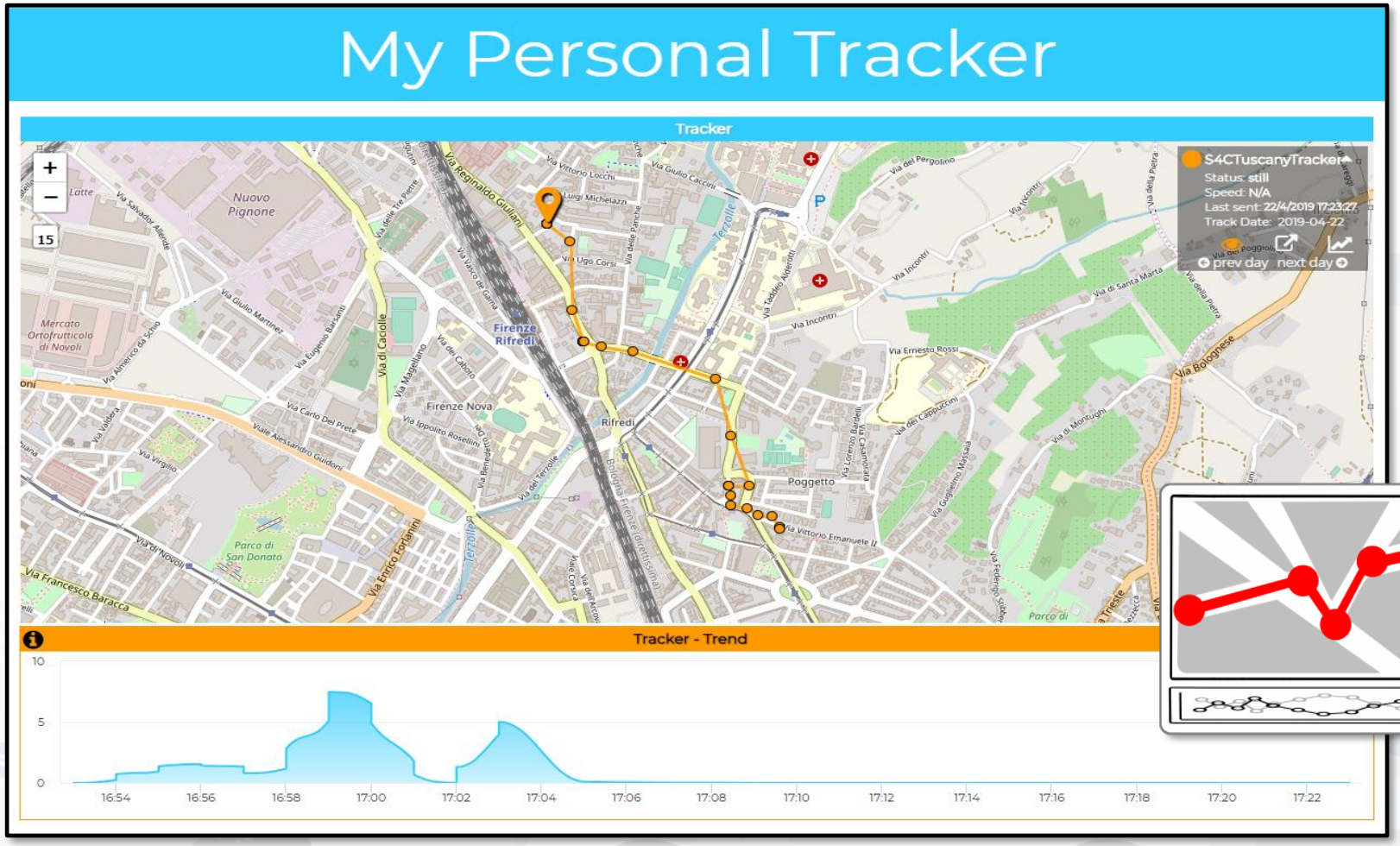



# Management of MyKPI, MyPOI, …



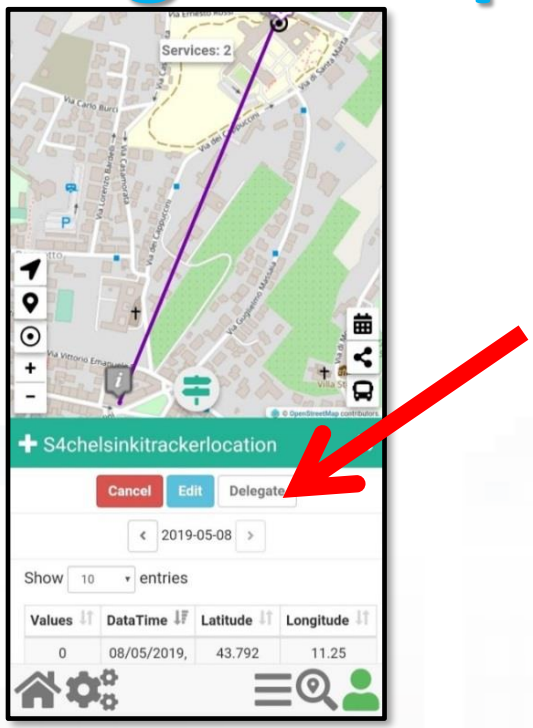



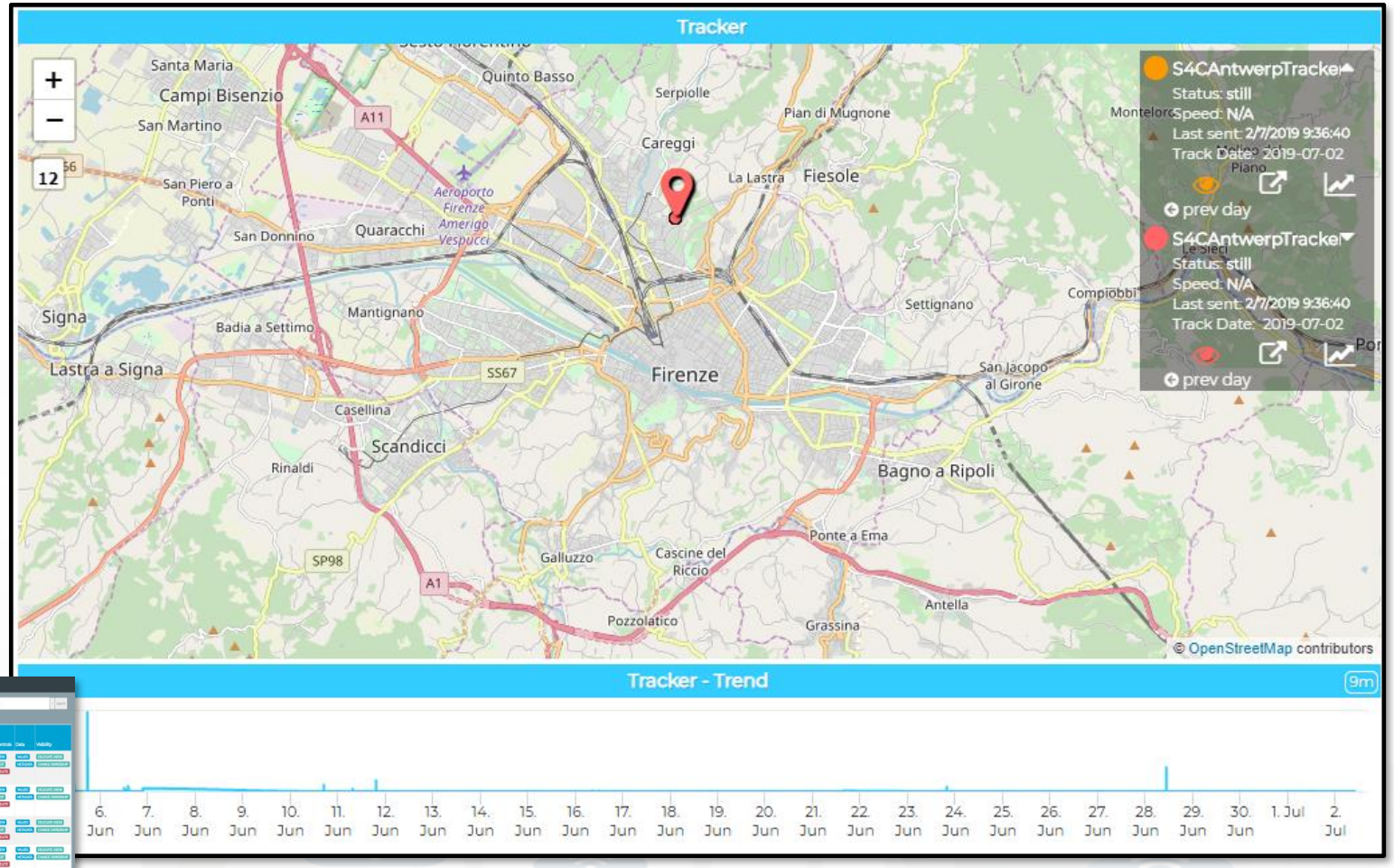
# Recalling Exercize number 3



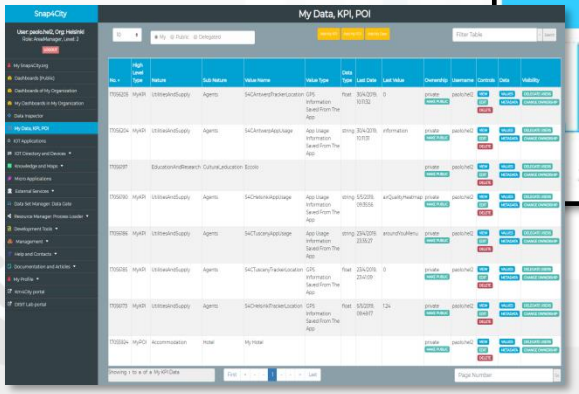



# Accessing Multiple Trajectories



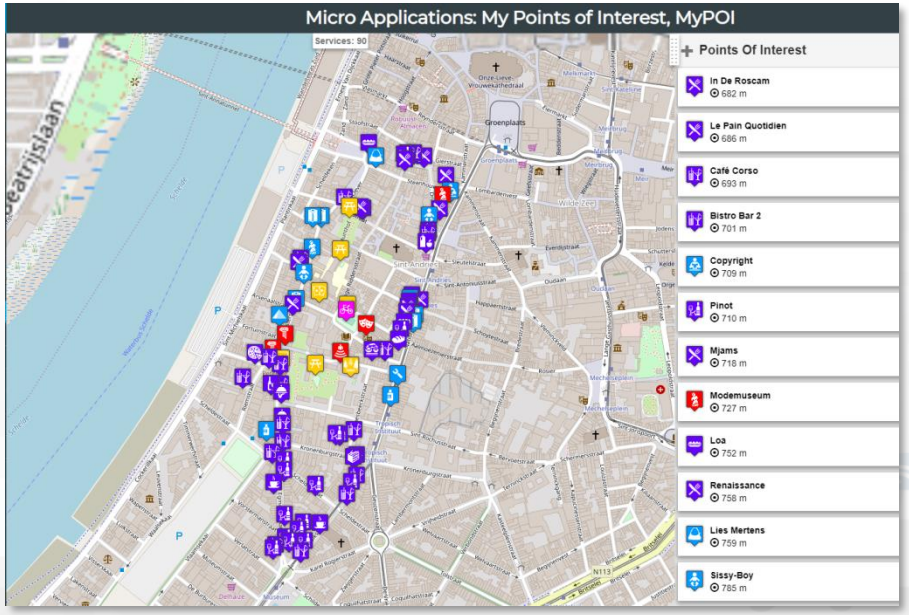



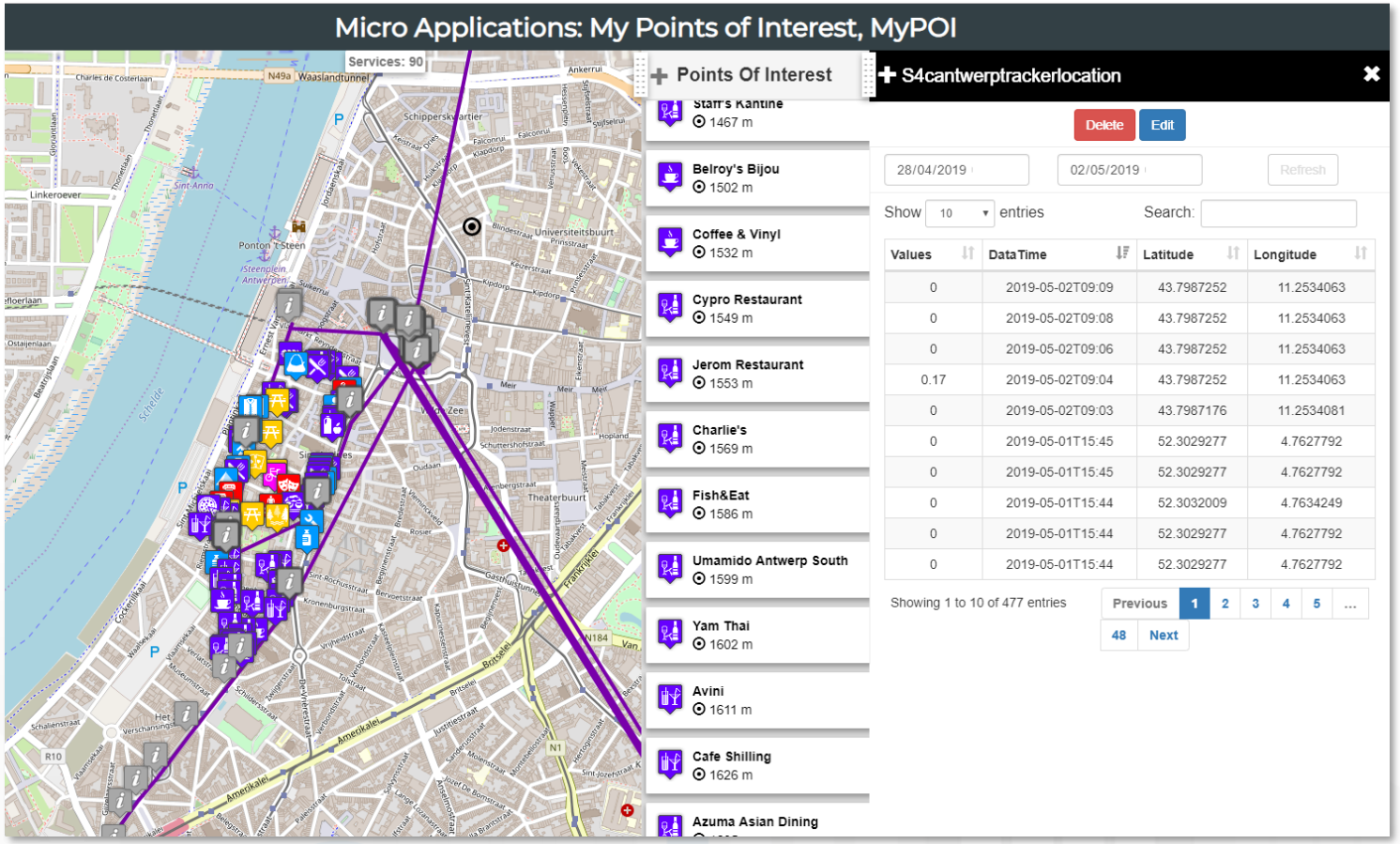

You can revoke at any instant from Web and mobile App



# MicroApplications: several new




- Personal POI, KPI, Trajectories/trips

# Advanced GDPR Aspects

- Snap4City has a model for Group of Smart City Entities that can be:
  - IOT Devices/sensors, My Data, MyKPI, Dashboards, MyPOI, …
- The user can create its own Groups
  - Each Group may contain a number of Smart City Entities
- This allows to delegate in access a complete Scenario with one delegation only. For example:
  - An user registered a set of device of an industrial plant with a 200 variables, some of them Sensors other KPI,
  - The user has also realized 10 Dashboards showing those data and some results from IOT Apps as well
  - The user can group these entities in a GROUP: for example Plant56.
  - Thus the user can delegate in access data of different kinds and Dashboards at a person producing a unique delegation action instead of performing a delegation for each entities that in this case could be hundreds. The same for revoking the access to that user.
  - This will avoid the user to remember all dependencies of a scenario, since they will be all listed. In the future these dependencies could be estimated automatically

# Dashboard GDPR Management



# Details for Main Data Kinds

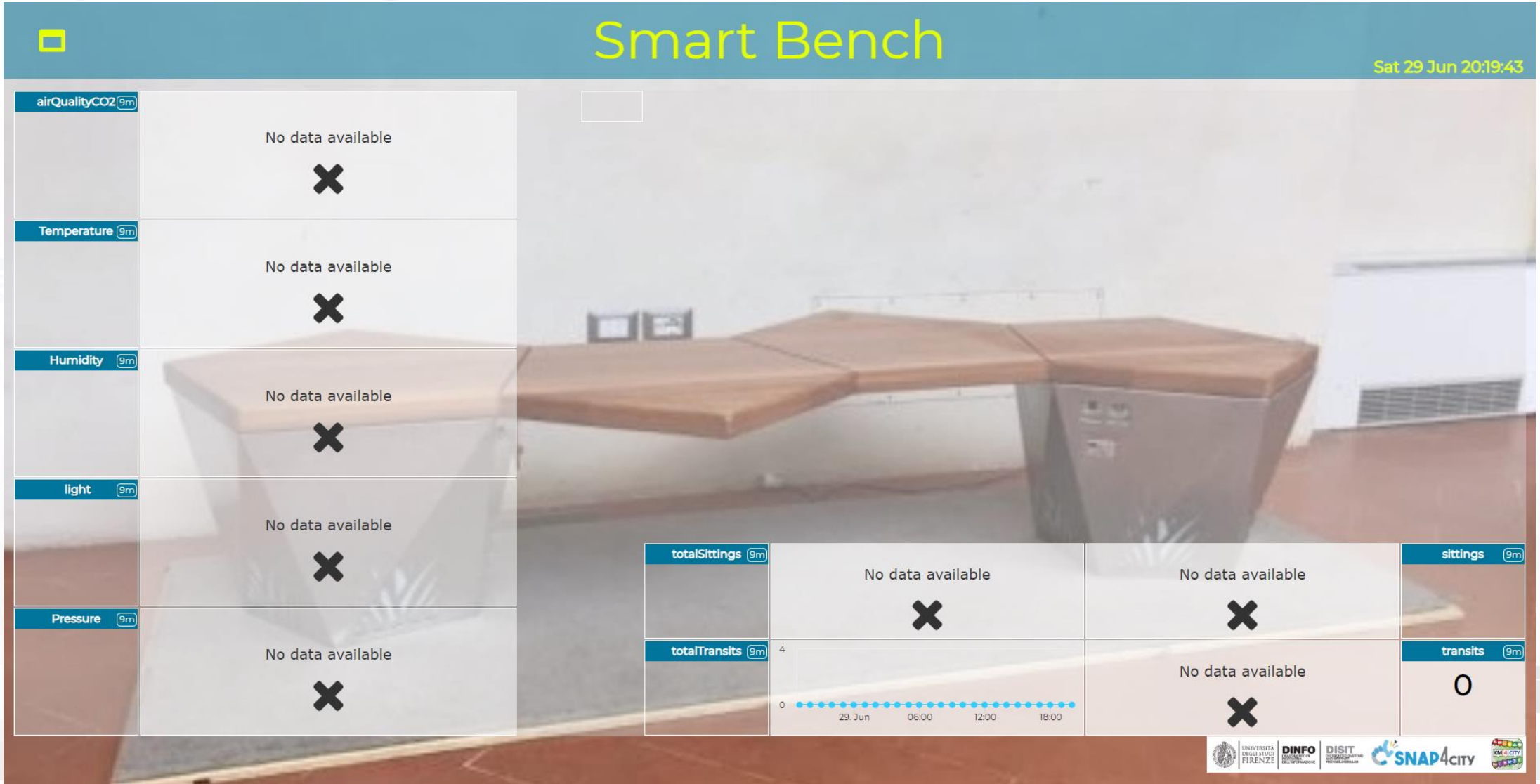
- **My Personal Data, My KPI and My POI**
  - to manage your personal MyKPI, MyPOI and trajectories, if any: view, edit, delete, delegation in access, revoke delegation, make public, change ownership
- **My Personal Engagement**
  - to manage your personal engagements received on the Mobile Apps, auditing, if any: view, delete
- **My IOT Devices**
  - to manage your IOT Devices in which it is possible to: edit, delete, make public, delegate in access, revoke delegation, change ownership
- **My IOT Applications**
  - to manage your IOT Applications in which it is possible to: delete, restart, change ownership.
- **My Dashboards**
  - to manage your Dashboards in which it is possible to: edit, delete, change ownership, delegate in access, revoke delegation, see list of delegations, make public.

# Smart Bench

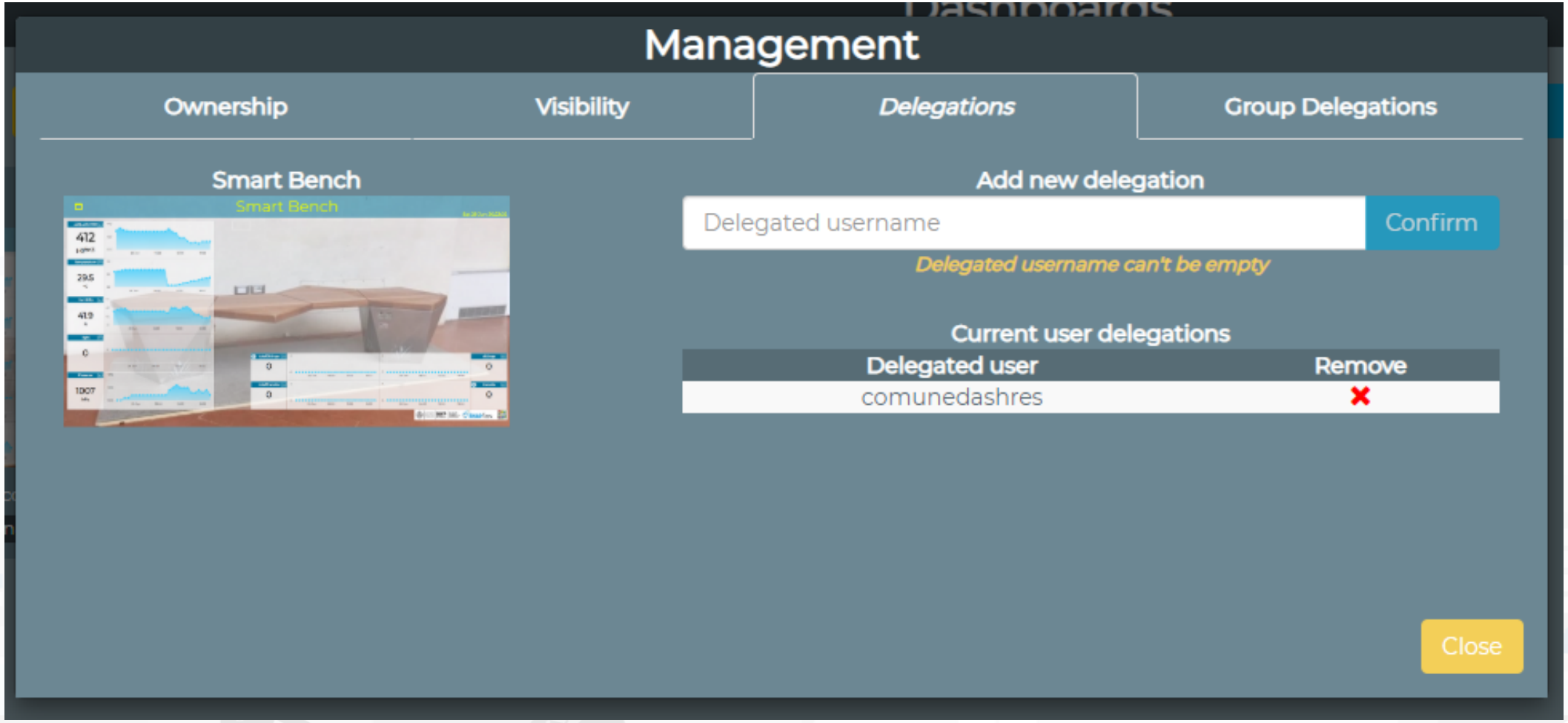
Sat 22 Jun 15:45:23



# Example: Delegated Dashboard but not all data



# Dashboard Delegation

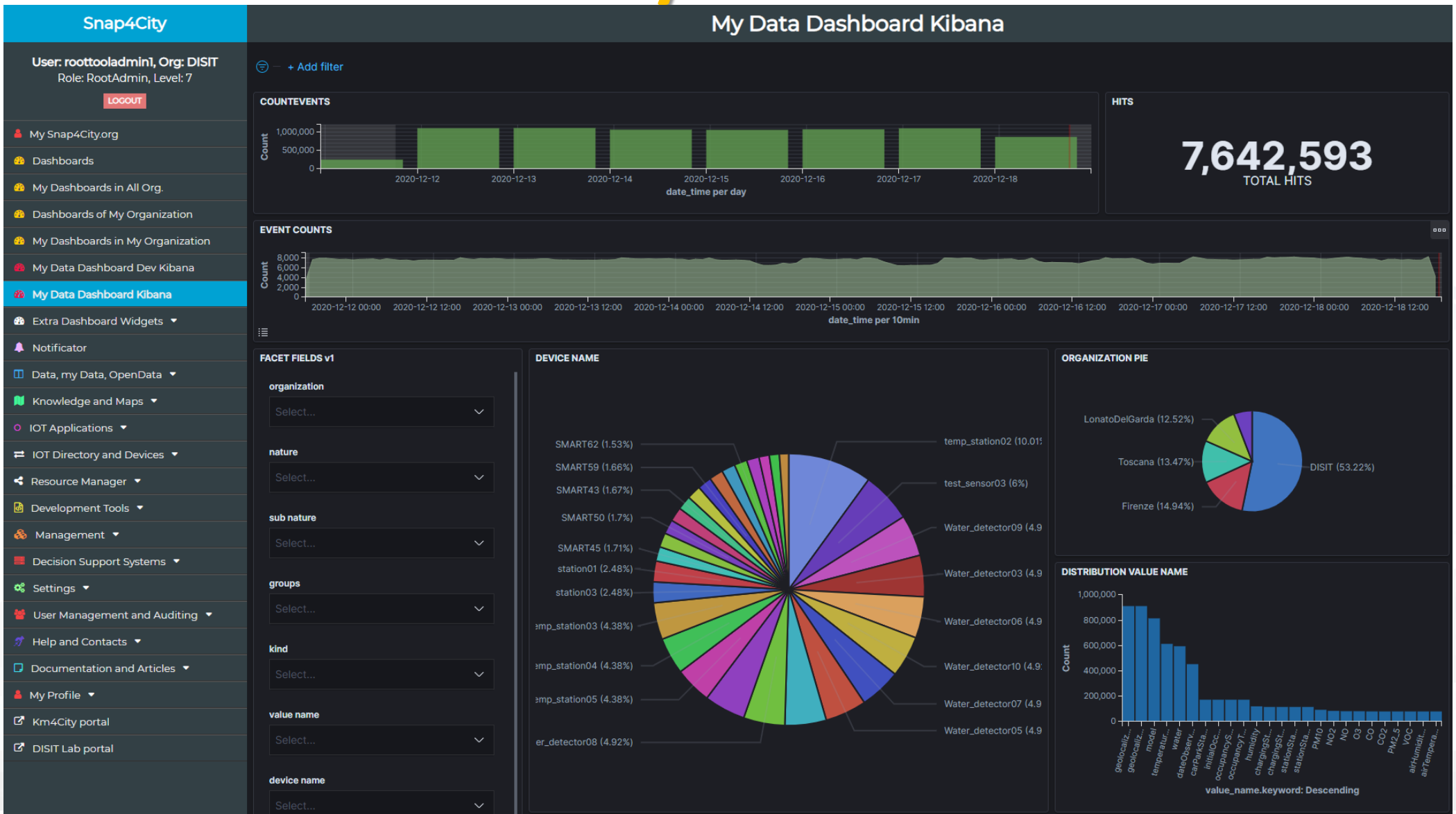


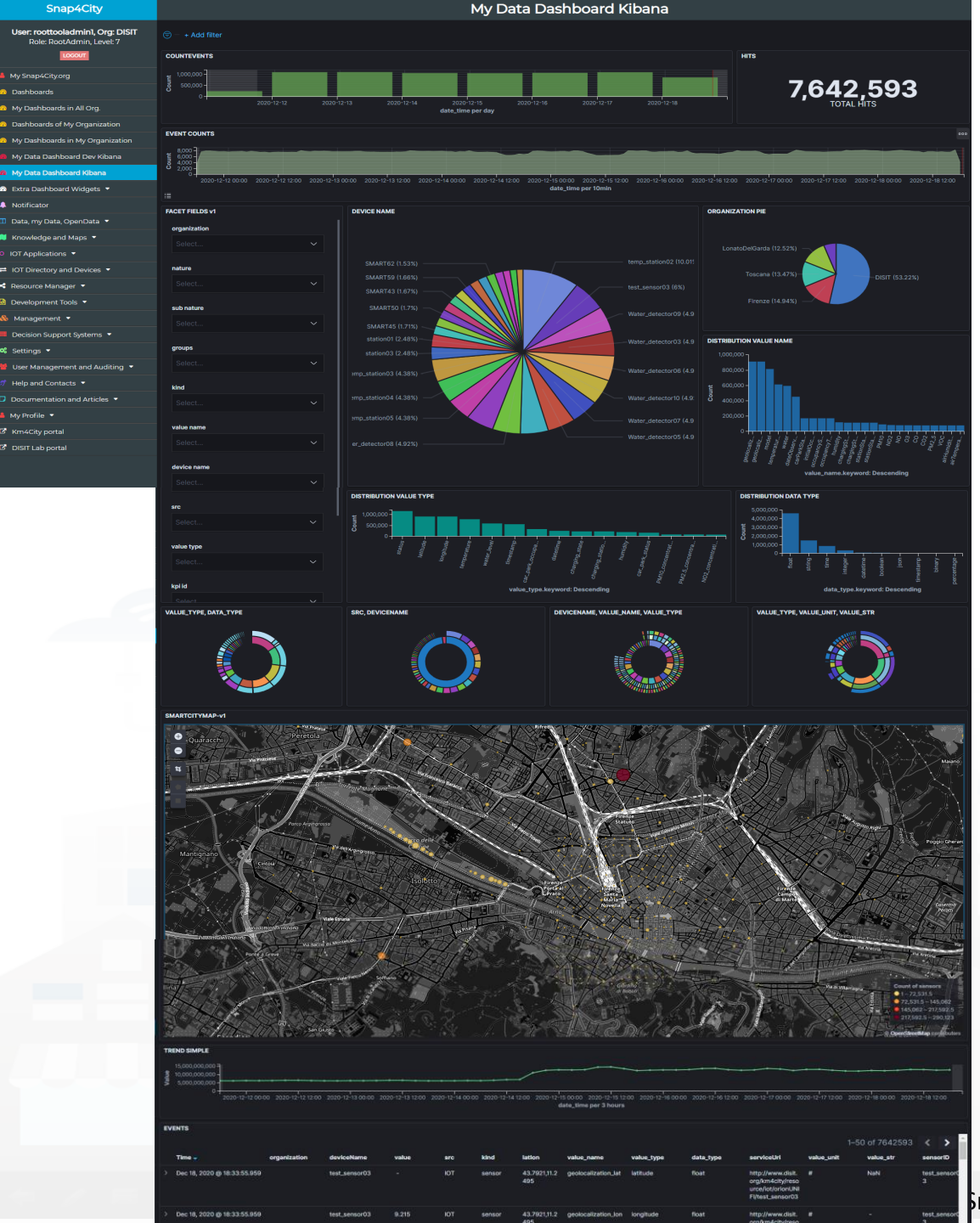
TOP

# DevDash: My Data Dashboard based on Kibana and customization



# DevDash: My Data Dashboard Kibana



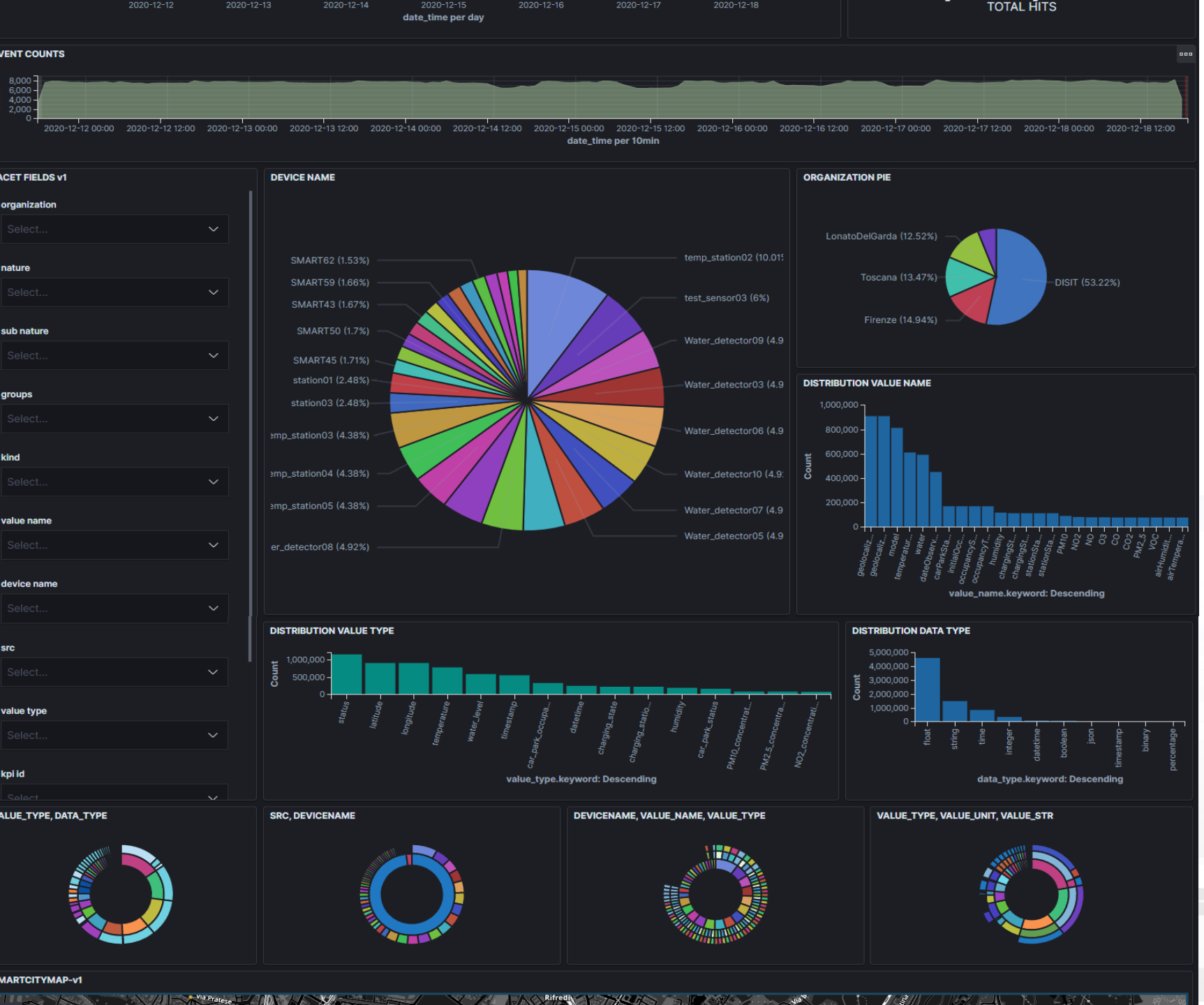



kibana

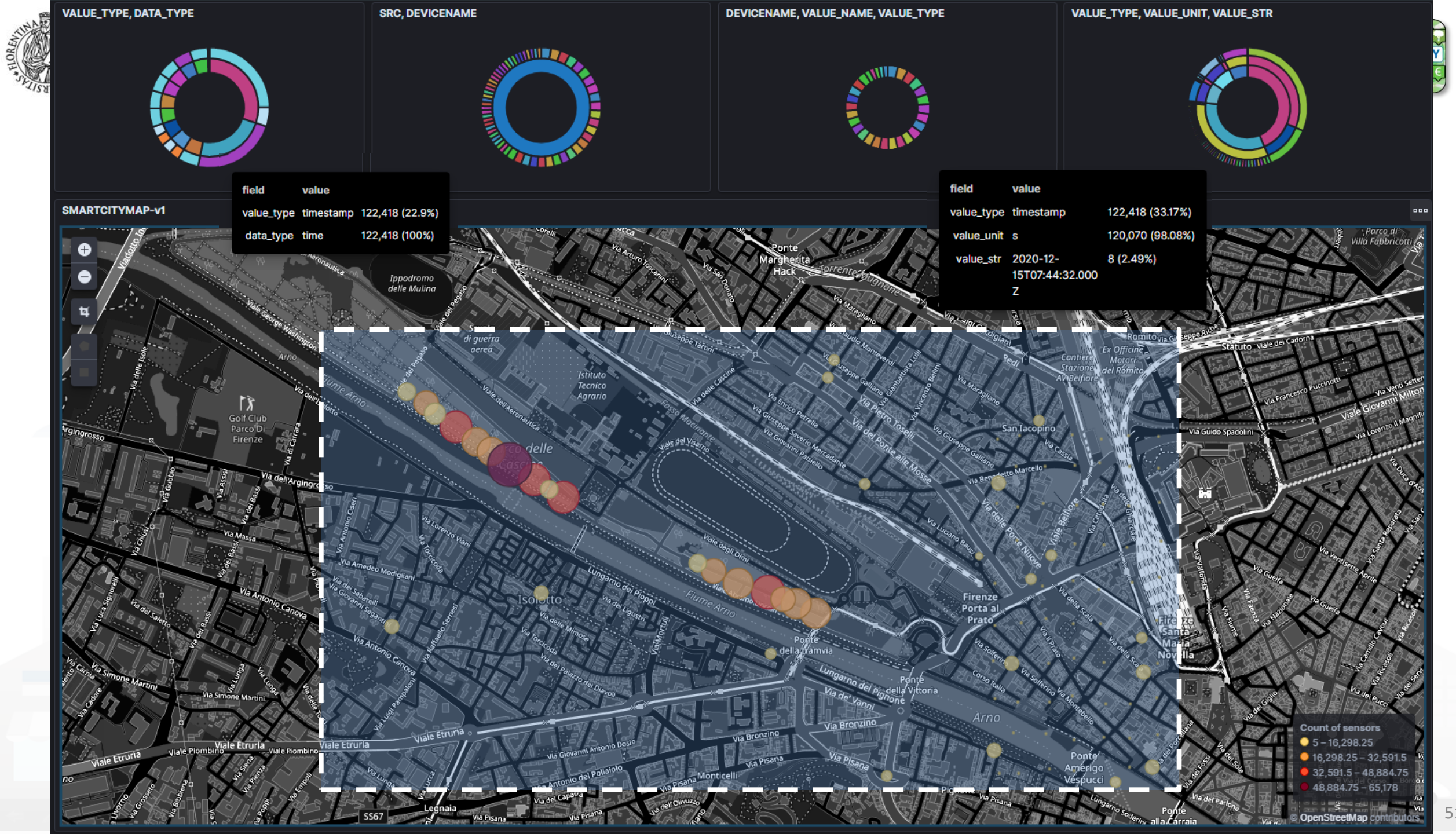
SNAP4CITY

# 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

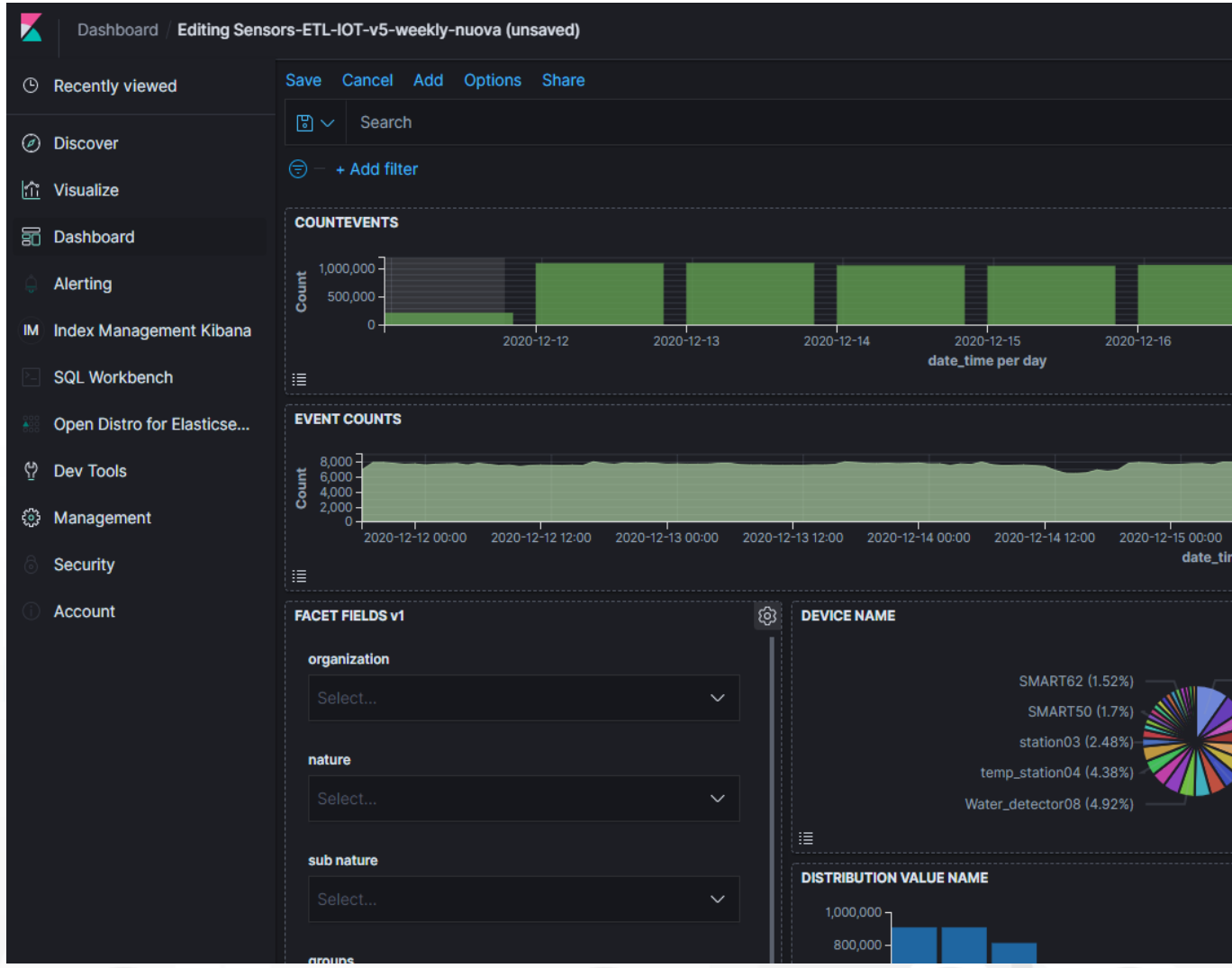



- Multi faceted Search by
  - Devices
  - Organization
  - Drill on Time
  - Drill on Map
  - Value Types
  - Data Type
  - Value name
  - Data table
  - Etc.
- Respect Privacy and GDPR


VALUE_TYPE, DATA_TYPE
SRC, DEVICENAME
DEVICENAME, VALUE_NAME, VALUE_TYPE
VALUE_TYPE, VALUE_UNIT, VALUE_STR
field value
value_type timestamp 122,418 (22.9%)
data_type time 122,418 (100%)
field value
value_type timestamp 122,418 (33.17%)
value_unit s 120,070 (98.08%)
value_str 2020-12-15T07:44:32.000Z 8 (2.49%)
SMARTCITYMAP-v1
Count of sensors
5 – 16,298.25
16,298.25 – 32,591.5
32,591.5 – 48,884.75
48,884.75 – 65,178
© OpenStreetMap contributors

# 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 OpenDistro (Kibana Elastic Search 7.1), and with multiple indexes of Snap4City



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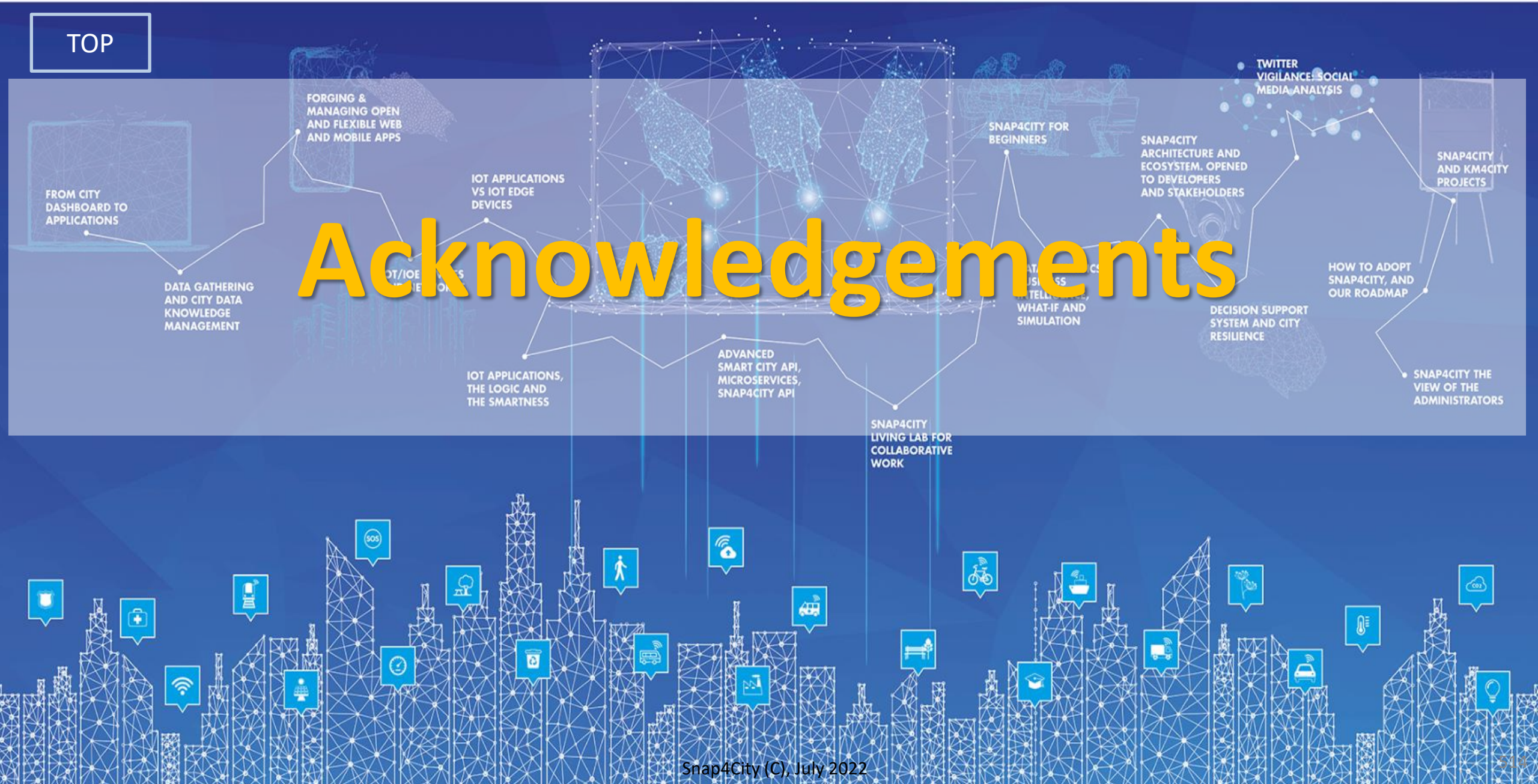



# Acknowledgements

# DISIT lab roadmap vs model and tools' usage

## 2013
Km4City Ontology 1.1

- Tuscany, Road Graph
- Mobility
- culture, tourism
- Events
- Parking
- Services
- Linked open graph

## 2014
- Weather Forecast
- Real Time Wi-Fi
- Entertainment
- LOD

- Twitter Vigilance
- Social Media Analytics, Sentiment Analysis

Km4City 1.4

## 2015
Km4City 1.5

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

ckan, resolute, H2020 (2015-18)

## 2016
(2016-21) H2020 REPLICATE

Km4City 1.6.4

- Smart Energy
- Sustainable Mobility
- Control Room
- Dashboard

Km4City 1.6.2

Sii-Mobility (2016-21) MIUR

SII-MOBILITY SCN

- Infomobility
- Mobile App
- Routing
- Multimodality

FIWARE

Km4City 1.5

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

## 2017
Sii-Mobility

- Origin-Destination and trajectories
- Traffic Reconstruction
- Offer Analysis
- OBU, smart devices

E0I5 digital ecosystem (Powered by EXPO MILANO 2015)

(2016-19) MIUR GHOST SIR

- Sardinia Region Smart City Strategies and plan

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

GREEN IMPACT
POR FESR 2014-2020

- Industry 4.0
- Critical Plant
- Monitoring

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

life weee (2017-20)

- Smart Waste

## 2018
MOSAiC Mobility 4.0 for SmArt (i) City (2018-20)

- Mobility Demand / Offer Analytics and Strategy

Sii-Mobility

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

IOT/IOE

Km4City 1.6.6

Node-RED

SNAP4CITY SELECT for Cities H2020 (2017-19)

## 2019
5G (2018-21)

- 5G tech
- Energy
- Industry 4.0
- Synoptics

TRAFAIR CEF (2018-21)

- Traffic and Mobility Impact on Pollution
- NOX predictions

EUROPEAN OPEN SCIENCE CLOUD

SIRIUS

LAID Smart Bed

- Smart Health

GREEN FIELD PEAS Soda4.0 Optimization and Automated Decision System 4.0

- Industry 4.0

bee smart city

- Smart Lonato

Reverberi Enetec Gruppo MPES

SNAP4CITY

Winner of Select4Cities PCP



# SNAP4CITY roadmap

SODA

## 2020

JRC EUROPEAN COMMISSION

Interreg Mediterranean HERIT-DATA

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

Interreg MARITTIMO-IT FR-MARITIME MOBI MART

- Smart Mobility
- PISA, PUMS
- Living lab

## 2021

JRC EUROPEAN COMMISSION

PC4City (2020-21)
Monitoring Terrain

Winner of Open Data Challenge of enel x

CAPELON

- Smart Light
- Sweden

Km4City 1.6.7

enel x
Contract

Smart Ambulance (2021-22)

Enterprise (2021-22)
Industry 4.0

Almafluida
Industry 4.0
(2021-22)

AMPERE (2021-22)
Industry 4.0

SYN-RG-AI
SmartCity

Smartea

ITALFERR GRUPPO FERROVIE DELLO STATO ITALIANE
Smart City

ASYMMETRICA URBAN TECHNOLOGY
Smart City

## 2022

AXIS COMMUNICATIONS
SmartCity

uni.systems
SmartCity

GRUPPO PRETTO
Industry 4.0

IMPETUS
Security and Risk

enel x
Contract

Filippi
Contract

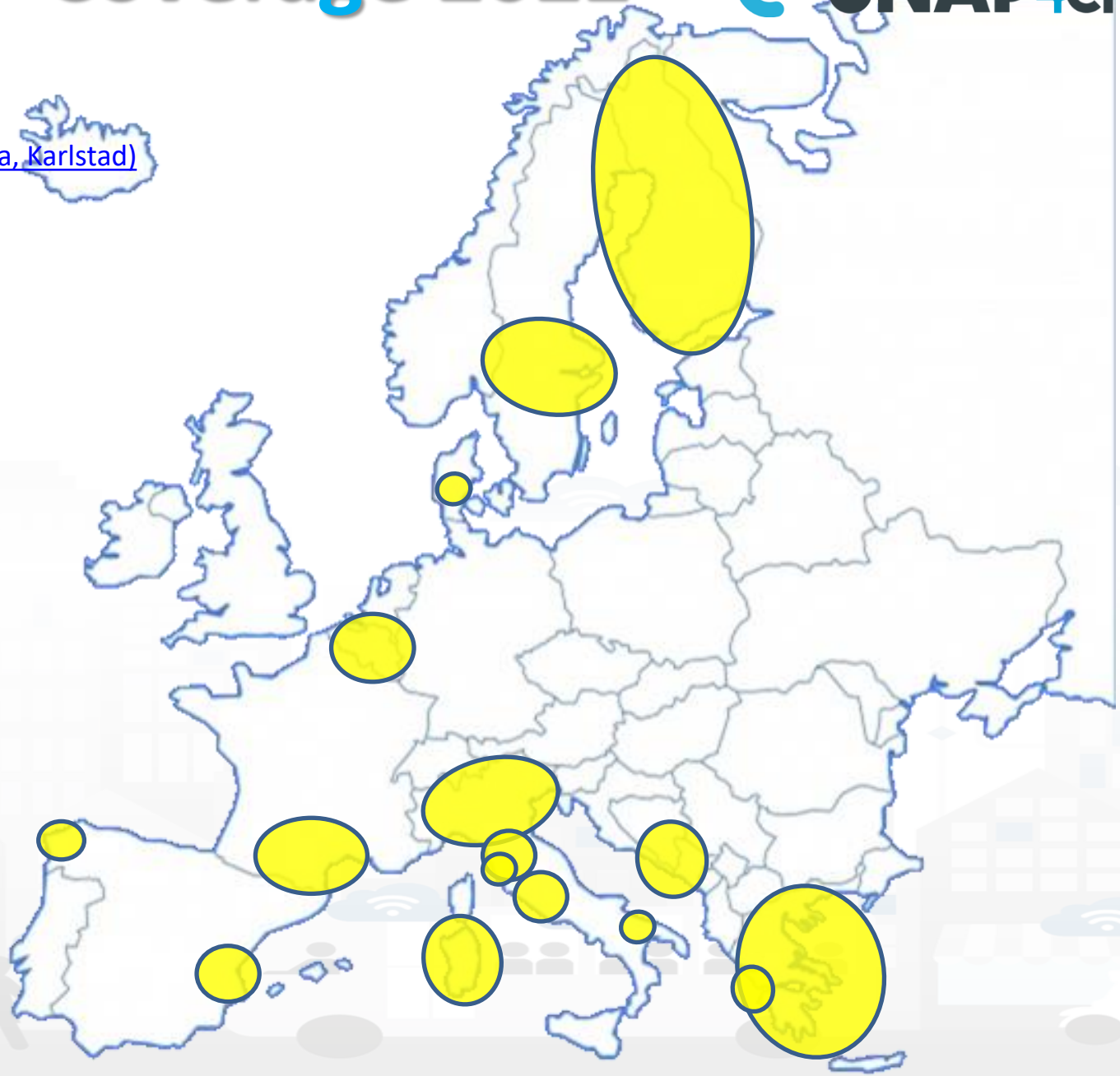
ART-ER ATTRATTIVITÀ RICERCA TERRITORIO
Contract

Some agreements

# Coverage 2022

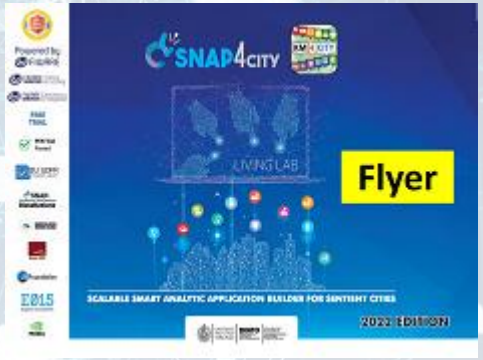
**Main Organizations/areas**

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



# 2022 booklets

- Snap4City



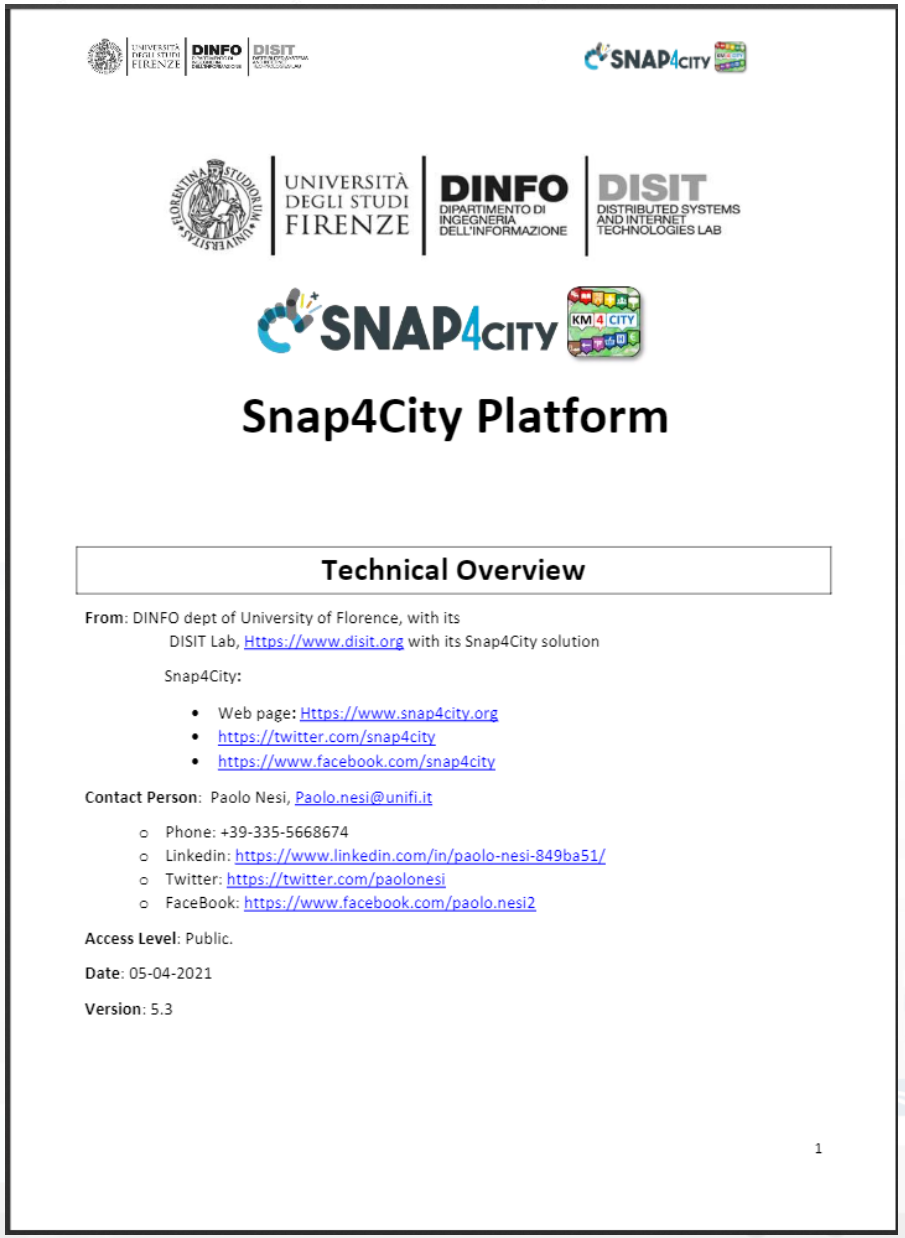

https://www.snap4city.org/download/video/DPL_SNAP4CITY_2022-v02.pdf

- Snap4Industry




https://www.snap4city.org/download/video/DPL_SNAP4INDUSTRY_2022-v03.pdf

# Overview



Snap4City Platform

Technical Overview

From: DINFO dept of University of Florence, with its
DISIT Lab, Https://www.disit.org with its Snap4City solution

Snap4City:

- Web page: Https://www.snap4city.org
- https://twitter.com/snap4city
- https://www.facebook.com/snap4city

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

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

Access Level: Public.

Date: 05-04-2021

Version: 5.3

1

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

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# Main running instances (11/21)

- 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, SMARTEA
- 5G → Industry 4.0 vs SmartCity
- Green Impact → Industry 4.0, Chemical Plant, control and plan
- SmartBed (Laid) → smart health
- Green Field Peas (Soda) → Industry 4.0, Chemical plant
- MobiMart and PISA Agreement → data aggregation, mobility and transport, 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
- PC4City → land slide monitoring and predictions
- Italmatic → industry 4.0 production control

# Acknowledgements


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

https://www.snap4city.org/577

## On Line Training Material (free of charge)

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

TOP

SNAP4CITY

KM 4 CITY

*Be smart in a SNAP!*




SNAP4
Appliances and Dockers
**Installations**

**CONTACT**

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