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

SNAP4CITY

Powered by KM4CITY

# Smart City and BIM

https://www.Snap4City.org

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https://www.Km4City.org
https://www.disit.org

# Requirements and Objectives

- Serve as a **City Dashboard**, **App User Interface**, etc.
  - Real time and historical data, any device, sensors and actuators
  - Sensors, KPI, maps, data trends, real time data, charts, etc.
  - Multi domain, smart city + industry 4.0 scenarious
- Referral / **historical data, and Open Data**:
  - shadow, access (API, storage, any protocol), production of OD, export
- **Data Driven Real Time communication &** processing:
  - IOT Applications, IOT edge, multiple operating systems, embedded systems, **MicroServices**
  - in/out data driven from/to the field into: applications, notifications, etc.
- **Data Analytics**: Machine Learning, statistics, reasoning, …
- **Serve as Living Lab**: open innovation, co-working; collaborative work; sharing: data, processes, dashboard, experiences, solutions, ….
- Experimented on **large scale cases**

# Non functional requirements

- **Open Source** based 100%
  - any **Standard**
- **Multi tenant:** to cope with multiple organization with a single installation
- **Scalable, Robust, Distributed** and Decoupled, modular, Service Oriented, open to external services and data sets, big data
- **Heterogeneous**: any device, private and public, custom and..
- **Security** by Design: HTTPS, TLS, … compliant with EC
- **User Centric** Design: privacy by Design (and **GDPR**), personalized, personal data management, ...

# 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

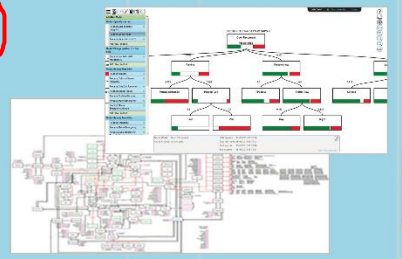
E015 digital ecosystem

NVIDIA

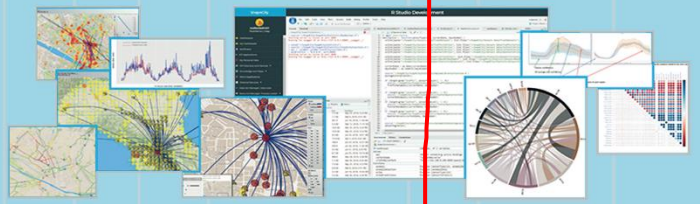


DASHBOARDS AND APPS - CONTROL ROOMS - DECISION SUPPORT SYSTEMS - WHAT-IF ANALYSIS - VISUAL ANALYTICS

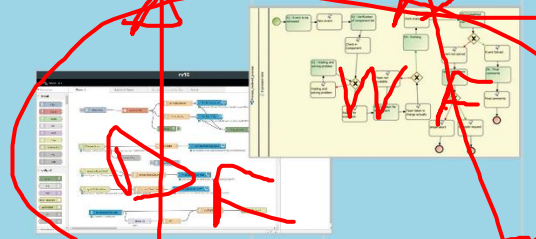
PREDICTION - ANOMALY DETECTION - ENVIRONMENTAL MODEL - 3D MODEL
KPI - SIMULATION - EARLY WARNING - SYNOPTIC - DIGITAL TWIN - VIRTUAL REALITY



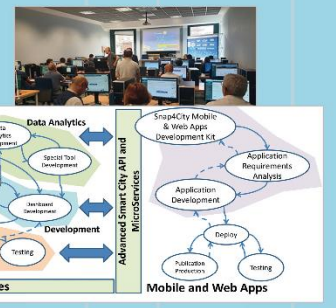
EXPERT SYSTEM
KNOWLEDGE BASE
STORAGE



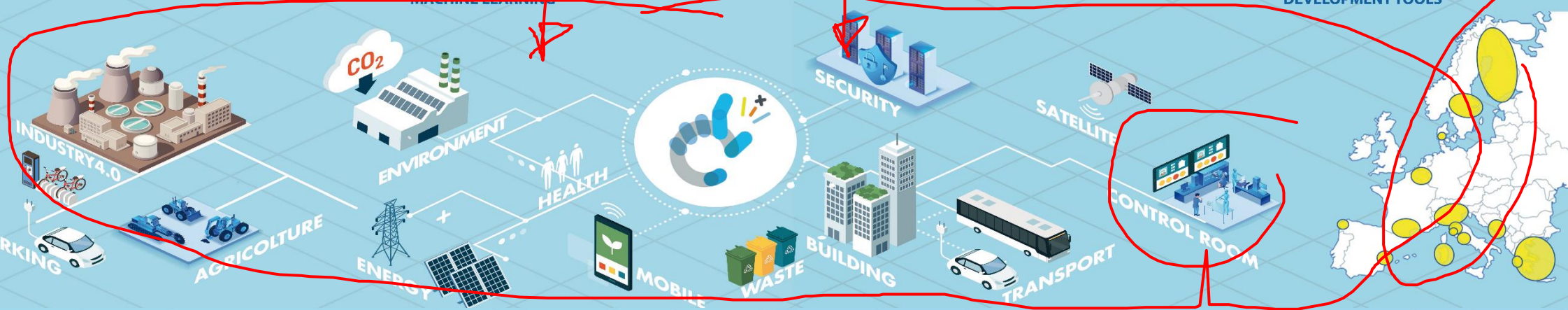
BIG DATA ANALYTICS
EXPLAINABLE ARTIFICIAL INTELLIGENCE
BUSINESS INTELLIGENCE
MACHINE LEARNING



DATA FLOWS, DATA DRIVEN
WORKFLOWS, MICROSERVICES
PARALLEL DISTRIBUTED PROCESSING

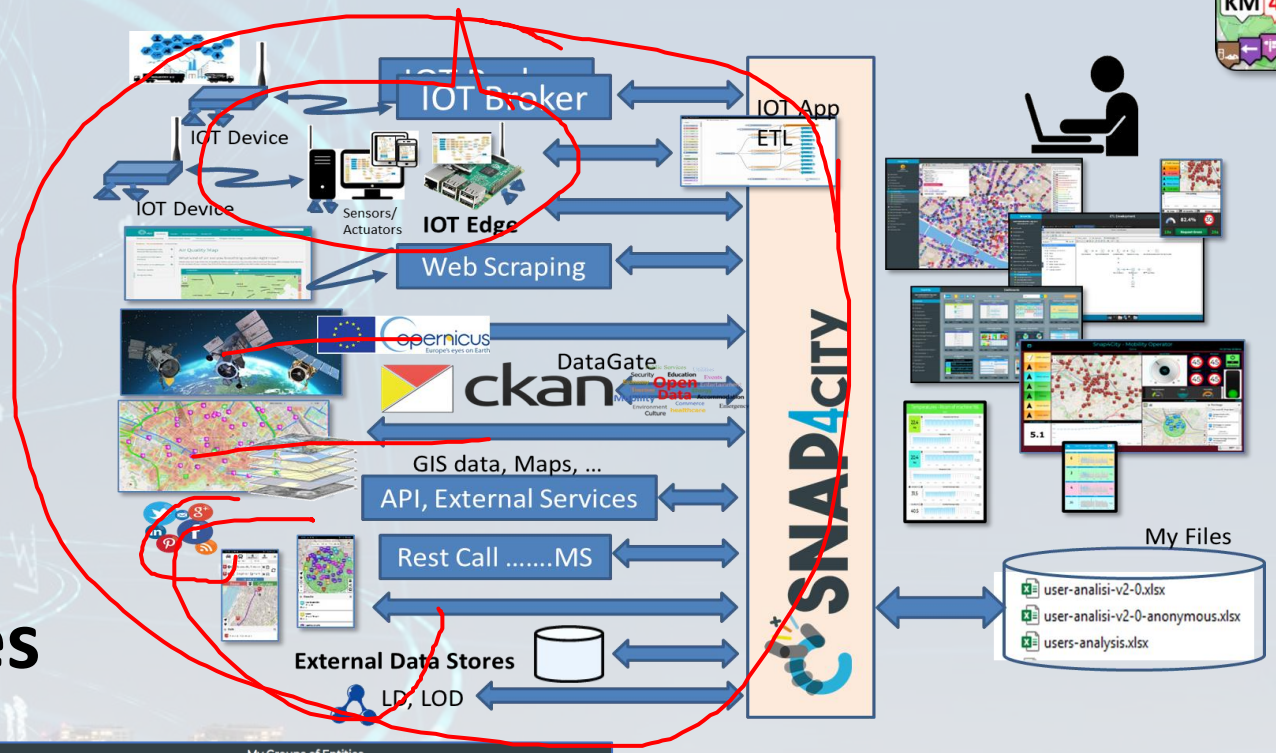


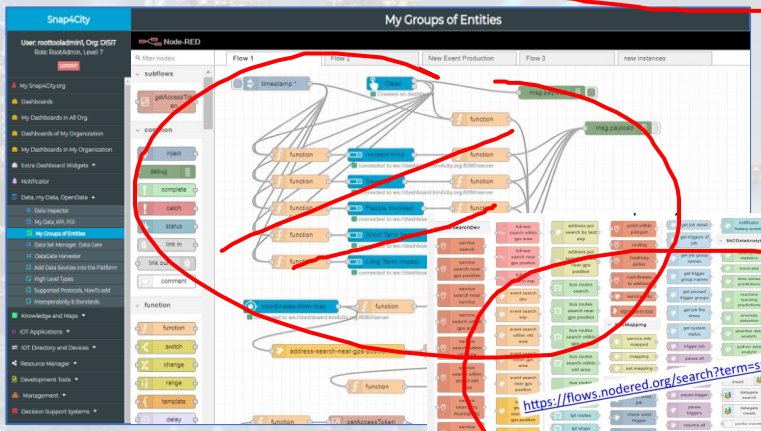

METHODOLOGIES
LIVING LABS
COURSES AND COMMUNITY
DEVELOPMENT TOOLS

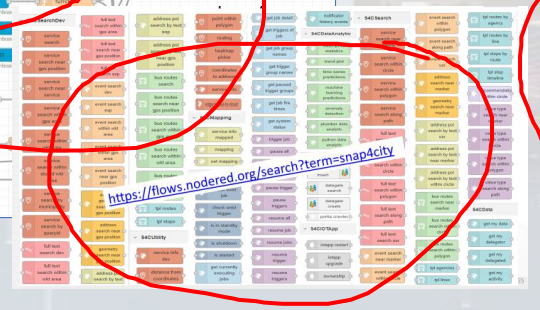


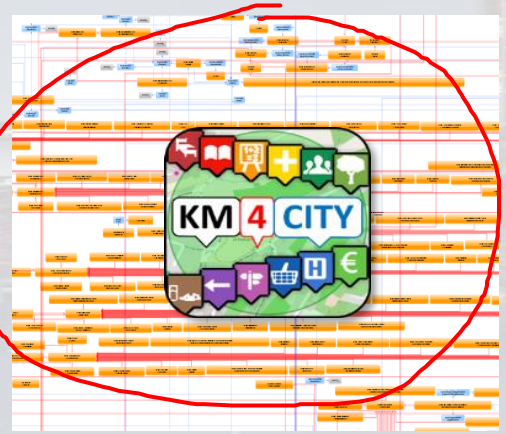
# *Ingestion, aggregation → exploitation*

- **Snap4City efficient tools for**
  - Bidirectional data channels
  - Any format, any channel, any data, any broker, any protocol, …
  - **Km4City** Knowledge base Ontology reasoning on geo, space, time, relationships
- **Expert System semantic queries accessible via**:
  - **Smart City API** for Apps and third party
  - **MicroServices** data driven develop via visual language Node-RED



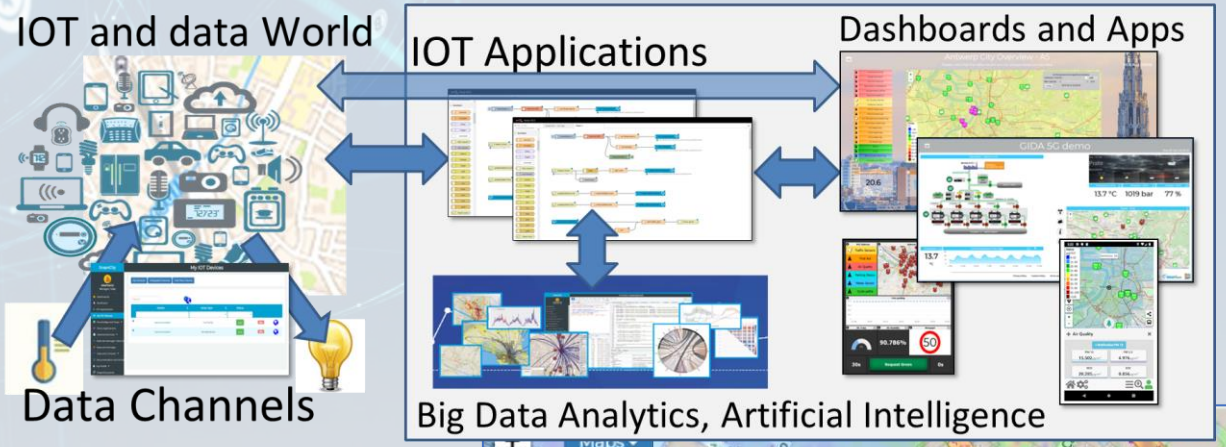



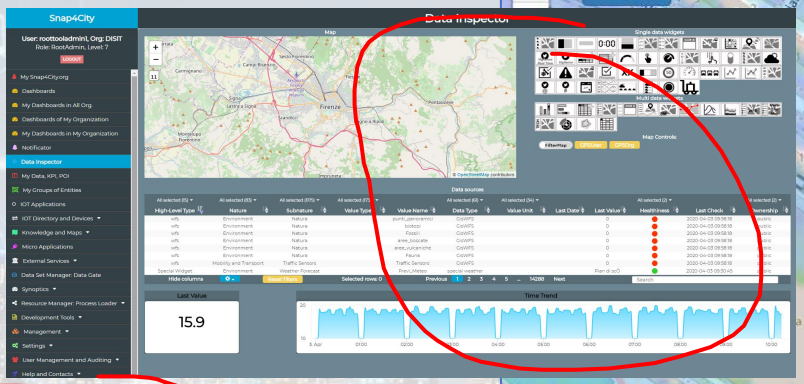



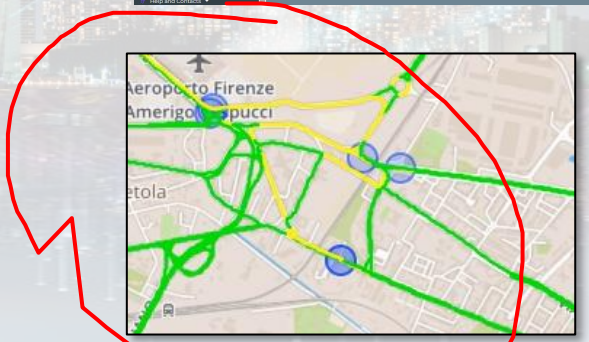
# Solutions: reliable, secure and fast to realize

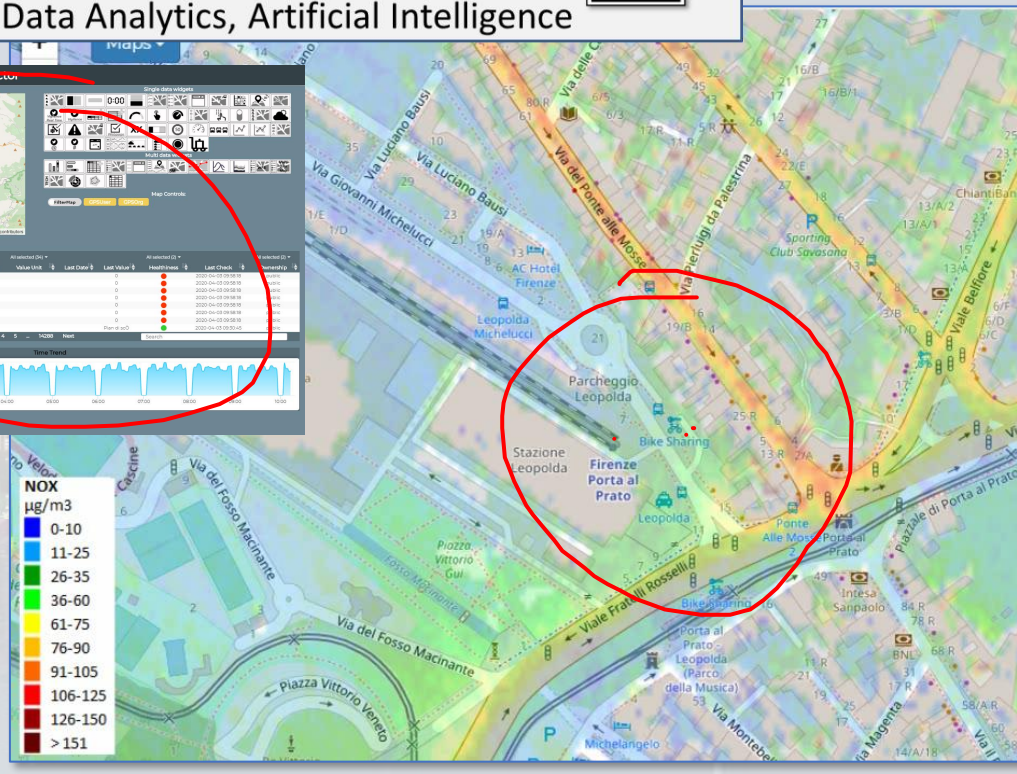
- **Via Snap4City tools**
  - **Dashboard Wizard**
  - **Dashboard Builder**
  - **Data/Visual Analytic**

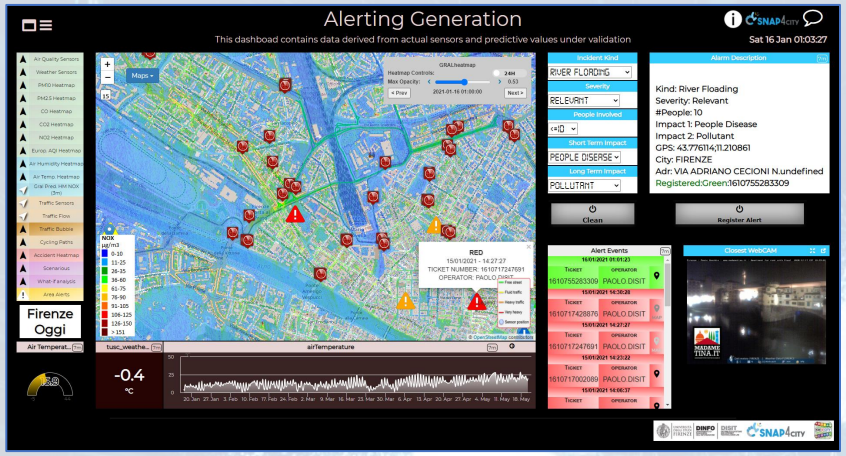
- **Smart Solutions results to be**
  - **Real time data drive**
  - **Secure end-to-end**
  - **GDPR compliant**
  - **Reliable, interoperable**
  - **Auditable, marketable**

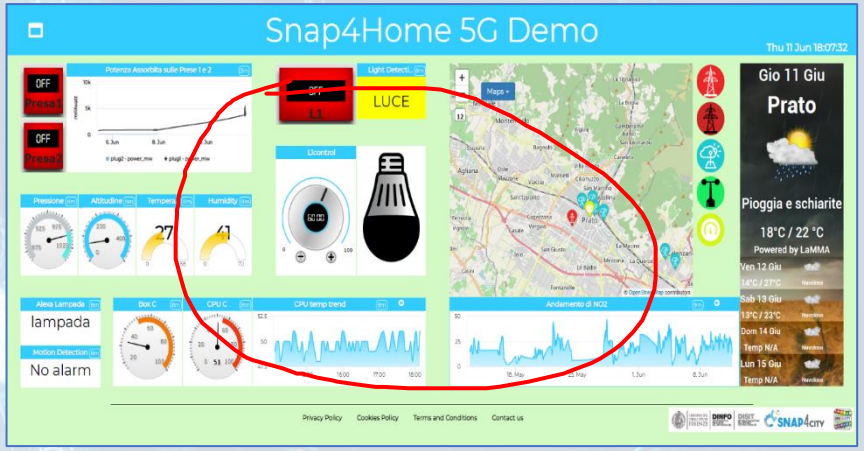


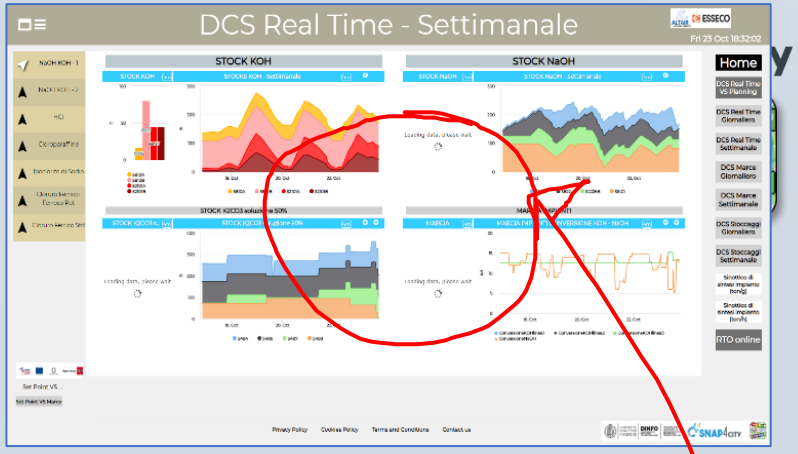



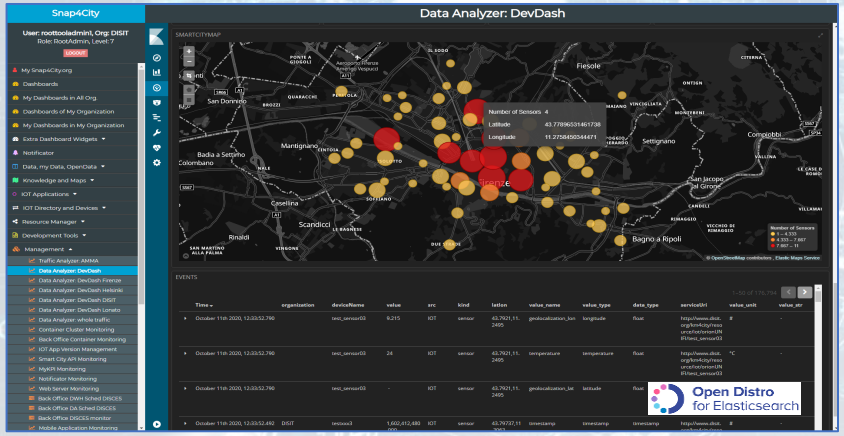



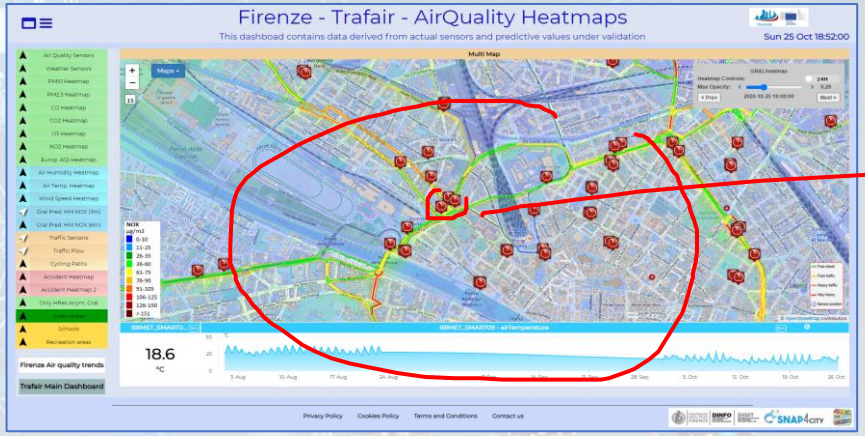


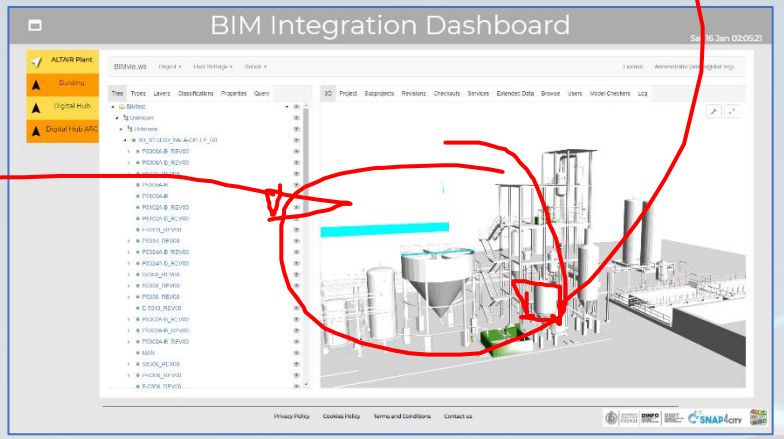

Alerting Generation
This dashboad contains data derived from actual sensors and predictive values under validation
Sat 16 Jan 01:03:27
Firenze Oggi
-0.4

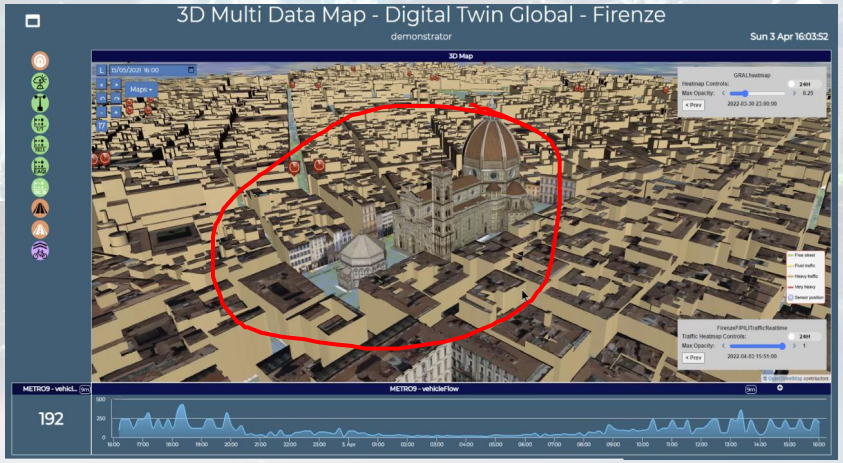

Snap4Home 5G Demo
Thu 11 Jun 18:07:32
LUCE
lampada
No alarm
Gio 11 Giu
Prato
Pioggia e schiarite
18°C / 22 °C

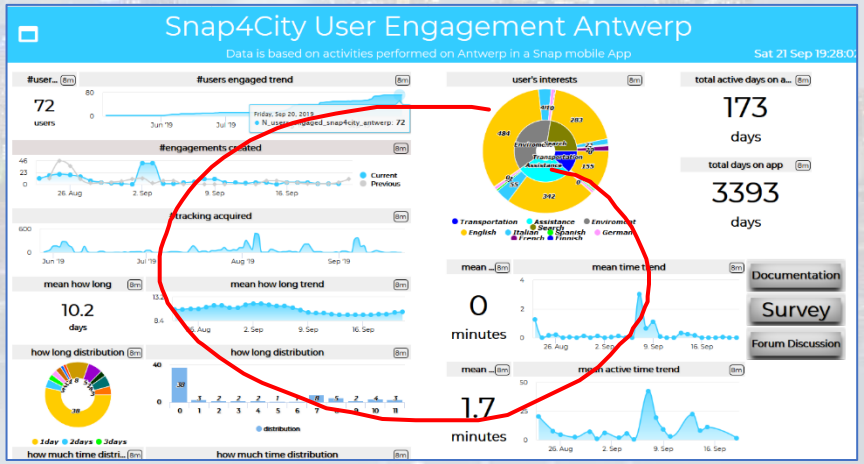

DCS Real Time - Settimanale
Fri 23 Oct 18:32:02
STOCK KOH
STOCK NaOH

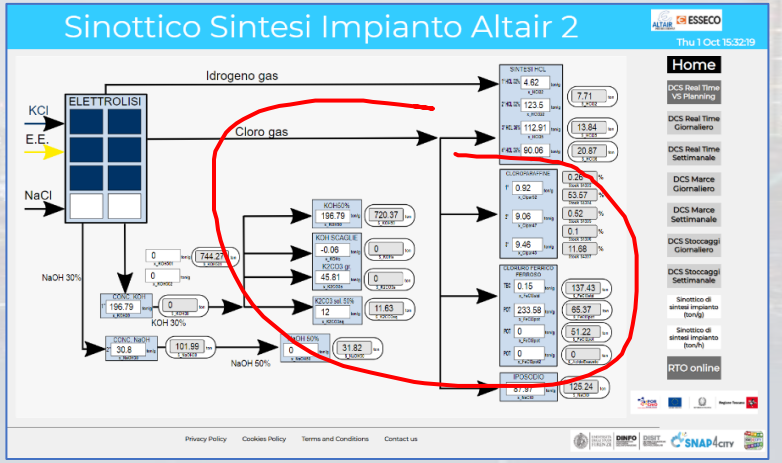

Data Analyzer: DevDash
Open Distro for Elasticsearch


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


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
10.2
days
0
minutes
1.7
minutes
Documentation
Survey
Forum Discussion

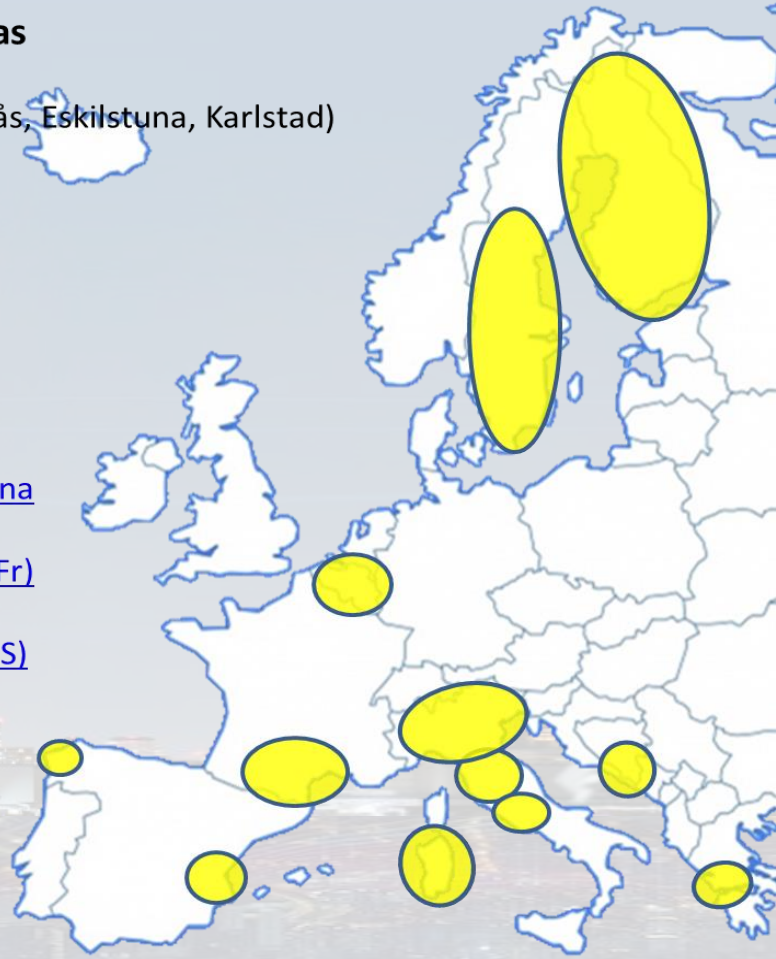

Sinottico Sintesi Impianto Altair 2
Thu 1 Oct 15:32:19
Idrogeno gas
Cloro gas
ELETTROLISI
KCl
E.E.
NaCl
NaOH 30%
KOH 30%
NaOH 50%

# 2021: Snap4City/Industry Numbers

- ***Domains**: mobility, energy, people flow, environment, Industry 4.0, vehicle tracking, Tourism,*
  - *smart park, smart waste, smart bed, smart ambulance, smart light, etc…*
  - *Predictions, simulations, anomaly detection, ..*
- 5 running installations, 13 projects, 12 pilots, 9 Countries
- > 100 Protocols
- **Scalable from vertical to large deploy**
- **On the largest deploy** https://www.Snap4City.org
  - 17 Organizations / tenant
  - > 80 applications on: cities, areas, scenarios
  - > 4800 users
  - > 1200 Dashboards
  - > 15 mobile Apps
  - > 2 Million of structured data per day in the larger deploy
  - > 500 IoT Applications/node-RED /Docker
  - > 680 web pages with training
  - > 40 videos, training videos

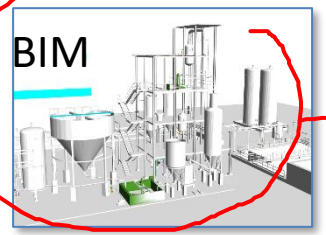
**Main Organizations/areas**

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



# Concept

BIM

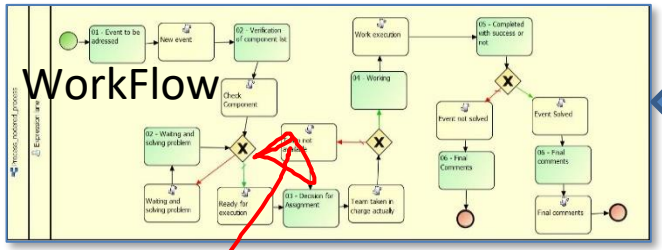


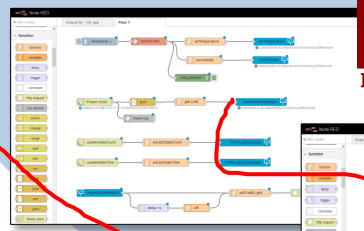
KPI, POI, MyKPI, ...

API, External Services

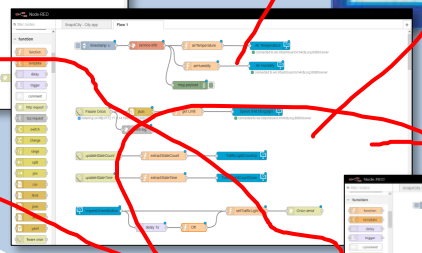
Web Scraping

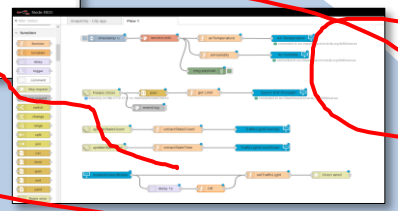
WorkFlow



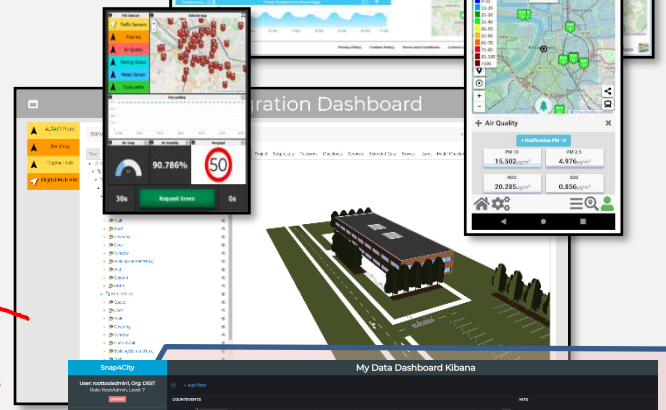


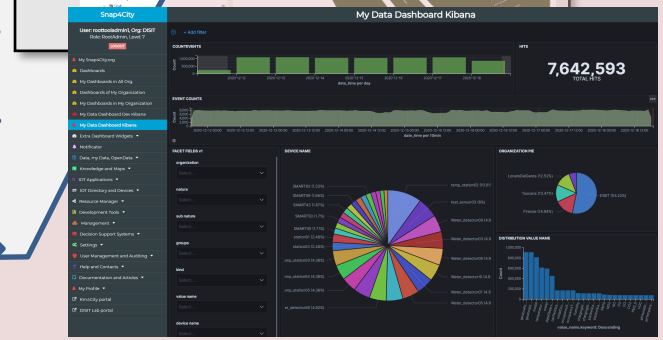
Node-RED





Data Analytics,
Artificial Intelligence





IOT Brokers

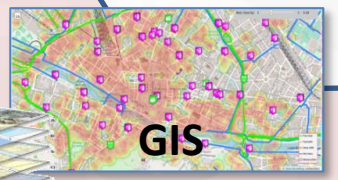
IOT Broker

IOT Broker

IOT Apps

FIWARE

ckan



GIS

Big Data

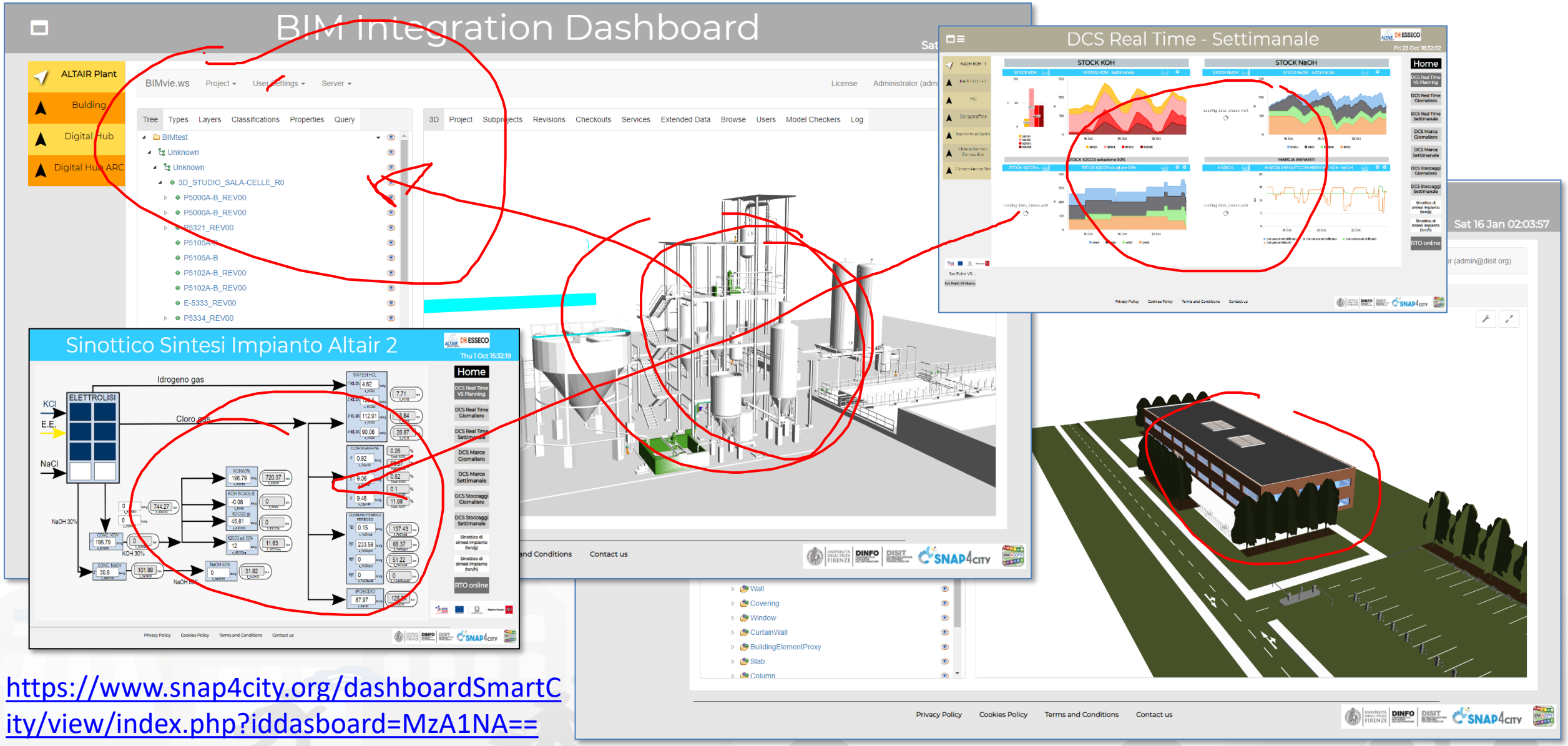
KB

LD, LOD

Dashboards and Apps

FI-WARE

# BIM Server




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

# Smart City Functional Architecture

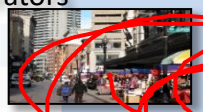
Transport systems
Mobility, parking

Public Services,
Govern, events, …

Sensors, IOT Cameras,
Wi-Fi

Environment, Water,
energy

Shops, services,
operators



Social Media

Social Media Crawler and Manager

Data Sources, External Services
*PULL Data*

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

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

Back-End

Front-End

Knowledge base
Semantic Reasoners

Indexing and aggregating
NiFi, OpenSearch

Federation

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

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

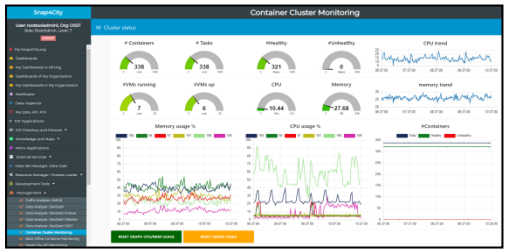
IOT Applications, Business Logic
Node-RED + Snap4City MicroServices

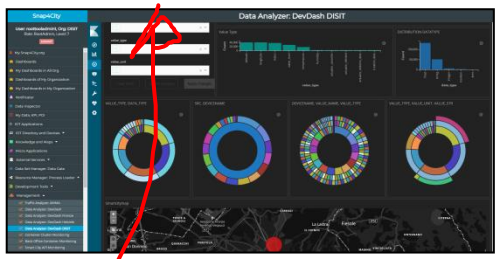
Rendering Acting, Widgets, Synoptics, MicroApps
User interface, Drill down, maps, heatmaps

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

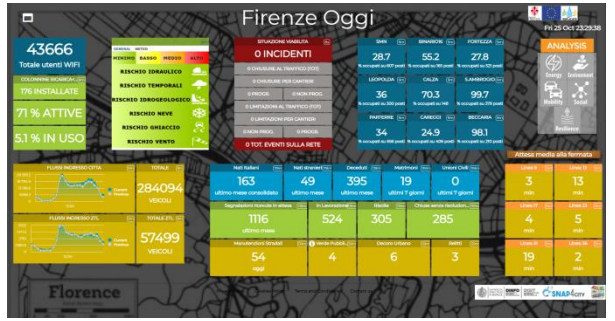
Authentication, Authorization, Platform & Processes Management, Data Inspector, Digital Twin, …

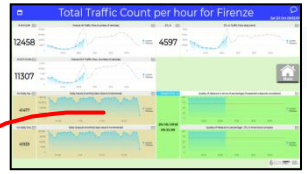
Back office tool

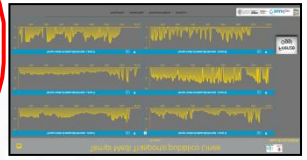




Dashboards, visual tools,
Web and Mobile Apps



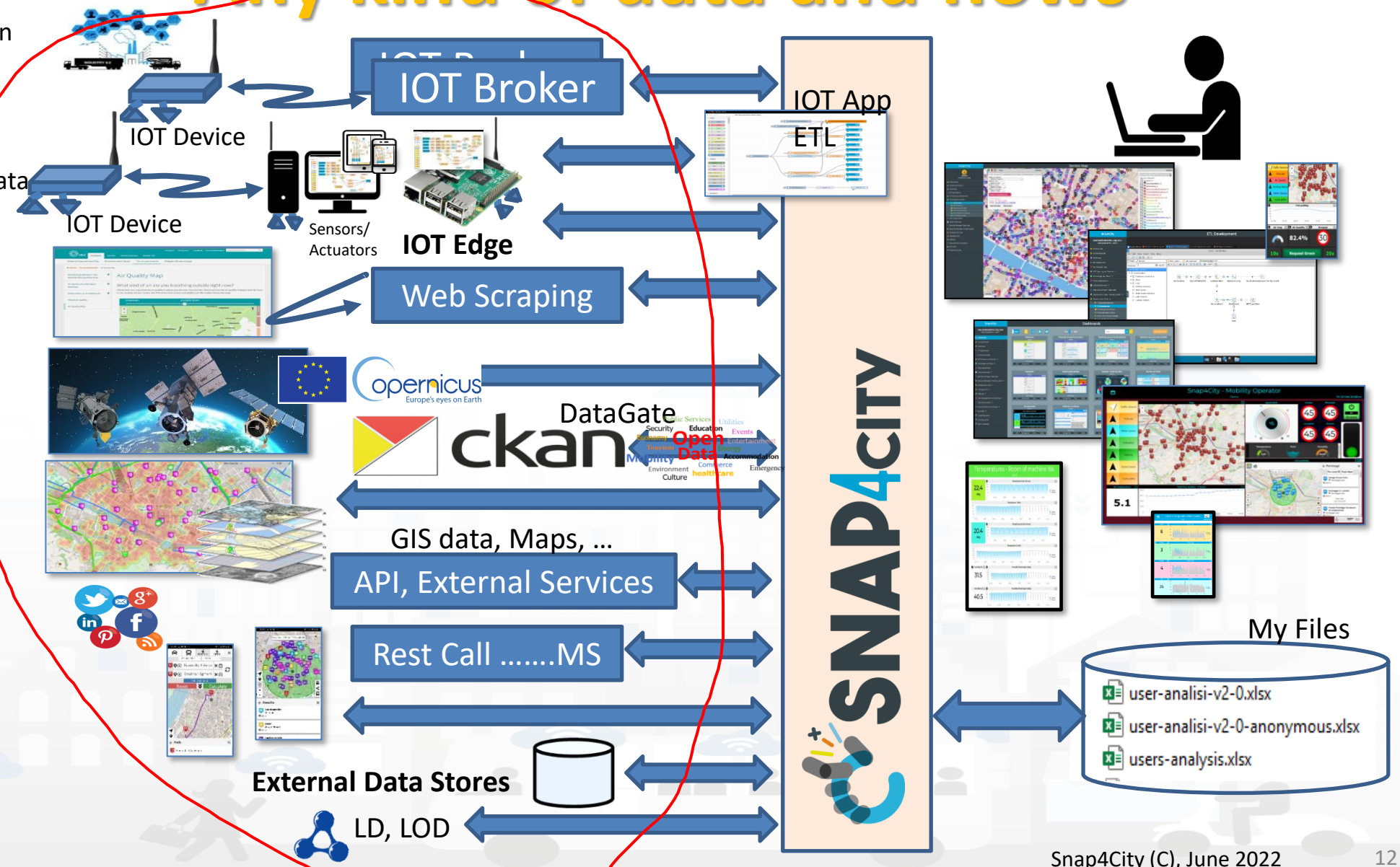







# Any kind of data and flows

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



# Standards and Interoperability (5/2022)

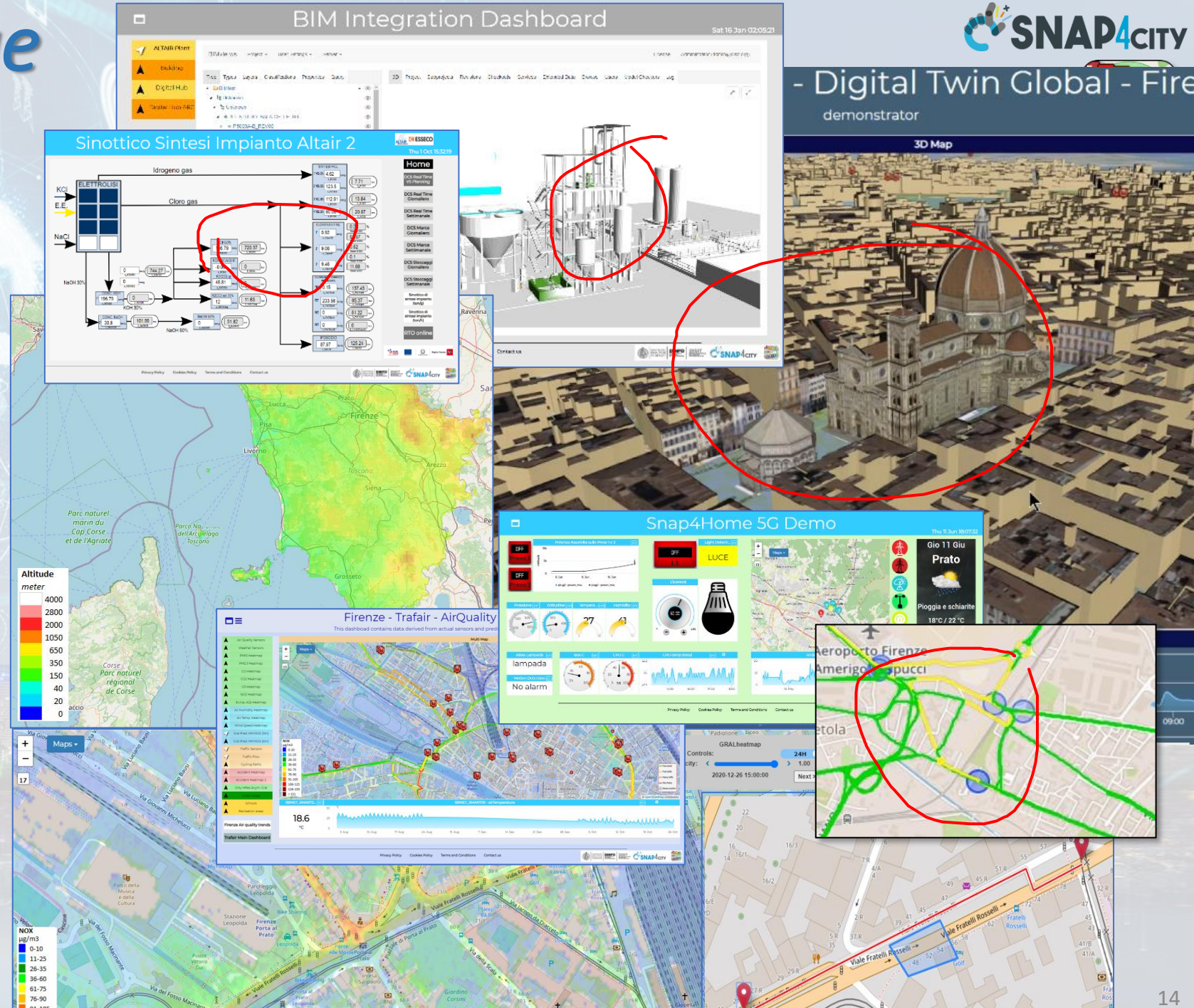
**Compliant with:**

- **IOT:** NGSI V2/LD, LoRa, LoRaWan, MQTT, AMQP, COAP, OneM2M, TheThingsNetwork, SigFOX, Libelium, IBIMET/IBE, Enocean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Protocol Buffer, KNX, ..
- **General**: HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, SOAP, WSDL, FTP, FTPS, WebSocket, WebSocket Secure, GML, WFS, WMS, RTSP, ONVIF, AXIS TVCam, CISCO Meraki, OSM, Copernicus, The Weather Channel, Open Weather, OLAP, ….
- **Formats**: JSON, GeoJSON, XML, CSV, GeoTIFF, OWL, WKT, KML, SHP, db, XLS, XLSX, TXT, HTML, CSS, SVG, IFC, XPDL, OSM, Enfuser FMI, …
- **Database**: Open Search, MySQL, Mongo, HBASE, SOLR, SPARQL, ODBC, JDBC, Elastic Search, Phoenix, OBD2, PostGres, MS Azure, ..
- **Industry**: OPC/OPC-UA, OLAP, ModBUS, RS485, RS232,..
- **Mobility**: DATEX, GTFS, Transmodel, ETSI, ..
- **Social**:Twitter, FaceBook, Telegram, ..
- **Events**: SMS, EMAIL, CAP, RSS Feed, ..
- **OS**: Linux, Windows, Android, Raspberry Pi, Local File System, ESP32, etc.

https://www.snap4city.org/65

# Data Type Coverage

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

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# KB, ServiceMap

TOP

# Some complete Use Cases


100% OPEN SOURCE

SNAP4 Appliances and Dockers **Installations**

# *Florence*

# Smart City Control Room
## Florence Metropolitan City

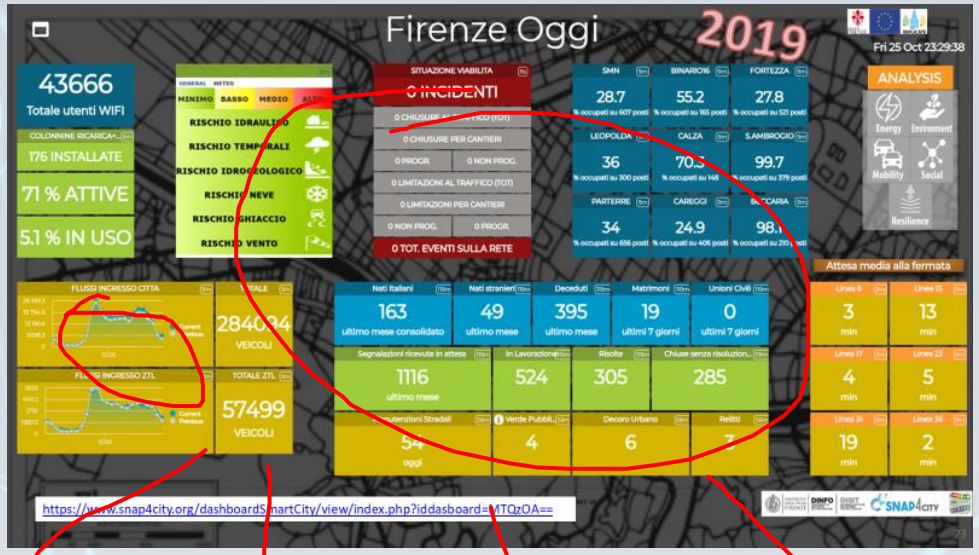
COMUNE DI FIRENZE

reference

SNAP4CITY

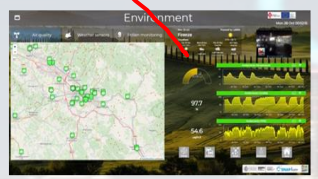
KM 4 CITY

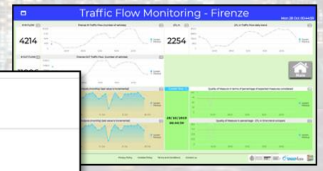
- **Multiple Domain Data**
  - ***Context***: Thousands OD, POI, IOT, etc.
  - ***mobility and transport***: accidents, public transport, parking, traffic flow, Traffic Reconstruction, KPI, …
  - ***AND***: civil protection, gov KPI, covid-19, social & social media, people flow, tourism, energy, …
- **Multiple dash/tool Levels & Decision Makers**
  - Real Time monitoring, Alerting, quality assess.
  - Predictions, KPI, DSS, what-if analysis
- **Historical and Real Time data**
  - Billions of Data
- **Services Exploited on:**
  - Multiple Levels, Mobile Apps, API
- **Since 2017**



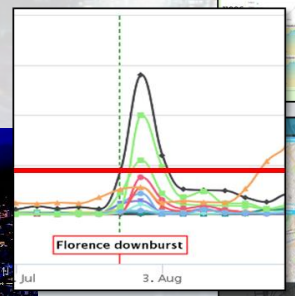




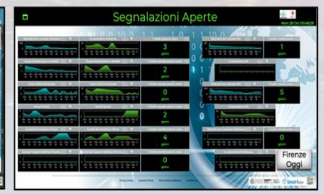


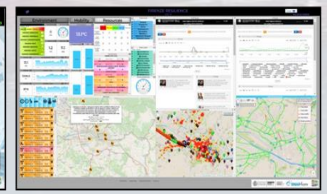



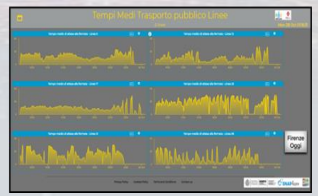









Firenze Oggi
Mon 16 May 12:59:27
20991
SITUAZIONE VIABILI
0 INCIDENTI
0 CHIUSURE PER CANTIERI
0 PROGR.
0 NON PROG.
SMN
42.2
BINA...
54.5
FORT...
23.2
LEOP...
37.3
CALZA...
48
S.AM...
58.6
PART...
55
CARE...
13.8
BECC...
77.6
ANALYSIS
Energy
Environment
Mobility
Social
Resilience
FLUSSI INGRESSO CIT...
TOTA...
92207
FLUSSI INGRESSO ZTL
TOTA...
15964
Nati italiani
175
Nati s...
48
Dece...
499
Matri...
72
Unio...
2
Manutenzioni Strad...
19
Verde
18
Decoro Urba...
3
Reiti...
5
Indicatore Rt per la provincia di
Rt
0.94
Linea...
Linea...
Linea...
Linea...
Linea...
Linea...
The European House
Ambrosetti

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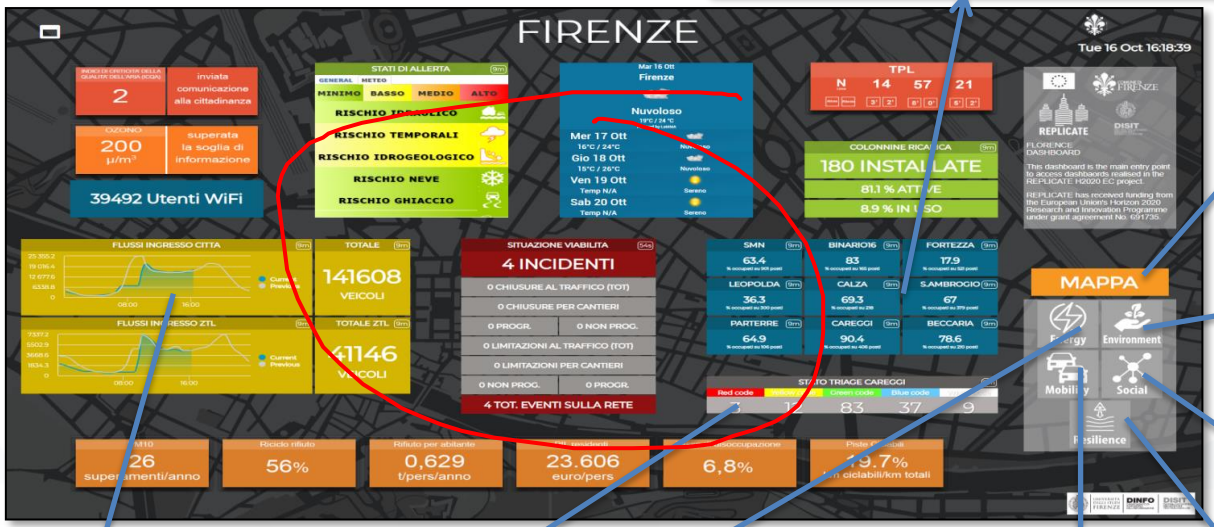
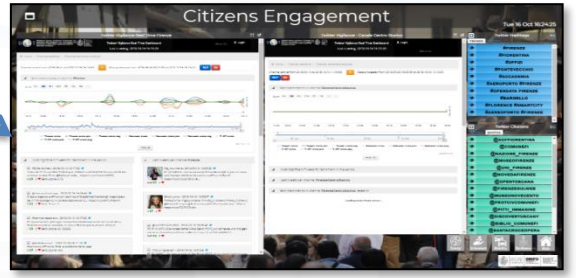
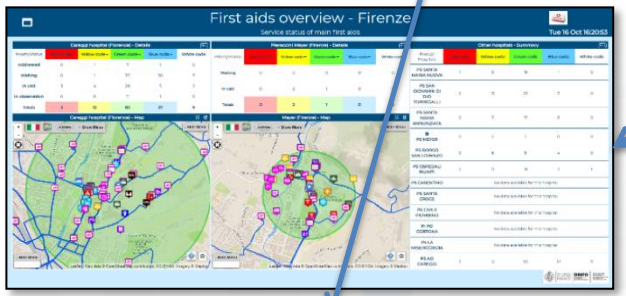
REPLICATE

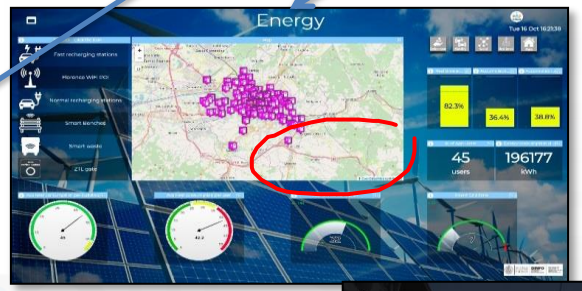
KM 4 CITY

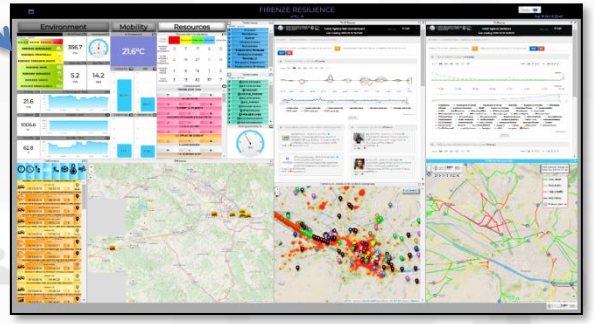



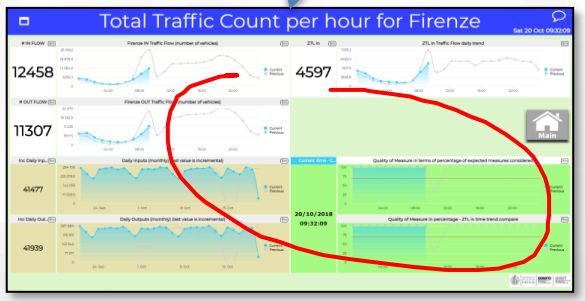


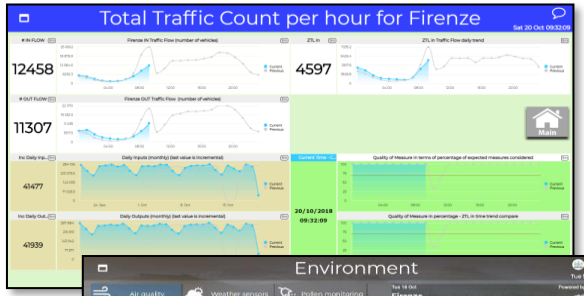




# Florence Case

- **Smart City Control Room**
- **Dashboards and Services**
- **Mobile App:** Firenze Where What



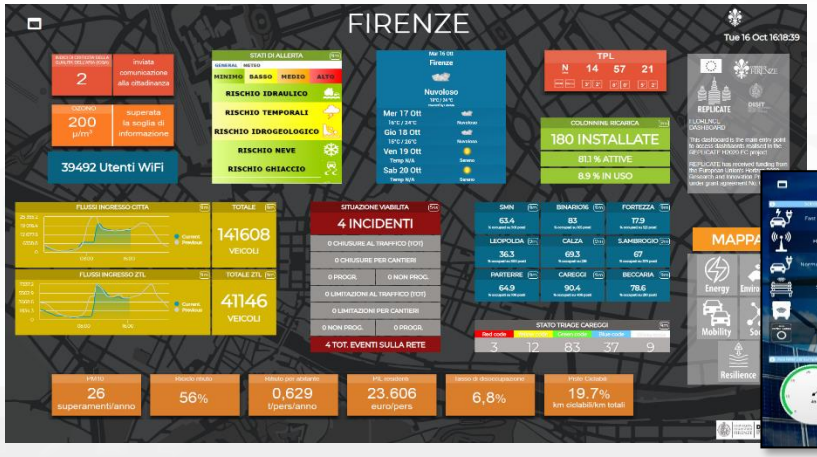



- **Mobility**:
  - quality of public transportation service (mean delay on bus-stops)
  - public transport operators schedule and paths, routing, multimodal routing
  - traffic flow reconstruction
  - Smart parking: predictions
  - Accidents and events, Log, heatmaps
- **Environment**:
  - smart irrigators
  - smart waste
  - Sensors: PM10. PM2.5,…..
  - Heatmaps: PM10, PM2.5, ….
  - NOX predictions
- **Energy**:
  - recharging stations (fast and reg.)
  - consumption meters (smart info)
  - smart light, street lights
- **Weather**
  - Forecast and actual

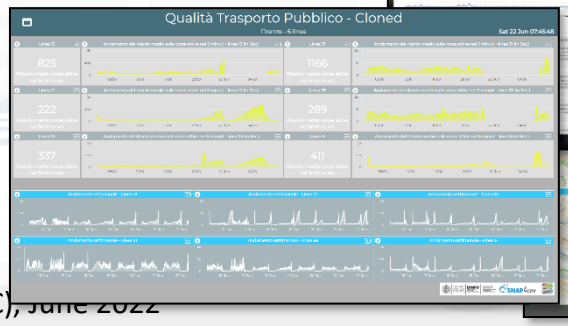
- **Social**:
  - smart benches
  - Twitter monitoring, Sentiment analysis, NLP text
  - TV camera streams
- **People Flows**:
  - Wi-Fi, people flow
  - Origin destination matrices
- **Governmental and Communications**:
  - KPI of the City
  - Digital Signage
  - Civil protection, Resilience (Resolute)
- **Tourism and Culture:**
  - POI, etc.

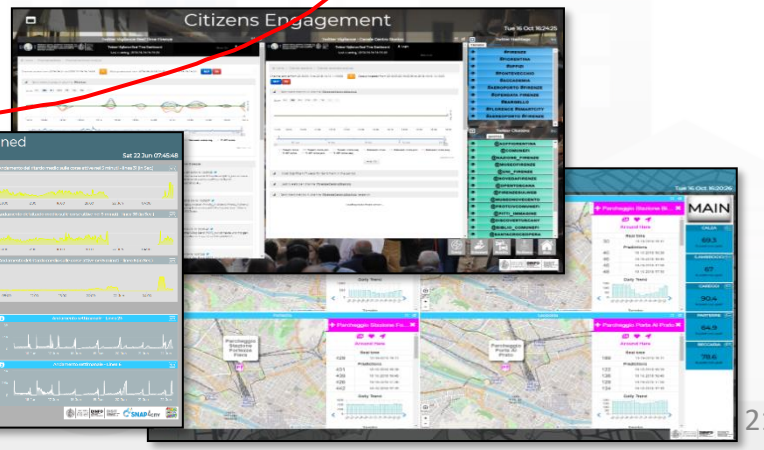
**Analysis:**

- **what-if routing, scenarios,**
- **traffic flow, environmental predictions**



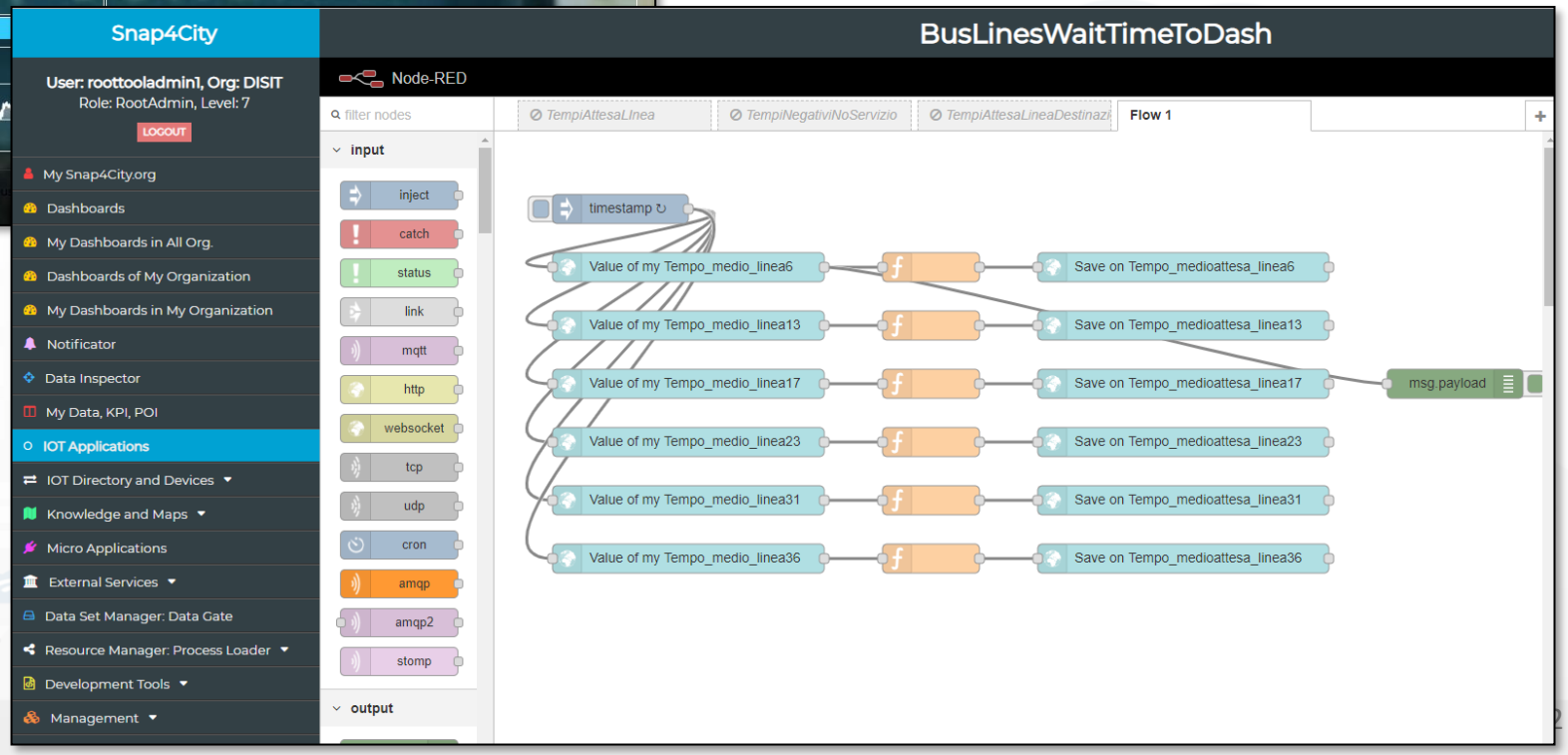




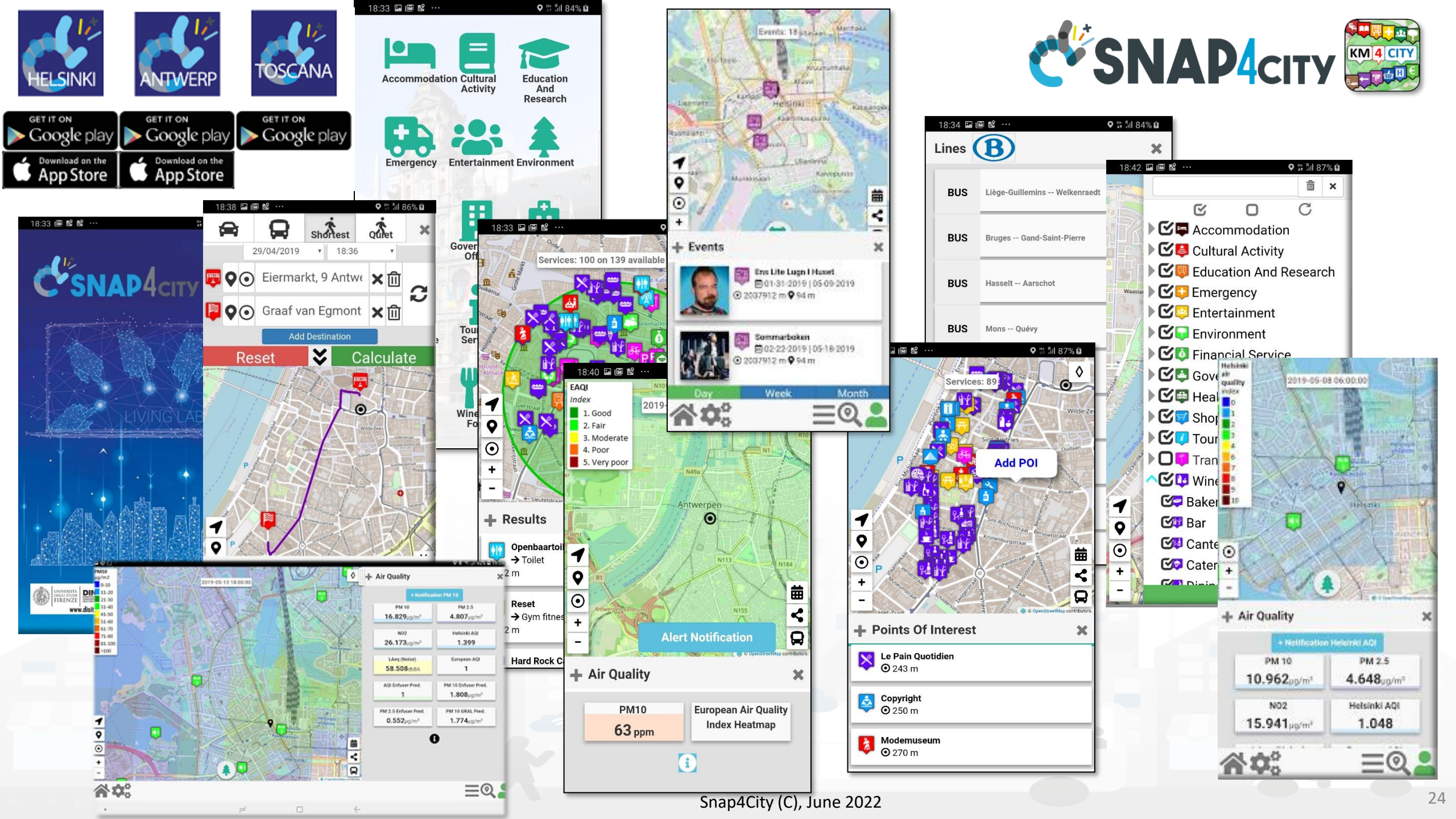
# Estimation of the mean waiting time at bus stops





# 3D views


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


HELSINKI
ANTWERP
TOSCANA
GET IT ON Google play
Download on the App Store
SNAP4CITY
KM 4 CITY
Accommodation
Cultural Activity
Education And Research
Emergency
Entertainment
Environment
Shortest
Quiet
Add Destination
Reset
Calculate
Events
Day
Week
Month
Services: 100 on 139 available
EAQI
Index
1. Good
2. Fair
3. Moderate
4. Poor
5. Very poor
Results
Antwerpen
Alert Notification
Air Quality
PM10
63 ppm
European Air Quality Index Heatmap
Lines
BUS
Liège-Guillemins -- Welkenraedt
Bruges -- Gand-Saint-Pierre
Hasselt -- Aarschot
Mons -- Quévy
Add POI
Points Of Interest
Le Pain Quotidien
243 m
Copyright
250 m
Modemuseum
270 m
Air Quality
PM 10
10.962
PM 2.5
4.648
NO2
15.941
Helsinki AQI
1.048

# *Tuscany Region*

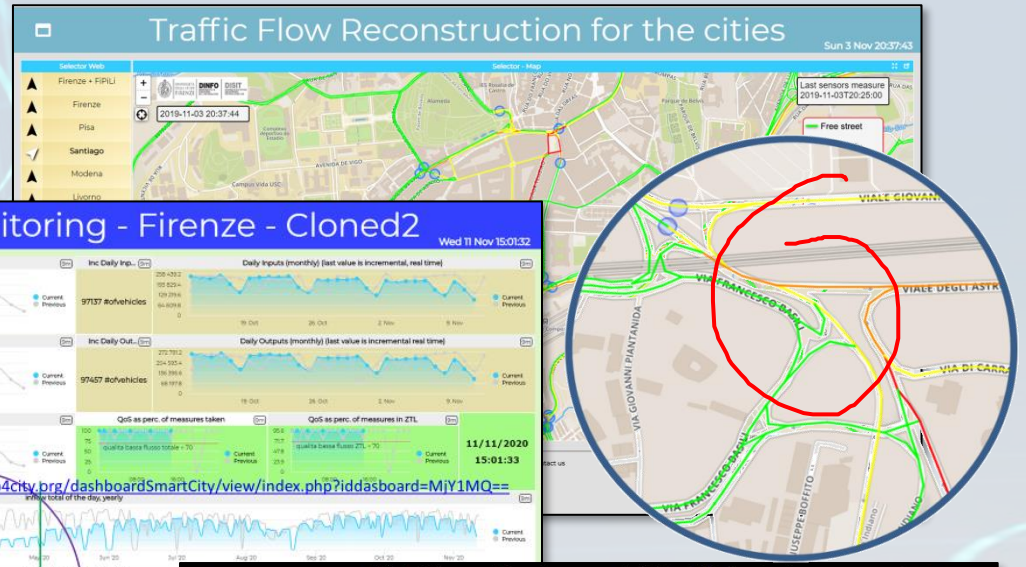
# *Firenze, Pisa, Livorno, Prato, etc.*

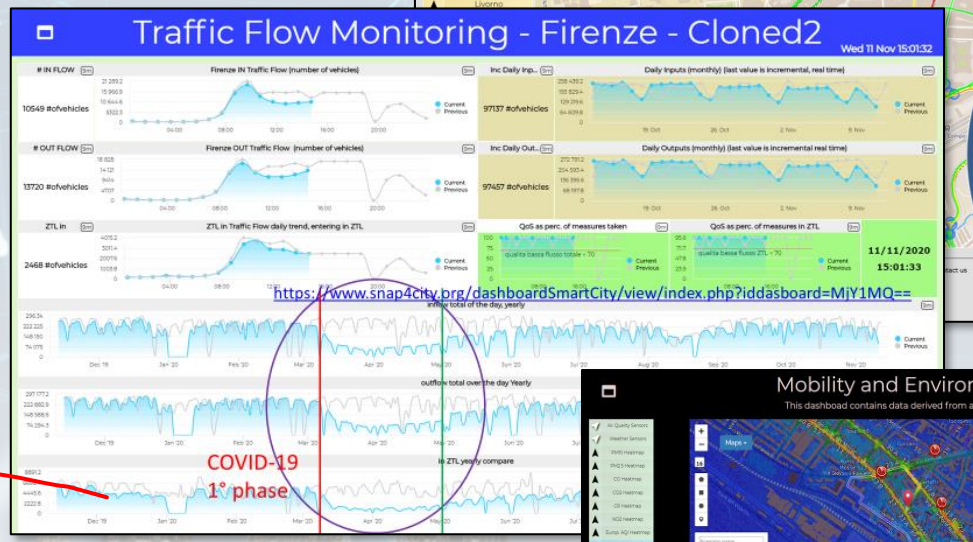
# Mobility and Transport
# Traffic Flow Analysis

Cities: Firenze, Pisa, Livorno, Modena, Santiago di Compostela

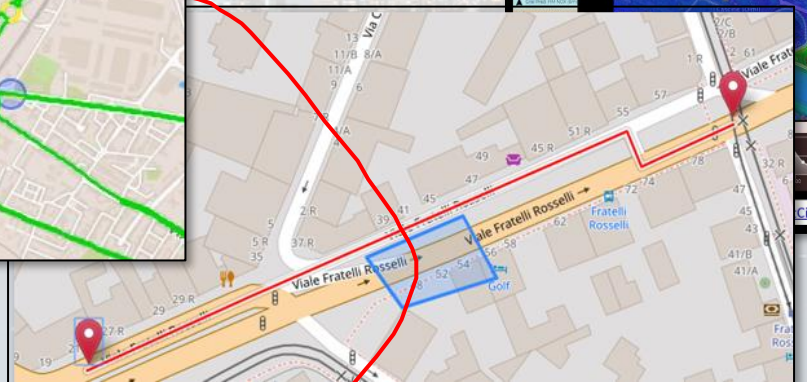
reference

- **Multiple Domain Data**
  - Traffic Flow sensors, city structure, weather
- **Decision Makers Multiple Locations**
  - Real time Monitoring, predictions
  - Traffic Flow Predictions,
  - Traffic Reconstructions, routing
  - Dashboards, What-IF analysis
  - Mobile App, people flows
- **Historical and Real Time data**
- **Services Exploited on:**
  - Dashboards, Mobile App
- **Since 2017, 2019**

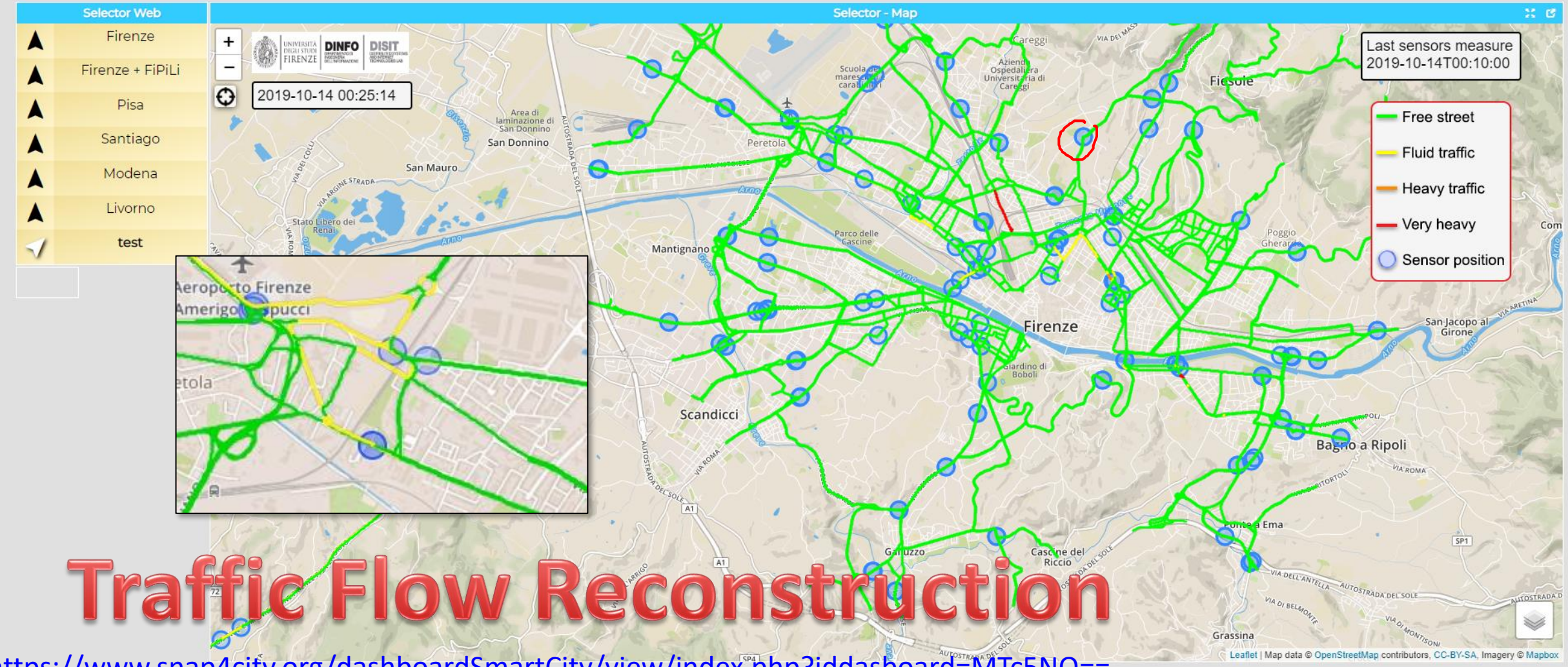






# Traffic Flow Reconstruction for the cities




# Traffic Flow Reconstruction

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc5NQ==

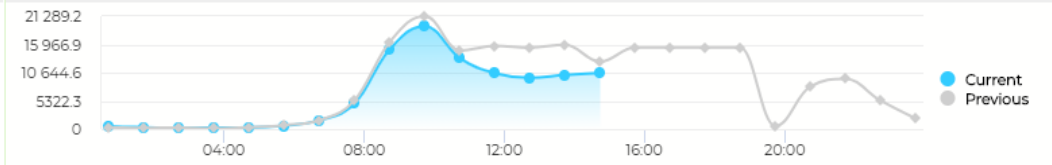
# Traffic Flow Monitoring - Firenze - Cloned2

Wed 11 Nov 15:01:32

**# IN FLOW** 9m

10549 #ofvehicles

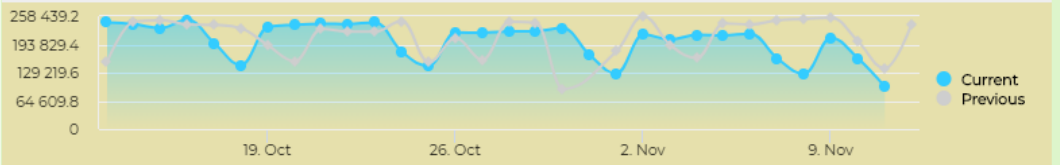
**Firenze IN Traffic Flow (number of vehicles)** 9m




**Inc Daily Inp...** 9m

97137 #ofvehicles

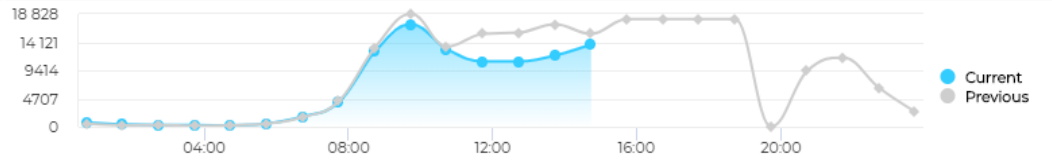
**Daily Inputs (monthly) (last value is incremental, real time)** 9m




**# OUT FLOW** 9m

13720 #ofvehicles

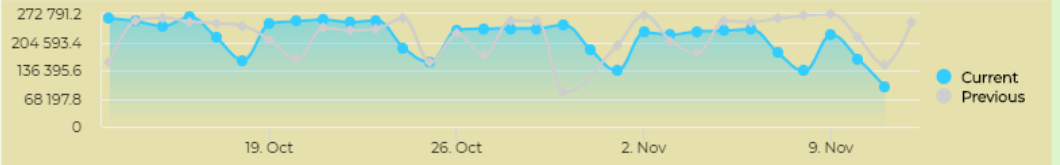
**Firenze OUT Traffic Flow (number of vehicles)** 9m




**Inc Daily Out...** 9m

97457 #ofvehicles

**Daily Outputs (monthly) (last value is incremental real time)** 9m




**ZTL in** 9m

2468 #ofvehicles

**ZTL in Traffic Flow daily trend, entering in ZTL** 9m


**QoS as perc. of measures taken** 9m

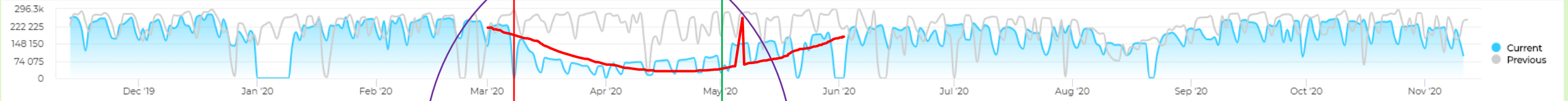

**QoS as perc. of measures in ZTL** 9m


**11/11/2020**

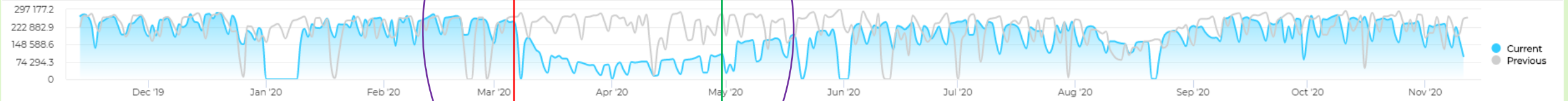
**15:01:33**

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjY1MQ==

**inflow total of the day, yearly** 9m



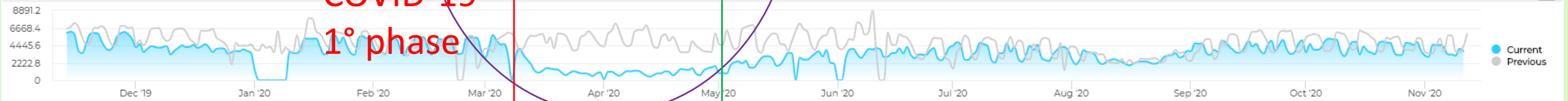

**outflow total over the day Yearly** 9m




COVID-19

1° phase

**in ZTL yearly compare** 9m



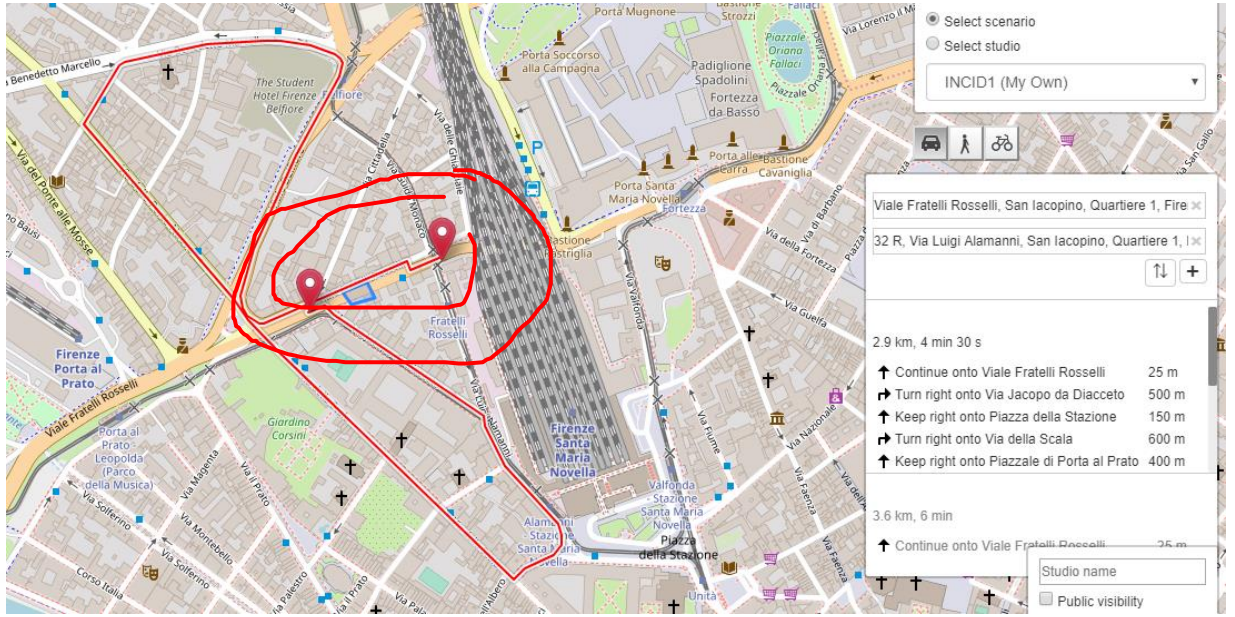
# What-If Analysis

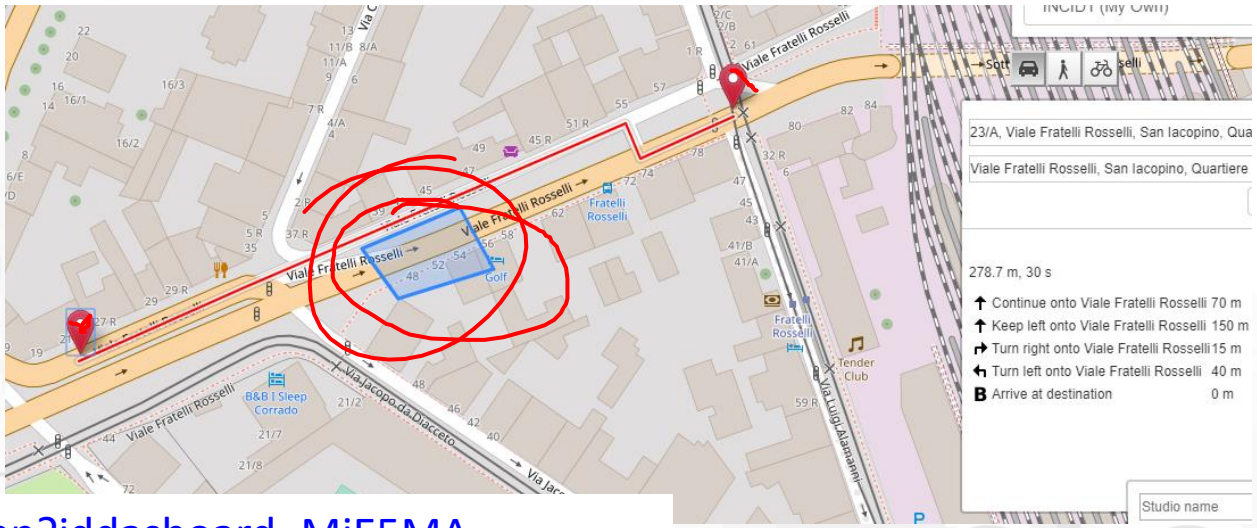
Accidents and elements blocking Points and Shapes taken into account for:

- Routing
- Traffic Flow reconstruction
- Evacuation paths
- Rescue team paths

Assessment on the basis of changes:

- Mobility demand assessment
- Mobility Offer assessment



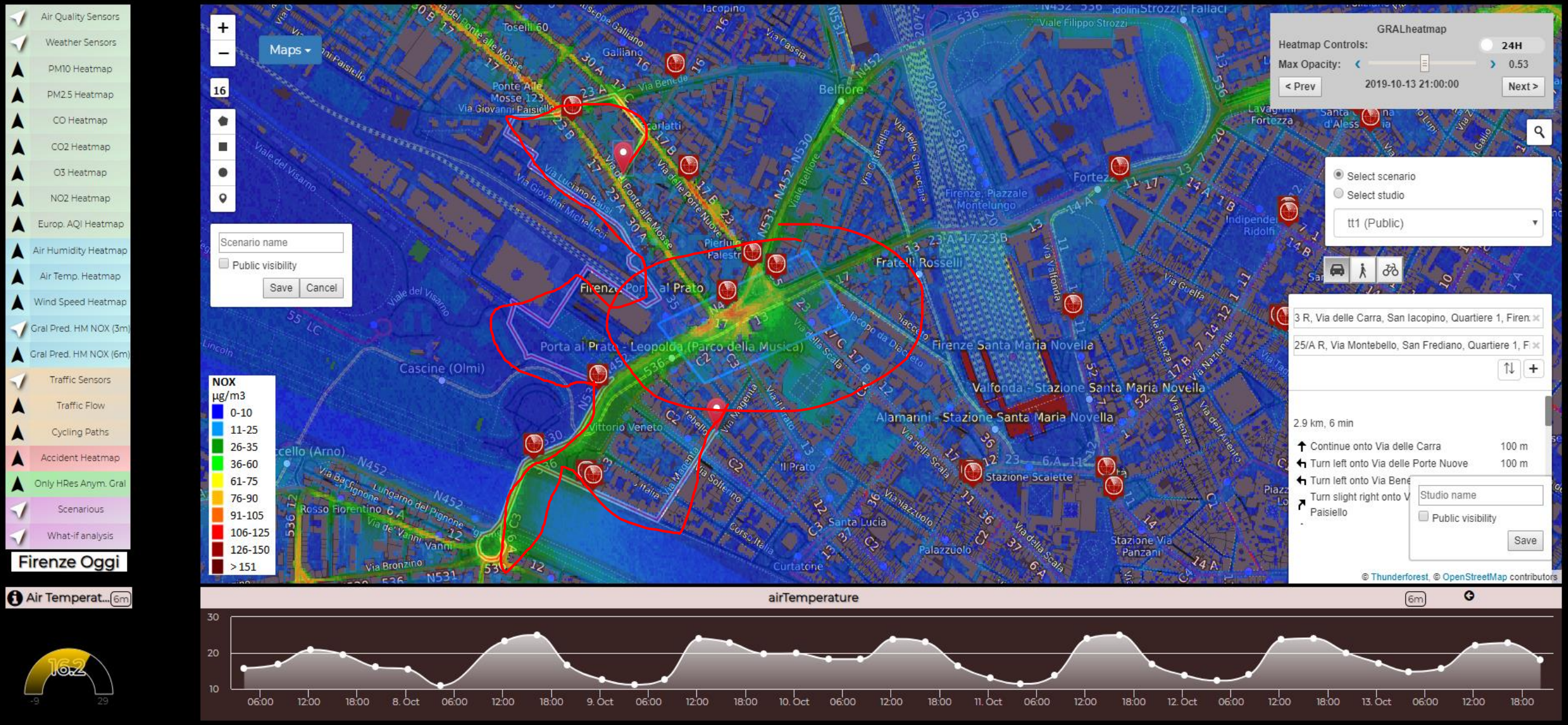




https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

# Mobility and Environment What-IF Analysis

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

Mon 14 Oct 00:48:17



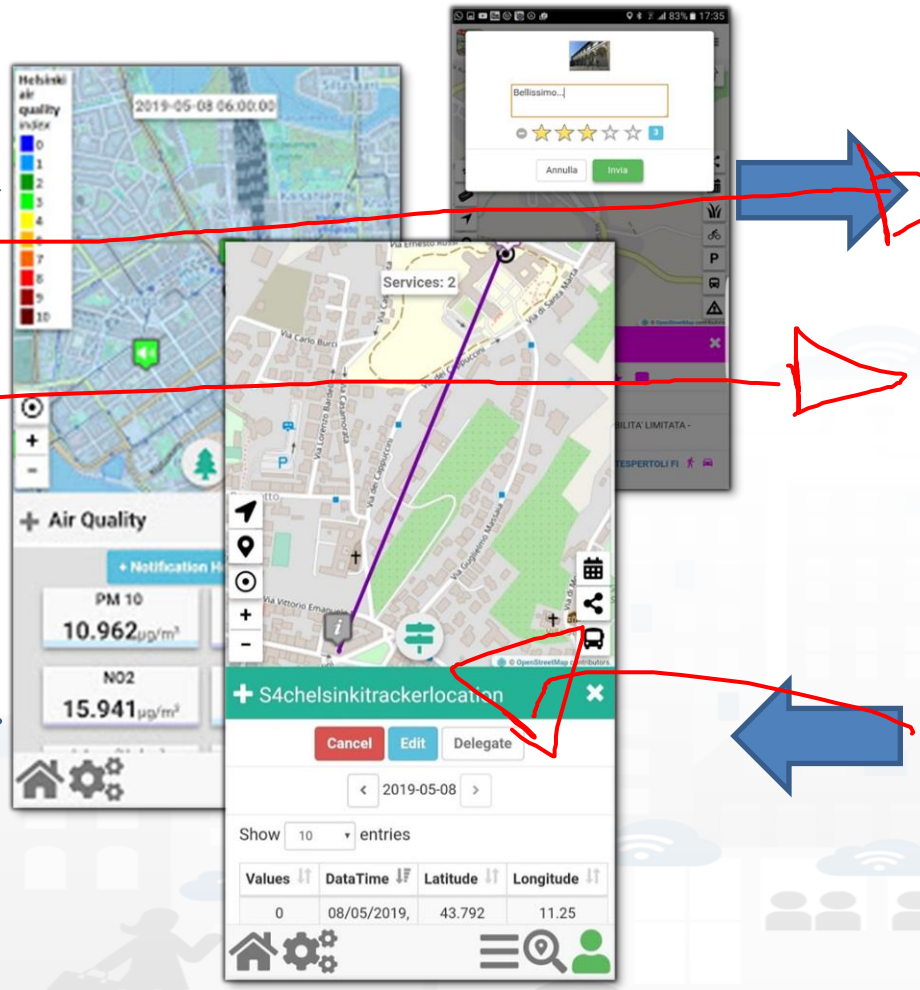

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjE5MA==

# The App is a Bidirectional Device

- GPS Positions
- Selections on menus
- Views of POI
- Access to Dashboards
- searched information
- Routing
- Ranks, votes
- Comments
- Images
- Subscriptions to notifications
- ….

**Produced information**

- Accepted ?
- Performed ?
- …




**Derived information**

- Trajectories
- Hot Places by click and by move
- Origin destination matrices
- Most interested topics
- Most interested POI
- Delegation and relationships
- Accesses to Dashboards
- **Cumulated Scores from Actions**
- Requested information
- Routing performed
- …..

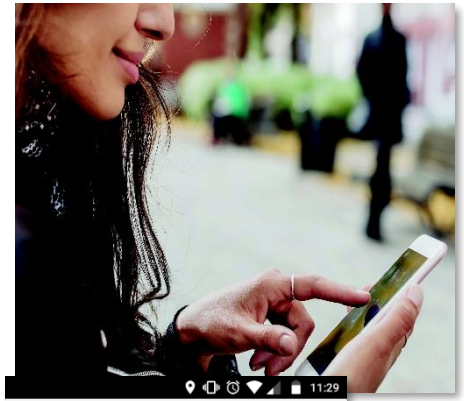
**Produced information**

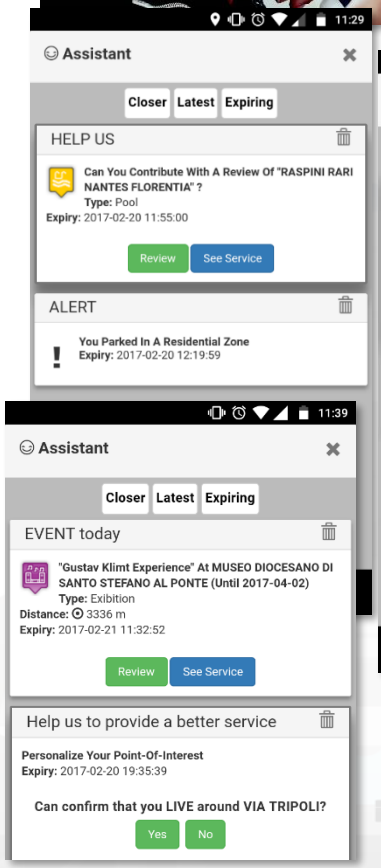
- Suggestions
- Engagements
- Notifications
- …

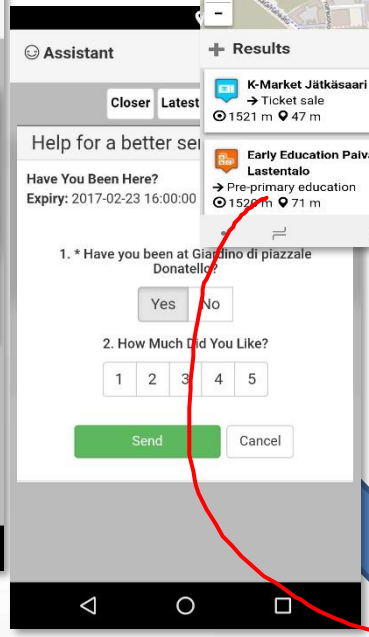
Users

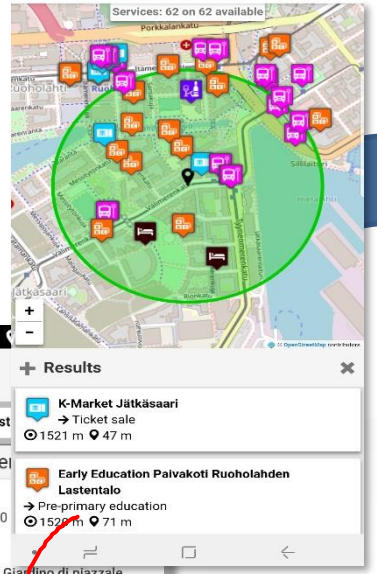
System

# Users' Engagement

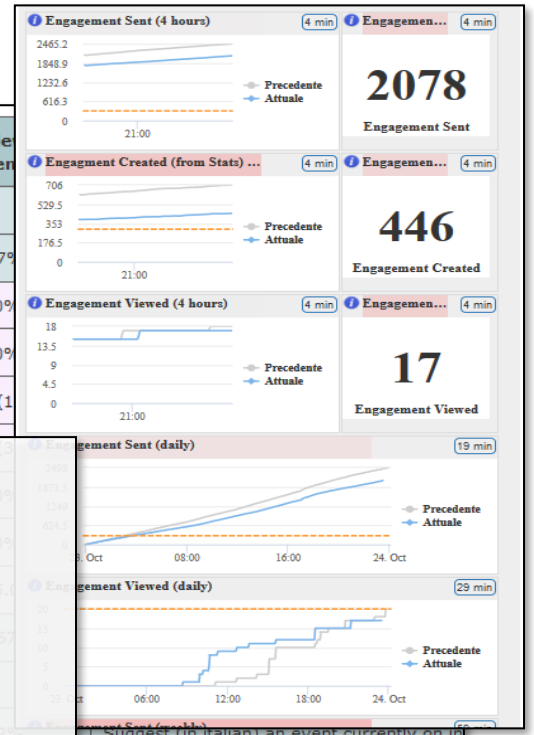





| Rule name | Type | #sent | #viewed | #vie #sen |
|---|---|---|---|---|
| daily_event_de | ENGAGEMENT | 1 (0%) | 0 (0%) | 0% |
| daily_event_en | ENGAGEMENT | 1720 (2.12%) | 70 (7.1%) | 4.07% |
| | - commuter | 5 (0.29%) | 0 (0%) | 0 (0% |
| | - student | 14 (0.81%) | 0 (0%) | 0 (0% |
| | - tourist | 1462 (85%) | 25 (35.71%) | 25 (1 |




Rules

**Inform**

Air Quality forecast is not very nice
You have parked out of your residential parking zone
The Road cleaning is this night
The waste in S.Andreas Road is full

**Engage**

Provide a comment, a score, etc.

**Stimulate / recommend**

Events in the city, services you may be interested, etc..

**Provide Bonus, rewards if needed**

you get a bonus since you parked here
We suggest: leave the car out of the city, this bonus can be used to buy a bus ticket

Suggest (in italian) an event currently on in
Alert (in english) if the user parked in a res
Alert (in spanish) if the user parked in a res
Alert (in italian) if the user parked in a resid
Ask (in german) a contribution for a nearby

User context

City context

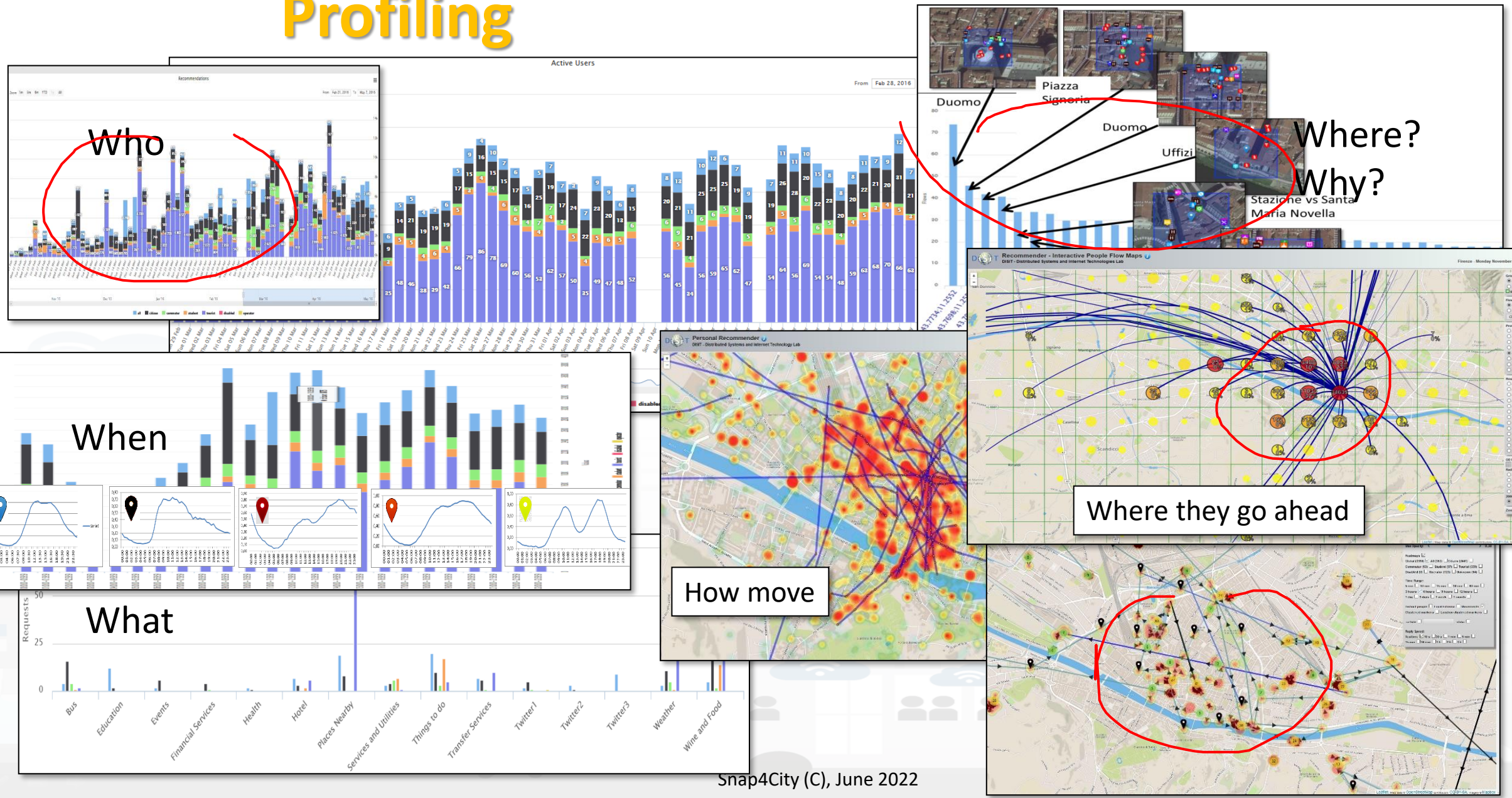

# Campaing on Sustainable Mobility

Sii smart.
Sii-Mobility!
Scarica, viaggia, vinci!

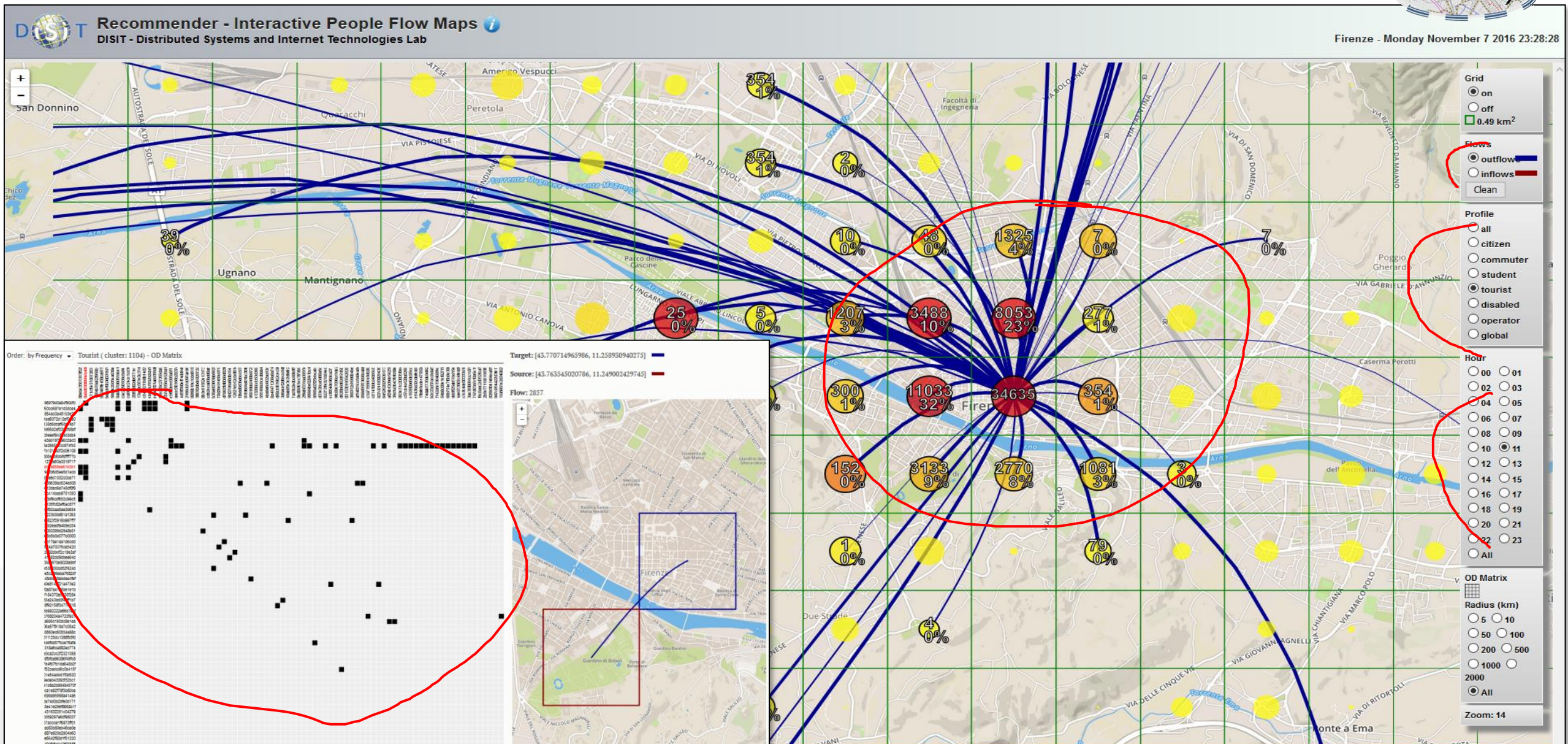
Dal 15 aprile al 15 luglio scegliere il trasporto pubblico ti premia!
Scarica l'app "Toscana dove, cosa", guadagna punti viaggiando in autobus e vinci tanti fantastici premi.
Per maggiori informazioni visita il sito info.sii-mobility.org
TOSCANA
ataf
BUSITALIA
GRUPPO FERROVIE DELLO STATO ITALIANE
MIUR
UNIVERSITÀ DEGLI STUDI FIRENZE
DINFO
DISIT

# User Behavior Analyser for Collective Profiling





# Scalable OD Matrix

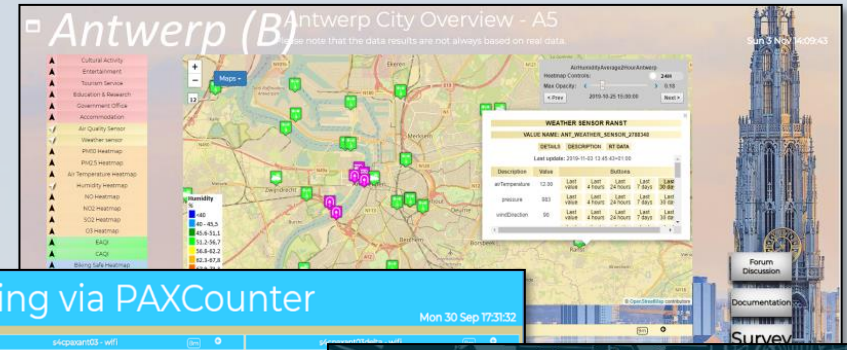


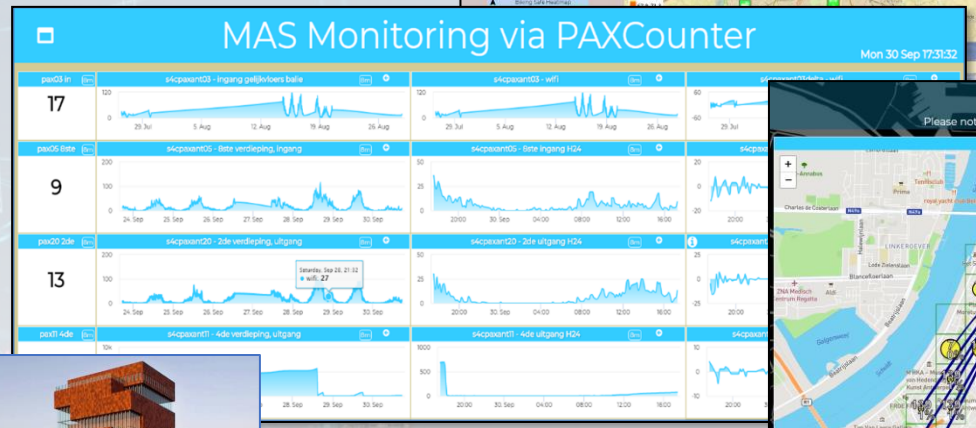
# Antwerp

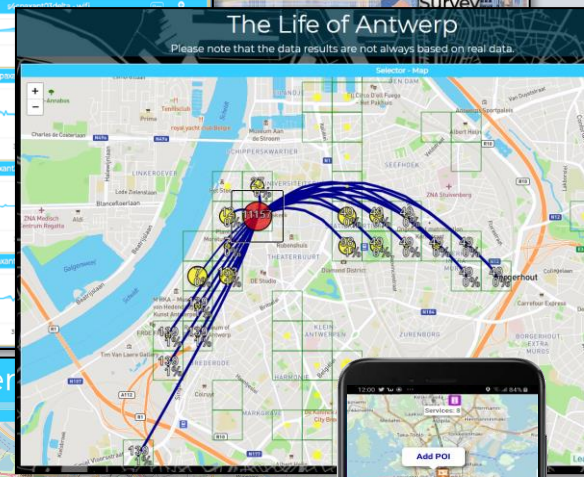
# People Monitoring on Pub Services
# DIGIPOLIS Antwerp

reference

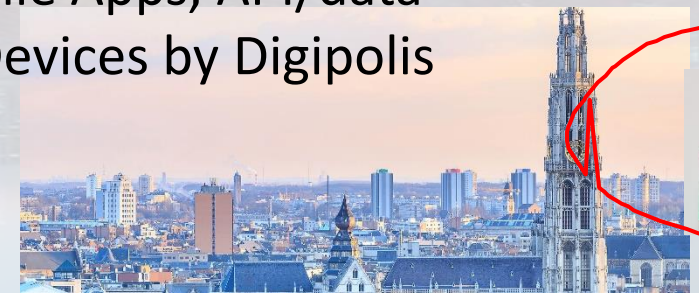
- **Multiple Domain Data**
  - PAX Counters: museum, pub services, COVID-19
- **Multiple Levels & Decision Makers**
  - Business Intelligence Dashboards
  - People flow, OD flows
  - Detection of critical conditions
- **Historical and Real Time data**
  - 20 fixed PaxCounters
  - 2 Mobile PaxCounters
- **Services Exploited on:**
  - Dashboards, Mobile Apps, API/data
  - Fully Controlled Devices by Digipolis
- **Since 2019**

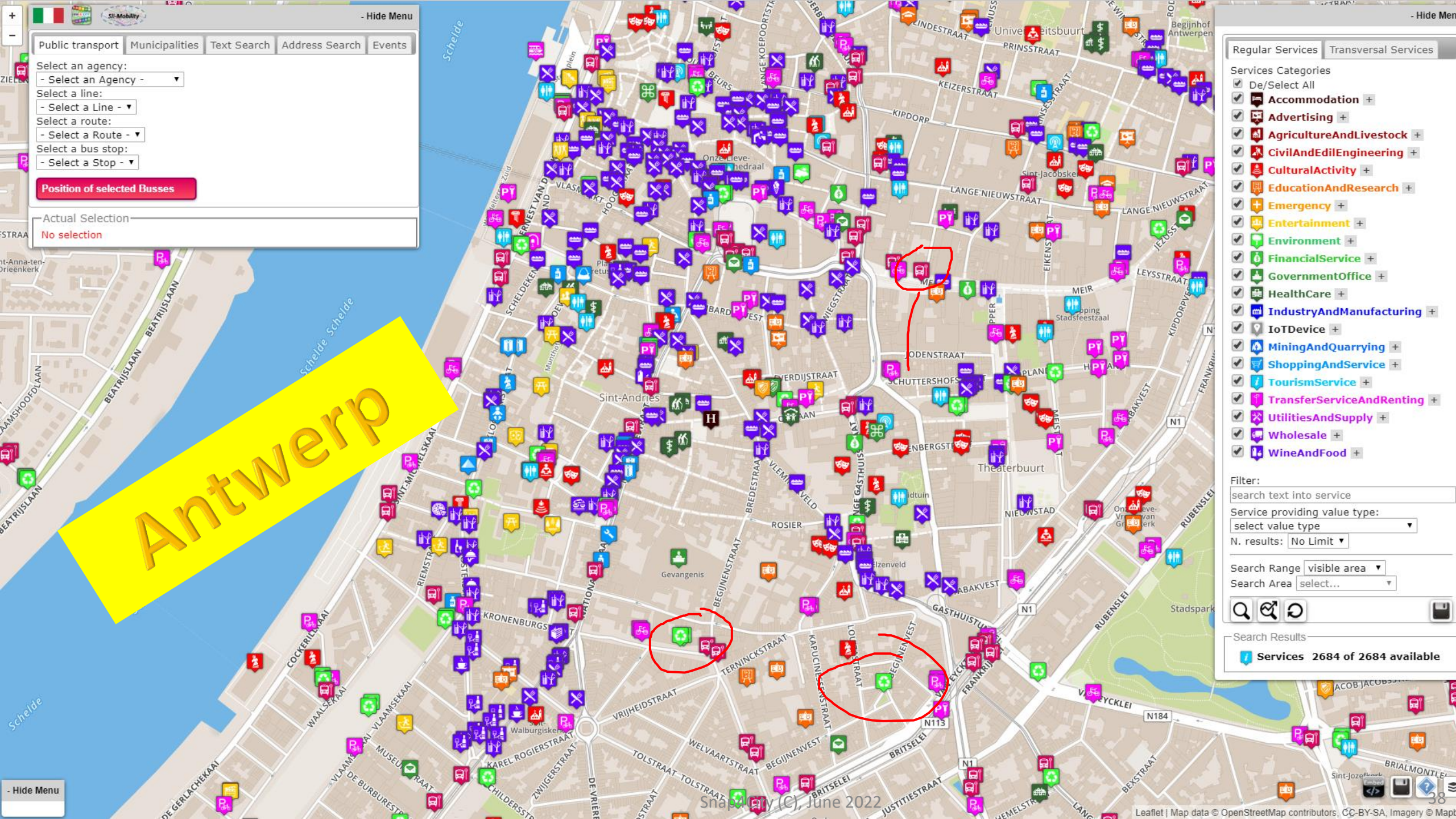


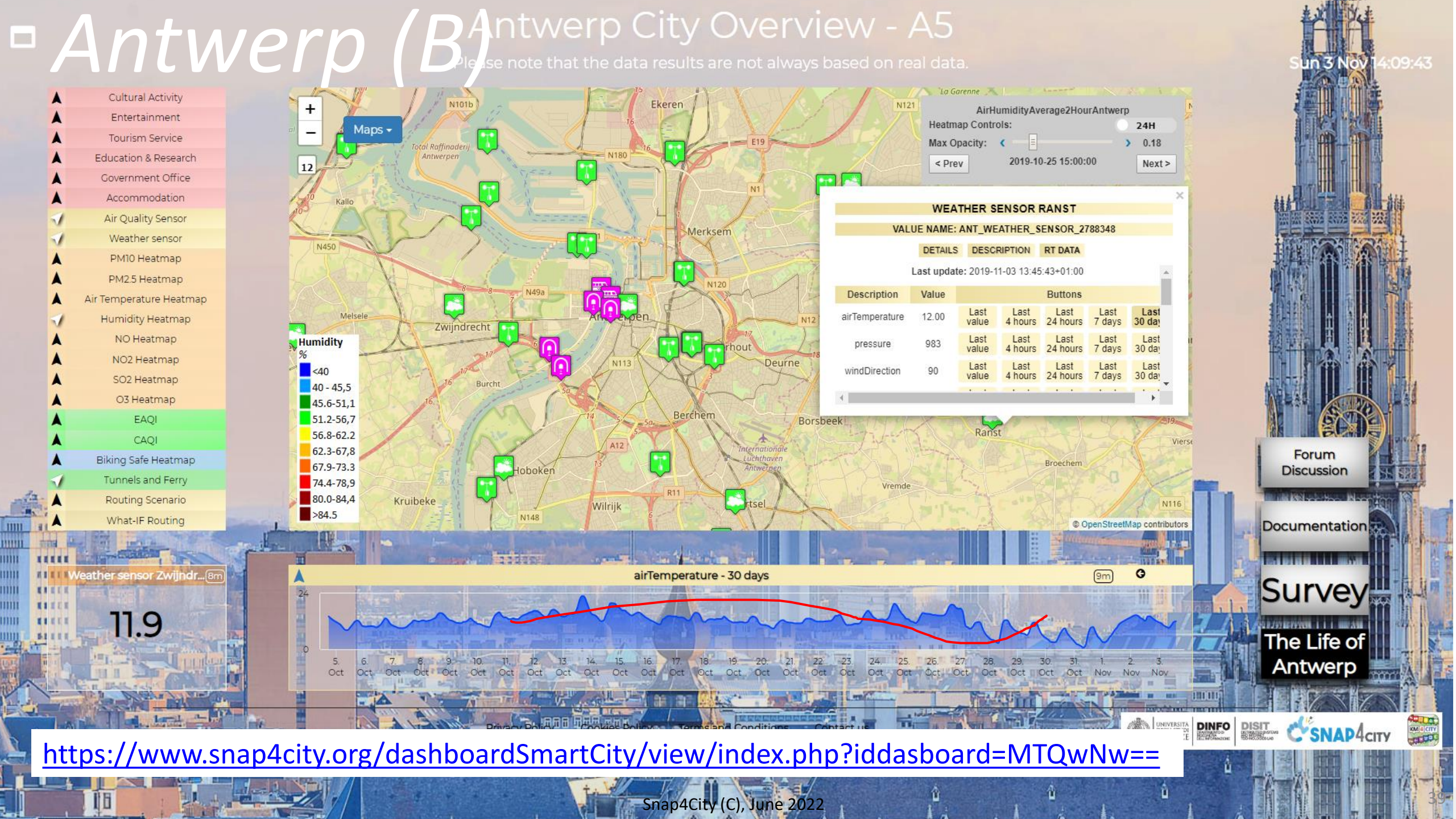








- Hide Menu
Public transport
Municipalities
Text Search
Address Search
Events
Select an agency:
- Select an Agency -
Select a line:
- Select a Line -
Select a route:
- Select a Route -
Select a bus stop:
- Select a Stop -
Position of selected Busses
Actual Selection
No selection
Antwerp
- Hide Menu
Regular Services
Transversal Services
Services Categories
De/Select All
Accommodation
Advertising
AgricultureAndLivestock
CivilAndEdilEngineering
CulturalActivity
EducationAndResearch
Emergency
Entertainment
Environment
FinancialService
GovernmentOffice
HealthCare
IndustryAndManufacturing
IoTDevice
MiningAndQuarrying
ShoppingAndService
TourismService
TransferServiceAndRenting
UtilitiesAndSupply
Wholesale
WineAndFood
Filter:
search text into service
Service providing value type:
select value type
N. results:
No Limit
Search Range
visible area
Search Area
select...
Search Results
Services 2684 of 2684 available
- Hide Menu
Schelde
Sint-Andries
Gevangenis
Theaterbuurt
Stadspark
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapb

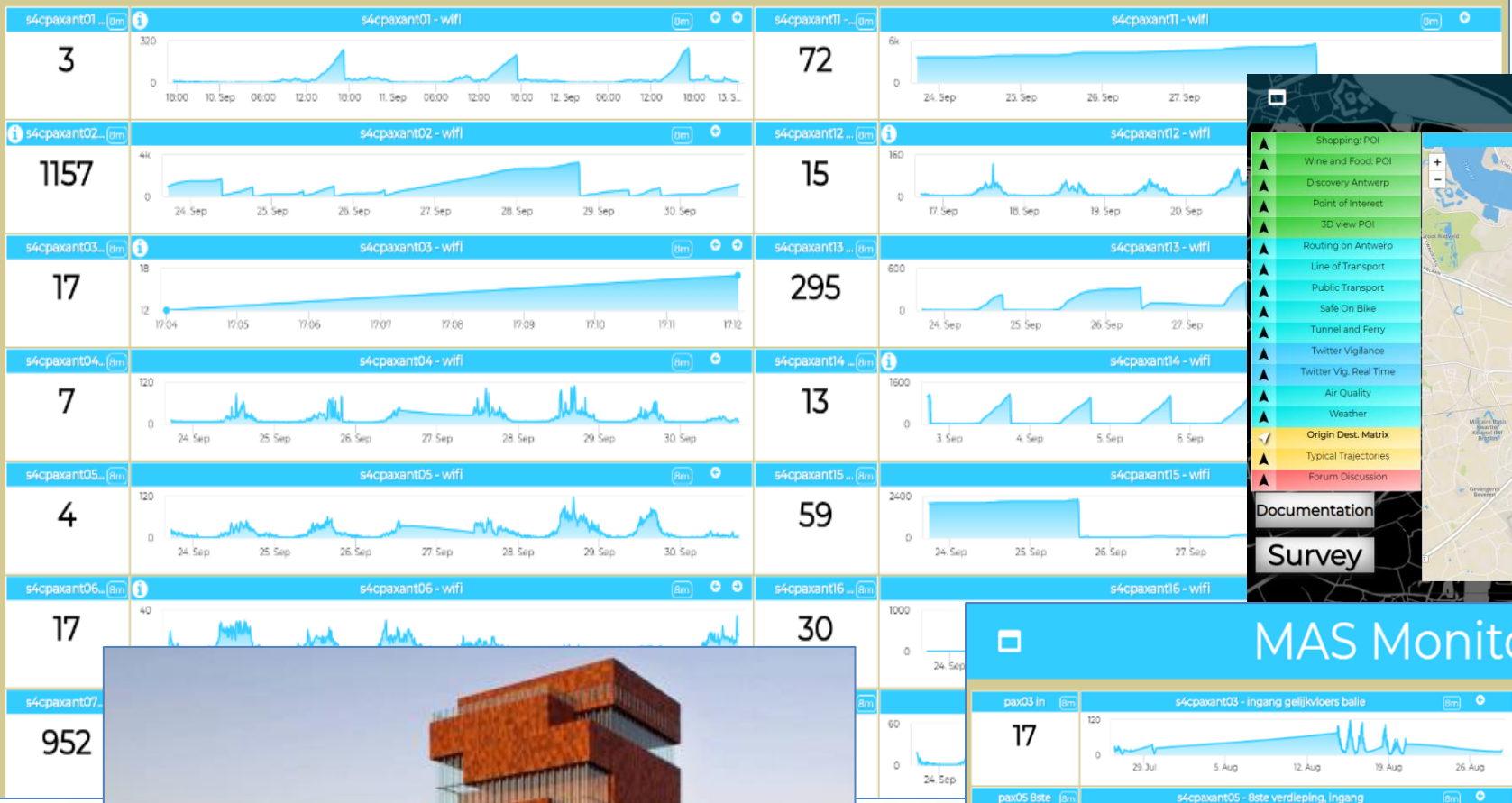
# Antwerp (B)



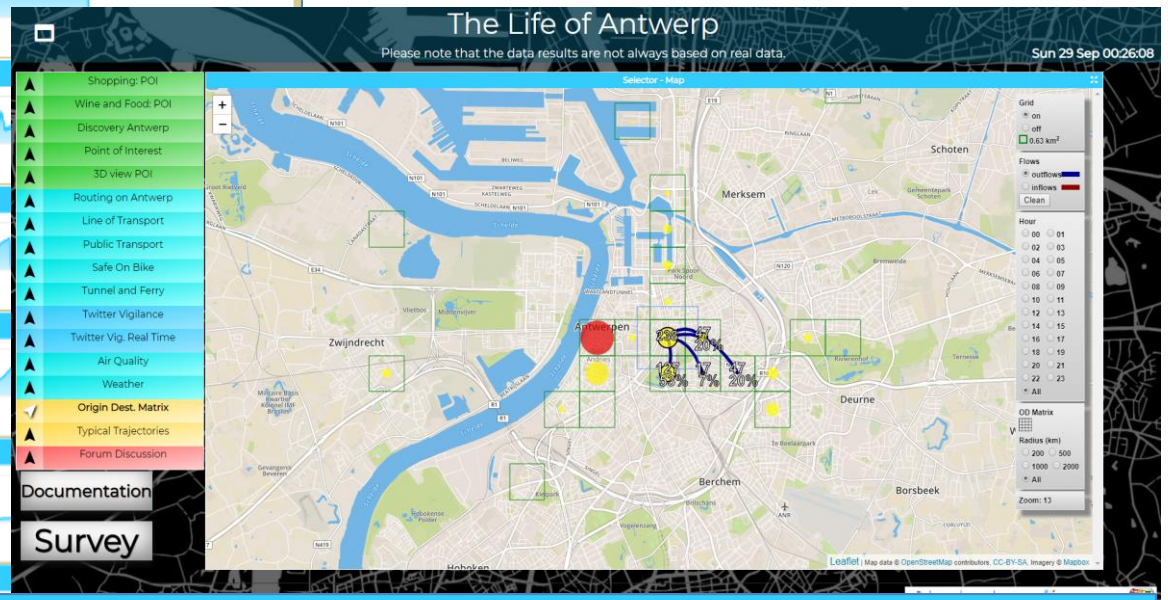

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNw==

# PAXCounter real time and trend

Mon 30 Sep 17:18:48



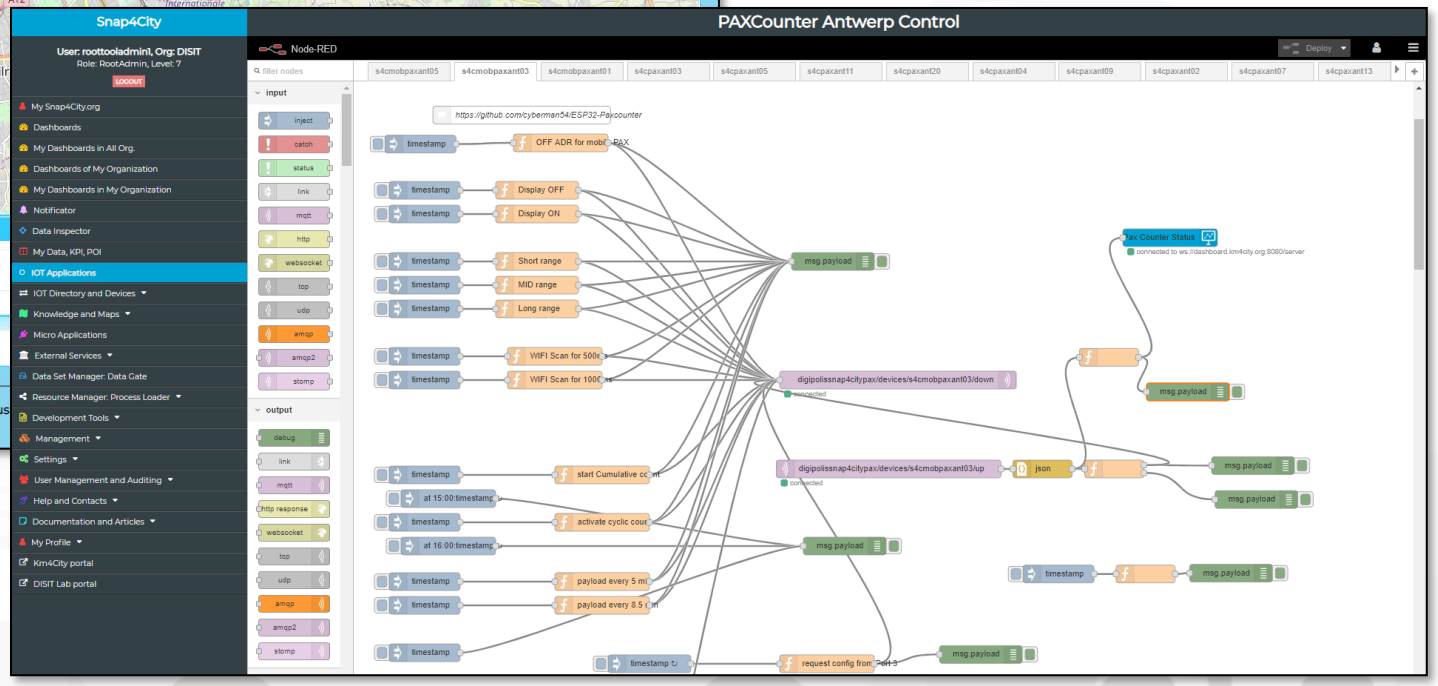




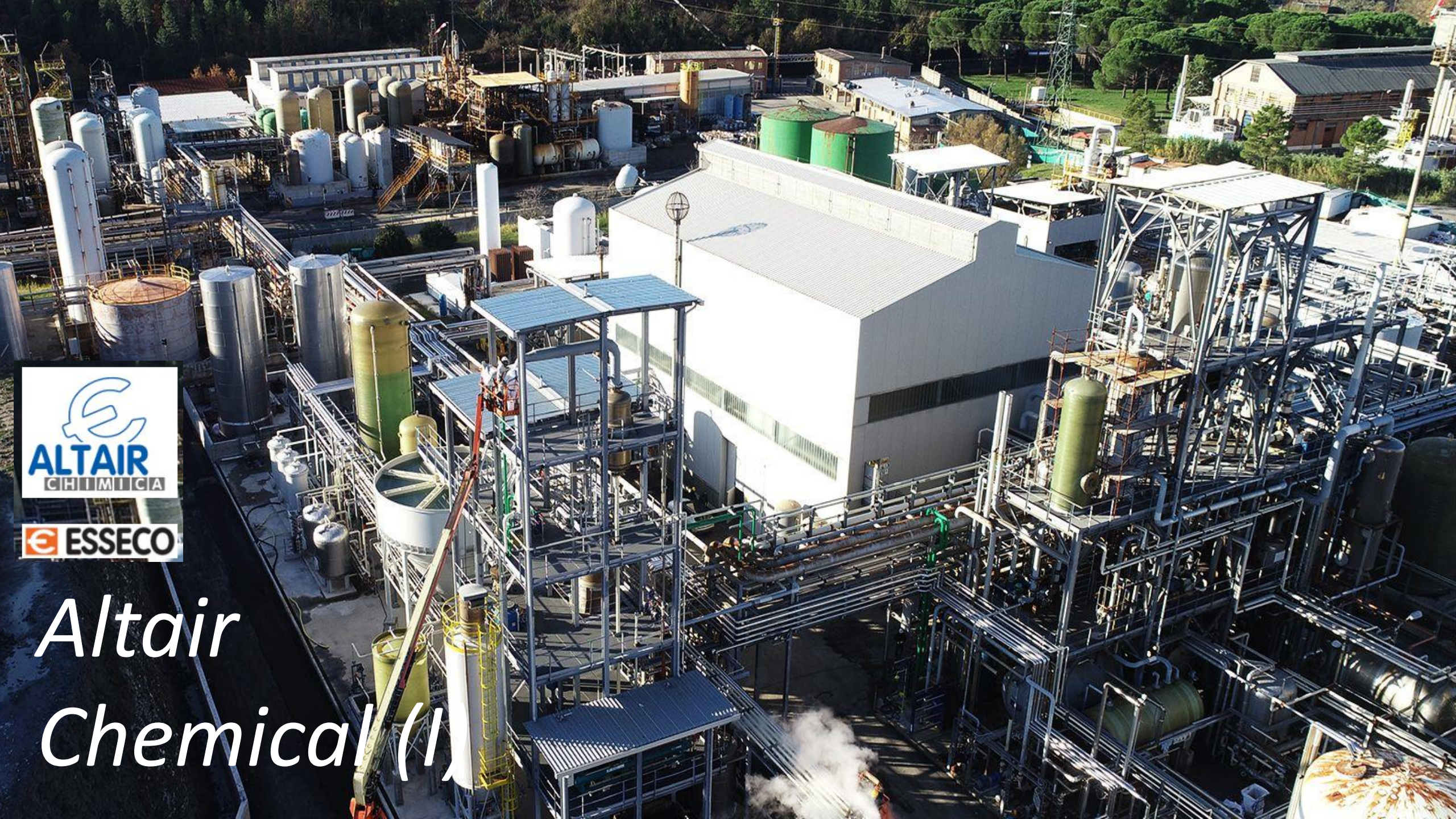

# MAS Monitoring via PAXCounter

Mon 30 Sep 17:31:32

# Programmable PAX counting


*Antwerp*

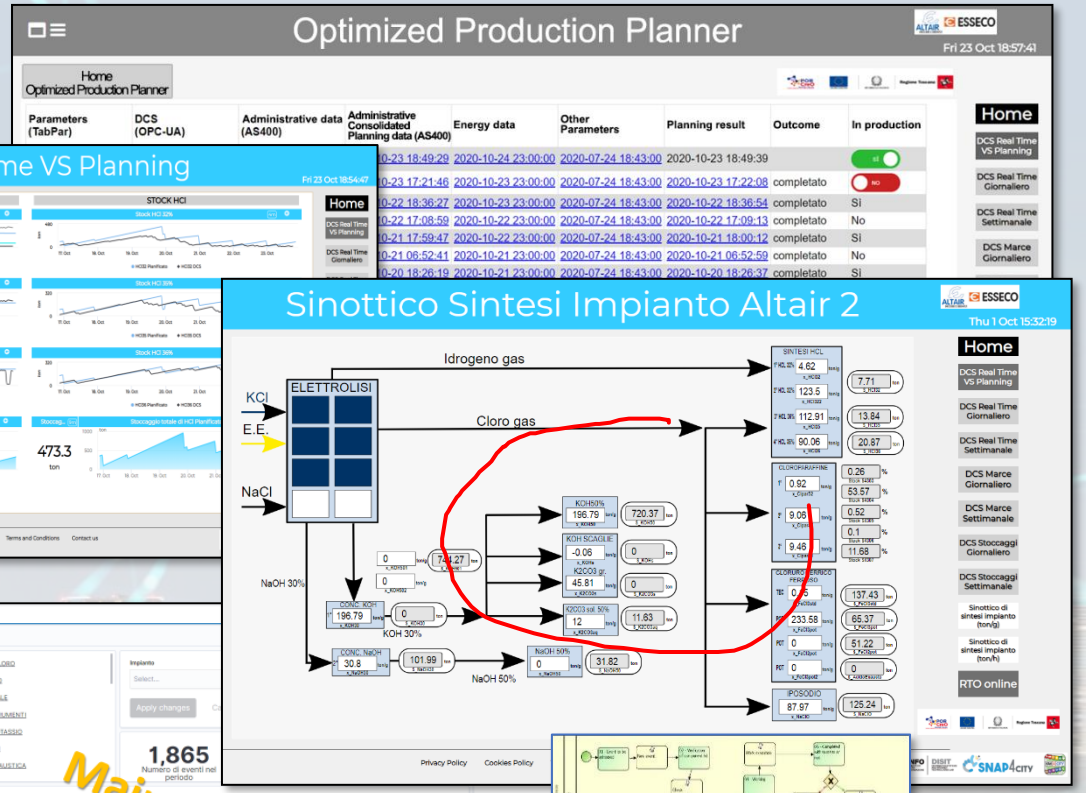



# *Altair Chemical (I)*

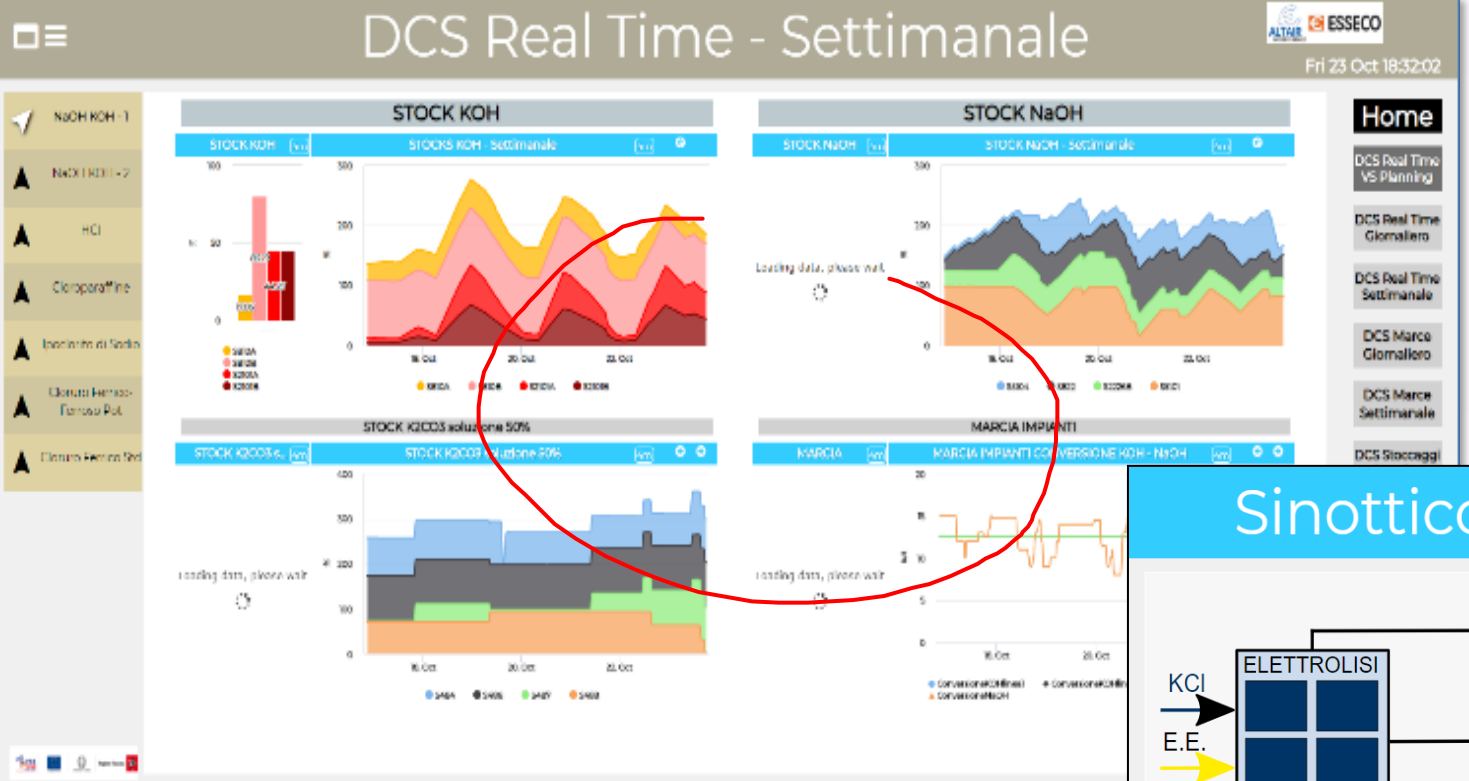
# Snap4Altair Decision Support supervision and control, Industry 4.0

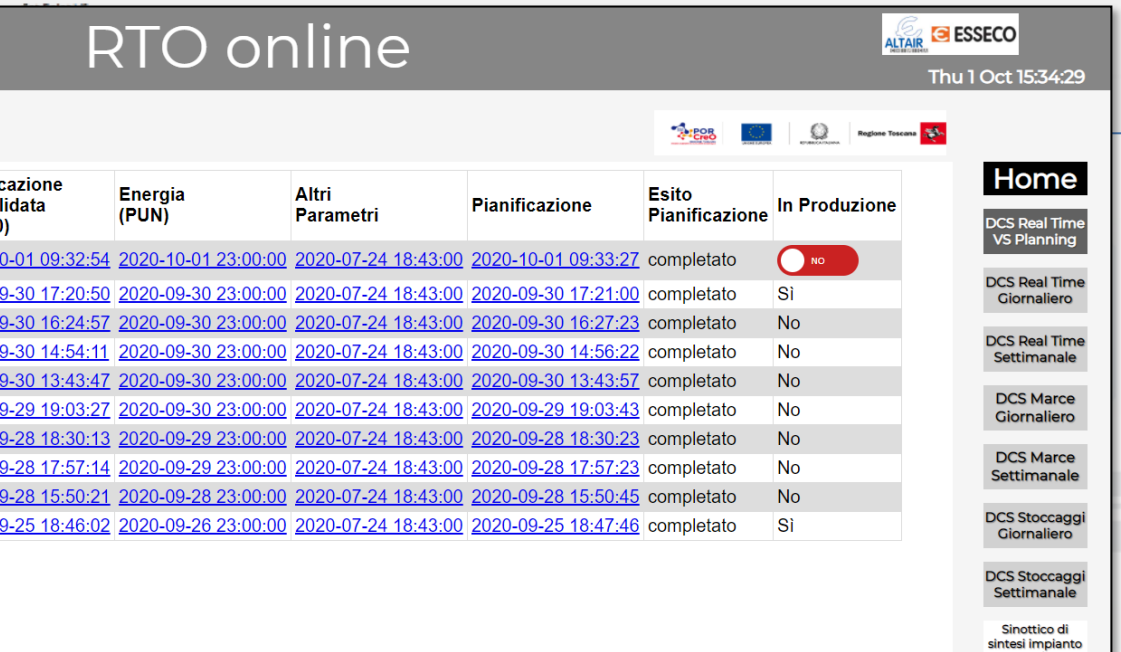
reference

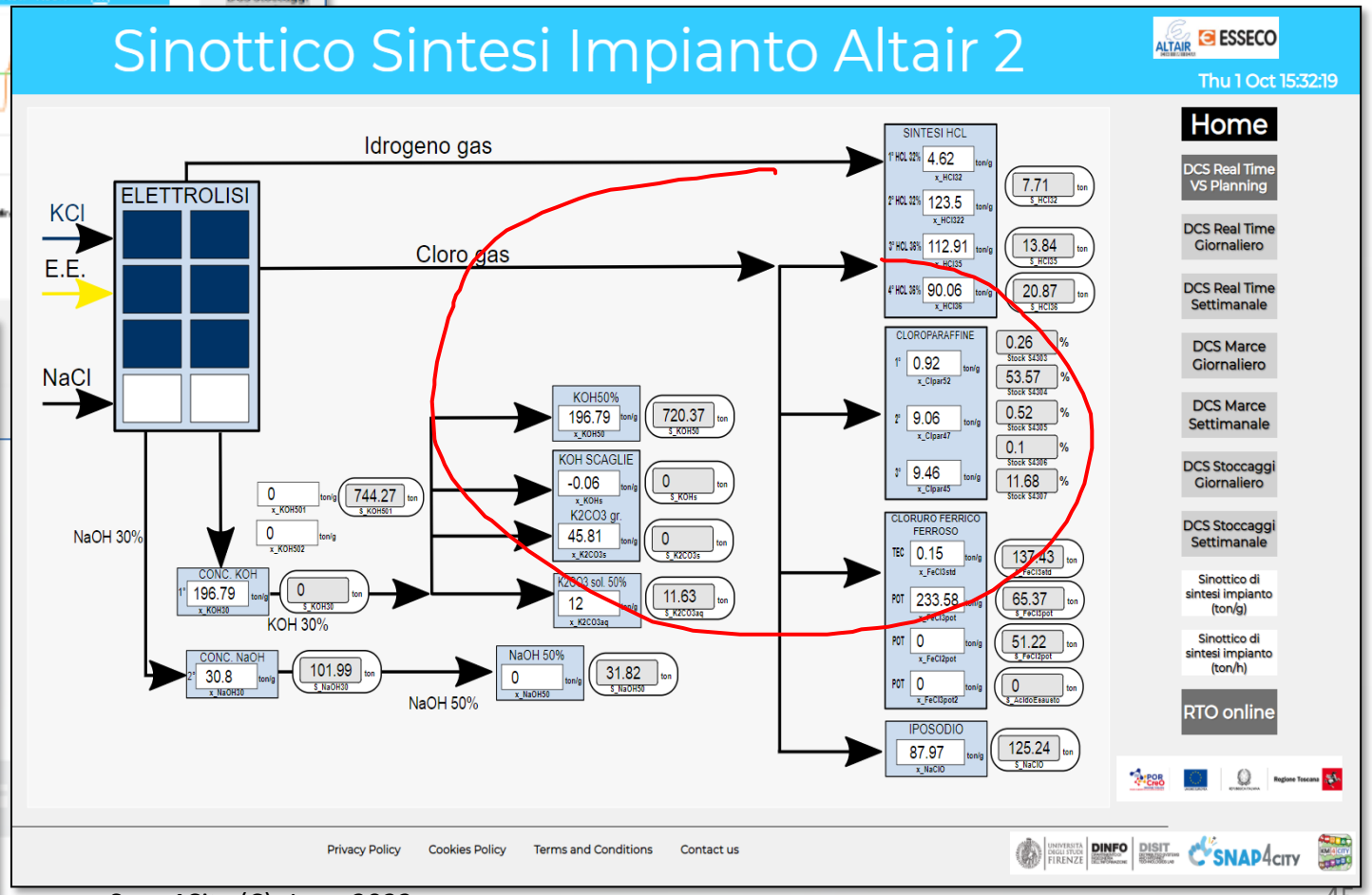
- **Multiple Domain Data**
  - Distributed Control System: energy, flows, storage, chemical data, settings, ..
  - Cost of energy, Orders,
  - Production Parameters
  - Maintenance data
- **Multiple Levels & Decision Makers**
  - Optimized planning on chemical model
  - Business Intelligence on Maintenance data
- **Historical and Real Time data**
  - Billions of Data
- **Services Exploited on:**
  - Multiple Levels, Mobile Apps, API
- **Since 2020**



# Altair Control room


DCS Real Time - Settimanale
Fri 23 Oct 18:32:02
STOCK KOH
STOCK NaOH
STOCK K2CO3 soluzione 50%
MARCIA IMPIANTI
Home
DCS Real Time VS Planning
DCS Real Time Giornaliero
DCS Real Time Settimanale
DCS Marce Giornaliero
DCS Marce Settimanale
DCS Stoccaggi


RTO online
Thu 1 Oct 15:34:29
Energia (PUN)
Altri Parametri
Pianificazione
Esito Pianificazione
In Produzione
2020-10-01 23:00:00
2020-07-24 18:43:00
completato
2020-09-30 23:00:00
2020-09-29 23:00:00
2020-09-28 23:00:00
2020-09-26 23:00:00
Home
DCS Real Time VS Planning
DCS Real Time Giornaliero
DCS Real Time Settimanale
DCS Marce Giornaliero
DCS Marce Settimanale
DCS Stoccaggi Giornaliero
DCS Stoccaggi Settimanale


Sinottico Sintesi Impianto Altair 2
Thu 1 Oct 15:32:19
Idrogeno gas
KCl
E.E.
NaCl
ELETTROLISI
Cloro gas
NaOH 30%
KOH 30%
NaOH 50%
SINTESI HCL
CLOROPARAFFINE
CLORURO FERRICO FERROSO
IPOSODIO
Home
DCS Real Time VS Planning
DCS Real Time Giornaliero
DCS Real Time Settimanale
DCS Marce Giornaliero
DCS Marce Settimanale
DCS Stoccaggi Giornaliero
DCS Stoccaggi Settimanale
Sinottico di sintesi impianto (ton/g)
Sinottico di sintesi impianto (ton/h)
RTO online
Privacy Policy
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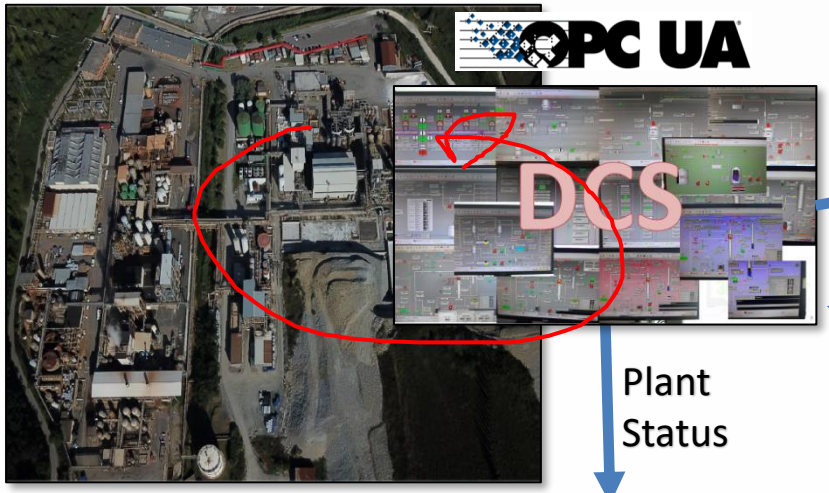
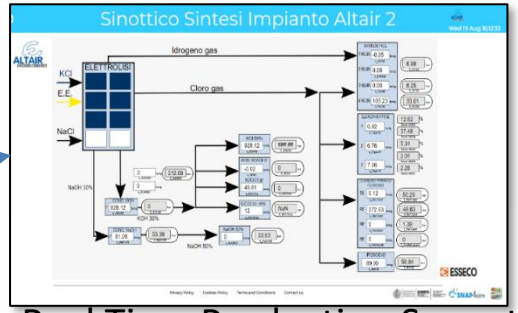
Terms and Conditions
Contact us



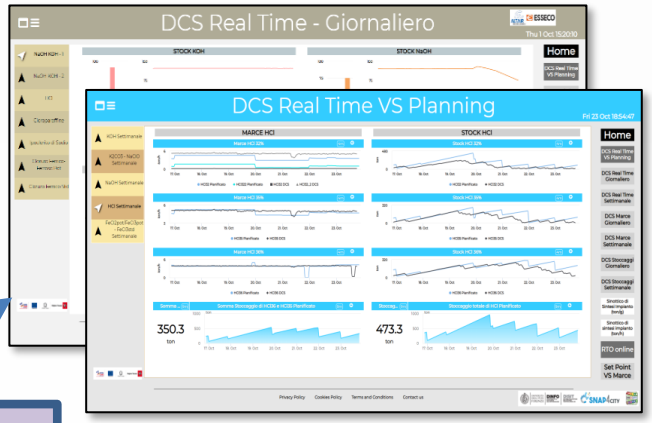

Plant Status




Real Time Production Synoptic

Production Plan

Production vs Planning




Data Storage

Decision Support

Data Ingestion

AS400

Orders

Energy Service

Transportation

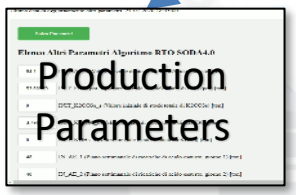
Other Costs

Production Plant Management

Optimized Production Planner

Possible Plan

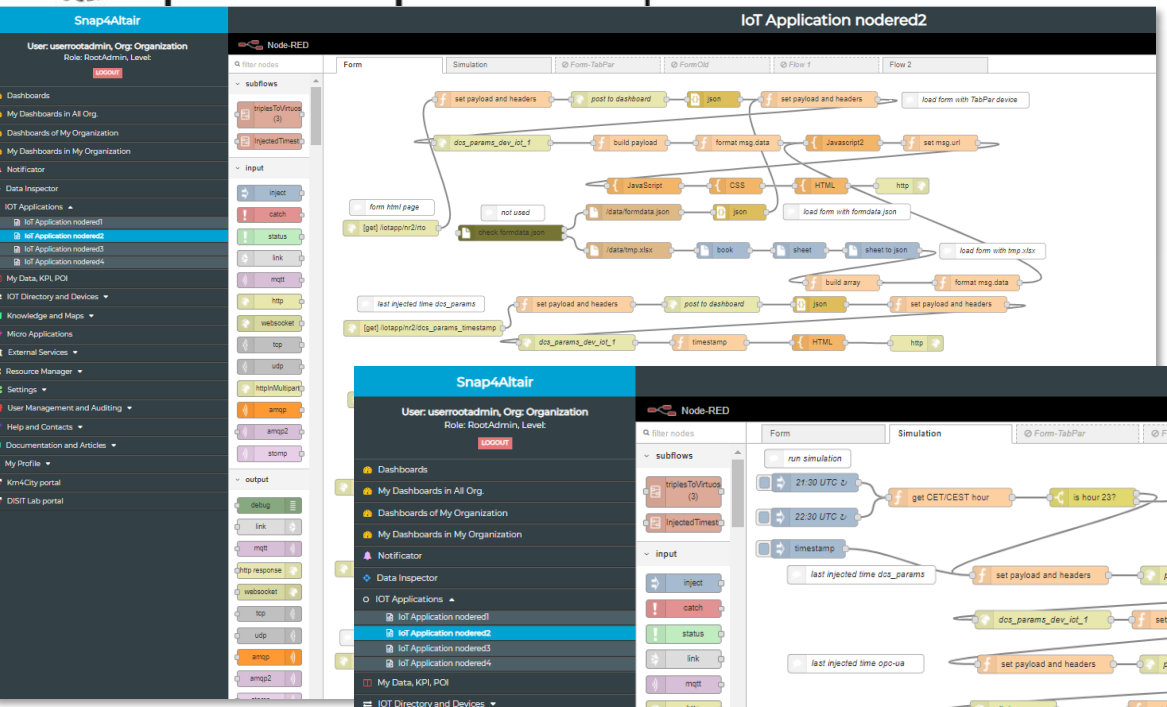
Possible Plans

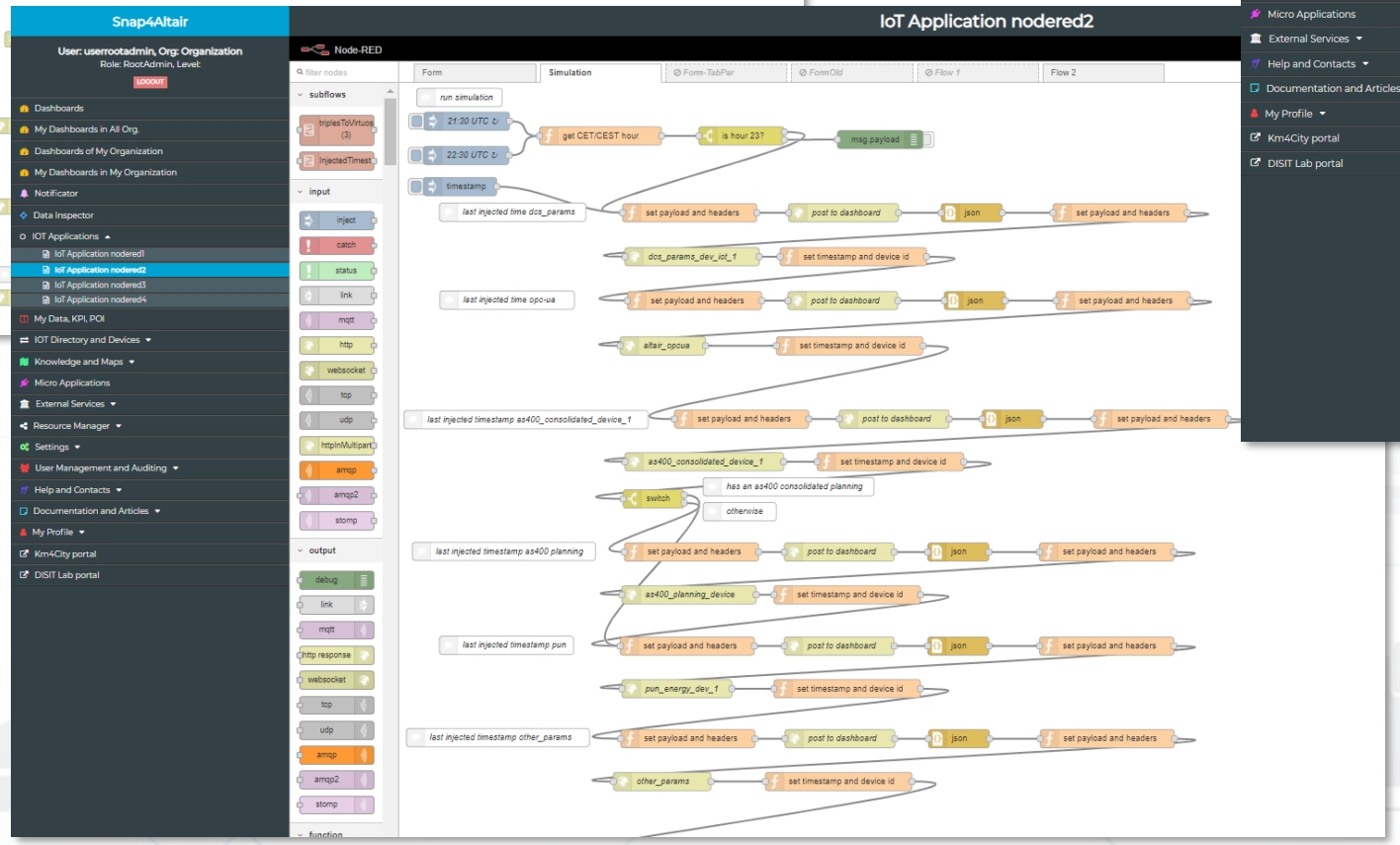



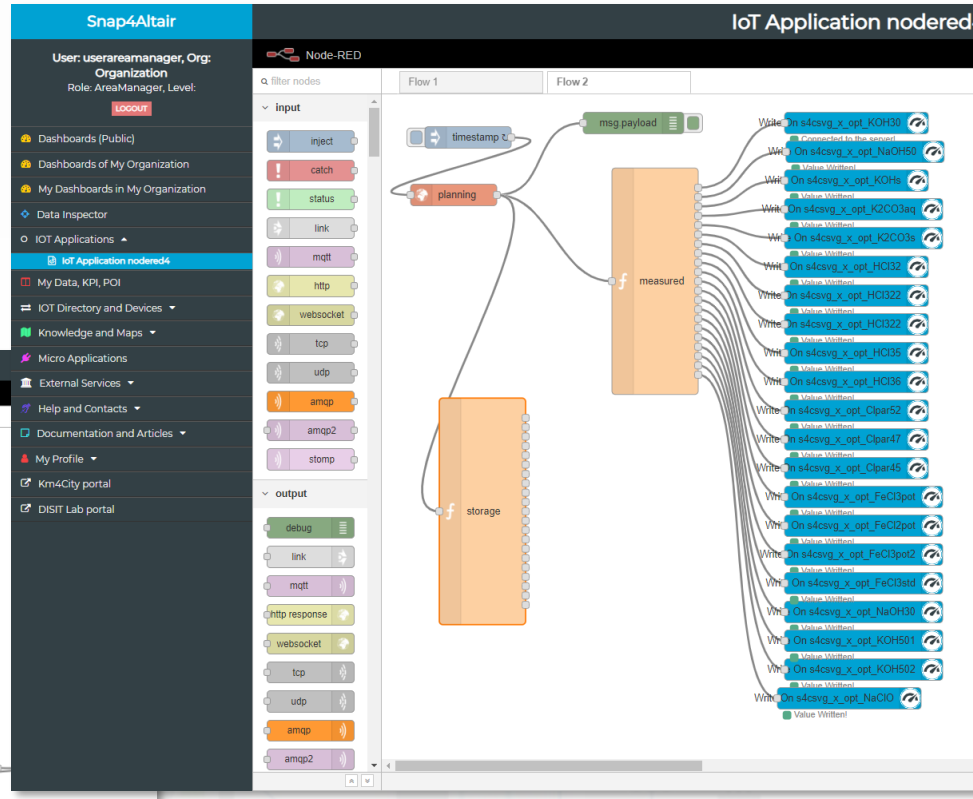


Plant Management

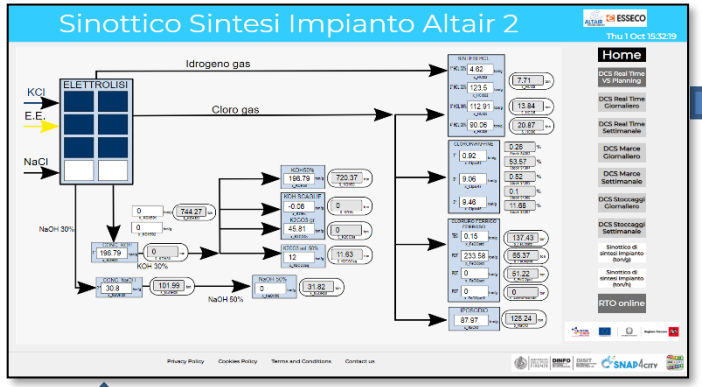
# Some Altair Flows



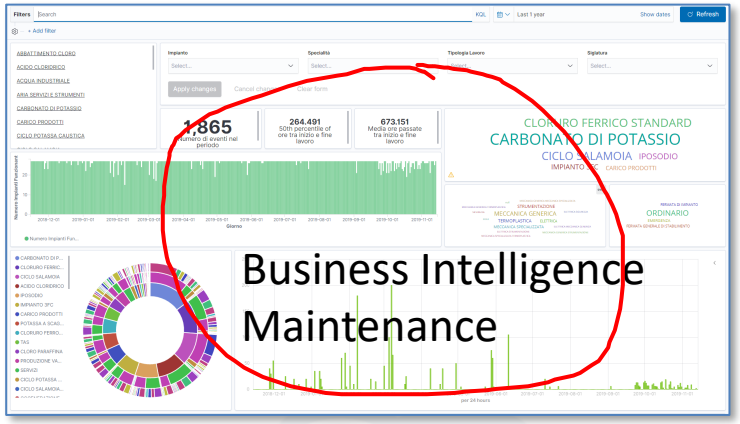
# Workflow for Ticket management

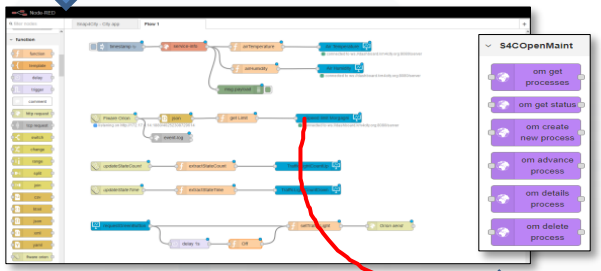


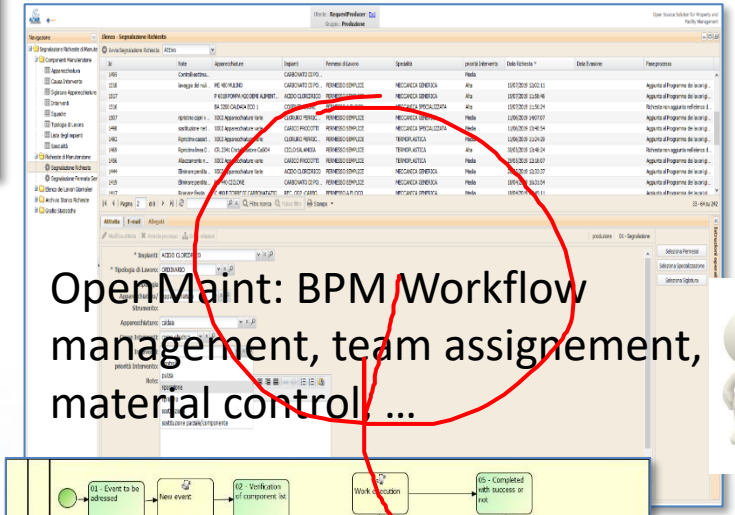

Dashboards and actions

Consumptions/productions

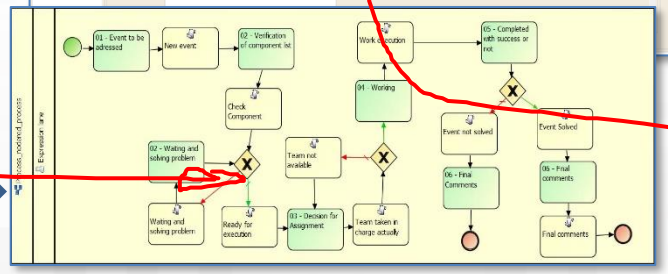
Events/actions

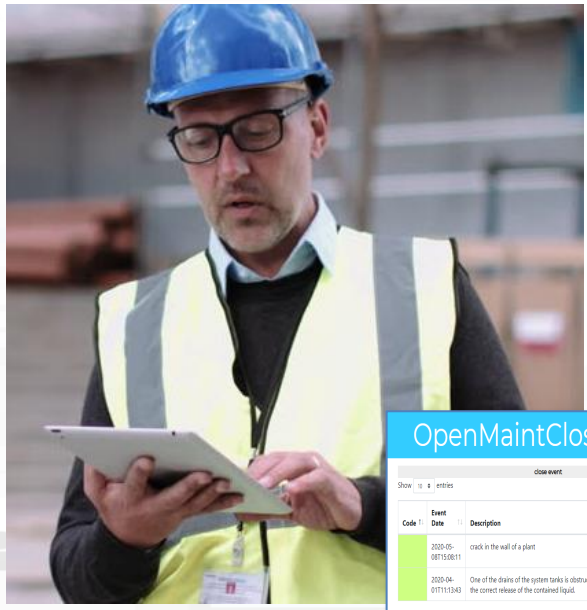


OpenMaint: BPM Workflow management, team assignement, material control, …






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

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

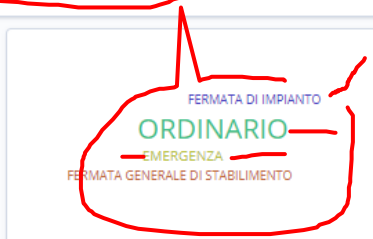
**264.491**
50th percentile of ore tra inizio e fine lavoro

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

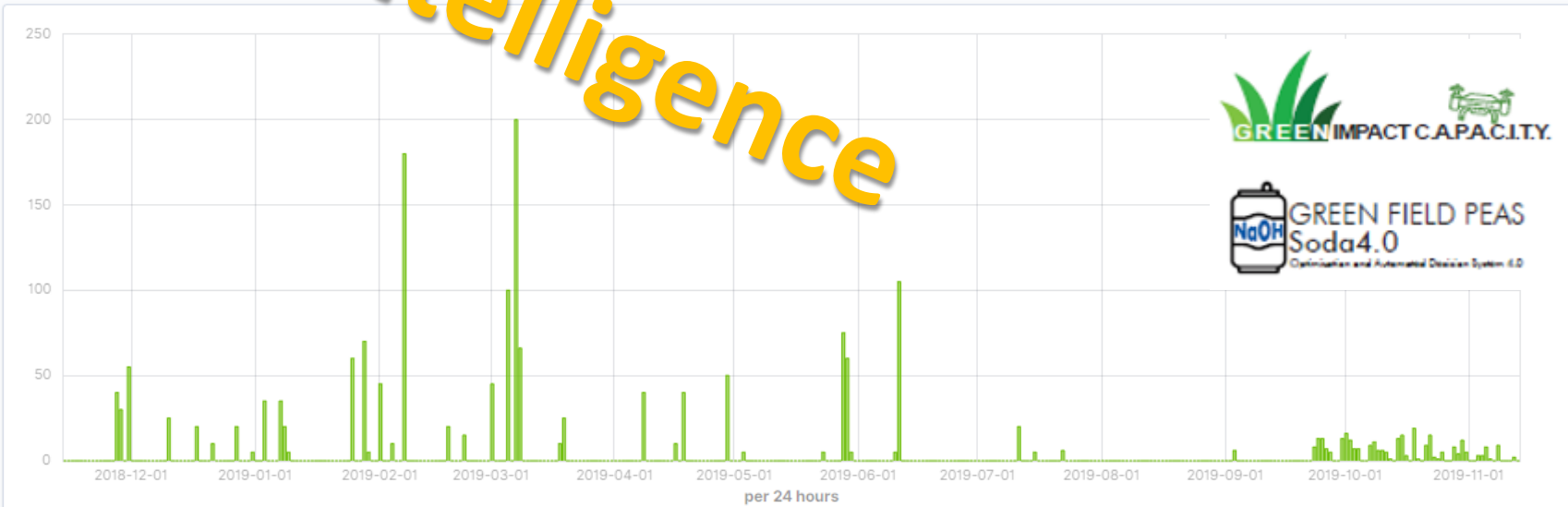
CLORURO FERRICO STANDARD
CARBONATO DI POTASSIO
CICLO SALAMOIA
IPOSODIO
IMPIANTO 3FC
CARICO PRODOTTI

Maintenance Intelligence





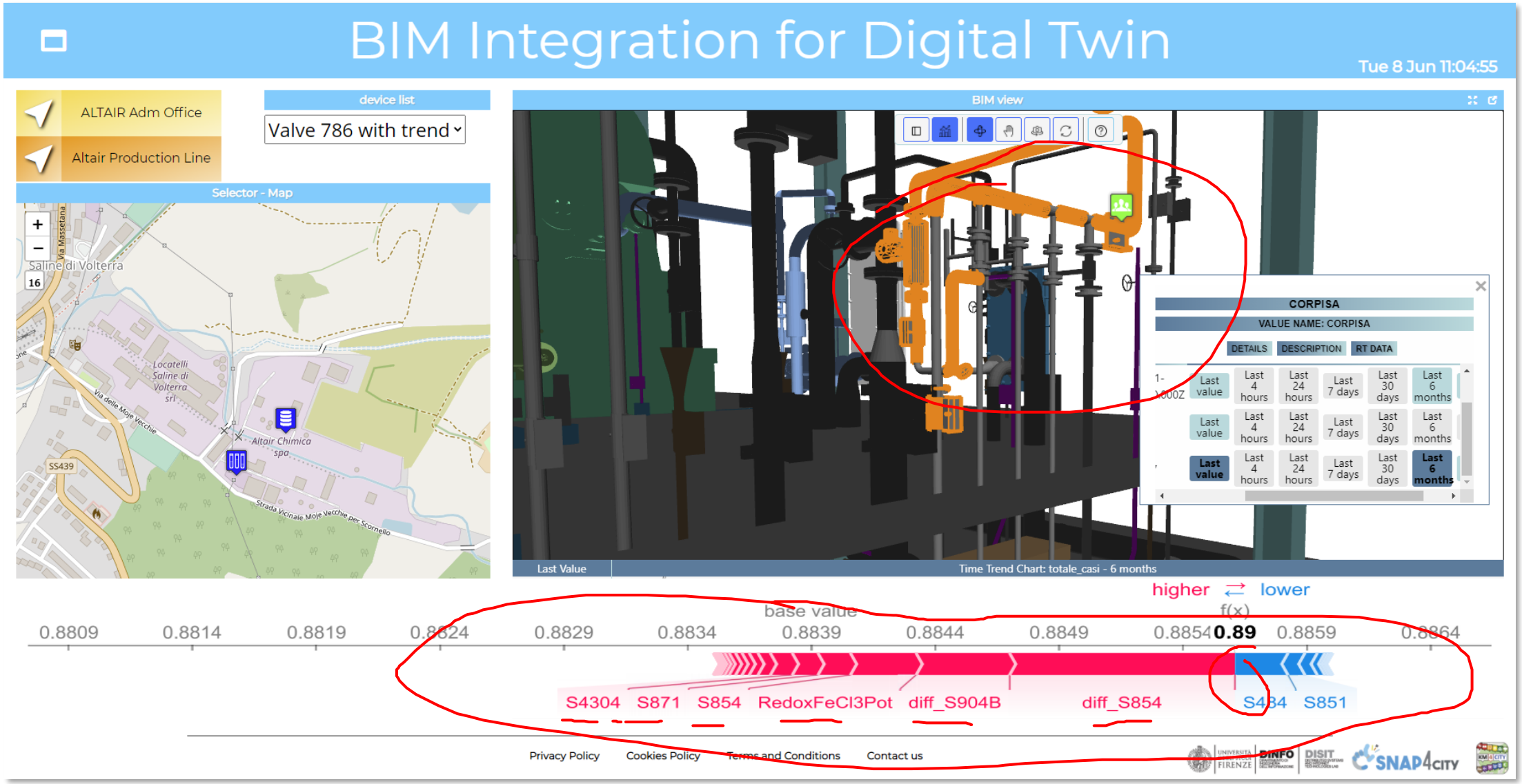

- CARBONATO DI P...
- CLORURO FERRIC...
- CICLO SALAMOIA
- ACIDO CLORIDRICO
- IPOSODIO
- IMPIANTO 3FC
- CARICO PRODOTTI
- POTASSA A SCAG...
- CLORURO FERRO...
- TAS
- CLORO PARAFFINA
- PRODUZIONE VA...
- SERVIZI
- CICLO POTASSA ...
- CICLO SALAMOIA...



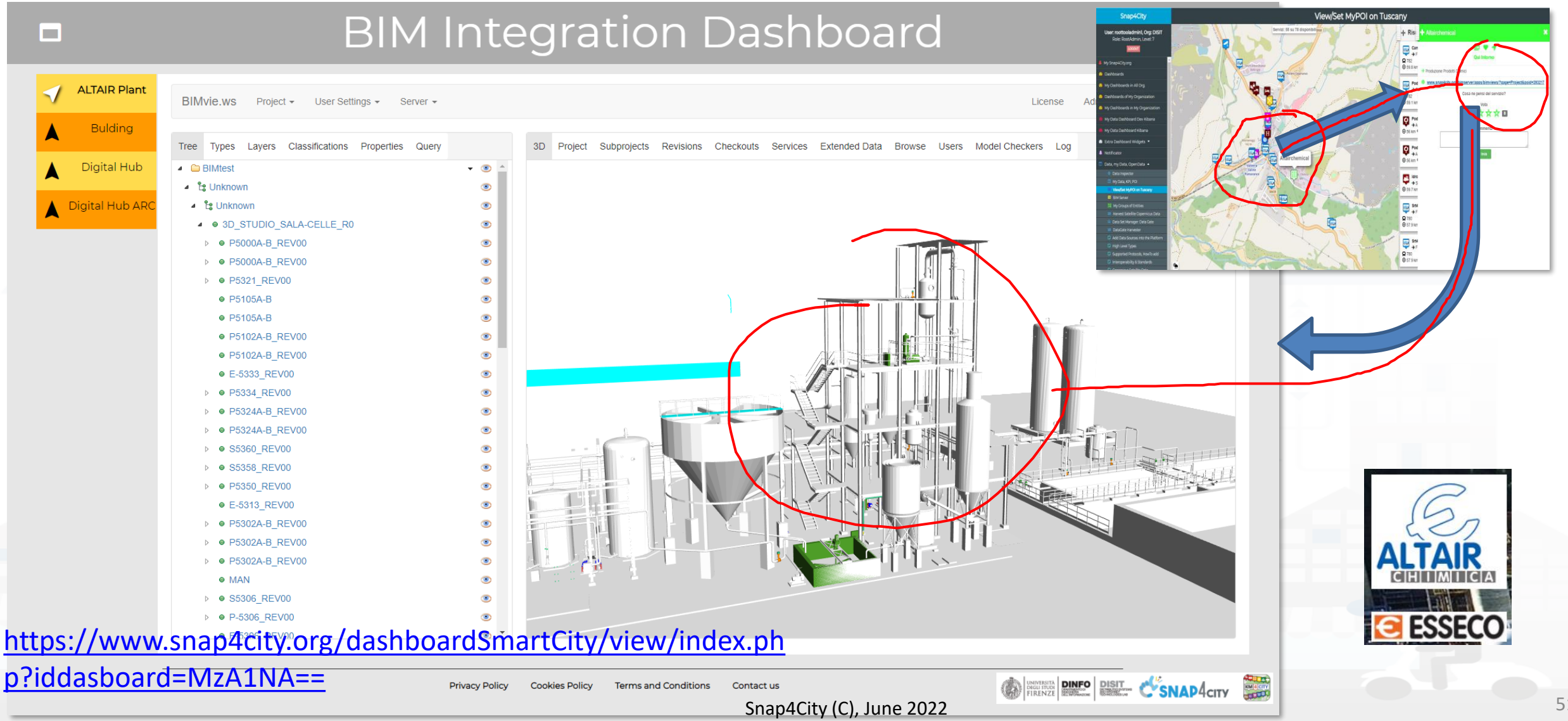

GREEN IMPACT C.A.P.A.C.I.T.Y.

GREEN FIELD PEAS
Soda4.0

# Digital Twin Local, 3D vs Real Time Data

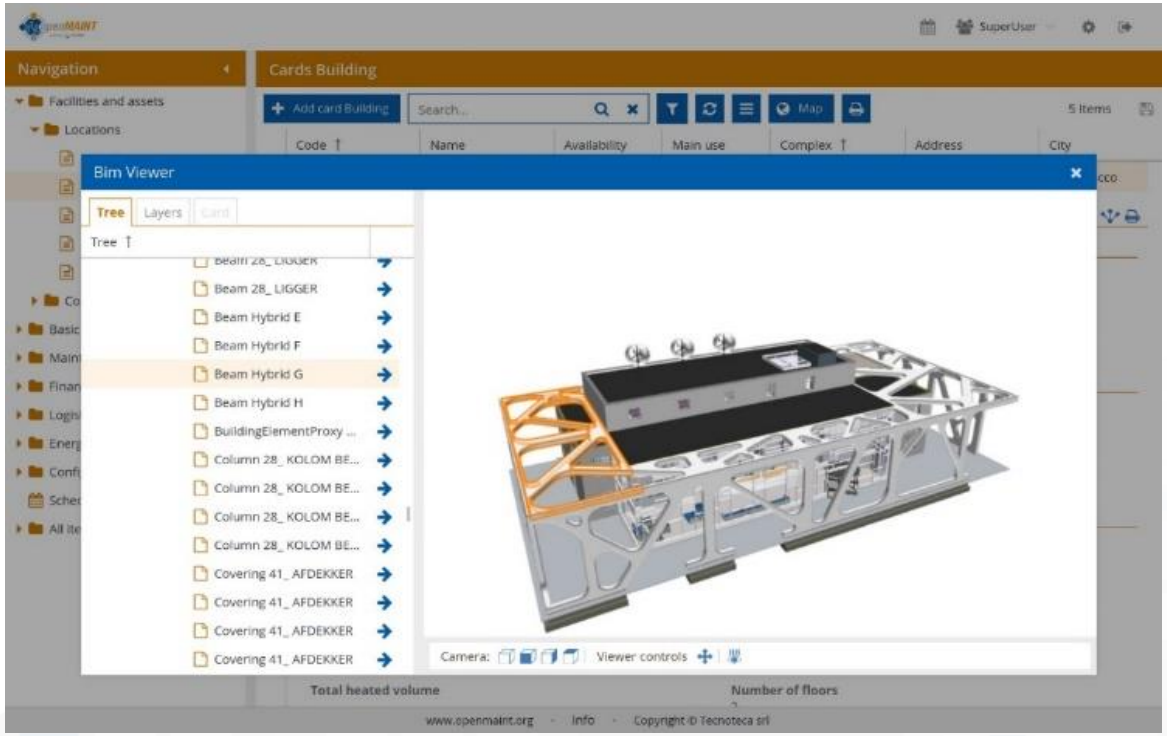


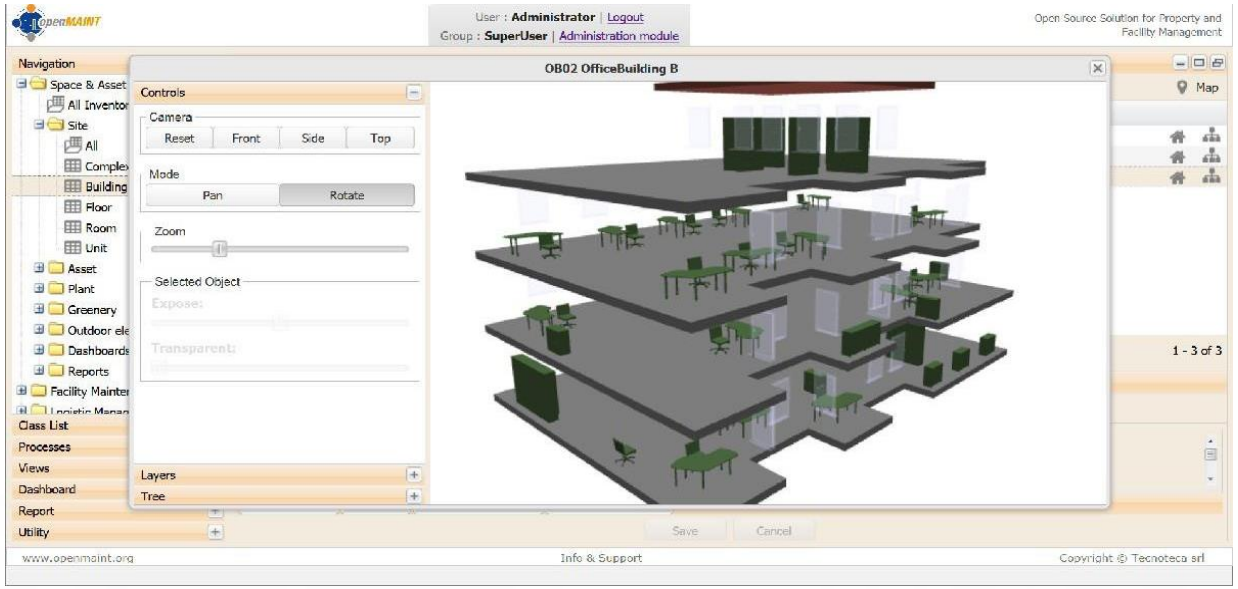
# BIM view of the Altair Chemical Plant

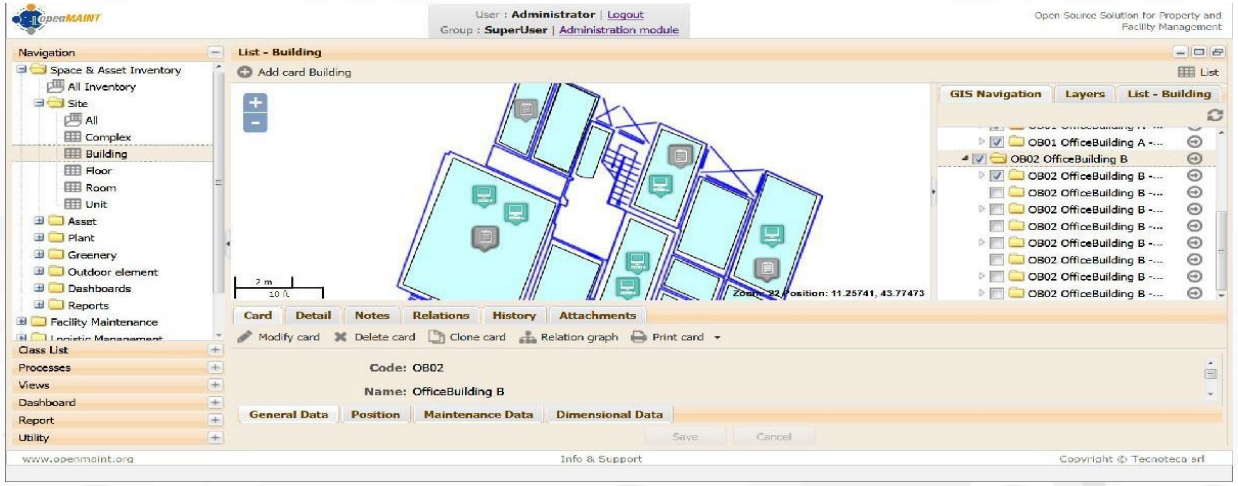



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA1NA==

# OpenMaint BPM, BIMServer



# *Tuscany Region*

# *Firenze, Pisa, Livorno, Prato, etc.*

# Environment and Quality of Life
# Air Quality Predictions

Cities of: Firenze, Pisa, Livorno

reference

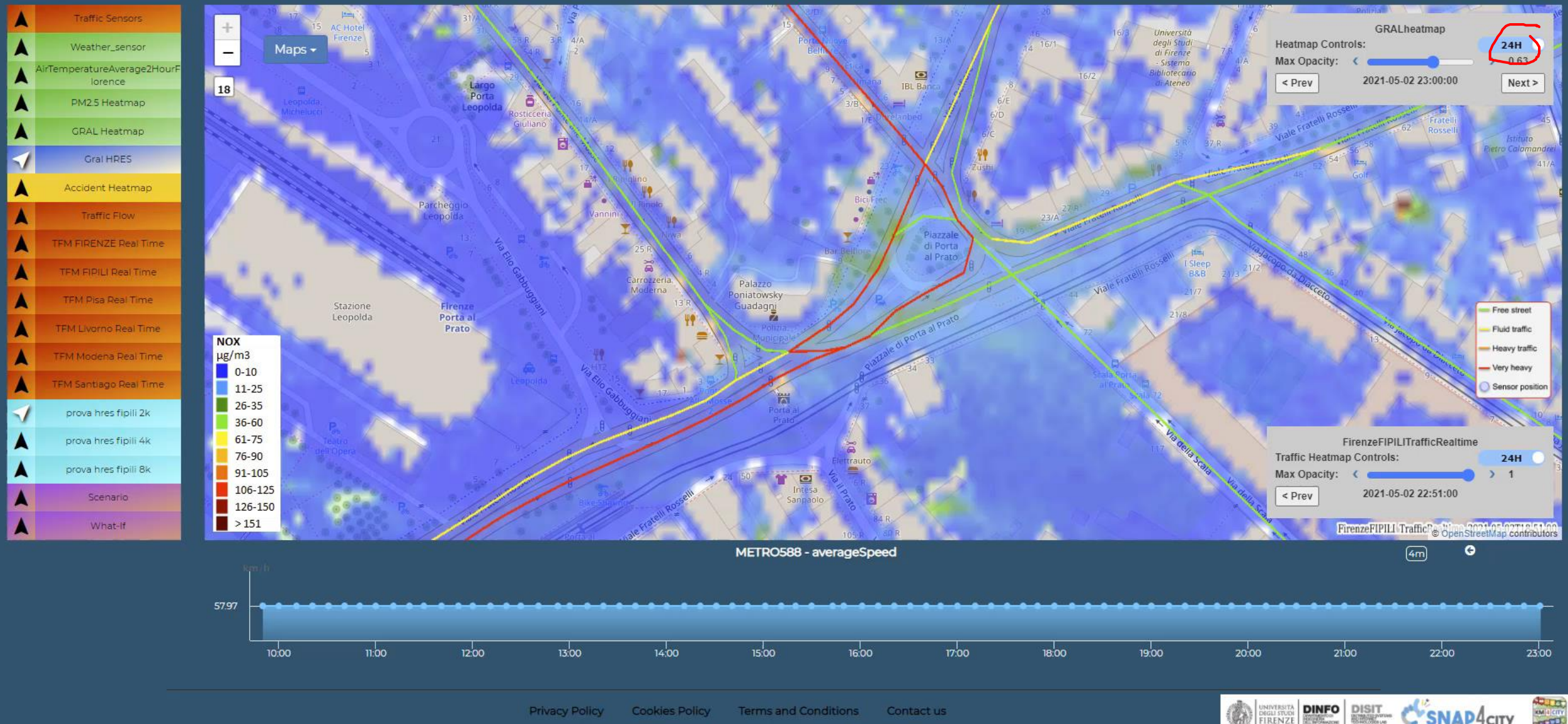
- **Multiple Domain Data**
  - Traffic Flow data, Pollutant: NOX, CO2, PM10, PM2.5, O3, ….
  - 3D City structure, weather, …
- **Multiple Decision Makers**
  - Pollutant Predictions: NOX, NO2, ..
  - City officers, energy industries
  - Dashboards, What-IF analysis
  - Traffic Flow Reconstruction
- **Historical and Real Time data**
  - Billions of Data
- **Services Exploited on:**
  - Dashboards, Mobile App
- **Since 2020**






| Pollutant | Averaging period | Air Quality Directive: Objective and legal nature and concentration | Air Quality Directive: Comments | WHO guidelines: Concentration | WHO guidelines: Comments |
|---|---|---|---|---|---|
| $PM_{2.5}$ | One day | | | 25 µg/m³ (*) | 99th percentile (3 days/year) |
| $PM_{2.5}$ | Calendar year | Target value, 25 µg/m³ | The target value has become a limit value since 1 January 2015 | 10 µg/m³ | |
| $PM_{10}$ | One day | Limit value, 50 µg/m³ | Not to be exceeded on more than 35 days per year. | 50 µg/m³ (*) | 99th percentile (3 days/year) |
| $PM_{10}$ | Calendar year | Limit value, 40 µg/m³ (*) | | 20 µg/m³ | |
| $O_3$ | Maximum daily 8-hour mean | Target value, 120 µg/m³ | Not to be exceeded on more than 25 days per year, averaged over three years | 100 µg/m³ | |
| $NO_2$ | One hour | Limit value, 200 µg/m³ (*) | Not to be exceeded more than 18 times a calendar year | 200 µg/m³ (*) | |
| $NO_2$ | Calendar year | Limit value, 40 µg/m³ | | 40 µg/m³ | |

# Traffic Flow Manager on multiple cities



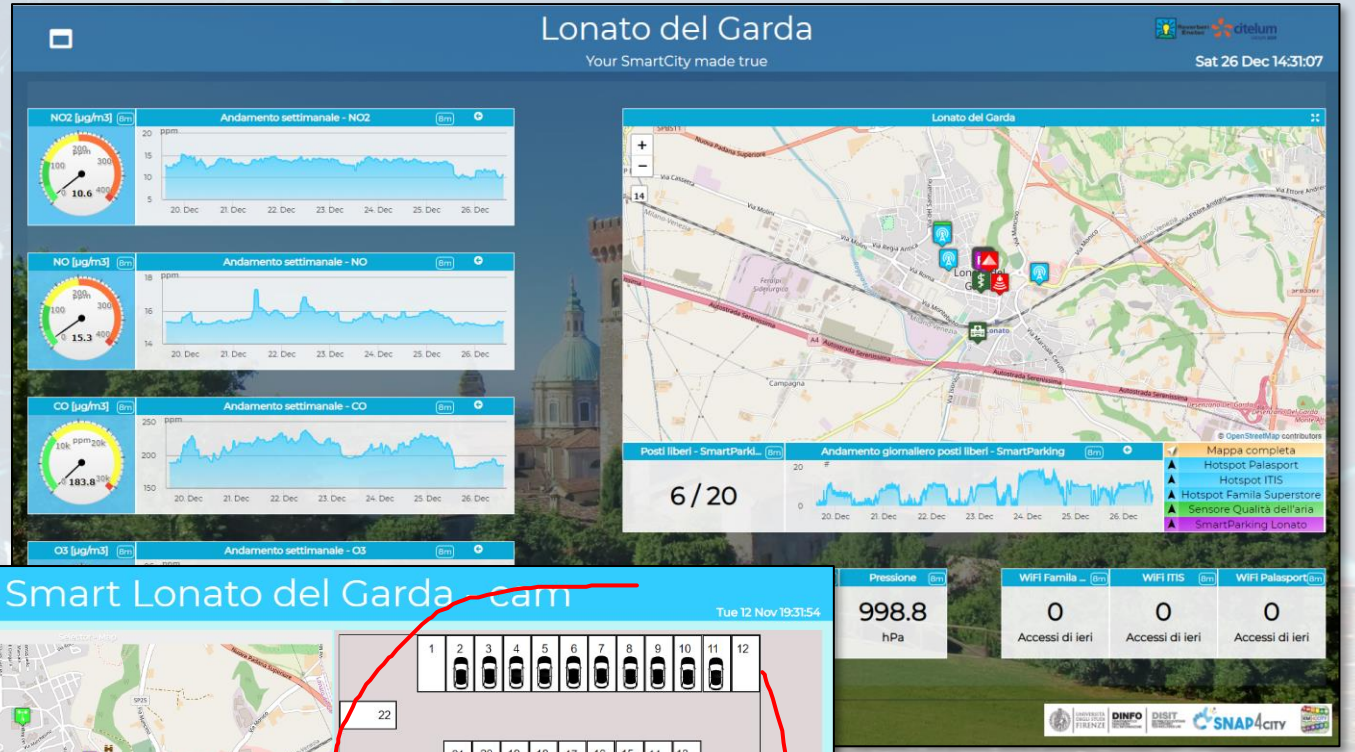

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzEyNg==

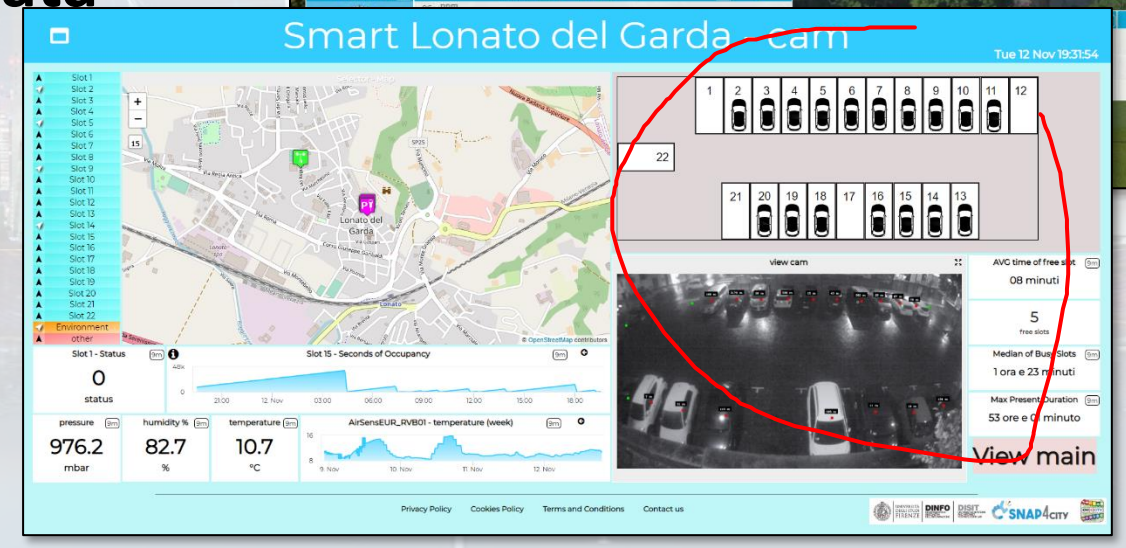

Lonato del Garda

# Smart City / Smart Parking + Environment Reverberi, Lonato del Garda

reference

- **Multiple Domain Data**
  - Smart Parking, Environment, Wi-Fi
- **Multiple Decision Makers**
  - City Officer, operators
  - Data monitoring, alerting
  - analytics
- **Historical and Real Time data**
  - Dashboards
- **Services Exploited on:**
  - Dashboards, API
- **Since 2019**

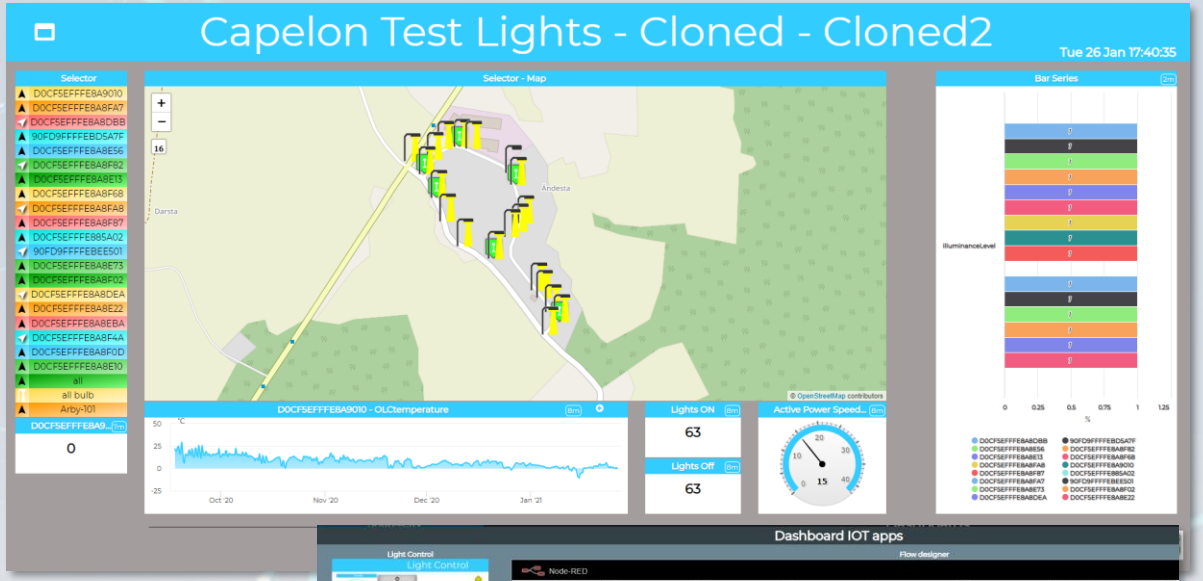


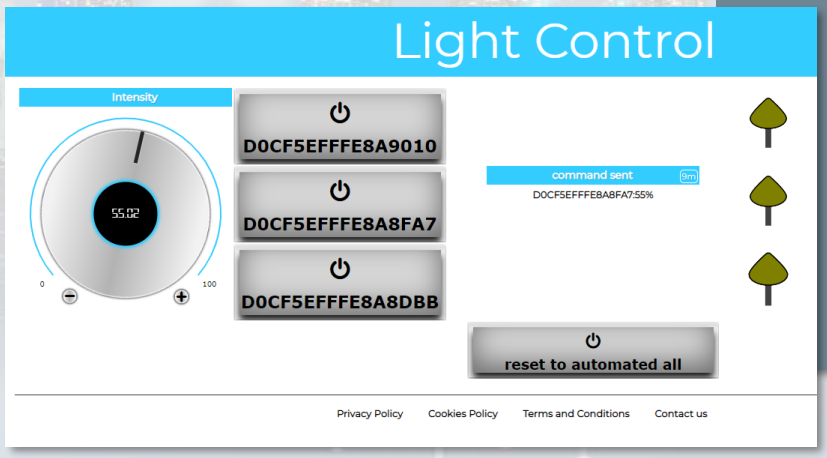



# *Västerås*

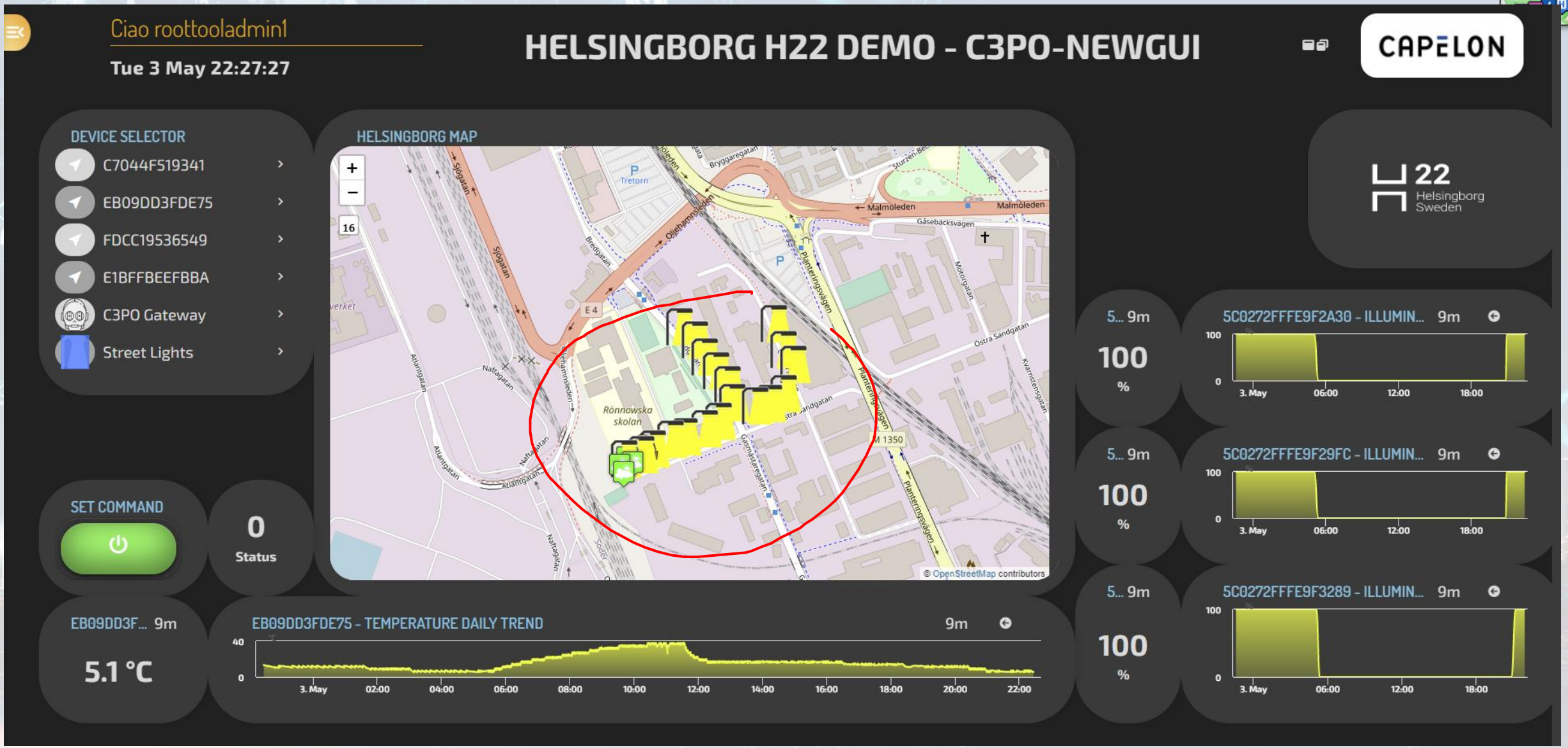
# *Smart Light Control of* CAPELON reference

- **Energy Domain**
  - Smart Light
  - IoT Orion Broker FIWARE
- **Dashboards**
  - Map coverage on Sweden
  - Monitoring and real  time control
  - Energy control, analytics
  - Direct control
- **Historical and Real Time data**
- **Services Exploited on:**
  - Multiple Levels, API
  - Dashboards
- **Since 2020**



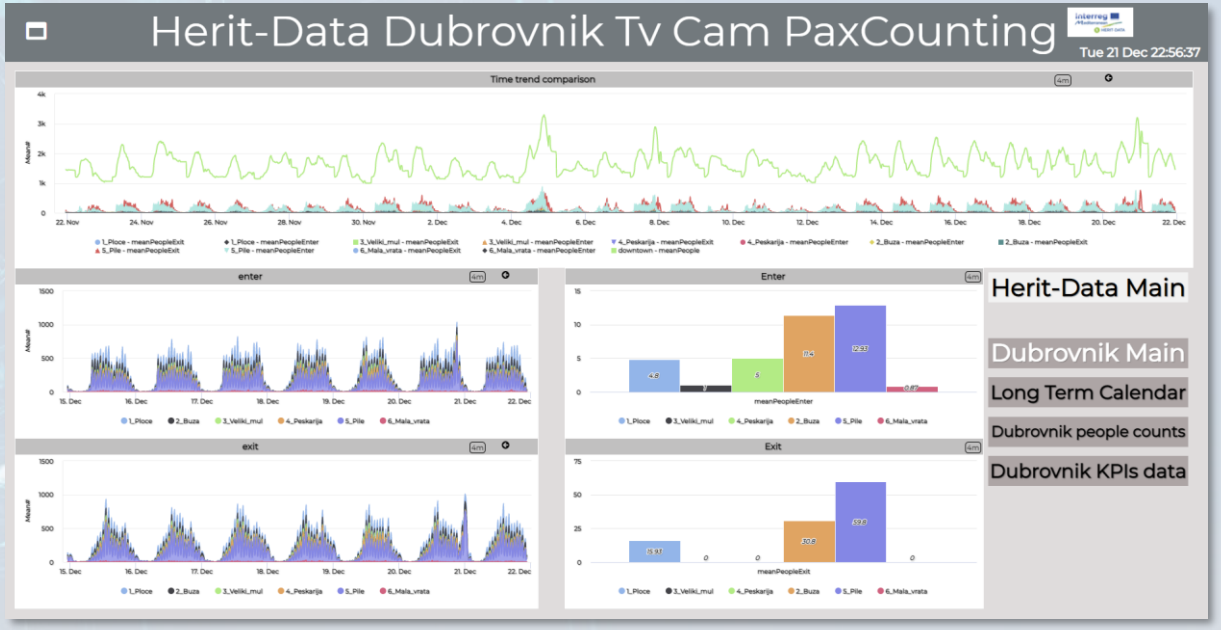
# C3PO Street Lights

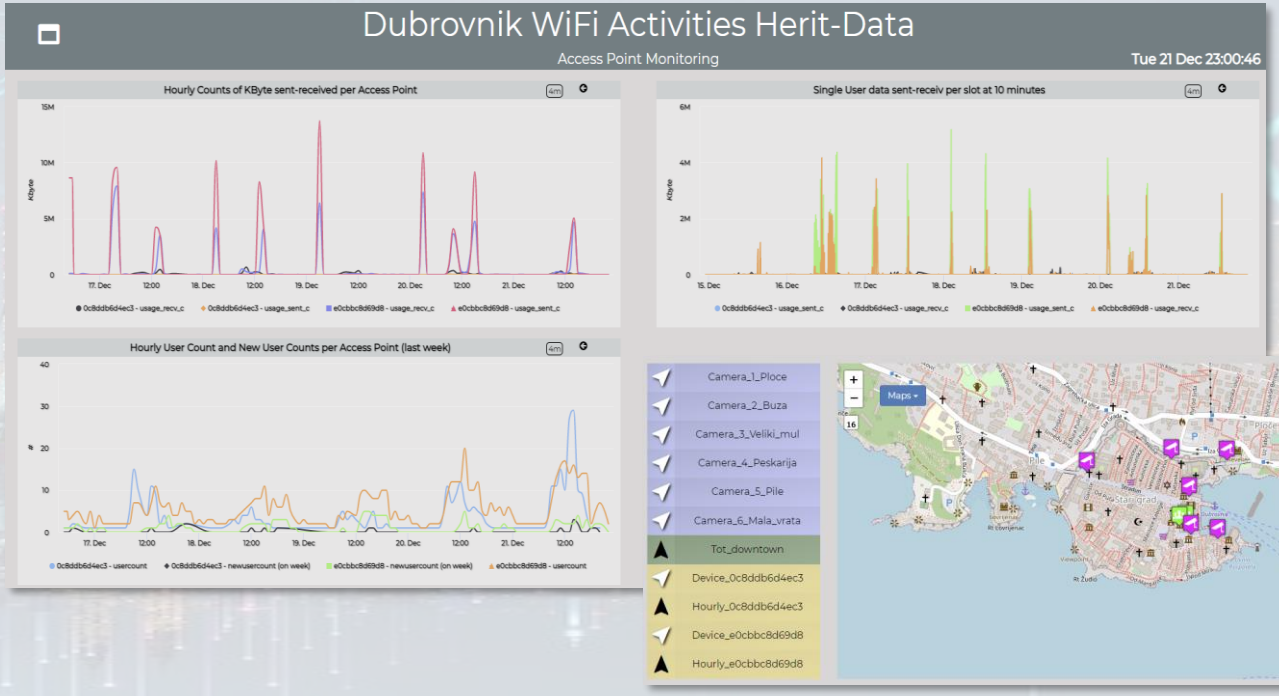



# *Dubrovnik, Croatia*

# Dubrovnik

- **KPI**
  - #overnights
  - #Cruise Passengers vs time
  - Environmental data
  - Tourists per Countries
  - Employers of the sector vs time
- **Real Time data**
  - PAX Counting via TV Cam
  - Pax Counting via Wi-Fi
  - Volume of Citizens vs Tourists
- **Social Media, Real Time**
  - A Set of Key: keywords, Hashtags, Citations
  - Volume of Tweets per Key and total
  - Sentiment Volume per Key and total

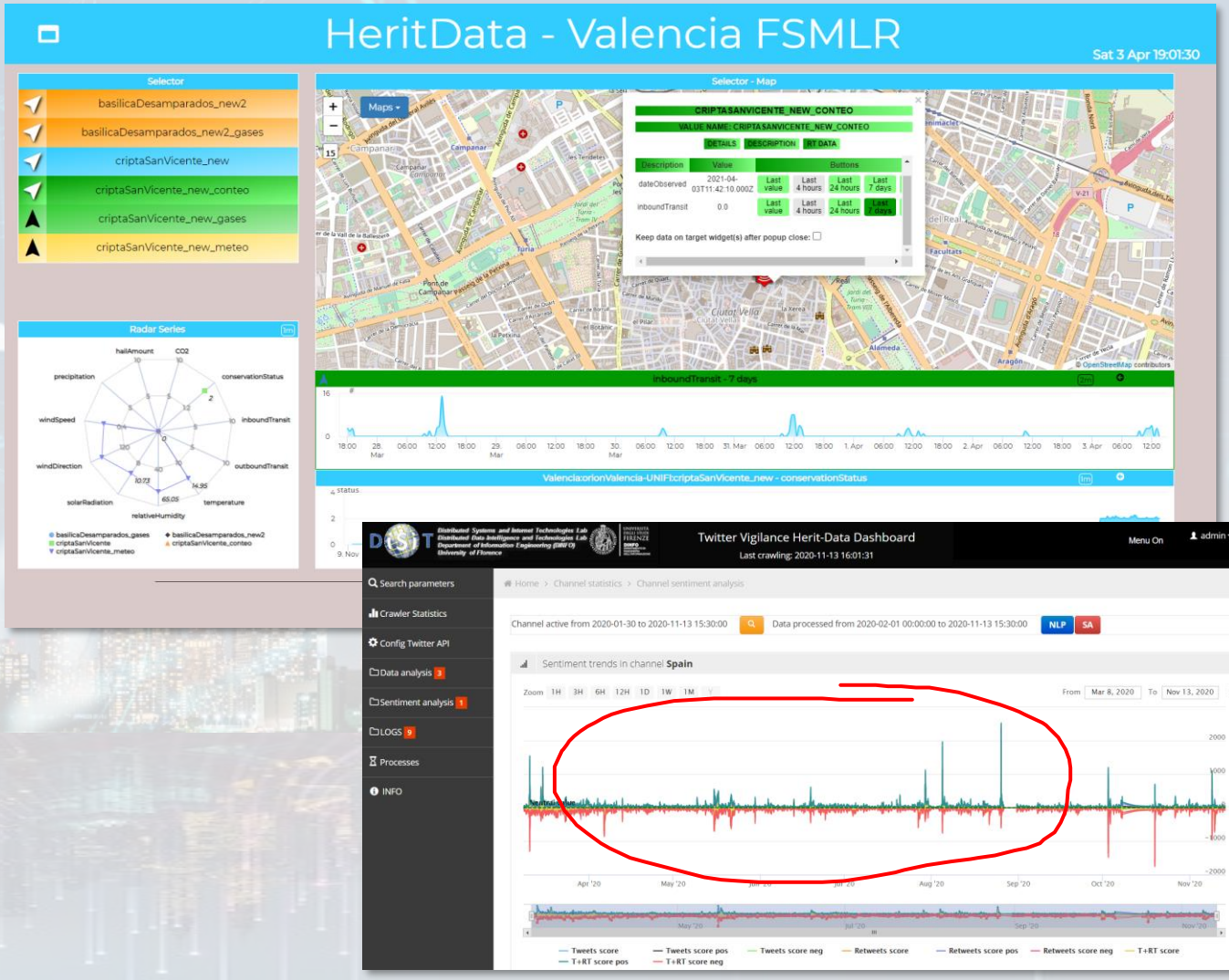



Interreg
MedRerranean
HERIT-DATA
Valencia, Spain

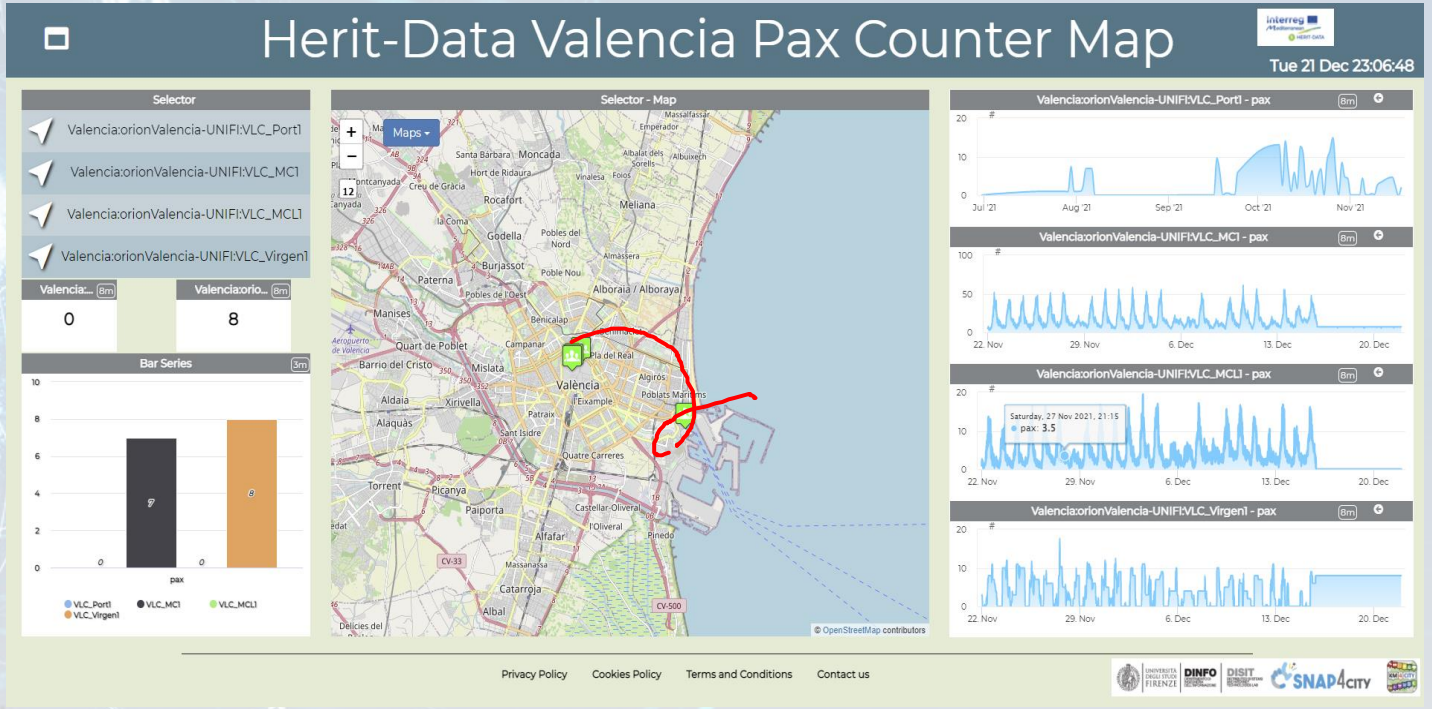
# Valencia, FSMLR

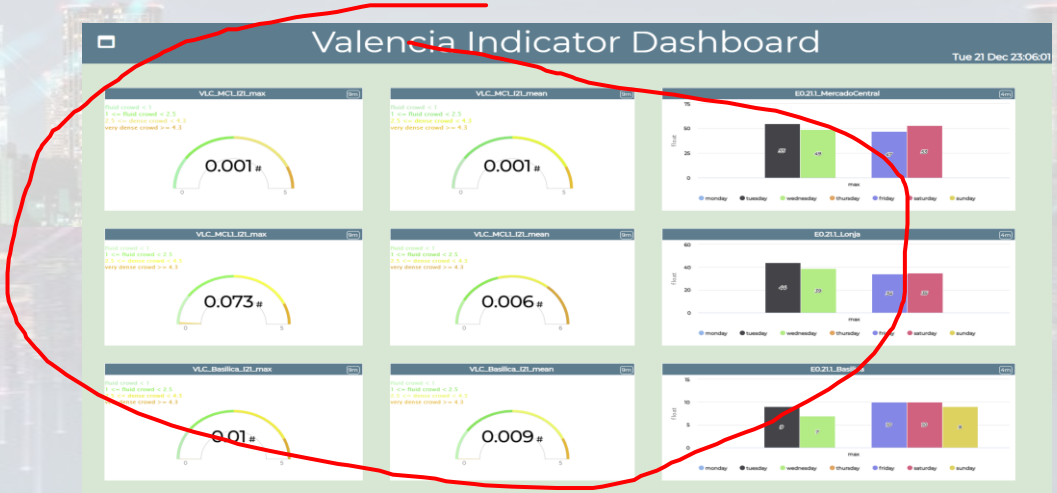
- **Tourism Domain**
  - Counting People
  - Environmental data
  - Social Media
- **Dashboards**
  - Monitoring and real  time control
  - People flow
  - Twitter Vigilance
- **Historical and Real Time data**
- **Services Exploited on:**
  - Dashboard
- **Since 2020**



# Valencia, FSMLR

- **KPI**
  - People
  - Environmental Data
- **Real Time**
  - PAX Counters
  - Environmental Data
- **Social Media, Real Time**
  - A Set of Key: keywords, Hashtags, Citations
  - Volume of Tweets per Key and total
  - Sentiment Volume per Key and total

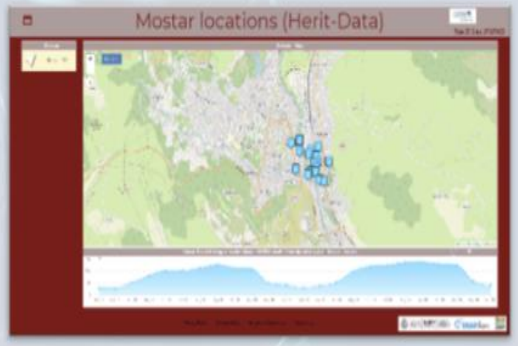


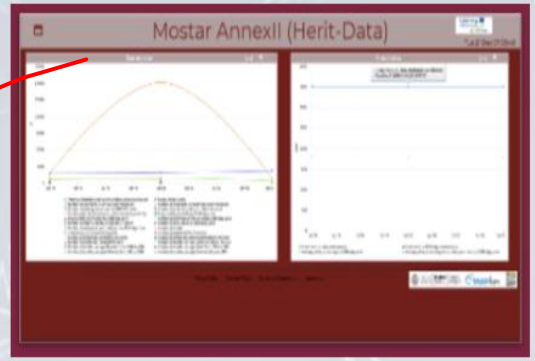



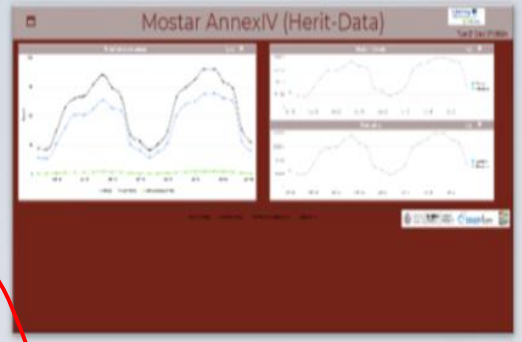
# Mostar, Bosnia-Herzegovina

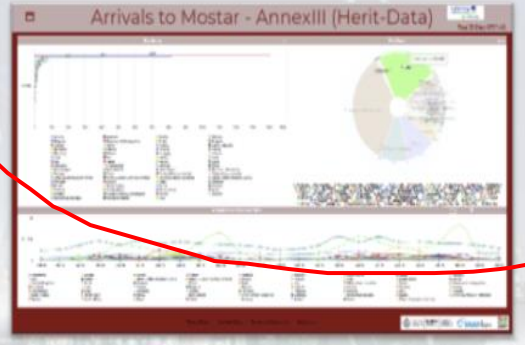
# Mostar, Bosnia Herzegovina

- **Tourism Domain**
  - KPI: business, house prices, investments, stay duration, etc.
  - Profiled POI, Point of Interests
  - People flows: arrivals, overhights
- **Dashboards**
  - Monitoring KPI
  - POI, flows
- **Historical and updated data**
- **Services Exploited on:**
  - Dashboard
- **Since 2020**



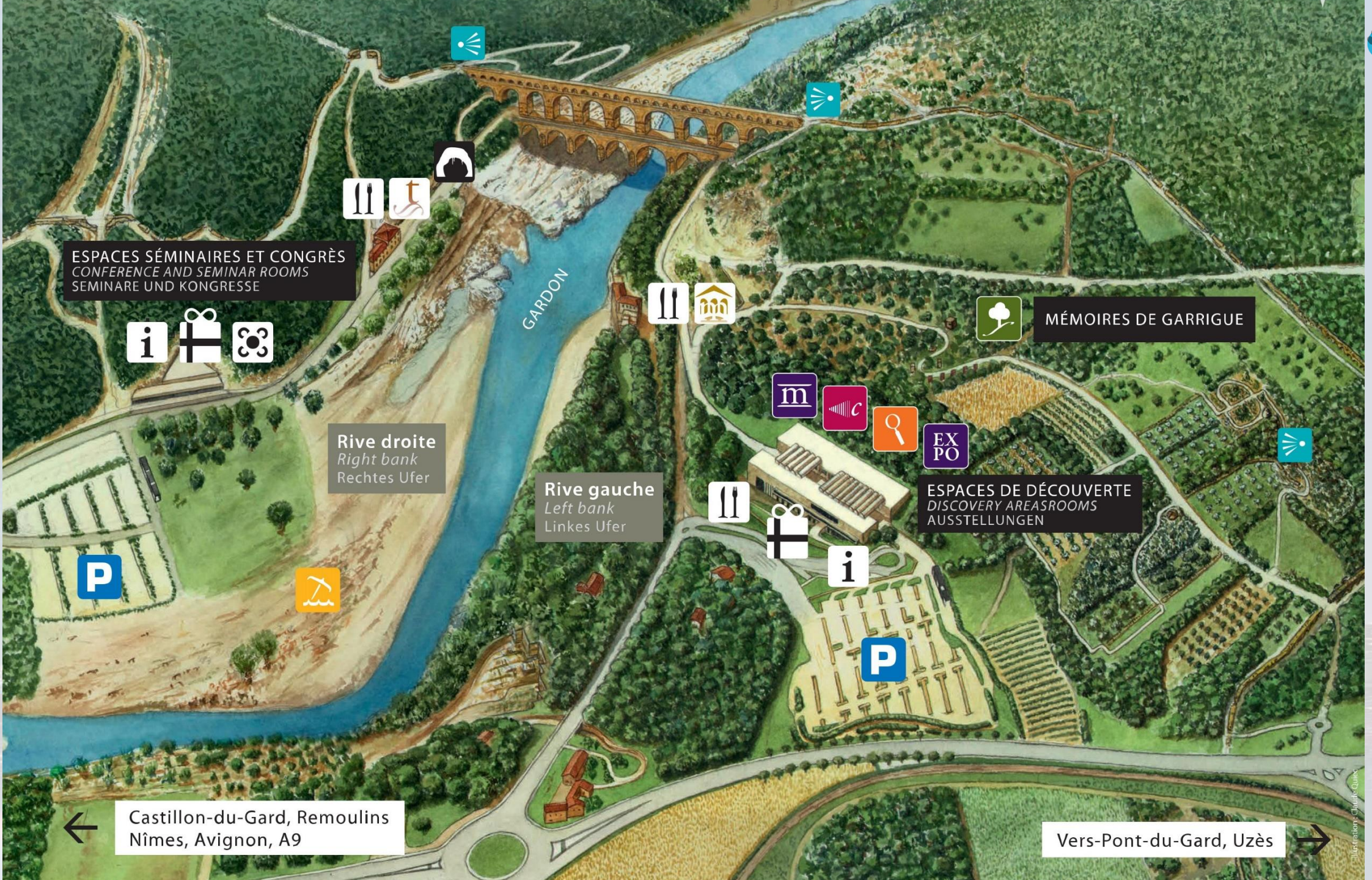



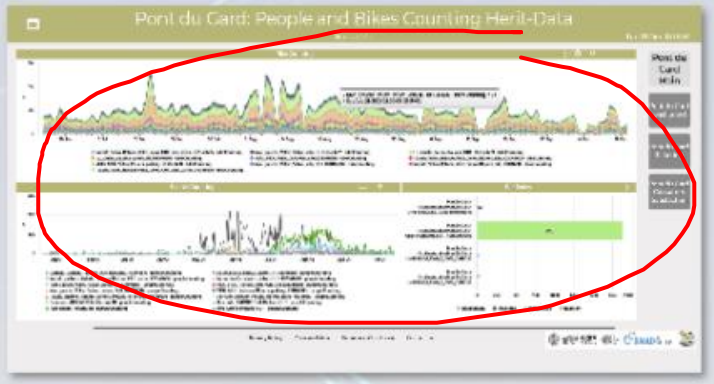

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzE0OQ==

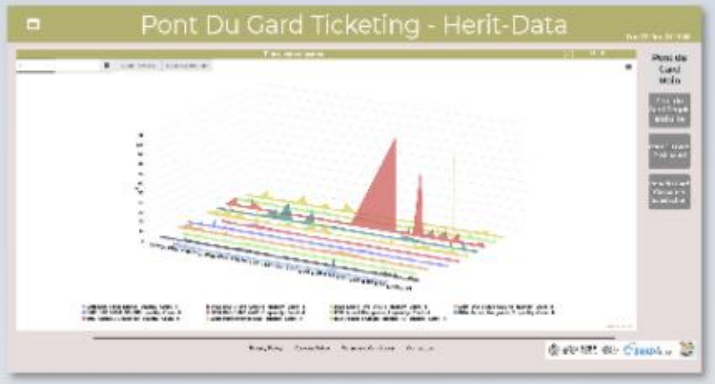

Interreg
Mediterranean
HERIT-DATA
Pont du Gard, Fr

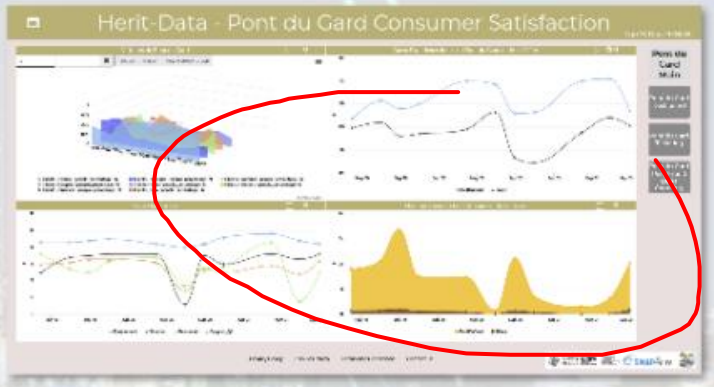

ESPACES SÉMINAIRES ET CONGRÈS
CONFERENCE AND SEMINAR ROOMS
SEMINARE UND KONGRESSE
GARDON
MÉMOIRES DE GARRIGUE
Rive droite
Right bank
Rechtes Ufer
Rive gauche
Left bank
Linkes Ufer
EXPO
ESPACES DE DÉCOUVERTE
DISCOVERY AREASROOMS
AUSSTELLUNGEN
Castillon-du-Gard, Remoulins
Nîmes, Avignon, A9
Vers-Pont-du-Gard, Uzès

# Pont du Gard

- **Tourism Domain**
  - KPIs
  - Social Media
  - People Flows
  - Bike Flows
- **Dashboards**
  - Monitoring KPI
  - People and bikes flows
  - Twitter Vigilance
- **Historical and updated data**
- **Services Exploited on:**
  - Dashboard
- **Since 2020**

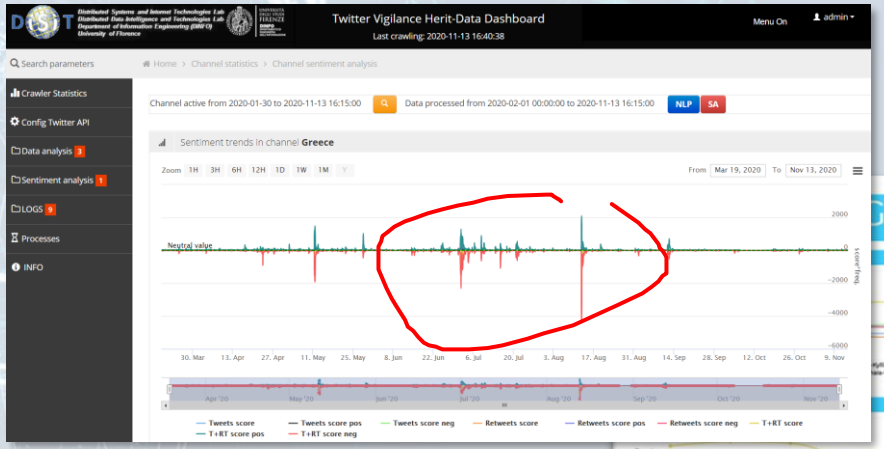


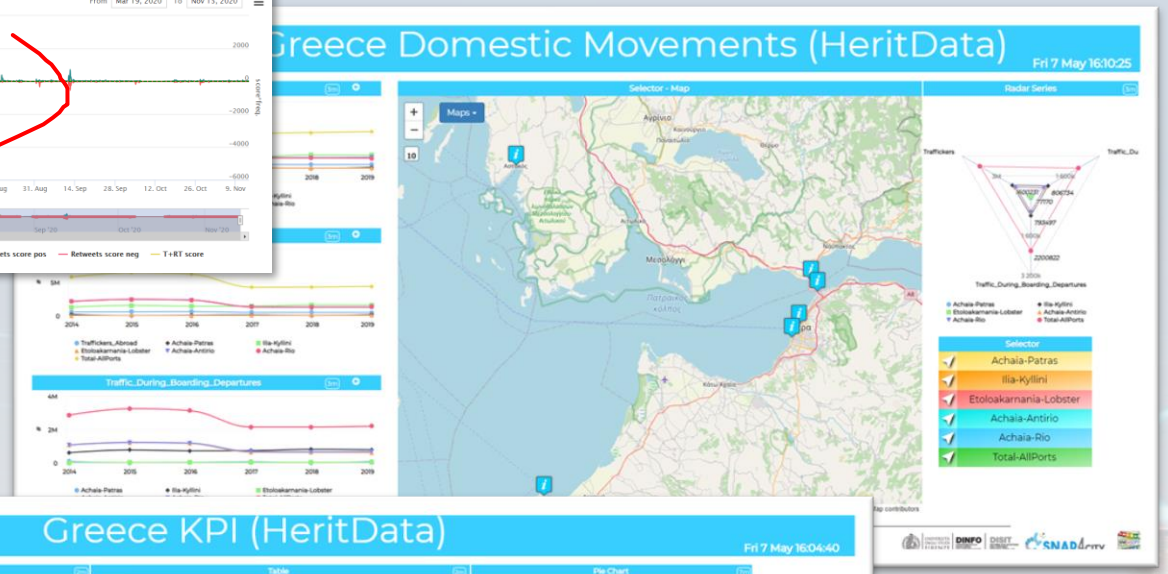
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzE1Mw==

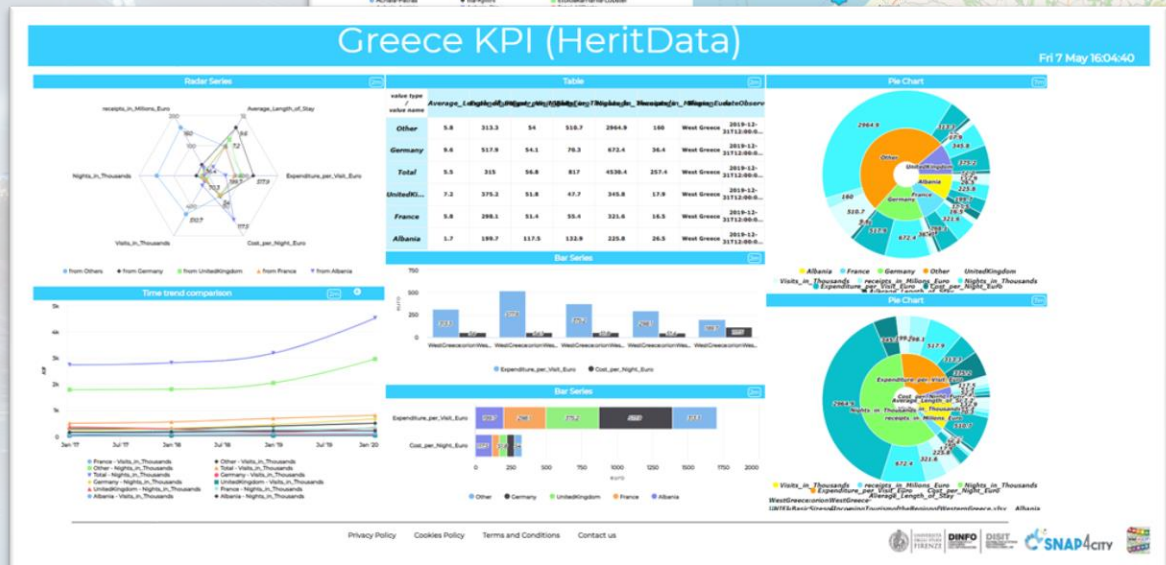

Interreg
Mediterranean
HERIT-DATA
West Greece

# West Greece

- **Tourism Domain**
  - KPIs
  - Social Media
  - People Flows
  - Social Media
- **Dashboards**
  - Monitoring KPI
  - People flows
  - Twitter Vigilance
- **Historical and updated data**
- **Services Exploited on:**
  - Dashboard
- **Since 2020**



# *Santiago di Compostela*

# Traffic Flow Reconstruction for the cities

Sun 3 Nov 20:37:43


# *Santiago di Compostela*

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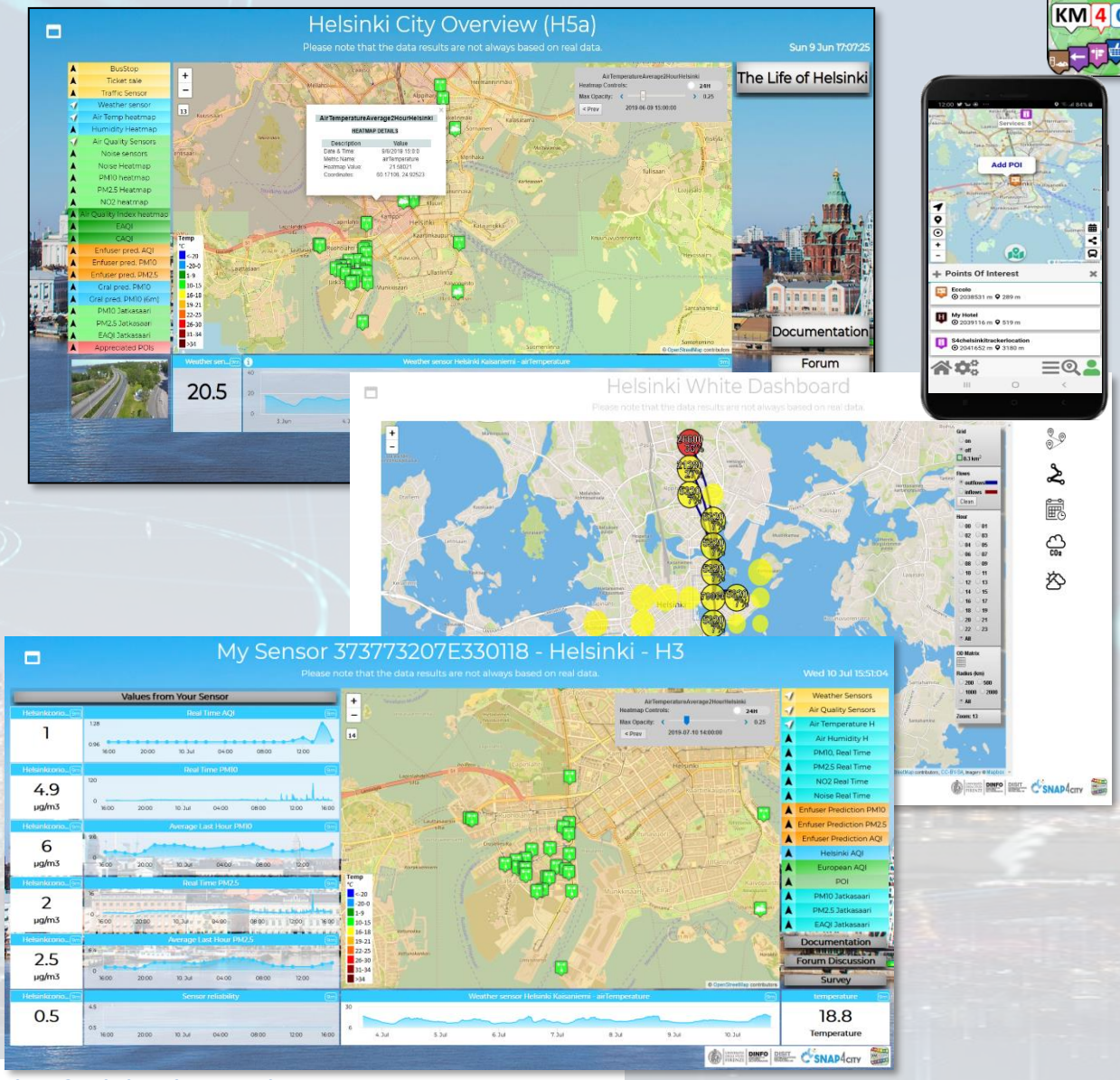
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTc5NQ==

# *Helsinki*

# Helsinki Case

- **Dashboards & Services**:
  - **Environment** & **Weather**, PM10, PM2.5,NO,  SO2, CO, noise, etc.
    - Sensors values, Heatmap & **Alerts** on critical
    - FMI Enfuser prediction: PM10, PM2.5, ..
    - GRAL predictions PM10, validations
    - Private sensors in Jätkäsaari area (personal dashboards)
  - **Mobility**: Traffic Sensors, Operators, routing, multimodal routing, whatif
  - **Social**: Twitter Vigilance, early warning
  - **Life in Helsinki**: OD matrix people flow, Twitter Vigilance SA, hot places, etc.
  - **Tourism and Culture**
- **Mobile App and MicroApplications:**
  - Helsinki in a Snap (all stores)



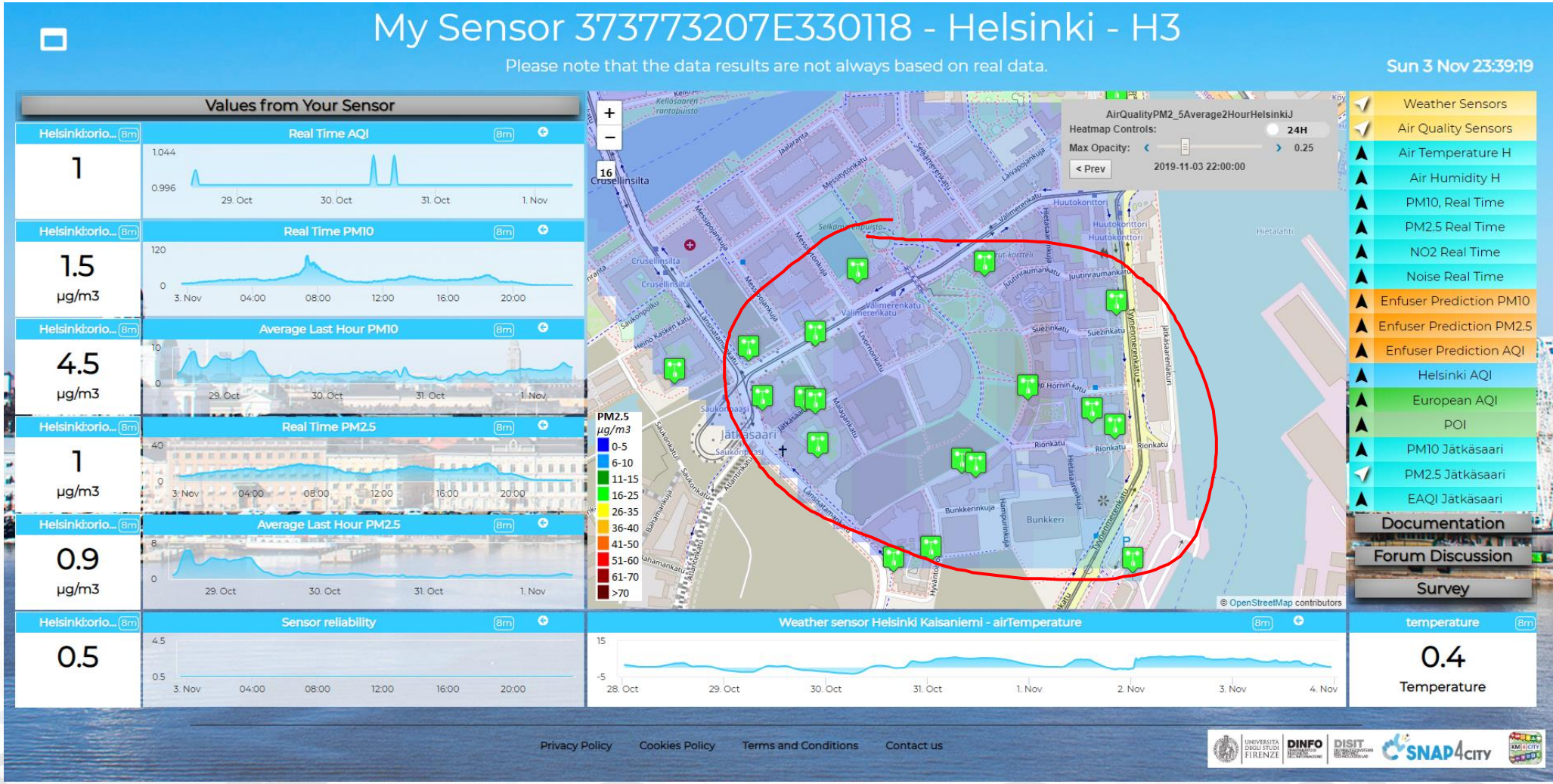

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MTQwNg==

# Environmental Data Predictions: GRAL

- **GRAL predictions: PM10, NOX, ….**
  - **Comparison wrt real time values in actual value of Sensors**
  - Graz Lagrangian Model.
- GRAL model takes into account:
  - pollution sources (for example the vehicles, their distribution on the streets, the about of pollution they produce according to their distribution over time and space, etc.),
  - structure of the city (streets and shape 3D of the buildings),
  - weather forecast (wind intensity and direction), etc.
- GRAL can be applied on NOX, PM10, PM2.5, … or any other particles


TRAFAIR

# Environmental Devices hosted by Citizens



# https://www.snap4city.org/4

## Scenarious

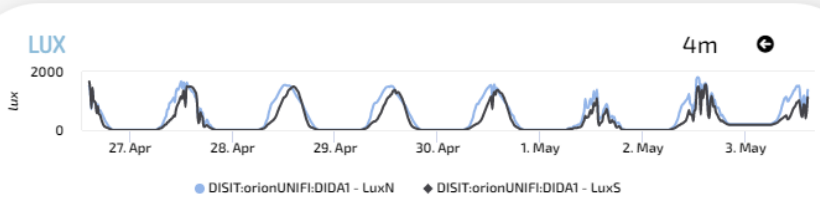
- Scenario: SnapBot: Real Time Smart City services via Telegram
- Scenario: Copernicus Satellite Data
- Scenario: SmartBed, Materasso Intelligente
- MicroServices Suite for Smart City Applications
- Scenario: MODBUS for Snap4Industry Snap4City Applications
- Scenario: MOBIMART Interreg: MOBilità Intelligente MARe Terra
- Scenario: City of Roma case, mobility and environmental data
- Scenario: Herit-Data video and aims
- Scenario: Control Room vs Video Wall
- Scenario: Snap4Home the case of: Alexa, Philips, Sonoff, TP-link, etc. (Italiano)
- Scenario: how to manage maintenance and accidents workflows
- Scenario: Snap4Home, how to exploit Snap4City solution on home automation
- Scenario: Energy Monitoring
- Scenario: Multipurpose User Engagement Tools
- Scenario: 5G Enabled Water Cleaning Control (smart city, industry 4.0)
- Scenario: High Level Control of Industrial Plant (industry 4.0)
- Scenario: Vehicle Monitoring via OBD2
- Scenario: Events and Museums Monitoring in Antwerp
- Scenario: High Resolution Prediction of Environmental Data
- Scenario: Mobility and Transport Analyses in multiple cities
- Scenario: People Flow Analysis via Wi-Fi
- Scenario: Antwerp Pilot on Environmental Data
- Scenario: Helsinki Pilot on Environmental Data
- Scenario: Firenze Smart City Control Room
- Scenario: Mobile & Web App: Toscana Where What … Km4City, Toscana in a Snap
- Scenario: Helsinki Pilot on User Behaviour
- Scenario: Antwerp Pilot on User Behaviour
- Data Analytic: Origin Destination Matrices, Algorithms and tools
- Data Analytic: Traffic Flow Reconstruction
- Data Analytic: in general, and the cases of Antwerp and Helsinki
- Data Analytic: Predicting Air Quality
- Data Analytic: Analyzing Public Transportation Offer wrt Mobility Demand

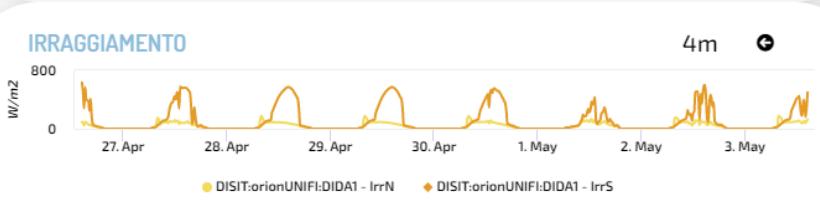
# Smart Building

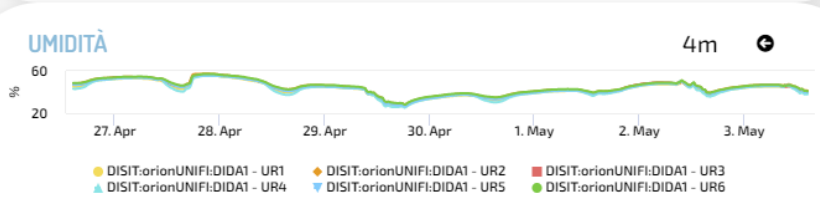
Ciao roottooladmin1

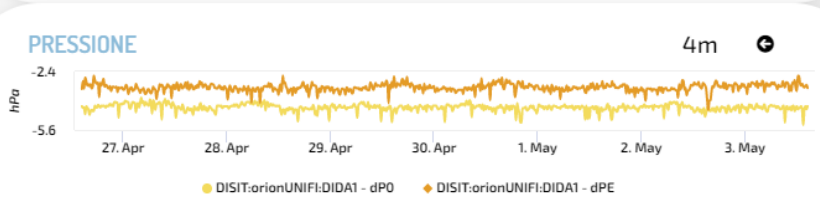
**Tue 3 May 14:37:14**

## DIDA DATA 2 - NEWGUI



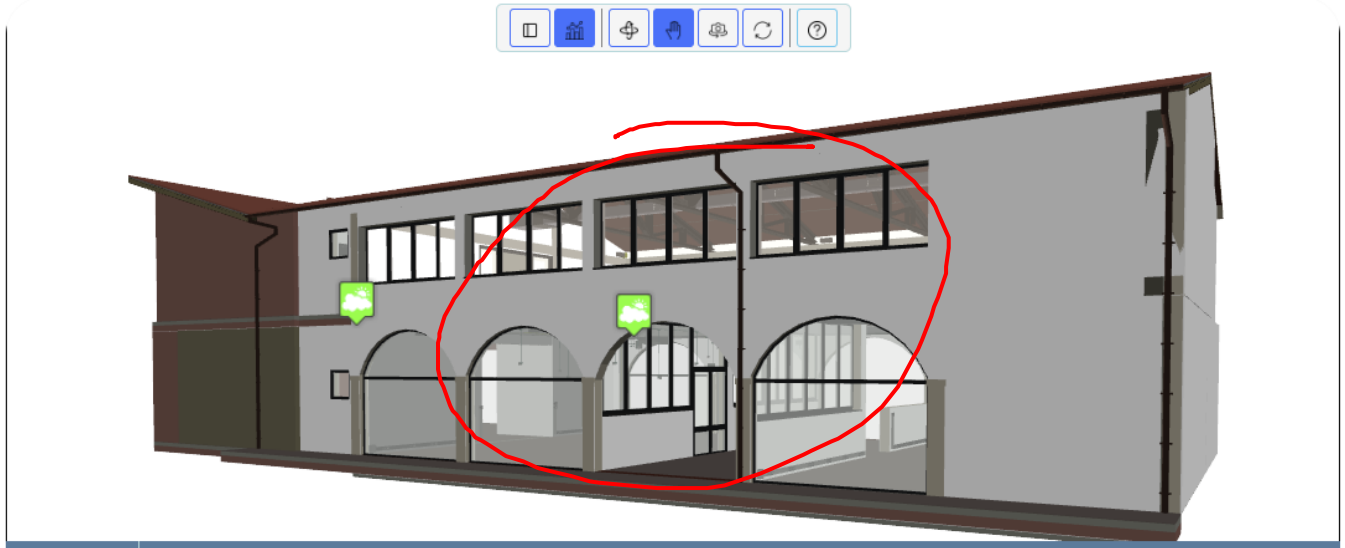



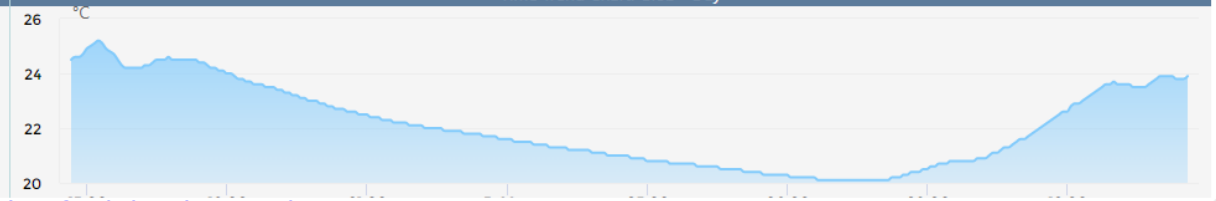




to see BIM log as user: info@disit.org, passwd: guest

BIM SANTA VERDIANA

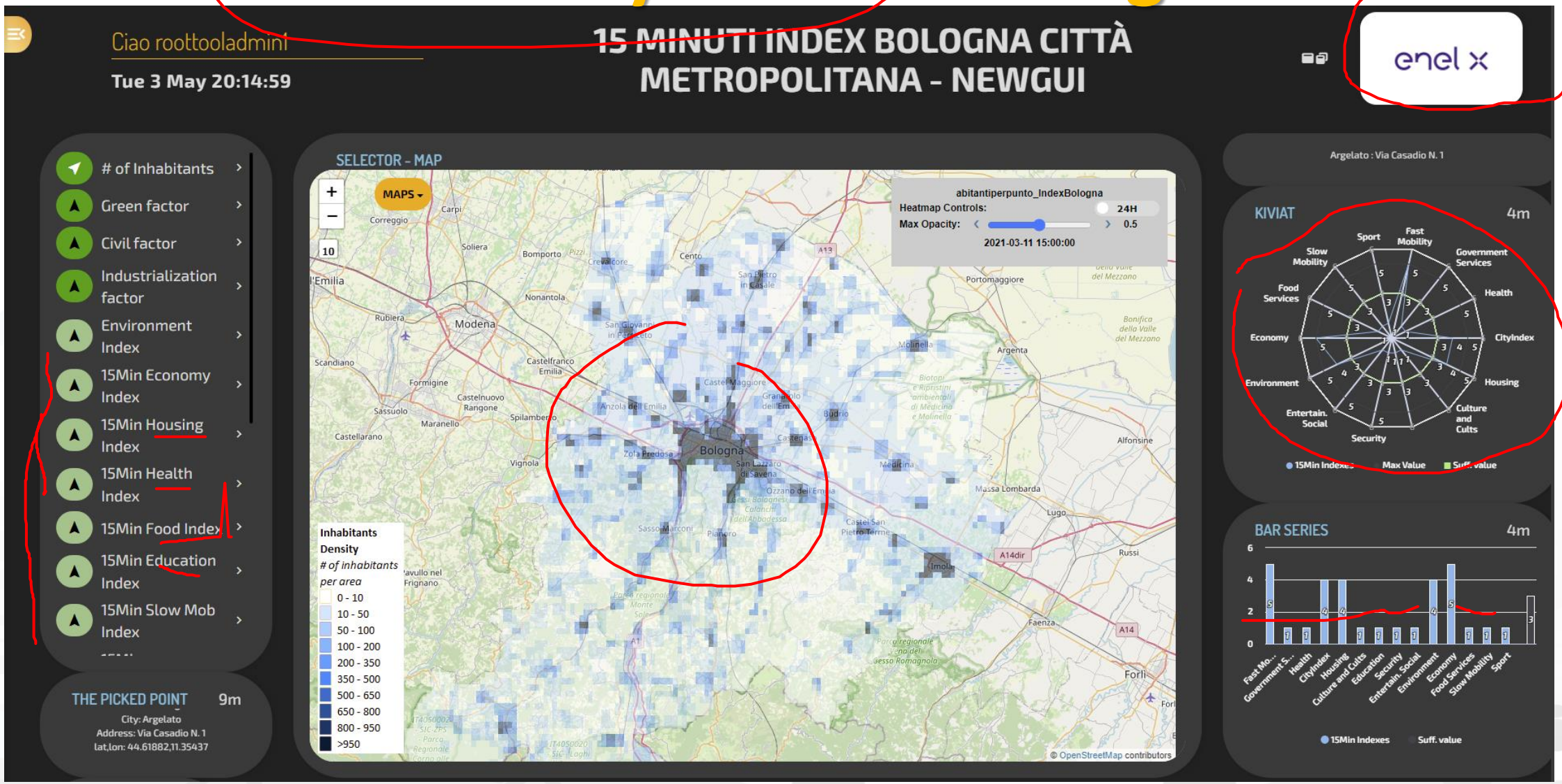


| Last Value | Time Trend Chart: Glob - Day |
|---|---|
| No data |  |



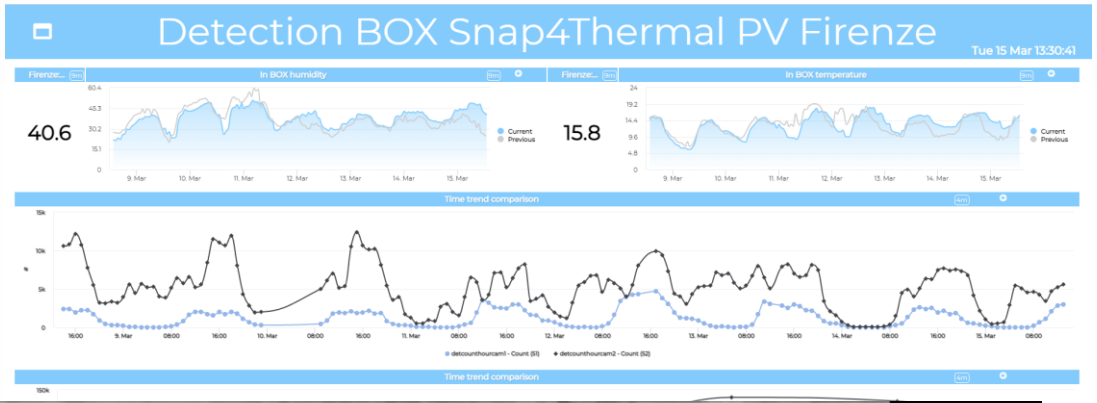
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzI4OA==

# 15MinCityIndex on Bologna



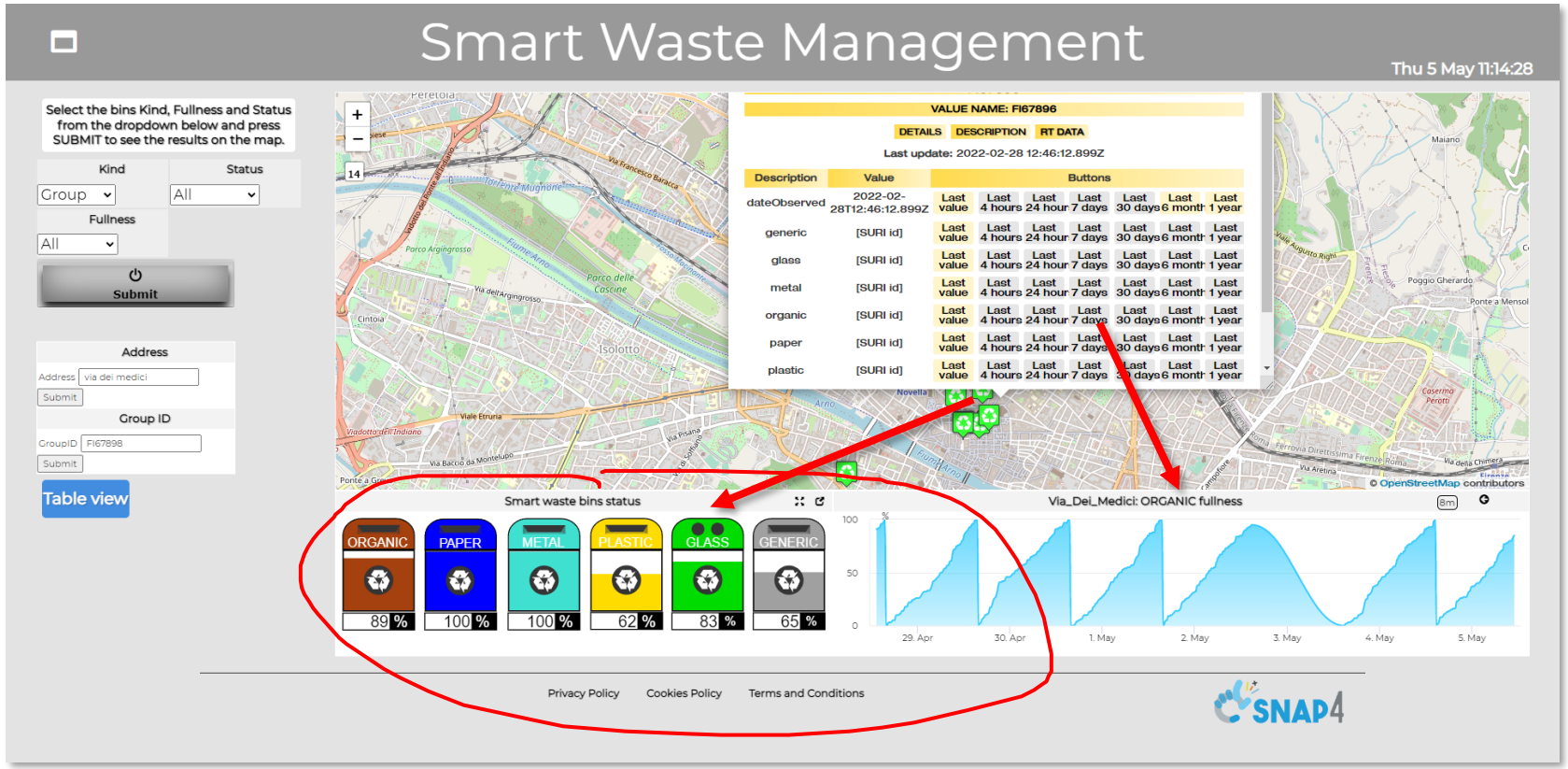

https://www.snap4city.org/dashboardSmartCity/view/Baloon-Dark.php?iddasboard=MzQxMg==

# A view and data from the Thermal Camera





# Smart Waste – Map view




Search bins on map by filtering per:

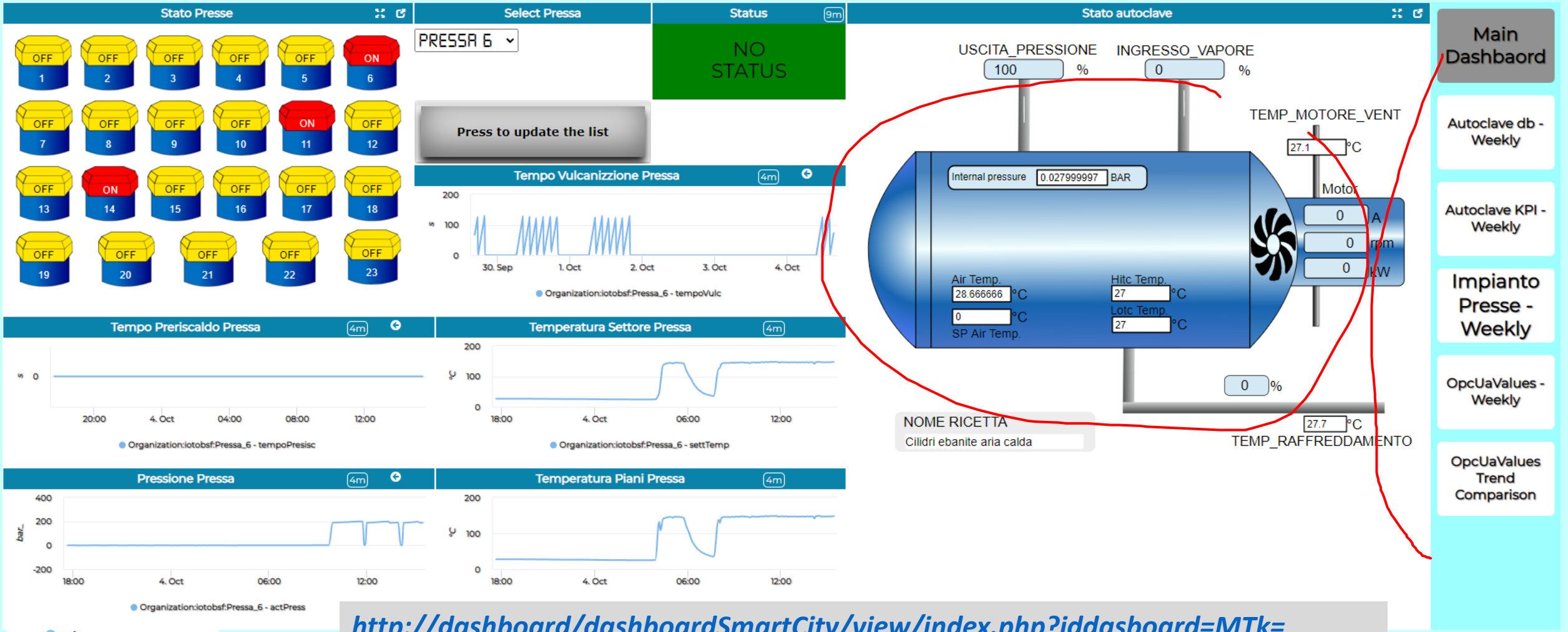
- **Kind** (All, generic, plastic, paper, glass, metal, organic)
- **Status** (Active, Not Active)
- **Fullness** (Full, Half-full, Empty)
- **Address**
- **Group of bins** (by GroupID)

- Refine a search by using the filters on the left side
- Click on a waste bin pin on the map:
- A popup with real time data is shown
- The fullness status of the selected group of bins is shown in the synoptic below the map
- Specific fullness weekly trends are shown below the map
- Chick on the «Table view» button to access the other dashboard

# Sinottico Impianto

## Sinottico Impianto Presse - Autoclave

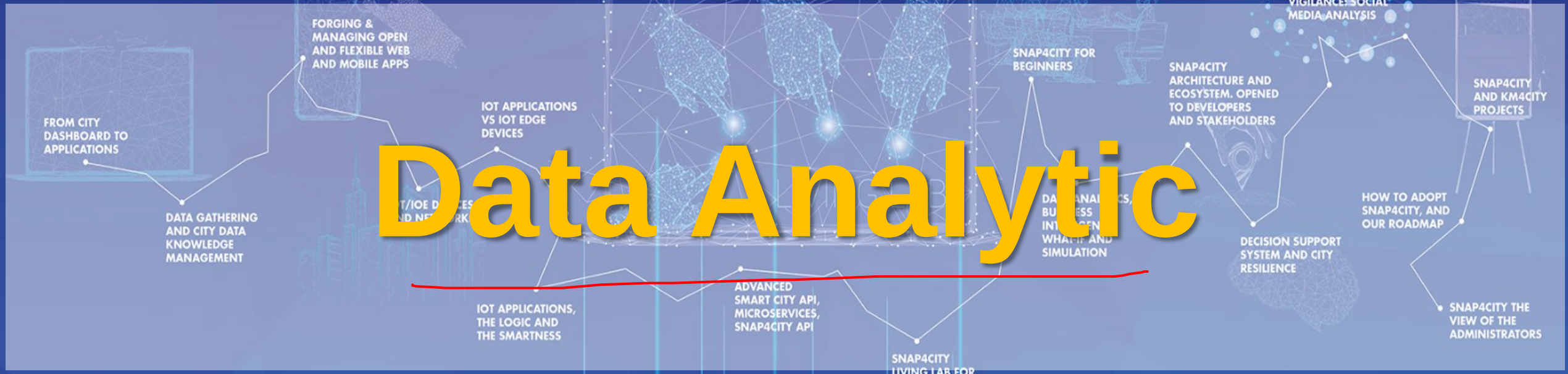
Mon 4 Oct 15:34:59




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

TOP

# Data Analytic




100% OPEN SOURCE

SNAP4 Appliances and Dockers **Installations**

# Data Analytics

- **Data Analytics: Examples from Snap4City**
  - Smart parking: Predictions
  - Smart Bike Sharing
  - User Behavior Analysis, via Wi-Fi, OD Matrices
  - User Behavior Analysis via trajectories
  - Recognition of Used Transportation means
  - Traffic Flow Predictions
  - Traffic Flow in/out of the city
  - Traffic Flow Reconstruction, from Traffic Sensors Data
  - Covid-19 vs other data: traffic and environmental
  - Quality of Public Transport Service
  - Origin Destination Matrices (from: Wi-Fi, Mobile Apps, etc.)
  - Modal and Multimodal Routing for Navigation and Travel Planning
  - Etc.

- **Data Analytics for City/Area Management**
  - Predicting Land Sliding
  - Estimating CO2 from Traffic Flow Data
  - DORAM: Demand of Mobility vs Offer of Transportation
  - Environmental Data Analysis and Predictions, early Warning
  - Environmental Sensors Hosted by City Users
  - Long Term Prediction of Annual Mean of NO2 index of EC
  - Anomaly Detection
  - What-IF Analysis….
  - 15MinCityIndex Assessment of Cities
  - Predictive Maintenance on Plant
  - Fashion Retail shop recommendations

- **Engaging City users Towards a Virtuous behavior**
- **Decision Support Systems, Smart DS and Resilience DS**
- **Twitter Vigilance: Social Media Analysis: Early Warning, Predictions**
- **HOW TO: Data Analytics: Enforcing and Exploiting**
  - Real Time Data Analytics: using R Studio Exploitation in IOT Applications


- ***15 Minute City Index:***
  - 13 differente subindexes


- Monitoring and Prediction of energy consumption
- Stimulating: Bikesharing, e-bikes, car charge,etc.


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


- Smart City infrastructure: monitoring and resilience
- Effective and Low cost smart solutions
- What-if analysis, Simulations

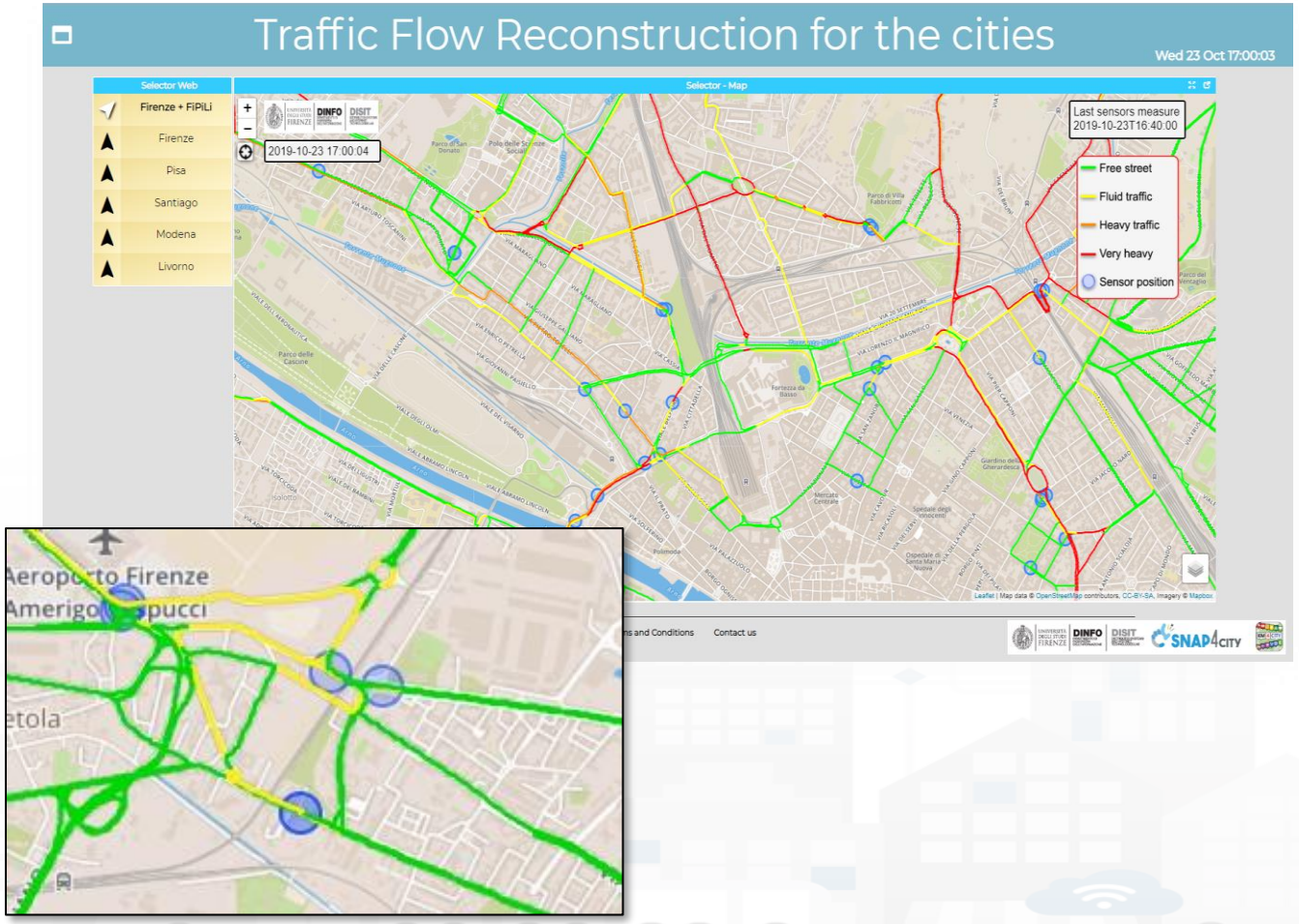

- Monitoring resource consuption,
- business intelligence tools for decision makers,
- Reduction production costs


- Monitoring and Predictions for
  - NO2, NOX, CO2, Traffic flow, pollutant, landslide, etc.
  - Traffic flow reconstruction


- Shortening justice time
- Predictiction of mediation proneness
- Ethical Explainable Artificial Intelligence

# Why Dense Traffic Flow Reconstruction ?

- Making decision on mobility and transport solutions → what if analysis
- Controlling pollution
- Dynamic Routing for Firebrigade, Ambulances, general public
- Planning Public Transportation routing

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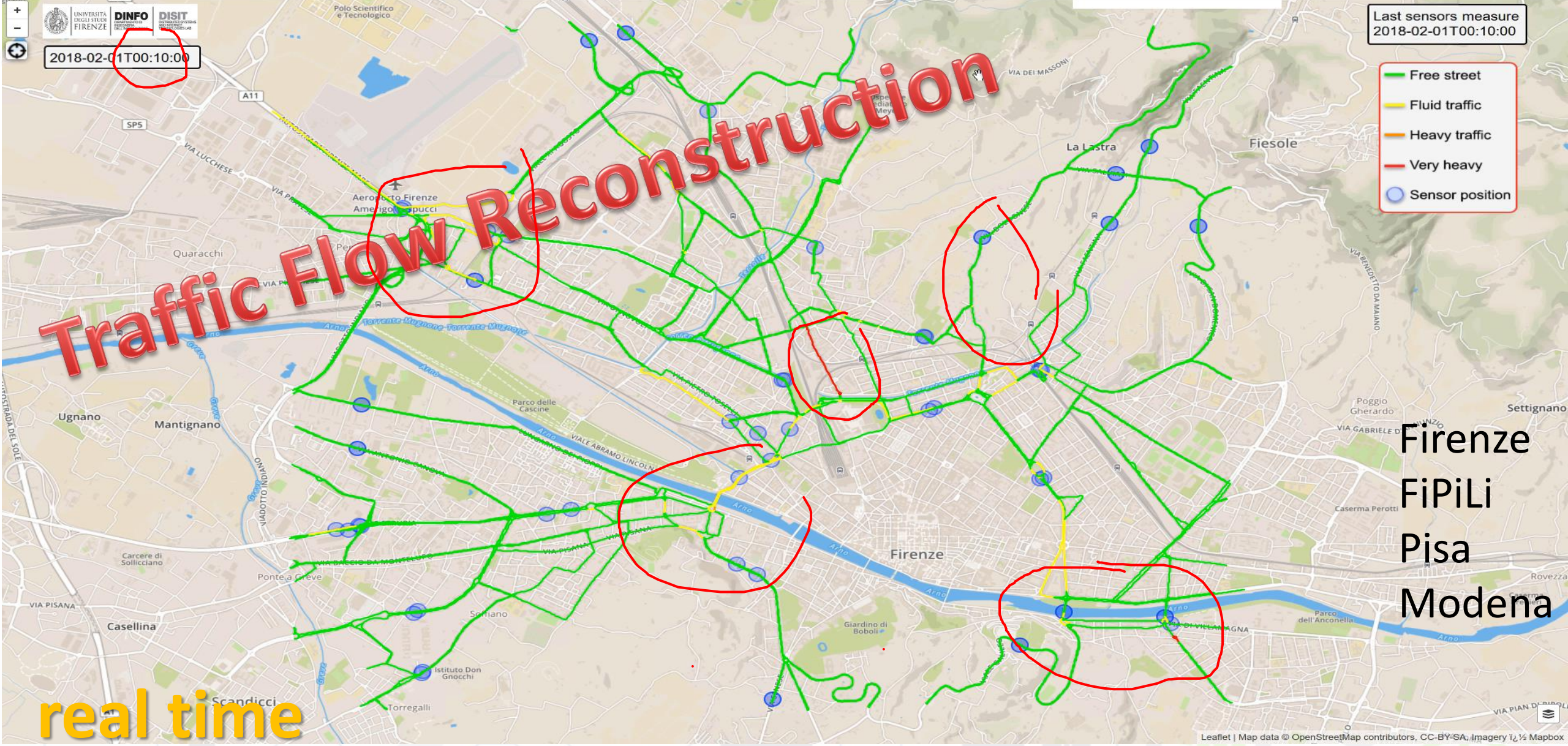
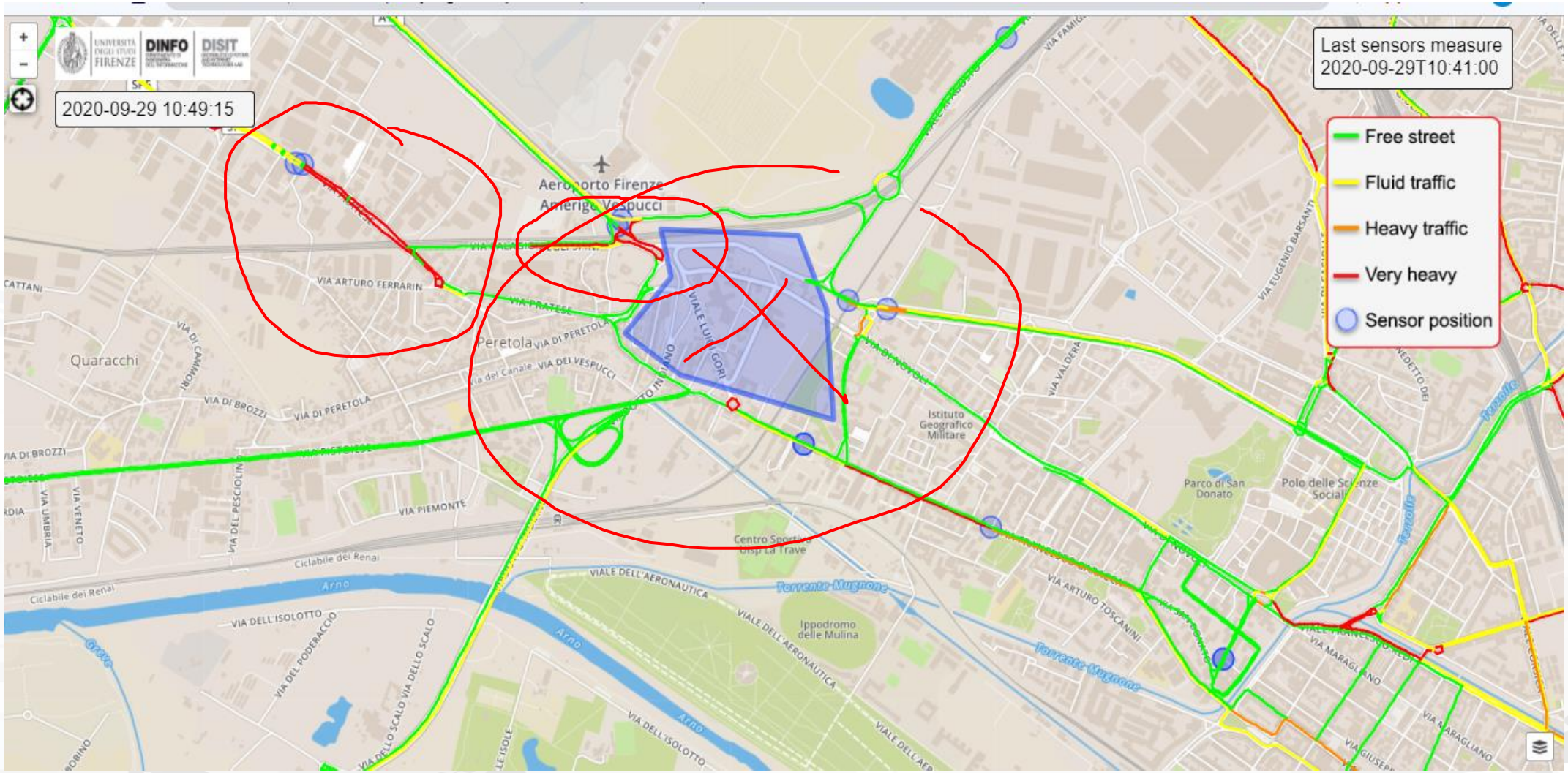
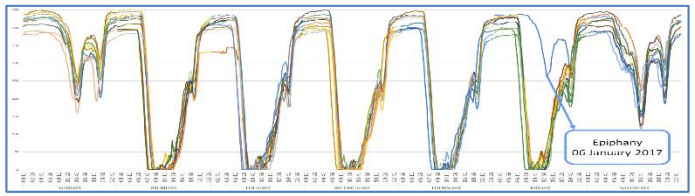

Traffic Flow Reconstruction
2018-02-01T00:10:00
Last sensors measure
2018-02-01T00:10:00
Free street
Fluid traffic
Heavy traffic
Very heavy
Sensor position
Firenze
FiPiLi
Pisa
Modena
real time
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery ©¿½ Mapbox

# Computation of Traffic Flow Evolution



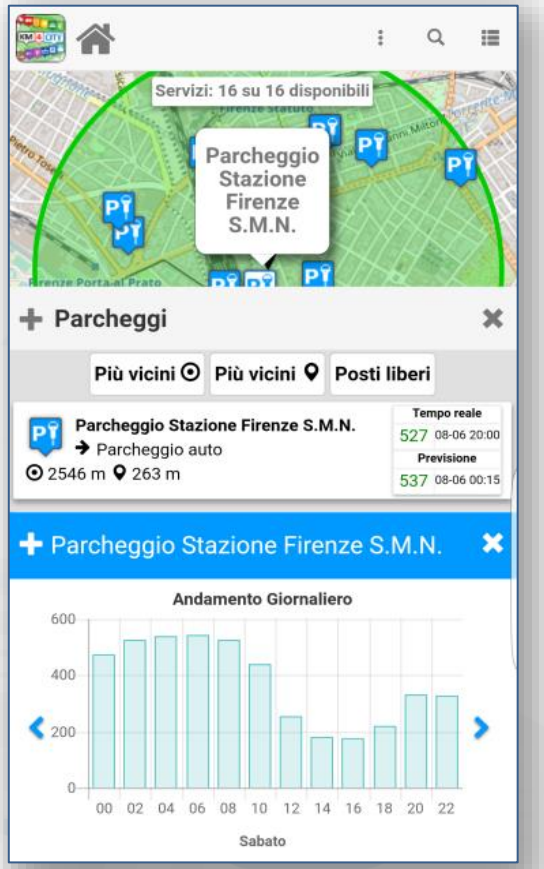
# I would arrive to surely Park in 45 Minutes??



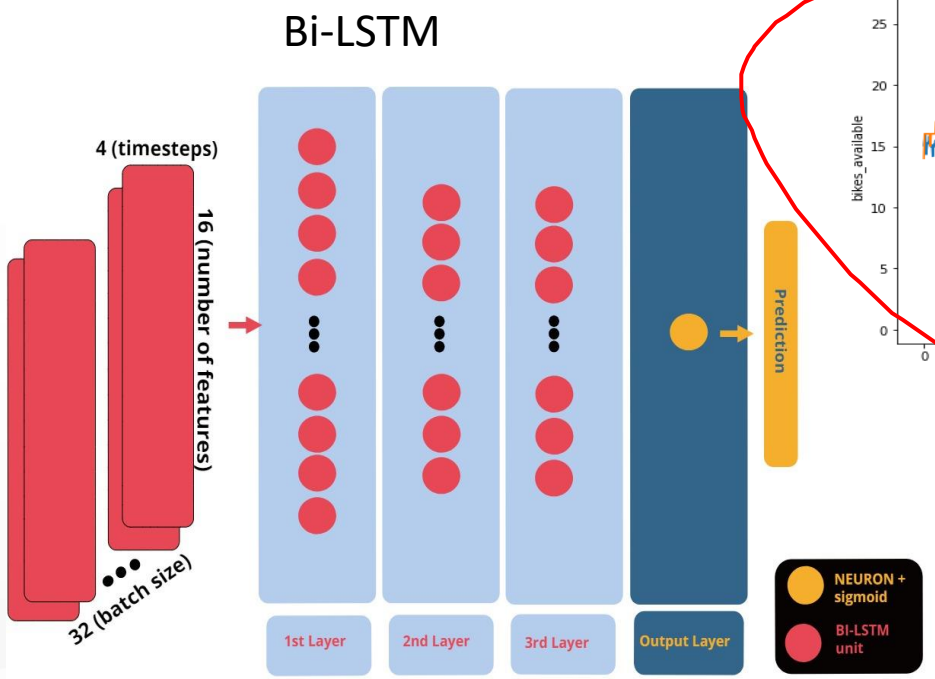

| Category | Features | Description of features variable |
|---|---|---|
| Baseline features of free slot data | Free parking slots | Real number of available slots recorded every 15 minutes |
| | Time | Hours and minutes |
| | Month | Month of the year (1-12) |
| | Day | Day of the month (1-31) |
|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

Artificial Intelligence Predictions

97% of precision



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

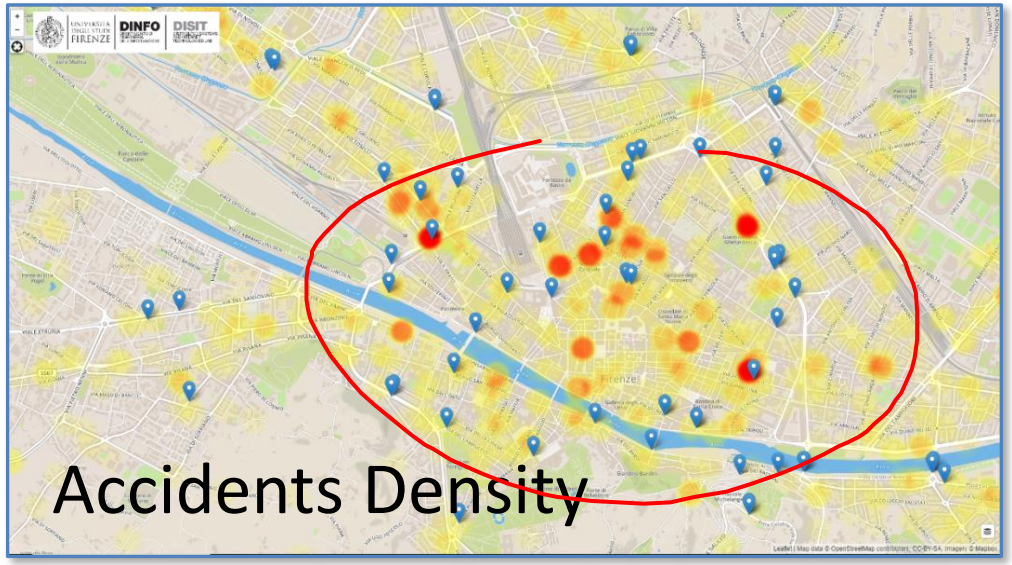



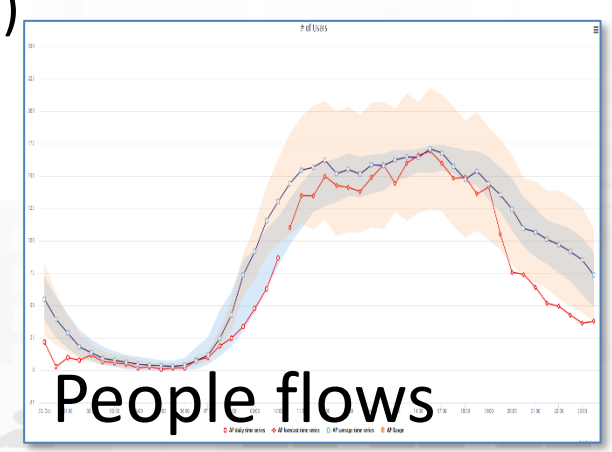


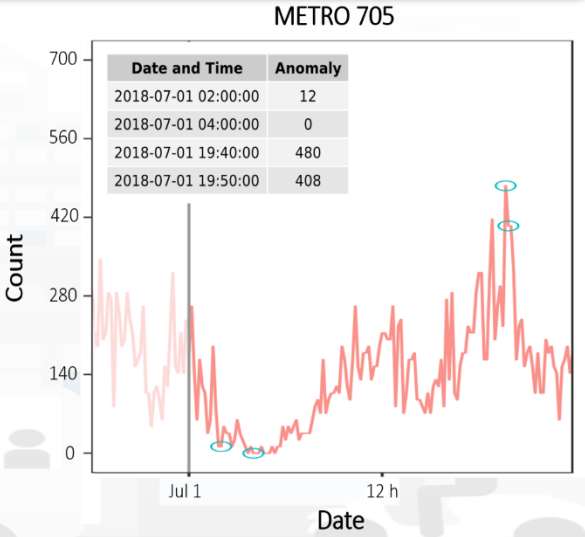
E. Collini, P. Nesi and G. Pantaleo, "Deep Learning for Short-Term Prediction of Available Bikes on Bike-Sharing Stations," in *IEEE Access*, vol. 9, pp. 124337-124347, 2021, doi: 10.1109/ACCESS.2021.3110794.
https://ieeexplore.ieee.org/abstract/document/9530580

# Anomaly Detections

- About the IoT Devices status
  - Eventual problems on IoT Devices, connections, etc.
- About People Flows and Density
  - Early warning of the ineption of critical events
- About traffic flow
  - Early warning on eventual incidents, or on the inception of critical conditions  on the traffic (e.g., a reduction in viability, a broken bus, ..)
- About….
  - Early warning, early detection of problems,
- Recurrence analysis
- Causal Analysis

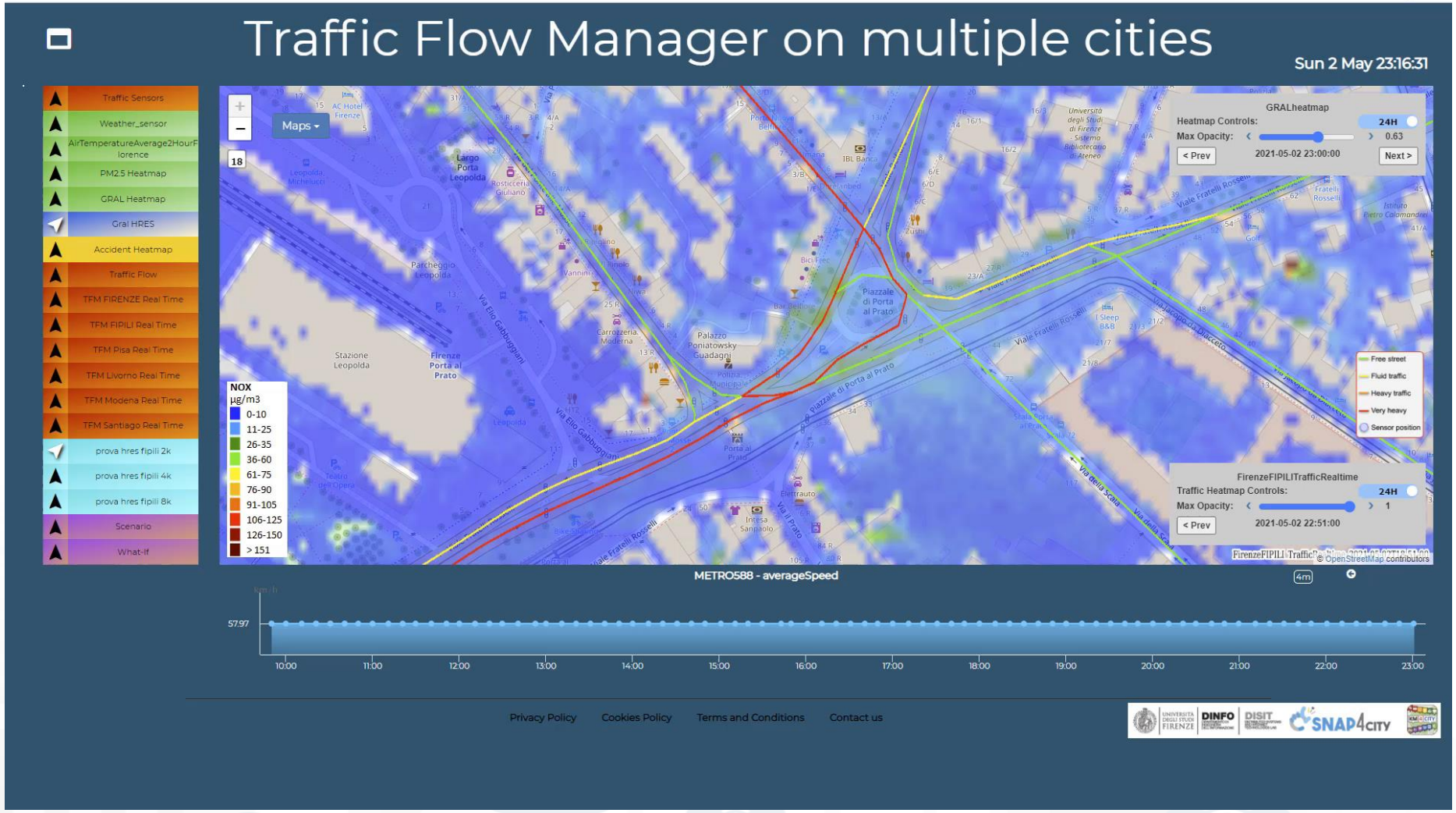


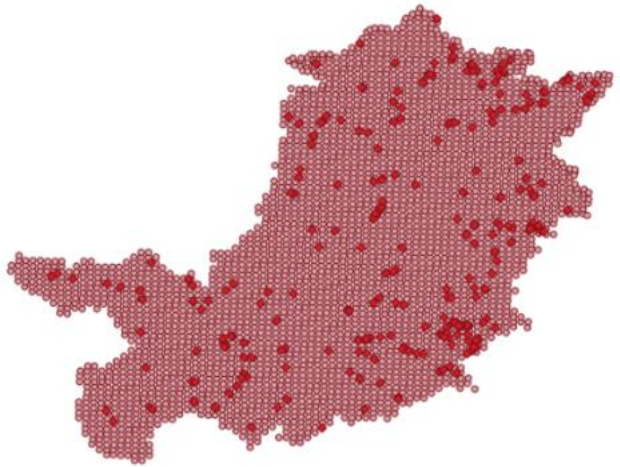



# Environment

- **Prediction**
  - **NOX Pollutant** diffusion on the basis of Traffic Flow (prediction), weather and 3D structure
  - **NO2 progressive average** (Long term)
- **Project:**
  - **Trafair** CEF EC
  - Mixed solutions of Fluidinamics modeling and AI



# Predicting Land slides



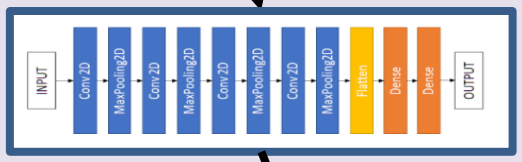
**Dataset Construction**

Dataset Construction

**Previsional Model**

Model training And validation

Model




Data

SNAP4City Advanced APIs

landslide DB

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

Processes

Ingestion

Big Data Storage and KB

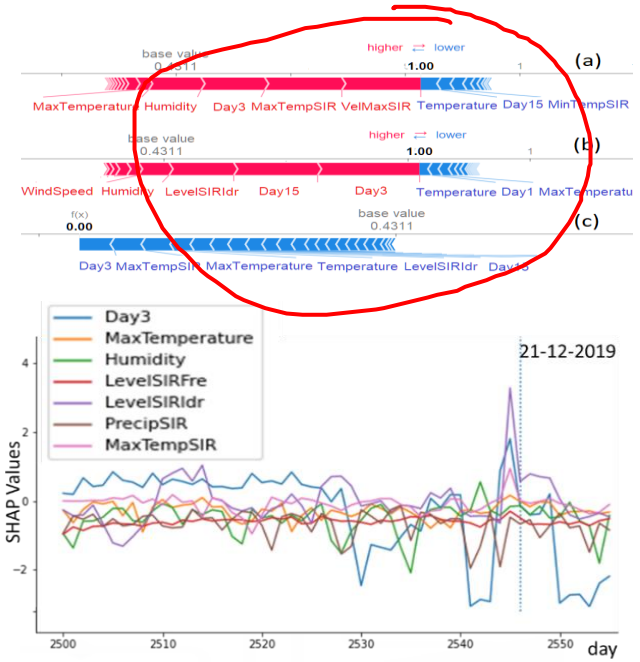
Predictions

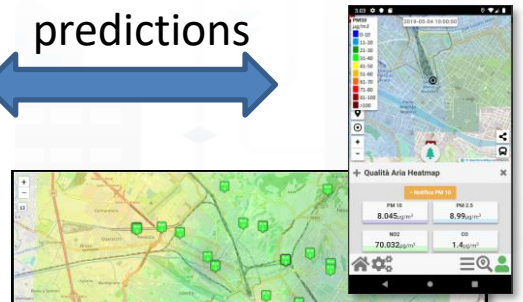
Model execution Shap Assessment

Data Analytics IOT App Management

predictions

Snap4City Servers and Tools: Dashboard manager, Heatmap manager, GeoServer, Smart City API.

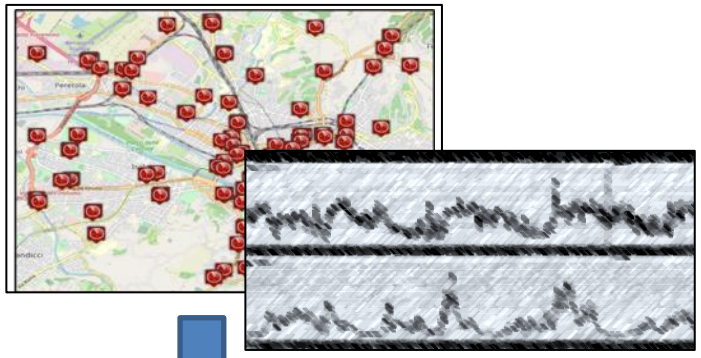


Dashboards and Mobile Apps

E. Collini, L. A. I. Palesi, P. Nesi, G. Pantaleo, N. Nocentini and A. Rosi, "Predicting and Understanding Landslide Events with Explainable AI," in *IEEE Access*, doi: 10.1109/ACCESS.2022.3158328.
https://ieeexplore.ieee.org/abstract/document/9732490

# Estimating City Local CO2 from Traffic Flow Data



Computing Traffic Flow into CO2 sensor area

Traffic Flow data

- Traffic Flow is one the main source of CO2
- **Dense estimation of CO2 into the city** is very useful to know to target EC's KPIs

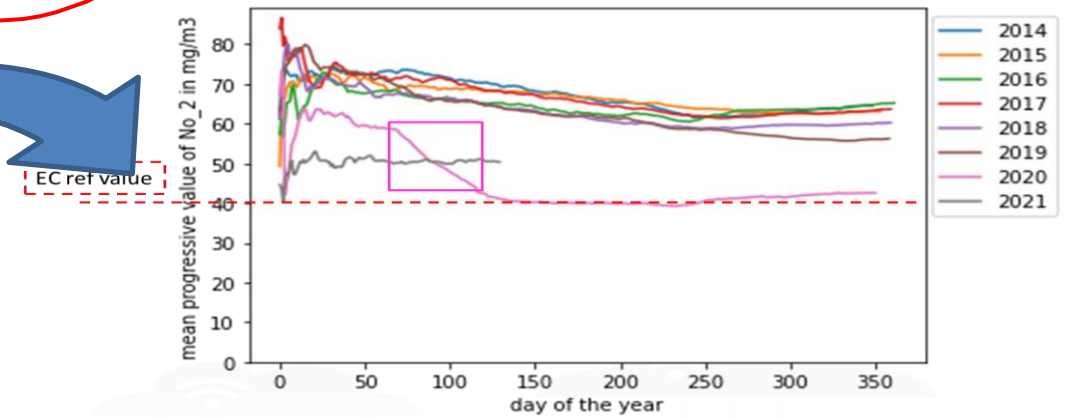
Computing CO2 on the basis of traffic flow data


CO2 estimation

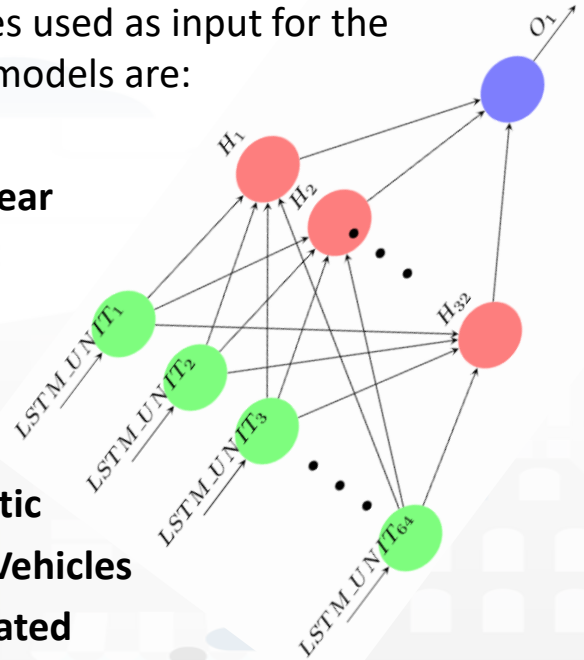
S. Bilotta, P. Nesi, "Estimating CO2 Emissions from IoT Traffic Flow Sensors and Reconstruction", Sensors, MDPI, 2022. https://www.mdpi.com/1424-8220/22/9/3382/

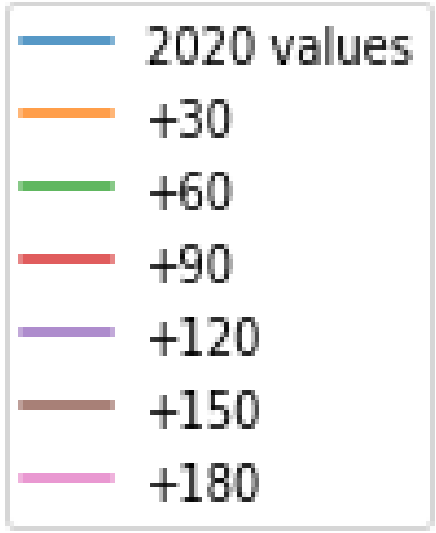
# Predicting EC's KPI on NO2 months in advance

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




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



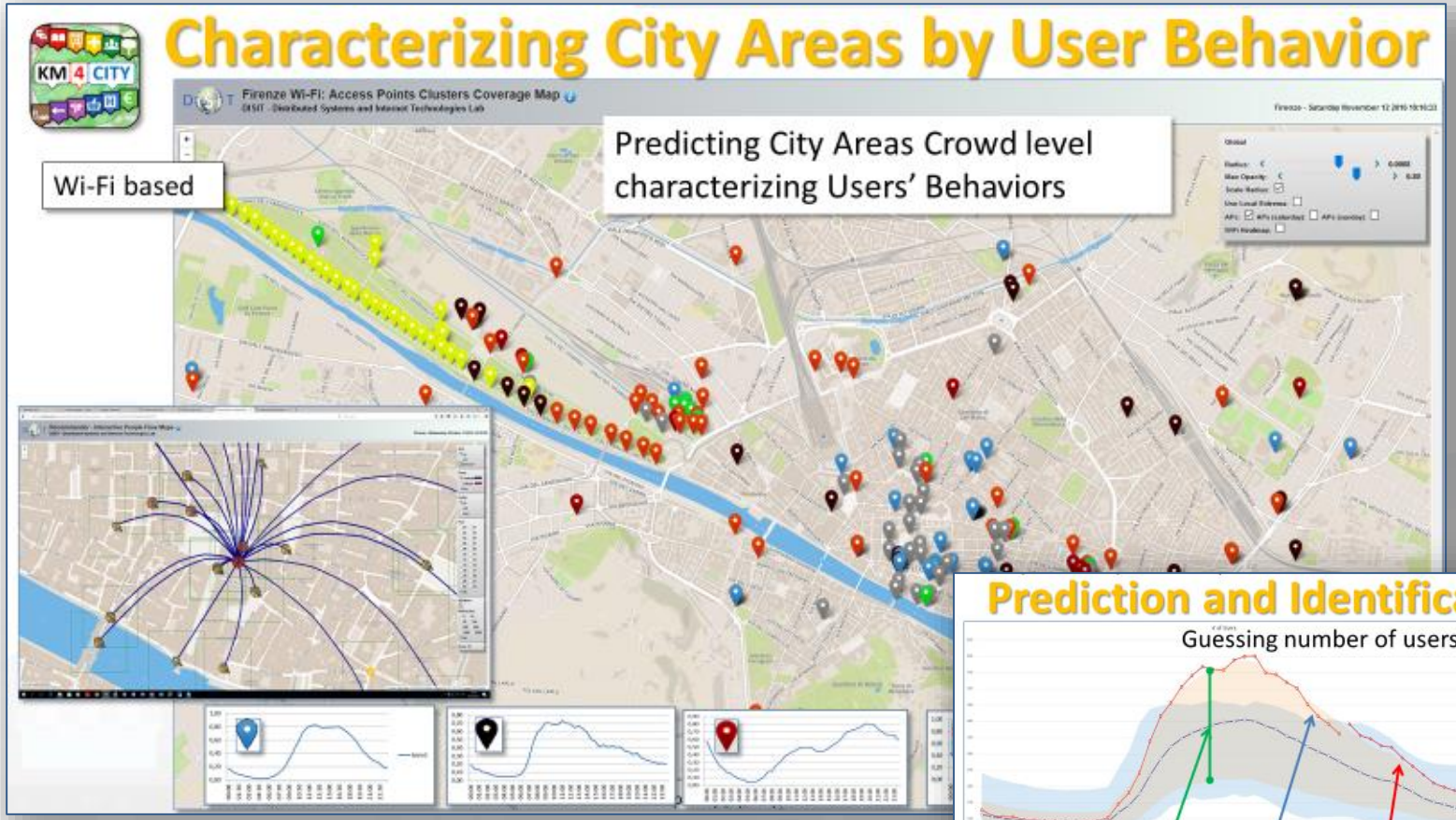



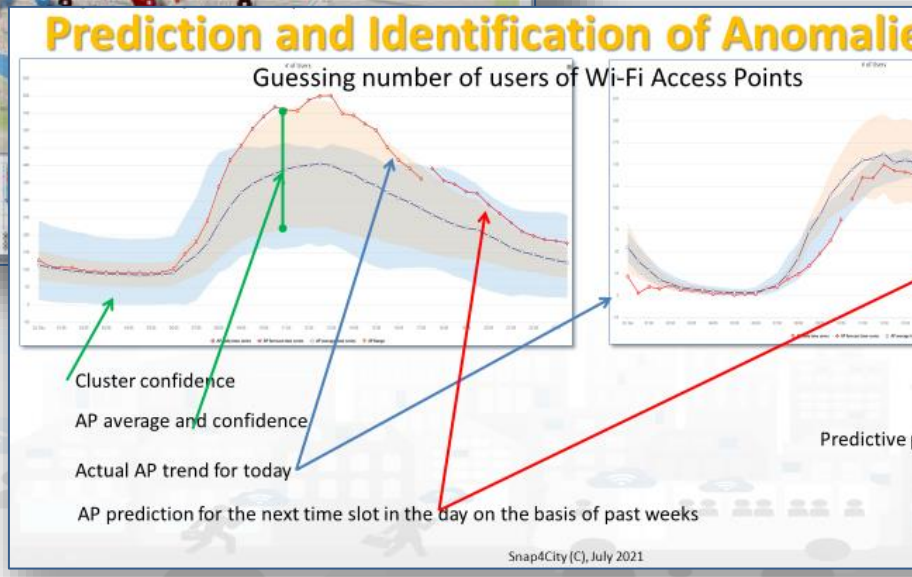

| | | Air Quality Directive | | WHO guidelines | |
|---|---|---|---|---|---|
| Pollutant | Averaging period | Objective and legal nature and concentration | Comments | Concentration | Comments |
| $PM_{2.5}$ | One day | | | 25 µg/m³ (*) | 99th percentile (3 days/year) |
| $PM_{2.5}$ | Calendar year | Target value, 25 µg/m³ | The target value has become a limit value since 1 January 2015 | 10 µg/m³ | |
| $PM_{10}$ | One day | Limit value, 50 µg/m³ | Not to be exceeded on more than 35 days per year. | 50 µg/m³ (*) | 99th percentile (3 days/year) |
| $PM_{10}$ | Calendar year | Limit value, 40 µg/m³ (*) | | 20 µg/m³ | |
| $O_3$ | Maximum daily 8-hour mean | Target value, 120 µg/m³ | Not to be exceeded on more than 25 days per year, averaged over three years | 100 µg/m³ | |
| $NO_2$ | One hour | Limit value, 200 µg/m³ (*) | Not to be exceeded more than 18 times a calendar year | 200 µg/m³ (*) | |
| $NO_2$ | Calendar year | Limit value, 40 µg/m³ | | 40 µg/m³ | |

# People Flows

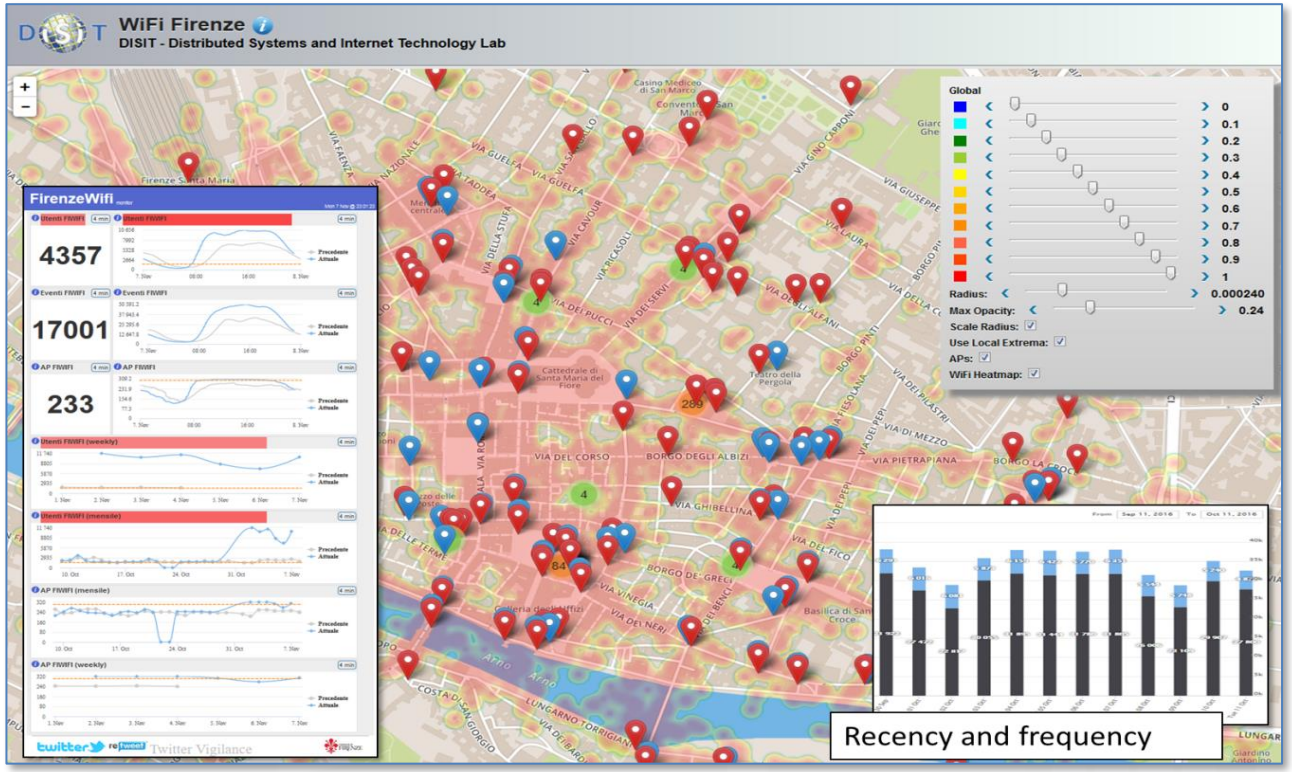


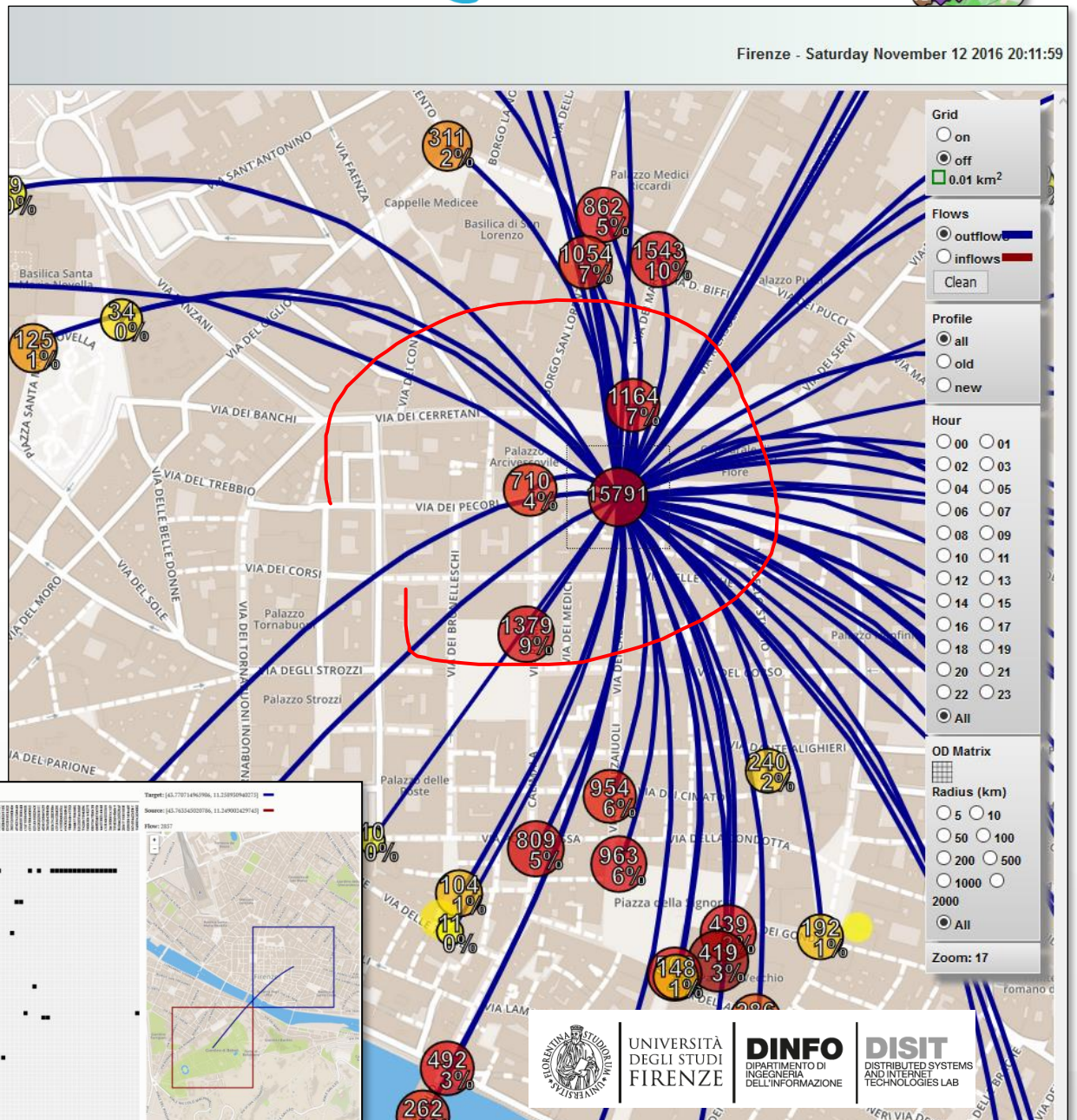
- **Prediction of people flows** on the basis of Wi-Fi data
- **Anomaly** detection
- **Resolute** H2020
- Classification of city areas

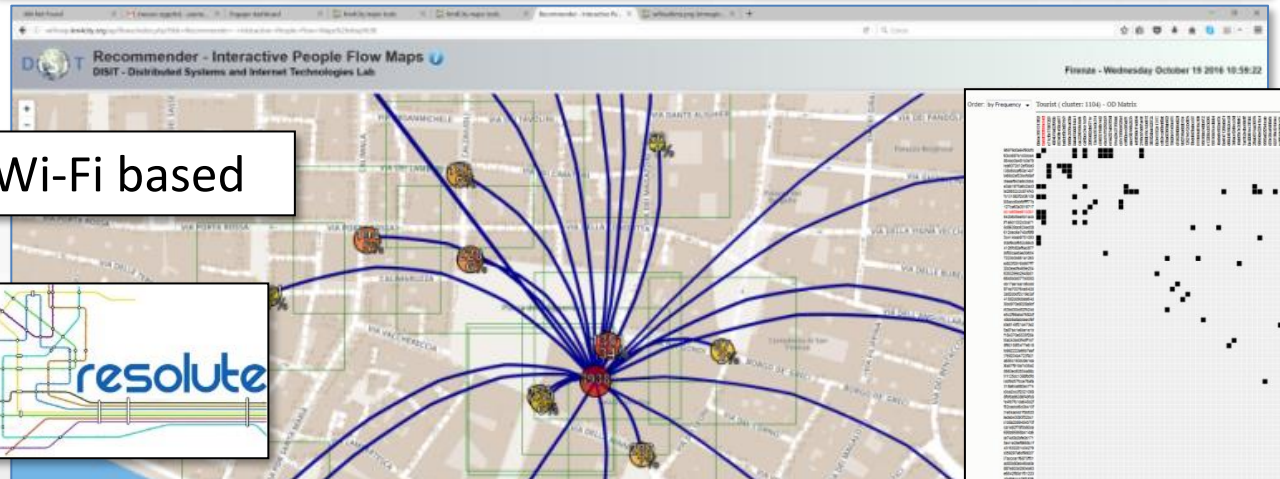


# Origin Destination Matrix Estimation




Wi-Fi based



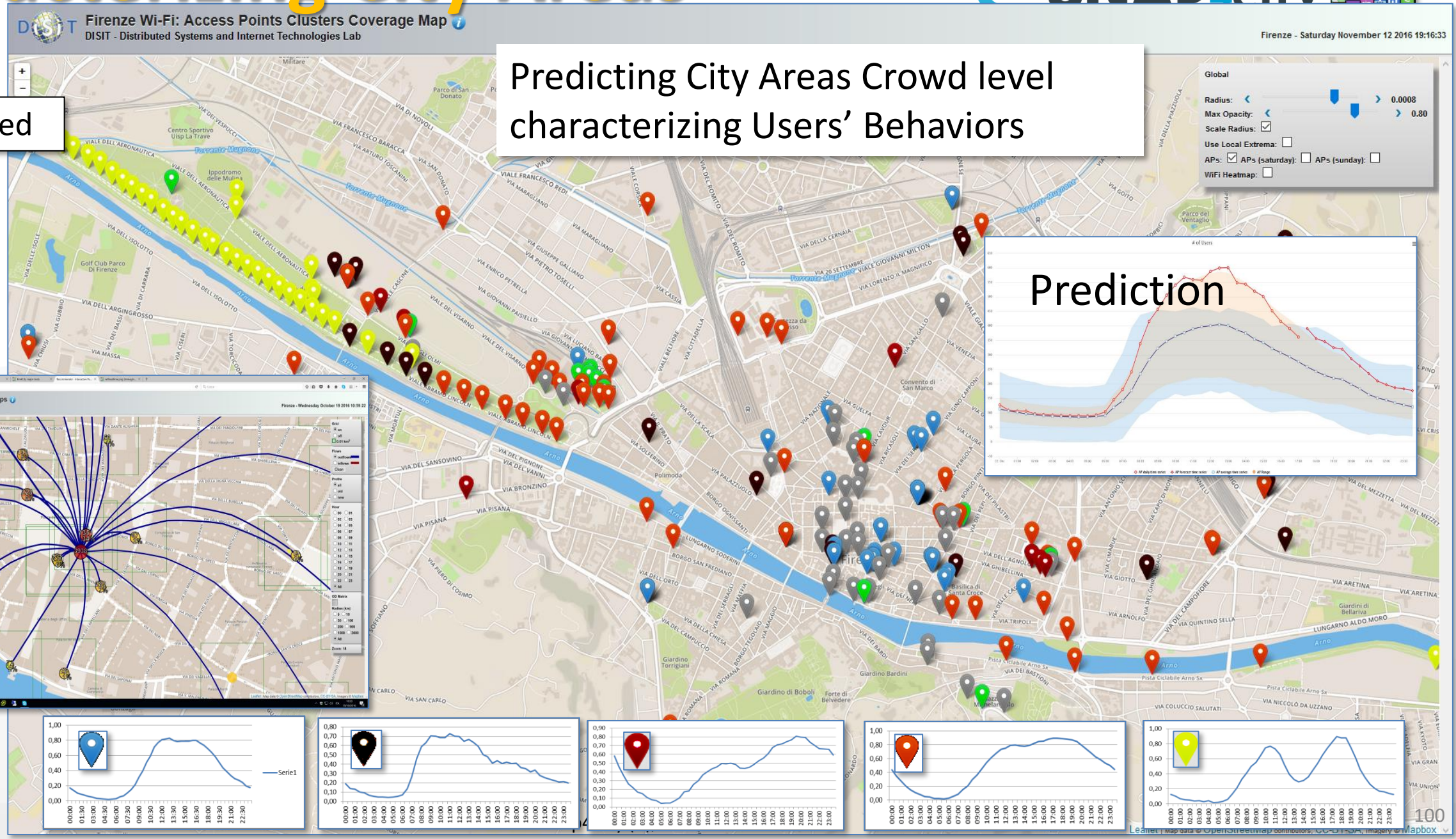
resolute

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

# Characterizing City Areas

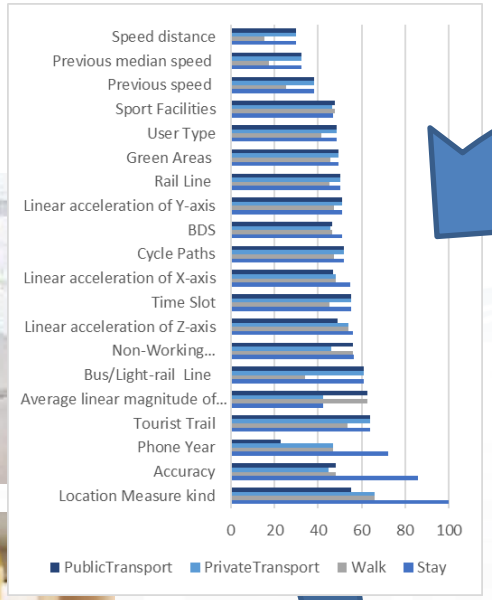
Wi-Fi based

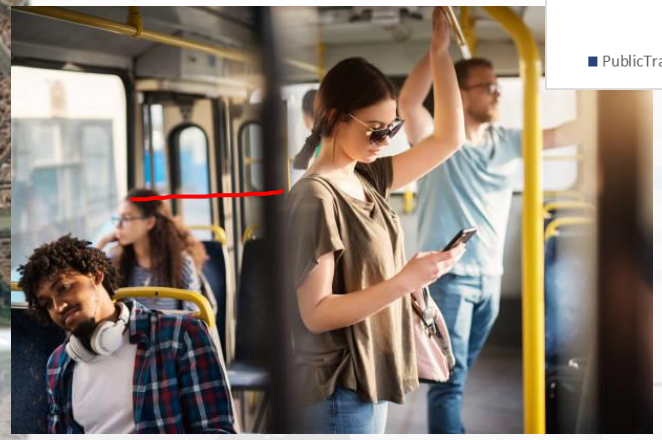
Predicting City Areas Crowd level characterizing Users' Behaviors

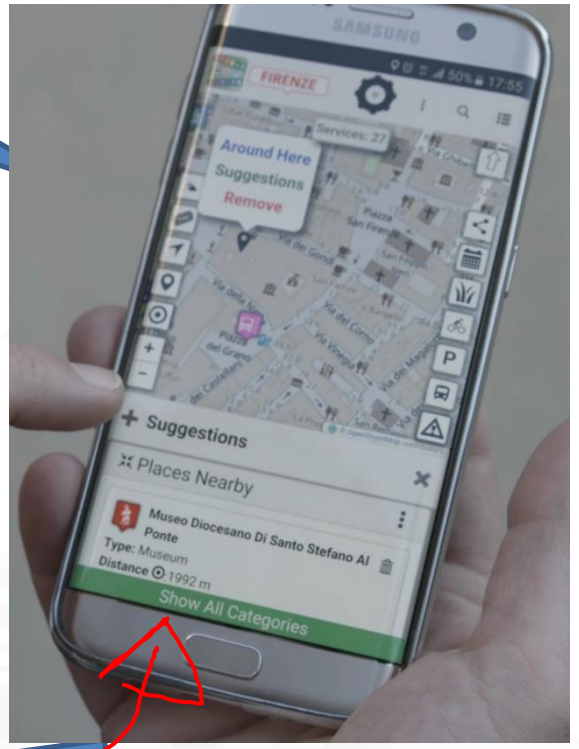


# To propose suggestions and Engage city user I need to know how they are moving










Artificial Intelligence Classification

Suggestions

# DORAM



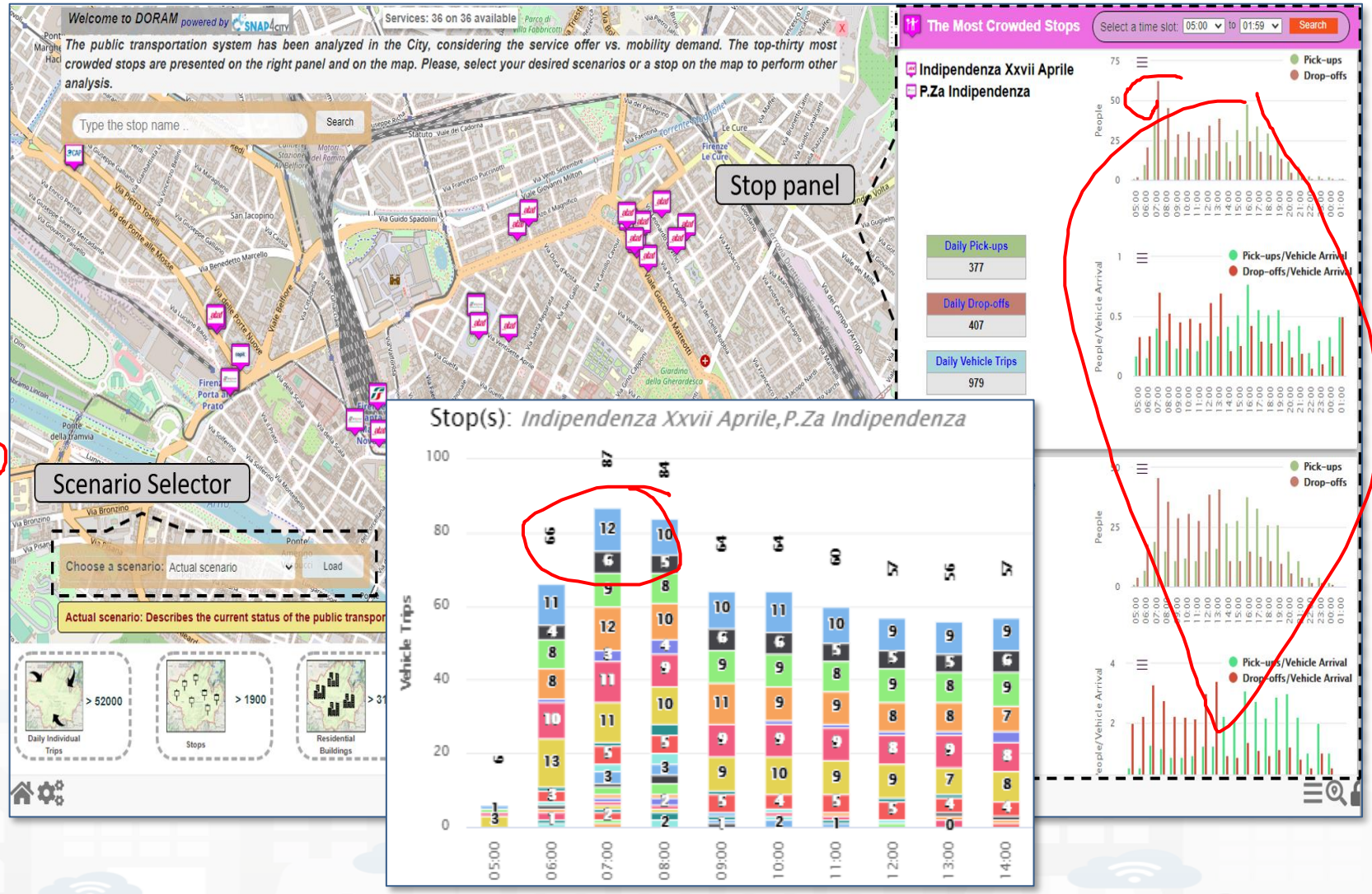
**Analysis of**

- **Demand** of Mobility
  - Via OD matrices
  - POI, city structure, etc.

**With respect to**

- **Offert** of Transportation:
  - Public services
  - Private services
  - Multiple agencies
  - GTFS

**Critical Busses, busstops, paths, rides, etc.**




https://www.snap4city.org/odanalyzer/#b

TOP

# Development of Solutions

FROM CITY DASHBOARD TO APPLICATIONS
FORGING & MANAGING OPEN AND FLEXIBLE WEB AND MOBILE APPS
DATA GATHERING AND CITY DATA KNOWLEDGE MANAGEMENT
IOT/IOE DEVICES AND NETWORKS
SNAP4CITY FOR BEGINNERS
DATA ANALYTICS, BUSINESS INTELLIGENCE, WHAT-IF AND
TWITTER VIGILANCE: SOCIAL MEDIA ANALYSIS
SNAP4CITY ARCHITECTURE
DECISION SUPPORT SYSTEM AND CITY RESILIENCE
HOW TO ADOPT SNAP4CITY, AND OUR ROADMAP
SNAP4CITY AND KM4CITY PROJECTS
SNAP4CITY THE VIEW OF THE ADMINISTRATORS

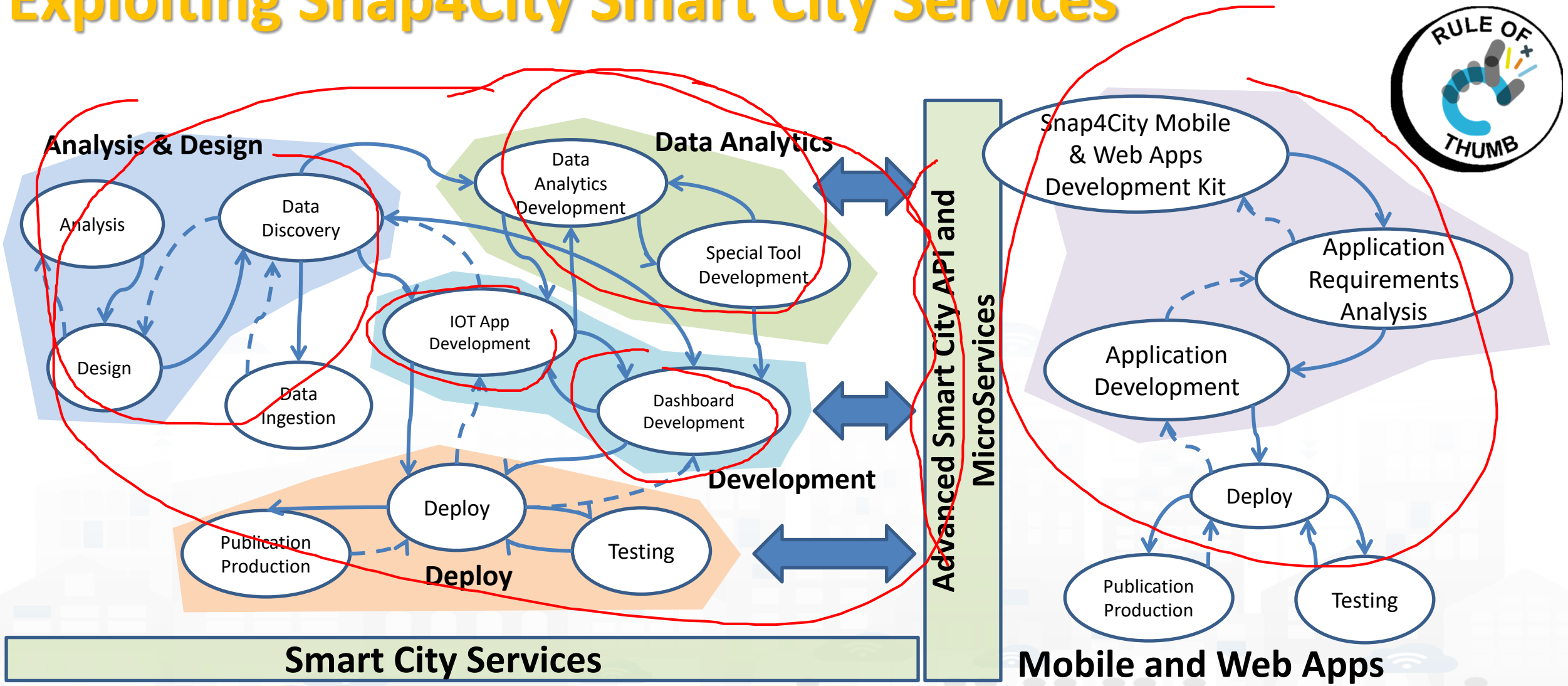
**On Line Training Material (free of charge)**

| | 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 |

100% OPEN SOURCE

SNAP4 Appliances and Dockers **Installations**

# Develop Mobile & Web Applications Exploiting Snap4City Smart City Services

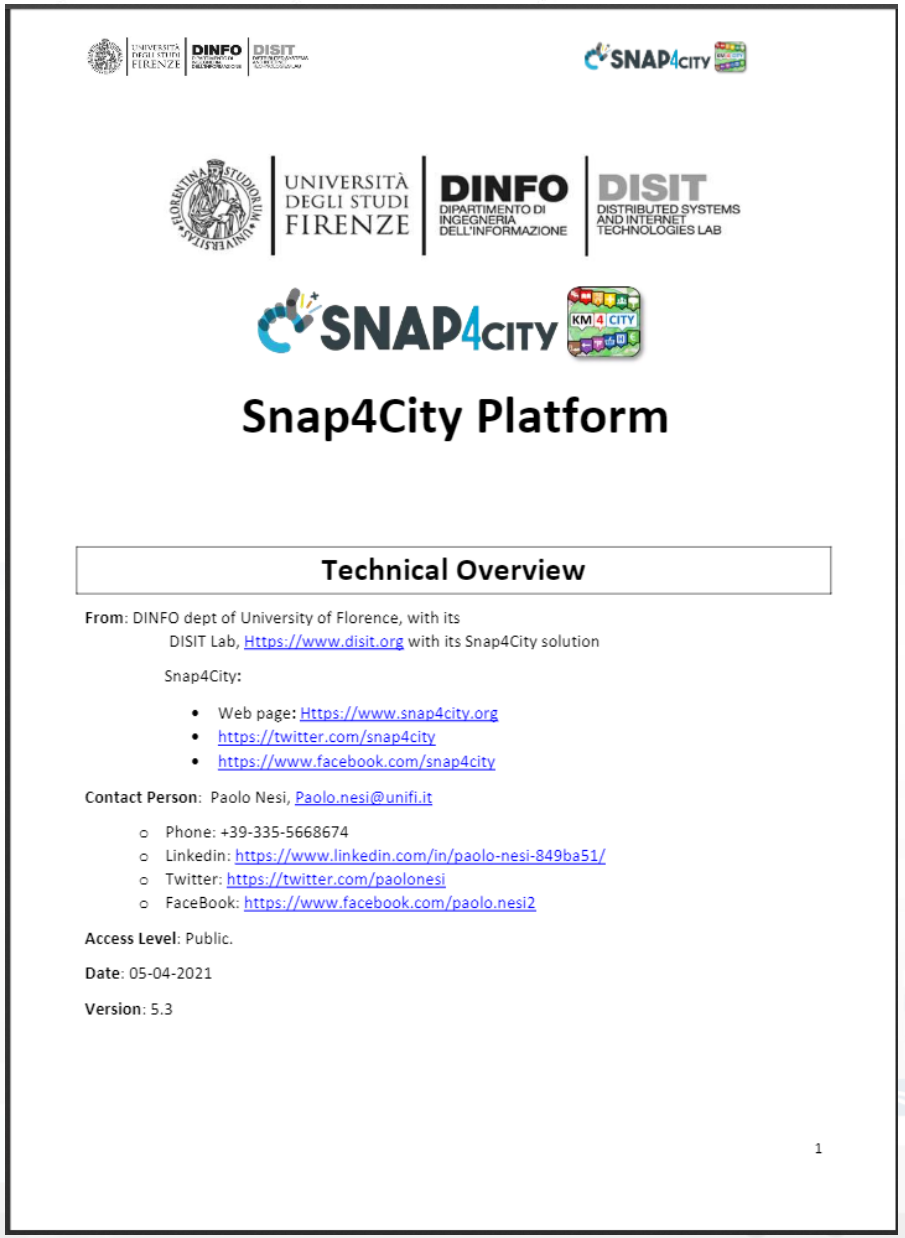


https://www.snap4city.org/577

## 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 |

# 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

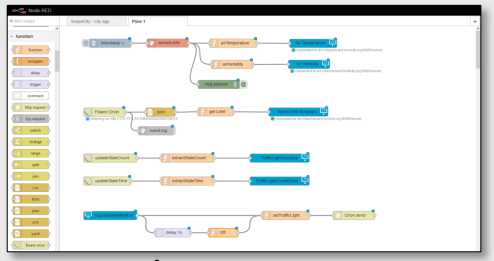
- https://www.snap4city.org/drupal/sites/default/files/files/Snap4City-PlatformOverview.pdf

# Dashboard and tools Development

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 | | | | | | | |
| Interactive | | | | | | | |
| Video1 | | | | | | | |
| Video2 | | | | | | | |
| Video3 | | | | | | | |
| Video4 | | | | none | | none | none |
| duration | 2:55 | 3:16 | 3:41 | 2:00 | 2:48 | 2:35 | 1:47 |

# Dashboard Development

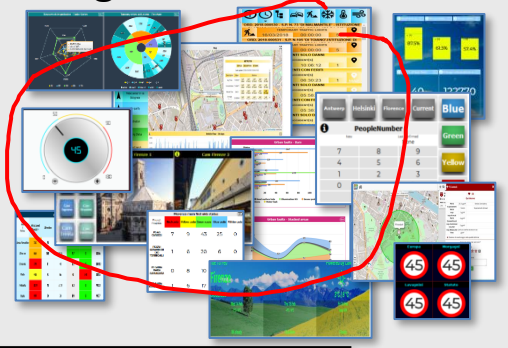


IOT Applications

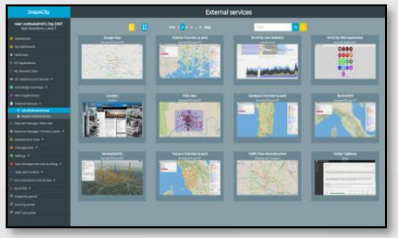
Knowledge Base,
Km4City

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

Widget Collection



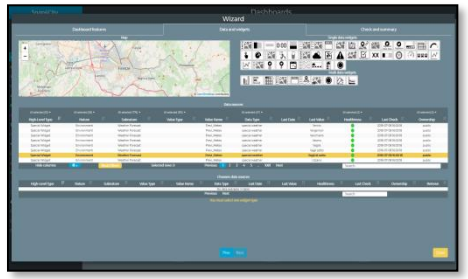
Micro
Applicat
ions



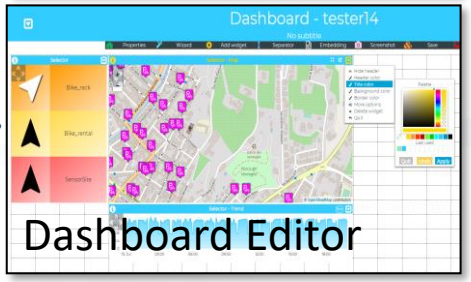
External
Services

Custom
Widgets/
Synoptics

Dashboard Wizard

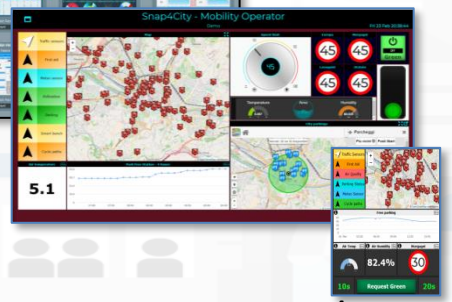


Create, save, load,
delegate, grant access



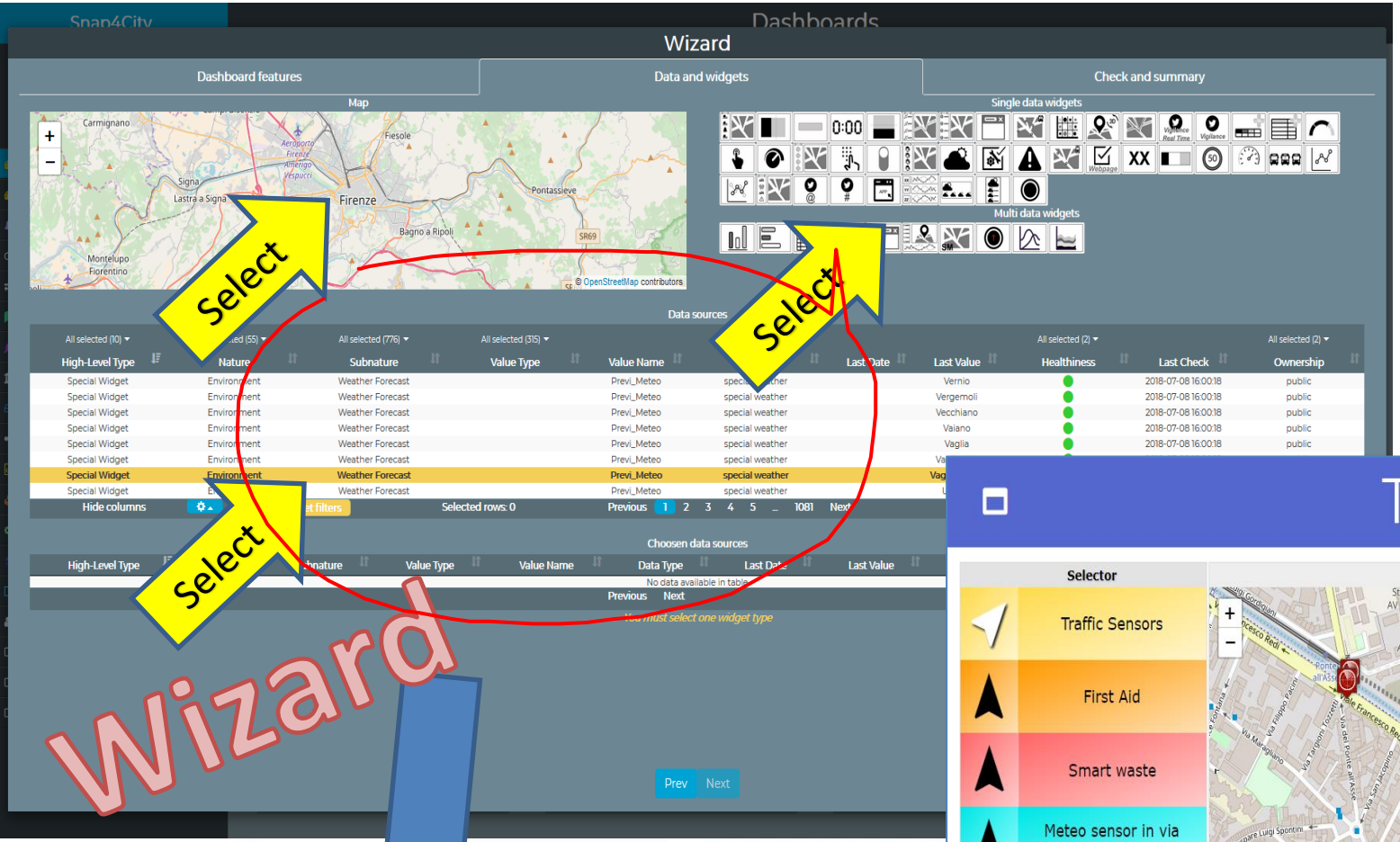
Dashboard Editor

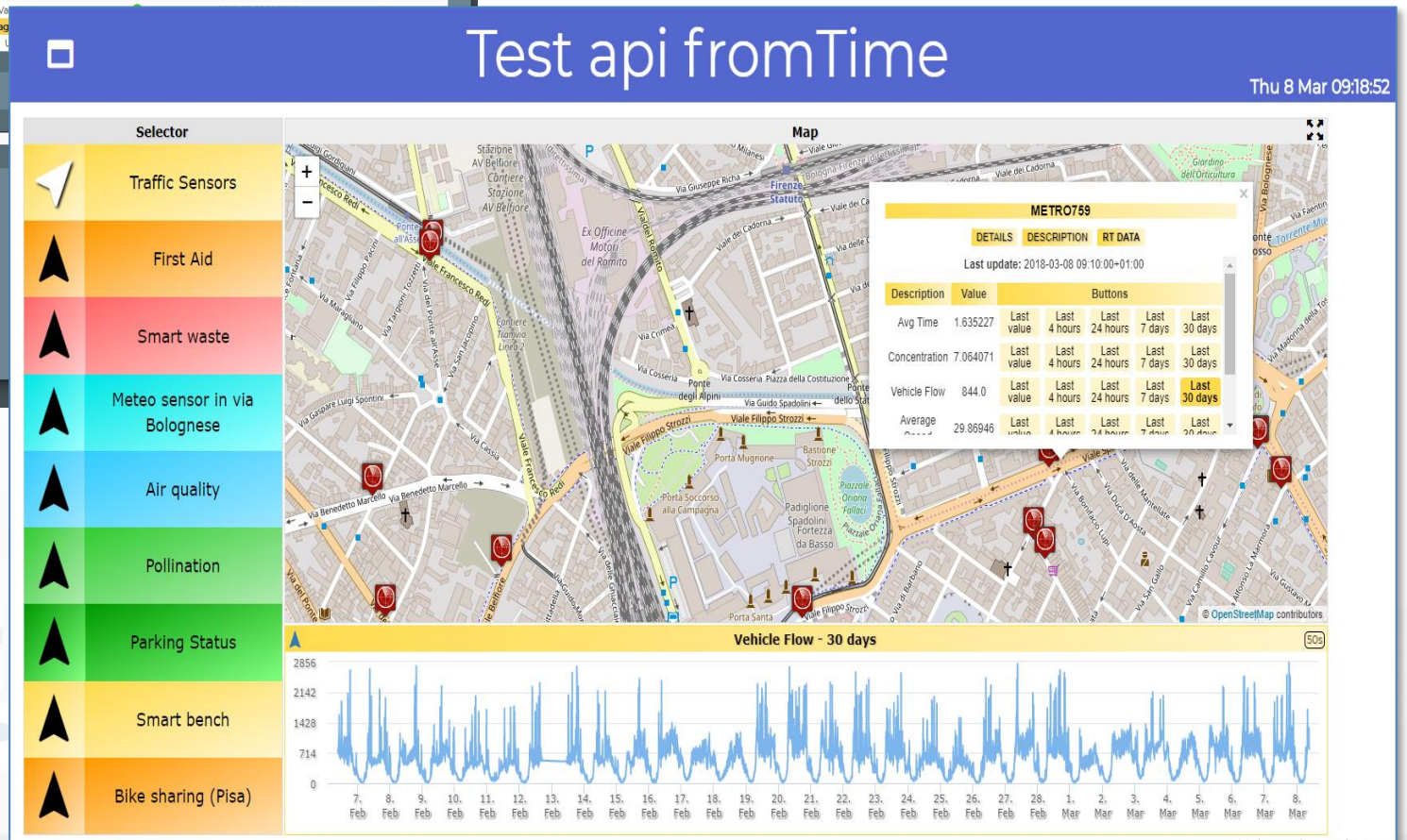
Public
Dashboard
Collection



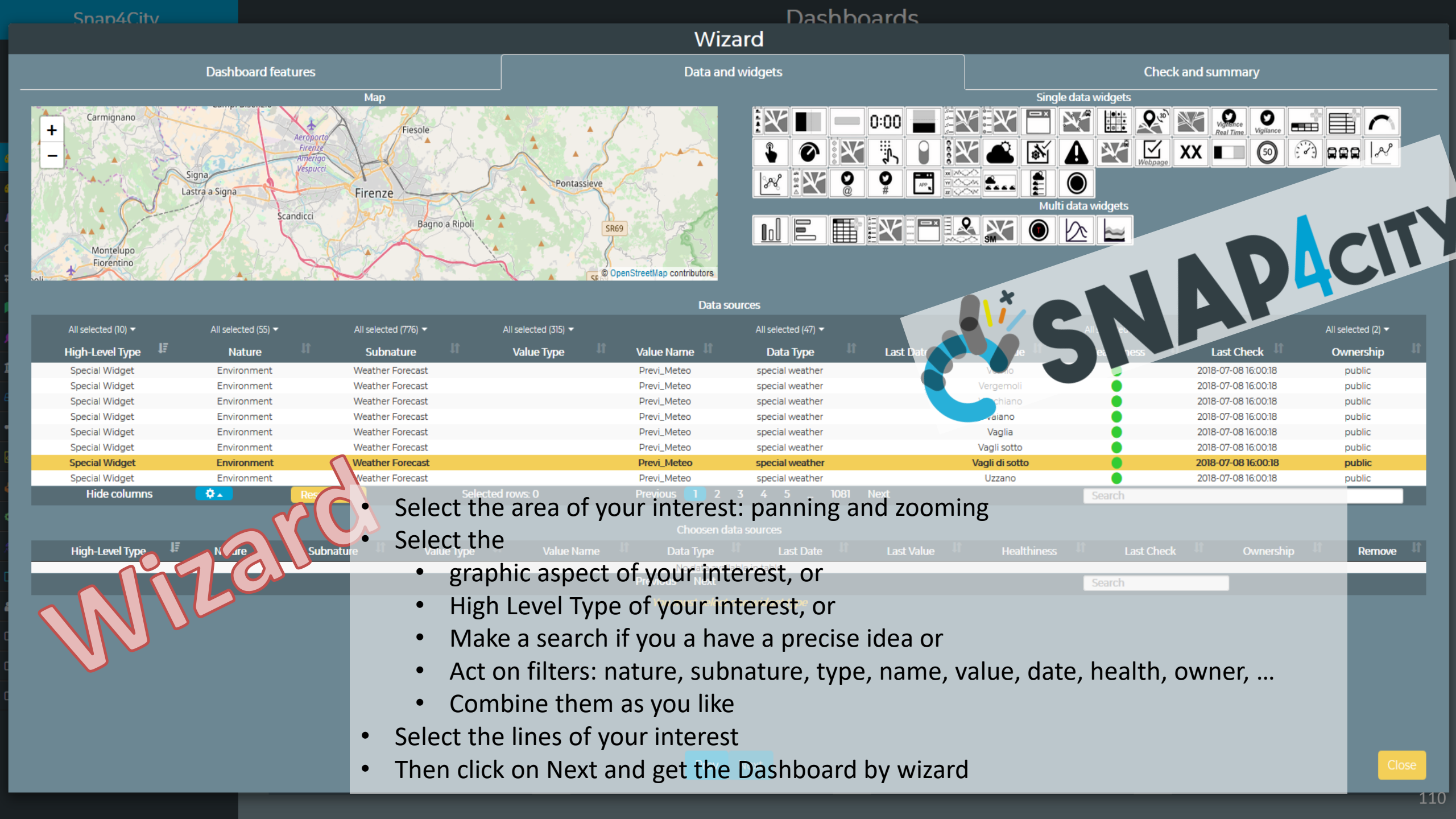
My Own Dash/App

# Dashboard Wizard

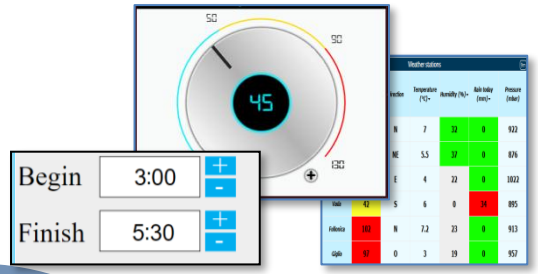


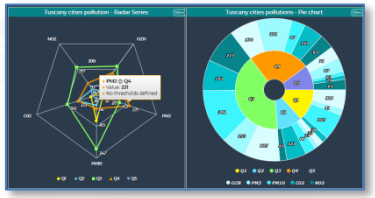



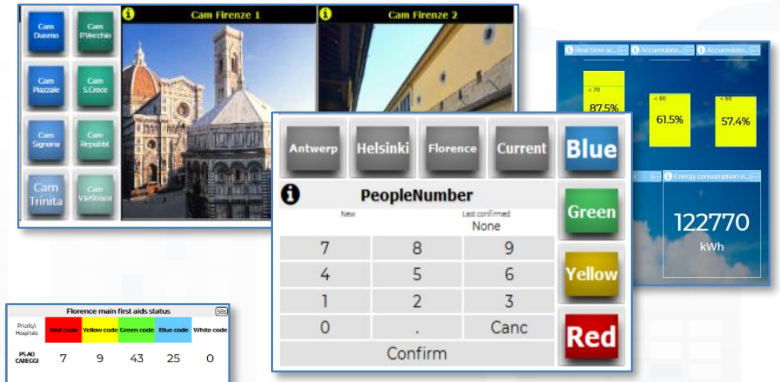

The Wizard help you in selecting only possible combination of data vs graphic representation

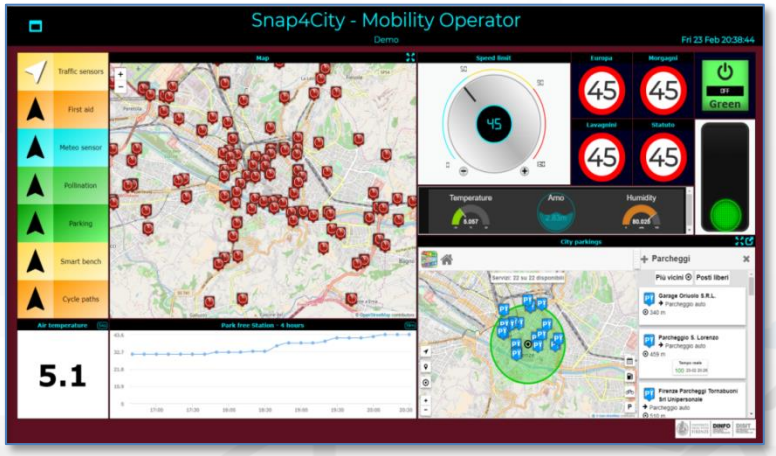

Wizard
Dashboard features
Data and widgets
Check and summary
Map
Carmignano
Fiesole
Aeroporto Firenze Amerigo Vespucci
Signa
Lastra a Signa
Firenze
Pontassieve
Scandicci
Bagno a Ripoli
SR69
Montelupo Fiorentino
© OpenStreetMap contributors
Single data widgets
Multi data widgets
Data sources
All selected (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 Check
Ownership
Special Widget Environment Weather Forecast Previ_Meteo special weather 2018-07-08 16:00:18 public
Vergemoli
Vaglia
Vagli sotto
Vagli di sotto
Uzzano
Hide columns
Selected rows: 0
Previous 1 2 3 4 5 1081 Next
Search
Choosen data sources
Last Date
Last Value
Healthiness
Remove
Close
SNAP4CITY
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

# Dashboard List and Editor

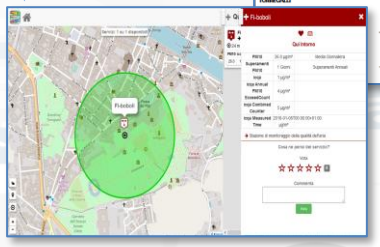



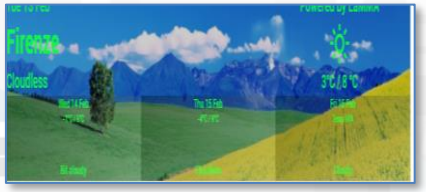


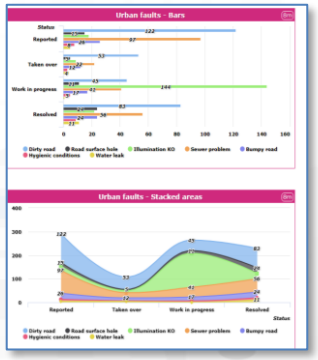







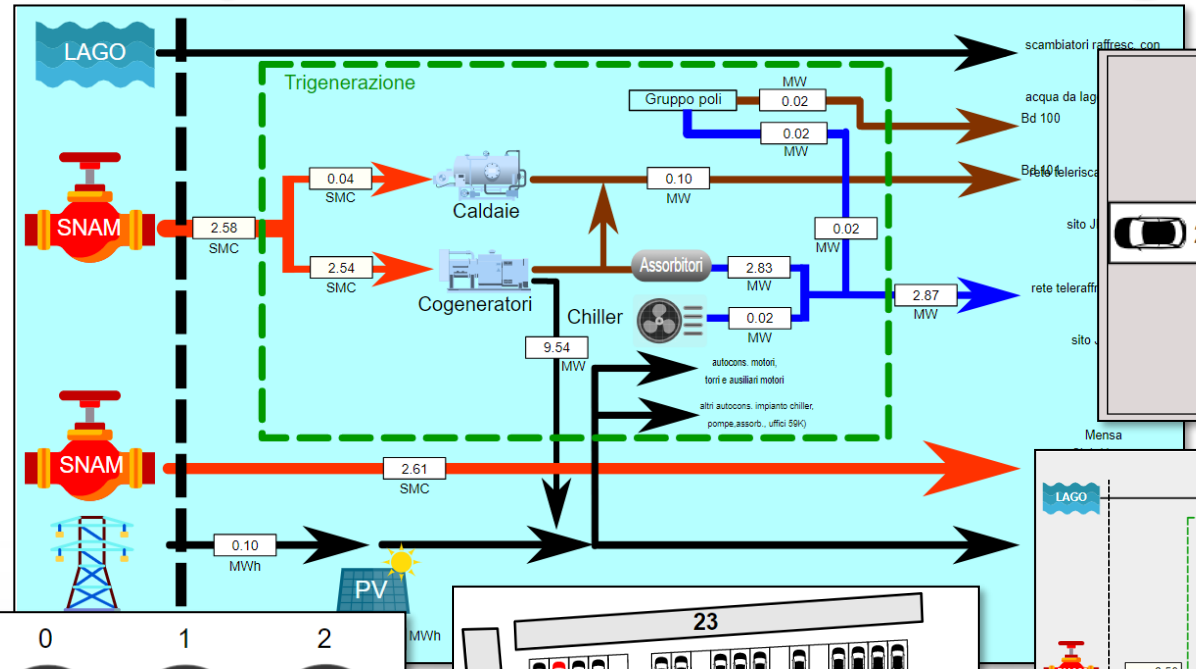


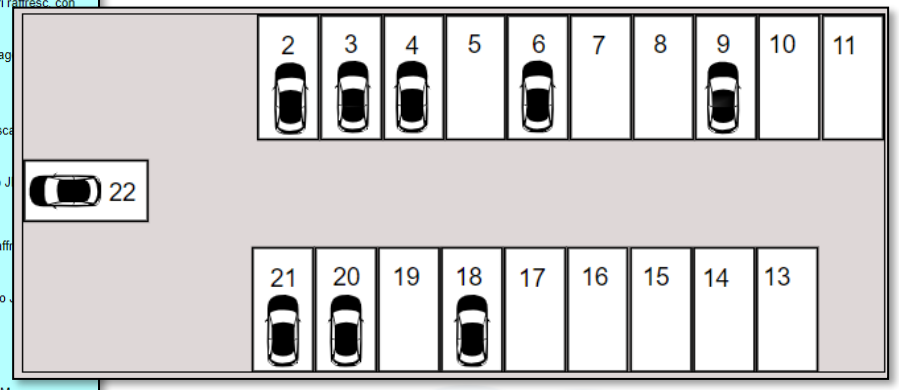



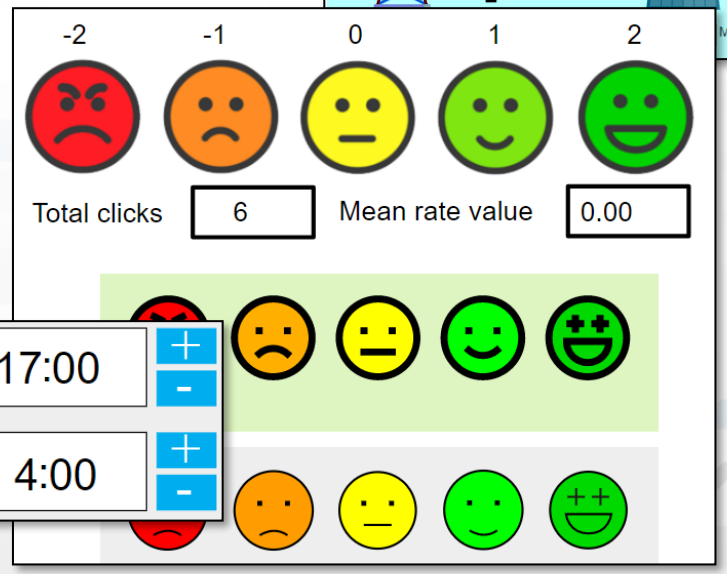



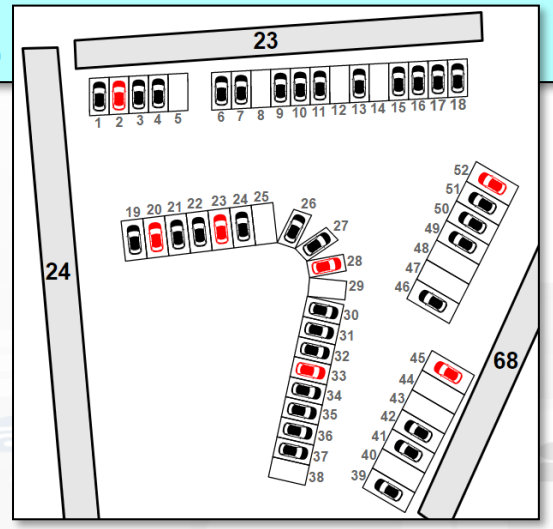
# Special Custom Widgets

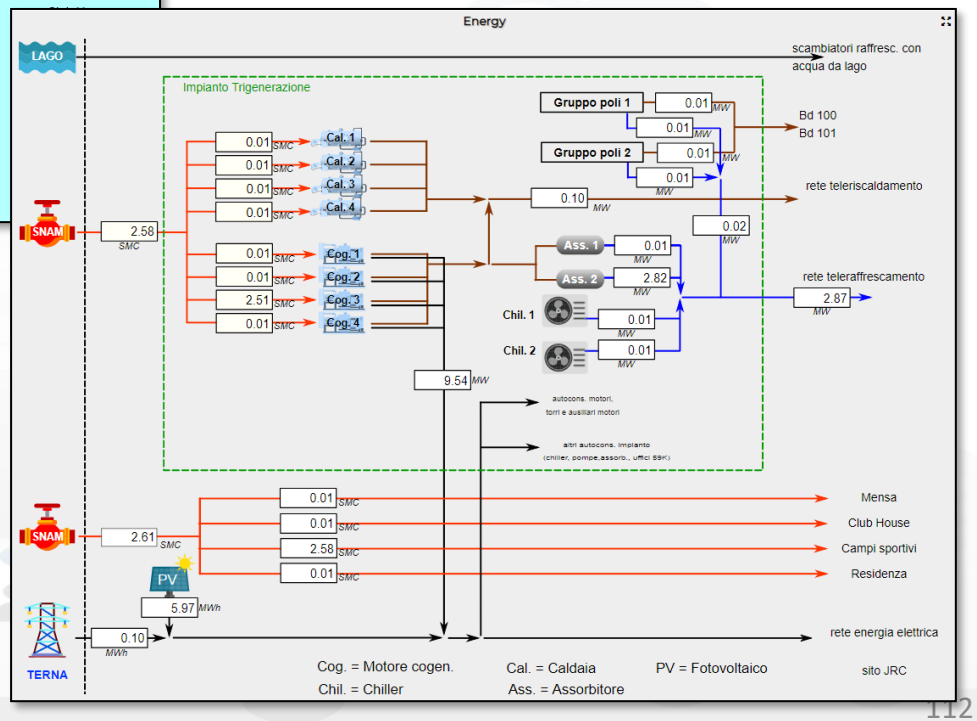
- Smart parking
- Smart Energy
- Smart Light
- Smart ….
- Energy View
- Custom Controls



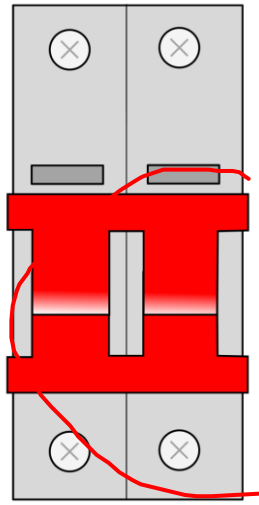



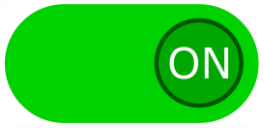



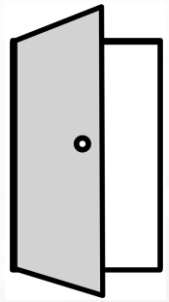



# Other examples

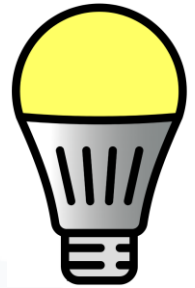


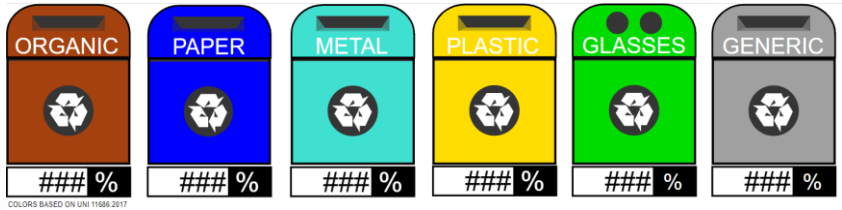
- **Virtual Actuators (sensor-actuator)**
  - From: Dashboard
  - To: IOT App, MyKPI, other Synoptics

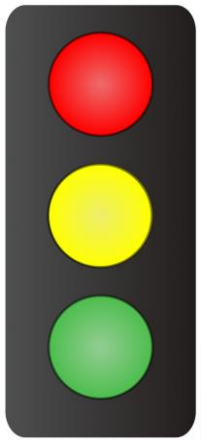



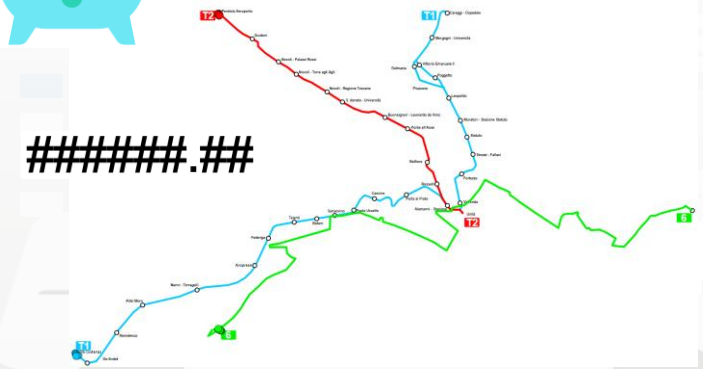



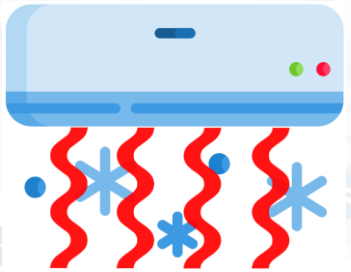
- **Virtual Sensors**
  - From: MyKPI, Sensors, IOT App, other Synoptics
  - To: Dashboards





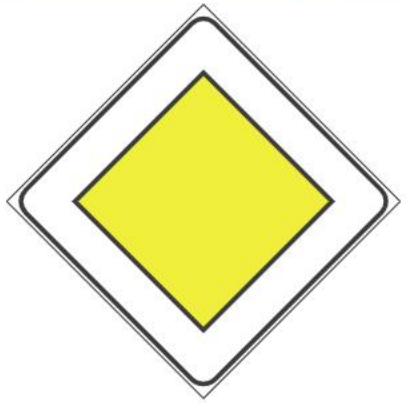


# SVG Custom Widgets Examples

Sat 16 Jan 01:07:39

Precedence Italians Road signals

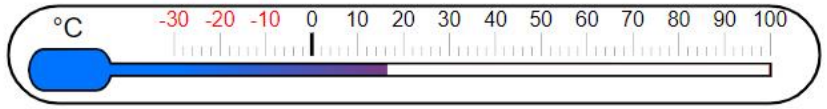


Select a code from 0 to 11 to change the road sign

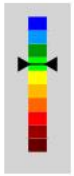
| New | | Last confirmed: None |
|---|---|---|
| 7 | 8 | 9 |
| 4 | 5 | 6 |
| 1 | 2 | 3 |
| 0 | . | Canc |
| Confirm | | |

s... Smart Light Luminosity

Air Temperature in Florence



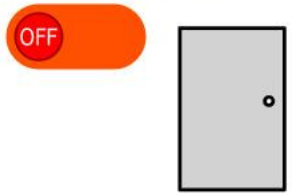

PM10 level - Bologna



fan Fan velocity


Symbols Legenda

open/... M...




Dynamic Prohibition...

Prohibition Traffic Signs Co...

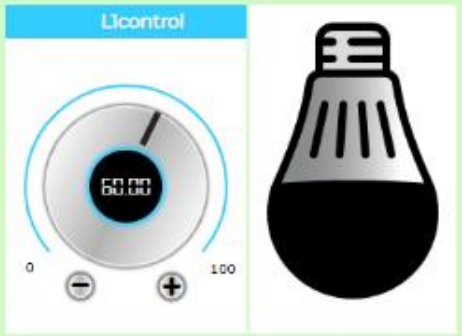
| New | | Last confirmed: None |
|---|---|---|
| 7 | 8 | 9 |
| 4 | 5 | 6 |
| 1 | 2 | 3 |
| 0 | . | Canc |
| Confirm | | |


Prohibition Traffic Signs Legenda

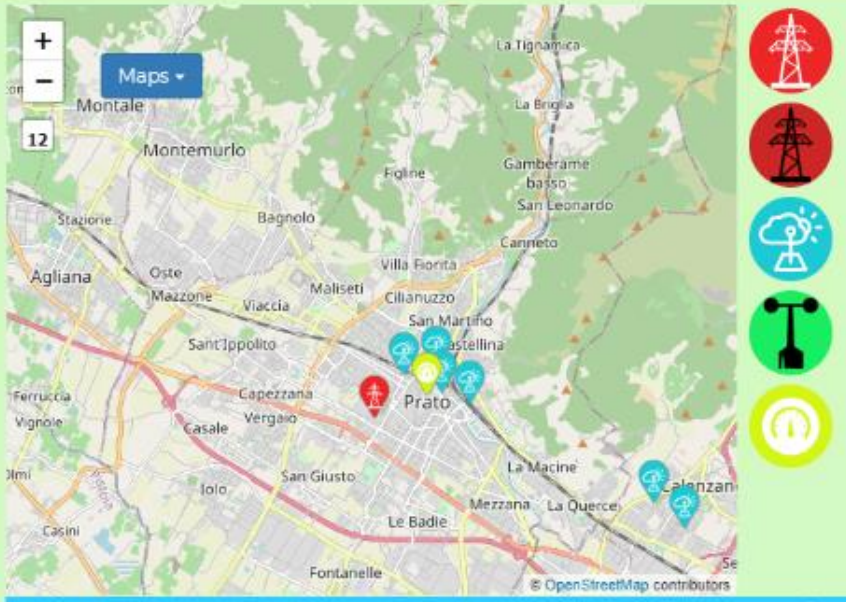
# Snap4Home 5G Demo

Thu 11 Jun 18:07:32

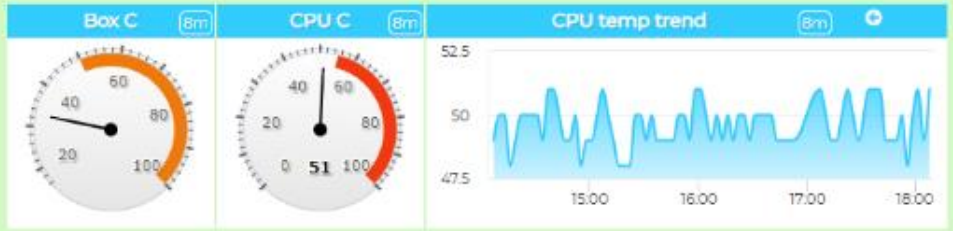








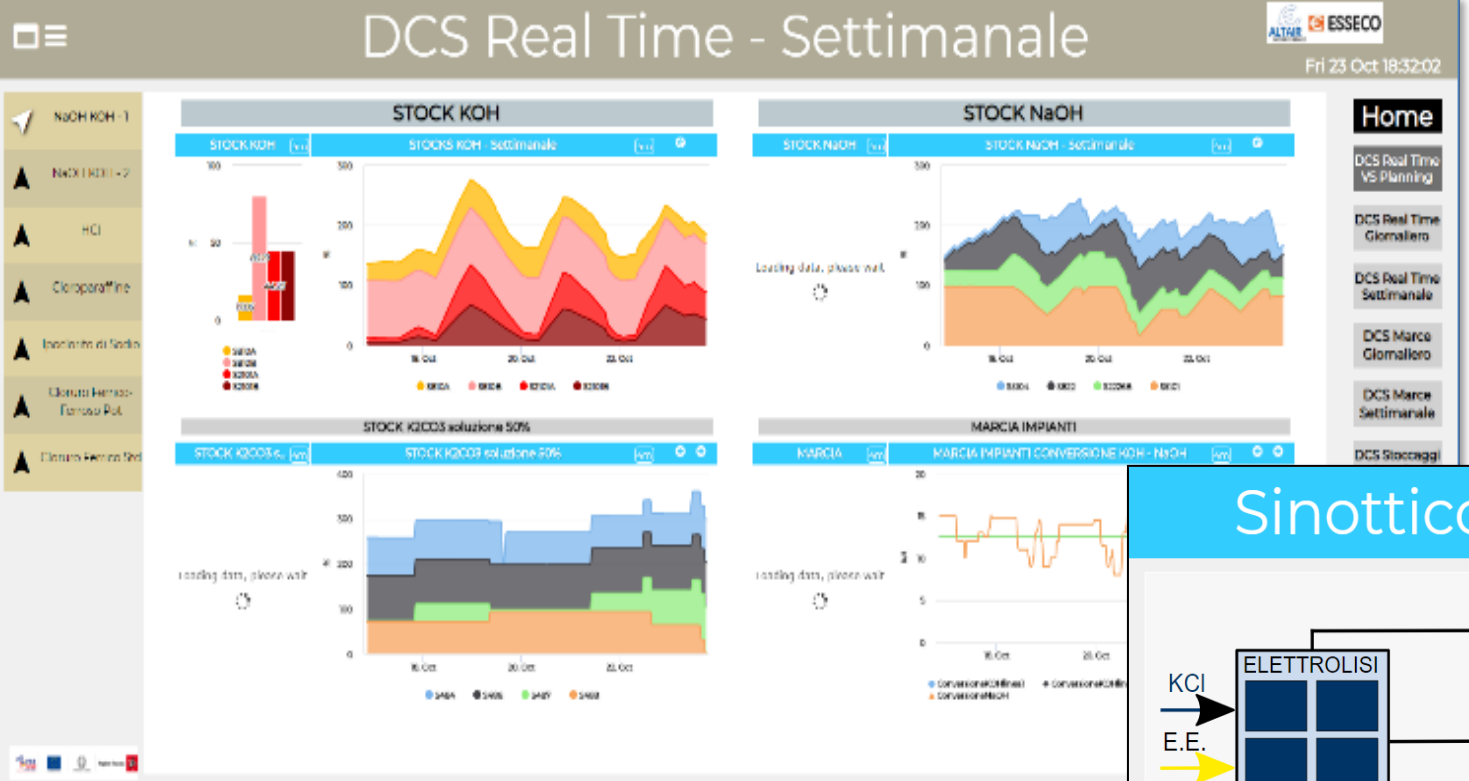


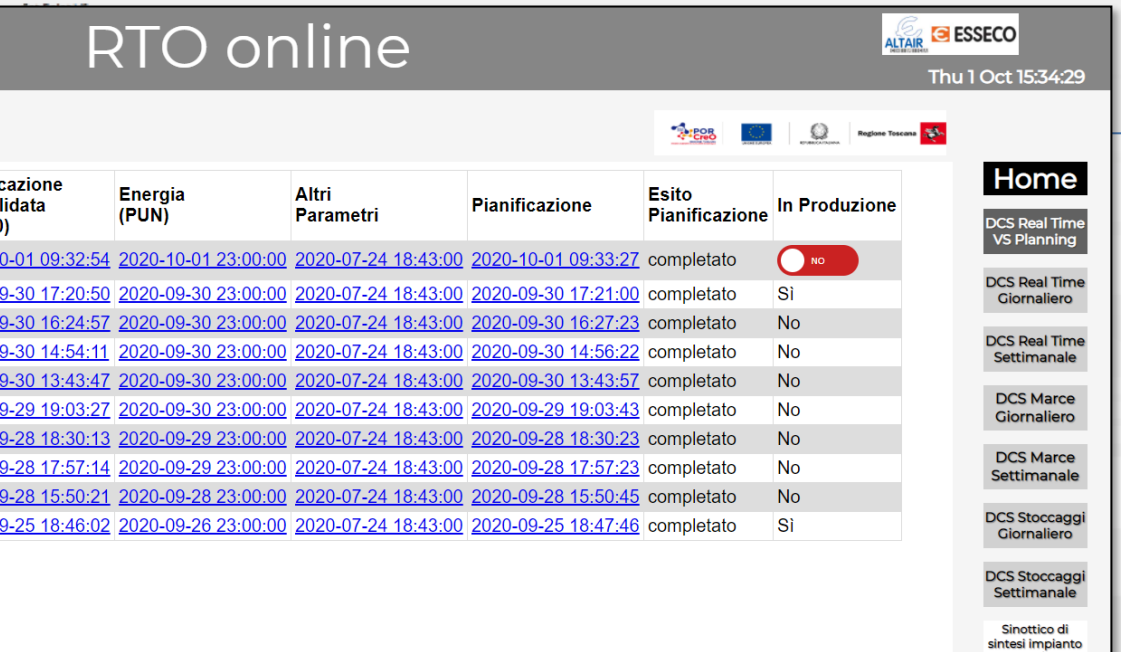





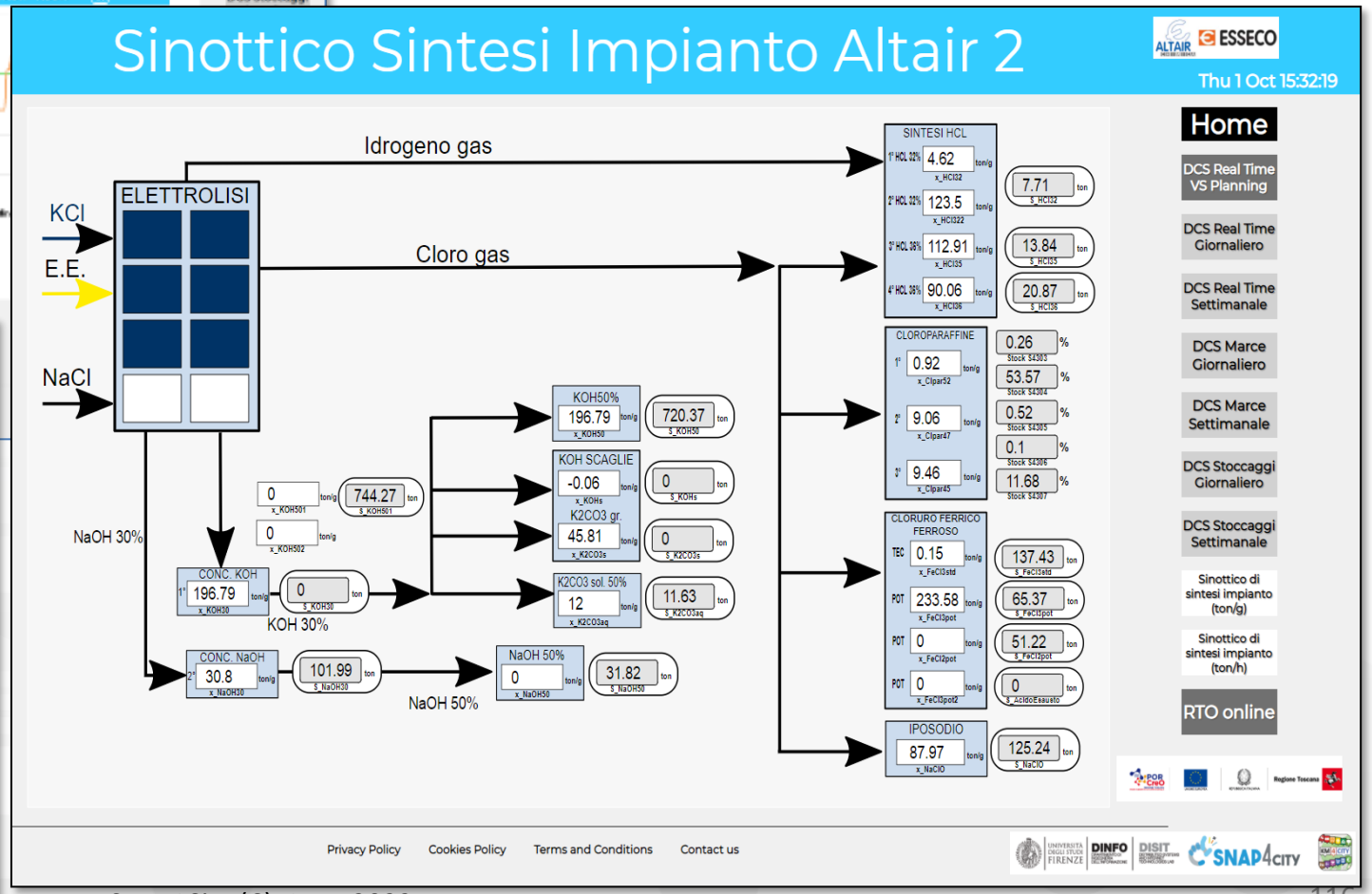


open fiber WIND 3 ZTE estra

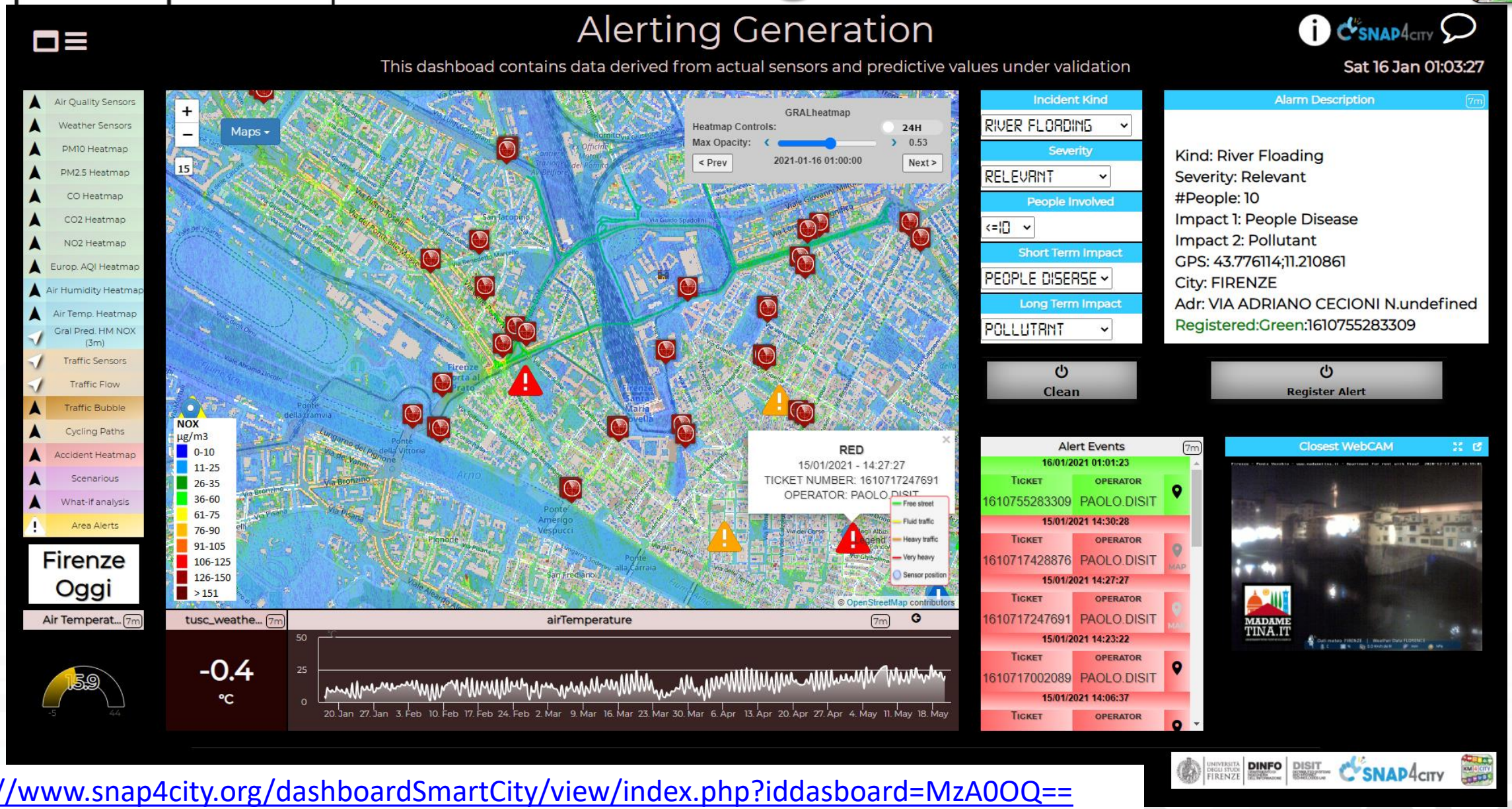



| cazione lidata ) | Energia (PUN) | Altri Parametri | Pianificazione | Esito Pianificazione | In Produzione |
|---|---|---|---|---|---|
| 0-01 09:32:54 | 2020-10-01 23:00:00 | 2020-07-24 18:43:00 | 2020-10-01 09:33:27 | completato | NO |
| 9-30 17:20:50 | 2020-09-30 23:00:00 | 2020-07-24 18:43:00 | 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 |

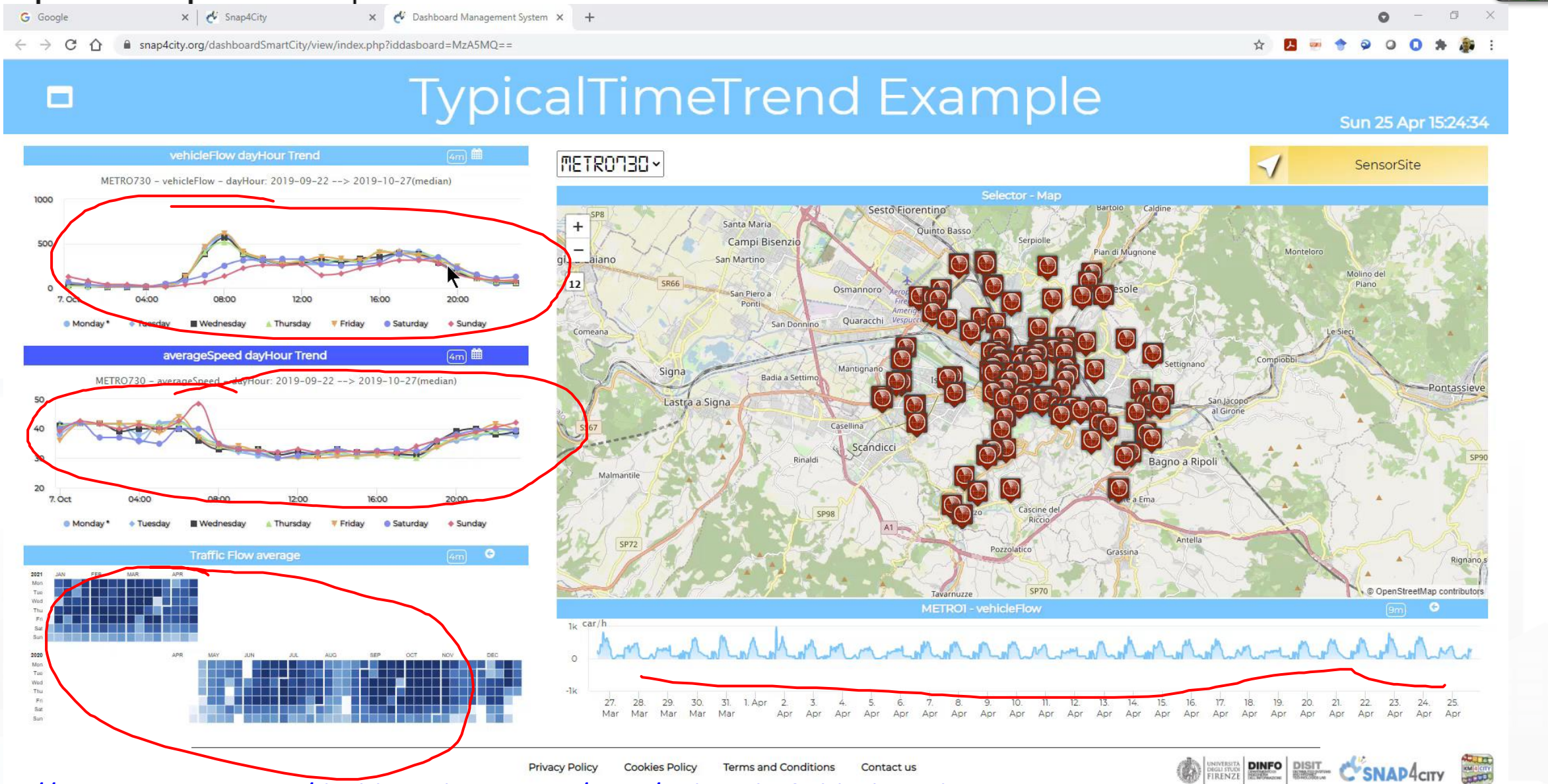


# Alert Registration




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

# Typical Time Trends




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

# How the Dashboards exchange data

Snap4City BigData Storage and KB

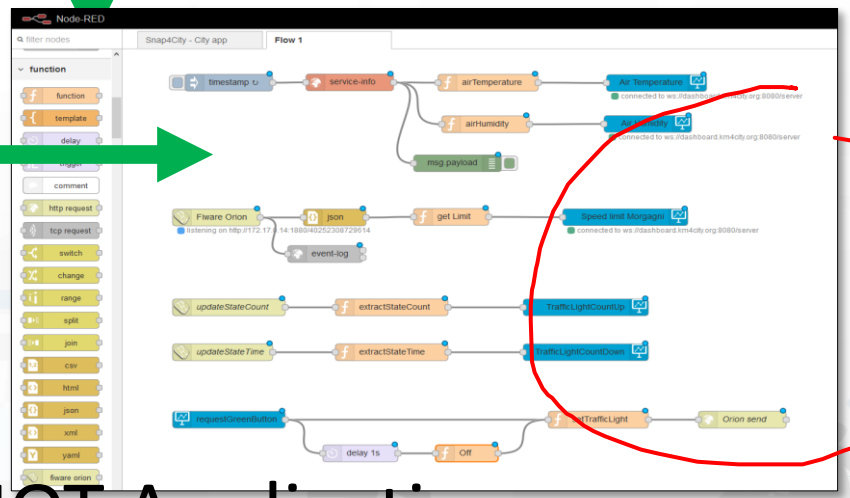
IOT Broker Orion Quantum Leap

ServiceMap Super ServiceMap

Metric, KPI

MyKPI, MyPOI, …

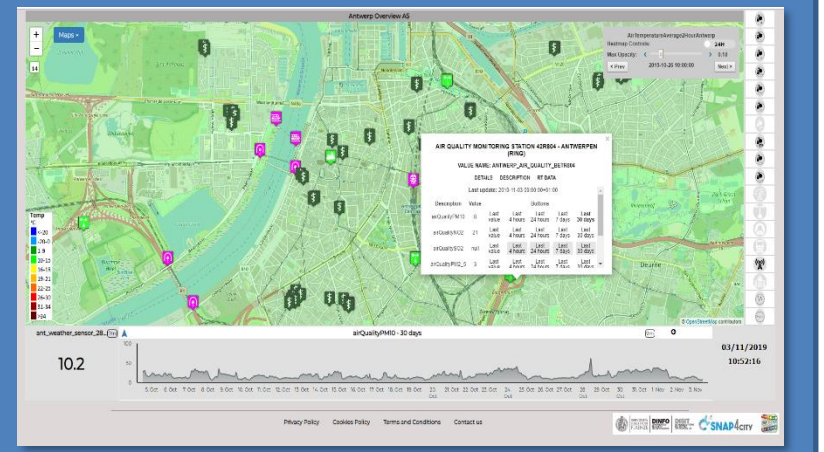
API, External Services, MicroApp



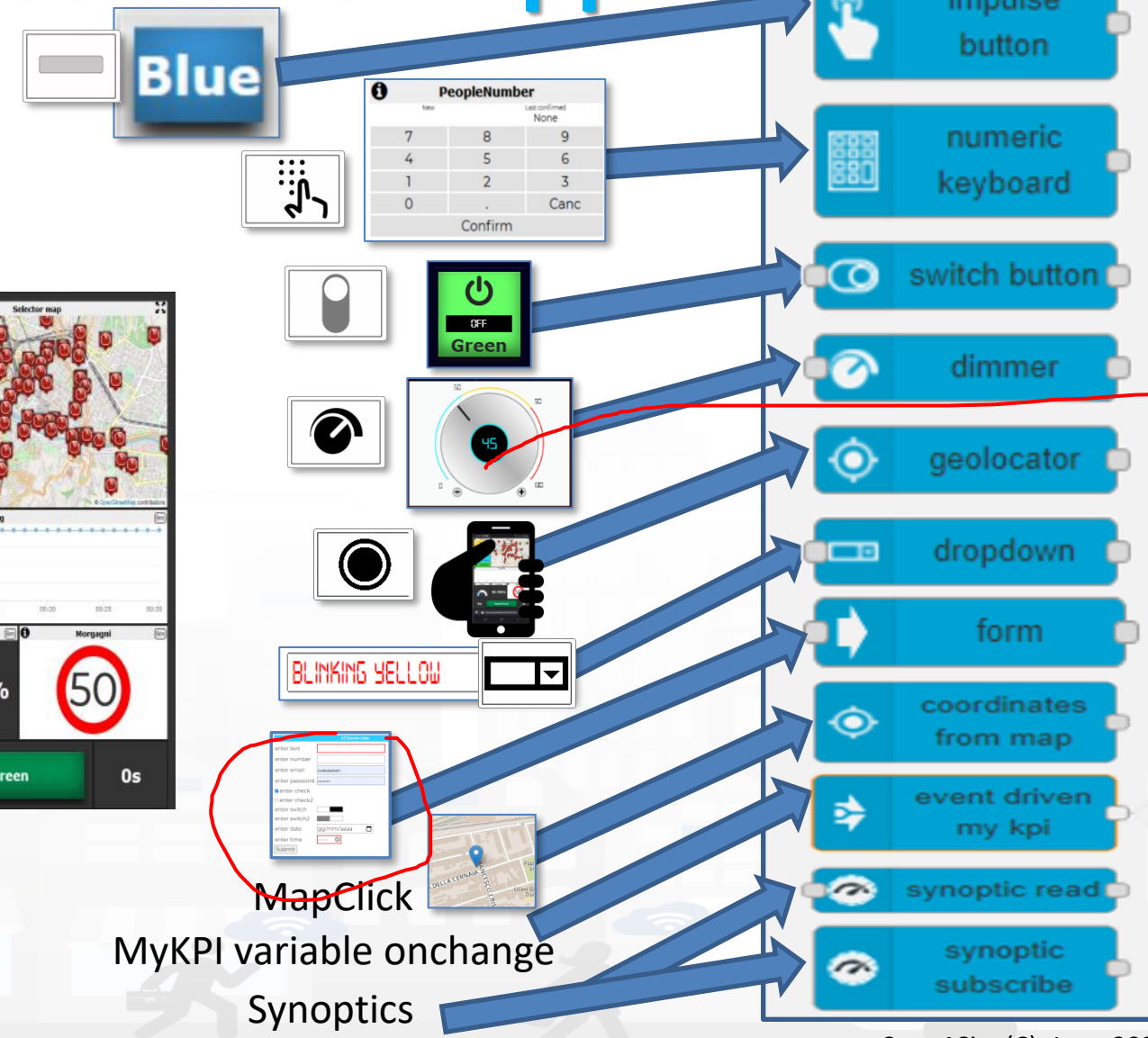

IOT Application

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

## Dashboards



# Dashboard-IOT App

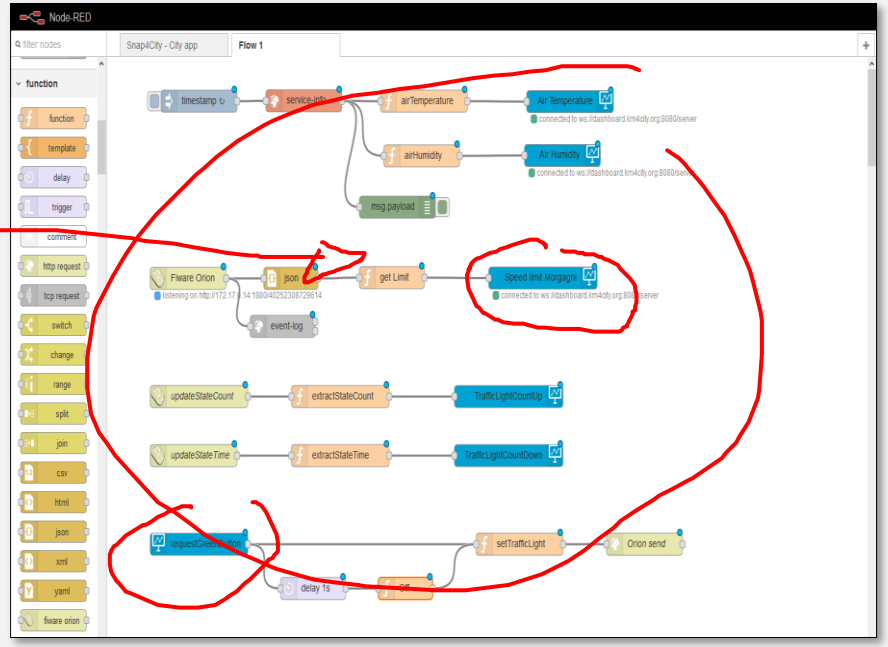




MapClick

MyKPI variable onchange

Synoptics

## From Dashboard to IOT App



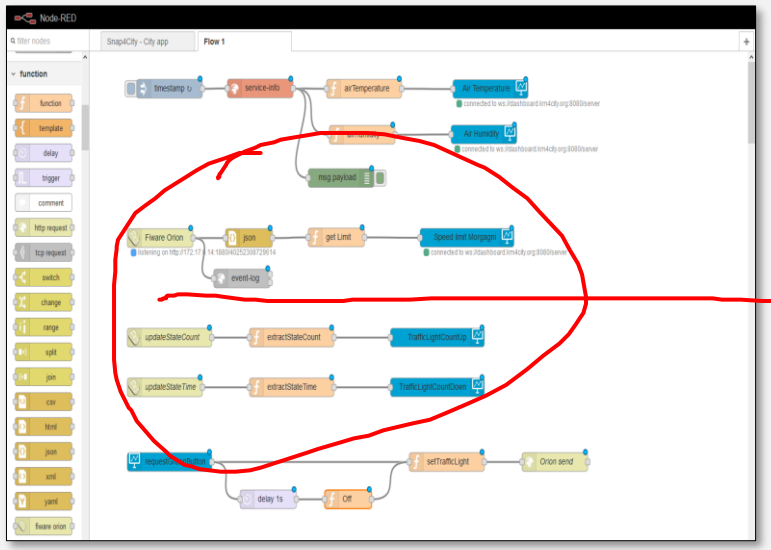

IOT Application

# Nature



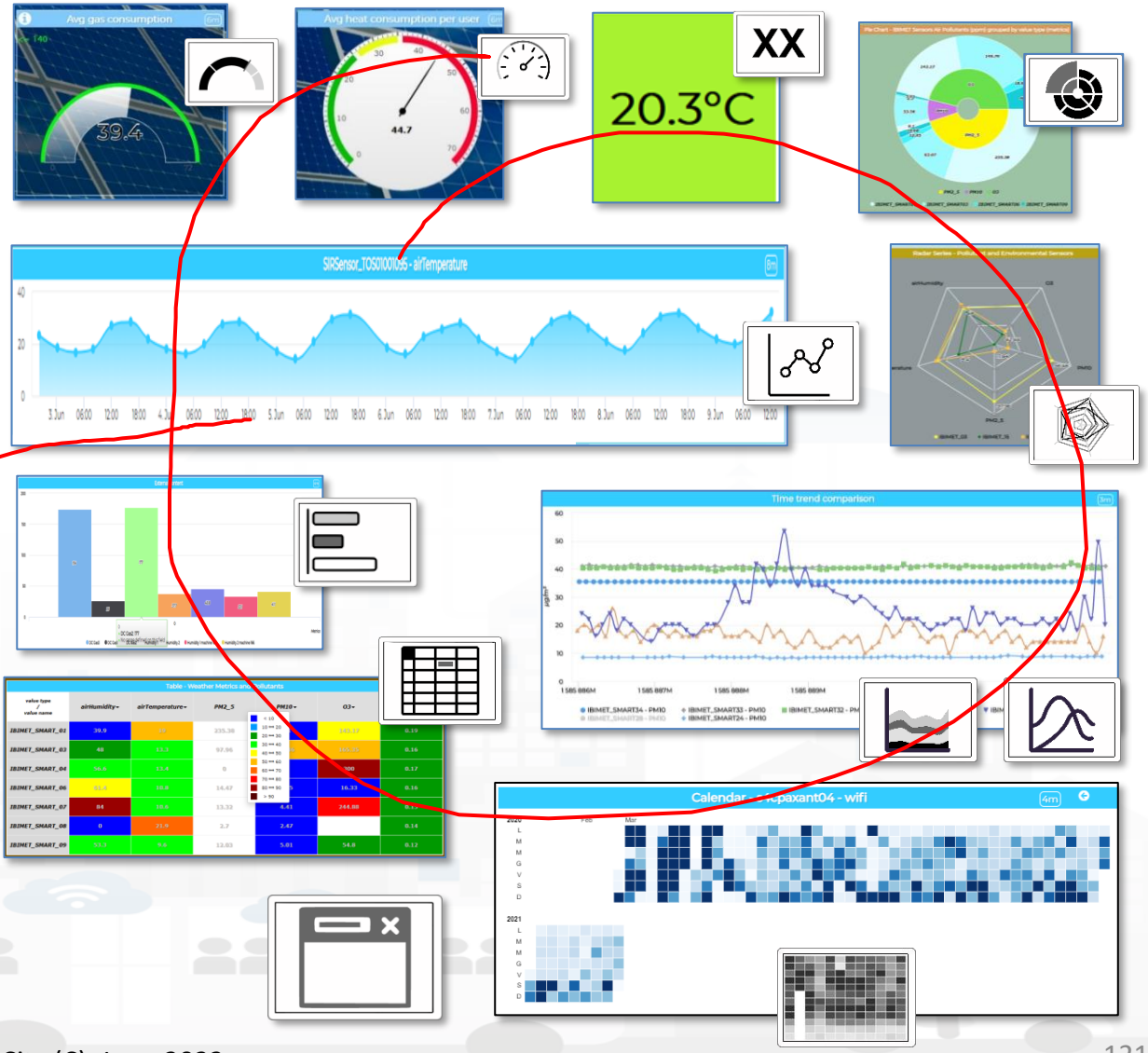
# Dashboard-IOT App

## 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
- synoptic write
- calendar

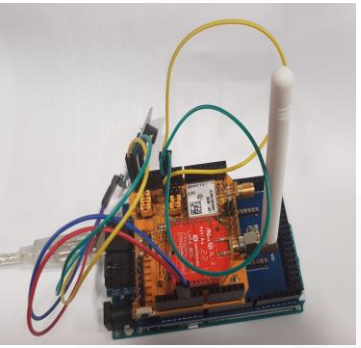


# IOT Devices

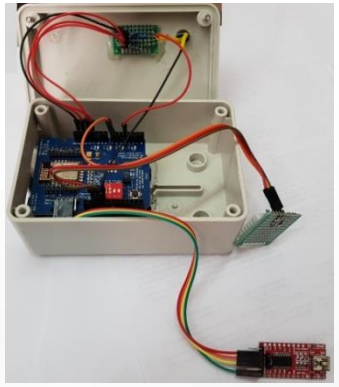
Sensors/
Actuators

# IOT Edge Devices

LoraWAN +
Arduino +
I2C, NGSI



Arduino,
Wi-Fi, NGSI

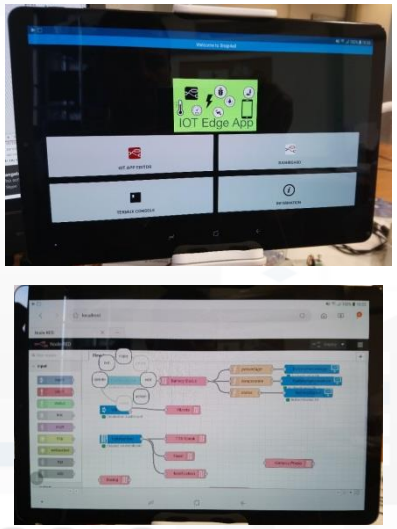


Snap4All
IOT Button
ESP, NGSI,
Wi-FI, BT

Snap4All PAX
Counter
LoraWAN
WIFI, NGSI,
GPS

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

IOT Edge
NodeRED:
Android, LINUX,
Windows, …



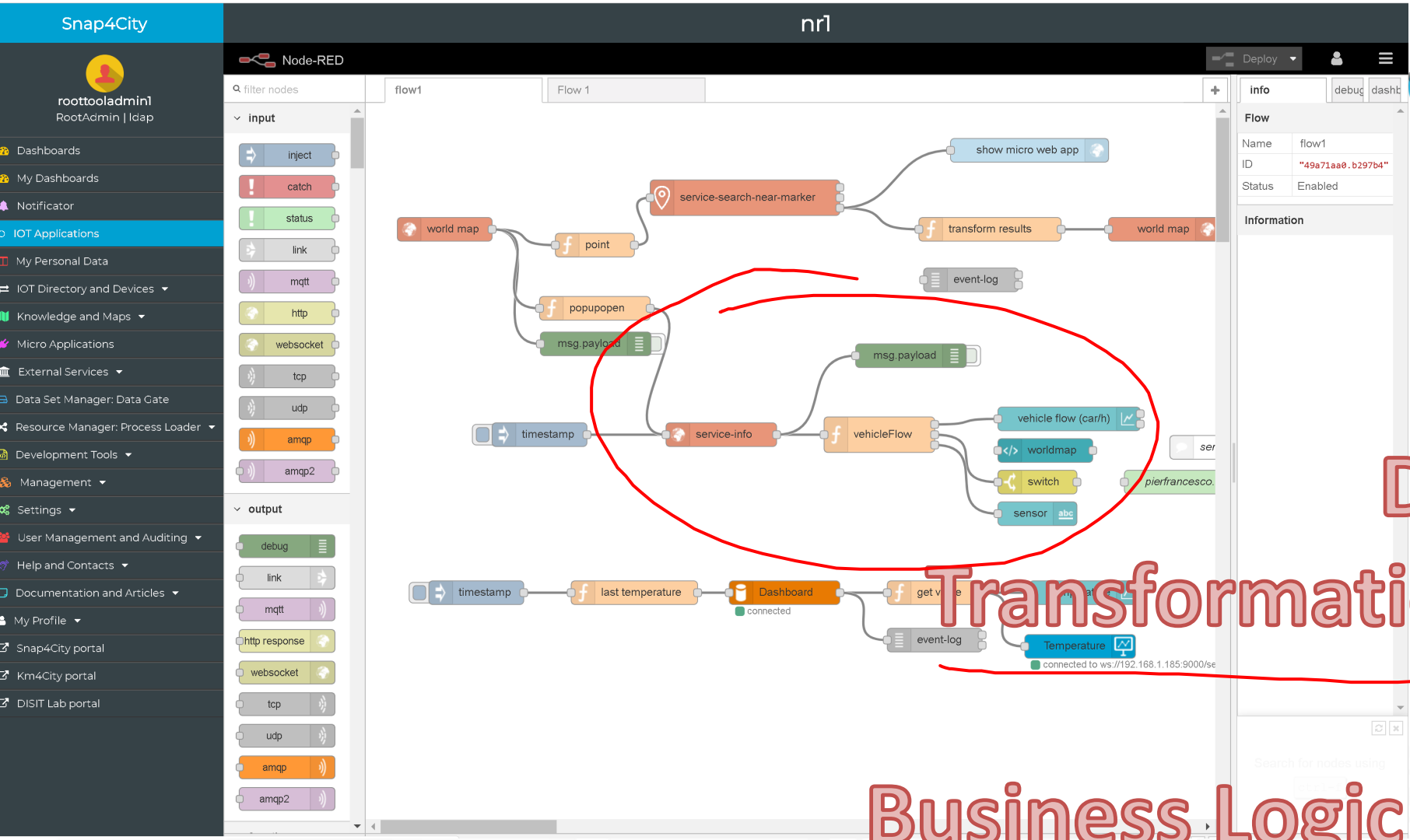

LoraWan
Gateway:
IOT Edge, NGSI,
WIFI, RJ45, GPS

Any Sensor / Actuator
Open to other protocols

# IoT Application Development smartening the solutions

**On Line Training Material** (free of charg

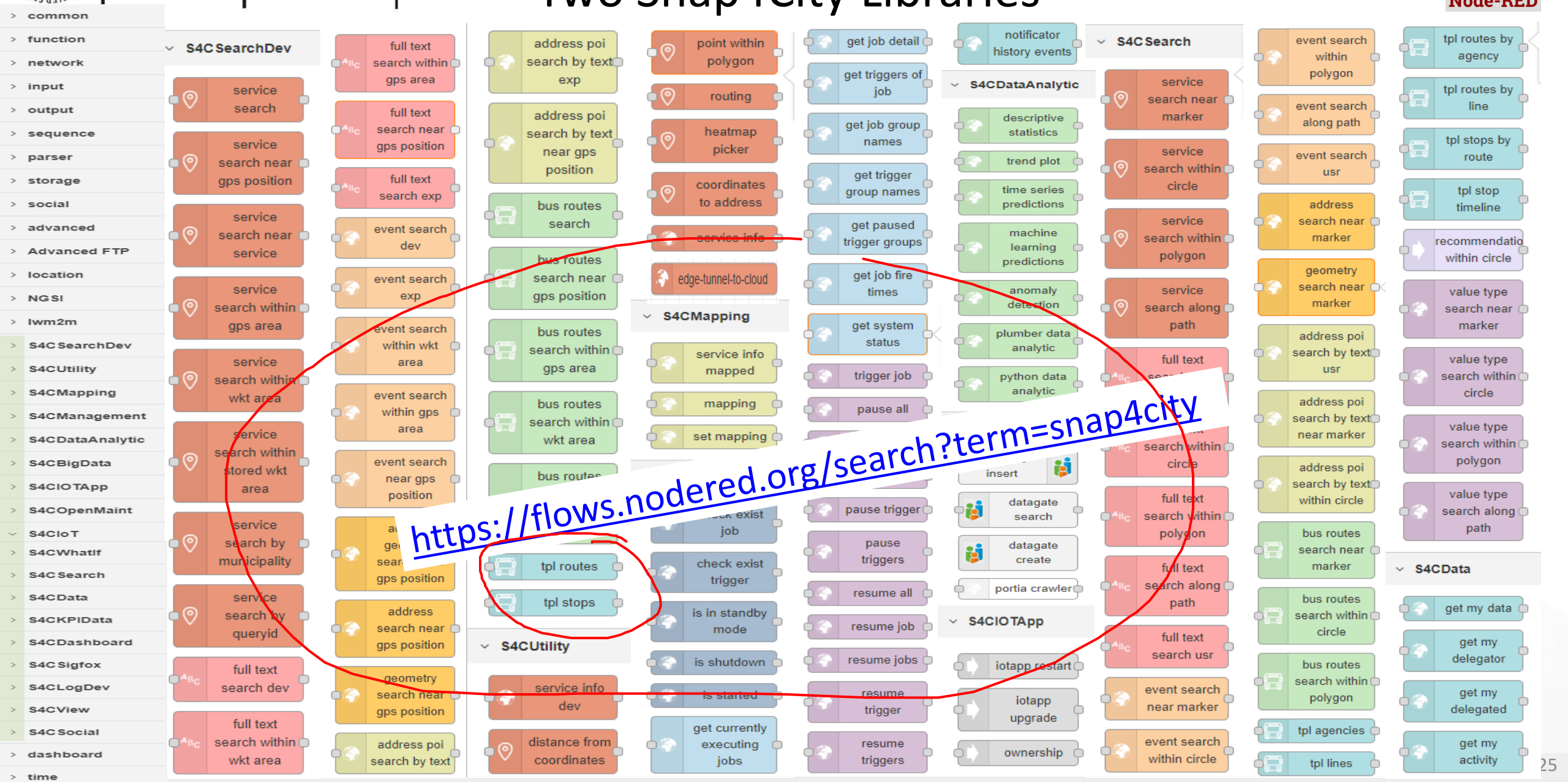
| | 1st part (*) | 2nd part (*) | 3rd part (*) | 4th part (*) | 5th part (*) | 6th part (*) | 7th part (*) |
|---|---|---|---|---|---|---|---|
| what | General | Dashboards | OT App, IOT Networ | Data Analytics | Data Ingestion processes | System and Deploy Install | Smart City API: Web & Mob. App |
| 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 |




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

# April 2022 collection

## Two Snap4City Libraries




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

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

# April 2022 collection

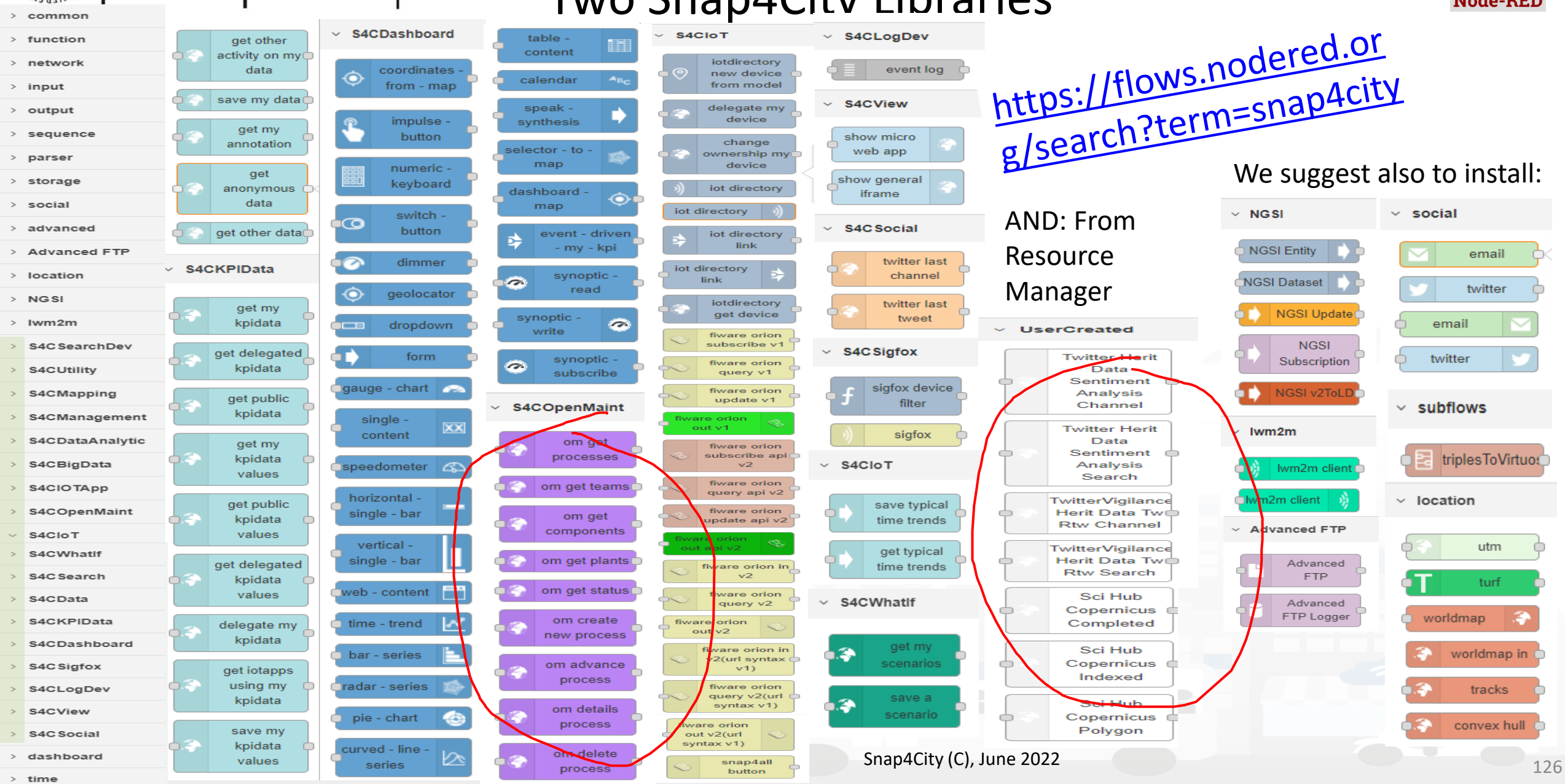
## Two Snap4City Libraries

SNAP4CITY | Node-RED

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

We suggest also to install:

AND: From Resource Manager



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# Nov. 2020 collection
## Two Snap4City Libraries

SNAP4CITY | Node-RED

-Search and management of Services, POI, Parking, Public Transport, etc.

-Event management, ticket management

-Routing, Data Analytic, Open Data processing

-IoT device registration, Virtual Devices full control

-IOT adaptation, network management

-Dashboard management

-Personal data management, KPI, etc.

.....

# Maps Business Logic vs IOT Apps

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

data

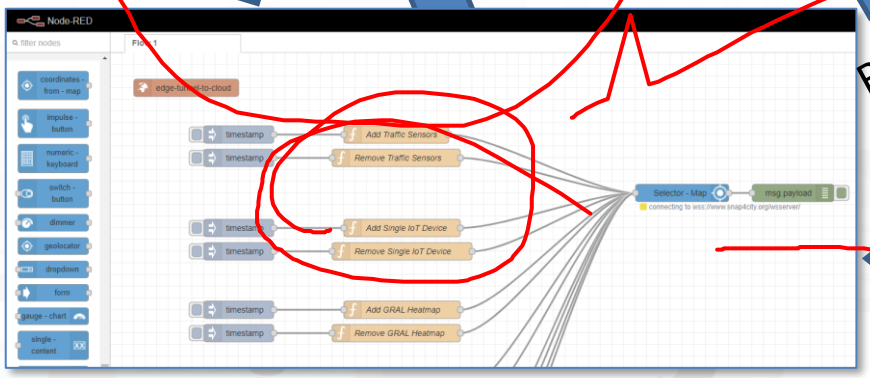
data

Data, changed data

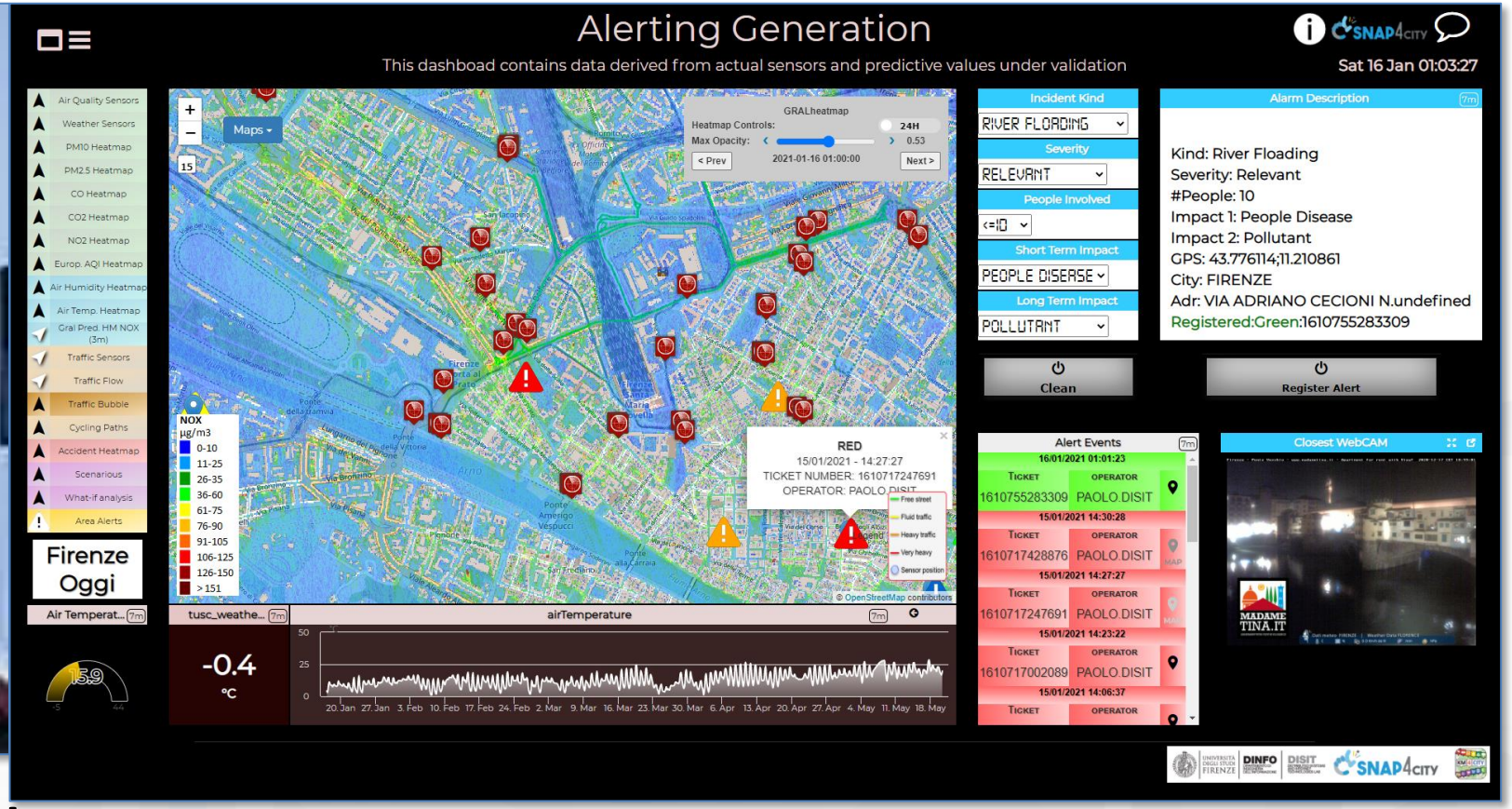
References, commands, directives, selections

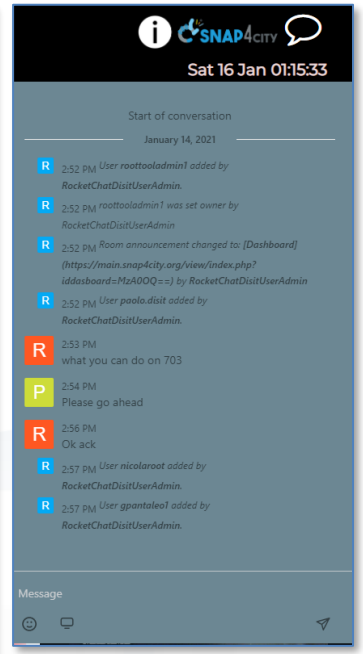
Selector

selections, positions, ServiceURI



# Registering Alerting events



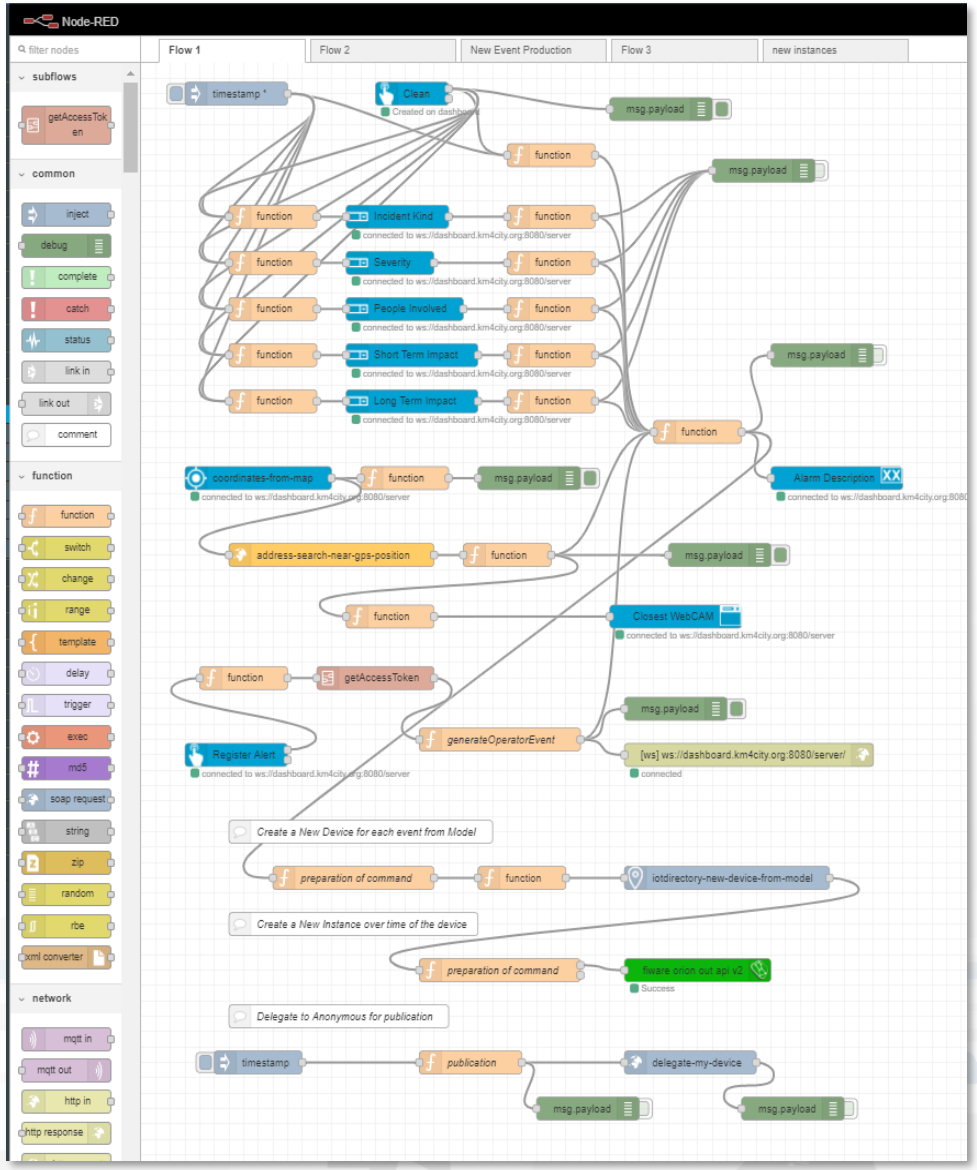



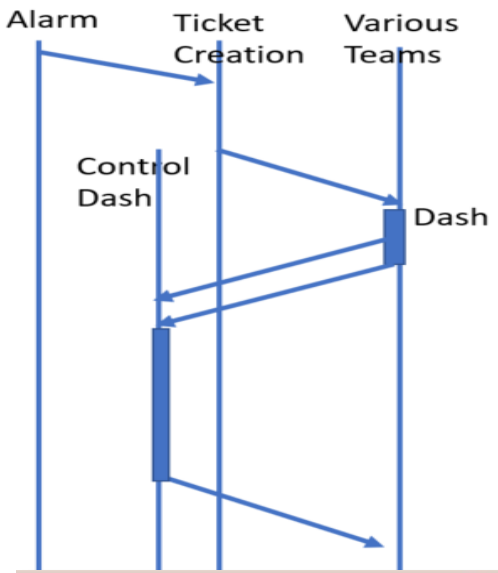

## Control Room Operator

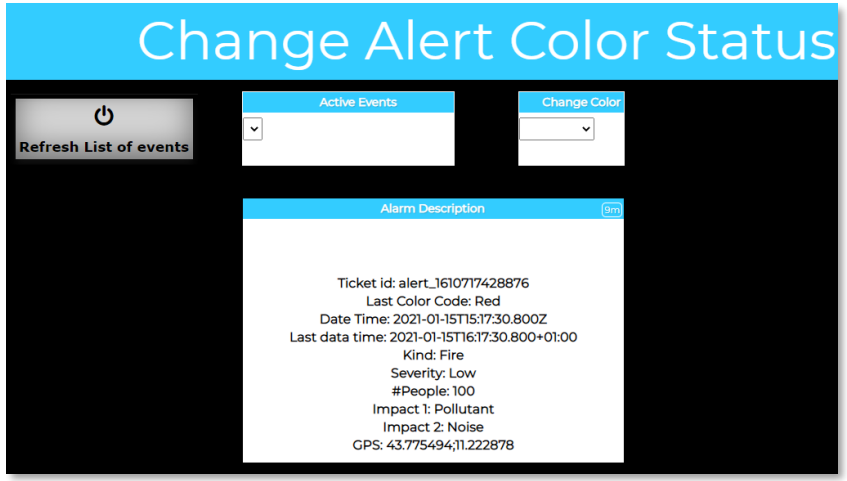
- **Monitor** traffic flow, Environment, Car parking, Cycling, First aid, temp., …
- **Registering Events: classification**
- **Changing status**
- **Acting**

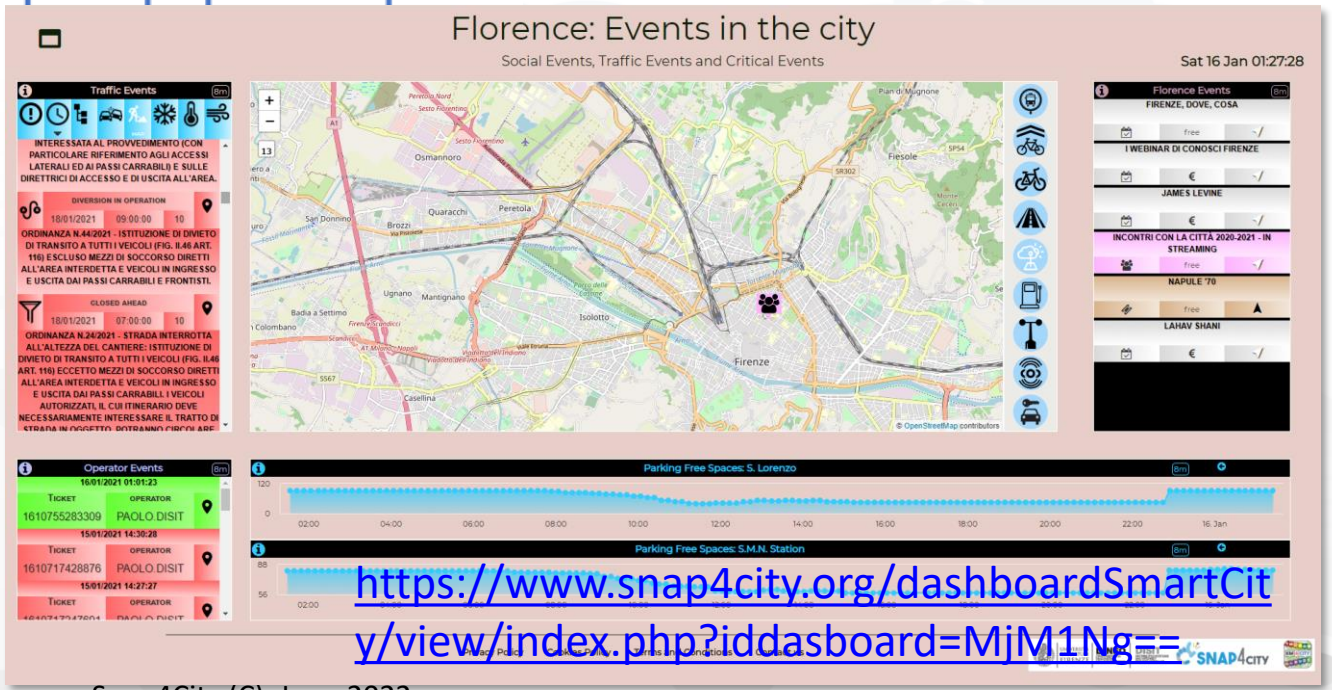
https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA0OQ==

# Flow Mng



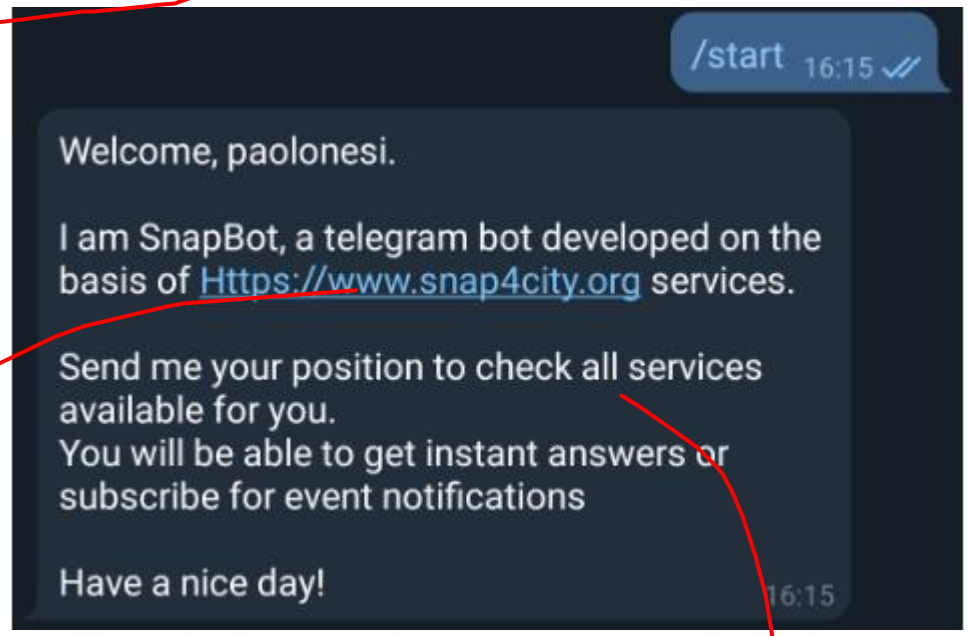



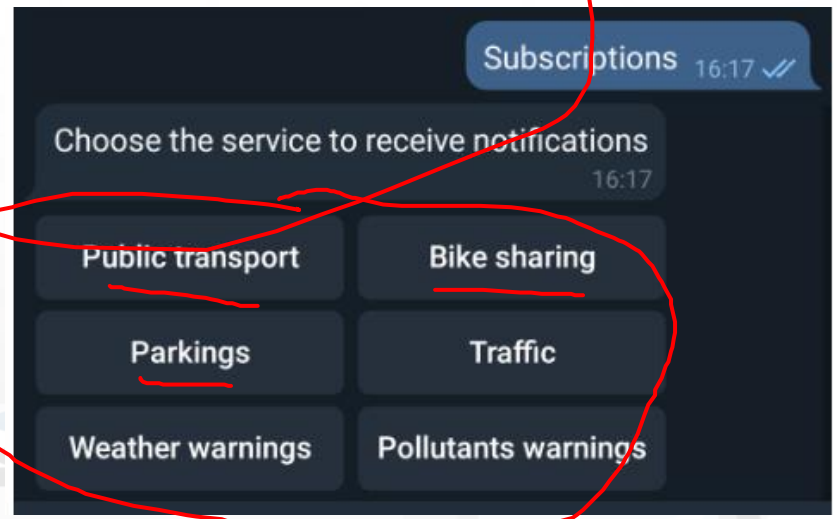

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MjM1Ng==

# SnapBot

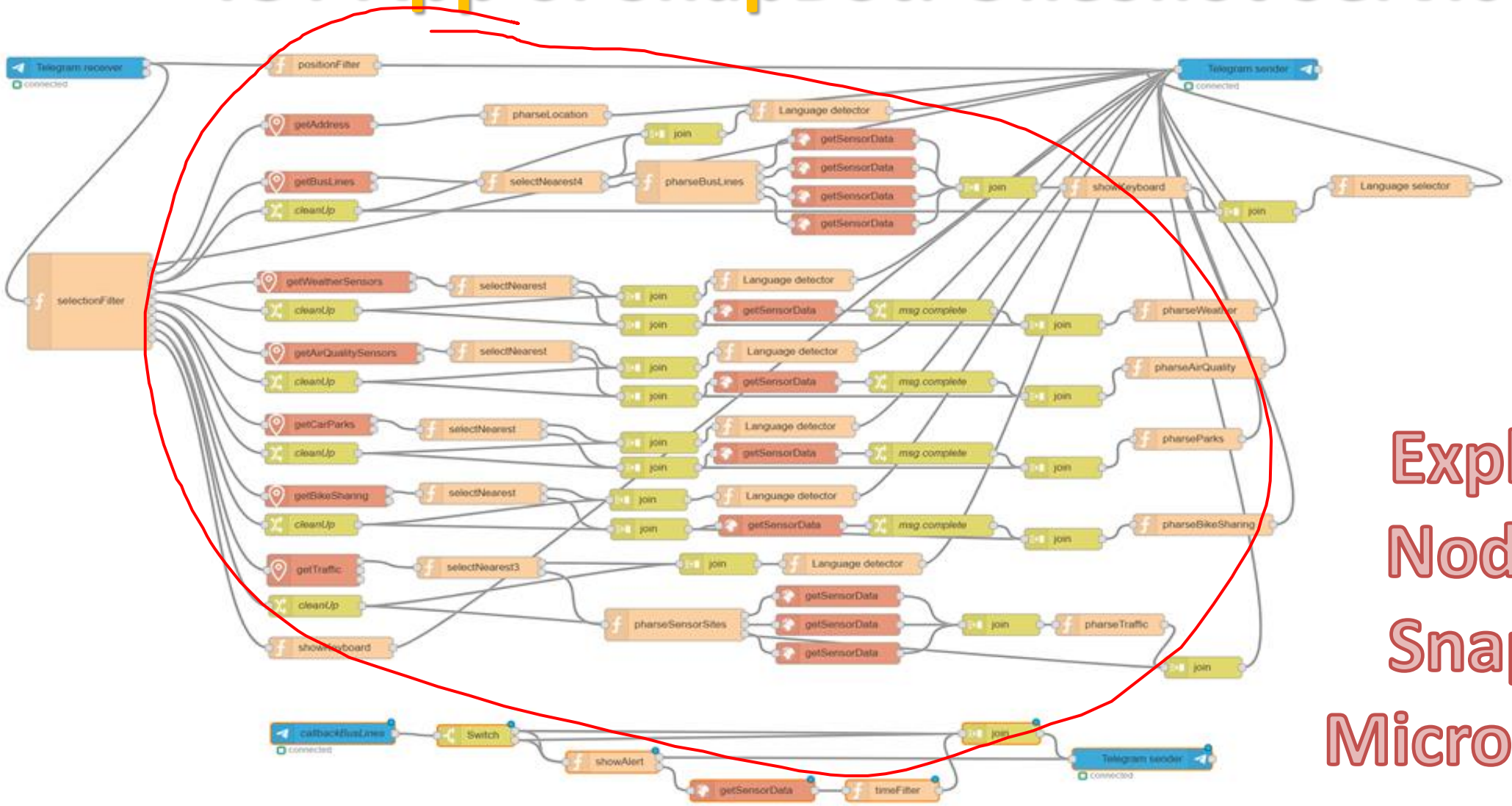
- provides real time smart city services to Telegram users, geolocalized, when you like, what you like
- active on Tuscany in all provinces and cities according to the data accessible on Https://www.snap4city.org
- Services on
  - Public Transport (more than 10 different operators),
  - bike sharing, parking lots,
  - traffic flow, weather warnings,
  - Air quality, pollutant,
  - find your location, etc.







# IOT App of SnapBot: OneShot Services




Exploiting Node-RED Snap4City MicroServices

# Development of Data Analytics

**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 Networ | 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 |

# Data Analytics on Snap4City platform

Swagger

Ontology Schema

LOG.disit.org

Knowledge Base, Km4City

**Big Data Store Facility**

Smart City API from Knowledge Base and other tools

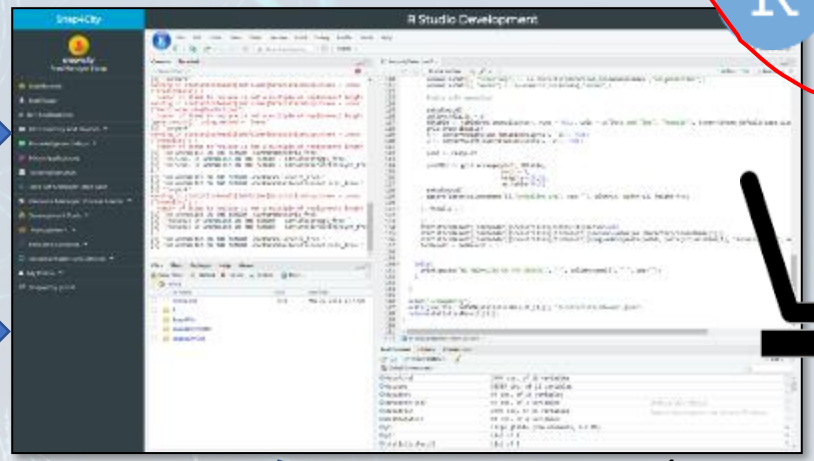
TensorFlow

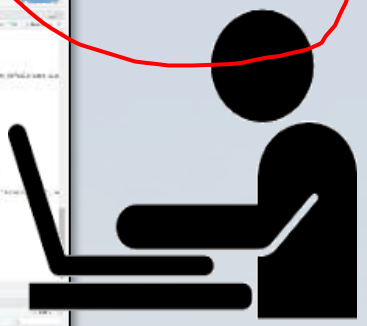
NVIDIA CUDA

python

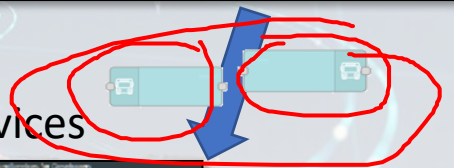
jupyter

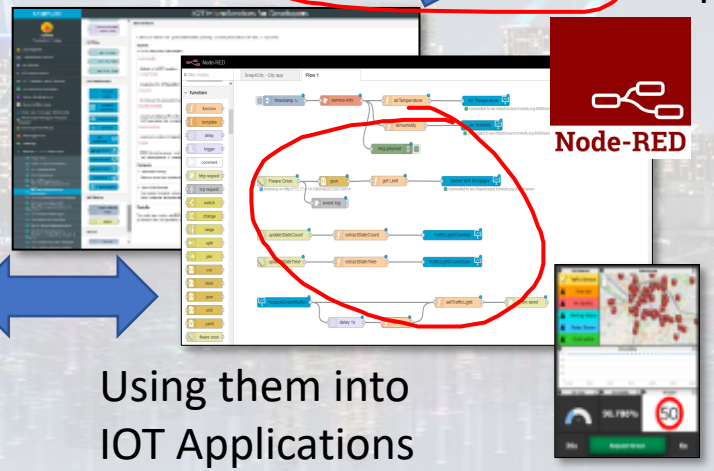
R Studio





Creating MicroServices





Node-RED

Using them into IOT Applications

Saving / Sharing reusing

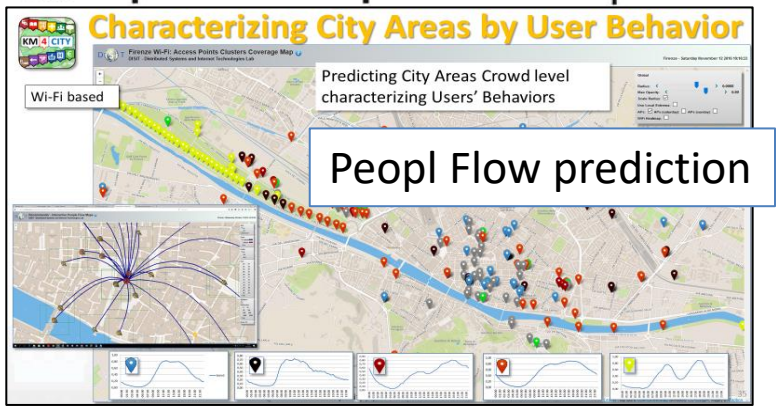
Resource Manager

SNAP4CITY

KM4CITY

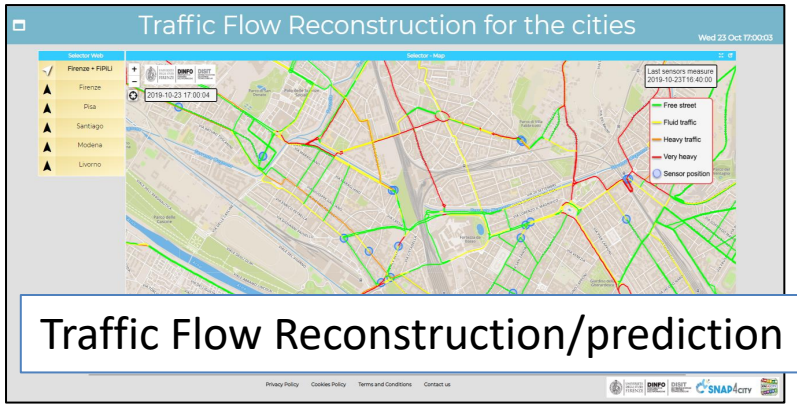
# Data Analytics

## Characterizing City Areas by User Behavior

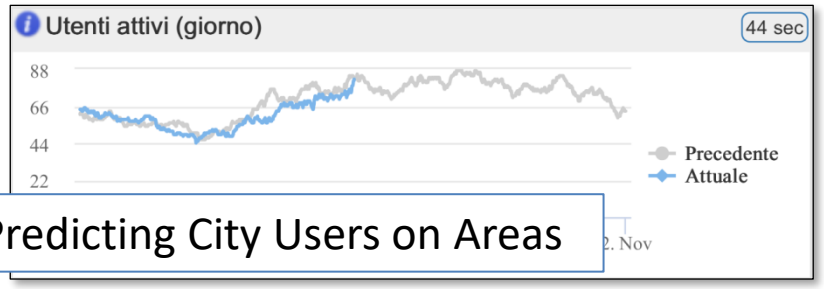



Peopl Flow prediction

## Traffic Flow Reconstruction for the cities



Traffic Flow Reconstruction/prediction



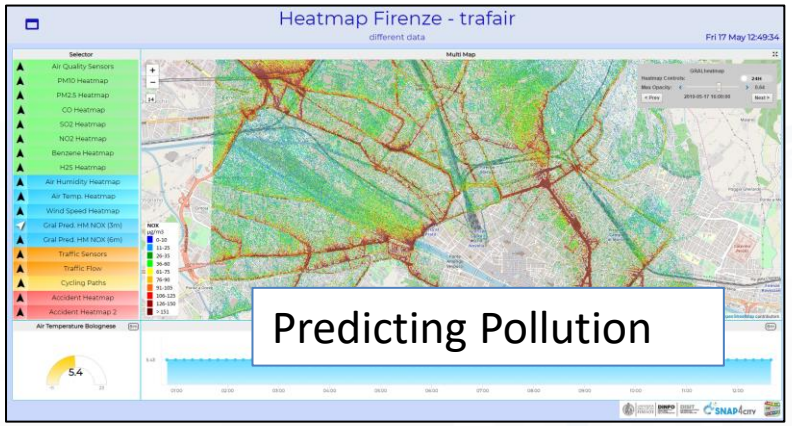

Predicting City Users on Areas

## Free Parking Predictions

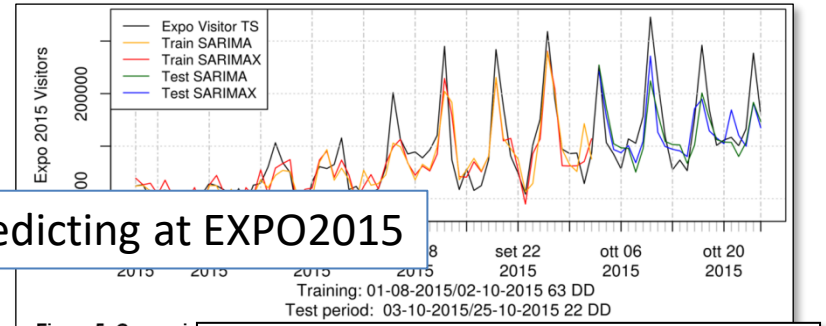
| Careggi car park | | | |
|---|---|---|---|
| Model features | BRNN model results | | |
| | R-squared | RMSE | MASE |
| Baseline | 0.974 | 24 | 1.87 |
| Baseline + Weather | 0.975 | 24 | 1.75 |
| Baseline + Traffic sensors | 0.975 | 24 | 2.04 |
| Baseline + Weather + Traffic sensors | 0.975 | 24 | 1.87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

Active on Mobile Apps as:
- «Firenze dove cosa»
- «Toscana dove cosa»

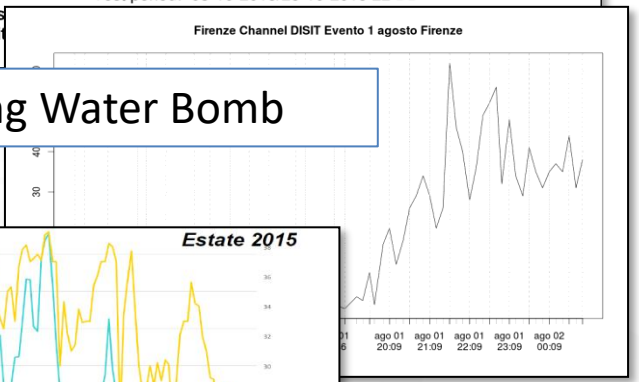
Precision: 97,5%



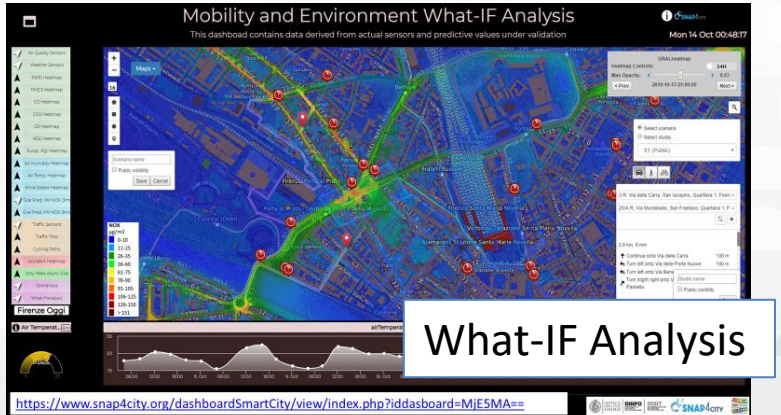

Predicting Pollution




Predicting at EXPO2015




Early Warning Water Bomb

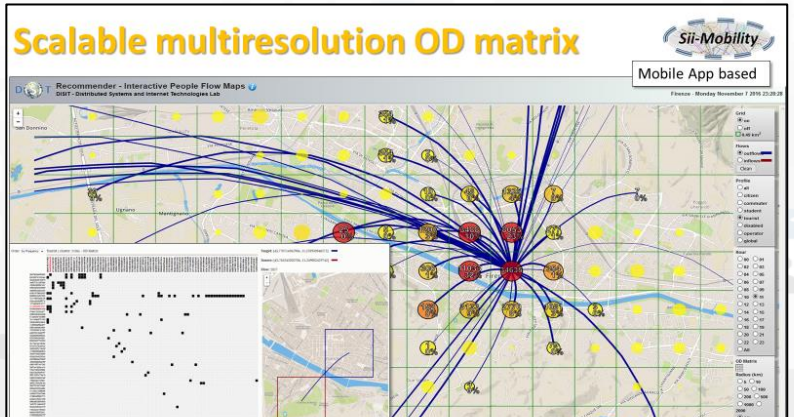


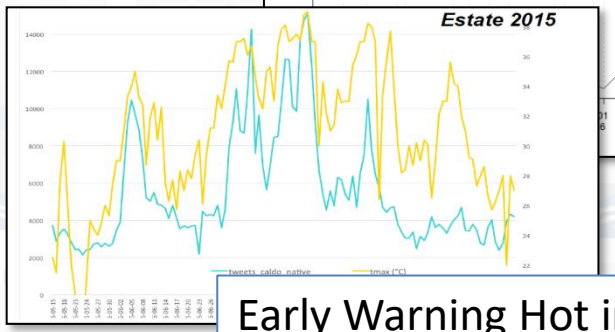

What-IF Analysis

## Scalable multiresolution OD matrix

Sii-Mobility

Mobile App based






Early Warning Hot in Tuscany

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

# Disappearing Data Analytics

SNAP4CITY | KM 4 CITY

| SNAP4CITY | Antwerp | | | | | Helsinki | | | | | | | | Where | | | | RULE OF THUMB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | City official | ICT official | Developer | Citizen, tourist, visitor | Business owner | city officials | City officials Domain experts | City officials City developers | Third party developers | Citizen | Citizens with respiratory problems | Tourists | Business owners | Mobile | MicroApplication | Tool, via Portal (ICT Developers) | Dashboards | Main Data Sources |
| Discovery near to me | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | | POI, OSM |
| Discovery along a path | x | x | x | x | | x | | x | x | x | x | x | | x | x | | | POI, OSM |
| Discovery in an area, shape | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x | | POI, OSM |
| browsing Public Transport | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | | OSM, GTFS |
| Full Text search | x | x | x | x | x | x | | x | x | x | x | x | x | x | | x | | POI, OSM |
| Routing: pedestrian | | | | x | x | | | x | x | x | x | x | x | x | x | | | OSM |
| Routing: pedestrian quite | | | | x | x | | | x | x | x | x | x | x | x | x | | | OSM |
| Routing: private vehicles | x | | x | x | | x | | x | x | x | x | x | | x | x | | | OSM |
| Routing: Multimodal Public Transport | | | | x | | | | | x | x | x | x | | x | x | x | | OSM, GTFS |
| heatmaps: weather (Temp, Humidity) | x | x | | x | x | x | x | | x | x | x | x | x | x | | | x | Sensors data, OSM |
| heatmaps: environmental variables, PM10, PM2.5, NO2, EAQI | x | x | | x | x | x | x | | x | x | x | x | x | x | | | x | Sensors data, OSM |
| heatmaps: environmental variables, Noise | | | | | | x | x | | x | x | x | x | x | x | | | x | Sensors data, OSM |
| heatmaps: safe on bike (Antwerp) | x | x | | x | x | | | | | | | | | x | | | x | Spec. Portal |
| heatmaps: Enfuser prediction, PM10, PM2.5, AQI | | | | | | x | x | | x | x | x | x | x | x | | | x | Enfuser data |
| heatmaps piking values any place | x | x | | | x | x | x | x | x | | | | x | | | | x | Computed Heatmps |
| heatmaps: GRAL prediction, PM10 | | | | | | x | x | | x | x | x | x | x | x | | | x | OSM, Traffic, Weather |
| Comparsison: Enfuser, Gral, Real Time | | | | | | x | x | | | | | | | | | | x | Enfuser, Sensors, GRAL |
| Sensors Data Time Trends, & drill down | x | x | x | | x | x | x | x | | | | | x | | | x | x | Sensors data, OSM |
| Weather Forecast | x | x | | x | x | x | x | | x | x | x | x | x | x | | | x | Forecast Service |
| Origin Destination Matrices | x | x | x | | x | x | x | x | x | | | | x | | | | x | Snap4City Mobile App |
| Typical trajectories | x | x | x | x | x | x | x | x | x | | | | x | | | x | x | Snap4City Mobile App |
| Hot Area in the city | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | x | x | Snap4City Mobile App |
| Hot Places in Smart Zone | x | x | x | x | x | | | | | | | | | x | | x | x | Snap4City PAXcounters |
| Services Suggestions on mobiles | | | | x | | | | | | x | x | x | | x | x | | | Snap4City Mobile App |
| Alerts on critical cases: several variables | x | | | x | x | x | x | | | x | x | | x | x | | | | Sensors data, OSM |
| The most used services | | x | | x | x | | x | | | x | x | x | x | | | | x | Snap4City Mobile App |
| Twitter Trends Daily | x | x | x | | x | x | x | x | x | | | | x | | | x | x | Twitter Vigilance |
| The auditing of user and living lab | | x | | | | x | | x | | | | | | | | x | | Snap4City Portal |
| Self assessment | x | x | x | x | x | x | x | x | x | x | x | x | x | | | x | | Snap4City Portal |
| Trajectories reg from mobile PAX Counters | x | x | x | | | x | x | x | | | | | | | x | | x | PAX Counters |

TOP

# Data Model, Ingestion and Management

On Line Training Material (free of charge)

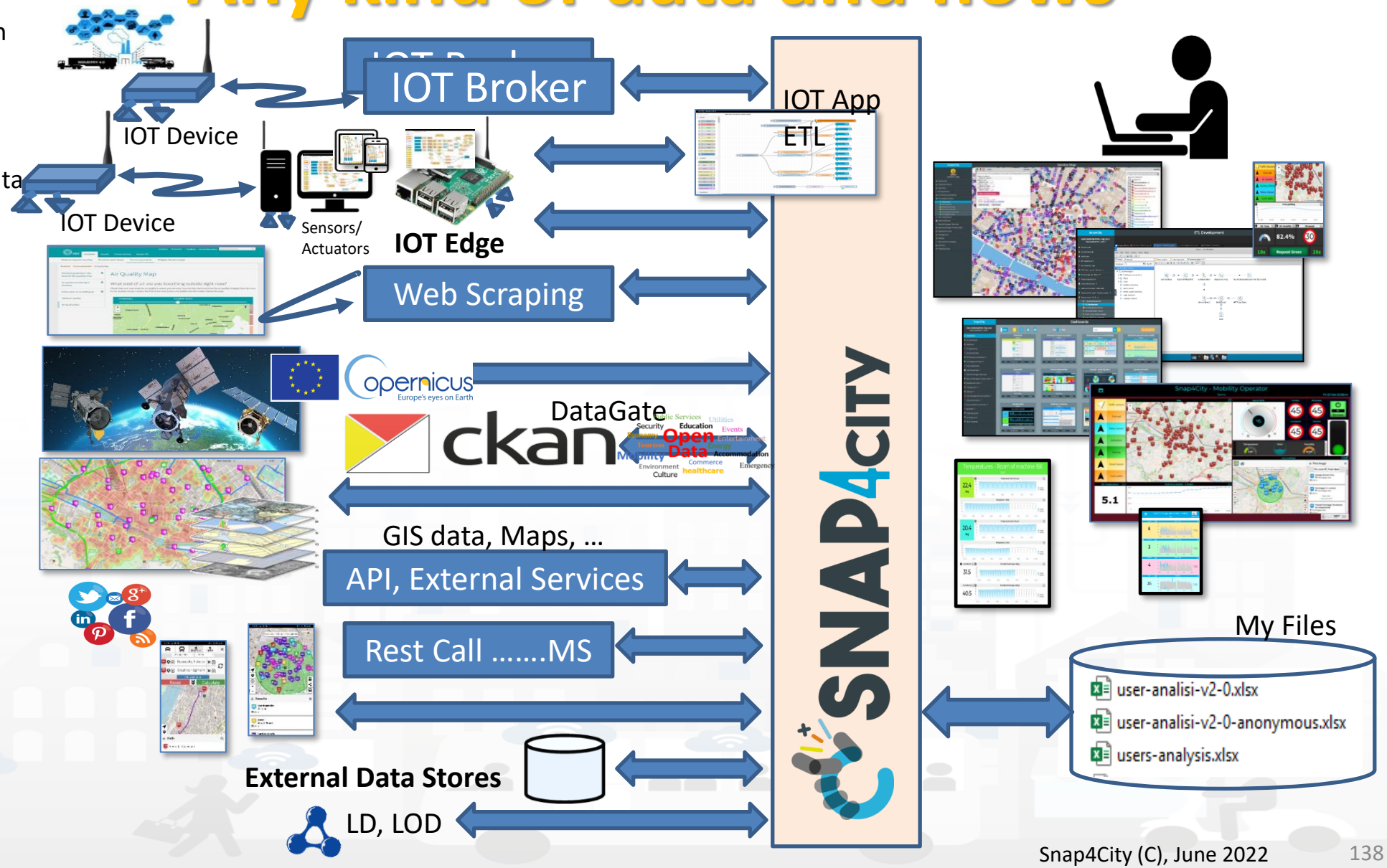
| | 1st part (*) | 2nd part (*) | 3rd part (*) | 4th part (*) | 5th part (*) | 6th part (*) | 7th part (*) |
|---|---|---|---|---|---|---|---|
| what | General | Dashboards | IOT App, IOT Network | Data Analytics | Data Ingestion processes | ystem and Deploy Install | Smart City API: Web & Mob. App |
| 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 |

100% OPEN SOURCE

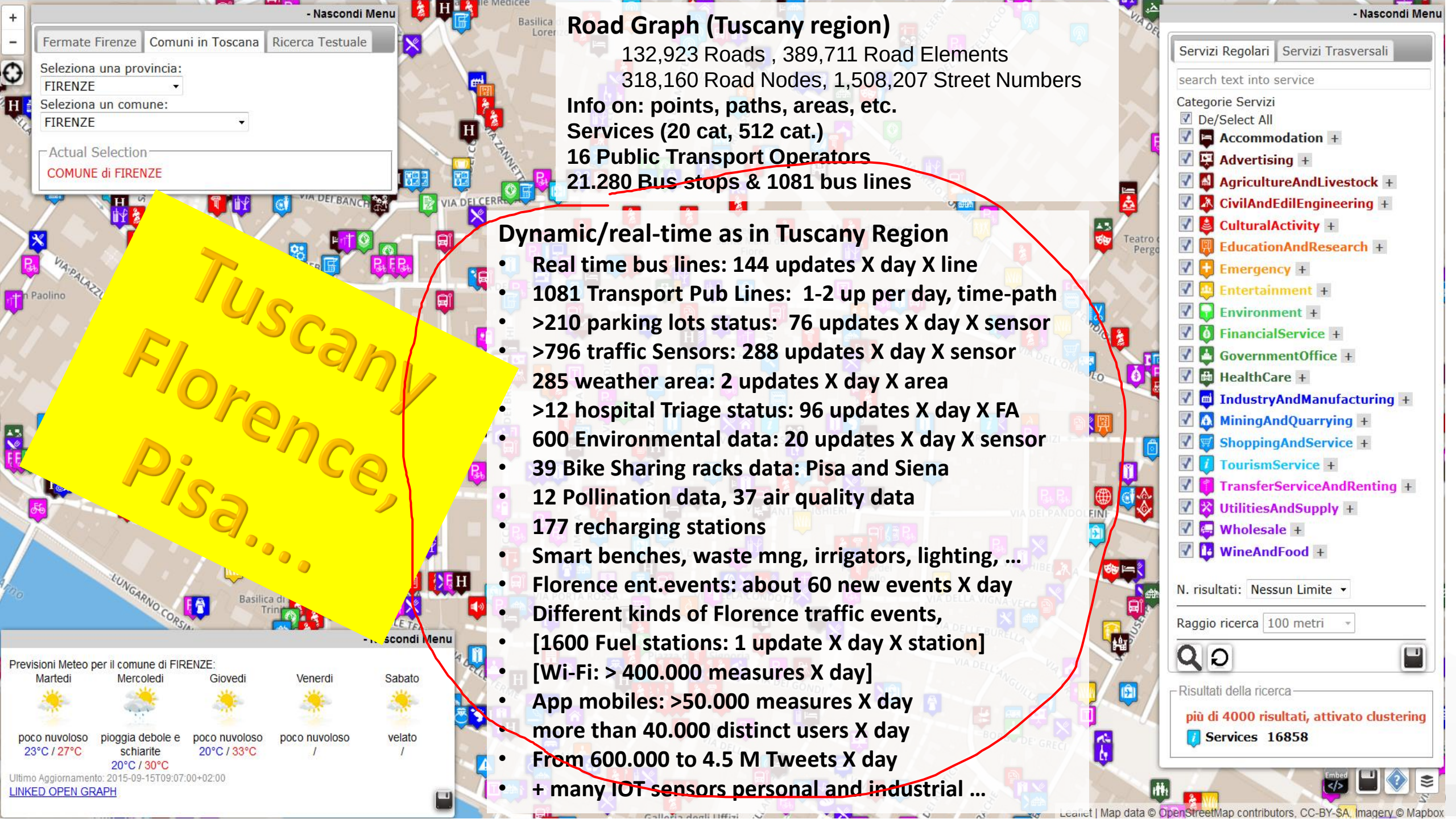
SNAP4 Appliances and Dockers **Installations**

# Any kind of data and flows

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

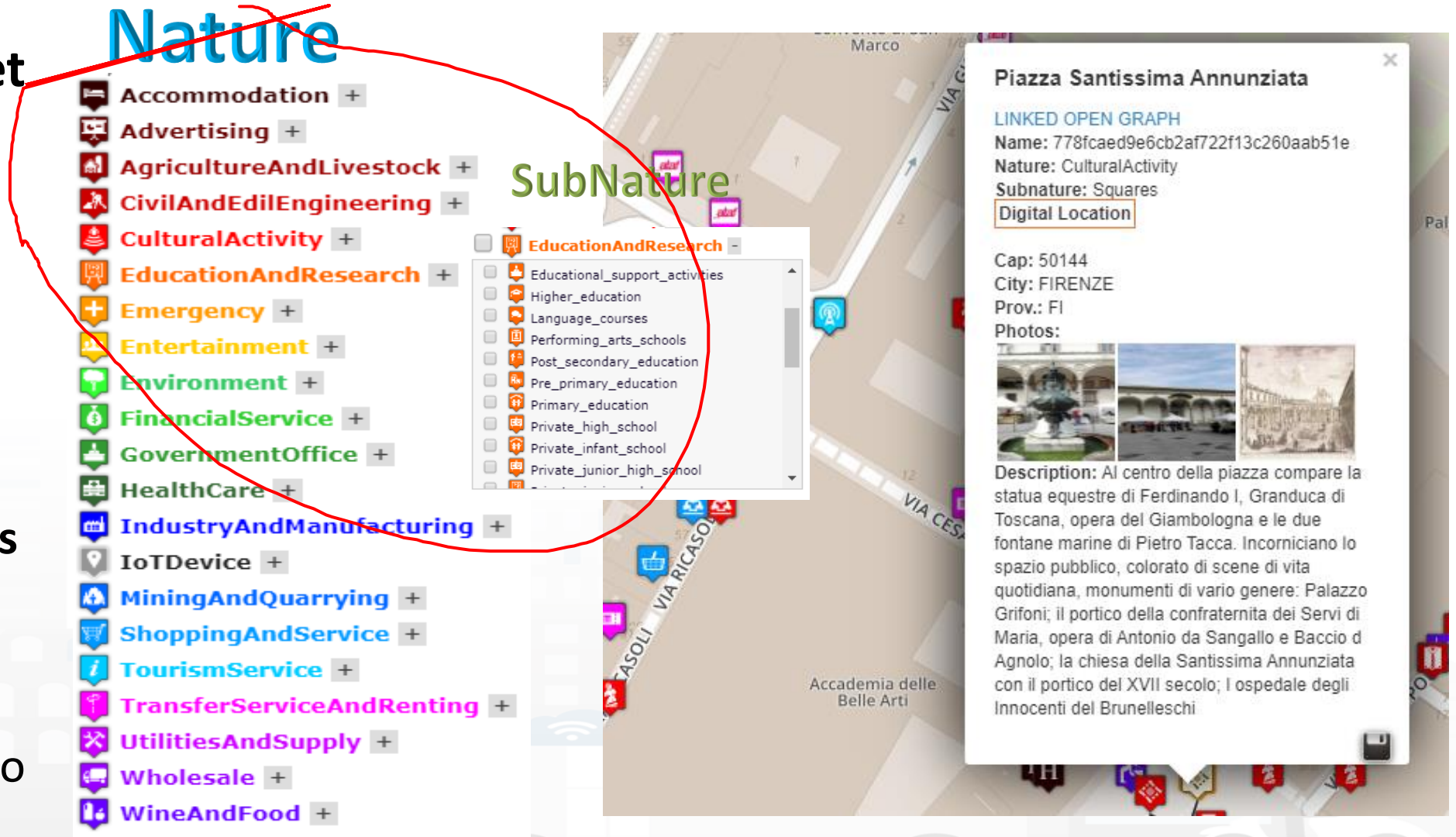


# Data Modeling


- Nascondi Menu
Fermate Firenze
Comuni in Toscana
Ricerca Testuale
Seleziona una provincia:
FIRENZE
Seleziona un comune:
FIRENZE
Actual Selection
COMUNE di FIRENZE
Tuscany
Florence,
Pisa....
Road Graph (Tuscany region)
132,923 Roads , 389,711 Road Elements
318,160 Road Nodes, 1,508,207 Street Numbers
Info on: points, paths, areas, etc.
Services (20 cat, 512 cat.)
16 Public Transport Operators
21.280 Bus stops & 1081 bus lines
Dynamic/real-time as in Tuscany Region
• Real time bus lines: 144 updates X day X line
• 1081 Transport Pub Lines: 1-2 up per day, time-path
• >210 parking lots status: 76 updates X day X sensor
• >796 traffic Sensors: 288 updates X day X sensor
285 weather area: 2 updates X day X area
• >12 hospital Triage status: 96 updates X day X FA
• 600 Environmental data: 20 updates X day X sensor
• 39 Bike Sharing racks data: Pisa and Siena
• 12 Pollination data, 37 air quality data
• 177 recharging stations
• Smart benches, waste mng, irrigators, lighting, …
• Florence ent.events: about 60 new events X day
• Different kinds of Florence traffic events,
• [1600 Fuel stations: 1 update X day X station]
• [Wi-Fi: > 400.000 measures X day]
• App mobiles: >50.000 measures X day
• more than 40.000 distinct users X day
• From 600.000 to 4.5 M Tweets X day
• + many IOT sensors personal and industrial …
- Nascondi Menu
Servizi Regolari
Servizi Trasversali
search text into service
Categorie Servizi
De/Select All
Accommodation
Advertising
AgricultureAndLivestock
CivilAndEdilEngineering
CulturalActivity
EducationAndResearch
Emergency
Entertainment
Environment
FinancialService
GovernmentOffice
HealthCare
IndustryAndManufacturing
MiningAndQuarrying
ShoppingAndService
TourismService
TransferServiceAndRenting
UtilitiesAndSupply
Wholesale
WineAndFood
N. risultati: Nessun Limite
Raggio ricerca 100 metri
Risultati della ricerca
più di 4000 risultati, attivato clustering
Services 16858
- Nascondi Menu
Previsioni Meteo per il comune di FIRENZE:
Martedi
poco nuvoloso
23°C / 27°C
Mercoledi
pioggia debole e schiarite
20°C / 30°C
Giovedi
poco nuvoloso
20°C / 33°C
Venerdi
poco nuvoloso
/
Sabato
velato
/
Ultimo Aggiornamento: 2015-09-15T09:07:00+02:00
LINKED OPEN GRAPH
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox

# POI: Point of Interest vs Classification

- A POI is defined as an **element of a set (collection)** and with general info:
  - **Nature**: ……..
  - **Subnature**: ….
- Specific infor for each POI
  - **Location**: lat, lon
  - A set of **Attributes**
    - www, email, opening time, phone, cap, address, city, etc.
  - Eventually a link to data

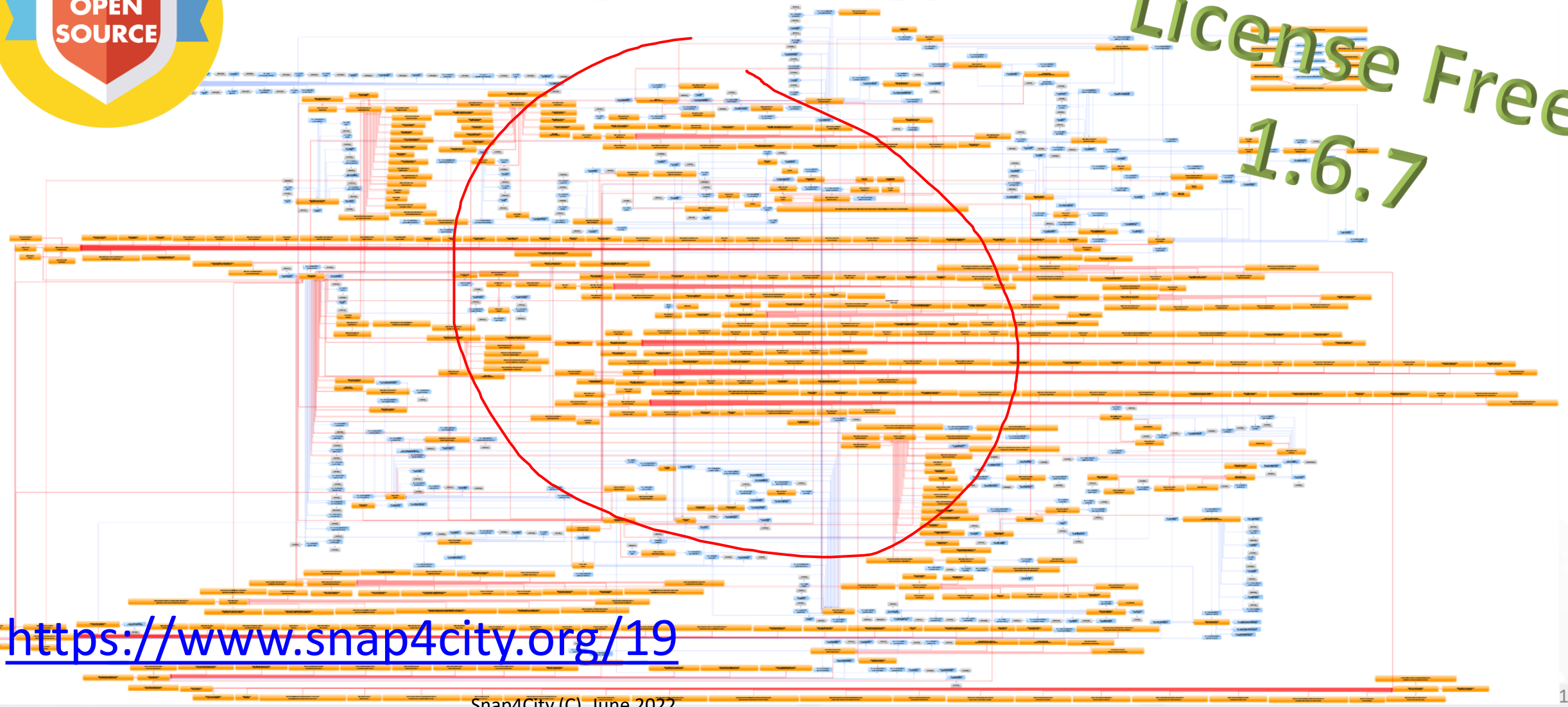


100% OPEN SOURCE

# Smart-city Ontology km4city

License Free

1.6.7



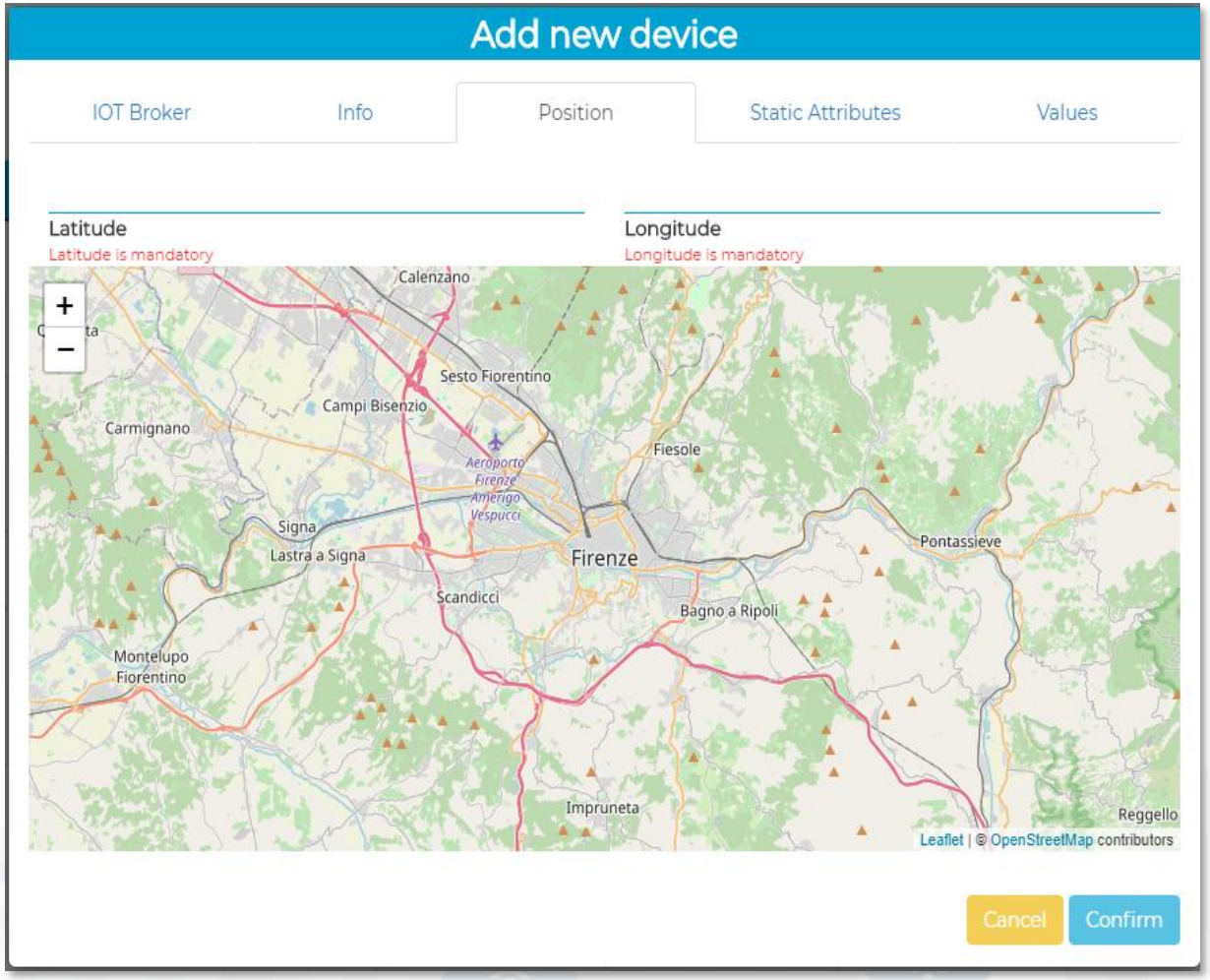
https://www.snap4city.org/19

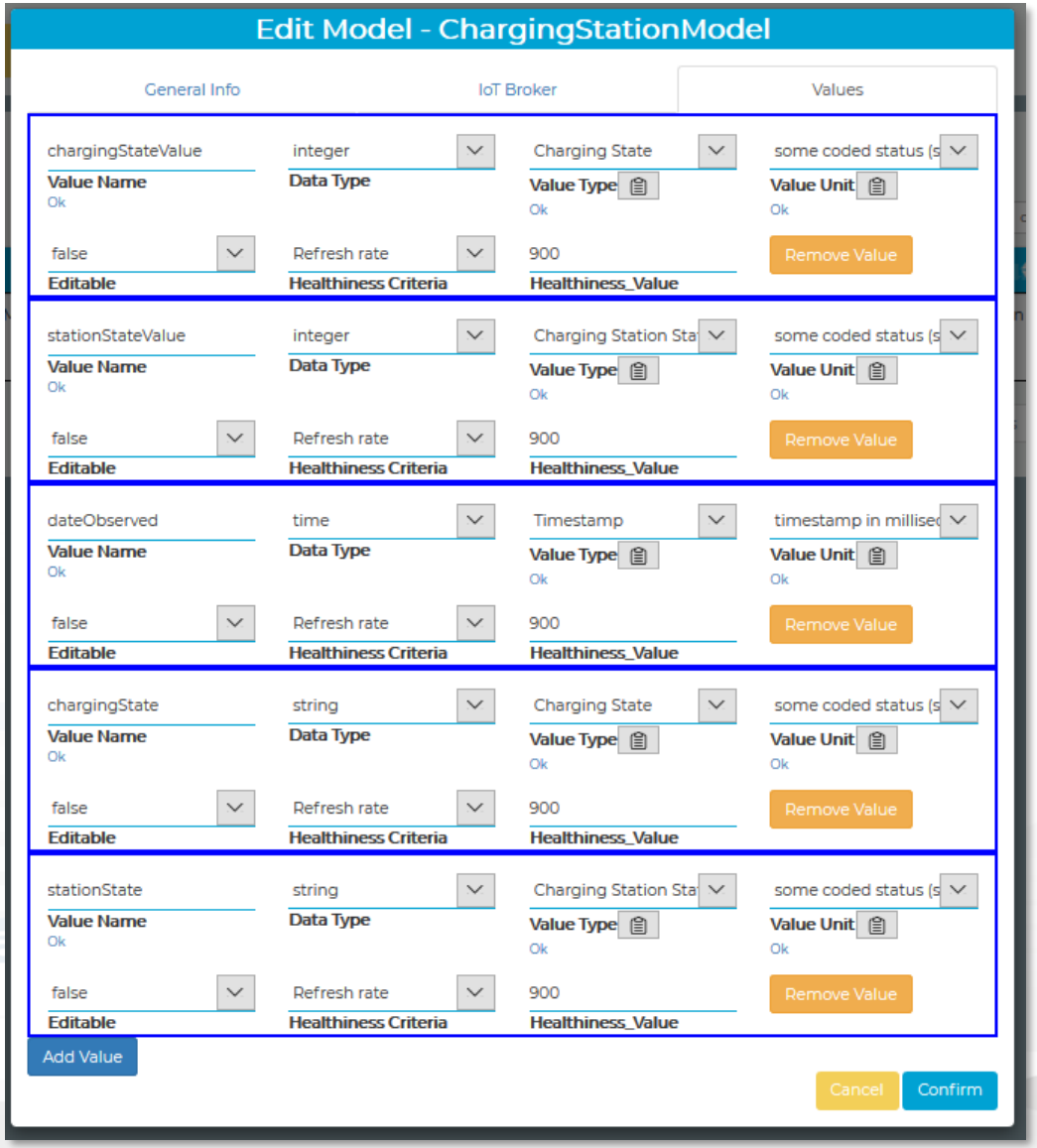
# IOT Device Model

# IOT Device Data Model (3): Attributes

| Where | IOT Device Model | IOT Device | A Temporal Instance |
|---|---|---|---|
| IOT Broker | Broker: OrionUNIFI | | |
| IOT Broker | Protocol: NGSI | | |
| Info | ID: string | ID: "park45" | park45 |
| Position | GPS: lat, long | GSP Position: 43.12, 11.34 | GSP Position: 44.12, 11.12 |
| Static attribute | Description: string | Description: "parking massaia" | |
| Static attribute | Location: string | Location: "Via Massaia" | |
| Static attribute | Civic Number: string | Civic Number: 3 | |
| Static attribute | MaxCapacity: number, cars | MaxCapacity: 456 | |
| Values | dateObserved: Timestamp | | 23-12-2019T20:13:12… |
| Values | FreeSlots: Integer, # | | 345 |
| Values | Humidity: float, % | | 25,5 |
| Values | Temperature: float, celsius | | 34 |

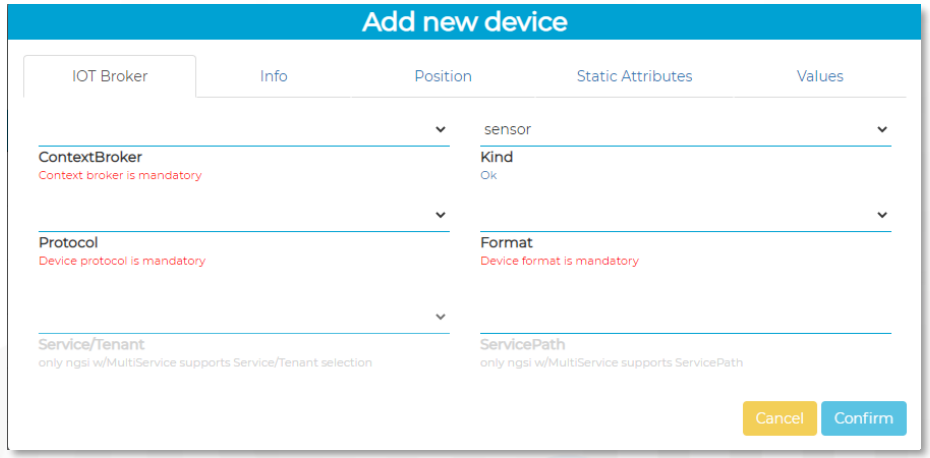
# IOT Device Data Model (2)



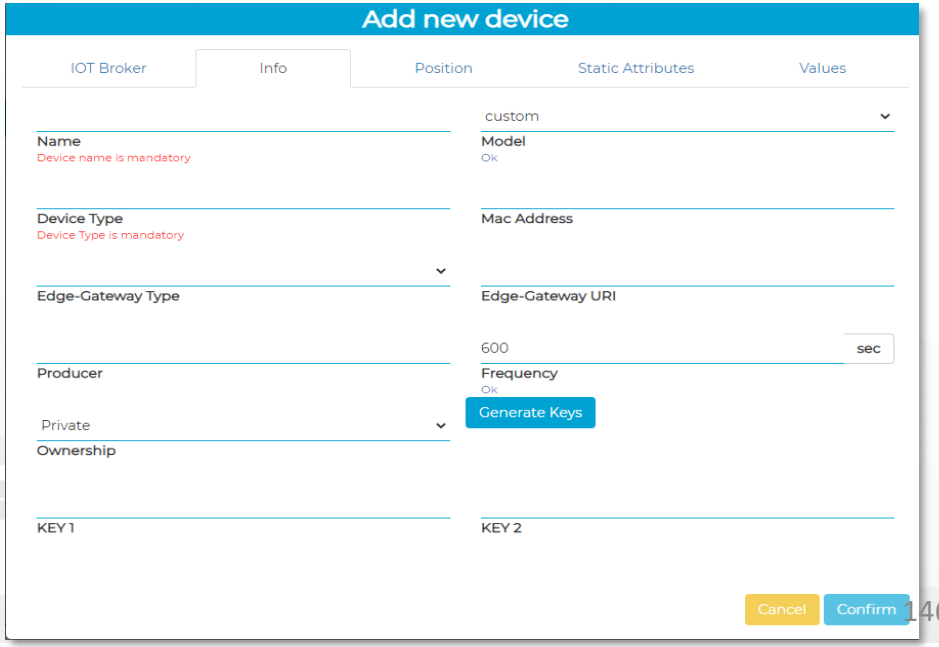



# IOT Device Data Model (1)

- IOT Broker
  - Name of the Brokers: among those registered
  - Protocol: NGSI, AMQP, MQTT, etc..
  - Format: CSV, JSON, XML.
  - Service/Tenant:……
  - ServicePath:……

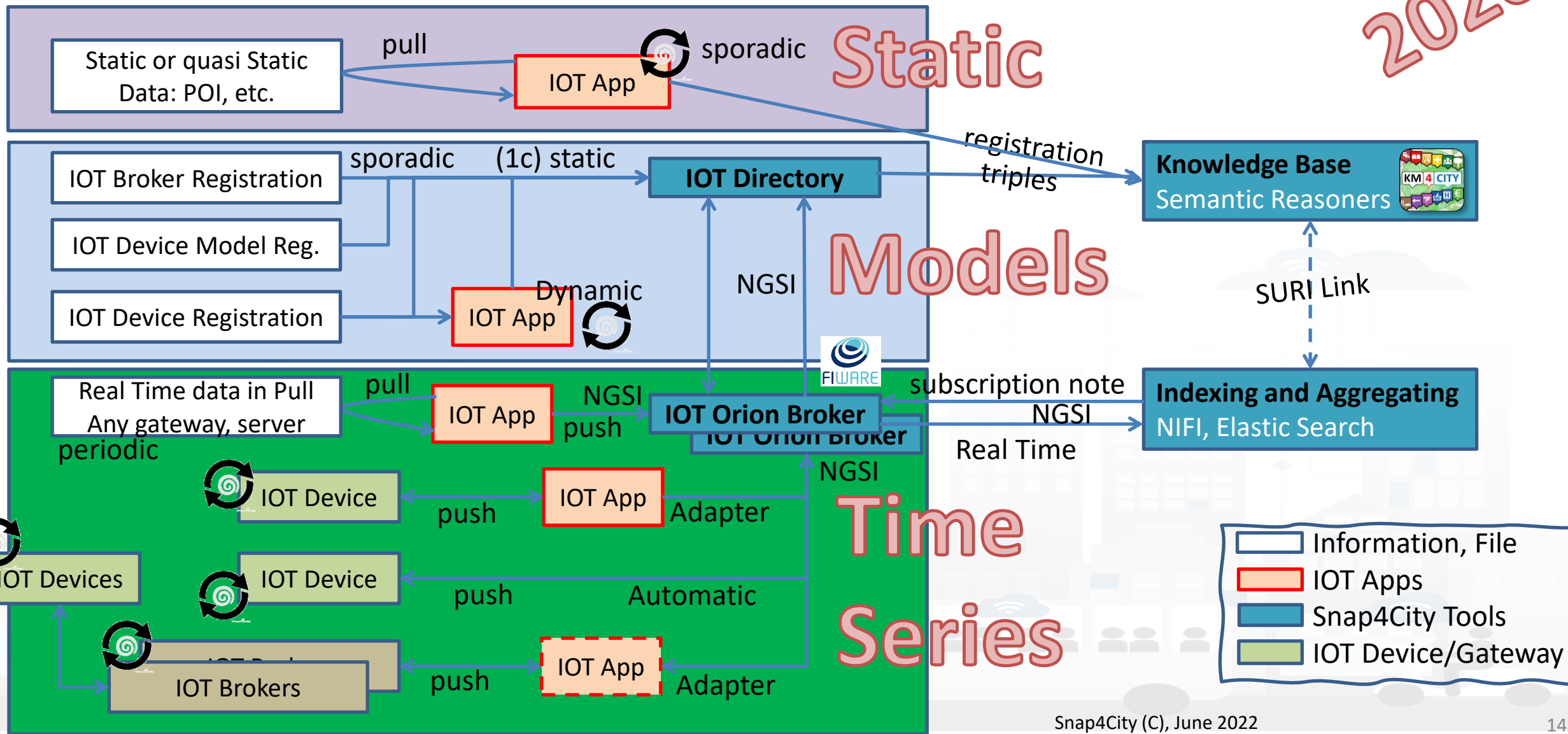



- Info
  - Name (Identifier)
  - Model: Custom or Model ID
  - DeviceType: ..a string..
  - MAC address: …optional…
  - Edge-GW: Raspberry, Android, …
  - Edge-GW: URI
  - Producer
  - Owner
  - Freq: ….. Sec
  - Keys: K1, K2



# Data Ingestion and Management

# Snap4city Data Ingestion Flow Diagram



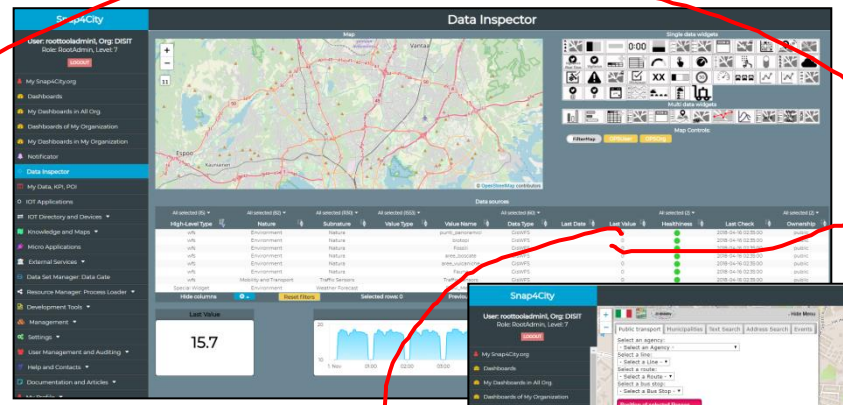
# Checking data ingestion results

**Knowledge base**
Semantic reasoners

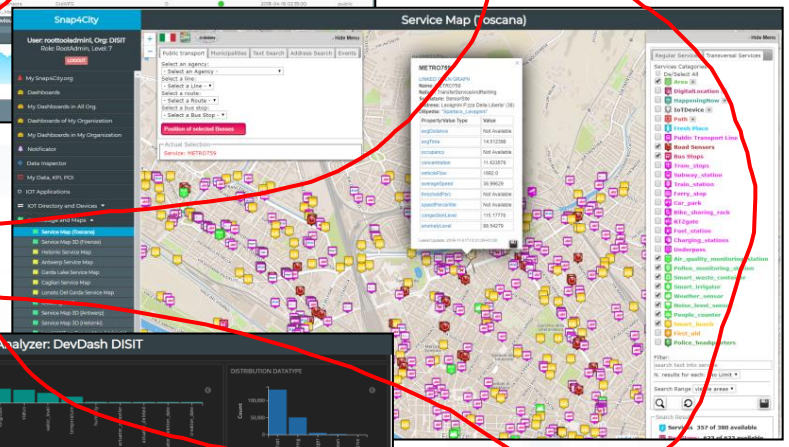
- **Data Inspector**
- **ServiceMap**, SCAPI
  - LOG / LOD viewer
  - Super Service Map
- IOT Directory
- SCAPI: Swagger
- IOT Broker

**Indexing and aggregating**
Elastic search

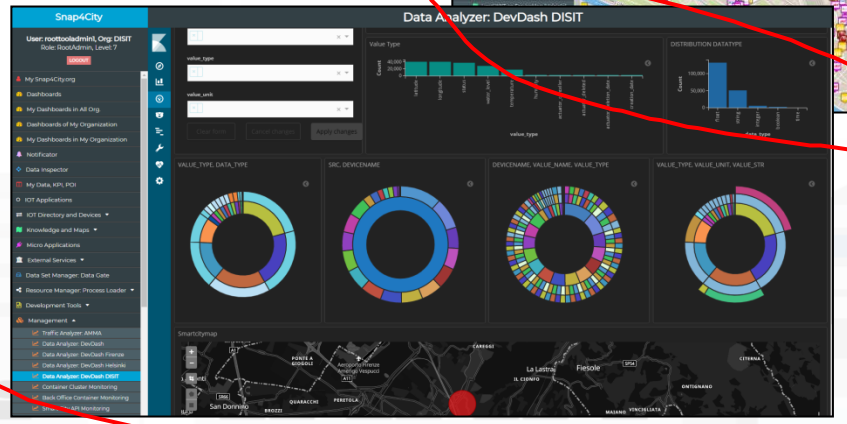
- **Data Inspector**
- **ServiceMap**, SCAPI
- **My Data Dashboard** (Kibana), DevDash
- Elastic Search




Data Inspector
Digital Twin view



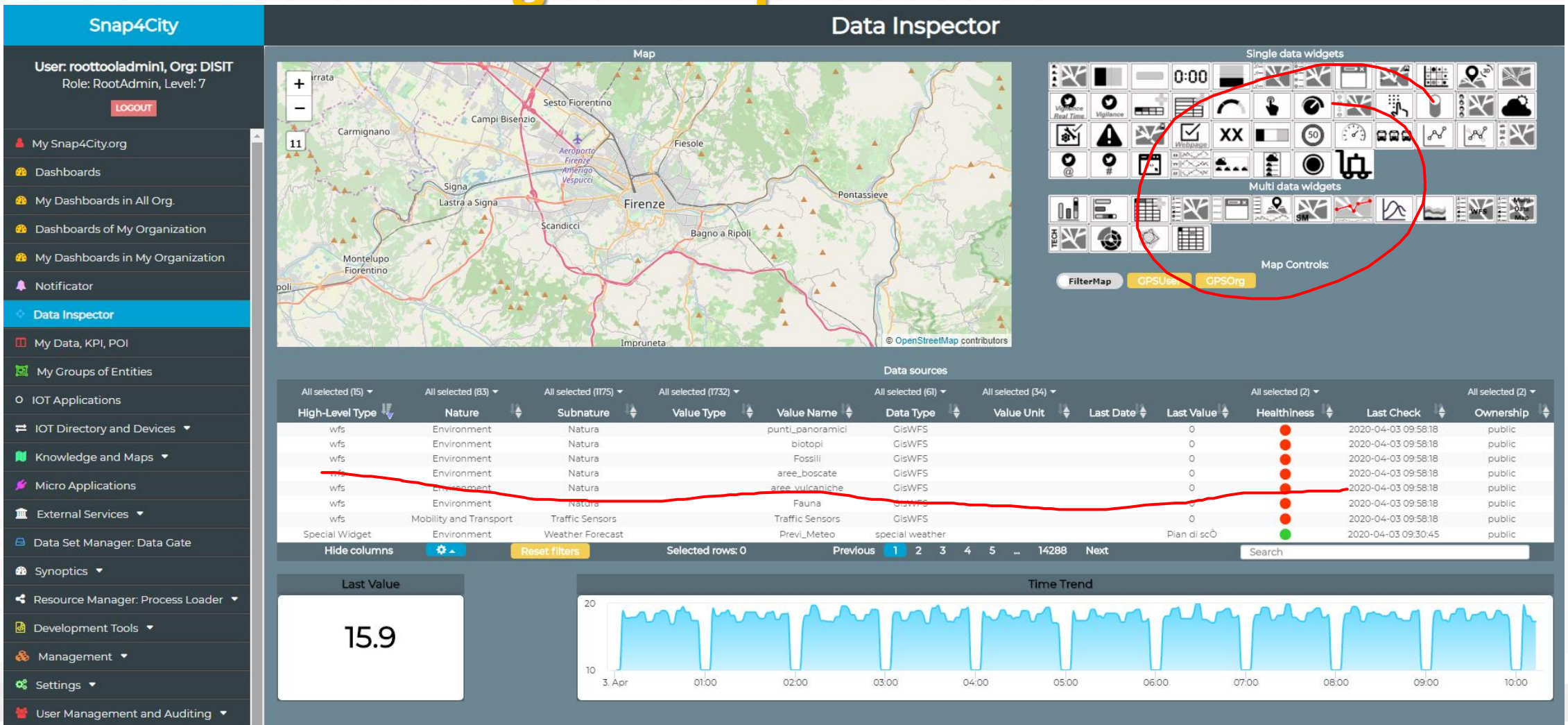

ServiceMap




My Data Dashboard
DevDash

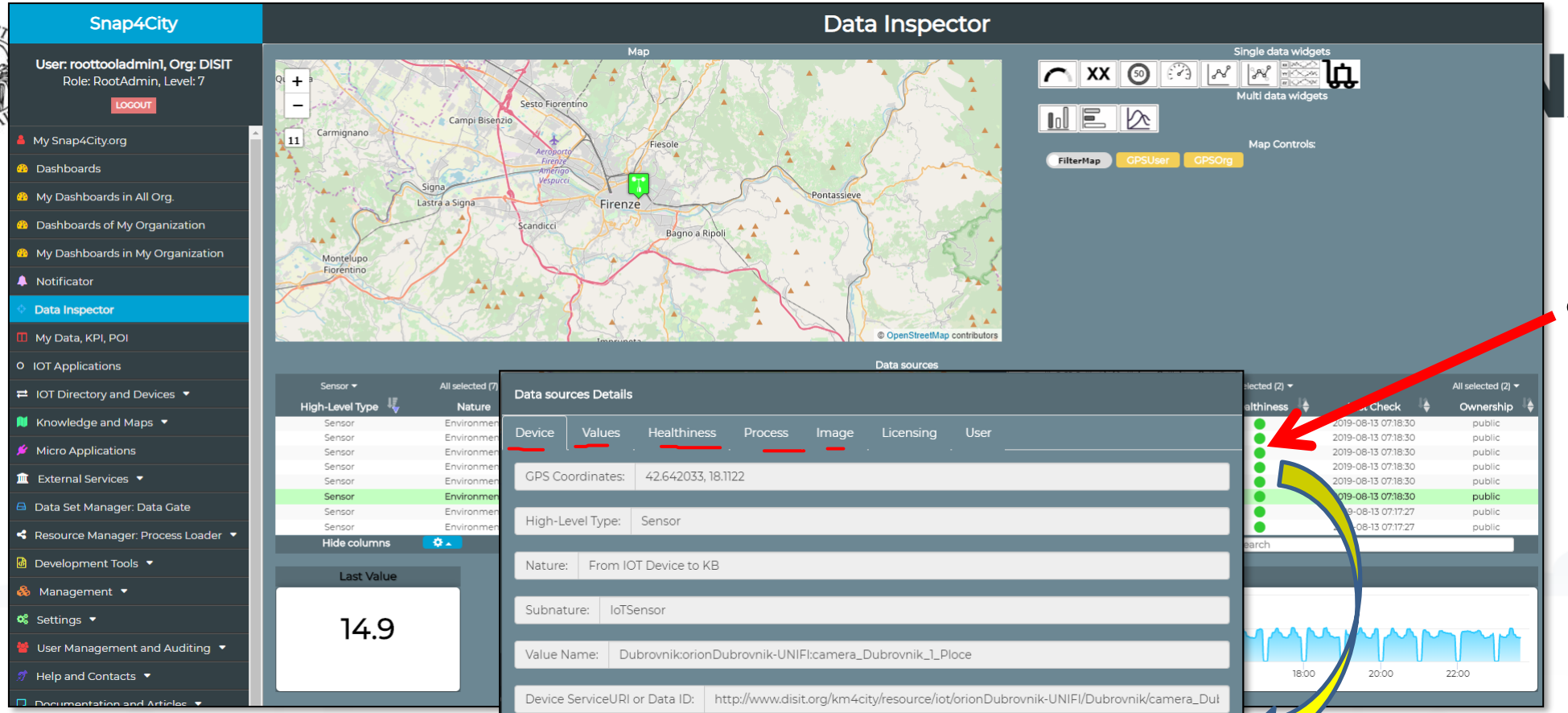
*Some functionalities are limited to certain roles*

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



# Data Inspector (Digital Twin info) Major Submodels

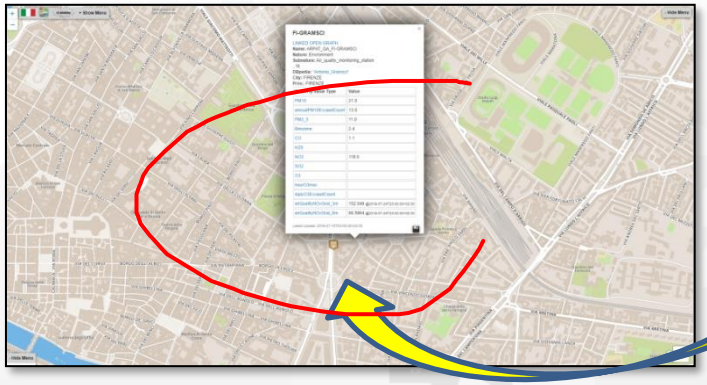
- **Digital Twin**
  - Device and sensors data
  - Values
  - Healthiness criteria and values
    - Machine learning tools
  - Images and physical world
  - Licensing
  - Users
- **Users**
  - Defined the Data and Devices
  - Defined the processes
  - Create dashboards
  - Etc.
- **Process Views**
  - Device Management tool
  - Data ingestion processes
    - ETL, IOT Apps
  - Data storage access views
    - Index views
    - Relationships view
  - Data Analytics and Transformation
    - IOT App, R Studio, Python
  - Data Rendering Dashboards
    - Synoptics
  - Processes' Developers

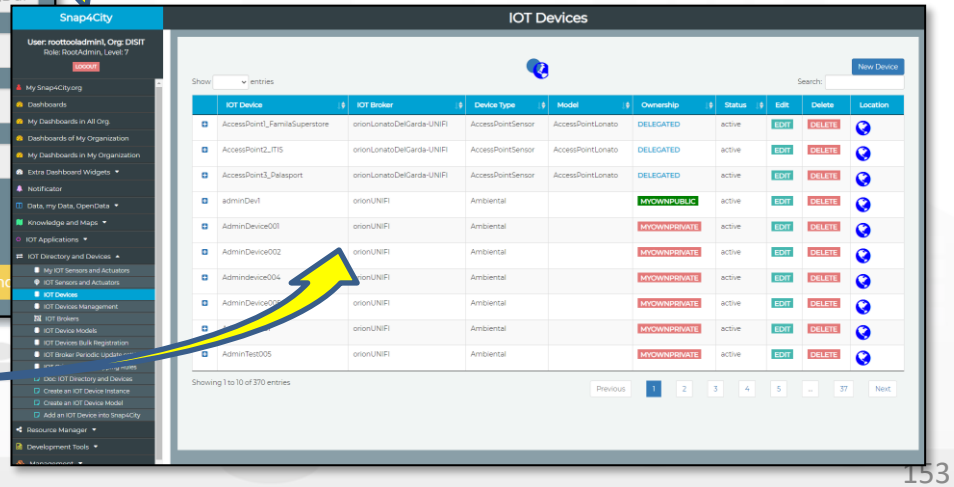



Knowledge Base view

- Click with the mouse on it

**HLT: Sensor**






*Some functionalities are limited to certain roles*

# HLT: Sensor

Data sources Details

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

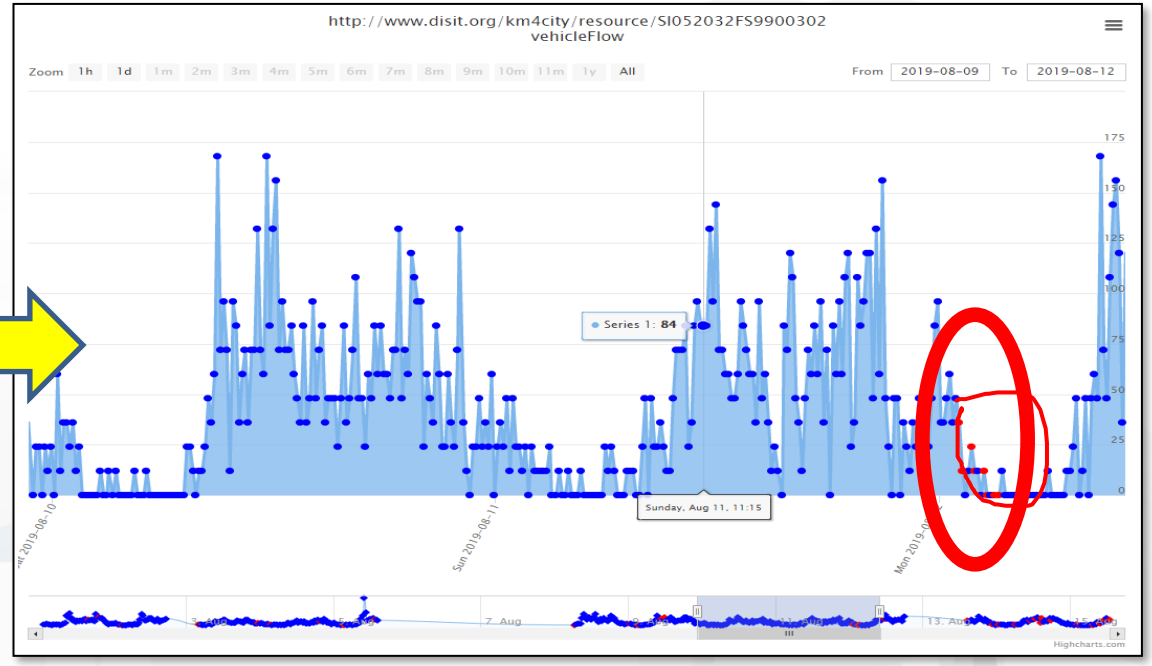
Last Date: 2020-07-21 19:00:00

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

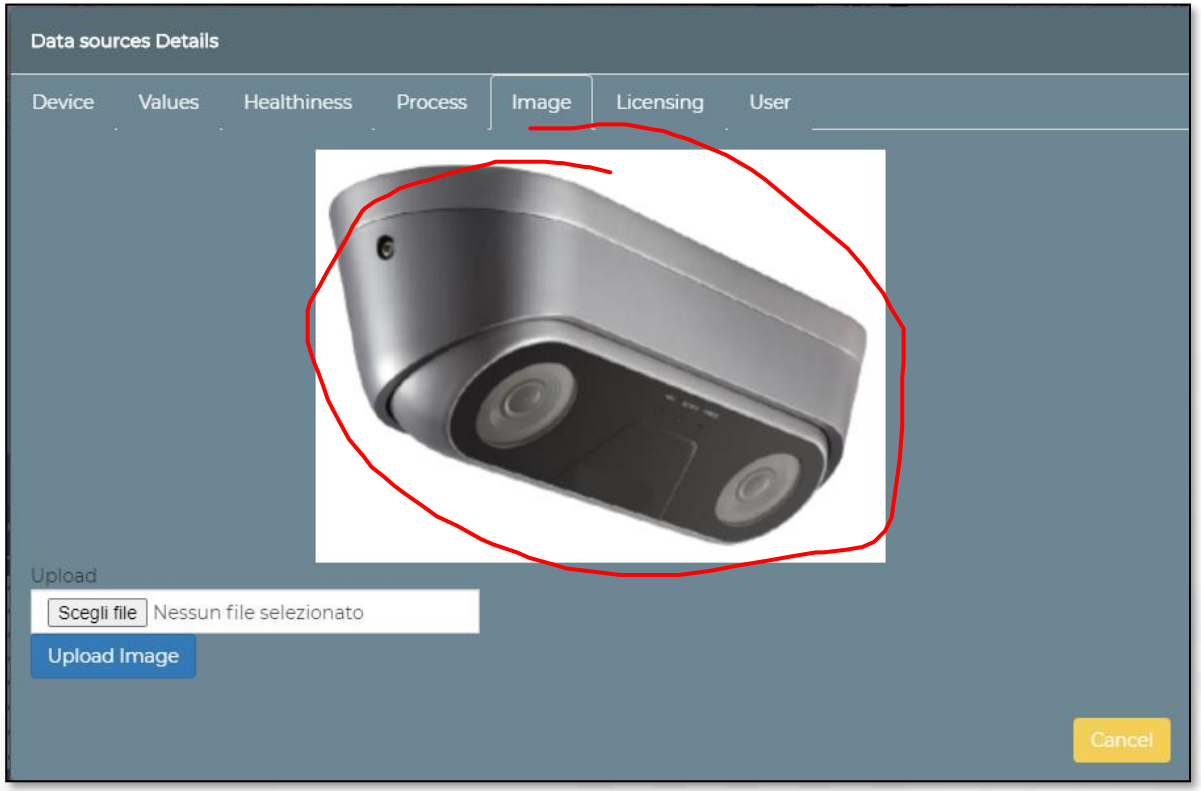
- Specific values of selected
- Information of the values of the other sensors on the same device
- View Trends, marking problems, healthiness by point according to a Fuzzy model
- Marking problems for future machine learning processes (separate tool)

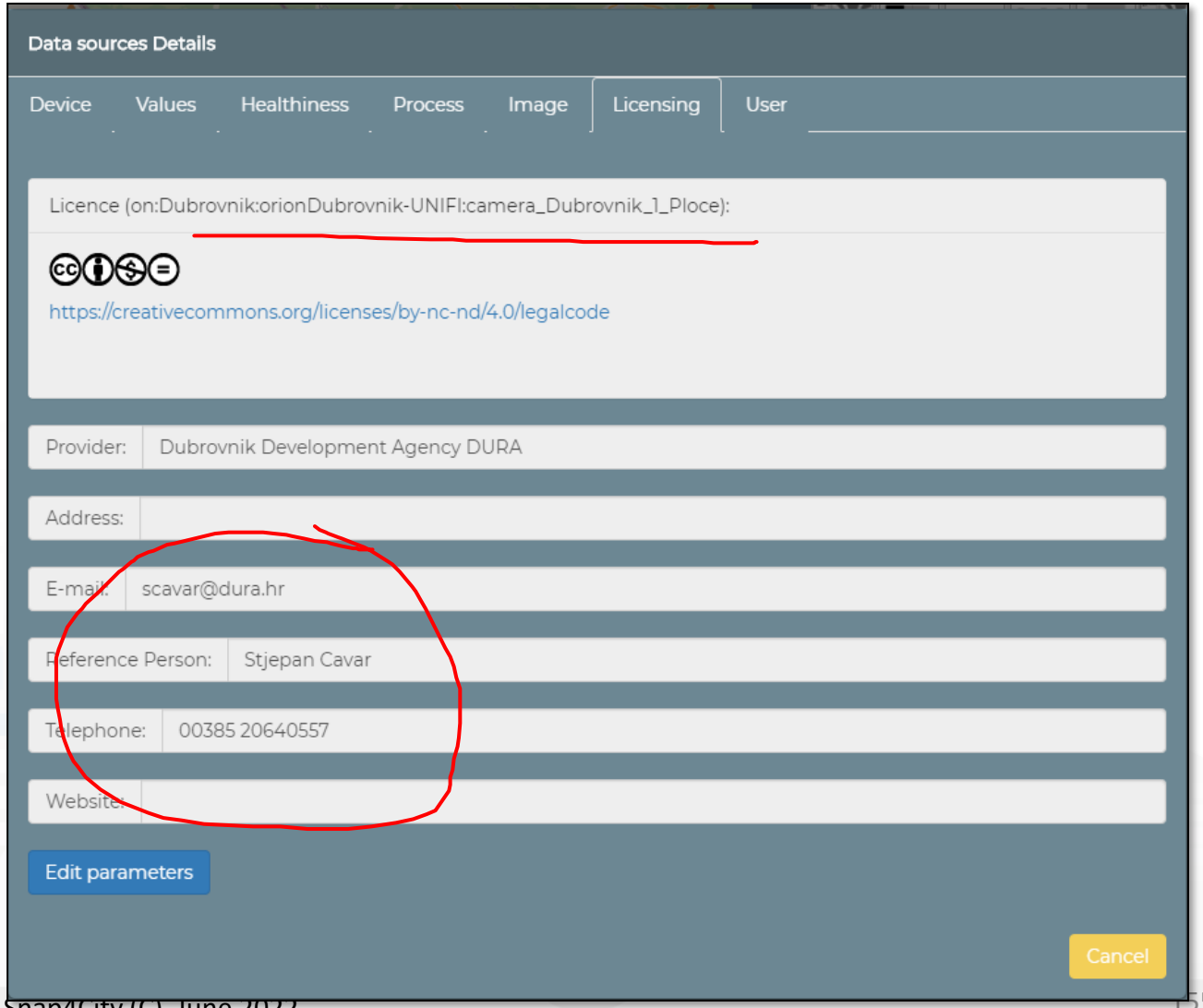



*Some functionalities are limited to certain roles*

# HLT: Sensor

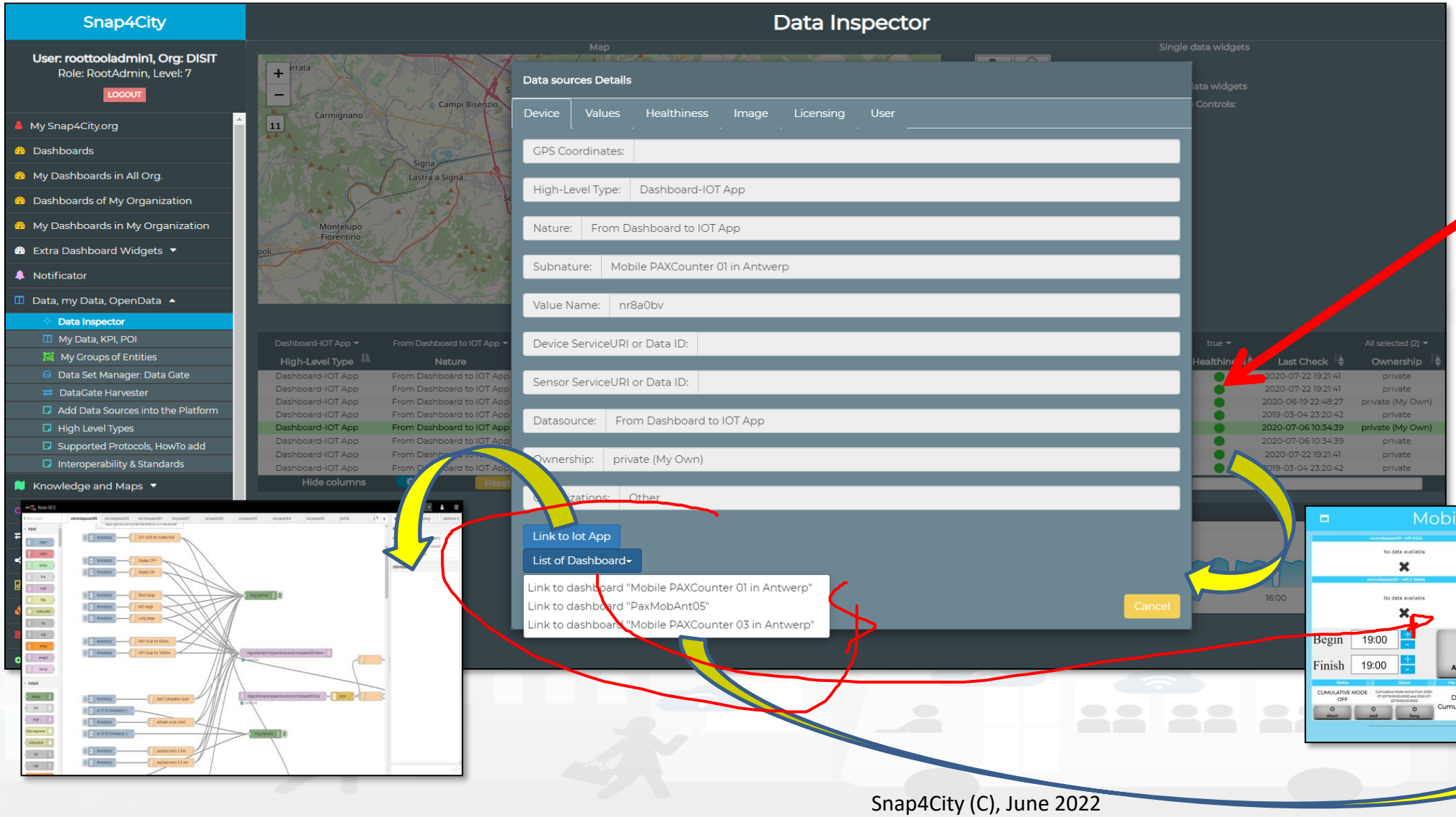
# Image of the Devices and Licensing



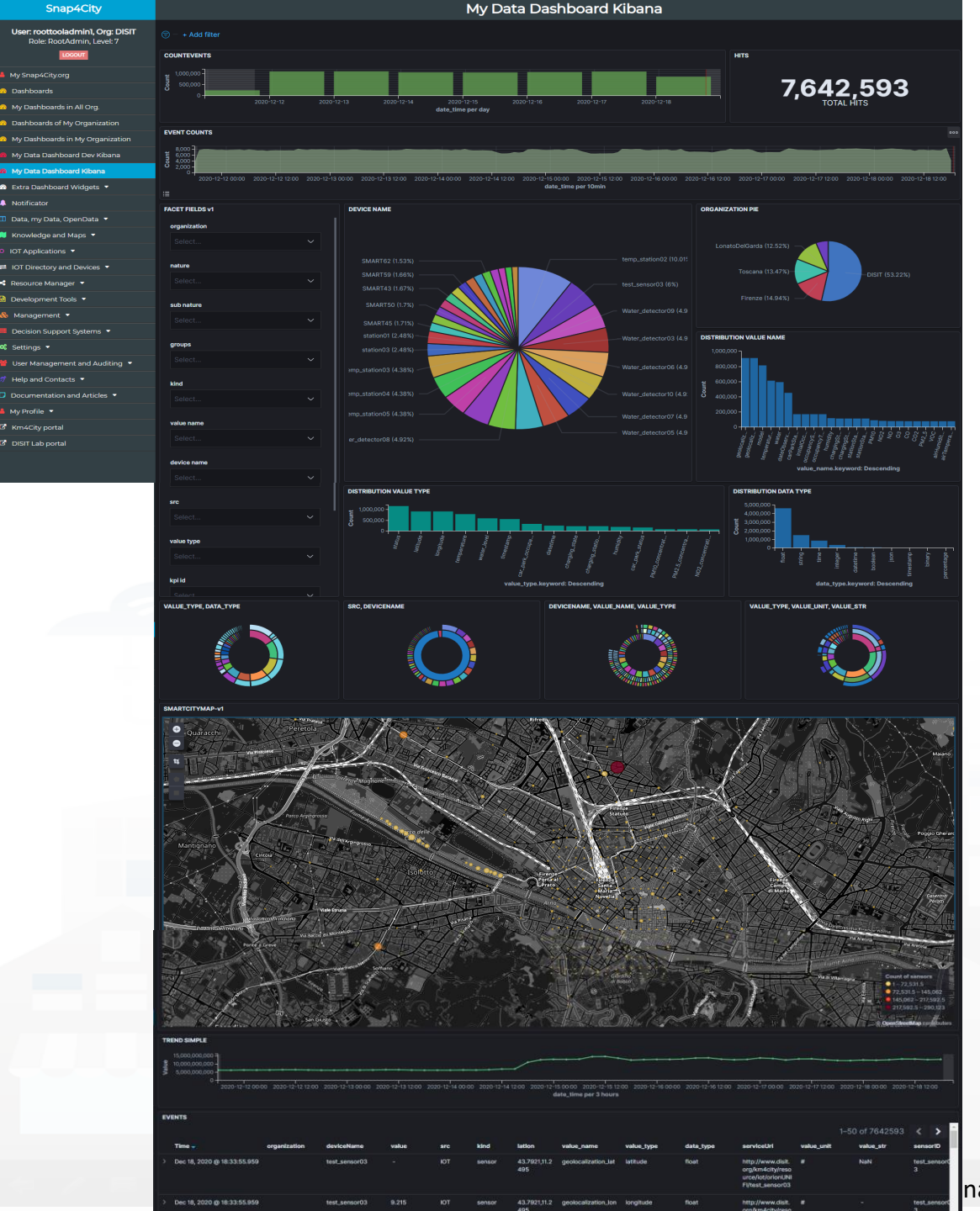




*Some functionalities are limited to certain roles*

# HLT: From Dashboard to IOT APP




- Click with the mouse on it

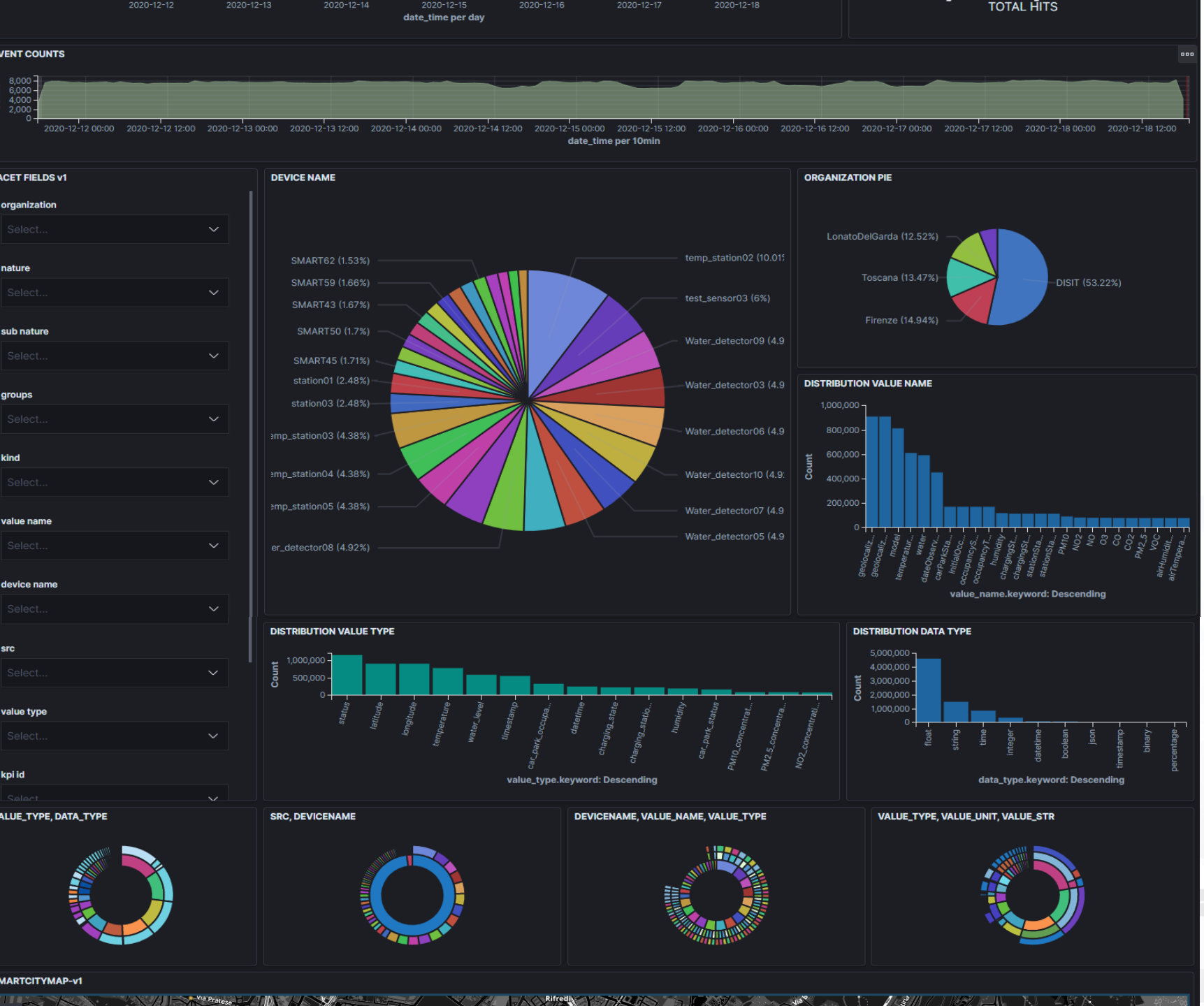



kibana

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



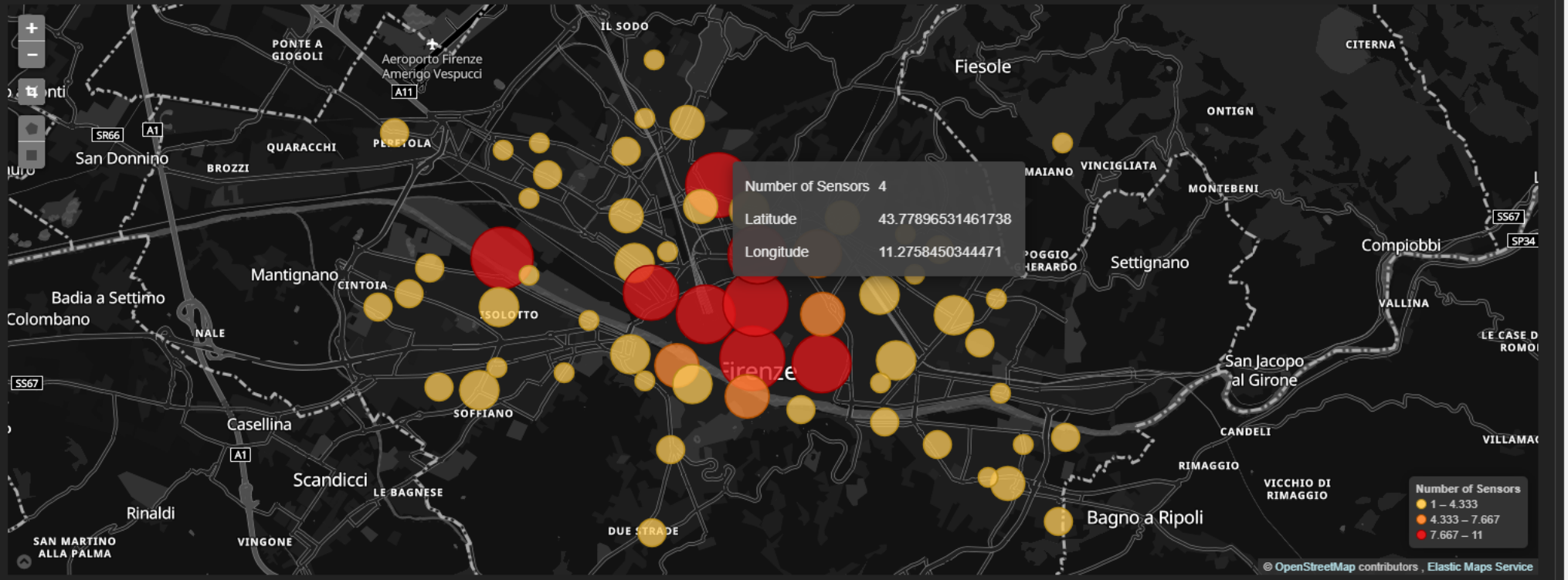

- Multi faceted Search by
  - Devices
  - Organization
  - Drill on Time
  - Drill on Map
  - Value Types
  - Data Type
  - Value name
  - Data table
  - Etc.
- Respect Privacy and GDPR

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

LOGOUT



SMARTCITYMAP




EVENTS

1–50 of 176,794

| Time | organization | deviceName | value | src | kind | latlon | value_name | value_type | data_type | serviceUri | value_unit | value_str |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| October 11th 2020, 12:33:52.790 | | test_sensor03 | 9.215 | IOT | sensor | 43.7921,11.2495 | geolocalization_lon | longitude | float | http://www.disit.org/km4city/resource/iot/orionUNIFI/test_sensor03 | # | - |
| October 11th 2020, 12:33:52.790 | | test_sensor03 | 24 | IOT | sensor | 43.7921,11.2495 | temperature | temperature | float | http://www.disit.org/km4city/resource/iot/orionUNIFI/test_sensor03 | °C | - |
| October 11th 2020, 12:33:52.790 | | test_sensor03 | - | IOT | sensor | 43.7921,11.2495 | geolocalization_lat | latitude | float | http://www.disit.org/km4city/resource/iot/orionUNIFI/test_sensor03 | # | NaN |
| October 11th 2020, 12:33:52.492 | DISIT | testxxx3 | 1,602,412,480,000 | IOT | sensor | 43.79737,11.3063 | timestamp | timestamp | timestamp | http://www.disit.org/km4city/reso | # | - |

TOP

# Platform Integration Capabilities

# 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

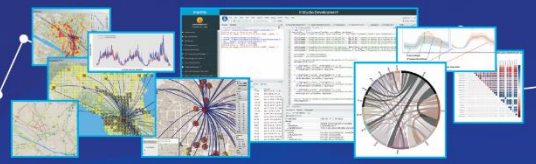
DEVELOPMENT KIT • SUGGESTIONS • MOBILE APPS • MONITORING PANELS • PLATFORM UTILITIES • READY TO USE SMART APPLICATIONS

## MICROSERVICES & ADVANCED SMART CITY API

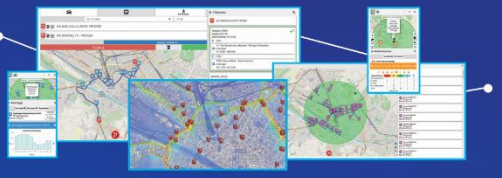
## LIVING LAB - DEV TOOLS - COWORKING

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 |
|---|---|---|---|---|---|---|---|---|---|

# Smart City Functional Architecture

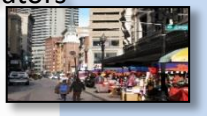
Transport systems
Mobility, parking

Public Services,
Govern, events, …

Sensors, IOT Cameras,
Wi-Fi

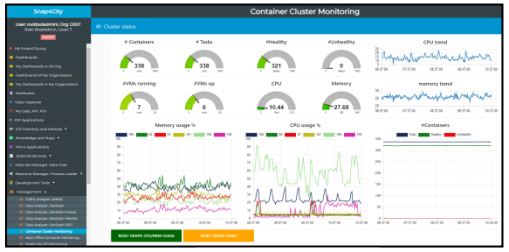
Environment, Water,
energy

Shops, services,
operators

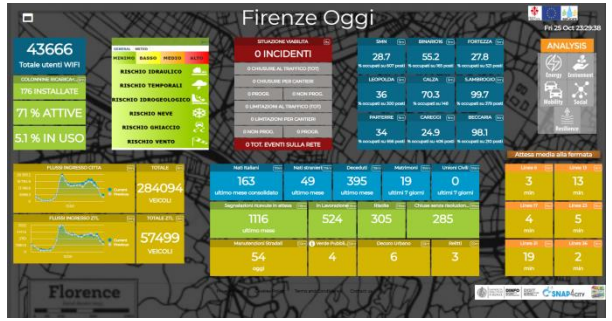


Social Media

Social Media Crawler and Manager






Back-End ⟵ ⟶ Front-End

**Data Sources, External Services** *PULL Data*

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

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

**Knowledge base** Semantic Reasoners

**Indexing and aggregating** Elastic Search

**Federation**

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

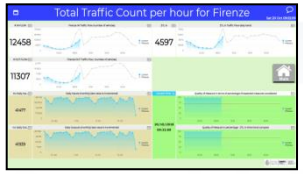
**Data Analytics, Simulations, Special Tools** R Studio, Tensor Flow, Python, ….

**IOT Applications, Business Logic** Node-RED + Snap4City MicroServices

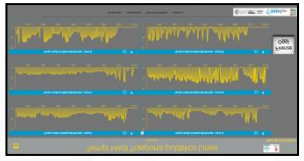
**Rendering Acting, Widgets, Synoptics, MicroApps** User interface, Drill down, maps, heatmaps

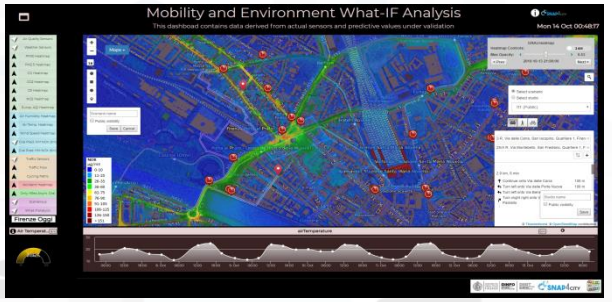
Inform, announce, Act!, warning, alarms, What-IF, ..

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

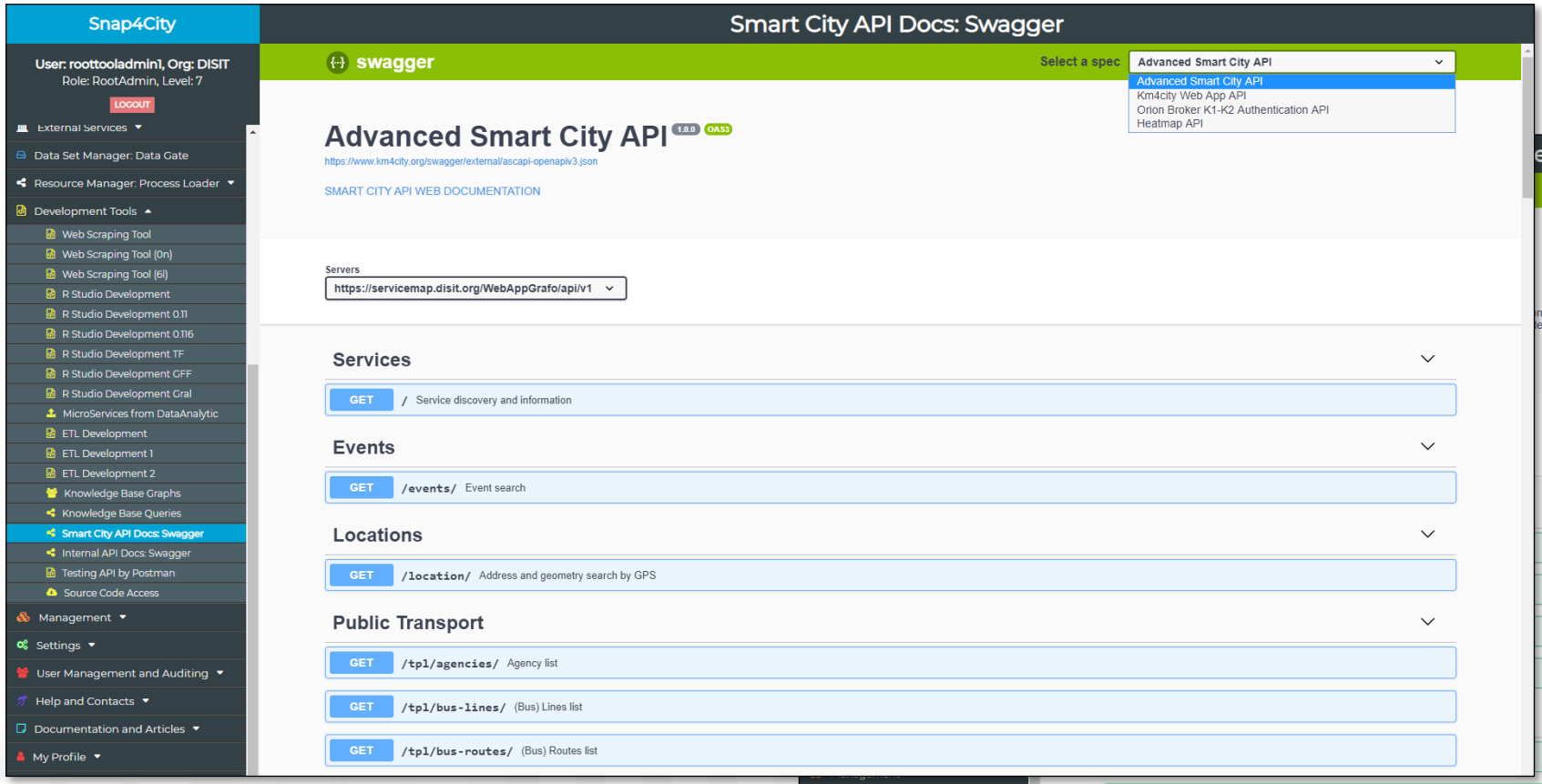


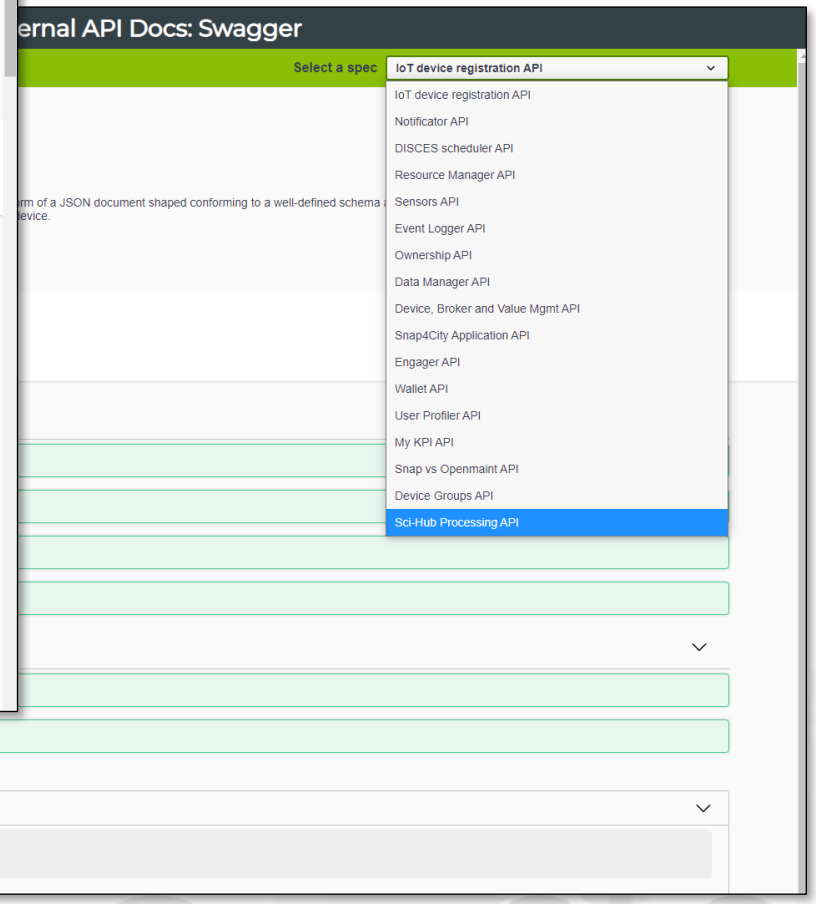






# Internal and External Smart City API



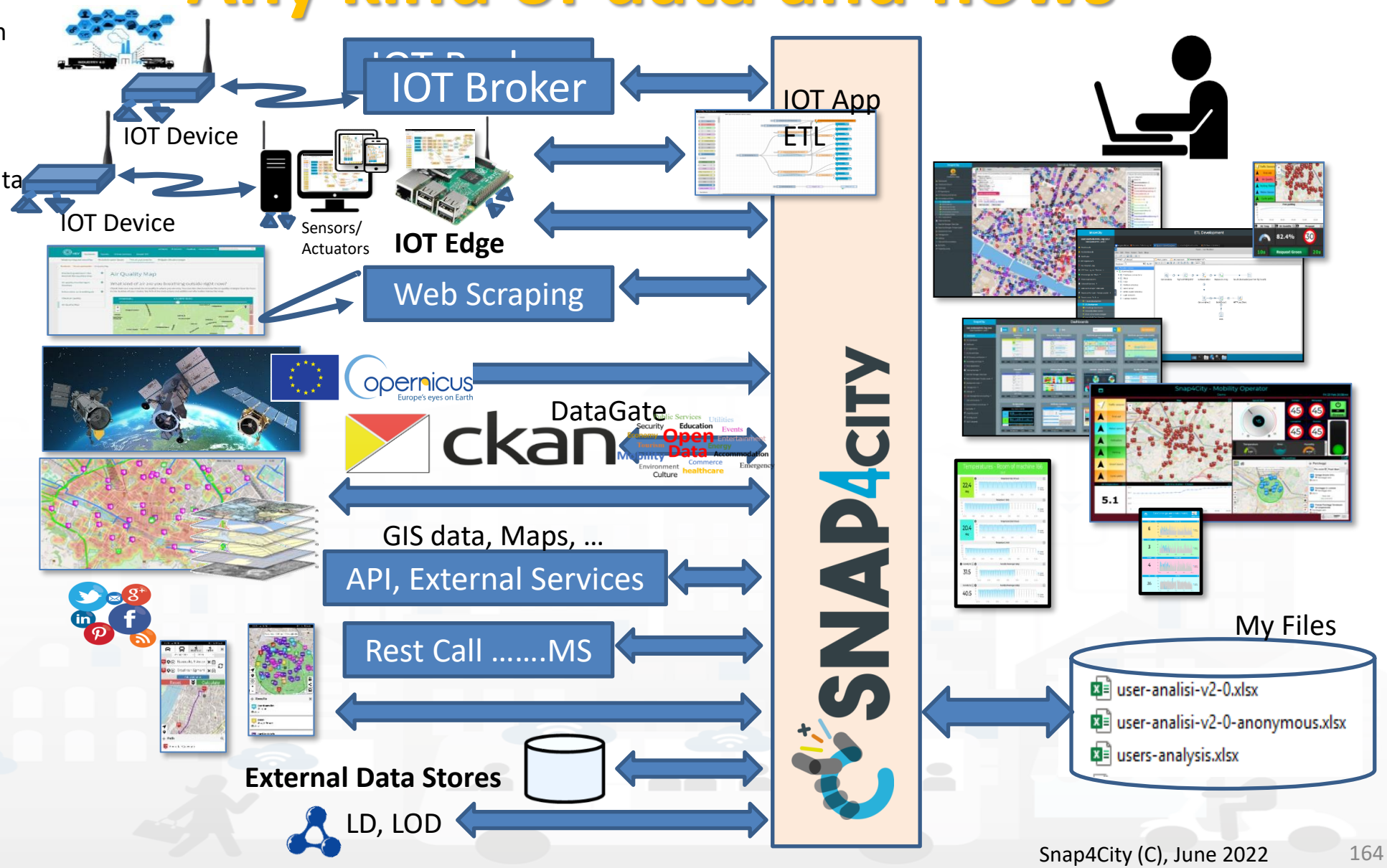




https://www.km4city.org/swagger/external/index.html

https://www.km4city.org/swagger/internal/index.html

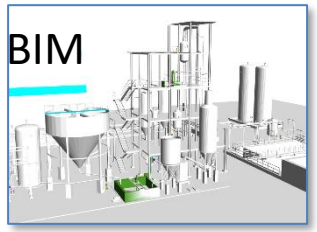
# Any kind of data and flows

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



# Concept

BIM

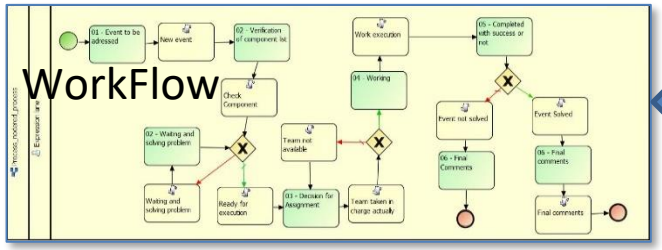


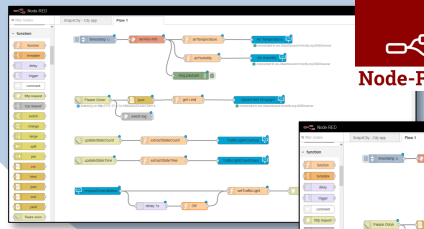
KPI, POI, MyKPI, …

API, External Services

Web Scraping

WorkFlow





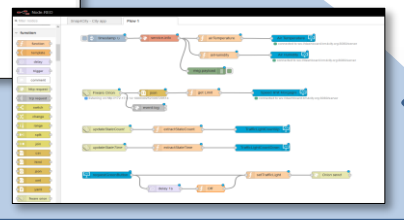

Data Analytics,
Artificial Intelligence


IOT Brokers

IOT Broker

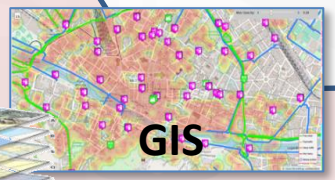
IOT Broker

IOT Apps



FIWARE

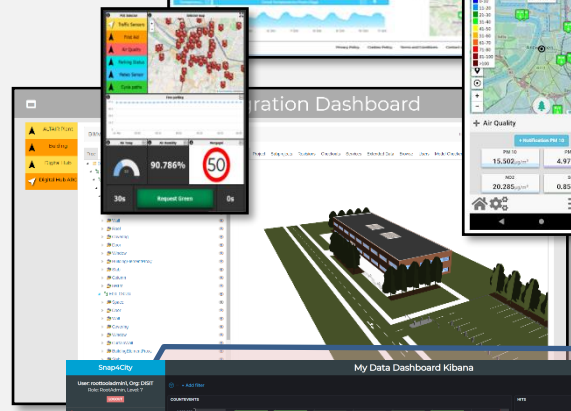
ckan

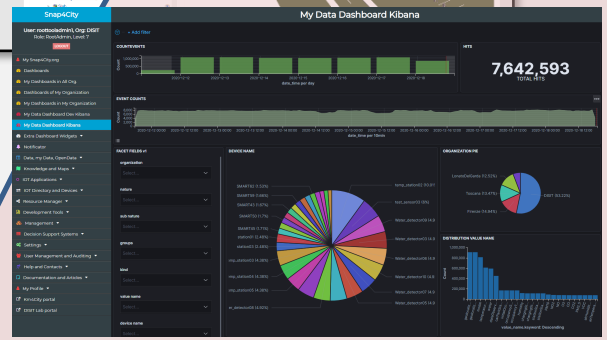



Big Data

KB

LD, LOD




Dashboards and Apps

FI-WARE

# IOT Network Interoperability

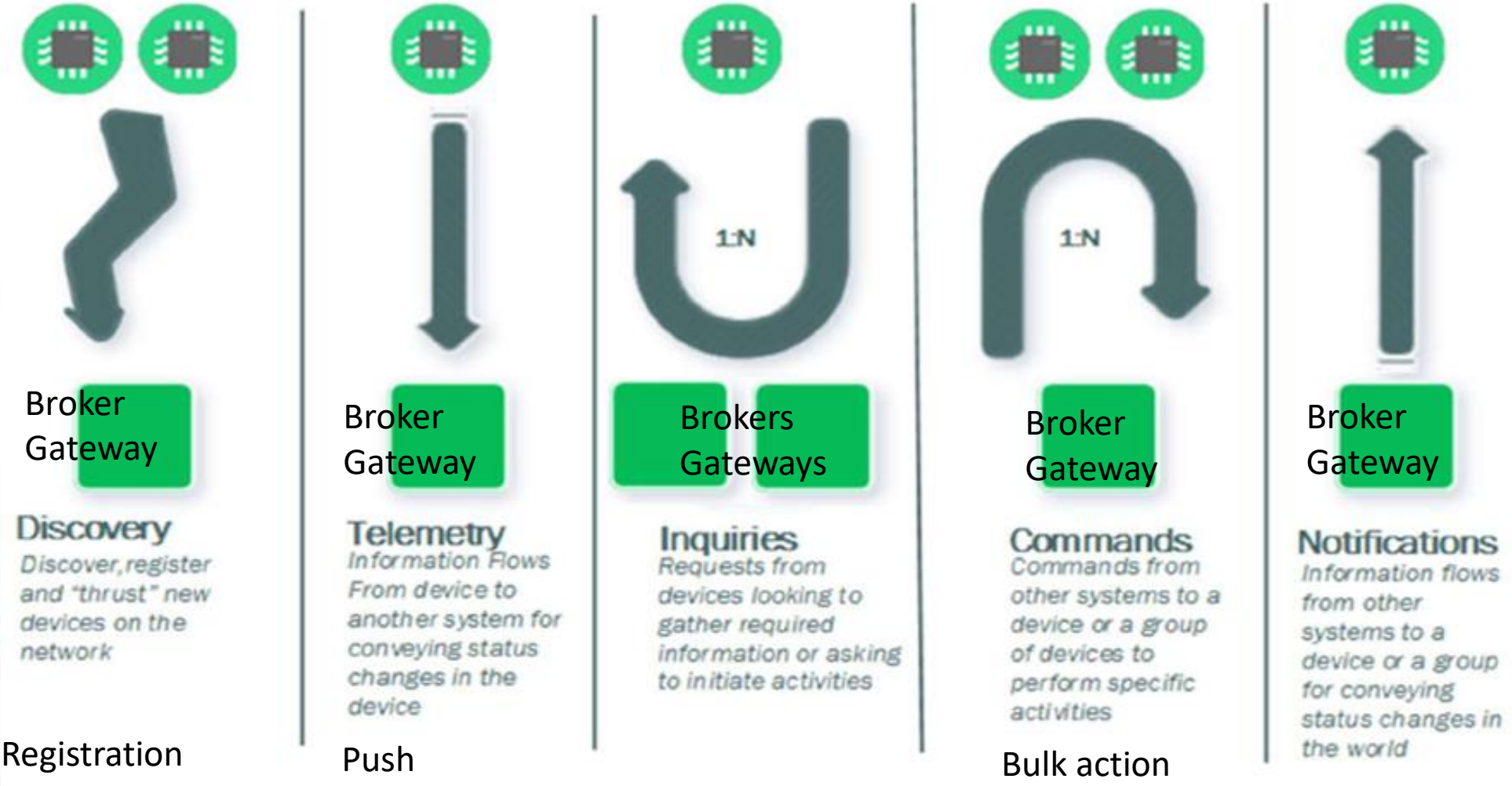
https://www.snap4city.org/65

# IOT Interoperability

**Compliant with:** AMQP, COAP, MQTT, OneM2M, HTTP, HTTPS, TLS, Rest Call, SMTP, TCP, UDP, NGSI, LoRa, LoRaWan, TheThingsNetwork, SigFOX, DATEX II, Telegram, SMS, WebSocket, WebSocket Secure, ModBUS, OPC, GML, RS485, RS232, XML, JSON, CSV, GeoJSON, ESP32, Libelium, IBIMET/IBE, OBD2, XLS, XLSX, KNX, Enocean, Zigbee, DALI, ISEMC, Alexa, Sonoff, HUE Philips, Tplink, BACnet, TALQ, Protocol Buffer, etc.

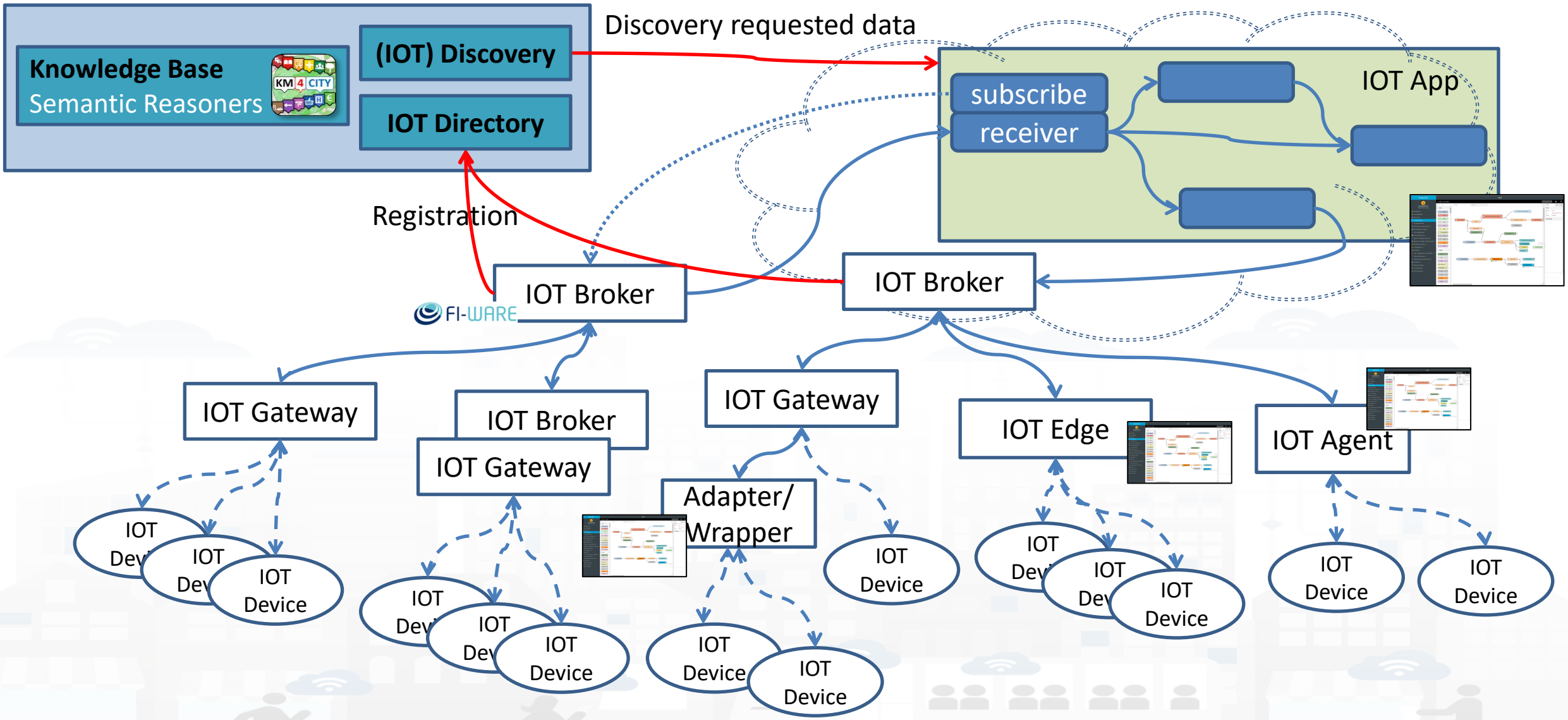
# IOT/IOE Protocols

## Communication Patterns




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

# IoT Network


Knowledge Base
Semantic Reasoners
(IOT) Discovery
IOT Directory
Discovery requested data
Registration
subscribe
receiver
IOT App
FI-WARE
IOT Broker
IOT Broker
IOT Gateway
IOT Broker
IOT Gateway
IOT Gateway
Adapter/
Wrapper
IOT Edge
IOT Agent
IOT Device

# IOT Network Manager vs Final User

Network of IOT Brokers

IOT Broker

External

Internal

IOT Directory

IOT Network Manager

My IOT Device

Register

Registering

Discovering

Knowledge Base, Km4City

Knowledge and Storage Data from the Field and City

Browsing

ServiceMap Knowledge Base

Discovering

IOT Application

Final user Manager

Prepare

Deep Manage

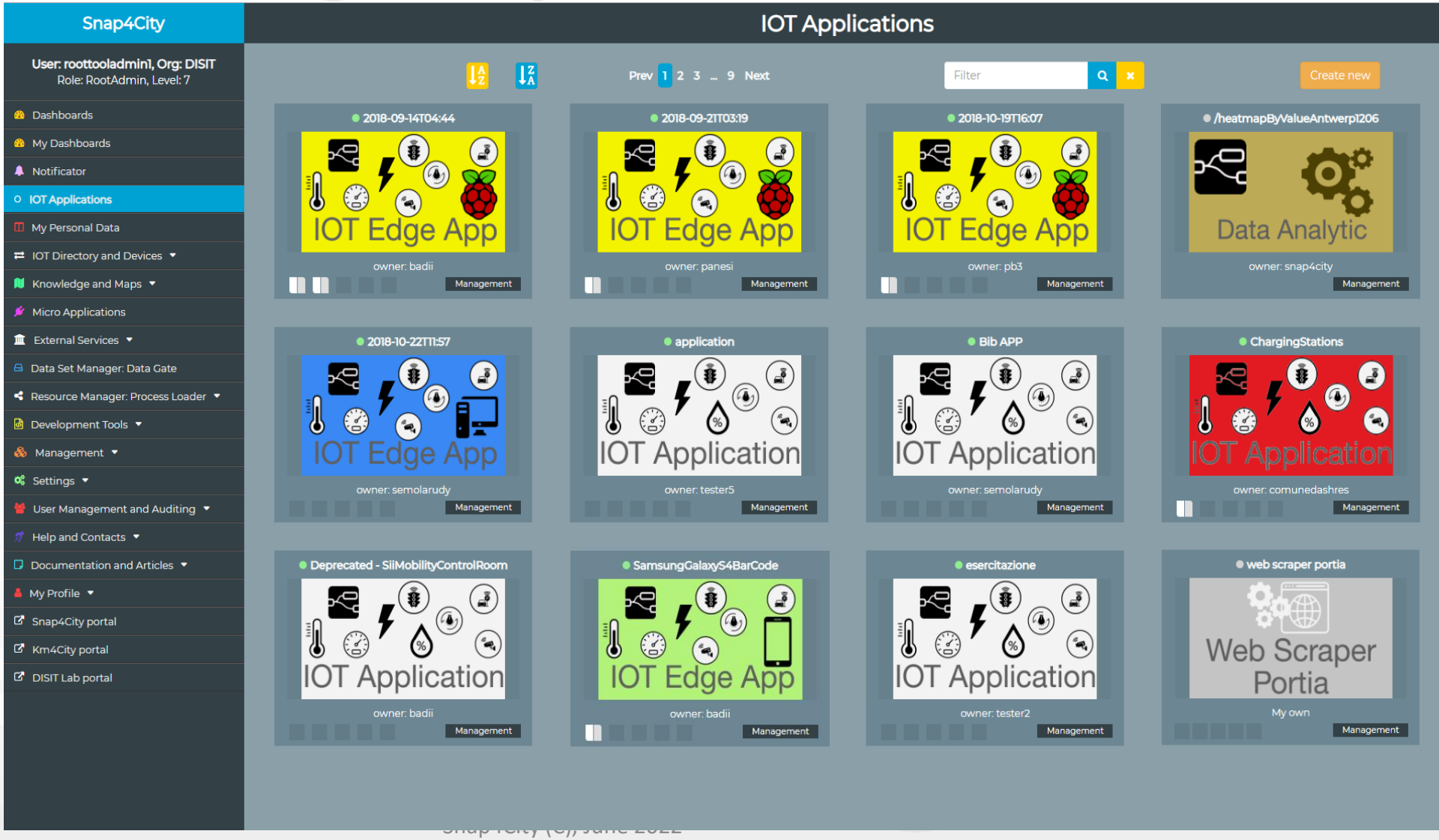
Exploit

Dashboard Wizard

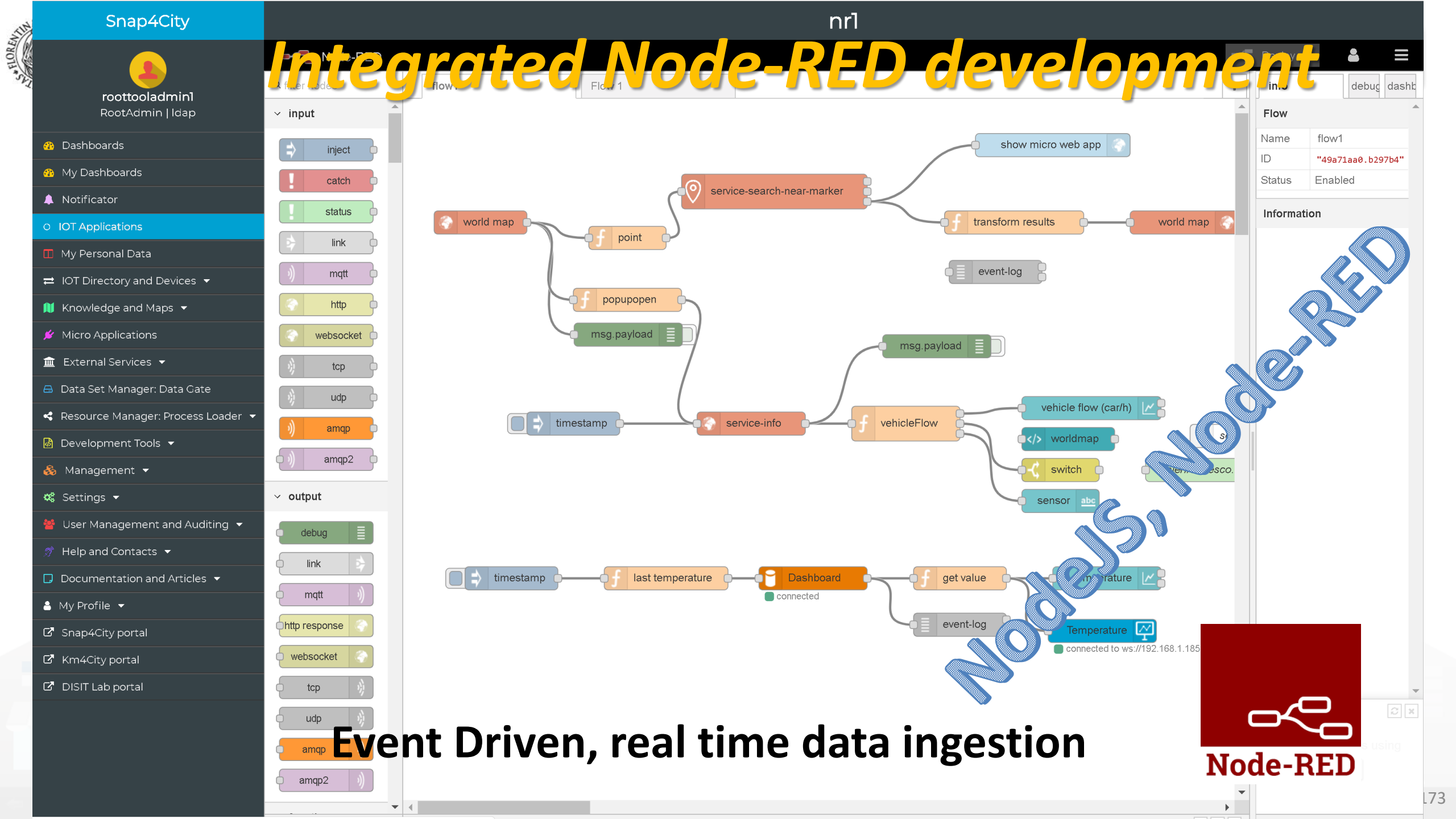
# Integration via IoT Apps and processes

# IOT Application Listing, they can be

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

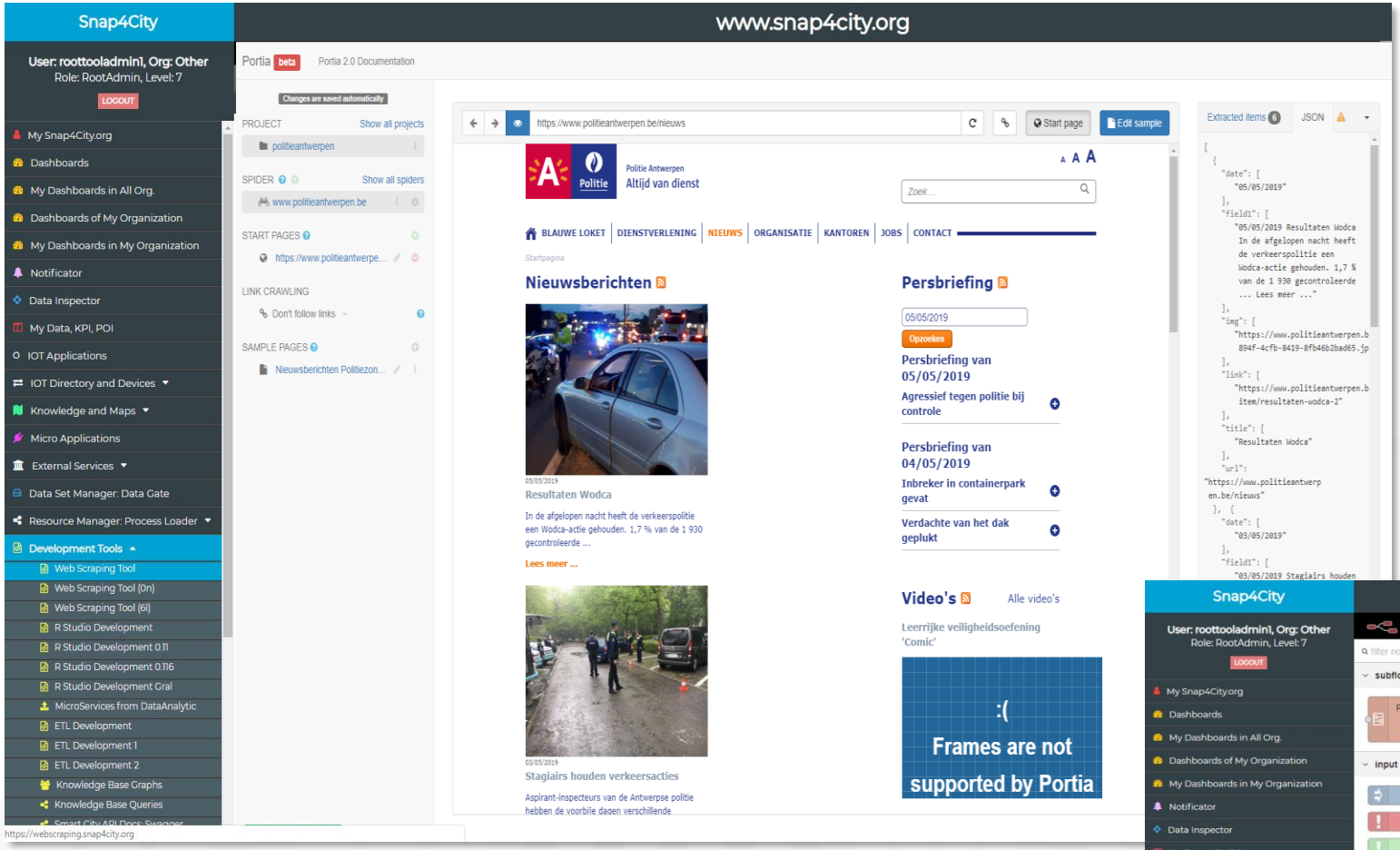


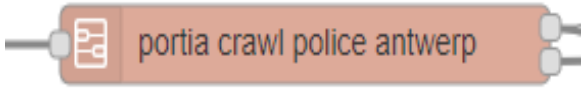
# Integrated Node-RED development

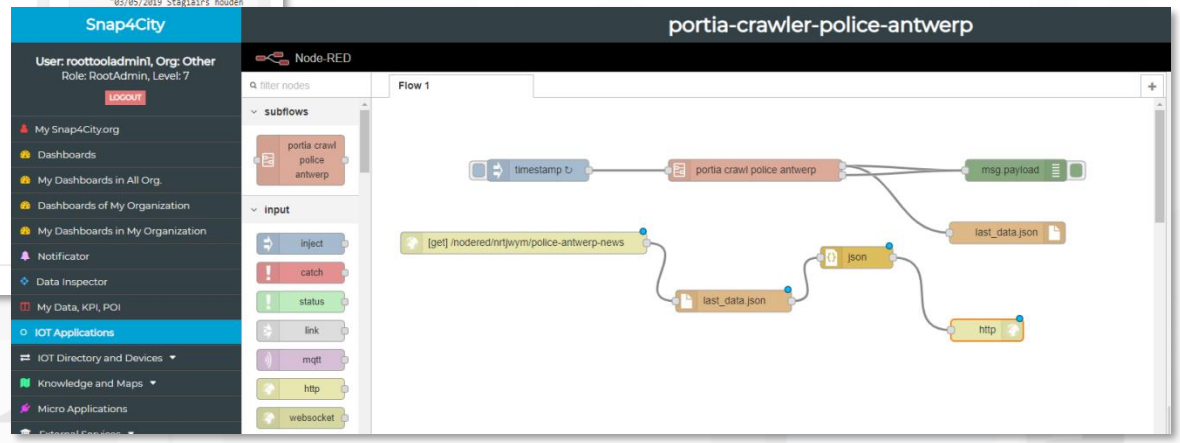



## Event Driven, real time data ingestion

# Web Scraping



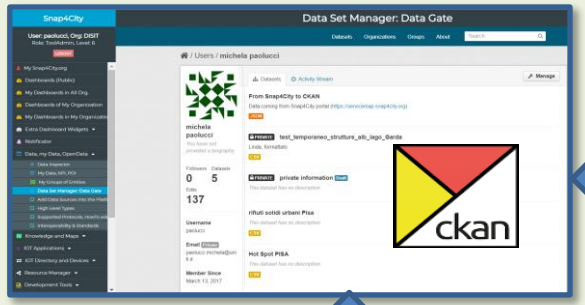



# Snap4City vs CKAN

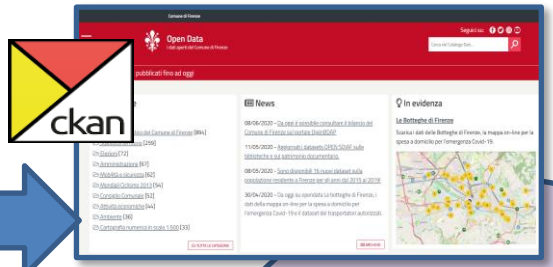
**Snap4City Portal and Integrated tools**

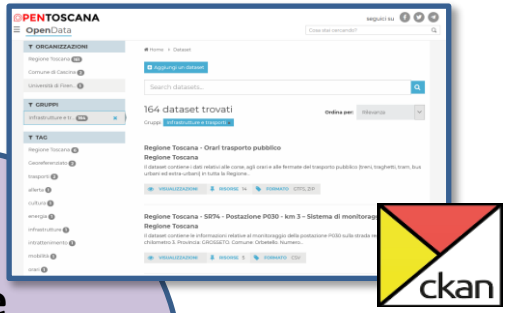
**Datagate**



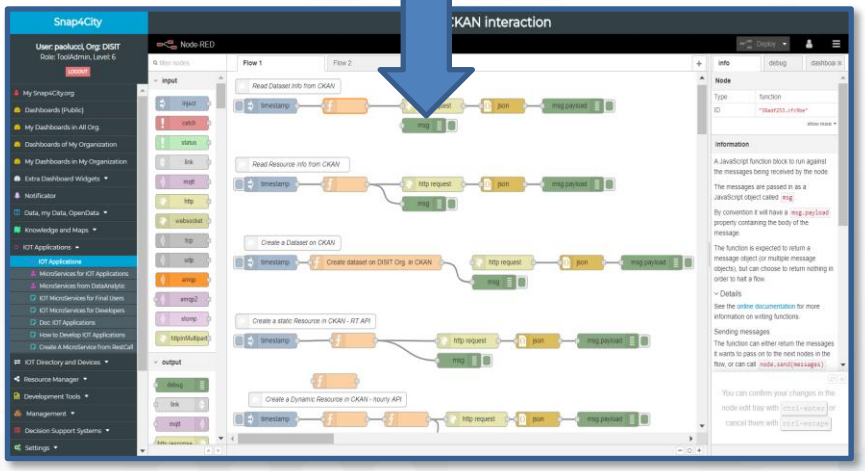

**Advanced Snap4City APIs and Micro Services**

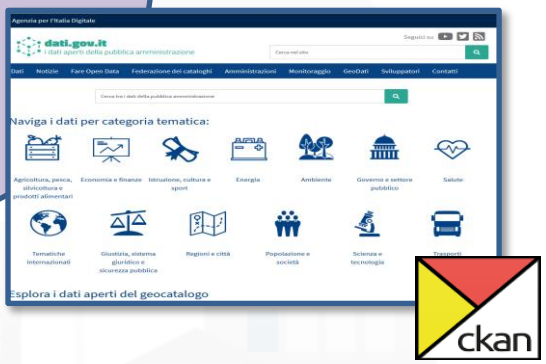
Harvesting and Publishing




**Open or Private External CKAN Data Portals**

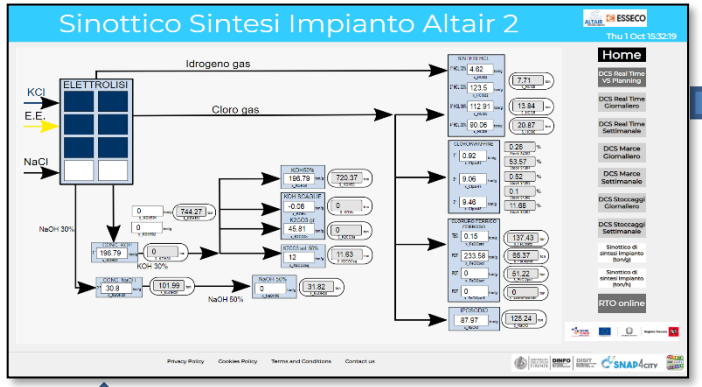


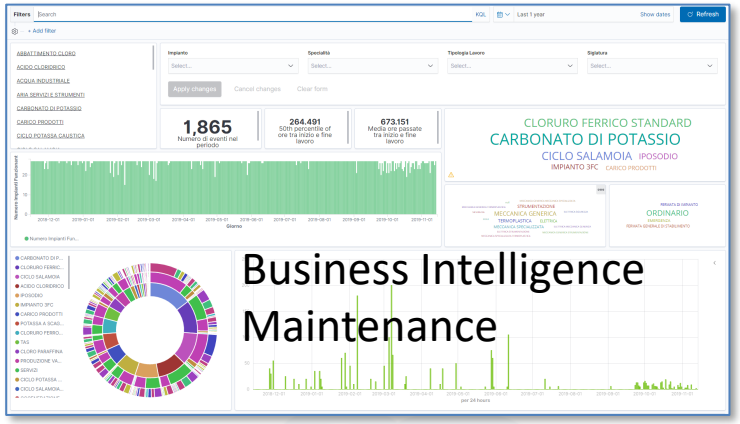

**Automatize:**

- Import data from CKAN to Snap4City
- Upload Public Data from Snap4City to CKAN
- Data Harvesting
- Dashboards and Mobile/Web Apps creation

# Example of Integrated workflow

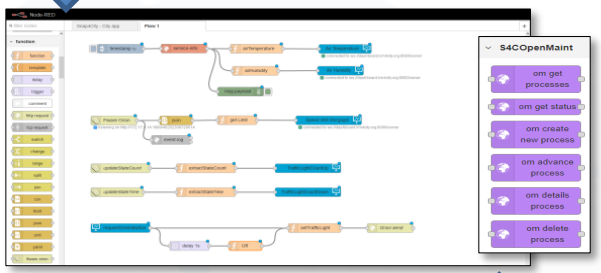


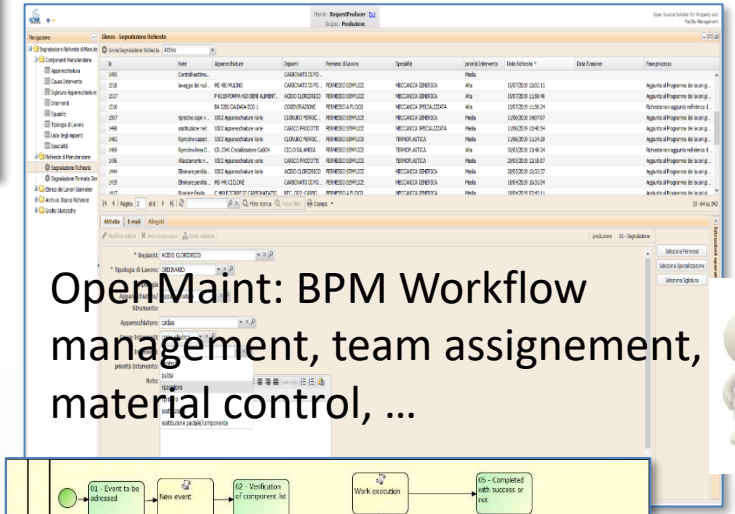

Consumptions/productions



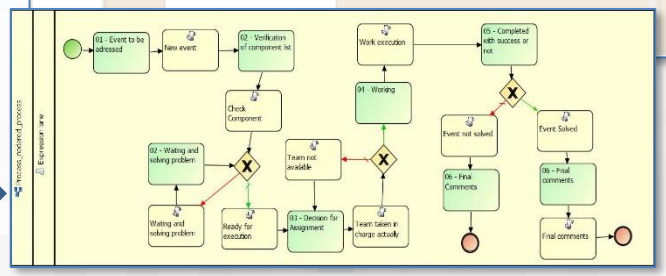

Events/actions

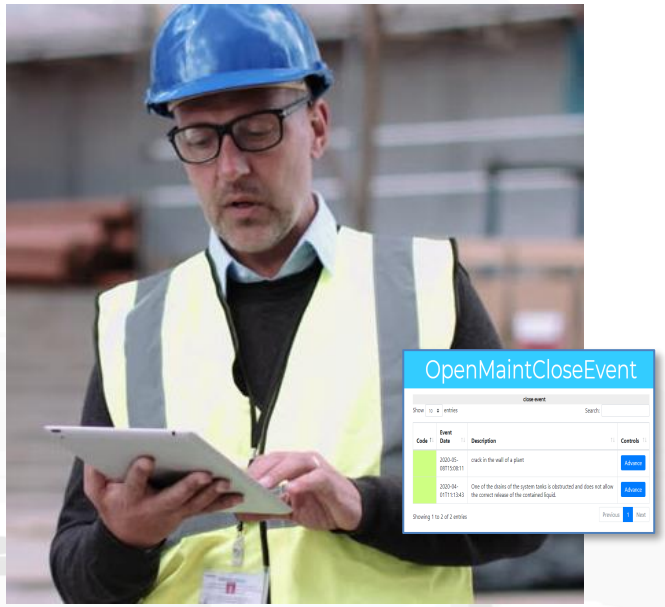
Dashboards and actions



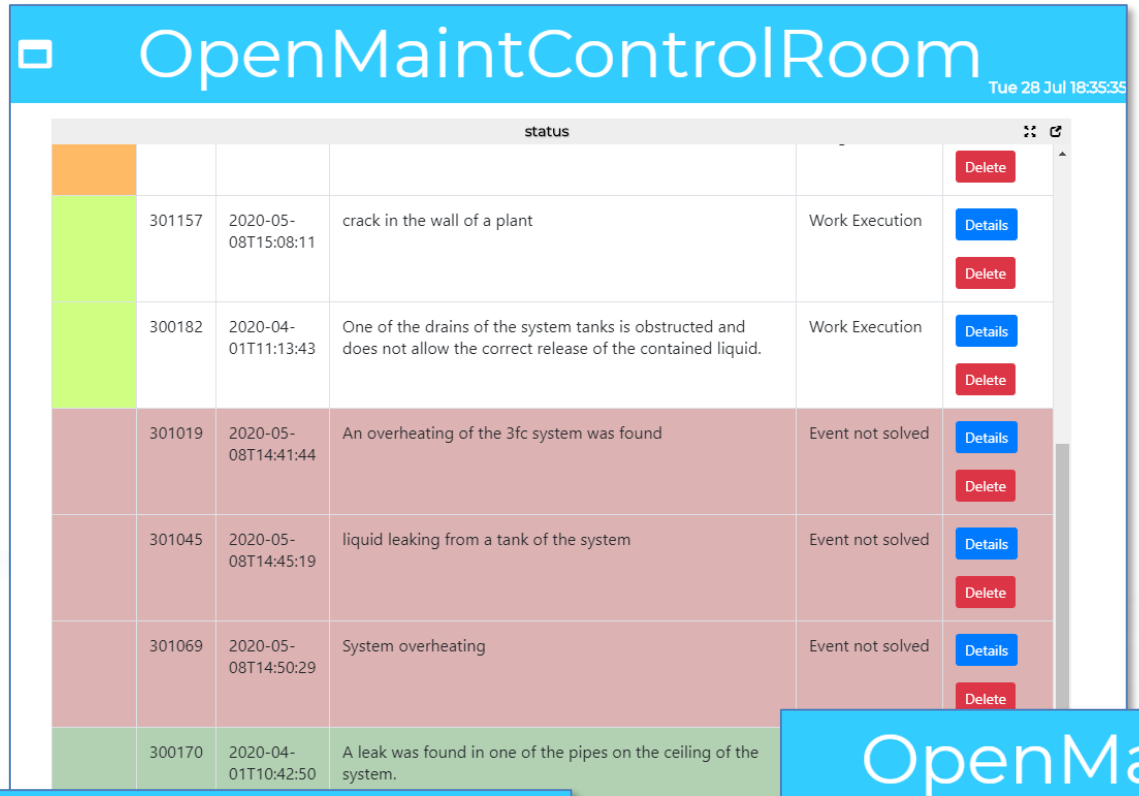
OpenMaint: BPM Workflow management, team assignement, material control, …

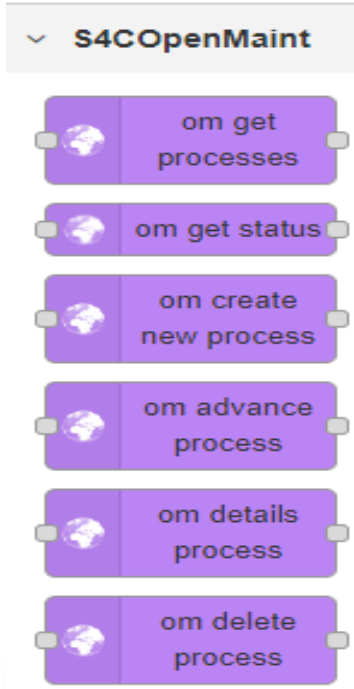


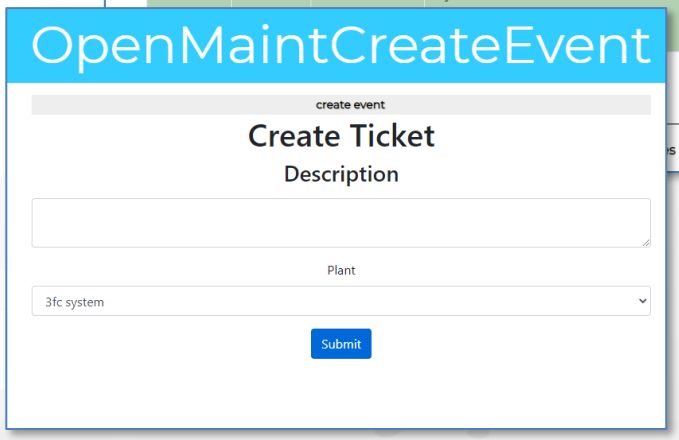



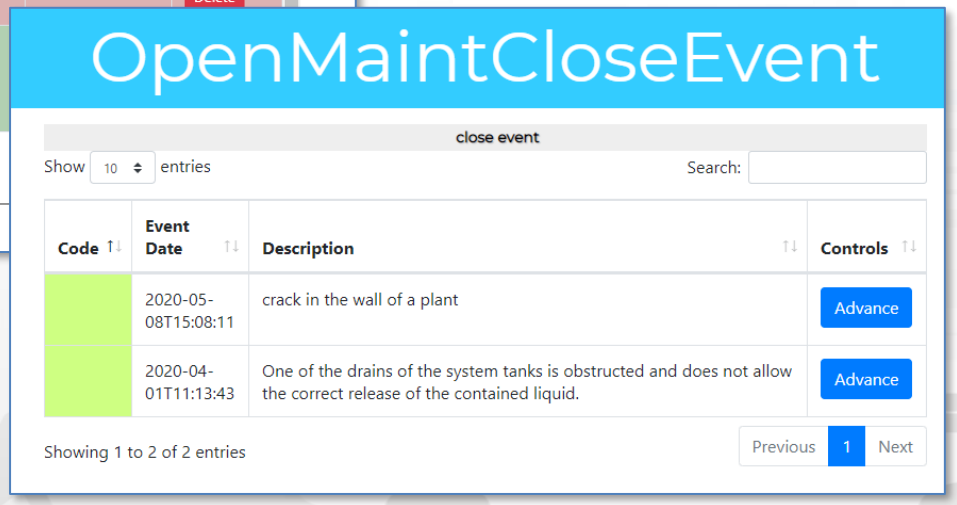

IOT App, Data event firing, event detection and firing Critical event management

# Dashboards



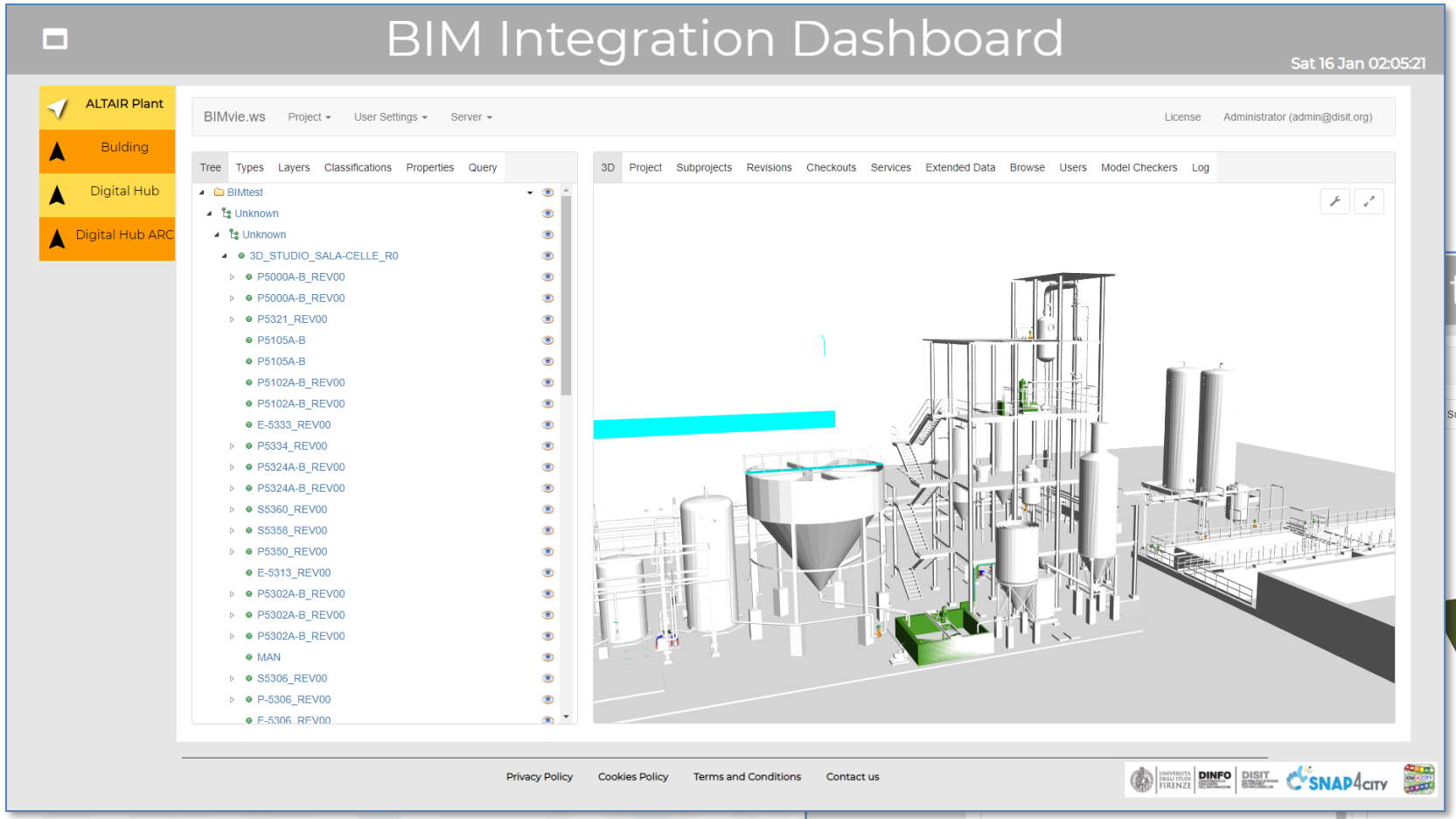



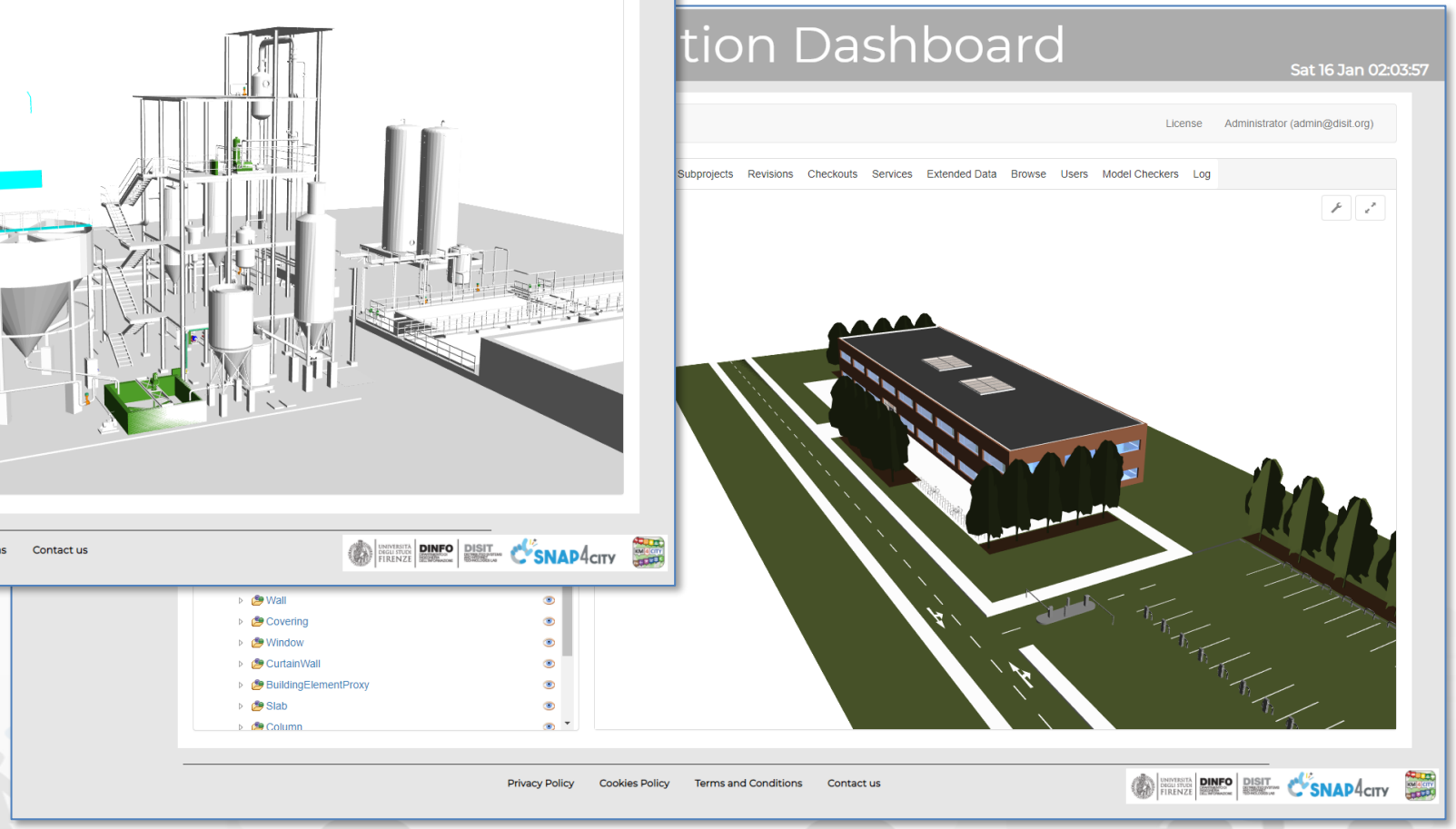




- **Snap4City can**
  - Create new tickets
  - Manage steps, workflow
  - Collecting feedbacks and results from teams
  - Manage all phases of the workflow on the fields via IOT Apps and logics
  - The integration if via API and MicroServices into IOT App.

# BIM Server

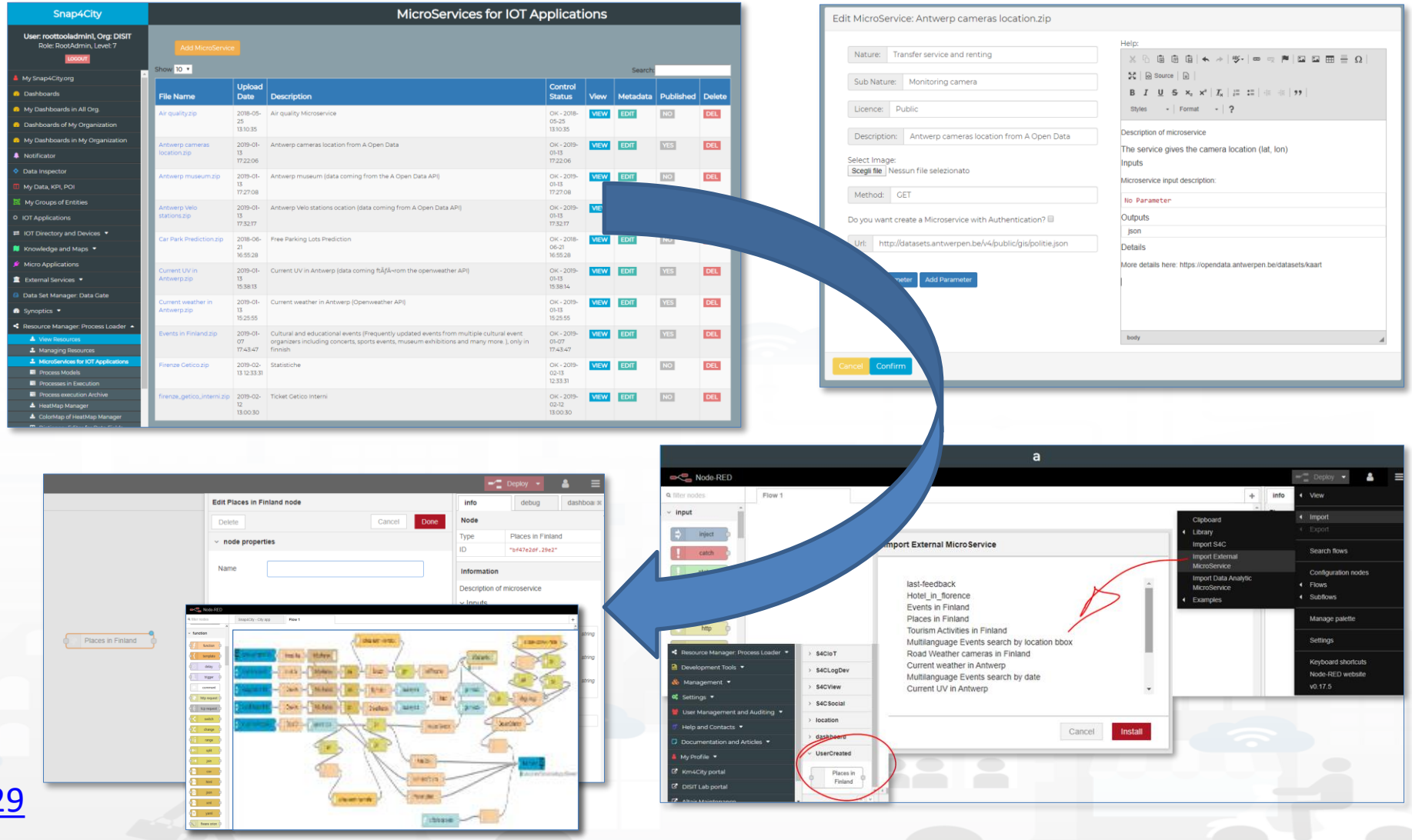



https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA1NA==

# External REST Call API vs MicroServices

- Each Rest Call API can be automaticaly transformed into e MicroService for the IOT Applications




https://www.snap4city.org/129

# Integration via IoT Apps on IoT Edge

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

https://www.snap4city.org/369

SNAP4CITY KM4CITY

Measuring any kind of sensors values

Controlling Energy Power

Measuring
Energy Consumption

Any kind of notification channel

IOT Edge:
Node-RED
+
Snap4City

Local Control

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

DCS

SCADA

Administrative Servers

ODBC

Alexa: Voice Commands

# Snap4Home

Sonoff: Controlling Energy Power

Philips Hue: Controlling Lights


Hue: Motion Control / Alarm

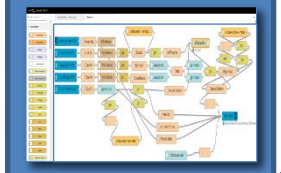
Measuring
Energy Consumption

TP Link: Controlling / Measuring Energy Plugs

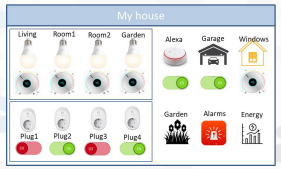
Alexa: Voice Control

IOT Edge:

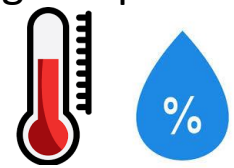
Raspberry pi: Node-RED + Snap4City



Local Control



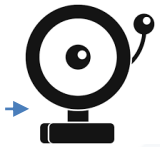

Measuring Temperature and Humidity



Garage Door

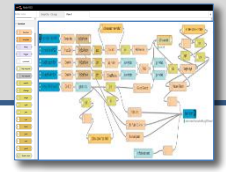
Window
Roller Shutters

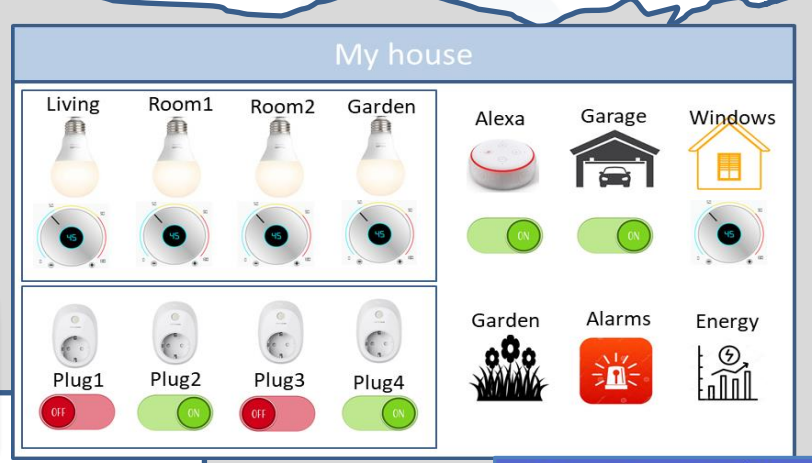
Controlling Motors

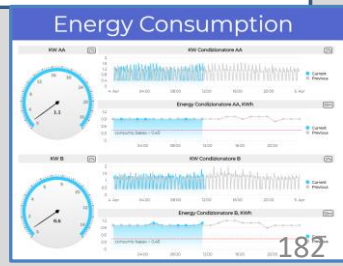


Alarm sound
and light

Controlling
Irrigators






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

https://www.snap4city.org/620

# IOT Edge Device

Other Local Connections

IOT Brokers

WiFi

Modbus

OPC UA

IOT Edge:
Node-RED + Snap4City

edge-tunnel-to-cloud

IOT Devices

HTTPS

HTTPS

WSs

HTTPS

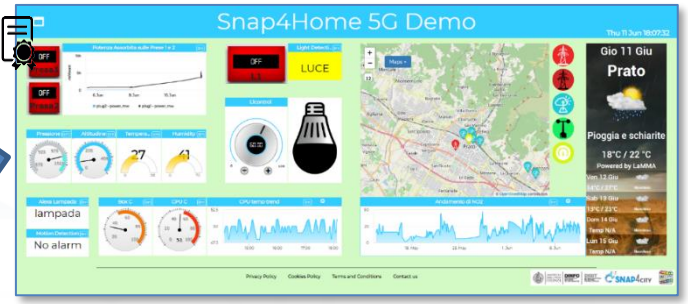
Firewall
Gateway
Towards internet

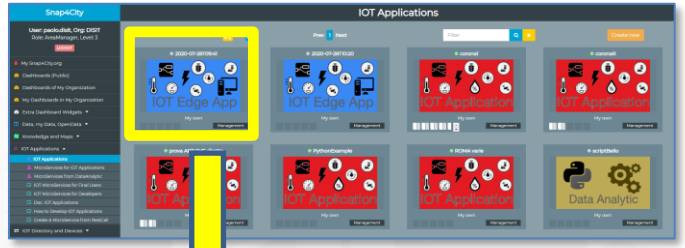
IOT Brokers

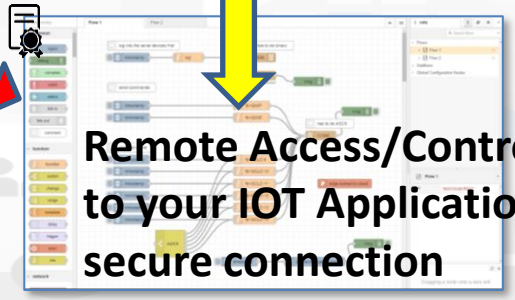
Search and Query, Smart City API
Facet, semantic search

Knowledge base
Semantic reasoners

Indexing and aggregating
Elastic search



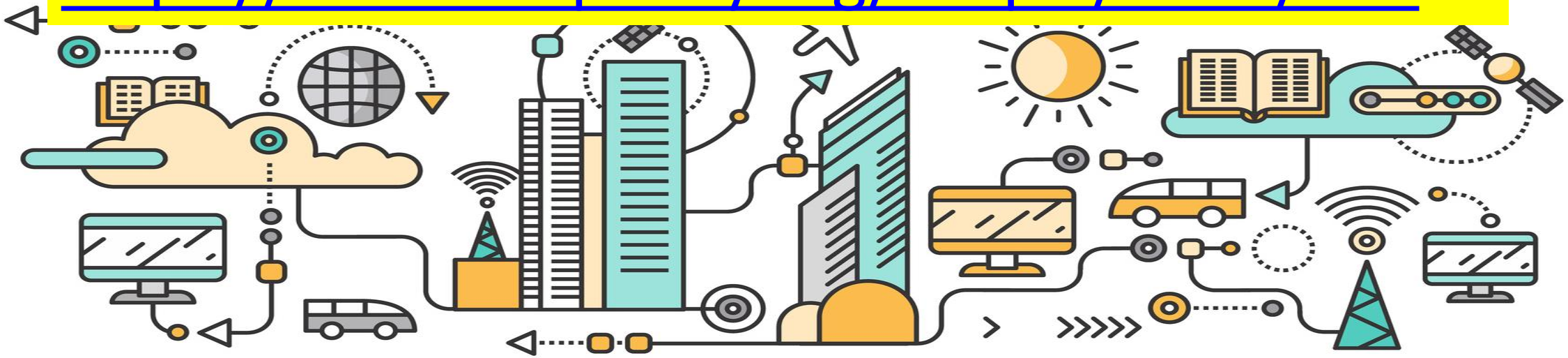



## Access to IoT Edge Maintenance

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

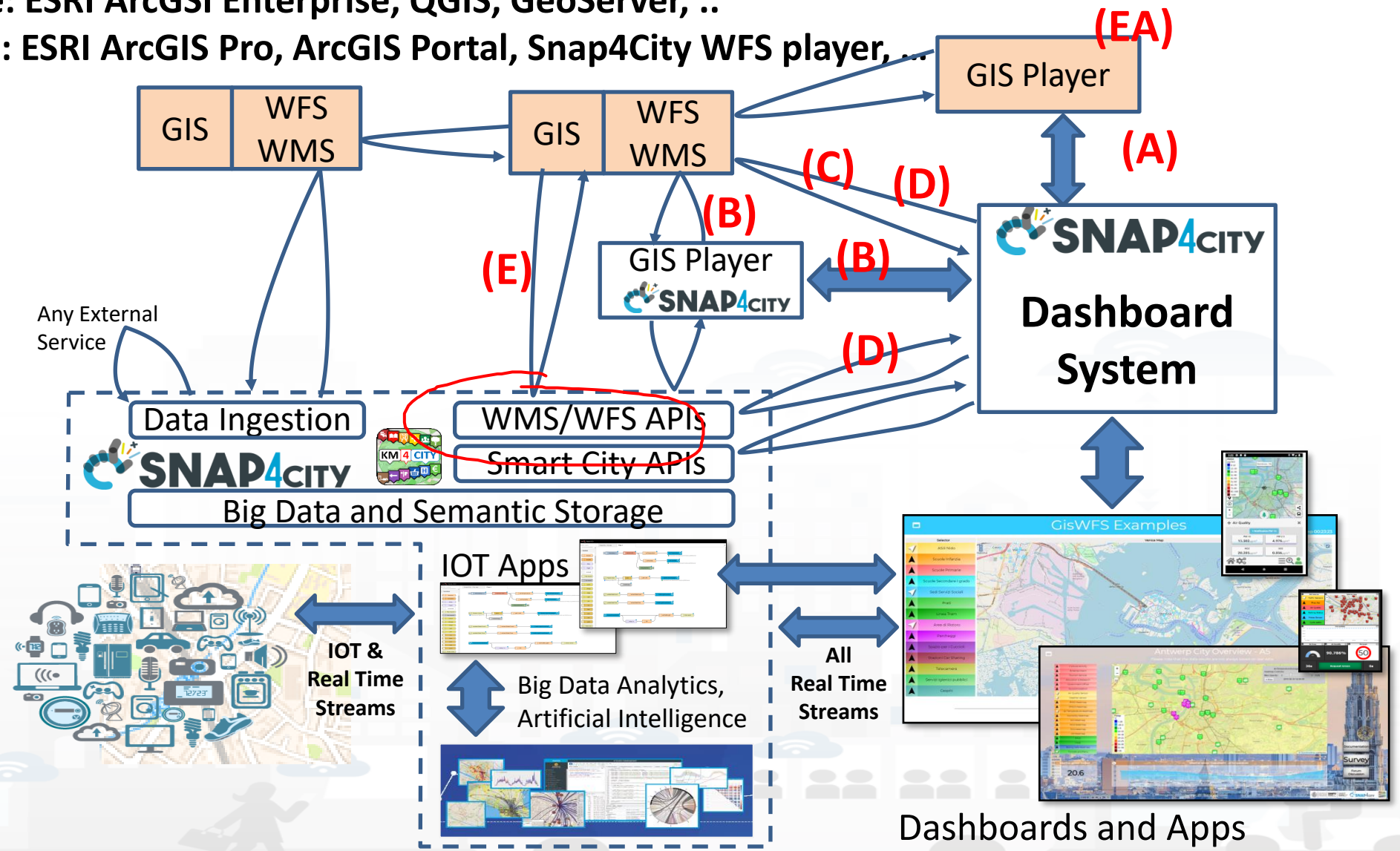
# Integration with GIS and ArcGIS

https://www.snap4city.org/drupal/node/368



# GIS vs Sna4City

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



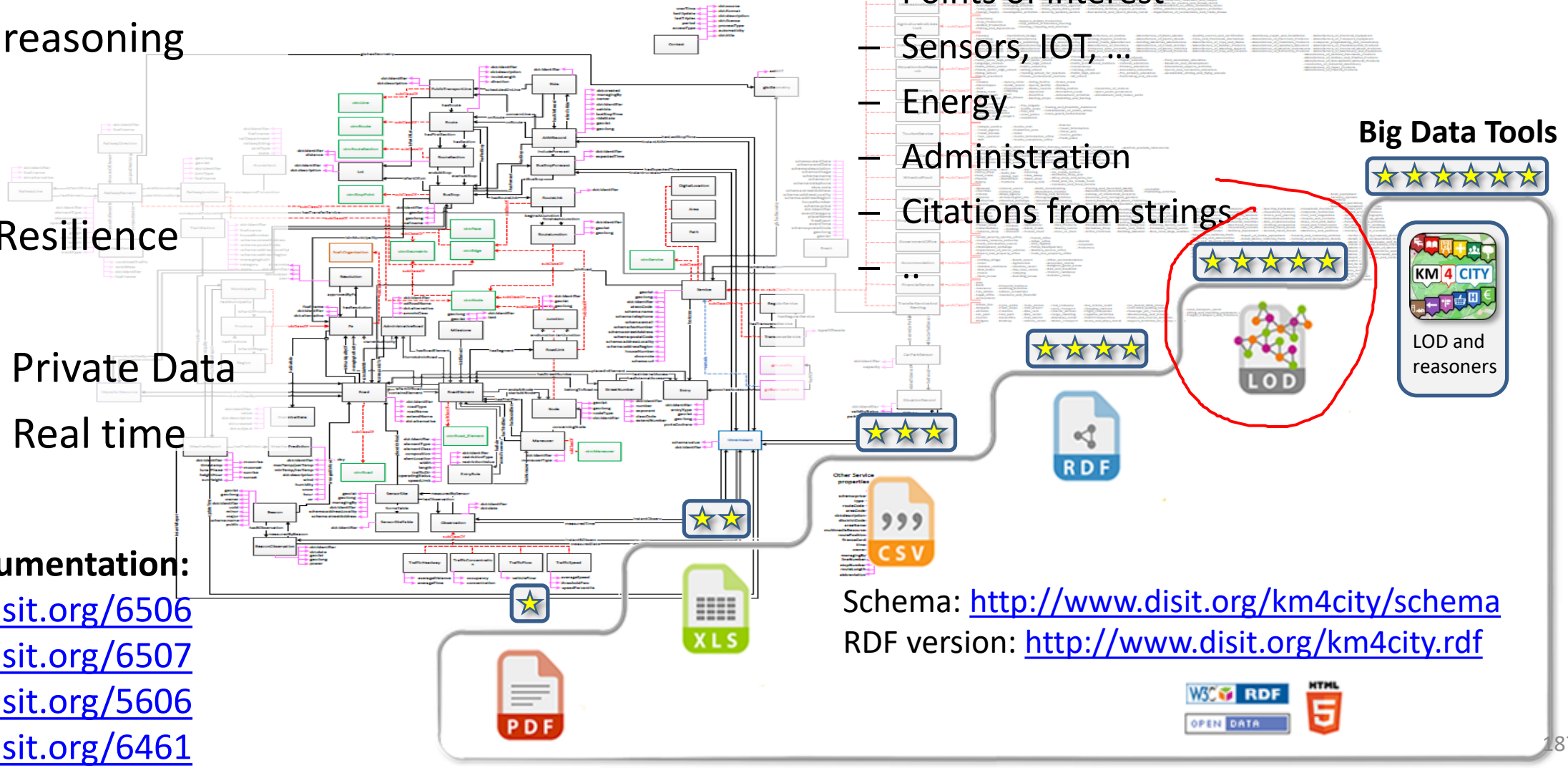

- **GIS:**
  - Geographic Information System
- **WMS:**
  - Web Map Service
- **WFS:**
  - Web Feature Services

# Linked Open Data

# Km4City: Knowledge Base

- **Multiple DOMAINS**
- Geospatial reasoning
- Temporal reasoning
- Metadata
- Statistics
- Risk and Resilience
- Licensing
- Open and Private Data
- Static and Real time
- IOT/IOE

- Street-Guide
- Mobility and transport
- Points of interest
- Sensors, IOT, …
- Energy
- Administration
- Citations from strings
- ..

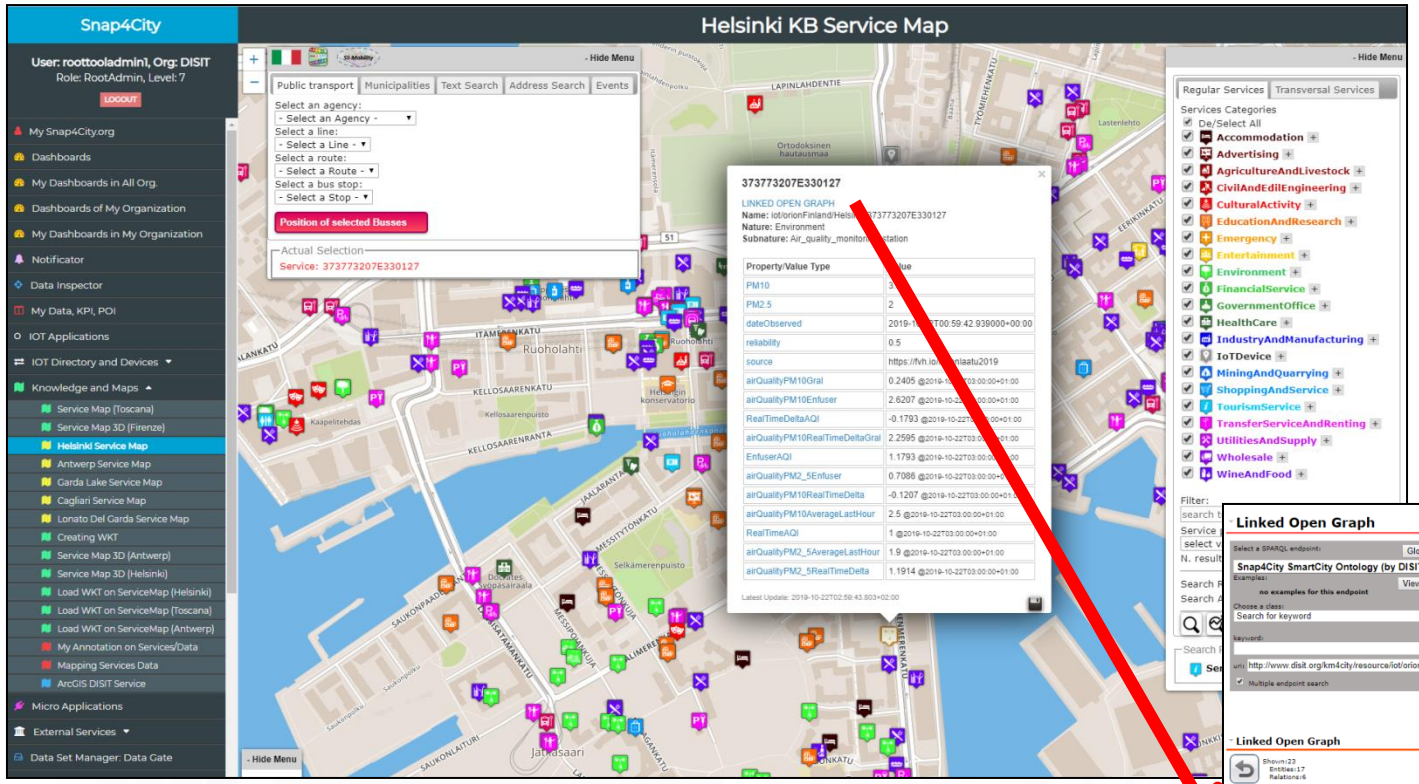


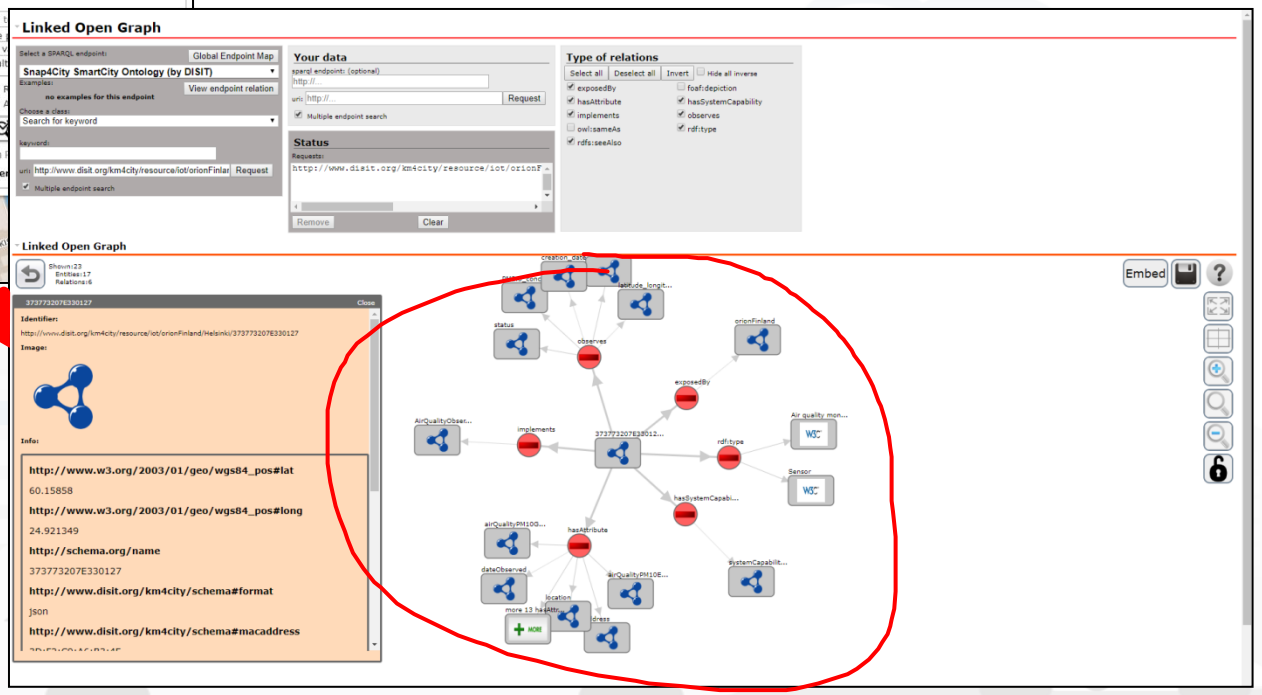

**Ontology Documentation:**
http://www.disit.org/6506
http://www.disit.org/6507
http://www.disit.org/5606
http://www.disit.org/6461

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

# Views of the Knowledge Base

**Knowledge Base**
Semantic Reasoners




- How pass from ServiceMap to Linked Open Graph, Linket Data view tool

TOP

# Integrated command and control center


100% OPEN SOURCE

SNAP4 Appliances and Dockers **Installations**

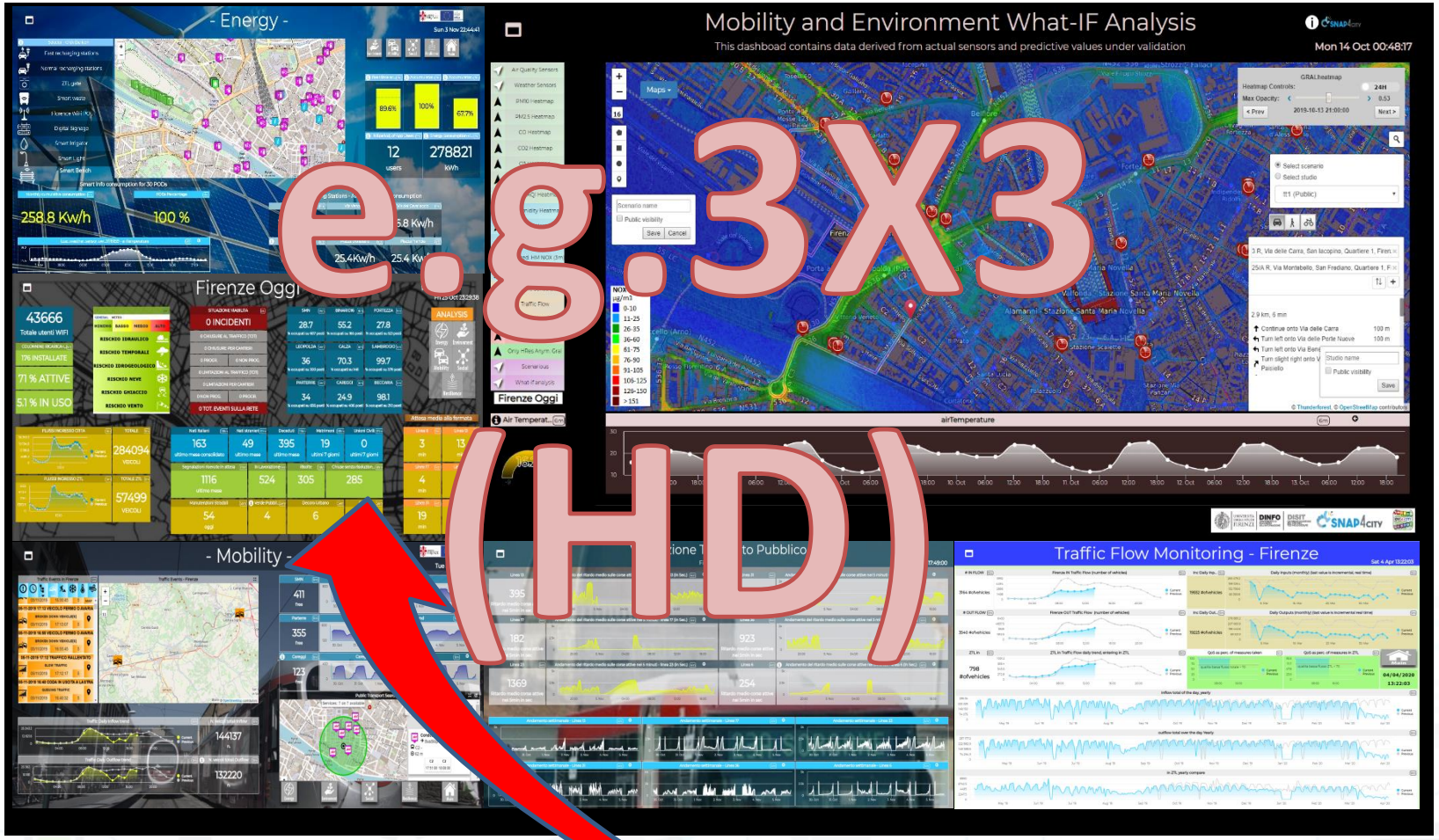

MAPPA FIRENZE
Fri 19 Oct 17:24:39
Colonnine Ricarica
Colonnine ricarica Fast
Pannelli a Messaggio Variabile
Parcheggi
Piste Ciclabili
Sensori del Traffico
Stazioni ambientali
Stazioni meteo
Traffico Real Time
Varchi ZTL
Wi-Fi
Eventi Traffico a Firenze
Concentration - 7 days
Main

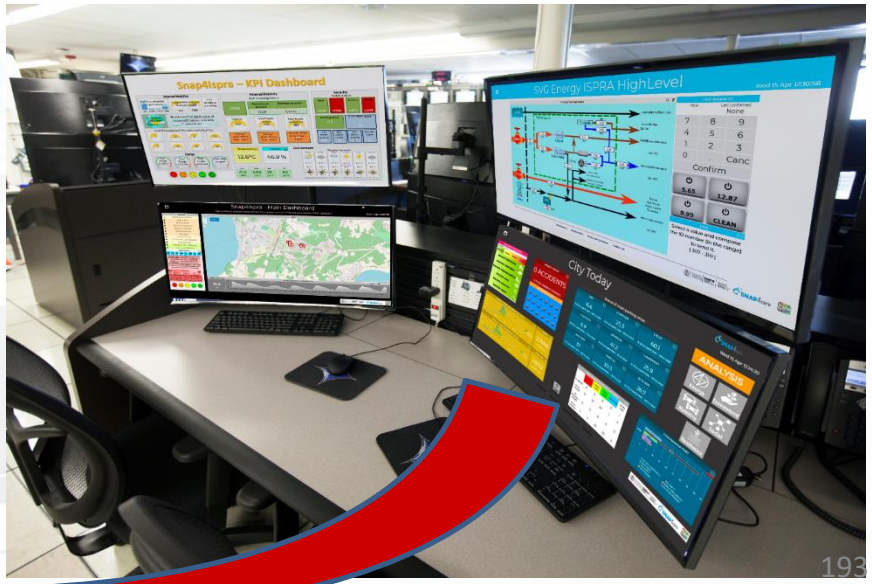

# Chemical Plant Dashboard Green Impact Capacity (GIC)

## Altair Control room

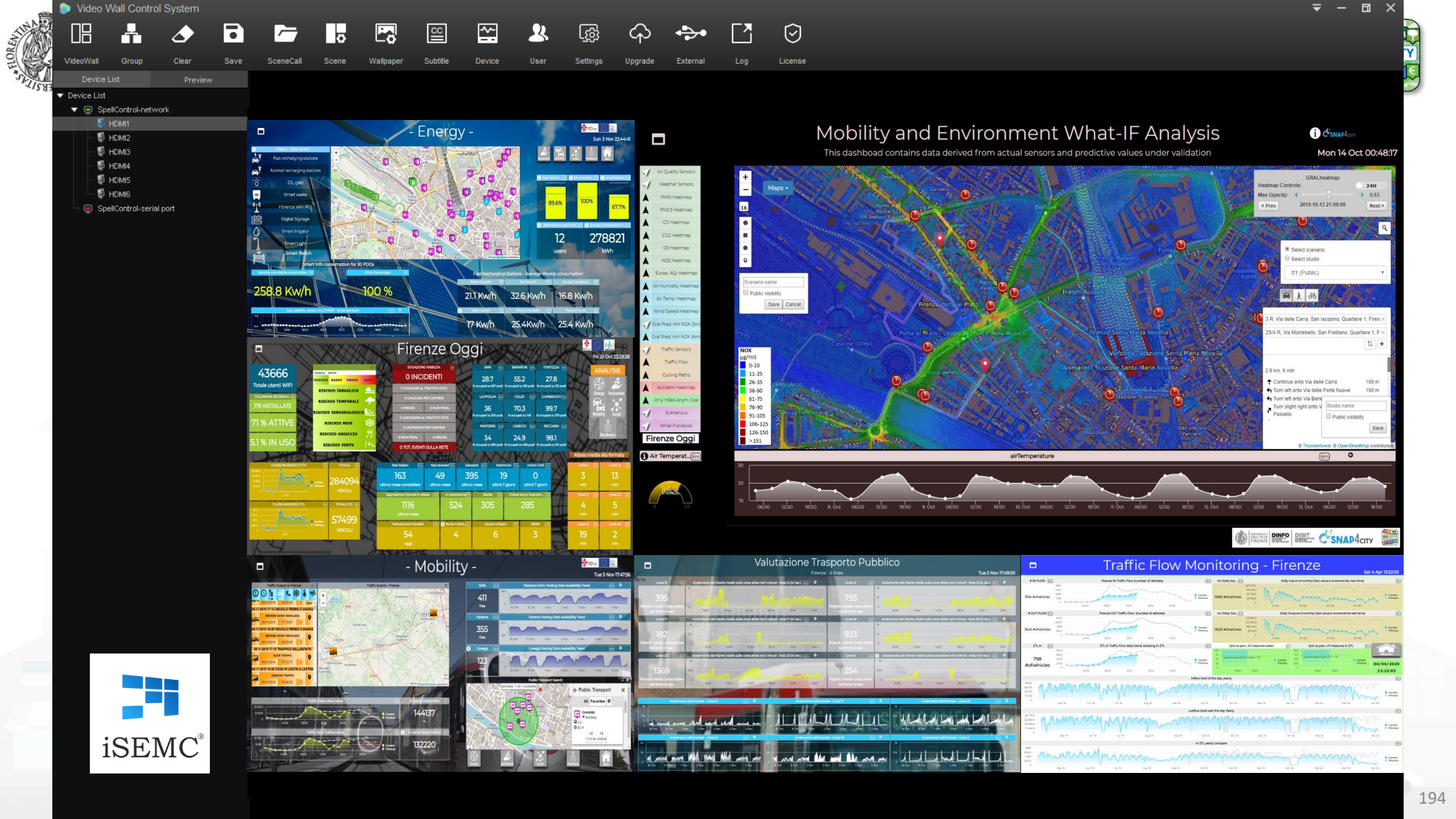
# Control Room

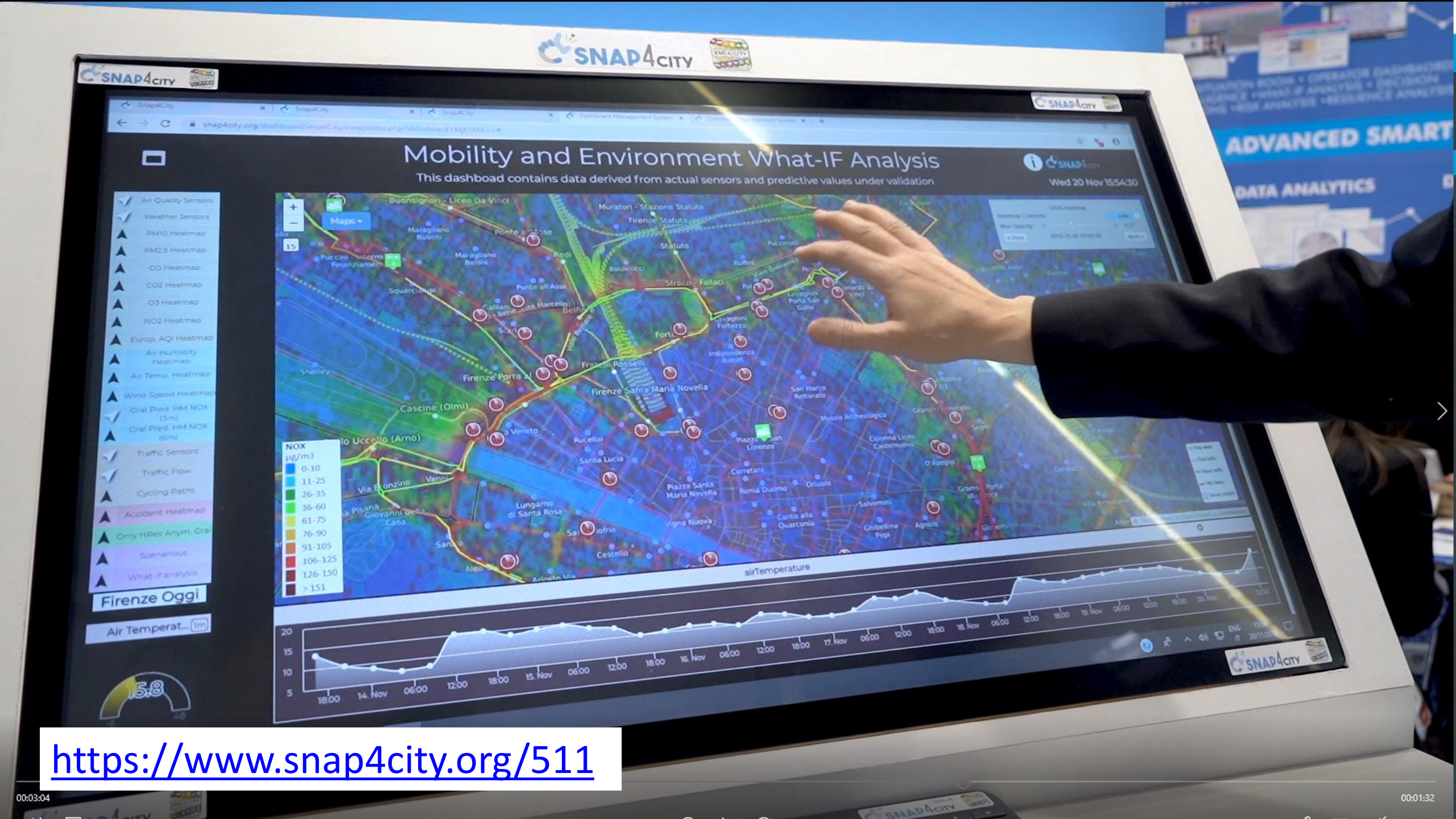

# Video Wall




From Consolle Operator to the Video Wall


Video Wall Control System
VideoWall
Group
Clear
Save
SceneCall
Scene
Wallpaper
Subtitle
Device
User
Settings
Upgrade
External
Log
License
Device List
Preview
Device List
SpellControl-network
HDMI1
HDMI2
HDMI3
HDMI4
HDMI5
HDMI6
SpellControl-serial port
- Energy -
Sun 3 Nov 22:44:41
Fast recharging stations
Normal recharging stations
ZTL gate
Smart waste
Florence WiFi PO
Digital Signage
Smart Irrigator
Smart Light
Smart Bench
89.6%
100%
67.7%
12
users
278821
kWh
Smart Info consumption for 30 PODs
258.8 Kw/h
100 %
Fast Recharging Stations - Average Weekly consumption
21.1 Kw/h
32.6 Kw/h
16.8 Kw/h
17 Kw/h
25.4Kw/h
25.4 Kw/h
Firenze Oggi
Fri 25 Oct 23:29:38
43666
Totale utenti WIFI
176 INSTALLATE
71 % ATTIVE
5.1 % IN USO
RISCHIO IDRAULICO
RISCHIO TEMPORALI
RISCHIO IDROGEOLOGICO
RISCHIO NEVE
RISCHIO GHIACCIO
RISCHIO VENTO
0 INCIDENTI
ANALYSIS
284094
VEICOLI
57499
VEICOLI
163
49
395
19
0
1116
524
305
285
54
4
6
3
- Mobility -
Tue 5 Nov 17:47:56
411
355
123
144137
132220
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
Traffic Sensors
Traffic Flow
Cycling Paths
Accident Heatmap
Only HRes Anym. Grid
Scenarious
What-if analysis
Firenze Oggi
Mobility and Environment What-IF Analysis
This dashboad contains data derived from actual sensors and predictive values under validation
SNAP4CITY
Mon 14 Oct 00:48:17
Maps
NOX
µg/m3
0-10
11-25
26-35
36-60
61-75
76-90
91-105
106-125
126-150
> 151
airTemperature
Valutazione Trasporto Pubblico
Tue 5 Nov 17:49:00
395
793
182
923
1369
254
Traffic Flow Monitoring - Firenze
Sat 4 Apr 13:22:03
798
#ofvehicles
04/04/2020
13:22:03
iSEMC®

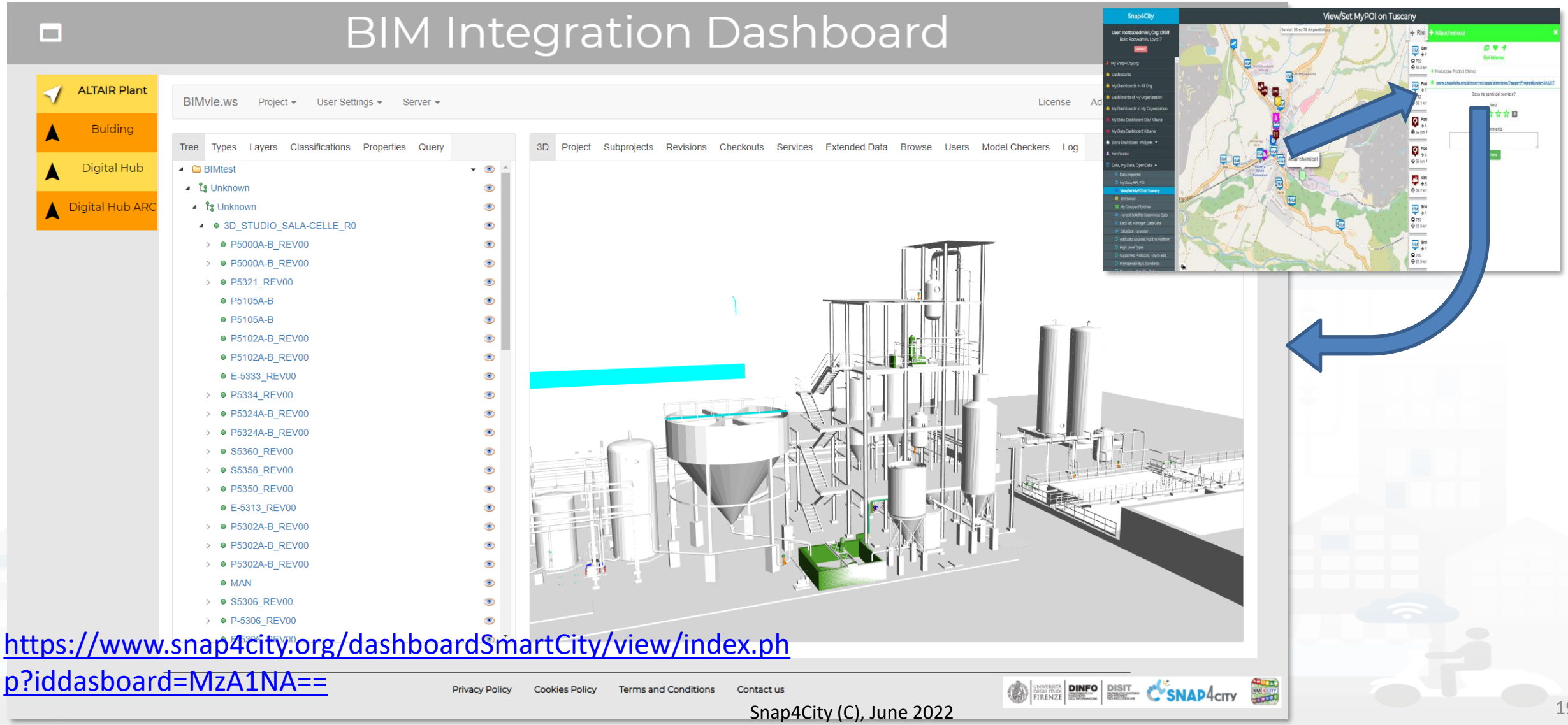



https://www.snap4city.org/511

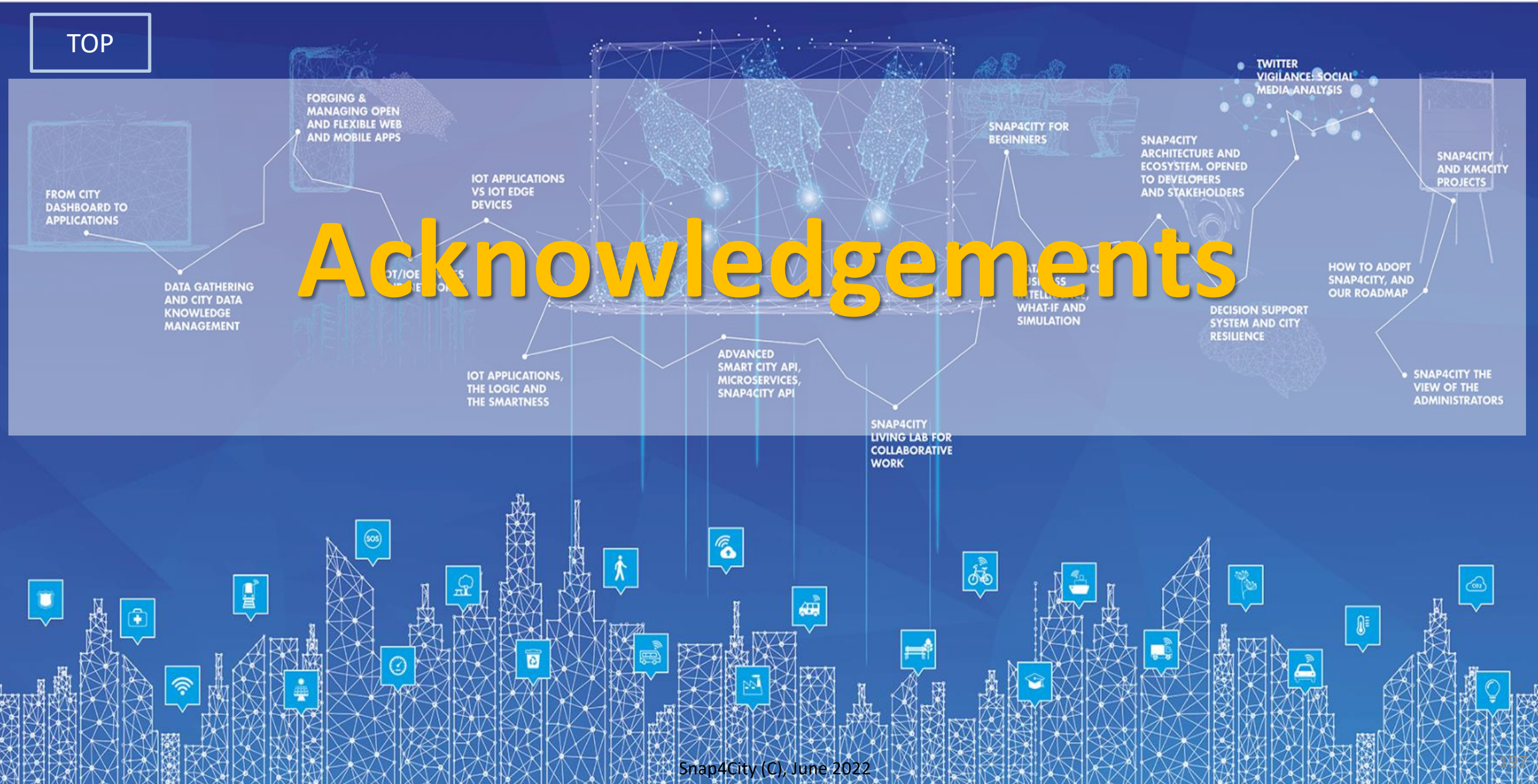
00:03:04

00:01:32

# BIM view of the Altair Chemical Plant




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

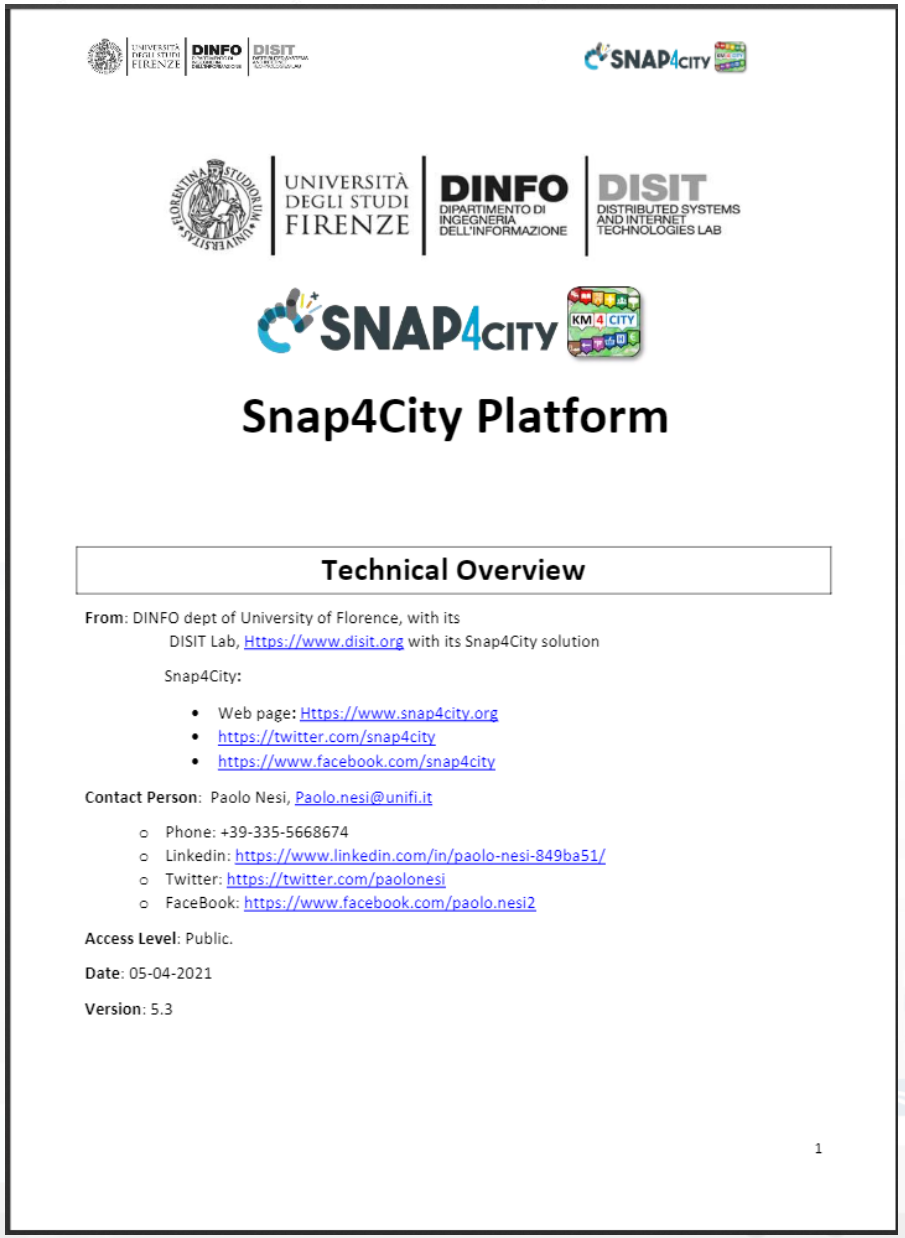



# Acknowledgements

# Main running instances

- Sii-Mobility → mobility and transport, sustainability
- REPLICATE → ICT, smart City Control room, Energy, IOT
- RESOLUTE → Resilience, ICT, Big Data
- GHOST → Strategies, smart city
- TRAFAIR → Environment & transport
- MOSAIC → mobility and transport
- WEEE Life → Smart waste, environment
- Smart Garda Lake → Castelnuovo del Garda, SMARTEA
- 5G → Industry 4.0 vs SmartCity
- Green Impact → Industry 4.0, Chemical Plant
- SmartBed (Laid) → smart health
- Green Field Peas (Soda) → Industry 4.0, Chemical plant
- MobiMart and PISA Agreement → data aggregation, 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

# 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

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- 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

TOP



*Be smart in a SNAP!*



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